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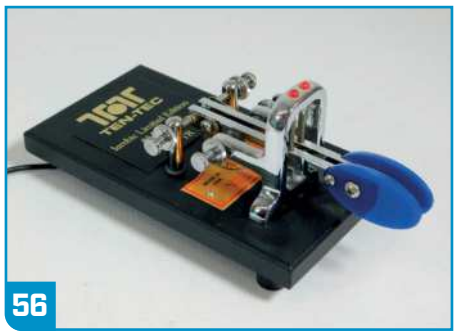
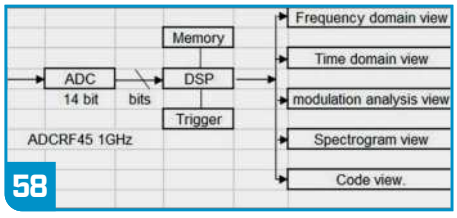
Keylines





I'm writing this in late December and about to exceed 25,000 QSOs in 2021! This is way more than I have ever managed in a year from home before (though I have made quite large totals if my various DXpeditions are included). Many of those contacts were, of course, short contest ones but one way or another I have obviously made a reasonable contribution to band occupancy. The reason for the large number isn't hard to find, of course, Other than working on *PW*, there hasn't been a lot else to do during the various lockdowns and I didn't try to travel abroad, which is tough enough with radio equipment in the normal course of events, never mind with Covid restrictions in place. Anyway, it's been fun despite relatively poor HF conditions for much of the year. The 6m sporadic E season proved a winner, though, and as always I have particularly enjoyed working the LF bands (160, 80, 40m).

That said, my most recent activity was on 15m during the CQWW CW Contest (using my M3D short contest call), always a favourite contest of mine and one where I usually manage to travel abroad to operate. But it was fun, given that I now have an effective HF station set up at my son's place with a 45ft trailer tower on which, for this event, I installed a 4-element monoband Yagi antenna (one I had bought from the Five Star DXpedition group when it disbanded a few years ago). I ended up with just over 1400 contacts from 124 'countries', which rather demonstrates that propagation is often there but it takes a major operating event to emphasise the point (although, that said, the 10m band was, I gather, rather disappointing that weekend). The only snag was the high winds for the first part of the weekend – I know that some UK amateurs suffered antenna damage while others played safe and wound everything right down. I stuck to having my tower at no more than 25ft for the Saturday but still managed plenty of contacts – the good news being that I benefit from a clear take-off in all directions across the Somerset levels.

Wireless without Wireless

In this month's *Valve & Vintage* column **Mike Bedford G4AEE** describes various methods of communication without wires.

This took me back to my teenage years when a schoolfriend and I tried out ground communication. This proved to work (albeit over limited distances!), our main problem (living in Northampton) being the strong ground-induced signal from GBR at Rugby on 16kHz, which we could hear quite clearly!

As for light communication, I can't claim any great success other than a university friend and I securing rooms at opposite ends of a rectangular block (in order to string up a topband antenna between them!) and communicating from time to time with Morse via our desk lamps. But I recall a talk by **David G0MRF** about his group's experiments with laser communications, using one of those low power laser pointers that are ubiquitous nowadays. They were able to communicate across the English Channel, the biggest problem being locating the beam but, once lined up, it was apparently the brightest light seen from the opposite shore, showing the benefits of a coherent light source. All fascinating stuff and while not 'amateur radio', certainly relevant to anyone with a broad interest in communications.

This Month's Issue

We have another packed issue for you this month. Indeed, I've had to hold over *From the Ground Up* and the promised article about restoring valve equipment. Both will appear next month. Meanwhile, do enjoy this month's eclectic collection of articles covering home construction, radio history, the 70MHz contest results and plenty more.

Don Field
Editor, *Practical Wireless Magazine*

Newsdesk

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

Xiegu X6100 QRP SDR Portable transceiver

Nevada Radio have been appointed a UK dealer for the new Xiegu X6100 QRP SDR portable transceiver from China. The X6100 has a high-resolution colour screen for easy reading, built-in Bluetooth function and will transmit on both the HF and 6m amateur bands. The receiver coverage is from 0.5MHz to 30MHz plus 50 – 54MHz. The transceiver produces 10W RF output from an external supply or 5W from a battery supply while also boasting a built-in automatic antenna tuner.

It is supplied with a 3,000mAh Lithium battery and a range of accessories, including hand microphone, connecting lead and charger. The Xlegu X6100 has both FCC and CE approvals and is expected to be popular for both travel and portable use. The first batch were due to arrive in the UK during January 2022, priced at £599.99 and available from Nevada Radio (URL Below). We at *PW* hope to have a review in due course.

www.nevadaradio.co.uk

BILL SOMERVILLE G4WJS SILENT KEY: Bill Somerville G4WJS died suddenly and unexpectedly in early December. He was in his mid-60s. In 2013 he was the first to join Joe K1JT in forming a core development group for WSJT-X and has been closely involved with the project ever since. *"Our free, open-source software could not have achieved its extensive worldwide popularity and influence in ham radio without Bill's essential contributions"*, Joe says. *"In addition to writing code for important portions of the Qt-based user interface for WSJT-X, Bill helped to bring the overall program structure more nearly up to professional standards. Moreover, he devoted countless hours to program support, patiently answering users' questions on WSJT-related forums"*.

ICOM SHF Project

Icom has announced details about a new ICOM SHF (Super High-Frequency Band Challenge) Project to develop a new amateur radio for use in the 2.4GHz and 5.6GHz bands.

Icom engineers have been researching and developing technologies to clear the particular challenges within the SHF band, such as large cable loss and higher frequency stability requirements. The goal is to bring a ground-breaking SHF band amateur radio to market that no one has ever achieved before.

To be kept up to date with all the developments that will be implemented, please visit:

www.icomjapan.com/lp/shf

Icom UK will post links about the development of the project on Icom UK social media channels when updates become available.

New Web-Based RSGB EMF Calculator

The RSGB has launched a new version of the Society's EMF calculator v11d, which is now available in a new browser-based version as well as the spreadsheet version. The web browser version does not require you to have Excel or another spreadsheet on your computer. It also has several new features to make compliance checking simpler and quicker.

You can find both versions on the RSGB emf web pages or you can go direct to the new web version. For the full list of new features see the RSGB's main announcement:

https://tinyurl.com/4n4t7u8z

IARU Honours Awarded

IARU Region 1 President **Don Beattie G3BJ**, a former President of the Radio Society of Great Britain, has been recognised with the prestigious **Michael J Owen VK3KI** Award, for his contributions to IARU over many years.

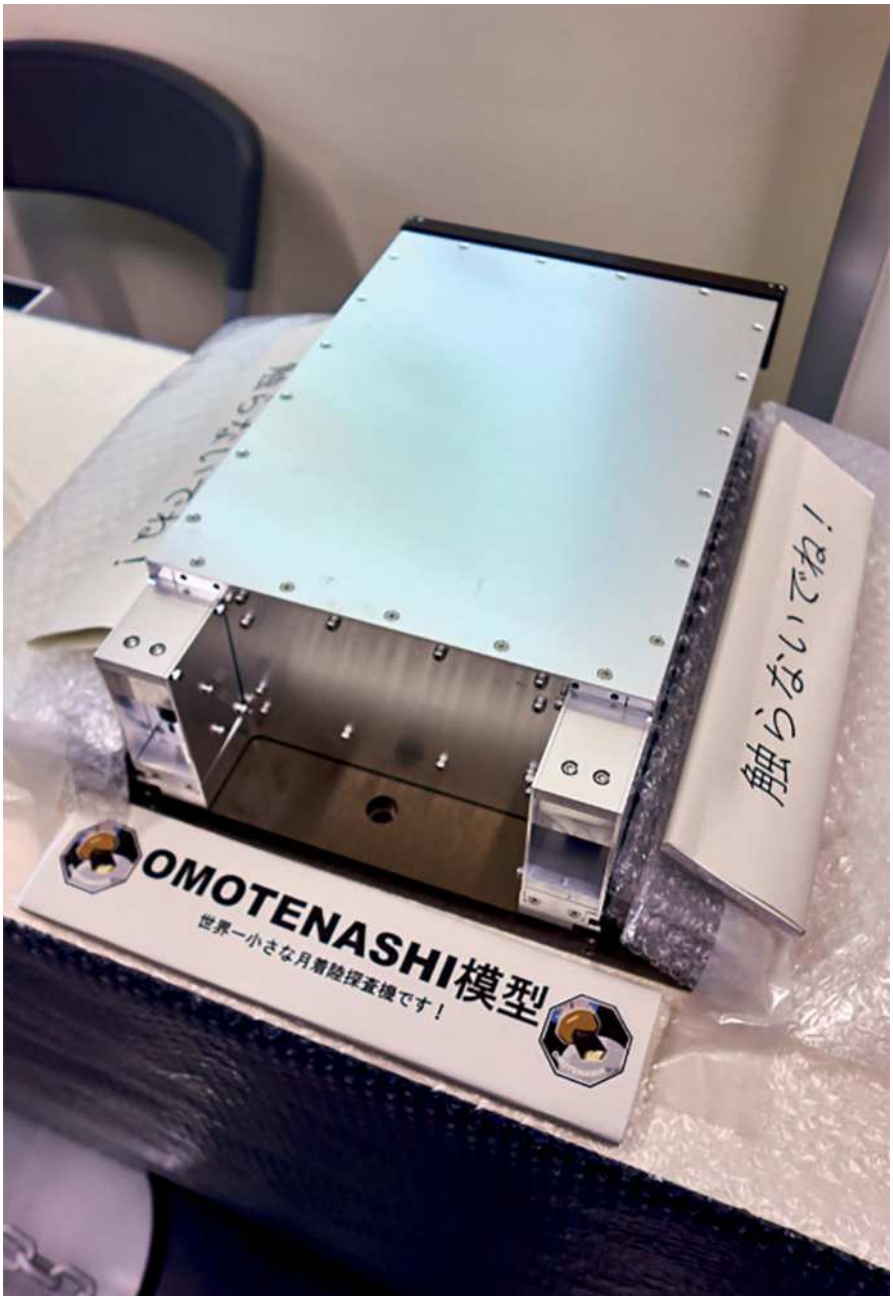
The IARU also chose two recipients for its Diamond Award, another honour reflecting unwavering service. They are **Gopal Madhavan VU2GMN/M0GDB**, and **Ken Yamamoto JA1CJP**. Gopal was selected based on his service on Region 3's executive committee, which he has chaired at times. Likewise, Ken has served as its Secretary and its Chairman.

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

RSGB EXAMINATIONS STANDARDS COMMITTEE REPORT PUBLISHED: The RSGB Examinations Standards Committee has published its 2021 annual report, which covers activities in 2020.
Despite the challenges of Covid, the Committee was quick to approve and support proposals for changes to the exam system, such as approving online remote invigilation and the suspension of practical assessments.
This allowed people to continue to take exams and get involved in amateur radio during lockdown.
The total number of exams administered by the RSGB Examinations Department in 2020 increased by 41.9% compared to the previous year.
The report can be found at:
https://tinyurl.com/yckvnnsu

VIDEOS OF G-QRP CONVENTION TALKS NOW AVAILABLE: The G-QRP club has made available the videos of the talks given at the 2021 G-QRP Convention.
The videos are:
• Charlie ZL2CTM talking about his approach to RF Construction.
• Tony G4WIF sharing his experiences of building and using RF Test Equipment:
• Farhan VU2ESE talking about his latest BITX transceiver for 2m.
• Steve G0KYA sharing his experiences of building and using the End Fed Half Wave antenna.
• Pete N6QW talking about building a valve transmitter in the 21st century.
• John M0JAV sharing the latest information and answering questions about EMF Assessments.
• Steve G0FUW talking about getting started with surface mount devices.
• Michael G0POT sharing his experiences of operating from hilltops.
• Roy W7EL talking about antenna modelling using EZNEC.
• Anthony K8ZT sharing his experiences of operating with QRP.
• Alan W2AEW talking about a range of RF test equipment.
• Bonus Session, Operating Panel with Peter G3XJS and Carl GW0VSW.
Watch the videos on the club's YouTube channel:
www.youtube.com/c/GQRPClub/videos

WORLD'S SMALLEST MOON LANDER WILL PUT AMATEUR RADIO TRANSMITTER ON THE MOON: (from *ARRL News*) Japan's OMOTENASHI, the world's smallest moon lander, will have an X-band and UHF communication system, although it will not carry an amateur band transponder. OMOTENASHI is a 6U CubeSat set for launch via a NASA SLS rocket as early as February 2022.
It will have a mission period of from four to five days. The name is an acronym for Outstanding



Moon Exploration Technologies demonstrated by Nano Semi-Hard Impactor. Wataru Torii of the Japan Aerospace Exploration Agency (JAXA) Ham Radio Club, JQ1ZVI, said radio amateurs can play a role in gathering data from the spacecraft.
The spacecraft is made up of two separable components, both having independent communication systems – an orbiting module and a surface probe. The orbiting module will take the surface probe to the moon. It will transmit beacon or digital telemetry data on UHF (437.31MHz). The surface probe – the moon lander – will transmit digital telemetry or three-axis acceleration analogue-wave with FM modulation on UHF (437.41MHz). Transmitter power will be 1W in both cases.
|*"If we succeed in receiving the UHF signal from the surface probe, we could know the acceleration data on the impact on the moon and the success of the landing sequence,"* Torii explained. *"We already have a station for uplink and downlink at Wakayama in Japan – used as an EME [moonbounce] station. However, if the satellite is invisible from Japan, we cannot receive the downlink signal. So, we need a lot of help from ham radio stations worldwide."* Torii noted that the RF system on the lander only operates on UHF.
The orbiting module beacon will transmit on 437.31MHz using PSK31. The surface probe beacon will transmit on 437.41MHz using FM, PSK31, and PCM-PSK/PM.
https://tinyurl.com/yckjdxca

PARKS ON THE AIR: In October Ireland and India joined Parks on the Air. October was another record-setting month, with an all-time high for both number of activators and number of QSOs, with 1,630 activators making a combined 329,019 QSOs.

AMATEUR RADIO EXAMS IN AUSTRIA CANCELLED: Covid has forced the cancellation of amateur radio exams in Austria as well as the popular Christmas Electronics and Radio Flea Market. Exams planned for Vienna and Graz were among those cancelled. Amateur radio exams in Austria are oral with amateurs asking candidates questions about the hobby. Unlike the UK, USA and Canada there is no capability to take the exam online. Austria has three categories of licence:

- Class 3 Entry Level: 100W 144/430MHz
- Class 4 CEPT Novice: 100W 1.8/3.5/21/28/144/430MHz
- Class 1 CEPT HAREC: 400W all bands, Clubs can run 1kW

https://tinyurl.com/IARU-Austria

NORWAY LOOKING TO INTRODUCE ENTRY LEVEL HAM RADIO LICENCE: (from *ICQ Podcast*) Norway is planning to introduce a 10W Entry Level Licence that will enable young people 12-13 years old to get started building simple transmitters and receivers

Within the framework of its program 'Strength of children and young people's digital competence and understanding of digital technology', the Norwegian Research Council has allocated 1 million kroner (£86,516) to the project 'Radio Communications Technology for Young People'. The project is carried out by NRRL and the Research Institute of Forsvaret (FFI) and the project manager is Torbjørn Skauli LA4ZCA. The project aims to increase interest in technology and science in schools. The idea is to introduce amateur radio as a kind of 'freely chosen work' in high schools. The project also includes developing an entry-level certificate, allowing 12-13 year olds to get started with amateur radio. Norway's communications regulator, NKOM, has received clear directives and work is being done to design certificate requirements and conditions. The project has a clear focus on the 'makerspace' phenomenon and wants to encourage young people to start by building simple transmitters and receivers. Therefore, you want a low power limit of a maximum of 10W to avoid interference from home-built appliances. Torbjørn, a professor at FFI, has previous experience from voluntary Code Workshops in the school where children are taught to program. An important challenge for programming, makerspaces and amateur radio is to get dedicated and trained teachers who can drive the business forward once the project has been ended.

HUNGARIAN INITIATIVE: The presidency of the Hungarian Amateur Radio Association has announced a tender for the lease of radio equipment. The aim of the tender is to provide young beginners who do not have an independent income with radio equipment.

The scheme is intended to bridge the period until they have their own equipment for HF and VHF and associated equipment, for a period of half a year, which can be extended by a maximum of two and a half years, taking into account the activities carried out in the previous period.

To be eligible, young operators must be members of the Hungarian MRASZ, hold a valid licence and be able to install antennas.

Supported applicants are expected to participate in club events and contests, and also report on their activities.

ON75 STATIONS FOR 75TH ANNIVERSARY OF UBA: In 2022, the UBA will blow out 75 candles. On the occasion of this anniversary, the HF committee will organise a special activity under the title 'UBA 75 On the Air Event' during January and February.

All participating UBA sections will be in the air during the months of January and February with special prefix ON75 followed by the three-letter abbreviation of the department as a club station.

https://tinyurl.com/IARU-Belgium

PW at 90 Years

As Practical Wireless approaches its 90th birthday, we take the opportunity to look back at its illustrious history, decade by decade.

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The second decade of *PW's* existence starts in the middle of WWII, 1942. Remarkably, there appears to have been a period in the late 1930s when the magazine was published weekly. In September 1940 it reverted ('temporarily') to monthly publication. This was, as explained in that issue, due to *"the acute paper shortage. All newspapers are now rationed as to their paper supply, and the ration allowed for this periodical would not have made it an economic proposition as a weekly publication. We have, therefore, used our ration of paper to produce a monthly edition, and it will be observed that we have increased the number of pages. Our readers will understand that we have been compelled to make this move with great reluctance"*.

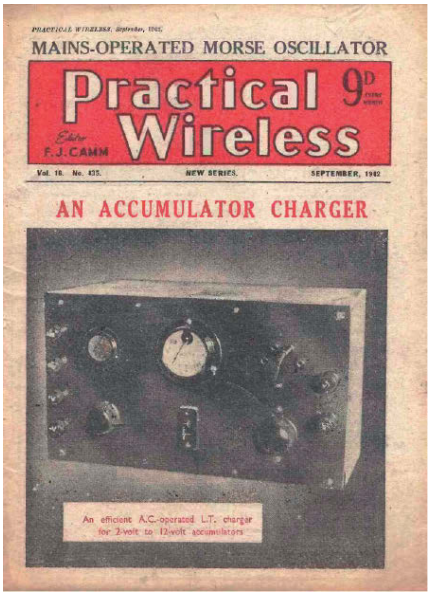
Interestingly, the editorial in the September 1942 issue, **Fig. 1**, focused on *"Post war planning in radio communications"*, the subject of a discussion which concluded the 1942 session of the IEE. Also of note is that the first article in that issue was about Luftwaffe radio equipment! And while amateur radio had been closed down, there appears to still have been an active British Long Distance Listeners' Club, reporting on the reception of broadcast stations from around the world.

Judging by the advertisements, there were still plenty of components available and, the publishers, Newnes, were doing nicely selling books by *PW* editor **F J Camm** such as his *Practical Wireless Service Manual* – I believe the armed services bought quite a number of his various books.

In the July 1945 issue the editorial reported that the RSGB had developed a list of components that would be needed by amateurs following the war, once experimental licenses were once again made available, but the editor thought this (and, indeed, the resumption of TV transmissions, again curtailed by the war) would almost certainly have to wait until the end of hostilities with Japan. That same issue had the first of a new series on building an 'Economy Communications Superhet'. I was, though, amused by one article looking at future applications of radio, which wondered about whether radar (developed largely during the war) would, if fitted to cars, be of use to motorists for driving in the dark or fog!

Post-War

The September 1946 issue discusses Radio Luxembourg and the government review of the BBC. Amusingly, the editorial states



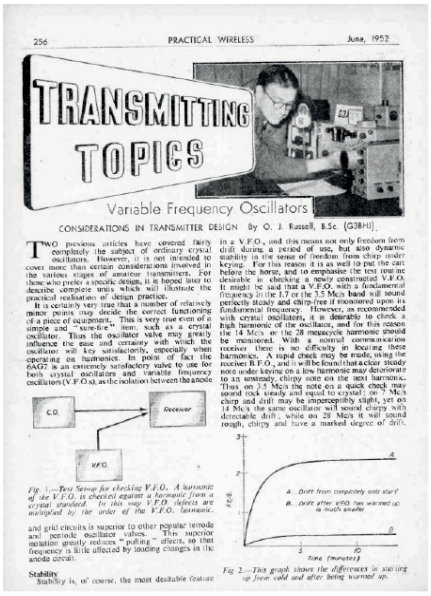


Fig. 1: The cover of the September 1942 issue. Fig. 2: Transmitting Topics. Fig. 3: Ad for the R1155.

that *"The debate in the House of Commons on the renewal of the BBC Charter was a disappointing affair, in that apparently the Government's mind was made up long before the debate started and it would appear to the non- political observer that the Government was going merely through the motions of democratic government"*. It was also reported that **Mr. Morrison** (spokesman) does not like commercial broadcasting. *"This particular type of sheer and naked commercial exploitation is one we don't like and we feel that we can discourage it if we should"*.

By April 1950, it was reported that *Practical Television* (a subset of *PW's* coverage for the previous 15 years after an earlier *Practical Television*, again under the editorship of FJ Camm, had ceased publication) would once again become a new magazine in its own right, given that the science of TV was progressing greatly, as was the number of viewers.

There was some delay in getting amateurs back on the air after the war, but less than a month after VE day (8 May 1945) a notice appeared in the *RSGB Bulletin* inviting holders of pre-war full licences to apply for a post-war licence, with a similar invitation three months later to those who had held pre-war Artificial Aerial licences and could now produce evidence of Morse Code proficiency. The post-war licence conditions were also somewhat more generous than those that had pertained before the war.

The result was that by the late 1940s and early 1950s, *PW* was again carrying designs for amateur transmitters and the number of advertisers had increased considerably following the end of the war. By the August 1952 issue (the last of *PW's* second decade) there was a regular *Transmitting Topics* feature, **Fig. 2**, and a number of amateur radio clubs were advertising regular meetings. Among the advertisements, it's good to see the availability of war-surplus gear such as the R1155 receiver, **Fig. 3**. That said, the main focus of the magazine was still on broadcast reception and hi-fi.

Dr Samuel Ritchie EI9FZB
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SDR (Part II)

Dr Samuel Ritchie EI9FZB continues the series by discussing tuning the LW and MW Bands.

In this second part, I have a look at using the quadrature product detector (QPD) described in the January 2022 issue to tune the long wave (LW) and medium wave (MW) bands. I have selected these bands as the starting point for two reasons. First, within Europe, you are likely to be within ground-wave coverage of one or more high power transmitters in these bands – or at least you were until the BBC started turning off MW transmitters in 2021. This guarantees a strong and stable input signal for your receiver to help build confidence in the hardware and to get a feel for using the software. Secondly, the voltage-controlled oscillator (VCO) I present here is easy to build, does not use an inductor (which seems to be a difficult component for some constructors to work with), and directly generates the square waves required to drive the QPD.

There are three choices for the constructor to consider: build an SDR receiver that only covers the LW band, only covers the MW band, or that covers both bands.

Block Diagram

This article covers the two elements shown in blue in **Fig. 1**. That is the bandpass filter(s), which help to attenuate strong, out-of-band signals and therefore aid in preventing unwanted, spurious responses at the output, and the VCO used to tune across the band(s).

The Bandpass Filters

In this design I provide for two bandpass filters (BPF), one for LW and one for MW, and use a relay to switch between them. For a single-band solution, build only one of the filters and ignore the relay. The circuit diagram of both BPFs with a switching relay appears in **Fig. 2**.

Each BPF is a 5th order design with a Butterworth response. The LW BPF was designed with –3dB points of 140kHz and 450kHz, and the MW BPF has –3dB points of 500kHz and 1,700kHz. As I wanted to be able to adjust the filter, I chose to use variable inductors. For the ten inductors needed here, I modified TOKO coils as described in the November 2021 issue of *PW*, which incidentally shows the MW BPF used here.

The relay (K2), a double pole, double-throw type, is switched using SW1 that appears in the schematic for the VCO (**Fig. 5**). The input to the BPF and the output from the BPF are connected to the common of the relay poles. Normally closed (5V is not applied to the relay coil) places the LW BPF in circuit, and 'open' (SW1 applied 5V to the relay coil) places the MW filter into the circuit. If you are going for a single band receiver, then the relay is not needed.

Fig. 3 shows my implementation of the dual filters using two (8 by 6cm) development PCBs. It may appear that I am missing a few capacitors but most of the parallel LC elements are contained inside the large shielding cans. At these frequencies I did not have to pay a lot of attention to the wiring.

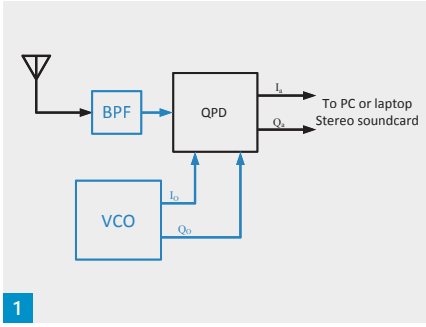
The Butterworth response is a medium-*Q* filter and has a very flat passband response that contains no ripple. The characteristics of these two filters after tuning are shown in **Fig. 4**, and each filter has a loss of circa 3dB.

The Voltage Controlled Oscillator

The circuit diagram of the VCO appears in Fig. 5.

U2, a 74LS628, is an improved version of the original, is still available from at least one manufacturer in 14-pin DIP packages, and features improved voltage-to-frequency linearity, range and compensation when compared with the original design. As a 74LS device it conveniently, directly interfaces with CMOS and TTL. In this design the frequency of operation is set by the value of Rx connected between pins 11 and 12, the total capacitance across pins 3 and 4 and the voltage on pin 13. Rx is recommended to be a 600Ω resistor (I used a 620Ω resistor) and for RV1, which is where you set the frequency, I used a 10-turn 50kΩ potentiometer.

In the normally closed position (no power applied) the relay K1 connects three capacitors (C1, C2 & C3) in parallel. This total capacitance of 384pF allows the oscillator to tune from 460kHz to 3.8MHz. In the open position (power applied via SW1) only 164pF provided



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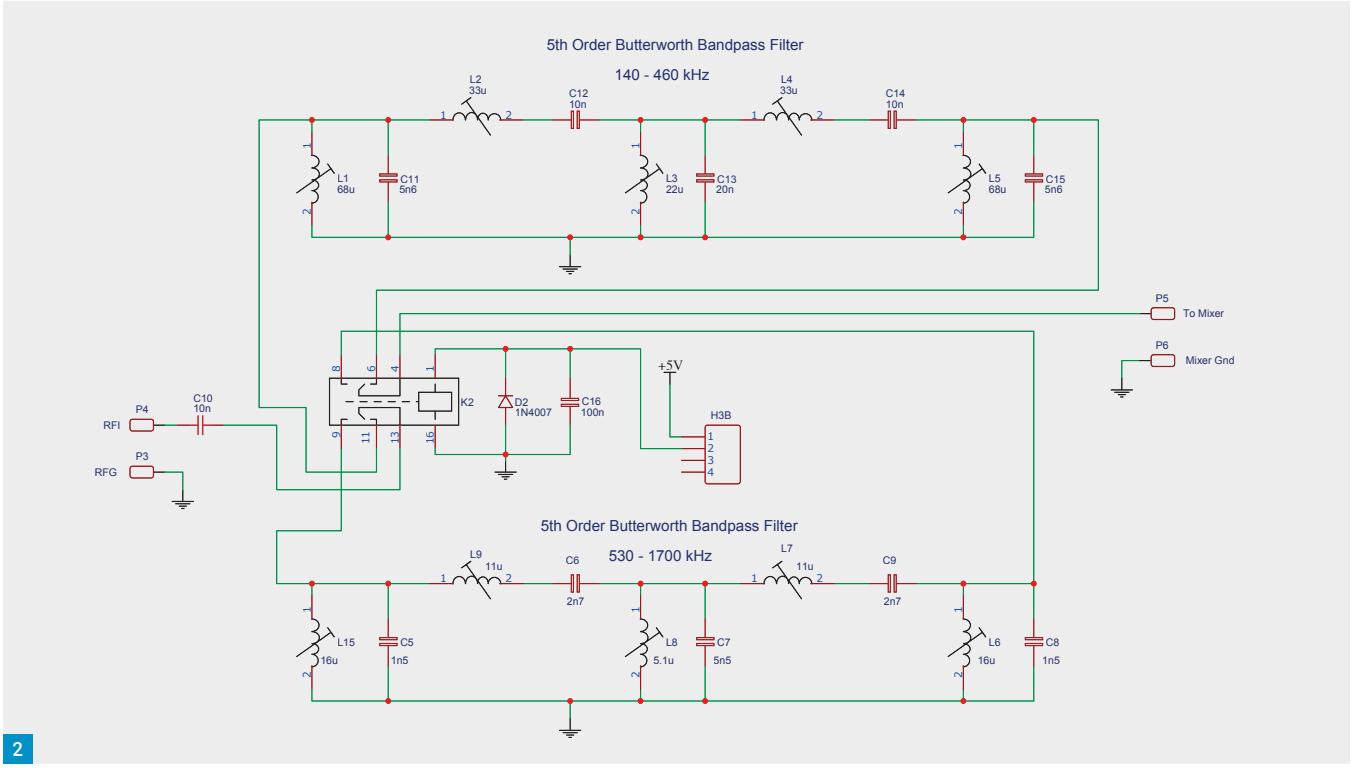
by C1 and C2 (two 82pF capacitors in parallel) is connected, which tunes the oscillator from 960kHz to 7.1MHz. Recall in the first of these articles I explained that the QPD needs two square waves, both at the frequency you want to receive, each 90° out of phase with the other, and how a dual D-type latch can provide this function but divides the input by four. The output of the oscillator (pin 8) feeds a U4 (a 74AC74) that provides the required quadrature oscillator square waves, which allows reception from 115kHz to 950kHz for the LW band and from 240kHz to 1,775kHz for the MW band. There is extensive overlap between the two tuning ranges and you need to be careful to tune within the extents of the BPFs.

If you choose to build a single band VCO, then you can take advantage of RA and RB. In the dual-band VCO these are just links or zero ohm resistors connecting RV1 (which needs to be a ten turn, linear potentiometer) directly to +5V and ground. For a single band VCO you can use these two resistors to limit the range covered by the VCO. As an example, see **Fig. 6**.

Using links in RA and RB I placed a voltmeter between the ground and the wiper of the potentiometer RV1. I varied the potentiometer to the wanted lower and upper frequency output from the VCO, measured these voltage values and then calculated the voltage drops required across RA and RB to limit the potentiometer to only supply a voltage between these minimum and maximum voltage values. Be aware that the input resistance of your voltmeter/multimeter



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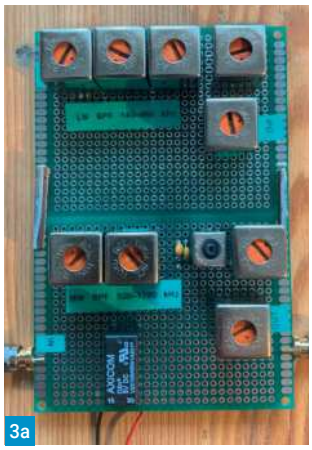
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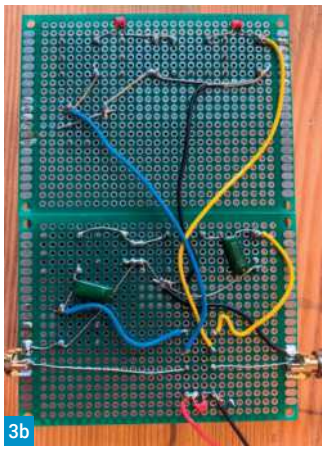
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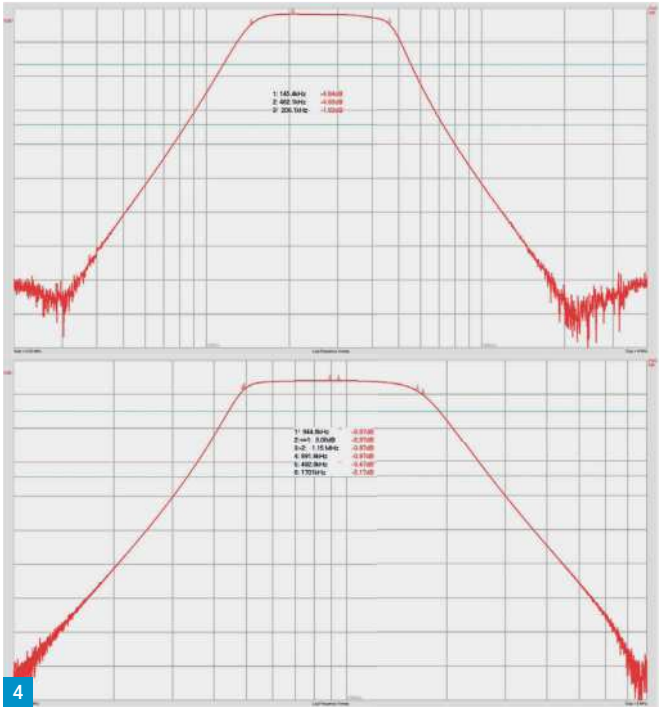
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Fig. 1: Basic block diagram. Fig. 2: Schematic of the LW and MW BPFs. Fig. 3: BPF – top and bottom view. Fig. 4: BPF characteristics (LW top and MW bottom).

