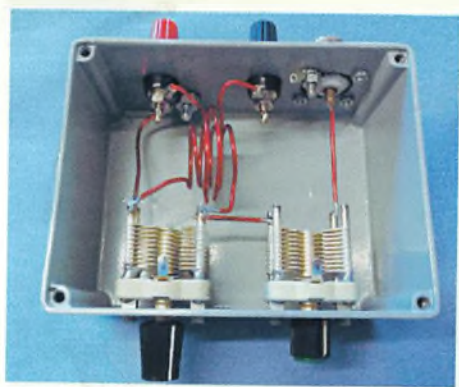


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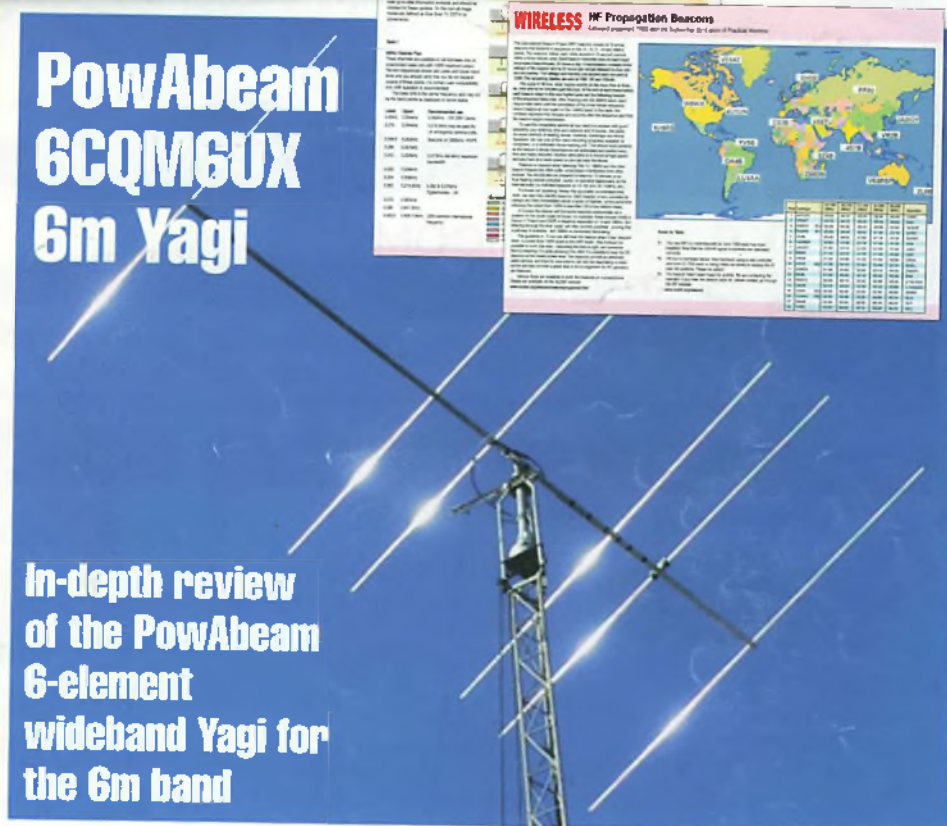
Transistors

**What you've always wanted
to know about transistors
but were afraid to ask!**



**PowAbeam
6CQM6UX
6m Yagi**

**In-depth review
of the PowAbeam
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wideband Yagi for
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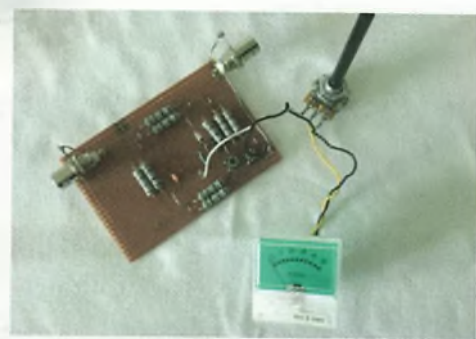


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K3S/100-F £2999.95

K3S/10-F £2449.95

K3S/100-K £2849.95

K3S/10-K £2299.95

Features:

- Accurate, high-speed CW transmit.
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KXPA-100-K £899.95

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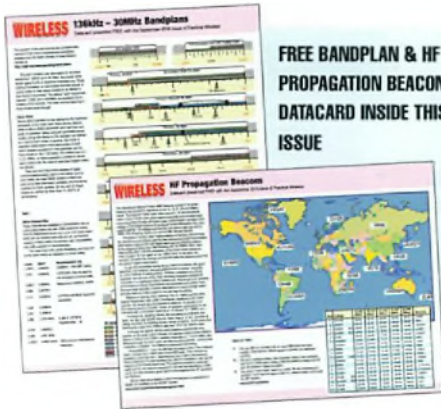
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Microphone Connection Data

PW reader **Bob Houlston G4PVB** draws our attention to a handy website. While some microphone connectors look the same, they could be wired differently and misplacing may damage your rig. **Roy G4WPW** has uploaded, via the link below, a phenomenal amount of free data and pictures to help you get it right. www.qsl.net/g4wpw/date.html

Dayton Hamvention Numbers

It is reported that attendance at this year's Dayton Hamvention (held in May) exceeded 25,000 for the second year in a row.

Hamvention attendance peaked in 1993 at 33,669, before the 1996 change in date from April to May. While attendance has fluctuated over the years, Hamvention has grown to international proportions, attracting members of the worldwide amateur radio community each spring. Indeed, at one time PW used to organise reader visits, with then Editor **Rob Mannion G3XFD** and publisher **Roger Hall G4TNT** acting as tour guides.

The Dayton Amateur Radio Association (DARA) has sponsored Hamvention since 1952. Originally called the Southwestern Ohio Hamvention, the inaugural event, held in March in downtown Dayton, attracted 600 attendees – twice as many as had been predicted. Today it is the world's largest amateur radio gathering.

DARA now is counting down the days to the next Hamvention on May 19th to 21st, 2017. Why not put it in your diary.

Blue Ham 2016

In our July News pages we featured the forthcoming Air Cadets on the Air Exercise Blue Ham. We now have a report on the event.

The exercise, on June 18/19th, was carried out on frequencies shared by the ACO/ACF/SCC/CCF with UK amateur radio stations. The Exercise was for Wing Headquarters and Units throughout the UK to set up a National HF Radio Network for the purpose of contacting as many radio amateurs as possible to exchange specific data between them. The data

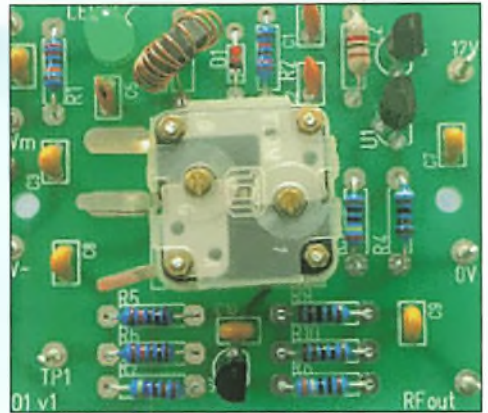
Jared Electronics Kits

Tony Jones G7ETW, who is back this month as *Carrying on the Practical Way* contributor, tells us he has a website under the name Jared Electronics.

Among other items he is making available is the Intermediate Course Soldering Exercise PCB as a kit, with 2.2Ω and 470Ω resistors, 2.5V E10 bulb and batten-type bulb holder, 2V red LED, BC108 NPN transistor and a battery box (for two AA batteries) plus all required hardware and connecting wire.

Please note that the kit does not come with batteries.

The PCBs are still available on their own. The photograph is of the 80m VFO project. <http://jaredelec.wix.com/home>



from both stations was then passed by e-mail reporting to HQAC RAFC Cranwell and posted onto the ALPHACHARLIE.org system.

Central & East Region had three stations working – one in the Regional Headquarters, one in Warwick and Birmingham Wing and one in Norfolk & Suffolk Wing.

Norfolk & Suffolk Wing were unable to set up a station at Norwich so permission was given by Norfolk & Suffolk Wing Radio Communications Officer to set one up at No 1132 (Stalham) Sqn, Norfolk run by Civilian Instructor (CI) **Terry Owen**.

The Exercise was not a contest or competition but Norfolk & Suffolk Wing came first in the country with a score of 109 points, almost double the score of any other Wings. This score, along with Warwick and Birmingham and Central & East Region HQ adding to the tally, enabled the Region to finish with the most contacts made at 236 out of a total of 715.

The Station at Region HQ was run by the Regional Radio Communications Officer **Flt Lt David Webb** with **CI John Shere** from No 73 (Huntingdon) Squadron. Warwick and Birmingham Wing station was run by Wing Radio Officer, **CI Peter Coates**.

A special mention goes to **Cdt Sam Brooker** for the number of contacts he made during his period of radio operating in the station (1000hrs to 1800hrs on the Saturday and 1000hrs to 1200hrs on the Sunday).

Cdt Brooker is a holder of an ACO Silver Communications Award so was able to put his radio training to good use by talking to licensed amateurs and other Cadet Force stations. This was a National Radio Event and it is hoped that another such Exercise will take place in the near future.

Pictured are (top to bottom) **Flying**



Officer Phil Barber RAFVR(T), Squadron Officer, Leading Cadet **Sam Brooker** and **CI Terry Owen**, Squadron Radio Officer, taking part in the Exercise and shows the radio setup at their location.

Cornwall Hospice Care Appeal 2017

Reader **Dennis Spratt GK7AGZ/MK3DJS** writes, "In the summer of 2017 I am planning an ascent of Ben Nevis in aid of Cornwall Hospice Care. The aim is to raise much needed funds for this local charity by sponsorship and to hopefully get local companies and individuals to sponsor me for every foot that I climb. Sponsorship can also be for a set amount covered or for completion on reaching the top. Once I have, hopefully, made it to the top, I plan to operate a special event amateur radio station on VHF for around two hours subject to the weather. All sponsorship from local companies and individuals will go to Cornwall Hospice Care. Any expenses will be met by me and since 1988 when I set up C. H. Appeals, I have raised over £12,000. I do hope that you will support me on what will be my only major project of a lifetime, which I hope to complete in my 60th year in 2017. As you will know, Ben Nevis weather can be unpredictable and this may change the



timetable slightly. I will be happy to answer any questions or enquires that you may have".

Dennis can be reached at 13ch26@gmail.com

First UK Contact on 122GHz Band

The Southgate Amateur Radio News website reports that the first UK contact in the 122GHz band took place on Sunday, July 17th between **Roger Ray G8CUB/P** and **Chris Whitmarsh G0FDZ/P**, both stations located at Hackpen, Wiltshire (IO91cl)

On the UK Microwave Group Yahoo

Group, Chris G0FDZ writes:

"The distance was 120m and the CW reports were 599 both ways. An earlier attempt at 5km failed for a two way QSO. As well as signals on 134GHz, of which only a very weak one-way QSO was possible on that band, only the merest hint of a signal on 122GHz was heard. The 122GHz band is noted for its high signal attenuation due additionally to atmospheric oxygen as well as water vapour attenuation.

"The weather during the Microwave contest gave high humidity and absorption of all millimetre wave frequencies was considered by many to be high. Although signals over the short distance were very good, an attempt will be made soon over 1.5km. Power levels were 70µW for Chris G0FDZ and 300µW for Roger G8CUB. One feature of G0FDZ's system was the use of a slab type mixer, which has been recently developed to make millimetre wave mixers easier to construct.

"With a QSO being achieved on this band, it means that every allocated UK band has now had at least one contact".

Variable SSB/CW Audio Filter Modules

SOTabeams have added a new continuously variable audio filter module to their filter line-up. The LASERBEAM-VARI produces near-perfect filters from as narrow as 200Hz up to 3500Hz. It is ideal for SSB, CW and data use. The modules are ready built and just require a few external components (supplied) for use. They can be used either as an external filter or built into existing radios. SOTabeams have a short video on their website showing how the filters perform. www.sotabeams.co.uk



IOTA Maps

The IOTAmaps website is run by and for radio amateurs with an interest in the Islands on the Air (IOTA) Programme. The site is independent of the programme itself but is intended to enhance the IOTA 'experience' by providing graphical and mapping tools to enable users to quickly find IOTA activations sites on the world map. In this way, users will hopefully develop a better understanding of the conditions under which IOTA activations take place.

www.iotamaps.org



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www.commsfoundation.org

to find out all about us and follow the link to Donations.

RCF - looking to the future



The PowAbeam 6CQM6UX 6m Yagi

Vince Lear G3TKN has an in-depth review of the PowAbeam 6-element wideband Yagi for the 6m band.

The PowAbeam Company was set up by Derek Hilleard G4CQM in 1994. In fact the first advertisement for his antennas was published in *PW* in that same year. Derek has been a keen VHF/UHF operator over many years and has been very involved in VHF/UHF antenna design over a long period of time. His very comprehensive website can be found at the URL below. In 1999 he formed an antenna design company (Antenna Designer UK) and became involved in the design of VHF/UHF antennas on a professional basis.
<http://g4cqm.www.idnet.com>

In early 2013, Derek handed over ownership and production of PowAbeam to Richard Mason G6HKS and Roger Banks GW4WND of *PW* advertiser The DX Shop, Fig. 1, (websites below).
www.powabeamantennas.co.uk
www.thedxshop.com

Richard sells the PowAbeam kits and parts, while Roger sells the ready-made Yagis. The PowAbeam range is composed of monoband Yagis of various types covering all amateur bands from 6m to 23cm. In addition to this, Roger also supplies bespoke products to commercial users. All the PowAbeam range is designed by Derek G4CQM.

The PowAbeam Model 6CQM6UX

My first experience of the 6m band was some ten years ago when I bought a transceiver that had 6m capability. I only ever dabbled on the band and this was always with antennas that were far from optimum. However, this year I decided I



Fig. 1: Alex, one of the DX Shop team, drilling out a boom for a PowAbeam in their large workshop in Powys, Wales.

would make an effort and erect a proper 6m Yagi.

I decided, for cost reasons, to go for the PowAbeam 6CQM6UX because it appeared to be good value for money while at the same time offering a reasonable performance. The 6CQM6UX is a 6-element Yagi on a 4.3m boom. Its quoted free space forward gain is 10.2dBi with a front-to-back ratio (F/B) of 23dB and azimuthal beamwidth of 54° between the half-power points.

G4CQM describes the design as a 'FLOWA' (Flat Line Optimised Wideband Antenna). More technical information can be found on Derek's website. This design has the advantage that by careful placement of the directors, together with their individual dimensions, it is possible to obtain an excellent resistive match to 50Ω at the driven element. This means that a direct connection can be made to 50Ω coaxial cable without the need for any extra matching such as a gamma match or impedance transformer.

Another advantage with G4CQM's designs is that they provide wide bandwidth and are very stable in terms of their frequency coverage during heavy rain



Fig. 2: The PowAbeam 6m Yagi prior to assembly. All hardware is stainless and comes in a sealed packet. The Stauff insulator blocks are all factory mounted on the boom, which comes in two sections. The heavy duty cardboard container can be seen on the left of the picture.

or snow. For those who would like to know more about Derek's excellent designs, he has published his work on his very comprehensive website.

Assembly

The antenna comes partly assembled in a 3m x 200mm (approx) very heavy duty cardboard tube with plastic end caps. The packing is very sturdy and would be ideal if the antenna were to be sent overseas or taken on a DXpedition. However, at 3m in length it doesn't come into the hand luggage category!

Although I couldn't find any reference on the DX Shop website as to the antenna's weight, Roger said it was about 4kg. With the very sturdy cardboard container that it comes in, then the total weight would certainly exceed 4kg. The square boom comes in two sections that are easily secured using stainless Nylock nuts. The total boom dimensions are 4.35m x 30mm x 30mm. The photo, **Fig. 2**, shows the antenna prior to assembly.

Each pre-cut element has a diameter of 15mm with rubber caps at its ends. All the elements are in one piece and slide through the Stauff blocks prior to being locked into position. All elements are insulated from the boom. The Stauff blocks are factory mounted to the boom, which has the advantage that no measurements of element spacing have to be made.

The elements are marked out 1 to 6. The driven element clamps into a sealed mounting box that bolts on to the boom.



Fig. 3: The completed antenna laid out on the lawn prior to mounting on the tower.

This has a short length of Ecoflex 10 low loss coaxial cable that is terminated in a female N-type connector.

All the drilled holes line up perfectly, which made assembly an easy task.

On the DX Shop website it states assembly time as just ten minutes. I would certainly agree that this is realistic although I took a little longer because I worked at a leisurely rate.

The photograph, **Fig. 3**, shows the complete antenna on my lawn prior to erection.

Mast-to-Boom Clamp

The antenna comes complete with a mast-to-boom clamp that can be used with support poles up to about 50mm diameter. However, when I came to mount the clamp on the boom I couldn't find any marked out position as to where it should be mounted. Although the antenna is relatively lightweight, I always prefer to fix the mast-to-boom clamp at a point of mechanical balance on the boom.

I used a short piece of square section wood at right angles to the boom and moved the antenna to a position where it was mechanically balanced. This worked out to be 1820mm forward from the reflector element.

In the interests of mechanical balance, it might be worthwhile if a mark were made on the boom as to where the mast-boom clamp should be fitted.

Director Elements

With most conventional Yagis, the director elements reduce in length towards the front of the antenna. When I assembled the PowAbeam, I noticed that the third director was slightly longer than the second director going forward from the reflector. I immediately thought that I had made an error. I checked the element

markings but found that I had assembled it in accordance with the markings on the elements.

I decided to get in touch with Roger to check it out before mounting the beam on the tower. Roger quickly put my mind at ease and said that the third director is indeed meant to be slightly longer than the second one. This information is clearly shown on G4CQM's website, where detailed dimensions are given of all his designs. The reason for the longer third director is connected with the FLOWA design.

However, I feel it might be prudent to include a paper copy of the actual dimensions of the antenna in the box and to highlight this point.

Balun

The antenna does not come with a balun and I discussed this point with Derek G4CQM. Derek said that he has found that so long as the coaxial cable is strapped firmly along the boom, there is sufficient decoupling and no balun is needed. Again, Derek does write about this topic at length on his website.

Initially, I fed the antenna with UR67/RG213 10.2mm diameter coaxial cable, which had a PL259 connector on its end. I used an SO259 to N-type adapter so that it could connect to the short piece of Ecoflex 10 cable (terminated in an N-type female, as mentioned above) that was connected to the driven element. I made sure that the connectors were well taped over so as to avoid any electrical contact to the boom from the outer of the coaxial cable. I reasoned that if the outer of the PL259 and/or SO259 to N-type adapter did short to the boom it could cause unbalance. The photo, **Fig. 4**, shows the boom-to-mast clamp and the feeder taped to the boom.

I have not experienced any RF in the



Fig. 4: The antenna comes complete with a short length of Ecoflex 10 cable connected to the driven element weatherproof housing and fitted with an N-type female connector at its far end. The cable is secured to the boom as shown. I placed the boom to mast clamp 1820mm forward of the rear reflector so as to achieve a mechanical balance.

shack and the pattern is extremely clean with a F/B that appears to be even better than quoted. I can only assume that taping the cable down the boom is effective. Although I used normal PVC tape to do this, I think in retrospect that a neater job would be done if cable ties were used. However, these would have to be UV resistant.

I have recently bought some Ecoflex 10 cable that has a loss figure of 2.8dB/100m at 50MHz. This will replace the present feeder in due course.

EZNEC Modelling

I modelled the antenna in free space on EZNEC 6+ using the exact dimensions for the 6CQM6UX PowAbeam model as on G4CQM's website. My results are shown at Figs. 5 and 6.

I was very pleased to see that my results mirrored those Derek had stated for this design using K6STI's professional software, which, unfortunately, is no longer supported or available. However, Derek also uses other professional antenna design packages. These results also agree with the specification put out by The DX Shop. As can be seen, the antenna shows a clean pattern with good back and side lobe rejection.

EZNEC 6+ showed a free space forward gain of 10.26dBi with a front-to-back ratio of 22.8dB. The beamwidth between the half power points came out at 54.2°.

Practical Results

The real test of any antenna is, of course, how it performs in practice.

I mounted the antenna at a height of 15m on my tower. It was fed with about 40m of UR67/RG213 cable.

With a certain amount of trepidation I fed some RF into it and checked the SWR. In the back of my mind I was wondering

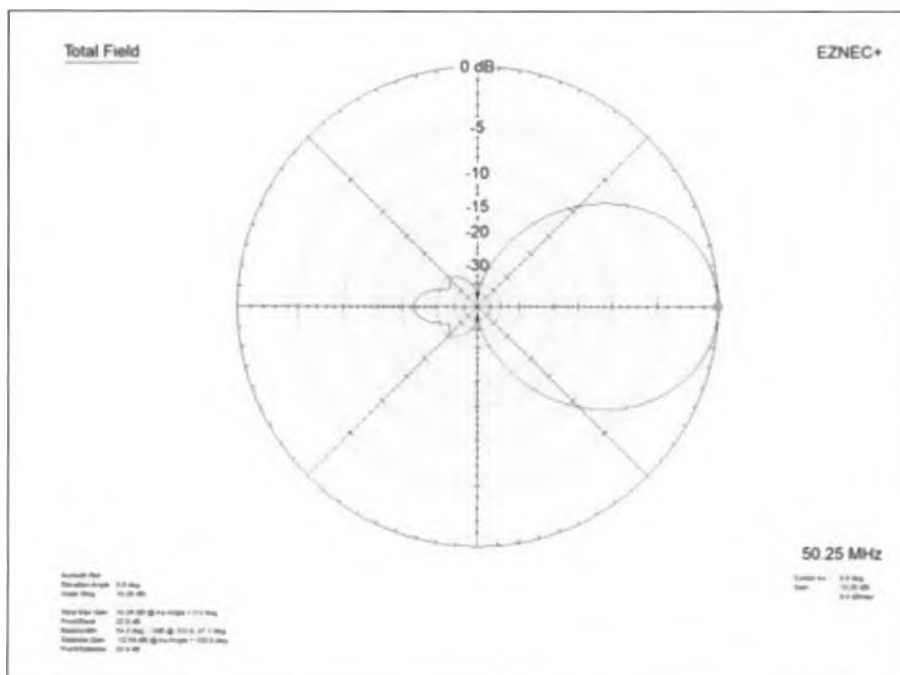


Fig. 5: Azimuthal Free Space plot of 6CQM6UX Yagi given by EZNEC 6+.

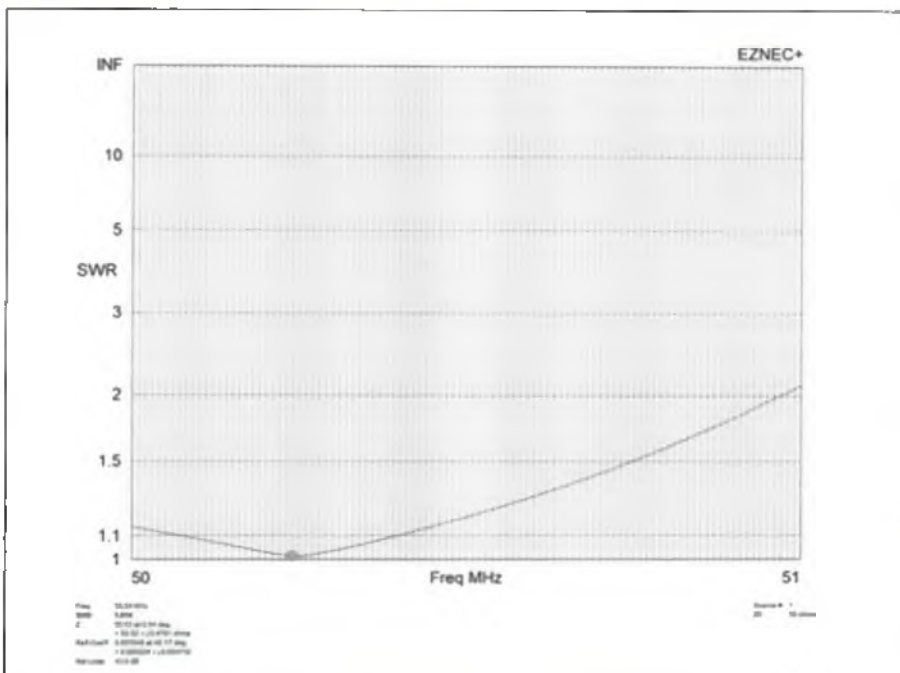


Fig. 6: Modelled Free Space SWR plot between 50.0MHz and 51MHz of 6CQM6UX.

what I should do if the SWR had been high because there were no adjustments I could make on the antenna. However, I was delighted to see a 1:1 SWR on the lower, most used, end of the band, rising to 1.5:1 at 51MHz.

It is important to stress that SWR is no indicator of an antenna's performance and if an antenna is fed with lossy coaxial cable, the SWR will, in fact, improve due to the reflected wave suffering more attenuation. The same will apply if losses are high in any matching circuit.

I checked the antenna out on general

band noise and found that the S-meter on my Icom IC-7600 rose to S5 when I beamed north towards a local housing estate. However, once I started to turn the beam away from it, the S-meter very quickly sank down to S0 (that was with the +16dB preamplifier engaged) and stayed there during rotation right round to the south.

The pattern certainly appeared to be very clean and highlighted the importance of having good side and back lobe rejection on a 6m beam when operating in suburbia. This topic has, of course, been mentioned many times in magazines and

on the internet by various VHF antenna designers.

I did a F/B test with **Rob G3RCE** some four miles away who was using a Flex 6300 SDR with a fairly accurately calibrated S-meter. Rob reported that my F/B appeared to be around 30dB! The specification for the 6CQM6UX gives 23dB and from practical operating I would say that it easily meets this figure.

I used the beam during a 6m activity evening last April. There was no sporadic E and conditions appeared flat. However, I was able to stay on one frequency and make a number of SSB contacts out to around 100 miles without any difficulty while running 100W.

I am able to copy the GB3MCB beacon in St Austell, Cornwall on 50.0424MHz most of the time from my home near Portsmouth. This is a distance of around 300km. The GB3RAL beacon near Oxford on 50.050MHz and the GB3BAA beacon near Tring, Hertfordshire on 50.016MHz can both be heard during flat conditions.

It is difficult to make detailed assessments during sporadic E because propagation can be very selective and while one part of the UK might have

favourable propagation into a specific area, another part may have no propagation at all. Even very simple and inefficient antennas can produce interesting results during sporadic E as I know from past experience when using antennas that were not designed for 6m.

I have, though, been very satisfied with the results of my casual operation with contacts on both SSB and CW (100W) into the west of Russia, ZB2, EA8 and CN8 in addition to the normal mix of European stations ranging from Scandinavia down to the Mediterranean area.

I have had some good contacts into Europe using JT65 under flat conditions, which, while not unusual on that mode, does indicate a very acceptable level of performance for a 4.3m boom 6m Yagi.

Summary

The PowAbeam 6CQM6UX 6-element Yagi offers what I believe to be a good mid-point Yagi, coming between the smaller short boom two and three element Yagis and the big multi-element ones on 7m-plus booms.

While perhaps a larger Yagi might be more suitable for EME, Roger GW4WND

made the point that users are able to take advantage of 'ground gain' with a smaller antenna when pointing to the moon at zero elevation. This would be useful for people like me with no elevation control on the rotator.

I have been very favourably impressed by both the electrical performance of this Yagi and its mechanical build.

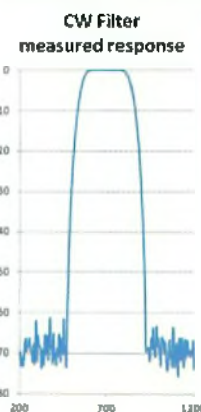
The only very minor points that I would want to highlight relate to the confusion on director length and the placing of the mast to boom clamp as I mentioned earlier. An enclosed information sheet and suitable marking on the boom as to where to place the clamp would clarify the situation.

With 70MHz opening up now in more countries and the new Icom IC-7300 providing 70MHz in addition to 50MHz coverage, it is worth noting that PowAbeam are now producing a dual-band Yagi for both 50MHz and 70MHz with five elements on each band. More information is to be found on their website.

The PowAbeam model 6CQM6UX is available from The DX Shop for £138 (inc. VAT) with carriage extra.



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NEW
SERIES
PART 1

Transistors

David Jardine GOFDV addresses what you've always wanted to know about transistors but were afraid to ask!



The great thing about electronics and amateur radio is that we learn something new every day (well almost) which makes

it a fascinating hobby. Transistors are everywhere, literally. Probably there are millions, even billions in your home and car – in the computer, TV, radio, washing machine, TV remote, mobile phone, DVD player, tablet, watch, ordinary house phone audio system, satnav, calculator and so on.

Recently I walked around my house and office and the number of digital and other electronic powered devices and hence transistors was absolutely astounding. I run a small computerised PR, advertising, web design and brochure business.

Transistors are probably the single most incredible items to have totally revolutionised all life on our planet today in just a few short years. They are used extensively in the aerospace industry, defence, printing, IT, banking, government, and the travel industry as just a few examples. They are truly ubiquitous, affecting us all daily, all day and every day.

Let's Get Started

A transistor is made up of the words transferable and resistor, hence tran-sistor – in other words resistance to a signal is changed by application of another, often smaller, signal.

The study of transistors is a huge subject, encompassing chemistry, electron flow theory, magnetic fields, nuclear physics and atomic structure. Here I'm going to explain just the basics that should be of interest and help to the radio amateur in practical terms.

Firstly, there is much debate and discussion and, yes, disagreement on the facts. I have trawled the internet, read several books and articles on the subject and present my findings here. This is, however, only a really very basic and superficial view of the subject.

Most electronics enthusiasts and radio amateurs know what a transistor can do but few, including myself (until recently), have worked out the whys and wherefores of how they actually work, how they amplify a signal and so on.

Wikipedia's definition is good and states the following: "A transistor is a semiconductor device used to amplify and/

or switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually but many more are found embedded in integrated circuits.

"The transistor is the fundamental building block of modern electronic devices and is ubiquitous in modern electronic systems. Following its development in 1947 by American physicists John Bardeen, Walter Brattain and William Shockley, the transistor revolutionised the field of electronics and paved the way for smaller and cheaper radios, calculators and computers among other things. The transistor is on the list of IEEE milestones in electronics and the inventors were jointly awarded the 1956 Nobel Prize in Physics for their achievement".

Shockley also went on to be involved in the commercial manufacture of transistors. Here I will concentrate on the bipolar junction transistor (BJT), which is constructed from semiconductor material.

Transistors are often referred to as semiconductors because they comprise material that only 'partially' conducts electricity. In this article I will concentrate on silicon constructed transistors (I will ignore germanium, used in many early devices and still found occasionally for particular applications, although some of the principles are the same.)

Let's first of all, consider silicon, the most popular material used in semiconductors. On its own it is a pretty useless conductor of electricity. In fact, from an electrical viewpoint it is useless and can be considered as an insulator or certainly an extremely bad conductor. To enable silicon material to partially conduct (and therefore become a semi-conductor), it has to be doped by a special process.

The silicon atom comprises a central nucleus with 14 positively charged protons at its centre, surrounded by 14 electrons that orbit the nucleus in three different rings or shells. The inner ring contains two electrons, the next ring contains eight electrons and the third ring contains four electrons. These outer four electrons join up or share with the four electrons in nearby atoms so that a crystal lattice is formed made up entirely of silicon. By adding or doping the silicon with another

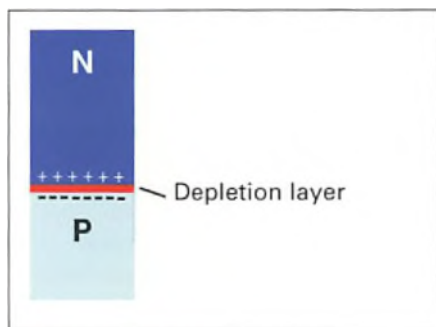


Fig. 1: A PN junction with no voltage applied.

