PRACTICAL WIRELESS

www.radioenthusiast.co.uk

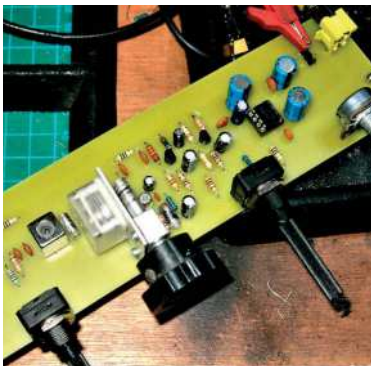
JUNE 2022 THE UK'S NUMBER ONE AMATEUR RADIO MAGAZINE SINCE 1932

WIN | The two Moonraker antennas we tested... (Editor not included!)

XIEGU X6100 REVIEWED

Practical Wireless REVIEW

The pros and cons of this great value Chinese SDR transceiver



Sensitive Receiver

Build this regenerative receiver for the 80m band

2022 Contest Rules

39th Annual PW 144MHz QRP Contest announced

EXPLORE Why Not Try Six Metres This Summer?

Sporadic-E Season in the Northern Hemisphere gives perfect conditions

PRACTICAL Compact 50-tone CTCSS Encoder

Extend the life of your legacy FM transceiver with our low cost project

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Icom, Nevada, Moonraker and more

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PRACTICAL WIRELESS

June 2022 Vol. 98 No 6
On sale: 12th May 2022
Next issue on sale: 9th June 2022

ISSN 0141-0857

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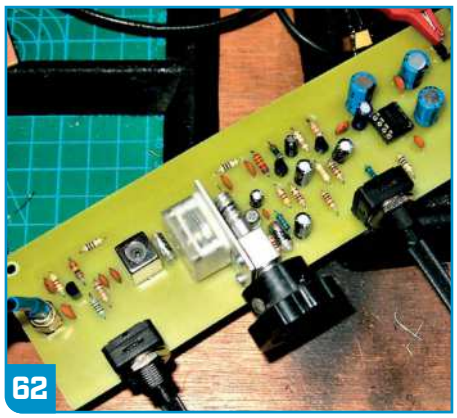
This publication is printed by Warners 01778 395111

Keylines



Another month gone by! And I've actually been to a couple of gatherings – quite a change after all those lockdowns! The first was a belated centenary dinner for my old University Wireless Society (G6UW, Cambridge), a very pleasant gathering where it was encouraging to meet some of the present crop of undergraduates as well as old lags such as myself. The second was the GMDX Convention in Stirling, well attended and with some excellent talks although the main pleasure was actually meeting old friends in person and sitting down to the evening dinner with many of them. And there are quite a few more in-person events to look forward to over the coming months as 'normal' life continues to resume.

Radials Update

A few months ago (in my March *Keylines*) I mentioned that I was installing radials for my LF antenna, fixing them to the ground with lawn staples rather than struggling to bury them. The good news is that I am now regularly cutting the lawn again (the grass has started growing like mad!) and, so far, I have yet to cut through any of the radials so the trick seems to have worked. Maybe I'll put some more down next winter!

Propagation

The GMDX Convention featured an excellent talk on Sporadic E propagation by old friend **Jim Bacon G3YLA**, who is something of an expert on the subject and runs a great website, propquest, which tracks a number of relevant data points and features Jim's daily Sporadic E season blog:

www.propquest.co.uk

This is, of course, relevant given that by the time this issue appears the Sporadic E season should be getting under way (indeed, from my own observations on the 6m band, there are early signs with the occasional openings to Scandinavia, the Balkans, Spain/Portugal and even North Africa by way of Morocco and Algeria).

For HF DXers, contesters and those who like to ragchew with friends around the world, the state of the sunspot cycle is of more relevance and while in Scotland and talking to another friend, **Kerry G8VR**, he mentioned the work of **Dr Scott McIntosh**, Deputy Director of the National Center for Atmospheric Research. I hadn't come across Scott before but Kerry assured me that his work on Hale cycles of solar activity (22-year cycles, of which each 11-year sunspot cycle is one half) has yielded better forecasts of recent solar cycles than most of the other pundits. So, we can but hope that his predictions for the forthcoming Cycle 25 are also good because they are more optimistic than many of the forecasts that have been doing the rounds.

You can learn more about Scott's work through watching the YouTube video (below):

https://youtu.be/GXmJAi57VIg

Geoff Theasby G8BMI

This issue has what will probably be the final article from **Geoff Theasby G8BMI** for the time being. Geoff hopes to contribute from time to time in the future but for health reasons doesn't feel he can keep up the pace of new projects that have characterised his work in the past. I want to thank Geoff for his contributions, which have always been thought provoking.

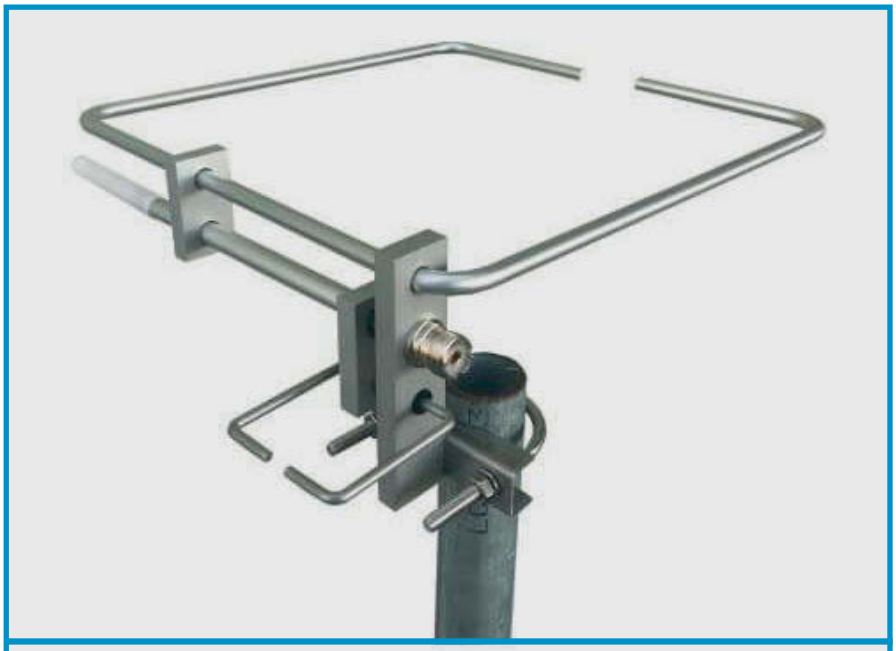
Receivers

Daimon Tilley G4USI's *On a Budget article* this month deals with the shack receiver. This reminded me of a debate that has raged on and off for years as to what exactly is the definition of a 'communications receiver'. Some argue that it refers to the performance but my own take is very simple – a communications receiver is one that can be muted by its associated transmitter to allow two-way communications to take place. By that definition it's true that some excellent receivers of the past fail (I seem to recall, for example, that the Lowe HF-150 had no such capability despite being sold as a 'communications receiver') while other less capable receivers such as the Lafayette KT-340 which I started out with met the criterion (as far as I recall). I'd be interested in whether PW readers agree with my definition! **PW**

Don Field G3XTT
Editor, *Practical Wireless* Magazine

Newsdesk

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



New from Moonraker

The Sharman MD-3500 Slider 80-6m (3.5-50MHz) Mobile Antenna is a complete antenna with simple slide tuning giving coverage of all bands 80 through to 6m. The MD-3500 is an excellent choice for temporary field operations.
Frequency: 3.5-30/50MHz Band
Max. Power Rating: 130W (SSB)
Impedance: 50Ω
Length: approx. 2.6m (max.)
Connector: PL259
Type: 1/4 wave reduced type (HF Band), 1/4 wave (50MHz)
The antenna uses a PL259 mount so you can use this on your existing car mount. Resonance is achieved by sliding the antenna for minimum SWR.
https://tinyurl.com/4avn37ct

Also, the Sharman HLP-270 Dual Band (2 & 70) Halo Antenna, a 'Super Light-weight Half Wave Dipole Square Loop Antenna'.
Mounted horizontally
Frequency: 140 – 150, 400 - 470MHz
Gain: 4dB(VHF) / 5dB(UHF)
VSWR: ⩽1.5
Max. Power: 800W
Impedance: 50Ω

Weight: 0.36kg
Connector: SO-239 (UHF)
Dimensions: 11 x 11in (28 x 28cm)
https://tinyurl.com/3z7c2e6v

TRANSATLANTIC TESTS: The RSGB and ARRL have been celebrating the centenary of the Transatlantic Tests. The Society has just released a video that highlights the fantastic exhibition put on by the National Heritage Centre in Saltcoats, the 1921 message re-enactment by the Kilmarnock and Loudoun Amateur Radio Club and also the 160m Transatlantic QSO Party:
www.youtube.com/watch?v=L1Ww7QDwDI4

EMF HELP VIDEO: The RSGB has recently published a very short video outlining the new EMF regulations and the help/tools the RSGB provides for radio amateurs.
https://youtu.be/pbslKR_NEpM

RSGB ANNOUNCES FURTHER DETAILS OF JUBILEE GB70 SES: As part of the forthcoming Jubilee celebrations, the RSGB has announced further details of its GB70 special event station activities. The seven SES callsigns will be active across the Jubilee weekend, from 2-5 June, on multiple bands and modes. After that weekend, these special callsigns will be available for activation by other RSGB affiliated clubs or individual RSGB Members until 28 June. For further information see the RSGB website:
www.rsgb.org/jubilee

TORBAY AMATEUR RADIO SOCIETY: The Torbay Amateur Radio Society (TARS) are excited to be re-emerging from the restrictions and shutdowns caused by the Covid pandemic and with this being their 75th anniversary the club has adopted a special event callsign GB75TARS. This will be used for the Jubilee celebrations and other special events promoting amateur radio in the local area throughout the year. As with any special event station, they hope to attract many bemused onlookers and, being based in the English Riviera, locals and holidaymakers alike, some of whom may be interested to learn this hobby.
During the darker evenings TARS have been preparing for outside events for when things returned to normal but being fortunate enough to have a large membership, time has been spent well at the HQ with many of their members being able to give an illustrative talk on a variety of subjects. Some of the talk's highlights are recorded and then become available on the club's website. Currently on the site and on you tube is an 'Introduction to QRZ' by John 2E0SPS.
www.torbayars.org.uk

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

AMATEUR RADIO FRIENDS RECONSTRUCT ORIGINAL FALKLANDS INVASION CONTACT: 2 April 2022 marked the 40th anniversary of the Argentine invasion of the Falkland Islands. On that day in 1982, Bob McLeod VP8LP, living at Goose Green, was hearing on a local VHF net that invading troops could be seen in the streets of the capital Port Stanley about 50 miles from him but was surprised to find that the BBC was making no mention of it in news broadcasts. Bob took to his amateur radio equipment and started calling out. In London, Laurie Margolis G3UML had been listening carefully for several hours, sitting in the BBC Ariel Radio Group radio room G3AYC on the roof of The Langham building next to Broadcasting House. G3UML had some expectation that VP8LP would try to call, and they were able to copy each other. Laurie was then able to pass on Bob's vital information to the authorities. Bob and Laurie have remained in touch ever since and Laurie is still a member of the BBC's Amateur Radio Group. On 2 April this year the two friends met up again on the air to relive their contact of 40 years previous, this time using the BBC centenary callsign GB100BBC. Both stations were good signals with each other, firstly on 10m and then 15m, despite the recent geomagnetic storms. Their chat was recorded for the archives and a feature about the original 1982 link-up was broadcast on Radio 4 the following morning as a feature in the 'Broadcasting House' programme. You can listen back to this via BBC Sounds. Laurie was also the guest presenter on last Tuesday's RSGB webinar Tonight@8 in which he talked about his historic contact with VP8LP as well the recent reconstruction and the audience enjoyed some clips from the event. You can watch the Tonight@8 presentation at:
rsgb.org/webinars

FISTS CW CLUB ROYAL PLATINUM JUBILEE WEEKEND CELEBRATION: FISTS CW Club is celebrating the Platinum Jubilee of HM Queen Elizabeth over the holiday weekend at the beginning of June.
The celebration will take the form of an international on-air activity and culminates in the award of commemorative plaques to two participants.
Work as many stations as you can on CW only over the three days – starting at 0001UTC on Friday 3 June and ending at 2359UTC on Sunday 5 June. All HF bands from 160m to 10m, excluding WARC bands and 60m. Each contact must include the exchange of callsigns and, as a minimum, must also include signal reports, operators' names, location of stations and – as applicable – each operator's FISTS number or 'non-member.'
Score 1 point for each QSO per station contacted per band per day (One callsign only once per band on each of the three days).
One QSO point plus bonus points added:
• 1 bonus point added for working any UK station using 'Q' RSL
• 1 bonus point added for a FISTS member when their member number is received on air and logged
• 5 bonus points added for a FISTS HQ station – including GX0IPX or GQ0IPX, GX3ZQS or GQ3ZQS, MX5IPX or MQ5IPX, VK2FDU, ZL6FF, JL3YMV, KN0WCW.
Scores will be subject to adjudication by FISTS Europe and that process will be final.
Logs must be submitted before the end of Monday 13 June 2022 using FISTS Log Converter or by email to jw2022@fists.co.uk in ADIF format. Paper logs cannot be accepted.
Two awards will be presented: one for the highest scoring UK station using 'Q' RSL; one for a station – UK-based or elsewhere – being the station, not using 'Q' RSL, with most points. These awards will be commemorative plaques, engraved with the recipient's callsign and name.
https://fists.co.uk/activities

WSPR BEACON ON THE AIR FROM ANTARCTICA: AMSAT Argentina has assembled and delivered a permanent WSPR (Weak-Signal Propagation Reporter) beacon system to the Argentine research station at Esperanza Base on the Antarctic Peninsula. Using the callsign LU1ZV, the 200mW beacon is presently active on 40, 20, 15, and 10m at 7.0386, 14.0956, 21.0946 and 28.1246MHz, and reception has been reported by stations throughout the world.
You can use WSJT-X to receive the LU1ZV beacon directly, or you can see reports from other stations online at:
www.wsprnet.org

New from Icom

IC-T10 VHF/UHF Dual-Band FM Transceiver

Icom has announced details of a new 5W VHF/UHF dual-band amateur handheld radio, the IC-T10. The radio features a clear easy-to-use layout, rugged commercial build, IP67 dust-tight specification and waterproofing, 1500mW audio and long-lasting Li-Ion battery life, all making it an ideal radio for beginners and seasoned amateur radio enthusiasts alike. Its strong Mil-Spec build and range of features will also make it a practical dual-band radio for voluntary amateur radio emergency services such as RAYNET.

- 5W RF output in 144 and 430MHz.
- Large speaker provides 1500mW loud and intelligible audio.
- IP67 dust-tight and waterproof construction.
- Up to 11 hours* operating time with supplied 2400mAh (typ.) Li-Ion battery pack.
- Home button on top panel provides quick access to calling channel.
- FM broadcast receiver.
- Built-in CTCSS/DTCS for repeater operation.
- 16 DTMF autodial memories.
- Priority, program, memory, skip and tone scan capabilities.
- Free downloadable CS-T10 programming software.
- Optional HM-222HLWP speaker microphone provides loud audio.
- VHF 11 hours, UHF 10 hours (approx.) at 1:1:8 duty cycle operation at 5 W output power (Power save function ON)

The IC-T10 should be available this summer with price and availability to be announced.
https://tinyurl.com/ej355vt3

MANGO GOES CONTESTING (AGAIN):
MANGO, that is Many Amateurs Not Going Out, was born out of lockdown and came together on Zoom. They are a mixture of established and newly licensed amateurs. Last October they took part in CQWW SSB and had a great time, although they don't profess to be a contest club. Amateur radio is a very diverse hobby and they try to have a go at many aspects, usually over the air.

The opportunity to get together again, in person, for the CQ WPX contest was an opportunity too good to miss. Nine of the group took part this time. There was one M6, one 2E, licensed during the lockdown, and two newly minted M0s. That leaves five of them that have been licensed rather longer than they care to admit.

The plan was to operate Multi Single (multiple operators and one radio) and they chose low power (100W). In the main they operated with one person on the radio and one on the computer. Not the way the big stations do it but a good social way of operating with amateurs that are not very experienced at contesting.

The station comprised a Yaesu FT-891 plus a venerable laptop running N1MM+ on two screens.

A selection of antennas included, for 160 and 80m, an enormous EFHW, which also allowed them to work NVIS on 40m. For 40m they also had a folded quarter wave vertical with reflector and director. The reflector and director were reversible so that they could take advantage of contacts into North America and then swap it round to give good coverage of Europe and Asia. For 20 and 15m they used a three-element tri-band Yagi on a 10m telescopic mast. The second section of the mast was left down to allow rotation by the Armstrong method. That is one of the team running over to the antenna and spinning round mast and antenna guided by much shouting and waving of hands from the shack.

The end result is a claimed score of 400,000 points and the little group's callsign is now at 99 countries worked. The group says there is no better way to sharpen up operating skills than contesting. No better way of teaching operating than watching a G4 take 20m Grey line by the scruff of the neck and going on a hunt for DX.

It was an opportunity to try antennas that are not easy to erect at home. The Yagi worked well on 20 and 15m. The 40m vertical worked well as did the end-fed on 80m while on 160m less so but each time they contest they learn a little more.

Mostly it was nine guys having a great time and working together over the two days setting up the station and a further 48 hours of operating and logging in the contest.

The photo shows Rick 2E1RAN and Karl M0KHB operating.

New from Nevada

Nevada Radio have announced a new Digital Audio Filter from XIEGU. The XIEGU GNR1 incorporates both Audio Digital noise reduction and Audio digital filtering. It will effectively reduce background noise, improve signal-to-noise ratio and make received voice transmissions more clear and intelligible. The unit will work with both HF and VHF/UHF radios to give a big improvement in reception.

The Filter has independent adjustments of both input and output levels to work with headphones or an external speaker, giving up to 3W audio output.

The XIEGU XRN1 sells for £229.95 and is available from UK importers Nevada: **www.nevadaradio.co.uk** or Waters& Stanton: **www.hamradiostore.co.uk**

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

Don Field G3XTT
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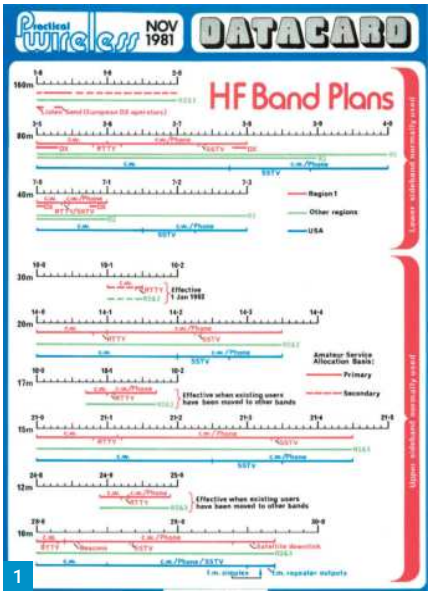

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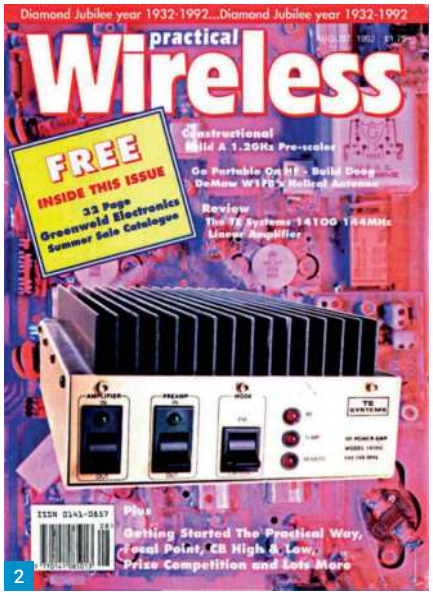

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PW at 90 Years

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

Fig. 1: The November 1981 datacard.
Fig. 2: Cover of the August 1992 issue.

And so to the 1980s and into the 90s. Let's start by going back a bit to the July 1981 issue because it contained an 8-page supplement about CB radio. Yes, this was the decade in which CB came to the fore and, in the course of time, brought many new folk into amateur radio. That whole issue was very much geared to amateur radio, with reviews (Air Test) of a Daiwa power/VSWR meter, a VHF antenna matching unit from LAR Modules and the Wood & Douglas 70FM 10/3 UHF power amplifier. Also, a 'Special Product Report' on the Icom IC-451E 430MHz Multi-Mode transceiver. Featured constructional articles included the *PW* Exe microwave transceiver, the *PW* Stour Top-Band transceiver and an auto cut-out power supply. Also, a speech processor for FM transmitters from the pens of **James Bryant G4CLF** and **Peter Chadwick G3RZP**, a friend of mine who continues to contribute to various publications.

There was also a special offer to buy a parabolic dish for use with the Exe, for £7.50 if collected from *PW's* office or including £2 postage if not. Also featured was an article about the ins and outs of regenerative receivers. And an article about VHF repeaters, the RSGB Repeater Working Group having been set up in 1975 and repeaters by now a well-established part of the VHF scene.

Regular columns included not only amateur loggings (and lots of Club news) but also Medium Wave and Short Wave broadcast reception reports as well as TV DXing column by the late **Ron Ham**.

Lots of advertisements, of course, including for the Drake TR-7 at £989 and the Collins KWM-380 at £1897.50 (I dread to think what that would be in 2022 prices – £7739 appears to be the answer!). And our old friend **Clive Sinclair** was advertising the ZX81 at £49.95 as a kit and £69.95 built (I bought the kit). Advertiser Tempus were offering a free Rubik's Cube (that takes me back!) with orders over £18. But although the magazine ran to 92 pages, I seem to think that the editorial content was somewhat less than is typical nowadays, given that many pages of ads!

December 1982 Issue

Which brings us nicely on to the December 1992 issue, featuring a 16-page supplement 'ZX Computing in Amateur Radio', and including a competition to win a 16k Spectrum computer and a special offer on the ZX81 kit. Unfortunately, I don't have a copy of the supplement so I've no idea what it covered but I feel sure it was a far cry from the multitude of uses we find for computers in our shacks nowadays! Sadly, the rest of that issue appears to have been a bit thin - articles on Radio Interference Suppression, Add-on Squelch, 2m Fox-hunter and Are the Voltages Correct? seemed to be pretty much the sum total.

Datacard

I also can't let this decade pass without mentioning the datacard included with the November 1981 issue, **Fig. 1** – remarkably I still have mine! It featured HF bandplans and a list of 10m beacons. Sadly, it's been many years since we have been in a position to include such supplements – I still have a couple of others tucked away somewhere, including one with resistor colour codes and another that is a very handy units converter.

Mid-Decade

Incidentally, the November 1980 issue appears to be the first in which **Elaine Howard** (later to become Elaine Richards, wife of *PW* data columnist **Mike Richards**) **G4LFM** was the Technical Features Editor – most readers will be much more familiar with her as Editor of the RSGB's *RadCom*, a role which she has occupied now for many years although her retirement is imminent. The editor for much of our decade was still **Geoff Arnold G3GSR**, but in 1989 he left to found *Radio Bygones* (and became a Silent Key some four years ago). **Rob Mannion G3XFD** first makes his editorial appearance in the January 1990 issue, which also featured a personal message to the world of amateur radio from **King Hussein of Jordan JY1**. Rob had engineered this coup through his wife, who had, at one stage, worked for the King, looking after his children. (Incidentally, double-checking this story with Rob recently, led to a fascinating exchange of emails – many of you will remember his 25 years at the helm with pleasure and be pleased to know he is still going strong.)

The Decade Ends

Our decade ends with the August 1992 issue, **Fig. 2**, which included a 32-page summer sale catalogue from Greenweld Electronics, a company which I cannot recall at all although I am sure many readers will.

But 1992 was also *PW's* Diamond Jubilee Year. Rob Mannion G3XFD was, as I have mentioned, in the editorial chair, **Tex Swann G1TEX** was also contributing as Technical Projects Sub-Editor and **Martin Lynch** (no sons yet!) was advertising.

The look of the magazine had changed too, with spot colour and a more 'modern' layout. But the price had also risen over the decade from 85p to £1.75.

And, yes, going back to where we started, there was indeed a CB column, to keep those possibly would-be amateurs interested. And our now CW columnist **Roger Cooke G3LDI** was penning a column entitled *Packet Panorama* – yes, this was the period when AX.25 packet radio was developing fast, with bulletin boards springing up around the country, linked by a backbone, mostly on 70cm and 23cm (no internet linking back then, although a 'wormhole' existed to link our system to the US, presumably hitching a ride on someone's company private circuit!). **PW**

1

The Xiegu X6100

Daimon Tilley G4USI gets his hands on the latest offering from Xiegu.

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

Regular readers will know that I am a bit of a Xiegu fan. I already own the G90 and X5105 radios and have also reviewed the G1M. I was delighted, therefore, when **Alan** at Sinotel asked if I would like to review the latest offering.

It was nice to see that when the rig arrived, Xiegu have updated their packaging, giving a more professional appearance, and there was a proper printed manual to get you started. The rig comes with a fist microphone, allowing quite a few operations to be performed from it, a USB-to-USB C cable, a dedicated mains charger (but the two-pin European variety and no adapter) and a power cord.

The rig itself, **Fig. 1**, is of a very similar size and weight to the existing X5105 and has a well-made feel about it. Covering 160m – 6m, the rig is capable of between 0.1 and 5W from its internal 3,000mAH battery, or 10W from an external supply. It is not clear what voltage is required from an external supply to achieve 10W, but I managed to get this with just over 10V, which is very handy – rigs such as the IC-705 require a full 13.8V for maximum power, which can be a disadvantage in some cases, such as mobile use for example.

First Impressions

Powering up (and down) takes a few seconds as the software does its thing, and when I first powered the rig up I was very impressed by the bright, clear and colourful screen, which is easy to read and displays all the information you need in one go. Actually, I was really pleased to see the display was quite readable even in direct sunlight. The second thing that struck me was the quality of the received audio, which is far superior to the X5105, probably in part to a larger speaker, but very noticeable indeed and drives to a very good volume without distortion.

The layout is similar to the X5105 in a broad sense, but there are some new buttons as well as common ones having changed position. Two new additions are a proper rotary knob used for volume, squelch and RF Gain (alternated by pressing the button) and a multi-function knob for choosing menu settings. I also like the change to the VFO control, which is now also a proper knob and, as a really nice improvement, the encoder has no detents and turns freely without clicks. In fact, you can even 'spin the dial' and it will freewheel a little, which makes spinning through the bands very nice indeed and quite quick too.

Of course, the waterfall display is yet another addition with the nice big screen, **Fig. 2**, and I find this clear and nicely done, with a little silhouetting done on the panadapter section to show a good few seconds of band activity history. The bandwidth displayed can be changed between either 50 or 100kHz and the main screen also shows an audio scope, which is useful, as well as SWR level, but this is not perfected yet on my version. More on this later.

2

Key features are now accessed via a dedicated button to the left-hand side, and these are as follows: a 'GEN' key, brings up a General menu list across the bottom of the screen, with two menu options for radio settings, one for display, one for system and one for memories. Each of these is accessed by a small button underneath the relevant option on the display (there is no touchscreen facility.)

An 'APP' key gives access to the digimodes Modem (CW, BPSK and RTTY can be both de-

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Fig. 1: Front view.
Fig. 2: The nice clear display.
Fig. 3: Top view of battery pack.
Fig. 4: The 3D-printed battery pack.
Fig. 5: High SWR reading on 30m.

coded and sent), the SWR Scanning function and Voice Call Messages.

The 'Key' button allows amendment of CW keyer functionality, the 'MSG' button, CW message functionality, 'DFN' gives access to Noise Reduction and Noise Blanker settings, and finally, 'DFL' gives access to three separate Filters.

Working through some of these functions again, in the 'APP' mode, when using the MODEM function I noticed that the CW decoding was reasonable, maybe a slight improvement on the X5105/G90, and in this mode the small audio scope on the display shows two red vertical lines at about 700 and 1,000Hz. I found that the 700Hz line works well as the CW Zero-In indicator. It would be nice to see these lines present on the scope in normal use. It was simple to adjust CW decoding speed from this screen, but to access the CW memories from this screen it is necessary to press the 'MSG' button as well.

I have to say that I was disappointed by the SWR scanning function, which did not appear to work very well or to be accurate. I think that this, in turn, limits the ability of the internal ATU. On one nice day I was operating from the patio using a long wire and 5m counterpoise. The X5105 tuned the wire on 40m beautifully, but the X6100 just plain refused to tune it at all on that band. I cannot believe that the ATU has changed much from the X5105/G90, so suspected this was a firmware issue, which I hope will be resolved. Indeed, when I took the rig out to my fields, I was able to tune up my cattle livestock trailer and over a half-mile of electric fence (switched off of course!) so I think that the SWR/Tune facility is a bit 'flukey' on my firmware version. A little more on this at the end of the article.

On the positive side, the digital noise reduction was excellent and I found that this did not greatly degrade the audio quality. The digital filters are also excellent and you can set the three defaults for different modes, setting high and low cut-offs, and allowing IF shift. They are really simple to use and very effective. I particularly like the fact that selecting the filters puts them as a large overlay on top of the waterfall making them very easy to read and adjust.

Again, similarly to the X5105, a number of buttons are placed on the top side of the rig. This is understandable to make space for the screen and knobs, but it does have the disadvantage of having to keep tilting the rig forwards to identify the correct button to press. Having said that, you do get used to the buttons' location, and should it be used regularly you could do it by touch alone, I am sure. All buttons are nicely backlit, making it great for evening and night-time use. The buttons on the top are for the inbuilt PTT, Band changes, Mode changes, switching between VFO A/B, selecting the ATU, Memories, AGC and VFO Tune rate.

In Use

Having familiarised myself with the basic functionality, my first CW QSO was a good 25 minute chat and it was a pleasant experience. CW filters of 500, 250 and 150Hz are available and although there was some ringing, I found these effective with good skirts. It is important to note that to make the most of CW functionality, including the CW Zero-In line and CW memories, it is best to operate this from the Modem setting. SSB was similarly easy to use and I received several good audio reports.

I decided to then try digimodes and found setting up with the PC to be very easy indeed, using OmniRig and instructions provided on the Sinotel website. The rig creates two COM ports on the PC, which are used with OmniRig. The only other need is to tell your digi software the Line In and Line Out to be used. Only the single USB-A to USB-C cable is required, and this carries the audio as well as CAT commands – a big improvement, especially when using the rig portable. I managed to get operational without needing any amendments to the X6100 settings except for choosing USB-DIG mode and went on to make a number of FT8 and FT4 contacts. I then turned to WSPR on both 80 and 40m, which I left to band-hop overnight. No drift was reported and this is in line with the manufacturer's claims of a one part per million high stability TCXO.

AM broadcast reception was also a pleasant experience and the audio continued to impress me for a rig of this size. The waterfall display also added to the BC reception experience.

Firmware

Let us turn our attention to Firmware. In my experience it takes Xiegu quite a little while to get to the point where the user can be satisfied that all functions perform well. This rig is no exception. The good news is that they nearly always get there in the end. If you are thinking of buying this rig, beware that we are not yet in that position, more needs to be done. My demo model shipped with the 1.1.2 firmware. Since that time, versions 1.1.3 and 1.1.4 have been released. I have chosen not to try to upgrade the firmware on this rig because the X6100 community tell me that while these later firmware updates fixed some problems, they created others! I understand that one of the things improved has been the SWR scanning functionality, and indeed this might allow me to tune my patio long wire. However, as an example, it is reported that while fixing this issue, it broke the CW decoding functionality. This is a feature with Xiegu updates, several improvements along with a number of unintended consequences!

Other functions not really working satisfactorily at the moment are Wi-Fi and Bluetooth. While I understand you can connect the rig to Wi-Fi, it currently serves no useful purpose. Where Bluetooth is concerned, I am able to

5

discover a number of devices and can connect to my phone, but again it provides no current functionality. I seem unable to connect to a Bluetooth speaker, although I know others who have – perhaps they are using a different Firmware version? A number of users have also been successful in connecting a Bluetooth keyboard and mouse, for RTTY etc. These Firmware issues do tend to get fixed in the end though, and I believe that in the next 12 months or so we will end up with stable and reliable firmware allowing full functionality.

Battery Life

One compromise made with all this new functionality is battery life. Xiegu have switched to an 8.2V, 3,000mAH battery. Combined with the enhanced functions and the lovely large colour screen, this does mean that battery life is a bit of an issue for portable work. I decided to test this out in two ways.

First, I turned the screen down to the lowest brightness, found an SSB contest station on 20m, and just left it to receive at a moderate volume, I did not transmit at all. I was sat alongside the radio for the entire time and the battery went from fully charged to flat in 2 hours and 50 minutes. By contrast, the X5105 lasted for 6 hours and 30 minutes.

I then decided to try a typical portable operating style. Once again, having gone from fully charged, I transmitted a total of 21 short CW CQ calls using the built-in memory keyer and had nine QSOs. Eight of these QSOs were of the brief contest type report in the CWOps activity sessions, with one more of a standard style QSO. I managed two hours of operating before the battery went flat. That is a bit short for my personal liking but might suit the odd ad-hoc portable spell. It would be a shame to have to cut your foray short though, so an additional external battery source would probably be sensible.

And therein lies my own dilemma. Make no mistake, this is a superior rig in nearly every respect to the X5105 for only an additional £50. It is excellent value for money, and when the firmware is fixed and stable in all respects it would make an excellent field radio, but the only things stopping me trading my X5105 for one are the battery life and the current SWR/ATU issues. For me the beauty of these two rigs is that they are true HF shack in a box rigs. The combination of internal battery, internal ATU and even an internal microphone and PTT button makes the X5105 my 'grab and go' radio of choice, but if I have to take another battery pack to be sure my trip is not caught short, would that work for me? At the moment, the honest answer is I just don't think so.

Interestingly though, I recently came across a Facebook feed of **Ralf Dollmann DL1BAX**, who has used a 3D printer to build a piggyback style Li-Ion 18650 battery case. The case itself was designed by N7DDC and bolts to the rear of the rig. It actually makes the body shape look almost identical to the IC-705 and provides front facing rack-type handles. Using six 18650 cells in a three series, two parallel combination (3S2P), this gives around 12V and allows the full 10W to be run too. Ralf is using 3,500mAH batteries for a total capacity of 7,000mAH, more than twice the capacity of the internal battery. Based on my experiments this should give a good six hours or more of CW usage using a combination of the built-in battery and this pack – much more like it. The other bonus of this pack is that it truly becomes part of the radio so, although adding both bulk and weight, it is still just the one unit to grab. I have included some photographs of Ralf's build here, with his permission, **Figs. 3** and **4**. The design files for the 3D printed case are available on Thingiverse.com, and the weight of the radio increases from just under 1kg to 1.25kg with the fitted battery pack.

Summary

To summarise, this is a great rig, which just needs some more firmware tweaking to be perfect. I am sure that will happen in the next 12 months or so and some of the additional features such as Bluetooth and WiFi will become more than just marketing gimmicks and be really useful. Once again Xiegu have hit the sweet spot, producing a great little radio that is a match for other, more expensive radios in the same market segment.

Last Minute Postscript

Just before the deadline for this article, I decided to give the latest Firmware a whirl. I downloaded the latest version from the Sinotel website along with the instructions. Updating was pretty straightforward, but you do need a micro-SD card. On successful completion of the upgrade, I went straight outside to my patio long-wire. You will recall that my G90 and X5105 both tune this beautifully on 40m. I was hoping the firmware upgrade had fixed the SWR/ATU issue on the X6100 and it would now tune it. No such luck, it stubbornly refused to tune it below 3:1. Returning to the shack, I connected the rig to the three antennas I use on HF and which, only yesterday I had checked with the NanoVNA. Unfortunately, the SWR scanning issue does not appear fixed. Just as an example, my 132-foot-long End Fed Half Wave for 80m returns a pretty flat SWR across the entire 30m band. Not according to the X6100, which, at times, was showing an SWR of over 10:1 at about 10.110MHz (see screenshot, **Fig. 5**). Even more bizarre is that the reading was not consistent between all of the sweeps, with the rig reporting very different 'high' spots on the band at differing times. The X5105 properly reported an almost 1:1 SWR. I assume (hope) that this erroneous SWR metering is driving the ATU issue I noticed and that it will eventually be resolved. As reported by others, the CW decoder just does not work at all on this current firmware release, although I don't personally make use of that functionality in any event.

My thanks to Alan at Sinotel for the loan of this review model. The X6100 costs £549.98 and is available from Sinotel (although the website reports 'sold out' at press time): **www.sinotel.co.uk** **PW**

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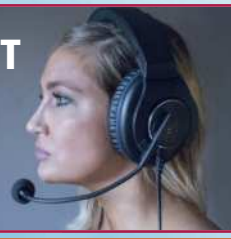

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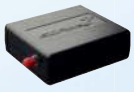

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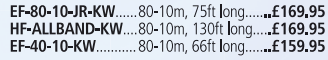

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PA70-5-3	4m 5 el 3m boom	£169.95
PA70-6-4	4m 6 el 6m boom	£179.95

Dual Band 2/70cms

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PA144-432-37-7-2CBGB	12 el/25 el 2 con	£349.95
PA144-432-13-1.5-2CB	5 el / 9 el 2 con	£289.95
PA144-432-17-2	6 el/ 12 el	£159.95
PA144-432-19-3-2C	7 el / 12 el	£219.95
PA144-432-21-3B	7 el / 14 el	£199.95
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1

Two Antennas from Moonraker

Don G3XTT takes a look at two very different antennas from PW advertiser Moonraker.