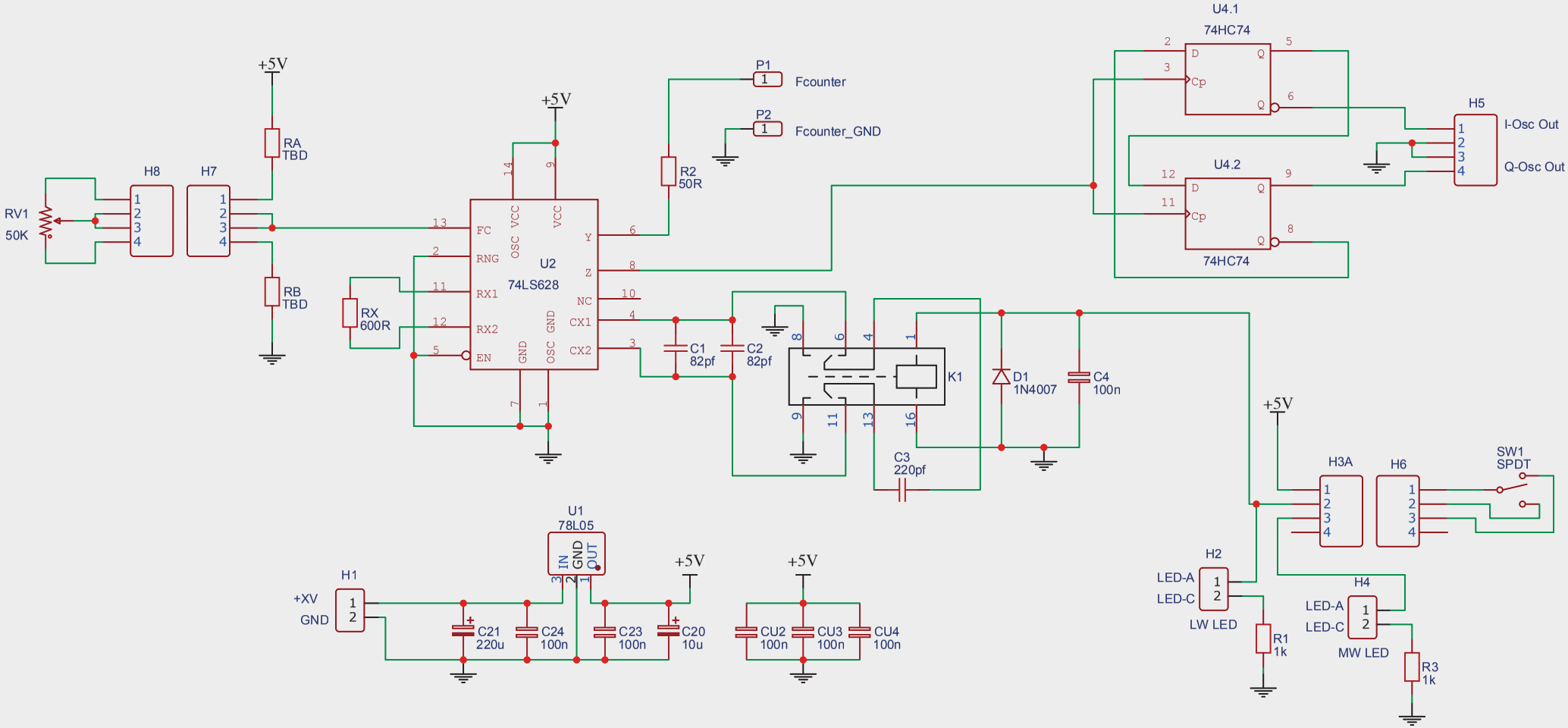
can slightly skew the results, so some empirical fiddling may be necessary.

Using a capacitance of 384pF and setting RB to 2.8kΩ generated a voltage drop of 0.2V, which set the lowest range of the oscillator to 560kHz, making it 140kHz after being divided by 4. Setting RA to 15kΩ set the maximum voltage the potentiometer can supply to 3.9V, which limits the oscillator output to 1.2MHz, which is 300kHz after being divided by 4. Why these particular frequencies? Well, the band 140–300kHz is the whole of the LW broadcast band.

I had considered switching in two sets of resistors (RA & RB) using two more relays (both switched by SW1) to limit the VCO tuning range to match the BPFs. But as you will see from future articles, I was eager to move on.

I was attracted to the 74LS628 as it promised a complementary output on pin 6. As discussed in the first article, this arrangement would allow us to operate the VCO at only twice the wanted receive frequency instead of four times. However, it is not the amplitude of the square wave that is important, rather the rising edges of the square wave, as it is these rising edges that trigger U4. Unfortunately, the edges of the complementary output are not synchronous and the difference varies widely as you change frequency.

Assuming a stable voltage supply, frequency stability is limited primarily by the temperature coefficients of RV1, RX and the capacitors between pins 3 & 4. I had intended to source components with small temperature coefficients and even


RV1
50K
H8
H7
+5V
RA
TBD
RB
TBD
RX
600R
U2
74LS628
FC
RNG
RX1
RX2
EN
OSC
VCC
GND
Y
Z
NC
CX1
CX2
R2
50R
P1
Fcounter
P2
Fcounter_GND
C1
82pf
C2
82pf
K1
D1
1N4007
C4
100n
C3
220pf
U4.1
74HC74
U4.2
74HC74
D
Cp
Q
H5
I-Osc Out
Q-Osc Out
U1
78L05
IN
GND
OUT
H1
+XV
GND
C21
220u
C24
100n
C23
100n
C20
10u
CU2
100n
CU3
100n
CU4
100n
H2
LED-A
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MW LED
R3
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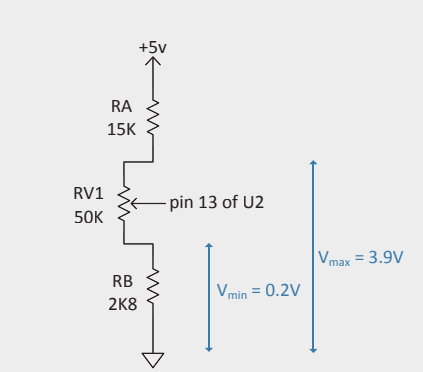

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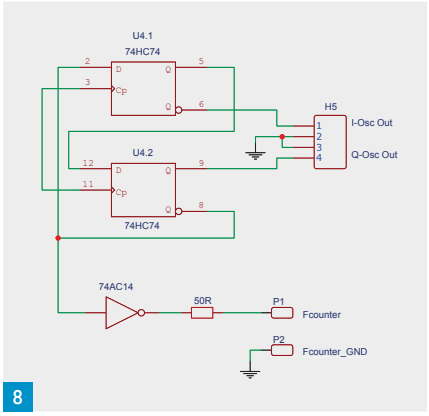

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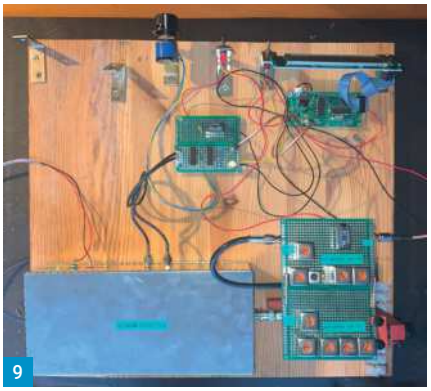
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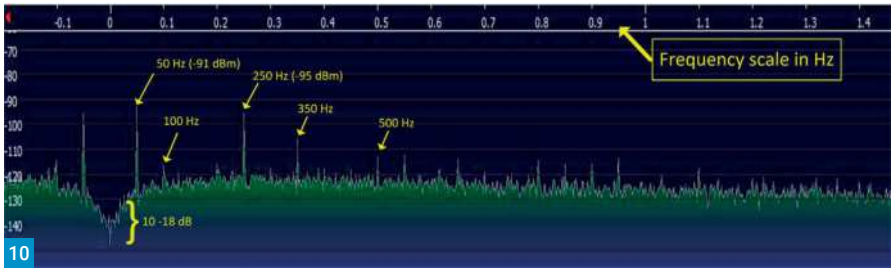
Fig. 5: Schematic of VCO. Fig. 6: Limiting the range of the VCO. Fig. 7: Top view of the VCO with relay for capacitor switching. Fig. 8: Alternative connection for a frequency counter. Fig. 9: Breadboard version of the LW/MW SDR receiver. Fig. 10: Examining signals between 0Hz and 1.4kHz. Fig. 11: Offset at 10kHz.



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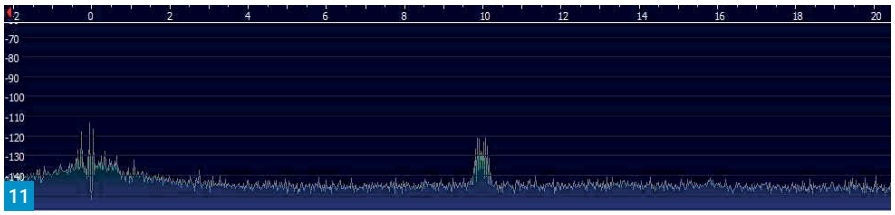
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considered enclosing the whole VCO in a simple temperature-controlled box, but just used what I had on hand to check my paper design. I found that for the purpose of listening to broadcast stations and some utility stations, the VCO was stable enough. This was good news as it might encourage people to build this simple circuit without needing access to specialist components.

Fig. 7 shows my implementation of the VCO using two 3×7cm development PCBs. The SMA connector at the top goes to the frequency counter (discussed next) and the two lengths of coax coming out of the white Molex connector on the bottom are the I_{Osc} and Q_{Osc} outputs to the QPD.

What Frequency Am I Listening to?

The complementary output on pin 6 of U2 does come in useful when fed through R2 to a frequency counter. Here we are spoilt for choice with many options available on eBay and its equivalents. I used a frequency counter that came in kit-form from N3ZI, and I have found these to be reliable, relatively accurate and very versatile. Unfortunately, N3ZI no longer has these for sale. Whichever frequency counter you select, I recommend that you ensure that it has two important functions.

First, the frequency counter will need a feature that that includes a software definable divide-by-N function. Remember that the frequency counter needs to display the frequency you are listening to and not the VCO frequency, which is four times higher. Second, the frequency counter needs an offset function, which is often incorporated to deal with intermediate frequencies. The use and value of this offset function will be described later.

If you have a frequency counter that does not have the divide-by-N function, then you can access the already divided signal coming out of U4.

As shown in **Fig. 8**, I suggest adding a buffer to one of the latch outputs (pin 5 or 8), which do not go to the mixer. **Fig. 9** shows all the modules (QPD – bottom left, BPF – bottom right, VCO – top middle and frequency counter – top right) connected and ready for action.

A Word on Soundcards

I had intended to use the soundcard on a spare laptop I had to hand. This particular laptop manufacturer uses one connector for both the input to and output from the soundcard. While inconvenient, what actually eliminated the laptop from use was the amount of power supply noise spikes and spurs that could be seen at high levels. Plugging in the laptop power supply only exacerbated the problem. I then tried a small external USB soundcard (<£30) and was again disappointed with its performance, which was not much better than the laptop's soundcard.

After some research I purchased a Creative Labs SBX-Fi external USB soundcard (circa £80), which was

found by a reviewer, who was looking at soundcards to use with SDR, to be a good balance between cost and performance. In addition, the reviewer shows how to improve the soundcard's performance by adding two electrolytic capacitors inside the enclosure, one to further quieten the USB power supply, and a second to filter the analogue-to-digital (ADC) reference voltage. Immediately voiding my warranty, I opened the enclosure, added both capacitors, and could see the improvement this made.

Software Options

Now we have the hardware ready we can discuss the software that is required to turn the quadrature (I & Q) audio streams going into the sound card into something we can watch, listen to, and even decode. Here I will mention two freeware programs, one very simple and one quite complex.

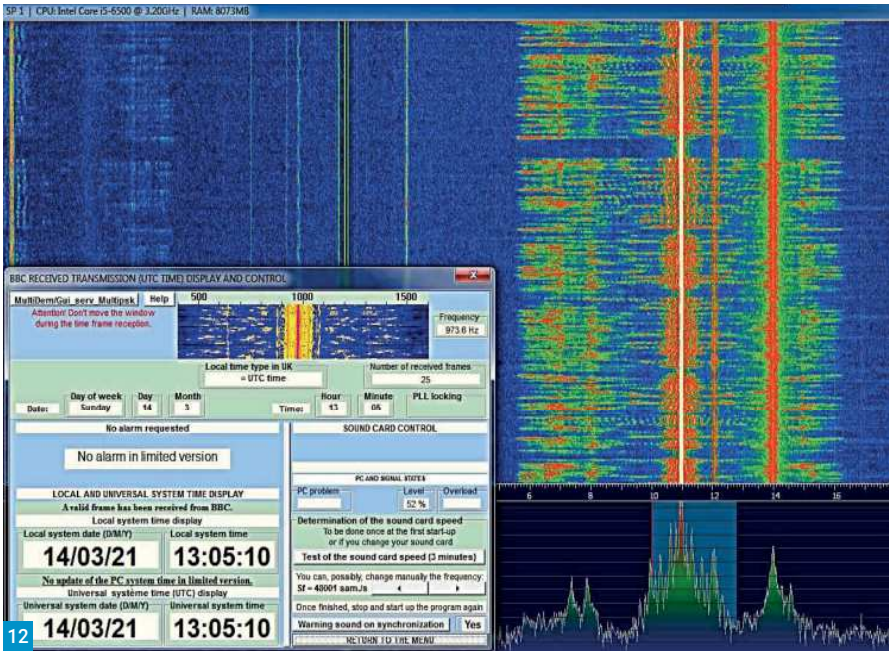
The simplest is called SDRadio, developed by **Alberto di Bene I2PHD**, and is a beta with version 0.99. This software is only intended to be used with the input from a soundcard. It does not have a lot of options or adjustments and is self-explanatory – all of which makes it a good place to start.

A lot more sophisticated, with many options and settings, is a program called HDSDR which is an advanced version of WinRad (also written by I2PHD). In addition to accepting input through the soundcard this program can also directly control a number of SDR devices. It is my preferred choice and used for all the screenshots provided in all these articles.

Using an Offset

Fig. 10 is an annotated screengrab from HDSDR showing the output from the QPD, from 0–14kHz while the QPD was tuned to a section of the MW band without any audible transmissions. Many SDR programs will show an unmodulated carrier exactly at 0Hz and this is a consequence of any offset in voltages between the two ADCs used in the soundcard. HDSDR provides a 'DC Removal Calibration' option, which in the extreme causes a dip around 0Hz – in this case a 10–18dB dip in signal level.

Despite the use of audio transformers and an enclosure, a small amount of AC mains still gets through and can be seen at various amplitudes from 50Hz all the way to 500Hz. Bear in mind that –90 dBm equates to about a S6 signal level. Also, what can be seen is that the noise floor



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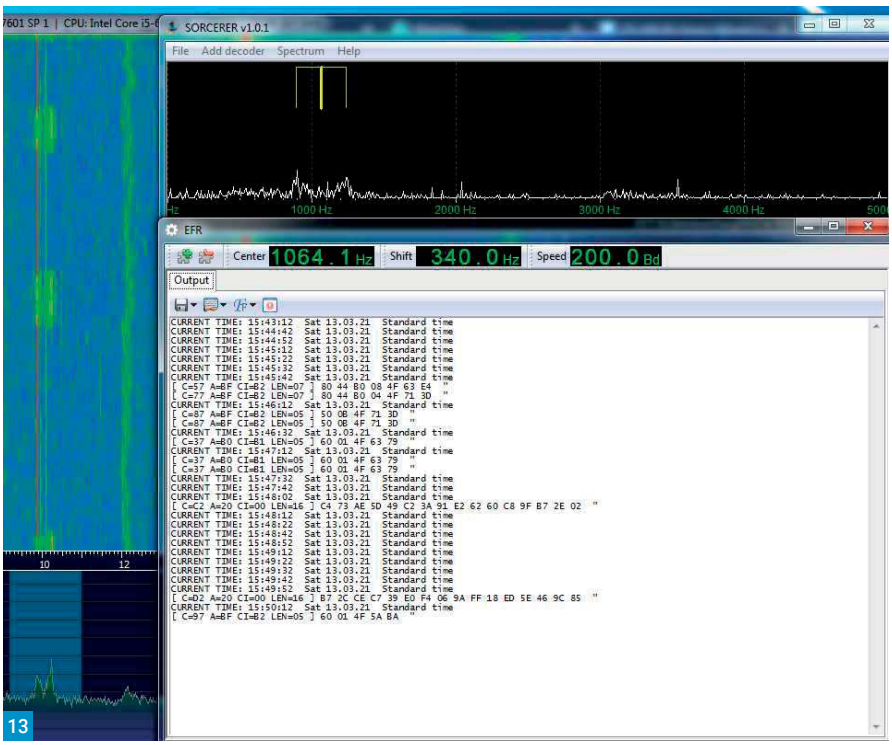

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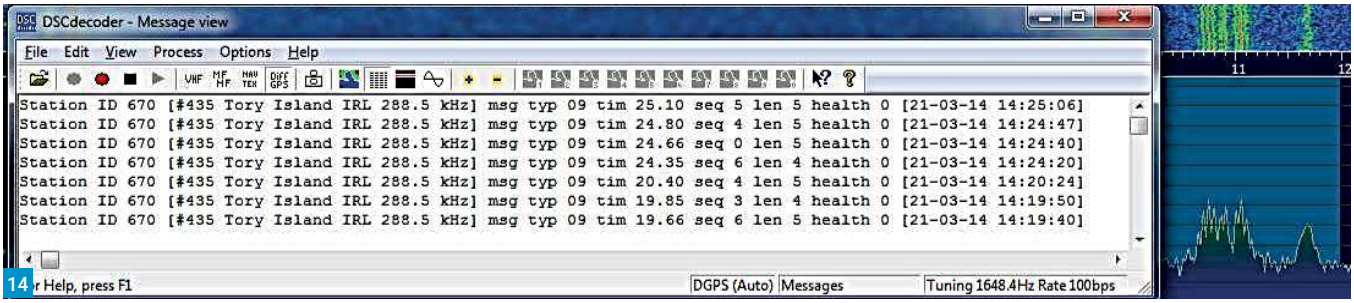
falls by about 10dB from 200Hz to 1kHz, and falls even further after 4kHz (as can be seen in **Fig. 11**).

If we do not implement a frequency offset, then the carrier frequency we are tuned to will appear at 0Hz and, as shown above, be in the dip and subject to interference from these spikes, spurs and harmonics. To overcome this issue, I use a frequency offset of 10kHz – that is, the carrier frequency I am tuned to now appears at 10kHz instead of 0Hz. Not only are there no dip, spurs, or harmonics, but by using at 10kHz I can see what is happening both above and below the signal I am tuned to. To achieve this I use the IF offset function of the frequency counter to offset the frequency counter by 10kHz. In HDSDR you lock the local oscillator at 0Hz and set the Tune value to 10,000Hz.

Shown in **Fig. 11** is the output of a signal generator set to output a continuous wave (CW) at a frequency of 1MHz and with a power level of –109 dBm (S3) (note that I had not at this stage



calibrated the power levels of HDSDR). The frequency counter shows 1MHz, and HDSDR shows the signal you are tuned to at 10kHz. Notice how using this offset function has moved you away from the noise range 0–500Hz, and takes advantage of the fall in noise floor above 4kHz.

To recap: the VCO is running at 4,040,000Hz, and following U4 we have quadrature oscillator outputs into the 'mixer', each running at 1,010,000Hz. The frequency counter measures the 4,040,000Hz VCO, divides by 4, offsets the value by 10kHz and displays 1,000,000Hz as the received frequency. My frequency counter is set to 100Hz resolution because this is a good compromise between fine accuracy and refresh rate. The result is the frequency we are tuned to appears at 10kHz on HDSDR. When we start tuning across a busy band or decoding digital signals you will see how this offset technique helps.

What can you See and Hear?

The easiest task is tuning into broadcast stations in the LW and MW bands. I started with BBC Radio 4 on 198kHz which, at 500kW and only 305km from my location, arrives with a signal strength of –45dBm (S9 +30 dB). As shown in **Fig. 12**, not only can you listen but also decode the time signal that is transmitted under the audio. The 198kHz carrier is BPSK modulated with an accurate time code and data packets that are used to switch storage heaters and set off-peak tariffs. The window overlaying HDSDR is the program 'clock', provided by F6CTE as part of his MultiPSK software package. The VCO described in this article has adequate stability for listening and decoding such services.

A little trickier is the data signal that appears on 129.1kHz as shown in **Fig. 13**. When tuned to this frequency, you will see a narrow unmodulated carrier, followed by a burst of data every ten seconds (with some bursts lasting longer than others). This is the transmission from DCF49 using 100kW from Mainflingen (near Frankfurt, Germany), and is an FSK modulation signal using a shift of 340Hz with a symbol rate of 200 baud. These signals travel 700km to arrive at my home at –77dBm (S8) and are used to control streetlights and heaters, and to set tariffs. I used the software programme Sorcerer, which has a demodulator called EFR, and you can see the regular transmission of the time (to maintain receiver synchronisation) and then the occasional burst of data messages.

All three General Lighthouse Authorities (GLA) of the UK and Ireland – Trinity House, the Northern Lighthouse Board and Irish Lights – have announced that they will discontinue their Differential GPS (DGPS) service in March 2022. I can see (on the screen, not out of my window) a number of these transmitters, and as shown in **Fig. 14**. I used DSCdecoder to decode the data from the transmitter on Tory Island on 228.5kHz. This much lower power transmitter (500–1000W) is 250km distance and arrives with a power of –95 dBm (S5.5) at my location. You can see on the right-hand side of the diagram that I have offset the receiver by 1kHz (to 11kHz) to place the carrier within the decoding window required by DCSdecoder.

Other easy signals to view and to decode without software are the non-directional aeronautical navigation beacons (NDB). My closest NDB is 15km away and what I see is shown in **Fig. 15**. These NDBs have a constant carrier, which is regularly modulated with a 400Hz tone, and keyed to provide Morse characters – in this case KLY. The Morse code is slow enough to show the individual characters on the waterfall. Remember that I am using a 10kHz offset so the carrier (378kHz) is seen at 10kHz on the screen, and the sidebands can be seen at 9600Hz and 10,400Hz.

The last example, shown in **Fig. 16**, is

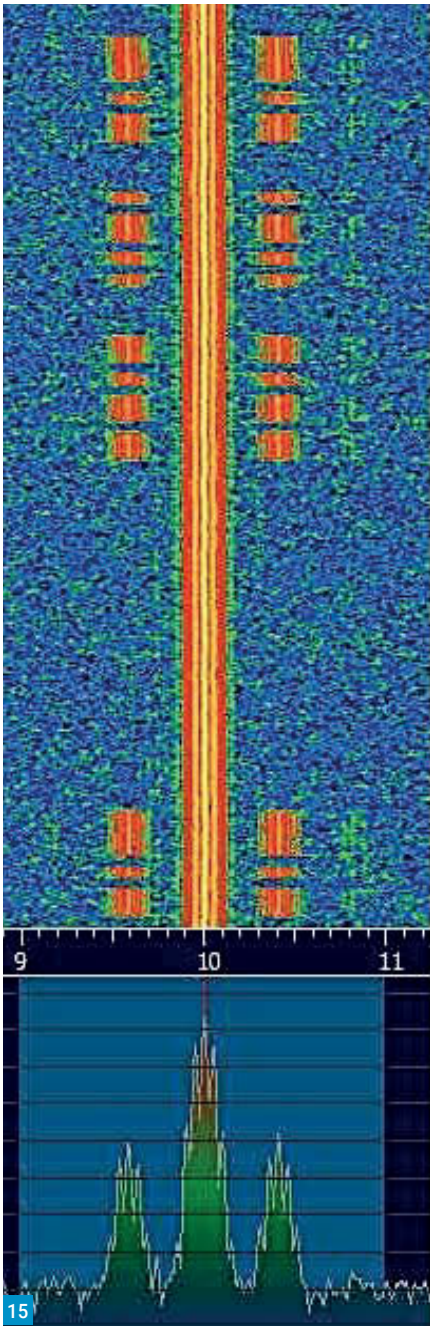
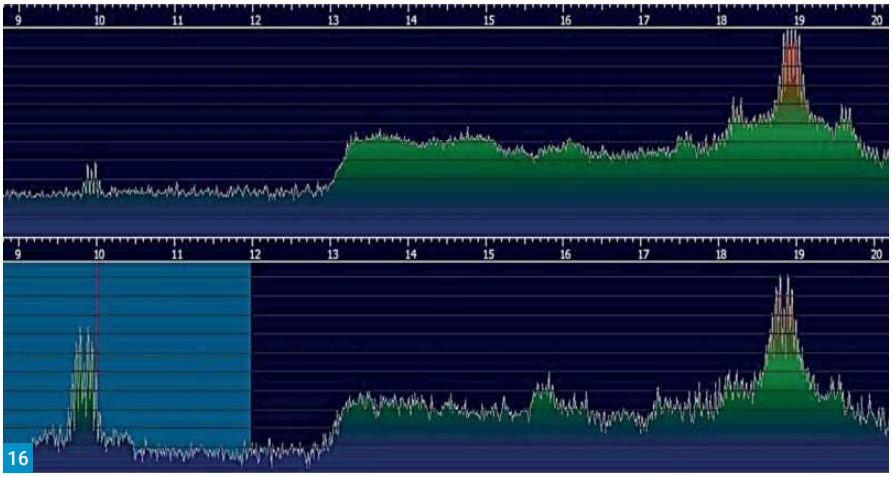


Fig. 12: Listening to BBC and decoding the time signal on 198kHz. Fig. 13: Decoding EFR at 129.1kHz. Fig. 14: Decoding DGPS at 228.5kHz. Fig. 15: Decoding NDB KLY on 378kHz. Fig. 16: Watch and measure the effect of the D-layer.

about watching and measuring the effect of the ionisation of the D-layer of the ionosphere. One useful feature of HDSDR is that it has an S-meter that can be set to read dBm or S-units (peak or RMS) and can be calibrated if you have an accurate signal generator. Do not be concerned if you are not able to calibrate as what we are interested in is relative values, rather than the absolute values.

The top panel of Fig. 16, taken at 1630UTC on 14 March 2021, shows at 10kHz the tip of the carrier of the 540kHz transmitter located near Solt (Hungary), which operates with an output power of 2MW. At 19kHz is a 25kW transmitter (Spirit Radio) operating about 125km from my location – incidentally the 9kHz spacing between these two transmitters reflects the agreed spacing between MW transmitters in Europe. Only the carrier of the 540kHz transmission is above the noise level, and the sidebands, which carry the audio modulation, cannot be seen or heard. Bear in mind that I am located well outside the groundwave zone of reception for this transmitter and to hear it I need a reflection from the E or F-layers. But, the D-layer is so highly ionised at this time that it is absorbing most of the signal.



The bottom panel was captured 75 minutes later. It shows that the carrier of the 540kHz signal has increased by more than 40dB (10,000 times stronger), and the sidebands can now be seen and heard. This dramatic effect shows the D-layer's rapid recovery after darkness falls. This effect can be seen at sunset with transmitters in France, Spain and Morocco, to mention only three countries. You can watch and measure physics happening

End Notes

I have made further information available on my website at:
www.samuelritchie.com

This includes larger schematic diagrams, high resolution pictures, more details on some of the components used, etc.

I have no personal connection with or financial interests in Creative Labs or any of the software mentioned in this article.

In the next instalment we are going to look at a single band (40m) receiver.

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practicalwireless@warnersgroup.co.uk

Test Equipment for the Shack

Chris Murphy M0HLS advises on the purchase of basic test equipment for the workshop.

During the lockdown I took the opportunity to reorganise my workshop – an activity well overdue. While doing so I began to consider the age of some of my test equipment and how well it has lasted – much of it being purchased in the late 1970s. The thought then came to mind that with lockdown restrictions hopefully gradually being relaxed, we may in the near future be able to attend rallies again where test equipment such as the instruments that I purchased as new years ago can often be picked up as bargains, internet auction sites being another option.

With this in mind, I thought that it might be useful to write a few notes about the sort of test equipment that is likely to be found second-hand at rallies etc. Hopefully these notes will benefit someone new to amateur radio or electronics who may be interested in designing and building their own equipment or even just experimenting with electronics.

Kits for instruments such as audio signal generators and frequency counters are available quite cheaply from internet sites but rallies often offer opportunities to buy older equipment that was aimed at the professional market.

Before Starting

Before describing the instruments, I feel that there are a few points that I should make before readers go out and spend their hard-earned cash. The use and operation of the instruments is beyond the scope of this article but there is plenty of information available on the internet and user manuals for many instruments can also be downloaded.

1. The test equipment described here is intended as a guide to people who wish to experiment with and/or build simple electronic and radio equipment, QRP projects being a typical example. The equipment described here is not intended to be recommended as the requirements for repairing the complex commercially available equipment that most radio amateurs use nowadays. Such repairs require sophisticated equipment of high accuracy and require regular calibration to ensure their performance.
2. Much of the equipment available that originated pre-1970s may use valve technology. It is therefore a good idea to ensure that the equipment is working unless you possess the knowledge and experience to repair such equipment. As well as using high voltages with the obvious safety concerns, spares are often difficult to find. Anything that is mains powered should have the mains cable, plug and fuse rating checked. Seek the advice of a more experienced person if in doubt.
3. Please don't think that it is necessary to go out and buy everything that is described here. The equipment that you may require will depend upon your own needs and interests. For example, as well as experimenting with radio and electronics, I used to repair televisions back in the days when such equipment could be repaired, and this influenced the purchase of at least one piece of equipment, namely the D52 oscilloscope.
4. You do not have to be an electronics genius to be able to use these instruments. If you see a bargain, buy it and play.
5. And finally I have no commercial or financial interest in any of the manufacturers that I have mentioned here.

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Multimeters.

The multimeter is a basic requirement for any electronics workshop and is a useful piece of equipment to own even if you have no interest in electronic construction or repair. As important as they are to the workshop, I don't want to dwell too much on the subject of multimeters as they are described in greater detail in an article that appeared in the December 2019 issue of *PW*.

Basically, multimeters fall into two

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Fig. 1: AVO 8 and AVO 73.
Fig. 2: Examples of RF signal generators.
Fig. 3: Two examples of AF signal generators.
Fig. 4: Typical oscilloscope controls.
Fig. 5: Three of the author's oscilloscopes.
Fig. 6: Thandar frequency counter.
Fig. 7: Heathkit power supply.

main types – analogue and digital – and both can be found on sale at rallies. Since quite sophisticated digital multimeters can be purchased new fairly cheaply there probably isn't much to be gained by buying second-hand. Having said that, digital meters aimed at the professional user can sometimes be found on sale at reasonable prices.

As well as being able to measure voltage, current and resistance, many digital meters can measure things such as capacitance, frequency and temperature. Some also have component testing facilities.

If you feel that you need an analogue meter, the classic AVO meter can often be picked up very reasonably. Over the years there have been several models of AVO and the one most commonly seen is the AVO 8. There are several versions of the AVO 8 but any is worth having. The AVO 70 series models are also sometimes to be found, **Fig. 1**.

As a final word on multimeters, if you buy one complete with test leads, make sure that these are in good condition and free from cuts, burns and other damage before you use them.

Signal Generators

Basically, from the home constructor and hobbyist point of view, there are two types of signal generators – Audio Frequency (AF) and Radio Frequency (RF). There are other types of signal generator such as Pulse Generators, but these are of limited use unless you do a lot of work with digital electronics.

Most signal generators have the output frequency determined by range switches that set a frequency range, 1MHz to 5MHz say, with the exact frequency being achieved by a variable control whereby the frequency is set by a pointer against a calibrated dial – similar to how the frequency on an old transistor radio is set.

The output level, or amplitude, is usually determined by a variable control and some signal generators have a switched attenuator to provide a rough setting with the exact output level being set by the variable control. Some signal generators also have a choice of output impedance.

Audio signal generators produce signals that are relatively low in frequency, although the term 'Audio' is a bit misleading as many AF generators produce signals that are of a far higher frequency that the human ear can detect. A typical frequency range for an AF generator is 10Hz to 30kHz.

Most AF generators produce a sinewave output, but many provide a square wave output too. There are also AF generators that as well as Sine and Square wave outputs also provide other waveforms such as Triangle and Sawtooth. These are often called Function Generators.

The generator should have a variable output attenuator so that the output level can be adjusted. Zero up to a few volts is a useful range. Some Audio Generators have a choice of output impedances to choose from such as 600Ω and high impedance.

AF generators are often to be found on sale at rallies and the J and H models made by Advance are good choices if you come across them. Other reputable makes are Heathkit, Levell and Marconi although this list is by no means exhaustive. **Fig. 3** shows two Heathkit AF signal generators: the AO-10 (top) and IG-18 (bottom) Both produce sine and square wave outputs. The IG-18 has a meter that shows the output level.

Radio Frequency (RF) Signal Generators

In terms of frequency, RF generators take over where AF generators stop. A typical frequency range for an RF generator is 100kHz to 150MHz although instruments capable of higher frequencies are sometimes available. RF generators can usually produce a constant high frequency signal, including both a carrier wave and a modulated signal output. The modulation frequency is typically 400Hz and this is often available as an audio signal output. Some instruments have facilities for an external signal, from an AF generator for example, to be used as the modulating signal.

Frequency Modulated (FM) signal generators are available but are probably beyond the needs of the average constructor. As with AF generators, useful instruments to look out for at rallies etc are from Advance (the E model), Heathkit, Altai and Marconi. **Fig. 2** shows an Advance model E and a Tech

TE20-D purchased from the National Hamfest for the princely sum of £7.

Frequency selection on RF Signal Generators is usually by switched ranges with a calibrated scale against which the desired frequency can be set. As with Audio Generators, RF Signal Generators should have a variable attenuator on the output so that the output level can be set. The output level from RF signal generators is usually much lower than that found on Audio Generators because signal levels in microvolts are required for the testing and alignment of RF circuits.

