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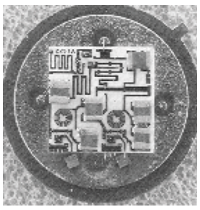

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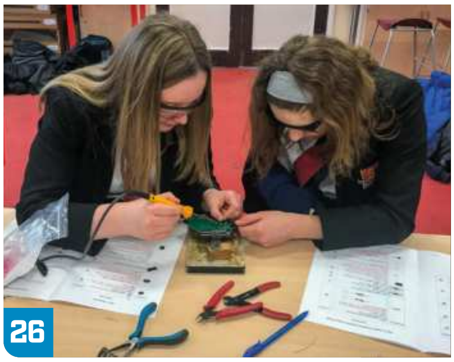

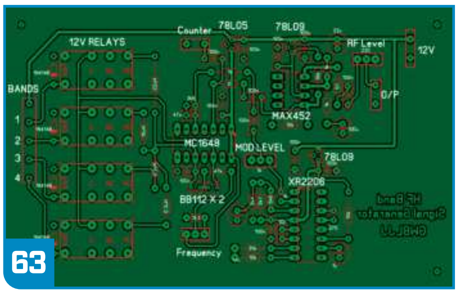

Keylines

Many of you will have read of the recent passing of **Sir Clive Sinclair**. What you may not be aware of is his link with *PW*. There is some vagueness about the exact story but it appears that, while still at school, he contributed articles to the magazine (I haven't been able to find his name against any, but some articles from that time were anonymous). Rather than go to university, after A levels he chose to seek employment and became an editorial assistant on this magazine, taking over the editor's role when the editor became ill (as far as I can work out, this would have been in early 1958 – **FJ Camm** was still editor and his name appeared on the cover, but died in February 1959). So, it appears that an 18-year old Clive Sinclair was left running the show although his name never appeared in lights – indeed, it appears to have been some years before the magazine again carried an editor's name. Sinclair's period of office can't have been that long – he moved to Bernard's Publishing (as in **Bernard Babani**, whose books will be fondly remembered by many) in late 1958 before starting his own company, Sinclair Radionics, in 1961. I recall attending a talk that he gave to the Cambridge University Engineering Society during my undergraduate years.

The Sinclair story can be found as a PDF at:
https://tinyurl.com/4ps7n8mw

Making Waves, etc.

This month sees the last in **Steve White G3ZVW's** bi-monthly series *Making Waves*. To my astonishment, I see that he has been writing the column for almost six years, but wants to spend more time travelling and following other pursuits. My thanks to Steve for his contributions.

But we do have some new series coming in the New Year. **Dr Samuel Ritchie EI9FZB** has an SDR project that will run over several months and which I hope will prove to be of great interest. And **Roger Dowling G3NKH** will pen an occasional *Face Behind the Call*, reminiscent of the series *The Other Man's Station* that ran in *Short Wave Magazine* for many years.

Unfortunately, for space reasons I've had to hold over *Notes from a Small Station* this month but it will return next month. But, as always, it's another packed magazine, which I hope you will enjoy. Well done to all those who participated in our summer 144MHz QRP Contest, the results of which you will find in this issue (with thanks to our adjudicator **Colin Redwood G6MXL**).

FISTS CW Club

Last but not least, I was very pleased recently to be made an honorary member of the FISTS CW Club (which gets an occasional mention in our own *Morse Mode* column). I am told it is in recognition of my own use and promotion of CW as an operating mode. And, indeed, I have always been primarily a CW operator. I discovered early on that CW enabled my then modest station to work over much greater distances than I was able to do on AM (it was a few years before I graduated to SSB). But during that time a love affair with the mode was born and although nowadays I do plenty of SSB and data modes operation, CW still accounts for some 57% of my QSOs (with more than 20,000 QSOs in total so far in 2021, so more than 11,000 on CW). Yes, many of these are quick-fire contest contacts, but I also enjoy the occasional extended ragchew and even during contests I stick to the key rather than the keyboard much of the time, both to keep up my skills and because that gives me more satisfaction.

Don Field
Editor, *Practical Wireless Magazine*

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

Newsdesk

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

The Tecsun H-501x

Nevada Radio have announced the arrival of a new radio from Tecsun. It is designed for both portable and desktop use with an integral tilt stand. It uses DSP technology to greatly improve sensitivity, selectivity and image rejection. Coverage includes Longwave, Shortwave and VHF FM with Multi mode capabilities, including SSB reception on Shortwave.

Features include Synchronous detection, 3150 memories, two-channel dual speaker for stereo reception, Local and DX input selector, and multi-search capabilities. Also, a Bluetooth function to play music from a smartphone, tablet or other Bluetooth device, an SD slot with 16GB card included and a USB sound card function so it can be used as stereo computer speakers.

The large LCD display is very easy to read with extra-large digits for frequency readout and lots of information about the receiver operation, such as signal strength in dB and microvolts, battery status, receive mode and more.

A unique feature of the H-501x is the dual charging facility that uses two 18650 batteries, allowing you to use one battery while charging the spare.

Included are a 16GB memory card, stereo earphones, USB charger with cable and a leatherette carrying case.

The Tecsun H-501x was expected to arrive during September and to sell for £329.95. It is available from UK Distributors Nevada and other selected dealers:

www.nevadaradio.co.uk

Exercise Blue Ham 21-2

The RAF Air Cadets are pleased to announce that they are proposing to run their ever-popular Blue Ham Radio Communications Exercise in October. The exercise will take place during the weekend of 16/17 October when they hope that readers can put some time aside to join in with the cadets and staff. Details of the exchange of information to count as a QSO will be published on their website (below) in early October.

Exercise logsheets are also available courtesy of **Gary M0PLT** in the files section on the Facebook page:

UK 60 Metre (5MHz) Band Group

https://alphacharlie.org.uk/exercise-blue-ham

Also, they will issue you a Blue Ham participation Certificate if you contact 15 or more special MRE Callsigns over the period of the exercise. Details of how to do this will also be on the website.

New from Moonraker

Moonraker have announced that they are now importing Comet antennas and accessories from Japan. These include the MRQ213 17.5ft stainless steel telescopic antenna, intended for portable use from 20m through 4m and also suitable for supporting a lightweight dipole antenna. £49.99. Also, the MRW-666 2m/70cm collapsible handheld antenna at £19.99. Another product, manufactured for Moonraker, is a mini magmount antenna kit, again for 2m/70cm, the MINI-270, for £19.99.

moonrakeronline.com

Transatlantic Tests Centenary

The early 1920s saw the dawn of international amateur radio. A series of significant milestones led, over some five years, from no amateur transmission ever having been heard on another continent, to intercontinental two-way communications becoming commonplace.

The RSGB will commemorate these historic events by encouraging everyone to get on the air to make QSOs – focusing on December 2021 and December 2022.

Full details of how you can participate will be published via the Society's communications channels over the coming weeks and months. There will be features and photos in RadCom but you can also read the fascinating story on the RSGB website:

www.rsgb.org/transatlantic-tests

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

Icom News

Icom is allowing the download of 3D data of the exterior case of the IC-705 HF/VHF/UHF Mobile Transceiver allowing customers to create their own related accessories.

The 3D data that will be made available will be compatible with several free 3D modelling programs and 3D applications and will allow individual users to create their own IC-705 related items.

All users of this data will be required to agree to a memorandum stating specific rules of use before download. The principle of any items created with the data is that it will be for individual use only and not for commercial purpose.

This is the first time that Icom have done something like this and will be a test as to whether they will consider disclosing 3D data for other products in the future.

To find out more, including FAQs and ICOM 3D Data License Agreement, visit the dedicated IC-705 Exterior Case 3D Data Download Page:

www.icomjapan.com/support/IC-705_STL

Also, the RS-MS1i (for iOS™ devices)/ RS-MS1A (for Android™ devices) App allows your mobile device to wirelessly connect to a D-STAR transceiver and remotely set DR functions, link with a map app and send/receive messages in DV mode. In addition, pictures on an iOS/Android device can be transmitted in DV Fast Data mode or DV mode.

Further details about these apps and compatibility with your radio can be found by visiting the RS-MS1i (for iOS™ devices) or RS-MS1A (for Android™ devices) product pages. Alternatively, you can download the RS-MS1 brochure here:

https://tinyurl.com/c2zp2aue

To find out more about D-STAR digital amateur radio read the article, 'What is D-STAR?'

https://icomuk.co.uk/What-is-D-STAR

For support visit the 'D-STAR Resources Page'.

https://tinyurl.com/euj8vu8t

AIR AMBULANCE WEEK 2021: In support of the International Air Ambulance Week 2021, the Essex Ham team was active as GB4EAA in September. The team was lucky enough to be sited at the Earls Colne Airbase near Colchester, home of the Essex & Herts Air Ambulance, and operated on HF and VHF. This is always a challenging event as they have to ensure that RF from amateur radio poses no risk to air traffic comms at the busy airfield, and this year, appropriate Covid restrictions were in effect too, to help safeguard members.

Ian Mills, one of the pilots of the lifesaving service, was able to spare a few minutes to send a greetings message to help raise awareness of the charity. Throughout the event, several messages in support of the service came in, including messages from amateurs relaying their own experiences of the air ambulance service. On HF, the team made contact with the US and Canada as well as across Europe.

Funding for charities, such as local air ambulance, is challenging at the moment with so many events cancelled due to Covid, so it's great that radio amateurs can get on the air to promote their work. This year, 16 stations around the UK registered to take part in International Air Ambulance Week. The photo shows EHAAT Pilot Ian Mills with Dorothy M0LMR.

2ND G-QRP VIRTUAL CONVENTION: The appeal of low power radio communications shows no signs of fading away. Registrations for the 2nd G-QRP Virtual Convention were up by over 40% with over 750 members booking places. The event took place over two days in September and included ten presentations by speakers from around the globe. Topics took the audience under the microscope with surface mount devices, on top of mountains for some portable operating, into the workshop with building valve gear in the 21st century and designing a 2m QRP transceiver. Sunday morning included an on-air activity period with the G-QRP Club call active on HF and VHF. Propagation was not great but some contacts were made, including some two-way QRP and one on 4m DATV.

Feedback has been nothing but positive and recordings of the presentations have been made available to those who registered. The videos will be opened up to non-members around Christmas time. The presentations from last year's Virtual Convention are already available to all on the G-QRP YouTube channel.

Plans are in train for 2022 with not one but two conventions. The first is being run by the RSGB Region 8 team in conjunction with the G-QRP Club and will take place in Northern Ireland on Saturday 25 June. The second will run in parallel with the Telford Hamfest over the first weekend in September at the Harper Adams University near Telford. The G-QRP Club intend to stream the events live to maintain the global audience who have enjoyed the Virtual Conventions.

EJ8JB: Charlie EI8JB writes, *"I just wanted to write to thank UK amateurs for the amazing support I have received during my recent activation. I was active as EJ8JB from Bere Isl (IOTA EU-121) between 16 - 19 September. Antennas used were a Mono Hex for 20m and a Fan Dipole for 20/40 & 80m and I was also active on FM satellites with an Arrow Dual Band and HT. Rig was a Yaesu FT-897D".*

RSGB REMOTE INVIGILATION FIGURES SOAR: Recently, the RSGB passed the fantastic milestone of 4,000 candidates passing their Foundation licence via remote invigilation. During 2020 the Society implemented remote invigilation in stages for all three licence levels, to enable people to become involved with amateur radio and progress despite the pandemic.

The RSGB is delighted that 1,241 candidates have since passed the Intermediate exam and 544 have gained their Full licence. The Society would like to thank the small team of remote invigilators and congratulate all those successful candidates.

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The Lab 599 Discovery TX-500

Daimon Tilley G4USI gets to play with a fascinating new QRP portable transceiver from Russia.

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

Since Autumn 2019, I have been watching the development and launch of this rig, from its Russian designers, with a great deal of interest. Initially, to be honest, the way the rig looked captured my attention – it has a very unique form-factor that sets it apart from other QRP transceivers. At the outset apart from its looks I was not sure what else might be unique about it.

Gradually, more and more detail emerged on the plans, and late last year the rig went into production and then on sale in the US. I watched and read a number of reviews and then, very recently, the rig gained CE Certification and our Editor was offered a pre-release model for review from Nevada Communications, one of the two recently appointed UK distributors, along with Waters and Stanton. Very kindly, **Don** thought of me and a day or two later the rig arrived at my QTH by courier.

First Impressions

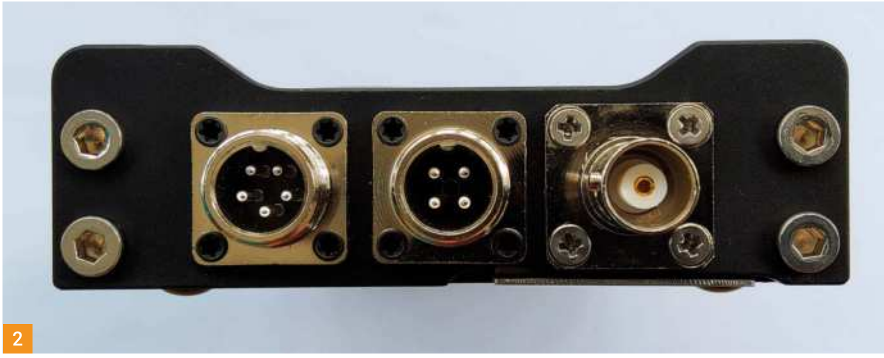
On opening the outer plastic wrap, the first thing that struck me was the quality of the packaging. The small and compact box was not just brown and boring, but a thing of beauty itself, black, sleek and shiny, like its contents. I confess to being quite excited. On opening the box I was not disappointed, and on taking the radio out of its wrapper, two things immediately struck me – first I thought it was tiny, and second I thought it was beautiful. It is a very sleek and tactile radio, just holding it is a pleasure.

Now I know this sounds superficial and silly, and I know that these things are pure marketing appeal, of the kind created by Apple in their infancy, but even on a person like me – hardened to such things normally – I was won over. The initial quality feel was supported by useful and concise printed *Quick Start* manual, which was a far cry from the printed manuals of some of my favourite Chinese rigs.

As I came to an end handling the rig, I decided to set it down on my desk. After having laid it flat for a few minutes, I realised that there were a pair of tilt legs at the back to stand it at a comfortable operating angle. Extending these, I re-placed it on the desk – only to find that it had a serious wobble. Every time I touched the rig it rocked. By several millimetres. Every time I pressed or touched a button to the right of centre, it rocked, and this meant it did so whenever I tuned around the band. Contact on the Facebook User Group revealed that not every rig has this problem, but a number of users had experienced the same issue. Nevada made contact with the manufacturer who provided this response:

"The legs are made by stamping and have some unstable dimensions. It is difficult to obtain a stable structure on a flat surface. In this case, it is better to use rubber feet on the body without tilt. The fold-down legs are of a secondary function and are intended for

Photo 1: The TX500, giving an indication of size. Photo 2: Side view, showing some of the connectors. Photo 3: The display.



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use in the field where there are no lacquered tables."

So, the bottom line is that the manufacturers are aware of the issue but there are no current plans to resolve it. The simple expedient of some Blu-Tack under one of the legs would fix it, but it would be nice to see the legs manufactured to a higher tolerance, in keeping with the otherwise really high-quality feel of the rig.

Enough of that though, let's take a look at the features of the rig and how well it works.

The Basics

The Unique Selling Point (USP) of this rig is in its design. It is marketed as a radio *"tailored for adventure, for extremes, for using in places unattainable before, with no sacrifice of performance or features."*

But what does that mean? Well, it is intended to mean that the radio is rugged, knock-proof and resistant to water and dust.

There are quite a number of QRP radios available now commercially or as kits and many of them are designed for use outdoors, in the field, in the sense that they are relatively compact, consume small amounts of power and are readily portable. Some of these are quite robustly made, and others less so. Some are relatively cheap, Xiegu for example, and some are very expensive and fully featured, such as the Icom IC-705.

What Lab599 have sought to do here is carve out a niche market for themselves. As far as I know, no other radio is marketed like this one, with emphasis on its robust construction and dust and, particularly, its water resistance. What I find a little unusual here is that the dust and water resistance are not at all defined. No international standard is claimed and no claims are made about the extent to which it can resist these things. For a device where the marketing has so clearly been very well thought through, I find this surprising. I would like to see these claims backed up by international standards accreditation, but realise this may well push production costs higher. What can I expect? Will it withstand a light drizzly rain? Will it survive a downpour? What if I dropped it in a puddle? To make claims about this radio's robustness in this regard could really do with backing up with facts. That said, no other QRP radio I know of makes claims like this, so I feel somewhat confident that it is more resilient in these areas than other rigs in this category, I just didn't know by how much. Specific feedback from Lab599 about this issue provided helpful guidance as follows:

"...we do not declare the transceiver as waterproof, since it does not have full tightness. Submerging it in water is not possible. At the same time, critical structural elements, in particular – knobs, connectors on the rear panel, are protected by silicone O-rings, which makes it more secure. The transceiver is presented as splash proof."

Later in this review you can find out how it fared in a downpour.

Design Features

The body is milled from solid aluminium in two halves, which are anodised in black, with a nice matt appearance and feel. Lab599 claim that the housing is *"liquid-protected housing and the absence of through-holes, spatter resistant plugs, valcoders with sealing rings, the transceiver will work reliably in extreme conditions, giving you real pleasure from traveling* (sic)."

Special aviation standard (GX-12) connectors are used throughout, to improve robustness and there is no internal loudspeaker, in order to preserve weather protection, a speaker-microphone being provided instead, although it is not clear to what extent this itself is water and dust resistant. An internal clock is fitted and the battery for this can be changed by the user when required by separating the two milled aluminium halves.

This radio uses software-defined (SDR) technology, providing operation 160m – 6m, with general coverage receive from 0.5 – 56MHz. Power output is adjustable from 1 – 10W of RF, there is a range of digital filters, a 48kHz Panadapter and a separate I/Q output.

The radio is really compact, just 30 (H) x 207 (W) x 90mm (D) and weighs in at 550 grammes.

One of the obvious differences with this radio are the connectors, located on both sides. These are non-standard in amateur radio terms. You won't find any phono connectors here! Apart from a standard BNC antenna connector, there are five further connectors, which are of the GX12 aviation type. These are available readily online for a few pounds each and are of a screw-on type, similar in design to the traditional

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microphone connectors on base station rigs. Every one of the five GX12 plugs has a different number of pins, so it is not possible to connect the wrong accessory to a socket. There are sockets for DC supply, Data, Microphone/Speaker, CAT control and CW key. The rig comes supplied with a DC lead, a Microphone/Speaker, a USB CAT lead, a separate lead to convert the Microphone/Speaker socket to two 3.5mm phono sockets and a PTT button for a headset. While not original equipment, mine was also sent from Nevada with a lead for the DATA socket, terminating in separate 3.5mm microphone and speaker plugs and with an open-wired electrolytic capacitor midway down the lead, presumably to isolate any DC component. This was provided for my benefit as tester as opposed to a factory supplied lead. Nevada tell me that the factory supplied radio comes just with the GX12 connector for this purpose, leaving users to fashion their own lead, either as a digital audio lead, or to activate PTT-out for amplifier keying, etc. Nevada will be stocking commercially made leads, as well as all the relevant GX12 plugs when the radio goes on general sale.

The panadapter allows visual searching for band activity and the sensitivity is user-defined, but there is no waterfall display. The rig boasts 11 discrete RF bandpass filters, one for each band, and modes included are SSB, CW, DIG, AM and FM. Additionally, there is a built in CW keyer, with four memories, plus four built-in SSB memories and 100 general purpose memories for storing VFO settings, modes, etc. Full CAT control is available via USB.

The rig can run off a DC supply of between 9 – 15V and draws as little as 100mA in receive, and between 1 and 3A on transmit. Yes, that is correct, around 100mA on receive – a tiny amount that will allow your battery to go further. There is over-voltage and reverse polarity protection, as well as temperature and SWR protection, built in.

Equaliser settings are available for low, mid and high frequency, which can be user-defined on a 1 to 100 scale, and there were the usual options for Preamplifier and Attenuator, as well as RF Gain, an Automatic Notch Filter, Noise Blanker and Squelch. There are four preset filter settings available, but these are adjustable if you wish to change the defaults.

On the transmitter side, RF power is claimed as 1 – 10W on all bands, reducing to 7W on the 6m band. My own measurements supported these claims. CW sidetone is adjustable from 400 – 1200Hz and there is a further three-band equaliser, which can be user-defined. There is also a speech compressor, again user-definable.

The Display and Controls

All controls are neatly laid out on the top surface of the rig – there are no hidden buttons on the edges, everything is in plain sight. The rig can be divided into two halves, with the left consisting of a nice, good sized monochrome LCD display, which displays most critical information at a glance and is viewable in bright sunlight. The level of backlighting of the screen can also be controlled by the user and set to dim, bright or auto, and the level of contrast is also variable.

A lot of useful information is displayed at once on the screen. A top and bottom row of inverse text displays menu choices, which are selected by a corresponding top and bottom row of buttons, sitting just outside of the display. The left and right buttons on the bottom row allow scrolling through the options. As you do so, both the top and bottom row of options change. This can be a little challenging when getting used to the rig, as you are not sure whether the option you are looking for is on the top or bottom of the screen, and they are far enough apart that you can only view/take in either the top or bottom row at once, and I find this slows navigation a little. These menu items control things such as CW settings, CW and Voice memories, the twin-VFOs, DSP controls, VOX and equaliser settings. The deeper, main menu is accessed by pressing and holding a dedicated Menu button and then scrolling through and selecting options on the bottom screen rows.

Other information on constant display includes options selected and ‘in-play’, both VFO frequencies, mode and filter preset selections, and tuning steps. The centrally located bargraph style meter can be selected to display MIC gain, ALC, Power or SWR. These latter two functions can be set either as a bargraph or an absolute number display. Whatever you choose to display, though, the SWR reading is always displayed as a number next to the graph while transmitting. This is really handy for tuning your antenna or just keeping a weather-eye on SWR.

Both backlighting and contrast can be controlled through the main menu settings, as well as selecting whether or not to sound a beep on any button press. A short press of the Menu button exits the menu.

On the right-hand half of the rig are buttons for Power, Band+ and Band–, Mode, Filter and Menu. To the right of those are

Photo 4: The TX500 after a soaking.
Photo 5: Out and about for SOTA.

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rotary controls for AF Gain, RIT/XIT, and the tuning knob, which also features as the device to change menu settings.

One of the things I like most about this rig is the 'intelligent' tuning knob. Not only does it feel nice and smooth, but it is clever in that, even if you set band tuning increments to just 10Hz, the faster you turn the knob the quicker it tunes. In other words, as I sit here and type, with the rig set to 10Hz steps in the CW portion of the band, a slow 360° rotation of the knob tunes about 50Hz of band, but if I spin the knob through 360° really quickly, using the finger depression in the knob, I can achieve over 1.5kHz of band coverage – the faster you spin the more band you cover. Putting this into context, even at 100Hz tuning steps, starting at the bottom of 20m, I can get to the top of the band in just eight fast turns of the knob, whereas tuning back to the bottom of the band at a more sedate speed takes me 30 or more turns. This is great, and unlike my other QRP rigs, means I don't have to keep selecting different tuning steps to achieve the same thing in a more cumbersome way. Other manufacturers please take note.

On the extreme right side is a vertical row of six small buttons to initiate RIT/XIT, clear RIT/XIT, set VFO memories, lock the buttons and change tuning steps up or down.

With the exception of menu functions being displayed both on the top and the bottom of the screen, I found the controls and menus easy to operate and follow. Little reference was needed to the manual. As I said earlier, a printed quick start guide is included in the box, but a more detailed and well written manual is available for download from the manufacturer's website.

In Use

Receiver figures are quite impressive and if you are a follower of the 'Sherwood List', then it comes out a little way behind both the IC-705 and the Elecraft KX2, but in front of the Xiegu G90 and the Yaesu FT-991. Personally, I don't take too much notice of these figures. Much work goes into a whole range of tests, only for them to be then ranked on a single one of them! I fully admit that I am not clever enough to understand many of these figures in any event, but I can see how they can be a useful guide as to the relative merits of the receivers in multiple rigs.

I found the receiver to be more than capable and suited to my needs on both SSB and CW. Using the filtering features was quick and simple. I found the noise reduction quite effective, but in common with other rigs, careful adjustment of levels is necessary to prevent a hollow sound that can be difficult to decipher. It worked well with some adjustment and made tuning a noisy band more comfortable. To be fair, the manual does state that this works best in CW mode and that fidelity of SSB signals is reduced.

I initially struggled with the AGC, particularly on CW. The AGC settings can be controlled from 1 (Slow) to 10 (Fast) and the default for CW is 5. I tried every setting from 1 to 10 extensively but it seemed to make no difference, when tuning from a relatively weak to a strong station, it literally blew my ears off. The AGC settings on their own made little difference.

Contact with Nevada brought the following, helpful response: *"The degree of AGC operation depends on some settings. For example:*

Preamplifier «ON» RF « + 5» - the work of the AGC is maximum, the broadcast is as flat as possible.

Preamplifier «OFF» RF « - 5» the work of AGC is reduced, the broadcast is transparent.

This tool makes it possible to optimally adjust the reception for a specific broadcast environment."

Experimentation with these settings did bring improvements, although Pre-amp on and RF +5 was just unusable due to the level of background noise created. Really, some experimentation by the user with various settings of AGC, preamplifier and RF gain settings will probably yield an AGC setting that works best for you as an individual – I certainly managed to improve matters to a level I was more comfortable with, although it would be nice if Lab599 were able to set this up with a better default starting position for ease.

Due to the dust and water-resistant design of this rig, as I mentioned earlier, there is no loudspeaker. The speaker/microphone works well though and volume and audio clarity are good. There is a facility to plug in headphones to a 3.5mm jack on the side of the microphone. When I plugged in my stereo headphones to this, I got output but it was very dependent on the position of the plug in the socket – I wonder if it is a mono, rather than stereo socket? The plugging in of headphones to the microphone also makes it really difficult to hold the microphone comfortably.

The unit comes supplied with a cable that replaces the speaker microphone, allowing connection of a headset and has a PTT button. I did not have a suitable headset to try, but plugging my headphones into the headphone outlet of this lead produced much better results and there was no dodgy connection leading to mono, stereo or no output as there was when plugging into the microphone. The only issue with this is that you have unused cables for the microphone and PTT switch hanging around. If I were to buy this rig, I would buy a new GX12 connector and make up a headphone-only lead. This would be useful if you knew you only wanted to operate CW on occasions.

One thing I did notice is that when powering off, there is quite a loud audio 'crack' that comes from the speaker, which can be a little disconcerting at first.

In the shack, connected to the Spiderbeam Yagi, the 80-10m End Fed Half Wave, and the vertical antennas, I made a number of decent SSB and CW contacts around Europe. Interestingly I didn't notice any particular issues with the AGC on SSB, set to the default setting of 3, although the majority of my use was CW.

Going Outdoors

But this is a rig for the great outdoors, not to sit on a shack desk, so I decided to use it that way. My first portable foray was to activate a SOTA site (G-SC005) Selworthy Beacon on Exmoor, overlooking Wales and the Bristol Channel. I was fortunate to pick a nice Sunday afternoon while my son performed in a band nearby, and had a full three hours on the summit. I used my homebrew 12V 12Ah Li-Ion battery box in an ammo box and my MFJ-1979 clone telescopic antenna.

This gave me a full height quarter-wave ground-plane on 20m and I used four radials on the ground. Band conditions were not great and a few calls to European SSB stations fell flat on their face – my 10W just couldn't be heard. Time then to move to CW. I programmed the easy-to-use CW memories, programming Memory 1 to a CQ SOTA call, using the beacon mode to repeat every five seconds, unless I pressed the key, and I used Memory 2 for the SOTA reference and my name. I then spotted myself on the SOTA app. Wow, what a response. Within seconds I had myself a nice little pile-up as SOTA Chasers saw my spot and gave me a call. I ended up with 24 contacts from 14 countries in 45 minutes from my single spot – what a result. Stations were worked in Sweden, France, Croatia, Hungary, Spain, Switzerland, Germany, Bulgaria, Portugal, Slovenia, Greece, Poland, Lithuania and Ukraine.

Selworthy Beacon is a popular spot for walkers on the Moor so I was not alone on the summit for very long. As a result, and as I did not have headphones with me, I wanted to work my CW reasonably discreetly.

Fortunately, the supplied speaker microphone is equipped with a spring-loaded clip on the rear and this was perfect for hooking on the collar of my tee-shirt. This allowed me to hear perfectly well at low volume and worked quite well.

Later that day I had an email from **Marton HA0MDA** saying how pleased he was that we had made contact with his one watt from a QCX and home-brew dipole, over a distance of nearly 1,900km. He was a tough copy and I gave him a 339 report, with QSB, but we made it!

After the initial pile-up and SOTA chasers were exhausted, subsequent CQ calls went unanswered, so I just listened around for a bit. I noticed there was quite a bit of activity on 40m, but I did not have an antenna for that band. As the rig does not have an ATU, and I didn't have one with me, I packed up, satisfied with my little pile-up and the rig's performance.

A few days later it was a mixed weather day, but in the middle of writing this piece I decided to do a little patio portable work. Rain threatened, and as I began to pack away, it started to fall. Although I had not had the intention of testing the waterproofing, I did take the opportunity, as it had started to get wet, to leave it, switched off, on the patio for a full five minutes in the moderate rainfall. As you can see from the picture it got quite a soaking, but a quick wipe down and connecting back to power, the rig sprang into life as before.

Personally, I am not the type of operator who goes portable in any weather, and I would never dream of operating in the rain, but if I did get caught out, it seems as though the rig will be OK – I could not say that about any of my other QRP rigs. It really does seem unique in this respect. I also believe, from its construction, that it would be able to take a fall or two with no serious damage, although that is something I am not willing to test!

On a more general note, I found that the panadapter graphics scrolled very smoothly and it was useful to see 48kHz of activity, but a waterfall as well would be a nice future enhancement. Setting CW speed was also a challenge at first. I set speed to 20, but then thought my key was broken – speed is measured in characters per minute, not words! Changing speed to 100cpm, equated to roughly 20wpm and all was good.

Sticking with CW for a moment, the rig is really semi-QSK as relays, rather than diodes are used for switching. You can dial down the QSK time (using VOX-CW in the main Menu) to 100mS but this resulted in loud relay clicks but no received audio between characters. A QSK time of 300mS provided the best compromise, with relay clicks just between the words, which was much less annoying. A further item of note is that when you are correctly zero-beat to a CW signal, a small diamond appears on screen to the right of the S-Meter and flashes in time with the code – a useful addition.

SSB performance seemed fine. Received audio quality was good and, while I didn't specifically seek to elicit audio reports, I had no negative comments. The speaker/microphone grew on me somewhat as I liked the ability to put the audio right where I wanted it, and this is particularly useful in noisy or windy environments – a really useful portable enhancement.

Data Modes

The rig comes equipped with a CAT cable, and an appropriate GX-12 connector for you to make up your own audio lead. Nevada will be selling ready-made leads too. The same connector is also used for PTT switching of a linear amplifier, so just bear this in mind if you want to do both at once – you will need a lead that can do both jobs.

Connecting up to my Raspberry Pi tablet, I decided to use WSJT-X as my test software. It is possible to use either CAT control or VOX for RX/TX switching and I opted for CAT.

The manual provides the COM port settings as follows:

Rig: Kenwood
Baud Rate: 9600
Data bits: 8
Parity: None
Stop bits: 1

The manual does not specify the model of Kenwood rig, so I chose the TS-590S in WSJT-X and set settings as described above, but I could not get CAT control. After a bit of fiddling, I found that if I turned the 'Handshake' setting in WSJT-X from 'Default' to 'None' then things worked normally and I proceeded to use FT8, FT4 and WSPR modes with success.

Photo 6: In use with homebrew battery pack.

Firmware Updating

One of the beauties of SDR technology is the ability to improve both rig features and performance by way of updating the firmware. My experience with firmware updating of some rigs is cumbersome and fiddly, however. In the case of the TX-500 though, while I had the rig on test, a new version of firmware was released. Primarily this later version increased CW memory size, at the trade-off of reducing CW memories from four to two, and also extended the lower range of the DIG mode filter.

What better way to assess the complexity of firmware updating than to try it? It is fairly straightforward, but you must follow the sequence exactly and in the correct order for it to work. First I downloaded the latest firmware to my Downloads folder. Then I connected the CAT lead to the radio (while it is switched off) and the computer. Using Device Manager in Windows, determine the COM port connection. You can plug and unplug the USB lead to determine this for certain if, like me, you have lots of COM ports.

Next, you hold the one of the top function buttons above the display (third one from the left) while powering up the rig. You are greeted with a *"The loader is waiting…."* message.

On the Lab599 website, download and execute the 'Firmware Update' software. In the dialog box that appears, select your COM port, select the latest firmware from your downloads folder and click 'Update'. Wait until the process is complete, as indicated by a message on the rig display, then turn the rig off and on. Job done – simple and painless.

Summary

There are a lot of things to like about this rig. It is, in my view, one of the best looking QRP transceivers I have ever seen. As our American cousins say, it is 'eye candy'. The form factor and engineering are excellent and it is very robust. The only downside, from an engineering point of view, is the awful wobbly tilt legs on some of the production models – I seriously hope that Lab599 correct this. It really is a bit of a spoiler when everything else is so nicely engineered.

It appears to be quite water resistant and is claimed to be dust resistant too. I would like to see this accredited to an international standard, but it is more than up to the job for most of us I suspect.

The controls and menus are easy to use but expect a little experimentation to try to get CW AGC to a level you are happy with. The external speaker-mic works well and is actually very useful if you don't want to use headphones. If headphones are your thing, then either use the headset cable provided or make yourself a headphone-only lead for CW use. I just adore the variable speed tuning dial and would like that on my other rigs too.

Is this a rig for you? Well, that depends on your preferences as a field operator – do you like a modular approach to power, rig and ATU, or an all-in-one package? There are two issues that might swing your decision, all other things being equal. The first is power supply and the second is frequency agility.

In relation to power, the rig does not have an internal battery. However, a small battery pack will likely last quite a long time, especially with the low receive current consumption. Tantalisingly, Lab599 are going to produce a Li-Ion battery pack that piggy-backs onto the rear of the rig. Pictures of it on social media look very nice. It will be engineered to fit to the back of the rig in the same shape and form factor and will contain space for you to fit your own Li-Ion 18650 cells. This is a nice feature as it puts you in control of being able to swap out faulty cells and replace cells as necessary. It also allows you to keep a spare set of cells charged, without having to buy more battery packs. It will approximately double the thickness of the rig but will be a great addition. The price is not yet announced.

As for frequency agility, I am referring to antennas here. The rig has no internal ATU. I fully accept that resonant antennas are best, especially with QRP levels, but, unless you always use an 80-10m EFHW antenna with 49:1 transformer, or a multi-band linked-dipole or similar, you can find yourself missing out.

For example, when I did my SOTA activation with the rig on Selworthy Beacon, my MFJ-1979 clone allows me to adjust the antenna for 20m and the higher bands. But, I could hear activity on 30m and 40m, which I would like to have joined in on, but couldn't due to the lack of a resonant antenna or ATU.

As I said, it is a matter of personal preference and operating style, along with the old trade-offs of increasing both rig size and price. Interestingly though, an enterprising German amateur has launched a company selling an RF amplifier and Auto-ATU combined, with the same form factor as the rig.

The project, by DIY599.com (no commercial link to Lab599) sells the PA500. This consists of a package covering 80-10m, with up to 60W output power for 5W drive. It appears to be well engineered, weighs 900 grammes and draws up to 10A at 13.8V DC. Being an external device, it can be used with other rigs too, and might be worth a look if this interests you. The cost is Euros 699 plus import duties and postage.