When **Chris Taylor** at Moonraker offered these antennas to *PW* for review, I jumped at the chance to check them out myself, albeit for two quite different reasons. Let's look at what he sent.

The MRQ213 17.5ft Stainless Steel Telescopic Antenna (70MHz to 14.3MHz) intrigued me. We are all familiar with telescopic antennas, but this is the first one I have come across that is long enough to be a quarter wave on the 20m band!

However, when you think about it, the idea is pretty obvious. I have used loaded antennas, with a short telescopic whip and loading coil, but they never seem to do the trick – they are simply too short to be efficient. But a full-size quarter wave should be different. The whip is terminated in a 3/8in thread, common for mobile installations but a PL259 adapter is available if required. The whip is just 75cm (30in) long when retracted.

The antenna arrived along with a substantial magnetic base, **Fig. 1**. This is never going to be a permanent home installation but on top of a car (while not in motion, it has to be said), on the beach or some other suitable location, it ought to provide the opportunity for some portable operation away from all that interference that many of us suffer at the home QTH. And, into the bargain, we can select a location that will afford a good take-off on whatever band we want to operate – any from 4m through to 20m.

There was only one thing to do – go out and try it in action. Would the car provide a sufficiently effective 'ground plane' to allow the antenna to work effectively? And would the antenna stand up to the rigours of typical English weather?

My first outing was to Berrow Beach here in Somerset, during the weekend of the ARRL Phone contest, a great opportunity, hopefully, to work some of those loud North American stations, **Fig. 2**. The 10m band was closed to the US but 15m was reasonably well open and I soon managed to work from Prince Edward Island in Canada down most of the East Coast as far as Florida. This with 100W using my Icom IC-7300. Not bad and, of course, a reminder, if needed, that a beach location is ideal for radio propagation (at Berrow it's fine to actually park on the beach itself).

To 'tune' the antenna I simply used a tape measure to measure out a quarter wave on 15m using the usual formula (234/freq. in MHz, to get the length in feet). Incidentally, you don't actually need to calculate anything – suggested lengths appear on the Moonraker website and are listed in **Table 1**. I checked out the SWR using my MFJ antenna analyser and it was below 2:1, sufficiently low that my IC-7300's tuner could deal with it without any 'tweaking' of the chosen length, which convinced me that simply measuring and operating would be fine, without needing to take an analyser every time.

The problem came when I tried to operate on 20m, simply because the windage on the extra length caused the magnetic base to lift from the car roof. It probably doesn't help that my car roof has ridges, rather than being completely flat. And, inevitably, the sea 'breeze' was actually quite strong. The triple magnetic mount (see later) might have helped.

Fig. 1: The 20-4m telescopic whip and magnetic mount. Fig. 2: Set up on Berrow beach. Fig. 3: Second outing, from my son's paddock. Fig. 4: The 4m vertical, on arrival. Fig. 5: 4m vertical set up in my garden.

Next Outing

For my next outing I went to my son's place and operated from one of his paddocks, **Fig. 3**. Now six miles from the sea and a rather better day, weather wise! Again, 100W from my IC-7300 and this time the weekend of the WPX SSB Contest and also the FOC QSO Party (on CW). What's more, band conditions seemed to be a lot better than that first outing. The 20m band was not really open to North America at the time I was operating – just one QSO – but I did work all over Europe without difficulty and into the Middle East (Kuwait). The 15m band was well open to many locations, resulting in contacts from Kenya across to Brazil, throughout the Caribbean (Curacao, St Eustatius and Belize) and well into North America, as far across as Arizona. For someone who is used to using 400W and a beam antenna, this was all quite satisfying, fun even, given the modest setup.

Of course, it's not necessary to use this antenna on a car. It could equally be used on ground or mounted on a pole, but in that case you would need to provide a suitable ground plane by way of a set of (ideally resonant) radials or a counterpoise wire of some sort. And you'd need to find a suitable way of feeding and supporting it – some sort of 3/8 connector or an adapter (Moonraker sell a heavy duty PL259 to 3/8 adapter, for example, although it was out of stock when I looked).

Conclusions

The MRQ213 sells for £49.99. The heavy-duty magnetic mount with 3/8 fitting (as I used) sells for £16.99. A triple magnetic mount (presumably more beefy) sells for £39.95. Other options include a PL259 to 3/8 adapter (£4.99). To my mind this is a very reasonably priced way of being able to get out and about, away from local QRM, and have some fun, while not being constrained to just one or two bands.

The SQBM499 4m (70-72MHz) 2.5m Aluminium Base Antenna

The SQBM499 is quite a different beast. This is a substantial 5/8-wave vertical antenna for the 4m band. I was particularly interested given that the Sporadic E season is expected to start in early May and run through July and even into August. While you probably won't work huge distances on a vertical antenna, most 4m activity is still confined to Europe and I am expecting that this antenna will be more than adequate to work across Europe on SSB, CW and, especially, on FT8.


2

The antenna consists of three substantial aluminium sections that screw together, along with three base radials, **Fig. 4**. The specification says:

Frequency: 70-72MHz
Gain: 4.1dB
Power :100W
Weight: 2kg
Length: 2.5m
Radial length: 90cm
Mast size: 30-52mm
Wind velocity: 40m/sec
Connection: SO239

Putting it together and installing it was trivial, **Fig. 5**, with the exception that the brackets would not go round the pole I had selected, a 2in aluminium one, despite the specification saying it was suitable for a pole up to 52mm. In practice, I would recommend using it with a 1.75 or 1.5in pole.

3

4

My fist action was to check the VSWR with my MFJ meter. It was very flat across the whole of the 4m band and beyond, with lowest VSWR at 1.01:1 at 71.2MHz. Unfortunately, there was very little activity on the band during the test period but I did copy several FT8 calls (I wasn't in the shack for these but could see what had been copied after the event), from several tens of miles away and, remarkably, one from GD7DUZ on the Isle of Man – I'd be interested to know what the propagation mode was. Aircraft scatter, perhaps?

Other than that, it was a case of setting up skeds with some 'locals', who all confirmed that I was a good signal.

Conclusions

The SQBM499 sells for £59.99, which, given its very solid construction, seems to me like a great price. If you don't have an antenna for the 4m band and perhaps have never actually tried the band, I'd certainly recommend giving it a go during the next few months. Obviously, the band won't be 'open' 24/7, but when it is, you'll be rewarded with some great QSOs. Of course, it makes sense to use some decent coaxial cable to feed it as losses mount as the frequency gets higher. In my case I have Ecoflex 10 Plus, bought last year for last year's Sporadic E season as I had a long run to my 50MHz antenna – the difference compared with the cheaper coaxial cable I had used the previous season was very noticeable. My only quibble is that the antenna's power rating is just 100W, whereas I typically try to run full licensed power but, frankly, 100W is more than enough power to make Sporadic E QSOs when the band is open. The power limit is presumably because, being a 5/8-wave vertical antenna, it requires a matching unit at its base. **PW**

5

70MHz (4 metres)	101.5cm
50MHz (6 Metres)	141.1cm
28MHz (10 Metres)	250cm
27MHz (11 Metres)	258.6cm
24MHz (12 Metres)	286.1cm
21MHz (15 Metres)	336.9cm
14MHz (20 Metres)	505.3cm

Table 1: suggested lengths for the various bands.

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk

Data Modes at VHF

This month **Mike Richards G4WNC** continues his look at data modes on the higher frequency bands plus a look at his latest Morse keyer project.

Last month I looked at tropo and meteor scatter modes, so this time I'll move on to what is one of the most significant VHF propagation modes for the summer months, Sporadic E. This propagation mode occurs in the E layer of the ionosphere, which extends from approximately 90-160km above the Earth's surface. Sporadic E is commonly known as Es and occurs in three distinct areas, which are: Auroral, Equatorial and Mid-latitude, **Fig. 1**.

Auroral Es are caused by additional electrons being injected into the E layer as they follow the earth's magnetic field lines into the polar regions. This form of Es tends to be at its peak in the early hours of the morning and supports transpolar contacts.

Equatorial Es occurs due to plasma instabilities in the equatorial region that generate a potential difference across the E layer. This results in an electric current that flows east to west, called the equatorial electrojet. The resulting Equatorial Es propagation is available daily during daylight hours for trans-equatorial contacts between stations up to about 10-15° either side of the equator.

For UK and European based operators, it is the Mid-Latitude Es that provide the greatest opportunity for extended contacts at 50MHz and above. The Mid-latitude Es are thought to be caused by ionospheric wind shear, which results in the relatively heavy, charged, metallic ions in the E layer forming clouds. It is these charged clouds that produce enhanced propagation by reflecting high-frequency radio signals.

Mid-latitude Es are at their best close to midday in the summer months. There is also an increase in Es following a meteor shower. This is thought to be due to the increased supply of metallic ions from the disintegration of the meteor. Once formed, Es clouds generally move North to South at speeds of up to 100mph. This often provides 50MHz and 144MHz openings from the UK to Southern Europe.

Operating Es

For data modes operators, there is no need to adopt a dedicated operating mode because Es openings are usually long enough to support regular FT8 QSOs. Because the propagation mode is sporadic, openings cannot be predicted with any certainty, so can appear at any time. However, there are times when Mid-latitude Es openings are more likely. For European stations, the optimum months are usually May to August and the best operating times are 0800-1200 and 1900-2300UTC.

One of the ways to identify an opening is to monitor 50.313MHz with WSJT-X set to FT8. When an Es opening appears, you will probably start seeing Italian or other southern European stations decoded with very strong signals levels. When I'm in the shack and looking for Es, I leave the rig powered up and set the volume for a gentle hiss. This provides a useful audio prompt when signals start to appear. Monitoring the FT8 channel in this way also works well for spotting meteor scatter opportunities as you will often hear a short burst or ping of a distant FT8 signal. If you hear a ping, you should switch over to MSK144 on 50.260MHz and start putting out a few CQ calls.

While in the shack I also encourage you to put out the occasional FT8 CQ call as you could be the first station to use an opening. As I mentioned last month, the propagation mode for a given contact is not always clear. However, if you see long-distance VHF contacts with unusually high signal levels, the propagation mode is probably Es. If you would like to understand more about Es, **Mike Willis G0MJW** has written an excellent paper that you can find here:
www.mike-willis.com/Tutorial/sporadicE.htm

NanoKeyer

While I don't usually cover CW operating in this column, I recently decided to rethink my Morse setup and add a new CW keyer. The idea was to fully integrate CW operation with my data modes software. As you may well be aware, there are lots of keyers out there, so it took me a while to sort through them and find the one for me. The model I settled on was the NanoKeyer by **Oscar DJ0MY**. This is an Arduino Nano based keyer that uses the popular firmware produced by **Anthony Good K3NG**. Oscar supplies the keyer as a kit, which normally costs 44 Euro but, at the time of writing, was available for just 39 Euro, including international shipping. Mine was duly ordered and arrived remarkably quickly.

The kit proved very easy to build as it avoids surface mount components and most of the complicated tasks are handled by the Arduino Nano. In addition to the electronic components, Oscar

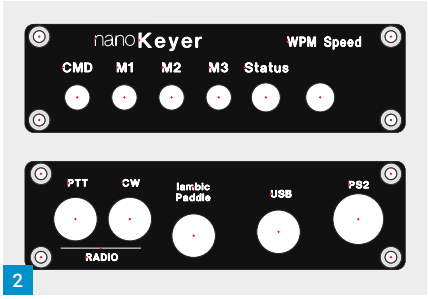

Fig. 1: The three modes of sporadic E propagation. Fig. 2: Revised panel markings for the NanoKeyer.

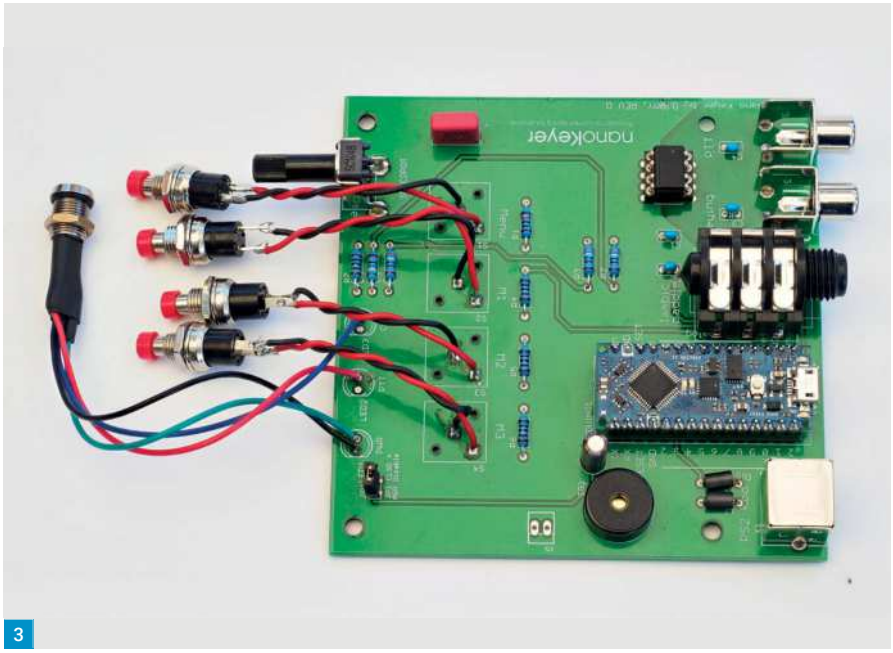

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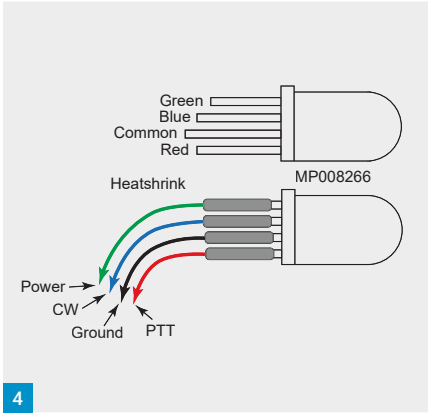
Fig. 3: The NanoKeyer assembled ready for mounting in the enclosure.
Fig. 4: Wiring the 3-colour LED.
Fig. 5: The completed keyer.
Fig. 6: Screenshot of the modified Arduino code.



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has published his graphic files for the front and rear panel markings. I did look at getting these produced professionally but they were very expensive.

I also hit a problem with the enclosure. Oscar has used a Fischer manufactured enclosure from Reichelt in Germany. However, thanks to the ridiculous international tax system we've introduced since Brexit, Reichelt can no longer supply the UK! It was time to think again and scour the UK suppliers for a suitable enclosure. The solution was to use an alternative Fischer enclosure that's available from Farnell UK, see **Table 1** for details. This enclosure is shorter than the original design and does not lend itself to installing the memory buttons in the lid, as proposed by the original design. Another rethink required!

The final solution was quite straightforward as I used miniature panel-mounted push buttons relocated to the front panel. The original design also used three LEDs to indicate Power, CW keying and PTT. Due to the limited space on the smaller front panel, I replaced the three LEDs with a single three-colour LED device. I've shown all the replacement parts in Table 1.

The next challenge was how to deal with the front and rear panel markings. As commercial engraving was so expensive, I thought I would try using my inkjet printer to produce the markings. A quick search around the internet revealed plenty of sources for self-adhesive transparent sheets for inkjet printers.

While these sheets would be ideal, I was using a different enclosure, so Oscar's graphics would be the wrong size. However, the site that Oscar recommends for front panel production has some design software (Front Panel Designer) that's available as a free download. This software can read Oscar's design files and I used this to produce a

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PDF copy that I could amend to the correct size and layout in Adobe Illustrator. The resulting files were used to print my front and rear panels, **Fig. 2**. Most of the wiring was straightforward and **Fig. 3** shows the assembled kit before installing into the enclosure. Wiring the three-colour LED was a bit tricky, so I used heatshrink sleeving and colour coded wires to link back to the PCB, **Fig. 4**. The completed and assembled keyer is shown in **Fig. 5**. In case you decide to use the same solution, I've made the revised front and rear panel artwork available as PDF files on my website (URL below). When printing these files, you must ensure that your printer does not scale the image. Even if you don't use my artwork for the labelling, it still makes for a useful drilling guide.

http://g4wnc.com

One other little twist to the assembly was the use of an Arduino Nano Every instead of the basic Arduino Nano. I wanted to use the later model because it has a more powerful processor and, more importantly, larger program memory. This would let me include more features of the K3NG keyer than could be done with the limited space on the Arduino Nano.

There are a couple of extra steps to take when using the Arduino IDE to compile and upload the firmware to a Nano Every.

The first is a change to the board selection. With the Nano Every connected to your PC via a USB cable, go to the Tools menu and select Board then navigate to: Arduino megaAVR boards and choose Arduino Nano Every. If the Every board isn't listed, you need to go back to Tools - Board Manager and

install the Arduino megaAVR Boards. Once you've done that and selected the correct board, you will have completed the first step. Next, we need to make a small change to the k3ng_keyer code file. This is required because the Arduino emulation of the megaAVR boards does not cover the PIND macro that's used by the keyer. However, the fix is very simple as we just need to update three lines of code as shown here:

Original code:
case 2: return(bitRead(PIND, 2)); break;
case 5: return(bitRead(PIND, 5)); break;
case 8: return(bitRead(PINB, 0)); break;
Replacement code:
case 2: return(bitRead(PORTA.IN, 0)); break;
case 5: return(bitRead(PORTB.IN, 2)); break;
case 8: return(bitRead(PORTE.IN, 3)); break;

I've shown a screen shot of the modified code in **Fig. 6**. To help those not too familiar with loading firmware on the Arduino, Oscar has produced an excellent and well-illustrated firmware upload guide that you can find here:
https://tinyurl.com/5fc6ybam

Next month I'll show you how to use the Keyer with FLDIGI and other popular CW software. PW

```
#ifdef OPTION_DIRECT_PADDLE_PIN_READS_UNO                    // si
  return (bitRead(PIND, pin_to_read));                       // us
#endif                                                       // OP
#ifdef OPTION_SAVE_MEMORY_NANOKEYER                          //
  switch(pin_to_read) {
    case 2: return(bitRead(PORTA.IN,0)); break;
    case 5: return(bitRead(PORTB.IN,2)); break;
    case 8: return(bitRead(PORTE.IN,3)); break;
  }                                                          // en
#endif                                                       // OP
#if !defined(OPTION_DIRECT_PADDLE_PIN_READS_UNO) && !defined(
  return digitalRead(pin_to_read);                           // co
```

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Item	Description	Farnell Order Code	Price Exc VAT
Aluminium Enclosure	Fischer: AKG105-30-100ME. Eurocard 105 x 30 x 100mm	2481096	£21.28
Memory push-buttons	Multicomp 7mm, normally open, momentary, pushbutton (pack of 10)	599270	£7.73
LED panel holder	Arcolectric A10480A LED holder	232324	£2.04
Three colour LED	Multicomp MP008266 LED	3796295	£1.31

Table 1: Modified NanoKeyer Parts

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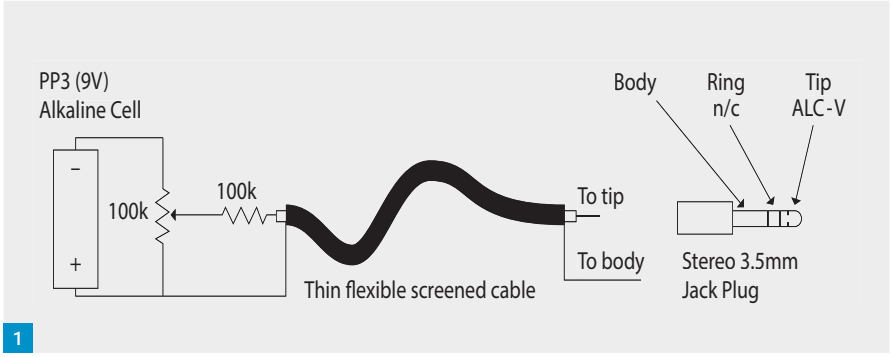

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The 39th Annual Practical Wireless 144MHz QRP Contest

Colin Redwood G6MXL, our QRP Contest adjudicator, introduces the 2022 event which takes place on Sunday 12 June.

The popular Practical Wireless 144MHz QRP Contest is the ideal way for newcomers to the VHF bands and contesting to get a good feel for many aspects of amateur radio contests. It is an excellent way to experience the thrill of making contacts over many km on the 2m band.

Power

The power limit will again be 5 Watts at the transmitter so that participants with all types of UK licence can participate equally.

Equipment

The only equipment you'll need is a low-power 2m transceiver and an antenna. While you can expect to make some contacts with a basic 2m FM handheld transceiver, most of the activity is likely to take place using single sideband (SSB). Most stations use horizontally polarised Yagi antennas when operating on SSB or CW.

Location

As always at 2m, a clear take-off such as a hilltop will certainly help. Every year new entrants are surprised just how far their signals can travel between hilltops.

You'll need to find the 6-character IARU locator (sometimes known as 'Maidenhead Locator') for your station's location, for example IO92KL. I think the easiest way is to visit:
https://dxcluster.ha8tks.hu/hamgeocoding

Contest Exchange

For each contact to count towards your score, you'll need to exchange your callsign (including any /P or /70), signal report using the standard RS(T) code, serial number and locator. The RS(T) code consists of readability on a scale of one to five and signal strength from one to nine. The serial number starts at 001 for your first contact and increases by one for each subsequent contact you make. So, the fourth contact you make will have serial number 004. For Morse contacts there is also the tone (on a scale of one to nine).

Exchange Example

Imagine your callsign is M7ABC/P and you are located in IO91GI and have a contact with M6ZXT/P as your fourth contact. You might transmit, "Mike six Zulu X-Ray Tango Stroke Portable from Mike seven Alpha Bravo Charlie Stroke Portable, you are five and six, zero zero four, in India Oscar nine one Golf India". Using phonetics will make sure that similar sounding letters (e.g. B, D, P, V) are clearly understood by the station you are in contact with.

Hints and Tips

Most newcomers to contesting find that replying to other stations' "CQ Contest" calls is a good way to start.

As your confidence in exchanging reports, serial numbers and locators increases, then finding a clear frequency and calling "CQ Contest" and waiting for stations to reply to you is also a good technique. A mix of the two techniques can be an effective strategy.

Make a point of accurately recording in your log the details of each contact as required by the rules – in particular the callsign of each station you contact, including any /P or /70 suffix, their locator and the time in UTC (not BST). If you are transferring a paper log to a computer log, be careful to transcribe the details accurately. The format of locators is letter letter number number letter letter.

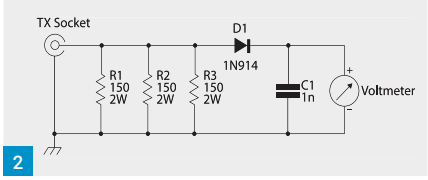

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Fig. 1: A useful technique to reduce power to 5W on higher power transmitters. Fig. 2: A small power meter, to verify the power output. A 21.7V level indicates 5W output. 2W metal film resistors are available from CPC (Farnell).

Directional Antennas

If you use a directional antenna, then I would strongly recommend that you rotate it to point in different directions during the contest (e.g. South West England, Northern Ireland, the Republic of Ireland and Scotland). This will not only enable you to make more contacts, but will likely increase the number of different locator squares you contact, which is a part of your overall score.

Batteries

Many entrants use rechargeable batteries for power. Make sure you have enough power to run your station for the full duration of the contest. I'd suggest making three diary entries: the first a couple of days before the contest as a reminder to charge your batteries, the second for the day of the contest (Sunday 12 June 2022), and the third a few days after the contest to remind you to submit your entry.

The rules appear on the next page. The contest website is also a valuable source of information and has a link for downloading log sheets and an online entry form (known as a cover sheet).
www.pwcontest.org.uk

Submitting an Entry

Don't forget to submit your entry after the contest. Although electronic entries via e-mail are much preferred and make the task of adjudication easier, paper entries are also welcome. All entries that provide an email address will be acknowledged.
entries@pwcontest.org.uk

Have a Go

There will certainly be plenty of other PW readers on the air, keen to exchange reports, serial numbers and locators. Good luck in the contest!

The 2022 Rules

1. General: The contest is open to all licensed radio amateurs operating fixed or portable stations, using SSB, CW, AM or FM in the 2m (144 to 146MHz) band. Entries may be from individuals or from groups, clubs, etc. The contest runs from 0900 to 1600UTC on **Sunday 12 June 2022.**
All stations must operate within the terms of their licence. Entrants must observe the band plan and must keep clear of normal calling frequencies (144.300MHz and 145.500MHz) even for "CQ" calls. Entrants must allow other users of the band to carry out their activities without hindrance. Please avoid frequencies used by GB2RS (144.250MHz and 145.525MHz), ATV talkback (144.750MHz) and other frequencies in use for non-contest purposes.
The station must use the same callsign throughout the contest and may not change its location.

2. Contacts: Contacts will consist of the exchange of the following minimum information:
- callsigns of both stations **(including any /P or /70 suffices)**
- signal reports, standard RS(T) system
- serial numbers: a 3-digit number incremented by one for each contact starting at 001 for the first contact.
- locator (i.e. full 6-character IARU Universal Locator for the location of the station.)

Information must be sent to, and received from, each station individually using just the 2m band, and contacts may not be established with more than one station at a time. Simultaneous operation on more than one frequency is not permitted.
If a non-competing station is worked and unable to send his full Universal Locator, his location may be logged instead. However, for a square to count as a multiplier (see rule 4), a full 6-character locator must have been received in at least one contact with a station in the square.
Contacts via repeaters, satellites, or using digital voice modes (including D-STAR, Fusion, DMR and Echolink) and data modes or machine-generated modes such as FT8, JT65, RTTY and PSK31 are not permitted. Neither is the use of DX Clusters, ON4KST chat (even just logging on), social media or any other method of enabling contacts or contest exchanges.

3. Power: The output power of the **transmitter** or **transverter** final stage must not exceed **5 Watts** peak envelope power (PEP). If the equipment is capable of higher power, the power must be reduced and measured by satisfactory means. With most modern transceivers, power can be reduced by using a menu setting.
An alternative is to apply a (variable) negative voltage to the transmitter ALC line reached via the accessory socket, **Fig. 1**. Stations cannot rely on feeder loss to meet the 5W power limit.
The output power can be accurately measured using the simple circuit of **Fig. 2**. Connect this to the 50Ω output of the transmitter and adjust the power so that the voltmeter does not exceed 21.7V on a 'good whistle' into the microphone.

4. Scoring: Each contact will score one point. The total number of points gained during the contest will then be multiplied by the number of different locator squares with which contacts were made (a 'square' here is the area defined by the first four characters of the IARU Locator).
Example: 52 stations worked in IO81, IO90, IO91, IO92 and JO01 squares; final score = 52 x 5 = 260.
Only one contact with a given station will count as a scoring contact, even if it has changed its location, e.g. gone /M or /P. If a duplicate contact is inadvertently made, it must still be recorded in the log and clearly marked as a duplicate (not necessary in computer log files).

5. The Log: Logs must contain the following information for each contact:
- time (UTC – not BST)
- callsign of the station worked **(including any /P or /70 suffix)**
- report sent (e.g. 56)
- serial number sent
- report received (e.g. 54)
- serial number received
- locator received.

The preferred form of a log is a computer file in REG1TEST, .log, .adi or .edi formats sent by email. This may be generated by contest logging software such as MINOS or EI5DI's SDV, provided it contains all the information listed above. Alternatively, a file in any other suitable format (such as the spreadsheet available on the contest website) or in plain text, provided each of the items above is separated by a separating character such as a comma or tab, is acceptable. Give the file a name including the station callsign (e.g. g6mxl-p.log), and send as a standard email attachment to **entries@pwcontest.org.uk**
Email entries will be acknowledged within 8 days. If there is any problem with your entry, you will be contacted by email.
Log sheets and covering information sheets for paper-based entries are available for downloading from the contest website: **www.pwcontest.org.uk**

6. Entries: The covering information listed below must be provided with each entry. Please submit this using the online facility on the website. For postal entries, it should be written on a separate sheet of A4-sized paper.
- The information required for every entry is:
- name of the entrant (or of a club etc. in a group entry) as it is to appear in the results table and on the certificate
- callsign you transmitted during the contest, **including any /P or /70 suffix (e.g. G6MXL/P)**
- name and address for correspondence
- location of the station during the contest
- full 6-character locator you transmitted during the contest
- whether single or multi-operator (a single operator is an individual who received no assistance from any person in operating the station, which is either his/her permanent home station or a portable station established solely by him/her); if multi-operator, include a list of operators' names and callsigns
- a full description of the equipment used, to include transmitted PEP output power
- if the transmitting equipment (including any transverter employed) is capable of more than 5W PEP output in the 144MHz band, a description of the methods used to (1) reduce and (2) measure the 144MHz output power
- antenna used and the approximate station height in metres above sea level (ASL)

the following declaration must be included in the email text or written and signed by the entrant: "I confirm that the station was operated within the rules and spirit of the event, and that the information provided is correct".
Failure to supply the required information may lead to loss of points or disqualification.
Entries by email must be sent to **entries@pwcontest.org.uk**
Paper entries should be sent to: Practical Wireless Contest, c/o Colin Redwood G6MXL, 53 Woodpecker Drive, Poole BH17 7SB.
Entries must be received not later than Tuesday 5 July 2022. Late entries will be disallowed.
Any other comments about the station, the contest and conditions during it are welcome along with photographs. Please note these cannot be returned and may be published in Practical Wireless or on the contest website. Please send them by separate email or post, to arrive by Tuesday 5 July 2022.
When entering, you will be asked to agree to the storing and processing of your entry and to the publication of the results. Warners Group Publications data policy can be seen at: **www.radioenthusiast.co.uk/privacy-policy**

7. Miscellaneous: When operating portable, obtain permission from the owner of the land before using the site and observe any restrictions on access. Always leave the site clean and tidy, removing all litter. Observe the Country Code.
Take reasonable precautions to avoid choosing a site which another group is also planning to use. It is wise to have an alternative site available just in case.

8. Poor Signals: Make sure your transmitting equipment is properly adjusted and is not radiating a broad or poor-quality signal, e.g. by over-driving or excessive speech compression. On the other hand, be aware that your receiver may experience problems due to the numerous strong signals it will have to handle, which may lead you to believe that another station is radiating a poor signal. Before reaching this conclusion, try heavy attenuation at the receiver input. Using a high-gain RF preamplifier is likely to worsen strong-signal problems, so it is best to be able to switch it off when necessary.
If after making the checks above, you are certain that another station participating in the PW 144MHz QRP contest is radiating poor quality signals, please call the station, giving your callsign, and tell them about the problem. You cannot expect a station with a poor signal to do something about it if they are unaware!
If you receive or send a report of poor-quality signals, you must record on the cover sheet full details of the complaint, including time, callsigns of stations involved, nature of complaint and actions taken **during** the contest to investigate and resolve.

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

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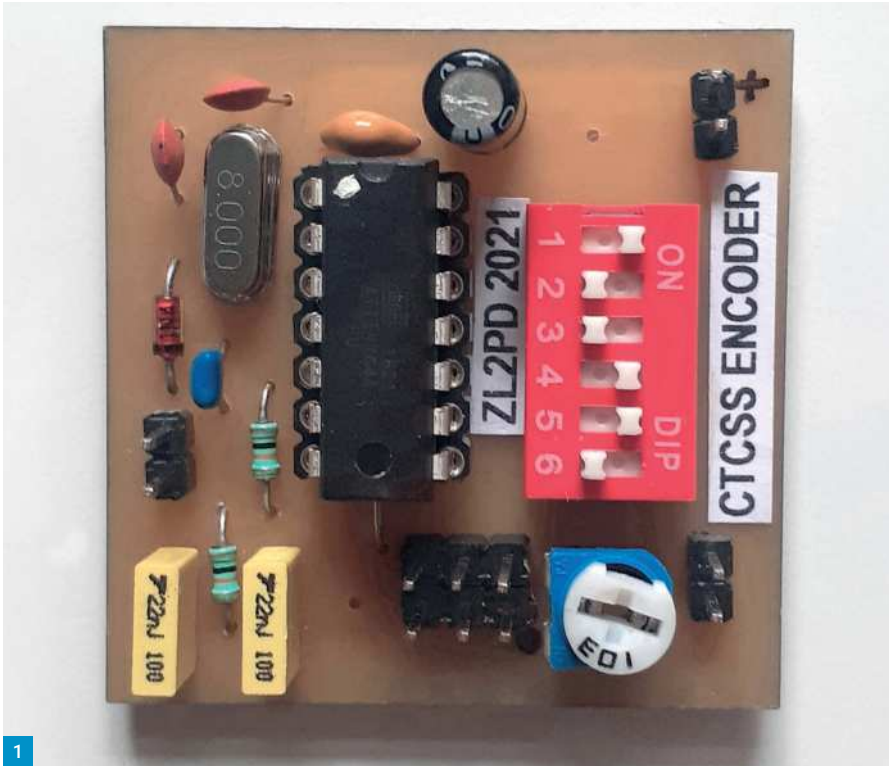
practicalwireless@warnersgroup.co.uk



1

A Compact 50-tone CTCSS Encoder

Many amateur radio repeaters now use Continuous Tone Coded Subaudible Squelch (CTCSS). Installing a low-cost CTCSS encoder is a simple way to restore or extend the life of legacy FM transceivers.

CTCSS is used in many analogue two-way VHF and UHF FM radio systems all around the world. A continuous low-level tone in the range of 67.0 – 254.1Hz is mixed with audible 300 – 3000Hz speech when transmitting. This CTCSS tone is detected by a matching CTCSS decoder in the repeater or transceiver receiver. This 'unsquelches' or unmutes the receiver, allowing users listening to the receiver to hear the speech. A high-pass filter in the decoder ensures the CTCSS tone remains inaudible to users.

The use of CTCSS can reduce interference, increase frequency utilisation, and expand radio services. For example, CTCSS can permit shared voice and data use of a repeater, ensuring voice users avoid hearing any data transmissions.

CTCSS was first developed during the latter half of last century as a method to increase frequency utilisation of commercial repeater channels. Groups of users are each assigned a common CTCSS tone. Receiver audio stays muted until their group tone is detected in each mobile or handheld. A number of such user groups can share a repeater, each retaining a moderate level of privacy.

Each repeater using CTCSS is fitted with a CTCSS 'tone panel'. This decodes any group tone assigned to that repeater on the received signals and retransmits valid tones again along with the voice signal. Each group sharing the repeater or channel only hears transmissions from their group.

Amateur radio users do not usually use CTCSS decoders in their transceivers. Everyone usually wants to hear all calls, an exception being noted earlier where a repeater is shared between data and voice users.

Older transceivers were not always equipped with CTCSS. When considering restoring an old transceiver, it is often only necessary to fit a CTCSS encoder to enable access to CTCSS-equipped repeaters. Almost all modern transceivers have CTCSS built-in as standard. As a result, add-on CTCSS encoders and dencoders (a module including both encoder and decoder functions) have become less widely available and more expensive.

Regulatory standards [1] define CTCSS functionality. These typically include up to 39 'standard' tones. These also define basic accuracy, stability and operational specifications. The industry has extended these to support a total of 50 tones although minor differences exist between vendors on support for a few of these extra tones. Inclusion of specific tones seems to be largely determined by a vendor's ability to reliably decode a few of the more technically demanding optional CTCSS tones.