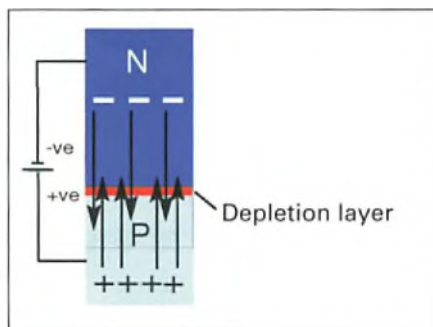


Fig. 2: A PN junction (diode) with forward bias.

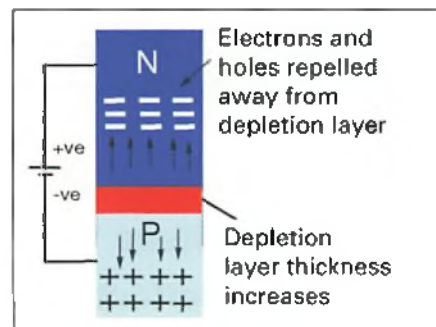


Fig. 3: A PN junction, reverse biased.

atom of, say, phosphorus or boron, the lattice takes on different properties (as explained below) and this new material is then able to partially conduct.

N- and P-type

The two types of semiconductor materials in a basic BJT. The first is known as N-type material. In N-type doping, phosphorus or arsenic is added to the silicon in small quantities. In the phosphorus and arsenic atom there are five outer electrons. These are introduced into the silicon lattice through a process called doping. The first four electrons join with the four in the outer ring of the silicon atom to form a complete shell (an atom can only have a maximum of two electrons in its first shell and eight in each of the subsequent ones). The fifth electron is free to move around, allowing an electric current to pass through the doped material when a voltage is applied. It takes only a very small quantity of the impurity to create enough free electrons to allow an electric current to flow through the silicon. N-type silicon now becomes a conductor. The lattice appears to be negative because there are now 'surplus' electrons floating around. Electrons have a negative charge, hence the name N-type.

The other material we need to consider is P-type. In P-type doping, boron or gallium is the dopant. Boron and gallium have three electrons in their outer shell. If this material is mixed into the silicon lattice, so-called 'holes' form in the lattice because the outer shell is now incomplete, with only seven electrons in total. The absence of an electron to complete the shell creates the effect of a net positive charge, hence the name P-type. Holes can, in effect, conduct current. A hole happily accepts an electron from a neighbour to fill the empty space, thus moving the hole over to the atom that has given up its electron. As a result, P-type silicon is also able to conduct an electric current.

A minute amount of either N-type

or P-type doping turns a silicon crystal from a good insulator into a viable (but not great) conductor, hence the name semiconductor.

How Transistors Work

To more easily understand what goes on in a transistor, let's start by considering the workings of a simple diode because we will understand more clearly what controls the transistor. In fact, it's all down to what goes on in the depletion layer – the area where the N-type doped silicon meets the P-type doped silicon. This is where interesting things start to happen.

When we study a junction where N-type and P-type materials come into contact as in a diode, Fig. 1, immediately some electrons in the N type (negative charges) jump towards the junction and, conversely, holes are attracted towards the junction by the negative charge on the opposite side.

What happens is that the holes and electrons combine, creating a small area of non-conducting silicon known as the depletion layer. What happens is that the 'surplus' electrons on one side of the junction fill the holes on the other, restoring the status quo. The silicon now reverts to its undoped state and is no longer able to conduct. The junction, therefore, becomes a barrier to current flow.

The only way to get current to flow is to create a potential difference across the device, attaching the positive supply to the P-type material and the negative to the N-type because like poles repel, Fig. 2. The result is that charge carriers (electrons and holes) will be forced towards the junction and current flow will occur. For silicon, the voltage must be in the region of 0.5 to 0.7V to start the flow.

If we therefore connect a supply (a battery, for example) of at least, say, 0.7V across the semiconductor junction as shown in Fig. 2 with the negative terminal to the N-type and positive terminal to the P-type, electrons will now happily

cross the junction from N- to P-type and combine with the holes in the P-type due to the fact that 'like poles repel' and 'unlike polarities attract' each other. In the same way, the positive holes can be considered as crossing to combine with the negative electrons in the N-type material. A current flow or charge flow is therefore set in motion. This condition is known as 'forward bias'. It is vital to remember in this case that when N-type material is connected directly to P-type material, the depletion layer, mentioned earlier, creates a barrier potential adjacent to the two materials that will actually oppose the flow of current unless sufficient forward voltage exists across the layer to overcome this barrier potential. Without this, the diode at the point of the depletion layer (which is typically only .001mm thick) returns to its original silicon state with no charge carriers.

When the polarity of the power source is reversed, Fig. 3, so that the negative terminal of the voltage source is connected to the P-type material, the holes are attracted towards the negative polarity of the supply and the electrons in the N-type are attracted to the positive terminal in like fashion. In this case, therefore, the depletion layer is widened considerably and no current will flow because there are no longer any charge carriers in the depletion layer. This is known as the 'reverse bias' configuration. It needs some study and thinking about it to fully grasp what is happening.

In a diode, by studying the above, we can see that when an alternating current is applied, current flow is allowed or permitted in just one direction. It is the thickness or strength of the depletion layer that is controlling things. The same principle applies to transistors, which have three layers of material in a PNP or NPN configuration, effectively two diodes back to back, one in forward bias configuration and the other in reverse bias. I'll explain how these work next month.

NEW
SERIES
PART 4

Making Waves

Auroral Propagation

This month Steve White G3ZVW looks at the propagation effects of the Aurora Borealis.

Radio signals can reflect off things. Radar wouldn't work if they didn't and if radio waves didn't reflect off the ionosphere, there would be no long-range radio. Those who hear signals that have travelled through or been reflected off an aurora are never left in any doubt as to the fact that something unusual is going on.

The Aurora

The Aurora Borealis (Aurora Australis in the southern hemisphere) is created by energy and particles from the sun being captured by the Earth's magnetic field. When this happens it leads to ionisation of the gases in the ionosphere, which enables them to reflect radio signals. It also causes the gases to glow. Auroras occur about 80km above the Earth's surface. On any given day and at any given time there are auroras present somewhere in the world. That being said,

they are more often stronger during the hours of darkness. Daytime auroras are not bright enough to be visible to the human eye, not that you'd see one at all if it was cloudy!

Auroras don't happen everywhere across the Earth. They occur mainly in areas called the auroral ovals. One exists around the Magnetic North Pole and another around the Magnetic South Pole. The illustration, Fig. 1, shows the auroral oval on a day when geomagnetic conditions were disturbed, that is to say, when the Sun was delivering a high dose of energy or particles. If a really high dose of energy is being received – typically from a solar storm – the auroral oval can become stronger and increase in diameter, spreading auroras to lower latitudes. The green patch indicates where auroras were taking place at that time. Compare this to Fig. 2, which is from a day on which magnetic conditions were quiet. In other words, there was no solar storm so the sun wasn't delivering a high dose of

energy or particles. Here the auroral oval is extremely faint, indicating that nobody in the entire Northern hemisphere would have been able to look up and see one.

Before I go any further I need to let you know that the magnetic North and South Poles of the Earth are not the same as the geographic North and South Poles (the two ends of the axis the Earth turns on). Neither are the magnetic poles in fixed positions. They move gradually. For many years the magnetic North Pole was over Northern Canada but it has now wandered farther north. Although it is not certain, if it continues to move in the same direction and at the same speed, it will be over Northern Russia in a few decades time.

Auroral Propagation

It's not possible to say something like, "tune to this frequency at this time and expect to hear signals that have passed through or been reflected from the aurora". That's not to say that auroras can't be predicted at all but they can't be predicted months in advance.

The shortest radio path between Britain and the West Coast of North America would have taken signals through the area of the aurora shown in Fig. 1, so – assuming there was propagation to that part of the world at that time – it is likely that signals would have been affected by it. HF signals that have travelled through auroral regions tend to sound raspy or fluttery. The shortest radio path between the UK and Japan also passes through the area of the auroral oval, the difference being that at the time of day that Fig. 1

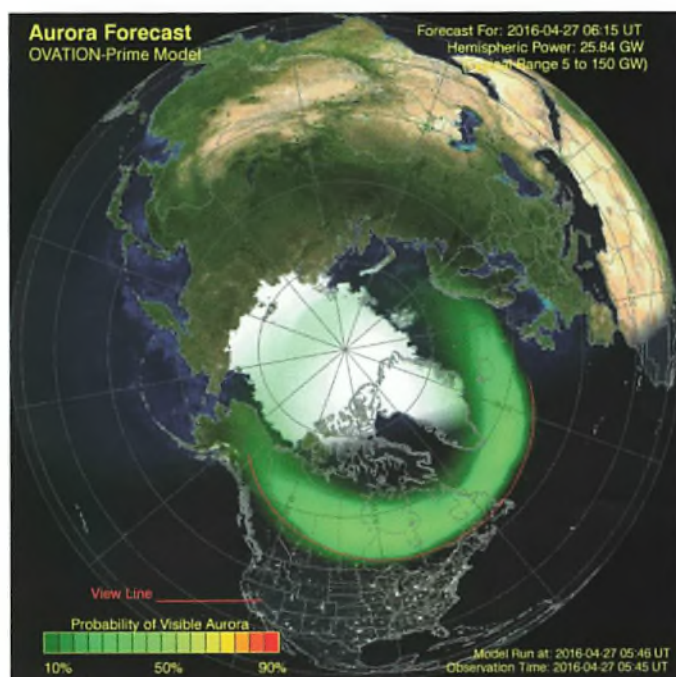


Fig 1: The auroral oval on a day of disturbed solar conditions.

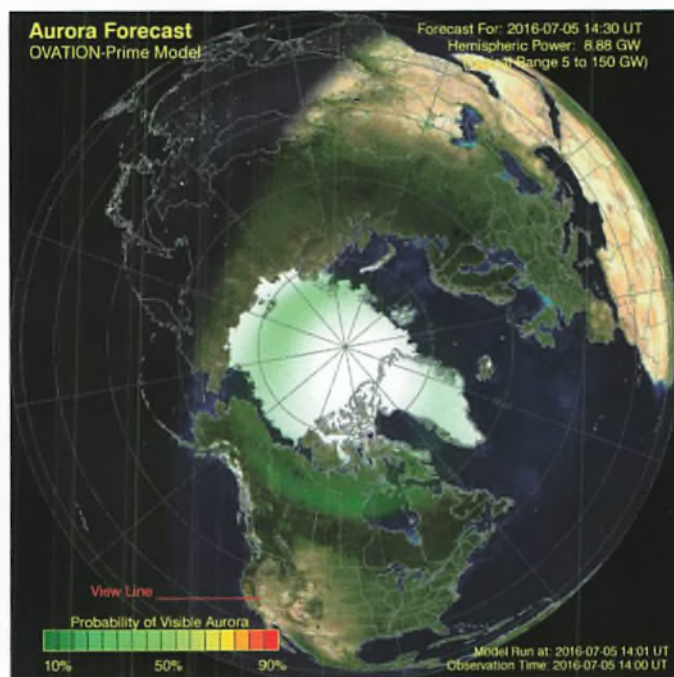


Fig 2: The auroral oval on a day of quiet solar conditions.

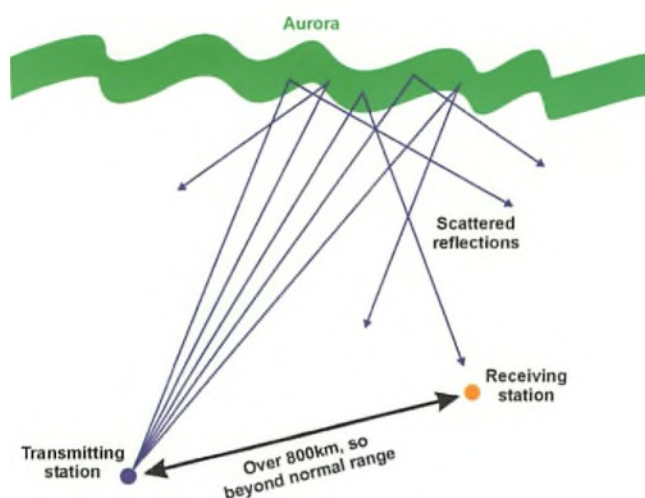


Fig. 3: VHF signals reaching an aurora get scattered in all directions.

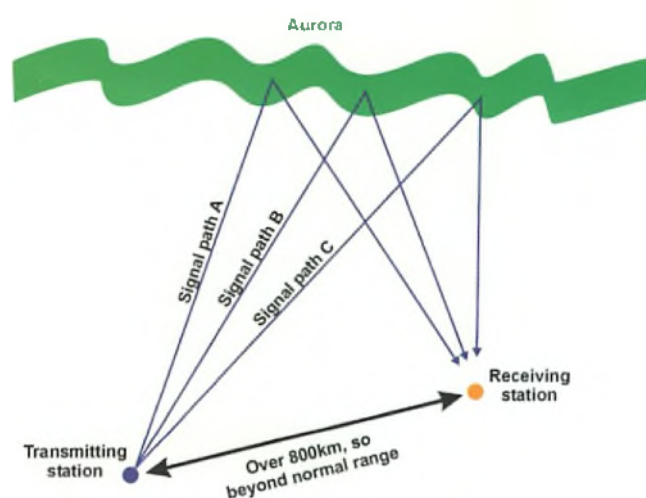


Fig. 4: Signals reaching an aurora at the right angle get reflected to the receiving station.

was created, it wouldn't have been happening.

Auroral activity moves around the world in a 24-hour period, just as the daylight does. Auroras vary in intensity but tend to be at their strongest during the evenings and during the months when there are long hours of darkness.

On an HF radio path it is likely that only part of a signal will have passed through an aurora because it only exists at about 80km above the Earth's surface. Much of an HF signal will miss an aurora and be reflected by a layer of the ionosphere above it so the effect that an aurora will have on an HF signal tends to be diluted. The bottom line is that auroras don't enhance HF radio propagation. They do, though, make signals sound raspy and fluttery.

The effect of an aurora is a different matter at VHF. Radio paths on VHF are shorter so we don't expect to be able to contact stations in, say, Japan or America direct. Under flat conditions, those with VHF stations set up for DXing or contesting might reasonably expect to be able to contact other stations up to maybe 800km (500 miles) away – 800km being just a fraction of the distance between the UK and Japan or the UK and America.

What happens at VHF is that an aurora can act as a reflector, bouncing signals back in the general direction from which they came. The diagram, Fig. 3, shows how signals that reach an aurora are scattered in all directions, with only a little of the signal ending up going in a direction suitable to reach the receiving station. Now things start to get interesting. Fig. 4 shows how it is likely that signals will be reflected at suitable angles from several different places along or within an aurora to reach the receiving station. To make this illustration clear I've removed all the reflections that don't go in the

right direction. The suitable reflections are labelled as signal paths A, B and C although in reality there are likely to be a great many more. All these signal paths will have slightly different lengths, which means that a transmitted signal will arrive at the receiving station not only from many directions but also at very slightly different times. This is known as multipath reception. It can cause the signals to cancel out although they never cancel out completely. It can also cause signals to be momentarily enhanced. Now things get even more interesting. Auroras don't just sit there and reflect signals. They flutter and they can do so pretty quickly. If you are interested, there are YouTube videos to watch that clearly show this. As an aurora flutters, signals experience something called Doppler shift. From the receiving station's perspective each individually reflected signal actually changes frequency a little. The frequency shift can be up or down and it can be going up from one reflection while it is going down from another. The net result is that the receiving station is likely to receive signals from numerous reflections simultaneously, all of them continually changing a little in frequency and each interfering with all the others to some degree. When this happens, it's a recipe for an interesting time in the shack!

VHF signals that have been reflected by the aurora have a very characteristic sound. There is absolutely no mistaking them. The effect on an SSB signal is to make it sound so distorted that it is almost unintelligible. Operators who bounce SSB signals off an aurora know they need to speak very slowly and repeat everything they say several times. Morse code that has been reflected by an aurora turns from a pure tone to a hissing sound. Auroras seldom reflect signals very strongly; indeed, received signals are often weak.

Beam antennas need to be used to make up for the fact that reflections are weak. Running high power helps and irrespective of where the station is that you are communicating with, both antennas need to point at the aurora (which will usually be roughly to the North) rather than at the other station. VHF QSOs of 2000km are quite common via an aurora. Auroras often last for a few hours, before fading away. Another might not occur for days, weeks or months. It all depends on the sun. It is, though, worth checking roughly 27 days after a big aurora because the sun will have rotated once on its axis and the same active region may still be throwing off enough energy to cause a repeat occurrence.

Auroral Alerts

The University of Lancaster have an auroral alert system that anyone can use. You can subscribe to their website, below, to receive automated e-mails as soon as their equipment detects auroral activity. The system works by observing sudden changes in the Earth's magnetic field, these having being detected by instruments called magnetometers. Although the university's instruments are sophisticated, you can make a simple magnetometer yourself although construction is beyond the scope of this series.

<http://aurorawatch.lancs.ac.uk/alerts>

Visible Auroras

I live in Southern England and I have only ever seen one aurora. It was green, very faint and right on the horizon. At the time I didn't know what it was. If you live in Northern Scotland, visible auroras are more common. Those who live arctic regions can see them frequently, cloud cover permitting.



A Simple Antenna Matching Unit for VHF

John Adams G3ZSE describes a handy matching unit for the VHF bands, allowing you to make contacts without having a resonant antenna.

At VHF (6, 4 & 2m), it is normal to have an antenna with a 50Ω feedpoint and it is generally easy to arrange this. However, there are times when I have found it useful to have a means of matching an antenna to a transceiver, either to try a new band or when a favoured antenna is undergoing some maintenance. For example, you may have an Icom IC-7100 and want to try 4m without wanting to put up a dedicated 4m antenna. The unit I describe here will match a variety of antennas for 6 and 4m.

An Outline Specification

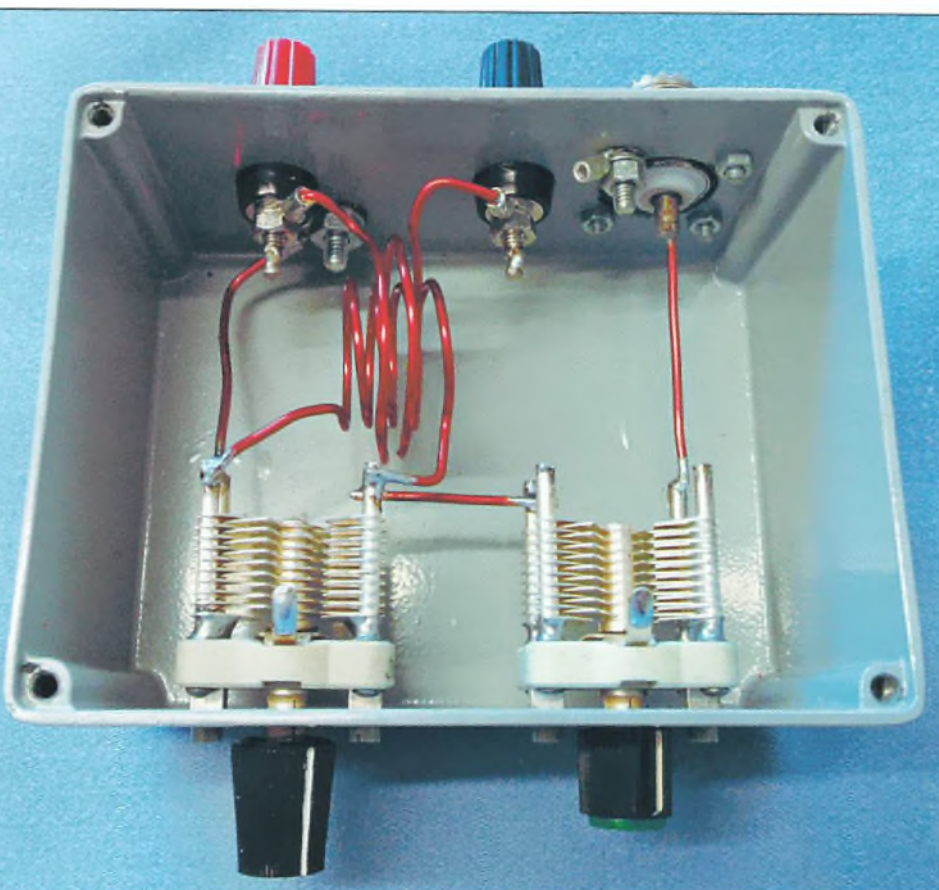
I decided that this unit should work with 100W of SSB, have a reasonable bandwidth (to avoid retuning when moving, say, $\pm 250\text{kHz}$) and have reasonable efficiency with low losses (especially in the coils).

A Little Bit About Tuning and Matching

I know there are often debates about the differences between an antenna tuning unit (ATU) and an antenna matching unit (AMU). I usually refer to all such units as ATUs or tuners. However, my opinion in this case is that what I describe is actually a matching unit. It will match the complex impedance of the (generally) non-resonant antenna in use to the 50Ω transceiver output. There will be some loss of power in this matching unit and there will be some loss in the antenna feeder. This may be higher than you think because the feeder will be unmatched to the non-50Ω antenna. That said, remember that here we are likely to be attempting to use antennas outside their design frequencies to get some useful signal out!

The Z-Match in General

The Z-Match unit dates back a long way and became popular for HF use in the UK in the 1960s and 70s, especially with the one made by KW Electronics. My own first real experience of a Z-Match came with building the HF version from the RSGB *Radio Communication Handbook* in the



A view inside the ATU.

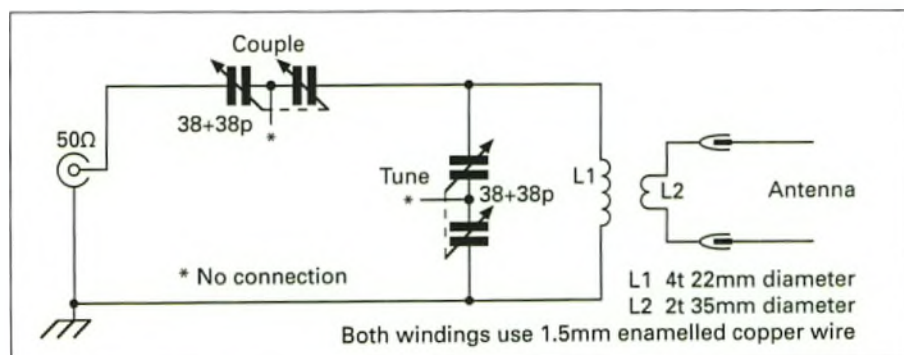


Fig. 1: The circuit diagram of the unit.

1980s. I found that it worked extremely well with a G5RV antenna and I use it still, despite having acquired two commercial Z-Match units (they look much nicer but mine has lower losses!). With all Z-Match units, it is advisable to find the two control settings on low power first. The Z-Match is connected between your SWR meter (or transceiver, if you are using a built-in SWR indicator) and the antenna. Start by setting the capacitors to mid-way and then use the Tune capacitor to find the minimum SWR. Adjust the Couple capacitor slightly and Tune again. Keep adjusting the two capacitors alternately until you find a point of minimum SWR, usually near to 1.0:1, with the Couple as high a capacitance as possible, that is to say, as meshed as possible. The diagram, Fig. 1 shows this well-proven circuit.

The Design

I took an experimental approach to the design, looking at the components in my three HF units. The critical components are the two linked coils and, basically, I scaled these down from the HF ones, using the ratios of the frequencies involved. I then did some checks using standard inductance formulas for coils. The coils are made from 1.5mm diameter enamelled copper wire. Two capacitors are needed. I would like to recommend a suitable source for these but I have not found a UK one. I frequently need variable capacitors and they are still plentiful at rallies and on eBay (at rallies, it can sometimes be cheaper to buy an item of gear and extract the capacitors from it). The capacitors need to handle the voltages found at 100W at unknown impedances and I have found a minimum spacing of 1mm between plates on the rotor to be adequate although larger spacing can be used. Split-stator types are to be preferred because then the RF current is not passing through the lossy rotor contact – again, see Fig. 1. Also, note that using the two stator sections of the capacitor puts these in series and halves the capacitance. For my particular capacitors, each 38+38pF capacitor becomes a single 19pF capacitor. In theory, much higher value capacitors could be used but if too high, then the residual stray capacitance may be too much for this VHF circuit.

Construction

I used a diecast metal box as shown in the photographs but any reasonable metal box will suffice. My box is 119 x 89 x 55mm. The size used will depend on the physical size and mounting arrangements



The front panel.

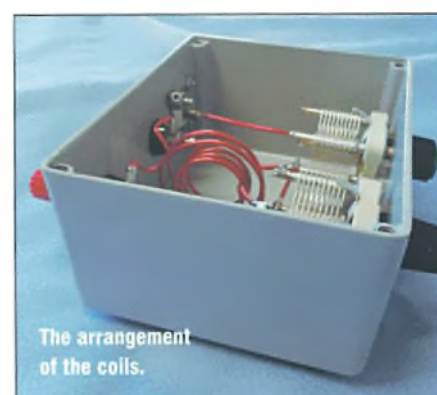


Rear view.

Parts list

- 1 x metal box – see text
- 2 x knobs
- 2 x spit-stator capacitors, around 38+38pF each
- 85cm of 1.5mm diameter enamelled copper wire
- 1 x SO239 socket
- 2 x 4mm terminals
- Various nuts, screws and washers

of the capacitors. I chose to use 4mm binding post terminals for the output so it would be simple to connect to a balanced 450Ω feeder from a G5RV antenna. I use a short cable that has a PL259 at one end and spade terminals at the other, for when I want to use the unit with coaxial feeds. You may want to fit an SO239 output as well as, or instead of, the 4mm terminals. Fit the capacitors and input and output connectors into the box, along with a simple ground terminal. Ensure that none of the metalwork of the capacitors is touching or too near to the metal box. You may need, as I did, to use nylon screws to mount the capacitors. Next, wind the coils, noting that these are self-supporting with the tuned coil sitting inside the output coil. This needs a little working out and it is best to have quite long tails on the coils and to trim these down as the fitting process progresses. Try to keep as close to the given diameters as possible. I used a large marker pen and a plastic bottle top to form the windings. Various knobs can be used but do make sure that any grub screws are recessed and will not touch your hand during use. Note that the box is also ground/earth. It is essential to make good quality solder joints between the parts. Use the same 1.5mm wire for the



The arrangement of the coils.

interconnections between components. Don't use thinner wire for the coils or connections or the RF losses will be too high.

Testing

Firstly, when testing, be aware that you have semi-exposed RF terminals and only make connections with the transceiver off. The first test should be at low power with a 50Ω dummy load, to ensure that the unit is fundamentally sound. You can also check that after feeding continuous carrier power through the unit and into the dummy load, the casing above the coils does not get warm. My own tests, using small car bulbs for comparison, indicated that the loss at 100W on the 6m band was probably around 5W. I carried out tests on 6 and 4m using a G5RV antenna and on 4m using two a 2m halo and a 2m dipole. All matched easily and well to 1:1 SWR. The G5RV gave surprisingly good results on both bands. On 6m, it was possible to cover about 1MHz without retuning.

Conclusion

Construction is straightforward and this matching unit will be handy to have in the shack. It will allow experimentation with non-ideal antennas at 6 and 4m.



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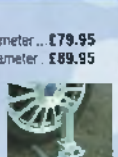


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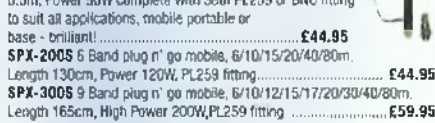
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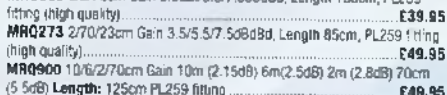
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You Can! Low Budget 70cm EME

Hartmut DG7YBN and Thomas MOABA report on their successes with low power EME operation on the 70cm band, expanding on our previous reports (PW November 2015 and subsequent News updates) and complementing the GOKSC/K1JT articles in August and September 2015 PW.

We all know that Earth-Moon-Earth (EME) propagation is the ultimate discipline in VHF/UHF DXing, don't we? So every ambitious VHF/UHF amateur dreams of establishing an EME QSO at least once in a lifetime. And EME is, like meteor scatter, one of the most fascinating propagation mechanisms for people who are interested in getting a glimpse into amateur radio. Most potential newcomers' eyes begin to gleam in excitement when I tell about my EME tests. Some of the more inquisitive have asked what is going on here, when they have observed my 4-bay of Yagis turning around and facing the sky late at night. Of course, some shake their heads in disbelief and turn away when I try to explain.

Alright, my 70cm EME equipment consists of four Yagis, each 4m (13ft) long, elevation and azimuth rotator, 5/8in coax with 7/16in connectors and a valve amplifier whose high voltage power source weighs 40kg (88lb) on its own. But what do we really need as a minimum by way of equipment to work a few of the so-called 'Big Guns' when using the digital WSJT JT65B mode?

The Story

I was attracted by a report I read in the 4/2015 issue of the *DUBUS* magazine about Thomas MOABA operating the MX0CNS club call and the club's achievements in QRPP (very low power) 70cm EME with just a 4-bay of 12-element

Yagis. This was based upon a thought by the Essex DX Group as to whether an M6 (Foundation) licence holder would be able to achieve an EME QSO while being restricted to an output power of 10W at the antenna feedpoint. After an initial success with 40W and a 16-element Oblong antenna (design by YU7XL) resulted in a QSO with UA3PTW (24 x 15-element DJ9BV Yagis and 1kW out), they built a 4-bay of 12-element Hybrid LFA Yagis by YU7XL. This did the job nicely. With just 10W they managed a WSJT QSO with UA3PTW in the *DUBUS* 70cm EME Championship with signal levels of -12 dB in the UK and -18 dB at UA3PTW. The most recent MX0CNS successes can be followed on Facebook:

www.facebook.com/mx0cns

So I was willing to give full support when Thomas contacted me asking for details of how to build an even smaller Yagi design in order to find the bottom line for EME equipment that would enable contact with the Big Guns out there.

Success!

On January 22nd 2016 around 1940UTC, MX0CNS with operator M0ABA established an EME QSO with DL7APV with a single 7-element GTV 70-7n Yagi designed by me and a Microset PR-430 masthead preamplifier running 80W from a Microwave Modules MML 432/100 PA through 14m (45ft) of H100 cable. Thomas's radio is an ordinary FT-847 with a crystal heater installed.

Reading his email you can feel the excitement: "Hartmut !!!!!!! We did it."



Fig. 1: The 7-element Yagi at MX0CNS used for Thomas's first low power EME contact.

First call with Bernd :-):-26 was my signal 80W at the feed, wow, wow, wow". After a proper measurement, the output power turned out to be around 60W at the feedpoint of that small Yagi, Fig. 1.

And again from M0ABA: "Many still think they cannot even try EME because their equipment or antennas are not good enough. Perhaps we can help dispel some of these myths?"