So overall, this is a nice, if quite expensive, field radio that is probably the best equipped to take the inevitable bumps, knock, bangs and even showers that it is likely to face. It was a pleasure to use and if it fits your style of operating, I am sure you would be very pleased with it indeed.

My thanks to Nevada Radio for the opportunity to test the radio over an extended period. It sells for £899.

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GP95N – Triband Base Antenna VHF 144/UHF 430-1260 MHz

Technical Specifications

- Coverage: 144/433/1200Mhz
- Gain: 6.00/8.6/12.80dBi (144/433/1200Mhz)
- Max power: 300 watts SSB (144MHz) / 200 watts SSB (430/1200 MHz)
- Impedance: 50 Ohms
- VSWR: less than 1 1:15
- Length: 2.42m
- Length: 1.78 m
- Weight: 1.28kg
- Mast: 30-62mm
- Connector: N-Type

Buy the GP95N for just

£119.95

UP TO 119 WATTS

COMET

GH-50 - 2.42M Half Wave Antenna 50MHz

Technical Specifications:

- Frequency: 50MHz
- Gain: 2.15dBi (1 / 2λ non-radial with frequency adjustment function)
- Input Resistance: 120W SSB
- Overall Length: 2.4m
- Weight: 1.2kg
- Wind Speed Resistance: 45m/sec
- Connector: M-J Type

Buy the GH-50 for just

£119.95

UP TO 119 WATTS

COMET

SB15 - Triband Mobile Antenna 50/144/430MHz

Comet SB 15 Mobile Whip 6m(50MHz), 2m(144MHz), 70cm(433MHz) 1.53m 120w 3 band mobile antenna

A longer tri-band mobile whip, covering the 6m/2m/70Cm bands. Fitted with the ever popular PL259 base socket, the antenna has useful gain figures of 2.15/4.5/7.2dBi per band. Antenna length is 1.53m, and is finished in high quality materials for a long life. Fitted with tilt over base for easy parking. A great way to work three bands automatically in the car without the inconvenience of fitting a triplexer etc.

Buy the SB15 for just

£59.95

UP TO 59 WATTS

COMET

GP-21 - Base Antenna For 1200MHz

Comet GP-21 UHF Base Vertical Antennas offer the best possible solution for 1240-1300 MHz Huge gain and famous Comet quality means that the GP-21 is an exceptional value for covering the entire 23-centimetre band! These superior-quality base station antennas feature a one-piece, heavy duty, UV-stabilized fiberglass covering for many years of reliable service. With the highest power rating in their class, these base station antennas are ready to handle long QSOs from your high-power 1.2 GHz radios. The Comet GP-21 is equipped with an N-Type female connector for maximum signal transfer! Although light in weight, they incorporate strong, easy-to-use extruded aluminium and stainless-steel clamp-on mounting hardware.

Buy the GP-21 for just

£129.95

UP TO 129 WATTS

COMET

CHA-250BXII - HF Multiband Vertical Antenna

The Comet CHA250BX-II Broadband Vertical Antenna will amazingly cover from 80m to 6m with no gaps! Weighing only 7.1lbs, this vertical's transmit range is 3.5-57 MHz, and receive range is 2-90 MHz

It fits together really well, nicely engineered, and if you're restricted for antenna installation space, this CHA 250BX-II could well be the answer to get on the main amateur bands from 80m - 6m.

Features / Specifications:

- Ultra-wide band coverage
- Thick base element (2mm) for heavy duty operation
- Stainless steel nuts and bolts used for longer life
- Type: Ground Plane antenna
- Transmit Frequency: 3.5 - 57 MHz

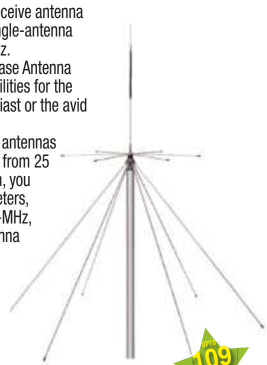
Buy the CHA-250BXII for just

£369.95

UP TO 369 WATTS

COMET

DS150S - 1.4m Discone Antenna 25-1500MHz RX TX 50/144/1300



Extremely wideband scanner/receive antenna with multi-band transmit - a single-antenna solution to VHF, UHF and 1.2 GHz.

The Comet DS-150S Discone Base Antenna offers unique multi-band capabilities for the Amateur Radio VHF/UHF enthusiast or the avid scanner listener.

These wide-band base/monitor antennas allow you to receive continually from 25 MHz to 1,300 MHz! For the ham, you will be able to transmit on 6-meters, 2-meters, 70-centimeters, 900-MHz, and 1.2 GHz… without an antenna tuner! A 6-meter tuning stub is even provided for fine SWR adjustment of your desired 6-meter band segment.

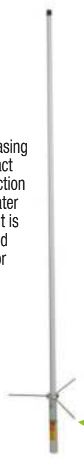
Buy the DS150S for just

£109.95

UP TO 109 WATTS

COMET

GP-3M - Base Antenna For 144/430MHz (SO239)



A combination of special power feeding and phasing coil, ensures highest gain figures for this compact base antenna. The one piece fiberglass construction assures long durability, and full resistance to water etc. Completely factory tuned and no adjustment is necessary. The perfect solution to your dual band base needs. Also fitted with SO239 connector for easy connection.

- Frequency Coverage 144/433 MHz
- Gain 4.5/7.2dB
- Impedance 50 Ohms
- VSWR less than 1:1.5
- Maximum power 200 watts
- Length 1.78m

Buy the GP-3Mfor just

£79.95

UP TO 79 WATTS

COMET

HFJ-350M Toy Box 1.8-Band Portable Telescopic Antenna 1.8-50MHz

Ideal for use with ICOM IC-705 and similar portable radios. Includes coils for 160m and 80m all in a handy green plastic carry bag

Features:

- 10-Band 1.8-50MHz portable Antenna • 3-stage construction that is convenient to carry • Telescopic antenna for multi-band HF to 50 MHz bands • Frequency can be easily changed by short plug • 1/4 base loading type antenna

Buy the HFJ-350M for just

£99.95

UP TO 99 WATTS

COMET

CA-52HB4 - 4 Element HB9CV Beam Antenna For 50MHz

The COMET CA 52-HB4 is a very high gain, twin driven 4 element beam antenna, high quality construction from aluminium and stainless-steel hardware ensures a long operating life, and it's 2.1kg weight still makes it perfect for field day and outdoor operations.

Technical Specifications:

- Antenna Type: 4 element beam
- Frequency: 50Mhz • Impedance: 50 Ohm
- V.S.W.R: Less than 1:1.5
- Gain: 10.4 dB • Connector: M (SO-239) Type

Buy the CA-52HB4 for just

£149.99

UP TO 149 WATTS

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COMET

CAA-500 MARK II Standing Wave Analyser 1.8-500MHz

Key Features:
• Auto Sweep Mode - Automatically graphs the SWR on the LCD display. Choose any one of the pre-set amateur band frequency ranges and press the sweep button in for about 30 seconds the SWR graph is completed and displayed. • Manual Sweep Mode - Choose the band and manually set the bandwidth and manually sweep the chosen frequency range. • Multiple Manual Sweeps - Should you want to make an adjustment to the antenna length, to the position, height above ground, a gamma match adjustment, etc- you can overlay 5 manual sweep results in different colours! Instantly graph and see exactly what happened after each adjustment! • Range: 1.8 - 500 MHz • RF output level: 0dBm 1 mW • Measured SWR Range: Analogue meter 1.0 6.0:1, LCD display 1.0 9.9:1 • Impedance measurements: 12.5-300 Ohms • Reactance range: 0 - 500 Ohms (absolute value) 1.8 -190 MHz • Battery indicator and selectable Auto-Power-Off timer • Internal trickle charger option when using NiMH batteries

Buy the CAA-500 for just

£349.95

UPTO 349 WATTS

COMET

24KG - Dual Band 144/430 MHz Mobile Antenna

Super Linear Converter (SLC System) achieves highest gain in 2 bands, 144MHz and 430MHz. Frequencies are completely adjusted before delivery, at roof-side mount, having wide enough band width, with low VSWR. Fold-over system is convenient when parking the car at narrow space (not to be folded when driving)

Buy the 24KG for just

£69.95

UPTO 69 WATTS

COMET

SB5 - Dual Band 144/430 MHz Mobile Antenna

This is the most popular antenna in the Comet line for several reasons: Mid-size / mid-price range / open coil flexs to absorb brushes with tree branches / black color fades into the skyline – ground independent.

Key features:
• Frequency / gain: 144MHz: 3.0dBi (1/2λ non-radial) 430MHz: 5.5dBi (5/8λ 2-stage non-radial)
• Input resistance: 144MHz: 120W (FM) 430MHz: 120W (FM)
• Wide reception 100MHz-170MHz, 350MHz-470MHz
• Length 0.95m
• Mass 1.70g

Buy the SB5 for just

£27.95

UPTO 27 WATTS

COMET

SB0 - Dual Band 144/430 MHz Mobile Antenna

144/430MHz for dual band mobile

Key features
• Frequency / gain 144MHz: 1.5dBi (1 / 4λ) * Grounding required 430MHz: 2.15dBi (1 / 2λ non-radial)
• Input resistance 144MHz: 60W (FM) 430MHz: 60W (FM)
• Wide reception 100-170MHz, 350-470MHz
• Length 0.31m
• Mass 80g

Buy the SB0 for just

£27.95

UPTO 27 WATTS

COMET

CF-530 - 600w Duplexer 1.3-90/125-470MHz

Comet CF-530 - 50Mhz/430Mhz Band Duplexer for Transmitting and receiving both 50Mhz (or HF Bands) and 144 MHz (or 430Mhz Band) at the same time. Combined high quality filters for preventing TVI at the same time. The isolation between the two connectors is more than 45dB, In the case of using the CF 530 for one frequency, the other connector can remain open, although an additional Dummy Load would be preferred. Fitted with the popular combination of 2 x output leads with PL259 plugs, and input of SO239 socket.

Buy the CF-530 for just

£59.95

UPTO 59 WATTS

COMET

BMG-M - Magnet Mount With 4 Metre 3.5DQEFV COAX

Technical Specifications
• Connector: MJ Type – MP Type • Coax Cable: 3.5DQEFV
• Cable Length: 4 Metres • Size: 78mm (magnet diameter)

Buy the BMG-M for just

£39.95

UPTO 39 WATTS

COMET

CSP-60 – SPEAKER

Technical Specifications:
• Maximum input: 6W • Impedance: 8Ω • Weight: 300g
• Connection Terminal: 3.5mm plug • Cable Length: approx. 3m
• Dimensions: 120mm (W) x 97mm (H) x 47mm (D)

Buy the CSP-60 for just

£24.95

UPTO 24 WATTS

COMET

CMX-400 - 140-525 SWR Meter

CMX-400 meter, up to 200 watts power handling on VHF/UHF 140-525Mhz. Large, clear cross needle display reads FWD/REF and SWR simultaneously, and to minimize power loss CMX-400 has a built-in low loss sensor. The meter is very well illuminated in red and green.

Buy the CMX-400 for just

£119.95

UPTO 119 WATTS

COMET

AT-283 - Antenna Tuning Unit 144/430MHz, 250W (PEP)

The Comet CAT-283 covers a frequency range of 144/430 MHz and handles up to 250 Watts power. The built-in duplexer helps tuning each band separately.
Cross needle display shows FWD, REF and PWR simultaneously.
Display beautifully illuminated when connected to the power supply.

Buy the AT-283 for just

£219.95

UPTO 219 WATTS

COMET

CF-50MR - Low-Pass Filter For 57MHz 1KW/CW

High Grade Low-Pass Filter for TVI, BCI from Comet, this model covers 50MHz, and can cope with high (500w CW) power. It makes sense on 6m to install a high-quality low pass filter, and this is the one.

Features / Specifications:
• Band Pass Frequency: -54Mhz • Impedance: 50 Ohms
• V.S.W.R.: Less than 1.2 • Max. Power: 500w CW, 1Kw PEP

Buy the CF-50MR for just

£79.95

UPTO 79 WATTS

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

A Full Postbag

With the recent upturn in HF conditions, **Steve PJ4DX** has plenty of reports from readers.

At long last the sun is showing signs of greater activity. The Solar Flux Index (SFI) peaked at 101 on 8 September, and the Sunspot Number (SN) increased to the remarkable level (for this stage in the sunspot cycle) of 124 a couple of days later. I'm fairly certain these are the highest figures so far in Solar Cycle 25. On the morning of 11 September the SFI had decreased to 95 but the SN remained at 124 for a while. **Table 1** shows the progression of the solar cycle over the last six months.

We have received a very full postbag this month so, without further ado, on straight away to the readers' news...

Readers' News

Ken Churms EA5/G4VZV said *"It's been a long time (10 months in fact) since I was last doing some pedestrian mobile working down by the salt lagoons of south-east Spain, but I'm back again,* **Fig. 1.** *... It's been a fantastic five weeks down on the Costa Blanca... It's been better than expected with inclusion on the* DX World *info pages and constant updates... on* Twitter *(G4VZV and EA5/G4VZV) and* Facebook *groups. All my activities have centred around the salt lagoons at Salinas de Bonmati and Salinas de Santa Pola. Propagation favoured long path to the Pacific area early mornings on both 40 and 20m. Stations worked include over 50 VK stations from all call areas VK2 to VK7 and over 20 ZL stations worked from both North and South Islands. On 8 September in the early morning I worked* ***E51JD Jim*** *in Rarotonga, Cook Islands. Other stations worked over the past five weeks include many USA, particularly in the states of Montana, Texas, California, Oklahoma and Utah."* Other countries worked by Ken included Trinidad and Tobago, Brazil, Canada, Costa Rica, Jamaica, Saudi Arabia, Israel, Cyprus – and two aeronautical mobile stations. *"My only issue was being so close to the still water of the lagoons (only a metre away). I suffered with mosquito bites, especially when there was no breeze. I'm returning to the UK this weekend but should be back beginning of October for more sessions by the lagoons... I took many video recordings of VK and ZL stations with 59+ signals and no background noise. I am uploading these one by one to* YouTube *under my callsign for anyone to listen."*

1

2

Kevin Hewitt ZB2GI wrote that the Gibraltar Amateur Radio Society *"activated ZB2LGT at Europa Point Lighthouse (GI-001),* **Fig. 2**, *for the International Lighthouse-Lightship Weekend (ILLW) on 21 and 22 August. GARS members Kevin Hewitt ZB2GI,* ***John King ZB2JK*** *and* ***Ronnie Payas ZB2RR*** *took part in the event, assisted by* ***Peter Leach G8NSS*** *visiting the Rock and club regular* ***Andrew*** *(white stick operator).* ***Ernest Stagnetto ZB2FK*** *and* ***Derek Austin ZB2CW*** *both operated CW. The station operated from 60m to 10m... The ZB2LGT log included over 700 SSB QSOs, 300+ FT8 QSOs and 200+ CW QSOs."*

Portable activity from the seaside seems to be a theme among our correspondents this month, with **John Rowlands MW1CFN** reporting that because he recently moved home he now operates mainly as MW1CFN/P from the North Wales coast, **Fig. 3**. *"The 12m LFA, tower and assorted delta loops at home are all now gone, as is worry over their winter survival at a very harsh, exposed location. Whilst portable work might be perceived by some as a second-rate option, it's anything but. Being near the sea offers very significant 'free' gain, which is typically around 10dB, but often much higher. This makes even the simplest antennas very capable indeed, when you realise 10W in effectively becomes 100W out. During tests earlier in the summer at 12m, some paths were up to 17dB stronger into a quarter-wave vertical than into my 3-element Yagi, just 6km inland. During very warm, calm weather, I've done a lot of 17m FT8 operating from the Anglesey coast of late. The results are spectacular* (see **Fig. 4**)*; I work endless JA, R0, HL, and other such Far East locations. On 7 September my 15W FT8 signal made it comfortably across to Fiji. I was regularly hitting VK."*

Victor Brand G3JNB reports that *"on the 4th [August] at 2100UTC, I realised that I could hear Argentina's national club L21RCA in Buenos Aries on 20m CW at a splendid S8. They worked a DL, called again and then, as a 9A and I responded, vanished... As days passed, it seemed that DX signals were beginning to reappear. ZD7BG St Helena was heard with a tantalising signal on 17m. On 20m, I thought I had bagged VU2CVS India but he had responded to fellow G-QRP club member* ***Iain GM4HBG****. A noticeably weak OH0/SM7RYR Åland Islands heard me immediately but special event RZ90FA Moscow did not, despite the strong signal path between us and, on the 12th,* ***Komatsu JH1GEX*** *was readable at midday. DX opportunities on CW remaining sparse, I switched to PSK31 and*

Fig. 1: The sack trolley pedestrian mobile station of Ken EA5/G4VZV at the salt lagoons in south-east Spain. Fig. 2: The Gibraltar club operated as ZB2LGT from the Europa Point Lighthouse (GI-001) in August. Fig. 3: The MW1CFN/P location in North Wales. John uses a £22 Ampro 17m whip on his car. Fig. 4: MW1CFN/P results after about an hour of mid-morning FT8 operating on 7 September. Fig. 5: Tony G4UZW tightening the bolts attaching the new rotator to the top plate of his Tennamast. Fig. 6: The new (vintage) amplifier in the shack of Tim GW4VXE.


3


4

	Sep '21	Aug '21	July '21	June '21	May '21	Apr '21	Difference
SFI:	95	72	72	77	78	73	(+23)
SN:	124	0	24	29	36	0	(+124)

Table 1: Rolling six-month Solar Flux Index and Sunspot Numbers as of 11th of each month. The final column shows the difference between the September and August figures.

with 10W to my vertical on 20m, TF2MSN Iceland and VE2EH Montreal both replied first call... On the 20th, I could hear weak CW from 5I3B Zanzibar Island (AF-032) on 17m; ***Josep EA3BT*** *and XYL* ***Nuria EA3WL*** *were there on holiday. Similarly, on the 22nd, YB4IR Indonesia was S8 at 1630UTC with both his and the split frequencies suffering DQRM* [deliberate interference – **ed**.] *from strong carriers. But on the 27th, still on 17m at 2110UTC,* ***Wald XQ6CF*** *Chile came straight back to my low power CW call whilst, closer to home, OJ0WS Market Reef worked me first call on both 30m and 40m CW. And, on the 30th, I had a QSO on 20m with UE80P Archangel who was celebrating the 80th anniversary of the legendary WWII Arctic convoys. Back in the day, before FT8, it was often said 'If you can't hear 'em, you can't work 'em'. In August, I started to hear DX again and actually work some of them. More sunspots please!"*

Etienne Vrebos OS8D wrote that *"Most of my activity is in the morning till 1000UTC on 7MHz (after that hour QRM increases rapidly). I enjoy more and more chatting with Europeans... Whenever I'm not the first or the second to answer a DX station, it's really impossible to reach them due to the 'European Zoo', even with 1.5kW allowed in Belgium! That happened for XV1X, where I was the very first when he called CQ... pure coincidence. It gives real satisfaction and my way of working most stations is just tuning around with the VFO because if a DX station is spotted, it is already too late. I wouldn't even think what could happen if P5 or EZ* [North Korea or Turkmenistan – **Ed**] *would be activated... I'm still not on digital transmission. I had some interesting talks with a local here. He told me that when you got 330 countries confirmed on nearly every band FT8 is a new challenge to start it all over again. I do agree with him that way..."* Etienne raises an important point for those chasing DX: it's far more efficient to tune the radio yourself rather than rely on the DX Cluster to find 'wanted' stations. Although Bonaire is not a rare DXCC entity, if I am 'spotted' on the DX Cluster a large pile-up normally develops and those running low power then find it difficult to get through. Yet on many occasions I call CQ without being spotted and weak stations, using low power or indoor antennas, respond and we have perfectly good contacts – until the pile-up eventually develops.

Reg Williams G0OOF said that *"SSB has taken a back seat at the moment so I am still concentrating on FT8/FT4; it does help to keep the interest up. September has been good with quite a few DX stations worked, along with lots of USA stations worked on 20m late into the evening. Great for collecting grids, counties and States... Late one evening on 20m FT8 I worked HL2EO Republic of Korea. Within a few minutes KL7ILA Alaska was in the log. Pleased to have worked PJ4EVA on three bands this month. Best DX was ZL3AAD on 40m at 0540UTC. Gridtracker, which works alongside WSJT-X, has a useful feature called OAMS (Off Air Messaging Service). This allows text contact with another station that has enabled this feature. If I am finding it difficult to make contact with a station, I send a short text containing my working conditions. This may influence a favourable outcome from the other station if he responds, by giving me some more time to make the QSO. Little bit hit and miss but it is something to try."*

5

6

Tony Usher G4HZW reports that his *"main task this month was a replacement rotator. I've retired the Kenpro KR400; it's served me well having been bought second-hand in 1981! I've replaced it with a new Yaesu G-450C from a well-known retailer,* **Fig. 5**. *It's working well and means I don't have to peer through the shack window to see if it's pointing in roughly the right direction. This wasn't a problem in daylight but more of a challenge at night!"* Tony says that it was *"A quiet month on 10 metres. Plenty of Europeans and the usual evening openings to South America. I did see some well-equipped stations working VK using FT8 and even SSB one day but nothing here at the time unfortunately. Perhaps we'll get some F-layer propagation during the latter part of September and into October."*

Tim Kirby GW4VXE said *"I went on for the CWops CWT session on 8 September at 1900UTC and was struck by how much the conditions had changed since I last did the 1900 event, probably three weeks ago. I like the CWT sessions, a one-hour CW activity period/contest run on a Wednesday. There are three, soon to be four, sessions each Wednesday 1300 – 1400, 1900 – 2000, 0300 – 0400 (Thursday) and 0700 – 0800 (Thursday)... I find it interesting to observe the week-by-week propagation changes. For example, last night 20m to North America was fading with me by the end of the 1900 session, but 80m was really buzzing. Three weeks ago, I don't think I even got on 80m...*

"New equipment has arrived at the GW4VXE shack. In fact, it's rather vintage. ***Roger GW5NF*** *now uses a solid-state PA in his shack and his 2x3-500Z amplifier, built by* ***Ross Clare GW3NWS*** *around 1975, was gathering dust. Roger asked me if I'd like to have it,* **Fig. 6**. *Of course, I jumped at the chance. It's an amplifier I know well, having used it many times, both at the Red Dragon Contest Group (GW8GT) and at Roger's home station. Even though the valves are now not as good as they once were, the amplifier will still happily produce 400W and keep the shack beautifully warm! It's quite something to think that in just three years' time, the amplifier will have been in use for 50 years – a real testament to Ross's construction skills."*

Owen Williams G0PHY says he had *"Not much activity to report this month. I spent a long time trying to work* ***Nuria 5I3W*** *on Zanzibar Island even though it wasn't a new IOTA for me. I heard her on 24, 21 and 14MHz but there were big pile-ups on all these bands, perhaps because of the dearth of DXpeditions over the past 15 months. I finally broke the pile-up on 14MHz using my amplifier. I managed a couple of contacts in the All Asian Phone contest last weekend and I'm hoping for some DX in the Worked All Europe Phone contest later tonight and tomorrow* [11/12 September – ***Ed***]*; I worked 4L2M and PT5J this morning."*

Around the Bands

Kevin ZB2GI: 5MHz FT8: 4X4DK, HP1CDW, KM4SII, KT1TK, ZL2AO, ZL2BH, ZL4OL, ZL4TT. **14MHz SSB:** 5X4E, CE5DSQ, CS8ABG, EA8CWA, K2TRD, KL7HRN, LU1FF, NU1O, PY2XV, T77LA, VE3DOU, W8BCM. **21MHz FT8:** 9Z4JC, A41ZZ, AC8L, AD4K, AF3K, AG5CN, CE3GRU, CX3DDO, HC1TFB, HI8RD, K1FE, K2CBI, K9GR, KO6LU, KP4JRS, LU5FF, N0YY, OA4DOS, PJ4GR, PV8BR, TA0LKJ, V31ZA, VE3YXO, XE3E, YV5JAU, ZY2FTDMC. **28MHz FT8:** CX5AZ, CX6VM, LW2DAF, N1KWF, PP2RON, PY1ZRJ.

GARS SES ZB2LGT: 5MHz FT8: HP1CDW, KT1TK, N3XX, ZL2BH, ZL4OL. **7MHz CW:** K3QU, K4EWG, N4NSG, N9RO. **7MHz FT8:** N0FW. **10MHz CW:** 8N4OLP, HK5NLJ/3, K0AL, K3RV, K4MPE, K9VKY, KP4TF, LU5VV, N2RC, W1ZE, W8BG. **10MHz FT8:** JA5FBZ, N4GJ, TA2FE, VK3BY, VK4ACN. **14MHz SSB:** 3DA0VV, 3V8HP, 4Z5SL/LH, 5B4AIX, AC1Z, CS2LH, HI8RD, HZ1TT, K4KCC, KP4GL, LU1JHF, N6AP, N9RD, NL7WD, OD5ZZ, PJ4KY, PV8AAS, PY2BRA, VE2CSI, VE3CKO, VO1CH. **14MHz CW:** K1RX, K3ZO, K6YGC, KP3LH, N0JR, N4AF, VE3AT, W2ZQ, WA9AQN. **14MHz FT8:** 4X1RU, 8P6PD, 9J2BS, C31CT, CX4CAW, HK2AQ, K5SM, K6MKF, LU8DMV, N4AWP, N7QT, N8LGP, NF1G, NP4JF, PP5DZ, VA2QA, VE3CFK, W2ZI, W9HJ, ZS1SA. **18MHz SSB:** 7X2GK, K4DY, NL7CO, W4AMP, ZS1WJ. **18MHz FT8:** 4X5WS, EA8UE, HI3I, KC4SAW, PY2IQ, W5SUM, W8HC, WA3YZD. **21MHz FT8:** PU2MVE. **28MHz SSB:** CE4WJK. **28MHz FT8:** CX8DSK, LU2DGZ, W5EAE, PT2VHF.

Etienne OS8D: 7MHz SSB: HB0/IK3TND, OH0KRF. **14MHz SSB:** BD7MHZ, BG4WOM, BI4MBC, S79KW/M, VU2DK, VU2GGL, ZB2LGT. **18MHz SSB:** 5X3R, EK1ET/P, EY7AD, U4MIR (a real cosmonaut!), XV1X. **21MHz SSB:** 5X3R, JH8RBY, JR7TKG, TI2CF, ZS6CCY.

Reg G0OOF: 7MHz FT8: HI8RMQ, HP8DPD, V31MA, VK3EGN. **10MHz:** JA1FNO, KP2B, L21RCA, PJ4EVA, VK3DRH, ZL4AS. **14MHz FT8:** JA9BFN, NP3CJ, PY2VZ, V31DL, YB6RMT, ZP6ARO. **14MHz FT4:** 9Y4DG, A41ZZ, CO8MCL, CX2AQ, HI8S, JI4POR, KP4PR, PJ4EVA, VP8LP, YV4BCD. **18MHz FT8:** 8P6ET, J69DS, PJ4EL, PJ4EVA, V31ML.

Tony G4HZW: 28MHz FT8: 5B4AHL, 8P6FH, CE2EC, CX3DDO, LU3AHY, N9ZTC/PY4, PP5AK, PT2VHF, PU1AJN, PY5XD/M, TF3VG, VO1CH, VP8NO.

Owen G0PHY: 14MHz SSB: 4L2M, 5B4ANY, 5I3W, BY1AS, EH8SDC, PT5J.

Signing Off

Thanks to all contributors. Please send all input for this column to teleniuslowe@gmail.com by 11th of each month. Photographs of your shack, antennas, or other activity would be particularly welcome. For the January 2022 issue the deadline is 11 November. 73, Steve PJ4DX.

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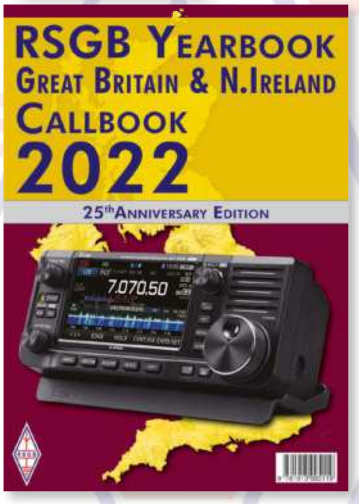

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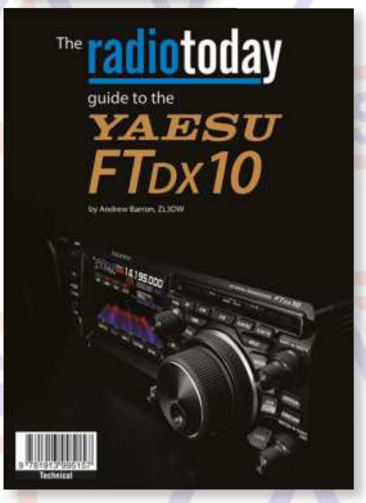

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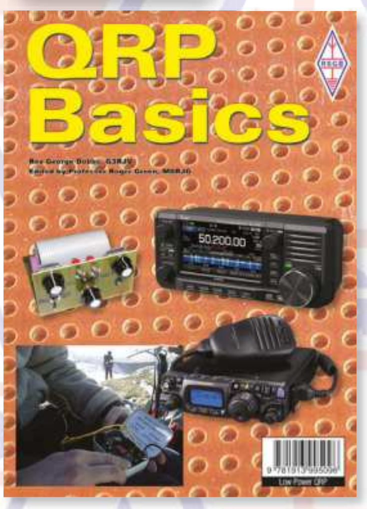

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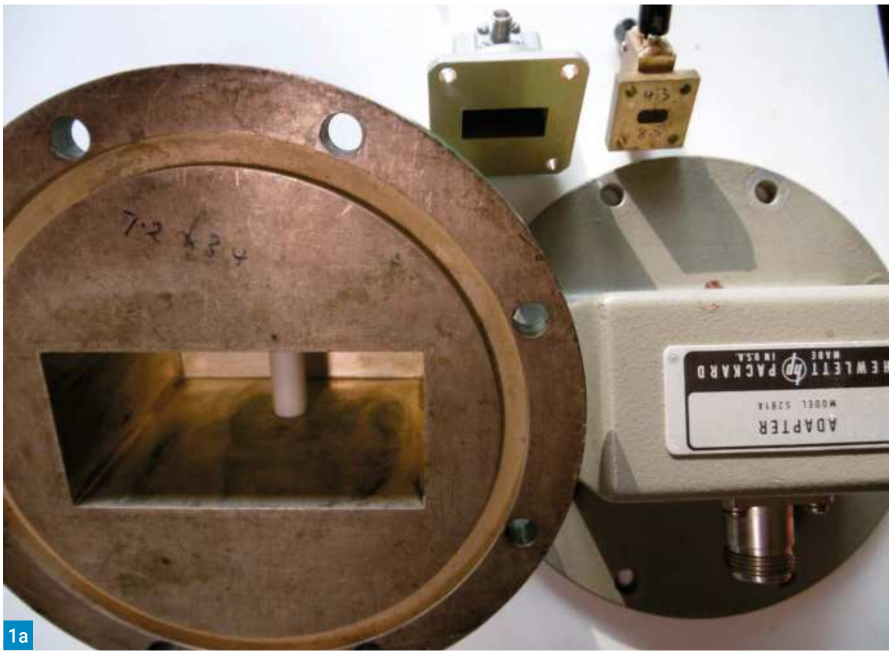
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1b

An Introduction to Microwave Radio (Part I)

Ian Dilworth G3WRT looks at microwave engineering advances, design, and construction for 2021 radio/wireless enthusiasts.

Ian J Dilworth G3WRT
practicalwireless@warnersgroup.co.uk

In this series I endeavour to cover all the relevant topics that distinguish microwave design and construction from HF and VHF hardware design and implementation. The aim being to encourage readers to experiment with building their own equipment by equipping them with solid practical tools and knowledge and hopefully to entertain in the process. Most of the techniques and advice introduced are good practice at VHF/UHF and HF in 2021 and inevitably involve surface mount (SM) devices and components in a sensitive enough way to realise this represents a transition, for many, from leaded components and coaxial cable connections. Readers may be surprised to find that microwave construction can be and is practically simpler than HF even if SM components are involved – well nearly! The requirement is applied knowledge. I deliberately minimise any associated mathematics, which can always be found e.g. [**1, 4**], to maximise illuminating the subject in the *PW* space available.

Microwave to millimetrewave through Terahertz (THz) and then upward to 'light' laser boundaries are rather arbitrary. Radio propagation characteristics are very important to appreciate because significant molecular interactions occur [**2**] and they are an important aspect to appreciate, especially if you want to use these frequencies for communications in the troposphere. Here I only deal with my own practical design experience, which is essentially limited up to 77GHz (a band allocated for car proximity radar), currently being expanded, by me, experimenting with mixing light lasers to produce THz. Even at 300GHz the same principals apply while the technology can change for practical reasons. **Fig. 1a** shows 2.4GHz (13cm) and **Fig. 1b** 300GHz (0.3THz) (1mm) waveguide, for comparison, which are low loss, band pass, transmission lines. Happily, these are not the only methods available.

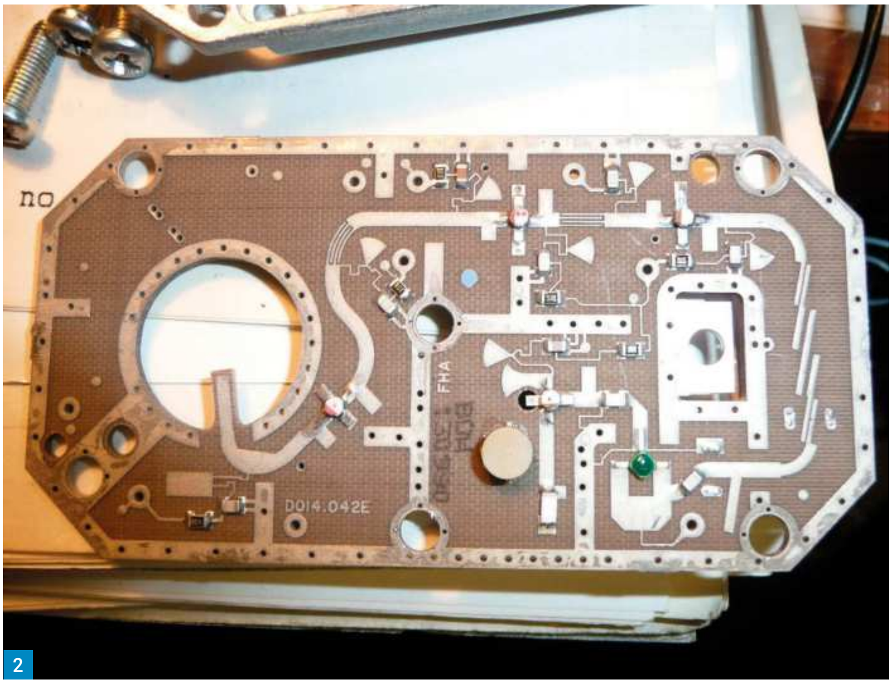
The word 'hardware' is important here because we are all aware of the advances of software defined radio (SDR), which in 2021 are impinging on VHF and UHF designs but we are still a way off true microwave frequency operation of analogue to digital (A-D) converters, which such transceivers rely on. True microwave A-D converters do exist [**3**] but are rather power hungry and not practically attractive.

Starting with an Example

Since this is *Practical Wireless* perhaps a good way to start is 'practically' with an example. I have one already prepared. This is a low noise ~12GHz single conversion superheterodyne receiver producing an intermediate frequency of 600-900MHz suitable for direct broadcast satellite television (DBS). It illustrates nearly every aspect of microwave design and implementation that is relevant to 2021 radio practice. I aim to provide the key to understanding the implementation. The design, the 'systems design', is common to all superheterodyne receivers and an educational spread sheet, in excel, is available [1]. As with all CAD its purpose is not design but as a tool to parametrically model/examine and optimise an existing design idea.

