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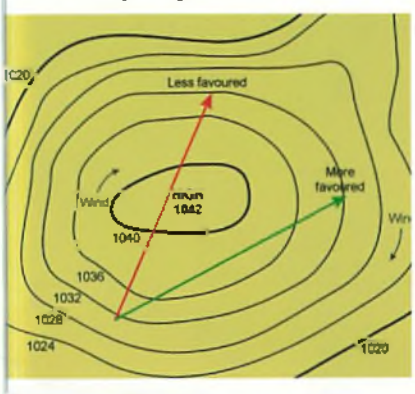
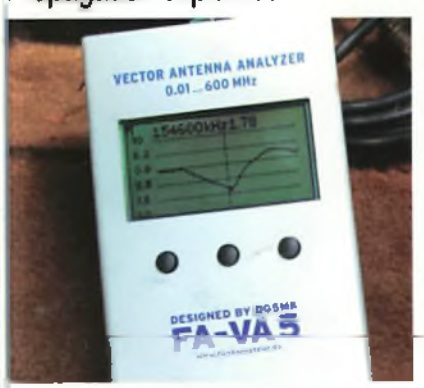


Making Waves Tropospheric Propagation explained



Review: SDR-Kits VA-5
Vector Antenna Analyser Kit

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REVIEW IN THIS ISSUE

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Elecraft is the undisputed leading performer in analogue transceiver design. This is confirmed both from www.sherweng.com and the many DXers and DXpeditions that use this equipment. Even the little KX3 will outperform almost anything else! But there is also another hidden advantage. It holds its price far better than any other range I know of. Compare the used prices of Elecraft with other mainline radios and you will soon see what a great investment it is. Ten year old K3s are still commanding good money. And talking about part exchange, we are more than happy to quote for your unwanted radio equipment. Call Paul or Glyn on 01702 206835.

Peter Waters G3OJV

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The K3S delivers the best of both worlds: a hybrid of software-defined radio (SDR) technology and our proven, high-dynamic range superhet receive architecture. The optional KRX3 high-performance, fully independent sub-receiver offers true diversity operation to reduce fading. 32-bit DSP provides stereo effects, NR, EQ, notch, and built-in PSK31/CW/RTTY decode/encode.

The K3S offers great value for money. Still the best analogue transceiver currently in production, it has great versatilty. Its light weight makes it easy to carry on DXpeditions. Its performance is legendary and beats any comparable transceiver, regardless of cost. You are protected against obsolescence by virtue of regular firmware updates and replacement modules. And you only pay for what you need! A wide range of options allow you to add a wide range of features to.

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K3S/100-F	100W Transceiver Ready Built	£2849.95
K3S/10-F	10W Yransceiver Ready Built	£2329.95

Accessories

KPA3A	100W PA for K3 10W Models	£549.95
KAT3A	Wide Range Auto ATU	£449.95
KFL3	8-Pole Roofing gi;ters	from: £169.95
KRX3A	Second Independent Receiver	£849.95
K144XV	2m Transcerter 8W	£449.95
KDVR3	Voice Recorder	£199.95

Top Choice for DX & DXpeditions
Elecraft Value for Money

Sherwood Engineering are the leading test house for ham radio transceiver performance. Their ratings are a great indicator for planning your purchase. You can check for yourself by going to www.sherweng.com. Here are the top contenders - half of them Elecraft!

1st	FlexRadio Transceiver Flex-6700	£6,899.00
2nd	Icom IC-R8600 (Receiver only)	£2,499.00
3rd	**Elecraft Transceiver K3S**	**£2,849.00**
4th	**Elecraft Transceiver K3S (2nd)**	**£2,849.00**
5th	**Elecraft K3 (upgrade)**	**Discontinued**
6th	Icom Transceiver IC-7851	£9,999.00
7th	Hilberling PT-8000A	£12,000+
8th	**Elecraft KX3**	**£1,149.00**

Elecraft KX3 160 - 6m, 15W

There is something very special about the KX3. It out-performs any similar transceiver and almost all of the base stations. You can run it at 100mW or increase to any power up to 15W (a bit less above 20m). You can add 2m or 4m, Add a narrow roofing filter or auto ATU. No other rig can match it.

Kit: £1099 Built: £1149

- KXAT3 ATU £239.95
- KXFL3 Filter £189.95
- KXBC3 Timer £99.95
- KXPD3 Key £159.95
- DC Lead £11.95
- 2m Transvert £309.95
- 4m Transvert £309.95
- MH3 Mic £79.95

KXPA100-F0

100W PA for:
- KX3
- KX2
- FT-817

- FT-817/818 option £11.95

Kit: £899.95 Built: £949.95

KPA500 600W HF-6m Amplifier
Matches Any HF Transceiver

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- RF sensed Band Change
- Ultra High Speed QSK
- No switching noise
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Kit £2449.95 Built £2699.95

The KPA500 easily delivers 600W output and can be driven by any HF transceiver that can provide around 30W of drive power. Instant operation from switch on means that DX is not missed. The large bar graph give true pep indication and the small foot print will enable it to fit onto almost any desk.

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The Alex Loop MkII Portable 40-10m

Low Noise, Low Profile

A loop antenna is a very efficient antenna which also exhibits narrow bandwidth for optimum receive conditions and high noise rejection. Measuring around 1m diameter, it will handle up to 25W of power and now features gold plated connectors for extremely low loss £449.95

The Alex folds down into this very small package. Assembly takes no more than a couple of minutes. Tuning is continuous and smooth. Typical VSWR is 1.5:1 or less and no ATU is needed. It's the perfect travel companion.

IC-7300 HF - 4m Transceiver

Almost every ham operator knows somebody who owns an IC-7300. That in itself is a great recommendation. It is the most successful radio for many years. Primarily because it is based on SDR that offers so many advantages and results in such a great receiver. And the added bonus with the IC-7300 is the 4m coverage. It's a great all in one station with lovely colour screen full of information. The internal ATU copes well with most antennas and the touch screen makes operations much easier to navigate the various functions.

£1199

The New IC-R8600 Receiver

A Great Receiver at a Great Price

£2499

- 10kHz - 3GHz SDR wide band performance
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- Supr FPGA for ultimate processing
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DIAMOND Yagi Antennas

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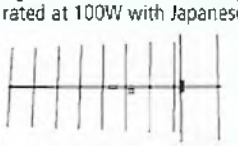

A-502HBR....6m 2 El. Phased 6.3dBi 400W.....£89.95
A144S10R....2m 10 Element 11.6dBi 2.13m boom .£73.95
A144S5R.....2m 5 Element 9.1dB 1m boom.....£39.95
A-430S10R ..70cm 10El, 13.1dB 1.19m boom.....£52.95
A-430S15R ..70cm 15 El. 14.8dB 2.24m boom.....£62.95
A-1430S7.....Dual 2m/70cm 7/9dBi 1.25m boom..£129.95

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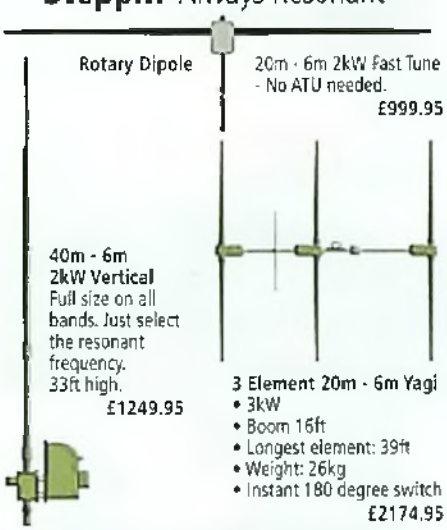

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* These headsets need adaptor leads £25.95 each
Please quote radio model

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6-Band 1.5kW Compact Yagi

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- 1.5kW
- 2 Els. per band
- Boom 2.2m
- Turn Radius 2.9m
- Gain 3 - 5dB
- F/B ratio up to 20dB
- Weight 11.8kg

Hustler HF Verticals

4BTV

40m - 10m 4 Band vertical that will handle full legal power and can be ground mounted Height is 6.52m. £209.95

5BTV

The ever popular 5-band model that covers 80m to 10m. This is a great backyard antenna that can be ground mounted. The height is 7.64m £269.95

6BTV

This antenna is identical to the 5BTV above but has the 30m band added. Again it handles full legal power and stands 7.3m high. £289.95

All antennas are rated at 1kW.

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20 Amp micro PSU variable voltage switchmode power supply, excellent value. £84.95

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45 Amp variable voltage switched mode power supply with 'noise shift' feature. £119.95

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- Air Band 117-138MHz
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All mode receiver with a wide range coverage of 530kHz-3GHz and enhanced, brighter display. Extend the capabilities of the MkIII by expanding the memory to 4,000 channels with the memory card slot.

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LA-400
Indoor Loop Antenna

This loop antenna covers the range 500kHz to 500MHz and can be used with any receiver. It offers low noise reception and is directional. This is a serious accessory for the AR-8600 MkII. Includes connecting lead and AC power supply.

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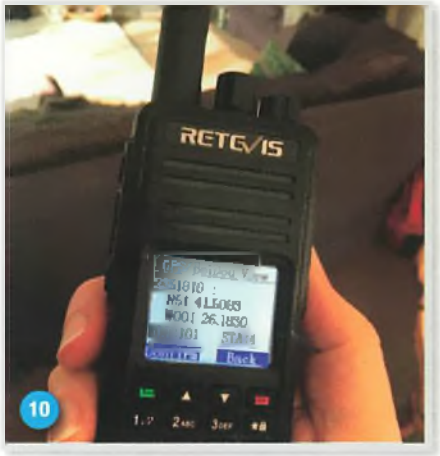
On Sale 11th October 2018



WARNERS GROUP PUBLICATIONS PLC

Keylines

Don is back from a trip to Ireland and celebrates five years at the helm of PW.

I am just back from a long weekend at the EI DX Group's DX Féile event on Inishmore, the largest of the Aran Islands. This is the group that has brought you operations from Nepal (9N7EI) and Malawi (7Q7EI) in recent years and, this year, has been responsible for activating all the Irish Islands on the Air (IOTA) counters as EJ0DXG and EI0DXG. They announced over the weekend that three members hope to activate the most remote inhabited island in the world, Tristan da Cunha, in the autumn of 2019, and have asked for the callsign ZD9EI. The Republic of Ireland doesn't have a huge number of amateur radio licensees so it's great to see this level of enthusiasm and activity and, indeed, a great weekend was had by all, with some excellent presentations, a DX quiz, both SSB and Morse pile-up challenges, a station for visitors to operate and, of course, some serious socialising. Thanks are due to all those who worked behind the scenes to make it happen and especially to **Dave Deane EI9FBB**, one of the main movers and shakers who was also kind enough to drive myself and my wife **Janet** from Dublin Airport and generally to take us under his wing. Amateur radio truly does engender international friendships. There will be a similar event next year.

Five Years and Counting

I just realised that this issue sees me complete five years in the editorial seat. It certainly doesn't feel that long – the time has flown by and I continue to enjoy the role and the interactions with contributors and readers. When I started, although I had written for amateur radio publications for over 30 years, I wasn't sure how being more directly employed in amateur radio would affect my enjoyment of the hobby. In practice, it's been nothing but beneficial. I have gained insights into aspects of the hobby that I wouldn't otherwise have explored. I've interacted with people I might not otherwise have met. And when I go along to amateur radio events, at home or abroad, I find myself gaining more from them if only because I'm always on the lookout for an angle that might be of interest to *PW* readers.

At the outset, the learning curve was steep. It's become a little more of a routine as the years have gone by but every issue presents new challenges if I am to keep the magazine fresh. In that respect, it's also been interesting to look back at *PW* from years gone by and to see how it has evolved, both in style and content. What we must not do is stand still because, thankfully, the hobby itself is constantly evolving.

Nothing Left to Discover?

Talking about looking back, I am grateful to the daughter of a long-time *PW* reader who recently passed away for donating his collection of magazines, dating from the late 1950s. I've been perusing them with interest! (Yes, I know our CD compilations now go back a long way but I still enjoy browsing actual paper magazines) In the December 1959 issue, **Thermion** (pen name of one of the regular columnists) says, *"Nowadays everything is over; there is nothing left to discover"*. A reader challenges with this in the next issue, arguing that *"Much work in the field of radio communication can only be carried out by the radio amateur who has the experience, patience and enthusiasm to develop ideas that might be rejected by the professional engineer as economically unworthy of development"*. Thermion rejects this argument, saying, *"It appeals to the whimsically minded to convince themselves and say that with all the much-vaunted facilities of the professional research worker, it takes an amateur struggling in some cold, dark dingy shed at the bottom of his garden to solve a problem that has been baffling the professional for months...It is best to consider amateur radio purely as an interesting, absorbing and exceedingly instructive hobby."*

Remember, this was 60 years ago. Was he right? For many radio amateurs Thermion may well have been right – an interesting and instructive hobby. But we have seen radio amateurs develop or contribute to the development of packet radio, microsats, new antenna designs and much more since then, as our late columnist **Chris Lorek** frequently pointed out in his *Emerging Technology* column. And where software development is concerned – SDR gear, new data modes and so on – it seems to me that the radio amateur still has much to contribute and certainly doesn't need a large, professional laboratory. The internet also allows groups of radio amateurs to work collaboratively on projects in a way that Thermion could hardly have foreseen. Long live amateur radio!

Carried Over

My apologies that the promised multimeters article has had to be carried over as a result of having more material this month than I have space for. It will certainly appear next month, along with some pre-Christmas entertainment, the annual index and lots more.

Don Field
G3XTT

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

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

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

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Kenwood Appoints ML&S as ASC

Kenwood UK have appointed Martin Lynch & Sons for amateur radio repairs as an authorised service centre. ML&S are the only service centre in the UK officially approved by Yaesu Musen (Japan), JVC-Kenwood and Icom UK with four engineers on site. To book your radio or accessory in for repair or health check e-mail **workshop@mlands.co.uk** or call 0345 2300 599.

ML&S also report that they were awarded 'Dealer of the year 2018-2019' by JVC-Kenwood.

New Desk Microphone

Nevada Radio have announced availability of the new DMS-629 Desk Microphone from INRAD USA. The DMS series of desk microphones are compatible with most makes of transceiver.

Mounted on a heavy-duty base, the DMS M-629 microphone is a unidirectional cardioid dynamic microphone with a large 1.125in diaphragm and internal rubber element suspension system for reducing undesirable noise. The microphone is tailored with a rise in frequency response from 500Hz to 4kHz. The result is described as a clear, overall well-articulated audio response, tailored to match the intelligibility of human voice.

The microphone is supplied with a transceiver interface cable of your choice but change your transceiver and you simply buy the matching interface cable.

INRAD, a division of Vibroplex®, now in their 36th year of business, have been appointed exclusive base microphone supplier to FlexRadio. The DMS M-629 sells for £158, including the rig interface lead.
www.nevadaradio.co.uk

ContestConsole for Icom Radios

The Icom IC-7300 has established itself as one of the most popular HF radios of all time. SOTAbeams has developed the ContestConsole to capitalise on some of the radio's features. The ContestConsole is a 'plug and play' device that connects between the radio and microphone. It allows direct access to voice and CW memories, frequency control, PTT and a low power tune feature (with optional lead).

The ContestConsole works with a wide range of different Icom radios. SOTAbeams has a compatibility table on their website. The ContestConsole is stocked by SOTAbeams and their agents.
https://tinyurl.com/yb6jlvns

New US Submarine Forces Commander is Radio Amateur

(from ARRL website) US Navy Vice Admiral **Charles A 'Chas' Richard W4HFZ** assumed command of US submarine forces during a change-of-command ceremony on August 4th, held aboard the submarine *USS Washington* (SSN-787). He assumed command from Vice Admiral **Joseph Tofalo**. An ARRL Life Member, Richard, 58, is well-known in the AMSAT and APRS communities. He had been serving as the deputy commander of US Strategic Command at Offutt Air Force Base in Nebraska.

A radio amateur since 1974, Richard said on his qrz.com profile that he is active on 6 and 2m, as well as on HF when the VHF bands are closed. He also enjoys digital satellite operations. Richard has been on active US Navy duty since 1982.

Realtime Band Conditions Website

The purpose of this experimental website (URL below) is to provide 24-7-365 actual (realtime) band condition information to CW QRPp, QRPe and CW/SSB contesters interested in increasing their scores. It can also be of benefit to other radio amateurs to determine band conditions for nets and casual QSOs. This information is not based on any software predictions or any kind of satellite-based readings but on a new ionospheric sounding method called HF Ionospheric Interferometry, which operates very similarly to the PolSAR system used by NASA.
www.bandconditions.com
Also, check out the VOACAP predication web page at:
www.voacap.com/hf
A daily HF radio wave propagation forecast can be found at:
https://tinyurl.com/ybnbz6u8

Spectrum News

The Paraguay telecom regulator, CONATEL, has released the WRC-15 Amateur Secondary Allocation of 5351.5 to 5366.5kHz with a maximum power of 25W EIRP.

ANATEL, the Brazilian telecoms regulator, has produced an updated bandplan, which releases 60m to their amateurs. This is the WRC-15 Secondary allocation 5351.5 to 5366.5kHz with 25W EIRP for Class A operators. In addition, they have been granted another two new bands – 135kHz (1W EIRP) and 472kHz (5W EIRP).

Also, the 160m band in Brazil has been expanded from 1850kHz, making it now 1.8 – 2MHz and the 80m band now becomes 3.5 – 4MHz (previously 3.8MHz). The new frequencies are expected to come into operation in the week beginning November 26th.

New VHF spectrum is being made available in Ireland. On a secondary basis, Ireland now has privileges on 30-49MHz and 54-69.9MHz. ComReg, the Irish regulator, has also extended the 4m band, to 69.9 to 70.5MHz, matching the current IARU Region 1 bandplan. The change is a result of IRTS (Irish national radio society) input in recent consultations.

The latest edition of *The 5MHz Newsletter* (No 21 – Summer 2018) is now available for free PDF download from the 'External Links' section of the Wikipedia 60m Band page:
https://tinyurl.com/yan4xv52
or the RSGB 5MHz page:
https://tinyurl.com/yd8ac3kl
This edition includes 5MHz news from eight countries, features the World of 5MHz, the Wikipedia 60 Meter Band page, CEPT, Do you monitor the UK 5MHz Beacons, Useful propagation sites for 5MHz and Reader's Feedback from G4DWV.

Celebrating 100 Years of Radio in Guildford

Amateurs from three Guildford-based clubs joined together at the town's Stoke Park over August bank holiday to celebrate 100 years of radio activity in the area. Over the three-day weekend they ran special events stations working CW, SSB, FM and DMR with the call GB1GWA (Guildford Wireless Alliance).

In 1918, seven years before the fledgling BBC could be received in the town, a group of local enthusiasts formed the Guildford Wireless Alliance to promote amateur radio.

At that time, wartime restrictions banned the construction and use of radio equipment by the public. But by 1920, following much lobbying from interested parties – including the 5th Earl of Onslow, who was a government minister as well as president of the Guildford enthusiasts – the restrictions were relaxed, radio licences were reintroduced, and experimental work by amateurs recommenced in earnest. This continues today.

FOC Celebrates its 80th Anniversary

The First Class CW Operators Club (FOC) was founded in 1938 following a letter from G5BW to the RSGB *T&R Bulletin*. It was then reformed in 1946 after WW2 and has continued ever since. While it has always been a British Club it now has a worldwide membership of around 500 Morse (CW) enthusiasts.

To mark such an important anniversary the Club held its AGM and Annual Dinner this year at Girton College in Cambridge, culminating in a very grand dinner held in the Great Hall of the College. 130 members and guests attended, some travelling from as far as New Zealand and western USA to join the celebrations.

Among the members attending were **Lionel Parker G5LP** and **Pete Windle G8VG**, whose respective fathers were both early FOC members in 1938. Pete, the current G8VG, has been a member himself since 1951.

At the dinner **Andy Chadwick G3AB** was installed as the new President. More details about FOC may be found at: **www.g4foc.org**

Experimentation and construction are important activities of the three local radio clubs that trace their lineage back to 1918. Guildford & District Radio Society is the direct descendent of the Wireless Alliance: it spawned the Guildford UHF Repeater Group in 1979 and the Wey Valley Amateur Radio Group in 2005. Between them they have about 200 members.

However, back in the 1870s, a tower on the Hog's Back overlooking Guildford unwittingly played a role in the science of radio communications – before wireless had even been invented. At that time **John Rand Capron**, Guildford's Clerk of the Peace, was a Fellow of the Royal Astronomical Society. He set up a 'corona of platinum points (an antenna) on a staff on the tower-top to gather atmospheric electricity', which was measured daily.

As a result of this work, he published a book in 1879 entitled *Aurorae, their characteristics and spectre*. Guildford UHF Repeater Group now uses the same tower as Capron for its repeater site, continuing its historical scientific role.

GB1NHS from Staffordshire

The National Health Service amateur radio station GB1NHS (see *In Focus* feature in August 2018 *PW*) teamed up with Burton upon Trent Amateur Radio Club for a special event on Sunday September 9th.

The venue was the National Memorial Arboretum in Staffordshire in support of the first ever national emergency services workers memorial day (Official 999 day). The aim of the day was to celebrate the work of emergency services personnel across the country.

The team had special permission from the National Memorial Arboretum to operate from the Ambulance Service memorial site within the grounds.

A significant number of visitors came to see GB1NHS. It was a huge success and a great opportunity to demonstrate how amateur radio can help to promote special events of this kind.

Members of the Burton upon Trent club were able to demonstrate a range of operating procedures. This ranged from Morse code to the latest remotely-operated FlexRadio. They also operated a special event callsign GB1ESM (emergency services memorial).

Paul Devlin G1SMP from the NHS Emergency Care Intensive Support Team and custodian of GB1NHS would like to thank the following organisations for helping to make the day such a success: The National Memorial Arboretum, Burton upon Trent Amateur Radio Club. Essex Ham, RAYNET UK, Leicester RAYNET, NHS Improvement and NHS England, along with the many individuals who made the day such a success.

Paul states that the greatest praise, though, should go to the team at the charity behind the National Emergency Services Memorial (NESM), who have worked tirelessly over a number of years to make this day a reality. They have won the backing of PM **Theresa May** for the event.

For further information please visit the following websites:

Official 999 Day
www.999day.org.uk/organisers
Burton upon Trent ARC
https://burton-arc.wixsite.com/burton-arc/the-club
NHS Amateur Radio Station:
www.GB1NHS.net

BARTG News

BARTG (British Amateur Radio Teledata Group) is a contest and awards group. It currently runs four datacoms contests a year and offers several awards for datacoms, notably its Quarter Century Award and its series of Continent Awards.

Earlier this century BARTG changed its membership scheme so that membership was free to everyone. The BARTG committee is now considering another change. All BARTG's contests and awards are open to all amateurs (including listeners) and there is no requirement to be a member of BARTG in order to participate in any of these activities. For this reason, the committee believes that the BARTG membership scheme is now unnecessary and is considering closing the scheme.

The committee believes that this closure would not affect any of BARTG's activities. Its contests, awards scheme and website would all continue to be run by the committee on a voluntary basis.

The committee also believes that this proposed closure would not affect BARTG's members. Members would keep their BARTG number for life and would be welcome to continue to display it and/or the BARTG logo on QSL cards, callsign badges and plaques, car stickers and suchlike.

The committee is keen to hear from members about this proposed closure. Please send comments to **secretary@BARTG.org.uk**
www.BARTG.org.uk

Peterborough Club News

August started with Peterborough and District ARC putting on a special event station at a local 1940's themed event. The event, Baston In The Blitz in South Lincolnshire featured a multitude of wartime living history groups and hundreds of re-enactors. Fortunately for the club, there was an area set aside for Cold War exhibits. This they joined and set up a Cold War military radio station, using two Clansman PRC320 sets, one on LSB and one USB. The LSB radio fed into a Clansman 40m dipole, which was set as an inverted-V on a Clansman 8m telescopic mast. The USB setup was a 20m Clansman inverted-V attached to a Clansman 5.4m fibreglass mast.

Both stations worked well and despite high temperatures and adverse band conditions, a good number of contacts were made. Along with the radio station, they had a display of other working Clansman radios and test equipment. There was a lot of public interest, especially from ex-members of the military.

August 22nd saw the Club's annual All-Day club meeting. It started about 9am with a small group of candidates for the Intermediate exam doing their practical work. While this was going on a few club members were setting up a large mobile lattice mast with a 20m homebrew beam on top. At lunchtime other members turned up, bringing vintage radios, test equipment and other antennas to try. The club's radios were also set up and ready for use.

GB100MPD

GB100MPD will be on the air from November 9th to 13th. The wireless station at Poldhu in Cornwall, callsign ZZ, sent a message to all British merchant ships advising them of the outbreak of WW1. The centenary was marked at Poldhu by the Poldhu Amateur Radio Club operating GB100ZZ from the site.

During the war, control of the station was passed from the Marconi Company to the Admiralty. Messages were sent to merchant ships using code and the callsign MPD. On Armistice Day November 11th 1918, Poldhu sent coded messages to merchant ships using the callsign MPD to advise them that hostilities had ceased.

The Poldhu club will again be on the air using GB100MPD to mark the end of the Great War and in memory of the hundreds of wireless operators who died in that conflict.

GB1WWI

During November the Chippenham and District Amateur Radio Club will be active with the special callsign GB1WWI to commemorate the ending of WW1. The activity will take place form the Chippenham and District Amateur Radio Club's new QTH at Kington Langley Village Hall.

Review by Tim Kirby G4VXE
E-mail: tim@g4vxe.com

Review: The Retevis RT3S 144/430MHz DMR Transceiver

Tim Kirby G4VXE gets his hands on another dual-band DMR handheld. What's more, we are offering it as a competition prize (see at end of review).

The Retevis RT3S is another of the generation of dual-band DMR/ analogue handhelds that have appeared in the last 12 months. Like the Anytone AT-868UV, Radioddity GD-77 and the Ailunce HD-1 that we have reviewed in recent months, it has a VFO mode, meaning that you can tune around, rather than having to program up the radio up in a channelised fashion for any frequency that you want to use.

Retevis produced an RT-3 last year so when the RT-3S came out, my initial reaction was 'what's new'? As it turns out, there are some quite substantial changes. The main change is that the RT-3 was single band, either covering 136-174MHz or 400-480MHz. The dual-band RT3S model covers both these segments. In addition, there is room for 3000 channels in the RT-3S compared to 1000 in the RT-3. There's a Record feature on the RT-3S allowing you to record up to 8 hours of digital audio as well as the ability to monitor two frequencies at the same time.

Features

I have listed the main features and functions in the sidebar, taken from the manufacturer's website: www.retevis.com

First Impressions

My first impression on getting the RT-3S out of the box was one of familiarity! The look and feel is identical to the TYT MD-380 and all the derivatives of that rig, including the Retevis RT-3, of course. The user interface and design are tried and tested and work well. It's easy to navigate and the controls are well thought out. The rig is substantial and well built without being heavy. Because the rig is identical to the MD-380, all the accessories will work, including the charger and any headsets that you may have.

The RT-3S came with a USB programming lead, a drop-in charger, belt clip and an instruction manual. I frequently comment that the instruction manual on many of the Chinese DMR rigs is not a huge amount of help because often a great deal of functionality is defined by the codeplug rather than the radio itself. This is true of the RT-3S. Although various functions are described in the manual, the instructions are not always that clear and suffer somewhat from 'Chinglish'. If you are reasonably experienced with DMR rigs and the concepts, this is not a barrier, but if you are new to using DMR and want your hand holding throughout the familiarity phase, the manual may not be a huge help. Having said that, Retevis have spent quite a lot of time producing 'How To' videos that you can find on YouTube and it's fair to say that these are much more helpful and perhaps reflect the fact that many people would rather watch a video than read an instruction manual.

Getting Started

Because the rig shipped direct from Retevis, there was no codeplug suitable for use in the UK already in the rig. It's worth noting that this will always be the case if you buy from outside the UK (even inside the UK in some cases!), so although you may pay a little less, you will have to do some setting up yourself. Of course, if you are experienced with DMR and codeplugs, this is nothing to worry about and, indeed, I find it part of the fun of getting a new rig going. However, you may have a different view and just want to switch on the rig and have it work! If you do, you are better off buying from a retailer who can support you with a codeplug and advice.

My first task, then, was to get the rig talking to my PC. I run a virtual Windows 10 PC on my Macbook so I downloaded the RT3S programming software from the

Retevis download site:
www.retevis.com/resources-center

Tim's top tip – make sure you get the RT3S download, rather than the old RT3 download making you wonder why the rig only shows up as a single-band radio. Don't ask me how I know!

Once I had the correct download, it was plain sailing and having installed the programming software (I already had a suitable USB driver for the lead and the rig), I was able to read the codeplug from the rig into the software and start making amendments.

When building a new codeplug, I always start with very simple and build up from there. First thing was to enter my DMR ID into the rig. And then the easiest thing was to start with getting the rig talking to my local digital hotspot in the 70cm band on DMR. That's just a case of setting the frequency, time slot, talkgroup and colour code and you're sorted. At least that's what you hope and in this case it was. I was soon able to hear voices coming out of the RT3S from the digital hotspot and shortly afterwards I had a quick QSO on the Brandmeister Worldwide talkgroup to prove that everything was well.

I used the RT3S very successfully with both an openSPOT as well as a zumspot hotspot.

Getting on the Air

So far, so good. Next, I thought I would program up some of my local analogue repeaters; GB3WH (Swindon 2m), GB3TD (Swindon 70cm) and GB3RD (Reading 2m) and check that worked correctly. I found that with quite weak signals around the house, I needed to change the default squelch level (which you set on each channel from 3 down to 1). Once I did that, I was able to listen quite easily. I set the CTCSS encode and found that I could get into the repeaters as I would expect given the 5W power level and the distances involved.

Audio reports on both digital and analogue were fine and I felt the RT3S had plenty of volume if you wanted to listen to it in the car. My wife, **Julie** commented that the lowest volume setting on the RT3S was quite loud. Oops.

Next was to try programming the Swindon digital repeater, GB7TC on 430MHz. I programmed up a couple of talkgroups where I thought I would likely hear traffic, UK Wide on TG235 and Worldwide on TG1. With the rig in the right place, even with minimal signal, I got crystal clear audio (compared to somewhat noisy analogue reception). This is one of the benefits of digital communication, although I was unable to get into the repeater with the same setup.

I was curious to see if there was a 'promiscuous' mode on the RT-3S, which would mean that rather than having to program up a channel with the talkgroup I wanted to listen to, it would let me listen to any talkgroup on that timeslot. Sure enough, I found 'Group Call Match' and 'Private Call Match'. Turn those settings 'off' and the RT3S will receive anything on the channel, talkgroup combination. These are really useful settings if you are listening to a DMR signal but don't know what talkgroups are in use.

Next, I decided to try out VFO mode. I had to Google how to do it, which is to switch the rig's memory mode from CH mode (channel description) to MR mode (channel numbers). Then press the Red 'Exit' or 'Back' key for a long press and you will see the frequency display change. You can then use the up and down keys or the top channel selector knob to change frequency. I found this a really cumbersome way of getting into VFO mode, particularly having to change from CH mode to MR mode. I prefer to use CH mode rather than MR so that I can see the description of what a channel is – for example, GB7NS UK Wide rather than what it would display in MR mode, which would just be the frequency. This would be the same for all talkgroups on the same repeater – not helpful! Having to switch it to MR mode to select VFO mode felt long-winded and unnecessary.