Basic Requirements

This CTCSS encoder design, **Fig. 1**, resulted from a request from an American amateur for a 50-tone encoder. Having already designed three such encoders using the 8-pin Atmel/Microchip ATtiny85 microcontroller (see my website, below), it wasn't immediately clear why another encoder was necessary. It turned out that Pete wanted an encoder with an external 6-way DIP switch for tone selection. Given the limits of an 8 pin chip, my existing encoders either used hard-programmed settings, an external pushbutton, or a rotary encoder and OLED display for tone selection.

www.zl2pd.com

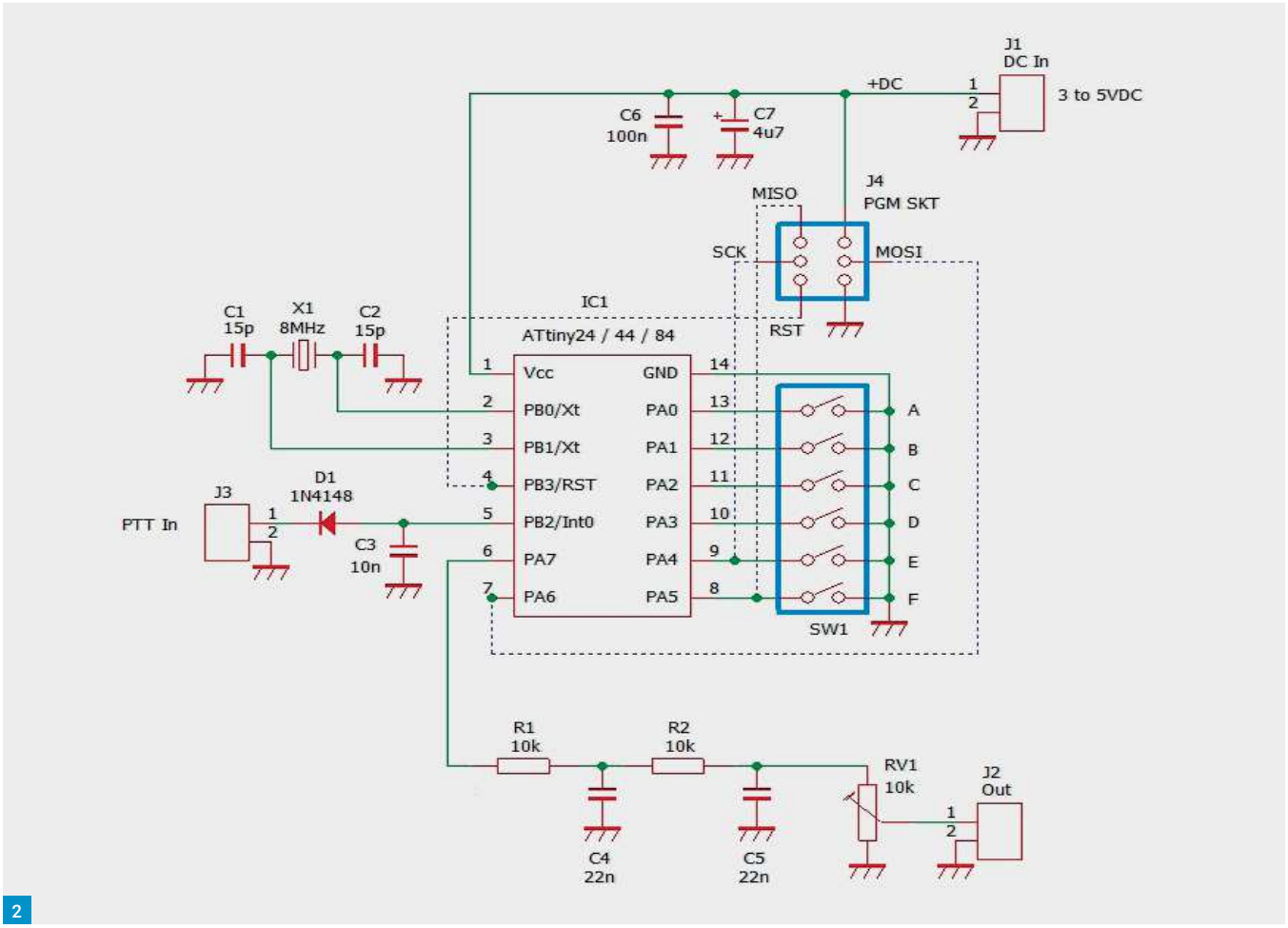
A 6-way DIP switch for tone selection required a device with more pins. Unfortunately, larger AVR devices lack the ATtiny85's PLL clock. Despite this, a successful encoder design was achieved using a low cost 14-pin ATtiny24. At about £3 each at time of writing, this chip allows the encoder module to be built for well under £10. That cost is important - Anything more expensive makes construction questionable given low-cost handhelds currently cost less than £30.

However, the addition of a CTCSS encoder to an older mobile transceiver is an easier choice. New VHF transceivers presently retail from about £60. Of course, there's a guaranteed additional 6dB advantage in 'brag value' at the next club meeting if you've successfully fitted a CTCSS encoder to your prehistoric mobile, saving the planet from further waste in a council landfill.

Design Details

While it's feasible to use a specialized CTCSS encoder chip for this task, many of these devices require a microcontroller to set the required tone. Such chips, often relatively costly, can also disappear from the market without trace. A lower cost solution with improved features is possible with just a microcontroller.

An ATtiny24 lies at the heart of this encoder. The schematic is shown in **Fig. 2**. Using less than 20 parts, it generates the required CTCSS sinewave tone accurately through the use of direct digital synthesis (DDS) software. The required frequency is determined by the DIP switch settings. These settings may be changed at any time.



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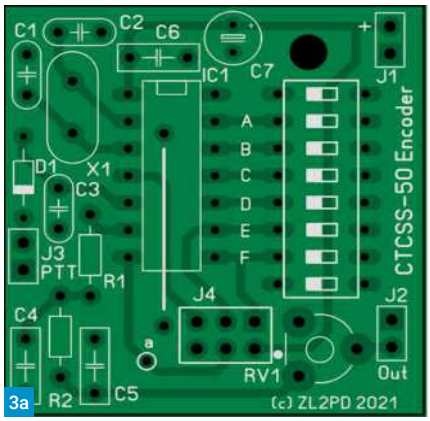

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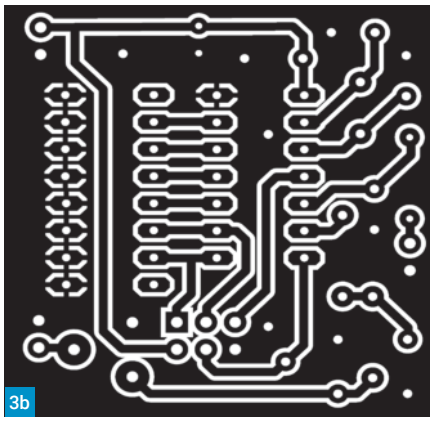


3b

Fig. 1: This 50-tone CTCSS encoder is very compact allowing it to fit into many older transceivers. Fig. 2: Schematic diagram of the 50-tone CTCSS encoder. Fig. 3: The PCB overlay identifies component location. Install the jumper located under IC1 first. It's more difficult to add this later in the construction process. Also shown is the track layout. Neither to actual size. Fig. 4: Example of USBasp programmer with 10-pin to 6-pin adapter. Fig. 5: Connecting the module into this example of a legacy transceiver demonstrates the relatively easy installation required. Wiring should be kept as short as reasonably possible. Fig. 6: Programmer connection details.

The DDS software uses a 24-bit word to accurately determine the CTCSS frequency within a resolution of 0.05Hz. Stability to within 0.025% is also assured through the use of a low cost 8MHz crystal. This approach also ensures variations in supply voltage and temperature do not affect the CTCSS tone frequency.

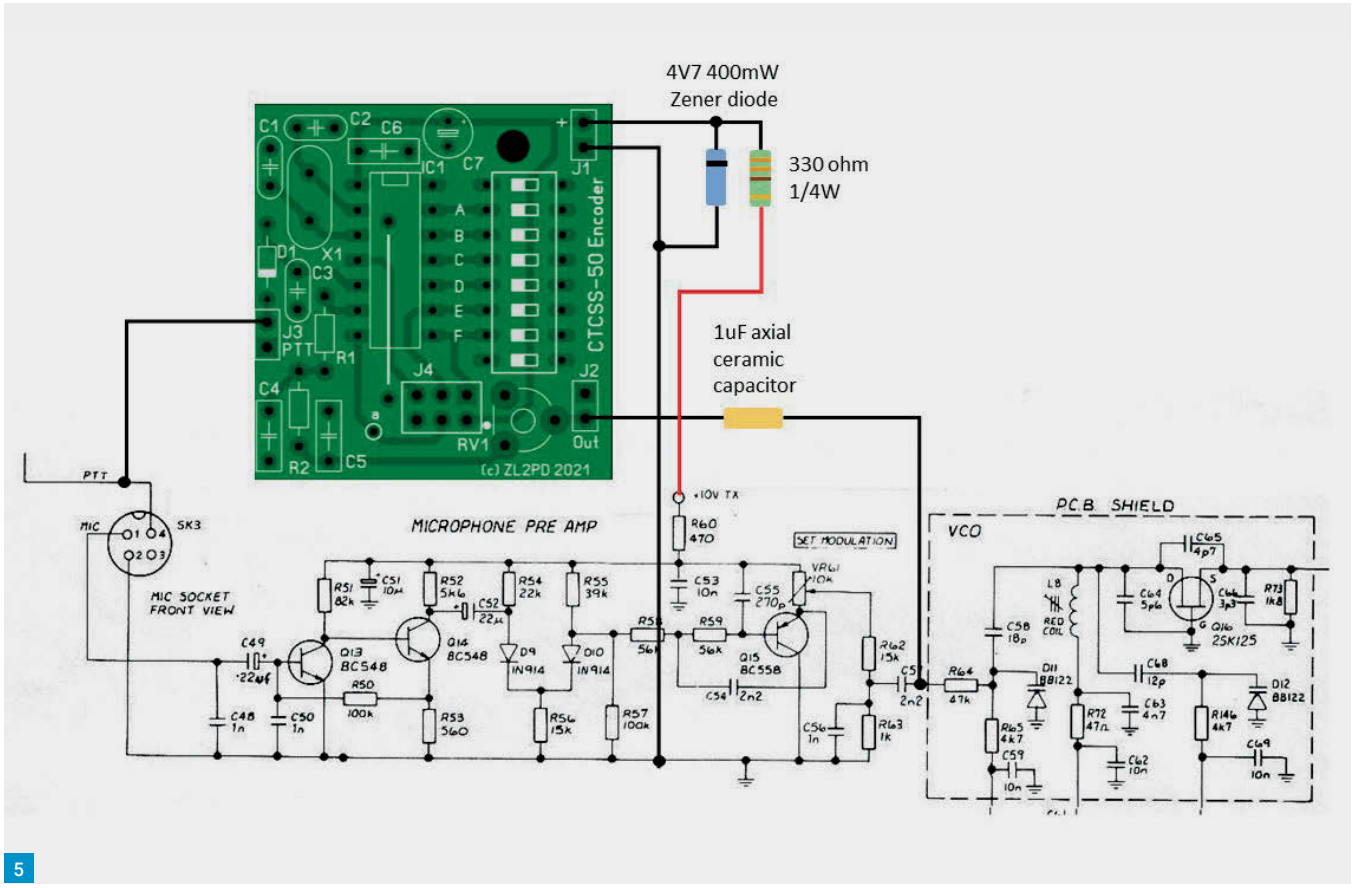
To minimise the size of the encoder and the number of components, the ATtiny's internal pulse width modulation (PWM) hardware is used to generate the required sinewave. The 32kHz PWM carrier allows a very simple RC filter to be used to reduce unwanted products by about 30dB below the output level. Tone distortion is typically less than 1%. (Fig. 1 shows a version of the prototype using a 3-pole elliptical LC filter, which can reduce spurious products by a further 30dB.) The tone output level may be set by RV1, a 10kΩ preset resistor.

The encoder may be powered from a supply rail between 3V and 5V. Do NOT exceed 5V! The encoder consumes about 3.5mA at 3.3V and 6mA at 5V.

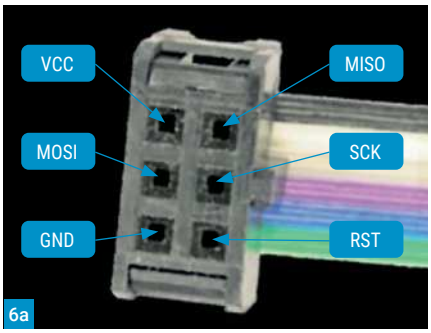
The available tones are listed in Table 1.

The design also includes an optional input for an 'active ground' PTT. When the PTT is released on the transceiver at the end of a transmission, the CTCSS encoder phase-shifts the output tone

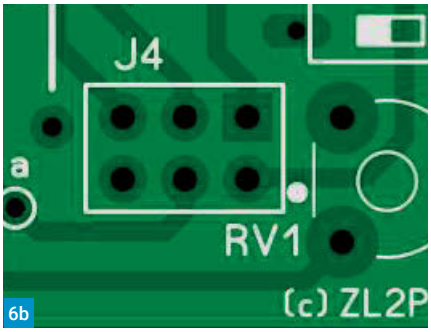
4



5



6a



6b

by 180°, the industry-standard Reverse Tone Burst (RTB) [**2**]. This is detected by most repeater CTCSS tone panels and significantly reduces the length of any repeater 'noise tail', the brief burst of noise at the end of each transmission.

Capacitor C3 was added to reduce the effect of particularly erratic or worn PTT switch contacts.

Construction

The current PCB layout supports through-hole components for ease of construction, and measures less than 40mm (1.5in) square. That allows the PCB to fit into most legacy equipment with ease. An SMD version, possibly required for older handhelds, could be up to 30% smaller.

While a 6-way DIP switch is preferable, 8-way switches are more commonly available. They are often slightly less expensive. For that reason, the PCB, **Fig. 3**, allows for both switch types.

Construction should begin with the PCB jumper fitted under IC1. An IC socket should be fitted next for IC1. Resistors and capacitors should then be added, followed by the crystal.

The various 0.1in 'DuPont' type pin connectors may now be installed. It is also possible to simply wire the encoder directly into a transceiver. Using connectors makes it easier to service the encoder should that ever prove necessary in future.

These board-mounting pin connectors are usually purchased in strips of 20 pins. These are then snapped to the required length, in this case into three sets of 2 pins, and two sets of 3 pins. The matching female connectors may be purchased in the required 2-pin or 3-pin sizes or cut from a similar strip of 20 'sockets'.

The PCB includes provision for a 6-way programming connector (J4). This is used to program the ATtiny24 with the encoder software and device configuration.

Programming

The ATtiny24 can now be programmed. Insert the chip carefully into the IC socket. A programmer is required along with suitable programming software. The lowest cost programmer is the USBasp: **www.fischl.de/usbasp**

An assembled version can be purchased online from many suppliers for under £3, **Fig. 4**. If possible, purchase one complete with a 10-pin to 6-pin adaptor. The 6-pin connector is the most widely used programming interface and matches J4 on the encoder PCB.

Such programmers connect via USB to a PC or laptop. Suitable software is available for Windows, Linux and Apple IOS online. This description assumes a Windows PC or laptop is used, but a similar approach can be used with the other operating systems.

The drivers for the chosen programmer must be installed prior to using it. If not supplied with your programmer, suitable Windows drivers for the USBasp can also be obtained from the same source.

To use this programmer, you now need to install a suitable application on your laptop or PC. Free software for Windows includes eXtreme Burner: **https://tinyurl.com/5ykww43n**
AVRDUDESS: **https://tinyurl.com/2p8r89v6**
and Khazama: **http://khazama.com/project/programmer**

Tone#	Tone (Hz)	Tone#	Tone (Hz)
1	67.0	26	156.7*
2	69.3	27	159.8*
3	71.9	28	162.2
4	74.4	29	165.5*
5	77.0	30	167.9
6	79.7	31	171.3*
7	82.5	32	173.8
8	85.4	33	177.3*
9	88.5	34	179.9
10	91.5	35	183.5*
11	94.8	36	186.2
12	97.4	37	189.9*
13	100.0	38	192.8
14	103.5	39	196.6*
15	107.2	40	199.5*
16	110.9	41	203.5
17	114.8	42	206.5*
18	118.8	43	210.7
19	123.0	44	218.1
20	127.3	45	225.7
21	131.8	46	229.1*
22	136.5	47	233.6
23	141.3	48	241.8
24	146.2	49	250.3
25	151.4	50	254.1*

* CTCSS tones not included in TIA-603 standard

Table 1: The available set of 50 tones includes additional widely used 'industry standard' tones

Component	Description	Quantity
R1, R2	10kΩ 1/4W 5% resistor	2
RV1	10kΩ PCB preset variable resistor	1
C1, C2	15pF disc ceramic capacitor	2
C3	10nF disc ceramic capacitor	1
C4, C5	22nF disc ceramic, MKT or mylar capacitor	2
C6	100nF disc ceramic capacitor	1
C7	4.7µF 16VDC electrolytic capacitor	1
IC1	ATtiny24	1
-	14-pin DIL PCB socket	1
X1	8MHz HC-49U crystal	1
SW1	6-way or 8-way DIP switch	1
J1, J2, J3, J4	0.1in DuPont SIL pin header	See text
-	Matching sockets	See text
PCB	Printed circuit board for encoder	1
Misc Parts:	Connecting wires, etc	-

Parts List

There are a number of online videos showing how to use these programs. However, here is a summary of the procedure required to program the ATtiny24 for this project:

Load USBasp drivers onto the Windows PC

Plug in and complete the installation of the USBasp programmer on the Windows PC. If the option is present on the USBasp programmer (Most provide this feature), select **5V operation** rather than 3.3V for programming the ATtiny24.

Download one of the programming software applications (I find Extreme Burner to be the easiest to use) to the PC and install it. Once running, select 'ATtiny24' from the menu as the device to be programmed.

Download the HEX file for the CTCSS encoder to the PC, and, using the programming application you just installed (e.g. Extreme Burner), select it as the file to be used to program the ATtiny24.

Plug the programming cable and adaptor, if necessary, between the USBasp and the CTCSS board. The cable **MUST** be connected in the correct orientation onto the six-pin connector J4. (See **Fig. 6**) The corner of J4 connected to +5V is marked with the white dot on the PCB.

Select 'Write FLASH buffer to chip' or 'Write – Flash' to program the ATtiny24 with the downloaded HEX file. The LEDs on the USBasp will blink furiously for about a minute while the HEX file is being programmed into the ATtiny24. A bar graph may be displayed in some software to show progress.

Next, the ATtiny24 firmware must be configured by programming the chip's internal 'fuses'. These set the chip's operating characteristics for the software being run on the device.

Enter the following settings into the relevant **Fuse** page/section of the programming application, then click on 'Write' to send the data to the ATtiny24's 'fuses'.

Low: 0xFF

High: 0xDF

Extended: 0xFF

Lock: 0xFF

Finally, assuming the programmer reports the programming has been successful, remove the programming cable from the CTCSS board. You can now power up the board, select the required tone, and verify it is working correctly before installing it in your transceiver.

Transceiver Installation and Alignment

Connect J1 to a suitable 3-5VDC supply in the transceiver. This may either be a continuously available voltage or voltage that is only available during transmit.

Connect J2 to a suitable CTCSS tone injection point in your transceiver. Most commercial transceivers have these clearly marked on the schematic and PCB. Where there's no marked input, a suitable location in synthesised transceivers is typically located close to the VCO and often adjacent to the location where speech audio is injected. In crystal-controlled radios, it's usually close to the transmit crystal oscillator.

You may, if you wish, connect J3 to PTT in the radio to implement RTB. This should be a point which is grounded (i.e. goes to 0V) when PTT is pressed.

As an example, **Fig. 5** shows the connections required in an elderly Dick Smith VHF synthesised transceiver. The tone level should be adjusted on transmit using an FM modulation meter (e.g. Marconi 2304) to give about 500Hz deviation (without speech modulation present) for typical amateur radio VHF and UHF 25kHz channels.

Operation

Where only one CTCSS tone is required, the tone may be selected on the DIP switch or the DIP switch may be replaced by fixed links fitted instead onto the PCB.

Where different tones are required on various repeaters, the switch connections may be passed to an external switch. The encoder tone may be changed while the supply is connected.

Final Comments

This encoder has certainly met all of the requirements identified at the outset of the project. It only took a couple of days to develop, and it's proven to be a successful addition to my family of CTCSS encoders.

I hope you find it equally useful for extending the life of some of your older VHF or UHF transceivers.

References

1. US: TIA-603 (previously RS-220), Europe: TS 103 236, Australia/New Zealand: AS/NZS 4295:2004 etc

2. One large manufacturer used 120o for RTB but this was never widely implemented and is not supported in this version of the encoder.

3. Hex listings for the ATtiny24 can be obtained by email request to the Editor. **PW**

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

Lots of News!

Steve Telenius-Lowe PJ4DX has a packed column, with several news items and plenty of reader reports.

Activity on the sun continues to increase, with the Solar Flux Index (SFI) peaking at 156 on 29 March and the Sunspot Number (SN) at 129 on 4 April, leading to some good propagation on the higher HF bands. I took part in the *CQ* WPX SSB contest on 25/26 March with a 28MHz single-band entry and made over 2000 QSOs, something that would have been impossible a year ago.

Although conditions in general remained good, the SFI and SN had dropped off a lot by the second week of April, as can be seen in **Table 1**.

Amateur Radio in Ukraine

Although the 30-day state of emergency that, among other things, banned amateur radio transmissions in Ukraine expired on 25 March, at the time of writing there are still few Ukrainian stations on the air. It seems likely the state of emergency has been extended and those active stations are believed to be in the Donetsk or Luhansk regions which were not covered by the initial declaration.

Numerous amateurs, myself included, have at one time or another used the QSL services provided by well-known DXer **Gennady Treus UX5UO**. Remarkably, in a message sent to a CDXC member and posted on the CDXC reflector on 9 April, Gennady said: *"Our QSL print service reopened. In spite of the war in Ukraine we can design/print/send any QSL cards. Orders help me personally and for economics of Ukraine of course. Please spread this info, thanks. Regards, Gennady UX5UO."*

Antoine 3D2AG

Following a recent QSO **Antoine 3D2AG** send in a photo of his QTH and antennas. As 3D2AG is probably the best-known amateur from Fiji and has been active on CW and SSB for decades (and more recently also on FT8) I thought readers would be interested to see his setup, **Fig. 1**. Antoine is located near Fiji's capital, Suva, but also operates from time to time as 3D2AG/P from Rotuma, a separate DXCC entity.

Zorro JH1AJT,SK

The news that **Yasuo 'Zorro' Miyazawa JH1AJT**, **Fig. 2**, became a Silent Key at the age of 72 in March was reported in last month's *PW* (see page 66), but I wanted to add my own thoughts. Zorro was an educator, philosopher, philanthropist, humanitarian – and one of Japan's best-known radio amateurs. He founded the Foundation for Global Children and the SEISA Group, which provided educational facilities for children around the world and organised projects such as helping Paralympic athletes in places such as Eritrea, Myanmar and Bhutan. Zorro organised numerous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DXpeditions and invited me to join him on the 2015 E30FB Eritrea DXpedition, although due to the difficulty of obtaining a visa in sufficient time I was unable to do so.

Before he died, Zorro endowed the INDEXA Humanitarian Aid Fund with a sum to be used by DXpedition groups for humanitarian projects. His fund is known as 'The Zorro Miyazawa, JH1AJT, Hams with Hearts Fund' and full details and a video are at:

indexa.org/hamswithaheart.html

Eva PJ4EVA and I had many contacts with Zorro over the years, the last one being at the end of January this year, on 24MHz FT8. Zorro will be sorely missed by DXers and his numerous friends around the world.

PJ4DX Antenna Work

March was antenna maintenance time at the PJ4DX/PJ4EVA station. With the help of visiting amateur **Holger PJ4/DL1COP** and non-amateur friend **Tommy** we took down the 22.5m (73ft) 1.8MHz vertical, **Fig. 3**. It had to be removed because the plot where it was located is being sold. I hope to put up a 1.8MHz inverted-L in a different place before the winter low-band DX season begins. Secondly, the balun on the 5-band HF Spiderbeam had physically broken due to UV damage (a common problem on Bonaire), so the mast came down and the balun was replaced with a new one. We also took the opportunity of the mast being lowered to mount a new 50MHz Yagi below the Spiderbeam (see *PW* May 2022, pages 16 – 18) so now I will be sending in some DX reports to the *PW World of VHF* column.

Readers' News

Steph Foster G4XKH of the Riviera Amateur Radio Club in Torquay says the club will be running a special event in June to commemorate the 40th anniversary of the Falklands conflict. *"We have obtained GB1FW for this event and look forward to making some good contacts"*, Steph added.

"Special event station A60EXPO, with a cracking signal from the UAE on 17m, opened my log on 1 March" reports **Victor Brand G3JNB**. *"Next day on 12m, **Bill V31XX**, Belize, and, up on 10m, **Chas PJ2/AD4ES** in Curacao, were added. TZ4AM Mali on 15m and OX3XR Greenland on 20m soon followed as reliability on the DX bands improved during the first week. I just pottered about the bands during BERU* [the RSGB Commonwealth Contest – **Ed**], *see band reports, and it was a pleasure to be greeted by 'Hello Victor' by* PW *author **Steve Ireland VK6VZ** using his contest call VL6T. Conditions really were so much better than last year. On the 16th, XV1X in Vietnam was a good signal on 17m working split to a clamouring crowd but I managed to slip past them for a first-call contact... I closed the month's log with 5H3MB Tanzania on 12m and E29TGW in Thailand who, on 15m split, was dishing out 599s to a huge pile-up of seriously strong stations. Positioning my transmitter just below the cacophony, I keyed a single call and back he came. For 100 watts to a fishing rod vertical, I deem that to be most acceptable"*. So would I, Victor, so would I!

Neil Clarke G0CAS sent a 28MHz beacon report covering the period 12 to 22 March. *"Openings to North America took place most days except for the 14th and 15th, with several new beacons heard from the States on the 13th and 20th. 4U1UN 28200 and K5AB 28280 were logged the most. South America was logged every day from midday onwards with LU4AA, OA4B and YV5B heard on 28200 and PY2MAB 28270, which proves to be an excellent indicator for conditions in that direction. Again on 28200 ZS6DN was heard every day except the 21st along with 5Z4B, which was logged on several days. FR1GZ 28214 Reunion Island has not been heard since the middle of February. Propagation towards Australia occurred most mornings with VK6RBP 28200 and VK8VF 28268 logged. Sporadic E took place to Germany during the morning of the 13th with DB0TEN 28241, DB0BER 28273 and DB0UM 28279 heard at good strength. IZ8RVA on 28240 was heard during the*

2


3

Fig. 1: The Fiji QTH and antennas of Antoine 3D2AG. Fig. 2: Zorro JH1AJT, SK (image: SEISA Group website) Fig. 3: Down comes the 1.8MHz vertical at PJ4DX. Fig. 4: The noise-finding Tecsun PL380 radio of Etienne OS8D. Fig. 5: Gordon Gray MM0GOR and John King ZB2JK operating ZB2TEN. Fig. 6: Carl Mason GW0VSW in his shack. Fig. 7: Lots of DX! Snapshot of G0OOF's Cluster screen during the CQ WPX contest.

morning of the 14th and again during the afternoon of the 20th. Hopefully, more European beacons will be heard and reported during April when the start of the summer season commences."

Jim Bovill PA3FDR was very active on FT4 and FT8. Jim sent in a long list of stations worked, the best of which are shown in 'Around the Bands'.

Etienne Vrebos OS8D wrote from near Brussels airport to report that, for the first time, he had a noise level of S9+40dB in the 3.5 and 7MHz bands and in part of the 14MHz band, though no noise at all on 21, 24 and 28MHz. *"I am very surprised as this is new for me: I was living as if on an isolated island (a friend said), knowing no QRN at all, and even on 80m mornings the S-meter needle of the Icom IC-7851 didn't move... I do agree this was exceptional, and near an airport or a capital city a dream location."* Etienne bought a Tecsun PL380 radio, **Fig. 4**, from the UK and has been walking around his neighbourhood to find the source of the interference. He traced it to a house *"where the noise on 5MHz was horrible"* – only to discover the inhabitants were away on holiday. We will have to wait until next month to hear the next instalment of this story!

As well as using his home call, **Kevin Hewitt ZB2GI** operated with Gibraltar resident **John King ZB2JK** and visitor **Gordon Gray MM0GOR**, **Fig. 5**, using the club call ZB2TEN in the *CQ* WPX SSB contest. Using an Icom IC-703 and home-made 2-element Yagi made from four telescopic flagpoles mounted in a plastic water pipe and attached to an aluminium boom, ZB2TEN worked stations in Africa, Asia and North and South America on 28MHz SSB.

Tim Kirby GW4VXE reported *"My Butternut HF6V [vertical antenna] started showing an intermittent on receive towards the end of last year, before I took it down for gale season (it is, after all, about 38 years old!) The other day I spent a little time cleaning up the joints, tightening the screws and so on. It seems improved, although not perfect, which probably isn't surprising as some of the bolt holes have widened out over the years and it moves around a fair bit in the wind. It does seem to work quite well though. I also spent a little time interfacing the FTdx10 with the computer to enable me to send CW as well as digimodes... So, just to try things out, I spent a little time on FT8, especially on 12m, where I worked CO8LY, CU6AD, EL2BG, 5T5PA, 3B9FR, TO1Q, KG6DX with 3B9FR and PJ5/SP9MQA worked on CW. 10m has been good at times and I stayed mostly on CW, with the highlights being 9J2BO, 9K2HS, HZ1SK, FH/K6ZO, FY5KE, 5R8AL, WP3TT, 3B9FR and OA1F. I got on 15m a little, especially during the FOC QSO party and it was nice to work* ***Andy 5Z4VJ*** *with no pile-up as well as lots of North American stations."*

Owen Williams G0PHY wrote that *"The increase in the SFI coincided nicely with the CQ WPX phone contest and resulted in G0PHY working three VK stations during the contest and a VK special event station outside of the contest. Other stations worked during the contest included NH7T in Hawaii and several in the Caribbean. I managed one contact with a VE7 and a K6 in Colorado. I heard some stations on 10m during the contest, including you* [PJ4DX] *but failed to work any. The strongest 10m signals during the contest appeared to be from Brazil. Outside of the contest I did manage to work S01WS on 10m for a new band slot. The DXpedition by three Polish amateurs to St Eustatius provided a new band slot on 7MHz and contacts on 14, 18 and 21MHz."*


4

	Apr '22	Oct '21	Apr '21	Difference
SFI:	101	89	73	(+28)
SN:	13	38	0	(+13)

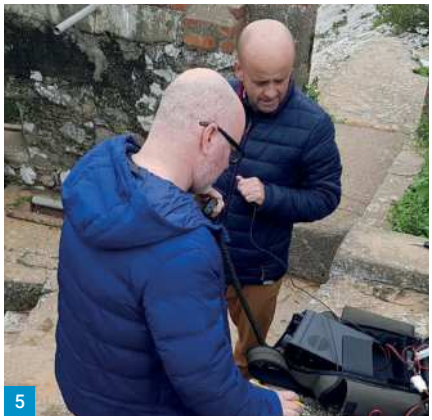
Table 1: Solar Flux Index and Sunspot Numbers on 11th of the month: this month, six months ago and one year ago. The final column shows the difference between now and the same time last year.

Carl Mason GW0VSW (**Fig. 6**) said *"I managed to operate in the BERU contest, though conditions did not seem to be so good... The Xiegu G90 was*

used for the first time in a contest with the power set at 5 watts. It was good to work Don [*PW* editor G3XTT, operating as C56DF from the Gambia – **Ed**] *who had a very strong signal here on two bands. Despite listening for most of the 24 hours very few stations were heard operating on 160, 80 or 10m... Nice to work into VK and ZL with low power."*

Reg Williams G0OOF reckons it was a good month with the improving band conditions. He wrote: *"The corner summer house at the bottom of a fairly long garden was on its last legs, which I have spent time dismantling and preparing for the new one to arrive shortly. This meant taking down a support mast fixed to the summer house for two of my dipoles. Luckily, I have the Hustler and DX Commander vertical antennas, which I made full use of during March. FT8 produced a good number of contacts for various awards. Amongst them was 9N7AA from Nepal. Keen to work him I stayed up late one evening on 40m as he was on that band (Fox and Hounds) for some time. Eventually after calling for a long period he picked me up but unfortunately we did not complete the contact. I noticed that* ***Steve PJ4DX*** *and* ***Eva PJ4EVA*** *worked him later in the evening. All was not lost, I managed to work him later in the month on 20m FT8. New countries worked were Hong Kong, Republic of Korea and Thailand on 10MHz, Indonesia and Maldives on 14MHz. At last I have worked the final state, South Dakota, for the Worked All States award on FT8, with a good chance of confirmation.*

"It was good to work SSB with good conditions, especially with the month culminating in the CQ WPX contest, I took a very relaxed part just working various stations appearing on the DX Cluster, ***Fig. 7****. I have never seen the list moving down the screen so fast with stations coming and going from around the world, depending on the band, time and propagation conditions. All bands were open although I struggled on 28MHz but did manage to work PJ4DX and PJ4K, amongst other islands in that area. 14MHz and 21MHz were open quite late into the evenings. Best long-distance DX was on 14MHz working three VK stations. Most stations worked on the upper HF bands were generally towards North and South America."*



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DX Spots Large (Ctrl+Shift D)

Call	Frequ...	QTH	Status	Comment
NL7V	14.2184	Alaska	Needed...	de: ON7A
BA7LOK	21.3051	China	Needed...	de: DR0V
BY3CQ	21.2160	China	Needed...	de: OM7F
PJ4K	7.1794	Bonaire		de: F5PV
NL7V	14.2184	Alaska	Needed...	de: DK7R
KD2RD	7.1984	USA	Needed...	de: EC1T
NL7V	14.2184	Alaska	Needed...	de: EA3H
TA3DE	14.2680	Turkey	Needed...	de: DL7F
LZ9W	7.1992	Bulgaria	Needed...	de: EC1T
BH1MCB	21.3210	China	Needed...	de: DR0V
4Z5LY	14.1715	Israel	Needed...	de: PA3B
4X6DK	21.2330	Israel	Needed...	de: OM5C
NL7V	14.2184	Alaska	Needed...	de: I5ZSS
YM3VBR	14.2080	Turkey	Needed...	de: DK7R
BH1MCB	21.3210	China	Needed...	de: HA6D
VK1A	14.3107	Australia	Needed...	de: DL4L
PJ4K	7.1796	Bonaire		de: PA8K
IQ3RP	14.2620	Italy	Needed...	de: IW3H
FR4KR	28.4070	Reunion I.		de: IW3IB
HI3LT	7.2093	Dominic...	Needed...	de: EC1T
D4Z	7.1935	Cape V...		de: PA3B
EA5HRM	3.6900	Spain	Needed...	de: EA5C
VK6SJ	28.3875	Australia	Needed...	de: IW3IB
YP3A	14.1913	Romania	Needed...	de: EC6D
K3ZO	7.1539	USA	Needed...	de: OZ1F
VJ3A	14.2331	Australia	Needed...	de: DK7R
9J2BS	21.2559	Zambia	Needed...	de: EF5U
WU2X	7.1913	USA	Needed...	de: PA3D
BA7LOK	28.4950	China	Needed...	de: HA6D
VU2YYF	28.4449	India	Needed...	de: ES3V
VJ2Z	14.1576	Australia		de: LZ1JZ
VU2YYF	28.4450	India	Needed...	de: IW3IB
LY2K	21.3405	Lithuania	Needed...	de: OM7F
9N7AA	28.4773	Nepal	Needed...	de: HA6D
VU3YYF	28.4449	India	Needed...	de: ES3V
JM1LPN	21.3481	Japan	Needed...	de: DR0V
OH1F	14.2214	Finland	Needed...	de: LZ2ZY
A61BR	21.2620	United A...	Needed...	de: OE2L
BH1MCB	21.3210	China	Needed...	de: I5ZSS
VJ2X	28.4000	Australia		de: OH4S
JA7QVI	21.4042	Japan	Needed...	de: DR0V
LZ5R	21.2660	Bulgaria	Needed...	de: DK7R
[illegible]7T	14.1907	Hawaii	Needed...	de: F6IIT

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Around the Bands

Victor G3JNB: 7MHz CW: VL6T, ZF2CA, ZL3AB. **14MHz CW:** CJ3A, V26K, VJ3A, VK4SN, ZF2CA, ZL4TT. **21MHz CW:** 5Z4VJ, ZD7BG, ZF2CA.

Kevin ZB2GI: 5MHz FT8: SV3RNJ. **14MHz SSB:** VK3EY, VK4GMH, VE3CRG, WX3B. **18MHz SSB:** PH9HB. **21MHz SSB:** 5B4AIX, NX4TT, VO1CAL, ZD7FT. **21MHz FT8:** AE4M, JA7BXS, JF1JEQ, JH0BQX, K3CLS, K8FH, KJ0I, N9MKC, NA2R. **28MHz SSB:** LW8DLF, PY1JSV, TO1Q (Guadeloupe). **28MHz FT8:** 9K2YD, AA4VT, AA7G, CA2EIH, CE3VBK, CX7BBR, HC1MD/2, HI8T, HK4ZZ, JY4CI, K5RAV, K6ND, K9TVG, KC3OSD, KF0QR, LU1AAX (+ many LUs), N1MVV, PS8MT, PT2PAG, PU1VKG, TI3ATS, VA4EEE, VE3XN, W2KNG, W8CYZ, XE1EE, XQ5BRC, ZL1FAB, ZS1/DK3ID.

Jim PA3FDR: 7MHz FT8: HS0YNM, NI4MX. **14MHz FT8:** 4L8A, 9V1BC, BH1WQR, HS0YNM, JA1AGE (+ many JAs), VK2BC, VK6AS. **14MHz FT4:** JA8KSF (+ many JAs), K2DAR, K9IHM, KK4BZ, N8OC, ND1X, UN6TA, VE1JBC, WV8DX, YB2HND, YC7YGR. **21MHz FT8:** AP2IN, HS2AQG, JA7LIP, JA9FFS, JR1NHD, K6EID, N3QE, PY2UG, VE2DA, W5XO, W9IIX, YB1HK. **21MHz FT4:** 3X2021, HC7AE, HI8S, HL3EPH, HS1OLQ, JA0PE (+ many JAs), K6LJ, KA3IRT, KA9WAR, KC2YIL, KH6M, KI4BQ, KE8ESJ, LU8EX, NG7M, PU5JVA, PY2FZ, VE2JD, W4UW, YB1HK, YB2HND, YC7YGR, ZD7BG, ZS6JHN. **28MHz FT8:** 5Z4VJ, 9M2TO, 9Y4DG, AP2IN, BG9MHC, K6EID, LU1AAX, LU3ETY, LU5VV, LW2EDM, N3MK, PU2MLO, PY7ZC, PZ5RA, YB1HR, YC0SAS, YD3YGY, VK2MBK, VK3BDX, VK5DOC, VK6OZ, VK8NSB, VP8LP, ZC4GR, ZS6AF. **28MHz FT4:** AA2Q, CX8ABM, FG5GP, LU2NI, LU4ER, LU5VV, LU8EX, PU2NKT, PY5EJ, PY7ZC, VP8LP, W1NRB, ZS6NL.

