Amateur Radio

Volume 89
Number 1 ▶ 2021
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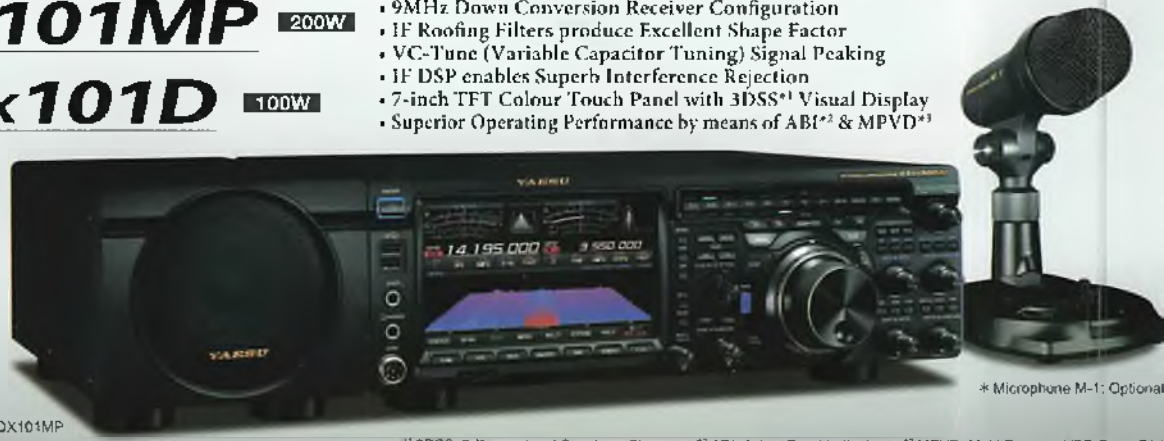

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Columns

Technical

This month's cover:
Jessica is excited by the prospect of DIY digital amateur TV. Yes, Jessica graced our cover back in Issue 2 last year. No dudes were harmed in the photo shoot for this cover.

Contributions to Amateur Radio

Amateur Radio is a forum for WIA members' amateur radio experiments, experiences, opinions and news. Manuscripts with drawings and/or photos are welcome and will be considered for publication. Articles attached to email are especially welcome. The WIA cannot be responsible for loss or damage to any material. Information on house style is available from the Editor.

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A radiocommunication service for the purpose of self-training, intercommunication and technical investigation carried out by amateurs, that is, by duly authorised persons interested in radio technique solely with a personal aim and without pecuniary interest.

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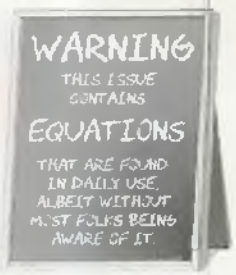


Courtesy Carmel Morris VK2CAR

Happy New Year!

I say that with a dose of cautious optimism that I find difficult to conjure up, given the events of 2020.

In any event, I hardly need to remind any of you about the events of 2020 as the print, broadcast and online news media reminded us all hour-by-hour, day after day. Hands up those of you who are wracked by news-cycle fatigue? The COVID-19 pandemic has been unprecedentedly relentless in reminding us of the fragility of life and the seriousness of such infectious diseases.

But COVID-19 has engendered some upsides, too. Many amateurs have used the community lockdowns to tackle long put-aside projects, or to spend more time on the air, among many possible activities during the times when public mobility was not an option.

While I was not personally impacted directly by COVID-19, I certainly feel for those that were. My day job moved from a city office to working-from-home last March. I took me back to the 1990s when I worked as a contract editor and freelance journalist and spent at least half the working days of each month working from a home office.

Over the last nine months of 2020, I swapped from working in a CBD office, commuting the 20 km from home to work and back again via public transport five days a week, to working from home and commuting from one end of the house to the other five days a week! LOL.

For the end of year break, I flew from Sydney to the Gold Coast to stay with my son and granddaughter, as has now become usual for me. I was able to cross the NSW-Queensland border without challenge.

Naturally, I took the opportunity for some 'face time' with old friends and colleagues from the amateur radio world, joining a gang of contesting enthusiasts for a rowdy lunch post-Christmas – no face masks, just a little social-distancing and logging-in when entering public premises. I have no quibble with such things.

I have to admit to some anxious moments, however, when it came time to return home to Sydney late in the first week of January. With only days to go, my return flight was cancelled as a result of changing pandemic conditions in both my home state of NSW, and southeast Queensland. Grump! Get on the website and book again. Hmm. Had to choose a later day. Fine. OK, then. But, that too was cancelled.

Suffice to say that, to secure a reliable flight home I had to change airlines and port of departure. Phew!

Booked the flight. From Brisbane, not the Gold Coast. But, waaiit a minute! The Greater Brisbane area was then sent into lockdown. Checked. Still OK to fly. Caught the flight. Phew (again)!

On the descent into Sydney, the flight captain announced that our flight would be met by NSW Police! And they did. Staff from NSW Health interrogated every passenger while the Police observed. I was told to "go straight home". Do not take public transport. Take a taxi or an Uber. Remain isolated until the Brisbane lockdown was lifted. So, for the price of two years' amateur licence renewals, I went straight home, to emerge from lockdown on the third day after. Just as *AR*'s deadlines loomed.

Board comment

Greg Kelly VK2GPK

Welcome to the first issue of *AR* magazine for 2021. I will start with wishing everyone a happy New Year for 2021 – and hopefully a better year than 2020.

So far, 2021 does seem to be shaping up with the potential for a much better year. Of course, given 2020, that's hardly a stretch goal! However, drought and high temperatures are now impacting Western Australia and have resulted in ideal conditions for bushfires this season. To WA members, we hope you and your families keep safe.

Science rules!: Australia has fared well relative to other countries in the handling of the pandemic, even with the recent outbreaks causing havoc for many. Science in this time, rather than political ideology[1], has been brought once again to the fore in both the guiding of suppression of the pandemic and with the amazing speed of development of effective vaccines. Applied science – electrotechnology – is so much a part of the Radio Amateur Service, that it is never top of mind. It is important to be aware that an Amateur licence is fundamentally an experimental licence – the reason we continue to have access to radio spectrum.

The list of contributions to science from innovations pioneered by Radio Amateurs is long. And, because science is exciting, we need to find more ways to share that excitement with the younger generation – of such things as communicating with satellites or the International Space Station. Or the application of Software Defined Radios (SDRs) and/or low-cost computer technology – such as the Raspberry Pi and Arduino – to various aspects of Amateur Radio.

Amateur Radio on the International Space Station (ARISS) has done much in this endeavour of engaging with youth. IARU initiatives such as YOTA – Youth on the Air – are gaining traction now after a slow start two or three years ago. The YOTA goal is introducing a new generation to electrotechnology and Amateur Radio – and showing them that science can really be fun.

But for YOTA to work, we need to recruit and support what are best called "YOTA Evangelists" – younger amateurs that can interact and "spread the word" in the context of the language of the already technology-enabled younger generation. This is a "train the trainer" approach that works – some earlier YOTA approaches were not so successful – primarily due to the "generation gap"!

Unfortunately, IARU Region 3 (that includes Australia) had to cancel its international YOTA event last year due to COVID-19, but we are hopeful for this year. It is early days with YOTA, but it is a worthwhile initiative. So, if you or your local club is interested in becoming involved with YOTA, I encourage you to visit the IARU Youth in Amateur Radio website: *www.iaru.org/on-the-air/youth-in-amateur-radio/*

ACMA January 2021 update: The ACMA has just released an "E Bulletin" for January 2021 clarifying the processes the ACMA will follow in future for Amateur Radio in regard to callsigns. The WIA would like to thank the ACMA for considering favourably the proposal from the WIA to remove the Foundation callsign series and implement the "callsign for life". The proposal was a direct result of surveying the Amateur radio cohort and an overwhelming number of existing amateurs endorsed the move; almost 60% of licensees polled were in favour of the changes.

We note with interest for DXers that the old format for our VK9s can be reintroduced, albeit on a voluntary basis. For many years, the various external territories used VK9 with a suffix suggesting the location. The series was abandoned after changes to the callsign structure as it was impossible to implement, the prefixes were: VK9C Cocos, VK9L Lord Howe, VK9N Norfolk, VK9W Willis, VK9X Christmas, VK9M Mellish.

The WIA recommends that future stations operating in these locations follow the old callsign suffix identifier system to help those seeking a contact to identify your location. For more details, see our news item on the WIA website, which includes a link to the ACMA E-Bulletin: *www.wia.org.au/newsevents/news/2021/20210119-1/index.php*

Extract from ACMA Amateur Radio update – January 2021 State/territory identifiers for call signs:

"As part of the July 2020 changes, we clarified operational policy so

Continued on page 4

1 It is a sad fact that not too many years ago, Australia didn't even have a Federal Minister for Science, but thankfully, that situation has been rectified.

Board comment

Continued from page 3

that amateurs can, if they wish, keep their call sign if they gain additional qualifications and/or move interstate.

Our policy is that, when an amateur obtains a call sign for the first time, it will indicate their state/territory of residence, as per the call sign template.

However, this practice, and state/territory identifiers in general, are not regulatory requirements[2].

Our policy represents a long-standing practice, which is consistent with our ITU obligations, and allows amateurs wanting to participate in things like amateur radio hobby competitions (that require state/territory identifiers) to do so.

If amateurs want to enter competitions that require competitors to have call signs indicating their geographical location, they can obtain a new call sign (if required) that has their new state or territory of residence to comply with competition rules."

2 WIA notes that the cessation of the requirement to require your callsign to match your state if you change address is not new. This has been the case since 1994, and follows the 1992 introduction of the Radiocommunications Act and its subordinate legislative documents.

In closing: The WIA today, almost 111 years since it was founded, exists entirely due to the continuing contribution of many volunteers over many generations – consider becoming one of these volunteers and contribute, even in a small way, to the future of the Amateur Radio Service.

We are currently seeking two or three volunteers for our marketing and media group. If you have skills and experience in this area (including social media), or are keen to expand your skills, please let us know. Send expressions of interest to the *NationalOffice@wia.org.au*

73

Greg VK2GPK, WIA President

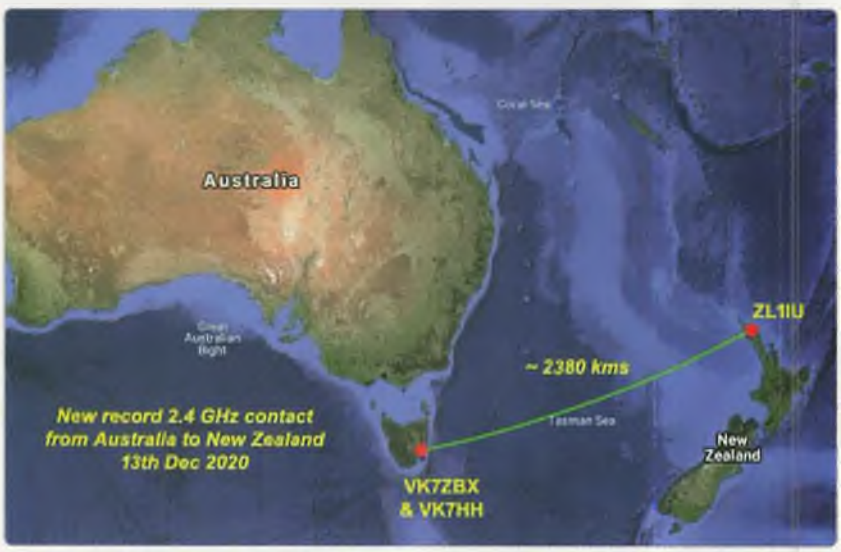
WIA news

New 2380 km VK-ZL record set on 2400 MHz

The Tasman Sea between Australia's east coast and New Zealand's west coast is an area where there are regular tropospheric ducting opportunities. On 13 December 2020, Hayden VK7HH and Richard VK7ZBX, operating portable on an elevated location in Tasmania, made successful SSB contacts with Nick ZL1IU in New Zealand on 144 MHz, 432 MHz and 1296 MHz.

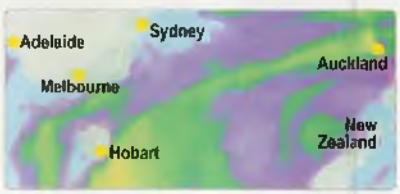
The tropo forecast map from F5LEN, shown here, indicated that the 2000+ km path from Tasmania to New Zealand (yellow-green area) was ripe for exploitation. The contacts on 2m through 23cm demonstrated that the path was open.

The really amazing contact came at 05:58 UTC when successful reports were exchanged between VK7HH and Nick ZL1IU on 2.4 GHz (13cm)! The contact was completed by using CW (Morse code) as the signals were too weak for a voice contact on SSB.



This 2380 km contact was a new Australian tropo record for 2.4 GHz, breaking the previous record by some 60 km, set in January 2011 between Adrian VK4OX and Brian ZL1AVZ. You can watch a video of the contact on VK7HH's YouTube site:

https://youtu.be/G1kiuYii_NA



Arecibo Observatory to be rebuilt after catastrophic collapse

Just a scant few days after our last issue was published, cables holding the 900-ton instrument platform suspended above the dish gave way, bringing about a catastrophic collapse, with the platform plunging the 130+ metres into the precision reflector structure below.

The disaster has prompted a campaign among the wider scientific community to rebuild a new and improved telescope at the site, according to news reports. The Puerto Rican government has already committed US$8 million of seed funding towards rebuilding the observatory.

The US's National Science Foundation (NSF), owner of the observatory, acted quickly to head-off notions that the facility was going to close.

The NSF said "Research involving archived data from the 305-meter telescope will continue and NSF is looking for ways to restore operations with the observatory's other infrastructure as soon as possible, including the 12-meter telescope and LIDAR facilities."

Arecibo was a multi-purpose radio telescope, featuring many unique capabilities. The facility supported a wide range of upper-atmosphere radar-based research as well as radio astronomy. The facility helped NASA characterise near-Earth asteroids using its high-power planetary radar.

Once the world's largest single-dish radio telescope, the Arecibo facility was the site of many key astronomical discoveries over the years, including observations of the spinning stars known as pulsars that led to the 1993 Nobel Prize in Physics. It was awarded to Joseph H. Taylor Jr (K1JT) and Russell A. Hulse (WB2LAV) for their discovery of a new type of pulsar, a discovery that has opened up new possibilities for the study of gravitation.

The NSF continues to investigate the possible cause or causes that led to the catastrophe as staff proceed with cleaning up the site.

Digital Amateur TV: Which. What. Why.

Dale Hughes VK1DSH

Our cover model, Jessica, is amused by the 1928 picture of a woman watching an early homemade experimental mechanical television receiver. The monochrome image provided by that early TV was about 4 cm square, with 48 scan lines refreshed at 7.5 frames per second. It's not digital amateur TV but some intrepid experimenters are still building such mechanical TV systems, often aided by modern electronics to improve the results. (1928 image is public domain, author unknown. Science and Invention magazine, November 1928, Volume 16, Number 7, cover, published by Experimenter Publishing Co., New York, NY).

Editor-in-Chief, Roger Harrison VK2ZRH, challenged me to write a brief introduction to Digital Amateur TV (DATV) for this issue, as the main feature is the design of a DATV station (beginning page 8). The intent of this article is to provide some relevant historical and additional technical information on the topic.

I should add that this article is my interpretation of the current state of DATV technology and associated amateur activities. There may be hotspots of usage and development not known to me, so my apologies for anything that you consider I have missed.

DATV is a very interesting aspect of the amateur service that expands our options . .

ATV

Amateur television is an extension of typical amateur radio activities where pictures and sound are transmitted in amateur bands by licensed amateur operators. Some form of TV or image transmission can be used on most amateur bands; from slow-scan TV (SSTV), which fits within a voice channel on HF, through to different types of high-definition fast-scan TV (FSTV) on bands above 50 MHz.

Amateurs have been experimenting with TV since its very beginning; starting with mechanical scanning systems[1], usually based on a Nipkow disk[2] as shown in Figure 1, but we have moved on since then.

Modern amateur TV probably started with the transmission of normal analog TV signals on UHF and microwave amateur bands using amplitude modulated transmission with bandwidths of 5-8 MHz, later moving to frequency modulation,

1. *https://en.wikipedia.org/wiki/Mechanical_television*
2. *https://hackaday.com/2017/06/28/mechanical-image-acquisition-with-a-nipkow-disc/*

with deviations up to 20 MHz, on amateur bands that are wide enough (e.g. 70cm).

Current amateur analog FSTV practice appears to use FM and the PAL (phase alternating line) colour standard on the bands from 23cm (1240-1300 MHz) and up. Equipment is readily available; e.g. a variety of kits can be purchased from Minikits[3] in South Australia.

Forward ho!

Like many aspects of modern life, there is a trend *towards* digital technology and *away* from existing ("legacy") analog methods. The amateur service has adopted and adapted various digital TV standards for both SSTV and FSTV. There are a number of reasons for this:

1. Digital techniques allow for error detection and correction as well as sophisticated image compression methods so that high quality TV can be received using less transmitter power and narrower bandwidth than required for comparable analog methods.
2. Personal computers have become ubiquitous, powerful and low-cost, so it is very much easier to generate and decode-&-display high quality digital video streams. The processing power of a PC, combined with an inexpensive Software Defined Radio, means virtually any transmission format can be received with the same hardware, which solves many problems.
3. The once large supply of analog TV equipment is 'drying up' and digital TV equipment is becoming more available and cheaper, so it makes sense to use what is more easily acquired, at least for initial activities.

On standards

Noting that there are a number of global digital TV standards[4] with a variety of technical differences (and which continue to evolve), there are two standards that have been widely adopted by amateurs. The key difference between these two DTV standards is the way the information is transmitted:

- **Digital Video Broadcasting - Terrestrial** (DVB-T), uses orthogonal frequency-division multiplexing (OFDM), which is a method of encoding digital data on many closely-spaced carrier frequencies. Each subcarrier is modulated at a low symbol rate using a conventional modulation scheme, such as Quadrature Amplitude Modulation (QAM), or Phase Shift Keying (PSK). The sum of all data rates is similar to a conventional single-carrier modulation scheme in the same bandwidth as the sum of all the sub-carrier bandwidths.
- **Digital Video Broadcasting - Satellite** (DVB-S), uses a single carrier frequency that is modulated at a high symbol rate using some type of digital PSK or QAM; either QPSK, 8-PSK or 16-QAM.

This key difference between DVB-T and DVB-S has implications for amateurs because of the way the 'transport stream' (the video signal) is modulated, i.e. a single modulator is easier to implement compared to multiple modulators and the greater linearity requirements of transmitter power amplifiers when transmitting OFDM compared to a single modulated carrier.

DVB-T used by amateurs is the same as that used by the commercial and state broadcasters, except that amateur bands are used. A number of Australian amateur radio organisations transmit regular DATV programs using DVB-T and have active groups of operators involved in TV activities. See, for example, the Radio and Electronics Association of Southern Tasmania[5] (REAST), the Melbourne Amateur TV Group[6] and the Whyalla Amateur Radio Club[7].

The use of DVB-S seems to be more recent, first appearing in 2017. The British Amateur TV Club[8] has adapted the DVB-S format for amateur use; in particular, the **BATC Portsdowen** DVB-S project, which is very popular. The advantages of this project include that it is modular, uses readily available components, and has a reasonable amount of 'do-it-yourself' construction which is appealing to many technically inclined amateurs.

The *defining feature* of the Portsdown project is its ability to send high quality vision and sound streams in a relatively narrow bandwidth (as little as 300 kHz!), which allows FSTV transmission in bands not traditionally used for amateur TV.

In the UK, Reduced Bandwidth DATV[10] (RB-DATV) is being used (with restrictions or special permission) on their 6m, 4m and 2m bands. This would not be possible if DVB-T or analog TV standards were used. In theory (at least) in Australia, we could transmit RB-DATV signals in amateur spectrum in our bands from 52 MHz and up, though there would need to be some very interesting band-planning discussions.

In summary, DATV is an application used by amateurs to transmit TV images on amateur bands.

It is possible to get on the air using a variety of equipment and transmission formats. DATV is a very interesting aspect of the amateur service that expands our options for communications and technical investigations (as the "official" definition of amateur radio sets out).

Read on and get out your soldering irons!

3. *www.minikits.com.au/electronic-kits/amateur-television*
4. *https://en.wikipedia.org/wiki/Digital_Video_Broadcasting*
5. *www.reast.asn.au/special-interest-groups/amateur-tv/*
6. *www.vk3rtv.com*
7. *www.users.on.net/~jgroffen/WARC/Amateur%20Television.htm*
8. *https://batc.org.uk/*
9. *https://wiki.batc.org.uk/The_Portsdown_Transmitter*
10. *www.nbtv.wyenet.co.uk/*

A Digital Amateur TV station using DVB-S

Dale Hughes VK1DSH

I was fortunate to attend the **Friedrichshafen Ham Fair** in 2018 in Germany. While there, I visited the exhibition stand run by the British Amateur Television Club (*www.batc.org.uk*) and I was intrigued by the Club's display of the **BATC Portsdown project**, a digital amateur television transmitter based on a Raspberry Pi computer and various other hardware.

The system uses the **DVB-S** transmission mode used for satellite-to-Earth TV broadcasting, which has been modified and adapted for terrestrial use by amateur operators. Quadrature Phase Shift Keying is used and various video CODECS, e.g. MPEG-2, MPEG-4 etc, can be selected as required.

A nice feature of the Portsdown design was that it uses readily available components and modules that can be assembled by the station operator; an extensive knowledge of the open-source Linux operating system is not required, as most options can be set from the touch screen featured in the project.

After seeing the project, I joined the BATC on the spot, and over some months acquired the necessary items and built a DVB-S system based on the Portsdown design. The project's software allows operation on amateur bands from 50 MHz and up, though checking the Australian band plans would be a good idea before transmitting.

A big advantage of the Portsdown software is its ability to generate a transport stream that requires a relatively narrow transmission bandwidth. This is done by using a reduced symbol rate and perfectly adequate TV is possible with bandwidths of less than 1 MHz (500 kSymbols/s or less). This article describes my version of the Portsdown transmitter and associated DATV station.

The Portsdown transmitter

This is based on a Raspberry Pi computer that runs a variety of programs to generate, display and transmit a DVB-S transport stream, which can be received by a suitable receiver. The original version of the Portsdown system required a specialised modulator module obtained from the BATC. However, the most recent version of the system supports the **LimeSDR Mini module** in place of the BATC modulator, but the version I built uses the original BATC modulator.

Versions using the LimeSDR device are substantially simpler because the synthesiser, BATC modulator and filters are not required. Figure 1 shows the block diagram of the current version of the Portsdown system. Given the evolutionary nature of the Portsdown project, intending constructors should use the latest version which is currently **Portsdown 4**.