Anyway, once in VFO mode, I tuned up and down the band, listening to various signals, which was fine. While in VFO mode, I thought I would try to listen for the 2m digital repeater GB7CT, which is audible around my location. Although I could use the 'promiscuous' modes to listen to whatever talkgroups I liked, initially, I wasn't able to change the DMR colour code, timeslot and talkgroup to match the values for GB7CT. **Vivian Xu** at Retevis kindly sent me a video showing that it was possible. The problem was that I had not checked 'Program mode' in the Utilities section of the codeplug. I spent 20 or 30 minutes in VFO mode and then thought I would like to return to channel mode, back to the usual channels. I pressed the red 'exit' key for a long press which took me back to channels and then went back into the Menu/Utilities to switch back to CH mode. But the option to do so had vanished! To start with,

The RT3S showing GPS information

I thought I was looking in the wrong place but I double-checked and it wasn't there. I tried switching the rig off and on again (of course) but nothing changed. In the end, I hooked the rig back up to the computer and reloaded the codeplug back into the RT3S from the computer, using the programming software. That did the trick. I'm

Features as Specified by the Manufacturer

Display
Colour LCD

Call Features
Single/Group/All Call

Specifications
Frequency Range: 136-174MHz & 400-480MHz
Channels: 3000 Channels
Battery Capacity: 2000mAH Li-Ion
Power: High Power 5W, Low Power 1W
Dimensions: 131 x 61 x 36mm
Weight: 258g

Main Features:
Digital & Analogue mode
Group Call Match (Promiscuous)
Private Call Match (Promiscuous)
Motorola Tier I & II Compatible
GPS optional
8 Hours Recording
Firmware can be updated
Time-Division Multi-Access (TDMA) digital technology

guessing this was a firmware glitch, which may well be resolved in future firmware releases, but it certainly had me wondering for a while. Subsequently, I have switched back and forth from VFO mode without any problems but I have read online of someone else having a similar experience so I don't think it was me.

The supplied antenna is adequate. I tried the RT3S with an aftermarket Nagoya NA-771 and the performance on 2m in particular, was better than with the stock antenna, although not so different on 70cm. If you want to get a little more distance out of the RT3S, then a better antenna will help although, of course, it will be bigger to carry around. Choices, choices!

Battery Charging and Battery Life

The drop-in charger that comes with the RT3S is the same as the MD-380 and Radioddity GD-77 charger and, indeed, I used the MD-380 charger to charge the RT3S. Battery life seems good, especially when using the rig on low power with my digital hotspot.

The RT3S (right) with its cousin the MD-380 (left). Don't they look alike?

GPS

The RT3S comes in GPS and non-GPS versions. I am somewhat ambivalent about whether or not it's good to have GPS on a DMR rig. Although Brandmeister can pass GPS information into the network, other systems do not. Having said all that, if you're like me, there's something rather satisfying to have a device that displays your position on the planet to a high degree of accuracy. The review model had a GPS fitted and it was able to display my latitude and longitude after a couple of minutes. Within the codeplug, you are able to set up the GPS so that it will report your position on a particular channel at specified intervals, sending to a particular DMR ID.

Recording

The RT3S allows you to record what you hear on DMR. You can switch on the Recording facility under Utilities. The recordings that are made can all be found under Menu/Call Log. Each 'over' is recorded separately and allows you to play it or examine the Source and Destination DMR IDs as well as date and time. Not only incoming overs are recorded but your outgoing ones too. Scary! Is this a useful feature? I can see it might be sometimes, particularly if you are working on RAYNET or similar business.

Conclusion

The RT3S is well built and feels good in the hand. It works well on both DMR and Analogue. This means that you'll need to have a comprehensive codeplug, which you can probably build up yourself or you may be able to load up a codeplug that someone else has built. I found the programming software reasonably easy to set up and use and did not find any problems.

I enjoyed using the RT3S as both a hotspot radio and a radio to carry with me. How does it compare to other models? At the price point of around £100 on eBay, it is cheaper than the Anytone AT-868UV, which feels a little more polished than the RT3S. Nevertheless, if you are prepared to work around these quirks, which are by no means showstoppers, you can do plenty with the RT3S and enjoy both DMR and analogue contacts. My thanks to Vivian Xu and **Yolanda Guo** at Retevis for their kind assistance as well as for their generous donation of the review model for our *PW* competition this month.

PW COMPETITION

WIN THE RETEVIS RT3S WORTH £100

Thanks to our friends at Retevis, we are able to offer the review transceiver as a competition prize. The winner will be picked at random from the correct entries and will win the Retevis RT3S Dual-Band Handheld Transceiver. To enter, just answer the simple question below over on our website **www.radioenthusiast.co.uk/competitions/**

Which Retevis radio did we review in our November 2017 issue? a.RT3 b.RT82 c.RT45

At the time of writing, the answer can be found, along with other useful information about Retevis products at: **blog.retevis.com**

Entry is only via our website. Entries close at midnight on November 11th 2018. To enter you must answer the question correctly and answers received after the date will not be accepted. The winner will be notified by e-mail on or after November 28th 2018. Warners Group Publications Plc standard competition terms apply. to view visit: warners.gr/compterms . For information on how your personal data is processed, secured and your rights, our Privacy Policy can be viewed here – warners.gr/privacy or available in hard copy upon request. The winner will also be announced in the January 2019 issue of PW.

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Fig. 3: The antenna at Carmarthen Amateur Radio Society GC4YCT/P.

Fig. 4: Sheffield & District Wireless Society G5TD/P.

Fig. 5: Hambleton Amateur Radio Society G0JQA/P.

didn't make many contacts but, *"Really enjoyed my time on top of the hill".*

Another Scottish first-time entrant in a contest was **Stewart Harvey MM0HUF**. He says, *"I wasn't able to get my camper van up onto the local hills because the road was closed for repairs so I used a local park car park. I used a quickly homemade Moxon antenna on a fishing pole tied to the rear ladders of the camper so was unable to get the antenna above the top of the trees. I only managed five contacts in the couple of hours I was able to operate.*

"I have a problem getting the right words sometimes when speaking and spend most of my time using digimodes to get past that problem so being on SSB was a 'refreshing' change for me. I just used a simple setup with a compact netbook and my trusty IC-706MkIIG with cross-needle SWR meter and clock set to UTC. The only other essential kit was my kettle to make the much-needed coffee", **Fig. 8.**

For **Stuart Hammonds G8VUW/P**, it was his first ever contest. It was also his first trip out in his new camper van, **Fig. 9**. Stuart says, *"I'll get a bigger antenna next year and will try to spend less time making tea!"* (see photo)

Welcome Back

Nick Grundy G4NKV last entered a 2m contest back in 1979. Being semi-retired for the last few months has given him more time for the hobby so he decided to have a go in the contest, **Fig. 10**. His transceiver had been in its box for the last 18 years but still worked. The antenna had been hung up in the garage gathering dust and cobwebs and required some repairs. His old mast had not been used for some 40 years but after freeing off the corroded bolts, it worked fine. Nick says, *"It took a while to get back into the swing of contest operating but it was quite enjoyable"*. He will be looking for a better location next time because no signals were heard from the north or east.

Logging Software

One entrant's logging software somehow managed to produce a log where every one of the serial numbers that he sent was erroneously copied into the corresponding serial number received. Fortunately, this was spotted during adjudication and a replacement log supplied.

Callsigns

One club actually submitted their entire

Fig. 6: Bittern DX group G6IPU/P, mostly operated by the YLs in the club with Linda G0AJJ and Sue 2E0TSZ.

Fig. 7: Swansea and District Amateur Radio Club MG0SDD/P with tape measure antenna.

Fig. 8: The operating position at MM0HUF.

Fig. 9: Stuart Hammonds G8VUW/P new camper van got its first trip out.

Fig. 10: Nick Grundy G4NKV operating from the back of his car.

entry using the wrong callsign! It was only when I came to do some detailed checking that I spotted it.

Time

Despite prompts, one entrant managed to log all their contacts in BST rather UTC/GMT. Fortunately, the entrant didn't make contacts outside the time period of the contest. Radio amateurs throughout the world keep their logs in UTC (which during the summer months in the UK is one hour behind British Summer Time).

Locators

Each year a number of entrants lose a few points by mis-keying locators. For example, the first two characters being keyed as numbers rather than letters (such as 10 instead of IO). The use of one of the established contest logging programs would prevent this.

E-mail

This year the adjudicator's task was a lot less smooth than usual. There was a problem with entries received from certain e-mail addresses (almost exclusively from entrants with either Yahoo or BT Internet e-mail addresses) not reaching the adjudicator. Many thanks to those entrants who were kind enough to re-send their entries direct to the adjudicator. I'm not aware of any that were missed but apologies to any that may have slipped through the net.

Date for Your Diary

The provisional date for the 2018 *PW* 144MHz QRP Contest is Sunday June 9th 2019. As usual the event will be arranged to run alongside the RSGB 144MHz 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 2018, and **Neill Taylor G4HLX** for devising what is without doubt one of the most widely supported single-band contests in the VHF calendar.

Pos	Call	Name	Single	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	GW1Y8B/P	Hereford VHF Contest Group	S	215	35	7525	IO81KW	Yaesu FT-817	9-ele DK7ZB	800
2	G4TCU/P	Steven Marsh	S	156	29	4524	IO82OJ	Kenwood TR-751e	Diamond A144S10R	533
3	G3NFC/P	Burton on Trent ARC		126	27	3402	IO93DH	Flex 6500 Kuhne TVTR	2 x 15-ele LFA Yagi	370
4	G5TO/P	Sheffield & District Wireless Society		114	29	3306	IO93FL	Icom IC-7400	5-ele Quad	320
5	G4RLF/P	SADGITS		119	27	3213	IO80WX	Trio TS-770,Masthead LNA	13-ele beam	277
6	G3SKY/P	Isle of Wight RS		125	24	3000	IO90JO	Yaesu FT-225RD + MuTek	7-ele OWL	225
7	G3NXQ/P	Otley ARS		127	22	2794	IO93DV	Yaesu FT-225RD + Mutek	2 x 9-ele Tonna	261
8	2E0FTL/P	2E0FTL and G4ZOI		93	22	2046	IO84TF	Yaesu FT-817	5-ele SOTA beam	736
9	M0KZP/P	Neil Simmonds	S	85	20	1700	IO83PB	Yaesu FT-991A	6-ele Yagi	136
10	G0VHT/P	Paul Morrison	S	79	19	1501	IO91GI	Yaesu FT-817	10-ele Diamond beam	297
11	G2XP/P	Sutton and Cheam RS		89	16	1424	IO91UH	Yaesu FT-817ND	7-ele ZL Special	133
12	G0WRC/P	Warrington ARC		82	17	1394	IO83WK	Icom IC-9100	Tonna 17-ele Yagi.	400
13	G4XZL/P	Andrew Vare	S	78	17	1326	IO90IO	Yaesu FT-817ND	9-ele DK7ZB Yagi	4
14	G8KVM/P	Bernard Rhead		73	18	1314	IO93AD	Yaesu FT-817ND	3-ele Quad	468
15	GW4WXM/P	Wrexham ARS		67	17	1139	IO82KW	Kenwood TS-2000	7-EL ZL Special	213
16	M0JCQ/P	James Stevens	S	67	15	1005	IO91RU	Elecraft KX3	9-ele Tonna	4
17	G2XV/P	Cambridge and District ARC		59	17	1003	JO02AH	Icom IC-7100	2x 9-ele Tonna	20
18	MC0YAD/P	Cwmbran and District ARS		60	15	900	IO81LQ	Icom IC-7100	A148-10S 10-ele Cushcraft	310
19	G8BUN	Ossett Amateur Radio Operators	S	44	20	880	IO93EQ	Yaesu FT-817	11-ele Yagi	110
20	GW8ZRE/P	Dave Hewitt	S	51	17	867	IO83JF	Yaesu FT-817	7-ele ZL Yagi	251
21	G0BWC/P	Bolton Wireless Club		61	14	854	IO83SO	Icom IC-910H	9-ele Vargarda	200
22	MW0GMZ/P	Huw Hughes, Barry Jones, Stuart Tweddle		41	20	820	IO73UJ	Yaesu FT-100	16-ele 2BCX beam	160
23	GC4YCT/P	Carmarthen ARS		43	18	774	IO72WA	Icom IC-820	8-ele Yagi	383
24	M0SXE/P	Downland Radio Group		47	16	752	JO00BT	Yaesu FT-817	17-ele Tonna	170
25	GI4TAJ/P	Joe Bingham	S	46	16	736	IO74AU	Yaesu FT-817ND	13-ele Tonna	340
26	G0JQA/P	Hambleton ARS		43	17	731	IO94IJ	Yaesu FT-847	Tonna 9-ele portable Yagi	300
27	G3VRE/P	Chippenham & DARC		53	13	689	IO81VJ	Yaesu FT-817	9-ele Tonna	9
28	G4NKV/P	Nick Grundy	S	43	16	688	IO94MJ	Icom IC-821H	12-ele ZL Special	415
29	G0OIW/P	Mark Palmer	S	41	16	656	IO91MP	Icom IC-202S	9-ele Yagi	260
29	G0FCA/P	Iain Groom	S	41	16	656	IO83VS	Icom IC-7000	8-ele Yagi	375
31	GW0EIY/P	Simon Pryce	S	44	11	484	IO82LO	Yaesu FT-857	10-ele long Yagi	354
32	G6IPU/P	Bittern DX Group		35	13	455	JO02QU	Kenwood TS-2000	17-ele Yagi	39
33	G8VUW/P	Stuart Hammonds	S	41	11	451	IO92EK	Yaesu FT-817	3-ele Yagi	180
34	GX2UG	Halifax & District ARS		32	13	416	IO83XR	Yaesu FT-991	17-ele Tonna	290
35	M1AEA	Mark Waldron	S	37	11	407	IO82WM	Yaesu FT-817	Cushcraft 4-ele Yagi	219
36	G4SRS/A	CARG Radio Group		35	11	385	IO81UR	Kenwood TS-711	12-ele HB ZL Special	198
37	M0SPA/P	Staffordshire Portable ARC		32	12	384	IO92EP	Yaesu FT-817	6-ele beam	112
38	G4EDR/P	David Mappin	S	29	13	377	IO94SE	Yaesu FT-817	5-ele ZL Special	182
39	M6NXG/P	Christine Harrison	S	29	12	348	IO92EP	Yaesu FT-817ND	7-ele ZL Special	112
39	G4PBN/P	John Vivian	S	29	12	348	IO80BP	Yaesu FT-857D	4-ele Yagi	370
41	G4MCQ/P	DMS Old Timers		34	10	340	IO81UN	Yaesu FT-857	Tonna 6-ele beam	0
42	GM4YEQ/P	Galashiels and District ARS		26	13	338	IO85MM	Yaesu FT-991	HB 4-ele beam	360
43	G4BZV/P	Roger Bracey	S	24	13	312	IO80PU	Icom IC-202E	3-ele Sotabeam	250
43	G4PGJ	David Ward	S	26	12	312	IO92ET	Icom IC-7100	7-ele ZL spec.	135
45	G4XTF	Nigel Hancocks obo Hereford ARS	S	21	12	252	IO82AA	Yaesu FT-817	10-ele Yagi	80
46	M6POA/P	Jon Lambert	S	24	9	216	IO91GI	Yaesu FT-290R	5-ele Yagi	289
47	GU3TUX/P	Chris Rees	S	20	10	200	IN89VR	Yaesu FT-817	5-ele Yagi	0
48	G3ASR/P	Edgware & District RS		19	10	190	IO91TN	Yaesu FT-818ND	5-ele Yagi	6
49	GD6ICR	Mike Webb IOMARS	S	14	12	168	IO74PF	Kenwood TS-780	11-ele COM	40
50	M0SNW/P	Simon Wheeldon	S	12	11	132	IO93FS	Yaesu FT-817ND	Dipole	85
51	MD0MAN/P	Robert 'Matty' Cunningham	S	13	10	130	IO74PD	Yaesu FT-817ND	9-ele Tonna	240
52	G7UHN/P	Andy Webster	S	16	8	128	IO90OW	Yaesu FT-817	3-ele tape measure Yagi	225
53	G4OTV	Dave Green	S	18	7	126	JO01CB	Yaesu FT-857	7-ele Yagi	180
54	MC0SDD/P	Swansea And District ARC		13	7	91	IO81AS	Yaesu FT-897D	6-ele HB 'tape measure' Yagi	377
55	GM4GRC/P	Glenrothes and District ARC		18	5	90	IO86JF	Yaesu FT-817ND	12-ele long-boom HB Yagi	370
56	PE1EWR	Frank L. Laanen		10	8	80	JO11SL	Kenwood TS-790E	10-ele Parabeam Jaybeam	0
56	GM3NHO/P	Tom Harrison	S	10	8	80	IO86NN	Icom IC-706	3 element Yagi	210
58	GM4ODW/P	Ruaridh Maclean	S	10	7	70	IO86DR	Yaesu FT-817	8-ele Yagi	380
59	GB4SIO	8th Oxford (Highfield) Scout Group		13	5	65	IO91JS	Yaesu FT-817	InnoVAntenna 5-ele Yagi	95
60	EI3ENB	Paul Norris	S	8	6	48	IO62JH	Yaesu FT-736R	Cushcraft 13-ele Yagi	70
61	G4AHO/P	Ken Jones	S	11	4	44	IO82XI	Icom IC-706	7-ele beam	230
62	GM0VGI/P	George Anderson	S	8	5	40	IO87PH	Yaesu FT-991	8-ele Yagi	386
63	GM3ALZ/P	Fred Gordon	S	7	5	35	IO87JE	Yaesu FT-817	HB 8-ele Yagi	650
64	PI4VNW/P	Veron Afd 59 Nieuwe Waterweg		5	4	20	JO21BX	Kenwood 255 E	4-ele Yagi Tonna	25
65	MM0HUF/P	Stewart Harvey	S	4	3	12	IO75WW	Icom IC-706mk11G	Homemade Moxon	73

Table 3: Overall results table, Practical Wireless 144MHz QRP Contest 2018.

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Challenges

Lee Aldridge G4EJB reports on some of the challenges faced when getting back into the hobby.

To say everything went right first time would be far from what really happened. A big issue to start with was a lack of parts so I kept the projects basic and had a modicum of success. As I bought a few parts, I started building using techniques that I had used years ago, notably with copper-clad stripboard. Some of the stripboard was old and I didn't clean off the tarnish thoroughly enough – this didn't make for good clean construction. So, what did I learn? Spend a little more time in the preparation stages.

As I continued to use this method of construction, I discovered RF doesn't always go well with stripboard and modifications didn't always go to plan because tracks would lift and break. I had been using desoldering wick but found my solder sucker did less damage, as well as waiting for things to cool (I believe it's called patience). I built tuned filters with plain stripboard with some success but found it time-consuming. Eventually I had a go at building Manhattan style by super-gluing small pieces of copper clad board on other copper clad board used as the earth plane. Once I'd got the hang of it, I found it a quick method apart from leaving the soldering iron on too long and lifting a pad – more glue. Years ago, Ferric Chloride, an etch resistant pen and insulation made for a good night's entertainment but it wasn't for me this time, I just wanted to get a few things built – but when my patience returns.... Recently, I have seen M0CWY's cut board method (see *PW* August 2018 – *The Bumpy Rocket*) and shall try that if my hand and eye coordination lets me. The main thing is to have a go and, find what works for you and the circuit being built.

Ah yes, eye and hand coordination. Fairly early on, I realised a hand-held magnifier was not the answer to soldering components to boards, which usually requires three hands or methods of holding things down. I found an illuminated bench magnifier on eBay for less than £20 that I thought would assist. I fitted a daylight 3W LED lamp and it seemed to shed plenty of light on matters but I was having the usual difficulty with varifocals and attempting to focus on small components, then introducing a soldering iron into the frame. It took me months to get it right but eventually I found a method that worked – basically I was too close to the magnifier. Taking off the varifocals also helped. Though I didn't need the magnifier for the next one.

The author's original centre piece with poor weatherproofing.

On a Spring evening I went into my shed to discover water on the bench. Not all water on a bench is a result of a shed roof leak but it took me a little while to realise this. A few nights later, more water on the bench and we hadn't had any rain. This time I happened to pick up the 20m dipole coax and water dripped from the BNC connector. With my DMM, I measured watery ohms across the connector. Was I chuffed! Now what's one of tasks emphasised by antenna builders? It's to make sure you weatherproof your connections. Well, obviously I hadn't and this was my only piece of coax.

On a dry day, I removed the coaxial cable from the shed and thought I might as well check for external damage to the cable sheath before bringing down the antenna. Nothing found. Then I laid the cable in such a way that hopefully any water still in the cable might make its way down by gravity. I put some paper towelling around the cable end to assist by capillary action. It stayed that way for a few days. I checked the end of the coax with my DMM again. At least it was now showing open circuit. To try and drive out any remaining water, I used an old paint stripper gun on a low setting, taking great care not to get the cable too warm. I knew the cable could be degraded but it was going to be pressed into service again.

With the dipole lowered, I had a look at the centre piece. See the embarrassing photo!

Not my finest effort – reminded me of an ancient school report – *"could do better"*. I stripped it down and it was obvious from the water marks how the water had entered. Determined not to let this happen again, I spent more time dressing the centre piece with overlapping self-amalgamating tape and finishing the ends off with good insulation tape. Since then I have discovered the paint-on liquid electrical tape although I have yet to try it: https://tinyurl.com/ya6gce6b

Once the cable was fed back into the shed, I left it a few more days before remaking the end of the cable off. Fingers crossed. An SWR check showed the antenna to have no worse an SWR than previously. Signals could be heard. Now having read an appreciation of SWR (see first URL below) and methods for checking cable loss using a SWR meter and a suitable load; I would have had a better indication of cable loss (see second URL). https://tinyurl.com/mduw9ux https://tinyurl.com/y7komsmg

So, would the antenna still be usable? Well that will come to fruition in next month's article.

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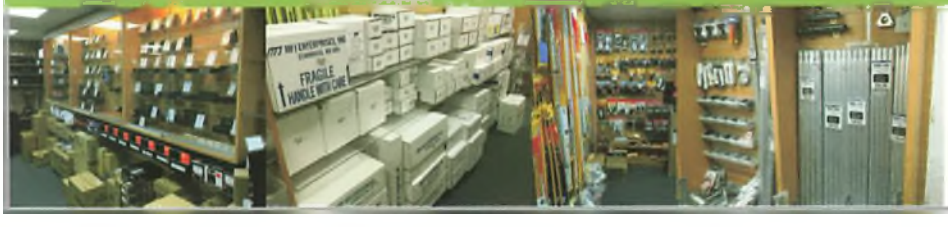

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The HT-500D takes the experience of DMR to a new level with features designed for the amateur radio user.
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The AnyTone D868UV radio was developed to conform to the DMR Tier I and II requirements. The radio offers 4,000 Channels, 10,000 Digital Talk Groups with 150,000 Contacts. The large colour display offers clear information about the radio operation and function, including displaying who you are connected to. The powerful transmitter is very reliable and offers up to 7 Watts of power for a hand-held. The Anytone AT-D868UV has been designed for radio amateurs and has the ability to take the radio outside of the code plug in VFO mode (Single button press) So it is a dual band Hand held with DMR rather than a DMR radio with a dual band handy!

LEIXEN

VV-898 £59.95
Dual Band
136-174/400-470MHz 10W
mobile transceiver
VV-898S Dual Band 136-174/400-470MHz 25W mobile transceiver **£69.95**
VV-898SP Dual Band 136-174/400-470MHz 25W mobile backpack transceiver, this mobile backpack transceiver you can take virtualy anywhere you need it! Leixen combined their micro-compact, 25 watt Dual Band UHF/VHF Mobile Radio with a powerful 12A Li-ion rechargeable battery and put it all in a sturdy chassis you can fit in your pack or emergency bag for use anytime, anywhere! .. **£149.95**
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TRX-1 25-1300MHz Digital Handheld Scanner (left) **£419.95**
TRX-2 25-1300MHz Digital Base Scanner (right) **£479.95**

ICOM

Base

IC-7610 HF/50MHz SDR base transceiver **£3499.95**
Following on from the technology incorporated into the IC-7300, the IC-7610 adopts the same RF direct sampling system for signal processing. By converting the analogue signal directly to a digital signal and processing it within the FPGA (Field Programmable Gate Array), it provides improved transmission phase noise and excellent RMDR of 105 dB (at 1 kHz detuning).

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

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ID-4100 D-Star dual band mobile transceiver **£479.00**
The ID-4100 makes using DSTAR more fun and more comfortable thanks to the terminal mode / access point mode for the first time in mobile devices . This feature enables DSTAR via the Internet from any location you do not have access to a DSTAR repeater.
IC-2730E Dual band mobile transceiver **£289.00**
This stunning new dual band mobile transceiver features a large high-contrast LCD screen with backlight, V/V and U/U simultaneous receive capability and optional Bluetooth® connectivity for hands-free and remote control communications.

Handheld

ID-51E PLUS2 D-star dual band handheld transceiver **£379.00**
This is the third generation of the successful D-Star handheld transceiver. Like the original ID-51E, it powers 2 meters and 70cms and receives two bands simultaneously (V/V, U/U & V/U)

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Baofeng DM-9HX DMR Digital & Analogue Transceiver **£89.95**

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- Digital Monitor Mode: support communication when frequency, time slot and colour code is paired, regardless of Contact ID, RX Group list

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

- Support analog repeaters and digital ones
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Alpha Antennas

ALPHA ANTENNA complete multiband loop for 10-40m + tripod & bag £349.95
The rugged & waterproof Multiband Loop is a complete HF antenna that transmits from 10-40 meters and has low noise receive capabilities from 7.0MHz to 29.7MHz. It can be assembled in less than 60 seconds even with thick winter gloves on. It is directional, packable into less than 25% the space of any other, and at 1.3 Kg (3 pounds), which includes Tripod, Bag, and Antenna, it is the lightest Complete Magnetic Loop ever made.

ALPHA ANTENNA 10-40M ALPHA LOOP JR with 6:1 reduction drive (inc tripod+bag) £399.95
A personal favourite of the Founder of Alpha Antenna, Steven Deines/NOTES. The Alpha Loop Jr+ for most CAP (SHARES), MARS, and Amateur Radio frequencies offers you a light 6.350MHz to 29.7MHz 15 watt PEP SSB transmit/receive antenna in a small package that deploys in approximately 60 seconds, which now has a 6:1 reduction drive.

ALPHA ANTENNA 6-80M complete multiband tuner free hf antenna £399.95
Directional Multiband System definition: A complete directional 500W PEP SSB multipurpose antenna, which can be configured to launch your signal as circumstances require from 6 through 80 metres.

ALPHA ANTENNA 6-160M J-POLE JR 34FT ANTENNA . £179.95
The Alpha J-Pole Jr Antenna is only 34 feet in length. The unique design characteristics of this 6-160 Meter HF JPole antenna enables it to approach resonance on the major HF bands

Tarheel Antennas

LITTLE TARHEEL II MOTORISED 80-6MHF ANTENNA 3.5-54MHz £449.95
When properly installed on your vehicle this antenna will provide continuous coverage from 3.5 to 54 MHz with the supplied whip. The Little Tarheel II antenna like all Tarheel motorized antenna models are built to meet the highest standards but in a more user friendly size. This antenna comes with the sensors already pre-installed so if you decide to add one of the auto controllers (SDC-100 Simple Controller, SDC-102 Programmable Controller, Turbo Tuner, Antenna BOSS and BOSS II) now or later everything is ready. This antenna has been designed for the person who wants to enjoy HF mobile but prefers smaller antennas. Don't let the small size fool you because when mounted higher on the vehicle you have less ground loses equalling higher performance

OTHER MODELS
BABY TARHEEL MOTORISED 40-6M HF ANTENNA
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LITTLE TARHEEL II-HP MOTORISED 40-6M
HIGH POWER HF ANTENNA 7-54MHz £449.95
TARHEEL 40A-HP MOTORISED 40-10M
HIGH POWER HF ANTENNA 7-34MHz £499.95
TARHEEL M100A-HP MOTORISED 80-10M
HIGH POWER HF ANTENNA 3.4-30MHz £529.95
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HIGH POWER HF ANTENNA 3.4-28MHz £529.95
TARHEEL M300A-HP MOTORISED 160-10M
HIGH POWER HF ANTENNA 1.7-30MHz £499.95
TARHEEL M400A-HP MOTORISED 160-10M
HIGH POWER HF ANTENNA 1.7-30MHz £529.95

Chameleon Antenna

CHAMELEON CHA F-LOOP PLUS 2.0 £549.95
The Cha F-Loop Plus 2.0 was designed with portability, ease of use simplicity, ruggedness and high performance in mind. Unlike any other similar antennas on the market, it is made with premium materials that are precisely manufactured and assembled in the USA! This is an exciting new product from Chameleon Antenna. Easily deployable HF magnetic loop antennas, also called small transmitting loops, have been routinely used for many years in military, diplomatic, and shipboard HF communication links, where robust and reliable general coverage radio communication is a necessity.

OTHER MODELS
CHAMELEON CHA F-LOOP 2.0 ..... £449.95
CHAMELEON CHA P-LOOP
PORTABLE HF ANTENNA £549.95

CHAMELEON CHA SKYLOOP 3.0-54 MHZ HF BASE ANTENNA £149.95
The CHA SKYLOOP is a 250' (14 gauge) full wave loop antenna cut for 80M. A yard of at least 60' X 60' will be required to install and support the antenna properly. With the help of an antenna tuner the CHA SKYLOOP will cover all the bands between 80M and 6M included. To match the loop to the coax cable a high power 4:1 air core balun (1000W CW) has been inserted in a waterproof container at the feeding point of the antenna. Even if the antenna can be installed at a minimum of 10' above ground the antenna should be ideally installed at least 30' to 40' off the ground for maximum performance. The antenna will be suspended by four evenly spaced support points. The main advantages of a sky loop are the reduced background noise and a better gain over a dipole

CHAMELEON CHA TD PORTABLE 1.8-30MHZ ANTENNA . £399.95
The CHA TD (Tactical Dipole) is a HF broadband antenna specially designed for portable HF communication where rapid deployment and simplicity of operation is essential.

CHAMELEON CHA TD LITE PORTABLE 1.8-54MHZ ANTENNA £159.95
The CHA TD LITE (Tactical Dipole LITE) is a HF broadband antenna specially designed for portable HF communication where rapid deployment and simplicity of operation is essential but compactness is primordial.

CHAMELEON CHA HYBRID MICRO PORTABLE HF ANTENNA BASE 1.8-54MHZ £229.95
The CHA HYBRID-MICRO is a lightweight highly portable broadband antenna system designed to offer maximum portability and performance. The antenna weights about 1 lb

Hustler Antennas

HUSTLER 5-BTV 5 Band 80-10m £239.95
Full band coverage on 10-40 meters (1.6:1 at band edges typical). Solid one inch fiberglass trap forms for optimum mechanical stability. Heavy gauge aluminium with stainless steel hardware construction throughout. Feed with any length 50 ohm coax

HUSTLER 6-BTV 6 Band 80-10m £279.95
Bandwidth at its broadest! VSWR 2:1 or better at band edges on 10-40 meters. Up to 100 kHz. on 75/80 meters. Solid one inch fiberglass trap forms for optimum electrical and mechanical stability. All sections 1.25" heavy wall, high strength aluminium. Extra heavy duty aluminium mounting bracket with low loss, high strength insulators. Easiest assembly and tuning of any multi-band vertical. Feed with any length 50 ohm coax.