And indeed, with that pocket size Yagi installed on a tripod, signal levels do not appear to be on that tight a budget, at least for working those Big Guns. The minimum signal level for decoding in JT65B, the common mode in WSJT for VHF/UHF EME, is around -30dB. Here, Fig. 2, is HB9Q, 10m dish and high power in QSO with IZ5TEP that M0ABA recorded during that first test of the small Yagi.

And here, Fig. 3, is the full EME QSO with DL7APV, who decoded MX0CNS at -26dB. The experienced WSJT user knows that the minimum level for decodes is, as I said, -30dB. DL7APV operates 16 x DJ9BV design long Yagis and high power whereas on the MX0CNS side we have 80W out, a feedline loss of 1.2 dB and an antenna gain of 12.8dBi. Thus the equivalent isotropically radiated power (EIRP) is just 1180W.

Why use the 70cm Band?

Path loss on 432MHz is roughly 10dB

higher than on 144MHz but the same size electrically of 1.46 wavelength is 1012mm on 432MHz but 2994mm on 144MHz. So we can compensate for the additional path loss with higher gain (but smaller) antenna arrays. The average size of 70cm EME 4-bay Yagi arrays is tiny compared to 2m ones. Let **Geert Stams PA3CSG** explain in a little more detail:

"You've worked everybody in 144MHz EME so try 432MHz EME!

"Calculating gain for a 6.3m long (3.1 wavelength antenna) on 144MHz results in 13.1dBd gain. The same length will produce a gain of 16.6dBd on 432MHz. The shorter wavelength will partly compensate for the higher path losses. We are still lacking another 3dB because the path loss on 144 MHz is 10dB lower than on 432MHz. But antenna gain also works on receive as well on transmit.

"Furthermore, the 70cm band yields much less background noise in both sky and earth's brightness temperatures. This adds an additional bonus. If we can also cancel out noise to a limited extent on the higher band as a result of the additional directionality of the antenna, then this is also helpful".

Equipment – Transceiver

Do you need a very special transceiver? No. As I said, M0ABA uses an ordinary FT-847 with crystal heater. I myself use an FT-736R without any gimmicks at all. That thing is as deaf as a bowl of nuts on 432MHz. It takes approximately 20 minutes of warm-up time and then its frequency is sufficient stable to make successful digital QSOs.

Preamplifier

A preamplifier is generally considered a must. And it has to be on the mast, very close to the antenna. Having said how deaf my transceiver is, it comes to life with a TGN ULNA 3013 low noise amplifier. But do we need a low noise preamplifier for QRPP EME? No again. Why so?

To realise the potential of a very low noise amplifier of, say, 0.25dB noise factor (NF), we need a very low antenna temperature or very quiet QTH noise-wise. In practice, what is more important in most instances is to overcome the feedline losses and boost amplification into our average receiver. Most EME operators would agree that a simple Microset PR-430 with a stated NF of 1.2dB does quite well in the QRPP EME configuration.

Alternatively, how about building your own or integrating a ready-made and measured board? There are plenty of assembled or kit boards with the PGA-103



Fig. 2: WSJT screenshot of HB9Q's signal off the moon, captured at MX0CNS during a QSO

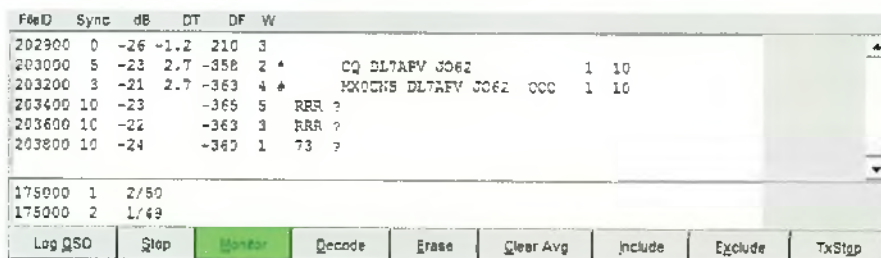


Fig. 3: Screenshot of that first QSO between MX0CNS and DL7APV.

available at a reasonable price. Look at G4DDK's website or search for F1JKY on Google, for instance. www.g4ddk.com

Now you need two surplus coaxial relays and a PTT switchboard with a sequencer. If not, your power amplifier (PA) provides that anyway. For a start there would be nothing to stop you locating the PA outside, underneath the pole or tripod, for example, although the quality of many amplifiers for EME work is questionable (because they are not designed for high duty-cycle transmissions. Operating WSJT modes requires putting out a constant carrier so you need to be able to watch the amplifier's temperature carefully). Some amplifiers also include a built-in receive preamplifier, making life even more straightforward. On the positive side, we have saved a great deal of feedline losses when transmitting by relocating the PA.

We could think about a bandpass filter following the preamplifier too. This field is ideal for building and testing bits and pieces of equipment and if it is good enough for EME, it is good enough for anything.

Output Power

Looking at signal budgets, we see that with 80W at the antenna feedpoint and the little 7-element Yagi, we get -26dB from a very capable Big Gun station. So that with 50 to 120 W out and two of those Yagis, maybe we can reach ten of the top 432MHz EME stations.

Antenna

QRPP EME is something for the typical backyard operation where space doesn't allow a Big Gun setup. So a short design with the ability to mount it on a simple mast or tripod is welcome because it enables fast setup and dismantling and also keeps the antenna electrically away from mast mounts and the tripod head.

With a total length of less than 1.4m (4.5ft) the GTV 70-7n is just within these specifications and delivers a gain of 12.9dBi (10.8dBd). Of course, you might also want to consider some of the more reputable commercial Yagis if you want something ready made.

Building the Suggested Yagi

The design I am introducing here is shown in Fig. 4 and the dimensions in Table 1. The boom is a 5/8in square tube. Elements are mounted insulated through the boom with the help of furniture hole plugs bought from a suitable DIY store. We only need to drill a 4mm hole through their tops to push the elements through. Their outer diameter should be close to 6mm (max. 1/4in) for best electrical fit and taking account of the boom correction (see below).

Excess lengths given must not be changed because they are a parameter of the through boom correction. Also, turnings and chippings inside the boom tube should be removed cleanly.

Find more about the boom correction and how to build this Yagi on my website –

see the links at the end of this article.

The photo **Fig. 5**, shows the insulators while **Fig. 6** shows the mounted element.

The diagram, **Fig. 7**, shows a Symmetrising Line made from Aircorn 5 or similar coaxial cable. The left-hand end connects to the driven element.

My DG7YBN website gives a lot of details on boom correction, phasing multi-Yagi arrays, symmetrising lines and, thanks to Thomas M0ABA, a photo series on how to build small 70cm Yagis in a lean, cost effective way and with 'EME test proven' performance. You'll find these photo step-by-step instructions on the GTV 70-4m web pages – again, see references at the end of this article.

Polarisation Mount

Assembling the boom into a piece of tube (**Figs. 8 and 9**) permits changing the Yagi's polarisation. This may well become an important asset for successful EME operation that many big stations do not have. With fixed polarisation at both sides of a transcontinental QSO, often only one of the stations has copy while the other one does not get any signal in at all. That's because the signal is arriving with a 90° shift in polarisation. This is due to geometrical fundamentals because the earth is round and a horizontal polarisation in Europe seen from space is like a vertical polarisation in another part of the world. There is also Faraday rotation to deal with, a 'twisting' of the polarisation of a radio wave as it travels through the ionosphere.

To clarify, here is what **Ian White GM3SEK** has to say (see his website) about one-way EME propagation:

"A big problem with VHF/UHF EME is that the transmitted polarisation is usually rotated before it reaches the receiving station so there can be very large losses in signal strength. Remember also that EME signals are always close to the noise, with rapid fading, so even a 1dB loss is noticeable."

Both phenomena can cost many precious decibels of signal level so it is very handy to be able to change polarisation in the course of a QSO.

Other Helpful Tools

There are several Smartphone Apps available to facilitate EME operation, starting with a simple compass bearing to showing the full night sky view depending on how the Smartphone is held in elevation and azimuth. This is quite helpful when the sky is cloudy and no moon visible.

A simple compass might do equally well because we have the moon's actual

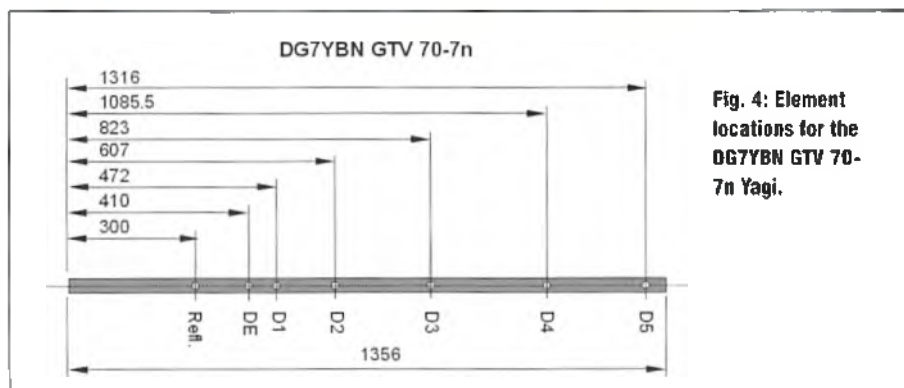


Fig. 4: Element locations for the DG7YBN GTV 70-7n Yagi.

Table 1: GTV 70-70n dimensions. Elements are 4.0mm diameter, boom is 5/8in square.

Element	Pos.	Length
End	0	
Refl.	300	335.6
Dipole	410	303
D1	472	318.5
D2	607	313.5
D3	823	305.3
D4	1085.5	297.2
D5	1316	285.7
End	1356	



Fig. 5: The insulators used to clamp the elements into the boom.



Fig. 6: Element to boom detail.

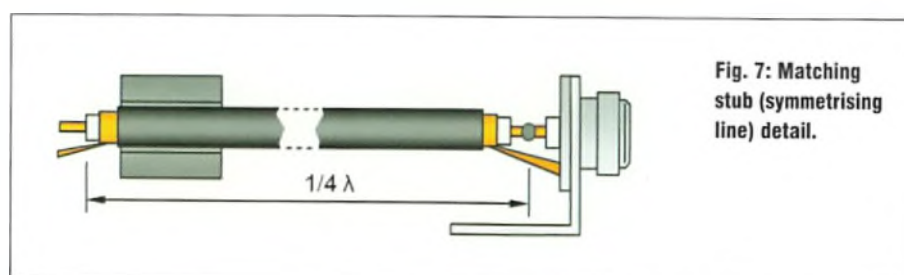


Fig. 7: Matching stub (symmetrising line) detail.

azimuth and elevation on display in the WSJT window and once we have found the direction from the compass bearing, we can then adjust the elevation until we get some decodes from a caller. We can usually see who is active from the HB9Q EME logger, website below. Someone announces his CQ call on, say, 432.090MHz and we tune to that frequency, adjust the azimuth angle and play with elevation until we see a trace on the WSJT monitor. To log on to the HB9Q logger, you need to register and receive a password but this is easily done and only basic data such as name and callsign are asked for.

www.hb9q.ch

Before Running WSJT

WSJT needs close time synchronisation between the two stations. Both M0ABA/MX0CNS and DG7YBN use the free program Dimension 4 for this. It runs fine on WinXP Pro and Win 7 and no doubt on other versions.

<http://dimension-4.software.informer.com/5.3>

Seeing Traces but getting no Decode

If you can see clear traces, as a new user please make sure it is not a birdie, some terrestrial based noise source, that you are monitoring. A real QSO trace will start/end

References and Further Reading

An introduction to antenna temperature:

http://dg7ybn.de/Ant_Temp/Ant_Temp.htm

More about the applied SM5BSZ boom correction:

http://dg7ybn.de/BC_numbers/BC.htm#BC_exe

More about Yagi-Uda antenna building in general:

<http://dg7ybn.de/Building/Building.htm>

More about this building style:

http://dg7ybn.de/Building/Building.htm#Elem_through_Boom

More about measuring the length of coaxial quarter wave lines:

<http://dg7ybn.de/Phasing/Phasing.htm>

A photo sequence of how to build such a Yagi:

http://dg7ybn.de/432MHz/GTV70_4m.htm#Building

The GTV 70-7n Yagis website:

http://dg7ybn.de/432MHz/GTV70_7.htm

More on polarisation and Faraday rotation by GM3SEK:

<http://www.ifwtech.co.uk/g3sek/eme/poi4.htm>

with the time periods marked by the time stamps by the minute in WSJT's SpecJT monitor.

Be sure to have set JT65B as the operating mode. If you see good traces but simply get nothing decoded at all, you might inadvertently be in JT65A mode.

Not Finding the Caller at All

Be aware that the Doppler shift on 70cm EME can be up to ± 1000 Hz, so check above and below the given frequency as

well. It may also be that a major Faraday rotation in the path between you and the calling station completely changes the polarisation of the incoming signal. This means that up to 30dB could be added to the already immense path loss. Even the real Big Guns on EME cannot afford such additional losses. Now is the time to play to one of the strengths of our very small array. We can adjust our antenna's polarisation by simply rotating the antenna on its axis until we get the brightest traces and best decodes.

Outlook and Update

Meanwhile MX0CNS with the restless Thomas M0ABA at the helm, achieved a contact with one of the biggest Big Guns, Bernd DL7APV, while using a single 4-element GTV 70-4m and just 60W at the feedpoint. This equates to an EIRP of 500W, yes, 500 watts only. Given the effective boom length of that Yagi of just 337mm, this might be a new EME record.

Completing the QSO involved waiting for one hour for the Faraday rotation to settle on February 13th 2016 at 2040UTC with the moon closest to earth, at its Perigaeum. Even more remarkable, both antennas were wet at the time, which detunes even the best 70cm design.

As if that was not enough, MX0CNS operated with a GTV 70-3w 3-element Yagi and 60W at the feedpoint to work PI9CAM, DL7APV and OK1DFC as reported in the July issue of PW (page 8).

So we have demonstrated some entertaining EME testing with a variety of very small station equipment. When will you have a turn?

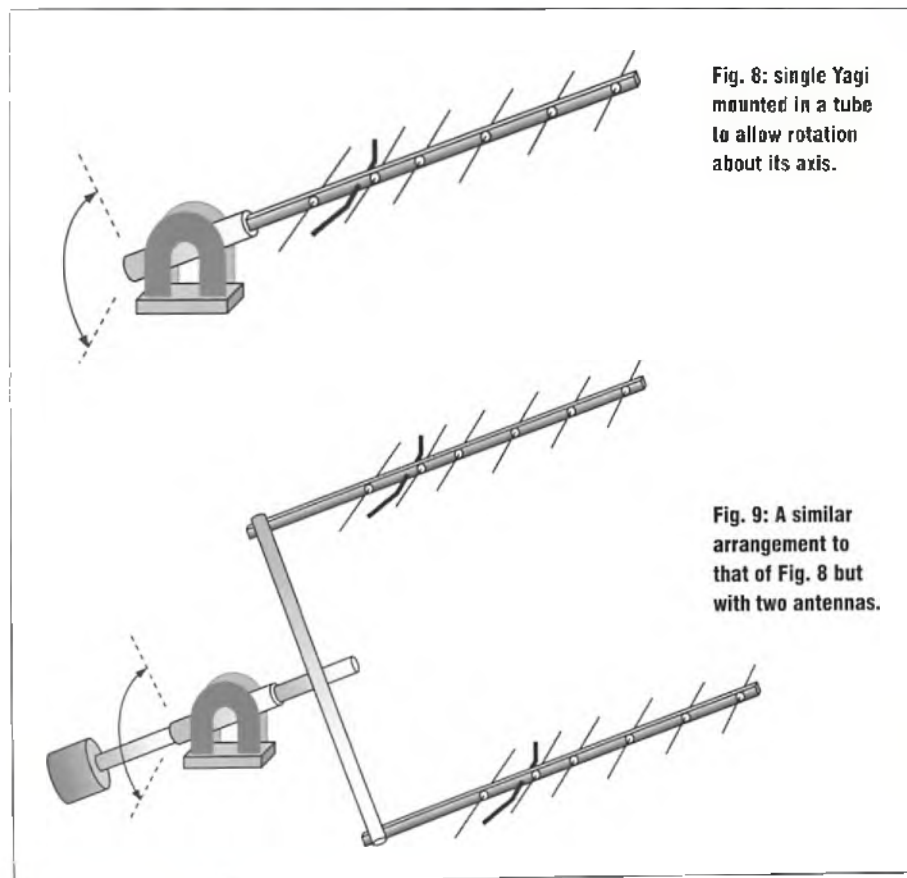


Fig. 8: single Yagi mounted in a tube to allow rotation about its axis.

Fig. 9: A similar arrangement to that of Fig. 8 but with two antennas.



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Multiband Receiver Project – Taking Stock

Tony Nailer G4CFY reflects on progress to date, the changing world of amateur radio and where the project may head in future.

In DiBD in the May edition of *PW*, I wrote about discussions with Tex Swann G1TEX regarding digital readout and the possibility of using a direct digital synthesiser (DDS) as second local oscillator. These discussions showed that there was no easy solution to achieving a digital readout correct for each of the 12 ranges based on the design with 12 first local oscillator frequencies and a tuneable second local oscillator.

Our discussions showed that by far the most elegant solution was to have conventional superhet with tuneable DDS first local oscillator driven from a PIC that also drives the digital readout. This also takes us back to the more preferred architecture of a single intermediate frequency (IF) with a choice of SSB, CW or AM/FM filter following the first mixer.

Single or Double Conversion

Most SSB/CW receivers do not feature a second conversion to a lower IF because suitable low frequency crystals are both difficult and expensive to source. In an earlier design of receiver for topband (160m) I used a 455kHz IF together with a two-pole crystal filter as an oscillator element. It appeared to be exceedingly stable and I don't see why it couldn't be used in a double conversion SSB/CW receiver.

The reason I favour double conversion is the ability to have as much gain as necessary without the tendency for instability when all the gain is at a single frequency. For a receiver, this situation is much easier than for a transmitter or transceiver where harmonics of the various oscillators can cause spurious signals within the wanted bands.

Choice of First IF

In *Technical for the Terrified* in October 2008 *PW*, I explored using a variable frequency oscillator mixed with a set of crystal oscillators to provide an analogue multiband first local oscillator. The calculations showed that a 10.7MHz IF worked well for the narrow 160, 40, 30, 17 and 12m bands. Similarly, a 9MHz IF worked best for the 80, 20, 15 and four sections on 10m – relatively wide bands.

So all this suggests that the present multiband receiver architecture will have to do without a digital readout and will require a VFO dial with two scales – 0 to 500kHz for 40, 30, 20,

17, 15, 10A & 10C and 500kHz to 1MHz for 160, 80, 12, 10B and 10D. These scales would need to be read in conjunction with the megahertz reading shown on the rotary band switch.

Old or New

It seems that the *Multiband Receiver* project is simply another version of 1980's technology akin to the FT-101 that was superseded about that time by the digital readout version, the FT-101ZD. The pages of *PW* and *RadCom* now rarely publish an article without a computer simulation, a waterfall display or a computer-generated map showing contact vectors.

I have an enthusiastic following of readers who regularly tell me how they enjoy my articles. There are also about four of my followers who like building complex receivers and might build this one. So it makes me wonder if it is worth all the effort. Of the four most recent projects, the *Triband Pesky* of May 2016 sold just two, the *Four Band Receiver Converter* has sold none, the *Arduino RF Power Meter* by Tex Swann has only sold one board other than a batch taken by Tex and the *Multiband Synthesiser* has sold three. So even the new technology Arduino based project attracts no more practical interest than the analogue kits.

Visit to 2E0JDF

In June I took a three-night break at Warners, Gunton Hall near Lowestoft. The day before I went, there was an order for a transverter power lead from Andrew Powell 2E0JDF at Hopton on Sea, just two miles from Gunton Hall. I quickly made up the lead and took it with me so that I could drop in to him rather than posting it.

When I visited Andrew, he kindly showed me his shack that had many rigs new and old together with a television screen about 1.2m (4ft) wide on which was a split screen display. On the left was a rolling scroll of what seemed to be station data with details and locations. On the right was technical information about the signals being transmitted and received.

While he was showing me his equipment, something happened on the screen and I asked him what this was. He replied that the algorithm was set to search for specific stations and make contact with them. The system had made the contact and an electronic QSL had been exchanged.

He explained that this was JT65 digital communications. I asked whether the –8dB level related to normal signal strength of S9 or 50µV. He said it showed his signal wasn't strong enough because he tries to get –12dB. The Editor, Don G3XTT, has told me that the level is related to the noise floor and shows how far the signal is buried in the noise.

I am a Dinosaur

The visit was an eye opener because Andrew is an Intermediate licensee and his main transceiver has both a spectrum analyser display and a waterfall display. I know nothing of these things and it seems from the advertisements in *PW* and *RadCom* that the vast

majority of radio amateurs nowadays like the displays and digital modes.

Modern transceivers are hugely expensive and seem ever so complicated with dozens if not hundreds of buttons. Software defined radios only have an input and output and the rest is done using the computer. The modern radio amateur obviously keeps his soldering iron in a drawer or box somewhere, perhaps to enable a plug to be fitted or refitted onto a cable.

Making Progress

It has been very difficult to keep focussed on the *Multiband Receiver* project recently as there were just too many distractions. I was very interested in the debates leading up to the Referendum and the surprise result and the political fallout decapitating Conservative, Labour and UKIP parties and still ongoing.

Then there was my holiday and Wimbledon tennis in between. And just this week as I was finishing off the printed circuit layout for the front part of the receiver, I slipped on a wet grassy slope when returning from walking *Meika* and smashed my thigh and left shoulder on the ground. My arm is now in a sling because I have torn a ligament from the shoulder joint.

Receiver Front Part

Anyway, back to the project in hand. The circuit of the front part of the receiver is shown in Fig. 1, including parts identification codes. A PCB overlay is shown at Fig. 2. The circuit is very similar to the previous design except that the tuneable IF is now an active tuneable IF and a DC blocking capacitor has been added between the secondary of L3 and the base of Tr10.

Another addition is to the Colpitts oscillator that is now using two coils L7a and L7b. I reasoned that the main cause of drift is the heating of the turns of the oscillator coil. This can be caused either by direct heating by hot parts nearby or due to RF currents flowing in the very thin wire of the coil.

For this development model, therefore, I have split the coil into two parts, with a toroidal-cored coil containing the bulk of the inductance and a 10mm coil with a small part and still including the output link winding. This means that the overall number of very thin turns is dramatically reduced.

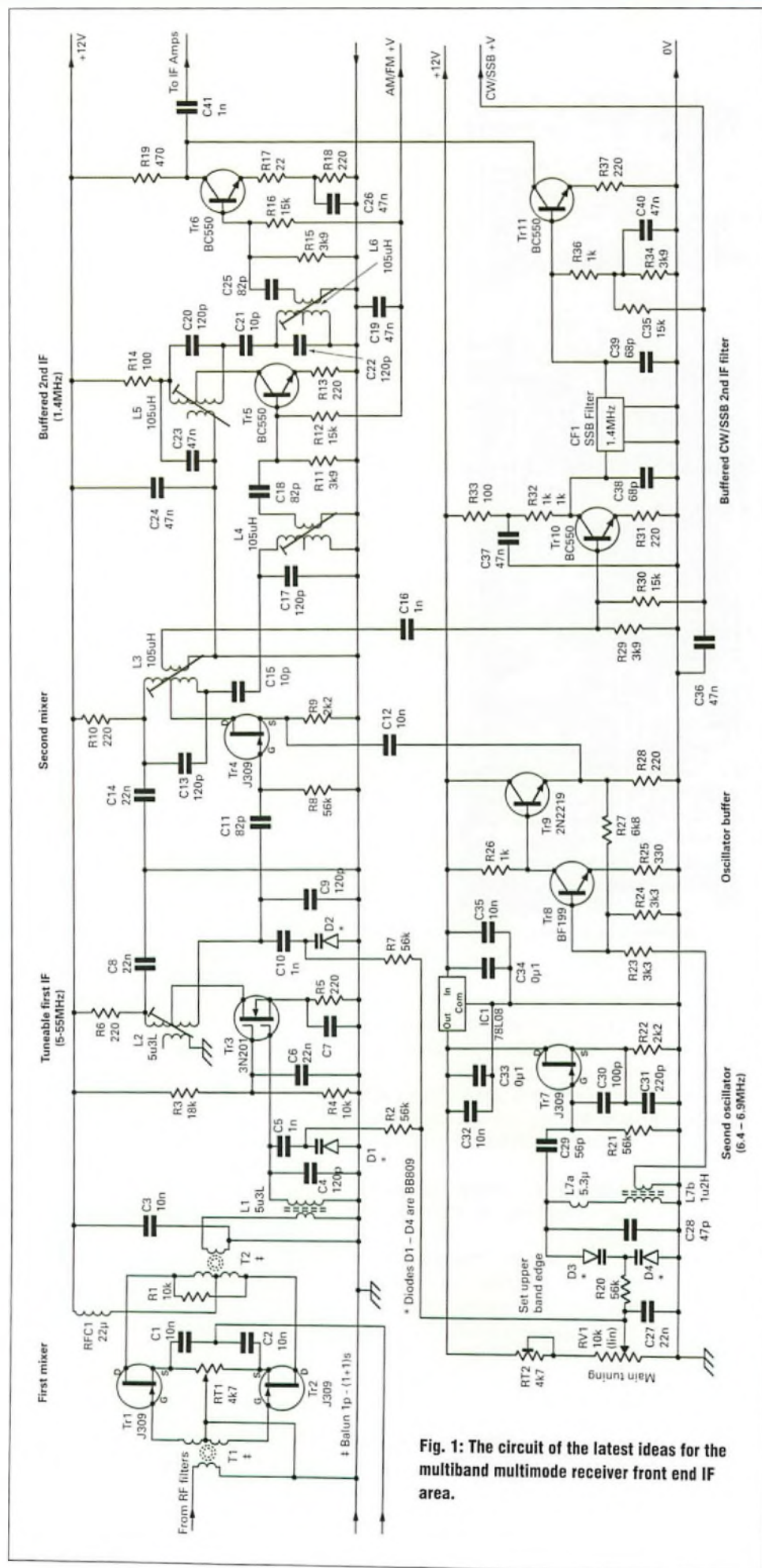


Fig. 1: The circuit of the latest ideas for the multiband multimode receiver front end IF area.

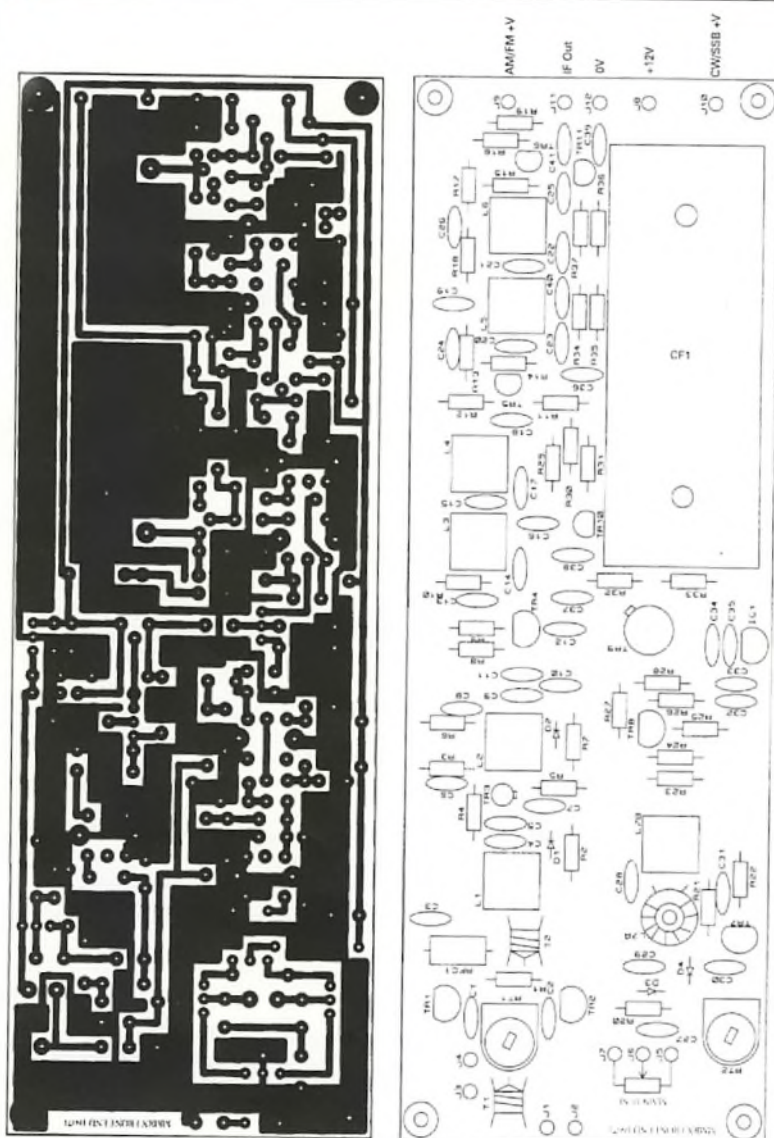


Fig. 2: Although not built and tested, Tony has designed a PCB to suit the ideas of the circuit of Fig. 1.

Coil Calculation

In the tuneable IF, in which the range is 5.0 to 5.5MHz, the varicap can be assumed to have a swing of 26pF, from 4pF to 30pF. Please refer to **Calculation Box 1** to see how this engineer does it.

To cover the range of 5.0 to 5.5MHz with a 1.4MHz product, the VFO is required to tune 6.4 to 6.9MHz and has two varicap diodes nose to nose giving a tuning range of 13pF from 2pF to 15pF. Refer this time to **Calculation Box 2** to see how I do it.

I haven't wound the core and tested it nor produced the board and populated it yet but it is possible I might have to remove or even add a turn if the inductance doesn't work out right.

The result needs to be such that the trimpot RT2 can adjust the upper band edge and the variable coil L7B (1.2μH) can adjust the lower band edge.

Of the 82pF capacitance required for the minimum capacitance across the VFO coil, 2pF is from the varicaps and another 30pF is from the series combination of C29, C30 and C31. This leaves 50pF for the fixed parallel capacitor. So I will make C28 47pF.

Final Remarks

Unfortunately due to other distractions described earlier, the project has only progressed a short distance but I hope this contribution has been interesting reading. Hopefully after the summer things will settle down and I can complete the development of the front part and get the back part done as well. I am looking forward to designing and writing about a number of much smaller projects in the future.

Calculation Box 1

Resonance in a tuned circuit
 $f = 1/(2 \times \pi \times \sqrt{L \times C})$

Then $f^2 = 4 \times \pi^2 / (L \times C)$
 $f_2 = 5.5\text{MHz}$, $f_1 = 5.0\text{MHz}$

$(f_2/f_1)^2 = 4 \times \pi^2 \times L \times C_1 / (4 \times \pi^2 \times L \times C_2)$
 $(f_2/f_1)^2 = C_1/C_2$

But $C_1 = C_2 + 26\text{pF}$, so $(f_2/f_1)^2 = (C_2 + 26\text{pF})/C_2$

$(f_2/f_1)^2 = (5.5/5.0)^2 = 1.21$
 $= (C_2 + 26\text{pF})/C_2$

$1.21 \times C_2 = (C_2 + 26\text{pF})$ $0.21 \times C_2 = 26\text{pF}$ $C_2 = 26/0.21 = 124\text{pF}$

Let $C_2 = 120\text{pF}$ and
 $C_1 = 120\text{pF} + 26\text{pF} = 146\text{pF}$

$L = 1/(39.5 \times f \times f \times C)$
 $= 1/(39.5 \times 5 \times 5 \times 146) = 6.9\mu\text{H}$
 I could use a TOKO K2027, 9μH nominal and hope it goes down to 6.9μH or use a Spectrum 5u3H, which will go up to 8.8μH.

