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PRACTICAL WIRELESS

August 2022 Vol. 98 No 8
On sale: 14th July 2022
Next issue on sale: 11th August 2022

ISSN 0141-0857

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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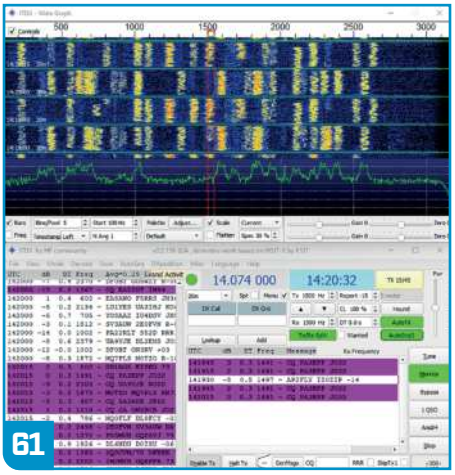
This publication is printed by Warners Midlands PLC Telephone: **01778 391000**



Keylines

Well, I should have been completing this issue on my way back from the Ham Radio show in Friedrichshafen, along with preparing a show report. Unfortunately, EasyJet cancelled my flight from Bristol just as we were about to board. The good news is that my good friend **Chris Duckling G3SVL** kindly agreed to prepare a report at short notice. My thanks to Chris for stepping into the breach.

6m Band

Like a lot of readers, I have been busy on the 6m band during the summer Sporadic E season. You will read reports of activity in **Tim Kirby GW4VXE's** column. My personal observations are that, other than a few very nice South American openings during late April and May, not a lot happened until June but then the band really came to life. I wanted to comment particularly on the North American opening of 12 June, which started shortly after lunch and went on until well after midnight. At times on 50.323MHz FT8, the screen would fill with anything from 30 to 50 decodes here, from all over North America, from the east coast across to Arizona and California. And even 50.318MHz was buzzing with North American activity on FT4 mode. Remarkable.

Remote Operation

Back in the February 2016 issue we carried an introductory article about remote operation. Since then the possible solutions have increased in number and many more operators are taking advantage, whether to operate their home stations when away or to operate a remote station because of problems at home (such as high noise levels). Indeed, the range of possible solutions is such that a single article could barely do them justice nowadays. There are radios with a separate head unit (such as the IC-7100 and TD-480), which can be separated by the length of a car (for mobile operation) or the length of a continent. There are solutions from companies such as remoterig.com, which allow you to connect up pretty much any radio and control it remotely. **Daimon Tilley G4USI** looked at running digital modes remotely in the May 2020 issue. There's the MFJ-1234 RigPi, reviewed in the June 2020 issue or the Elecraft solution of using a K3/0 remote head to ape the operation of the K3. And many more, along with solutions to control ancillary equipment such as linear amplifiers, antenna rotators and more.

In my case, I have taken a simple approach to running FT8 remotely to the station at my son's house. I use Google Remote Desktop to control applications running on a PC at his location, including JTDX (for FT8), a program to control my Expert linear amplifier (when needed) and software to control an MFJ antenna rotator that replaces the Yaesu controller but offers PC control facilities. I am still some way off being able to operate SSB or CW remotely. But it's an interesting challenge and one that I hope to solve eventually. I'd certainly like to hear from readers who have found solutions of their own.

Corrections

Samuel Ritchie (SDR series) writes, *"I have found an error – all of my own design – I blame the rum cocktails while on that veranda. I gave the wrong email address for **Joe G8KAM**. The article gives his email as joe_nand@hotmail.com but it must be* **joe_nand@hotmail.co.uk**. *Sorry about this"*.

Mark Tuttle G0TMT (Paston project) writes, *"My super-keen builder/follower pointed out an error in the parts list in the last article in which I wrote that L1 & L2 are wound on FT37-43 ferrite cores. This is incorrect and it should read T37-2. The circuit diagram has them correctly labelled"*.

And unfortunately the two references were omitted from the most recent Microwaves article. They are:
[1] **https://tinyurl.com/2p8bm53k**
[2] MATLAB and CATAM (Computer-Aided Teaching of All Mathematics) – find through Google.

Competition Winners

Finally, I am pleased to announce the winners of our June competition to win one of two antennas kindly donated by Moonraker. They are **Tristan Alwyn-Clark** of Lincoln and **Mr T Herbison** of Ballymena, County Antrim.

Don Field G3XTT
Editor, *Practical Wireless* Magazine

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Newsdesk

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

The XIEGU G106

Nevada Radio have announced the new Low cost XIEGU G106 entry level QRP transceiver. The unit is ideal for outdoor and portable operation, weighing just 720g and size 120 x 40 x 135 mm.
With 16-bit sampling SDR architecture and delivering 5W RF output, the transceiver covers the bands 80 to 10m, including the WARC bands. On CW there are three filter bandwidths for easy reception of weak signals. The transceiver can also be used for digital modes with the optional DE-19 Digital adaptor.
The receiver covers 550kHz to 30 MHz and 88 to 108 MHz (WFM Commercial radio band).
The G106 was due to be available around the end of July and target price is expected to be around £399. The transceiver will be available from Nevada or Waters & Stanton:
www.nevadaradio.co.uk
www.hamradiosstore.co.uk

CONSTRUCTION HUB/CLUB IN SE: A regional hub for makers and home brewers of radio related projects is proposed by Eric Stammers M0REQ and Graham Smith G4NMD. The idea is for a club that co-operates with knowledge, experience and test gear to support those who are already building or wishing to build radio related projects. It is hoped that the group can mutually support each other with:
• Practical help with projects
• Access to experience and advice
• Access to tools and kit (some has already been donated by industry)
• Inspiration for a new project
• Time and space to work on a project in company with other like-minded people.
It is initially suggested that the group will have a monthly evening meeting with perhaps a quarterly all-day meeting. The possibility of group builds and buildathons are under consideration too.
The inaugural meeting is set for Wednesday 7 September 1930-2130 at Grafham Rooms, Grafham, Surrey GU5 0LJ (on A281 South of Bramley Village).
Info from Graham or Eric via the club e-mail **HamRadioBuilders@gmail.com**

New from ML&S

ML&S have introduced the MyDEL JPC-7 (dipole version) & JPC-12 (vertical) Portable Shortwave Antennas. Both antennas cover 40- 6m, 100W PEP & contained in a small carry case for portable use. The JPC-7 & 12 are beautifully manufactured to a very high standard and available from stock at Martin Lynch & Sons. Special introductory deals on both. For more information and feature video see:
www.HamRadio.co.uk/JPC
The cost of the JPC-7 Dipole kit is £339.95, the JPC-12 vertical kit is £199.95. Prices include VAT.

SOS RADIO WEEK 2022: Paul G1OVK in Worcester operated GB0SOS in the above event. Using a Yaesu FTdx101MP and a variety of antennas, Paul decided to concentrate on phone operation, especially on 10m, where he was using a three-element Yagi. His best contacts on 28MHz phone this year were: VK5AVB Australia, 9W6EZ East Malaysia, FR4QT Reunion Island, ZD7FT St Helena, ZS1CJH South Africa, VP8LP Falkland Islands, VU2XO India, JY76FA, JY76CI Jordan, CX1AV Uruguay, YC2DBW Indonesia, PZ1EL Suriname, HI8AT Dominican Republic, HP9SAM Panama, FY5KE French Guiana and KP4WQ Puerto Rico. In total he made 747 QSOs.

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New from Icom

Icom's SHF-P1 concept model and the IC-PW2 HF/50MHz 1kW linear amplifier were shown at the recent Dayton Hamvention, one of the world's largest amateur radio events held in May. The event, which saw it celebrating its 70th anniversary, had the Icom team out in force with new products, including the forthcoming IC-T10 dual-band hand portable and glimpses into these future products.

The ICOM stand was bustling with many radio amateurs asking questions about the SHF-P1, part of the development project called the ICOM SHF Project (Super High-Frequency Band Challenge) aimed at developing a new amateur radio for use in the 2.4GHz and 5.6GHz bands. Visitors were also excited to be getting a good look at the forthcoming IC-PW2. Both products were also on display recently at Ham Radio 2022 in Friedrichshafen, Germany.

To find out more, you can download the pre-release/concept information distributed at Dayton Hamvention 2022 from the Icom UK website:

https://tinyurl.com/25cvurhc

SHF-P1 Concept Model Information (0.5MB) (PDF)
IC-PW2 Pre-release Information (0.5MB) (PDF)
IC-PW2 Technical Information (0.5MB) (PDF)

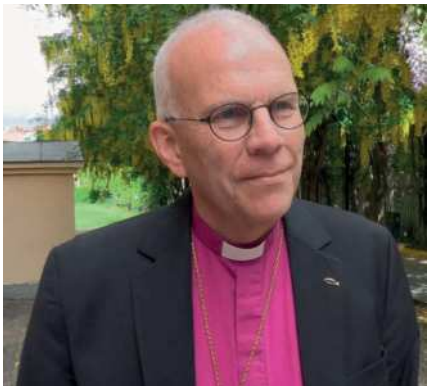
As to their launch date and pricing, Icom UK said, *"we don't have those details but rest assured we will publish them on our website and social media channels when we have them. We will be showing them later this year at the National Hamfest so make a note in your diary to come along and see them for yourself on our stand at Newark"*.

CORNISH RADIO CLUB SUPPORTS INTERNATIONAL MARCONI DAY: The last IMD event run by the Cornish Radio Amateur club properly was in April 2019 and then in 2020 everything went crazy We had Covid, lockdowns and various restrictions so in 2020 the club's IMD event was cancelled then in 2021 the club ran the event but not to full capacity and not at the normal venue. The Cornish Radio Amateur Club is an extremely well established club with history dating back to the 1940s. International Marconi Day was founded and organised by Norman Pascoe G4USB, sadly now silent key, and since 2016 has been organised by the Club's Chairman Steve G7VOH. Steve has worked extremely hard on IMD, usually starting in November and then continues right up to the start time of the event making sure everything was in place to allow it to run as smoothly as previous years. For 2022 he ended up with 62 official stations from around the world registering to take part.

This year they were back to their normal venue of Stithians Showground, Stithians near Redruth, Cornwall. The equipment used was two Kenwood TS 570Ds (for voice) and a Yaesu 450D for FT8. They also had an added VHF station run by Rich 2E0TGK and Lisa 2E0PXI using the Club's Icom IC-910H.

2022 was extremely special as they had the greatest of pleasure to have had a prearranged telephone call between Steve G7VOH and Princess Elettra, Gulielmo Marconi's daughter. The conversation lasted for over 20 minutes where she expressed her sincere gratitude to Steve and the Cornish Radio Amateur Club for organising this event each year to celebrate the birth and works of her father. They spent a great deal of the time talking about her father and of course Cornwall where Princess Elettra was reminiscing over the time she had spent there with the Cornish Radio Amateur Club visiting places her father had been. Before the phone call ended Princess Elettra also spoke to Anne-Marie, aged 13, one of their youngest members, making this a truly a memorable occasion for them both.

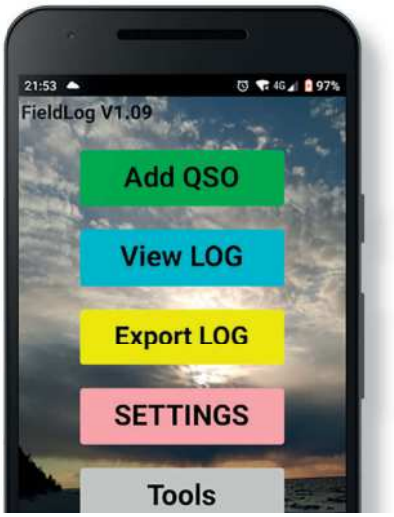
The club thanks everyone who helped out and also those stations from around the world for making this a truly remarkable event in the amateur radio calendar.



LICENSED ARCHBISHOP: The Church of Sweden has elected Martin Modeus SM5LVQ (above) to be the 71st Archbishop of the Church of Sweden. According to the Swedish Society of Radio Amateurs, Martin already serves the church as bishop of the Diocese of Linköping, the fifth largest city in Sweden, located in the south of the country. Martin will be received as archbishop during a service to be held in December at Uppsala Cathedral, which has been the see of the Church of Sweden's archbishop since the 12th Century. Martin is to succeed Antje Jackelen, Sweden's first female archbishop, who is retiring.

https://tinyurl.com/3m3c7brw

FIELDLOG: FieldLog is a new App for Android phones designed for easy logging when out and about, such as when operating SOTA, IOTA, etc. It also supports contest logging, general QSO logging and export to ADIF, Cabrillo and CSV formats. It costs 79p:



Chris Duckling G3SVL
practicalwireless@warnersgroup.co.uk

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Friedrichshafen Ham Radio Show 2022

The Ham Radio event at Friedrichshafen returned in June after a three year hiatus. **Chris Duckling G3SVL** has a report on the show.

There are a number of Hamventions (amateur radio conventions) each year around the world, but the biggest one in Europe takes place on the last weekend of June in Friedrichshafen, Germany. The town lies on the banks of Lake Constance and the show is held in a modern exhibition centre three miles from the centre, next to the airport. The show runs for three days, Friday to Sunday, and attracts thousands of visitors. This year's event was the first in three years due to the previous two events being cancelled for Covid reasons. We all wondered whether the enthusiasm to meet up again would overcome travel nervousness and recent travel disruptions – here's what happened.

Getting There and Staying There

Although there is an airport at Friedrichshafen (FHN) there are currently no direct flights from the UK. I've previously flown to Munich and taken a train, flown to Zürich and taken a train to Romanshorn then caught a ferry across the lake to Friedrichshafen or flown to Basel and rented a car. Others fly to Frankfurt and get a connecting flight while a few cross the Channel and drive the 500 mile journey from Calais. I met some from the UK who were adding on additional days to explore the area. **Phil G4OBK** along with **Victor GI4ONL** was planning to activate over 30 summits in the Czech Republic, the Allgau Alps and Bavaria as part of the Summits on the Air (SOTA) programme. This year I was meeting up with **Ian G3YBY** and **Tony G4LDL** at Basel and hiring a car. The three of us rented a three-bedroomed Airbnb, which was very comfortable but was a 30 minute walk each way to the lakeside restaurants.

There are plenty of hotels, guest houses and Airbnbs to choose from in the town and surrounding villages and it was noticeable this year that rooms that would usually be booked up months in advance were still available a few weeks before the show. On show days there are frequent, free, buses to and from the town centre to the exhibition. It's all rather easy and organised, although the buses can get full in the mornings.

The Show

For me the event comprises a number of elements: traders showing and selling new kit, a 'flea market', Club stands, a lecture programme and socialising. Catering facilities include snack bars, a restaurant and a beer garden (this is southern Germany after all!).

I've been going to the show on and off for the past 15 years and in the early days the large 10,000 square metre exhibition hall was full and there were five or six 6,000 square metre flea market halls. Multiple lecture streams ran in parallel and queues to get in could take 20 minutes to clear. The flea market boom came as Europe expanded and Russian new old stock (NoS) parts appeared at very reasonable prices. Over the years the number of traders has reduced but the big three (Yaesu, Icom and Kenwood) as well as Elecraft and Wimo (the large German agent for many brands) were always in attendance. This year only Icom had a presence and Elecraft was shown on their German dealer's stand. Wimo did not attend. Bhi were showing their range of noise cancelling devices and seemed busy every time I passed by.

Major product releases are usually timed for US or Japanese events, but Friedrichshafen often provides the first opportunity to see new kit in Europe. After extensive touring of the exhibition hall I could find no new releases other than some software defined radios (SDR) developments. The Charly 25 RADIOlab range from Smart Radio Concepts was a case in point. They have developed a modular SDR transceiver based on RF assemblies, cases and displays and which use a STEMlab 14/16 from Slovenian company Red Pitaya for its SDR core. **Edwin DC9OE** told me their approach is to sell anything from an assembly or kit right through to built and tested radios. This will surely appeal to those who want to build their own complex radio and experiment with the open-source software. Their product looked professionally made.

Reuter Electronik were showing their RDR54 – a compact SDR receiver, which consists of a basic unit with a bus board and pluggable modules to allow direct sampling to 2m. I particularly liked another product of theirs, the sPocket radio, which links directly to a tablet to produce an easily transportable radio. But at €2,500 for a fully configured sPocket C4 device to cover up to 2m with 2 x 16bit DACs, I'm not sure I'm their target market.

The exhibition hall was not fully used with perhaps one third commercial traders, one third clubs and national societies and one third cordoned off and not used. I was told that manufacturers felt Covid restrictions and general uncertainty made it difficult for them to commit to exhibiting when asked earlier in the year. Hopefully they will return next year. By contrast, the clubs and societies area appeared to be as occupied as usual. The RSGB had a large stand and were doing a roaring trade in selling their extensive collections of books. Other national societies were also present with DARC (German Amateur Radio society) unsurprisingly having

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Photo 1: Icom were the only one of the 'big three' to exhibit. Photo 2: The Charly 25 (see text). Photo 3: As always, the beer garden proved popular for some catching up. Photo 4: Some 'classic' gear on sale in the flea market. Photo 5: Crowds in the flea market. Photo 6: An antenna, anyone?


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the largest representation. European DX Clubs were to be found in the enlarged DX Plaza with CDXC and IOTA (Islands on The Air) from the UK receiving a steady stream of visitors. In total there were 394 participants, including 129 commercial exhibitors, in the main hall.

The flea market this year was down to one and a half halls but the official press release says there were still 265 exhibitors from 27 countries in those halls. It remains the place to find anything from an egg insulator to a solid-state linear, a vacuum relay, second-hand radios, 1960s and 70s Heathkit and Drake products, second-hand laptops, cables, connectors as well as some stuff that I cannot see anyone would ever want! I bought a few odds and ends at what I thought were bargain prices.

Lectures were reduced to just two lecture streams this year and seemed to be poorly attended most times I dropped by.

Attendance on the Friday was noticeably down on previous years and it was easy to get close up to exhibits and to talk with traders. Saturday always attracts more day visitors and while the exhibition hall was never overly crowded the flea market was its normal three deep in places. Noticeable by their absence, both in the flea market and general attendance, were Russian traders and visitors. They have been a significant presence over the years but the current political situation appears to have reduced their numbers to almost zero.

Friedrichshafen has never been only about the equipment and lectures, there is a huge social scene that goes on around it. During the day the beer garden is packed. The food franchises serve traditional German food with rarely a green leaf or piece of fruit in sight! This year it poured with rain on the Friday but under the umbrellas the socialising was as evident as usual. If you are relatively well known, it can take a fair amount of time to weave your way through the crowds as you meet friends, many of whom you haven't seen in three years. Over lunch there are newly acquired items to be shown and discussed and it is not uncommon for the beer to make a purchasing decision become far easier! Of course, those who travelled with only cabin baggage allowances are at a distinct disadvantage here.

Socialising doesn't end at the show. There are organised dinners, the Bavarian Contest Club event being the biggest, and the lakefront restaurants are full of amateurs and their partners. I often feel as if I am walking through an international callbook with some of my contest and DX heroes sitting at the restaurant tables. If the show itself seemed smaller and less well attended, the socialising element appeared to be undiminished.

The official press release from the show said the weekend attracted 10,200 amateur radio enthusiasts from 52 countries. This is about 30% down on 2019 attendance numbers.

Final Thoughts

If I were to sum up Friedrichshafen 2022, I would say that the social element was as good as or maybe even better than 2019, that the lack of major dealers and new products was a disappointment, that the reduced attendance made things a little easier but that the lecture stream was underwhelming. Nevertheless, I had a great time and despite a rail strike and reported airport chaos, my travel worked as planned. The dates for 2023 are 23 to 25 June and I plan to be there. I think that says it all. **PW**

Ray Howes G4OWY/G6AUW
g4owy6@gmail.com

Out & About Al Fresco

Join **Ray G4OWY/G6AUW** with a light-hearted tale as he visits the seaside!

I was going to begin with a quick chat about art. However, I didn't think you'd be interested in that? Instead, I'm going to regale you all with my al fresco amateur radio misadventures into the big wide fresh-air outdoors. So, I'd better mention the exotic equipment I took with me. An FT-817, an HF whip, a counterpoise, a VHF/UHF antenna of dubious quality and a microphone to stir up some excitement on 20m, or so I hoped. I also brought an old military type Morse key along, just in case a stint on CW might help tempt the weak signals out of the on-air woodwork.

Before I get into the action of contacts and that sort of thing, my partner was eager to get away but had other ideas on how we would spend the time away. For a start, she told me she *"wanted to breathe in the sea air, sit in a deckchair and watch the waves hit the shoreline and just chill out with a '99' and a G&T"*. But that also meant no phone activity (only for emergencies), no excursions or fancy candle-lit dinners. And definitely no *"amateur radio racket disturbing the peace"*.

As you may imagine, it was going to be an uphill struggle to dissuade my other half from her perfect get-away. Anyhow, a couple of bribes later the other half relented. She packed her bag and I packed mine. And of course, I packed my radio gear. Yippee!

Some Exotic Hideaway

Where did we go, I hear you ask? Sidmouth, on the sunny south Devon coast. When we arrived and parked up the car, we both breathed in at least eight pints of fresh sea bracing air. We waved at the doorman and he happily waved back. We've stayed at the same hotel in Sidmouth for yonks, so **Paul**, the doorman, knew a good thing when he saw it. Another tip was heading his way.

Once inside our usual room, my unpacking took minutes. My partner's unpacking seemed to take a lifetime to complete. I quickly unpacked the radio gear and was ready to go out and begin CQing, or as is usually the case running flea power, tail-ending QSOs, and hoping the bloke at the other end, heard you!

Luckily, Sidmouth is blessed with a few high hills just minutes from our hotel. After a liquid lunch I set off for a spell of amateur radio. The XYL brought along a few magazines that she'd 'borrowed' from the hotel foyer. I quickly set up the rig, plugged in the HF whip etc and spun the tuning knob to see what rare DX I could snag on 20m. Zilch. All I could hear were a few Italian stations doing what they do best, over-driving their outboard linear amplifiers and talking Italian. There was a Norwegian station calling CQ, but his signal was so weak and watery that he may as well have been located on the other side of the Milky Way, rather than somewhere in Norway. The DX that afternoon was France, and a bloke on the Isle of Mull doing what I was doing in Sidmouth. I guessed that Sidmouth to anywhere up North is a big hop. So, I congratulated myself.

I switched bands and alighted on 40m. More action there. I worked a few G stations and a station in Northern Ireland. Can't remember his location, it was unpronounceable. I wrote it down but lost the bit of paper. Feeling depressed, I went to 2m to see what was happening there. Not much. A couple of stations on the local repeater were bitching about the RSGB and giving all and sundry who happened to be listening their views on why amateur radio is *"going to the dogs"*. I was going to put both oars in but thought better of it. Besides, it was 5.30pm, and we were both gagging for a plate of fish & chips and mushy peas, or maybe a posh meal at the hotel. We chose the fish & chips. A posh meal at the hotel would have meant a plate of fish & chips afterwards anyway.

A Quick Stroll

After the food, we went for a stroll along the promenade. I took the rig. I hid it in a carrier bag (I prefer to be incommunicado). Again, not a lot heard on the local repeater. Put out a few calls here and there until I was hoarse but no takers. Then, as we were walking back to the hotel, I had a

quick chat with a new licence holder somewhere in Axminster. Or so he said. I only mention this because his operational technique appeared to be slightly suspicious. He only announced his callsign once. At the beginning. At the end of the QSO it was different, he'd elevated it from an 'M6' to a 'G8'. Strange, that. I think his name was **Dave**. Or was it **Derek**? There again, maybe it was **Darren**?

A few gin & tonics later and a couple pints of the local ale, we went to bed. Me, dreaming of putting some notches on my DX gun tomorrow.

Day Two

As Sod's law would have it, the next day it decided to tip down. So, plan 'B' went into operation. Hill top radio action was put on the back burner until the precipitation stopped. It didn't. Plan 'C' happened. That was sitting under an umbrella on the hotel patio drinking coffee with the FT-817 replete with rubber duck in receive mode. That was a mistake. Because, before long, I had an appreciative audience. Two members of staff and three fellow hotel guests who all looked to be at least 200 years old, quizzing me on the finer points of amateur radio. One old boy, thought it was 'Chicken Band'. Another guy suspected I was a 'spy'.

Needless to say, I spent too much time explaining and promoting the ins and outs of amateur radio. A whole two hours. But I made sure that they all understood that amateur radio had progressed the technological landscape, particularly with regards to mobile phones and so on. They were all very impressed. So impressed in fact, that I didn't have to buy any drinks. I gave one member of the hotel staff (who displayed an interest above and beyond just talking about radio) two copies of recent *RadComs*, a copy of *Practical Wireless* and an *OTNews*. These days unlike yesteryear, I treat all magazines like newspapers. When I've read them, I bin them.

I took with me, an FT-817, an HF whip, a counterpoise, a VHF/UHF antenna of dubious quality and a microphone to stir up some excitement on 20m

Well, nobody wants to buy them. At one point, I must have had about a ton or more of radio related magazines. *QST*, *CQ* mag, *RadCom* and *PW*. Most of which I would probably never read again. I used to dump them in GP/dental surgeries. Not now of course. Covid has put an end to that.

And More

On the third day, the sun shone. Again, after my partner had her fill of looking in shop windows and buying shoes she'd only wear once, we ended up on another high hill with the radio gear. This time, tuning 20m I felt like a man possessed. The band was on fire. I worked Russia, Sweden, Spain, Germany, Switzerland and so on. I was like a kid let loose on an antenna farm. Then, the band decided to take a break. So, onto 40m. Signals were strong, so off I went again. I must have worked about 30 stations plus in an hour. All on 5W or so (CW/SSB). The thrall of al fresco radio is addictive.

After that, I was replenished and reinvigorated. My partner wasn't. So, I packed up the gear and we walked back to the hotel for refreshments. Whereupon, that member of staff that I gave the mags to, collared me for another talk about you know what. This young chap was really keen. He'd read the mags I gave him and proceeded to tell me all about his excursion onto the internet, soaking up all the info he could find about amateur radio. Fortunately for me he was on duty, so I got away with a 15-minute introduction all about amateur radio and a short explanation of all the whys and wherefores. Oh, he asked me if there was a local radio club in the area and if I was a member of one. I told him that I don't belong to any clubs, amateur radio or otherwise. But I did offer him some info regarding the Sidmouth amateur radio crew, and their repeater GB3SW. Anyhow, I guess we all have a duty to bang the drum for the hobby, right? Even if it meant being button-holed each time I sat down in the hotel lounge.

Mind you, as we all know, there are a few misfits within our midst who believe that amateur radio will be extinct next year, or the year after. And what's more, some of them even refuse to stump up a lousy 50 quid or so to join the RSGB. Can you believe it? Besides, where would we all be without the RSGB? Perhaps fully paid up RSGB

members should refuse to communicate on-air with anyone who is a non-member of the RSGB? Just a silly thought, so please don't choke on your cornflakes. Besides, as many of my radio playmates keep saying, it's a privilege to have an amateur licence. And I, and them, are aware of the challenges faced by people who would like that privilege. Like that hotel employee I mentioned earlier. So maybe, as an act of pure altruism, instead of giving him a few mags and my time, perhaps I should have given him my rig too. So he can practice. Again, don't choke. It was just another silly thought.

And in that vein, don't you ever feel that nagging need to leave this world a little further ahead than when you popped into it? It's a need that chewing the rag on 40m or Kurchunking the local repeater probably won't placate. Besides, not everyone can invent a new mode like FT8, or win a Nobel prize. But we can give it go with persistence.

One Day to Go

My al fresco operations were still buzzing. Eager to go again. But we only had one more day to go in Sidmouth. It was a toss-up between finding another hill to operate from, or both of us getting on a bus for a shopping trip to Exeter. Ugh! We'd reached a stalemate. Negotiations began, then ended. I stayed in Sidmouth and the other half swanned off to Exeter. We kissed and hugged as if we weren't going to see each other for at least a month. After we'd waved goodbye like a couple of lovesick teenagers, I raced back to the hotel, got the kit together and proceeded to hike up the nearest hill.

Bish, bash, bosh, I was sat atop a hill overlooking a glorious scene, a sun-kissed sea and a cloudless blue sky. Better than moping about in Exeter I thought. Yep, everything was tickety-boo. Just me and my FT-817. But hang on. As I was about to begin another session of CQing, a couple of bearded blokes dressed up like SAS rejects came strolling along with the obvious intention of flinging themselves off the nearest cliff edge. Paragliding, it's called. I'd call it suicidal gliding. Each to their own. They came over for a chat apparently intrigued with my 'setup'. One thing led to another, I filled them in with a short discourse about amateur radio and they filled me in on the finer points of flinging yourself off cliff edges, and the difference between hang-gliding and paragliding. The former method is laying down, the latter method you're sat up (and kite size). Without a parachute. I asked them how long they could remain airborne? It's all to do with thermals, could be hours or minutes. Hmm, in my case, it'll be as soon as I needed a pee, 20 minutes or less. If this activity rocks your boat (it's definitely not for the faint hearted!), contact: the Flying Frenzy Paragliding School. I informed the 'suicide-squad' to contact the RSGB, where leaping off cliffs is not mandatory.

Once back to CQing, signals romped in on 20m. I knocked off several Russians and three Swiss stations in a few minutes. No unnecessary chit-chat, just the business of contacts. Felt like a contest. I had to bump the total up quickly as the other half was at the hotel. No doubt laden with more shoes she'll only wear once. Several contacts later, two US, a CT and roll-call of stations that can be worked most days of the week.

I packed up my gear and wandered back down the hill to the hotel. I waved goodbye to the paragliding gang. They didn't wave back as they were still busy jumping off cliff edges tempting fate. Back in the hotel room, I was right, more shoes. The other half had a wonderful time. Me too. This al fresco operating was something I had to do more often! Next time though, I'm going to have to get more organised. Leave the other half at home and go on my lonesome. That way, we'll both be happy.

Next morning, one last gasp of sea air. Then a drive back to the daily grind of dealing with grumpy clients. There again, there's nothing perfect in this world, not perfect clients, nor perfect propagation or perfect QSOs. But out and about al fresco really is a regeneration for the soul. Lastly, I'd love to give you all a roll-call of the stations I worked. Unfortunately, I forgot to pack the scraps of paper I'd written them all down on! **PW**

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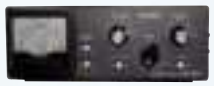

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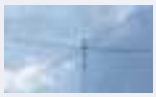

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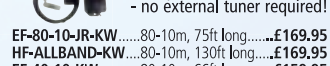

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The Marconi 2955 Radio Test Set

Gary Clark G0BKR takes a look at the Marconi 2955 Radio Communications Test Set

I am sure that like me many *PW* readers have collected various items of test equipment over the years, either from rallies or web auction sites. The challenge is always knowing what test equipment to buy. Radio amateurs should ideally be able to conduct some basic tests on their station such as measuring transmitted frequency and power, so frequency counters and power meters are popular. It is also very useful to have some other test equipment if you are constructing, such as an oscilloscope and audio frequency (AF) and Radio Frequency (RF) signal generators.

If you are like me, you may have ended up collecting an array of different test kit of differing quality and vintage. Some of your purchases may have proved to be very useful, others less so. Some you have perhaps used once, before selling them on at the next rally. Others may be out of sight in the loft in the category "*one day that might be useful!?*" Wouldn't it be better to buy just a single piece of test kit that does all the useful radio testing? This article covers a piece of test equipment, readily available on the second-hand market, which was designed to do just that – the Marconi 2955 radio communications test set.

Marconi Instruments (MI) was a UK manufacturer of quality test equipment. They became part of the GEC group of companies but sadly are no longer in existence. MI had a long history and its roots can be traced back to through mergers and takeovers to The Marconi Company Ltd, founded by **Guglielmo Marconi** in 1897. In the mid 1980s I was fortunate to be a student apprentice sponsored by MI during my electronics degree course and I worked for them in various departments over three years as part of my industrial training program. The company made a very wide range of equipment, including signal generators, spectrum analysers, power meters and some advanced automated test equipment used for in-circuit PCB testing. When I worked for MI by far their most successful selling product was the 2955 Radio Communications Test set.

Fig. 1 shows a page from the Marconi Instrument 1987 product catalogue. When it was new in the 1980s the MI 2955 cost many thousands of pounds and sold worldwide in very large numbers. The product even won the Queen's award for export in 1989. It was designed to test mobile, marine and airborne radio telephone equipment and the target market was public services and the military. It can be used on the bench with a mains supply or powered by a DC supply and some were supplied with a battery pack for field use. It has a carrying handle, but at about 16kg you would likely not want to carry it far.

Description

The test set essentially consists of 11 different pieces of radio test equipment all in one box, computer controlled, with built-in test programs. It is capable of testing radio transceivers up to 1000MHz. In terms of separate instruments it comprises the following:

- RF Frequency counter from 1.5 to 1000MHz (10Hz accuracy)
- AF frequency counter from 20Hz to 20kHz (1Hz accuracy)
- RF signal generator from 0.4 to 1000MHz with AM, FM modulation
- AF signal generators 20Hz to 20kHz with two-tone generator
- RF power meter up to 100W (1.5 to 1000MHz)
- True RMS AF and DC voltmeter
- Modulation meter for FM, AM and phase modulation
- Distortion meter operating at 1kHz
- Signal-to-noise (S/N or SINAD) meter
- Digital storage scope up to 50kHz
- Sequential tones decoder and encoder

The functionality is configured by push-button selection keys on the front panel to set up each instrument individually or by built in pre-programmed menu options for basic transmitter and receiver test functions, **Fig. 2**. In the automatic modes the instrument makes all the necessary interconnections for each measurement, eliminating the need for many interconnections when separate instruments are used. Function selec-

Fig. 1: Marconi 2955 listed in the company's 1985 product catalogue.
Fig. 2: The author's Marconi 2955 Radio Test Set.
Fig. 3: MI 2955 rear panel Connectors.
Fig. 4: Self-test feature
Fig. 5: Receiver testing.
Fig. 6: FTdx3000 6m sensitivity testing (10dB S/N ratio). Fig. 7: Transmitter testing.
Fig. 8: Marconi external power head (Higher frequency version). Fig. 9: Internal construction.

tion and data entries are made on a colour-coded keyboard with the operating sequence arranged logically from left to right. The user interface is presented in the form of menu options with digital measurement readouts. Analogue measurements are displayed on the built-in digital oscilloscope with single shot and freeze facilities as well as five auto-ranging bar charts. There are also built-in help pages to explain the automated test functions.

