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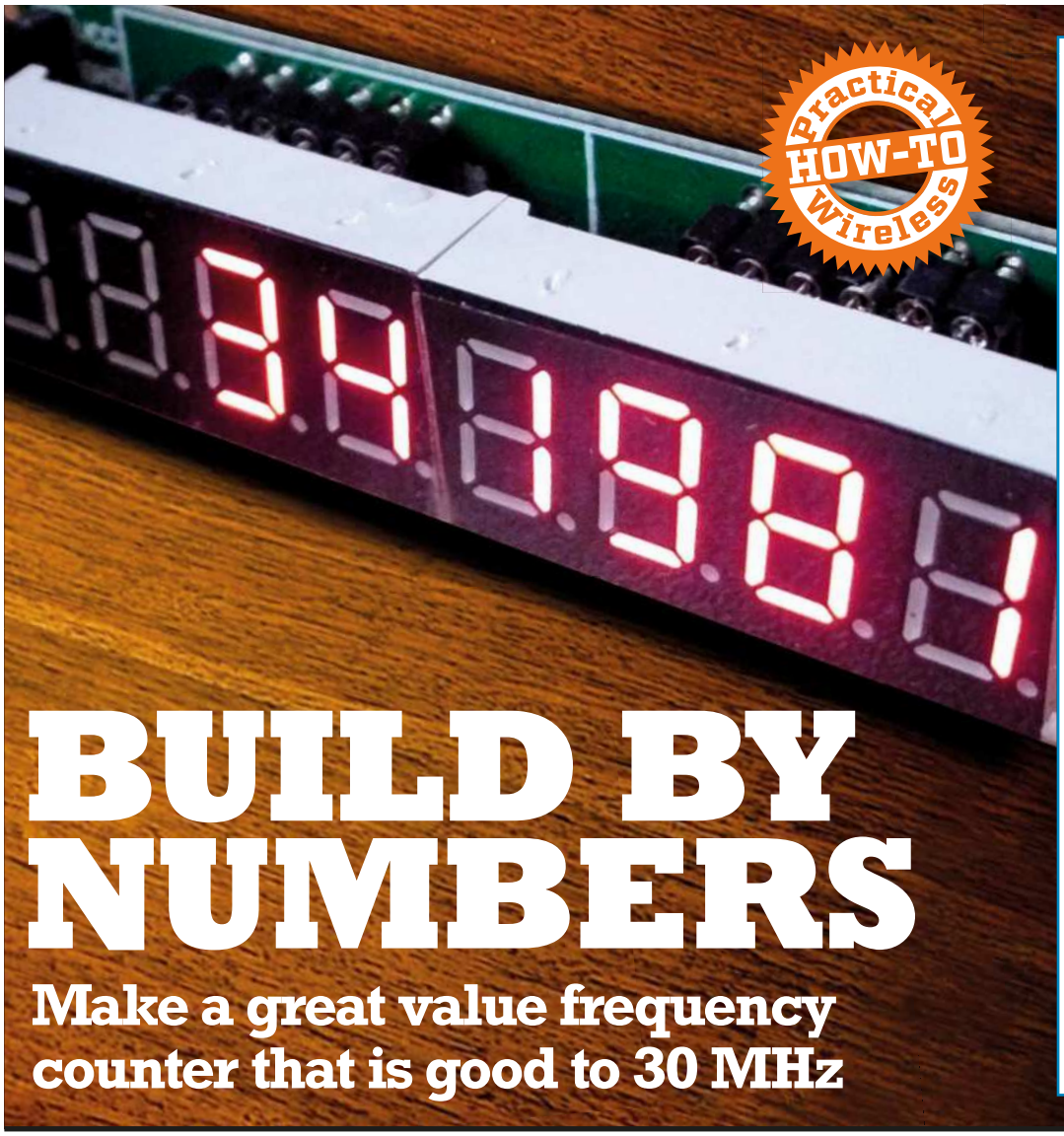
PRACTICAL WIRELESS

FEBRUARY 2021 THE UK'S NUMBER ONE AMATEUR RADIO MAGAZINE SINC

GET SET FOR 2021 | **News of the latest gear and radio clubs inside**

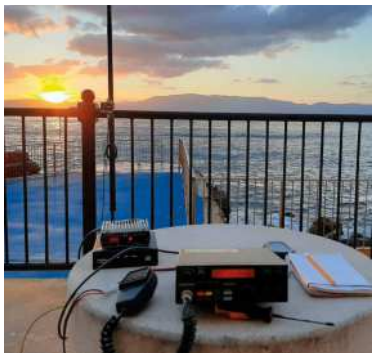


BUILD BY NUMBERS

Make a great value frequency counter that is good to 30 MHz

Happy Memories

Harry Leeming looks back in his final PW column



HF Highlights

A column packed with FT8, propagation & more

TIPS **Low Noise Antenna Options for Small Gardens**

Expert advice on choosing receive-only antennas where your space is limited

RESULTS **70MHz 12th Annual Contest**

All the winners of our popular competition revealed inside

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Get Started!

Part seven of our 'how-to' series

Readers' letters

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Peter Waters G3OJV

ELECRAFT

Mic & paddle key are optional extras

2 Year Warranty

KX2 Portable HF Transceiver

Elecraft's KX2 'stealth' transceiver can go wherever your imagination takes you! A rear tilt-foot angles the KX2 for use on any surface, from desktop to park bench to rock.

- 12W Out 80m-10m
- Fits into a coat pocket
- Built-in microphone
- Variable selectivity
- CW audio filter
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- Very low current drain
- PSK31 and RTTY send
- Backlight can be turned off
- Internal ATU option
- 2 Channel SSB Recorder

£959.95

Mic & paddle key are optional extras

2 Year Warranty

KX3 160-6m, 15W

It out-performs any similar transceiver & almost all of the base stations. Run at 100mW or increase to any power up to 15W (a bit less above 20m)

- All modes
- 3.4"H x 7.4"W x 1.7"D
- 18 oz (less options)
- Rear tilt feet fold up for transport
- Custom high-contrast LCD
- Current drain as low as 150 mA in receive mode

Built: **£1349.95**
Kit: **£1299.95**

PX3 Panoramic KX3 Display A great companion for the KX3

Built: **£829.95** Kit: **£789.95**

KXPA100 100W Power Amplifier

For KX2, KX3, FT-817/8 and IC-705

It has a switched input selectivity for 5W or 10W drive. That enables you to turn your QRP portable station into a 100W base station. Works with any QRP radio. Just needs RF input and PTT input. Band-switching is RF sensed.

Optional Internal Auto Tuner Built: **£1249.95** Kit: **£1199.95**

Tecsun PL-990x High Performance SSB Shortwave Radio

- Covers: LW, MW, FM, SW (1.711-29.999)MHz
- MP3 player via SD port
- Memories: 3150
- Local, Medium, DX input selector
- Bluetooth connectivity
- Optional USB mains supply.....£9.95

£259.95

Tecsun PL-680 Portable world band receiver with SSB and full frequency coverage including VHF Airband.

- FM, MW, SW, LW, Civil Air band 118 - 137MHz
- Dual conversion
- SW Single Side Band (SSB) with BFO control
- 1900 station memories
- Multi-tuning methods
- Built-in charging system

£149.95

Tecsun PL-880 This new Flagship SSB portable radio uses multi-conversion and DSP decoding technology

- FM, MW, SW, LW
- 3050 station memories
- Low / Mid / High sensitivity switch
- Alarm clock with snooze function
- Treble / Bass Tone selection
- Built-in charging system

£189.95

AN-200 Loop Antenna

Operates in MW, we found that it could just manage the 160m Ham radio band. This receive only antenna requires no power and can be coupled to MW portable receivers just by placing it close to the radio and peaking the tune control. If your radio has an external antenna input, then it can be directly connected with the supplied cable. Greatly improves reception, is directional and reduces noise.

£39.95

See our Demo YouTube Video!

ICOM IC-705 160m - 70cm 10W

£1299.95

It's the latest radio from Icom. It is at home as a base station, mobile, or portable radio. This all-mode radio has many great features. The menu system is very similar to that of the IC-7300, easy to reach and easy to adjust. The full colour touch screen is bright and clear. Receiver current is low at around 250mA. The supplied battery is 1.8Ah and is charged by the external 12V supply. You can also charge from USB and the same socket will power the radio on receive only. You get a keypad microphone and D-Star capability. CW is full break in and both TX and RX have EQ controls. The front facing speaker delivers good punchy audio or plug in the second mic connecor for true speaker mic operation. Of course you have up to 1MHz of spectrum display and large metering display option. If you need an ATU we suggest the Elecraft T1-A. And for a great pocket AC supply, check out the KX-33. Wideband RX includes Airband and FM broadcast. Check out our video links on our website.

KX-33 Pocket QRP AC Supply

The KX-33 is a 4 Amp very low noise supply with auto 230/115V switching. Ready terminated for Elecraft LX2 or KX3. Adaptor leads for other radios below.

£69.95

33-120.....Adaptor for FT-817/FT-818 .....**£12.95**
33-140.....Adaptor for IC-705 .....**£12.95**

mAT-705
Auto tuner for IC-705

- Freq: 1.8 - 54MHz
- Power: 9V battery

£229.95

Pro-Audio 33-140

Power adaptor for IC-705

£12.95

Icom MBF-705

Desk top holder for IC-705

£19.95

Icom LC-192
Rucksack for the IC-705. Radio can be operated whilst in place

£169.00

BP-307
7.2v 3350mAh Li-Ion battery fits IC-705

£89.95

RC-105
Antenna bracket
Easy direct mount for portable verticals

£34.95

Icom AL-705
Magnetic loop antenna
- Covers (40 - 10)m
- Diameter 67cms

£359.95

Vibroplex EF-80-10-JR-KW

- 1kW power rated
- No external tuner required
- Covers: 80/40/30/20/17/15/12/10m
- Only 75ft long

£169.95

Our NEW TV Channel!

Hosted by **Peter, G3OJV**, this very popular channel has videos on products, Antenna design and installation. Topical comments and views and plenty of information for beginners as well as hints and tips.

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FREE Headset worth £116

IC-7300

A superb Heil PMD-IC worth £116 is yours for FREE when you buy the IC-7300

The IC-7300 has quickly become a piece of ham radio history. A marker by which the competition is judged. The fastest selling radio of 2017 and still going strong, replacing all those old radios that many hams gave clung to for years. It's a great performer and great value. 160m - 4m. 100W Max. **£1195.95**

IC-7610

The new IC-7610 transceiver is now a reality. Few can fail to be impressed with the advanced technical promises. And nobody should be disappointed once their new radio arrives. We have good orders in for this radio and so will be happy to bring your dreams to reality. And if you need any additional items to go with your new radio then we are sure that we can delight you. 160m - 6m. 100W **£2999.95**

IC-9700

The IC-9700 brings together the three popular VHF bands and puts them into one very high tech. box. The large screen, packed with information, will be a welcome addition and copies their HF range in presentation and flexibility. Top of the feature list is SDR employed on both 2m and 70cms, with all the benefits that go with this. And there is no extra charge for the 23cms down converter which will be the icing on the cake for many. The recent trade demonstration showed us just what a great radio this is. Call us today for a quote. **£1795.95**

Icom IC-7100

HF-70cm (inc 4m)

It's a great all-mode, all-band, transceiver and one of the few that covers 4m as well. The detached head (which also contains the speaker) makes it and ideal radio that fits in the domestic scene. It allows you to place the main radio out of site next to your 12V power supply. Great price as well **£1099.95**

Icom IC-R30 All-mode Scanner

Some scanners have complicated menu systems that make operation difficult. The IC-R30 is different. Its user friendly. Its ICOM!

- 100kHz - 999MHz
- Big, clear display
- GPS and Band Scope
- 2000 'Name' memories
- AM, FM, SSB Digital
- 8 hours + battery life
- RF Gain and Attenuator
- Tone Squelch

£569.95

Yaesu FT-DX10 Transceiver 160m - 4m

New!

Great PX Deals
Call Today for a Deal

£1549.95

100W all modes
- Colour touch screen
- SDR Hybrid
- Remote ready
- External screen ready

It's the exciting transceiver from Yaesu based on the FT-DX101 but with single receiver. Dual superhet front end and SDR back end. It promises to be a leader in its class. Full details on web site with links to our Great Videos!

Top Station Accessories

CX-SW2PL
2-Way Antenna coax switch
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Analogue PSU
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Dipole Centre Balun
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Superb!
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Diamond SX-200
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PS-30M
Analogue PSU
Fully variable and very low noise, 30 amps
£99.95

AV-20
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- 30/150W
- Cross Needle

£49.95

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FT-3DE Digital Handheld

The Yaesu 3D is one of our top sellers. The touch screen makes it so much easier to get up and program. Its a smart phone performance for ham radio!
High resolution screen with bandscope display. Digital and analogue operation on 2m & 70cms. Features wide band receive and has GPS reception. A great travel radio. **£399.95**

FT-991A HF - 70cms 100W max

This is a real top seller. It's the one radio that you can put on the desk and enjoy HF and VHF. Includes ATU.
.....£1239.95

Yaesu FT-dx101D

Now top of the Sherwood list for SDR HF Technology. When you buy from us you get a 3-Year Yaesu UK warranty. Full SDR technology with a selectable superhet front end to provide optimum dynamic range and front end selectivity. Full colour touch screen offers variable bandwidth up to 1MHz, clever screen presentation options and a rear panel HDMI output for an external display.
£3149.95

Yaesu FT-dx3000

- All Modes 160m-6m
- 100W Power Output
- Wide Receive 30kHz-56MHz
- RTTY PSK31 Decode Encode
- Auto ATU
- USB PC Connection
- TFT Colour Screen **£1299.95**

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Professional Scanning & Monitoring from AOR

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Multimode digital demodulation receiver featuring wideband reception, D-STAR, Yaesu Fusion, DMR and much more.
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AR-5700D

- 9kHz - 3.7GHz
- Multi-Mode
- Digital
- Video Out
- I/Q Out

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Professional communications receiver that offers a level of versatility and capability, beyond that of any similar receiver. See our website for full spec!
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£939.95

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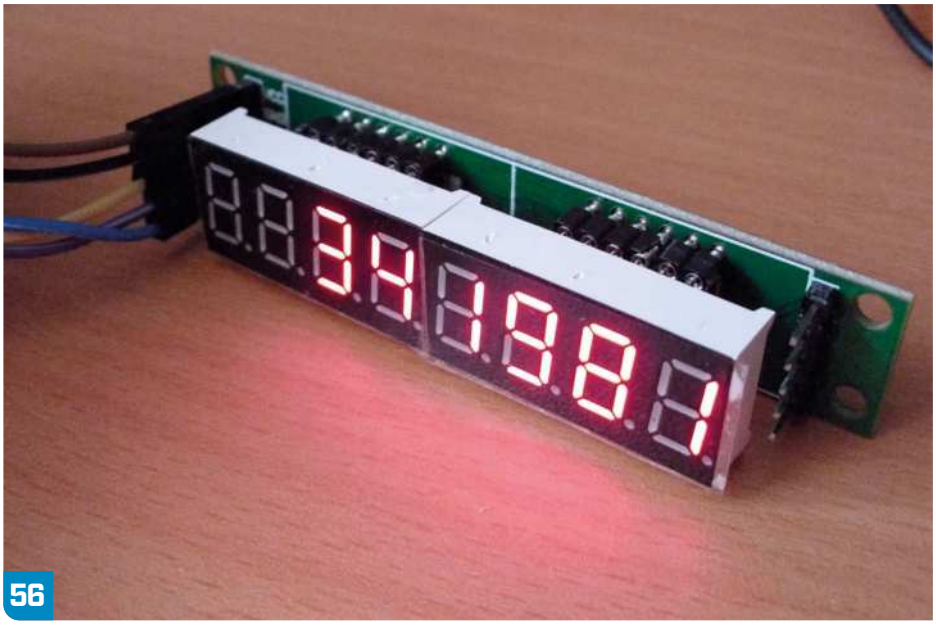

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Keylines

I have been rather absent from the airwaves since putting last month's issue to bed but it seems that quite a lot has been happening on the VHF bands (see **Tim Kirby's** VHF column), while the LF bands (160 and 80m in particular) have been in remarkable shape, with long-distance signals coming in well before dusk and well after dawn, something that seems to happen regularly in December. But even the 10 and 12m bands have been showing signs of life, albeit not during the ARRL 10m Contest. Let's hope 2021 brings a steady upturn in HF propagation as the sunspots return – if you've never experienced 10m at sunspot maximum, you have a treat in store!

Spending on Your Station

I never cease to be surprised at the folk who will spend a considerable sum on a high-end transceiver but use, say, a G5RV antenna and no linear amplifier. Is their money wisely spent? Of course, they may well have antenna limitations – not everyone can put up a 60ft tower with rotatory beams, even for the VHF/UHF bands. And maybe there is little interest in increasing the power, on the basis that if you can't hear them, you can't work them – after all, one of the biggest inhibitors to DX chasing nowadays is the level of local noise at many locations.

But the simple fact is that, nowadays, even entry-level radios have very acceptable performance – something that certainly couldn't be said of the first generation of solid-state rigs (the best thing that happened to my FT-101 Mk1 many years ago was when its front-end transistor blew and it no longer overloaded at the drop of a hat).

Tristan da Cunha

There are very few DXpeditions at the moment, which is a shame because we are all stuck at home with nothing to do but chase them! Yes, a Russian group did travel to Malawi but then a couple of them caught Covid and had to stay on and isolate, which doesn't bode well for other would-be DXpeditioners right now.

Anyway, by way of consolation, we have a great article this month by **Steve Taylor G4EDG** about a trip he made not so long ago to what must be the most isolated but populated island in the world, Tristan da Cunha. I hope you enjoy it.

70MHz Contest Results

We also carry the results of last *September's* PW 70MHz Contest. It's good to see participation up again, possibly because it was great to be out and about after the first lockdown. Of course, the 70MHz band has benefited greatly in recent years for being incorporated into more mainstream transceivers (or, at least, in the versions sold in Europe), reflecting the availability of the band in many more countries. This year has seen activity on the band from the Middle East, too, something I was able to reflect in my new book, *The Magic Bands*.

My thanks, as always, to our indefatigable contest organiser and adjudicator, **Colin Redwood G6MXL**.

Back Issues

Digital readers and subscribers to *PW* now have the opportunity to complete their collection of back issues at a highly discounted price. If you have previously purchased a digital issue, are a current subscriber or if you have previously subscribed via Pocketmags.com, you'll be alerted to a special offer the next time you log into your account, enabling you to complete your magazine collection and giving you access to all the digital back issues of your chosen magazine at the click of a button.

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Don Field
Editor, *Practical Wireless Magazine*

Newsdesk

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

More from ML&S

MyDEL FT817/8 Feet + Fold Away Stand: An easy to fit neat fold away stand with four rubber feet specifically designed for the Yaesu FT-817 & FT-818. Replaces the original strap panels and neatly folds underneath the body of the transceiver when not in use. Available from ML&S at £49.95:
www.HamRadio.co.uk/FT818FEET

TX Factor Episode 27

The TX Factor team is pleased to announce the release of Episode 27 of the only professionally produced TV show dedicated to amateur radio. In this latest episode the RSGB's General Manager **Steve Thomas M1ACB** explains how the Society's positive response to the spring and summer lockdown helped to boost awareness of amateur radio in the UK. Steve stresses the importance of the ongoing work needed to maintain the impetus.

Bob G0FGX and **Mike G1IAR** get to grips with using an RF Shark openSPOT Hostspot for some mobile DMR action.

It's said that moving house can be one of life's most stressful experiences, and that is especially true for the radio amateur keen to get their station back on air after moving. *Practical Wireless* Editor **Don Field G3XTT** recently moved to Somerset, and in this episode Bob pays a visit to Don at his new QTH near Wells to see how Don created some simple antennas to swiftly resume his on-air activities.

All this and our free-to-enter draw is back! TX Factor episode 27 is proudly sponsored by the Radio Society of Great Britain.

Episode 27 is viewable in stunning HD on all devices from smartphones to smart TVs and is available on the website below, where you will also find all the previous episodes. You can also search for TX Factor on YouTube.
www.txfactor.co.uk

New from Nevada

Nevada Radio have introduced a new 2m high power bandpass filter from DUAL in Serbia.

Designed by **Goran YU1CF**, the filter uses high *Q* coils and capacitors, with N-type connectors, to achieve low insertion loss of less than 0.1dB. The filter handles 1.5kW of power and covers 144 to 148MHz.

The BPF2 is ideal for reducing out of band interference from other close by services and for harmonic suppression on transmit. Rejection of out-of-band signals starts from –31dB rising to –90 dB depending on frequency. The filter sells for £225 and is available from Nevada.

Nevada have also announced the release of a new portable antenna system from Comet Japan covering 1.8 to 50MHz. The Comet HFJ-350M (Toy Box version) comes complete with a plastic carrying case for convenient transport.

The antenna is in four parts with quick and easy assembly for when out portable. The complete assembled antenna is 1.6m long, in a quarter-wave base-loaded configuration, and will handle up to 100W of RF power. There is also an optional canvas carry pouch for more rugged outdoor use.

The complete system sells for £149.95 and available for Comet exclusive UK importers Nevada Radio.
www.nevadaradio.co.uk

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

MBF-705 Desktop Holder for the IC-705

The Icom MBF-705 is a neat desktop holder for the new IC-705 QRP SDR transceiver. The MBF-705 will position the IC-705 in a user-friendly angled position making operation easier while keeping the radio and desktop neat and tidy.

It provides another excellent addition to this radio and was due to be available from amateur radio stores from December.

The MBF-705 has a suggested retail price of £19.99 inc. VAT.

NEW BARTG CONTEST: BARTG are introducing a new contest for 2021. This is a Sprint event using PSK63. This new contest replaces the September Sprint75 event. Full details and the rules are available at:
http://bartg.org.uk/wp/bartg-sprint-psk63-contest

G PREFIX CALLSIGNS, NEW FULL EXAM PASS: Ofcom allows those who pass the amateur radio Full exam to select a callsign from the old G and M call blocks, including G3, G4, G5 and M5.

In recent weeks a number of those passing their online remote invigilation Full exam have chosen to take the opportunity to get one of these callsigns. It requires paying a fee of £20 but enables amateurs to get a call suffix with letters that are meaningful to them.

G or M + 3 letter calls for a Full licence can be obtained from Ofcom by filling in a paper application form and giving your three preferred choices of callsign. Download OfW346:
https://tinyurl.com/y9fhfx8o

YASME Foundation Excellence Awards

The Yasme Excellence Award is presented to individuals and groups who, through their own service, creativity, effort and dedication, have made a significant contribution to amateur radio. The contribution may be in recognition of technical, operating or organisational achievement, as all three are necessary for amateur radio to grow and prosper. The Yasme Excellence Award is in the form of a cash grant and an individually-engraved crystal globe.

The Board of Directors of The Yasme Foundation is pleased to announce the latest recipients of the Yasme Excellence Award:

Brett Ruiz PJ2BR and **Helena Ruiz PJ2ZZ**: Brett and Helena have been active leaders of VERONA for more than 20 years, including technical activities, disaster preparedness and relief, as well as training potential licensees. They act as liaisons to government and international organisations, as well as contributing to important events such as GAREC and IARU assemblies and meetings. Brett is also active in pursuing long-distance VHF propagation and digital communications.

Bob Wilson N6TV: Yasme recognises Bob's technical support to literally hundreds of hams through various radio manufacturers' user groups, to logging software communities, and the detailed assistance he provides to Reverse Beacon Network hosts, keeping their equipment configured and running. Bob also provides invaluable support to travelling hams worldwide when they most need help. Along with being technically talented, he is exceptionally selfless in using that talent to help others, quick to encourage others in many areas.

Jari Perkiömäki OH6BG: Jari has supported the online VOACAP software and website, **www.voacap.com**, for almost 20 years, without compensation, making world-class HF propagation prediction and modelling services available to any radio amateur. He believes in teamwork, acknowledging the contributions and ideas from all of the ham community for further development of the service, but especially from **James Watson M0DNS/HZ1JW** and **Juho Juopperi OH8GLV**. He estimates that today VOACAP Online serves thousands of users, with visits from more than 100 countries every month, including integration with the DX Summit and Club Log services. He is part of the Radio Arcala, OH8X team and acts as a propagation specialist, assisting the WRTC community, RSGB and others.

Jim Brown K9YC: Amateurs worldwide have benefited from Jim's extensive contributions to amateur radio regarding ferrite materials and their use in combatting RF interference, feedline applications, and transformers. His efforts to improve transmitter performance and operating practices are also greatly appreciated, as are the extensive set of personal publications available to the public and performing reviews of technical material for amateur radio publishers.

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UKAS MANAGEMENT SYSTEMS 015

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Rigol DS1000Z Oscilloscopes

DS1054Z	50MHz	4 Ch
DS1074Z/-S Plus	70MHz	4 Ch
DS1104Z/-S Plus	100MHz	4 Ch
DS1202Z-E	200MHz	2 Ch

From: £272 +VAT

Siglent SDS1000X-E Oscilloscopes

SDS1104X-E	100MHz	4 Ch
SDS1202X-E	200MHz	2 Ch
SDS1204X-E	200MHz	4 Ch

From: £300 +VAT

Micsig STO1000C Plus Oscilloscopes

STO1102C	100MHz	2 Ch
STO1104C	100MHz	4 Ch
STO1152C	200MHz	2 Ch

Battery powered

From: £379 +VAT

Siglent SDS2000X Plus Oscilloscopes

SDS2102X plus	100MHz	2 Ch
SDS2104X Plus	100MHz	4 Ch
SDS2204X Plus	200MHz	4 Ch
SDS2354X Plus	350MHz	4 Ch

BND OFFER

From: £788 +VAT

Rigol MSO5000 Oscilloscopes

MSO5072/4	70MHz	2/4 Ch
MSO5102/4	100MHz	2/4 Ch
MSO5204	200MHz	4 Ch
MSO5354	350MHz	4 Ch

BND OFFER

From: £732 +VAT

Siglent SSA3000X Plus Spectrum Analysers

Series	Frequency Range	Resolution Bandwidth
SSA3015X	9kHz~1.5GHz	1Hz to 1MHz
SSA3021X	9kHz~2.1GHz	1Hz to 1MHz
SSA3032X	9kHz~3.2GHz	1Hz to 1MHz

From: £1,054 +VAT

Rigol DSA800 Spectrum Analysers

Series	Freq. Range	Resolution BW
DSA815	9kHz~1.5GHz	10Hz to 1MHz
DSA832	9kHz~3.2GHz	10Hz to 1MHz
DSA875	9kHz~7.5GHz	10Hz to 1MHz

From: £726 +VAT

Brymen Handheld Meters

Clamp-On Multimeters

Handheld Multimeters

Insulation Multimeters

From: £66 +VAT

Microtest 6360 Series LCR Meters

6 models, up to 1MHz test frequency

- Basic accuracy up to ±0.05%
- Synchronous test with four parameters settings
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- USB Host can storage testing screen and data
- PC Connection data analysis software is available

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PCR500MA	1V TO 155V 2V TO 310V (2 ranges)	5A/2.5A
PCR1000MA		10A/5A
PCR2000MA		20A/10A
PCR4000MA		40A/20A

From: £1,895 +VAT

Siglent SDG1000X Waveform Generators

SDG1032X	30MHz	2 Ch
SDG1062X	60MHz	2 Ch

Siglent SDG2000X Waveform Generators

SDG2042X	40MHz	2 Ch
SDG2082X	80MHz	2 Ch
SDG2122X	120MHz	2 Ch

From: £231 +VAT

Rigol DG800 Waveform Generators

DG811	10MHz	1 Ch
DG812	10MHz	2 Ch
DG821	25MHz	1 Ch
DG822	25MHz	2 Ch
DG831	35MHz	1 Ch
DG832	35MHz	2 Ch

From: £180 +VAT

JBC Soldering Irons

JBC CD-2BQE General Purpose Soldering Station

Includes:
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The Twelfth Practical Wireless 70MHz Contest: Results 2020

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

Contest Manager **Colin Redwood G6MXL** has the results of the 2020 contest.

Good weather greeted those who ventured out portable for the 12th *Practical Wireless* 70MHz Contest on Sunday September 22nd 2020. The 43 (24 in 2019) entrants made a total of 862 (505) contacts with 125 (153) different stations in 21 (29) different squares, **Fig. 1**.

Low Power Section Winner

Steve Clements GW1YBB/P operated from the 800m summit of Pen-Y-Gadair in the Black Mountains in IO81KW, **Fig. 3**. He is again the winner of the low power section. He used a Yaesu FT-817 with a UT5JCW transverter running 8W to a homebrew 6-element Yagi antenna.

Open Section Winner

The winners of the open section are again **Pauline** and **Chris Kirby G8HQW/P**, **Fig. 4**. They used an Icom IC-7300 + Gemini 4m amplifier feeding a 7-element Yagi antenna. They are so committed to the contest that they came back from their caravan holiday in Scotland specially to participate. This year, for the first time, they were given permission to be at the summit of Rogan's Seat, the seventh highest peak in the Yorkshire Dales National Park in IO84WK. They couldn't claim their contacts for Summits on the Air as they had towed a trailer to the summit.

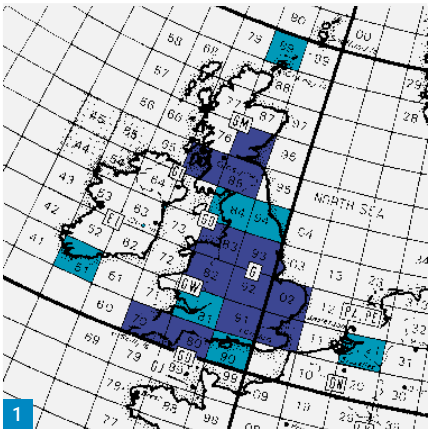
Full details of the results can be found in the tables in this article. As usual certificates will be sent to all the leading stations and leaders in each square.

Portable Activity

Several stations, including the winning stations, took advantage of the easing of government restrictions associated with Covid-19 to get out in the September sunshine and operate from favourite hilltops. However, not all were so lucky. **Dave Shaw G5TO** says that, *"circumstances meant that I couldn't go portable to my usual hilltop (310m asl) and only had a lashed up Moxon antenna at a noisy location to work with"*.

Home-based Activity

Ken Eastty G3LVP had many nearby stations, which made it hard going. He likes the contest as it doesn't allow the use of MGMs (machine generated modes). Several other stations operated for part of the contest due to other commitments.



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Description	Name/Team	Callsign
Low-Power Winner	Steve Clements	GW1YBB/P
Open Winner	Pauline & Chris Kirby	G8HQW/P
Leading Single Operator	Steve Clements	GW1YBB/P
Leading Multi-Operator	Pauline & Chris Kirby	G8HQW/P
Leading English Station	Pauline & Chris Kirby	G8HQW/P
Leading Welsh Station	Steve Clements	GW1YBB/P
Leading Scottish Station	Peter Moran	MM0CEZ
Leading Overseas Station	Frank L. Laanen	PE1EWR

Table 1: Leading stations.

Fig. 1: Map showing locator squares of stations that entered (dark blue) and other stations worked (light blue) Fig. 2: QTH of Terry Downing G3MXH of the Stratford Upon Avon & District Radio Society Fig. 3: Steve Clements GW1YBB/P setup in the Black Mountains. Fig. 4: Pauline Kirby G8HQW/P operating in the Yorkshire Dales National Park. Fig. 5: Richard Constantine G3UGF/P operating in Yorkshire.

RF Conditions

Terry Downing G3MXH, **Fig. 2**, thought RF conditions seemed to be average, with some very deep QSB at times. He was pleased to see so much portable activity.

Steve Down G3USE operated from his VHF/UHF shed/shack in Devon, with 'armstrong' rotation of the antenna. He felt conditions seemed flat with just a few peaks that helped with the distant contacts.

Two stations reported poor signals (abominable QRM 5kHz away and still raising noise floor when 25kHz away), without naming the culprits. I hope that the offending station was made aware of the problem so that they could investigate and rectify for the future.