HUSTLER 4-BTV 4 Band 40-10m £189.95
Exceptional mechanical construction with all sections of 1.25" high strength, corrosion resistant aluminium. Stainless steel clamps permit adjustment without damage to the aluminium tubing. The easiest to assemble multi-band vertical on the market. Full band coverage on 10-40 meters.

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E-mail: keith.g4miu@gmail.com

The FA-VA5 10kHz to 600MHz Vector Antenna Analyser

Keith Rawlings G4MIU has been busy with an interesting and useful Vector Antenna Analyser from SDR Kits.

When I was first licensed all I had to measure my antennas was a cheap SWR meter and a transmitter. Over the years I've used various noise bridges but in recent times I settled on an MFJ269 antenna analyser for basic tasks. For work at frequencies outside the range of the MFJ I used an old Wiltron Scalar Network Analyser with an SWR plug-in. These two served me well until the day the Wiltron expired. It was replaced with a DG8SAQ VNWA-3, which is a PC-based Vector Network Analyser (VNA) and this, along with the MFJ, covers all of my requirements.

The FA-VA5

Recently, I spotted the FA-VA5 Vector Antenna Analyser kit marketed by *PW* advertiser SDR-Kits (URL below). This is a compact and accurate handheld analyser with many features. It sports a neat graphic display and has a frequency range from 0.01 to 600MHz.

www.sdr-kits.net

While I didn't really need another analyser, what got my attention was the ability of the VA-5 to interface with the software used by the VNWA-3. A VA-5 would enable me to keep my VNWA-3 purely as a bench instrument. It would give me the benefit of a handheld analyser with greater range and accuracy than the MFJ and using the comprehensive VNWA software, I could carry out analysis of data saved by the VA-5 when needed. I could also use the VA-5 as a PC-based antenna analyser in its own right and being familiar with the software, there would be no learning curve.

After further research I learned that the analyser is housed in a metal case measuring 23 x 86 x 127mm (H/W/D). It has a large backlit liquid crystal display (LCD) with all functions selected via front panel switches. It also has a piezoelectric sounder to assist with SWR measurement. Coming in semi-kit form, the main board is already populated with the key components, leaving the constructor the job of adding the USB interface board, LCD and associated connectors, switches and so on. I decided to order one.

Fig. 1: Package.

Kit Description and Construction

The VA-5 arrived promptly and on opening the Jiffy bag, I found it packed in a smart cardboard box, **Figs. 1** and **2**. Inside were all of the components as well as the Universal BNC Cal-Kit I had ordered as an extra. You get everything you need to complete the kit, including the essential and extremely informative *Assembly and Operating Manual*.

Assembly is straightforward but some care needs to be taken. The first task is to solder the On/Off switch and USB interface to the main board. The former is simple but the latter needs some care to locate correctly. Once done, the board needs to be placed temporarily in the case to ensure the USB connector lines up correctly with the pierced hole for the lead.

Fig. 2: The kit of parts.

Now the display needs to be soldered to the backlight panel. This is an easy job but don't let solder run down any of the pins, otherwise it will make it difficult to insert the LCD into the headers.

Next the header strips for the LCD are soldered into the main board. Again, care is needed to get the correct height so that the display sits neatly and in the cor-

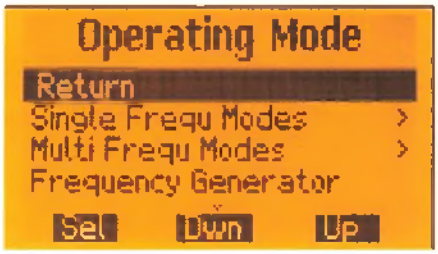

Fig. 3: Main menu.

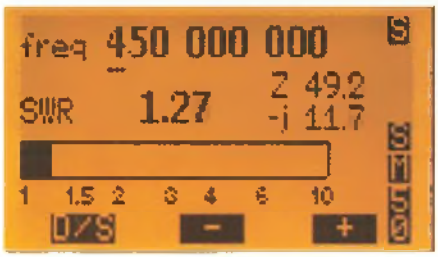

Fig. 4: Making a single frequency SWR measurement.

Fig. 5: Making a single frequency impedance measurement.

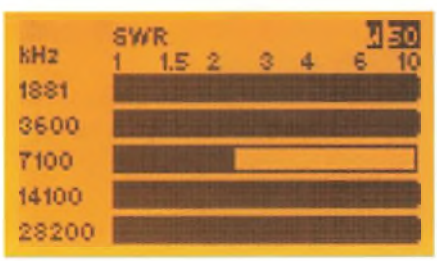

Fig. 6: The simultaneous Five Band measurement.

rect position. Cardboard strips are used between the header and board to get the correct spacing. I found this fiddly but managed to hold them in place and turn the board over for soldering, making minor adjustments afterwards.

This then left the fitting of the LCD by inserting into the headers, soldering in the sounder, switches, battery holder and BNC socket to the main board.

Completion and Testing

Now is the time to insert two AA batteries and see if it all works. Mine did, first time! On switch-on I was greeted with a nice clear display with a snazzy 'splash' introduction. Plugging into the USB port on my PC, the VA-5 displayed 'USB Mode', hinting that I had soldered that part correctly and it was working.

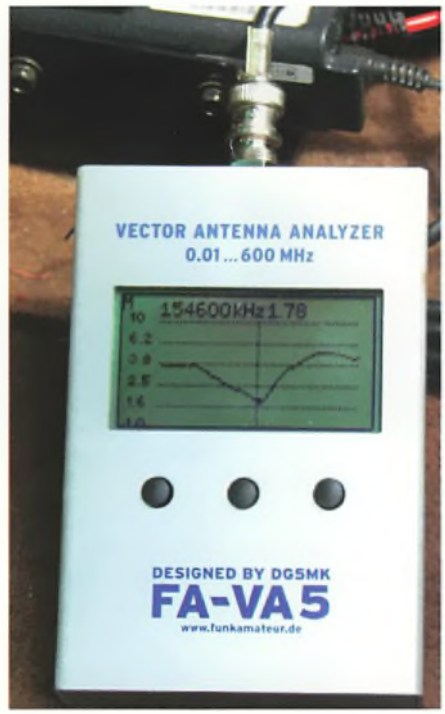

Fig. 7: Plot for the Diamond 8900 antenna.

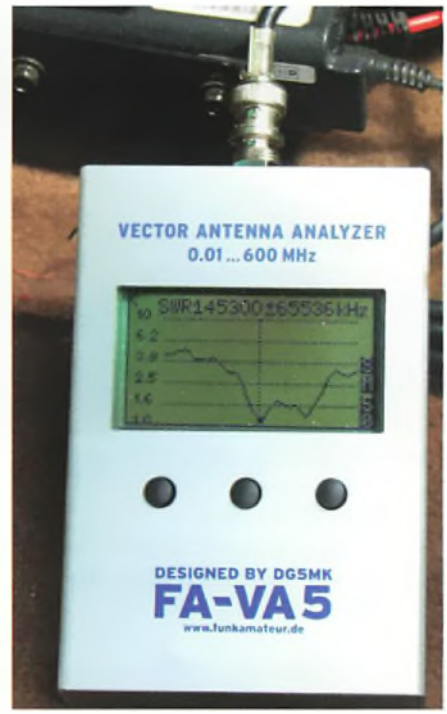

Fig. 8: Plot for the 7/8-wave whip antenna.

This left me to fit the rubber feet onto the case and then fit the board into the case. I took my time and construction took about an hour.

It is important to note that the VA-5 is a single-port VNA, a vector antenna analyser as SDR-Kits describe it, not a full dual-port device. Nevertheless, it will read phase as well as magnitude. It also has the ability to read SWR, return loss and complex impedance up to 1000Ω, including resistance and reactance.

Some handheld analysers lack the capability to calculate the sign for complex impedance. The VA-5, however, will display this (+j and –j). The unit can also be used as a grid dip oscillator (GDO) and a simple signal generator is included in the design with approximately 1V pk-pk output.

The VA-5 is menu driven and uses three front-panel buttons to step through and select the various modes, features and values, **Fig. 3**.

Measurements may be made on single frequencies, swept frequencies and by a Five Band mode, where measurements are made at, not surprisingly, five frequencies virtually simultaneously. Default settings for the latter are 1852, 3600, 7100, 14100 and 28200kHz but they can be reprogrammed. Information is displayed to the user in various ways as shown in **Figs. 4**, **5** and **6**.

The setup menu allows the user to preset a number of parameters. Examples are Master Calibration, 5 Band Frequencies, Time and Date (important for screenshots and datasets) and so on.

I found operation intuitive and had worked my way around the analyser within a few minutes, only reading the operating part of the manual afterwards! It is difficult to assess battery life because this depends to a certain extent on settings but quoted battery life is around 20 hours. The unit can also be powered via a PC USB port.

In Use

To get the best accuracy out of the VA-5 it really needs to be calibrated before it is used for each task. The unit follows the standard Short, Open, Load (SOL) method of calibration used for most VNAs. Provided in the kit are a 50Ω BNC load and two crimp-style BNC plugs for the user to make their own Short and Open, which should be good to 100MHz. The manual covers calibration so I won't repeat the process here.

I checked accuracy over a range of frequencies against the VNWA-3, using my 'standard' 50, 100 and 150Ω loads, which give 1:1, 2:1 and 3:1 mismatches. I don't have room to print figures here but the VA-5 returned figures very close to those from the VNA, only deviating slightly at the upper end of the range.

A useful feature of the VA-5 is the ability to measure inductance and capacitance. Importantly, the user can measure a component at any frequency (with care) within

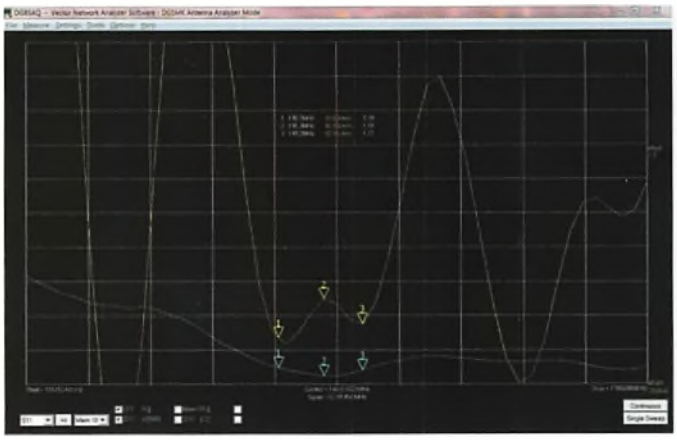

Fig. 9: Screenshot of Dataset for 7/8-wave whip.

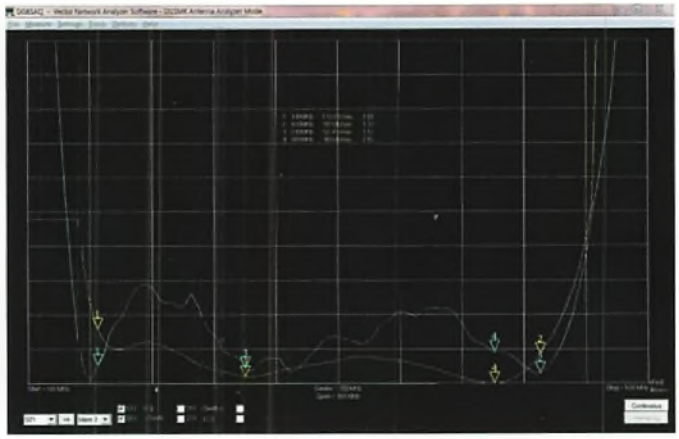

Fig. 10: Screenshot of sweep of after-market dual-band handie-talkie antenna.

its 0.010-600MHz range.

Measuring a range of capacitors and inductors again gave results comparable with those from the VNWA-3.

An Example Measurement

To demonstrate a simple antenna measurement, let's test a pair of mobile whips.

With an analyser like the MFJ269, an antenna is either measured at the end of a run of feeder, probably coaxial cable, where the feeder is measured as well as the antenna itself or, preferably, the analyser should be connected directly to the antenna and measurements taken there. However, using the VA-5 it is possible to accurately measure the antenna in its operational position while also taking the feeder into account.

By connecting the analyser to the system feeder at one end and the calibration kit at the other, the user can perform an SOL calibration. This way, the measuring point is located at the far end of the feeder where the antenna will be. Then, connecting the antenna to the feeder, measurements can be taken as if the analyser were connected directly to the antenna.

Because, in this case, the mount was a mobile SO239 fitting, I used an SO239-to-BNC adaptor to attach the BNC Cal Kit. For greater accuracy I could have factored the adaptor into the calibration but for this example did not do so.

My examples were a Diamond CR8900 and an unknown make 7/8-wave whip, both tested at 145MHz. The CR8900 was measured first and found to be way off the nominal 145MHz. Opening up the sweep range by using the buttons, I could see it was resonating high in frequency. I altered the VA-5's frequency to put the trace in the centre of the display and could see that 'resonance' was above 154.600 MHz with an SWR of nearly 1.8:1, **Fig. 7**. To cross-check I used my MFJ269 and this confirmed the reading – not good! I then fitted the 7/8-wave to the mount, **Fig. 8**. Here I found results considerably better. 2m resonance was found to be 145.300MHz with an SWR reading of 1.45:1. In this example I used the existing system cable.

If desired, a dedicated test cable could be kept and a master calibration carried out for use with the VA-5.

VNWA Software

As mentioned, the VA-5 can be interfaced with the excellent VNWA software, which has many advanced features. At first glance, it may seem daunting. However, it doesn't take long to get used to the more basic functions, while the informative help file will answer most questions.

The VA-5 can store up to ten Screen Snapshots and also 16 Datasets for later retrieval. All have a date and time stamp for identification. Datasets can be read into the VNWA software and analysed in much the same way as if they had been read from a VNA, although the data is fixed.

The screenshot, **Fig. 9**, shows the Dataset view of the 7/8-wave whip, which has been recalled into a memory in the VNWA software. Marker 2 shows the point centred on 145.300MHz. Marker details can be seen top middle of the display. I have only displayed two traces, in this case VSWR and R, but it is possible to display up to six, such as Impedance (Z) or Smith Chart. This plot can be saved by the software for future analysis or comparison. It can also be printed or copied to the clipboard for use in other documents.

When using a Dataset, data is fixed to what the VA-5 read at the time of saving. The VA-5 can be used as, and I quote, a 'Front End' to the VNWA software. In doing this, real-time measurements can be made in the same way as any other Single Port VNA.

The screenshot **Fig. 10**, taken in VNA Mode, demonstrates the real-time measurement of an aftermarket dual-band handie antenna. I set a sweep range from 100 to 500MHz and calibrated the VA-5 in software with the Cal Kit fitted to the BNC socket. I then mounted the antenna directly on the BNC socket of the VA-5 as if it were a handheld and carried out the sweep. Markers one and two are set for 145 and 430MHz respectively, those of three and four show the lowest SWR points. Had this antenna been adjustable, I would have been able to make alterations and easily monitor results 'on the fly'.

Further Information

I have barely touched on the VA-5's capabilities and uses but I hope the foregoing gives you some idea of its versatility. For more information, see:

https://tinyurl.com/y8f8b2al
www.dg5mk.de/pages/downloads.php

For details on VNAs, including information on S Parameters, see here:

https://tinyurl.com/ydxwk5lg

Personally, I find a vector analyser an invaluable accessory and I would suggest that anyone who experiments with antennas or RF networks will wonder how they ever managed without one!

Summing Up.

I believe the VA-5 represents good value for money. The kit is simple to build and comes with a good manual. The unit itself is easy to use and presents its data clearly in graphical format. Not only do you get a precise and versatile standalone analyser that can be taken anywhere, you also get access to the powerful VNWA software, giving you a sub-£200 VNA.

The present cost of the kit is £175 plus postage from SDR kits.

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

FT8 Thoughts and Developments

Mike Richards G4WNC reports on the latest developments to the popular FT8 software.

The introduction of FT8 has completely transformed HF data modes operating and activity more than any other system I can think of. The PSK Reporter (pskreporter.info) site is a good indicator of mode usage and has a table that shows the utilisation of data modes over the previous two hours. On most occasions when I've checked this, FT8 can be seen to be handling around 98% of data modes traffic! **Table 1** shows the utilisation of the top six data modes for a two-hour period on September 11th. This shows that FT8 is dominating data modes on the HF bands with CW in second place.

I think there are several reasons for the mode's amazing success. The most obvious reason is that FT8 is a foolproof communication system that works extremely well. **Joe Taylor K1JT's** development team includes some of the best brains in amateur radio communications and we get to enjoy the benefits through the WSJT-X suite of programs. Many have criticised FT8 because it stifles content and permits little more than the bare minimum to confirm a contact. However, if you look back at PSK31, RTTY and even CW, you will see that the desire for minimal (rubber-stamp) contacts has been with us for a very long time. It is therefore unfair to lay the blame on FT8 because it's simply fulfilling a demand. One of the other reasons for the mode's success is today's propagation conditions. Not only are we in the sunspot doldrums but we have an ever-increasing RF noise floor, thanks to the rapid spread of electronics and connected devices in the domestic environment. This is compounded by the cheap imported electronic products that flaunt the EMC regulations and the telecom operators that seem to be exempt from the rules when it suits them (Power Line Technology, PLT). The net result is very difficult operating conditions for many amateurs, particularly those living in our towns and cities. For those amateurs, FT8 has transformed the bands because they can continue to make contacts under these very poor conditions.

FT8 Future

All WSJT-X modes enjoy continuous development because Joe Taylor's team are always looking for improvements. The next release to get to us will be WSJT-X v2.0 and a Beta test version was expected to be launched in September or October this year. Keep an eye on the WSJT-X home page (below) for more news on the release dates.
https://tinyurl.com/hg6rnxm

Version 2.0 brings some significant changes for both FT8 and MSK144. In addition to improving the installation and upgrade process, v2.0 will bring support for many of the major contest message formats. To make room for the additional content, the FT8 information payload is being increased to 77 bits. The DXpedition mode is also undergoing improvement. A particularly welcome feature of v2.0 is its ability to use the contest and DXpedition modes seamlessly and automatically without using tick boxes. One interesting addition is the provision of a 71-bit telemetry message that can be used to send arbitrary information. Maybe this could be used to add some personalised messages to the FT8 QSOs.

As you may have guessed from the changes I've described, FT8 v2.0 will not be compatible with the existing FT8 system. As a result, the update to v2.0 is a mandatory requirement, once the testing period has finished. This shouldn't be an onerous task because one of the objectives of v2.0 is to simplify the update process. At the moment, the plan is to include dual working in the beta version of v2.0 so it can be used with the v1.9 software.

FT8Call

FT8Call is a new and rapidly developing, experimental, offshoot of FT8 that is examining the feasibility of a keyboard-to-keyboard mode by adding a messaging and network protocol layer on top of the robust FT8 mode. This new mode is neither endorsed nor supported by the main WSJT-X development team but is based on their WSJT-X GPLv3 Licensed code and is heavily influenced by both FLDIGI and FSQCall.

FT8Call uses two main message types, which are soundings and directed messages. Soundings are typically used as beacons to announce to all that your station is active and available, whereas directed messages provide a way to direct communications to a specific station. Within the directed messages there are several sub-modes that include command requests, acknowledgements, free text and free text relays, but more on this later. Channel allocation, **Fig. 1**, uses 1500Hz as the centre frequency with each channel occupying a 50Hz bandwidth and spaced 10Hz apart. This allows for up to 25 channels in a 1500Hz wide band centred on 1500Hz. If you'd like to know more about the inner working of FT8Call, there is a useful design document available for download on GitHub at:
https://github.com/jsherer/ft8call

From a protocol viewpoint, two important changes have been made. The first is to modify the CRC (Cyclic Redundancy Check) so that FT8 and FT8Call signals don't get confused and the second is to allow the full 75-bit payload to be used to transport data.

Using FT8Call

The first step is to get a copy of FT8Call and this is available for free download from:

https://tinyurl.com/ycj4223y

Downloads are available for Windows 7-10, Mac OS 10.11, Linux and Raspberry Pi. The Linux downloads are slightly unusual in that they are available in AppImage format. This is a very useful format that has the FT8Call software and all its dependencies wrapped up in a single package. To install the AppImage, you download the file to a directory of your choice and make it executable – that's it! FT8Call is also available in AppImage format for the Raspberry Pi, so installation is as simple as it gets. For those that are interested, I've now added FT8Call to my *Data Modes* microSD cards for the Raspberry Pi, see my website: www.g4wnc.com

The Windows download is a standalone EXE installer that you can run from the download folder in Windows. Setting up FT8Call is pretty much the same as WSJT-X, but I've shown the step-by-step process here:

1. Use the File – Settings menu and the General tab to enter your callsign, locator and station details, **Fig. 2.**
2. Move to the Radio tab and enter your radio details, if you're using CAT. If you'd rather use VOX, that's fine, and you should leave the radio set to None.
3. The next step is to use the Audio tab to select the appropriate soundcard.
4. Finally, I recommend enabling spotting in the Reporting tab. When using a new mode such as FT8Call, it's helpful to advertise your presence and report your spots to help new users find each other, **Fig. 3.**

During the download, you may have noticed that FT8Call has a time-limited licence. This has been done to force operators to use the latest software version. This is particularly important for a new mode such as FT8Call because the software is frequently updated to remove bugs or add new features.

In my experience with FT8Call, 20m is the most active band during the day with 40m being the best bet for evenings. As with most amateur modes, the weekends are the busiest. To help you get started, I've shown a screen capture of the main screen, **Fig. 4.** As you can see, the screen is divided into four text panels. The left-hand panel shows band activity across all channels, while the

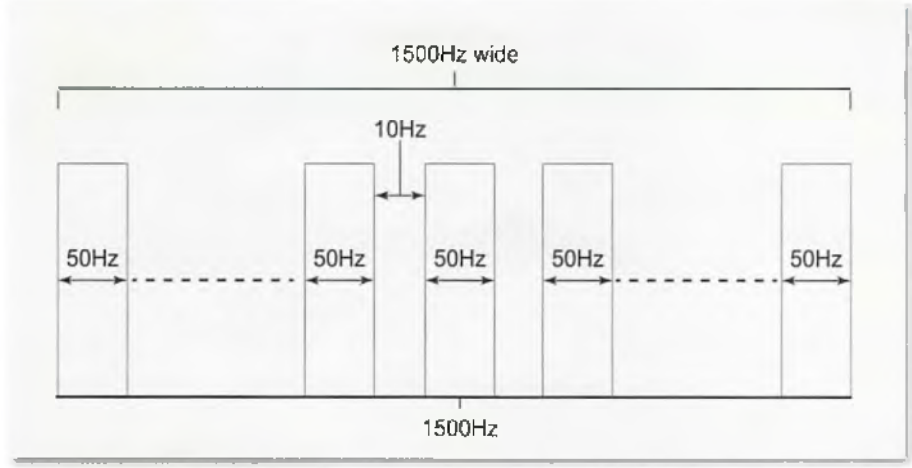

Fig. 1: FT8Call channel allocations.

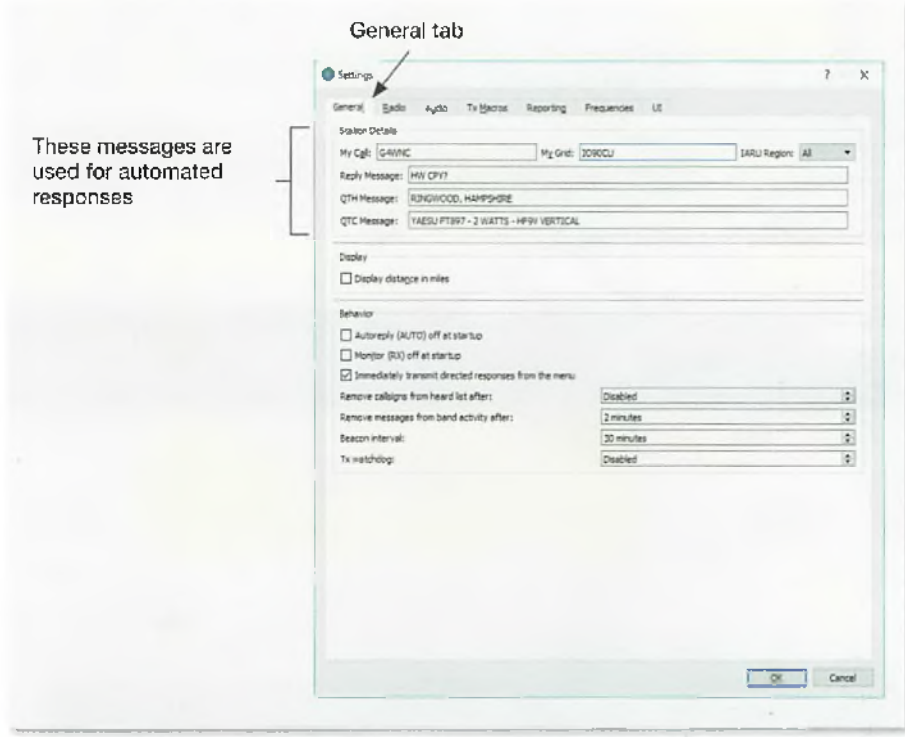

Fig. 2: FT8Call entering station details.

Data Mode	Number of active stations	Percentage
FT8	311895	98.91%
CW	1568	0.50%
SIM31	787	0.25%
FT8Call	674	0.21%
PSK31	215	0.07%
JT65	208	0.07%

Table 1: PSKreporter (pskreporter.info) two-hour analysis, September 12th 0918UTC

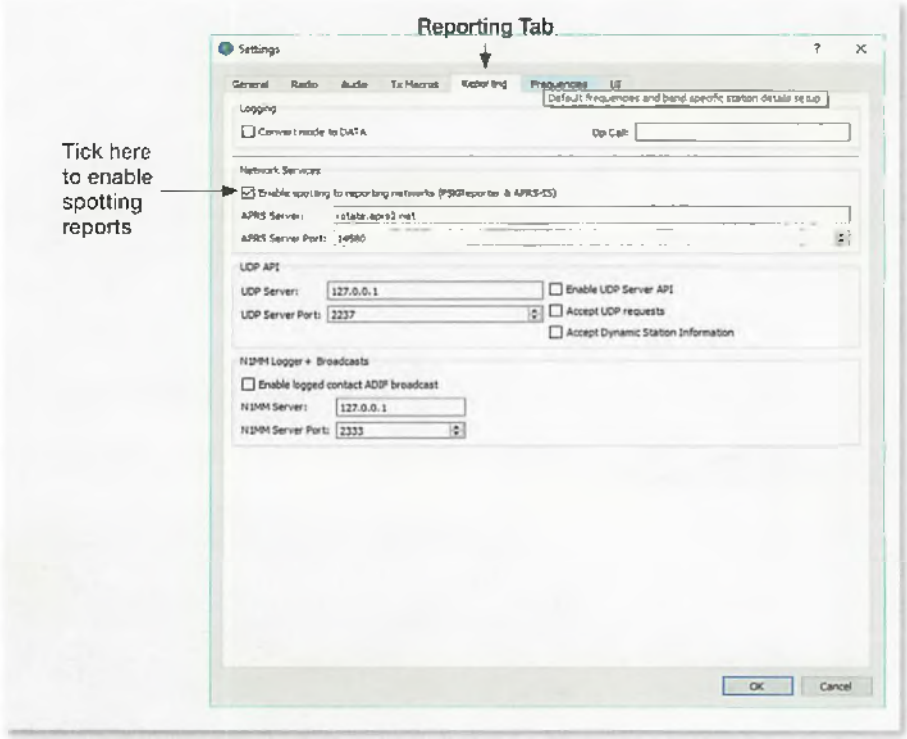

Fig. 3: FT8Call enabling spot reports.

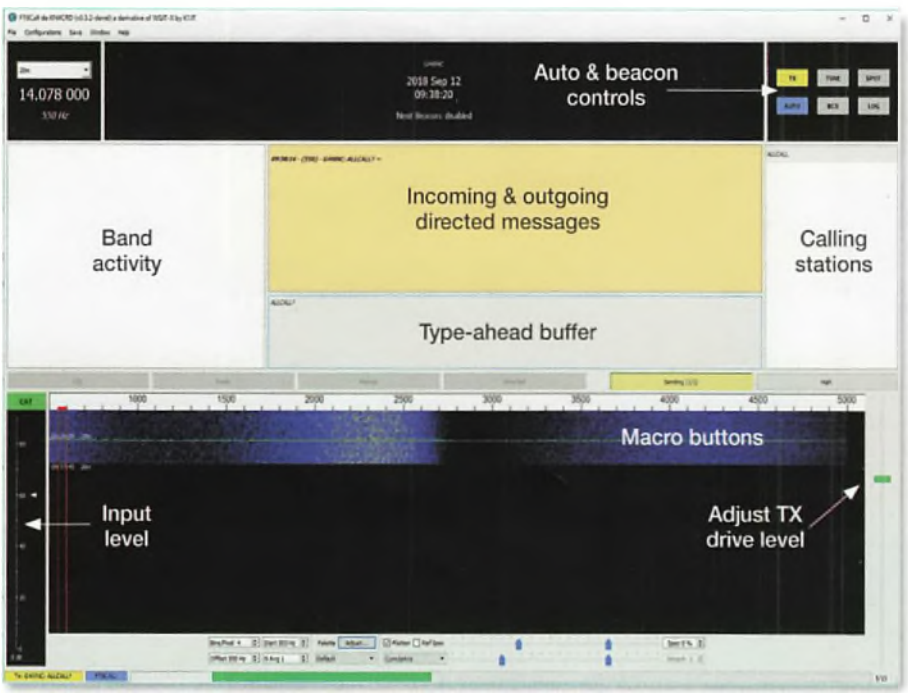

Fig. 4: FT8Call main screen controls.

right-hand side shows calling stations and when they were last seen. The central section relates to your station with the top part displaying all the incoming and outgoing directed messages. The bottom section is your type-ahead buffer where you enter transmit commands and messages. Looking at the top right of the main screen, you will see a set of control buttons and you should make note of the Auto and BCN buttons because these activate the automated features of FT8Call. Auto activates the transmission of automatic responses from your station such as SNR, heard list and so on. The BCN button activates the beacon that transmits your callsign and locator at regular intervals with a default interval of 30 minutes.

The beacon is a useful feature in a new mode because it lets other operators see that you are on frequency. The beacon uses the current tuned frequency, unless it's busy whereupon it will select a random free channel. In the current version, the beacon cannot detect if you're in a QSO, so can transmit on top of your QSO. I suspect this will be fixed in a later version but the simple fix is to disable the beacon when you start a QSO. Please note that the beacon and Auto modes should only be used while you're in control of your station: they are not for unattended operation.

Starting to Operate

Before you start operating, I suggest you spend time monitoring the bands so you can see how FT8Call is being used. This is particularly important with a new mode because operating methods often change as the mode develops. I also recommend that you get a copy of the FT8Call pre-release documentation. This is available from:
https://goo.gl/Bs8TG3

You will also find a set of operational guides on the FT8Call site here:
http://ft8call.info/guides

One particularly interesting feature of FT8Call is the directed calls that can be used to solicit a response from other stations. For example, ALLCALL? will trigger all stations that can hear you and have Auto enabled to send your SNR (Signal-to-Noise Ratio). This is particularly useful for discovering stations that are within range, so you can follow up with a directed QSO. To start a QSO with a specific station, begin with the callsign of the station you want to contact, followed by the message, such as *"G4LFM How copy?"* You don't need to add your own callsign because this is automatically added by FT8Call, so the actual transmitted message becomes: *G4WNC: G4LFM How copy?* If you carry out all your QSOs in plain language using FT8Call, they can take a while to get through so it is common practice to use CW abbreviations to help shorten the message. One other important point to note is the end of message symbol ⌁. Because messages can span several 15 second frames, FT8Call uses the lightning symbol (⌁) to mark the end of a message.