Oscilloscopes

One of the most useful instruments is the oscilloscope and even a simple basic model is useful provided that its limitations are understood. A search of the range of oscilloscopes available today will reveal some very sophisticated instruments with measurement capabilities up into the hundreds of MHz, with four or more colour coded traces on an LCD display and options to carry out all sorts of functions. The price range matches the capability!

Many people when they hear of an oscilloscope being described in terms of a frequency, a 5MHz or 10MHz oscilloscope say, believe that this is the maximum frequency of signals that the instrument will be able to display. This is not the case. The inputs of an oscilloscope consist of complex impedances and are therefore frequency dependant.

The frequency quoted in the description is the bandwidth of the instrument and is the maximum frequency of signals that can be displayed without experiencing any attenuation. So, for example, if you're looking at a 30MHz signal that has an amplitude of 1V on an oscilloscope that has a bandwidth of 10MHz, it's true value will be greater than 1V.

Basic oscilloscopes are usually single trace or double trace. This means that either a single signal or two signals can be displayed on the screen. More sophisticated instruments offer four or more traces with the traces displayed in different colours. These instruments also often have digital readouts that show details such as the peak-to-peak voltage, RMS voltage, etc.

Most oscilloscopes have controls that enable the brightness and focus of the trace to be adjusted.

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Each channel will have an input attenuator, where the range is usually selected by means of a rotary switch that is labelled in terms of volts per centimetre (V/cm). The oscilloscope screen is fitted with a graticule where both the vertical and horizontal lines are 1cm apart. The graticule along with the V/cm switch can be used to calculate the amplitude of signals. There is also a switch that enables either DC or AC input signals to be selected. Double-trace oscilloscopes will have input selector switches for both traces.

Another control, again usually in the form of a rotary switch, controls the speed at which the trace moves across the screen. This is known as the timebase and is labelled in seconds per centimetre. In terms of electronic signals a second is a long time, so the switch is usually labelled in milliseconds and microseconds. Other controls include a trigger control and a vertical position control that enables the trace to be moved up and down on the screen. Oscilloscopes typically provide a calibration signal, usually a square wave of a set amplitude and frequency that can be displayed on the screen, and allows a fine adjustment of both the input attenuator and timebase to be set.

Fig. 4 shows the controls on a single-beam oscilloscope. The input attenuator is on the left and the timebase control to the right. The red controls in the centre of the switches allow fine adjustments to be made.

Input connectors are usually of the BNC type although UHF PL259 and 4mm banana plug sockets are sometimes encountered. Although simple leads terminated with crocodile clips can be used, it is worth investing in a proper set of oscilloscope probes. They come with a range of accessories that enable them to be connected to the circuit under test in various ways. A useful probe is an X1/X10 type. A switch is used to select either X1 or X10 and in the X10 position if the input attenuator switch is set to, say, 1V/cm a voltage of 10V will be shown as

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being 1cm high on the screen.

Older models of oscilloscopes likely to be found at rallies come from manufacturers such as Telequipment, Tektronix, Gould, Scopex, Hameg, and Philips. I have owned two Telequipment oscilloscopes, an S51 and D52, since the 1970s and both have proved to be excellent instruments. These are shown in **Fig. 5** along with a Philips PM3210. Over the past couple of years I have purchased another S51 and a D52, both in working order, but for use as a source of spare parts if necessary. Both cost less than £30 each.

Frequency Counters

A frequency counter is a useful instrument for checking the output frequencies of signal generators as well as for checking the frequency of oscillators than have been constructed or being tested. As with all other instruments described, care has to be taken as to whether or not the reading can be relied upon but if the frequency meter displays a frequency that is fairly close to what is being expected, it is probably nearly correct.

As mentioned at the start of this article, the instruments described here should not be relied upon for applications that require high accuracy measurements.

Frequency counters usually have a set of switches that are used to set the input range. This means that since the displays have a fixed number of digits, the number of digits after the decimal point will be different for each range.

Frequency counters from many of the manufacturers already mentioned can be picked up at reasonable prices. Others include Thandar and Racal-Dana. **Fig. 6** shows a Thandar TF200 200MHz battery operated model. Most have either LCD or LED displays but some older models may use Nixie tubes.

Variable Power Supply

It is probably debateable as to whether or not a power supply could be classed as a piece of test equipment, but I believe that it can – especially if has meters that monitor the output voltage and current. What happens to the supply voltage and current when a piece of equipment or experimental circuit is switched on can often give a clue as to possible faults. If, for example, when the equipment under test is powered up, the output voltage from the power supply drops dramatically, there is probably a short circuit somewhere.

Variable Power Supplies come in a wide range of varieties. Output voltage range and output current may be the obvious things to look for when choosing a power supply but there are many other features as well. Meters to measure the output voltage is something that I consider to be essential. The output can be measured using a multimeter but this has to be done each time the output is varied. Life is much easier if the power supply has a voltage meter. Accidental changes to the output are also more easily noticed. A meter to monitor current is also useful and many of the power supplies available have a single meter that can be set to monitor voltage or current by means of a switch. More modern instruments tend to use either LED or LCD displays rather than analogue meters.

Another useful feature is current limiting. Here the supply can be set so that if the output current exceeds a pre-set amount, the power supply will automatically shut itself down and prevent the equipment under test from drawing large currents that may lead to damage.

There are Variable Power Supplies on the second-hand market from a wide range of manufacturers and since they used to feature quite often in the various electronics hobbyist magazines as construction projects, homemade units are often to be found. **Fig. 7** shows a Heathkit IP 28, which is variable from 0 to 30V and up to 1A, a suitable range for experimental or test use. As already mentioned, meters to monitor the output are useful and it is also useful to be able to switch the DC output on and off without having to switch off the mains supply to the unit. Current limiting has already been mentioned.

There are power supplies available with several outputs that can be individually set. These can often be connected in series to provide a higher voltage range or in parallel for a higher current.

Component Testers

It is often useful to be able to measure the value of passive components and also to be able to test basic semiconductor devices such as diodes and transistors. Nowadays, many digital multimeters have the facility to be able to measure capacitance and even inductance as well as resistance. The range of capacitance and inductance that may be measured, however, is usually quite limited.

Likewise, most digital meters have the ability to be able to measure the voltage drop across a diode, enabling them to be able to determine whether the diode is faulty or not. This method can also be used for testing transistors although many digital meters have a dedicated transistor test facility available. Diodes and transistors can also be tested using analogue meters by measuring the forward and reverse resistances across the device junctions using the resistance ranges.

Instruments for measuring resistance, capacitance, and inductance can sometimes be found under the name of LCR bridges. Such instruments come from manufacturers such as Marconi, AVO and Heathkit. If you do a lot of work requiring the measurement of capacitance and inductance, it is probably worth investing in one of the modern instruments from suppliers such as Peak Electronics rather than relying on an older instrument whose accuracy may be questionable.

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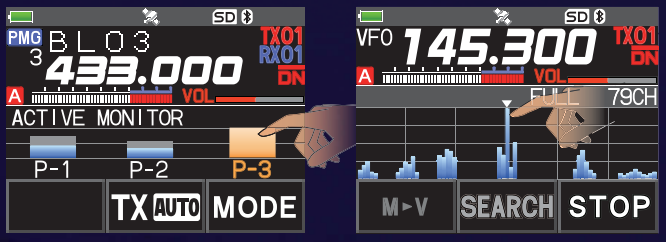

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1

Fancy a Chat?

Tim Kirby GW4VXE makes a plea for more FM activity, to keep our bands alive day to day.

People often say to me that there is no activity on VHF/UHF. I usually counter that there is plenty of activity (see this column for details!) but it may not be happening where they are expecting. I genuinely believe this is true and that there is probably more VHF/UHF activity now than there has been since the 1980s.

Nevertheless, for beginners and people who are 'generally' interested in VHF/UHF rather than specialist DX, satellite, or other work, I appreciate that there is real value in turning on a FM set and being able to listen to or join in a conversation. It does no harm for the future of our hobby, either, for our regulators, OFCOM, to switch on a scanner and hear plenty of activity.

I know there are many club and other nets, up and down the country, which take place on a regular basis, even 'informal' gatherings on a particular repeater at a regular time. I am assuming that even where these nets are club nets, they would welcome other participants, on the basis that these other participants might represent potential new club members.

What I would like to do is to start publishing a list of the different nets that take place on VHF/UHF so that readers can listen out for any nets that may be taking place in their area and hopefully join in. I will aim to publish the list regularly.

So, if you are aware of a regular VHF/UHF net taking place, please drop me an email with the subject 'VHF/UHF Net Information' and include the following information:

Day of the week: (e.g. 'Every Tuesday', 'Third Thursday')

Frequency/Repeater: In the case of repeaters, please include the callsign and for simplex nets, please include the frequency

Description: e.g. Anytown Amateur Radio Society 2m Net

Where digital or Echolink repeaters or gateways carry nets, I am happy to list those as well.

You do not have to be a club secretary or official to contribute to this listing! Let's just get as much information as possible together in order to help people who want to, get talking on the air.

I am looking forward to hearing from you!

Regular Activity on 23cm FT8

Roger Greengrass EI8KN wrote to say that the regular FT8 Activity sessions taking place each month on 2m and 70cm will now be extended to 23cm. The 23cm session will take place every third Wednesday from 1700 to 2100UTC starting in January 2022.

Roger says, "*My Icom IC-9700 does not currently have a 'Precision Frequency Reference (GPSDO)' installed, so it will be interesting to see how it performs as is. That's assuming I can make the trip over the Irish Sea with 10W!*"

There are plenty of IC-9700s out there – please try and get them going and see what contacts can be made on FT8 during this session. And, of course, when you do make some contacts, please let me know. It would be really great to include the information in the column. FT8 on 23cm is a fairly unknown quantity at this stage, so it will be interesting to see what is possible.

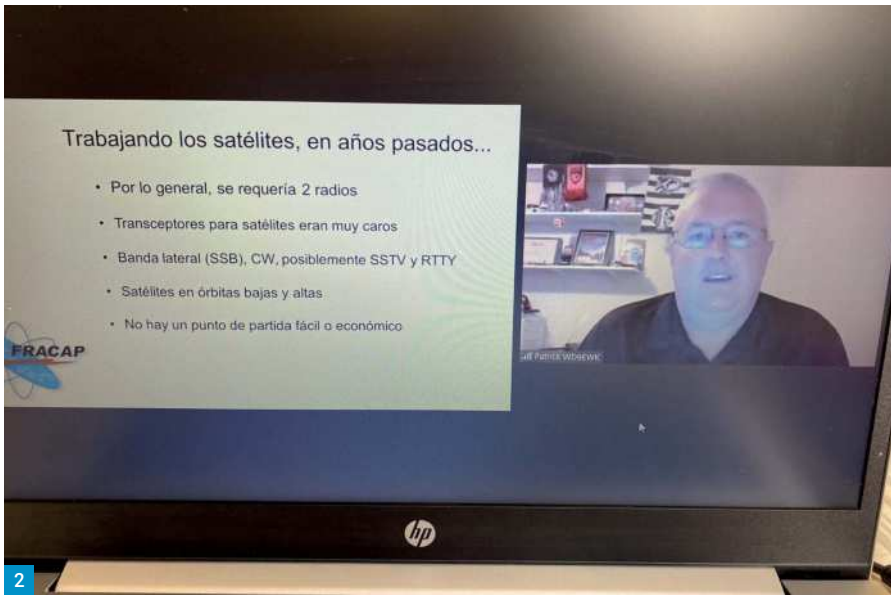
The 6m Band

Kevin Hewitt ZB2GI reports monitoring the 6m band during late November using an indoor dipole. He said that he had one solitary decode at strength –26 of K2KA.

I am not sure what software Kev uses, but it's worth pointing out that the JTDX software, which is excellent in many ways, has a bug where it will produce spurious decodes at a signal strength of –26. When I used the JTDX software this caught me out several times and made me think I had completed QSOs that I had not. In fact, it is why I stopped using the JTDX software and reverted to WSJT-X. There are enough people who would take any chance to devalue digital QSOs, without giving them 'just cause' to do so. If you use the JTDX software, please be mindful when you see FT8 decodes at –26 and perhaps wait for another decode to be certain of what you are receiving. Better still, contact the developers and see if they can fix the bug.

Peter Taylor G8BCG (Liskeard) says that the first two storms of the season have passed without too much damage. His big 50MHz array was luffed over, but one of the four 8-element Yagis is now 45° from the other three. Peter's single 6M8GJ Yagi

Fig. 1: The aftermath of Storm Arwen at G8ZRE. Fortunately, damage was not too severe. Fig. 2: Patrick WD9EWK has been making satellite presentations via Zoom in Spanish for operators in Central America. Fig. 3: Peter G8BCG operating QO-100 from IN79 at the Lizard in Cornwall. Fig. 4: Holding a 1.2m dish stable in 50MPH winds can be a challenge. Fortunately Peter G8BCG found plenty of rocks to help.



was parked beaming East and is now stuck there. Peter is hoping it's a cable issue rather than the rotator.

Tony Collett G4NBS (Cambridge) learned from **Paul G3YDY** that there is a Danish 50MHz Contest on the fourth Tuesday of every month. On the 23 November, Tony had a listen and although his local noise was causing problems, he did work SM5EPO on MSK144 and then GI6ATZ and GI4SNA on FT8. The December UK Activity contest seemed to have very poor tropo conditions, with Tony making 47 QSOs. Unusually, GI4SNA was very weak, but GD8EXI was an easy QSO!

The 2m Band

Roger Greengrass EI8KN (Co. Waterford) enjoyed the tropo opening on 18/19 November, working EA1M (IN53), DF7IW (JN39), DF6PW (JO40), DF7KF (JO30, PA3PCV (JO20), DL4VAI (JN39), DK0A (JN48), DL3RL (JN59) and DL5FCW (JO40). Roger says that the getaway was OK1VVT who was a good strength, but didn't seem to be able to hear Roger's signals.

Tony G4NBS found some good conditions late on 19 November, working LX/PE1ITR, DL2NEQ (JN59), DJ8RZ (JN58), OK2UZL (JN79), OE5JSL (JN68) and DH4SBM (JN48). Tony saw another OK as well as OE5KE, but unfortunately, wasn't able to work them. During the 2m FT8 activity period on 1 December, conditions seemed poor but Tony worked GM4CXM (IO75), GI6ATZ, MI0IHH and EI8KN. To the east there was nothing beyond JO31/JO32. During the 2m AFS contest on 5 December, things started off well with a good signal from G7RAU (IN79) but Tony found distant QSOs a bit of a struggle, making 113 QSOs in 25 locators. Best DX was GM4JTJ (IO86). During the UK Activity Contest, Tony made 52 QSOs with only GI4SNA, GD8EXI and PA5Y at any distance. Tony says it was great to hear G3WGV (IO84) at good strength, but unfortunately Tony's local QRN started up before the QSO could be completed.

G8ZRE is a well-known callsign for many who participate in the UK Activity and other VHF/UHF contests. **Dave Hewitt, G8ZRE** wrote with an account of what happened to his station in Storm Arwen, **Fig. 1**. "*The storm took its toll on my 2/6m setup at home. The aerials are rotated by a Yaesu rotator, which was connected to a stub mast at the top of my pump-up Clark mast. I was away at the weekend and forgot to drop the mast right down, leaving one section up. I arrived home on Sunday to find that the stub mast had bent through 90°. I had to angle grind it off the top of the mast. Luckily, as the aerials fell, they rested on nylon ropes, which secure the 70cm aerial on side of house. Only one element was bent on the 2m aerial. Four days of repairs and I got everything back up for the 2m contest on Sunday and UKAC contests during the coming week*".

Phil Oakley G0BVD (Great Torrington) was also unlucky enough to suffer some antenna damage during Storm Arwen. Hopefully Phil will be back on the VHF/UHF bands again before too long.

Simon Evans G6AHX (Twyning) worked F6APE (IN97) on SSB during some tropo on 20 November and on 5 December found that there was a French contest going on, so was able to work F8KGU (JN19), again on SSB.

David Johnson G4DHF (Bourne) uses the **G6LI** club call with his IC-705 and portable 2m Moxon, which you will see more information about elsewhere in next month's *PW*. During the November tropo, using FT8, David was receiving OE5KE consistently with the best DX being HA and 9A in excess of 1500km. David worked DK0A (JN48) using the 8W from the IC-705 and the Moxon at 10ft. He is looking forward to trying the antenna in the summer.

Andy Adams GW0KZG (Letterston) wrote just as I was putting the column together to say that he had heard ZB2GI (IN76) on meteor scatter and was starting to call him.

Here at **GW4VXE** (Goodwick) there have been the 'regular' 2m FT8 QSOs with nothing too much out of the ordinary. F6DBI (IN88) was worked on 19 November and F5LMG (IN88) on 26 November. At the time of writing, meteor scatter activity is picking up for the Geminids shower.

The 70cm Band

Tony G4NBS caught some tropo on 19 November, working DF1NP (JN58), DL6KAI (JO30) and DK5WO (JO30) as well as GW3TKH (IO81) off the back of the beam. During the EU FT8 activity period on 8 December, Tony found UK activity was poor outside IO91, JO01/JO02, but he still made 48 QSOs in 19 locators. OV3T (JO46) was a good signal for a long period though, mostly aircraft scatter, but some residual tropo. OZ2OE (JO45) was just visible on tropo, but once a plane arrived, a QSO went through easily. GM4CXM (IO75) was worked in the last ten minutes.

To the east, DL1DBR (JO41) was the best DX with a fair amount of activity from the Netherlands and Germany.

Satellites

Kev ZB2GI tried operating through the ISS voice repeater during a busy afternoon pass, but found there was too much competition. Too bad, as I am certain most of those active would have loved to have worked Kev.

Patrick Stoddard WD9EWK (Phoenix) has been making use of the cooler weather in his part of the world and writes, "*There is still a lot of satellite operating going on, as autumn approaches wintertime. I made a couple of trips to rarely-heard spots in the last month, making satellite operators across North and Central America happy, along with more presentations on amateur satellites.*

"In mid-November, after almost two years of COVID quarantine requirements in the state of New Mexico, I made a trip to the DM61/DM62 grid line in southwestern New Mexico. This was a day trip on a Saturday, about 4½ hours on the road each way, along with several hours and many passes from that location.

"My day started around 3am (1000 UTC), and I was on the road about 30 minutes later. It is about 340 miles from my house in central Arizona to the DM61/DM62 grid line near the town of Deming in New Mexico, which is similar to a drive from my house to Los Angeles in southern California. It took me about three hours to reach the Arizona/New Mexico state line, as the sun was about to rise above the horizon. I made a quick stop at the 'Welcome to New Mexico' sign along the I-10 freeway, then proceeded to the grid line about 90 minutes away.

"After the stop at the state line and a fuel stop, I made it to the DM61/DM62 line just in time for a very shallow AO-91 pass. How shallow? Maximum elevation of 1.5° to the northeast. In the deserts of southwestern New Mexico, even with some hills around the area, it was a workable pass. I worked three stations in the eastern USA (N5BO/R in North Carolina/FM13, N2NWK in Maryland/FM19, KC1MMC in Vermont/FN34), and one in eastern Canada (VE1CWJ in Nova Scotia/FN85) within about two minutes. I was happy with four contacts in about two minutes on that shallow AO-91 pass, and it shows AO-91 is still a good option for longer-distance contacts when it is near apogee in its orbit.

"At midday (around 1900 UTC), there was another shallow pass. This time, it was SO-50 to the east and southeast, rising to a maximum elevation of 3.5°. I worked only one station on this pass, CM2ESP in Cuba. Given the low elevation and low power on SO-50's downlink, I was happy to log just one contact on this pass. Both DM61 and DM62 were new grids for CM2ESP, and CM2ESP's grid in Havana (EL83) was a new one for me out there.


4

"After that AO-91 pass, I worked other passes in SSB and FM from the DM61/DM62 grid line. I was visited by the US Border Patrol a couple of times during the day, being near the USA/Mexico border, but the US Customs aerostat base north of the grid line appeared to be quiet for the day. The tethered blimp did not rise above the base during the day.

"Late in the afternoon, I started my drive home. Just after sunset, I was back at the Arizona/New Mexico state line on the I-10 freeway, this time looking at the 'Welcome to Arizona' sign. After a moment to take some pictures, it was back in the car for the drive home, about 3½ hours from the state line. This was a productive trip, bringing me to a new satellite VUCC award just from operating from southwestern New Mexico (grids DM52, DM61, and DM62) over many years.

"A couple of weeks later, I made a quick drive to another spot that is rarely heard on the satellites, the DM52/DM53 grid boundary, about three hours southeast of the Phoenix area. I have visited this spot many times in the past decade or so, and helped put those grids in the logs of many stations around North and Central America.

"In early November, I gave two satellite-themed presentations to the Central American FRACAP virtual convention. These presentations were in Spanish, (**Fig. 2**) *and similar to presentations I gave at the QSO Today Ham Expo in August. The presentations were warmly received, and there were many satellite operators from around Central America and the Caribbean in attendance. In the past year, there has been an increase in the number of satellite operators in Mexico and Central America, along with a few who are regularly working satellites in Cuba".*

Patrick has also been busy giving presentations, via Zoom, to encourage Central American operators to try satellite operation. If this weren't enough, Patrick has been presenting in Spanish. It's great to see more operators from Mexico and Central America getting on the satellites. If you use RS-44 or AO-7, some of them are workable from Europe!

Peter G8BCG made a DXpedition to The Lizard in Cornwall to activate IN79 square on QO-100, **Fig. 3**, and writes, "*I managed to squeeze in the operation between the two storms on Sunday 5 December. I made 151 QSOs in 36 countries. It was a beautiful sunny day, but was a bit cool with the wind gusting to 50MPH. Lots of rocks were required to keep the 1.2m dish stable!* (**Fig. 4**)" Peter operated from between the Lloyds Signal Station and the Marconi huts. As he says, *"Flags to Sparks to Satellites!"*

At GW4VXE, a low AO-91 pass on 18 November gave contacts with three continents in just a few minutes: EA8TL (IL18), VE1CWJ (FN75), GM7PBB (IO68) and G0ABI (IO80). I looked for FS/FG8OJ on RS-44 in early December but was unable to work Burt with my minimal antenna, but **Pete 2M0SQL** was able to complete a very nice QSO.

Well, that's it for this month. Thanks to everyone for their contributions. See you next month and don't forget to send in some details of your FM nets – let's see if we can help people to get chatting on the air on VHF/UHF.

The Nevada team and I wish you a happy and healthy New Year.

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Mike Devereux - G3SED
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The Thirteenth Practical Wireless 70MHz Contest: Results 2021

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

Contest Manager **Colin Redwood G6MXL** has the results of last September's event.

Good weather greeted those who ventured out portable for the 13th *Practical Wireless* 70MHz Contest on Sunday 26 September 2021. The 25 entrants made a total of 565 contacts with 111 different stations in 20 different squares, **Fig. 1**.

Low Power Section Winner

Steve Clements GW1YBB/P operated from the 800m summit of Pen-Y-Gadair in the Black Mountains in IO81KW. He is again the winner of the low power section. He used a Yaesu FT-817 with a UT5JCW transverter running 8W to a homebrew 6-element Yagi antenna.

Open Section Winner

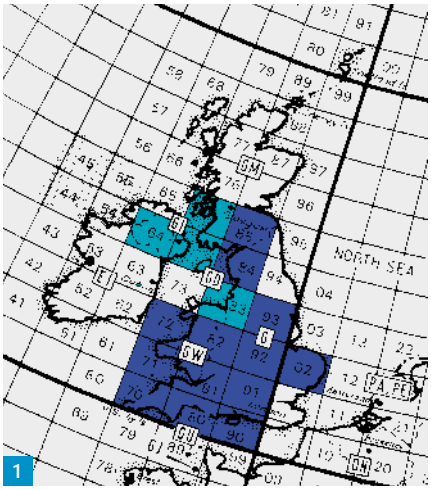
The winners of the open section are again **Pauline & Chris Kirby G8HQW/P**, **Fig. 2**. They used an Icom IC-7300 + Gemini 4m amplifier feeding a 7-element Yagi antenna. They operated from a grouse moor in the Yorkshire Dales, but there was no shooting on the day of the contest, so they were granted permission to operate from there. It is the 17th highest in North Yorkshire. It is also a SOTA summit (G/NP-014), but their operation didn't count for SOTA since they didn't actually carry the equipment to the top, choosing instead to operate from the 'luxury' of their box trailer, **Fig. 3**.

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

General

In common with several other 70MHz contests, activity in 2021 was well down on the previous year. In some parts of the country, the forecast of strong winds may have deterred some from venturing out on the hills. This may explain at least in part why no contacts were made outside of the British Isles – all contacts were confined to England, Wales and Scotland. Despite this, many stations enjoyed the contest.

Peter Knight G6EPN/P summed up the contest, **Fig 4**: *"Well, it was a great contest – 70MHz is very different to 2m. It's an odd nature of noise, sounding much like I'm set to FM on receive, then it goes quiet. I could hear the St Austell Beacon at times (and Buxton), and was able to work 2E0VCC/P in IO70CP. He had difficulty hearing me, and gave me a 44 report but he was romping in with me".*



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Description	Name/Team	Callsign
Low-Power Winner	Steve Clements	GW1YBB/P
Open Winner	Pauline & Chris Kirby	G8HQW/P
Leading Single Operator	Steve Clements	GW1YBB/P
Leading Multi-Operator	Pauline & Chris Kirby	G8HQW/P
Leading English Station	Pauline & Chris Kirby	G8HQW/P
Leading Welsh Station	Steve Clements	GW1YBB/P
Leading Scottish Station	Brian Howie	GM4DIJ

Table 1: Leading stations.

Fig. 1: Map showing locator squares of stations that entered (in dark blue) and other stations worked (light blue). Fig. 2: The box trailer used by G8HQW/P on the North Yorkshire moors. Fig. 3: Pauline G8HQW/P operating from the relative comfort of the box trailer. Fig. 4: The antennas at G3MXH. Fig. 5: The station at GW0JLX/P. Fig. 6: The setup at G6EPN/P. Fig. 7: The antenna at G2HX/P. Fig. 8: The setup at G4RLF/P.

Activity

Tony Wallbank G4CIZ enjoyed the contest this year. *"There were plenty of portable stations on, making it interesting. Unusually for me I contacted the complete IO8x vertical row from IO80 to IO84. That is the first time from this QTH in any VHF contest. The contest seemed more popular this year, though perhaps that was just conditions and weather attracting more people to be active."*

Local Noise

John Beech G8SEQ G-QRP Club VHF Manager operated G5LOW and only worked one station in his own locator square. He had to contend with *"Horrendous locally generated noise at S7 (unsure where from), which lasted for about an hour in the middle of the contest when I could only hear strong stations. This noise occurs from time to time at this QTH and is not heard by G4GEE who is only 400m away so is very local."*

Signal Complaints

Two stations complained about each other's


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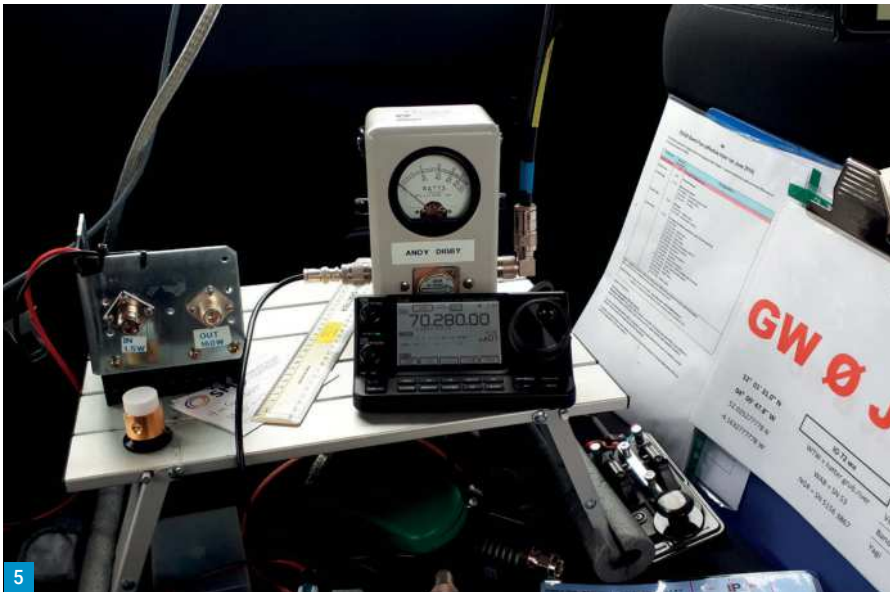
Pos	Call	Name	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	GW1YBB/P	Steven Clements	62	18	1116	IO81KW	Yaesu FT-817+UT5JCW TVTR	homebrew 6 ele	800
2	G4RLF/P	Martyn Wright	40	16	640	IO80WX	Icom IC-7300	5-ele Yagi	255
3	G6EPN/P	Peter Knight	12	7	84	IO91DL	Elecraft KX3 + Ukraine 28/70 TVTR.	Home-built 2-Element HB9CV	6
4	G5LOW	G-QRP Club	9	6	54	IO92GK	Icom IC-706 + Spectrum TVTR	Double turnstile	8
5	G8ZAX	Guildford And District Radio Society	6	4	24	IO91RF	Elecraft K3s+TVTR 4m	Moxon	87
6	G0EIY	Simon Pryce	5	4	20	IO82OR	Kenwood TS-2000 + UT5JCW TVTR	Six-ele LFA Yagi	70
7	2E0RWR	Guildford And District Radio Society	6	3	18	IO91RF	Icom IC-251 + MM TVTR	bazooka dipole	85
8	G4CIB	Brian Woodcock	5	3	15	IO81VX	Yaesu FT-817ND + MM TVTR	Dipole	25

Table 2: PW 70MHz Low Power results table

Pos	Call	Name	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	G8HQW/P	Pauline & Chris Kirby	54	17	918	IO84WK	Icom IC-7300 +Gemini 4/6 amp + Yaesu FT-847	7-ele Yagi & half-wave vertical	672
2	G2HX/P	Gloucester Amateur Radio & Electronics Society	42	14	588	IO81WU	Icom IC-7300. Gemini 4 Amplifier	5-ele Quad	273
3	G0LGS/P	Stewart Wilkinson	40	13	520	IO81XV	Icom IC-7300	5-ele PowAbeam	6
4	G3SKY/P	Isle of Wight Radio Society	37	13	481	IO90JO	Icom IC-7300 + HB MOSFET amplifier	5-ele h/b yagi	235
5	G3LVP	Ken Eastty	32	14	448	IO81WV	Kenwood TS-850 + Meon TVTR + 4CX250 PA	6-ele	46
6	G3MXH	Stratford Upon Avon & DRS	30	14	420	JO02LF	Icom IC-7610 + ME4t -pro TVTR + HB Mosfet linear	6-ele Dual 4-6m Yagi at 8m AGL	50
7	G0SKA	Charlie Mitchell	30	13	390	IO91OQ	Icom IC-7300	7-ele PowAbeam Yagi	204
8	G3WAG/P	Derek Gillett	32	12	384	IO82QE	Icom IC-7300	5-ele DK7ZB Yagi	248
9	GX5TO/P	Sheffield & District Wireless Society	27	13	351	IO93FL	Icom IC-7100	4-ele HB	310
10	2E0VCC/P	Darrell Jacobs	28	12	336	IO70SP	Icom IC-7300	5-ele PowAbeam	237
11	G5RS/A	Peter Croucher	22	12	264	IO91RG	IC-7300	4ele Jaybeam	40
12	G4CIZ	Tony Wallbank	18	11	198	IO91FG	HB TX/RX, HB 150W VMOS PA	4-ele Yagi	125
13	GW4JQP	Peter Harston	15	8	120	IO71KR	Icom IC-7300	5-ele Powabeam	52
14	GW0JLX/P	Andy Digby	7	4	28	IO72WA	Icom IC-7100 + PA	PA70-6-4B Yagi	400
15	GM4DIJ	Brian Howie	5	5	25	IO85IW	Yaesu FT-847+TE Systems Linear	6-ele Yagi	69
16	G8RF	Frank Raby	1	1	1	IO82VP	Kenwood TS-590S + TVTR	Quad Band Collinear	140

Table 3: PW 70MHz Open Section results table



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Square	Name	Call	No. ents
IO70	Darrell Jacobs	2E0VCC/P	1
IO71	Peter Harston	GW4JQP	1
IO72	Andy Digby	GW0JLX/P	1
IO80	Martyn Wright	G4RLF/P	1
IO81	Steven Clements	GW1YBB/P	6
IO82	Derek Gillett	G3WAG/P	3
IO84	Pauline & Chris Kirby	G8HQW/P	1
IO85	Brian Howie	GM4DIJ	1
IO90	Isle of Wight Radio Society	G3SKY/P	1
IO91	Charlie Mitchell	G0SKA	6
IO92	G-QRP Club	G5LOW	1
IO93	Sheffield & District Wireless Society	GX5TO/P	1
JO02	Stratford Upon Avon & DRS	G3MXH	1

Table 4: Leading stations in each square.

signals. Neither station appeared to have carried out a full range of checks to ensure that the problems were not due to receiver overload. No other entrants made complaints about either station.

Weather

Several stations commented about strong winds. **Simon Pryce G0IEY** had to keep the mast low as the wind peaking at force 5 or 6. In addition to his horizontal beam, he tried calling on 70.450MHz FM using a vertically polarised collinear antenna without any success.

Equipment

The trend to using transceivers with a built-in 4m capability rather than separate transverters continues – particularly in the Open section. The Icom IC-7300 was used by over half the entrants in the Open section of the contest. Nearly all entrants in the low power section used transverters. One station reported problems with his transceiver resulting in only 20W output from his linear due to the low power drive.

Logging

Logging accuracy was generally good with just a few points deducted during adjudication.

Checklog

Many thanks to **Peter Day G3PHO** for his checklog.