Weather

Several stations commented favourably on the weather. **Richard Constantine G3UGF**, **Fig. 5**, said, *"it was an unusually lovely day up on the mountains in Yorkshire"*. Pauline Kirby G8HQW/P thought, *"The weather was kind this year, with the temperature at 10°, with only a light northerly wind"*. On the other side of the Pennines, **Ross Wilkinson G6GVI** enjoyed

Pos	Call	Name	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	G8HQW/P	Pauline & Chris Kirby	73	19	1387	IO84WK	Icom IC-7300 + Gemini Amplifier	7-ele Yagi	672
2	M0ICK/P	Warrington Contest Group	61	17	1037	IO93AD	IC-7300 (Gemini LDMOS Amp)5 Element (homebrew) LFA	5-ele (HB LFA	400
3	M7Z	Fred Handscombe	54	18	972	JO02FH	Yaesu FTdx101D	67ele PowAbeam	18
4	G2HX/P	Gloucester Amateur Radio & Electronics Society	37	11	407	IO81WU	Icom IC-7300. Linear Amps UK Amplifier.	5-ele LFA Yagi.	273
4	G3NPI	Geoff Suggate	37	11	407	IO92MA	ANAN 10 + T4M Txvtr+ LDMOS PA	6-ele LFA Yagi	118
6	MM0CEZ	Peter Moran	25	13	325	IO75XU	Kenwood TS890S - GEMINI DX1200	15-ele dual band PA5070-15-9BGP	95
7	M0ORO	Ossett Amateur Radio Operators	32	10	320	IO93EQ	Yaesu FT-847 + Gemini	6-ele Yagi	110
8	G3LVP	Ken Eastty	25	10	250	IO81WV	TS850 + Meon TVTR + Single 4CX250 PA	6-ele Yagi	50
9	G1POS/P	Jon Page	21	10	210	IO91AW	Yaesu FT-847	6-elemet LFA Yagi	280
10	2E0MDJ	Hereford ARS	19	11	209	IO81WV	Icom IC-7300	3-ele LFA-Q	80
11	GW4RWR	Rhys Thomas	19	9	171	IO83HE	HB 14.8MHz x 4 VXO + 10.7 IF	HB 7-ele DK7ZB	9
11	G4FEV	Dave	19	9	171	IO92RG	Icom IC-7100	5 el Yagi	90
11	G3PHO	Peter Day, Sheffield & District Wireless Society	19	9	171	IO93GG	Icom IC-7300	4-ele dual band Yagi	100
14	2E0VCC/P	Darrell Jacobs	16	9	144	IO70RP	Icom IC-7300	5-ele PowAbeam	293
14	MC0IBI/P	Taff Vale ARC	18	8	144	IO81HS	Icom 7100 & Motorola GM350	Sirio vertical & single-ele beam	441
16	GW0GEI	Steve Jones	14	10	140	IO72VE	ftdx101mp + gemini amplifier into 7 ele powabeam	7-ele powabeam for 4m	300
17	G4CIZ	Tony Wallbank	14	8	112	IO91FG	HB rig, single conversion + bipolar transistor amplifier. Rx front end BF981.	4-ele Yagi	130
17	G1VDP	Chris Colclough	16	7	112	IO92FM	Kenwood TS-790	7-ele	123
19	GW4EVX	Ron Price	13	8	104	IO83KE	Icom IC-7300	5-ele Yagi	150
20	G3MXH	Stratford Upon Avon & DRS	12	7	84	JO02LF	IC-7300 + ME4T PRO TVTR + HB SSPA	7 -ele CQM	8
21	GM4DIJ	Brian Howie	9	9	81	IO85IW	Yaesu FT847+TE Systems PA	6 ele	66
22	G4FKI	David Thorpe	11	7	77	IO92SA	Icom IC-7300	Dipole	60
23	G8FRS	Keith Gurr	9	7	63	IO92DE	Icom IC-7300	Halo	40
23	G3USE	Steve Down	9	7	63	IO80JT	Icom IC-7300	Sirio 3-ele	133
25	GW4JQP	Peter Harston	8	7	56	IO71KR	Icom IC-7100	5-ele PowAbeam	52
26	G5TO	Dave Shaw	9	6	54	IO93HL	Icom IC7100	Moxon	67
27	G0OIW/P	Mark Palmer	10	4	40	IO91LO	Ascom SE550	Homebrew Slim Jim at 10 metres	230
28	M0GQB	Martin Cox	8	4	32	IO93BR	Yaesu FT-817, Spectrum 4m TVTR	dipole	207
29	G0LGS/P	Stewart Wilkinson	0	0	0	IO81WU	Icom IC-7300	6-ele PowAbeam	6

Table 2: PW 70MHz open section results table.

the lovely sunny afternoon on Winter Hill, albeit with a cool breeze. On top of the Black Mountains, Steve Clements GW1YBB/P found it was freezing cold and windy for the setup.

FM Activity

Ross Wilkinson G6GVI took his converted Motorola FM 'handie' up to the top of Winter Hill and set up a home-made half-wave antenna, suspended from a 5m telescopic pole. He was there for 90 minutes, and was delighted to make so many contacts on FM, including five stations he had not worked previously.

Equipment

The trend to using transceivers with a built-in 4m capability rather than separate transverters continues, particularly in the open section. Well under half the entrants used transverters this year.

Logging

Logging accuracy was generally good with just a few points deducted during adjudication. One station lost a number of points due to what appeared to have been 'creative' logging by claiming to have received serial number

Square	Name	Call	No. ents
IO71	Brian Woodcock	G4CIB/P	1
IO73	Dafydd Ellis	MW0CHZ/P	1
IO80	SADGITS	G4RLF/P	1
IO81	Steven Clements	GW1YBB/P	5
IO82	Simon Pryce	G0EIY	2
IO83	Jeff Snowling	G1DYN/P	1
IO84	Pauline & Chris Kirby	G8HQW/P	1
IO91	Tony Wallbank	G4CIZ	2
IO92	Geoff Suggate	G3NPI	3
IO93	Ossett Amateur Radio Operators	M0ORO	5
JO02	Fred Handscombe	G4BWP	1
JO03	Brian Jones	M6OXO/P	1

Table 3: Leading stations in each square.

096 (higher than any other serial number ever sent or received in the 12 years that this contest has been running) from a well-known VHF operator that wasn't QRV during the contest and did not feature in any other station's log!

Checklog

Many thanks for the checklog submitted by **Jean-Jacques ON7EQ**.

2021

The 13th *PW* 70MHz Contest is provisionally booked for Sunday September 12th 2021. I am expecting the rules to appear in the September 2021 issue due in the shops mid-August 2021.

Congratulations & Thanks

Congratulations to the winners and a big *"Thank You"* to all stations that participated. Let's hope that the 2021 contest is again blessed with such excellent weather.

3

4

5

Pos	Call	Name	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	GW1YBB/P	Steven Clements	70	15	1050	IO81KW	Yaesu FT817+UT5JCW TVTR	homebrew 6 ele	800
2	G4RLF/P	Martyn Wright	39	11	429	IO80WX	Icom IC-7300	5-ele Yagi	275
3	G0JCC	Andrew Lancaster	28	11	308	IO82MA	Icom IC-7400 + Spectrum TVTR	6-ele Yagi	265
4	G3RIR	Neil Ackerley	19	11	209	IO92JL	Icom IC-7300	5-ele	200
5	G8HXE/P	Keith Haywood	18	10	180	IO83RO	Yaesu FT-817 + HB TVTR	3-ele Yagi	300
6	G7RHF	Al Rich	16	8	128	IO82QK	Icom 756 pro 3 + Spectrum TVTR	3-ele xyj beam	4
7	G3UGF/P	Richard J Constantine	15	6	90	IO93AS	Icom IC-7300	3-ele	440
8	M1AEA	Mark Waldron	11	6	66	IO82WM	Kenwood TS570D + Spectrum TVTR	Flower Pot	720
9	G0EIY	Simon Pryce	11	5	55	IO82OR	Yaesu FT-897D + UT5JCW TVTR	6-ele LFA Yagi with pawsey stubb	77
10	G6GVI/P	Ross Wilkinson	8	3	24	IO83RP	Motorola Lancer (ex-PMR FM handie)	half-wave vertical	440
11	PE1EWR	Frank L. Laanen	3	3	9	JO11SL	Icom IC-7300	4-4 EPS 6_4	8
12	M6KIO/P	Dom Bloomfield	2	2	4	IO82MK	Anytone AT779	5/8th wave end fed	393
12	MW0CHZ	Dafydd Ellis	2	2	4	IO73UC	Yaesu FT-817 + Spectrum TVTR	HB9CV 2-ele	135
14	M0HFY	Barry Eames	3	1	3	IO81UT	Yaesu FT-857D + TVTR	HB9CV	22

Table 4: PW 70MHz low power results table.

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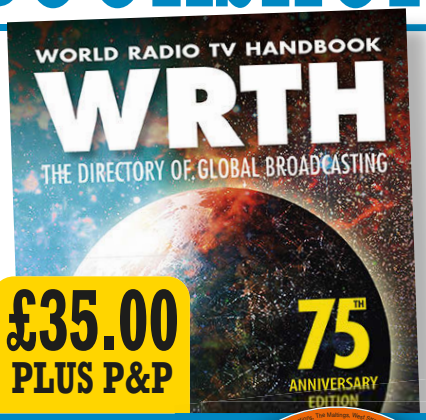

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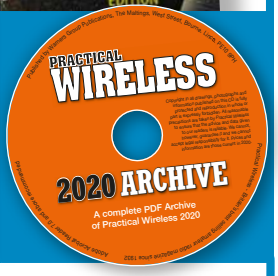

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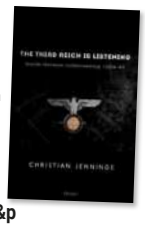

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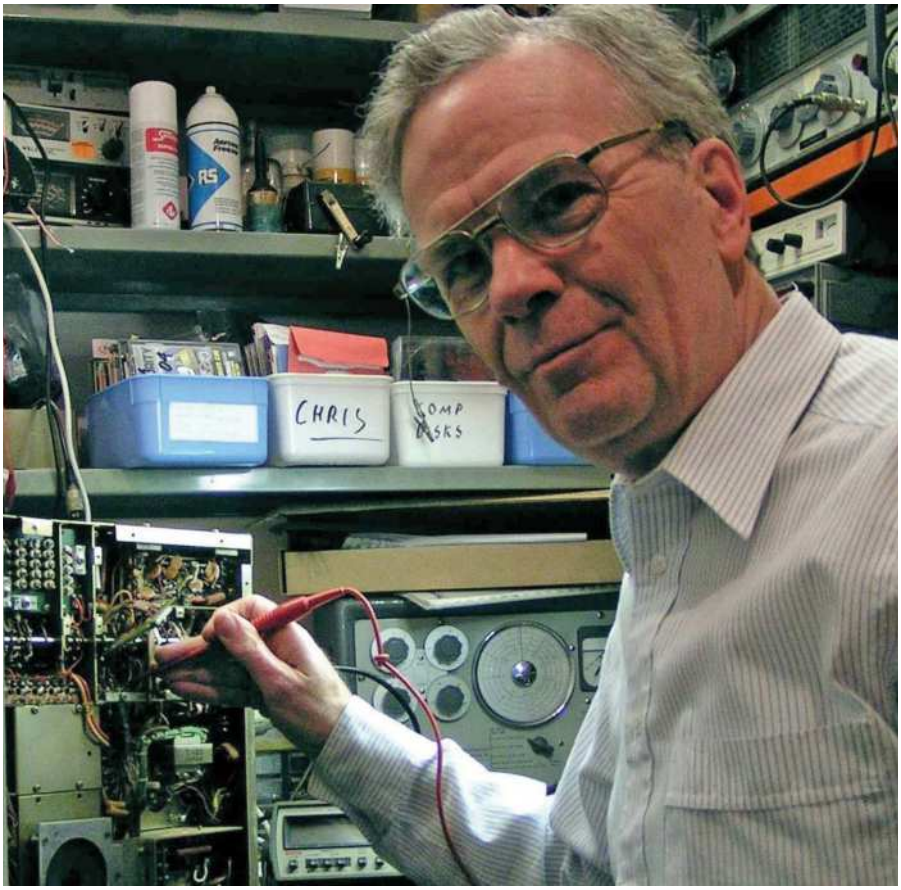

Looking Back

Harry G3LLL indulges in some reminiscences for the last of his regular columns.

It is now just over 20 years since we retired from our shop at Blackburn, and I am now in my 80s. Perhaps before I am called back to be completely refurbished by my Maker, it is an appropriate time to look back and then 'lock up shop'.

I had always been interested in radio and electricity, and when I was due to leave school in the early 1950s I spotted an advert for a job as a trainee radio and TV engineer at JL Haworth & Co in Accrington. As it was only a 20 minute cycle ride away I applied, got the job, and started at £1.50 a week on my 15th birthday.

As part of the deal, I had to go to the technical college for two nights and one afternoon a week, to take the City and Guilds Radio and TV servicing course. By the time I was 20 I was a radio amateur and a qualified Radio and TV engineer, but still a trainee on £4.50 a week. Then at 21 I came out of my time, and my wage shot up to £11 a week, which was quite a decent wage in the 1950s, but more importantly I had a job, a career, and a knowledge of electronics.

The job and pay did not last long though, because two months later I was called up to do National Service. I was back to £1.50 a week, and spent the next two years in REME at Manorbier near Tenby, sorting out radio-controlled target practice planes for the Royal Artillery.

The Army just wasn't 'me' though, I tended to get my lefts and rights mixed up, swung my arms out of sync with my legs, and was hopeless at drill.

They wanted electronic technicians, however, and tried to persuade me to stay on by giving me two stripes, and an increase in wage, but I was just not interested. I went back into civilian life servicing 16mm sound film projectors, hi-fi, and tape recorders, until eventually I became a 'professional radio amateur'.

How Things Have Changed

I asked my grandson what he wanted to study at university, and he told me 'Philosophy'. My first reaction was to ask him if had he looked under the 'Situations Vacant' column, to see how many companies were advertising for philosophers, but then perhaps I am getting out of touch!

Still Thinking About Opening a Shop?

Location Location Location

We originally ran the amateur radio department as part of a town centre family hi-fi and photographic retail business. It was in a prominent position, but really it was not good from an amateur radio point of view, and we did much better when we set up on our own later in a back street. This was cheap, was easily accessible from main roads and the motorway, and had plenty of free parking, all points you should think about.

Blowing your Trumpet.

There is an old saying *"If you don't blow your own trumpet, no one else will"* and I must admit that I did a bit of this. Writing articles for amateur radio and hi-fi magazines brought in some spending money, but more importantly it provided free publicity. I am not a gifted writer, in fact I am a bit dyslexic. So, before computers and spell checkers, I had to dictate articles to **Brenda** who also polished up my English.

While we were still attached to the photographic side of Holdings we often got comments such as *"What does a photographic shop know about electronics?"* So, I decided to have a photo taken of myself and my chief engineer in our workshop, surrounded by a load of test equipment, to put in the shop window. It came out rather well so on the off chance I sent a copy to *Hi-Fi News*, who I wrote a monthly column for. I got an enthusiastic reply from the editor, who said they were wondering how to fill the front page in the next issue, and our photo just fitted the bill. There we were, in full colour, spread across the front

page smiling out from the newsstands. Buying a space like this would have cost a fortune but we got it with full acknowledgment as to the picture's source, for free!

Businesses, magazines and newspapers thrive on newsworthy stories. Just note Martin Lynch and Waters and Stanton as examples. They always seem to be doing something that is 'newsworthy'. This helps magazines fill their pages, and gains extra publicity.

Getting known this way will pay dividends. In our case when Brenda and I wanted to set up in business on our own, copies of letters from magazine editors, and offers of support from suppliers, suitably impressed the bank manager.

How about Shop Fittings?

Items such as tills, counters, display cabinets, and window display shelving can be quite expensive, and no doubt you will be tempted by salesmen making offers to set you up with these for *"only a few pounds a week"*. Do your sums, work out how much it is going to cost you over, say, three years, look at your potential customers at the local radio club, and ask yourself if you need a posh setup? I have never been a snappy dresser (as Brenda often complains!), and a lot of radio amateurs tend to fall into the same slightly scruffy category, and might even be put off by a shop that looks too upmarket. Not only are new shop fittings expensive to buy, but they are difficult to sell, and if you keep your eyes open you may spot a shop that has some useful fittings that is closing down. You may be able to buy the fittings, or even rent the shop complete, or you may see some fittings at an auction. You should then get them for a tiny fraction of what they would have cost to buy new.

Insurance and Security

Of course, you will need to make the premises secure and be insured against break-in's, and you will need an alarm system, but before you have any bright ideas about doing it all yourself, have a word with a few reputable insurance companies and find out what they will want. You will find that all the major insurers will only insure business premises that meet their security requirements, and that they have a list of approved security companies.

On top of this for your own personal protection when the shop is open, you will need some kind of 'panic alarm'. CCTV is also a good idea, and here we had a cheap DiY system set so that the first thing a customer spotted when entering the door was their own face on a monitor, a real 'turn off' for light-fingered types.

Some devious people tend to think that shopkeepers are 'fair game', and the rise of 'No win no fee' solicitors has encouraged them to 'try it on'. If someone claims to have tripped over your door mat, or that the equipment you have repaired has burst into flames, and claims heavy damages, could you afford to fight it? Make sure that you are fully insured against all eventualities and liabilities, as false claims melt away if the claimant finds that they are up against an insurance company.

A Few Daft Questions and Comments from Customers

I want this repairing, Under Guarantee.

When we first set up on our own, I still carried out repairs to hi-fi equipment and tape recorders, and got quite a few customers in who expected me to repair 'under guarantee' items they had purchased elsewhere or via post from catalogue companies. They were disappointed!

Can I borrow an Amp meter?

He had just moved house, and wanted to check if the mains sockets were 3A, 5A or 13A!

How do I get a radio ham closed down?

After complaining about the ham who was upsetting his TV, this loud-mouthed individual was not the slightest bit interested in my advice regarding filters or ferrite rings, he just wanted the operator closed down. I told him to contact Ofcom. He then looked slightly worried and as he was leaving the shop he said, *"Actually I don't have a TV licence, will that make any difference?"*

I am being bugged

People with this complaint ranged from those whose lives were probably not worth listening in on, to those with obvious mental health problems. I declined to get involved.

Closing Shop

Well that is about it for now, many thanks for the encouragement I have received over the years, but all things come to an end sometime. I hope, however, to be able to provide the odd corner filler occasionally in the future, something on the lines of the following.

Things You Should Know

A Part Exchange

If you turn up at a dealer with a rig smelling of cigarette smoke, yellow with nicotine, or generally filthy, hoping for a part exchange deal, he will quietly rub his hands in glee. By its condition you have told him that you don't really value the rig, that a little work with a toothbrush some Brasso and foam cleaner, will add 20-40% to its value, and that most likely the majority of any faults will disappear with the application of some switch lubricant and cleaner. He will, see this as a great opportunity to make you a low offer and, as they say on the TV programme *Homes under the Hammer* to 'add value' and make a good profit.

Fuses

In over 30 years servicing Yaesu equipment, I only came across one mains transformer that had failed for no apparent reason, but I found scores that had been burned out due to some minor fault having developed, when the rig was been fitted with the wrong value or type of fuse. In some cases, so much damage had been done that the rig was not worth repair.

Do yourself a favour, go and look at your manual, check what value of fuse should be fitted to match your mains voltage, and see that it is. (Don't rely on any rating stamped on the chassis, or any spares that came with it, as these may be for 115V or 12V supplies)

Transistor Voltages

Quite often transistors, particular in audio stages, are directly coupled to each other, and this makes checking voltages and sorting out cause from effect difficult. The thing to remember is that a correctly operating non-digital silicon NPN transistor should always have a base voltage that about 0.6V higher than its emitter. If the voltage difference is higher than 0.7V, there is every chance that the transistor is open circuit, or if less than 0.5V, that it is short. Remove it and test the device before looking elsewhere.

Using Modern Stereo Headphones with Old Equipment

Some older equipment has the phone jack wired directly across the speaker output, which produces far too much volume, together with background hum and noise, usually in one ear only, with the volume control near minimum. Swap the plug for a mono one, and incorporate a resistor of about 100Ω in series with the lead.

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AT-588 Single band FM mobile 4m radio (66-88MHz), 40 Watts, 200 channels ..... ~~£169.99~~ **£149.99**
AT-5555N Single band AM/FM mobile 10m radio (28-29.700MHz) 30 Watts ..... ~~£189.95~~ **£159.95**
AT-6666 Single band AM/FM/USB/LSB 10m radio (25.615-30.105MHZ) 60 Watts ..... ~~£199.99~~ **£169.99**
AT-D578UV Pro FM/DMR mobile radio This AT-D578UV-pro is a true TWIN band radio for digital DMR radio systems, compatible to MOTOTRBO Tier 1 and 2. Traditional FM is of course equally supported. In contrast to many other DMR radios the AT-D578UV offers real VFO operations, which makes it much more suitable for amateur radio. Here you can adjust frequency and other parameters as you are used from traditional radios, instead of just using pre-programmed memories. Ofcourse the AT-D578UV offers these memories as well, quite a lot: 4000 to be precise. But you are not limited to those memory channels. **£349.99**

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AT-D878UV PLUS BLUETOOTH Digital DMR Dual-band Handheld Commercial Radio with Roaming and GPS VHF/UHF Dual-band Digital/Analog Part 90 DMR commercial transceiver with 1.77 inch colour TFT display and GPS. This model includes DMR Roaming, faster processor and larger memory for future enhancements. Ideal for Fire, Search & Rescue, EMS, Police, Sheriff, Forestry and Security operations. Frequency coverage 140-174 / 400-480 MHz **£199.99**

Accessories

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CPL-01 Car charger ofr AT-D868UV **£8.95**
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Vero Global Communications compant is a science and technology enterprise in Fujian Province, specializing in R&D, production and sales of electronic products and accessories such as radio communication equipment, alarms, radio frequency smart cards, and GPS equipment.

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NOW JUST £29.95!

UV-9R PLUS DUALBAND HANDIE
140/174/400-470MHz, IP67 waterproof & dustproof (Not diving), Relay Forwarding Confirmed, Dual Band, Dual Display and Dual Standby, High & Low Power Switchover. Everything you need for just £29.95!

Handheld Transceiver

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NOTE is a rugged 400-480 MHz handheld transceiver with a massive 20W output! Comes comlpetre with antenna, belt clip and drop in charger – are you ready to be heard! **£69.95**

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SenHaiX was estabished in 2012 and is in located in the located in the hometown of two way radio Quanzhou city, Fujian Province, China. The company is a high-tech enterprise specialising in radio communications R&D, manufacture of two way communications and accessories.

Handheld Transceiver

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New SenHaiX 8600 5W Dual Band Sport Two-way Radio Waterproof Handheld Radio with VOX Function – includes a host of features such as dual band, dual standby, 128 channels, waterproof, VOX, Eco Mode, Scan Function, FM Radio, PPT ID and Automatic backlight plus more . ..... **ALL FOR JUST £59.95**

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Why buy loads of different antennas when Moonraker has one to cover all! SPX series has a unique fly lead and socket for quick band changing

37 WATTS

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MR777 2/70cm, Gain 2.8/4.8dBd, L. 150cm, 3/8 fitting..... **£19.95**
MRQ525 2/70cm, Gain 0.5/3.2dBd, L. 43cm, PL259 fitting (high quality)..... **£19.95**
MRQ500 2/70cm, Gain 3.2/5.8dBd, L. 95cm, PL259 fitting (high quality)..... **£26.95**
MRQ750 2/70cm, Gain 5.5/8.0dBd, L. 150cm, PL259 fitting (high quality)..... **£36.95**
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RG58M-DRUM-100 military spec RG58 6mm 100m reel..... **£44.95**
MINI8-DRUM-50 military spec MINI-8 7mm 50m reel **£34.99**
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RG213-DRUM-50 military spec RG213 9mm 50m reel **£64.99**
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SQBM200P 2/70cm, Gain 4.5/7.5dBd, RX 25-2000MHz, Length 155cm, SO239..... ~~£54.95~~ **Special Offer £44.95**
SQBM500P 2/70cm, Gain 6.8/9.2dBd, RX 25-2000MHz, Length 250cm, SO239..... ~~£74.95~~ **Special Offer £69.95**
SQBM1000P 6/2/70cm, Gain 3.0/6.2/8.4dBd, RX 25-2000MHz, Length 250cm, SO239..... ~~£84.95~~ **Special Offer £79.95**
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SQBM3500N Triband 2/70/23cm, Gain 6.8/9.2/11.8dBd Length 2.70m **£99.99**

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Our HF wire antennas are made with complete waterproof potted baluns and high quality "original" flexweave antenna wire.

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OSHF-40 7.0-30MHz balun matched off set dipole, length 22m **£44.95**
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LWHF-80 3.5-50MHz unun match end fed antenna, length 20m ... **£44.95**
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AMPRO-17 Slim line design 18MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-20 Slim line design 14MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-30 Slim line design 10MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-40 Slim line design 7MHz 2m approx. 3/8th fitting..... **£22.95**
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450-20 Ribbon feeder 450 ohm high quality slotted, 20m **£19.95**
DPC-W Wire dipole centre with securing clamps **£5.95**
DPC-S Wire dipole centre with SO239 socket for PL259 ..... **£6.95**
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DOGBONE-S small plastic insulator **£1.00**

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PRESENT & FUTURE CUSTOMERS

FT8, Propagation and More

Steve Telenius-Lowe PJ4DX has a full column, despite the continuing lack of DXpedition activity.

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

The increase in solar activity reported last month continued into early December. By November 30th the Solar Flux Index (SFI) had risen to 116 and the Sunspot Number (SN) peaked at 84. However, the sunspot groups that led to all that activity then rotated away from the earth leading to a drop in the SFI and SN, as shown in **Table 1**. The sun completes a full rotation every 27 days so it remains to be seen whether there will be another dramatic increase in activity when its more active side returns to face the earth, or whether the sunspots will have fizzled out in the meantime.

FT8 Takes Off in Bonaire

The three newest resident amateurs on Bonaire, **Gerard PJ4GR**, **Berry PJ4BZL** and **Erwin PJ4EL**, are all keen exponents of FT8 and are making several hundred QSOs every week using that mode. Between October and December four German amateurs visited Bonaire, **Holger DL1COP**, **Monika DC7MO**, **Marcin DL3KMS** and **Martin DL6KR**. All four operated as PJ4/ own calls mainly using FT8 although PJ4/DL6KR also made many SSB and CW QSOs (see photo on page 64 of last month's *PW*). My wife **Eva PJ4EVA** was interested to see FT8 being used and decided she would like to give it a try. DL3KMS and DL6KR kindly set up JTDX on our computer and both Eva and I are now active using that mode too. Finally, in December, another visiting amateur, **Johannes PA5X**, **Fig. 1**, came to Bonaire for a short holiday and was also very active on FT8 during his stay. Johannes is currently on a work contract in Mauritania, where he is perhaps better known as **5T5PA**.

Users of 'traditional' modes should not despair, though: **Bert PJ4KY**, **Peter PJ4NX** and I are still active on SSB (and occasionally CW)!

Vertical Enhancement

It is now well established that a vertical antenna located very close to the sea or ocean provides considerable enhancement at the low angles required for long-distance DX contacts when compared with a similar vertical located inland or a horizontally-polarised antenna also on the sea. While on the 3B7 DXpedition to St Brandon in 2007 I was able to compare a single quarter-wave vertical on the edge of the ocean with a 4-element monoband Yagi on a 40ft mast equally close to the sea. We found there was little or no difference in received and transmitted signal strengths between the vertical and the horizontal 4-element Yagi.

1

What is less frequently done, though, is simultaneously comparing a vertical on the ocean with an antenna located inland, but this is exactly what **John Rowlands MW1CFN** has done, using WSPR. He wrote that he had been doing *"lots of work at 14MHz from coastal locations... with a simple quarter-wave vertical and WSPR down to 50 microwatts (yes, microwatts) getting comfortably across the Atlantic. A good coastal environment, which doesn't require getting feet wet, but simply being somewhere reasonably close to it, yields typically 8 – 14dB enhancement over a location only slightly inland. Some signals get a 'free' 20dB or more enhancement. Thanks to Raspberry Pi portable computing, I can also run a full SDR receiver for hours on end from a USB battery pack while on location, all fitting into a small backpack."*

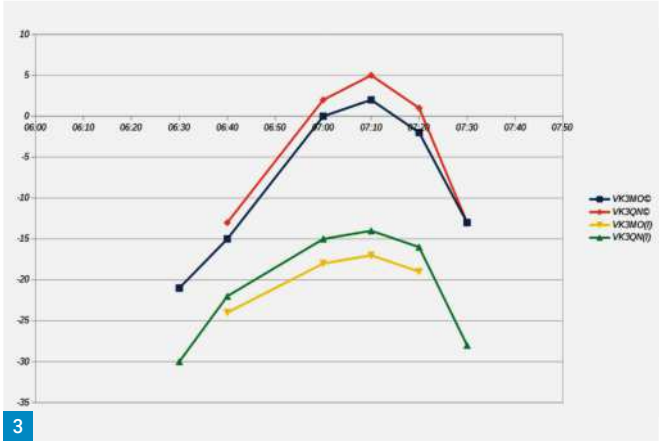
Fig. 2 shows John's portable WSPR station antenna on the west coast of Anglesey, while **Fig. 3** is a plot of John's reception of VK3MO and VK3QN (both run by VK3MO), sending a 5W WSPR signal via long path. (The VK3MO station sports a 20-element, 5-over-5-over-5-over-5, 14MHz array on a 200ft rotating tower – *Ed.*)

In **Fig. 3** the top two traces (in red and blue) were received on the west coast of Anglesey, using a quarter-wave vertical within a half wavelength of the sea, while the lower two traces (in green and yellow) show reception of the same stations using a delta loop, but 13km inland. Enhancements as great as 20dB can be seen at the peak around 0710.


2

DXpeditions

It has been some months since I reported on any DXpeditions and that is, of course,



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5


4

Fig. 1: Steve PJ4DX with Johannes PJ4/PA5X (5T5PA) while he was visiting Bonaire in December. Fig. 2: The MW1CFN portable WSPR station antenna on the west coast of Anglesey. Fig. 3: MW1CFN reception of VK3MO and VK3QN WSPR signals (see text). Fig. 4: The portable set-up of Carl 2E0HPI/P on the Durham coast. Fig. 5: QRP Labs transceiver kit built by Martin GW4TPG during his rehabilitation, along with his favourite reading matter! Fig. 6: 'El Quarry', location for ZB2GI/P operations. Fig. 7: The OS8D Hexbeam and the moon on a cold early winter morning in Belgium.

because of the Covid-19 pandemic. Many DXpeditions have been announced but almost all have been cancelled or at least postponed until travel once again becomes more feasible. There have been a few exceptions, though. A team from the Russian Robinson Club, which usually operates from islands, activated 7Q7RU from landlocked Malawi in November. Two members of the team contracted Covid-19 and were forbidden to leave Malawi when planned. They therefore continued operating and were still on the air as this column is being compiled, having made a total of nearly 45,000 QSOs.

Readers'News

It is a pleasure to welcome another new contributor to this column, **Steve Down G3USE** from Honiton in Devon. Steve responded to my piece, 'Personal Operating Milestones', in last month's column. He wrote, *"It is a few years since my 50-year-licensed anniversary but you may be interested in some personal targets that I set. My aim was to achieve an average of 50 DXCC per band 160 to 10m and 50 locators on 6m* [during 2020 – *Ed*]. *All to be CW, so 6m would be mainly during the Es season. An average/band was selected as I expected to only have one major session on 160 during the CQ 160m contest in January and I anticipated some difficulty with one or more of the WARC bands. I also knew that a QTH move from Bedford to Devon later in the year would probably preclude using the November CQWW to catch the last few. However, in the event I got there by September for both HF and 6m."* Congratulations on achieving your personal targets, Steve, and we look forward to hearing more from you now that you are active from the new QTH in Devon.

