PRACTICAL WIRELESS

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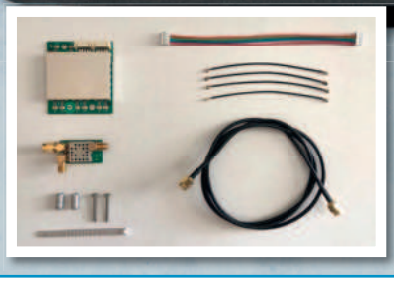
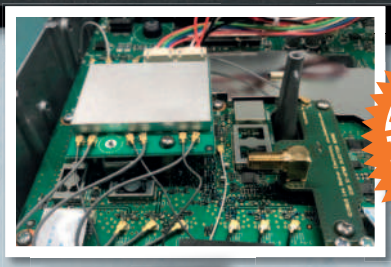
APRIL 2022 THE UK'S NUMBER ONE AMATEUR RADIO MAGAZINE SINCE 1932

HOW TO BUILD... | **An 80-40m AM receiver plus a 40m transceiver VFO board**

IC-9700 ADD-ON BOARD

Our verdict on the RadioAnalog PTRX-9700 for a second receiver





Practical Wireless REVIEW

Valve and Vintage

The Hallicrafters S20R Sky Champion Receiver

The World of HF

Why propagation and band conditions are improving

HISTORY **We continue to remember PW at 90**

This time we dissect the magazine through the 1960s to the 1970s

GEAR **The NanoVNA as an Antenna Analyser**

How this thrifty gadget can be used to measure your antenna's SWR

58 VHF/UHF NETS

Your handy list of groups to participate in

NARSA RALLY

News of Blackpool's return & more

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Practical Wireless
Warners Group Publications plc
The Maltings, West Street
Bourne, Lincs PE10 9PH
www.warnersgroup.co.uk
Tel 01778 391000

Editor
Don Field G3XTT
practicalwireless@warnersgroup.co.uk
Designer
Mike Edwards
mike.edwards@warnersgroup.co.uk
Advertisement Manager
Kristina Green
01778 392096
kristina.green@warnersgroup.co.uk
Production Manager
Nicola Glossop
nicola.glossop@warnersgroup.co.uk
Production Assistant
Charlotte Bamford
Charlotte.bamford@warnersgroup.co.uk
Marketing Manager
Katherine Brown
katherine.brown@warnersgroup.co.uk
Marketing Executive
Luke Hider
luke.hider@warnersgroup.co.uk
Publisher
Rob McDonnell
robm@warnersgroup.co.uk

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

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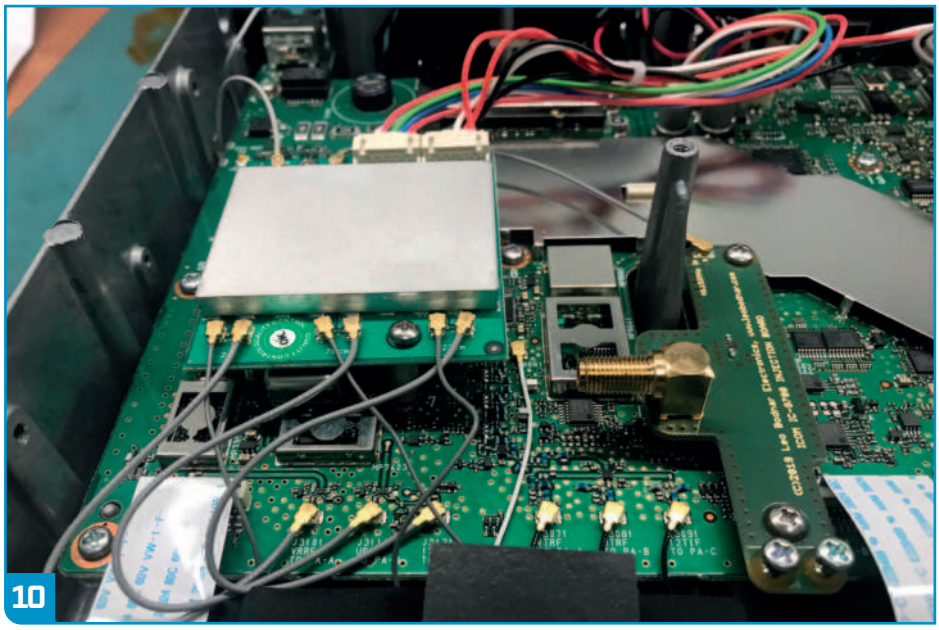

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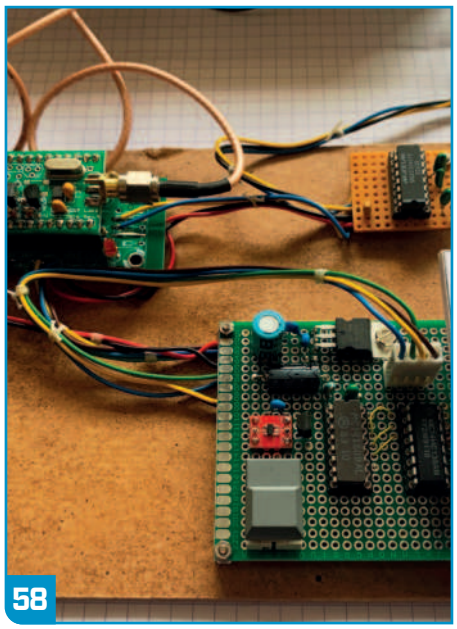

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Keylines

Firstly, my thanks to those of you who congratulated me on having edited 100 issues of *PW*. If nothing else, it shows you read my editorials!

It's good to see that many rally organisers are biting the bullet and announcing events for this year. I am writing this on the day that the government has announced the ending of Covid restrictions, so hopefully even more organisers will feel confident in planning for events later in the year. While I realise that many radio amateurs are older and potentially vulnerable, many others of us consider that losing two years of events at our age is more than enough and it's time to get out and about again!

Weather

In mid-February I had planned a 15m entry in the ARRL CW Contest, one of my favourites because US operators tend to be excellent and I always run across many old friends, from my visits over the years to the USA. However, this year it was not to be. Storm Eunice promised gales so I wound the tower (at my son's place) right down in anticipation and then, on the Saturday, just to make matters worse, their power went off. Oh well, there's always another year!

But I certainly hope that *PW* readers managed to get away lightly. I've already come across stories of damaged masts and antenna, broken wires and more. While there is an old adage that *"if your antenna didn't come down last winter, it isn't big enough"* I suspect most of us prefer to see our antennas standing year in and year out!

Pocket Portable Beam Antenna

David G4DHF, whose article appeared last month, asks me to let readers know that a 70cm version has also been developed, which locates inside the 2m element, allowing successful satellite communications. Since these antennas were developed, both the 2m and 70cm versions have achieved QSO distances of over 1000km using just 8W power output, proving their design objectives. See: QRZ.com/G6LI

He hopes to provide more details in a follow-up article in due course.

TX Factor

In our *News* pages you will read that a new episode of *TX Factor* has recently been released. This is great news insofar as *TX Factor* has proved very popular since it first started but a number of factors, not least Covid, have conspired to it being quite some time since the last episode appeared (December 2020, so more than a year ago). I've been featured twice now but there is plenty of other good stuff and all previous episodes are downloadable from the website. And they hope to be able to offer regular episodes again now that things have settled down a bit. Welcome back!

This Month

It's another full issue this month and with plenty more articles waiting in the wings. As I look back over the decades in my *PW* at 90 series, I realise that amateur radio wasn't always well represented in these pages, presumably because there were plenty of other magazines also catering to the amateur radio market, but nowadays we remain as the only high street amateur radio magazine in the UK. And for that, we thank each and every reader for your ongoing support!

GB90PW

And finally, in this 90th year of *PW*, we have been thinking about how best to recognise that achievement. One way is to run a special event station. With that in mind, we are hoping to get hold of GB90PW, probably for the month of September, when our anniversary is due. This would follow from GB80PW and, before that, GB75PW. Watch this space.

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**

SOUTHERN FUSION: Phil Bridges G6DLJ reports that owners of Yaesu C4FM transceivers may be interested to learn of a new Wires-X room, Southern Fusion, currently room 41893. Focusing primarily on repeater and gateway users in Southern England and, of course, Wires-X users anywhere on the planet!
At the time of writing RF access is available (by default) via a growing number of C4FM repeaters, including the donor repeater GB7IV (Southampton), GB7CM (Blandford), GB7IE (Plymouth), GB7TM (Ipswich) plus Gateways in Reading, Hastings and Ringwood with more joining every week.
The room also hosts a regular Sunday morning one-hour net at 1100UTC, which all are encouraged to participate in.

NEWS FROM JERSEY: Jersey Club President Rob Luscombe MJ0RZD tells us that Jersey Amateur Radio Society meets on Friday evenings from 7:30pm at the old German Signal Station at La Moye on Rue Baal just past the prison.
The local VHF repeater GB3GJ operates with its output on 145.6375MHz and -600kHz input using CTCSS tone 'B' (71.9Hz) to open, while for UHF there is the choice of the analogue repeater GB3JU with output on 430.900MHz and +7.60MHz input with CTCSS tone 88.5Hz and for the Icom D-Star system GB7JI with output on 430.850MHz and input on 438.450MHz. Peter GJ8PVL, the club secretary, is also the repeater keeper and can provide more information. He is also developing the DMR system (Digital Mobile Radio) locally. Details of the club and further information can be found on the club website: **www.jerseyars.org.je**

HEIL SOUND CHANGES HANDS: US manufacturer Heil Sound, which has been run by Bob Heil K9EID and his wife Sarah for decades, has been sold. The Heils announced the purchase of the well-known professional microphone company by Ash Levitt and Steve Warford. Ash, the company's president and CEO, and Steve, director of operations, are veterans of the business, having worked with Bob since they were teenagers. Bob will remain with the company as founder and CEO emeritus, continuing to do product design for the amateur radio market. Heil Sound has been in business since 1966 and its headphones, microphones and other products are popular with radio amateurs.

ESSEX HAM NEWS: The 14th of February 2022 saw the 100th anniversary of the birth of regular British broadcasting, with the launch of the experimental station 2MT set up in an ex-Army hut in Writtle, near Chelmsford.
To commemorate this piece of radio history, Essex Ham ran its regular weekly net from a modern-day experimenters hut in Essex, the East Essex Hackspace. The Hackspace is a community workshop with woodworking, metalworking, electronics and 3D printing facilities aimed at allowing the Essex community to 'make stuff' and experiment, which was very much what the Marconi company was doing back in 1922 with early wireless radio.
In keeping with the desire to experiment, Essex Ham live-streamed the evening, running parallel video and audio streams with multiple camera angles. The net ran with the callsign of GB2MTC ('2MT Centenary'), and linked up live with Jim Salmon 2E0RMI, from Radio Emma Toc. Their streaming service had been running an all-day stream reviewing the history and staff behind that historic amateur radio station that was the precursor to the BBC.
The Essex Ham activation was also able to link up with another centenary station, GB1002MT, operated by the Chelmsford ARS from close to the original 2MT hut. The event was also promoted to students of the group's online training course, to allow students to get a feel for a fun, and sometimes hectic, special event station. During the live linkups, the team joined other amateurs on 2m by raising a glass to those radio pioneers 100 years ago, who would hopefully have been proud to know that amateur radio experiments continue to this day.

SYLLABUS 2019 VERSION 1.5 PUBLISHED: The RSGB's Examinations Standards Committee and Exam Syllabus Review Group have released the latest version of the Syllabus: Syllabus 2019 version 1.5.
New regulations from Ofcom require all UK radio amateurs to comply with the international guidelines for limiting exposure to electromagnetic fields (EMF). The updated syllabus includes learning points relating to these new licence conditions. The adoption date for this version is 1 September 2022, meaning that after that date the examinations will include questions on the new EMF-related material at all levels. You can see the updated syllabus on the RSGB website: **www.rsgb.org/syllabus2019**

TX FACTOR RETURNS: The latest episode of TX Factor is now available. Bob and Mike attempt to construct a digital voice modem using an MMDVM module kit and Raspberry Pi Zero, and Bob reviews the long-awaited ID-52 5W handheld transceiver from Icom. And there's a chance to win a bundle of books from the RSGB in a free-to-enter draw. As well as regular episodes featuring all aspects of amateur radio, the guys at TX Factor provide a podcast of the GB2RS news every week. Details of how to download or subscribe are on the TX Factor website: **www.txfactor.co.uk**

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

RUNBO P5 4G DMR VHF/UHF: The Runbo P5 4G DMR VHF/UHF is a 10in tablet PC running the Android operating system and featuring VHF/UHF FM and DMR.
Running Android, you can install all the available Play Store apps. This means that you can install Zello, Team Speak, EchoLink and many others and use the built-in PTT button to key the transmission on such apps.
If you don't reach an EchoLink node, just use 3G, 4G or even WiFi, and you are connected. Never miss a QSO again just because there isn't a nearby repeater!
The Runbo currently sells for £667.
https://tinyurl.com/yc32bmtj

NEWS FROM THE RSGB: The RSGB has launched a new set of web pages to draw together the RSGB's activities for Her Majesty the Queen's Platinum Jubilee. More activities are planned and details will be added to this web section over the coming weeks. You can find all the information in one place at:
www.rsgb.org/jubilee
The RSGB's Examinations Standards Committee and Exam Syllabus Review Group have published initial results of the Direct to Full survey and information regarding next steps. You can see the update on the RSGB website:
www.rsgb.org/direct-to-full

VIEWPROP TUTORIAL VIDEO RELEASED: Rick Kiessig ZL2HAM has published a tutorial for his propagation analysis and visualisation tool, ViewProp on YouTube. ViewProp uses data from the Reverse Beacon Network and DxAtlas to provide a graphical view of propagation.
You can view the video at:
youtube.com/watch?v=McUB2eY5atk
A user forum and discussion group for ViewProp is also available at groups.io

URESAT-1 - A CHESS PLAYING AMATEUR RADIO SATELLITE: (from *ICQ Podcast*)
Intensive work is underway to make URESAT-1 available before the end of the year. If all goes according to plan, URESAT-1 will launch aboard a SpaceX Falcon-9 rocket from Cape Canaveral in October.
URESAT-1 is based on the architecture used in the GENESIS, EASAT-2 and HADES missions but will include significant improvements, such as a 32-bit computer compared to the 8-bit computers of the previous satellites and improvements in the mechanisms of deployment of antennas and batteries.
It will have a VHF/UHF FM repeater and FSK frames, like its predecessors. This will allow voice QSOs and digipeating of AX.25 and APRS frames.
The payload is not yet defined, but it could be the same SSTV camera that flies in HADES, a thruster or some kind of experiment.
One of the projects that is confirmed is a chess game that will allow radio amateurs to play having as an opponent the on-board computer sending FSK frames with the movements, to which the on-board computer will answer in its telemetry. Several radio amateurs are working on the project and if it is completed by the time the satellite is due to be delivered, it will be included.
The expected orbital altitude is around 525km and the inclination will be polar, probably around 97°, which would place it in the same orbital plane as its companions EASAT-2 and Hades.
URE has created a blog in WordPress where the status of the project will be reported, including details of the functionalities and technicians. Although in Spanish, Google will happily translate into English:
https://uresat.ure.es


British Railways Amateur Radio Society

RAILS and RADIO

January 2022

G0FYX – Railways on the Air 2021

In this issue:

Editorial – President's Piece – Chairman's Chat
Secretary's Scribblings – Special Event Station GB1FRT – Rallies
AGM 2021 Informal Report – Treasurer's Report
Membership Secretary's Topics – ROTA 2021: GB1SLR and GB4MHR
KWVR Calling – ROTA 2021: GB0LMR
My Favourite Heritage Railway
Accounts – Society notes, subs, contacts

Subs for 2022 are now due - see inside back cover

BRARS PR 22-01 NEW LOOK RAILS AND RADIO: BRARS (the British Railways Amateur Radio Society) is delighted to announce the arrival of its new look *Rails and Radio* magazine. The magazine now has more pages, more articles, more columns and more photos than its recent predecessors and will be published regularly every quarter. The new look came about due to the retirement of the long-standing editor. A new editor was needed so Ian Brothwell G4EAN and Richard Waterman G4KRW jointly took on the role of editor. They literally had to start with a clean sheet and decided to make *Rails and Radio* more of a magazine and less of a newsletter.
The January 2022 issue of Rails and Radio is their first new look issue. It has a colourful look and lots of photos and articles. More significantly, it has more pages than the sum total of all the issues published in 2021. The April 2022 issue is well in hand and will soon be posted to every BRARS member.
Membership of BRARS is open to anyone interested in any aspect of amateur radio (whether licensed or listener) and in any aspect of railways (including trams, miniature railways, model railways and suchlike).
For more information about BRARS please visit the website below or contact the membership secretary Richard Waterman G4KRW, 170 Station Road, Mickleover, Derby, DE3 9FJ.
membership@brars.info
www.BRARS.info

INTERNATIONAL MARCONI DAY: International Marconi Day (IMD) celebrates the huge part Guglielmo Marconi played in the invention of radio.

IMD is a 24-hour amateur radio event that is held annually to celebrate the birth of Marconi on 25 April 1874. The event is usually held on the Saturday closest to Marconi's birthday and in 2022 will be held on 23 April.

The purpose of the day is for amateur radio enthusiasts from around the world to make contact with Historic Marconi Sites using communication techniques similar to those used by Marconi himself. Hopefully many special event stations will be active. At the time of writing, we have been notified that with the kind permission of the National Trust, Weston super Mare radio Society will be operating GB0IMD from the Old Fort on Brean Down. More information, including registration for participating special event stations, on the Cornish Radio Amateur Club website: **http://gx4crc.com/gb4imd**

GREEK AMATEUR RADIO STAMPS: The Greek amateur radio society, RAAG, recently carried the following announcement: *On the occasion of the opening of the Radio Telecommunication Station of the General Secretariat of Telecommunications and Posts of the Ministry of Digital Government, the Hellenic Post Office is issuing a Leaflet of four Stickers of Personal Stamps with 20 illustrations on the topic of Radio Amateurism in Greece.*

https://tinyurl.com/2p8pw3dj

Don Field G3XTT
practicalwireless@warnersgroup.co.uk

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.

We move now into the 1960s, the decade in which I first encountered *Practical Wireless*, and the same is no doubt true of many of our readers. Astonishingly, the September 1962 issue had some 21 pages of advertisements, even before we reach the editorial! The editorial reported on the findings of the Pilkington Committee, which had been looking at the introduction of local radio broadcasting in the UK. Its findings were that the BBC should set up local stations but that the introduction of commercial stations would lead to a decline in standards and should therefore not be allowed.

Constructional projects included a transistorised receiver for the broadcast bands, a valved hi-fi amplifier and the cover projects, **Fig. 1** – the *Miniscope* (a multi-function test set) and *The Tudor*, a battery-powered valved portable for the medium and long wavebands. There was very little of direct interest to the active radio amateur, who presumably got much of his material from *Short Wave Magazine* or the RSGB's *Bulletin*.

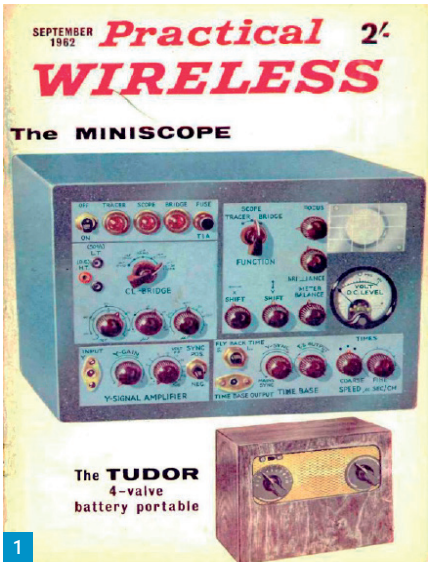
And so to 1966

I'm pretty sure the first *PW* I bought was the August 1966 issue, which, ironically, also featured a multi-function test set, **Fig. 2**. There was a page dedicated to reception reports from shortwave broadcast DXers and another to reports from the amateur bands. Radio amateurs were also treated to an article on great circle calculations – thank goodness these days we have computer programs that take care of such things! I see that the redoubtable **FG Rayer G3OGR** featured in that issue, too, with a solid-state multiband TRF (tuned radio frequency) receiver and Part 3 of his 3-band *Imperial* transmitter project

I mentioned Codar last time. By now they were running a full-page advertisement and had introduced new, more advanced products, including the CR.70A communication receiver and the AT5 transmitter (my very first transmitter, bought in 1968 and covering 80 and 160 metres with 10W of AM and CW). *Club Spot* (this was number 10 in a series) featured the Loughton and District Radio Society.

And in a two-page spread, Sinclair Radionics were advertising the Micro FM and Micro-6 portable receivers, the Z.12 amplifier and the PZ.3 power supply unit.

Also advertised was the (in)famous Joystick antenna from Partridge



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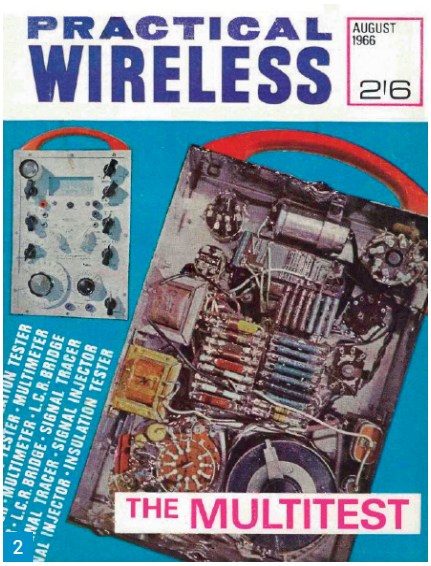

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Electronics. Their advertising was legendary but conventional wisdom had it that it was actually the feeder that did most of the radiating!

Incidentally, *PW's* sister magazines *Practical Electronics* and *Practical Television* both appeared to be going strong at this time.

The end of the Decade

The August 1972 issue is notable, if nothing else, for the fact that by then the price had gone decimal – 20p.

FG Rayer G3OGR is still going strong, this time with a topband converter (to enable listening to the 160m amateur band through a medium wave receiver).

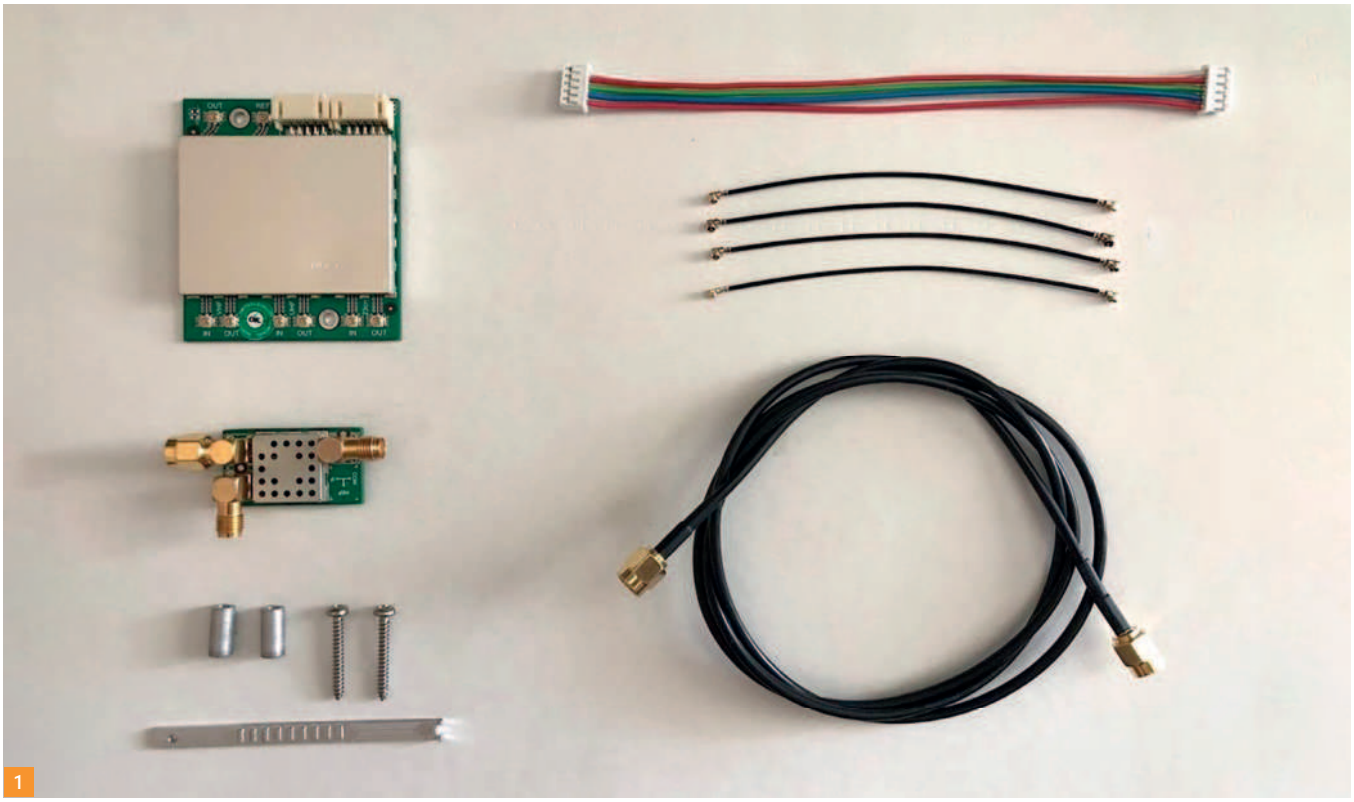
It has to be said that there was relatively little else aimed specifically at radio amateurs. Most of the projects and content were related to hi-fi, broadcast radio and test equipment of various sorts. Sinclair were still taking two pages and had expanded their product range, **Fig. 3**.

What I do find interesting throughout the decades we have looked at so far are the number of advertisements for self-training in electronics and radio, through correspondence courses and the like (some with practical projects to build along the way). I imagine that many young folk in particular fancied a career in the expanding world

3

Fig. 1: Cover of the September 1962 issue.
Fig. 2: The August 1966 cover.
Fig. 3: Sinclair advertisement from the August 1972 issue.

of electronics and I expect anyone with a knowledge of transistor circuit techniques would almost certainly have been in great demand. Courses in TV repair were also popular – this was a period in which many people rented their TVs and repairs were all too common.



1

RadioAnalog PTRX-9700

Sam Jewell G4DDK takes a look at an add-on board to allow a second receiver to be added to the IC-9700.

Sam Jewell G4DDK
practicalwireless@warnersgroup.co.uk

When I reviewed the then-new IC-9700, back in the July 2019 issue of *Practical Wireless*, it was not clear how popular the new VHF/UHF transceiver would be. At close to £1800 it would have to offer a lot of value to prospective buyers. Subsequently sales seem to be doing well, judging from the number of people I have worked who use one.

Without doubt the IC-9700 has some shortcomings in terms of RF performance and 'missing' facilities. This article describes one of the accessories I have used to enhance my own IC-9700.

PTRX-9700

A second receiver, on the same band, with a frequency spectrum display, is now considered by many to be an indispensable operating aid. Although the IC-9700 does have two receivers the second receiver cannot operate on the same band as the main receiver and this limits its ability to monitor, for example, the beacon sub-band while operating in the 'DX' allocation on the same band. Opening up the display width (dispersion) of the spectrum display usually results in poor resolution of weak signals when using the IC-9700's built in display. Adding the waterfall display can improve matters, but again, resolution is lost at wide display widths. The IC-9700 does not provide for connecting a larger, external display, as you can with the IC-7610, TS-890 and some other transceivers.

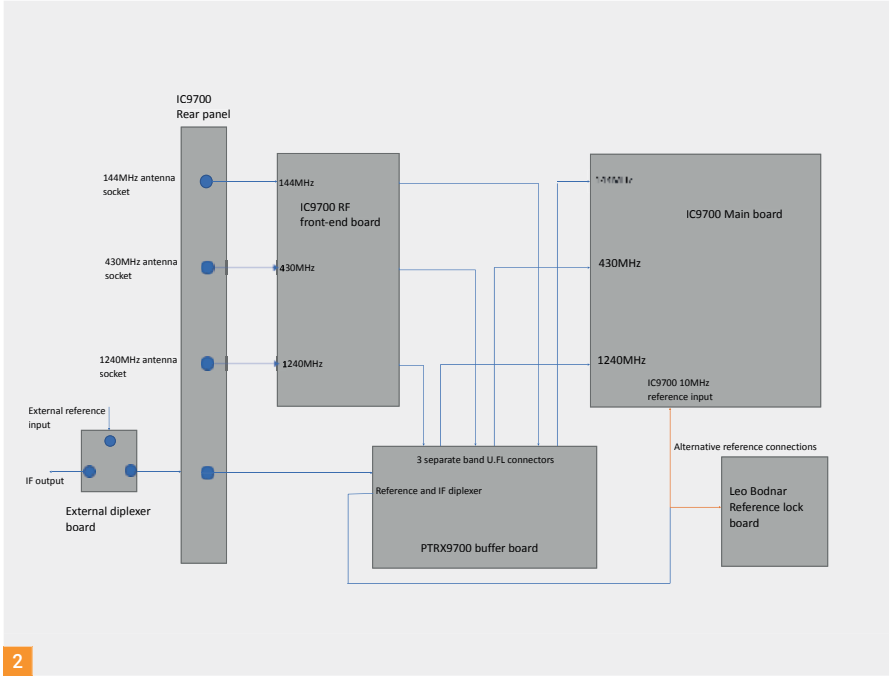
A second receiver also allows the operator to listen for a wanted station while in QSO with another station, without continually switching between VFO A and B.

A second receiver can often be added to a single receiver rig by using what is known as a PAT board (Panoramic Adapter Tap), together with an external SDR receiver or spare transceiver. PAT boards were made popular by G4HUP from his G4HUPRF company, and now available from SDR Kits. A PAT board taps into the transceiver's IF at some convenient point in the receiver circuit and allows the connection of an external second receiver, such as the SDRPlay RSP or Airspy SDR. This can then function as a second receiver with the added benefit of a larger spectrum display.

Some transceivers, such as the Elecraft K3 already incorporate a suitable IF output, which allows an external SDR or another transceiver/receiver to be used without having to access the inside of the radio. The problem with providing an IF tap on the IC-9700 is that it is an SDR and therefore does not have an IF to tap into. This is not strictly accurate as the IC-9700 1296MHz receiver and transmitter part does have an IF at 311 to 371MHz, ahead of its SDR stages. This is not, though, the case with 144 and 430MHz.

RadioAnalog (manufacturer of the PTRX-9700) have got around the problem of a lack of IF output by using a high frequency, high impedance, 'probe' or buffer board, which taps the three IC-9700 internal receiver RF front ends with minimal effect on normal IC-9700

Fig. 1: The PTRX9700 kit on arrival.
Fig. 2: The various interconnections required.
Fig. 3: The new boards installed in the author's IC-9700.



receive operation. In the case of the 1240 to 1300MHz (23cm band) the probe is connected after the internal down-conversion from 1240 to 1300MHz to the 311 to 371MHz IF. Otherwise, it is the same as the 430MHz (70cm band) band tap. The tap is, of course, across the entire bandwidth of the individual bands and is not actually an IF tap (except for the 1240MHz band).

It should be noted that the IC-9700 front-end stages are necessarily bandpass limited to eliminate aliasing (see my July 2019 review). What this means is that although you may be connecting a wideband SDR receiver after the in-built front-end stages, the frequency range that can be displayed is still limited to a little more than the range of the three individual IC-9700 bands. In practice the filters do not cut off too sharply and the available frequency display range exceeds that of the radio by a few extra MHz either side of the three amateur bands. **Table 1** shows the 3dB bandwidth for each of the three bands, as measured from IC-9700 RF input socket to PTRX IF output socket (after the diplexer – more on this later). Since the frequency response within each of the bands is not completely flat, a best estimate of the 3dB bandwidth has been shown in the table.

The clever bit of the RadioAnalog PTRX-9700 arrangement is that it taps the IC-9700 RF circuits such that the internal signal path is not disturbed. Doing this at 144MHz, 311MHz (1240MHz band IF) and 430MHz, without introducing additional loss into the tapped-off path, and without increasing the noise figure between the IC-9700 antenna sockets and the 'IF' output socket, is not easy, but RadioAnalog seem to have achieved it with the PTRX-9700. Making up for lost signal level with additional amplification is quite easy, retaining noise figure is not. If this is not done, then the external SDR receiver may not be as sensitive as the main path receiver.

Table 2 shows my measured insertion loss and noise figures from IC-9700 antenna sockets to diplexer IF output. The insertion loss is shown as higher than the RadioAnalog published figures because it necessarily includes the front-end stages of the IC-9700. The slightly higher noise figure and lower insertion gain at 145MHz, compared to the two other bands, had to be double checked and is confirmed.

A check of the IF output spectrum from the PTRX-9700 showed a completely spurious-free output over the frequency range from 10MHz to 500MHz.

What is Included?

The PTRX-9700 comes as a comprehensive kit of parts, with a pre-assembled radio buffer board, diplexer board (more on this a bit later) several miniature coaxial leads with Hirose U.FL series connectors, a U.FL 'tool' to ease attaching the connectors to the boards, an RG174 coaxial lead with SMA male connectors, a DC supply lead and some mounting screws and pillars, **Fig. 1**.

Fitting the PTRX-9700 is straightforward using the RadioAnalog web page instructions, requiring the removal of two grounding screws from the original main board and then carefully fitting the new buffer board with the two spacers and the two longer screws that are supplied. The more difficult part is removing the three miniature coaxial U.FL connectors from their original input sockets on the IC-9700 main board and fitting three of the new (supplied) leads. This is made easier by using the supplied tool but even then, requires a lot of care.

In effect the original three IC-9700 front-end signals are diverted from their input to the main board to now being routed via the new PTRX-9700 board and then to the main board. Martin Lynch and Sons, the official UK supplier of the RadioAnalog PTRX-9700, can do this for you. **Fig. 2** shows how the new buffer board and reference interconnects with the IC-9700 boards.

I have deliberately not yet mentioned the diplexer board that is supplied with the PTRX-9700. Unfortunately, there is no convenient place on the rear panel of the IC-9700 to mount a new and dedicated IF output socket. The RadioAnalog solution is to use the existing 10MHz reference input signal SMA connector for this purpose. However, this socket may still be required for use as the reference signal input. The dual use of the one connector is accomplished using diplexers.

Multiplexing two signals together, over a single RF path, requires two diplexers, one at either end of the path. The internal diplexer is contained on the buffer board. The second, external, diplexer is in the form of a small, screened board with three SMA connectors. This diplexer combines the 10MHz or 49.152MHz reference input with the new IF output.

Inside the IC-9700 another U.FL connectorised miniature coaxial lead is used to connect the reference signal from the PTRX-9700 buffer board to the IC-9700 main board. The existing back panel SMA is an SMA bulkhead cable end jack, the other end of which is terminated in a U.FL plug connector, and this is plugged into the remaining U.FL socket on the buffer board. This may all sound quite complicated but is quite straightforward if you follow the instructions on the RadioAnalog web page: www.radioanalog.com

As the new buffer board needs to be powered, this is done by using the new, supplied, power lead. This entails removing an existing multiway plug from its socket on the IC-9700 main board and moving it over onto the right connector on the buffer board. The new cable is now plugged into the second socket on the buffer and routed back to the original socket on the main IC-9700 board.

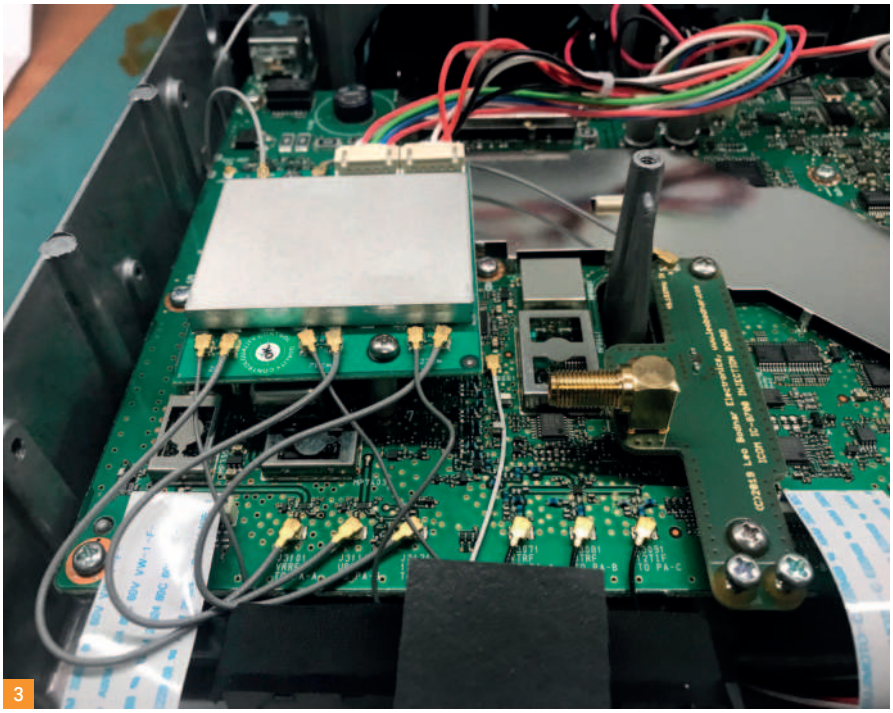
PTRX-9700 in Use

Before purchasing the PTRX-9700 I contacted RadioAnalog to enquire if the bandwidth of the diplexer was wide enough to pass the 49.152MHz reference signal that I use with my Leo Bodnar frequency locking board.