That's all I've got space for this time so next time I'll show you how to use some of the more advanced features of FT8Call. If you want to keep up to date with FT8Call developments, I recommend joining that mailing list at:
https://groups.io/g/ft8call

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Pointers, Hints & Tips

Colin Redwood G6MXL passes on a few pointers that newcomers to the hobby may find helpful and a number of hints and tips for already established radio amateurs.

Undoubtedly one of the most common questions asked by newcomers to the hobby is what antenna to use. Although I don't recommend it, in reality, just about anything made of metal can be made to 'work' – I've even had a QSO across town on 70cm with a dummy load being used at the other end of the QSO, albeit I was using a multi-element Yagi! Anything that allows you to make a contact can be said to 'work'. However, there is a world of difference between an antenna that just 'works' and something that facilitates making numerous contacts.

If you are keen to explore the HF bands, it is very tempting to choose a multi-band antenna so that you can easily experience the different bands simply by switching band and matching the antenna system to your transceiver with an ATU. Many amateurs choose either the half-size G5RV (named after its inventor, **Louis Varney G5RV**) or end-fed verticals of one sort or another. While both of these antennas will work, I would suggest that they are not the best choice in many circumstances – they are not inherently resonant on most bands (it needs to be appreciated that when G5RV devised his antenna, the 30, 17 and 12m amateur bands didn't exist, so we cannot necessarily expect it to provide a good match on those bands).

The half-size G5RV is a noisy antenna, in that it will tend to pick up more noise than a similar size dipole. With a half-size G5RV you'll also need to use it with a good ATU that can match it to your transceiver on the various frequency bands. If you don't already have an ATU, then the cost of a suitable ATU will easily exceed the cost of the antenna.

Vertical antennas work better with radials than without. Those sold to operate without radials employ an un-un (unbalance-to-unbalance transformer, often of 9:1 ratio) to help match them to reactances that a typical ATU can handle. Even with an un-un, the built-in automatic ATU of some transceivers can only handle a limited range of reactances, so you may find that you still can't get a good match on some bands. If you use radials, then you'll need at least one separate quarter-wave long radial for each band that you want to use. For better performance you should aim for three or even more radials per band.

A vertical will only perform well if it has a clear take-off towards the horizon. You'll not get the full benefits if you are surrounded by local housing or trees such as found adjacent to many back gardens of modern properties built on estates. Furthermore, you'll not get the full benefits of verticals if the ground is dry. In many parts of the British Isles, the soils are sandy and hence tend to be free-draining and thus dry. Verticals perform best when they are over salt water – hence their use on the LF bands by DXpeditions to islands when they can be erected on the beach with a clear take-off to the horizon over the sea to get the full benefit of low-angle radiation *(In contrast, a horizontal antenna should be at least half a wavelength high to achieve reasonable results at the low take-off angles needed for long-haul propagation, beyond the scope of many DXpedition operations. See also this month's RWWR article – **ed.**)*.

I'm still firmly of the view that in typical urban environments a half-wave dipole for your chosen band is a good choice for an antenna. True, a half-wave dipole is essentially a single band antenna but it really does take some beating. *PW*'s HF author, **Steve Telenius-Lowe PJ4DX** in the RSGB's excellent book, *Successful Wire Antennas*, **Fig. 1**, describes the dipole as "*perhaps the most effective, yet simple, single band antenna, and one which can be virtually guaranteed to perform well even when used in far-from-ideal situations*".

In many installations, a half-wave dipole will be below a half-wavelength above the ground, so there won't be much really low angle radiation but this is one of the reasons why it is less noisy than a vertical. If you are on a tight budget, then with a half-wave dipole you don't need the additional expense of an ATU if you stick to the band it's designed for.

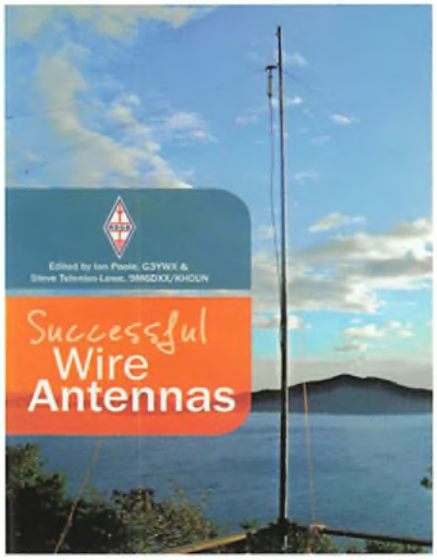

Fig. 1: The RSGB's Successful Wire Antennas book by Steve Telenius-Lowe PJ4DX.

If you are looking to operate on more than one band, then consider a trapped dipole, or a fan of dipoles. If you are able to raise and lower a dipole easily, then I've found that swapping either single band dipoles or even trapped dipoles can be a good solution, although for safety reasons I try to limit this to dry daylight hours. It's not much fun trying to change antennas on a cold dark winter's night when it is bucketing with rain or frosty.

In many cases, amateurs who use antennas that just 'work' rather than perform well are reliant on the station at the other end of the contact to have a better performing antenna to not only hear weak signals but also to transmit a strong signal.

It Takes Two to QSO

Just as it takes two to tango, it takes two stations to make an amateur radio contact. The better the antenna system at each

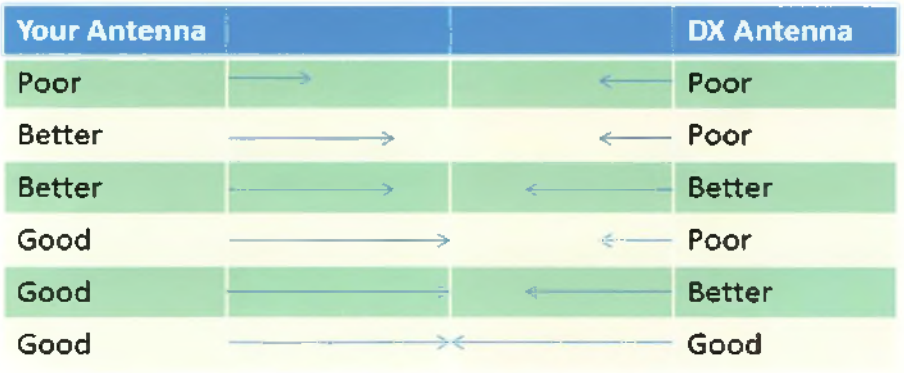

Fig. 2: Limited contacts using various antennas under worse than average conditions.

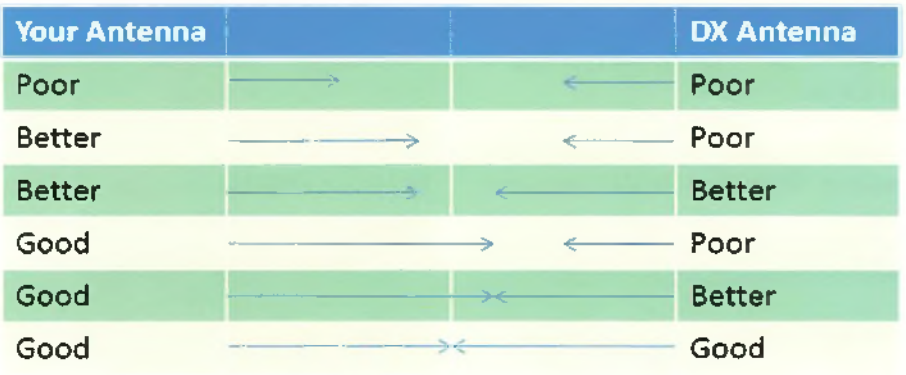

Fig. 3: Slightly better contacts using various antennas under average conditions.

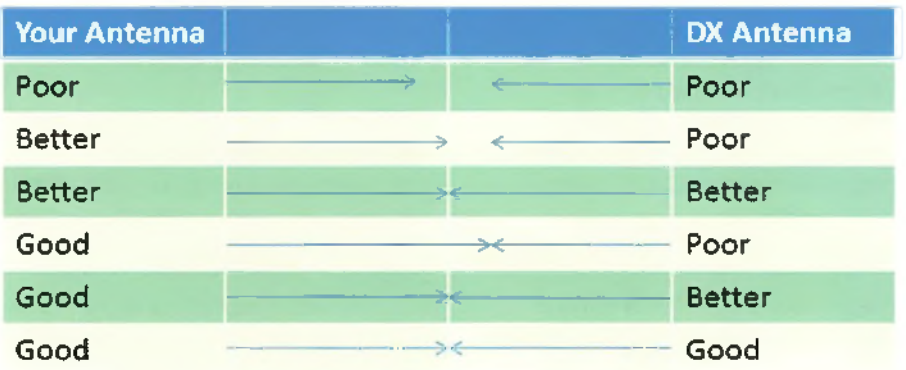

Fig. 4: Much better contacts using various antennas under better than average conditions.

end, the better the chance of a contact. In the diagrams, **Figs. 2**, **3** and **4**, I've tried to illustrate the point, showing how better antennas enable contacts to be had even when propagation is not too good. The diagrams show how stations with a poor antenna system can be missing out on contacts. Please bear in mind the diagrams aren't intended to represent any particular antennas or propagation, just the principle. I've assumed the same feeder loss, transceiver, power and mode being used throughout.

Experiment

Why not carry out some experiments with some other local amateurs? Put up an end-fed vertical, a half-size G5RV and a half-wave dipole for 20m. Now conduct some tests comparing how far your signals are heard. You could use WSPR or the reverse beacon network to see how well you are being copied from each antenna. Alternatively, just use your ears as you switch between the antennas. I would suggest repeating the tests several times to get an average reading in case propagation changes. Don't forget to match the antenna systems to your transceiver each time before transmitting.

Digital Voice

There are three main digital voice technologies currently available for the VHF and UHF bands. In no particular order these are Fusion/C4FM, DMR and D-STAR. The first thing to note is that they are totally incompatible with each other (see **Table 1**). For example, a DMR transceiver cannot resolve an audio signal from a C4FM transceiver and vice versa. If I say they are more incompatible than Betamax and VHS video recorders were, then I hope that more senior readers will grasp the point I am making. So, a D-STAR repeater will not recognise a DMR transmission and vice versa. I'm sure I'm not the only amateur who refuses to be tempted by the various digital voice modes due to these incompatibility issues.

If you are thinking of buying a transceiver that uses one of the digital voice modes or one that incorporates a digital voice mode in addition to other (analogue) voice modes (SSB, FM), then I would suggest that you get in touch with other amateurs in your area to find out which digital voice modes are popular in your area and what activity is like on the digital voice mode repeaters that are available in your area.

Digital Voice and Bandplans

The VHF and UHF bandplans have been built up over many years of analogue (FM, SSB, CW) use. In recent years, these bandplans have evolved to incorporate digital voice modes (shown as DV in the published bandplans). So, for example, the 2m calling frequency for digital voice modes is 144.6125MHz while the FM (analogue) 2m calling frequency remains on 145.500MHz.

'DX' and Digital Voice

There are various technologies that can be implemented to link local digital voice repeaters with other regional, national and international repeaters. It is quite feasible for a UK station to speak to an amateur in Japan or Australia, for example, just as they can using Echolink with analogue signals. Most of these rely on an internet connection to enable these 'DX' contacts to take place.

Most mainstream awards, including DXCC for example, only credit contacts made without the use of repeaters or the internet so a digital voice contact between the UK and Japan won't count towards DXCC if it has been made using a repeater. That said, DXCC does have a satellite option for its awards (a satellite simply being a very high repeater!).

Nevertheless, many newcomers to our hobby are getting a real buzz out of speaking to other amateurs all around the world using digital voice modes. They may also appeal to those who can

```
115830  Tx          344 ~  CQ G6MXL/P
115900  Tx          344 ~  CQ G6MXL/P
115915  -1 -1.5     344 ~  G6MXL/P PF0IS
115930  Tx          344 ~  PF0IS G6MXL -01
115945  -2 -1.4     344 ~  G6MXL/P PF0IS
120000  Tx          344 ~  PF0IS G6MXL -02
120015  -2 -1.4     344 ~  G6MXL PF0IS R-09
120030  Tx          344 ~  PF0IS G6MXL RRR
120045  -3 -1.5     344 ~  G6MXL PF0IS 73
120100  Tx          344 ~  PF0IS G6MXL 73
120200  Tx          344 ~  CQ G6MXL/P
```

Fig. 5: An FT8 QSO made by the author operating G6MXL/P. Note that the /P is missing from most of the overs. The full call will have been written to the FT8 log at both ends of the QSO.

no longer operate HF due to antenna or other restrictions. They could be an excellent way to keep in contact with fellow amateurs around the world from a retirement home, for example.
www.hamdigitaal.nl/?wpfb_dl=194

FT8 Callsigns

This year I've operated away from home on several occasions. Although I upload my contacts to eQSL in addition to Logbook of the World (LoTW), I don't actively use eQSL very much. When I logged on recently, I noted a number of stations claiming contacts with me that didn't feature in my log. On digging a bit further, they were all FT8 contacts that had occurred when I was operating away from home. They had all omitted the /P off the suffix that I was using. They were trying to confirm a contact with G6MXL when I was using G6MXL/P or GW6MXL/P at the time.

Why was this happening? Well the pre-defined format of messages that FT8 uses is limited to 16 characters. While FT8 can handle a seven- or eight-character callsign such as G6MXL/P or GW6MXL/P when calling CQ, it cannot include both callsigns in full in messages with other information such as the report, **Fig. 5**. I suspect that the stations had copied my callsign from an FT8 message during an over when the software had excluded the /P from my callsign. These longer callsigns are termed Compound Callsigns in the FT8 documentation, which describes in some detail how they are handled in the current version of WSJT-X used for FT8.
https://tinyurl.com/yahsagxq

A new version of FT8 that supports longer messages is currently being developed by the WSJT-X team. I understand this will enable longer callsigns to be handled in all messages. I suggest readers keep an eye on the website:
https://tinyurl.com/mmfjh38

Finding Your Locator

For many years I've been using the Google Maps-based system developed by **Laurent HAAS F6FVY**, to find my locator from a map. I've mentioned it in several *What Next* columns over the years. At the time of writing it appears to have stopped working due to some Google Map restrictions:
http://qthlocator.free.fr/index.php

I've been made aware of an alternative that provides similar functionality and which can be found at:
https://tinyurl.com/yb6ea6tv

Incidentally, the HA8TKS DX Cluster has some interesting features, including the ability to choose what columns you see, including for example the locator of the DX station – which could particularly appeal to those taking part in the ARRL's Grid Square Chase.

AVO Meter Manuals

I mentioned AVO meters as a good choice for buying second-hand a couple of months ago. I am grateful to **Bob Houlston G4PVB,** for pointing me to a useful source of manuals not only for AVO multimeters but also AVO valve testers (and see also Bob's other recommendations in his Letter in last month's issue):
https://tinyurl.com/ybuqqvye

CTCSS for Older Transceivers

If you have an older VHF or UHF transceiver, you may find that it isn't fitted with a CTCSS board. I received an e-mail from **Brian Williams GW0GHF** looking to source a suitable board for his Yaesu FT-736R. It appears that the original Yaesu FTS-8 board has been discontinued but Piexx Computers and Electronics in the USA do a range of CTCSS boards for a number of mainly Yaesu transceivers:
www.piexx.com

D-STAR	DMR	FUSION	
Vocoder	AMBE+	AMBE+2	AMBE+2
Modulation	Gaussian Mimum Shift Keying (GMSK)	4-level Frequency Shift Keying (4FSK)	Continuous 4-level Frequency Modulation (C4FM)
Multiplex Method	Frequency Division Multiple Access (FDMA)	Time Division Multiple Access (TDMA)	Frequency Divisinn Multiple Access (FDMA)
Transmission rate	4.8 kbps	4.8 kbps x 2	9.6 kbps
Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz
Channels supported	1	2	1

Table 1: Some of the principal differences between D-Star, DMR and Fusion digital voice modes.

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Doing it by Design by Eric Edwards GW8LJJ

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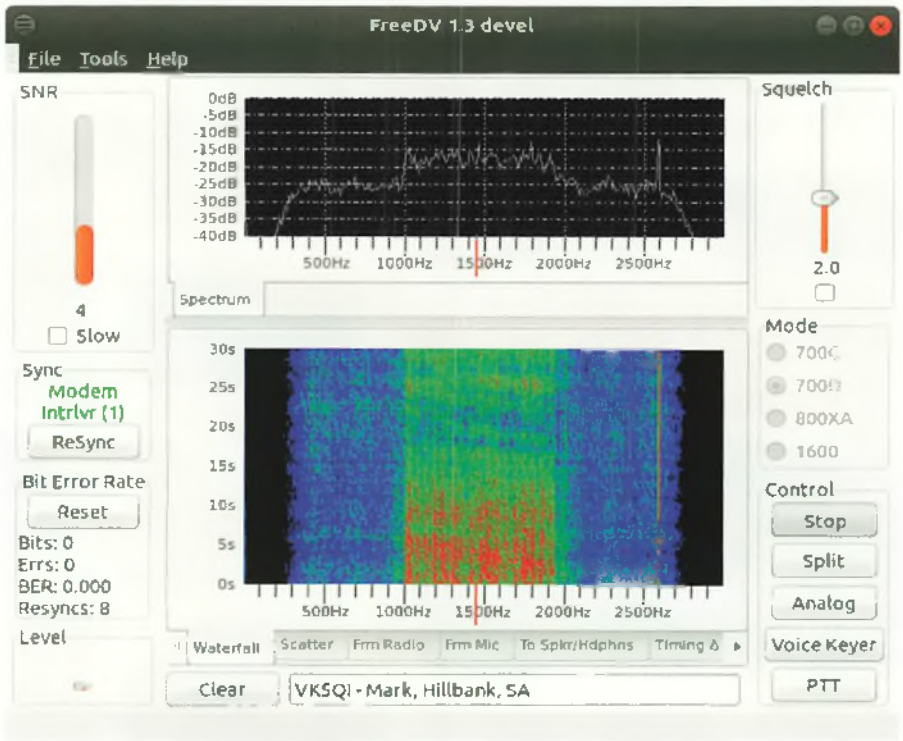
Digital Voice for HF

We have something a little different for this month's column. Eric Edwards GW8LJJ introduces FreeDV, the mode that is becoming the de facto solution for digital voice on the HF bands.

Many of you will be familiar with digital transmissions on the HF bands. These are usually RTTY, PSK31, WSPR and other data modes. This article is an introduction to digital voice. Again, there will be many that already know about voice communications using digital modes such as APCO, D-STAR, Fusion, DMR and NXDN. These have bandwidths that are too wide for the popular bands such as 80, 40 and 20m and are restricted to the upper VHF and UHF bands.



What's Different?

FreeDV is a digital voice system that is well suited for use on the popular HF bands and that includes 60m. As the name suggests, it is free! Also, any SSB transceiver can be used. There is no special radio or internet connection other than downloading the FreeDV software, which is simplicity itself and it can be downloaded onto any PC.

FreeDV

You can run FreeDV using a free GUI application for Windows, Linux and OSX that allows any SSB radio to be used for low bit rate digital voice. There are several reports of the new FreeDV 700D mode outperforming SSB at low signal-to-noise rations (SNRs). At high SNRs FreeDV sounds like FM, with no annoying analogue HF radio noise. Speech is compressed and then modulated onto a 1.00kHz wide signal, which is sent to the microphone input of an SSB radio. The signal is received by an SSB radio, then demodulated and decoded by FreeDV. FreeDV is unique in that it uses 100% Open Source Software, including the speech codec. No secrets, nothing proprietary! FreeDV represents a path for 21st century amateur radio where radio amateurs are free to experiment and innovate, rather than a future locked into a single manufacturer's closed technology.

FreeDV has been around for several years now but is starting to come of age, both in its development and usage. Modems are available, should you not want to use your PC and sound card but in this article I will focus on the software solution so that you can try FreeDV at no cost.

Should you want to know more, ther FreeDV website (below) is the place to find the answers – it has links, videos, history and much more.

http://freedv.org

What is Needed?

As an introcuction to this mode it will prudent to start with a receive version. To receive FreeDV the software can be found on the FreeDV website, mentioned above. Scroll dowr the page until you reach the heading Download. The selection of software is available for different PCs and Windows has two versions, 32-bit and 64-bit. My setup is XP, which is 32-bit, and I also use Win7, which is also 32-bit. Others use Win10. You may have Win 10 and a new PC that has 64-bit so that will be the one you will need. Either way, once installed the software can run on a PC with no need for an internet connection. To receive the FreeDV transmissions it is only necessary to connect the output (headphones or loudspeaker) from your radio and tune for the digital voice signals. On the website there is a list of popular frequencies used for UK and other countries and I have included a list here as well (**Table 1**).

How Wide is the Signal?

The screenshot, **Fig. 1**, shows a comparison between two SSB signals (seen at the right) and a FreeDV signal (to the left of the SSB signals). The SSB signals are typically 3kHz wide whereas the FreeDV signal is just 1kHz wide! This screenshot was provided by **David Rowe VK5DGR**.

What about the Audio Quality?

Although this is digital voice and is

very narrow in comparison to the SSB transmission, it has an adequate dynamic audio range and the audio spectrum is typically as good as an average SSB signal but without the noise. The bands are getting a lot noisier and an SSB signal can be lost in the 'bacon and eggs' frying in the foreground. With FreeDV there is no noise. It is completely clear and the voice is punchy even when the received signal levels drop several 'S' points. Tests have been made with transmissions using SSB and FreeDV and showed that when a received SSB signal falls to, say, S5 it is unreadable whereas the same transmitter and power using FreeDV received S5 is no different to it being received at S9.

Setting up for Receiving FreeDV

To use FreeDV for receive only, and this will be a good starting point to get used to tuning in and listening to the digital transmissions, open the FreeDV software by clicking (or double-clicking) on the icon. Once opened, at the top left of the page you will see 'File Tools and Help'. Click on Tools and on Audio Config in the drop-down menu (first one in the list). A window will open in the centre of the main window and at the top of the upper window is labelled From Radio. Look for the soundcard installed in your PC and mouse-click. It will show the card in the aperture below, labelled Device. To verify that you have selected the correct one and with the radio output connected to the PC soundcard input (line in), press the Rec 2s button (and wait two seconds) seen on the right-hand side of the top window. If it is correct and the radio is producing an output, which can be noise or speech, there will be an indication of input from the radio as seen in **Fig. 2**. There is another aperture labelled Sample Rate and that will show 44100. Leave that as it is or change if it is different from a list in the drop-down menu.

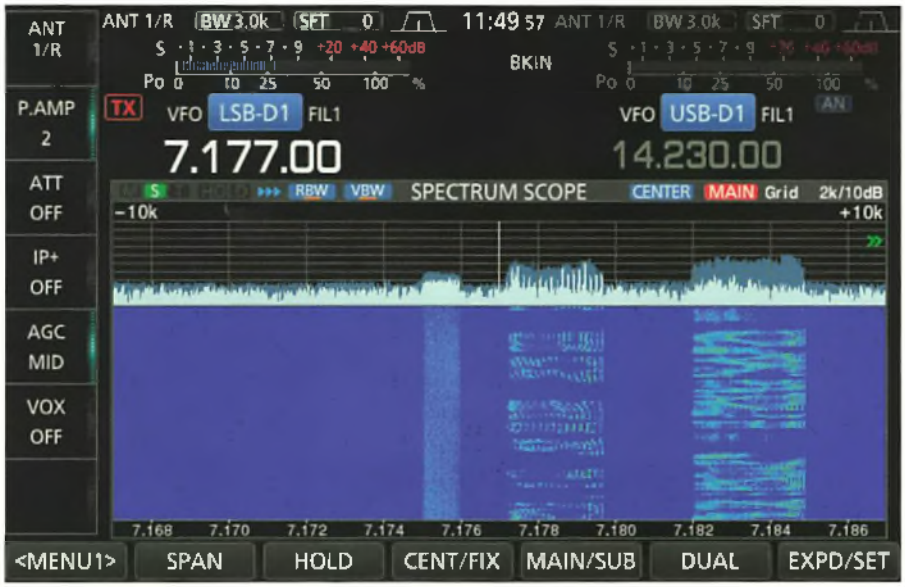


Fig. 1: A comparison between the spectra of FreeDV and SSB signals.

The bottom window is labelled To Speakers/Headphones. Under the heading Device is a list of items and the one you need to select is your soundcard. To verify that the correct one is selected, press the Play 2s button (and wait two seconds) and it will produce a note in your soundcard speaker.

Once that has been set up, click the 'X' at the top of the window inside the main one then press start and Analogue to hear your signals from the radio. The analogue button allows straight-through listening from the radio but when a digital signal is being received the Analogue button has to be depressed.

Your FreeDV has now been set up for receiving the digital voice signals and there is a choice of modes, 700C, 700D, 800XA and 1600. The popular ones are 700C and 700D. Some are using 1600 but most are experimenting with 700D and

Australia VK5
7.177MHz
Every Sunday 10AM Local
WIA Broadcast and call back

Australia VK3
14.150/14.153 MHz
Every day at 3 and 4pm AET
Casual QSOs

Netherlands
3.720 MHz in USB
Every Sunday 1000UTC
Net

UK
3.643MHz LSB
Sundays mornings at 09:00 Local
RSGB broadcast by Matt G6WPJ

UK
3.697 MHz LSB 700D
1600 Local
Casual QSOs

USA
14.236 MHz USB
Anytime
Casual QSOs

Table 1: Frequencies currently used for FreeDV.

Fig. 2: The software, showing audio being received from the radio.

this is the mode we are using in the UK on 3697kHz at about 1600 (local) daily. There are developments progressing to improve this system of digital voice operating and many of us are convinced this is the way forward in amateur radio and can be compared with the transition from AM to SSB in the 1950s and 1960s. As with those other newer modes, it is not a complete changeover and they work side by side as is evident with AM still having a large following. Band conditions are getting worse for noise and FreeDV is one answer to the problem.

History

In 2012 FreeDV was coded from scratch by **David Witten** (GUI, architecture) and **David Rowe** (Codec 2, modem implementation, integration). The FreeDV design and user interface is based on FDMDV, which was developed by **Francesco Lanza HB9TLK**. Francesco received advice on modem design from **Peter Martinez G3PLX**, who has also advised David on the FDMDV modem used in FreeDV. **Mel Whitten K0PFX** has contributed greatly to the design, testing and promotion of several Digital Voice systems, including FDMDV. This practical experience has led to the current design – a fast sync, no FEC, low latency system that gives an 'SSB' type feel for operators. Mel and a team of alpha testers (**Gerry N4DVR; Jim K3DCC: Rick WA6NUT; Tony K2MO**) provided feedback on usability and design of FreeDV. **Bruce Perens** has been a thought leader on Open Source, patent free voice codecs for amateur radio. He has inspired, promoted and encouraged the development of Codec 2 and FreeDV.

Credits

FreeDV is being maintained and extended by David Rowe VK5DGR. **Richard Shaw KF5OIM** maintains the Cmake build system, Windows and Fedora packaging. **Walter K5WH** is leading Windows testing in the USA. Debian packaging thanks to **A Maitland Bottoms AA4HS** and the Debian Hamradio Maintainers. **David Tiller K4DET** is kindly building OSX images for the project. As development continues, many others are becoming involved and their efforts are appreciated.

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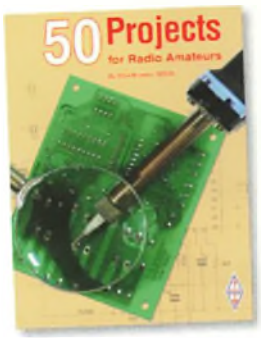
Book of the Month



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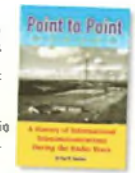

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• E-mail: g4aqb@outlook.com

A Simple Topband Converter for an R1155 Receiver

Steve Macdonald G4AQB describes a topband converter that can be used with receivers (typically, ex-military and similar) that don't cover that part of the spectrum.

When I first got my licence back in 1971, topband (160m) was very popular for AM contacts. At the time there were lots of ex-ministry and WWII receivers available, including the famous R1155 receiver. One limitation with some of these receivers was the lack of topband coverage, the R1155 included. I remember tweaking the coils of an old R109A receiver to make it cover 1.8 to 2.0MHz and used it as my first receiver.

I have always wanted an R1155 receiver and to be able to spend a bit of time renovating and modifying it for my own use. Recently I acquired an early version of the R1155 and began to work on it. I now have it working fine. Only a couple of later versions of the R1155 (the L and N models) had topband. Most versions covered 3.0 to 18MHz along with the medium wave (MW) and long wave (LW) bands. I found various old circuits and articles for converting the receiver to topband, ranging from valve converters to major tweaking of the trimmers in the RF unit, which I did not want to attempt!

After a bit of research, I came up with a simple solution that uses just a handful of components and is based around an NE602 integrated circuit. This is a versatile 8-pin device and is frequently used in superhet and direct conversion receivers.

The NE602 is a double balanced mixer with a built-in oscillator. Although it can be used in various configurations, it is used in its simplest form for the Topband Converter. The circuit is shown as **Fig. 1**. It just requires a tuned input inductor covering 1.8 to 2.00MHz, a suitable crystal and a power supply.

Choice of Tunable IF

Because the R1155 receiver covers the MW band of 600 to 1500kHz, I decided to use this band for the converter output frequency. This part of the spectrum has a wide bandspread on the R1155 tuning dial. The mixer will change an input frequency of 1.8 to 2.00MHz between pins 1 and 2 to an output frequency of 800 to 1000kHz on pin 5. To achieve this, a 1MHz crystal is required in the crystal oscillator tuned circuit on pins 6 and 7 with the capacitors C3 and C4 set to appropriate values. These values are C3=100pf and C4=1000pf for use with a 1Mhz crystal. The NE602 mixer will produce an output of 800kHz (1.8MHz – 1.0MHz), although it also produces an output of 2.8MHz (1.8MHz + 1000kHz),

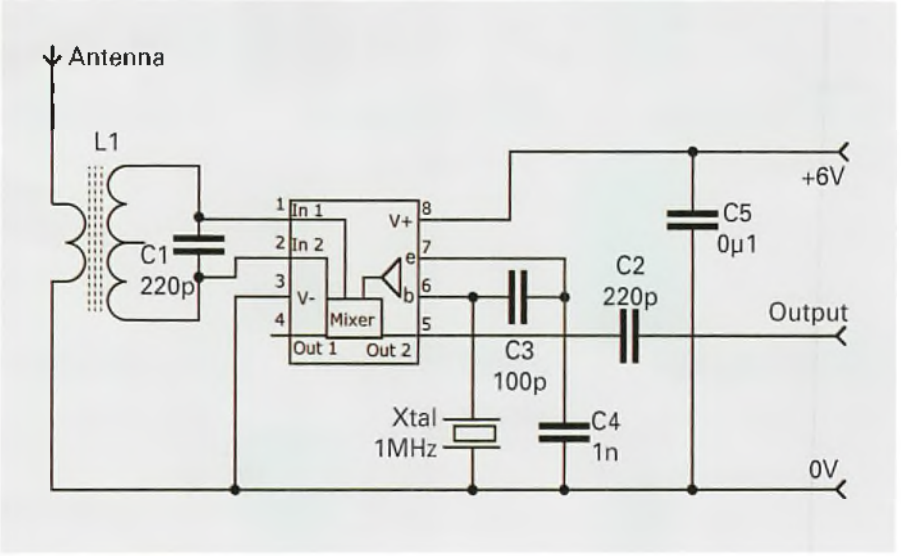


Fig. 1: Circuit diagram.