Calculation Box 2

$f^2 = 4 \times \pi^2 / (L \times C)$
 $f_2 = 6.9\text{MHz}$, $f_1 = 6.4\text{MHz}$

$C_1 = C_2 + 13\text{pF}$, so
 $(f_2/f_1)^2 = (C_2 + 13\text{pF})/C_2$

$(f_2/f_1)^2 = (6.9/6.4)^2 = 1.16$
 $= (C_2 + 13\text{pF})/C_2$

$1.16 \times C_2 = (C_2 + 13\text{pF})$ $0.16 \times C_2 = 13\text{pF}$ $C_2 = 13/0.16 = 81.25\text{pF}$

Let $C_2 = 82\text{pF}$ and $C_1 = 82\text{pF} + 13\text{pF} = 95\text{pF}$

$L = 1/(39.5 \times f \times f \times C)$
 $= 1/(39.5 \times 6.4 \times 6.4 \times 95) = 6.5\mu\text{H}$. In this case I will use a Spectrum 1u2H coil in series with a toroid, giving 5.3μH.

A T37-2 core has an inductance factor AL of 2.5μH per 25 turns.
 $N = 25\sqrt{(\mu\text{H}/\text{AL})} = 25\sqrt{(5.3/2.5)} = 36$ turns
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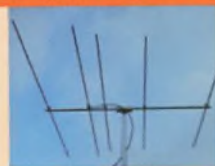
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The Eighth Practical Wireless 70MHz Contest

Colin Redwood G6MXL invites readers to participate in the Practical Wireless 70MHz Contest.

The eighth annual *Practical Wireless* 70MHz Contest takes place on Sunday September 25th 2016 from 1200 to 1600UTC.

The contest is split into two sections. The low power section with a power output limit of 10W enables Foundation Licence holders to compete on an equal basis with other low power stations. The high power section allows stations to run up to the full power permitted by their licence conditions.

The rules are very much in line with those used last year and are based on the popular *PW* 144MHz QRP Contest. You may operate from a fixed location or portable – a good hilltop location can make a huge difference to your score.

For those new to the 4m band, the *PW* 70MHz contest is a great introduction to the friendly nature of contesting found on the band.

Equipment

The choice of equipment at 70MHz (4m) is somewhat limited in comparison with 144MHz. Please don't let this put you off, because 4m is a band where the FM and AM modes can be used to make some quite long distance contacts. Cheap ex-PMR equipment running AM or FM is used by many stations to great effect on 4m.

A number of FM transceivers for 4m

have come onto the market in the last few years. These include the Wouxun KG-UDV1P/L 4m and 2m dual-band handheld, the Wouxun KG-699E 4m handheld and the Mydel ML-5189 mobile.

The Icom-7100 transceiver, introduced in 2013, is a fully-fledged multi-mode transceiver covering 4m in addition to other HF and VHF bands. It has been used by several stations in contests since its launch.

2014 saw the launch of the Noble NR-4SC, a dedicated 4m SSB/CW (but not FM) transceiver, which was reviewed in the March 2015 issue of *PW* and used by a number of stations in 2014 and 2015.

For 2016, it will be interesting to see how many stations use the newly introduced Icom-7300 transceiver, reviewed last month in *PW* and which includes 4m.

The UK version of the older Yaesu FT-847 also covers 4m and second-hand models often come available.

Transverters are also popular with 4m operators. Most use an intermediate frequency (IF) of either 28MHz or 144MHz, taking the 28MHz output from an HF or 144MHz transceiver and mixing with a local oscillator to deliver 70MHz for transmit and vice versa on receive. Transverters usually require drive levels much lower than the full output power of

most HF and VHF transceivers, sometimes as little as a few milliwatts. You may need to build or buy a suitable attenuator unless your main transceiver has a low-power transverter output. **Spectrum Communications** in Dorchester have a good range of transverters available as kits or ready to use.

Antennas

Many stations will perhaps be using nothing more than a simple dipole or quarter-wave vertical antenna. Stations with Yagi antennas are likely to have fewer than six elements.

Vertically polarised antennas are generally used for FM and AM operation. For SSB and CW, most stations use horizontally polarised antennas. For those who like building antennas, there are a number of designs for the 4m band on the *PW Antenna Collection Archive Disc*.

Operating

I would suggest spending some time on FM and AM in addition to SSB and CW. If you are unfamiliar with the 4m band, you could be in for quite a surprise at just how many stations are using these modes.

In previous years there has been activity from almost all parts of the British Isles, including a number of EI stations. It is easy to miss out on contacts simply by not checking all directions or by trying to work stations off the back of the beam. Don't forget that slow QSB (fading) is a common occurrence on the 4m band, so you may miss a station altogether if you don't rotate a directional antenna a number of times during the contest. The QSB can cause stations to disappear for a minute or two and then reappear.

Entries

After the contest, please submit an entry. Although electronic entries via e-mail are preferred, those of you who don't use computers will no doubt be pleased to know that you can easily submit an entry without going anywhere near a computer.

Do make a note in your diary now

The 8th *Practical Wireless* 70MHz Contest takes place on **Sunday September 25th 2016**. If you plan to use batteries, don't forget to charge them a day or two before and do put a reminder in your diary to submit your entry to be received by **Tuesday October 18th**. Let's hope for some good weather and propagation on the day so that we can all have a really enjoyable time.

The 2016 Rules

1. General: The contest is open to all licensed radio amateurs, fixed stations or portable, using SSB, CW, AM or FM in the 4m (70MHz) band. Entries may be from individuals or from groups, clubs and similar organisations. The duration will be from 1200 to 1600UTC on Sunday September 25th 2016.

All stations must operate within the terms of their licence and only transmit within the 4m allocation allowed within their licence. Stations using transverters are reminded to be particularly careful to ensure that they don't transmit out of band.

Subject to licence conditions, split frequency operation is permitted for the purpose of working stations in countries with different 4m allocations. Cross-band contacts where either station is not operating between 69.0 and 71.0MHz will not count for points.

Entrants must observe the band plan for their country and keep clear of normal calling frequencies such as 70.200MHz. Entrants must avoid using any frequency that is obviously in use for non-contest purposes. **The 4m band is not an exclusive amateur band in many countries. Contest stations must allow all other users (including non-amateur users) of the band to carry out their activities without hindrance.**

The station must use the same callsign throughout the contest and may not change its location. Entrants not operating as a fixed station must use the /P callsign suffix.

2. Contacts: Contacts will consist of the exchange of the following minimum information:

- (i) callsigns of both stations **(including any /P suffix)**
- (ii) signal report, standard RS(T) system
- (iii) serial number: a 3-digit number incremented by one for each contact and starting at 001 for the first contact
- (iv) locator (i.e. full 6-character IARU Universal Location for the location of the station).

Information must be sent to and received from each station individually and contacts may not be established with more than one station at a time. Simultaneous transmission on more than one frequency is not permitted.

If a non-competing station is worked and is unable to send his full universal locator, his location may be logged instead. However, for a square to count as a multiplier (see rule 4), a full 6-character locator must have been received in at least one contact with a station in the square.

Contacts via repeaters or satellites or using any digital modes (including D-STAR, Fusion and DMR) are not permitted.

3. Power: In the low power section, the output power of the transmitter or transverter final stage must not exceed 10W PEP. If the equipment in use is capable of a higher power, the power shall be reduced and measured by satisfactory means. Stations cannot rely on leader loss to meet the 10W power limit. In the Open section, stations may use whatever power they are permitted to use by their licence conditions.

4. Scoring: Each contact will score one point. The total number of points gained during the contest will then be multiplied by the number of different locator squares in which contacts were made (a square here is the area defined by the first four characters of the universal locator).

Example: 52 stations worked in JO81, JO90, JO91, JO92 and JO01 squares; final score = $52 \times 5 = 260$.

Only one contact with a given station will count as a scoring contact, even if it has changed its location, e.g. gone /M or /P. If a duplicate contact is inadvertently made, it must still be recorded in the log and clearly marked as a duplicate (not necessary in computer logs submitted by e-mail).

5. The Log: Logs may be submitted by e-mail or by post. In either case the log must contain the following information for each contact:

- (i) time (UTC – NOT BST)
- (ii) callsign of the station worked **(including any /P suffix)**
- (iii) report sent
- (iv) serial number sent
- (v) report received
- (vi) serial number received
- (vii) locator received (or location)

The preferred form of a log is a computer file sent by e-mail. This may be generated by contest logging software such as EISDI's SOV or MINOS or a file in any other suitable format (plain text is fine) provided each of the items above is separated by a separating character such as a comma or tab (please don't mix separators). Give the file a name including the station callsign (e.g. g6mxl-p.log) and send as a standard e-mail attachment to contest@pwpublishing.ltd.uk

The REG1TEST, .log, .edi and .adi formats or the spreadsheet available on the contest website are preferred. If there is any problem with your entry, you will be contacted by e-mail. Log sheets and covering information sheets for paper-based entries are available for downloading from the contest website: www.pwcontest.org.uk

6. Entries: The covering information listed below must be provided with each entry. The preferred method of submitting this is by the use of the online

facility on the website. Alternatively, the information may be written in the e-mail message to which the log file is attached. For entries sent by post, it should be written on a separate sheet of A4-sized paper.

The information required for every entry is:

- (i) name of the entrant (or of a club etc. in a group entry as it is to appear in the results table and on the certificate)
- (ii) callsign used during the contest **including any /P suffix** (e.g. G6MXL/P)
- (iii) name and address for correspondence
- (iv) location of the station during the contest
- (v) full 6-character locator as sent during the contest
- (vi) whether single or multi-operator (a single-operator is an individual who received no assistance from any person in operating the station, which is either his/her permanent home station or a portable station established solely by him/her); if multi-operator, include a list of operators' names and callsigns
- (vii) a full description of the equipment used including transmitted PEP output power
- (viii) if you are entering the low power section and the transmitting equipment (including any transverter employed) is capable of more than 10W PEP output, a description of the methods used (a) to **reduce** and (b) **measure** the output power
- (ix) antenna used and the approximate station height in metres above sea level (ASL)
- (x) if you receive or send a report of poor quality signals (e.g. wide/splattering), full details of the complaint, including time, callsign, nature of complaint and actions taken **during** the contest to investigate and resolve
- (xi) the following declaration must be included in the e-mail text or written and signed by the entrant: "I confirm that the station was operated within the rules and spirit of the event and that the information provided is correct".

Failure to supply the required information may lead to loss of points or disqualification.

7. Other Entry Information

Entries by e-mail must be sent to contest@pwpublishing.ltd.uk

Paper entries should be sent to: Practical Wireless Contest, c/o Colin Redwood G6MXL, 53 Woodpecker Drive, Poole BH17 7SB.

Entries must be received not later than Tuesday October 18th 2016. Late entries will be disallowed.

Any other general comments about

the station, the contest and conditions during it are welcome (written on a separate sheet of paper in the case of entries sent by post). Photographs relating to the operation are also invited. Please note that photographs cannot be returned and may be used for publication in *PW* or on the contest website. If these are not available by the time the entry is submitted, they may be sent later by e-mail or post. **to arrive by October 25th 2016.**

The results will be published in *PW*.

8. Miscellaneous: When operating portable, obtain permission from the owner of the land before using the site. In particular observe any restrictions on access. Always leave the site clean and tidy, removing all litter. Observe the Country Code.

Take reasonable precautions to avoid choosing a site that another group is also planning to use. It is wise to have an alternative site available in case this problem does arise.

9. Poor Signals: Make sure that your transmitting equipment is properly adjusted and is not radiating a broad or poor quality signal, e.g. by over-driving, excessive speech compression or low voltage supply. On the other hand, be aware that your receiver may experience problems due to the numerous strong signals it will have to handle and that this may lead you to believe that another station is radiating a poor signal. Before reaching this conclusion, try heavy attenuation at the received input. The use of a high-gain RF preamplifier is likely to worsen strong-signal problems so if you do use one, it is best to be able to switch it off when necessary.

If after making the checks above, you are certain that another station participating in the PW 70MHz contest is radiating poor quality signals, please call the station, giving your callsign, and tell them about the problem. You cannot expect a station with a poor signal to do something about it if they are unaware!

If you receive or send a report of poor quality signals (e.g. wide/splattering), you must record on the cover sheet full details of the complaint including time, callsigns of stations involved, nature of complaint and actions taken **during** the contest to investigate and resolve.

10. Adjudication: Points will be deducted for errors in the information sent or received as shown by the logs. Unmarked duplicate contacts in paper-based logs will carry a heavy points penalty. Failure to supply the complete information required in rule 6 may also lead to deduction of points. A breach of these rules may lead to disqualification. In the case of any dispute, the decision of the adjudicator will be final.



The Spotless Sun

PW's HF specialist Steve Telenius-Lowe PJ4DX reflects on the current state of the sun and what it bodes for HF propagation.



Fig. 1: Rudolf Wolf, 1816 – 1893.

It is well known that HF propagation conditions are influenced by the solar cycle and that the solar cycle is approximately 11 years in duration. But not all cycles are equal and those of us who have been in amateur radio for a few decades know that the current solar cycle, number 24, has been a poor one as far as HF propagation is concerned. I first came into amateur radio as a teenage shortwave listener in 1968, just before the peak of cycle 20, so I'm lucky enough to have experienced five solar cycles (so far). Those who are a little older than me wax lyrical about cycle 19, which peaked in 1958 and which was undoubtedly the best for HF propagation since the dawn of radio itself.

Counting Sunspots

The amount of solar activity correlates closely to the number of sunspots, which can be observed from earth and, these days, from orbiting telescopes. But how is it possible to come up with an agreed number when the quantity of sunspots visible is dependent on the power of the telescope used? That question was answered in 1848 by Rudolf Wolf. Fig. 1,

who was born near Zurich (purely coincidentally) exactly 200 years ago in the week this is being written. The sunspot cycle was already known about but it was Wolf who calculated the period of the cycle at just over 11 years. He also realised that sunspots often form in groups and derived this formula to quantify the amount of sunspots:

$$R = k(10g + s)$$

where R is the relative sunspot number, g is the number of sunspot groups, s is the number of individual sunspots and k is a factor that takes into account variables such as the power of the telescope being used and the location of the observatory.

Note that the smallest possible sunspot number (other than zero) is therefore 11, when there is just one sunspot and so only one group. This figure is known as the Wolf number and is still used today. The number of sunspots and the 11-year sunspot cycle might have remained a

scientific curiosity but with no practical use had it not been for Wolf who, with a small group of co-workers, discovered the relationship between the solar cycle and geomagnetic activity in the atmosphere.

An average of many observations taken around the world, after application of the k 'fudge' factor, provides the daily relative sunspot number. This number can fluctuate wildly from day to day, though, so a 13-month rolling average, called the Smoothed Sunspot Number (SSN), is usually used instead, for example in propagation prediction programs.

Table 1 shows when each of the solar cycles since cycle 19 took place, along with the maximum SSN recorded in that cycle and when that peak of activity occurred. The same data (although only from the late 1970s onwards) is shown in graphical form in Fig. 2.

Most solar cycles tend to peak quite quickly, dip a little, then peak again before gradually declining to solar minimum. These 'twin peaks' can be seen clearly in Fig. 2, particularly in cycles 22 and 23. It can also be seen that now in 2016 we are on the downward slope of cycle 24, which is expected to continue to decline until late 2019, when solar cycle 25 is expected to begin.

The Spotless Sun

This current cycle seems to be an unusual one, though. Firstly, it is the cycle with the lowest peak of SSN since the invention (or 'discovery' might be a better word) of

Table 1: Maximum SSN of solar cycles 19-24 and number of spotless days at the end of each cycle

(Source: https://en.wikipedia.org/wiki/List_of_solar_cycles)

Cycle number	Period	Maximum SSN	Peak	Number spotless days
19	1954-1964	201	Mar '58	227
20	1964-1976	111	Nov '68	272
21	1976-1986	164	Dec '79	273
22	1986-1996	158	Jul '89	309
23	1996-2008	121	Mar '00	821
24	2008-?2019	82	Apr '14	?

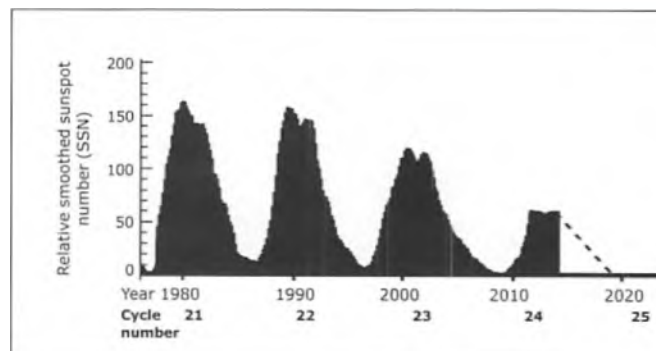


Fig. 2: Solar cycles since 1980.



Fig. 3: The spotless sun, on July 5, 2016. (Credit: SDO/HMI).

Fig. 4: Beams and verticals adjacent to the ocean at 3B7C, St Brandon, in 2007. 137,500 QSOs – without a single sunspot!



radio. Secondly, it is probably the quickest to decline from its peak, in April 2014, to a spotless state. Yes, in June this year the sun became totally spotless for the first time since the peak of the cycle. This occurred only 26 months after the solar maximum. The usual gradual decline has actually been rather rapid this time. As this is being written, on July 5th, the sun is still spotless, **Fig. 3**, and so far there have been 16 spotless days.

It may therefore be tempting to think that we have already reached the solar minimum, but, sadly, that isn't the case! Table 1 also shows the number of spotless days at the end of each solar cycle, before the next one begins. This number can vary from as few as 227 days, at the end of cycle 19, to estimates of over 1,000 days in the late 19th and early 20th centuries. In the radio age, though, the longest period – by far – was 821 days at the end of the last cycle. There seems to be an inverse correlation between the size of the cycle and the number of spotless days at the end of it, with smaller cycles having a larger number of spotless days. What this means is that we probably have another 700, 800 or more spotless days to look forward to before cycle 25 begins. Note that these are not consecutive spotless days but a total number, with days that do have sunspots interspersed. So if there are 730 spotless days at the end of cycle 24, it doesn't mean that the new cycle will begin in June 2018, two years after the first spotless days of the current cycle were observed. Rather, it is far more likely to be at least a year later than that.

A Word About Solar Flux

We said earlier that the amount of solar activity correlates closely to the number of sunspots. In the 19th century it wasn't possible to measure solar activity directly. The only method available was to count the number of sunspots and sunspot groups. These days the solar flux – in effect the amount of radio 'noise' coming from the sun – can be measured directly. This is measured at a frequency of 2800MHz (2.8GHz), a wavelength of 10.7cm. There

are two main advantages of monitoring solar activity this way. As discussed earlier, the number of visible sunspots is dependent upon the power of the telescope so it is always a subjective figure, whereas measurement of the solar flux provides a definitive figure. Secondly, such measurements can be carried out under virtually all weather conditions, whereas counting sunspots requires clear skies (at least when using terrestrial telescopes).

As this is being written in early July 2016, the SFI (Solar Flux Index) has been around 72 to 75 SFU (Solar Flux Units) yet the sun has been totally spotless for nearly two weeks. Why is this? The answer is, of course, that the sun still has some activity even when there are no sunspots. When we have had a spotless sun for a much longer period, the SFI can drop to a value of around 67 SFU but that is about as low as it ever goes.

There is a strong correlation between the daily relative sunspot number, R , and the solar flux, though the conversion formulae are fairly complex. If you want to read more, see: www.sws.bom.gov.au/Educational/2/2/5

What This Means for HF Radio

A long period of sunspot-free days leads to depressed HF propagation. Depending on the time of year, there will be little long-distance F2 layer propagation on the higher HF bands – 10, 12, 15 and maybe even 17m. Most DX traffic will be on 20, 30 and 40m.

However, it is not all doom and gloom. There will still be seasonal improvements in propagation, typically around the spring and autumn equinoxes, but propagation during most of the year is likely to remain depressed until at least 2020.

DX can still be worked even with long periods of a totally spotless sun, though. Back in September 2007, I took part in the 3B7C DXpedition to the island of St Brandon in the Indian Ocean. This was a major operation, with a sufficient number of stations and operators to ensure that few band openings were missed. We also had monoband Yagi antennas and

vertical arrays on the edge of the ocean, **Fig. 4**. The expedition took place during that period of 821 spotless days at the end of cycle 23 and, after the operation, we discovered that during the entire 19 days we had been on the air, there had not been a single sunspot. Yet we still made 137,500 QSOs, setting a new DXpedition total QSO record for an operation made with zero sunspots throughout.

We had anticipated that propagation would not be too good on the higher HF bands so in order to eke out the maximum number of contacts, we ran two stations simultaneously (one on SSB and one on CW) on both 20m and 80m. Certainly we made QSOs – over 8,000 in fact – on both 10m and 12m, but this compares with over 40,000 QSOs on 10m alone during the similar size and duration D68C Comoros DXpedition in February 2001, close to the peak of the same cycle. This neatly illustrates the difference in HF propagation between times of high solar activity and during a totally spotless sun but it also gives a lie to the impression that the higher HF bands are completely dead when there are no sunspots about. Note that the 3B7C DXpedition took place around the autumn equinox, the time of year when propagation is likely to be at its best, no matter what the state of the solar cycle.

Long periods of the spotless sun can actually provide one advantage and that is fewer geomagnetic disturbances. In terms of HF propagation, this means the lower frequency bands – 40, 80 and particularly 160m – are less disturbed and signals can therefore be stronger than in solar maximum years. It is well worth improving your lowband antennas now because conditions are likely to improve on those bands over the next four years or so.

Other sites that are well worth a look if this subject interests you include:

www.spaceweather.com

www.spaceweather.gc.ca/solarflux/sx-2-en.php

https://en.wikipedia.org/wiki/Solar_cycle_24

https://en.wikipedia.org/wiki/Solar_flux_unit



The Resistive Bridge

Tony Jones G7ETW returns, this time taking a look at a practical implementation of an age-old measuring device.

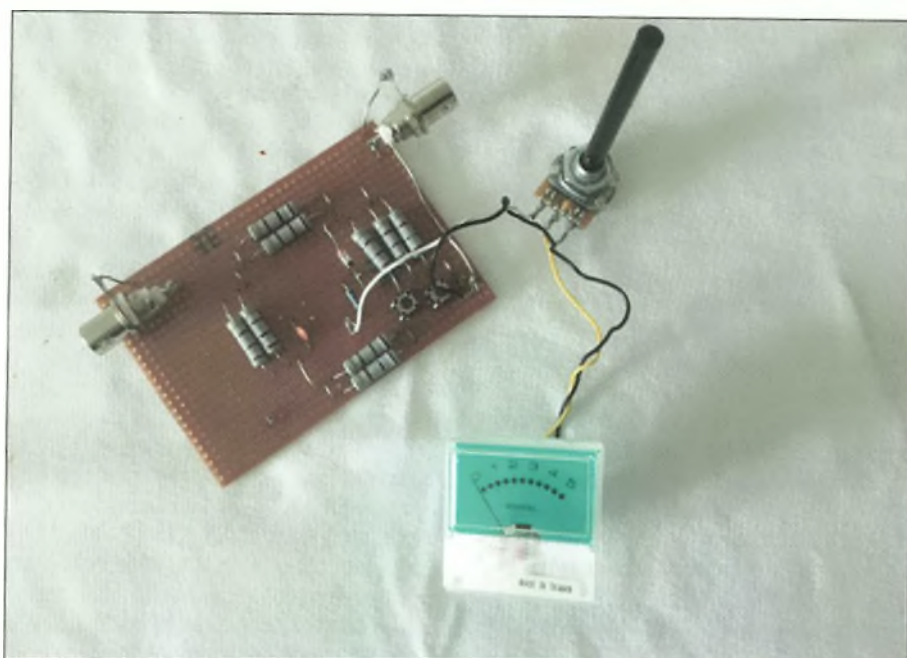


Fig. 1: A simple Wheatstone bridge.

If the circuit in Fig. 1 looks familiar, so it should. The essence of this is the Wheatstone bridge, a device for measuring resistance that has been around since 1843. I remember using one when I was at school and making measurements to hundredths of an ohm.

This is not a nostalgia piece but a constructional article to provide you with a useful tool for checking and matching HF antennas. With the exception of the diode, you probably already have all that's needed.

The Wheatstone Bridge

Before we get to RF I think it's worth a reminder of how a Wheatstone Bridge works with DC. Fig. 2 shows the classic

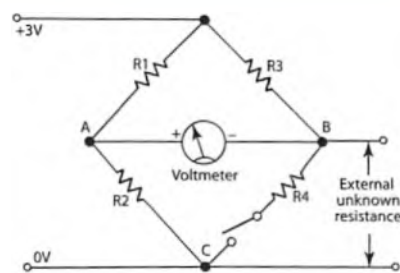


Fig. 2: The basic and familiar Wheatstone bridge circuit.

diamond-shaped circuit, which usually has just three resistors, the fourth being the external resistance that is to be measured.

My test bridge comprises three fixed 50Ω resistors and a variable, switchable resistor, labelled R4. I could have left a gap and connected different test resistors with crocodile clip leads as required but this group of three resistors was chosen to

make a useful on-board self-test facility.

The left side of the circuit is simplicity itself. Resistors R1 and R2 are connected across the voltage source, in series. At point A, the voltage will be exactly half the supply voltage, assuming the resistors are of the same value. This will always be true.

The right side is also a potential divider. R3 is a 'reference' resistor, in this case 50Ω because that is the value we want to be able to measure differences from accurately. The voltage across R3 and R4 is the same as that across R1 and R2 so if R3 equals R4, the voltage at point B will also be exactly half that of the supply.

Actually, I can almost hear a friend of mine tut-tutting me here. Voltages are potential differences so I should not say there is a voltage 'at' a place in a circuit. There is a potential there, certainly, but for there to be a potential difference, it must be relative to somewhere else – in this case point C, ground. However, I daresay you, the readers, understand what I am saying!

So in a balanced bridge, the potentials at points A and B are the same and a voltmeter connected between them sees no potential difference between them. Resistors R1 and R2 could be any value just so long as they are the same. Resistor R3 is usually the same value again but doesn't need to be.

To make tests, I applied just over 3V DC to the bridge. That puts a constant 1.6V at point A.

The photograph, Fig. 3a shows the bridge with an open circuit for R4 (because none of the three self-test resistors is switched in) resulting in 3V at point B. Result: minus 1.6V as shown on the DMM.

Photograph Fig. 3b shows the bridge with a 50Ω load, achieved by pressing the rightmost switch. That perfectly balances the bridge and the voltage across the middle disappears.

Photograph Fig. 3c shows the bridge with R4 equal to 33Ω . The voltage at point C is now less than half the supply because the combined resistance of R3 and R4 is 83Ω and R4's 33Ω is less than half of that. The DMM (correctly – it's just Ohm's law) shows 0.3V.

What happens if R4 is made a short-circuit (This is not an academic what-if. If the end application is to measure antenna impedance, open and short circuits are the worst-case scenarios)? There is now only one resistance on the right side. So all of the 3V is across R3 and point B is at ground. The DMM sees the same 1.6V difference but of the other polarity, as Fig. 3d shows.

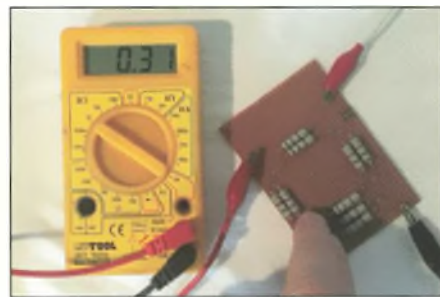
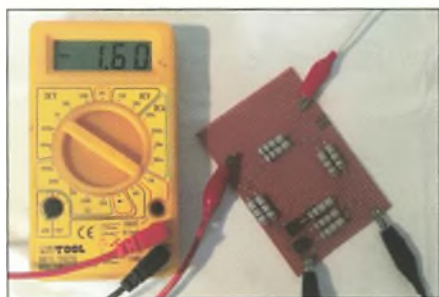


Fig. 3a, b, c: The Wheatstone bridge with various conditions applied as described in the text.

AC Wheatstone Bridge

Measuring a differential DC voltage is easy but doing the same for RF frequencies is a different matter. To convert our circuit to an AC bridge, it needs an RF detector fitted across the bridge. At its simplest, this can be just a diode and a capacitor, see Fig. 4. The diode half-wave rectifies the RF voltage that appears when the bridge is unbalanced. Capacitor C1 stops the resulting direct current from leaking away through R2. The DC voltage is 'sampled' via a limiting resistor and the variable resistor controls the current passing through the microammeter. Any small DC meter could be used – this one can handle up to 100 μ A. The capacitor across the potentiometer's wiper and ground connections provides a little smoothing.

Diodes – Silicon and Germanium

The diode is an OA91, a venerable component indeed, much associated with crystal sets. This is a germanium diode, which has a voltage drop of 0.3V. Compare that to a modern silicon signal diode, which has a 0.6V voltage drop. A 1N914 diode, say, would still work but the circuit would be less sensitive.

The maximum voltage an OA91 can handle is 30V, which worried me until I did the sums. The maximum voltage that can appear across the detector is half the supply voltage so there would need to be 60V peak-to-peak RF for the diode to be in trouble. That makes the power coming in rather more than the resistors can handle. This is, after all, a QRP bridge so the OA91 is perfect for it.

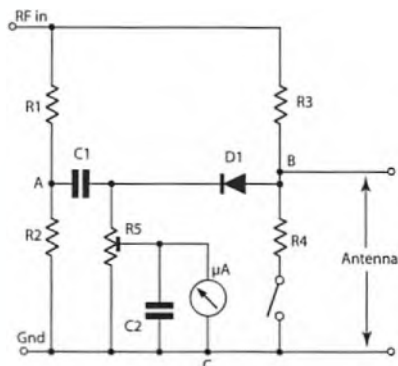


Fig. 4: An RF bridge for low power applications.

There is a modern alternative, a Schottky diode such as a BAT43. Schottky diodes have an even lower turn-on voltage, as little as 0.2V. They also have fast recovery times as well as being easier to come by (and cheaper).

Testing with RF

Using my trusty Yaesu FT-817, I tested the bridge with just 500mW going into it. There was plenty of DC current coming out of the detector to drive the meter so I'm sure that this would work perfectly well with even lower powered transmitters. I adjusted the potentiometer for maximum meter deflection and switched in the on-board test loads one at a time.

With a 50 Ω load, as expected, the meter reading drops to zero, indicating a perfectly balanced bridge, Fig. 5a.

With all three test resistors in circuit, giving a 33 Ω load, the meter shows a reading of 1.5 as illustrated in Fig. 5b. This should be a VSWR of 1.5 so the meter is reading a bit high. It should deflect to

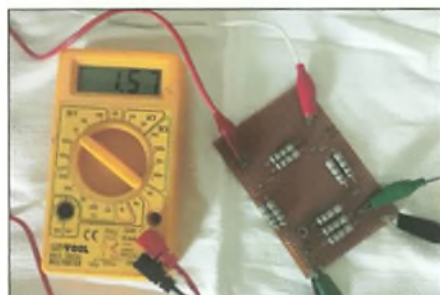


Fig. 5d.

about 1.0 (see sidebar for an explanation of VSWR maths). Perhaps stripboard, with all that track-to-track capacitance, wasn't the best construction method after all!