Etienne OS8D: 14MHz SSB: 9V1YC, UK8IQ. **18MHz SSB:** XV1X. **21MHz SSB:** BA7LOK, D4Z, FY/F4GPK, JA1XRA (+ many JAs), JT1CO, P40L, PJ4R, PJ5/SP9FIH, ST0HQ, TI5VMJ, UP0L, VK4BXX, VL6C, VU2DK. **24MHz SSB:** 3B9FR, EY7AD, PJ5/SP9FIH, S01WS, TI2CF, TO1Q, YB3KM. **28MHz SSB:** CB6CPC, CW2R, CX2RA, D4Z, EX0DX, EX2V, FG5GP, FM5BH, KP4AA, LT7F, LT9H, LU8DPM, LW4EF, NP2AR, PP5EI, PT4A, PY1FI, S01WS, S79VU, VU2XO, WP3B, YB1KI, ZS1OPB, ZS5DCF.

Owen G0PHY: 7MHz SSB: PJ5/SP9MQA, V31XX, V47T. **14MHz SSB:** D4Z, FM8QR, K6BFL, NH7T, PJ5/SP9FIH, VJ3A, VJ4T, VK3X, VK80LAN, XO2O. **18MHz SSB:** PJ5/SP9FIH, PJ5/SP9MQA, VE80LAN. **21MHz SSB:** D4Z, P40L, PJ4K, PJ5/SP9FIH, TO3Z, V31MA, V31XX, V47T, VE7GL. **28MHz SSB:** S01WS.

Carl GW0VSW: 7MHz CW: ZF2CA. **14MHz CW:** C56DF, CJ3A, VK2GR, VO1HP, ZL3AB. **21MHz CW:** 5Z4VJ, C56DF.

Reg G0OOF: 7MHz FT8: VK2XN, VR2XYL. **10MHz FT8:** 3D2AG, E20WXA, HL2IFR, JI4POR, TG9AJR, VK2KDP, VP8BTR, YB5QZ. **14MHz SSB:** D4Z, FR4KR, K1LZ, V47T, VK2BY, ZB2BU, ZS1OPB. **14MHz FT8:** 3D2AG, 8Q7PR, FG5FI, JA7BXS, LU2ICA, TO1Q, VE1KEV, VK7YUM, YF3BVD. **18MHz FT8:** JH2KAC, ND7C, PY2DPM, VA3MJR. **21MHz SSB:** P40L, 5B4KH, 9Z4Y, D4Z, FG4KH, FR4KR, FY5KE, H25A, KP2M, PJ4K, PJ5/SP9FIH, PY2QT, TO3Z, V31XX, VC2A, ZP5AA. **28MHz SSB:** 4X1VF, CX5A, D4Z, FM5BH, FY5KE, HI3T, LO5D, PJ4DX, W3PC.

Signing Off

Thanks to all contributors. Please send all input for this column to teleniuslowe@gmail.com by the 11th of each month. For the August issue the deadline is 11 June. 73, Steve PJ4DX. **PW**

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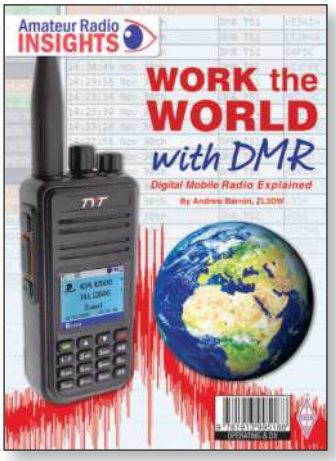

NanoVNAs Explained

A practical guide to Nano Vector Network Analysers

By Mike Richards, G4WNC

Vector Network Analysers (VNAs) have traditionally been out of reach for most radio amateurs because of cost but the introduction of low cost NanoVNAs has changed this. VNAs are incredibly useful in measuring antennas but they do much more too. However, getting the most out of these devices is not easy, and that is where *NanoVNAs Explained – A practical guide to Nano Vector Network Analysers* is designed to help.

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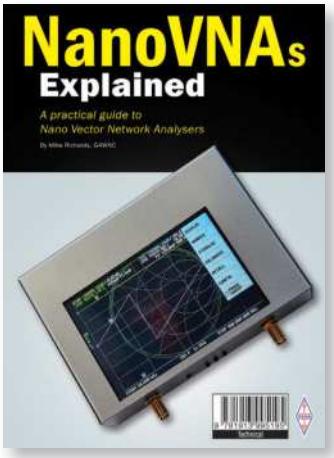

Mini DXpeditions for Everyone

By Billy McFarland, GM6DX

Many regard DXpeditions as complex events. However, it doesn't need to be like that, and this book shows '*you can do this!*' alongside the fun that can be had on a shoestring with a few friends or on your own.

DXpeditions are expeditions to a particular place for the purpose of operating DX (long-distance radio contacts) on amateur radio. A mini-DXpedition is of course simply a smaller-scale event - maybe a trip from the UK to Europe with 5 or less operators or a trip to a local island or beach.

Mini DXpeditions for Everyone shows that everyone can organise a DXpedition and most importantly the fun that can be had doing so.

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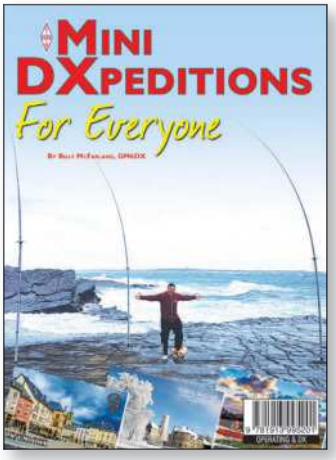
Price: £12.99



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Tim Kirby GW4VXE
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More Six Metre Surprises

Tim Kirby GW4VXE reports on some nice 6m propagation as well as 40MHz news and more.

Last month I mentioned that some interesting QSOs were being made on 50MHz using Trans Equatorial Propagation, not only from the Mediterranean but from Eire. **Mark EI3KD** has continued to make some great contacts into South America. On the evening of 4 April there was a really excellent opening when Mark made 58 QSOs into South America, including two new DXCCs, ZP and CX. It wasn't only well-equipped stations making contacts either. Here at **GW4VXE** I came up to the shack to see if anything was happening and was surprised to see LU5FF and CX6DRA on my screen at decent strength. I was really excited to work LU5FF, LU8GMM, ZP9HTL and PY5BW while running 100W to my vertical antenna. Clearly, I was in the right place at the right time and propagation was focussed in this area. **Richard GW1JFV** in Haverfordwest, about 15 miles away was also able to make several QSOs into South America using his vertical.

Well-equipped stations have been making QSOs on a fairly frequent basis, usually between 1900 and 2100UTC, but I have spotted a couple of signals on the vertical. On one occasion it was almost like aircraft scatter where a signal would come up really strong for a couple of periods and then disappear completely, but I suspect this is an effect of the fading, which is a feature of TEP. As far as I'm aware, these openings have been pure TEP and haven't been Es and TEP combined, although if anyone has any evidence to the contrary, I'm happy to hear it.

Steve PJ4DX is using a new InnovAntennas 4-element LFA Yagi on 6m [see the review in the May *PW*, pages 16 to 18, ***Ed***]. However, his best DX so far was made just before the antenna was put up when, on 14 March, he worked VK4MA over a distance of around 15,400km while using his 40m inverted-V dipole! Steve wrote: *"On the evening we put up the 6m Yagi I decoded ZL1RQ on FT8 but unfortunately, I was watching television at the time, so I missed the brief opening and I have not heard ZL or VK again since.*

"However, after that disappointment things have looked up. After a period of working only semi-local South American stations (PY, LU, CE, CX, CP and ZP) by TEP, on 31 March I made my first trans-Atlantic QSOs of the year with EA8JF and D44EO. The next trans-Atlantic opening was on 3 April, when I worked CN8LI (for a 6m 'ATNO'), CT1FFU and CT1ETX.

"The following day was better still with more CT and EA8 stations, then, at 1859UTC another new one in the form of S01WS (Western Sahara) and then, remarkably, FO5QB on Tahiti at 2016UTC,

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followed by several Mexicans and then, at 2233UTC TR8CA in Gabon. Three new ones in one day!

*"The 5th and 6th were quiet, but **Alain TR8CA** was coming in again on 7 April, this time with a tremendous signal, and I worked him on FT8, FT4, CW and SSB with genuine 599/59 each way reports. The 7th was probably the best day of all: Alain was coming in for about two hours, **Antoine 3D2AG** on Fiji was worked at 2214UTC for another new one and I could not resist calling FO5QB for a second QSO as he was calling CQ for a long time with no other takers.*

"On 8 April 5Z4J was yet another new one for me, while D44EO has been workable most days so far this month. On the 8th I also saw 3D2AG completing with TT8SN in Chad via long path, a distance of over 20,000km, although I could not decode TT8SN here.

*"On 11 April, TR8CA and 5Z4J were worked again as well as another new one, HD8MD on the Galapagos Islands. **Eva PJ4EVA** also worked most of the DX this month and must have hit the absolute peak of propagation when she called HD8MD, receiving a +32dB S/N report from him!*

"Things then quietened down and on 12 and 13 April I only saw local Caribbean stations in PJ4, PJ2, P41, J35 and 9Y4 being decoded. But the first month with a 6m beam has been a revelation and it bodes well for the forthcoming Sporadic E season."

40MHz Experiments

Readers may be aware that the Eire PTT permitted Irish amateurs to transmit on 40 and 60MHz last year and that a number of stations overseas have been experimenting, particularly on 40MHz.

With improved solar conditions this Spring, there has been further impetus to experiment on these interesting frequencies. What are the chances of UK amateurs getting an allocation on one or both of these bands, even a narrow one? Slim, to non-existent, it seems, according to OFCOM last year. However, a number of amateurs, including **Roger Lapthorn G3XBM**, continued discussions with OFCOM on the subject and an interesting solution was found. Roger, and a number of others, have applied for and been granted an Innovation and Research licence to operate between 40 and 42MHz. What is interesting is that this is not an amateur radio licence and you do not need to have

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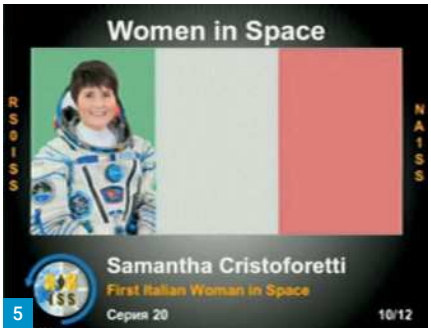

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Figs. 1 & 2: Two views of the 'Meat Pie' antenna as used by Steve G4AQB on 9cm. Fig. 3: Erin and Hughie took over their dad (M0GIW)'s shack to try decoding some SSTV from International Space Station. Figs 4 & 5: Two of the Women in Space SSTV pictures as decoded by Erin and Hughie.

passed an examination to be granted permission to transmit. In the application, however, you do need to explain the nature of the experimentation you want to carry out, so it is unlikely that a proposal that was not sufficiently competent would be accepted. The licences last for a year and OFCOM have made it clear that they may, or may not be, renewed and the licence costs £50 for a year.

As the Innovation and Research licence is not an amateur licence, no callsign is issued, so those using permits may choose to use their own callsigns, or to make something up! At the time of writing a small number of these permits have been issued and already some interesting results have been obtained.

ZS6WAB and ZS6OB are active from South Africa and have been received in Europe and indeed, in the UK on 40.681MHz FT8. **Phil EI9KP** was testing on 40.680MHz FT8 on 10 April when he was heard in the Falklands, by **Bob VP8ADR** who was using a fan dipole for 40, 20 and 10m! On 11 April, VP8ADR heard **Paul G7PUV** (operating as G9PUV on 40MHz) on FT8. **Robbie EI2IP** has worked **Borut S50B** who is a very reliable signal via Es. The ZS6WAB beacon on 40.675MHz has been widely heard in the UK by a number of stations with non-resonant antennas for the band, so maybe have a listen and see if you can hear it. Afternoons are probably going to be the best time, but I am happy to be proven wrong…

It's disappointing that the prospect of even a small amateur allocation at 40MHz is unlikely, but even as things are, there is still plenty of interesting propagation work that can be carried out.

If you listen on 40MHz, please let me know how you get on.

M17

Jef Van Raepenbusch ON8NT says that he has been experimenting with the new open-source digital mode, M17 (URL below) using the DroidStar software on an Android device. Jef, as well as a number of UK and Australian stations have made tests using the M17-GBR-A and M17-GBR-C reflectors. Jef kindly invited me to join the net too and we were all surprised by the quality of the audio from the CODEC.

https://m17project.org

VHF/UHF Nets

Don't forget that thanks to your input, the UK's best list of VHF/UHF Nets is available on the web at:

https://tinyurl.com/2ma53dyy

You can use this to find when stations in your area will be active on the VHF/UHF bands.

As last month, **Table 1** has a random selection of five nets from the listing.

The 6m Band

Phil Oakley G0BVD (Great Torrington) took part in the 6m contest on 10 April working a number of stations: G4RLF/P (IO91), GW0RHC (IO71), G4RRA (IO80), G3SED (IO90) and EI8GS (IO51).

Tony Collett G4NBS writes, *"I worked a couple of UK stations on FT8 during the month but not a peep of DX when I have looked. I was aware of the Aurora prior to the UK Activity Contest but although detectable nothing was readable. For once, PA5Y was just clear of my noise and PE1EWR was worked with extreme difficulty on CW through my noisiest direction – it was the first time since last June that we have succeeded. GI4SNA was also clear of my noise and once I'd managed to get GD0AMD/P to tweak his beam he was also a good signal. Fingers crossed for a good season to come".*

Kevin Hewitt ZB2GI has been very active via TEP and has made over 140 QSOs on FT8, mostly to Brazil, but the log also includes Argentina, Paraguay, Chile, Uruguay, Bonaire, Trinidad and Tobago, Falkland Islands and Cape Verde. Kev has also made some Es QSOs on FT8, into Spain France and the UK.

The 4m Band

Simon Evans G6AHX (Twyning) has put his antenna back up, ready for the Sporadic E season and has already made some local QSOs while testing.

Steve Macdonald G4AQB (Bolton) says that since we published the details of VHF/UHF nets in *PW*, the Manchester area 4m morning net seems to have become a little more popular with several new stations calling in, using a variety of different equipment.

The 2m Band

Simon G6AHX writes, *"On 5 April I did the 144MHz SSB UKAC using 80W from the IC-9700. I had 22 contacts in 16 squares. My best DX was GM4JFJ in IO86RP 516km away. There was a good opening to the North at the very end of the contest".*

It's great to hear again from **David Johnson G4DHF** (Lincolnshire) who writes, *"I've only*

been operating from home (IO92) if there's been anything like good conditions and that has proved to be very infrequent. On 13 March I worked a small aurora on 2m CW with a few GM and SM stations, the best DX being UA2FZ in KO04. Also, in the event on 14 April, the Northern DLs, PAs and OZs were strong with not too much to the East. The best DX was SM0DJW in JO88 at a distance of around 1350km in the late afternoon. Sadly, there was no second phase for me up until around midnight when I called it a day. This is one mode that CW really does make for efficient communication and is the reason why I took my Morse test back in 1974! I wonder how many newcomers are missing out on the opportunity of working some interesting DX?"

Tony G4NBS writes, "*My activity on the band really been limited by noise. It was amazing in the UK Activity Contest to hear GM4AFF so strong and clear, but 30° to the West and GM3SEK is buried in my noise! There was good activity during the 2m FT8 Activity Contest, but I was unable to see anything of distance owing to the noise level. OV3T saw me weakly, but nothing from him here. DK6JU (JO33), DL1DBR (JO41) and DG6YID (JO42) were all worked before the RSGB session along with JO21/22/30/31/32 but no more seen after 1900! MM0CEZ. MM0ABM, GI6ATZ, GU6EFB and EI8KN were the only stations seen/worked outside of G although I did work G7RAU (IN79) and G1BHM (IO70)".*

The 70cm Band

Tony G4NBS says that the UK Activity Contest was plagued by the Airscout software not working properly, making it difficult to arrange aircraft scatter contacts. He says there was almost no EU, only PA0WMX, PA5Y (JO21) and PE1EWR (JO11) plus F1MKG (JN08) and F1BHL/P (IN99). Conditions didn't seem particularly good yet M0AFJ/P (IO70), GW0RHC (IO71), GI6ATZ, GD0AMD/P, GD6ICR, GD8EXI, GM4DIJ/P (all IO74), GM4AFF and GM4JTJ (IO86) were all worked. Tony was active in the FT8 Activity Contest too and found decent conditions across to JO4x line as well as seeing EI3KD (IO51) and EI9KP (IO54) but wasn't able to work them. Airscout was playing up again, which didn't help. Tony says that the GMs were marginal and hard to work through all the activity but it was nice to work GM0HBK immediately followed by GM0EWX after an earlier failure.

Jef ON8NT took part in the 70cm UK Activity contest in March, working G3XDY (JO02) and G4CLA (IO92).

The 23cm Band

Simon G6AHX writes, *"On 15 March I did the 23cm UKAC with 10W of SSB from the rig fed to my Dual 36el beam. I had 15 contacts in nine squares. My best DX was G3XDY in Ipswich JO02OB 229km away".*

Day	Time (local)	Frequency	Description	Area
Every day	0755	145.525	Waterside group	South Coast
Tuesday	1900	145.450	South Normanton, Alfreton & District RC	Derbys
Wednesday	2000	145.425	Oldham ARC	N West
Wednesday	2030	1297.500	Manchester area 23cm FM	N West
Thursday	1930	GB3MR	Stockport RS	N West

Table 1: This month's selection of VHF nets.

The 9cm Band

It's very interesting to hear from Steve G4AQB that, *"Over the last few weeks I have been trying out the 9cm band together with a small group of local amateurs G6GVI, G4HGI, G4JLG and M0UFC. Most of us are using SG-Lab 9cm transverters and are experimenting with different antennas. The most interesting one is my 'meat pie' antenna, which is a Dual Bi-Quad mounted inside a Fray Bentos pie tin*. (See photos, **Figs. 1** and **2**) *It works remarkably well and could easily be adapted for 13cm with a single Bi-Quad. Needless to say, this has triggered some Northern humour regarding the use of a 'meat pie' antenna!"*

Satellites

As ever, it's great to hear from **Patrick Stoddard WD9EWK** with his roundup of satellite activity from the USA. Patrick writes, "*I have been trying MIR-SAT 1 (MO-112), the satellite from Mauritius. Its 9600bps digipeater has been on for the past month, and I finally made a contact through it with **Christy KB6LTY** in California earlier this week. As it is expected to re-enter the atmosphere in late April, there's little time left for this one. The ISS cross-band FM repeater remains operational, and ARISS has yet to publish a date when this will change to the 145.825MHz packet/APRS digipeater. AO-91 is on the low side of its orbits over the Northern Hemisphere in the mornings, which means the footprints have been smaller. Even with that, AO-91 passes remain busy.*

*"I have been operating from locations around Phoenix lately, and last week made a very quick drive into the mountains of northern Arizona. I briefly operated from the city of Flagstaff, near the Grand Canyon, so I could activate grid DM45. **Tyler WL7T/P** had been traveling around the northern part of the continental USA, activating many grids for satellite operators in North America and Europe. I logged WL7T/P in DN76 (Montana) while I was in Flagstaff – a new grid for me up there.*

"After his trip around the continental USA, Tyler now plans to be active from the very rare grid DM02 at the end of April. DM02 is located off the coast of southern California. Except for a US Navy base on San Clemente Island, a base that is virtually impossible to visit, DM02 is all water. Tyler will charter a boat to sail into DM02 outside of the restricted area around the Navy base, and has posted plans to work many satellite passes on 30 April. Hopefully Tyler's trip is a success, and satellite operators around North and Central America can log that grid.

*"Just after my report last month, I finally worked the last three grids I needed of the 488 continental USA grids for AMSAT's GridMaster award. This award, which mirrors the ARRL's Fred Fish Memorial Award for 6m operators, uses the same list of 488 grids. The last three grids I needed were all in Maine – FN56, FN57, and FN67. I worked all three on 14 March, as part of a long road trip **by John VE1CWJ**. John drove from his home in Nova Scotia around the northern part of Maine into eastern Quebec to reach FN56 without crossing the international border (and, at that time, a mandatory COVID test before re-entering Canada). After missing each other on AO-91 and RS-44, I worked VE1CWJ on JO-97 to get FN56 in the morning.*

"After the FN56 contact, John drove back around Maine into New Brunswick to reach the FN57/67 line. This time, now in the early afternoon here, there was a low SO-50 pass. I was able to make a contact with VE1CWJ on that pass! A few hours later, John had his logs in Logbook of the World, and I had confirmations for the last three grids I needed for the 488 continental USA grids! (Congratulations, Patrick – that's a huge achievement! **Ed**.) *VE1CWJ was on from other rare grids in eastern Quebec, as well as New Brunswick, on his way back to Nova Scotia. making lots of satellite operators happy.*

*"The Dayton Hamvention is next month, and there should be lots of satellite activity from the Hamvention and in that area. **Philippe EA4NF** has been traveling around Europe, operating from different grids and countries, making satellite operators in Europe and the Americas happy. With warmer weather, we should hear more activity from stations operating from locations all over North America".*

Kev ZB2GI was one of the people who reported receiving SSTV from the International Space Station, this time celebrating 'Women in Space'**. Dave Ryan M0GIW/EI4HT** turned his shack over to his children **Erin** and **Hughie** to try decoding some SSTV from the ISS, **Fig. 3**. They did a great job as you can see from the pictures (**Figs. 4** & **5**).

Jef ON8NT has been busy on both RS-44 and FO-29 satellites using FT4, the highlight being AK3Y (FM19).

That's it for this month. Hopefully there will be more Es contacts to report next time. Your reports of 40MHz experiments, in particular, will be very welcome! **PW**

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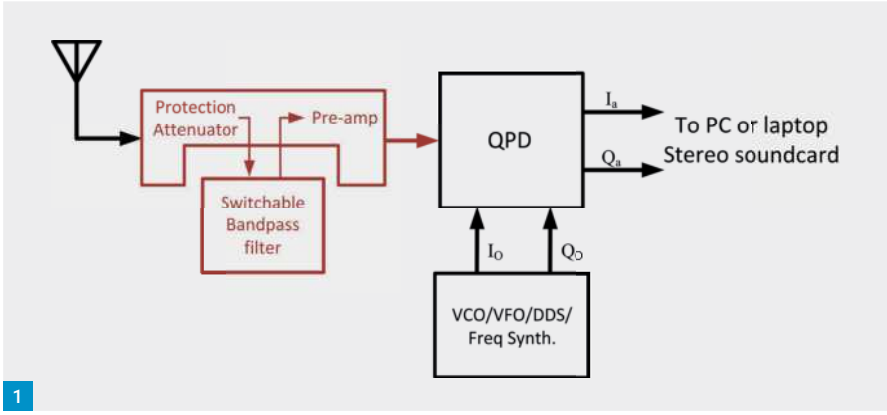


1

Towards an all-band HF receiver

In this sixth part, I move closer towards the final goal, an all-band HF receiver based on the quadrature product detector (QPD) described in the January, 2022 issue.

This article covers two elements shown in red in the block diagram, **Fig. 1**. The first is a module that provides some protection to the front end, an attenuator and a preamplifier. Second is a switchable bandpass filter (BPF) arrangement, and the manner in which it is drawn reflects that the bandpass filter needs to be inserted after the protection and attenuator, but before the preamplifier. In my implementation, the protection, attenuator and preamp are in one enclosure, and the BPF is in a separate enclosure. This reflects the development of each module as a standalone item.

Protection

The schematic of my protection circuit is given in Fig. 2. When the receiver is not switched on, relay K1 is not energised, and the input passes through C1 and then R1 to ground. The receiver input is terminated in 51Ω by R2. When the receiver is switched on, relay K1 is immediately energised and connects the receiver input via C1 to the attenuator.

Pushbutton switch SW1 breaks the 5V supply, which lets me terminate the receiver in 51Ω. I found this useful when I needed to adjust my soundcard, or calibrate the software to optimise the noise floor. SW1 provides both normally-closed and normally-open terminals and the normally-closed provides the 5V to the relay. I use the normally-open contacts to light an LED indicating the switch has been depressed. As SW1, R16 and LED1 are on the front panel, J1, J2 and J8 are connections to a DB-9 connector on the enclosure.

This circuit is in the nice-to-have category, and there are many other published designs to protect against EMP, static and/or large RF signals that might be used here instead of what I have done.

Attenuator

In normal operation it is not easy to overload this receiver. The purpose of the attenuators in this design is rather to facilitate my interests in HF radio propagation measurements where I am concerned primarily with the signal strength of what I am listening to.

The schematic is given in **Fig. 3** and consists of four resistor pads that are pulled in or out of circuit with four relays (K2 – K5). Here I show a 5-way rotary switch (SW2) – ignore for a moment the circuitry below the switch. With SW2 in position 1, none of the relays is energised and the attenuator is bypassed. Each subsequent switch position pulls in a different relay in the sequence 3dB, 10dB, 20dB and 30dB. You could do away with one relay, K5, and its associated circuitry by facilitating relays K3 and K4 to be switched in at the same time when the switch is in position 5.

In the final receiver build, SW2 is replaced by a push button and some digital circuitry to cycle through the attenuation options, as the single push-button is repeatedly pressed with LEDs on the front panel indicating what attenuation value has been selected. For this circuit SW2 is replaced by SW3, U7, U10, U11 and U12. I have described the use of U12, a MAX6816, in Part 4 (April, 2022) of this series and here it debounces SW3 and provides a positive-going edge, to clock U7, each time the switch is depressed.

U7 is a five stage Johnson decade counter with built-in code converter and is set up to provide the outputs as shown in **Table 1**. U10 and U11 (74AC14 Schmitt trigger inverters) are used to drive the relays, which require 40 – 50mA to switch. U7 has limited drive capability so each output pin of U7 is buffered first by one Schmitt trigger, which in turn drives two Schmitt triggers in parallel to ensure there is enough current (even if you use relays with higher current demands).

Preamplifier

The schematic for the preamplifier is shown in **Fig. 4** and is more how a module is connected in or out of circuit, rather than a description of a preamplifier circuit. There are a number of published designs for HF preamplifiers, but I found it more convenient (and of similar cost) to purchase a quality kit rather than breadboard my own implementation of a published design.

I built the Dual J310 Push-Pull Low-noise HF pre-Amplifier kit from **SV1AFN.com** (~ €25), which comes with a quality PCB, all the components, and even the wire to use with the two dual-hole cores that need to be wound. It provides 15dB of gain, has a noise figure of 3dB and requires a 12V DC supply.

The preamplifier always has power applied and is switched in and out of circuit by relay K6 operated by SW7. In the final build SW7 is replaced by SW5 driving a latching circuit U2, which also debounces SW5. I have described the use of U2, a MAX16054, in Part 4 (April, 2022) of this series and here it operates on 5V (instead of 3.3V), drives LED2 and Q2, a PNP transistor, to switch the 5V rail to the relay.

All three of the circuits described so far are mounted in the same enclosure as shown in **Fig. 5**, a Perancea Tin Plated Steel PCB Enclosure (50 x 100 x 160mm RS No 627-6326). The black relay in the top left corner is K1, the four attenuator relays are white and the relay to switch in the preamplifier (K6) is next to the blue preamplifier PCB in the bottom right corner. The BNC connectors (top left) are the antenna input and the output to the QPD. The SMA connectors (bottom left) where the bandpass filter can be inserted. If you are testing without a BPF, then do not forget to link the SMA connectors together. The power and switching lines enter via the DB-9 connector.

Switchable Bandpass Filter

The HF bands are covered by one lowpass filter and seven bandpass filters with the schematic shown in **Fig. 6**.

For frequencies below 250kHz, a lowpass filter is used and for all other frequency bands, bandpass filters are utilised. Each bandpass filter has –3dB points set one octave apart. To manage the size of the schematic, six of the filters are shown as blocks and the parameters

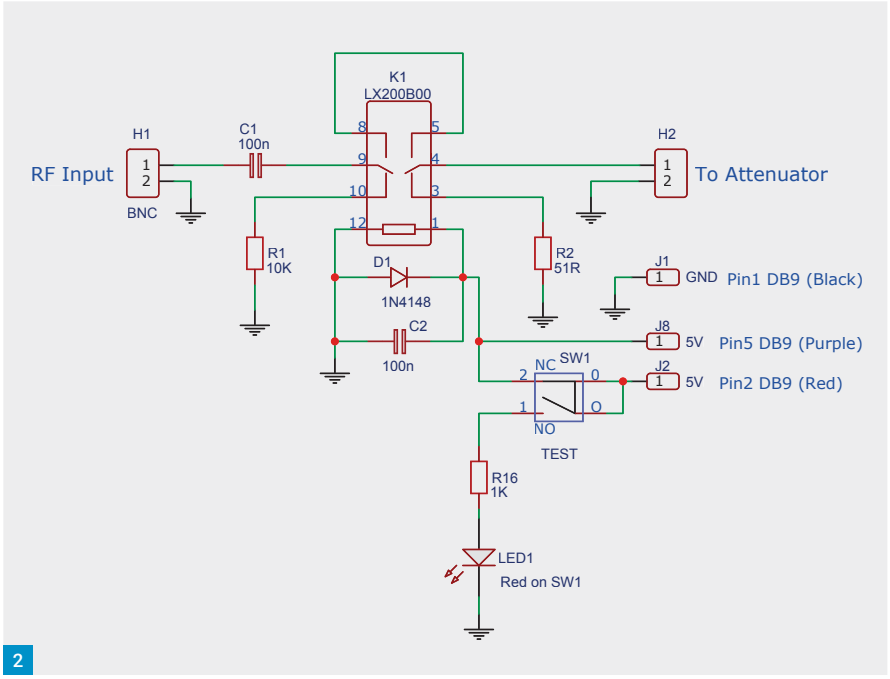
Fig. 1: Basic block diagram. Fig. 2: Schematic diagram of the simple protection circuitry. Fig. 3: Schematic diagram of the attenuator circuitry. Fig. 4: Schematic Diagram of the Preamplifier circuit. Fig. 5: The built protection, attenuator and pre-amplifier. Fig. 6: Schematic Diagram of the switchable bandpass filter. Fig. 7: Response of the LPF and 1 to 2MHz BPF. Fig. 8: The built BPF circuitry.

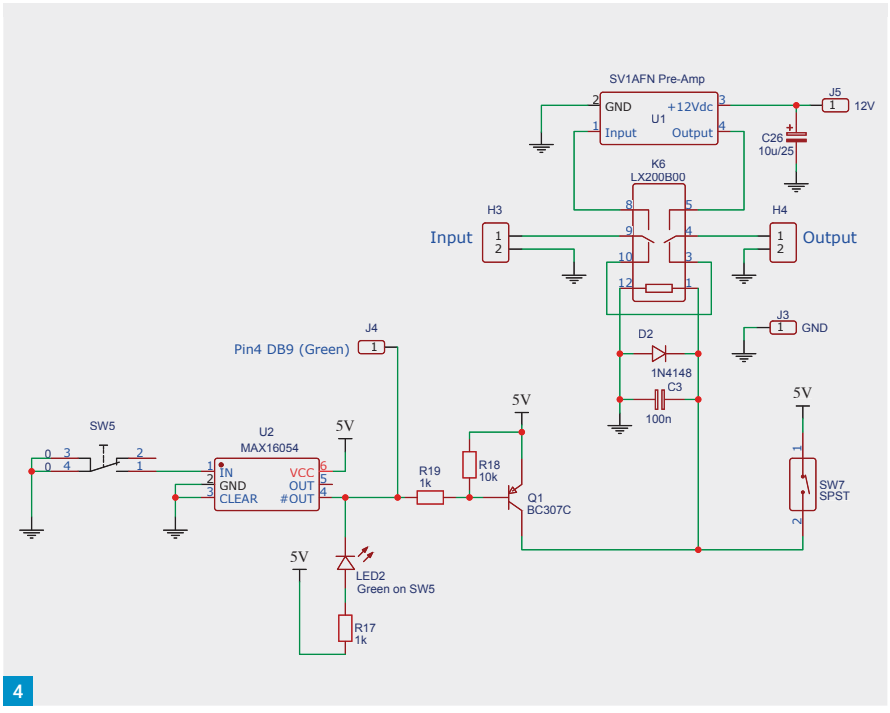
of LA, LB and CA are given in **Table 2**. For the reason explored in Part 3 (March, 2022), this is an implementation using fixed components, and no winding of coils or tuning is required.

The transfer function of the lowpass filter (LPF) is shown in the top panel of **Fig. 7**. The LPF is a five-pole filter with a Butterworth response and has a loss of just less than 2dB. The –3dB point is at 0.35 MHz – slightly higher than the design value. The response of the BPF designed for 1 – 2MHz is shown in the bottom panel of Fig. 7, and the –3dB points are at 1MHz and 2.5MHz to allow some overlap with the next BPF.

Selection between filters is made by a FST3253 multiplexer/demultiplexer bus switch on both the input and the output with their control lines in parallel. There are four control lines marked S0, S1, /1OE and /2OE and the truth table is given in **Table 3**. I show on the schematic that a switch is used, and in the prototype I had some circuitry to allow a rotary encoder to step through the options, but in the final version the selection of which filter is in circuit is made by the microprocessor that controls the DDS. More about this in the next article.

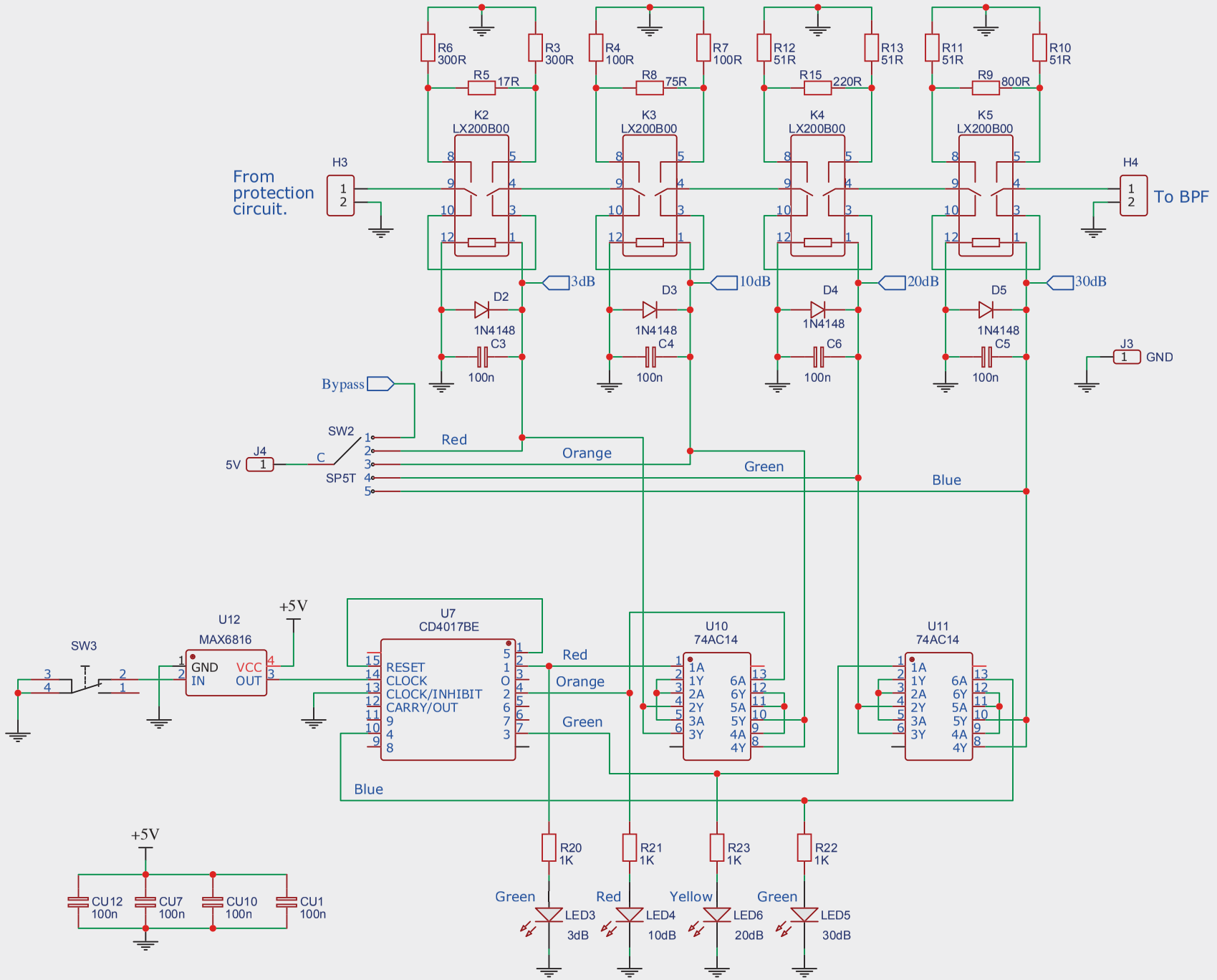
This module is enclosed in a box made from PCB as shown in **Fig. 8**. On the right-hand side the two bus switch ICs on converter PCBs mounted on a development board can be seen. Each of the filters uses a generic PCB as described in Part 3 (March, 2022). I used a 50Ω coax (green wires) that was developed for wire-wrapping applications to join each filter to the bus switches. A purpose-made PCB that has all the filters and supporting circuitry would certainly make it easier for the builder by requiring a lot less wiring work. As usual, all the power and control lines enter the enclosure via feed-through capacitors (top-right).





Event	U7						Relay selected	LED Lit
	Pin 3 Q0	Pin 2 Q1	Pin 4 Q2	Pin 7 Q3	Pin 10 Q4	Pin 1 Q5		
Start-up	1	0	0	0	0	0	None	-
Push SW3	0	1	0	0	0	0	K2	LED 3
Push SW3	0	0	1	0	0	0	K3	LED 4
Push SW3	0	0	0	1	0	0	K4	LED 5
Push SW3	0	0	0	0	1	0	K5	LED 6
Push SW3	0	0	0	0	0	1	Immediate reset of U7. Pin 1 Q5 going high triggers a reset on U7 pin 15.	
Back to start up	1	0	0	0	0	0	None	-

Table 1: The sequence of events for SW3.