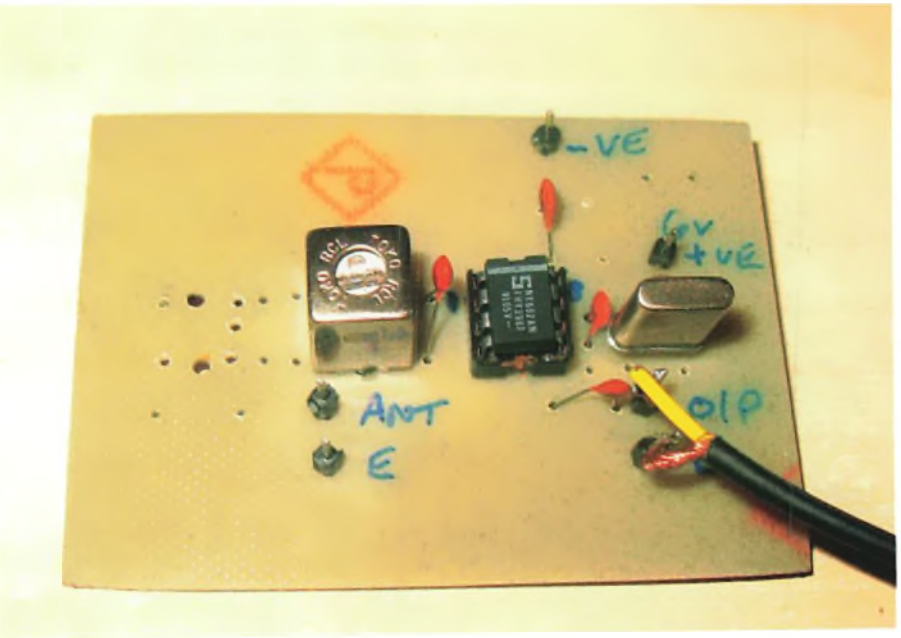


Fig. 2: The printed circuit assembly

the image frequency. This has not been a problem because the front-end tuning inductor is selective enough to eliminate the image frequency. At first, I was going to add an extra inductor stage to the front end but found it to be unnecessary.

The input inductor (L1) can be any TOKO type coil tuned to approximately 1.9MHz. Although TOKO type KANK3333R 10mm coils are hard to find these days, equivalents are available. I got mine from Spectrum Communications.

Construction

I built the converter unit on a small printed circuit board, **Fig. 2**, but because there are few components, it can easily be built using a 'dead bug' type of construction. In Fig. 2 you can see that I also included holes for an additional front-end inductor and tuning capacitors. The unit requires a supply voltage of approximately 6V. After testing first with a bench power supply, I used a rectified 6.3V heater voltage taken from pin 2 of the Tuning Indicator valve in the R1155 receiver. This consists of a single 1N4005 diode smoothed with a 3300µf 25V capacitor, giving an output voltage of 6.3V DC.

I added a 4-pole 3-way rotary switch to the front panel of the R1155 so that the converter can be switched in and out as well as having a mute facility for earthing the receiver antenna input if required. Unused tags on the rotary switch were used to mount the printed circuit board inside the R1155 receiver, **Fig. 3**.

Testing

I tested the unit on the bench first of all without the switch in place. I connected an antenna to the input pin and a lead from the output pin to the antenna input of the R1155. Using 6V from a bench power supply, I set the wavechange switch on the R1155 to 1500 to 600kHz and tuned to 900kHz on the dial (1.9MHz when converted). On switch-on you should hear noise coming through with an antenna connected. Using a suitable adjusting tool, peak the inductor for maximum noise. Depending on the inductor used, the capacitor C1 may need a different value in order for the inductor to peak half-way up the core. I found that 220pF was the best value to use.

If there is no noise at switch on, set the dial on the receiver to 1000kHz (1MHz) and listen. You should hear the crystal oscillator working. If you can't hear it, check the oscillator circuit C3, C4 and X1, ensuring that you have the value of the capacitors correct because they can be critical.

I found that the converter works very well. The NE602 is very sensitive and stable, giving an output that suits the R1155 receiver front-end. A couple of additions could be considered, such as a tuned output inductor and an additional tuned circuit on the input, but I was quite happy with the operation of the basic circuit.

Although the converter was used in an R1155 receiver, it could be used in any older receiver that does not cover topband but has Medium Wave. This could be built as an external unit in a small box. The converted output frequency can also be changed in order to convert to a different frequency by simply changing the crystal frequency and values of C3 and C4. The values can be calculated from the following formulae: C3 = 100 √ F(MHz), C4 = 1000 ÷ F(MHz)

The photograph, **Fig. 4**, shows the modified R1155 – the 160m switch position is on the switch to the right of the front panel.

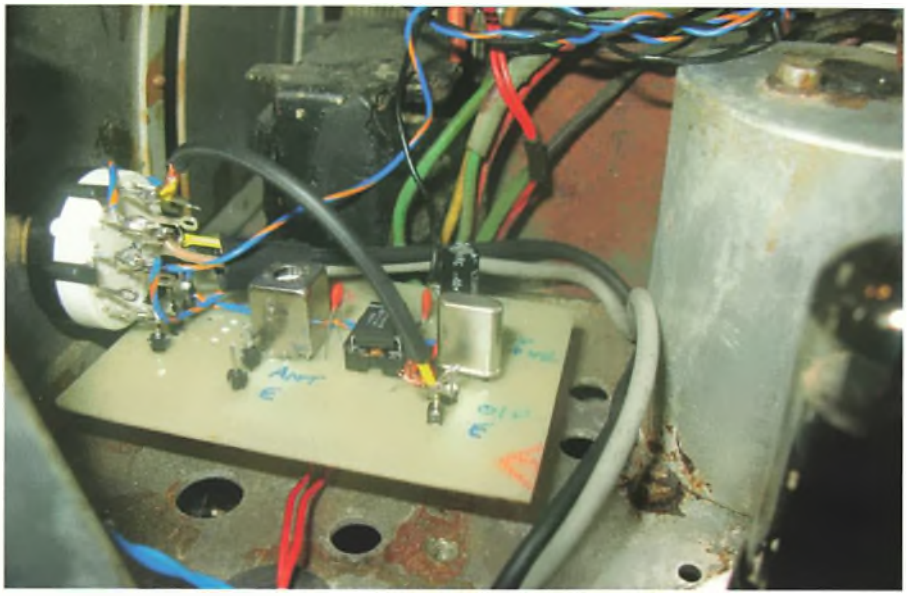


Fig. 3: Mounted inside the R1155.

Fig. 4: The R1155 with additional switch setting for the 160m transverter.

Parts List

C1	220pF Disc Ceramic
C2	100nF Disc Ceramic
C3	100pF Disc Ceramic
C4	1000pF Disc Ceramic
L1	TOKO Type KANK3333R or equiv. Inductance of approx. 45µH
XTAL	1MHz
IC1	NE602
Switch	4-Pole, 3-Way Rotary Switch (if required)

E-mail: teleniuslowe@gmail.com

A Busy Month on the Bands

Steve Telenius-Lowe PJ4DX has a full postbag and lots of interesting HF-related news.

Most readers of these pages will be all too aware that we have been at the bottom of solar cycle 24 for a while now. When, then, will the new solar cycle begin? Most predictions suggest that it will be some time in 2019. However, in a *YouTube* video posted by the very amateur-radio-friendly **Tamitha Skov**, aka 'Space Weather Woman', **Fig. 1**, she suggests that solar cycle 25 has in fact already begun – rather earlier than most experts predicted. The active region 2720 that appeared on the Sun's surface on August 24th was from the new cycle, she said.

If we are already at the beginning of solar cycle 25 this is good news indeed. Most cycles show a relatively rapid increase from solar minimum to a peak in solar activity. There are often two peaks, with a short period of slightly depressed conditions between, followed by a relatively slow decline to the next solar minimum and all this takes place over a period of about 11 years. Having said that, if the new solar cycle has already started, that would make previous cycle 24 atypical, in as much as activity declined from its peak in early 2014 to the minimum in mid-2018, a period of only slightly over four years.

In her video, Tamitha Skov also commented on a major solar storm, the effects of which were felt on Earth on August 26th, with spectacular visual auroras at high latitudes. She said it was one of the top five solar storms of the last cycle. Here in Bonaire the 20m band was completely dead – not a single signal was audible on the band – at the time of day when European stations often peak S9+20dB (40m was also almost dead, though a few semi-local stations were audible).

To view the Space Weather Woman videos, Google 'YouTube Tamitha Skov'. The particular video referred to was uploaded on August 30th and is titled *Aftermath of Hurricane Lane & A New Cycle Begins: Solar Storm Forecast 08-30-2018*.

Fig. 1: 'Space Weather Woman' Tamitha Skov says solar cycle 25 has begun (screen shot from her YouTube video).

FT8 Anniversary

It was exactly one year ago that FT8 received its first mention in this column, when I wrote that *"FT8 has been introduced in the latest WSJT release and its use has taken off astronomically."* Those words were written at the end of August, only a few weeks after FT8 was launched on to an unsuspecting world in July 2017. But I think it fair to say that no-one could have foreseen just how astronomical that take-up of FT8 would be.

Since then a debate has raged about whether the new digital mode is the greatest technological development in amateur radio since SSB in the 1950s or whether it portends the end of amateur radio as we know it. I have kept out of this argument because although I have witnessed others making FT8 contacts I have not actually used it myself, so am hardly qualified to argue the case either way. Indeed, I can see both sides of the argument.

On the one hand, because it allows contacts to be made with signals at a level of –20dB, it is a boon to those operators who are unable to put up external antennas or are only allowed to use (or choose to use) low power. Even a 5W or 10W station with an indoor wire can suddenly make DX contacts that would be quite impossible on SSB or CW. On the other hand, some operators complain that FT8 is *"computers talking to computers"* with no operator skill involved. Many don't like the fact that FT8 only allows for the absolute minimum of information exchange in order to qualify for the word *"contact"*. It is impossible to tell your QSO partner your name, the local weather conditions or what rig and antenna system you are using, for example (though the new 'FT8Call' overcomes this objection: see below).

Others complain they have spent years operating, and not a little money perfecting their stations and antennas, to work towards DXCC on five, eight or maybe even ten bands using SSB or CW, only to have FT8 operators with basic stations claiming the same sort of results in a matter of months. Is this *"fair"*? I don't know.

The tremendous upsurge in FT8 activity has certainly had a detrimental effect on the use of other modes. There is proof that the number of SSB and CW QSOs being made has decreased (see *HF Highlights*, April 2018), while the use of RTTY has almost ground to a complete halt during the period that FT8 use has sky-rocketed. The same

could, of course, have been said when SSB supplanted AM.

A UK amateur recently spent a month writing 3000 lines of C# code to design a multi-band 'DX-chasing robot' using FT8 that went on the air in August. The stations are found and worked by the robot without any intervention whatsoever by the licensee. It took just 28 hours for it to work its first 100 DXCC entities. This was undoubtedly an incredible feat of programming skill but is it really amateur radio if there is no human actually making the contacts? The amateur concerned says this was purely an intellectual exercise for his own use and he has no intention of marketing or releasing the software. But he also points out that any professional or skilled amateur programmer could do this without too much effort. Surely it won't be long before someone does precisely this? Will the bands then become full of band-hopping QSO machines hunting down the DX 24/7 while their licensees are at the pub or tucked up in bed? No matter what you think of the advantages of FT8 as a mode, surely no-one would welcome this?

FT8Call

After writing the above, I received a report from regular contributor **Tony Usher G4UZW**, who drew my attention to FT8Call, **Fig. 2**, the latest incarnation of FT8. Tony says that FT8Call is *"derived from the WSJT-X application and is designed for keyboard-to-keyboard communication allowing 'proper' QSOs. I've downloaded it and watched what it offers but the uptake seems to have faltered. Perhaps FT8 'traditionalists' (!) are not interested in longer contacts with more information passed to and fro' and are content with the current limitations of the FT8 mode?"*

The website from where the FT8Call software can be downloaded states: *"The idea with FT8Call is to take the robustness of FT8 mode and layer on a messaging and network protocol for weak signal communication on HF with a keyboard-to-keyboard interface..."*
http://ft8call.info

I'm an Assistant Judge!

The 2400 or more amateurs who helped with checking the World Radiosport Team Championship competitors' logs in July by sending in their own log to the organising committee (and this included many UK stations of all licence classes) can download their own 'Assistant Judge' certificate, **Fig. 3**, by going to the WRTC2018 website, clicking on 'Activities', 'Assistant Judge' and then their own callsign.
www.wrtc2018.de

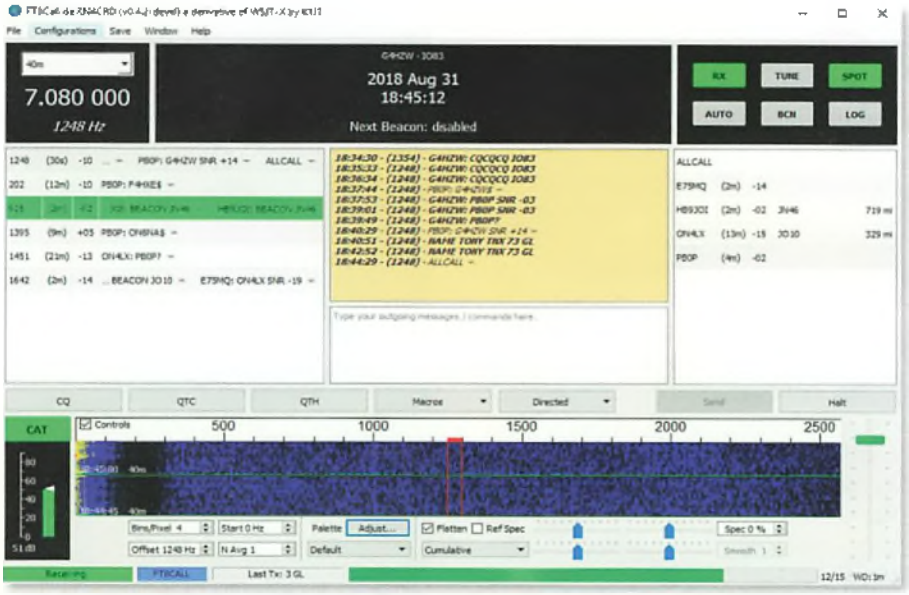


Fig. 2: The new FT8Call allows 'proper' keyboard-to-keyboard QSOs (tnx: Tony Usher G4UZW).

Working Baker Island

In the September *HF Happenings* column I said I'd be interested to receive any reports of contacts made with the June/July Baker Island DXpedition, **Fig. 4**. I was therefore pleased to receive e-mails from no fewer than three new correspondents who worked KH1/KH7Z. First, a note from **Dave Yeoman G4SQA** who said, *"I had a QSO with KH1/KH7Z on 20m at 0819UTC on July 5th. It was my last 'country' that I required and because I am 79 I would think that it could be my last opportunity to work KH1!"*

Nick Garbett M1DDD showed great dedication in his efforts to work Baker Island by getting up at 5.00am and operating portable from the Derbyshire Dales in the Peak District. He put up a 20m elevated quarter-wave vertical with two radials plus a full-wave delta loop mounted on a 10m SOTApole as a back-up antenna, **Fig. 5**. His dedication paid off because he worked KH1/KH7Z on July 2nd at 0900UTC on 20m SSB.

Writing from Scarborough, **Conrad Fox M0VCB** said, *"I worked them on 20m CW at 0720UTC on 14027kHz after two hours, then on SSB on 14215kHz very soon after. My friend **Kelvin M0AID** had just worked them on SSB on 20m and told me he thought they were working downwards. I called 5kHz down and sure enough, 'bam!'... I was running legal limit with my Yaesu FTdx1200, Acom 1000 and a Hex-beam from MW0JZE. It sits on a pneumatic mast by Total Mast Solutions because I live in the National Park. I was over the moon because our Scarborough club chairman said that it was a 'once every 15 years DXpedition'. Only had my full licence for 12 months and DX and contests are my thing. Love your column as I subscribe to PW."* Thanks for the flowers, Conrad, and congratulations to all three for the rare DX QSOs and to Dave for completing DXCC by 'working them all'.

Fig. 3: 'Assistant Judge' certificate for helping log checkers at the WRTC2018 event.

Fig. 4: KH1/KH7Z Baker Island DXpedition logo.

Readers' News

First up this month is **Victor Brand G3JNB**, who provides a useful reminder that you don't need to work DX to derive a great deal of enjoyment from amateur radio contacts. His QSO of the month was with **'Ian' IK4EWX** in the medieval town of Ceatu on 17m on August 4th. They had a long 'ragchew' on the key while Victor was viewing Ian's QRZ.COM page of photos and historical notes. *"It was a such a pleasure to copy his beautiful and precise Morse, itself perhaps a reflection of his calling as a bank manager! A QRM-free frequency and his big fifth-floor antenna, a Force 12 C4, enabled us to hold a good old-fashioned 'telephone style' finger-tip conversation. Without breaks (well, with the odd callsign now and then), back and forth we discovered just how much we had in common... we both own Drake MN-2700 ATUs and have several Morse keys in common, including gold-plated Begalis and the iconic Vibroplex iambic. With routine '599 TU' reports from hard-pressed DX, these days such a CW QSO is becoming increasingly rare and should be properly appreciated."* Generally dull conditions prevailed mid-month so Victor hooked up his QRP Labs QCX 5W 40m rig and pottered about working Europe, enjoying routine contacts. Victor says he has noticed how impatient some stations can be when they are called by a QRP operator: *"It is as though some just cannot be bothered unless you are bending their S-meter needles. Perhaps just a sign of the times? Thankfully, the majority are only too pleased to pull you through and often say so."* Finally, G3JNB worked **Bill VK4FW/P** in Queensland on 20m. *"Bill says that, these days, most of his operations are working portable from remote WFF locations and this QSO was from VKFF-1222 with a K3 and KPA-500,"* Victor reports.

A brief report from **Etienne Vrebos OS8D / ON8DN** this month because once again he has been touring with his motorbike, clocking up 15,000km in six weeks. This time he was in the Lake District and southern Scotland and caught some bad weather with 100kph gusts. When home he worked some good DX, as shown in the band reports.

FT8 aficionado Tony G4HZW wrote that this month he did also make some "proper" QSOs on SSB! *"10m propagation dropped off as the month progressed, a good opening to North America on the 2nd gave contacts with two VE stations and five from the United States as far across as Iowa. Just one new 10m DXCC during the month in the form of ZD7BG on Saint Helena, bringing me to 109 on the band in 12 months... I fired up the TS-830 on August 27th, sat on 28.4567kHz and called CQ. I worked a string of EUs, most seemed to be running low power and verticals and were happy to participate in 'proper' QSOs – most enjoyable!"*

Fig. 5: The portable station and antennas of Nick Garbett M1DDD/P.

Reg Williams G0OOF hopes that *"Conditions may improve somewhat now we are heading towards autumn... Surprisingly, listening on 20m late in the evening, around 2330 local time, on the 30th of this month* [August] *the band was open with reasonably good signals from North and South America. Tuning around the band I came across HC5DX in Ecuador. I tried a few calls with no success. Within a few minutes he was spotted on the Cluster. 'Oh no', I thought, but I was lucky to work him as his last contact of the day: a new one for me on 20m. Moments like that, the challenge of DX, is worthwhile and exciting. On another note, I had a look on websdr.org... [and] saw an SDR station in south-east England... I thought I would try an experiment. I found a strong French station calling CQ on 80m and tuned my radio to the same frequency. I responded to his CQ and worked him along with a short QSO. This was all recorded with the recording facility on the websdr. Playing back the recording I could see how my voice quality was being received by the other station. I now have the websdr site on my tablet and phone so I can listen to stations when away from home."*

Fig. 6: DXFF40 certificate awarded to Carl 2E0HPI for contacting WWFF stations in 40 DXCC entities.

Fig. 7: QSL from the ISS Conero radio team station IQ6KX sent to Kevin ZB2GI.

The August highlights of **Kevin Hewitt ZB2GI** included activating the Europa Point lighthouse and working GB5RC on board Radio Caroline ship the *Ross Revenge* in the Blackwater River. The best of his log is in the band reports.

Terry Martin M0CLH commented that *"The extraordinary summer heat has now disappeared to be replaced with more*

seasonable weather. It has though produced some activity on the higher bands courtesy of Sporadic E... It was a bit of a surprise to get VK8MS on 12m FT8 (I guess his 3-element SteppIR had something to do with it!). Another first was a QSO with OJ0C on Market Reef who were using FT8 'Fox and Hounds' expedition mode. Having seen them spotted on the Cluster, it resulted in a frenzied search for the document that told me how to operate in that mode. China (BG3UPA), now confirmed by LoTW [ARRL's Logbook of The World] *on 30m, was also a welcome addition to the log."*

Carl Gorse 2E0HPI has been chasing World Wide Flora and Fauna (WWFF) stations. Using an Elecraft KX2 at 5W he worked DM5MR (DLFF-0110) and OK1DOY/P (OKFF-0010) on 20m SSB plus GB1PBL (GFF-0331) and C37FF (C3FF-0002) on 40m SSB. The Andorran station was a new WWFF DXCC entity for Carl, taking him to 40 and earning him the DXFF40 certificate, **Fig. 6**. For the International Lighthouse and Lightship Weekend (ILLW) in August Carl operated with other members of the Hartlepool Amateur Radio Club as GB0HLH from the Heugh gun battery at Heugh Lighthouse. The location has ILLW Reference UK-0188 as well as WWFF GFF-0348 and CASHOTA G572. Carl made 70 of the club's more than 250 QSOs on 20m SSB, mainly with Europe but also a couple of RA9 stations in Asiatic Russia.

Owen Williams G0PHY said he *"enjoyed chasing F5BLC from a couple of islands in the Orkneys and there were also plenty of European stations active during the ILLW. The 'International Youth at Sea' activity from Market Reef as OJ0C provided contacts on 7, 14, 18 and 21MHz. Intercontinental contacts were with 4X6DK during the ILLW and XQ6CFX in southern Chile. However, the best DX was with RT65KI on an island in the Chukchi Sea in the far east of Russia. On August 23rd on 14MHz at 0740UTC he just popped up out of the noise at almost ESP levels. I called him... but wasn't 100% sure that it was my call he came back to. Later that afternoon he was much stronger and I switched the amplifier on and definitely had a QSO. I was very surprised when checking the online log to find both QSOs were there and also a little embarrassed because I don't like making duplicate QSOs."*

Band Reports

Victor G3JNB reports: 30m CW: XQ6CFX. 20m CW: 3B9FR, C31CT, KP4TF, OY1CT, ZP6CW.

Etienne OS8D/ON8DN offers: 80m SSB: OJ0C. 20m SSB: BG7FKH, OJ0C, PH5HB/AM (flying 500km west of Casablanca), XT2BR. 17m SSB: 9Q6BB. 10m SSB: 5E5A.

Tony G4HZW used FT8 on 40m to work: A41CK, A45XR, CO2KL, HI8PAP, TF3VS, VK3BL, VK7AC, ZL2IFB, ZL3IO. 10m FT8: FG5FI, OD5KU, T77C, VP8LP, ZD7BG.

Reg Williams G0OOF came up with 80m SSB: EI0DXG, OJ0C, OL100CSR. 40m SSB: CT9/OH2LZ, OJ0C. 20m SSB: 7X2DD, EA8BWW, HC5DX, OD5ZZ, V47FWX, VP8LP, ZB2BU, ZY159CAT. 17m SSB: ZD7FT. 10m SSB: OY1OF.

Kevin Hewitt ZB2GI from home and as ZB2GI/P used FT8 on 60m to work: 5B4AIF, HB0CC. 40m SSB: EJ0DXG, IQ6KX (ISS Conero radio team, **Fig 7**), LZ2MAT/MM. 20m SSB: A61FK, GB5RC (Radio Caroline), K0IZ, PY2BEK, WP9ID, W1NVT (KFF3098), YV6BXN plus many other Europeans and Americans. 17m SSB: GB5RC. And, as ZB2BU/P from the 'Top of the Rock' with other ZB2 operators Kevin worked over 100 European and North American stations on 20m SSB, including: AA2IA, KA9KLR, N7QT, SV8GGI, TA1CM, VC8VMR, VE9SM, W4PR.

Terry M0CLH sent in a long log of which the highlights are 40m SSB: EJ0DXG. 40m FT8: A45XR, R8CCJ. 30m FT8: BG3UPA, RG7F, UN6G, WU2M. 20m SSB: LZ1146SPS. 20m CW: 4K100K, SN0UNESCO. 20m FT8: A41CK, CU3BL, GJ0KYZ, K0BLT, NL8F, PP5AM, VE1VAS, WA0LIF, YB1IQE. 17m FT8: 9K2BM, AA5AU, CT3HF, EK3GM, HL4CJG, JA1NCZ, LU5VV, OJ0C, OX3LX, SV9RNG, UN7FBW, VE3YXE, WD9HSY, YB1BML. 15m FT8: 5B4AMX, EA8DFQ, K4MF, YC3PIT. 12m SSB: OJ0C. 12m FT8: HB0WR, VK8MS. 10m SSB: 9A7JCY. 10m FT8: 5B4AMX, KE1R, RW9QA plus many Europeans via Es.

Owen G0PHY reports 40m SSB: RW9QA. 20m SSB: 4X6DK/L, OJ0C, R25RRA, R25RRC, RT65KI, XQ6CFX. 17m SSB: OJ0C. 15m SSB: OJ0C.

Signing Off

Lots of news this month, so I'm grateful to *PW* editor **Don G3XTT** for finding an extra page for *HF Highlights*. Don has also agreed to a later deadline to ensure reports as as up-to-date as feasible. From now on please send any input for this column to teleniuslowe@gmail.com by the 11th of the month (October 11th for the December issue, November 11th for the January 2019 edition). Thanks to all contributors. 73, Steve PJ4DX.

E-mail: practicalwireless@warnersgroup.co.uk

Tropospheric Propagation

Steve White G3ZVW provides an overview of an atmospheric effect that can lead to enhanced propagation at VHF frequencies and above.

When a high pressure weather system settles over the British Isles, keen VHF operators head into their radio shacks and search for long distance contacts.

Before I go into the subject of tropospheric propagation itself I would like to provide some background information, to give newcomers an overview of the subject.

What is the Troposphere?

Just as there are several Regions and Layers in the ionosphere, **Fig. 1**, where High Frequency (HF) radio signals can be refracted back to Earth, there are several regions to the atmosphere beneath it, **Fig. 2**. 2m, 70cm and microwave signals are sometimes affected by it, resulting in longer distance contacts than is usually possible.

The bottom layer of the atmosphere is called the Troposphere. The troposphere isn't the same height all across the World, being about 14km (8.7 miles) thick in tropical regions but only about 8km (5 miles) thick in Polar regions. It is the densest part of the Earth's atmosphere and is where the weather occurs – rain bearing clouds. To relate the height of the troposphere to something you can visualise, commercial aircraft flying at cruising altitude are likely to be about 11km (37,000ft) above sea level, so they are around the upper edge of the troposphere.

As regards temperature, the normal situation in the atmosphere is that the temperature drops as you go higher. Depending on conditions the amount varies but a 2-3°C drop per 1000ft would be normal. Something else that happens as you go higher is that the air gets thinner. As it gets thinner the refractive index changes. Interesting things occur when this doesn't happen!

Atmospheric Pressure

The instrument used for measuring atmospheric pressure is the barometer and traditionally atmospheric pressure was measured in inches of mercury.

Now, here's an experiment you can't try at home! If you were to fill a 3ft-long glass tube that was sealed at one end with mercury, then turn it upside down and place the open end in a bowl of mercury, the weight of the mercury would cause a vacuum to develop at the top (closed end) of the tube. The height of the mercury column would be about 30 inches but it wouldn't remain constant. Instead, it would change as the atmospheric pressure changed. Changes would not be perceptible from moment to moment but you would certainly notice them from day to day. These days you can't try this experiment at home because it is recognised that mercury is such a toxic substance. Also, these days, inches of mercury have been replaced with millibars. One Bar is the standard atmospheric pressure and it is subdivided into a thousand millbars (mb).

Highs and Lows

An Anticyclone is an area of high-pressure air. It is the opposite of a Cyclone, which is an area of low-pressure air.

So, what constitutes low pressure and high pressure? The first thing that needs to be said is that it never changes by a huge amount. The nominal atmospheric pressure is 1000mb, while the pressure at the heart of the kind of winter storm we experience in the UK might be as low as 950mb and the pressure at the centre of an anticyclone might be as high as 1050mb. In other words, it doesn't deviate from the nominal by more than about five percent.

Anticyclones bring settled weather and low wind speeds, and it is these that can result in enhanced propagation at VHF, UHF and the microwave part of the frequency spectrum.

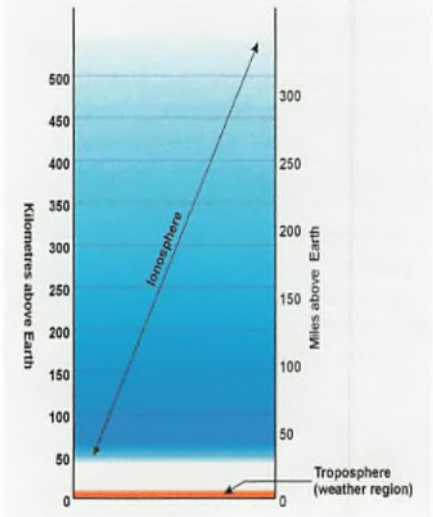


Fig 1: The ionosphere.

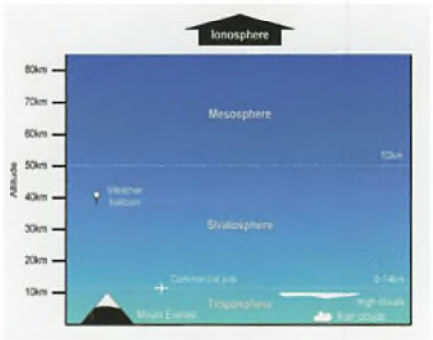


Fig 2: The troposphere is below the ionosphere, but there are other layers between.

If the weather is too windy, as it is most of the time and certainly when there is a cyclone present, the atmosphere gets stirred up too much for something vital to form – a temperature inversion.

What to Look For

If you are interested in taking advantage of this type of propagation, look for visible signs of a temperature inversion. The smoke from a fire is warm, so it rises. As **Fig. 3(a)** shows, smoke rising from a bonfire or a chimney is normally blown to one side and disperses but if there is little

or no wind, it tends to rise straight up. If it then bumps into an even warmer layer of air, the warmer air acts as a blanket and prevents the smoke from rising further. The result is that the smoke abruptly stops rising and drifts slowly outwards instead. I show this in **Fig. 3 (b).** Look for this when you're out and about. You won't see it often but if you are observant, you will notice it from time to time. Bear in mind that even in the lightest breeze more smoke is likely to drift to one side than the other.

Smog is also an indication of a temperature inversion. In this case smoke is trapped at ground level by a blanket of warmer air that is really low in the atmosphere. The Great Smogs of London were caused by temperature inversions, trapping the smoke from industry and domestic coal fires at ground level. An estimated 4000 Londoners died during the smog of December 1952 and an estimated 6000 more died afterwards, poisoned by the fumes. The subsequent Clear Air Act outlawed the burning of coal in London.