Rather than immediately dipping into

Fig. 1a: Low loss microwave transmission line in rectangular metal waveguide TE10 mode. The horizontal, largest dimension is a half wavelength, and the E field is vertically polarised with respect to it: Illustrated are 2.4GHz (23cm) back and front, 10GHz (3cm), 24GHz coax to waveguide transitions and 300GHz (1mm) waveguide. The induced currents in the walls introduce loss, hence the need to have smooth, electroformed, coating to the 'skin depth' required. Fig. 1b: The 300GHz waveguide. Fig. 2: A simple, one polarisation, 12GHz DBS receiver. Fig. 3: A dual polarised 12GHz RX version to a similar design.



the (important) details, I use this hardware to illustrate some relevant aspects. If the reader is interested, then further details are certainly available. It all depends on how deep you wish to develop your knowledge and expertise [**4**].

The Single-Conversion Superhet

Starting on the left of **Fig. 2** is a circle with many plated through VIAs. A VIA (Latin for path or way) is an **electrical connection between layers** in a physical electrical short circuit that goes through the plane of one or more adjacent layers of a PCB to the underneath conducting ground, often called a ground plane. The essential characteristics of a 'VIA' is minimal inductance and capacitance, but there is always some resultant RF impedance, which is frequency dependent. The board itself introduces losses, which is why it maybe sometimes appropriate, but less practically convenient, to employ air suspended stripline.

This construction is known as stripline and is a planar, printed side and ground plane side, producing transmission lines of a given impedance (governed by their width – the wider it is, the lower the impedance) and passive components. Unlike waveguide it is not bandwidth limited. It is two dimensional (2D) if you ignore the VIAs and the conducting housing. It requires a housing because it does radiate a little (~10%) and it is consequentially also sensitive to outside influences. So, despite being essentially 2D it is 3D in operation, as far as the RF currents are concerned. Where they go governs the hardware's operation.

The circle houses the aperture of a horn antenna [**5**] whose feed can be seen projecting into the aperture by a probe, which in this picture is nearly vertically polarised. Satellite DBS use two orthogonal linear polarisations [4,5] and around 12GHz the wavelength is ~2.5cm so the feed for a high gain antenna shown is a quarter wavelength monopole [5]. The printed antenna feeder has no ground plane behind it, but a cavity is used as illustrated by studying **Figs. 3** and **4**, which show a dual-polarised receiver of similar design to Fig. 2. In this version a resonant patch fed antenna is employed, coupled via high impedance orthogonal couplers. The printed stripline feed arrangement width-to-height ratio (w/h) governs the antenna impedance and hence match or return loss (dB) or SWR. At microwaves, the return loss in dB is universally employed rather than SWR.

Back to Fig. 2, the first RF amplifier fed by the antenna feed, at 12GHz, is the orange tipped device. The bias for the input is fed at DC via a black SM resistor followed by an SM low-frequency decoupling C and then a 12GHz stripline LCL filter to isolate the 12GHz feed. Inductors are high impedance and hence of narrow printed width and the length governs the inductance value. A quarter wave of low impedance, open ended, printed line acts as a resonant high impedance at one end and low impedance at the other [**4**]. Think of it as a monopole antenna, although in this case it is used to produce a low impedance decoupling component. This CLCL arrangement isolates the low impedance antenna feed while allowing DC bias for the 12GHz active low noise amplifier (LNA). The printed, low impedance, right angle, stubs match the device at its different input and output impedances (all low), a combination of

distributed capacitance and inductance. The output requires slightly more inductance than the input to match to a relatively long 50Ω transmission line to the following amplifier. Before this the first device needs a DC supply fed by a similar LCL network. This time, because of board space, the decoupling employs a triangular element which exhibits similar properties to a quarter wavelength stub, high to low impedance [4]. Of course, there are obvious limitations on the impedance that can practically be achieved in stripline because its impedance depends on the w/h ratio and its dielectric constant above a ground plane.

Then a DC block is needed, which is also an RF short circuit. At microwave frequencies cheap lumped SM components are usually rather lossy and have unwanted, parasitic, inductance and capacitance and couple to the housing, even the smallest, present day, SM, which this example does not employ. So, as a compromise, a printed interdigital capacitor is fabricated as illustrated. At 12GHz 1pF has a reactance of ~10Ω. Unfortunately, anything with RF current flowing through it radiates and by enlarging the area of radiation this design shoots itself in the foot somewhat. And debatably because it is a significant fraction of a wavelength long, it radiates relatively well, as we know from using low frequency inefficient HF antennas! It can be modelled, of course, but it is easiest to suppress the radiation with absorber. This is, after all, a commercial design made for a price. High performance low loss SM components are available, at a price, for critical design applications.

The second and third amplifiers are identical to the first before the rather lossy printed 3-pole bandpass filter. This consists of resonant elements that are coupled in such a way as to produce the desired bandpass response. The loss is intrinsic to this sort of filter built on substrate, hence the need for three amplifiers. By this stage the overall noise figure does not suffer. The systems design [1] is centrally important and used to optimise the noise performance or the sensitivity. Different types of microwave filters (and UHF) and their performance and construction will be introduced in another article.

The matched output of the filter is fed to a balanced mixer (green), which is DC biased, hence the DC blocking SM capacitor, because here it can be cheap and relatively lossy. The usefulness of spreadsheets is that you can parametrically examine the system effects [1]. The output of the mixer is ~700MHz and is fed via a matching inductor to the IF output 75Ω coaxial cable. 72Ω is the optimum low loss coax impedance, 50Ω (as commonly used by amateurs) is a compromise between loss and power handling.

The local oscillator, operating around 11GHz, is centrally important to this design. It consists of a remarkably simple but effective FET oscillator whose feedback is governed by a dielectric 'puck', to the left of the green mixer. This is coupled by proximity to the FET transmission line resonator and the internal capacitances of the FET result in oscillation, which the high-*Q* puck governs. This sort of oscillator is acceptable for wideband (digital) TV where the TV can compensate for the frequency drift, caused by temperature change, by automatic frequency control (AFC), but it is not adequate or suitable for the usual narrow band amateur frequency allocations. It also has relatively poor phase noise sidebands. This is the central point to make with this illustration. It is made for a purpose and to a price. However, it does illustrate general aspects of distributed component, printed, microwave engineering. I'll discuss oscillators and frequency control, so centrally important in 2021 with narrow band (SSB and FT.*) and narrow modulation, now universally employed, to obtain more range (Moonbounce, Mars, Venus, and Jupiter communications!), in a later article.

There are several other practical points to make as Fig. 4 illustrates. This is a diecasting that fits over the stripline of Fig. 3 with the purpose of screening and isolating each stage, compartmentalising, and isolating the sections, but not perfectly, its lossy material helps. The black areas are microwave absorber, essentially graphite loaded sponge, which is very RF lossy and helps to make the design stable.

It suppresses the RF currents above the stripline, which would otherwise couple to other areas of the circuit possibly resulting in instability. A disadvantage of stripline is it radiates (~10%), as do circulating currents in screens. Holes in screens do the same and I will be dealing with those practical aspects including VIAs in another article.

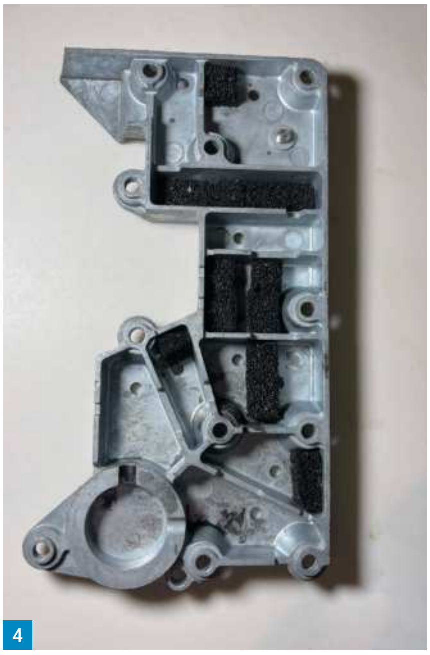


Fig. 4: The shielding and absorber fit over the top of Fig. 3. Notice that the antenna is backed by a cavity reflector, a quarter wavelength behind the radiator antenna, which is the only part of this PCB that has no ground plane.

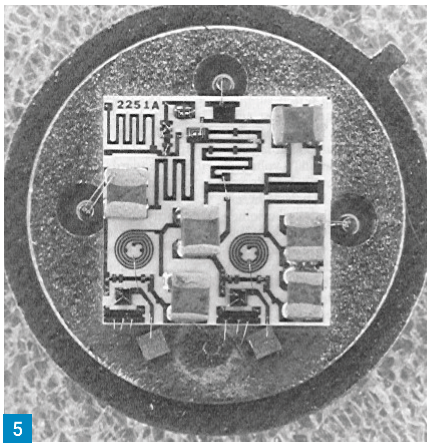


Fig. 5: Bonding wire example, evident in the left 2, and bottom 3, inductors (bonding wires) in parallel reduce inductance but remain capacitive and inductive connecting to an IC.

Modifications?

I realise many radio amateurs will immediately ask, *"How can I modify this for the allocated 2-10GHz bands or 24GHz?"* Frankly, moving from 12 to 10GHz (~17%) is too far, despite efforts with scalpels and cutting or soldering new adhesive copper sections to the printed tracks. It would be better and less frustrating to start from scratch and use parts of what I have, hopefully, illuminated as a start. It will not be difficult, except perhaps with transmission where inefficiency means sinking a lot of thermal power. This will be the subject of another article in this series, and it might surprise readers how simple it all becomes, and no printed circuits involved! Just adhesive copper strip. So very accessible and easy to do. The next question, often asked, is if this is so good (low noise) at 10GHz, it must be fantastic at 30MHz? Unfortunately, that is not necessarily the case.

Microwave active devices are always optimised for their application and in so doing become band limited. This is especially true for transmitting devices, which are always frequency specific in their matching, and matching is centrally important. The reason is the unavoidable

Continued on Page 24

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Meteor Scatter

In his final column, **Steve White G3ZVW** covers a propagation mode increasingly popular with VHF DXers.

Meteor Scatter is a specialised mode of radio propagation that used to be employed by relatively few people, but in recent years activity has increased among VHF DX enthusiasts.

Meteorites travel through space at incredible speed. They can enter Earth's atmosphere at 25,000 to 160,000 mph! The huge margin of speed can be accounted for by the fact that Earth orbits the Sun at 67,000 mph, so if one enters the atmosphere ahead of Earth's path it is going to be faster than one that enters the atmosphere from behind Earth's path. See **Fig. 1**.

When a meteorite enters Earth's atmosphere friction between the atmosphere and the meteorite will cause it to quickly burn up. This happens in the very outer reaches of Earth's atmosphere, way above the height of the highest mountains. Indeed, meteorites generally burn up at the height of the E Layer of the ionosphere, about 80-120km above the surface of the Earth. See **Fig. 2**. Every day many thousands of meteorites enter Earth's atmosphere. Most of them are tiny, the size of a grain of sand or smaller, so they burn up very quickly. Nonetheless they can blaze a bright streak across the night sky. Some meteorites are larger so take longer to burn up, sometimes causing a bright flash when the heat they have acquired makes them burst or explode. Some meteorites are large enough not to burn up completely in the atmosphere, so occasionally part of a meteorite can land on Earth, as happened on 28 February 2021 at Winchcombe near Cheltenham.

History

The first person to realise there was a link between meteorites (also known as shooting stars) and radio propagation was Japanese physicist **Hantaro Nagaoka**. The year was 1929. In 1931 **Greenleaf W Pickard** (American) observed that bursts of long-distance propagation occurred at times of meteor showers.

What Happens

When a meteorite enters Earth's atmosphere it burns up at the height of the E Layer of the ionosphere. At the height of the ionosphere, which is not quite a vacuum, there are very small amounts of the gases that exist in the atmosphere. At these heights electrons can be stripped off those gaseous elements by energy from the Sun, which is what occurs normally and results in the ionosphere that refracts radio signals. When a meteorite burns up the resultant ionisation is very strong, but very localised (maybe only 1m across, but hundreds of kilometres long). The enhanced radio propagation from a meteorite burning up may last for a faction of a second up to several seconds. A very short-lived period of enhanced propagation is known as a meteor ping, whereas a longer lasting period is known as a meteor burst.

The maximum distance that a meteor ping or burst will enable a station to be heard is about 2200km (1400miles). It is no coincidence that Sporadic-E propagation has the same maximum figure.

Random Meteors

As I said previously, many thousands of meteorites enter Earth's atmosphere every day. They can come from any direction in space, but while they are random there are more favourable and less favourable times of day for this to occur. More random meteors enter the atmosphere at about dawn local time than at other times of day. This is because at dawn the planet is moving into the path of random meteors more directly.

Meteor Showers

In addition to random meteors entering Earth's atmosphere there are regular meteor showers that occur annually. **Table 1** shows the dates of the main meteor showers. These showers are caused by comets that leave a trail of material when they are in the inner part of the Solar System and being warmed by the Sun. Incidentally, did you know that comets only have tails when they are relatively near the Sun? Most of the time they are way out in space – some-times further out than all the planets of the Solar System – and have no tails. Earth flies through some of these trails of cometary debris on an annual basis, so the dates of meteor showers are highly predictable. Basically, the names of the showers are associated with the star constellations that the meteorites appear to come from.

Listening for Meteors

If you want to listen for a meteor burst or a meteor ping, it isn't difficult. You will need an SSB receiver and an antenna. A simple antenna for the 144MHz band will do the job. Tune to 143.049MHz Upper Sideband (USB) and listen.

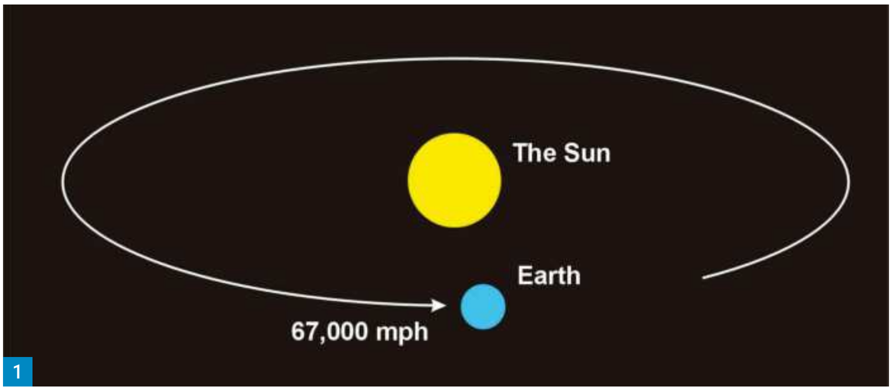
You can also listen for meteor pings using an online SDR (Software Defined Radio). If you don't have suitable equipment at home, this is definitely the way to do it! There are numerous SDRs dotted about, but few of them cover 143MHz. The one I want to tell you about does and is located at Farnham in Hampshire. Here's how to do it.

Type http://farnham-sdr.com/ into your internet browser and hit <enter> to go to the page. You will need to log in with a callsign or name to listen, otherwise all you will hear is silence.

http://farnham-sdr.com

Tune the receiver to 143.049MHz and select Upper Sideband (USB).

Listen. And listen. And listen. Except when a known meteor shower is taking place it might take quite a while for a meteor ping or burst to occur, so most of the time all you will hear is background noise. When it does you should hear a brief tone, which will quickly disappear.



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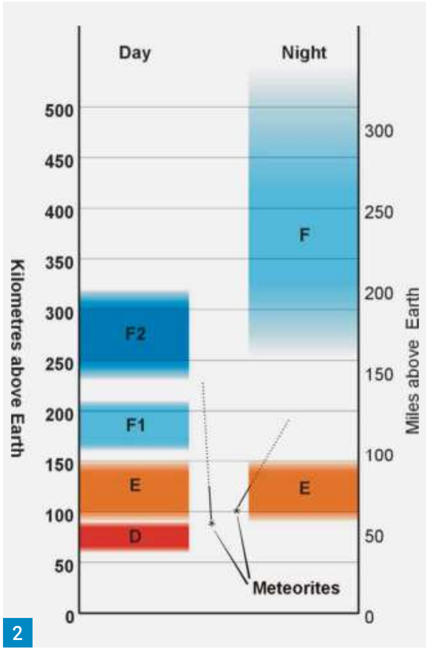

Fig. 1: Earth's orbit around the Sun. Fig. 2. Layers of the ionosphere and a couple of meteorites burning up.

So why listen to that particular frequency? The French military run a transmitter permanently on 143.050MHz at Graves, near Dijon. It transmits just a plan carrier wave. They use it and associated receivers at other locations in France to monitor objects in space that are overflying France; objects such as satellites, space junk, etc. Essentially it is a radar station, but operating at a lower frequency than most radars. The reason you select upper sideband and tune a receiver to 143.049MHz is so that when a ping or burst occurs you hear a tone of 1kHz.

If you want to listen for meteor pings or bursts using the Farnham SDR, the best dates in the next few months will be during the Geminids shower on 14 December and the Quadrantids on 3-4 January. Make a note in your diary.

Amateur Meteor Scatter

Amateur radio meteor scatter contacts take place at VHF. The 50MHz and 70MHz bands can be used, but 144MHz is where most of the action occurs. Most contacts are scheduled and follow a set procedure.

Making a two-way contact via Meteor Scatter – which is often abbreviated to MS – was not easy in days gone by. Mostly it used to be done using high speed Morse code. Enthusiasts would record a brief message in Morse, speed it up (at one time with a multi-speed tape recorder, but eventually from a digital memory) and transmit it repeatedly for a set period of time. Then it would be the other station's turn to transmit. On receive the frequency would be monitored and recorded, once again with a tape recorder. When a meteor ping or burst occurred a brief snippet of Morse code would be heard. The Morse would be too fast to understand, so the recording would then be played back and slowed down, to bring the Morse speed back to something that was copyable by the average operator. A lot of the time only a signal report or part of a callsign might be heard, but because the message was repeated the receiving operator would eventually be able to piece things together. Making a two-way contact would almost always take tens of minutes, back and forth, back and forth, but sometimes it was much longer. In terms of what information is actually exchanged during a meteor scatter contact, it is very little.

Today, computers and modern modes of data communication have made things easier and resulted in a big increase in the number of people making contacts via meteor scatter. You still need a decent station – an SSB transceiver, moderate power and ideally a beam antenna. That's not to say it is impossible to hear someone or make contact with a simple antenna such as a vertical collinear, because it is. SSB capability is the essential element. FM and digital voice radios aren't suitable. Voice is occasionally used, but it is boring repeating spoken messages in the hope that part of one of them will be heard. These days a voice message can be recorded on a computer and repeatedly played back over the air, but modern data modes now rule the day because they can work at low signal levels and instantly display a message on screen when one is received. Typically, the mode used is MSK144, one of the modes offered in the WSJT-X software, so if you are set up for FT8, for example, you are also ready to go with MSK144. Using this software, meteor pings can be seen quite clearly on the display. Contacts can be made most days although the best times are, of course, when those regular meteor showers occur.

Shower Name	Date of peak	Rate per hour
Quadrantids	3-4 January	120
Lyrids	22 April	18
Eta Aquariids	6 May	40
Delta Aquariids	28-29 July	<25
Alpha Capricornids	30 July	5
Perseids	12-13 August	150
Draconids	8-9 October	Variable
Orionids	21 October	15
Leonids	17-18 November	<15
Geminids	14 December	120+
Ursids	22-23 December	<10

Table 1: Annual meteor showers.

Continued from Page 22

parasitic construction (packaging must include welded inductive bonding wires from the device to the package as illustrated in **Fig. 5**). These, combined with capacitance mean that they are not optimised at other than their design band. This is especially true in MMIC (microwave monolithic integrated circuits).

All microwave ICs and single active devices suffer the band limiting effects of these connections because they act as unavoidable LC filters. The need to remove heat from active devices, especially in PAs, mean they are unavoidable in manufacture. Multiplying (paralleling) the bonding wires minimises the inductance but it clearly has a practical limit. 2021 SM are far smaller than these illustrated in Fig. 5 and so are their parasitics that add that to the fixed parameter (diameter) of the bonding wires, which are increased (lower inductance) with the next generation. But they remain significant at microwaves as do the RF fields that surround them. A screen/enclosure cuts lines of flux and hence reduces the inductance of any wire depending on how close to the conducting screen, typically by ~10% but simultaneously increases the capacitive coupling and so produces an LC filter.

References

[1] A whole series of simple but useful CAD Excel spreadsheet calculators will be available for these Microwave and Radio systems design related parametric design tools. The proceeds will go to supporting the worldwide beacons on HF and Microwave bands. The intention is to equip these with GPS frequency control and tropospheric pressure telemetry.
[2] Fundamentals of Microwave and millimetrewave radio propagation.
[3] *Microwave receivers with electronic warfare applications*. Tsui, SciTech publishing. 2005. This provides a different useful perspective.
[4] A series of in-depth, quasi professional, chapters will be available in due course in downloadable form and, possibly, a book bound version. Depending on interest and demand. For example, the existing Filters chapter, alone, is 120 pages and growing.
[5] A thorough review of antennas suitable for microwave applications, new advances plus new low cost commercially available antennas, to come. The best radio is useless without a decent antenna.

RCF Supports School Radio Clubs

Steve Hartley G0FUW has an update on the work of the Radio Communications Foundation.

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Long-standing readers will, no doubt, know something about the Radio Communications Foundation, or RCF, for short (see, for example, *PW* June 2019). However, there are many radio amateurs who were newly licensed during lockdown who may not know about the charity. This article has two main themes, firstly to let newcomers know about the RCF, how it works, and what it has to offer, and the second part is a report on some support we have been giving to the Kingsmead School radio club.

The RCF - An Amateur Radio Charity

Around 20 years ago, the RSGB's General Manager recognised the need for an amateur radio charity. Many amateurs were keen to make donations and bequeathments to help others but the RSGB was not best placed to make the most of this money. The RCF was therefore set up by the RSGB as a separate charity with the aims of helping young people get into amateur radio and to find a path to careers in radio electronics and wireless communications. The charity was formally launched in 2003 with Trustees coming from across the RF world; amateurs, professionals, regulators and academics. The current Trustees are shown on the RCF website.

The charity has made grants to many projects, including the resurrection of the Swansea University Radio Club and radio kit building workshops for youngsters as part of British Science Week, **Fig. 1**. Every year the RCF sponsors two or three Arkwright Engineering Scholars and awards a prize for the best undergraduate project in association with the UK Electronic Skills Foundation (UKESF).

The charity continues to receive donations and bequeathments from radio amateurs and, because of its charitable status, the RCF is able to make good use of Gift Aid, where donors are eligible. The whole operation is overseen by the Charities Commission and we submit an annual report to show that the RCF is delivering its charitable objectives.

Helping a new School Radio Club

There aren't too many radio clubs in schools but the RCF is always keen to help new ones get started. Last year we were approached by **Jon Matthews G6ASK**, who was in the process of setting up a radio club at the school where he works as a Teaching Assistant for Special Educational Needs and Disabilities (SEND). He had plenty of radio equipment but needed a vertical antenna to enable multiband HF operation in a fairly limited space.

The RCF Trustees agreed a grant to fund a Hy-Gain AV640, which covers all bands from 40 to 6m. This grant was specifically made possible due to a donation made when the STELAR organisation wound up; the RCF now holds a sum of money that is specifically designated for helping school radio clubs.

Due to various factors, not least the dreaded pandemic, it took much longer to deliver the project than anyone imagined. However, the antenna is now erected at Kingsmead School, Wiveliscombe, near Taunton, and is working very well, **Fig. 2**.

In July this year, it was safe for me to pay the school a visit, just before they started their summer holidays. I met Jon who showed me how an unused music practice room had been transformed into a neat little radio shack. He explained that the Club had been meeting at lunchtimes with school year 'bubbles' being given specific days to access the shack. Jon had put in a lot of work to make the shack look the part and he had provided much of the equipment from his own shack. The Club has been affiliated to the RSGB and now has its own callsign, M0KSB. You can look them up on QRZ.com.

The club had also had great support from the school teaching and support teams and the Governors. I met some of them and, even though they are not radio amateurs, they were clearly enthused by the addition of the school's own radio club.

The enthusiasm went up several notches when I met three of the boys from Year 8 who have been spending lots of time in the shack; they were clearly loving it and were very keen to get their own licences, **Fig. 1**. Jon has plans to get the exams all sorted in the new Autumn term.

Another rollover from the STELAR organisation were a couple of transceivers which came with a caveat – they could only be donated to school radio clubs. Jon mentioned that his older transceiver was not coping well with the electrical noise in the school so we asked if a TS-950SDX might help. He was over the moon at the offer and that was delivered shortly after my visit; it has much improved filtering and handles the noise so much better.

Fig. 1: Pupils at Sandringham School building RCF sponsored radio kits as part of British Science Week. Fig. 2: RCF funded antenna on the side of the school. Fig. 3: Kingsmead School Radio Club Shack with Tom, Dick and Harry (not their real names), Jon G6ASK, and Steve G0FUW.

It was great to see the shack and the antenna but meeting the pupils who are going to be able to operate under Jon's supervision gave complete reassurance that the RCF's money had been well spent. My visit made the school newsletter, showing that the school really does value Jon's initiative.

I asked Jon if he would like to contribute to this article and this is what he said "*On behalf of all of us at Kingsmead School I would like to extend my sincerest thanks to the RCF for their very generous support with this project. Without such organisations we would struggle to find the funding and resources to achieve our goals. The RCF and its Trustees, in particular **Steve Hartley** and **Jackie Tite**, have been instrumental in making the club station a reality. I would urge anyone with a similar school project in mind to contact the RCF – I am sure they would be delighted to hear from you!*"

Can the RCF help you?

The Trustees are always keen to help school, and university, radio clubs. We have another transceiver looking for a new school home, an Icom IC-746, and there is money specifically tagged for school radio projects. The grant application process is quite simple, just write to the Secretary with your proposal and show us how it fits in with the RCFs aims. If it links to British Science Week, or December's YOTA Month, so much the better. Further details of the grant making policy are on our website.

Can you help the RCF?

Just as we like to make grants to enable radio communications to be experienced and enjoyed by more young people, we also welcome donations and bequeathments. You can donate very easily online via the RSGB Shop or via the RCF website, or you can contact the Secretary direct by post. Remember, the RCF is a charity so donations and bequeathments are a very tax efficient way of helping the future of our wonderful hobby, and hopefully helping young folk make a career in the UK's RF industry.

Or, maybe you have relevant knowledge, skills and experience to be able to help the RCF in a more direct way? The Trustees are always looking for enthusiastic volunteers to join them. There are not too many meetings and if we have more willing helpers, we can deliver more exciting projects. If you would like to know more, drop a note to the Secretary.

RCF Secretary – Jackie Tite, c/o RSGB HQ, 3 Abbey Court, Priory Business Park, Bedford, MK44 3WH, or
RCFsecreaty@commsfoundation.org
RCF Website:
https://commsfoundation.org
RSGB Shop Donation Page:
https://tinyurl.com/aaub4u3v

Rallies & Events

Due to the ongoing Coronavirus situation, the Rallies calendar remains dynamic at the moment, and there will be more cancellations and postponements. All information published here reflects the situation up to and including 28th September 2021. Readers are advised to check carefully with the organisers of any rally or event, before setting out for a visit. The Radio Enthusiast website will have updates, please check here regularly: www.radioenthusiast.co.uk To get your rally or event onto this list, please, e-mail full details as early as possible to wiessala@hotmail.com

9 October
RSGB ONLINE CONVENTION: The event will be streamed live on the Society's YouTube channel. You can find more information at this URL:
www.rsgb.org/convention

15-17 October
JOTA - JAMBOREE ON THE AIR 2021: JOTA is an annual global event, in which Scouts and Guides all over the world connect using amateur radio. Short wave radio signals carry their voices to virtually any corner of the world. It's the excitement of having a live conversation with a fellow Scout or Guide at some other place in the world that attracts so many young people to this event. JOTA is a real Jamboree, during which Scouting experiences are exchanged and ideas shared.
https://www.jotajoti.info

16 October
BATC CONVENTION FOR AMATEUR TV 2021 (CAT 21) PART 2 (ONLINE): CAT 21 (Part 2) will be a day of free online talks about Amateur Television, using a similar format to the very successful CAT 20 (Online Zoom event). We would like to hear from anyone who would like to present to an audience of nearly 500 'ATVers' worldwide.
https://batc.org.uk/events
https://tinyurl.com/4v55p35r

16 October
ESSEX CW BOOT CAMP: 3rd Witham Scout & Guide HQ, at the rear of Spring Lodge Community Centre, Powers Hall End, Witham, Essex CM8 2HE. Open 8.30 am (registration). 9 am (public). Finishes at 4.30 pm. Admission is £10, with free soup/ drinks/ cakes. (CR | FP)
g0ibn1@yahoo.com

17 October
HACK GREEN RADIO SURPLUS HANGAR SALE : Hack Green Secret Nuclear Bunker, Nantwich, Cheshire CW5 8AL. Government Covid Regulations Permitting. Fully Covid-compliant. From 10 am to 3 pm. Any last-minute cancellation will appear on our Facebook page:
https://tinyurl.com/2b7ayfbv
http://www.hackgreen.co.uk
https://www.hackgreen.co.uk/events

17 October
HORNSEA AMATEUR RADIO RALLY: Driffield Show Ground, Driffield YO25 3AE. Open 10 am. Admission: £2 (under 14s free). There will be a raffle (BB | CR | CBS | FP)
Les 2E0LBJ Tel: 01377 252 393
lbjpinkney1@hotmail.com

7 November
HOLSWORTHY RADIO RALLY: Holsworthy Leisure Centre, Well Park, Western Road, Holsworthy, Devon, EX22 6DH. Open 10 am. Traders. (BB | CR | D)
Howard M0MYB
m0omc@m0omc.co.uk

2 January
SPARKFORD WIRELESS GROUP RALLY: Davis Hall, Howell Hill, West Camel, nr Yeovil BA22 7QX. Open 9.30 am to 1 pm, entry is £2. (FP | CR)
wjh069@gmail.com

BB Bring & Buy **CBS** Card Boot Sale
CR Catering /Refreshments **L** Lectures
D Disabled visitors **FP** Free Parking
RSGB (RSGB) Book Stall
SIG Special-Interest Groups
TI Talk-In (Channel) **TS** Trade Stalls

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- On-line firmware updates
- Only 30mm thick
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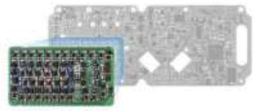
- Size: 90mm × 207mm × 21mm
- Weight: 0.55kg

A liquid-protected housing, no through-holes, spatter resistant plugs with sealing rings and a special anodising layer on the case, ensures operation in extreme conditions.

Unique form-factor

Allows you to operate from anywhere. The transceiver is only 30mm thick, including knobs, weighing only 0.55kg. Fold out the kickstands at the rear for use on a desktop or picnic table.



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Z-11 Pro II
QRP Portable Auto Tuner
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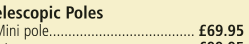

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N type connector (Part: 7395)................................ £9.95
Ecoflex 10
per metre........£3.79 price per 102m drum...........£359
Ecoflex 10 Plus
per metre........£3.79 price per 102m drum...........£359
PL259 connector (part: 7378).................................. £5.95
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2021 PW 144MHz QRP Contest Results

Colin Redwood G6MXL has the results of the June 2021 2m QRP Contest.

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

2021 saw 56 entrants submit logs in the 36th *Practical Wireless* 144MHz QRP contest held on Sunday 13 June 2021. The entrants made a total of 2403 valid contacts with stations in 36 different squares, **Fig. 1**.

2021 Winners

The overall winner, leading single operator and leading Welsh station is the **Hereford VHF Contest Group GW1YBB/P,** operated by **Steven Clements G1YBB** from Pen-Y-Gadair (800m asl), the second highest peak in the Black Mountains in South Wales (IO81KW). He used a Yaesu FT-817 transceiver and a 9-element DK7ZB antenna, **Fig. 2.**

Runner up and the leading English station is **Mike Lewis M0XMX/P**, operating from IO93AD, **Fig. 3**.

The leading multiple operator team is **Malvern Hills R.A.C GW4IDF/P**, operating from IO81NV.

The leading fixed station is again the **Ossett Amateur Radio Operators M0ORO,** operated by **Jim Brown** from IO93EQ.

The leading Scottish station is again the **Galashiels and District Amateur Radio Society GM4YEQ/P**, operating from IO85MM.

The leading GI/EI station is **Paul Norris EI3ENB/P**, operating from IO62OL

The leading GJ/GU station is **Chris Rees GU3TUX**, operating from IN89VR.

The leading Isle of Man station is **Mike Webb GD6ICR**, operating from IO74PF.

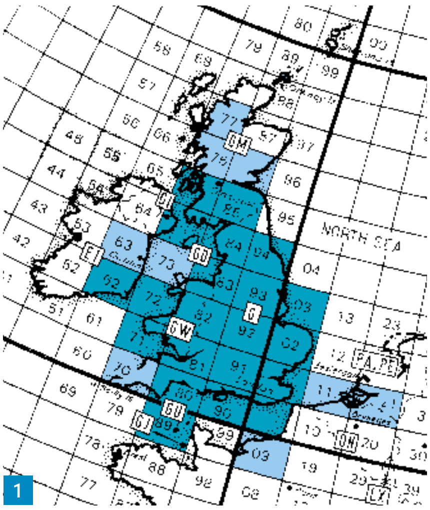
Full details of the results can be found in the tables in this article. As usual certificates will be sent to all the leading stations above and the leading station in each square.

Check logs were received from **Stewart Wilkinson G0LGS**, **Roger Blackthorn G3XBM**, **Dave Keston G8FMC**, **Charlie Jonas M0ZCJ**, **Robert Matty Cunningham MD0MAN/P** and **Colin Redwood G6MXL/P**.

Propagation & Activity

Tony Collett G4NBS said that he made *"some nice contacts and found a nice quiet band for once enabling weak signals to be copied"*. This was not a universal view – **Daphne Newsum G7ENA** said, *"I think abysmal is the word, just didn't hear anyone"*.

Gwil Jones GW6PVK found, *"conditions to be more constant throughout the day this year with the southern part of the UK workable through up into Scotland. The number of stations dropped quite sharply after the backpackers contest had finished, which made*



1

the afternoon hard going at times to make new contacts".

Ken Eastty G3VLP likes the format of the contest, "*Well done* PW. *A 'proper' straightforward SSB/CW contest, no 'data' modes or use of ON4KST chat for 'arranging' contacts!"*

Dave Hewitt GW8ZRE/P enjoyed a lovely sunny day, for his first time out portable since September 2019. *"So, a real taste of fresh air and nearly back to normal staying socially distanced from the local sheep! Good to hear so many stations portable again. Good first hour working IO70/JO01/IO73/IO71/IO81/IO90. Good activity from IO84. Did not work IO91 until 1332. My aim this year was to score over 1000 points, which I think I have. Colin, once again thanks for running this happy friendly contest, long may it continue. I wonder has any other station put in as many entries over the years as myself. Dave GW8ZRE/P."*

David Smith GM4YEQ/P on behalf of **Galashiels and District ARS** says, *"We made 27 contacts over the day, reaching from Fife down to South Wales, and from the Isle of Man to Yorkshire, including one contact from the summit of Mount Snowdon. Not quite the lift conditions we've experienced on some contest days and unusually for us we had no Irish, European or south of England QSOs."*

On Guernsey, **Chris Rees GU3TUX** reports, *"Band conditions were, at best, flat. Operation was from my home QTH as my /P site is no longer available. I suffered from the usual Channel Islands problem of UK stations south of Birmingham seldom turning their aerials in our direction. This is accentuated by the low TX power, i.e. even less chance of being heard 'off the back of the beam'. My home QTH is also a lot noisier than the erstwhile /P location"*.