Using external resistors laid across the antenna BNC socket I got the results shown in Table 1.

To get some horrible VSWRs, I used a dummy load and an ATU, deliberately detuned to make non-ideal antennas. The second table, Table 2, shows the results.

I tested this on all the bands an FT-817 has. It was remarkably consistent all the way through HF and even gave good

Table 1: Measurements of meter reading at various SWR levels.

VSWR	Meter Reading
4:1	3.2
3:1	2.5
2:1	1.3

Table 2: Measurements at more extreme SWR readings.

VSWR according to MFJ	Meter Reading
20:1	4.6
15:1	4.4
10:1	4.2
8:1	4.1



Fig. 5a, b: The RF bridge under various conditions as described.

results at 50MHz. Above that it became useable.

I will have to do some field calibration to really know the bridge's characteristics but as a first impression, I'd say that a meter reading less than about 1.5 tells me an antenna is workable, indicating a VSWR below about 2:1.

Protection Guaranteed

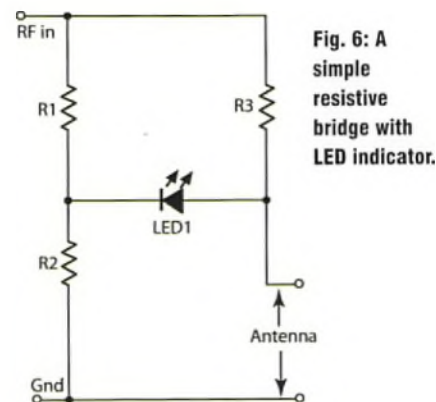
There is a very useful side effect of this kind of bridge, as can be seen in Figs. 5a and 5b. The radio is displaying VSWR and clearly is not seeing a bad VSWR. Regardless of the actual match, the radio never sees a worse load than R1 and R2 in series (100Ω or 2:1). Had R1 and R2 each been 25Ω, the worst VSWR the radio would experience is 1:1 but I wanted the increased power handling that pairs of resistors give.

Most modern radios are clever enough to 'throttle back' when faced with a nasty VSWR but not all. I also have an X1M Pro, a Chinese 5-band QRP set, and the instruction booklet makes it clear that the PA must be protected from loads worse than 2:1 (Given that the some of the early UK kits came with spare PA transistors, the manufacturers must be serious!). Many simple QRP designs lack such protection too.

This feature of protecting the radio from unfavourable loads is well worth having but it has a cost. Even with a perfect match, only 25% of the power is dissipated in R4. In use, the circuit cannot be left in place as a monitor, as many people do with VSWR meters. Putting a bypass switch to connect RF in to the antenna directly is a good idea and I will be doing that when I box the circuit up.

Even Simpler Bridge with no Meter

There is a resistive RF bridge circuit with even fewer parts, as shown in Figs. 6 and 7. This uses an LED as a rectifier and display device. In use, the antenna is tuned for the dimmest illumination of the LED. Indoors, almost any LED would



VSWR Mathematics Explained

We all know that a VSWR of 1.5 indicates that reflected power is 4% of forward power. But do you know why?

Suppose that 100W is the forward power and 4W is the reflected power. These can be read easily on a VSWR meter with forward and reverse power options.

As a fraction, power reflected is 4 divided by 100 or 0.04. This is 1/25th.

Power is proportional to voltage squared so the voltage being reflected must be the square root of that.

No calculator is needed for this one. The square root of 1/25th is obviously 1/5th or 0.2. This is the 'Voltage Reflection Coefficient', usually called V_{ref} .

The VSWR figure is defined as (1 plus V_{ref}) divided by (1 minus V_{ref}).

In this case, that is (1 + 0.2) divided by (1 - 0.2), which is 1.2 divided by 0.8 or 1.5! To take another common example, 2:1 is commonly seen as a reflected power of 10%. It's 11% actually, as shown below.

100W is the forward power and 11W is the reflected power.

11 divided 100 is very nearly 1/9th.

V_{ref} is the square root of that. That's 1/3 or 0.333.

The VSWR figure in this case = (1 + 0.333) divided by (1 - 0.333), which is 1.333 divided by 0.667, which is 2.

This is very easy to model in Excel and makes for a useful tool. The rule is:

- Work out the power reflected as a fraction of power out (forward power).
- Take the square root of that to get V_{ref}
- Use the formula $VSWR = (1 \text{ plus } V_{ref}) \text{ divided by } (1 \text{ minus } V_{ref})$

Parts List for Circuit with Meter

6 x 100Ω Carbon resistors 5% (or better) tolerance, power handling 2W

OA91 Germanium diode or similar, e.g. 1N34A

1kΩ 1/4watt resistor

2 x 10nF disc capacitor

2 x RF socket

Small DC current meter. Anything up to 1mA full-scale deflection is fine (At the next rally look out for an old cassette deck – an old VU meter would do the job nicely).

Small piece of Veroboard (although this circuit could be made by wiring the resistors and so on from the sockets, potentiometer and meter connections).

If the on-board test loads are wanted,

- 3 x 100Ω carbon resistors 5% (or better) tolerance, power handling 2W
- 2 x push-to-make non-locking switch

Parts List for Simpler Resistive Bridge with LED

6 x 100Ω carbon resistors 5% (or better) tolerance, power handling 2W

2 x RF socket

2V LED, preferably very bright kind

suffice but for outdoor use a bright one is needed or the LED might look dim when it actually isn't, making the whole thing rather a waste of time! As expected, I found that the circuit needed more than 500mW to give meaningful relative indications. With 5W it worked nicely.

This circuit is very tiny and would be

a good addition to a homemade QRP ATU. But just like the meter circuit, this consumes power all the time and must be switched out when transmitting.

Conclusion

These circuits have been around for a long time and ways of measuring RF loads have moved on. Compared to even a simple analogue VSWR meter that directly samples forward and reverse voltages, a resistive bridge is unsophisticated, crude even. It is limited in its power handling and it certainly isn't a precision instrument.

But so what? It is fun making and using something like this. I like this circuit and I plan to box mine up and use it for Sunday afternoon QRP forays, leaving my MFJ analyser safely at home. Above all, this shows that something that is basic and easy to understand can do a useful job.

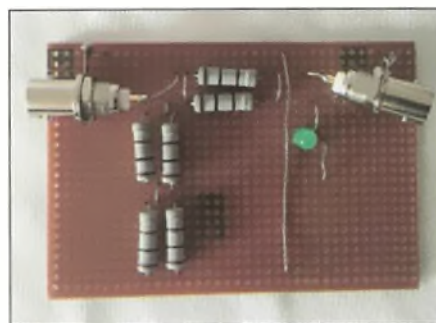
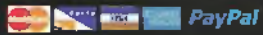


Fig. 7: The bridge of Fig. 6 built on stripboard.

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And another thing... Have you noticed how other retailers seem to be fiddling with their web addresses? Many years ago I was the only UK retailer to list "HamRadio" in our URL and indeed refer to ML&S as "a Ham Radio Store." Others were still referring to "Amateur Radio", not Ham.

It seems that all of a sudden the words "Ham Radio" can't be left out of their web address or indeed strap-lines in adverts. So, before you get misguided on to the wrong site for your next purchase, or indeed information on the vast range of products we actually stock, there is only one HamRadio.co.uk

That's the one without hyphens and other words stuck in at random. Can someone help me down off my soap box please? My legs aren't as agile as they used to be.

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Watching Signals Passing You By

A modern amateur radio phenomenon.

Over the last two decades the equipment in the average radio shack has changed radically. Where once older receivers and transceiver from our earliest radio explorations had sat gathering dust, these were moved out, stored away or sold off to make room for a personal computer and its associated screen.

First on the computer came logging software, then the internet brought us online DX clusters and then digital radio emerged. The latter brought digitisation of radio signals so these could be converted from analogue to digital by the computer's sound card and displayed in bandscope fashion.

I was one of those, inspired by my close friend Phil Harman VK6APH, who enthusiastically embraced this new visual dimension to amateur radio. Phil had one of the first Flex Radio transceivers and I followed on his coat tails with his help, using a Softrock software defined radio tapped onto the second intermediate frequency chain of my FT-1000 as the basis for a bandscope.

As the number of computers and screens grew each year in the VK6VZ radio shack, I found myself watching what was happening on the airwaves rather than listening to it on my radios. With multiple software windows open for a general bandscope and VE3NEA's CW Skimmer to view what was happening on the bands, plus more windows for logging, watching DX clusters and the progress of the grey line across the globe, absolutely nothing could escape my notice.

It was at this time that amateur radio began to lose its shine. So I started to think about what I, along with a major proportion of the amateur radio of the world, was doing. Rather than actively listening, tuning up and down the various frequency bands, looking for interesting signals to listen to, I had turned to passive watching. To quote



G3ZZD in 1973 doing pure radio.



VK6VZ in 2013 surrounded by computers and monitors.

my dad Ossie (G0TYJ SK, a World War II RAF navigator also trained as a radio operator) I had been "taken over by the goggle box" (or in this case, goggle boxes).

Older radio enthusiasts will recognise this term, which was derisively given (perhaps by radio enthusiasts) in the 1960s to those who became a slave to the visual attractions of the newly arrived television set. In fact, what the television set actually gave us was an audio-visual world, capable of tying us to our armchair in a way that the simpler sensory audio world of radio didn't.

Most of us can listen to the radio while our brains do other things at the same time such as cook, clean and look at nature – I do all these simultaneously in the VK6VZ kitchen, which overlooks the garden. However, if we try doing these other things while watching television – or look at a computer screen for information while listening to the radio – this is much harder and quickly becomes a chore. There is just too much going on for our brains to process enjoyably and our senses start to drown.

As a result of this conclusion, I turned off the shack computers and their monitors, one by one, and soon found myself getting close and personal again with my radio and what was actually happening on the airwaves. I tuned the bands simply listening and reacquainting myself with the amazing soundscape that is radio. The sounds of atmospheric noise, as it comes and goes with changes in the weather; the jangling music of a broadcast station just outside (or even inside) the amateur bands; the miscellaneous heterodynes, bleeps and strange radio noises that are always present on whatever band you are tuning; and the individual sounds of people's voices and Morse code signals.

Once again, radio became a wonderful audio world that I can lose myself in after a long day's work in front of at least one, sometimes two, computer screens. I've gone back to experiencing how the bands continuously change as day becomes night, the weeks progress and the seasons come and go. I live and breathe radio, rather than watching it pass me by on a screen.

On internet reflectors and chat rooms associated with radio, there is a continuous cry about a lack of activity on the bands. Most of all, the best thing for me is I've gone back to calling CQ and being delighted with the variety of people, many old friends, who return to my calls. What I loved most about amateur radio right from the start was the opportunity to communicate with a huge variety of people from all over the world – and now I've gone back to simply communicating using radio, the joy in it has returned.

The computers and monitors are still there if I really want to find out about a rare DX station, which it turns out is a very rare event. Doing pure radio (like I did 40 years ago) mostly with a paper log is much, much more fun – if you haven't done it for a while, please try it.



A Busy Month on VHF/UHF

Tom Kirby G4VXE has lots to report, what with summer Sporadic E, satellite activity, aircraft scatter and more.

The GB3VHF beacon in Kent has given wonderful service for as long as I have been interested in the VHF bands – and longer!

I'm delighted to report that there is now a 70cm beacon, GB3UHF, at the same location, Fig. 1. It uses the same type of antenna installation (3-element Yagis beaming 288° and 348°) as GB3VHF and runs a similar ERP. Like GB3VHF it runs both CW and JT65B modes. Why not try listening to 432.430MHz and see whether you can hear the CW. You might have to wait a few minutes for the beacon to peak up, perhaps via aircraft scatter. The beacon is weakly audible here in Oxfordshire on a simple vertical but very strong on a small 10-element Yagi beaming that way.

Chris Whitmarsh G0FDZ is the key man behind the project and deserves the thanks and support of the VHF/UHF community for putting on the beacon. You can read more about GB3UHF as well as learning how to make a donation to the beacon fund at this website: www.gb3vhf.co.uk/GB3UHHome.html

Airways and Aircraft Scatter

It was nice to hear from Godfrey Manning G4GLM who wrote in response to the section on aircraft scatter in the July column. I'd mentioned the reflection experienced by Lyn GW8JLY on a couple of paths to the north and had speculated that it was as a result of reflection from aircraft flying along the 'Green 1' airway. Godfrey writes, "They don't do it like that anymore! They ran out of those evocative colour names years ago, the nearest air routes now being (Upper) Lima 9. Modern navigation techniques mean that routes no longer need to hop from one beacon to another. For example, UL9 passes north of Brecon via significant point DIKAS". Thanks Godfrey – that's good

to know. Looking at FlightRadar24, it's clear that there is a steady 'procession' of aircraft over the Brecons, which might be responsible for the reflections. In the meantime, if you're interested to learn more about aircraft communications, you can check out Godfrey's Sky High column in our sister magazine, *RadioUser*.

New Release of the DL4MF Control Panel Software

Users of the DV4mini may be interested to know that there is a new version of the DL4MF control panel software available. This allows you to connect to D-STAR, DMR and Fusion systems through the internet and to create a local hotspot. The new release coincided with the Dayton Hamvention and the main improvements seem to be with associated with a much greater choice of talkgroups available through the Brandmeister Extended Routing capabilities. This appears to work very well. I tried it out on a Windows 10 system and was able to have some interesting DMR contacts with stations as far away as Australia and the USA.

Talking of the Brandmeister DMR network, Ian Abel G3ZHI wrote with some plans to connect some of the talkgroups on the Brandmeister network to the WIRES-X (Fusion) network. Keep an eye on Brandmeister reflector 4420. There are plans to connect it to the WIRES-X room 27753. Take a look, too, at the

page below on the Brandmeister network, which gives details of the latest regional talkgroups. You may find useful if you use a DV4mini or have a local DMR repeater connected to the Brandmeister network. www.bm-dmr.uk/dashboard/UKREFTG.pdf

The 6m Band

Jim Edgar GM4FVM (Eyemouth, Berwickshire) just missed the last deadline with a really nice 6m QSO he had on JT65A with AB1NJ (FN34) on June 13th, Fig. 2. Jim continues, "Just after reporting last month, there was a transatlantic multi-hop Es opening on 6m. I found it while I was on JT65 and I stuck to that mode throughout. I worked five stations in the USA, two in Iceland and one in Canada. Best DX was W3CP in Georgia (EM74 6452km). Signals were fairly stable over the four minutes or so that a QSO takes on JT65 but signal strengths varied between QSOs; between -22dB and -01dB. The opening here lasted for about 90 minutes and I was aware that others using faster modes could have fitted a lot more activity into that time. However, JT65 is a very civilised way of working (no pileups!)"

Ron Pincho ZB2B found a good Es opening on June 27th, working GW0LPL (IO72), GK6GWX (IO70), G8LZE (IO92), EI3GYB (IO53), GP3ZME/P (IN89), EI5EV (IO62), GW3XRM (IO73), M0SWL (IO91), G4YPC (IO91), K1TOL (FN44) – Ron's first transatlantic QSO on the band this year – and GW4WND (IO82).

Kev Hewitt ZB2GI has also been busy on 6m. Trying out his FT-920 and a wire



Fig. 1: Map showing the beam headings for the new GB3UHF beacon.

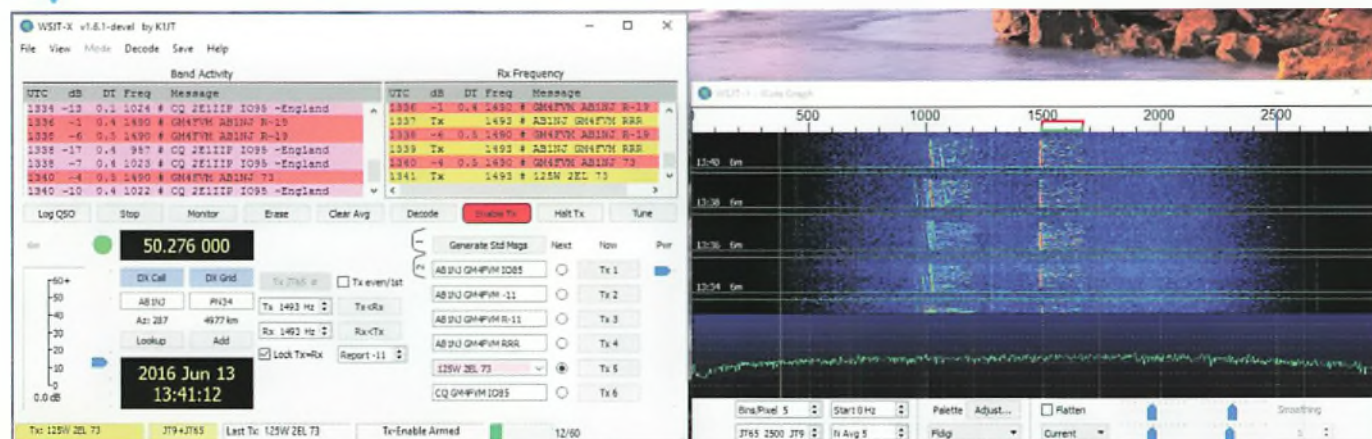


Fig. 2: Screenshot of GM4FVM's 50MHz QSO with AB1NJ.

dipole, he worked IW1AZJ (JN35), IK1PFW (JN44) and EA7JNC. Switching to using a Hexbeam, he worked more stations, including 9A5CW (JN65), PB2A (JO21), I2PJA (JN45), TM16EFC (JN18), IW2BZY (JN45), DK9WB (JO30), F1ADG (JN16), EA9CD (IM75), I1APQ (JN34), ON7EQ (JO11), GW0PLP (IO72), F5SRH (IN97), M5BXB (IO91), EI8GS (IO51) and 9H1TX (JM75).

Paul Bowen M0PNN says that the Telford group had a good time in Guernsey operating GP3ZME/P. "The 6m band did open and it was fun when it did. The best DX was ZB and EA8 with short openings to other parts of Europe. The 50MHz CW contest was slow but fun. It was hard to get some stations to accept GP as a prefix. Very short skip allowed us to work EI and GM on 6m, giving many a new one".

Paul also made some nice contacts from home, the highlights being TF3ML/P (HP93) and NP4A on June 10th and FS/K9EL on June 11th. S01WS (Western Sahara) was a nice one on June 12th with more activity from Iceland on June 13th, with TF3SG along with NN4T (FN65) and K4PI (EM73). JW7QIA from Svalbard was a new country for Paul, worked on June 30th.

As ever **Mark Marment CT1FJC** (Algarve) sends a really interesting log with many Es contacts on CW, SSB and JT65A. Some of the highlights are UB7K (KN85), JT1CO (ON38), 5B4AAB (KM64), SV9CVY (KM25), 4Z5MU (KM71), PJ4NX (FK52), KV4FZ (FK77), WP2B (FK77), NP2X (FK77), K1TOL (FN44), NN4T (FM65), VO1HP (GN37), R6KA (KN75), UR5LAK (KN89), WP4JCF (FK68), HV0A (JN61), TA1BM (KN40), 5B4AIF (KM64), VE1SKY (FN74) and VE3DLC (FN58).

Phil Oakley G0BVD (Great Torrington, Devon) has worked plenty too, with the highlights being TF2MSN (HP84), TF3ML/P (HP93), LB2AG (JP53), IS0BSR/IMO (JM48), EA9PY (IM75), IF9ZWA (JM67) and EI9E/P (IO62).

Here at **G4VXE** I have enjoyed

operating a lot of JT65A this month, sometimes remotely controlling the station at home across the internet, allowing me to be active at times when I wouldn't normally be. My 50MHz JT65A signal has been heard at UN3M, although with no QSO as yet. As well as the interesting single, double and even triple hop Es openings, I've particularly enjoyed some QSOs over 400-500km with EI, GI, GM, ON and so on. The propagation method for these contacts intrigues me.

The 4m Band

Simon Evans G6AHX (Twynning, Gloucestershire) enjoyed a 4m contact with S51DI on June 19th at 1825UTC via Sporadic E.

Ron ZB2B found some Es on both June 27th and 29th. On the 27th, he worked a single station, GD3YEO (IO74), but on the 29th there were a good number of stations to work, including GJ0JSY (IN89), G0ORG (JO02), G4YHF (IO92), G7RAU (IN79), GW4HBK (IO81), GU4CHY (IN89), G6CQC (IO94), EI4DQ (IO51), G3OIL (IO91), GM4NFC (IO76), G7DKE (IO92), G3NPI (IO92), G3WZT (IO90), G0JJL (IO92) and G3VXM (IO90).

Paul M0PNN found some good openings on 4m with highlights of an interesting log being SP5XMU (KO02), SP1MYG (JO74), LY2BAW (KO25) and SP2MKO (JO93) worked on June 12th. TF3ML/P (HP93) was worked next day, the 13th, and OH6CT (KP24) on June 30th.

Dave Thorpe G4FKI/M had a nice Es QSO with LA9DL (JO59) while mobile in Somerset at sea level, using a quarter wave whip.

Jim GM4FVM says, "On 4m I worked into Greece on June 18th (SV2DCD, KN00, 2413km). However, sporadic E has been poor later in the month at this QTH".

The 2m Band

Simon G6AHX was active on the 2m band during the VHF NFD contest, running 50W to a horizontal beam. He worked 42 stations, with the best DX being F6KCP/P

(JN18) at a distance of 518km. During the UK Activity Contest on July 5th, Simon was pleased to work into Northumberland at a distance of 356km.

Lyn Leach GW8JLY has found some Es openings and writes, "On June 12th I returned home just in time to catch a 2m Es opening to LY and EW. I worked just three stations (LY2CH (KO15OV), EW6FS (KO35LB) and EW6DX (KO45JL)) and heard a few more. KO35 and KO45 were new locators. I also heard EW6AA in KO55 but his signal faded before I could complete a QSO. On June 29th there was another opening, this time to Morocco. There was only one station QRV there, CN8LI in IM63NX. Unfortunately, IM63 was not a new locator but it was nice to work CN again because it's not often that I hear that country. On July 10th at 1306, IZ8YBS (JM89CH) returned to my CQ DX call. After a short period of silence, Gilberto IK7LMX (JN80XP) was copied at 59++ and he gave me a report of 59+40dB. Signals in Es openings can be very, very strong. JM89 was a new locator for me and one I had been waiting to work for many years".

Moving onto his meteor scatter activity, Lyn writes, "During the last few weeks there have been several DXpeditions to rare locators and these have enabled me to work new locators KO07, KO18, JO29, JP42 and JP44. The station in both KO07 and KP18 was ES0UG, operated by a group of German amateurs who started their expedition in KO18 before moving on to KO07. In JP42 I worked Stefan LA0BY operating as LA0BY/P while Lars SM4IVE operating as LA/SM4IVE activated JO29 and JP44 for another two new ones".

Paul M0PNN reports on the Telford club's DXpedition to Guernsey and says that they enjoyed operating on the band, with many stations saying they'd not worked Guernsey for many years. He writes, "The best DX worked was GM4JJJ in IO86 at 740km, F6DRO in JN03 at 747km near the EA border and PA5M, JO21b, at 620km, all on CW".

Paul was also active from home during

VHF NFD and worked a good number of UK and near continental stations.

Dave G4FKI reports that 144.265MHz SSB seems to be used as a centre of activity with a number of mobiles and fixed stations monitoring that frequency. This might be well worth a look if you are in search of some regular activity outside of contest periods. **Chris Taylor** of Taylor Made RF has recently created a Facebook group specifically aimed at promoting SSB activity on '265'.

The 70cm Band

Simon G6AHX reports 18 contacts on 70cm during VHF NFD with the best DX being EI9E/P at a distance of 321km.

Panos Dadis SV1GRN (Athens) reports that he was active on 70cm during the Aegean VHF Contest on July 3rd, **Fig. 3**. He went to Mt Penteli (KM18WC) and operated only UHF SSB and FM. Panos says he made just ten QSOs because of a lack of stations to work (it's usually a case of quality not quantity on the higher bands). Panos also says it was very hot and he had to operate from inside the car. He was running 5W to a 15-element Diamond Yagi.

Satellites

Pete Goodhall 2E0SQL had the opportunity to compare two portable Yagis popular with satellite operators, the Arrow and the Elk. Pete found them much of a muchness although the Elk was perhaps harder work to hold for an extended period. I'd always wondered. The Elk is easier to source in this country, being available from the AMSAT-UK shop, but I'd always been curious about the performance of the Arrow, in particular the giant Alaskan Arrow, which has been used to great effect by **Dave Swanson KG5CCI**.

Kev Hewitt ZB2GI writes, "**Tony Bailey MW0TBP** operated satellite for the first time while visiting family on the Rock. Using two Baofengs with a 3-element tape measure Yagi for 2m and a 4-element Yagi for 70cm, Tony twice operated as ZB2/MW0TBP through SO50, working I6GTJ (JN62), EA1JM (JN70) and 9A3ST (JN75).

"We also worked through the ISS digipeater and received NOAA weather images while portable and tracking the pass manually with a 2m/70cm log periodic antenna. On returning to Wales, Tony purchased an Elk and worked EC4TR from the back garden with a Yaesu FT-817".

Kev's ZB2GI satellite log looks good this month. Through FO-29, he worked HA6NM, EA4SG, G4DOL, G1LJA, RW3XL (KO80), ON5NY and 2E0SQL. Through



Fig. 3: Panos SV1GRN's portable setup for the Aegean VHF contest. It was too hot to operate

SO-50, he managed OH5LK, HB9OAB, G6GLJ, IZ5TEP, EA1IW, DG0ER, F4CIJ, ON5NY, UR3CTB, M0NPT, EB1AO, 2E0SQL, EA7JHV, DL1PN and F0GWP.

Patrick Stoddard WD9EWK (Phoenix) sent a fascinating write-up of his ARRL Field Day activity. Let Patrick take up the story:

"The big activity related to satellite operating in the past month was the ARRL Field Day. This is the most popular on-air activity in North America and there were stations all over the USA, Canada and Mexico participating. AMSAT also has its own Field Day competition, focused on the satellites, running in parallel with the ARRL event. Satellite operating is very popular during Field Day, due to the 100-point bonus available to stations in the ARRL Field Day that complete one satellite QSO.

"For the first time in a few years, I returned to a picnic area in a national forest in northern Arizona for Field Day and had fun. The picnic area was along the old Route 66, about 25 miles west of the northern Arizona city of Flagstaff (think about some of the cities named in the song 'Route 66' and Flagstaff is mentioned there). This part of northern Arizona has an elevation of just over 7000ft and the weather was a lot cooler than what I normally see in the central Arizona desert where I live.

"The satellite passes I attempted in the early afternoon didn't go well but later in the day I started having success. I also claimed the 100-point bonus for completing a satellite QSO and doing it in a way I didn't expect to make my first Field Day satellite QSO.

"Around 2310UTC, there was an ISS pass coming by. Using my TH-D72A HT and Elk log periodic, I started transmitting my location and text that identified my station with a CQ call for Field Day. Within a minute, I received an APRS message from VE5AA in the Canadian province of Saskatchewan. A nice surprise! I sent my Field Day exchange back to VE5AA in an APRS message and we completed a QSO. This earned me the 100-point bonus. I worked two other Field Day stations during this pass, KK6QMS in southern

California and the K7RDG club in southern Arizona near the USA/Mexico border. I had practised making quick QSOs using APRS messages in the week before Field Day and the practice paid off.

"A few minutes after the ISS passed by, there was an SO-50 pass coming from the southwest over the Pacific Ocean. I made one very quick QSO and then listened to the remainder of the pass. SO-50 was the most popular satellite during Field Day and this pass was a good example of that. With only 5W at my disposal to stay within the QRP category, I was thankful to get one QSO.

"About an hour after the SO-50 pass, NO-84 came by. NO-84's 145.825MHz APRS digipeater had been activated before Field Day and I made one QSO on this pass with the only station I heard, a club, WK7B, operating from a location 26 miles east of me. We made a Field Day QSO using APRS messages and I continued transmitting my location with a CQ call for the rest of this pass. Unfortunately, nobody else showed up.

"A few minutes after NO-84 went by, there was another ISS pass. I worked two stations, neither of which was participating in Field Day. Instead of sending my Field Day station information, I sent my grid locator (DM45), which is not normally heard on the satellites. There were no other stations on this pass participating in Field Day but I was happy to give out a rarely heard grid to the two stations that worked me.

"In the early evening, with some daylight remaining in the forest, I had two more passes I wanted to work. LilacSat-2, the Chinese satellite with the very irregular operating schedule, had been turned on. This pass was not as busy as the earlier SO-50 pass and I was able to make six QSOs. With this being a Chinese satellite, I used my Chinese-made Wouxun KG-UV9D HT and Elk log periodic to make the QSOs. This was probably the most orderly FM satellite pass during Field Day that I've worked in the past 10 years!"

During our holiday to Pembrokeshire, I enjoyed some satellite operating as **GW4VXE/P** (IO71) using handheld equipment to work through SO-50, FO-29, AO-85, ISS and NO-84. I was particularly pleased to make some real-time packet exchanges via both the ISS and NO-84.

Finally

That's it for this month. Apologies to those of you whose contributions I've had to edit down a bit – there's been lots of news, which is great. See you all next month.



Colin's Collection

This month Colin covers a number of topics helpful to newcomers and old hands alike.

AMSAT-UK has recently made available to UK radio amateurs the 2016 edition of *Getting Started with Amateur Satellites* by G. Gould Smith WA4SXM and Friends, Fig. 1. To keep postage costs down, it has been printed (in black and white) and bound in the UK. The book has all the information you need to get started with amateur satellites, including lists of suitable transceivers, both current and likely to be available in the second-hand market. Chapters include *Satellite Basics*, *Locating Amateur Satellites*, *Your Antenna System*, *Your Radio System*, *Operating the FM Satellites* and *Operating the SSB/CW Satellites*. In addition there are chapters on each of the main satellites, including several expected to launch over the next year or so, as well as the International Space Station. I would suggest ordering this excellent book promptly because last year it sold out very quickly. It costs £15 and can be obtained from the AMSAT-UK online shop, website below.

<http://shop.amsat-uk.org>

Choosing Sites for VHF/UHF Portable Contests

When choosing a site for a VHF or UHF contest, it is worth remembering that just because a site is on the top of a hill, this doesn't necessarily make it a good choice. If the hilltop is surrounded by buildings or trees, then, unless your antenna masts are high enough to get your antennas above the buildings and vegetation, you'll still find your transmitted and received signals attenuated, particularly at times when there are leaves on trees. In addition, many buildings such as shops, offices, educational establishments and factories have a variety of equipment that can increase noise levels. On many otherwise 'good' sites, there may also be commercial masts that may increase

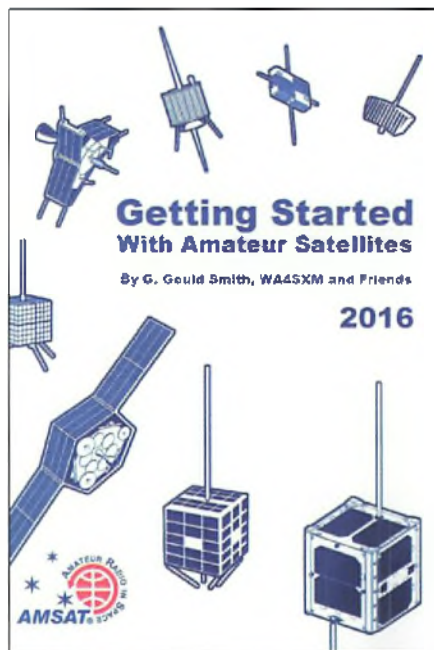


Fig. 1: This new satellite book is available from AMSAT-UK.

noise levels or even cause out-of-band breakthrough to very sensitive amateur equipment. In short, a good site will have unobstructed views in all directions that you are likely to want to point your antennas, Fig. 2.