From protection circuit.
H3
H4
To BPF
J3
GND
J4
5V
R6 300R
R3 300R
R5 17R
K2 LX200B00
R4 100R
R7 100R
R8 75R
K3 LX200B00
R12 51R
R13 51R
R15 220R
K4 LX200B00
R11 51R
R10 51R
R9 800R
K5 LX200B00
3dB
10dB
20dB
30dB
D2
D3
D4
D5
1N4148
C3
C4
C6
C5
100n
Bypass
SW2
C
SP5T
Red
Orange
Green
Blue
SW3
U12
MAX6816
GND
IN
VCC
OUT
+5V
U7
CD4017BE
RESET
CLOCK
CLOCK/INHIBIT
CARRY/OUT
U10
74AC14
U11
74AC14
1A
1Y
2A
2Y
3A
3Y
4A
4Y
5A
5Y
6A
6Y
R20 1K
R21 1K
R23 1K
R22 1K
Green
Red
Yellow
Green
LED3
LED4
LED6
LED5
3dB
10dB
20dB
30dB
CU12 100n
CU7 100n
CU10 100n
CU1 100n

End Notes

I show in the schematics the use of relays with the designation LX200B00, which were made for many years by CP Clare and of which I had a number to hand. However, when I came to purchase some more to finish the attenuator I discovered that CP Clare is no more, and these relays do not appear to be available. I have changed to using relays from TE Connectivity that have AXICOM written across them – be careful which model you use as some require a lot of current to switch.

I have made further information available on my website:

www.samuelritchie.com

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

I have no personal connection with or financial interests in SV1AFN.com, Perancea or Radionics.

In the next instalment we are going to look at a DDS and its microprocessor to finish off the receiver. **PW**

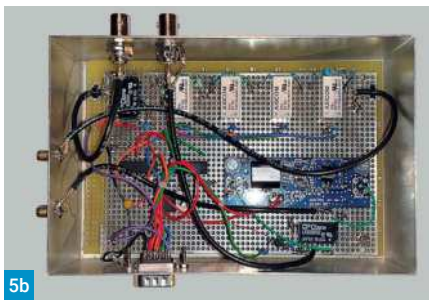
Band	LA	CA	LB	CB
0.25 – 0.5 MHz	22µH	10nF	47H	4.7nF
0.5 – 1 MHz	10µH	4.7nF	22µH	2.2nF
1 – 2 MHz	4.7µH	2.7nF	10µH	1.2nF
2 – 4 MHz	2.2µH	1.5nF	4.7µH	680pF
4 – 8 MHz	1µH	820pF	2.2µH	390pF
8 – 15 MHz	470nH	390pF	1µH	180pF
15 – 30 MHz	330nH	180pF	680nH	82pF

Table 2: Bandpass filter component values.

Band	S0	S1	/1OE	/2OE
< 250 kHz	0	0	0	1
0.25 – 0.5 MHz	1	0	0	1
0.5 – 1 MHz	0	1	0	1
1 – 2 MHz	1	1	0	1
2 – 4 MHz	0	0	1	0
4 – 8 MHz	1	0	1	0
8 – 15 MHz	0	1	1	0
15 – 30 MHz	1	1	1	0

Table 3: Control lines truth table.

5a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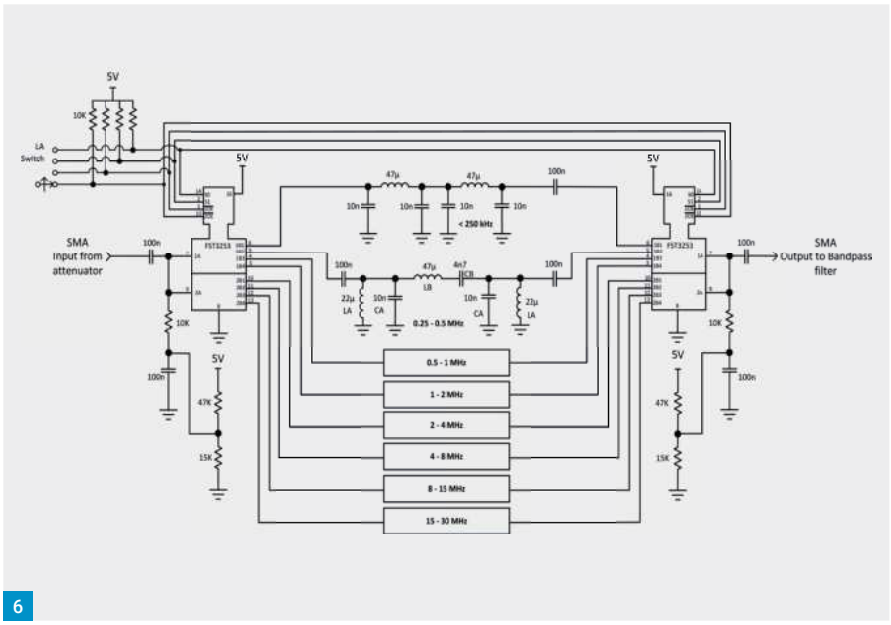

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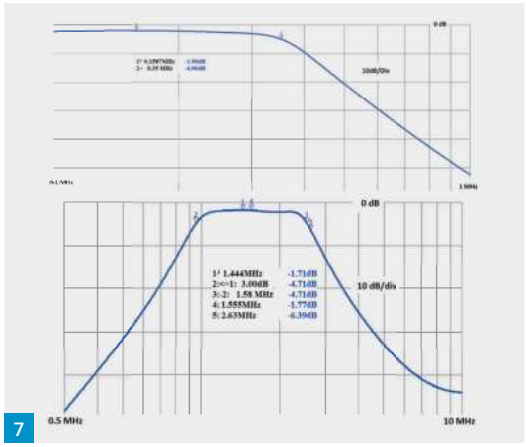
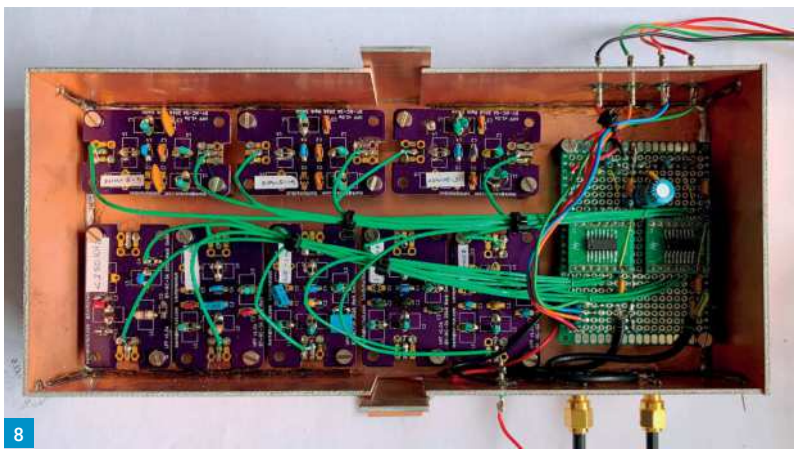


7


8

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WHISTLER

TRX-1E Digital Handheld Scanner

We have worked with Whistler to customise a UK band plan for the scanners! This ensures the radios cover UK bands in the correct steps and the correct mode. The TRX-1 will receive both amateur and commercial DMR transmissions as apart from the frequency they are fundamentally the same mode. The radio is supplied with software and users can select mode when writing memories or select auto and it will work out the mode itself!
This multi-system adaptive digital trunking scanner supports Motorola P25 Phase I, X2-TDMA, Phase II and DMR.

Buy the TRX-1E for just
£419.95

WHISTLER

WS1065 Desktop Radio Scanner

The Whistler WS1065 employs cutting edge technology to bring a high level of performance and innovative features. This model clearly raises the bar in the area of advanced trunking scanners. Frequency coverage is extensive including: 25-54, 108-17, 137-174, 216-512, 764-776, 795-805, 849-869, 896-960 and 1240-1300 MHz.
1800 memories are available and may be dynamically structured to bank sizes you prefer. Plus you can store 21 virtual scanners (so that is a total of 37,800 objects).
The large backlit LCD is four lines by 16 characters. The keys are also backlit. Supported trunking systems include Motorola Analog, EDACS, LTR and Digital APCO (9600 bps).

KEY FEATURES
- Alert LED • Audible Alarms • Automatic Adaptive Digital Tracking
- Backlit Liquid Crystal Display • Data Cloning • Digital AGC
- Flexible Antenna with BNC Connector • High Speed PC Interface
- Free-Form Memory Organization • LTR Home Repeater AutoMove
- Key Lock • Lock-out Function • Memory Backup
- Menu Driven Programming with Context Sensitive Help
- Multi-System Trunking • P25 NAC Functionality

Buy the WS1065 for just
£299.95

WHISTLER

WS1025 Desktop Radio Scanner

This 300-channel scanner can be categorized into 10 separate memory banks. Plus one-touch searches of marine, air and ham Frequency Range: 29-54 VHF Low Band. 87.3-107.9. 108-137 Civil Aircraft Band Includes 833 kHz steps. 137-144 VHF. 144-148 Amateur Band 2 Meters 148-174 VHF High Band

Buy the WS1025 for just
£89.95

WHISTLER

TRX-2E Digital Desktop Scanner

Buy the TRX-2E for just
£479.95

The radios will receive both amateur and commercial DMR transmissions as apart from the frequency they are fundamentally the same mode. The radio is supplied with software and users can select mode when writing memories or select auto and it will work out the mode itself!

This multi-system adaptive digital trunking scanner supports Motorola P25 Phase I, X2-TDMA, Phase II and DMR making it capable of monitoring the following unencrypted channels/systems:
- Conventional DMR (Entered as a DMR trunked system)
- Hytera XPT
- MotoTRBO™ Capacity Plus
- MotoTRBO™ Connect Plus
- MotoTRBO™ Linked Cap Plus systems
- NXDN & DMR out of the box

KEY SPECIFICATIONS
- Frequency: 25-54MHz, 108-136.99MHz, 137-174MHz, 216-379.97MHz, 380-512MHz, 764-781MHz, 791-796MHz, 806-960MHz (excluding cellular), 1240-1300MHz
- Simple Zip Code programming
- Easy updating via Internet
- APCO P25 Digital Phase I & II
- Removable, remote magnetic head
- Scanning at up to 70 channels/second
- CTCSS and DCS subaudible decoder
- IF Discriminator Out • Store Favourites Scan List
- User upgradable CPU firmware
- Spectrum Sweeper • Clock / Calendar
- Tuning Steps: 2.5, 3.125, 5, 6.25, 7.5, 8.33, 10, 12.5 ad 25 kHz.

WHISTLER

WS1010 Handheld Scanner

This 400-channel scanner lets you listen to FM radio bands and can be categorized into 10 separate memory banks. Also, it offers the convenience of one-touch searches of marine, air and ham
Key Features/Specifcations:
200 Channel memory - plenty of memory to store all your favorite frequencies in 10 separate storage banks. Backlit Liquid Crystal Display - easy to read and program data even in low light situations.. Data Cloning - allows transfer of the programmed data to another WS1010 scanner.

Buy the WS1010 for just
£89.99

WHISTLER

WS1040 Handheld Scanner

The WS1040 scans most common trunked radio system signalling formats, including Motorola, EDACS, LTR and P25 trunked radio networks. Talk group and individual call monitoring is supported.
When monitoring P25 digital systems, the exclusive Automatic Adaptive Digital Tracking instantly adapts the digital decoder to the digital modulation format of the transmitted signal, then analyses the signal over 50 times each second and adapts to any subtle changes caused by multipath or fading. No cumbersome manual adjustments are required.

Buy the WS1040 for just
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WHISTLER

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Keep your traesued TRX-1 safe with this high quality leather case
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MRW-TRX3 Antenna Pack
Three compatible antennas in this great pack
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UKAFG UK Airband Frequency Guide 2022

A printed ring-bound Aviation frequency guide, Includes free UKAFG website access to frequency updates, Civil and Military call signs and Maps until the 1st of Jan 2023
- HF VHF UHF • Civil and Military
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PR781 - AR Dynamic Studio Quality Microphone

A professional quality dynamic cardioid microphone for amateur radio that is specifically designed for use with most makes of Elite transceivers. This is a truly remarkable dynamic microphone. Heil engineers were requested by ICOM to develop a very special microphone package for their iC-7800 radio.

FEATURES

- Output Connection: 3 pin XLR
- Generating Element: Dynamic
- Frequency Response: 50 Hz to 16,000 Hz
- Polar Pattern: Cardioid
- Output Level: -55 dB
- Impedance: 600 ohms balanced out , 3pin
- Diaphragm: 1 1/8" Low-mass aluminium
- Weight: 14oz.
- Finish Black: Black Satin Epoxy

All for just

£199.99

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BM17DYN – AR Lightweight Dual Sided Boom Set With Dynamic Element

A lightweight dual-side headset designed for Amateur Radio use. To accommodate different radio setups, the BM-17 is available with a BM-17-Dynamic element. The speakers used in the BM-17 are very sensitive and don't require much AF gain from the transceiver. The frequency response is 200 Hz – 5 kHz with very low distortion. The ear pads are replaceable acoustic foam. The microphone audio for the BM-17 series terminates into a 1/8" mono plug while the headphone terminates into a 1/8" stereo plug (1/8" to 1/4" adapter included).

The use of the AD-1 series mic adapters allows simple interface with popular transceiver inputs. The adapter cable has a 1/8" female input jack for the headset microphone while the 1/4" female that exits the adapter is the PTT (push to talk) line for the Heil foot switch or hand switch. The 1/8" or 1/4" stereo plug goes into the headphone jack on the transceiver front panel.

All for just

£119.99

119 WATTS

Proset 3 – Pro Stereo Studio Headphones

There is no better product than the Heil Pro Set 3 stereo headphones, to illustrate the fact that Bob Heil's ability to listen leads to his company, to build high quality professional sound products.

Anyone who has ever professionally recorded or monitored audio will tell you that the last thing they worry about is whether headphones look good… The fact that the Heil Pro Sound 3 looks so good is a bonus.

You get three detachable cables. A 1.8 M flexible straight cable; and a 1.8 M straight cord with mating iPhone/iPod compatible 3.5mm plug; and also, a 3 M coil cord – all twist lock terminating in a 1/8" (3.5 mm) professional gold plated screw-on 1/4" (6.3mm) adapter.

All for just

£109.95

109 WATTS

Proset Elite 6

The new Heil Pro Set Elite is the ultimate boom set designed for amateur radio operators and uses the Heil HC-6 wide response microphone element. The HC-6 is designed for full range audio or can be adjusted (with radio adjustment) for bright, articulate audio to cut through amateur radio noise and signal pileups. The Pro Set Elite offers dual side, highly efficient speakers mounted in acoustically tuned chambers which offer high rejection of outside noise. The exclusive Heil Phase Reversal feature allows the user to move the signal acoustically, which creates a spatial widening of the sound field that makes it easier to 'see' a signal inside a pileup while removing listener fatigue during prolonged use. The headphone's speakers fold up for easy storage.

The field-replaceable cushioned ear pads also come with removable cotton covers that can be easily removed for washing. The 6' coiled cable terminates in a 1/8" mono plug for the microphone, and a stereo 1/8" plug for headphone speaker connection. An 1/8" to 1/4" adapter is also supplied. The Pro Set Elite works with all Heil AD-1 adapter cables, which mate with just about every type of amateur radio transceiver.

All for just

£189.95

189 WATTS

PRO 7 - AR Industrial Headset

An aviation-style headset designed for amateur radio use in high noise environments. The specially designed foam-gel ear pads provide 26 dB outside noise reduction and provide exceptional comfort. A true dual channel, stereo headset, the Pro 7 Series feature an audio balance control which allows the user to adjust the level of the left earphone to match the right. A unique phase-reversal switch greatly helps the listener "dig out" weak signals. The latest version of the Pro 7 features a monitor jack which allows a second operator to plug in headphones and monitor audio. The flexible gooseneck mic boom on Pro 7s may be rotated for use on either the right or left ear.

All for just

£289.95

289 WATTS

PMSIC – AR Pro-Micro Single-Sided Headset

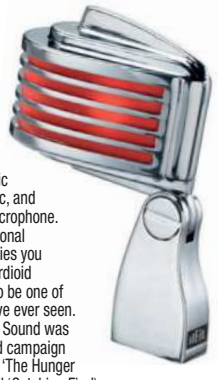
The Pro Micro is a lightweight single-side headset designed for Amateur Radio use. The Pro Micro is available with a IC electret element. The speakers used in the Pro Micro are very sensitive and don't require much AF gain from the transceiver. The frequency response is 20 Hz – 17 kHz with very low distortion. The ear pads are replaceable acoustic foam. The Pro Micro IC: contains the Heil IC electret microphone element.

All for just

£84.95

84 WATTS

FIN RED – Professional Chrome Microphone



The Fin microphone from Heil Sound was featured prominently in the ad campaign for the 2012 smash hit movie 'The Hunger Games', (as well as the sequel 'Catching Fire'), for its amazing looks. The Fin combines that "vintage mic look", with a blend of futuristic, and TIMELESS, all in one shiny microphone. However, The Fin is a professional microphone with all the qualities you could ask for in a dynamic cardioid microphone, it just happens to be one of the coolest looking mics you've ever seen. The Fin microphone from Heil Sound was featured prominently in the ad campaign for the 2012 smash hit movie 'The Hunger Games', (as well as the sequel 'Catching Fire'), for its amazing looks.

All for just

£219.95

219 WATTS

PRASEQ – AR Parametric Receive Audio System EQ

The new receiver audio processing system for ham radio and general communications. It enables you to optimise your reception for band and signal conditions as well as for your personal hearing.

Midrange frequencies are the most critical for achieving clear voice articulation in receive audio. The PRAS allows operators to have unique control over these important frequencies. First, operators can adjust the parametric midrange filter (MID FREQUENCY) from 400 Hz through 4 kHz, with the recommended sweet spot being at 2.5 kHz. In addition, operators can control the presence of these midrange frequencies plus or minus 15 dB using the MID GAIN control. Combined with a low-frequency filter (LOW) set at 160 Hz, and a high-frequency filter (HIGH) set at 6 kHz, the PRAS provides operators unparalleled control and quality of their receive audio.

All for just

£219.95

219 WATTS

PR10 PKG -AR Dynamic Microphone with LB-1 Lighted base

This microphone will bring your radio to life with full speech articulation and perfect balance. This package contains Heil's compact PR10 microphone, an LB-1 table base with an LED-backlit transmit status light, and an adjustable 8" mic boom to bring the mic up to a comfortable operating position during use. Although compact in size this microphone is built around a full 1-1/8" diameter dynamic element, just as our other. Producing full articulate sound from 85Hz to 16kHz you will be sure to be heard with every transmission.

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SHARMAN multiCOM

AR-600XL VHF/UHF Antenna Rotator

The SHARMAN AR-600 VHF/UHF Antenna Rotator with Base Control unit and Infa red remote control is designed for use with the smaller antennas Typical suitable antennas are smaller 2m and 70cm beams or tv antennas The AR-600 has programmable antenna controller with Infra-red remote-control. AR-600 remembers up to 12 antenna directions with back up Control over all functions is either with the infra-red remote control or control unit.
The control unit displays location chosen and relative position. Rugged Light-duty rotator is built in a weather-proof one piece cast aluminium housing. Has precision metal gears and steel thrust bearings for durability. Supplied with rotator, controller, 3-device universal remote, mount clamps and hardware.

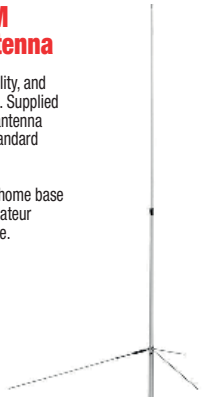
SPECIFICATIONS
- Mast size : 28 to 44 mm (1.1/8" - 1.3/4")
- Rotation time : approx. 74 sec.
- Rotation torque : 21.5 Nm
- Weight : 4.2kg
- Control unit : with digital direction indicator
- Operating Voltage 220-230VAC
- Requires 3-wire control cable (not included)

Buy the AR-600XLfor just
£199.95

199 WATTS

SHARMAN multiCOM

V-2000 6M/2M/70CM Triple Band Base Antenna



GRP fibreglass outer shell for durability, and pre-tuned for the appropriate bands. Supplied complete with mast brackets. This antenna is a two section antenna and has standard SO239 connection fitting.

A good value for money triple band home base antenna for the 50/144/430MHz amateur bands offer outstanding performance.

KEY FEATURES:
- Frequency range - 50 / 144 / 430MHz
- Max power - 150W
- Gain - 2.15dB @ 50MHz 6.2dB @ 144MHz 8.4db @ 430MHz
- Length - 2.2M
- Weight - 1.3Kg

Buy the V-2000 for just
£69.95

69 WATTS

SHARMAN multiCOM

SM-50II 50 AMP Switch Mode Power Supply Unit

Includes noise offset control to eliminate the pulse noise of the switching circuit. This patent pending function is specially designed for communication equipment use. Its effectiveness may vary depending on the frequency and mode.

KEY FEATURES/SPECIFICATIONS
- Input Voltage: 220VAC
- Output Voltage: 9-15Vadjustable
- Output Voltage regulation: less than 2%
- Output current: 50A
- Meter: Displays the supply voltage and current
- Cigarette plug terminal: 10A (max)
- Protection: Short circuit and automatic current limiting over 50A
- Dimensions:170mm (W) X 120mm (H) X 260mm (L)
- Weight: 3kg • Fuse: 8A

Buy the SM-50II for just
£129.95

129 WATTS

SHARMAN multiCOM

AV-508 – Deluxe Desktop Microphone

Suitable for most modern radios with required lead

FEATURES
High-sensitivity condensed microphone element - ensures better voice quality Runs on 2 AA batteries (Not included), Flexible goose neck supporting the microphone

Buy the AV-508 Receiver for just
£69.95

69 WATTS

SHARMAN multiCOM

AV-SW2M - 2 Way SO239 Coax Switch

KEY FEATURES/SPECIFICATIONS:
- Sockets SO239 • Power 2kW (DC-30MHz), 1kW (30-200MHz), 500W (200-500MHz), 250W (500-1000MHz)
- Range DC-1000MHz
- Insertion Loss: DC-500MHz 0.05dB, 500-1GHz 0.10dB
- Size 89 x 70 x 40mm • Weight 446g

Buy the AV-SW2M for just
£34.95

34 WATTS

SHARMAN multiCOM

STORM 100 CB Base Antenna

The Storm 100 CB base antenna is ideal when you only need local range and a compact antenna.

SPECIAL FEATURES
- Frequency - 26-28MHz
- Max Power - 30W
- Length - 1m
- Radials -3
- Gain - 0.5dB
- Bandwidth - 500kHz

Buy the STORM 100 for just
£39.95

39 WATTS

SHARMAN multiCOM

AV-600 VSWR Power Meter

Treat yourself to the Sharman AV-600 VSWR / Power Meter. It reads RMS and PEP and covers from 1.8MHz to 525MHz. It uses two sensors with five power ranges 0-5W / 20W / 200W / 400W

KEY FEATURES/SPECIFICATIONS
- 1.8-160MHz (S1) • 140-525MHz (S2)
- Two Sensors • 5W, 20W, 200W, 400W
- 13.8V DC Lamp • 155 x 63 x 103mm • Weight 720g

Buy the AV-600 for just
£74.95

74 WATTS

SHARMAN multiCOM

AV-6075NF – 75 AMP Swtch Mode Power Supply

The Sharman AV-6075NF is a lightweight, high performance, high efficiency, durable, switching power supply with highly visible back light, easy to read dual meters and audio noise cancel function.

Buy the AV-6075NF for just
£349.95

349 WATTS

MC-4MT 4M 5D-FB Cable Kit SO239 to PL259

Buy the MC-4MT for just
£17.99

17 WATTS

BM145 -PL (SO239) Large Magnetic Base

Buy the BM145-PL for just
£19.95

19 WATTS

Visit our website's product pages to see
Mini YouTube Clips

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

1

The Shack Receiver

Daimon Tilley G4USI addresses himself to the shack receiver, as a stand-alone piece of kit.

In my view, the general coverage receiver is the heart of a good shack, but for many, especially in recent years, I believe that is not so much the case.

When I first became interested in radio, it was as a Short Wave Listener (SWL). I was 13 years old and on holiday at my Great Aunt's in Suffolk. She had an old Pye domestic radio, which I still own, **Fig. 1**, and I spent many evenings with a length of scrap wire in the antenna socket, tuning around the SW broadcast bands amazed at what I could hear. As I tuned around I was entranced with Radio Sweden, Voice of America, HCJB, Swiss Radio International and many others. In short, I was hooked.

I guess many of us of a certain age started that way and I got to wondering why that was, and why it is much less the case these days. I think there are four main reasons. First, most domestic receivers from the 40s onwards contained the SW bands, so people, if they turned the dial, could see what was available. Over time, SW band coverage became a specialist item rather than a generalist one and many receivers dropped SW reception. Second, in the early days of the hobby, transmitters and receivers were separate items; you needed both pieces of equipment to operate as an amateur. Third, other than newspapers and then television, radio was the only other way of accessing global news. And finally, transmitters, until fairly recently, were capable of transmitting and receiving on amateur bands only. It wasn't until much later that transceivers were available with general coverage receivers, so anyone interested in radio, amateur or otherwise, needed a separate receiver. A little internet research leads me to believe that one of the first amateur radio transceivers with general coverage receive was the Yaesu FT-One, launched in 1982, and with a list price of £1,300 (£4,885 in today's money!).

The arrival of general coverage transceivers and the internet, in my view, are the main cause of the demise of SW receivers and general coverage HF receivers in the shacks of today. So why am I covering them here? Why should amateurs still consider a general coverage receiver in their shack?

Why a 'Traditional' Receiver?

Well, there are a number of reasons I think that we should still have a place for such devices. Here are a few:

Nostalgia (OK, maybe that's just me!) but it is nice to keep an old piece of gear alive and actively used.

General background accompaniment to activities in the shack, other than operating. When I am building or reading in the shack, I often tune around the SW bands first and listen to a broadcast station, instead of commercial domestic radio. It makes a pleasant change and there are often more in-depth news reports on particular topics. For example, while writing this, I am listening to a very interesting piece on Radio Romania International about the 1989 revolution.

The activity of Short Wave Listening itself. While it is true that there are now a fraction of the old number of broadcast stations around now, there is still plenty to listen to. I really enjoyed listening to Radio New Zealand the other afternoon with a piece on a NZ jazz musician.

If you enjoy building and using stand-alone transmitters. I have recently started going back-to-basics by building a number of simple transmitters using just one or two transistors. A general coverage receiver is used as the 'other-half' of this pair.

More modern, SDR-type receivers are available very cheaply and are often used to provide facilities such as a panadapter for a rig without those facilities, or for specialist purposes such as weather satellite reception, ADS-B and other modes. Of course, they make excellent general-purpose receivers in their own right and often provide coverage from 0.5kHz to the GHz range.

The shack receiver is an excellent tool to check on the quality of your signal. By ensuring you transmit into a dummy load and perhaps disconnect the antenna from the receiver, or use a built-in attenuator, you are able to hear your transmitted signal and listen for modulation and audio quality, chirp etc. in a way that the 'Monitor' function on your transceiver cannot – you hear it as others will hear you.

So, back to the purpose of this series of articles – what can we achieve on a budget? The answer, thankfully, is an awful lot, for not much money at all. Let's start with looking at three main sources for budget general coverage receiver: vintage general coverage receivers, designed specifically for SWLs; current receivers that provide SW capability; and SDR and dongle-type devices.

Vintage Receivers

In the vintage receiver category, because of the reasons already mentioned, we are really spoilt for choice. There are literally hundreds to choose from at very reasonable prices. There is no real need to be put off an old receiver, as their performance is usually more than good enough for broadcast reception. If you wish to use it in the amateur bands, however, you need to ensure it is suitable for that too, as some are not.

So, what should we consider when purchasing a vintage receiver? First you should be cognisant of things like general condition, any modifications, etc. I always think it is nice to find a piece of vintage gear in really nice condition, but don't be put off something shabby either, as they can

Fig. 1: The Pye domestic receiver.
Fig. 2: Heathkit Mohican.
Fig. 3: The Kenwood R-1000.
Fig. 4: The Datong FL3.
Fig. 5: The Yaesu FRG-7.
Fig. 6: The Lowe HF-150.

make rewarding restoration projects. Often front panels and knobs will be grubby with use, but a general light clean with a toothbrush and tiny amount of soapy water (mind those circuits!) can make a world of difference.

There is also a choice between valve and solid-state. Both can make fine receivers. Whichever you choose, beware that with age, sometimes a careful re-alignment might be required, and electrolytic capacitors might benefit from replacement. If you are confident a rig is working OK before you buy it, you may not need to worry about this, but it can provide a useful project and good learning later. For example, I brought a Heathkit Mohican, **Fig. 2**, from an online auction site for £60 delivered. This wonderful looking solid-state classic rig was sold as working, and indeed it is. I use it fairly frequently, but a tune around shows me it will benefit from re-alignment and that is a project I will look forward to when I have the time.

A further consideration is the ability to receive amateur as well as broadcast bands. Even if a receiver covers the amateur bands, it may not be suitable. You need to look for two things really. First is the ability to be able to tune finely enough for narrow band (comparative to SW broadcast) signals. This means that, for an analogue tuning dial, you would benefit from a separate bandspread dial. In the case of a receiver with a digital display, ensure that the tuning steps are fine enough, for example at least as fine as 1kHz for AM and SSB use, even smaller is better for CW.

The second feature you will need for amateur reception is the ability to resolve SSB. In more modern receivers, this will often be in the form of a dedicated SSB or CW mode. However, in older receivers, such as my Mohican, for example, you select a BFO (Beat Frequency Oscillator) mode and, once on your desired frequency, tune a separate BFO control to resolve the SSB.

There really is a fine selection of vintage receivers available, but do ensure you shop around before buying, particularly on price, which I find can vary widely. For example, I have a very nice Kenwood R-1000 receiver, **Fig. 3**. As I write, three of this type of receiver are listed on a well-known auction site. One is priced at £350, one at £250 and one, with a few issues, at £99. Well, in my humble opinion, the first two are at a ridiculous price – I bought mine in perfect condition from a local person on a social media site for £60. I think I was particularly lucky, and perhaps a realistic price is in the £150-£200 range.

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A final consideration when purchasing a vintage receiver is if you wish to use it for CW reception. Many receivers of this type will either be 'wide-open' with filters of around 9kHz for broadcast stations on AM, or have filters around the 2.4 to 3kHz range for SSB. You can receive CW with filters that wide, but in busy conditions on a crowded band, it will just receive too many signals to be able to resolve the one you want to hear. Don't worry though, because all is not lost, and you can buy, or make, a lowpass audio filter that sits between your audio amplifier and loudspeaker/headphones that will narrow the filtering further to enhance reception. As examples, I use a Datong FL-3, **Fig. 4**, purchased for £60 used, which does a remarkable job of CW reception with my HW-9 transceiver and my other receivers too. Phoenix Kits produce an easy to build SCAF audio filter kit for £30, which works quite well too. Other kits and modules are also available.

So, to round this section off, and to give you ideas of what to look and search for online, I have spent the last few weeks scouring the web and identifying good quality general coverage receivers and noting their price, **Table 1**. Please be aware, I am not saying these are good prices, but they are the prices advertised. I hope you find them of some help, and as always, I would refer you to the eHam website for real user reviews.

Please note that this is not meant to be a definitive list and there are very many more options you may choose. These include some ex-military receivers from the venerable AR-88 to the Racal RA17, the Larkspur R-210 and others.

Other options, certainly for broadcast station use, include some of the 1980s era portable receivers, such as the Sony e.g. ICF-2001 and ICF-7600DS in the £30 to £50 range.

Modern Receivers (New)

There are very few modern equivalents to the range of vintage general coverage receivers, certainly for SW and a non-commercial budget, while there are still a number of commercial scanners around for the higher frequencies.

Let's take a look at what is currently on offer. I will ignore SDR receivers as these will be covered in the next section.

TecSun offer a wide range of models available through our usual amateur radio retailers, and online. I see a lot of these radios advertised and found the range a bit confusing, so I went to the Tecsun website and searched using their 'SSB' filter. No less than 12 different models are available offering a wide choice of style and features. There is the PL-368 handheld at £70, a range of small portable receivers, ideal for holidays or shack use varying between £55 to £250, as well as the S-2000 desktop receiver at £299. I have no experience of these radios, and while many of them offer SSB the specifications that I could find

do not indicate what degree of filtering is available. For SSB you would want a 2.4kHz filter and for CW a filter as narrow as 500Hz would be the widest I would want on a busy band.

Sangean are another brand with several portable SW receivers. I found six models, five of which claim to offer SSB. Again, no filter width details were available and prices range from £90 to £215.

Once again, be very careful shopping around. For the Sangean ATS-909X2, prices online varied from £215 to £301 for the identical radio! The cheapest was with one of our well-known amateur radio outlets at £215.

Also in the portable category are radios from Eton. The Elite 750 is the desktop radio and appears identical to the Tecsun S-2000 in every way. Their Elite Executive radio, Elite Field Radio and Elite Traveller radio all cover SW, but only the 750 and Executive are listed as receiving SSB.

At the cheaper end is the quite popular Malahit or Malachite range. This appears to be a bit of a minefield! The original version started life from some Russian amateurs, but being open-source it was soon the subject of a lot of Chinese copies of varying quality. There are some social media groups out there about this receiver that will guide you to the good ones and the full firmware, which provides coverage from 50kHz to 2GHz in a very compact, pocket sized package with touchscreen and internal battery. Do your research wisely and this could be a good, cheap and effective route, but it is a jungle out there! The original Russian version is doubtless the safest, if more expensive, choice and the only real downside seems to be quite a bit of internally generated noise, but with lots of bells and whistles, including a full-colour waterfall type display. Of course, recent tragic events in Ukraine will mean buying direct is not possible currently.

As a final note in this section, I have just discovered a tiny SW receiver, smaller than a pack of cards with incredible reviews, called the Belka DX. If you pop it into a search engine you will find literally dozens of hugely positive reviews, even for CW on a crowded band, where filtering is described as excellent. It is made in Belarus by amateur **Alex EU1ME** and is ordered from him directly. The price at the time of writing is 400 BYN, or £111, with just £4.75 postage. I am thinking it would make a great companion receiver to my current project of an Arduino controlled all-band HF CW transmitter. Surprisingly, given the current situation with Belarus, it arrived without problems and first impressions are excellent. I can recommend it highly.

SDR/Dongle-type Receivers, requiring a Computer to Work

Many (certainly in the 'budget' range) SDR or Software-Defined Receivers, will require the use of an external computer, monitor and mouse to function, so bear that in mind when considering such a purchase, but there are a few self-contained units and I will start with those.

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At the slightly more expensive end, but below £1,000, is a unit from ELAD – the FDM-DUOR at £750. This is the cheaper sister of the £960 transceiver version, so only worth considering if you are not a licensed amateur. It can be used as a very attractive stand-alone receiver or can be connected to a computer for a bigger display.

While still retaining good budget prices there are some very high quality SDR receivers out there, requiring a computer, and while I have not yet been able to justify one to myself, I am sorely tempted. Here are a few that attract very good reviews.

SDRs from SDRPlay are well regarded. They range from the amazing value RSP-1a at £99 to the RSPdx at £195 and the range-topping, dual-receiver RSPduo at £240. All cover 1kHz to 2GHz and will do a sterling job of receiving any mode, with excellent provided SDR software and allowing you a wide (10MHz) waterfall view of spectrum at any one time. SDRPlay radios have proven so popular that there are a number of fakes – buy from a reputable dealer only! Helpfully, SDRPlay have a list of trusted resellers worldwide on their website.

Airspy are another highly respected brand in the SDR marketplace. Their HF Plus Discovery covers 0.5kHz – 31MHz and 60 – 260MHz and costs £200. The AirSpy Mini is a USB stick dongle

device covering VHF and UHF for £120.

On the subject of USB dongle SDRs, these are often known by the generic name RTL-SDR and are based on DVB-T TV tuners that can be used in a wideband fashion. Often these dongles are designed to cover about 26MHz up to 1 or 2GHz, so do not cover the SW bands very well, with some exceptions. They can be purchased for anything from about £20 to £100 depending on brand and quality. A couple of years ago I purchased the NooElec brand via an online retailer for about £35. It was easy to set up with my Raspberry Pi and I was able to use it with a number of free SDR software packages. I found it interesting but living very rurally, there was not much traffic at VHF/UHF to make it worthwhile and it also suffered very badly from a local community FM radio station, which was breaking through in all sorts of unexpected places! As a consequence, this week my son and I turned it into an ADS-B aircraft receiver using a spare Raspberry Pi and the PiAware software, enabling us to receive live aircraft identifications at 1090MHz of aircraft within range. More information on RTL-SDR dongles can be found at the RTL-SDR URL below and a good source of information about creating an ADS-B receiving station can be found at:

www.flightaware.com
www.rtl-sdr.com

DIY/Kits

What if I were to say that you could build a complete AM/SSB SW and FM/AM broadcast receiver easily at home for considerably less than £20? Even easier still, it contains only six discrete modules!