The last time **Bill Ward GM0ICF/P** entered was in 1990. He was only able to be on for a few hours but thought the *"nice weather made it a pleasant morning out"*. He could hear quite a few G stations but couldn't raise them, and activity seemed low.

Ross Wilkinson G6GVI/P managed to catch the last 15 minutes of the RSGB event, *"then although the band did get a lot quieter after 2pm, there were still enough stations to keep me going for another 90 minutes."*

Weather

Stuart Hammonds G8VUW/P summed up the feelings of many entrants, *"The weather was superb this year, maybe a little too warm, though a gentle breeze helped keep me nice and cool"*.

Simon Gosby GW8OVZ/P was very pleased to be back out portable again. He thought it *"was the best weather I have had working from IO71. Whilst the south-east may have had higher temperatures, I was very pleased with just over 21° and a nice cool breeze. This year I had to contend with the stare from a group of horses, which meandered past, and also a Red Setter, which was keen on investigating everything I had. I managed to keep it away from the guy ropes until its owner caught up"*. He worked a good number of locator squares around the UK and Ireland but didn't hear anything from the continent. The light breeze made it easier to keep on a beam heading.

David Smith GM0KCN on behalf of GM4YEQ/P says, *"Starting with warm weather and sunshine peaking 20°C but a persistent brisk cool wind whilst setting up the station. Increasing cloud cover and rising wind and the temperature dropped suddenly to 16°C meant that we had to don warmer clothing and shelter between the vehicles to protect ourselves and the microphone from wind* *noise. It stayed mostly dry with just a spot of drizzle late on, so we were able to operate outside with no interruptions."*

Ross Wilkinson G6GVI/P thought that the *"weather didn't live up to the forecast. Although I had slapped on a load of sun cream in the car park, the sun didn't show at all whilst I was out on the hills. But it was quite warm with a very light breeze, so probably more comfortable than it would have been in bright sunlight."*

Transceivers & Antennas

This year the Yaesu FT-817/FT-817ND/FT-818 accounted for 39% of the transceivers used by all entrants. Five stations used the new Icom IC-705. A wide variety of antennas were used, at least ten of which were home-brewed.

Keith Bareham G1RRR had recently acquired a Yaesu FT-736R. The contest *"was an opportunity to discover how well it works and give a few points away while doing so. Although I only made a few contacts, it was enjoyable as ever and was good to hear some activity on the band. All seems to be OK with the radio, even the S-meter lamps work. This should be a permanent fixture here, allowing 23cm for the first time for me"*.

Martyn Wright G4RLF/P says that, *"After 40 years of using the TS-770 for 2m contesting we moved into the 21st Century by using a new IC-705. The aerial, mast and location were the same as usual, but our score was at a record low. Whether it was conditions or the modern rig or just lack of activity it difficult to know. Perhaps back to the old setup next year?"*

Dave Hewitt GW8ZRE/P says, **"***Double checked everything as I put equipment into car. Once all was connected on site, I thought it strange I could hear nothing on 144MHz but lots of good strong signals on 21MHz. Then the penny dropped. VHF was set up on front panel BNC connector of the FT-817 – menu change and everything OK"*.

2

Ross Wilkinson G6GVI/P only decided on Saturday to take part in this year's contest and just as a casual part-time entry for an hour and a half in the afternoon. He really enjoyed the event as *"I've not been out radio-backpacking for around ten years, so it's good to know that I still have enough energy to make it up the hill carrying the old IC-202!"* It was quite a heritage event for Ross. He bought his second-hand IC-202 back in 1983, and used it in many of the early *PW* contests. He also built his folding HB9CV antenna back in 1981, and repaired the gamma-match capacitor to celebrate its 40th birthday for this year's contest.

Cambridge and District Amateur Radio Club G2XV/P had their first non-virtual meeting since lockdown started in 2020, **Fig. 4**. They used a 17-element Tonna antenna, but found the horizontal bandwidth a little too narrow for effective use in a contest. *"The edge of the Fens is not the best place for a VHF station, but the aerial height at 45ft, supported on an ex-army pneumatic SCAM mast, gave a reasonable take-off. The highlight was using CW to complete a contact with Guernsey"*.

Site Problems

Your adjudicator arrived at his favourite location to find another station already well set up and participating in a multi-band Amateur TV Contest with 2m talk-back. This meant a change of site and a late start.

Problem Logs

Logging accuracy was generally very good. As usual a few points were lost due to missing /P from some calls. Some locators were incorrectly recorded, either due to not using phonetics or through transcription errors.

Date for Your Diary

The provisional date for the 2022 *PW* 144MHz QRP Contest is Sunday 12 June 2022. As usual the event will be arranged to run alongside the RSGB 144MHz

Fig. 1: Map showing locator squares of stations that entered (in dark blue) and other stations worked (light blue). Fig. 2: The antenna and excellent take-off at the winning station, GW1YBB/P. Fig. 3: The antenna and operating van for the runner Mike Lewis M0XMX/P. Fig. 4: Members of Cambridge and District Amateur Radio Club G2XV/P.

Description	Name/Team	Callsign
Overall Winner	Hereford VHF Contest Group	GW1YBB/P
Runner Up	Mike Lewis	M0XMX/P
Leading Fixed Station	Ossett Amateur Radio Operators	M0ORO
Leading Single Operator	Hereford VHF Contest Group	GW1YBB/P
Leading Multi-Operator	Malvern Hills R.A.C	GW4IDF/P
Leading English Station	Mike Lewis	M0XMX/P
Leading Welsh Station	Hereford VHF Contest Group	GW1YBB/P
Leading Scottish Station	Galashiels And District ARS	GM4YEQ/P
Leading GI/EI Station	Paul Norris	EI3ENB/P
Leading GJ/GU Station	Chris Rees	GU3TUX

Table 1: Leading stations

Square	Name	Call	No. entries
IN89	Chris Rees	GU3TUX	1
IO62	Paul Norris	EI3ENB/P	1
IO71	Simon Gosby	GW8OVZ/P	2
IO72	Andy Digby	GW0JLX/P	1
IO74	Mike Webb	GD6ICR	2
IO75	Bill Ward	GM0ICF/P	1
IO80	SADGITS	G4RLF/P	3
IO81	Hereford VHF Contest Group	GW1YBB/P	5
IO82	Bryn Howell-Pryce	GW4ZHI/P	4
IO83	Dave Hewitt	GW8ZRE/P	5
IO84	Chris Leviston	M0KPW/P	2
IO85	Galashiels and District ARS	GM4YEQ/P	1
IO90	Andrew Vare	G4XZL/P	4
IO91	Ron Flemming	G0BNC/P	5
IO92	Stuart Hammonds	G8VUW/P	8
IO93	Mike Lewis	M0XMX/P	8
IO94	Nick Grundy	G4NKV/P	2
JO00	Southdown ARS	G1KAR/P	1
JO01	Martin Munro	M0FAQ	1
JO02	Tony Collett	G4NBS	4
JO03	Daphne Newsum	G7ENA	1

Table 2: Square winners

Backpackers contest for the benefit of entrants to both contests. Keep an eye on *Practical Wireless* and the *PW* Contest website at:
www.pwcontest.org.uk

Thanks

Many entrants expressed thanks to other stations taking part or giving points away. I would like to thank everyone who participated in 2021, and **Neill Taylor G4HLX** for devising what is without doubt one of the most widely supported single-band contests in the VHF calendar.


3


4

Pos	Call	Name	Single	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	GW1YBB/P	Hereford VHF Contest Group	S	218	26	5668	IO81KW	Yaesu FT-817	HB 9-ele	800
2	M0XMX/P	Mike Lewis	S	127	23	2921	IO93AD	Yaesu FT-991	WiMo Big Wheel	480
3	GW4IDF/P	Malvern Hills R.A.C		139	19	2641	IO81NV	Yaesu FT-817	Cushcraft 11-ele Yagi	425
4	G4XZL/P	Andrew Vare	S	120	19	2280	IO90MX	Yaesu FT-817ND	HB 9-ele DK7ZB Yagi	270
5	GW8OVZ/P	Simon Gosby	S	103	22	2266	IO71OW	Yaesu FT-817	7-ele Yagi based on DK7ZB design	536
6	G4RLF/P	SADGITS		100	20	2000	IO80WX	Icom IC-705	13-ele Yagi	277
7	G5TO/P	Sheffield & District Wireless Society		99	19	1881	IO93FL	Icom IC-7100	HB 12-ele	310
8	M0ORO	Ossett Amateur Radio Operators	S	82	19	1558	IO93EQ	Icom IC-910	12-ele Yagi	110
9	M0KPW/P	Chris Leviston	S	84	17	1428	IO84KF	Yaesu FT-817	5-ele Yagi	330
10	G3XNO/P	Otley ARS		78	18	1404	IO84VB	Yaesu FT-736R	9-ele Tonna Yagi	488
11	G8VUW/P	Stuart Hammonds	S	77	15	1155	IO92EK	Yaesu FT-897D	Diamond A144S10R	180
12	GW8ZRE/P	Dave Hewitt	S	65	17	1105	IO83JF	Yaesu FT-817	7-ele ZL Special	261
13	G3UGF/P	Richard J Constantine	S	69	16	1104	IO93AS	Icom IC-7300	10-ele Yagi	432
14	GW4ZHI/P	Bryn Howell-Pryce	S	56	17	952	IO82CH	Yaesu FT-817	5-ele DK7ZB Yagi HB	562
15	GW6PVK/P	Gwil Jones		59	16	944	IO83LC	Yaesu FT-817ND	10-ele Yagi	329
16	G7UHN/P	Andy Webster	S	55	17	935	IO90OW	Yaesu FT-817 + preamp	6-el Yagi	225
17	G0BNC/P	Ron Flemming	S	56	14	784	IO91EU	Yaesu FT-897D	DB8NP QUAGI	198
18	G0SRC/P	South Derbyshire & Ashby Woulds ARG		47	16	752	IO92FT	Yaesu FT-817	6-ele Yagi	100
19	G4PGJ	David Ward	S	42	17	714	IO92ET	Icom IC-700	7-ele LFA	133
20	G4NBS	Tony Collett	S	43	15	645	JO02AF	Elecraft K3 + internal TVTR	9-ele Tonna	11
21	G4CIB/P	Brian Woodcock	S	49	13	637	IO81VX	Yaesu FT-817ND	8-ele Jaybeam Yagi	75
22	G4BZI/P	Roger Bracey	S	42	14	588	IO93AC	Icom IC-202E	3-ele Sotabeam Yagi	385
23	G0FCA/P	Iain Groom	S	38	14	532	IO83VS	Icom IC-7000	5-ele LFA	375
24	GW0JLX/P	Andy Digby	S	33	16	528	IO72WA	Yaesu FT-857	7-ele ZL	400
25	G2XV	Cambridge & District ARC		32	16	512	JO02AH	Kenwood TS-790e	17-ele Tonna	14
26	GD6ICR	Mike Webb		31	13	403	IO74PF	Yaesu FT-817	11 ele CQM	10
27	G3LVP	Ken Eastty	S	29	12	348	IO81WV	Kenwood TS-850 + Anglian TVTR	8-ele J beam	540
28	G4NKV/P	Nick Grundy	S	31	11	341	IO94RJ	Icom IC-821H	12-ele ZL Special	267
29	G4PBN/P	John Vivian	S	24	14	336	IO80AR	Icom IC-705	7-ele Wimo Yagi	335
30	GX2UG	Halifax & District ARS		33	10	330	IO83XR	Icom IC-705	7-ele ZL Special	305
30	G1KAR/P	Southdown ARS		30	11	330	JO00DR	Icom IC-271E MuTek Front End	10-ele J beam Yagi	146
32	GM4YEQ/P	Galashiels And District ARS		25	12	300	IO85MM	Yaesu FT-991	HB 5-ele Yagi	359
33	G0JQA/P	Hambleton ARS		24	12	288	IO94IJ	Elecraft KX3	13-ele Tonna Yagi	290
33	G8TRS/P	Tamworth ARS		24	12	288	IO92EP	Yaesu FT-817ND	5-ele Yagi	114
35	G6GVI/P	Ross Wilkinson	S	27	10	270	IO83SO	Icom IC-202	HB9CV	430
36	EI3ENB/P	Paul Norris	S	21	12	252	IO62OL	Icom IC-7100	Diamond A144s10r 10-ele Yagi	270
37	G0OIW/P	Mark Palmer	S	21	10	210	IO91LO	Icom IC-202S	9-ele Yagi	230
38	GM0ICF/P	Bill Ward	S	18	11	198	IO75PP	Yaesu FT-817ND	HB 3-ele Yagi	150
39	G0POT/P	Michael Sansom	S	19	10	190	IO91IH	Yaesu FT-817	SOTAbeams 2m beam	205
40	G5RS	Guildford & DRS	S	16	7	112	IO91RH	Icom IC-275E	9ele Vagarda	26
41	M1AEA	Mark Waldron	S	14	7	98	IO82WM	Yaesu FT-817	Diamond X30 Vertical	219
42	GW4JQP	Peter Harston	S	13	7	91	IO71KR	Icom IC-9700	HB 5-ele Powabeam	52
43	GU3TUX	Chris Rees	S	10	7	70	IN89VR	Icom IC-705	3Y	60
44	M7OBS/P	Oliver Peake		10	6	60	IO92HK	Icom IC-202S	HB 4-ele DL6WU	123
45	G0EIY	Simon Pryce	S	14	4	56	IO82OR	Yaesu FT-817	10-ele long Yagi	77
46	M0JPA	John Wake	S	12	4	48	IO93CS	Yaesu FT-847	HB 5-ele cross Yagi	233
47	G8VEN	Harold Chapman	S	7	6	42	IO92JN	Yaesu FT-817ND	10-ele Yagi	85
48	M7EGD/P	Gary Harper	S	9	4	36	IO93KE	Yaesu FT-991a	HB 4-ele Yagi	78
49	GW8HEB	Tom Brady	S	7	3	21	IO82KP	Yaesu FT-817	SQBM200P MkII Dual Band Vertical	149
50	M0FAQ	Martin Munro	S	5	4	20	JO01GU	Yaesu FT-847	5-ele Diamond Yagi	70
51	G8FRS	Keith Gurr	S	6	3	18	IO92DE	Yaesu FT-817	5-ele Yagi	15
52	2E0KOJ/P	Mark Gilchrist	S	4	3	12	IO93BR	Yaesu FT-817	HB horizontal dipole	190
53	M7TXR	Ben Roberts	S	3	3	9	IO92JO	Yaesu FT-991A	5-ele Yagi	100
53	G1RRR	Keith Bareham	S	3	3	9	IO90CU	Yaesu FT-736R	5-ele Yagi	25
55	G7ENA	Daphne Newsum	S	2	2	4	JO03AJ	Icom IC-705	12-ele ZL Special	42
56	G8IBL/MM	Huw G Hallybone	S	1	1	1	IO90KR	Yaesu FT-817	MFJ Vertical	1

Table 3: Overall results table, Practical Wireless 144MHz QRP Contest 2021

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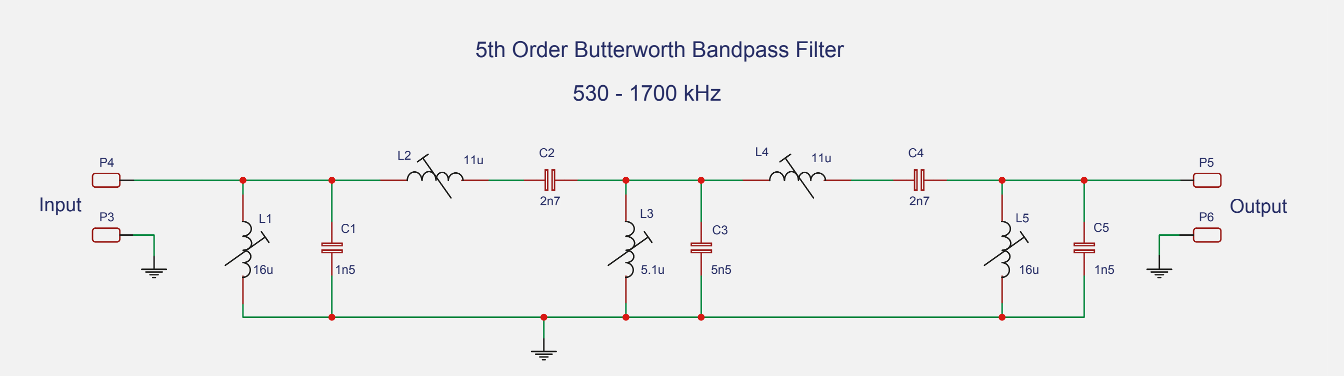

1

Dr Samuel Ritchie EI9FZB
practicalwireless@warnersgroup.co.uk

Repurposing TOKO Inductors

Dr Samuel Ritchie EI9FZB explains how to make use of TOKO inductors in a modern project.

I recently needed to design and build a bandpass filter that covered the medium wave broadcast band and settled on a 5th order Butterworth configuration that resulted in the circuit as shown in **Fig. 1**.

I wanted to be able to tune the filter and the two options considered were to use variable capacitors or variable inductors. The practicalities of variable capacitors when such large capacitance values are required moved me to go down the variable inductor route. For this design all the inductors are in the microhenry (µH) range, ranging from 5µH to 16µH.

In the last few years a number of UK based eBay sellers have been selling off various TOKO inductors in batches of five or ten and in some cases in the original boxes of 100 pieces. I took the opportunity to purchase a few of these original boxes to see if they could be repurposed for my needs.

The TOKO 17SNS1879HMS Variable Inductor

This TOKO inductor is in a shield that is 15 by 15mm and 20mm high and is easily disassembled by holding the shield and gently pulling on one of the five legs. **Fig. 2** provides a view of the inductor from two angles and its disassembly into three parts. Instead of a ferrite core that moves though the centre of the coil this arrangement is a ferrite cap that moves over the coil.

This inductor is a single winding of very thin enamelled copper wire of about 1100 turns. Without the cap the inductance is 20 millihenry (mH), 23mH with the cap just on, 40mH with the cap half in and 75mH when the cap is screwed all the way in. My initial thought was to start removing turns until the inductance reduced to what I needed. However, after removing 100 then 200 turns it struck me that I would need to remove at least 1000 turns before getting into the right ballpark. This led me to remove all the turns and undertake a complete rewind.

Removing the Original Windings

My tools of choice for this task are shown in **Fig. 3** and are fine nosed tweezers, the stainless steel high quality type, and a scalpel with a new blade. I also wear a pair of cut-resistant gloves (the type chefs wear) because one slip and you have the opportunity to badly cut yourself as those scalpel blades are extremely sharp.

As shown in **Fig. 4a** I make a deep cut into the windings and then using the tweezers peel away the wire. This leaves a naked core as shown in Fig. 4b.

Now you are ready to add new windings. The equation to determine the number of turns required based on the inductance you want is:

$$N = \sqrt{(L \times 1000)/A_L}$$

Where N is the number of turns, L is the value of inductance required in µH and A_L is the inductance factor for this inductor. Apologies to the purists who may want the A_L value in terms of µH per 100 turns.

To find the A_L value of this particular coil former I separately wound 10 turns, 20 turns and 30 turns on the former (after I had removed the original windings), inserted the cap halfway down, measured the inductance in each case, ran the equation above and came up with an average A_L value of 32 for this inductor when the cap is inserted halfway in. I say an average value of A_L because it varied between the three different test windings. The reason is that the equation assumes a symmetrically-spaced, single-layer winding is employed and this was only possible for the 10 turn test because after 15 turns it was necessary to start winding on top of the first layer and some turns lay on top of the first layer, some turns got interleaved with the first layer, etc. Practically it doesn't matter as you have so much adjustment available via the cap.

Now I can reveal how I came to estimate that there are about 1100 turns in the original winding. I used 40,000 as the value of L as the inductance was measured as 40 mH and 32 for the value of A_L in the equation above.

For L1 and L5, which are required to be 16µH, I used 22 turns and for L2 and L4, which are 11µH, I used 18 turns. My 22 turns can be seen in **Fig. 5a**. You will notice from Fig. 1 that L1 and L5 are in parallel with capacitors C1 and C5 so I added the small capacitor in parallel with the winding as shown in **Fig. 5b** as there is adequate room in the shield.

I used 32 AWG enamelled copper wire, which has a diameter of 0.2mm and is easy to handle. I use a soldering iron with a pool of solder on the tip to burn the varnish off the ends of the wire. I find this technique to be quick, easy and preferable to scraping or using sandpaper, which may damage the wire. While I could have used this former for L3 (5.1µH) I chose to use a second type of former.

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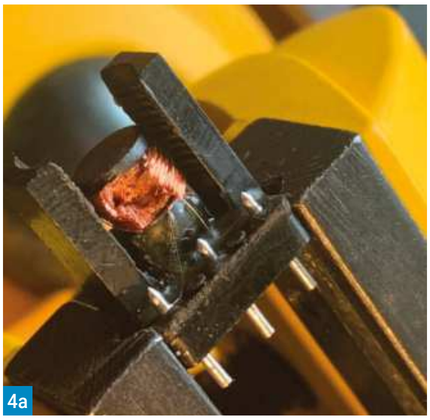
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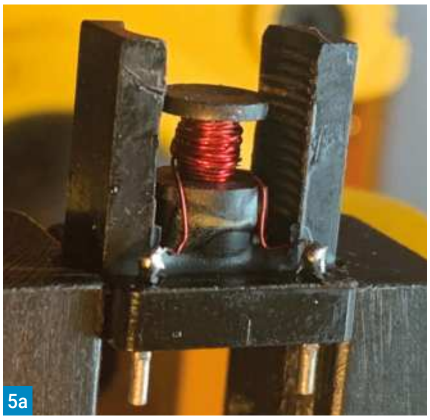
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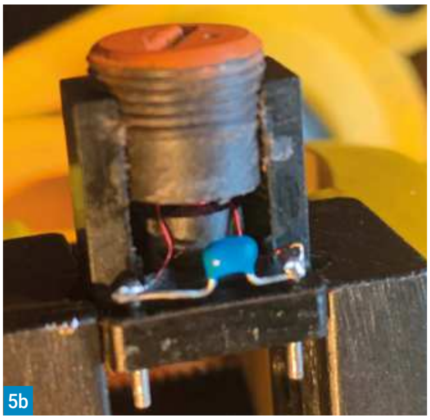
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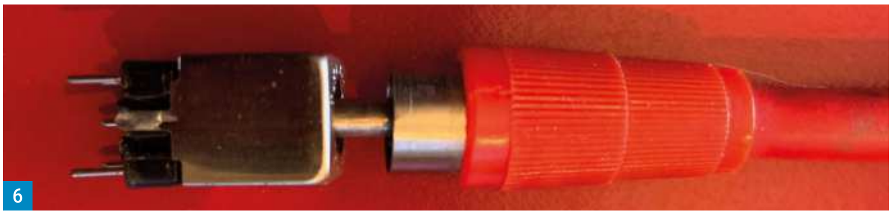
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Fig. 1: Schematic diagram of filter circuit. Fig. 2: Inside a Toko 17SNS1879HM2 inductor. Fig. 3: The right tools. Fig. 4: Removing the original windings. Fig. 5: New windings and adding a capacitor. Fig. 6: Removing the coil shield. Fig. 7: Inside the Toko 10K inductor shield. Fig. 8: The assembled medium-wave band pass filter. Fig. 9: Tuned and ready for use.

The TOKO TKACS-35396 Variable Inductor

For L3 I repurposed a TOKO inductor marked 10K-35396, which is one of the 10K range of inductors from this manufacturer and in a shield that is slightly more than 10 by 10mm and 12mm high. This type of inductor is a little more fragile and you cannot remove the former from the shield by just pulling on one of the legs. The technique I use is shown in **Fig. 6**. I screw the ferrite core in (so I do not push against it) and then push on the plastic core using a RCA plug (aka phono plug) while holding the shield between my fingers.

Fig. 7 provides a bottom view of the inductor and its disassembly into three parts. This former has the ferrite core that moves though the centre of the coil and can be adjusted from either the top or the bottom of the former.

This inductor has a primary winding of 14 turns, which is centre tapped, and a secondary winding of seven turns. Across the primary winding is an 82pF capacitor (the white tube with a brown stripe), which resonates with about 2.7μH inductance at 10.7MHz. The small number of windings and the capacitor are easily removed. The former has four slots into which you wind your turns and I understand that this minimises stray capacitance and helps yield a high *Q* factor.

Using the same method as described previously I determined that this former has an A_L value of 14 and hence for an inductance of 5.1μH that I would need 19 turns. Using 32 AWG wire limits you to no more than five turns per slot but that was adequate for this

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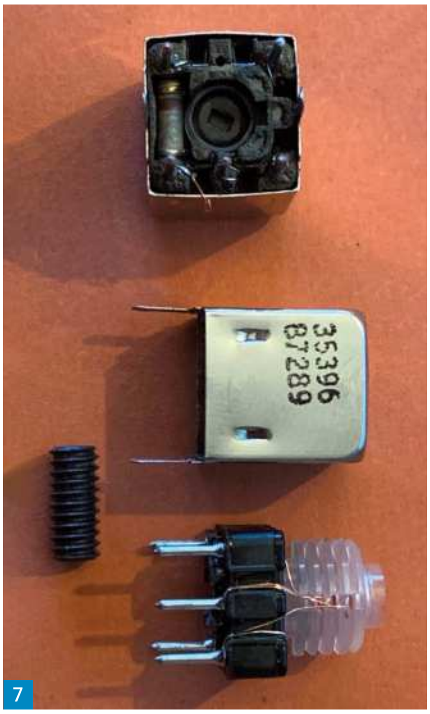


7

1

The National Radio Corp. HRO Senior Receiver/ Army R106 Mk1 & 1/1

Philip Moss describes the once-popular HRO Senior receiver.

Philip Moss
practicalwireless@warnersgroup.co.uk

This is another receiver that was donated to the British Vintage Wireless & Television Museum, Dulwich. It was donated specifically for my 'Comms Corner' display, by a similar sounding organisation, The British Vintage Wireless Society, publisher of *The Bulletin*, magazine about vintage radio TV and electronics, and holder and organiser of many vintage electronic sales around the country. There have always been close relations between the two organisations, who are both charities. I was offered a choice between the original version, with UX-based valves, or the later Octal types. I said for my own preference I would take the latter, but for a museum, I thought the former, and that is what I got, with almost two complete sets of coil-packs, and the original wooden box for the coils not in use.

History

Apart from the valves and bases the circuit did not change at all between the two series of valves, with one exception, so their characteristics must be very similar. This is a bit surprising as the Octal series have internal screens, and I would have expected if nothing else the capacitor values in the tuned circuits would change with a change in stray capacitance, but clearly it was within the adjustment range of the tuned circuits. The exception was that the 6B7 was a double-diode-pentode, and was replaced by a DD triode in the 6Q7. The Octals used would be the original metal types. They didn't need external screening cans.

This set, like the also famous RCA AR88, was not designed for the Military, but for the radio amateur. It is suggested that HRO stood for Ham Operator's Radio, though Hell-of-a-Rush has also been suggested. In both cases the letters are in the wrong order: for obvious reasons… **Fred Osterman** (see footnote) suggest *"Helluva Rush Order"*. Take your choice. As this was made long before the war, however, I cannot see why it would need to be rushed.

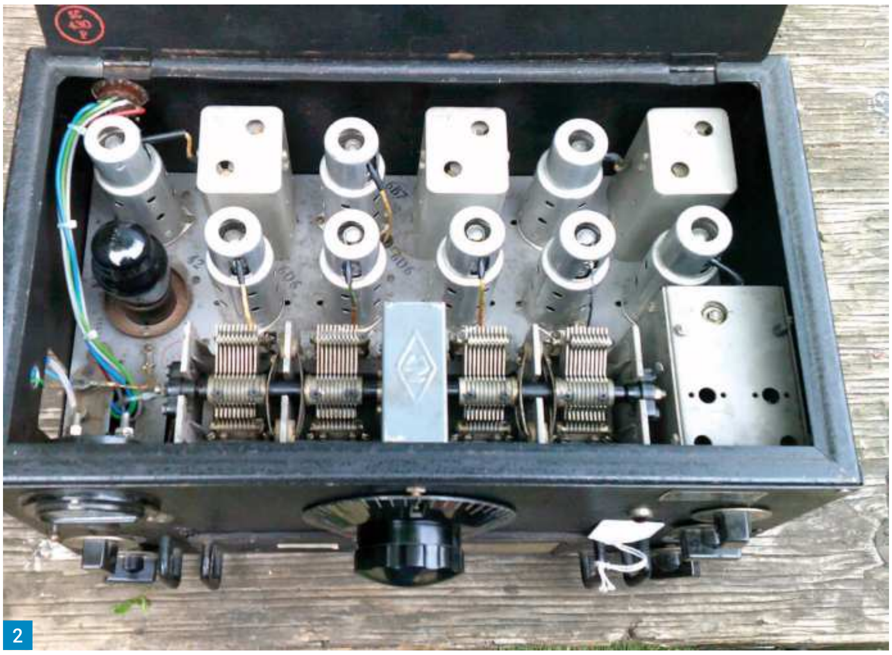
Apparently designed about 1935, it used the rather old-fashioned idea of band change by changing coils. In fairness, there was a very large frequency range covered, and if it was a switched-waveband set, it would have a great many coils in, and not all users wanted the full coverage. For those amateurs, therefore, with a couple of favourite bands, it was OK, and alternatively if you couldn't afford to buy the lot in one go, you could buy them later, perhaps one at a time. Each pack contains four sets of circuits, each in its own aluminium can.

The set was not well regarded by the British Services, as deemed not easy to use, according to **Louis Meulstee**, in *Wireless for the Warrior, Vol 3, Reception Sets* (see footnote), where a very full description is to be found of the sets and how they were used. He dates the set to 1939, but that is when we got them, not the original introduction date. Many were bought by amateurs after the war, and some people loved them.

The late **Pat Hawker G3VA** was one, and went on (and on…) about them in *Technical Topics* in *RadCom*. The fact is a set where you have to plug different coil packs in and then read off the graph to find the frequency is not the height of ergonomics. The bandwidth control isn't the easiest to use, either. It was deemed to require operators to gain too much skill to use effectively, and hence too much time for training. I didn't find the layout of controls to be conducive to easy use but I suppose if this was my own set I would have learned. I far prefer my CR100/B28.

In contrast to Pat, I did like the reminiscence of a user in the war in the Far East who said when they got AR88s, they put their HROs in a rowing boat, went out to sea and threw them over! A bit extreme? They wanted to ensure that the Japanese couldn't get hold of them. The set was replaced with the British R206: a much more complex receiver with no plug-ins! However, many of them were used, mainly for interception. Meulstee has pictures of vehicles with several operator positions, using them.

Photo 1: The set in situ.
Photo 2: Top view.
Photo 3: Bottom view.
Photo 4: The coil packs.



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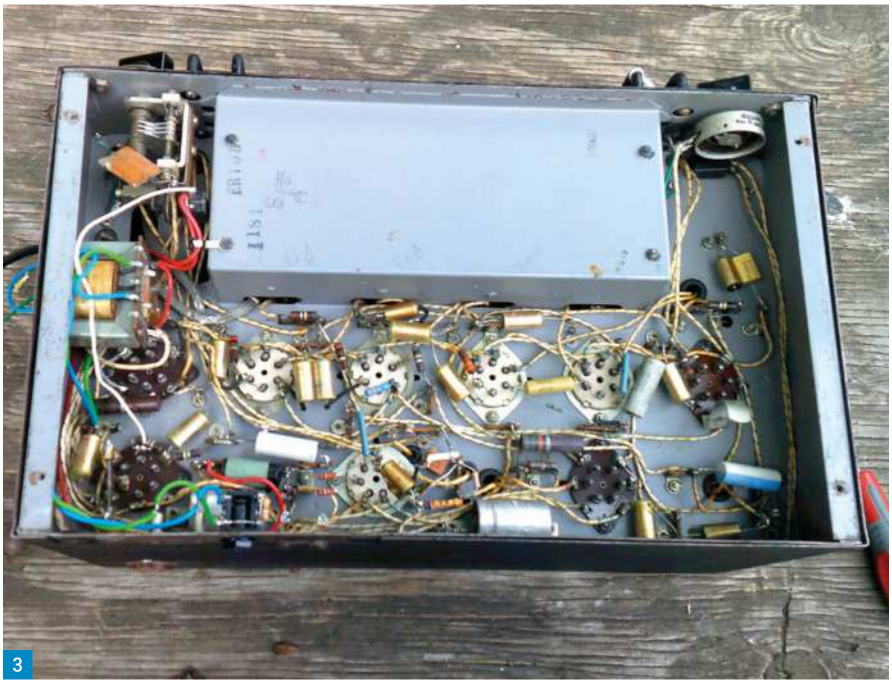

3

Description

The set is in two parts, apart from the coils. The main set, and a separate PSU. It does not ordinarily contain an output transformer. Why set makers, professional or domestic, liked running HT and anode around, and not putting the output transformer with the valve, I don't know. The original PSU is known as a 'dog kennel' because of its shape with a 'roof' sloping up to a flat section, instead of a simple rectangular box. This set came with no PSU, and I had to build one for it, which I built as two separate supplies in one box to run an R1155 (see *PW* August 2021). Sets supplied to the UK didn't come with a PSU. They were made here in a straightforward rectangular box.

The set follows (almost) conventional lines apart from the plug-ins. For a station main receiver, it has two RF amplifier pentodes, a pentode mixer, a separate local oscillator, two IF amplifiers, double-diode-triode or pentode for audio detection, AF signal amplification, and AGC detection, followed by a power pentode output valve. There is a beat frequency oscillator (BFO) for CW operation, and the PSU contains a full-wave rectifier and transformer for AC mains only, the other PSUs are vibrator types. Why did I say almost conventional? Because they have done what I frequently comment on other sets not doing where a separate local oscillator (LO) is used: they have used a pentode mixer, not a polygrid. Cheaper, simpler, lower noise and higher gain. It also means the spares kit needed one less valve type. The two pentodes are 6C6 (6J7), the straight ones or 6D6 (6K7) the variable mu types. I have given the Octal equivalents in the brackets. The straight ones are the two oscillators: LO and BFO. The DDP/DDT is a 6B7 (6Q7), and the output valve is a 42 (6V6).

The power supplies were model 697 for 115/230V AC, 50/60Hz giving 240V DC at 70mA and consuming 70W. The 686 PSU was for 6V DC and the 1286 for 12V. They only consumed 38W but things are not quite the same, as the HT was only 165V at 45mA. The rectifier in the mains pack was a 6X5, but sometimes a 0Z4, requiring no heater power.

The manual tells us that to attain essentially flat sensitivity across the frequency range of each band, which intrinsically changes as the L/C (inductance/capacitance) ratio changes, a high-inductance primary is used in the inter-valve RF transformers, leading to the opposite, which is then compensated for by having a small top-coupling capacitor between primary and secondary. This however is not shown on the circuit diagrams.

To get the tuning knob in the centre of the front-panel, and also to have the coil-pack central, an unusual tuning capacitor was needed with a gearbox in the middle between the two pairs of variable capacitors where the shaft from the knob entered. The mixer anode circuit contains the crystal filter circuit. This is quite a complex arrangement. The crystal has a variable phasing control on the front panel. This capacitor has a short in one end of its travel to switch the crystal out, thus leaving the bandwidth to be determined by the selectivity of the IF transformers alone. When used, however, the circuit is balanced against a pre-set capacitor in a push-pull circuit, formed of an untapped secondary winding on the first IF transformer, but balanced to earth by two capacitors. Adjusting the phasing control gives variable bandwidth to the IF response and the ability to peak it either side of the nominal IF, which is 465kc/s. The combined output from the two joined phases then goes to an autotransformer, which is tuned and steps up the voltage and impedance into the grid of the first IF amplifier.