2022

The 14th *PW* 70MHz Contest is provisionally booked for 25 September 2022. I am expecting the rules to appear in the September 2022 issue due in the shops mid-August 2022.

Congratulations & Thanks

Congratulations to the 2022 winners and on behalf of all entrants a big *"Thank You"* to all stations that participated.


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Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

Try FT4?

Steve Telenius-Lowe PJ4DX has lots of reader input, as usual, but starts with a review of recent propagation and a suggestion to try the RSGB FT4 events.

During the month in review the Solar Flux Index (SFI) briefly peaked at 108 on 27 November (coincidentally day one of the CQWW CW contest) before dropping below 100 again. The Sunspot Number (SN) also rose to 52 on that date. Disappointingly, the higher solar activity in October and November did not last long into December and by the middle of the month the sun was spotless once again: see **Table 1**, which shows the SFI and SN on 11 December, as well as on the 11th six months ago and a year ago. **Neil Clarke G0CAS**, who regularly monitors beacons on 28MHz, sent in a report saying: *"Conditions improved significantly* [during November – **Ed**] *to log VK6RBP 28200 and VK8VF 28268 some mornings and then later in the afternoon 4U1UN 28200 New York and a total of 17 different USA beacons plus VE3TEN 28175 from Canada. 4X6TU and ZS6DN both on 28200 and FR1GZ 28214 were regularly heard either side of midday."*

Transatlantic Anniversary

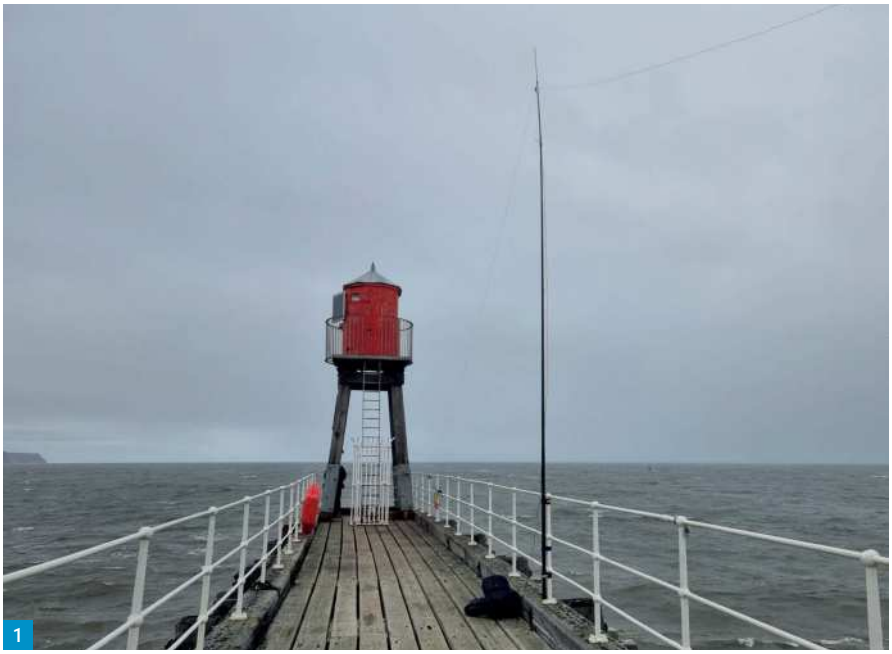
The first reception of amateur signals from across the Atlantic took place on 12 December 1921. American amateur **Paul Godley 2ZE** was sent by the ARRL to Ardrossan in Scotland, where he successfully received over two dozen American stations. On the 100th anniversary special event station GB2ZE in Scotland, historic RSGB callsign G6XX in England, and ARRL HQ station W1AW were all active overnight on 160m CW to relive the excitement of those early tests.

The first signal received by Godley in 1921 was from US station 1BCG and on 12 December 2021 W2AN/1BCG recreated those transmissions using a replica of the original transmitter. Remarkably, its drifting and chirpy CW signals were received in the UK. I was also able to cross the Atlantic and worked both GB2ZE and G6XX on 12 December, but using 21st century equipment!

RSGB FT4 Contest Series

If you enjoy operating digimodes but find FT8 a little slow, you should definitely give FT4 a try! With transmission periods half the length of those on FT8, an FT4 QSO really zips by. In 2021 the RSGB organised a series of nine 90-minute FT4 contests on 3.5, 7 and 14MHz. **Eva PJ4EVA** and I took part in eight of them and we won the overall 100W non-UK section.

The first event of the 2022 series will be on Monday 28 February at 2000 – 2130UTC and the full rules are at: **tinyurl.com/3kxkfzeb**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Readers' News

First up this month is **Carl Gorse 2E0HPI** who operated portable from several locations in November. *"I last operated the lighthouses in Whitby, North Yorkshire, back in 2013 with my M6HPL call. The pier I operated today* [20 November – **Ed**] *was the Whitby East Extension,* **Fig. 1**, *which was recently reopened after many years... I was operating with the Icom IC-705 with 5W on 40m at the end of the pier in strong winds and low temperatures, but within two hours I managed 105 QSOs... Piers can be a fantastic spot for DX."* Carl's operations from Whitby count for the English Castles Awards (ECA) as he was close to Whitby Abbey. He also ventured further north and made 67 QSOs from Ludworth Tower, a ruin in County Durham, for ECA. For further details of the ECA programme, see: **https://awardseca.wordpress.com**

Confirmed CW operator **Victor Brand G3JNB** said *"What a delight to see the huge CW support for CQWW over the weekend* [27 – 28 November – **Ed**]*... a wonderful sight on my Cluster screen and I had a few QSOs for fun on Sunday."* Earlier in the month Victor had been unable to break the pile-ups for the 7P8RU DXpedition, but *"on 2 November I heard them on 17m CW and decided to just sit there and really pour on the pressure. Eventually, back came 'G3?' and I was in! My helical and some 12W did the trick. Later, it took me a good hour to make it again on 30m but very long pauses spoke of difficult reception in Lesotho – or was the operator simply exhausted?... On the recommendation of OZ1DT, I [tried] out the LOG4OM logging software. Having relied upon WinEQF for over 20 years, I found it singularly attractive and efficient. To have automatic logging and upload to LoTW and Club Log is sheer bliss and the propagation display with the path 'Reliability' most helpful...*

"With diminished band occupancy during the last three sunspot minima, my low power CW operations have still attracted some of my best DX contacts. Why? Because, during those quiet months, they turn up the RF gain, open the bandwidth and listen much more carefully for weaker signals. Now that the 'good times' are returning, knobs are twiddled to cope with the solid wall of S9+ calls frantically trying to grab their attention. So,

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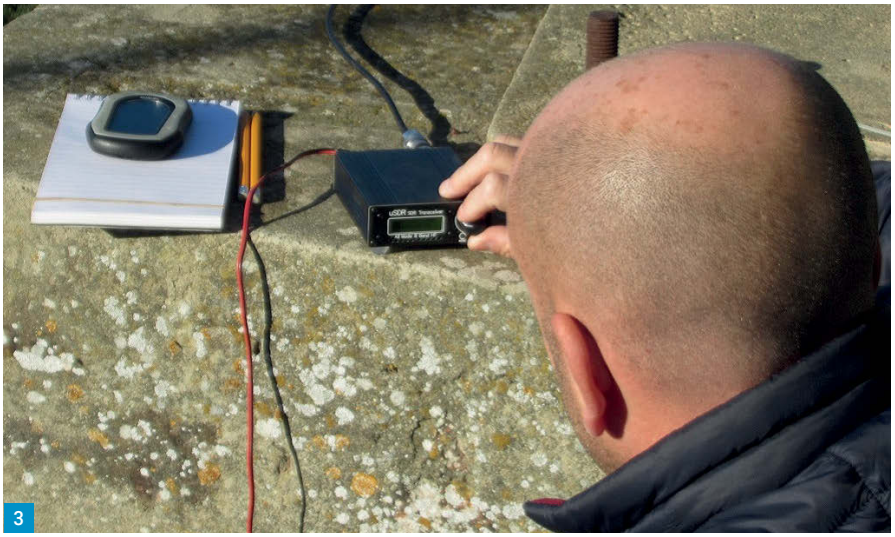

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Fig. 1: Whitby East Pier extension from where Carl 2E0HPI operated portable.
Fig. 2: Award commemorating the 60th anniversary of the signing of the Antarctic Treaty, issued to Reg G0OOF. Fig. 3: John King ZB2JK with the uSDR. Fig. 4: 7MHz FT8 signals being received deep underground by John MW1CFN. Fig. 5: The fine station of Etienne OS8D.

after a pleasurable 'QRP and QRP+ only' stint, needs must and I am about to 'up-size' again with a 100W rig to augment my faithful FT-818, which has performed so magnificently as a tiny base station for 15 months!"

Reg Williams G0OOF reports that *"I have been building a homebrew 10m 2-element Yagi comprising a driven element and director. This is taken from a design by IW5EDI and is quite easy to build. I have the two aluminium elements from a discarded antenna... but they required extending by a couple of metres. This was done using aluminium tube, which comes in various lengths from a local garden centre and is normally used for making propagating frames. Luckily the internal diameter of the tubes fitted perfectly over the ends of the elements. A gamma match was constructed to match the coax to the antenna. Following initial SWR adjustments the antenna was mounted on a 5m mast facing roughly south-west. Unfortunately, monitoring over a week at various times during the day there were no openings on 10m at this location. Next time to test will be during the ARRL 10m contest in December. Radio conditions have been variable during the month with most time spent on FT8 with some SSB activity."* Finally, Reg noted that this year is the 60th anniversary of the signing of the Antarctic Treaty and there are several amateur radio awards commemorating this. He qualified for the '60ATS' award, **Fig. 2**, issued by the Italian-based Worldwide Antarctic Program: further details at:
www.waponline.it

We welcome another new contributor to the column, Neil Clarke G0CAS, who sent in the beacon report mentioned earlier. Neil wrote that he was on the RSGB Propagation Studies Committee for 25 years during which time he compiled the solar/propagation report for GB2RS news. *"These days I am mostly listening via a WebSDR site remotely, which is semi-local to my QTH (Devon)... My interest in propagation has never waned and I am a very keen beacon listener."*

Owen Williams G0PHY reckoned that *"After the excitement of last month things were a lot quieter this month. The only DX worked this month were Z81S and VE9FI. Z81S provided a new band-slot on 21MHz and, unusually, he was using a 'roger bleep' so you knew when he had stopped transmitting. I've spent quite a bit of time chasing **Ulmar TZ1CE** from Mali. He has been very strong on 21 and 18MHz but so far I've been unable to break the pile-ups. I have also heard ZL2JBR mid-morning here on 14MHz and, also on 14MHz, I heard KK7TV from Arizona this afternoon, so conditions are not too bad. As it's December there are plenty of YOTA and Christmas SES (special event stations) to work."*

Kevin Hewitt ZB2GI says he *"was pleased to work fellow* HFH *contributors **Etienne OS8D** and **Kevin M0XLT** on 15m SSB. I went up the Rock with **John King ZB2JK** to test his uSDR* (**Fig. 3**). *The uSDR is a $100 compact eight-band all-mode HF QRP SDR transceiver."* As usual, Kevin sent in a long list of stations worked from various locations, including the Gibraltar ARS club station and the Top of the Rock. By far his best DX, though, was no fewer than six Indonesian stations on 10m FT8, worked from his home station using a mobile whip and counterpoise wire attached to a broom handle deployed out of his window!

	Dec '21	Jun '21	Dec '20	Difference
SFI:	78	77	81	(–3)
SN:	0	29	11	(–11)

Table 1: Solar Flux Index and Sunspot Numbers on 11th of the month: this month, six months ago and one year ago. The final column shows the difference between now and the same time last year.

John Rowlands MW1CFN, among his many other interests, is keen on exploring the slate mine tunnels below North Wales. He wrote that on 4 December he went underground in the Cwmorthin mine near Blaenau Ffestiniog with an FT-818 and 80m

dipole. *"The selection of 80m was due to the expectation that longer wavelengths get through rock better than shorter ones... I strung the dipole just above the floor within the connecting tunnels between chambers, which are often a hundred or more metres long... Tuning to the 80m FT8 frequency, no hint of a signal, but quite a bit of RFI from the Raspberry Pi, not helped by being very close to the antenna."* There was also nothing on 60m, but: *"Bingo! The 40m waterfall had loads of FT8 signals on it. I couldn't quite believe it, but here's the proof* (**Fig. 4**). *At 30m, I could only detect a couple of weak FT8 signals, although they were at reasonable distances. By 20m, there was no more to be detected, not even using WSPR. I also had a listen to 40m SSB. Yep, there were signals there, too... I'm intrigued that slate is so transparent to 40m signals at this depth."*

Jim Bovill PA3FDR said, *"Once again I have managed, in addition to the usual European contacts, a good bunch of DX QSOs. It has been fascinating to see how the propagation across the bands has improved this last month, just hope the improvement continues."*

Tony Usher G4HZW reports that, despite the 98MPH gusts from Storm Arwen, *"My trusty Sirio budget [28MHz] 4-element beam just shrugs off these winds as it has done for the past 10 years – remarkable value for money! I did stray on to 40m and 15m briefly during the last period, but mainly again on 10m. The high SF index seen towards the end of October wasn't sustained and, during November and the beginning of December remained in the 80s with a brief period of 90+ around the end of November when, on the 28th, I saw other G stations working New Zealand on 28MHz FT8. I did quite well and worked Hong Kong, Australia and the Philippines plus a new one on 28MHz FT8 in the form of TZ1CE in Mali."*

Tim Kirby GW4VXE *"concentrated on 10m CW this month, dipping down on to 15m sometimes even 20m, depending on conditions. Although I built the 40m quarter-wave vertical last month, it's spent most of the time on the ground this month, owing to high wind speeds. The 10/15/20m vertical provides a lot less wind resistance. When the 80m dipole came down in the aftermath of Storm Arwen I spent a little time trying to make it a bit more robust. I seem to have had more troubles with it than before – although actually, this morning I tracked that back to a rogue bit of feeder... I made a handful of QSOs during the WAE RTTY contest, just using the internal decoder/transmitter on the FTdx10. It's great having the inbuilt decoder on the rig although I must say the tuning indicator is a little small."*


5

Etienne Vrebos OS8D *had "a lot of QSOs every day: no weather to ride out with the motorcycle, cold, grey and wet, again more restrictions due to Covid here makes it all very pleasant to stay home."* Etienne enjoys calling CQ which he says encourages beginners and the mic shy to reply, rather than expecting them to call CQ themselves to initiate a QSO. *"I got a lot of US guys answering with their 100W and really very simple long wires between two trees... I think we have a responsibility to them and we should help them out,"* he added. As usual, Etienne worked plenty of DX from his fine station, **Fig. 5**, and noted he found it strange that 15m was much better than 20m this month.

Around the Bands

Carl 2E0HPI/P: 7MHz SSB: LY1SR, OE100GOA/6, OZ7PR/P. **14MHz SSB:** 4Z4DX, CT7ASV/P (CTFF-1224).

Reg G0OOF: 7MHz FT8: HK4GSO, PP1WW, TI2JV, S01WS, VE1RY, WA9FZB. **10MHz FT8:** 4S7AB, AA0JR, CP6UA, HC3RJ, HD8R, JA3DAZ, PJ4DX, PS8RV, PZ5RA, TZ1CE, VK2YZ, WA6DKZ. **14MHz FT8:** 3B9FR, JG1SRO, OX3HI, VK6XI. **21MHz SSB:** CU3HN, HD8R.

Kevin Hewitt ZB2GI and ZB2GI/P: 5MHz FT8: Europe. 14MHz SSB: Europe. **21MHz SSB:** 9Z4FE, K4BBH, K5GN, K8RUE, KC3JXG, KE4HIE, KJ2N, KU1CW, M0XLT, OS8D, TI2SD, VO2CV, ZS1WY. **21MHz FT8:** KA1QAP, KA4AHU, PY2EU. **24MHz FT8:** HC2PY, K0BJ, K4JGR, K7CTM, N9FN, PU4YEN, W1YRC, W5AJ, W8ASA. **28MHz SSB:** LU3MCJ, PP5BT. **28MHz FT8:** 8P6ET, AB1OC, AB4UF, AC9EM, K2HAT, K8WFL, LU1COP, LW6EQG, PP1WW, VA3DX, VE2GCE, XE2JS, YB1APD, YB1BA, YB1TJ, YB2HAF, ZS6AF.

Jim PA3FDR: 7MHz FT8: KB1EFS, KW4SP, TF5B, VO1IV. **14MHz FT8:** 4O7CC, 4X5MZ, 5B4AMM, A45IND, BU2FF, CU3HN, HL2ZN, HS2AQG, JA1JAN, JH3IEG, KP4MAQ, PU4CEP, VE7SA, VE3XN, VO1CH, VU2RCY, W2CG, YC0SAS, YC1ING, YV5DRN. **21MHz FT8:** 3B9FR, 5B4AMM, 5Z4VJ, 7X3WPL, BG0CHC, CX3DDO, K0HUU, K4WQ, K5EK, K6EID, L21RCA, LW6EQG, OD5ZZ, N3MK, PU1JSV, PY2DNR, VK8NSB, ZB2MR. **28MHz FT8:** 9G5FI, CX6VM, ZS6HON.

Tony G4HZW: 28MHz FT8: 9G5FI, 9K2NO, CX1CW, DU3TW, E25ETT, EK1KE, LU4EFC, PP5AB, PY1ZRJ, TZ1CE, VE1CSM, VK3AXI, VK5AKK, VK6GC, VP8LP, VR2CO, ZS4AZ, ZS5TC, ZS6BOS.

Tim GW4VXE: 21MHz CW: 3B8M, 7X4AN, FM5BH, PJ4K, TI/N6MJ, V26K. **28MHz CW:** 3B8M, 3B8/M0CFW, 4L/LY4ZZ, CE2ML, FY5KE, HS5NMF, PJ2T, PJ4K, ZD7BG.

Etienne OS8D: 7MHz SSB: JW4PUA. **14MHz SSB:** 4L1BB, 5H3MB, FJ/KP4DO, HS6OKJ, ZB2JK. **18MHz SSB:** 9Z4FE, TI2CF, TZ1CE, ZL2SP. **21MHz SSB:** 5H3WX, AU2JCB, CE4PS, CO8MGY, CX2DK, EY7AD, FG5GP, FM5DN, KP4JRS, L21RCA, PP1WW, PY2JV, PZ2YT, S01WS, TI5/N3KS, TR8CA, UN4Q, V31XX, VU2XO, YC1LJT, Z81S, ZB2GI, ZP5DBC. **24MHz SSB:** OX3LX, TZ1CE, VK2BY. **28MHz SSB:** VK6IR.

Signing Off

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

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Mike Bedford G4AEE
practicalwireless@warnersgroup.co.uk


1

Wireless Without Wireless

Mike Bedford G4AEE suggests that we can have wireless without wireless, looks at some of the pioneers who did exactly that, and considers what it means to us

OK, so we have to admit that we chose the title to this article because it's eye-catching, in a paradoxical sort of way, but it's not as meaningless as it might appear. Let us explain. In the phrase "wireless without wireless", the first "wireless" is used in its most literal sense of communication without wires, while the second "wireless" is used as the somewhat dated word for radio, albeit a quaintly old-fashioned word that we take some pride in keeping alive here at *PW*.

A Bit of Theory

To better understand how we can have wireless communication without using radio, we're going to start with a bit of theory that isn't universally appreciated by those who take a more practical approach to radio communication. That theory concerns the 19th century Scottish physicist **James Clerk Maxell** and the equations that bear his name. Given that an understanding of these equations isn't needed to design a transmitter or receiver circuit, to plan and erect an antenna, and to use that equipment to span the globe with your radio signals, we promise to keep it brief and not overtly mathematical. After all, we'd very much prefer you to stay with us throughout this article than to turn the page now.

Maxwell's Equations are a set of coupled partial differential equations, which describe the electric and magnetic fields that result from distributions of electric charges and currents, and how those fields change in time. However, although Maxwell brough the four equations together, most are attributed to others. In fact his only unique contribution to any of the individual equations is the final term of the fourth equation. Yet that contribution was profound. By solving the set of equations, Maxwell showed that it's possible for electric and magnetic fields to jointly propagate through space at the speed of light. In so doing, this 1860s result predicted the propagation of electromagnetic radiation, and paved the way to radio communication that Marconi would not demonstrate for another 30 years. This takes us no closer to shedding any light on our bizarrely sounding "wireless without wireless", although the conclusion that we've just referred to relates only to the fields at some distance from their source. This is the far field and we can think of it as true radio. However, closer to the source, it transpires, we find the mutually independent near fields, specifically the near electrical field and the near magnetic field. These fields don't actually radiate, in the strictest sense of the word, since they can be thought of as being tethered to the charges and currents that give rise to them. What's more, while the electric field strength of the far field decays

Fig. 1: Nathan B Stubblefield with one of his later wireless telephones, that operated by magnetic induction instead of via a true radiated signal. (source: Wikimedia Commons)
Fig. 2: Operating on a quite different principle from his magnetic induction phones, Stubblefield's other wireless telephones injected a current into the ground via two electrodes, as visible here. (source: Wikimedia Commons)
Fig. 3: Our third form of wireless without wireless, as depicted here from Edison's 1881 patent application, used electrostatic induction for ship-to-shore communication. (Public domain, from https://tinyurl.com/2wyptc9b
Fig. 4: We can envisage communication by magnetic induction, electrostatic induction and ground conduction as being represented by these three configurations, top to bottom respectively.
Fig. 5: Barry Chambers G8AGN operating his light wave equipment (Thanks G8AGN).
Fig. 6: In all fairness, we can't suggest you try your hand at soundwave DX in the open air, but it might just have limited use in small cave passages – Rob Gill, G8DSU, experiments.

linearly with distance – even though the flux density decays with the square of distance – the field strength of the near magnetic and electric fields decay with the cube and square of distance respectively.

Introducing Nathan B Stubblefield

We might be used to hearing the title 'Father of Radio' used to describe **Guglielmo Marconi**, but the residents of the small city of Murray in Kentucky have claimed that endorsement for one of their most famous sons, **Nathan B Stubblefield**. He wasn't the most obvious person to be credited with this title, having had no high school education, and working as a fruit and vegetable farmer. However, while it seems likely that he knew little of the finer points of Maxwell's Equations, his passion as an inventor was very much tied up with the conclusions drawn from those equations. It's uncertain when his most well-known invention first saw the light of day. After all it would surely have taken several years for his dream to become reality, and Stubblefield was notoriously secretive about his work. However, there is some evidence that it first saw the light of day in 1892. The invention in question was a wireless telephone – in fact he invented two, that worked on quite different principles, and we'll see the other one later – that he developed with the aim of side-stepping Bell's patent on the wire-based telephone. Despite the uncertainty about exactly when this breakthrough was first made, though, it's very likely that it pre-dated Marconi's famous demonstrations of wireless telegraphy. And although his first public demonstration took place after Marconi's historic achievements, it would still be several years before anyone would achieve voice communication by radio.


2

Although it was wireless in the sense of not requiring wires between the two ends of the communication path, Stubblefield's creation didn't rely on electromagnetic radiation. Instead, it worked on the principle of magnetic induction or, in other words, it operated via the magnetic near field, using loops for transmitting and receiving. Another way of visualising the system is of an air-cored transformer with a very large separation between its primary winding, that's the transmitter loop, and its secondary winding, the receiver loop. Using induction severely limits range, though, due to the inverse cube relationship between field strength and distance, as evidenced when we look in more detail at Stubblefield's achievements. That first public demonstration of his wireless telephone took place over a range of 125 yards, and much of his subsequent work was concerned with improving the figure. However, due to the law of diminishing returns, this was only ever going to go so far. It doesn't seem that the size of the loops used in that first demonstration was recorded, although several photos show Stubblefield with a circular loop about a metre in diameter, **Fig. 1**. However, a year later he'd increased the range to 200 yards, but at the expense of having to use a 26ft diameter transmitter coil and two 7ft. diameter coils at the receiver. The greatest

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recorded range of 423 yards required 40ft and 26ft transmitter and receiver coils respectively. It's interesting to note that, despite the residents of Murray claiming their city as the birthplace of radio, it seems that Stubblefield and his daughters who assisted him in his experiments weren't so naive. In a signed affidavit concerning a 1904 demonstration, **Pattie** and **Victoria Stubblefield** admitted *"it is not understood by us or father whether it is by electromagnetic wave that this is done but well known that simply a primary current passes through coil and transmitter connected one to each distinct circuit or coil"*.

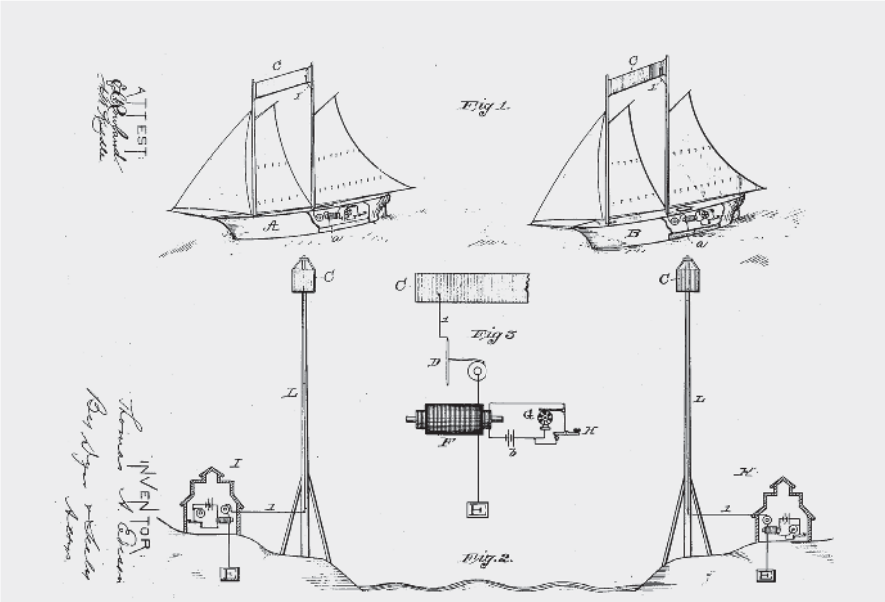
Earth Communication

Although telegraph systems initially used an electrical circuit comprised of two wires between the transmitter and receiver, this soon became a single wire with an earth return. This was common practice from the mid-19th century, and this development led several experimenters, **Samuel Morse** included, to consider whether it would be possible for the earth to replace both conductors. Needless to say, any such attempt would result not only in the ground resistance impeding conduction along the path, but also it would introduce a partial short between the transmitter's output terminals. And in these days before the invention of the valve would make amplification possible, the engineering challenges were not inconsiderable. Nevertheless, this is our second form of wireless without wireless.

Morse's development followed an unfortunate episode in which his attempt to establish contact between Manhattan and Governors Island in New York Harbour was derailed when a ship tangled its anchor in the underwater cable, resulting in the ship's crew cutting the cable. In 1842, using two metallic plates in the water to act as electrodes at each end of the path, Morse was able to transmit the 80 yards across a canal in Washington DC. This was later increased to a distance of a mile across the Susquehanna River in Maryland.

But while Morse's developments were to extend telegraphy circuits across water when the separation was too great for an overhead line, others used a similar technique for telephony. And here we return to Nathan B Stubblefield and the other of his strands of work in developing a wireless telephone. The birth of Stubblefield's ground conduction phone is somewhat lost in the mists of time, although it first came to the attention of the public when he demonstrated it to the press on his farm in 1902 and, shortly after, during a trip to Washington DC with a view to demonstrating it publicly and to prospective financial backers. With one notable exception, Stubblefield used metallic rods driven into the ground as electrodes, **Fig. 2**, instead of the metallic plates that Marconi immersed in the water for communicating across that medium. Using this approach, he established contacts over a range of up to a mile with reasonably portable equipment. That exception was when Stubblefield set up a station near the banks of the Potomac River and established contact with a steamer on the river, which had dropped wires overboard to act as electrodes.

Even after the development of radio, earth conduction mode communication wasn't totally consigned to the history books. For example, a system in which a signal was injected into the ground through a pair of earth electrodes, separated by 15 to 300m and received by a similar array up to three kilometres away, was used on the front line during the First Word War. When radio – or at least portable radio – was still in its infancy, this technique had a major advantage over field telephones, namely eliminating the potentially vulnerable wired infrastructure. Somewhat closer to home, reportedly, radio amateurs in some countries turned their hands to communicating by ground conduction when their licences were revoked during the Second World War.



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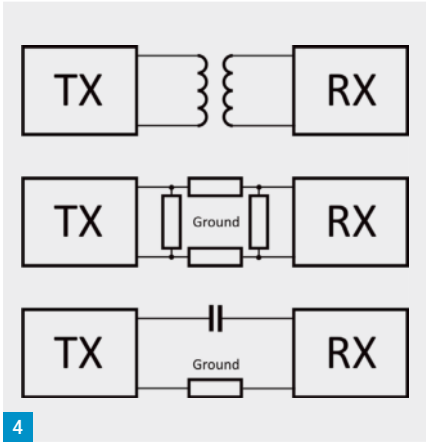

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The Electrostatic Alternative

This isn't intended as a chronological review of the early days of wireless communication, so we feel entirely justified in turning our attention back to the 1880s, this time most definitely before Marconi first demonstrated radio communication. In particular, we're thinking of **Amos Dolbear** who, at the time, was Professor of Physics at Tufts College in Boston. Considered a competitor to **Alexander Graham Bell** in the invention and commercialisation of the telephone, Dolbear made a fortuitous and remarkable discovery. On one occasion, he noticed that his experimental telephone system didn't entirely stop working when a faulty connection meant that there was no wired connection between the two ends, although the two sets still shared a ground connection.

Although a patent application for this form of wireless telephony soon followed,

details of his follow-up work are sketchy but here's gist of what he later achieved. The transmitter used an induction coil, i.e. a step-up transformer, to generate a high voltage audio signal from a microphone and battery.

One of the transformer's secondary terminals was connected to the ground, while the other was attached to a metallic plate. A similar arrangement was used at the other end although, when it was used as the receiver, the induction coil wasn't in circuit. This was shown operating over about a quarter of a mile, and there are reports that the range could be increased by using a larger metallic plate such as a corrugated iron roof. Dolbear referred to this as operating by electrostatic induction so, in contrast to Stubblefield's telephones that operated by magnetic induction, we can envisage this system as conducting the signal via a capacitor, albeit one with a hugely exaggerated separation between its two plates.

Thomas Edison, the American inventor and businessman who's credited with inventing anything and everything from the electric light bulb to the phonograph (gramophone) , also turned his hand to wireless communication by electrostatic induction. While his 1885 patent application allows us to make some educated guesses about the technical details, it's not entirely clear what distance could be covered but, given that ship-to-shore communication was considered to be a key application, it seems reasonable to assume that the range wasn't trivial.

However, this was only achievable with some serious antennas, using that word in its broadest sense, or induction plates as Edison called them.

In the diagram reproduced here from Edison's patent application, **Fig. 3**., we see shore stations with masts – presumably not too far apart along the coast – about four times taller than the buildings containing the transmitting and receiving equipment. On top of these are so-called condensing surfaces which, according to Edison, *"might be light cylinders or frames of wood covered with sheet metal"*, which appear to be of substantial dimensions. We don't claim any expertise in 19th century American sailing ships but, to our untrained eyes, the vessels illustrated in Edison's patent application appear to be double-masted schooners so, from typical sizes, we estimate that the condensing surface stretched between their masts was approximately 10 x 2.5m – that's one huge capacitor plate.

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Wireless without Wireless Today

The three alternative approaches we have discussed are summarised in **Fig. 4**. Much of what we've seen so far has concerned the history of wireless communication, but some of these forms of communication still have applications today. In fact, my personal interest in these techniques stems my involvement in enabling through-the-earth communication for use by cavers, especially during a rescue.

As we reported when we introduced the subject of sub-surface communication here in *PW* in September and November 2020, this commonly uses LF because it's less absorbed by the rock than higher frequencies. However, the consequentially long wavelength means that small portable antennas would be hugely inefficient or, in other words and in the strictest sense of the word, they would radiate a negligible signal. Instead, therefore, early cave radios used loop antennas and operated by magnetic induction, allowing the few hundred metres from a cave to the surface to be bridged. Today, these systems have largely been replaced by radios that connect to the earth via a pair of electrodes.

Some radio amateurs have also turned their attention to injecting signals into the ground in recent years. We're thinking here of those experimenters who are interested in VLF and below, and their motivation is much the same as that of cave radio developers, namely that efficient antennas for radiation would be much too large to be practical. What isn't entirely clear, though, is to what extent these antennas operate via ground conduction and how much radiation occurs. There's also some indication that such systems generate a near magnetic field, as evidenced by the fact that a cave radio using earth electrodes is able to communicate with one using a small loop antenna.

By far the most common type of non-wireless wireless that's in use today, though, is near magnetic field communication, more often referred to as NFC or near-field communication. And while the inverse cube relationship was a show-stopper to Nathan B Stubblefield, thwarting his ambitions for long distance communication, modern NFC is used specifically because of its short range. In particular, for reasons of security, it's used for contactless communication with credit cards and for making payments via mobile phones.

A Challenge?

To close, we're going to challenge you to pick up the gauntlet of wireless without wireless DX. But we're not talking of magnetic or electrostatic induction, nor of ground conduction. Instead, we're thinking of yet another form of non-wireless wireless, and one that radio amateurs have turned their hands to on occasions. Puzzlingly, we'd have to say that unlike most of the other techniques we've seen here, it does involve electromagnetic radiation, but it's still not wireless. Confused? Well, the answer to that riddle is that we're talking about electromagnetic radiation at a frequency above that normally thought of as radio. Specifically, while the highest frequency

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amateur band is at 248GHz – although the use of frequencies up to 3THz is allowed via an NoV – we're referring to frequencies from 400 to 790THz. If the penny hasn't dropped, this in the visible light spectrum, and the corresponding wavelengths range from 750 to 380nm.