Sometimes, you may not have a choice. In these circumstances, it is best to position the antenna as far away from the obstructions as you can, in the direction where you expect to beam most of the time. This will be more difficult in the middle of the UK, where you are likely to want to beam in all directions. Stations in the southwest of England will generally want to beam between north and east most of the time. In Scotland, stations will generally want to beam between southwest and southeast most of the time.

Before any major activity, it may be

worthwhile to visit a proposed site with a fairly basic setup for an hour or so, to see whether there is noise coming from buildings or nearby commercial masts and whether trees are attenuating signals. Beacons on the relevant bands can be a good source of signals to provide a rough standard of comparison. Don't forget that propagation can also change with time. The RSGB Tuesday evening activity contests are also an excellent opportunity to try various sites.

QSLing

Dave Hobro G4IDF wrote an interesting e-mail regarding contact confirmations,



Fig. 2: Burton upon Trent ARC's antennas for the 2015 PW 144MHz QRP contest are clear of local vegetation and buildings with a clear take-off in all directions.

usually referred to as QSLs (QSL being the Q-code for "I confirm receipt").

"Reading your column in the May issue of PW I get the impression that you are wholeheartedly in favour of electronic QSLing. My experience with Logbook of The World (LoTW) is worse than paper QSL cards. Over the last three years I have transferred all of my logbooks from paper to computer. These logbooks cover 1979 to the present and include many Backpacker, PW QRP and Low Power contest QSOs as well as numerous portable operations in various parts of the country. The transfer project has also provided an electronic back-up for all the contest logs that were submitted on paper."

"During the paper logging era, regular batches of paper QSLs were sent via the RSGB and various other organisations and

batches of cards would come back via the sub-managers. With the advent of electronic QSLing I hoped that the returns using LoTW would be somewhat better. Sadly this was not the case. With 10,500 QSOs submitted to LoTW, the return after six months was fewer than 600 confirmations, well below 10% response. Currently with 11,500 QSOs uploaded, the total confirmations stands at 1,050 – still less than 10%.

"I am still sending out paper QSLs for contacts – at least those give a return of 15 to 20%. Another reason I send out paper QSLs apart from collecting awards is that they offer a far better standard of imagery than the stereotyped electronic confirmations."

QSLing will continue for many years to come.

I sense that amateur radio is at the start of a very long transition period from paper to electronic QSLing. I think of this a bit like the transition from cheques to internet banking, payment cards, direct debits and so on, except that the replacement of cheques is much further along the road. Even now, while the number of cheques written is 80% down on 25 years ago, it certainly hasn't disappeared altogether and I suspect that over a similar period of time, paper QSLing may follow a similar pattern.

When I surveyed my local club

from HF contacts over the last seven years. I sense that the matching rate for recent HF contacts is much higher (already over 33% for those made in March 2016) than with older contacts. Many of my matches on LoTW are with the 'big gun' contest and DXpedition stations, rather than typical back-garden dipole stations although I would certainly count myself in the latter group. It is also clear that some stations only upload their logs to LoTW rarely, in some cases once a year or even less frequently. As an example, it was only in the last few weeks that some of my 2013 contacts were confirmed on LoTW.

In my limited experience, I also find that overall LoTW matching of older VHF/UHF/SHF contacts is exceedingly rare (about 3% on 6m, 2% on 4m, 3% for 2m, 1% for 70cm and zero for 23cm and above) so I'm not sure whether it is worth the effort to key in old VHF/UHF/SHF contacts from my older paper logs – perhaps something for a wet winter's day! One thing is clear which is that more recent VHF/UHF/SHF contacts have a higher matching rate (in my case, 12% for 4m contacts made in 2013). So I have decided that in future I will concentrate on re-keying more recent VHF and above contacts.

(For interest, of 178,853 QSOs I have uploaded to LoTW, dating back to 1968, I have 50,291 confirmations, or 28.1%. Not too bad and this is skewed because the rate is much lower for the early years and much higher for recent years. I suspect, as Colin says, VHF operators make less use of LoTW than do HF operators – G3XTT)

While the images on eQSL cards vary. I tend to agree with Dave's comments about the standard of imagery from eQSL, although there are clearly some exceptions, Fig. 4.

After a break of some 10 years (roughly 2000 to 2010 when I was generally less active than I am now), I am certainly still sending out QSL cards via the bureau. The main reason for this is that the RSGB require traditional paper QSL cards for most of their awards (but see this month's *HF Highlights* column for news regarding the RSGB IOTA awards programme). I've not done an analysis of response rates but I suspect it is lower than with LoTW. The speed of response for QSL cards sent via the bureau can vary between a few months and 22 years (!) to my knowledge. I only QSL direct very rarely indeed (a handful of QSLs per annum at most).

I refer to QRZ.COM before writing a QSL card, to establish whether the station collects QSL cards, whether direct, via bureau or a manager. It is also a good

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 **IKØOKY**

QSO WITH	CONFIRMING						
	DAY	MONTH	YEAR	GMT	MHZ	RST	2 WAY
G6MXL	06	7	93	1143	58	53	338

WW LOCATOR ☒ JN61 GT
 WW LOCATOR/P ☐
 PSE ☐ QSL ☒ TNX

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Fig. 3: A typical paper QSL card (although some are much more colourful and elaborate).



MI6BAI

Brian Baird
 12 Manse Park
 Newtownards, NORTHERN IRELAND
 United Kingdom BT23 4TN
 Loc: IO74do ITU: 27 CQ: 14
 Icom IC-7200, Vert. IT-100 ATU
 EPC # 13321 30MDG # 4424
 WAI Square J47

To: G6MXL This confirms our 2-way PSK31 QSO
 Date: December 1, 2013 Time: 09:26 UTC
 Band: 30M UR Sigs: 599
 Many thanks for QSO, Best wishes from Northern Ireland, Brian

Fig. 4: An example of an eQSL card.

I certainly didn't mean to give readers the impression that I wholeheartedly support electronic QSLing. At present my view is that there is an absolute mixture of QSLing techniques being used and I certainly wouldn't advocate using any one in preference to another. I think a mix of paper QSLing, Fig. 3, and electronic

members in late 2014, it was clear that well over 80% of members were not using computer logging of any type so I doubt that many are using anything other than traditional QSL cards.

That said, my experience with LoTW is somewhat better than Dave's, with an overall matching rate of 22.8% – mainly

guide to whether a station uses LoTW or other electronic QSL systems. It is also worth noting that according to the IARU, 29 countries don't have a QSL bureau service. **Table 1** [and in many others the bureau is all but defunct as I discovered, for example, on visits to Ghana where a bureau is supposed to exist but doesn't – G3XTT].

My apparent enthusiasm for electronic submission for awards is largely down to the speed and, in some cases, no requirement for paper QSL cards to obtain an award using LoTW or in some cases eQSL. I think this can be particularly appealing to newcomers, helping to get some really hooked on the hobby and award chasing.

I wonder what other readers' experiences are of matching rates on LoTW. Do you see any patterns in respect of types of stations, bands, modes and so on?

Licence Training Courses

During September, many amateur radio clubs up and down the country will be starting their training courses for the autumn and winter seasons. If you've never got round to obtaining an amateur radio licence or to upgrading your current licence, now could be a very good time to join a training course.

Advanced Examinations

Until recently the Advanced examinations could only be held on seven specific occasions during the year on predetermined dates and times nationwide. For many clubs that only meet on a particular evening in the week, it meant that at best only one of those

dates corresponded with their meetings so they had to incur additional expenses of hiring a venue when they wanted to offer the Advanced examination on any of the other six permitted occasions during the year. Now, as reported in our July News pages, just by giving one month's notice, clubs will be able to run an Advanced examination at any time on any day of the year to suit them.

Hopefully this will enable clubs to arrange more opportunities to sit the Advanced exam. It will also assist candidates who need to resit the examination and those candidates who have self-taught or learned by remote learning such as offered by **Steve Hartley G0FUW's** team in Bath. Some clubs may find it possible to offer Foundation, Intermediate and Advanced examinations simultaneously and thereby provide better opportunities for resitting or perhaps for external candidates to sit the Advanced examination with no extra costs to the club. This additional flexibility may also encourage clubs to run Advanced courses in the knowledge that arrangements for candidates to sit the examination will be almost as straightforward as for the Foundation and Intermediate levels.

Revalidating Your Licence

Finally this month, a quick further reminder to UK readers to revalidate your amateur radio licences with Ofcom. It is part of your licence conditions that you need to revalidate at least every five years and also to notify Ofcom whenever you address changes. The revised licences issued in spring 2015 to existing licence holders do not reset the clock. If you have more than one licence (for example, Foundation,

Table 1.
DXCC entities without a QSL
Bureau Service (source IARU)

Prefix	Country
3B	Mauritius
3DA	Swaziland
4J	Azerbaijan
7P	Lesotho
9L	Sierra Leone
A3	Tonga
C2	Nauru
C5	Gambia
C6	Bahamas
CN	Morocco
D4	Cape Verde
HH & V4	Haiti
HV	Vatican City
KH8	American Samoa
PZ	Suriname
ST	Sudan
SU	Egypt
TU	Cote D'Ivoire
V3	Belize
V4	Saint Kitts & Nevis
V7	Marshall Islands
VP2E	Anguilla
VP2M	Montserrat
VQ9	British Indian Ocean Territory
XY & XZ	Myanmar
Z2	Zimbabwe
ZA	Albania
ZD7	St. Helena
ZD8	Ascension Island

Intermediate, Full, Club), don't forget that you'll need to revalidate each of them. Ofcom have already written to some amateurs who have not revalidated their details for over five years, with a view to revoking their licences. If you have not revalidated, Ofcom will only have your earlier contact details, which will be at least five years old.

Radio Book Store

See page 72 or order securely online at
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Practical Wireless and **RadioUser** 2015 Archive CD-ROMs are now in stock. *Carrying on the Practical Way*, *In the Shop* and *Data Modes* Archive CD-ROMs are now available too.



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Icom IC-7700 £4997.95
Icom IC-7300 Deposit £20.00

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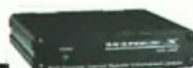
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What's happening and what's about to happen – you read it here first!

Emerging Technology

Chris Lorek G4HCL shows how amateur inspired radio techniques are being used in the future of communication, including wireless-controlled robotics ranging from takeaway food delivery to car parking.

Radio-Based Fast Food Takeaway Robotic Delivery

If you're like me, you may in the past have given your local Indian, Chinese, or pizza fast-food outlet a call to order some food for home delivery. Online firms such as Just Eat can also be used to offer you a selection of local takeaways of your chosen cuisine, where you simply click through a selection of outlets and their menus and place your order online for home delivery.

Regular readers may have seen my mention in a previous column of a mainland European firm experimenting with food delivery to home by a wireless-controlled aeronautical drone. Well, something similar about to happen in the UK, although with a ground-based robotic system travelling along our town and city streets. This is because the online takeaway business of Just Eat is currently trialling autonomous delivery robotic vehicles that are monitored and able to be controlled over radio links. We amateurs have done this for some time with our amateur satellites and remote radio operation using software. I personally use Ham Radio Deluxe software (look out for next month's review), developed by amateurs, for remote control of my transceiver frequency and mode, antenna rotator, multiple antenna switching and automatic satellite tracking.

The Just Eat company, reported as being the world's leading digital marketplace for takeaway food delivery, has partnered with Starship Technologies to trial self-driving delivery robots along pathways and roads. The testing programme is expected to begin within the

next few months and will initially be used on the streets of London. The knock at the door from a harassed delivery driver clutching a plastic bag full of food could be about to end.

The drones have been tested in US and European cities since the end of 2015. The fleet of autonomous wheeled drones that are to be used on the streets of central London will carry meals ordered through the Just Eat takeaway App. Meals will be placed inside the insulated compartments of the droids and customers will be given a secure code to open them when they arrive at the door.

The cyber-couriers will be monitored over radio by human operators in control centres who can take over remotely by radio should the drone get lost or encounter some difficulties during the delivery. Each of the six-wheeled robots can travel on pavements to avoid becoming a hazard to traffic. Getting the technology to work won't necessarily be straightforward though. The drones will need to negotiate their way through streets, avoiding people and animals and crossing roads while keeping away from cars, bicycles and other vehicles. Integrated navigation and obstacle avoidance software will, for example, enable the robots to steer clear of pedestrians or to negotiate over kerbs and cobbles.

They will also use sensors and camera technology to help them negotiate busy city streets. Using these sensors, the robots are able to cross roads while avoiding pedestrians and cars. Trundling along the pavement at about four miles per hour, which is a typical human walking

pace, the robots can reportedly complete local deliveries within five to 30 minutes from a local hub or retail outlet.

Unlike robots that are designed to resemble humans, these bots are purely functional with a large compartment to hold deliveries, around the size of two grocery bags. Each six-wheeled 'ground drone' is almost completely self-driving and is constantly connected to the internet using 3G wireless technology to find its way to the customer's address. Customers will be able to track the robot's location using an App and they will receive a message to let them know when their order has arrived at their door.

Security

Now what's to stop somebody stealing the drone and your chicken vindaloo and pilau rice takeaway along with it? The company's CEO, **Ahti Heinle**, suggested that given they are alarmed and of relatively little value to thieves, the drones are no more likely to be targeted than a parked car. The battery-powered bots can also send an alert back to the dedicated operator centre while snapping a picture of the culprit attempting to pinch your supper. Human operators are ready to step in if an emergency should arise, including if someone tries to steal the bot. If a thief attempts to tamper with the robot or to snatch it, the operator can take over via the radio link, talking directly to the wrongdoer and sending police to the drone's location. The drone's nine cameras can also capture the criminal's face. In any case, the bot's 'cargo trunk' is sealed throughout the trip and only the customer can open it after Just Eat sends them the code.

Advantages

"This is another example of how we are pushing technology boundaries to provide our customers and restaurant partners with more choice and flexibility", says Just Eat's chief product and technology officer **Fernando Fanton**. *"We've always been committed to offering our customers new ways to order and pay for their food and now we're right at the heart of a new way of delivering food that is as exciting for us as it will be for those who find a robot on their doorstep."*

Another advantage of this delivery system is the battery-powered bot's zero direct CO₂ emission, as opposed to the pollution brought about by short shopping car trips and food deliveries. *"Our vision revolves around three zeroes – zero cost, zero waiting time and zero environmental impact,"* said Ahti Heinle. *"We want to*



do to local deliveries what Skype did to telecommunications.” For businesses, the technology eliminates the largest inefficiency in the delivery chain, the last mile. Instead of expensive and time-consuming door-to-door delivery, retailers can ship the goods in bulk to a local hub, then the robot fleet completes the delivery to the shopper’s door for a fraction of the cost. Another example of emerging wireless technology, albeit an unusual one!

Wireless-Controlled Parking Robot

Another example of robotic technology using radio-based emerging technology is a parking robot that drives underneath vehicles to move them into position, which could eliminate parallel parking and allow for greater parking capacity in high density areas such as multi-storey car parks. Developed by Chinese inventors, the robot has been designed to take away the stress for anxious drivers in tight parking situations.

Dubbed ‘Geta’ (get a car), the laser-guided robot slides under your vehicle, picks it up, finds a parking space in the parking area, whether this be an open space or a multi-storey car park, and places your car in the very tightest of spots. The soon-to-be-launched robot typically needs just two minutes to park a vehicle, does not need tracks, has 360° mobility and will utilise space better than humans, said creators Yee Fung Automation Technology, based in the south China city of Shenzhen.

“The parking robot is designed to increase parking space,” Yee Fung’s chief executive and the brains behind Geta, Marco Wu said. “The robot can go everywhere and will reform parking in the future.” Mainland China is expected to



have more than 200 million cars by 2020, meaning that finding space to park could become increasingly difficult. Wu said Geta finds spaces by transmitting signals by radio to a computer containing a map, which then directs the robot, again over radio, to an available spot.

The purple and lime green robot will cost more than 1m Yuan (£115,000) but Wu said there had been lots of interest from car park operators in busy city centres where space is at a premium. “There are many companies interested in our products, such as commercial property companies in Singapore and London, public parking companies in the Middle East, developers and governments, as well as public parking companies in China,” he said.

In the future on a shopping or leisure trip in your car, rather than entering a multi-storey car park and driving round and round across various levels looking for a parking space, you may just be able to leave your car at the entrance and get an automated ticket. You’re then free to go away. On your return, you’ll enter the ticket and your car will magically appear before you in a couple of minutes. Just think of the time you’ll save!

The Future of Two-Way Radio

No one can accurately predict the future and I certainly don’t have a crystal ball available. But predictable future trends certainly take place in the field of two-way radio, as well as in many other fields.

Bandwidth and Spectrum Allocation

PW readers will know that VHF and UHF spectrum for the increasing demands of radio communication is in short supply and future two-way communication is certainly liable to require greater channel bandwidths for communication. Spread spectrum and white space operation within existing spectrum allocations can assist to a considerable degree here. But higher two-way communication frequencies, reportedly up to 60GHz, are likely to be required to accommodate the communication parameters that are likely to be needed, and indeed expected, from future users.

Many years ago we wouldn’t have dreamt that PC processor speeds of 2GHz and above would be likely at low cost, nor



the availability, again at low cost, of several gigabytes of digital memory. The future of two-way communications is invariably based on digital technology and the development of faster processing speeds will allow this. But geographical coverage for public wireless communication at such higher frequencies will require a greater number of base station sites on a terrestrial basis and this will lead to an increase in the number of terrestrial microcells. Aerial-borne cells are currently being predicted to offer an increase in coverage, either through low-Earth-orbiting satellites, high-altitude balloon-based systems or drones to fulfil an extra temporary bandwidth need for situations such as large public gatherings at planned future events or for the rapid-deployment of emergency communications following an unexpected event. Higher frequency spectrum allocations will require near line-of-sight radio coverage and these technologies are among those that will provide this. We amateurs are already using this with our network of orbiting amateur radio satellites as well as high-

orbiting balloons carrying amateur data and video transmitters on 70cm (430 to 440MHz). Is this a case of amateurs leading the way and guiding two-way wireless technology into the way forward? We've historically always done this and we're continuing to do so.

Oriental Influences

We're seeing a growing number of Eastern two-way radio manufacturers, including those in China such as Hytera, who are currently producing high quality equipment along with employing several hundreds of degree qualified development engineers in China and Europe. We've already seen plenty of Chinese amateur VHF/UHF handhelds and mobiles appearing on the hobby radio market through the pages of PW and online at absolutely bargain prices. At one time such manufacturers were regarded as being low specification low quality analogue two-way radio suppliers but the trend is changing for current and future equipment. At an annual IET Appleton Lecture I attended some years ago, the

subject was Mobile Communications and this trend was certainly noted there. What was a little surprising was that even further into the future, it was predicted at that lecture that along with the Chinese, Indian radio manufacturers would also start to make inroads into this market.

The Future

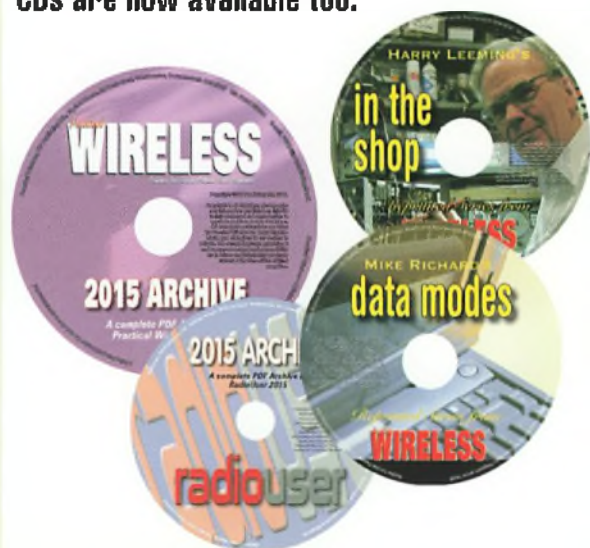
Overall we may look forward to seeing combined radio, Wi-Fi and LTE-equipped cognitive SDR mobile and handheld radios, with many from China and possibly also India in due course. These will be wideband multimode radio terminals, capable of being programmed for analogue FM, amateur D-STAR, DMR, dPMR, LTE, TETRA, Wi-Fi and other communication modes. Higher frequency spectrum allocations will be employed to allow the greater bandwidth and greater number of expected users and significantly different base station situations will be required to accommodate this. It's happening already, the emerging future of two-way radio technology is visible and it'll be continually evolving.

See you soon as I explore the future on behalf of PW readers. Chris G4HCL.

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The IARU



In the November 2014 issue we featured an interview with International Amateur Radio Union President Tim Ellam VE6SH. This month ARRL volunteer historian Michael Marinaro WN1M takes us through the organisation's history and role.



Fig. 1: The Paris banquet

The IARU is the institution that defends amateur radio interests worldwide. It is the sustainer of the present and assurer of the future serving as:

- The concerted interface to the international wireless regulatory community
- Protector of amateur radio spectrum space and privileges
- Promoter of consistent amateur radio policies, practices and procedures internationally
- Forum for regional interests and facilitator of standard agreements
- Promoter of the value of amateur radio, its technology and its culture

Organisation

The IARU is organised primarily to interface with the International Telecommunication Union (ITU) but engages with six regional telecommunications organisations such as the European Conference of Postal and Telecommunications Administrations

(CEPT) as well as with the European Commission. The ITU is the United Nations (UN) agency that among other activities manages the international radio spectrum and consequently influences amateur radio services worldwide. *The Radio Regulations* promulgated periodically by the ITU since 1912 stipulate how the radio spectrum is to be shared and used.

The IARU currently comprises over 160 member amateur radio associations in three regions. The UK falls within Region One, which includes Europe, Africa, the Middle East, Russia and North Asia. The USA is included in Region Two – the Americas. Region Three comprises all of Asia and the Pacific. Within each Region leadership is provided by a group of amateurs (no more than one from any one member society) who are elected on a three-yearly cycle to run the day-to-day activities of the Region. Policy matters are determined every three years at Regional General Conferences at which each member society has one vote regardless of the number of individual members.

One member society functions as the International Secretariat (IS) to be the global focus for IARU. The ARRL currently provides the IS and has done so from the IARU's inception.

History

The IARU was created during the period of rapid growth of wireless that followed WWI. Amateur radio almost instantly expanded from a local phenomenon to an international activity. Marconi's long distance feats encouraged US amateurs to span the Atlantic in late 1921 and, in late 1923, to accomplish the first two-way contact with Europe between 1MO (USA) and 8AB (France). Oceans were spanned and continents linked as amateur radio broke distance record after distance record. The wireless world was shrinking so swiftly that regulating governmental bodies in the major developed countries scrambled to keep order. Regulation of wireless was required as more and more powerful commercial and marine interests and broadcasters jostled with amateurs for space in the expanding radio spectrum. Largely unorganised amateurs clamoured for recognition by government bodies such as the General Post Office in Britain and the Department of Commerce and Bureau of Navigation in the USA. The amateurs won concessions but their status was both tentative and tenuous.

Enter **Hiram Percy Maxim**, cofounder of the ARRL, who we have talked about before in these pages. Having engaged successfully with US governmental regulators, including the Navy and the Department of Commerce, Maxim envisioned similar conflicts confronting the amateurs of other nations. These struggles for amateur spectrum and privileges were already in motion elsewhere, particularly in Europe where most wireless was already stringently controlled by government monopolies. Recognising the growing emergence of the ITU as the sole international regulatory body in the wireless world, Maxim saw the need for a standardised, concerted amateur radio front. He began to do what he excelled at – organising. He started by proposing such an international body at the ARRL National Conventions of 1921 and 1923 and during intervening trips to Europe.

The Paris Banquet

The French group that had mounted a part of the listening effort for the transatlantic tests invited Maxim to a dinner in Paris, **Fig. 1**. On March 12th 1924, amateur representatives from seven European nations and Canada toasted

Maxim and the ARRL. The accepting honouree proposed the formation of an international amateur radio organisation. The suggestion was eagerly accepted. Maxim was called upon to lead the effort. Two days later an organising committee was formed and the fledgling entity was christened the International Amateur Radio Union (IARU). Shortly afterwards the ARRL Board of Directors heartedly endorsed the concept.

Congress

Events moved at an extraordinary pace and barely thirteen months later Maxim, ARRL General Manager **Kenneth B. Warner** and a US delegation were in Paris again for the first International Amateur Radio Congress, **Fig. 2**. 250 delegates from 24 other nations attended from Europe, Canada, South America and Asia. A constitution was drafted modelled on that of the ARRL and unanimously approved. Directors and Executive Committee and subcommittee members were elected or appointed. Maxim was elected President and **Gerald Marcuse G2NM**, a prime mover from Britain (see *Valve & Vintage* March 2015), was elected international Vice President. April 18th 1925 became the official date of birth of the entity and is now recognised annually as World Amateur Radio Day.

Initially conceived as an organisation of individual memberships from the countries of the world, it was constitutionally understood that this arrangement would prevail until individual members formed strong national societies in their respective countries. As intended, the IARU gradually transitioned to a federation of national amateur radio societies as they emerged. This structure was formalised with a new constitution in late 1928. However, the core was sufficiently in place to meet the most serious threat to amateur radio up to that time, the ITU International Radio Telegraph Conference (IRTC) of 1927. The intent of the conference was to revise the London Convention of 1912, which established the rules of wireless conduct and regulation and, most significantly, frequency allocations. Attendees came from 55 countries and 23 dominions and colonies, all with opinions on a wide range of matters, including how the spectrum was to be allocated. The general environment was not favourable for amateur radio. However, a strong US delegation and lobbying by the IARU and ARRL successfully won privileges for the amateurs that are the basis of those that amateurs still enjoy today. Thus the IARU entered the arena of international wireless



Fig. 2: The first international amateur radio congress.

regulation with the prospect of many more challenges to follow to maintain amateur privileges.

As nations of the world developed, the IARU encouraged the formation of national amateur radio societies in each country. By the onset of WWII the roster of member organisations stood at 33, up from 14 in 1928.

Post-WWII

Following the war the newly created UN (created during WWII to replace the ineffective League of Nations), in 1949, recognised the ITU as the specialised international agency with the remit for telecommunications. Confronted with the increasing globalisation of telecommunications markets, the ITU began to shape itself to lead in the sectors of worldwide telecommunications standardisation, regulation and development. In particular, the agency convened a significant World Administration Radio Conference in 1979 (WARC-79) providing UN member nations with the opportunity to revise or amend the Radio Regulations.

IARU constitution and structure were modified over time to keep pace with the growth of the organisation and the rapid pace of technology. In 1982, following WARC-79, the need for a more focused IARU organisation was recognised. The three-region structure was adopted. A global Administrative Council (AC) was

created to lead and coordinate the IARU's principal activities, particularly with respect to international telecommunications conferences. The AC comprises the President and Vice President, nominated by the IS and ratified by the member societies, the Secretary appointed by the IS and two members from each region.

The constitutionally stipulated functions of the AC are mainly those of coordination. This includes regional activities and proposals, international conference activities, long-term planning and the adoption of resolutions and recommendations favourable to the federation. Each region is guided by a constitution, elects an Executive Committee (EC) and meets no less than once every three years. This is the structure that prevails today except that the scope of activities has expanded a great deal.

The IARU celebrated its 75th anniversary in Paris in April 2000 with a membership of 148 individual national organisations and a growing interest. From the early 1960s the federation had evolved to be the formal representative of amateur radio and of Amateur Satellite Services at the ITU and regional telecommunications organisations as previously mentioned. The ITU, with input from the IARU representing amateur interests, allocated frequencies to the various growing Space services and enacted regulations governing the use of orbits. Space issues

IARU Region 1 Executive Committee

Don Beattie G3BJ, IARU Region 1 President
Faisal Alajmi 9K2RR, Region 1 Vice President
Eva Thiemann HB9FPM, Treasurer
Dennis Green ZS4BS, Secretary
Thilo Kootz DL9KCE, Member and EMC Working Group Chairman
David Court EI3IO
Ranko Boca 4O3A
Ivan Stauning OZ7IS
Oliver Tabakovski Z32TO

became important topics for WARC and ITU World Radio Conference (WRC) agendas.

The WARC (and post-1992 WRC) have become the central international forum for telecommunications issues. Held periodically from 1979 to 2015, these meetings afford the ITU member nations the opportunity to act on matters within the scope of the ITU's charter. Amateur radio issues customarily appear as only a small part of the overall agendas. The role of the IARU is to prepare their member nation delegations to defend, refine and expand amateur privileges and policies. The IARU process of assuring informed and appropriate representation at preconference delegation meetings is complicated, involving years of research and preparatory work as well as intricate coordination. The technology and the legal aspects of the issues have become so complex that the IARU has engaged the counsel of specialists and advisors from the amateur ranks.

The last WRC meeting was held in Geneva in 2015, Fig. 3, and the next is to be held in 2019. IARU teams are already beginning to prepare for this meeting. The agenda includes a proposal for a global



Fig. 3: The 2015 World Radio Conference, held in ITU Headquarters, Geneva.

allocation at 50-54 MHz (this is mainly of interest to those in Region 1 where 50MHz allocations are inconsistent) and consideration of the spectrum needs of the so-called small satellite operators. Small satellites are of low mass and size, easily launched, and increasingly used for navigation, weather, defence and other applications. It has been predetermined that the existing frequency allocations for amateur satellites, established in 1979, would be exempt from consideration and other frequency ranges be considered for new satellite allocation.

All Volunteer Effort

The activities of the IARU are conducted every day. It's an all-volunteer organisation powered by amateurs for amateurs. The IARU has no staff. As part of its function as IS, some ARRL staff perform support

tasks for the federation. Funding, covering out-of-pocket expenses and various administrative costs, is by a levy on the members societies, generally based on their membership numbers. You can therefore support IARU by being a member of your national IARU-affiliated amateur radio society – in the case of the UK, the RSGB.

In the course of its successful history, many amateurs, from many countries, have contributed their efforts to the furtherance of the ideals and objectives of the IARU.

The foregoing describes an organisation that is essential to the existence of our hobby. We suggest that you keep abreast of IARU and ITU activities and support the efforts of the fellow amateurs who represent you.

Representing the UK and Region 1 generally, the Executive Committee currently comprises the individuals listed in the sidebar, all of whom give up large parts of their spare time on our behalf. The IARU Region 1 website, where you will also find a lot of information about the youth work of IARU, can be found at: www.iaru-r1.org

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AUGUST

August 12th (Friday)

The 23rd Annual Mini Rally Night

The Cookenzie and Port Seton Amateur Radio Club 23rd Annual Mini Rally Night will be held in the main hall at Port Seton Community Centre, South Seton Park, Port Seton, Prestonpans EH32 0BQ. It is an opportunity for you to bring along your 'junk' and sell it yourself. The event will run between 6.00pm and 9.00pm and admission will cost £2.00 (for both sellers and buyers). Food and drink will be available and the venue has toilets and disabled access. Tables will be available on a first come, first served basis.