Owen Williams G0PHY wrote that *"After the excitement and activity last month there was a bit of a lull this month with very little activity* [for Owen] *despite the second lockdown theoretically giving more time for the radio. The only real DX worked was your temporary next-door neighbour* ***Martin PJ4/DL6KR*** *on 18MHz SSB and KK9R in Florida on 14MHz. However, with the improvement in propagation SSB signals from ZL and VK stations on 14MHz for the first time in a long time and 7Q7RU was heard on 28MHz SSB. Let's hope that the propagation gods continue to look favourably upon us!"*

	Dec '20	Nov '20	Oct '20	Difference
SFI:	81	86	73	(–5)
SN:	11	27	26	(–16)

Table 1: Solar Flux Index and Sunspot Number on December 11th 2020 compared with previous months.

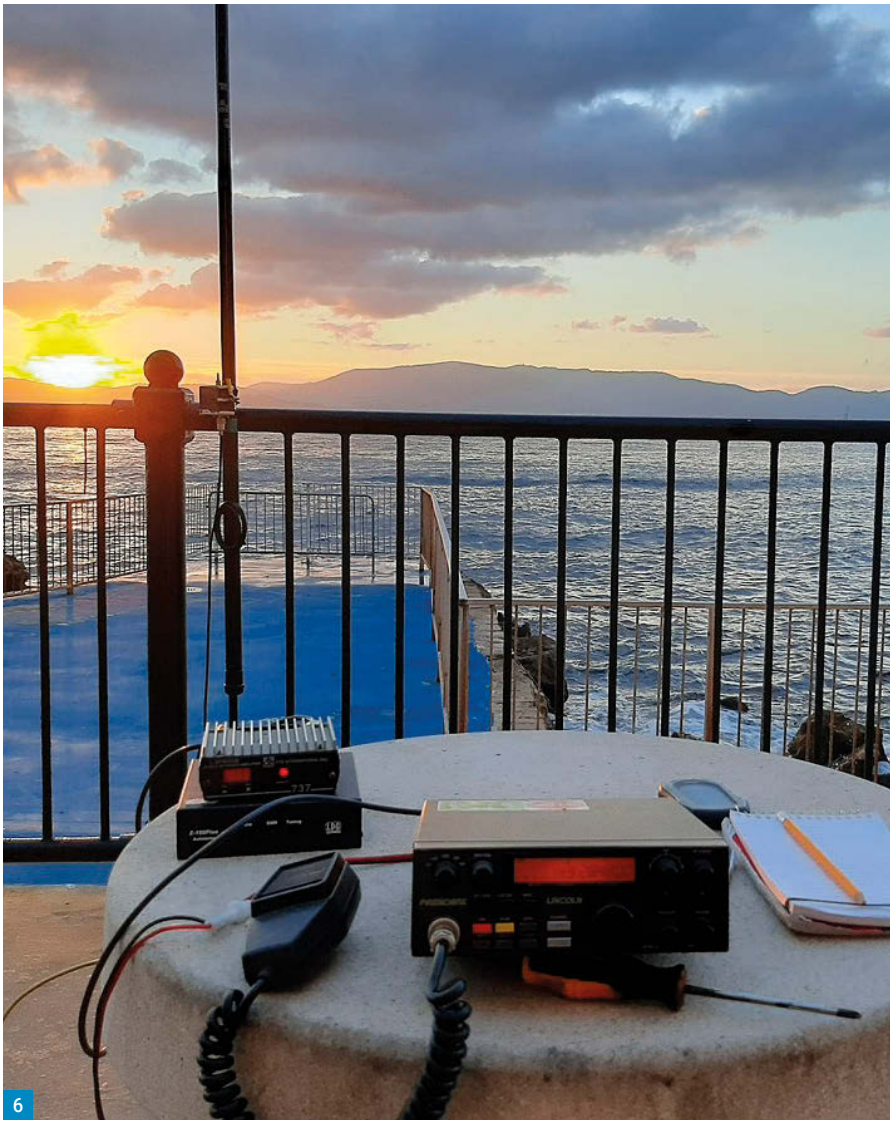
Carl Gorse 2E0HPI was a regular contributor to this column but it had been a long time since we heard from him. He wrote to say he had not been too well recently but is now on the mend and so has once again been able to go out portable. Operating from the Durham Coastal/Beach areas using a Xiegu X5105 transceiver at 5W and an Elecraft AX1 antenna close to the sea, **Fig. 4**, he worked VK3XXY on 20m SSB as well as stations in North America, commenting *"I was amazed the stations even heard my call"* and concluding *"it's been so nice to get out again."* There can't be too many who would brave the North Sea coast in November to operate portable, so well done Carl.

We had also not heard from **Martin Evans GW4TPG** for quite a while, but he wrote in December to say that he has been more or less QRT since July following an accident, which resulted in a bout of hospitalisation and a long period of recuperation. *"I have kept up reading* PW *every month, and during my layoff I managed to build a 20m QCX Plus QRP transceiver,* **Fig. 5***, doing a little work each day over about four months... I would highly recommend QRP Labs to anyone, the kits are outstanding and packed with features like A/B VFOs, keyers etc and the prices are amazing."* A couple of days later Martin sent a follow-up: *"I've just found out Santa is bringing me the matching QRP Labs 50W amplifier: it's class C from a pair of MRF510s so it's not a linear but it's FB for CW."* It's good to hear you're up and about again, Martin.

Early morning on November 1st, the amateur radio club on board the historic museum ship and ice breaker *Krasin*, built at the UK Armstrong Whitworth yard in 1916 and now moored in St Petersburg, was in huge demand on 40m CW. It took **Victor Brand G3JNB** over 45 minutes to get through on QRP. *"I just had to take my turn in the queue for R1LK and wait for propagation to improve. Over the next few days, I logged a series of similar special event stations, including LY111A on 20m celebrating the Lithuanian war hero* ***General Zemaiti****, ditto on 40m TM50GDG for* ***General de Gaulle*** *and then DF70DARC marking 70 years of the DARC. Also II0GD and IQ0ID of Sardinia's Grupe Radioamateur Sardi nel Mondo, plus the powerful annual All Saints award station LZ350PI operated by the Blagovestnik ARC. That 4U2STAYHOME call challenged my logging program...*

"The paucity of daytime weekday CW DX stations on HF led me back to PSK31 for some company, only to be equally disappointed. So, needs must, I sallied forth on to FT8. Initial calls on 40m QRP provided routine contacts that enabled PSK Reporter to list over 400 reports showing my coverage from the Canary Islands, up to the north of Finland and round to Asiatic Russia and the Near East. [Later] as the SFI soared, I dabbled in the CQWW contest on 40m QRP when on the Sunday night and just a moment before I decided to QRT, BY8AC at the Changdu Youth Palace appeared and I worked them loud and clear. Definitely my 'QSO of the Month'!"

Bill Ward 2E0BWX said *"Nothing exotic this month I'm afraid, just the usual European stuff, but I'm certain band conditions will improve soon (hopefully)... I have also been 'playing' on WSPR again this month and was very pleased to be spotted in Australia with just 5W of power"* [by VK4CT on 14MHz at 0850UTC on November 15th with an SNR of 022 – ***Ed***].



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Jeff King ZL4AI says *"20 metres appears to be back!"* and makes a plea for European stations to look for ZL amateurs on 14MHz via long path between about 0730 and 1000UTC, with the peak (in December) being at about 0920. He sent a list of some 70 stations, almost all in Europe, that he worked between December 4th and 7th and, in a break from tradition, I am listing just the UK stations worked by Jeff in 'Around the Bands' below.

Tony Usher G4HZW thought that 28MHz brought *"Better conditions in the first half of the period with further VKs, good openings to north and south America. Guernsey is included* [in 'Around the Bands'], *despite the fact that it's in Europe, as it was a new one on 28MHz digital and not easy from Cheshire. Not included are a handful of very strong EUs worked on the band using my TS-830 and SSB. On December 3rd* ***Alex RU3GC*** *was 59+30dB, thanks to his eight elements and 700W."* As for 7MHz, Tony said *"Nothing to write home about, although I was pleased with the JA contact."*

John Rowlands MW1CFN said *"The past month has seen 12m pick up in activity... FT8 has allowed QSOs with numerous VK stations, two YB, one FR5 and a handful of ZS by mid-morning. By early lunchtime, PY stations are starting to populate the waterfall, with a fairly rare OA9 appearing on November 13. HK stations, with distances in excess of 8000km, have also appeared on a regular basis. By lunchtime, Caribbean and countless US stations out as far as Texas (>7000km) appear. On several days, propagation on 12m has been strong enough to support ragchews on SSB with Florida (59) and Tennessee (57). On November 26th, a beautiful example of a backscatter signal allowed SSB contact with* ***Tony M0IQD***

in Kent at 1325UTC. Entirely undetectable along the 410km direct path of 120°, Tony was a stable 4/0 with my 3-element beaming 240°, out into the mid-Atlantic."

John concluded, *"For those, like me, curious about the potential (i.e. not proven!) link between Polar Summer and Winter Mesospheric Echoes (PMSE/PMWE) and higher HF/lower VHF propagation, there have been plenty of PMWE appearing at 70° north during the end of November, and much weaker apparitions over mid-Wales in early December."*

Kevin Hewitt ZB2GI reckons that *"band conditions are improving with some FT8 activity on 12m and occasionally on 10m [but] any SSB openings are short-lived. I operated SSB from the club station last week in the morning, hoping to get Australia and New Zealand in the log."* Kevin was very active once again in November, making over 600 FT8 QSOs, including over 100 on 60m. He also operated as ZB2GI/P from Camp Bay, known locally as 'El Quarry', **Fig. 6**, on 10m SSB and FT8, commenting that *"El Quarry is a great location to work South America at this time of year."*

Reg Williams G0OOF says: *"I am pleased to send a report after a long interval... The Butternut vertical is having a rest for the time being and stored in my garage. It has made way for a Hustler 6-band vertical with 17m add-on. It was second-hand, advertised on the internet, complete with a base tilt plate. A bargain price and only a year old from new. We experience a fair number of strong winds this time of year so the tilt base is useful for lowering the vertical as it is quick and easy to lower... Conditions are improving as I heard a few VK, ZL and other DX stations in the mornings on 20m SSB. Too weak for me to work at the moment but I am sure that will improve as time goes on. I gave a few points away during the LZ DX SSB contest, working stations on the 40m, 20m and 15m bands. I have worked FT8 mode in particular during the month on the 30m and 17m bands, which are a favourite for me. In the early morning 30m brings in ZL, VK and JA stations. Both bands are good for working NA stations in the late afternoon, which feeds my pursuit for collecting states, counties and grid squares."*

Etienne Vrebos OS8D/ON8DN used his Hexbeam, **Fig. 7**, to make around 150 SSB QSOs during the month. *"Nothing really exceptional"*, he said, but a *"great opening on 21MHz, and was happy to catch Nicaragua, I never reached [before] with OS8D."* Etienne mainly uses his OS8D callsign but says *"I still do use ON8DN sometimes when I'm not sure of a difficult QSO, as with YN, but always wait for an hour or more between the two QSOs with a DX station."* ON8DN now has 255 DXCC confirmed, while OS8D is lagging a little with 250.

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Around the Bands

Carl 2E0HPI/P: 7MHz SSB: ON5SWA/P (WWFF ONFF-0607), OZ7AIE/P (OZFF-0049). **14MHz SSB:** HB9BTI/P (SOTA HB/SG-064), KA0HDJ, SA0BRW (SMFF-1059), SP9BIJ/P (SP/BZ-042), VE9JEF, VK3XXY.

Bill Ward 2E0BWX: 7MHz FT8: HB9EBV, OE4RGC, PE1SCV. **14MHz FT4:** EA3IEO, IZ5CMG, UT0EK. **14MHz PSK31:** DM4RM. **18MHz FT8:** IQ8BI. **24MHz FT8:** E75CV.

Jeff ZL4AI: 14MHz SSB: 2E0KDB, G0AOJ, G0DEF, G0DJQ, G0HWK, G0MTQ, G1IZQ, G1ZHD, G3MLO, G4AKC, GM3ITN, GM4ATA, GW1YQM, M0NKR, M0ZNK, M1CMR, M5ARC.

Tony G4HZW: 7MHz FT4/FT8: 7X2ARA, A450XR, JA1LDG, KE9CK, N1UL, N2TSQ, N3DT, PY2CX, WD6BNY, Z32ZZZ. **28MHz FT8:** K4NKT, K5LCY, K9ZA, KC0OW, KC2DUX, LU8GMM, LW6DLS, MU0FAL, N3GX, PU5CRD, PY1ME, PY2GAS, VK3EW, VK5MRD, VO1AW, VP8NO, WQ5L, WW1L, ZR6CV, ZS6MGM.

Kevin ZB2GI and **ZB2GI/P: 5MHz FT8:** 5B60ALJ, 5T5PA, 8P2K, GD3YUM, K1RI, K4EA, K8KS, K5YCM, N2TK, VE2EBK, VE6WQ, W7UT, W9TB. **7MHz FT8:** LX1TI, WW1L. **10MHz FT8:** K4SO, TF1OL, VK3BDX, WX4G. **14MHz SSB:** 5B4AAB, JA5AQC, JA6FIO, JH6QFJ, JH9AUB, MU7ASX, PP5AK, PY7BC, PZ1EL, TK5AE, VK6WX, W2VP. **14MHz FT8:** 4X4MF, 5B60AMR, BA5CJ, CX1RL, FK8CE, JA3APV, JA6JEW, JE6DOI, JH4ADK, K2KGR, NN8B, PY2AB, PY4BK, PY7XC, VK3BDX, VK5GR, VK7NET, ZL4KYH. **21MHz FT8:** 5Z4VJ, AA4SS, AA8SW, AB1J, EA9BO, K0BBC, K5VIP, K6XT, K7STO, K9MU, VE3XN, W3FJ. **24MHz FT8:** AA3S, AA5JF, AJ4HW, CE2SV, K0LB, K2SN, K9XD, KM8AM, N1NK, PY2CX, XE1KK. **28MHz SSB:** LU4DJB, SN6P. **28MHz FT8:** CD7CKU, LU1HW, LW2EIY, PP2CS, PT9AL, PY4WL.

Reg G0OOF: 10MHz FT8: JK3AGC, PJ4EL, UA9LL, VK3VM, ZL2BH. **18MHz FT8:** CO8WFP, HP1KZ, K6MF, VP2EIH. **21MHz FT8:** J69DS, KP4JRS, RA0R.

Etienne OS8D / ON8DN: 14MHz SSB: PY6RT, ST2TS, VE0ZZZ, WP4RJO, YC9BHJ, YN7ZTR, ZL2SDX. **18MHz SSB:** 4A50CRH (Mexico), FP5AC, V51WH. **21MHz SSB:** 7Q7RU, 9Z4AH, 9Z4FE, AU2JCB (India), CO8MGY, CX3AT, EX8VM, FG4SO, FM5DN, NP4ET, PJ4/DL6KR, PZ1EL, T6AA, XE1CQ, XQ6CF. **24MHz SSB:** KP4YO, VP2ETE, ZD7FT. **28MHz SSB:** ZD7FT.

Signing Off

Thanks to all contributors. Please send all input for this column to telenius-lowe@gmail.com by 11th of each month. Photographs would be particularly welcome. For the April issue the deadline is February 11th. 73, Steve PJ4DX.

Pop Blundell, Morse Code and the Y Stations

John Adams G3ZSE recounts a fascinating piece of family history.

John Adams G3ZSE
g3zse1@gmail.com

William Blundell was my grandfather on my mother's side. Born in Queen Victoria's reign, he saw two world wars, making a significant contribution to the new ways of gathering and using signal intelligence in World War 2, which, of course, is part of the back-story of the success of Bletchley Park.

Early Life

He was born in Kettering, Northamptonshire to **John** and **Emily Blundell** on July 13th 1888, and was one of four children. Before his fifth birthday the family was thrown on to hard times when his mother died in May1893 at the age of just 36. His sister, **Annie**, was also to die young, some years later, at the age of 19 from TB. Unbelievably today, young William entered a job in the shoe trade at the tender age of nine. Luckily, a philanthropic factory owner kindly allowed him a day's schooling each week, which gave him a basic education, allowing him to progress as he grew up. There was talk of him wanting to run away to sea in his early teens, but in the end he signed up for the Army in Northampton, despite being under age at the time. He was originally enlisted into the 2nd Battalion of The Loyal North Lancs. Regiment. He was probably sixteen then, but his age was increased by two years, either by himself or the Army. At some point a little later on he became involved in telegraphy and Morse code and was posted to India. It is unclear exactly when or why, but certainly in India he became known as 'Pop', and this name stayed with him through the whole of his life.

India

Pop served in India before and after WW1. For at least part of the war he also served in France, where he was wounded. Pop became part of the new Royal Signals, which was formed in 1920. He certainly progressed through his Army life in signalling proficiency and could read and send Morse code very fast. The British Army had used wireless telegraphy since about 1903, but WW1 had shown that signals had to be carried out by dedicated units. He gained rank, had a trip back for leave in England in 1921, and met **May Fitch** through his brother **Bert**. They became close and later that year Pop sent for May, and they were married at Colaba, near Bombay, on November 4th 1921. Very few pictures of Pop survive in the family, but **Fig. 1** shows Pop and May at a later time. In the next few years they had two daughters, the first of whom was my mother Cynthia. With promotions Pop enjoyed a comfortable lifestyle in Jubbulpore, and my mother always remembered her Indian 'ayah', or nanny. In 1926 Pop left the Army as a warrant officer – Regimental Quarter Master Sergeant (RQMS) – and returned to England by sea with his family on His Majesty's Troopship *HMT Nevasa*, **Fig. 2**. The family then settled in a house in Northampton, where Pop found work back in the shoe trade. Sadly, their younger daughter fell ill and died shortly after arriving back in England.


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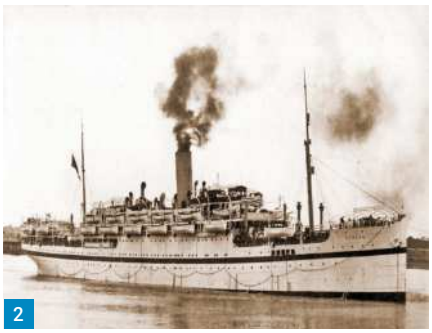
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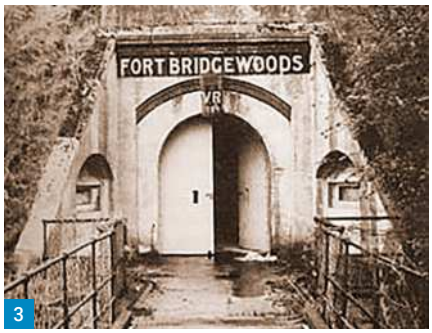

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The War Office Offer

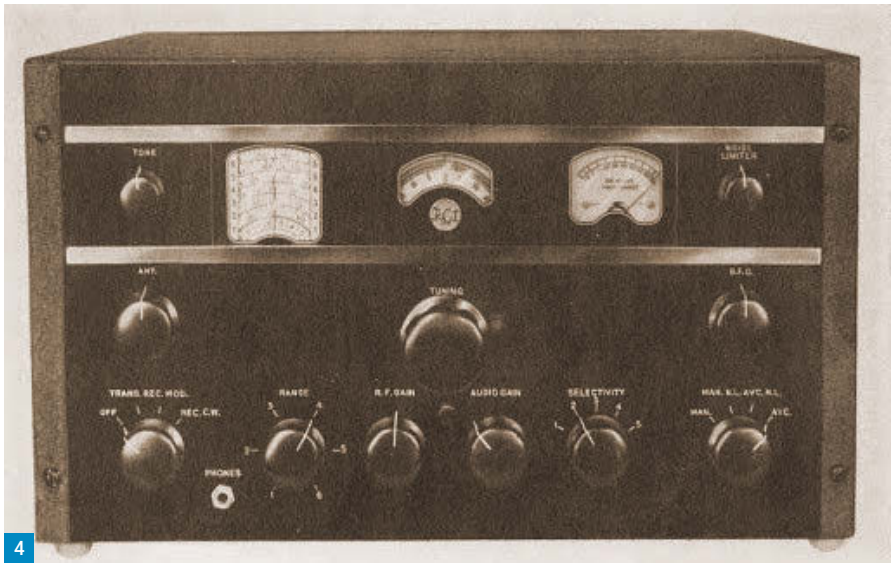
Within a few months Pop was approached by the War Office (now the Ministry of Defence) and invited to join them in the new, and secret, undertaking of intercepting potential enemy wireless signals. Pop had obviously been noticed in the latter stages of his Army service as someone who could be very useful! He was made aware that because he had been a civilian for less than six months, they had the power to recall him

Fig. 1: Pop and May Blundell. Fig. 2: HMT Nevasa (*The Caledonian Maritime Research Trust*). Fig. 3: Fort Bridgewoods gatehouse (*The Admiralty*). Fig. 4: AR88 receiver (*RCA*). Fig. 5: Beaumanor Hut H (*Dr Philip Blenkinsop*). Fig. 6: Group picture c.1946 (*The Beaumanor Staff Magazine*). Fig. 7: Barometer. Fig. 8: Barometer inscription. Fig. 9: Gravestone.

anyway – so Pop volunteered! It was clear then that Britain had to be war-ready for when the inevitable second big one came.

The family moved to Chatham, so Pop could work at *Fort Bridgewoods*, an old Victorian fort near the village of Borstal in Kent. (The original Borstal Institution was nearby.) *Fort Bridgewoods* was completed in 1889 and was built as part of **Palmerston's** plan for four forts to defend The Royal Naval Dockyard at Chatham and the principal River Medway crossing at Rochester. **Fig. 3** shows the entrance to the Fort. There was a new baby daughter in the family too, but, again tragically, six years later she too was taken ill and died in hospital. Pop's new position was a civilian post, in a group known as Wireless Interception, or WI. This was pronounced 'why' and hence the term 'Y' station. At about this time *Fort Bridgewoods* disappeared from Ordnance Survey maps. This new group answered to the old Military Intelligence section MI1b, part of the relatively new Government Code and Cypher School (GC&CS), which itself later grew into GCHQ. This was the Army's prime WI facility, although the Navy and RAF also had WI establishments, and all of these were built up and added to during the 1920s and 1930s.

Fort Bridgewoods was certainly a very secret establishment, and to this day is still missing from various lists of wartime Y stations. Nobody that worked in them in any capacity gave away any indications of what they really did, either at the time or for many years afterwards. Pop was one of five Experimental Wireless Assistants (EWAs), all reporting to **Lieutenant Beale** of the Royal Signals as the officer-in-charge. So, he was one of only six people in at the start of this exciting new venture. The General Strike of 1926 resulted in all of the six being temporarily relocated to Chelsea Barracks to ensure Government communications could be secured during a time of national unrest. Receiving equipment was extremely hard to come by, and a big step forward was a receiver that Beale himself had made some years previously. The staff grew through the years, mainly young men, and Pop's key task was to recruit and train them to accurately read Morse code at high speed. 22 words per minute was the level required for progression to full training and final competency. They were also trained to recognise a sender's 'fist', that is, his or her tell-tale traits of how the Morse was sent. It is very impressive that pre-war preparation was started 13 years before hostilities commenced.



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WW2

By 1938 the *Fort Bridgewoods* Y Station was basically fully ready for war, and had a total complement of 73 working there. Much of the work was carried out below ground level in very heavily fortified areas. Pop was the senior instructor and training officer then. Station X, Bletchley Park, was set up for the GC&CS in 1938 also. Key information was gleaned early on from the *Fort Bridgewoods* intercepts that enabled countermeasures to be deployed in 1940 to jam the new German Knickebein radio beams. Knickebein translates as 'crooked leg', and refers to a mystical raven in an old German tale. The antennas used by the Germans were a crooked shape to achieve the directivity. This navigational system used two intersecting radio beams to guide bombers to their target. By the time of the Battle of Britain in the second half of 1940 it was determined that 132 personnel were needed

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at *Fort Bridgewoods*.

Some time during his Y station service Pop also acquired his second nickname of Tubby. Again it's not known why – he was never very large! During 1940 the Medway Towns became a major German target, not least because of Chatham Dockyard and Shorts aircraft factory. On October 16th 1940 *Fort Bridgewoods* sustained direct bomb damage, although it was probably not known by the enemy as a target. Even so, three young ATS girls were killed in the air raid. So, the decision was taken to re-locate the whole operation to Beaumanor Park, near Loughborough, in Leicestershire. The need to move was quite urgent, so there was a brief interim facility set up at Chicksands in Bedfordshire at the RAF base there in 1941, with the move to Beaumanor following soon after. Beaumanor became the HQ of the War Office Y Group, and was well equipped from the very start, with the latest HRO and AR88 receivers, **Fig. 4**. Pop continued to train the large number of operatives there, and this now included many women from the ATS. **Fig. 5** shows Experimental Wireless Assistants in Hut H, or the 'New Chatham' room.

Although the staff numbers were large, nearly all would have been unaware of Station 'X' at Bletchley Park, where their Morse transcripts were taken daily by dispatch riders. These particular riders were the only ones allowed to carry revolvers, rather than cumbersome rifles, to better protect themselves and their dispatches in the event of being intercepted by enemy agents. Y Station personnel didn't need to know about Bletchley, and, although it may seem strange to us now, their commitment to national security was such that they were content to trust that they were just part of a human machine working to win the war and save lives. Great operator accuracy was essential in taking down the raw five-letter groups of Morse letters, otherwise decoding would have been even harder for Bletchley. By 1943, Room 61 on the top floor of Beaumanor Hall was being used for 'radio fingerprinting', using film cameras to capture signal traces. From these it became possible to identify individual transmitting sets. In some ways, this was an early forerunner of the waterfall displays we now use for many aspects of our hobby.

The Post-War Era

Although hostilities had ceased, all of those involved in the X and Y Stations were bound under the Official Secrets Act to maintain silence about what they did and what they knew. Little was in the public domain until some information was published in 1974. To cover their tracks many of the records held at Bletchley were destroyed almost immediately, although much was saved by those who, rightly, felt that Signal Intelligence would need to go on forever.

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Pop continued to be part of the Beaumanor operation intercepting signals from hostile powers. May, his wife continued to live in Chatham, with Pop visiting each week. **Fig. 6** shows Pop with *Bridgewoods* colleagues at Beaumanor at the end of the war. Further tragedy, however, was looming, and on the March 11th 1947, just a few weeks after her grandson, my brother **Michael**, had been born, May was crushed to death between two buses on Chatham Hill as she started to cross the road after alighting from one of them. After this Pop continued to work at Beaumanor until 1953, when at the age of 65 he retired. One of my first memories is going to meet him at Gillingham railway station in a taxi with my mother. He then came home to live with us in Gillingham, where the hallway wall was adorned with his new barometer shown in **Figs. 7** and **8**, his retirement gift from colleagues at Beaumanor.

In my early years Pop would often take me out, and take in old military sites such as The Great Lines and the Gun Wharf at Chatham, both old defences for the River Medway and the Dockyard. Beaumanor continued to be used for signal interception into the 1960s, but was closed in 1970 when it was relocated to Cheltenham as part of the new GCHQ. Pop loved to go to cricket matches, especially with friends. Unlike many ex-Royal Signals staff he never showed any inclination towards amateur radio though. In 1961, when I was ten, Pop found that living with our family had become too stressful and decided to move out. The different generations were just not mixing harmoniously. It may also have been that the impact of the deaths of his mother, his sister, two of his daughters and his wife could have finally caught up with him in old age. Pop went to live with an old Army chum

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for a short while, before finally moving into the Royal Hospital Chelsea. Unfortunately, family contact was lost with him before this last move.

A Final Dignified Resting Place

Pop Blundell departed this life on December 9th 1963, aged 75 as a Chelsea Pensioner. The Royal Hospital saw to it that he received a military burial, befitting an old soldier and servant of his country. His grave is in the military section of Brookwood Cemetery, Woking, where the gravestone gives his age as 77, see **Fig. 9**. So, the phantom two extra years are now etched in stone! Our family visited the grave in May 2004 to pay our respects while our mother was still alive and could make her peace there. Pop never spoke of any of the operational details given here in this summary of his life. By chance, I moved to Kettering with my wife and children in 1983, totally unaware then that this was Pop's birthplace. My youngest daughter shares the same birthday as Pop, July 13th. His barometer now proudly hangs on my wall and is in good shape and in daily use.

A fascinating and detailed wider view of Y Station activity is given in the RSGB book *Fort Bridgewoods* by **Stephen Small G4HJE**.

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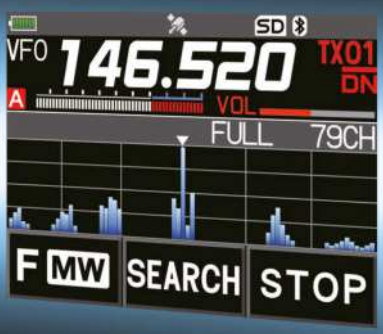
《Actual Size》



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Some More Trans-Equatorial Propagation

Tim Kirby GW4VXE starts with more news about interesting VHF and UHF TEP.

Last month I included details of some fascinating contacts that had been made on 2m from the Caribbean to South America on 2m. The contacts that I mentioned had been on SSB and, remarkably, on FM! I speculated whether FT8 would be suitable to support the propagation on account of the Doppler shift, which is a feature of Trans-equatorial propagation (TEP). **David Lama HI8DL** had been looking at this too and told me that you see a lot of signals on the waterfall, and sometimes it takes several cycles before you start to get some decodes and occasionally there are no decodes at all. David said that in 20 minutes or so watching the waterfall one day produced two decodes from LU9FVS and LU7FIN. David was interested to note that things did not seem to be reciprocal, because he had been decoded by several stations. Perhaps ERP makes a difference. Maybe some of the JT9 'wide' modes might show better results. In any case, 'good old SSB' seems to work pretty well, with both David HI8DL and **Edgar HI8PLE** working LU2EPO at a distance of 6102km on November 29th. Previously on November 26th, David had worked LW2DAF at a distance of 6011km on FT8.

It was great to hear from **John Farrar G3UCQ** who wrote, "*Your article in the January 2021 issue of* PW *prompts me to tell you of the first time I encountered TEP. In the RAF I was posted to Cyprus in 1962 and, being a very keen SWL, soon met up with some of the local hams. Notably* ***George Barrett ZC4GB*** *(who always entered BERU and was an excellent CW operator) and* ***'Chalky' White ZC4CW****. It was the latter who was conducting TEP tests from Cyprus to Southern Rhodesia as it was then, the path being at virtually right angles to the Equator. His equipment was a Heathkit DX-40 with 75W of CW on 10m. The station was acting as a beacon and to send his callsign he had a rotating 78rpm record with notches cut in the rim so the parts left keyed the transmitter. No computers then! He had discovered that signals often peaked just after sunset. He was also receiving signals from S. Rhodesia (I have forgotten the callsign), which were written onto a paper tape with an inked pen. I believe he had an article on the subject published in the ARRL's magazine around 1965".*

My own first introduction to TEP was back in 1987 on a trip to Gibraltar, operating as ZB2/G4VXE on 50MHz. I had an Icom IC-505 portable with 10W output and a wire dipole. As I recall, I did not make many contacts. I did work **Kosie ZS3E** (South West Africa, what is now Namibia) who was a very prominent signal on 6m from Africa at the time. I remember hearing **Hal Lund ZS6WB** who was a well-known 6m DXer but cannot now remember if we managed to work or not.

On 50MHz, it is possible to work TEP from the UK, particularly the southern part of the UK and occasionally, particularly in the Spring, Sporadic E to the Mediterranean area from northern areas (including the UK) will couple with a TEP opening and provide opportunities to work into Africa. Back in the late 1980s, this was quite common and even with a modest station I can remember working South Africa, Zimbabwe and Malawi for starters. Others who were active at that time will have done much, much better than me.

The 2m band, though, is a different story and I am not aware of any TEP contacts being made from the UK. Back in 1979 I4EAT (JN54) worked ZS3B (JG73) on TEP, which remains the Region 1 TEP record on 2m. In 1982, OK1MBS (JO70) heard the ZE2JV/B beacon (KH52) in what is now Zimbabwe.

There is lots of enthusiasm to try the paths from Europe to Africa from the European side, so it will be great if some African stations are willing to point their beams north and see what is possible. There are good contacts waiting to be made, I am sure.

For what it's worth, 432MHz may support the propagation too! In 1981, I can find details that OK1AIY/P (JO70) heard ZS6LW (KG43) although the SSB contact was not completed.