To digress from the review a little. The IC-9700 has an acknowledged frequency stability problem in the basic design. The PCB placement of the original IC-9700 reference 49.152MHz reference clock oscillator makes it susceptible to thermal changes when any of the three power amplifiers are in use. ICOM have released several firmware upgrades to minimise the problem. However, running digital modes such as FT8 or JT65 on 432MHz or 1296MHz, it still shows significant drift during each 'over', such that weak signals may not always decode. Several other parties have suggested solutions, but the one now most often used is the Leo Bodnar injection lock board. This, however, requires an external 49.152MHz reference signal instead of the original 10MHz. This alternative reference signal needs to pass through the diplexer. RadioAnalog assured me that the diplexer passband had been designed with this in mind. Indeed, my own measurements on the supplied diplexer showed it readily passed 49.152MHz with minimal loss. The photo, **Fig. 3**, shows both the PTRX-9700 and the Leo Bodnar ICOM IC-9700 Reference Injection Board installed in my IC-9700. With both boards installed I was keen to see how well the new PTRX-9700 performed and whether it had any negative effects on normal operation.

I use my RSP Pro 2 as a second receiver with the IC-9700 and PTRX-9700. My preferred software is SDR Console by **Simon Brown G4ELI**: www.sdr-radio.com

In operation the SDR must be set to cover all or part of the 144 or 432MHz bands, as required, and for the 23cm band the SDR is set to cover 367MHz to 368MHz, corresponding to 1296MHz to 1297MHz. Any part of the 1240



3

to 1300MHz band can, of course, be covered by setting the SDR to cover the corresponding IF of 311MHz to 371MHz. I found it possible to cover a bit beyond 1300MHz (the band extends to 1325MHz in the UK), although the RF filtering in the IC-9700 tightens quickly above 1320MHz, so sensitivity falls quite quickly with increasing frequency.

I prefer the display spectrum and waterfall display in SDR Console compared to that available using the Win4ICOM software. Resolution is better, together with the ability to measure noise levels with greater accuracy. This is important to me for sun and moon to cold sky measurements for moonbounce (EME).

Overall, the PTRX-9700 is a good solution to the problem of adding a second receiver to the IC-9700, with the bonus of being able to use a bigger spectrum display when using an external SDR. The 430MHz and 1240MHz band insertion gain and noise figure are adequate to ensure no penalty in sensitivity from the second receiver.

The slightly higher noise figure on the 144MHz band may result in slightly poorer sensitivity with the second receiver. If a good external preamplifier is in use, then the sensitivity should not be affected at all, since this will (should?) determine overall receiver sensitivity.

The RadioAnalog PTRX-9700 is available from Martin Lynch and Sons Ltd. at £279.95. I purchased mine in November 2021.

Frequency (MHz)	Insertion gain (dB)	Noise figure (dB)
145	12.3	7.7
435	23	4.2
1296	23.3	3.5

Table 1: Insertion gain and noise figure from IC-9700 antenna input to diplexer IF output with IC-9700 internal preamplifier on.

Band	From	To	3dB bandwidth
144MHz	140MHz	152MHz	12MHz
430MHz	427MHz	452MHz	25MHz
1240MHz	1237MHz	1322MHz	85MHz

Table 2: Approximate 3dB bandwidth available at the IF output, from antenna input, for each of the three bands. The frequency response is not completely flat across each band. There is some ripple and peaking apparent, especially in the 144MHz band.

CW Protocol or Protocols

Roger Cooke G3LDI returns to the topic of learning Morse Code and, in particular, getting to grips with operating protocols.

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

I had quite a bit of feedback on the subject CW Protocol or Protocols and not much deep criticism, which is what I was expecting. Morse Code has been around in its present form for decades, with all the prosigns to complicate the learning process. I shall suggest a new learning method, which might make it more straightforward for the newcomer to the code. Instead of learning 'prosigns', which can be designated in several different ways and thereby making it look too complicated, I will state what procedural and punctuation signals are in di-dah fashion. This will obviously put more emphasis on the student to perform due diligence and learn what might appear to be 'more' Morse Code, but will in the end benefit him.

Hopefully a new version of my *Morse Code for Radio Amateurs* will be published in the near future, as soon as I can get a new CD submitted. However, the next update will be based on what I have said above. There is no written rule that says prosigns MUST be used and I think the change may help the new students.

To pre-empt the next version of my book, here is the code as I am proposing that all students learn. If there are any newbies wishing to learn the code, then **Table 1** will be very useful.

Using dots and dashes to represent Morse code is HIGHLY discouraged. DON'T EVEN BOTHER WITH LEARNING DOTS AND DASHES. Morse code is a language of SOUND, so forget dots and dashes. Learn the code as it is set out here.

Prosigns

I had quite a bit of feedback on the subject of prosigns and was pleased to hear that most agreed with my premise, in that prosigns were a hark to the past. A few views.

Ian DJ0HF/G3ULO said that he learned Morse professionally with Overseas Telegraphs and got his amateur licence G3ULO in 1965 before becoming DJ0HF in 1974. He remembers the characters such as full stop, comma, slash, etc. being treated as single characters just like the letters of the alphabet. But when passing the transmission he ended with K for anyone to answer but KN when passing the transmission to a station he was working, though normally sent the K and the N as separate characters and thought of them as such. Back then I never heard any of the combinations being called barred to indicate the combination of two characters.

Geoff G3XDE had some valid comments, *"As for the comments you made about prosigns, and as someone still learning the code, I would find it pretty much impossible to use prosigns since I still need to write them down when I am practising. I am learning like you did without using letter combinations for punctuation but this is simply because there is punctuation or other symbol that can be written down. Of course, with practice, there would be no need to write down prosigns, I guess.*

"When I originally started learning CW, it was with G2BRH who was quite firm about needing to start everything with the prosign <CT>, but we were just doing five letter groups at that time and I never learned how to use it in a QSO. When I recently restarted to learn the code, and realising that <CT> is not used anymore, I started to wonder how it was supposed to have been used in the first place. Unfortunately, I have still failed to work it out properly!"

Geoff is correct about copying proof. Obviously if you are taking an exam,

Letters

A	di-DAH
B	DAH-di-di-dit
C	DAH-di-DAH-dit
D	DAH-di-dit
E	dit
F	di-di-DAH-dit
G	DAH-DAH-dit
H	di-di-di-dit
I	di-dit
J	di-DAH-DAH-DAH
K	DAH-di-DAH
L	di-DAH-di-dit
M	DAH-DAH
N	DAH-dit
O	DAH-DAH-DAH
P	di-DAH-DAH-dit
Q	DAH-DAH-di-DAH
R	di-DAH-dit
S	di-di-dit
T	DAH
U	di-di-DAH
V	dI-di-di-DAH
W	di-DAH-DAH
X	DAH-di-di-DAH
Y	DAH-di-DAH-DAH
Z	DAH-DAH-di-dit

Numerals

1	di-DAH-DAH-DAH-DAH
2	di-di-DAH-DAH-DAH
3	di-di-di-DAH-DAH
4	di-di-di-di-DAH
5	di-di-di-di-dit
6	DAH-di-di-di-dit
7	DAH- DAH-di-di-dit
8	DAH- DAH- DAH-di-dit
9	DAH-DAH-DAH-DAH-dit
0	DAH-DAH-DAH-DAH-DAH

Cut Numbers

Mostly used in contests when numbers are expected and the ubiquitous 5NN reports from DX stations.

1	di-DAH
5	Dit
9	DAH-dit
0	DAH

Punctuation & Procedural

Pause	DAH-di-di-di-DAH
?	di-di-DAH-DAH-di-dit
/	DAH-di-di-DAH-dit
,	DAH-DAH-di-di-DAH-DAH
.	di-DAH-di-DAH-di-DAH
End of message	di-DAH-di-DAH-dit
End of work	di-di-di-DAH-di-DAH
Closing down	DAH-di-DAH-dit di-DAH-di-dit
Break	DAH-di-di-di-DAH-di-DAH
Invitation to transmit	DAH-di-DAH DAH-dit
Wait	di-DAH-di-di-dit
Error	di-di-di-di-di-di-di-dit (old method)
Error	di-dit di-dit (Modern one)
Starting signal	DAH-di-DAH-di-DAH
	(Also used di-di-di-DAH-dit)

Question mark is also used for repetition. Break is used in place of callsign sequence when a fast response is needed. KN can be sent as one string or separated as two letters. I personally prefer the latter. The N can add emphasis and means ONLY the station being worked, nobody else.

Table 1: Learning the Code without dots and dashes!

Fig. 1: The BamaKey TP-II.
Fig. 2: An ex-Navy signalling torch.

you will be required to write it all down, punctuation included. Procedural signals are not usually used in amateur tests. However, and this is why we push head copy here in Norfolk, there is no need to write down superfluous material. I just jot down bullet points of what I wish to comment on.

I also received a nice snail mail from a stalwart supporter of 'proper' procedure on the air, **Gerald G3MCK**. One of his pet hates is after calling CQ getting a response of just one callsign. The proper response would be G3MCK de G3LDI G3LDI AR K. That is the way most were taught a few decades ago and should still apply.

Unusual Paddle

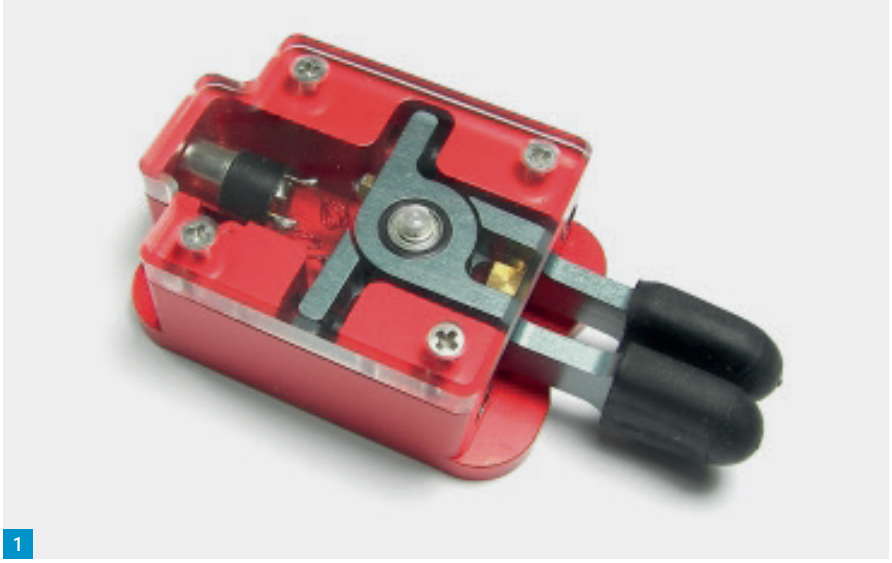
The picture in Fig. 1 shows the BaMaKeY TP-III – ultra compact twin paddle key – red and must be a very popular one as they are presently sold out. They cost 155 Euros to buy and these are the specifications:

- weight: 70g/2.47oz
- dimensions: 0.79x1, 38x1.97 (2.87) in, 20x35x50 (73) mm
- aluminum housing, anodized
- housing colour: red
- levers colour: grey
- high precision ball bearings,
- sensitive adjustment of stroke and preload,
- preload adjustable with magnets,
- silvered and golden contacts,
- backside with four magnets and protective film
- Ø 3,50 mm socket in the housing
- It is manufactured in Germany by BaMaTech Feinmechanik – Inh, by **Markus Baseler DL6YYM**.

The BamaKey TP-II is a piece of high precision that combines Mini Bearings with magnetic adjustment, contacts silver and hard gold, with adjustment of tension and career or opening between pallets very sensitive. And although it comes pre-adjusted it can be adapted to almost any taste. Experts can transmit at higher speeds and beginners can use it at 5wpm or less.

The housing is made of hard anodized aluminum and all the pieces are chromed brass, resulting in a beautiful piece that is complemented by an optional base in chromed brass with a weight of 400 grams and magnets that firmly hold the key for use on the desk.

Since all the moving parts are covered by transparent Plexiglas, its maintenance is very simple.



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Another Unusual Key to Use in The Dark!

This one, **Fig 2,** was sent to me by **Don G3XTT** and was found in his local reclamation yard. A naval torch (hence the colour!) with built-in Morse key for signalling, I wonder how many can actually use this type of communication these days? I don't think I could manage without audio myself but would be interested to hear of any naval guys who can copy this with no problem!

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

73 and may the Morse be with you! Roger G3LDI

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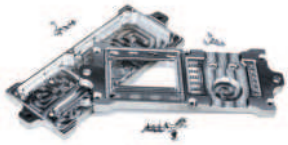
Discovery TX-500 has 11 discrete RF bandpass filters. The RF signal is only passed through one of the band-pass filters - any out-of-range signals are rejected.

Built-in panadapter

The transceiver features a built-in high-performance panadapter, for better search for new contacts and evaluation of band conditions - wherever you are, at any time.



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1

Using the NanoVNA as an Antenna Analyser

The NanoVNA costs a fraction of the amount of even the cheapest antenna analyser. Although it's a bit fiddly to do so, **Steve Telenius-Lowe PJ4DX** explains how this diminutive device can be used to measure an antenna's SWR.

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

I consider an antenna analyser (sometimes called an SWR analyser) to be an almost essential piece of test equipment for every amateur who likes to experiment (or just 'mess about with') antennas – and isn't that all of us? I have owned a few such analysers over the years, starting with the trusty old MFJ-259, which I used for many years and which worked faultlessly until one day I dropped it from a not inconsiderable height on to a concrete floor – and that was the end of that. I replaced it with a different manufacturer's analyser that had received rave reviews, although the particular one I bought must have been a 'Monday morning model' as it developed a series of faults over the years.

I was able to repair the first fault myself (the inner of the SO-239 connector had not been properly soldered to the board and it soon failed), but the second fault required the analyser to be returned to the dealer in the USA for repair.

It was out of warranty and the cost of repair and carriage to and from Bonaire was not trivial although it was a little less than buying the newer model that by then had superseded it. Recently, though, the analyser developed yet another fault, which would also have required a return to the dealer for repair.

At that point I decided not to throw any more good money after bad and I was loath to buy another model from the same manufacturer so, tempted mainly by its bargain basement price of £49.95, I decided to go for a NanoVNA, **Fig. 1**, from Mirfield Electronics **[1]**, run by **Martin Stokes G3ZXZ**. The first VNA Martin despatched was lost by the courier between England and Bonaire and I am extremely grateful to Martin for sending a replacement at no additional charge. He also included an SO-239-to-SMA adapter free of charge – what truly excellent service!

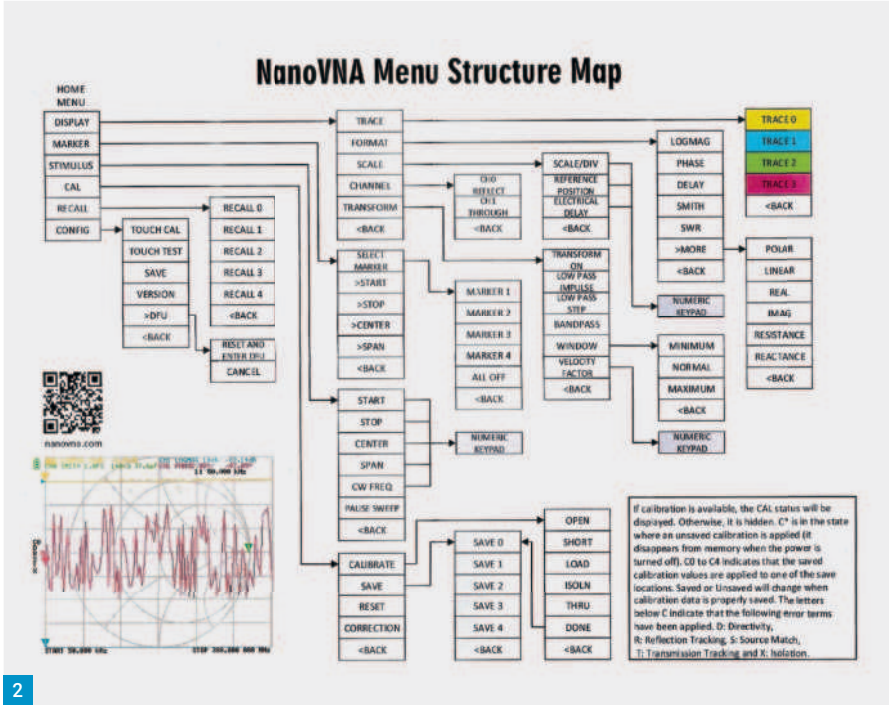
Overview

VNA stands for Vector Network Analyzer (or 'Analyser') and a 'Nano' VNA is just a very small one. Two versions are available, with either a 2.8in or 4in screen and I went for the smaller version. The NanoVNA may be tiny, but don't let its diminutive size fool you. This is a very powerful piece of equipment but, consequently, it is also rather more complex to use than an antenna analyser.

However, the main reason I wanted one (at least initially) was to be able to analyse the SWR of my antennas. Surely, I thought, this must be a reasonably simple thing to do?

The *PW* review of the NanoVNA by editor **Don Field G3XTT [2]** gave an excellent overview of what this device is capable of doing, and the article by **Michael Jones GW7BBY [3]** went into

Fig. 1: The NanoVNA and all its accessories come in a smart presentation box.
Fig. 2: There are no instructions, but this 'Menu Structure Map' is provided with the NanoVNA.
Fig. 3: When you first switch it on you are presented with a confusing-looking screen similar to this.
Fig. 4: The frequency range, along the horizontal axis, has been set from 1MHz to 30MHz. The yellow trace at the top of the screen is showing SWR but because there is nothing connected to the VNA it is nearly 15,000:1!
Fig. 5: The SMA loads, from left to right: the Open Circuit load (gold coloured with no centre pin), the Short Circuit load (also gold coloured but with a small centre pin), and 50Ω load (silver coloured).
Fig. 6: Calibrating the NanoVNA between 1 and 30MHz. In this picture, the Open Circuit load is attached to the CH0 port and in the menu 'OPEN' has already been selected. The display now highlights 'SHORT' to indicate that the Short Circuit load should now be attached to the CH0 port.
Fig. 7: SWR curve of the 40m inverted-V dipole. Note that the frequency range has now been reset to 6 – 8MHz. The small size of the NanoVNA can be gauged from the PL-259 adapter attached to the CH0 port.



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greater detail, but neither explained how to use the NanoVNA to measure SWR. A 'Menu Structure Map', **Fig. 2** (printed in English on one side and Chinese on the other), is included in the box but there are no operating instructions whatsoever: you're on your own, which is where I hope this article will help.

Step 1: Setting Up

This isn't another review of the NanoVNA – see Don's review **[2]** for details of what it can do and what comes in the box – but rather a step-by-step guide to how it can be used to analyse antennas. My NanoVNA arrived with its internal battery partially charged but, should it need charging, simply connect it to a device such as a PC or 5V charger using the supplied USB-C cable.

Switching on the NanoVNA for the first time will bring up a very confusing-looking screen, like that in **Fig. 3**. That is because the VNA screen can display up to four different traces, in yellow, blue, green and purple and, initially, all four are displayed simultaneously. To make the screen easier to read, you first need to turn off three of the four traces.

There are two ways of doing this, by using either the touch-sensitive screen or the rocker switch on the top of the NanoVNA. This switch looks like a thumbwheel but is actually a three-way (left or 'up', right or 'down', and push-to-select) switch. In this article I refer to use of the touchscreen, but using the rocker switch is equally easy. You can use your finger on the touchscreen but the menu items are very small so it's a bit 'hit and miss' (quite literally: it's easy to accidentally select the wrong setting). I soon resorted to using an old plastic pen as a stylus and this worked just fine.

So, to remove the unwanted traces first touch the top right section of the screen. Doing this brings up the 'Home' menu screen:

DISPLAY – MARKER – STIMULUS – CALIBRATE – RECALL – CONFIG

Touch DISPLAY and the next level of menu shows TRACE – FORMAT – SCALE – CHANNEL – TRANSFORM – <BACK

Touch TRACE and TRACE 0 – TRACE 1 – TRACE 2 – TRACE 3 – <BACK comes up in yellow, blue, green, purple and grey respectively. Leave the yellow TRACE 0 illuminated and turn off the others by touching each one twice until it is no longer highlighted. This should just leave TRACE 0 showing in yellow, with a tick (or 'check' mark) in the small box to the left of the word TRACE. At the same time, the blue, green and purple traces on the screen will disappear and you will be left with just the yellow trace line, which should now be running across the top of the screen.

Step 2: Calibration

The NanoVNA covers 50kHz to 1.5GHz, a very wide range of frequencies indeed but, because it scans only 101 equally-spaced spot frequencies, in order to obtain accurate readings you need to select a narrower range of frequencies that you are interested in using and calibrate the device over that range. Clearly the narrower the range selected, the closer together the 101 spot frequencies will be and therefore the measurements will be more accurate.

An HF operator could calibrate the NanoVNA for 1MHz to 30MHz and it should provide accurate results for any antenna analysed within that range. The higher you go in frequency, though, the more important calibration becomes, so probably for VHF and definitely for UHF or SHF you should re-calibrate for each frequency band.

Let's assume though that you want to analyse several HF antennas covering the 160m to 10m bands and you therefore decide to calibrate the NanoVNA from 1MHz to 30MHz.

To do this, open the Home menu again: if you still have another menu open touching <BACK once or twice will reopen the Home one. Touch STIMULUS (why it is called 'Stimulus' I have no idea, but it is!) This opens the following menu screen:

START – STOP – CENTER – SPAN – CW FREQ – PAUSE SWEEP – <BACK

Touching START brings up a numeric keypad. For this example enter '1' followed by 'M' (for Megahertz). This closes the menu and 'START 1.000 000 MHz' will be seen at the bottom left of the screen.

Then open the menu again and touch STOP, then enter '30' followed by 'M'. Now 'STOP 30.000 000 MHz' will be displayed at the bottom right of the screen. In effect, this is setting the horizontal, or 'x', axis of the screen – see **Fig. 4**.

Calibration of the NanoVNA for the range just entered is done using the three SMA loads provided. The loads are an Open Circuit, a Short Circuit and a 50Ω Load. You need to identify which one is which: see **Fig. 5**.

Go back to the Home menu and this time select CALIBRATE. This brings up another screen, the top selection of which is also labelled CALIBRATE. Touch this and the following menu appears:

OPEN – SHORT – LOAD – ISOLN – THRU – DONE – <BACK

Next connect the Open Circuit load to the CH0 female SMA connector on the NanoVNA. *(Do NOT use the CH1 connector: this is not used at all for SWR measurements.)* When the load is connected touch OPEN on the menu screen and a tick ('check') will appear next to OPEN, **Fig. 6**.

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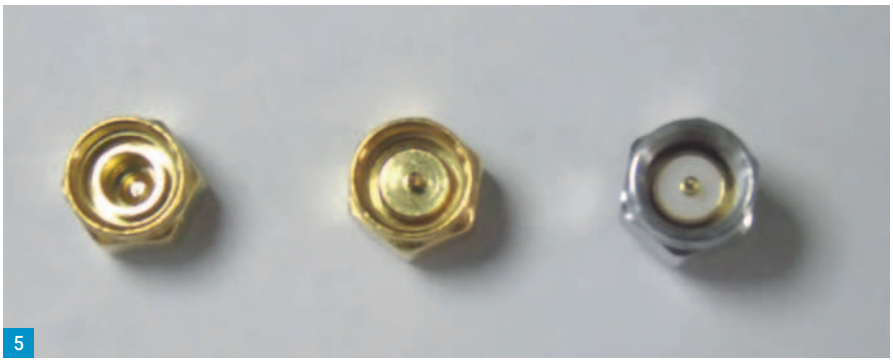
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Unscrew the open circuit load from the CH0 port, repeat the procedure for the SHORT load and then for the 50Ω LOAD, in that order, then touch DONE. This brings up the SAVE 0 – SAVE 1 – SAVE 2 – SAVE 3 – SAVE 4 – <BACK screen. Touch SAVE 0 and the settings you have just input have been saved, so (you'll be pleased to hear) you don't need to go through that rigmarole again, at least not until you want to measure antennas in a different frequency range.

Step 3: Resetting the Range

The NanoVNA is now calibrated for 1 to 30MHz and if you have an antenna such as an HF multiband vertical covering 80m to 10m, you may be tempted to go ahead and analyse the antenna right away. However, with such a wide range the eventual SWR graph displayed would consist of several very sharp 'V' shapes and it may be difficult to determine precisely the frequencies at which the SWR is at a minimum. Furthermore, with as wide a frequency range as 1 to 30MHz each spot frequency scanned will be 287kHz apart (29MHz divided by 101) and if analysing a high-*Q* antenna with sharp resonances, the NanoVNA's spot frequencies may completely miss the band, giving you the false impression that there is no resonance at all. It is easier and more accurate to analyse each frequency band individually, even for multiband antennas.

In my case the first antenna I wanted to analyse was a 40m inverted-V dipole I had recently put up, so I reset the range to 6MHz to 8MHz (remember, when calibrating the NanoVNA for 1 to 30MHz the range was set at that, so now it needs to be changed to 6 to 8MHz).

To do this, repeat the procedure in Step 2: open the Home menu, touch STIMULUS, then START and enter '6' followed by 'M', re-open the menu, and touch STOP, then '8' and 'M'.

Step 4: Setting the Scale

Now you're almost ready to look at an antenna but I'm afraid there is yet another

menu setting required before you do so. In Step 3 you set the screen's horizontal, or 'x', axis for the frequency band of the antenna you wish to analyse but you now also need to set the scale of the vertical, or 'y', axis.

There are seven horizontal lines across the screen and they can represent any interval you wish. For measuring SWR I suggest 0.2 per division, so that at the bottom of the screen the SWR is 1.0:1, the first horizontal line from the bottom would represent 1.2:1 and the top line would represent an SWR of 2.4:1.

If you do not consider this a wide enough range, you could instead input a value of, say, 1 in which case the bottom of the screen would still indicate an SWR of 1.0:1 but the first line would be 2:1 and the top line would be 8:1.

To set the interval go back again to the Home menu, touch DISPLAY and on the next screen SCALE, and then SCALE/DIV. This opens the numerical keypad from which you can enter your desired vertical interval, in this case the decimal point followed by '2' and then 'x1'.

The top left of the screen now shows the selected interval in yellow: 'CH0 SWR 200m/'.

Touching RECALL 0 from RECALL in the Home menu brings back all the above settings later if required.

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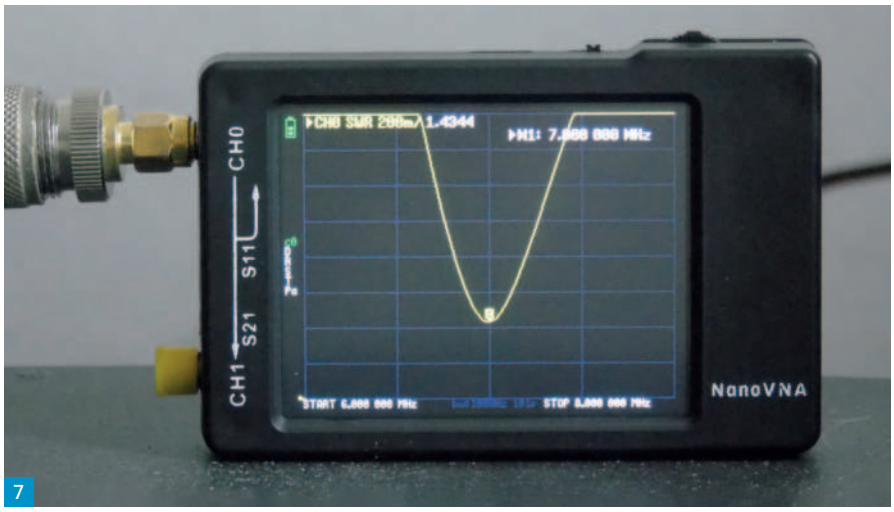

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Step 5: Measuring the Antenna

Finally, you can measure your antenna. Connect an antenna to the CH0 port on the NanoVNA. To do this you will need an adapter, such as an SO-239 to male SMA, or N-type to male SMA, and (having never used these tiny SMA connectors before) this is why I was so grateful to G3ZXZ for including an adapter when I bought the NanoVNA.

From the Home menu touch DISPLAY and, from the next screen, FORMAT and then SWR. Bingo! You will get a graph of the SWR of your antenna on the screen, **Fig. 7**. (Or, by touching SMITH instead of SWR, a Smith chart will be displayed.)

There is a Marker, M1, associated with the SWR curve, although it may be just off the edge of the screen. To display the marker, move the rocker switch to the left or right. The marker can be positioned anywhere on the SWR curve to enable you to read the minimum SWR point, the 2:1 SWR points and so on.

In my case the minimum SWR of the 40m inverted-V dipole was at exactly 7000kHz, where it was 1.43:1 and the 2:1 points were at 6760 and 7240kHz, so the antenna was good over the whole of the UK (ITU Region 1) 40m band (though it is a little too long if I want to operate right up to 7300kHz, which I am able to do here in Bonaire as we are in Region 2).

Even at HF you could probably get slightly more accurate results if you recalibrate the NanoVNA for the specific frequency band of the antenna you wish to analyse. However, I have found there is little or no difference to the results obtained when calibrated between 1MHz and 30MHz and when calibrated for the specific band being analysed.

Summing Up

All the above may sound overly complicated for what is actually rather a simple measurement. But bear in mind that if you are only using the NanoVNA for measuring SWR, most users will only need to go through the calibration process occasionally and will not need to change the vertical interval on the 'y' axis. It is then just a matter of entering the START and STOP frequencies for the particular antenna you wish to analyse.

So why pay over £200 (or up to almost £850) for an antenna analyser when you could buy a NanoVNA for £50? For most amateurs I would suggest the main answer to that question would be 'ease of use', but for the budget-conscious the NanoVNA will do the same job.

Yes, it's a bit more fiddly to use, but when you have demystified its workings you will also find that the NanoVNA is capable of doing so much more than just measuring SWR.

References

[1] mirfield-electronics.co.uk
[2] *NanoVNA*, review by Don Field G3XTT, *PW* July 2020, pp10-11.
[3] *NanoVNA: Can You live without One?* Michael Jones GW7BBY, *PW* May 2021, pp42-45.

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

An 80m to 40m AM Receiver

Eric Edwards GW8LJJ describes the build of a single conversion AM receiver for 80 through 40m.

This is a single conversion (455kHz IF) receiver covering from 3MHz to 8MHz in one continuous tuning. It covers the 80m, 60m and 40m bands and all in between and a bit over on both sides so that interesting continental broadcast stations transmitting AM (Amplitude Modulation) on the 'short wave band' can be listened to. The main component is a car radio chip (integrated circuit) TDA1072A, and although considered obsolete I have a large stock for all that want to build this project. This integrated circuit (IC) contains all the circuitry from the bandpass filter (BPF) input to the audio stage. It has its own internal oscillator but an external one is used in this project to allow more flexibility.

Image Signals

Using a low IF (intermediate frequency) can present problems because of the close proximity of the second channel (image signal) so when, say, a signal is wanted at 7MHz the local oscillator (LO) can be above or below the wanted received signal and as the IF used here is 455kHz the LO is either 6.545MHz (lower) or 7.455MHz (higher). Let's take it as being lower for the first example. Any signal that is 455kHz away from the LO will produce an IF of that frequency. 7MHz is 455kHz away but so is 6.09MHz (6.545MHz – 6.09MHz = 455kHz). If the LO is above the wanted signal, which at 7MHz will be 7.455MHz, a signal at 7.91MHz (i.e. 7.91 – 7.455MHz) could also be heard. Placing the LO lower or higher than the wanted off-air signal will depend on the possibility of any unwanted (image frequency) signals interfering. One way to avoid this is by using a higher IF so the image frequency will be out of the range of the BPF and the other way is to use a BPF that has a narrow response so anything outside the filter will be rejected or greatly attenuated. In this project the higher LO is used but the user can tune the LO so that it is below the wanted signal if there are strong image signals when using the higher LO frequency. Both were tried in the prototype and providing the BPF is adjusted for the correct band/frequency, no image signals were evident. It is prudent to use an ATU as well although the tests carried out were using a doublet antenna resonant at 3.6MHz without an ATU in circuit. An ATU could be an advantage in some areas.

While the 40m (7MHz) band is not normally considered suitable with receivers of low intermediate frequencies (IF), in this receiver project, the bandpass filter (BPF) is also tuneable so the required signals can be peaked and the unwanted (image) signals (if any) are rejected or greatly attenuated. The BPF and LO use variable capacitors but unlike the radios of yesteryear these are of the 'polycon' type, which are much smaller and readily available at the time of writing. Newer designs using variable capacitance diodes (Varicaps) could have been used but it was considered that using the polycons kept the design to the more conventional type.

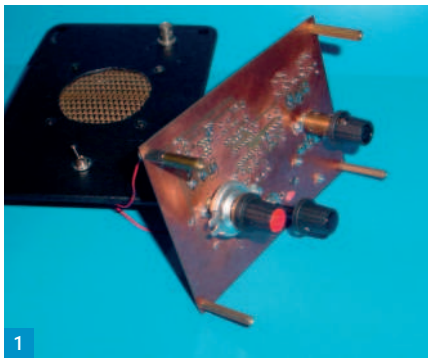

1

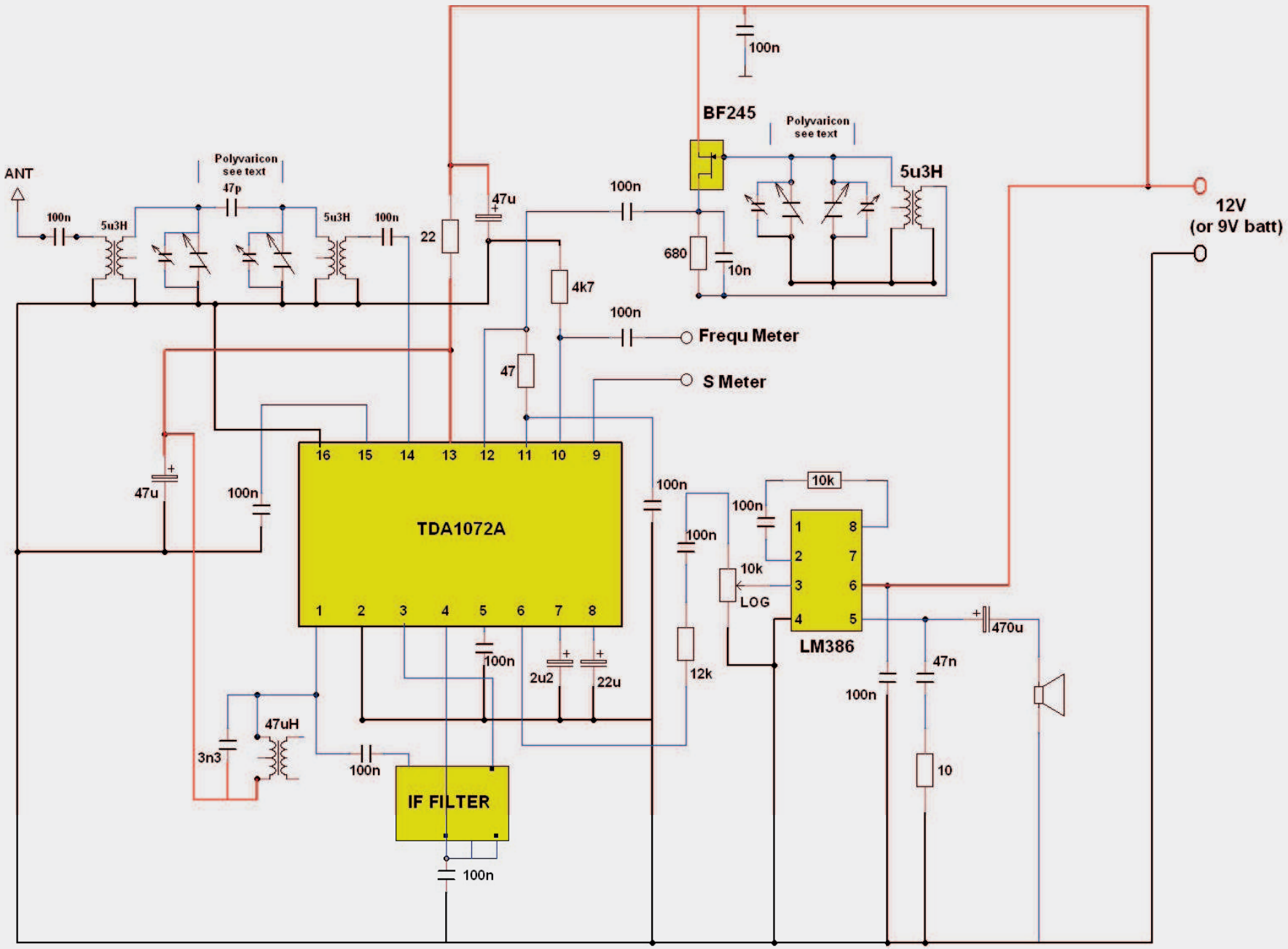
Fig. 1: Slow motion tuning drive. Fig. 2: Circuit diagram. Fig. 3: PCB (not to size). Fig. 4: Components mounted on the PCB. Fig. 5: PCB links to allow reversal of connections to oscillator transformer. Fig. 6: Cabinet holes to cater for the main controls. Fig. 7: Slow motion drive. Fig. 8: Or an alternative slow-motion drive – more retro. Fig. 9: A selection of frequency displays. Fig. 10: Battery holder fitted to the PCB.