There are two RF input/output ports on the front. This allows for duplex testing where the RF generator can be used at the same time as the RF power meter. The 50Ω N-type socket is more versatile and can provide higher level RF signal along with automatic protection for reverse power. There is a second lower power input/output on a BNC socket. For normal transmitter or receiver testing only, one of these sockets is used and they can be switched using the selector button. There are also audio frequency output and input ports on the tester. These can connect to the transceiver's audio output and microphone input connectors so that the tester can modulate a transmitter and measure the received audio quality and level. External modulation can also be used for testing if required.

In addition to the AC and DC power input the rear panel, **Fig. 3**, provides IF output, demodulated auto output and an input for an external high stability frequency reference. There is also a connector to the built-in GPIB interface (IEEE 488), which allows it to be computer controlled to form part of an automatic test system.

Power Up and Self-Test

On power-up the instrument remembers the last test settings you were using. A good first step is then to run a self-test, **Fig. 4**, which is a menu option on the help menu. The self-test function automatically connects internally the RF generators to the frequency counters and internal power meters to check the levels and frequencies at a few set points. It also connects the modulation meter to the RF generator and measures the accuracy of the modulation. If there is major discrepancy with one of these functions, the self-test software identifies it and reports an error. The service manual provides more information on each test, which allows you to quickly troubleshoot if necessary. Common faults are covered later in this article.

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Receiver Testing

The MI 2955 is very useful for conducting basic receiver tests. The built-in RF signal generator is high stability and accurate to ±2db. It has a good quality step attenuator and this can deliver a very low output down to a fraction of a microvolt (–140dbm) making it useful for receiver sensitive testing. The RF signal can be AM, FM or phase modulated using the built-in AF generator, external modulation or built-in tone sequence generator. The receiver's audio output from the headphone socket can be fed into the 2955's AF input meter and used for signal-to-noise sensitivity testing and also for measuring the distortion introduced in the signal/demodulation path using the 2955's built-in distortion meter.

Fig. 5 shows the MI 2955 connected to my Yaesu FTdx3000 transceiver. I am testing the radio's S-meter calibration using the receiver test mode. The MI tester's RF signal generator is connected to the front panel RF N output connector and the Yaesu receiver's audio into the tester using the AF input port. In this test the RF generator is set to the receiver's frequency of 14.2MHz and I am varying the RF level to see what level is needed to achieve a S9 meter reading with the

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FTdx3000's preamp on setting one. For this preamp setting it is 47.9μV. The modulation is switched off so the tester is generating just a carrier wave at the set frequency, which tests the receiver's frequency accuracy. The MI 2955 is also measuring the received audio frequency as 716Hz, which is close to the sidetone value I have configured on the receiver. The accuracy of the AF frequency counter is 1Hz at this frequency and can measure down to 1mV levels. The receiver's audio is displayed on the instrument's digital oscilloscope or optionally as an analogue bargraph.

In **Fig. 6** the tester is measuring the FTdx3000's sensitivity on 6m using the built-in signal-to-noise ratio meter. This tester automatically switches the RF signal on and off about once a second and compares the levels of the received AF signal when the RF is present with the background noise. It automatically calculates the signal-to-noise ratio from this measurement, presenting the result in decibels. As you turn down the MI 2955 RF output level slowly using the front panel rotary control the measured single-to-noise ratio drops from over 30dB when the receiver is reading S9 to about 10dB for a very weak level RF level of about 0.2µV. The radio is performing according to specification and is very sensitive.

The tester can also measure the signal-to-noise and distortion ratio (SINAD), which is a measure of the quality of a signal from a communications device. The distortion meter has built-in band-pass filters and the distortion and SINAD filters both operate at 1kHz modulating frequency using a high-quality signal source in the 2955 to modulate the RF generator. Again, this test is automated by the MI 2955 and results are a shown on bar charts in addition to the digital display. The distortion on the received audio can also be measured at 1kHz test frequency.

Transmitter Testing

The 2955 is very useful for conducting some basic transmitter testing. When switching to TX testing on the main menu, the tester connects the internal RF frequency counter and RF power meter to the RF input and the internal demodulator. The output from the demodulator is connected to the instrument's AF power and AF distortion meters. You simply connect the transmitter's output to the N type input socket, which provides a 50Ω dummy load suitable to peak power levels of 100W or 30W continuous power. If the internal load heats up too much, an alarm is displayed on the tester telling you to stop transmitting to avoid damaging the instrument's power attenuator. Once transmitting power into the MI 2955, the test set automatically detects the frequency within a few seconds and measures the power, the results are then displayed on the screen.

Fig. 7 shows the FTdx3000 configured to transmit 26W at 7.15MHz. The 2955 measures 23.5W, power at exactly 7150000Hz, power measurements are ±10% accurate and frequency accuracy is dependent on the accuracy of the internal or external standard used. The original product has a claimed frequency accuracy of 1Hz up to 200MHz and 10Hz up to 1GHz if calibrated against a suitable standard. My own MI 2955 has had a replacement high precision 10MHz OXCO fitted.

The tester also attempts to demodulate the RF signal and the audio is displayed on the built-in oscilloscope. Demodulated audio can also be heard on the built-in speaker if required. The MI

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2955 was not designed to demodulate SSB but AM and FM transmissions can be demodulated. The quality of the demodulated audio can be measured using the distortion meter by using the high-quality built-in AF generator to modulate the transmitter on AM or FM.

Other Functionality

As well as the programmed transmitter and receiver test functions, the 11 individual instruments can be used stand-alone. The MI 2955 is also very useful for testing audio circuits. In the Audio Test mode, both the AF generators and the AF voltmeter are enabled. This allows the AF generators to be tuned while the voltmeter readings are noted thus allowing the operator to plot the characteristics of an audio filter or amplifier.

The Radio Communications test set also enables tone calling equipment to be checked and is capable of generating and receiving four defined tone frequencies as well as a sequence of up to ten programmable tones, including sub-audio CTCSS tones. The tester also has 38 non-volatile memories for storing complete instrument configurations.

Different Models

The first model of MI 2955 was launched in the early 1980s and was a very popular product for Marconi. The 2955A was released some years later. This has a 75W continuous RF power rating (rather than 30W) but I have heard it said that that Marconi never actually changed the design of the input attenuator but rather just revised the spec sheet! There is also the 2955R, which is identical to the 2955A with the addition of a sensitive


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receiver for off-air monitoring of transmitters, essentially turning it onto a receiver as well to monitor on-air transmissions. Later, around 1990, Marconi also introduced the 2955B, which was a transition to a white more modern looking colour scheme and with rubber keys rather than plastic.

Marconi Instruments was sold to IFR Systems in 1998, itself acquired by Aeroflex in 2002 and the name is no longer used. The MI 2955 continued to be sold into the 1990s and evolved into the 2945 and then 2965 range sold by IFR, which included a built-in spectrum analyser. The later models command much higher prices second-hand.

Accessories

A useful accessory is the external RF directional power heads, **Fig. 8**. When connected they turn the MI 2955 into a comprehensive through-line power meter. They allow transmitter power testing up to 500W, measuring forward and reflected power, peak envelope power and SWR. There are two models of power head, one for up to 50MHz and another up to 1GHz and they connect to the MI 2955's accessory socket.

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Marconi also manufactured and supplied an external printer in a matching metal case, which connected to the instrument to print out test results. When I worked for Marconi I never worked in the 2955 design department but I do remember doing a few weeks of 'manufacturing experience' and one of the tasks I was given was assembling these little printers.

Maintenance

Like all Marconi Instrument test equipment the MI 2955 is well built in a strong metal case. Internally it is designed for easy servicing. Removing the top cover, **Fig. 9**, reveals the non-RF circuitry on a series of circuit boards, which contain different functionality such as the modulation meter and CPU control card all in a shielded metal sub-case. These boards each have edge connectors and an individual card can be pulled out for servicing. There are sellers on a popular action site who sell card extenders to allow servicing in situ. Also, usually visible underneath the top cover, is the CRT tube and associated HT power supply but in the unit shown in the picture this has been replaced by an LCD screen.

A couple of years ago an Australian ham VK2KVJ designed a replacement Composite Video Board, which can be used to drive an LCD screen that replaces the CRT thus giving these instrument an extended life. This replacement board is visible in Fig. 9 in the centre of this instrument. The upgrade also removes the EHT circuitry needed for the CRT. More information on how to obtain this board and fit it is available in an internet Groups.io forum listed in the references.

Underneath the bottom cover is the RF tray with the RF signal generator synthesiser and associated RF circuitry. The back of the unit has the power supply and fans for cooling.

Possible Faults

Unfortunately, there are some common faults on these vintage test sets but fortunately there is lots of information on the internet, including an active Marconi instrument groups.io forum, Facebook groups and YouTube videos. Operating and service manuals are also easily available on the internet.

The first common fault is the failure of the Line OutPut Transformer (LOPT), which provides power to the CRT screen. Fortunately, there are sources online that sell compatible replacements devices. Alternatively, the LCD upgrade is another option, removing the CRT altogether.

By far the most common fault is due to one specific component failure. The tester uses a number of Philips OM series hybrid amplifier modules. These are ceramic encased semiconductors covered in resin with five pins, popular in masthead TV preamplifiers in the 80s. They deliver about 10dB of wide bandwidth RF gain and are used in a number of places in the tester. When they go bad the instrument usually fails self-test and the symptoms are low output failure, lack of sensitivity or frequency synthesiser inaccuracy. The original Phillips modules are virtually unobtainable but you can purchase replacement modules or in many cases fix them. They tend to fail with an internal bias resistor going open circuit and simply by soldering in an external resistor between their input and output pins they can be brought back to life. My own test set had an OM345 failure this year and I was able to fix it quickly using this method.

Buying Guide

The various models come up for sale fairly frequently on the usual internet auction sites and prices vary a lot. A few years ago they were selling for over £1000 but I have seen many standard 2955s in the last year advertised in the £500-700 range. I bought the one shown in this article a few months ago for £600 and this included the LCD modification and upgraded frequency reference board. The units with 75W continuous power labels are usually more sought after and the 2955B and R modules command much higher prices.

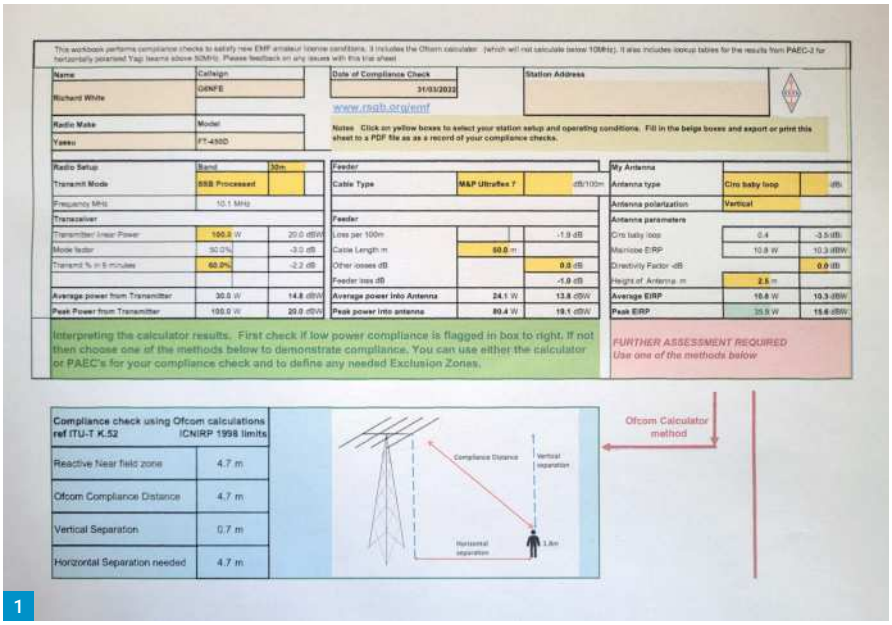
Check that the unit passes self-test before buying. If you see a MI 2955 on the second-hand market and it fails self-test, then chances are this is the Philips OM module fault so you might be able to get it for a bargain price if you are feeling up to the challenge of fixing it.

The MI 2955 was one of many pieces of high-quality test equipment sold by Marconi Instruments and despite it being pretty old now it is still a valuable tester to have in your shack. **PW**

References

Marconi Instruments:
https://tinyurl.com/3nxe7bbc
A good video describing the different models:
www.youtube.com/watch?v=Pjos0YJjQ-o
https://tinyurl.com/5dfnby6e
www.jvgavila.com/2955_pa.htm

Richard White G6NFE
practicalwireless@warnersgroup.co.uk



1

Moving Home and a Fresh Start with Amateur Radio

In Part 1 of a new series, **Richard White G6NFE** recounts the trials and tribulations of starting afresh.

The following is just a record of my build-out of an amateur radio station in a new house. It isn't meant to be read as a 'you must do this' article, instead it describes my thinking and how I went about the installation. Readers will no doubt question some of my ideas and have better ideas and that is fine. Due to weather, financing and other, more important things in life, the project has proceeded in small, manageable stages over winter, spring and summer.

A New Opportunity

Since my 'born again' re-start with amateur radio about seven years ago, I'd been hankering after a bigger garden, more antenna space and a reduced probability of annoying my neighbours with ungainly and 'ugly' antennas. Due to the sort of constraints we are all familiar with, jobs, children at school, and an element of should we move after 15 years, things conspired to keep us in place until 2021. Then circumstances changed and we had the opportunity to move.

To cut a long story short, we had friends in Shropshire and after lots of visits over three years, it became apparent this was the place for us. So, on 13 September last year we made the move and one of the first things I did after the house was more or less straight (Rule 1 when moving house: House straight before playing with amateur radio!), was figure out exactly where and how to install the Ciro Mazzini Baby Loop I'd purchased used in 2018.

Before I bought the Baby Loop it was demonstrated to me with a successful SSB contact at the previous owner's house. I was satisfied it worked and handed over the cash. Once I got it home it occurred to me that unfortunately I couldn't install in it my sub-miniature back garden without incurring the wrath of my neighbours for putting up an intolerable 'eye sore' and bathing them, and ourselves, in a considerable EMF field! Yes, the garden was that small……

So, with a resigned feeling I carefully wrapped it up and moved it into dry storage in the garage where I and it waited patiently for a new house and much bigger garden. On the plus side I'd purchased an expensive and well-made piece of engineering for about 60% of its retail price new and I was confident it would prove to be a good investment.

Fast forward to late 2021 and I am standing in my new garden thinking about where and if I could get away with installing the Baby Loop. I wondered also if I could once again mount my MFJ-1788 horizontally above the house and install two end-fed half wave antennas in a sloper configuration. But, first things first, the Baby Loop had cost a lot of money, I knew it worked and the time had come to make it pay its way.

No Wires!

One thing I had promised my wife was that I would not be stringing 'wires' (I've learned not to be pedantic here and don't explain they are cables) across fences or across the grass and absolutely no vertical antennas would be acceptable stuck in the grass with radials….. so maybe, just maybe, I could get away with my 'horrible radio thing' (the Baby Loop) if I sited it carefully and kept it close to the recommended 2.5m AGL.

After plugging some figures into the OFCOM EMF calculator it became apparent that if I operated it at 100W maximum, a compliance distance of 5m would ensure it could be used within the rules, **Fig. 1**. However, this calculation is only valid from 10MHz to 28MHz and doesn't cover the Baby Loop's ability to be operated on 7MHz. This made me think. Do I increase the compliance distance (an unknown) or just accept that I won't be transmitting on 40m with the Baby Loop? Given that an increase in compliance distance would bring the antenna even closer to the house I elected to keep it in its original position and accept that I may not be using it for 40m transmissions.

Happy that the public could not get within the 5m compliance zone I marked the final position in the soil then started thinking about how I was going to get the three cables from the Baby Loop back to the shack.

One thing I definitely wanted to ensure was that once buried, the cable would be fully protected. I recalled the flexible cable conduit used for signal cables alongside motorway road works and assumed it must be extremely tough. A supplier was found and I ordered enough to cover the 40m run from the antenna to the side of the house. Digging it in was a bit of a pain, but I reasoned that given I knew where the conduit was installed, I could keep the trench relatively shallow.

The Installation

I wanted to make sure the Baby Loop wasn't going to fall over, so a thick-walled aluminium tube was sourced and postcreted into the ground, **Fig. 2**. The Flexi conduit was installed next to the post and stapled into the ground with heavy duty awning support pins. **Fig. 3**




Fig. 1: OFCOM compliance calculations using the RSGB spreadsheet.
Fig. 2: The start of flexi conduit dig-in. A long and sometimes frustrating experience thanks to buried bricks, rocks and tough tree roots!
Fig. 3: Huge, industrial scale rope tie-down pins ideal for holding the flexi conduit in place.
Fig. 4: showing drilled back plate with Array Solutions AS-16SP fitted and the first Diamond surge arrestor.
Fig. 5. The ESD protection mounted on the wall.

shows one of these giant pins anchoring a small section of conduit above ground.

As this was a brand new amateur radio installation I also had time to consider ESD (Electrostatic Discharge) protection and earthing arrangements. Both things I hadn't bothered with at the old house, but I knew I had the space and time now to consider. I was aware of the gas discharge tube type devices and looking around I thought I'd use five Diamond surge arrestors to allow for future antenna growth. Because I was also installing a Yaesu antenna rotator, I thought it would be a good idea to protect the control lines at the same time. To protect the rotator control lines an Array Solutions AS-16SP, 16-way arrestor was sourced from the US and arrived quickly. I also decided to use the AS-16SP to protect the shack mounted, two-wire tuning controller on the Baby Loop. As this is a 16-way device it leaves spare capacity for another rotator in the future too.

A waterproof, external rated box was found and the metal back plate drilled to accept the five Diamond surge protectors and the AS-16SP from Array Solutions, **Figs. 4** and **5**. Happy that earth continuity indicated 0.1Ω across the zinc coated steel back plate and all the devices, I fitted a few sections of slotted trunking in place for cable management, installed a substantial earth connection strip and ensured the back plate was well bonded to the earth pipe I had buried earlier.

And this is really the point that I started to have doubts about my earthing and ESD methodology so far. Prior to building the ESD protection I had become aware of the real and potentially serious issues surrounding RF earthing and domestic electricity supply earthing into our homes. Readers will no doubt have read letters and articles in various publications about this issue. What appears to be on face value a simple concept, is not. I have read and re-read various publications, but the most illuminating so far has been the RSGB article in the April 2022 *RadCom*. More on this in a moment.

Before fitting the ESD protection I buried a 1.5m long copper pipe horizontally in the nearby 'soil' (and I use that term loosely), as I knew I couldn't make a second attachment to the existing mains protection earth rod a few metres away. The only place I could pick this connection up is the MET (Main Earth Terminal) in the consumer unit and I know this is not something I should be tampering with. I mounted the earth pipe horizontally because I was close to the side of the house and the incoming gas, electricity, water supply and wastewater/sewer pipe.

Not having access to site plans I had absolutely no idea where any of these services were buried and didn't want the nightmare of puncturing any of them! The obvious question arises about just how effective a horizontally laid copper pipe really is in poor quality soil. I am concerned the answer is 'not very' and I will have to check this. The idea of the ESD protection is to sink the very high voltages from a nearby lightning strike to earth, not to provide an RF earth to transceivers, amplifiers and/or tuners in the shack. I hope that the freshly laid copper water pipe will suffice for this job.

The plan also is to ensure the Baby Loop mast is also earthed to a substantial new earth rod in the garden.

Earthing and PME

Back to the April 2022 *RadCom* article by **Russell Tribe G4SAQ**. This article is clear and well written and I recommend all radio amateurs read it. In essence if I have understood it correctly, a loss of the Protective Earth Neutral (PEN) on a PME electrical supply system, could lead to lethal voltages on the earth connections in house mains wiring. Not such an issue inside the house, but definitely an issue when the earth is 'exported' outside the house, in this case an earthed amateur radio coaxial cable. This can be and is, mitigated by two solutions, and in both of them, a 'local' earth electrode is installed at the house. Fortunately, I can see that my house already has one of these just a few metres from the incoming mains supply and it is connected back to the MET in the consumer unit. That said, I am seriously considering getting this 42-year-old installation tested professionally before I start terminating coaxial cables.

So, safety earthing with mains supplies is not a simple subject area and can't be taken lightly or ignored. The theory is that in a failure of the PEN the 'local' earth electrode will handle the fault current. My concern is how much of that fault current, if any, will end up on the shield of the coaxial cable to the external antennas and then, critically, to an 'external' earth, via a human being. This is a thought-provoking area and must be worthy of more conversation by radio amateurs.

Results so Far

So, where about am I with the new installation at the moment? Today is 31 March and the ESD protection box is now wall-mounted and waterproof. Late March weather has stopped play for the time being, but when things warm up again in April I will extend the conduit and cables into the house. This part will involve a builder as I need some substantial holes drilling through solid bricks and cement blocks! Not to mention the installation of two runs of 2in diameter UPVC drainpipe and elbows inside the garage and across the ceiling to carry multiple coaxial and signal cables.

My aim in Part 2 is to cover this off and also the hard part, fitting the Baby loop, testing the connections back to the shack and hopefully getting the antenna to demonstrate a low SWR, then to tune and rotate. Not too much to ask for then! **PW**

Maurice Webb GW0UGQ
gw0ugq@yahoo.com

1

A Small Magnetic Loop for the HF Bands

Maurice Webb GW0UGQ describes a small magnetic loop suitable for use by those with restricted space.

I was contemplating this idea quite a while ago. But sadly it had to be slightly shelved because of poor health and the outbreak of the dreaded COVID-19. A brief history of my QTH (see also qrz.com). As mentioned in a previous article (*PW*, April 2020), I now live in a high-rise multi-storey apartment block. The local CC will not allow any forms of HF antennas; hence the reason for experimenting with magnetic loops. My apartment block was built in the late 1960s and consists of reinforced concrete walls etc. So, it's a little like living in a Faraday cage. But I cannot complain. I built this antenna with the possibility of trying a bit of portable work, but as mentioned above, I had to shelve the idea. The antenna to be described covers 10 to 21MHz and is motor controlled from a small dry cell battery pack (4V) or 13.8V DC feed when out portable.

Most of the components used may be in your junkbox or can be bought quite cheaply from most general hardware stores. However, the variable capacitor is the most important item – that is if QRO power might be wanted when out portable. The variable capacitor must be quite wide spaced to handle the excessive voltage and current flowing, without arcing across. Most constructors would mainly go for a Jennings or similar vacuum variable capacitor, but of course that would drastically increase the cost of the project. I originally used cheap bamboo garden rods from a local hardware store, but you could easily improve on that to make it more rigid (see picture on my QRZ page).

The antenna to be described uses 22mm copper tubing. (You can experiment with what you have.) Previous to using 22mm copper tube I first used RG213 coax and also experimented with 10mm microbore copper tubing. I am not going into the full mathematical calculations, as all that can be found on the internet. However, my sizes will be quoted. You can also use a different size loop, depending on where (in the HF spectrum) you wish to operate. You may also have to change the value of the variable capacitor to suit your needs.

My Configuration

Right, my test loop has a diameter of 30.55in, which equates to a circumference of 7.99ft. I chose this size because it was small enough to experiment with, before making a much larger one – if, of course, that may be your intention. The small coupling loop is one fifth of the circumference of the main loop. If you use micro-bore copper tubing, then with a little practice it can be made into an almost perfect circle; that being the best configuration for a magnetic loop main element. The variable capacitor on my loop was one I had hanging around. It had a value of about 120pF. It was just a standard broadcast receiver type, which is only good enough for QRP RF power of around 10-15W, before arcing may begin! (My original variable capacitor has now been changed, see below.)

As I said before, the voltage across the capacitor when current flows can be quite excessive; see internet blogs for more information. The idea is to make all connections as short as possible so as not to add unnecessary resistance to the loop circuit. That is the magnetic loop nightmare, keeping that resistance down to a minimum. Some constructors swear by silver soldering every joint, but I have not done that with my design due to its being a test experiment. I may do that with my final loop, should I ever reach the end of the yellow brick road. Although I will describe my mounting arrangement of the loop, you could probably make a better one. The tripod I used is just a cheap one off the internet (eBay).

The simple motor system I used is the MFA/Como Drills 919D series. These can operate on a DC voltage of between 4.5 to 15V DC. Up/Down (frequency) is achieved by simply reversing the DC feed to the motor (crossover network). The gearbox ratio is 3000:1 (slow/fast can be done by switched voltage adjustment). Obviously, this simple arrangement has its problems; especially if a variable capacitor with an end stop is used! My type of motor has a standard 1/4in shaft, which is ideal to fit the same size variable capacitor shaft (two couplings needed). It should be noted that the variable capacitor shaft will be hot/live with RF voltages, therefore an isolation shaft (non-metal) is needed between motor and variable capacitor, hence the two coupling shaft connectors: **www.technofix.co.uk**

The variable capacitors I use are 360° type, so I don't need to worry about any end stop microswitches. Also, my capacitor now (150pF) has a vane spacing of around 10mm. My first construction of this magnetic loop was made using bamboo from my local (Bevans) store. A bit crude, I admit, but I don't build a Rolls Royce initially, as they always fail in some way. I did not use any form of rotation for different beam headings. Being indoors I just change the direction slightly and then re-check the tuning. Also, to note; a magnetic loop antenna can be mounted horizontally if wished. This would then give an omni-directional antenna, but I have never tried this so you will have to check for results on the internet blogs.

I have included some pictures of the construction, which should be self-explanatory. Basic principles of operation (for beginners) are first tune the loop for a peak in band noise. Then transmit a low power RF carrier and adjust the SWR for minimum. If problems occur, then you can try moving

Photo 1: The basic loop and tuning capacitor. Photo 2: A close up of the capacitor and loop connection. Photo 3: Motor drive to the capacitor. Photo 4: The feedpoint with coupling loop. Photo 5: The stand. Photo 6: The control box.

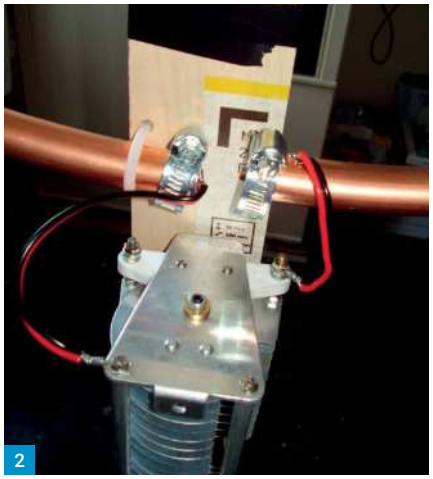
the small coupling loop closer or further away from the main loop. If that fails (SWR quite high), then you can play around with the coupling loop length but only a little at a time. Please note that you may not be able to achieve a very low SWR on all the bands that the loop is designed to cover. You have to bear that in mind.

Thoughts and Results

I can imagine that a few people may not like the principle of a magnetic loop. For example, a small change in frequency means that you may/will have to re-tune the loop. This is a characteristic of the loop due to the high *Q* factor. I mainly use mine for the new digital modes such as FT8 and FT4, and I get a great deal of fun out of it. Bearing in mind that I only use 5W RF power output, from home, I have worked America (K1) and Indonesia (YB), which is not bad from an apartment. Also, the magnetic loop exhibits a reasonable amount of usable low angle (RF), at only a small height above the ground. This makes the magnetic loop slightly more attractive than, say, a dipole, which needs to be quite high above ground to exhibit the same low angle of radiation that is needed for long range DX.

Please study pictures as I describe construction and changes done. I changed the original vertical mounting arrangement to a single stout bamboo rod. To this I then fitted a 3 x 1/2in long piece of wood. This was clamped to the bamboo using 10mm copper pipe saddles (from a local hardware store). I drilled four small holes – two on the left and two on the right. This then had two cable ties (vertically mounted), which held the top centre of the main loop. I did the same with the left bottom section – where the variable capacitor will be mounted. Only for the test I used tight jubilee type clips to hold the 6mm capacitor short cables to the loop base. These can be silver soldered as required when tests are finalised.

The smaller coupling loop was mounted about 1in below the top centre of the outer loop. Again, as with the initial tests, I used a large chocolate block to take the ends of the coupling loop and the coax cable connection from the transceiver. This coax I ran down the back of the vertical wood, to the bottom where the tripod was. The new wide-spaced variable capacitor, as mentioned above, was then mounted just below the bottom open section of the main loop. The motor was then mounted below the capacitor with its insulation shaft (as mentioned above). The control box was/is just two switches; a simple switch for slow/fast being 4V or 13.8V DC. The other switch controlled the DC from the first switch to the motor. The switch was/is wired as a crossover, so that, say, left was up (higher freq) or right down (lower freq) or whatever configuration is needed to suit your capacitor used.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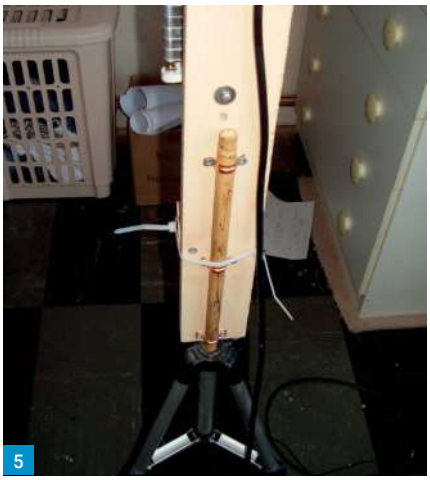
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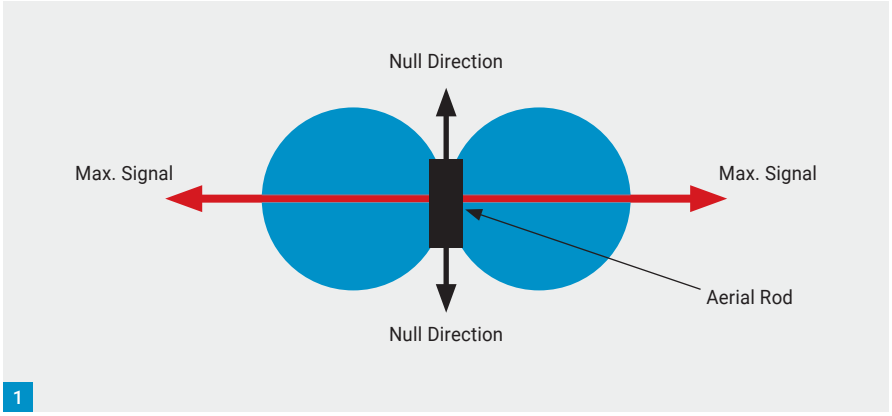
May I also take this opportunity, with the recent release of documentation from Ofcom, to mention that to operate a magnetic loop antenna within close proximity to your body, or any other body, can be very dangerous at medium to high RF power output. There is a lack of technical information with reference to the magnetic field generated by a magnetic loop antenna at high RF power output levels, within the HF bands. Please read the limited safety documentation that appears on the internet. And, of course, use common sense. As advice, when I play around with loops constructing or testing wise, I tend to use a maximum of a few watts. It is always better to be safe than sorry!

I know that a lot of people out there will feel that my construction is by no means perfect – and I accept that. My design does have added resistance, but it can still give some people an idea of how to still have a great deal of fun in amateur radio, without the high expense of costly antennas or the problems associated with not having enough real estate. Another important fact, often overlooked, is if you find that your loop construction will say not peak the band noise or will not exhibit a low SWR – then please don't be tempted to try and rectify the issue by using an ATU. That is the wrong way. After all, a magnetic loop has its own 'L & C' network, so it already is a tuned circuit. If it doesn't produce what you want or expect, then there is either a fault in your construction or your mathematical calculations are incorrect.

Always remember the old radio amateur who said those famous words, *"You can have a 6in nail at 40ft above ground. And get a good match with an ATU. But it doesn't mean it will radiate"!* 73 and good DX as well as some fun in a construction project.

Any feedback would be great at my email address via QRZ.com and at the start of this article. **PW**

Colin D Merry G4CDM
practicalwireless@warnersgroup.co.uk



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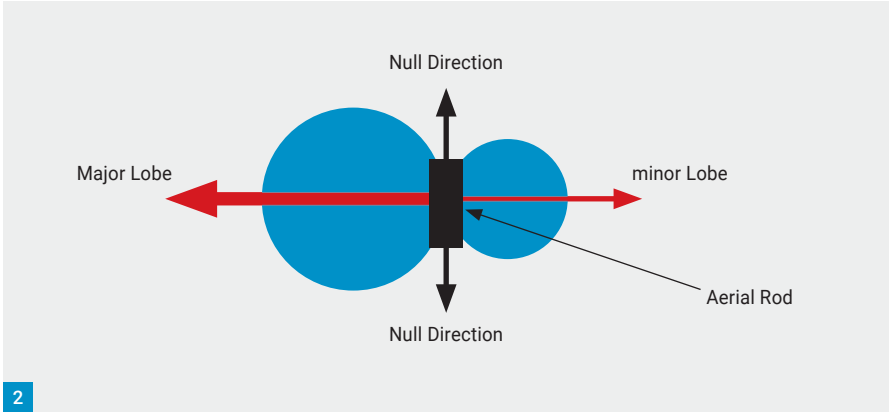


2

An Introduction to Topband DF

Colin D Merry G4CDM describes 160m Multi-Transmitter Direction Finding Events, how to have having fun tracking down transmitters.

The source of a radio signal can be tracked down by using a direction finding (DF) set (a receiver with a directional antenna). So, using this ability we can have some fun. See if you can find the hidden transmitter station(s) before other competitors do.

We make the assumption that radio waves propagate in a straight line from transmitter to receiver (which is not always true). However, this is a reasonable assumption if using low frequencies. An example of a directional antenna is a ferrite rod (as typically used in MW/LW radios). The ferrite rod antenna is simply rotated horizontally to find where the peaks and troughs are in signal strength. Turning through a full circle will reveal two peaks and two troughs. It will be noticed that the troughs are much sharper than the peaks. Hence the trough or 'null' is used to more accurately determine the direction of the transmitter. A compass aligned with the antenna's direction can be used to take a bearing on the transmitter. Another type of directional antenna that can be used is a frame antenna. This typically consists of a number of turns of wire around a wooden frame and works in a similar manner to the ferrite rod.

Sense

There are two nulls, one is true, the other is reciprocal (180° displaced). You could move to a new location and repeat the direction-finding procedure. Then, if both bearings are plotted on a map, the point where the lines cross is where the source of the signal is. There is another method, which can eliminate the reciprocal bearing without moving, and that is to use a 'sense' antenna. This is a vertical antenna, receiving exactly the same signal while the directional antenna is being rotated. One of the two peaks will be in-phase with the sense antenna whereas the other peak will be anti-phase. Combining the signals from both antennas will cause either an increase in signal strength or a reduction depending on the relative phase of the signals via the two antennas. This is used to determine the actual direction.