Welcome to the fascinating world of micro-controllers. Don't be put off if you have never touched a soldering iron or even looked behind the scenes of an Arduino. There are many great tutorials online where you are talked through the very simple steps required and the computer code is free to download. The hardest part, and it is not difficult, is getting the software onto the micro-controller.

These projects make use of the Si4730 range of radio chips. These are essentially complete radios on a single device, a bit like the famous ZN414 AM 'radio on a chip' in a transistor style package launched back in the 70s. If you remember building one of those, as I did, well this is just a more sophisticated version and nearly as simple. Indeed, it is this range of chips that are used as the basis of radios like the Tecsun portables, albeit they are used in a more sophisticated way.

I came across this project quite by chance as I am a micro-controller fan, and have used and programmed a large number now for various projects. But having seen it I immediately thought of this upcoming article, and given I had every part needed in my junk-box, apart from the Si 4735-D60 chip, costing £5 from China, I ordered one to give the idea a go. At the time of submission of this article I have not got around to building it, but you may read about it here in the future!

I won't repeat the instructions here but will signpost you to the best tutorial I found at:

https://tinyurl.com/bddspnd5

with a more technical description, if you want it, here:

https://github.com/pu2clr/SI4735

Manufacturer	Model	Recent price advertised	Comment
Yaesu	FRG-11	£200	
	FRG-7	£130	An all-time classic! 1976-1980 (Fig. 5)
	FRG-7000	£300	1976-1980
	FRG-7700		1981-1984
Kenwood	R-600	£125	
	R-1000	£100 - £350	Mine was £60!
	R-2000	£295	
Trio	9R-59DS	£20	My first 'proper' SW receiver
Heathkit	Mohican	£200	What a looker! Beware of the price – I paid £60!
	SW-717	£50-80	
Eddystone	840C	£60	Handsome receivers, every one of them!
	888	This and the 740 together for £200	
	740		
Lafayette	KT340	£40	
Icom	IC-R72E	£300	1990-98
	IC-R100	£100	
Realistic	DX300	£100-£200	
Radio Shack	DX-394	£135	
Lowe	HF-150	£150-200	1980s – I aspired to own one as a teenager!

Table 1: Some examples of older receivers currently advertised for sale.

ATUs

My final thoughts turn to effective use of the receiver. Often, we are guilty of just throwing up a random long wire and expecting things to work – and they will, but not efficiently. Using a non-resonant antenna with a receiver is as effective as using a non-resonant antenna with a transmitter, but without the damage! Remember, from my article on ATUs, that an ATU merely provides impedance matching between the 50Ω usually expected from the transmitter and the differing impedance of the antenna. In simple terms this increases the amount of power radiated, or in this case the amount of signal received. It is truly astonishing the difference in reception this can make. For comparison I tuned my R-1000 to the 40m band and listened with the random wire I use for general SW Broadcast listening and convenience, and then connected it to my 80m End Fed Half Wave antenna. This antenna is fed with a 49:1 transformer meaning it is a good match on 40m where it acts as a full-wave antenna. The difference was palpable and signals came up right out of the noise.

Remember, though, that some receivers are different. For example, some might require a 75Ω impedance antenna, and others like my Heathkit Mohican are specifically designed for random long wires and incorporate their own internal antenna matching device. I was a little shocked (excuse the pun) when I tried connecting my Mohican to my antenna switch and got a spark, and later discovered the Mohican has a positive chassis! Thankfully no damage was caused, but beware of this if you pick up a vintage receiver.

Whatever the situation you will receive more/better signals with a well-matched antenna. Any ATU that does not require RF to activate it (ruling out Auto-Tuners) will work. Instead of tuning for lowest SWR, which you cannot measure as you are not generating RF power, you merely tune for maximum noise or volume on the band concerned. You can buy used ATUs specifically made for SWL's, or why not make your own from scratch or a kit?

Conclusion

I hope you have found this latest instalment in the *On a Budget* series helpful and that it has inspired you to find yourself a shack receiver where perhaps you did not have one before. You do not have to spend much money to get a really excellent piece of vintage or modern gear.

In the next instalment, we will examine shack accessories, from antenna analysers to power supplies and SWR meters, with more in between! Until then, 73. **PW**

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The KW201

Philip Moss M0PBM describes the KW Electronics KW 201 amateur bands receiver.

The particular radio I describe here is in the collection of the British Vintage Wireless & Television Museum, Dulwich. The KW201 was specifically intended for amateurs using SSB, but also catered for CW and AM. I think it fair to say that in the sixties SSB was still more a coming than fully arrived mode, so the KW 201 and other KW sets were ahead of their time. Britain was slow to adopt SSB despite the fact it was a British invention in about 1929. It was developed by Rediffusion, not for conventional broadcast but for power-line transmission of radio, to consumers. The idea was that the listener could have a simpler radio, by using signals sent along power lines, and it would be possible to get more signals into a given bandwidth if only one sideband was used. By only partially suppressing the carrier, it could be regenerated in the receiver. The idea didn't catch on, and I suspect that with the technology of the day, the receiver would be more, not less complicated. There was another objection, and one that remains today for radio with a short range, and that is that governments that like to keep their populations ignorant of views other than their own don't like international radio reception.

The Americans took SSB up in the Second World War, and used it very effectively for communications from North Africa to the USA, where more powerful British sets failed to reliably get back here. I assume that they used it elsewhere also. So typical that a British idea is exploited elsewhere.

KW Electronics

The KW company was started by **Rowley (Roland) Shears G8KW** and **Ken Ellis G5KW**, hence the company name. It appears this was in 1956. The company was relatively short-lived, and situated in Dartford. A reason for this was that the designs failed to successfully integrate receiver and transmitter, making it harder to achieve quick and easy changeover between receive and transmit, where competitors did this better. Growing infiltration from foreign imports from low-cost countries was probably also a factor, even after they did have a properly integrated product.

The company was taken over in the 1970s by Granger Associates who used the plant to assemble their products. They discontinued the amateur gear, and made professional MF and HF radios.

Circuit Description

So, to the set in question, **Fig. 1**. It covered the 80 to 10m bands as they were then, the actual bands being 1.8 to 2.0, 3.5 to 3.7, 3.7 to 3.9, 7.0 to 7.2, 14.0 to 14.2, 14.2 to 14.4, 21.0 to 21.2, 21.2 to 21.4, 28.0 to 28.2, 28.4 to 28.6 and 28.6 to 28.8Mc/s. Note the strange gap at 28.2 to 28.4Mc/s, unless the specification was printed incorrectly. A disadvantage of this architecture is the many narrow bands to cover the range. A wider VFO and first IF could make it easier to use, though at the expense of likely more trouble with unwanted signals getting through. A tunable first IF would counter that at the expense of, well, more expense. There was a matching transmitter, though the only interconnection was the muting line. It was the KW2000A at £220. In the absence of being able to find a circuit, I have drawn a block diagram of the set, **Fig. 2**.

This is a best-effort attempt and will not be either complete or entirely accurate. For example, I have not shown all the tuned circuits as this would be hard to determine, but I have shown the general layout and essential detail to enable it to be understood in principle. This is required because it is not a conventional superhet: even as dual-conversion sets go, though it is also not unique, and similar architecture was/is used in other sets.

Who got there first, I don't know. It is a dual-conversion superhet, with a wide first IF, at a fairly high frequency of between 2.955 and 3.155Mc/s, and a second IF of 455kc/s. The high first means that image frequency rejection is much better than if a low IF were used, and then a 'normal' second IF where it is easy to get the required bandwidth with sensibly attainable *Q* of the filters. All active devices are valves, with power and signal rectifiers being solid-state.

The first local oscillator (LO) is fixed for each band by a crystal, so there is a bank of them. This gives high stability with easy circuitry. The crystals plug into the PCB, there is no oven, but that is good enough. The set does not dissipate much power, 60W, and the crystals are away from the transformer and output valve. The case as can be seen, **Fig. 3**, is designed for easy heat loss. The set is entirely built on a PCB, front panel controls excepted. The options are also on PCBs if fitted. Our set has the crystal calibrator, but not the *Q*-multiplier.

The calibrator can be seen as the small PCB standing vertically with what appears to be two valves horizontal, but the taller one is the high-quality crystal. If it had the *Q*-Multiplier too, the bandwidth would be variable down to 200c/s, from the standard 3.1kc/s. That was optimised for SSB, and a bit narrow for broadcast AM, but then this set was not designed for that use, and any AM broadcasts received were a bonus, assuming that they didn't come as break-ins to the amateur reception! The crystal calibrator was £6 extra, the *Q*-Multiplier was £8-10s. I have no details on the latter. The radio itself was £105.

So, to the circuit detail. The aerial signal is manually tuned for peak using the calibrated control. This is not the tuning control though, that comes later. The signal is fed to an EF183 high-slope low-noise pentode (of TV fame), whose amplified output is again tuned before going to the first mixer. There is only one coil used for each of these circuits covering the whole range in as-

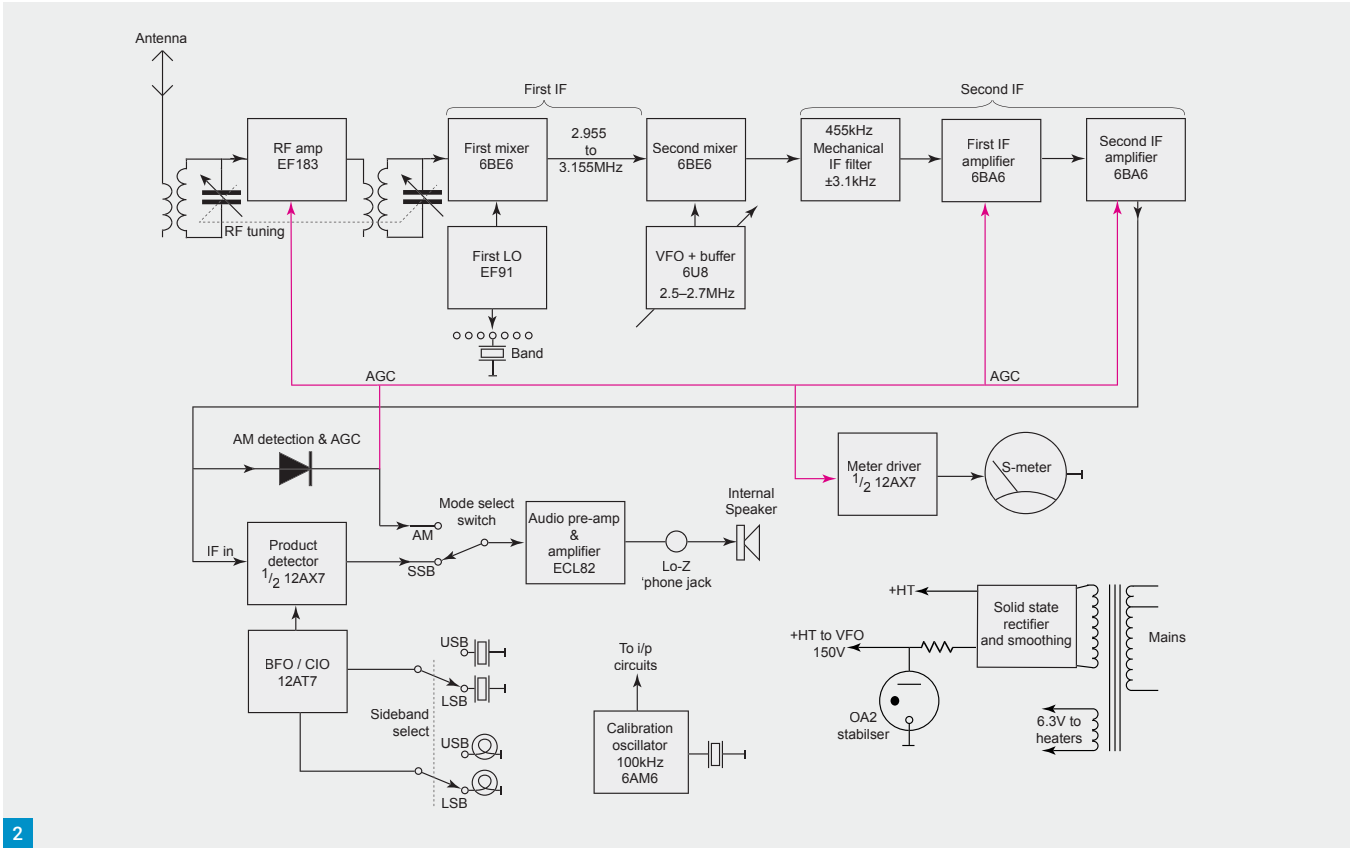

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Fig. 1: The KW201. Fig. 2: Block diagram of the circuit. Fig. 3: Top view, note the perforations in the case for easy heat loss.

sociation with the tuning capacitor. Tuning is attained by first selecting the band, which selects the crystal for the first LO, then tuning the required frequency with the VFO within its 200kc/s range. This comprises a 6U8 (ECF82), with a pentode oscillator and triode buffer. The VFO was imported from Italian manufacturer Geloso, who are thought to have influenced the design of the radio.

Here I note that all but two valves are given their American style numbers, despite this being a UK set, using UK or European valves. I have added the familiar numbers in brackets after the original numbers. The first mixer is a 6BE6 (EK90) heptode. The crystal oscillator is a 6AM6 (EF91, Z77). This is the 'straight' version of the 6BA6 (EF93) variable-mu pentode. Again, the EF91 is of TV fame. The output from the first mixer goes to the second mixer, again a 6BE6. Its output goes to a mechanical filter at 455kc/s, which has a bandwidth of 3.1kc/s at –6dB and 6kc/s at –60dB, then to two stages of amplification by 6BA6s. Thereafter depending on mode chosen, it either goes to a diode for AM reception, or a product detector in the form of a 12AX7 (ECC83), where it is mixed with another crystal-controlled oscillator, whose frequency is either above or below the IF to give either USB or LSB, whichever is selected. These can be seen on the right-hand side of the PCB, with the 12AT7 between them, and they are of the very high-quality glass-encapsulated type on B7G bases. Two crystals are needed for this as a single crystal cannot be 'pulled' far enough to cover both frequencies. The valve is a 12AT7 (ECC81). CW can be received on either a CIO (carrier insertion oscillator) or BFO (beat frequency oscillator) – really the same thing, except while a 'sniff' of BFO is all that is needed, for SSB reception without severe distortion, a very much higher level is needed. Ideally there would have been a very narrow filter for CW reception, but there is no dedicated filter in this design.

The designer was very keen to ensure you knew which sideband you were on, hence the two rather large, rectangular illuminated signs at the upper right-hand side of the front panel. In either green or red suggesting either go or stop, or safe or danger! Whichever demodulated/detected signal is chosen, it is then fed to an ECL82 triode-pentode audio pre- and power amp, then to an internal 2.5Ω speaker. A headphone socket intended for low-impedance 'cans is provided, which cuts off the speaker.

The S-meter is calibrated for 50µV at S9, and is driven by a 12AX7 (ECC83), which seems rather elaborate for the purpose. As there is only one 12AX7, only half is used for the product detector. Not on the list of valves in the manual is the OA2 voltage stabiliser, which is only used for the supply to the VFO. You might have thought that the same supply would be used for all the oscillators. The magnet for the speaker is just visible about in line with it, poking through the metalwork on the right-hand side.

Work

There were only two problems to get this set running. One was due to the failure of the manufacturer to mark connectors. The other was rather more awkward. The set was generally in good condition, and after having its face washed looked very respectable. But it was completely silent. Nothing. Suspicious. No smoke and heaters on, and HT was found. Also, a suspicious number of places had high negative volts on. I suspected that two very small sockets on the rear were mutes, but just shorting together two unknown sockets, one with this high (~50V) voltage and earth, seemed risky, I didn't want to be the cause of smoke… I used a 1kΩ resistor. The set came to life so I permanently wired the sockets together.

The higher ranges when peaked seemed too sensitive and too many signals, leading me to the correct conclusion that the RF amplifier was oscillating. Inspection revealed nothing. If there were 'stickys' as I call the old waxed-paper capacitors, I would suspect them and change them as a matter of course, but this is too new for them, and the decouplers were ceramic disc, generally very reliable. Soldering looked fine. The solution turned out to be to replace the 10Ω anode-stopper, which by the way had already more than doubled in value, to 100Ω. Problem solved. Not entirely satisfac-


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tory as I did not find the cause of the problem, but that could involve replacing a lot of components before finding a solution.

Although this set seemed lively enough, I have discovered that there is a potential future fault according to **Steve Shorey's** website (see Acknowledgements). That is the Kokusai mechanical filter is lined with foam rubber, which disintegrates into sticky goo, and causes the filter to increase its attenuation. It should not exceed 12dB. That seems a high value anyway. A crystal lattice filter would have an insertion loss more like 2dB.

This is a nice compact set, and for a short-wave listener with ideas of getting licensed, who wants to get the hang of how amateurs operate, on analogue signals that is, it is quite attractive if the price isn't too high. As a collectors' item, it is also an attractive set. It is quite complicated to understand for a beginner though, not being a simple superhet design. The performance seems very good: 1µV for 20dB signal-to-noise on all bands. The conditions are not stated, but I assume as it is specifically for SSB, that is the mode concerned.

Acknowledgements

I would like to acknowledge the following sources, which enabled me to write this article:

- **James Sawle MD0MDI**, whose website (below) has the handbook to the set, regrettably without the circuit, despite listing all the components etc. It appears to be complete though.

www.md0mdi.im

- The Radiomuseum website (below) has short-form information on the set and thousands of others! A very interesting site.

www.radiomuseum.org

- An advert for the set appeared among other dates in *Short Wave Magazine* in a 1967 copy. This was found at:

https://tinyurl.com/munhm9f8

- The site of Steve Shorey has many KW sets displayed with comments. Also, a history of the company and other content: I have found this very useful, and the site is a good read.

G3ZPS.com

The BVW&TM is in Dulwich:

www.bvwtm.org.uk **PW**

Radio News

CAISTER MARCONI RADIO STATION CONTACTS MORE THAN 160 AMATEURS IN 25 COUNTRIES: Radio amateurs at Caister Lifeboat in Norfolk managed 162 contact in 25 different countries on Saturday 23 April when they took part in the annual International Marconi Day (IMD) event to mark the inventor's birthday.

Using the call GB0CMS and a mixture of Morse code, telephony and data (FT8), contacts were made with other radio amateurs across the UK, Europe, the USA, Canada and Australia. Notable contacts were made with other IMD stations in Newhaven, East Sussex and Chelmsford – the home of Marconi's original factory.

Other long-distance contacts were made with Ian VK3MO near Melbourne in Victoria, Australia and John VK6WC in Chidlow, Western Australia.

The Norfolk Amateur Radio Club (NARC) ran the all-day special event station at Caister Lifeboat to commemorate the village's original Marconi Wireless Station, which was established at Caister in 1900. The station was in a house in the High Street known as Pretoria Villa and its original purpose was to communicate with ships in the North Sea and the Cross Sands lightship.

The equipment used was 200W maximum from a Kenwood TS-480 (20m) and 100W maximum from an Icom IC-7300 (40m). Antennas were a W5GI dipole on 40m and G0KYA-designed monoband end-fed half-wave vertical for HF.

The photo shows PW columnist Roger Cooke G3LDI operating the station.

LUNCH ON THE AIR: Radio amateurs in Staffordshire are invited to join Lunch on the Air, a new VHF net that will be held every Wednesday lunchtime, 12.30pm onwards, on 144.700MHz from 11 May 2022. Chaired from the county town of Stafford and launched by Daniel M7CFW, a member of Stafford and District ARS G3SBL, initial trial nets have been promising with a good uptake from amateurs, reaching most of the county at moderate power levels. Daniel says it's a friendly net aimed at those at home, working from home, caring from home or having lunch in the area who want to call in. Alternative frequency is 145.375MHz and web details are at:

https://2mfm.uk

CADET RADIO EXERCISE BLUE HAM 22-1: Across the UK Cadet Stations came together and took part in Exercise Blue Ham over the weekend of 26/27 March 2022. Blue Ham is a radio communications Exercise on the 5MHz (Shared) Band. The exercise has been running for a number of years and was introduced to broaden the Cadet experience of radio operation and to reach out to radio amateurs who may be interested in joining the Cadet Organisations as Radio Instructors. During the exercise, Cadet Forces Adult Volunteers (CFAV) and Cadets operated HF radio stations contacting radio amateurs with the purpose of exchanging specific information during their QSOs. The Blue Ham Co-Ordinator issued 25 MRE callsigns for the Exercise. This included ten Cadet stations that had never participated in Exercise Blue Ham before. This time around it was great to see and hear many cadets back behind the microphone with plenty of excellent teamwork going on at the stations to handle at times the pile-ups of people calling them.

Conditions on Saturday morning were a bit quiet but did pick up greatly after 10am when they improved a great deal, which continued throughout the rest of the weekend. On both days all the assigned frequencies within the band showed some excellent Inter-G and many stations also managed to work out to the Baltic coasts.

There were again many contacts with Portable stations, which may have been down to the good weather conditions. It was also noted that Cadet operating procedures and prowords were used by amateur radio participants, which helps out immensely with the new Cadets operators who may have been first time users of HF equipment – thank you.

The online log page has listed some 1225 QSOs made by Cadet stations during the period of operation, which is a great result but showed slightly down on the last couple of Exercises, which were run through Covid lockdown. The log also showed many amateur callsigns that had been logged on previous Exercises plus quite a flurry of new callsigns who gave their support, time and patience, which again indicates how popular the exercise has become.

There were four Data capable stations on air using mainly OLIVIA 16/500 with some switching to BPSK31 when asked to by amateur operators. This attracted a number of amateurs with some new callsigns appearing for their first go at Data modes. During the Exercise Amateurs were contacted across the UK, Republic of Ireland, Sweden, Norway, Denmark, Netherlands,reaching Jersey in the south and the Shetland Islands in the north.

The organisers would like to thank all of the Cadets, CFAVs and amateurs for their time and effort they put into exercise weekend. The next exercise is programmed for 11/12 June 2022 and the best place to find out more information is at:

https://tinyurl.com/ycx3rjpk

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1

Why Not Try 6m?

To coincide with the start of the summer Sporadic-E season in the Northern Hemisphere, **Colin Redwood G6MXL** encourages readers to explore the 6m band.

Before looking at the 6m (50MHz) band, I thought it would be a good idea to introduce readers to Sporadic E propagation. Every year amateurs in the northern hemisphere are blessed with some enhanced propagation known as Sporadic E. This rather erratic enhancement can result in much stronger signals and better propagation than is usually encountered at sunspot minimum on the 10m, 6m and 4m bands. A previously dead band can suddenly become alive with strong signals from distant stations. Occasionally the enhancement can extend as high as the broadcast FM band II frequencies and even up to the 2m (144MHz) band. Most years the Sporadic E season runs from about mid-May to early August. With this in mind, I thought it would be timely to look at the 6m (50MHz) band.

6m

While Sporadic E may be the propagation mode that most newcomers to 6m will encounter during the next few months, just about every propagation mode that occurs on other HF and VHF bands may also be encountered, ranging from ground wave to EME (moonbounce). While many will think of the 6m band as a DXing band, there are also plenty of opportunities to make local contacts using ground wave and occasionally tropospheric enhancement.

UKSMG

If you get a real interest in the 6m band, then I'd certainly recommend joining the UK Six Metre Group (UKSMG). Besides a quarterly magazine, UKSMG organise a number of contests during the year. I'd also suggest visiting their website at: **www.uksmg.org**

Transceivers for 6m

These days most HF transceivers include the 6m band. It is worth checking whether any built-in ATU operates on 6m or not. This will inform your choice of antenna or the need for an external ATU. Some transceivers include a separate antenna socket for 6m, while others share a common antenna socket with the HF bands. With some transceivers the output power on 6m may be less than on the HF bands (perhaps 50W instead of 100W). If you like low-power (QRP) operation, models such as Yaesu's FT-817 and FT-818, Icom's IC-705 and Elecraft's KX3 all incorporate 6m.

Transverters

If you have a HF transceiver without 6m, then you could consider a transverter enabling you to operate on 6m with a low power 28MHz drive from your main HF transceiver. Remember to check the maximum power input your transverter can handle from your transceiver. In many cases this will be 5W, but it can be as little as 1mW. Transverters are available from a number of sources in the UK and abroad. Some are ready to use, while others are available in kit form. Unfortunately, one popular source of transverters is currently unavailable due to the war in Ukraine.

Antennas

I'd suggest avoiding pontificating over the 'best' antenna for your initial foray on 6m. To get on 6m simply and cheaply, a centre-fed wire-dipole that is 2.85m long (with insulators) or 2.90m long without insulators should do the job. I'd suggest cutting the wire a little longer and then pruning it a cm or two at each end until you get a reasonable match. If you are using an inverted-V configuration, then you'll probably find that the length will end up a few cm smaller than the suggested lengths above. Attach some RG58 or RG213 feeder at the feedpoint, not forgetting to seal the feeder against moisture ingress, and you'll have antenna that will be sufficient to get contacts when the band is open. Enjoy working whatever you can during the summer!

In comparison with the HF bands, antennas for 6m can seem relatively small. A simple dipole cut for the band will work surprisingly well. I've made 6m SSB contacts across the Atlantic Ocean using as little as 10W to a dipole. A Moxon or a Yagi will give better results, and enable a useful degree of directionality to be used – which can be helpful for more predictable propagation modes such as tropospheric enhancement, rather than Sporadic E, the favoured direction for which tends to drift. Designs can be found in one of the books referred to later. If you are planning on building your own Yagi for 6m, remember to cut the elements accurately to length if you want to get the very best performance. If you are planning to operate away from home, you need to consider boom and element lengths if you propose to transport them in the typical family car or on foot.

Commercial 6m antennas are available from many amateur radio dealers, including those advertising in *PW*. The May 2022 issue of *PW* included a review of a commercial 4-element Yagi for the 6m band. If you are also looking for a Yagi antenna for the 4m (70MHz) band, then you may wish to consider designs that incorporate both 6m and 4m elements on the same boom, such as that shown in **Fig. 1**.

If you are planning to add a 6m antenna to your existing VHF/UHF antenna mast and rotator, it is worth bearing in mind that 6m antennas are generally much bigger that their 2m counterparts, and thus heavier and present a greater wind loading on the mast and rotator. You'll also need to check that you have enough space at ground level when you luff (tilt) your mast over.

Polarisation

As with other VHF bands, by convention 6m operators generally use horizontal polarisation for SSB, CW and Data Modes, and vertical polarisation for FM. Sporadic E signals often get their polarisation changed during their passage through the ionosphere, so antenna polarisation is perhaps not too critical. For some other modes, such as ground-

Fig. 1: A small dual-band Yagi antenna for 6 and 4m. Fig. 2: 6m repeaters in the UK. [Source RSGB ukrepeater.net Copyright of the Radio Society of Great Britain] Fig. 3: The RSGB 25 Squares award for 6m. Fig. 4: The RSGB 10-Country awards for 6m. Fig. 5: The 'Magic Bands' book written by PW editor Don Field G3XTT. Fig. 6: The 'Magic Band Antennas for Ham Radio' book by Bruce Walker N3JO.

wave and tropospheric propagation, the same polarisation at both ends of the contact will certainly give better results.

Feeder

While feeder losses on 6m are less than on other VHF bands, they are higher than on HF. For short runs (say up to 10m or so), good-quality RG58 is sufficient. For longer runs, RG213 should be sufficient to keep feeder losses below 2dB for runs up to about 30m in length.

Modes

Most activity on 6m tends to use CW, SSB and data modes such as FT8. These will no doubt be familiar to many operators on the HF and VHF bands. I've noted a few points below that are specifically relevant to 6m.

FM and Repeaters

In addition to the 'DXing modes', some 6m FM activity can be found in some areas. The FM calling frequency is 50.510MHz. There are also a number of 6m repeaters, **Fig. 2**, which use a 500kHz split, where the repeater transmits 500kHz lower than it receives. You'll need to transmit 500kHz higher than the frequency you are hearing the repeater on. UK 6m repeaters use CTCSS tones to enable access. Lists of 6m repeaters can be found on the UKSMG and RSGB websites at:

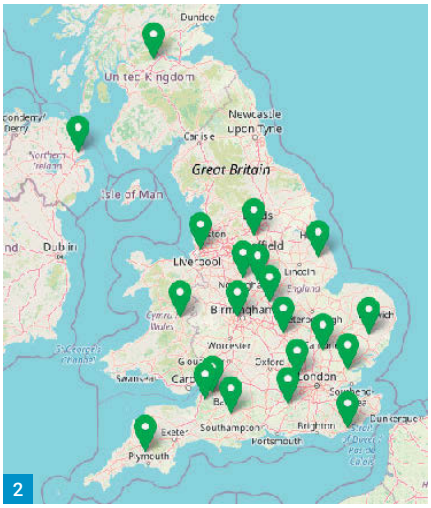
https://tinyurl.com/pwxrrcev
https://tinyurl.com/m25mz96j

Bandplan

Over the years, the 6m bandplan has evolved as more European countries gained access to the band. I'd suggest visiting the UKSMG's website to check the latest version and to get an update on current operating custom and practice. In particular, the frequencies between 50.100 and 50.130MHz are designated as the SSB and CW DX window, meaning that they are intended for genuine DX (intercontinental) contacts. Note that for CW and SSB, there are no 'calling frequencies'; instead there are centres of activity. In practice this means that you find a clear frequency and make brief CQ calls. When you get a reply to your CQ (or reply yourself to a CQ call), you make your contacts on that frequency, just as you would on the HF bands.

FT8

50.313MHz is the main frequency used for FT8,



with 50.318MHz used for FT4. As 50.313MHz can get crowded with European stations working other European stations, an alternative frequency, 50.323MHz, is recommended by the UKSMG specifically for European stations wishing to make contacts outside Europe, with European stations transmitting first period.

Operating

There are several techniques for establishing whether the band is open. Listening for 6m beacons can be helpful – bearing in mind that in some cases their antennas may not be pointing in your direction. Keeping an eye on the DX Cluster is also a useful technique. I've also found that listening on the usual FT8 frequency is a quick check. In less than a minute you can get a good feel whether the band is open, and in which directions.

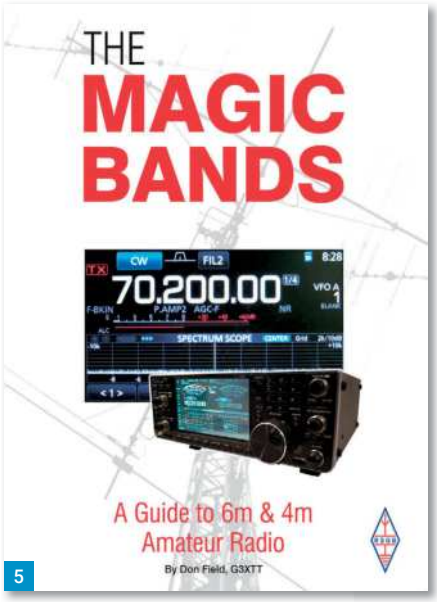
Due to the nature of sporadic E propagation, which can come and go very unpredictably, most contacts are quite brief, exchanging callsigns, reports and perhaps locators. Once the basics are exchanged, if propagation allows and there isn't a pile-up of stations wanting to have a QSO with the station you are in contact with, then by all means have a longer contact.

Contests

For those who enjoy contesting, there are many to choose from. I've listed those organised by the Radio Society of Great Britain (RSGB) and the United Kingdom Six Meter Groups (UKSMG) in **Table 1**. Other contests are organised by other national societies and groups, including Worked All Britain (WAB). I'd suggest readers who are interested in participating visit the relevant websites to get the full rules.

Awards

A number of organisations offer awards for contacts on the 6m band. For example, the RSGB have awards for confirmed contacts with just 25 IARU locator squares, **Fig. 3**, or 10 countries, **Fig.**



4. In both cases contacts can be confirmed by QSL card and/or Logbook of the World (LoTW). During breaks from sightseeing and operating on the HF bands, I was able to claim both these awards during a week's operating in late June 2021 from North Wales, using just a wire dipole. Once you get well established on 6m, then the ARRL offers awards for confirmed contacts with 100 DXCC entities (DXCC) on 6m, and 100 locator squares on 6m (VUCC).

In addition to the awards above, you can use 6m contacts for numerous operating award schemes, including Islands on the Air (IOTA), Summits on the Air (SOTA), HuMPs Excluding Marilyns Award (HEMA), World-Wide Flora and Fauna (WWFF) and Parks on the Air (POTA) to name a few. I've looked at each of these in past *What Next* columns in *PW*.

Name of Contest	Date	Time
50MHz UKAC	2nd Thursday Each Month	20:00 to 22:30 Local
UKSMG Summer	Early June	13:00 to 13:00 UTC
50MHz Trophy	Mid-June	14:00 to 14:00 UTC
Spring 50MHz	2nd Sunday April	09:00 to 12:00 UTC
50MHz AFS	Mid-October	09:00 to 12:00 UTC
50MHz CW	End-June	09:00 to 12:00 UTC
VHF NFD	Saturday of 1st W/E July	14:00 to 22:00 UTC
Christmas 50MHz	26 December	14:00 to 16:00 UTC
UKSMG Marathons	Summer & Winter	See rules

Table 1: Some regular 6m contests – check the rules to confirm dates and times.

Books

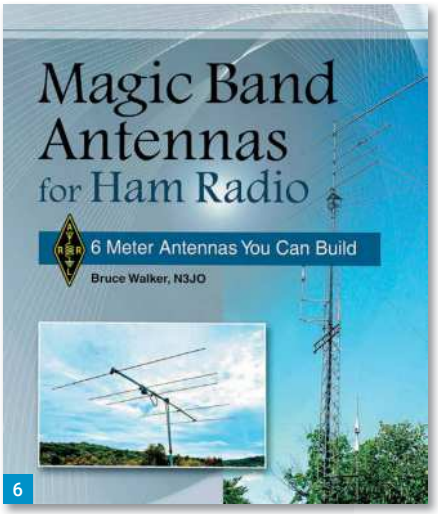
There are a couple of books that readers interested in 6m may wish to purchase. The first is *The Magic Bands*, written by *PW* Editor **Don Field G3XTT**, **Fig. 5**, which can be obtained from the *PW* bookstall.

In addition to the 6m band, the book also includes material on the 4m band, and has a useful chapter on using FT8 on the 6m band. A number of antennas are also covered.

The second book is *Magic Band Antennas for Ham Radio*, written by **Joel Hallas W1ZR**, **Fig. 6**, and published by the ARRL. It can be obtained from the RSGB Shop. The 6m antenna designs include simple antennas such as J-Poles, Moxons and Delta Loops as well a variety of Yagi designs. Note that the dimensions are all in feet and inches.

Operating Aids

The 6m band is supported on the DXCluster and on the ON4KST Chat facility. You'll often see stations' locator (grid) squares included in spots. This can be helpful to know in which direction to point directional antennas. Electronic logs all support 6m as do online systems such as eQSL, Logbook of the World (LoTW), Club Log and QRZ.COM.



Conclusions

Now is a great time to get on the 6m band. Don't miss out on the annual opportunity to work stations on this band. As I've explained, a simple wire dipole antenna resonant on 6m is all you need to make plenty of contacts. I'm sure that **Tim Kirby GW4VXE** will pleased to receive readers 6m reports for the *World of VHF* column in *PW*. **PW**

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1

CW Protocol or Protocols

After a brief word about protocols, **Roger Cooke G3LDI** takes a look at visual signalling of Morse code.

I have had quite a bit of feedback on the subject of Morse protocols and as suggested in my last column; I shall be presenting the code without calling procedural signals 'prosigns' in a future update to my book.

I am not sure when the next version of *Morse Code for Radio Amateurs* will be published or even if it will be published, so my revisions may not appear in the next version, the text for which has already been accepted.

Signalling Lamps

Don's picture last time created quite a stir! It seems that there were quite a number of people involved in sending 'visual' Morse so this month has been devoted to the feedback I had.

Paul G3VPT, who lives locally to me, sent a picture of a WW2 signalling lamp **Figs. 1** and **2**. Paul takes part in WW2 events in Norfolk and he uses it for those. He says: *"I have something similar, it's a WW2 signalling lamp that was given to me for our display but it's a shame it had been rewired with modern wiring. It has fittings for mounting on a tripod and three screw-in rods for pushing in the ground that are visible in the box".*

Alan G3XOI sent the following interesting information: *"I was a member of Admiralty Ferry Crews, later subsumed into the RNXS. As well as being a Skipper, I was one of the first two A level communicators, which involved biffer, flags, RT and WT. I certainly used an Aldis.*

"In fact, one fellow and I used to exchange chat across the room using our cupped hands, open for dits/dahs and closed for spaces.

"There was a story, possibly apocryphal, that two bunts ratings in a train carriage were semaphoring to each other about the charms of a young lady also in the carriage and she shamed them by saying, loudly, that their semaphore was atrocious – she was a Wren on leave.

"I certainly used a lamp for signalling, and passed out, at Portsmouth, at 8 wpm on the lamp (and 18 wpm on the key). My text was to take a biffer signal from an aircraft carrier alongside, requesting a tow! I had to reply that we were not a salvage tug and to get the hand to get out the oars.

"One Dit, a fellow traveller, waiting at the bus stop, worked for a shipping agent and got me a free ride on a cross-channel ferry (and back). When the RO realised that I could read Morse he went below for a rest and while alone in the radio cabin, I picked up a relay SOS, which I reported to the skipper. Later, one of the deck officers came looking for the sparks because Southend Pier was flashing. As the RO was still teaching his bunk not to float in the air, I volunteered to come up to the bridge. I read the signal, quoted it to the Master and sent his answer back using the Aldis. He then had the cheek to say I was better than the RO and did I want a job sailing with him".