Sensitivity and Gain

This receiver can resolve signals at around 1µV so weak stations can be heard subject to the local noise. The full output (audio) level is quite high such that it enables your neighbours to listen in as well! So, it will be prudent to keep the volume control setting low for normal 'armchair' listening.

To BFO or not to BFO

It was decided to keep this project as an AM receiver mainly because a wide tuning range is employed and without a very slow-motion dial (reduced gearing) it will be difficult to tune and lock onto a narrow signal such as CW. With AM this is not as difficult because of the wider bandwidth of the received signal so that if the tuning drifts or is off tune by a


ANT
100n
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Polyvaricon
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12V
(or 9V batt)
680
10n
4k7
100n
Frequ Meter
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S Meter
47u
100n
TDA1072A
16 15 14 13 12 11 10 9
1 2 3 4 5 6 7 8
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22u
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LM386
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IF FILTER
100n

few hertz, the station can still be resolved. A BFO was tried by loose coupling of the oscillator to the IF in the receiver. SSB stations were resolved but careful tuning was needed.

If a lower geared drive was used to have better control over the main tuning, then it would not have been quite so critical. Ideally, to use a BFO (or product detector) either a much narrower tuning such as 7.00MHz to 7.3MHz with a low geared tuning drive, or better still, a very stable LO such as provided with DDS (Direct Digital Synthesiser) or Arduino based modules.

A suggested slow tuning drive for AM is shown at **Fig. 1**. The left-hand control is the main tuning with a drive fitted to the spindle of a polycon tuning unit and the right-hand control is the variable bandpass filter or pre-selector as it was once called in early superhet receivers. It has a coupler fitted to another polycon unit to allow an extended spindle to be attached.

The Circuit

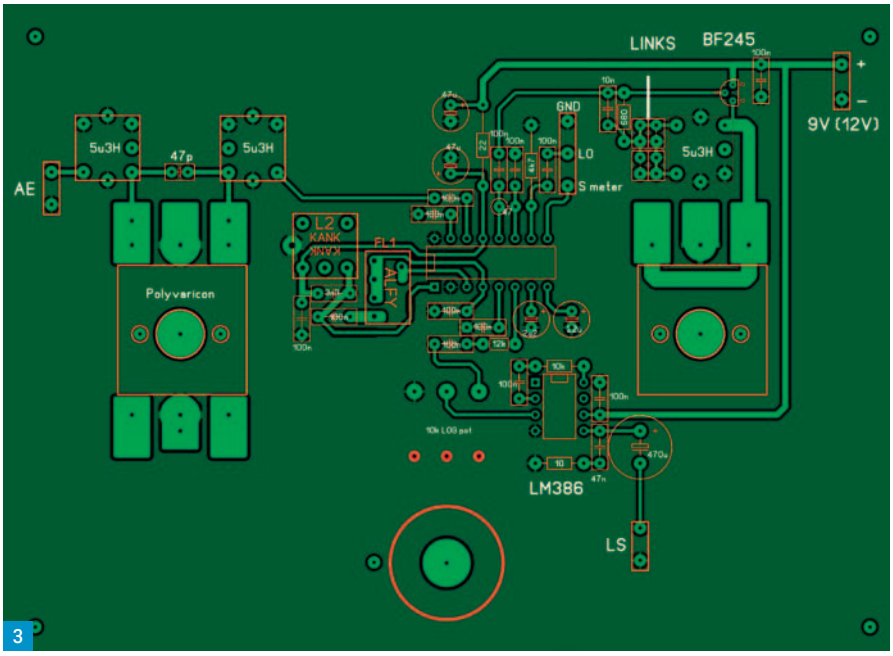
The circuit, **Fig. 2**, is built around a very sensitive and stable car radio receiver integrated circuit (IC). The antenna (AE) is connected to a variable BPF that is tuned with a polycon unit. This is a twin variable capacitor (gang capacitor) with internal presets. Two are used in this design, one with capacitor values 280pF + 280pF with 24pF across each 280pF section. The other one has capacitor values of 160pF + 65pF with 15pF trimmers across each main capacitor.

The one used in the BPF is the larger of the two (280 + 280). The other parts of the filter are two 5u3H (5.3µH) transformers and a 47pF capacitor. The BPF is connected to pin 14 of the TDA1072A via a 100nF coupling capacitor.

The LO comprises a JFET (junction FET) type BF245 and a 5.3µH transformer with the secondary connected in a positive feedback network. The secondary has to be connected the correct way for the positive feedback to be applied and for some reason the wiring on these coils varies in the phasing from one coil to another so links have been supplied on the PCB such that the correct phase relationship is attained between the primary and secondary windings. The oscillator variable capacitor (polycon) uses the smaller of the two types (160pF + 65pF).

The IF is at 455kHz and uses an LT455HTW 6-element ceramic filter. This has a centre frequency of 455±1 and an input and output impedance of 2kΩ. This is very good for amateur AM signals and resolving shortwave broadcast stations.

The demodulated signal at pin 6 of the TDA1072A (AF pre-amp) is connected to a popular LM386 IC that provides strong output levels using an 8Ω speaker.



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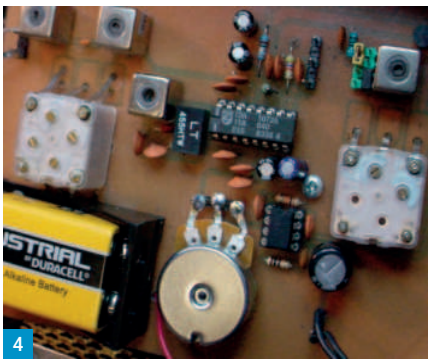
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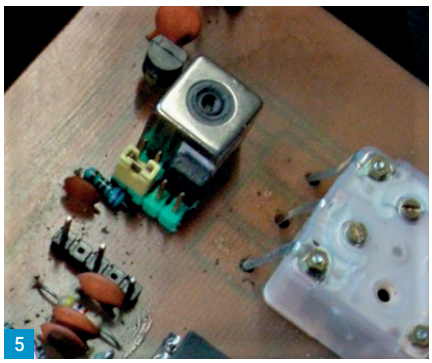
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The PCB

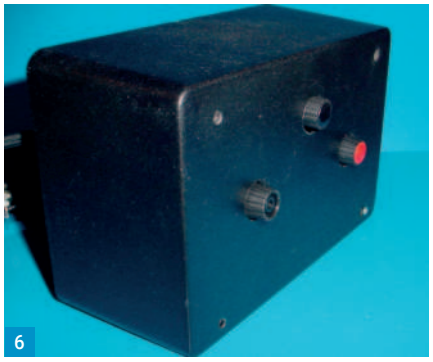
The PCB, **Fig. 3**, is an FR4 type and is single-sided with tracks surrounded by a groundplane. The polycons and volume control are mounted on the board **Fig. 4**. The volume control tabs are soldered onto pins on the board and secured with the nut on the spindle of the control. The polycons are fitted as shown and the screws supplied with them are to be fitted with the nuts as spacers and screwed lightly so as not to protrude onto the plates of the capacitor. They are not essential for securing the polycons as these are secured with their tabs soldered onto the PCB. As mentioned in the 'circuit' paragraph, the secondary of the oscillator transformer must have the correct phasing relationship so links are provided on the PCB to allow for this, **Fig. 5**. The prototype shows the yellow linked on the left-hand pins at the top and black linked at the bottom on the right-hand pins. If the circuit does not oscillate and you have checked your wiring, the linking tabs can be reversed so that the yellow is on the right-hand side of the top pins and the black on the left-hand pins on the bottom row.

The PCB has been cleaned but it will be good practice to clean it before soldering with a PCB scrubbing block or similar. Please **do not** use unleaded solder on the PCB when fitting the parts.

The Controls

The control knobs on the prototype are fitted before placing in the housing (cabinet) as seen in Fig. 1 and the cabinet has holes cut out to allow the control knobs to push through, **Fig. 6**. You may have better methods and maybe extend the spindles on the two polycons and volume control to allow placing the control knobs outside the cabinet.

The slow-motion drive can also be as in **Fig. 7**, or if you want to go really 'retro' then perhaps **Fig. 8** will be your choice!



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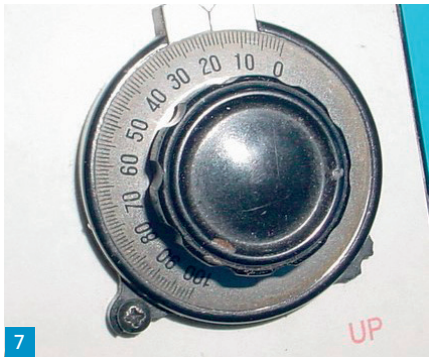

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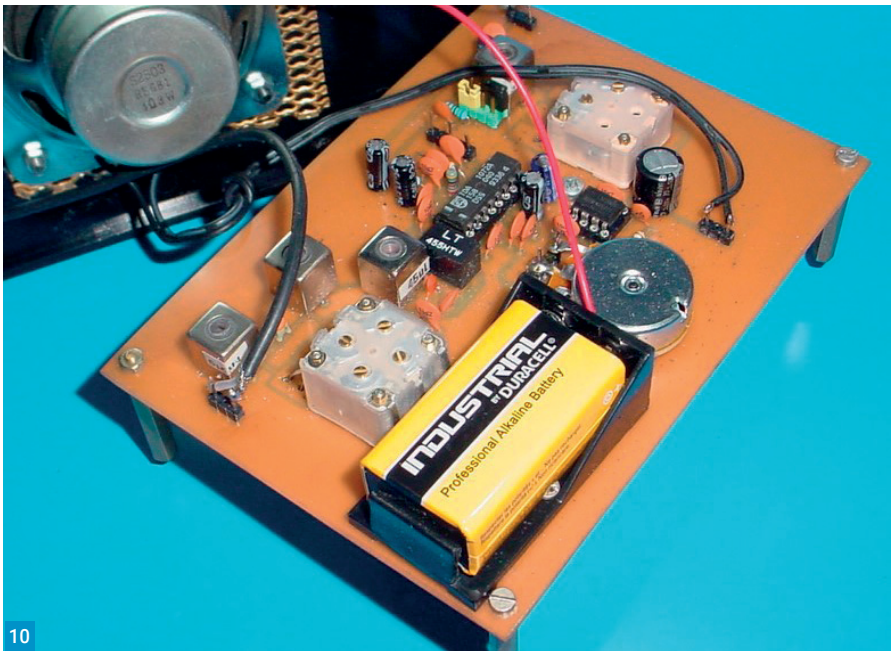

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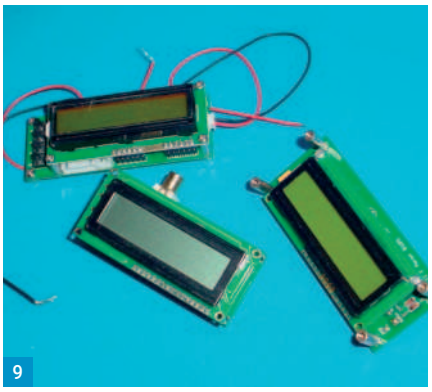

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Alignment

There is not much alignment to carry out but the LO band edges need to be set along with the BPF bandspread. To align the LO, a frequency counter can be connected to pin10 on the TDA1072A via a coupling capacitor. There is a set of three pins on the PCB. One is ground, another is the frequency counter and the third is for an 'S' meter if needed.

The frequency counter will show the LO frequency and to align the receiver the IF must be taken into account. If a high LO is used as in the prototype, this must be taken away from the LO frequency shown on the counter.

When setting the bottom end of the band, which is 3MHz on the prototype, the counter will display 3.455MHz. Similarly, when setting the top end of the band, say 8MHz, the counter will read 8.455MHz. There are (signal) frequency meters available that allow setting of different IFs so the meter can show the received off-air frequency **Fig. 9**. To set up the bottom end of the bands (3MHz), turn the main tuning polycon anticlockwise and adjust the core of the oscillator coil until 3.455MHz is seen on the frequency counter.

Turn the polycon clockwise and set the core in the oscillator coil until 8.455MHz is seen on the counter. Go back again and repeat until there is 3.455MHz at the bottom end and 8MHz at the top end of the band. These frequencies may not be exactly as stated but can be set to near at both ends.

Once the band edges are set up, the bandpass filters can be set by using a signal generator set to the same frequency as the LO minus the IF (455kHz) or simply by receiving an off-air signal set at 3MHz or at the same frequency as the oscillator is set for the bottom of the band.

With an antenna connected, turn the polycon BPF (pre-select) anticlockwise and adjust the cores of the two bandpass coils (transformers) until a signal is heard in the speaker (use a modulated signal if a signal generator is used). Adjust for maximum signal strength. Turn the polycon fully clockwise and set the signal generator to the same LO used at the top end of the band less 455kHz or set the receiver to 8MHz or whatever the top of the band LO frequency is set to (less 455kHz).

Adjust the BPF coils again for maximum signal at that frequency. Repeat this adjustment until the signal strengths at both ends of the band are as strong as it gets. If necessary, do this several times, until maximum gain is achieved all across the bands. The IF transformer can finally be adjusted for overall maximum gain.

Note: when adjusting the transformer cores use a non-metallic trimming tool so as not to damage the brittle iron cores. With no antenna fitted and the receiver powered from 12V or 9V as can be seen, a battery holder can be fitted on the PCB, **Fig. 10**, there will be no output noise (hiss) from the speaker but be aware when connecting the antenna to keep the volume at low level otherwise the wax in your ears may fly out!

Is there a Kit?

As per normal with my project designs, I am offering a 'picking list' so that some or all of the parts as fitted onto the PCB can be chosen.

References

TDA1072a datasheet.
www.s9plus.com (RAT5 receiver)
Acknowledgement to **Ray G7BHQ** for checking over the text and correcting any silly mistakes!

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk

More on SDR-Console

Mike Richards G4WNC has a mixed bag of goodies for readers, but begins by finishing off the signal analysis tools in Simon Brown's SDR-Console.

Last month I showed you how to make spectrum recordings as the first analysis stage. Once you have the recordings, SDR-Console's powerful playback tools let you play back the spectrum so you can home-in on the area of interest. From that point, you can use the data editor tool to extract a narrower slice of the recorded spectrum. Not only does this make analysis more accessible, but it will significantly reduce the file size, so the next stage of analysis will be much quicker. With the smaller file, you can use the playback tool to loop over specific sections of interest. When analysing signals, we often want to know how the signal level changes over time. This can be particularly useful if you're going to monitor a beacon or other continuously transmitting station to see how a path changes over time.

SDR Console has another tool available that greatly simplifies that task. The Signal History can be found on the View tab in the Spectrum section. When selected, you will see the Signal History panel, **Fig. 1**. The Signal History operates by storing the signal level of the currently tuned signal in a memory buffer. This data is stored in standard CSV (Comma Separated Values) format that can be imported and analysed by most spreadsheet software. The recorded data is initially held in a memory buffer so it can be saved to a file at the end of the recording. One of the surprising features of the Signal History is the recording detail. The default setting records the signal level every 50ms, so there's a lot of data available. You need to be careful when setting this sample rate as you could end up with a massive data file. For example, I did a 24-hour recording with 50ms samples and the resulting CSV file had just over 1.5 million lines of data! I was able to process the file in QtiPlot, but 1.5 million lines is way more data than Excel can handle.

Before starting the Signal History, you need to click the lower of the three icons in the top-left of the panel. This opens the Configuration panel, **Fig. 2**, where you can set the size of the recording buffer plus the speed and whether to include the noise floor in the data set. The Export section, **Fig. 3**, is used at the end of the recording to select the data format and the file name. Once the recording has been completed, you return here and click the Export button to send the data from the memory buffer to the selected file. I've shown an example of the data format in **Fig. 4**. Once you have the data, you can use your favourite spreadsheet software to plot the results. While you can process the data with Excel, I prefer to use QtiPlot as it is particularly good with very large data files, and I find it easier to customise. QtiPlot is available as a free trial from the website below, while the full individual license is €19.90.

www.qtiplot.com/index.html

Here's a step-by-step guide to displaying signal history in Excel:

- Double-click on the signal history data file to open the file in Excel
- Delete the header lines (should be 14 lines) so the first line (A1) shows Time
- Click on cell A1 to select it
- Use the scroll bar to scroll to the end of the file
- Press and hold the Shift key and click the last cell on column B
- Select the Insert tab on Excel and click Recommended Charts
- You will see a selection of charts of which the Line chart is likely to give the clearest display
- Click the Line chart followed by OK and position the chart as desired.
- Here's how to do the same thing in QtiPlot:
- Open QtiPlot
- Select File – Import ASCII…
- Format should be set to Comma Separated Values
- Click the folder icon to the right of the Name field and navigate to your CSV recording
- You should see that it automatically skips the header information and gives you a preview of the recorded data
- Click OK to import the data into a new table
- Next, we select the columns to plot
- Click on Time to select that column then hold Shift and click on the Level column to select it
- To display a graph of the data, go to the Plot menu at the top and select Line – Line
- You will now have a line graph of the data
- To customise the plot, right-click inside the chart and choose Properties
- This gives access to a huge range of customisations to change the displayed format
- To change the size of the chart, choose Properties – Geometry and alter the width and height to suit

Once you've captured the data there is a wealth of processing tools you can use to analyse the data. I've shown a simple example in **Fig. 5**, where I've recorded the signal history from the 9.96MHz standard frequency transmission over a 24-hour period. As I mentioned earlier that produced a 1.5-million-line table. To make the plot easier to interpret, I applied FFT smoothing with 2000 points in QtiPlot. This makes the chart more readable yet still reveals the signal strength patterns during the period. The propagation variation with sunrise and sunset is clearly demonstrated.

Here's a quick guide on applying FFT smoothing to a graph:

- Create your graph as explained earlier
- Click on the graph and go to the top menu and choose – Analyze – Smooth – FFT Filter
- That will open the smoothing options box.
- In this panel, you can experiment with values in the Points box to get the desired smoothing.
- After you enter a number, click the Smooth button to see a preview.
- Increasing the number in the Smooth box will increase the smoothing effect.
- To control the displayed curves, right-click on a blank area of the graph and choose properties.
- You will see all the available curves listed and you control them with the tick box.

If you enjoy this type of signal analysis, **Nils Schiffhauer DK8OK has** written an excellent paper that can be downloaded from here:

https://tinyurl.com/kbxrmhu3

Raspberry Pi OS – Now 64-bit

After a year in beta, the Raspberry Pi team have formally launched the 64-bit version of their Raspberry Pi operating system. Closely based on the main Debian Linux release, the new 64-bit version enables full access to the 8GB of RAM as well as some performance increases when using 64-bit software. The new 64-bit OS can be run on the following

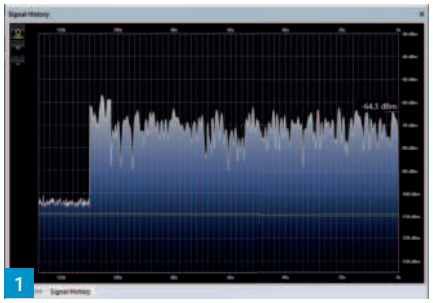
Pi models: Pi Zero-2, Pi-3, Pi-4 and Pi-400. I have been busy updating my pre-formatted cards and the DataModes and Spy Server cards should be ready by the time you read this. If you want to try the new OS, it's available as a free download from the Raspberry Pi site. Just one point to note, you can't upgrade an existing 32-bit OS to 64-bit, you must start afresh. My pre-loaded cards can be found here:
https://g4wnc.com/shop-2

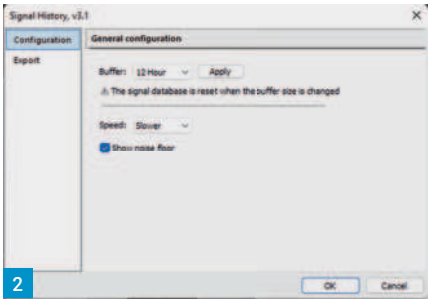
RadioBerry Update

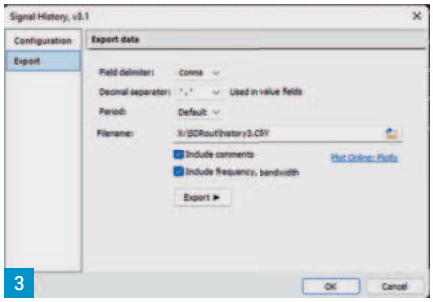
Regular readers will know I've been following the development of this project for a couple of years. The RadioBerry is derived from the Hermes Lite transceiver project, which is itself based on the Hermes single-board SDR transceiver that formed the basis of the Apache Labs ANAN range of commercial units. That's quite a pedigree but the difference with the Hermes and RadioBerry is the use of a cable modem chip to provide the ADC and DAC functions. This considerably reduces the cost and, when available, you can buy the Hermes-Lite-2 mainboard assembled for around £250.

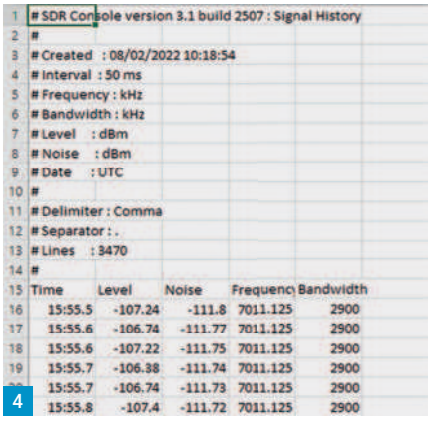
The RadioBerry project aimed to further reduce the size and cost of the Hermes-lite by using a Raspberry Pi to provide the processing power and the Ethernet connection. This worked well and sits neatly on top of the Pi. The only snag with the original RadioBerry was its output of just a few milliwatts and the requirement for an external Tx/Rx switch. The author **Johan Maas PA3GSB** soon solved that with the development of what is known as the Preamp board. This is a very neat board that sits on top of the RadioBerry, provides a power supply for the whole system and includes the logic to drive a Tx/Rx relay as well as the 5W HF PA design from the Hemes-Lite-2. The only extra required is some transmit filtering. However, that can be handled by using the N2ADR filter board that's currently available from MakerFabs for about £40.

While this would have been a neat end to the project, Johan has continued development and has recently introduced the 'Juice' board. This has been designed to remove the dependency on the Raspberry Pi and open up the design for use with other, more powerful, computers, **Fig. 6**. The Juice board is built around the FT2232H USB chip that provides a high-speed link to send and receive IQ samples from the transceiver software. In addition to the IQ samples, the Juice board has to load the FPGA with its gateware and run an SPI link for general control of the rig. The Juice board is still a work in progress but recently Johan had a few built and I was able to buy one of those. Although there is still work to do, the combination is compact and works very well. See **Fig. 7**.









	Time	Level	Noise	Frequency	Bandwidth
16	15:55.5	-107.24	-111.8	7011.125	2900
17	15:55.6	-106.74	-111.77	7011.125	2900
18	15:55.6	-107.22	-111.75	7011.125	2900
19	15:55.7	-106.38	-111.74	7011.125	2900
	15:55.7	-106.74	-111.73	7011.125	2900
	15:55.8	-107.4	-111.72	7011.125	2900

Fig. 1: SDR-Console Signal History panel.
Fig. 2: Signal History configuration.
Fig. 3: Signal History Export panel.

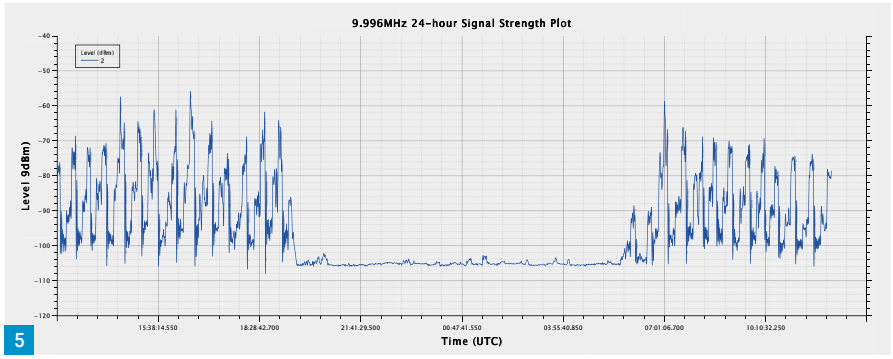
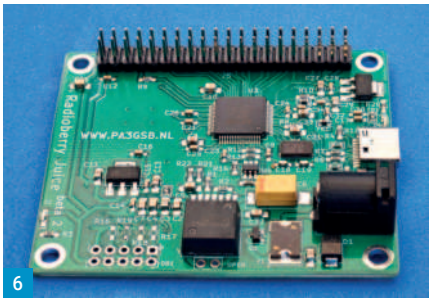
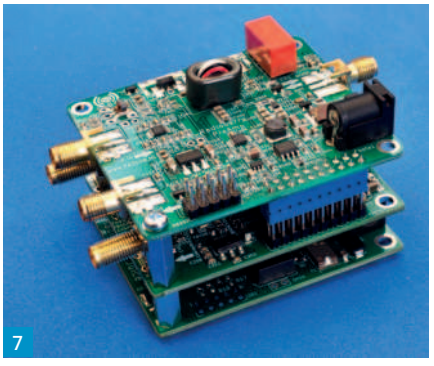


Fig. 4: Example of the Signal History data format.
Fig. 5: A 24-hour signal strength plot of the standard frequency signal on 9.996MHz.
Fig. 6: The new Radioberry Juice board.
Fig. 7: Radioberry, Juice board and Pre-amp make a very compact stack.





Neither the Preamp or Juice board are available from MakerFabs, but Johan and others in the RadioBerry group often run a group buy for assembled board and this is the best way to get into this project. As this is an open-source project, full details are available on the GitHub site at:
https://tinyurl.com/2p8wruhk

You should also join their Google Group at:
https://tinyurl.com/3y35yps7

You can find additional information on Johan's site at:
www.pa3gsb.nl

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

Propagation Gets Better

Steve Telenius-Lowe PJ4DX has plenty of HF news as band conditions continue to improve.

We are now seeing a definite upward trend in the solar flux and sunspot number month by month and, with them, a welcome improvement in propagation on the higher HF bands such as 24 and 28MHz. However, although several people have commented to me that *"10 metres is wide open"*, I would beg to differ. When 10m is 'wide open' we should be seeing both short path and long path openings from the UK into Hawaii and the South Pacific and that has not happened yet, despite more frequent openings to Australia and occasionally also to New Zealand. The solar flux was around 125 in early February and the sunspot number was up to 120 but both fell back a little by this column's deadline on 11 February, as shown in **Table 1**.

Transatlantic QSO Party

I was pleased to be able to download a certificate, **Fig. 1**, for making a 1.8MHz CW contact with GB2ZE on 12 December last year, the exact 100th anniversary of the reception of the first amateur transatlantic signals. If you made a QSO with GB2ZE or W1AW during the Transatlantic Centenary QSO Party, you can download a PDF certificate from:
contests.arrl.org/transatlantic2021.php

Queen's Platinum Jubilee

To celebrate the Platinum Jubilee of Her Majesty the Queen Ofcom has granted permission for all UK radio amateurs to use the special regional secondary locator (RSL) 'Q' during the month of June 2022. The change of callsign will require a Notice of Variation: an application form is available on the RSGB's website. Stations in England should add Q to their prefix, i.e. GQ, MQ or 2Q, whereas stations in other parts of the UK and Crown Dependencies should substitute their normal regional locator with Q, e.g. GM would become GQ, MW would become MQ and 2I stations would become 2Q.

Amateurs may also use the suffix /70 instead of, or as well as, the GQ/MQ/2Q prefix if desired.

DXpedition News

Members of the Perseverance DX Group (PDXG) will operate as TX5N from Raivavae in the Austral Islands (French Polynesia) for 12 days between 15 and 29 April. The team expects to make between 60,000 and 80,000 QSOs. The QSL Manager is **Tim Beaumont M0URX**. For the team's QSLing policy see their website: tx5n.net

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Readers' News

Carl Gorse 2E0HPI sent in two reports this month. He had a busy month in January with a move of location to a new flat, from where he operates with a vertical on his balcony, and plenty of portable operation. *"Most stations I work are repeat chasers for WWFF and CQGMA etc. I'm going to start using 17m to 10m more next month as it seems it's starting to open up quite nicely. On average I'm getting around 50 to 120 QSOs each trip."* One location Carl operated from using his new Icom IC-705 was the site of a WWII radar station, **Fig. 2**, near Ravenscar in North Yorkshire, which counts as GFF-0500 for the WWFF awards programme.

Later, Carl wrote *"I've been out on the Northumberland Coast using the Yaesu FT-891 at 50W and managed quite a few on 17m and 20m with the vertical. I had a good run on two activations with 165 QSOs and 142 QSOs over the two days. I'm looking at going out more early mornings and on an evening to hopefully get more DX."*

Steph Foster G4XKH contacted us to say that the Riviera Amateur Radio Club in Torquay will be operating as GB8AOA for the RAF Airfields on the Air event on 9 April.

Etienne Vrebos OS8D achieved the UBA 75 Platinum Award, **Fig. 3**, for working 50 ON75 special event stations commemorating the 75th anniversary of the founding of UBA, the Belgian national amateur radio society. As Etienne says, *"It's really very hard to get a QSO made in a neighbourhood of 100km. It was much easier to get over 100 Russian Districts from far east Vladivostok to nearby Moscow all with decent 59, but Belgians were 33, most even lower. 80m was the only band with nice signals... I really like working by coincidence or luck... I have a very good friend in Scotland, **David 2M1DWK**, and believe it or not we always meet by coincidence on one or another HF bands.*

"I'm starting a new award, the Russian RDA, districts/oblasts. It seems easy but the language problem is a reality. I already have 275 districts of the 2700 to reach... I discovered I worked Sakhalin Island without even knowing it and some extremely small icy islands in the Arctic Ocean."

Kevin Hewitt ZB2GI once again operated from several locations this month – his home station, the GARS club station and portable from Princess Anne's Battery at the north end of the Rock, along with **John King ZB2JK**, **Fig. 4**. They used a uSDR transceiver, powered by eight AA alkaline batteries to a 5m telescopic whip antenna connected via a 9:1 balun. From Kevin's home station one noteworthy QSO on 30m FT8 was with **Joe Taylor K1JT** – the man who released FT8 on to an unsuspecting world back in 2017!

Victor Brand G3JNB reports hearing DS3EXX and thinking *"What a great improvement in propagation! On 15m, I managed to work **Gilbert ZD7BG** St Helena and, on 3rd January, a South American 'triple' on 17m with **Wald XQ6CF** on the Pacific coast of Chile, CX2DK Uruguay and PZ5RA Suriname. Next day, Wald logged in again on 15m and, on 20m, both PJ2/NA2U and PJ2ND Curacao. Then the sunspots subsided, DX propagation collapsed and it went awfully quiet for a few days until I worked regulars TZ4AM, 5Z4VJ and CO8LY on 17m plus JH1GEX on 20m, hopefully heralding better conditions.*

*"Highlights of my January included working **Nigel G3TXF/OE5TXF** on 40m from his home in Austria and, following*

Fig. 1: Certificate for making a transatlantic 1.8MHz CW contact with Scotland, exactly 100 years after the reception of the first amateur transatlantic signals. Fig. 2: Carl 2E0HPI/P operating from the site of a WWII radar station near Ravenscar, North Yorkshire.
Fig. 3: UBA 75 Platinum Award, issued to Etienne OS8D. Fig. 4: One of the 'big guns'? John King ZB2JK operating from Princess Anne's Battery (photo: Kev ZB2GI). Fig. 5: The teenage Victor G3JNB and SWL Brian A2388 (now 9J2BO) circa 1952, both using National HRO receivers.
Fig. 6: Carl GW0VSW achieved this award using QRPp power levels.


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a 10-year gap, ***Brian 9J2BO*** *in Zambia, a splendid signal on 15m. As teenagers we were both HRO men* (**Fig. 5**)*! After a three-year absence, it was good to get through on 17m to* ***Chad JT1CO*** *Mongolia. Four excellent 15m contacts with XQ6CF Chile,* ***Robert 3B9FR*** *on Rodrigues Island plus his 'neighbours'* ***Alain 5R8AL*** *Madagascar and FR4KR Reunion Island (also 10m!) were gratifying. On 20m, both DXpeditions to Guadeloupe was bagged by working TO6S and FG/F5HRY.* ***Ed CX5FK*** *Uruguay also popped up on 17 and promptly logged. As the slogan once promised us… 'We're getting there!'"*

Neil Clarke G0CAS provided his regular 28MHz beacon report*: "The regular but short-lived winter Sporadic E season was very poor during January but small localised openings did take place* [on 2, 9, 20 and 22 January – **Ed**]*... F2 layer propagation proved a lot more exciting with the Turkish beacon YM7TEN 28225 heard on 15 days of the month, all during the morning period, while 4X6TU 28200 was heard on 27 days during the month again during the morning but also into the afternoon on some days. Still on 28200 all three of the South American beacons, LU4AA, OA4B and YV5B were heard at the same time during the afternoon of the 29th. From Australia during the morning VK6RBP 28200 and VK8VF 28268 were logged… towards the end of the month."*

Jim Bovill PA3FDR says he *"somehow managed to miss the December deadline, although to be honest there were few good DX [stations] for most of the month. Fortunately, things improved for most of January."* The best of Jim's log is in 'Around the Bands'.

Tony Usher G4HZW reported that *"Since my last update the SFI has continued to rise, with the exception of a quieter period in mid-January. Highlight was exchanging signal reports with ZL4AS on 31 January, although we didn't manage to swap 73s so that's a bit frustrating as it was my first 28MHz contact [with ZL] of cycle 25. XV1X was a new country, JS6TKY was my only JA, he's on Yaeyama Island, the western-most point of Japan and YO4RYU/MM was east of the Philippines."*

Tim Kirby GW4VXE says *"I tend to have the rig on 10m CW when I'm in the shack so just watch what comes and goes. FY5KE has been very active on CW and I was pleased to exchange reports on a number of days in late January. The highlight of my 10m operating was working* ***Stuie VK8NSB*** *on 30 January, using the GW4MM call. Reading through Stuie's QRZ page, I spotted that he'd stayed with* ***Rob MW0RLJ*** *who lives just a mile or so from here. I dropped Stuie an email telling him where I was and he very quickly replied suggesting we try another QSO the following day, which we completed easily. 31 January was a good day, with QSOs with VK8NSB, EA8CN, XQ6CF, LU7HN, ZF2OO and W3IL. PZ5KV (DL6KVA on his travels) was a nice one on 3 February. Axel was very active during*

	Feb '22	Aug '21	Feb '21	Difference
SFI:	118	72	72	(+46)
SN:	78	0	0	(+78)

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.

the FOC Marathon event the following weekend. Also worked on the 3rd were CX5FK, LU7HN and PY4HGM. The 4th was good too, with QSOs with 4L8A, HC5AI, 9Z4Y and AC4TO. Although I tend not to get involved with pileups these days, I did work TU5PCT on the 6th, but that and calling Z21A put me off for a few days! Enthusiasm returned on 10 February for a QSO with CE3CT. The period just before sunset usually proves quite productive and I often hear PYs calling CQ – sometimes they hear European stations, sometimes not! It's really great to hear 10m opening on a regular basis now."

Carl Mason GW0VSW says *"I decided to remain at 1W for both CW and SSB this month and see what could be logged with my modest station. The antenna, a folded G5RV inverted about 8m high and folded to fit alongside my house. It cost next to nothing to make and so far I have been very pleased with it. I actually broke a few pile-ups which was quiet satisfying with just QRPp. It was nice to work SSB and log some special events and several operators commented on the strength of the signal. Most were running 100W plus! To date I have worked 29 DXCC entities since 1 January. Not bad with such low power."* Carl qualified for the World Radio Team Championship (WRTC) 2022 award, **Fig. 6**, for working the special event stations set up to promote the World Radio Team Championship, which is scheduled to be held in Italy in July this year.

Owen Williams G0PHY wrote that, like Carl and Etienne, *"I've been chasing the Italian SES for the World Radio Team Championships and also the Belgium ON75 stations celebrating 75 years of the UBA. The only DX worked was the French IOTA DXpedition to NA-114 Les Saintes, Guadeloupe. 10m was open to South and Central America for a couple of afternoons with stations heard in CX and FY and I'll claim a QSO with V31XX but I'm not 100% sure I got through. TU5PCT has been heard on 14, 21, 24 and 28MHz. Apart from 14MHz the signals have been weak at this QTH considering the relatively high SFI; but yesterday evening they were a genuine 59 on 14MHz. I've not cracked the pile-ups yet but there are a couple of days to go."*

Around the Bands

Carl 2E0HPI: 7MHz SSB: G4YBU/P (G/SE-002). **14MHz SSB:** 4Z4DX, 9Z4FE, K2TRD, KD1CT, VA1SEA, VE3EXY, VE9MY. **18MHz SSB:** 4L4GB, KG8P, LZ290WA, S55G/P (S5FF-0202). **21MHz SSB:** US4IQS.