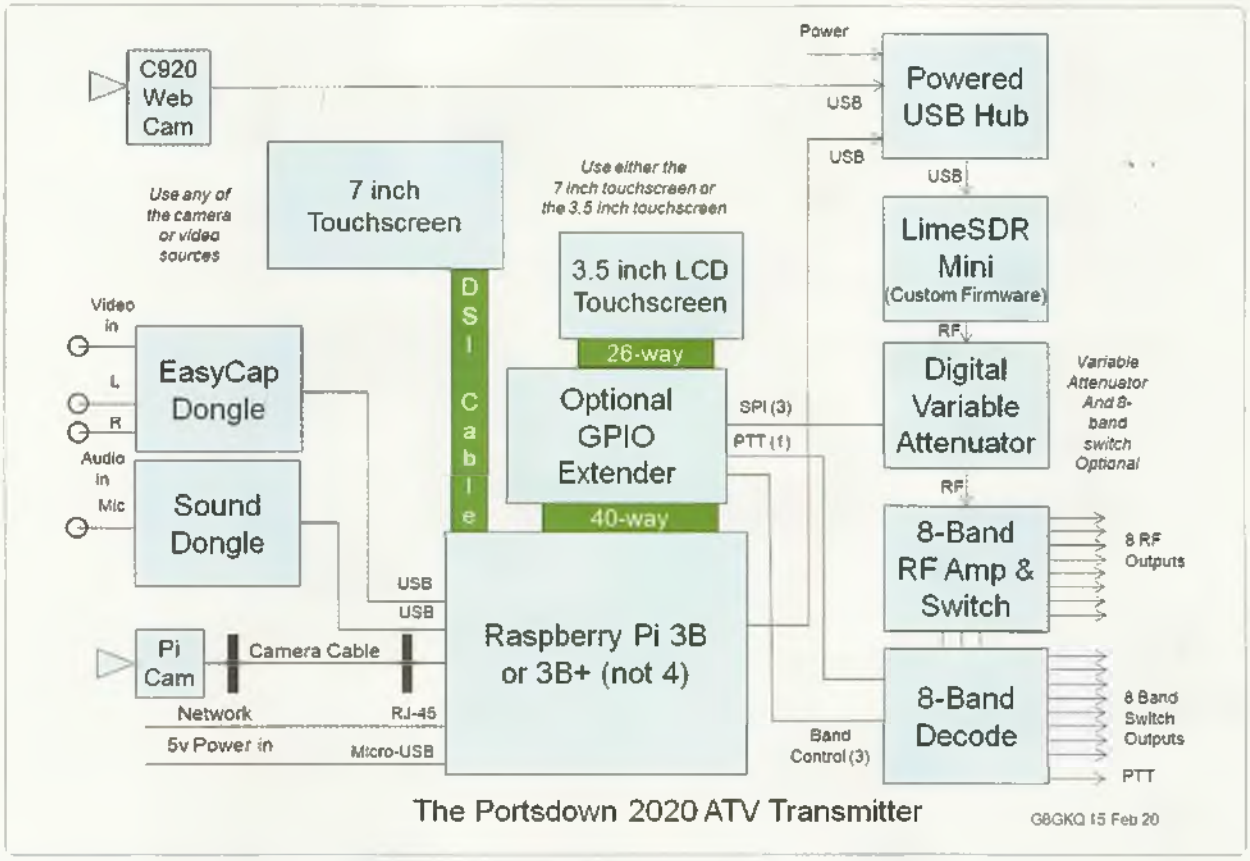


Figure 1: Portsdown 2020 ATV transmitter block diagram (from the BATC website, used with permission).

Figure 2: The VK1DSH DATV station, with the Portsdown transmitter, video switch, DVB-S set-top box and preview display on the right-hand side, then the MiniTiouner PC and second PC VGA display on the left-hand side. The centre contains a small TV camera, audio mixer and microphone. The preview monitor is a 7-inch truck-reversing monitor, which has analogue video inputs.

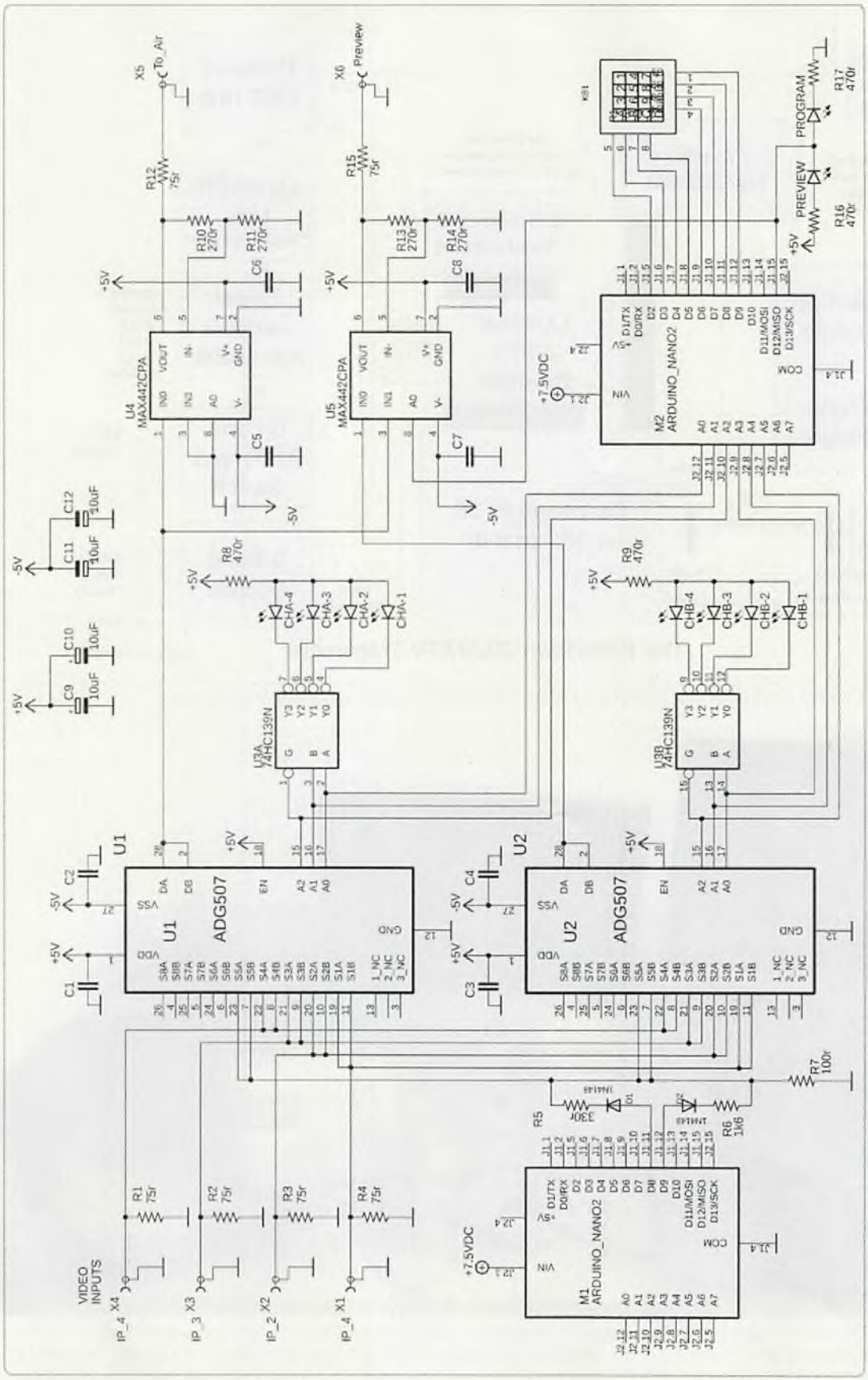


Figure 4: The video switch schematic diagram. Note that the +/- 5 Vdc and 7.5 Vdc supplies are not shown as they can be generated simply in a variety of different ways. Arduino M1 is the video test frame generator, while M2 controls the switch.

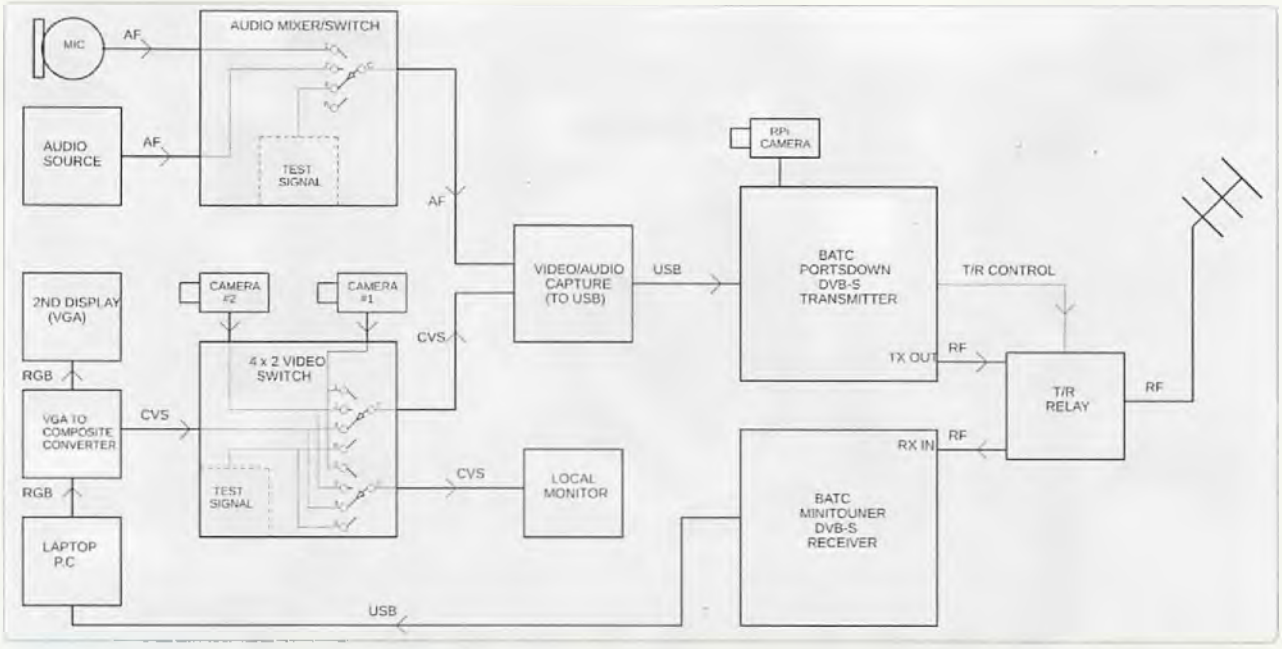


Figure 3: The DATV station layout at VK1DSH.

My Portsdown transmitter can be seen in Figure 2, the hardware was built into a 2U high rack enclosure which contains the Raspberry Pi computer, a touch screen, the PLL frequency synthesiser, modulator, transmitter power amplifiers and various filters; the transmitter operates on the 70 cm and 23 cm bands where there are a number of frequency ranges designated for amateur TV use.

Power linear amplifier modules for both bands are available from **Minikits**. These were used in the

Figure 5: The MiniTiouner receiver module. The receiver has two separate RF inputs and connects to the host PC through a USB connection.

Figure 6: The MiniTioune software display on a PC screen. The test pattern is generated by the Portsdown software.

transmitter. Amplifier linearity is very important for DVB-S signals and it was found that each amplifier module could only be operated at a fraction of the rated output power before there was unacceptable distortion of the video signal. The 23cm transmitter runs at approximately 5 W out, while the 70 cm transmitter runs at approximately 20 W out. In both cases, this is about 30% of the rated peak envelope output power.

Station configuration

While the Portsdown transmitter is a complete solution, it was interesting to build a more elaborate system that allowed a wider variety of program inputs. Figure 3 shows the current VK1DSH station layout. Composite video streams and audio signals from a variety of sources can be switched into the input of the Portsdown transmitter for transmission.

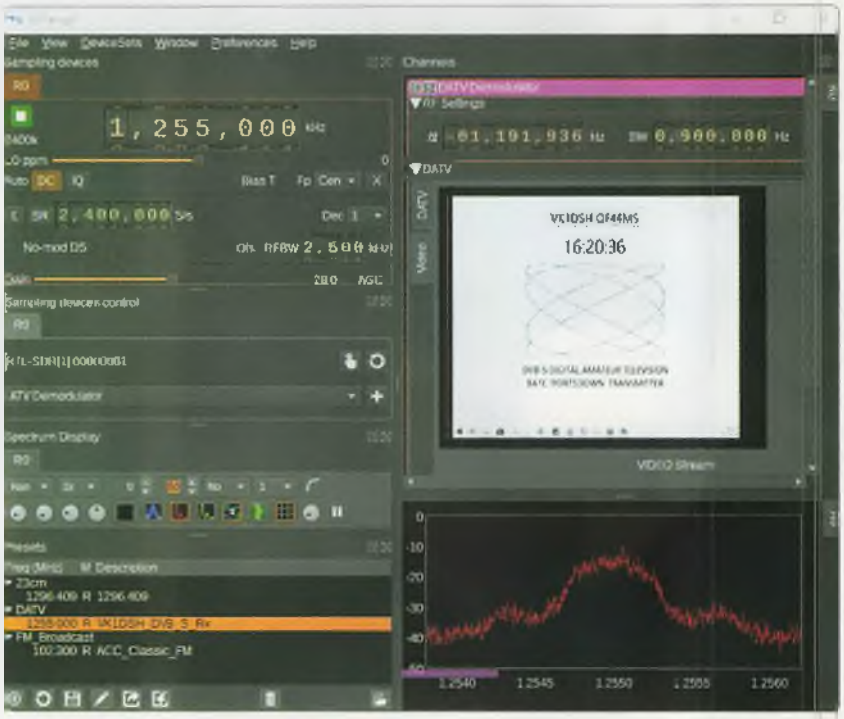


Figure 7: The SDRangel screenshot, showing a transmitted image of the PC VGA screen output.

Figure 8: A small satellite set-top box and TV monitor. The total cost was about $60. The receiver operates from 12 Vdc and appears to be designed for use in caravans and motor vehicles, but is limited to reception of standard DVB-S signals, rather than amateur reduced-bandwidth signals.

Live video from a number of cameras can be selected, or images from a PC VGA monitor can be transmitted. Images from the PC monitor are converted to composite video by a low-cost VGA-to-composite converter (**Jaycar XC4907**). This allows presentations from the PC to be transmitted, if desired. Converters also exist for other PC monitor types if VGA is not available or suitable for the intended use. There are a number of options for receiving signals from the other stations, depending on the symbol rate being used at the time.

Video switching

In its basic form, the Portsdown transmitter can transmit a test card, some animated images, video from a Raspberry Pi camera, or images converted from a composite video source via a USB video capture dongle. For testing and initial use, the built-in test card and Raspberry Pi camera are completely adequate. But being able to make more interesting 'programs' was something I wanted to try and that required some sort of video switch to select a video stream.

Building a simple video switch was an interesting project in itself. The switch has four video inputs and an inbuilt test source that provides a basic video frame for testing the system. The switch also provides the capability of previewing video streams while another video

stream is being transmitted, which is a useful function. Of course, switches and signal sources can be purchased but it was more fun to design and build them.

The schematic diagram of the video switch is shown in Figure 4 and it can be seen that there are two more-or-less identical paths for the video signals. One path through switch U1 selects the video source going to the program output, while the second path through U2 selects the preview output which goes to a separate video monitor.

The preview channel can also be connected to the program output if desired. Arduino module M2 interfaces to a 4 x 4 matrix keyboard that allows the operator to select the wanted program and preview inputs and the selected input are shown on Light Emitting Diodes driven by a dual 2-to-4 line decoder, a 74HC139 (U3). A decoder was used instead of output ports on the Arduino as it simplified the construction of the switch and minimised the number of Arduino I/O lines required.

Note that the switch was built on Vero board using various components I had on hand and there are many ways and other components that can achieve the same results. Hence, there is plenty of opportunity for experimentation.

The video test source is built using an Arduino Nano (M1), which generates a low resolution black and white video frame with station details in fairly 'chunky' text; it was surprising that the Arduino could generate the video signal but it produces an acceptable result. There are only two outputs used on Arduino M1 – one is the horizontal and vertical synchronising pulse output (D9), while the other is the image pixel output (D8).

The two outputs are combined using two diodes and resistors, with the resistor values selected to give more-or-less the correct amplitude for each part of the video waveform. See the GitHub page called **Arduino-TVout for Video Experimenter** for further details of hardware and software of the video source.

Note that video source switching is not synchronised with the incoming video frames because none of the input sources are synchronised, so there is a momentary flicker on the screen when switching sources; for now, that is acceptable. The selected video output goes to the video capture dongle of the Portsdown transmitter and the video stream is converted to DVB-S format for transmission.

Audio input

The audio source for the TV program passes through a home-made audio mixer. A microphone, line level input, or a built-in test source can be selected as inputs. The test source is another Arduino Nano microcontroller that generates a 'beep' every second and transmits the station callsign in Morse code every minute or so.

Surprisingly, the audio aspects of the station gave the most amount of trouble during development of the station. Earth loops and interference from the various digital circuitry was hard to eliminate. Using balanced low-level audio lines, isolation transformers, good screening of signal cables, and low resistance earthing solved the problem.

The program audio stream is digitised by the same video capture dongle that processes the video stream. Owing to the basic nature of the audio circuitry, no further details are provided in this article. Again, it's another area for you to be creative!

Receivers

There are various options for receiving the DVB-S transmissions. The **BATC MiniTiouner** receiver and associated **MiniTioune software** is the most flexible option as it allows reception over the 143 – 2450 MHz frequency range with almost no restrictions on symbol rate, so it works perfectly well with standard DVB-S broadcast signals as well as reduced bandwidth amateur signals.

The receiver has dual RF inputs, which is useful for operating on different bands or with different antennas, and it appears to be a reasonably sensitive receiver. The specialised components can be purchased directly from the **BATC online shop** (if you are a BATC member) and the remaining components are readily available from the usual suppliers. The MiniTiouner receiver connects to a standard PC via a USB connection. The DATV video images and diagnostic information are shown on the PC screen (see Figure 6).

Another receiver option is the **SDRangel** software and a suitable SDR receiver module; see the references to SDRangel on the **RTL-SDR.COM** website for more details and links to download the application.

A low-cost **RTL SDR dongle** is suitable for reception of reduced bandwidth amateur DVB-S transmissions and they work very well. Along with RTL dongles, the SDRangel software supports a variety of other SDR hardware (including the **LimeSDR** , **ADALM-PLUTO**, and others), which offer a wider reception frequency range, a wider receive bandwidth, and therefore reception of a wider range of symbol rates, as well as the ability to operate as a transmitter (though not DVB-S, at present).

For testing and general QSO usage, this approach is a simple and low-cost option (see Figure 7). The **Signals Everywhere You Tube** channel has some interesting tutorials about using SDRangel with a variety of different SDR hardware.

A standard DVB-S satellite set-top box can be used for reception of 2000 kSymbols/s transmissions, which may be useful for initial system testing, or if high symbol rate usage is anticipated. If this option is chosen, make sure that the set-top box covers the frequency range around 1255 MHz and will handle the DVB-S mode. A variety of units are available, some of which operate from a 12 Vdc supply, which is convenient for portable operation (see Figure 8).

Other DATV options

While I chose to use the BATC Portsdown design, there are other options that require less construction through the use of SDR techniques for transmission and reception of DATV signals. My co-experimenter, Jim VK1AT, uses a Windows PC, ADALM-Pluto Card (or LimeSDR), **DATV-Express** Transmit Software for transmission, and SDRangel software for reception. A **GALI-84 driver amplifier** and linear amplifier from Minikits completes the transmit chain. The BATC website provides much information about **getting started with DATV** and a useful summary of the various ways of **generating DVB S signals**.

Conclusion

Digital amateur TV is an interesting aspect of amateur radio, and is a technically interesting and challenging subject to explore.

There is a variety of hardware and software solutions to transmit and receive DATV DVB-S signals; the option of reduced bandwidth modes means it makes good use of the spectrum we have available. Source code for the Arduino modules described above is available on request from the author. The author thanks Jim VK1AT for his participation in the experiments, DVB-S QSOs and review of this article.

Links

The bold text throughout the article signifies a URL for the topic (correct as at January 2021).

Friedrichshafen Ham Fair
https://www.hamradio-friedrichshafen.de/

British Amateur Television Club
https://batc.org.uk/

BATC Portsdown project
https://wiki.batc.org.uk/The_Portsdown_Transmitter

DVB-S
*https://en.wikipedia.org/wiki/DVB-S_*

LimeSDR Mini module
https://limemicro.com/products/boards

Portsdown 4
https://wiki.batc.org.uk/Portsdown_4

Minikits
https://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-high-power

Jaycar XC4907
[Search product XC4907]

Arduino-TVout for Video Experimenter
https://github.com/nootropicdesign/arduino-tvout-ve

BATC MiniTiouner
https://wiki.batc.org.uk/MiniTioune__

MiniTioune software
https://wiki.batc.org.uk/MiniTioune#Software

BATC online shop
https://batc.org.uk/shop/

SDRangel
https://github.com/f4exb/sdrangel

RTL-SDR.com
https://www.rtl-sdr.com/?s=sdrangel

RTL SDR dongle
https://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/

LimeSDR
https://limemicro.com/products/boards

ADALM-PLUTO
https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/adalm-pluto.html

Signals Everywhere You Tube
https://www.youtube.com/channel/UCGvakD8eB8Asnz8ETmQBlVw

DATV-Express
https://www.datv-express.com/Home/About

GALI-84 driver amplifier
https://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-wideband/Gali-84-Amplifier

Getting started with DATV
https://wiki.batc.org.uk/Getting_Started

Generating DVB-S signals
https://wiki.batc.org.uk/DATV_transmitting_Equipment

How I stubbed my allegorical toe on a digital amateur TV rig and finally found "my path" in amateur radio – you can, too

Roger Jordan VK5YYY

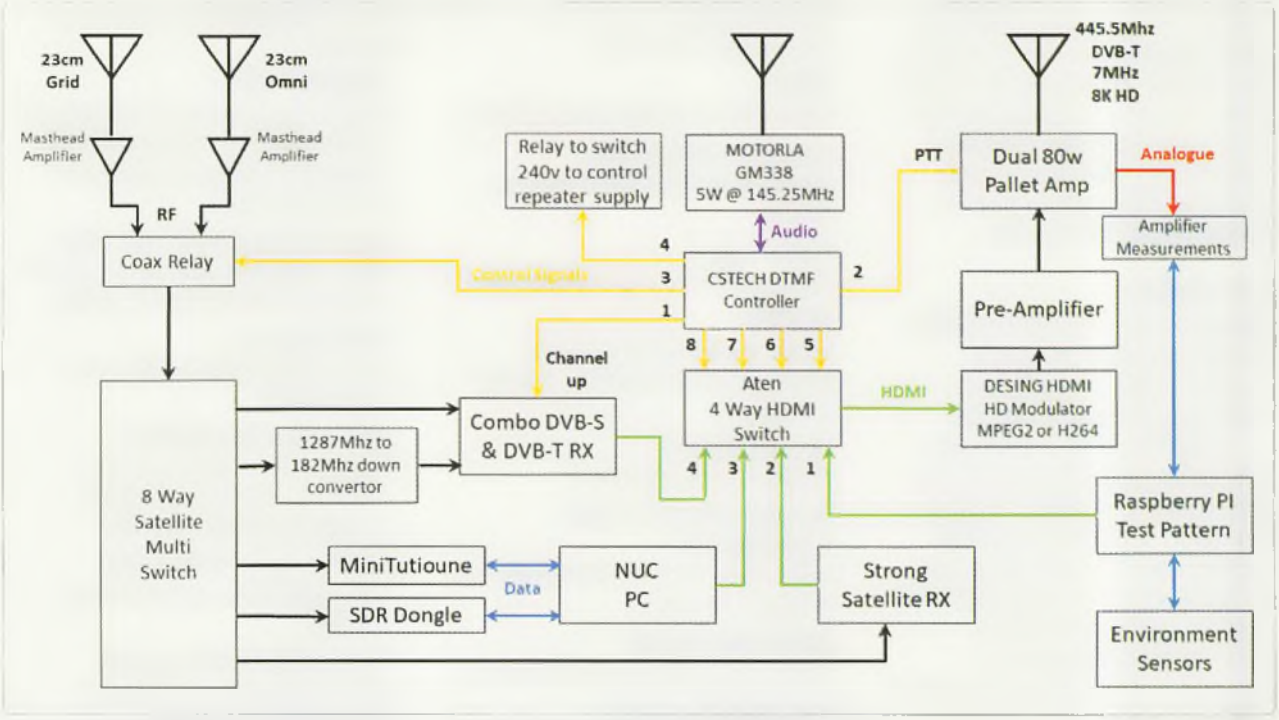


Figure 1: Block diagram detailing the present configuration of the VK5DRC ATV repeater.

Our local amateur television (ATV) repeater, VK5RDC, was pioneered by David VK5DMC around 2012. It had standard definition 23cm DVB-S input and 70cm DVB-T output, covering Port Pirie and Whyalla. It was configured along the lines of that widely respected, legendary ATV repeater in Melbourne – VK3RTV – which led the way at the time (indeed, for many years). Having been licensed myself for years and done extraordinarily little operating, I saw ATV as a great opportunity to get back on the air.