Homing-In

Being able to determine an unambiguous direction to a transmitter using a portable receiver is the main tool for direction finding. In addition, the strength of the signal can be used to judge the distance of the transmitter. As you approach, the signal will distinctly increase in strength, so much so that attenuation becomes essential as you get close.

The DF Set

The DF sets we use cover topband, that is the amateur radio allocation between 1.81 and 2.0MHz. This low frequency band is well-suited to direction-finding. The receiver used needs a few refinements such as attenuation, BFO, good screening and of course the all-important antennas. Most competitors own their own sets and these are usually self-built. For an example of a DF set visit:

www.topbanddf.org.uk/construction.htm

A Multi-TX DF Event

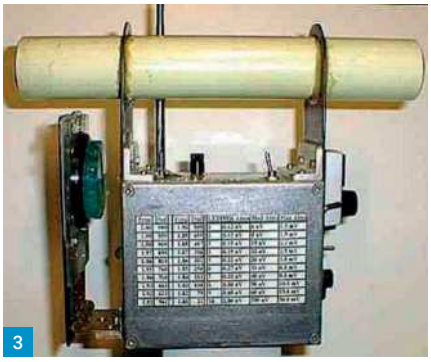
The art of tracking down a group of small transmitters can become a lively, competitive game combining technical skills with some map reading and orienteering expertise. The basic objective is to track down a number of transmitters, on foot, within about 1km. Competitors are provided with a simple timetable and frequency chart to enable them to tune in and listen at the appropriate times.

Ten small, unmanned, hidden transmitters are planted in a defined area, woodland, open space, etc. All of the competitors start at the same time from the same place. The transmitters automatically transmit according to a predetermined schedule and the competitors head off seeking their chosen first transmitter (TX). Every transmitter visited adds to a competitor's points, those arriving first getting many points, those arriving later, not so many points. A handicapping scheme favours newcomers and hampers previous event winners, so everyone is in with a chance.

Transmitters

Compact, programmable transmitters are built into small plastic snap-shut plastic food containers. They come with a length of fine brown

Fig: 1: Bidirectional polar diagram for a ferrite rod antenna. Fig: 2: Adding a sense antenna changes the pattern to be more unidirectional.



wire, which is their antenna, tidily concealed up a tree or bush. Below this, possibly buried, is the transmitter. Having located it there is no requirement to touch the transmitter. Instead, you must find the associated 'Triffid'. This is somewhere within 3m.

A triffid is another plastic box covered with camouflage. This is the timing device. Each competitor is given a numbered 'dibber' to place briefly into each triffid found. A confirmatory flash indicates that your time of arrival has been logged in both the triffid and your dibber. (These devices are read later and used to compile an accurate record of achievements for all competitors and overall results.) Triffids and dibbers are PIC-based contactless communication devices using a 125kHz carrier produced by the triffid to power the dibber and provide two-way data communication.

The transmitters are low power (less than 1 Watt). They are controlled by a PIC microcontroller and include a frequency synthesiser. Thus, they are frequency-agile and able to turn on and off according to a set pattern. Transmitters share a common frequency. They are all time-synchronised so that only one transmitter on each frequency will operate at any time. Fairly long periods of constant carrier allow for ease of DFing, interrupted briefly to send a TX identifying letter in Morse code. Additionally, a callsign is sent in Morse at frequent intervals to comply with the licence requirements.

Fig: 3: A typical DF set.
Fig: 4: Taking part in a multi-transmitter event.
Fig: 5: A 'triffid' in the undergrowth with dibber inserted.

Participation

If you would like to have a go at multi-TX DF hunting or would like to find out more information, then visit the website at:

www.forjac.co.uk/df/multitx/multiexp.html

Here you can also read about previous events, find contact names and dates of future multi-TX DF events. Most events are currently held in Essex but future events are being planned elsewhere. There are always loan sets available for newcomers. **PW**

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

1

HF Continues to Deliver

Despite the onset of summer, **Steve Telenius-Lowe PJ4DX** has reports of plenty of HF activity, but starts with some useful news items.

Welcome to the August *HF Highlights*. Solar activity continued to climb in May, with the sunspot number (SN) peaking at 173 on 17 May and the solar flux (SFI) peaking at 180 two days later. However, activity then declined and the SFI dropped below the 100 mark in early June. On the day this column was being finalised, 11 June, the SFI was 111 and the SN only 33, as can be seen in **Table 1**, which compares these figures with those recorded six months and 12 months ago.

Queen's Platinum Jubilee

I write this as Her Majesty's Platinum Jubilee celebrations are in full swing. Please send any reports and photos of your, or your club's, activities with the GB70 or GQ prefixes, or the /70 suffix, to this column by 11 August.

DXers in Devon

Eva PJ4EVA and I left Bonaire for the first time in three years to spend some time in Devon in May-June. We took the opportunity to get together with some radio friends we have met over the air. First was **Jamie Sliman G0XJS** who lives in the town where I grew up but who I had never met before. **Tim Beaumont M0URX** acts as QSL manager for both Eva and me and we were very grateful to him for driving down from Coventry to hand over our incoming QSL cards! It was good to catch up with Tim again after 11 years, and for Eva to meet him for the first time, **Fig. 1**. Finally, **David Aslin G3WGN** kindly invited us to join a small but select lunch-time get-together of Devon DXers and contesters near Exeter, **Fig. 2**. It was good to meet David again after several years and to meet **Paul G4RRA** and **Tim G4FJK** for the first time.

QSL Bureau Problems

As HF operators we, as a group, are probably the greatest users of the world's QSL bureaus. But if it is a very long while since you have received cards via the bureau from certain countries, there is an explanation. QSL manager Tim M0URX says *"Don't blame Brexit! New customs regulations brought in by the World Customs Organisation (WCO) are now in force world-wide, and parcels sent to QSL bureaus are no longer considered 'Value 0' for customs purposes."* As a result, they attract customs duty and some IARU QSL bureaus either can't or won't pay the fees. Some parcels do get let through without charge by customs and some bureaus pay the duty charged, but other parcels either get returned to the sender or are destroyed. Tim says that customs officers now have the power to carry out either of those options: *"So far, I have had bureau parcels returned from Brazil eight times, Argentina many times [as well as some from] Sweden, Portugal and Turkey, to name just a few, while the Cuban bureau has not picked up their packages from the Cuban PO box in five years,"* he added. However, it seems that because most international bureaus are run by volunteers, many are not yet aware of the new WCO regulations.

Readers' News

First up this month is another new contributor to the column, **Dave Thorpe G4FKI** from Ampthill in Bedfordshire, who wrote, *"My Shefford radio colleague G3JNB is a regular contributor. We have a regular SSB net on 1985kHz on Mondays at 1900. From the central Bedfordshire area all are welcome. I have recently been doing mobile operation WSPR on 40m using 200mW from a QRP Zachtek WSPR transmitter* (**Fig. 3**)*... The little transmitter runs off a simple 5V USB battery pack. The transmitter is GPS locked: this changes the six-figure Maidenhead square automatically whilst travelling... The antenna is a base-loaded monoband mobile whip 4ft long* (**Fig. 4**)*. My best DX on 26 May overnight was VK7JJ 10 times from 0454, distance 17,000km, followed by KD2OM and five other Stateside stations."* Thanks for the report, Dave: 17,000km with 200mW to a 7MHz mobile whip is astonishing, even using WSPR!

"May Day opened well on 30m CW with the logging of a weakish FY5KE French Guiana" reports **Victor Brand G3JNB.** *"Then, there followed one of those occasional periods of being able to 'hear 'em but not work 'em': Fiji, China, Nepal, the Andaman Islands and Chile et al just ignored me. However, on the 8th,* ***Antoine 3D2AG*** *Fiji on 17m heard my calls and, despite struggling with his intense local QRN, eventually copied my full suffix for a notable 10,000 mile QSO. On 20m, D4L Cape Verde came straight back but on the 9th VK3DHI, VK3XU and OA4DX just did not hear me. Nevertheless, long skip paths were recovering. Much later at 2244BST, I could hear a readable signal on 15m from LU5OM Argentina running 2kW to a roof-mounted beam. Awaiting my turn, I called and eventually he copied my 100 watts to a small vertical at 339, which was reasonable at that time of the evening.*

"Two days later, HS3NBR Thailand was audible on 15m. Clearly having difficulties copying Europeans, it took him almost half an hour to send 'G3?' and make the QSO. Conditions varied throughout the month at my QTH. On the Thursday and Friday before the CW WPX contest weekend, I was hearing some strong DX from around the world but on Saturday and Sunday propagation declined.

"Mid-month, I restored my Data/PSK31 capability. As always, I wrestled with the settings

Fig. 1: In May Steve PJ4DX and Eva PJ4EVA visited England and met up with QSL manager Tim M0URX (centre). Fig. 2: David G3WGN, Eva PJ4EVA, Steve PJ4DX, Tim G4FJK and Paul G4RRA at the Devon DXers get-together. Fig. 3: The 200mW Zachtek WSPR transmitter with which Dave G4FKI/M was heard in Australia. Fig. 4: The G4FKI/M 4ft long base-loaded mobile whip on Dave's car. Fig. 5: Sun pillars as seen from the Upper Siege tunnels, Gibraltar. Fig. 6: The ZB2JK 10m backpack station, a modified CB rig, used by Kevin ZB2GI at Coaling Island, Gibraltar.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and rig control system, discovering eventually an intermittent plug into the data interface. Once all was well, I ventured back on to HF and found that, despite improving conditions, my loggings were still confined to 'local' EUs. Hopefully, PSK will recover its 'keyboard to keyboard' charm as time passes. Meantime, apart from a QSO with TR8CR Gabon on 30m in the very last hour, for the rest of the month it was the Caribbean and South America that proved productive (see 'Around the Bands'). Finally, I applied for my GQ3JNB licence variation and a matching TQSL certificate for Logbook of the World. June should be great fun sporting the call on the DX bands."

Etienne Vrebos OS8D had *"an unusually quiet month with no spectacular catches and strange propagation... Made only 200 QSOs with no noise any more on 80 and 40m but it started now on 21 and 28MHz... But that new noise can be totally cancelled by the excellent noise blanker of my IC-7851, without decreasing the reception signals. It means not disturbing the reception of weak signals sometimes from Japan on 21MHz... These noises keep me walking around with my Tecsun and the long wire between my arms and being known by all neighbours, and keeping an eye on their new electrical purchases – they know it!"*

Neil Clarke G0CAS sent in his 28MHz beacon report for the month of May. *"Comparing May this year with May last year the summer Sporadic E got off to a rather slow and sluggish start. The daily average of the number of beacons heard during May was seven as opposed to 14 last May. Beacons heard were very sparse until the 6th when a good opening to the Mediterranean occurred with several beacons in Italy and Spain heard. Also, ZB2TEN 28167 was strong during the afternoon. It was not until the 18th and 19th when more widespread openings took place with several new beacons heard for the first time this year. Looking further afield outside Europe towards South America the three beacons on 28200, LU4AA was heard on 26 days and OA4B and YV5B were heard on only 10 days. Another beacon PY4MAB 28270 still proves a good indicator in that direction and was heard on 27 days. African beacons ZS6DN and 5Z4B on 28200 were heard on 18 and 20 days respectively. 4X6TU 28200 was logged on 24 days of the month: some days it was nor heard till later in the day and occasionally not until the evening. No beacons from North America and the Pacific were logged throughout the month."*

Jim Bovill PA3FDR wrote that *"DX conditions were rather poor from my QTH during the first part of May, with only a few contacts outside Europe. In the first week I only managed nine DX QSOs; in previous months I often managed that or more in one day. Fortunately, propagation improved during the remainder of the month, with good openings to the Far East and North and South America, especially on FT4. Among the new contacts were PZ5RA, CX5ABM and YV5JLO in South America, XP3A in Greenland, VR2ZUZ in Hong Kong and EK1KE in Armenia. TR8CA in Gabon added to my list of DXCC entities along the west coast of Africa... JW4D was the callsign of a group of eight Norwegian amateurs active on a DX expedition from Svalbard, also known as Spitsbergen, a Norwegian archipelago in the Arctic Ocean about midway between the northern coast of Norway and the North Pole."* Jim added *"I would like to include my QSOs with three UK amateurs who used special callsigns during the period of 2 - 5 June to celebrate Queen Elizabeth's Platinum Jubilee celebrating her 70 years on the throne. They were GB0QE from the city of Newry in my home country of Northern Ireland, GB70U who operated an RSGB special event station in Guernsey and GB3RS/70 operating from the RSGB National Radio Centre at Bletchley Park."*

Owen Williams G0PHY reported that *"The dip in the SFI* [in early June – **Ed**] *coincided with a falloff in activity at G0PHY with only a few DX stations worked this month. There was, however, interesting propagation on the evening of 19th May on 14MHz. DU3LA from the Philippines was a very strong signal but, unfortunately, I could not break the pile-up. Someone who did get through was PJ4KY who was an even stronger signal with me at well over S9. When I saw his QRZ.com page I could see why he was so strong!"* [**Bert PJ4KY** uses a very large SteppIR MonstIR Yagi at 60ft – **Ed**]. *"Listening to the QSO I understand that PJ4 to DU is a difficult path. I have just started using Logbook of The World as a way of cutting down on the need to send physical QSL cards to claim DXCC credits etc. I still have a paper log so I am only entering QSO needed for credits and it's taken some detective work trawling through old logbooks finding QSOs in the different CQ zones."*

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	Jun '22	Dec '21	Jun '21	Difference
SFI:	111	78	77	(+34)
SN:	33	0	29	(+4)

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.

Once again **Kevin Hewitt ZB2GI** was very active (see 'Around the Bands' below: this is but a small selection of the stations worked by Kevin!) During the month he operated from the Top of the Rock, Coaling Island and the Gibraltar Amateur Radio Society's club station and his home station. "I *also went to the Upper Siege tunnels with* ***John ZB2JK,*** *we set up the 10m backpack with the home-made 2-element Yagi, only to find the band closed."*


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The photograph of the sun pillars, **Fig. 5**, was taken by Kevin from the Upper Siege Tunnels in Gibraltar. The backpack station shown in **Fig. 6** is a 'Superstar 3900' CB rig modified for 10m and mounted in a backpack with a 4Ah SLA battery. The antenna is constructed from four telescopic flag poles mounted in a plastic water pipe, attached to an aluminium boom.

Around the Bands

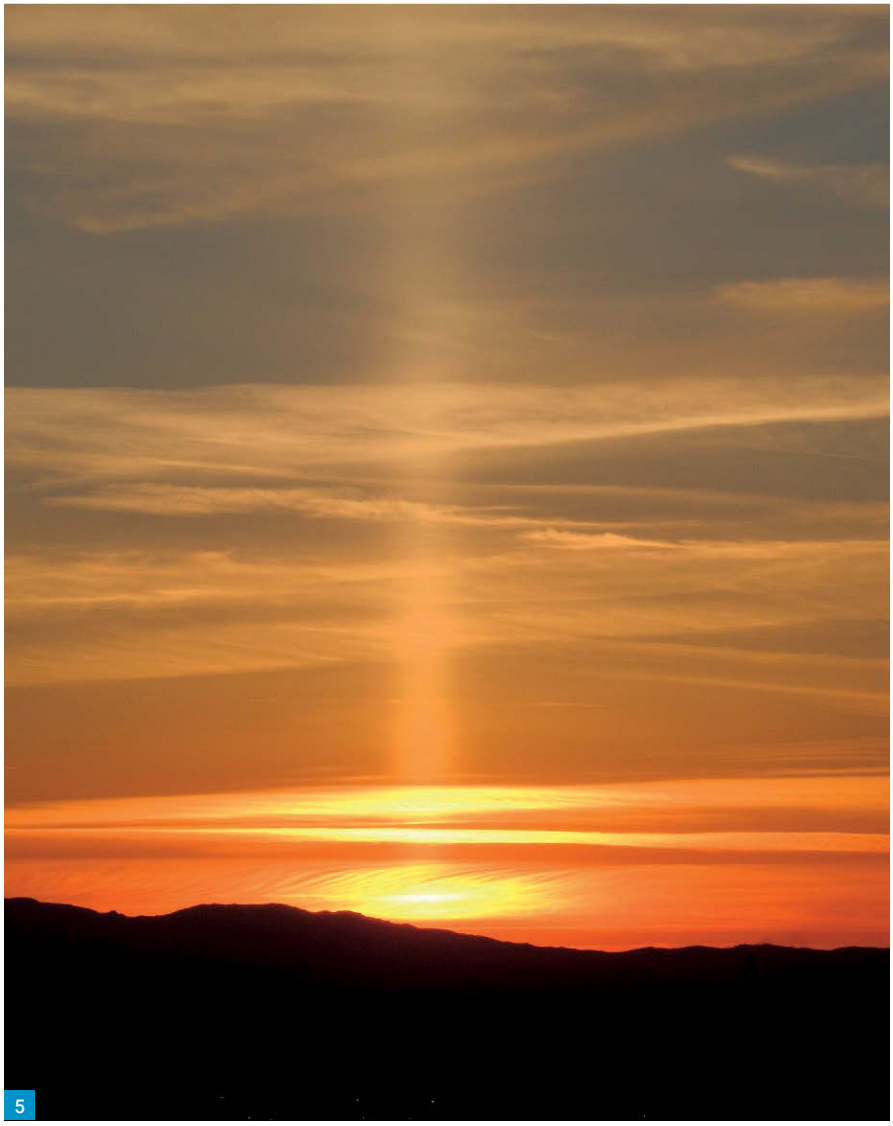
Victor G3JNB: 10MHz CW: FY5KE, TF3JB, TR8CR. **14MHz CW:** D4L, LU6OA, PY4HO, TF3JB. **18MHz CW:** 3D2AG, KP4JRS, OX3XR, PZ4JW, XQ6CF. **21MHz CW:** HS3NBR, LU5OM, LW1F, P44W, P49Y, TO3F, W3PC, WP3C, ZF1A.

Etienne OS8D: 14MHz SSB: 4L7D, EK6CW, JT5DX, UN5P. **18MHz SSB:** 4L5O, C5C, KL7KK. **21MHz SSB:** 4L4W, HL4CAF, JA2FTR, JA6XMM, JE1AON, JY76MM, PY1EZ, S79VU, T42ITU, UN9L, YB1DFE, YC2DBW. **24MHz SSB:** VP8LP.

Jim PA3FDR: 7MHz FT8: GB0QE, GB3RS/70, GB7OU. **14MHz FT4:** JA6OXT, JA8KSF, JA9NFO, JK6DXD, PT2VHF, VK5PO, VR2ZUZ, W5XO. **14MHz FT8:** BH6LIG, PY4XX, R0AX, VE2GSO, W5XO, WC4J. **21MHz FT4:** CN66PA, CT3MD, EA8DHA, JA2QXP, JA3FYC, JA8BZL, JG3RPL, K0IR, KZ9DX, LU5UFM, LU8DY, N3MK, NP4TX, NU1O, PP5LC, PU1JSV, PU4MMZ, PY2AB, PZ5RA, TA2K, TA7I, UN6TA, WJ2D, WU6W, YC1CBC, YC4AOK, YC7YGR, YV5JLO, XP3A. **21MHz FT8:** 4J3DJ, 9K2NO, AP2AM, DS1AAK, EK1KE, JA7ZF, KB8BIP, KP4JRS, LU8EKC, PS2GOB, PY7PX. **28MHz FT4:** 5B4VL, CX5ABM. **28MHz FT8:** JA6FIO, LU5EPB, LW3DAS, PU5CVB, TR8CA, VK6AS.

Owen G0PHY: 14MHz SSB: CN66DEM, FM4SA, KL7KK, PS2GOB.

Kevin ZB2GI: 5MHz FT8: DF5RA, G3UHU, LY2FN, MM0JTV, SP7IWA. **10MHz FT8:** BH4QYX, JA0UUA, JA3FYC, JA5AUC, JA9AVA, JE1SYN, JF8QNF, K3LJ, K4AAX, W1MI, WB5BHS. **14MHz SSB:** 5B4AIX, 8P5AA, AA2AS, AD8FD, AF7WH, BA4TB, JR3VXR, K1DVL, K2AR, K3OLK, K4BSZ, K7CCL, KD8EDN, KD9HQD, LU1HAS, N0CEL, PY2SO, PY5CB, TA2TAZ, VE2VOL (QRP), VE9FI, VK2BY, VK2EIR/M, VK3ACZ, VK3BY, VK4KA, VK5MRD, VK5PAS, VK6NTE, VO1SDS, WP3AV, WP4NQY, YV5HNJ, ZL1KVA, ZL1MTO, ZL4AI. **18MHz SSB:** II5WRTC, TZ4AM. **21MHz SSB:** LZ01MLN. **21MHz FT8:** A92EE, AA0N, AD5ZA, AG4Q, AH0U, AK9B, BG2QMO, BG3RZA, BH2SWB, CO2AV, CO3LY, HK6JCF, JA0LFV, JA1LSY, JG3RPL, JR6EZE, K2FJ, K3FS, K4TT, K6EV, K8RAR, K9OM, KG5PNN, KV0X, N7MDW, VA3DYD, VE2YZX, VE2YZX, VE3JAR, VP2EIH, XI0X, YB8RSE, ZL3IO. **21MHz FT4:** AB8E, AD1C, WD4GBW, K0MLD, K9CW, KA3ZLS, N2JT, NM7H, VA3ROC, WB6RSE. **24MHz SSB:** 2M1EUB, TZ4AM. **24MHz FT8:** HI8T, JE7JDL, JG3QZN, KQ8E, N3GTG, N5PEL, VE2ENN. **28MHz SSB:** LU1JHD, LU4DJB, PU1WZY. **28MHz FT8:** 4Z4DX, 5B4VL, AK4CB, BG8SRK, C31MF, CX1AZ, HC5VF, JA0EOK, JA1NQU, JA2KVB, JA6BZI, JA7HRM, JA8UIV, K1MDA, K5MBL, K7JE, KD4SIX, LU2AEZ, LU3QDF, LU6FL, LU7DK, LW1DG, N2KBF, N6PM, NL7D, NP4JE, PP2KR, PY4HI, TA3BD, VE1JBC, WP4CQ, YB1AM, YC1LIN, YG9BKM, YV5MHX, ZP6LMR.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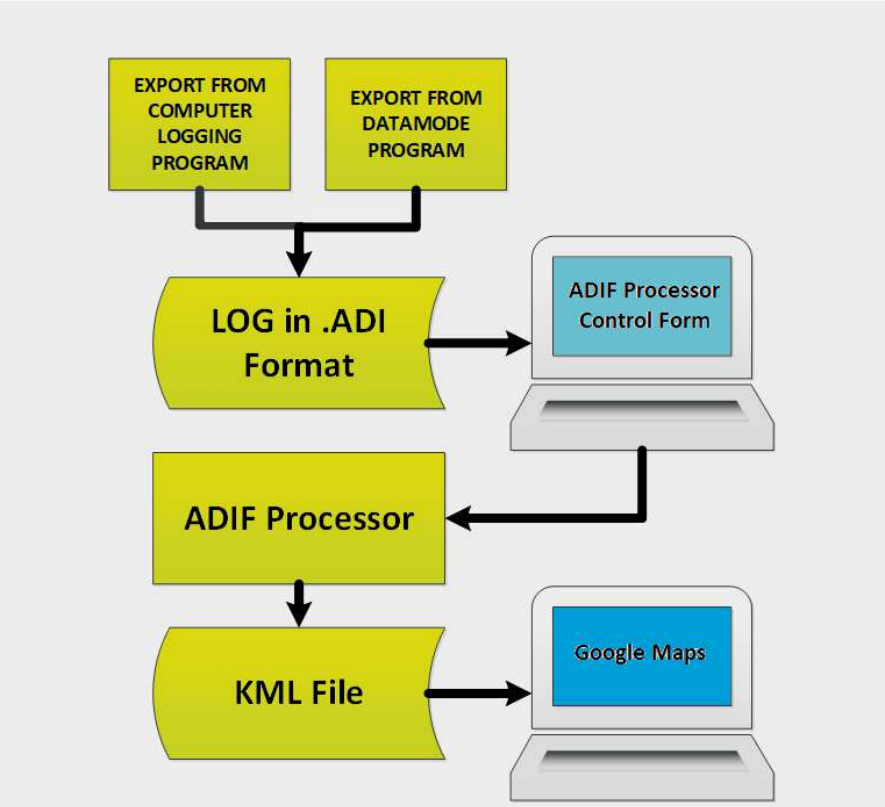
Signing Off

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

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk



1

Maps and JS8

Colin G6MXL looks at a way to map contacts you've made and the JS8 data mode that combines the weak signal capabilities of FT8 with the ability to have more free-format contacts that some readers might prefer.

Many amateurs like a visual presentation of the contacts they have made, either for their own benefit or to illustrate to others the DX they've worked. There are a number of ways of mapping such contacts. I was recently made aware of one that I had not come across before, 'ADIF Processor' written by **Mark Wickens M0NOM**. ADIF Processor takes data from your .adi file, and enriches it with data from QRZ.COM where location data is missing, before producing a .KML file, which can be imported into Google Maps, **Fig. 1**.

ADIF Processor

The main advantage of using ADIF Processor over some of the other mapping systems, which rely on reports of signals received by distant stations and can't handle telephony contacts, is that ADIF Processor can handle QSOs in all modes supported by your log and does not require reports from distant stations.

ADIF Processor will use the type of antenna (Vertical, Yagi, Dipole Inverted V) you used in combination with the frequency band of the contact to show the likely path through the ionosphere that the signal took. ADIF Processor makes a number of fairly basic assumptions, which are described in the documentation. Antenna type is accessed via 'Options' on the ADIF Processor Control Form. ADI files are submitted to ADIF Processor online using the Processor Control Form, **Fig. 2**. ADIF Processor can be accessed online at:
https://tinyurl.com/3ux6v6y8

Google Maps

As I was new to Google Maps, I downloaded it and installed on my computer:
https://tinyurl.com/2sk4sduh

Once installed I could just click on a .KML file that I had obtained from ADIF Processor to produce a map showing me my contacts. In addition to mapping the contacts, the 3D map showed a possible propagation route (refractions in the ionosphere etc.) for each contact.

Results

I am certainly impressed with the results, **Fig. 3**. I'd suggest readers keep the number of records in the .adi file to perhaps 10 to 20, which is ideal for many limited duration activations (SOTA, HUMPS, WWFF, POTA and WAB for example), so that you can see the individual contacts on the map, and which will also keep the processing time by the processor manageable.

JS8

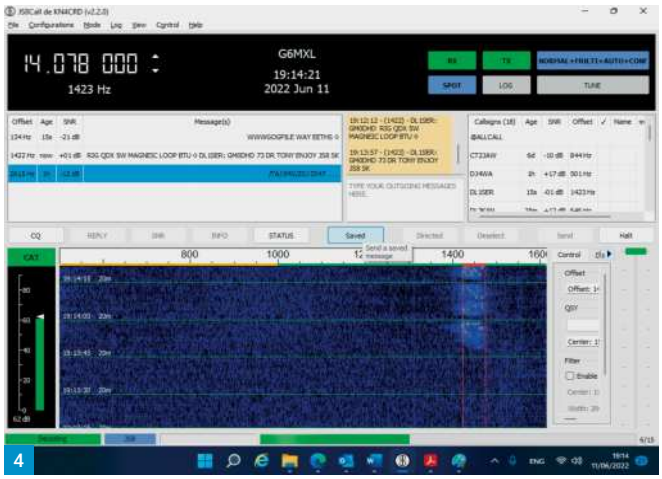
Many amateurs are familiar with the FT8 and FT4 data modes, whose popularity has rocketed over the past few years. These weak signal modes are great for having basic 'rubber stamp' QSOs. These modes are not intended to enable the exchange of information beyond the absolute minimum required for a valid contact, so just callsigns, reports and optional 4-character locators (grids) can be exchanged. This means that FT8 and FT4 contacts that are confirmed by Logbook of the World (LoTW) or QSL card can be used towards many major award schemes such as DXCC.

Many amateurs appear to love FT8 and FT4, with over 80% of QSOs uploaded to Club Log using these modes in the week ending 10 June 2022. Others complain that they take all the human interaction out of the hobby. A mode that enabled the exchange of additional text such as names, towns, station details etc. while keeping the weak signal capabilities of FT8 or FT4 would certainly go some way towards making weak-signal digital modes more palatable to some amateurs.

This flexibility is possible with modes such as PSK31 and PSK63 or RTTY, but without the benefits of being able to decode really weak signals in the noise that FT8 and FT4 modes provide. The fact that RTTY and PSK31/63 can still be heard on the bands suggests to me that there remains a following for free-format or at least macro-driven data modes.

JS8 is a mode that attempts to offer the exchange of more information in a QSO using the weak signal techniques of FT8 and FT4, without sacrificing the ability of the underlying engine to extract data from weak signals. Some might consider it to be a half-way house between the free format or macro-driven PSK31/63 and RTTY exchanges and the highly constrained fixed format of the FT8/FT4 exchange.

JS8 also overcomes some of the other limitations of FT8/FT4. With these modes, the characters that can be sent and received are limited to the upper-case letters of the alphabet, numbers and a few characters of punctation such as the stroke (/) in callsigns such as G6MXL/P. JS8 increases the range of letters



Offset	Age	SNR	Message(s)
566 Hz	1m	+08 dB	GM0DHD: @HB HEARTBEAT IO85 ◊
850 Hz	1m	-11 dB	M0KNC: GM0DHD HEARTBEAT SNR -08 ◊

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Fig. 1: Overview of ADIF Processor showing the main process (excludes some optional files). Fig. 2: The ADIF Processor Control Form. Fig. 3: Typical output from Google Maps showing a few 30m European contacts from GW6MXL/P in North Wales. Fig. 4: The main screen of JS8Call comprises a number of panes (see text) showing a QSO underway. Fig. 5: Some heartbeats received in the Band Activity Pane.

that can be sent and received to include some upper-case letters and accents found in various Western European alphabets, such as É, Ű, β.

JS8Call

To transmit and receive JS8 signals, you'll need to install a program called JS8Call on your computing device. Note that JS8Call does not support FT8 or FT4, and conversely the popular WSJT-X program doesn't support JS8 (nor does FIdigi). Versions of JS8Call are available for Windows, Mac and Linux. JS8Call can be downloaded from:

http://js8call.com

Equipment Needed

The equipment needed for JS8 is the same as for any of other data modes, namely a transceiver capable of transmitting USB, which is connected to a matched antenna, and a computer running any of the common operating systems (Windows, IOS, Linux etc.). If your transceiver does not incorporate a sound card, then you'll need a data interface. If you have CAT control on your transceiver, that can be useful, but as with other data modes it certainly isn't essential. In addition, you'll need the appropriate leads to connect the hardware together.

Settings

Initial configuration of JS8Call is similar to most data mode programs – selecting the relevant sound card (in your computer, interface or transceiver as appropriate). You'll also need to enter your callsign and locator. If you use CAT control with your transceiver, then you'll also need to configure it.

Getting Started

Just as with FT8, you'll need to make sure that your computer's clock is synchronised to a good time source, so that you are within a second of the correct time. I'd recommend setting up a sked with a local station who is already active on JS8 and making your first JS8 contact with them. I looked for contacts initially on the WARC bands and didn't find any JS8 signals when I was listening. A local amateur suggested trying 40m, where I certainly found stations operating JS8. Subsequently I've found some JS8 activity on 20m.

Like RTTY and PSK31, the length of transmissions depends on the amount of text being transmitted. This means that you can be looking at a much higher ratio of transmit time to receive time than FT8 or FT4, so I'd recommend reducing power to protect the output stage of your transmitter. As with other data modes, you should avoid over-driving your transmitter by keeping the drive below the point where ALC starts to operate. With the longer JS8 overs, you may wish to review your EMF assessment and ensure that you are still compliant. You may need to introduce some additional controls or other changes to remain compliant.

Operating JS8Call

I found the documentation supplied with the program was rather scant, and it assumed that you knew some of the terminology. I found a number of useful YouTube videos, and would suggest readers view some of them.

The main screen is split into a number of 'panes', **Fig. 4**, which can be dragged to increase and decrease their sizes. These are the Band Activity pane, which shows decoded messages you have received, Incoming Message Activity Pane, and Call Activity pane, which usefully lists the callsigns you have heard.

The Message box is where you enter your messages to be transmitted. At the bottom of the screen is the Waterfall. This shows where the signals are in your receiver's passband. It is also where you can select any frequency offset you may wish to use.

Calling CQ

To call CQ, you just click on the CQ button. Your CQ message with appear in the message window, which JS8Call will send at the start of the next time frame. If you receive a reply, simply click on the station's callsign in the Call activity pane, type your message into the message box and click Send. JS8Call will automatically add your callsign and the selected station's callsign to the message and send it.

Speed

JS8Call enables transmissions to be made at four different speeds. I've summarised these in **Table 2**. Regardless of what speed a message is transmitted at, JS8Call will attempt to decode it automatically. I found that calling CQ at the Normal speed worked well. I could then switch to a faster speed if the initial reports exchanged showed reasonably strong signals. You'll need to have some patience if you use the slower speeds with long messages.

Heartbeat

JS8Call includes a 'Heartbeat' function, which transmits your callsign and locator at user-defined intervals. This enables other stations to know your station is on the air so that they can call you. It also provides station identification.

The reception of some heartbeats is probably the most useful indication of JS8 activity, **Fig. 5**.

Logging

JS8Call keeps logs in a manner similar to WSJT-X. Besides a detailed log, it also produces an adi format log, which can be exported and uploaded to all the popular logging systems and online logging systems such as QRZ.COM, Clublog, Logbook of the World and eQSL for example.

My Experience

I found the operation of JS8Call was somewhat different to what I was used to – generally less intuitive. For example, to change band, you click on the frequency display, from where a drop down enables you to select the new band. Once you know what you are doing, it all makes sense, but it is different to what I have experienced with other programs such WSJT-X or FIdigi.

I'm a little reticent to encourage readers to try JS8, as in my limited experience, I've found very little JS8 activity on the bands.

The only bands I've found with actual QSOs in progress were 20m and 40m (I don't have antennas for the LF bands). This was at a time on a Saturday evening when upwards of 40 FT8 stations could be received on 20m. I'd therefore suggest making sure that your chosen band is open before trying JS8. **PW**

JS8 Frequencies (MHz)

1.1842	18.104
3.578	21.078
7.078	24.922
10.130	28.078
14.078	50.318

Table 1: Usual JS8 Frequencies

Rate description	Frame	Bandwidth	Effective Rate
Slow	30 Seconds	25Hz	8WPM decoded down to -28dB
Normal	15 Seconds	50Hz	16WPM decoded down to -24dB
Fast	10 Seconds	80Hz	24WPM decoded down to -20dB
Turbo	6 Seconds	160Hz	40WPM decoded down to -18dB

Table 2: Effective rates of Transmission

Tim Kirby GW4VXE
Longworthtim@gmail.com


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Activity from the International Space Station

Tim Kirby GW4VXE reports on another busy month on the VHF and UHF bands.