On the other side of the world, the path between Japan and Australia is another very interesting one for VHF propagation with plenty of 2m QSOs being recorded as well as 6m contacts.

The 6m Band

On 6m **Tony Collett G4NBS** (Cambridge) has been plagued with local noise recently, but found the noise reduced a little to allow some UK working and he managed to complete with GD8EXI and GW0GEI in the December 10th UK Activity Contest. On the evening of December 11th he worked SP5Y (KO02), 9A5M (JN95) and EB1HRW (IN71), all on MSK, as Tony says, without resorting to ON4KST for skeds.


1

The 4m Band

Gordon Smith GW6TEO (Castlemartin) managed to get on the 4m band for a couple of days for some meteor scatter contacts, working DL6BF (JO32), OZ1BUR (JO46) and DM2BHG (JO51).

The 2m Band

Jef VanRaepenbusch ON8NT said that his 2m activity had been reduced owing to a faulty computer, but spurred on by the warning from the TV weatherman, **Frank Deboosere**, of an upcoming temperature inversion, Jef made a PC up quickly! He made some nice contacts on November 29th: F4FMB (IN96), F8PRC (IN99), F6CIS (IN94), EA1HRR (IN83), EA1MX (IN73),

Fig. 1: Simon G6AHX's antennas for 2m and 23cm. Fig. 2: ZB2GI's portable system used to receive SSTV pictures from the International Space Station. Fig. 3: G3VKV on DATV as received by Dave G4FRE.

F4ILK (IN97), GU6EFB (IN89), EA2XR (IN83) and F8BON (IN86). Jef says he also received an e-mail from EA7HLB saying that he had copied Jef's signals – I'm guessing a meteor burst was responsible. Next day, Jef worked F6AQN (JN08). All stations worked on FT8 with 25W from an IC-9700 to a 5-element log periodic.

Godfrey Manning G4GLM (Edgware) was pleased to work G4CLA (IO92) during the UK Activity contest on December 1st. Godfrey runs 3W SSB to a big wheel antenna. Signals were weak but steadily readable.

Tony G4NBS says that his noise level is getting worse and it is impossible to hear European stations on SSB/CW outside a lift. During UK Activity contests he can usually work GM3SEK, GD8EXI and GI6ATZ but during both November and December sessions also worked GD1MIP. On December 1st, Tony worked GD6ICR, GD0AMO/P, GM4JTJ and GM4AFF. A surprise in the 2m AFS was to work GM8MJV and GM4PPT as well as GM3SEK and the last QSO of the session was with G4ELI (IO70). On the evening of December 11th, Tony worked EB1HRW (IN71) on meteor scatter (random MSK144). During an opening on December 2nd, Tony made 32 QSOs in 15 squares IO71/80/82/83/91/92 and JO01/02/10/20/21/22/31/32/33.

Tony also mentions an organised FT8 Activity period during the first Wednesday of each month from 1700 to 2000UTC on 2m, with the second Wednesday of the month at the same time being the 432MHz session. See details:

www.ft8activity.eu/index.php/en

Simon Evans G6AHX (Twyning) took part in the AFS contest on December 6th, with the best DX being GD8EXI (IO74) at a distance of 289km.

Andy Adams GW0KZG (Letterston) has been busy with other projects but worked F8BON during the opening on November 18th. Andy says that during the Leonids meteor shower, he tried a sked with EA8TX (IL18). They tried several times, heard signals, but were unable to complete. The best was on November 17th when there were three bursts. Not bad over a 2800km path!

Gordon GW6TEO says that contacts have been very sparse because he has had to keep his tower luffed over for much of the time, on account of the gales that seem to have been almost continuous. Gordon managed to get on for a few meteor scatter QSOs on December 6th, working S51AT (JN75), IV3/HB9CAT (JN65), IK0BZY (JN61), IV3GTH (JN65), IZ2PO, IK1EQE (JN44) and OZ1HDF (JO55).


2

Here at **GW4VXE** (Goodwick) I enjoyed the opening on November 17th, working F6CIS (IN94), EA1MX (IN73), EA1HRR (IN83), EB1FNS (IN73), F2MM (IN95), EA1U (IN62), F4VPC (IN87), and EA2XR (IN83). November 20th saw another opening to Northern Spain with EA1UR (IN62) and EA1M (IN53) worked. EI3FW (IO54) was a nice one on December 1st and F5TXM (IN98) and F6APE (IN97) were worked on the 2nd along with some East coast UK stations, including G4NBS (JO02) and G3YDY (JO01). It was really great to work G8ECI (JO03) on December 7th, on aircraft scatter – a new square from here. During the MGM contest on December 12th, I was very pleased to work GM0HBK (IO77) and GU6EFB (IN89). Plenty of stations, including OY9JD, were heard on meteor scatter too!

The 70cm Band

Keith Watkins G8IXN (Redruth) found 70cm conditions good on November 29th, working a station in Dorset via the Isle of Wight Repeater, GB3IW. Keith also noted the Pembroke repeater GB3SP strong and Irish DMR audible on 439MHz. One of the 'propagation indicators' used here at GW4VXE is a DMR handheld sitting on the windowsill of the shack, tuned to the EI7MLD digital repeater on Mount Leinster. When the radio springs into life, I know things are on the up.

Jef ON8NT also caught the tropo on November 29th, working G0RQL (IO70) and F8BON (IN86) with F6CIS (IN94) worked the next day.

Tony G4NBS writes, "*70cm is the only band where I can hear as well as I used to but still odd noises appearing in unwelcome places. Up here GD8EXI, GD0AMD/P and GD1MIP are easier to work and I can normally work GM4JTJ without waiting for a big plane. In the October UKAC I worked GM3SEK, GM4BYF, GM4JTJ and MM0CEZ, then in the November UKAC it was GM3SEK, GM4AFF, GM4BYF and GM4JTJ but conditions in the December UKAC were probably the worst I've ever encountered. IO93 is normally my 'bread & butter' but I could hardly hear any this time and the regular G4FZN/P, G4KUX and G8PNN/P were all much weaker than normal. The QSO with GM4JTJ was harder than normal and we had to wait for that plane to come along this time! The other side of the country was more normal with GD0AMD/P, GD1MIP, GD8EXI, GI6ATZ and GM3SEK all worked OK.*"

On October 14th, Tony worked 20 QSOs in eight squares with DO6BI (JO42) being the furthest. On November 11th, Tony made 25 QSOs in 13 squares with DD1OP (JO42) being the best DX. Tony says that despite the poor conditions in the December UK Activity contest, the next day produced 21 QSOs in 11 squares. Tony goes on to say, "*What is interesting, at least on 70cm, is that most of the Dutch stations are using omni verticals and 20W to 50W but they can't hear my 150W to a horizontal beam*

when conditions are poor! Probably about another ten PA/ON/F stations were seen that I couldn't raise, some of them I messaged via JTAlert to let them know they were being heard, all of those I did were on verticals".

The 23cm Band

Simon G6AHX writes, "*I restored the 23cm system using my IC-9700 with the Dual 36el beam and a preamp by the antenna. Particularly in winter here, I only have a couple of antennas up on the mast so it doesn't get blown down. Once the antenna change had been done, I arranged a sked with G1YFG in Bewdley. With similar antennas at each end (**Fig. 1**) I reduced the 9700's output to 0% and he could just copy me. One of the local amateurs just across the Avon, G4NZV, has a weekly sked on the band with his father-in-law G3SQQ. I have been joining in when possible".*

3

Satellites

Kevin Hewitt ZB2GI writes, "*Moscow Aviation Institute hosted another Inter MAI 75 SSTV event on December 1st (1230 to 1825UTC) and December 2nd (1150 to 1825UTC). However, no images were transmitted on the 1st. The activation periods coincided with ISS orbits over Moscow. The ARISS transmitted on 145.800MHz FM using PD120.*

"I received five full images with one duplicate during two passes (15° and 46°) from the top of the Rock on December 2nd. My setup comprised a Yaesu FT-817 connected via a data interface to a Win7 Notebook PC running MMSSTV and a manually tracked 2m/70cm Log Periodic". See **Fig. 2** for Kevin's setup.

As ever it's great to hear what **Patrick Stoddard WD9EWK** has been up to. He writes, "*In mid-November, I made one of my periodic trips to a grid boundary about an hour's drive north of the Arizona state capital, Phoenix. This spot straddles the DM34/DM44 boundary, not far from a freeway, with a little bit of off-road driving to reach it. I spent a couple of hours at this point, handing out contacts to stations across North America. After a couple of AO-91 passes, it was back home down the freeway.*

"At the end of November, after the Thanksgiving holiday, I made a longer trip toward the southwestern corner of Arizona. Out there, another grid boundary – DM22 and DM32. After a cold start to the morning, seeing the temperature on my car's thermometer reach freezing point, it was a nice day to be out and playing radio, on a grid boundary that other satellite operators around North and Central America were hoping to log. Working FM, SSB, and packet through the ISS digipeater, I logged 89 QSOs on 15 different passes. But that wasn't the end of the day on the radio...

"Instead of taking a more direct route home, I made a detour north. Driving parallel to the Colorado River, the border between Arizona and California, I made it to another rarely-heard grid on the satellites over here, DM23. By the time I reached this area, it was dark. No lights along the highway. I parked and used my car's lighting along with a couple of flashlights to set up for a four-minute AO-27 pass covering the western USA. With four contacts in the log at this location, I packed my gear and drove home, completing a drive of over 400 miles.

*"With the holidays approaching, there have been others getting out and operating away from home. **Mitch AD0HJ** just concluded a drive from northern Minnesota down to Kansas and Oklahoma, activating lots of grids on the way. Many others have been getting out, activating a grid or two, helping other satellite operators get these grids in their logs. Even with the continuing COVID-19 pandemic, these operations are ways to enjoy the radio while keeping some distance from others.*

"The new radio on the International Space Station was switched from being a packet/APRS digipeater back to a crossband repeater in early December. Based on an update from ARISS, it appears this will remain active through late January or early February."

I asked Patrick what the situation is with the AO-91 satellite and he replied, *"It recently started experiencing issues with its rechargeable batteries. When the satellite isn't in sunlight, the battery voltage is dropping below 3.6V, causing the satellite to switch into 'safe mode'. The FM repeater is not active while in safe mode, but switches back on after the satellite re-enters sunlight and begins to recharge the batteries. For now, AO-91 is operating normally when in sunlight, and AMSAT is monitoring the situation. We hope AO-91 doesn't follow AO-85 and AO-92 into silence..."*

With AO-91 at apogee in early December it was fun to try for some longer distance contacts at GW4VXE. Best DX was AA8CH/P (EN61) on December 2nd being the best DX. On November 23rd, I worked VE1CWJ, MI0ILE, KB1HY and AA8CH (this time in EN72). I really enjoy AO-91 and hope that the batteries hang in there.

Digital TV

Dave Robinson G4FRE (Malvern) reports that he was pleased to have a two-way DATV QSO with **Graham Jones G3VKV** (Cheltenham) on 2m, **Fig. 3**. Dave says, "*Onwards and upwards, with 70cm next once Graham finishes off his PA!*" Dave says that he was using his new Ryde1 DATV receiver, which he reports is excellent for home use, but might be less convenient portable.

I was interested to learn from **Pete Goodhall 2M0SQL** that Elad are marketing a commercial version of the Minitiouner – Pete found details on the Elad Italy site (below). This may be a good option for people who don't want to build their own.

https://tinyurl.com/y84o88oc

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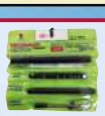

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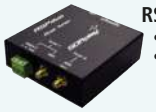

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Getting Started (Part VII)

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

Colin Redwood G6MXL briefly looks at the various ITU Regions and Zones, CQ Zones and IARU locators before exploring Worked All Britain.

I will start this month by looking at some of the ways the world is divided up for amateur radio purposes, especially for various awards and contests.

ITU Regions

The International Telecommunication Union (ITU) splits the world into three regions. Region 1 encompasses the whole of the continents of Europe and Africa. Region 2 covers North and South America, Region 3 covers Asia and Oceania. Many of our HF band-plans are based on ITU Regions. For example, here in Region 1 the 40m band now covers 7.000 to 7.200MHz, but in Regions 2 and 3 it extends up to 7.300MHz.

ITU Zones

The ITU splits the world into 90 ITU Zones, which are very roughly of similar areas. The British Isles along with mainland France, Benelux, Andorra and Monaco are in ITU Zone 27. The full list can be found at:
https://tinyurl.com/y4x64h3m

CQ Zones

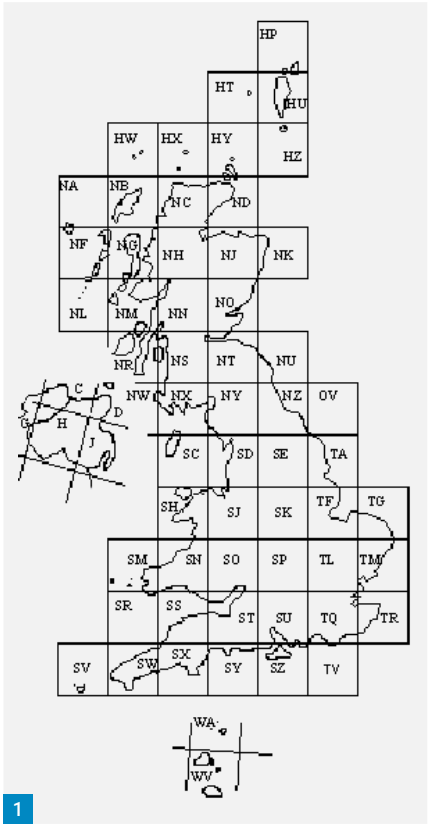
For its contests and awards the American *CQ* magazine splits the world into 40 zones. The British Isles along with much of Western Europe are in CQ 14. During the various contests organised by CQ magazine, you'll often hear reports of 59 14.

IARU Locators

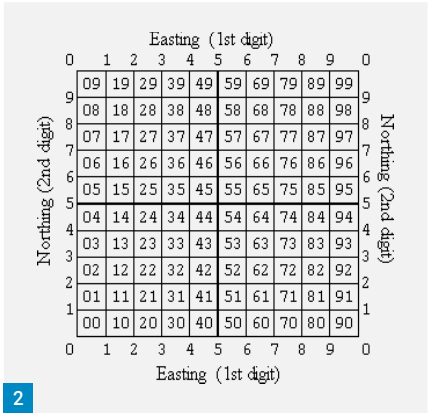
For worldwide use, the IARU or Maidenhead locator (sometimes called Grid) system is used internationally. It is derived from latitude and longitude. This is usually seen as six characters (two letters, two numbers, two letters) such as IN89VR. Knowing the IARU locator of a station can be incredibly useful when rotating a directional antenna such as a Yagi or dish.

The IARU locator is often part of the information exchanged in VHF and UHF contests and by VHF and UHF DXers. There are established routines for calculating the distance between stations.

IARU locators are beginning to be used on the HF bands. If you have used FT8, then you'll have come across the first four characters being used as part of the information exchanged. The ARRL also had a year-long award scheme based on 'Grids' in 2018. And some HF contests have been using the locator as the contest exchange for a number of years.



1



2

Finding Your IARU Locator

You can find your locator by visiting the site below, entering your nearest large town or city and then navigating to your actual location.
https://tinyurl.com/ycec66pg

WAB

In the UK, Ordnance Survey maps can also be used to define a location. The Worked All Britain (WAB) award scheme is based around the first four characters of the National Grid Reference (a 1km x 1km square).

Even if you're not interested in amateur radio awards or contests, it is likely that from time to time you may be asked for your WAB area by other amateurs. These requests may come from stations within the British Isles and beyond.

Over the years WAB has grown into one of the largest award schemes based in the UK, fostering an increase in mobile activity not only on the LF bands, but also 4m, 2m and other bands. It has also encouraged many mini expeditions to the more remote parts of Britain.

WAB Squares

Some of the WAB awards are based on the National Grid 100km x 100km squares in the United Kingdom, **Fig. 1**. These are known as large squares. These large squares are sub-divided into 100 10km x 10km smaller squares, **Fig. 2**. These smaller squares are allocated two letters and two numbers (e.g. SZ09) and, together with the country (e.g. England), define the WAB area.

The squares used for WAB are not the same as the IARU locator squares that I mentioned earlier.

To participate in any WAB activity, you'll need to know the WAB area that you are actually operating from. To find this, refer to a sufficiently detailed Ordnance Survey map of the area.

The first letter and the first digit give the position on a horizontal scale, which is read across the top or bottom of the map. The second letter and second digit

Fig. 1: Large WAB Squares (courtesy of WAB).
Fig. 2: Small WAB Squares (courtesy of WAB).
Fig. 3:WAB 'Books' now come on a USB stick.
Fig. 4: The WAB Large Squares Award (courtesy of WAB).

give the position on a vertical scale, which is read from either side of the map.

There are thousands of WAB areas to try to work! Sometimes mobile stations will drive around a district giving an opportunity to work several neighbouring WAB areas over a few hours.

Membership & Books

Lifetime membership of WAB currently costs £7.50, for which members receive a WAB numbered 'book' in the form of a USB stick, **Fig. 3**. This can be used to track your progress towards the various WAB awards. Some members buy more than one WAB 'book'. In case you are wondering, historically WAB books were indeed books, but with increasing use of computers in shacks, a decision was made to move to CDs and more recently USB sticks. WAB also publishes an A5 size quarterly magazine, which is available for £6.50 per annum by post.

WAB Awards

The WAB awards are open to all radio amateurs. Any band and mode that you are authorised to operate on can be used towards the awards. I have summarised the basic requirements for the main WAB ongoing awards in **Table 1**. Please refer to the WAB website or WAB Award book for more details. In most cases there are stickers available for working a higher number of squares, members, trig points, islands etc. Most of the awards are also available to listeners, **Fig. 4**.

In addition to the ongoing awards, there are a number of other WAB awards that run for a limited period of time. For example, there is a Winter award for contacts between December 1st and the end of February to encourage activity when portable and mobile activity may be less attractive for some. Details of all current awards can be found on the WAB website. I would strongly recommend that readers check the full rules for each award on the website at:
http://wab.intermip.net/default.php

Applying

To apply for a WAB award, you'll need to complete the relevant claim form from the WAB website and submit the appropriate fee (currently £3 per award for most

3

awards). QSL cards are not required for any of the WAB awards. Nevertheless, WAB sell some attractive blank QSL cards, which certainly are a good way of getting into QSLing before getting QSL cards printed with your own details on.

Bands

While any band can be used to make contacts towards WAB awards, I suspect that most WAB activity takes place on 40m, as it is often the best band for contacts within the British Isles. If you don't have a capability to put out a good signal on 40m, then you are certainly going to find it harder to work towards some of the WAB awards, especially if you have a small garden at home which makes fitting in a 40m band antenna difficult.

Using a mobile or portable station on 40m is well worth considering, especially as you can then operate from different WAB areas. The VHF bands for well-sited stations can also be used for WAB. Given the relatively small size of simple 2m antennas, I think it is a good idea to take at least a 2m handheld when out portable.

Nets

A net is where a group of amateurs take it in turns to transmit to others in the group. Some nets, such as those run by the WAB, are well organised and disciplined. Other nets may be less organised and far more informal.

WAB Nets

One very popular way of gaining necessary WAB squares, book numbers and trig points etc. towards the various WAB awards is to participate in the WAB nets. The WAB nets require some discipline from all the participants. A net controller is used to help the nets run smoothly and efficiently.


Worked All Britain
LARGE SQUARES AWARD
This is to Certify that
Philip Wattie RS88763/886
has been listening to Amateur Radio Stations in 52 One Hundred Kilometre Squares of the Ordnance Survey grid of Great Britain & Northern Ireland and is awarded Certificate Class II
Mode SSB Band 40 metres
18th April 2002
Certificate No: 1018 / 686
Awards Manager
4

You should only call into the net when the net controller asks for check-ins. The net controller will usually decide to give priority to mobile stations so that they can work everyone on the net. This allows the mobile station to get underway – hopefully to activate another WAB area. Occasionally the net controller may give priority to a portable station where circumstances make a compelling case for this.

Make a note of the sequence of the stations in the net and in particular your place in the list, so that you know who to pass transmission to after you have worked the station (usually a mobile or portable station) that is being 'run down the net'.

When exchanging signal reports, you should repeat the signal report you received back to the station you are working. This is to ensure that you have got the report correct. This can take a bit of getting used to, but it's quite an effective way of confirming the details

Award Title	Bands	Basic Requirement to Work / Hear / Activate
WAB Squares Award (UK)	HF	300 10km x 10km WAB Squares
WAB Squares Award (UK)	VHF	150 10km x 10km WAB Squares
Channel Islands Award	Any	5 WAB squares in the Channel Islands
Isle of Man Award	Any	5 WAB squares in the Isle of Man
Large Squares Award	Any	30 100km x 100km Large WAB Squares
Islands Award	HF	25 Islands
Islands Award	VHF	10 Islands
Book Numbers Awards	Any	100 Book Numbers
Members Award	Any	50 WAB Members
Overseas Members	Any	10 WAB Members outside Great Britain and Northern Ireland
DX Award	Any	WAB Members operating from 10 different countries
WAB Expedition & Mobile	Any	Activating 100 WAB Squares
Navigation Aid to Shipping	HF	25 Land-based lighthouses etc.
Navigation Aid to Shipping	VHF	10 Land-based lighthouses etc.
Trig Point Activated	HF	Activate 15 Trig Points
Trig Point Activated	VHF	Activate 5 Trig Points
Trig Point Worked	HF	Worked 15 Trig Points
Trig Point Worked	VHF	Worked 5 Trig Points
Coastal & Tidal	HF	Working 50 WAB Squares containing tidal water
Coastal & Tidal	VHF	Working 15 WAB Squares containing tidal water
Worked all GI	HF	Working 10 WAB Squares in Northern Ireland
Worked all GI	VHF	Working 5 WAB Squares in Northern Ireland

Table 1: The basic requirements for the main WAB ongoing awards

without the need for QSL cards.

As with so many aspects of amateur radio, I would suggest listening to a couple of nets (7.160MHz LSB is a good place to start listening) to get the idea before joining in. I would also suggest letting the net controller know that it is your first time on a WAB net, so that they can help you get used to the way WAB nets operate.

Incidentally reports exchanged are 'real' reports, and not just RS 59 reports that are so often heard on the bands these days.

WAB Contests

WAB run a number of contests throughout the year. The main bands used for these are 160, 80, 40, 20, 6 and 2m. In most cases these are phone contests, although there is also a data modes contest. The 6m and 2m contests are scheduled to run alongside RSGB contests on the same bands. I'm always struck by the friendly nature of WAB contests.

Charity

WAB is run entirely by volunteers. Each year the WAB group donates a significant sum of money to amateur radio charities such as the Radio Amateur Invalid & Blind Club (RAIBC) and St. Dunstan's Amateur Radio Society along with other charities from the proceeds of the income it receives from members applying for membership, books, awards, and returns on investments from legacies.

Addictive

WAB square chasing can be very addictive. Unlike DXing, where operating technique and manners can get forgotten at times, WABers have a remarkable ability to keep things in perspective, which tends to make WAB activity quite a pleasurable experience. You'll also find that you get to know the geography of the British Isles far better than perhaps you have done before – another of the aims of the WAB awards! You can find more information about WAB at: http://wab.intermip.net

Radio Round-up

RBN ENHANCEMENT: DX Engineering has provided equipment as part of an effort to add 15 nodes to the Reverse Beacon Network (RBN). RBN is a global system of software-defined radio receivers that monitor amateur radio bands and report CW, RTTY, and FT4/FT8 signals to a central database.

Benefiting both amateurs and the space weather/geophysics scientific community, the global RBN node project is made possible through a grant from the Yasme Foundation in cooperation with Amateur Radio Digital Communication (ARDC).

Each node includes a DX Engineering ARAV4-1P Active Vertical Receive Antenna, a Red Pitaya 122-16 SDR, and CW Skimmer software by VE3NEA. RTTY Skimmer and WSJT-X software can also be used.

Designed and manufactured by DX Engineering, the ARAV4-1P can be used in installations when spacing from transmit antennas is less than 1/2 wavelength but more than 1/10 wavelength (on the lowest frequency). It is recognised for its weak-signal sensitivity, third order intercept of +30dBm, wide bandwidth (100kHz to 30MHz), reduced noise, and durability.

In October, a Yasme-funded node was successfully installed in Tunisia, bolstering RBN representation in northern Africa. Additional nodes are planned for Algeria and Libya. The success of this small program led to the global 15-node project to expand the RBN into under-represented areas such as the Caribbean, the South Pacific, Central Asia, the Middle East and South America.

Among other benefits, the RBN enables radio amateurs to see near-real-time band openings on an animated map, maintaining a database of 'spots' that record what stations have been heard, on what frequencies and at what times. Reports from RBN receivers can be used to assess antenna performance and where a station is being heard after one or two CQs. PSK Reporter and WSPRnet are complementary networks that also spot automatically received and decoded signals of other modes.

The archived data has been used by the research community to analyse ionospheric and geomagnetic phenomena, as well as solar events such as the August 2017 total solar eclipse. Use of RBN data is discussed on the HamSCI website, which provides a forum for researchers and amateurs to interact and conduct studies and experiments. www.hamsci.org

"This large and growing database of records supports scientific research and allows hams to be more effective on the air and in planning operations and station design," said Ward Silver N0AX, president and director of the Yasme Foundation.

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Low Noise Antenna Options for Small Gardens

Joe Chester M1MWD
m1mwd@gmx.com

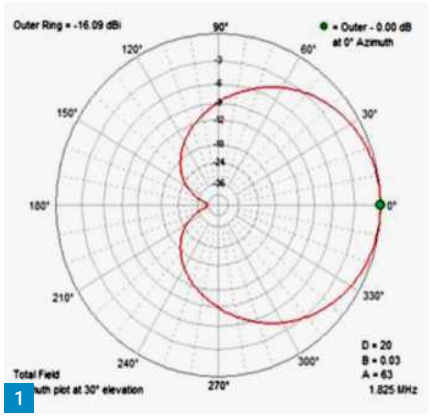
Joe Chester M1MWD takes a look at options for receive-only antennas where space is limited.

Over the past few months I have been active on 80m most mornings. I haven't ignored the higher frequency bands. For instance, I worked Indonesia in a recent contest, an all-time new one for me. But, in general, conditions on the higher bands have been suffering from the lack of sunspots, although things are starting to look better as I write this. One of the daily topics discussed on the 80m nets, and even in random QSOs, is the background noise from man-made sources. Elsewhere, I invited those struggling with this issue to become creative to avoid the noise, and in particular, to use the many online web-SDRs as a workaround.

But what about other solutions to this problem? I think that today we have a very particular issue with the noise generated by the current implementation of broadband connectivity, xDSL. Much work is in hand to try to effect change here, which is good. But there are other contenders for the most annoying noise generator – principally poorly made switch-mode power supplies, and action on xDSL won't fix this problem. Meanwhile we struggle on, but there are things we can do to lower the impact of local man-made noise. These include the idea of the low-noise receive-only antenna, which comes in various forms – the BOG, the EWE, for example, and of course, the active loop and the E-field probe.

The BOG

Let's start with the BOG – which stands for the Beverage on the Ground. The Beverage is a very old antenna, going back all the way to the very beginnings in 1920, with some experiments by **Harold Beverage** even earlier. He discovered that the mostly omnidirectional long wire antenna became unidirectional if it is mounted over a lossy ground and one end is terminated by a resistor. Note the lossy ground here – I will say more about this later. Beverage's patent dates to 1921. To understand the Beverage, you need to realise that this is not a resonant antenna, like a dipole or a monopole where RF energy exists as a standing wave. The Beverage is sometimes called a travelling-wave antenna, because the RF moves in just one direction along the wire, in the same direction as the radio wave. Also note that this a receiving only antenna. If you transmit into it all the RF energy goes straight to ground because of that resistor.



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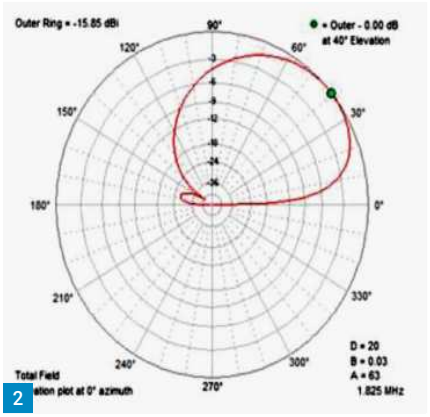

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It has one other disadvantage for those of us with small stations. It's long, very long! Typically, one or even two wavelengths long on the frequency in use. For example, for a 160m two-wavelength Beverage, we are talking about 300-350m long. You need some serious real estate to run this out, unless you can persuade the neighbours to allow you to run it along their back fence or hedge. It also needs to be mounted one to two metres above ground on insulated posts. The terminating resistor can be between 400-600Ω, the characteristic impedance of the wire, and well grounded. It also needs something like a 9:1 transformer to reduce that end impedance, for presentation to the transceiver at the other end. But what about the performance?

The Beverage is hard to model with the NEC computer modelling software, but it can be done. You will find the resulting radiation pattern in the *ARRL Antenna Handbook* and online. **Luis IV3PRK** has his results (**Figs. 1** and **2**) on the website below. The advantages of the antenna arise from its directionality. Put quite simply, the Beverage has a huge lobe along the length of the wire, from the transformer end towards the terminating resistor, reminiscent of that of a beam antenna. Of course, unlike the beam, the Beverage can't be rotated – although its directionality can be reversed, by terminating both ends suitably. But if the downside is that it can't be rotated, its directionality delivers huge advantages. This is because of the huge front-to-back selectivity of the antenna, which can be more than 20dB in some installations. Going back to the ground issue I mentioned earlier, note that the Beverage should be mounted over lossy ground. When mounted over good or very good ground, the front-to-back ratio declines sharply. In effect the Beverage has a huge impact on the signal-to-noise of incoming RF energy, which is why it's so popular with DX hunters. Surely there must be a way to be able to mount one in a small space?

www.iv3prk.it/bog-modeling.htm

The EWE

Well, I think there may be. Let me introduce you to the EWE, so called because of its profile. It's an inverted U! This idea goes back fewer years than Beverage, to **Floyd Koontz WA2WVL**, in *QST* February 1995. He was working on directive wire antennas, mainly loops, when he came up with a

Fig. 1: Azimuth plot of BOG.
Fig. 2: Elevation plot of BOG.
Fig. 3: Plots of EWE.

unique design. Although it might look a bit like a bent Beverage, and indeed that's what I thought when I first encountered it, its mode of operation is actually quite different. You can view the EWE as a vertical two-element array, or as a loop, with the ground plane acting as the lower element. Whatever, the EWE has many of the characteristics of the Beverage. The radiation pattern, **Fig. 3**, from Floyd's website, below, is a horizontal cardioid along the direction towards the terminating resistor, with a deep null on the reverse. Again, a front-to-back ratio of 20dB or more is achievable, giving the EWE good low-noise performance.

https://tinyurl.com/yysynaxq

Again, the EWE is not easy to model in NEC, but it can be done. I have taken the diagram for this antenna from referenced online sources, so that you get an idea of what the modelling says. Experiments by others show that the precise dimensions are not critical for either antenna. So, I believe that the EWE is doable in a small garden, or even on my barge! Putting up a EWE, about 5m high at both ends, and with a length between verticals of about 11 to 12m, should be within reach at this QTH. So, my next challenge is to gather the materials, including mounting poles, and the hardware to mount these. The end impedance for the EWE is said to require a 3:1 transformer so I will need to source this as well.

Other Possibilities

Active antennas are popular choices with operators struggling with noise problems. Magnetic loops and E-field probes can both help, but in different ways. Both the Wellbrook loop and the E-field probe by **Roelof PA0RDT** are reviewed by **Steve G0KYA** in his book *Stealth Antennas*, available from the *PW* Bookshop. Some have built their own versions of these receive antennas. In use, the loop can be mounted on a rotator, and turned to minimise the incoming noise, and the probe mounted up at 8m, on a fibreglass pole. There are many good reviews of these antennas, but I suspect that their performance is very site sensitive. At some QTHs they seem to perform well, but others have had more variable results.