The slope of the filter is poor, stated by Meulstee as only 5dB/kc/s. The attainable bandwidth is between 2500 and 200c/s. The second and third IF transformers are conventional with no switched coupling. All the bandwidth variability is in that first transformer. The coupling to the detector diodes is only on the secondary of the transformer, not the more typical approach of taking the AVC feed from the anode via a small capacitor, thus reducing loading on the tuned circuits. The audio then goes to a pentode in the UX- series valve, or triode in the Octal valve, then to a conventional output stage. For headphone operation, the output valve isn't used, drive being taken from the preamplifier. Not stated in the manual is that if running on battery power, the output valve can therefore just be unplugged.

Both the LO and BFO circuits use a Hartley oscillator running between cathode and control grid, the output taken from the cathode in the case of the LO. Thus, there is little load on the tuned circuit. The BFO uses the same configuration except that the output is taken from an untuned anode connection. The BFO on/off switch is coupled to the BFO pitch tuning capacitor. Another switch allows the meter to be switched off. Why is unclear. I suspect that with the BFO on and manual control of HF gain, the meter was overloaded. It is stated in the manual that AVC must be off when the BFO is on, or the set is deaf. This is typical though. The BFO signal adds to the received signal and is therefore detected by the AVC diode.

The Coils

Not so simple! Some coils were designed with the radio amateur particularly in mind, and could be adjusted to bandspread (BS) the amateur bands, by simply moving screws within the coil-pack - no adjustment was needed. There are two windows on the front with graphs of frequency versus dial read-out, one for standard and one for the BS setting. There is a B+ switch (HT), and that must be off when changing coils. The antenna terminals float for balanced input, but there is a link installed for earthing one side for unbalanced input. Coverage is as shown in **Table 1**.

The J packs were therefore for non-

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amateur use, generally, and were simpler and therefore cheaper. The set covers an unusually wide HF range if the user had all the coils. As is often the case, the MW broadcast band is not ideally covered as in an all-in-one coil-pack, and neither is LW, but then the Americans didn't use it. The dial has 500 divisions. There is a marker at the top, and a window through which a number can be seen, plus the marks around the edge give a very fine read-out of the setting. The re-setting accuracy is good.

The set has a lidded top, and unusually the heaters are not earthed one side, but balanced to chassis by resistors. While this is good practice at audio for hum reduction, it is rare in RF practice. It has the disadvantage of increasing the likelihood of instability due to RF being transmitted along the heater wiring and indeed the heaters at the first IF amplifier and the BFO have RF bypass capacitors to chassis from one side.

Variants

As with many sets there was more than one version. The set here is a table-top set, the HRO-5A1, but a rack version was also made being sold as the plain HRO. The -C was the HRO, 697 PSU (AC mains) and SPC coil storage rack all in one table-top unit. There was also the cheaper HRO Junior, which omitted the meter and crystal filter, nor were bandspread coils available.

The company loved their unique tuning dial and made other latter models using it too. Examples include HRO-7 of 1947/49, HRO-50 of 49/50, HRO-60 of 52/54, by now using miniature glass valves in the front-end but still using, I assume, cheaper Octals for the IF amplifiers onwards. Even the very much more modern looking HRO-500 used a similar dial: but now in brushed aluminium. The last two sets were dual-conversion.

The company, which became defunct from about 1971, started in 1914 as the National Toy Company. It made toys and 'parts' the nature of which was not specified, but we may assume mechanical and electrical, which would easily lead into radio at that time. In 1916 they changed name to reflect the change in business to The National Company Inc. Their heyday was in the War, as with so many companies, producing all the radios they could for the Allied war effort.

An extremely memorable post-war set was the FRR-24. It was in four 19in racks, each about 300lb in weight, and was for triple diversity point-to-point communications. It is extremely scarce, as are those with the space to accommodate it!

Work

The set had already been re-capped, but the soldering was awful in places and leads left long.

The original 4-pin UX plug that the

Coil set	Coverage	Band spread
A	14-30Mc/s	28-29.7Mc/s
B	7-14.4Mc/s	14-14.4Mc/s
C	3.5-7.3Mc/s	7-7.3Mc/s
D	1.7-4Mc/s	3.5-4Mc/s
E	900kc/s-2.050Mc/s	
F	480-960kc/s	
G	180-430kc/s	
H	100-200kc/s	
J	50-100kc/s	
JA	14-30Mc/s	
JB	7-14.4Mc/s	
JC	3.5-7.3Mc/s	
JD	1.7-4Mc/s	

Table 1: Coverage by Coil Set.

set came with to plug into its PSU was replaced with two 2-pin plugs that were interchangeable and unpolarised. Useful! It came with a PSU, which was beyond a joke, quite incapable of supplying the current due to its tiny transformer and high resistance choke. It was scrapped, and a new one as mentioned would be built. An Octal socket was fitted to the rear, and a cable and plug made up to go with it. Some new wiring also done badly, so it was necessary to rewire the output transformer (which sensibly had been fitted internally) and the connection of HT to BFO. Add a jack socket for the speaker output. The set however was dead, although we did get signal by touching antenna to mixer grid. Another coil-pack was much better and it turned out that all those nice easily accessible adjustments had been adjusted! We went through the packs, roughly assessed their condition, and noted, then went through and re-aligned them all. That was the biggest job. Why people have to fiddle with things, even when it is obvious they are not making them better, I don't know.

The design is poor: the moving vanes are live so using a screwdriver adds stray capacitance. I tried the insulated tool from a Redifon R50M set but the vanes are very stiff and would have broken the tool. I had to strip part of the cabinet down to get access to the trimmers and eventually managed to align it by using a screwdriver, then removing, seeing the effect and trying to allow for it when readjusting, until it was peaked with the tool withdrawn. What a fuss! A very slim 4BA tube spanner was needed, which would have allowed me to do the alignment without the stripping-down.

A number of resistors had gone well beyond their tolerance and were replaced. A 30kΩ was >3MΩ. There was distortion, and no AVC. I found that where a capacitor had been replaced: for the wrong value, it should have been 0.01µF and was actually 0.1µF. This was replaced. An adjacent wire on the tag board had been accidentally cut. Reconnect to restore AVC. Some of the 0.01µF capacitors had been replaced with 0.015µF, but as it didn't seem to unduly effect the AVC operation they were left.

The set was still insensitive. The first IF transformer had been got at. Re-align then much better.

The meter had always read oddly. I found I couldn't zero it, and then noted loose connections. Someone had reversed them despite there being different size studs and solder tags to denote which way round. Rewire correctly then OK. I also glued back the loose glass in the meter, and then polished all the contacts on the coil-packs and in the receiver. The shaft of the zeroing pot is live and positioned to make it easy to short to chassis.

Finally, I got the kind of sensitivity I should have, which varies according to the specification between 1 and 5µV for 20dB SNR. Those are impressive figures.

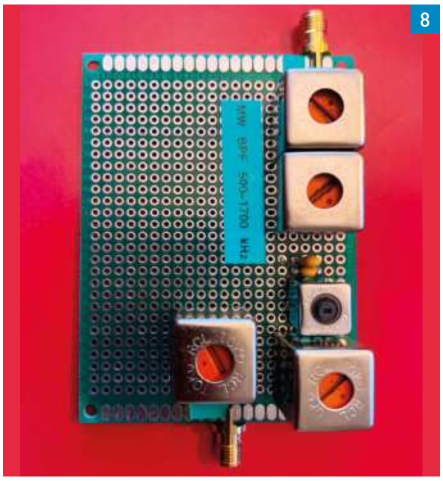
Conclusions

I would not want this as my main set, but it did very good service for amateurs after the War, and indeed was still used by the Forces into the fifties. For those who love a particular band, and don't need to keep changing coils, it is fine. It would take a long time for radios to be available new at the price that could compete with its specification and facilities. It is also one of the most-needed sets in the Museum 'Comms Corner' collection, on the grounds of fame and being 'Iconic'.

Sources

The following sources were used in writing this article, apart from experience doing the renovation of the Museum's set. Photocopies of the original manual were available and came with the set. Also Fred Osterman's *Shortwave Receivers Past & Present* (subtitled) *Communications Receivers 1942-1997, third edition.* This is a compendium of 1000 receivers, giving short-form descriptions with a picture. Hard to get hold of but very interesting to those who collect such sets. *Wireless for the Warrior, Vol 3, Reception sets,* by Louis Meulstee. There are five volumes covering virtually all the sets used by the British Army in the WWII, and sets running up to and just after it. A hugely comprehensive work of the design, detail and use of these sets. Circuits and service information are also generally included. I can thoroughly recommend both.

Continued from page 39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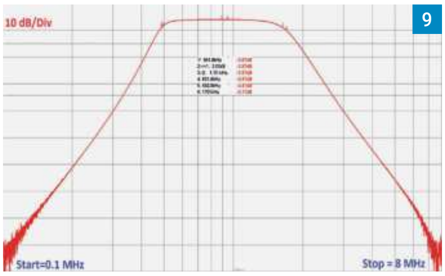

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purpose. However, any larger inductance values would need a smaller diameter wire to be used.

The Prototype

The assembled filter is shown in **Fig. 8** and following some work with a vector network analyser the tuned filter's performance is shown in **Fig. 9**. The loss through the filter is slightly less than 1dB and setting the 3dB points and the shape of the filter was fairly simple to achieve.

End Note

Capacitor C3, 5.5nF, is not a standard E12 or E24 value and as can be seen Fig. 8, next to L3 (the smaller can) is made up of two capacitors in parallel – a 3.3nF and a 2.2nF. There is no issue with using a standard value capacitor of 5.6nF as there is more than enough adjustment achievable with L3 – I just did not have that particular value to hand.

You only need a small length of wire to achieve low µH values with these two formers and it is simple enough to remove 100 or more turns of the original wire from the large former and then use that for your own windings. While it is very thin and needs good eyes the enamel coating burns off easily.

If it helps, I have made high resolution copies of all the graphics in this article as well as a few examples of using the one equation, available on my website at:
www.samuelritchie.com

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UPTO 389 WATTS

YAESU FT-3DE C4FM/FM Dual Band Digital Handheld Transceiver

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UPTO 369 WATTS

YAESU FT-70DE C4FM/FM Digital Dual Band Digital Hand Handheld Transceiver

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UPTO 169 WATTS

YAESU

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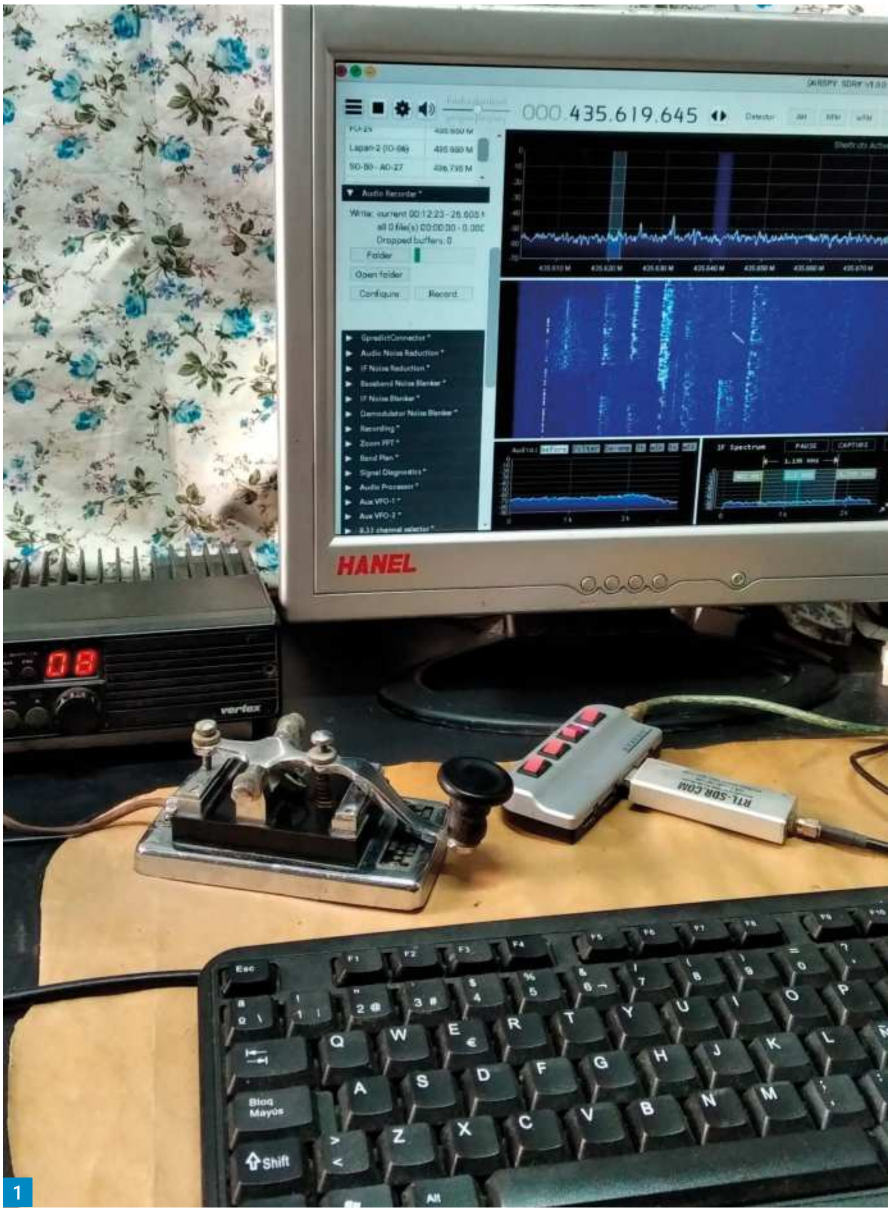
UPTO 399 WATTS

Tim Kirby GW4VXE
longworthtim@gmail.com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A Transatlantic Opening on 144MHz

Tim Kirby G4VXE has another packed column, starting with news of a great 2m opening across the Pond.

Last month, I wrote about how our more intensive operating and monitoring was resulting in new paths being discovered, particularly at VHF/UHF. I was excited to learn, this month, of some excellent propagation between the Canary Islands and the Caribbean on 2m.

On 19 August, **Cesar Regalado Leon EA8CXN** and several other stations in the Canary Islands made some exceptional QSOs to the Caribbean. EA8CXN found paths to NP4DM, KP4EIT, WP3DN, WP4G, FG5GH and FG4ST, while EA8RH and EA8DEC worked NP4BM. Interestingly, FG4ST decoded two periods from CT1ETL/1 on the Portuguese mainland, showing that a contact from Europe 'proper' is very much on the cards.

Next day on the 20th, there were more contacts over the same paths with some new stations joining in the fun, such as FG4SU, EA8TL, EA8TX and EA8RCP. Although most contacts were made on FT8, that's by no means exclusively the case and some SSB contacts were possible. Have a look on **John EI7GL's** blog about the opening (URL below) and you'll be able to see some video of an SSB contact between EA8CXN and KP4EIT as well as FG4ST and EA8CXN.

https://tinyurl.com/yhj5mdjj

The distances of these contacts are all in the region of 5000km. Quite amazing!

Running the Airscout software on Linux

If you are interested in aircraft scatter on the VHF/UHF/Microwave bands, then the Airscout software (URL below) can be very useful in determining when an aircraft is going to illuminate a particular path. **John Hawes G8CQX** spent some time trying to get the software running on an Ubuntu Linux machine. John said that in the end, he got it running within a Docker container, having seen someone mention that this had worked on a Mint machine. John says that it's a little flaky but usable and sent me a video of it running as he monitored the GB3MCB beacon in Cornwall from his station in Cheltenham. Hopefully this may be of interest to those of you who use Linux based machines in the shack.

http://airscout.eu

European FT8 Activity Sessions

Thanks to **Tony G4NBS** for pointing out an error in my last column. I wrote that the 2m and 70cm events alternated each month. They don't! The 2m session is always on the first Wednesday of the month and the 70cm session on the second Wednesday of the month. Sorry for any confusion.

The 6m Band

Kevin Hewitt ZB2GI (Gibraltar) has once again been active on 6m from the top of the Rock during the month on FT8, using an FT-450 and 3-element Yagi. Kev worked a number of Europeans, but the highlight was an opening to the USA when he worked K2CKA (FM06), K2IL (EL97), KB4MRX (EL96), K4SV (EM85), W3GQ (EM95) and WA4TMJ (FM16).

Jef VanRaepenbusch OS8NT (Aalter)

Fig. 1: Satellite operation Cuban style. Juan Carlos CO8TW uses this innovative and effective station on the RS-44 satellite. Fig. 2: CO8TW's downlink antenna for 70cm, a Moxon. Fig. 3: The 2m uplink antenna at CO8TW an Elk-style antenna.
Fig. 4: Doug N6UA with his portable satellite setup.

2

3

worked IM0/I2KQE and 5T5PA (IL10) on FT8 during August and F4ARU on MSK144 during the Perseids meteor shower. Jef runs 10W from an IC-7300 to a V-2000 vertical.

Colin Fawcett G8YIG (Stalybridge) took part in the September UK Activity contest, working G0VAX (IO83), GW4SHF (IO82), M0WBG (IO83), G4RRA (IO80), GW0RHC (IO71), G3RKF (IO83), G4FZN (IO94), GW1YBB/P (IO82), G8ZRE (IO83), G4EII (IO83), GW8ASD (IO83), G3TDH (IO83), GI4SNA (IO64), G0XBU (IO83) and G0CDA (IO83).

Tony G4NBS (Cambridge) says that his only activity was for the UK Activity Contest on 9 September when conditions seemed a little better to the southwest for him, with several good signals from IO81 and Paul G4RRA (IO80) being a consistently good signal. GI4SNA was an easy SSB QSO and GW0GEI (IO72) was worked on CW. Tony says the only station heard from IO83 was G8ZRE and the sole European station was F4HRD (JO00).

The 4m Band

Jef OS8NT continues to use his V-2000 tribander on 4m, with some good results, working SW8YA (KN20) and G3MXH (JO02) on FT8 with 10W from his IC-7300.

Roger Greengrass EI8KN worked EA6VQ (JM19), EA7B (IM76), EA7HTE (IM66) and EC4C (IM68) on 18 August.

Dave Thorpe G4FKI (Ampthill) reports that the Tring parrot repeater was switched back on during August after being off air for a few years. It's on 70.4375MHz and needs a 77Hz tone. If you're in the south-east, it's good fun to use it. Dave says that transmit power is reduced at present, but the coverage area is still good.

The 2m Band

During the Perseids meteor shower, Kev ZB2GI operated from the top of the Rock, using 50W from an FT-897 into a 5-element dual-band 2m/70cm Yagi with a 20dB gain preamp. Using FSK441, Kev worked, IK2JUG (JN45), IT9GSF (JN67), IV3/HB9CAT (JN65), I8TWK (JN70), G1KAW (JO00), IK0IXO (JN52), S50C (JN76), EA3BTZ (JN11), IK4PMB (JN54), IK8BIZ (JN70), DK5AI (JO51), PA4VHF (JO32), G0CHE (IO90), ON6NL (JO21), DK5OX (JN59), G4AEP (IO91), PA0CAB (JO22) and IK0SMG (JN61).

Kev also made some very nice QSOs during the month on FT8. I'm not sure if some of these were Es, or some tropo along the Med. Highlights of Kev's log were IH9YMC (JM56), I8/UT3UX (JM88), EA8A (IL18), IZ8DVD (JM88), IQ8LR (JM88), IT9GSF (JM67), EA6ET (JM19), EA8AIN (IL18), EA8TL (IL18), IZ8YBS/8 (JM89), EA8JF (IL38) and EB8AC (IL28). On SSB, Kev worked I8/UT3UX (JM88), EB8AYA (IL18), IK8CNT (JM78), EA7FGJ (IM67), EA7UA (IM67), EA5GJ/M (IM66), EA8AZ (IL28), EB8BRZ (IL28), F5VKV (JN33), EA8BPX (IL18), EA8CTK (IL18), EA8AVI (IL28) and EA3MS (IN80).

Simon Evans G6AHX (Twyning) said that on 3 September, he turned on the radio on and just below the calling frequency was SN7L (JO70) setting up for the weekend contest. Simon mentions that he didn't hear SN7L during the contest, by which time conditions had faded a little. During the contest, Simon took part in the six-hour section and worked 42 stations. His best DX was DK5WO (JO30). Simon says that he heard EI and EA1 stations during the session but wasn't able to work them. Simon is on the eastern side of the Malvern Hills, making paths to the west difficult. He also took part in the UK Activity contest on 7 September, working 29 stations in 17 squares, with his best DX being PA5Y (JO21).

It's really good to hear from **Simon Rodda G4PEM** (West Cornwall). We had a QSO on 2m FT8 a few weeks ago and realised in subsequent discussion that we'd last worked back in 1983. Simon writes, "*I'm discovering amateur radio all over again, having moved QTHs: I can now hear or work GW, GD, GI and GM. Previously in Penzance, that was impossible. Up the band, Irish and local FM repeaters are beating. I swear the bands are busier now than they were 'back in the day'. My antennas are still evolving. My rotator, an elderly AR40 is yet to be installed, so the beam is fixed, or at least 'armstrong'. I have a vertical for 6/2/70, a horizontal beam for 144/432, and a couple of dipoles for 6, that tune OK on 70MHz.*"

During the UK Activity Contest on 3 August, Jef OS8NT worked G4FEV (IO92), G4CLA (IO92), G4ODA (IO92) and G3YYD (IO92), all on SSB.

Tim Hague M0AFJ (Helston) writes, "*Conditions have been excellent during the period since the last report starting with a quick QSO in the Perseids shower with HB9CYN (JN36) on 9 August.*

"Tropo has been about for most of the month. A great opening started on 14 August with contacts into EA8, CT and DL. The highlights were CT4SU (IN51), CT3KN (IM12), DC0KK (JO41), EA8CSB (IL18), DJ6AG (JO51), EA8JK (IL18) and EA8FB (IL18). The last contact of this opening was CT1HIX (IN51). Tropo conditions came back in early September with an opening all over Europe from IO70, including DL3TW (JO44), DK1AX (JN59), SP1MVG (JO74), DJ5AR (JN49), DF5HC (JN49), DC2MW (JN58), OZ5NW (JO55), OZ9FZ (JO46), SK6QA (JO58) and OZ9FZ (JO46)". All Tim's contacts were FT8 using an IC-7600 driving a Q5 transverter and a Gemini amplifier to a 9-element Powabeam.

Ian Bontoft G4ELW (Bridgwater) writes, *"It's been an interesting couple of weeks or so.*

"Around the end of August GM3POI was decoded on FT8 here on the Somerset levels, with the best signal from him at –5dB. Although I tried, 15W to a V2000 could not get past Newcastle (I was still quite pleased with that though!). Things really opened up on 1 September with F6DBI, OZ1BEF, DF7KF, EI3KD, DL3TW, GJ3YHU, EI8KN, ON4JES and GU6EFB all being worked. The French, Irish & Channel Island stations had been worked before but I was pleased with Germany and Denmark. Things tailed off a little on 2 September but managed to get the following in the log: F8PRC, EI3KD and OZ0A. I was copying Swedish stations at times but no luck with them".

Roger Daniel G4RUW (Newbury) feels it was a good Es season on the band and he logged 17 openings. Some were only very short lived with others lasting hours on end! Roger also enjoyed the recent tropo, working 2M0TNM (IO67), GM3POI (IO88) and GM0HTT (IO89) as well as many other stations in GJ, GU, EI, OZ, ON, LA, DL and SM.

The August tropo started with Roger EI8KN on 16 August working EA1YV (IN52) and EB1B (IN73) quickly followed by CT1EEQ (IM58). Things were good to the north on 29 August when Roger worked MM0CEZ (IO75), GM4FVM (IO85), GM7PKT (IO76), GM0EWX (IO67), MI0XZZ (IO74), GI4SZW (IO64), GM0HTT (IO89), GI0OTC (IO65), GM3POI (IO88), GM0HBK (IO77), LA9AKA (JP20) and 2M0TNM (IO67). The opening then moved more to the east with many OZ, DL, PA stations being worked. On 1 September, Roger worked OK1AGE (JN69) and then next day SP1DPA (JO73). There were more SPs on 3 September in JO83, JO73 and JO74.

Robert van der Zaal PA9RZ (Sassenheim) writes, *"On 3 September, in the evening, I heard* ***Chris G0DWV*** *from near Norwich with a fair signal. Lo and behold, the 3W from my IC-202 allowed a ragchew and knowing his area I asked about his local, 'The Checkers', which surprised him!*

"I very much enjoyed the September contest on 4/5 September. First running my IC-202, barefoot again (3W to a 5-el. Yagi at 55ft ASL) easily getting me in to JO01 and JO02 but even reaching DL0GTH (JO50), DL4FNM (JO50) and OL7C (JO60), When F8KGU didn't copy me, I fired up the IC-705, running 10W and some speech processing, getting me in to JN19 square. The next morning, OK4C in JO60 was very loud. Other stations worth mentioning: G8W (IO90) and my best DX: DA2X (JO61), at about 664km! Although the IC-202 is my favourite rig, the IC-705 proved very useful too. I suppose the extra 'push' from some speech processing helps.

"During the Activity Contest on 7 September, running my QRO Compromise (the IC-9700) got my old pal PA0FEI (JO33) in the log, followed by DL4TO/P (JO33, the Frisian island of Norderney). After 1900UTC I pleased some of my G pals in IO92, JO00, JO01 and JO02 with 'a point'. The QRO contacts are not very important to me though, apart from the 'social' aspects that is."

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Robert concludes by saying, *"Try to get some Yagis up so you can more often use the software between your ears to decode the signals rather than the one in your computer!"* Cheeky!

Tony G4NBS said that there seemed to be good activity in the FT8 Activity session on 1 September, helped, no doubt, by the good conditions. Tony also says that hopefully at some point we will start using more than 3kHz for FT8 activity. Some of the highlights of Tony's log were DK5EW (JN48), DL2FQ (JN49), OZ1III (JO47), DL2AKT (JO50), LA3TL (JO58), SM6TZL (JO67), DF1NP (JN58), DL2NBU (JN59), DG6YID (JO42), OZ1BEF (JO46), OZ5NM (JO55) and GM0EWX (IO67) as well as the more usual EI, GI and GM stations. After the contest, Tony made some more nice contacts, including OK1AGE (JN69).

During the September trophy contest, Tony was surprised to work SN7L (JO70) as well as OL1R (JO70). Other nice ones were DA2X (JO61) and DM5D (JO61) as well as some closer DL and F stations. The UK Activity Contest on 7 September seemed average in terms of conditions but Tony made 110 QSOs in 27 locators. OZ1BEF (JO44) was the best DX with plenty of QSOs from the UK.

The 70cm Band

Running 20W from an FT-897 to a 5-element dual-band 2m/70cm Yagi, from the top of the Rock, Kev ZB2GI worked EA8AIN (IL18) on 70cm FT8 and on SSB, EA8AIN (IL18) and EA7KLL (IM76).

Tim M0AFJ caught some tropo in the opening that started on 14 August; EA8FB (IL18), AM1CCB (IN82), EA1YV (IN52) and EA1CCM (IN52). Tim uses an IC-7600, Q5 transverter, Gemini amp and an 18 element Powabeam.

Roger EI8KN has some nice contacts in the log from the tropo, including EA1YV (IN52), GM0HBK (IO77) and SM6VTZ (JO58) as well as many PA, ON, DLs. DL7APV (JO62) was a particularly nice one on 3 September.

Tony G4NBS found the FT8 Activity session on 8 September not quite so well supported this month and made 36 QSOs in 19 locators, with fewer Dutch stations seen than earlier in the year. DJ6AG (JO51) was the best DX. Another nice QSO was with GM0HBK (IO77).

Satellites

Jef OS8NT has been enthusiastically trying FT4 and FT8 on some of the satellites. His first successful contact was with his 'neighbour' ON2ACO on 16 August. During the weekend of 21/22 August, Jef made a number of FT4 QSOs using the RS-44, CAS-4A, CAS-4B and XW-2F satellites, including ON2ACO, EB4ADC, IZ6GZM, EA3HAH, EA3TA, EA4CO and KO4ENU. Jef was also decoded by W4WT (EM74), VE6WK (DO20) and A65BR (LL75).

Jef mentions that he and some of the others interested in FT4 operation on the satellites have been using the chat feature on the DXMAPS website. You'll find a satellite – WW section under Chat/VHF & up. For those interested in setting up the IC-9700 for FT4 operation on satellites using SatPC32 and WSJT-X, Jef recommends the video from NU1U:

https://tinyurl.com/ydm296ux

Jef says, *"Thierry and I were experiencing difficulties in decoding even at good signals, when* ***Oleg A65BR*** *came to the rescue on the chat, and came up with the solution: 'update interval 100ms' and 'minimum* *frequency change 1Hz' in the settings of the CAT Controller".*

Patrick Stoddard WD9EWK (Phoenix) writes, *"As the unofficial end of summer over here – Labor Day in the USA, and Labour Day in Canada – has come and gone, there continues to be lots of satellite activity on this side of the Atlantic. I saw reports of QSOs between* ***Raydel CM2ESP*** *and* ***Juan Carlos CO8TW*** (**Figs. 1**, **2** and **3**) *with European stations. It is nice to see satellite activity from Cuba, as it is difficult for the Cuban hams to get the necessary equipment for satellite operations, especially for SSB and CW.*

"In early September, on a drive north of Phoenix to operate from the DM34/DM44 grid boundary, I made a quick contact on SO-50 with W7ASC, the amateur radio station at the Arizona Science Center in downtown Phoenix. W7ASC has been part of the science center for over 20 years. The original Kenwood TS-790 that W7ASC received over 20 years ago, along with the 2m and 70cm Yagis above the center's roof, are being put to work on the satellites once again. From my spot at the DM34/DM44 line, W7ASC was a 90-minute drive south of me. After the SO-50 contact, I drove back to Phoenix and visited the science center. I met the satellite operator, ***Rusty WA8ZID****, one of the many volunteers that keep W7ASC on the air.*

"During the Labor Day holiday weekend, I made a day-trip to northwestern Arizona. I visited the city of Kingman, located on the I-40 freeway that crosses the continental USA, and the old route 66. I parked on the DM25/DM35 grid boundary that cuts Kingman in half, planning to work lots of satellite passes from two grids that are not heard much on the satellites. After a day on the grid boundary, I worked a total of 25 passes on 12 different satellites (6 in FM, 6 in SSB), logging 94 QSOs. One of those 94 QSOs was a D-STAR QSO via AO-27 with KE6LB, commemorating 100 years of radio in Long Beach, California, a suburb of Los Angeles. ***Endaf N6UTC****, who had also ventured to a different grid in central California (DM15) earlier in the day, was operating KE6LB, and we were able to work each other in D-STAR and FM on that AO-27 pass. From those 25 passes, I picked up 28 new grids for a new satellite VUCC award covering northwestern Arizona and the Las Vegas area in Nevada with a total of 120 grids from many trips to that area. This will be the ninth satellite VUCC award I have received, for operating in and around Arizona over many years."*

Here at **GW4VXE**, I have been enjoying some nice QSOs on RS-44 and AO-7. I was particularly pleased to work Juan Carlos CO8TW on RS-44. His uplink is a converted FTL-2011 FM rig, which he uses on CW, putting the CW key between the PTT and ground. The receiver is an RTL-SDR v3. Juan Carlos says that as it does not have a filter, very often the 145MHz uplink can cause a lot of interference on the receiver. His antennas are homemade, an Elk-type for the 2m uplink and a Moxon for the 70cm downlink. We had a few skeds before we were able to complete a QSO and during some of those, Juan Carlos had no electricity supply. It all came good in the end and Juan Carlos had a very nice signal on the satellite.

Another memorable QSO was with **Doug N6UA** (Wyoming, **Fig. 4**) on AO-7 using CW. Doug uses a pair of FT-817s and a handheld dual-band Yagi. He was a great signal and despite us thinking signals might be weak so we opted for CW, we completed an SSB QSO as well.

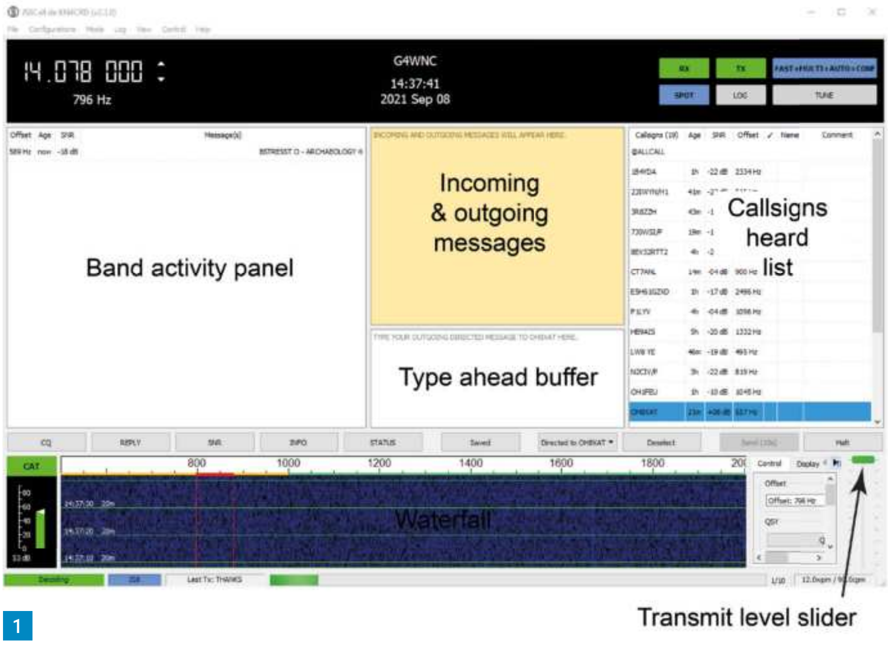
That's it for this month. Thanks for all your contributions and please keep them coming. See you next time.

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk

While discussing disk speed tests last month, I made an error in the name of the disk drive utility for the Raspberry Pi. The installation line should read as follows:

Enter: sudo apt install -y gnome-disk-utility

My thanks to **Malcolm Richardson** for pointing out my error.



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JS8CALL

Mike Richards G4WNC describes JS8CALL and has some Windows & Linux advice, but starts with a correction.