In fact, this method of communication predates most of the other developments we've discussed here. In 1880, Alexander Graham Bell took out the first US patent on a method of wireless telephony. Called the Photophone, its transmitter had a silver coating on the back of the vibrating diaphragm of an ordinary telephone.

By directing a narrow beam of sunlight onto this diaphragm, that light was modulated with the audio signal, which was received, some distance away, using a selenium-based photoelectric device at the focus of a parabolic reflector. A range in excess of 200m was attained. According to Bell, in a statement made shortly before his death, this, and not the wired telephone that he's normally associated with, was his greatest invention.

If the idea intrigues you – but you think that, like Bell, you'd be lucky to span a few hundred metres – you'll be surprised to learn that amateurs have achieved line-of-sight ranges in excess of 100km, and even longer via a non line-of-sight path by bouncing signals off the clouds. What's more, while at one time making DX contacts involved using highly expensive devices such as helium-neon lasers, today, the widespread availability of high-powered LEDs means this has become much more affordable and achievable, **Fig. 5**.

Communicating by light might be something of an eye-opener – quite literally – to those of us who were brought up on radio communication, although we can make an even more off the wall suggestion, only partially in jest. That suggestion is audio DX. No, we're not talking of modulating that audio onto radio waves, light, or anything else for that matter. Instead, we're referring to transmitting over long distances using those vibrations in the air that we call sound waves.

Although this really hasn't progressed very far, my interest in this possibility came about through my interest in cave communication, for establishing links along tortuously small passages in which RF propagation is totally impractical, **Fig. 6**. In a cave, though, there really aren't too many people around to have their ear drums offended.

The same wouldn't apply if you were to set up an audio station in your garden. So, unless you relish the ideas of being castigated by justifiably irate neighbours, and possibly being charged with a statutory nuisance offence, perhaps you'd better take our suggestion of pursuing this particular form of wireless communication without wireless with a rather large pinch of salt.

Geoff Theasby G8BMI
geofftheasby@gmail.com

The Malahit SDR Receiver

Geoff Theasby G8BMI plays with a cheap but interesting SDR receiver.

This little radio receiver (available from several suppliers, including Amazon) offers a spectrum display, coverage to 200MHz, extendable, and a host of features. It was originally designed and marketed by three Russian amateurs. It proved so popular that demand grew rapidly and the market is now awash with Chinese clones. See the link below for one man's view of this situation. Several retailers offered this module at prices down to £20, but all claimed to be out of stock when I tried to order.

www.qsl.net/n9ewo/malahit.html

Another range of receivers using the Si4735 (below) is completely separate, do not confuse with the subject of this brief review.

https://tinyurl.com/y4nd7kyc

First Impressions

Ordered in mid-August, from AliExpress, it arrived in late October. I bought the un-cased unit, ready built, and quickly found out that the volume and tuning controls were too close together for 'normal' fingers, and worked the 'wrong' way, ie anticlockwise to increase. Fortunately, this last can be reversed in the software, with a menu-selected key, or using the rotary encoders. Once I had contrived a shaft extender for the tuning control, life became much easier. The usual reception modes are available, and easy to tune, with a choice of tuning steps. Alternatively, a keypad can be called up for direct frequency entry.

First impressions though were very favourable. The 88 x 55mm LCD display is impressive but, I thought insensitive. It often did not sense a finger or probe. I found that removing the protective film from the screen helped... Oops! Anything else touching the screen such as tools or fingers, will confuse the program. It does not respond well to a 'stylus' formed by the eraser on the blunt end of a pencil, as my NanoVNA does. It prefers fingers, positively placed. Avoid the use of a metal stylus, or pressing too hard on the screen, or it will be damaged.

The filters provided are 'narrow' and 'wide, or to the experienced receiver user, 'wide and 'what filter'? The display is 88 x 55mm, very easy to read, and contrasty. The variable controls, audio volume and tuning, are by rotary encoders, which feel firm and precise in operation, and needing a firm push to switch. The on-off switch is so small as to be almost invisible. Power required is 5V, but the consumption of 300mA is high, with output to headphones or speaker, and the antenna input is an SMA socket. The attachment of

1

Photo 1: The complete unit.
Photo 2: The board.

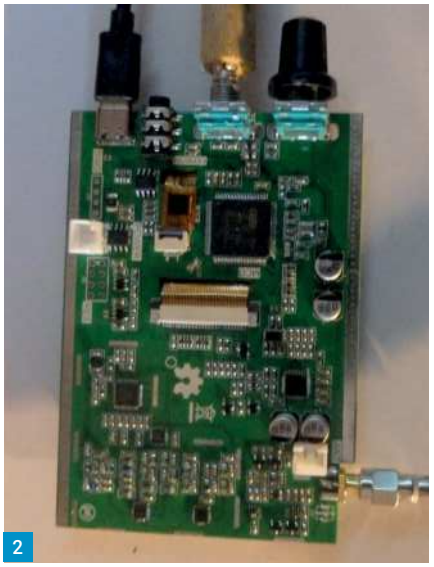
this connector to the PCB relies solely on the strength of the solder, so before it breaks off, usually from hanging connector adaptors, dummy loads etc. from it, do make or obtain an SMA 'pigtail' to your favourite connector, on lightweight flexible cable, to avoid this. A telescopic antenna was supplied but is not much use. The receiver works best when connected to a proper, outside, antenna. There is no internal battery.

Neither are there any instructions! Fortunately, '**John**' has translated the original, Russian, manual into English.

https://tinyurl.com/yckuwsju

Clones

The original Russian receiver design was rather good, and priced accordingly, about £200. The clones are offered down to about £50. The original version is cased and more presentable, but the usage is similar. These offer fewer facilities, although the difference is marginal, especially when the latest firmware is loaded, and depending on which exact model is purchased. There are several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available but go for the large screen, not the 1in square type.

Some users report interference from the LCD screen, but without proper test gear I couldn't determine the origin of the noise floor. The spectrum display is not calibrated for signal levels, but it compared well with my FunCube Pro+ Dongle into GQRX.

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- IF Discriminator Out • Store Favourites Scan List
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- Simultaneously receive on two totally independent 2MHz spectrum windows anywhere between 1kHz and 2GHz
- Simultaneous processing from 2 antennas enables direction-finding, diversity and noise reduction applications
- Ideal for cross band full-duplex reception, e.g. HF + VHF or VHF + UHF
- Simultaneous Dump1090 and VHF ATC reception
- Simultaneous monitoring and recording of 2 ISM bands
- Covers all frequencies from 1kHz through VLF, LF, MW, HF, VHF, UHF and L-band to 2GHz, with no gaps
- Receive, monitor and record up to 10MHz of spectrum at a time (single tuner mode)
- External clock input and output for synchronisation purposes, or connection to GPS reference clock

Buy the RSPduo for just

£239.95

239 WATTS

IN STOCK

HF Plus Discovery High Performance SDR Receive

Building on the proven Airspy HF+ architecture, Airspy have designed the Most Refined HF/VHF SDR with world class performance in the smallest form factor.
The Airspy HF+ Discovery sets a new standard in terms of reception performance with extra pre-selectors for all the supported bands and a New DSP Core to optimize the gain distribution and the filtering parameters in real-time and dig deeper in the noise.
The signal path includes very high dynamic range data converters along with high performance passive mixers with an excellent Polyphase Harmonic Rejection structure.

Buy the HF Plus Discovery for just

£199.95

199 WATTS

IN STOCK

SDRplay RSP-1A SDR Receiver

The SDR-Play RSP1A is a major upgrade to the popular RSP-1, it is a powerful wideband full featured 14-bit SDR which covers the RF spectrum from 1kHz to 2GHz. All it needs is a PC and an antenna to provide excellent communications receiver functionality. Combined with the power of readily available SDR receiver software (including 'SDRuno' supplied by SDRplay) you can monitor up to 10MHz of spectrum at a time. Documented API allows developers to create new demodulators or applications around the platform

KEY FEATURES/SPECIFICATIONS:

- Covers all frequencies from 1kHz through LF, MW, HF, VHF, UHF and L-band to 2GHz, with no gaps
- Excellent dynamic range for challenging reception conditions
- Low levels of spurious responses
- Works with all the popular SDR software (including HDSDR, SDR Console, Cubic SDR and SDRuno)
- ExtIO based plugin available

Buy the RSP-1A for just

£99.95

99 WATTS

IN STOCK

R2 High Performance SDR Receiver

Airspy R2 sets a new level of performance in the reception of the VHF and UHF bands thanks to its low-IF architecture, high quality ADC and state of the art DSP. The coverage can be extended to the HF bands via the SpyVerter up-converter companion.

Buy the R2 SDR Receiver for just

£199.95

199 WATTS

IN STOCK

MINI High Performance SDR Receiver

An affordable high performance alternative to RTL-SDR and other TV dongles for the VHF and UHF bands.The coverage can be extended to the HF bands via the Spyverter up-converter companion.It is 100% compatible with all the existing software.

Buy the MINI SDR Receiver for just

£119.95

119 WATTS

IN STOCK

SDRplay RSPdx 1kHz-2GHz HDR SDR Receiver

The SDRplay RSPdx is a complete redesign of the popular RSP2 and RSP2pro multi-antenna receiver. It's a wideband fullfeatured 14-bit SDR which covers the entire RF spectrum from 1kHz to 2GHz. Combined with the power of readily available SDR receiver software (including 'SDRuno' supplied by SDRplay) you can monitor up to 10MHz spectrum at a time. The RSPdx provides three software selectable antenna inputs, and an external clock input. All it needs is a computer and an antenna to provide excellent communications receiver functionality.

KEY SPECIFICATIONS

- Covers all frequencies from 1kHz through VLF, LF, MW, HF, VHF, UHF and L-band to 2GHz, with no gaps
- Receive, monitor and record up to 10MHz of spectrum at a time
- Performance below 2MHz substantially enhanced – improved dynamic range and selectivity

Buy the RSPdx for just

£194.95

194 WATTS

IN STOCK

YouLoop Indoor HF Antenna

This simple, lightweight travel loop is quick to deploy and the perfect companion for Airspy and similar SDR radios!

A New Magnetic Loop Concept

The success of our award winning Airspy HF+ series brought us a lot of feedback from hundreds of customers and enthusiasts. Most of the problems were related to ineffective RX antennas that were too sensitive to the surrounding noise, had excessive gain and lack the necessary linearity. So, we decided to bite the bullet and design a new Noise-Cancelling Passive Loop (NCPL) to fix the noise problem, leverage the low-noise performance of our SDR receivers while being perfectly suitable for portable operation.

Buy the YouLoop for just

£29.99

29 WATTS

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Moonraker (UK) Ltd, Cranfield Road, Woburn Sands, Bucks MK17 8UR

RigExpert

IN STOCK

AA-2000 Zoom Analyser

SPECIFICATION

- Frequency: 0.1 to 2000MHz
- Frequency entry: 1KHz resolution
- Measurement for 25, 50, 75, 100, 150, 200, 300, 450 and 600-Ohms systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range 0…2000, -2000…2000
- Dimensions: 230mm x 100mm x 55mm
- Weight:650g
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-2000 for just

£849.95

849 WATTS

RigExpert

IN STOCK

AA-1500 Zoom Analyser

SPECIFICATION

- Frequency: 0.1 to 2000MHz
- Frequency entry: 1KHz resolution
- Measurement for 25, 50, 75, 100, 150, 200, 300, 450 and 600-Ohms systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range 0…2000, -2000…2000
- Dimensions: 230mm x 100mm x 55mm
- Weight:650g
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-1500 for just

£699.95

699 WATTS

RigExpert

IN STOCK

AA-650 Zoom Analyser

SPECIFICATION

- Frequency: 0.1 to 650MHz
- Frequency entry: 1KHz resulotion
- Measurement for: 25, 50, 75, 100, 150, 200, 300, 450 and 600Ω systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range: 0… 2000, -2000… 2000
- Dimensions: 230mm x 100mm x 55mm
- Weight:650g
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-650 for just

£549.95

549 WATTS

RigExpert

IN STOCK

AA-230 Zoom Analyser

This analyser is designed for measuring SWR (standing wave ratio), return loss, cable loss, as well as other parameters of cable and antenna systems in the range of 100kHz to 230MHz A built-in ZOOM capability makes graphical measurements especially effective.

SPECIFICATION

- Frequency: 0.1 to 230MHz
- Frequency entry: 1KHz resolution
- Measurement for: 25, 50, 75 and 100-Ohm systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range: 0…10000, - 10000…10000 in numerical mode /0…1000, -1000…1000 in chart mode
- Dimensions: 82mm x182mmx32mm
- Weight:236g
- Operating temperature: 0-40 C (32-104 F)

Buy the WS1010 for just

£339.95

339 WATTS

RigExpert

IN STOCK

AA-55 Zoom Analyser

This analyser is designed for measuring SWR (standing wave ratio), return loss, cable loss, as well as other parameters of cable and antenna systems in the range of 60kHz to 55MHz A built-in ZOOM capability makes graphical measurements especially effective.

SPECIFICATION

- Frequency: 0.06 to 55MHz
- Frequency entry: 1KHz resolution
- Measurement for: 25/50/75/100/150/200 /300/450/600 ohm
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range: 0…10000, - 10000…10000 in numerical mode /0…1000, -1000…1000 in chart mode
- Dimensions: 103mm x207mmx37mm
- Weight:310g (without batteries)
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-55 for just

£279.95

279 WATTS

RigExpert

IN STOCK

AA-35 Zoom Analyser

This analyser is designed for measuring SWR (standing wave ratio), return loss, cable loss, as well as other parameters of cable and antenna systems in the range of 60kHz to 35MHz A built-in ZOOM capability makes graphical measurements especially effective.

SPECIFICATION

- Frequency: 0.06 to 35MHz
- Frequency entry: 1KHz resolution
- Measurement for: 25, 50, 75 and 100-Ohm systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R & X range: 0…10000, - 10000…10000 in numerical mode /0…1000, -1000…1000 in chart mode
- Dimensions: 103mm x207mmx37mm
- Weight:310g (without batteries)
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-35 for just

£209.99

209 WATTS

RigExpert

IN STOCK

STICK PRO Antenna Analyser

SPECIFICATION

- Frequency: 0.1 to 600MHz
- Frequency input step: 1KHz
- Measurement for: 25, 50, 75, 100, 150, 200, 300, 450 and 600Ω systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in graph mode
- R&X range: 0… 2000, -2000… 2000
- Dimensions: 185mm x 40mm x 33mm
- Weight:185g with battery
- Operating temperature: 0-40 C (32-104 F)

Buy the STICK-PRO for just

£329.99

329 WATTS

RigExpert

IN STOCK

STICK 230 Analyser

SPECIFICATION

- Frequency: 0.1 to 230MHz
- Frequency input step: 1KHz resolution
- Measurement for: 25, 50, 75, 100, 150, 200, 300, 450 and 600 Ohm systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in graph mode
- R&X range: 0… 10000, -10000… 10000
- Dimensions: 185mm x40mmx33mm
- Weight: 185g
- Operating temperature: 0-40 C (32-104 F)

Buy the STICK-PRO for just

£269.95

269 WATTS

RigExpert

IN STOCK

TI-5000 Transceiver Interface

RigExpert TI-5000 is a new and powerful USB transceiver interface based on high quality stereo codec IC, for operating phone, CW and digital modes using personal computer.
All in one through a single USB port. Ideal interface for FT8 and WSJT modes!
Transceiver audio interface: Analog audio interface is a connection to transceiver audio output (external speaker connector or line output) and transceiver audio input (microphone connector or line input). Audio interface enables operating digital modes, recording and playing voice, as well as other useful functions (such as measuring levels of a signal from the air) by using a computer. Input (two channels) and output volume levels are adjusted by potentiometers on the front panel of the device.

Buy the STICK-PRO for just

£154.99

154 WATTS

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We have the best deals

We have your favourite brands, ready to ship!

Seen a better deal?

We will match or beat any other UK in stock price!

IN STOCK

IC-R8600 Professional Communications Receiver

The IC-R8600 is a super wideband communication receiver that covers the radio spectrum from 10 kHz to 3 GHz. It also has the capability to decode selected digital communication signals including, D-STAR, NXDN, dPMR and P25. The IC-R8600 incorporates the latest software de-modulation technology incorporated on Icon's latest HF Amateur radios, providing superior performance and intuitive operation. With the optional remote control software for a Windows PC, received audio and spectrum scope data can be transferred through an IP network for monitoring from remote locations

KEY FEATURES

- Ultra-wide frequency coverage (10kHz-3GHz) with RSSI (Received Signal Strength Indication) function
- Fast moving, real-time spectrum scope and waterfall functions
- Decodes multiple digital protocols, including D-STAR, NXDN, dPMR and APCO P25
- Large 4.3 inch TFT colour touch screen display
- Clear audio quality using FPGA/DSP base architecture with superhet-erodyne circuitry
- Optional RS-R8600 PC remote control software allows control of all receiver functions
- I/Q signal output for use with third-party SDR software and/or external decoding
- An SD card slot for received log, decode log and voice recording
- Optional SP-39AD external speaker with integrated power supply

All for just

£2699.00

2699 WATTS

GET TWO FREE ANTENNAS

- Moonraker Whizz Loop V3 40 - 6m QRP Antenna
- Skyscan 25 200MHz Scanner Sntenna

IN STOCK

IC-7100 HF/VHF/UHF Portable & Mobile Transcieiver

A first for an Icom transceiver, the IC-7100 is designed to the 70MHz band in European versions where 70MHz is open to Amateur radio enthusiasts. Touch Screen Control Portal An amateur radio first! The radio control head features a large, multi-function, "touch screen"' DOT-Matrix LCD display that is positioned for easy view and operation. This is an important feature as the controller display not only provides information, but is your control portal to the IC-7100's feature settings and menus.

KEY FEATURES

- Intuitive Touch Screen Interface
- Innovative Slant Top Controller
- HF/6M/4M/2M/70cm 70MHz
- D-STAR DV Mode Operation
- IF DSP Digital Processing
- Built in Speaker • Mounting Base Option
- Built-in SD card slot for voice storage and data cloning
- Built-in RTTY demodulator and decoder
- Multi-function meter
- SWR graphic display
- DSP controller RF speech compressor
- Total of 505 memory channels
- Voice recording and playback functions
- 0.5ppm high frequency stability
- Optional RS-BA1 IP control remote control

All for just

£999.95

999 WATTS

GET A FREE ANTENNA

- IC-7100 Portable & Mobile Transcieiver
- SPX 300S Plug & Go Mobile Antenna

IN STOCK

IC-9700 2/70/23cm Base Transceiver

The Icom IC-9700 is the first VHF/UHF/1200 MHz transceiver which introduces the RF direct sampling system for the 144 and 430 MHz bands, a real-time spectrum scope and waterfall function. The RF direct sampling system has already provided high performance in Icom's IC-7610 and IC-7300 HF transceivers. In addition, the spec-trum scope and waterfall function have been indispensable tools for operators to increase QSO opportunities, without missing weak signals. The radio has many other impressive features including a built-in 1200 MHz band, 4.3 inch TFT colour touchscreen display, full duplex with Dualwatch on separate bands, Satellite mode, D-STAR DV (Digital Voice) /DD (Digital Data) modes and Terminal/ Access point modes. Also, a newly designed power amplifier and cooling system provide stable and high-efficiency operation, even when continuously transmitting for a long time.

All for just

£1795.00

1795 WATTS

GET A FREE PSU & ANTENNA

- Sharman SM30 (20amp) Switch Mode PSU
- Moonraker SQBM3500N 2/70/23/cm Base Vertical

IN STOCK

IC-705 All Mode D-Star Portable Transceiver

The portable HF/VHF/UHF IC-705 Mobile Transceiver has many great features such as SDR platform, internal battery, GPS, Bluetooth and D-STAR, all in a compact and lightweight body. The Icom IC-705 uses the same 4.3-inch colour touch screen display as the bestselling IC-7300 and IC-9700 featuring real-time spectrum scope and waterfall display.
HF/50/144/430 MHz Multimode Operation - From HF to 50/144/430 MHz, you can enjoy a variety of bands in D-STAR DV, SSB, CW, AM and FM modes. The IC-705 receives continuously from 30 kHz through the 144 MHz band. You can also enjoy FM broadcast and Airband reception.

Buy the IC-705 for just

£1299.95

1299 WATTS

GET 50% OFF MAT-705 ATU

- Buy the Icom 705 Portable transceiver

AND the MAT-705 Plus ATU for just £1389.95

IN STOCK

IC-7300 HF/50/70MHz Base Transceiver

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.

KEY FEATURES

- 70MHz band (European versions only)
- Class Leading Real-Time Spectrum Scope
- High-Resolution Waterfall Function • Audio Scope Function
- RF Direct Sampling System • New "IP+" Function
- Class Leading RMDR (Reciprocal Mixing Dynamic Range)

All for just

£1199.99

1199 WATTS

GET A FREE PSU

- IC-7300 Base Transcieiver
- Sharman SM30 (20amp) Switch Mode PSU

IN STOCK

ID-5100E Dual Band D-Star Mobile Transceiver

Icom's ID-5100E VHF/UHF dual band D-STAR digital mobile trans-ceiver enhances core features found in the celebrated IC-2820H mobile and incorporates the user-friendly technology found in the IC-7100. The radio features a large responsive touch screen and also integrated GPS, optional Bluetooth connectivity and support for Android devices. The standard version comes complete with multi-functional microphone and hanger, DC power and controller cables and CS-5100 cloning software

KEY FEATURES

- 5.5 inch display (320 × 128 pixel)
- 118–174MHz and 375–550MHz
- DV Dualwatch
- Integrated GPS Receiver
- DV/FM Repeater List Function
- Dplus reflector linking
- UT-133 Bluetooth® unit (option)
- VS-3 Bluetooth® headset (option)
- RS-MS1A Android™ application
- Menu-driven user interface

All for just

£574.99

574 WATTS

GET A FREE ANTENNA

- ID-5100E Dual Band D-Star Mobile Transceiver
- MRM-100P 2/70 Micro Mag Mobile Antenna with PL259

A HAPPY NEW YEAR FROM EVERYONE AT MOONRAKER

Joe Chester M1MWD
m1mwd@gmx.com

Au Revoir

Joe Chester M1MWD moves to yet another QTH and bids adieu, for the time being at least.

So, here's the thing! Young **David G7URP** called me recently. David is President and Chief Organiser of NARC, the Norfolk Amateur Radio Club. He, and his wife **Tammy M0TC**, are probably more famous for the RSGB Tonight@8 Zoom sessions, which have brightened all our lives during lockdown (and still continuing). And as if that wasn't enough, they have time it seems to run a very successful business, along with a weekly zoomcast for NARC. It was about this latter that he called me.

The point of this intro? David was in charge when I gave my first Zoom presentation, at the RSGB Convention in 2020. I duly got through it, but at the end of the presentation, I put up a slide of my QTH. David tells me that as he fell off his perch, he distinctly heard other chairs also tumbling. Was it so strange to be living and operating radio from a canal barge? I didn't think so, as I believed that I had operated from weirder places, like the middle of the Irish Sea from a yacht, for example.

I think you are either an amateur radio operator or you're not. You either want to do fun things with amateur radio equipment or you shouldn't have taken that examination in the first place. I've lost track of the number of times I've spoken to people about the fun I'm having. And this column has been a great way to reach out in similar fashion.

Yes, this pastime has a technical element to it, and you can dig in as much or as little as you want, as long as you have the basic knowledge to pass that exam. But predominantly, this is a social hobby, an activity whose basic premise is communication – or just talking with other people if you want it in a plain unvarnished language. Hence, in the 30 years or so since I was licensed, everywhere I go, everywhere I have lived, I have set up my radio station and got on air somehow, someway. Today this starts all over again.

Restarting

To say that I have a chequered history might be an exaggeration, but I have lived in lots of places, a consequence of my profession as a wandering academic. But this latter doesn't quite explain how I came to live on a boat, or rather one of several boats. The list? A sea-going yacht, several fast twin engined motorboats, a Dutch barge, and the latest a widebeam narrowboat (what an interesting phrase that is). And before all of that, I had lived in several houses and in a few different countries. It would be fair to say that in every case, priority was given to getting on air, somehow, someway. For example, on that barge, the station consisted of an Icom 706 Mk2G, an MFJ 943E matchbox, and a set of Hamstick verticals for several HF bands, as well as a 2m vertical. Much fun was had, not least by the changing callsign as I sailed from one jurisdiction to another.

Fig. 1: Balcony at the new QTH.

Many of you will be aware that 2021 has been a bad year. and for me personally. I lost my wife of 25 years to sudden illness, almost overnight. And with that loss went the current instantiation of life afloat that we had created together. My interest in boats and boating seems to have died as well. So, with close family mostly in Dublin, it was time to weigh anchor once more and set off on the latest expedition. I lived briefly in an apartment in the early 90s, due to work commitments, but never really tried it as a lifestyle choice. So here I am now, embarking on my latest adventure.

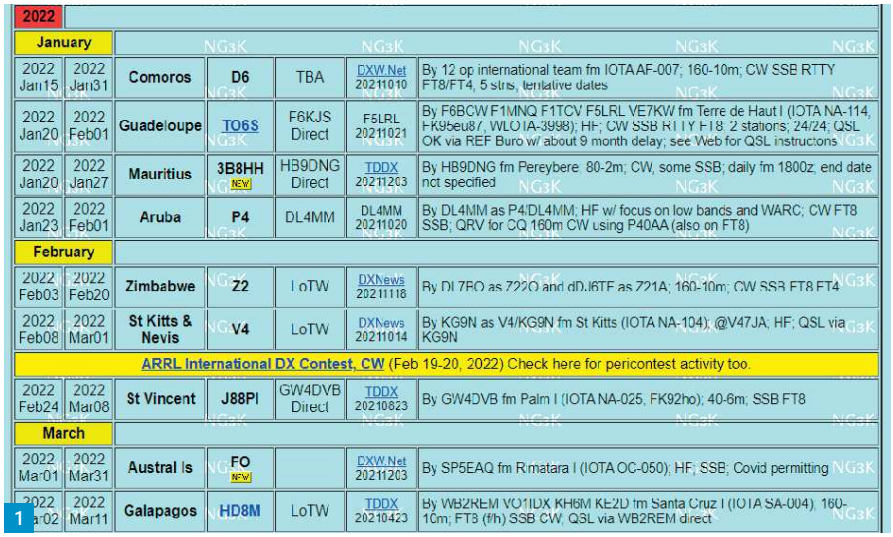
Fortunately, this apartment has a balcony, **Fig. 1**. So, I'm eyeing up the possibilities as I write this piece. It's three rooms long, if that gives you some impression, and one storey tall (I guess 10-12m long). Guess what? It's a corner plot, and I'm quite certain that my inverted-L will go up there. I have travelled over without the pole, but that's a detail. My faithful KX3 and KXPA100 are in the boot of the car. Now, just give me one fair weather day, and look out for me on air. It's fun after all.

The Fly in the Ointment

Of course, there is a fly in the ointment – the property has an HOA! Specifically, it says

Continued on page 51

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk



2022						
January						
2022 Jan15	2022 Jan31	Comoros	D6	TBA	CXW Net 20211010	By 12 op international team fm IOTA AF-007; 160-10m; CW SSB RTTY FT8/FT4, 5 stns, tentative dates
2022 Jan20	2022 Feb01	Guadeloupe	TO6S	F6KJS Direct	F5LRL 20211021	By F6BCW F1MNQ F1TCV F5LRL VE7KW fm Terre de Haut I (IOTA NA-114, FK95eu87, WLOTA-3998); HF; CW SSB RTTY FT8; 2 stations; 24/24; QSL OK via REF Buro w/ about 9 month delay; see Web for QSL instructions
2022 Jan20	2022 Jan27	Mauritius	3B8HH NEW	HB9DNG Direct	TDDX 20211203	By HB9DNG fm Pereybere. 80-2m; CW, some SSB; daily fm 1800z; end date not specified
2022 Jan23	2022 Feb01	Aruba	P4	DL4MM	DL4MM 20211020	By DL4MM as P4/DL4MM; HF w/ focus on low bands and WARC; CW FT8 SSB; QRV for CQ 160m CW using P40AA (also on FT8)
February						
2022 Feb03	2022 Feb20	Zimbabwe	Z2	LoTW	DXNews 20211118	By DL7BO as 7Z2O and dDL6TF as 7Z1A; 160-10m; CW SSB FT8 FT4
2022 Feb08	2022 Mar01	St Kitts & Nevis	V4	LoTW	DXNews 20211014	By KG9N as V4/KG9N fm St Kitts (IOTA NA-104); @V47JA; HF; QSL via KG9N
ARRL International DX Contest, CW (Feb 19-20, 2022) Check here for pericontest activity too.						
2022 Feb24	2022 Mar08	St Vincent	J88PI	GW4DVB Direct	TDDX 20210823	By GW4DVB fm Palm I (IOTA NA-025, FK92ho); 40-6m; SSB FT8
March						
2022 Mar01	2022 Mar31	Austral Is	FO NEW		CXW Net 20211203	By SP5EAQ fm Rimatara I (IOTA OC-050); HF; SSB; Covid permitting
2022 Mar02	2022 Mar11	Galapagos	HD8M	LoTW	TDDX 20210423	By WB2REM VO1IDX KH6M KE2D fm Santa Cruz I (IOTA SA-004); 160-10m; FT8 (f/h) SSB CW; QSL via WB2REM direct

1

Various!

This month's wide-ranging What Next covers topics as diverse as DXpeditions, Cabrillo contest logs, Ofcom's EMF regulations, and an update on exam arrangements.

I'm starting by considering some ways to take advantage of improved HF propagation. Then I'll look at some ways of producing a Cabrillo contest log, even if you didn't set out to enter the contest. The new Ofcom EMF regulations have started to take effect, so I thought it would be useful to provide pointers to some recently published material for the VHF, UHF and SHF bands. I'll conclude by updating readers on arrangements for taking the amateur radio licence exams.

Sunspot Cycle 25

If you haven't tried the higher HF bands for a few months, it may come as a surprise that almost every day there are daytime contacts to be had on the 12m and 10m bands. Antennas for these bands are much smaller that their equivalents on the lower HF bands, so can often fit into smaller gardens than those required for the lower frequency bands. It is certainly worth considering putting up antennas for these two bands.

DXpeditions

I'd be the first to acknowledge that chasing DX is not every amateur's cup of tea. However, for those who do like to chase DX, it is useful to have information about DXpeditions to remote parts of the world. These were certainly starting to pick up again during autumn as Covid restrictions on international travel were easing and nicely coinciding with improvements in propagation on the higher HF bands. At the time of writing, it is not yet clear how travel will be affected in 2022. This makes the need for up-to-date information even more useful than in 'normal' times. There are various sources of information on the internet, but I have found the list on NG3K's website, **Fig. 1**, especially helpful as it brings together information from a number of sources into a common format:
www.ng3k.com/Misc/adxo.html

Split

Many DXpeditions operate split frequency on the HF bands when using CW, SSB and RTTY. This means that the DX station will be listening a few kilohertz higher or lower than the frequency that they are transmitting on. This helps everyone hear the DX station better so they can time their calls, follow instructions, and not create unnecessary interference. You'll need to set up your transceiver to receive on the DXpedition's transmit frequency but you'll need to transmit on a frequency where they have announced they will be listening. A DXpedition station may announce that they are listening "5 up" or "5 to 10 up", for example. You'll need to use twin VFOs (usually labelled A and B). If you're not familiar with this, then I'd suggest referring to your transceiver's operating instructions and practising a few times before you need to use split frequency operation in earnest. If you are lucky enough to have a transceiver with a spectrum scope, it can help you see the frequency where successful stations are working the DX station.

Once you've made your contact with the DXpedition, don't forget to revert to normal (non-split) operation.

Contest Logs

On a few occasions recently, I've encountered a contest while operating that I hadn't planned to enter, but just made a few contacts to give a few points away. After a while, I'd made sufficient contacts that I decided that I'd submit an entry or checklog.

Even if you aren't a great lover of contests, it is sometimes fun to 'give away' a few points. If you've worked a few stations in a particular contest, you may subsequently decide that you would like to submit a checklog or entry even if you don't expect to win. If you find yourself in this position, you may well have been exchanging reports etc, and logging these on paper or on a main station log rather than a contest logging system.

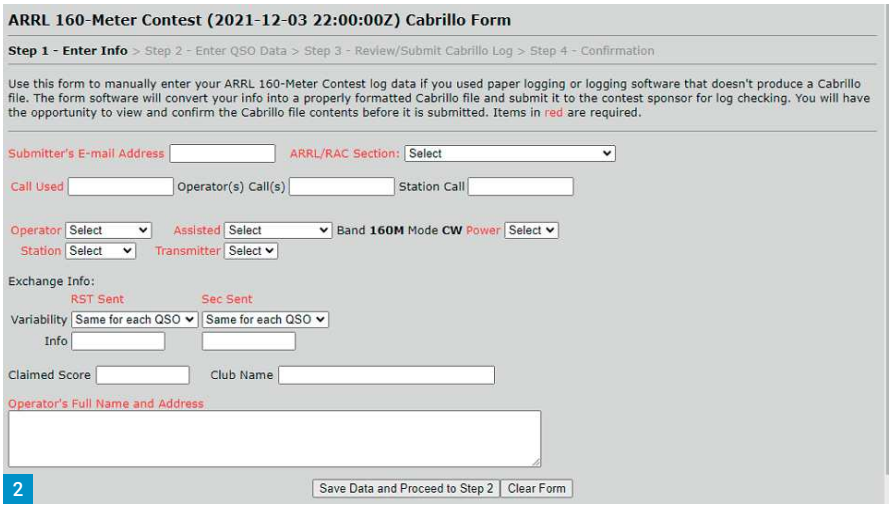
There are several ways to go forward from here. At the end of the contest, you could re-key your paper log into a contest logging program and submit an entry or checklog from the contest logging program. You might even be able to transfer your log from your main station logging program to a contest logging program. I recently came across a useful facility that readers may find useful on some occasions – Cabrillo Web Forms.