Looking at weather maps is also a good idea. If the pressure rises above 1030 millibars, some enhanced tropospheric propagation is likely to occur. Above 1040 millibars and the likelihood becomes good, especially as the pressure starts to drop. Below 1030 millibars it tends not to do so.

A third thing to look at is the website by **William Hepburn** (URL below). It is a really useful resource of tropo forecasts. A lot of people refer to tropospheric propagation as ducting but the website explains how there are a variety of tropo modes, only one of which is ducting.
www.dxinfocentre.com

What to Listen For

Unlike ionospheric propagation, where different HF bands open at differing times of the day, when enhanced tropospheric propagation is taking place the 2m and

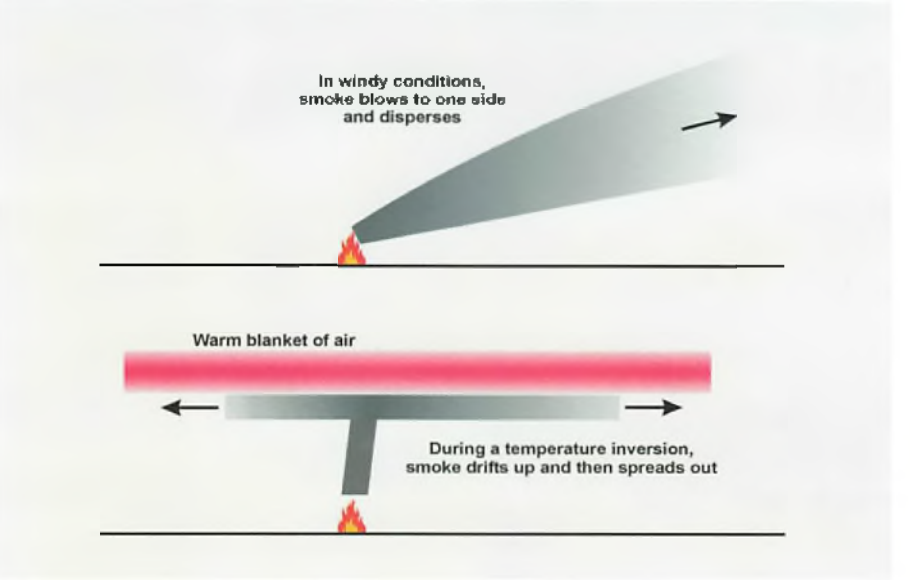


Fig 3(a): Smoke from a fire is warm, so it normally rises and disperses.
Fig 3(b): In a temperature inversion smoke drifts up, then spreads out sideways in a narrow band.

70cm bands tend to be affected by similar amounts at the same time. On VHF/UHF a beam antenna is a practical proposition for many people and it is useful to know in which direction to point it. This should be towards the station you are listening to but bear in mind that during such propagation the conditions are often more favoured around the centre of an anticyclone, rather than across the middle of it. Isobars are the lines on a weather map that show where the barometric pressure is the same. On standard maps the isobars are shown at 4 millibar intervals, and sometimes the 20 millibar intervals are shown with thicker lines, **Fig. 4.**

When it occurs, tropo propagation can last from hours to days. It can take place at any time of the day and any time of the year but is not affected by the solar cycle.

Even if the barometric pressure is not high enough to trigger a full-blown tropospheric opening, small scale temperature inversions occur quite often around the times of dawn and dusk. These

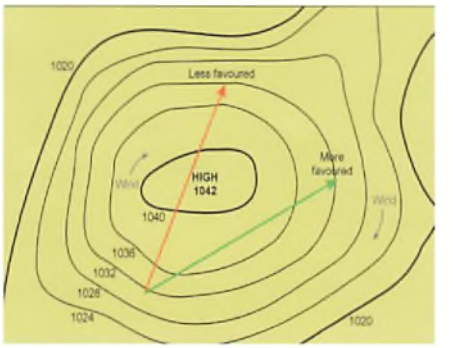


Fig 4: Isobars as they may appear on a weather map.

can happen in any season but the wind needs to be very light for them to occur.

Unlike ionospheric propagation, where refractions take place 100 or more kilometres above the Earth, the refractions that cause enhanced tropospheric propagation can take place quite close to sea level. If you live on a big mountain, your signals may not be refracted because you are actually above a temperature inversion.

Rallies

Send all your rally info to Georg Wiessalaat: wiessala@hotmail.com

Plan your rally visits with our comprehensive list of forthcoming events. RadioUser will be attending events marked with an asterisk* – come along to our stand for great deals on subscriptions to *Practical Wireless* and *RadioUser*. Club Secretaries and Event Organisers: please send us details of your events if you would like them to be mentioned here.

OCTOBER

October 11th to 14th (Thursday to Sunday)

MICROWAVE UPDATE 2018

The 2018 Microwave Update takes place at the Holiday Inn Dayton, Fairborn, Ohio (near Dayton), USA. This is an international meeting, dedicated to microwave equipment design, construction, and operation. It is hosted by The Midwest VHF/UHF Society (MVUS).
www.microwaveupdate.org

October 12th to 14th (Friday to Sunday)

RSGB Convention

The RSGB Convention is at Kent's Hill Park Training and Conference Centre, Swallow House, Timbold Drive, Kent's Hill Park, Milton Keynes, Buckinghamshire MK7 6BZ. The Convention programme of lectures for all interests is available on the website. Principal sponsor: Martin Lynch & Sons.
https://rsgb.org/main/about-us/rsgb-convention
www.hamradio.co.uk

October 14th (Sunday)

HOLSWORTHY RADIO RALLY

The Holsworthy Rally will be held at the Holsworthy Community College, Victoria Hill, Holsworthy, Devon EX22 6JD. There will be traders, a bring-and-buy and catering. The venue has disabled access. Doors open at 10am.
Howard M0MYB
holsworthyarc@gmail.com
www.qsl.net/m0omc/holsrally.html

October 14th (Sunday)

HORNSEA AMATEUR RADIO RALLY

The HARC Rally will take place at the Floral Hall, Hornsea HU18 1NQ. Doors are open from 10am; admission is £2 (under 14s go free). There will be trade stands, a bring-and-buy (run by the Hornsea ARC) and an RSGB bookstall. Hot and cold food is available in the café.
Les 2E0LBJ
Tel: 01377 252 393
lbjpinkney@hotmail.co.uk
www.hornseaarc.co.uk

October 20th (Saturday)

CARRICKFERGUS ARC RALLY

The Carrickfergus Rally 2018 will open at 11 am. All welcome to come along. Details from:
Liz Forde MI6GHA
elisabethforde64@yahoo.com

October 21st (Sunday)

GALASHIELS RADIO RALLY

The Galashiels Annual Open Day and Radio Rally will take place at the Volunteer Hall, St Johns Street, Galashiels TD1 3JX. Doors open at 11am for those needing disabled access, for other visitors it is at 11.15 am. There will be traders and a bring-and-buy; refreshments will be available on site. Admission is £2.50.
chairman@galaradioclub.co.uk
http://galaradioclub.co.uk

October 27th (Saturday)

ESSEX CW ARC CLUB BOOT CAMP

The Essex CW ARC Club 'Boot Camp' takes place at the 3rd Witham Scout & Guide HQ (at the rear of Spring Lodge Community Centre), Powers Hall End, Witham, Essex, CM8 2HE. Doors are open at 8.30am for registration. The one-day session will run from 9am to 4.30pm. Parking is free, £10 entry, free snacks.
Andy G0IBN
Tel: 0745 342 6087
g0ibn@yahoo.com
www.essexcw.org.uk

NOVEMBER

November 3rd (Saturday)

BUSHVALLEY ARC ANNUAL RADIO RALLY

This rally will take place at the United Services Club, 8 Roe Mill Road, Limavady, Co Londonderry BT49 9DF. Doors are open from 11am to 4pm (Disabled: From 10.50am) and admittance is £3. There will be an auction, bring-and-buy, flea market, special interest groups, trade stands and an RSGB Bookstall. Family attractions and catering also on-site
Jason Smyth MI3UIW
Tel: 07793 314 313
smyth261088@gmail.com

November 3rd (Saturday)

VERON HAM RADIO CONVENTION

The VERON Ham Radio Convention (DvDRA: Dag voor de RadioAmateur 2018) will take place at IJsselhallen, Rieteweg 4, 8011 AB, Zwolle, The Netherlands, from 9.30am to 5pm. The cost of entry is €9.00 (free for under-16s). Tickets available on the door from 9am. On-site Car Parking is €5.00. The organising committee of the Dutch Radio Society (VERON) has created an attractive programme. Besides the 'official' part, several lectures will be given. There will be a 'homebrew' exhibition, demonstrations and measuring facilities, the AMRATO (amateur radio equipment sales), and the VERON components market (flea market). Several commissions, working groups & associated societies are also presenting, and there will be a Youth Zone to inform youngsters about the techniques and many aspects of our hobby.
https://dvdra.veron.nl/english/visitors/programme

November 17th (Saturday)

RADARS TRADITIONAL RADIO RALLY

The Rochdale & District Amateur Radio Society Rally takes place at St Vincent de Paul's, Caldershaw Road, off Edenfield Road (A680), Norden, Rochdale, OL12 7QR. The doors are open to the public at 10:30am and disabled visitors will gain access 15 minutes earlier. Admission is £2.50, with those under 12 years free. The cost is £5 per pitch (for traders with own tables) or £10 for a pitch, with the table provided. There will be a bring-and-buy, commercial traders and amateur radio sellers. Refreshments are available, including bacon and sausage butties.
Robert Lynch M0NVQ
Tel: 07778113333
m0nvq@outlook.com

November 18th (Sunday)

CATS RADIO & ELECTRONICS BAZAAR

The 41st Coulsdon Amateur Transmitting Society Rally/ CATS bazaar will take place at the Oasis Academy, Homefield Rd, Coulsdon CR5 1ES. There will be free car parking, doors will open at 10am and admission £1.50. There will be trade stands, special interest groups and refreshments.
Andy Briers G0KZT
Tel: 0772 986 6600
bazaar@catsradio.org
https://www.facebook.com/events/437043790050777

November 18th (Sunday)

PLYMOUTH RADIO RALLY

The Plymouth Radio Rally will take place at Harewood House, Church Rd, Plympton PL7 1NH. Doors are open at 10.30am, and there is a £2 entrance fee. Hot and cold drinks and hot food are available, all for a very good price. There will be a bring-and-buy stall and many other radio-related 'goodies'.
David Beck
d.beck123@outlook.com
www.plymouthamateurradioclub.btck.co.uk

November 25th (Sunday)

BISHOP AUCKLAND RADIO AMATEURS CLUB RALLY

The Bishop Auckland Radio Amateurs Club (BARAC) 2018 Rally will take place at Spennymoor Leisure Centre, 32 High Street, Spennymoor, County Durham, DL16 6DB. There will be the usual radio, computer and electronics stalls, bring-and-buy tables, catering and bar facilities. As you can imagine, there is a lot to do for all the family within the confines of the Leisure Centre, even for those of the family not interested in radio. Doors are open at 10.30am (10.15am for disabled visitors) Admission is £2, under 14s go free of charge, if accompanied by an adult.
John G4LRG; Tel: 01388 606 396
Brian G7OCK; Tel: 01388 762 678
www.barac.org.uk

DECEMBER

December 1st (Saturday)

READING DX MEETING

The Reading International Radio Group will be meeting in Room 3 of the Reading International Solidarity Centre (RISC), 35-39 London Street, Reading RG1 4PS. The meeting will take place from 2.30 to 5pm.
Mike Barraclough: 01462 643899
barraclough.mike@gmail.com
www.bdxc.org.uk/diary.html

December 1st (Saturday)

SOUTH LANCASHIRE ARC WINTER RALLY

The rally takes place at the Bickershaw Village Community Club, Bickershaw Lane, Bickershaw, Wigan WN2 5TE. Attractions include trade stands, a bring-and-buy, special interest groups, car parking, disabled facilities, catering and a licensed bar. Admission is £2.50. Doors are open at 9am (traders – limited number of pitches – venue opens 7.30am).
Jason G0IZR
Tel: 01942 735 828

December 29th to 30th (Saturday and Sunday)

HAMFEST INDIA

Hamfest India takes place in conjunction with REVA University, Bangalore. This is the largest gathering and festival of amateur radio operators in India.
hamfestindia2018@gmail.com
or ham7388@gmail.com
www.hamfestindia2018.com

World of VHF with Tim Kirby G4VXE

Willowside, Bow Bank, Longworth, Oxfordshire OX13 5ER
• E-mail: tim@g4vxe.com • Twitter: g4vxe

A 70cm Radio for Around a Tenner?

Tim Kirby G4VXE starts his usual roundup with a look at a remarkably cheap handheld for the 70cm band.

When I was in Cheltenham back in the summer, I spoke to my old friend Graham Nuttall G8XRS. In the course of the conversation, Graham told me that he had recently purchased one of the cheap Baofeng BF-888S rigs, **Fig. 1**, to use on the 70cm (432MHz) band. These simple radios, available for around a tenner or even less, allow you to program up to 16 channels, selectable by a knob on the top of the radio. Graham had set his up to monitor the local 70cm repeaters.

I quietly filed the idea but didn't do anything about it. However, when I saw some discussion on Twitter about how cheaply these radios can be obtained, I thought, 'why don't I get one and have a play'. For a tenner or so, you can't really go wrong.

The rig arrived last week. It's actually surprisingly solid and doesn't feel like a toy. Neither, though, is it a robustly constructed rig that will stand being dropped. The first job was to get the frequencies programmed up because it comes pre-programmed with non-amateur frequencies, which it would be illegal to use in the UK. Although as many readers will know that I enjoy setting up radios from computers, this proved to be quite a frustrating process!

First of all, I had to get the USB cable (it's a standard Baofeng cable/connector), which you may already have, set up on my computer. Because it uses a fake Prolific chip, you have to go through the well documented process to get this installed. Once I'd done that, I thought it would be plain sailing to get the rig talking to the excellent CHIRP software or the Baofeng programming software. Not so!

Despite the programming software being set to look on the correct COM port, the programs both reported that the rig was not responding. I fiddled and kept trying and at some point (after several minutes of intense effort), it started working. Unfortunately, it wasn't clear to me why! When I researched the problem a bit more, I discovered that the BF-888S Plus model, which mine is, had a slightly different memory layout, which caused CHIRP in particular to fail.

Fortunately, once it started working, it continued to do so for that programming session at least. I hastily set to, adding all 16 channels with repeaters that I might conceivably want to use as well as various simplex channels. I uploaded the configuration to the rig, unplugged the cable and selected a channel.

Fig. 1: 433MHz for a tenner – the little BF-888S handheld.

Oh! Despite having selected 'English' in the settings for the voice announcement, the channel number was read out very distinctly but in Chinese. Try as I might, I couldn't find a setting in the software that would take effect to provide the announcements in English. I had just about resolved to try to learn the numbers 1 to 16 in Chinese, when I discovered that if you switch the rig on with the channel knob set to 14 while holding the PTT and monitor button, this will force the language to English. It worked!

Despite the programming process being somewhat fraught (and I think this was because I have the Plus model rather than the straightforward BF-888S), I am delighted by the little rig. In a good location on the outskirts of the village, I was able to get into the GB3UK repeater on the Cotswolds, some 40 miles away while from home, sat in the lounge, I can use it to listen to various repeaters. And, contrary to what some would have you believe, there is activity.

If you haven't tried 70cm before, or even if you have, these rigs make FM on the band very accessible. I'm told that the BF-888S models are easier to program than the Plus models so, hopefully, if you get one of those, you will not have such an 'interesting' experience as I did. It might make a great club project to get some local activity on a repeater or a 'club channel'. The simple nature of the rigs rather reminds me of the old Pye Pocketfones, which many people used to get on 70cm FM when I was first licensed. All good fun for a tenner.

Choosing the Right Frequency for your Digital Hotspot

Recently, the amateur satellite community highlighted an issue when the FO-29 satellite was suffering interference from a ground-based digital voice (DMR) transmission. Although most digital hotspots (MMDVM, openSPOT, DV4Mini and the like) are very low powered, sometimes the radios that are used with them are running higher power, 5W or so, which could be received by a satellite if it happened to be passing over your location at the time and if your hotspot was located in the wrong part of the band.

There are a couple of issues here, then. First, to make sure that your digital hotspot is in the part of the band recommended in the RSGB/IARU bandplan (434MHz or 438.8MHz) and, second, to ensure that when you are communicating with your hotspot, you use a minimum of power to do so, selecting the lowest power possible on your handheld radio.

The 6m Band

Peter Taylor G8BCG (Liskeard) says that

August was another great month on the 6m (50MHz) band made better, perhaps, by increased activity on FT8. On August 4th, Peter finished his Worked All States on the band, working KB7Q/P (WY) via moonbounce (EME), which was followed by another solid 12-hour opening to North America and the Caribbean as well as some South Americans. Peter closed down at 2330UTC with the band still open. On August 13th, Peter hosted a visit to his shack from the Callington Amateur Radio Society – there was lots of chat as well as EME QSOs with **Lance W7GJ** on both 50 and 144MHz. August 21st saw the first opening to TR8CA, which Peter says is very early in the year for propagation to Gabon. On August 23rd there was an exceptional morning opening to the Middle East with YI1SAL extremely loud on FT8, as well as A9, 9K, 4X and OD. There was a good level of CW/SSB activity with 9K2MU making lots of people happy on 50.102MHz. Things seemed to go pretty quiet on the band around the end of August. However, on September 7th, Peter had some easy EME QSOs with ZL3NW and VK3WTN. Peter says, *"If you think this is not for you, then consider this:* ***Wayne VK3WTN*** *uses a 7-element YU7EF antenna with no elevation and we worked with his moon at around 25°. Why not give EME a try?".* Peter worked KG6DX and JR2NQU on EME next day, September 8th.

After enjoying FT8 on 2m, **Martin Mills M0MLZ** (Plymouth) decided to try the mode on 6m and was pleased to work OK2GM over a distance of 1600km during August after the main Es propagation had ended.

Jef VanRaepenbusch ON8NT (Aalter) found plenty to work on 6m during August, finding over 60 stations on FT8 alone, with the highlights being EA8MT (IL27), Z32ZM (KN02), EG81CM (IL18), EA9ACF (IM75), E77EA (JN84), EA8JK (IL18) and EA8YV (IL18). There were QSOs on CW and SSB also, with the highlights being EA6VQ (JM19), E72U (JN94), HG60KCI (KN06), 4O3A (JN92), LZ1146SPS and IS0GQX (JM49).

Kevin Hewitt ZB2GI (Gibraltar) made 30 or more contacts on FT8 during the month, using an FT-450 and a dipole, including G3YQC (IO82), G3XGS (JO01), M1SLH (IO91), G0KSC (JO01), G3YJQ (IO70), G0CKP (JO01) and M0JBM (IO81). Operating as ZB2LGT from Europa Point lighthouse using an FT-817 and a homebrew two-element Yagi, Kev made over 50 FT8 contacts, including 3A2MW (JN33) as well as a handful of stations on SSB.

Fig. 2: ZB2GI's portable station for 2m meteor scatter from the top of the Rock.

John Wood G3YQC (Hereford) says that 6m Es has been slowing down after a good Es season, although August produced plenty of contacts, albeit not at the great distances reached previously. TF3ML was worked on August 14th, followed on the 15th by a central European opening, with CT1ANO worked on the 16th and another central European opening on the 18th. The 20th was a good day with highlights being 9K2YM and C31MF with ZB2GI and TR8CA worked on the 21st. Another station from Iceland, TF3JB, rounded out the month on the 24th with contacts being a bit sparse since then.

Mark Marment CT1FJC (Algarve) has made a few contacts over the month, the highlights being UT4XU on August 6th and TR8CA on August 14th.

The 4m Band

Jef ON8NT worked G4FUF (JO01) on 4m FT8 using 10W from his IC-7300 to a halo antenna on the balcony.

Mark CT1FJC caught an Es opening on August 7th when he worked GD0TEP (IO74) on FT8.

Simon Evans G6AHX (Twyning, Gloucestershire) is getting back on the band after a few months, with both vertical and horizontal antennas. He plans to be active on both SSB and FM.

The 2m Band

On September 1st, Peter G8BCG turned his focus from 6m to working CT8/W6PQL on 2m (144MHz) EME. He notes that during the September 2m contest, DR9A was a solid S9 signal at a distance of 750km throughout the contest. Peter added 24 vertical elements to his 2m array to help with EME when the polarisation changes. However, he tested it with some amazing simplex QSOs on FM over a distance of 350km. He also says he can't believe how loud the satellite downlinks are when tracked with the array.

Martin M0MLZ continues his FT8 activity from Devon, using his vertical antenna, and does very well. August 19th saw conditions above normal and Martin worked two stations in Wales and one in Lancashire as well as G4VXE in Oxfordshire. Martin hopes that his August 144MHz UK Activity Contest entry will have seen him go up a few places from usual because it was his best result so far with 74 contacts made, which is excellent from the south-west.

Pete Walker G4RRM (Crewe) has been using a vertical with between 25 and 50W on FT8 on the band and has made some nice contacts, including G8IXN (IO70), GW1JFV (IO71) and GM4FVM (IO85). Pete says he hasn't had so much fun on the 2m band in years and is tempted to put his Yagi back up.

Kev ZB2GI was excited to make his first 2m meteor scatter contacts during the Perseids shower in August. He operated from the top of the Rock using an FT-897 running 50W to a Cushcraft 5-element dual-band 2m/70cm Yagi on an 8m pneumatic mast along with a 0-20dB preamplifier, **Fig. 2**. Stations worked on FSK441 were F6BEG (IL18), F6APE (IM97) and G4SWX (JO02). **Fig. 3**. On SSB, Kev worked EA8EY (IL18) and EB7BKY (IM77). He says that his presence on the ON4KST VHF chat server caused the screen to go orange and there was an almost constant 'meep meep' of incoming messages with people wanting to work Gibraltar on 2m.

Simon G6AHX says he's not had too much time for radio recently but operated the September UK Activity contest running 10W into his 8-element Yagi. He made 26 contacts with the best DX being DF0MU at 644km.

Here at G4VXE I have noticed a lot more 2m FT8 activity since the 6m Es season

has quietened down. I made well over 100 contacts on the mode on 2m over the month, with the highlights being MM0CEZ (IO75) on August 7th, M1AVV (IO84 and also using a vertical) on August 20th, F1DRR (JN18), F6APE (IN97), F4CHB (JO00), F5BZU (JO11) and F6DBI (IN88) on August 21st, ON3SS (JO10) and OV3T (JO46) on August 28th, ON4AIQ (JO10) on September 1st. All contacts were made using 50W to a V2000 vertical.

The 70cm Band

Jef ON8NT enjoyed the UK Activity Contest on 70cm, especially having missed the 2m leg owing to thunderstorms, with the highlights being G4CLA (IO92), G4ODA (IO92) and G3MEH (IO91).

Derek Brown G8ECI (Louth) has decided to build a K2RIW amplifier for the band as well as a W2GN design for 144MHz, because he has plenty of valve bases and valves and hopes that will make him louder on both bands!

Satellites

Jef ON8NT monitored four different voice contacts from the ISS to schools on August 16th, 23rd, 25th and 27th. The contact on August 16th was made using low power and Jef says that signals were between 51 and 54 with him.

Kev ZB2LGT used an FT-817 and a manually-tracked 2m/70cm log periodic and worked 7X3WPL (JM13), IK8YZZ (JN70) and F4DXV (JN04) through AO-91 and EA7AGZ (IM76), 2M0SQL (IO87) and EA8CUZ (IL18) via AO-92.

Patrick Stoddard WD9EWK (Phoenix) sends a really fascinating report of his summer's activity which sadly, I've had to abridge slightly.

"I was back in southern California in August for another one-day event - this time, one involving model rocketry and space. Two radio clubs in the Los Angeles area had a booth at the event on August 18th, called Rocket Fever, at the Columbia Memorial Space Center in Downey, California, southeast of Los Angeles. The center is on the site of the former Rockwell (and North American Aviation) plant involved in building the Apollo command and service modules, and parts of the space shuttles in later years.

"The radio clubs had a booth in front of the building. For the satellite demonstrations, I stood away from the booth with my Kenwood TH-D72, Elk log periodic, and an external speaker plugged into the TH-D72. This was a simple way to demonstrate full-duplex satellite operations, without using a larger radio and battery, and not causing audio feedback when transmitting from the HT. This worked for AO-91 and AO-92 passes around the middle of the day. In addition to the FM satellite demonstrations, the NO-84 satellite passed by for a few packet QSOs using my TH-D74.

"Make no mistake... kids love all things space. Even though the kids liked the HF and VHF/UHF stations at the radio booth, they were more interested in the satellite demonstrations. I had to do a 'play-by-play' commentary while working NO-84 but the kids heard the packets coming from NO-84 and I showed them the TH-D74's display when packets and messages came in.

"In addition to the hams at the radio booth, other hams stopped by to visit. A couple of hams from the Los Angeles area were looking to work me during one of my demonstrations because they were interested in a confirmed QSO with the grid locator for that event (DM03). Those hams parked a short distance away from the event and I worked them both via AO-91. For the NO-84 demonstration, I worked ***Endaf N6UTC/MW1BQO*** *who was in another part of the event with his TH-D72 and Arrow Yagi, along with three other stations around southern California. My TH-D74 reported Endaf's distance from me as 0.04km (40m, or about 131ft). To cover that short distance, our packets made 800 mile round trips going through NO-84.*

"On my way home from California, I took a detour northeast to Las Vegas in Nevada. I made it from Anaheim to the DM25/DM26 grid boundary on the south side of Las Vegas in about three and a half hours and worked FM satellites along with NO-84 from that line. After working those passes and getting some lunch, I still had a drive home of almost five hours. Getting on the satellites from other places is always fun!

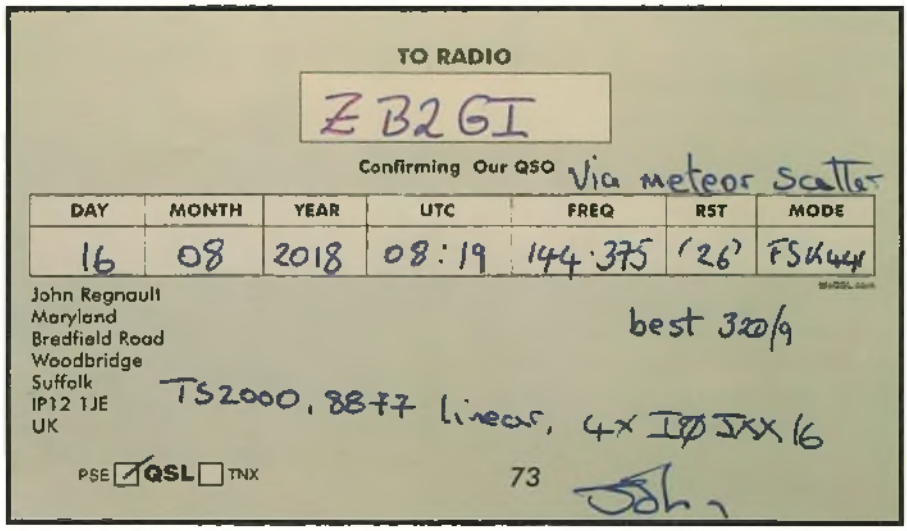
"ISS packet has been active for the past few weeks. Once it was found to be working again, it didn't take long for stations to get back on 145.825MHz, even though NO-84 has been operational recently. Along with those who were regularly on the frequency before the ISS packet system stopped working last December, including the unattended beacons, many new operators have been showing up. One of those was ***Paul N0BBD*** *in Missouri, in the middle of the continental USA. N0BBD and I made an exchange of APRS messages to complete a QSO on September 8th. A few days later, I received N0BBD's QSL card. When I sent my QSL card to N0BBD, I included a printout of images of my TH-D74's display showing our positions and messages, along with an excerpt from the* ***http://ariss.net*** *website showing those packets captured by gateway stations".*

Mark CT1FJC has been active in the early part of September on both FM and SSB transponders. On September 10th, he worked special event call AM1SAT from Spain.

Graham Jones G3VKV (Cheltenham) worked FG8OJ through FO-29 on August 12th and JW/OH8FKS/P on August 22nd.

Here at G4VXE I've used the TH-D72 and the MFJ Long Ranger whip to make some APRS contacts through both NO-84 and the ISS. Stations worked were DL7ORE, MM0CMV, DL6AP, M0JFP and M0OSA.

That's it for this month – a bit of a squeeze to get it all in. Thanks to everyone who has been in touch and please keep all your information coming.


TO RADIO

ZB2GI

Confirming Our QSO Via meteor Scatter

DAY	MONTH	YEAR	UTC	FREQ	RST	MODE
16	08	2018	08:19	144·375	(26)	FSK441

John Regnault
Maryland
Bredfield Road
Woodbridge
Suffolk
IP12 1JE
UK

best 320/9

TS2000, 8877 linear, 4x I0JXX 16

PSE ☑ QSL ☐ TNX

73

Fig. 3: ZB2GI's QSL card from John G4SWX for their 2m meteor scatter contact during the Perseids.

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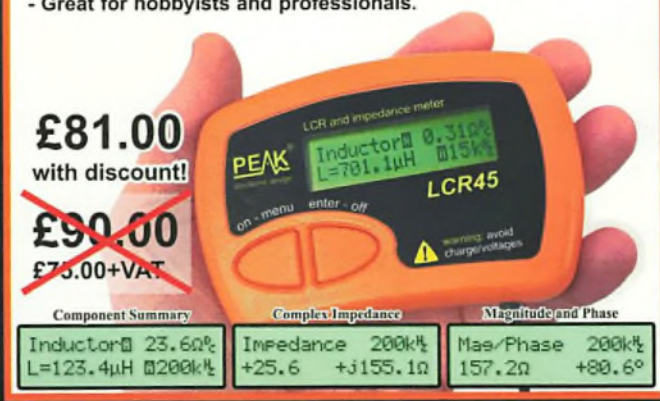

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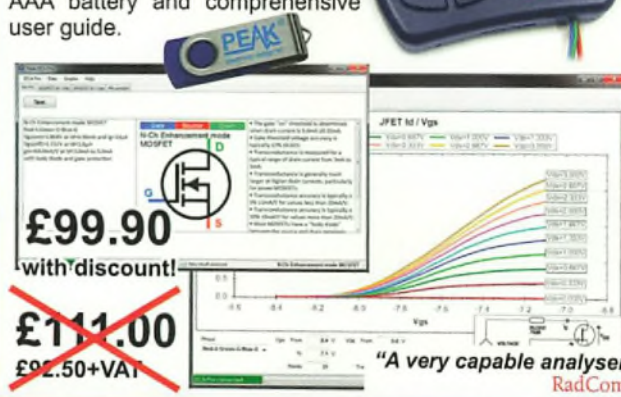

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Herbert Clark Hoover (1874-1964): Guardian of the Air Waves

The early days of amateur radio were challenging, with commercial and military interests trying to close down amateur radio. One key supporter was Herbert Clark Hoover. Michael Marinaro WN1M relates the story.

On August 31st 1921 American Radio League President Hiram Percy Maxim convened the first of what were to be many national conventions of the organisation he had co-founded. The union was barely seven years old and growing rapidly. Maxim proudly termed the Amateur members *"pioneers"* and exhorted them to be steadfast in their faith and loyalty to one other. Marking the event as historically significant he expressed his awe of the tremendous speed with which the events in wireless had advanced.