JS8CALL

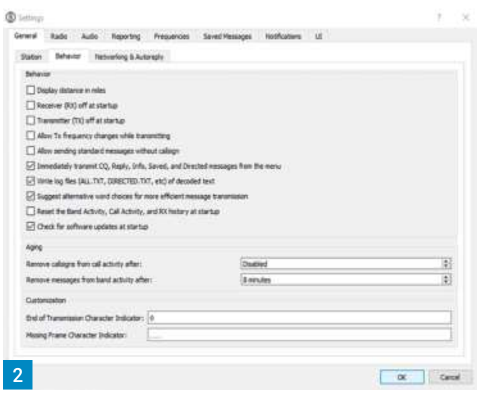
Following my theme of promoting conversational data modes, this time I'm looking at JS8CALL. This mode is derived from FT8 and was developed by **Jordan Sherer KN4CRD**. His idea was to adapt FT8 so that it could be used to send plain text messages, instead of the original structured messages. This would potentially create a very robust, albeit slow, messaging system. JS8CALL has survived for a few years now and seems to satisfy a demand, although development has slowed recently. During its development several enhancements have been added, one of which is the heartbeat that provides a JS8CALL propagation tool. More on this later. The software for JS8CALL is a free download from the JS8CALL website at:

js8call.com

You will find versions available for Windows, MacOS, Linux and Raspberry Pi. Once downloaded, run the installer and accept the default installation options. When the installation completes, JS8CALL will open the setup wizard where you enter your callsign, grid and station information. If you've used FT8, the setup screen should be very familiar. While JS8CALL supports full rig control, it's probably easier to start by using VOX for Tx/Rx switching. On the Radio tab of the Settings panel, set the Rig to None and make sure VOX is selected. Moving on to the Audio tab, this is where you tell JS8CALL which soundcard to use. This will be the same as you use for FT8 and will normally display in the list as a USB Audio Device. That completes the basic set up, so let's take a look at the main screen, **Fig. 1**. The top panel shows current information and includes some useful buttons in the top right. These provide quick access to commonly used features of the software. The left-hand panel is used to show the band activity and will display all the decoded QSOs for the currently selected band. To help keep this panel from getting too congested, JS8CALL uses an ageing control that deletes activity older than a preset age. The default is to delete activity after two minutes but, with low band activity, it's probably better to set this to eight or ten minutes. This can be changed by navigating to File – Settings – General – Behaviour and adjusting the Aging setting, **Fig. 2**.

The centre panel of the display shows your transmit and received messages while the lower (white) part of the display is the type-ahead buffer where you enter your free-form messages while in a QSO.

The right-hand panel displays a list of all the directly heard callsigns. This is useful because these are the stations that you may be able to contact. This is further enhanced with the JS8CALL heartbeat. This is similar to a beacon transmission and causes JS8CALL to periodically transmit a 'hello I'm here' message. Other stations, with heartbeat enabled, will respond with an acknowledgement. When JS8CALL receives an acknowledgement from a heartbeat station, the callsign is marked with an asterisk to indicate that a two-way



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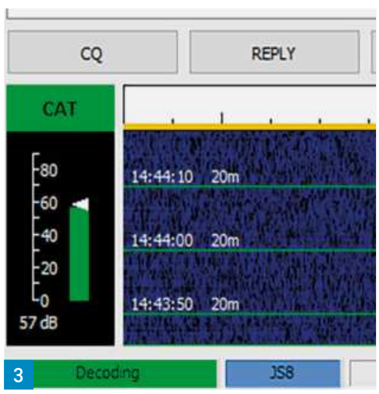

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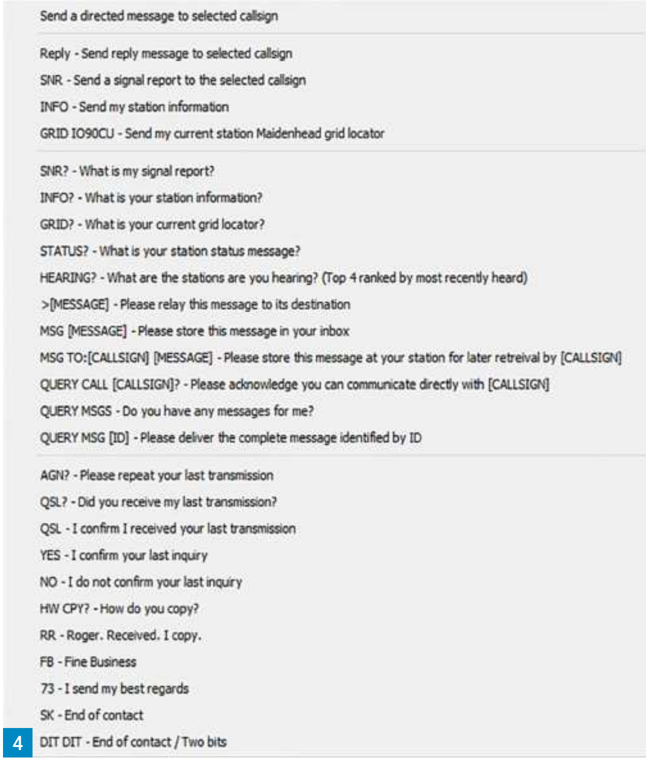
Fig. 1: JS8CALL main screen. Fig. 2: JS8CALL aging settings. Fig. 3: JS8CALL input level monitor. Fig. 4: JS8CALL standard abbreviations. Fig. 5: Windows 10 user profile display. Fig. 6: Raspberry Pi disk speed test using dd.



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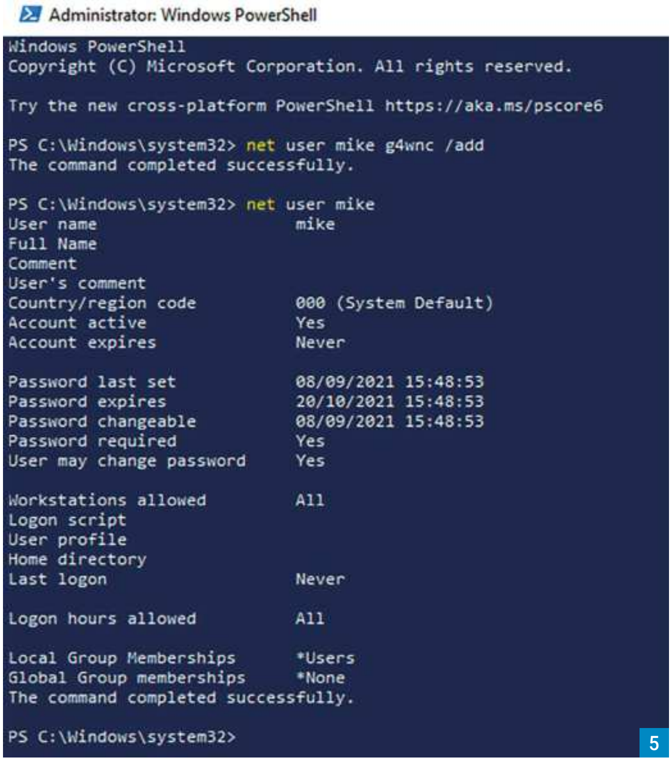

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QSO could be possible with that station. Like the band activity panel, this panel has an aging option that you can activate via File – Settings – General – Behaviour.

The bottom panel shows the familiar waterfall display where you can see the band occupancy at a glance. To the left of this panel is the incoming audio level and you should adjust your soundcard levels for a reading of between 40% and 60%, **Fig. 3**. The right-hand side of this panel contains the transmit drive level slider. This controls the audio output level going to the rig and can be used to trim your transmit power. As with FT8 and other weak signal modes you rarely need more than 30W for JS8CALL QSOs. You can use the Tune button (top right) with the Tx slider to set the correct drive level for your rig.

JS8CALL Modes

During JS8CALL development new operating modes have been added that allow the data speed to be adjusted to suit the link quality. The four modes are shown in **Table 1**.

Operating JS8CALL

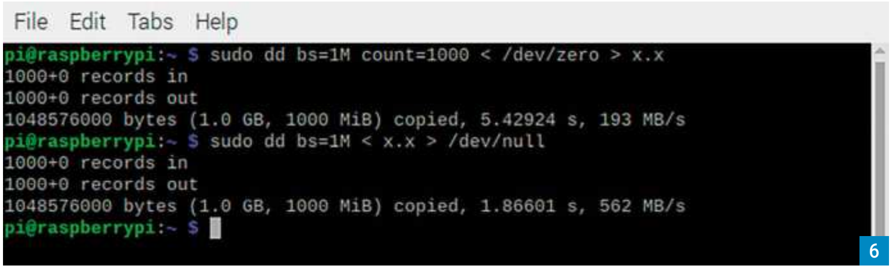
As with all new data modes, I recommend spending some time using JS8CALL to monitor band activity before you start transmitting. This will give you a useful insight into the way the mode is being used. While there are underlying similarities with FT8, the operating technique is totally different because there are no automated messages, and you remain in full control of what's being sent. However, JS8CALL is a relatively slow communications system, so a selection of standard abbreviations has been developed to help pass common messages as succinctly as possible. This is similar to the abbreviations used extensively in CW QSOs.

As with most of the new narrow-band data modes, JS8CALL operates in a nominal 2kHz wide band above a fixed frequency in each band. For example, the 20m JS8CALL operating frequency is 14.078MHz. I've shown a selection of the popular frequencies in **Table 2** and the full range of frequencies are stored within the JS8CALL software. A QSO will normally begin with a CQ call on a free slot in the chosen band. The waterfall display shows the activity and left-clicking on a free space will set the operating frequency. The QSO is then started by clicking the CQ button in the panel above the waterfall display. A common reply is for the distant station to send your callsign followed by HW CPY? For someone calling me that would be G4WNC HW CPY? With two-way communications established the QSO can begin. To ease the typing burden, JS8CALL includes a selection of stored messages that can be sent using the Directed to button, **Fig. 4**. You can also use the type-ahead buffer to enter your own free-form text that can be transmitted using the Send button. The JS8CALL software will automatically format your free-form message into to transmit packets and the length of time required for the message is automatically updated on the Send button.

Next month I'll run through some of the more advanced options available in JS8CALL.

Windows User Management

As regular readers may know, I provide IT support for a school and this inevitably leads me into troubleshooting Windows PCs. This can be a fraught process, so I always keep a note of any techniques that worked well for me. This time I was asked to set up some new users and passwords to make it easier for teachers to operate in different classrooms. Now, you can create and delete users with the wizards that are built into Windows. However, when creating a new user, Windows insists on you selecting inane security questions such as what was your nickname at school, what's your favourite colour, etc. I'm sure you know the drill! As I was setting-up these accounts for others to use, the security questions were not the way to go. However, after a bit of internet searching, it was clear that the best way to deal with user accounts was via the command line. I ought to offer a word of warning before I delve into this topic. While operating at the command line is usually the quickest way to get things done, there is a risk! Most of the command line actions have little if any operator error protection. By that I mean that if you accidentally tell it to do



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something disastrous, it will go ahead and do just that, often without asking you to confirm that's really what you want.

Getting back to user management, the command that's proven to be very useful for me is **net user**. To make full use of the command, you need to access the command line with administrator rights. The simplest way to do that is to right-click on the Windows button and choose: Windows PowerShell (admin). That will give you the command prompt with full administrator rights. The first task is to list all the users registered to the current PC. To do that simply enter:

net user

Now that you can see all the users, you can get the details for any single user with the command:

net user name

Where name is the username you want to check. If you have a username that includes a space (generally a very bad idea), you will need to put speech quotes around the name like so:

net user "fred bloggs"

The net user command will produce a tabular output with all the important information about the chosen user account, **Fig. 5**.

This is very useful if you're having problems giving a user the correct access, as group membership is also listed with this command.

Creating a new user is extremely simple using a single line:

net user mike g4wnc /add

This command creates a new standard user with the specified username (mike) and password (g4wnc). You can also set a new password for any user simply by entering their username and the new password like so:

net user mike g4lfm

Where g4lfm is the new password for username mike.

To completely remove a user account the command is:

net user mike /delete

Where mike is the target username to be deleted.

Another common account requirement is to give a user elevated permissions as an Administrator so they can install software and make other changes to the PC. You can do this via the command line using the **net localgroup** command as follows:

net localgroup administrators mike /add

This would add the user mike as an administrator. Conversely, you can remove a user from a group using **/delete** as follows:

net localgroup administrators mike /delete

Mode	Cycle time	Bandwidth	Speed
Slow	30s	25Hz	8wpm
Norm	15s	50Hz	16wpm
Fast	10s	80Hz	24wpm
Turbo	6s	160Hz	40wpm

Table 1: JS8CALL modes

Band	JS8CALL frequency
40m	7.078MHz
30m	10.130MHz
20m	14.078MHz

Table 2: Popular JS8CALL operating frequencies

Alternative Disk Speed Test

Elwood WB0OEW contacted me with an alternative disk speed test for Linux PCs using the command line utility dd. Please be careful using dd as it writes directly to the disk and offers no prompts to catch errors! If you tell it to wipe your hard drive, it will do so without question!

The following lines will first write 1000 blocks containing 1MB of data to file x.x and show the transfer speed

To measure the write speed use:

sudo dd bs=1M count=1000 < /dev/zero > x.x

This will write 1000 blocks each containing 1MB of data to file x.x and display the output, as shown in **Fig. 6**.

To measure the read speed, we read the same file back and display the speed using the following line:

dd bs=1M < x.x > /dev/null

NB: It's important to run the write test first as this creates the file that will be used for the read test. Once the test has finished you can delete the test file with: rm x.x

Radio Round-up

MANGOS ARE NOT THE ONLY FRUIT: Early into the Covid pandemic Lee M0RLE started a Monday evening net that he called 'It's Good To Talk'. It used repeaters GB3RF and GB3PF in Lancashire. The Repeater Group kindly linked the repeaters for the evening in order to extend coverage.

'It's Good to Talk' was simply a 'touch base' type net, allowing people to 'check-in', have a few words and a couple of short overs.

By June 2020 it was clear that the meeting of local radio clubs and the possibilities of meeting to operate in the field would be out of the question for some time, so the obvious next step was to meet up online.

Amateurs love acronyms... SOTA, JOTA... The list is long but every good amateur radio group seems to utilise an imaginative 'play on letters' in naming themselves. Hence MANGO was born: (M)any (A)mateurs (N)ot (G)oing (O)ut. Extremely relevant at the time.

OK there is a name but how does it work? Basically, it is a Zoom Group. It meets online each Wednesday to talk radio as well as discussing every topic imaginable! On occasions there have been presentations and invited guest speakers. The group has also undertaken sessions of formal training but mainly they learn from one another. They occasionally go on air during meetings to test things out.

They expected the group to attract established amateurs but gained a number of M7s who had had their training interrupted by the pandemic. They were able to help, encourage and guide them towards taking the RSGB online examinations.

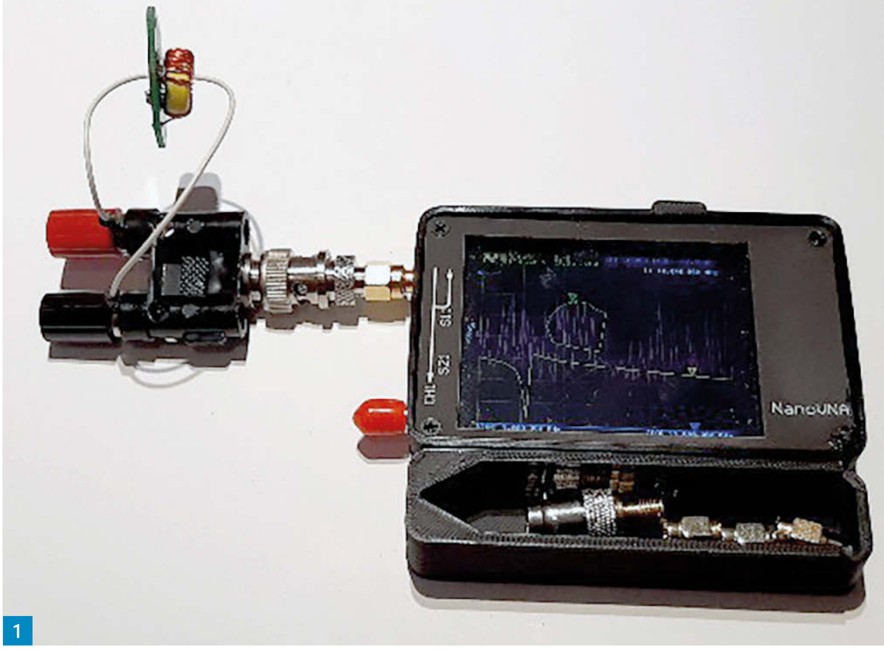
All the new licence holders operate. Most have run large nets. This included a Christmas Day

Continued on page 66

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

HF Antennas

Daimon Tilley G4USI talks readers through some cheap but effective HF antennas.



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If this article results in just one more amateur building an HF antenna, who would not have built one before, then I will be happy! It always surprises me how relatively few people in our hobby actually build antennas. The radio-related social media groups I am a member of are full of *"Which long wire antenna should I purchase?"* or similar questions. Why is that? Is it because people lead busy lives and just don't have the time to research and make an antenna? Or is it because they think it is some kind of 'dark art' that they can't possibly understand? Whatever the reason, there are plenty of commercial providers who have stepped in to fill the gap but, of course, these providers need to make a mark-up in order to turn a profit, which is not helpful when you are on a budget. In this article we are going to explore how to make several basic HF antennas very cheaply, and certainly at a fraction of the commercial price.

The Basics

First, let us consider what the basic 'tools' of antenna making are, which I suspect most amateurs will already have lying around. Here is a list as a starting point:

- Side-cutting pliers
- Insulating tape
- Cable ties
- Tape measure
- Soldering iron and solder
- Miscellaneous connectors, e.g. solder tags, crimp connectors, etc.
- Some means of measuring SWR/resonant frequency.
- A good book and/or access to the internet.

I strongly recommend that beginners to antenna building buy a good book and have access to the internet. There are too many books available to recommend one really, but anything suitable for beginners and wire antennas would make an excellent starting point. My own first antenna book, bought around 1980, is the now out-of-print *Simple, Low Cost Wire Antennas* first published in 1972 by **Orr** and **Cowan**. Many of the illustrations here are taken from that book which has served me well for over 40 years. If you can find a used copy, snap it up!

The most interesting item to consider here is the means of assessing SWR/resonant frequency. There are a number of ways to do this. Let us start with the cheapest. Many more modern HF rigs will have some form of built-in SWR meter. For example, my Xiegu X5105 and G90 both have SWR-sweep functions, providing a graphical display of the SWR around a given frequency, as well as indicating where SWR minimum occurs. If you use an external ATU, often this has SWR metering inbuilt and, of course, there are literally loads of stand-alone SWR meters. As a practical point, you should always have some way of monitoring your SWR during transmissions anyway, as this can show up antenna faults and protect the finals of your rig from cooking themselves.

Another, and highly recommended, option is to have an antenna analyser. Until fairly recently these were very expensive lab-grade instruments, but we are very fortunate to have more affordable options now. Perhaps the most affordable is the NanoVNA, **Fig. 1**, which can be brought for £30 to £40, and I promise you that if you intend to make more than one antenna, this will pay for itself very quickly in terms of convenience and speed. It will also let you make antenna traps and other tuned circuits.

I do not intend to go into detail here, much is available in books and the internet, but the (very simplistic) essence of SWR measurement, for the purposes of this article, is that you are trying to alter the length of the antenna to bring its resonance close to the frequency on which you wish to operate. At resonance the antenna will be a pure resistive load, which will make it easier to match to the output of your transceiver. Once matched, more power is radiated from the antenna as opposed to being reflected back to it (the SWR – Standing Wave Ratio – reduces). When you have the wire at the resonant length, you should have minimum SWR.

The Difference between Resonant and Non-Resonant Antennas

Antennas fall into two broad camps – resonant and non-resonant. A resonant antenna is designed deliberately, to specific measurements, to resonate on your chosen frequency, or sometimes multiple frequencies. Non-resonant antennas are of a length/design that means they are deliberately non-resonant. Some resonant antennas, such as a quarter-wave vertical or half-wave dipole, will have an impedance close enough to match reasonably with the 50Ω that your rig is designed to accept without any matching device. Others, such as the End Fed Half Wave (EFHW) or Full Wave loop, will need a form of impedance matching device, as will any non-resonant antenna.

Impedance matching is sometimes in the form of a matching transformer, an Antenna Tuning Unit (ATU) or both together. An ATU is not really 'tuning' your antenna to resonance

Fig. 1: The NanoVNA, in this case measuring a trap. Fig. 2: A basic half-wave dipole. Fig. 3: Typical commercial dipole centre piece.

– that is just not possible. Rather it is 'matching' the impedance of the antenna to the 50Ω impedance of your rig in a way that can be continually altered by the user, or by the software in the case of an automatic device.

I will touch more on this a little later, but for now, let us look at some designs you can build easily and cheaply with the minimum of fuss and technical ability.

Wire HF Antennas

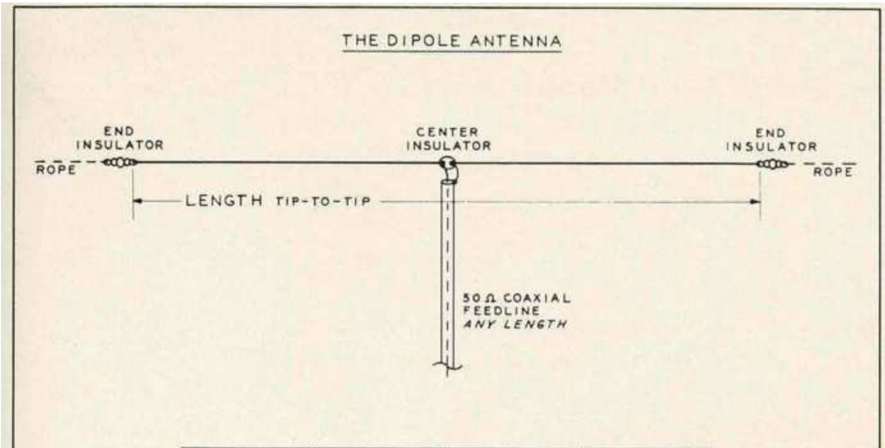
I want to encourage antenna building, so I don't want to make this article too complex or introduce designs that require any engineering skills. On that basis, I am not going to cover Yagi or magnetic loop construction. The focus will be on wire antennas – that is antennas that use cheap and readily available electrical wire as the radiator. They can be built as either resonant or non-resonant antennas depending on the design.

Let us be clear, resonant antennas are the most efficient, as they radiate well with less loss than those antennas that require some form of ATU matching. ATUs will introduce some losses, but for most practical purposes, unless you are running low power, these losses can be acceptable. The advantage of non-resonant antennas used with an ATU is that they can be used on many different bands, which can be highly convenient, if less efficient.

What Wire should You use?

The answer is simple really – any wire that won't corrode. Although not strictly necessary, I recommend using insulated wire for two reasons. First, it helps if your wire comes into contact with trees or other objects and second because it is very readily available. You don't need special wire! The only real practical considerations are length, strength and power handling (directly related to wire diameter).

For home use I personally use wire of the type that you might find in your car, or as speaker cable, for example. You could even strip the wire out of mains flex if you have enough of it. Speaker wire is quite cheap, and is two-conductor, so you can cut a length to one half of a dipole, separate the two sides and you have your elements. Wire of really small diameter is good for keeping down visual impact. SOTABEAMS sell decent antenna wire. Their lightweight wire is only 1.2mm in diameter but will handle 150W at 50Ω. I use this a lot for QRP portable antennas as it packs up very small, but you could use it for permanent antennas that you want to 'hide' as much as possible. It is £8.25 for 100m. They also do a heavy-duty wire at 2.55mm diameter. This is green, great for hiding in trees, can handle 1,000W and is £11.50 for 50m or £22.50 for 100m. I use this for all my wire antennas at home. If you want to make a lot of wire antennas, or a really big one, I bought a 500m drum of 2.4mm automotive wire from Farnell for £33 delivered. I now just need to get around to making my full-wave loop for topband – just 530ft or so of wire!



BAND	CENTER FREQ. (MHZ)	LENGTH TIP-TO-TIP	METRIC LENGTH
160	1.85	253' 0"	77.10
160	1.95	240' 0"	73.15
80	3.60	130' 0"	39.82
80	3.80	123' 2"	37.54
40	7.15	65' 6"	19.98
20	14.15	33' 1"	10.10
15	21.20	22' 1"	6.73
10	28.60	16' 5"	4.98
6	50.20	9' 2"	2.80
LENGTH (FT.) = 468 / F (MHz)			

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Resonant Antennas

We are going to look at three basic resonant wire antennas, and show you how to build them, but before we do so, we need to look at how to make the antenna resonant. Again, I am going to try to make this as simple as possible, to encourage people who have never built an antenna before to do so.

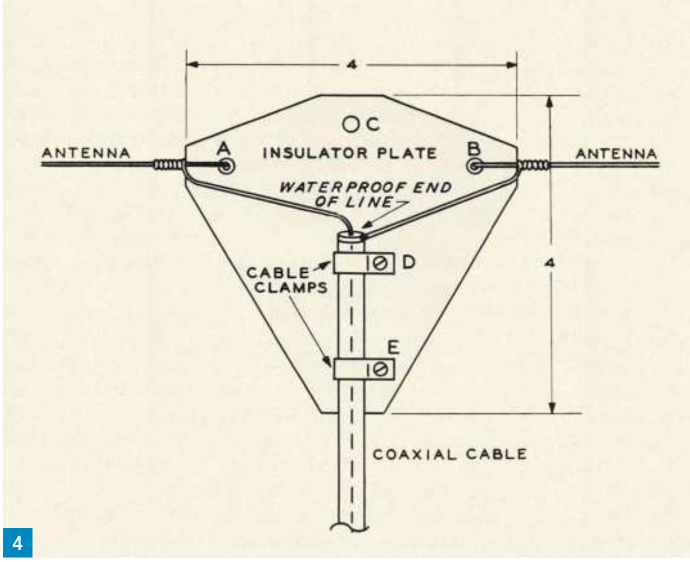
Resonance is a natural phenomenon. Every object has a natural frequency or frequencies at which it is considered resonant. For our simplistic purposes, we can think of this resonant frequency as the point at which the antenna is most efficient.

The resonant frequency is a function of the electrical length of the antenna rather than the physical length but there is an easy relationship (and approximate calculation) for this:

Length of a dipole in feet and inches (1/2 wavelength) = 468 / Frequency (MHz)

And it follows, therefore, that the length of a quarter wave vertical = 234 / Frequency (MHz)

It is actually a little more complicated than this though, but we don't need to worry about this when getting started. Wire covered with insulation actually needs slightly shorter lengths than un-insulated wire. However, for this article we will ignore this – it means that our first 'cut' of the antenna will be longer than we need, and therefore will be resonant at a lower frequency. This is helpful, as we can trim the wire a bit at a time to raise this resonant frequency (and therefore lower the SWR) to a point that suits our needs. It becomes a 'trial and error' process. For the sake of all those new to the hobby, or who



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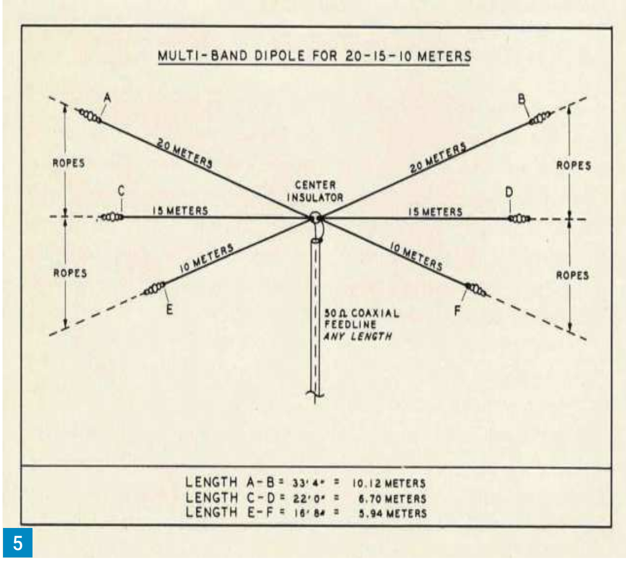

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have no idea of how to go about constructing an antenna, I am going to be quite descriptive, so my apologies to the 'old timers' out there – much of this will be second nature to you.

The Simple Dipole

A dipole is a very basic, but efficient antenna. What does it consist of? Well, it is an antenna that is a half-wavelength long at the desired frequency. It is in two parts, each a quarter of a wavelength long and fed in the middle by, typically, coaxial cable. See diagram, **Fig. 2**. One side of the antenna is one quarter wavelength long and connected to the centre of the coax and the other is the same length and connected to the coax outer. The central connection point is of insulating material and both ends of the dipole are terminated in insulators, often with rope or cord attached to suspend the antenna. Let's build one!

Let us assume we wish to build a dipole for the 40m band. We want it to be resonant in the centre of the band – 7.1MHz. Using the formula, we will start with a length equal to 468/7.1MHz, which gives us an answer of 65.9ft. Let's be practical and cut it for 66ft. Then cut this in half, giving two lengths of 33ft.

Now, let's connect one end of each wire to the coax. You can either choose to spend about £7 on a dipole centre, **Fig. 3**, which is convenient and ready to use, as well as easy to waterproof, or you can make your own using any insulating material such as plastic pipe, a piece of cutting board or similar. An example is shown in diagrammatic form, **Fig. 4**. Just remember that you should provide strain relief for the wire and the coax and protect it from the weather with self-amalgamating tape or liquid electrical tape.

The far ends of the wires need to be attached to insulators, and again you can buy insulators for a little over £1 each, or make them from bits of scrap plastic – 21mm water overflow pipe is ideal. The end of the insulator opposite the wire is attached with cord or rope. I have found that paracord works well for a while but degrades quite quickly. Dacron/polyester cord is better. I use that sold by Mastrant.

Now, and this is important, you are going to need to raise and lower the antenna a few times to alter its physical length, and therefore its resonant frequency. In order to do this, the safest way is not to cut the wire when tuning. Instead, you will fold the wire through the insulator at the ends and alter its length by changing the length that is folded over in increments. As long as you keep the folded-over portion close to, and parallel with, the main wire, it will appear electrically shorter. Remember that the dipole is a balanced antenna, so you should make similar adjustments to both ends to keep them the same physical length.

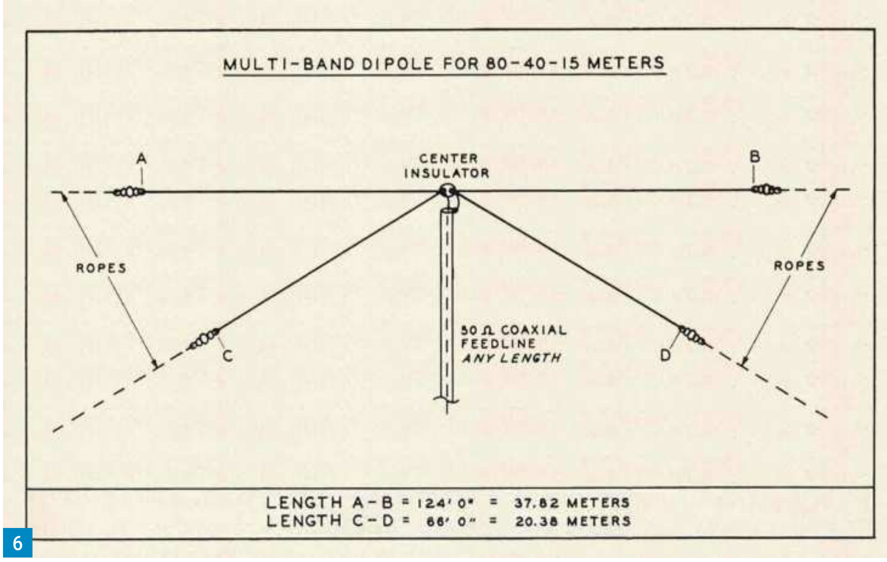
To begin with, fold the ends over the insulator and back on themselves by just an inch or so and use a cable tie to hold it firmly in place. Now raise your dipole to the height it will be when complete and either measure your resonant frequency with an analyser, or check the SWR. Using an analyser (following the manufacturer's instructions) means you do not need to use your rig to transmit and you can determine exactly what the resonant frequency is at any time, allowing you to decide to shorten or lengthen the antenna.

If you are measuring SWR instead, then you will need to transmit on 7.1MHz using a constant carrier (AM, FM or CW tone). In order to protect your rig and not cause undue interference, turn down the power to just a watt or two. In almost every case the initial length will be too long, usually because the insulation on the wire will mean it needs to be shorter than your calculation (research 'velocity factor' if you want to know more). Note down the resonant frequency and/or SWR at 7.1MHz. Repeat SWR measurements at 7.005MHz and at 7.195MHz, again making a note of the measurements.

Now look at your results. If your SWR at the bottom of the band (7.005) is lower than at the mid and high points, then the antenna's resonant frequency is lower than you want and therefore it is a little long. If, on the other hand, the SWR is lower at 7.195MHz than at the low and mid-points, the wire is a little short – you need to hope that you have some spare where you folded over!

Let's assume that, as I predict, your SWR is lower at the bottom of the band. Now lower the antenna. Cut the cable ties at both ends and fold the wire back on itself creating a longer length of tail, and therefore a shorter half of the dipole. Start by shortening both ends this way by a couple of inches. Make sure to keep the folds the same length at each end (roughly.) Raise the antenna again and measure once more. You should see that the resonant frequency has increased, or SWR at the 7.1MHz point has come down, as you have shortened. If not, then shorten some more and measure again. You may need to repeat this process several times. At some stage, you will find that a change will reverse the improvements you have made. When this happens, gradually lengthen the wire again (shorten the folded tails) between the length you have now and the length you had with the previous best reading, until you find the best match to 7.1MHz on your analyser or to your SWR meter. The antenna is now resonant – congratulations!

You can now make your length more per-



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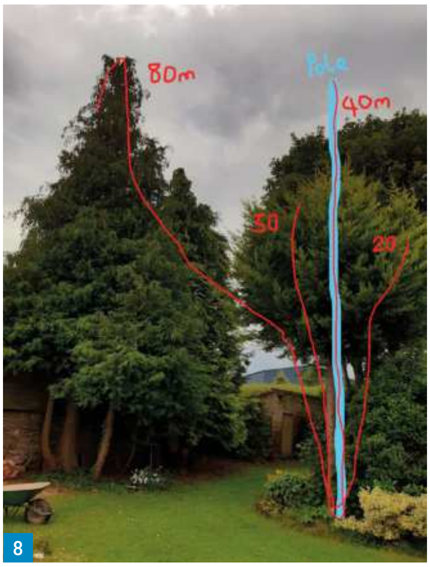

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Fig. 4: Making your own centre piece. Figs. 5 and 6: Fan dipoles with starting dimensions for various bands. Fig. 7: Fixing the author's quarter-wave vertical antenna. Fig. 8: The finished multi-band vertical antenna.

manent. To do this, I recommend that you hold the wire firmly on the insulator, cut the cable tie and take an extra turn around the insulator, so you now have one full turn rather than a half-turn – this will help prevent chafe. Then use two cable ties to tightly hold the tail on itself next to the insulator and cut off the excess. If this is a little wordy, don't be put off, once you have raised and lowered a couple of times you will soon know what to do.

By the way, don't over-exercise yourself on trying to achieve perfect SWR. While it is sometimes possible to achieve 1:1 SWR or very close, often it is not practical for a variety of reasons, including your surroundings, the antenna itself, the feeder, etc. Be happy with anything less than 1.5:1, but try for lower if you can achieve it. Even an SWR anywhere below 2:1 should be safe for your rig. If in doubt, check the specifications, but if you are careful and methodical you should easily be able to get below 1.5 in most cases and this is absolutely fine.

Congratulations you now have two resonant HF antennas! Two? Yes, dipoles are resonant on the fundamental frequency you cut them for and every third harmonic. So, your 7.1MHz dipole will also resonate nicely on 21.3MHz (and probably 6m, 50MHz, too.) Use your analyser or SWR meter to see for yourself, remembering to keep power low while you check *(strictly speaking because of 'end effects', the higher resonance won't be exactly on the third harmonic, but almost certainly close enough for the antenna to be usable on the higher band – **ed**.).*

Now, this is where things get even more interesting! You can use your 40/15m dipole's feedpoint to connect another antenna for another band. Let's say you would also like to operate on 20m. Let us cut dipole elements for 14.15MHz (the approximate centre of that band). Using 468/14.15 gives us an overall length of 33.1ft. Let's call it 33.5 feet for ease (33'6") and divide that by two. That is two lengths of wire 16'9" long. Now solder those two wires onto the dipole centre where the 40m dipole connects to the coax. Remember to provide strain relief. In the same way we did last time, take the other ends and fold them through two new insulators, using cable ties to temporarily secure them. You now have the makings of a 'fan dipole'. The centres of both antennas are electrically and physically connected, and the RF from your radio will automatically take the path of least resistance. In other words, your RF will flow into the correct element like magic. No antenna switching or ATU required! What is important though is that the ends of the antenna are separated. You can achieve this in two ways. Either you can attach the 20m insulators to separate supporting ropes, or you can support these insulators using either non-conductive rope or a stiff plastic spacer between the 20m insulator and the centre of the 40m leg above it. You may wish to experiment with spacing distance, but at least a foot or eighteen inches will help to minimise any negative interaction between elements. In accompanying diagrams from *Simple Low Cost Wire Antennas*, **Figs. 5** and **6**, some starting measurements are given for various bands.