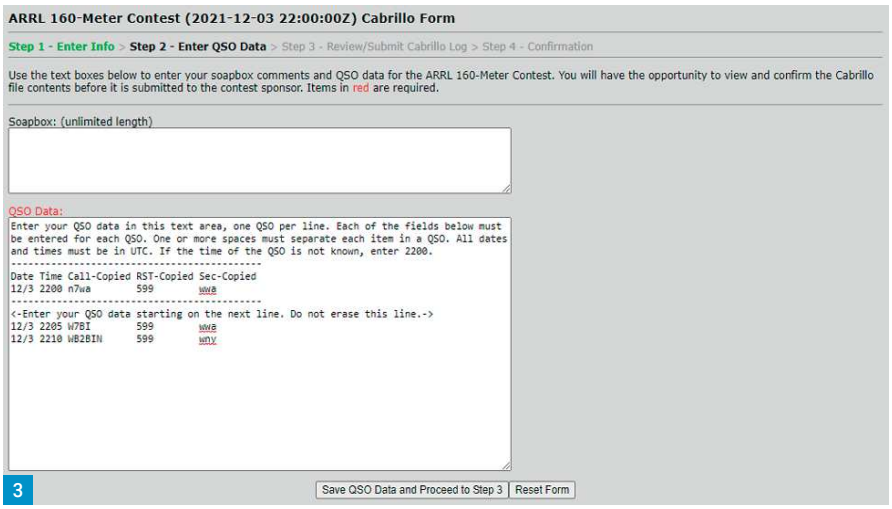
Cabrillo Web Forms

Almost all contests use the Cabrillo format for entrants to submit their electronic logs. If you want to manually enter log data to produce a Cabrillo file and submit it to a contest sponsor, then these Cabrillo Web Forms can be used. They are designed for contesters who use paper logging or logging software that doesn't produce a Cabrillo file. Many ARRL, CQ and IARU contests along with a range of other major international contests are supported:
www.b4h.net/cabforms

There are three steps. The first deals with the 'cover sheet' information, **Fig. 2**. This is the information about your station, section of the contest you are

Fig. 1: NG3K's DXpedition website showing DXpeditions planned for the first two months of 2022. Fig. 2: The Cabrillo Web Form Cover sheet information for the ARRL 160m contest. Fig. 3: The Cabrillo Web Form with examples of some contacts for the ARRL 160m contest. Fig. 4: Cover sheet and contacts converted to Cabrillo format for the ARRL 160m contest ready for submission to the ARRL.





entering, operators and contact details. In the second step you a presented with a template to enter your contacts. The fields will be specific to the contest. Unlike a completed Cabrillo log, you simply separate each field by at least one space, **Fig. 3**. Note dates are in US format (for example Christmas Day is 12/25). Once your data is validated, in step 3, a Cabrillo log file is produced that you can copy and paste into a text editor, **Fig. 4**, and save as a file that you can submit to the contest adjudicator.

EMF Regulations

Many readers will be aware that there are new regulations coming into force with the aim of protecting people from potentially harmful exposure to strong electromagnetic emissions. In the first of three phases, from 18 November 2021, Ofcom requires amateurs to complete an EMF Assessment for our stations when using bands from 144MHz and higher. Note that those operating equipment with less than 6.1W ERP are exempt, so many handheld transceivers are likely to be exempt when used with their standard antennas. Ofcom has published an excellent overview at:
https://tinyurl.com/5n839y57

There's also a lot of detailed and updated guidance, examples and spreadsheets on the RSGB website. The main calculator is now also available as a web-app, which should be helpful to those amateurs not using up-to-date version of Excel:
https://tinyurl.com/rm9juv34

VHF & UHF

There is a good guide from the RSGB covering VHF and UHF Yagi-like antennas for the 6m (50MHz) to 23cm (1296MHz) bands. Graphs for each band show recommended minimum distances according to power and antenna height:
https://tinyurl.com/2p87yxbh

Microwaves

For the microwave bands, the British Amateur Television Club and the UK Microwave Group have published a particularly helpful guide for those using 'aperture' antennas (principally dishes with feed horns). Using this, I was able to quickly confirm that my low power 10GHz station that runs 200mW into a small 50cm diameter dish is unconditionally compliant when I use it on a tripod at just under 2m above the ground. Regardless, you should get into the habit of not looking into the waveguide:
https://tinyurl.com/2p84y77n

Three Steps

In general, there are three steps to the process for each band and mode combination that you use. Firstly, you determine the strength of your signal averaged over six minutes in the area that people (e.g. other members of your household, neighbours, public) have access to. The RSGB spreadsheets and web-app are helpful for this.

Secondly, you'll need to consider what to do if the strength of your signal is too high in areas accessible to people. You might consider reducing your transmit power and/or increasing the height of your antenna or moving it, reducing the proportion of the time you transmit (listen more, shorter transmit overs, longer breaks between calling CQ). Another way of complying may be to introduce physical controls that prevent people accessing the relevant area when you operate. This might be by, for example, locking a gate when you are operating to prevent access to the area closest to your antenna, signage, or stopping operating when people are in the relevant area. Finally, you need to document your results and controls.

It is worth noting that the regulations also apply to mobile and portable activity. So, you may need to be prepared to control access to antennas when operating on Field Days, for example. It may be as simple as not operating if someone is close to the antenna.

In subsequent phases, the regulations will also be extended to the frequencies above 10MHz (including the 30m band) from 18 May 2022 and frequencies below 10MHz from 18 November 2022.

```
START-OF-LOG: 3.0
LOCATION: DX
CALLSIGN: G6MXL
CATEGORY-ASSISTED: NON-ASSISTED
CATEGORY-BAND: 160M
CATEGORY-MODE: CW
CATEGORY-OPERATOR: SINGLE-OP
CATEGORY-POWER: QRP
CATEGORY-STATION: FIXED
CATEGORY-TRANSMITTER: ONE
CLAIMED-SCORE: 50
CLUB:
CONTEST: ARRL-160
CREATED-BY: WA7BNM Web2Cabrillo 2.07
NAME: Colin Redwood
ADDRESS: 53 Woodpecker Drive
ADDRESS: Poole
ADDRESS: BH17 7SB
ADDRESS: England
EMAIL:
OPERATORS: G6MXL @G6MXL
SOAPBOX:
QSO:  1800 CW 2021-12-03 2205 G6MXL         599       W7BI          599 WWA
QSO:  1800 CW 2021-12-03 2210 G6MXL         599       WB2BIN        599 WNY
END-OF-LOG:
```

4

Exams

For over a year, the RSGB have been offering remotely invigilated exams, whereby candidates sit their exam at home online, with a webcam or similar used to ensure proper conduct of the exam by a remote invigilator. This has proved to be very popular with thousands taking the various exams, and providing a large intake into the hobby. In order to facilitate this, the practical aspects of the Foundation and Intermediate licence syllabi were both dropped.

With the reduction in restrictions associated with Covid, the RSGB have announced the resumption of 'normal' exam arrangements, while keeping the option of sitting remotely invigilated exams at home. This will enable candidates to sit their exams at venues organised by clubs or trainers and be invigilated in person. These exams can be online or paper based, although the RSGB are hoping to phase out paper-based exams in the not-too-distant future. The RSGB have agreed with Ofcom to drop all the practical aspects of the syllabi, although tutors are welcome to illustrate training with demonstrations etc.

Candidates

What do the changes mean for candidates sitting exams? Candidates now have a choice of sitting exams at home or at a local venue approved by the RSGB. It is worth noting that many venues will charge for renting their premises, which will add to the cost of sitting the exam. Arrangements for payment have also been changed.

Candidates sitting remotely invigilated exams can pay the RSGB by credit or debit card. Those sitting locally invigilated exams can either pay the organiser (club) and the club pay the RSGB, or can pay the RSGB directly for the exam and arrange to pay the organiser any local costs for room hire.

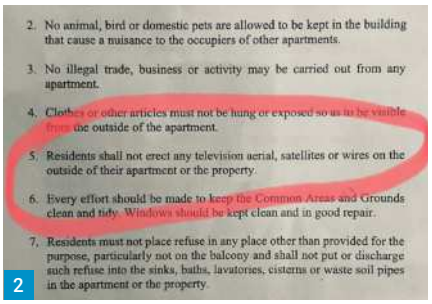
Tutors

What does this mean for delivering training? Whether teaching is face-to-face or remote, some aspects of the way the Foundation course is taught may need to be reviewed if you've not delivered the course since the Covid lockdowns. For example, those teaching the operating practices and procedures module will need to consider that candidates may never have tuned in a SSB or AM signal on a radio, so will not appreciate the need for longer CQ calls when using these modes as compared with channelised FM. Probably the simplest way to deal with this is either by demonstration or better still a hands-on practical. Note that operation by an unlicensed person is only permitted if they are on a training course leading to an amateur radio exam and they are supervised by someone holding a Full licence.

Mock Exam Papers

The RSGB have published updated mock exam papers with a separate answer sheet. The questions have been taken from the 'live' exam question bank, so they should certainly be typical of the questions that might be encountered in an exam: https://tinyurl.com/2359pvcb

Continued from page 48



2

Fig. 2: House rules!

"Residents shall not erect any television aerial, satellites, or wires on the outside of their apartment or property", **Fig. 2**. Which leaves me in a quandary, like many others in similar situations. Now let's ignore the bit about not erecting any satellites; clearly the writer has no understanding of what erecting a satellite would entail! I suppose I will have to rely on the exact meaning of the word 'erect'. I can't imagine the owner of the apartment, who is a friend of a friend, really wants me challenging the management company about this. I suspect I wouldn't win anyway. But does the word erect assume permanently? So would the occasional /P operation, in the sense of sticking up a pole for an hour or so, and then taking it down again, really count as 'erect'. And, of course, there is always the tripod mount for the AX1, or even a magloop on the terrace. Plenty to think about in the coming weeks. One thing is certain – if I can operate an amateur radio station on a canal barge, or from the middle of the Irish Sea, then I can operate from here. And there is always the opportunity for portable work too. And I know of several interesting places from which to operate when conditions allow.

Meanwhile, as I described last month, there is always the DMR handset. Used within the DMR world this may provide my 'amateur radio fix' in the short term. And I can always purloin one of the NRCnet controllers to allow me to join that net with the DMR handheld.

In the short term, and with the indulgence of our esteemed Editor **Don**, it may be that *Notes from a Small Station* might need to go into hibernation for a little while, just until I get sorted. May I thank you all for putting up with my jottings, and the very many of you who wrote about some of the material I put together. It's been a very rewarding experience for me personally. Finally, to Don, my most sincere thanks. I think we both took a leap in the dark when we started, and I hope you have enjoyed hearing about the world of small stations!

See you on the air.

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

Mark Tuttle G0TMT
g0tmt@theshack.org.uk

Building the PW Paston (Part I)

Mark Tuttle G0TMT embarks on building a homebrew CW, QRP transceiver for the 40m band.

There is a certain buzz to be had from making a QSO using homebrew equipment. If you've built a radio kit or two before, you will know this and be well placed to build this project. You might think there's a gulf of knowledge between constructing a kit and designing a homebrew kit but this project will hopefully show you that you do not need the depth of knowledge you might expect. Rather than designing a circuit from the bottom up, I take established working circuits and 'bolt' them together. It's beneficial to have a reasonable understanding of how each circuit works because you might need to change some aspect of it either to suit your needs or be able to effectively couple to the next stage. However, there are vast resources available to help you understand how circuits work. Besides, why re-invent the wheel? There are many circuits available either online or in books and magazines like this one that are there for anyone to incorporate in their designs, and this project does just that.

To make life even easier, I seldom make PCBs. I use the Manhattan method to construct my circuits so I will also be giving a brief introduction to this. Again, there are plenty of good documents on this method of construction so I won't go into too much detail, preferring to give further reading links where appropriate. My strongest recommendation is to just try it. Get that soldering iron hot and build something. That said, I cannot in good conscience recommend this project for a construction virgin. If this describes you, then I would urge you to cut your construction teeth on a kit or two first. They're great fun and you'll certainly get that feeling of accomplishment when you make your first homebrew QSO.

The aim of this article is to discuss my choice of design and how each section functions by breaking it down into appropriate blocks. I also hope to furnish you with enough knowledge to replicate the design should you want to. A word of caution though: I wouldn't recommend copying it in its entirety unless you're already proficient in the Manhattan construction technique that I use and, yes, I'm also slightly bonkers. Like many of us I'm always one for a bargain and on a whim I bought a very nice little equipment enclosure from one of the Chinese distributor websites. It measures just 170 x 130 x 75mm (6.5 x 5 x 3in – ish). It's made from painted steel, yes steel (although in the description it claims it's made of iron; I don't think so). It has two plastic frames and yes, it was cheap! I set myself the additional challenge of building this transceiver into this tiny box, which manifested into a whole new level of cursing. Unless you're also a tad crazy, or crave a challenge, building this rig into a case that's even just an inch or so bigger each way will save you a lot of hassle. You do however have one advantage over me in knowing that it can be made to fit before you start. Even though this box has roughly twice the footprint of my Elecraft KX2 (they are small!), this little rig only works on one band, transmits with less power than the KX2, is only for CW and has very few goodies. That's because there are no SMD devices or microcontrollers. It's made entirely from off-the-shelf, readily available components and, of course, I built it. Even so, it probably gives me more satisfaction to use than the KX2 and should it go wrong, who better to fix it? With the KX2 I've not got a hope.

Background

Unsurprisingly, I found myself with more time on my hands during the dark winter months of 2020/21. I'm a very keen constructor and having completed a DDS (direct digital synthesis) controlled Direct Conversion Receiver, I had a hankering to build something a little more old-school. I don't mean with valves, not that old-school, but a project that wasn't based around an Arduino, a DDS or even a PLL (phase locked loop). No, I felt this project should have a good old fashioned VFO (variable frequency oscillator), mixers and amplifiers and be about as far removed from a homebrew SDR (software defined radio) as you can get, using basic, easily available components. So why 'The Paston'? As a young lad I

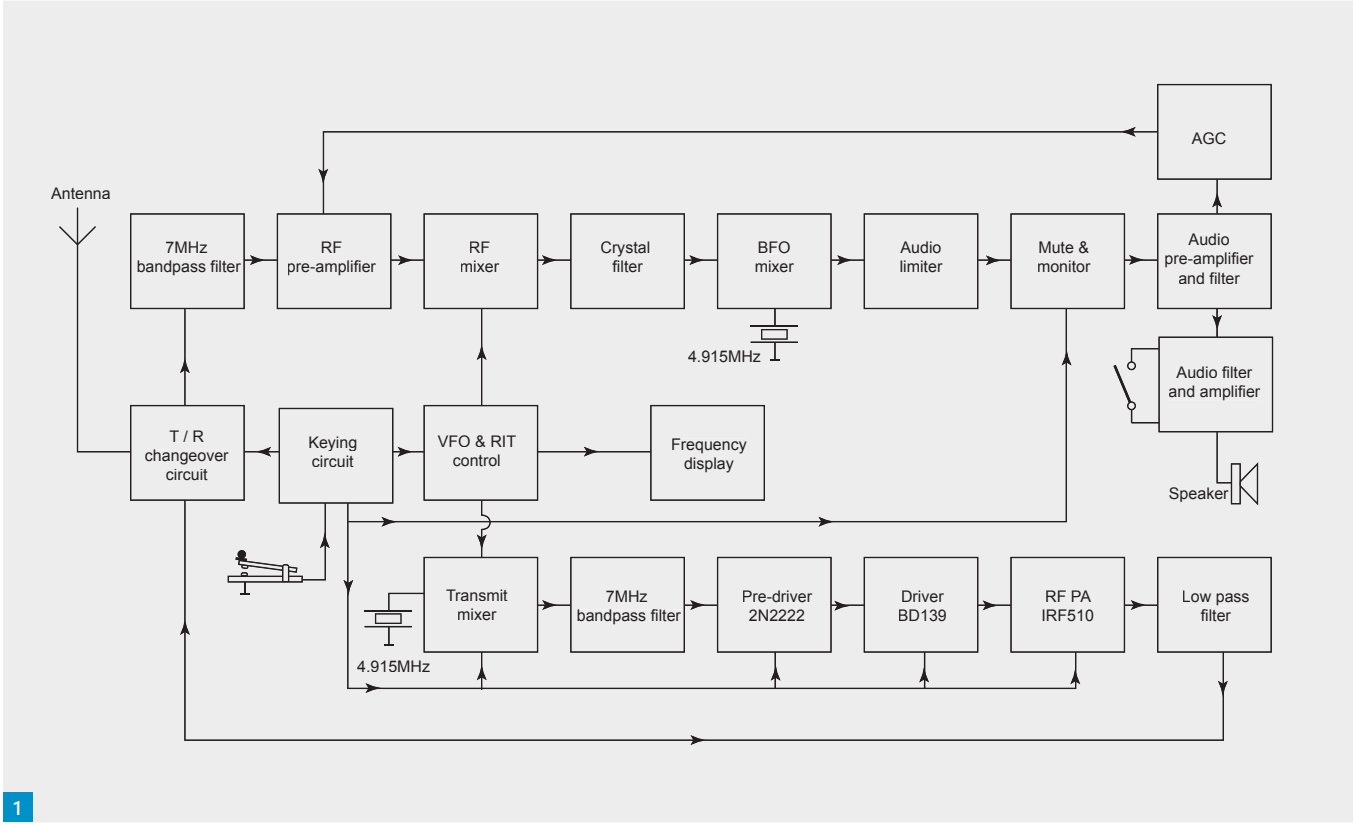


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Fig. 1: Transceiver block diagram.

attended Paston Grammar School in North Walsham, Norfolk. It was also the school of **Horatio Nelson** but there were a few hundred years between us so no, he wasn't in my class. Being founded in 1606, I think it qualifies as being an 'Old School'. Years ago *PW* projects were nearly all given names so I thought I'd revive that tradition. Hence The *PW* Paston it is.

I should point out the design I settled on is far from ground-breaking. I'm comfortable with 'borrowing' the designs of others who have been generous enough to publish their work. As we go through the circuits I will make reference to my sources so that should you want to, you can investigate further for yourself or even improve on it. Please don't forget to tell me about it though.

Getting Started

The first step was to decide on a specification for the project. My favourite mode is CW. I wouldn't say I'm all that proficient at it but I really enjoy a pleasant QSO in CW, even if we simply exchange name, RST, QTH, weather, temperature, you know the routine. Some operators will go on to tell you about their rig and power and it's fun to advise them you're using a homebrew rig running 5W. It usually invokes a 'FB' response. I also wanted to build a transceiver this time and not just a receiver. That said, this rig is in fact a receiver with a transmitter bolted on top of it so if you fancy building just a 40m CW receiver or your licence does not allow you to transmit with homebrew equipment (as a reminder, Foundation licensees must use commercial equipment or an approved kit, which this is not), then you could just build the receiver. It performs very well for such a simple circuit and will offer hours of fun building and using it. My main station rig is a Yaesu FT-920, which has very nice receiver performance. The receiver in this project can hear every signal my FT-920 can. Even I was surprised at that. Admittedly there's no DSP (digital signal processing) or noise cancelling, the selectivity is adequate not awesome, and the AGC (automatic gain control) doesn't have huge dynamic range but even so you will be able to hear, and work if you also build the transmitter, lots of stations with this little transceiver.

Test Equipment

If you're thinking about building this rig, then you are going to need some test equipment so if you don't already own and know how to use it, you might need to borrow an item or two from another amateur or your local club. As a guide this is what I would recommend:

- A basic oscilloscope. It doesn't need to be all that fancy but one with at least 20MHz bandwidth will suffice. You will struggle to work out where you've gone wrong without one.
- A DMM (Digital Multimeter). My favourite is quite a cheap option by a company called Vici (who?) and works just fine.
- A variable power supply. Preferably with some sort of built-in current limiter. You're going to need 12-14V at a couple of amps. If you've made a stupid connection error, then you don't want the 20A plus from your shack power supply (or battery) going to deck on your homebrew copper clad board. You could vaporise it or worse. We always aim to keep the magic smoke inside the components.
- Your main station HF rig can be a really useful bit of test equipment too. You can use it to compare a station's frequency and signal strength, and by keying low power into a dummy load it can provide a nice strong signal to help you tune the receiver section. Just be careful not to key power from your homebrew rig directly into your HF rig or vice versa. I use an antenna changeover switch (and a

separate receive antenna on the 920).
• The following items are probably not essential but they'll make your life easier, particularly when a circuit doesn't work first time:
• A nanoVNA. A brilliant little device and a godsend for setting up filters. If you own one and didn't know you could use them for this purpose, or thought it was just an antenna analyser, I highly recommend a visit to W2AEW's YouTube channel.
• An RF signal generator. Having a source of a nice strong signal in the region we're working (7MHz) is a boon but by no means essential. See comment above regarding your main shack rig.
• An AF signal generator. In conjunction with the 'scope, this will help you test and set up the audio section with the CW filters. However, you can get pretty close just by tuning them by ear.
• An RF frequency counter. Again, a nice to have but the design has a ready-made frequency counter module built into it, there's no reason why you can't use that.
• If you have or can lay your hands on inductance and capacitance meters, that also helps but they are by no means essential.

Design Criteria

So, let's take a look at my design criteria. Obviously, your requirements may vary but the circuits lend themselves to chopping parts out and adding others in as you like. Actually, I'd like to see that because it means you've understood how it works enough to experiment and at the end of the day that's what homebrewing is about. I've outlined below the features I wanted so they've all been incorporated in the design.
• 40m CW band. I chose 40m because there's usually some activity almost any time of day. My antenna at the home QTH is pretty much resonant on 40m meaning I would be making the most of this rig's QRP output. There's nothing stopping you using this design for pretty much any HF band but you will need to change several circuits and I don't feel that's within the scope of this article.
• VFO frequency control. I find crystal-controlled rigs very limiting. Even with a VXO (Variable Crystal Oscillator) you're unlikely to be able to tune more than a few kilohertz. For this rig I wanted to build a solid, stable VFO that tunes the entire CW portion of the band. The VFO in this design tunes the transceiver between 7–7.100MHz. In the UK there's little CW activity above 7.050 so if you'd prefer to limit it to that, then it's very easy to do. The tuning rate is fine and it takes ten rotations to tune across the band.
• Receiver to be a single conversion superhet design with an IF of 4.915MHz. I chose this frequency so I could use cheap, readily available computer crystals (I bought a bag of 100 for less than £7 on eBay and only used six so far!). Other cheap crystal frequencies are available (e.g. 4.333MHz) and could be used providing you adjust the VFO range to suit. However, be careful not to choose an IF frequency too close to the signal or VFO frequencies.
• Homebrew IF Crystal Filter with a bandwidth of 500Hz. We're not listening to SSB so if we keep the filter bandwidth narrow, we don't hear so much noise or QRM.
• Incorporated CW Audio Filter for more comfortable listening.
• Semi Break-in (QSK) operation with variable delay. I could easily have used a design with full break-in but I actually don't like it and even have the main station rig set to semi-QSK.
• Sidetone/TX monitoring on transmit. The sidetone you hear when you're transmitting is actually the receiver listening to the transmitter by leaking a little bit through to the audio board even when it's muted. It works really well and has the advantage that if you can hear a sidetone, you know you're transmitting, or at least producing RF.
• Basic AGC. In a recent homebrew receiver project I didn't include an AGC circuit and let me tell you, if you inadvertently tune onto a whopping great German station, you'll be ripping your headphones off. So, as far as I am concerned, AGC is essential. It also has the advantage of providing a DC voltage proportional to the incoming signal, which could readily be used for an S-meter. However, with my daft choice of case there simply wasn't enough room for an S-meter of any description. Seriously, I tried.
• Full QRP (5W) output using the shack 13.8V power supply.
• Speaker or headphones audio output. I always work CW wearing headphones but I do enjoy listening up and down the band without them so I wanted both.
• Digital Frequency Display. Having a printed dial is one thing but nothing beats a direct frequency readout. Luckily the same Chinese website who tempted me with the case also sell a great 8-digit frequency display (I only use six digits) for a little over £9. It measures the VFO directly and can be programmed using just two buttons to add (or subtract) the IF frequency (in our case 4.915MHz-ish) on the fly. Very clever. The one downside is because they multiplex the seven segment displays it does put a low-level buzzy noise on the power rails that you can hear in the headphones but I have a fix for that, which I will cover when we get to it. Chinese electronics creating noise? Shocker!
• Built entirely using a Modular Manhattan Construction method. There's no etching or PCB fabricating here. The late, great **Rev. George Dobbs G3RJV**, founder of GQRP club and frequent *PW* author was a staunch advocate of the Manhattan method of construction and so am I. It makes design changes, prototyping and experimenting much easier. I divided the circuit into functional modules, built them on the bench and transferred them to the main board. I tested each stage as I built it and if anything needed changing, I just popped off the whole circuit if I needed to. If this method is new to you, I will be covering the basics in Part 2 when we start to build the first section.

The Basic Design

Now that we have the design features, let's take a look at the block diagram, **Fig. 1**.
• The transmit/receive circuit has three functions. Firstly, when the key is pressed it changes the relay to direct the antenna from the receive circuits to the transmit circuits. This is held in for a set period of time dictated by the delay control on the board (semi break-in). Another pole on the relay provides the supply voltage to the power amplifier and activates both the mute and RIT (receive incremental tuning) circuits. The third function of the changeover circuit is to send the supply voltage to the transmit mixer, pre-driver and driver circuits only for the duration the key is pressed. The receive circuit is powered up all the time to provide the monitoring/sidetone.
• Following the signal through the receive side you can see the layout of a typical superhet. Firstly, we have a bandpass filter (BPF) for 7MHz-ish to keep out the strong broadcast stations that are liable to overwhelm simple receivers like this. After that we add a little gain to overcome the BPF losses. This also offers us a good place to control the gain with both a front panel RF Gain control and the AGC.
• The signal then goes straight into the

Rallies & Events

All information published here reflects the situation up to and including 30th December 2021. Readers are advised to check carefully with the organisers of any rally or event, before setting out for a visit. The Radio Enthusiast website will have updates, please check here regularly. To get your event onto this list, please, e-mail full details as early as possible: wiessala@hotmail.com

6 February
RED ROSE RALLY: St Joseph's Hall, Mather Lane, Leigh WN7 2PR; Individual stands, LAMCO dealership stand, low-cost Bring and Buy (BB | D | FP | CR | RSGB | TS).
Colin: rally@wmrc.co.uk
http://wmrc.co.uk/rally.htm

10 February
AMERICAN RADIO RELAY LEAGUE (ARRL): Orlando, Florida 32821, USA. (See also next entry)
www.arrl.org/arrl-expo

11-13 February
ORLANDO HAMCATION: Central Florida Fairgrounds and Expo Park. Second-largest ham radio convention in the USA. More than 65 commercial traders, a huge boot sale area, US ham license tests. HamCation is also excited to host the ARRL National Convention.
www.hamcation.com

20 February
RADIOACTIVE FAIR: Mid Cheshire ARS; Nantwich Civic Hall, Cheshire CW5 5DG (BB | CR | D | FP | RF | RSGB | TS)
https://midcars.org
http://www.radioactivefair.co.uk

6 March
EXETER RADIO & ELECTRONICS RALLY: America Hall, De La Rue Way, Pinhoe, Exeter, EX4 8PW.
Pete G3ZVI
g3zvi@yahoo.co.uk

13 March
HAMZILLA RADIO FEST : Discovery Science Park, Gateway House, Ramsgate Road, Sandwich, Kent CT13 9FF. Tickets are available now from £3/ Tables £12. Those who bought tickets and tables in advance will have their booking carried forward to Hamzilla 2022.
https://hamzilla.uk

9 April
YEOVIL ARS: 36th QRP CONVENTION. The Digby Hall, Sherborne, Dorset, DT9 3AA (Car parking charges apply on Saturdays)
Doors open 09:30 am to 2:00 pm; Admission £3 (regrettably, no dogs except guide dogs) BB | TS | Club Stalls; Supported by RSGB, RAFARS & BYLARA. Regrettably, there will be no talks this year, due to Covid.
https://tinyurl.com/fyj9vtca

24 April
CAMBRIDGE REPEATER GROUP RALLY: Foxton Village Hall, Hardman Road, Foxton, Cambridge, Cambs CB22 6RN; Doors open at 9.30 am for the public (7.30 am for traders). Admission is £3. (BB, CBS, CR, TI, TBS).
Lawrence, M0LCM
Tel: 07941-972724
rally2022@cambridgerepeaters.net
www.cambridgerepeaters.net

1 May
NARSA (NORTHERN AMATEUR RADIO SOCIETIES ASSOCIATION) EXHIBITION (BLACKPOOL RALLY): Norbreck Castle Exhibition Centre, Blackpool FY2 9AA
Dave M0OBW
Tel: 01270 761 608
dwilson@btinternet.com
www.narsa.org.uk

2 May
DARTMOOR RADIO RALLY (BANK HOLIDAY MONDAY): The Yelverton War Memorial Hall, Meavy Lane, Yelverton. Devon, PL20 6AL. Doors open at 10 am and admission is £2.50 (BB | CR | FP | TS).
Roger, Tel: 07854 088882
2e0rph@gmail.com

20-22 May
DAYTON HAMVENTION
https://hamvention.org

BA Buildathon **BB** Bring-and-Buy **CBS** Car Boot Sale **CR** Catering /Refreshments **D** Disabled visitors **FP** Free Parking **LB** Licensed Bar **L** Lectures **RF** Raffle **RSGB** (RSGB) Book Stall **RU/PW** RadioUser/ PW attendance **SIG** Special-Interest Groups **TI** Talk-In (Channel) **TS** Trade Stalls

first mixer where it is mixed with the VFO signal. Remembering our mixer theory we should get the two main products and, if the mixer is well balanced, very little of the signal or VFO. One of these products (Our incoming signal minus the VFO) is our IF at 4.915MHz. We then send everything into our crystal filter, which filters out the unwanted stuff and leaves us with a nice clean IF signal. Now we mix that again with another oscillator running a few hundred Hertz off our IF in the BFO (Beat Frequency Oscillator) mixer so that it beats with it and give us the audio. Voila! We then take that audio, feed it through a limiter so we don't overload everything, add the ability to mute it on transmit, and then into an audio preamplifier. This has some filtering so we can select just around the frequency we want to listen to, about 600 to 800Hz, usually. Some of this signal is amplified and then rectified to provide us with an AGC voltage to use in the AGC circuit to knock down those big signals. We also send this audio off to the audio board where we have the option to sharpen the filtering even more, controlled by a front panel switch, and then boost it so it's at the right level to drive a little speaker or headphones.

• On the transmit side we start with the signal from the VFO, which runs at about 2.1MHz (2.1+4.9 = 7). Like we did for the BFO mixer, we mix the VFO with another crystal oscillator. We pull this one a little as well to match the frequency of the incoming station. The result, once again, is selected with another filter and fed to our first amplifier or pre-driver as I've called it. It's amplified again in the driver stage and then finally up to full power with the power amplifier. After all this amplification our transmit signal is not likely to be squeaky clean and we want to avoid transmitting any nasties. To get a nice sinusoidal waveform we feed the final amplified signal into a lowpass filter. This is then fed through the T/R relay and up to the antenna each time the key is pressed.

• The VFO is basically a free running oscillator in a tin box. It needs to be shielded from all the other goings-on in the rig case, and also from any heat sources. It also houses the RIT circuit. This moves the VFO up or down by 200Hz or so with a front panel control. However, when the key is pressed we want the VFO to spring back to its original value. The output from the VFO is sent through individual buffers to both receive and transmit mixers and also to the frequency display.

In Part 2 we'll cover the design and construction of the Audio Board. I'll also be showing how I use the Manhattan style of construction to complete the audio amplifier and the CW filter.

Roger J. Cooke G3LDI
roger@g3ldi.co.uk

1

CW Protocol or Protocols

Roger Cooke G3LDI starts off by discussing matters procedural.

I was licensed in 1956 and have abided by the Protocol and Procedures I was taught at that time ever since. While there is nothing dramatically wrong with them, I recently had some email exchanges with a good friend of mine, **Andy G0IBN** regarding this subject. Andy was a professional marine CW operator so I obviously have a lot of respect for his opinions. We have quite a number of ex-marine operators in our midst and all of them extol and demonstrate good operating practices on the air.

However, in my case, having been licensed since 1956, I have probably developed some 'bad' habits. Investigating this, I set up my MicroHam keyer in monitor mode as I transmitted my normal CQ. I was taught to send:

CQ CQ CQ DE G3LDI G3LDI G3LDI AR PSE K

This was a general CQ for any contact or QSO (preferably a conversational one and not the ubiquitous 59973 you hear these days). However, monitoring this, I was surprised to see that every time I sent it, I omitted a space after the third CQ. Now, as a tutor, I teach that spaces are equally as important as characters and in fact can result in a QSO or no QSO! I had to concentrate in order to repair what I had been sending, obviously for years.

Then Andy emailed me regarding a CW article he had read, by a much-respected operator, in which he talked about prosigns. He wrote that a barred NR is the Morse for / (slash or stroke). He also said it could be DN or TF, again barred. I found this strange, because I had never learned the / as a prosign at all. I had learned it as part of punctuation. I learned it as 'dah-di-di-dah-dit', which had no bearing on prosigns at all. Andy found this strange too and started questioning other prosigns. It was also stated in this article that GW barred is a comma, and RK barred is a full stop. I have problems with these too, inasmuch that I do not recognise those as prosigns. Again, I learned them as stand-alone punctuation, in other words, just another character that I had to learn.