The Engineering

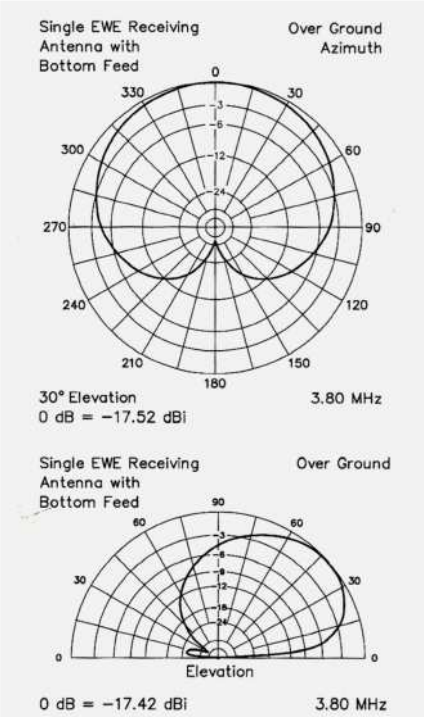
Now we come to the engineering of the station in order to be able to take advantage of one of these low-noise antennas. The issue is switching between the receive and transmit antenna. The low-noise solutions I have described cannot be used for transmission, so a means to switch antennas on transmit is needed. What I really need is a transceiver with two (or more) antenna inputs, and where the Tx/Rx switching is taken care of inside the transceiver (more about this idea in another piece). That said, I have researched and found, with input from the 80m net denizens, several ways to achieve what I want with my existing transceiver.

One solution comes from MiniKits, the EME215 active receive antenna switch. This is either a kit, or can be supplied built, and provides switching of two antennas triggered by a line from the transceiver's ACC socket, with an isolation from radio to the receive antenna of >55dB.

Another solution comes from the MFJ 1708B-SDR. This device is RF sensing and designed to prevent damage to a separate SDR receiver. To use this device, I could connect the receive antenna, my EWE, or E-probe to my KX3, and then use the MFJ box to isolate my receive system when I transmit with my IC-7300. Isolation is said to be better than 60dB (which is what they told me when I contacted them). So, if I've done the calculations correctly (every 3dB halves the power), then 100W from the transmitter results in less than 0.00002W getting anywhere near my KX3! It does however leave a question I can't answer – how fast does this circuit operate? I don't think I'd like 100W of RF getting into my KX3, from six inches away, even for a fraction of a fraction of a second. More research needed. But I think I prefer the idea of switching with the PTT line, as the MiniKits does. I also know of an operator who has ordered one of these kits for use with his active loop – so hopefully I should get a report soon!

Then, specifically for the IC-7300, there is the RX7300. This little device allows IC-7300 owners to add a second receive antenna socket to this transceiver. Once installed, this modification allows the IC-7300 to transmit through the SO239 socket, but to receive through the antenna connected to the RX7300. This is an easy mod to install, which requires nothing more than resiting a single cable inside the transceiver (again easily reversed if required). But the worry about transmissions into the receive antenna remains. The receive path of the KX3 is diode protected. But I think I would be happier if there was some kind of RF limiter between the receive antenna and the receive antenna jack. DX Engineering have what looks like a suitable device, but there are circuits online if you want to DIY one yourself.

There is a very interesting alternative to all these, which I hope to talk about next time. But for now the plan looks like this – put up the E-field probe, and connect it to my KX3, to compare what this is hearing to my IC-7300. Of course, I won't transmit with this setup, but I will report back what I find. Then I think I will try to set up the EWE. Much of this is weather dependent, but I'm looking forward to starting the work. And to the results!



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MAT-180H is an automatic antenna tuner designed for modern ICOM and Kenwood HF transceivers, 0.1-120 Watts, 1.8-54MHz..... **£159.95**

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Sharman have been totally focused on sourcing and distributing radio communications and hobby products for dealers, distributors, and retailers throughout the UK, Ireland and Europe for many years. They produce a lovely range of power supplies to compliment their range.

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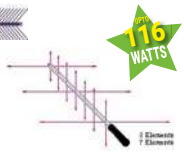

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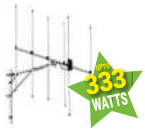

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CS Premium RG58 10M (PL259 to BNC) **£19.99**
CS Premium RG58 10M (PL259 to N-TYPE Male) **£19.99**
CS Premium RG58 10M (PL259 to SMA Male) **£19.99**
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CS Premium RG58 10M (PL259 to SMA Male) **£19.99**
CS Premium RG58 10M (N-TYPE Male to N-TYPE male) **£19.99**
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CS Premium RG213 1M (BNC Male to N-TYPE Male) **£19.99**
CS Premium RG213 1M (PL259 to BNC Male) **£19.99**
CS Premium RG213 1M (PL259 to N-TYPE Male) **£19.99**

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MFJ offer the best range of analysers the most popular being the MFJ-259C

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MFJ-249D HF/VHF/UHF 530kHz-230MHz with analogue meter...**£379.95**
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MFJ-393 are professional grade MFJ Boom-Mic Head-phone set is for contesting, DXing and traffic nets. Comfort designed leatherette padding lets you operate for hours at the rig. Superb inch thick padding on each ear and headband. The MFJ-393 is so super lightweight, you won't even know you are wearing them Available pre wired for ICOM, Kenwood, Yaesu.....**£79.99**
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Chose between dry and oil filled
dummy loads between 15-2500W

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These switches are built like a rhino, tough inside and out! A superior internal design lets them work for you for a long lifespan.

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MFJ-2703N N-Type 3-Way 0-1.5GHz 2kW.....**£109.95**
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MFJ
Cobweb Antenna

Restricted space spoiling your operating fun?
MFJ Cobweb puts your call back on the map!

This six-band (20, 17, 15, 12, 10, 6 Meters) full half-wave Cobweb Antenna is perfect for restricted space or portable operation. Sky-gray fiberglass spreaders and nearly invisible wire elements (flat 9x9x1/2 feet square. 8 pounds), blend in with your surroundings while standing tough against nasty weather. Outstanding performance! Horizontally polarized for less local noise pickup plus solid gain over verticals will allow you to work DX easily -- even on QRP. Omni-directional. No radials needed! Works great at low heights. Low SWR is due to MFJ's exclusive Spider-MatchTM broadband network

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MFJ
MFJ-2100
HF Octopus antenna base

Octopus antenna hub turns your ham-sticks into four fully balanced dipoles in minutes! Mix and match any four HF/VHF/UHF bands. Example: screw in 80,40,20 meter hamsticks and a dual band 2M/440 MHz whip (two on each band) on opposite sides. Now you have an automatic band switching 5-band dipole! Rotate it for maximum signal and minimum QRM and noise with a small rotator like Hy-gain AR-500,
Works at any height, low for local NVIS and high for DX. At a fixed height, (say 20-30 feet) use 80-Meters for NVIS and 20-Meters for low-angle Exomoons on any mast up to 1-inch in diameter. Use a fiberglass pole on a tripod and you are on the air! Check out our MFJ-1919EX a perfect mount for the new Octopus Antenna. Perfect for casual portable operation, limited space, HOAs, field day, camping, and ARES. Single coax feed, built-in balun.....**£139.95**

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Antistatic Mat and 30MHz Signal Generator

Geoff Theasby G8BMI
geofftheasby@gmail.com

Geoff Theasby, G8BMI has two more suggestions for useful items around the shack.

Good morning, children, now settle down. Today we will look at 'Electronics'. The Cat sat on the Anti-Static Mat...

The use of such mats is common in industry, but not so among hobbyists and enthusiasts. The aim is to provide a safe environment for handling electronic components that are prone to damage by static electricity, CMOS devices particularly, and to avoid losing small parts. The mats don't need to be earthed as such, so long as the same electrostatic field strength conditions prevail across the bench area, but it is usual. Several versions are available, measuring about A3 paper size, 300 x 420mm, for about £12. Most have pockets, trays and ridges moulded in, and an all-round lip, to retain components and tools for instant use without rolling about or dropping on the floor. These mats are quite flexible, laying flat on the work surface, heatproof to 500°C and include several moulded-in trays, lidded and open, a partly ribbed or honeycomb surface and a larger area to the right for small tools, pens, etc, **Fig. 2**.

30MHz Signal Generator

For the second time in the history of this column, (The first being the MF-47 multimeter in *PW* October 2019) I am pleased to report a first-class kit, from 6V6 Electronics here in the UK. It is a 0 to 30MHz signal generator, using a good quality PCB and including a preprogrammed IC, but not the LCD display or DDS module. These are generally available in the UK, costing only a few pounds each.

I began the quest for a signal source with the building of a function generator from Amazon (*PW* November 2017) and then buying a preprogrammed IC from G8KAM on eBay for about £8. This is available as an amateur-bands only, or a continuously tuned 0-30MHz device to which are added LED or LCD readouts and an AD9850 DDS module, as above. I constructed this on plugboards, and it worked well, but the forest of connecting wires made it vulnerable to damage or possible failure if a wire became detached and replaced.

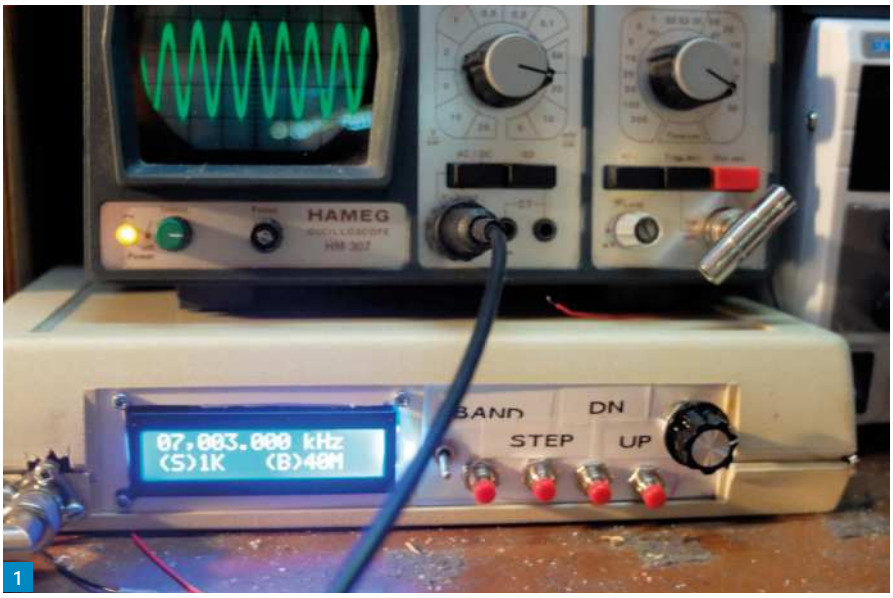

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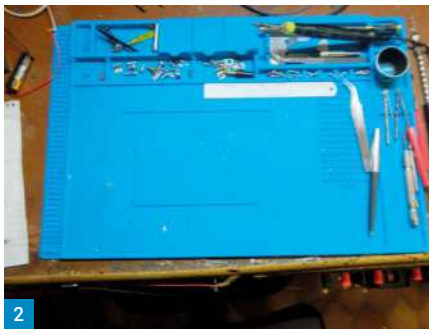
Fig. 1: Signal generator and my scope.
Fig. 2: Antistatic mat.

The kit, costing £28, arrived well packed. The colour printed leaflet attached gave all necessary details, parts list, menu and operating information. The project will operate from 0-30 MHz in 1Hz steps (or more) with instant amateur band selection, or identification when tuning.

I built the kit into a wedge-shaped box acquired at a rally, which, though an odd shape, looks quite stylish compared with diecast boxes and the like. It will, however, act as a bail stand for placing below similarly-sized equipment on the workbench, in this case, my 'scope, **Fig. 1**. When operating, it does what it says on the tin. I built it in an evening and spent the next two days boxing it up. Apart from initially mounting the display upside down, and a power connector that mated well, but made no contact within, it worked first time. I detected a strong output on my Icom R-70, and on a FunCube Pro+ Dongle, running the program GQRX while checking for spurii (I didn't find anything serious). The output level declines gently over the range, but remains useful at all frequencies, producing a visually appealing sine wave.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I thought about installing a 10 or 20dB reduced output, using a taper pad T attenuator, from **electronics-tutorials.ws** because the output of the DDS module is at 200Ω, and I wanted it matched to 50Ω at the socket. A 10dB attenuator is not possible in this configuration, but 20dB is. A design calculator at **chemandy.com** makes this very easy, and using preferred value resistors, arrives at a solution very close to the ideal. A separate socket for the reduced output is better than a switched socket, but as I have a selection of Mini-Circuit connectorised in-line versions, I didn't include this facility.

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Data Modes Audio and CAT Control

Mike Richards G4WNC turns his attention to communicating between PC and rig.

I'm delighted to see that many of you have been using my *Data Modes* introduction to have a go at some data operation. From some of the e-mails I've received, it's clear that getting to grips with the CAT and audio interconnections is not necessarily as simple as you would hope. This month I'm going to tackle the subject in detail so you will be better informed if you hit a problem. I'm going to divide the topic into two specific rig types as they each have their own issues. The first group are what I will call analogue rigs and by this, I mean those rigs that don't have any USB ports for CAT or audio signals. These are generally the older rigs such as the FT-897, TS-2000, etc. The second group I'll call digital rigs, and these do include a USB port or two that can be used for audio, rig control or both through a single USB port.

Data Modes: What do we need?

In my introduction to data modes, I explained how we can generate all the popular data modes signals using audio frequencies in the 100Hz to 3kHz range. Once generated, these audio tones are applied to the audio input of our SSB transceiver (normally USB) where they are mixed up to the desired RF frequency. The result is almost indistinguishable from a true FSK (Frequency Shift Keyed) or PSK (Phase Shift Keyed) transmitter. Data modes reception uses the same technique, so the first thing we need is a two-way audio link between the rig and the data modes software, **Fig. 1**.

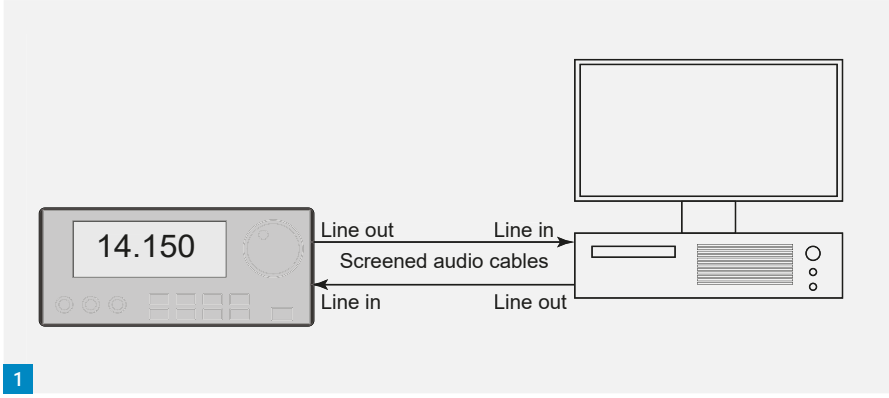
You can operate data modes successfully without adding rig control, providing you're happy to rely on VOX for the Tx/Rx switching. However, adding automatic control of the rig makes data modes operation so much more convenient, that I think it's worth the effort. Not only can you swap bands from within the software, but operating frequency and mode data can be transferred to the log. If you ever use WSPR, then rig control is a must, because you can automatically send WSPR soundings on all your favourite bands.

Data Modes Connections: Analogue Rigs, Audio

Let's begin with the audio connections for older rigs. All we require is audio input and output connections to the rig, which sounds simple enough. We could do this by making a connection to the microphone input and the speaker or headphone output, but both have a few problems. While the microphone input will have plenty of sensitivity, it may also have some frequency response tailoring and there is likely to be some speech processing or compression applied that we certainly don't want. The speaker or headphone output can also be troublesome because using either of these usually cuts out the internal speaker, so you won't be able to hear the rig. The output from this connection is also affected by the rig volume control, which can be a nuisance.

What we really need is clean input and output connections with a flat response and no speech processing. Most manufacturers provide this via a multi-pin rear panel connector that is usually marked as a Data or Accessory socket. You will need to check your manual to identify the socket and its connections. This same socket also provides a line-level audio output signal that's unaffected by the rig's volume control.

The audio input and output pins are often marked as Data in/out. Building your own leads is simple enough using screened cable with 3.5mm jacks at the far end to connect with your computer soundcard. If you do decide to build your own leads, you might also like to consider adding a simple potentiometer in the transmit audio line as shown in **Fig. 2**. This provides adjustment of the transmit power and is especially useful on older rigs where the drive requirement often varies between bands. You can also add a level control in the receive line, although this not so important.



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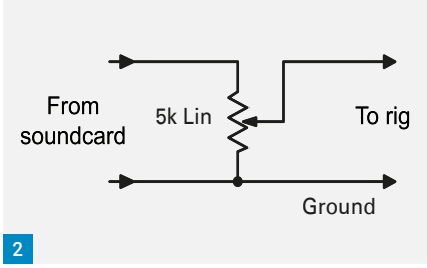

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Fig. 1: Data modes basic audio connections.
Fig. 2: Simple circuit for a transmit level control.

The computer end of the link can be as simple as plugging the 3.5mm audio in and out jacks into your computer's soundcard. However, those connections are often not in the most convenient locations and may well be in use for your computer speakers. A simple and cheap alternative is to add a USB soundcard to your computer. The units I recommend are the Ugreen USB Audio Adapters, **Fig. 3**. These are available on Amazon for around £10 and are excellent value.

The cards have a short USB tail, so they don't block the adjacent USB ports. They also use standard drivers and are compatible with all systems from

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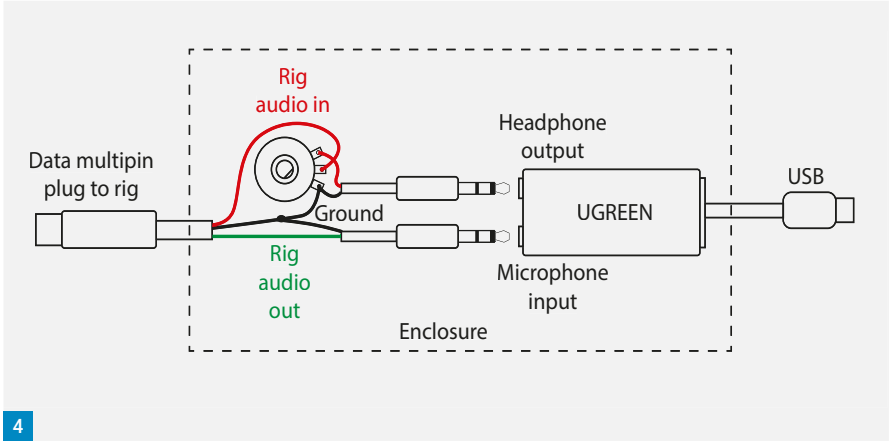

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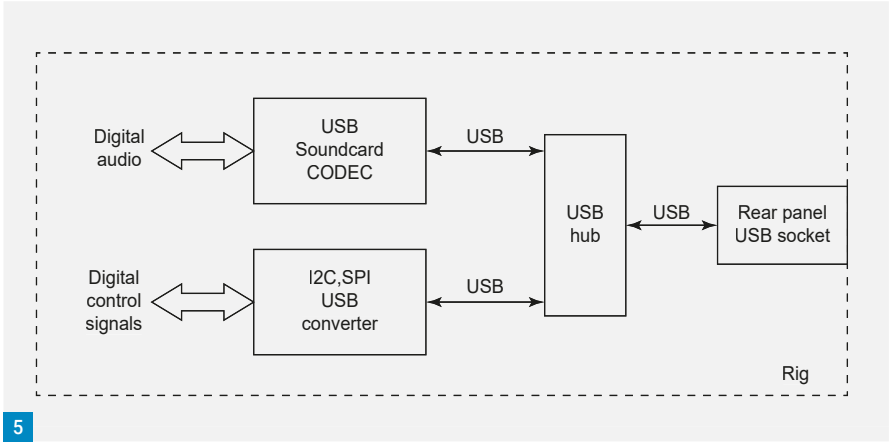

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Fig. 3: Ugreen USB Audio Adapter.
Fig. 4: Combined USB Audio and transmit level control.
Fig. 5: Typical audio/CAT internal block diagram of a digital rig.

a Raspberry Pi to a Mac. It would also be very easy to incorporate the USB soundcard and level controls into the same enclosure, **Fig. 4.**

Analogue Rigs: Interface Unit

If you want to avoid building your own leads and adding a soundcard, you will find a selection of data modes interface units at your favourite radio store. Signalink are the most widespread and have versions for all the common rigs. This Signalink also provides level controls as well as isolation to reduce the risk of RF getting into your computer. Please note that the Signalink USB doesn't include CAT control.

Data Modes Connections: Analogue Rigs, CAT

CAT (Computer Aided Transceiver) has been around for a long time and most of the analogue rigs use a serial data link to pass signals to and from the controlling computer. These connections are based on the long-established RS-232 serial protocol but the voltages used on the link are usually 5V TTL (Transistor-Transistor-Logic) levels. The typical shack computer dropped the use of RS-232 ports many years ago but, like soundcards, the serial port is easily re-provided with a cheap USB adapter.

You can easily make your own CAT leads because you can buy a lead that has an RS-232 to USB converter built into the USB plug. These leads are wire-ended and powered from the USB port. All you need to do is connect the ground, Rx data and Tx data wires to the correct pins on the Rig's CAT socket on the rear panel.

Alternatively, for very little extra you can buy a ready-made USB-to-CAT cable for all the common analogue rigs.

Data Modes Connections: Digital rigs

In this section, I'll cover the connections for modern rigs that have a USB port available. Most rigs now feature a single USB socket that provides access to both CAT control and an internal soundcard. They are able to do this because they have an internal USB hub as shown in **Fig. 5**. The only rig I'm aware of that uses separate USB ports for audio and CAT is the Elad FDM Duo. Using a digital rig for data modes is very simple as you just need the USB cable between the rig and the computer. **NB:** Before connecting the USB cable, check with the manufacturer to see if you need to download and install a dedicated Windows driver. You will certainly need drivers for most Icom and Yaesu rigs.

Analogue and Digital Rigs: Setup Tips

I can't give you detailed setup instructions here because the steps vary between rigs, so you'll need to refer to your manual.

However, I can offer the few tips that might save some time.

No transmit audio: Many rigs require you to switch to a Digital mode, as opposed to USB, to activate the digital audio inputs or outputs. This is logical, when you think about it, because the transmit audio path would normally be connected to the microphone.

A change to a Digital mode is the trigger the rig uses to switch the transmit path to data and remove the speech processing. If you are having problems with no transmit audio, check the operating mode first.

CAT configuration: For both analogue and digital rigs, it's important to get the serial data settings right. The rig's user manual is your best guide, although you'll find plenty of online tutorials for the popular rigs. Windows users will need the COM port number assigned to the rig's USB connection. To find this, open the Windows Device Manager.

The quick way to do this on Windows 10 is to press the Windows and Pause keys simultaneously and you'll find Device Manager of the left-hand menu. Scroll down to the Ports (COM & LPT) entry and double-click to expand. Here you will see

all your COM and printer ports. If your CAT cable is not obvious, make a note of the numbers displayed, then unplug your CAT cable – the port that disappears will be the one you want.

The key configuration elements for CAT control are the baud rate, data bits, stop bits and parity. It's easy to get in a pickle with baud rates, so it's important to ensure that the settings match in both the data modes software and the rig.

Most setups should be fine with the fastest baud rate the rig will allow. However, if you encounter any erratic behaviour from the rig, try dropping to 9600 baud at both ends.

FLDIGI: This program supports several different CAT systems, but I recommend using Hamlib. When you've set the correct parameters in the FLDIGI configuration menu, you must press the Initialise button and then the Save button or your settings could be lost.

WSJT-X: When you've finished configuring CAT control, you should click the TestCAT button to check the connection. If all is well, the button will turn green, unless you're using a Raspberry Pi where it won't change colour. This is a known issue with the Pi and WSJT-X that will probably be fixed in a later build.

Raspberry Pi Operating System

December saw the release of an important update to the new Raspberry Pi operating system. One of the main improvements is with the Chrome browser that has now been updated so it will work with the popular video conferencing clients. For data modes users, the main change is the move to the PulseAudio sound server. This is an important change that brings the Pi in line with other major Linux distributions. The PulseAudio server brings lots of useful features, including the ability to route digital audio to multiple devices. I'll provide more detail on this later. To update your Pi to the new OS do the following:

Open a terminal session (Ctl-Alt-T)

Enter: sudo apt update && sudo apt full-upgrade -y && reboot

When the Pi reboots, Enter: sudo apt purge bluealsa

Then: sudo apt install pulseaudio-module-bluetooth

Radio Round-up

UK FULL LICENCE STUDY GROUP: The Online Amateur Radio Community (OARC) hosts a full licence study group within its community that is open to all. *"We are an informal group, very much like a book club. We set about a chapter a week to read and then gather together on a Wednesday at 7:30pm for an hour to chat about any issues/ provide support as required. Useful links are also added into the study group folder that may be helpful. We read a different chapter each week. This is not a training course, but a study opportunity with like-minded individuals with a common goal."*

https://tinyurl.com/y9co8mcy

Online Amateur Radio Community (Twitter):

https://tinyurl.com/ybe4h3hm

A number of tools have already been written by previous members/trainers, from an annotated syllabus, to help you track your progress and likely exam success – through to structured weekly online meets to discuss the weeks chapters. There is a well-used 24/7 text chat facility, notes and useful docs/videos from previous group members along with access to a number of trainers and specialists.

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ZD9CW: a trip to Tristan da Cunha

Steve Taylor G4EDG relates the tale of his 2018 trip to Tristan da Cunha to play radio.

I handed over my fifty pence and became the owner of a tatty little book from the 'For sale' shelf in my local library, I can't even remember the title now, but was excited that I'd at last found something about Tristan da Cunha, a tiny remote island evacuated due to a volcanic eruption that I'd heard talked about in my childhood. The book contained several hand-tinted photographs that had been artist enhanced as was the custom years ago, along with compelling pages about life on the island. I was hooked and the fascination with the island endured, along with a pipe dream of one day visiting the island. This was over 40 years ago.

Having itchy feet since returning from the S21(Bangladesh) IOTA DXpedition in 2017, my mind turned to making another trip. Tristan da Cunha (ZD9) stood out as it had not been activated since 2014, surely there must be a reason why there was such a dearth of activity. On the face of it no real barriers stood out.

I phoned **Nigel G3TXF** who along with **Paul ZS1S** had activated ZD9 in 2014. He gave me so much information and was enthusiastic for me to visit the island... an hour later I was 'on my way'!

Roger G3SXW had visited the island 25 years previously and had written at length in his book *Two Up* about his trip and the difficulties in communicating with the island to organise the trip...telex one way and difficult QSOs with **Andy ZD9BV** the other way.

Today it is quite different, the Island has a very comprehensive website with all the relevant e-mail addresses and information needed to visit. Even so, anyone intending to visit will have to be quite determined to make it a reality.

Getting There

Tristan da Cunha lies 2810km due west of Cape Town and is a gruelling sea passage of at least seven days. There is no airport. This is indeed the most remote inhabited island in the world, both in terms of distance and time to reach it.

My first task was to apply for permission to visit the island. Applications are discussed at the monthly island council meetings. It was quite something to think of my request being discussed one winter's evening thousands of miles away on a remote speck in the South Atlantic.

Permission was duly granted, and I moved to the next step of securing a berth on a ship. There are only three ships that ply this route, two are fishing boats and the other an Antarctic survey ship. The latter is definitely the best way to go but places are for scientists and a berth for a tourist is rare. The two fishing boats each have twelve available berths and make on average two trips a year to the island. The places are allocated on a priority system of eight levels, level one being medical evacuations, down to level eight – tourist.

The places are typically allocated to islanders returning to Tristan from having medical treatment in Cape Town, or from visiting relatives, along with visiting officials and contractors working on the island. It's very rare for a tourist berth to become available and even if it does there is a possibility of being 'bumped off' at the last moment if there is a need for someone in priority groups 1-3 to travel. It's just something you have to sign up to if you want to go!

I applied for my place and waited and e-mailed often to check the status. **Cynthia Green**, the lady on Tristan who deals with the bookings, replied each time that nothing was available yet. I had all but given up hope as the sailing date was getting extremely near but decided to send one last e-mail. I got an almost instant reply saying that three of the Medivacs in Cape Town had decided not to return yet and I could have one of the berths – what great news!

I looked at the calendar in horror, just nine days until the *MV Edinburgh* sailed. I already had the radio and antenna gear sorted out, so it was just organising the payment for the sea passage and the flight. I'd read of a visitor of just a few years earlier having to meet someone from the shipping company, Ovenstones, in the docks and handing over the required $(US)1000 in cash. Thankfully I could do it all online!

I booked my flight with Emirates because they were the second cheapest (never go cheapest) and they had the best baggage allowance, a generous 30kg, compared to the usual 23kg of other airlines. In addition, this could be spread over as many bags/items as I needed.

I fine-tuned my packing to the nearest

Fig. 1: Paul ZS1S with the author and extra equipment, before the voyage. Fig. 2: The cage transferring passengers from the Edinburgh to the barge. Fig. 3: Approaching Tristan da Cunha. Fig. 4: Tristan sign – only brought out once a week for photos because it's too windy to leave it up permanently.

gram, ending up with three items for the hold, a wheelie suitcase (I've had enough of huge rucksacks), a cluster of three drainpipes carrying the fishing rod antenna supports and a small rucksack. The rig and laptop were cabin luggage, which weighed in at 7kg exactly.

Nine days was plenty, and I was soon on my way to Heathrow for the first leg to Abu Dhabi. It was here in Abu Dhabi that the trip nearly ended. My hand luggage was checked and two items were deemed forbidden, a small VHF handheld (for listening to the marine band) and four 10m radials for the 40m vertical. It seemed quite serious. I was willing to leave both at the airport. After a few hours, the police contacted the airline and it was agreed the bag could be locked away with the crew's baggage. A close call. Onward to Cape Town.

Many hours later my prearranged taxi dropped me at my guest house near the dock area. I had arranged to meet Paul ZS1S, who was active as ZD9ZS back in 2014. We spent a good evening together and he very kindly lent me equipment that would make my trip a lot easier – a spare rig, two Spiderpoles, long lengths of coax, a 500W linear amplifier and other smaller things he felt might be useful to me from his experience on the island.

Suddenly my 30kg lightweight trip was more heavy duty.

The moment I arrived in Cape Town I realised that I had not brought enough warm clothes. It was freezing, and no doubt Tristan would be worse. Fortunately, South Africa has a chain of outdoor shops called Cape Union, so I was able to buy some warmer gear.

Prior to the trip I had contacted **Simon ZS1XG**, an ex-pat, as we had worked a few times over the years and had arranged to meet up before sailing, I spent a great day with Simon and his wife as they showed me the highlights of Cape Town, most memorably Table Mountain.

I arrived at the dock where the *MV Edinburgh* was tied up, still half expecting to be 'bumped off the list'. Fortunately my place was safe, and I finally met my fellow travellers, **Gan**, a metal detector dealer from Israel, who had won a competition to visit a dream remote location, and **Susan**, a judge from Baffin Island in Canada.

I think it's fair to say anyone who gets this far has read and researched the history and culture of Tristan until there are no more books to read. In addition to this we were fortunate to have **Ian Laverello**, the chief islander, aboard who patiently answered our many questions. All three of us were thoroughly prepared for our visit by the time we arrived.

The *MV Edinburgh* is an old vessel, being built in Europe in 1970, and is well suited to the trip. My cabin was basically a 7ft cube with a porthole, complete with bunk beds, storage and a small desk. Fortunately I had the cabin to myself, as I was the oldest of the tourists. I think I was granted this privilege on that account. I wasn't arguing!

It was warm and we were fed well. The smell of fish, diesel and fresh paint soon faded into the background and we settled into the seven-day voyage. I spent a lot of time being smashed from one bulkhead to another due to the rough seas. Showering was difficult but very satisfying. The true

meaning of cabin fever became very apparent.

The *Edinburgh* was followed constantly by several albatross, wheeling around the stern one wingtip just inches above the sea. In the seven days I only saw one other ship and a whale briefly surfacing.