Usually, you would hang the 20m element underneath the 40m one, but you could run it at right angles or some other angle, which would minimise interaction further. You should then follow the same process for tuning the 20m section. You may find that the 40m section needs tuning again, so if you decide a fan dipole is for you, then I recommend cutting and fitting all the elements you intend to use first. Start by trimming the longest element, then the next longest, etc. In theory, there is no limit to the number of other dipoles you could attach in this way, it becomes more of a practical issue. I think three or four elements is a practical number. So, at the moment, for two elements, you now have a resonant dipole for 40, 20 and 15m. Why not add another band of your choice, perhaps 17m, or 30m if you enjoy CW. Adding a band such as 30, 17 or 12m (known as the WARC bands) gives you a place to escape away from busy contests at the weekend if you wish, as these bands are not used for those purposes.

As a final note here, I have deliberately not mentioned baluns at this point, to keep


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Fig. 9: BNC terminal post adapter.
Fig. 10: End-fed Zepp (W3EDP) antenna.

things simple. I will describe what one is and leave it for you to decide if you wish to use one for a dipole. I personally do not. A balun is a BALanced to UNbalanced transformer and sits next to the dipole centre, in fact it often acts as the centre insulator. It matches the balanced nature of the dipole to the unbalanced nature of your coax cable. Purists would insist on one and you can either buy them or make them. Use one if you wish, but to encourage you to make your first antenna, I suggest thinking about that as a possible later enhancement.

There are two further variations on the dipole antenna you may wish to consider, which produce a multi-band antenna. Space prevents me going into detail here, but I recommend you enter the terms *"trapped dipole", "linked dipole"* and *"doublet"* into your favourite internet search engine to explore these further. All three types of antenna are cheap and easy to make. The trapped dipole is perhaps the most complex of the three, requiring the insertion of tuned circuits or traps to allow multi-band use. The linked dipole is a variation of the fan dipole we examined earlier, but requires you to physically alter its length when you want to change band, and the doublet requires a suitable ATU.

A Multi-Band Quarter Wave Vertical Ground-Plane

In the same way that we built the fan dipole, we can build a fan vertical antenna. In fact I have a fan vertical at home covering 80, 40, 30, 20 and 15m that cost me less than £50 to make and works very well.

A quarter wave vertical element, as we saw earlier, is calculated roughly by the formula 234/(frequency in MHz). The vertical element connects to the centre core of the coax. We need to provide something to connect the outer of the coax to. For this we use radials. Radials are lengths of wire that form the 'other half' of the antenna (when compared to a dipole, for example). They effectively provide a ground-plane. Now if the base of the vertical element is at ground level, the radials will be laying on, or just underneath the ground. In this case, their length is not important, they are de-tuned and do not need to be resonant. If you raise your base of the vertical, perhaps to your eaves, then the length is more important to get a good match. Roughly speaking the best results are achieved in this scenario with three or four radials, slightly more (typically 5 to 10%) than a quarter-wave long and sloping downwards at 30 to 45°. However, for this article I am focussing on a ground mounted antenna.

The first step is to decide where to put it, perhaps bearing in mind the new EMF requirements. Mine is at the base of a conifer tree. The conifer supports the vertical mast. When the location is known, next place some radials. These can be any number and any length. Just put down as many as you can. Many say that there is a law of diminishing returns beyond about 16. I personally use 16, but when I am portable only use four and still get good results. In my own case I cut four radial wires 10m long and 12 wires 5m long. I used thin insulated wire and stripped back insulation from one end. I then cut a length of solid copper electrical wire from house wiring, four feet long. I attached one end of each radial at regular intervals along the four feet and soldered them. I went to the base of my conifer and lay the radials on the ground. I then brought the two ends of solid wire together around the base of the tree. This formed a ring of copper wire around the base. I then separated the radials in a star pattern and used a garden edging tool to slit the grass a centimetre or so deep and pushed the wire into the slit. My radial bed was complete.

Next, I needed a vertical support. The conifer was only about 5m high, so I bought a 10m fishing pole online for about £40. I extended this firmly and wrapped each junction with insulating tape to prevent it collapsing under its own weight. To fix it to the tree I simply rested the its base on a small slab, and screwed two lengths of heavy galvanised builders strapping to the trunk at about 2 and 5ft high. I then used strong cable ties through the holes and around the pole, **Fig. 7**.

Using my NanoVNA I added a quarter wavelength (about 10m) of insulated wire to the top of the pole, loosely winding it downwards in a spiral around the pole, trimming for resonance. The use of a waterproof box, some terminal posts and ring terminals allowed me to provide an enclosure where I could terminate my coax and keep it dry, while providing an easy way to connect antenna elements.

I then decided, over a period of time to add additional bands, and the element for each of these extra bands was added to the same feedpoint at the base of the antenna, but like the fan dipole, I needed to separate them on their vertical journey. To do this, I used the bushy nature of the tree and an adjacent tree for support. I used my 3D printer to print some plastic hooks, which doubled as end insulators, then hooked these over appropriate tree branches. I have taken a photograph of the general arrangement to show how this works, and have had to roughly draw on the elements in red to be seen, **Fig. 8**. This antenna is a really good performer and ideal for limited spaces, as well as being easy to hide.

You can buy the commercial equivalent of antennas like this, and the DX Commander has good reviews at about £200. Mine cost me about £50 to make. If you have some parts to hand, such as spare wire, etc, then it could be cheaper. Of course, if the tree you use is high enough, you could dispense with the fishing pole and save £40! I did have trees I could use for that but not in a location where I could evenly spread the radials around the base, which is something I wanted to do, but is not essential. Just use what you have.

In this arrangement, you can use an antenna analyser to trim the vertical element to length, or use your SWR meter as we saw in the dipole example. Remember though that you only need to trim the vertical element to achieve resonance.

A Full-Wave Loop Antenna

There are a number of variations of the full-wave loop antenna. A popular one is the Delta Loop, which is a triangular shape. In the case of a full-wave loop, the impedance presented at the feedpoint is around 100Ω. There are two key options here. If you wish to use the Delta Loop on a single band, let's say 40m, then you can feed it with a quarter wavelength length of 75Ω coaxial cable (this is an electrical quarter-wave, taking velocity factor of the cable into account, and is used to transform the 100Ω of the antenna down to 50Ω), which then connects to the 50Ω cable (any length) back to your rig. By trimming the overall length of the loop as we described earlier, you will achieve a resonant 40m antenna. However, if you use a 4:1 balun at the feedpoint and an ATU in your shack, with 50Ω ohm coax in between, you will have an effective multi-band antenna for 40-10m. In this case, you would trim the antenna overall length for the lowest band only (40m).

In order to save space here, and allow me to examine a few more simple antennas, I do not intend to go into more detail on how to build one. The principle of trimming for resonance we have learned with the basic dipole applies to all our antennas. Instead, I will signpost you to some excellent resources if you wish to build a full-wave Delta Loop. The details of a single band 20m Delta Loop, along with a handy length-calculator can be found here:

https://tinyurl.com/7pr42zb6

and there is an excellent description of how to build a 40-10m Delta Loop here:

https://tinyurl.com/d6y5z4e8

The End Fed Half Wave Antenna (EFHW)

I really like End Fed Half Wave (EFHW) antennas, which are efficient and convenient. I have covered them before in my *Using End-Fed Half Wave Antennas* article in *PW* February 2020. There is also a presentation that I gave to my local Taunton club on the subject on my website for download at:

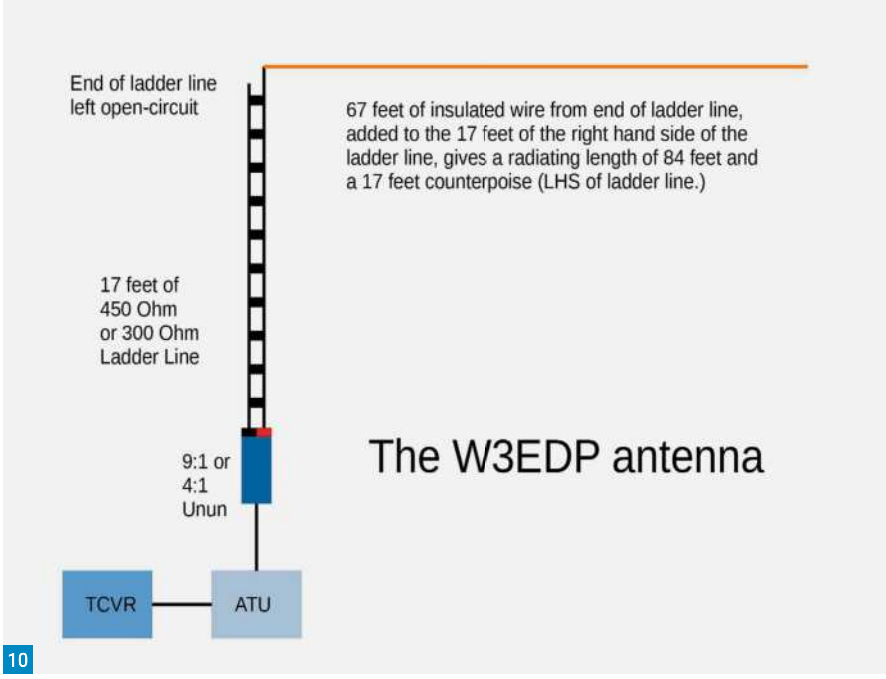
https://tinyurl.com/h5zej7b4

In this case we have an antenna capable of multi-band operation. As the name implies, they are typically a half-wavelength long at the lowest frequency they are to be used, and fed at one end. This makes them very convenient and they can be used in a variety of formats, such as inverted-L, inverted-V or sloper. Due to their characteristics, they present a very high impedance at the feedpoint, of the order of 2,500Ω or so, and as such are fed with coax via a transformer, usually either 49:1 or 64:1. One great bonus of such an antenna is that, unlike a dipole, which we have seen is resonant on every third harmonic, EFHWs are resonant on every harmonic. At home I have one cut for 80m, which is about 136ft long, and which, via its homebrew 49:1 transformer, gives me excellent SWR (below 1.5:1) on 80m, 60m, 40m, 30m, 20m and 15m. SWR on 17m, 12m and even 6m is below 2.5:1 and within the range of most ATUs. However, having access to a Spiderbeam Yagi for 20m and up, I use the EFHW as an alternative to my vertical on the low bands only.

Not everyone is blessed with a large garden of course. But an EFHW cut for 40m is only 20m (66ft) long, and if that is fed near ground level, run up a 10m fishing pole vertically (or the side of the house) and then horizontally for 10m, it becomes a quite compact multi-band antenna and will not need an ATU on its harmonics.

By the way, don't be too concerned about having to run things in a straight line if you can't achieve it. Dipoles and EFHWs both have their maximum radiation occur in the centre of their length. Having this point as high and in the clear as you can will serve you well. If you need to zig-zag the rest to fit it into your space, then do so. It will still work.

Due to their growing popularity it is possible to buy such an antenna if you are not confident to build them, and a glance in a recent magazine shows very affordable ones available at Moonraker, with an 80m version, complete with wire and transformer for £44.95 and a 40m version for just £40. I made mine from scratch, including the transformer, but actually at this price, they seem excellent value, although I cannot vouch for their quality as I haven't seen or tried one.



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A Non-Resonant HF Wire Antenna

Let's finish with a practical and versatile antenna for any space and just about any band. A simple long-wire antenna has to be one of the most straightforward around. It is just a length of wire and is sometimes called a 'random wire' or 'random end-fed' antenna.

In fact, random is the last thing it should be! To make an end-fed wire like this as versatile as possible, you should try to avoid certain lengths, such as a length that is in anyway resonant or harmonically resonant on any of the bands you operate on. So, for example, if you want to make an end-fed wire for 40m, you would want to avoid a wire length that was resonant on 80m.

If that sounds complicated, take a deep breath, because others have done the hard work and calculations for you! Here is a good article that will explain things:

https://tinyurl.com/28hjscf5

Continued on page 62

Coaxial Cable

Tony Jones G7ETW unravels the mysteries of coaxial cable.

Tony Jones G7ETW
charles.jones125@yahoo.co.uk

I didn't set out to write a piece about coax. J-Poles and Slim Jims, and how these are harder to get working than websites claim – for the simple reason that the websites seldom take cable characteristics properly into account – was my aim, but so much useful information came out of my findings-out I thought I'd better get that down on paper first.

Characteristic Impedance

See **Fig. 1**. This shows how coax – two insulated conductors on the same centre, hence 'co-axial' – is constructed. E, the dielectric constant, is defined as an insulator's ability to store charge and is expressed relative to that of dry air. Polythene, commonly used in coax, has a value of 1.6.

Any type of coax has its own characteristic impedance Z_f, which is a constant determined purely by the physicality of the coax. The formula is:

Z_f = (138 times square root of E) times log (base 10) (R divided by r)

Now I like radio maths, but that is a bit daunting. I'd have great difficulty measuring R and r with any precision, and as for measuring E, I'd have no idea.

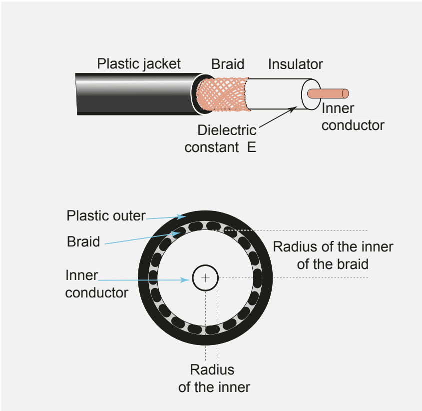
There is an approximation that is much easier to use:

Z_f = square root of (L divided by C)

I have an Atlas Peak LCR meter so I took 1.5m of RG58 and took some measurements as shown in **Fig. 2**. Plugging my values (0.3μH and 125pF) into the equation gave me 48.98Ω, which is amazingly close to the expected 50Ω.

I discussed this with a friend of mine and, somewhat sceptical, he did some testing with his Atlas LCR meter. He observed that while capacitance scales nicely with cable length, inductance doesn't.

So, I tried again with some 75Ω coax. See **Table 1**. My results were no better on short cables but with nearly a 100m reel I got a result of 74Ω, again very respectable. Conclusion: the method works, but an Atlas LCR meter, presented with very small inductances, isn't accurate.



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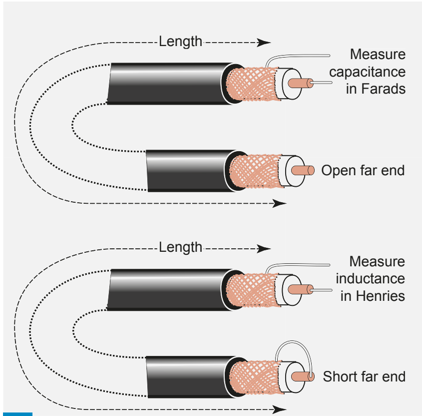

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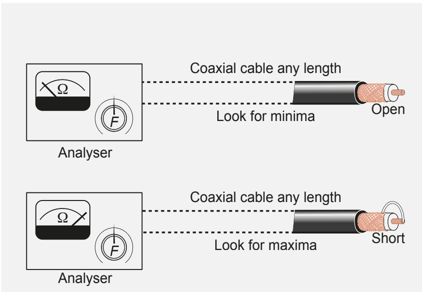

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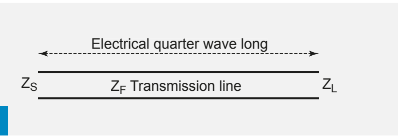

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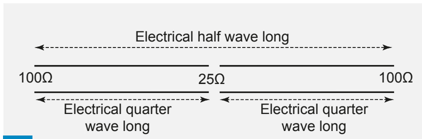

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Fig. 1: Coaxial cable construction.
Fig. 2: Measuring coaxial cable characteristics.
Fig. 3: Looking at the effects of velocity factor.
Fig. 4: Using a quarter wave stub as an impedance transformer.
Fig. 5: Two quarter waves back to back take you back to where you started.

Why do we use 50 Ohms?

The usual reason given for 50Ω coax being 'standard' is that it matches to a dipole whose theoretical impedance at resonance is 73Ω. Well yes, but surely 75Ω cable would do even better – not to mention that it's rare in practice for a dipole to be anywhere near 73Ω!

Early coax had an impedance of 30Ω. This was found to be the optimum for power transfer. But 77Ω cable had lower loss, especially as the frequency went up, so a compromise was sought and 50Ω – the geometric mean (square root of 30 × 77, approximately) – was chosen.

Coax is available today as 50, 62, 75, 93 and 100Ω so we could spread our wings a little if we chose. Later I will show why we might want to do that.

Velocity Factor

In a vacuum, light travels at 299,792,458 metres per second. (Precisely that speed – the metre is defined to make this true.) When it passes through a material such as glass, it slows down – 'refractive index' we call this. When radio waves travel in coax, the same thing happens but we call this 'velocity factor'.

Coax manufacturers quote, among other technical details, velocity factor – see **Table 2** (whose data mainly came from the *Radio Communication Handbook* 13th edition with a little help from Farnell's Belden product offerings). When connecting a feeder to an antenna most people (including me, before I'd really thought about this) never give this a first, never mind a second thought. But coax length does matter. I shall explain.

For coax, a quarter-wavelength and a half-wavelength are special cases. One wavelength (using the usual rounded 300,000,000m/s figure for the speed of light) for 37.5MHz is 8m, and 2m is a quarter-wave. An RG58 cable cut to 1.3m is a 'velocity-factor adjusted' or 'electrical' quarter wave for this frequency.

Length (m)	Capacitance(pF)	Inductance(µH)
1.5	84.9	0.3 or 0.2 (alternating readings)
3	173	0.6 or 0.7 (0.7 slightly more often)
Most of a reel	4619	25.8

Table 1: – 75Ω Satellite TV cable Capacitance and Inductance readings

F(MHz)	λ(m)	λ/4(m)	λ/4 (electrical)	n(λ/4) (electrical)
37.5	8.00	2.00	1.30	1.00
112.5	2.67	0.67	0.43	3.00
187.5	1.60	0.40	0.26	5.00

Table 3: – RG58 coaxial cable, VF = 0.65, Length = 1.3m

			Loss @ MHz				
Cable	Z0(Ω)	VF°	10	100	144¶	432§	1000
RG16/U	52	0.67	0.4	1.2	1.4	2.5	6.7
RG174	50	0.66	3.3	8.4	10.1	17.4	34.0
RG213/U	50	0.66	0.6	1.9	2.3	3.9	8.0
RG316	50	0.695	2.7	8.3	10.0	17.2	28.6
RG58/U	53.5	0.659	1.3	4.7	5.6	9.7	17.5
RG59/U	75	0.659	1.1	3.4	4.1	7.1	12.0
RG6/U	75	0.659	0.8	2.9	3.5	6.0	11.2
RG62/U	93	0.84	0.9	2.7	3.2	5.6	8.6
RG8/U	50	0.659	0.6	2.0	2.4	4.2	8.0
MINI 8*	50	0.8	1.0	3.2	3.8	6.6	11.3
UR70	75	0.66	0.5	1.5	1.8	3.1	5.2
Westflex 103	50	0.85	0.3	0.9	1.0	1.8	2.7

° VF Velocity Factor (has no units) § Approximate Loss at 432MHz (based on 100MHz)
* MINI 8 data is calculated from Nevada Radio's quoted 10.5dB per 100m at 100MHz
¶ Approximate Loss at 144MHz (based on 100MHz)

Table 2: – Cable details, losses given in dB per 100 ft

F(MHz)	λ(m)	λ/4(m)	λ/4 (electrical)	n(λ/4) (electrical)
12.5	24.0	6.0	3.90	1.0
37.5	8.00	2.0	1.30	3.0
62.5	4.80	1.20	0.78	5.0
87.5	3.43	0.86	0.56	7.0
112.5	2.67	0.67	0.43	9.0
137.5	2.18	0.55	0.35	11.0
162.5	1.85	0.46	0.30	13.0
187.5	1.60	0.40	0.26	15.0

Table 4: – RG58 coaxial cable, VF = 0.65, Length = 3.9m

ZF(Ω)	ZL(Ω)	ZS(Ω)	VSWR
50	100	25.00	2.0:1
50	25	100.0	2.0:1
75	100	56.25	1.33:1
75	25	225.0	3.00:1

Table 5: – Effect of a quarter-wave transformer

A quarter-wave 'stub' exhibits these characteristics:

- An open circuit at the far end 'looks like' a short circuit 'this end'
- A short circuit (far end) looks like an open circuit
- A known Impedance (far end) is 'flipped' around the characteristic impedance and transformed into a related but different value

Anyone with an antenna analyser can see the effects of velocity factor and measure it. See **Fig. 3**.

Cut a length of coax, connect this to an analyser and tune up from 'DC' looking for impedance dips. These will be very clear. 0 + j0 Ohms at first. As the frequency rises the dips will spread a little but they will be discernible.

Short the far end of the coax keeping the flying leads short. Starting from a low frequency again, look for very high impedances. The peaks are less well defined, but with some 'experimenter's interpretation' they are indicative enough. These should be seen on or very close to the same frequencies as before.

I used a 1.3m length of RG58, and my first quarter-wave zero impedance was found at 37.5MHz. Others were seen at 112.5, 187.5 and 262.5MHz. **Table 3** shows why.

The formula is V_f = cable length times 4 divided by wavelength.

For my RG58, this gave me 1.3 times 4 divided by 8, which is 0.65, very close to the usual quoted 0.66.

What if I'd used a longer cable? See **Table 4**. This cable is long enough to be a quarter wave at a harmonically related lower frequency. If I'd calculated velocity factor based on 37.5MHz, it would be wrong. It's very important to identify the fundamental frequency a length of coax is a quarter wave for.

Quarter-Wave Stub as Transformer

In understanding the open-to-short circuit and vice versa transformations the cable's 'characteristic impedance' can be ignored, but when a length of cable is being used as a transformer (deliberately or not!) the impedance controls things.

See **Fig. 4**. The formula is Z_s divided by Z_f = Z_f divided by Z_l.

This rearranges to Z_s = Z_f squared divided by Z_l.

See **Table 5**. 'Normal' 50Ω feeder has little effect – a radio looking in sees different (related) impedances, but the VSWR does not change. Using a 75Ω transformer, it would. I've seen this technique used in matching HF quads and VHF Yagis – designers splice some 'alien' coax into a 50Ω line. Given the range of available coax types, this is a useful tuning tool. (Although, rather like using an ATU, it doesn't actually 'tune' anything).

Half-wave Stubs

This is all very well, but an electrical quarter wave is not ideal for testing an antenna because it clearly changes things. On my analyser I want to see the truth, and for that I need a cable length that manifests a load's impedance faithfully.

See **Fig. 5**, which shows two quarter-waves back-to-back. Each acts as a transformer, but two cancel each other out. When the Radio Society of Harrow erected its Cobweb antenna the club's antenna maven brought along a bag of specially-cut half-wave feeders to ensure we got accurate readings.

A quarter-wave on one frequency is a half-wave on twice that frequency, so 1.3m of RG58 is one velocity-adjusted half-wave on 75MHz, two of these on 150MHz and three on 222.5MHz. Electrical quarter-waves go up in odd numbers; half-waves are sequential.

How does Loss Vary with Frequency?

Information on this complicated subject is scarce but in his book *Transmission Lines Explained* **Mike Parkin G0JMI** tells us: *"At radio frequencies, the loop resistance loss is a function of skin-effect because this determines the effective area of the conductor carrying the RF current"*.

There is a well-known formula for loss –

Parkin correctly calls it an approximation – which is:

Loss at Frequency 1 / Loss at Frequency 2 = Square root of (Frequency 1 divided by Frequency 2)

Table 2 shows – quelle surprise – that cables are less lossy at lower frequencies. This square root relationship means that a cable's loss at 1GHz should be 3.16 times that at 100MHz, and so it approximately is. This looks odd because applying a 3.16 ratio of anything else would be achieved by adding exactly 5dB, but that is how loss and frequency seem to work.

I extrapolated from 100MHz to get loss figures for 2m (multiply by 1.2) and 70cm (multiply the 2m loss by 1.73). It was a sobering moment; I doubt I shall use RG58 above HF ever again!

RG58, RG213 and Westflex are enduring popular coax choices but take a good look at the others. Admittedly I have never seen RG16 on sale, but this 50Ω cable gives Westflex a run for its money – on paper at least! And RG8 Mini, which some people tell me they're using instead of RG213, does look quite reasonable (well, up to VHF). As for RG174 and RG316, enough said, I think!

To determine loss yourself, take some power readings. See **Fig. 6**. In this made-up scenario only half of the 40W available is being transmitted, yet the cable loss is a respectable 1.5dB per 100ft. But that's a long coax run for a UK garden. I'd build a shed nearer to the antenna, myself!

I'd need to learn a lot more before trying to sound like an expert; this radio topic is pretty complicated. In the meantime I thank *Wireless World* magazine for this simple explanation: *Cable loss consists of conductor wire loss, insulation loss and connector loss. Conductor loss relates to the square root of frequency, insulation loss relates to frequency and connector loss relates to connectors used in the cable*.

This is their actual formula:

Coax loss (dB per 100ft) = (k1 times sqrt of F) + (k2 times F) where k1 and k2 are constants. Please visit *Wireless World's* website for more detail:

https://tinyurl.com/yfvmfb8c

Conclusion

I hope readers find this of interest and use; I certainly feel that I understand coax much better, and that knowledge is already helping me practically. Much of what's here applies equally well to parallel-wire 'open' feeders, but I limited myself to coax to keep the article short. Open feeder's idiosyncrasies I will address in my J-Pole article.

Continued from page 59

but to save you some effort, good lengths of wire for such an antenna are (in feet) 29, 35.5, 41, 58, 71, 84, 107, 119, 148, 203, 347, 407, 423. Not so 'random' after all! Bear in mind, though, that the longer the wire, the lower the band you will be able to tune. For example, tuning a 29ft wire for 80m, while not impossible, is beyond most tuners, but they may well be able to tune it at 40m and higher.

Work out what will fit in your plot, and again don't be too worried about zig-zagging, just get as much wire as high in the air as possible. By the way, there is no need to trim these antennas for SWR by adjusting their length any further, so some of the dark art has been removed for you here!

How you feed that antenna depends on your rig and ATU. Many modern rigs with in-built ATUs will struggle to match the impedance of a long-wire. However, my Xiegu X5105 and G90 rigs ATUs do so beautifully well just by connecting the wire to the centre pin of the coax connector and a short counterpoise of around 5m to the outer of the coax connector. I do this by using a BNC terminal post adapter, **Fig 9**, which are very cheap. This is fine for QRP use.

However, if you are using a rig from Kenwood, Yaesu or Icom etc. with a built-in ATU they may not be able to provide a match, as they are mostly designed to just 'touch-up' tune resonant antennas at band edges etc. In this case, use is often made of a 9:1 UnUn or transformer. You can make or buy one of these. This allows your 50Ω coax cable (Un-balanced) to connect to one side of the balun and the wire (Un-balanced) to the other, hence the term UnUn. By doing this, the balun acts as a matching transformer, bringing the overall impedance of the antenna closer to the matching range of the ATU in your rig.

If using more than 20W or so, and certainly at 100W, you need to take a little more care on siting of the antenna, as having the feedpoint close to the house or shack could lead to RFI problems. Again, some form of ground or counterpoise at the antenna feedpoint will be required. You can experiment here with different lengths of a single counterpoise wire laid or buried in the ground. A bed of radials at the feedpoint, as with the vertical antenna, would be effective, for example.

A tried and tested variation of the end-fed wire is the W3EDP antenna, sometimes known as the end-fed Zepp (from their use on the Zeppelin airships) or Marconi antenna. This is ridiculously simple and cheap to make, consisting of a 9:1 or 4:1 UnUn, 17ft of ladder line (450 or 300Ω) and 67ft of insulated wire. The diagram, **Fig. 10**, shows how this goes together and most internal ATUs on modern rigs will be capable of tuning this from 80m to 10m with no problems at all. Xiegu and Elecraft owners will find the UnUn is not needed as their ATUs are very effective.

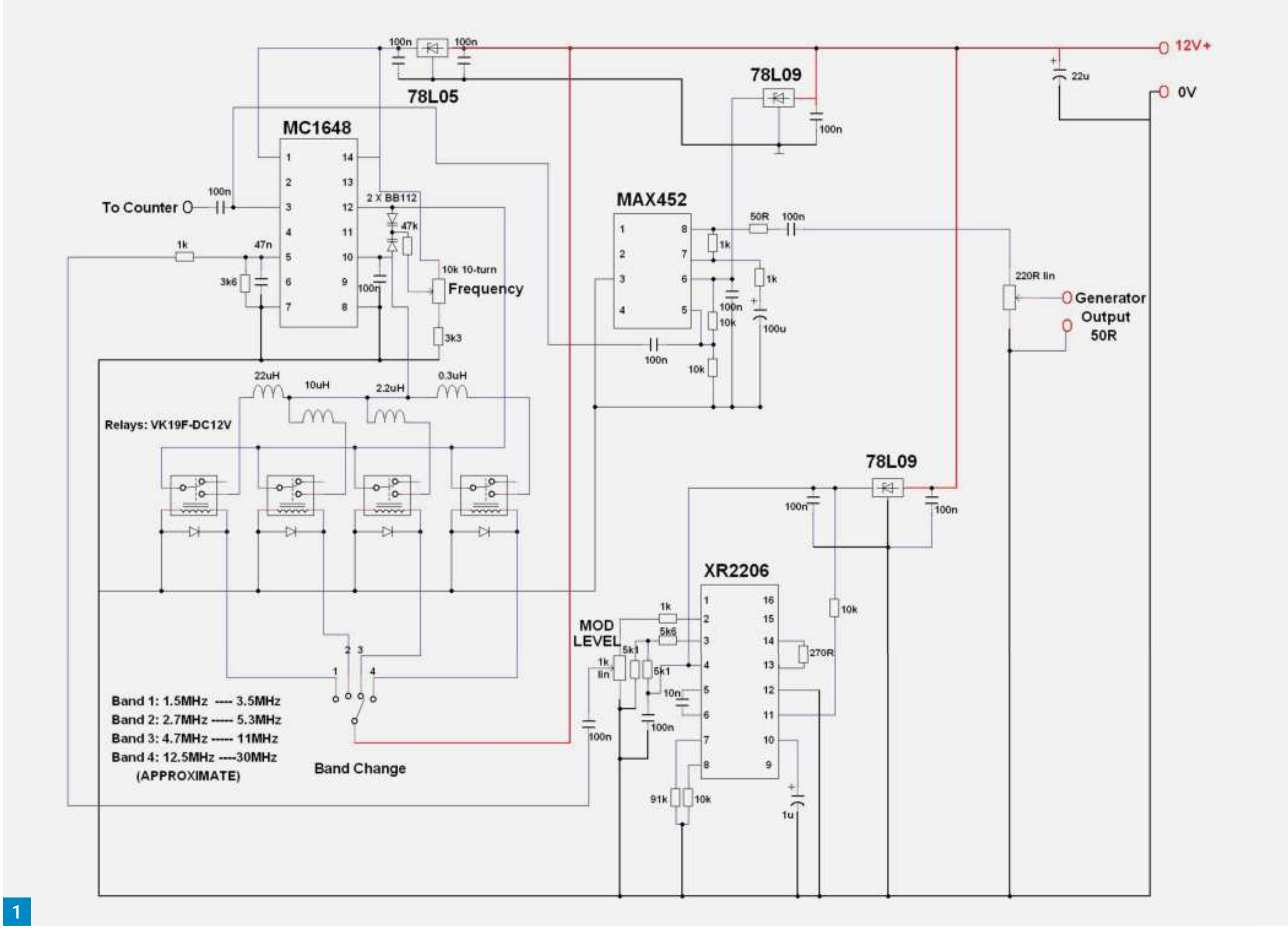
One of the benefits of this antenna, apart from its simplicity, is the fact that no additional radials or counterpoises are necessary. That function is performed by the open side of the ladder line, so there is no need to lay or bury radials on or in the ground. This also lends itself well to shacks on upper floors of properties. By the way, don't feel constrained that the vertical and horizontal sections have to be thus either. It would be fine to slope these, or allow the far end of the radiator to slope down to ground in inverted-V fashion. I actually used one of these dangling vertically downwards from a very high hotel window in Germany once! They say a picture paints a thousand words so my diagram should make all this clear. Those of you still awake will have noticed that 87ft of radiating wire is not one of the lengths suggested in the earlier paragraph, but it is the length people use. Now you are an accomplished antenna experimenter, why not experiment with this and vary this length and see what happens?

Summary

This has been one of my longest *On a Budget* instalments, but it is written in the fervent desire that if you have never built an antenna before, after reading this you will.

I sincerely hope that I have demonstrated just how easy and simple it is to build cheap, easy, effective wire antennas, and have fun in the process. Believe me when I say that there is nothing more satisfying in this hobby than making contacts with something you built yourself.

Hopefully I have given you enough basic knowledge and antenna ideas that you will be heading out for the workshop right now. If you feel confident to tackle adjustments to make an antenna resonant, then a good place to start is a simple dipole or vertical for a single band. If even that frightens you, and you have an ATU either in-built or separate, buy or build a 4:1 or 9:1 UnUn and make the W3EDP where you just need to cut everything to the stated length and not worry about trimming anything other than your ATU. Whatever you do, please have a go, enjoy, and drop our Editor a line with how you got on. Good luck!



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An HF Signal Generator

Eric Edwards GW8LJJ describes how to build a useful piece of test equipment for the shack.

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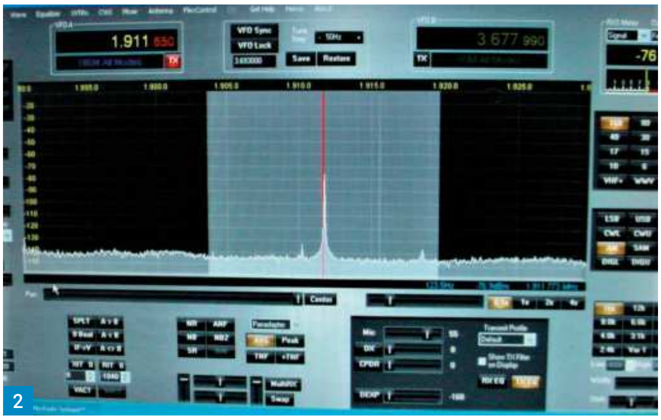
Signal generators for testing and aligning HF radio receivers are available commercially and on the second-hand market. Some of these are expensive but some are available at reasonable cost depending on the complexity and age of the unit. Most have adjustable attenuators both as variable and switched, normally shown in dB (Decibel) settings. Some have a useful audio generator built-in that can be used to modulate the RF signal provided by the generator.