Lots of effort and smoke have pushed the boundaries in VK for this incredibly fascinating hobby. Figure 1 shows the 5th Generation VK5RDC.

Inputs include DVB-T, DVB-S/S2 [MPEG2/4 standard definition (SD) and high definition (HD)], and reduced bandwidth. With the aid of the NUC PC ('Next Unit of Computing', a small-form-factor barebones PC), and an RTL dongle, our DVB spectrum can be displayed as a diagnostic tool.

Bevan VK5BD has enhanced the VK5RDC test pattern, shown in Figure 2, to include real time measurements, including: power, temperatures, VSWR, and a talking-head to annunciate repeater parameters. Check it out via this link: *http://skyvisionsa.com.au/vk5rdc/*. For real-time data, click on the boxes.

DATV of old comprised an SR-Systems DVB-S 23cm composite video modulator with a camera or PC input. The setup was completed by a Humax (of gold card fame) DVB-S receiver, 23cm antenna and preamplifier at the repeater. There was also a test card generated by a Raspberry Pi for station identification (ID). The inputs and control were switched by DTMF (dual tone multi frequency) tones on a 2m 'control channel'.

The repeater's magic was the DVB-T Standard Definition (SD) modulator tuned to 446.5 MHz, with 7 MHz bandwidth below 0 dBm. DVB-T amplification is complex. Class A/AB amplification on the order of 50 dB is required. This process can be the source of much

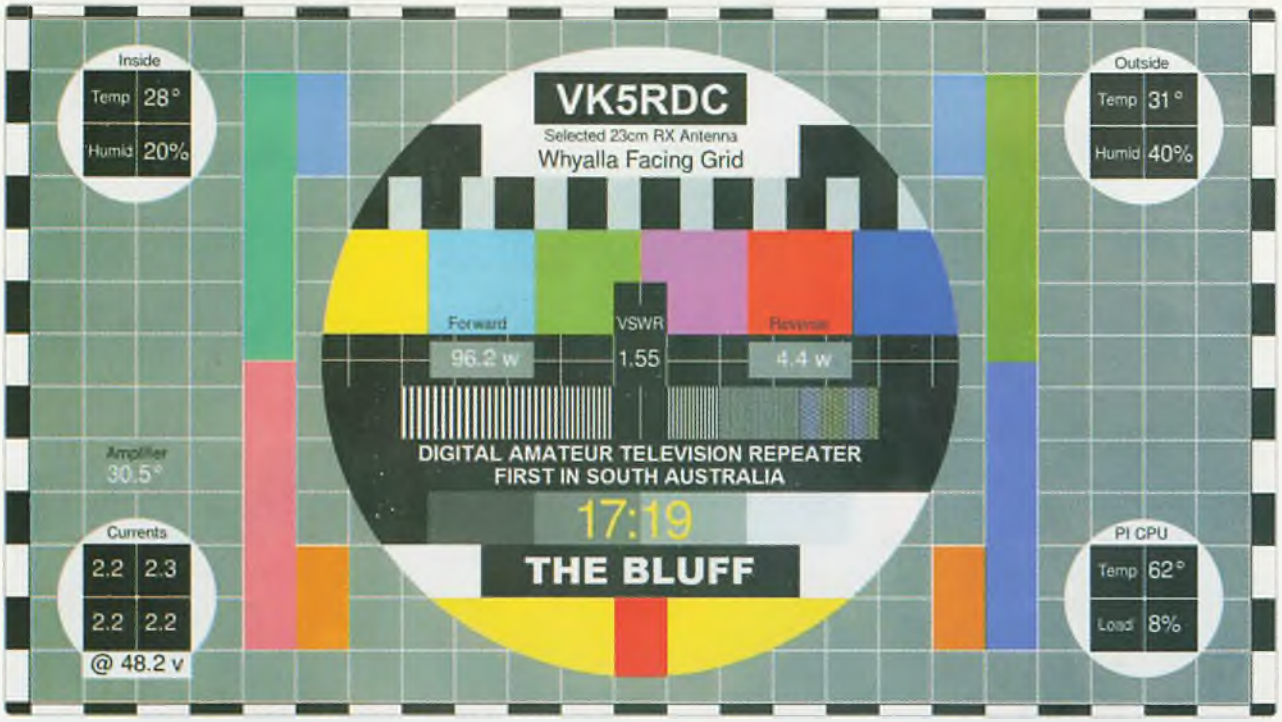


Figure 2: The test DATV pattern developed by Bevan VK5BD who, just quietly, produces and broadcasts the video edition of the weekly WIA News.

Figure 3: The ultra-QRP Portsdownunder rig.

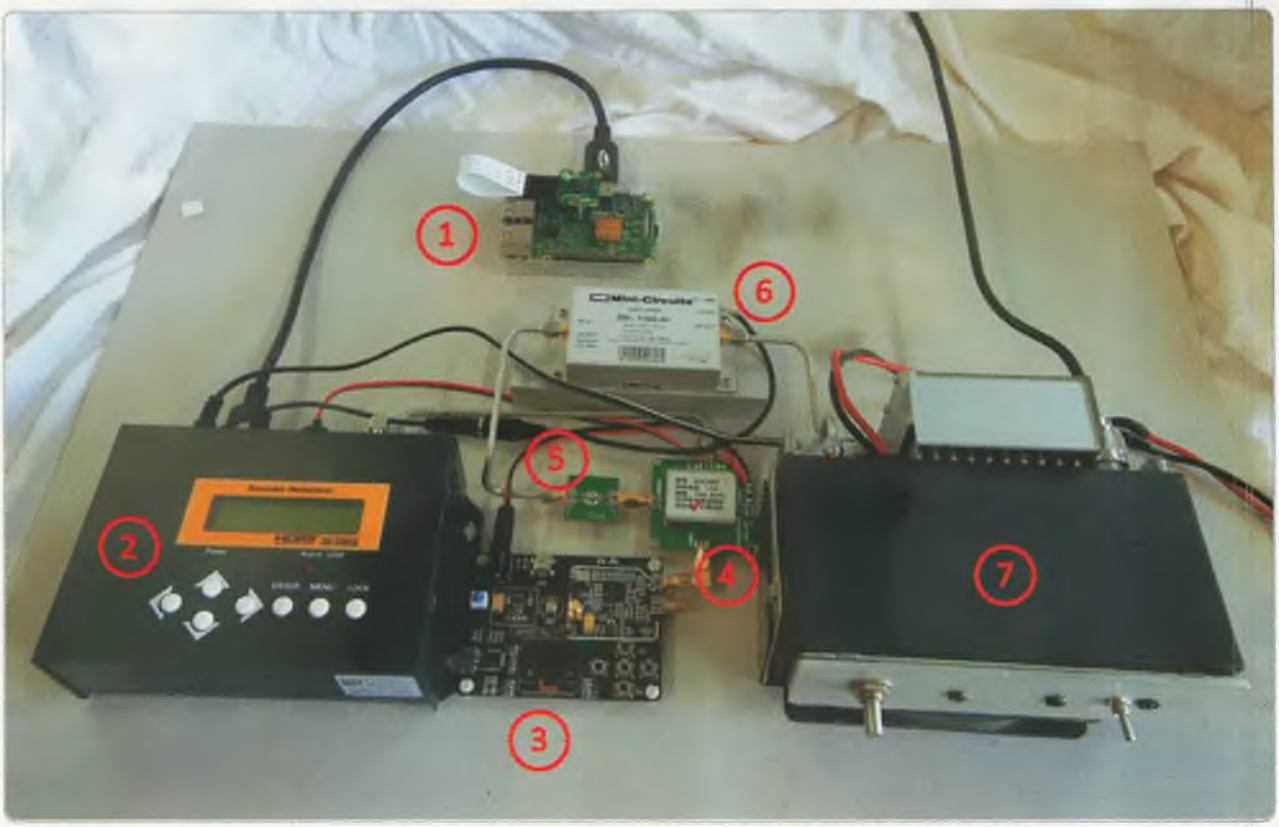


Figure 4: A modular roll-your-own rig. 1 – Raspberry PI video source. 2 – DVB-T modulator. 3 – Local oscillator. 4 – Active mixer. 5 – Filter. 6 – Preamplifier. 7 – Power amplifier.

grief and the occasional 'please explain' from the ACMA when our neighbours in the 450 MHz region get grumpy. Filters help.

Sympathy is required for the commercial users above 450 MHz if our 'skirts' (intermodulation noise) are too high. Class A/AB amplifiers with low efficiency requires air conditioning and engenders high power bills. VK5RDC's output antenna is horizontal, in line with local broadcast TV transmission polarity. Some TV receivers and set-top boxes tune to 445.5 MHz, which is the new lower frequency for ATV, with 'guard band'. This allows some reception for viewers in the prime reception area with a regular TV installation.

To get started, Bevan VK5BD and I first used old DVB-S broadcast equipment sourced via eBay. The "Digilite", then "Portsdownunder" followed, which is a Raspberry Pi-based DVB-S transmitter. Figure 3 shows the Portsdownunder making an ultra-QRP, battery-powered contact to VK5RDC over a 55 km path. With a little more power, Alex VK5ALX and I had a 95 km contact to Wayne VK5BI portable at Gulnare.

Broadcasting from the VHF-UHF field days at Iron Knob to our repeater is our local record: 105 km. I'm sure that could be smashed by three or four times with favourable conditions. In 'the good books', 23cm DATV is 'line of sight'. Hills merely provide a challenge for the likes of Alex VK5ALX, who just turns up the wick and gets his signal through. It can be done.

DIY verses commercial products

I recommend the DIY approach if you want to learn. The British Amateur Television Club (BATC) sells kits to members off its website. In addition, Minikits here in South Australia is a good source of up/down converters and amplifiers. Then there is the 'roll you own', as illustrated.

For the more technically challenged, manufacturer Dexing has a good range of DVB-T and S encoder/modulators. I used its low-cost HDMI (High Definition Multimedia Interface) unit in the Figure 4 rig, while the Blauhaus-branded unit is much the same for <$300. A top of the range DVB-T HDMI modulator is around $1500, which has a clean 42 Modulation Error Ratio. DVB-S2 HD modulators are typically >$5K. HiDes (pronounced "hi dez") provides a range of DVB-T equipment. They have transmit and receive units with selectable bandwidths available. I've never used HiDes so I can't really comment.

Buying DVB-S ex-broadcast equipment from eBay is an interesting exercise. In the broadcasting world, they have

separate encoders and modulators. Studio cameras produce Serial Digital Interface (SDI), which is uncompressed digital video that is then encoded to MPEG format. Once compressed into MPEG2, or these days MPEG4, it arrives at the modulator in Asynchronous Serial Interface (ASI) format.

Simply put, ASI and SDI are signals transmitted over 75 ohm cable between buildings and studios. Going this route is an eye opener, but works well as the equipment is of high broadcast quality.

DVB-S broadcast modulators may require an upconverter as they often have a 70 MHz IF output. A cheap encoder and modulator with upconverter will set you back somewhere around $500. You also need a SDI-to-HDMI converter and I recommend old school black-magic HDMI-to-SDI converters for around $100.

With the advent in Australia of DVB-T input and output repeaters, the cost of participation is decreasing. A low-cost DVB-T modulator can be upconverted to 23cm and above. QSOs can be made with only milliwatts of power

Figure 5: Another modular approach. 1 – Local Oscillator 2 – Active mixer down conversion 3 – Strong DVB-T set-top box. 4 – Celebratory coffee! 5 – TV watching comfort food.

and a good antenna with line-of-sight paths, and one watt will easily span 50 km. Whyalla, a small city, can be mostly covered on 70cm with one watt and a three-element Yagi antenna.

Amplifiers

Mitsubishi modules are commonly used for drivers and PAs, biased to maximum for clean output. I use a re-purposed solar inverter heatsink and a fan from an old Kenwood radio (slightly modified). NB: Minikits no longer stock 23cm Mitsubishi modules. I procure mine via eBay (caveat emptor!). About two watts of clean DVB-T is all you can expect from the 23cm module, and about double on DVB-S.

Amplifying digital signals is different to amplifying FM and SSB. DVB-T is a complex signal with up to 8000 sub-carriers, which is a potential recipe for disaster. Spectral regrowth, intermodulation noise, skirts, call it what you will, highly linear Class A/AB amplifiers are required. The Spectrum gods will protest unless you derate your amplifier by around 10 dB from analogue levels.

DVB-S is not so bad, but "bow waves/skirts" will start to appear when amplifiers are over-driven. Push-pull amplifiers are a good way to go, and a good heatsink and power supply will be your best friends. For levels below 0 dBm, things are not that demanding, so you've been warned. Also, matching stages is everything; reflected power in the system is trouble waiting to happen.

Boxes and receivers

The Strong brand of DVB-T set-top box is upgradable to 445.5 MHz with a USB software upgrade. Strong has always been supportive to the DATV community. However, not all manufacturers are of the same mindset. With random TVs and set-top boxes, try before you buy, or get a confirmation from the supplier that the device you are considering is suitable. RTL dongles also make good DVB-T receivers. The brand HiDes manufactures them as well. Down converters into the set-top box can be easily built for the higher bands (Figure 5).

It's hard to go past Strong's DVB-S/S2 boxes as well, although most boxes work fine for 23cm receive. Some boxes can go down to 1 Megasymbol, or 2 Msym at the lowest. Msysm relates to the channel bandwidth. We need one or two channels for DATV, whereas Foxtel uses around 30 Msym to squeeze all its programming into a small space.

As a rule of thumb, one SD channel takes around 3 Msym, and HD 5-8 Msym. These numbers vary, depending on the codec. MPEG2 is about half as efficient as MPEG4. Low-cost DVB-T/DVB-S combo set-top boxes on eBay are also available, but it's a moving target. They might look the same, but there seems to be two or three versions in the same housing. Again, buyer beware.

Antennas

Antennas for 23cm come in a few flavours. I am a BBQ grid dish man myself (search VKlogger VK5YYY). Inspired by VK4APN's logger post showing a KBT grid, I have made over 10 based on that picture. Dish feeds are wideband and easy to make from a converted Austar or TP-Link Grid (aka gridpack) antenna. Gain is somewhere around 17-18 dBi, and pinpoint pointing accuracy is not required.

Others use Yagis. Then there are panels, whips and Bi-Quads, all of which have lower gain than grid pack antennas. For testing on the bench, we've use quarter wave ground planes and dipoles made from hard-line coax. It is hard to go past Minikits 23 cm preamps if you need more receiver gain.

A customised antenna to receive 70 cm may not be required. A regular commercial TV antenna may be fine if the signal path is reasonable. I have had good success with 450-470 MHz Yagis locally made by RFI. For a DIY preamp, I suggest a Minikits 70cm PGA-103-based unit, or similar. Kingray has a couple of amplifiers in their range that do 445.5 MHz, but most of their products have filtering to block out the commercial PMR band and consequently DATV.

Operating

If you decide to build a DATV station, I suggest a spectrum analyser (or access to one), or at least an RTL dongle as essential pieces of equipment. Being able to measure Modulation Error Ratio/Signal to Noise/Skirts is an advantage. LESS is MORE. i.e. a more spectrally pure signal will achieve far more than an overdriven, higher power transmission. DATV has the advantage of Error Correction, which helps in fringe reception (weak signal) situations.

There are many innovations in DATV. Full HD was pioneered on VK5RDC, first with DVB-S. Now, most operators are transmitting HD DVB-T into the repeater, which is quite cost-effective.

Sydney's VK2RTS repeater has followed, fostered by John VK2ATU, using architecture based on that illustrated in Figure 4.

Whether it be a QSO or presenting a program, DATV can be extremely rewarding. Many lectures can be rebroadcast by simply seeking the author's permission and giving credit. Don't forget the video edition of the WIA broadcast, kindly produced by Bevan VK5BD. Downloading it using the freeware 4K video downloader removes adverts from YouTube. Also, Justin VK7TW presents 'Digital Amateur TV Experimenters Night' on YouTube most Wednesday nights.

If you become a DATV operator, you might consider VMIX or OBS freeware for your PC. Your PC's second-screen output is used to broadcast the picture, while the first screen is for control. You can try green screen and ticker tapes for announcements, such as your club activities. Broadcasts can be streamed through the BATC's

streamer service. See *https://batc.org.uk/live/*

Activities

While QSOs are the basic form of amateur television, more is possible. Locally, our club has broadcast meetings, which is great for members who are ill or out of town. Field days and International Lighthouse Lightship Weekends (ILLW) have been broadcast and small videos produced. There are no excuses, most of us have a video camera in our pocket these days!

Peter VK3BFG held a well-attended ATV QSO party earlier last year. Local operators broadcast short segments from VK2, VK3, VK5, and VK7. Everyone used their local repeater and afterwards the Americans joined in. All the sites were linked using Zoom.

Mark VK5QI launched a high-altitude balloon recently with local amateurs tracking it using software he developed. Alex VK5ALX broadcast the live tracking updates on ATV and Steve VK5MSD made a video of tracking the balloon next day for recovery, which was then presented on-air. Great fun for all.

VK5QI plans to launch another balloon soon having a camera and DVB-S 445.5 MHz transmitter payload. The video downlink will be reduced bandwidth 1 Msym and receivable using an RTL dongle.

Clever freeware 'Lean DVB' (lean as in lean meat) can be used to receive these exciting transmissions. Alternatively, the F6DPZ Minitutiouner is a highly specialised DVB-S/S2 receiver built for the extremes. Narrow bandwidth signals increase the coverage area, bandwidths below 100 kHz are possible.

Amateur Radio on the International Space Station (ARISS) had amateur DATV up until 2018.

Martin VK6MJ, Tony VK5ZAI, Joe VK5EI, and Shane VK4KHZ made ground stations for video hook-ups to schools with the ISS astronauts (many of whom are licensed amateurs), but their efforts were dashed by equipment failure. Let's hope some replacement equipment is sent to the ISS so kids can benefit from space contacts.

The future

In the future, reduced bandwidth television will push Shannon's Limit (the theoretical boundary). Reception below the noise floor may become common as compression codecs are getting better. How about sporadic E QRP DX with reduced bandwidth DATV on six metres? Move over slow scan.

I see a future where repeaters

Photo 6: My 'compleat' DATV station, with coffee, cake and re-purposed backpack antenna.

could be linked for wide area access via the internet, like IRLP. I also hope for a library of Australian amateur video material and standardised packet identifier values.

If you need any convincing that DATV is cool, try Raspberry Pi 'UGLY DVB-S' straight out of a GPIO pin. Yes, an old Raspberry Pi can generate a harmonic ridden DVB-S signal for $50 (not to be broadcast!). Treat yourself to this experiment if you want a true jaw-dropping moment. Clever British and French amateurs have done so much with so little. Check out *https://wiki.batc.org.uk/DATV_transmitting_Equipment#Portsdown_Ugly_Mode*

For Amateur Radio to survive, it needs to have relevance to those that join our ranks. Think carefully about the future of our precious service and the younger generations to come. I've never operated HF. While that might sadden some, I look to the future with intrigue. What next? It's almost 100 years since John Logie Baird played with TV, so get into it, and above all, have fun!

If you wish to contact me to discuss this topic further, do so at: *roger@skyvisionsa.com.au*

About the Author

Roger has always been intrigued with radio and started a community FM radio station, 5YYY, at age 19. He studied electrical and electronics technology, which lead to an interest in satellite TV after a visit to the USA. He has been involved with amateur radio since the mid-1990s. He started SkyVision SA in 2000, selling and supporting TV, satellite, and commercial radio communications equipment.

AMSAT-VK

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Paul Paradigm VK2TXT
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Group Moderator
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email: ***secretary@amsat-vk.org***

Website:
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Group site:
group.amsat-vk.org

About AMSAT-VK

AMSAT-VK is a group of Australian amateur radio operators who share a common interest in building, launching and communicating with each other through non-commercial amateur radio satellites. Many of our members also have an interest in other space based communications, including listening to and communicating with the International Space Station, Earth-Moon-Earth (EME), monitoring weather (WX) satellites and other spacecraft. AMSAT-VK is the primary point of contact for those interested in becoming involved in amateur radio satellite operations. If you are interested in learning more about satellite operations or just wish to become a member of AMSAT-Australia, please see our website.

AMSAT-VK monthly net

Australian National Satellite net

The Australian National Satellite Net is held on the second Tuesday of the month (except January) at 8.30 pm eastern, that's either 9.30 or 10.30Z depending on daylight saving. Please note we will be taking check-ins from 8.20pm-ish. Check-in starts 10 minutes prior to the start time. The AMSAT-VK net has been running for many years with the aim of allowing amateur radio operators who are operating or have an interest in working in the satellite mode, to make contact with others in order to share their experiences and to catch up on pertinent news. The format also facilitates other aspects like making 'skeds' and for a general 'off-bird' chat. Operators may join the net via EchoLink by connecting to either the *AMSAT* or *VK3JED* conferences. Past experience has shown that the VK3JED server offers clearer audio. The net is also available via IRLP reflector number 9558. In addition to the EchoLink conference, the net will also be available via RF on the following repeaters and links.

In New South Wales
VK2RBM Blue Mountains repeater on 147.050 MHz

In Queensland
VK4RRC Redcliffe 146.925 MHz -ve offset IRLP node 6404 EchoLink 44666

In South Australia
VK5TRM, Loxton on 147.175 MHz
VK5RSC, Mt Terrible on 439.825 MHz IRLP node 6278,
EchoLink node 399996

In Tasmania
VK7RTV 2 m. Repeater Stowport 146.775 MHz. IRLP 6616

In the Northern Territory
VK8MA, Katherine on 146.750, CTCSS 91.5, IRLP Node 6800

We are keen to have the net carried by other EchoLink or IRLP enabled repeaters and links in order to improve coverage. If you are interested in carrying our net on your system, please contact Paul via email. Frequencies and nodes can change without much notice. Details are put on the AMSAT-VK group site.

Become involved

Amateur satellite operating is one of the most interesting and rewarding modes in our hobby. The birds are relatively easy to access and require very little hardware investment to get started. You can gain access to the FM 'repeaters in the sky' with just a dual band handheld operating on 2 m and 70 cm. These easy-to-use and popular FM satellites will give hams national communications and handheld access into New Zealand at various times through the day and night. Currently only SO-50 is available.

Should you wish to join AMSAT-VK, details are available on the web site or sign-up at our group site as above. Membership is free and you will be made very welcome.

A vertical beam for 7 MHz in suburbia

Dr David 'Doc' Wescombe-Down DScEd PhD VK5BUG

I live and operate in an Australian capital city, on an inner suburban block 1150 m² in area, which includes a backyard that's nearly 19 metres wide. Our large, six bedroom, 90 year-old dwelling, plus workshop shed, aviary, chicken run, and intensive home-grown organic vegetable garden with 11 fruit trees, have each progressively filled the backyard over time.

Photo 1: David 'Doc' Wescombe-Down VK5BUG.

During the past decade, this 'compact' arrangement has encouraged me to design, build and trial a generation of 'Big Bore', helically-wound antennas for use on the 2200m (136 kHz) through 40m (7 MHz) bands.

In my context, 'Big Bore' means antenna masts comprising a PVC former of 75-150 mm diameter (three

Photo 2: Winding of both parasitic elements placed on sawhorses.

Photo 3: PVC pipe element extensions prior to painting.

Photo 4: Close-up of two parasitic elements, showing the windings and Gaffer tape wrap with zip-tie.

to six inches) at local council-compliant heights of up to 10 metres. Each has used wide-spaced insulated-turn spacings from 12 mm to 50 mm, providing 1.5:1 SWR bandwidths of 15 – 250 kHz. They are 'quiet listeners' and one-person construction projects.

Earlier LF-MF versions for the 2200m, 630m (475 kHz) and 160m (1.8 MHz) bands have been well-documented in my 2016-2020 trilogy of low band amateur radio books (including Ref. 1, pp 113-131, 160, 180-187) and remain in operation today.

Working through the 2020 Covid-19 restrictions and inspired by Callum McCormick M0MCX (Ref. 2), I modified my Big Bore physicality and experimented with a dual-element (reflector and radiator), 40m vertical parasitic array (VPA) oriented 10 degrees North of East across our backyard.