Tristan was sighted from about 80 nautical miles distant on the seventh day, its 2000m peak dropping in and out of view behind the clouds. As we neared, the vast bulk of the island dominated the horizon. As darkness fell the lights of the settlement could be seen. We anchored some several hundred metres offshore and would have to wait till dawn to go ashore.

As day broke the squat single-storey houses looked like crouching sumo wrestlers to me. The fierce storms experienced by the island dictate this design, so similar in appearance to the pictures of the first settler's homes. Only the materials have changed.

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Going Ashore

There is a small harbour suitable only for the open Tristan fishing boats. Larger vessels must anchor offshore and be unloaded by a barge, known as the *Tight Lucy*. The arrival of a ship is a reasonably rare occasion and most of the islanders turn up to help unload the cargo and greet returning islanders and visitors. Passengers are unceremoniously transferred from the ship to the barge in a cage, swinging wildly as it is lifted until it is put down on the barge.

Once ashore, we were transported the short distance to our accommodation. I was allocated the Rectory, a rather spacious bungalow with several bedrooms and an office with a huge desk, ideal as the shack.

I visited Andy ZD9BV at the island radio station and after a short chat was issued with a callsign. I cheekily asked for ZD9CW and I got it!

I rushed back to the Rectory and set up the station. It went together easily after all the practice runs at home. I had left nothing behind. I quickly set up the 20/17m L dipole (basically a quarter-wave vertical with one elevated radial) and called CQ on CW. The pile up was instantaneous and huge – this was going to be fun! I stayed on these two bands for the day and gave CW, RTTY and SSB a good working out before going to bed that evening exhausted.

Settling in to Routine

After the initial excitement of the first day I got to work putting up the antennas for other bands. For 30m another L dipole and for 40/15 a 10m vertical with the four radials that so nearly lost me the trip, supplemented with numerous shorter random lengths of wire. All the antennas were carefully tuned at home but, as usual, setting them up in a different location inevitably requires more trimming. I took my YouKits FG01 antenna analyser along as well as short lengths of wire and connectors to make the adjustments. Eventually all the antennas were tuned perfectly, if looking a bit messy.

I chose to operate only on the bands 15 to 40m. I have found on previous DX-peditions that 12/10m, if open, yield the same stations just worked on 15m. I would rather hand out QSOs to those for whom ZD9 was an all-time new one than to fill band slots for the big guns. I remember how frustrating it was as a new DXer to have called for hours only to have the DX QSY to another band to chase a better QSO rate. As for 80m and certainly for 160m, I find it is just too difficult to get an effective antenna up on my own, and the resulting QSO rate disappointing.

One thing can be guaranteed on Tristan and that is the near constant wind, each direction having its own characteristics, blustery or constant, or even coming down off the volcano. The locals were experts on this and gave me warnings in good time. I managed to damage two of my fibreglass fishing poles, both during the putting up or taking down phases, the poles being wrenched from my grip, each time finding a rock to break on! The 12m Spiderpole, so generously lent to me by Paul ZS1S, saved the day. With its top two sections removed it was up to the worst Tristan could throw at it.

As for the choice of mode, my greatest passion is for CW, which is where I spent most of my time. I noticed that ZD9 was 14th on the most wanted RTTY list, so put in quite a bit of time there too. The pileups on RTTY were immense. I did put in some time on SSB, my least favourite mode, and was surprised how well the pileups behaved. Notable openings were the 40m long path to Japan at my sunrise, an incredible distance at a heading just grazing the volcano. Signals were always strong and interest always high on CW and RTTY. Unfortunately, the beautiful grey line opening to New Zealand, an even more challenging path, coincided with this. It was a real struggle to get the Japanese operators to stand by. I did however work two ZLs.

The electricity supply on Tristan is superb. It delivers a solid 240V and is provided by the generator that serves the lobster processing factory. All cables are underground and the settlement has a 6kV ring dotted with transformers. Remnants of the old overhead distribution system can be seen in some gardens in the form of short poles with their sturdy insulators. Tales of flashes from shorting wires during storms sounded terrifying! The streets are lit with modern 60W LEDs on short lampposts, which are most useful when you are out at night.

Tristan has a 5MB satellite link, which gives the island internet access and telephone service. During the day the internet is used by the administration services and the school, but after about 16:00 the internet is available to the whole island, each home having a wireless 'nano station' to gain access. Everybody is aware of the limitations of 5MB being shared between 250 people and behave accordingly. There is also access via an internet café adjacent to the admin building. It has a warning notice, probably for the tourists, not to use video calling! The Wi-Fi signal within the internet

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Fig. 5: Inside the shack at the Rectory. Fig. 6: Antennas at the Rectory. Fig. 7: A view of the settlement from the peak of the 1961 volcano.

café manages to make its way as far as the ditch outside where I spent many sessions crouched in the wind and rain uploading my logs.

Uploading the logs to Clublog and LoTW proved very popular with the chasing pack, and I think reduced the number of duplicate QSOs, with the bonus of actually getting a confirmation on the day of the QSO – one concession I will give to modern technology! I logged QSOs on a 2007 vintage Dell mini 910. This was once a popular give-away with mobile phone contracts, and its 9in screen makes for an ideal DXpedition computer. I used the DXpedition version of WinTest for logging, along with MMTTY for FSK RTTY, neither giving me any trouble.

Curiously, the telephone system has London telephone numbers so it was cheap and easy to keep in touch with family and friends in the UK. The call clarity was quite unnerving!

Island Life

I arranged to have a daily meal with a local family, **Cliff** and **Lillie Swain**, who kept me full with delicious traditional Tristan meals along with chat about what was going on around the island as well as tales of the past. Indeed, Lillie had had the callsign ZD9LG, which she used at the radio station before the days of telephone and the internet as a form of recreation, as did many of the islanders.

English is spoken exclusively on the island with what sounds like a west country accent

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with a hint of Norfolk. I noticed several twists of grammar, one being, using *"had"* in place of *"have"* when talking about the past, i.e. *"I didn't had a hat"*. Something remaining from the original settlers or developed over the many years of isolation.

To complete the home-from-home feel the currency used is British too, although the new pound coin hadn't reached Tristan yet.

I stayed for a total of 30 days on the island, and my QSO total of 13,500 (10,000 CW, 2,500 RTTY and 1000 SSB) may seem a bit low by some standards. It was certainly not my intention to go Tristan and hole myself up in a room 24/7 playing radio. I spent many hours exploring the island and speaking to the locals and making the most of my visit to this remote, historic, and mysterious island that I had dreamt about for so many years.

Departure

Transport to and from the island is very weather dependant and the schedule may be changed at the last moment due to developing storms etc. This was the case for my return journey. The *Geo Searcher*, the other the fishing vessel in the Ovenstone fleet had been anchored offshore for some days and was scheduled to leave on the Saturday. I intended to pack up in good time to be ready for its departure. Rumours of its late/early departure circulated, and it was eventually decided to leave a day early. A hasty round of thank you and goodbyes, and I was soon heading out to the *Geo Searcher* on a small orange open fishing boat, getting soaked on the way, again being swung by cage onto the deck.

The *Geo Searcher* is a larger boat and the cabins more spacious, but the sea is just as rough! In spite of the early departure we arrived into Cape Town about a week later. My flight was around 13:00 the next day, so the sense of rush didn't end until I was safely seated on the Emirates plane. I just sat there and asked myself if the last seven weeks had really happened!

Looking Back

As I write this piece in June 2020, Tristan has suffered several traumas. In 2019 she was hit by a massive storm, which caused terrible damage, ripping roofs from buildings and even picking shipping containers up and moving them considerable distances. The islanders are resourceful and work to make repairs began immediately, the *MV Edinburgh* being used to transport vital supplies. Later that year as repairs had progressed it was hit by another huge storm, undoing much of the repair work. In 2020 the island is fearful of the Coronavirus. The population is weighted towards being older, and there are many who suffer from asthma, so it is vital to keep Tristan virus free, and as such they are accepting no visitors and ensuring there is no contact between crew of the supply ships and the local population.

I think the prospect of a large-scale DXpedition to Tristan is remote, due mainly to the transport limitations and accommodation, but also the need to be able to commit 6-7 weeks to the project, but I've no doubt when the current problems have passed the small trickle of solo DXpeditoners will continue to activate this interesting island from time to time.

I would like to thank Nigel G3TXF and Paul ZS1Z for their invaluable help, equipment loan and inspiration, **Tony LZ1JZ**, for printing and starting to send out QSL cards before I was even home, and of course all those that called ZD9CW over the course of that month, I hope you made at least one contact.

The Tristan da Cunha website (below) is a mine of information if you would like to learn more about the island.

www.tristandc.com

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Capacitors and Capacitance (Part II)

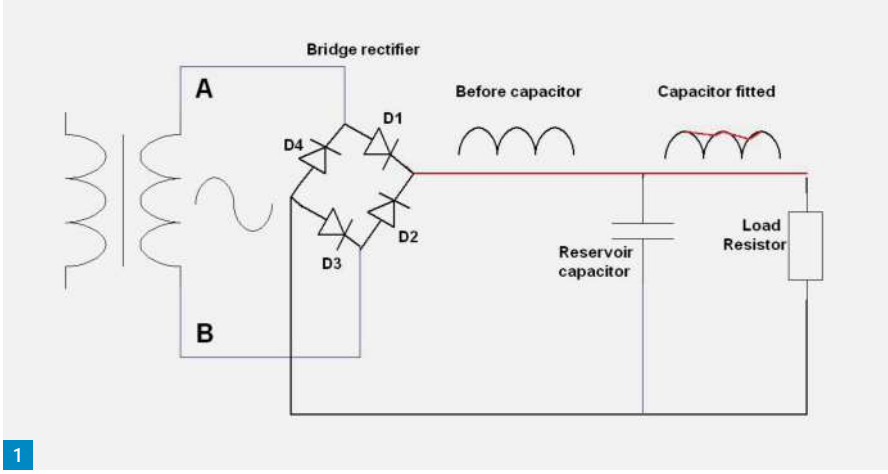
Eric Edwards GW8LJJ looks in more depth at what capacitors we have available and how they can be used.

Capacitors are, of course, one of the main components in electronic circuits. However, they can also be there when we don't want them to be. This is called 'stray capacitance'. In the first part of this article it was shown that if a potential difference (voltage) was placed across two metal plates in proximity, a charge would be built up and this is referred to as capacitance, with the expression C=Q/V where C is capacitance, Q is the charge and V is voltage or PD (Potential Difference). The larger the capacitance the more charge it can store. Capacitance is measured in farads (F) and this is a very large value in terms of electronic circuitry so smaller units are used. There are three commonly used submultiples and these are: Microfarads (μF, 10^{-6} of a Farad), Nanofarads (nF, 10^{-9} of a Farad) and Picofarads (pF, 10^{-12} of a Farad).

When there is a potential difference there will be capacitance. This can be within semiconductors (inter-electrode capacitance) and across collector loads of a transistor, **Fig. 2**. This shows an NPN transistor with a collector load resistor. The capacitor Cx across the resistor is the stray capacitance and is composed of the internal electrode of the transistor (collector to ground) and the capacitance of the wiring or track to ground (gnd). From a point of view of AC, the Vcc and ground are the same.

Capacitors in Parallel

When two capacitors are connected in parallel the capacitance is the total of all the capacitors used. This is similar to placing resistors in series as the total resistance is the combined value. Placing capacitors this way, it can be considered as one large capacitor with an increased plate area. However, it must be noted that the highest voltage placed across the total is limited to the capacitor with the lowest working voltage. If three capacitors were connected and one was 50V, the other 63V and the third 100V, the maximum safe total voltage would be decided by the 50V capacitor. It is very important to remember when connecting electrolytic or any other polarised capacitors in parallel to connect poles like for like. The positive tags or leads of all the capacitors are connected together and all the negative ones connected together. Unlike a resistor, a capacitor does not dissipate energy. Instead, it stores it in the form of electrical fields between its plates, which can be recovered later when it discharges.



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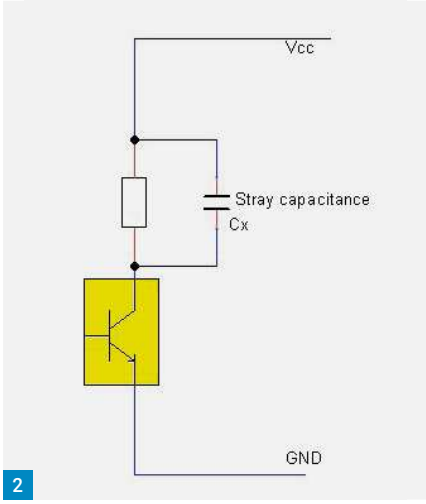
Capacitors in Series

Connecting two or more capacitors in series the total capacitance is always less than the smallest value capacitor (similar to calculating resistors in parallel). They are usually placed in series to be able to use a larger voltage than on an individual capacitor. Of course, there is a 'trade off'. It will allow the capacitor bank to work at a high voltage but at the expense of lower capacitance. As with all things, all are not equal and that applies with the voltages across each capacitor when a total voltage is placed across all those in series, so the rule of thumb is to place equalising resistors across each capacitor with values of about 100Ω per volt. This is/was common practice in high voltage power supplies for valve equipment where single high voltage capacitors are impossible, or difficult, to obtain.

Capacitors in Power Supplies

One of the most common uses of capacitors is in power supplies where they hold a charge from a rectified AC voltage, **Fig. 1**. The output from the bridge is connected to a reservoir electrolytic capacitor and is charged with the 'pulsed DC' voltage, which holds the positive pulses so providing a 'rough' DC output. This is improved by adding a filter comprising a series resistor and a 'smoothing' (filter) electrolytic capacitor. There are three types of capacitors that are normally used for decoupling (taking AC or signals to ground) in power supply rails. They are electrolytic, tantalum and ceramic. Electrolytic capacitors are generally the best because they are low cost and are very linear and with low ESR (Equivalent Series Resistance), which makes them a good component to use in power supplies and for coupling in low frequency (audio) stages.



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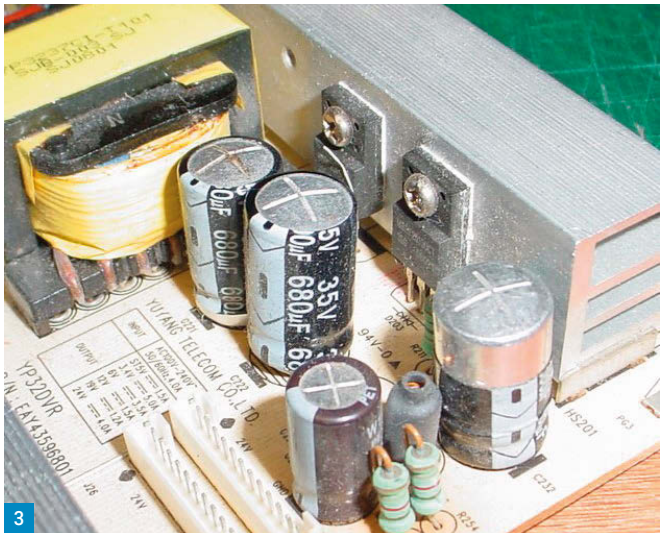

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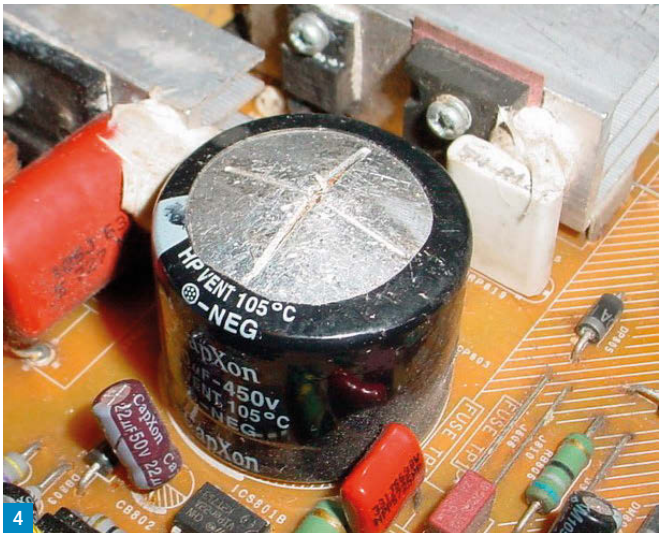

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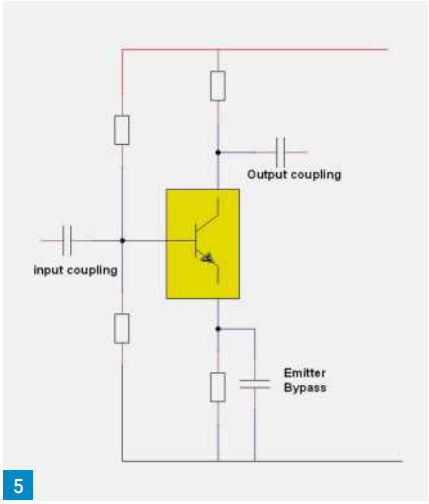
Fig. 1: Bridge rectifier circuit. Fig. 2: An NPN transistor with a collector load resistor. Fig. 3: Switched mode PSU with 'bulging' capacitors. Fig. 4: Another example of a 'bulging' capacitor. Fig. 5: Emitter follower circuit. Fig. 6: Exploded polypropylene capacitor. Fig. 7: Homebrewing a capacitor. Fig. 8: Measuring the homebrew capacitor. Fig. 9: Measuring the 'gimmick' capacitor. Fig. 10: Multivibrator circuit. Fig. 11: Using a capacitor to charge to double voltage.

The main problem with electrolytic capacitors is that they can change value and performance over time and is more problematic especially in high temperature circuitry. They dry out because of their construction. They have an electrolyte (hence electrolytic) that is damp and this dries out. High temperature versions are available and will last longer, usually shown on the body as, say, 85°C or 105°C, which is the temperature rating. Tantalum capacitors are alternatives but are more expensive than electrolytic. One advantage of tantalums is that they do not dry out, are suited for higher temperatures and are generally smaller than electrolytic types for the same value. It has to be remembered that electrolytic and tantalum capacitors are polarised and must be connected the correct way otherwise they will explode! They can only be used in DC circuits or when an AC signal is being carried with a DC voltage. Ceramic capacitors are used for decoupling higher frequencies such as RF signals on power supplies.

Bulging Capacitors

When electrolytic capacitors get hot and dry out, they can bulge, and if not caught in time, will explode. **Fig. 3** and **Fig. 4** show two switched mode power supplies that have these capacitors. Fig. 3 shows three that have bulged and the 'safety' split can be seen with one that has the outer label shrunk due to the heat. The smaller one at the bottom-left by the two resistors is normal.



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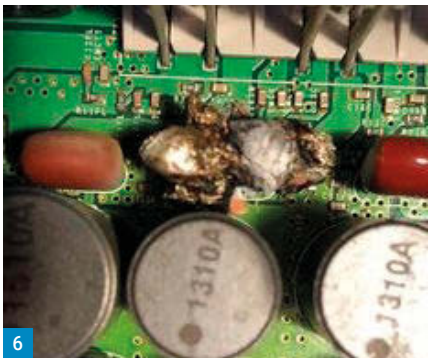
Coupling Capacitors

Coupling capacitors block DC and appear to allow AC to flow through it (A capacitor connected to a sinusoidal voltage source will allow 'displacement' current to flow because the voltage across it is changing). They are used to separate AC and DC signals and their value is calculated so that the resistance is as low as possible for the frequency that is needed to pass through. These are also used to bypass signals in the emitter of a transistor amplifier, **Fig. 5**.

Ceramic Capacitors

Ceramic capacitors come in various types and are all non-polarised, which means they can be connected in a circuit any way round and can be used for coupling and decoupling.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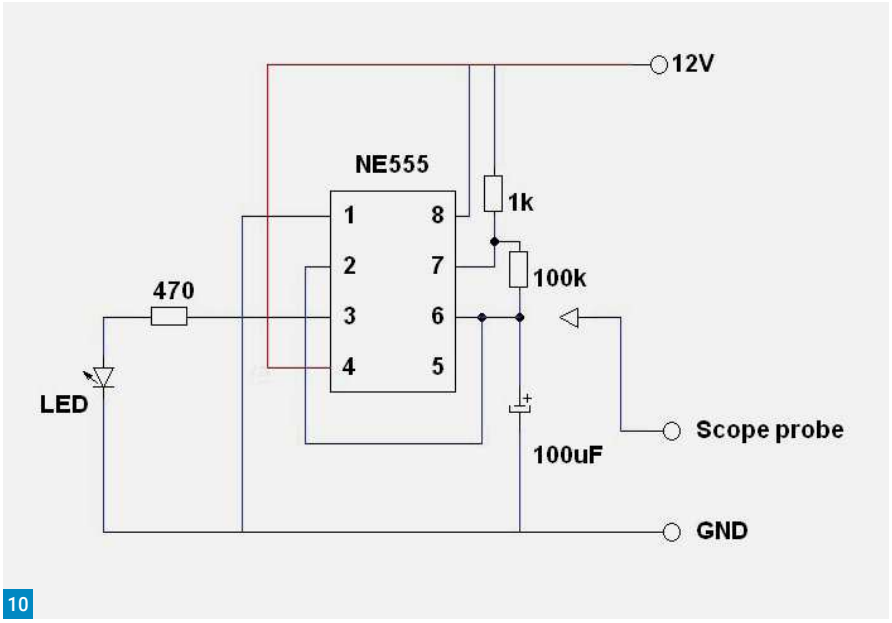
Single layer: These have titanium or barium dielectrics and because they are not made in coil form, have low inductance making them suitable for high frequency applications as well as audio and other low frequency circuits, such as coupling between stages.



NP0 (COG): These are the most highly stable of the ceramic capacitors, are made from a mix of titanates and have very good temperature stability and no aging problems. They can be used in high frequency circuits but only by keeping leads short. NP0 is an abbreviation for Negative, Positive, Zero and they have zero variation in capacitance when subjected to temperature changes. COG refers to the former that the capacitor is built on and stands for Ceramic on Glass.

HiK: These are poor capacitors in comparison but are cheap and used for DC blocking (AC coupling). It is better to use the lowest K available.

Multilayer: These incorporate multiple printed layers of electrode plates made of thin ceramic sheets. They have better temperature characteristics than the single layer types and are therefore a bit more expensive. They are very good for HF decoupling well into the gigahertz range. They are also used in Switched Mode Power supplies (SMPSU).

Polystyrene

Polystyrene is the dielectric used in this type and because they are constructed as a coil (rolled up inside) they are tubular in shape and are not suitable for high frequency use, being inductive. They are mostly used for filter and timing circuits of a limit of a few hundred kilohertz and are highly regarded because of their electrical characteristics such as exceptionally high insulation, low leakage, low dielectric absorption, low distortion and excellent temperature stability.

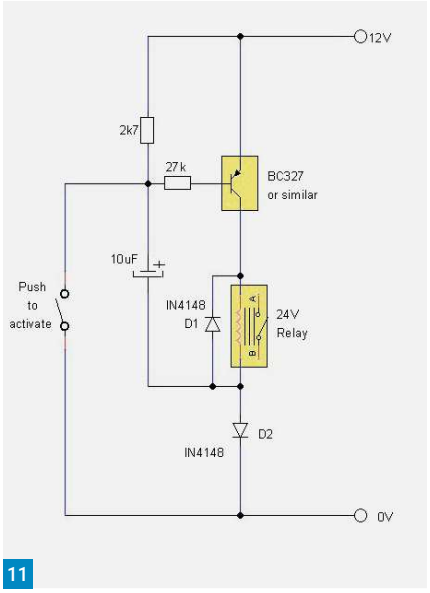
They are of close tolerance but can change value when exposed to temperatures over about 70°C and will not go back to their original value. Polystyrene capacitors are the favourite capacitor of audiophiles. Some of them have a black band at one end (some have red and black bands) and although they are not polarised capacitors it would be better to place the end with the black band at the most negative part in the circuit where it is to be connected, to prevent any possible radiation or hum pick up.

Polyester and Polypropylene

Some polyester and polypropylene capacitors are metal types and are used where low current/high impedance small signal levels are employed. They have high insulation resistance and low loss. They are not suitable for large signal AC applications. Foil or film types can be better suited for those purposes. The non-metallised film capacitors have a slightly high dissipation factor. It could be argued that the best capacitor types for coupling between stages are the polystyrene and polypropylene types with polystyrene probably the better of the two. **Fig. 6** shows an exploded polypropylene capacitor, which I was told was caused by overloading the input of an audio amplifier! One advantage of the polypropylene type is that there is very little change in capacitance value over time.

Mica and Silvered Mica

Mica and silvered mica types offer high levels of stability with low losses and are close tolerance but tend to be on the large size. They are very much suited to RF circuits. The dielectric is mica with the plates made of lead or aluminium foil. They are clamped very tight during manufacture to prevent moisture getting in between the plates. The capacitor is waxed and placed in a moulded (Bakelite) casing. A modified



version is the silvered type where the plates are silver and coated with mica on both sides, which makes them more stable. The outer is lacquered and finished with a coating of wax.

Roll your Own

A small value capacitor can be made easily with some kitchen baking paper and aluminium foil, **Fig. 7**, by placing a length of baking paper. Glue a length of aluminium foil to it and put a connecting lead at one end. Place another length of baking paper over the foil and glue another length of foil on the paper. Position a connecting wire at the opposite end of the foil to the other one. Roll up as tight as possible making sure the two foils are not connecting. Secure the roll with adhesive plastic tape. The photo

at **Fig. 8** shows the one I made (earlier) as 6pF. In some radio circuits where only a very small capacitor is needed to couple two circuits such as adding a BFO to an AM receiver, a twisted wire can be very effective as a 1pF (or near) capacitor **Fig. 9**. This is sometimes referred to as a 'gimmick' capacitor.

Memory Effect

Let's charge an electrolytic capacitor for a few minutes then remove the charging voltage. Discharge the capacitor by placing a wire link across the capacitor leads so the capacitor has now lost its energy (charge). Normal (safer) practice is to use a low value resistor, especially when charging the capacitor with a high voltage. To discharge the capacitor otherwise, the neighbours may report a gunshot! Leave it on the bench for a while and then test with a high impedance meter (digital) connected to the capacitor leads and there will be a small voltage once again provided by the capacitor. This is called dielectric storage. The reason being that during the charging of the capacitor some voltage gets into the dielectric and after the capacitor is discharged, it leaks back to the capacitor plates.

There are two types of material in the capacitor, the metal (foil) plates and a chemical composition within the dielectric. The capacitor plates can lose their energy quickly when being discharged but the chemical reaction takes longer.

While not normally a problem, it can be if using that type of capacitor for high fidelity (quality) audio and instrumentation equipment and also in some (slow) timer circuits relying on charging and discharging capacitors. This effect can be avoided if the capacitor's dielectric is polystyrene or Teflon type.

Those of you that were in the TV servicing industry when CRTs (Cathode Ray Tubes) were fitted to TV sets may well remember having a 'belt' from the EHT connector of the tube the day after it had been discharged. The charge from the dielectric had transferred to the capacitor contacts of the tube.

See the Charging

Capacitors are used in timer circuits where a capacitor is charged and discharged at a particular rate. Other circuits such as a multivibrator, **Fig. 10**, also take advantage of this property. In the circuit using an NE555 as an astable the output at pin three will illuminate a standard LED when the capacitor is charging and it will extinguish during discharging. Place a scope probe set to X10 and the 'Y' on the scope to 2V per division, set to DC. Set the DC level (press the gnd button to set this) to two divisions below the zero line and release the gnd button. Set the 'X' (timebase) to 1mS and the trace on the scope will rise and fall slowly as the capacitor charges and discharges.

Using a 24V Relay with 12V by employing a Capacitor

It is possible to use a lower voltage to energise a relay with a higher voltage coil. A 24V relay is connected to a PNP transistor and a few components to allow it to be used with a 12V power supply. A relay needs the coil voltage, 24V in this case, to be energised and the contacts made to operate.

Once the relay has been energised it can continue to hold its contacts with a much lower voltage across the coil. A simple circuit can be made to use a 24V relay on a 12V power supply. This is also applicable when using other lower voltage relays. A 12V relay for example can be operated with a 5V power supply. The circuit in **Fig. 11** is using a capacitor to charge to twice the applied power supply voltage and then discharged to provide 12V to keep the relay activated.

How it Works

When the 12V is applied, the 10µF electrolytic capacitor is charged via the 2.7kΩ resistor connected from the 12V supply. When the push-to-activate switch is closed the transistor turns on, putting the 12V on the top end of the relay coil. This also shorts the positive connection of the capacitor to ground, which means the negative connection of the capacitor is at negative 12V, applied to the other end of the relay coil. It cannot go to ground because it is a negative voltage so the diode D2 cannot pass because it is reversed biased. The relay coil briefly has 24V connected across it, which is enough time to activate the relay contacts.

This voltage drops to 12V and now D2 can conduct, so placing 12V (less the diode drop voltage) across the relay's coil and continues to keep the relay activated. Opening the push-to-activate removes the voltage across the relay coil. The capacitor used along with the relay coil resistance is an RC (resistance/capacitance) time constant and determines the time the relay de-energises when the switch is open and the larger the electrolytic, the longer the delay in returning the relay to its resting state.

Radio Round-up

JERSEY BASED GB7JI JOINS THE D-STAR REPEATER NETWORK: The Jersey Amateur Radio Repeater Group has recently set up a new D-STAR repeater based in Jersey, just north of St Helier. The D-STAR repeater will mainly serve Jersey but should also provide coverage for the Channel Islands and adjacent French coast. GB7JI D-STAR repeater is connected to the gateway and the internet.
Details are as follows:
• Height 88m above sea level
• TX Freq 430.850MHz
• RX Freq 438.450MHz

CDXC HF CHALLENGE 2020 – WINNERS ANNOUNCED: Held in September each year, the CDXC HF Challenge seeks to stimulate DXing on the high HF bands, from 15m to 6m.
After nearly a decade of declining scores in the CDXC HF Challenge, this year's scores have improved substantially vs. last year, supporting the view that the sunspot cycle minimum has passed. The 2020 high score for Traditional Modes (SSB & CW) was up 83% over last year's score, and the high score for MGMs (machine generated modes) was up 18% on last year's score. Because of the improved conditions combined with increased operating times due to COVID restrictions, the level of interest in the HF Challenge increased this year, with 80 stations from 37 DXCC entities on six continents participating by posting their scores on the Club Log HF Challenge page.
In the traditional CW/SSB category, Gary G0FWX was awarded the Hinson Trophy based on his total of 86 DXCCs worked. The six highest scorers all had more DXCCs worked than last year's winner.
Andy 5Z4VJ (G3AB) was awarded the Chairman's Cup based on his total of 140 DXCCs worked using Machine Generated Modes (MGMs) while providing a new one for many of the other HF Challenge participants.
Individual Band salver winners were Andy 5Z4VJ for 15m and 12m, Andrew M0NKR for 10m, and Gordon G3PXT for 6m. Certificates of Merit have been awarded to 5B60AIF, G0FWX, M0BEW, M0NKR and SV2AEL. Congratulations to all the winners!
More information on CDXC is available at: www.cdxc.org.uk

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

Normal Life

Roger Cooke G3LDI looks forward to a resumption of normality, but in the meantime discusses various topics, including our preferences for a listening tone.

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By the time you read this, a lot of us will have had, or are about to have, the Covid vaccine. One advantage of becoming chronologically challenged is the fact that I am in the top tier of those who will be getting the vaccine first. I do hope that this will mean that from the summer of 2021 and onwards we will all be getting our lives back again. Who knows, perhaps Newark, the Convention and other events will be enjoyed. However, I am writing this in December and still keeping away from people. One good thing about our hobby is the fact that we can 'mix' with hundreds of people, all over the world, with no fear at all of catching or spreading the virus. You are never alone with a Morse key at hand!

Inherited Skill?

John G3OGE recently sent me a link to a possible relative, **William Fothergill Cooke**, born in the UK in 1806 in Ealing. In 1836 he set up a telegraph company for the railway. So, he could have been a long lost relative of mine, hence the reason I am keen on Morse! Very much tongue-in-cheek, of course, but it is interesting reading going back to those early telegraph days. Do take a look:

https://tinyurl.com/yxplohnq

I don't really think I look much like him though!