Discussing this further made me refer back to my own *Morse for Radio Amateurs* book. I did note a few prosigns in there that indeed could cause confusion with newcomers to learning Morse Code. Prosigns have been around for as long as I have been learning the code and probably long before that too. It got me wondering if we should stop using that description. If the code itself was presented in dit-dah fashion, with a suitable description, and the student told this was what they had to learn, it would make the whole exercise a lot more straightforward. For example, the slash or stroke would cease to be described as barNR, or barDN or barTF. Actually, I found it extremely difficult to think of a slash as barNR. NR is used in other circumstances, and I feel describing it like this is extremely confusing to a new student.

So, in view of all this, I feel it about time we forgot all about prosigns, and merely called prosigns, punctuation etc under the same header of Procedural Signals and just described them like this:

Comma: dah-dah-di-di-dah-dah
Full stop: di-dah-di-dah-di-dah
/ (slash or stroke): dah-di-di-dah-dit
End of work: di-di-di-dah-di-dah

This would apply to the whole range of punctuation, prosigns as we know them at present, and other procedural signals that are described with a bar** It would certainly simplify the learning process and prevent any ambiguity.

I would like to know what readers think on this but I shall certainly consider changing any future revisions of my Morse book.

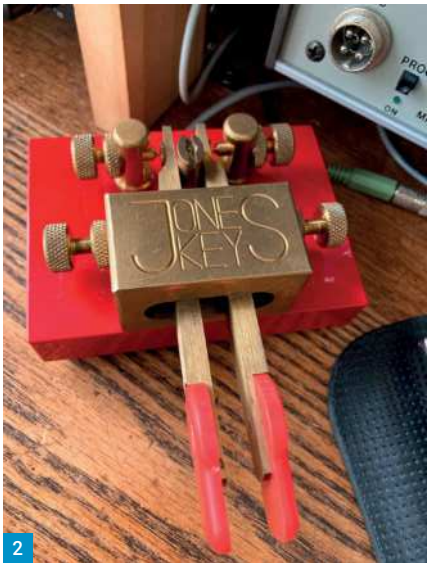
Incidentally, there is an extensive article on Morse code on Wikipedia, with playable examples, and MorseCode.World is good too, both of them covering procedural symbols as well as the basic alphabet and numbers:

https://tinyurl.com/bdzn2hkn
https://tinyurl.com/mtdz6uah

Keying Mode and Paddles

Some discussion took place on the CWops reflector recently regarding Iambic keying. Various views were discussed, but they mostly depended on what method was used in the first instance of learning. I have mentioned this before, but it always pays the beginner to try various paddles before deciding which is best for him/her personally. I had a single lever paddle (and still have it, the Vibroplex) and that is all I can manage now after 70+ years of using a single lever. It is very uncomfortable for me to use a dual-lever paddle.

Obviously, you would need a dual lever to use iambic keying. However, don't place too much importance on using iambic keying (not all dual lever users do send iambically



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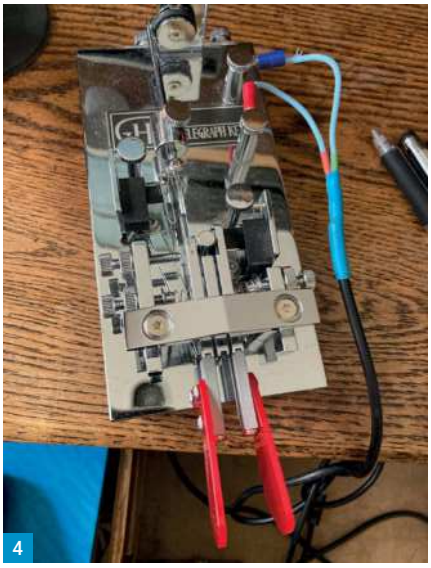
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Fig. 1: Puck W4PM's as-new Vibroplex.
Fig. 2: Barry VK2BJ's Jones key.
Fig. 3: The Bencher Mercury key.
Fig. 4: GHD key from the estate of the late Summer VE5SDH. Fig. 5: Barry VK2BJ's Ten-Tec Omni 6 Plus transceiver.

anyway) because you only benefit from about six characters. In my opinion it is not worth the effort of trying to change. Iambics is all about meter, similar to poetry, using iambs, trochees and anapests. Further reading if you want it:
https://tinyurl.com/2p883ymk
http://www.cq-cq.eu/DJ5IL_rt007.pdf

An electronic keyer can support the iambic sending technique, in which case it is an 'Iambic Keyer'. The term Iambic has nothing to do with the paddle!

Iambic sending requires a dual-lever paddle.

An 'iambic keyer' can be driven with a single-lever paddle, and a 'non-iambic keyer' can be driven with a dual-lever paddle.

Suffice it to say I would not change from my single lever paddle but it is an individual choice.

Some Further Keys

Puck W4PM recently bought a very nice example of a dual-lever Vibroplex off eBay, **Fig. 1**. It looks in very good condition too, I particularly like the blue finger pieces.

Barry VK2BI came back with this! *"Not to be outdone, here are pictures of my two newest paddles, a Jones Key bought from the USA on QRZ.com and a Bencher Mercury that I found on the local Australian eBay. To round it off, there are pictures of my GHD bug I bought from **Summer's** estate and my immaculate (outside and inside) Omni 6 Plus that I got from eBay USA.*

I did see your Vibroplex on Ebay and I was very taken by the blue finger pieces. Barry VK2BJ". See **Figs. 2** to **5**.

Please send all your comments, offerings, information to: **roger@g3ldi.co.uk**

73 and may the Morse be with you!

Ian J Dilworth G3WRT
practicalwireless@warnersgroup.co.uk

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Practical 2022 Microwave Hardware

Ian Dilworth returns to the subject of Microwaves with a look at the sort of components and test equipment that are available to the experimenter.

In this introductory microwave (μwave) series, **Don**, the editor has kindly let me decide what order to present material. I happen to specialise in μwave/Millimetrewave radio propagation and there will be an offering on that in due course. But first I address practical measurement hardware aspects, which I hope will be of general interest. Primarily, but not exclusively, amateur radio orientated. For example, a 'Dicke switched' Radiometer, which I will be using, as an example [1].

In the first of this series (PW Nov 2021) I mention that detailed pages, much more than is possible to cover in *PW*, will be available in due course. For example, simple and sensitive practical VHF/UHF field strength meters I developed. This article takes the application up into the μwave region 1 – 18GHz with practical measurement hardware.

Field Strength Meter

The VHF-UHF field strength meters that I describe in my additional notes work by mutual inductive coupling and are aimed at local oscillators and transmitter applications, e.g. monitoring of RF fields for EMC. In the microwave region the coupling is invariably in the 'far field' and measures the electric field component of the radiated energy. Nevertheless, a sensitive field strength detector is readily achievable by employing both old and recent technology. These are invaluable when testing signal sources, amplifiers, filters, components e.g., couplers and antennas.

Spectrum Analyser

A commercial **spectrum analyser** (SA) is the traditional and best way of observing and measuring μwave signals often by just connecting a simple, matched to 50Ω, antenna, i.e. they are just sophisticated receivers. Recently some very cost-effective SA versions have become available [2], very welcome, and while not of commercial accuracy or span are useful. One example is shown in **Fig. 1**. Maximum frequency, as of 2021, is currently limited to 4GHz. Current **SDRs** such as the IC-9700 or 7300 have quasi-SA time and frequency display characteristics, albeit displays of relatively narrow frequency span and speed but nevertheless good enough for most narrowband amateur radio applications. For example, you can see on a spectrum display the phonemes generated by speech, in time and frequency. If a μwave superheterodyne front end is employed ahead of these SDR, with a microwave mixer and swept synthesised local oscillator, these allow the display of frequency and time dependent characteristics in very useful multi-dimensional ways, **Fig. 2**, which have yet to be, tantalisingly, fully exploited and remain an exciting, hopefully imminent, commercial advance.

For μwaves I suggest a practical 2022 cost effective 2–18GHz superheterodyne configuration, outlined in **Fig. 3** along with suggested, current (2021), μwave mixer (Miteq DB0218LW2) and fast ADC allowing, in this case IFs up to 1GHz (Texas ADCRF45), not so cheap but currently the most cost effective. The higher the IF then the easier it becomes to filter out the image response, **Fig. 4**. I recommend the mixer as a starting point, **Fig. 5**, for cost effective experimentation plus the 6GHz synthesiser [2], **Figs. 6** and **7**, and the ADC for those committed to 2–18GHz serious receivers/measurement gear as state of the art and ahead of commercial products specifically because of the generality of application. The broadband mixer is excellent value. Taken together they represent a cost-effective resource ready to be exploited at modest cost.

On the other end of the expenditure scale, **Fig. 8** shows a very cost-effective UHF sweeper and a receiver/detector display [2] with excellent -100dBm sensitivity. I love its simplicity despite its serious limitations in terms of image rejection possibilities. It illustrates what is possible for very low cost. It is not to be dismissed.

In all cases filtering of the image frequency band and aliasing artefacts limit the performance of simple designs. So, this will be another important aspect to be explored in this (educational) series.

Fig. 1: A recent affordable spectrum analyser. Fig. 2: Displaying results in the frequency and time domains. Fig. 3: A superhet approach to measurement. Fig. 4: Filtering out the image response. Fig. 5: Microwave mixer. Fig. 6: 6GHz synthesiser.

Traditional µwave SA are generally expensive even second-hand, largely because of their calibrated accuracy. The trend has become increasingly dependent, over the last two decades, on software (and updates and contracts) and as a result can prevent intelligent misuse (e.g., operating the sweep rate faster than filters theoretically allow), which, I know from experience, paradoxically, is often especially useful!

The hardware involved has changed little over decades, systems wise, but the control has significantly.

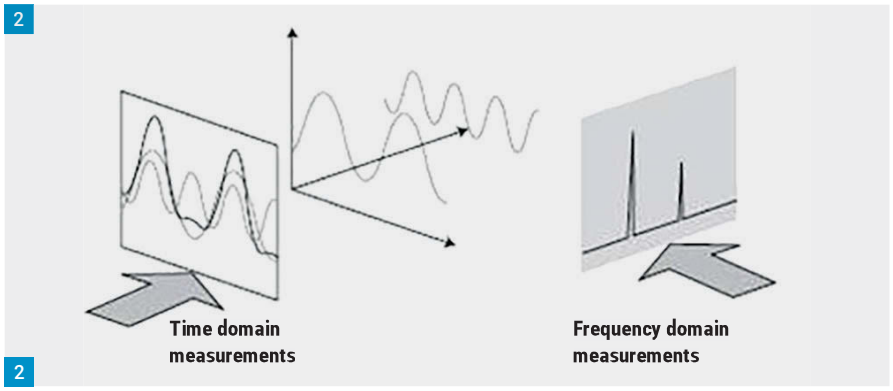
Cheaper quasi-analogue SA, non-software dependant, equipment frequency span (which is always restricted) can usefully be increased using harmonic mixers as illustrated in **Figs. 9** and **10**. I have always bought my hobby equipment at the lowest possible cost. Fortunately, 1970s commercial equipment is well built, lasts and is without software control. This is not a luddite statement, µwave equipment is designed for a commercial need. GSM and current 3-6G applications and beyond lead the demand.

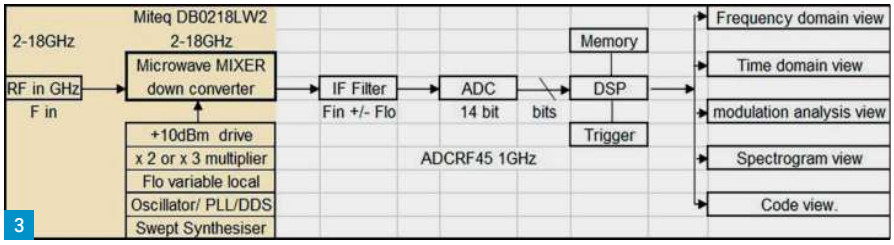
These are specialised in what they do. Hobbyists require more generally useful equipment, so older equipment is increasingly more desirable, despite reliability issues, which can be control knob degradation of contacts, silly (cheap) push buttons implementations, etc. Expect this genre to become increasingly more desirable and useful. For example, I have an HP GSM generator/test set unit, which has proven a boon as a ~1GHz signal generator but not much else, $200 when bought.

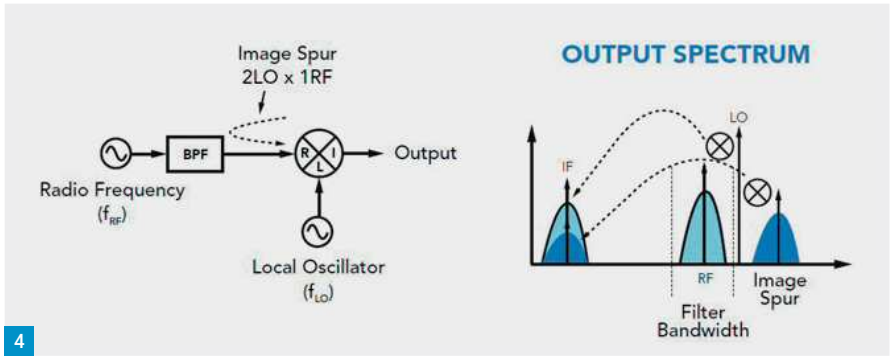
Much more dependable (so far) than another synthesised Marconi signal generator, which I might get around to sorting out its problems. But that is, frankly, very unlikely. So, thinking beyond the original application of the equipment can be economically sensible. Not necessarily so in terms of bench space, **Fig. 11**, which is a thoughtful consideration for everyone!

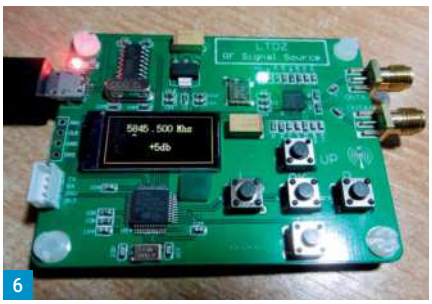
Broadband Harmonic Mixers

I use broadband harmonic mixers with my ancient HP SA. Instead of DC detection a non-linearity (diode) can be used for RF mixing and this can be harmonic mixing. If two frequencies, f_1 and f_2, are introduced together, then the output signal consists









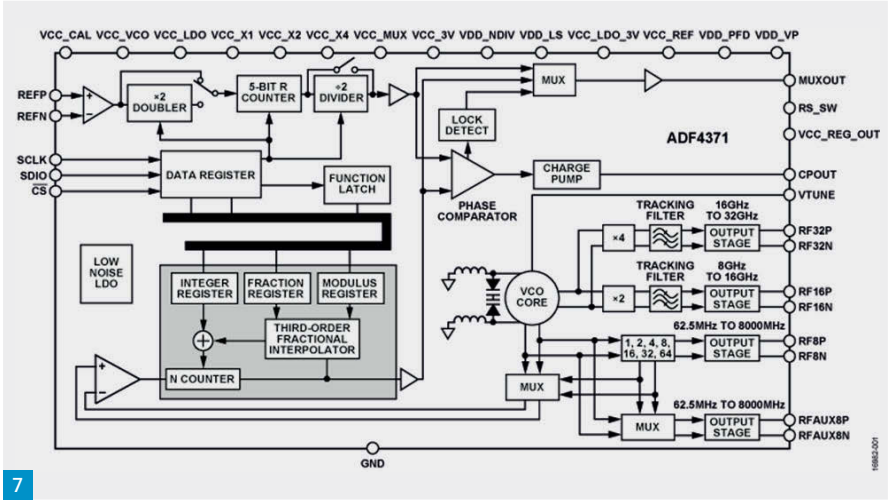
of sum and difference frequencies at a harmonic multiple of one of the inputs. The output signal then contains frequencies such as f_1+Nf_2 and f_1-Nf_2 where N is an integer. Note that the sensitivity decreases with the harmonic number at a rate of 20 log(N), i.e. N=2 = −6dB, N=10 = −20dB. So, for example, if the SA has a noise floor of, say, −80dBm, for N=6 that is reduced to −80+16 = −64dBm. Hewlett Packard (HP), now called Agilent, use that method in the broadband (12 – 40GHz) mixer illustrated in Fig. 10 and used in conjunction with the LO produced by the classic and incredibly special 8555 spectrum analyser plug in module of the HP141 SA, Fig. 11 left top. In this case, to obtain broad banding a TE10 ridge waveguide is employed working from 12–40GHz. A simple **TE10 mode waveguide**, say waveguide 16, only operates over 8–12.4GHz. A disadvantage of mixer type detectors is that their exposed RF power levels must be restricted, which in the case of a specific waveguide means employing a precision **waveguide attenuator, Fig. 12**. I often employ a piece of graphite loaded wood and/or a graphite loaded sponge rather than a proper TE10 vane attenuator. Which can be a risk for the diode employed so perhaps unwise,

Fig. 7: Block diagram of 6GHz synthesiser. Fig. 8: UHF sweeper. Fig. 9: Ridge waveguide mixer. Fig. 10: A mixer from HP.

but certainly more convenient. Care and thought is always required. There are more modern versions of my ancient 1970 equipment, which are now affordable and relatively cheap, e.g. an Advantest tr4131 series SA to 4GHz (but with cheap nasty pushbuttons! Caveat emptor). I am aware of more modern equipment and have used it, on hire, recently 60GHz, but I am thus also aware of the restrictions the software control (and software updates etc.) increasingly impose. That is not generally useful and makes this equipment less desirable. The sweet spot for amateurs is 1970/80s equipment.

Network Analyser

The most useful equipment is a **Network analyser** (NA) because this consists of a swept signal source and a receiver/detector. So ideal for measuring just the amplitude of |S11| (match or return loss (SWR)), |S12| (insertion loss or gain), |S21| (reverse gain or isolation), which is important because all µwave systems are far more RF transparent than lower frequency systems, and finally |S22| amplitude, which is a match or return loss of the output. A **vector NA** (VNA) is a more powerful tool than a scalar NA because it employs a coherent detector and produces phase as well as amplitude results. My HP only works to 2GHz. Recently VNAs have become available up to a synthesised ~4GHz, at bargain prices, **Fig. 13** [2]. An 'NA' is used for measuring loss or gain of a component or an active device and can even be used to measure antenna gain and radiation patterns. 'NA' hardware above 6GHz, without the sweeper, is available at bargain prices, again from the 1970s era. **Fig. 14** illustrates my now 50-year-old setup useful to 18GHz and it did not cost much in the 1990s. There is nothing much to go wrong with these passive units apart from APC-7 connector degradation with use and the inbuilt RF relays, so they are very worthwhile units to acquire. The mechanical relays incorporated are precision, broadband impedance matched, **microwave switches** to 18GHz, which can provide useful low power transmit/receive switches. Transmit/receive relays that can manage watts of power with low microwave loss are a problem and quarter wavelengths of unterminated transmission lines can provide significant isolation (~30dB) as was illustrated in the stripline example used in **Part 1** for



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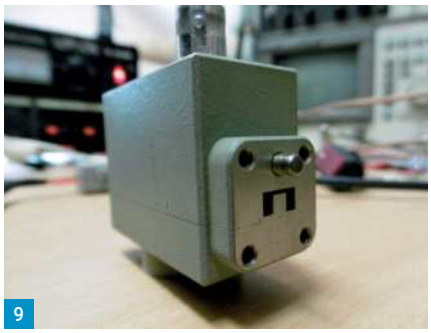
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decoupling, if used as part of the switching arrangement. Fig. 12 illustrates large mechanical, high quality, 10GHz waveguide switches. One alternate is separate antennas (e.g. my bistatic 42GHz doppler system) because, of course, as frequency increases mechanical relays make way for PIN switches of limited power handling.

Smith Charts

Tutorials on the use of **'smith charts'** are available. These are a useful thing to understand and use since all these new (and old) VNAs can display this format. **Scattering parameters** 'S parameters' are used (S11, S12, S21, S22) to evaluate any passive or active device and the VNA is ideal for this application. Details of both these can be found on the web and in my additional pages. It is well worth becoming familiar with both these simple concepts because they are universally used in datasheets and in understanding impedance matching. For example, how long to make a stub in a microstrip amplifier and where on the transmission line it is to be located using adhesive copper, as will be illustrated in another part.

Connectors and Adapters

Connectors and **adapters** come in many sizes, and merit significant attention since none are perfect at µwaves. **Fig. 15** illustrates some types and adapters between types, plus connector cables of various lengths you accumulate as an experimenter. There are even rotatable joints as illustrated in **Fig. 16**, which is SMA type I use to mechanically rotate an antenna for EMC testing. Also waveguide versions used to couple to phased array radar antennas. The APC-7 multiple jointed arms, top of Fig. 15, is extremely useful with VNA work. All connectors have a limited on/off capability and they do degrade with use, so care with them is important. Cheap adapters and connectors are to be avoided unless of single use. Checking a cable and connectors for S11 (match) and S12 (loss) is a valuable facility of a NA or VNA. To minimise losses

Fig. 11: Bench space can become a problem! Fig. 12: Waveguide attenuator and waveguide switches. Fig. 13: A bargain priced VNA usable up to several GHz. Fig. 14: Comprehensive test setup, workable to 18GHz. Fig. 15: A selection of connectors!

connecting stripline to coaxial cable or to waveguide and antennas has resulted in many novel designs and is worth web exploration (e.g. the wideband Vivaldi antenna illustrated, **Fig. 17**, [4]) These and other antennas/feeds for reflector antennas will be reviewed and their characteristics in polarisation, illumination angle, bandwidth and spillover will be explored because they are important for optimising reflector antenna applications.

Components

Components such as illustrated in **Fig. 18** are useful, especially if broadband and coaxial. Radio rallies are a good place to find these. From left to right, all work up to 12.4GHz (X band is 8–12.4GHz): PIN switch 100mW, Gunn diode 100mW 40GHz in a resonant adjustable (screw) cavity and heatsink, 10dB directional coupler, non-reciprocal isolator 20dB to isolate a component such as an antenna (band specific), Hybrid 4 port coupler. I could add more. A coupler with a backdiode is ~–50dBm sensitive when connected to a directional coupler, **Fig. 19**, and so becomes a particularly good indicator of reflected or forward power without employing anything else. The logarithmic, amp, which converts RF to DC over 10GHz, AD8317 in Fig. 17, is also attractive for the cost considerations alone compared to the backdiode.

Coaxial Cable

We are conditioned to the idea that the bigger the diameter of **coaxial cable** at HF then the lower the loss, i.e. bigger surface area conductors equal lower loss. Unfortunately, large diameter coax does not work at μwaves, it becomes uselessly lossy (evanescent) because of moding. Small diameter coax must be employed, which can be especially lossy and that is why interconnects are kept as short as possible and why feeding a reflector antenna is usually with lower loss, band limited, waveguide. Airspaced APC-7 is employed in this older HP (pre-Agilent) equipment and adapters (notice the flexible multiway arm in APC-7, Fig. 15) to smaller coax like UT-141 are readily available but good ones do command decent second-hand prices and need to be looked after and respected because they do have a limited on/off capability. Discovering good ones


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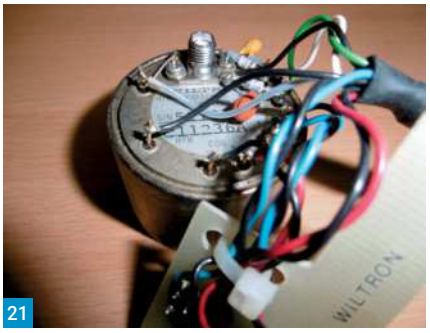
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is now quite feasible, even at a radio rally, because of the pocket portable battery powered VNA. Expect to see one in use at our next covid 19 restriction-free radio rally! Which we are all looking forward to. I, for one, am also really looking forward to the up-and-coming improved 11-year sunspot cycle HF conditions and these may well, paradoxically, provide a good opportunity to acquire microwave 'gems' in the baton passing progression of our RF hobby.

Microwave Oscillator Sources

Microwave oscillator sources have hitherto been and remain a challenge especially in power levels. They are a centrally key component in µwave systems. In 2022 we now have very cost effective, sweepable synthesised sources to ~6GHz at +10dBm power levels. Above this the backward wave oscillator (BWO), a valve travelling wave tube (TWT) with feedback, remains the most convenient means of producing a relatively powerful (e.g. 100mW) swept signal source. Until very recently and presently TWT are the technology of choice in transmitting 12GHz DBS satellites in 40,000km orbits because of their proven reliability and no possibility of repair.

Fig. 20 shows a 26-40GHz waveguide output (left) and Fig. 14 shows the front co-axial output of an 8-12.4GHz plug-in sweeper. Not, however, providing the frequency stability we desire in 2022 but excellent for evaluating hardware over a frequency band. **YIG**, **Fig. 21**, **Gunn**, Fig. 18, the large 40GHz waveguide and heatsink and Impatt diode, µwave sources, can be employed. So, for example, the failed electroformed example in **Fig. 22** is a Gunn diode video transmitter ~26GHz but because of poor frequency stability, as evidenced by the large volume heating and feedback control indicate, these have been superseded. Fig. 6 shows a ~6GHz synthesised source [2]. When fed from a **GPS locked** source this is a bargain as a good, experimental, starting hardware (without GPS).

I recommend it because it is so cheap and when used in sweeper mode stable enough. Put in a temperature-controlled environment it will be excellent. The GPS derived frequency control just avoids that complication and GPS control is readily incorporated. **Fig. 23** illustrates one GPS example producing 10MHz and an arrangement of dividers and multipliers. Searching GPS on the web indicates several cost-effective GPS locked signal sources and resources.

There is a well-trodden way of generating µwaves, usually from a PLL typically incorporating 2-4GHz VCO and a multiplier to the final frequency (e.g. 10GHz), and frequency controlled by a ~100MHz quartz crystal, as illustrated in **Fig. 24**. These **Microwave 'bricks'** are sought after second-hand and with the advent of cheap 100MHz synthesisers [2], remove the need for an expensive quartz crystal, which they rely upon. Typically, they can produce 10–100mW (+10 to +20dBm) so are ideal for driving a µwave mixer. They predate stripline construction. That is no problem, and they are valuable, useful items, which lend themselves to GPS locking via the crystal drive.

Passive **frequency multipliers** can be employed to achieve higher frequencies as illustrated by the hardware in **Fig. 25**, which is followed by an interdigital bandpass filter


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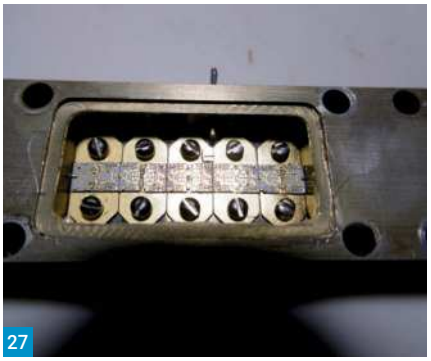
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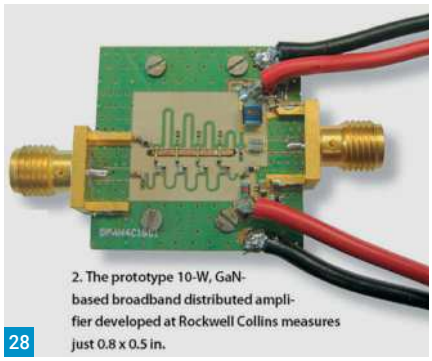
2. The prototype 10-W, GaN-based broadband distributed amplifier developed at Rockwell Collins measures just 0.8 x 0.5 in.
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Fig. 16: Rotatable waveguide joint.
Fig. 17: 10GHz logarithmic amplifier and Vivaldi antenna. Fig. 18: A selection of microwave components, including Gunn diode source.
Fig. 19: Backdiode and 15dB directional coupler.
Fig. 20: 24GHz TWT. Fig. 21: YIG microwave source. Fig. 22: Failed electroformed Gunn diode video oscillator. Fig. 23: 10MHz signal source with various dividers and multipliers.
Fig. 24: Microwave oscillator 'brick'.
Fig. 25: Passive frequency multiplier.
Fig. 26: MMIC frequency multiplier.
Fig. 27: an alternative MMIC frequency multiplier.
Fig. 28: 10W amplifier using TWT structures.
Fig. 29: 12GHz prescalar. Fig.30: 12GHz counter.

built using metal cavities to obtain superior performance than possible using stripline. Limited drive levels remain challenging. Note, however, that such devices also multiply the phase noise modulation of the sidebands, an undesirable characteristic. Expensive MMIC frequency multipliers (40GHz), as illustrated in **Figs. 26** and **27** using waveguide input and output and cascades of MMIC stages, indicate the practical complexity involved. These always result in narrowband amplifiers because of unavoidable parasitics. Another approach is shown in **Fig. 28**, a 10W device, which illustrates an attempt to incorporate travelling wave structures (just like a solid state TWT) to broaden the available bandwidth and these become more practically realisable and amenable for an amateur constructor. The most versatile arrangement, I have found, is however, using a broadband logarithmic amplifier, Fig. 17 [2]. A large bandwidth produces a large noise bandwidth (kTB), the antenna provides some filtering [2 & 4] but is not really significant so a (lossy) filter becomes important to incorporate in most instances. Always seek screened versions of such amplifiers because signals at µwave frequencies only require (very) small holes to couple energy. An effective way to identify those is by observing the spacing of the VIAs used in the PCB (the reverse side), the closer the better. Unlike waveguide these coaxial fed amplifiers are intrinsically broadband (TEM) mode operated.

It is often possible to pick up surplus µwave RF amplifiers cheaply (at rallies) and these can save a lot of effort. I use broadband +30dB gain coupled to my NA/ VNA in my antenna test range. It is educational to look on the **DB6NT** website and others to see commercial but quasi-amateur (hence affordable) available hardware. For example, a cheap 3GHz **frequency counter** becomes 12GHz-able when preceded by a divide by 10 **prescalars** as illustrated in **Fig. 29**. However, this particular one is no longer being produced. A current cost effective but sophisticated 12GHz counter is shown in **Fig. 30**.

References

[1] To come. Microwave and Millimetrewave radio propagation.
[2] Banggood, search on the web.
[3] MAX2870, ADF4371 (32GHz) /ADF4351, AD8317 etc., Hittite – look on web.
[4] Antennas for sale, [2] and e.g. www.wa5vjb.com
[5] *Scatterpoint*, look on the web and join. www.microwavers.org/indexs.htm

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Overcoming Problems

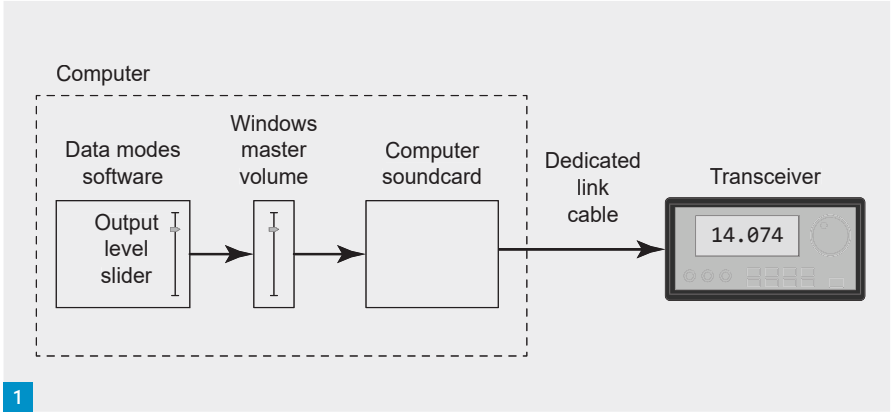
This month **Mike Richards G4WNC** has an introduction to SDR-Console and some ideas for solving problems commonly encountered by those new to data modes operation.

Readers often write to me asking for help when starting in data modes, so I thought it might be helpful to cover some of the more common problems here.

No transmit audio: This is by far the most frequent help request. New users can find themselves stuck where all the settings seem to be OK, the transmitter switches into transmit, but there is no RF output. This indicates that the transmit audio tone from the data modes software is not reaching the modulation stage of the rig. In **Fig. 1** I've shown a simplified block diagram of the transmit audio path. This frustrating problem usually occurs when using dedicated cables to connect the computer to the audio and CAT connectors on the rear panel of the rig. However, this can also happen when using a USB cable for the rig to computer link. The first thing to check is that you are using your rig in its Data mode, not just USB. Several rigs will only accept audio from the rear panel connections when the rig is in Data mode. When set to standard USB or LSB the rig looks to the Mic input for its transmit audio source and ignores the rear connections. Although it might be tempting to change to using the microphone input for data, you should avoid this because your data signal is likely to be adversely affected by the filtering and compression used by most rigs. You will also encounter more audio gain from the microphone input, which can lead to audio distortion that can ruin your signal and interfere with adjacent stations.

If putting your rig into its Data mode doesn't fix the problem, you will need to intercept the audio path to localise the problem. If using an older rig without a USB connection, you need to adapt an earbud or headphones to listen to the audio. I've shown an example in **Fig. 2**. Put your data software into transmit using the Tune button. Disconnect the audio cable from the rear of the rig and use the earbud/headphones to listen to the appropriate pins on the cable, **Fig. 3**. You'll need to refer to your rig's manual to identify the correct pins. You should hear a clear audio tone. If the tone is present, it indicates that the problem is with the rig settings, so you need to revisit those. If the tone is absent, the problem is either in the cable itself or, more likely, the wrong soundcard selection.

Transmit power: Popular data modes such as FT8 are more efficient than SSB, requiring far less transmit power to achieve a similar range. You should also note that most data modes send continuous tones with a 100% duty cycle, and many rigs aren't rated to sustain full power. For example, a 100W rig will typically be rated for 30W of data modes operation. However, even 30W is often far more than you need for effective communications with modes such as FT8. A useful guide as to whether you're using too much power is to check your received SNR reports. If they're greater than 0dB, you should consider reducing your power. A good operating target is to receive SNR reports in the range 0dB and –10dB.