John G3UCQ also used lamp signalling and sent this: *"The 'Unusual Key to use in the dark!' piece has inspired me to tell you about another key that was used to signal light and not radio. That is the Spitfire Morse key, **Figs. 3** & **4**. The key was mounted on the right side of the cockpit and was used to signal other pilots without breaking radio silence. There was a lamp on the top of the fuselage, behind the antenna and another on the bottom. The pilot could select either lamp or both with switches on the lamp. Pilots were trained up to 15 wpm so those who cannot make 12 wpm hang your heads in shame! Imagine flying a combat aircraft sending Morse with one hand and controlling the aircraft with the other? I purchased my key and lamps from a dealer in Australia a few months ago having been inspired to buy one after I discovered that a friend, **Neil N4FN**, had one. Once the key and lamp arrived I connected the key to my IC-7610 and had a few QSOs with it. The highlight was a QSO with Neil in Georgia, USA, which was probably the first radio to radio QSO using a Spitfire Morse key and certainly the furthest. I have a YouTube video of the QSO here":*
www.youtube.com/watch?v=UY0Geb4N0fs
(I seem to remember covering a Spitfire key in a previous column some time ago.)

Tony M0TDK is another visual Morse man! *"The torch in last month's picture is what I would have called a lifeboat torch. The fact that it is grey does not necessarily mean it was RN, unless it has the broad arrow on it. I misspent my youth in the Merchant Navy where every ship's lifeboat would have had a lifeboat torch complete with Morse key. Keeping them supplied with working batteries was an endless task, as you never knew if or when you might need the lifeboat and its contents.*

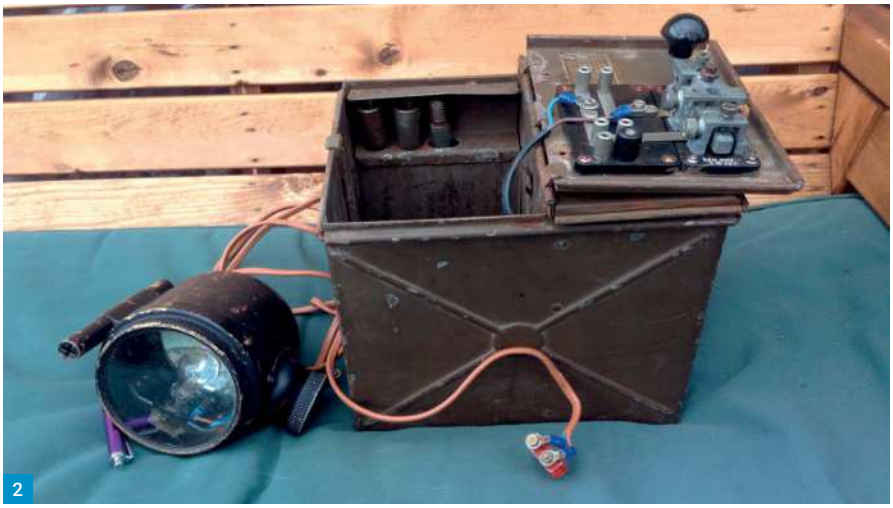
"I learnt to read Morse by light, and it is very different from learning by sound, but if you can read it by ear then by eye is easier. We didn't send Morse by light very quickly, probably only about 8 wpm, but the RN signallers could do it very much faster.

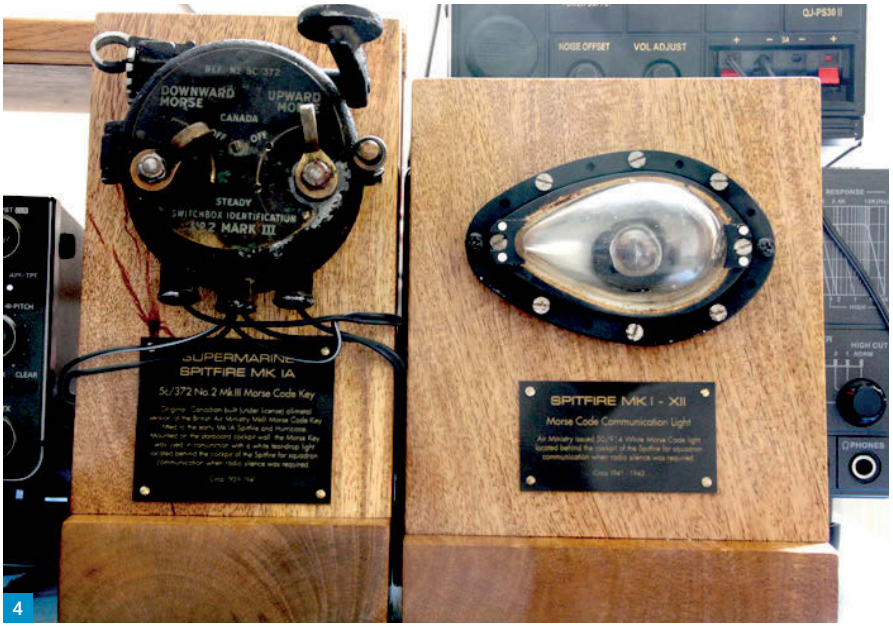
"I still have my 1969 International Code of Signals *book, which reminded me of how to signal by light.*
www.seasources.net/PDF/PUB102.pdf

"AA repeatedly sent as a prosign is the call to an unknown station, who, if interested would reply with 'T' sent repeatedly until the caller stops (it's duplex!).

"Caller sends one word at a time and the receiver responds with a T if received OK, or lots of EEE if not. Otherwise, it's pretty much like sound Morse.

"There are strange nautical tales about the use of Morse by light. Typically, the caller would send "What ship where bound" *(we didn't mess about*





Figs. 1 & 2: WW2 signalling lamp.
Figs. 3 & 4: The Spitfire Morse key.
Fig. 5: Royal naval signalling torch.

with punctuation) to which you would give your ship's name and destination, and receive the caller's name and destination in return. Skill levels were not always high! I well remember being called by a Greek tanker in mid-Atlantic, who had difficulty with his ship's name. As he vanished over the horizon astern he was still trying to spell it out.

"On the southern tip of Gibraltar there was (is?) a Lloyds Signal Station, which would report ship movements back to Lloyds of London. Passing the Rock you would almost always be called by them by light.

"It is said, perhaps allegorically, that once when RMS Queen Mary *was passing in daylight, they called her and asked* "What Ship" *to receive the reply* "What Rock".

"A tanker carrying jet fuel to Da Nang in Vietnam was called by a little red light from an otherwise dark and apparently empty South China Sea. Being in no mood for such hilarity, the OOW sent YT4 (I can't read your light, go away) by way of reply. Suddenly, a set of navigation lights appeared around the source, and they executed a rapid turn and drew up alongside. Then a very large light repeated the question. Being illuminated as if on a stage, when asked "what ship" *the OOW just pointed to his ship's name clearly visible during the flashes on the board above him. Warships, particularly US ones, never really had a sense of humour. The US allocated two letter phonetic IDs to ships going into the war zone. That particular ship's was* "Mortuary Xray".

"I was told by the OOW in question that discharging jet fuel close to an active battery of howitzers in Da Nang can be interesting. That jet fuel, JP4, could detonate if mixed with water, allegedly, so standing on top of a few thousand tons of it could spoil your entire afternoon".

Chris M0TXB sent a picture of a torch, **Fig. 5**, that I also had when I was a boy. I often wondered why there was a push button to key it as well as the on/off switch! (It was, however, before my radio days!)

"As an operator in the Royal Navy, I encountered this signalling device whilst serving onboard HMS Albion *(1970-1973), which was a commando carrier, and used it with great effect during landing exercises and replenishment at sea. My only criticism of this piece of kit was the very flimsy Morse key and, of preference, I much preferred the good-old NATO issue right-angle torch with its push button, which could also be used to good effect.*

"At the time, the fleet speed for Morse by light was 10 wpm although a good operator, at each end (!), could achieve around 14. Anything higher than this would be just a blur and difficult, if not, impossible.

"In your article you feel you couldn't manage this device without audio but anyone who can 'read' Morse would have no problems, just imagine the sound. I like to think that I could still operate by light at the speeds indicated above, having been properly trained at HMS Ganges and HMS Mercury (the former signal school for the Royal Navy)."

I do take the point that Chris made about imagining the sound, but I think I would prefer to rely on my ears rather than my eyes to copy Morse!

Next time I shall be looking at comments I have received about the PreppComm Morse Decoder and Converter. I shall try to maintain an open mind, but I am rather a purist as you know.

Please send all your comments, offerings, information to: **roger@g3ldi.co.uk** 73 and May the Morse be with you! **Roger G3LDI**. **PW**

Building the Receiver Board AF Section

Mark Tuttle G0TMT completes the receiver section of the 40m transceiver.

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In the last part we followed the signal path from the antenna through to the product detector. The differential output of this stage resulted in a low-level audio signal. We now need to do a little work on this signal before we can put it into the audio amplifier we built at the start of the series.

We're also going to use the audio level to automatically adjust the incoming signal. So, let's make a start describing the audio chain circuits, see **Fig. 1**.

Audio Limiter

The first few stages of the audio chain are taken from a great little book called *QRP Power*, an ARRL publication, which is getting a bit difficult to find these days. The circuit is featured in a design from *QST* magazine, November 1994 and has been reworked and reused multiple times. I've seen it used all over the internet so I don't even feel a pang of guilt 'borrowing' it here. Besides, it works really well, which is probably why it's been copied and adapted so many times.

Firstly, let's look at what's in the feedback loop of U4A amplifier. R8 sets the gain of the amplifier and C23 provides a little filtering, nothing particularly novel there but what about D1 and D2? Just like the diodes at the antenna input, they'll conduct once the signal gets over about 0.6 to 0.7V threshold. When this happens the signal that is fed back will be increased, limiting the output of the amplifier. This amplifier therefore acts as an audio limiter.

Any huge incoming signal resulting in an equally huge audio signal won't get passed on by this stage. Remember that our receiver runs all the time, even when the transmitter is operating. During normal receive periods we're hoping to detect below microvolt level signals at the antenna but our transmitter, that's producing over 5W of power, which equates to several tens of volts into a 50Ω antenna, is doing so in the same box! Our receiver needs to be robust enough to handle this and as we're about to see, even make use of it.

Mute and Sidetone

TR2 is an FET type transistor. In this operation you can think of it as acting rather like a switch. Now, U4A has been biased (by R7) to operate at roughly two thirds of the supply voltage. This means the output from pin 1 will have a DC component as well as our audio signal. Notice there's no coupling capacitor to remove this before the next stage.

That's because this DC voltage is used to pull the gate of TR2 high, using R16. (Incidentally, I put a coupling capacitor in here thinking they'd forgotten about it until I figured out it was deliberate, doh!). This voltage switches the FET on, conducting the audio signal through it. When our Morse key is pressed and the 'key' line is pulled towards ground, the gate of TR2 is taken low, through D3. This switches TR2 off and by doing so mutes the following audio stages. The audio signal is effectively blocked from going any further by TR2.

However, it's a very nice feature to have a sidetone on CW rigs. Most commercial rigs generate a separate tone from an audio oscillator and feed it to the audio stages when the key is pressed. We're going to save on those extra circuits by listening to our own transmission.

We have this whopping great signal being limited by U4A when we transmit. So, we're going to let a little of this leak through by setting VR4 appropriately. Now when the key is pressed, the beat of our actual transmitting signal is being leaked through the audio chain so we can actually listen to our own signal. Not only do we have a very useful sidetone, it's also acting as a monitor.

If we can't hear anything, chances are we're not transmitting. Clever little circuit, eh? Well, I was impressed, which is why I decided to put it into this design.

Audio Filter/Preamplifier

I found this circuit in a book called *QRP Classics*: Another ARRL production. Its purpose is to take the audio from the mute/sidetone circuit, amplify it a little and also provide a bit of audio filtering. Our audio signal is first coupled by C32 and fed to the second op amp in the TL072 package, U4b.

Here a simple audio bandpass filter shapes the signal. The peak of the passband can be adjusted using VR3 and can be set to your preferred CW tone. Mine is set around 600Hz. Keep in mind that this control needs to be set in conjunction with VC1 in the RF section of the receiver. It's no use setting the BFO to give 800Hz in U3 and then peaking VR3 for 600Hz.The output from this amplifier is then fed to the input of the audio board we made earlier.

Automatic Gain Control (AGC)

It took me a long time experimenting with different AGC circuits to find one that worked well in this receiver. The principle of AGC is simple. When a big signal comes in the AGC reduces the gain somewhere so the signal is still comfortable to listen to. But think about that for a moment. You've reduced the level of the signal, so now the AGC is lowered, so the signal is bigger again, so the AGC level is raised and so on. Yes, it's a feedback loop so you have to be careful where you apply it and what hang time you design into it. It is very easy to get what is called 'hunting'. This gives the signal a kind of wobbly whooping sound as AGC is constantly adjusted and I ended up with this on more than one occasion.

My AGC circuit started life from a design I found online for modifications to the uBitx transceiver by ND6T. We take the audio from the output of the audio pre-amp U4b, and, after adding a sensitivity adjustment with VR2 we amplify it with a simple one transistor circuit. It doesn't need to be a clean signal at this point, we're not listening to it with this circuit. In actual fact we're going to rectify it, with D4 and D5, so at the gate of TR4 we will have a DC voltage that is, broadly speaking, proportional to the level of the incoming signal.

Now, TR4 is a special beastie. It's a small-signal MOSFET transistor. Let's think of it for this purpose like a voltage-controlled resistor. As we provide more volts to the gate it conducts more so its 'resistance' to ground is lowered. Now look where the drain is connected in the RF section diagram. From the signal's point of view it's the same place as our RF gain potentiometer on the front panel. So, it's just like having the RF gain potentiometer controlled automatically. Yes, that's AGC!

Just a note here about TR4. You might be thinking an 'off-the-shelf' bipolar transistor would work just as well here. Well no, it won't. Bipolar transistors are current driven devices. Remember that we want to control the hang and decay time of the AGC voltage. If it drains away really quickly, we're going to get that hunting effect I described. However, if we can hold the AGC voltage on for a little while after it's built up and then decay it relatively slowly when the signal disappears, we'll avoid that. That's the purpose of C24 and R9. When a big signal comes in and we get our AGC voltage at the cathode of D4 it charges C24. Now with

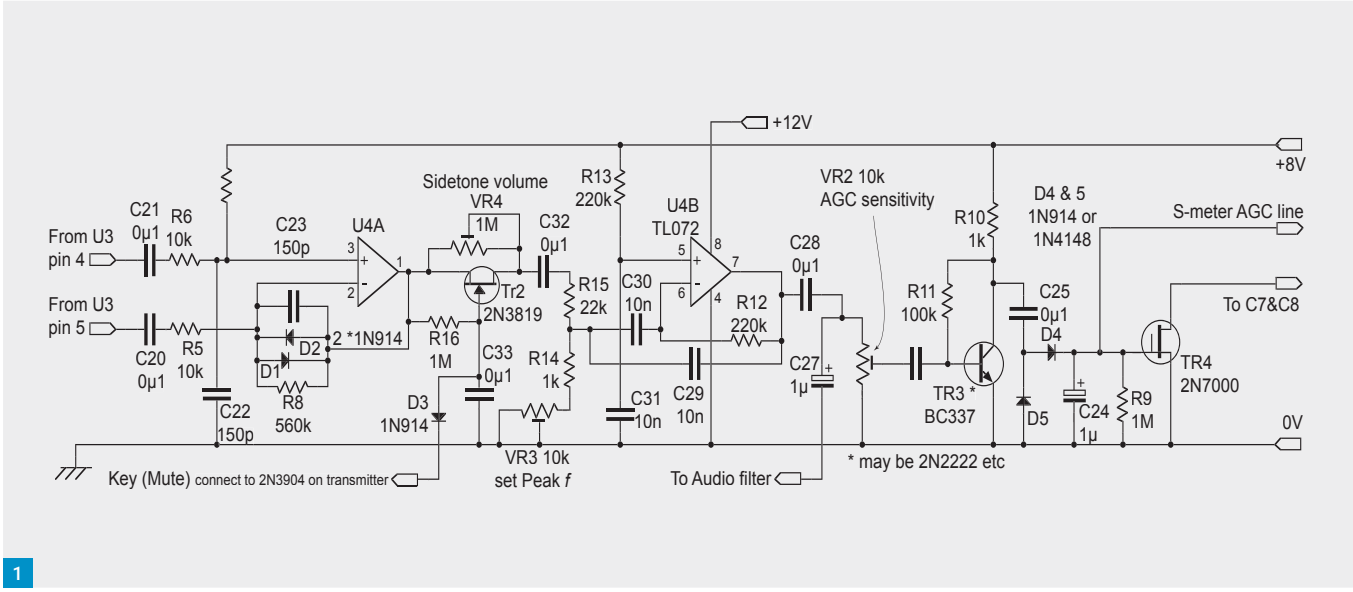

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Fig. 1: Circuit diagram of the stages discussed in this month's article.

a normal bipolar transistor for TR4 our AGC voltage would simply drain away through it because it takes current. A MOSFET, on the other hand, has a very high input impedance so the only way our AGC voltage can drain away is through R9. So, together C24 and R9 set the AGC time constant. 1µF and 1MΩ gives a time constant of one second. Yes, you multiply them together.

Once again, you can experiment with these values but I find a one second AGC decay comfortable. Don't forget it will start increasing the gain after a hundred milliseconds or so as the capacitor discharges so in reality it's not held off for the entire second. The capacitor also takes a few milliseconds to charge up and apply so on a big signal you'll hear this being applied. The signal will start loud and then quickly be reduced. This should be your cue to reach for the front panel RF gain control and turn it down. It's not perfect but it's simple and for what it is, actually works surprisingly well.

Construction & Testing

I've not got a lot more to say on construction and testing. We're adding these circuits onto the same board as the RF section. So as usual, take everything stage by stage. You should be able to work out where I placed the components from the layout photograph (last month) but as I've said before, there is no reason why you should copy my layouts.

Once you've finished the audio limiter you should be seeing audio from its output on your 'scope. Don't inject much signal into the antenna input now as all these stages add gain and you'll easily get the limiter doing its job. If you've got any RF attenuators, then now's the time to put them in circuit, between your signal generator and the receiver. 50µV equates to an S9 signal so try to keep any input below this. You only need a couple of hundred microvolts at the most. If you don't have a signal generator, then you can use your main shack rig. Key a few watts into a dummy load and even with no antenna fitted your receiver should be able to tune onto it. If you feed the output of U4a via a 1µF capacitor into the audio board you made earlier, you should be able to hear your CW tone, albeit at a low level.

Keep building the stages and testing as you go. You won't be able to test the AGC until you listen to the 40m band for real. Even your shack rig into a dummy load is likely to produce full AGC although that's a test of sorts in itself I suppose.

I've labelled where you could take off a feed for an S-meter if you want to. As I wrote in the first part, my silly choice of case prevented me from adding an S-meter. There are many circuits for S-meters online so just research and experiment and see what works for you. Once again, please show me your results.

By the time you finish this board you will have a working 40m CW receiver. Measuring its performance is beyond both my test equipment and the scope of this article but do try comparing it to your main shack rig. I'll wager you'll be surprised at how well it stacks up or at least it should if it's working properly. It certainly shouldn't be deaf. If anything, it might sound quite lively.

I felt I should add a tip about operating the receiver. A modern commercial receiver will handle the vastly different magnitudes of incoming signals much better than our little homebrew receiver. Our AGC isn't going to have the dynamic range of a more sophisticated circuit so it might need a hand as you tune

'By the time you finish this board you will have a working 40m CW receiver'

across the band. I recommend that you start off with the RF gain control set to maximum (fully clockwise) and the audio gain control fairly low; set it for comfortable listening. If you tune onto a big signal that is much louder, don't hastily reach for the audio gain control, use the RF gain control instead. This has two advantages. Firstly, you won't be making the AGC work so hard so the signal will sound much 'smoother' and secondly, you're reducing the volume of all the other signals too. This means that QRM and QRN are also reduced. It's good practice with any receiver really but with this little one it makes a lot of sense.

When you have finished listening to the big signal remember to turn up the RF gain control again so you can hear the little ones. In practice I've found the AGC handles everyday QSB pretty well but no receiver can help if the signal disappears altogether. Combined with the audio limiter it will also protect your ears when that big DL (German) signal suddenly tunes up on the same frequency.

I know I keep picking on the DL stations but if you've ever listened to 40m of an evening I think you'll know why. Some, but not all, are particularly loud in the UK.

That's it for the Receiver board. Next time we'll move on to the transmitter side of the rig but in the meantime keep thinking about what case you're going to put this into and where you're going to fit everything. **PW**

Rallies & Events

Due to the ongoing Coronavirus situation, the calendar remains very changeable at the moment, and there will be more cancellations and postponements. Information published here reflects the situation up to and including 25th April 2022. Readers are advised to check carefully with the organisers of any event, before setting out for a visit. The Radio Enthusiast website will have updates, please check here regularly. To get your event on this list, e-mail details as early as possible: **wiessala@hotmail.com**

14 May
BARRY ARS RALLY: Sully Sports & Social Club, South Road, Sully nr Barry CF64 5SP. Open to traders from 7.30am and to the public from 9.30am. Admission is £2.50 (FP).

15-17 May
RADIODAYS EUROPE (MALMÖ)
https://www.radiodayseurope.com

20-22 May
DAYTON HAMVENTION : 20 Fairgrounds Road, Xenia, OH 45385, USA. ARRL and RSGB presence, including bookstall. US exams, prizes, special events, exhibitions. Friday & Saturday, 9am to 5pm; Sunday, 9am to 1pm. TS | FM | L | TI
https://hamvention.org

22 May
DUNSTABLE DOWNS RC NATIONAL AMATEUR RADIO CAR BOOT SALE: Stockwood Park, Luton. All the usual facilities will be there, further details on:
www.ddrcbootsale.org

29 May
DURHAM DISTRICT ARS RADIO RALLY: Bowburn Community Centre, Durham Road, Bowburn, Co Durham DH6 5AT. Doors are open 10.10am to 2.30pm (disabled: 10am) Admittance is £2. BB | C | LB | RF | RSGB | SIG | TI| TS
Michael Wright, G7TWX
Tel: 07826924192
dadars@gmx.com

5 June
SPALDING RADIO RALLY: Holbeach United Youth FC, Pennyhill Road, Holbeach, Lincs PE12 &PR. Doors open at 10am (disabled at 9.30am). Entry is £3. CBS | CR | FM | RF | TS
Graham, G8NWC
07754 619 701
rally2022@sdars.org.uk

11 June
ROCHDALE & DISTRICT AMATEUR RADIO SOCIETY SUMMER RALLY: St Vincent de Paul's, Caldershaw Road, off Edenfield Road (A680), Norden, Rochdale OL12 7QR. Doors will be open to the public at 10.15am; disabled visitors at 10am.
Robert M0NVQ
Tel: 0777 811 3333
m0nvq@outlook.com

12 June
MENDIPS MICRO RALLY: Farrington Gurney Memorial Hall, Church Lane, Farrington Gurney, Somerset, BS39 6TY. Open 9.30am (traders 7:30am). Entrance £3 (FP). Indoor & Field pitches. Tables: inside £8 | outside £5.
Luke Kelly, 2E0VHV
Tel: 07870 168 197
mendipsrally@hotmail.com

12 June
JUNCTION 28 RADIO RALLY (SNADARC): Alfreton and District Amateur Radio Club, South Normanton. Alfreton Leisure Centre, DE55 7BD. Tables are still £10, and admission is £3. Everything is indoors with a meeting room, bar, refreshments and a full Café onsite. Opening at 10:15, traders will have access from 08:00.
Alan Jones M0OLT
Tel: 01332 679913
secretary@snadarc.com
www.snadarc.com

18 June
BANGOR & DISTRICT ARS 53RD RALLY : Ballygilbert Presbyterian Church, 376 Belfast Road, Ballyrobert, Bangor BT19 1UH. Doors open at 11.30am.
Andrew, MI0OBR,
Tel: 07980 846 272

19 June
EAST SUFFOLK WIRELESS REVIVAL (IPSWICH RALLY): Kirton Recreation Ground, Back Road, Kirton IP10 0PW (just off the A14). Doors open at 9.30am and the entry fee for visitors is £2. Trade tables are froma£10. BB | CBS | CR | FP | RSGB | SIG | TS | GB4SWR HF station.
Kevin G8MXV
Tel: 07710 046 846
www.eswr.org.uk

24-26 June
HAM RADIO FRIEDRICHSHAFEN: Messe Friedrichshafen, Neue Messe 1, 88046 Friedrichshafen. Exhibitors & visitors from 52 countries . (FM | L | TS). Plus, meetings, socialising, and so much more.
www.hamradio-friedrichshafen.de
https://tinyurl.com/ycnxskle

25 June
GI-QRP CONVENTION: Tandragee Golf Club, 11 Markethill Road, Tandragee, Craigavon BT62 2ER. Doors are open at 9am; the presentations start at 10am. The Convention is being held in association with the GQRP Club. BA | CR | FP | D | L | LB | RF | SIG | TS.
Philip MI0MSO
Tel: 078 4902 5760
r8.giqrp@gmail.com

26 June
NEWBURY RADIO RALLY: The Newbury Rally is now back. It will take place at Newbury Showground, Priors Court Road, Hermitage, Thatcham, Berks. RG18 9QZ (Next to J13 of the M4). The is organised and run by the Newbury And District Amateur Radio Society (NADARS) and attracts visitors from all over the country.
https://www.nadars.org.uk/rally.asp
http://www.nadars.org.uk

1 July
DADARS SPECIAL EVENT: Durham and District Amateur Radio Society is privileged to be participating as one of the bonus stations in this popular event. The NoV special callsign GB13COL has been issued and will run from the club station from 1st July 1300 UTC to 8th July 0400 UTC. The focus of the event will be the HF bands, including VHF, UHF and Satellite, for QSOs using SSB, CW, FM, and various digital modes.
www.13colonies.us
g0vlf@yahoo.co.uk

3 July
BARFORD NORFOLK ARC RADIO RALLY
www.norfolkamateurradio.org

3 July
CORNISH RAC RALLY: Penair School, St Clement, Truro, Cornwall TR1 1TN. Doors open at 10am. Admission is £2. BB | CR | D TS | Local Club Stands.
Ken Tarry G0FIC
Tel: 01209 821073
pendennis38@btinternet.com
www.gx4crc.com

9 July
HOUGHTON RADIO CLUB FREE RADIO RALLY: The Dubmire Royal British Legion Club, Britannia Terrace, Fencehouses DH4 6LJ. Doors are open from 10am to 3pm. Open to trade, clubs and private sellers/exhibitors but table space is limited.
No charge for tables. Free entry. Donations welcome to the Royal British Legion Club. CF | LB [11am]
Amanda M6LXK
Tel: 07787 155 745.
westona84@gmail.com

17 July
MCMICHAEL AMATEUR RADIO RALLY & CAR BOOT SALE : Begins at 09:30am, with car boot setup from 8:30am. The location is Reading Rugby Club, Sonning Lane (B4446) – just off the A4 at Sonning, east of Reading, Berkshire. Postcode: RG4 6ST, NGR SU 753 747. Admission: £3 per person.
Car boot sale: £10 per pitch, no booking required. Sorry but no dogs are allowed, except for assistance dogs (site rule)
CBS | FP | SIG.
https://mcmichaelrally.org.uk
rally@radarc.org
traders@radarc.org

24 July
FINNINGLEY ARS RALLY: Car-boot style rally. Food bar. Near J2 M180, Doncaster.
www.g0ghk.com

31 July
WILTSHIRE RADIO RALLY, ELECTRONICS FAIR & CAR BOOT: Kington Langley Village Hall and Playing Field, Kington Langley, Wiltshire SN15 5NJ. 9am to 3pm. Admission free.
Traders Welcome.
Brian, G6HUI
rally@chippenhamradio.club
https://wiltshirespc.org/wp/g3vre/rally

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

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

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

A 2N3904 Regenerative Receiver for 80m

Eric Edwards GW8LJJ describes a novel but easy to build regenerative receiver for the 80m band.

This is a fun to build and use, very sensitive receiver for the serious builder. It is a regenerative receiver that uses a different method to create the regeneration of the received input signal compared with what is normally used. It uses commonly available transistors, and is a complete receiver with all the parts from the antenna preamplifier to the loudspeaker (LS) audio amplifier fitted on a single PCB.

The Circuit

The circuit is shown in **Fig. 1**. All the controls are fitted on a custom-made PCB to avoid any 'flying' leads that can cause instability and frequency variations. It is intended to operate from a regulated 12V power supply with about 500mA current capability as the circuit consumes an average of around 200mA, but more than 300mA with strong signals and the volume turned up if you want the neighbours to listen as well! The voltage can be a little below or above 12V, and the shack 13.8V will be suitable but preferably with current limiting set to a maximum of 500mA. This project has the same type of transistors for the antenna pre-amp, oscillator tuning and the two audio preamplifier stages. In most designs of this type it is usual to see 'BF' series (low signal RF type) transistors used in the RF stages, but as the 2N3904 transistors are capable of operating to well over 200MHz they are well suited for this project and are readily available at low cost.

The Front End

The front end is where the antenna is connected to a 2N3904 transistor used in grounded base configuration. The term grounded base refers to the base at ground to RF signals because of the 10nF capacitor connected between the base and ground but the 18kΩ resistor provides a DC bias voltage for the base to allow it to be at a higher potential than the emitter for the transistor to overcome the barrier voltage to permit full conduction. The base is common to the input and output, described as being in common base configuration. This provides a low input impedance so that a 50Ω antenna can be used as well as a long-wire antenna. The output at the collector is high impedance, along with signal voltage gain, and is connected to the primary of a TOKO (KANK) type transformer 'L1'. These are no longer manufactured but equivalents are readily available and the type used is the equivalent to a TOKO KANK3333. See ref section. The secondary, L2, is part of the oscillator circuit.

The Main Tuning

This circuit uses a Clapp oscillator and the frequency is determined by the tuned circuit, L2, a polyvaricon variable capacitor, **Fig. 2**, and the two 33pF capacitors along with the 470pF capacitor fitted between the base and emitter of TR2, and its emitter capacitor (1nF), connected to ground. If you were to change the transformer (coils L1 and L2) to cover another band, the capacitors at the base and emitter of TR2 may also need a change of value as these are selected in this project for the 80m (3.5MHz to 3.8MHz) band. The 33pF capacitor connected from the bottom of L2 to ground is the main frequency tuning and can be referred to as the band set. The polyvaricon along with the series connected 33pF is the bandspread control and allows fine tuning for the bandset. This combination provides a bandspread of approximately 400kHz, which is ideal for the 80m band.

Fig. 3 shows the polyvaricon fitted on the PCB under test, along with all the other controls. This prevents stray capacitances and inductances that can cause instability in the audio and tuning stages.

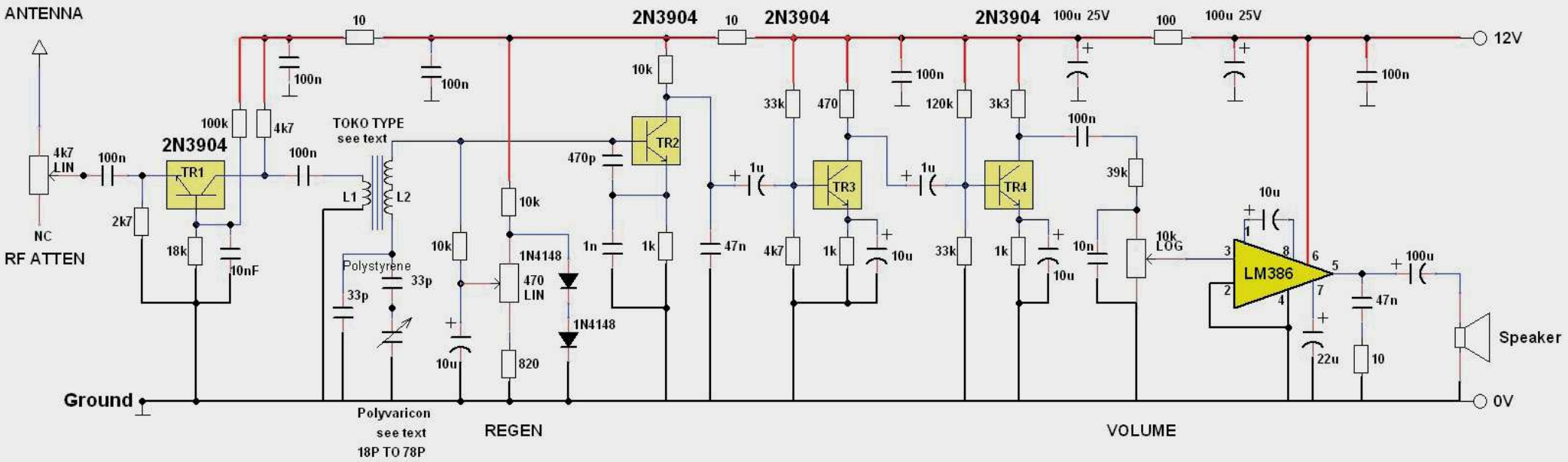
The Polyvaricon

The Polyvaricon is a variable capacitor that replaces the large metal types. The one used in this project is fitted with a 20:1 reduction drive (10 full turns of the control). The body, made from aluminium, has three fixing tapped holes, one on the front for fixing to a panel, and two on the bottom of the body, allowing it to be fixed directly to the PCB. The shaft is 13mm length x 6mm (1/4in) diameter that a control knob can be fitted to. The capacitors are 60pF and 140pF with trimmers fitted for fine adjustments. The adjustment of the capacitance is in reverse to a normal variable type of tuning capacitor because of the reduction drive and its gearing mechanism. When the tuning is fully clockwise the capacitance is at its lowest as the vanes are fully open, and when turned anticlockwise the vanes are fully meshed and the capacitance is at its largest. The lowest frequency (3.00MHz) at the receiver will be when the tuning is fully clockwise. Turning the tuning control anticlockwise will increase the frequency of the receiver's oscillator stage. This unit is included in my picking list.

Regenerating It

In most other regenerative receivers, the regeneration is created by taking a sample of the signal at the output of the oscillator and sending it back to the input where it is amplified again. This process being repeated until the required amount of feedback makes the circuit oscillate due to the positive signal being sent back in phase, similar to the howling from an amplifier when a microphone is too close to it. It is only required for the circuit to just oscillate to enable a sample 'carrier' for the CW or SSB signal that beats with it. This sampling level can also be used for AM signals by adjusting the level to just before it oscillates. This acts as a gain control similar to adjusting an RF or IF gain control in a conventional receiver.

The method used in this receiver is not by sampling the signal from the tuning coil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2N3904
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4k7
2k7
18k
10nF
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100n
TOKO TYPE
see text
L1
L2
Polystyrene
33p
33p
Polyvaricon
see text
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10k
1N4148
470 LIN
820
10u
1N4148
REGEN
2N3904
10
10k
470p
TR2
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1k
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2N3904
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2N3904
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3k3
TR4
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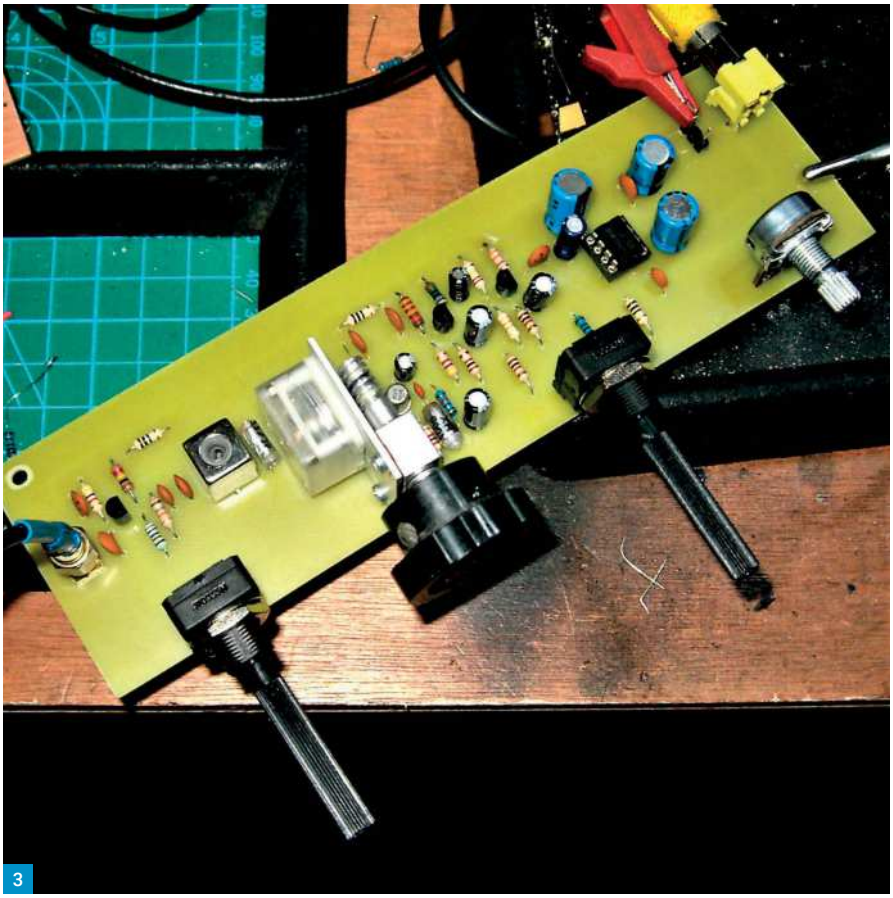


Fig. 1: Circuit diagram. Fig. 2: The polyvaricon capacitor. Fig. 3: The polyvaricon fitted to the circuit under test. Fig. 4: The PCB (not to scale). Fig. 5: Layout of the author's prototype.

and feeding back, but is by increasing the amplification of the oscillator circuit (TR2). This transistor is connected as a Clapp oscillator and depending on the level of amplification it will oscillate when used with CW or SSB, or behave as an amplifier when receiving AM stations before it oscillates. This is governed by the 470Ω linear potentiometer. The best setting to receive CW and SSB is to set the level so that the circuit 'just' oscillates. It can then be slightly adjusted either side for best resolution of the received signal. There are two 1N4148 diodes connected at the junction of the regeneration control and the 10kΩ resistor connected to the positive voltage. These diodes provide 1.4V (2 x 0.7V) approx, to provide regulation for the regeneration voltage. Without this voltage stabilisation, the sampling range would be different for different power supply voltages, for example if the input power supply was changed from 12V to 13.8V. Using the diodes to stabilise the regeneration voltage allows either a dedicated 12V power supply, or a shack 13.8V power supply to be used.