During Phase 1 of my endeavours, the radiator was a long-standing, base-tuned 40m-20m alloy tubing, ground-mounted vertical, while the reflector was a helically-wound telescopic fibreglass fishing pole; I spaced the two verticals six metres apart. I immediately noted a reception benefit of about 4 dB to 6 dB greater than pre-Phase 1 path observations, based upon the calibrated meter in my Yaesu FT-902D rig.

I experimental Phase 2 activities, I added a companion director element which was similarly constructed and spaced. Reception enhancement was noted to be more like 6 dB to 8 dB across that same original path.

Phase 3 saw each element spacing increased to 9.29 metres, as close to a quarter wave at 7025 kHz as I could fit into our cramped yard. Reception observations showed about a 10-12 dB improvement over the pre-phase one readings. Based on available literature, its forward (main lobe) operational arc is suggested to be

Photo 5: Black PVC irrigation riser as a 'socket', mounted on Teflon pad.

about 70 degrees, with a vertical plane take-off angle in the mid-to-high 20 degree range.

I was also able to switch between the VPA and two low-height, fixed reception loops previously dedicated to 160m operation. One is a vertically-oriented loop, 16.8 metres in perimeter, constructed of 2 mm diameter enamelled copper wire with the loop's base at 600 mm above the ground. The other is a horizontal loop, 32 metres in perimeter, also constructed of 2 mm diameter enamelled copper wire and mounted at 2.15 m above the ground (above head height!), strung around our small fruit tree orchard and chicken run.

Photo 6. Concrete block base mount for element socket.

Both loops are fed via a heavy duty ceramic knife switch to a homebrew, balanced link coupler antenna matcher at the operating position in my shack. Having the three switchable arrays is a great low band, fingertip-controlled facility that I recommend to interested others.

The telescopic fishing pole elements I used for my VPAs were both fully extended and made lift-in/lift-out removable for bad weather or other storage demands, able to be rested horizontally on the lawn, a shed wall, or

Photo 7. End view of three elements in-line, east to west.

fence rail racks. Only one stainless bolt requires undoing: the ground system connection beneath them.

Element base-mounting sockets are sections of heavy duty, black irrigation pipe, supported through a stack of three hollow, heavy, concrete cinder blocks for stability.

Thus far, the parasitic elements have remained installed for about six months, enduring plenty of 100 km/h wind gusts without resulting damage. I made both poles taller than their original seven metre advertised commercial length, and also more robust, by adding at the base three metre long, heavy wall PVC pipe sections that are secured to the poles.

My individual element assembly provides the robust status. Black gaffer tape of 75 mm width was applied at each telescoping pole junction, accompanied by a pair of cable/zip ties. No joint slippage here!! Gaffer tape was then 'criss-cross bandage wrapped' across the joints and again zip-tied above and below the junction zones.

Multi-strand copper aerial wire of the required dimensions (see Table) was individually hand-wound and tensioned along the extended and taped poles. Two coats of satin marine varnish was also applied to assist

with maintaining the integrity of the turns.

Each element so formed is easily lifted in and out by my elderly self and carried to storage while held at its balance point in one hand, if desired. Array grounding is via single-bolt connections on each paras itic element to the extensive wire radial mat network already installed beneath the 40/20m groundplane, supplemented by Coreflute portable radial/counterpoise pads made for 40m (Ref. 3, pp 42-44).

I am very pleased with the VPA appearance, integrity, concept and performance, and I hope you have similar success should you give one a try.

Phase 4 of this Big Bore-related helical antenna experimental project is about to unfold, having been interrupted by my total hip replacement surgery in November 2020.

Using the existing empty 40m reflector and director mounting sockets will allow for an 80m two-element array in the same space. Reflector and radiator telescopic fiberglass elements will follow similar construction theory and practice, spacing being 18.6 metres in that case; again, not quite a quarter wave, but as close as my real estate dimensions allow.

May I caution readers – please do not allow 'pursuit of the perfect' to prevent working DX and having fun!

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TABLE

40m Vertical Parasitic Array dimensions for 7025 kHz

Reflector	**10.592 m**
Radiator	**10.211 m**
Director	**10.008 m**
Spacing	**9.296 m**

Antenna analyser/GDO antenna base testing results

7025 kHz, SWR **1.08:1**
Z = 48 ohms @ 100 W CW
7025 kHz, SWR **1.5:1**
Z = 40 ohms @ 400 W CW
Bandwidth **~300 kHz**
Bonus band: 14,030 kHz, SWR 1.2:1 at 100 W CW; based on original 40-20m tuned LC networks still in-circuit.

Behind the Rig

A portable potentate

They're a practical lot those hams from inner-city Brisbane, state capital of Queensland. A fine example of the breed is Doug Friend VK4OE.

For the 2020 Spring VHF-UHF field day in later November, Doug operated portable from his ham shack de wheels to enter the Single Operator, All-Bands, 24-hours category. By all accounts so far received at WIA HQ here in drizzly Melbourne, Doug mounts an impressive portable station, pictured here as deployed for the event.

We note the 50, 144, 432 and 1296 MHz antennas mounted on the tall mast, along with dishes for 5.7 GHz and 10.3 GHz. There is a short rotatable mast at the front of the roof rack with antennas for 2.4 and 3.4 GHz. On the roof rack is a tripod supporting a dish for 24 GHz, while in the foreground two ground-mounted tripods carry dishes for 47 and 76 GHz.

Doug reports that, from site arrival to being operational usually takes about 40 minutes; less if the dishes are not going to be used. Doug also sent a bonny picture of himself operating hand-held portable on 10.3 GHz from Scotland.

Electronics has only ever been a hobby for Doug, and an intriguing area of interest, which developed in his teen years into amateur radio and a passion for the whole idea of operating portable. Professionally, Doug

is a microbiologist who was involved in the delivery of quality healthcare services in the field of sterilization, disinfection and infection control. Doug retired in 2004.

Safety around your RF emissions

Visualising your electromagnetic radiation limits with Google Earth

Martin Luther VK7GN

In Australia, every amateur licensee is required to have a basic knowledge of electromagnetic radiation safety and to assess the risk that their station presents in relation to human exposure to the transmitted RF fields[1]. To simplify the evaluation and reporting requirements for most transmitting stations, including Amateur stations, the ACMA has adopted a system of two compliance levels – titled simply: Level 1 and Level 2. You are required to determine the compliance level of your station. Here is some help.

Electromagnetic radiation (EMR) safety has become an issue over the last few decades. While I prefer the term EMR, it is interchangeable with EME – electromagnetic emission. Although it is presented that running below 100 watts does not require a Level 2 type analysis, it is good practice to do it for anything other than QRP.

This article relates to HF operation. While some of the techniques apply also to VHF and above, as the frequencies get higher you need to do your own study to be sure your operation complies with the standard. I have not done any of the following work for frequencies above 50 MHz.

While we should all be aware of EMR, the likelihood of doing any harm at the frequencies we use between 1.8 and 50 MHz is very low.

The standards themselves are set at a level that is low risk and are mainly set to protect from very high levels of RF found in some occupational situations. The equations used to calculate safe distances and power densities are very conservative. The ARRL and FCC did some checks on typical amateur stations that showed that the calculated results were conservative compared to "real world" measurements or model analysis with NEC4 (Numerical Electromagnetics Code)[6]. Further, amateur operations are very intermittent, not only two-way, but also amateur operations are not on 24/7.

In my early career, I was involved with safety around high power microwave links. Get your head directly in front of one of those dishes and you could well fry an eyeball or a brain cell or two.

At all frequencies, EMR heats up body tissue, but as those of us who have used high power at HF know, the heating effect is minor until you get direct contact with high voltage RF, which can cause very nasty, deep burns.

The warning here first is to make sure the loading network at the base of that 160m vertical is covered and insulated so that small (or inquisitive) fingers cannot get near the high voltage! The same care should be taken with low wires drooping below head height. Many new amateurs have been surprised to see an air-spaced capacitor arc over at quite low powers!

This is also a case of self-protection. You never know when you will get a neighbour who sees your antenna as a threat to their wellbeing. You need to be able to defend yourself.

The standards

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) standard, contained in the ARPANSA Radiation Protection Standards Series No.3, details the limits set on human exposure to RF. Many of us may quibble over the standard, but the standard is what it is, and we need to defend our situation against that standard.

In carrying out analysis, I use three things:

- The VK3UM calculator available on the WIA web site.
- An antenna analysis program using NEC. I use EZNEC but there are several others (Refs 2 and 3).
- Google Earth.

The VK3UM calculator provides the basis for most analysis. In my calculations I look at powers of 100, 500, and 1000 watts to allow for situations where more power is produced. Typically, forgetting to wind back from SSB settings when changing over to CW or DATA results in accidental excess power. Also, changing bands can result in overpower. The standard is to average RF over a six (6) minute period. It may certainly take that long to notice that there is excess power being produced.

The calculator takes us from power to the (safe) distance to people. It provides distances as safe distance from tower, an on-axis exclusion zone, and safe tower height.

Figure 1 Screen shot from Google Earth showing my rural location.

The antenna analysis program can show us where the main axis of the radiation is for a particular antenna. This where we look at the "on-axis direction" to assess the distance given in the calculator. More on this problem later.

Google Earth can provide us with a view of the radiation limits surrounding the antenna at its real location within your property. We can also work backwards. Where there is an antenna too close to the property boundary, we can evaluate the maximum power that can be used with that antenna to comply with the EMR standard.

Google Earth

This software[1] is provided free by Google. Just make sure to download the software for use with *any* browser if you are not using Google Chrome! Finding a location is easy. There is a search function at the top left. Just enter an address, or latitude and longitude, and the software moves to that location, displaying a satellite view.

You can play with the various controls to get familiar with tracking the software. Just above the picture in the browser are a few icons. One of these is called the 'ruler' and allows you to measure distances using lines and circles. Choose *circle* and mouse-click on the antenna location, then move the mouse until the ruler shows the desired exclusion distance, then click again and there is a circle in yellow showing the exclusion zone.

Or, working the other way, draw the circle for the available distances and then the ruler will give the distance required for the exclusion zone.

Analysis

1/ Large country property

Figure 1 is a Google Earth image of my country property. It is just possible to see the HF beam on a picture display full-size on a monitor. From the VK3UM Calculator set to 14 MHz, we know that the on-axis exclusion for this antenna is 15 metres, tower height is 8.5 metres, and safe distance from the tower is 0 metres. This is a worst-case analysis using 1000 watts and full carrier.

For my normal operating mode of CW, even at 1000 watts the numbers become 9.5 metres on-axis, 6 metres tower height, and zero metres from the tower base. As I rarely make long transmissions and don't have authority to use 1 kW, the true answer is even less. The antenna is a three-element Yagi-type tri-band beam at just over 10 metres height on a tower. Feedline loss is 1.2 dB at 14 MHz.

I have drawn a circle around the beam at 15 metres to show that there is no problem with EMR at this location. A similar analysis is easily done at other frequencies and on other antennas.

For interest, the equivalent measures from the FCC, with ground reflection, are 11 metres exclusion zone, 7 metres tower height, and zero metres from the base. I find it useful to look at exclusion zones under different standards to make sure I am in the right "ball park".

I could just use the distance from tower base as the "safe" area. However, the land rises to the south of my tower, such that

Figure 2: In suburbia, I have a multi-band vertical mounted on the carport (circled).

a person standing on a ridge (still in my property) would have their head close to the beam's major lobe (on-axis). Of course, the simple expedient of not beaming south would solve the problem another way! However, the 15 m circle still doesn't get to the hilltop, so all is clear.

I have a 7 MHz vertical that works out to 4.5 m on-axis safe distance. That would be the case for a perfect earth, not the rocky outcrop that is my block in the country! The problem with all vertical antennas is determining the angle of radiation over the ground or radial field. This is, again, where I use the worst-case type of analysis.

We may not necessarily know the exact answer, but we know we are operating with a safe margin. So for a vertical, assume "perfect" earth, which means that the main lobe is only a few degrees above horizontal.

From this analysis, you can see that we always tend to look for examples of worst case. Not difficult, as long as you think about what is happening. I find that Google Earth does help in the way it shows me where these distances are in circular form and I don't have to wander around with a tape measure trying to make sense of it all.

2/ Suburban property

Looking now at a suburban location, our house in Bellerive (part of the Greater Hobart area) could hardly be more surrounded by neighbours. The S9 noise level from their various electronic devices confirms that! See Figure 2.

I have a trap vertical located at the corner of the car port. Let us see how much distance there is to the two neighbours on that side. Using Google Earth and the ruler, I find that the safe distance available is three metres.

On 14 MHz, a safe power level using the worst case analysis is 180 watts (just 0.2 dB feedline loss). Using the full analysis rather than worst case, we can see that on processed SSB we could run 350 watts still using the example of a 100% duty cycle. Using CW (Morse) 450 watts is still within the EMR limits.

Now, I don't do that. Partly because of the noise level and partly because I do not think it is sensible to operate high power in a close-spaced suburban environment.

Exploring this in Google Earth, I can determine where to place an antenna and still be within the EMR limits. I first tried moving to the corner of the garden shed, which allows a six metre radius of exclusion. Taking the worst-case example of full carrier for the full six minutes, this location would allow 700 watts without exceeding EMR limits.

I then tried a typical 10 metre tower with a small three-element tri-band Yagi in the middle of the garden (a typical amateur installation, gain of about 6 dBd and allowing 0.5 dB feedline loss). There is a nine metre exclusion zone. That permits us to use 380 watts at full carrier. We are well ahead of the vertical because the Yagi has gain and directivity on receive as well as transmit.

With a 10 metre tower and 500 watts, the EIRP (Effective Isotropic

Figure 3: Screen shot of the setup screen in the VK3UM Calculator.

Radiated Power) is below 3200 watts, so the system is compliant at Level 1, even though they give an exclusion zone greater than the nine metres. Again, worst-case, I would limit my power to that which can be contained within the nine metre radius.

One of the lessons of this analysis is that, although our current conditions for the Advanced licence allows 400 watts on SSB, if the antenna is badly placed, then it may not be possible to run that power without coming into conflict with the EMR standards, especially if running an efficient speech processor on SSB. If the antenna is optimally located, then even on a suburban block it is possible to run quite high power.

3/ Antenna analysis

For wire antennas, some form of radiation pattern analysis may be the only way to determine what the radiation pattern looks like. For example, a half wave dipole at a low height, or in an inverted V configuration, may look more like an omnidirectional antenna than the familiar doughnut pattern.

Random long wires may have very unpredictable directions of maximum gain, which vary with frequency. Hung between trees in areas like my country location, this does not present any problem, but when located in suburbia, then it is as well to err on the side of caution.

On a suburban block with a wire antenna, I would stick to barefoot operation with 100 watts. I have seen installations where a wire has been suspended on the boundary fence, forming a loop antenna. It would not take a lot of power to exceed the EMR standard in a neighbour's property!

4/ The VK3UM Calculator

See Figure 3, which shows the setup screen[1]. This is an excellent piece of free software (available for download from the WIA website) but, at the extreme, it does not replace physical measurement that requires expensive equipment. The way to treat the software is as a guide, in the manner as I have described above.

Always lean towards a worst-case analysis. If you can achieve the power that you want into the antenna in the location you want, at full carrier full duty cycle, it is easily okay. If you can only achieve it by taking all the allowances for different modes and different duty cycles, then proceed with caution. That is the time to check all frequencies to be used and document everything thoroughly.

It is also worth downloading the FCC paper, *OET Bulletin 65*. Although the FCC uses a different standard, it provides some tables that can support being in the right "ball park".

There were comments some time ago that the calculator did not correctly reflect the ARPANSA standard for frequencies below 10 MHz. However, I have checked against the ARPANSA *Radiation Protection Paper No. 3*, Table 7 and Schedule 3, and the calculator is in step with those standards. Looking at 1.8 MHz, Table 1 shows the comparative results.

Table 1.

	VK3UM 1.8	ARPANSA 1.5	ARPANSA 2
H-Field Strength	0.405	0.486	0.365
E-Field Strength	64.7	70.9	61.4

Further, the calculation of EIRP correctly uses the mathematically precise value for gain derived from the dBi in the antenna specification. It calculates numeric gain from dB in the correct formula, $G = 10^{\frac{dB}{10}}$. Then taking the EIRP value into the formula

$S = EIRP/4\pi r^2$ so at 14 MHz, $s = 2w/M^2$

and calculation for r is correct in the model, where r is the safe distance or what is described here as the "on-axis exclusion zone".

I am happy that the calculator follows the standards as currently set; except for the test for Compliance Level 1 or Level 2.

The Compliance Levels 1 and 2 are useful in determining whether there is a legislative need to do a full analysis. However, the calculator does not give the last word on Compliance Level 1. It uses the cumulative test of 3200 EIRP to determine the cut off between Levels 1 and 2.

However, it does not appear to monitor the antenna height, which must be at least 10 metres for this to apply.

The value of average EIRP is monitored and reported, but the operator has to make a decision about Level 1 or Level 2 from the calculated data. That is why I choose to do everything at Level 2 and look for worst-case distances.

However, if your antenna is over 10 metres above ground and the calculator shows EIRP at less than 3200 watts, you are still Level 1 compliant, which provides for less reporting but you still have to keep your calculations to prove that you are justified in claiming Level 1 compliance.

The calculator also works out the average power at the feedpoint, which takes into account the mode and any feedline losses. It is worth having a play to see what input/losses/mode still gives 100 watts at the antenna feedpoint, thus being Compliant at Level 1. Note that the power at the feedpoint is not affected by the type of antenna, but the EIRP does change with antenna gain.

Using the VK3UM calculator, it is possible to test if your station is Level 1 or Level 2 compliant. If Level 2, then we have to move onto the right-hand side of the form and make decisions about mode, duty cycle, and then distances as I have described above. The antenna height is important for distance from base of antenna, it is set with a slider control just to the left of the box showing distances.

Another "worst case" is to use the variable gain figures to align with those for your antenna. My current Yagi claims 6 dBd. The one I had up last year claimed 8 dBd. Just use the variable button to change both dBd and dBi simultaneously.

It was working with these tools that prompted me to try again to convince the ACMA that their policy on EMR is wrong and simply does not and cannot work. Anyone who is similarly convinced that Australian amateurs are just as intelligent as those in the USA, Canada or New Zealand and are willing to help convince the regulator of their error may care to get in touch with me at *vk7gn@wia.org.au*.

It seems especially silly to me that we are expected to be EMR safe at 400 watts but are considered incapable of doing the same thing at 1000 watts. Maybe they think we have trouble with four-figure numbers!

Please enjoy experimenting with Google Earth. It is a very powerful tool in assessing safe distances and hence can be used to analyse the EMR distance effects from amateur antennas. In fact, I think that distance is the most important parameter in EMR analysis.

If you want to explore the EMR issue further, I recommend the ARRL/FCC papers from the US[5]. The ARRL has extensive training and reference material about EMR. I am not sure how much is available to non-members, but it is worth a browse on their website *(www.arrl.org)*.

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How to mount a VHF-UHF Field Day multi-operator station and win your category without losing friends, breaking the bank, or going bonkers

Kevin Johnston VK4UH, Scott Watson VK4CZ and Colin Cortina VK4MIL

This is the story of the Brisbane VHF Group's (VK4IF/p) entry in the 2020 Spring VHF-UHF Field Day, subtitled "The Mouse that Roared", with due apologies to actor, Peter Sellers, who starred in that satirical comedy film.

Photo 1: The triumphant trio from the Brisbane VHF Group (BVHFG). Left to right - Scott VK4CZ, Col VK4MIL, and Kevin VK4UH.

Queensland (VK4) is Australia's second largest state by area, but is only home to about 20% of its total population. Of that, the vast majority is concentrated in its South East region, clinging to the southern part of the state's coastline. The general VK4 amateur population reflects this distribution. VHF and microwave activity has been comparatively low in this region.

From the perspective of a VHF or microwave operator, the geography of VK4 presents some "significant challenges" to overcome when compared to the southern call-areas. With a relatively low number of established VHF stations in our region, and the majority of those concentrated in a small area, compounded by the large distances to the next-closest population centres that are generally beyond VHF range under flat propagation conditions, the number of in-range target stations with which to make contact is limited. Never is this more apparent than when it comes to VHF contesting.

Although there are many mountains and other high locations in southeast VK4, there are relatively few really good locations for portable VHF and microwave activities that are easily accessible and within a useful range of the available stations in the region. The majority of peaks' high-spots are either not accessible or are tree-covered with limited visibility, which is not conducive to microwave activities. The higher, inaccessible, peaks frequently block the radio paths from those that are accessible.

About Brisbane VHF Group

The Brisbane VHF Group (BVHFG) is a small club, affiliated with the WIA, that caters for those amateurs in and around the state capital with an interest in any aspect of VHF or microwave amateur radio. The majority of BVHFG members also belong to other radio clubs in their own areas.

Although small, the BVHFG is a very active group – holding group meetings, lectures, demonstrations, tune-up and workshop sessions, and regular Microwave Activity Days (MADs – where members attempt to establish portable and home microwave stations from high spots around the region.

The group also constructed, hosts and maintains a comprehensive system of VHF, UHF and microwave beacons (VK4RBB and VK4RTT) for the benefit of all amateurs. The system provides 24/7 beacon outputs on all amateur bands through 6m, 2m, 70cm, 23cm, 2.4 GHz, 3.4 GHz, 5.7 GHz, 10 GHz and 24 GHz, all running digitally encoded modulation; all are time and GPS frequency-locked.

For many years the, BVHFG has also activated its club call VK4IF in as many contests and field days as possible.

VHF-UHF Field Day Contests (the FDs)

The FDs are a series of contests, sponsored and run by the WIA, which are held three times each year – Spring, Summer and Winter. The stated intention of the Field Day contests is to provide a platform to encourage activity on VHF, UHF and microwave bands, to encourage portable activity with an aim to achieve greater distances than local contacts, and to provide the opportunity for stations to activate and work into new grid squares. The contests are also open to home-based stations.

The contests can be entered in a variety of different categories to accommodate a wide range of interests, circumstances, and activities within this area of our hobby. There are different sections for portable and home stations, for single or multi-operator stations, for 8-hour and 24-hour activations, along with single-band, four-band, or all-band and cross-combinations of all of these categories. There are even Rover sections where the intention is for stations to rapidly deploy and then move around a number of different locations.

The scoring system employed in all sections of the FDs takes into account the number of contacts made, the distances over which those contacts are made and, very importantly, the degree of difficult involved. In general, the higher the frequency, especially across the microwave bands, the more difficult contacts are to achieve and the score awarded reflects that.

The most challenging and demanding sections, as always, are for portable all-band entries.

Despite the small group membership, the small "target station" base to make contacts with, and the challenging VK4 geography, the BVHFG has frequently achieved modest success over a number of years, achieving first places in several sections of the VHF-UHF field days, including the four-band portable sections, and even in the Rover sections.

A sketch map of the VK4IF location and directions to 'target' stations.

For a long time, achieving a high score or even a winning entry, in the most difficult and challenging section, i.e. the multi-operator, portable, all-band, 24-hour category, from VK4 at least, was considered a "bridge too far" given all the negatives to be faced. Entries in these sections involve a significant investment in time away, planning, station assembly, fuel and travel, etc.

Over the last two years, a team was established within the BVHFG, comprising the three authors, who committed to give our best shot at making the grade in the most difficult section of the FD – with a focus of challenging the status quo, yet still having fun!

Finding a suitable site

While there are a number of high peaks in southeast VK4, very few offer what is required to enable the establishment of a 'contest grade' station, that just three operators (in full-time employment) could establish and run in a weekend.

This brought to light some minimal critical criteria – distance from Brisbane, ease of vehicle access, and access to power to remove the need to carry and set up generators, plus clear take-off in most directions. For the Spring Field Day, held in late November, this means a clear take-off to ZL due to the potential of exploiting tropospheric propagation that might be exploited.