Miniature Key

I saw this recently from **Tom K3TW** and thought it might be of interest. It's the diminutive Whiterook MK-11 Spy Telegraph Key, **Fig. 1**, that works exceptionally well. The flexible rubber panel pushes a small. sealed microswitch, so no adjustments or contact cleaning are required.

Tom says: *"I love using this key! I can easily send perfect 35wpm CW with it!"*

Here is the Whiterook web link and a YouTube video showing the key in action:

http://electronicsusa.com/mk.html
www.youtube.com/watch?v=onyfFzAz8l8

I challenged Tom with his claim about sending at 35wpm on any straight key! He admitted his affection for the key got the better of him! Mind you I was only basing my challenge on what I can do these days and that is no more than 20wpm!

Norfolk ARC CW Net

Every Monday evening, contest nights excepted, Norfolk ARC hold a CW net on 3545 ±occupancy. We have five GB2CW classes each week and those progressing through those classes are invited to join in. This serves several purposes. The first is obviously to get some activity from each person if we can and get rid of the nerves! Some people do suffer a lot with nerves and it takes a lot of persuading to get some to take part. It is also intended to improve their netting. With a large variety of transmitters/transceivers being used, this is not always as easy as you might think. We have had people off frequency by several hundred Hertz, which is not exactly netting or joining a 'net'. Over the months these things have improved hugely and it is now very satisfying to hear most netted to within a few tens of Hertz. I must admit I am pedantic about it and get a lot of satisfaction from not being able to tell when one station stops transmitting and another station starts. In a net, I think that is always to be aimed for. We normally have around nine, sometimes ten stations in the net, so overs have to be short.

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Are there other nets of this size running at all? I would be interested to hear from you if so. The other thing I would like to know is what procedures do you adopt? We don't use net procedures I see other groups in the USA are using QNI, QNN and such. I am just wondering if we should both learn and adopt those Q codes into our nets. I can see the advantages and appreciate the reasons for doing so, but I have never heard those being used in the UK. Mind you, I have not heard that many nets in the UK either. It's all part of being a good CW operator after all, and far better than concentrating on sending 5nn 73 to all and sundry.

A large net like ours does seem to attract DQRM (deliberate interference) however. We occasionally get a load of dots being sent on us, CQ calls with no callsigns and all the usual rubbish. Quite why people have to do that is beyond me. Although I have not said so as yet, our net is not restricted to our club members. Anybody is welcome to join. We also run a straight key night on the last Monday of the month.

What Tone Do You use?

There was an interesting discussion doing the rounds a while ago regarding the tone that operators use to receive CW. Our hearing starts deteriorating in our twenties and although some people brag about their frequency range, later in life it is highly likely that none of us can hear much above 12,000Hz.

Due to the impact of continued exposure to loud noise over time, usually the younger we are, the better we hear. The 'normal' hearing frequency range of a healthy young person is about 20 to 20,000Hz. Though a 'normal' audible range for loudness is from 0 to 180dB, anything over 85dB is considered damaging, and if you attended some of the rock concerts, that was probably over 100dB. As we age, it's the upper frequencies we lose first. So, by the time we hit middle-age, we can expect to hear up to around 14,000Hz. Obviously this gets worse as we get to octogenarian status!

Youngsters usually use tones around 700 to 1000Hz for receiving CW and think that comfortable. Well, to me, being an octogenarian, it is not comfortable at all. I can hear it, and could receive the CW, but I don't like it. I have found that now at my age, 82, my preferred tone is 400Hz. To me, that sounds sweet and I can use that all day long. There was even one amateur some time ago suggesting that 270Hz was a good frequency to listen to.

Table 1
Percent Preference for Each Tone Frequency Averaged Across All Intensities

S	Tone Frequency (Hz) 60	110	210	400	750	1410	2660	5000
1	71.4	71.4	50.0	66.7	47.6	42.9	33.3	16.7
2	11.9	45.2	83.3	92.9	88.1	47.6	23.8	7.1
3	19.0	45.2	73.8	85.7	78.6	40.4	40.4	16.7
4	0.0	16.7	40.4	90.4	97.6	64.3	54.8	35.7
5	52.4	66.7	66.7	80.9	57.1	38.1	28.6	9.5
6	4.8	33.3	64.3	85.7	80.9	71.4	45.2	14.3
7	26.2	66.7	83.3	88.1	66.7	30.9	33.3	4.8
8	0.0	19.0	69.0	90.4	85.7	64.3	45.2	26.2
9	73.8	38.1	42.9	35.7	71.4	54.8	50.0	33.3
10	52.4	73.8	80.9	78.6	66.7	26.2	19.0	2.4
11	16.7	42.9	54.8	88.1	85.7	54.8	42.9	14.3
12	2.4	19.0	52.4	85.7	90.4	73.8	47.6	28.6
13	2.4	11.9	42.9	76.1	85.7	66.7	64.3	50.0
14	4.8	9.5	28.6	47.6	85.7	73.8	76.1	73.8
15	9.5	14.3	54.8	85.7	88.1	59.5	52.4	35.7
16	7.1	26.2	40.4	69.0	85.7	52.4	66.7	52.4
Mean Percent	22.2	37.5	58.0	77.9	78.8	53.9	45.2	26.3

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Fig. 1: The Whiterook MK-11 Spy Telegraph Key.
Fig. 2: Preference for tones as a function of frequency (hertz) and intensity (decibels) (Paul Vitz, New York University, New York, New York 10003).

Using lower tones is more relaxing, much better to use in a long contest too. So, give it a try, you might be pleasantly surprised. It might take some practice, but better that a screaming 700Hz note!

A few interesting comments: *"Very interesting! I've always used 700Hz because that's what my first radio used and I'm so familiar with the pitch that I can zero beat without thinking. All these years, I thought everyone used 700Hz… One thing I've noticed, which might be related to aging ears is that when I turn my head certain ways while listening through the loudspeaker, 700Hz will noticeably attenuate. I can almost make it null out and then turn and make it sound louder. 3D audio makes use of Head Related Transfer Functions (HRTF) to virtually position sound in a sphere around your head. The outer ear squiggles form sort of a comb filter and the ear computes the time arrival difference for left/right position and uses frequency differences to compute up/down/front/rear. Higher frequencies come into play for these computations which help us in fight or flight situations to locate the threat. Compare trying to locate a dog bark or a bird tweet with trying to find something humming at 120Hz! I wonder if lower frequencies negate this phenomenon and make copying CW easier? I use headphones to avoid this but I may give lower frequencies a try. Thanks for the interesting topic! 73* ***Gene KJ4M****."*

"I agree with others that one's preferred sidetone frequency changes over time. Mine has drifted significantly lower, originally around 600Hz, but now around 430Hz. I have had to adjust the centre frequency of some of my resonant 'CanSpeakers', which were built for 500Hz, my preferred frequency at the time. Placement of these speakers is critical and moving from your normal operating position or rotating your head can cause cancellation effects. More details on my QRZ.com page. 73 ***Phil VK6GX****."*

"I go down to 360Hz, which is most pleasant note for me. For very weak signal I'm listening a bit higher but never over 440Hz. 73 ***Martin OK1RR****."*

"I listen to CW notes like I listen to musical pitches. I think in terms of octaves and fifths and fourths and thirds and all that. It's just the way my head works.

"I'm gonna say the same thing as Chris and Rich, only I am going to couch it as a sort of brief music lesson (per Ted): If you look at a piano, the number of Hertz between each note on the piano continuously increases as you move from left to right on the piano keyboard. This means if you were to filter those pitches through a 500 Hz filter, the number of different notes that you could fit in the filter's passband would get smaller as you set the passband's centre frequency higher. Whereas two notes that are a 'half step' apart (musical term) are easy to tell apart for most people wherever they fall on the piano's keyboard. If you've ever listened to a piano tuner doing their job, you get a very front-row kind of seat for how this really sounds. 73 ***Mark N5OT****."*

"Well, as I live and learn… in an earlier comment about the frequency tone I said that my preference was 750 cycles…but in reading the comments from others… I decided to try the lower frequency of 400 cycles, but it was too soft and then I tested my ears for 450 and 500 cycles… after hours of copying CW on 20 and 40m I have learned that my ears like 450 cycles best… wow what a difference. Good thread, thanks to all who have posted. ***73 Louis W3RZ****."*

Paul N6EV did some research on the internet and came up with some interesting links below. Good rainy day reading here and food for thought:

https://tinyurl.com/y95wqtc7

Article discussing various studies in the 90s:

https://tinyurl.com/y75nb2w8

2013 discussion of the topic on the Elecraft mail list.

https://tinyurl.com/ydz3s9a7

Adaptive pitch test referenced in that Elecraft discussion:

https://tinyurl.com/y7afggrt

A thesis by **Jesse Washburn**, 2nd Lt, USAF titled *Improving the Morse Intercept Operator's Audio Display* that cites Harris's work.

https://tinyurl.com/y77332x2

And by way of a final take on this subject, in an academic study 16 students (S in **Fig. 2**) were subjected to various tests regarding frequency and the results (see the Fig) show that the average preference is for 750Hz. However, bear in mind that these were students, probably young. The older you become, preference changes and if a poll was taken for the 60+ age group, I am betting that most would prefer around 400Hz. It is an interesting paper to read and does provide the impetus to experiment with lower tones. It can be read and downloaded here:

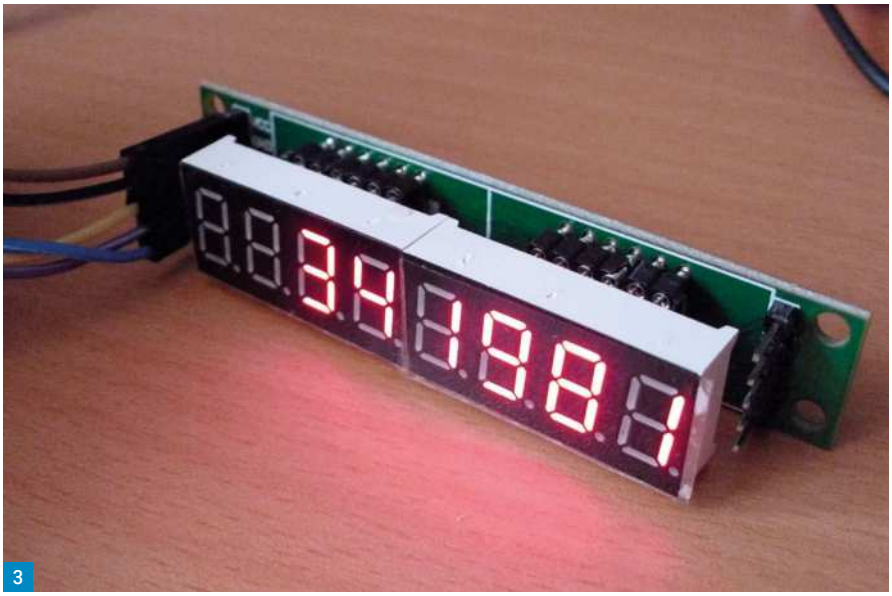
https://tinyurl.com/ycefhv8n

73 and May the Morse be with you!
Roger G3LDI.

John Dunton G1RXC
john@john-dunton-co.uk

Frequency Counter

John Dunton G1RXC constructs a frequency counter that is cheap but good to 30MHz.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I was doing some filter measurements and found that frequency scale on my signal generator was hard to see and nowhere near accurate enough. Also, my Velleman frequency counter update rate is so slow it was nearly impossible to do the adjustments I wanted. What I needed was a fast updating accurate and cheap frequency counter. The signal generator has a TTL output as well as 50Ω sine so the counter could be connected to the TTL output and not need an input amplifier.

There have been quite a few articles and web pages written about PIC based frequency counters over the years. Notably **Eamon Skelton EI9GQ** and **Wolfgang Büscher DL4YHF**, the latter's design 'inspiring' many of the Frequency counter kits on eBay. Both used the PIC16F628. There is also a Microchip app note from 1997, AN592 that describes a *Frequency Counter Using PIC16C5X*. This is interesting because it shows how to access the pre-scaler count and get a 16-bit count value from the 8-bit TMR0.

I have a number of PIC16F54s because I used them as the target for my PIC Programmer and they are very cheap, although almost all ICs seem to have gone up by 50% in price at Farnell in the last couple of years!

PIC16F628A-I/P (Farnell 9760423 £1.74)

PIC16F54-I/P (Farnell 1212691 £0.81)

I wanted to develop the implementation from scratch because my experience of using other people's code is that it is more fun to do the coding yourself and modification becomes much easier because you know exactly what the code does. Obviously, you write well commented code! So, with time on my hands from Lockdown I thought I would try to develop a counter from scratch with just the parts and the datasheets.

I started by writing down what I wanted as a specification. Always a good idea!

Frequency range: 100Hz to >20MHz (32-bit count)

Resolution: 10Hz (or 1Hz)

Fast update <1s

Accuracy ±2ppm

Input: TTL

Display: 8 digits (I don't want auto-ranging because then you have to check what range you are on)

Display size, at least 0.5in so I can see it which probably means LED.

Cost preferably <£5

Looking at displays I noticed that various eBay sellers listed MAX7219-based 8-digit LED displays 'for Arduino' at low prices. The complete display, i.e. assembled PCB with eight 7-segment 0.5in displays and MAX7219 for £3, **Fig. 1**. Farnell list the MAX7219 for £7! Then you would need the displays, at least another £5. Looking at the MAX data sheet the interface is a simple 3-wire SPI data.clock,latch and the part has a built in BCD decoder. I ordered some from eBay immediately.

So, now I had chosen the display and the processor, it was time to work out how to do the frequency count and write code.

Coding

The PIC16F54 is a very simple processor. Program memory holds 512 words (instructions) and it has 12 GPIO pins and a timer input. It only has 25 bytes of RAM (registers) so it is necessary to be careful in use of the registers. If you store the result of the count for a 32-bit count, that will be 4 bytes, the display will need 4 bytes to hold 8 BCD digits, so 30% of the resources are consumed! There will need to be a few bytes for counting the gate time and there are no interrupts so everything will be based on delays created by cycle counting. Then there will need to be a way of converting the 32-bit binary count into decimal for the display, which will need some temporary variables.

When programming, it is useful (essential) to have a way of seeing what is going on otherwise when the code does not work, which in development is most of the time, you have no way of working out what is going on. Simulators are helpful but setting them up takes almost as much time in a simple application as writing the code; often observing the hardware is quicker. So, the place to start is the display driver.

The MAX7291 starts up in 'a mode of non-functionality'. That is to say it does not display anything until you tell it what and how. The part has a display test mode so you can check that the displays work at power up, for example. This is also a good way of checking the connections

Fig. 1 MAX7219 display from eBay. Fig. 2 Counter schematic. Fig. 3: PIC16F54 TMR0 input circuit. Fig. 4: Inside the Altoids tin. Fig. 5: The counter in use. Fig. 6: The input amplifier.

are correct, the commands are correctly formatted and getting through.

The data is clocked into the chip on the rising edge of the clock, msb first, and consists of a 16-bit word with the format shown in **Table 1**.

Display test is turned on by sending a 1 to D0 of the display test register address 0xXF, so as a quick test to see if things are working all I needed to do was send 16 clocks with data high and then load the data with a rising edge on the load pin.

With the connections:

RB1 MAX7219 LOAD

RA2 MAX7219 CLK

RA1 MAX7219 DATA

This just needs a few bytes of code, as in **Table 2**.

The final routine to write data to the MAX7219 is as shown in **Table 3**.

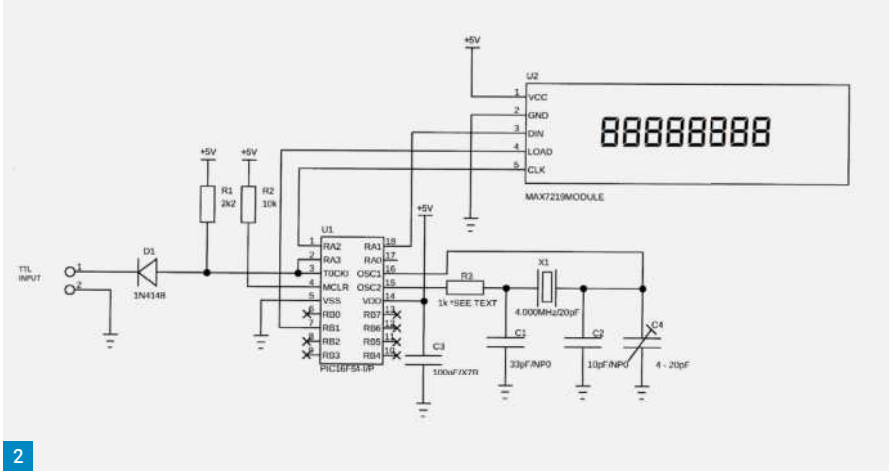
Configuring the Display

Once I had the interface working the next thing to do was to configure the display for 8 digits, BCD decode 25% brightness, and turn it on. Then write an 8 digit number to it, which meant having the number available in memory. To save registers I packed the BCD 4-bit digits into 4 bytes at the top of memory, locations 0x1C to 0x1F. The PIC architecture provides a register pointer mechanism for reading and writing tables of data using the file select register (FSR) and indirection register 9INDF) pair. You set the address by writing it to the FSR and then a read or write of the INDF register act on that address.

So, to read the 8 digits and write them to the display, the code is as detailed in **Table 4**.

Once I had a working display it was time to start looking at counting. The first thing to do was convert 32-bit binary stored in 4 bytes into 8 digits of BCD stored in 4 bytes. There are various approaches to this. You could use a library routine, but I prefer to write code from scratch since I like the challenge of solving the problem. This is after all my hobby. I decided to start with a simple brute force approach, which has the advantage of being easily understandable and reasonably fast. Start with the highest decade, successively subtract the decade value from the data until the result is negative, save the number and reduce the decade and repeat until we run out of data.

This requires a look up table of decimal



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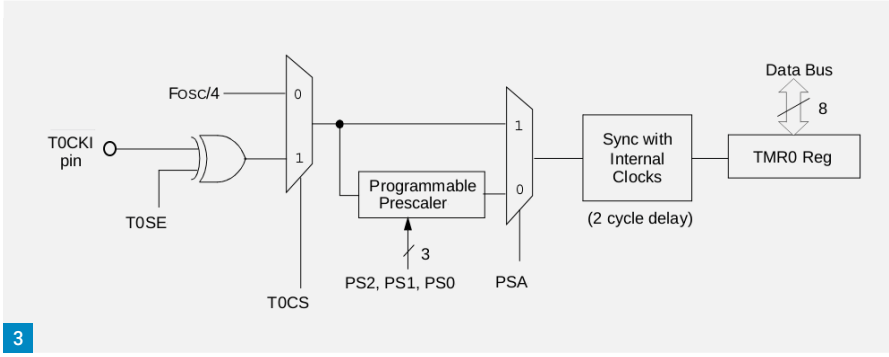

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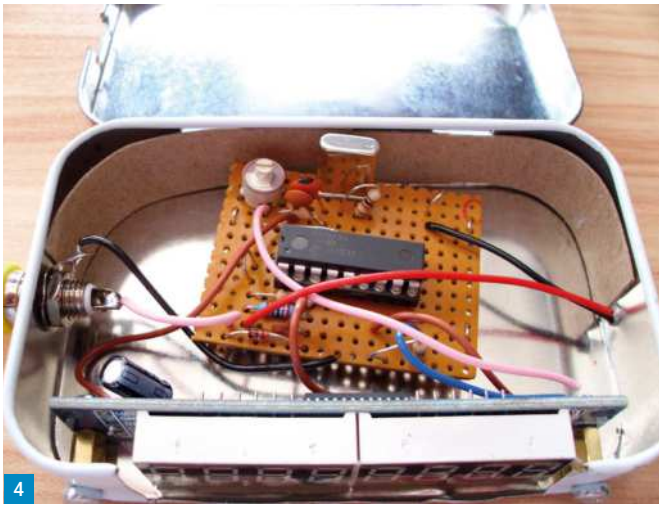
decades, from 10M down to 1 and a repeated subtraction loop. The code is very straightforward, I calculated that the maximum time for the conversion would be if we ever needed to display 99.999999MHz. This would be 8 digits times 9 subtractions, 72 loops. The subtraction loop takes 18 cycles, getting the decade takes 8 cycles and the set up and store of the result take a further 20cycles. So, at 1µs per cycle (4MHz clock) the maximum time is 18 × 72 + 8 × 8 + 20 = 1380 cycles or approximately 1.4ms so fast enough!

To test that this works, i.e. there are no bugs where a specific numeric value crashes the conversion, the easiest test was to increment a 32-bit count and display the result after each increment, roll over at zero and run for ever... I left this running for a few hours checking on it when I walked past my bench.

The PIC16F54 has a counter with dedicated input pin. The input has selectable edge select (more about this later) and can have a pre-scaler of divide by 2, 4, 8, 16, 32, 64, 128 or 256.

The PIC TMR0 counter is an 8-bit counter. In many members of the PIC16 family it causes an interrupt when it overflows. In the PIC16F54 there are no interrupts so you have to poll it to see if it has rolled over. This is not a problem because as long as you check often enough you won't miss the overflow and the pre-scaler means that the count can be quite slow. The maximum input frequency that the 16F54 can work with according to the datasheet is at least 25MHz. With the divide-by-256 this implies that the fastest overflow we will see is 381Hz (2.6ms). If we test the TMR0 register at least ten times this rate all will be good.

I needed a gate, and a timing loop that would give an accurate gate time while polling the counter frequently enough that it can't miss an overflow. The TMR0 input on the 16F54 can not be gated internally, in fact if it is not used, the datasheet says it must not be left floating as excessive current may be drawn! I decided that the simplest approach was to diode AND the input signal using the RA3 pin next to T0CKI pin to gate it, as shown in **Fig. 2**. RA3 is set high impedance (Set TRIS input) to open the gate and set as a low output to close the gate, saving a diode. I used a 2.2kΩ pull-up resistor and a 1N4148 diode as the input gate. Some of the designs for minimal counters use a series resistor but, unless this is a very low value, it will limit frequency response as it forms an RC low pass with the input capacitance of the chip, in this case as we have two pins connected approximately 20pF input capacitance.



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The counting routine took shape as:

Clear Counter

Open gate

wait 100ms, checking every 20µs for overflow, update registers.

Close gate

Save the TMR0 count

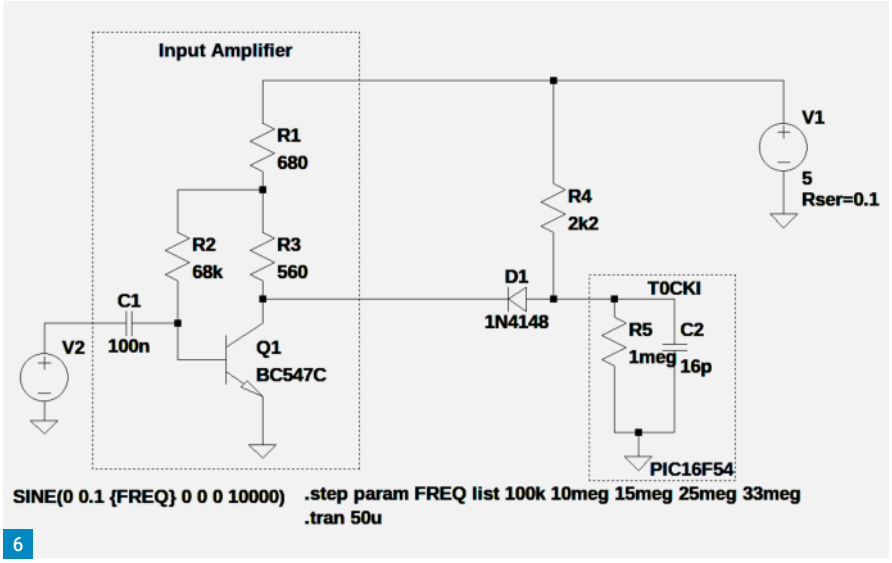
Get pre-scaler count

Convert the count

Display value

Initially I left out the pre-scaler to see if the rest worked, just displaying the top 24bits of the count. Using the TTL output of the signal generator to provide the input, I got a count but some of the time it was wrong. I realised that I had re-used a register in the gate timing count and the BCD conversion routine and it was shortening the count because I assumed it was cleared at the end of the previous count, which it was, but if the BCD conversion did not leave it a zero the next count value wrong, shortening the gate time by up to 20µs × 250 = 0.5ms. It pays be careful with registers!

The pre-scaler value is not readable directly, but you can get the count value by clocking the pre-scaler until it overflows and counting the cycles required to do this, then subtract the count from 256 to get the number of cycles that were in the pre-scaler when the gate was closed. Now most PIC counters that I have seen on the web and in application note AN592 from microchip clock the pre-scaler by toggling the pin used as a gate, but this seems to me to be potentially problematic from the point of radiated emissions and possibly because it might allow more cycles to enter the pre-scaler than you intend if the input signal is toggling fast. Looking at the datasheet, **Fig. 3**, I realised that the edge select mechanism, which is an XOR gate, could be used to toggle the pre-scaler input while holding the gate low. This eliminated the pulsing of the external



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pin and any possibility of random counts from the external source interfering with the pre-scaler while clocking the count out. See **Table 5**.

The counter basically working, it was time to test it thoroughly, but before I did that I decided to add leading zero blanking because the leading zeros were irritating. This turned out to be very easy because the display decoder in the MAX7219 blanks if the all bits are set. So it was just a matter of adding a flag to the BCD converting routine to indicate if a non-zero value has occurred, and since conversion is from high decade to low the blanking is simply a matter of saving 0xF rather the 0x0 if the result of the subtraction loop was zero. In the extract, the variable temp_flag holds the leading zero flag in bit 0. The code is shown in **Table 6**.

So, software was running and testable and appeared to be fine. It was time to put the counter to use and see how it performed.

The first task was to mount it and the display in an enclosure so it could be used, it was built on Veroboard as the circuit is really simple, I used an Altoids tin as a case in the best traditions of GQRP club, **Fig. 4**.

The first thing I noticed was that tuning the crystal oscillator was tricky, I prefer external oscillator circuits for drive level control and ease of adjustment, the PIC oscillator is fine but does need the series resistor to avoid over driving crystals. Note the value of the resistor will depend on the crystal used. With care I arrived at capacitor values and series resistor that allowed ±45ppm adjustment, the crystal nominally a 20pF load type about 30ppm high in the centre of the adjustment range so a bit of room for aging.

The circuit worked well in use, **Fig. 5**, allowing easy observation of the set frequency of the signal generator. I used it to measure some DIL oscillators and it coped well with 4.096MHz, 16MHz, 20MHz, 27MHz and 32.768MHz units I had but did not work with a 50MHz one.

```
D15 D14 D13 D12 D11 D10 D09 D08 D07 D06 D05 D04 D03 D02 D01 D00
 x   x   x   x  A03 A02 A01 A00 D07 D06 D05 D04 D03 D02 D01 D00
```

Table 1: 16-bit word format.

```
write word to MAX7219
; RA1 DATA, RA2 CLK, RB1 LOAD. 16 bit packet, 12bits used top 4 don't care
; Data shifted out MSB first, latched on rising edge of clock
; address passed in in W, data in bin
writeMAX7219

                ;send address
      bcf PORTB,1   ;make sure LOAD is low
      movwf temp    ;save a copy of data
      movlw 0x08
      movwf bit
aloop             ;send address bits
      rlf temp,f
      btfss STATUS,C
      bcf PORTA,1
      btfsc STATUS,C
      bsf PORTA,1
      bsf PORTA,2
      clrwdt
      bcf PORTA,2
      decfsz bit,f
      goto aloop
                ;send data
      movlw 0x08
      movwf bit
dloop             ;send data bits
      rlf bin,f
      btfss STATUS,C
      bcf PORTA,1
      btfsc STATUS,C
      bsf PORTA,1
      bsf PORTA,2
      clrwdt
      bcf PORTA,2
      decfsz bit,f
      goto dloop

      bsf PORTB,1
      clrwdt
      bcf PORTB,1

      retlw 0
```

Table 3: Data written to MAX7219.

```
      ;get pre-scaler bits
      ;apply  pulses to pre-scaler via T0SE until TMR0 increments
      ;value of TMR0 in hold from read after gate closed
       movlw 0xFF
       movwf temp

psl
       clrwdt
       movlw 0x37
       option   ;set  tmr0 input /256 pre scaler falling edge
       movlw 0x27
       option   ;set  tmr0 input /256 pre scaler rising edge
       decf temp,f  ;if pre-scaler empty count down 255 times.
       movfw TMR0
       subwf hold,w
       btfsc STATUS,Z  ;if TMR0 has changed
       goto psl

       movfw temp    ;store value in low byte (lb)
       movwf lb
```

Table 5: Getting the count value.

```
      bcf PORTB,1   ;make sure LOAD is low
      movlw 0x10    ;16 bits
      movwf bit     ;bit count register
      bsf PORTA,1   ;set data pin high
loop

      bsf PORTA,2   ;clock high
      nop
      bcf PORTA,2   ;clock low
      decfsz bit,f  ;next bit or end?
      goto loop     ;

      bsf PORTB,1   ;latch
      nop
      bcf PORTB,1
```

Table 2: Test data.

```
;write LED data to MAX7219 display
; data in bin, register address in W
       movlw 0x1C
       movwf FSR    ;initialise pointer high digit
       movlw 0x01
       movwf dig


writeloopLED
       movf INDF,w    ;get low nybble

       andlw 0x0F
       movwf bin
       movfw dig
       call writeMAX7219
       incf dig,f     ;next digit
       swapf INDF,w  ;get high nybble
       andlw 0x0F
       movwf bin
       movfw dig
       call writeMAX7219

       incf dig,f     ;next LED digit
       incf FSR,f     ;next
       movlw 0x1F
       andwf FSR,w    ;mask of high bits

       btfss STATUS,Z ;test for zero, i.e. FSR>0x1F
       goto writeloopLED
```

Table 4: Code to read the 8 digits and write them to the display.

```
          movf dig,w       ;result of subtraction loop
     btfss STATUS,Z
     bsf temp_flag,0   ;if not zero set flag
     btfss temp_flag,0 ; if leading zero
     movlw 0x0F        ;blank
     andlw 0x0F        ;mask off high bits
     iorwf INDF
```

Table 6: Adding a flag to the BCD converting routine.

I built a single stage input amplifier to allow the counter to work with lower level signals such as 0.2V pk-pk.

Spice simulation of the input amplifier, **Fig. 6**, based on a cheap BC547C in LTSpice matched the performance of the PIC counter. The amplifier was built on a scrap of Veroboard and tested, allowing signals of less than 0.5V pk-pk from a few kHz up to 25MHz to be measured reliably.

If anyone is interested in building the counter I will be happy to e-mail the source code and HEX files.