Bob Glasgow GMMUZY

E-mail: bob.gmmuzy@talktalk.net
www.oparc.com

August 14th

The Flight Refuelling HAMFEST

The Flight Refuelling Amateur Radio Society HAMFEST will be held at the Cobham Sports and Social Club Ground, Merley, Nr. Wimborne, Dorset BH21 3DA. The gates will open at 10.00am and admission will cost £3.50 (under 14s free). There will be talk-in on 145.550MHz parking (including spaces for the disabled), trade stands (both indoors and outdoors), a car boot sale, special interest groups, lecture stream and demonstrations, a licensed bar and catering will be available.

E-mail: hamfest@frars.org.uk
www.frars.org.uk

August 20th and 21st (Saturday/Sunday)

The JAAR Ham Fair 2016

The Japan Amateur Radio League Ham Fair 2016 will be held at Tokyo Big Sight, 3-11-1 Ariake, Koto-ku, Tokyo, Japan 135-0063.
www.jaarl.org/English/4_Library/A-4-6_ham-fair-ham-fair.htm

August 21st

The Rugby Rally

The Rugby Amateur Transmitting Society Annual Radio Rally will be held at Princethorpe College, Princethorpe, Rugby CV23 9PY (NGR: SP395710; 52.336N 01.421W). The doors will be open between 10.00am and 4.00pm (8.30am for sellers). Admission will cost £3.00 and there will be trade stands, a car boot sale and catering will be available.

Tony G0DLS, 23 Sycamore Drive, Lutterworth, Leicestershire LE17 4TR.

Tel: 07759 684411
E-mail: rally@rugbyats.co.uk
www.rugbyats.co.uk

August 27th (Saturday)

Jaycee Electronics Ltd. Open Day

Jaycee Electronics Ltd. will be holding an Open Day that will include special offers, a charity raffle with great prizes, an RSGB bookstand and refreshments. In addition to equipment on display from Apache Labs, Elecraft, FlexRadio Systems, Icom, Kenwood and Yaesu, there will be talks by Justin Johnson (4m), Chris Ridley from Icom (JC-7300 – The Inside Story) and Ian White GM3SEK (Clean up your Shack). For more information, please contact Jaycee Electronics Ltd.

Jaycee Electronics Ltd, 20 Woodside Way, Glenrothes, Fife KY7 5DF.
Tel: 01592 756962
www.jayceecomms.com

August 28th *** New Venue***

The Milton Keynes Rally

The Milton Keynes Amateur Radio Society Rally will be held at Milton Keynes Irish Centre, Manor Fields, Watling Street, Bletchley, Milton Keynes MK2 2HX (opposite Dobbies Garden Centre). The doors will

open at 10.00am and admission will cost £3.00. There will be talk-in on 145.500MHz (S22), free on-site parking, trade stands, special interest groups, catering, a licensed bar and facilities for the disabled.

Roy G8RCK

Tel: 07866 673192

www.mkrars.org.uk/mkrars-rally

August 29th (Bank Holiday Monday)

The Huntingdonshire Rally

The Huntingdonshire Amateur Radio Society Rally will be held at the Emulf Academy, Barford Road, Eynesbury, St Neots, Cambridgeshire PE19 2SH. For further information and bookings (tables and outdoor spaces), please contact the rally organiser.

Malcolm Hirst M0DLG (Rally Organiser)

Tel: 01480 214282

E-mail: hirst@hotmail.com

SEPTEMBER

September 4th

The Telford Hamfest

The Telford & District Amateur Radio Society will be holding the Telford Hamfest at the Ingenuity Technology Centre, Coalbrookdale, Telford TF9 7DU. The doors will open at 10.15am and admission will cost £3.50, which includes discounted admission to the hands-on exhibits at Ingenuity. This year, the guest speaker will be Noel Matthews G8GTZ, who was greatly involved in the ARSS project in 2015/16. There will be ample free car parking at the Aga works, trade stands, a flea market, special interest groups, family attractions, catering and facilities for the disabled.

Martyn G3UKV

Tel: 01952 255416

www.telfordhamfest.org.uk

September 10th (Saturday)

The Caister Lifeboat Radio Rally

The Caister Lifeboat Radio Rally will be held at Caister Lifeboat Station, Tan Lane, Caister-on-Sea, Norfolk NR30 5DJ. The doors will be open between 9.30am and 3.00pm and admission is free. There will be easy parking (access to car park via Beach Road) and disabled access, trade stands, a prize draw and refreshments will be available. Traders will have access to the venue from 8.00am. Indoor tables will cost £10.00 per table and outdoor boot sale pitches will cost £5.00 (booking advisable). All proceeds to Caister Lifeboat.

Zane M1BFI

Tel: 07711 214790

E-mail: m1bfidx@ntlworld.com

www.m1bfidx.wix.com/ci-radio-rally

September 11th

The Andover Radio and Computer Boot Sale

The Andover Radio and Computer Boot Sale will be holding its autumn Radio and Computer Boot Sale at Tangleby Parish Village Hall, Wildhem, just north of Andover, Hampshire on Grid Reference SU350510, postcode SP11 4JE. The doors will be open from 9.00am (8.30am for disabled visitors) to 4.00pm and admission will cost £2.00. There will be trade stands, a Bring & Buy, a car boot sale, a prize draw and on-site catering. Tables in the Hall cost £10.00 and car boot pitches in the field cost £8.00.

Paul Phillips G4KZY

Tel: 07775 738200

E-mail: paul.g4kzy@gmail.com

www.arac.org.uk

September 11th

Murphy Radio Day

A Murphy Radio Day will be held at the Mill Green Museum, Bush Hall Lane, Mill Green, Hatfield AL9 5PD. The doors will be open between 11.00am to 5.00pm and admission to the event, the Mill and

Museum will be free. The event offers the chance to "See the fantastic display of vintage Murphy TVs and Radios manufactured by one of Welwyn Garden City's biggest employers during the twentieth century." Cream teas will be available between 2.15pm and 4.30pm.

www.welhat.gov.uk/special-event-days

September 11th

The T.A.R.S. Communications Fair

The Torbay Amateur Radio Society Annual Communications Fair will be held indoors at Newton Abbot Racecourse, Newton Abbot, Devon TQ12 3AF. The doors will open at 10.00am (9.30am for disabled visitors) and admission will cost £2.00. There will be free parking, trade stands, a Bring & Buy, an RSGB bookstand, catering and facilities for the disabled.

Pete G4VTO

Tel: 01803 864528

E-mail: rally@tars.org.uk

www.tars.org.uk

September 17th (Saturday) *** New Date ***

The Fog on the Tyne Rally

The Angel of the North Amateur Radio Club will be holding the seventh Fog on the Tyne Rally at Whitehall Road Methodist Church Hall, Whitehall Road, Bensham, Gateshead NE8 4LH. The doors will open at 10.30am and admission will cost £2.00. There will be car parking (entrance in Whitehall Road), trade stands, a Bring & Buy, a bookstand, a junk stall and catering (bacon butties and a cup of tea or coffee for £2.50) will be available. In addition, there will be enrolment for Foundation, Intermediate and Advanced Examination courses and Morse class.

Nancy Bone G7UUR

Tel: 07990 760920

E-mail: nancybone2001@yahoo.co.uk
www.znarc.net

September 18th

The Great Northern HamFest

The 28th Great Northern HamFest organised by South Yorkshire Repeater Group will be held at the Metrodome Leisure Complex, Queens Ground, Queens Road, Barnsley, South Yorkshire S71 1AN (or follow the brown Metrodome signs). The doors will open at 10.00am and admission will cost £3.50 (free for children under 14 accompanied by an adult). There will be trade stands, special interest groups, an RSGB bookstand, family attractions, catering and facilities for the disabled.

Ernie G4LUE

Tel: 07984 191873

www.gnhamf.co.uk

September 18th *** New Venue ***

The Weston-super-Mare Rally

The Weston-super-Mare Radio and Electronics Rally will be held at The Campus Community Centre, Highlands Lane, Weston-super-Mare BS24 7DX. The doors will be open between 10.00am and 3.00pm and admission will cost £3.00 (under 16s free). There will be free parking, trade stands, group exhibitors, an auction of surplus equipment, homebrew competition and lectures. The venue has level access.

Dave G4CXQ

Tel: 07871 034206

E-mail: g4cxq@btinternet.com

September 23rd, 24th and 25th (Friday/Sunday)

The YACRAL Fellowship Weekend 2016

The World Association of Christian Radio Amateurs and Listeners Fellowship Weekend 2016 will be held at the Elm Conference Centre, De Walden Road, West Malvern, Worcestershire WR14 4DF. The total cost of the weekend (full-board Friday

Dinner to Sunday Lunch) is £160 (Single) or £284 (Double). The Conference Centre is set in the heart of the Malvern Hills, with stunning views across the Worcestershire countryside. The guest speaker on Saturday evening is the Editor of *Practical Wireless*, Don Field G3XTT. For further information, please contact Shirley Jackson, CSWL:1199.G.

Shirley Jackson, 24 Woodfield Park, Welton,

Wakefield WF2 6PL.

Tel: 01924 229630

E-mail: Shirley.Jackson1199@sky.com

www.yacral.org/Fellowship%20Weekend.htm

September 24th & 25th (Saturday/Sunday)

The BATC 2016 Convention for Amateur TV

The British Amateur Television Club 2016 Convention for Amateur Television (CAT16) will be held at the RAF Museum Cosford, Shifnal, Shropshire TF11 8UP. The Convention will start at around 1.00pm on the Saturday and conclude with the Biennial General Meeting early on the Sunday afternoon. The cost of admission will be £10.00 per day, which includes unlimited tea & coffee for attendees in the Conference Room. In addition to the BATC lecture programme, attendees will have free access to the RAF Museum. For further information, please see the BATC website and Forum.

www.batc.org.uk

September 25th *** New Venue ***

The Chippenham Mini Radio Rally

The Chippenham & District Amateur Radio Club Mini Radio Rally will be held in Kingston Langley Village Hall, Church Road, Kingston Langley, Chippenham, Wiltshire SN15 5NU. The doors will be open between 10.00am (9.30am for disabled visitors) and 3.00pm and admission will cost £2.00 (under 16s free). There will be on-site car parking, trade stands, a car boot sale and refreshments. The new venue is 1.5 miles south of the M4 J17. Please keep an eye on the Club's website for further information.

Brian G6HUI

Tel: 07722 242741

E-mail: g6huim3hu@gmail.com

www.g3vre.org.uk

September 25th

Foire Radioamateur de La Louvière

Foire Radioamateur de La Louvière will be held at Louverpo, Rue du Hooquet 7, 7100 La Louvière, Belgium. The doors will be open between 9.00am and 4.00pm and admission will cost 8.00. Foire Radioamateur de La Louvière is claimed to be the largest amateur radio and IT fair in Belgium and Northern France, with trade stands and exhibitors from Belgium, France, Germany, the Netherlands and the UK.

Michel ON7FI

E-mail: on7fi@skynet.be

www.on7fi.be

www.louexpo.be/events/foire-radio-amateur-2

September 30th and October 1st (Friday/Saturday)

The National Hamfest*

The National Hamfest, organised by the Lincoln Short Wave Club in association with the RSGB, will be held at the George Stephenson Pavilion, Newark Showground, Lincoln Road, Wintborne, Newark, Nottinghamshire NG24 2NY. Admission will cost £5.00. The outside display area will open at 9.30am and the doors to the main hall will be open between 10.00am and 4.00pm on both days. There will be free parking, trade stands, a Bring & Buy, a car boot/flea market, special interest groups, catering and facilities for the disabled. In addition, there will be a range of RSGB stalls and Morse proficiency tests will be available on demand.

www.nationalhamfest.org.uk



Don't forget – all reports to Steve now by the 1st of each month please!

QSLs, Taiwan and Other News

Steve Telenius-Lowe PJ4DX has another full column of HF news, with some interesting items about QSLing and operating from Taiwan to add to the mix.

In common with most HF operators, I have always enjoyed sending and receiving QSL cards. If you are starting from scratch, though, the cost of QSLing direct (by post) can seem prohibitive, while many are too impatient to wait the two, three or more years that a bureau card can take to arrive. When I moved to Bonaire in 2013, I took the decision to no longer request paper QSL cards (I have an excellent QSL Manager, **Tim Beaumont M0URX**, who responds to everyone requesting a card from me). These days I chase DXCC entirely using LoTW, the ARRL's Logbook of The World electronic verification system, and this has allowed me to achieve seven-band DXCC (over 100 countries confirmed on each of seven bands) in two and a half years.

However, there has been no equivalent to LoTW for the other major HF activity programme, Islands On The Air (IOTA) – until now, that is. On June 30th, a press release from the IOTA IT Team stated, "We have started offering IOTA credits by Club Log QSO Matching. Go to <http://www.rsgbiota.org> > **My Credits** click on "Club Log QSO Matches", scroll down and click on "Show Accepted Activations" to see the list of operations for which QSO Matching is available. Please note that at this time this is mainly provided for island operations

from locations for which one DXCC corresponds to one IOTA group only. A few operations carried out since January 1st 2016 have already been included, and we are working now to extend this to other operations that took place this year. Check the above link periodically for an update on operations available for QSO Matching. If you have questions, please send them to iota_ltd@aol.com the only address for them. We would appreciate it if you can refrain from sending enquiries that fall outside the scope of what is on offer on the website. We will extend the coverage as and when we can."

To use this facility you will of course need to create accounts with both IOTA and Club Log, if you have not already done so, and upload your log to Club Log. www.rsgbiota.org
www.clublog.org

An SWL QSL Collection

Owen Williams G0PHY wrote that he had been looking through his late father's QSL collection. He held a class B licence but Owen says, "I believe he only made a couple of QSOs on a borrowed 2m rig. He was an avid SWL and was much more interested in DX and propagation and his logbooks indicate that he had heard all DXCCs." The QSL collection includes VK9MM Mellish Reef, Fig. 1, AH1A Howland Island and KC6CEX/WH9 Wake

Island from 1993, VP8SGI South Georgia 1995, AH4/AHOW Midway 1996, VK0IR Heard Island 1997, FT5ZH Amsterdam Island 1998, K5K Kingman Reef 2000 and P5/4L4FN (North Korea). There are also cards for Willis Island, Cocos (Keeling), Norfolk Island and Campbell Island.

Owen continued, "He used various communications receivers including a Lowe HF-225, finishing with a Yaesu FRG-100. He used a number of wire antennas, one running from the eaves to the end of his small garden. There was even a wire antenna running across his landing. He also experimented with small delta loops.

"What I find interesting is that he was able to hear these DXpeditions with simple antennas while I struggle to hear anything from the Pacific. Of course, I don't know what the solar numbers were back then but I can only presume that they were a lot better than now. He would have chased the DX the old-fashioned way because he did not have a PC and relied on the weekly QRZ DX newssheet from N4AA and the DX 'voicebank', which was a telephone service offered by the RSGB. I think there was also a DX newsletter published in the UK" [This was DX News Sheet, originally published by SWL **Geoff Watts**, who also founded IOTA, but later edited jointly by **Martin Atherton G3ZAY** and none other than PW editor **Don Field G3XTT**. Subsequent editors were **Brendan McCartney G4DYO** and **Chris Page G4BUE** before the internet rendered paper newssheets obsolete – PJ4DX].

Owen concludes, "Another interesting point is that a lot of the DXpeditions were made by small teams. For example, VP8SGI was activated by three US amateurs and FT5ZH by two French operators. I can only presume that access to these rare places was not as regulated then as it is now and it did not need mega-DXpeditions to finance such trips."

Fascinating stuff, Owen, and it brought back memories for me because I was an operator on the 1993 VK9MM Mellish Reef DXpedition.

News from Taiwan

Rod Harvey G3YHM called me on the air



Fig. 1: The front of the six-sided gate-fold VK9MM Mellish Reef QSL card from 1993.



Fig. 2: Rod G3YHM being presented with the radio club banner in Taiwan. It is signed by all the members present.

from his home in Worthing one day and not long later e-mailed from Taiwan, where he and his wife were visiting their son and his family. Rod wrote, "When I first visited Taiwan many years ago, I found the local radio club. I visit them every time we go, **Fig. 2**, and have made good friends there. I am always sure of a warm welcome; it is second to none. I recommend any radio amateur who travels to Taiwan on business or holiday to make contact with the local amateurs. I can give contact details if they get in touch with me."

Rod added that although there is no formal reciprocal licensing agreement between the UK and Taiwan, it is possible to get a permit to operate from existing Taiwanese stations. He operates from BV2DQ's station using the callsign BW/G3YHM.

June on the Air

Victor Brand G3JNB wrote that PZ50X in Suriname opened his log on 17m CW on June 1st, followed by FM/DL7VOG on 20m. PZ50X was worked again on 20m CW, followed by TF3JB. On June 3rd, 17m yielded JH1MDJ in Tokyo and, after a long struggle due to QSB, E21EJC in Bangkok. Victor said, "A 2200 check on 30m revealed a strong H3TEJ holding court with a huge simplex pile-up of EU stations." Using 50W to a helical ground plane, hidden in an apple tree and only 3m off the ground, Victor slipped through by transmitting up just a smidgen (13Hz!) and, thus, was able to "pay my respects to the brilliant operator **Ted** in Puerto Plata, on the northern coast of the Dominican Republic. Regular DX contact V44KAO on St Kitts came back first call on 17m." Then band conditions changed and a day later, at 2130, G3JNB had the unusual experience of hearing both CO8LY and

ZP6CW calling CQ side by side on an otherwise silent band. Victor did manage to work them both – just! He also broke an early evening pile-up to work E21EJC again, this time simplex on 30m. Victor says, *"The QSO took ages due to deep QSB but, amazingly, the other stations calling kindly stood by until the final exchange."* Things are looking up, Victor. Other notable QSOs included 9M2PUL, JT5DX (Mongolia), JR4OZR, P48DI and RD9DX on 20m and FM5FJ on 17m. Victor sent in a 'PS' just before the deadline: *"At about 5 o'clock I happened to hear a strong CQ on 20m and it was VU2TS. I rapped out a reply immediately, before the EU hordes got there. He responded first call and a nice QSO was completed. Excellent really because WWV figures were in the SFI 75 range. Then I saw the very high SWR: the ATU had been out of circuit. So 20m – 20W – antenna mismatch – rarish*

DX at 9000+km. Now that is what I call DXing!"

Owen G0PHY e-mailed to say, "As I write this the SFI is currently 74, the K index is 2, and conditions have not been good this month. There was an IOTA DXpedition last weekend to EU-102 in the Russian Arctic, one of the two Russian European IOTAs that I need. If conditions had been better, I would have fully expected to have heard them. However, I only heard stations in Brittany, Germany, Italy and Russia working them, rather than the DX station itself. Most contacts this month have been within Europe (mostly special event stations and IOTA operations) with only two DX contacts, both on 20m: TR8CA and SU9VB (world traveller **Vlad UA4WHX**)."

Carl Gorse 2E0HPI says, "I have just purchased an Elecraft KX2, **Fig. 3**, and am really enjoying using it. I have been very busy working over the past few months and have managed to get out when I can." On June 3rd Carl operated from WWFF-GFF-0369 (Greenlee Lough) on 40m and 20m SSB, working a string of European stations on both bands. Later in the month Carl took his new KX2 up to Gisborough Moor, SOTA G/TW-003, and under very poor conditions still managed to work DF5WA, GB0HGB, MK0BKV and a number of other UK stations plus as far afield as S58AL on 40m SSB. Finally, on June 26th Carl operated portable from the Museum of the Royal Navy in Hartlepool for Museums on the Air and worked GB0PAM (Parham airfield), GB0HGB (at Heugh Gun Battery, Hartlepool) and GP3ZME/P (Guernsey) on 40m SSB. He concludes by enthusing, "I cannot wait to get out portable more now with the KX2. So far it's excellent and next month I will send in a



Fig. 3: Carl Gorse's new Elecraft KX2.

detailed report and photographs with the new radio."

Terry Martin M0CLH wrote, "No significant DX this month because we now seem to be in the summer doldrums and gardening also calls. There were, however, some nice short hop openings on 10m due to Sporadic E [see Band Reports section]. Over the weekend of June 11/12th, the Russians organised a Domino extravaganza. This was a new mode for me so seemed like a good opportunity to try it out. On the waterfall display, it does indeed look a bit like dominoes but feels rather clunky and slow. It is meant to be good for noisy conditions. There was quite a bit of activity and the ten contacts required for a certificate, **Fig. 4**, were easily attained."

Kevin Jackson M0XLT near Skipton also commented on the "very poor band conditions for DXing, but lots of special event stations about made things interesting and the summer Es season livened things up. My highlights: TM16EURO and TM16EFC on a few bands for the European Football Championship – I qualified for the award. The International Museum Weekends brought in plenty of stations operating from museums and I also qualified for that award. Other interesting QSOs were JW/M0MIE, RW9LL, W4AAW (Virginia), HB0/VK1AD/P – who said he'd never experienced such pile-ups (welcome to Europe!) – and a number of A4 and A7 stations from the Middle East, all on 20m. I had great fun with plenty of short skip on 20m, which at times sounded like 40m, full of UK stations. Adam 2U0DWD was a good QSO [I also worked Adam on 20m on June 20th – PJ4DX]. He has just passed his Intermediate examination." Following a 20m QSO with 2E0VOV/M in Dorset on the night of June 29th, Kevin was sent the YouTube video clip of the contact, which illustrates the great summer short skip conditions. Making the very valid point that there is always something of interest to work on HF, even when there is not much DX about, Kevin concluded his report by saying, "there are far too many special event stations and short skip stations to mention and it would become a long list so suffice to say that for me it's been great."

<https://youtu.be/0Xcjj8t720>

Despite the poor DX conditions, **Kevin Hewitt ZB2GI** wrote, "I worked three new countries on HF this month. I also operated on 6m for the first time and made ten contacts." As usual, Kevin operated both from his home, using a Kenwood TS-570 running 10W into a magnetic loop mounted on his balcony and portable from Rosia Bay with an Icom IC-703, also



Fig. 4: The Russian Domino certificate awarded to Terry M0CLH.

running 10W to 5m of wire twisted around a 5m telescopic fishing pole via a 9:1 balun. The best of Kevin's logs are in the Band Reports.

Band Reports

The log from Terry M0CLH once again shows almost all possible modes being used. The following is a small selection. 20m SSB: HA8RT/P. 20m CW: LZ425STA. 20m RTTY: F4CVQ. 20m DominoEX: DL1RI. 20m JT65: N9YLE. 20m JT9: F8RZ. 20m PSK125: TM62EURO. 20m PSK31: 2M0MZ0. 20m PSK63: N4VN, TF2MSN. 17m SSB: LZ425STA. 17m PSK31: SV8LMQ. 15m JT65: MM0HVU. 15m PSK31: OZ5THY. 15m PSK63: SA3CFY. 10m DominoEX: EA7CI. 10m PSK125: SQ9LFQ. 10m PSK31:

EA6BH, SK70HW (70th anniversary Kronoberg Radio Society, SK7HW). 10m PSK63: 9A1AA, DG0CG, EA7IRI, IU1DUK, OE9MDI, OK2MEZ, S51AB, SP1TJ.

Here's the best of the log from Kevin ZB2GI / ZB2GI/P. 40m SSB: 4O7TC. 20m SSB: 9A702YM, 9H4JX, A61SM (**Fig. 5**), CT8/OE9SDV (EU-175), RT2F, SU9VB, V47JA. 20m PSK31: F1IEE, G3HQT, LA4GHA, R7RIB. 17m SSB: HZ1GT/M. 10m SSB: 9Z4BM.

Signing Off

Thank you to all our contributors. Please send any input for the column to teleniuslowe@gmail.com by the first of the month (September 1st for the November issue, October 1st for December). 73, Steve PJ4DX.

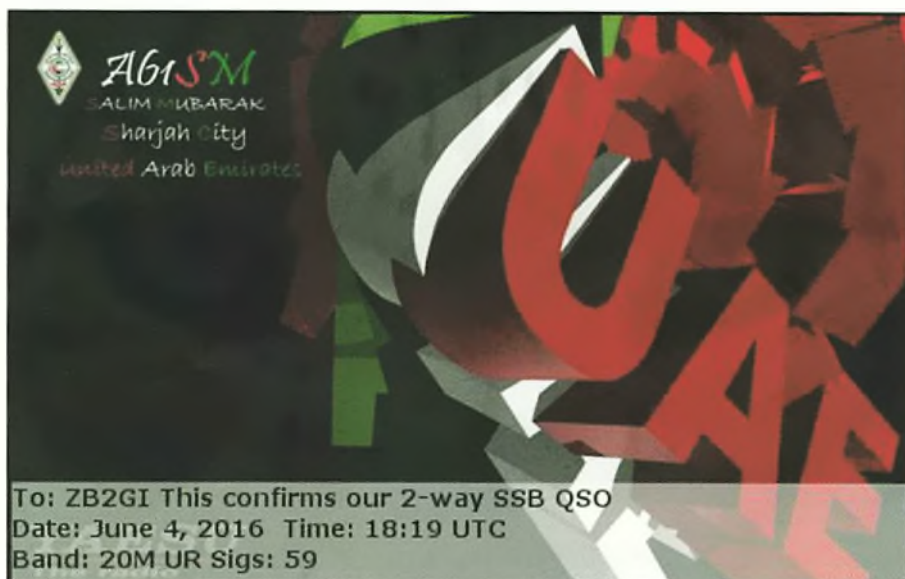


Fig. 5: eQSL from A61SM in Sharjah, sent to Kevin ZB2GI.

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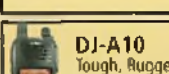
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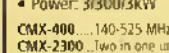
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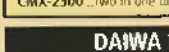


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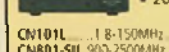


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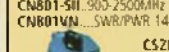
DAIWA Products



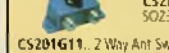
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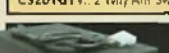
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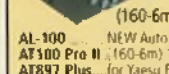
CN801VN... SWR/PWR 140-525MHz N type... £119.95



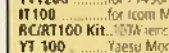
CS201A... 2 Way Antenna Switch... £24.95



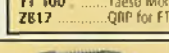
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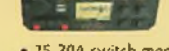
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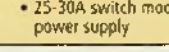
AT180 Pro II... 160-6m 125W... £209.95



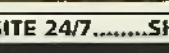
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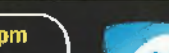
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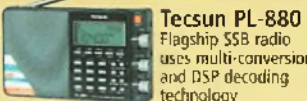
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WSPR

Mike Richards G4WNC describes how you can set up and use the WSPR software and reporting network to compare antennas and equipment.

This month I'm back to data modes with a look at how you can use data modes to check your antenna coverage, spot openings and even compare receivers.

Available Systems

There are currently two data modes systems that can be used to provide very comprehensive details of your station's coverage and they are WSPR (Weak Signal Propagation Reporter) and the RBN (Reverse Beacon Network). I start this month with a detailed look at WSPR and next month I'll turn to the RBN.

Table 1 – WSPR Operating Frequencies

Band	Frequency
2190m	136kHz
630m	474.2kHz
160m	1.8366MHz
80m	3.5926MHz
60m	5.2872MHz
40m	7.0386MHz
30m	10.1387MHz
20m	14.0956MHz
17m	18.1046MHz
15m	21.0946MHz
12m	24.9246MHz
10m	28.1246MHz
6m	50.293MHz
4m	70.091MHz
2m	144.489MHz
70cm	432.3MHz
23cm	1296.5MHz

Inside WSPR

WSPR is a sophisticated mode that was developed as part of Joe Taylor K1JT's range of specialist weak signal modes and is available for free download. Originally produced to encourage his students at Princeton University to try moonbounce and other difficult signal paths, the potential of these weak signal modes soon spread into the general amateur radio community. The WSPR system operates using a very slow, narrowband, transmission with minimal message content and a very low transmit power (usually 5W or less). The mode is officially designated as MEPT_JT (Manned Experimental Propagation Transmission). The final JT is just the last two letters from

Joe's callsign. Although WSPR is clearly a data mode, its message is preset and it cannot be used for conversations. Each transmission comprises the originator's callsign, the first four characters from the Maidenhead locator and the transmit power level. The idea is that distant stations receiving the transmission will have sufficient information to be able to assess the propagation conditions for that path – the distant location and power used.

The total message length for each WSPR transmission is just 50-bits with 28-bits used for the callsign, 15-bits for the locator and 7-bits for the power level. **Fig. 1.** The keying rate is extremely slow at just 1.46 baud and the modulation is continuous phase 4-FSK with each tone separated by just 1.46Hz. That gives an overall bandwidth requirement of just 6Hz. The very slow data rate combined with the fixed message size results in each transmission having a duration of 110.6 seconds. The very slow speed and narrow bandwidth enable this mode to operate down to a signal-to-noise ratio of -27dB in a typical 2.5kHz SSB passband. Because many WSPR signals will be inaudible, it is not practical to tune around looking for signals so a more structured approach is necessary. The solution for WSPR is to

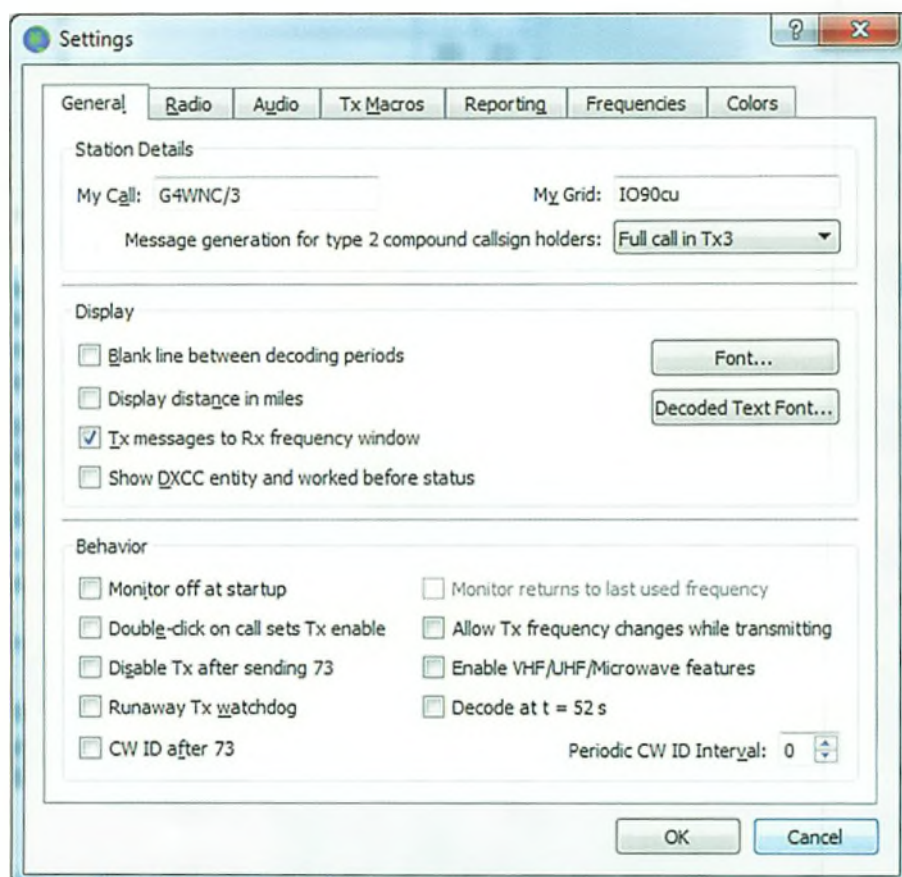


Fig. 2: Setting the callsign and locator.