Although it's not uncommon for us to mention schools contacts, the APRS digipeater on the International Space Station or the crossband repeater, astronaut activity from the ISS has been sparse in recent years in terms of making QSOs with 'normal' stations. In the last few days, reports have been coming in, mostly from North America of a number of contacts being made. **Patrick Stoddard WD9EWK** takes up the story.

*"In the past few days, hams across North and Central America have had the pleasure of hearing ISS crewmember **Kjell Lindgren KO5MOS** (yes, that is his personal callsign) working stations as NA1SS on the ISS cross-band repeater. ISS crews can pick up the microphone on the Kenwood TM-D710G in the ESA Columbus module and join in the activity on the repeater, without changing the radio's active configuration. One huge advantage of this over the split-frequency operations on 2m that ISS crews normally use for unscheduled QSOs is that hams can hear both sides of these NA1SS contacts. I was able to make one of these NA1SS contacts on the afternoon of 14 June, using my Icom ID-5100 dual-band mobile radio and Elk log periodic antenna while in front of my house. It was 106°F (41°C) outside that afternoon, but I was happy to put up with the heat as I logged my contact* (**Fig. 1**).

"Kjell Lindgren is part of the SpaceX Crew-4 mission to the ISS, which is scheduled to return to Earth in September 2022. Kjell holds a US General class license, compared to almost all other NASA and other astronauts who usually hold the entry-level Technician class license. Kjell also changed his original callsign to get KO5MOS, something else that other astronaut hams don't normally do."

Although, as Patrick reports, most of the reports of Kjell's activity have been from North America, it may be worth keeping a closer eye on the crossband repeater while Kjell is on board the ISS.

VHF/UHF Nets

Don't forget that the UK's best listing of VHF/UHF Nets can be found at:

https://tinyurl.com/2ma53dyy

If you have any additions or changes, please email me and we will update the listing. This month's random selection of nets from the listing appears as **Table 1**.

The 8m Band

Roger Lapthorn G3XBM (Cambridgeshire) says that his QRP from his FT-817 and low dipole has been spotted in ten countries so far, with the furthest report coming from the Canary Islands.

On receive, Roger has heard ZS6WAB. Roger finds the apparent position of OFCOM and the RSGB baffling and is disappointed that it hasn't proved possible to make even a spot frequency allocation to the amateur service. As Roger puts it, *"Personally I would happily trade 5kHz of spectrum rather than have to pay to do self training"!*

It probably doesn't work like that, but it's a shame something has not yet been possible. It's been my impression that OFCOM have been very supportive of radio amateurs and genuine experimentation in the past.

It's clear from the experiments so far, that 40MHz is a fascinating part of the radio spectrum, which, to my knowledge has not received a great deal of attention up until now (I'm happy to be proven wrong if anyone knows different). For example, **Javi Estel LU5FF** has reported seeing signals from a number of European stations, as has **Martin Moens PJ4MM**. Some 50MHz operators are starting to use 40MHz to give an indication that the 6m band is about to open.

I would welcome news from any other 8m equipped stations, whether transmitting or not.

The 6m Band

For **Jef VanRaepenbusch ON8NT** one of the highlights of the month was working ZD7BG (IH74) on 21 May – a very nice contact running 10W to a V-2000 vertical. Other interesting contacts were SX33ST, EA9ACF (IM75), 7X2RF (M16) all on 22 May; OH0/OH2HOD on 25 May and 7X4CZ (IM95) and 7X3WPL (IM13) on 27 May.

Tony Collett G4NBS caught a good number of openings, with the highlights being: 20 May PY2XB (GG66) and PP5KC (GG42), 25 May TA9J (LN10), 27 May EA9QD, C31CT, and PU1JSV (GG87), 3 June OD5OJ (KM73), 9K2NO (LL39) in the afternoon and WP4G, WP3C, WP3R and FG8OJ in the evening, 4 June VO1CH (GN37), KP4EIT (SSB), KP4JRS (CW), 5B4AAB & 5B4AIF/P (KM64), 4X1TI (KM71) and CN8KD, 5 June ZB2RR, ZQ2GI and HK3PJ (FJ34), 10 June SVs, 5B4 and EY8MM (MM48), 12 June Tony switched on at 2215UTC and found the band open to the USA, it seemed to fade and then came back with a vengeance allowing Tony to work K0GU (DN37), K9MU/P (EN64), AA7A (DM52) and KF8MY (EN84) – all new grid squares. On the evening of 14 June Tony worked

Fig. 1: WD9EWK braved the heat (and his neighbours!) for a QSO with NA1SS on the International Space Station. Fig. 2: Kev ZB2GI used an FT-450 for his portable operation at the top of the Rock. Fig. 3: Kevin ZB2GI has been trying SSTV on 6m and 4m with EA7SL.

7X3WPL (JM13) followed by ZA/IW2JOP on FT8, but checking the CW section quickly, Tony heard a station signing but not giving a callsign. He asked who it was and it was TT8SN who he worked on CW and SSB. On the 15th Tony worked HC2FG, FG/F6HMQ and XP3A (GP44).

Kevin Hewitt ZB2GI (Gibraltar) has once again been operating with a monoband whip mounted on a broomstick, poked out of his window and has worked many, many stations on FT8 over the month. Highlights include 9H1AZ (JM75), ER5GB (KN45), IW9HII (JM67) and TK5JJ (JN42). Kev has also operated from the top of the rock, with **John King ZB2JK** on SSB, **Fig. 2**.

The highlight of **Don G3XTT**'s 6m log for the month has to be 9N7AA worked on 16 June at 0559UTC. Don says he's worked eight new DXCC entities this season – and there's still half a season to go! **Peter G8BCG** also worked 9N7AA and VK3BD around the same time. Here at **GW4VXE** 5/6 June were good days for new DXCC entities; HK3PJ and MU0FAL! Lots of new grid squares too through the month, mostly from the USA, and plenty of QSOs.

Phil Oakley G0BVD (Great Torrington) was surprised and delighted to be called by UN7DAT (NO00) on 9 June for a new country. Phil also worked N1DG (FN42) and K1TEO (FN31) on 12 June.

Ian Bontoft G4ELW (Bridgwater) says that he had not found his V-2000 vertical very effective on 6m so has recently built himself a dipole and mounted it in the loft. Ian finds this is working better than the V-2000 and worked K0GU (DN70) using 20W of FT8. Ian also tried some CW and worked S59A running 40W. Ian says he heard K2GSO on CW too, but unfortunately he was too weak to work.

David Thorpe G4FKI (Ampthill) runs 25W to a X50 tribander at 10 feet but made his first transatlantic contact to work W3LPL on FT8 on 12 June. David worked a number of CW and SSB QSOs around Europe, with OY1CT being a new country.

Roger Greengrass EI8KN (Co Waterford) missed a few days of the good propagation through being in Italy for a wedding but worked XP3A (GP44) and VA3NCD (FN03) on 12 June. During the opening on 15 June, Roger worked WP4G (FK68), WP3R FK68), N5DG (EM20), HC2FG (FI07), FG8OJ (FK96), HC1BI (FI09) and PJ2BR (FK52).

The 4m Band

Jon Stow G4MCU writes, *"I purchased a small vertical antenna for the 4m band. It is the Moonraker SQBM412. That is the smaller one, not that re-*

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*viewed by Don in PW, only 1.2m high. A friend of mine, **Mike G8EFG**, kindly installed it on my garage roof a couple of weeks ago, and it is only less than 4m above ground, although my QTH is quite decent for VHF.*

"I had worked only one station, an FM contact with a guy down the road, and have found local activity rather low so far. On 3 June, much to my surprise, I heard EA4CZV calling CQ DX and I called him more in hope than expectation. After some persistence on both sides we completed the SSB contact and I have IN80 as a new square and actually only my second one on 4m."

On 11 June, following the 2m Es opening, Jon checked back on 4m to see what was happening, just after 1800UTC and was pleased to work 9A2SB (JN95) and 9A1Z (JN86).

Arron Reason M0HNH (Gloucestershire) caught an opening on 12 June, working CT1EEB (IN50) and OK1TEH (JO70). Arron says his QTH is not good for VHF working, so he was delighted with these contacts.

Simon Evans G6AHX (Twyning) caught his first Es opening of the season on 2 June when he worked S51RM and EA3ECK. Next day, Simon worked EA1WA, EA7Q, EA5Z, EA4CSV, EA8BPX, EA9IB, EA6SA, ZB2GI and CT7ASX. On 12 June, Simon worked EA1UR, EB4CUV and EA7KI. All Simon's contacts were on SSB.

Kevin ZB2GI uses a monoband whip and counterpoise wire, attached to a broom handle, poked out of the window. With this setup he has worked many stations, with the highlights being EA9E (IM75), EI2FG (IO61), EI4DQ (IO51) and G3XTT (IO81) on FT8. Kev also tried some SSB with the same setup, making several QSOs, including G6AHX (IO82) and M0AFJ (IO70). Kevin also mentions trying 4/6m SSTV for the first time with EA7SL, **Fig. 3**.

David G4FKI worked SQ9LDR and S50B on 70.450MHz FM and 9A5B on SSB, along with several EA, HA, SPs on FT8 on 12 June.

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Roger Daniel G4RUW (Newbury) caught his first opening on 3 June with an opening to Spain, working EA5EF (IM99), EA7Q (IM67) and EA4CZV (IN80).

Here at **GW4VXE**, I've been running 10W of FT8 into a V-2000 vertical, which is not exactly resonant on the band, but it's not too bad. I caught my first opening on 2 June working S51RM (JN76), 9A4ZM (JN64) and 9A6R (JN83). Next day on 3 June some Spanish stations were worked and then on 11 June, the band was good to Germany, Spain, Belgium (short skip!), Poland, Hungary and best of all the Canary Islands in the shape of EA8DBM (IL18). On 12 June the band was good into Spain once again, including EA6SX (JM19) and EA9IB (IM85). ZA/IW2JOP was a gotaway for me this month – but go back a few years – would we have ever expected to even hear Albania on 4m?

The 2m Band

Jef ON8NT took part in the UK Activity Contest on 3 May, working G0LTG (IO81) and MW1LCR/P (IO81). During the FT8 Activity session on 4 May, Jef worked GW4FRX (IO82), G4EH (IO83), G3WAG/P (IO82), 2E0IEI (IO81), G8EEM (IO93), GI6ATZ (IO74), M0BKV (IO70), M7REV (IO82), GW4HDF (IO81), MW3ASG (IO81) and G4RRA

(IO80). During the RSGB May contest on 22 May, Jef worked M0ICK/P (IO93), G0LTG/P (IO81) and G2P (IO82).

Jon G4MCU caught an opening on 11 June, around 1510UTC lasting for about 20 minutes, during which he worked IK0FTA, IK0SMG, IK0RMR and IK0BZY on SSB. All the stations were located in JN61 square.

Tony G4NBS caught some Es during the afternoon of 9 June, working EA6SX (JM19), YO5AVN (KN17), UW8SM (KN28) and HA6NQ (JN98). On 11 June Tony said he was sat in the shack watching stations to the east of him working things that he couldn't see and similarly, stations to the west, working a completely different set of stations! Fortunately, it all came good and Tony worked 22 stations between 1322 and 1642UTC, which he thinks is probably the most he has ever worked in a single Es opening. Stations were, IT9GSF (JM67), IW9BAZ (JM68), IT9HTV (JM67), IT9GUL (JM78), IC8FAX (N70), IK0IXO (JN52), IW0FFK (JN61), IZ5EME (JN52), IK0SWT (JN61), IK0FTA (JN61), IW8PQU (JM88), LZ7DF (KN22), 9A7JCY (JN74), SV2HNH (KN10), E77D (JN94), Z31TU (KN02), YU5C (KN02), 9A4MZ (JN85), LZ1GHT (KN12 and LZ2CM (KN13). Just before the Es started, Tony had nice QSOs with GM1MYF (IO87), GM4FVM (IO85) and GM0HBK (IO77).

Simon G6AHX worked TM5R and F5SGT/P during the European contest on 4 June. During the UK Activity contest on 7 June, Simon worked 22 stations in 13 squares, with the best DX being GM3SEK (IO74). Simon caught an Es opening on 11 June, working IC8AJU, IK0FTA and YU1LA. During the *PW* contest on 12 June, Simon made 19 QSOs in 10 different squares, with the best DX being GD0AMD/P (IO74).

Phil G0BVD gave some points away in the Backpackers/*PW* QRP contest on 12 June with the best DX also being GD0AMD/P.

Thanks to the efforts of **Stevie Brosnan EI8FHB**, I was very happy to put the rare square, IO41 into the GW4VXE log on 2 June.

Keith Nolan EI5IN writes, *"Shannon Basin Radio Club in Ireland has enthusiastic contesters keen to work stations or help with points. If anyone would like to consider turning beams westwards in future contests, the members would be delighted to help with contacts. During the RSGB 144MHz contest in May, club members **Owen EI4GGB** worked G8T, G0VHF/P and MW0IDX and Keith EI5IN in IO63hm reported hearing **Mick M0ICK/p** in Staffordshire via aircraft scatter"*.

Andy Adams GW0KZG (Letterston, Pembrokeshire) caught three different Es openings; 3 June EA7GNO (IM86), 9 June IK0OKY (JN61), IK0SMG (JN61), IK0FTA (JN61) and IU8JTA (JN70) and 11 June IK7FPV (JN80), IW7DVM (JN80), IZ6ZER (JN61), S58P (JN76), 9A3TN (JN85), 9A5CY (JN85) and LZ2CM (KN13). Andy also mentioned that **Keith G4FUF** worked TA2BZ on the morning of 9 June with a double hop Es opening.

Day	Time (local)	Frequency	Description	Area
Sunday	1200	145.575	Torbay ARS	Devon
Sunday	2100	EI2SBR	Shannon Basin Radio Club	Eire
Monday	2000	GB3SW	Sidmouth ARC	Devon
Thursday	1900	70.400 FM	Flight Refuelling ARS	Dorset
Friday	1915	145.350	Chichester area activity	Sussex

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

Ian G4ELW caught the Es opening on the afternoon of 11 June, working IU0MBS, I7CSB, IZ7NLJ, IK7JNM, IZ6ZER, IW7DLE, IK2FTB and 9A3TN. Ian uses 15W to a V-2000 vertical.

David G4FKI worked YU1LA (KN04) on 12 June, running 25W to a vertical antenna.

David Johnson G4DHF (Spalding) has been very busy with work commitments, but has found some good evening openings: 3 June CN8LI (IM63) and CN8NY (IM75) on FT8, 9 June YO7FWS (KN24), YO3FAI (KN34), UT4UEP (KN49), SQ5TF (KO02) all on FT8. On 11 June, while driving home from IO93 running 40W into a homebrew 'square halo', David worked IT9DJF (JM68) on SSB, followed by E77D (JN94), LZ1GHT (KN12), LZ1ZP (KN22), SV2JAO (KN10) and SV2HNE (KN10) all on FT8.

Roger G4RUW found the opening on 11 June a good one and made contacts with stations in JN70, JN53, JN54, JN61, JN85, KN13, KN05 and KN04. Roger says that he made contacts on both SSB and FT8 and the opening lasted over two hours. The one that got away was ZA/IW2JOP!

The 70cm band

Tony G4NBS found the 8 June FT8 Activity session a little quieter than usual, but made 59 QSOs in 27 locators. To the east, Tony worked DG9BFE (JO33), DL8DAU (JO40), DL2AKT (JO50), DF4IAE (JN49) and heard DL2RZ (JO54). Tony started the RSGB session with a quick aircraft scatter contact with OV3T (JO46) and was also called by OZ2ND, although that contact took nearly 30 minutes to complete, followed by OZ3Z (JO45). Turning the beam to the north into the UK, Tony worked MM0ABM (IO75), GM8MJV (IO85) and GM0HBK (IO77) in quick succession – either a big plane, he says, or conditions up slightly. GI4SNA and GI6ATZ were both worked but Tony just missed GD6ICR before the contest ended.

It's nice to hear again from **Robert van der Zaal PA9RZ** (Sassenheim). With the Dutch locator contest and the 70cm Activity contest on 14 June, Robert had a good session and writes, *"I easily worked F1BHL/P (IN99), F5RZC (JO10), G0GQT (JO01), G3XDY (JO02), G4LPP (JO02), G0LBK (JO03), G4KQH (IO92) and with some more effort G8XVJ/P (IO93). Good to catch up with my ex-colleague **Uffe PA5DD** (JO22) and to work a few more locals too. What I appreciate of these contests is that they are somewhat laid back allowing a more personal chat rather than '59 Adios'."*

The 23cm Band

Jef ON8NT took part in the UK Activity contest on 17 May and noticed that the GB3MHZ beacon was up to S9. Jef worked G4DDK (JO02) on SSB and heard, but not worked were G4FEV (IO92) and G3ZEZ (JO01). Jef carried out a successful FT8 test with M5BOP (JO02), with both stations running 10W to a Wimo flat panel antenna. Next day on the 18th, in the FT8 activity session, Jef failed to work G4DDK who had been worked the previous day on SSB, but did work G8IFN (JO01) and G7LRQ (IO91) – a distance of 274km.

Satellites

Jef ON8NT has been continuing his FT4 activity on the satellites, working EA3IGB (JN11) ON2ACO (JO11) and AK3Y (FM19). ON2ACO (JO11) on CAS-4A, ON2ACO (JO11) and EC5M (IM98) on CAS-4B and ON2ACO (JO11) on both JO-97 and XW-2A.

Kevin ZB2GI continues his QO-100 activity from the Gibraltar club station, working; GW4ABP/P (IO72), DL8YHR (JO41), OM3WAN (JN88), R1BHJ (KO49), YO9DOC (KN23), SP3AU (JO71), PE2D (JO22), LZ1JH (KN12), ON7EQ (JO21), G0ABI (IO80), GW8TIX (IO81), ON7UC (JO11) and PY1SAN (GG77).

Patrick WD9EWK writes, *"In mid-May, I spent a day in the forest west of Flagstaff, Arizona, along old US route 66 on the DM35/DM45 grid boundary. These grids are rarely heard on the satellites, and that area has much cooler daytime temperatures than where I live in the central Arizona desert. It had been almost a year since I last visited this grid boundary, and I was able to make a bunch of satellite contacts in FM and SSB from up there. The only bad part of the day... having to drive back to the desert heat at the end of the day.*

"A couple of weeks later, near the end of May, I spent a few hours working satellites next to a trail in southern Arizona, south of the city of Tucson. I was parked along the de Anza National Historic Trail, a trail that runs from northern Mexico through Arizona and California, ending near San Francisco. This time, I was in grid DM41, a grid that straddles the USA/Mexico border, and I had fun on the radio from there."

That's all we have room for this month. Thanks to everyone who's been in touch. I always welcome new correspondents with news from any aspect of VHF/UHF operation. Photographs are always very useful too! See you next month. **PW**

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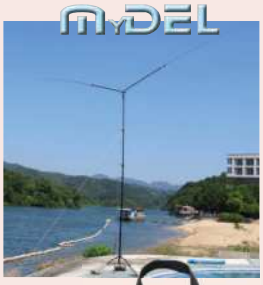

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Bernard Nock G4BXD
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1

Valved Radio Repair (Part III)

Bernard Nock G4BXD gets to grips with an actual set, describing the fault finding process.

Carrying on from my first part about repairing old valved radios, looking at getting some tools together, some test equipment items and finding a nice warm, brightly lit place to work and Part 2 describing valves and power supplies, we can now look at an actual radio set. With this in mind I spotted in a charity shop a nice old valved radio, which followed me home.

Safety

To reiterate, safety at all times. Check your supplies, your tools, the fuses fitted to any plugs and try to find a work location where it's restricted access by others, children, pets and the like. You obviously do not want your wife, sorry, partner or children hurt but also, you do not want the dog to jump up and pull live sets off the bench.

There was a comment made after Part 1 about keeping one hand behind your back when measuring high voltages. I am actually unable to do so but oddly, in 50 odd years of working with valved equipment I have never suffered due to that inability. Working with mains powered valved equipment is dangerous so take care. Of course, mains powered semiconductor equipment can be just as dangerous so care is needed even there.

The Receiver

The receiver in this case is a Bush DAC90A. This five-valve receiver, **Fig. 1,** was first introduced in 1950 and has a moulded Bakelite case. This radio proved to be a very popular model to own at the time and was also available in an ivory cabinet. The radio receives the medium and long wavebands. An internal frame aerial, on the left of the set from the rear, **Fig. 2**, was used for the reception. The retail price was £12.1s.8d, including purchase tax. The average working wage in 1950 was £4.19s.4d for a 47-hour week.

The nice thing about this set is that there is plenty of information, servicing notes, component values, circuit diagrams, **Fig. 3**, etc. available online which makes our job a lot easier. This an AC/DC type of set, which means one side of the mains goes to the chassis, you should ensure this goes to the Neutral of the mains plug used, and one side gets rectified for the HT or high voltage supply and feeds the valve heaters. A neon screwdriver is a handy tool here.

In AC/DC sets the valves usually have their heaters wired in a chain, series connected and the valves used all draw the same current, in this case 100mA. The various voltages are added up, here its 116.6V needed for the heaters, so a dropper resistor is needed, R17 in the circuit. Assuming a 250V AC supply (will be less in reality) a resistor of 1334Ω is needed to drop the remaining 133.4V. In the set a 1250Ω with taps is used so different mains voltages can be accommodated.

Switch On

With a mains lead connected and the fuse checked in the plug (a 13A fuse is a NO NO, fit a 2 or 3A before you start), the back is removed and set switched on. If the valves light up, we are on to a winner. If they do not light up, we need to start measuring. Now is the time to remove the chassis from the case. On this set the control knobs are held by screws you access from two holes under the case and a long shaft screwdriver in the rear for the wave-change knob.

I croc-clip my meter's black lead to chassis ensuring the red lead and probe are in good condition, meter on AC 250V, and check there is a voltage at both ends of the dropper. If not, it's probably open circuit. If there is voltage, then one of the valve heaters might be open so you will need to find the heater pins and work your way along until you find the fault.

Assuming the heaters are glowing but there is no sound out of the speaker you now need to see if there is any DC being supplied to the valves. The underside of this radio, **Fig. 4**, gives excellent access to the components. The rectifier valve feeds the DC filter capacitors, C20/21 on the circuit, which is the big round can top right on the underside. Meter on DC 250V, black lead to chassis, positive one to either of the capacitors, some volts is good, no volts might mean the rectifier is dead.

It has been my experience many times that a non-working set is rarely caused by a dead or duff valve. It's usually one of the other components, often the capacitors that have gone short circuit or low resistance and are pulling down other components or voltages.

The service data, **Fig. 5**, states there should be 190V or so on the anode of the pentode type (note the 3 grids) output valve, V4, so if you're measuring anything like that on the filter capacitors, it's good. In this case I measured about 50V, which indicated something was pulling too much current and dropping the voltage.

Looking at the circuit you can see there are several capacitors that are connected between the main HT line and ground, either directly or via a resistor. On the central tag strip you can see eight yellow coloured wax-type capacitors. With so few I simply replaced all of them, C17, 18, 15, 16, 9, 10, 1 and 5, **Fig. 6**, with modern types, mainly 0.047μF 400V types. With the capacitors changed, **Fig. 7,** each resistor was measured with a digital meter.

Fig. 1: The DAC90A.
Fig. 2: Inside the radio.
Fig. 3: The circuit diagram.
Fig. 4: The central tag strip.
Fig. 5: The old capacitors.
Fig. 6: The parts layout and voltages.
Fig. 7: The new capacitors.

If any resistor is way off its marked value, then it should be changed. In this case they were all quite close to what they should be so I needed to replace none of them. With the capacitors changed I again applied power to the set. Now the HT voltage on the filter capacitor was 200V and there was even good sound coming out of the speaker. The set tuned both long and medium wave although the volume control and bandswitch were crackling as operated.

A squirt of switch cleaner fixed the bandswitch but the volume control was sealed. I could drill a small hole in the side and ingress cleaner that way or, if I were repairing the set for a customer, I'd replace the control. As it was, I left it and will put up with the crackle as I switch it off.

Deeper Servicing

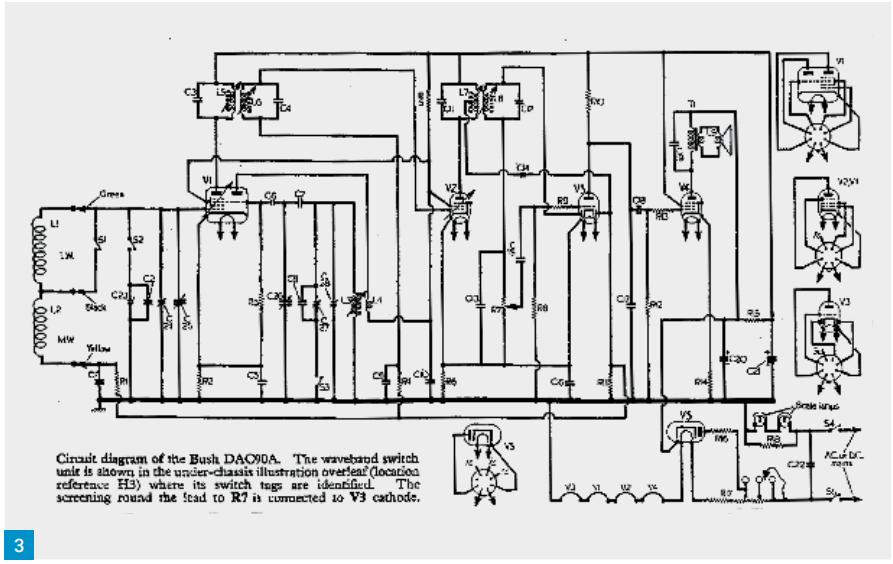
If you're working on an AC set, it's basically the same. Once you have the power supply working you can start working through the set stage by stage. Of course, this was an easy fix. It may be you changed all the capacitors and still have faults. Assuming the HT has returned to near normal you would then need to start tracing the fault. With an audio signal generator you could inject an audio signal, always via an isolating capacitor 0.01µF 400V, to the junction of C18/R18, g1 of the audio output valve.

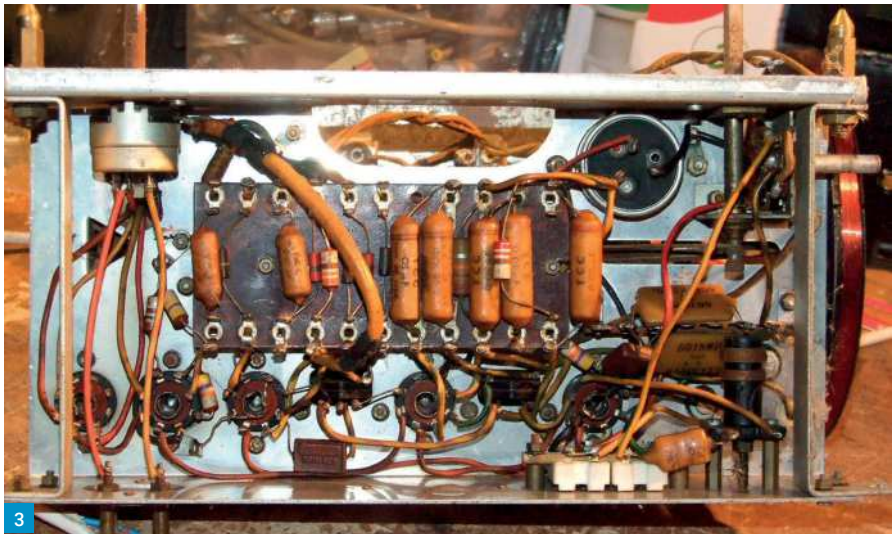
If there is nothing in the speaker, check the components connected to V4, cathode resistor, grid resistor, g3 and anode voltage. Also, if C18 is leaking, it will put positive volts on g1 of V4, not good. If they are all OK, it's a new valve most likely needed.

If you get sound, then inject audio to C15/R7 junction, g1 of the audio preamplifier valve. If nothing, check components and voltages again. If a nice loud output, it's on to the next stage. Now you need an RF signal at the IF (Intermediate Frequency). In this set a 465kHz one is needed, modulated and injected at g1 of V2. Again, checking components and voltages as needed.

Injecting the IF signal, via a capacitor, into g1 of V1 will also give an output if everything after is fine but it still might be there are no stations received. V1 is special in that it is an oscillator and a mixer. The oscillator generates a signal at the receiving frequency plus or minus the IF frequency. This signal is mixed with the incoming RF signal to generate the IF frequency. In the DAC90's case, say you want to receive 1MHz on the Medium Wave, then the oscillator is at 1.465MHz. Mixed it gives the difference, 465kHz


2


Circuit diagram of the Bush DAC90A. The waveband switch unit is shown in the under-chassis illustration overleaf (location reference H3) where its switch tags are identified. The screening round the lead to R7 is connected to V3 cathode.
3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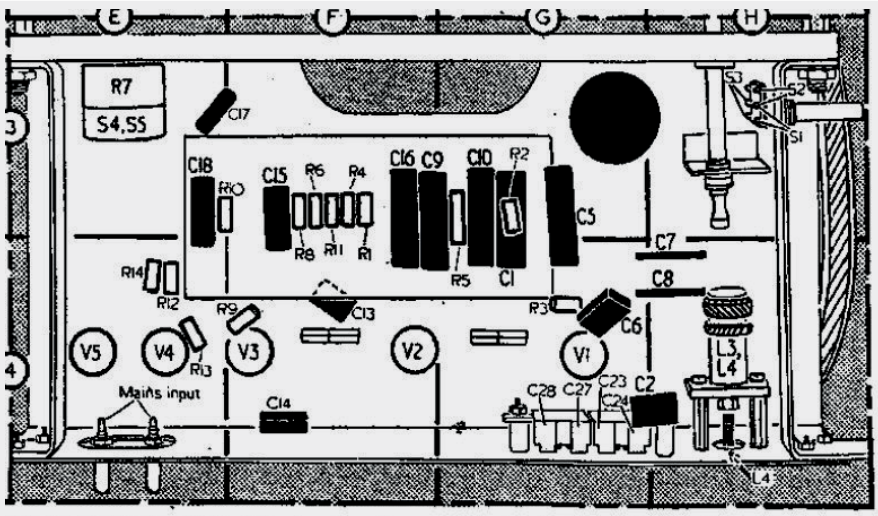


Under-side view of chassis, showing the waveband switch unit in detail (location H3).

5

VALVE ANALYSIS

Valve voltages and currents given in the table below are those derived from the manufacturer's information. They were measured on a receiver operating from 230 V A.C. mains, and switched to M.W. There was no signal input.

Voltages were measured on the 1,000 V and 10 V ranges of a Model 7 Avometer, chassis being the negative connection. Total cathode current of the rectifier V5 was quoted at 39 mA.

Valve	Anode		Screen		Cath.
	V	mA	V	mA	V
V1 UCH42	98	1·5	47	1·6	0·8
	Oscillator				
	47	0·5			
V2 UF41	98	2·5	47	0·8	1·0
V3 UBC41	74	0·2	—	—	1·0
V4 UL41	190	27·5	98	4·0	5·0
V5 UY41	222*	—	—	—	205·0

* A.C. reading.

as the IF. The RF and oscillator circuits track each other so the difference is always the IF frequency.

The UCH42 is an early all-glass triode-hexode from 1948 and was designed as oscillator and mixer for superhet receivers, and the hexode section was designed to operate with an AGC control voltage. The 100mA heater was intended for universal (AC/DC) sets, and this explains the low anode voltages, just 48V on the oscillator.

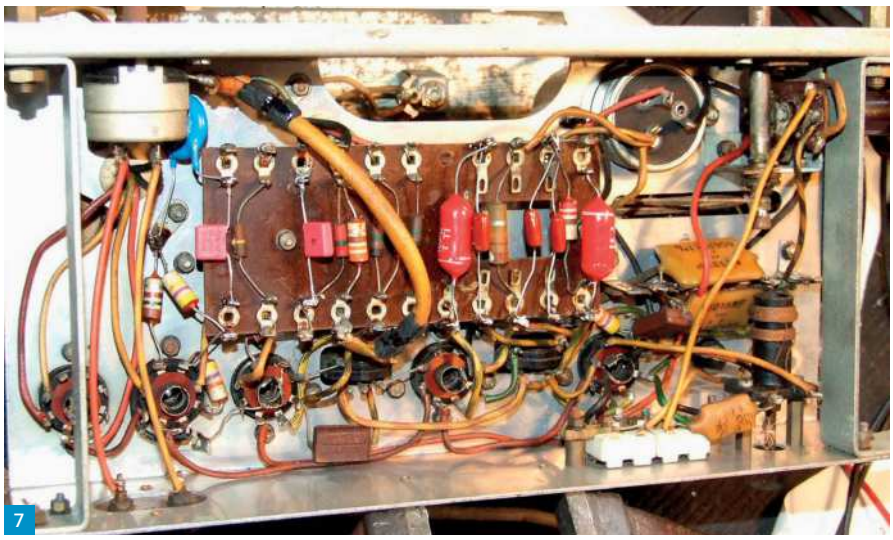
If your set is hearing your injected IF signal but not receiving signals, then a component and voltage check of V1 is needed. If these look all fine and still nothing, then a new valve may be called for, as is the case for the other stages if everything else checks out.

You can see the pattern of starting at the speaker and working towards the aerial is the best way of tracing any fault in your set. In this manner you work through the set using its own loudspeaker as an aid, stage by stage until you lose a signal, when you can explore the affected stage in more detail. Check the components and then the voltages present on the various pins until something unusual is found, replaced and hopefully solving the problem.

Of course, there can be some really complicated faults. The large decoupling capacitors, the 0.1µF, 0.01µF, 0.05µF as they were, are usually easy to fault find and replace. The small capacitors used in tuned circuits such as the oscillator might be faulty but are harder to diagnose. Valves do 'wear' out, in effect they can go what's called low emission when they lose their gain and punch. If you invest in a valve tester, then they can be checked that way. Though I have several testers it's usually quicker just to find another and try it in the set but this does require a stock of common valves, which, if you pursue this side of the hobby, you will soon acquire.