Etienne OS8D 14MHz SSB: 3B9FR, FM8QR, S79VU, VK3OCD **18MHz SSB:** V31XX, VP8LP. **21MHz SSB:** 9Z4FE, BG0CAB, CO8LY, EX2V, FK4QX, FM4SA, FY5KE, JA3MIX, JR6RHF, KP4DO, LU1JHD, PJ2MAN, TI2CC, TO6S (Guadeloupe), V31XX, V55Y, ZF2PG, ZL2SP. **24MHz SSB:** CO8LY, CX7SS, FM5DN, VK2BY, VP2ETE, ZF2OO. **28MHz SSB:** 4L8A, 8P6CH, CE8EIO, CX1JK, LU1JHD, VK2HJ, VK2LX, ZD7FT.

Kevin ZB2GI & ZB2GI/P: 5MHz FT8: 4Z1KD, 5B4ALJ, ON75GTM. **7MHz FT4:** HZ1CY, K3MM, KC2YIL, KE8NQL, SV5SKD, W1OP, WE9V. **10MHz FT8:** 4X4MF, 8P6BC, AI2N, CO6HLP, EA8RS, K1JT, K9ZBU, KN4LYF, N3VA, PY2IQ, T77BL, VA2QA, VE1HQ, W7DO. **14MHz SSB:** CT3FE, ON75HCC, OZ50Q, PV8AL, PY6HD, VK3MO, W2RE, YB7TUU. **18MHz SSB:** TA2LG, WP3ZN. **21MHz FT8:** AA5AM, N7NF, OD5ZZ, PY2YS, TA2FM, WA3OFR, YD3DCZ. **24MHz FT8:** AC0B, HI3CMQ, K1DJ, K2TQC, K3QIA, KC9K, KI8JP, N4WJQ, N5OK, NM6V, OZ50DDXG, PU2MBO, VA2KS, VA3MO, W0FK. **28MHz FT8:** 5B4ALJ, K4FW, K5OMC, KA1YQC, N2LD, N7BD, NP2SS, PY2DCA, V51MA, W3RW, W9PDS, ZS6BJU.

Jim PA3FDR: 7MHz FT8: CN8DN, CO8MCL, EA9ACE, KP2B, KW4SP, V31MA. **14MHz FT8:** BH4QBV, J69DS, JA7HRM, JE2BSJ, HL2EO, HL3IUA, NF3R, PU2PX, S01WS, UA0QNE, UN30RK, VE1JBC. **21MHz FT8:** 7Z1WW, A41CK, A61QQ, A71AM, AA3B, BG0CAB, CM2RSV, CT3IQ, CX1RL, JA3APV, JA7QVI, KA9FOX, KI8JP, KP4JRS, N4ZZ, PY2XU, R9MBO, TA2ANK, UN7DT, VA3KGB, VE1JBC, VE2FTA, VK6MIT, VK8NSB, W1ARY, W5CIA, ZB2GI, ZL2BX, ZS6AF. **28MHz FT8:** 4Z4DX, R8CCN, TA4RC, V51MA, VK6AS.


4


5a


5b

6

Carl GW0VSW: 3.5MHz CW: ON4JXC (2xQRP). **7MHz SSB:** GS8VL (IOTA EU-009), ON75GDV. **7MHz CW:** II5WRTC, ON75UBA. **10MHz CW:** HB50SH, II8WRTC, ON75CRD.**14MHz SSB:** LB0FI/P. **14MHz CW:** CT9/DF3MC/P, II1WRTC, W4TJE (5W). **18MHz SSB:** IT9PQO. **18MHz CW:** CT9ABV, II8WRTC, LZ251MA. **21MHz CW:** EA8/OE6FEG/P. **24MHz CW:** CT9ABV.

Tony G4HZW: 28MHz FT8: 3B8CW, A41ZZ, CE0YHF/CE3, CO8MCL, CX1BBN, FR5DZ, HC1BI, HI8MSB, HP1RY, HS4QKN, J35AC, JS6TKY, JY5IB, KP4JRS, OA1F, OD5KU, P40AA, PJ4DX, TA7I, V51MA, VR2ZUZ, WP4J, XE1AE, XQ6MO, XV1X, YB3OK, YO4RYU/MM (near DU), ZL4AS, ZP5DA, ZS4JAN. **28MHz FT4:** YV5JLO.

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 June issue the deadline is 11 April. 73, Steve PJ4DX.

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

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SSTV pictures from the ISS

Colin introduces readers to Slow Scan Television and Satellites by showing how to receive SSTV pictures from the International Space Station.

While there are several aspects of amateur radio that need to be brought together to receive SSTV pictures from the International Space Station (ISS), it certainly isn't difficult, and neither does it require a lot of expensive equipment. If you have a way of receiving 2m FM signals and have a computer, then you are well on your way.

The first aspect to consider is receiving SSTV pictures, and the second is Satellites. Subsequently, each of these can be pursued separately as you wish.

What Is SSTV?

The pictures that are transmitted from the ISS use Slow Scan Television (SSTV). The SSTV images are transmitted as audio tones. A program decodes the audio tones and presents them on the computer screen as an image that slowly appears, becoming a full image over a period of a minute or two, **Fig. 1**.

SSTV Equipment

If you already operate data modes such as FT8, PSK31 or RTTY, then you already have almost everything you need to send and receive SSTV on the same bands. To receive SSTV images from the ISS, you'll need a receiver capable of receiving 2m FM signals – a handheld or mobile transceiver is fine. If you don't have a suitable data interface, then you'll just need a lead to go between the headphone socket of your transceiver and the sound input of your computer. In most cases both sockets require jack plugs (usually 3.5mm at the computer end and either 3.5mm or 1/4in at the radio end). I normally use stereo plugs and connect wires to the tips and sleeve, leaving the rings unconnected, **Fig. 2.** For the purposes of receiving the ISS, you don't even need a data interface. Antenna-wise, almost any 2m antenna will do, although a large Yagi array will need careful steering during a pass. The flexible whip antenna that many amateurs use with 2m FM handheld transceivers may provide an adequate signal from some passes.

SSTV Program

You'll need a program on your computer to decode the audio tones and convert them to SSTV images. I've been using MMSSTV on various Windows computers for many years. I'm told that MultiScan 3B is suitable for MAC computers and QSSTV is suitable for computers running Linux. Installing MMSTV on a Windows PC is straightforward. You'll need to do a little setting up, configuring to reflect the type of interface (or lead) that you are using between your receiver and computer and entering your callsign, **Fig.3.**

SSTV Modes

There are many SSTV modes. The various modes define the speed at which pictures are sent and received and their resolution. MMSSTV supports all the ('analogue') SSTV modes that are commonly encountered. On the HF bands you'll most likely come across SSTV on the 20m band around 14.230MHz (USB). In MMSSTV select Martin Mode 1 as the mode.

The ISS SSTV transmissions are usually on 145.800MHz (2m) FM using the PD120 SSTV mode. You'll probably get better results if you can receive with a wider (5kHz) FM deviation on your receiver rather than the more modern 2.5kHz deviation. Nevertheless, you should still be able to receive pictures with 2.5kHz receiver.

Slanting Pictures

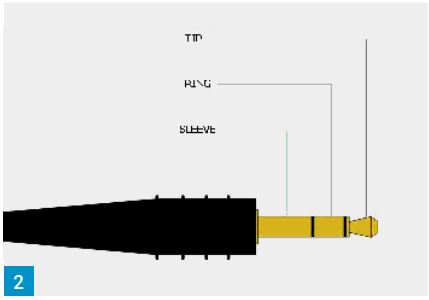
If the images you receive appear slanted, **Fig.4**, you'll need to adjust the receive clock oscillator frequency in MMSSTV. The AMSAT UK website provides some example audio files that you can use to check out your SSTV software before trying to receive the ISS:

https://amsat-uk.org/beginners/iss-sstv

Using the audio files, the easiest way to do this in MMSSTV is to use the Sync button at the top left of the picture. Receive a picture, make small adjustments and try again until the verticals are no longer slanting. On one computer, I found I needed to change from the default 11025.00Hz to 11026.20Hz. Once you are happy, press the Mem button to save the changes.

ISS Orbits

For the purposes of receiving signals, the ISS can be considered like most other amateur radio satellites. The ISS orbits the earth, so that unlike the geostationary satellites used for commercial purposes, it moves across



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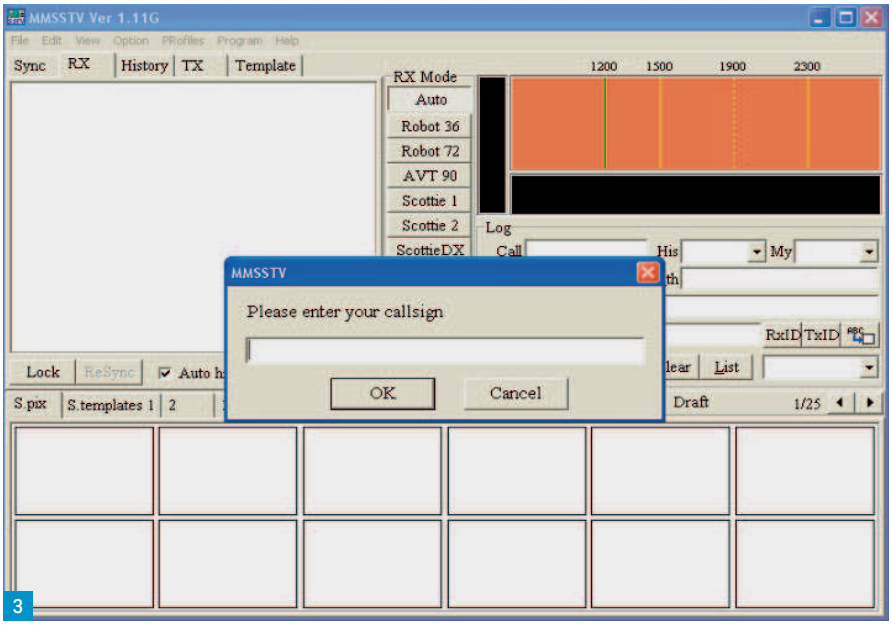

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the sky as seen from earth. Most of the time, it will be below the horizon at any particular point on earth, so that its signals will not be audible.

Satellite Prediction

Each time the ISS comes above the horizon at your location is called a pass. To know when it will be above the horizon, you'll need the satellite equivalent of a bus timetable. There are two main ways of predicting when a satellite (such as the ISS) will be above the horizon. One way is to look up the passes on the AMSAT website:

www.amsat.org/track

The tracker on the AMSAT defaults to the ISS, but you can also use it to predict passes of many other satellites, **Fig.5**. You'll need to provide it with your IARU locator square (Grid). To get the best predictions, you'll also need to enter your height above sea level (AMSL).

The other way is to use a satellite prediction program. If you use a program, make sure that you keep it up to date with orbit parameters (known as Keplerian Elements or Keps) for the satellites that you are interested in. Keps can be downloaded from the AMSAT website. No matter which way you use to predict the passes, don't forget that these are usually presented in UTC. One popular program is SATPC32, which can be obtained from the AMSAT shop for £32 at the time of writing.

Prediction Terminology: Pass

Each time a satellite goes round the earth is called an orbit. Each time the satellite's footprint passes within range of a particular point on the earth is referred to as a pass. **Fig. 6** shows the ISS passes for a period in mid-January 2022.

AOS and LOS

For each pass, the time at which the signal from the satellite can be expected to be audible (assuming there are no visible obstructions) is known as Acquisition of Signal (AOS). Readers with memories going back to the manned moon landings may remember the tense moments awaiting AOS as the spacecraft came back into sight of the earth from behind the moon. The time at which the signal is lost is known as Loss of Signal (LOS).

Fig. 1: An SSTV image received from the ISS.
Fig. 2: Connections to stereo jack plugs.
Fig. 3: Entering your callsign into MMSSTV.
Fig. 4: A slanted SSTV image. Fig. 5: Entering data into the AMSAT tracker. Fig. 6: The tracker from the AMSAT website showing a few passes of the ISS in mid-January 2022. Fig. 7: AOS and LOS. Fig. 8: The Amsats and Hamsats book can be obtained from the PW Bookstore.

The angle, and thus the apparent height above the horizon is also a consideration. The predictions all assume that the earth is a smooth sphere. If there are hills or other obstructions such as houses and trees between your station and the smooth horizon, AOS may be after the predicted time, and LOS may be before the predicted time. Unless the satellite is at least a few degrees above the horizon, you may miss out completely on some passes. At best, we can only hear a satellite between AOS and LOS, **Fig. 7**.

AOS and LOS Azimuth

During a pass, the satellite will move across the sky. The AOS Azimuth (or bearing) is the angle (in degrees) clockwise from north that the satellite will appear above the horizon. So, in Fig. 7 the first pass of the ISS will rise above the horizon at 185° from north, which is almost due south. Likewise, the LOS Azimuth (or bearing) is the angle from north that the satellite will disappear below the horizon. So, the first pass of the ISS will disappear below the horizon at 84°, which is almost due east. This will be particularly important when using a directional antenna.

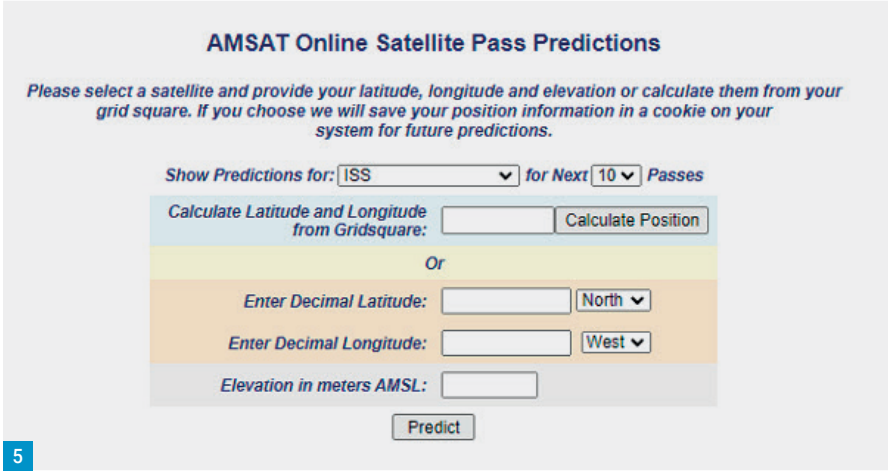
4

Maximum Elevation

The maximum elevation gives information on how high in the sky the satellite will reach. In the case of the first pass of the satellite, the ISS will reach just 9° above the horizon. This will occur at azimuth 125° clockwise round from north (i.e. roughly south-east as shown in Fig. 7).

Choosing Passes

Some passes are likely to give better results than others. Passes with a low maximum elevation (such as the first pass listed) are unlikely to yield signals if you don't have clear visibility to the horizon, for example where the view is blocked by buildings, hills or trees. If you are using a vertical antenna such as a collinear, you may find that you lose the signal if the ISS passes almost directly overhead. I'd suggest trying several passes with different maximum elevations to find which yield the best results with your



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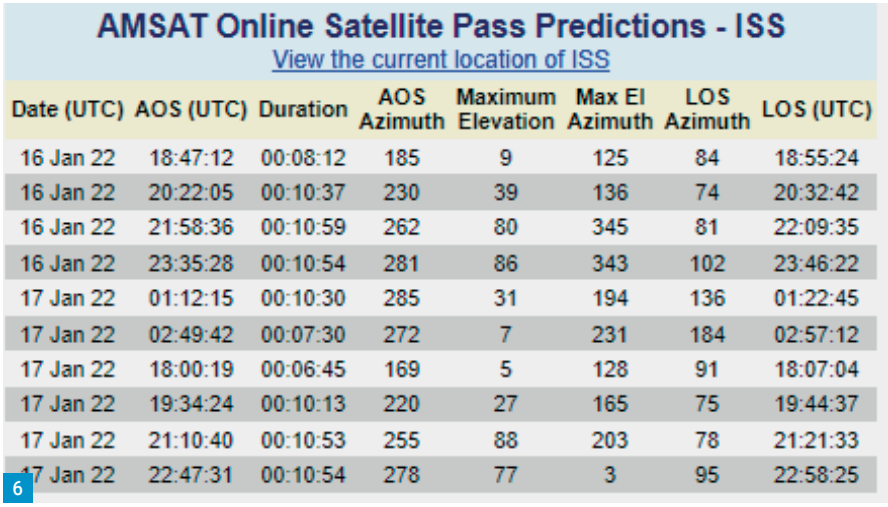

AMSAT Online Satellite Pass Predictions - ISS

View the current location of ISS

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
16 Jan 22	18:47:12	00:08:12	185	9	125	84	18:55:24
16 Jan 22	20:22:05	00:10:37	230	39	136	74	20:32:42
16 Jan 22	21:58:36	00:10:59	262	80	345	81	22:09:35
16 Jan 22	23:35:28	00:10:54	281	86	343	102	23:46:22
17 Jan 22	01:12:15	00:10:30	285	31	194	136	01:22:45
17 Jan 22	02:49:42	00:07:30	272	7	231	184	02:57:12
17 Jan 22	18:00:19	00:06:45	169	5	128	91	18:07:04
17 Jan 22	19:34:24	00:10:13	220	27	165	75	19:44:37
17 Jan 22	21:10:40	00:10:53	255	88	203	78	21:21:33
17 Jan 22	22:47:31	00:10:54	278	77	3	95	22:58:25

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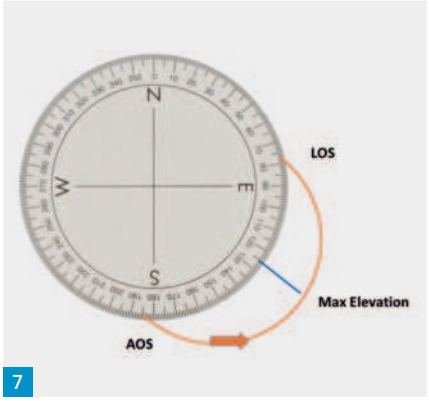

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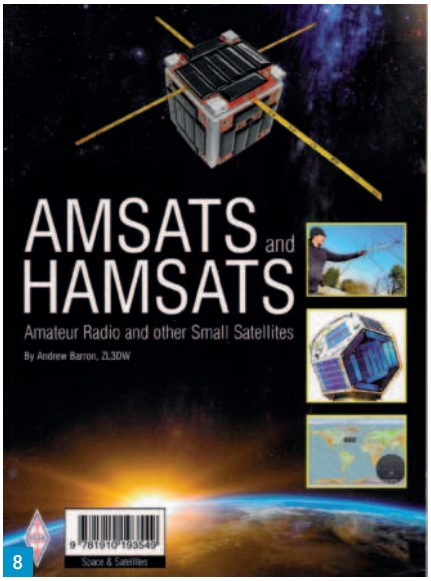

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particular location and antenna. You may find that tilting your handheld between vertical and horizontal will improve reception, particularly when the maximum elevation is above 45°.

Doppler

Ideally, you'll need to take account of what is called Doppler shift during the pass of the ISS. As the ISS approaches, it will appear to be slightly high in frequency, and as it moves away it will appear to be getting slightly lower in frequency. If you are able to tune your receiver accordingly, it will help. I've found that storing relevant frequencies in adjacent memories can be a useful technique. You should be able to leave your receiver on the nominal frequency for the middle part of the pass and get at least one good picture.

SSTV from ISS

On the longer passes, you should be able to receive two or three SSTV pictures from the ISS. There are often gaps of a minute or so between each picture being sent. To make the most of a pass requires good preparation, as unlike buses, the ISS in common with other satellites, is always on time!

SSTV pictures are not transmitted from the ISS all the time. It is usually planned for a few days at a time (at the time of writing, in mid-January 2022, the most recent was between 26 and 31 December 2021). You'll need to keep up to date with AMSAT news to find out when SSTV is planned: **https://amsat-uk.org**

First Attempts

I'd suggest treating your first attempt at receiving SSTV from the ISS as purely experimental. There are a lot of things to bring together. Satellite prediction, operating MMSSTV, tracking the ISS and managing Doppler shift are plenty of things to get right! Treat the reception of any image, even partial, as a bonus.

Other ISS Transmissions

There are other transmissions from the ISS. Probably the most well-known of these are the pre-planned contacts the astronauts on board make with schools from time to time. There are also occasional periods when conventional contacts are made with amateur stations around the world – keep an eye on the AMSAT website to get information on upcoming activity.

Book

If you start to become hooked on Satellite operation, I'd suggest getting hold of a copy of the *AMSATS and HAMSATS* book by **Andrew Barron ZL3DW**, **Fig. 8**. In its over 350 pages, it covers many aspects of satellite operation from an amateur perspective. It starts off by describing how to make contacts with simple 2m/70cm handheld transceivers through what it terms 'Easy Sats'.

AMSAT-UK

AMSAT-UK have an excellent website for anyone interested in satellites. The beginner's section has plenty of information to help newcomers. Membership of AMSAT-UK costs £15 per annum, which includes a quarterly electronic version of *Oscar News*. For an extra £7 you can have *Oscar News* posted to your UK address.
https://amsat-uk.org

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

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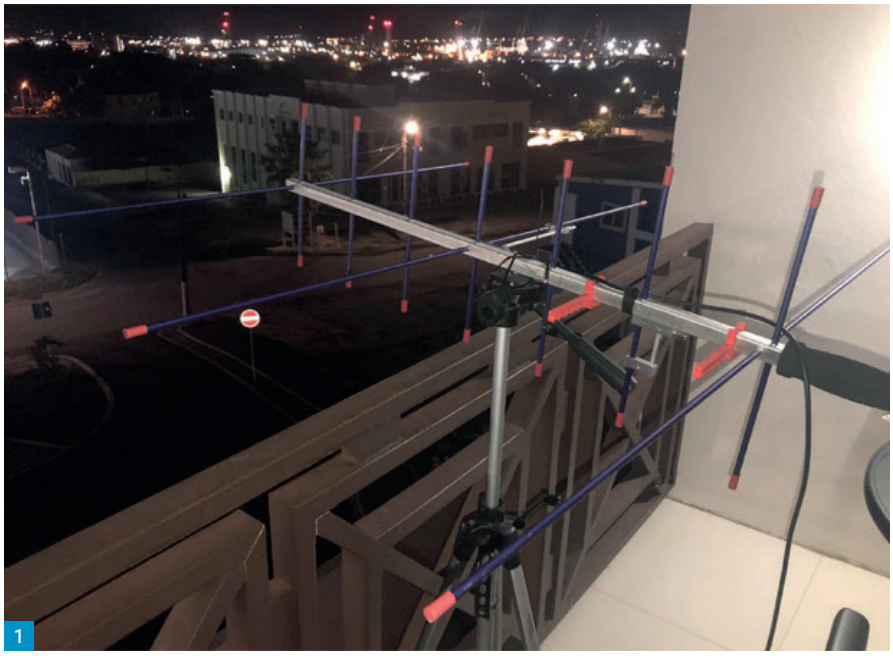
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VHF/UHF Net Information

Tim Kirby GW4VXE adds to the list of VHF/UHF nets as well as bringing readers the latest news from around the world.

The *PW* initiative to help VHF/UHF activity by compiling a list of regular nets has really taken off this month. Thanks to everyone who has emailed with information. We now have a list of nearly 100 regular nets taking place on the VHF/UHF bands. Some of them happen every day, some of them might be once a month, but what is clear is that the VHF/UHF bands are being used widely on FM as well as on the digital modes. Rather than repeat last month's list, **Table 1** this month lists additional nets that I have become aware of since that was compiled. We have also put the complete list on the Radio Enthusiast website, where I can keep it updated:
https://tinyurl.com/2p9c3s72

As I've said before, the hope is that the list will help give people a focus for their FM activity. If you know that a net takes place at a particular time from a particular area, then that's a great time to listen with the expectation that you might hear something. Absolutely everyone who has written in with information has said that all comers are welcome on their nets – you don't have to be a member of the club involved. So, do listen and get involved!

If your club or activity net is not included in the list, it's not too late – please email me and I will be glad to include the information in future lists.

Finally, the list has been compiled mostly from first-hand sources, but there are one or two nets where I have taken the information from sources pointed out to me. To the best of my knowledge the details are correct, but if you see an entry in the list that you know to be incorrect, please drop me an email and I will be pleased to correct the information.

I hope you find the list useful and find some interesting activity to participate in as a result.

Bob Bruninga WB4APR

The inventor of the Automatic Packet Reporting Systems (APRS), **Bob Bruninga WB4APR**, **Fig. 1** has died. He passed away on 7 February, aged 73. The first foundation for APRS was laid in 1982 when Bob (as a US Naval research engineer) wrote a program to map the position of US Navy ships using the Apple II platform. Over time, he refined the ideas and in 1988, ported the software to the IBM PC, it being named APRS in 1992. The APRS software was originally MS-DOS based, but over time APRS has evolved to be embedded in the firmware of radios that we use every day as well as becoming available for Smartphones, Windows and Linux platforms among others. Bob's initial work was a great foundation for all of that.

Indeed, Bob's work on APRS was visionary and there are some little-known facilities in APRS that are really quite advanced (check out the QSY facility, for example!). Bob was also keen to expand the system beyond a position reporting system to be an easy 'worldwide information channel' for applications and amateur radio stations to exchange data across the air and over the internet. The evidence that he was successful in this regard is that APRS remains one of the major uses of 1200baud packet radio, where the majority of other uses have fallen away. Bob also helped encourage satellite builders to incorporate APRS into their satellites, starting with PCSat in 2001. Digipeaters such as on the International Space Station continues this legacy.

If you'd like to see Bob talking about APRS, his vision and his work, as well as his preparations for what he calls the 'Final QRT' you can find an interesting presentation that he made to the Vienna Wireless Society in the USA on YouTube at:
https://youtu.be/qs3V8QqLgwo

Journey well, Bob and thank you.

Transequatorial Propagation on 2m from the Caribbean to South America

Thanks to **John EI7GL**'s excellent blog (URL below) I've been able to keep tabs on some of the interesting QSOs that have been made on the 2m band from Curacao, Puerto Rico and Bonaire into Uruguay and Argentina. Some contacts have been made with as little as 10W to a 3-element Yagi. In early February, openings were happening almost every day, around midnight UTC, which is around 8pm local time for the stations concerned.
https://ei7gl.blogspot.com

Of the opening on 8 February, **Brett PJ2BR** wrote on Twitter, "*This is an unusual evening. Was able to work LU4DJC, LU1FAM and LU2EPO on 2m Q65. What makes this unusual is, made the contact with 10W and a 3-element Arrow Yagi!* (**Fig. 2**) *My signal was*

Fig. 1: The simple Arrow antenna setup used by PJ2BR for some 2m TEP contacts into South America. Fig. 2: Bob Bruninga WB4APR who passed away in February. Fig. 3: Video received from DP0GVN in the Antarctic by Graham G3VKV. Fig. 4: Kevin ZB2GI took this screenshot of an image from the ISS CAM as it flew over Gibraltar.

also rx'ed in Uruguay. 5461km on 2m 10W!"

John EI7GL also reports that FM radio stations from Jamaica have been heard on Band II in Chile on several occasions via TEP, which is very interesting. The distance was around 5700km. Once again, the time these stations were heard was around midnight to 0100 UTC.

In discussions online, people have asked why there doesn't seem to be a similar path between Europe and Africa. We have to assume that the answer is that there is but that levels of activity are not sufficient to establish the path. Maybe any readers in southern Europe might be able to listen on Band II FM and see if any African stations are audible (as well as trying 50 and 144MHz too, of course, if you have a suitable station!).

Thanks as always to John EI7GL for his invaluable work in recording these openings.

The 6m Band

Tony Collett G4NBS (Cambridge) was on for the UK 6m Activity Contest on 10 February. The band was noisy for Tony and it was a real challenge to scrape 44 QSOs, with the best being GI4SNA.

The 2m Band

Simon Evans G6AHX (Twyning) writes, "*On 1 February I did the RSGB 2m UK Activity Contest using just 10W of SSB. I had 19 contacts in 14 squares. My best DX was G8PNN/P in IO95, 357km from me. On 2 February there was an opening to the south on 2m. I had contacts with F5ICN and F4BKV. I have worked F5ICN many times before. He's in JN03BF, near the Pyrenees 994km away. We gave each other reports of 59+20dB! F4BKV is a bit closer in IN95PP, 718km away by the mouth of the Gironde.*

"I have been checking reception of the Marine channels here in Twyning using my FTM400XD set to scan between 156MHz and 162MHz. Milford Haven coastguard have a transmitter on the old Severn Bridge. So, their safety information broadcasts are easily received any day as are the locks and bridges of the Sharpness Canal and the River Severn. Also, any day I can hear traffic around Avonmouth Docks. During the lift in early February, I identified London and Southampton VTS [Vessel Traffic Service] as well as a French coastguard station checking ships travelling along the English Channel. Yet another way to check conditions!"

Jef VanRaepenbusch ON8NT (Aalter) has been experimenting with an Android app called AndFLmsg on 2m FM. The app combines FLDigi and FLMsg and using a cable or Bluetooth, or even audio coupling to your transceiver, allows you to send messages and pictures. It can be downloaded at:

https://tinyurl.com/yep9kump

and Jef says that OH8STN has produced a useful video about it, which you can see at:

https://tinyurl.com/mv5b2yau

For those with the newer Icom D-STAR radios, Jef also mentions where to find the Picture Exchange Nets: REF072D all the time, REF055D on Thursday at 0130UTC and REF055C on Wednesday at 2000UTC.

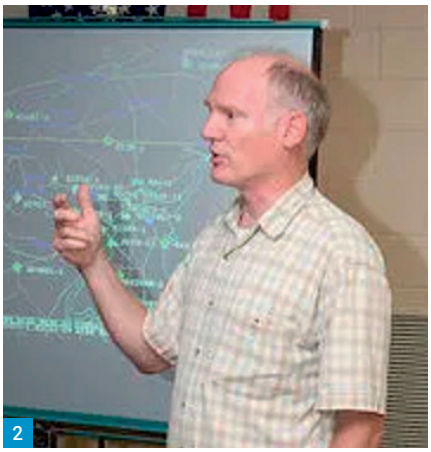
Jef lists his FT8 QSOs in excess of 500km. On 15 January, he worked G7HEM/P (IO82) F6EGD (IN88), GI4FUE (IO74), MW0PJE (IO82), GI4SNA (IO64) and G8EOP (IO93). Next day he worked F5BEG (JN07). 24 January saw the band good to the west, allowing QSOs with EI3KD (IO51), GW6TEO (IO71) and M0BKV (IO70).

Andy Adams GW0KZG (Letterston, Pembrokeshire) got on for the 2m FT8 Activity period in February and worked 13 stations, with the best DX into Northern Spain with both EA1HRR and EA2XR (IN83) as well as F6BYJ and F4EZJ (JN05). Andy was also pleased to work a number of stations that he hadn't seen active before.

Roger Daniel G4RUW (Newbury) found the band good on the evening of 2 February, working a number of stations on SSB: F5ICN (JN03), F5DYD (JN03), F1HFW (JN03) all at very good signal strength. On FT8, Roger worked F6CIS (IN94), F5DYD (JN03) and EA1HRR (IN83). By the next morning, the opening had gone.

Roger Greengrass EI8KN (Co Waterford) caught the tropo opening to the south from 13-15 January, working EA2TZ (IN83), EC2BBS (IN93), F5DRD (JO10), F4EEJ (IN95), F0GOW (IN96), F5HIJ (IN95), F5DYD (JN03), F0EYI (IN98), F6BQG (IN98) and F6GLQ (IN98). Roger caught an opening to the east on the 23/24 January, working DG1KBY (JO30), DD7DAC (JO31), PA4VHF (JO32), DL2AKT (JO50), DK1FG (JN59), PA3PCV, DK2EA (JO50), PG2F (JO21), EC2BBS (IN93), DL5DAW (JO31), PA5Y (JO21) and PA3DNA (JO32).

Ian Bontoft G4ELW (Bridgwater) took part in the FT8 Activity on 2 February and worked F1HFW (JN03) and F5DYD/P (JN03). He notes that he didn't hear any stations in 'middle' France and suggests that the ducting was going over the top of western and central France, which I am sure is correct. Ian runs 15W to a V-2000 vertical, making these very nice QSOs indeed.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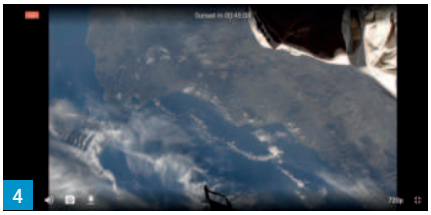
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Tony G4NBS made some nice contacts during the month. On 17 January, Tony noticed some good activity in the evening – mostly UK stations, but LX1BH to the east and GI7ULG (IO64) in completely the opposite direction. Next morning, things were good to the west with GW4VXE (IO71), G7RAU (IN79), M0BKV (IO70), EI4ACB (IO62) and MM0CEZ (IO75) all worked. In the early evening of 24 January, Tony worked GW6TEO (IO71), PA3GEG (JO32) and DJ6OL (JO52). During the FM activity contest on 1 February, Tony was surprised to work five stations and saw a few others on the waterfall. During the SSB section, Tony worked the usual GI/GD/GM stations but struggled to work stations in IO83 and IO93. Next day during the FT8 Activity period, Tony spent an hour before the RSGB contest started, working to the East although he noted that stations to the west of him were working to the south, which he could not see at the time. During the evening, Tony made 64 QSOs on FT8 in 30 squares, with EI8KN

Day	Time (local)	Frequency	Description	Area
Every	0755	145.525	Waterside group	South Coast
Every	0830	145.300	Kings Lynn ARC activity	Norfolk
Every	1330	145.550	Aberdeen area activity	Scotland
Every weekday	0615	GB3IW	Breakfast Club	Hants
Every ex-Sun	1000	144.775	Dorking and District RS	Surrey
Sunday	1200	145.575	Torbay ARS	Devon
Sunday	1500	145.500 QSY	Blackmore Vale	Dorset
Sunday	1600	145.550	Solent Radio Group	Hants
Sunday	1900	145.3875	Flight Refuelling ARS	Dorset
Sunday	1900	GB3KY	Kings Lynn ARC	Norfolk
Sunday	2000	GB7PO/GB7MT	Portsmouth/Southampton Fusion net	Hants
Sunday	2030	50.180 SSB	Flight Refuelling ARS	Dorset
Monday	1900	70.350	Northeast area 4m activity	North East
Monday	1930	144.155	Fareham and District ARC CW	Hants
Monday	1930	145.325	RAF Waddington ARC	Lincs
Monday	2000	GB3CC	Chichester area activity	Sussex
Monday	2000	145.475	Poole Radio Society	Dorset
Monday	2000	GB3SW	Sidmouth ARC	Devon
Monday	2030	50.155 SSB	Torbay ARS	Devon
Monday	2030	144.155	Fareham and District ARC SSB	Hants
Monday	2030	1296.220 SSB	South Coast area activity	Hants
Tuesday	1900	145.575	Fareham and District ARC	Hants
Tuesday	1900	144.290 USB	Kings Lynn ARC	Norfolk
Tuesday	1930	433.500	Aberdeen area activity	Scotland
Tuesday	1930	GB3IW	Fort Purbrook ARC Portsmouth	Hants
Tuesday	2000	144.330 SSB	Blackmore Vale (Vertical SSB)	Dorset
Tuesday	2000	144.250 SSB	Havant area (Vertical SSB)	Hants
Tuesday (2)(4)	2000	GB3FG	Carmarthen ARS	Wales
Tuesday	2000	145.375	Newport ARS (Gwent)	Wales
Tuesday	2000	GB3SU	Southampton area activity	Hants
Tuesday	2000	GB3IW	South Coast area activity	Hants
Tuesday	2000	145.475	South Manchester RC	N West
Tuesday	2130	144.725	Horsham ARC	Sussex
Wednesday	1430	145.475	Poole Radio Society	Dorset
Wednesday	1900	1294.500 FM	South Coast area activity	Hants
Wednesday	1930	GB3FG	Carmarthen ARS	Wales
Wednesday	1930	Freestar network	Freestar Network Wednesday night Net	National
Wddnesday	2000	GB7BN	Bognor Regis area (Fusion)	Sussex
Wednesday	2000	51.510 FM	South Manchester RC	N West
Wednesday	2030	70.425 FM	Blackmore Vale Club	Dorset
Wednesday	2030	144.625	SE Hants Raynet (all welcome)	Hants
Wednesday	2100	145.500 QSY	Waterside Radio Club Southampton	Hants
Thursday	1900	70.400 FM	Flight Refuelling ARS	Dorset
Thursday	1930	144.725	Christchurch ARS	Dorset
Thursday	1930	145.275	Fort Purbrook ARC Portsmouth	Hants
Thursday	2000	GB3SH	Fort Purbrook ARC Portsmouth	Hants
Thursday	2000	GB3FG	Carmarthen ARS	Wales
Thursday	2000	145.3875	Flight Refuelling ARS	Dorset
Thursday	2000	145.375	Havant area	Hants
Thursday	2000	145.475	Poole Radio Society	Dorset
Thursday	2000	145.475	South Manchester RC	N West
Thursday	2000	TG 23501	Sidmouth ARC DMR (Brandmeister)	Networked
Friday	1915	145.350	Chichester area activity	Sussex
Friday	1930	144.155	Fareham and District ARC CW	Hants
Friday	2000	GB3SW	Sidmouth ARC	Devon
Friday	2030	144.155	Fareham and District ARC SSB	Hants
Saturday	1030	145.475	Fareham and District ARC activity	Hants
Saturday	2130UTC	Freestar network	Freestar Network Top Talk net	National

Table 1: Additional VHF/UHF Nets known to be active around the UK.