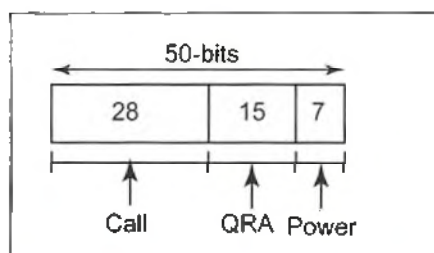


Fig. 1: WSPR message structure.

use a combination of specific frequency allocations combined with synchronised transmission slots. In the current system, the bandplan shown in Table 1 is used for WSPR transmissions. All WSPR transmissions start at two seconds into each even minute (UTC), that is to say 00:00:02, 00:02:02, 00:04:02, 00:06:02 and so on. At the receiver, the decoder will look for valid WSPR signals in a 200Hz bandwidth centred on the nominal frequency. At the end of each transmission slot there is a 19.4 second gap that is used to process the received data and display the results on the screen.

Practical WSPR

Now that you have a basic understanding of WSPR, let's look into the practicalities of setting up your station for the mode. The good news is that WSPR is included in the open-source WSJT-X suite of programs and free downloads are available for Windows, Linux and OS-X operating systems. You will find the software on Joe Taylor's site at Princeton University, URL below. The package to download is WSJT-X and, at the time of writing, the latest version was 1.6.0. Windows users should download and run the .EXE file while those using Linux will probably find WSJT-X available via your system's software repository: `apt-get install -y wsjtx`. <http://physics.princeton.edu/pulsar/k1jt/wsajtx.html>

Windows installation is menu driven and very straightforward so you shouldn't have any problems.

With the installation complete, the first task is to enter your station details and configure the connection to your rig. If you're already operating other data modes, you will have all the connections you need for WSPR. The first step is to enter your callsign and location and this is accessed via the File menu where you choose Settings – General, Fig. 2. While you can use WSPR on a single band, you can get a much better view of propagation and your antenna coverage by linking WSJT-X to your CAT interface. WSJT-X includes built-in support for a wide range of popular radios and to access these settings choose File – Settings – Radio, Fig. 3. Here you can select your rig in the drop-down list and then set the COM port,

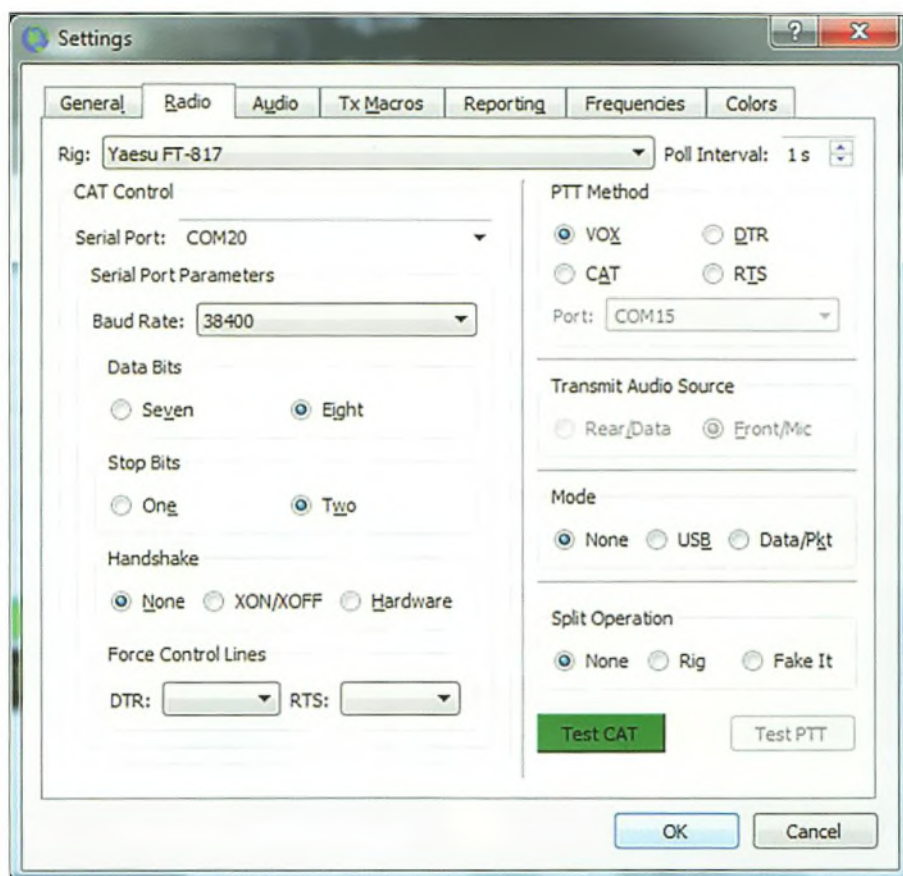


Fig. 3: Configuring the CAT interface.

baud rate data bits and stop bits to match your rig's requirements. Check the CAT section of your user manual if you're not sure. If you don't have PTT control, VOX transmit switching is the simplest option. Before you leave this section, press the Test CAT button and the button will turn green if all is set up correctly. Now you can move on to the Reporting tab and, under Network Services, tick the Enable PSK Reporter Spotting. This is not required for WSPR operations but it's good practice to share any other spots with the PSK Reporter site.

The next step is to choose the Audio tab and select the appropriate soundcard for your system. If you already use data modes, this will be the same card that you use for your normal data operation. That completes the setup for WSPR operations but you can also use the same software for other weak signal modes such as JT4, JT9, JT65 and an Echo

mode for monitoring EME reflections. When you get back to the main screen, use the Mode menu to set the mode to WSPR-2 and in the bottom section of the main screen, tick the Upload spots box. This will upload details of all your WSPR spots to the main WSPRnet online database.

The next step is to consider the bands you want to monitor. Thanks to the CAT control, WSPR can be set to automatically retune your rig to both transmit and receive on any or all of the bands you have available. Before we go on to select the bands, let's adjust the transmit power. I suggest you start with 1W or less. Connect a suitably rated dummy load and power meter to your rig and press the Tune button on WSJT-X. Now you can adjust your rig's power setting and the WSJT-X power slider (Pwr) to get the desired power into the dummy load, Fig. 4. You can now reconnect the antenna.

Table 2 – Band-Hopping Transmission Schedule

Band	160	80	60	40	30	20	17	15	12	10
UTC	00	02	04	06	08	10	12	14	16	18
minute	20	22	24	26	28	30	32	34	36	38
	40	42	44	46	48	50	52	54	56	58

Final Points to Address

Before we move-on to start operating there are two vital points we need to address. The first is your computer's clock. Accurate time keeping is essential with WSPR so you need to ensure your PC clock is spot-on. The simplest way to do that is to install a time synchronisation program. There are several free programs around but I currently use NTP for Windows. This software is available as a free download from here: www.meinbergglobal.com/english/sw/ntp.htm#ntp_stable

You will also find an excellent installation tutorial for the software at: www.satsignal.eu/ntp/setup.html

In addition to accurate timing, WSPR also demands good frequency accuracy. Your main rig should be sufficiently accurate but if you are using an SDR dongle, you will need to check and adjust the tuning offset. The simplest way to do this is to tune in to the RWM frequency standard on 9.996MHz because this is a reliable signal across the UK. With RWM tuned in, you can adjust the SDR frequency correction to correct the tuning. To avoid short-term drift problems, I usually leave my SDRs powered up.

Before we finally get going we need to configure WSJT-X to operate on the desired bands. To do this click the Band Hopping button on the main screen and then click on the schedule. This will open up the schedule matrix, Fig. 5. Here all you need to do is to tick the combination of times and bands that you want to use. Any band with a tick in the Rx only box means just that – it will listen and report but not transmit. The Tune row is there for those who need a short transmission to activate/tune a multi-band ATU. When this option is ticked, the software will send an unmodulated carrier for several seconds before the formal WSPR transmit time begins. For more advanced operators, WSPR can be set to execute custom commands when band changing but you will need to check the WSJT-X online manual for full details of this. When you have band-hopping enabled, WSPR will operate on the selected bands using the 20-minute schedule shown in Table 2. One final adjustment is the audio level. In the bottom left of the main screen you will see an input level indicator and a volume slider. This should be set to just above 0dB on the scale while tuned to background noise. This is not a critical setting and I usually run mine at around 3dB so I can just see the orange marker on the level scale.



Fig. 4: WSJT-X showing the Tx power slider and audio input controls.

Using WSPR Results

Once you have your WSPR station up and running, you can see a summary of all your uploaded spots by visiting the WSPRnet site (below). When you get to the site, click on the Database tab to look at the received data, Fig. 6. The database is very powerful and includes filters that you can apply via the link just above the results titled: Specify query parameters. Here you can select the band, the maximum number of spots, the spotted call, reporting call and time period. You can also select the field to sort the data, reverse the sort order or only show unique callsigns. If you want to see a list of stations that have heard you on any band, then set the band to All, count to any number you like up to a maximum of 1,000 and put your callsign in the Call box. Press the Update button and the data will appear. If you want to take a closer look at the data in Excel or similar spreadsheet software, you can select the table results and copy/paste them into the spreadsheet.

<http://wspnet.org/drupal>

For a more visual indication of the results, click the Map tab and scroll down to the bottom of the map where you will see the search and display criteria. To see only the results for your station, simply put your callsign in the Call box, set the other parameters and click the Update button.

You can then use the mouse wheel to zoom in to the map, Fig. 7.

Comparing Receivers and Antennas

While manufacturers' and reviewers' measurements can help to differentiate between the performance of different receivers, the on-air opinion can be different and clouded by all manner of issues. So how about using WSPR as a technique to compare receiver performance with real signals. One way to approach this could be to connect two, or more, receivers to the same antenna via a suitable antenna splitter. This could be a simple DIY Owen resistive splitter or maybe a commercial unit from Cross Country Wireless or Mini-Circuits.

With multiple receivers connected to the same antenna we could run multiple instances of WSPR, download the results from the WSPRnet database and compare the results. I have been testing this over the past few days and I can offer you a few pointers to setting started. The first requirement is to be able to differentiate between uploaded reports from the different receivers. The simplest way to do this is to amend the callsign stored in the WSPR software by adding /1, /2, /3 and so on to denote each additional receiver. The second issue is to be able to run a second instance of WSJT-X but using a different settings file. The WSJT-X development



Fig. 5: WSPR band-hopping matrix.

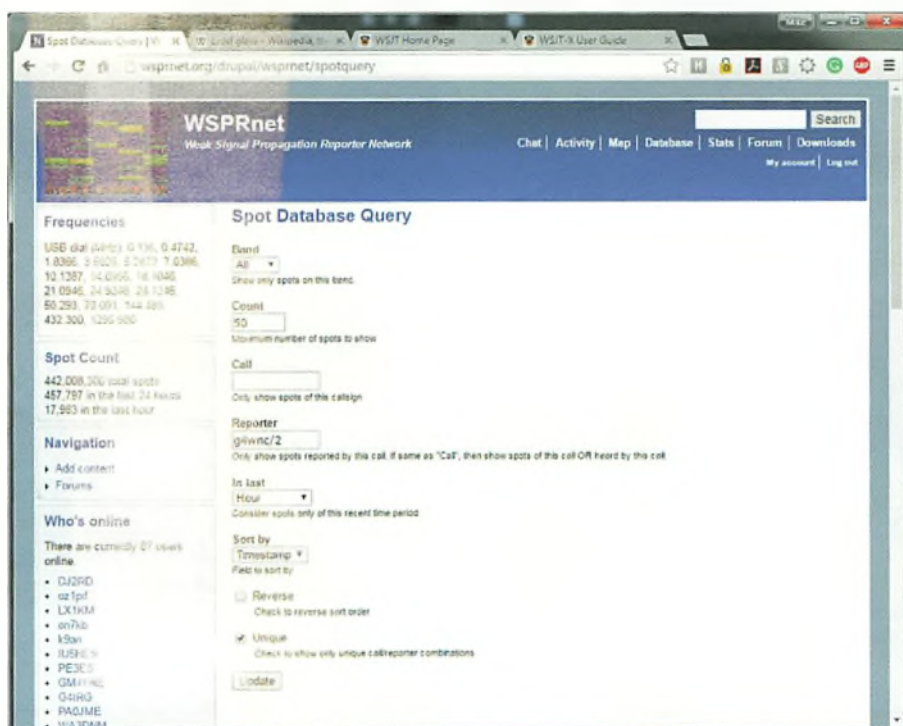


Fig. 6: WSPRnet database query screen.

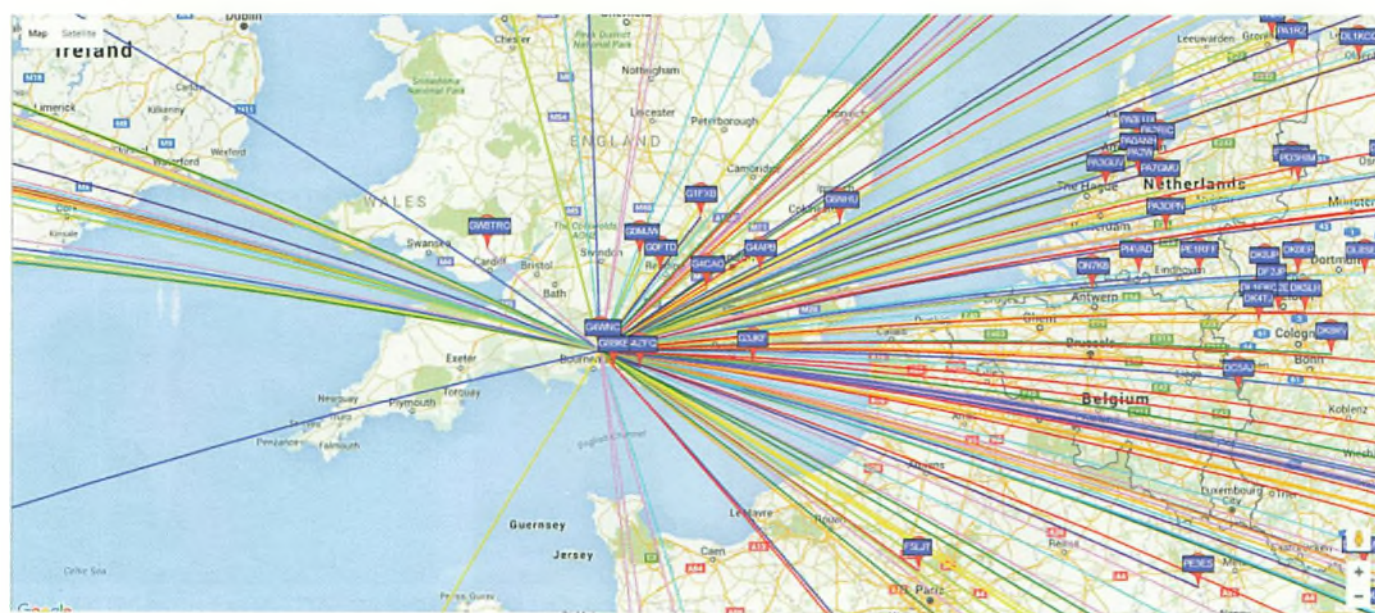


Fig. 7: WSPRnet, zoomed-in propagation map for my Wellbrook ALA1530+ Imperium antenna.

team have thought of this and you can add a simple command-line option to start the software with a different configuration file. In my case, I was running some tests with an SDRplay, AirSpy + SpyVerter and an FT-897. Here's a step-by-step guide to creating a desktop shortcut for each receiver type:

1. Navigate to the folder where WSJT-X is installed and locate wsjtx.exe.
2. Right click on wsjtx.exe and choose Send to - desktop (create shortcut).
3. Find the shortcut on the desktop (it will probably be called WSPR), right-click and choose Properties.
4. Locate the Target box and after wsjtx.exe, add a space and then: --rig-name=myradio where myradio is the name you want to use to describe your radio. Do note that there are two hyphens preceding rig-name. Here's an example of a shortcut target from my system: `C:\WSJT\wsjtx\bin\wsjtx.exe --rig-name=SDRplay`
5. Click Apply to complete the changes.

Repeat this process for each receiver you want to run. The WSJT-X software is very efficient so doesn't present a very high processor load. However, you will need to be careful if you are comparing USB-connected SDR receivers. These receivers often make heavy demands on the USB bandwidth that can result in dropped samples and stuttering in the resultant audio. I'm rapidly running out of space this month so next time I'll put together a few ideas on how you can make sense of the comparisons and I'll also have a look at the RBN.



Ham Radio 2016

Don Field G3XTT covers some highlights of this year's Ham Radio event in Friedrichshafen, southern Germany.

Last year we carried an extensive report on the Ham Radio event so this photo montage is by way of a brief look at some of those products that were new for 2016 along with a few other highlights. Attendance is reported as being 17,230 and as always there was a good showing from the UK.



Kenwood representative Mark MODXR holds Kenwood's new D-STAR handheld.



There was a lot of interest in the Red Pitaya development platform, covered recently by Mike Richards G4WNC in his Data Modes column.



As expected, Elecraft's new KX2 (to the left of this photo) attracted lots of interest.



As we reported last month, several new amplifiers were on show. Here is the solid-state OM 2002 for the 144MHz band.



Acom's new amplifier range appears to have been styled after typical hi-fi equipment.



Reuter Elektronik of Germany (www.reuter-elektronik.de) had a range of SDR receivers and transceivers on show.



The Maker Faire in the adjacent hall attracted some unusual visitors!



Youngsters busily soldering away in the Maker Faire area.



The pretty waterfront at Friedrichshafen – it's a great place for a holiday and during Ham Radio you'll find fellow amateurs at every restaurant along the shoreline.



The insides of the OM Power bandpass filter unit.



CDXC (the UK DX Foundation) had a stand at Ham Radio for the first time. (photo courtesy G3YBY)



Editor Don G3XTT meets Hartmut DG7YBN, 70cm EME enthusiast (see article in this issue).

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

VHF/UHF Activity

Dear Don,
I totally agree with **Ben Nock G4BXD's** comments in his letter in the July issue of PW. Two occurrences I had the other day while driving around my home city of Derby might be of interest. Firstly, I tuned around the repeater section on 2m and was surprised to hear a QSO in progress on 145.650MHz because there are no local repeaters on that frequency. Not being very good at Morse, it took me a while to discover that I was hearing GB3WH near Swindon but, of course, I couldn't join in the QSO because I didn't know which CTCSS tone to use (and even if I did know the correct tone, setting the radio up was not something I would have done while driving).

I continued tuning up the band and found my local 2m repeater GB3DC in use. Having this programmed into the radio's memory, I could join in the conversation but was somewhat put off when I found that the users were a KC3 talking to an M10 via Echolink. So I couldn't even have a chat with a local amateur through my local repeater. I thought repeaters were intended to aid local communications for mobile stations, not to allow a North American station to talk to a Northern Ireland station via a repeater in the East Midlands.

Another thing that annoys me is when I put out a CQ call on S20 and get no reply and then two minutes later a station with a 59 signal calls his buddy down the road. Obviously he doesn't want to speak to me and invariably his buddy doesn't answer either.

Dave Allsebrook G1VAC
Derby

Dear Don,
I'm over here on holiday, picked up PW and saw the letter from **Ben Nock G4BXD** and could not disagree more. I accept

the point regarding access via 1750Hz but to say D-STAR and the like is killing conversation is, in my opinion, simply not the case.

I was in the UK before digital modes took off and, to be honest, activity on local repeaters had died off compared with when I was first licensed in the mid-1980s. I think this is more due to the vast increase in the number of actual repeaters since then and the number of amateurs not increasing at the same rate.

In New Zealand, the amount of radio traffic has certainly increased as opposed to destroying it. I now use D-STAR on an almost daily basis on my work commute. On local repeaters I would not bother because, as in the UK, there is a relatively high ratio of repeaters to operators. There is relatively little activity on analogue repeaters even though we don't use access tones and we have a national linked system. I also have quite a few QSOs with UK amateurs that I would not get to work otherwise.

The new technology is what spurred my 15-year-old son, **Kieran ZL4TM**, into getting his licence. He is studying Japanese at school and uses Echolink and D-STAR to improve his language skills. Without this technology I think it is unlikely that he would have bothered with amateur radio.

It may be a bit of a chore working out tones and the like but to say new technology is destroying radio traffic is, I believe, very far from truth.

Amateur radio always has embraced technology and this will attract new blood into the hobby while changing where and how we operate. Just because the traffic is not on local repeaters does not mean it isn't there, it's just that things are moving on. After all, if our predecessors had not embraced new technology, we would still be using spark gap equipment!

Pete Leng ZL4TE
Cambridge, New Zealand

Dear Don,
I read with interest your comments in response to **Ben G4BXD's** letter (July).

You say, "you can enjoy chatting to amateurs world wide without the need for a large HF antenna and lots of power".

I'm not trying to be rude but I am not sure where you were ten to fifteen years ago. Back then you could do just that using your local Echolinked repeater or via your laptop. 15 years ago I was living in Lincolnshire and set up two repeaters, GB3FJ on 70cm and GB3JF on 2m. Both at one time were Echolinked.

The local radio amateurs said that was what they wanted but after a very short time there were complaints about the constant keying up of the repeaters via Echolink. Indeed, I seem to remember that many Echolinked repeaters suffered the same problem. Operators would open up a repeater from afar just to prove they could do it but many never called CQ through the link.

I shut down GB3JF and took the Echolink facility off GB3FJ. Have we moved forward? I don't think so. I believe it is just case of the manufacturers of amateur radio equipment selling us the latest Emperor's New Clothes. I agree with **Ross GK4DTD**. I also moved to Cornwall and although where I live I can access no fewer than six repeaters, both 2m and 70cm (two of them are still Echolinked I believe), almost no one uses them. There is more activity on FM CB and a lot of the people on CB are licensed radio amateurs, chatting locally. It just does not make sense spending money on a digital VHF/UHF black box to do the same thing you can do reliably on an FM repeater assuming, of course, that there is anyone around to return your call. What we need is more activity on all bands.

I don't think we stand to lose any bands/frequencies. Quite the opposite, in fact, now that so many broadcast shortwave stations have shut down and gone to the internet. I do hope this does not happen to amateur radio.

Len Baddeley GK8LXI,
Gunnislake, Cornwall

Dear Don,
I wish there was a quick way to answer the comments – I could write a column on this one!

With regard to **Ross GK4DTD's** comments respect to activity on VHF/UHF, I am sat here on July 9th reading my PW that just dropped through the letterbox. I noted that there was a nice tropo opening on 2m from Cornwall to EA1 and southern France but even better were reports from many stations in Cornwall of EA8 being worked on SSB and FM. Cornwall sits on the top of the Azores high pressure system and has experienced some of the finest VHF/UHF openings in history like D4 (Cape Verde) on 70cm! The sea path is fantastic and there's plenty of real activity and DX out there.

The same goes for guys in Kent – they have a superb path via ducting/tropo to LA/SM/OZ and the like.

VHF/UHF has so much to offer if you put a little effort into it. Tremendous distances can be worked even on FM and vertical antennas. Watch the weather patterns that create the openings and work real DX!

Geoff Brown G4ICD
Southampton

Editor's comments: My thanks to all the foregoing correspondents. We certainly seem to have opened something of a can of worms here. There appear to be a number of aspects. The hobby has changed and diversified over the past 20 years or so, what with new modes to try (HF data modes, for example) and Class

Send your letters to:
Don Field G3XTT, PW Publishing Ltd, Tayfield House,
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E-mail: don@pwpublishing.ltd.uk

B licensees gaining access to the HF bands, which led to something of an exodus from VHF. In correspondence on the subject with our VHF columnist Tim G4VXE, though, we do wonder if things were quite as rosy as some are painting back in the 1980s or thereabouts. Activity was patchy and many repeaters were, sadly, subject to jamming. There does, though, seem to be more interest in setting up and running repeaters than actually using them – at the recent McMichael Rally here in Reading I was chatting to the movers and shakers of the Thames Valley Repeater Group and they were telling me that their various repeaters are all working well but activity is very low.

Although I have rarely used repeaters, I do indeed recall that Echolink brought international linking many years ago. However, the additional facilities available through the new digital voice modes appear to offer a number of advantages to users. For example, selective calling surely avoids the problem Len mentions of people keying up distant repeaters just for the sake of it.

I do though, suspect that local VHF activity is still alive and well in various hotspots around the country, often as a result of club nets. I'd also draw your attention to the mention in Tim's VHF column in this issue of a new Facebook group dedicated to encouraging SSB activity on 144.265MHz. Many of those taking part are using simple vertical antennas but still managing to make QSOs. However, maybe none of us has time to chat nowadays, hence the frequent complaint of HF operators that many QSOs are reduced to a short exchange of signal report, name and location. Who knows, perhaps the pendulum will swing back again in the fullness of time when we all get tired of social media and e-mail.

Drivers for Handhelds

Dear Don,
Having recently upgraded from Win 7 to Win 10, I found my Wouxun KG-UVDP1P handheld would not connect with the PC when using programming software, indicating a com port error. An internet search revealed that the black coloured USB cable supplied with the original software was not compatible with Win 10. This might also be the case with other similar Chinese manufactured transceivers. My thanks go to Gary Spiers and the Martin Lynch & Sons team for the solution. A new red coloured cable is necessary, which they are able to supply from stock. It also requires a Prolific PL-2303 driver to be installed from the Wouxun website.

On another subject, I remember some correspondence in PW a few years ago on the subject of trading-in surplus radio equipment in exchange for new and the apparent low prices offered by dealers. This reflected my position recently and I resolved my disappointment with the low sum suggested when I remembered that, on resale, the dealer needs to offset business overheads as well as applying VAT, currently 20%.
Nick Hockenhull MW0NAB
Deganwy, Conwy

Clear Enunciation

Dear Don,
I must reinforce the comments made by Julian Goodman M6GIS (Letters, August). I too have trouble discerning call signs that are rattled off with no phonetics. People sometimes repeat their call sign so quickly that you cannot tell what is the beginning of the call sign.

Fingers crossed for an improvement!

Ken Grover G3KIP
Tunbridge Wells

£20 STAR LETTER

Nothing Changes

Dear Don,
Today while browsing around a local charity shop, I found three old copies of PW dating from 1959 and 1961. In the December 1959 issue I found an intriguing article entitled *On Your Wavelength* by someone called Thermion.

The first part was a good old rant about the early days when amateurs had to make all their own equipment, parts and so on and how, of course, this was much better and more rewarding than in 1959. He then goes on to say this:

"The main reason for lack of enthusiasm is the lack of new inventions or discoveries in the world of amateur radio today. When radio first began, hardly a day went by without details being given or talked about concerning some new station, some new combination of crystals or whatever. Nowadays, everything is over; there is nothing left to discover. Any amateur with the money and inclination can talk to Australia if he so desires."

How, if he were still alive today would he have to eat those words "there is nothing left to discover" but there is a ring of truth in his final sentence.

As someone who was ten years old when that article was written and who came to the hobby later in life in 2010, I have treasured the few contacts I have made to Australia using my second-hand 'black box' transceivers and simple wire antennas.

To make regular contacts to VK still requires a large monetary investment in masts, antennas, amplifiers and so on, which many of us can't meet.

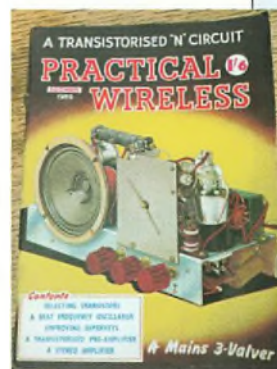
It is amazing how, historically, people's thoughts and ideas can be either way off target or timeless in hindsight.

Keep up the good work with PW.

Phil Croxford M0PSC
Bicester, Oxfordshire

Editor's comment: Thank you for this Phil. Quite often I look back through old radio magazines and see very much the same complaints about subjects such as home construction, interference, propagation or whatever that we see today. I take heart from the fact that the hobby is still thriving and its adherents remain as passionate as ever about amateur radio or, at least, their particular subset of the hobby. I do worry sometimes that we are in danger of becoming a legacy hobby, interested only in looking backwards, but then, as recently when we had an open evening at the Reading club and members talked about their various ongoing projects, I am encouraged by seeing some of the real state-of-the-art work that is going on. Truly, this is a hobby with many facets of which getting on the air is just one. That said, and on the subject of working Australia, I well recall one of my local amateurs in my early days in Northampton whose friend had emigrated to Australia. He set up a one-and-a-half wavelength loop for the 20m band, oriented with its main lobe to VK and hung from trees and he and his friend were able to make daily QSOs almost without fail, throughout the sunspot cycle and using modest power levels.

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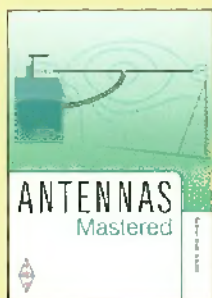
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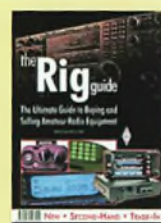
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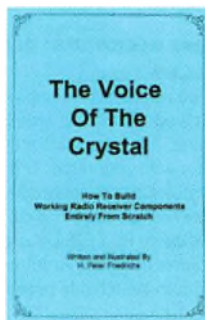
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Scanning Scene Bill Robertson responds to correspondence, relays snippets of news and offers his view on what to look for in a wideband receiver or scanner

Decode Mike Richards concludes his look at the Red Pitaya development board by showing you how to use it as a vector network analyser

Military Matters Pat Carly reports on major exercises in Northern Europe and then offers his thoughts on Armed Forces Day in Yorkshire, American Memorial Day and HM The Queen's Birthday Flypast

Sky High Godfrey Manning muses on the frequency for London VOLMET South and one reader's experience of foreign radio procedures

DXTV Keith Hamer and Garry Smith bring you their compilation of reception reports for May, including log submissions from the UK, France, Italy, the Netherlands and the US

Maritime Matters Robert Connolly allays the fears of readers regarding the possible loss of comms on international marine VHF channels and then details some new technologies

Airband News David Smith considers the requirement in 2018 for radio equipment on aircraft operating in the airspace of EU member states to have the capability for 8.33kHz spaced channels

LM&S Broadcast Matters Chrissy Brand and fellow Radiouser readers give you plenty of reasons to scan the broadcast bands this summer

NDB DXing Despite the short nights, Robert Connolly details some recent successes and tells the saga of one reader's effort to enable him to pursue his hobby

Mosque Radio Paul Besumont G7VAK take a look at analogue broadcasts on UHF: from mosques that are licensed as part of the On-Site Religious Observance Radio service

Airshow Guide

Radio Websites Chrissy Brand explores the world of radio-related websites from her city centre balcony and brings you links to news, summer radio and vintage radio stations

Radio Events

News & Products

Off the Record Oscar delves into his mailbox and ponders on the current state of the medium wave band and then offers his thoughts on how to create more clear channels

Comms from Europe Simon Parker reflects on the question he's asked most frequently and then looks at the UP technology from President, the Team CB Mobile MiniCom 2016 and the CRT P7LCD PMR 446 transceiver

Software Spot This month, QSP7.3 Services brings you another superb collection of software, with programs for generating azimuth maps, antenna pointing, Morse training, satellite tracking and weak signal digital communication

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Review - Ham Radio Deluxe

Steve White G3ZVW takes a look at a very comprehensive suite of amateur radio software for logging, rig control and much else besides.

Transistors (Part 2)

David Jardine G0FDV concludes his two-part article about the inner workings of transistors.

In the Shop

Harry Leeming G3LLL is back with another entertaining collection of anecdotes from his days as an amateur radio retailer.

The Morse Mode

Roger Cooke G3LDI discusses the accurate sending of Morse code, the use of Morse on the VHF bands and other Morse-related topics.

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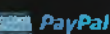
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