This has been a very simple set to work on and an ideal starting point but, of course, other radios might have more stages. However, the basics of servicing are the same, start at the speaker, working backwards, checking voltages and components one by one. After a while though you do get a 'nose' for faults and can usually spot likely culprits. **PW**

6



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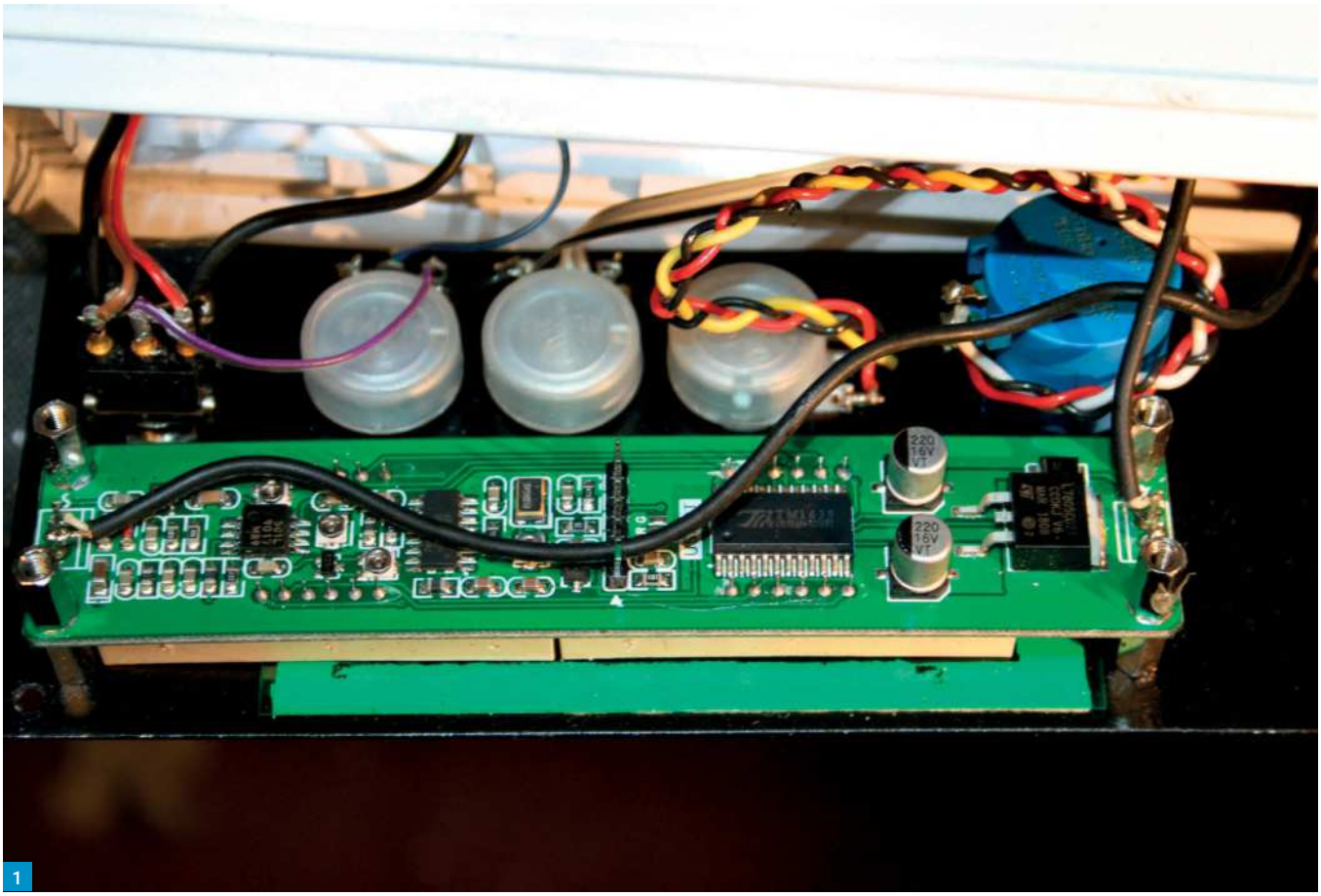


1

Adding the Antenna Changeover Circuit

Mark Tuttle G0TMT completes the build of the Paston by describing the antenna changeover circuit.

Mark Tuttle G0TMT
g0tmt@theshack.org.uk

In the previous part we completed the transmit mixer, pre-driver, driver, PA and Low Pass Filter. In this final part of the series we're going to construct the antenna changeover circuit and set it up for our semi-QSK operation.

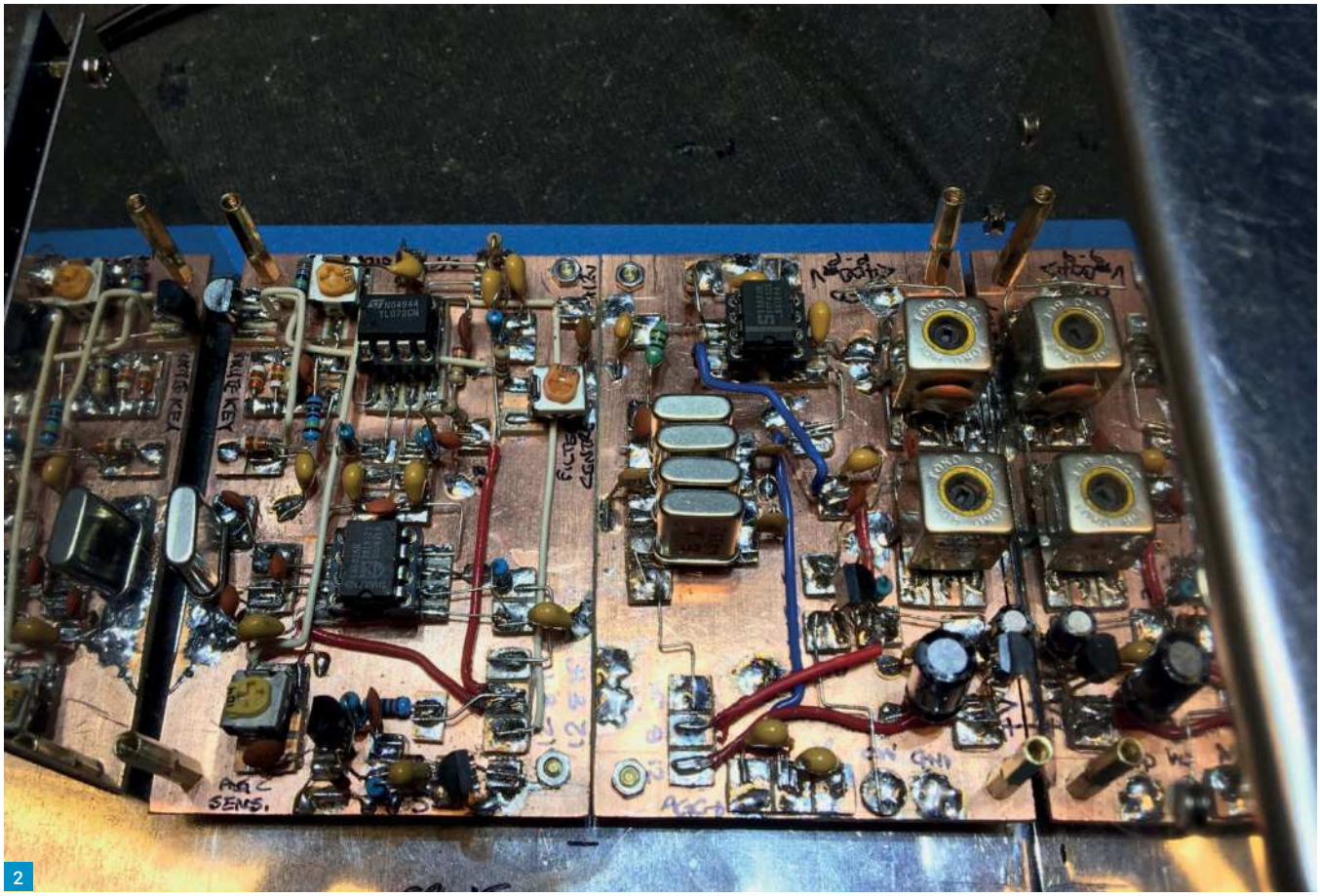
This circuit was originally published in *PW* back in May 2007 in an article by **Rev George Dobbs G3RJV** as part of his excellent series *Carrying on The Practical Way*.

So, let's take a look at the circuit, which appeared last month as the top half of **Fig. 1**, and see how it works.

When the Morse key is pressed down it takes the cathode of D2 to ground. This makes TR1 and TR2 conduct allowing our 12V supply to pass through them. In essence they are acting like switches. TR1 collector supplies power at every push of the key. This is our +12V keyed line, which provides power to the transmit mixer, pre-driver and driver stages of our transmitter. TR2 however is a little different. The 12V now appears across C16, which quickly charges up and turns on TR3. This energises relay RL1, the antenna changeover relay. We also take the collector of TR3 off to our mute and RIT circuits. It's not quite at ground potential but at around 2V it's close enough for our needs. When you lift the key, C16 will start to discharge through R9 and VR1 but will hold TR3 on a little while as it discharges. When this voltage reaches a certain point Q3 turns off and the relay is also turned off. This gives us our Semi-QSK operation. VR1 can be adjusted to vary the time it holds the relay on and my preference is for something shy of half a second. If you send very slow Morse, you might prefer to lengthen this a little. It's easy to test this circuit before using it to supply power because you can hear the relay engaging and dropping out. While the relay is engaged, power is being fed to the PA and the antenna is connected to the transmitter output. As soon as it drops out, power is no longer supplied to the PA and the antenna is switched back to the receiver. It's a simple but clever little circuit and I've used it before.

I built this little circuit onto the same board as the transmitter but there's no reason why it couldn't be built on its own board if you have room. Take RF signals to and from it with screened cable if you do this, though.

Well, that's it for constructing the boards. While researching for this transceiver I found the entire original article of the 2N2/40 transceiver online. It too uses the Manhattan construction method and much to my amazement there were drawings of every board, component position and wiring. It was extremely thorough. So why didn't I do the same? Well, apart from the huge undertaking of doing all the drawings, I also found the follow up files that detailed all the errors in drawings, some of them very serious. I really didn't want this to happen with this article. Besides, following a join-the-dots drawing doesn't really have the same impact for learning the Manhattan construction technique as figuring it out for yourself.



2

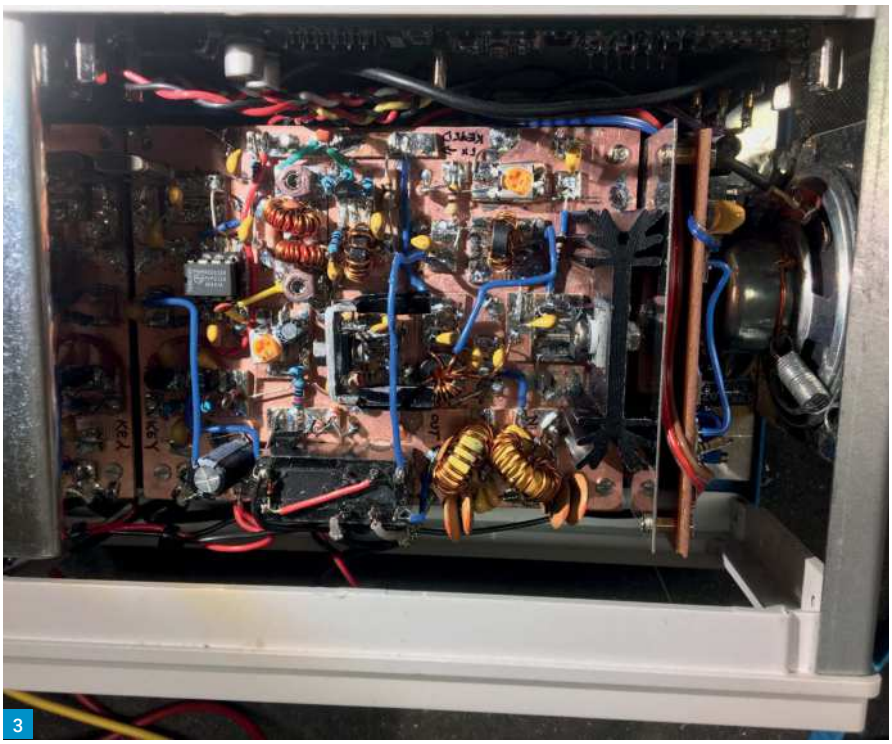
Fig. 1: Rear of the front panel.
Fig. 2: Part built receiver board.
Fig. 3: Transmitter board mounted above the receiver board.
Fig. 4: The back panel.
Fig. 5: Side view, showing the mounting of the speaker.

Completing the Project

I thought I'd round off the series with a few pictures and tips for boxing up your completed transceiver.

Fig. 1 is a view of the rear of the front panel. Far right is the 10-turn potentiometer that is the main tuning control. On my design this is a tight fit in front of the VFO box. I always fit any main tuning control with a large knob on the front panel. This makes it easier to control the fine tuning. Next to main tuning is the centre detent RIT control. You can also see the back of the digital frequency display. Note that I replaced the horrible little Dupont connectors it is supplied with and hard wired screened cable on the back for both the signal and supply.

Fig. 2 is a photo I took during construction. I'd just finished the receiver board but it's not wired up yet. There aren't four Toko coils by the way, it's a reflection in the VFO tinplate enclosure. Notice how I label the board with a fine tip marker so I know where cables are to go.



3

It's easy to wipe off with a cotton bud and some acetone. Incidentally, 'CW' on the board is nothing to do with Morse, it means clockwise, referring to the potentiometer connection. I'm sure I modified the circuit after this photograph but it does clearly show how I implement the Manhattan construction method. I tend to take a few photographs of boards and layouts of projects as

Antenna Changeover Component List

Resistors
All Resistors are ¼ or ⅓ Watt Carbon

R7, R8	2.2kΩ
R9	330Ω
R10	10kΩ

Capacitors

C12, C13, C14 & C15	10nF Multilayer ceramic
C16	100µF Electrolytic

Variable Resistors

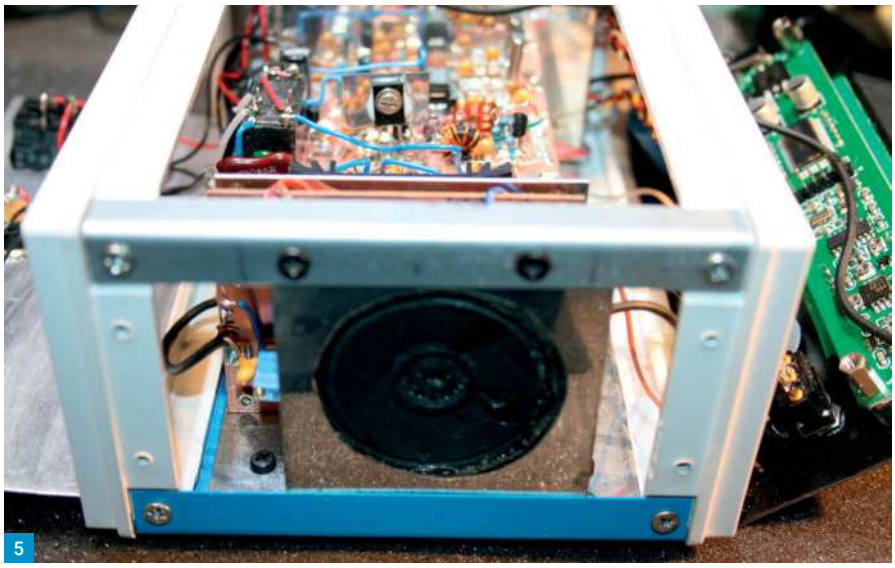
VR1	10kΩ Miniature pot

Semiconductors

TR1, TR2	2N3906 (or pretty much any general purpose PNP bipolar transistor)
TR3	2N3904 (or pretty much any general purpose NPN bipolar transistor)
D2, D3, D4, D5 & D6	1N914/1N4148 small signal diode

Miscellaneous
- Small 12V DC DPDT relay eg HF115F
- Hook-up wire
- Thin screened cable eg RG174 or similar
- Copper clad board for groundplane and islands

4


5

I go. I might make a radical change that doesn't work so well so it's nice to be able to look at a previous setup before the change.

Fig. 3 was also taken during construction and shows the transmitter board mounted above the receiver board. To the right of the heatsink, vertically mounted on a tinplate divider, is the audio board and to the right of that is the little speaker. Notice the transmitter low pass filter was an earlier fifth order filter design I tried but it didn't suppress the second harmonic enough for my liking. As you can see, it was deliberately built on its own little piece of copper-clad board so I just lifted this off the main board and replaced the whole filter with the new design. If I had made a printed circuit board for this project, this would have been impossible! If you adopt this 'module' strategy, and I can recommend it, then it's a good idea to solder short links between the ground plane of the individual modules to the main board ground plane copper in more than one place. I use the ends of components leads I've cut off. Yes, I save them all, don't you?

Fig. 4 is a view of the back panel. As you can see, I prefer BNC connectors for my homebrew projects. I have a certain dislike of SO239s and besides, they're much larger than BNC. I found the switch in my junk box and I always fit those type of little power sockets to all my homebrew kit. That way I only need one plug with power in the shack. A fuse is good practice and so is some kind of polarity protection. For this project I put a diode with its anode to ground and the cathode on the cold side of the fuse. Should I ever inadvertently get the supply reversed this will hastily blow the fuse.

And finally, **Fig. 5** is a view from the side where the speaker is housed. I included this more for the view of the little heatsink I fitted to the BD139 transistor than for the speaker. I'm sure you all know what a speaker looks like!

Final Thoughts

We've come to the end of this construction project. I really do hope it has sparked your interest in homebrew beyond kit building. I certtainy enjoyed writing it up. It's not that I have anything against kits, I've made plenty myself and I'm a firm advocate of them. I do, however, consider constructing a homebrew project by research, experimentation and evaluation to be a level up from kits. I also hope I've demonstrated that it's doesn't have to be as daunting as it might appear.

To design your own project, research has to be the key. Understand how each module works and how it passes on signals and levels to the next stage. Don't be afraid to experiment, especially with receivers. If you plan to build your own transmitters though, do ensure you thoroughly test your output for purity and stability.

Finally, if you have been following this series and decided to build this rig in any shape or form, or if you've used some aspect of it for your own design, I would love to read about it. My email address is at the top of every part in this article. I know this simple rig is open to all manner of changes and improvements and I know there are readers out there who are far more knowledgeable than I am about these things. **PW**

I HPE CUAGN ON 40M DR OM, 73 DE G0TMT

WHISTLER

TRX-1E Digital Handheld Scanner

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

Buy the TRX-1E for just

£419.95

WHISTLER

WS1065 Desktop Radio Scanner

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

KEY FEATURES

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

Buy the WS1065 for just

£299.95

WHISTLER

WS1025 Desktop Radio Scanner

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

Buy the WS1025 for just

£89.95

WHISTLER

TRX-2E Digital Desktop Scanner

Buy the TRX-2E for just

£479.95

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

This multi-system adaptive digital trunking scanner supports Motorola P25 Phase I, X2-TDMA, Phase II and DMR making it capable of monitoring the following unencrypted channels/systems:

- Conventional DMR (Entered as a DMR trunked system)
- Hytera XPT
- MotoTRBO™ Capacity Plus
- MotoTRBO™ Connect Plus
- MotoTRBO™ Linked Cap Plus systems
- NXDN & DMR out of the box

KEY SPECIFICATIONS

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

WHISTLER

WS1010 Handheld Scanner

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

Buy the WS1010 for just

£89.99

WHISTLER

WS1040 Handheld Scanner

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

Buy the WS1040 for just

£299.95

WHISTLER

TRX-1 Leather case

Keep your traesued TRX-1 safe with this high quality leather case

£29.95

MRW-TRX3 Antenna Pack

Three compatible antennas in this great pack

£39.95

TRX SD cards

A genuine replacement for the Whistler TRX-1 SD card

£19.99

BEST SELLER

UKAFG UK Airband Frequency Guide 2022

A printed ring-bound Aviation frequency guide, Includes free UKAFG website access to frequency updates, Civil and Military call signs and Maps until the 1st of Jan 2023

- HF VHF UHF • Civil and Military
- Common Frequencies • Airports A to Z
- UK ATC and high-level European
- 8.33khz conversion • Transmitter Sites
- Frequency/Channel list • Squawk codes

Buy this guide for just

£16.95

PR781 - AR Dynamic Studio Quality Microphone

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

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

All for just
£199.99

199 WATTS

BM17DYN – AR Lightweight Dual Sided Boom Set With Dynamic Element

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

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

All for just
£119.99

119 WATTS

Proset 3 – Pro Stereo Studio Headphones

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

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

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

All for just
£109.95

109 WATTS

Proset Elite 6

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

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

All for just
£189.95

189 WATTS

PRO 7 - AR Industrial Headset

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

All for just
£289.95

289 WATTS

PMSIC – AR Pro-Micro Single-Sided Headset

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

All for just
£84.95

84 WATTS

FIN RED – Professional Chrome Microphone

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

All for just
£219.95

219 WATTS

PRASEQ – AR Parametric Receive Audio System EQ

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

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

All for just
£219.95

219 WATTS

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

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

All for just
£249.95

249 WATTS

RigExpert

AA-2000 Zoom Analyser

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

Buy the AA-2000 for just
£849.95

RigExpert

AA-1500 Zoom Analyser

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

Buy the AA-1500 for just
£699.95

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
£619.95

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

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

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

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

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

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 output volume levels are adjusted by potentiometers on the front panel of the device.

Buy the STICK-PRO for just
£154.99

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.

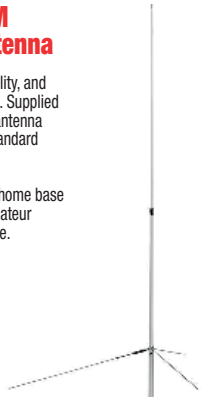
SPECIFICATIONS
- Mast size : 28 to 44 mm (1.1/8" - 1.3/4")
- Rotation time : approx. 74 sec.
- Rotation torque : 21.5 Nm
- Weight : 4.2kg
- Control unit : with digital direction indicator
- Operating Voltage 220-230VAC
- Requires 3-wire control cable (not included)

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

17 WATTS

SHARMAN multiCOM

SM-50II 50 AMP Switch Mode Power Supply Unit

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

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

Buy the SM-50II for just
£129.95

129 WATTS

SHARMAN multiCOM

AV-508 – Deluxe Desktop Microphone

Suitable for most modern radios with required lead

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

Buy the AV-508 Receiver for just
£69.95

69 WATTS

SHARMAN multiCOM

AV-SW2M - 2 Way SO239 Coax Switch

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

Buy the AV-SW2M for just
£34.95

34 WATTS

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
- Bandwidth - 500kHz

Buy the STORM 100 for just
£39.95

39 WATTS

SHARMAN multiCOM

AV-600 VSWR Power Meter

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

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

Buy the AV-600 for just
£74.95

74 WATTS

SHARMAN multiCOM

AV-6075NF – 75 AMP Swtch Mode Power Supply

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

Buy the AV-6075NF for just
£349.95

349 WATTS

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

A 12V Two-Valve Reflex/Regen Receiver

Eric Edwards GW8LJJ encourages a return to retro with a design for a low voltage valve receiver.

Projects using valves are normally associated with high voltage power supplies varying between about one hundred and several hundred volts, and currents from milliamps to amps, depending on the circuits and purposes used. Some valve linear amplifiers have more that 1000V (1kV) as their power supply. Several decades ago valves and their associated power supplies were commonplace in the radio amateur's shack as there was little other choice. In these modern times we are spoilt with semiconductors that operate from low voltages such as 12V and 24V as examples. There are amateurs today that still use valve transmitters of which some are home-made (home-brewed) and others that are vintage commercial and military, but today, health and safety is a big concern. This project is of interest for those that wanted to have a go at making a valve radio, but were reluctant because of the high voltages normally associated with them, and of nostalgic interest for the amateur brought up in that era.

What is Different About This Receiver?

This is a valve (vacuum tube) regenerative type that was very popular in the early days of radio receivers and had a good following with radio amateurs. Although valves usually operate from a high tension (HT) voltage, this one is designed with safety in mind, and uses 12V, or the shack 13.8V power supply, so that the Safety Elves can put away their safety pins. This design is a reflex /regen receiver, also referred to as a 'reflectional receiver' design, in which the same amplifier stage is used to amplify the high-frequency radio signal (RF) and low frequency audio (sound) signal (AF). The original reason for using the amplifier for 'double purpose' was to reduce the number of active devices (thermionic valves) required in the circuit, and to reduce the cost. The economical reflex circuit was used in inexpensive valve radios in the 1920s, and was revived again in simple portable valve radios in the 1930s.

No Loudspeaker

This project is a receiver tuner, as it has no audio amplifier for driving headphones or a speaker. It does, however, have high gain audio stages to enable connecting to an audio amplifier or even the line-in on a PC or external sound card. The circuit is designed around two valves, one is an ECC86 and the other an ECC82, which are both double triodes, so technically, there are four valves used. **Fig. 1** shows two valveholders mounted on a home-made 'chassis.' The valveholders I used also have skirts to enable screening cans to be fitted, which also protects the valves.

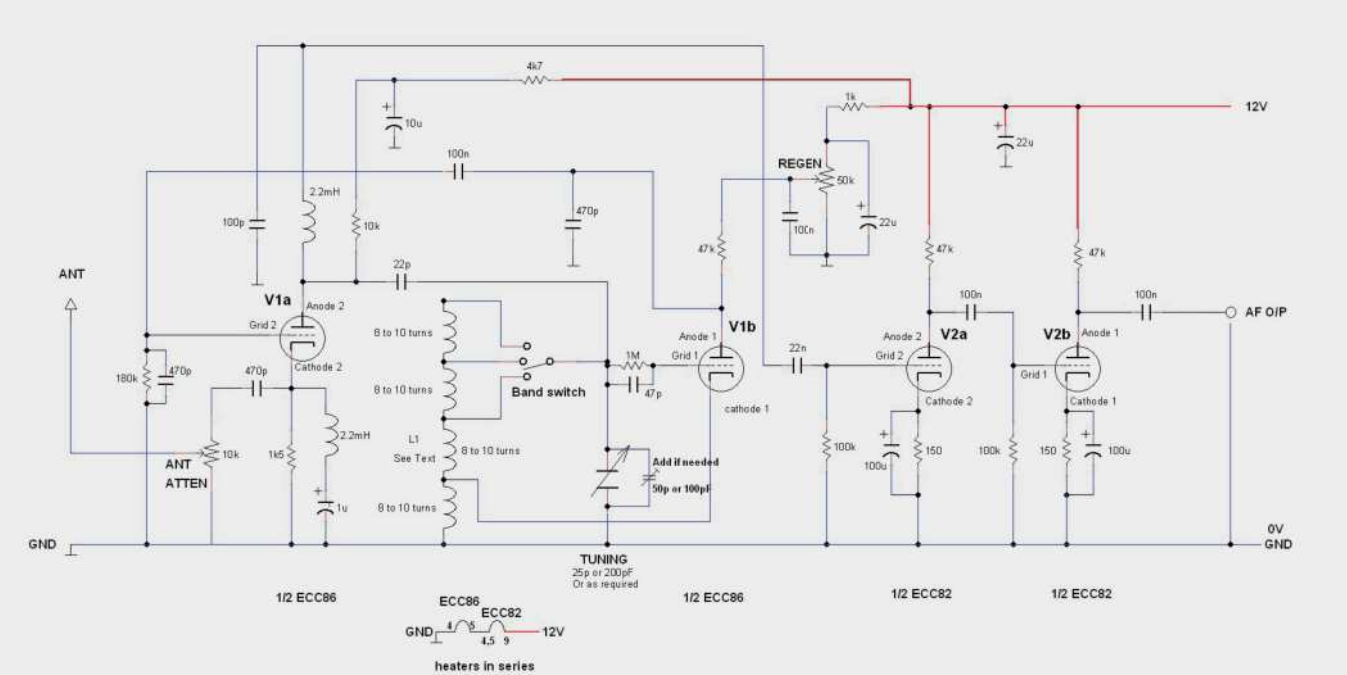
The Valve (From Wikipedia)

A vacuum tube, electron tube, valve (British usage), or tube (North America), is a device that controls electric current flow in a high vacuum between electrodes to which an electric potential difference has been applied. The type known as a thermionic tube or thermionic valve utilizes thermionic emission of electrons from a hot cathode for fundamental electronic functions such as signal amplification and current rectification. The simplest vacuum tube, the diode (i.e. Fleming valve), invented in 1904 by ***John Ambrose Fleming****, contains only a heated electron-emitting cathode and an anode. Electrons can only flow in one direction through the device, from the cathode to the anode. Adding one or more control grids within the tube allows the current between the cathode and anode, to be controlled by the voltage on the grids. These devices became a key component of electronic circuits for the first half of the twentieth century.*

The Valves: ECC86 and ECC82

The valve used in the 'front end' (RF stage) is an ECC86, which is a double triode type. The valve nomenclature used by Mullard and Philips (the manufacturers) for these valves are given by the letters and numbers used and follow the European coding. The first letter is the heater rating and 'E' refers to 6.3V or 12V/6.3V series or parallel designed for AC. Valves designed for battery operation have, for example, 'D' as the first letter indicating a 1.4V or 2.8V/1.4V series/parallel filament. The remaining letter, as for the second and third of the valves used in this project is 'C' and stands for small signal TRIODE. It has two similar triodes, as shown with two 'Cs', in one glass envelope and they share the same heater. The numbers refer to the type of base ('8' is for a B9A base) and valve characteristics.

The ECC86 is a special high frequency double triode with 6.3V heaters. The second valve used is an ECC82. This series of valves, ECC81, ECC82 and ECC83, are normally designed for audio preamplifiers. The last figure (or figures) indicates the design or development number. The ECC82 for example shows that it is also a twin triode type with 6.3V heaters and fits into a B9A base. These valves, ECC81, ECC82 and ECC83 were also manufactured under the American code with the numbers 12AU7, 12AT7 and 12AX7. The '12' indicates the heater voltage, which is 12.6V. The letter 7 in this coding indicates that seven electrodes are available at the base, two cathodes, two grids, two anodes and one heater. As the European ignores the 12V heater, so the American code ignores the 6V heater facility.



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The Circuit

The circuit appears at **Fig. 2**. The antenna is connected to a potentiometer, which is used as an RF attenuator to reduce any possible overload and is used in conjunction with the reaction control for best resolution of the received signal. The first triode (V1a) of the ECC86 valve has two purposes: one as an RF preamplifier to amplify the received signal and another as an AF preamplifier. The RF preamplifier is used as a grounded-grid amplifier with the signal entering at the cathode via the attenuator and a 470pF capacitor. The grid is 'RF' grounded by another 470pF capacitor connected to it and the other end connected to ground. The grid needs to be biased with a negative voltage with respect to the cathode and this is supplied by the 180kΩ resistor connected to it and the other end connected to ground (commonly known as a 'grid leak 'resistor). The amplified signal is taken from the anode and is AC coupled (DC blocking) with a 22pF capacitor, which is connected to the common connector of the tuning coil, main tuning capacitor, the 'grid leak' grid resistor in parallel with a 47pF capacitor, to the other triode of the ECC86 (V1b), which is the oscillator stage. The anode of V1a has a 10kΩ resistor as its anode load, which is similar to the collector load in transistor circuits.

Reflexing

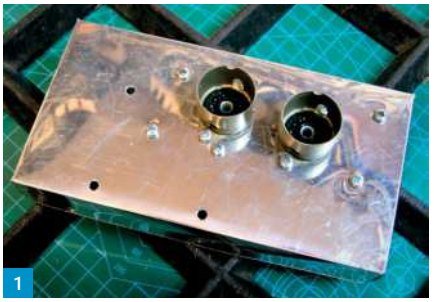
The triode V1a doubles as an AF preamplifier. It amplifies the RF (antenna input) via the cathode, and the AF (audio) is amplified using the control grid as the input. Using one valve to operate at two different frequencies is referred to as 'reflex operation'. The audio output signals

Fig. 1: Two valveholders, on a home-made chassis. Fig. 2: The circuit. Fig. 3: Heater wiring. Fig. 4: Tag strips in place. Fig. 5: The completed wiring. Fig. 6: The chassis construction Fig. 7: Coil with taps. Fig. 8: A suitable audio amplifier. Fig. 9: Circuit for a suitable high pass filter.

from the anode of V1b, the Hartley oscillator, are connected via a 100nF capacitor to the grid of V1a. There is a 470pF also connected from the anode of V1b to ground, to decouple (bypass) any radio frequency (RF) to ground but allowing audio frequencies (AF) to pass through the 100nF capacitor. The cathode of V1a has an low frequency (LF) inductor (2.2mH) with a 1µF electrolytic capacitor connected in series that allows the audio to pass to ground for AF amplification. This triode has an inductor also at its anode, which acts as a 'choke' to block RF but allow the audio to pass through onto the grid, via a 22nF DC blocking capacitor, of V2a (ECC82) and further amplified by V2b (ECC82). At the top of the 'choke' is a 100pF capacitor to bypass any RF to ground. Both the ECC82 triodes are constructed as simple audio preamplifiers and are identical in component values and layout. The cathodes have a 150Ω resistor bypassed with a 100µF electrolytic capacitor, and the grids use a 100kΩ resistor as the grid leaks. The coupling between the two stages (two triodes) is with a 100nF DC blocking capacitor, and the anode loads are 47kΩ each.

The Oscillator

The triode, V1b (ECC86) is used as a Hartley oscillator in which the oscillation frequency is determined by the tuned circuit comprising a



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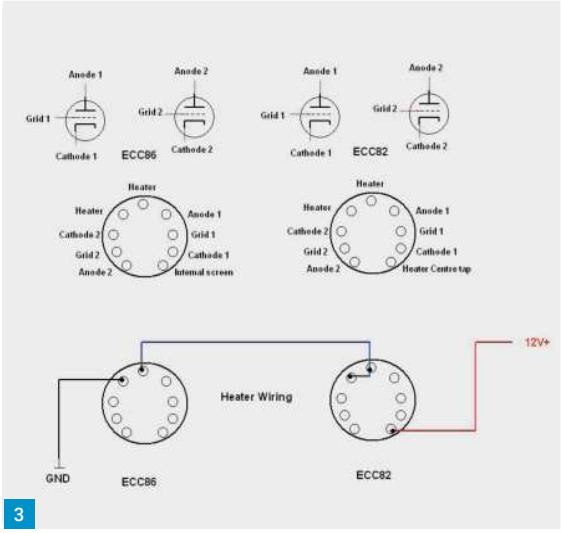
tapped coil (L1) and the tuning variable capacitor. The circuit was invented in 1915 by American engineer **Ralph Hartley**. The distinguishing feature of the Hartley oscillator is that the tuned circuit consists of a single capacitor in parallel with two or more inductors in series (or a single tapped inductor), and the feedback signal needed for oscillation is taken from the centre connection of the two inductors (L1). The top of the coil is connected to the grid of the triode via the 47pF capacitor and the bottom coil tap is connected to the cathode of the valve. Feedback, hence RF oscillation, is set up between the grid and cathode of the valve. Once the valve has 'warmed up', the frequency of oscillation is very stable. The gain of the oscillator stage is controlled by a potentiometer (regen control). Adjusting the control clockwise to place more voltage on the anode increases the amplification of the stage such that it will start to oscillate. When a circuit oscillates (or just before it oscillates) it is at its highest amplification.