(IO62), M0BKV (IO70), GW0KZG (IO71), EA1HRR and EA2XR (IN83) all worked along with the 'usual' stations in JO20-23 and JO30-32 as well as with DL9YF (JO42). Things then improved to the south and Tony was able to work EA2TZ, EA1IXQ, EA1U (IN83), EA2EGM (IN93), F6EGD (IN88), F6CIS (IN94), F4BKV (IN95), F8DHA (IN95) and F5DYD (JN03). The evening ended with SSB QSOs with F5ICN (JN03) and EA2XR (IN83).

Not too much in the **GW4VXE** (Goodwick) log this month, but a few nice ones, all on FT8: F4HRD (JO00), EI9KP (IO54), GM0HBK (IO77) worked at huge strength on 22 January and F6DBI (IN88).

The 70cm Band

Jef ON8NT made a single QSO during the UK 70cm Activity Contest on 11 January: G4CLA (IO92).

Roger EI8KN found conditions good to the east on 23/24 January working DF2VJ (JN39), G8VHI (IO92), PA1BVM (JO21), DC6KI, G0JJG (JO02), PA4VHF (JO32), PA3CWS (JO22), PA1CW (JO22), PA1BVM (JO21), PA2V (JO22) and PE1ITR (JO21).

Tony G4NBS says it's a shame that all the activity was concentrated in one week in the month – but at least there is plenty of it! On the evening of 24 January, Tony found conditions quite good later on, working DJ6AG (JO51), DJ6OL (JO52), DL7APV (JO62) and DF5VAE (JO64). On 2 February, Tony says that no one seemed interested in FT8 QSOs, so he made do with working F5ICN and EA2XR, both on SSB. During the AFS contest on 6 February, Tony said that poor conditions and high winds conspired to make things difficult. Tony's only European QSO was DF2VJ (JN39) who was very strong and was not arranged through ON4KST! Activity from the UK was good though and Tony ended up with 93 QSOs, including EI8KN and GM4AFF who were both worked by aircraft scatter.

During the FM Activity contest on 8 February, Tony made seven QSOs. During the SSB leg, conditions seemed better than the previous Sunday, although there were fewer aircraft. Tony made 109 QSOs in 23 squares. F1BHL/P (IN99), F1CBC (JN09), PE1EWR (JO11) and PA1BVM (JO21) were all worked from EU with UK highlights being GM4AFF (IO86), GM4JTJ (IO86), GM3SEK, GD0AMD/P, GD6ICR, GD8EXI, GI6ATZ (all IO74). There were five GW stations, including GW4JQP (IO71).

During the 9 February FT8 Activity session, conditions were very flat and Tony made 73 QSOs in 23 locators. Best to the east were DL1DBR (JO41), DK5IR

(JN49) and DG9BFE (JO33). Tony decoded GM0EWX while Callum was working GM4FVM but unfortunately, he faded out before Tony could try a QSO.

The 23cm Band

Roger EI8KN reports a single QSO, a Q65 test with G4HGI (IO83), which was successfully completed.

Satellites

Jef ON8NT has been focusing on working DX using FT4 on satellites, with AK3Y (FM19), AC9DX (EN45), OH1FOL (KP11), OH3NQT (KP21) and W3TI (FN20) all worked on RS-44 using his V-2000 and IC-9700.

Graham Jones G3VKV (Cheltenham) writes with news of his activity on the QO-100 satellite. *"On 23 January I received some QO100 satellite video from DP0GVN, located on the Neumayer Station III in Antarctica* (**Fig. 3**). *It was good to see they have the station up and running again after the storm damage last year. On 2 February had a contact with* ***Theresa Thoma DC1TH*** *operating DP0GVN on SSB. We had a good chat about Antarctica for 20 minutes or so. She mentioned being there for one year this March and returning to Europe soon on the German Research Icebreaker* Polarstern.

"On 5 February on QO100 I worked ***Gustavo CX/PR8KW*** *located in GF35, Uruguay, South America. According to the QO100 footprint elevation calculator he is at –0.2° to the satellite, North East of Montevideo, on the coast of the Atlantic Ocean. There was a lot of fading on his 2.4GHz uplink transmission although he was giving good reports on the incoming signals on 10GHz".*

Phil Oakley G0BVD (Great Torrington) enjoyed decoding some of the SSTV from the International Space Station (ISS) in early February but has also been busy preparing his new feeder runs for his VHF/UHF station.

Kevin Hewitt ZB2GI enjoyed the ISS SSTV event on 7/8 February and received six full images with one duplicate during three separate passes, **Fig. 4**. On 10 February Kev monitored the ARISS contact with a station in Germany. Finally, Kev made a number of QSOs during through the ISS Crossband repeater using an FT-817 and Log Periodic antenna. Stations worked were EA4MR (IN80), EA7IRJ (IM76), EA7P (IM76) and I6ONE (JN63).

Huge congratulations to **Peter Green G0ABI** and **Joe KE9AJ** for breaking the AO-91 distance record with a 6215km QSO. Joe was operating from a SOTA summit in Wisconsin and the satellite was at negative elevation for the QSO with Peter, located in Devon. Peter works really hard with the low passes and I'm delighted he's been rewarded with such a great QSO.

A short email from **Patrick Stoddard WD9EWK** (Phoenix), who, at the time of writing was at the Orlando Hamcation for the weekend. Naturally, Patrick has been active from there. He writes, *"I have worked passes from Orlando in the past couple of days, taking advantage of being in a different part of the country this weekend. I worked PV8DX in northern Brazil on AO-91 this morning. After contacts over the past few years on AO-7 with PV8DX from other parts of the continental USA, it was great to make an FM contact on AO-91 here in Orlando".*

Patrick also mentions that the FO-29 satellite is available again and should be in sunlight 100% of the time until the end of April.

That's it for this month. Thanks as always to everyone who has contributed – please keep your news and photos coming!

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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).

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- Backlit Liquid Crystal Display • Data Cloning • Digital AGC
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- MotoTRBO™ Connect Plus
- MotoTRBO™ Linked Cap Plus systems
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- 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.

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KEY FEATURES

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- Fast moving, real-time spectrum scope and waterfall functions
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KEY FEATURES

- Intuitive Touch Screen Interface
- Innovative Slant Top Controller
- HF/6M/4M/2M/70cm 70MHz
- D-STAR DV Mode Operation
- IF DSP Digital Processing
- Built in Speaker • Mounting Base Option
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The RF direct sampling system has already provided high performance in Icom's IC-7610 and IC-7300 HF transceivers.

In addition, the spectrum scope and waterfall function have been indispensable tools for operators to increase QSO opportunities, without missing weak signals.

The radio has many other impressive features including

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- 4.3 inch TFT colour touchscreen display
- full duplex with Dualwatch on separate bands
- Satellite mode, D-STAR DV (Digital Voice) /DD (Digital Data) modes and Terminal/Access point modes.

Also, a newly designed power amplifier and cooling system provide stable and high-efficiency operation, even when continuously transmitting for a long time.

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KEY FEATURES

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

Buy the AA-1500 for just

£699.95

699 WATTS

RigExpert

AA-650 Zoom Analyser

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

Buy the AA-650 for just

£549.95

549 WATTS

RigExpert

AA-230 Zoom Analyser

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

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

Buy the WS1010 for just

£339.95

339 WATTS

RigExpert

AA-55 Zoom Analyser

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

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

Buy the AA-55 for just

£299.95

299 WATTS

RigExpert

AA-35 Zoom Analyser

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

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

Buy the AA-35 for just

£209.99

209 WATTS

RigExpert

STICK PRO Antenna Analyser

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

Buy the STICK-PRO for just

£349.99

349 WATTS

RigExpert

STICK 230 Analyser

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

Buy the STICK-PRO for just

£269.95

269 WATTS

RigExpert

TI-5000 Transceiver Interface

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

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154 WATTS

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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.

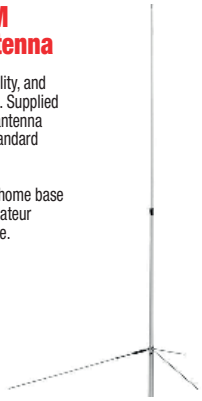
SPECIFICATIONS
- Mast size : 28 to 44 mm (1.1/8" - 1.3/4")
- Rotation time : approx. 74 sec.
- Rotation torque : 21.5 Nm
- Weight : 4.2kg
- Control unit : with digital direction indicator
- Operating Voltage 220-230VAC
- Requires 3-wire control cable (not included)

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

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

Buy the MC-4MT for just
£17.99

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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

BM145 -PL (SO239) Large Magnetic Base

Buy the BM145-PL for just
£19.95

19 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
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Buy the STORM 100 for just
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39 WATTS

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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
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Mini YouTube Clips

Mark Tuttle G0TMT
g0tmt@theshack.org.uk

Building the VFO Board

Mark Tuttle G0TMT moves this month on to the VFO board of the 40m transceiver project.

The VFO section is an amalgamation of quite a few designs; taking what I believed to be the best parts of each. The bulk of it was published by PA2OHH in his article entitled *A Nice Rig* (see first URL below), which in turn lifts ideas from the NE-QRP Club's 40-40 rig. The expression 'There's nothing new under the sun' springs to mind here. The latter was included in a publication entitled *QRP Power*, a great little book that is getting harder to find. I get the impression one of the forerunners using a similar layout is a well-known design called the 2N2/40+ by K8IQY (see second link below), which first appeared in an issue of *QST* magazine in 1998 (I did say this was old school). Anyway, enough of the back story, let's take a look at the circuit diagram, **Fig. 1**.

www.qsl.net/pa2ohh/qrp30.htm
https://tinyurl.com/2ab6hcb6

The Circuit

The VFO design is based around a Colpitts oscillator using TR1. I used a PN2222A, which is a low noise version of the ever-popular 2N2222A. I had some left over from a previous project. I suspect a regular 2N2222A would work quite well, but I've not tried it. There are a number of NP0 capacitors in the design. These are more stable than regular disc ceramic capacitors as they do not change their value nearly so much with temperature. C8 and C9 must be NP0 and I recommend C7 and C8 be at least polystyrene types if you don't use NP0. Any capacitors in the frequency determining part of the circuit would benefit from being low drift types, in order to keep the frequency drift to a minimum.

To tune my oscillator nicely I needed to pad out C6 and C7 with a small 47pF capacitor. I used a small tubular one I had in the junk box but I doubt these are available any more. Use either NP0 or disc ceramic. L1 provides the inductance in the oscillator tank circuit. It comprises 44 turns on a T50-7. This might seem like a strange choice of toroid; it did to me. Further reading suggests the type 7 material is the most temperature stable choice. I would have chosen type 2 or type 6 to make this coil but I went with type 7 anyway as I was aiming for stability. The frequency is changed by two Varicap diodes, D1 and D2. These are cheap 1SV149 diodes that do a more than adequate job. The articles mentioned earlier use oddball, hard to find, varicaps so I had to adjust several values in the circuits to use the 1SV149s. The voltage across D1 adjusts the main tuning and is controlled by the front panel tuning control. R2 and R1 set the upper and lower limits and in conjunction with VC1 will set your tuning range. You may find you need to experiment with the value of R1 but 15kΩ is a good start. R4 is there to linearise the tuning. D2 is used by the RIT circuit. This is quite a clever little circuit that I've only ever seen in the 'Nice Rig'. With the key up, the voltage on D2 is set by VR2 and VR3.

However, when the key is pressed, TR3 is switched off so VR2 is no longer in circuit. This will return the voltage on D2 to the original value before VR2 (RIT) was changed. It can be a tad fiddly to set up but the idea is that you make a note of the frequency with the key up and no RIT. Adjust the RIT either way and then take the 'Key' line to ground. Adjust VR3 so that the frequency returns to your noted value.

I found about 150 to 200Hz swing either way was plenty but if you want more, or less, experiment with the value of R17. I chose to use a centre detent potentiometer for the RIT so it's easy to return to the same spot for 'no RIT'. I found mine on eBay and it was no more expensive than a regular pot. Incidentally, if you don't want RIT because you're only building the receiver, then you can leave out TR3 and all its associated components and also D2, C3, R6 and C4.

There are two buffers in the circuit, comprising TR2 and TR4. TR2 is an emitter follower and sends a not too pretty looking waveform to the frequency counter. TR4, however, is biased properly so it sends a very nice sinusoidal waveform to the receiver and transmitter boards. The mixers used on those boards are the ubiquitous NE602/SA612. These ICs ideally require between 200 and 300mV on the LO pin. The VFO produces a smidgen over that so there are suitable dropping resistors on the other boards.

The VFO needs a nice stable voltage, which is provided by a Zener diode, D3 plus smoothing capacitor C12.

The VFO needs to be housed in a small metal enclosure. I constructed mine by bending a small piece of tinplate to form the bottom and the two long sides and then fabricated the two longer sides out of two pieces of copper clad board. I then soldered the smaller sides into place to form the box.

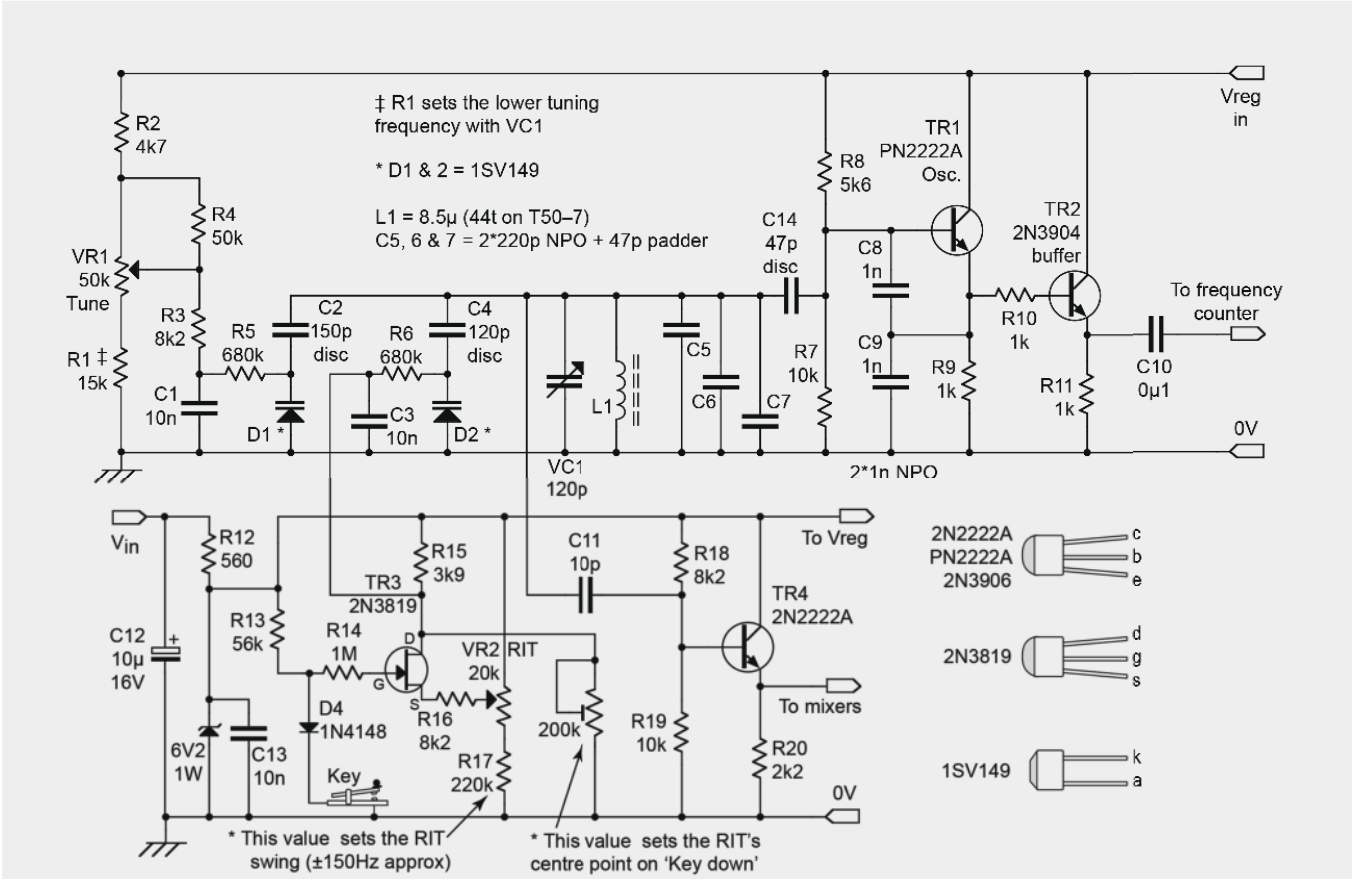
I used the brass PCB mounts again to mount the board inside the box and also, by soldering others in the corners, it allowed me to fit a top to the box. This is now fastened using a 2mm screw in each corner that screws into the soldered-in PCB mounts. Before soldering in the PCB sides of the box I constructed a means of taking out the points for the tuning pot, the RIT pot, the frequency counter output, the key connection and the power supply. I chose to make islands in the copper for pins to carry the various signals out but it's not the only method. You can drill a hole and take wires straight through if you prefer. Choose whatever suits your needs. A small 1nF capacitor from the supply rail direct to the VFO box should keep any RF that might try and get into the box under control.

For newcomers to homebrew, this is called decoupling. More experienced builders might well use feedthrough capacitors, which do the same job.

Stability

It is well worth a paragraph about stability. This is not only dependent on using temperature stable components but also mechanical stability. It is important to keep component leads short and any frequency dependent component must be very stable. This includes the coil L1. Once you are happy with the performance of your VFO I strongly recommend you

Fig. 1: Circuit diagram of the VFO
Fig. 2: The VFO board



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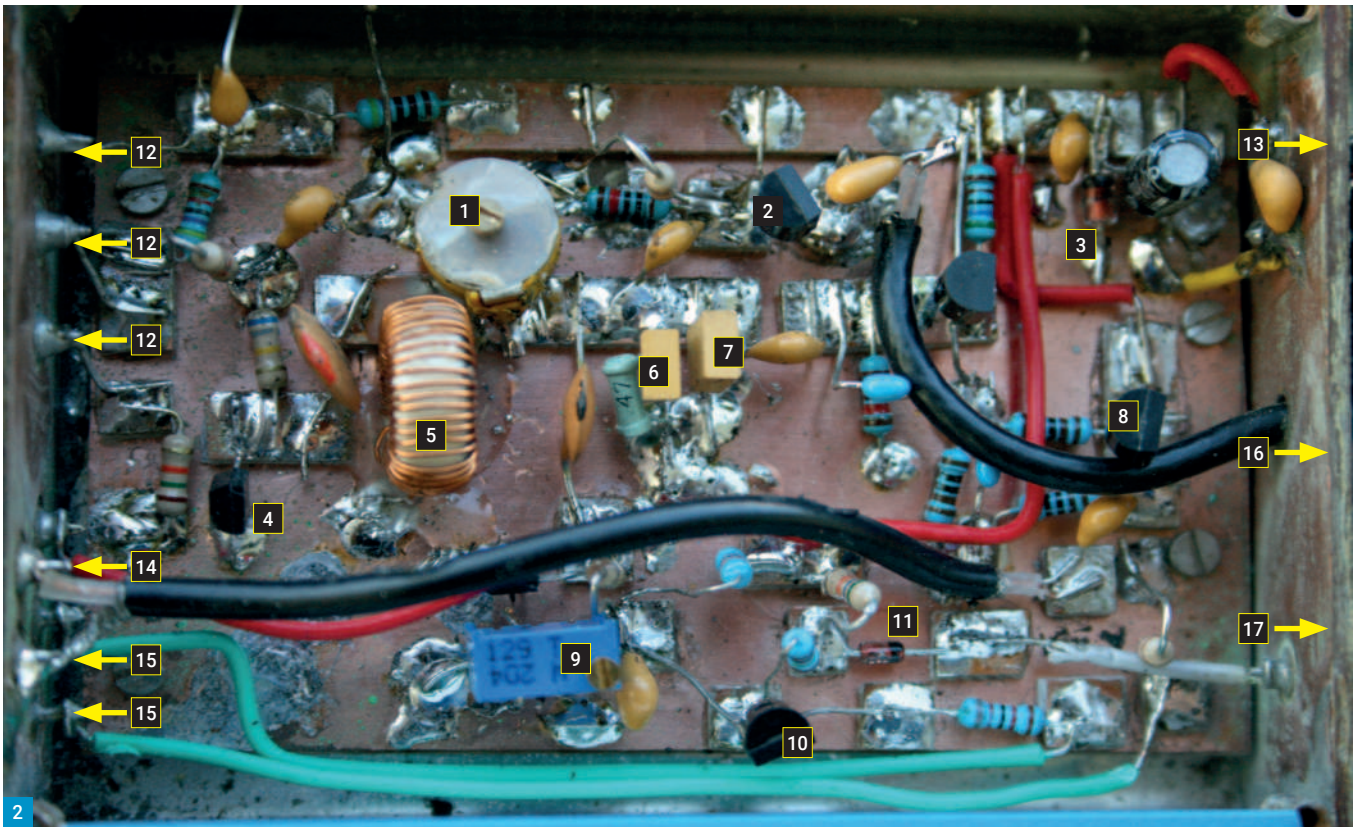


2

1. VC1 2. TR4 3. D3 4. D1 5. L1 6. C6 7. C7 8. TR2 9. VR3 10. TR3 11. D4 12. VR1 Main Tuning 13. 12V Supply 14. Freq Display o/p 15. To RIT Pot 16. o/p to Mixers 17. Key

VFO Board Component List

Resistors – All Resistors are ¼ or ⅓ Watt Carbon

R1	15kΩ
R2	4.7kΩ
R3, R16, R18	8.2kΩ
R4	47kΩ
R5, R6	680kΩ
R7, R19	10kΩ
R8	5.6kΩ
R9, R10, R11	1kΩ
R12	560Ω
R13	56kΩ
R14	1MΩ
R15	3.9kΩ
R17	220kΩ
R20	2.2kΩ

Capacitors

C1, C3, C13	10nF (10)	Multilayer Ceramic
C2	150pF	Disc Ceramic
C4	120pF	Disc Ceramic
C5	47pF	NP0 or small tubular *see text
C6, C7	220pF	NP0
C14	47pF	Disc Ceramic
C8, C9	1.0nF (102)	NP0
C10	100nF (104)	Multilayer Ceramic
C11	10pF	Disc Ceramic
C12	10µF 16V	Electrolytic
VC1	120pF	Trimmer capacitor

Source – try Bowood Electronics for NP0 capacitors

Variable Resistors

VR1	50kΩ	10-turn front panel style, Bourns or similar
VR2	20kΩ	Centre indent, front panel style or similar
VR3	200kΩ	10-turn Trimpot 3296 style or similar

Inductors

L1 44 turns of 28g (0.3mm) enamelled copper wire on T50-7 toroid – 8.5µH *see text
A small 100mH inductor inserted in the supply to the frequency counter *see text

Semiconductors

TR1	PN2222A
TR2	2N3904
TR3	2N3819
TR4	2N2222A
D1, D2	1SV149 Varicap Diode
D3	6.2V 1W Zener Diode
D4	1N4148/1N914

Miscellaneous

8 Digit Frequency Counter Module PLJ-8LED-C (Source: Ali Express)
The VFO needs to be housed in a small metal enclosure *see text.
Hook-up wire
Thin screened cable eg RG174 or similar
Copper clad board for ground plane and islands

glue L1 firmly down with two-part epoxy. Cables taking RF out of the box should be screened. I use RG174 but there's no power here so any good quality small diameter screened cable should suffice. As a guide my VFO is stable to within a few (10 max) hertz, given about 5 to 10 minutes of warm-up time. In other words, you will not be able to detect any change in the tone of an incoming station over either short or long durations, nor will they be able to detect any drift or chirp in your transmission either. I mentioned this was after a warmup period. This is important. Remember, this is old-school technology. Components change their value very slightly from cold until they reach their normal operating temperature. My VFO drifts upwards by about 40 to 50Hz in the first five to ten minutes. After that it seems very stable. Is it stable enough for digital work? Hell no. Is it stable enough for a CW rig? Absolutely.

The Frequency Display Module

The frequency display is a cheap module with the part number PLJ-8LED-C (I think the 'C' is the revision so I doubt this letter is important). The full instructions for this unit can be found at the URL below so I won't repeat them here. They are available with different coloured digits but I chose green. I urge you to experiment with it on the bench. I would also strongly recommend swapping out the hideous little connectors for soldered-in screened cable. I had a lot of trouble with this display until I did this for both the supply and input. I set mine to read six digits at 7MHz. Setting it to go down to 1Hz is pointless for two reasons. Firstly, you do not need to know the frequency to that resolution (most commercial rigs only read to 10Hz) and secondly, the VFO isn't that stable so all you'll see is an ever changing least significant digit. I wouldn't set the IF frequency just yet as we need to get that spot on. It won't be exactly 4.915MHz I can assure you. You can, however, test the output of your constructed VFO. You should be able to tune it from around 2.04 to 2.12MHz or thereabouts. There ought to be enough adjustment with VC1 to correct any slight differences later. You can also use it to set up the RIT circuit. It's also a good idea to look at the output of your VFO using your 'scope. The feed that goes to the mixers should be a near perfect sinewave of about 300 to 400mV pk-pk. If it's not, you've made a mistake somewhere I'm afraid.

https://tinyurl.com/4yb3evm3

Noisy Display

Earlier I mentioned that the frequency display adds low level noise to the power rail. I found this to be a little obtrusive when using headphones although you can't really hear it when only using the speaker. I found the cure to be a small 100mH inductor in the positive rail to the display. It needs to be able to handle a few milliamps.

The best place to put this is where you take the power feed off one of the boards. I feed mine directly from the power input to the VFO. The inductor does a fine job of smoothing the supply to the display and stops any nasty noise getting back onto the power rail.

Winding Toroid Coils

Every time the wire goes through the centre, it counts as one turn. Even the very first time. L1 is easy to make. You simply feed the wire through the hole, counting as you go. Try to keep the wire pretty close to the core but don't pull too hard or you could snap the wire or crack the toroid former. Leave about an inch of wire free either end. Try to make the turns occupy from around 8 o'clock to around 4 o'clock around the toroid.

Most enamelled copper wire these days has a coating that will burn off when you run it through a pool of solder on your soldering iron. With the older stuff like I still have, you need to gently scrape off the enamel coating with a sharp knife or with some fine emery paper before you can tin it. The enamel coating, especially on the old stuff, gives off some pretty toxic fumes so I recommend, at the least, opening a window when you do this.

I've invested in a fume extractor for my soldering activities so if you intend to get into homebrew big time, they're a good idea. When you've completed a toroid, if you have an inductance meter you can check the value. You can increase it a little by squeezing the turns together or vice versa. If you don't have an inductance meter, then don't worry. The values will be pretty close. Put one on your Christmas list.

Constructing the Board

Hopefully, you're getting into the Manhattan construction now so, as promised, I offer an annotated photo of my well-butchered VFO board, **Fig. 2**.

As I said at the end of the last part, this board has been swapped and changed about a lot and is looking a bit worse for wear but you can take two things from this. 1) It is testament to the flexibility of the Manhattan construction method and 2) My VFO is still extremely stable for a free-running oscillator, most likely because everything is tight to 'mother-earth'.

Please don't try to copy my layout though. I'm sure you can work out a much better design. As we did with the Audio Board, start with the mounting holes and then decide where you want the 'Ins' and 'Outs'. Then work from the power rail inwards. Build the oscillator first and confirm it runs and that the tuning pot adjusts the frequency.

Don't forget the RIT circuit will change the frequency when you add it so don't worry about getting the frequency range exactly right until the board is completed.

Hopefully, you'll have a completed working VFO board, in its housing ready to be mounted in your rig enclosure. If you have one in mind, then it's up to you where you fit it but I suggest that you aim to keep it as far away from where you intend to mount the PA transistor as you can.

If you're using the same silly case I have, then you should know that I mounted it vertically on the right-hand side, looking at the front of the rig. I'll provide pictures of the internal layout of my rig in a later part.

And Finally ...

My aim has been to write these articles with enough detail to enable you to understand how these circuits work and fit together. I'm also trying to find a balance that avoids giving too much detail as I'd really like you to experiment with your boards too. I learned a lot building this rig, much more than I would have learned by following the instructions to a kit. I am hoping that by following my design each month you will also learn a lot too.

James Stevens M0JCQ
practicalwireless@warnersgroup.co.uk

How to Check Propagation Using FT8

James Stevens M0JCQ explains how to use FT8 as an aid to understanding propagation and chasing DX.

My initial use of FT8 was just like any other data mode that came before it, such as RTTY, PSK31 and JT65. What I soon noticed was that it's also an incredibly useful tool for checking propagation, on many bands across our allocated spectrum, from LF, HF, VHF and even on the 70cm and 23cm UHF bands.

We already have several ways to monitor propagation from the traditional beacons, and more recently WSPR was used extensively to monitor where your own signal was being received. This article will explain how I've been using FT8 to monitor propagation on various bands to see which paths might be open and workable for me and my station.

FT8 isn't everyone's cup of tea, but even if that is the case for you, hopefully this article will highlight how it can still be a useful tool to check propagation, even if you intend to operate using another mode.

Why Check Propagation Using FT8?

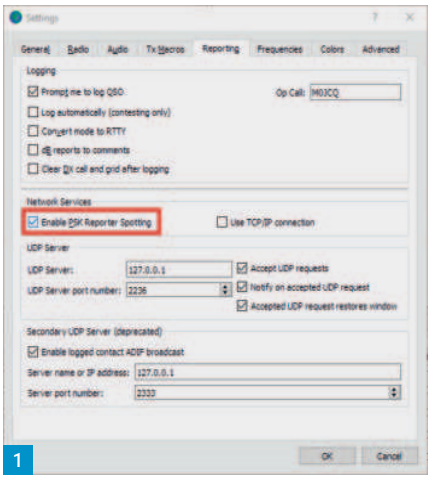
Before we get started let's review just why using FT8 for checking propagation could be a useful tool:

- FT8 allows very sensitive decoding down to –24dB.
- Extensive network of stations monitoring and reporting 24/7 around the world on a wide spread of bands.
- Reception reports are available almost in real time, so you can see where your own transmissions have been received.
- See which stations you've received.
- The pskreporter.info website displays these reports in an easy-to-use visual format.
- You can monitor the propagation conditions as they change.
- FT8 is widely used across our bands.
- Understand which bands are open.
- Understand the paths open in near real time.
- Understand the propagation modes enabling the open paths.

What You'll Need

Before we get started, we need some basic tools in place, some of which you may already have set up:

- FT8 capable software such as WSJT-X or JTDX (we'll refer to WSJT-X throughout this article).
- The pskreporter.info website.
- Accurate PC clock time (software such as Dimension 4 [1] will update this automatically for you).



1

If you've used FT8 previously, then you'll probably have all of these in place. This article is going to assume that you've already got FT8 set up and working with your rig.

How to Check Propagation: 1. Set WSJT-X to report decodes:

We need to configure WSJT-X to monitor our decodes and automatically 'spot' (report) them to the pskreporter.info website. This means that everything your computer successfully decodes will be reported back to the website and available for others to use – if you're going to make use of seeing who's received your signals, then you should do the same to help others out.

To enable this, go to the File > Settings... menu option in WSJT-X and then click the 'Reporting' tab, **Fig. 1**.

Remember this is the key that allows everyone to monitor where their own signals have been received. With reporting enabled we all receive and decode a signal and then report it back to a central source, which everyone can monitor. WSJT-X does all of this in the background automatically after you've enabled this option.

2. Put out a few CQ calls:

We're not so much interested in making contacts right now, but by putting out a few CQ calls we will start to get reports back from the stations who have received our signal. If you don't want to call CQ, you can also just respond to another station's call – the result is the same – stations will report back if they've received you.

While on 20m one morning, I started putting out a few CQ calls and soon got a pileup of responses from Japan and China. Obviously, the propagation towards South-East Asia was exceptional on this morning and I continued to work many stations from this part of the world, **Fig. 2**.

3. Change Timeslots:

FT8 is a time-sensitive data mode and transmissions are split into two distinct odd and even timeslots of 15 seconds each. Try a few calls in each slot to see an accurate overview of band conditions – some stations will be receiving on one slot and transmitting on the other and vice versa, **Fig. 3**.

4. Visit pskreporter.info:

Now you've put out a few FT8 calls on both time slots, the reports will start appearing on the PSK Reporter website. To see your reports, simply enter your callsign in the search box at the top of the page and press 'Find'.

Next, you'll see a page showing a map with (hopefully) all your spots. This page lets you filter your results to drill into what you're interested in. Here you can filter by a specific band, signals sent or received by you, the mode and the time frame (between 15 minutes up to the last 24 hours). I typically apply the band and time filters

Fig. 1: Where to enable reporting within WSJT-X. This only needs to be done once.
Fig. 2: Sometimes, just putting out a call or two will result in responses like this. It was clear that propagation to Japan and China was red hot on this day!
Fig. 3: Testing the conditions before a 4m SSB contest by using FT8. A nice amount of SpE FT8 contacts were made on 6m. Only EA7JXH was worked during the contest on 4m SSB, but it did account for half my points at 1,723km and he called me!
Fig. 4: How I filter my reports on the pskreporter.info website.

to see what I'm interested in. In terms of the time filter, if I'm interested in near real time propagation, then I'll set this to 15 minutes. You will then only see the reports for the last 15 minutes. This will give you a clear picture of when propagation paths are opening and closing across the world, **Fig. 4**.

5. Try Different Bands:

You don't need to restrict testing the propagation to a single band. I will often test the waters on 20m and then progressively move up to 17m, 15m, 12m and even 10m if it looks as though propagation is being supported on the previous band. This helps me build a clear idea of what the maximum usable frequency might be and also if a band is starting to open for the day.

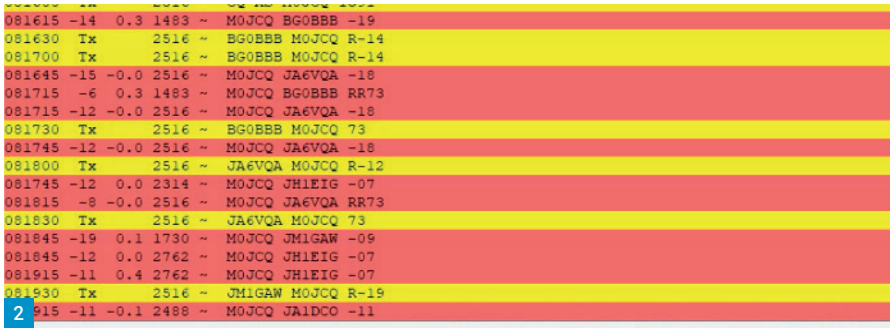
I do a similar exercise during the Sporadic E season in the summer, I'll put out a few calls starting on 10m and then move up to 6m and then 4m. The average distances of the reports on each band will give me an idea of how strong the opening is.

6. Analysing the Results:

Are your signal reports strong enough to switch to a different mode?

All stations who report receiving you will also report the signal strength you were received at. This can tell you a lot about the path that is open to that part of the world and which modes might be suitable for a contact. Here we can use FT8 to tell us which other modes might work, sounds a bit counterintuitive right?

It all comes down to the signal reports we receive back in decibels. Here we need to understand the minimum signal levels needed to use a given mode; roughly FT8 is around –24dB, CW –15dB and SSB is +6dB (these figures are relative to the noise floor) depending on many factors. Based on these assumptions, if we can see that we're receiving reports at +6dB and above, then it would be worth switching to SSB instead and trying to make some contacts as the propagation path would seem to support this. Some would argue you shouldn't stick with FT8, a weak signal mode, when propagation is good enough to support other modes, **Fig. 5**.



7. Compare Antennas:

Do you have different antennas for the same band? Maybe you'd like to compare the performance of the two antennas? With an antenna switch you can easily switch between the two antennas, trying a few calls on each timeslot and then switching to the other antenna and do the same. The spots on pskreporter.info tell you how long ago you were received, so it's easy enough to find out which antenna was responsible for the reception. The key here is not to wait too long between transmissions on both antennas, otherwise it would become less conclusive that the antenna itself was responsible or improving/deteriorating propagation was the cause. It's not an exact science but will quickly identify if one is slightly better for working DX (more DX reports seen), or in fact better for working relatively local stations.

If you have a 2m station, try switching between a collinear and your horizontal Yagi. You may well receive reports from the same stations, but you'll notice the cross-polarisation effects, depending on their receiving antenna the signal reports should be very different.

8. Change the Beam Heading:

For most of us this one probably only applies when using the VHF/UHF bands, but if you're using a directional antenna, try to experiment with various beam headings. I'd call once or twice at each beam heading, and then you'll be able to build a clear picture of any special propagation and path openings in certain directions.

A classic example would be during Sporadic E openings on 6m. These are, by their nature, both sporadic and sometimes very localised. During the summer months it pays to beam at least to the East, South and West on 6m and 4m to build an idea of the paths available via the Es propagation.

I've capitalised on this in the past and spotted some very localised openings in certain directions. A good example would be beaming West on 6m and noticing the spots were no longer just groundwave to Wales and Ireland, but suddenly a multi-hop Es path to Florida appeared. With this in mind, I beamed towards Florida and worked a nice number of squares there. Nowhere else on the Eastern seaboard of the US seemed open, but thinking about it, if I was getting spots in Florida, then a path to the Caribbean might also be possible. Despite no immediate spots on pskreporter.info, I continued to persevere and worked Puerto Rico, Guadeloupe, Anguilla and the Dominican Republic on the magic band. By seeing a few spots in Florida, I had the patience and gall to call and call fishing for some DX and it paid off, **Fig. 6**!