Our search considered a number of sites, from the New South Wales border right through to near Hervey Bay in the north. But only one started to stand out – the Bunya Mountains, which divides the Western Downs and South Burnett regions of southeast VK4. It had altitude, an abundance of holiday rental accommodation and is just on three hours' drive from home QTHs.

However, Bunya Mountains had over the years been attempted as a field day site unsuccessfully, largely due to the majority of available rentals surrounded by rainforest. Further searching revealed that only four rentals provided the required uninterrupted views, and only one provided the take-off in the required directions (a site previously visited and activated by Scott VK4CZ for family holidays).

Located next to the trig point on Mount Mowbullan, the rental is situated at just under 1100 mASL, with uninterrupted views from northeast through south to the southwest. Mt Mowbullan is 150 km from the coast (Caloundra), and 160 km from Brisbane. Significantly, it is 370 km from Vista Point in NSW, the usual field day location of the Summerland Amateur Radio Club station VK2SRC, and 2300 km from ZL1!

Building a competitive station

To challenge the status quo, a four-band entry wouldn't suffice. We needed to be able to establish a station that would cover all bands from 50 MHz through to 24 GHz (10 bands); higher, if possible.

After our initial attempts in Spring 2019 and Summer 2020, we also knew that we needed to improve on what we started with to ensure that every potential contact could be captured and logged.

With just three operators, this focused us on establishing three operating positions: Station #1 – 6m; Station #2: 2m to 23cm; Station #3: 2.4 GHz and up. This also required implementing a networked

logging system, centred on the VK Contest Log (VKCL). It's free (as in free beer), from *www.mnds.com.au/vkcl/*

The station in Spring 2020 saw a number of improvements over previous efforts, which included a new Yagi for 6m, new and longer feedlines for 6m and 2m (LMR-400), and also for 70cm and 23cm (LDF4-50), new taller masts, which also included separate rotators on the three masts that supported the 6m, 2/70cm and 23cm Yagis. No small feat!

Here's a summary of the stations established and operated in Spring 2020:

Station #1: ICOM IC-7300, SSPA and 5-element OWA Yagi (mast #1).

Station #2: Kenwood TS-2000, SSPA for each band, 144 MHz 12-element DL6WU Yagi, 432 MHz 29-element DL6WU Yagi (mast #2), 1296 MHz 36-element DL6WU Yagi (mast #3).

Stations #3: The microwave station consisted of five separate Kuhne DB6NT-based transverters assembled with a variety of preamplifiers and PAs, some ex-commercial and some home-brewed.

All stations were driven by a single "IF go-box" based around a Yaesu FT817 transceiver, and containing a 10 MHz GPSDO and digital interface. The 2.4 GHz rig put out 100 watts, the 3.4 GHz rig – 30 watts, the 5.7 GHz rig – 9 watts. These lower three bands shared a single 1m (long axis) mesh dish with a multiband feed. The 10 GHz rig, put out 60 watts to a dedicated 600 mm diameter solid dish with shepherd's crook feed. The 24 GHz rig, with 2 watts output, also had a dedicated 600 mm solid dish with shepherd's crook feed.

Band change was achieved by transferring the single "umbilical cord" containing the IF, 10 MHz reference and control lines, between transverters, and for the lower bands, the antenna coax was transferred between the respective feed sockets on the dish.

Photo 2: The eastern take-off from our Mt Mowbullan accommodation.

Photo 3. The view south for VK4IFIP. That's our 6m antenna on the left.

Photo 3A: Kevin VK4UH at Station #1, the 6m station, working VK5 on Sporadic E.

Photo 3B: Col VK4MIL at Station #2, the 2m – 23cm operating position.

Photo 3C: Station #3 – the VK4IF/P microwave operating position, from behind the dishes.

A series of mounts for the three dishes were home-constructed. These allowed accurate positioning of the dishes in both azimuth and elevation, calibrated by visual sightings and allowed the unused antennas to be swung out of the view of the dish in use.

During set-up, signals were sought-out and received on all microwave bands from the BVHFG beacon chain VK4RBB. At 179.2 km distance, signals were received at good strengths on all bands from 2.4 GHz up to 10 GHz.

It's quality that counts (add a little quantity to help!)

Since our first attempt from Mount Mowbullen in the 2019 Spring 2019 Field Day, we realised that to start to make a dent in the lead that the southern stations held, we needed to deliver on three key objectives that were set in our planning:

1. Increase the number of contacts overall, with an emphasis on the microwave bands.
2. Improve the longest and average length of QSOs across most bands.
3. Be ready to 'pounce' the moment any potential trans-Tasman tropo was available.

Happily, we can report that all three objectives were achieved!

Our QSO count in total increased by almost 70% year-on-year. The biggest improvements came from 6m [103% increase], 70cm [77% increase], and 10 GHz [200% increase]. But increasing the QSO count cannot be achieved alone. This requires both an increase in the number of available operators worked, but also the number of repeat contacts throughout the contest period. Our sincere thanks must go to all those stations we worked and logged, one or more times! Unfortunately, this meant that, at some times, we favoured microwave QSOs over repeat contacts on lower bands, to the detriment of other stations chasing repeat QSOs to support their efforts.

Photo 4: The Yagi arrays for 6m (on the left), on one mast, and for 2m and 70cm on the other mast, at right.

To improve the longest distances for contacts and therefore drive our average length up, we made a number of station improvements that were described above and we have more in planning for Spring 2021!

We also ensured that we maximised our chances with tropo potential, monitoring Hepburn charts and planning times to focus, then monitoring WSPR when possible during these periods. This meant that, at any moment we saw ZL1SIX on 2m WSPR, we'd pounce. The result - a number of Trans-Tasman QSOs on 2m, 70cm and the pièce de résistance, three 23cm QSOs: ZL1IU – CW, ZL1RQ – SSB, and ZL1SG – SSB.

Photo 4A: Installing the 2m and 70cm Yagis on their masts. Carefully thought-out mechanics eases the tasks.

The published results of the Spring 2020 Field Day reported that the BVHFG achieved First Place in Section B1 – Portable, Multi-Operator, 24 Hours, All-Bands. The final score of 174,157 points was the highest ever achieved by our group, and for a Queensland-based station.

VK4IF/p also achieved the longest "verifiable distance" for contacts on 50 MHz and 5.7 GHz. It is likely that the contacts between VH4IF/p and ZL on 144, 432 and 1296 MHz would also have been recognised had logs been submitted from the ZL stations.

You've gotta be heard

Our achievement, and the key to any field day operation, or even home station for that matter, largely comes down to having capable antennas and suitable feeds, to ensure every ounce of our signal can 'get out'.

With the majority of stations to be worked well over 100 km away, every effort was taken to ensure that the station had the required arrays to cover all the 10 bands we intended to operate, balancing practicality and gain.

The VK4IF/p station now includes:

6m: 5-element OWA design Yagi with LMR400 feeder, mounted at six metres above ground level (AGL) – built by Scott VK4CZ specifically for field day use. This antenna was built in a fashion that it quite easy to assemble and disassemble (once again, due to Scott's obsessive with perfection).

2m: 12-element DL6WU design Yagi with LMR400 feeder, mounted at four metres AGL – also built by Scott VK4CZ.

Photo 5: Operating position for the microwave bands from 2.4 GHz through 24 GHz, showing the three dishes which were able to cover from west through to the southeast.

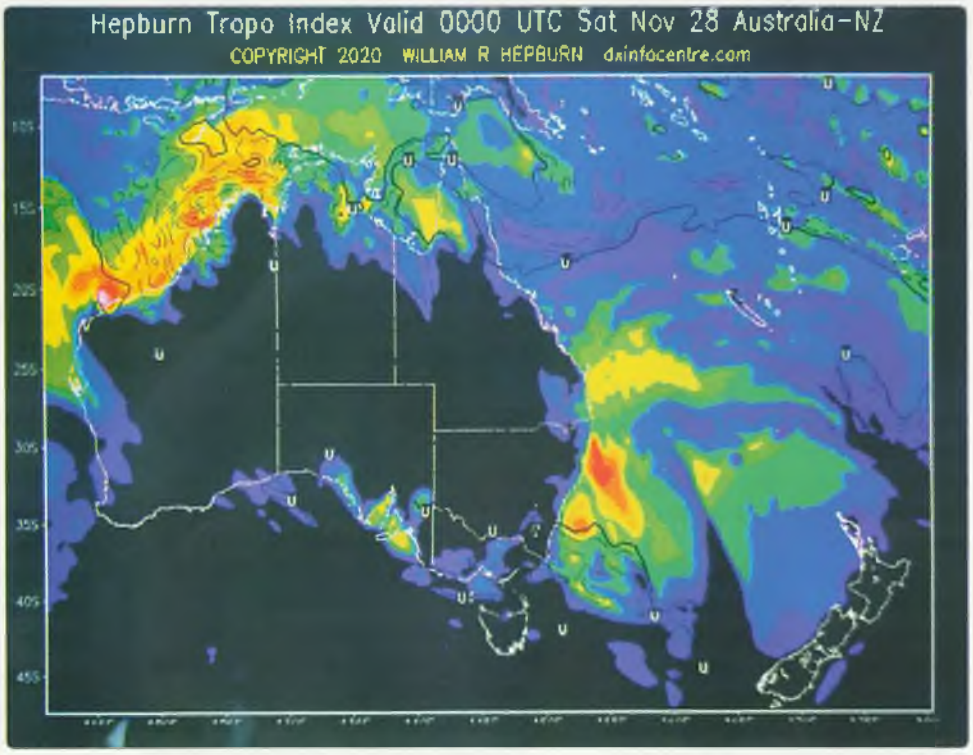


Photo 6: The Hepburn chart relating to the period of our 144, 432 and 1296 MHz contacts to ZL1.

70cm: 29-element DL6WU design Yagi with LDF4-50 feeder, mounted above the 2m array at 5.5 metres AGL (built by Scott VK4CZ).

23cm: 36-element DL6WU design Yagi with LD4-50 feeder built by Scott VK4CZ and situated 5.5 metres AGL – mounted on a veranda.

13cm + 9cm + 6cm: all used a one metre (1m) diameter dish with a multi-band feed (loaned courtesy of Rob VK4ZDX – thanks Rob!).

10 GHz (3cm): 600 mm diameter prime feed dish.

24 GHz (1.25cm): 400 mm diameter prime feed dish.

Building on the learnings after our previous attempts from Mount Mowbullan, the Spring 2020 Field Day also saw the introduction of new masts and rotators for 6m through 23cm – a move away from 'armstrong' rotators and multiple antennas using single masts, providing increased flexibility and more rapid direction pointing.

Kevin VK4UH sorted these by making supports that could be installed and removed easily, left no impact, and allow the masts to be raised and lowered (with an appropriate amount of heave-ho!), with increased safety.

These new supports consisted of a star picket with pivoted cup (for the want of a better description) that the sub-mast mounts into. The cup is attached to the star picket through a welded spigot forming the pivot point, and to which the sub-mast with rotator and main mast are attached and raised.

Each mast consists of a thrust bearing (or stay point) with rope stays that allow for 360 degree rotation. Once raised, the guys are securely set and it's good to go (well, sort of).

With this set-up, there's now 100s of meters of rotator control and coax cable to run, and each of the three stations can be assembled. The increased antenna capability and cable runs has also meant that each station has an allocated area of the rental house – Col VK4MIL no longer has to sit it out in the walk-in robe. Although cosy, it wasn't practical.

Table 1. VK4IF/P results by band

Band	6m	2m	70cm	23cm	13cm	9cm	6cm	3cm
Contacts	63	85	53	36	12	11	9	9
Final score	29171	21622	34265	53907	8073	8811	8491	9817
Longest [km]	1823	2300	2300	2300	203	203	203	203
Average [km]	386	364	387	405	155	150	150	150

Note: Although we had 24 GHz, no 2-way QSOs were completed.

Making it come together is aided by Scott VK4CZ's tendency to plan – in detail (maybe something to do with his profession as a Corporate Strategist) – the spreadsheet lists every item and aspect required to mount the operation so that nothing is forgotten, and there's even redundancy built in. Remember, we're over three hours from our home stations, so racing back to get that one little thing forgotten just ain't going to happen!

And now, from the first time we were there to this time, the preparation work, planning and organisation and set-up has increased tenfold . . . but worth every bit of the time invested.

Down time – we do make some!

While mounting a serious entry into the Field Day is a high priority, enjoying the surrounds is also high on our agenda. The Field Day weekend is a chance to have time to take stock, enjoy the area, soak in the views, take a walk up the mountain and, again, enjoy more views. And at the end of each day, also share each other's company – oh – and Scott's cooking!

A menu is prepared (in another spreadsheet!) for all meals across the weekend, ensuring we are all suitably fed and watered. This year was no exception. Friday evening: Marinated Thai pork rashers with a spicy satay sauce, served with Asian greens in a chilli oyster sauce and Jasmine rice. A choice of New Zealand Sav Blanc and/or Australian Pale Ale. Saturday evening: Gourmet Angus burgers with fried haloumi and desert of sticky date pudding, custard and ice cream. This time, with the choice of an Australian Pinot and/or Australian XPA. Diets are in order on our return!!

While it may be Spring, and back home in Brisbane it was over 30 degrees C, the mountain air chills rapidly as soon as the Sun lowers and the temperatures at Mount Mowbullan quickly drop below 20 degrees C overnight. As Queenslanders with thin blood, the wood burner is lit and kept running across the weekend, ensuring we're all warmed up and 'match fit'.

Being on the edge of the Bunya Mountains National Park also means that we can enjoy the fauna – which is something else. The area surrounding the house is full of wildlife, with wallabies, paddy melons and bandicoots scampering around at all times of the day and night. And the birdlife is plentiful. Numerous species are observed, all within metres of the house, but we especially love the King Parrots and Magpies that call the rental their home and wander through it whenever they please!

A quick overview of the effort

An operation of this type, doesn't just happen – as you can well imagine, it keeps the three operators pretty busy. It included:

Planning: Commences at least four weeks out, involving a few face-to-face sessions (over coffee) to challenge and confirm thinking and lock-in plans.

Logistics: Three vehicles (large 4WDs) and one trailer. All full – no passenger seats left.

Travel: Minimum of 250 km each way, representing a >500 km round trip, creating a distance travelled in excess of 1500 km, or a cumulative total of 18 hours of travel.

Masts: Three 6m-tall masts, with stays and rotators. Four Yagis, minimum boom length 3m. Over 100 m of cable runs, coax and control.

Food: Enough for six meals, for three people, plus snacks and refreshments.

Plus: The list goes on!

It's a wrap – but we'll be back!

"The whole point of records is to be broken – the whole point of contests is to be better next time."

In our case, this has been a largely personal challenge for the team. We want to continue to challenge, learn and improve. Mounting the VK4IF/p entries does that in spades. And achieving the top score in Spring 2020 Category B1, while immensely satisfying, in breaking the existing paradigms, doesn't mean that we will again achieve it – without continual renewal and refocusing on our operations.

It also can't be achieved without the support of other stations. Our sincere thanks go to a large number of operators across southeast VK4 who participate and provide valuable contacts.

There are a few who need special mention. Gary VK4GU for his consistent activity on the microwave bands. Trevor VK4AFL for his contribution to the QSO count across a number of bands. Graeme VK2QJ and the team he brings together at VK2SRC/p – who we're supporting to develop their capabilities, which will soon see them on 2.4 and 3.4 GHz and eminently workable from Mt Mowbullan – enabling them to also grow and develop their score and ranking. Mention goes also to the ZL contingent of Nick ZL1IU, Alan ZL1RQ, Graeme ZL1SG, and Stephen ZL1TPH, who have always made themselves available over the Spring and Summer Field Day weekends to be at the 'other end', just in case the "tropo gods" favour us with an opening.

The reward!

Erratum

We committed an editorial sin in Issue No.5 for 2020, in the article on **A novel arboreal aerial for the 630m and 160m MF bands**, by Leigh Turner VK5KLT.

The paragraph at the top of column one on Page 18 should read: "The crux of the challenging problem here is how to maximally induce that RF current longitudinally into the ionic fluid laden, relatively high resistivity (circa 30 – 200 Ωm) peripheral tree tissues."

My apologies. Roger Harrison VK2ZRH, Editor in Chief.

Hamads

FOR SALE – VIC

ICOM IC-718 Transceiver (100 watts, 1.8 - 30 MHz) $400

LDG IT-100 Automatic tuner (for ICOM transceivers) $200

MFJ Antenna tuner Model MFJ-989D $300
Power rating: 1500 Watts, SSB/CW.
Configuration: T-Network with rotary inductor.
Has 300 watt peak dummy load. Tunes coax fed & long wire antennas. (Weight 4 kg)

All items in very good condition with manuals. Freight extra.

Contact: Alex VK3AMX (03) 9850 7493

VHF/UHF - An Expanding World

David K Minchin VK5KK

In this edition of the column, for something different, we have details on both 480 THz (red light) and 30 THz (infrared) transmission experiments and records. Also, we have the fifth instalment of the construction series, this time looking at OCXO frequency references, followed by another flashback from my column 20 years ago, looking at KH6 QSOs 53 years apart!

480 THz records!

A quick update: "480 THz" is right at the convergence of orange and red light in the electromagnetic spectrum, and slightly higher in frequency to the usual "474 THz" referred to in records. I don't think that presents any problems! Chris VK3CJK reports:

"On 9th January 2021, Chris VK3AML/7 on Deal Island made successful two-way voice contact with Chris VK3CJK at Blackwarry, in Gippsland – a distance of 134.7 km – using modulated light. This is the first known such contact between VK7 and VK3 and, subject to confirmation, sets a new VK3 distance record.

A big thanks to Chris VK3AML for organising the contact opportunity. Also at Blackwarry were Ralph VK3WRE, Dean VK3NFI, Michael VK3ALZ, and Jim VK3ZYC, while on Deal Island were Dave VK3ASE, Steve VK3SL and Henry VK3FACT.

"Unfortunately, due to ill health, Mike VK7MJ, who assisted VK3AML with design and construction of his lightweight transceiver, was not able to travel to Deal Island. Further

Showing the Bass Strait location of the southern site of January's THz band record breaker, VK3-VK7. Deal Island is the largest of the small Kent Group of Islands, situated between Flinders Island and the southern coast of Victoria.

Photo 1: Chris VK3CJK's 480 THz Lightwave equipment by day.

Photo 2: Chris's 480 THz Lightwave equipment by night.

information to be published in AR at a later date."

Experimenting on 30 THz

OK, the second "THz" math test! As an explanation, 30 THz is in the infrared spectrum and a frequency commonly used for medical imaging and, more recently, security systems. Thermopile detectors are commonly used in these devices. However, this is probably the first serious work done with the technology over any distance. Andrew VK3CV reports:

"In November 2020, Andrew VK3CV / WQ1S and Karl VK3LN made a contact in a previously unexplored section of the upper electromagnetic spectrum at 30 Terahertz (THz) which is 30,000 GHz.

"A two-way contact over 60 metres distance was achieved with 5x5 signals received each way. The contact is believed to be the first ever in this band anywhere in the world.

"The 30 THz band sits above the upper mmWave bands (>300 GHz) but well below the previously used optical band at 474 THz in an area of spectrum known as "the upper THz Gap". The band is shown in yellow in the diagram below at between 20 – 38 THz. This area of spectrum sits in a very suitable low loss atmospheric window."

"A technical article is being prepared to detail the techniques and equipment utilized in the contact. In brief, The Transmitters used exploit what is known as Black Body radiation which is modulated with a manually operated gate or a steered reflector to send CW morse code pulses. The receiver technology uses a Thermopile sensor with an integral BPF. This is mounted in a dish reflector connected to a microprocessor to

The impact of the atmospheric losses on signals in the spectrum between 3 GHz to beyond visible light. The window at 20-38 THz affords low losses.

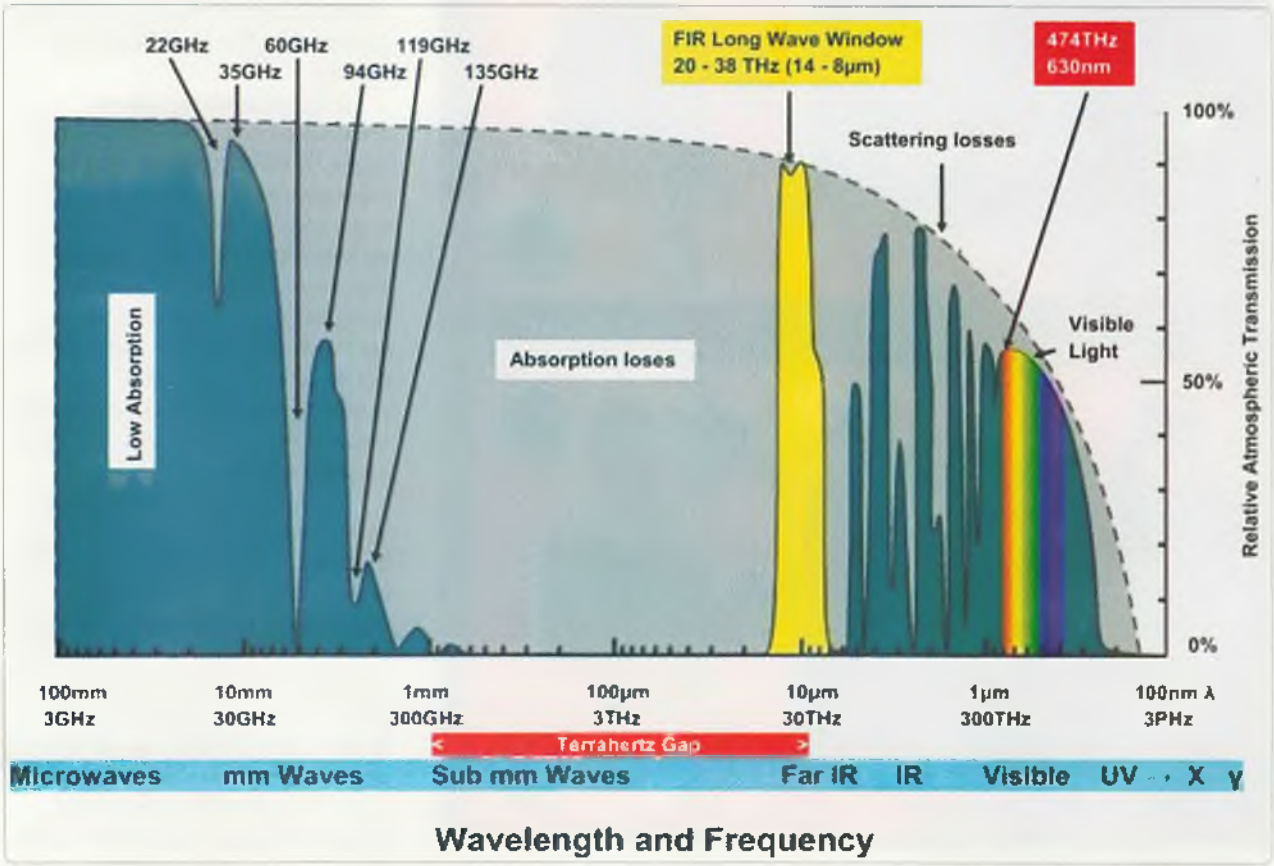


Photo 3: Andrew VK3CV's experimental 30 THz transmitter.

Photo 4: VK3CV's experimental 30 THz sensor (receiver).

demodulate the THz signals and to provide an RSSI indication. See the VK3CV_WQ1S YouTube channel for a video made during testing."

Construction Series Part 5

Back to basics, OCXO frequency reference for uWave PLLs

Last issue, we looked at a VCTCXO PLL frequency reference for microwave PLLs. The article stirred up some interest with a couple of readers emailing "could this also be used to replace the discontinued XRef for reference locking VHF/UHF transceivers". The answer is, of course, "yes", for that or any other frequency you can find a VCXO up to 500 MHz. The only issue is the different footprints of available VCTCXOs so that has led to a few weeks' delay for new PCBs and testing.