Valve Heaters

The heaters of both the valves are in series (see **Fig. 3**) allowing 12V (13.8V) to be used for the



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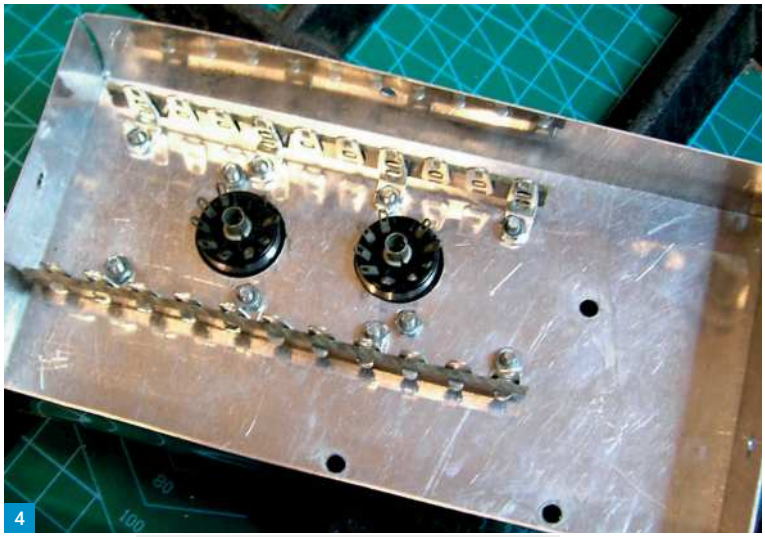
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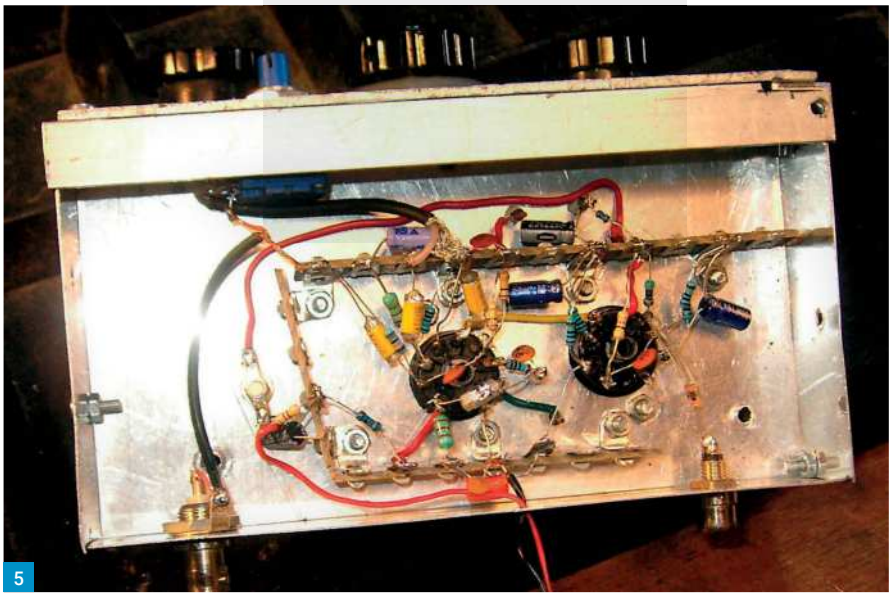
heater and the rest of the circuit. Both valves have 6.3V heaters but the ECC82 heater has a centre tap that can be used with either 6.3V or 12.6V. The two valves have their heaters in series so the ECC82 heaters need to be wired for 6.3V operation. This is accomplished by joining pin 4 and pin 5 together as one connection of the heater and using pin 9 as the other end. The heaters are wired so that pin 4, one end of its heater, of the ECC86 is connected to ground and the other end, pin 5, is connected to pins 4 and 5 of the ECC82 with its other end, pin 9 connected to the 12V (13.8V) power supply terminal.

Point to Point

There is no PCB design for this project so all connections are made by direct connections to and from the valve pins. Tag strips can be fitted under the chassis and near the valveholders to provide multiple connections, **Fig. 4**. More tag strips can be added if needed or small group board type connections can be used. It is suggested that the valve heaters are wired first and the other components added as the stages are built up. **Fig. 5** shows the completed wiring with a BNC socket fitted for the antenna and a phono socket for the audio output.

Be Rigid

The chassis is made from thin sheet aluminium and has angle aluminium bolted to it with M3 hardware to make it a box shape for strength and rigidity. The front panel is also made from sheet aluminium and bolted to the chassis with side arms fitted using angle aluminium. **Fig. 6**, shows this along with all the other parts fitted. This photo show two ECC86 valves, but the second valve has since been replaced with an ECC82 (V2). The mechanical construction needs to be rigid to reduce microphony (mechanical vibrations) and all wiring to the coil, tuning capacitor and coil tap switch, if fitted, must be solid core hook-up wire preferably 2mm or greater diameter. Any movement on the front panel or the tuning components will cause frequency variations.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Tuning Parts

The main tuning capacitor can be any that is available but the lower the capacitance value, say 25pF, the more selective the tuning will be. Using a larger capacitance value such as 200pF or greater, for the standard tuning type, will cover more of the band but it will be difficult to separate the received stations even with a slow-motion drive fitted, which is advisable even for low capacitance value tuners. A fixed (or pre-set) capacitor (50pF or 100pF etc) can be used as the band set and the variable tuning capacitor as the bandspread. The coil can be wound on a former made from wood (dowel) or plastic (PVC), such as 25mm diameter conduit pipe. The taps can be made using 2.45mm printed circuit male header pins with every other pin removed, **Fig. 7**, and glued into 1mm holes drilled into the PVC pipe. The wire used can be 24SWG (0.559mm) or similar and 8 to 10 turns between each pin for the taps. Although there are seven pins shown in my prototype and three in the circuit diagram, it can be as required and three or four taps may be enough. The number of taps and the choice of tuning capacitors will determine the bands. In my prototype it covers from 160m to 20m and is subject to the coil/ capacitor combination.

Add-Ons

The audio level output from the tuner can be connected to an audio amplifier for which there is plenty of volume for the neighbours to hear as well. A suitable amplifier can be home-made or one as shown in **Fig. 8**. This is a complete amplifier with a volume control fitted and a TDA2050A as the active device and it produces loud audio signals into an 8Ω speaker. These are available at reasonable prices from our Oriental friends on the usual internet site.


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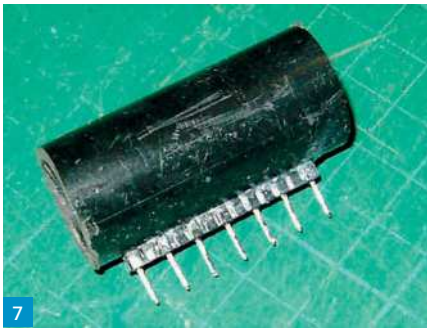
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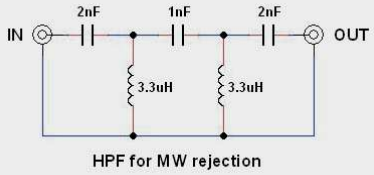
Parts List

Component	Value and type	Quantity
Resistor	100kΩ 0.25W carbon or metal film	1
Resistor	1.5kΩ 0.25W carbon or metal film	1
Resistor	10kΩ 0.25W carbon or metal film	1
Resistor	4.7kΩ 0.25W carbon or metal film	1
Resistor	1MΩ 0.25W carbon or metal film	1
Resistor	47kΩ 0.25W carbon or metal film	3
Resistor	100kΩ 0.25W carbon or metal film	2
Resistor	1kΩ 0.25W carbon or metal film	1
Resistor	150Ω 0.25W carbon or metal film	2
Potentiometer	10kΩ lin	1
Potentiometer	50kΩ (47kΩ) Lin	1
Capacitor	470pF NP0 ceramic or polystyrene	3
Capacitor	100pF Ceramic or polystyrene	1
Capacitor	1µF 25V electrolytic	1
Capacitor	10µF 25V electrolytic	1
Capacitor	22µF 25V electrolytic	2
Capacitor	100µF 25V electrolytic	2
Capacitor	22pF polystyrene	1
Capacitor	100nF ceramic	4
Capacitor	47pF ceramic	1
Capacitor	22nF ceramic or polyester	1
Variable Capacitor	Main tuning polyvaricon or open mesh type 25pF or 100pF	1
Preset Capacitor	Band set Trimmer capacitor 50pF or 100pF	1
Coil and former	See text	1
Switch	Bandswitch multi-pole if required	1
Valve	ECC86 V1a and b	1
Valve	ECC82 V2a and b	1
Sockets	Antenna in, Audio out, 12V+ and 0V.	As required



HPF for MW rejection
9

In Use

With all the parts fitted, ensure that the chassis and front panel, the main tuning variable capacitor fitted with a slow-motion drive mechanism, and its associated components are made rigid. Connect the audio output phono socket to an audio amplifier using a screened lead. The amplifier can be the one as mentioned or any one available one in the shack. Turn the RF attenuator to about mid-way, the tuning control also to mid-way and if used, the coil taps to a place near the bottom, say two taps up from the cathode connection. Set the reaction control to fully counterclockwise and apply the voltage, which can be 12V or 13.8V from a shack power supply. The current will be about 600mA but will increase if an amplifier is also connected to the same power supply so one capable of supplying at least 1A will be suitable. Connect an antenna with preferably an ATU or coupler if available. Increase clockwise the antenna attenuator and the reaction control until some noise appears at the speaker. If there is oscillation, turn the reaction control counterclockwise so that it just stops oscillating. If a signal is heard and can be tuned with the main tuning control, adjust the attenuator and reaction control along with the tuning until a station is resolved. If it is an AM station, set the reaction control for the strongest signal with no oscillation. The settings of the main tuning along with the other two controls are dependent on each other and it will take a little practice to operate the receiver to provide the best results. It will be worth the effort as this is a sensitive receiver. Please note that while these valves have low current heaters they can still get warm and may cause burning to sensitive fingers if left on for a long time. It will be prudent to let the valves cool down by switching off before handling them.

Broadcast Breakthrough

Receivers that have an un-tuned front end (no bandpass filter, coupler or ATU) along with high audio gain, are prone to interference from strong commercial broadcast stations on the medium waveband. This can be eliminated or greatly reduced (attenuated) by the use of a filter. The type of filter suggested is a high pass (HPF) as it removes all signals below a certain frequency and allows the higher frequencies to pass through, **Fig. 9**. Using the filter completely removed the broadcast interference on my unit when the antenna was connected directly to the BNC socket whereas without it the unwanted signals were very strong.

References & Acknowledgements

- The Valve Museum
- Mullard maintenance Manual 1961
- **Cess Davies GW3OAJ** for suggestions and following with interest.
- Proof Reading: **Ray Koster GW7BHQ** PW

Calculating L & C the KISS Way

Dave Gordon-Smith G3UUR offers a simple, practical way of calculating L and C values for a variety of applications.

Dave Gordon-Smith G3UUR
practicalwireless@warnersgroup.co.uk

An old-timer once told me about a very simple, but quite ingenious, way of estimating the inductance and capacitance required for a tuned circuit. It's a method that dates back to the very early days of wireless. The only slight drawback is that it doesn't use frequency directly; it requires the wavelength corresponding to that frequency instead. If that's not known, calculating it usually involves another equation. However, the amateur bands are loosely named after the range of wavelengths they cover, so if a tuned circuit is required for the 40m band, for example, 40m can be used instead of a more accurate figure and a simple correction made to the predicted values of L or C to compensate for the difference. In fact, it's wise to overcompensate a bit to make sure the values are large enough as ATUs or receiver RF stages need to cover the whole band with a good margin below the LF end to cater for unforeseen variations. I've been using this KISS method for predicting the values of L and C for many years now and had always assumed that the 'wavelength-by-two' method on which it's based is widely known, but apparently it's not. So, I thought I'd better write a short article to spread the word about this incredibly simple way of finding a suitable pair of values for L and C.

The Wavelength-by-Two Equation

Rather than bore you with the full derivation, I'll keep this short and just say that the relationship between wavelength (λ) and frequency (f) is used to eliminate frequency from the standard LC equation. Then, the units of both L and C are chosen very carefully to cancel most of the remaining constants. So, the derivation involves the substitution of c/λ for f, where small c is the velocity of light, juggling the units of L and C to cancel much of π^2c^2 and then some further algebraic manipulation to yield $LC = 1.1258\times(\lambda/2)(\lambda/2)$, where λ is the wavelength in metres, L the inductance in μH and C the capacitance in pF.

If that coefficient of 1.1258 is ignored, just dividing the wavelength λ by 2 gives a number that can be used as a starting point for both the L and C values. This is the basic wavelength-by-two method as explained to me many years ago. So, for the 20m band, we could use 10μH with 10pF as our starting values. And, since the resonant frequency of a tuned circuit stays the same if L times C is held constant, L can be reduced to a more convenient value for the 20m band by dividing it by some suitable scaling factor as long as C is multiplied at the same time by the same factor. How much scaling is done depends on the intended application or, more often, what's readily available. Anyway, keeping the calculation extremely simple, let's divide L by 2 several times while also multiplying C by 2 each time. That gives us 5μH with 20pF for the first step, then 2.5μH with 40pF for the second, followed by 1.25μH with 80pF for the third. It's best to make a note of these values on a scrap of paper to keep track of them. It can come in handy at the end of the scaling process when deciding which pair to pick and what the correction ought to be.

I had always assumed that the 'wavelength-by-two' method on which it's based is widely known, but apparently it's not.

Making Simple Corrections

Now, because we're making use of the wavelength associated with each amateur band, rather than a more precise figure, we have to make a correction to one of the chosen pair of scaled values to ensure that they're capable of resonating down at the low frequency end of each band, or lower if need be. So, considering 14.000MHz; that corresponds to a wavelength of 21.437m, which is a bit over 7% longer than 20m. Most of the HF bands have a similar relationship because many are harmonically related and the wavelengths associated with them are rounded off to the nearest whole number of tens for the longer wavelengths and the nearest metre for the shorter ones. On bands where the required correction is smaller, using 7% errs on the generous side and isn't usually a problem – there's just more of a margin below the bottom end of the band. So, since LC is proportional to λ^2, the correction needs to increase it by around 15% to allow for the difference in wavelength.

However, if we just correct for the inaccuracy of the wavelength, the predicted values will still be slightly out because of that 1.1258 coefficient we ignored initially to make the calculation simpler. Fortunately, only one correction needs to be made to cover both sources of error and the value of either L or C can be increased by about 30% to accomplish this. Even then, it will only just tune down to the lower band edge on some bands, so I use a correction of 50% because this is much simpler to deal with and also ensures that the resonant circuit is capable of tuning well below the lower band edge. It's always best to have a bit in hand! So, to provide a tuning range that goes well below 14.000MHz, an inductor of 2.5μH needs a variable capacitor of 40pF plus 50% (that's 20pF extra – the value of C from the previous step when successively doubling C and halving L). The lowest frequency covered with a 60pF variable is 13.0MHz, which gives an adequate margin below the band edge.

Which Values to Choose?

Potentially, the scaling process can produce a large range of options, depending on the choice of scaling factor. My advice is to keep things simple and scale by 2 a number of times if necessary. Apart from component availability, the final choice of L and C values may depend on the application. Purists often go on about the optimum L/C ratio for receiver tuned circuits, but stray capacitance and coil self-capacitance complicate what can be achieved theoretically and it's often practically as good to go with the initial inductance value given by the wavelength-by-two method, rather than anything larger. However, tuning units for antennas are a different kettle of fish. When I first started out in amateur radio, I was told to use at least 1pF per metre for antenna tuning units, which I've found works quite well for parallel tuning end-fed wires on the HF bands. So, in that case, perhaps a 5μH coil with a 30pF variable would be the most appropriate choice for feeding an end-fed wire on 20m. On the other hand, 2 to 3pF per metre always seemed to work out better for me when series tuning a quarter-wave wire on the 160-metre band – the loaded *Q* was lower, tuning less critical and flash-over less of a problem on transmit when using variable capacitors with barely adequate spacing. So, what's most suitable depends not only on the application, but also on the impedance levels involved. Half-wave antennas are high impedance and quarter-wave ones are low impedance, so that really determines the circuit configuration – parallel for high and series for low. Generally, though, quarter-wave antennas on the higher bands have enough bandwidth not to require a tuning unit.

An Extreme Example

I normally use the improved wavelength-by-two method to predict values for tuned circuits at LF and HF, but it can be used up at VHF as well. Take the 4m band as an example. Dividing the wavelength of 4m by 2 gives starting values of 2µH for L and 2pF for C. Scaling by 2 twice then gives 0.5µH and 8pF as a possible pair of values, only they resonate up at about 79.6MHz. However, adding 50% to either L or C will more than correct that. So, we could use either 0.75µH with 8pF or 0.5µH with 12pF, whichever is more convenient. Both these pairs of values resonate down at about 65MHz. So, if either L or C is made adjustable the circuit can be tuned from 65MHz upwards; the upper limit depending on the capacitance or inductance range of the component that's variable. Often, using the uncorrected value as the lower limit will give a tuning range that nicely brackets the band. For example, a capacitor variation of 8 to 12pF with a 0.5µH coil tunes from just under 65MHz to over 79MHz.

Similarly, an adjustable coil that varies from 0.5 to 0.75µH would tune over the same range with an 8pF fixed capacitor. Using the nearest preferred value of 8.2pF, instead, would only alter that tuning range slightly (64.2 to 78.6MHz), so it still covers the 4m band quite nicely with a reasonable margin either side.

Final Remarks

Despite the simplicity of the improved wavelength-by-two method, it's able to predict practical pairs of values for tuned circuits right up to 2m using the wavelength associated with each amateur band. It's the fact that these wavelengths are convenient round numbers that makes this method so simple – simple enough to do in your head!

This method is not intended to be a means of working out precise values for resonance at a particular frequency, though it could be modified to do that. Rather, it's a way of generating suitable pairs of values capable of resonating over an entire amateur band, with a good margin either side, if either the capacitor or inductor is variable.

Those who know the exact wavelength they require for a fixed frequency can use the wavelength-by-two method with a smaller correction at the end of the scaling process. In this case, a correction of only one-eighth or 12.5% is needed to allow for most of the 1.1258 coefficient in the wavelength-by-two equation. For example, taking an easy case such as 1.0MHz. This corresponds to a wavelength very close to 300m, so 150pF and 150µH should resonate above 1MHz and a correction of 12.5% ought to bring that resonance down close to the right frequency. One-eighth of 150pF is 18.75pF and the sum of these two does actually resonate with 150µH at 1.000351MHz, which is pretty close. If a particular inductance has to be used, scaling can be used to achieve that as long as L times C is kept the same.

Although most of my examples have favoured adding 50% to the capacitor value, sometimes there can be an advantage to correcting the inductor value, instead, if it fits in better with the capacitor and inductor values available. This choice and the option to scale the starting values by any convenient factor make this simple method very flexible. So, there you have it – a method so simple that neither a calculator, nor a computer is actually required to work it out. A scrap of paper to note down the intermediate values in the scaling process can come in handy, though. **PW**

Tony Smith G4FAI
g4fai@btinternet.com

1

Double Agent Ham Chat

Tony Smith G4FAI relates a curious tale from the war years.

Stories about enemy spies who were captured and 'turned' to send false or misleading information to the enemy during WW2 can be found in many articles, books, films, and on the internet; and their activities impacted, in some cases to a considerable degree, on the outcome of the war.

This article describes how one of these double agents maintained radio contact with his control masters in Germany with a simple one-valve transmitter and a three-valve regenerative receiver; keeping up the illusion that he was undetected and freely able to obtain and send information of value to them.

Arrival by Parachute

On the evening of 19 September 1940, **Wulf Heinrich Schmidt**, a Danish citizen, designated by the enemy as Agent 'Leonhard', parachuted into a field near Willingham in Cambridgeshire. He was arrested by the police the next day, and taken into custody at Camp 020, MI5's centre for captured civilian agents, at Ham Common in South London.

Under interrogation he said that his instructions were to establish himself somewhere in a triangle between Cambridge, Bedford and London. He was to report by wireless on anything likely to be of interest to the German invasion force (Operation Sealion) which, he had been told, would arrive in Britain very shortly.

Faced with the possibility of trial, and execution, as a spy, he agreed to become a double agent and was given the code name 'Tate'. Controlled by MI5 and the Double Cross (XX) System, which co-ordinated the work of all the double agents, his task would be to transmit false information to the enemy, obtained by fictitious intelligence gathering activities and imaginary contacts with important people in high places.

He was then taken to Willingham under escort where his parachute, flying overalls and helmet, transmitter, receiver, batteries, Morse key, two aerials and a map, were recovered.

Confirmation Expected

His crystal-controlled transmitter had an output of 3 watts, with two plug-in crystals, for 4603kc/s and 6195kc/s. He had two aerials, one for each frequency. His instructions stipulated that they were to be erected, running from East to West, as high and free as possible and, if necessary, the shorter aerial could be used for either frequency.

He had received no instruction in wireless theory but knew how to erect the aerial and tune the transmitter.

He was to contact his control station in Hamburg as soon as possible after he arrived. If the transmitter failed, he was to report this on a postcard sent to an address in Lisbon, writing his message with invisible ink on the reverse of the card. If that happened, Hamburg would not expect to hear from him again.

Morse Operation

He was to transmit between 0000 and 0200 GMT, and listen for a reply on 6200kc/s. He knew Morse from his previous service in the Danish army, but to improve his skill he had been on a course in Brussels. Although he could send at 18-20 words per minute (wpm) he had been told to reduce his speed to 6-8 wpm. One German operator, **Brandt**, who he had met during training, knew his style and they had a private arrangement. If Brandt was operating, he would send Leonhard (i.e. Tate) HR BRA in greeting.

Tate was asked if there was an emergency signal that he should send to indicate that he was being used by the enemy. He did not know of one. The possibility of being captured and 'turned' was never mentioned by his instructors.

All messages to and from his control were to be coded by use of a circular disc he had brought with him; and the callsigns for the day could also be determined from the disc.

First Transmissions

Under escort, and supervised by an MI5 radio officer, Tate now attempted to send his first message to Hamburg, to report his safe arrival in England.

Several locations were tried, using different aerials, to simulate typical situations where he might have tried to set up his station if he had not been caught. These included Central London, Cambridge, Steeple Bumpstead, near Cambridge, Ham Common, and a house in Barnet, all without any response from Hamburg.

On one occasion a weak chirpy signal was heard on 6200kc/s, sending material that was unreadable. It sent a series of Vs (QSV) after Tate sent QRZ? QSV (who is calling me? Send a series of V's), but it was not clear if they were replying to him.

Photo 1: Hallicrafters Sky Buddy receiver as used by Tate (Advertisement 1939). Photo 2: HRO receiver, as used by Tate (Photo: Tony Smith). Photo 3: TKP Morse key. Photo 4: Tate's radio at the National War Museum, Edinburgh, wrongly attributed to Walti(Photo: Dave Pack). Photo 5: Tate's transmitter (Photo: Harry Matthews). Photo 6: Tate's receiver (Photo: Harry Matthews). Photo 7: Tate's Transmitter schematic (by Harry Matthews). Photo 8: Suitcase radio, type SE 92/3, as carried by Walti (Source unknown).

Throughout this time, Radio Security Service (RSS) stations, including some VIs (Voluntary Interceptors), given advance notice of the times, frequencies, and callsigns of his transmissions, without being told their purpose, reported them mainly at good strength. Assuming that Hamburg had also been listening for them, Tate's supervisors reported that there should have been no difficulty in making this initial contact.

Success!

For three weeks he called without success, but band conditions were difficult. His receiving frequency was very close to those of several shortwave broadcast stations, including the BBC Overseas Service, Andorra, Lisbon, Vatican, Zeesen and New York. Equally, Hamburg must have had difficulty in receiving his QRP (low power) signal among all the high-power broadcasters.

Contact was finally made on 16 October 1940. Reception in Germany was poor on 6195kc/s. He was asked to change to 4002kc/s, a frequency which he didn't have; but finally managed to get through using his 4603kc/s crystal.

Regenerative Receiver

From then on, he was in regular contact with Hamburg, but conditions continued to be difficult. Solar cycle 17, which began in 1934, had peaked in 1939 and was declining steadily towards its minimum (which it reached in 1944), creating QSB (fading) at times, while a number of solar storms in that period disrupted radio communication worldwide.

Tate's regenerative receiver was of the type used by many radio amateurs before the war. With the regeneration correctly adjusted it could receive weak CW and other signals well but there were problems when they were close to strong signals from other stations.

To improve reception, he was given a better receiver, the Hallicrafters Sky Buddy. Later, he was given an HRO receiver as used by the RSS monitoring stations and by some Voluntary Interceptors.

On-air 'Ham' Exchanges

Hamburg often used what Tate's supervising officers called 'a form of ham chat'. He had brought with him a selection of Q-codes written in Spanish on a small card, all of which he used on air. An additional signal, the letter D, was to be sent several times if he had to stop transmitting because of the danger of being caught.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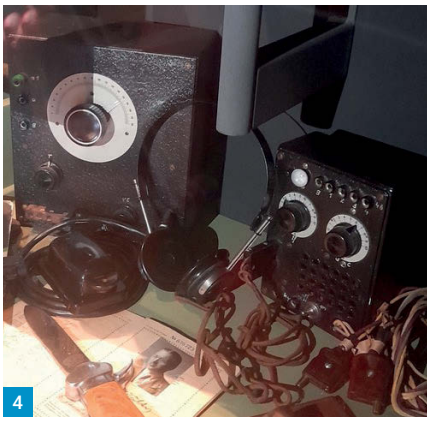
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Typical phrases noted before and after the coded messages, included, among others:

GE OB, QSA4, ERE QTC1, QRU? AR K

R R OK OK, TKS, GB DR FRD, VY 73 ES CHEERIO SK SK SK

CHEERIO ES DX, NW IMPOSSIBLE, FB SK

HAPPY NEW YEAR OB, DO NOT GET DRUNK

PSE SEND YOUR QTC, HAPPY CHRISTMAS

GB OB, SLEEP WELL

TNX DR FRD FR ALL

TNX FR FB QSO

and it was concluded from such exchanges that Hamburg was manned by at least some pre-war professional, or amateur, operators.

QTC?

To call Hamburg (H), he sent his callsign, repeating it for about ten minutes, then QSA? QSA? PSE K PSE K awaiting a reply.

H would reply with their call, repeating it for about five minutes, then send OK QSA3 (or other strength of signal received) QSA? (What is my strength?) PSE K K.

H would repeat their call several times, then QTC? (How many messages for me?) ERE QTC 1 (I have one message for you).

Tate would then send and receive his coded message or messages.

If there was doubt about anything, H would send PSE RPT WD 6, (for example, repeat sixth word in text.)

If H received the message satisfactorily, they would send QRU (I have nothing for you), or sometimes OK ERE NIL PSE K, and Tate would finally send OK SK CL.

A report on file noted that Tate sent very good Morse, 'clean stuff and quite fast,' and that he had increased his speed by practice on the receiver.

He was able to read Hamburg through quite a lot of interference, and this was described as 'the mark of a good operator.' However, he didn't like the small 'Mouse' key which came with his set and was given a larger, better key.

Fear of Discovery

There was a constant fear that other German agents (V-men) might try to contact him and discover that his imaginary role, as a well-off, well-connected man-about-town, financed by money sent from Germany, was a sham.

A few of the contacts mentioned in his messages give an idea of the range of his 'sources'. 'Met an RAF Sergeant on leave'; 'Got into conversation with some Irish Guards'; 'Overheard conversation of two very high officers'; 'Mary works in a cypher office of one of the big ministries'; 'Have been working my way slowly but surely into the better circles in London'; 'An RAF officer told me…';

'Following rumour is current…'

Far from such a well-connected information-gathering life, an inquiring agent would have found 'Leonhard' in a safe house at Watford, supervised by an MI5 Radio Officer, a small team of watchers, and a cook/housekeeper.

During the day, when he was not engaged in clandestine communications, he was allowed to work for a local photographic company, and as a freelance photographer for a local newspaper, under the name of Harry Williamson.

It was not realised until after the war that there were no V-men left in the country to try to contact him. With one exception, who arrived undetected and subsequently committed suicide, all those who had arrived had been captured, imprisoned, or executed, or persuaded to become double agents.

There was serious concern in February 1944, however, when the Intelligence Agency of the SS (the SD) took over the Abwehr and reorganised the system of contacting and controlling the V-men. It was feared that they might find cause to doubt the authenticity of the reports they received from 'Leonhard' but eventually everything settled down and continued much as before.

Awarded the Iron Cross

A note on file, dated 15 April 1941, reported that Tate had been renamed 'Iron'. Despite this, many of the reports, notes, or correspondence on the files continued to refer to him as Tate; and, to avoid confusion, he continues to be known by that name in this account.

A few weeks later, on 6 May 1941, he, as Leonhard, received a message from Germany: 'Have just learnt that you have been decorated in the name of the Führer with the Iron Cross, First and Second Class. We all most heartily congratulate you and our thoughts are with you.'

Increased Power?

Notes on the files discussed the possibility of using a more powerful transmitter after Hamburg instructed Tate to 'increase power somewhat,' but this idea was rejected for several reasons.

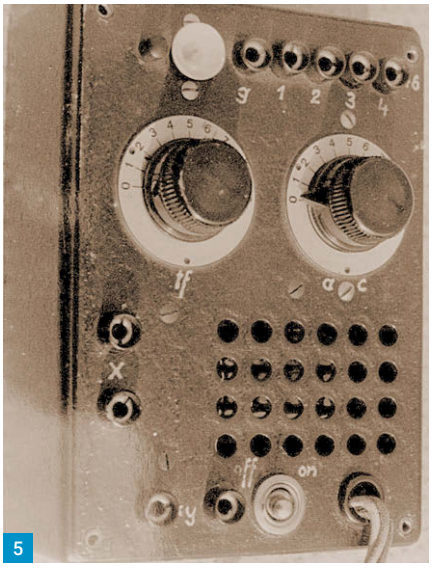
A similar type of transmitter would have to be used and it was doubtful if his crystals would tolerate much more power that that already used.

Any replacement would have to be battery powered. If a mains powered supply was used, any trace of mains ripple would be detected and fatal to the operation; or a mains failure would immediately put him off the air and arouse suspicion.

Other reservations were that batteries for a more powerful set would be very expensive and require constant renewal; the character of the signal would change; and it would be very difficult to ensure that there was no change in its audible note.

New Frequencies

In March 1942 Hamburg changed to two new frequencies, 6620kc/s and 4850kc/s; and new traffic



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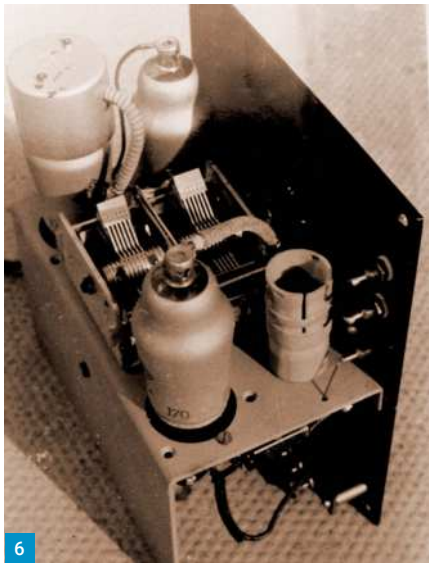

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times at 0630 and 1830 GMT.

Interference on Tate's transmitting frequency of 6195kc/s was so bad that it was practically unusable, and he sent a message: 'Absolutely essential you send another crystal. Jamming makes contact impossible. Please arrange something.'

His 4603kc/s frequency had been giving reasonable communication, but efforts were made to persuade Hamburg that conditions were not so good on that frequency either. The output power of the transmitter was reduced by inserting a series resistance in the HT lead; but despite a considerable reduction in power, the signal reports were still quite good.

A shorter aerial, of about 15ft (4.5m) was tried, resulting in QSA1, which was barely readable in Hamburg and the original aerial was reinstated. More resistance was added to the HT line, and the output was reduced to 1.5W.

It was hoped that this reduction in power would expedite the delivery of the requested crystal, as Hamburg might conclude that contact was in danger of breaking off completely. In January 1942, another spy, who was captured on arrival, brought more money for Tate to subsidise his 'lifestyle'. He also brought a new 7412kc/s crystal which, unfortunately, was outside the range of Tate's transmitter and was unusable.

New Operator

When Tate became ill, an MI5 operator, copying his style, transmitted his messages for him. A specially made monitoring circuit enabled the operator to hear both his own transmission and the reply station on one set of headphones, while another set wired to Tate's bedroom enabled him to listen to both ends of the contact. Two receivers were used, the HRO and the Sky Buddy, previously mentioned.

After recovering from his illness, Tate did not operate again. He did, however, continue to monitor the transmissions and assist in compiling, coding, and providing an authentic personalised flavour to the messages, as well as suggesting new areas of misinformation likely to confuse the enemy.

Longest Serving Double Agent

On 21 September 1944, to emphasise his value and commitment to his 'mission', he sent, tongue in cheek, 'On the occasion of this, my 1000th message, I beg to ask you to convey to our Führer my humble greetings and ardent wishes for a speedy victorious termination of the war.'

In all, he sent or assisted with, around 1100 reports or messages to Hamburg from 16 October 1940 until 2 May 1945, the day before that city surrendered to the British Army.

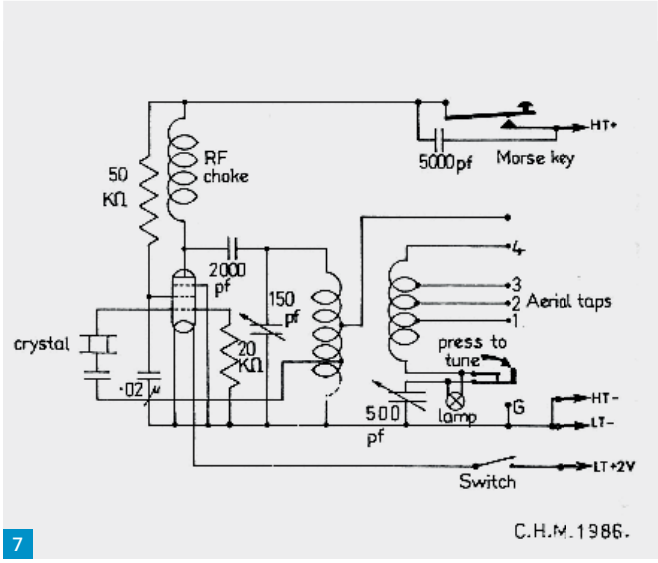
He sent misleading weather reports, deceptive information about military, naval, air force, industrial, and agricultural matters; the effect of bombing raids, including the V1 and V2 missiles; food supplies and the morale of the population.