Early Days

Just recently released from the stringent regulatory grasp of the US Navy, the amateurs and all US wireless activities were newly governed by the Department of Commerce headed by Secretary **Herbert Clark Hoover**. Hoover sent a radio message to the conventioneers, which was read to the assemblage by his Chief Radio Inspector, **W D Terrell**: *"The Department of Commerce, by authority of the Congress, is the legal 'Patron Saint' of Amateur Radio Operators. Outside of the coldly legal regulations the Department is anxious to be helpful in encouraging this important movement of Amateur Radio."*

Although they both served in Washington simultaneously and were sometimes confused, our Herbert Clark Hoover is no relation to **J Edgar Hoover** of FBI repute. Herbert Clark Hoover served during the terms of Presidents **Harding** and **Coolidge** (1921 to 1923 and 1923 to 1929 respectively). His tenure as Secretary of Commerce was a tumultuous one. The world of wireless had grown beyond all bounds. Commercial, marine, military and particularly broadcast radio interests had strengthened and demanded not only spectrum

H Hoover at his personal radio in 1922.

but a myriad of operating privileges. The prevailing antiquated radio regulations in effect since 1912 made the administration and the maintenance of order among these powerful elements exceedingly difficult because they were concerned primarily with licensing. The Act did not even mention broadcasting and limited private radio communications to the longer wavelengths.

Birth of the ITU

The US Congress was also unwilling to enter this conflict and modernise the radio rules, which were based on The Regulations of the International Telegraphic Convention (ITC) enacted in 1912. The ITC had been founded in 1865 as a multi-country organisation designed to standardise inter-nation telegraph operations and procedures. This group consisted of 20 European nations contending with telegraph operations across adjoining borders and in diverse languages. The extent of its communications regulatory scope was later broadened to telephone and even later to wireless and radio. The jurisdiction of radio interested the US as it began to monitor the development of regulations in that realm and adhered to their basic enactments. In 1932 the ITC became the International Radio Telecommunications Union (ITU). In 1946 the ITU became a specialised agency of the United Nations and today is comprised of 193 member nations.

Hoover Conferences

Unilaterally, Hoover set out to conduct meetings with the interested groups. Four Hoover Conferences shaped informal gentlemen's agreements among the services. As a result, Hoover developed and adopted an entirely new concept that defined specific bands of frequencies for each service within which specific stations were assigned frequencies.

Importantly, and upheld to this day, the radio amateurs were exempted and were assigned specific bands within which any licensed amateur station could operate. The spectrum assigned to the amateurs was roughly the familiar 160, 80, 40, 20 and 15m bands. True to his word, Herbert Carter Hoover was a friend and supporter of amateur radio with long lasting influence beyond its infancy.

Unruly Broadcasters

The broadcasters, on the other hand, were another matter. They continued to be unruly.

Hoover expanded on the band/frequency allocation concept by persuading them to share assigned frequencies, limit power and divide the broadcast day into daytime and night operations. However, these remedies did little to relieve the interference

1911 ITU conference.

and other problems. Hoover suspended issuing licences as all involved began to agree that self-regulation was not working.

Hoover's frequency policy, and it was only a policy, was contested in the court in 1926 and was found invalid because the 1912 law was still in effect. To avoid total air wave chaos the various entities, at Hoover's bequest and under his influence, voluntarily continued to abide by his frequency policy and the gentlemen's agreements previously evolved.

The Secretary was not entirely alone in his efforts. His subordinate **William Dandrige Terrell** (1871-1965) served as Chief of the Radio Division in the Commerce Department from 1915 onwards. Terrill embraced Hoover's concepts and was instrumental in implementing them with succeeding Agencies, which he served as Chief of Field Operations until 1943, and also as a member of US delegations to international conferences.

Further Progress

It was three successive proceedings that further solidified the position of the amateurs and brought order to the air waves domestically and internationally.

Firstly, encouraged by the League's leadership, the International Amateur Radio Union (IARU) had taken form in Paris in 1925.The IARU was sufficiently organised to participate momentously in the imminent ITU conference of 1927. The IARU became a significant factor in advocating for amateur radio at the conference and succeeding international radio law forums organised by the ITU. (See Marinaro, Michael W, *"The IARU" QST* magazine, ARRL. September 2016 p.53).

Secondly, with the intention of revising the Regulations set forth by the London Conference of 1912, the ITC had previously announced and convened an International Radio Telegraph Conference (IRTC) in 1927. The principal topics were wireless conduct and, significantly, frequency allocation, the same issues that were confronting the US Department of Commerce. The initial Conference was held in Washington, DC, and 73 delegations attended. Secretary Hoover acted as President of this gathering, which was followed by others in Ottawa and Prague in 1929 and concluded with a full conference in the Hague, also in 1929.

The atmosphere in these assemblies was not favourable for amateur radio. Amateurs were considered pests and intruders. Opinions varied from complete disbarment to severe curtailment. However, a strong US Delegation and the IARU won lasting privileges for the amateurs and US concepts.

Concurrently, in 1926 the US Congress, during the term of the next President, **Franklin Delano Roosevelt**, established the Federal Radio Commission (FRC). The purpose of the commission was to... *"regulate radio use as the public interest, convenience or necessity requires"*. The Commissioners prepared for and organised the formal US Delegation participation in the vital IRTC and other Conventions.

Herbert Clark Hoover won the very next presidential election, that of 1929, becoming 31st President of the US. He was again confronted with challenges as the great depression began shortly after his inauguration. The Radio Laws were of low priority during his difficult tenure. Complete collapse of the AM air waves was avoided by Hoover's continued personal influence and the efforts of incumbent Commerce Secretary R P Lamont and W D Terrell.

During Hoover's Presidency the number of licensed amateurs in the US more than doubled from 16,289 in 1929 to 41,555 in 1933, attributable to the favourable regulatory environment.

He was defeated in the 1933 election. Hoover went on to serve the remainder of his life in an advisory capacity to a number of succeeding Presidents, mostly concerned with humanitarian projects, and was a co-founder of UNICEF.

Lastly, following the resolutions and stipulations of the ITU, the US Congress enacted the Radio Act of 1927. Regulation of the broadcasters was a principal concern. The Commission was mainly authorised to grant and deny licences and to assign frequencies and power levels for each licensee following Hoover's concepts. The Commission firmly positioned the broadcasters in the initial 540 to 1500kHz band and prohibited some operating practices.

1927 Act

Rather than nebulous rules imposed by an agency, the 1927 Act solidified the status of amateurs and amateur radio by act of Congress (and indirectly the ITU). And, it bestowed several new privileges:

- Amateur radio was precisely defined.
- Existing band/frequency allocations were confirmed.
- A ten-metre band was added.
- Three bands were specified where Radio Telephone was permitted.
- Prohibitions were stipulated: Spark Transmission; Communication with non-

The ITU Radio Regulations.

Two Hoover family members influenced amateur radio by direct participation:

Son, **Herbert Charles 'Herb' Jr. (II)** (1903-1969) was interested in radio from an early age and licensed as W6ZH (ex 6AE, 6XH, 3ZH, W4SR and K6EV). Herb was President of the ARRL and the IARU from 1962 to 1966. He served as Undersecretary of State during the administration of **Dwight D Eisenhower**. As a manager he headed several firms in the energy sector and as an educator and humanitarian he voluntary served on the boards of many public welfare institutions.

Grandson, **Herbert William, 'Pete', (III)** (1927-2010), was licensed as W6APW and adopted his father's callsign W6ZH. Pete was an ARRL member for 50 years; a member of the ARRL Long Term Planning Committee from 1978 to 1981; Director of the ARRL Foundation; and active in amateur satellite endeavours. He also served as a Director of the Red Cross.

amateur stations (Government, Commercial, etc.); Conduct of commercial activity; Broadcast of news, music, lectures etc. or any other form of entertainment.

The accomplishment of this formal US affirmation is attributable to the unwavering, persistent lobbying efforts of President Hiram Percy Maxim, General Manager **Kenneth B Warner** and the other leadership staff of the American Radio Relay League (ARRL). And, at the ITRC, the efforts of the IARU. The amateurs had earned their status by their superior performance and resolution.

Creation of the FCC

In 1934 Congress acted again, creating the Federal Communications Commission (FCC) to supersede the FRC with a broader charter and greater powers. The authorisation was: *"to regulate interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States, without discrimination on the basis of race, colour, religion, national origin, or sex, a rapid, efficient, nationwide and worldwide wire and radio communications service."* As an independent, self-sufficient agency overseen by Congress, the FCC regulates interstate and international communications by radio, television, wire, satellite and cable in the US and functions as the primary authority for communications law, regulation and technological innovation.

Amateur Radio at World Radio Conferences

This law ushered in a period of favourable regulatory relations. For 84 years US amateurs, led by the ARRL, have been respected as equals to other services and had many proposals of mutual benefit accepted and implemented. The League is valued as a self-policing organisation and initiator of policy proposals not only favourable to amateurs but in the best interests of the US. This constructive cooperation has also led to a unified presence in the ITU World Radiocommunication Conferences (WRC) regulatory forums. The WRC is a treaty-level forum held by the ITU every three to four years at which countries decide on the allocation of frequency spectrum in order to allow the deployment or growth of all types of radiocommunication services.

The function of the Conference is to review and, when necessary, revise the international Radio Regulation treaty governing the use of the radio spectrum and both geostationary and non-geostationary satellite orbits.

Revisions are made on the basis of an agenda determined by the Council of the ITU, taking into account recommendations made by previous WRCs. The general scope of the agenda is established four to six years in advance, with the final agenda set by an ITU Council two years before each conference, following general agreement with a majority of the 193 ITU member states. The last WRC was in 2015, the next in 2019. Although there is no legal stipulation to do so, the results of a WRC are subsequently ratified and enacted at the national levels by each of the ITU members (as was done by the US after the 1926 IRTC and each subsequent Conference).

Preparation for a WRC requires a great deal of effort and coordination. The inputs of many diverse sources are considered and a consensus national position formulated on the principal agenda items. Corporate and academic bodies often participate in the position planning conferences. In the US, the process is orchestrated by a Department of Commerce agency, the National Telecommunications Information Administration (NTIA) who, since 1978, manage the nation's use of spectrum. NTIA carries out this responsibility with assistance and advice from its Interdepartmen-

tal Radio Advisory Committee (IRAC). The IRAC comprises a member from each of the armed services, the major government agencies and departments and interested invitees. In turn, its Radio Conference Sub-committee (RCS) prepares the preliminary proposal containing the US suggestions, views, and opinions in respect to the agenda items. NTIA conveys the proposal to the major parties including the FCC. Differences are reconciled and the final approved document is sent to the Department of State for representation to the ITU.

Present Day

In over a century wireless has grown from simplicity to sophistication. Simultaneously, oversight has grown from virtually none to stringency. Hoover's methods and tenets form the basic construct of the regulatory bodies that have followed. Today, the electromagnetic spectrum utilisation issues are complex and complicated contending with satellites, cellphones and other modern advances. These issues present a dramatic leap from the need to separate the broad raspy spark gap signals of yesteryear and the heterodyning AM broadcasters that shortly followed. Thanks to the foresight of H Hoover and others and the tireless efforts of amateur radio organisations, amateur radio continues to enjoy significant frequency privileges and a place at the international negotiating table. However, none of this can be taken for granted and constant vigilance is required to ensure that we do not lose what has been gained over the past century or so.

The most recent World Radio Conference, organised by the ITU.

Feature by Dr Bruce Taylor HB9ANY
• E-mail: bgtaylor@iee.org

The Transistor Revolution (Part 2)

Dr Bruce Taylor HB9ANY concludes his look at the history of the transistor, relating how the invention impacted amateur radio and moving on to modern developments in integrated circuitry and microprocessors.

Wireless World first reported the invention of the transistor in October 1948. Using little more than a microscope, an Avometer and a pulse source for point-contact forming, enterprising amateurs were soon making their own transistors by replacing the single cat's whisker of selected germanium diodes by two. By 1950 enthusiasts in the UK were building simple receivers using commercially-available Raytheon point-contact transistors that were primarily made for hearing aids.

Radio amateurs also started experimenting with transmitters as soon as suitable transistors became available at accessible prices. The February 1953 issue of *QST* described how RCA manager K2AH even made a 146MHz CW QSO with W2UK over 25 miles with a power input of 24mW to a single selected experimental point-contact germanium T165/6 transistor. In the UK, a miniature 3.5MHz transistor transmitter by G5CV aroused great interest when operated at the 1953 Amateur Radio Exhibition. A simple receiver using two GEC point-contact transistors was described in the January 1954 issue of *Wireless World*, while a topband (160m) transmitter by G3IEE using a Mullard OC50 featured in the *RSGB Bulletin* for March. At this time manufacturers such as Philips made 'experimental transistors' available to amateurs at low prices. These were devices that failed to meet the full professional specifications and would otherwise have been scrap.

In mid-1956 IDEA launched the Regency ATC-1, a simple two-transistor mobile converter that tuned the five HF amateur bands. One germanium npn transistor acted as oscillator/mixer, with output at 1230kHz for a broadcast receiver, and a second pnp one as Q-multiplier/BFO. It was sold for $79.50.

In September of that year W1OGU, a technician with Raytheon, achieved the first transatlantic QSO with a transistor transmitter, working OZ7BO in Copenhagen and G3AAM in Birmingham on 14MHz. His crystal-controlled rig used one 2N113 germanium alloy junction transistor as 7MHz oscillator, driving a second as doubler/output stage with 78mW input.

One of the first shortwave transistor receivers for radio amateurs to be made in the UK was the Heathkit GC-1U Mohican, which was sold in 1961 for £38 15/- (around £800 in today's money). The

The 1956 Regency ATC-1 HF band converter was one of the first commercial transistor products for radio amateurs. (W8ZR)

10-transistor kit set used three Mullard germanium AF115s as RF amplifier, local oscillator and mixer, with four OC45s for the BFO and three IF amplifiers coupled by 455kHz piezoelectric 'transfilters'. After replacing the audio output stage by a higher power amplifier, I used the compact set as a mobile receiver for several years but its performance didn't match that of good valve receivers of that period. Starting with the Model IM-30 in 1961, Heathkit also produced a series of rudimentary transistor testers and curve tracers that evolved with the device technology until the final Model IT-2232 was phased out in 1990.

It took several years for many of the traditional shortwave receiver manufacturers to change from valve to transistor designs and not all did so successfully. Eddystone's first solid-state communications receiver was the S960; virtually a model S940 with 12 transistors in place of valves. Its performance was inferior to its parent and it was dropped two years later. The more compact EC10 that was introduced in 1963 was more successful and over 6,000 were made, followed by around 10,000 of the Mk2 version with an S-meter and fine-

tuning control. In 1971 you could choose between the valved Model 830 receiver and the transistorised 1830 version with slightly better performance. The 830 was Eddystone's last valve receiver and continued in production until January 1973.

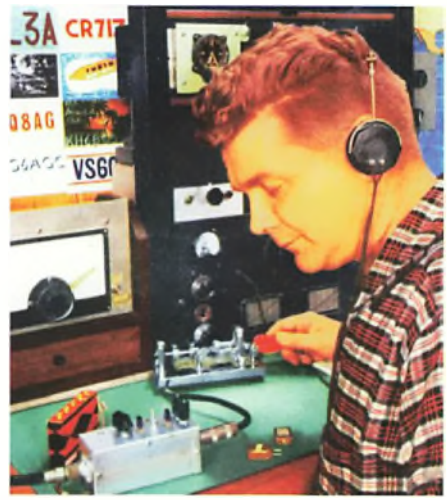
National HRO receivers had been a long-time favourite with radio amateurs, and around 10,000 sets were used by the Y-Station service that supplied intercepted enemy wireless messages to Bletchley Park during WW2. In 1964 National introduced a transistor version of the receiver that retained the classic 'PW' gear drive but no longer had plug-in coils. This transitional set had 37 germanium transistors in sockets connected by conventional point-to-point wiring, just like its valve predecessors.

Diffusion

The first successful method of making a junction transistor involved creating the base layer by dropping a tiny p-type pellet into the n-type melt while drawing the crystal, and then converting it back to n-type. With this double-doping process, and also the improved rate-grown variant, it was difficult to accurately produce and connect to the very narrow base region required for high frequency performance. Problems also arose with the alternative alloy junction process developed by GE and RCA, since precise control of the alloying temperature and the thickness of the base layer was difficult. In a batch of 100 transistors, the gain could vary from 20 to 50dB.

Once again, chance played an essential role in the development of a hugely important new technology. While doping by gas diffusion had been used to introduce the donor impurities into germanium crystals, attempts to use the process at the very high temperatures required for processing silicon were initially unsuccessful because of damage to the wafer surface. But while Bell Labs chemist **Carl Frosch** was experimenting with diffusion, the hydrogen carrying the dopant impurities accidentally caught fire, causing water to be produced in his diffusion chamber. Frosch discovered that the fine green silicon dioxide layer that this formed on the surface of the wafer sealed it and protected it from damage. Unlike germanium oxides, silica is strong, inert and an excellent insulator. Initially considered a problem, the oxide turned out to be a key element of reliable solid-state electronics.

Photolithography techniques from the printing industry had already been used for the production of printed circuit boards, using a photosensitive resist that was exposed through an optical mask. The technology was readily adapted to chemically etch precisely-dimensioned windows in the oxide layer covering the silicon wafer, through which the n and p-type impurities could be diffused to make a double-diffused transistor and this important invention was announced by Bell Labs in June 1955. With the Cold War in full swing, ample military funds were available to develop these new transistors that could operate at high temperature and high frequency.



W1OGU achieved the first transatlantic QSO with a 78mW transistor transmitter in September 1952.

W1OGU's historic 14MHz transatlantic transmitter used two germanium 2N113 transistors. (Raytheon)

Nobel

It had been expected for several years that the invention of the transistor merited a Nobel Prize, so it was no real surprise when **Bardeen** and **Brattain** were chosen to receive the 1956 award for Physics. It was less certain that **Shockley** would also share the coveted prize but in the end his name was included although the vote was not unanimous. Shockley tried to find out from the Swedish Royal Academy of Sciences who had opposed him but was told that he had no right to know.

All three men attended a celebration dinner in New York but the Bardeen and Brattain families travelled to Stockholm separately from the Shockleys and only shared the formal ceremonies there. For all three Laureates, it was the pinnacle of their careers. For Shockley, it was the prelude to his demise.

Silicon Valley

In view of his abrasive management style, Shockley was repeatedly passed over for promotion at Bell Labs. So, during 1955 he left to launch his own enterprise and, with

The UK version of the 10-transistor Heathkit Mohican receiver was launched in 1961. (GM3NZI)

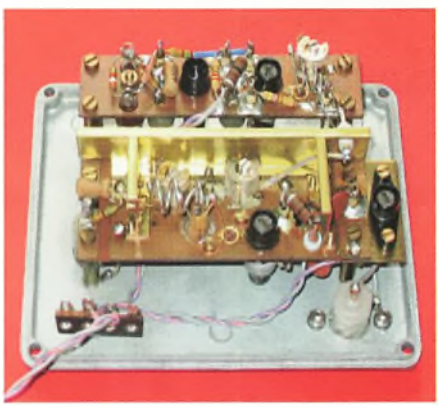
The IM-30 was the first of a series of simple transistor testers that could measure DC gain and leakage current. (Heathkit)

Early transistor receiver technology. The glass-encapsulated Mullard germanium transistors are mounted on solder sockets like little valves. (GM3NZI)

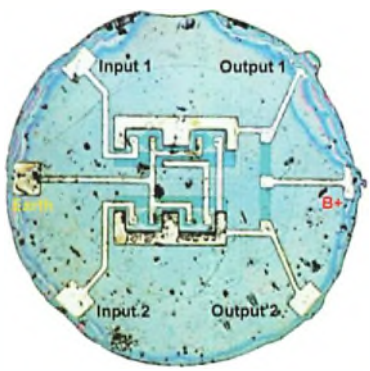
National launched the solid-state HRO 500 in 1964. It was built like a traditional valve receiver but used 37 germanium transistors and 20 diodes. (Merate Chronometer Center)

Robert Noyce (right) addresses the other seven members of the 'traitorous eight'. (Fairchild)

The 33-transistor Eddystone 1830 had a JFET/MOSFET cascode RF amplifier and dual-gate MOSFET first mixer. (Eddystone UG)



This 432MHz converter was typical of the homebrew UHF art in 1965. It uses three TI germanium pnp transistors in the UHF stages and three Mullard OC171s for the frequency multiplier and 28MHz IF amplifier. (GM3NZI)



Noyce made the first monolithic silicon IC in 1961. This basic flip-flop had four transistors and two resistors. (Fairchild)

the financial backing of Beckman Industries, Shockley Semiconductor Laboratory started up in April 1956. The facility was located in a new industrial park that was being set up in the Santa Clara Valley on land owned by Stanford University. It was the start of silicon in Silicon Valley, the extraordinary zone of innovation and technology that now accounts for one-third of all the venture capital investment in the US. Shockley planned that his company would *"set the world on fire"*. Indeed, it did, but not at all as he envisaged.

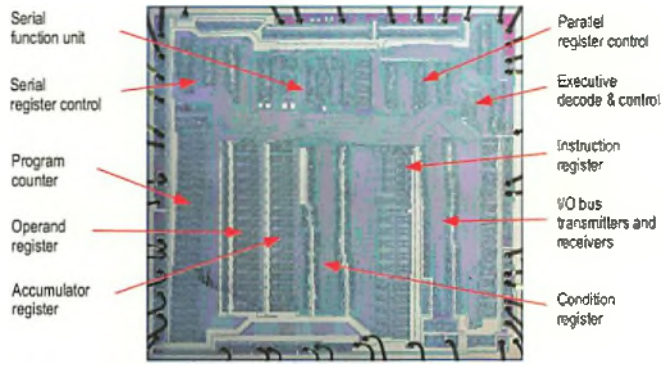
None of Shockley's Bell Labs colleagues wanted to join him. But because of his reputation as a scientific genius, he had no difficulty recruiting very talented staff, including the chemist **Gordon Moore** (of Moore's Law), Swiss physicist **Jean Hoerni** and **Robert Noyce**, who was employed at that time by the radio and TV manufacturer Philco but was seeking research-oriented work. In the UK, Ferranti began producing bipolar silicon diffused transistors in 1954. Shockley could also have directed his new team to ramp up production of silicon transistors to profit from a rapidly expanding US market. But instead, he insisted that they devote their efforts to developing a special four-layer pnpn diode that was difficult to fabricate reliably and of limited application. As a result, Shockley Semiconductor Lab never turned a profit.

Shockley proved an even worse manager in his own company than at Bell Labs. He constantly feuded with subordinates, insulted his staff and refused to listen to their advice. He became paranoid about trivial incidents, recorded all phone calls, and at one point even ordered all his employees to take a lie-detector test. Genius without ethics wasn't a winning formula and by September 1958, after a mutiny of eight dissidents lead by Noyce, the company had fallen apart. Shockley did almost no further work of scientific value and went on to pursue a racist dysgenics agenda, lecturing about the inferiority of African-Americans and advocating the sterilisation of people with an IQ under 100. He died in 1989 without fortune but knowing that he had been the intellectual driving force behind a technological revolution and the catalyst of an industry that turned a quiet Californian valley into the most concentrated source of wealth on the planet.

Planar Technology

The 'traitorous eight' that defected *en masse* from Shockley Lab went on to found Fairchild Semiconductor with a $1.38 million loan from Sherman Fairchild, a New York playboy-inventor who was the largest shareholder in IBM. Each of the eight had to make an initial investment of $500 to purchase 100 of the company's shares, a sum that Noyce had to borrow from his grandmother since neither he nor his parents had any savings. He had no difficulty repaying her with interest, for less than two years later his stock was worth $300,000 and his personal fortune was eventually to grow to over $3 billion.

The timing was fortuitous. Alarmed by the surprise launch of Sputnik 1 in October 1957, the US Military suddenly had major requirements for lightweight miniature solid-state components for its catch-up programme and total annual purchases soon exceeded $100 million. Fairchild's first contract was to manufacture silicon mesa transistors for IBM's navigational computer for the XB-70 Valkyrie bomber. To make arrays of transistors, they cobbled together a step-and-repeat camera using ordinary 16mm movie camera lenses. The yield was reasonable but reliability proved an issue and technicians had to 'tap test' the transistors with pencil erasers to check



The 1976 Ferranti F100L was the first 16-bit microprocessor designed and manufactured in Europe. It used an enhanced rad-hard bipolar technology with 3.5 micron features. (Ferranti)

Inexpensive SDR dongles spawned a new generation of communications receivers. (HB9ANY)

whether tiny loose particles trapped in the hermetic package could contaminate the exposed p-n junctions.

To solve this problem, Hoerni built on the earlier work of Frosch to invent the ground-breaking planar technology that protected the sensitive junctions with oxide and allowed all the contacts to be made on one side of the silicon wafer. This passivation process reduced leakage currents and the configuration automatically created graded bases that reduce the charge carrier transit time, as in drift transistors. It also supported the aluminium-over-oxide interconnection scheme that was used by Noyce to make the first commercial monolithic silicon integrated circuits in 1960, after the problem of aligning successive photolithographic masks had been solved. Patent litigation between Fairchild and TI over the invention of the IC lasted many years but out of court the two companies entered a cross-licensing agreement with a net payment to Fairchild.

The individual components in the production versions of these ICs were isolated by reverse-biased p-n junctions, a technique that had been patented by **Kurt Lehovec** while at Sprague Electric, who paid him only $1 for the rights to this key invention. (A common practice at the time). Until it was overtaken by TI in 1967, Fairchild became the undisputed leader of the semiconductor industry and in due course, spin-off 'Fairchildren' spawned the creation of dozens of successful companies in Silicon Valley, such as AMD, Intersil, National Semiconductor, Signetics and Teledyne.

The silicon dioxide layer also proved the key to neutralising the troublesome surface states that had thwarted attempts to make an insulated-gate field-effect transistor. **John Atalla** finally succeeded in making a working FET at Bell Labs in 1959, paving the way for modern MOSFET integrated electronics. In the UK, Plessey was involved in integrated circuit development at an early date but the first ICs to be produced commercially in Europe were the Micronor devices introduced by Ferranti from 1962. These ICs had a wired OR function and were used mainly in computers developed by Marconi for the Admiralty. The second generation of this family used an enhanced DTL technology that was faster but less dense than TI 74 series TTL, which emerged as the most popular logic configuration after it appeared in 1966. Micronor II ICs powered the Argus 400 computers that were used in many industrial control applications, such as nuclear power stations and the Jodrell Bank radio telescope. In 1966, Plessey started the first European production of MOS ICs at Swindon.

Evolution

In 1968 Moore and Noyce left Fairchild to found Integrated Electronics Corp, a name they abridged to the snappier Intel. Inspired by HP, they practised a non-hierarchical management style that encouraged the exchange of ideas and innovation and in 1971 their four-bit 10-micron 4004 CPU chip with 2300 MOS transistors launched the microcomputer age. At that time few people envisaged the wide-ranging consequence of the synergy of microprocessors and wireless, and in the same year a marketing study commissioned by AT&T reported that *"there is no market for mobile phones at any price"*!

The first European 16-bit microprocessor was the Ferranti 3.5-micron F100L, introduced in 1976. This mil-spec rad-hard chip, designed in Bracknell and fabricated in Manchester, had about 7000 components and 2m of aluminium track interconnects. It was orbited in OSCAR-9, although it wasn't frequently enabled in that satellite because of its high power consumption. Two years later Intel introduced the commercial 16-bit 3-micron 8086 microprocessor and the x86 family architecture rapidly became ubiquitous in desktop PCs and laptops. In due course this led to the next iteration in wireless technology. Although the concept was much older, in 1995 **Stephen Blust** coined the term Software Defined Radio and soon SDR hardware and software allowed any PC to be turned into a high-performance transceiver capable of handling a wide range of communications modes.

Today there are 19 silicon manufacturing facilities in the UK. A single modern FPGA can have as many as 50 billion microscopic transistors and (including memory) a high-end smartphone contains a total of around one trillion, or ten times more than the number of neurons in the human brain. To visualise the total number of transistors that have been manufactured, we can take as a metric the number of cells in the human body – about 100 trillion. Then a Fermi estimate of the total number of transistors made since 1947 exceeds the number of human cells in the entire population of the UK and within a few years the number of transistors produced may equal the number of human cells on the planet. Even visionaries like **Bill Hewlett** and **Dave Packard** would have been astounded.

In the years immediately following its invention, the transistor was conceived as a replacement for the thermionic valve. Indeed, it was, and a very good one but it also triggered revolutionary growth in communications technology and created a world that has become interconnected as never before. Apart from wireless itself, perhaps no other modern invention has had a greater influence on almost every aspect of our daily lives.

• E-mail: mwimwd@gmx.com

The RWWR Project (Part II)

Joe Chester MW1MWD reflects on the experiences and lessons learned from his early outings around Wales.

This is the result of the inquiry into the failure of RWWR-3, the third expedition of the Round Wales With a Radio project. So, what went wrong? Did I hear you say, *"nearly everything"*? My friend, we will call him M for now, and of whom more later, agrees completely. But he's like that is M; finds it a bit difficult to see the positives in life!

You will recall that I had what I thought was a simple idea – to go around the Welsh countryside, set up an antenna and make a few portable QSOs. Last time I explained what happened when I took a Buddipole dipole antenna, a 12V car battery and my Icom IC-706 out to a Welsh beauty spot. All I managed was to hear some very bad tempered QSOs on 20m and I failed to make a single QSO. The rig kept shutting down and getting the antenna to its resonant point was awkward. I left for home exhausted. But the birdwatcher had a good day and the picnic catering was excellent. It was time for a rethink.

There seemed to be two issues – the radio and the antenna. At least that's what I thought; but there's M again, looking strangely at me. So first let's talk about the antenna.

My initial thoughts had been to go mobile. However, extensive research indicated that grounding issues would require extensive drilling and welding on the car. This, the car 'owner' found unacceptable (it used to be my car, then became ours but now its hers!). My second attempt was with homebrew solutions of various sorts, from verticals to long wires. Some of these experiments worked, or nearly worked, but each one had its own drawbacks. For instance, a 40m inverted-V, using a fishing pole, was so long that I couldn't get it into the back garden. Out portable, the footprint was significant, with the ground stakes so far away from the car that they represented a serious trip risk to innocent passers-by. Eventually, after much research, I decided to try the Buddipole (BP), principally because the footprint out portable is just a tripod beside the car. So, I would like to begin with a subjective review of this system. I will talk about the radio later on.

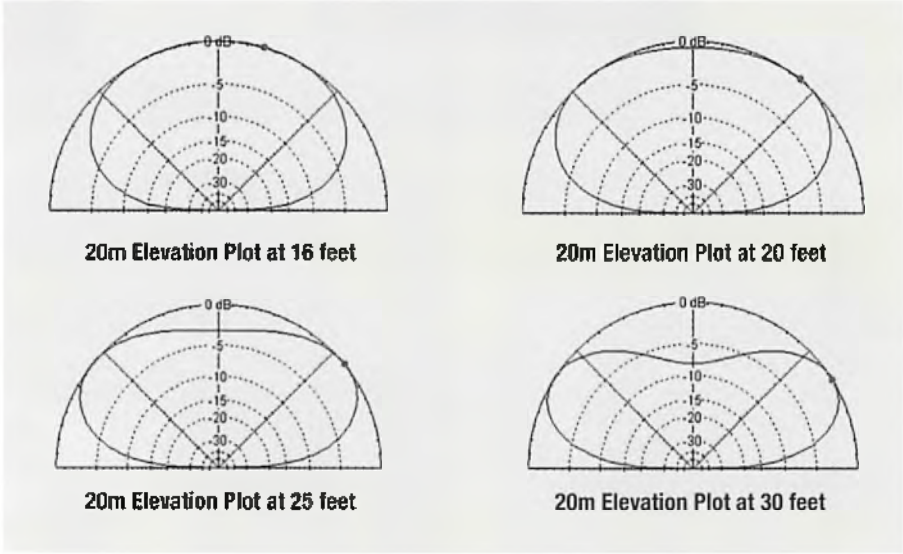


Fig. 1: Buddipole EZNEC plots for a 20m dipole, taken from NE1RD's excellent documentation.