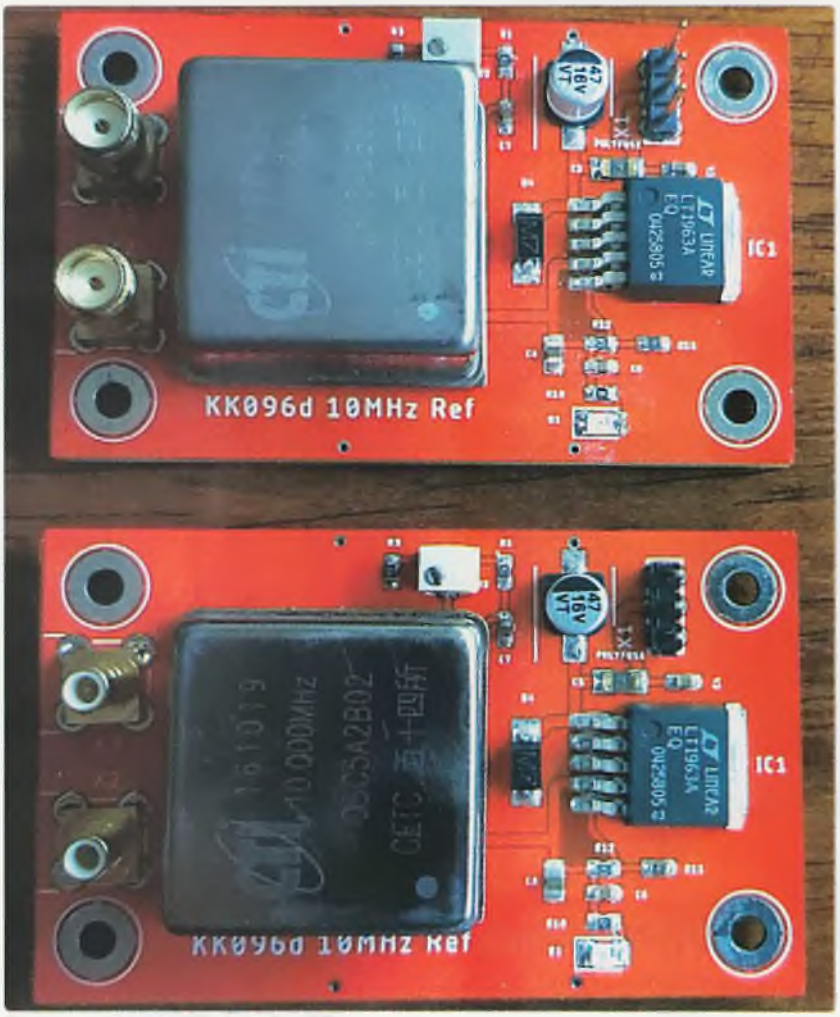


Photo 5: 10 MHz CT: OCXO PCBs.

In the meantime, a local amateur dropped by with one of those 10 MHz OCXO PCBs that have appeared on eBay recently. It worked OK, but was mediocre on the "122 GHz voltage rail drift and noise test". Since then, one thing has led to another and now we have a sinewave 10 MHz OCXO construction project with a low noise regulator, better components, a smoother multiturn pot, and twin +3 dBm outputs.

But why use a low noise OCXO vs a super accurate GPSDO? Well, if you need a reference for VHF/UHF, or even probably up to 10 GHz, a good quality GPSDO is fine for shack or portable use if you don't mind the extra cables and set up. Above 10 GHz, it will depend greatly on the quality of the GPSDO, digital artifacts and/or supply noise can become a significant problem unless you injection lock an intermediate OCXO.

Here's why six metres is called The Magic Band

On the 10th of January 2021, 50 MHz lived up to its reputation as "the magic band", with openings across the Australian continent, spanning the Tasman to New Zealand and beyond to the South Pacific. Not content to stop there, transequatorial propagation (TEP) kicked-in, with openings between Australia's Eastern seaboard and Japan, Korea, Taiwan, and the Ryukyu Islands. **Roger VK2ZRH**. Learn a little about TEP here: *http://home.iprimus.com.au/toddemslie/aTEP-Harrison.htm*

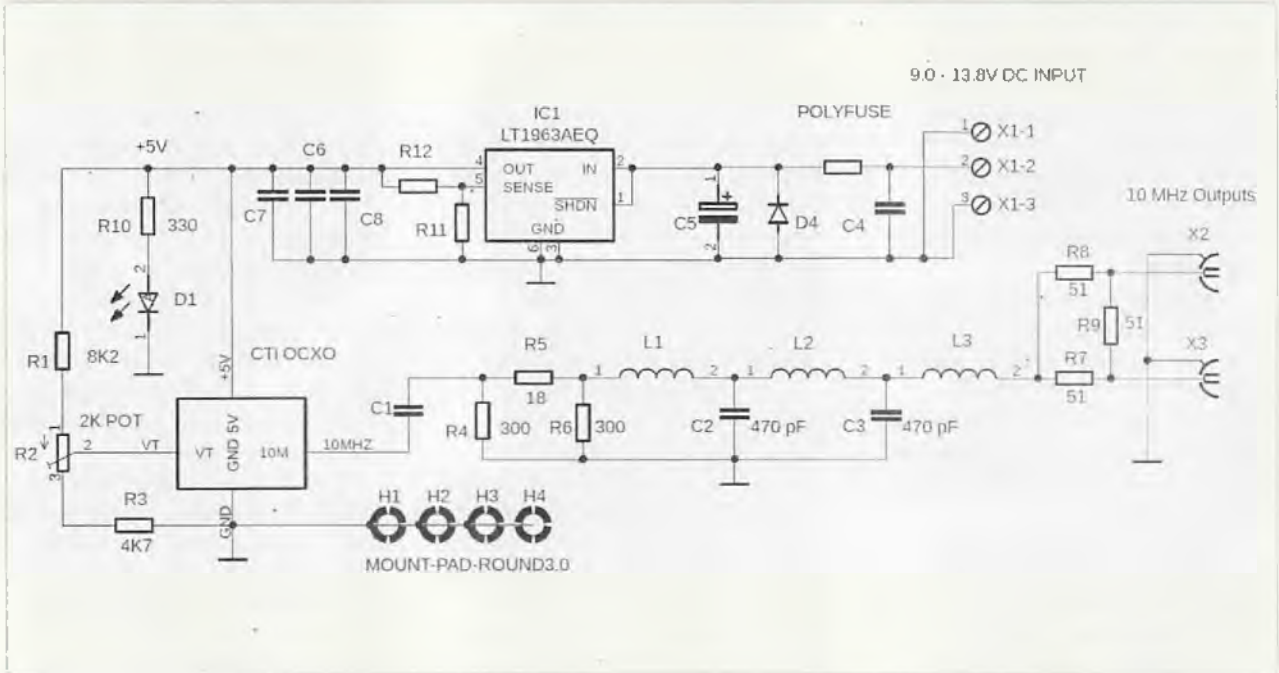


Photo 6: 10 MHz CTi OCXO Schematic.

There are several popular Chinese GPSDOs available, some are quite good but some others that use 5 V switching regulators to power the base OCXO are virtually unusable for microwave work.

For quite a few years, eBay and other online auction sites have been selling OCXOs removed from surplus equipment. There are many different types available, but they usually operate on either 5 or 12 volts. Square wave or HCMOS types are most common, with sine wave versions usually only available in 12 V. Our favoured frequency of 10 MHz is most common, with 12.8, 13.0 and 38.88 MHz about for bargain prices, if you can use them. There are many manufacturers, including Rakon, CTi, Dapu, Vectron, ISO temp, etc.

Unfortunately, the pinouts and footprints almost always vary between brands, so for this project I settled on the CTi OSC5A2B02 10.0 MHz OCXO. This a 5 V OCXO with square wave output. There is also a CTi OC5SC25 HCMOS output version about.

The market has been flooded with both versions, driving the price down below A$15.00, including postage. Either will work in this project, the 10 MHz LP filter will clean up the square or HCMOS wave quite well, to achieve -154 dBc/Hz @ 10 kHz phase noise. Warm up is < 5 minutes, to be within spec with short-term drift < 0.05 ppb/s.

Aging over 24 hours of use is less than < 0.5 ppb, or ~ 60 Hz on 122 GHz. As these used OCXOs have already had 10 – 20,000 hours of operation in mobile phone network equipment, the crystal has been "aged" and will probably be better than spec.

In casual amateur use they hardly move. For a quick sanity check, I've included a second 10 MHz output for connection to a frequency counter without disconnecting the PLL. You can also use this output to drive another transverter or reference lock your transceiver in the field.

Part	Value	Description
C1, C6	10 nF	0603 or 0805 SMD Cap
C2, C3	470 pF	0603 or 0805 SMD Cap
C4	1 nF	0603 or 0805 SMD Cap
C5	47 uF, 16 or 25 V	SMD mount, various sizes
C7	1 uF	0603 or 0805 SMD Cap
C8	10 uF	0603 or 0805 SMD Cap
D1	0805 or 1206 Red LED	Mouser 599-0213-007F
D4	IN4007 or equiv	DO214AA package diode
IC1	LT1963AEQ	LDO regulator
L1, L3	LQM21PZR47MC0D	470 nH 0805 Choke
L2	LQM21PZ1R5MC0D	1.5 uH 0805 Choke
POLYFUSE	PFNF.050.2	Polyfuse 1206 ~ 1A
R1	8K2	0603 or 0805 SMD Resistor
R2	2K Multiturn pot	Bourns 3223W
R3	4K7	0603 or 0805 SMD Resistor
R4, R6	300	0603 or 0805 SMD Resistor
R5	18	0603 or 0805 SMD Resistor
R6	100	0603 or 0805 SMD Resistor
R7, R8 & R9	51	0603 or 0805 SMD Resistor
R10	330	0603 or 0805 SMD Resistor
R11	1K8	0603 or 0805 SMD Resistor
R12	5K6	0603 or 0805 SMD Resistor
U$1	OSC5A2B02	CTi 10 MHz OCXO
X1	3 pin	DC Header 0.1" pitch
X2, X3	BU-SMA-G	SMA or SMB, PCB mount

Photo 7: 10 MHz CTi OCXO Parts list.

The schematic, Photo 6, is simply a dc regulator, OCXO and low-pass filter. The dc input has a PTC fuse and a 1N4007 (or 16 V zener) diode for input protection. Rather than the noisy 7805 regulator found in our online example, I have used an adjustable low noise LT1963AEQ LDO regulator.

There are several reasons for the selection. Firstly, low voltage rail noise on both the supply and adjustment pins is critical to obtain phase noise specs, but it has been found useful to be able to change supply rail volts (4.5 – 6.5 V) to optimise stability. From experience, the flattest part of the crystal stability curve is not always at 5.0 V and can be as high as 6.5 volts.

I've used fixed resistors (R11/R12), rather than a pot, as a safeguard, so you will need to calculate the combination from the LT1963AEQ datasheet. Disclaimer – don't go any higher that 7 volts or else the OCXO may die prematurely! While on warnings, TTL OCXOs are dc-coupled, so it's not a good idea to connect them directly to a 50 ohm load as this may kill the last stage. I have a couple of Isotemp OCXOs here that are now only good for – 30 dBm output!

Frequency is adjusted using a Bourns 5-turn pot with series resistors, so that the tuning range is restricted to 1.5 V – 2.2 V. This was another problem with the online version, a single no-name pot made it almost impossible to get on exactly 10 MHz. From the CTi data sheet, 2.0 V is the nominal centre voltage, but with age they seem to be around 1.95 V. If you want even finer control over adjustment, once you have found the middle spot, you can restrict the range even further by increasing R1/R3 values.

The OCXO is followed by a 3 dB pad and a 7-pole low pass filter. The 2nd order harmonic is -42 dBc and 3rd-order – 60 dBc. This cleans-up the square wave nicely. The output is then a simple two-way splitter to deliver ~3 dBm per port. This works with most popular PLL oscillators, and mid-range for PLL chips like the ADF4157, etc (max +9 dBm).

Some microwave oscillators, like the Kuhne 8 – 13 GHz unit, do need at least +1 dBm to work, so you may need to experiment. A quick check is to drive the PLL with one port disconnected, this gives + 2 dB output. In normal operation, the unused output should be terminated in 50 ohms when not being used, although leaving it open circuit only changes frequency by ~1 ppb.

The printed circuit board is double-sided, 62 x 38 mm, with dc components and the OCXO on the top and the 10 MHz components on the bottom. I've used 0603 SMD parts, but 0805 will also fit.

The standard output footprint for SMA/SMB/SMC connectors has been used and can mount either straight or right-angle jacks. The PCB should be mounted inside a solid box. It has been sized to fit inside a small diecast box, like a

Delton part # 459-0140. You can either use short length SMA patch leads to panel connectors, or use a 90 degree SMA PCB jack with an extra-long threaded part. The long thread will allow you to mount the PCB right up to the wall of the box. Linx CONSMA002-L-G (~A$5) is one good example, but you will find others on eBay; mine are still on the "slow boat", so no photos!

Assemble the PCB minus the OCXO to first check that the power supply is set to around 5.0 V. All being well, solder in the OCXO then connect +12 Vdc. On start-up, the OCXO will draw up to 500 mA for the first two minutes and the regulator will get quite warm.

Once it stabilises, this will drop to ~200 mA +/- 10%, depending on ambient temperature. Connect a frequency meter or use an oscilloscope to compare with a GPSDO to adjust R2 until it's spot-on 10 MHz. Watch the oscillator over the next hour, it may drift upwards 0.01 – 0.03 Hz, depending on the crystal and things settling in. Adjust accordingly, let it cool down and then repeat.

For "Red PCBs", just drop me an email. While doing this project, I was asked if a version of the PCB could be done for the ISOTEMP 131 series 10 MHz OCXO. It has a different pin spacing and pinout, but it is easy enough to update the PCB with extra holes so both can be used if anyone is interested. Notably, there is a 131-191 12 V sine wave version available that draws ~100 mA when warm. The LT1963AEQ regulator could be set for 12 V, but I have run one of these in my 10 GHz "Patchverter" for years at 10.5 V, so that is something to consider.

Next month we will publish the schematic and PCB layouts for the VCTCXO PLL reference from part 4.

What happened 20 years ago

Continuing this series – from my January 2001 column, and best described as a long time between drinks . . . KH6 on 50 MHz again after 53 years!

Clarry Castle, VK5KL (now SK), Enfield, SA has written to say ... *"Thought you might like to know that after 53 years I have again worked KH6 on 50 MHz. Wednesday 6th of December 2000, at 350Z the KH6 Beacon was audible. Tuning to 50.110 MHz there was KH6SX calling CQ and I made QSO at 0352Z 589/559. The band was not open to anywhere else this week other than VK8RAS being in 9/12/2000" . . . Clarry VK5KL."*

So, what's the significance of the 53 years? The last time Clarry worked KH6 (Hawaii) was during August 1947, as VK5KL in Darwin, working W7ACS/KH6. The distance of 8533 km, was the first significant world record on the newly-allocated Six Metre band (50 – 54 MHz) and it stood for many years after that.

Even though 1947 was at the peak of cycle 18, the rudimentary equipment of the day and the yet-to-be-discovered workings of the F2 layer (or TEP) made this contact even more special. Unfortunately, with the advent of TV in Australia, VK lost the 6m band in 1955, just prior to the infamous Cycle 20. Australia was given temporary access to the pre-WW2 5m allocation (56 – 60 MHz) until 1962, when we moved back to 52 – 54 MHz (a truncated 6m). It wasn't until 50 MHz operation slowly returned in the 1980s-90s that we were truly back on a level playing field again.

More on what happened 20 years ago next issue!

Online path loss calculator for 24 GHz and above

As previously covered, Iain VK5ZD's website that displays the calculated path loss for 24, 47, 76, 134 and 241 GHz has become a well-used resource to quantify mmWave band conditions. The website can be found here *http://weather.vk5microwave.net/Weather.aspx?State=H* There is also a path loss calculator available on this following link that allows live meteorological data to be entered for any site, anywhere in the world. *http://weather.vk5microwave.net/Calculate.aspx*

In closing

Feel free to drop me a line if you have something to report or details on a project you are working on, it doesn't take much to put a few lines together and helps with the diversity of this column. Just email me, at *david@vk5kk.com*

73

David VK5KK

Meteor Scatter Report

Dr Kevin Johnston VK4UH

Operating, software updates, coming events and showers, activity schedules

Writing this during the Christmas holiday period, I would like to take the opportunity to wish a Happy New Year to everyone for 2021 – it could hardly be any worse than 2020, and also to thank all those who have taken the trouble to provide feedback on the recent four-part introductory series of articles on VHF Meteor Scatter propagation and operating.

From the very outset, the purpose of that series was to focus on operators with little or no previous exposure to this fascinating aspect of our hobby. To that end, the information and explanations were deliberately kept simple, with a minimum of off-putting maths or equations.

Much of the feedback suggests that many now seek *MORE* detail on some aspects of Meteor Scatter. In this edition I hope to address some of the questions raised about operating during Meteor showers.

Meteor shower operation

As this column was being prepared, the 2020 Leonids and Geminids meteor showers have already passed. The Leonids is a Class 1 Meteor Shower, which peaks around 18 November each year, with a Zenith Hourly Rate (ZHR) of up to 20 meteors/hour. This shower occurs each year as the Earth's orbit around the Sun takes it through tracts of debris remaining after the passage of 'Comet 55 P/ Temple-Tuttle' through our solar system.

The Geminids is also a Class 1 Major shower, which peaks around 15 December each year. The Geminids is considered one of the most important showers for radio propagation here in the southern hemisphere, with a Zenith Hourly Rate (ZHR) of up to 120 meteors/ hour, although activity of this shower has noticeably declined over recent years. The shower occurs each year as the Earth's orbit around the Sun takes it through tracts of debris remaining after the passage of asteroid '3200 Phaeton' across our solar system.

As was outlined in the introductory articles, for many MS operators it is sufficient to know that, on certain specific and highly predictable dates through the year, the normal "background" level of meteor returns will be enhanced – sometimes, enormously so. This is a very reasonable place to start.

However, with more experience, it becomes apparent that there is a lot more to this aspect of the meteor scatter propagation mode. Some of the more detailed aspects of operation during meteor showers were intentionally omitted from the earlier basic articles that ran from Issue 3 through Issue 6 for 2020.

The first point to make is that there are many websites and on-line applications available providing information about meteor showers. The majority, however, are concerned with the prediction and timing of **visual** meteor sightings for astronomers, rather than VHF propagation for radio amateurs.

For best visualisation of meteors, the optimum showers have their Radiant (the point in the sky where the shower meteors appear to be radiating from) at high elevation in the heavens. However, optimum long-distance radio communication requires those Radiants to be low in the sky and close to the horizon, where they are often not visible to the naked eye. Further, most Meteor related websites are intended for observers based in the northern hemisphere and the information is frequently misleading for this region.

For optimum Meteor Shower operation there are a number of additional factors to consider:

- The best time for operation does not follow the usual pre-dawn peak rule, as applied to normal random meteor scatter practice. The optimum timing is determined by the position of the meteor shower in the sky.
- Each shower will "peak" on highly predictable and consistent dates each year; however, propagation enhancement may occur for many days on either side of that peak date. The date windows for some showers are recognised as being much "wider" than for others.
- Enhancement of MS propagation occurs when the radiant of the shower is at low elevation in the sky and close to the horizon. This, of course, means that as the naming-star constellation rises, crosses the sky and then sets, then there are two times when this occurs, Star-rise and Star-set. In general, the earlier Star-rise peak of returns is the best.

- Enhancement of MS propagation is very path dependant. The optimum orientation is where the predicted meteor paths are at right-angles to the path between any two stations. For example, a hypothetical shower rising directly in the East would provide enhancement for north-south paths but would have little effect for East-West paths. (N.B. no such shower exists!)
- Enhancement of MS propagation is also location dependant. In general, the naming-star constellation has to above the horizon for the stations at both ends of the path.

Once the radiant has gone over the horizon (i.e. star-set), at either end, then enhancement stops. For some showers, e.g. the Perseids in August in the Southern hemisphere, the Radiants are so far north that, although they are visible above the horizon in VK4, they have only a transient window of view for VK7, and Perseids is borderline useless for amateurs in the southern call areas in Australia, even though it is a major event in USA and Europe.

The ZHR (Zenith hourly rate) is a prediction of the level of meteor activity expected in each shower, but it is only a prediction or forecast. The quoted figures are often widely different from the actual observed values in any particular year.

There are two applications that can be of assistance for Meteor Shower operations.

Photo 1: Typical skymap image from the NASA Meteor Radar site, showing the relative position and activity of several meteor showers. The bright focus near the cetre of the image is the Orionid shower.

The first is the NASA Meteor Radar Sky-Charts (Ref 1.). This sky-scanning radar facility gives a daily representation of meteor activity across areas of the sky. The service is freely accessible to all.

This app gives a daily visual representation on a sky-chart of the actual observed meteor activity associated with each shower, as it waxes and wanes. The website also gives a lot of useful information on the overhead meteor radar plot and the International Astronomical Union code of meteor classification.

The second application is VIRGO. (Ref 2.). This application, produced by DL1DHC for the amateur meteor scatter community, gives a sky-map representing both the track and timing of major meteor showers based on your own grid locator. The display produced appears similar in many respects to that used for satellite path prediction software, showing the headings and timing of the star-rise and star-set for each shower (naming star). It also gives a "compass rose" representation of headings for either the predominant meteor tracks **or** the likely path enhancement (these two of course being at right angles).

*Photo 2: Typical Virgo Skymap image showing the relative position and track of the Perseids (PER) Meteor Shower in PURPLE at the north of the screen (on the left) and the corresponding optimum antenna orientation (radio path) also in purple on the compass rose (on the right) - which is almost East-West. Also shown is the position of the Southern Delta Aquarids (SDA) Shower in **red**, almost due West at the same time. This shower supports North-South paths from the author's location in grid-square OG64.*

I draw the attention of new users to the fact that the sky-map can be configured in two different ways. It can be set up to represent the paths as you would expect them to appear on a normal map; that is, with North at the top and East appearing on the right-hand side (as if looking down on the Earth from above.

However, by default, the sky-map has east and west reversed. This is the "normal" convention used by astronomers and represents the sky as it appears if you are lying on your back and looking upwards. With North at your head, then East, of course, appears on your left-hand side.

The website also has a number of associated files containing much useful background information for the MS operator.

Software updates

At the time of writing, I am happy to report that the WSJTx software production team has released a new Candidate Release (RC) version of this software platform (WSJTx V 2.3.0-rc2); note that **-rc** versions are early release software intended for beta testing, are subject to frequent updates, and will generally expire automatically at a pre-determined date, by which time a General Availability (GA) release would be expected.

This new version includes the new digital modes FST4 and FST4W, but also now includes the highly anticipated upgrade with support for the Icom IC-705 transceiver. This will have value for many lucky enough to own one of these great little rigs.

The '705 contains an on-board sound card so that all the requirements for digital mode operation on the VHF and UHF bands, including those for meteor scatter, (i.e. audio in, audio out, PTT control and software rig control) can be achieved with a single CAT cable between computer and radio with no other form of interface required.

When first introduced, the

IC-705 was not supported directly by any of the common software platforms normally used for Meteor Scatter modes. Many early owners employed a "work-around" to get the software to work by forcing their rigs to masquerade as an IC-9700 or IC-3700 by changing the default CI-V address of the radio from A4h to 94h.

Remember that, to employ the new software version, it will be necessary to reset that CI-V address to the default setting. The easy way of doing this is to press and hold the CI-V address panel on the '705 screen for one second and the default setting will be reinstated. As always, it is essential to review the Release Notes before using this or any other new software on-air. It is likely that a parallel upgrade for the MSHV platform will also be released shortly.

Weekend activity sessions

The weekend MS activity sessions run on Saturday and Sunday mornings from before dawn (around 2000 UTC, or earlier) until propagation fails.

- Focus frequencies: 2m 144.230 MHz, 6m 50.230 MHz.
- Current Preferred Mode: MSK144 Version 2.0, running 15 second periods.