The Project

However, why not build your own? This is a signal generator that covers frequencies from 1MHz to 30MHz in four switched bands. The first of these starts at 1.55MHz and ends at 3.55MHz, so it covers the 160m (top) band. The second band covers from 2.77MHz to 5.33MHz so including the 80m band. Band three starts at 4.78MHz and ends at 11.9MHz so it covers the 60m and 40m bands. The fourth position of the bandswitch starts at 12MHz and ends at 30MHz. This covers the 20, 17, 15, 12 and 10m bands. This is the coverage of my unit but because there are variations in tolerances of the components this may not be exactly the same as another one built, but it will be very near.

The Circuit Description

The circuit is shown in **Fig. 1**. While this is not a precision signal generator it performs very well considering its simplicity in design. It has been kept as simple as possible and consequently it is not in competition with commercially available generators. The 'active' components are integrated circuits (ICs), and the oscillator IC contains several transistors on one substrate thereby keeping the same temperature and other properties among all the transistors in the chip. This reduces frequency drift normally caused by variations in temperature using separate single components. The output of the oscillator is connected to a wide (frequency) band op-amp (operational amplifier) to provide unity gain (gain of 1) at 50Ω impedance from a continuously variable level of 1V (approx) to zero volts output. The output is a 'clean' signal as seen in **Fig. 2**. The modulation is provided by a waveform generator IC (XR2206) set to produce a 1kHz (approx) sinewave. This provides amplitude modulation depth from zero to over 100% with a 1kΩ linear potentiometer (pot). **Fig. 3** shows the



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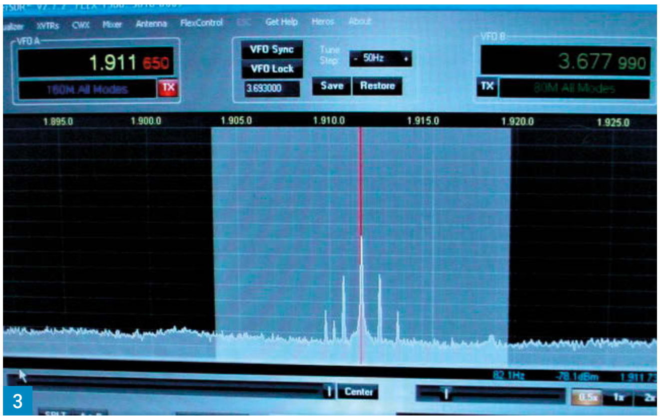

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Fig. 1: The circuit
Fig. 2: The clean output signal.
Fig. 3: The output with modulation applied.
Fig. 4: Using a varicap for tuning, with a blocking capacitor. Fig. 5: The fixed blocking capacitor replaced with a second varicap.
Fig. 6: The PCB. Fig. 7: The completed project.

signal with amplitude modulation and it is displaying the signal at the centre with the lower and upper sidebands, which is the result of modulation, but only one 1kHz signal will be heard on a receiver tuned to the generator's 'carrier' signal.

Amplitude Modulation (AM)

The two larger signals seen either side of the main (largest) signal are the sidebands created by the modulation and are the effect of non-linear mixing, which applies when the current flowing is not proportional to the voltage. In other words, the current does not increase or decrease at the same rate or proportion as the voltage.

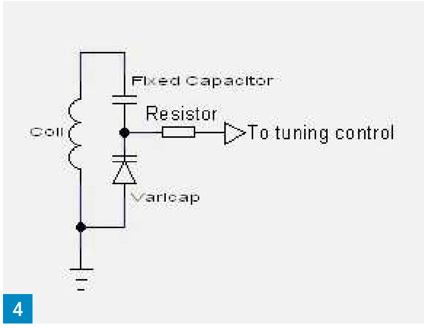
Linear mixing is the result of a resistor connected to a load where as the voltage increases, so does the current in proportion. For example, if the current through the resistor is 1A when the voltage is 10V, it will be 2A when the voltage is 20V. Double the voltage, double the current. This is called 'square law' as the power is squared when the voltage is doubled.

Non-linear mixing happens when using semiconductors (and thermionic valves) as the mixing media, because current through a semiconductor does not follow that rule when they are used as mixers.

AM is similar to producing an IF (intermediate frequency) in a superhet receiver. The incoming signal (off-air) mixed with a local oscillator (LO) produces another two signals. One is the difference of the two input signals and the other is the product of the two. Let's take an example: an incoming signal is 3600kHz (3.6MHz) and the local oscillator is set to 3145kHz (3.145MHz). The output of the mixer will be two other signals. One will be 455kHz (the difference) and the other will be 6745kHz (6.745MHz), the product. An IF transformer will be tuned to accept the wanted frequency of 455kHz and reject the unwanted, much higher, 6745kHz frequency. Intermediate is another term for Difference. In modulation terms. The difference is the lower sideband and the product is the upper sideband. Looking again at the two off-screen photos, Figs. 2 and 3, you will have noticed that the modulation does not increase the carrier (main signal) of an AM transmitter, as was believed in the 'old' days. The carrier is at the same amplitude with or without modulation. The modulated signal from the generator will be an audio note of 1kHz as it is the difference between the main carrier and the sideband. If it were received on an SSB receiver, it would be audible on either of the sidebands tuned to the centre frequency and switched to upper or lower sideband.

The Oscillator

Many commercial signal generators have separate oscillators and filters for each of the bands. This project has one oscillator and no filters. The oscillator used is an MC1648 integrated circuit and consists of a bank of transistors. The MC1648 was designed for use in the Motorola Phase–Locked Loop, but it can be used in many other applications requiring a fixed or variable frequency clock source of high spectral purity. In this design it is used as an LC (inductor/capacitor) oscillator. The device is 14-pin DIL (Dual in Line) powered from a 5V supply, which in this case is a 78L05 regulator. The oscillators for the four bands are supplied by fixed inductors (coils) and a variable resistor (10kΩ linear). The coils are switched using relays because



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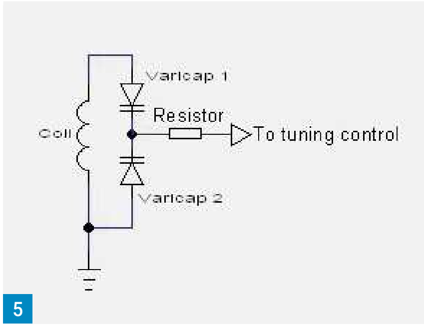

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this gives good positive connections, and are connected across pins 10 and 12 of the IC.

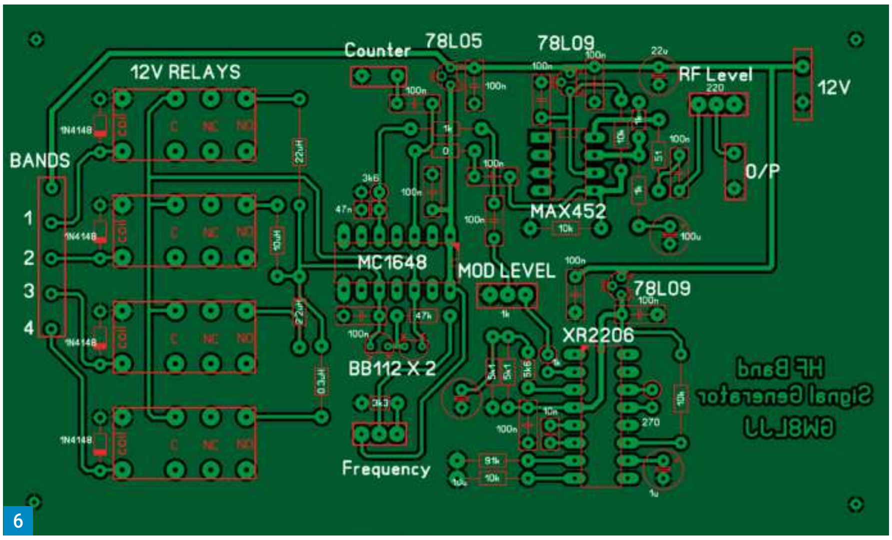
Tuning is by the use of varicap, also called 'varactor' (variable capacitance), diodes and the 10kΩ pot, preferably a multi-turn type, or a single turn with a slow-motion drive. A common way is to use one varicap and a fixed capacitor for DC blocking, **Fig. 4**, which is used to prevent the DC from going to ground through the coil. The resistor is a high resistance value that is used to provide good isolation from the circuit. If a low value is used, it will 'load' the oscillator circuit. The diode is reverse biased and very little current will flow, so a high value resistor will still provide the required voltage. Two varicaps, back-to-back are used in this circuit, **Fig. 5**, to provide the tuning. Varicap 1 replaces the usual fixed capacitor and is wired in reverse to the other so the cathodes are connected together. The reason for using two varicaps is because of the series capacitance affect. If one capacitor is fixed as in Fig. 4, when the voltage varies the varicap capacitance the resulting series capacitance will not be linear. Using two varicaps, the series capacitance will vary in a linear way, thereby having an equal capacitance value across the coil top and bottom.

Let's look at that again. If the capacitance of the fixed capacitor is 100nF and the varicap has its voltage set so it is 100pF, the total capacitance across the coil is 99.1pF. If the fixed capacitor is 10nF, the total capacitance is 99.01pF. If the varicap capacitance is changed to 50pF the total capacitance across the coil is 49.97pF when a 100nF is used as the fixed capacitor and it is 49.75pF when a 10nF fixed capacitor is used. You can see that the fixed capacitor has little effect and is only used as a DC block. Using the two varicaps, they both change at the same rate so when the voltage changes the capacitance value to say, 100pF, both will have that value and the capacitance is now 50pF across the coil. Consequently, when the voltage changes the capacitance value to 20pF, both will be the same value and the combined capacitance will be 10pF.

NOTE: Most of these chips are now available as clones, as they are no longer manufactured. These work but may not be to the full specifications as the original. I have several here that I have sorted to be useful in this design, albeit I had to throw away some I had from the usual online 'auction' sites. It is for this reason I have used on several occasions throughout this description the term 'approximate'. Those I have selected are not exactly the same in output level. Some may be lower than 1V overall or as the frequency is increased. This will not be much lower, however, and a typical example of full power out may be about 900mV instead of the 1V (1000mV). This should not, though, prove to be a problem.

Modulation

Another old integrated circuit is used for the audio signal generation for the signal generator. The device used is an XR-2206, which is a monolithic function generator IC capable of producing high quality sine, square, triangle, ramp, and pulse waveforms of high-stability and accuracy. It is used as a sinewave oscillator for this project. The audio frequency is set at about 1kHz and can be altered by changing the value of capacitor fitted across pins 5 and 6 or by changing the value of the resistor on either pin 7 or pin 8. The formula for this is F = 1/RC (Hz).



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The power supply for this part of the circuit is supplied by a 78L09 (9V) regulator. The sinewave output is taken from pin 2 via a 1kΩ resistor and then into the top end of a 1kΩ linear pot (level control) and the slider is connected to a 100nF capacitor for DC isolation and then via another 1kΩ resistor to pin 5 on the MC1648.

Output

The signal is routed from the MC1648 pin 3 via a 100nF capacitor to the non-inverting input (pin 5) of a MAX452 IC. This is classed as a unity gain stable 50MHz video amplifier and is usually powered from a dual 5V supply and customed for video applications (75Ω) and can drive 50Ω loads directly. The most common gain settings (by two resistors) are 0dB or 6dB, which is unity-gain (1V) or double the voltage output (2V). In this project we are using it as an impedance converter to change the impedance of the output from the MC1648 (1.2kΩ) to 50Ω at the output of the MAX452.

This IC is powered from a single 9V regulator (78L09) so it has to be set for half supply voltage on the non-inverting input. This is obtained from the two 10kΩ resistors as a potential divider with one resistor connected to the supply voltage and another resistor to ground and is the bias voltage. The values of the resistors are not critical as they are only there to provide the half-supply voltage and I have chosen 10kΩ as a typical resistance value. The gain is set by the two resistors connected on the inverting input (pin 7) and the output (pin 8). The feedback resistor is from pin 7 to pin 8 and the other resistor connected from pin 7 to ground via a 100µF electrolytic capacitor.

The resistor combination sets the gain and as both are 1kΩ the gain is one and is calculated simply by dividing the resistor value from the ground side into the resistor value to the output pin. As an example, if the 'ground resistor was 1kΩ and the 'output' (feedback) resistor value was 2kΩ, the gain would be set at ×2 (2/1). As can be seen, this is another voltage divider from the output back to the inverting (negative) input and is the negative feedback path. The 100μF capacitor in series with the bottom resistor blocks DC so the divider network only works on AC (the signal) and will not affect the bias point on the negative input pin. As the op-amp is designed to work on a dual power supply the signal input will be able to swing above and below ground (0V). When it is used, as in this project, with a single power supply, a capacitor is connected in series with the resistor from pin 7 so that the signal can go below the half power supply rail set by the potential divider resistors on pin 5. This is the same effect as the signal 'swinging' from maximum positive to maximum negative, when using the dual power supply. The capacitor to ground also adds to stability. In simple terms it 'fools' the op-amp it is running with a dual power supply. The output (pin 8) is variable from zero to approximately 1V at 50Ω set by the 220Ω potentiometer level control.

Frequency and Level

Commercial signal generators, along with some home-made ones, use a dial and/or a meter to show the frequency and the output levels. This project relies on a frequency counter (connected to pin 3 of the chip) for the frequency or calibrating with the aid of a communications receiver covering the HF bands. A dial can be drawn on a front panel around the frequency control with the frequencies plotted to calibrate the frequency dial.

As with all free-running LC oscillators there will be a 'warm up' drift for a minute or so. This is also common with commercial signal generators of this type and it is good practice anyway to switch on a signal generator (and frequency counters (meters)) several minutes before use. After this settling period, the frequency is very stable and compares with many similar types of commercial signal generators. If an oscilloscope is available, the output level can be seen on the display and it will be an easy matter to calibrate a home-made scale to mark the RF output levels.

The PCB

The PCB, **Fig. 6**, is a single-sided FR4 type with a ground plane on the copper side surrounding all the tracks. All components are 'through-hole', so no surface mount parts are used in order to make it easy for construction. Of course, care must be taken when soldering because the ground plane is close to the tracks. Anyone with reasonable soldering skills will not find this a problem when using a soldering iron with a fine tip. PCB pins are used for attaching the controls and a frequency counter if fitted. It is highly recommended to place this unit in a metal enclosure to avoid frequency movement such as placing a hand near the coils and relays. It will be prudent to keep all leads to the controls as short as possible. The main ones are the connections to the counter if fitted (using screened cable) and the modulation level control. The other controls are used for voltage switching or levels so are not as critical but it is still best to keep all leads short and especially avoid 'floating' leads over or near the coil and relays.

In Use

The finished signal generator is shown in **Fig. 7**. Turn on the unit and leave it running for several minutes to allow the frequency to stabilise. This is good general practice with all equipment for generating or measuring purposes. Once the band and frequency are selected, both level controls should be set for minimum outputs. The bands have some band edge overlap so you can choose the most convenient band for your test signal. The RF level is then increased for the desired level for the receiver under test. Modulation can be applied by increasing the 'mod pot' to the desired mod percentage.

Is there a Kit?

I can supply a 'picking list' to choose all or any of the available parts. If you choose to use you own components, the coils will have to be very close in inductance values to the ones I have used along with the resistors having 1% tolerance. Any variation in these will affect the difference in frequencies. The MC1648 IC is also difficult to get hold of but I have sufficient for several of these projects. As I explained earlier, some advertised are not always as described! A full A4 size drawing of the circuit diagram and the PCB will be sent with all orders. Please do not use unleaded solder!

Acknowledgement

Cess Davies GW3OAJ for following this project with interest and providing suggestions.

References

The following datasheets: XR2206, MC1648 and MAX452.

Continued from page 52

net, run by Karl 2E0KHB. Another of the newer licensees Phil 2E0PRV got the group playing BINGO on the on air. Strange but it proved to be very popular during lockdown. Plus, nearly all the newbies have had a go at running the 'It's Good to Talk' net.

The photo is of Rick (now 2E1RAN) after making his first 'Stateside' contact with his M7 call. Rick got into the hobby after listening to the net on his scanner and giving Lee (the host) a ring. He is now studying for the Full Licence along with other members of the MANGO group. (Just for the record, yes, Rick was using 10W to a speaker-wire-vertical and it wasn't an arranged QSO!).

Once they were finally able to go out, in a limited way, they staged what they termed 'QSO Parties' on 2m FM.

They were a type of mini-contest. They did this by each setting up portable stations and seeing how many contacts could be made in a given time. Being unable to find a clear channel on 2m was a unique experience! ARRL have a really handy tool on their website for these fun competitions. It allows you to enter the QSOs with both locators to get a total miles worked.

The station with the greatest total of miles worked won the day.

More recently the group 'activated' St James' Church, Dalehead (near to Slaidburn in Lancashire) for 'Churches and Chapels on the Air' using special event callsign GB2DH. It was a great opportunity to operate HF and VHF together and to meet in person for the first time. It was great fun even if it does now make them Many Amateurs Now Going Out.

Some have been involved in amateur radio for many years but the enthusiasm of new amateurs and the various things they have done together as a group have often pushed them out of their comfort zones as they explore the different parts of our hobby. It continues to be a very welcome weekly distraction

The group has also kicked the trend of the 'disappearing Foundation Licence holders'! All their new licence holders are on air and a credit to the hobby.

Group, MANGO, was born out of the needs of 2020 and has developed in ways the originators did not plan or expect but this new technology does come with advantages. Because it was not part of an existing group it did not come with any baggage. They have been able to operate using their own equipment during meetings. There is no need to drive or park, or to hire a room and very little cost involved.

Their challenge is "Pick a fruit and Just Do It". See if the format works for you. If it does, allow it to develop to meet the needs of your group. Hopefully you will find you enjoy the hobby in new ways with new and old friends.

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Too Technical or not?

Dear Don

I noticed a recurring theme in recent letters pages about *PW* having too much technicality and (separately) someone highlighting that circuit diagrams are too small. While agreeing with both I also get your response to those letters and know you have to judge articles accordingly.

However, what I can't let go without comment is the 160m vertical antenna article in the September issue! Not one diagram, instead we are forced to read and picture in our heads the design. But what really riled me was that the article saw fit to have pointless photos of a carrying bag (laid on the grass) and an SWR meter, err apparently showing the SWR though too small to actually see. The space for these photos could have been put to better use. Come on *PW* you are better than this, we don't need to see what a bag looks like!!

Martin Kay G1EOJ
Leighton Buzzard

*(**Editor's comment**: Thanks Martin and a fair point! I apologise that this article wasn't up our usual standards. You could, of course, email the author for more information, but we should definitely have done better.)*

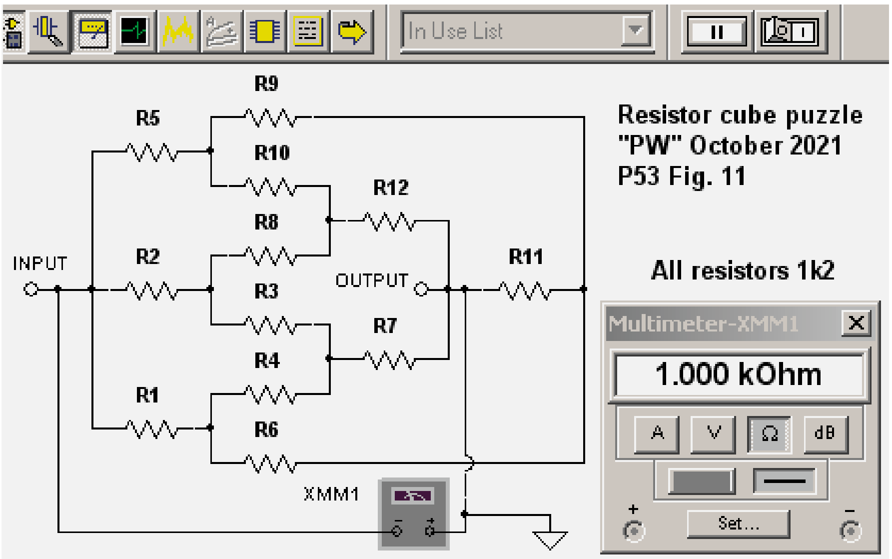
Cube Resistor Puzzle, October PW

Dear Don,

Twelve identical resistors (value R) are arranged one along each side of a cube. At each of the eight corners, three resistors meet in a solder joint. A pair of diametrically opposite corners are (arbitrarily) designated INPUT and OUTPUT terminals. What is the total resistance (Z) of the network between the terminals?

A fixed but unknown voltage is applied across the terminals causing current I to flow. The only known parameter is R.

The circuit has been drawn as a two-dimensional layout (see picture), without crossovers (except where the ohm-meter has been added to see the result of the simulation, the ground also being a requirement of the simulation package's calculator). A pattern is revealed whereby INPUT current splits into three (R1, R2, R5). Each of these three paths then splits again, this time into two (R1 feeds R4 & R6; R2 feeds R3 & R8; R5 feeds R9 & R10). Pairs of these latter paths then recombine, giving another three resistors (R3 & R4 feed R7; R6 & R9 feed R11; R8 & R10 feed R12). Finally, the final three paths (R7, R11, R12) merge to form the OUTPUT. The pattern is then a series of splits/merges of the INPUT current, first into three, then into six (actually three pairs) and finally back into three that combine to send all the current to the OUTPUT. Current is preserved (Kirchoff's First Law) so what goes IN also comes OUT.



On inspection, the pattern has symmetry such that R1, R2 & R5 each carry one-third of I (I/3). Each of these resistors feeds a split which is in two equal parts, each part being half of I/3 = I/6. The final merge sees once again three equal parts with I/3 going through R7, R11 & R12. Hence six resistors each carry I/3 and the other six pass I/6.

With only I and R available for calculation, the 'I-Squared-R' power equation is applied

$W = I^2R$

to find the power dissipated by each resistor, summed to give the total power in the network, which is:

$W = [6.(I/3)^2.R] + [6.(I/6)^2.R]$

$= [(I^2.R).5]/6$

The same power dissipation would be achieved if the same fixed voltage were to be applied to a single component with resistance Z. Then:

$W = [(I^2.R).5]/6 = I^2Z$

Divide out I^2 to give $Z = (5/6)R$

The total network resistance is five-sixths of the value of any one of the component resistors. The simulation is made of 1.2kΩ resistors, five-sixths of this is 1kΩ as confirmed by the simulation.

Godfrey Manning G4GLM
Edgware

From Here to Eternity?

Dear Don,

Following on from **Ray Howes' G4OWY** letter in October, I offer this letter in my defence regarding the 'truth' about cellphones mentioned in my letter to *PW* in May – I include an excerpt from a government website below: **https://tinyurl.com/a6y4zt8n**

Is the radiation from cell phones harmful?

Cell phones (2G, 3G, 4G) emit radiofrequency in the frequency range of 0.7–2.7GHz. Fifth-generation (5G) cell phones are anticipated to use the frequency spectrum up to 80GHz. These frequencies all fall in the non-ionising range of the spectrum, which is low frequency and low energy. The energy is too low to damage DNA. By contrast, ionising radiation, which includes x-rays, radon, and cosmic rays,

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B40D Receiver, May 2021 issue

Dear Don,
This is a belated response to **Philip Moss's** article on the B40 series of communication receivers used by the RN from the early 1950s till the early 1980s (although by that time most of them had been withdrawn and replaced by other types more suited to digital and microwave working).

I have disconnected, lifted and shifted then repaired then shifted and lifted then reconnected more than I want to remember. As the label states, they really do weigh 112lbs. They were also well designed so that only the mains power and headphone leads went in the front under the anti-shock and fixing tray. The antenna and AF output connections were at the rear top, protected by the raised outer casing. Also, being tall and narrow instead of wide and short, more receivers could be squeezed in the available space. The unitary construction could be a pain at times, but at least it meant no turning the receiver on its head to replace a defective component. There are two variants of the B40, the first being the B41, exactly the same build but with different IF frequency and tuning range from around 9kHz to 230kHz, just wide enough to bring in the BBC at 200kHz (now 198kHz, divisible by 9 for the for the new channelisation of LF). This receiver was designed primarily for long-range reception and for the DX submarine broadcasts below 30kHz.

The second variant was the 62B, which covered all the BBC transmit frequencies (180kHz to 25Mhz) and was for entertainment purposes having a slightly improved audio circuit and feeding into the SRE (sound reproduction system, a record deck and a set of 3 or 4 mixers). These days we carry all this around in our pocket on the mobile.

A word a warning is a good thing. If you have a B, C or D type and it has the black encased LF chokes and power transformer, beware. When the receiver doesn't show any signs of life, and it is a supply problem, no dial lights, no hum from the loudspeaker, etc. Just in case, wear a pair of elastic gloves (Marigolds) and a mask over mouth and nose (plenty of those around just now) and carefully remove the power and AF unit at the bottom. Examine the mains transformer and the smoothing chokes. If any of them show signs of the casing being bowed out, just a little or even a lot, look for oil on the chassis or if you are lucky, just seeping out from inside. Just look, do not touch or smell, get a large bucket or basin, place the power unit over the basin and let the oil run (drip) into the container. Also needed are a tough plastic bag and plenty of old rags, kitchen paper is too thin. Some of these inductive components were filled with oil that when heated turns into something rather less friendly. This oil and all the rags will have to be disposed of in a (possible) hazardous waste site. Your local council will have details of how and where.

I stated some, so you may escape. I cannot recall the name of the coolant oil, but there is no labelling on the casing to distinguish what is inside. The voltages and currents are all in the manual, and are also on the item as well, so it may be reasonably straightforward to cobble up a replacement power supply. I had this trouble, but on a different piece of gear. It took forever to get rid of the oil from the floor. I didn't replace the transformer, just signed out for a new power pack!

Thanks for bringing back some memories.
Dave Francis MM0DYX, ex-submariner
Dunfermline

is high frequency and high energy. Energy from ionising radiation can damage DNA. DNA damage can cause changes to genes that may increase the risk of cancer.

The human body does absorb energy from devices that emit radiofrequency radiation. The only consistently recognised biological effect of radiofrequency radiation absorption in humans that the general public might encounter is heating to the area of the body where a cell phone is held (eg. the ear and head). However, that heating is not sufficient to measurably increase body temperature. There are no other clearly established dangerous health effects on the human body from radiofrequency radiation.

When I worked as a medical physics technician at The Christie Hospital in the 1990s I was informed by the staff there that much investigation into the effects of EMF on treating cancer (ie destroying cancerous tissue) had been done before that line of research had been dropped as a dead end. Radio waves have little or no effect on living tissue.

I hope this clarifies what might have appeared as a rash statement. Perhaps I should forward this to OFCOM and the RSGB as well.
Pat. Walton M1BNH
Bury

Harry G3LLL and RSGB

Dear Don,
It was heart-warming to know (October 2021) that **Harry Leeming G3LLL** is alive and well and enjoying his retirement. As for the 'ultimate DX location' he mentions, hopefully that ain't going to happen any time soon.

Harry's plea for someone to take over where he left off might fall on stony ground. There again, maybe not. However, it would be a great result if someone does indeed volunteer to take over the reins. Besides, it is a fact that out there in amateur radio world many people are still using rigs that should have died long ago but, whether by divine intervention or whatever, are all still strutting their stuff on VHF, UHF and HF. And long may it continue, eh?

So, it's probably the case, that some people who would much rather use the old rather than the brand new, might welcome a monthly column devoted to keeping their amateur radio treasure alive and kicking.

And on that note, who is actually buying all those expensive dual- band digital handhelds? The Yaesu FT5DE, for example.

John Fellows G3YRZ mentions why *"none of the candidates for RSGB President or Board Members"* didn't mention any of the current problems with OFCOM *"in their election CVs?"* It could be that the candidates know that most negotiation with OFCOM is a one way street?

Or, if they did mention what G3YRZ would like them to advertise, it would put their comments on the horns of a dilemma. Anyhow, it's probably better not to promise too much or give the impression that a prospective candidate could solve what is, a seemingly intractable solution. But hope springs eternal.
Ray Howes G4OWY/G6AUW
Weymouth

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(***Editor's comment**: Thanks Ray, and you are one of two readers who, this month, have asked for more on old rigs. Of course, our Second-hand columnist **Chris Lorek G4HCL** sadly passed away a couple of years ago. But next month I do have an article about old Trio/ Kenwood rigs. Any further articles about older but still usable rigs would be very welcome!)*

Morse Keyboard?

Dear Don,

It's quite boring being stuck indoors for weeks on end. So much so that I found myself photo shopping an image of a keyboard. I originally did it as a bit of fun for all the Morse enthusiasts.

Nev Young M0NFY
Norwich

Ofcom EMF Rules

Dear Don,

From the Ofcom EMF exposure document: *"A reduction in the transmit time over any six-minute period will give a corresponding reduction in the average power."*

This phrase 'any six-minute period' confuses me. 'Average power' is not unambiguous either.

Imagine I have two scheduled QSOs a day, each lasting six minutes. For one I use 100W and for the other I use 1W. The rest of the day my radio is off.

'Any' means 'any', presumably. When a magician says 'pick a card, any card' he or she means one card out of a fanned-out pack. Whatever I pick, the other 51 cards are not represented.

Now 1120 to 1126 is a 6-minute period, one of 240 in a day. It qualifies as 'any six-minute period'. The (peak) power in this - in 'any' - period could therefore be 100W (1 chance in 240), 1W (1 in 240) or 0W (238 in 240).

This does not help. Ofcom must want some kind of average six minutes.

The arithmetic mean is what people usually mean by an average. This is 101/240 which is 420mW, much less than the 10W EIRP lower limit.

If Ofcom meant any 'active' six-minute period - one in which I actually transmit - the average peak power is 50.5W.

Now assume I operate 12 hours in the day. Six minutes QRP, the rest on 100W. I'm clearly putting out a lot more RF.

'Any six-minute period', by my magician's argument, is unchanged and the peak power could still be 100W, 1W or 0W. The distribution of powers has changed, but the values have not.

Average peak power in any six-minute period is now 11901/240 = 49.59 W and for any 'active' six minutes we get 11901/120 = 99.18W.

So, what precisely do Ofcom mean? The assessment power, in these two rather extreme examples, could be anywhere from zero to 100W.

And I still haven't allowed for the nature of our operating. Assuming a 50:50 transmit to receive cycle, each active six minutes has only three minutes of actual transmission. So, should all this be based on 50W and 500mW?

I'm not writing this to stir things up - would I do that? I really don't know how Ofcom meant me to work this out.

Tony Jones G7ETW
Harrow

Next Month

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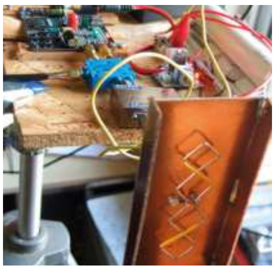

A 6cm ANTENNA: Bernard Nock G4BXD describes an easy-to-build antenna for the 6cm band.
ORBITAL DYNAMICS: Godfrey Manning G4GLM takes a look at some of the aspects of satellite operation.
THE MORSE MODE: Roger Cooke G3LDI reports on the CWops Open event, GB2CW and some Eddystone Morse keys of interest.
VALVE & VINTAGE: Ray Howes G4OWY shares some history of Heathkit.
SECOND-HAND: Gary Clark G0BKR looks at the classic hybrid (valve/transistor) rigs from Trio/ Kenwood.
CHRISTMAS QUIZ: We have our annual pre-Christmas quiz, to amuse you over the holidays.

There are all your other regular columns too, including HF Highlights, World of VHF, What Next, Notes from a Small Station, From the Ground Up and Data Modes.

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- Dual Band Antenna - 20cm long
- Desktop Charger (100-240VAC- 12v input supplied with UK Power Supply
- Headset with PTT & Mic
- Battery Eliminator with Cigar Lighter Plug
- Silicon Case
- Remote Mic/Speaker
- 2 x 3200mAh Heavy Duty Li-Ion Batteries
- PC Programming Lead
- PC Drivers & Software
- SO239 Adaptor
- 2 x Battery Clip
- Handle Strap

ML&S ONLY: £279.95

Wouxun KG-UV980PL

The Wouxun KG-UV980P is a new Quad Band base/mobile two way radio packed with a plethora of features at an unbelievably affordable price. With four band transmission and eight band reception, this powerful radio delivers up to 40 watts UHF and 50 watts VHF for maximum range and power at extremely low cost!

The KG-UV980P has 999 programmable memory channels with CTCSS and DSC encode/decode, DTMF encoding/decoding, priority channel scanning and twin band simultaneous reception. You can select wide or narrow bandwidth (25kHz/12.5kHz) at the press of a button and select your output power level to high, medium or low for optimal transmission.

Want more power? That's only the beginning. The real power of the UV980P is in its versatility. The Wouxun KG-UV980P isn't merely a two way radio, it's a full duplex cross-band mobile repeater! Choose from five repeater settings - normal radio mode, directional cross-band repeater mode, two way cross band repeater mode, repeater receiving mode (receiver) or two-way cross-band relay mode (used to combine two transceivers into a repeater). Yes, that's right. You can connect two KG-UV980P radios together using the 15 foot extension cable or the microphone connection cable (both included) to create your own working repeater! Now that's power!

Wouxun KG-UV9K Pro Pack New Step 8.33K, Cross Band Repeat

New version of the ever popular UV9D - the UV9K! Now with 8.33 step for Airband Channel Spacing Changes

Included in the pack:
- KG-UV9K Transceiver with one Antenna
- Two Batteries
- Two Belt Clips
- Software and transfer Data Cable
- Fast Charger Dock and Power Supply
- Hand Speaker Mic
- Battery Eliminator
- Manual
- Wrist Strap
- Leather Case
- In-car Charger
- SMA-PL259 Adaptor
- Hands-Free Kit

RRP: ~~£239.94~~ ML&S: £144.95

Wouxun KG-UV9D Mate Latest Colour Display Dual-Band 144/432MHZ Handie

ML&S ONLY: £139.95

This new rugged bright orange HIGH POWER handie is the latest release from Wouxun. A nominal 10W of power (we tested at 8W at least) on VHF ensures you will be heard over other less powerful handies.

Package Contents:
- KG-UV9D Mate Radio Body
- 3200mAh Li-ion Battery
- Intelligent Wall Charger & Pod
- Belt Clip
- SMA-Male Antenna
- Handstrap
- User's Manual

NEW DEFINITION OF DIGITAL HANDHELD

Meet the Advanced Technologies

《Actual Size》

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5W DIGITAL TRANSCEIVER

FT5DE

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AMS Automatic Mode Select

66 ch GPS

WIRES-X

Touch & Go OPERATION

microSD Card

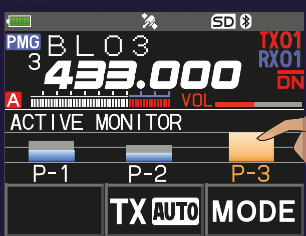
Bluetooth®

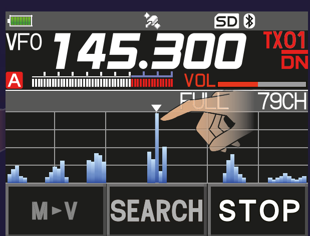
- ◆ Advanced C4FM Digital / 1W Audio Output
- ◆ Robust Tough Body with Rubber Protection
- ◆ Worldwide WIRES-X Internet Communications
- ◆ Fully Compatible with APRS
- ◆ Memory Auto Grouping (MAG) / VFO Band Skip Function

Primary Memory Group Touch & Go operation

Touch & Go OPERATION

Quick & intuitive Touch and Go PMG key channel monitoring operation, by simply touching a bar on the LCD





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Comfortable size & form with no protrusions provides excellent grasp, even when wearing gloves for outdoor activities

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Specifications subject to change without notice. Some accessories and/or options may only be standard in some areas. Check with your local Yaesu Dealer for specific details.

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The UK's only diecast model magazine featuring the latest news, releases & reviews.

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The perfect go-to guide for all loving dog owners filled with advice & expert tips.

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