Another example on 6m included beaming South and Southwest during an Es opening and noticing out of the typical Spanish station spots, that suddenly my signal was reaching the Canary Islands. This led me to spend some time working EA8 stations, but then I noticed the propagation reaching further into Africa, with spots appearing from some exciting DX locations such as Mauritania and Senegal. After a few attempts Mauritania was in the log for an ATNO (all-time new one) on 6m, but the opening further south to Senegal (6W1TA at 4,393km) proved to be too fleeting to make a contact, despite the odd spot. I continued beaming in this direction and also worked Morocco, the Azores and six EA8 stations, **Fig. 7**.

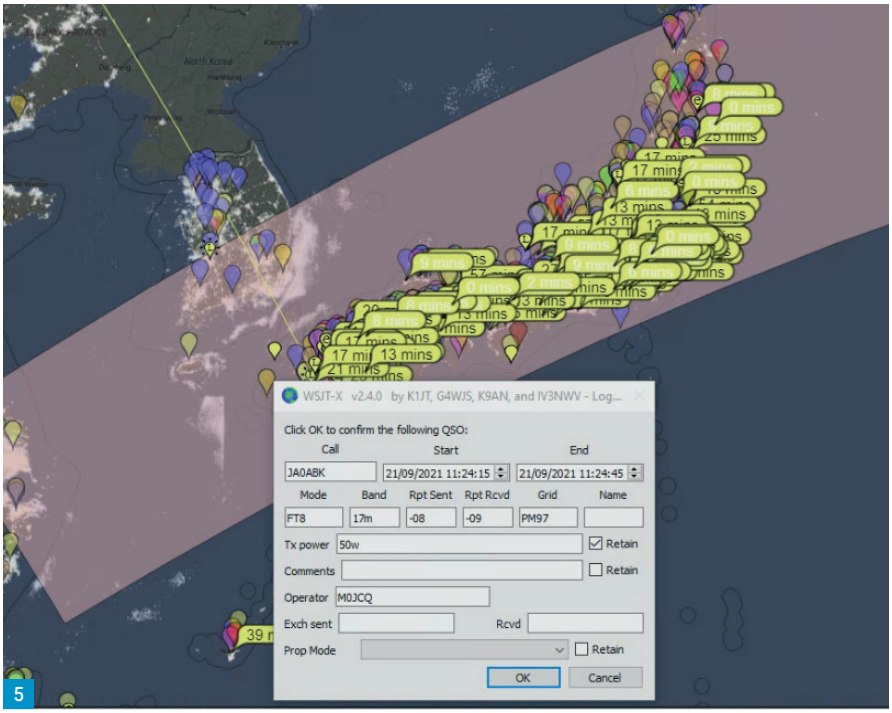
9. Review the Receiving Station's Equipment:

The PSK Reporter website will also show you basic information about the station who received your signal, **Fig. 8**. This is useful because it will also inform us about the overall conditions. If you're only being received by mega-stations with HF Yagis, then the propagation to that part of the world may just be marginal. Conversely, if you're being received by more modest stations using simple wire antennas, then the propagation is probably stronger and actual contacts more likely.

10. Marginal Openings:

Depending on the propagation mode(s) at play on your chosen band, you may notice very fleeting openings to certain locations. If you notice these quickly enough, you may be able to work some extra DX. On HF you may notice temporary enhancements due to greyline propagation, on VHF it could be due to any number of temporary propagation modes!

A common one you might notice on the 2m band, is where suddenly and for a short time (typically several overs) your signal will be received further than usual in a very specific direction. From my QTH in IO91 this manifests itself with short lived spots from Belgium, the Netherlands and Ireland. Being so close to major airports, often these can the result of aircraft along the signal path, resulting in aircraft scatter propagation. This (artificial) propagation mode results in temporary enhancements where your VHF signal is being reflected back down to earth by the metallic aircraft body, instead of simply continuing up into space. Many serious VHF operators take advantage of this during contests to bag extra DX. The excellent AirScout software



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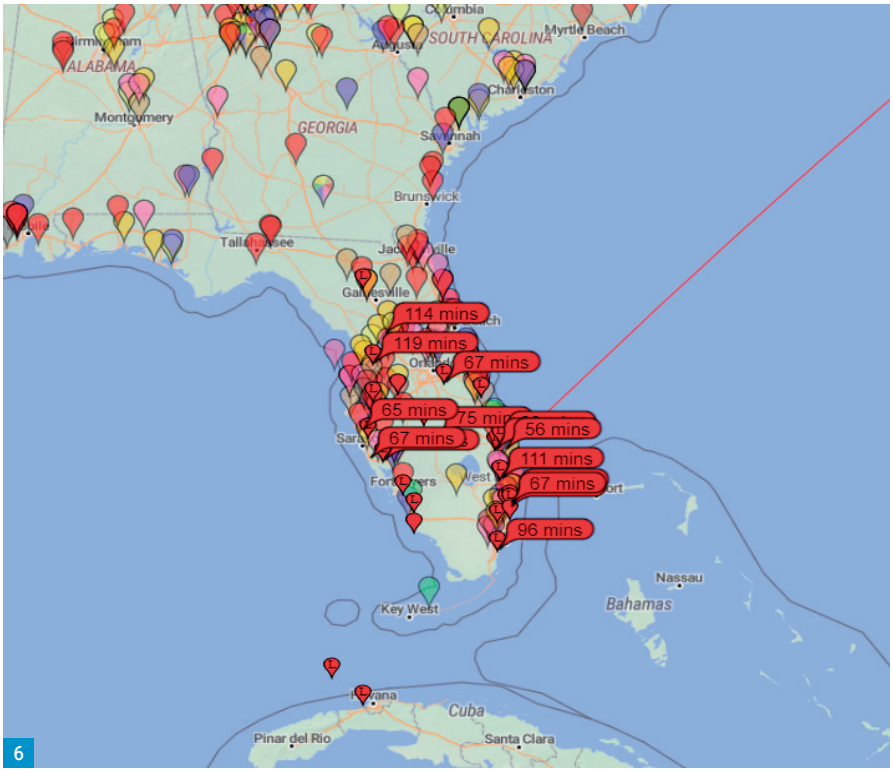

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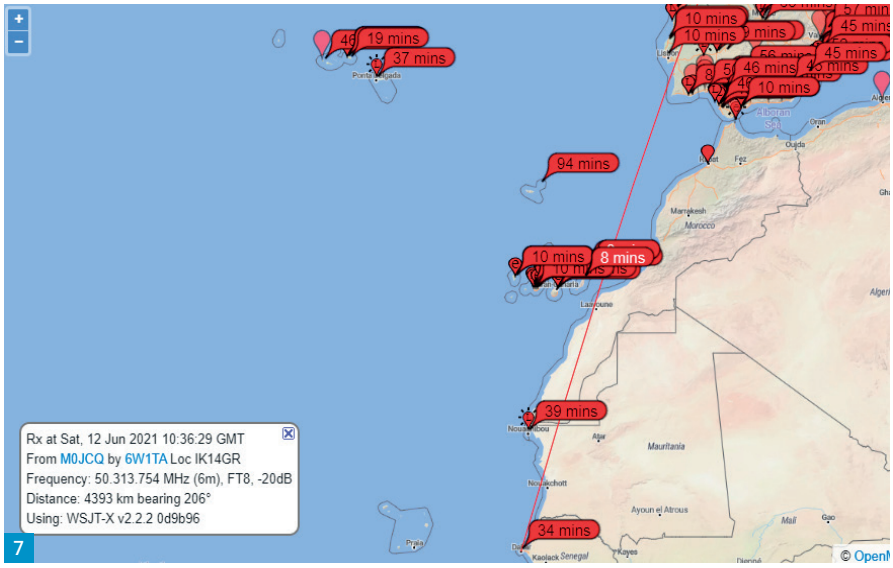


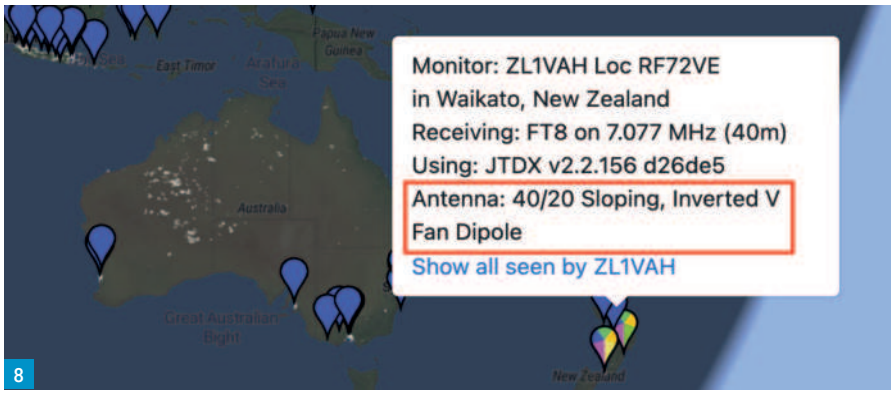


Fig. 5: Catching a great opening to Japan on 17m. Fig. 6: Seeing a Transatlantic opening on the 6m band while beaming West – all spots were localised to Florida, but this gave me confidence to try working some DX in the Caribbean. Fig. 7: A nice opening to North Africa on 6m. From these spots I continued to get Mauritania, Morocco, Azores and multiple stations from the Canary Islands in the log. Fig. 8: Clicking a receiving station's pin on pskreporter.info will display basic station information. Here we can see ZL1VAH is using an inverted-V dipole for 40m, so any spots from this station would suggest decent propagation to ZL and contacts might be more likely.

[2] helps to understand the potential planes available and the resulting stations you could contact.

11. Catch DX:

Once you've seen where you've been received, you will have built a logical idea of what you might be able to work. If you notice a DX station spot you, then there's a fair chance you can work the station. This can give you confidence to be more persistent and try to net that DX contact. After all, you know they've received you recently, so it's at least possible!

I worked 3D2USU (Fiji Islands) in September last year and this is a contact I wouldn't have persisted with if I hadn't seen him receive me earlier. I was using a wire antenna and 50W, and at around 16,192km, I wouldn't have been so confident otherwise. His signal report from the spot was low enough that I knew I would need to persist to complete the contact.

Disadvantages

While no method of checking propagation is perfect, this FT8 approach also has some drawbacks. Obviously, the major one is that you'll only get spots from stations set up to decode FT8, which are actively monitoring and reporting what they've received.

Also, the reporting stations aren't distributed evenly across the globe. For example, Africa doesn't have too many stations reporting. This is something to be aware of as you'll only see reports if there is a station located there to receive you in the first place. Propagation could still be open to that part of the world, but maybe the active stations are using a different mode!

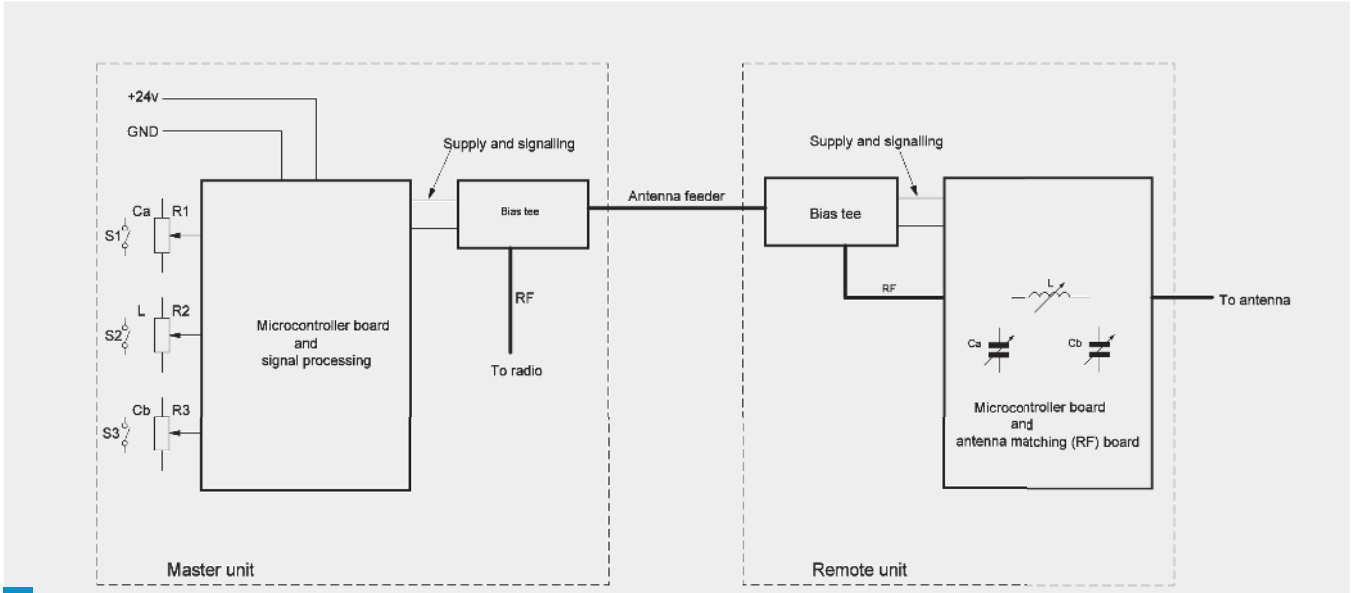
Conclusion

I'm sure I'm not the only one using FT8 in this way, but I personally have found it to be a very useful way of checking propagation in real time. I'd also say it's helped me to understand the types of propagation at play and enabled me to make more DX contacts.

There's a good chance you may already have an FT8 enabled station and if so, I'd encourage you to try using it this way.

Web Links

[1] Dimension 4 Clock Synchronisation software:
www.thinkman.com/dimension4
[2] AirScout software for Aircraft Scatter:
www.airscout.eu



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Ken Ginn G8NDL
practicalwireless@warnersgroup.co.uk

Remote Manual HF ATU (Part I)

Ken Ginn G8NDL describes the construction of a manual ATU that operates remotely.

In an HF radio installation we have a choice as to where an antenna's ATU (if used) can be sited, either in the shack or closer to the antenna. The best position for an Antenna Tuning Unit (ATU) is to have the ATU at the antenna end of the installation rather than being local to the radio in the shack. This offers the best solution where the feeder is matched all along the signal path to the ATU. Even when matched, a shack sited ATU will have a degree of mismatch from the ATU along the coaxial feeder to the complex impedances offered by the antenna.

Remote auto ATUs offer a better solution and there are a good number of commercially available auto ATUs on the market. Alternatively, there are a small number of remote ATU designs published on the internet, which offer remote manual control over an automatic remote ATU. Published designs have a control cable running alongside the coax feeder to adjust the various inductor and capacitor arrangements to offer a good impedance match. This new design is a two-part ATU, where the control data is sent along the coax feeder and not along a separate control cable, and the impedance matching is accomplished at the antenna end.

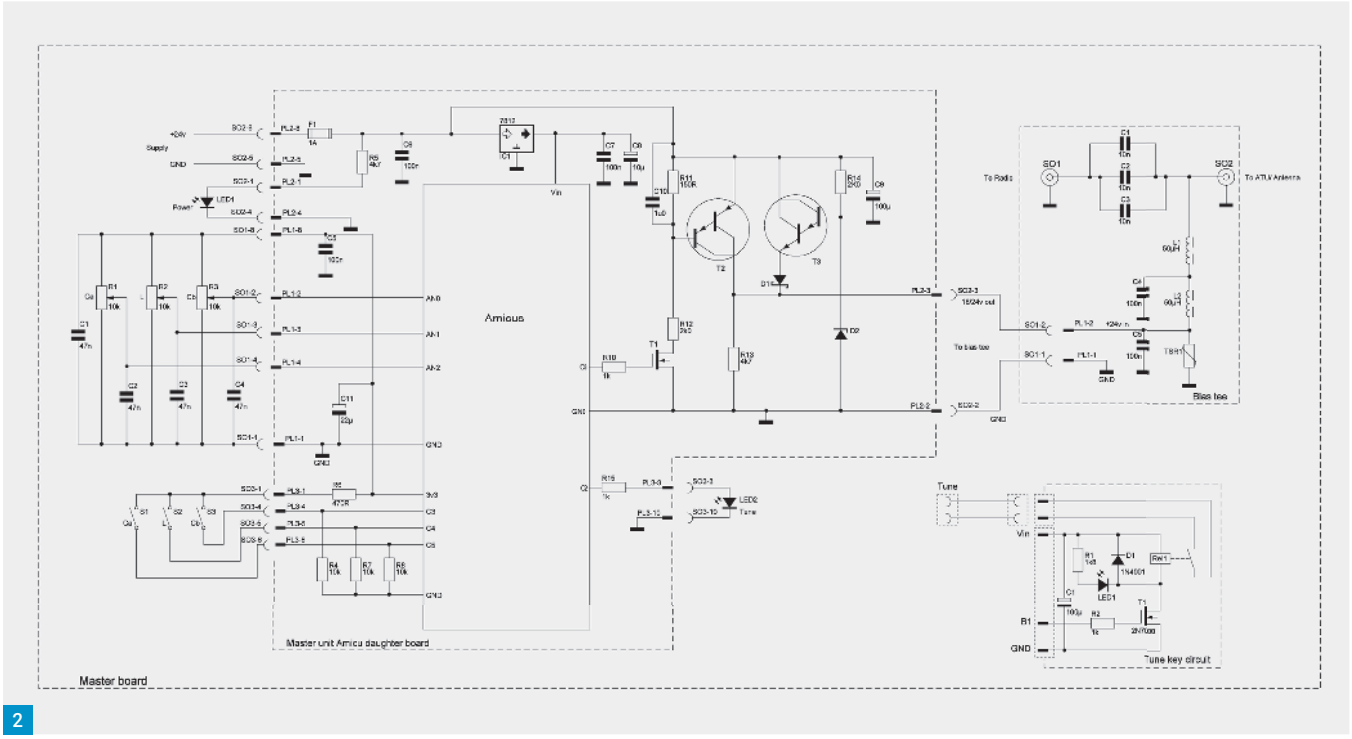
Having manual control of the ATU offers a better chance to match the antenna to the feeder impedance. With the auto ATUs I have, I have found on occasions that it can be difficult to obtain a match at the higher HF bands; in particular 12, 10 and also 6m – patience is often required. This initiates switching off of the remote ATU and back on again. This action often does not always cause the auto ATU to subsequently find a good match for the antenna. Repeating the procedure may see the ATU eventually provide a decent match of less than 2:1. Manual tuning was thought to solve the problem, and it does.

Overall Design

The block diagram is shown at **Fig. 1**. In this design I decided to have a similar pi arrangement of switched capacitors and inductors used in one the original auto ATUs. I have designed systems using discrete components and microcontrollers in the past that have used power line signalling. These systems have proved to be reliable and extremely robust. One such system has been running for seven years without a single problem.

This remote manual ATU has been split into two parts. The master unit is located in the shack. This contains a microcontroller system where the user is presented with three front panel controls, Ca, L and Cb. Pressing the button below the rotary control controls the action of a set of relays at the remote end where the pi network of capacitors and inductors does its magic to match the antenna to the impedance of the feeder. The remote unit, some 30m away, has an array of relay switched capacitors and inductors to effect a match. 24 volts DC and serial data is fed from the master unit along the coax feeder to the remote unit. This provides power and control signalling for the remote unit. The remote unit uses a second microcontroller to decode the data and adjusts the capacitance and inductance values to match the antenna's impedance to the feeder.

The ATU detailed here runs from the home QTH, and I can select either one of two transceivers to use. Either an Icom IC-7410 or a Yaesu FT-911. These radios are limited to 100W RF output on HF bands and 6m. I normally limit my rig's output power to 50W, this I have always done. I am also required to comply with exposure limitations with the recent introduction of the ICNIRP regulations with the antenna close to family members and the general public. The circuit should be capable of running to 200W or more but I have never tested the ATU beyond 100W.



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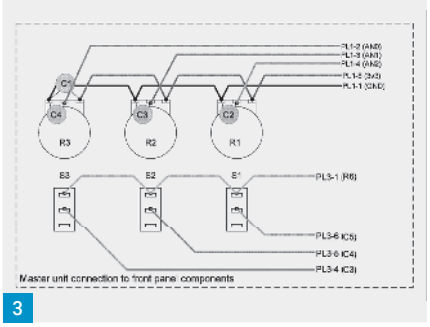

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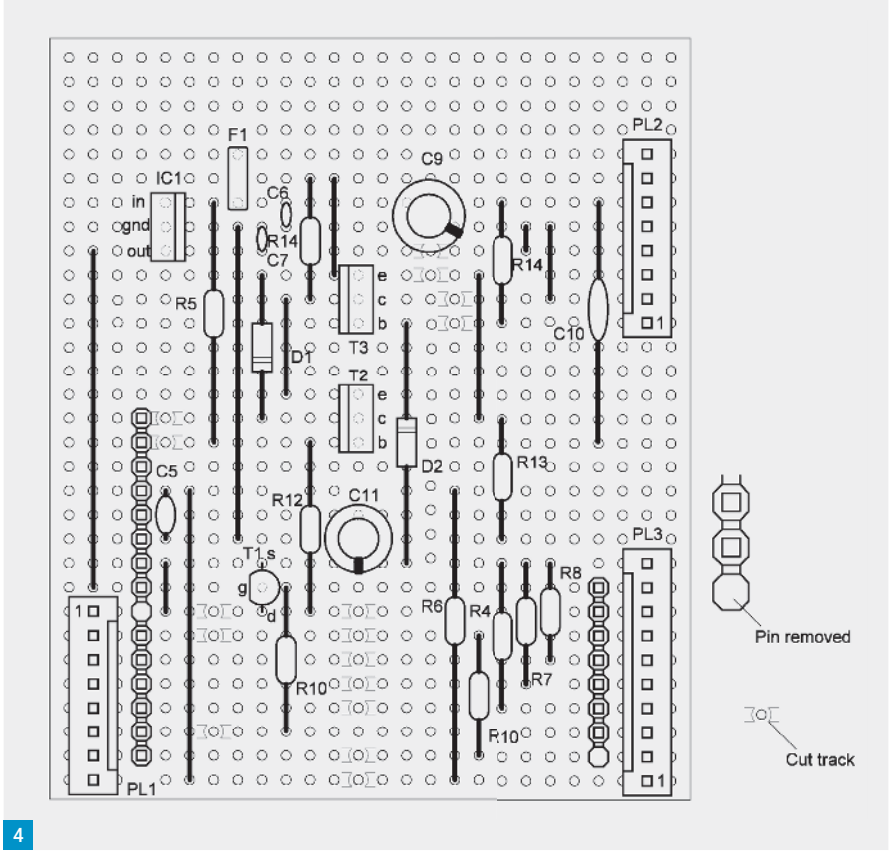

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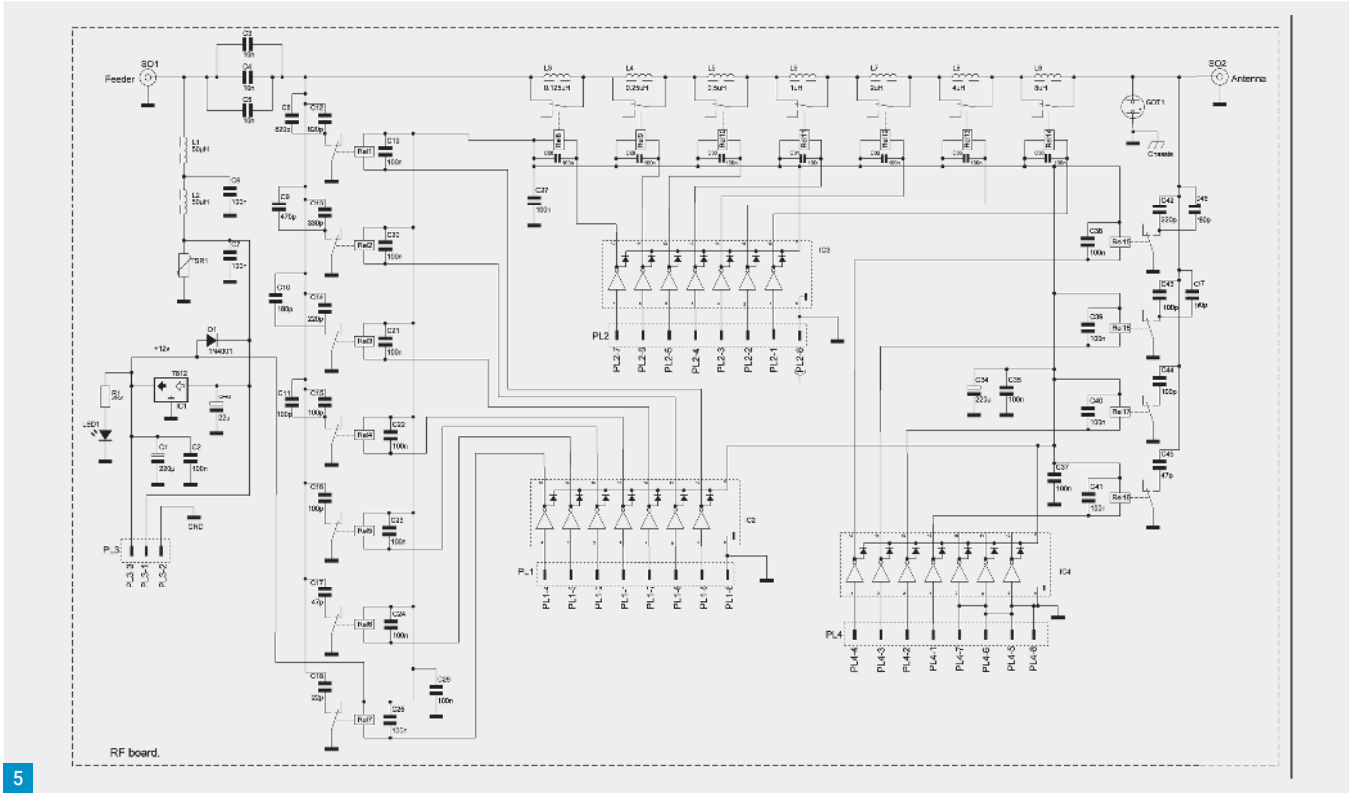
Fig. 1: Block diagram.
Fig. 2: Master unit schematic.
Fig. 3: Master unit front panel wiring.
Fig. 4: Strip board shield circuit component location.

A good number of the components used for this project were from surplus components, such as all the toroid cores. Some like the relays and high voltage capacitors were ordered in.

Microcontrollers

Three very similar microcontroller development boards exist with the same footprint. The Amicus and Firewing boards both use PICs, whereas the Arduino uses an ATmega microcontroller. The Amicus uses the PIC18F25K20 PIC and the Firewing uses the PIC18F25K22. A search on the internet reveals variations on the Amicus, even a kit with discrete components to solder in. Programming language for the Amicus and Firewing boards in their own development suite is generally PIC BASIC where the Arduino is programmed in C, although it is possible to program an Arduino in BASIC. The author has a quantity of the Amicus boards and sets of the project's PCB boards, which can be made available. The Amicus can be supplied programmed or unprogrammed. The project does lend itself to be modified and used with an Arduino, but no such code has been written for the Arduino for this project as yet.

In the master and remote units the PIC



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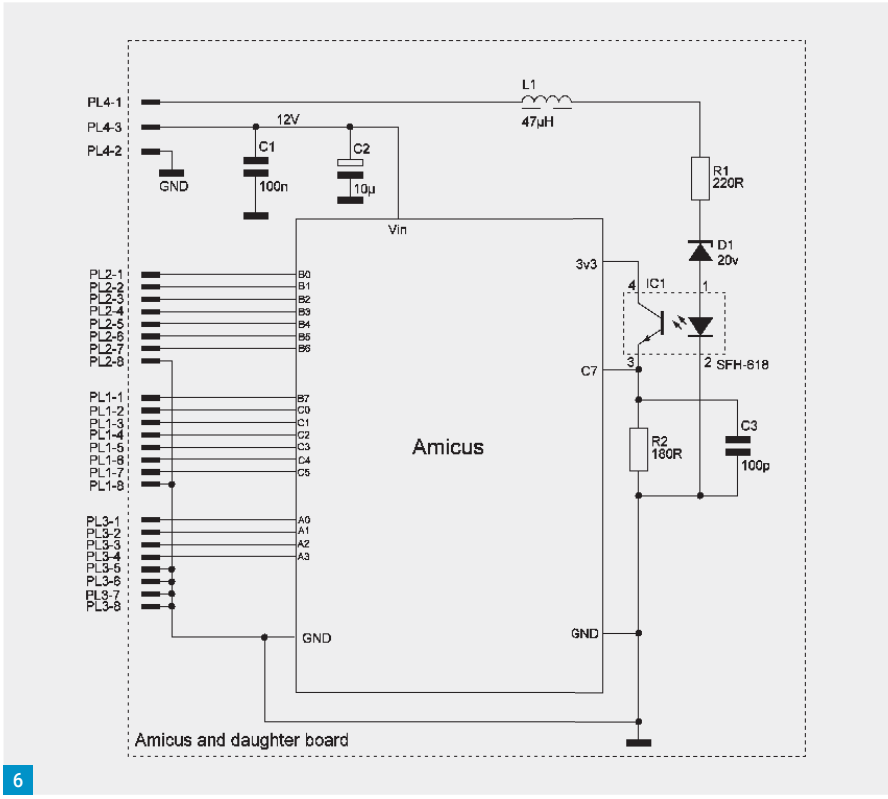

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Fig. 5: Remote RF relay board schematic.
Fig. 6: Amicus shield schematic.
Fig. 7: Remote unit wiring.

version of the Arduino, an Amicus, is used to run both parts of the ATU. Proton IDE was used to write and program the firmware into the on-board PICs. Proton IDE is available free from internet sources. See notes at end of article.

The Circuit (Master)

The system is mains powered with an internal variable 24V switched mode power supply. Alternatively, an internal linear 24V 1.5A DC supply would suffice. With either choice of power supply, variable voltage control over the range of 22 to 27V is preferable; this will compensate for resistive losses in the coax cable and ensure correct signalling levels at the remote unit. The cost and convenience of the switched mode power supply unit (SMPSU) made the building more attractive than using a conventional mains-powered linear power supply. However, the SMPSU is a little noisy, probably more so than a linear power supply.

A resettable 1A Polyfuse fuse (F1) is used in the event of a fault as this helps should a short be presented to the master unit's RF port. Troubleshooting and replacing a cartridge fuse when setting up or working on an antenna is so much easier with the resettable Polyfuse. This was learned from experience.

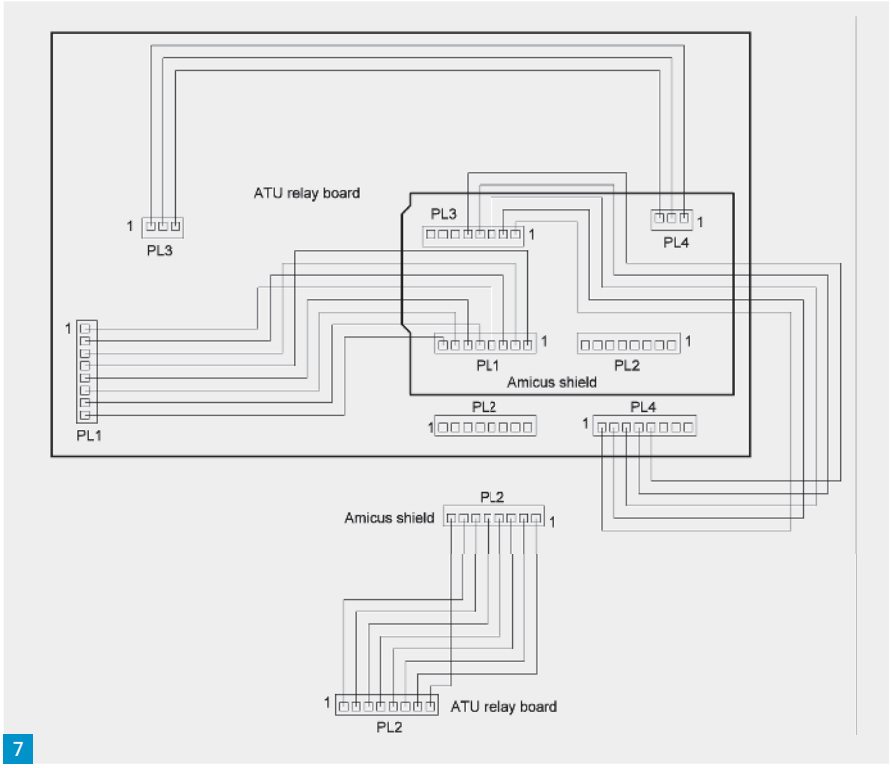
The master unit schematic is shown in **Fig. 2.** Power is supplied to the master Amicus board via a 7812 12V 1A three-terminal regulator; this needs a heat sink. The master unit will draw some 50mA from the 24V supply with no load connected to the output of the bias tee. Under load and tuning the calculated current drawn from the supply would be a maximum of 800mA with all relays energised. Heat sinking of T2 and T3 is required. A small bracket with insulating washers was fabricated to assist in heat dis-

sipation away from these components. This heat sinking arrangement also offers a small degree of shielding from the bias tee circuit carrying the full RF power during transmit. **Fig. 3** shows the front panel wiring of the master unit.

During quiescent conditions (no tuning) a constant 24V supply is sent from the master to the remote unit, this is done to reduce the power consumption on the power supply transistor T2 in the master unit. Also, in the quiescent state the FET T1 is turned on under instructions from the Amicus board causing T2 to conduct. When a control potentiometer is selected with the use of its associated switch, for example, this being switch S1 and using the rotary control R1 (Ca), serial data is sent twice from the Amicus board and modulates the DC supply to the remote unit. This serial control data is sent at 1200Bd 8N1. Sufficient signal amplitude is carried along a long 30m or more run of coax to be recovered at the remote end. When the 24V supply is modulated, T2 no longer conducting opens a path of current via the 18V power supply formed with D1, D2, T3 and R14. These are brief transitions as a data bit is generated and sent to the remote unit. D1 is provided to protect T3 when the circuit is in a quiescent state, without D1 the emitter and collector junctions of T3 could be momentarily reverse biased. **Fig. 4** shows the strip board shield circuit component location.

The use of switches to initiate tuning was considered in order to reduce any occurrence of accidental tuning of the ATU when in use. This could otherwise cause problems to the radio during a transmit phase.

The alphanumerical value of serial data sent from the master unit is dependent on which control is selected. Selecting the control Ca, the numerical value of serial data is related to the potentiometer slider's position R1, and the voltage on the slider. Three Analogue-to-Digital Convertors (ADCs) are configured on three inputs for Ca, L and Cb. The potentiometer's slider voltage is read by the ADC and translated to a numerical value. This numerical value with the Ca control selected will be in the region of 0 to 127, evoking the L control the numerical value generated will be in the region of 200 to 327, and the Cb data will be in the region of 400 to 415. Ca and L controls are associated with the actuation of seven relays, Cb four relays. During a tune routine the Tune LED D2 will illuminate. Pressing two or more buttons initiating tune will result in an error and the TUNE LED will flash and indicate a tuning error. In this case the last valid value will be sent to the remote unit and further data will suppressed. Only one tuning procedure can occur at one time.



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Along with the numerical values generated from the master unit the ASCII character 'S' is inserted before each numerical value and the ASCII character 'E' is added to the end of each value. This instructs the remote unit there is a valid command and this informs the remote unit where the start and the end of each instruction is located.

On the IC-718 and in particular the IC-7410 a four-pin connector is supplied on the rear panel of the radio, which will initiate tuning of the transmitter. A relay driver and a reed relay on an additional circuit board with a closing set of relay contacts provide this facility. A socket mounted on the rear of the master unit provides connection to the radio. **Fig. 5** shows the remote relay board schematic.

Along the Cable – Data Stream

The bias tee used in the master unit is there to inject the RF signal, the 24V DC supply to the remote unit along with the serial control data in the coaxial feeder. This does not affect the running of the radio connected to the ATU. Capacitors C1, C2 and C3 in the bias tee block the DC path back to the radio. This supplies DC current to the remote unit and a signal path between radio and antenna. Along the feeder there is a 24V DC supply, modulated with an 8V peak-to-peak data stream. This data stream only occurs when tuning. The serial data is extracted at the remote unit with a second bias tee and fed to the Amicus board for decoding and subsequent actuation of the relays. The DC voltage on the coaxial feeder is removed with the bias tee in the remote unit. **Fig. 6** shows the Amicus shield schematic while **Fig. 7** shows the wiring of the remote unit.