The Buddipole System

There is a large following for the Buddipole worldwide (the user group – the B.U.G – has over 8000 members). The system also has its detractors, who dislike the compromise nature of the beast. **Steve KJ4KKI**, on the B.U.G list puts it more strongly: *"This antenna seems to cause people to either hate it or love it....Getting good reports means propagation was good that day. It's not that the antenna works magic"*. It's important to realise that the BP is not an antenna as such, rather a set of highly engineered components with which to make antennas, lots of different ones. The components include extendable whips, coils with taps, arms to which the coils and whips can be attached, and a component called a Versatee, onto which the coils and arms screw. There is also a wire winder with wire for making counterpoises, and even a radial kit. It comes with a length of RG58 milspec feeder topped with a choke-balun made with clip-on ferrites. A tripod mast to which the Versatee screws completes the kit. There are lots of additional components available but these are not needed to get started. I got the Mini-kit. All of it, except the tripod, comes in a purpose-designed laptop bag.

Scott Andersen NE1RD has written a book (free from the Buddipole website – see URL below) about his scientific work with the BP system. It is essential study for anyone playing with the BP or, indeed, anyone interested in antennas. One of the first things I learned from this book was that a dipole less than a half-wavelength above ground, is mainly a cloud warmer.! Of course, I knew this since I was first licensed (!). But Scott's work showed why this is so in graphic detail. A 20m dipole needs to be 10m high, otherwise all the radiated power goes straight up! This explains the usual recommendation to get the thing up 10m into the air, if possible. **https://tinyurl.com/y9w7v7ab**

The EZNEC antenna models of a 20m dipole at lower heights are given in Scott's book. (The Documents section of the Buddipole website has many more EZNEC files from Scott's book). It shows clearly that most of the RF energy goes straight up into the air at lower heights. Note the difference between the 16ft high diagram, **Fig. 1**, where the maximum of the lobe is 90°, and the 30ft one, where the maximum

Fig. 2: The Buddipole, configured as a 20m dipole, at a height of 5m.

is at about 20° (either side of the vertical). HF at 20m is poorly reflected off the ionosphere anyway, which means that the RF energy mostly heads directly into space. Despite this, many of us 'make do' with lower heights – mine is in my attic at about 5m above ground. But I now know why I can only make contacts as far as Asiatic Russia, and occasionally the USA east coast when propagation is good. Forget Australia and Japan – at least with the current setup. Of course, the state of ionisation of the ionosphere also affects this, driven by the number of sunspots (currently low and heading lower). The images in **Steve White G3ZVW's** piece on the F layer (*PW* March 2018) are also informative. But I digress.

As well as the commercial version (CBP), there is an active homebrew gang and **Budd**, the originator, is very helpful to those people too, giving them designs for how to DIY the system (see his website, URL below). My sense is that he has created a process and a set of components, which if the process is followed correctly, will yield antennas that will perform reasonably well. So, the BP is really a kind of Lego for antenna builders. If you want something you can stick up again and again, then you have to be prepared to follow the directions, do the work to make the mods and see what happens. This is my story too. Lots of back garden work to understand it all and work towards something that can be set up consistently and that works. It takes time and I'm not quite there yet.
https://tinyurl.com/ydayc9eg

The CBP is very well designed and built, and, after a careful study of Scott's book, and my initial experiments, I'm sure it will work. I select one of the set of options in the guide provided, put it together, and stick it up in the air. I attach an antenna analyser, and check for resonance. To move the resonant frequency, I take it down and adjust the whip lengths a bit at a time until I get what I want. For a 20m horizontal dipole, the one I started with, after a few attempts, **Fig. 2**, I finally got the resonant point to 14.220MHz, with the SWR below 2:1 over a 300kHz band around this frequency. Other frequencies and setups work the same way, whether vertical or horizontal. It may not be the rare DX hunter's choice but for portable operation it combines a small footprint with a resonance tuning process to produce probably the best that can be done. I will keep experimenting to get the setups that work for me.

Next month I'll review some of the other lessons learned.

Letters

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Wireless Engineer

Dear Don,
I was fortunate enough recently to have been given a copy of an old radio book. The book is entitled *Second Thoughts on Radio Theory* by '**Cathode Ray**' and was first published by Iliffe & Sons Ltd. for *Wireless World* in 1955.

'Cathode Ray' was a prolific author for *Wireless World* and the book seems to be a collection of his articles for the magazine collated together to form a book. From the early 1970s I used to buy *Wireless World* every month along with *Practical Wireless*, *Practical Electronics*, *Everyday Electronics*, *ETI*, *Television* and *Radio & Electronics Constructor*.

In the back of the book, however, there was an advertisement for a magazine that I have never come across before called *Wireless Engineer* – see photo. From the description is seems that the magazine may have been aimed at professional readers rather than hobbyists. Have you or any of your readers ever come across this magazine?
Chris Murphy M0HLS
Derby

Editor's comment: *Not one I've come across Chris, although I do remember all the others you mention (and a few more besides, such as* Amateur Radio, Ham Radio Today, RadioActive *and, of course,* Short Wave Magazine*). But I feel sure one or more of our readers will be able to help. We have a couple of other requests for help this month too – if any readers are able to answer the questions being asked, please drop me a line at the editorial address and I'll forward to the original letter writer.*

Great Time?

Dear Don,
Yep, **Mark G0ACQ** is right on the money (*Letters*, October). It is now 'a great time to be a radio amateur'. Mind you, it wasn't always a great time to be a radio amateur.

When I first discovered the delights amateur radio about 55 years ago or so, getting a licence appeared to be about as difficult and insurmountable as entering the hallowed halls of Oxbridge academia. Not only that, without waxing too lyrical, amateur radio was, without knowing it, heading towards a crossroads of sorts. Not only was its popularity hidden from those who might add to and change its then complacency. Commercial equipment was, for many people, prohibitively expensive. You had to build it instead.

Nowadays, that has all changed. New rigs now appear seemingly as often as cups of coffee each morning in a branch of Costa. And many are ridiculously cheap. Just wade in and fill your boots with all manner of RF goodies and more. Many of us do, me included. Want an antenna? No sweat. Buy one. The choice is bewildering. However, I still prefer to build an antenna. Mainly, because I'm a cheapskate.

And then, the RF boffins have brought us the almost magical enhancements of what was, once upon a time, the boring and not very exciting analogue communications we used to love. Digital communications arrived. DMR. EchoLink and so on. Now, Network Radios. What's next? Whatever it is, a few diehards will not like it. No surprise.

But the best thing to happen is this: amateur radio has become democratised. It's now open and accessible for all. No barriers. How I wish it was like that 55 years ago. So, let's enjoy the continuing munificence of what is now available in the amateur radio marketplace rather than moan about it. The future has nearly arrived.
Ray Howes G4OWY/G6AUW
Weymouth, Dorset

Editor's comment: *Thanks as always, Ray. As I mention in this month's editorial, I have recently been enjoying reading some copies of* PW *from the 1950s and 60s. It's interesting to see the doomsayers – transistors will never catch on, the removal of the mandatory year of Morse operation will be the death of amateur radio, SSB is the work of Satan – you get the idea. But the hobby continues and thrives, as do the naysayers. And, hopefully,* PW *will continue to be here to record and support the hobby in all its varieties.*

Help Please

Dear Don,
May I ask the help of your readers to identify the object in the enclosed photographs? It was found on a Lincolnshire beach this summer. Basically, it is three coils wound on a former. The layers of the coil have copper foil tape and cotton tape and these have deteriorated a little.

The first photo shows the coil former, which has a triangular knob on top and fits into a protective case. The second shows the base of the coil (which appears to be made of wood). It has two holes and I am guessing that there were two pins protruding here that fitted into a socket. The third shows the former out of its case. Visible are the three coils, copper tape and cotton tape. The white marks on the case and former are marine growths.

I cannot identify the material from which the knob, former and case are made.

To me it looks like one of a set of tuning coils that used to be used to change frequency/band on radios in the early years of wireless. Any ideas or positive information would be gratefully

£20 STAR LETTER

Data Modes

Dear Don,
I wanted to express my belated thanks (belated because I've been putting the article into practice!) to *PW* and **John G3YQC** for the most helpful and detailed article in June *PW* titled *A Data Modes Primer*, which was published at exactly the right time for me.

As an old DX chasing G3 I've gone about as far as I can go using CW and SSB and after only 40 (!) years managed to get all my DXCCs. The recent band conditions have not been good and there are no encouraging signs of propagation improving before I get too much older.

Becoming increasingly depressed with the poor conditions on CW/SSB and becoming less radio active, I could not fail to notice the Cluster showing other people working decent DX using FT8. It seemed I was missing something and I decided to give FT8 a try around the same time as John's article was published.

I have used RTTY but no other digital modes so I am effectively a newcomer to things like FT8.

John's article was extremely helpful, going into the degree of detail that people like me need. I kept the article open for weeks for reference as I progressed with FT8.

Over the last few weeks FT8 has fulfilled my need that some of us amateurs have for communication, the further the better, and I admit to having had fun with this new mode. It's definitely an effective mode. If the band is devoid of any CW or SSB signals, try FT8 and the band will be busy. The simple screen belies the many clever things that the program obviously does and which I am not clever enough to understand. I have asked but when things like the Fourier Transform get mentioned I just go blank and go back to operating.

I have heard 'its not proper radio' comments but can remember similar adverse comments being made about that new mode of SSB back in the 1960s. The minimal exchange of information on FT8 is no more or less than a QSO made in a pile-up with a DX station.

Anyway, it's an amateur mode that is obviously very popular and I have noticed several well-known DX operators using FT8 so it's not just me who seems to be affected.

As radio amateurs we now have a wide and varied selection of modes to use and it's an individual choice which to use. For now, I'm happy with FT8. However if, I've upset anybody or called when I shouldn't, I apologise. I'm just a beginner!

Keep up the good work with *PW*.

Ken Filmer G3XPO
Hawkinge, Kent

Editor's comment: *Thanks Ken, it's always nice to hear when an 'Old Timer' (you must have been licensed just a matter of weeks before me!) can admit to enjoying new aspects of the hobby. Too often amateur radio seems to have become a legacy hobby. As for FT8, you'll see from* ***Mike Richards'*** *column this month that additional features are being added that will allow at least a minimal exchange of pleasantries.*

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

received!
Eddie Lingard G3WNQ
Mablethorpe, Lincs.

The Bowline Again

Dear Don,
Rope end in right hand and pointing away from you, standing part laid across palm of left hand. Thumb of right hand under the standing part on left palm, first and middle finger on top of standing part. Roll right hand away and you find the end is now through the loop you have made. End round the standing part and back through the bight and there you are. Takes longer to write than to do.....

Naturally, if you are a southpaw, reverse the hand names!

This has the advantage, if you get used to it, that you can do it one-handed round your body if someone throws you a rope to pull you out of the water.

Alan Gordon G3XOI
Shoreham-by-Sea
(sometime Skipper in the Admiralty Ferry Crews and Sea cadet instructor, etc)

Transistors

Dear Don,
With regard to your interesting article *The Transistor Revolution* in the October edition, when I worked in the semiconductor industry in Los Angeles during the 1950s and 1960s it was thought that the term transistor was derived from 'Transfer' and 'Resistor'. The first configuration the pioneers used was apparently the common-base one, in which the collector current was only slightly less than the emitter current but because the output resistance was very much higher than the input resistance, a high voltage gain was obtained. (V = I × R). This does seem to be a reasonable explanation.

Robert Dancy G3JRD
Gillingham, Kent

A Puzzle

Dear Don,
I wonder if any reader could help me with this puzzle. I am trying to repair some electronic gear and have come across a component that I am unable to identify. I don't have any circuit diagram for the gear but the fault will be in the switch mode power supply. I have started at the primary side and come across a component, coloured black but not apparently burnt. (There was no fuse blowing, just a failure to start up after being unplugged.) The PCB identifies it as BL...??... The component is the size of a resistor and has no markings on the body but may be polarised because one end of the lead-out is coloured pale yellow. It tests short-circuit on the meter. I wonder if it is some type of thermistor or is polarised and is actually a short-circuit diode. But why no markings and what is a BL? I don't think it is a Wickmann fuse because they look like a transistor with two legs.

Frank Bailey M1EYH
Oswestry

Simple Construction

Dear Don,
I have a question for **Gary Andrews M0CWY** concerning his article *Simple construction for simple circuits* published in the June 2018 issue (*Carrying on the Practical Way*). I have used his construction a couple of times with success but I now want to use it for a circuit containing an integrated circuit (IC). However, I am unsure how

Letters

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to apply his technique because the pins of the IC holder are less than 2mm apart. I would very much appreciate his advice.
Jim Bovill PA3FDR
Uithorron, Netherlands

Gary M0CWY replies: *James, Thanks for your query. I'm glad to hear that you have been successfully using the cut-board technique. When using DIL and SOIC devices, I bend the leads out horizontally to the device, like aeroplane wings, trim off any excess length leaving about 3mm, and glue the device to the board using cyanoacrylate (super glue). Then I make connections between the pins of the device and the pads on the board by soldering short lengths of 30SWG (0.315mm diameter) tinned copper wire. You will need a small tip on your soldering iron, a steady hand and perhaps a magnifying glass, but it isn't difficult. You mentioned an IC holder but I recommend not using one even for devices such as PLCCs. Simply glue those to the board upside down and make the connections as above.*

Radios of Old

Dear Don,
Many older radio amateurs think back to their early days and the gear they used when they first started to operate. But are we looking back with rose-coloured glasses? Well, this is what happened to me.

Back then, I started out with my first ever rig, a Yaesu FL-50B transmitter and FR-50B receiver. Both used mainly valves but with transistors in the receiver for VFO and local oscillator. The receiver VFO was also used to run the transmitter.

Now, over the last few years I have again obtained both the FR-50B and FL-50B sets as well as the external VFO, the FV-50B (see photo). None had been modified.

The only modification I made was to the receiver. In the second of a two-part article in *PW* (December 2017), **Dr Samuel Ritchie EI9FZB** showed that there was a way to cut down the drift of the VFO in the FR-50B. In the original circuit (shown in Figs. 6 and 7 of that article), the VFO supply was sourced from a 10V zener diode in series with a 4.7kΩ resistor to drop the 150V supply. However, the heat from the resistor, some 4W, led to a change in the Zener voltage and, hence, VFO drift. I got round this by disconnecting the resistor and associated components and, instead, used an external 12V stabilised supply to run the VFO. The VFO line is shown on the FR-50B circuit as 9V while the zener is a 10V device but the three transistors are rated at 30 and 35V so I decided it was safe to use a 12V stabilised supply. This modification did away with a lot of receiver drift.

Running the transmitter from the receiver is straightforward because you are in transceiver mode but if the received station is slightly off, you use the BFO control as a Clarifier or RIT control. Don't forget that the receiver bandwidth is 4kHz, unlike modern rigs that use 2.7kHz. That BFO comes in very handy.

The external FV-50B VFO is more stable anyway, being away from the heat generated within transmitter or receiver. You can 'zero' the transmit signal to the receive signal by using the 'spot' facility on the transmitter. You will, however, on 'spotting' the signal, need to swing the receiver dial a few kilohertz each way as you search for a reply to your CQ calls.

You can, of course, use a fixed crystal but you cannot just plug in any crystal. There is a calculation to use to determine what the crystal is cut to, as I explained in my own article here in the March 2018 issue. So, a crystal you want to use to transmit on14.015MHz would be worked out as 14.015 minus 5.1724 (the local oscillator frequency), which gives a crystal frequency of 8.8426MHz. Some bands would use the fundamental, while for some the resultant figure would be one half or one third. The manual can be downloaded for clearer instructions.

In practice, after modifying the receiver VFO, I used my setup with just the receiver and transmitter. I found it best, after fruitlessly calling CQ, to find someone calling CQ and answer him. Thus, I was able to work a number of European stations and, best of all and to my surprise, W1MK in Massachusetts. Not bad for 20W and a longwire only 3m above the ground. Regardless of how you use the FR/FL setup, do follow my lead and always use a frequency counter nearby to check on the outgoing transmission.

So, yes, some old rigs can do well but with a passband of 4kHz you can hear more than one station at a time so you have to pick out who is answering you. As a result, operating with this old rig can be hard work! For more modern gear I use an FT-7B or if I want higher power, I use my FT-101ZD Mk1. Progress happens to other people.
Ross Bradshaw G4DTD
Roche, Cornwall

Editor's comment: *Thanks Ross. There's a lot of pleasure to be gained from bringing older gear back up to scratch but you did the right thing in dealing with VFO drift – you wouldn't be too popular on the bands nowadays if your rig was drifting in the way that would have been acceptable in years gone by. Of course, modern rigs will be far better, for example, in the heat of a contest (better filtering and dynamic range) or for the newer data modes (requiring high frequency accuracy and stability). Horses for courses.*

More G4PVB Words of Wisdom

Dear Don,
When connecting and testing cables for hobby radio, you will likely need a multimeter even if only basic and costing only a few pennies more than an issue of *PW*.

I've often drooled over owning a BK Precision 388B multimeter (it looks to be superb) but the

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VAT (Vague Additions to the Total) alone will buy you five of the NENG A830L eBay Chinese-sourced cuties. So, what's the difference? At first glance they're both blue and white, PP3 powered, measure AVO (Amps Volts Ohms), AC/DC current, transistor tester and offer a continuity buzzer that you could maybe use with a key to practice Morse code. (Be aware that some meters with continuity buzzers may have a slight delay.) Well, quality versus cost is the deciding factor. If you drop the NENG on the floor you break the meter. On the other hand, if you drop the BK on the floor then you damage the floor. It's a bit like comparing a Nokia 3310 to a Smartphone. They both have a niche market. (I'm not clever enough to have a Smartphone and I'm much 'appier without it!) If you're starting out in hobby radio (and working with less than 30V) I suggest that you go for the NENG A830L £5 meter. If you do drop it on the floor, just get another one or buy two and always have one in reserve. See a favourable and most thorough review of the A830L via the link below and just simply Google for the BK Precision 388B where you'll find lots of information.
tinyurl.com/nengmeter

Welcome also to my mains monitor (see photo). It is displaying the apparent 248V (not RMS voltage, as explained to me by **Norman G8ATO** of Verulam ARC) on the large square meter and mains frequency 0.047kHz/47Hz on my smaller multimeter. The yellow mains input is fitted with a 5A ceramic fuse. The Martindale break-out box offers shrouded connection to the multimeter. USB charging sockets on the top of the 3-pin socket panel are obscured by the Martindale. Yes, the mains voltage does vary but within limits. The mains frequency also varies but this is catered for by the generating station to equalise across the day to maintain accuracy of clocks dependant on 50Hz overall. Voltage optimisation is explained via the link below. If you thought we were now on 230V, then you're in for a shock. (Pun not intended, it just came out that way.)
tinyurl.com/voltageoptimisation

While on the subject of metering, I was a teenage apprentice studying City & Guilds Radio and Television maintenance. Whether at work or college the ubiquitous AVO meter was there. Nowadays we usually have access to digital multimeters (DMMs) but those classic meters still have their uses and may be harvested from eBay. However, they often need maintenance of the meter movement. This is something we can mostly do ourselves. See the link below, which also explains why analogue meters are sometimes to be preferred. While working in a laboratory, one of the senior test engineers was dismayed that the pointer on his AVO meter was detached. We had just taken delivery of the first cycroanalyte adhesive (now known as Super Glue), which I used to repair the needle. He was overjoyed. I can still fondly remember his delight: *"How did he do it!"*
tinyurl.com/metermend
Bob Houlston G4PVB
St Albans

Editor's comment: *Thanks Bob. Look out next month for our feature on multimeters – you'll need to know something about its specification if needing to make accurate measurements. But I couldn't agree more that there is a case for taking the cheaper option if that does what you need. It's the old adage – anyone can build a bridge (or whatever) but it takes an engineer to know how to do it for the lowest price while still meeting the specification!*

Please note: The opinions expressed in any letter published in PW are those of the named correspondent whose letter has been published and they don't necessarily reflect the opinions of the editorial staff or Warners Group. **Editor**

Classified Adverts

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

Antennas

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

Repairs

REPAIRS TO RECEIVERS, TRANSMITTERS ETC. New/old, valve/transistor. Call 07903 023437 for details. Web: www.kent-rigs.co.uk

For Sale

LATEST VERSION 3 SUPER STABLE RTL-SDR USB STICK with 1ppm TCXO. Now with HF mode, software activated bias tee, longer SMA, clock and GPIO pads. Also Thumbnet N3, pigtails, connectors, adapters and many more useful items. Buy direct from our web shop at **technofix.uk** or **www.technofix.co.uk**

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

Wanted

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

While prices of goods shown in advertisements are correct at the time of going to press, readers are advised to check both prices and availability of goods with the advertiser before ordering from non-current issues of the magazine.

Valves

VALVES AND ALLIED COMPONENTS IN STOCK Ring for free list. Valves/ books/ magazines wanted. Geoff Davies (Radio). Tel: 01788 574774.

Order form for Classified Adverts

PLEASE WRITE IN BLOCK CAPITALS

The prepaid rate for classified advertisements is 42 pence per word (minimum 12 words), box number 70p extra. Semi-display setting £13.90 per single column centimetre (minimum 3cm). Please add 20% VAT to the total. All cheques, postal orders, etc., to be made payable to Warners Group Publications. Advertisements, together with remittance, should be sent to the **Practical Wireless Classified Adverts, Warners Group Publications, West Street, Bourne, Lincs PE10 9PH.**

Please insert this advertisement in the ..... issue of Practical Wireless (if you do not specify an issue we will insert it in the next available issue of PW) for ..... insertion/s. I enclose Cheque/P.O. for £ .....(42p per word, 12 minimum, please add 20% VAT to total).

Category heading: .....

Name: .....

Address: .....

.....

.....

.....

.....

Telephone number:

.....

Please photocopy this form or write on a separate sheet if you prefer

Bargain Basement

Bargain Basement adverts now cost £5 per advert (subscribers still free) and will also be published in *RadioUser*, our sister magazine, unless requested otherwise.

Send your advert to **Bargain Basement, Practical Wireless, Warners Group Publications, West Street, Bourne, Lincs PE10 9PH** Please write your advert clearly in BLOCK CAPITALS up to a maximum of 30 words, plus 12 words for your contact details on the form provided and send it together with your payment of £5 (subscribers can place their advert free of charge as long as they provide their subs number or mailing label). Cheques should be made payable to Warners Group Publishing, credit card payments also accepted. Please prepare your advert carefully. Any advert which contains ?? marks indicates that the advertising dept. could not read/interpret the wording. Advertisements from traders or for equipment that is illegal to possess, use or which cannot be licensed in the UK, will not be accepted. No responsibility will be taken for errors and no correspondence will be entered into on any decision taken by the Editor on any of these conditions.

You should state clearly in your advert whether equipment is professionally built, home-brewed or modified. The Publishers of Practical Wireless wish to point out that it is the responsibility of the buyer to ascertain the suitability of goods offered for purchase.

FOR SALE

HEATHERLITE EXPLORER HF LINEAR AMP. In good working order, surplus to requirements. Offers, Collection preferred.
Tel: C. James 07932 473601 Surrey

PHILIPS SIMOCO FM 1100 1200 SPARES, parts, mics, leads, heads etc.
Gary G6NYH Email: g6nyh@aol.com

CTCSS ENCODE BOARDS. Works on all radios. Fully built and tested. £15.00 **Gary G6NYH Email: g6nyh@aol.com**

YAESU FT 2000 mint boxed £650. Icom IC781needs TLC, working offers. Plessey PRS2282A, working with fault. Offers. RFT500 German Receiver, VGC, manual, working order. £350. 3x Racal RA17 A515. £150.
Tel: Mr Crowson 01279 815020 N/W Essex

WANTED

SWLS & LICENSED to join Verulam ARC St. Albans conversation.net Sundays 8.30pm 28.040 mhz. Follow: **www.verulam-arc.org.uk**
All welcome. Send QRs for Slow. **73 Bob Houlston G4PVB**

ONLY £5

Bargain Basement order form

Please make any cheques or Postal Orders for advertisments payable to Warners Group Publications.

Please insert this advertisement in the next available issue of Practical Wireless.

☐ For Sale ☐ Wanted ☐ Exchange

PLEASE NOTE: as a security measure, you must include your house number and postcode.

Name .....

Address .....

..... Post code .....

Telephone Number .....

CARD NUMBER

Signature..... Security number

Last three digits on the back of the card

Switch issue number (if on card) .....

Name on card.....

Start date of card..... Expiry date of card.....

My Subs Number is.....(or send mailer label)

PW & RU ☐

PW ONLY ☐

		(30)	

CONTACT DETAILS FOR ADVERT. Please only write in the contact details you wish to be published

Specialist Dealers

Mid Glamorgan

SANDPIPER AERIAL TECHNOLOGY

Unit 5, Enterprise House
Cwmbach Industrial Estate, Aberdare
Mid Glamorgan CF44 0AE

Tel: (01685) 870425 Fax:(01685) 876104

A full range of transmitting & receiving antennas available for the amateur commercial market.

www.sandpiperaerials.co.uk
e-mail: sales@sandpiperaerials.co.uk

Scotland

TENNAMAST

A complete range of Multi purpose Masts
The best of Scottish engineering!
Tel: 01505 503824
www.tennamast.com
sales@tennamast.com

Somerset

LINDARS RADIOS

'A Modern Company With Old Fashioned Values'

USED AMATEUR RADIO EQUIPMENT PURCHASED AND SOLD

www.AmateurRadioSales.co.uk

01935 474265

Suffolk

www.itender.co

Monthly communications tenders!
Ex Police Service
General comms company stock

Contact: 07788 498962

To advertise your business or event...

Please Contact Kristina Green
Tel: 01778 392096
E-mail: kristina.green@warnersgroup.co.uk

The Future of Violence: Robots & Germs, Hackers & Drones

JUST £10.99 PLUS P&P

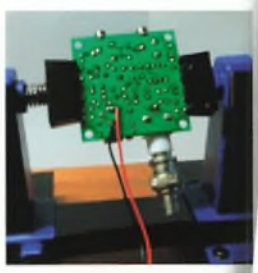
Advances in cyber technology, biotechnology and robotics mean that more people than ever before have access to potentially dangerous technologies - from drones to computer networks and biological agents - which could be used to attack states and private citizens alike. The Future of Violence, details the possibilities and enormous risks present in the modern world.

MANY MORE BOOKS NEW IN STOCK AT THE PW BOOK STORE ON PAGE 43

Advertisers' Index

Coming next month

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



REVIEW – THE ZUMSPOT DIGITAL HOTSPOT Tim Kirby G4VXE reviews the ZUMspot hotspot board for digital voice modes on UHF.

VALVE & VINTAGE Bernard Nock G4BXD has the second part of his series on equipment from the Pye stable.

THE NATIONAL HAMFEST AND 2018 RSGB CONVENTION We have our annual reports on the happenings at Newark and at the RSGB Convention.

CARRYING ON THE PRACTICAL WAY Martin Waller G0PJO builds an Isotron antenna.

KITS & MODULES Geoff Theasby G8BMI describes a handy jog for supporting PCBs.

There are all your other regular columns too, including *What Next, The Morse Mode, HF Highlights, World of VHF, Data Modes, In the Shop, Technical for the Terrified, Starting Over* and *Exploring New Fields*. The issue will also feature some fun pre-Christmas items and the Annual Index.

Yaesu FTdx101D (100W) & FTdx101MP (200W)

In homage to YAESU Musen Founder, Sako Hasegawa, Yaesu Japan is excited to introduce a new High-Class HF/50/70MHz Transceiver, the all-new FTdx101D (100W) & FTdx101MP (200W).

A pre-production sample of the FTdx101D was first displayed to thousands of visitors at Dayton Hamvention 2018.

The FTdx101D & just announced FTdx101MP utilise the latest SDR Technology and classified as Yaesu's High-End HF line, the FTdx series, which amateurs have come to know represents superior quality and leading edge performance.

Here's a few of the remarkable features of the new FTdx101D/MP:

- Superb and Astonishing Close-in Dynamic Range Performance even in today's crowded bands situations
- 9MHz IF Roofing Filter Producing Excellent Shape Factor
- 400MHz HRDDS (High Resolution Direct Digital Synthesiser)
- Hybrid SDR: Direct Sampling & NBW (Narrow Bandwidth) SDR
- Completely Independent Dual Receivers
- High-Q VC Tuning Front-End
- YAESU Renowned Interface Reduction System
- Large Touch-Panel Precision Colour Display
- 3DSS (Three Dimension Spectrum Stream) Waterfall Display
- Active Band Indicator with LED illumination of the operating band, enables rapid band changes
- MPVD (Multi-Purpose VFO Outer Dial) provides Sub VFO dial, Clarifier operation VC-TUNE adjustment, VFO fine tuning or a CS (custom selection) function

YAESU High-Class HF/50MHz/70MHz* 100W (D) & 200W (MP) Transceiver

- Full SDR Technology and Waterfall Display
- Large Touch Panel precision Colour Display
- Active Band Monitor enables rapid band changes with LED illumination of the operating band
- Independent control of the Main and Sub Bands allows effortless operation for the serious contester needing to move quickly between the amateur bands High-Q VC Tuning Front-End
- Main tuning dial for Main and Sub Band frequency control includes an Outer Dial for clarifier, VC tuning, fine tuning or custom settings.

As you may recall, the name "101" comes from Yaesu's legendary, popular best-seller FT-101 series.

With all its strength & design power, YAESU produced this new HF transceiver to carry on the tradition of high quality known from the original 101 series. The new FTdx101D & MP will be certain to satisfy the variety of many amateur radio enthusiasts' demands.

As soon as pricing and availability is known we will update this advert.

*70MHz Output Power TBA

The radio... YAESU

The Legend Continues

The Transceiver that could only be created by Yaesu
Offering New Excitement and Surprises

In homage to Sako Hasegawa

FTDX101MP 200W

HF/50MHz TRANSCEIVER

The Ultimate

FTDX101D 100W

HF/50MHz TRANSCEIVER

- Superb and Astonishing Close-in Dynamic Range
- 9MHz IF Roofing Filter Producing Excellent Shape Factor
- 400MHz HRDDS (High Resolution Direct Digital Synthesizer)
- Hybrid SDR: Direct Sampling & NBW (Narrow Bandwidth) SDR
- Completely Independent Dual Receivers
- High-Q VC Tuning Front-End
- Yaesu Renowned Interference Reduction System
- Large Touch-Panel Precision Colour Display
- 3DSS (Three Dimension Spectrum Stream) Waterfall Display
- Active Band Indicator with LED illumination of the operating band, enables rapid band changes
- MPVD (Multi-Purpose VFO Outer Dial) provides Sub VFO dial, Clarifier operation, VC-TUNE adjustment, VFO fine tuning or a CS (Custom Selection) function

YAESU
The radio

YAESU UK Ltd
Unit 12 Sun Valley Business Park, Winnall Close
Winchester, Hampshire SO23 0LB

For the latest Yaesu News , visit us on the internet at www.yaesu.co.uk