Pre-Audio Stages

There are two audio stages (TR3 and TR4) in this design so as to have sufficient drive signal voltage for the main audio amplifier, the LM386. The first one is connected from the collector of the oscillator TR2, via a 1µF capacitor to TR3, which is selected for the audio frequencies. There is a 47nF (bypass) capacitor connected from the collector to ground, which helps to remove any RF content by passing it to ground. The output of TR3 is connected to a second audio amplifier stage TR4, which has its gain set to a lower level than the first stage by the base bias resistors, 120kΩ and 33kΩ (potential divider). The level is set to that required by the main audio amplifier circuit, using an LM386

The Output Circuit

The output circuit uses an LM386 and the 10µF electrolytic capacitor connected from pin 1 to pin 8 sets the gain at times ten (x10) while the 22µF electrolytic capacitor connected from pin 7 to ground is a bypass capacitor that reduces HF (High Frequency) noise. The output at pin 5 is connected to the speaker socket on the PCB via a 100µF electrolytic capacitor. There is a 'Zobel Network', a 47nF and a 10Ω resistor, also connected from the output, pin 5, to ground and this helps also to prevent instability. The output will drive a fairly wide range of speaker impedances, and an 8Ω will be suitable.

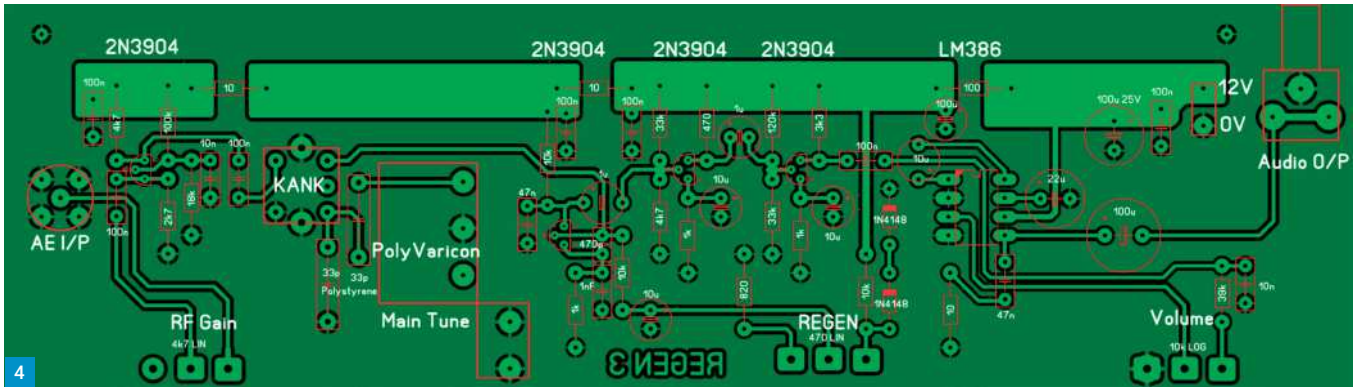
The PCB

The PCB is shown at **Fig. 4** and is a single-sided FR4 type. The tracks are surrounded with a ground plane to keep it all stable and no low frequency (hum) was noticed in the final project. The controls, along with the polyvaricon, are fitted onto the PCB and no surface mount components are used. Care must be taken when soldering on the PCB because the ground plane is close to the tracks and there is no solder-resist on the board. Average soldering skills are all that is necessary for populating this PCB. There are two holes at the rear of the PCB that can be used as extra support as shown on my prototype, **Fig. 5**. The controls are secured on an aluminium front panel. The polyvaricon (see Fig. 2) is a dual capacitor type with a common connection connected to ground, which is also the body of the drive unit. Only the smaller capacitance value (60pF) is used in this project.

Using It

As with any regenerative receiver, a little practice is needed in adjusting the controls to obtain good quality resolution of the received signals until it becomes second nature. Before applying the power supply, turn the RF gain, regen and volume controls anticlockwise. Connect a speaker and then apply power. If a signal generator is available, connect the output, either CW or AM at a low level (–20dB for example), directly from the output of the generator to the antenna socket of the receiver. Adjust the iron dust core of the coil (TOKO transformer) three full turns from the top with a non-metal trimming tool. A nylon knitting needle will do for this with the point filed to a blade. Turn the polyvaricon spindle fully clockwise and adjust the signal generator frequency to 3MHz. Turn the regen to about half-way and the same for the volume control. With the generator settings there should be a signal heard on the regen at approximately 3MHz. If no signal is heard, adjust the signal generator signal slowly above and below 3MHz until a signal is heard in the receiver. If the signal is below or above 3MHz, slowly adjust the signal generator to bring it to 3MHz and 'follow' the tuning with the adjustment of the receiver's coil. With the suggested regen settings, adjust the core very slightly until a signal is heard at 3MHz.

Once set up at this end of the tuning, set the polyvaricon fully anticlockwise, adjust the signal



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generator to 3.80MHz and check that a signal is received. It may be necessary to adjust the regen control to resolve this. If no signal is received, adjust the signal generator frequency until a signal is heard and it may be nearer 3.9MHz. Check both ends of the tuning to set it to be within the 80m band. There will probably be some overshoot on both sides, which makes no difference to the performance.

If no signal generator is available, tune to a station on the 80m band on the shack receiver and then locate it on the regen. Tune the shack receiver across the 80m band and log the stations on the regen to calibrate it. It will be necessary to swap the antennas from the shack receiver to the regen for this setting up. Once the band has been set up, connect an antenna, if not already connected, with either a dipole resonant at 80m or with an ATU or even a long-wire will be suitable. Set the RF antenna to fully clockwise to start with and the volume control about halfway. Adjust the regen control until a rushing sound is just heard, and this will provide some receiver gain.

When a signal is heard, adjust the regen for best resolution. The RF attenuator may need turning down as well. If the station is AM, reduce the regen control setting until the oscillation stops, and it will operate as a gain control when operated from a low level to a point just before the circuit oscillates. If the station received is CW or SSB, advance the regen control until the receiver just oscillates and set for the best resolution, which is probably at the point of just oscillating whereas increasing the control further may reduce the sensitivity of the received signal. The frequency may also need adjusting in conjunction with the regen for best resolution. The RF attenuator should be used as the main gain control with the volume control set to a comfortable level for listening and using the RF attenuator control for the received signal gain. This is common practice with SSB operators to use the RF attenuator as the main gain control and leave the volume set, as this reduces the off-air noise (QRN). When familiarity is gained with this type of receiver it will provide good quality AM signals along with CW and SSB resolution.

Is There a Kit?

As usual, I supply a picking list on receipt of an email which lists all the parts that I can supply.

I can also supply a large copy (A4) of the circuit diagram and the PCB layout. I can answer any questions that you may have before and during construction via my email address.

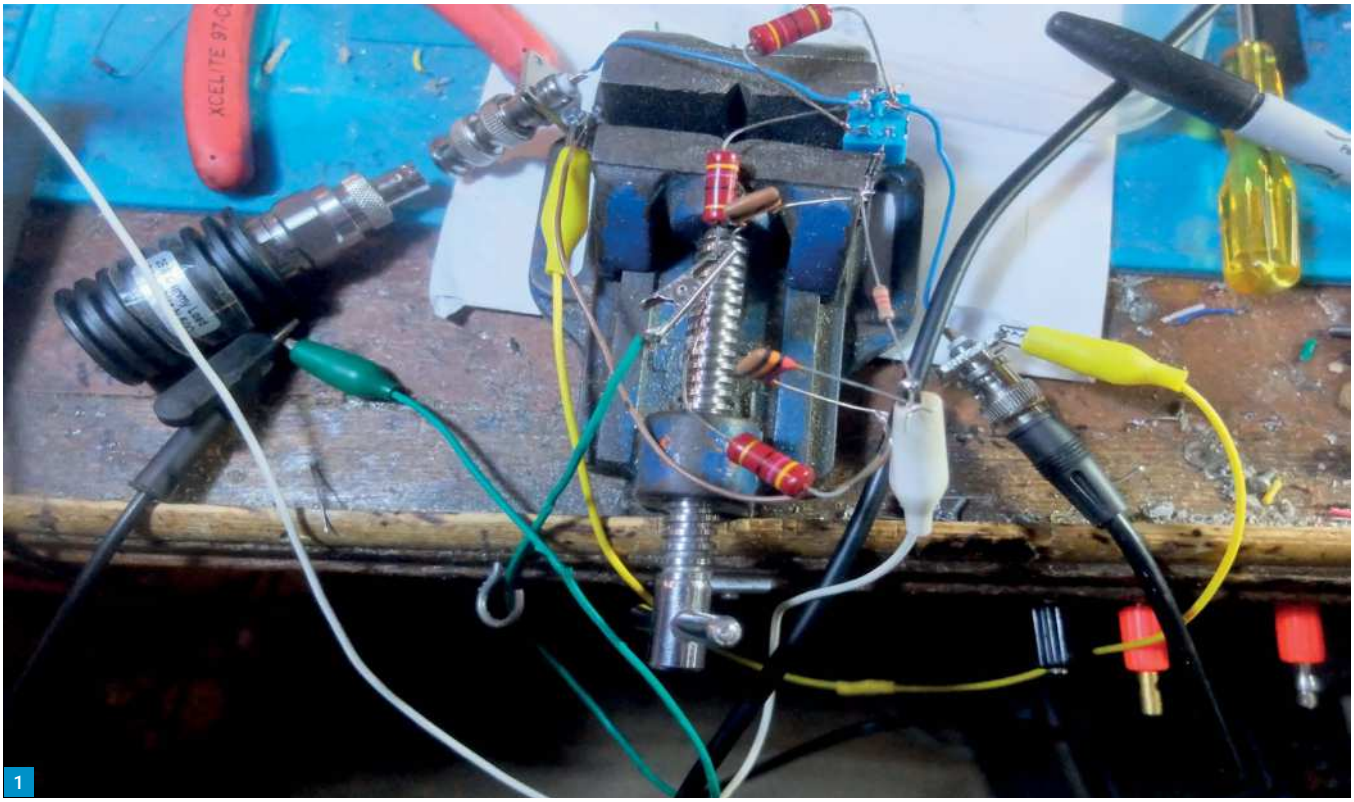
Parts List

Part	Value	Qty
Resistor, Carbon or Metal Film	2.7kΩ, 0.25W	1
Resistor, Carbon or Metal Film	18kΩ, 0.25W	1
Resistor, Carbon or Metal Film	100kΩ, 0.25W	1
Resistor, Carbon or Metal Film	4.7kΩ, 0.25W	2
Resistor, Carbon or Metal Film	10Ω, 0.25W	3
Resistor, Carbon or Metal Film	10kΩ, 0.25W	3
Resistor, Carbon or Metal Film	820Ω, 0.25W	1
Resistor, Carbon or Metal Film	1kΩ, 0.25W	3
Resistor, Carbon or Metal Film	33kΩ, 0.25W	2
Resistor, Carbon or Metal Film	470Ω, 0.25W	1
Resistor, Carbon or Metal Film	120kΩ, 0.25W	1
Resistor, Carbon or Metal Film	3.3kΩ, 0.25W	1
Resistor, Carbon or Metal Film	100Ω, 0.25W	1
Resistor, Carbon or Metal Film	39kΩ, 0.25W	1
Potentiometer	4.7kΩ LIN	1
Potentiometer (multiturn preferred)	470Ω LIN	1
Potentiometer	10kΩ LOG	1
Capacitor, Disc Ceramic	100nF	7
Capacitor, Disc Ceramic	10nF	2
Capacitor, Disc Ceramic (NP0) or Polystyrene	33pF	2
Capacitor, Disc Ceramic	1nF	1
Capacitor, Disc Ceramic	47nF	2
Capacitor, Disc Ceramic (NP0) or Polystyrene	470pF	1
Capacitor, Electrolytic 25V	10µF	4
Capacitor, Electrolytic 25V	1µF	1
Capacitor, Electrolytic 25V	100µF	3
Capacitor, Electrolytic 25V	22µF	1
Transistor	2N3904	4
Integrated Circuit	LM386	1
Diodes	1N4148	2
Tuning capacitor Polyvaricon with geared drive	18pF to 78pF	1
Transformer TOKO TYPE KANK3333	45uL	1
PCB single sided FR4 type Supplied by GW8LJJ		1
PCB pins for connections to parts off the PCB		Set

References

- Radio Communications Handbook, 14th Edition.
- The Art of Electronics.
- 2N3904 datasheet.
- LM386 datasheet.
- TOKO Coils: The equivalent is 45uL and is on my 'picking list'.
- Polyvaricon: it is on my picking list.

- Proof Reading: **Ray Koster G7BHQ** PW



More from Geoff

Geoff Theasby G8BMI starts with two simple SWR meters and then goes on to describe his collection of Morse keys.

Geoff Theasby G8BMI
geofftheasby@gmail.com

The first suggestion describes a simple, resistive SWR meter, which is not frequency conscious, in that no tuned lines or pickup loops need to be fabricated or etched, but which is good up to 30MHz. This was described by G3ROO and G4WIF, and originally appeared in the G-QRP Club magazine *Sprat*. A sensitive meter is not required, I tried several up to 1mA full scale deflection.

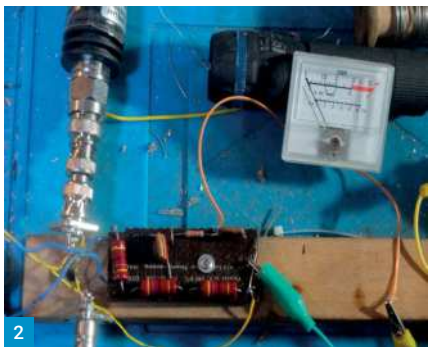
The circuit was first built 'in mid-air' to prove my construction and component values, **Fig. 1**, then rebuilt on 0.15in Veroboard, **Fig. 2**. It works like a charm!

www.gqrp.com/resistive_swr_bridge.pdf

The second returns to the original theme of these occasional articles, being a ready-built module, **Fig. 3**, available from the usual suspects for about £7 *(£7.79 from Banggood at the time of writing – **Ed**)*. This also is good up to 30MHz. It is very similar to the W3DIZ kit from Kitsandparts.com. Connect a QRP transmitter and dummy load, and adjust R3 for full scale deflection. Then reverse the connections and set R4 for full scale deflection. Job done!

My Morse Keys

As readers will probably guess from my callsign, I have not seriously used the Morse code in my amateur radio life. Since knowledge of the code was dropped from the licence, I have used it on the air occasionally.



Mention at my local club, SDWS, of homebrew keys spawned an idea, and I now have a handful of keys, homebrew, ex-government and commercial, none of them costing more than £10. I thought I would introduce them:

The first photo, **Fig. 4**, shows a soldering exercise, good fun to make and with a purpose too.

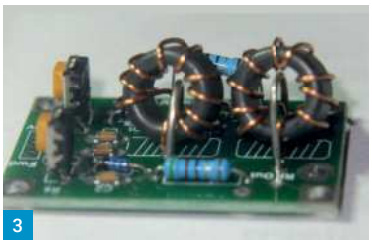
The next photo, **Fig. 5**, shows a homebrew key made from a scrap of plastic conduit, a microswitch and pivoted on the drill used to make it. No weights or springs but pivoted off-centre for a return action. 1mm steel base used for mass.

Keys are normally heavy so they don't skate about the table in use. This one, **Fig. 6**, is held down on its non-slip feet by the mass of the operator's hand. It uses the flexibility of Plastikard, beefed up as required by bolting two or three thicknesses together for its 'sideswiper' action.

Fig. 7 is an ex-government key, and the nicest to use. **Fig. 8** is a Hi Mound key, rebuilt from a scrapper, using a small wooden doorknob painted black. **Fig. 9** is a homebrew compact key from a rally, not made by me.

I like a skirted key, I know that skirts were originally to shield the operator from the high voltages of spark transmitters, but I think a key looks incomplete without one. Some of the above skirts were found in my junk box, handles from kitchen cupboard knobs. All the above are fitted with non-slip rubber feet. **PW**

Fig. 1: The breadboard SWR meter.
Fig. 2: The completed project.
Fig. 3: Kit-built SWR meter.
Fig. 4: Soldering exercise. Fig. 5: Homebrew key.
Fig. 6: Homebrew sideswiper key.
Fig. 7: Wartime, ex-government key.
Fig. 8: Rebuilt hi-mound key.
Fig. 9: Homebrew compact key.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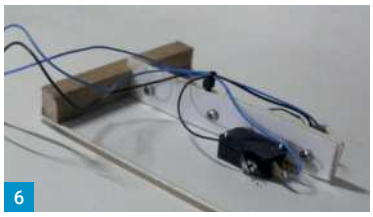
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Steve Macdonald G4AQB
practicalwireless@warnersgroup.co.uk

A Simple BFO to use with an old Broadcast Receiver

Steve Macdonald G4AQB describes a handy project for enabling CW or SSB reception on an old broadcast receiver.

Over the last few years I have enjoyed renovating old communication receivers. There has been quite a lot of information recently in *PW* about Eddystone Receivers and I have renovated several of my own. Not long ago I acquired an Eddystone EB35 receiver, **Fig. 1**. This is a broadcast receiver meant for the domestic radio market rather than a communication receiver.

One big difference between the two types being that broadcast receivers are for receiving AM or FM transmissions and communications receivers for AM, CW and SSB. Older communications receivers were fitted with a 'Beat Frequency Oscillator' or BFO, which is used to resolve CW and later, SSB transmissions. Broadcast receivers such as the EB35 do not have a BFO fitted, making it difficult to listen to CW or SSB stations on the amateur bands.

The Eddystone EB35 covers all the Short Wave and Amateur Bands up to 15m, all it needs is a BFO! There are many other older receivers and radios with the same problem, Eddystone produced other models meant for the broadcast or marine use.

What is a BFO?

A Beat Frequency Oscillator is a circuit that oscillates at the same frequency as the IF frequency of the receiver or radio. Most broadcast receivers use an IF frequency of around 465Khz. The sinusoidal output of the BFO is injected into the IF circuit, which produces a heterodyne or 'beat' with the incoming IF signal. This is then heard as an audio tone on CW signals. With SSB signals the injected BFO signal is used to replace the missing carrier and is then resolved by the AM detector in the receiver making SSB signals audible.

Communications receivers with a BFO fitted do exactly the same, but the IF frequency may be different. Some receivers use 1.6MHz or even 85kHz for the final IF frequency. The BFO has to be tuned accordingly.

Regenerative receivers do not need a BFO to resolve CW or SSB because the regen control can be advanced until oscillation takes place and produces a heterodyne similar to that of a BFO.

My very first receiver was a kit called a 'Roamer 7' bought in 1969, which was a regenerator receiver. The volume control doubled as a regen control and with some practice I could listen to SSB stations on 160m and 80m.

Making a BFO

There are many circuits available for BFOs on the internet. Some are quite complex. I was looking for a very simple circuit that can be easily adapted. This one uses very few components and is easy to build.

I decided to build the BFO in a separate box powered by a 9V battery. This would sit nicely on top of the Eddystone EB35 and could also be used for other broadcast receivers with a similar IF frequency if required.

The BFO circuit consists of a single transistor and suitable coil. The coil is not critical and any Toko RF type coil tuned to the frequency required, in this case 465kHz, will work fine. At one time 465kHz IF coils were in abundance, but today they are quite difficult to find. I used a Toko coil tuned to medium wave and added a capacitor of 1200pF across the coil to move the frequency down to 465kHz, **Fig. 2**.

The circuit was built on a small printed circuit board, but it could easily be built as a 'dead bug' or on Veroboard. There are two options available for the circuit for tuning the BFO.

The first is to have a small variable capacitor on the front and the second is to have two switchable preset trimmers tuned for USB and LSB with a single switch on the front. I decided

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

Parts List

R1	150Ω
R2	1kΩ
R3	1MΩ
C1	See Text
C2	22pF
C3	100pF
C4/5	30pF Trimmer
C6	47nF
C7	100nF
D1	7.5V Zener
Q1	BC548, BC108 or similar
Coil	Toko type (see text)

Phono socket (output)
SPST and SPDT miniature switches.

on the latter option. Simply remove the switch and replace the two trimmers C4 and C5 with a variable capacitor of around 40pF to make tuning continuous, **Fig. 3**.

Testing the BFO

First, the BFO frequency will be determined by the choice of coil. If you are using a 465kHz IF coil, then C1 will be around 100pF (which may already be fitted in the coil). If you are using a coil meant for a higher frequency, then C1 will be a higher value to tune the coil down to 465kHz. This may need a bit of experimentation.

Remember that a larger value of C1 will be necessary depending on the how much higher the coil is originally tuned. Suitable Toko type coils are available from Spectrum Communications.

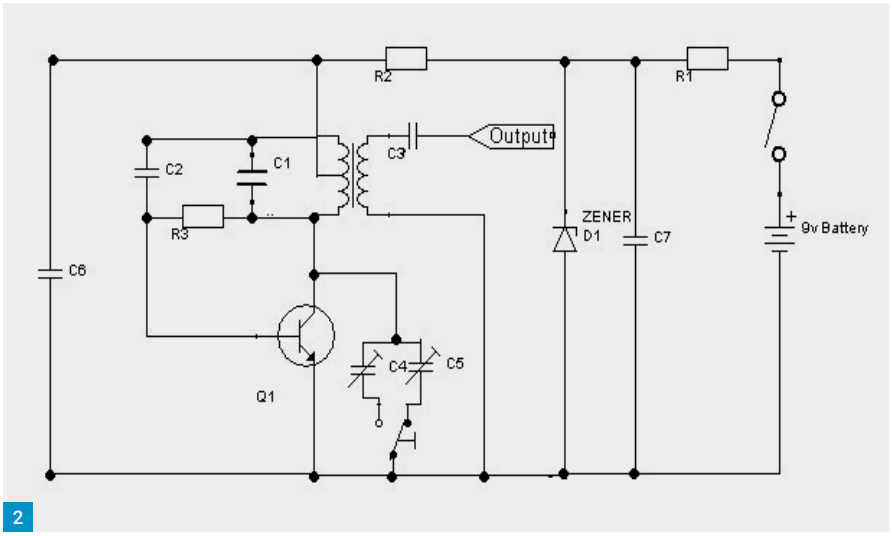
To test the circuit you will need to measure the output frequency using a frequency counter or oscilloscope, Fig. 4. Set the core of the coil and each of the trimmer capacitors to half way.

Check the output frequency on the end of C3. If it is too high, then increase the value of C1 to bring it as near as possible to the IF frequency. Fine tune by carefully adjusting the core of the coil with a plastic trimmer tool.

Testing on a receiver will involve injecting the BFO signal into the IF of the receiver. This is quite easy as all that is needed is to connect a wire from the BFO output and hold it near to the final IF amplifier. The BFO signal should be heard on the loudspeaker. Tune the receiver to an AM broadcast station and adjust the core of the coil to obtain 'zero beat' in the loudspeaker.

Next, tune to an SSB signal on one of the lower HF amateur bands without the BFO switched on. Once tuned in, switch on the BFO and adjust trimmer C4 to resolve the LSB signal. Repeat this with the other trimmer C5 to an SSB station on one the upper HF amateur bands to resolve the USB signal.

1



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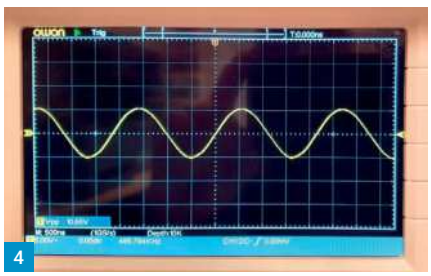
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Fig. 1: The EB35 receiver (with external BFO).
Fig. 2: The circuit used.
Fig. 3: Construction of the add-on BFO.
Fig. 4: Checking it out on an oscilloscope.

Conclusion

The BFO is simple to make using very few components. It seems to be quite stable with the addition of a Zener diode. No physical connection to the final IF of the receiver is required. All that is required is to loop a wire in the vicinity of the final IF circuit for a good pick-up.

The Eddystone EB35 works well with the external BFO making it possible to listen to SSB and CW signals that could not be resolved before. Many other short wave broadcast radios could also benefit with the addition of an external BFO similar to the one described. **PW**

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What a Treat

Dear Don,

Well, what a treat this month's (May 2022) *PW* was. Something for almost everyone. Microwave, millimetre wave and terahertz antennas, a nostalgic trip down 'The Panda Cub' road, Valve Radio Repair, the machinations of Jodrell Bank and last but not least, construction projects. And of course, no ham magazine would be complete without rig reviews. This time, a D-STAR handheld but this one has got a 'waterfall' display. I wondered how long this innovation would take to migrate from an HF rig to something you can caress in your hand.

Yes, it is indeed the VOA 80th Anniversary as commented on by **Steve PJ4DX**. And no real surprise that this station is still operating. Like Steve, who also stumbled across it, I discovered this station when I began my very first tentative steps onto the short-wave bands back in the late 1950s courtesy of an RCA AR88 (my late father found it abandoned in a skip). However, a few years later, I decided to stop listening to Voice of America broadcasts. My father renamed it VOP (Voice of Propaganda). I soon realised what he'd meant. But perhaps I shouldn't single out VOA because the BBC did much the same thing. Many other commercial short-wave broadcasters followed the same script too. And still do.

Lastly, I've also enjoyed reading about the histrionics of *PW*. Compelling, even.

Ray Howes G4OWY/G6AUW
Weymouth

90 Years!

Dear Don,

The May edition is simply great! Talk about nostalgia for my youth. Thanks for the delightful list of the retailers. **Bernie** and **Brenda**, **John Wilson** up at Lowes. **David Tong** and our **John Birkett**….what an amazing collection of characters and businesses they were.

And that Panda Cub…it was THE most desirable piece of transmit gear. Was it not on display at the Royal Hotel in Woburn Place show….**John Clarricoats** 'locomoting' down the aisle and sweeping us youngsters aside? Doesn't the front panel look like a homebrew project now?

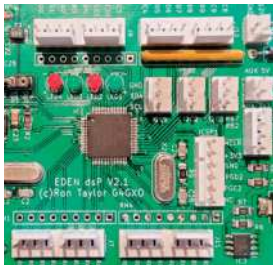
Victor Brand G3JNB
Shefford, Beds.

…and Finally

Many readers will have spotted that *PW* was the featured magazine in the BBC satirical news quiz *Have I Got News for You* in early April (although the quotes were not from the magazine!). Anyway, lots of viewers will now know that *PW* is still going strong after 90 years!

Next Month

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



THE EDEN DSP CARD: Ron Taylor G4GXO describes a versatile and compact 16bit DSP processor for radio projects.

THE FACE BEHIND THE CALL: Meet Jim Lee G4AEH, radio amateur and professional broadcaster.

VALVE & VINTAGE: Bernard Nock discusses the state of German UHF radio in 1936.

MICROWAVES PART 4: Ian Dilworth G3WRT completes his look at microwave antennas by discussing antenna modelling.

SDR AND THE PW PASTON: The latest instalments of these two constructional projects.

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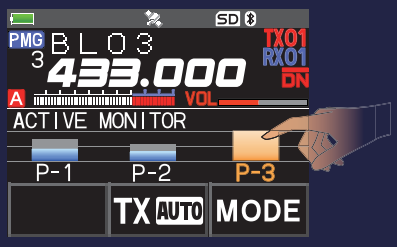

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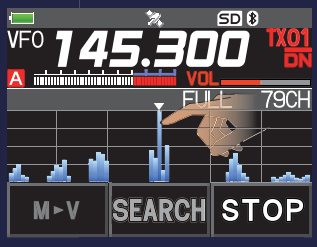

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The Battle of Britain
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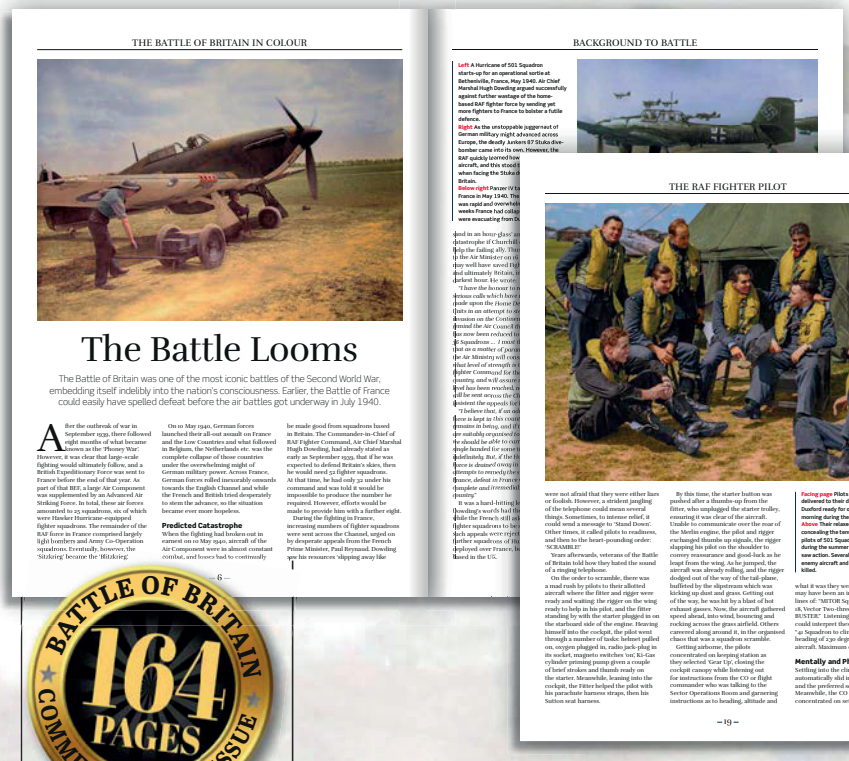

THE BATTLE OF BRITAIN IN COLOUR

The Battle Looms

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

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

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

Predicted Catastrophe

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

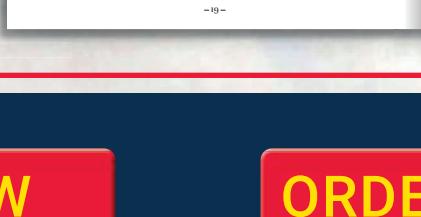
During the fighting in France, increasing numbers of fighter squadrons were sent across the Channel, urged on by desperate appeals from the French Prime Minister, Paul Reynaud. Dowding saw his resources 'slipping away like

BACKGROUND TO BATTLE

Left A Hurricane of 501 Squadron starts-up for an operational sortie at Bethenville, France, May 1940. Air Chief Marshal Hugh Dowding argued successfully against further wastage of the home-based RAF fighter force by sending yet more fighters to France to bolster a futile defence.

Right As the unstoppable juggernaut of German military might advanced across Europe, the deadly Junkers 87 Stuka dive-bomber came into its own. However, the RAF quickly scored how aircraft, and this stood t when facing the Stuka a Britain.

Below right Panzer IV t France in May 1940. Th was rapid and overwhe weeks France had colla were evacuating from D


THE RAF FIGHTER PILOT

were not afraid that they were either liars or foolish. However, a strident jangling of the telephone could mean several things. Sometimes, to intense relief, it could send a message to 'Stand Down'. Other times, it called pilots to readiness, and then to the heart-pounding order: 'SCRAMBLE!'

Years afterwards, veterans of the Battle of Britain told how they hated the sound of a ringing telephone.

On the order to scramble, there was a mad rush by pilots to their allotted aircraft where the fitter and rigger were ready and waiting: the rigger on the wing ready to help in his pilot, and the fitter standing by with the starter plugged in on the starboard side of the engine. Heaving himself into the cockpit, the pilot went through a number of tasks: helmet pulled on, oxygen plugged in, radio jack-plug in its socket, magneto switches 'on', Ki-Gas cylinder priming pump given a couple of brief strokes and thumb ready on the starter. Meanwhile, leaning into the cockpit, the fitter helped the pilot with his parachute harness straps, then his Sutton seat harness.

By this time, the starter button was pushed after a thumbs-up from the fitter, who unplugged the starter trolley, ensuring it was clear of the aircraft. Unable to communicate over the roar of the Merlin engine, the pilot and rigger exchanged thumbs up signals, the rigger slapping his pilot on the shoulder to convey reassurance and good-luck as he leapt from the wing. As he jumped, the aircraft was already rolling, and the rigger dodged out of the way of the tail-plane, buffeted by the slipstream which was kicking up dust and grass. Getting out of the way, he was hit by a blast of hot exhaust gasses. Now, the aircraft gathered speed ahead, into wind, bouncing and rocking across the grass airfield. Others careered along around it, in the organised chaos that was a squadron scramble.

Getting airborne, the pilots concentrated on keeping station as they selected 'Gear Up', closing the cockpit canopy while listening out for instructions from the CO or flight commander who was talking to the Sector Operations Room and garnering instructions as to heading, altitude and

Facing page Pilots of 19 Squadron are delivered to their dispersal point at RAF Duxford ready for operations early one morning during the summer of 1940.

Above Their relaxed look perhaps concealing the tension, these Hurricane pilots of 501 Squadron pose for the camera during the summer of 1940. All of them saw action. Several of them shot down enemy aircraft and some of them were killed.

what it was they were intercepting. It may have been an instruction along the lines of: "MITOR Squadron, ANGELS 18, Vector Two-three-zero, Fifty Plus. BUSTER." Listening in, the other pilots could interpret these coded instructions: "40 Squadron to climb to 18,000 ft on a heading of 230 degrees. Fifty plus enemy aircraft. Maximum cruising speed".

Mentally and Physically Draining

Settling into the climb, the pilots automatically slid into section order and the preferred squadron formation. Meanwhile, the CO or flight commander concentrated on setting course as the

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other pilots concentrated on what was going on in their cockpits: oil temperatures and pressures, fuel state, oxygen contents checked and selected to 'On', microphone not on 'Transmit' (this could effectively block all other transmissions), straps tight, gun-sight 'On' and illuminated, straps tight and canopy firmly shut. A surprising number could carry out a little good luck routine – the feeling for a lucky charm, or even crossing themselves.

Now, the workload was high, and still they needed to concentrate on formation keeping while permanently keeping a wary eye open for the enemy and quartering the sky in a relentless search. A moment of relapse could literally spell death. The squadron 'Weaves', winding from side to side, kept a rather more wary eye open than the rest, as the squadron got closer by the second to their quarry. Brief instructions might crackle through the headphones: 'Close up Red 2' or, on receipt of further instructions from the Fighter Controller: 'Turning to Port, Go!'

Meanwhile, pilots fiddled with the radio tuner, struggling to tune and re-tune their wireless sets in a constant battle to receive and properly understand the messages. Sometimes, a squawk of static drowned out everything, sometimes resulting in one section

having off suddenly, upwards or downwards, the rest of the squadron watching in bemusement and puzzled because they received no transmission, or else just couldn't understand what had been said. Meanwhile, constant juggling of the throttle setting with the left hand, and judicious adjustment of position through the control column and rudder pedal inputs, were all necessary just to keep station. It was incredibly hard work, and mentally and physically draining.

By now, the squadron was 'on oxygen', masks clamped securely to pilot's faces as cold began to permeate the cockpits. Now, with all the hard work of take-off, formation flying and getting to altitude, came further nervous tension with realisation that the enemy were near. Then, a tight knot of fear returned as the gunsight was checked and the SAFE and FIRE ring on the gun button turned, ready, to the FIRE position. Goggles pulled down. And then the shout:

'BANDITS! Ten o'clock, above. Coming down now! Break, break, break...'

Chatter Of Gunfire

Suddenly, to avoid the 'bounce' of fighters coming out of the sun, the squadron had dispersed in a pre-ordered plan. Now, the enemy fighters were among them. This time, there was no

Facing page Although posed for a news cameraman, the squadron telephone orderly shouts instructions for a 'scramble' as pilots lounge in the dispersal hut. The smartly dressed officer is Duty Pilot – the pilot rostered for ground admin tasks such as recording take-off and landing times etc.

Above It was not unusual for aircraft to return damaged after an engagement and with pilots wounded. This brand-new Spitfire had just been delivered to 602 Squadron at RAF Westhampnett when it was hit by cannon shells from a Messerschmitt 109 in a combat on 18 August 1940. The aircraft was written off and Flight Lieutenant Dunlop Urie wounded in his feet.

chance of a well-ordered textbook 'Number One Attack'. Instead, it was every man for himself, but with 'wing men' desperately trying to maintain station and protect their section leader.

Now, the pilots were climbing and hanging on their props, the sun glaring and blinding as they turned, all the while listening out and looking out. Now, there were shouts: "Behind you Blue 3!", permeated by chattering gunfire. A cacophony of shouts and static made communication unintelligible. One pilot may be drawing a bead on a

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