Remote Unit Data Recovery

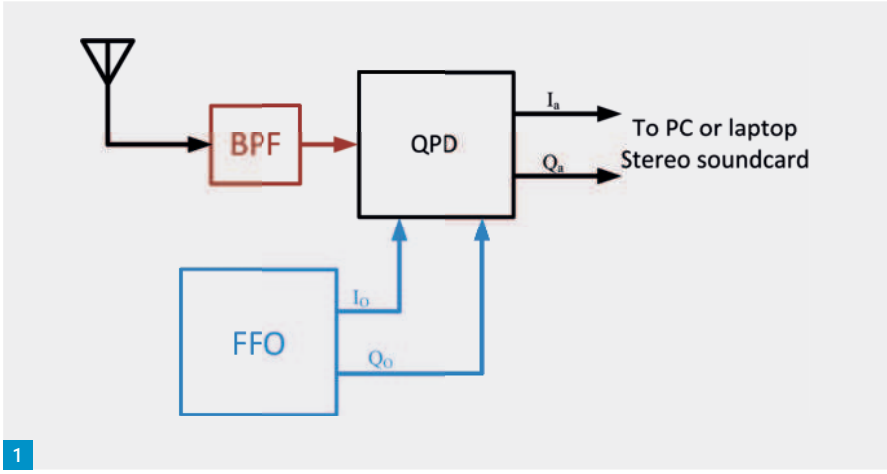
Data is received at the remote unit and with the use of the Zener diode D1, R1 and the optocoupler IC1. An optocoupler is used as this offers a good degree of isolation between the microcontroller circuitry and the RF signals on the feeder. This also significantly reduces any erroneous transmissions from the remote Amicus board to the radio, and any signals from the transmitter affecting the microcontroller. This could otherwise cause undesirable effects on the microcontroller; such as random mis-tuning of the ATU when in use.

The received serial data at the remote unit is decoded into three parts, one part for the actuation of Ca, the second for L and the third for Cb. This is handled by the microcontroller on the Amicus board and directs drive to the appropriate relay drivers. The remote unit's relays are switched in a BCD sequence offering a capacitance of approximately 22pF to 2.5nF (Ca), inductance of approximately 0.125µH to 15µH (L), and for Cb a range of 10 to 500pF.

Next Month

Next month we will cover construction, testing and use.

Dr Samuel Ritchie EI9FZB
samuel.ritchie.8@gmail.com



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Fixed Frequency Operation

In this fourth part, the author has a look at using the quadrature product detector (QPD) described in the January 2022 issue for fixed frequency operations.

This article covers the one element shown in blue in the block diagram **Fig. 1**, that is the fixed frequency oscillator (FFO) used to tune to a specific frequency, or perhaps a limited number of spot frequencies.

You may recall in the previous article that I advised it was good practice and often useful to include a bandpass filter (BPF) to attenuate strong out-of-band signals, which helps to prevent unwanted spurious responses at the output. However, the QPD is fairly robust and resistant to very strong out-of-band signals on its own merit. To demonstrate this and for this article I have not used a BPF (shown in red in Fig. 1) and still achieved good results.

A GPS Referenced Oscillator

Having scanned a number of forums that deal with digital modes, it's easy to come away with the view that a very stable oscillator is required. The problem is one of definition, as what 'stable', 'very stable' or 'super-duper stable' actually mean to me may differ from the understanding of another. So, if you do want exceptional stability, then consider a GPS referenced oscillator.

The August 2019 publication of *RadioUser* magazine (the sister publication to *PW*) had a review by **Andrew Barron ZL3DW** of the 'Leo Bodnar GPS-disciplined reference clock'. In essence, this device provides two synchronised low-jitter reference clocks that have the long-term stability of the atomic clocks carried by the satellites that form part of the GPS system. The outputs are 3.3V CMOS square-waves with a characteristic impedance of 50Ω, which drive the QPD without any modification.

For our purpose, you select both outputs to have the same frequency, and then offset one by 90° to provide the quadrature signal we need. **Fig. 2** is a photo of the setup I used. **Fig. 3** shows the setup receiving WSPR on the 30m band. In the background HDSDR is running, the grey control panel for the GPS-disciplined oscillator is overlaid on the left and WSPR 2.0 is overlaid on the right.

Both outputs are set to 10,138,700Hz and the phase-shift between them is set to 90°. I class this as a fixed frequency setup as there is no way to tune up and down the band. You can change the frequency of operation easily enough, but it can take a few seconds for the software to find the right parameters, make the changes required to its internal registers, and for the phase-lock loop(s) to lock. Then you must remember to change the phase-angle each time, because this is reset to zero degrees each time you change frequency.

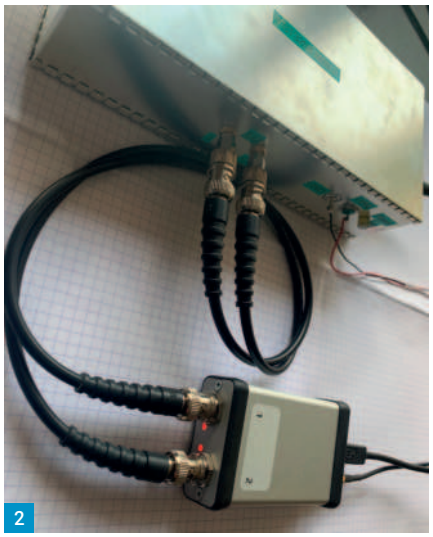
Do not allow me to lead you to think that single frequency is limited to digital modes – the advantage of the QPD as I have it set up is that you can see 20kHz either side of the frequency that you are tuned to. This is demonstrated in **Fig. 4**, which was taken during the CQ WW WPX SSB contest on 28 March 2021. Tuned to 14170kHz, and then using the HDSDR software to tune my USB decoder across the 40kHz, I could see and listen to the pile-ups.

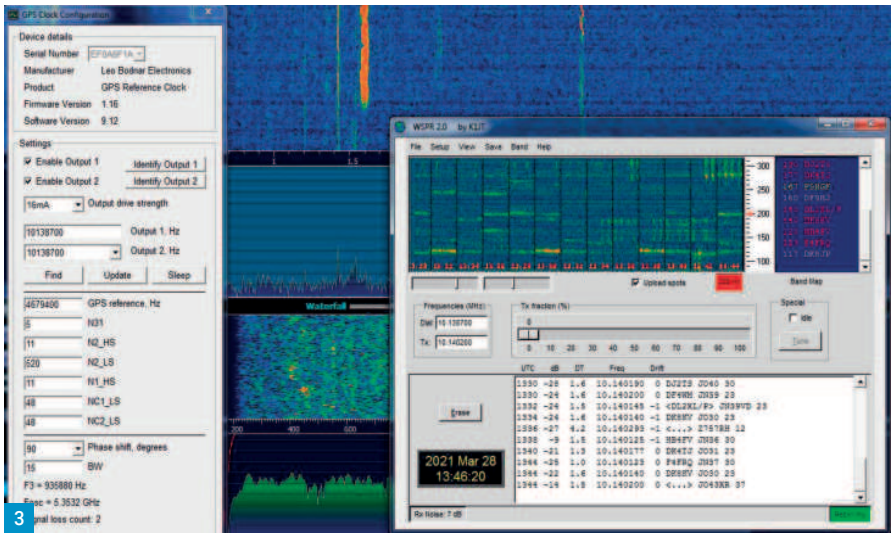
A Traditional Panoramic Adaptor

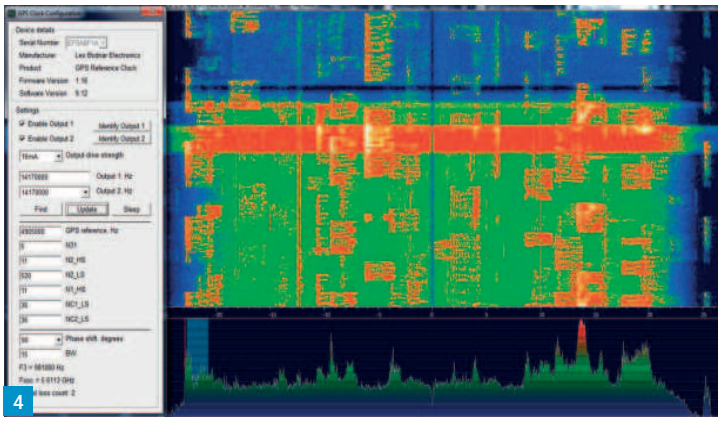
It is common practice on many semi-professional and professional receivers to provide a buffered output from one of the intermediate frequency (IF) stages of the receiver, and I note that a number of modern amateur rigs are now including this functionality.

Access to the IF was facilitated to permit the connection of a monitor (actually a form of oscilloscope) so that the operator could see the level of all signals being received within the IF bandwidth around the frequency that the receiver was tuned to. This gives the operator a visual indication of signals in the band (both above and below the frequency currently tuned and listened to) so that transmissions could be identified without having to constantly tune backwards and forwards and stillnot be in doubt that you may just have missed a short transmission.

I connected by QPD to one of my professional receivers that has a number of buffered IF outputs – one for each conversion stage. I chose the 455kHz IF output that has a bandwidth of 16kHz and no AGC applied. The result is shown in **Fig. 5**, which was taken during the 2021 Dutch PACC digi contest, which only caters for FT8 and RTTY. The professional receiver is tuned to 14078kHz and the light blue box







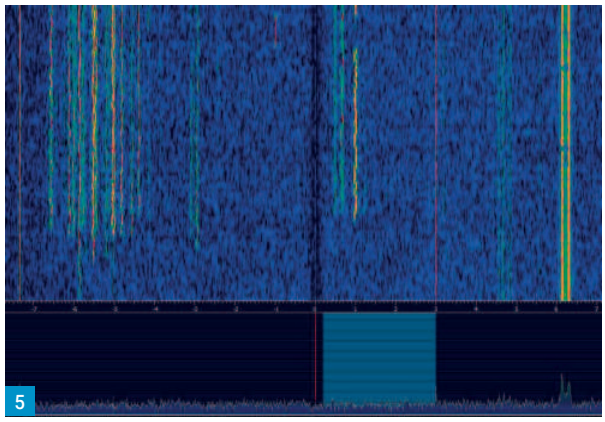


Fig. 1: Basic block diagram.
Fig. 2: Connection of the GPS disciplined oscillator to the QPD.Fig. 3: WSPR on 30m.
Fig. 4: A busy 20m band during a contest.
Fig. 5. Watching FT8 on the IF output of a receiver.Fig. 6. Block diagram of setup.
Fig. 7. Schematic of the RS-232 converter.
Fig. 8: Schematic of bank selection circuit.
Fig. 9: ProgRock and associated circuitry close up. Fig. 10: Block diagram of Si590 setup.
Fig. 11: Schematic of the Si590 oscillator.
Fig. 12: Si590 circuitry close up

indicates the USB reception bandwidth that the receiver is listening to – you can see a number of digital transmissions.

From viewing the 14kHz bandwidth segment, I can see some activity (unidentified) 4500 to 5000Hz above the frequency I am tuned to, and a strong RTTY signal 6kHz above what I am tuned to. There is also a lot of FT8 activity 4300 – 6600Hz below where I am listening on the professional receiver, and an additional digital transmission 3000Hz below where I am tuned on the receiver.

Connecting the QPD to a VHF receiver (this time with a 10.7MHz IF output) and monitoring the aeronautical band where air traffic control (ATC) transmissions are very short in duration is where the real advantage comes. This visual display of all activity in a 40kHz segment of the band helps to spot those short transmissions, identify active channels, and guide your retune to listen out for the next transmissions.

The ProgRock by QRP Labs

Amateurs used to refer to quartz crystals as 'rocks', and **Hans Summers G0UPL** provides through his company, QRP Labs, a kit called the ProgRock. This kit is aimed at replacing quartz crystals – especially the many unusual frequencies you would need, for example, to tune the many digital modes across all the HF bands.

The essence of the kit is a control board that is connected to a supplied frequency synthesiser board. This setup provides for the simultaneous output of three programmed frequencies, and provides for eight banks of three frequencies – all for $18. Compare that to the cost of quartz crystals. For another $23 you can add a GPS receiver board to frequency discipline the synthesiser although you do lose one of the output frequencies.

The outputs are conveniently 3.3V pk-pk, CMOS, square wave outputs and Hans has made a provision for quadrature outputs – although this limits you to eight spot frequencies as you can only make use of two frequencies in each bank. You will need to examine the circuit diagram and explanation which Hans makes available on his website:
www.qrp-labs.com/progrock.html

Having assembled the two PCBs, I added two additional PCBs as shown in teal and red in the block diagram in **Fig. 6**.

The kit has a facility to program the banks of frequencies using a 4-way DIP switch, but I chose to use the RS-232 port option to do this programming. However, to add this functionality I needed to convert the logic levels of the ProgRock microprocessor (0V to +5V) to RS-232 levels (–15V to +15V), and **Fig. 7** is the circuit diagram of my converter.

I use the MAX232 in a standard configuration. This allowed me to

use the serial port on my PC, run a terminal program and easily change the frequencies in each of the banks. I could easily tinker with the calibration settings to compensate for any inaccuracies in the crystal used to set the accuracy of the frequency synthesiser.

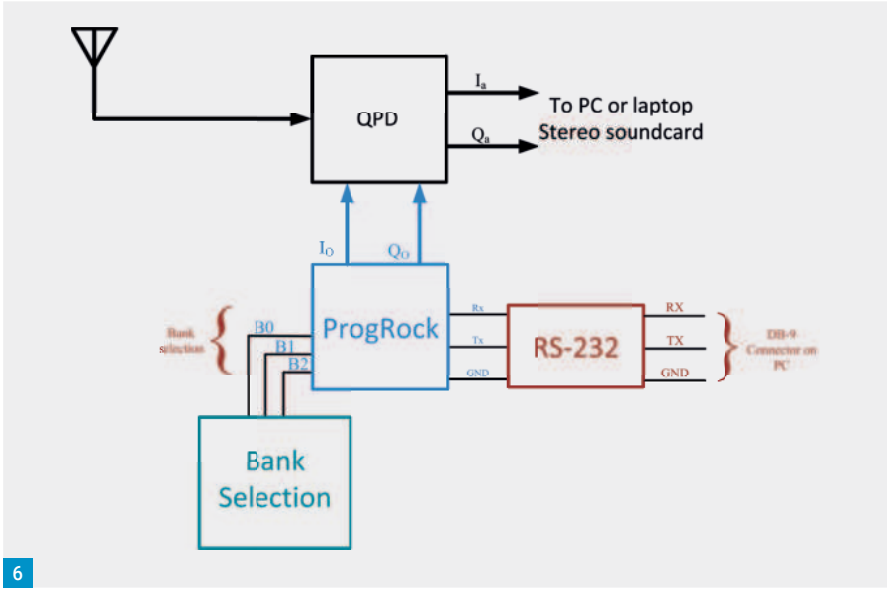
To select which frequency bank is used by the ProgRock, three input pins to the microprocessor (labelled B0, B1 and B2) are provided, and these use active-low binary coded decimal (BCD). The circuit diagram for how I implemented by bank selection circuit is shown in **Fig. 8**.

SW1 is a normally-closed pushbutton and goes to a MAX6816 (U1), which is a CMOS switch debouncer. As configured here, on start-up the output of U1 is always low. When the switch is pressed the output goes high, and when it is released the output returns to a low state – both without any false triggers caused by the switch bouncing. The smallest pulse I could create was 50ms, but the duration of the pulse is not important as U2 is only triggered by the rising edge created when SW1 is pressed. U2 is a CMOS synchronous presettable 4-bit counter, which I have configured as a BCD up-counter. R1 and C5 ensures on start-up that the output of U2 is set to 0000. On the rising edge of each pulse from U1 this counter counts up by one in BCD. As I only want to count from BCD 0000 to BCD 0111, Q1 resets the counter output when BCD 0111 is exceeded.

As the counter is outputting active-high BCD, I simply reverse the wires connected to B0 and B2 to change it to active-low BCD as required by the ProgRock. I chose to use LEDs to indicate which frequency I am tuned to, and used a 74HC138 1-of-8 decoder/demultiplexer to convert the BCD output from U2 to eight mutually exclusive active low outputs with each output driving an LED. **Table 1** hopefully helps to explain this more clearly.

Fig. 9 shows the ProgRock and its support circuitry. The ProgRock is in the upper-left quadrant with the two looped coax cables going to the QPD. In the upper-right quadrant is the RS-232 board with a DB-9 connector. The frequency selection board is in the lower-right quadrant.

The grey switch is a Schadow model SE, and U1 is a surface-mount device, which I have mounted on a red SOT-23 to DIL-8 converter PCB to make it easier to work with. I have the eight LEDs mounted through a board with the frequencies programmed into each bank written down.



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Event	U2			ProgRock Bank Selected	LED Lit
	Pin 14 Q1	Pin 13 Q2	Pin 12 Q3		
Start-up	0	0	0	7	1
Push SW1	0	0	1	6	2
Push SW1	0	1	0	5	3
Push SW1	0	1	1	4	4
Push SW1	1	0	0	3	5
Push SW1	1	0	1	2	6
Push SW1	1	1	0	1	7
Push SW1	1	1	1	0	8
Push SW1 Resets back to start-up by U2 Pin 11 Q4 going high and triggering Q1 (2N7000).					
Start-up	0	0	0	7	1

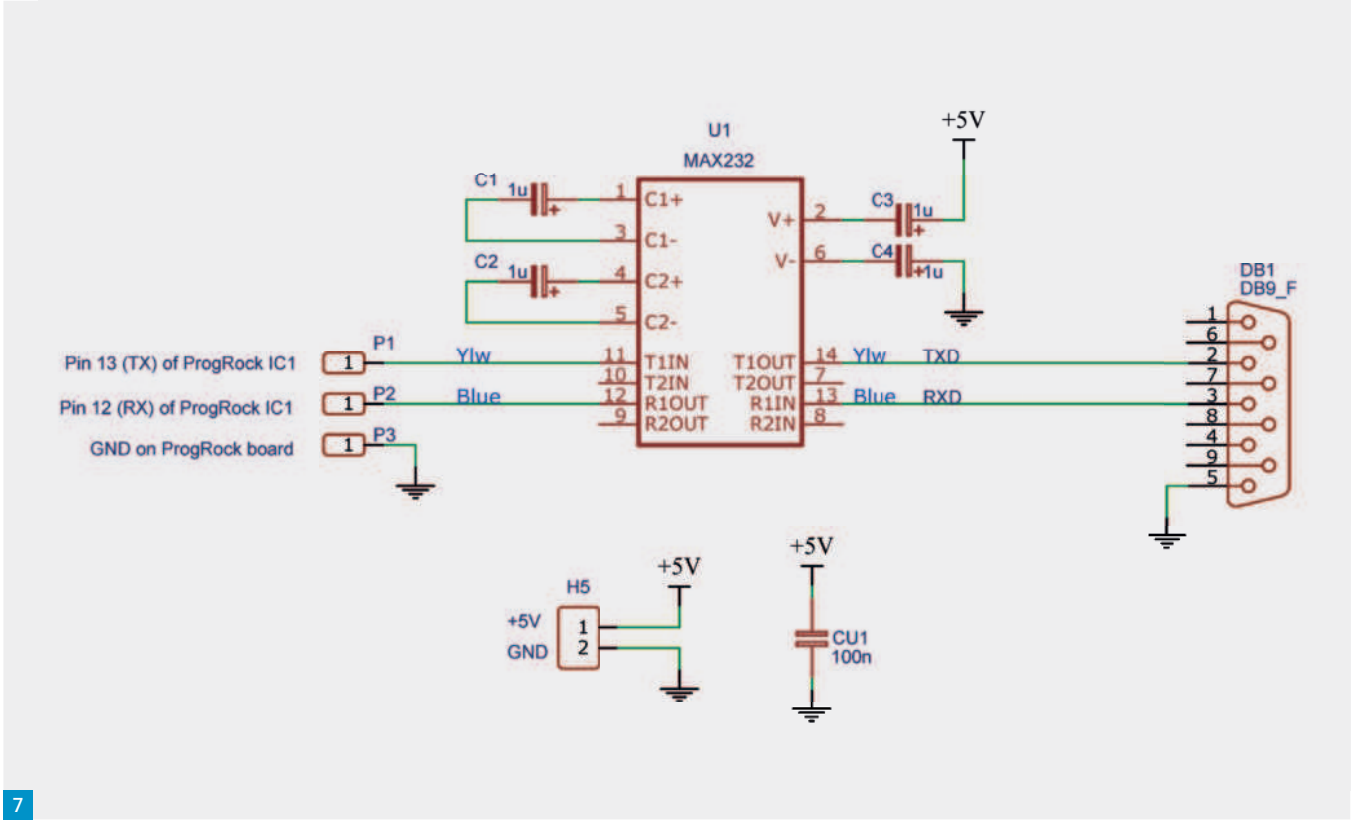
Table 1: Understanding the sequence of events.

Silicon Labs Si590 Crystal Oscillator

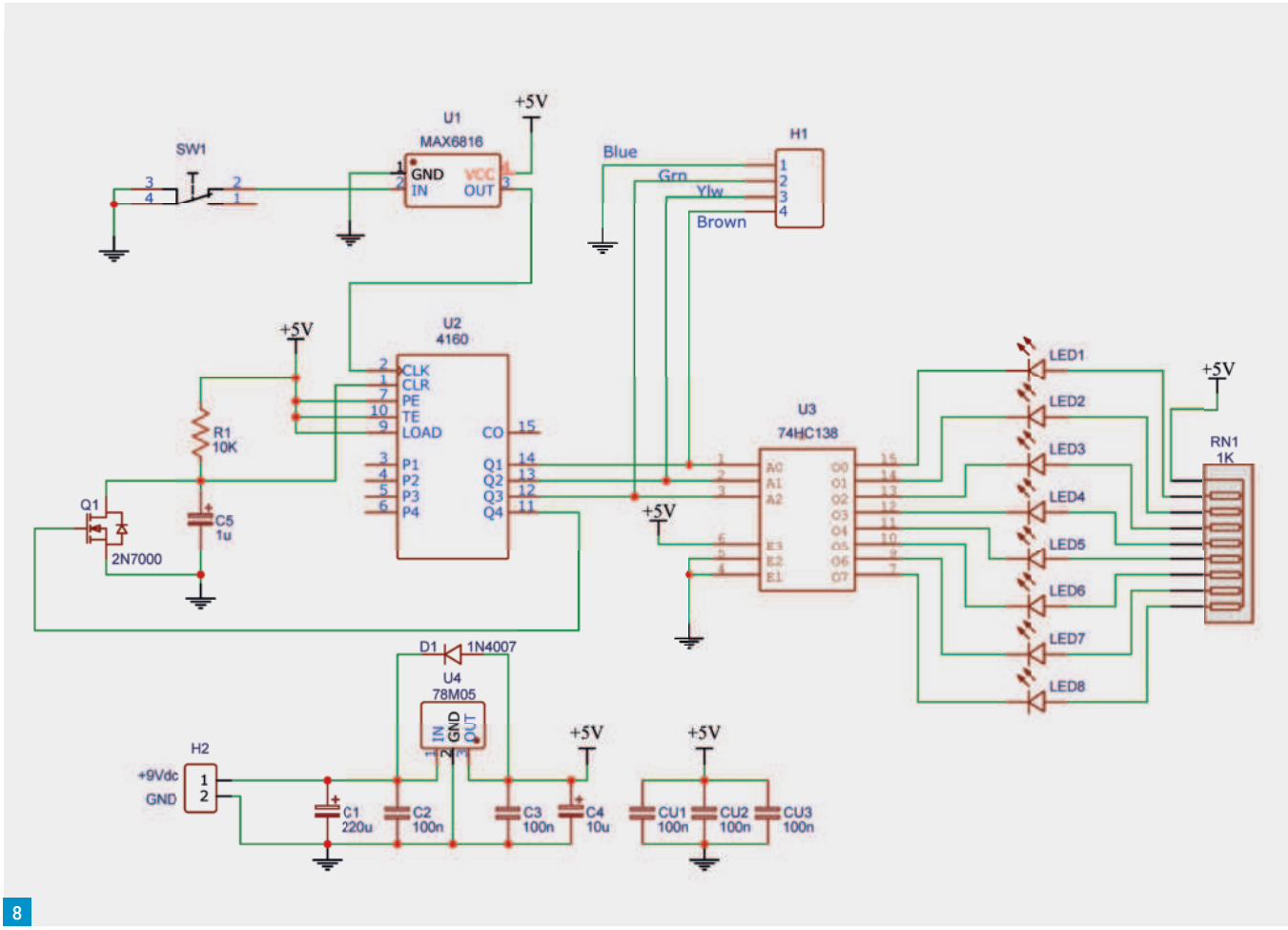
When speaking of fixed frequency operation, my first thought was to use a quartz crystal to set the frequency. For many years I had a RACAL RA7915, which had three crystals in the six available slots. The cost of each crystal, in the order of £45, was prohibitive but I did enjoy connecting up a signal generator in place of the crystal oscillator and tuning the bands (USB only), while trying to mentally calculate in the 10.7MHz IF to see what frequency I was actually tuned to.

Fortunately, the clever designers at Silicon Labs have developed the Si590 to provide a low jitter clock at any frequency from 10 to 810MHz. Unlike a traditional crystal oscillator, where a unique crystal is required for each output frequency required, the Si590 uses one high-quality, fixed-frequency crystal to generate one programmed frequency. There is a range of options open to the designer, including supply voltage from 3.3V, 2.5V or 1.8V, output enable pin to be active high or low, technology (LVPECL, LVDS, CMOS or CML) and size of package. The output is conveniently a square wave, in my case at 3.3V amplitude.

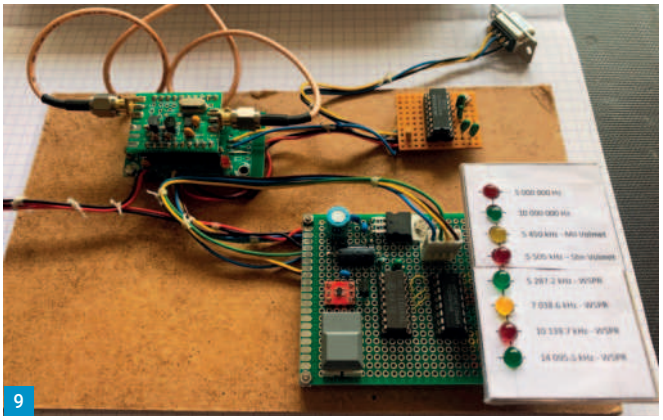
The required frequency of operation is programmed into the Si590 device at the time of shipment, and no doubt if you buy in bulk from Silicon Labs they program these to your specification. However, if you want just one device, then you need to buy these from the components suppler, Digi-Key Electronics, who take a blank generic Si590 that has the required options (as noted above) and program your wanted frequency into it. You just add the devices to your basket and then on checkout, note which frequency needs to be programmed into which device. This adds a day or two to getting the order delivered but they are far cheaper than looking for custom quartz crystals. I ordered the models with the


U1
MAX232
C1
1u
C2
1u
C3
1u
C4
1u
+5V
C1+
C1-
C2+
C2-
V+
V-
T1IN
T2IN
R1OUT
R2OUT
T1OUT
T2OUT
R1IN
R2IN
P1
P2
P3
Pin 13 (TX) of ProgRock IC1
Pin 12 (RX) of ProgRock IC1
GND on ProgRock board
Ylw
Blue
TXD
RXD
DB1
DB9_F
H5
+5V
GND
CU1
100n

7


SW1
U1
MAX6816
GND
IN
VCC
OUT
+5V
H1
Blue
Grn
Ylw
Brown
U2
4160
CLK
CLR
PE
TE
LOAD
CO
P1
P2
P3
P4
Q1
Q2
Q3
Q4
R1
10K
C5
1u
Q1
2N7000
U3
74HC138
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
RN1
1K
D1
1N4007
U4
78M05
H2
+9Vdc
GND
C1
220u
C2
100n
C3
100n
C4
10u
CU1
100n
CU2
100n
CU3
100n

8



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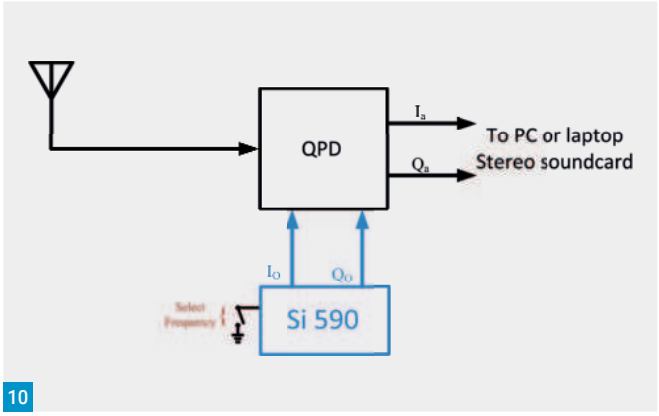

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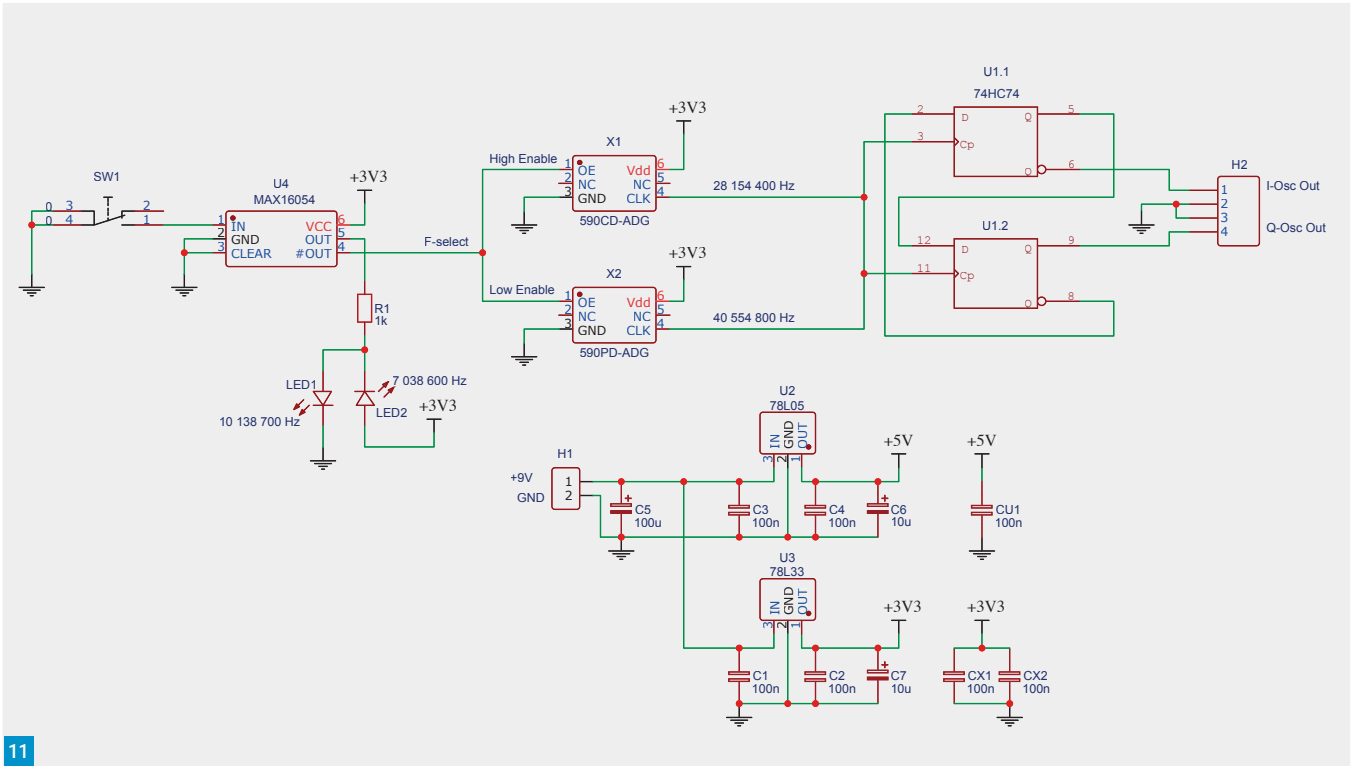

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best temperature stability (±7ppm) and the best total stability (±20ppm) for €7.83 each.

Silicon Labs guarantee that the programmed frequency will be accurate to within ±1.5ppm (parts per million) at 25°C at the time of shipping. In addition, the frequency will have a stability of ±7ppm from –40°C to +85°C and will have a total stability of ±20 ppm, which includes the initial accuracy, temperature, shock, vibration, power supply drift, load drift and 15 years of aging at 40°C. I am not sure that any quartz crystal oscillator I could build would achieve those specifications.

The block diagram of a two-frequency option is shown in **Fig. 10**. The CMOS version of the Si590 is only available with a single output, so as we once again use a flip-flop arrangement to form the required quadrature signals, the oscillators must run at four times the required frequency that you want to tune to. I selected the 40m and 30m WSPR frequencies and had my Si590 devices programmed to 28.1544MHz and 40.5548MHz.

The schematic diagram is in **Fig. 11**. U4 is a MAX16054 switch debouncer, but unlike the MAX 6816, toggles the output (pin 4) between high and low on each press of SW1. In addition, it always starts up with pin 4 in a high state. As I had ordered X1 to be enabled by a high on pin 1 and X2 to be enabled by a low on Pin 1, this toggle action easily selects between the two. When disabled, X1 and X2's outputs go into tri-state so the outputs (pin 4) can be connected together. The outputs of X1 and X2 feed U1, which divides by four and generates the quadrature signals required by the QPD. I use the complementary output on U4 (pin 5) to drive two LEDs

Event	U4		Oscillator Selected	LED Lit
	Pin 4	Pin 5		
Start-up	1	0	X1	LED 2
Push SW1	0	1	X2	LED 1
Push SW1	1	0	X1	LED 2
Repeats ad nauseam				

Table 2: Sequence of events.

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 18th February 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**

5 March
LAGEN VALLEY ARS RALLY: Hillsborough Village Centre, 7 Ballynahinch Road BT26 6AR. Doors open at 11 am. Please check before travelling.
www.lvars.uk

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

6 March
HACK GREEN RADIO SURPLUS HANGAR SALE / HACK GREEN BUNKER RALLY: Nantwich, Cheshire CW5 8AL. Sale of electronic equipment, amateur gear, components, military radio items & vehicle spares. Doors open 10 am.
Tel: 01270 623 353
coldwar@hackgreen.co.uk
https://tinyurl.com/2b7ayfbv
www.hackgreen.co.uk

13 March
HAMZILLA RADIO FEST : Discovery Science Park, Gateway House, Ramsgate Road, Sandwich, Kent CT13 9FF. Tickets are available now from £3/Tables £12. Those who bought tickets and tables in advance will have their booking *carried forward* to Hamzilla 2022. We will continue to follow UK Government guidance until the event and look forward to seeing you there.
https://hamzilla.uk

27 March
CALLINGTON ARS RALLY: Callington Town Hall; More information from Roger, 2E0RPH.
Tel: 0785 408 8882

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

24 April
ANDOVER RADIO CLUB SPRING BOOT SALE: Wildhern Village Hall , SP11 0JE. (just north of Andover). Open for sellers at 9 am; buyers: 10 am. The cost is £8 per boot and £2 for buyers. Tables in the Hall £10.
arac@arac.org.uk
http://www.arac.org.uk

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

24 April New Date
NARSA (NORTHERN AMATEUR RADIO SOCIETIES ASSOCIATION) EXHIBITION (BLACKPOOL RALLY: Norbreck Castle Exhibition Centre, Blackpool FY2 9AA.
dwilson@btinternet.com
www.narsa.org.uk

1 May
THORPE CAMP VISITOR CENTRE, RADIO AMATEUR (HAMFEST) RALLY: Thorpe Camp, Tattershall, Thorpe, Lincolnshire, Open to the public from 9 am to 1 pm; open to traders at 6.30 am. Entry £4 per person, under 12 Free.
Anthony Freeman: Tel: 07956 654481

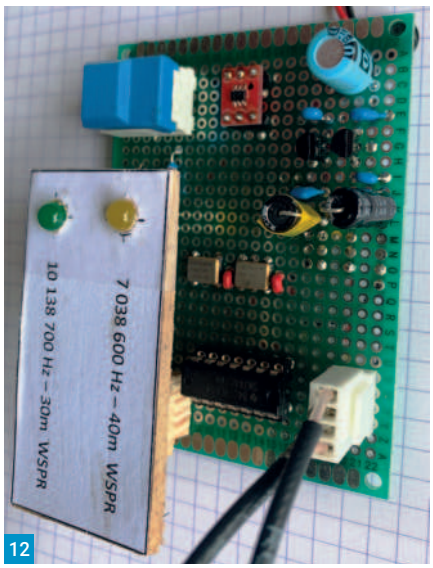
2 May
DARTMOOR RADIO RALLY: The Yelverton War Memorial Hall, Meavy Lane, Yelverton PL20 6AL. Doors open at 10 am. Admission £2.50 (BB | CR | FP | TS).
Roger, Tel: 07854 088882
2e0rph@gmail.com

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 Stalls**

that indicate which oscillator has been selected. **Table 2** shows the sequence of events. Be careful to run U4, X1 and X2 on 3.3V – you can also run U1 on 3.3V as this is compatible with what the QPD wants to see, but I chose to run U1 on 5V. Each of the Si 590's typically needs 80mA of supply current, so your power supply does need to be adequate.

To put the ppm values into context, my 28,154,400Hz device (X1) was 33Hz high in frequency (at 20°C), which is +1.2ppm, and my 40,554,800Hz device (X2) was 44Hz high in frequency, which equates to +1.1ppm.

Fig. 12 shows the Si590 circuitry close-up. The blue switch is a Schadow model SE and U4 is a surface mount device, which again, I have mounted on a red SOT-23 to DIL-8 converter PCB to make it easier to work with. The Silicon Labs Si590 devices are 6-pin 7 x 5mm modules. These modules, shown in the middle of the board with a red decoupling capacitor above each, do not have pins or wings but pads under the device. I found I had to pre-tin all four PCB pads (two of the Si590 pins are not connected) and then get the solder to flow underneath to make a good connection.