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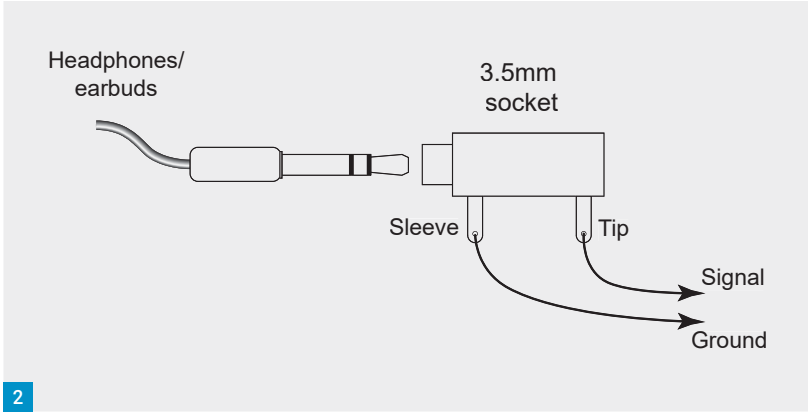
Transmit drive setting: In addition to keeping the power down, you need to be careful when setting the audio drive level. Remember, we create our modulated data modes signal with audio tones and use the SSB modulator in the rig to generate the RF. If you send too much audio into the rig, it will overload the audio stages and cause distortion and ghost signals in the audio spectrum. These will pass through the SSB modulator and cause interference with adjacent stations. The simplest way to overcome this is to use the transmit drive slider in your data modes software to control your output power. **Fig. 4** shows the transmit slider in WSJT-X, which has a 45dB adjustment range. With the Tune button activated and a dummy load connected, you should be able to see your output power change as you move the TX slider. If the RF output remains constant, that's a sure sign that you're into audio overload. To fix this in Windows 10, right-click on the speaker icon (bottom right of screen) and select Open Sound settings. In the Output section, choose your soundcard from the drop-down menu and use the Master volume slider to reduce the output level. The ideal setting will produce full RF power when the WSJT-X slider is around 75%. Once you have the levels back under control, you can adjust your working power level using the transmit slider in WSJT-X. For maximum drive, increase the slider until the RF power stops rising and then back off slightly.

New Pi OS

Those familiar with the Disney/Pixar Toy Story films will know that the Raspberry Pi operating system (PiOS) releases are named after characters from these films. The latest release is Bullseye (Woody's horse in Toy Story 2). While there aren't that many visible changes, plenty is going on under the bonnet. The main change is in the interface toolkit that provides the GUI (Graphics User Interface). This has been updated to GTK+3 to bring the PiOS in line with most other Linux distributions. Linked



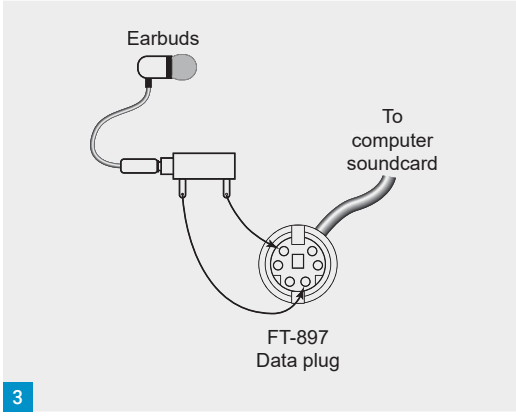
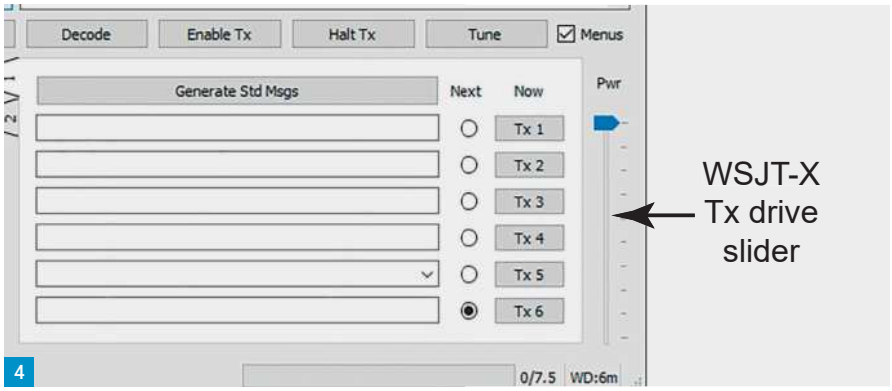
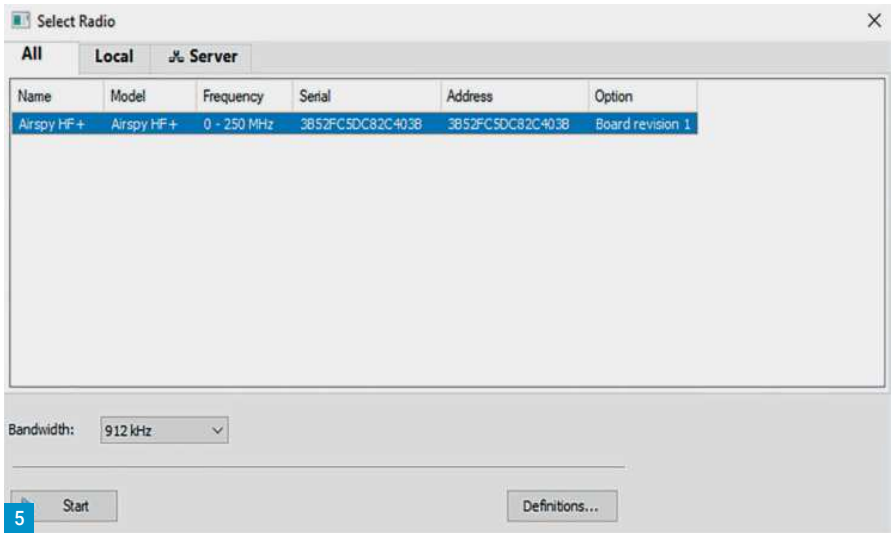


Fig. 1: Typical transmit audio path.
Fig. 2: Adapt headphones/earbuds for monitoring.
Fig. 3: Monitoring the audio from the computer.
Fig. 4: WSJT-X Transmit level slider.
Fig. 5: SDR Console Select radio panel.
Fig. 6: SDR-Console main display.





to GTK+3, is the new window manager, Mutter. This controls the drawing and display of windows on the screen. The significant change with Mutter is that it creates the GUI in buffer memory, prior to sending to the hardware for display. With the complete display in a buffer, Mutter can add drop-shadows, opening and closing animations and other embellishments to provide a more polished looking display. However, the new screen system requires more RAM, so is only available on Pi 4 and 400 models with 2GB or more RAM. The new PiOS will run on other Pi models, but they will automatically revert to using GTK+2 without the embellishments. The changes to GTK+3 are a precursor to moving from the X windows system to one based on Wayland.

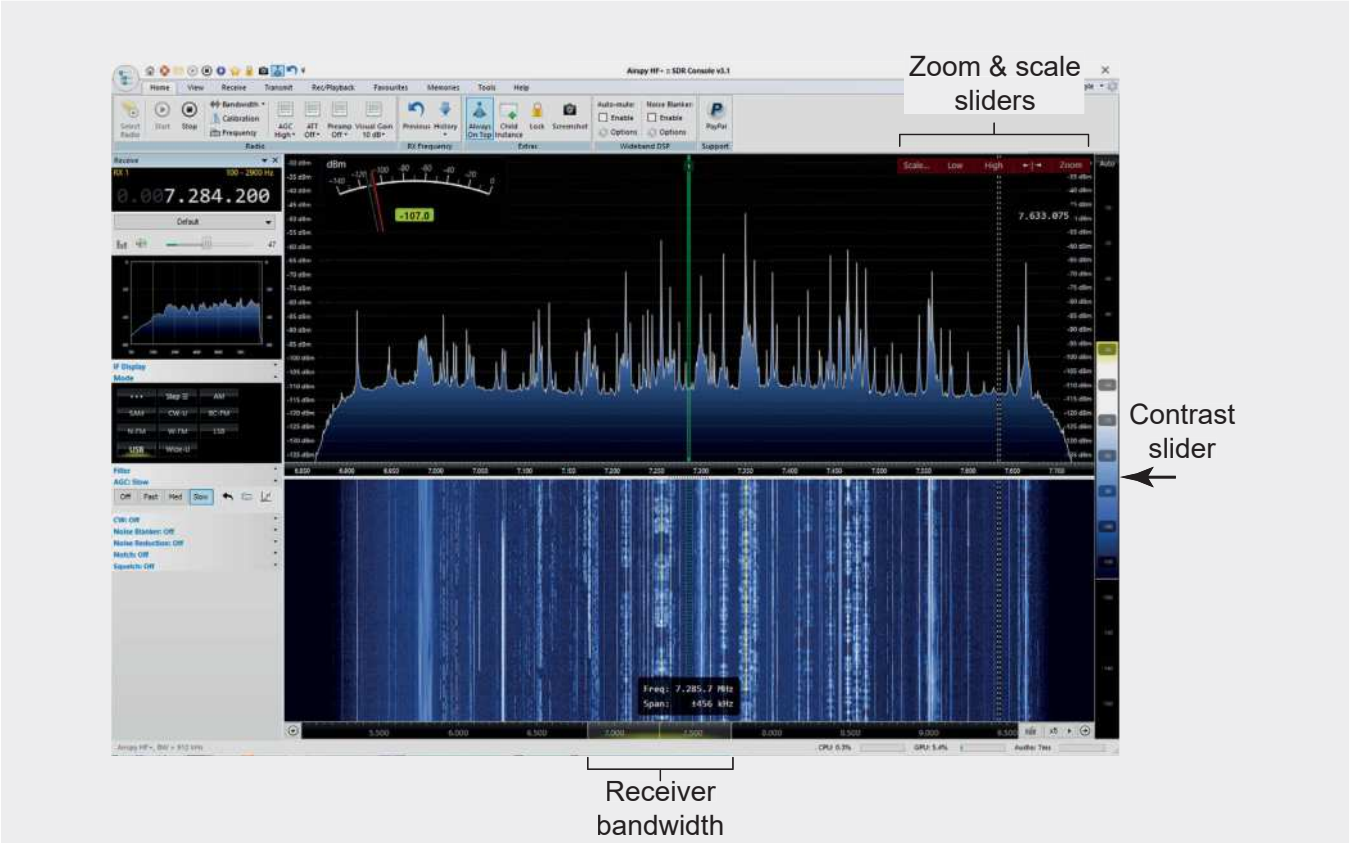
One of the most useful changes to the new OS has been a serious update to the notification system. The default setup will show all systems notifications using a pop-up box that appears in the top-right corner of the screen. These can be cleared with a single mouse click or left to self-close after 15 seconds. Standard notifications include power voltage warnings, USB memory removal without ejecting, etc. System updates have also been improved with a new updater. This automatically checks for updates every time the Pi boots and displays a download icon and a message when new updates are found. You can then choose whether to install. This is a much friendlier system than opening a terminal and using the update/upgrade commands.

Finally, there are changes to the display and camera drivers. In previous releases, dedicated closed-source drivers were used, which limited utilisation by third party software developers. That has changed, and KMS (Kernel Mode Setting) handles the display connection. This is the standard Linux method to access display connections. The camera now uses the open-source libcamera API instead of dedicated Pi APIs.

As there are so many under-the-bonnet changes, it's better to start with a fresh download than try to upgrade the existing OS. Readers interested in my pre-loaded microSD cards may be pleased to hear that all but the PiAware card are using the Bullseye release. As a bonus, the Data Modes, Spy Server and iGATE cards use 32GB, 100MB/s microSD cards!
www.g4wnc.com/shop-2

SDR-Console – Getting Started

Although I frequently recommend the powerful SDR-Console software from **Simon Brown G4ELI**, I haven't yet provided a tutorial, so I'll put that right here. SDR Console is a free download for amateur radio use and can be downloaded from here:
www.sdr-radio.com/download



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Although Simon doesn't charge for his software, I encourage you to donate if you find the software useful. Donations can be made via the PayPal button in the Home tab when you have SDR-Console running. Simon and his development team put tremendous effort into refining and extending this software. I've had access to the development stream for a few years now and have seen how hard they work to fix problems and develop new features. A donation is a small price to pay for their hard work.

Once the SDR-Console download has finished, double-click the file to start the installation wizard, where it's OK to accept the default settings. Before using SDR-Console with your radio, I recommend testing your radio's operation with the manufacturer's recommended software. This will ensure that any essential drivers have been installed and are working correctly.

The next step is to start SDR-Console and select your receiver. SDR-Console supports an extensive range of receivers and a few rigs. You can see an up-to-date list here: www.sdr-radio.com/radios

During start-up you will see a Radio Definitions alert reporting that you haven't added any radio definitions. To add a radio definition, click the word Definitions to open the Radio Definitions panel. Here you click the Search button and choose your receiver model from the drop-down list. SDR-Console will then search your computer to see if it can detect the selected radio. When found, you will see a message with an option to add the radio. Accept that. To complete the radio detection, press the Save button. This will return you to the Select radio panel, **Fig. 5**, where you can click to select your new radio and press Start to begin monitoring.

If all is well, after a short delay the display should spring into life. I suggest you familiarise yourself with the main panel before venturing into multiple receivers and other sophisticated features. As shown in **Fig. 6**, the large spectrum and waterfall graphics dominate the display. The graphical displays are one of the strong points of the software and they look imposing when shown on 4k screens. These displays feature well-honed controls that make it easy to customise the display for any signal type. The popular click-tune method using the mouse is available for tuning into specific stations. You can follow that up by pressing the centre icon (two opposing arrows with a vertical line between). This is located in the top right by hovering the mouse over the display. Clicking this option retunes the receiver to put the tuned station in the centre of the display. You can then use the Zoom slider (next to the centre icon) to zoom-in and examine the tuned signal in detail. This provides a very detailed view of the signal to the point where you can see the modulation on data signals. Adjacent to the zoom control are sliders to adjust the highest and lowest levels on the display. A real design masterpiece is the contrast slider on the far right of the display. If you click and drag the centre of this slider, you can adjust the waterfall display for maximum detail. To extend the dynamic range of the slider, click on the top or bottom edge and stretch it.

In addition to click-tuning, you can roll the mouse wheel over the digits in the frequency display for fast frequency changes. You will also see a shaded bar just below the waterfall. This shows the current overall receive bandwidth of the radio and can be dragged with the mouse to a new frequency band. You can also use the keypad symbol on the lower status panel or use the presets available on the Favourites tab.

This is just a brief introduction to this software, and I'll be delving into some of its more sophisticated features next time.

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Radio over the Internet

Dear Don,
As soon as I read **Joe Chester M1MWD's** very interesting article (December issue) I knew what would happen, and it has! Operators writing in to prophesy the death of amateur radio!

I have 78 turns on my personal toroid now and I can remember, as a callow youth of 13 years, winding coils on toilet roll formers for one and two valve circuits designed by such luminaries as **FJ Camm** and **FG Rayer G3OGR**.

Over the decades, I have owned and loved various rigs, and more recently, following 23 years QRT, I built the G-QRP 'Sudden' line up, and the thrill of working a Swedish station on my blistering 2 watts was almost as good as hearing an Australian broadcast station on my first one valver!

When I came back on air just over five years ago, I bought a Yaesu FT-7900, which I still use on 2m and 70cm. I also now have an FT-817ND.

I use the 817 on all the modes that it is capable of. Before going QRT 28 years ago, I had an FT-101E and an IC-240, both splendid rigs in their day. But the 817 is better than the 101 was as it is so much more capable. And it seems I'm doing just as well for contacts with my 5 watts as I used to do with 100 watts!

But coming back was quite a culture shock. I'd never heard of SDR and various of the modern digital modes, and although I'm still a CW operator at heart, I do enjoy using them, including (wait for it!) DMR!

The point of all this is to reiterate something I was told by a very respected radio amateur circa 1956. One of the great beauties of our hobby is that it really is all things to all men and women! It can be as technical or a simple as any one of us wishes for. You can still design and build your own gear or you can buy it. It's entirely up to you and is nobody else's business.

I reckon that amateur radio will still be around 50 years from now and there will still be letters predicting its demise and harking back to the good old days of the birth of WSJT-X and DMR!

I clearly recall, still in my teens, listening to two old timers on 80m AM on my R1155 moaning about the racket those new-fangled teleprinters were making on the bands!

It's called amateur radio for a very good reason. Any amateur activity is performed purely for the love and pleasure that can be derived from it, be it playing the dame in your local village panto or working the DX.

I'm personally not a contester, but good luck to all those who are. I can use the bands in midweek when they're all slaving in their salt mines!

Ivor Wilkinson G4RJA
Hilton, Derbyshire

*(**Editor's comment**: Many thanks Ivor and delighted to know you are still getting pleasure from the hobby after so many years.)*

Online Learning

Dear Don,
Further to **Pat Walton M1BNH's** letter regarding Foundation Licences. I benefitted from the RSGB's brave decision to have licence exams online. As a senior citizen looking for a new challenge, I joined my local radio club (Furness Amateur Radio Society) in early 2020 and enjoyed a few Saturday sessions preparing for my Foundation Exam. We actually did complete practical sessions, but the dreaded Covid restrictions came into force a week prior to taking our exams (there were three of us training) when everything was closed down. That was a bitter disappointment!

Thankfully the RSGB took the radical decision to have online exams, I thought I was privileged to have President **Dave Wilson M0OBW** conduct the online exam I and two other candidates took just prior to Easter 2020. I got my licence on 22 April 2020 and then went on to train with the excellent Bath Distance Learning Course for my Intermediate on 11 March 2021 and finally my Full in July 2021.

Without online exams, online learning, indeed online meeting (Zoom, Jitsi etc) many of us would have been deprived of enjoying this great hobby, joining in club meets and many other things. I applaud the RSGB for the action they have taken and am pleased to see that they intend to retain online exams, which will benefit future operators that do not have the fortune to live close to radio clubs.

As for lowering standards, has Pat actually tried an online course or indeed an online exam? The excellent Bath course I took, as a qualified electrical engineer with 40 years' service as both an operational engineer and senior manager in the supply industry was both demanding and stretching. Followed by many hours of swotting prior to taking the exams. I think the bar is set high and no one need to be worried that standards are about to plummet.

Graham Postlethwaite M0POS
Ulverston

*(**Editor's comment**: Congratulations Graham on moving through from Foundation to Full during the pandemic. But, as you say, online learning also benefits those who don't have easy access to a club. The RSGB are indeed to be applauded but thanks also to Ofcom for agreeing to the change – too often they suffer from our brickbats!)*

Earthing

Dear Don,
I enjoyed reading **John Adams G3ZSE's** article on the 630m band as it's years since I built an LF transmitter. I noticed the Earthing subject was mentioned. After being part of **Dave Wilson M0OBW's** 4 counties group from

2001 until 2017 I found large numbers of students had questions about Earthing. The bottom line on Earthing in the UK is owned by the IEE regs. They say, *"Under no circumstances must you disconnect a mains Earth"*. They also say that *"All metal other than current carrying conductors shall be Earthed"*. It's the law, break it and you may meet a judge and jury. There are a couple of exceptions. *"Equipment marked with a double square one inside the other is double insulated"* and does not need an Earth. *"Equipment manufactured and ready for use"*, for example a metal wall light with a flexible lead and a moulded 13A plug. If you cut the plug off to extend the cable, you break the exception. So what else can happen?. If your neutral wire is cut outside your house, you also lose your Earth as the neutral is connected to the Star point of the transformer in your local Sub Station. The Star point is connected to Earth in the Sub Station and we are supplied with a neutral and one phase of the transformer, for example 230V AC. All the power to the house will fail and you need the local area board to sort it out. At this time due to equipotential bonding in modern houses all the metal in the house such as radiators, sink units, etc will have 230V AC on them but you probably won't get at shock as there is no Earth return. However, if you have a good RF Earth connected to that wingnut, it is possible for a circuit to exist between your RF earth and the Earth in the Sub Station via a link through the soil. Most soil links have quite high resistance and danger of a bad shock can be low. Back fed circuits do happen.

At our Warrington ARC special Olympic station GB2012MV we operated on several bands from 7am until 7pm. Each rig had a 13.8V PSU. All but one had their DC Negative connected to Earth, which took the mains earth to each setup. One PSU had a floating negative so no Earth to the rig or ATU. This rig was connected to a PC for logging via a thin wire. When I checked, the mains Earth via the PC wire was connecting the rig to Earth. Nothing went wrong but a heavy fault would have damaged the cable to the PC. Back feeds can creep up on us. Thanks for a great year in *PW* keep the good reads coming.

Albert Heyes G3ZHE
Warrington

Various

Dear Don,

Christian Bravo W4ALF has uploaded a free how to Bicycle Mobile pdf to the internet at link below. May be of interest to your readers:

tinyurl.com/bicyclemobile

See how an Elecraft K4 is assembled in a 3D presentation by **Wayne Burdick N6KR**, a co-founder of Elecraft:

tinyurl.com/2y22j2vb

The recent changes to Ofcom EMF test requirements are best followed here:

https://tinyurl.com/rm9juv34

From 2004, UK amateur radio licences are in three tiers: Foundation, Intermediate and Full. Before then, it was the RAE (Radio Amateurs' Examination). In response to recent online conversations, this page takes a quick look at the RAE and how it compares to the 2019 syllabus.

https://tinyurl.com/mtfkk95j

Bob Houlston G4PVB
St. Albans

Changes in the Hobby

Dear Don,

Well, it certainly had to be 'many years' since **Terry Sims** (September 2021) happened upon amateur radio.

And then he suggests a page or two devoted to 'jargon busters'. With respect, I can think of several much more interesting things that would be far more instructive than giving over two pages to explain all the various acronyms that litter our hobby like confetti at a wedding.

Terry explains that he moved onto computers and became a *"chartered electrical engineer and later an MSc in digital stuff"*. Surely, he must know that these areas of expertise are rampant with acronyms too, especially in the computing realm. Talk about acronyms, nowadays digital speak is like another language. And let's not even mention physics, geology, medicine, spin theory and rocket science etc.

However, I do empathise a bit with his views with regard to newcomers. Mind you, I do recall that when I was a newcomer to amateur radio, I had to figure out all the confusing acronyms by myself. The more time I spent with amateur radio, slowly, most of the acronyms fell into place. I knew what 'CW' and 'ALC' meant and so on. And 'CAT control'. That's something to do with computers!

In all my time with amateur radio, I have not seen any magazines (including *QST*, *CQ* or *RadCom*) devoting a page or two giving a blow-by-blow account of what acronyms they choose to publish and what they all actually mean. Never. No, once you jump aboard a hobby or a profession, all the acronyms fall naturally into place. One by one. Like, for example, KISS (Keep It Simple Stupid).

Ray Howes G4OWY/G6AUW
Weymouth

*(**Editor's comment**: Thanks Ray. There is actually a great way of handling this nowadays, which is to put them on the web. That way the list can be kept up to date and without taking space in the magazine. As I said in a recent editorial, I am currently working with my colleague **Georg Wiessala**, editor of* Radio User, *to do just that.)*

Antenna Switch

Dear Don,

OK. I'm dead lazy. I look for the easy way. Or for the cheap way.

Loved the antenna switch project (March 2021) but a bit complicated I thought.

First idea was to use an eight-way relay bank and a Pi Zero W to drive it via the GPIO pins. Control signals sent over WiFi using ssh:

https://tinyurl.com/766zh4td

Then I remembered the remote relay thing I have to work the garage door. OK, it's only four-way but if you need eight-way, then buy two (see url below):

https://tinyurl.com/vsbpeh9v

Yes, you still need to send DC down the feeder but as there's no signalling that can be much simpler.

Nev Young M0NFY
Norwich

CE or Not?

Dear Don,

In the recent review of the Lab 599 Discovery TX-500 (November 2021), I noted the phrase *"the rig gained CE Certification"*.

As I understand the situation, since BREXIT, Great Britain (i.e. England, Scotland and Wales as opposed to the UK which is England, Scotland, Wales and Northern Ireland), CE marking on goods sold in the UK is now not required. CE marking is only required on goods sold in the EU and Northern Ireland.

Prior to BREXIT, it was a legal requirement to CE Mark relevant goods (including most electrical equipment) sold in the UK to legally comply with the EU CE Marking Directive. CE marking was an indication that the goods met the relevant EU Directives, which include Electrical Safety and EMC directives.

Post BREXIT, it has become a legal requirement to mark relevant goods (including most electrical equipment) sold in the GB with the UKCA mark. This applies to all goods that were previously CE marked. UKCA marking is an indication that the goods meet the relevant UK Directives which include Electrical Safety and EMC directives.

Note that the UKCA mark is not valid for the goods sold in Northern Ireland. There is a version of the UKCA mark that can be used in Northern Ireland, this is the UKNI mark. However, this is not valid for goods sold in the EU, they still have to have a CE mark.

There is a transition period in which goods bearing the CE Mark can still be sold in the GB, this finishes on 31 December 2022. After that date all relevant goods sold on the GB Market must bear the UKCA mark to comply with the UK legislation.

Jim Carter G0LHZ
Reading

ATUs

Dear Don,

I read the recent article in *PW* about various ATU setups. I would recommend reading the article in *PW* some years ago by **Tony Nailer** in his *Technical for the Terrified* series, which explained the various types, along with their pros and cons.

The usual built-in ATU these days will cover up to 150Ω impedance and is mainly for co-ax fed antennas such as dipoles or verticals.

Manual ATUs are quite a lot different.

The Yaesu FC 107, FC 301, FC 901 and FC902 using 50Ω output cover antennas from 10-250Ω impedance. Using a 75Ω output they cover 18-300Ω impedance.

Kenwood AT120, AT130, AT200 and AT230 using 50Ω output cover 20-300Ω impedance, while using 75Ω output they cover 50-500Ω impedance.

Comet CAT 300 covers up to 600Ω impedance.

KW 107 and KW 109 cover 30-2000Ω impedance.

SEM Transmatch will cover 30-5000Ω impedance.

Figures taken from the manuals.

Ross Bradshaw G4DTD
Cornwall

Q Multipliers

Dear Don,

I was amused by **Bill Kitchen G4GHB** (*Letters*, December 2021) delving into the past for a *Q*-multiplier circuit for his R1155. If he had gone back another few years (*PW* November 1961, pp 633-634) he would have found what I think was the first transistorised *Q*-multiplier circuit described in a short article by myself. It worked well in both an R1155 and a 19 set. I doubt whether a germanium 'white spot' transistor is still available anywhere... If memory serves, they were selling for about 7s 6d (37.5p) at the time.

Paul McGoldrick G6AAC
Sittingborne, Kent

Next Month

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

SDR RECEIVER PART 3: Samuel Ritchie EI9FZB continues by looking further at the bandpass filter and the voltage controlled oscillator.

THE FACES BEHIND THE CALLS: Roger Dowling G3NKH returns to introduce us to Linda G0YLM and Ian Maude G0VGS.

THE KENWOOD TL-922: Dr Bruce Taylor HB9ANY describes this potent HF band linear power amplifier.

THE PW PASTON: Mark Tuttle G0TMT describes the building of the audio board.

A POCKET PORTABLE 2 METRE BEAM ANTENNA: David Johnson G4DHF has a design for a useful 2m antenna for portable work.

There are all your other regular columns too, including HF Highlights, World of VHF, Valve & Vintage, Amateur Radio on a Budget, Kits & Modules, Doing it by Design and Data Modes.

The highest satisfaction score for Ham Radio on Trustpilot?

That would be us then!

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2022 HAPPY NEW YEAR

Here are some review samples:
I have purchased many items from ML&S over the years back to 1990 when I first got my licence. ML&S have always had excellent customer service and are very helpful regarding any questions you might have, hats off to you Martin and your superb staff. I recently traded in my Acom 1010 which I purchased from you for a used Acom 1000 you had in stock and I'm very pleased with it. Keep up the excellent service you provide, definitely the best amateur radio store in the country, all the best for the future Martin to you and your staff. Roy G0OVK.

Yet another great purchase from ML&S I tend not to use any other dealer now. Cheers, John M0CDL Fists.

Excellent service and product knowledge from a very efficient staff. Robert.

The Product was on back order so I requested a notification when it came in stock, which they did. Bought and paid over the phone, very easy delivery, promised for next day arrived, as promised, next day well packed. Real end-to-end service from ML&S where others fall short. The 5 Star is an earned mark not a rubber stamp and they earned it valuing their customers. WB.

Purchased from here several times now & will do so in future. Mr Steve Venner is also a very helpful employee when it comes to sourcing parts that I found difficult to source on other websites.
Keep up the good work guys. Damian.

Ordered DMR Radio Anytone 878UVIIPlus on 27 November 2021. Took delivery here in Brisbane on 3 December 2021. Great service from Martin Lynch and DHL as courier. Thank you very much - radio is working very well. Brinley Taylor VK4GF.

A great radio retailer! I have ordered several items from this company. I can thoroughly recommend them as very efficient and reliable. Goods are always well packaged and postage very quick. Advice given is first class - from a team of real professionals. Thanks for great service - I'll be back!! David Pounder.

My favourite radio shop **Friendly, reliable, helpful and thoroughly trustworthy. Everything you need from a ham radio store. Geoff Wilkerson.**

As usual Brilliant service from them
I have never had to complain in all the years i have dealt with Martin Lynch and Son. Must be Twenty Years now. Michael Downes.

Fantastic customer service **Without doubt the best customer service I have received from any company. I can't thank Paul enough for his care and attention. He is a credit to the company. Well done, and you will have my custom going forward. Paul H.**

A truly excellent experience I have recently bought a few things from ML&S, and have to say the advice beforehand and the fast service after purchasing was excellent. I would thoroughly recommend them as a trusted retailer. I will definitely return. Neale Hambly.

Outstanding in every way **Service, delivery, product knowledge and accessibility. Nothing too much trouble and highly recommended. Laurie Vaughan.**

What a service Where do I start? Wanted a handheld radio to fit my needs so after much deliberation decided to email ML&S sales for a recommendation on various radios and was emailed straight away by "RICHARD". He pointed me in the right direction and unlike most he didn't try to oversell me products I didn't need, and the delivery service was amazing. The transceiver came well packed the very next day, now that's what you call customer service so a great big thank you to ML&S.

PS: Give Richard a pay rise lol.
Regards and 73's Christian.
(We did – the Guv'nor)

Reviews posted on a daily basis from our customers always make great reading for me.

I've always tried very hard to put a smile on everyone that walks through my door (or more so these days via email and phone calls). My dedicated staff are carrying on the standard set by me from the very first day of opening my little corner shop in Ealing. A lot has changed in the last 31 years but one thing that never falters is the ML&S customer service and satisfaction. When we get it right we get it right. When we get it wrong we try even harder to get it right. That's the difference. Anyone can knock off a few quid to get a deal but no one comes close to the level of service we offer.

Thank you all for your continued support as we look forward to 2022. ***73 de G4HKS the Guv'nor.***

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The must-have magazine for all cat lovers and cat owners alike.

Leave us a review

If you have enjoyed this magazine then do the next thing to shouting it from the rooftops and leave us a review instead! We all like to know when something is good and if something has been rated highly by others. Leave us a review to let others know what you think of Practical Wireless.

The Battle of Britain
IN COLOUR

"Praise where due. This is the best magazine available which I have read - I am very impressed. I thoroughly enjoyed reading each chapter and it was written in such an easy style. It covered every aspect and I was saddened when I reached the end."

This 164-page special collector's edition commemorates the 80th Anniversary of the momentous Battle of Britain, making it the perfect gift for any aviation or Battle of Britain enthusiast.


THE BATTLE OF BRITAIN IN COLOUR

The Battle Looms

The Battle of Britain was one of the most iconic battles of the Second World War, embedding itself indelibly into the nation's consciousness. Earlier, the Battle of France could easily have spelled defeat before the air battles got underway in July 1940.

After the outbreak of war in September 1939, there followed eight months of what became known as the 'Phoney War'. However, it was clear that large-scale fighting would ultimately follow, and a British Expeditionary Force was sent to France before the end of that year. As part of that BEF, a large Air Component was supplemented by an Advanced Air Striking Force. In total, these air forces amounted to 25 squadrons, six of which were Hawker Hurricane-equipped fighter squadrons. The remainder of the RAF force in France comprised largely light bombers and Army Co-Operation squadrons. Eventually, however, the 'Stukoj' became the 'Blitzkrieg'.

On 10 May 1940, German forces launched their all-out assault on France and the Low Countries and what followed in Belgium, the Netherlands etc. was the complete collapse of those countries under the overwhelming might of German military power. Across France, German forces rolled inexorably onwards towards the English Channel and while the French and British tried desperately to stem the advance, so the situation became ever more hopeless.

Predicted Catastrophe

When the fighting had broken out in earnest on 10 May 1940, aircraft of the Air Component were in almost constant combat, and losses had to continually be made good from squadrons based in Britain. The Commander-in-Chief of RAF Fighter Command, Air Chief Marshal Hugh Dowding, had already stated as early as September 1939, that if he was expected to defend Britain's skies, then he would need 52 fighter squadrons. At that time, he had only 32 under his command and was told it would be impossible to produce the number he required. However, efforts would be made to provide him with a further eight.

During the fighting in France, increasing numbers of fighter squadrons were sent across the Channel, urged on by desperate appeals from the French Prime Minister, Paul Reynaud. Dowding saw his resources 'slipping away like

BACKGROUND TO BATTLE

THE RAF FIGHTER PILOT

THE RAF FIGHTER PILOT