He was the longest serving double agent in WW2, and he remained in England after the war until his death in 1992. He was described by **Sir John Masterman**, Chairman of the XX Committee, as: 'One of our most trusted wireless agents.'

From the German side he was described by **General Lahousen**, Head of Abwehr II (sabotage and espionage), as 'one of the most reliable and trusted German spies in Britain… all through the earliest parts of the Blitz, at great danger for his own life, he was in the heart of the bombed areas… and made reports by his radio. In 1944, he made long reports on the preparations for D-Day supposedly moving about the restricted coastal area of southern England. He also sent important information about the V-1 and V-2 rockets.

Historic Artefact

QRP enthusiasts today can appreciate how well Tate's 3W transmitter performed throughout its long operational life, and the similarity to amateur operation and practice is interesting. The early



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problems with simple wire aerials, coupled with difficult conditions, both QRM (interference) and QSB (fading), sound familiar, and all the while he was operating in great secrecy.

His little transmitter is an important radio artefact of WW2. A German set that saw war service in a way that was never intended. The story of how, operated by Tate, and later by an MI5 substitute, it successfully transmitted misleading messages on behalf of the Allies is extraordinary, and can be read about in greater detail in the reference material listed at the end of this article.

Pure CW Note

Wireless World (WW), in February 1941, carried an officially approved description of Tate's transmitter although, for security reasons, it was not identified as such. Comment was made that the circuit was almost the same as one used by a member of the WW staff in 1924, apart from the use of a quartz crystal and a pentode valve, and that 'a rather more finished job might have been expected from the best German technicians.'

Nevertheless, when crystal controlled it produced a pure CW note. If the crystal was removed, and the plug sockets were short-circuited, the set could be operated without frequency control, still with good stability, and with a pure note over the useful part of the tuning range.

Where is Tate's Radio Now?

After the war some captured German spy radios were distributed to museums or other appropriate repositories. Tate's set was sent in error to **William Merrilees**, the Chief Constable of Lothians and Peebles Constabulary who, in 1940, then a Police Superintendent, arrested a German spy, **Werner Walti**, in Edinburgh. When arrested, Walti had a suitcase radio, and the intention was to return this to **Mr Merrilees** when the war was over.

In 1986, Tate's set, still believed to be Walti's, was given to Leith Police Museum in Edinburgh. Before being displayed in the museum, it was examined and photographed by **Harry Matthews**, founder of the Museum of Communication, Burntisland, Fife.

The Police Museum closed, in 2013, and the set is now on display in the National War Museum, Edinburgh Castle, still attributed to Walti.

The National War Museum has been told about this long-standing error. It is making its own enquiries to confirm the provenance of the set, and it is hoped that the misunderstanding will eventually be resolved.

Where is Walti's Set?

Further research has revealed that the Imperial War Museum (IWM) in London has a suitcase set in store, Ref. IWM (COM 1500), which it describes as '..... believed to have been the set belonging to agents Werner Heinrich Walti and **Karl Theo Druecke**, who were captured in 1940.'

However, Walti and Druecke who landed on the coast of Scotland with a woman agent, **Vera Eriksen**, did not share a radio. Druecke and Eriksen were arrested shortly after landing, and Walti later the same day in Edinburgh. Both men had suitcase radios and different missions and, apart from landing together, had no connection with each other.

It seems possible that the set at the IWM is Walti's. This has been pointed out to the museum, and no doubt, if they think it is of sufficient interest, they too will make their own enquiries to clarify the situation.

Meanwhile, In Edinburgh, Tate's radio, which played such an important part in the 'deception' war waged by the Double Cross (XX) system, remains uncredited, and unrecognised, as it has been since 2 May 1945!

My thanks to **Dave Pack**, who visited the National War Museum in Edinburgh Castle for me to photograph and confirm the existence of the wrongly attributed 'Walti' radio display.

Specification of Tate's Transmitter and Receiver

- Transmitter: Type SE 88/5, with one KL2 valve and 3W output; crystal-controlled with two plug-in crystals, 4603kc/s and 6195kc/s.
- Frequency range: 6600kc/s to 3900kc/s (45.4m to 76.9m).
- HT power supply: Three Pertrix Piggi 90V batteries in series, giving 270V.
- LT battery: 4.5V. A resistance was built into the circuit to enable the 2.5V KL2 valve to work from a 4.5V battery.
- Separate Receiver: Type E88, three-valve, regenerative.
- Frequency range: 8810kc/s to 4140kc/s (34m to 72.4m).
- Power supply: HT battery 90/150V. LT battery, 4.5V.
- Aerials: Two aerials supplied, one for each of the two crystal frequencies. For 6195kc/s the aerial and counterpoise were each 9.5m (31ft 2in) long. For 4603kc/s they were each 13m (42ft 8in) long, in both cases including the lead-ins. **PW**

Reference and Further Reading

- *Double Cross Agent Tate*, Tommy Jonasson & Simon Olsson, Amberley Publishing, 2012.
- *Seven Spies who changed the World,* Nigel West, Secker & Warburg, London 1991.
- *Tate*: Selected historical papers. National Archives, Files KV 2/61 and KV 2/62.
- *The Counterfeit Spy*, Sefton Delmer, Hutchinson & Co., Ltd, 1973.
- *The Double-Cross System in the War of 1939–45*, J.C. (Sir John) Masterson, pub. Australian National University Press, 1972.
- *The German Spy Set SE88/5 in a Box,* Thomas Höppe DJ5RE, in *Wireless for the Warrior*, Vol.4: **https://tinyurl.com/3pd2davp**
- *Walti*: National Archives, File KV 2/17.

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

1

Shack Accessories

Daimon Tilley G4USI looks at some of the accessories that you will probably need around the shack.

In this instalment of *On a Budget* we will examine some essential and desirable shack accessories, which will enhance your shack and operating. For many of these accessories you will find options on the second-hand market as well as new, allowing some keen purchases to be made.

I am not listing these accessories in any particular order but will leave the reader to determine what is essential and what is desirable for their own circumstances, so let's make a start.

Power Supplies

Power Supply Units (PSUs) are found in nearly every shack to provide (typically) 13.8V DC to power most transceivers that do not have an internal mains supply, and key accessories such as linear amplifiers, etc. Until a few years ago, power supplies were only available in 'linear' form, meaning that in practical terms, anything providing more than just a few amps was big, bulky and very heavy. Linear supplies are still available and do not tend to produce 'noise', which might affect your reception activities. For most of us though, linear power supplies have been replaced by 'switched-mode' supplies. These supplies use transistorised switching technology to provide higher currents in a much smaller form factor and weight. Your mobile phone charger, will for example, be a switched-mode supply. In the early days of these type of supplies, users often reported them as being 'noisy' in the sense of producing radio frequency interference (RFI). This led some manufacturers to add a small potentiometer control to 'offset' this noise if it caused a problem and many supplies for the amateur retain these. In my personal experience, although I have come across cheap and nasty 'wall-wart' adapters, those that plug directly into a mains socket and sit there physically, I have not had a problem with the larger supplies designed for use as shack PSUs. I personally use Sharman Multi-Com PSUs, having both 30A and 50A, **Fig. 1**, models, with no detectable RFI.

In terms of size, I always think it pays to buy one that is capable of running more than one device at a time and with a good overhead of performance. For example, if my main rig drew 20A, I would probably buy a PSU of at least 30A to give some headroom. If you are solely a QRP operator, then a 30A PSU will be significantly larger than you need, but will allow the opportunity to run QRO or other accessories later without the need to upgrade. On the new market expect to pay between £70 to £100 for a 30A model, as an indication. On the used market they are not very often for sale as they have a long lifespan, and a new model with warranty might well be worth the little extra cost over used, unless you can find a bargain.

An alternative to a mains powered PSU is some form of battery solution and this can be particularly helpful if, for example, you like to operate portable or from a garden shed or similar, where mains power is not readily available. For many years some amateurs have operated using a large 12V car or leisure battery, and charge this between operating sessions by some combination of mains, generator, solar or wind power, providing good capability in the event of a power cut, for example. If you decide to go down this lead-acid battery route, then I would recommend the purchase of a leisure-type battery rather than a car battery. Leisure batteries are designed for caravans and boats and are better suited to providing continuous loads, whereas car batteries are designed to also provide high cranking power to start an engine.

If you are not operating at 100W but are primarily a low power operator, then other options become viable. For example, Lithium-Ion batteries (Li-ion) are now widespread and these can be harvested (with care) from many redundant devices. Many laptops, for example, use six or so Li-ion batteries. When these reach the end of their life, often there are still four or five good batteries with lots of life left inside. These can be repurposed quite easily to produce small and effective battery packs for QRP use. I hope to cover the building of such packs in a future article. Other options are to purchase ready-made Li-ion packs from online retailers. Here I recommend that you use reputable UK companies as your supplier, as many batteries sold on online sites state current ratings far in excess of their reality! Although I have made a number of battery packs from salvaged laptop batteries, I have also purchased a 12V Li-ion battery in the form factor of the old 12V Sealed Lead Acid Battery (SLAB), which provides 20 ampere hours (Ah) and which I fitted into a plastic ammunition can, via a control panel with on-off switching, voltage display, and 12V and 5V USB output, **Fig. 2**. This is my battery pack of choice when operating with my Xiegu G90 at 20W but it would power higher- power rigs for short spells too. I paid around £90 for the battery and a dedicated charger a couple of years ago.

SWR Meters

SWR meters, in my view, are an essential shack accessory. Not only are they useful for building and trimming antennas, but by leaving them in line with your antenna at all times, you can readily spot problems as they occur, and thereby prevent expensive damage to the final sections of your transmitter. Remember that high SWR can be caused by a number of things and can occur at any time, even on a perfectly resonant antenna. Causes of these sudden and unexpected SWR increases are often mechanical, for example, poor connections emerging on coaxial patch leads, water ingress, broken balun connections,

Fig. 1: A modern switching power supply. Fig. 2: The author's portable battery pack, with space for other items. Fig. 3: A typical SWR and power meter. Fig. 4: A selection of adapters. Fig. 5: A substantial antenna switch. Fig. 6: A wall map – notice the stickers to show places worked!

even selecting the wrong antenna for your rig at the coax switch. When choosing an SWR meter you should be mindful of the frequencies you wish to use it on and your likely power output. Some models, for example, are only suitable for HF or VHF frequencies, while others might cover a wider range by switching or other means. Expect to pay anything between £60 to £100 for a new model, and £25 to £60 for a used one.

A power output meter is another worthwhile accessory, although perhaps not essential. This will allow you to monitor your output in Watts and detect any problems early. Power meters are available as stand-alone items, but also are available combined with SWR meters, **Fig .3**. In this case, there are two varieties, one where you flick a switch to alternate the display between SWR and power, and another which is called a cross-needle meter. In this latter case, both power and SWR are displayed simultaneously on two meter scales using two meter needles. These are highly convenient. Digital versions are also available. Combined SWR/Power meters are, of course, a little more expensive, but are probably cheaper than two stand-alone units. Expect to pay from £80 to £150 new and £40 to £90 used.

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Patch Leads

When connecting devices such as the SWR meter and other accessories such as ATUs to your rig, patch leads are essential. A patch lead is just an appropriate length of coaxial cable, terminated at each end in a standard plug of some sort, for example, the PL-259 or BNC connector. While essential items of equipment, they can be the source of much frustration! I usually make my own cables to the length I need, and, with the exception of my QRO linear, I tend to use good quality RG-58 for its size and flexibility. I tend to standardise my patch leads with PL-259 plugs, and then use adapters where needed to match BNC or SMA connectors (more on this later). The issue with patch leads is making a quality connection to both the inner and outer shield of the coax at the plug termination. I used to use standard soldered PL-259s where the outer is soldered to the body of the plug through a hole. I did not find this satisfactory as the heat required is significant, sometimes melting cheaper plug centres or coax inner insulators, and there is no strain relief in many cases, other than the soldered joint. If you do manage to make satisfactory soldered joints, then the lack of strain relief can cause failures with repeated plugging and unplugging, or even just the movement of equipment on the desk while plugged in. It took a while for me to learn not to scrimp in this area and I now only use really good quality plugs of the compression type. In these plugs, the centre of the coax is still soldered to the pin, but the outer is forced by compression against the plug outer body to create a connection without solder, and the compression joint also provides strong mechanical connections, minimising strain on the connection points through use. You can of course purchase your patch leads, but even on a budget, it does not pay to scrimp here. It really is a case of buy cheap, buy twice! I won't list prices here, but all the reputable dealers provide patch leads of varying types. Just a final word of advice here though: avoid second-hand patch cables unless from a source you know and trust!

Even if you try to standardise connectors, you will sooner or later buy a piece of equipment that is different. While it is perfectly possible to buy or make patch leads with different connectors on each end, it is often more convenient and cheaper to buy some form of adapter, and these are readily available, **Fig. 4**. I keep a stock of these and find them very handy. There are many varieties, which fall into two broad camps. The first is to provide a transition between the male and female varieties of the same connector, for example male PL-259 plug to the female SO-239 socket. The second, transitions from one plug (or socket) type to a different type. Examples include PL-259 to BNC, BNC to SMA, etc. These are really helpful because QRP rigs are often supplied with BNC connectors, while higher power rigs tend to use PL-259s. SDRs and handy-talkies increasingly use the SMA variety. Again, quality varies, so buy wisely. They are not expensive and it is possible to buy a selection of types or packs of five or ten of a single type cheaply from the usual internet suppliers.

Antenna Switch

As your shack grows, you may wish to switch multiple antennas to a single rig, or multiple rigs to a single antenna. An antenna switch, **Fig. 5**, will allow you to do this and is a very useful accessory. If you are operating at QRP levels, where powers are low, it is perfectly possible to make and use a very cheap antenna switch using standard switches, a rotary switch for example. But when you move much above five to ten watts, you need something more robust to handle the increased power. There is no shortage of antenna (sometimes called coaxial or coax) switches to choose from and you will find many

advertised in the pages of this magazine. I personally use a combination of three antenna switches and patch leads to switch multiple rigs to multiple antennas. Switches vary quite a bit in price according to how many devices you wish to switch, commonly two, three or four. Expect to pay between £45 and £90 for a decent mid-range quality switch, but they can also be a useful and cheap used buy. If you do buy used, then if possible, remove the back plate (held on with screws) and check for good connections and no arcing or pitting of contacts. I found used switches online ranging between £25 and £45 in price.

Dummy Load

A dummy load makes a useful shack accessory when testing or building equipment. Essentially a dummy load is a 50Ω resistive load designed to 'absorb' the power output of your transmitter and disperse it as heat rather than RF power. It allows you to connect to a device designed for a 50Ω load and test power output without putting a signal on the air – good practice unless you are seeking to make a contact. Dummy loads are not as prevalent to purchase as they once were, and as you will see from my earlier article, they are included in some ATUs. Your choice of dummy load will be dictated by the power it needs to handle and, of course, size and price increase as power increases. It is perfectly possible to make your own dummy load, either from scratch or a kit. I hope to cover the making of a dummy load in a future article in this series, but there are some good kits available for QRP levels. QRP Labs do a 20W dummy load kit for just $8.50. Phoenix Kits do two dummy load kits. One is the QRPLoad+ priced at £8.50 and includes an RF detector circuit that allows you to use a standard voltmeter to measure power output. The other is the DL-2 HF dummy load, handling up to 15W and having a similar voltmeter test connector, priced at £19.99. Phoenix Kits' sister site – Kanga Products – offers a 20W SMD dummy load kit for £10.

External Speaker

The use of an external speaker can transform long periods of operating. While many base-station, and even mobile transceivers, can provide good quality audio, this can often be improved by connecting to an external shack speaker. With small QRP rigs, with commensurately, no or small loudspeakers, your experience can be transformed. This is an area where good results can be achieved at budget prices. There are a number of main routes for you to follow here. Many manufacturers of base-station HF rigs offer matching external speakers, but these tend to vary in quality and can be expensive, often over £100 or more. You could buy an after-market external speaker, although not many of these are available new. My fairly local amateur radio shop had a variety of used stand-alone station speakers for sale, ranging from £10 to £20. You could, of course, build your own very cheaply with a suitable salvaged or new speaker unit and a homemade enclosure and this could make a good first building project, as it is simple with very little to go wrong. A used pair of powered stereo computer speakers can be very effective and these are available very cheaply from friends, the internet or charity shops. Finally, there are some really excellent and cheap Bluetooth speakers available, some of which will accept input from a 3.5mm stereo socket, making rig connection easy. These are particularly good for portable use as they have internal batteries, but can also be used in the shack, powered by a USB cable. I have a few of these varying from just 3in in diameter and from varying sources, including internet auction sites and supermarkets such as Aldi or Lidl. Each of them makes a really useful addition to portable or shack work, and these can be picked up for £10 or less new.

Headphones

Headphones of some description can also be very useful, either when operating in noisy environments or when you don't want to disturb the family. My wife finds the noise of CW particularly irritating! Again, there are lots of options here, from expensive hi-fi quality phones to communications headsets to small earbuds of the type that come with your mobile phone. In my case I use earbuds or a Bluetooth speaker when operating portable, and over-ear headphones, for comfort at home. My over-ear phones are from bhi and cost me only £20. I find them very good, but sometimes I get dropped audio. I can't lay this at the doors of the headphones directly, but have experienced some disparity in the length of tip, ring and sleeve plugs and sockets between different devices and different headphones, which I think causes this. It is irritating though, and you might need to try different combinations for reliable connections.

Maps

Good quality maps can provide a useful addition to the shack and come in many varieties. You can buy callsign maps, locator maps and great circle maps, to name just a few. However, if you are on a budget, one of the cheapest ways to get a large map of the world or of Europe is to visit a retail outlet such as The Works, who sell these for just a few pounds, **Fig. 6**. If you don't want to use wall-putty to fix them to the wall, then do as I did and pick up one of their cheap blank painting canvasses and glue the map to it using PVA. This provides a good reference, and you can use cheap round stickers to mark new countries worked.
If it is a great circle map you are after, there are a number of free online tools that will create a great circle map centred on your QTH and these


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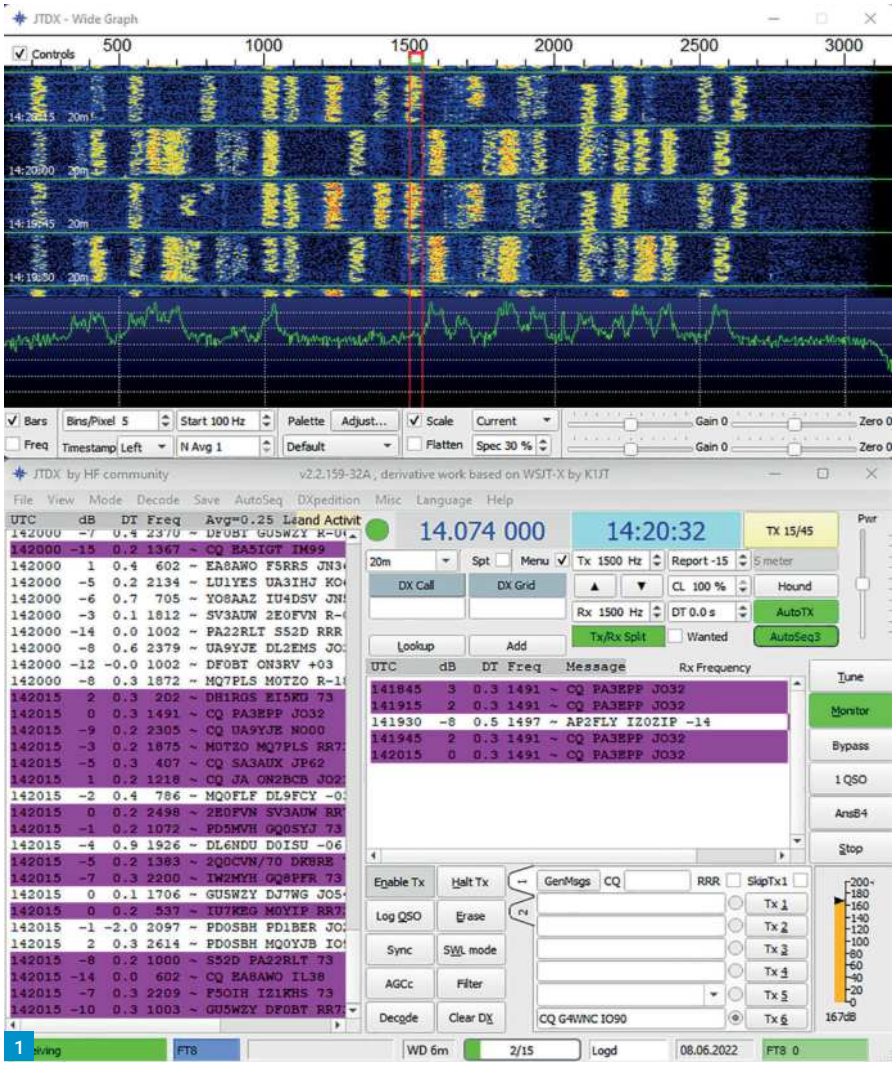
are a great reference for pointing your beam. I downloaded one, and rather than print it, I have it set as my shack computer desktop wallpaper. A good website for such maps is that of EI8IC at: **https://tinyurl.com/mryeua7c**

Recording Device

A final accessory to consider (for this article at least) is some form of recording device. You can use this to record your favourite shortwave broadcast station, or the signal of a station you are working, so that you can play back the quality of their transmission to them. In the past we may have used a tape recorder (remember those?) but now some rigs and SDR transceivers have this functionality built in. Alternatives include cheap handheld digital dictation devices, or a mobile phone or tablet can be used.
That's all for this instalment of *On a Budget* and I hope you found it useful. In the next instalment we will look at options for the shack computer on a budget and free radio software. **PW**

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk



1

FT8 Comparisons

Mike Richards G4WNC compares the decoding performance of four FT8-capable programs before looking at measuring network performance.

This month, by popular request, I'm running a comparison between WSJT-X and a few clones to see if there is any measurable difference in their FT8 decoding performance. This is often a subject of debate when deciding which software to run for a contest or special event station. On an unrelated topic, I have recently found a handy tool for network performance measurement that I'll show you how to install and use.

WSJT-X Comparisons

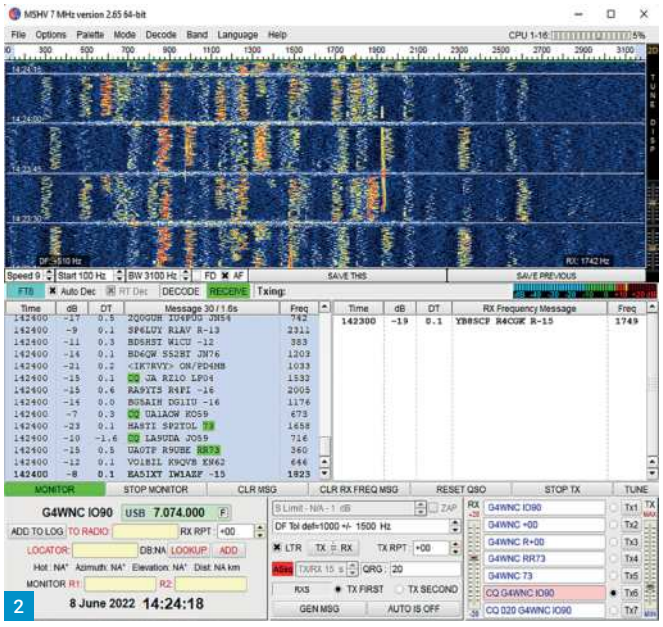
For this experiment, I wanted to see if there was any discernible difference in decoding ability between the popular WSJT-X software and three popular alternatives. These alternatives exist thanks to the generosity of the WSJT-X team led by **Joe Taylor K1JT**, who have kept to the true spirit of amateur radio and shared the code for their software. While the software is subject to copyright, it is licensed under the terms of Version 3 of the GNU General Public License (GPLv3). This means that the end-user can modify the software, provided the same licensing is applied to any new software derived from or dependent on the WSJT-X source code. This shared approach makes it relatively easy for other software developers either to create potential improvements to the code or to modify the interface to favour a particular operating mode. The clones I'll be using in this comparison are: JTDX, WSJT-Z and MSHV, **Figs. 1**, **2** and **3**. These clones offer a different look and feel for FT8 operation, and claim higher sensitivity, hence the trigger for this comparison.

Inside WSJT-X & FT8

Before I get into my comparison method, it's worth reminding ourselves how WSJT-X processes FT8 signals. One of the many reasons FT8 is so effective is its use of multipass decoding. The FT8 decoder iterates over the received signal several times, digging deeper to reveal more decodable messages. That is a one-sentence oversimplification, but the important point is that the reception process has two distinct phases. The process begins by storing the received audio data in WAV files. Next comes the decoding phase, where the stored WAV files are spectrally analysed and processed to extract and decode the message. WSJT-X discards these WAV files but stores all the decoded messages in a file called ALL.txt, located in the WSJT-X log file folders. For Windows users that location is C:\users\userName\AppData\Local\WSJT-X. As far as I'm aware, all the FT8 programs compared here use the original WSJT-X decoding algorithms, but the sensitivity parameters are trimmed to increase sensitivity. The clones also tend to lag behind the official WSJT-X releases when new features are added.

Test Setup

In any experiment, the test conditions are critical, and, in this case, I wanted to get as close as I could to monitoring live signals. However, I had to be able to apply precisely the same test signal to each program, or the comparison would be compromised. I used SDR-Console with my AirSpy HF+ Discovery receiver and a Wellbrook ALA1530 loop antenna to capture the live signals. Rather conveniently, the June ARRL International Digital contest was running, so that was my source of real signals. Using this receiving setup, I made several 15 minute, 192kHz wide IQ data recordings on a selection of bands at different times during the contest. The next step was to review the recordings and identify some challenging examples. One of the many benefits of **Simon Brown G4ELI's** excellent software is his datafile editor. This editor made extracting a 12kHz slice of the 192kHz spectrum very easy. The result was a more manageable 41MB file (the original was 1.4GB). The final processing step was to replay the reduced size IQ file through SDR-Console and make a 3kHz wide audio recording using the lossless WAV file format. This audio WAV file was used to feed to the FT8 software for the decoding tests.



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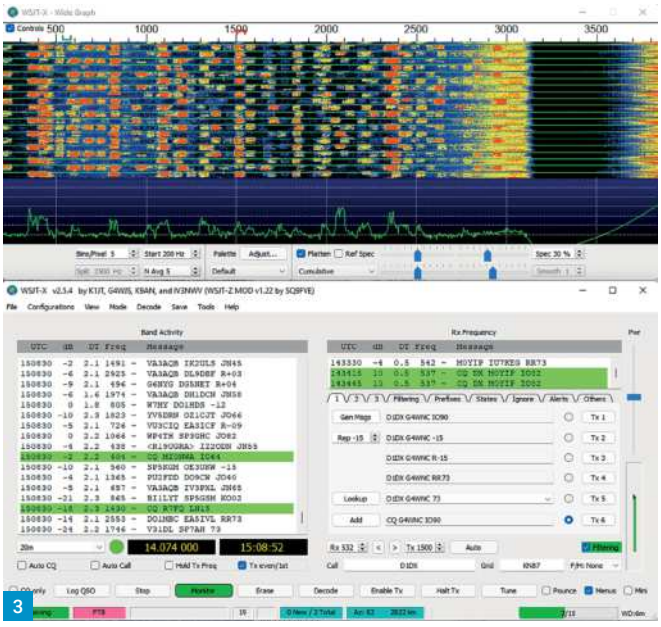

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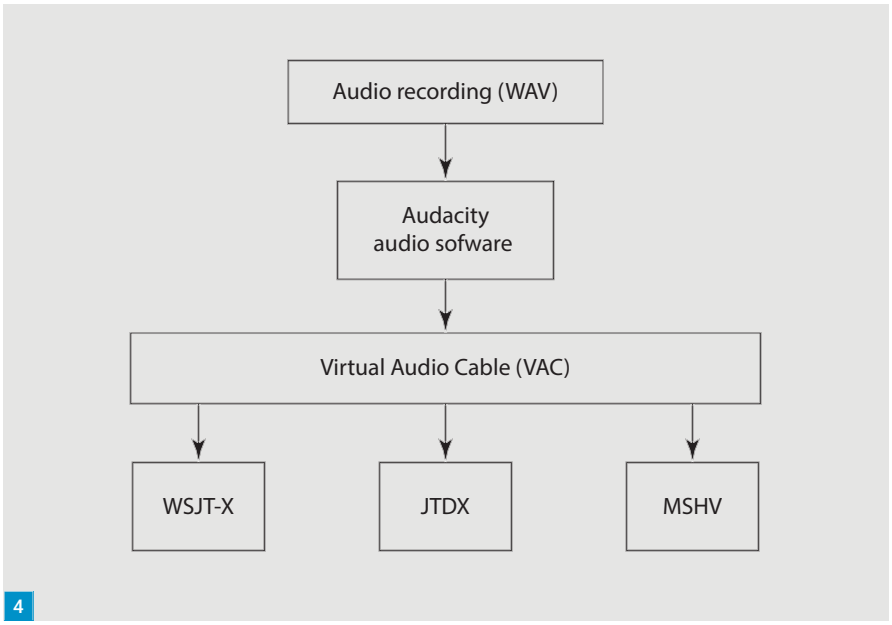
I have shared the test files on my website for those of you who might like to run your own tests or validate my findings. While I could set the FT8 software to decode directly from the WAV file, that would mean testing each program separately with the risk that something might change while swapping between software. As a solution, I simultaneously fed all the FT8 programs with the same test signal using **Eugine Muzychenko's** Virtual Audio Cable (VAC). This VAC application supplies identical but isolated audio feeds to multiple applications and is ideal for this type of testing. I've shown a block diagram of the test setup in **Fig. 4**. I used the open-source Audacity software for the audio player as this is a very versatile application with a proven track record for quality. To achieve synchronisation with the FT8 receive cycles, I trimmed the audio test files to include a 500ms pause before the FT8 signals appeared. I was then able to manually start the playback by pressing play at the 15th second.



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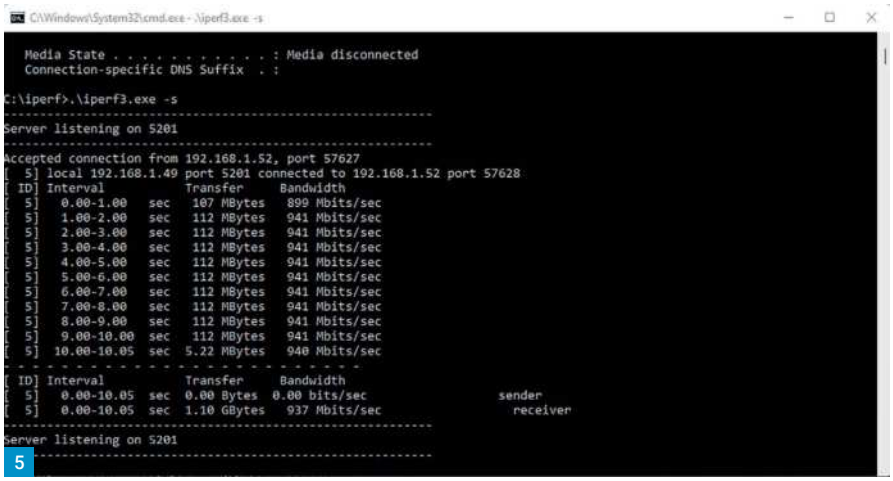
The next task was to install and configure the FT8 software. At least for my initial tests, I wanted each program to install with its default settings. I uninstalled my existing FT8 software packages using IObit Uninstaller to ensure no residual remained on my PC. I also searched my Installation folders and the Windows registry, deleting any residual files. At this point, I discovered that WSJT-Z is not a very good adaptation of the WSJT-X code. While the interface is very different, the installation files retain their original names and directories. As a result, it installs itself over the top of any existing WSJT-X installation – not very helpful! For this reason, I put WSJT-Z to one side for the initial testing. The more sensitive FT8 software can create a heavy processor load during the decode cycle. To avoid any issues, I installed the software on a high-spec PC running Windows 11 with an i7 processor and 32GB RAM.

Measuring Performance

The next problem was how to measure the decoding performance. I wanted a simple and repeatable solution that would show which program decoded the most messages from a given test signal. This task was simplified because all the FT8 decoders produce a plain text file that contains all the decoded messages. Taking a simplistic view, all I had to do was delete the existing ALL.txt files from WSJT-X, JTDX and MSHV, run the test signal, then compare the resultant messages in each ALL.txt file. For the initial run, I used a 5-minute recording of the 7MHz band on the evening of 5 June. This was during the last few hours of the ARRL International Data contest, so the band was busy. The only software change was to direct the input source to my VAC and extend the receive bandwidth of the MSHV software to match that of the recording.

When I checked the result, I was quite surprised to find that JTDX had decoded 466 messages while MSHV was just behind at 450 messages and WSJT-X returned just 340 messages. That's a significant difference. I repeated the test but with a different three-minute recording of 21MHz in the afternoon of the contest. This produced 421 decodes for JTDX, 398 for MSHV and 224 for WSJT-X. Still a significant spread of results. To better understand what was happening, I decided to run another comparison but using just a single 15-second FT-8 cycle. That would reduce the number of decodes and hopefully make it

Fig. 1: JTDX interface.
Fig. 2: MSHV interface.
Fig. 3: WSJT-Z Interface.
Fig. 4: Block diagram of the test setup.
Fig. 5: Example of speed test using iperf3.



easier to understand the difference. To further simplify the comparison, I extracted only the CQ calls from the received messages. I've shown the results in **Table 1**. You can see that JTDX and MSHV produced matching decodes while WSJT-X missed three calls. As is often the case during contests, the signal levels were generally very high, but the band was congested so there were plenty of overlapping QSOs.

As promised, I did return to WSJT-Z and found that the number of decoded messages matched WSJT-X on both the 7MHz and 21MHz test recordings.