In VK, we have a well-established protocol for which call areas use which transmission period during these weekend activity periods, as follows:

- Southerly stations (VK1, 3, 5, 7) always run 1st period beaming North.
- Northerly stations (VK4) always run 2nd period beaming South.
- Stations in the middle call-areas of VK2 and VK1 change period depending on the day. Saturday run 2nd period beaming South, Sundays run 1st period beaming north.

Upcoming meteor predictions and showers

As this is published, we are already in the "best" period of the year for meteor scatter propagation. Optimum operating times remain just prior to dawn, which makes it very early indeed at this time of year, particularly in VK4.

The next significant Major showers in the calendar will be the Quadrantids (peaking around 4 January – already passed) which, although a Class 1 shower with a ZHR of 120 meteors/hour, generally produces very poor results and then only for a few hours around the peak.

The next significant shower will not be until 22 April 2021, with the predicted appearance of the Lyrids Shower. This shower results from the passage of Comet Thatcher and, although the ZHR is only a modest 18 meteors/hour, this shower often has a very wide window of enhancement extending for several days either side of the peak.

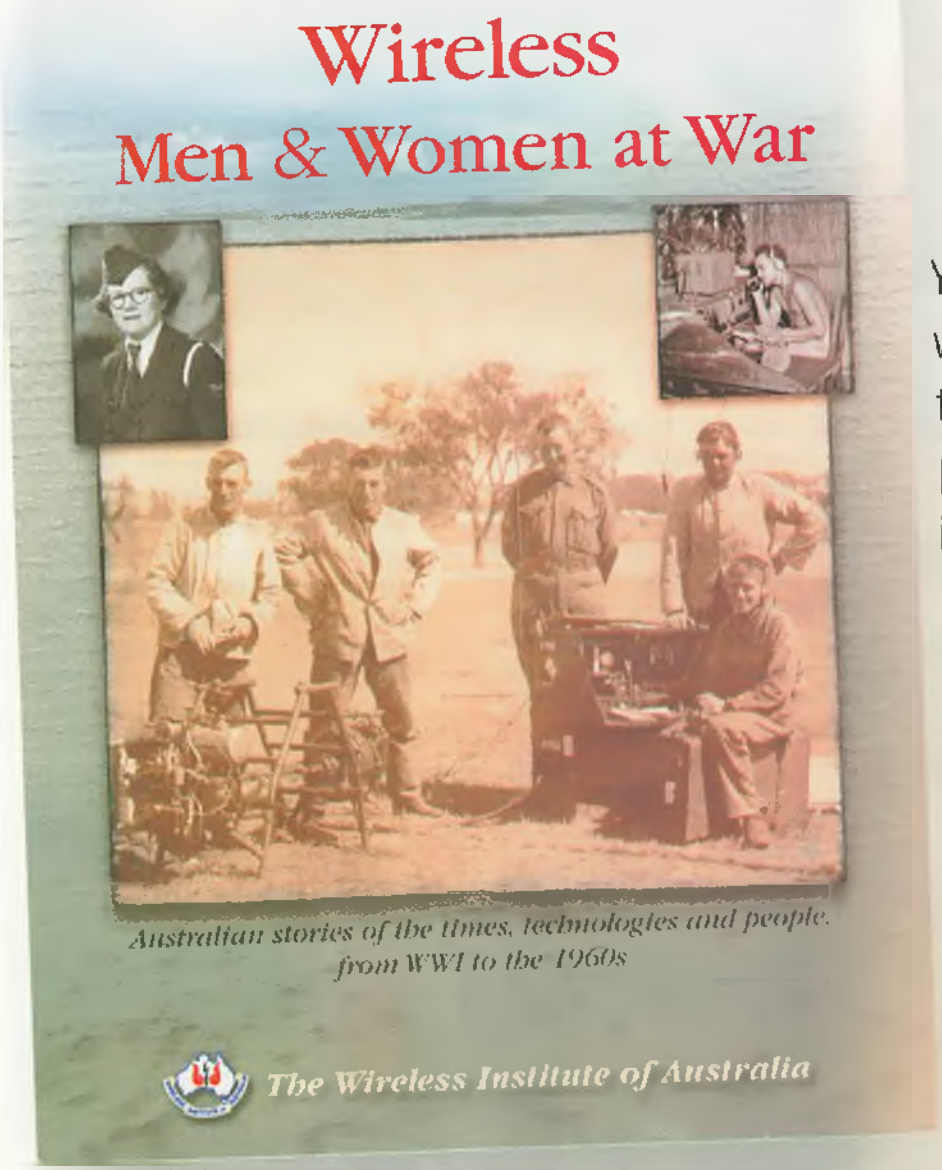
Register with the VK-ZL Meteor Scatter Facebook Page (a closed group of AR operators) for up-to-the-minute advice and information.

Contributions for this column are as always welcome. Please email me at: *vk4uh@wia.org.au*

References

1. Meteor Radar: *https://fireballs.ndc.nasa.gov/cmor-radiants/*
2. VIRGO: *dl1dhc.net*

Wireless Men & Women at War



Young men and women who used their skills from a personal interest in radio, made a difference.
Read their **amazing stories**.
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www.wia.org.au/members/bookshop/page_data.php?id=258

SOTA and Parks

Allen Harvie VK3ARH
e *vk3arh@wia.org.au*

2020 VKFF Activation Weekend

November saw 42 activators participate in the annual WWFF Activation Weekend. A total of 62 different parks were activated, with 694 Park-to-Park contacts recorded. With over 2000 QSOs recorded during the event, the symbiotic nature of this activity is demonstrated – it needs both Activators and Hunters for success.

Compare this to last year, where 38 amateurs took part for 75 different parks, it shows activators still keen to get out but maybe not travelling as much as previously. As always, a great weekend. Thanks to Paul (VK5PAS) and Marija (VK5MAZ) who invested considerable time to organise and post weekend processing of the results and awarding participates' certificates.

Check out the WWFF Facebook page, at: *www.facebook.com/groups/1805720889702979*

SOTA UTC New Year rollover

The New Year always starts with great enthusiasm for VK and ZL SOTA. As Activators can only claim points for each summit once per calendar year (Chasers can claim points for each summit daily), so New Year places all summits back on the table to activate.

Also, the UTC New Year rollover presents an opportunity for activators to claim points for activation both pre- and post-UTC (11:00am for AEDT). In this case, an activation in two different years! Many took advantage of both this and the milder weather to activate. As a result, many positioned themselves in high-scoring or remote summits. This year was no different, with 45 Activators activating 51 summits over VK and ZL, which lead to summit-to-summit (S2S) opportunities aplenty.

Photo 1: Marija VK5MAZ operating from Scott Conservation Park VKFF-093[illegible]. This also qualifies for SANPCPA (5CP-20[illegible], given the portable nature of the activation.

The year stated at 4:00am for me, meeting Andrew VK3ARR on the outskirts of Melbourne to head up to Mt Buffalo ready for the New Year. Worth the effort, as I picked up 36 Activator points for three summits and made 24 summit-to-summit (S2S) contacts for the day. Better than what several months during lockdown allowed.

Achievements

Peter VK3PF clocked over 5000 SOTA points (5x Mountain Goat)! Gaining SOTA Goat takes a lot of effort in VK, as the majority of the summits are in remote areas. 5000 point represents years of consistent, tireless effort. Peter is a regular blogger and is a great source of access information. Check out his blog: *vk3pf.wordpress.com/*

Photo 2: Andrew VK3ARR and Allen VK3ARH on VK3/VE-019 "The Horn", for UTC New Year.

Photo 3: Satellite map, showing the 16 regions across VK2 activated by Phil VK2JDL during his "SOTA VK2 Grand Tour". Nomenclature: UW = Upper West; CW = Central West; NW = North West; NR = North Region, etc.

Well done, Peter and we're all looking forward to more activations.

Adam VK2YK (VK5GA) achieved 100 unique VKFF park activations. Adam is another tireless activator and a frequent Facebook poster, with descriptions of location access as well as fishing opportunities.

VK2JDL completes VK2 Grand Tour

Phil VK2JDL, reports he has completed his "SOTA VK2 Grand Tour" of NSW, activating all sixteen regions. Here's what he had to say about it:

This journey has taken several years, given the long distances between regions, over 95% QRP and beset with the odd setback, but always worth the effort. There are no prizes or certificates, just a measure of personal satisfaction.

Starting with Mount Tomah (VK2/CT-043) back in May 2014, and finally completed with Mount Gunderbooka (VK2UW-001) in October 2020.

There have been many wonderful summits and many hard slogs up some mountains, flies, broken antenna masts, several antennas, multiple antenna repairs on the fly, Mountain Goat and Mountain Sloth along the way, snowing on some summits and over 40°C on others, multiple chasers, as well as being nearly blown off several mountains due to the wind. My SOTA experiences have been so educational and always fun.

As England, the birthplace of SOTA, can fit into the VK2 area six times, there has also been many a mile travelled. The Tour was nearly completed in 2016, but I was thwarted by rain in the Outback when all dirt roads in the region were closed in the Upper Western and Lower Western regions, due to flooding and the slipperiness of the wet red dirt.

So, what goals are next? Time to increase my "Unique Summits Activated" (presently at 114) and increasing my "Summits Complete" (at 55), activating some VK9 summits, as well as more digital from the summits. I am also close to getting onto 10 GHz from a summit in the future (thank you Richard VK3ZCL). Plus, the obligatory "relearning CW" and becoming proficient enough at it to work from a summit. So many facets to amateur radio as well as so many in SOTA.

Looking forward too many more contacts in the future, thank you all chasers.

Phil VK2JDL

Coming up

As I wrote this, Australia Day was fast approaching. With it the annual airing of the AX prefix, many thoughts were on a celebratory expedition. AX is special call sign prefix we get to use on a handful of days every year. Australia Day is such a day, so hopefully this adds a further attraction to wake early to activate that remote park, or summit.

Hotham Weekend: As the chances of VK2 getting to Hotham this year are diminishing, keep your eyes on the OZSOTA Group as plans are laid for parallel activations within the expected restrictions but to maximise summit-to-summit (S2S) opportunities. See *https://groups.io/g/OZSOTA/*

Correction: In the last issue, No.6 for 2020, Photo 2, on page 49, has an error in the caption. That's not Scott VK4CZ, it's Rob VK4SYD. The Editor apologises for it.

73 & 44,
Allen VK3ARH

DX Talk

Steve Barr VK3KTT
vk3ktt@gmail.com

New Year surprises after a tough 2020 in the solar trough

Well, it's been a long hard year, especially if you were in Melbourne with the long lockdown, like me. But the start of the year was huge, with five "all-time new ones" (ATNOs) for me and other lots of rare slots to fill.

January 2020

We had 4U1UN, TR7CA, T6AA, 9G2HO, 3D2AG/P, ZC4UW, E44RU, 8Q7BS, PL1YXJ, VK9NH, C21NH, 9Q1C, XZ2B and HU1DL.

February 2020

TI9A, 5I5TI, 5I4CC, E44CC, TZ1CE, 9N7AM, TN/UA9FGR, TU4PCT and VP8PJ.

March 2020

The virus really bit; only YJ0NC, 9J2LA , T32AZ and VP2VB were active.

2020 stand-outs

Other notable activations over 2020 were **JX2US** from Jan Mayen (in the Greenland Sea – see last issue, page 51), who will still be there through to March 2021.

7Q7RU, Malawi, who arrived in October 2020 for a two-week stay. When the team went to leave, two of the members tested Covid positive and had to stay while self-isolating.

The Malawi DXpedition offers a QSL card of striking design.

VQ9T from Diego Garcia in the Chagos Islands (in the mid-Atlantic), who I barely heard on CW, but not sure if I'm in the log.

We wound-up the year with Tony **3D2AG/p** from Rotuma and some 6m DX from the Americas.

Keep an ear out for Miralda **VP6MW**, from Pitcairn Island. She's mainly on in our mornings; 17m SSB has been mentioned (18.147 MHz), but from her QRZ page, she is trying to get FT8 working.

It was a benchmark year for myself, reaching 300 DXCC worked in one cycle; 295 confirmed 7-band DXCC, despite our Sun passing through the minimum of its solar cycle.

The time at home under Covid-19 restrictions was really only a slot filler and the high bands didn't open until mid-November when we had some great openings to EU on 10m SSB, working G0FWX and the usual suspects, IW3IBK etc.

Then, 6m came to life in December with a JT65 opening to South America – yielding contacts with Argentina (LU), Bolivia (CP), Brazil (PY), Chile (CE), and others, worked in the morning local time.

The New Year

In January, feared disappointments failed to appear. On 6m, during the early days of the New Year, there were openings to Mexico (XE), Costa Rica (TI) and a few US stations across the Southern states.

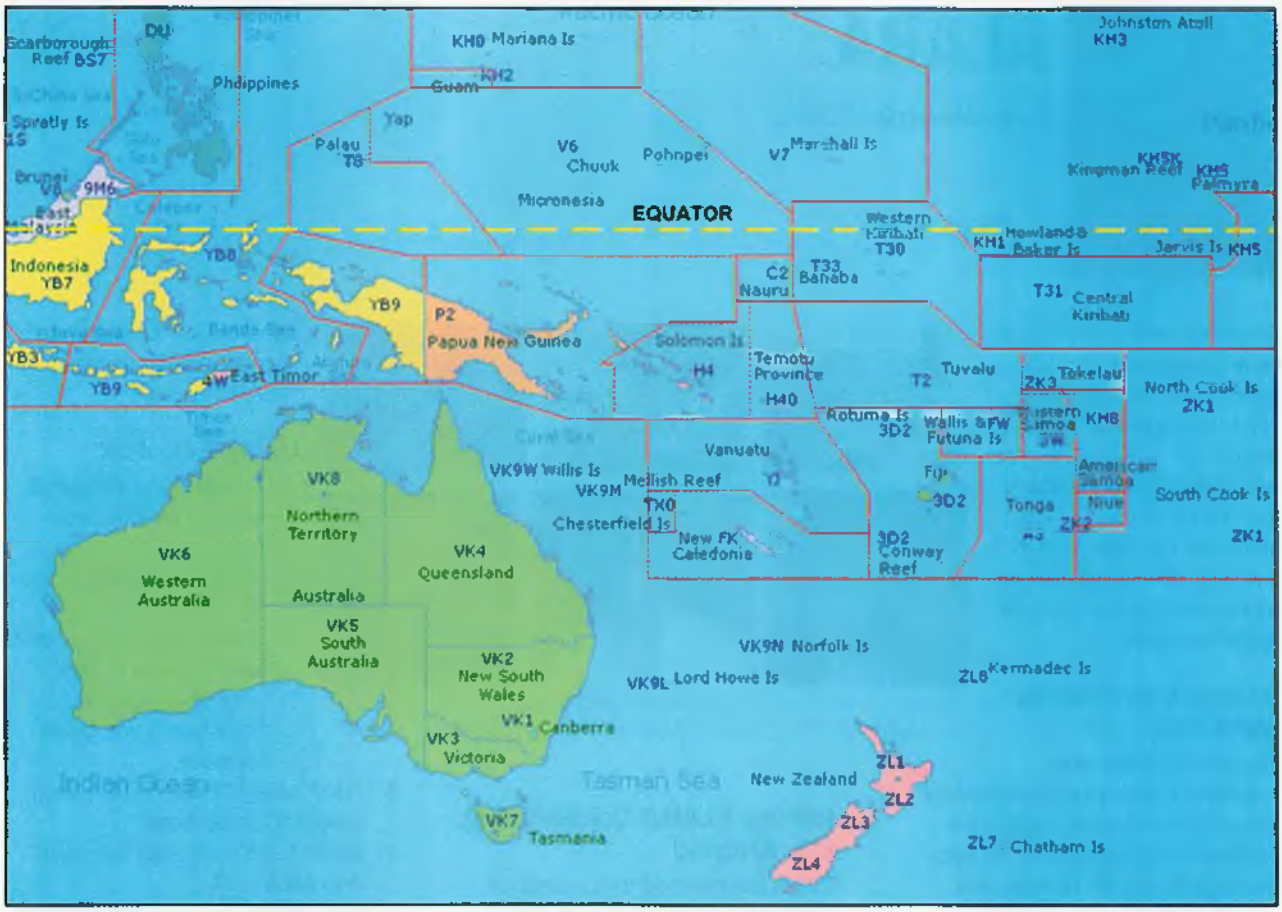
This trend continued and 6m was busy. On 10 January, a very long 6m opening ran from 11am until after 9pm Eastern Daylight Saving Time, with stations appearing across the Asia-Pacific – NH6Y (US Pacific Islands in the equatorial zone), ZL7DX (Chatham Is), FK8HA (New Caledonia), and 3D2AG/p (Rotuma Is) being logged. See the map here for locations.

With my four-element Yagi at seven metres off the deck, masses of JAs on FT8 piled-up on the band – some 40+– during that opening on the 10th. Then came Taiwan (BV), Korea (HL), and Indonesia (YB), along with KG6DX and KG6JDX on Guam. It's apparent that the opening was multi-hop sporadic E (Es) propagation.

I have seen a lot of new call signs on FT8, which is great. I have even seen a few who swore to me they would never do digital! FT8 is a great way to keep busy, monitor the bands and work some DX as the signals get stronger, then the return of the mic and the key will come.

I worked 186 DXCC contact on FT8 or digital this year, and that was fairly casual operating. I challenged a few people who were new to digital modes such as FT8 and asked them to try to work DXCC in a month! Yes, it is very achievable with a simple station. Are you up for the challenge?

Lastly, the WIA runs a very good awards program, which is simple and free if you are a member. Have a look for it online, at *www.wia.org.au/members/wiadxawards/about/*



Map of South Asia and the Pacific. showing callsign prefixes across the region (Oceania, by Mapability, courtesy of EI8IC. from: www.mapability.com/ei8ic/maps/prefix/index.php).

Pages from the Past

From Amateur Radio magazine, December 1950, p11.

1925

Clubs were numerous in those days. Geelong Radio Club distinguished itself by giving the first complete radio religious service in Australia. It was transmitted by the club from the Newtown Church. Records state that the rectifier used one dozen (12) Aspro bottles with aluminium and lead strips.

Hawthorn, Prahran, Malvern, East Kew, St. Kilda were each represented by radio clubs of the period. ¶

ALARA

Jenny Wardrop VK3WQ

Greetings and a very happy New Year to you all. I'm sure that we all hope that 2021 will be kinder to us than 2020! A friend of mine said that although she and her OM don't usually stay up to see the New Year in, this year she would, just to make sure that the old year really had gone!

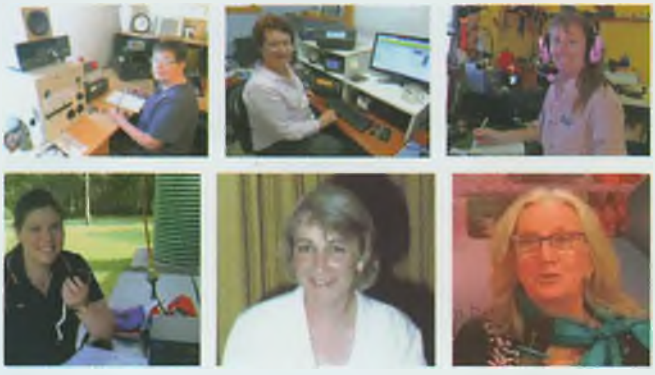


Photo 1: Shirley VK5YL, Catherine VK7GH, Lyn VK4SWE, Michelle VK2FMYL, Sue VK5AYL and Paula VK8ZI.

Changes to Monday night nets

For several years now, probably since we started having some of our Monday night nets on Echolink, because of the poor propagation on 80 meters, the schedule has been like this:

The first Monday of the month – on Echolink only; the third Monday on Echolink **and** 80 meters; with all the rest on 80 meters only.

Christine VK5CTY has closely monitored 80m every third Monday since we began doing this and has not heard anyone on the band.

It has now been decided to make the third Monday net Echolink only. So, the new schedule is:
1st Monday – Echolink
2nd Monday – 80m
3rd Monday – Echolink
4th & 5th Mondays – 80m

I have been calling-in to the 1st Monday Echolink net when I have been able to, and we have had a very good number of check-ins, often including nearly every State (now try doing that on 80m with the current propagation!)

If I have whetted your appetite and you would like to join us, perhaps the following may be of interest.

Joining ALARA Echolink Net with Android

This is the method that I used for getting on to Echolink with both my Android phone and later, my Tablet.

I didn't have to register with Echolink a second time for the Tablet as they already had my details.

The process involves two initial steps and is similar for both Android and iPhones.

A: You need to load a suitable software application on to your phone.

This is done by obtaining the Echolink application from your "App store". There is no cost involved with this.

B: You also need to register with Echolink your authority as a licensed amateur.

This is done by emailing a copy of your ACMA licence document to Echolink and following their instructions. There is no cost for this but it may take a few hours for them to authenticate your details.

You should then be able to freely access Echolink for "one on one" contacts or "Conference" contacts, such as via the *ALARA* server.

Using Echolink

1. Turn on your data and select the "Echolink" App.
2. If this is your first time, try *ECHOTEST* to check your microphone levels. (You will hear your voice played back when you go to receive).
3. Next, select "Node Type", then select "Conferences".
4. Find *ALARA* in "Conferences", and click on it.
5. You should now see the stations involved in the net listed.
6. Use the "Transmit" button to transmit to the group and at the end of your over, tap the "microphone" image to return to listening to the group.

Leave a four-second break before you transmit, and remember to turn off your data at the end of the Sked!

YL profiles on the ALARA website

In the past couple of months some of our YLs have been persuaded to put up their personal profiles on our website, and very interesting they are. Those who currently feature are, Shirley VK5YL, Catherine VK7GH, Lyn VK4SWE, Michelle VK2FMYL, Sue VK5AYL and Paula VK8ZI.

Questions like, "how did you first get interested in amateur radio", "what aspect of amateur radio do you particularly like", and "what other interests do you have",

are answered, plus more besides. They are all very interesting and I encourage you to have a look at **our** website, at: *www.alara.org.au*.

If you are an ALARA member and would like to have your profile included, please contact your State Representative or another Committee Member.

DX222 YL Net

Shirley VK5YL advises that, as propagation is ever so slowly improving these days – I've managed quite a few new DX contacts in Europe and South Africa – we thought it might be a good idea to re-instate the DX222 YL Net this year.

It used to run on a Monday at 0530 UTC on 14.222 MHz. June VK4SJ was one of our earlier net control people. We've contacted here and she is more than happy for this net to be started up again but, alas, she is not able to be net control.

So, this is a plea for the YL HF operators amongst you, anywhere in the world, to have fun on the air waves. A commitment once a month, on a Monday or Wednesday at 0500 UTC, is all that we ask.

I'm happy to be in charge of the roster but can't be available every week, due to other commitments - whoever said retirement is for rest and relaxation!

Come on ladies, let's get more YL voices out on the air! 33 and stay safe, Shirley VK5YL, Vice President, ALARA.

Last but not least, a big thank-you to the VK5 YLs who changed their January luncheon date, so that I could join them on Tuesday 5th and still attend a granddaughter's "Unicorn themed" 7th birthday on the 8th! It was also more convenient for Tina VK5TMC, who had a less happy experience in hospital on the 8th. We hope everything went well for you Tina. My thanks to John Elliott VK5EMI, for providing the photo.

Photo 7. Clockwise from left: Geoff VK5ACZ, David VK5DB, Meg VK5YG, Jeanne VK5JQ, Marilyn VK5DMS, Shirley VK5YL, Tina VK5TMC, Jean VK5TSX, Christine VK5CTY, Jenny VK5FJAY, Jen VK3WQ (VK5ANW), Diedre YF of John VK5EMI, Peter VK3RV, and Kevin VK5AKZ.

Pages from the Past

From the Argus Newspaper (Melbourne), 12 November 1908

POSSIBILITIES OF WIRELESS ROUND-THE-WORLD MESSAGES

Mr. Marconi doubted, owing to the cost of cables, if it would be possible to send penny-a-word messages over great distances without incurring a substantial loss.