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Cutting the Cost

In respect of the ProgRock you could replace everything in Fig. 8 with a BCD-coded rotary switch connected to H1. For example, RS 881-3150 (~€10) is for panel mounting, but is a ten position switch and only eight positions are used. To go small, a push-wheel switch (RS 118-7710 at about €12) might be considered – these also have ten positions but if you are careful with your selection, you can buy models that allow you to block off unwanted positions. Of course, you will need some way to correlate switch position or number with what frequency you have programmed.

In respect of the Si 590 circuit you can replace U4 with a toggle switch (SPDT) if you only have two devices. Simply marking the panel with the frequency selected would suffice. Run U1 off +3.3V and do away with U2, C3, C4 and C6.

End Notes

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

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

I have no personal connection with or financial interests in Leo Bodnar Electronics, QRP-Labs or any of the software or components manufacturers mentioned in this article.

In the next instalment we are going to look at options to cover a large part of the HF band using a variable bandpass filter on the front end of the QPD and a wide band VFO to control the frequency of use.

Philip Moss
practicalwireless@warnersgroup.co.uk

1

The Hallicrafters S20R Sky Champion Communications Receiver

Philip Moss describes an elderly but interesting set from the USA.

I bought this set, **Fig. 1**, from eBay, for £45 in 2012. Seeing at the time yet another ubiquitous DAC 90 was up for £51, I don't think I did too badly. The radio was in OK but not wonderful condition. Probably the many honest caveats the seller put in the description put people off, including that it was probably for 110V, which was true. Much more about the transformer later. He also said the speaker cone was jammed. The pictures, which were in-focus, showed that it was not too bad, but some corrosion was visible and it would turn out that it had probably got into the mains transformer, which he wouldn't have known. I found that out much later. It had clearly had a replacement electrolytic can, but didn't look much interfered with. Well, not quite true… I was lucky, the owner was a long way away, but his wife worked not that far from me so I was able to collect it from her and avoid a delivery charge.

A War-Time Story

Somewhere I have read that there was an important role this model played in World War 2, although it may have been another similar model of Hallicrafters. We were very short of radios at first, and that included sets working into VHF. This set goes up to ~44Mc/s.

The story goes that one day Men from the Ministry (quite which I am not sure) went off to Edgware Rd or Lisle Street in London, saw the set, and promptly requisitioned it.

The set was then flown on an AVRO Anson light bomber, which was also used as a fighter, and incidentally also was used to carry the experimental versions of air-borne air-intercept radar, which enabled night-fighters to find their targets, as implemented in the Bristol Beaufighter, dedicated night-fighter.

The result of this was that as **Prof Lindermann** had suggested, the Germans were using radio beacons for bomber navigation. These were near the frequency of the Crystal Palace TV transmitter, with that service obviously suspended 'for the duration', and with this knowledge we had countermeasures available to mislead the Germans till they 'twigged', and cause them to bomb off-target. Both the UK and Germany had used similar frequencies for their TV services.

Specification

The S20R has four bands, 540kc/s to 1.8Mc/s, 1.7 to 5.75Mc/s, 5.62 to 18.4Mc/s and 17 to 44Mc/s. There is a need to have more bands to comfortably cover these ranges, even with the fine-tuning facility. The set has a tuned RF amplifier stage, a 6SK7 variable-mu pentode, a 6K8 triode-hexode frequency-changer, then two IF amplifiers, both 6SK7, hence a total of three IF transformers, all double-tuned using trimmer capacitors, then a 6SQ7 double-diode triode for detection and AGC detection with the diodes strapped together, and the triode as audio pre-amp, with a 6F6 output valve. It is unclear why AGC is often taken from the same diode as the audio. It saves the whole cost of one small capacitor, and probably a resistor too.

Against doing this is higher audio distortion, a heavier load on the IF transformer and hence lower *Q*. The other way of doing it is that the AGC is taken off the anode of the valve and only loads the primary winding. Also, you cannot have delayed AGC doing it this way. A 6H6 double-diode is used in the noise-limiter circuit, and a 6J5 triode as BFO, finally an 80 directly-heated full-wave rectifier. All valves are octal, and most are metal although my set had glass valves for output and rectifier.

Bandspread is by a small variable capacitor, which is part of the main tuning capacitor, see picture **Fig. 2**, and is on all three sections, not just the local oscillator. The standard version of the set is for 110V mains. Only the export version has a multi-tapped transformer primary. Consumption is 85W. The antenna input is stated as 400Ω, which was not untypical when this set was designed (along with 100, 200 and probably 300Ω!). 50Ω didn't become standard for professional and amateur radio sets until sometime post-War. The set cost $49-50 in 1939. I found two useful websites for this set, which did not come with a circuit or other information:

antiquradio.org/halli10.com

and the manual at

www.one-electron.com

then go to Tech's Filing Cabinet.

First Inspection

On first inspection I noted that the 6F6 had been replaced by a 6V6GT. It is clearly visible in the photo of the chassis top, Fig. 2 again. An apparently melted Octal plug was in the back but actually this was some type of rubber I think, that had hardened and shrunk with age. The socket is for external battery or vibrator pack operation. The mains lead was worn, but as it was rubber-covered cotton, it was fine to try the set, via

Fig. 1: The S20R.
Fig. 2: Top view.
Fig. 3: Bottom view.

a Variac, for 110V. The unused tag on the mains transformer was not the hoped-for 240V tap. All controls were mechanically sound. All the trimmers looked to be done up tight, a bad sign suggesting someone had been at them and didn't know what they were doing. Who would ever think....

A check with a DMM showed no leakage to chassis from the mains and a sensible value HT to chassis. It also showed an open circuit mains switch but I am used to that. It usually isn't true, and the application of mains blows away the oxidation and the set comes on. True in this case. The internal cables were all cotton-covered rubber, but looked fine, and the grommets were all perished.

Some resistors were checked and found in good order, some spectacularly close to their marked value. None were 5%, almost all 20% tolerance. I clearly hadn't checked any in the AGC though, as I found out later.

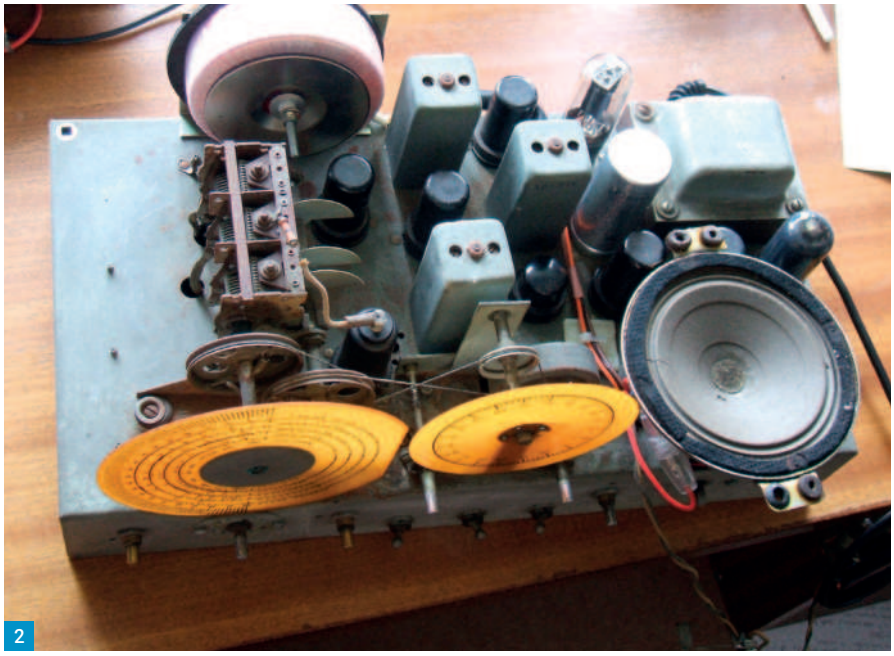
Access

The bottom, **Fig. 3**, allows easy access, perhaps too easy, to the trimmers for the RF circuits. The coils are all air-cored and wax-impregnated, as they should be, and as the set had been damp, a very good thing too. For most purposes the top of the chassis has easy access through the lid in the top but things I did required the cabinet to be taken off. Also, the front-panel, which was a bit fiddly. I needed to repair some of the lettering. I couldn't get the correct font for the Hallicrafters name, and my work with Letraset wasn't entirely straight, but it looks fine if you don't look too closely and is much better than unreadable legends to the controls.

First Try

So, time to try it. An antenna was attached to the screw terminal, the main connector being an N-type, which I avoid. The input is balanced, but there is a shorting-bar, which was already in place for unbalanced antennas. Mine is a random length inverted-L. Very little in the speaker so I used headphones. Very quiet, but plenty of signals.

At this point I will say that I had to do a lot to this set, and the article would be too long if I listed it all, so this is an abbreviated version. The wavechange switch operated reliably, there was more power as I could hear chatter from the output transformer, and it turned out that the break contacts on the phones jack were dirty/intermittent.


2

The Repairs

It would also turn out that someone, when 'repairing' the HT section and replacing the electrolytic, had managed to mis-wire it so that all the set's current went through the output transformer's primary. As though that wasn't enough, they also failed to solder a wire at the output valve's holder, so the set was running on the screen grid's current, not the anode, hence very low output intermittently. The speaker cone was gently freed, and as it was torn with the cone being very brittle, it was repaired using single layers of Engineers' Tissue (known by the uneducated as loo-rolls), stuck with Bostic or similar and built up both sides of the cone, a method I have used successfully before. Next, I applied diluted Bostick to reinforce the cone's roll-edge, but without making it stiff. I then applied Wood Hardener, a liquid for converting soft, rotten wood into a hard inert substance that can then be painted. It is for work on houses generally, but stiffened the cone well. I have had to use quite a lot on my house's windows. It is made by Tetrion and Bonda, stinks and is highly flammable, be warned. I was glad to have saved the speaker because finding a small energised replacement would have been hard. Obviously, I could have used a normal one, and a smoothing resistor and/or choke, but I preferred to leave the original if possible, which it was.

The volume control was open circuit at the earthy end so had little effect, but the track was fine, and washing with isopropanol cured it. The set had initially hummed badly, and I found the replacement reservoir capacitor was itself dead so replaced it.

The output valve grid was at +7V, although measuring the resistance of the coupling capacitor showed it open circuit at a meter maximum of 33MΩ. This was a long time ago. I have learnt not to rely on resistance measurements at low voltage, as they mislead. One give-away is if a small value capacitor slowly creeps up on measurement, or measures differently if measured the other way round (obviously I am not talking about electrolytics here). Some think they are batteries and have a voltage of their own, and in a sense they are. Clearly there is a chemical reaction going on, remembering that paper has a natural tendency to self-destruct, going acid, and this in the presence of metal. I now almost always change paper capacitors, even high-grade metal-encased and military ones, automatically in high-resistance circuits. The grid-leak resistor had crept up from 500 to 680kΩ, and while I would not automatically change out-of-tolerance resistors, actually for the output valve it is important because with age valves tend to suffer leaks, which drive the grid positive, and hence draw too much current. In passing, I noted a neat feature. The valve type was stamped three times around the rim of its base, and then filled in with white paint. I had not seen that before. I occasionally see numbers written or stamped onto the chassis adjacent to the holder. I wonder how often someone got the wrong holder and the stage had to be stripped down and rebuilt with the correct one?

I found the noise-limiter to be hopeless. It immediately introduced terrible distortion. Again, I tested the resistance of the two capacitors used, and they were both >30MΩ,

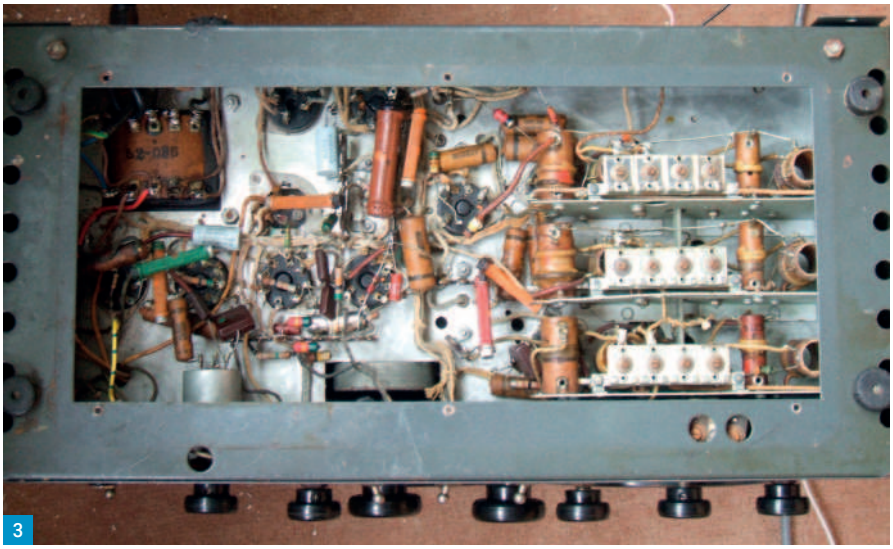
though one only one way. As previously stated, they can think themselves to be batteries, this one a 0.8V one. The resistors were close enough to be fine. On replacing, the distortion had gone, and finding a suitably (impulse) noisy signal, demonstrated the circuit did work. The AVC, or AGC as we call it these days, switch didn't work due to oxidation, so was always on. I will rarely if ever want it off anyway, but would like it working. Strangely, after operating it many times, it appeared to make no difference but worked the next day. I couldn't get to it to use a contact cleaner on it.

The next saga was the AVC. The volts at the diode were very high. They dropped off very fast after the series 2MΩ resistor, which had drifted to 3.6, but replacing it was hardly likely to be the issue, and wasn't. The two decoupling capacitors were replaced: 0.02 and 0.05μF, which greatly reduced the AVC volts, as the voltage was now being passed along better, but it was still a big difference. The RF amplifier, which should have been a 6SK7 and was a 6AB7, had a leaky grid. I thought I had 6SK7s, but it turned out no, after I risked life and limb lifting down a big box of valves. Fortunately, at the Museum (British Vintage Wireless & Television Museum, Dulwich, URL below), I picked up a valve for about 10p in rusty condition, but it worked fine, so that was dealt with.

bvwtm.org.uk

The Great Disaster, the Mains Transformer

It can be seen in the photo of the receiver top, Fig. 2, that at the back there is a bracket with a toroid on. That was the conversion from 110 to 240V. I used a transformer I had changed when doing a repair. The secondary had suffered damage, and I had stripped it off, leaving the primary, which as is often the case was in two equal parts for parallel connection for 110V, or series for our mains. By connecting the mains across the two windings with the set across one end and the joint, it makes a conversion transformer. I made a nice, neat job of that, so great shame then that suddenly the original transformer went bang, with an insulation failure between primary and HT secondary. So, I had to replace the transformer with something suitable from my considerable stock, and my conversion efforts were a waste of effort. As previously stated, I knew the set had suffered damp, and although dry when I got it, I suspect the damage had been done. Mains transformer failure is uncommon in my experience.



3

Miscellaneous items were cleaning the heavy knobs, made by Hallicrafters, with their name embossed on the rear. I soaked them for a day in hot detergent water, then used a toothbrush to clean both them and the tuning scales. They are better but the material has gone distinctly yellow with age, no cure to that.

My suspicion about the trimmers being got at proved right. On applying a signal generator, all the signals tuned high so the local oscillator was running low, and sensitivity varied from quite good to poor. Aligning the IFs first, some made a lot of difference, all needed adjusting. I got about 40dB improvement in sensitivity, 100 times in linear voltage terms, so a great deal. As to the RF sections and local oscillator, I had two slightly different versions of the circuit, ambiguous alignment instruction about how to set the fine-tune, and a set with a trimmer from oscillator anode to ground, not shown on either circuit, but a fixed capacitor of illegible value on one. Further, the trimmer was not the type to need the mounting holes in the chassis, but I was sure the soldering was original, and anyway it was jammed solid. Not a great situation. Suffice it to say that after a lot of fiddling about, I did get the front-end aligned, and the sensitivity was generally good, as shown in **Table 1**.

The signal used was from a 50Ω generator, 40% modulated. The range of input levels used reflects the quite large range of SNR (signal <plus noise> to noise ratio) encountered. The figures are not as good as they could be if the set aligned properly, but with the exception of that at 17Mc/s, are pretty good. As per instruction I had a 390Ω resistor in series with the antenna input.

Conclusions

It should be noted that without bad storage and incompetent attention, it would have needed little attention, just a handful of capacitors changing.

The set is of a fairly conventional design, built on a solid chassis with generally solid components. The scale is fairly cramped as is so often the case. It needs a fifth band but that is expensive. The amateur bands are highlighted but some are only a few millimetres long.

I suggest it wasn't the best set for amateur use, even with bandspread signals were very close, and that was with a random-wire antenna and at sunspot minimum. I think it may have fallen between two stools – too expensive because of all it offers for the lower end of the market, but lacking the greater ease of use of say an HRO or AR88 at the more expensive end. A nice set though.

The SX20 was much the same, but with push-pull output and a bass boost switch. Did they anticipate the Ghetto Blaster?

Band	Trim freq	SNR	Padder freq	SNR
1	1400kc/s	11dB @ 5μV	600kc/s	16dB @ 5μV
2	4Mc/s	10dB @ 1μV	2Mc/s	14dB @ 1μV
3	14Mc/s	15dB @ 10μV	7Mc/s	10dB @ 1μV
4	34Mc/s	18dB @ 10μV	1 Mc/s	10dB @ 50μV

Table 1: Measured parameters

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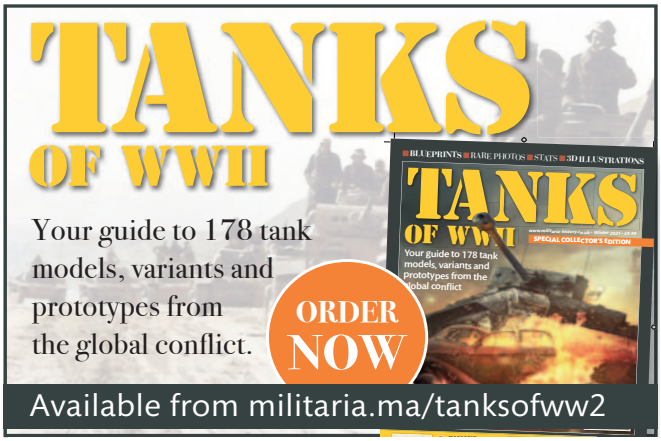

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Valved Radio Repair and The Superhet

Dear Don,

As someone who has been repairing valve sets since youth, I read **Bernard Nock's** article with interest. I feel though that he did not emphasise enough an essential safety aspect, though briefly referring to it. That is the most likely way to get electrocuted is to get one's hands between HT or mains and chassis. It MUST be clearly understood that an isolating transformer is absolutely useless in this situation, as indeed is an RCD. There is an essential safety rule: KEEP ONE HAND BEHIND YOUR BACK when working on a live unit. It is more comfortable I find to tuck it into the back of my trousers. This includes if wanting to adjust an instrument simultaneously with a hand in the unit being tested, unless it has a fully insulated front, as many modern instruments do. In other words, generally do one at a time with one hand only.

I feel it necessary to pour a proverbial bucket of cold water over some who may be inspired to have a go. If you needed Bernard's explanation of how the isolating transformer worked, or will need his future explanation of valve basics, I suggest you are not ready to risk working on mains equipment. Sources of information on valve basics and valve testing apart from Bernard's coming articles can be found, among other places, at The British Vintage Wireless & Television Museum's website:

www.bvwtm.org.uk

Along the top of the home page are listed a number of menus. Use Exhibits, then Articles, you will find two blocks, **Keith Weevil's** and mine. My one on valves is for those with no previous knowledge, and is unillustrated. Keith's is illustrated and more detailed. Both of us have a number of other subjects there too. I wrote mine while I was Curator of Radio. While in that position I also read many books to find ones I could recommend to beginners. Sadly, the vast majority I rejected on the grounds of too many errors, or being too old even for most vintage restoration work. This left me one book only I can wholly recommend, the RSGB *Radio Communication Handbook*, 4th edition, 1967. There are quite a lot still around at rallies and on eBay, among other places. The third edition is the other, pre-war and used by the Forces as the basic training book, but it isn't as comprehensive as the 4th. This is a big book: but you can skip most of it if you just want theory and basic practice, and who still uses Creed 444 printers now for RTTY anyway?

On the subject of getting service information, yes the web has a lot. An excellent source I have acknowledged in my articles for military and test instruments, and some amateur radio gear I have found is the site of the Vintage and Military Amateur Radio Society:

www.vmars.org.uk

It's free, but if you join, they have a very interesting member's newsletter. Another source with probably thousands of service sheets, circuits and some full manuals is **Paul Stenning's** DVD. You can find him via a web search or at:

www.service-data.com

On another topic, regarding the Superhet article by **Tony Smith G4FAI** (January), an interesting article and a very collectable early superhet. However, it is not as early as he thinks.

When we had to reduce the collection at the British Vintage Wireless Museum, that included our library, and one of the books thrown out is I suspect a rare one, being *The Superhetrodyne Receiver*, by **Alfred T Witts AMIEE**. This was first published in 1934, although my edition is the fifth, of 1941, published by Sir Isaac Pitman. This book refers to work by **R A Fessenden**, who on 28 September 1901 patented a design for a superhet. I can imagine immediately many readers think that is impossible, after all there were no valves, so how could there be a local oscillator and mixer? It does not need a valve to mix two signals. Anything non-linear will do the trick. Think Gunn diode or indeed any diode as in modern balanced ring-diode mixers.

This worked by using a fine-wire core of iron, driving a diaphragm. The 'Local' oscillator wasn't. It was a simultaneous transmission from wherever the signal was sent, on an adjacent frequency, slightly offset so as to produce a heterodyne, or beat-note. As a polarised type phone could not be used, it was insensitive. However, that did not stop a signal being received at 3000 miles, and the system was less sensitive to atmospherics. The tests were done by the US Navy.

In 1913 a revised version using a passive mixer allowed the use of a polarised phone, and the range at sea was now 6400 miles. Conveniently in time for the First World War. Also, a real LO was used, which would have been another spark-transmitter on the ship. Who really developed the superhet as we know it is another matter. Frenchman **Lucien Levy** had a 1917 patent, which pre-dated the US one, just, but also referred to an IF amplifier if needed. However, **W Schottky** in Germany may well have beaten both. However, as it was during the War, it was hard for him to establish his claim. He, of course, went on the develop other things: including the eponymous diode.

Philip Moss
Surbiton

*(**Editor's comment**: Many thanks Paul. I suspect quite a large proportion of our readership actually grew up with valved equipment – I certainly did. But you are right that those who cut their teeth in the days of transistors and ICs need to be very aware of the potential dangers of working around valves.)*

October, 1956 PRACTICAL W...

An A.C. Straight 3/4

By F. W. Austin

ALTHOUGH the T.R.F. receiver has become somewhat outmoded of recent years, there still remain a large number of home-constructors either requiring a handy stand-by receiver which can be used in any room, or other readers who have not yet had sufficient practical experience to make a really sound job of a superhet. The beginner is in no position to embark upon a superhet unless proper alignment procedure is thoroughly understood; even then some trifling fault of wiring is likely seriously to discourage and upset him.

This receiver should prove interesting to both old hands and beginners alike. All parts are easily obtainable and the cabinet, chassis, tuning condenser, scale and pointer are of a type universally stocked and sold separately by almost every radio dealer. Very slight modification to the chassis only is necessary (to accommodate the modern small valves used—6BA6, Z77 and ECL80).

Performance

It was designed primarily from the point of view of sensitivity and on local stations (on full volume) the receiver is overloaded. We know this is undesirable, but no reader is likely to need full volume and the set therefore has power in reserve for the time when valve emission begins to deteriorate. The quality is no more than can be expected from a small speaker in a small cabinet, but is quite tolerable and not unpleasant. For local reception no more than a yard of throw-out aerial is necessary, whilst the recommended length for best overall results (long and medium waveband) is approximately six yards.

Circuit Details

The full circuit diagram is shown in Fig. 1. The aerial feeds the control grid of V1 (6BA6) in conventional manner, but the grid bias of this valve is fixed by R3 (100 ohms) and volume control is by means of varying the screen potential via R1 (2 megohm potentiometer) and R2 (47 K).

V2 (Z77) is H.F. transformer-coupled to V1 and is operated as an anode-bend detector. In this arrangement a low anode and screen voltage are necessary for correct operation. R4 (2.2 Meg) and R5 (470 K), shunted by C6 (.1 μF), regulate the screen, whilst R6 (680 K) and C7 (.1 μF) help to smooth and by-pass unwanted responses from the main H.T. line. R7 (1 Meg) is the anode load and C9 (250 pF) is for the purpose of by-passing the residual R.F. components to chassis.

V3 (ECL80) is used as a two-stage L.F. amplifier and the signal is passed to the triode control grid via C10 (.01μF coupling condenser). The lower end of R9 (680 K grid leak) is taken to a tapping point of (two separate resistors) between cathode of ECL80 and chassis. As this valve has a "common" cathode for both triode and pentode sections, the

A three-quarter rear view of the receiver.

Looking for Parts

Dear Don,

I am looking to build an A.C. Straight 3 / 4 as described in the October 1956 issue of *PW* (see attached clipping). It is quite possible one of your older readers could have such a thing in his attic that he never got round to building. I could do with a vintage cabinet, chassis, tuning capacitor, scale and pointer as supplied at that time.

Nick Dewhurst
nickdewhurst@hotmail.co.uk

Valved Radio Repair

Dear Don,

I find the article by **Bernard Nock** to be very interesting and I am looking forward to the next instalment.

He suggests the first steps might be to plug the set in and see what state it is in. I have found the best way is to dismantle the unit and have a good look around. Look for signs of damage to components and the wiring, also check the electrolytic capacitors. I am sure that Bernard will be going through the method for this.

Malcolm Williams G0ISX
Huddersfield

A Tale of TVs

Dear Don,

This story might ring bells with older readers, especially if they've dabbled with televisions at any time.

Sitting in a local pub over the Christmas holidays I was interested to hear a man telling his audience about how back in the 1960s the family's TV that was on rental terms and was replaced on an almost weekly basis due the 'picture valve' going wrong.

This took me back to the late 1970s when I used to fix televisions and heard the words *"It won't take you long mate, It's only the picture (or sometimes the sound) valve"* on many occasions!

Furthermore, it took me back to the tales told by the late, great **Les Lawry Johns** in *The Television* magazine. They always made for hilarious reading. I'm sure that many readers of *PW* will remember him.

Chris Murphy M0HLS
Derby

Bad Language

Dear Don,

Why is it that bad language seems to be creeping into the hobby? 80m seems to be the main culprit but on any band you can hear it these days. We need the young in order to keep the hobby going. Let's clean up lads.

Peter Norris G4VUN
Ripon

*(**Editor's comment**: Thanks Peter. I can't say I've noticed but I probably don't spend enough time listening on 80m! Certainly, there has always been a problem on VHF repeaters – probably a lot less so nowadays than in the past. A reflection on society as a whole? But, yes, I do worry when my 11-year old granddaughter, **Caitlin M6XTT**, goes on air.)*

Bill Kitchen's letter, March Issue

Dear Don,

I read with interest **Bill Kitchen's** letter p69 *PW* March 2022 and his mention of the 19 set and *Q* Multiplier reminded me of the circuit I built in the 70s using a 12AT7 as I recall.

The 19 set Bill refers to could be bought for £2-19-6d or 2.5np short of three quid to those who have never used proper money. There were other surplus sets too. I started with an R107 from long gone Huggetts in Croydon. Cost me £8 saved up from a paper round at 10/- a week [50p]. It replaced the Bush Imperial Receiver, EBS44, we brought home with us on our rapid return from Aden.

In his letter Bill outlined what our hobby is really about, but it's sadly changing. Bill said, *"I wouldn't want to pay £12,000 for a transceiver..."*. Well in my case I definitely won't pay £12k for a transceiver. It's a stupid price and indicates many 'amateurs' of today just want an extended CB ability.

I still make the odd item. Last was a CW transmitter. Not particularly earth moving but I've never paid mega cash for antennas where aluminium tops platinum prices and prefer to calculate and make my own.

At the moment I'm repairing a defunct FRG-7700. It needs a replacement obsolete chip. I wonder how many of our new 'amateurs' could actually repair their receivers, whatever?

Paul Beaumont G7VAK
Upper Norwood

*(**Editor's comment**: Thanks Paul, always good to hear from you. The hobby has, of course, changed and I agree that many amateurs nowadays would be in no position to repair their own gear. Personally, I wouldn't dare to start tinkering with my HF transceiver although I'd happily have worked on my early DX-100U transmitter and Lafayette KT-340 receiver. But I wouldn't want to go back – the performance I get from my current set is in a completely different league! A 'price' I am prepared to pay.)*

Help Please

Dear Don,

I am **Kevin G0HBL** and on QRZ.com. I am trying to trace **Roy G4UNL**. He got me through my RAE and morse during the 1980s. I know he moved to the Philippines some years ago, but I would love to get in contact with him. Can you help?

Kevin Alderman G0HBL
Buntingford

*(**Editor's comment**: Kevin's email address is available on qrz.com if any reader can help with this.)*

VHF/UHF Activity

Dear Don,

In reference to the letter from **Ray Howes G4OWY/G6AUW** (March *PW*) about quiet VHF/UHF bands. I wonder if it's perhaps the time of day when UHF/VHF comes alive?

My own location in a valley between Swindon and Gloucester limits me to the repeaters near Swindon (GB3TD, GB3WH) and their digital equivalent in DMR and Fusion plus any simplex from the high points of Swindon and the Ridgeway. Certainly, Saturday and Sunday mornings seem to be most popular with people out walking the dog or taking the wife shopping. I am somewhat amazed at how many radio amateurs can strike up a conversation while shopping. My own wife would disown me if I pulled out a handheld in the middle of the local high street.

The attached screenshot is a Monday evening in January 2022. I've had to drive ten miles from my home to a viewpoint overlooking Cheltenham and Gloucester but as you can see, the bands have lit up with activity. The location and the time are perfect as it seems that Monday evening is a popular time for all the club nets and this gives me access to groups all the way up to Solihull, east across to Daventry and west into Wales as well as the usual Gloucester, Cheltenham and Swindon crowd. It's not quite walking distance from my house but my home location means it's not possible to operate HF so I live in the VHF/UHF and digital realms.

The use of an ICOM IC-705 in Terminal mode has enabled me to use the D-STAR reflectors around the world. Ironically my most popular reflector is Skegness at XLX102S. It so happens that it is part of a reflector in Florida where one of the rooms is tied to the Skegness GB7DL repeater. The time of day does dictate when this reflector is busy so Tuesday morning around 10:30 GMT is when a rather large Australian group use it for a ragchew. They are a friendly lot and happy to include anyone who calls in. **Graham G4HFG** is a local in Skegness and always around for advice and details about his local repeater. What I particularly like about D-STAR and these reflectors is that they are used by everyone regardless of location. I've had a good few chats with a trio of retired Americans who live in Okinawa and use D-STAR to chat around the world and all this is from the Skegness room. Switching to the Florida room XLX102B brings you into a really huge ragchew on Tuesdays around 1215UTC. It can take some time to get around to you as the numbers can rise into the 30 plus but it's well managed and polite.

UHF and VHF are alive out here in the Cotswolds although only at specific times. Mostly in the morning and weekends. The evenings get busy when the radio clubs meet up with radio chat to and from the meeting locations.

It could be busier but that's a limitation of my location as proven by having to drive to a high point but digital mode has its uses from home.

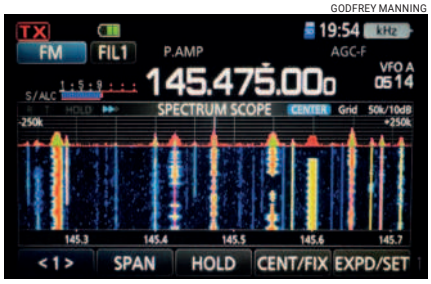
Nick Woodruffe M0NYY
Cirencester

Units & the Hobby

Dear Don,

With reference to **Bill Kitchen G4GHB's** letter in March *PW*, Shannon Volmet might seem strange in quoting heights in feet and visibility in metres, but that is the agreed European standard. Few countries quote heights/altitudes in metres. There is a complication in the USA, though. European barometric pressure was stated in millibars, now hectopascals, but there's no change

GODFREY MANNING

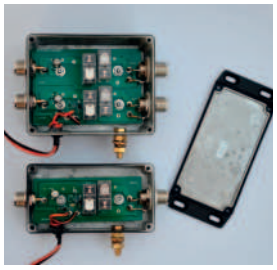


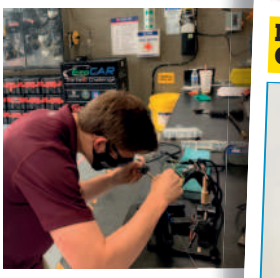
to the numeric value. In America it's inches of mercury. The altimeter from my Aircraft Museum (illustrated) shows both scales and is seen at the standard pressure setting 1013.25 millibars (it's incorrectly labelled Mb) and 29.92 in Hg.

Godfrey Manning G4GLM
Edgware

Next Month

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





PARADAN PRODUCTS REVIEW: Richard Constantine G3UGF takes a look at a range of handy products from US manufacturer Paradan.

VALVED RADIO REPAIR, Pt 2: Bernard Nock G4BXD continues his series on repairing classic valve equipment.

FROM THE GROUND UP: Eric Edwards GW8LJJ concludes this series by covering transistors.

MICROWAVES, Part 3: Ian Dilworth G3WRT moves on to covering microwave antennas.

NEED A HAND? OR SIX: Frank M Howell K4FMH describes an Artisan Soldering Platform for Builders.

There are all your other regular columns too, including HF Highlights, World of VHF, PW at 90, The Face behind the Call and Data Modes.

New Astron Power Supplies from the USA

Three superb Laboratory Grade Power Supplies that are so rock solid, smooth on output and nailed down for Over-Volts protection you'll wonder why you choose any other premium brand to supply your shack radio.

Astron SS 30M AP. £179.95

- Connectors: [AC] IEC320-C14, [DC] 2 USB ports, 2 Anderson Power Pole ports, 1x2-Wire Terminals Rear panel port.
- Digital Displays: Front Panel numeric LED, 1 DC Volt meter and 1 Amp meter, Illuminated ON/OFF switch.
- Adjustable Voltage: 13.8 VDC ±1V, User manual control.
- Technology: >82% efficiency switching, PFC, specific filtering for communication equipment all frequencies and HF.
- EMI: Built-in EMI filter meets EMI Standards, EN55022/CISPR 22 (Class-B), FCC Part15 (Class-B), EN55024, EN61000-3-2 (Class-D) , EN61000-3-3 (Harmonic) IEC61000-4-2,4,5 (EMS).
- Protections Built-in: Current Limiting, Overvoltage protection, Fuse protection, Over Temperature shutdown.
- Construction: Low profile, light weight and industrial metal case quality. Optional rack-mount front panel is available.
- Safety: Certified to UL/CUL/EN/IEC 62368-1 standards.
- Environmental: Certified to Energy Star and CEC standards where required, and RoHS (lead free) compliant.

Astron SS 50M. £144.95

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- Built-in protections: Current Limiting, Overvoltage protection, Fuse protection, Over Temperature shutdown.
- Low profile and light weight package. An optional rack-mount front panel is available.
- Heavy duty industrial design with metal construction quality.
- Certified Europe and North America to 60950-1 and CE safety standards.
- Certified to Energy Star and CEC environmental standards, where required, and is RoHS (lead free) compliant.

Astron SS 30 AP. £209.95

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- Power On/Off: Front Panel Illuminated ON/OFF switch.
- Adjustable Voltage: 13.8 VDC ±1V, User manual control.
- Technology: >82% efficiency switching, PFC, specific filtering for communication equipment all frequencies and HF.
- EMI: Built-in EMI filter meets EMI Standards, EN55022/CISPR 22 (Class-B), FCC Part15 (Class-B), EN55024, EN61000-3-2 (Class-D) , EN61000-3-3 (Harmonic) IEC61000-4-2,4,5 (EMS).
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* Photo shows the FTDX101MP

*1 3DSS: 3-Dimensional Spectrum Stream *2 ABI: Active Band Indicator *3 MPVD: Multi-Purpose VFO Outer Dial

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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.

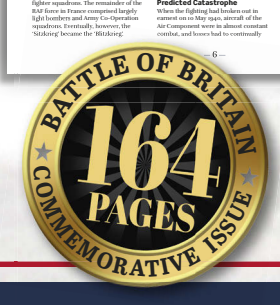
After the outbreak of war in September 1939, there followed eight months of what became known as the 'Phoney War'. However, it was clear that large-scale fighting would ultimately follow, and a British Expeditionary Force was sent to France before the end of that year. As part of that BEF, a large Air 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 eventually be made good from squadrons based in Britain. The Commander-in-Chief of RAF Fighter Command, Air Chief Marshal Hugh Dowding, had already stated as early as September 1939, that if he was expected to defend Britain's skies, then he would need 52 fighter squadrons. At that time, he had only 32 under his command and was told it would be impossible to produce the number he required. However, efforts would be made to provide him with a further eight.

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



BACKGROUND TO BATTLE

THE RAF FIGHTER PILOT

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