Conclusion

My initial testing shows that MSHV and JTDX will produce more decoded messages than WSJT-X and WSJT-Z. However, the answer is not quite that simple. The decoding settings used for WSJT-X have been carefully selected over an extended period to provide the best sensitivity while minimising false decodes and working within computing power available to most radio amateurs. The WSJT-X team have also addressed the ethical principle of only using information received over the air to help form the decoded messages. This makes the WSJT-X software the best choice for all occasions with the safest decoding parameters.

Conversely, JTDX, as implied by the name, has been fine-tuned for HF DX operation and uses customised decoding parameters for maximum sensitivity. JTDX also uses a database of calls and locators that helps prevent false decodes. Some may think this breaks the principle of only using the received signal to decode the message. MSHV similarly extends the decoding sensitivity and includes some fully automated modes. JTDX would seem the best choice from these tests if best sensitivity is your goal but MSHV is a close second. This experiment has been a first look at comparing FT8 software performance. I'll be doing some more digging over the coming months. If you would like to replicate my tests, you will find the 7MHz and 21MHz test files available for download on my website. You can find them via this post:
https://tinyurl.com/yckzwhar

Network Performance Testing

Like many radio amateurs, my home network has evolved over the years and has become ever more critical to general household harmony. After exchanging pleasantries, visitors' next question is often *"what's your Wi-Fi password"!* Everything from TV to room temperature goes

JTDX	MSHV	WSJT-X
CQ EA5IGT IM99	CQ EA5IGT IM99	
CQ F5OIH JN06	CQ F5OIH JN06	CQ F5OIH JN06
CQ IW2MYH JN45	CQ IW2MYH JN45	CQ IW2MYH JN45
CQ M7CQA IO91	CQ M7CQA IO91	CQ M7CQA IO91
CQ MQ0FLF IO93	CQ MQ0FLF IO93	
CQ PD0SBH JO21	CQ PD0SBH JO21	CQ PD0SBH JO21
CQ S51TA JN75	CQ S51TA JN75	

Table 1: Single FT8 cycle showing the number of received CQ messages by each program.

through the network. Add amateur radio and a few Raspberry Pis into the mix, and the network becomes a pretty complex beast. This is further compounded by the addition Wi-Fi mesh networks. As a result, seemingly random problems occur, often ranging from video buffering to Raspberry Pis dropping off the network. Trying to troubleshoot suspected network bottlenecks can be a fraught process, but I recently found a tool that significantly simplifies the testing. That tool is iperf3, an open-source command-line tool that can measure the speed of individual links in a network. The small software tool is available for PC, macOS, Linux, iPhone/iPad and Android devices. It can be downloaded free of charge from:
https://iperf.fr

Versions for mobile devices are available from Google Play and Apple iStore. Although the application hasn't been updated since 2016, it still serves a useful function. To install on a Windows PCs, begin by downloading the zip file, then expand the two included files to a new folder on your C: drive. That's all you need to do! To start testing, you need to install iperf3 on computers at each end of the network section that you want to test. The test works by configuring one PC/device as a server and then sending data from other PCs/devices to that server. By installing iperf3 on multiple devices, you can quickly measure the available data rates on your network. PCs and devices can be connected by Wi-Fi or Ethernet, as long as they link back to the same router. Iperf3 will find its way through the network and report the results. Here's a step-by-step guide to measuring the path between two Windows computers:

On the first computer, open a Windows Terminal and navigate to the folder where you expanded iperf3

- Enter: ipconfig and note the IPv4 address; this is the PC's IP address
- Enter the following .\iperf3.exe -s
- This will start the iperf3 server, and you will see a message reporting that it's listening on port 5201
- Now move to the second PC, navigate to the iperf folder
- Enter the following command but using the IP address from step 2 above
- Enter: .\iperf3.exe -c 192.168.1.11

The test will start and report the network speed every second and finish with a summary.

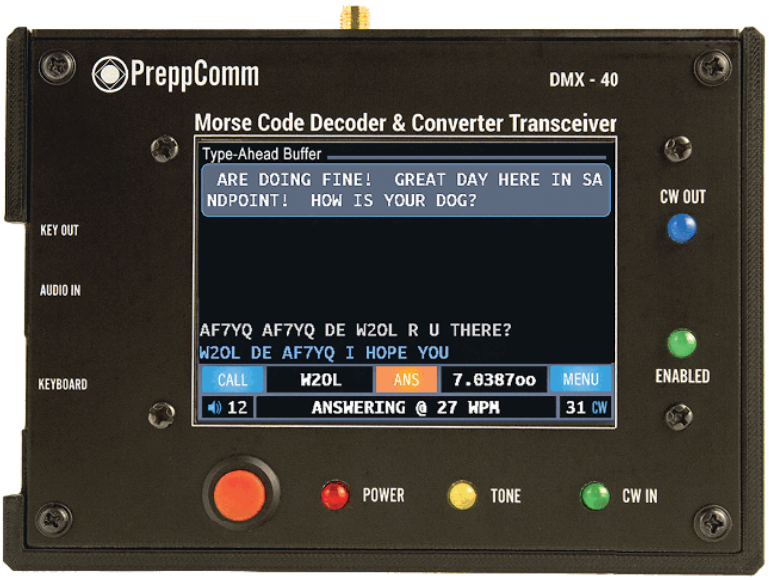
This test uses the standard TCP protocol for its speed measurement, but iperf3 can also be used to measure the UDP transfer rate. To start these tests we change the command on the remote PC as follows:

.\iperf3.exe -c 192.168.1.11 -u -b 1000m

The only change from the previous command is -u which converts the test to UDP packets and -b 1000m to set the maximum test bandwidth to 1000Mb/s. You should set the bandwidth high to send test data as fast as possible.

By using iperf3, you can quickly test your network performance and highlight any bottlenecks. **PW**

Roger J Cooke G3LDI
roger@g3ldi.co.uk



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The DMX-40

Roger G3LDI has more interesting keys to discuss but starts with news of a self-contained CW transceiver.

Mike G4GUG recently sent me some information on this device, **Fig. 1**. Essentially it is a self-contained transceiver with a built-in CW decoder and encoder, complete with its own keyboard. No computer is needed and it comes in a small box to enable portable operation.

It was designed by **Eric Anderson AF7YQ**. It is a single band device, covering 40m and runs about 4W output, so not too much power, but QRP portable operation is the challenge and there are plenty of people doing that with a wide variety of rigs, not all having an in-built CW receive/transmit capability!

This has been recently featured in the *RadCom* April edition should you wish to find out more.

Mike was dubious about sending the information to me, knowing my purist views! In fact, he said that "*I expect you were apoplectic when you saw this*". I must admit I was not too happy about it. However, I did promise him I would comment here about it.

My basic views have not changed, but I have grown somewhat tolerant about using decoders/encoders etc. A selling point of this device is that it actually helps the user to learn Morse. I would dispute that. It does enable him to 'use' Morse, get on the bands and have QSOs, despite the fact that all he is doing is typing his message with the keyboard and reading incoming messages on the screen. He might just as well have been using RTTY.

However, in my tolerant mode, at least it is possibly encouraging the user to actually get to grips with the mode, learn the code and learn how to use a key. Or, would it just be another *"Can't be bothered to do all that practice"* and enable him just to type away.

Nothing can replace sitting at the rig with a pair of headphones on, listening to conversations taking place, no keyboard, no screen, just a brain that has been trained. I will admit that the older one gets, the more difficult it is and the longer it takes, but perseverance and practice will pay off in the end. This is why I get bored with FT8, so detached and letting a computer work your DX for you. Great for those who wish to do it!

We are all entitled to our opinions and if it pleases you, then by all means carry on.

Learning Morse at the Other End of Life!

This reminded me of when I was learning Morse, but I wasn't licensed at the time. I just had great Elmers, **Pat G3IOR** and **Bill G3CQE**, to teach me Morse. Bill was also a BBC engineer so he mentored me in my RAE too. I was 16 when I got my licence.

Megan EI5LA, **Fig. 2**, is obviously very keen, has had a very permanent Elmer in her life as her Dad EI3KM encouraged her to learn CW and get her licence. She is now a member of CWops and can be heard in a lot of the midweek sessions. She has been trained well, enjoys ragchewing with friends and also taking part in contests and working DX. Megan represents what I would like to see in all youngsters these days, but it is so rare. Most seem to get on their mobile phones, DMR or repeaters and stay there. She must have some similar minded friends though if she ragchews with them on CW!

Megan did all this at 14 and she now sounds like a seasoned and competent operator. Mind you, I have always said that females do make very good Morse operators. We have a few in Norfolk. **Mui M0MUI** is the latest one and sets a very good standard.

Autronic Paddle.

I saw this recently on the FOC reflector and thought it worthy of a mention here for the key enthusiasts. I have never heard of an Autronic Paddle, **Fig. 3**, but I assume that is because they originated across the pond.

Ulis K3LU posted this: *"One of my favourite keys is the mid-century American made, and older than me, Autronic single lever key. After being shown the light 10 plus years ago of the greatness of single lever keys by our own then W3MC (now W0VTT) and K2WYE, I dropped my childhood BY1 and became a true believer in single lever accuracy, success and comfort!*

"Last week I purchased a second and in really nice condition Autronic from the SK [Silent Key] *estate of W9GE, who was a very friendly local op and contester that I knew, and very much respected. No doubt some of you here may have worked him and knew Bob. I was unaware it was his key until I had already paid for it. At that moment I was humbled and honoured that I had taken custody of one of his keys. Call me sentimental but I have always felt that radios, coax and antennas will come and go but our Morse keys are really the most venerated tools of our beloved hobby. Something that sadly most of the new non-Morse generation of radio amateurs will unlikely experience.*

"But I digress…. The reason I am writing about this key is it is unlike any Autronic I have seen before. It has two holes on the front of the base that appear to be perfectly symmetrical. My other Autronic doesn't have it and I've looked on the internet and see no other photos that look similar with these holes. The holes even appear to have in paint in them. I see no scarring on the base as if it was held in a vice. Also, the key had no rubber feet nor what would have been residue from the rubber.

"That leaves two questions. Was this some sort of factory modification or special run of this key? Or were the holes put there by someone; admittedly extremely well done?"

The other keys, **Fig. 4**, are from **Tom K3TW**. Tom thinks that the key owned by Ulis has been modified.

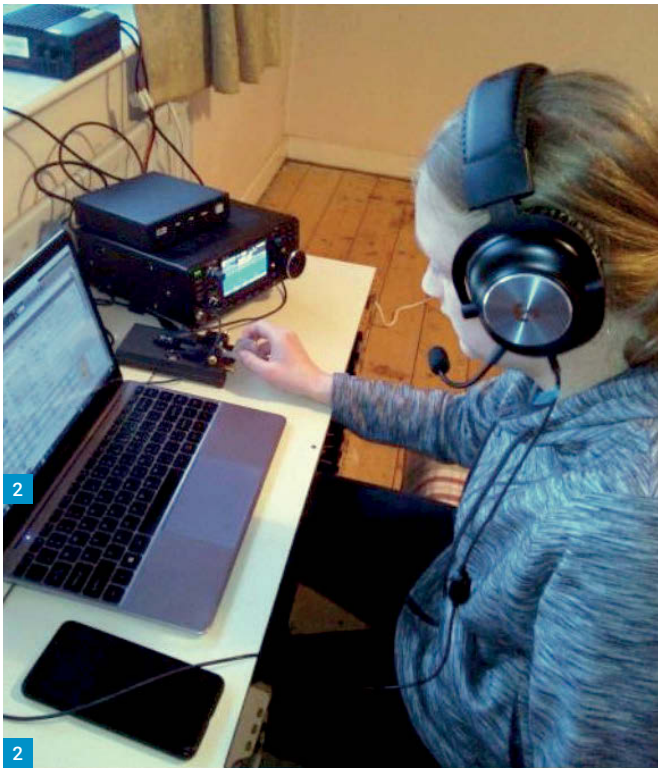

Fig. 1: The DMX-40. Fig. 2: Megan EI5LA> Fig. 3: K3LU's Autronic paddle. Fig. 4: K3TW's Autronic keys. Fig. 5: A Collins paddle. Fig. 6: A Collins keyer.

Collins Paddle.

My friend **Roy G3ZIG** is an avid fan of Collins gear and he has a lot! In his collection he sent me a picture of a Collins paddle, **Fig. 5**, and a Collins keyer, **Fig. 6**. I was unaware that Collins ever made a paddle! I guess my beady young envious eyes were too busy looking at that picture on the back cover of the *SSB Handbook*. If you are old enough, you will know what I am talking about. Never did get to own a Collins rig!

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

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.

Don Field G3XTT
practicalwireless@warnersgroup.co.uk

We start this time with the September 2002 issue of *PW*, which, understandably, celebrated *PW's* 70 years, with a suitably nostalgic front cover, **Fig. 1**, recreated from the October 1957 issue. Several of the articles looked back over the decades, including memories by **Gordon King G4VFV**, who had been writing for the magazine for 50 years, a short history of TW Electronics Ltd by the man himself, **Tom Withers G3HGE**, a look back over 70 years by the editorial team, reflections by **Ray Herbert G2KU** (who worked alongside **John Logie Baird**) on his 70 years' involvement with the radio and TV industry, a *Valve & Vintage* column by **Phil Cadman G4JCP** looking back at the *PW* Blueprints of old, and a *Carry on the Practical Way* article by **George Dobbs G3RJV** looking at using Acorn valves.

The two-page centre spread also featured covers and articles reflecting the previous 70 years. The cover price was £2.75. I was interested to see the price of equipment, with the Icom IC-765-ProII at £2495.95, the Yaesu FT-1000MkV at £2899.95 and the Yaesu VL-1000 linear amplifier at £3999. Add 59% to take account of inflation from then to now, and that Icom would be £3968, rather more than today's IC-7610, with the FT-1000MkV at £4611, again more expensive than today's FTdx101MP.

The change in the prices of hand-held VHF/UHF radios is even more marked, due largely I suspect to the competition from new Chinese entrants such as Wouxun. Incidentally, on the front cover it proclaimed, *"The UK's only independent amateur radio magazine"* so even then it appears to have been the sole survivor of the many such magazines that had existed over the years.

2012

Forward now to the August 2012 issue, the last of the eighth decade. The cover price had risen another pound to £3.75. The editor was, of course, still **Rob Mannion G3XFD**, whose editorial reflected on his loss of hearing, necessitating the use of a hearing aid, but of his determination to continue enjoying the hobby (which, indeed, he is still doing 10 years later).

Roger Cooke G3LDI reviewed the BLA350 linear amplifier, the first linear amplifier to be reviewed in the magazine for many years (and Roger also featured with his regular *Morse Mode* column, still going strong and here again this month). The late **John Heys G3BDQ** looked at fractal antennas, something he was very keen on.

Haydon Communications were still advertising regularly. To be honest, I thought they no longer existed but I see they, along with another regular advertiser Spectrum Communications, are now entirely an online store. Such is the way of the world although it does impact on the finances of magazines such as this one and we continue to be grateful to those advertisers who do still value a presence in the magazine world. **Tony Nailer G4CFY** (the man behind Spectrum Communications) was still writing for PW and his *Technical for the Terrified* column in that issue dealt with antennas for the beginner and the radio listener.

There is a fascinating article on the history of Bakelite (did you know there was a Bakelite museum in Somerset? Sadly, according to its website, it is currently seeking a new home.), featuring, among others, the Bush DAC90 which, as it happens, also gets a mention this month in **Bernard Nock G4BXD's** *Valved Radio Repair* column.

Mike Richards G4WNC's data modes column was going strong, with a feature on identifying data modes on a waterfall display. Did you know, incidentally, that the original WSJT was released as long ago as 2001, and as open source since 2005 (allowing other developers to use the code as part of their software)? Of course, FT8 and FT4, now probably the most popular modes in WSJT, were not introduced until 2017 and 209 respectively, so for many years WSJT was the province of specialist VHF operators.

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Fig. 1: Cover of the September 2002 issue.
Fig. 2: Looking back – the Duke of Edinburgh meets Tom Withers G3HGE of TW Electronics at the 1966 RSGB Show.

Tim Kirby G4VXE (now GW4VXE) was already in the VHF chair, while HF duties fell to **Carl Mason GW0VSW** who, I am pleased to note, still contributes from time to time to our HF column. And **Colin Redwood G6MXL's** *What Next* column was exhorting newcomers to give the 1296MHz band a try. **Harry Leeming G3LLL** was still going strong – we do miss his regular contributions. And Ben (Bernard) Nock G4BXD was in the *Valve & Vintage* chair for the month, looking at the museum's collection of Russian equipment and how it could be used on the 70MHz band.

Bargain Basement, Classified ads and Traders Table collectively occupied four pages of the magazine, whereas nowadays they are minimal, of course, the internet having become pretty much ubiquitous for such sales.

It's perhaps worth adding that, in addition to the magazine, PW was interacting with its readers in other ways too. Editor Rob Mannion was very much out and about speaking at radio clubs, while the team as a whole were to be found at events such as the London Amateur Radio Show, the NARSA rally in Blackpool and, of course, at Newark. **PW**

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CTCSS ENCODER AND DECODER KITS. DTMF kits and modules. Pic development kits. **https://cstech.co.uk**

DISCLAIMER Some of the products offered for sale in advertisements in this magazine may have been obtained from abroad or from unauthorised sources. Practical Wireless advises readers contemplating mail order to enquire whether the products are suitable for use in the UK and have full after-sales back-up available. The publishers of Practical Wireless wish to point out that it is the responsibility of readers to ascertain the legality or otherwise of items offered for sale by advertisers in this magazine.

Bargain Basement

Wanted

HELP WANTED. Heathkit Model GR-78 general coverage receiver (circa 1972) - alignment and clean. Needs electrical alignment and mechanical drives and pulley cleaned. I have original manual. I do not have equipment or detailed knowledge. Please help me. Willing to travel.
Brian g8nhn: 07792 859886
brian.x.house@gmail.com MANCHESTER

VINTAGE CABINET, chassis, tuning capacitor, scale and pointer suitable for building a valve TRF receiver (PW October 1956) as was available then from radio dealers.
Email: nickdewhurst@hotmail.co.uk

AOR ABF 128 Airband filter with BNC sockets
Tel: 07748 948685

HIGH IMPEDANCE PRESS TO TALK MICROPHONE with Amphenol plug for a hallicrafters Model SR-42A 2 Metre rig.
Andy 2E0NDZ
andrewhumphriss@tinyworld.co.uk

KEYPAD FOR FRG100.
Contact Allan: 01724 763404

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CRT XENON MOBILE CB. AM FM UK81. Cept. FCC. As new boxed £35.00
Tel: 07748 948685

RM KL203P 20 to 30 MHz amp. With quality fan. £40.00 boxed unused.
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ICOM IC-R8500 w matching SP-20 speaker and AD-55E psu. Original box, manual, 2x schematics, fused dc power lead. USB-serial 19-pin connector, ftdi chip. Owned since new. Excellent condition. Full set photos available. £775 or reasonable offer. Buyer collects or will deliver up to 3hrs from Clacton (+£50).
Noel 0747 952 0285 or pnoelw@yahoo.com

UNIDEN BEARCAT BCT15X Trunking scanner w matching ESP12 speaker. Both w mounting brackets. USB-front serial port connector, Prolific chip. Owned since new. Excellent condition. £140 ono +pnp.
Noel 0747 952 0285 or pnoelw@yahoo.com

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FUNCUBE DONGLE pro+ v2.0. Perfect working condition. £50 incl UK pnp.
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KENWOOD TS-570D HF Transceiver in good condition, wide banded, fully working. Complete with original box and manual. £390.00. Collection preferred but happy to post at cost.
Contact: i.sweet@blueyonder.co.uk

UNIDEN UBC3500XLT, 2500 channel memories. Excellent condition in original box with handbook - £100.00.
Email: Ann.Fletcher@paragonbank.co.uk or call: 07462 079361

LEGENDARY YUPITERU MVT7100 Multi Band receiver. Good condition, one owner - £100.00
Email: Ann.Fletcher@paragonbank.co.uk or call: 07462 079361

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SIGNAL Corp 537 airband,rx works on vco, Not sure if xtals fitted £40. Drake Model 2-BQ Q multiplier with connecting cables for Drake 2B/2C receiver. Good condition/order rare £100. Heathkit HR 1680 ham receiver spares or repair only £40
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or email: shadobi23@gmail.com SUSSEX

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Rallies & Events

Due to the ongoing Coronavirus (COVID-19) situation, the Rallies calendar remains changeable. All information published here reflects the situation up to and including 26th June 2022. Readers are advised to check with the organisers of any rally or event, before setting out for any visit. The Radio Enthusiast website will have regular rally updates, please check it regularly. To get your event on this list, e-mail full details as early as possible: **wiessala@hotmail.com**

9 July
HOUGHTON RADIO CLUB FREE RADIO RALLY: The Dubmire Royal British Legion Club, Britannia Terrace, Fencehouses DH4 6LJ. Doors are open from 10 am to 3 pm. Open to trade, clubs and private sellers/exhibitors but table space is limited. No charge for tables. Free entry. Donations welcome to the *Royal British Legion Club* (CF | LB11 am).
Amanda M6LXK
Tel: 07787 155 745.
westona84@gmail.com

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

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

31 July
WILTSHIRE RADIO RALLY & CAR BOOT SALE: (Chippenham and District Amateur Radio Club Rally 2022). Kington Langley Village Hall and Playing Field, Kington Langley, Wiltshire SN15 5NJ. 9 am to 3 pm. Admission free. Traders Welcome (CA | Covid-19 safe).
Brian, G6HUI
rally@chippenhamradio.club
Chairman@chippenhamradioclub
https://wiltshirespc.org/wp/g3vre/rally

7 August
BATC CONVENTION FOR AMATEUR TV 2022 (CAT 22) PART 1: Midland Air Museum, Rowley Rd, Coventry CV3 4FR. CAT 22 will be a meet-up, show and tell, test and fix-it, and Bring & Buy event, from 10 am to 4 pm. Full test facilities are available for 5.6GHz/Portsdown/ MiniTiouner/Ryde/power amplifiers/ preamps.
https://batc.org.uk/events

KING'S LYNN ARC 32ND GREAT EASTERN RADIO RALLY: Gaywood Community Centre, Gayton Road, King's Lynn, Norfolk. PE30 4EL. NGR TF638203. Open 9 am (trade from 7 am). Admission is £2.50. Outdoor pitch £8; indoor £10 per table (BB | CF | FP | TS).
rally.klarc@gmail.com
http://www.klarc.org.uk

12 August
COCKENZIE & PORT SETON ARC 27TH MINI-RALLY NIGHT:: Community Centre, Main Hall, Port Seton. 6 pm. Admission is £2. Tables on a first-come-first-served basis.
www.cpsarc.com

12-14 August
19TH INTERNATIONAL EME CONFERENCE (PRAGUE): Registrations open from 1 January 2022.
http://www.eme2020.cz

14 August
FLIGHT REFUELLING ARS HAMFEST: Cobham Sports and Social Club Ground, Merley, nr Wimborne, Dorset, BH21 3DA. Talk in will be on S22. The gates open from 10 am to 6 pm; entry will be £4, which includes car parking. No dogs are permitted, except guide dogs (landowner's condition) (L | TS | Indoor and Field Pitches).
Tony Baker, G3PFM : 07743 475018
tbaker@tiscali.co.uk
www.frars.co.uk

21 August
RED ROSE RALLY: Organised by West Manchester Radio Club. St Joseph's Hall, Leigh WN7 2PJ. Those requiring tables please contact Colin (BB | CR | FP | MS).
rally@wmrc.co.uk
www.wmrc.co.uk

21 August
RUGBY AMATEUR TRANSMITTING SOCIETY RADIO RALLY: Princethorpe College, Princethorpe, Rugby CV23 9PY. Open 10:00 (CBS).
Steve G8LYB: 07956 855816
rally@rugbyats.co.uk
www.rugbyats.co.uk

28 August
MILTON KEYNES ARS RALLY: The Irish Centre, Manor Fields, Watling Street, Bletchley, MK2 2HX (Opposite *Dobbies* Garden Centre), which has excellent modern facilities (FP | CF | D). The entrance fee is £3.00. Open to the public from 9:00 am. Outdoor pitches and indoor tables are available.
Brendan (G8IXK), Vice Chairman
rally@mkars.org.uk
www.mkars.org.uk

TORBAY ANNUAL COMMUNICATIONS FAIR: Newton Abbot Racecourse Devon TQ12 3AF. Doors open at 10 am, with disabled visitors gaining access at 9.30 am. Indoor event (FP | BB | RSGB CF).
Pete G4VTO: 01803 864 528
Mike G1TUU: 01803 557 941.
rally@tars.org.uk

29 August
HUNTINGDONSHIRE ARS (HARS) ANNUAL RALLY : Ernulf Academy, St Neots PE19 2SH. Gates open for Traders at 7 am and the public at 9 am. Indoor and outdoor stalls are available. Talk-in is on 145.550 MHz on GX0HSR (BB | CR | FP).
Malcolm M0OLG: 01480 214282.
events@hunts-hams.co.uk
www.hunts-hams.co.uk

4 September
TELFORD HAMFEST: Harper Adams University (HAU). TF10 8NB.
Martyn G3UKV: 01952 255416
http://www.telfordhamfest.org.uk

9-11 September
67TH WEINHEIM VHF CONFERENCE: The traditional Weinheim VHF Conference has been organized by committed radio amateurs (on a non-profit and voluntary basis) since 1956. It sees itself in its tradition as a meeting place for everyone interested in radio and electronics. amateurs from all over Europe present their experiences at this forum, provide information on innovative developments and share their know-how .
https://tinyurl.com/2httjbt9

11 September
CAISTER LIFEBOAT RADIO RALLY: Caister Lifeboat Station, Caister on Sea, NR30 5DJ. The entrance is via the car park on Beach Road and admission is free for the public. Doors are open from 9 am to 2 pm (8 am for sellers). Inside tables £10 each, outside £5 each. Raffle, onsite cafe, gift shop, museum.
Zane M1BFI: 07711 214790.
m1bfi@outlook.com

RIPON RADIO RALLY: Hugh Ripley Hall, Ripon, North Yorks, HG4 2PT, 100 m west of High Skellgate traffic lights B6265. Traders from 7 am to 9.30; tables £10 each. Doors are open at 10 am. £3 per person. The Bring-and-Buy is upstairs: if you can't carry it, don't bring it! Donation £1 per item to a local charity, sold or not.
https://www.g4sjm.co.uk/contact-us

17 September
ANGEL OF THE NORTH RADIO RALLY: Whitehall Road Methodist Church Hall, Bensham, Gateshead NE8 4LH. Doors are open from 10.30 am till 3 pm. The entrance charge is £3; for those under 16, it is £1. Tea or Coffee and bacon butties £3.50. Car parking is at Caedmon School, next door on Whitehall Road. The cost per 6ft table is £10 (BB | FP).
Nancy Bone: 07990 760 920
nancybone2001@yahoo.co.uk
Amanda Weston: 07787 155 745
westona84@gmail.com

25 September
WESTON SUPER MARE RS 7TH RADIO & ELECTRONICS RALLY: The Campus Community Centre BS24 7DX.
https://tinyurl.com/2p986v6t

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

Your Letters

Send your letters to: Practical Wireless Letters, Warners Group Publications plc West Street, Bourne, Lincs PE10 9PH
E-mail: practicalwireless@warnersgroup.co.uk

CTCSS Encoder

Dear Don,

The CTCSS encoder was a great article in the June PW. After receiving the HEX file I built one with no problems and loaded the software as per the article (have used PIC chips for many years so it was a variation on that).

My thanks to **Andrew Woodfield ZL2PD** for the work that went into this design. I have made a small double-sided PCB (SOIC and SMD parts) for it and will put it in my 70s and 80s Yaesu radios.

I have in my collection every mobile and handheld Yaesu radio from the FT2FB and FT202 onwards through the 80s all restored and working, I just needed a CTCSS board to bring them into the 2000s.

I realised when testing it that many PW readers many not understand that the DIP switches A through F need to be in binary sequence, tone 1 = 0, tone 2 = 1 (1, 2 ,4, 8, 16, 32) etc. I made the attached table of DIP switch positions to tone number and frequency for myself to ease setting the correct tone. You are welcome to use it, publish it or distribute it (see **Table**, **ed**.).

Thanks and 73 to both of you (Don and Andrew).

Kevin Jackson AA3XV/G4NEJ
Orlando, Florida

Tone Selection Setting for ZL2PD CTCSS Encoder : June 2022 Practical Wireless

DIP Switches						Tone	Tone
A	B	C	D	E	F	(Hz)	Number
0	0	0	0	0	0	67.0	1
1	0	0	0	0	0	69.3	2
0	1	0	0	0	0	71.9	3
1	1	0	0	0	0	74.4	4
0	0	1	0	0	0	77.0	5
1	0	1	0	0	0	79.7	6
0	1	1	0	0	0	82.5	7
1	1	1	0	0	0	85.4	8
0	0	0	1	0	0	88.5	9
1	0	0	1	0	0	91.5	10
0	1	0	1	0	0	94.8	11
1	1	0	1	0	0	97.4	12
0	0	1	1	0	0	100.0	13
1	0	1	1	0	0	103.5	14
0	1	1	1	0	0	107.2	15
1	1	1	1	0	0	110.9	16
0	0	0	0	1	0	114.8	17
1	0	0	0	1	0	118.8	18
0	1	0	0	1	0	123.0	19
1	1	0	0	1	0	127.3	20
0	0	1	0	1	0	131.8	21
1	0	1	0	1	0	136.5	22
0	1	1	0	1	0	141.3	23
1	1	1	0	1	0	146.2	24
0	0	0	1	1	0	151.4	25
1	0	0	1	1	0	156.7	26
0	1	0	1	1	0	159.8	27
1	1	0	1	1	0	162.2	28
0	0	1	1	1	0	165.5	29
1	0	1	1	1	0	167.9	30
0	1	1	1	1	0	171.3	31
1	1	1	1	1	0	173.8	32
0	0	0	0	0	1	177.3	33
1	0	0	0	0	1	179.9	34
0	1	0	0	0	1	183.5	35
1	1	0	0	0	1	186.2	36
0	0	1	0	0	1	189.9	37
1	0	1	0	0	1	192.8	38
0	1	1	0	0	1	196.6	39
1	1	1	0	0	1	199.5	40
0	0	0	1	0	1	203.5	41
1	0	0	1	0	1	206.5	42
0	1	0	1	0	1	210.7	43
1	1	0	1	0	1	218.1	44
0	0	1	1	0	1	225.7	45
1	0	1	1	0	1	229.1	46
0	1	1	1	0	1	233.6	47
1	1	1	1	0	1	241.8	48
0	0	0	0	1	1	250.3	49
1	0	0	0	1	1	254.1	50

Where there is a '1' in the table the DIP switch should be in the On position = Tones not in the TIA-603 Standard

Ordering after Brexit

Dear Don,

Following on from my previous observation about Brexit, my (pooled-production) PCBs came from Germany today and there was no administrative delay nor any further duty to pay. There is no fundamental barrier to trade, as far as I can see.

Godfrey Manning G4GLM
Edgware

Cartoons/CQ Inductees,etc

Dear Don,

Ian Dilworth G3WRT's EM Modelling piece (July 2022) brought forth an interesting concept. Putting to one side the main thrust of his antenna simulation comments, his idea that such modelling techniques might be a 'game changer in the near future' at HF has

probably got legs. However, as Ian points out, there is the seeming restriction of 'physics and practicality'. But luckily, there is no limit to our collective imagination or our collective experimental tinkering.

Besides, who would have thought many decades ago that one day we could sit in front of a screen and design/model an antenna and not only that, see your creation performing right there and then. Such a happening would be in the realm of science fiction. That's no longer the case. Again, as Ian points out, there is the expensive kind of simulation software if you have deep pockets.

But cheaper software solutions are available. However, these will incur consequential limitations. And yes, we need to exploit '3D antenna designs'. So maybe some of us should spend more time (with the appropriate software) letting our imagination let rip experimenting with 'space diversity designs', and less time spinning the dial on our rigs? And although we can now have an HF contact via the internet and via a handie, maybe one day exclusive HF operation via microwave links will be the order of the day? Well, we wouldn't need towers and beams etc, then. Or wire dipoles. Or G5RVs.

Yes, the future of antenna technology courtesy of modelling techniques does look rosy. And maybe the advent of multipath terrestrial radio propagation will filter down into the amateur radio lexicon, sometime when.

Clearly though, there is a lot more homework that needs to be done on the ins and outs of our current understanding of electromagnetic radiation, the arrow of communications.

Finally, there is one thing I personally miss in PW. Cartoons! A few years back, G3COI's irreverent cartoons adorned the pages of Practical Wireless on a regular basis. Sadly, G3COI is now a SK. I've included a photo of one of them here.

Ray Howes G4OWY/G6AUW
Weymouth

Next Month

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

THE FACE BEHIND THE CALL: Meet Mike Isherwood G4VSS, an amateur who plays with almost every aspect of the hobby and shares his passion with the whole family.
VALVE & VINTAGE: Michael Jones GW7BBY gets to grips with the PCR receiver, reputedly based on the receive section of the classic Wireless Set No. 19.
THE 2022 PW 70MHz CONTEST: Colin Redwood G6MXL has the rules and advice on taking part.
SOLDERING JIG: Godfrey Manning G4GLM simplifies the fiddly problem of soldering wires together.
PW AT 90: We round up the nine decades of PW's success.

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Simply Touch the displayed Channel Bar to Quickly Start Communications

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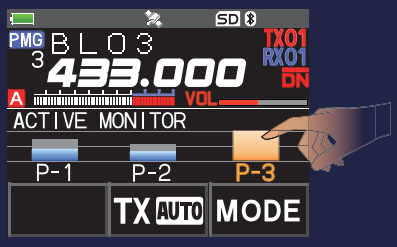
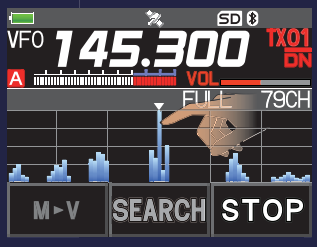
PMG (Primary Memory Group) Activity Monitor

- Register the current display frequency into PMG with one press of the "PMG" key.
- Simply press the "PMG" key to instantly display the receive status of the registered frequencies in a Bar Graph (Activity Monitor).
- Touch & Go Operation allows quickly starting communication by touching the displayed target channel bar.



79 channel Band Scope

- Displays a bar graph of up to 79 channels, in high-speed real time, centered on the current VFO frequency.
- Select the number of channels from 79ch/39ch/19ch by touching the displayed channel number.
- Touch & Go Operation allows immediately moving to the frequency and starting communication by touching a displayed channel bar.



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