A reliable wireless service at a penny a word between Canada and Great Britain would be possible in time. He had made a step in the right direction by sending press messages at 2½ pence a word. ¶

Over to you

Towards the end of 2020, I was attracted to an item on the WIA Sunday news broadcast that revealed how Indonesia had commenced online testing of amateur radio candidates. A remarkable achievement for a third world country and a giant leap ahead of cumbersome and expensive bureaucratic paper shuffling that has defined Australia's approach for decades.

We are at the other end of the wealth spectrum and quite validly expect our regulator, the Australian Communications and Media Authority (ACMA), to be employing a world's best practice procedure for amateur radio assessments and licensing.

The mainstream business of the ACMA is diverse, with key functions like monitoring the communications industry for compliance, enforcing industry codes and standards, right through to providing consumer advice and education.

Oversight of the Amateur Radio Service is now an infinitesimally less important function for the ACMA than it was last century, and it has become clear that calls for reforming how the Amateur Radio examination service and associated administrative functions are delivered is now falling on increasingly deaf ears.

That being so, I have some thoughts on how to make us even less visible and less draining of the precious time and resources of the ACMA while concurrently reducing the financial burden on the amateur community. I will restrict my comments to the administration of the examination service

How is it done elsewhere?

The logical place to start would be to review the methodology prevailing in other first world countries, where the regulator has devolved the process to a non-government entity, and then compare respective outcomes to the status quo here in Australia. I will summarise current practices in the USA, Canada, New Zealand and the UK.

The USA model is one that I am familiar with as I have sat the three grades of exams over there in May 2019 while attending the annual Hamfest at Xenia (previously Dayton), Ohio.

The exams – Technician, General and Extra Class build upon each other and must be taken sequentially. I completed these exams on a Friday morning and received my call sign by email from the FCC, along with my licence as a PDF attachment, the very next morning.

Compared to the current Australian system, that was an absolutely stunning result, and furthermore, the licence is free 'for life', renewable in blocks of 10 years. The Dayton Amateur Radio Club waived their usual exam fee of US$15, meaning the whole process cost me . . nothing, zero dollars, zip.

USA

The USA examination service is devolved to the ARRL. The question bank is in the public domain, with combined theory and regulations questions selected by dedicated software.

Exams are conducted, graded, and outcomes notified on the day. Results are entered directly into the FCC database (called the Universal Licensing System - ULS) by a Volunteer Examiner Coordinator, often on the same examination day. Call signs are issued on a 'next available' basis. In summary, an extremely quick, very low cost, and exceptionally efficient process.

Canada

In Canada, there are two broad grades of licence – Basic licence (access to bands above 30 MHz with a 70% pass, and HF privileges with an 80% pass), and the Advanced licence.

Like the USA system, the licence grades are sequential and the Basic licence must be obtained before the Advanced licence is granted. Exams, comprising a mix of theory and regulation questions, are computer generated from a public domain database and conducted by accredited examiners.

The pass/fail result is immediately available. Should a failed candidate wish to be retested, a new and different paper is generated as often as required.

The licence is free and is granted for life. Call signs are issued also on a 'next available' basis, unless a prior request has been lodged online. This whole process is essentially paperless. The peak Amateur Radio body RAC - Radio Amateurs of Canada - provides training courses and study material.

UK

The UK Amateur Radio examination system is devolved to the representative body, the Radio Society of Great Britain (RSGB). None of the question bank is in the public domain. Like the USA and Canadian system, the UK licences have a tiered structure and all three examination papers (Foundation, Intermediate and Full), comprising a mix of theory and regulation questions, must be passed sequentially.

The fee imposed for sitting each of the papers is £27.50, £32.50 and £37.50, respectively. The Foundation and Intermediate exams can be taken online and the result is given at the end of the assessment.

The Full licence examination is only available in a paper format. It is forwarded to the UK regulator (Ofcom) for computer grading, and the result is mailed out within six business days. In all cases, the candidate pays no more fees as the licence is granted 'for life', subject to revalidation every five years. A call sign is selected online and the licence is then downloaded from Ofcom.

New Zealand

Closer to home, this is how the process works in New Zealand: there is one single licence grade – equivalent to our Advanced licence – and the question bank of combined theory and regulation questions is in the public domain. Exam questions are generated by software for each candidate, and on the examination day it is quite likely that no two papers are alike.

The examination process is devolved to the representative Amateur Radio body, known as the New Zealand Association of Radio Transmitters (NZART). There is a NZ$5 examination fee, but the regulator, RSM (Radio Spectrum Management) imposes a NZ$95 processing fee. On the upside, however, there is no annual licence fee and the licence is granted 'for life' in blocks of five years.

Compare & contrast – the way ahead

How extraordinarily archaic the Australian system is by comparison! Rather than dwelling on why the current process here has ended up in an obscene profit-driven price-gouging mess, run by a non-representative body with absolutely no empathy for the community of licensed amateur operators, let me propose a better/fairer/cheaper alternative.

The examination service must be returned to a representative Amateur Radio body. There may be more than one, but all are to be subject to precisely the same rules for the accreditation of examiners and the conduct of assessments.

1) The current practice of having separate theory and regulation papers for the Standard and Advanced licences is to be dropped and, like the Foundation licence, combined into a single paper. This may well result in papers with additional questions, BUT the double-dipping of examination fees must cease.
2) The question bank should be placed in the public domain. Every prospective examinee will then have the opportunity to review the questions and be guided to learn only what is to be tested. A corollary to this may ultimately see the demise of the Standard licence, which is a remnant of the old Novice grade from last century!
3) Examination papers should be generated using appropriate software. A pass/fail result is to be immediately communicated to the candidate and a call sign is to be automatically issued on a 'next available' basis. The end game here would be to have a predominantly online testing format in lieu of paper shuffling.
4) To the maximum extent possible, the ACMA register of communication licences is to be updated directly by designated examiners using a secure encryption protocol.
5) As is the case in the USA/Canada/UK/NZ, licences should be granted 'for life', subject to revalidation every (say) five years.

These are the core elements. Wrapped around them are other necessary features, such as the syllabus and question bank (both subject to being regularly reviewed to ensure continued fitness-for-purpose), examination room protocols, auditing and so forth.

Nothing in the proposed model is tinged with fantasy or is utterly impossible to implement.

It is done elsewhere by more progressive administrations. Hence, there is absolutely no good reason why it cannot be replicated in Australia. All that it takes is a willingness by all the parties to commit to implementing a robust model that features inherent fairness, same-day service and removal of the crippling financial barrier for new entrants to the Amateur Radio Service.

The phasing-out of paid labour content in shuffling paperwork must lead to dramatically reduced financial costs to the assessed candidates, as well as to the ACMA. If our regulator were to impose a once-only processing fee for first time licensees, and dispense with the annual licence fee, then we would become truly invisible in the system.

I conclude by saying, should these proposed reforms not be achieved, then our wonderful hobby will be fatally wounded, not by design but by (dare I say it) a callous indifference on the part of our regulator, and to some extent the contracted examination service provider, AMC.

For our future's sake, the present system must not be allowed to continue in its current guise.

Chris Bourke VK4YE/AG5US
BA (Mathematics) Dip. Ed.

VK6news

Led by President, Geoff VK6GHD, October and November saw many members of the Peel Amateur Radio Group (PARG) enjoying some back-to-basics amateur radio, and the roll-out of a new strategy – fewer meetings, more amateur radio.

80 metres

On the suggestion of John VK6FAAJ, a Group 80m net has started on the second Tuesday of each month at 1900 WA time, on 3600 kHz.

Getting back on 80m has been surprisingly challenging, and with all the switchmode power supply interference, amateur radio retailers and the supplier of the VK5TM X-Phase kits reported an upsurge in sales of noise cancellers to WA.

HF noise cancellers

No doubt 2020 will go down as Noise Canceller year for the Peel Amateur Radio Group (PARG). So, after Martin VK6EEE found the VK5TM X-Phase receive noise canceller kit available at a very low price, several members built them.

Maurice VK6HLY reported instant success, with the simple kit able to make a dent in what little locally-generated QRN he experienced in the quiet zone of Bouvard. Terry VK6TTF also built a kit – after brushing off a speck of dirt, which he discovered was in fact one of the surface mount device FETs that he was supposed to be soldering to the board!

When the Group was trying to hook up with VK6GHD portable at Kalbarri, we were all suffering from S9+ static crashes that just wouldn't let up – it was almost as if every time Geoff's FT-817 emitted a syllable, a lightning crash would occur.

Terry VK6TTF was heard to say: "it's a pity that the noise cancellers can't get rid of static crashes", and the discussion turned to what might happen if a sharp out-of-band antenna was used as the sense antenna, to pick up the static crashes but not pick up the 80m signals?

The next day, Terry reported that he'd used a 20m mobile whip as the sense antenna, and it worked well on reducing the static crashes.

Like the noise cancelling system for in-house QRN, we need a sense antenna that picks up the noise, but doesn't pick up the desired signal. Mobile whips generally have very sharp tuning – they'll pick up signals on their resonant frequency, but because the close-spaced windings just look like a choke to non-resonant frequencies, they'll pick up very little else.

So Terry had the perfect solution – a sense antenna that picked up the electromagnetic pulses from the lightning, but not the desired 80m signals.

Portable ops

El Presidenté Geoff VK6GHD operated QRP portable at Kalbarri and Prevelli in October and November, and continued his experiments on portable HF antenna configurations for 80m contacts back to Group members in Mandurah and Rockingham.

The 80m half wave Inverted Vee supported by a squid pole seemed to work the best over the paths, but conditions were marginal before dusk (i.e. before the absorption layer frequency was below 80m).

The morning skeds were more successful and Maurice VK6HLY was copied at 5x7 with 10 watts from the mighty Wheatbix home-brew transceiver to the VK6XT Remote at Broomehill.

The back-to-basics strategy has seen more members come out of the woodwork to enjoy the simple challenges of real amateur radio. All sorts of stealthy and not-so stealthy home antennas are being considered, and for those not able to get on just yet, the Australian Travellers' Safety Net SDR has been well used.

Among the not-so-stealthy solutions, encouraged by Mrs Baz who wanted a better solution to the 80m dipole in the Hills Hoist, VK6MU twisted the arms of Tony VK6DQ, Terry VK6TTF, and Paul VK6LL, to put up a 10 m-tall lattice tower.

Paul, having a tower-like physique, was just about able to walk the thing up as it turned out (don't try this at home folks), with just a little assistance from a jib. We're looking forward to hearing some big signals from Calista.

Geoff VK6GHD continued liaison with the managers of the three lighthouses and heritage homestead and confirmed an invitation for PARG to deploy to the lighthouses at Cape Leeuwin, Cape Naturaliste and Foul Bay, as well as the Ellensbrook homestead.

Given the RF remoteness of Ellensbrook, we would like to setup a small portable station to establish communications with the two Capes, as well as to talk the world on HF – listen out for the team on the weekend of 27th and 28th of February.

PARG Portable Parks Field Day – 29Dec20

Following on from recent portable activities by club members and the interest and support shown by other members, the PARG committee decided to schedule a family-friendly portable field day for Tuesday 29 the December 2020, focused on regional VKFF parks.

Some initial planning work had

Photo 1: Debrief at the Ravenswood pub.

been done over the preceding months, including a presentation on portable operations and the WWFF/VKFF programme at a recent technical Tuesday meeting (see the PARG website for the YouTube video, at: *www.parg.org.au/workshop-technical*). Many members had already begun preparing portable and mobile gear.

Advice was sought from national and VK6 state VKFF coordinators, Paul VK5PAS and Hans VK6XN. Sue VK5AYL, developer of the outstanding Parks and Peaks IOS phone/tablet app, provided members with invaluable advice on using the app for identifying parks, alerts, spotting and logging QSOs.

A number of other members nominated to be chasers (shack sloths), including David VK6FAAZ, Baz VK6MU, Don VK6DON, Tony VK6DQ, Terry VK6TTF, and Mark VK2KI.

Most of those who planned to deploy spent the week in a flurry of preparation – finding transceivers, antennas, batteries, etc. Luckily, a number of members did an early reconnaissance of their proposed parks, some of which identified challenges – particularly, access through locked gates. However, when dawn broke on 29 December, all were packed and ready to go.

On the day, all PARG members succeeded in achieving at least 10 QSOs, meaning that they all successfully activated their first parks, but most importantly, a fun day was had by all.

The aim was also to encourage as many partners as possible to share the fun, and a number of members' intrepid XYLs accompanied the explorers, including Leslie (with Maurice VK6HLY), Jackie (with Geoff VK6GHD), Jean (with Martin VK6MJ), and Julie (with David VK6FAAZ), for some or all of the activities.

During the replenishment and debriefing session at the Ravenswood hotel, many tall stories and tales of woe emerged, including Geoff (VK6GHD) who, despite many recent portable operations, remembered his radio gear – but forgot his camp chair and table!

And then, from Maurice VK6HLY, there was: *". . . all was going well when I felt something squirreling up my inner thigh. But after a couple of attempts to stop any further progress, I thought it was time to drop the jeans while still trying to sound cool and collected on air.*

Sure enough, a tic looking for a meal. Leslie was then placed on tick watch as well as continuing as scribe. After an excellent lunch at the Ravo in great company and then returning home, a thorough mutual tick inspection was carried out (yeah, sure!) and another was discovered on Leslie's knee which was promptly dealt with . . ."

Keep an ear out on 14 March and 24 April for more PARG portable ops field days.

TechTalks

Recovering from his honeymoon, our Secretary, David VK6FAAZ, presented a TechTalk on Website Management to the Group in October; the YouTube video of the presentation is available on the PARG website, at: *www.parg.org.au/workshop-technical*.

The video includes follow-on discussions on Morse keys by Tony VK6DQ, a superb example of a Crammond Commodore – 55A maritime transceiver by John VK6FAAJ, RF-phasing HF noise cancellers by Maurice VK6HLY, PAKRAT configuration by Terry VK6TTF, and a preview of a web-based magnetic loop antenna design solver, by Miguel VK3CPU.

Not surprisingly, the November TechTalk and Workshop focused on HF noise cancellers – theory, demonstration and comparison of the MFJ-1026 and VK5TM XPhase units, as well as an experiment on reduction of both static crashes and in-building switchmode power supply QRN.

The December TechTalk was a terrific Zoom presentation by our Victorian member Miguel VK3CPU on his development of smarthone and computer-compatible web-based calculators for loop antenna design and RF inductor design – see the PARG website (as above) for YouTube videos of TechTalk presentations.

Photo 2. VK6MJ/p valiantly trying to reach the Cirrus clouds.

VK6RMH Repeater

Martin VK6MJ has enabled the 91.5 Hz CTCSS subtone on the repeater. The purpose is to reduce interference triggering the repeater and to allow Perth stations to work the 146.850 MHz Exmouth repeater via tropospheric propagation without triggering RMH.

Slow CW Contest

The Group has decided that the first of the February 80m slow CW contests would be held on Saturday 20 February as an intra-club event, with a view to expanding to VK6, and maybe beyond, down-stream. Timing of this article for AR Magazine didn't allow details to be advertised in time, but a note will be included in the WIA Broadcast closer to the event.

Meetings

PARG meetings are now at 1900 WA time, as follows:

1st Tuesday of the month – 2m net on VK6RMH.

2nd Tuesday of the month – 80m net on 3600 kHz, with 3595 as a backup.

3rd Tuesday of the month – TechnicalTalk / Workshop meeting at the SES HQ in Greenfields and via Zoom Videoconference – links to YouTube videos of the TechTalks are available in the Workshop/Technical area on the Group's website: *www.parg.org.au*

Contact the Secretary, David VK6FAAZ via *parg_secretary@iinet.net.au*, or check the website for more information.

Cheers,
Geoff Hart-Davies VK6GHD
Mark Bosma VK6QI / VK2KI

WIA Awards

Marc Hillman VK3OHM/VK3IP

Below are listed all New awards issued from 2020-11-14 to 2021-01-07

Go to *http://www.wia.org.au/members/wiadxawards/about/* to use the online award system.

New awards

DXCC Multi-band (3)

#	Call	Name	Mode	Band	Count
188	VK3WE	Rhett Donnan	Open	30-20-15m	361
189	VK5SA	Chris Levingston	Open	30-20-17m	423
190	VK5SA	Chris Levingston	Digital	30-20-17m	376
191	VK6SJ	Stephen Kennedy	Open	20-15-10m	344
192	VK5SFA	Steve Adler	Open	30-20-15m	403
193	VK5SFA	Steve Adler	Digital	40-30-20m	329

DXCC Multi-band (5)

#	Call	Name	Mode	Band	Count
137	VK5SA	Chris Levingston	Open	40-30-20-17-15m	634
138	VK5SFA	Steve Adler	Open	40-30-20-17-15m	621

DXCC Multi-band (7)

#	Call	Name	Mode	Band	Count
62	VK3GA	Graham Alston	Digital	80-40-30-20-17-15-12m	1313
63	VK3OHM	Marc Hillman	Open	80-40-30-20-17-15-10m	1046
64	VK3BDX	David Burden	Open	80-40-30-20-17-15-12m	1398

DXCC Multi-mode (CW)

#	Call	Name	Count
274	VK2PW	Adam McCarthy	111

DXCC Multi-mode (Digital)

#	Call	Name	Count
125	HB9FPC	Jens Geisel	100
126	DM1HR	Hans-Rainer Langner	140
127	VK3QM	Michael Andrews	107
128	VK5NG	Nicholas Gibbs	111
129	VK5SFA	Steve Adler	205

DXCC Multi-band (8)

#	Call	Name	Mode	Band	Count
32	VK3GA	Graham Alston	Open	80-40-30-20-17-15-12-10m	1804

DXCC Multi-mode (Open)

#	Call	Name	Count
509	HB9FPC	Jens Geisel	100
510	VK3QM	Michael Andrews	107

DXCC Single-band

#	Call	Name	Mode	Band	Count
816	VK3BOY	Phillip Vis	Open	40m	108
817	VK3BOY	Phillip Vis	Open	20m	107
818	VK3BOY	Phillip Vis	Digital	40m	107
819	VK3BOY	Phillip Vis	Digital	20m	107
820	VK3WE	Rhett Donnan	Open	15m	100
821	VK5SA	Chris Levingston	Open	40m	110
822	VK5SA	Chris Levingston	Open	30m	112
823	VK5SA	Chris Levingston	Open	17m	123
824	VK5SA	Chris Levingston	Open	15m	101
825	VK5SA	Chris Levingston	Phone	20m	104
826	VK5SA	Chris Levingston	Digital	30m	104
827	VK5SA	Chris Levingston	Digital	20m	163
828	VK5SA	Chris Levingston	Digital	17m	109
829	VK3GA	Graham Alston	Open	12m	127
830	VK3GA	Graham Alston	Digital	12m	105
831	VK6SJ	Stephen Kennedy	Open	15m	100
832	VK6APK	Aleksandar Petkovic	Digital	15m	100
833	VK2BY	Bradley Devon	Open	12m	104
834	VK2BY	Bradley Devon	Digital	12m	103
835	VK6WX	Wesley Beck	Digital	40m	105
836	VK3OHM	Marc Hillman	Open	80m	100
837	VK3BDX	David Burden	Open	12m	104
838	VK6MIT	Brian Mitchell	Open	20m	101
839	VK6MIT	Brian Mitchell	Digital	20m	101

Grid Square

#	Call	Name	Mode	Band	Count
528	VK2ZQ	Michael Ramsay	Phone	6m	51
529	VK2NN	Peter Garoufalis	CW	HF	117
530	VK4CUZ	Gary Crothers	Digital	HF	342
531	DM1HR	Hans-Rainer Langner	Digital	HF	774
532	IU0LFQ	Alessio Bravi	Open	SHF	87
533	IU0LFQ	Alessio Bravi	Phone	SHF	83
534	IU0LFQ	Alessio Bravi	Digital	SHF	10

Islands of Australia

#	Call	Name	Count
16	VK3BDX	David Burden	20

Oceania

#	Call	Name	Count
49	VK3BOY	Phillip Vis	34
50	VK2ZQ	Michael Ramsay	60
51	YL2CA	Arnolds Preiss	32
52	YO8CRU	Iulian Manolescu	28
53	VK6RZ	Peter Drew	60

VHF Century Club

#	Call	Name	Mode	Band
162	VK2ZQ	Michael Ramsay	Open	6m

Worked All States VHF

#	Call	Name	Mode	Band
233	VK3GA	Graham Alston	Open	6m
234	VK3GA	Graham Alston	Digital	6m

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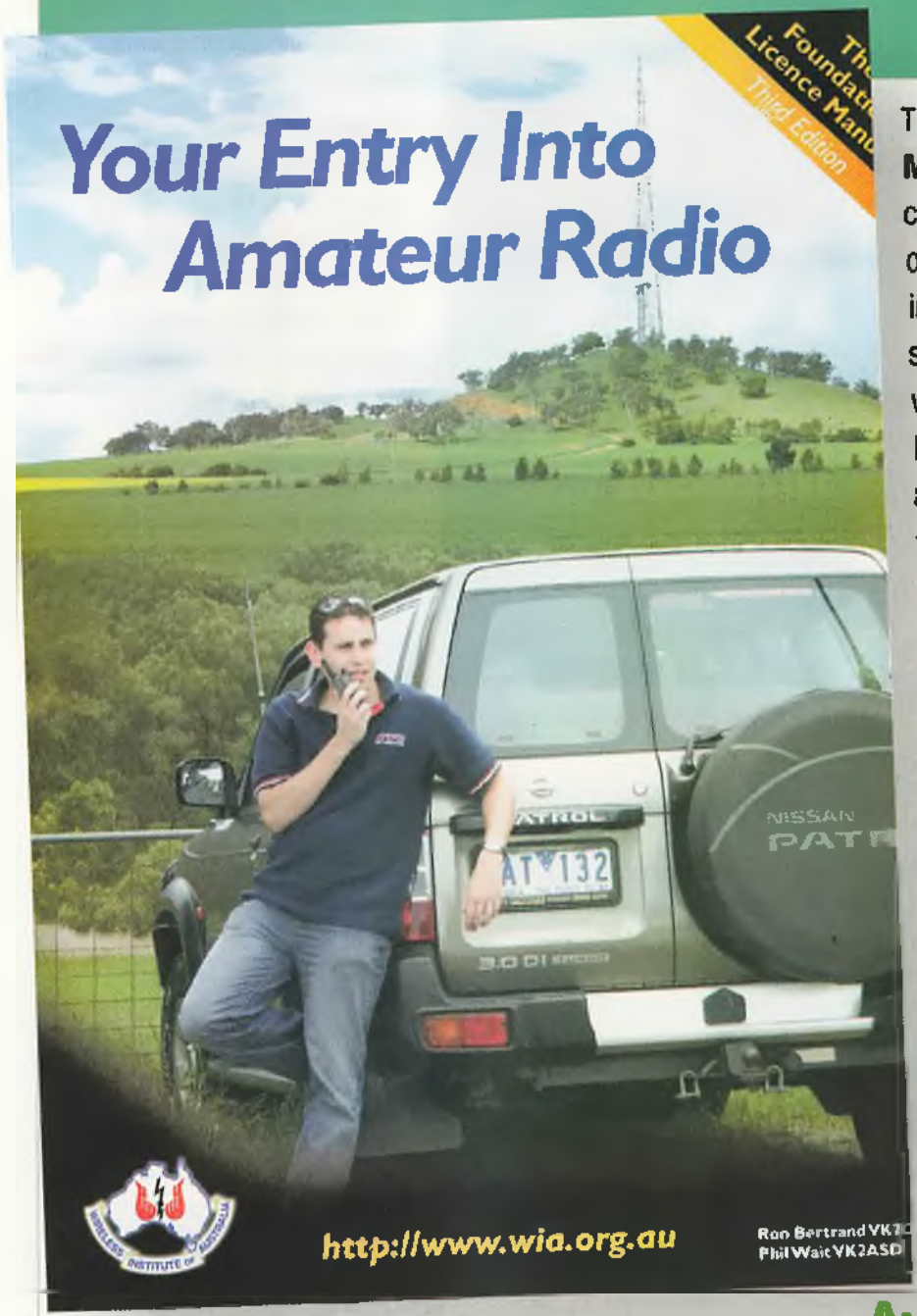

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