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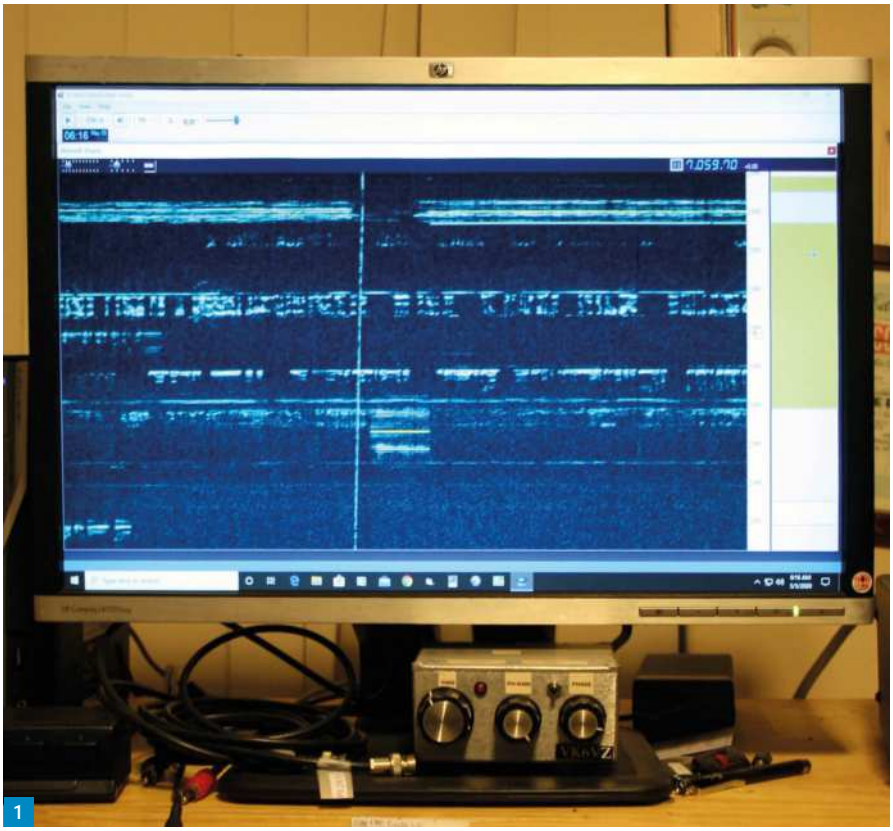

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Getting a Quieter Radio Life

When it comes to amateur radio operation in the 21st century, perhaps the biggest challenge is coping with electrical 'noise'. **Steve Ireland VK6VZ/G3ZZD** looks at some practical methods of reducing this problem and how to build a noise canceller from a kit.

Even though I live in what the local council calls a semi-rural area, like just about every radio amateur the bane of my radio life is noise generated by nearby consumer electrical devices.

Almost every consumer electrical device now seems to contain a switch-mode power supply (SMPS) or inverter – from the light emitting diode (LED) globes that illuminate most houses to the solar panels on our roofs that power them. Televisions, telephones, modems, network switchers, mobile phone chargers, set-top boxes, personal computers, DVD players, CD players, washing machines and dishwashers are all powered from a supply whose output produces lots of harmonics because of generating power from what is basically a square wave, rather than the sinusoidal one of an old-fashioned well-designed linear, transformer-based supply.

An SMPS usually converts sinusoidal Alternating Current (AC) mains voltage into a much lower Direct Current (DC) voltage using switching circuitry that broadly produces noise between about 100kHz and 10MHz [1]. While the noise can be filtered out by a low pass filter, unless this is done well an SMPS is likely to produce enough 'hash' to be heard nearby on a communications or domestic receiver. Consumer devices are generally built to the lowest possible price and good filtering and RF shielding of an SMPS inconveniently costs money.

As most will know, solar panels generate low DC voltages so 230/240V AC mains voltages are subsequently produced by a circuit called an inverter. This can be considered as a kind of reverse-operating SMPS, taking a low DC voltage and generating the much higher AC voltage by means of switching circuitry that operates at frequencies in the radio spectrum.

The good news is the inverters used with solar panels are relatively expensive and so often contain good filtering and can be built into metal boxes (check before buying!), which provide RF screening. The bad news is these inverters generate much higher currents than a simple SMPS and may generate much more noise.

This noise may extend from a few tens of kilohertz all the way up to UHF. There is an excellent video on the RTL-SDR website showing solar panel inverter interference all the way from 30MHz to 120MHz and what it looks like displayed on an RTL SDR-driven bandscope [2].

In short, if you are unlucky, the result of combining an array of solar panels and an inverter with a large range of SMPS-powered electrical devices can be a living hell for a keen radio amateur.

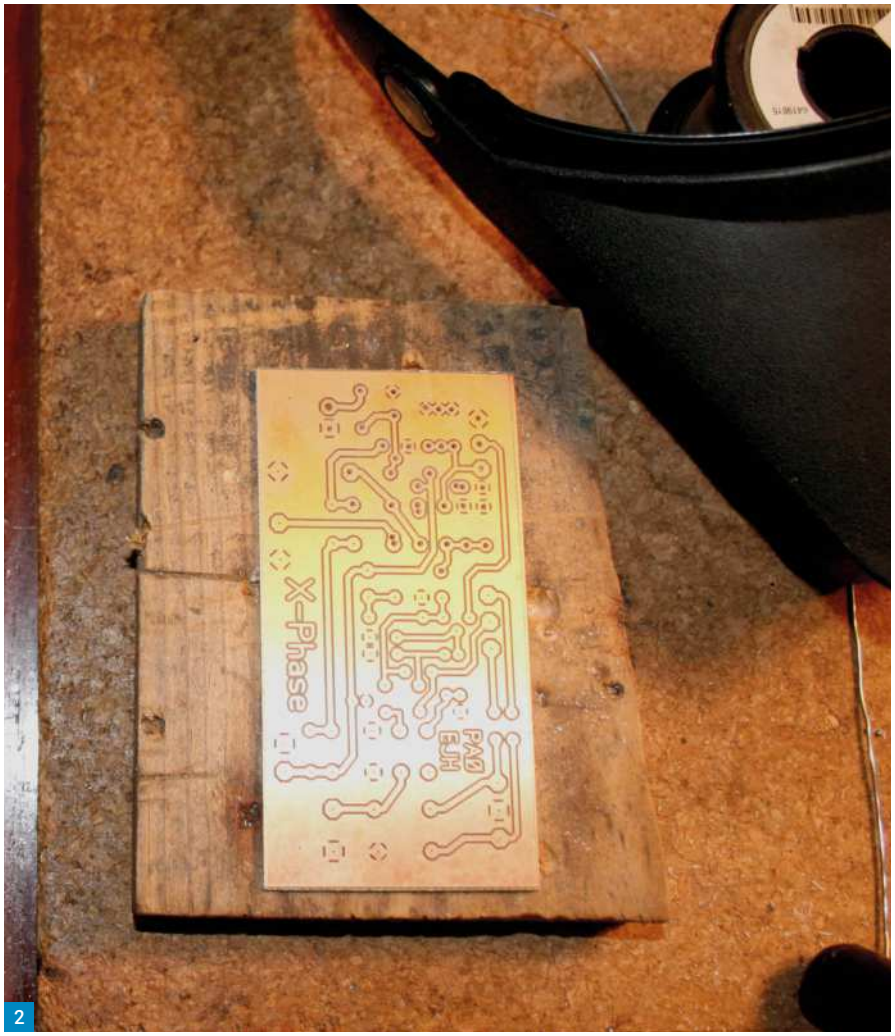
The Easiest Way to Cancel Noise

Those who have watched any TV drama about vampires will know they can only enter your household if you invite them in. Much the same can be said about electrical devices, so the key before purchasing a new domestic appliance is to do your research on how noisy it could be.

As is usual, the key is to ask around among your fellow radio amateurs, particularly those with a solid radio or electronics background. If your radio passions lie in in the low shortwave frequencies, then ask advice from someone who is similarly inclined but if your passion is VHF/UHF, then you need to talk to someone who shares this interest. Unfortunately, very few domestic electrical devices seem quiet at all frequencies so an LED striplight that is quiet on the 1.8MHz band may be much less so at 432MHz, or *vice versa*.

Any small mains powered (or charged) device purchased these days is likely to have an SMPS supplied with it. However, even if you have invited it into the house doesn't mean you can't then pull out its fangs. While transformer-based 5 to 24V 'wall warts' are almost

Fig. 1: VK6VZ X-Phase in place under my main computer monitor. Fig. 2: VK6VZ X-Phase PCB, with half the 1mm holes drilled in it.
Fig. 3: Inside the completed VK6VZ X-Phase.



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extinct in electrical/electronic retailers, owing to their commonplace status a decade or two ago you can find them relatively easily at car boot sales, radio rallies and the like and they are easy to distinguish from SMPS types owing to their much greater weight. These make great replacements for a similarly rated SMPS.

Every time I go to a sale of this kind I look for 'used but in good condition' transformer-based power supplies of this kind. Obviously you need to have one that has an identical voltage output to the SMPS you are intended to swap it for, along with a current capacity that is at least equal to or greater than that of the SMPS. It will also need an identical plug to the SMPS, which is wired with the same polarity.

There has been more than one occasion when I have gleefully pulled a transformer-based power supply from my junk box with the correct output voltage and current to replace an SMPS, along with an apparently identical output connector. However, a closer inspection of the power supply's case (which usually has a diagram showing the polarity of the connector) has revealed its connector has the opposite voltage polarity to the SMPS (i.e. the outside of the barrel connector carries a positive voltage rather than a negative one).

While this is easily corrected by reversing the connector's polarity (using a pair of cutters and a soldering iron), if I hadn't noticed this the incorrect voltage polarity would likely at least have destroyed my newly-purchased electronic device and could have potentially caused a fire.

As the standard small print goes, the author and this magazine take no responsibility for you carrying out modifications of this nature and replacing SMPS with transformer-based linear power supplies.

Knowing about Noise Cancellation

My good friend **Phil VK6GX/G3YC** and I are both seriously interested in lowband DXing. Long distance signals on the 1.8/3.5/7MHz bands are often weak and the bands atmospherically and electrically noisy. The best way to hear these DX signals is thus to increase the amplitude of the signals relative to the received noise (i.e. improve the signal-to-noise [S/N] ratio).

This is traditionally achieved by having a directional receiving antenna that captures signals only from a limited area/region, such as a Beverage or a Pennant. An antenna of this kind is also going to be directional in terms of the noise it receives.

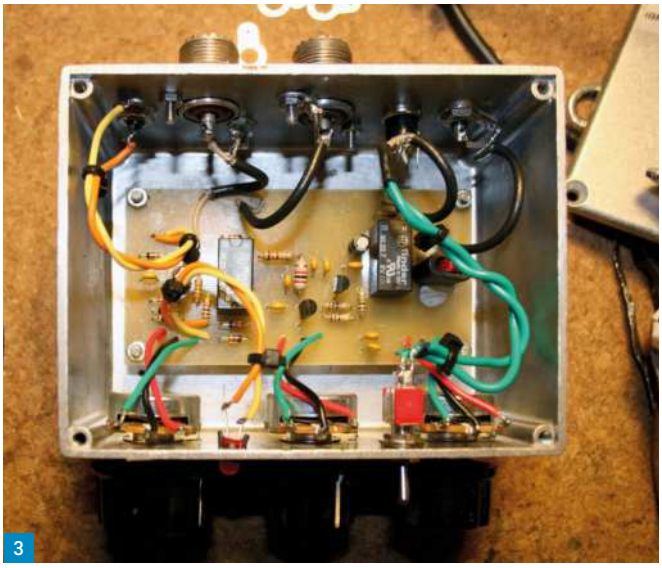
Those who are interested in the HF bands above 10MHz and VHF/UHF have been lucky enough to be relatively free from electrically-generated noise until the last decade or two, particularly those who have rotatable, directional beam antennas. However, as the use of LED lighting, SMPS, solar inverters and VDSL modems has increased, these frequencies are no longer safe havens.

About three years ago, with increased noise on every frequency between 1.8MHz and 30MHz at our homes, VK6GX and I began a concerted crusade against it. As described earlier, SMPS were replaced throughout our houses with linear, transformer-coupled power supplies. Next, using a professional electrician and following advice from **Jim Brown K9YC** [3], the AC mains earthing in our houses was greatly improved by installing a chain of 1.5m-long ground rods (spaced 1.5m apart connected by 6mm diameter earthing wire) between the mains entry point to the house/earth connection and our radio shacks. In my case this resulted in a 3dB drop in ambient electrical noise.

At VK6VZ, the previous coaxial-fed (i.e. unbalanced) parallel dipoles for 1.8/3.5MHz were replaced with a 1.8MHz doublet antenna system using balanced open-wire feeder and a link coupled tuner – see my article in *Practical Wireless*, July 2019 (*The Magic of the LCT Tuner*) – to minimise any common-mode noise picked up by feeders or still being carried by the earth system. This resulted in a drop of 15dB in my noise level on 1.8MHz – from S5/S6 to S1 in a 500Hz bandwidth – and also helped on 3.5MHz and 7MHz.

As far as the bands above 10MHz were concerned, by virtue of using multiple K9YC ferrite common mode chokes on my Yagi feedlines [4] and the aforesaid earth improvements, my noise level was now the lowest it had ever been. Unfortunately, shortly after this triumph, several of my closest neighbours installed solar panels for mains electricity and the fight against electrical noise restarted.

What had happened was I now had patch-



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es of noise a few kilohertz wide across most of the bands, including 14, 18 and 21MHz. The noise seemed to get stronger as sunset approached and was in the order of S3 to S6 – enough to cover weak DX signals from Europe and the Americas.

While the DSP Noise Reduction on my Icom IC-7610 was helpful, knocking back the noise an 'S' point or so, sometimes more, it was far from a total cure. Weak S2 signals that I could previously hear were being masked.

This setback caused me severe agitation but a trip to the local pub with VK6GX, a pint or two of Guinness and some soothing words about a noise canceller kit Phil had bought recently calmed me down.

VK6GX had purchased an X-Phase QRM Eliminator kit from Haje Electronics in the Netherlands for just under 50 euros [5], which had made a noticeable improvement to his electrical noise level on all bands. To whet my appetite, he suggested watching a YouTube video by **John PD7MAA** [6].

I pointed out to Phil that I had several noise sources, so how was a noise cancelling device going to deal with this situation? He said I was thinking about this the wrong way. The idea was to simply reduce the level of the worst of the overall noise sources. If I put up a noise antenna that could pick up as much of the noise as possible, then some sort of useful reduction would almost certainly occur.

When I watched the PD7MAA video I was quite astounded by the results John had achieved. The Haje website was subsequently visited, where I found two X-Phase versions were available – one for use on frequencies from 500kHz to 30MHz and the other for 2MHz to 50MHz. The former was purchased online and arrived ten days or so later by airmail.

Without going into too much technical detail, the X-Phase works by cancelling locally generated 'signals' picked up by a relatively inefficient 'QRM antenna', such as a length of wire a couple of tens of metres long, by altering the phase of these signals so they are the opposite phase (i.e. 180° out of phase) to the ones picked up by your main antenna, which contains both the wanted signal and the unwanted QRM signals. Like the noise antenna, the main antenna is also connected to your radio by the X-Phase.

What happens practically is when the wanted and QRM signals from the main antenna are mixed in the X-Phase with the QRM signals from the noise antenna (which have been changed to the opposite phase) the QRM signals are cancelled out, leaving only the wanted signal.

Building the Haje X-Phase

My package from Haje contained some basic building instructions, a small package of parts and a printed circuit board (PCB). Both PCB and instructions have been done by **Egbert PA0EJH** and the circuit is apparently a design from **Hans DK9NL**.

These are not step-by-step instructions of the kind you might find in a kit from Elecraft or QRP Labs, but with a component count of less than 30 conventional through-hole components and only a simple ferrite-cored RF transformer (using a binocular core) to wind, the instructions are quite adequate. Note that English isn't PA0EJH's first language, so some of the phraseology may seem a little strange.

Now the PCB has a feature that some may find a little odd, but to me was part of the charm of making the kit. The PCB is a good quality and all its tracks and pads are well defined, but none of the component holes have been drilled – builders have to do this themselves.

5

I purchased a 1mm drill bit from a local hardware shop and, using my 40 year old Stanley hand drill and a hobbyist magnifying visor, found that drilling the holes was both straightforward and fun. Finding the centre of each pad was easy using the visor.

One thing that is not obvious from the instructions is there is a wire link, which the constructor has to make underneath Relay A (i.e. before soldering the relay in place – see the PCB layout nearby). This link can be simply made by cutting one lead off a junk-box resistor and then soldering it into place.

The PCB was assembled in my customary fashion. First identify all the components and check all of them are present. Then assemble the board in a systematic manner. Solder in the resistors first, then the capacitors, the link under Relay A, the semiconductors (transistors and diodes) and finally the transformer T1 and the two relays. Use a small, temperature-regulated soldering iron and 0.5 to 1 mm diameter solder. The only tricky part is T1 – make sure you remove the wire varnish (with a piece of emery paper) from the end of each transformer winding before soldering.

There is no case or mounting hardware supplied with the kit but the X-Phase PCB fits

Photo 4: Front view of X-Phase – note the large knobs used which make adjustment easy.
Photo 5: Rear view of X-Phase.

neatly into an aluminium diecast box 120mm long, 90mm wide and 50mm deep. The PCB is mounted using M3 nuts and bolts and 10mm long spacers to keep it above the bottom of the case. The three 5kΩ potentiometers (used to control gain, phase gain and phase) are supplied, but you will need to purchase your own knobs. You will also need to supply two coaxial sockets for connection to your transceiver and antenna (I used SO239), two RCA sockets for the QRM/noise pickup antenna and the connection to the transceiver's PTT line output plus a socket for 12V DC power.

Photos 3, 4 and 5 show the VK6VZ completed unit.

As it is possible you are placing the X-Phase between your transceiver and the antenna, the PTT line connection is necessary so when you go on to transmit, the X-Phase is switched out of circuit and isn't destroyed by your transceiver's RF output power being passed through it.

A much better way to connect the X-Phase, if your transceiver has this facility, is using the lattter's separate receiver antenna ports. On some modern transceivers – and older radios, such as the Icom IC-751A or a Ten Tec Corsair – on the rear panel you will have 'receiver antenna input' and 'receiver antenna output' RCA sockets, which 'as standard' will be connected together via a jumper lead. The X-Phase is simply hooked-up by removing the jumper and connecting its 'transceiver' input socket to the 'receiver antenna input' and its 'antenna' socket to the 'receiver antenna output'.

Inrad's excellent RX7300 receive antenna add-on [7] provides an identical facility for the Icom IC-7300, which should make interconnection with the Haje X-Phase simple and effective.

What you are doing is when the transceiver is on receive, the X-Phase is connected between the main antenna and the receiver input, but when the transceiver is on transmit, the X-Phase is isolated from the transmit antenna by the transceiver's transmit/receive switching and subsequently protected. I'd also still connect up the PTT line from your transceiver to the Haje X-Phase PTT to disconnect the canceller electrically from the main antenna circuitry on transmit to provide extra isolation 'to be sure, to be sure'.

At VK6VZ, the QRM/noise antenna consists of about 30m of wire, end fed with RG-58 coaxial cable with its earth braid connected to the aluminium pole/earth stake that supports the shack end, run about half a metre away from the garden fence. If you are not interested in 1.8MHz, 10 to 15 metres of wire, run along the fence farthest away from the transmit antenna, should be adequate for picking up enough local noise.

I haven't tried this but some radio amateurs have been using the famous active PA0RDT Miniwhip [8] as the noise/QRM antenna. As this covers from 10kHz to 30MHz with a reasonable output, it sounds an excellent solution, which could be mounted outside on a short wooden pole and take up very little room. The better the noise antenna, the better the X-Phase will perform.

Using the X-Phase

Once the X-Phase was completed, I did my usual tests for any 'short circuits' with a digital mulimeter, in particular on the various connectors and between the +12V line and earth. The X-Phase was then hooked up to my IC-7610, using the receiver antenna in and out connectors and selecting the receive antenna option on the IC-7610's menu facility, and powered by the operating table's auxiliary 12V supply. The main antenna was then attached to the transceiver as usual, along with the noise antenna to the X-Phase.

The X-Phase 'Gain' (overall gain) 'Phase Gain' (noise antenna gain) and the 'Phase' control were each set at about half-rotation After switching on the radio and the X-Phase, I then adjusted the two gain controls upwards and found there was an increase in background noise, indicating the noise canceller was apparently working.

Each time you change frequency more than a few tens of kilohertz, the noise canceller is going to need adjustment, with the biggest changes obviously occurring when you change bands.

It is a good idea to keep a small chart of where the controls roughly need to be on each HF band. It is also really useful if your radio is connected up to a personal computer using HDSDR or similar bandscope software because this provides a useful visual aid for adjusting the X-Phase.

Basically, the adjustment process is as follows – and is the same for most noise cancellers. With the 'Gain' set at half to two-thirds, adjust the 'Phase Gain' and 'Phase' controls in tandem to achieve the best possible null in the nose level. Note that both controls interact with each other. If you can't find a null, try turning the 'Gain' control down (i.e. reducing the overall gain).

Once you have found a null in the noise, juggle the adjustment of the three controls (they all interact) to make the null as deep as possible. This takes a little practice but is well worth it. In my case, despite having multiple noise sources, I was able to make my overall noise level drop by at least one to two 'S' points – making signals almost buried in noise become comfortably readable. Although the X-Phase was most effective on 1.8, 3.5 and 7MHz, it has also proved useful on 10 and 14MHz in dropping the noise floor.

I tend to use my ears when making these adjustments, but others may find it useful to watch their 'S' meter, particularly if it is an analogue-format one. If you happen to have HDSDR, you will see a shallow valley forming in the noise floor on the PC screen as the null gets deeper.

A final note, if you are still getting a real poor null after playing with the X-Phase's controls, try lengthening the noise antenna so you get more noise pick-up. This usually will do the trick.

Conclusions

Since I bought the Haje X-Phase, I've discovered **Terry Mowles VK5TM** sells a kit of parts of an apparently similar performing noise canceller [9] at a very good price – and with a case. He will also potentially assemble the kit for a fee. In addition, RA0SMS often offers his 'QRM Eliminator' noise cancelling kit (note it has some Surface Mount Device (SMD) components) on eBay.

While DSP Noise Reduction is an excellent tool – and is much better implemented in modern radios than in older ones – sometimes it can do with help. A phase-cancelling noise reduction device like the X-Phase can make the difference between hearing – or not – a rare DX station.

That being said, as was explained at the beginning of the article, you also need to pay attention to removing/minimising any noise sources in the vicinity of your radio shack. Do this and get a noise canceller and you really should have a quieter radio life!

References

[1] **www.ukqrm.org/smps**
[2] **https://tinyurl.com/y699e792**
[3] Power, Grounding, Bonding, and Audio for Ham Radio Safety can be downloaded from **https://tinyurl.com/zssqccr**
[4] Jim Brown's excellent book A Ham's Guide to RFI, Ferrites, Baluns, and Audio Interfacing can be downloaded from **https://tinyurl.com/22q2hx**
[5] See **https://tinyurl.com/y54yy2pz**
[6]. PD7MAA: **https://tinyurl.com/y68gc6cs**
[7] **https://tinyurl.com/y5ovj7r7**
[8] **https://tinyurl.com/pcd69fs**. Kits and ready-made versions of this can be found on the web.
[9] **https://tinyurl.com/y2cscy46**

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Transistors

Tony Jones G7ETW discusses the fundamentals of transistors.

I've sat down to write about Colpitts Oscillators. I want to truly explain things so I need to start with amplifiers first, but even that isn't square zero.

Let me kick off with what a transistor does. This is not the usual 'electrons and holes' approach. I will derive all this from practical readings using a 2N2222 and a few resistors stuck into breadboard.

An Old Friend

Fig. 1 shows the 'transistor switch' circuit from the old Intermediate course, with a 270kΩ resistor R1 substituted for a human hand. This isn't a switch at all; it is a self-biasing emitter-follower, also known as common-collector amplifier. Such shorthand terms are useful if you completely understand them, but they can hide the fact that you don't. I will explain as I go.

Transistor Fundamentals, Step by Step

We start with **Fig. 2a** to get a baseline. The various voltages and currents are summarized in **Table 1**.

Fig. 2b has a diode inserted to bridge B and E. The voltages, **Table 2**, rearrange themselves, and the diode conducts. (Shorthand: it is 'forward biased'.) I was a bit surprised at my diode's voltage, but it came out of a scrapped PSU I was given so I didn't lose any sleep over this!

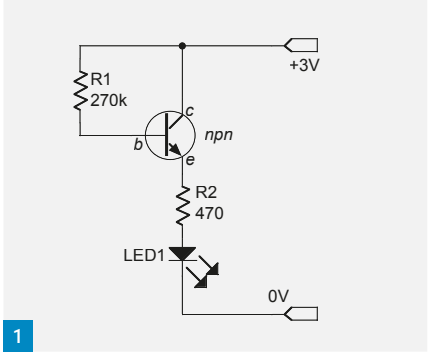
Fig. 2c has an 2N2222 NPN transistor in place of the diode. The collector-to-supply connection is deliberately omitted.

The voltages, **Table 3**, were slightly different, because the 2N2222's base-to-emitter junction took a bit more voltage than my mystery diode. I included this step because people often say a base-to-emitter junction 'acts like' a diode. It doesn't 'act', it is a diode.

Fig. 2d shows the same circuit but with the collector now connected to the supply. The voltages and currents are shown in **Table 4**.

So what, I hear you thinking. Give an LED some current and it lights. But hold on for a minute.

Before, I had a base current of 4.4µA. Gain for my 2N2222 as measured on a Peak Atlas tester was 248, so I_c should have been about 1mA. It wasn't, it was barely half of that. What had gone wrong with the currents?



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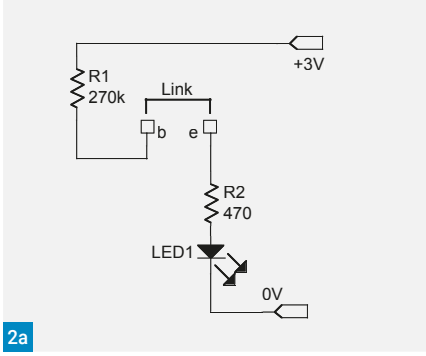


2a

A Balancing Act Goes On

When a collector current flows, a much bigger PD develops across R2. As I_c rises, this voltage rises.

This lifts the voltage on the base, because the emitter and base are in series. Increasing the base potential reduces the PD across R1 and that reduces the base current.

So, as I_c rises, I_b falls – classic negative feedback. All by itself my 2N2222 set its base potential for stable operation. (Shorthand: self-bias).

Amplifier or Switch?

Yes, the base current switches the LED on, but this is not a switch. It is a DC amplifier, only useable with one value of I_b. As a practical circuit for controlling LEDs this is almost useless because so much of its operation depends on the transistor's gain, something a builder usually has no control over.

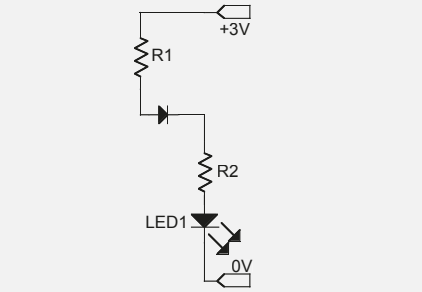
This circuit would make a good NPN tester though – if the LED fails to light, the transistor is a dud, and by measuring I_b and I_c the gain can be calculated.

More to Learn

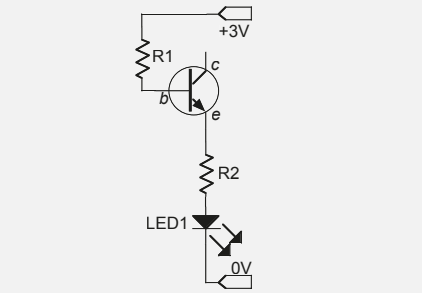
Supply voltage is also a factor. The voltage across R1 has been substantially cut, and this is crucial for I_b. There isn't much 'headroom' running off a 3.4V supply.

To show what I mean, I made up the bare bones of an LM317 voltage regulator circuit. **Fig. 3a** shows my construction and **Fig. 3b** shows a better circuit.

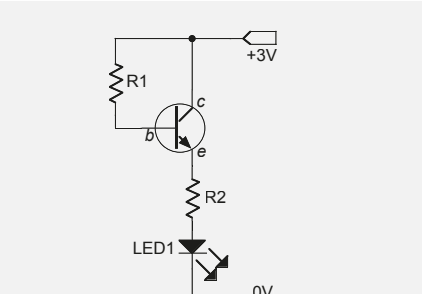
I set my PSU to 6V and adjusted the LM317's output to 3.4V, the same as I'd had before. I then carefully reduced the supply voltage. Down to 2.7V the LED was



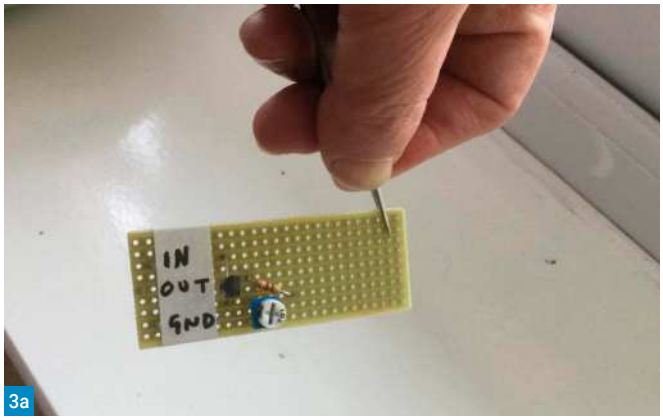
2b



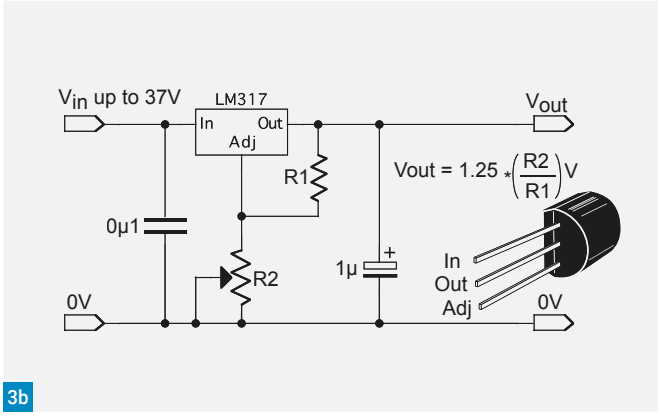
2c



2d



3a



3b

Fig. 1: Circuit of common-collector amplifier. Fig. 2a: Simple resisitive circuit. Fig. 2b: As Fig. 2a but with a diode in place of the link. Fig. 2c: As Fig. 2a but now with a transistor (open collector). Fig. 2d: As Fig. 2a but with the transistor fully connected. Fig. 3a: LM317 circuit on breadboard. Fig. 3b: Circuit using an LM317. Fig. 4: Thinking of the circuit as common-collector. Fig. 5: Our circuit reconfigured with the LED and resistor connected to the collector. Fig. 6a: Collector current vs. base current with 6V supply. Fig. 6b: Collector current vs. base current with 7.5V supply. Fig. 6c: Saturation occurring as the potential difference between collector and emitter drops to zero.

quite bright, but at 2.3V it went out. At this point, try as the 2N2222 might, there is not enough voltage to forward bias the base-emitter junction. Clearly my LED was an only-diode – it wasn't prepared to share!

Why is this Called an 'Emitter-Follower'?

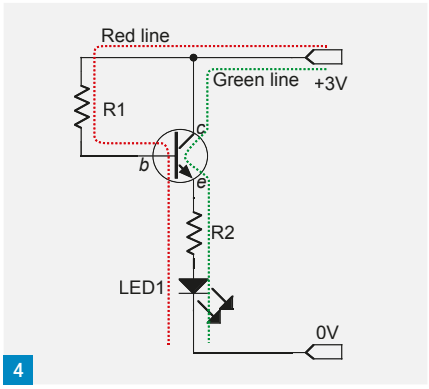
Base current only flows when the base-emitter voltage exceeds about 500mV. After that the base-to-emitter PD is fixed, even though the base current varies. As the base's potential rises, or falls, so does that on the emitter. This leads to the name: 'emitter follower.'

For completeness, collector current only flows when a base current does. And the potential on the collector has nothing to do with the base or emitter potentials.

Why is it also Called a 'Common-Collector' circuit?

See **Fig. 4**. Both base and collector can draw current from the supply because each is connected to the positive rail (red line). When a collector current flows the collector is obviously connected to the emitter (green line).

Looking out of the supply positive terminal and thinking 'I'm a current', there are two paths back to the negative and the collector is common to both. Hence the confusion; this is also a 'common-collector' circuit.



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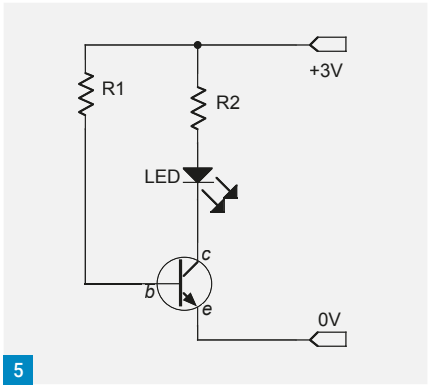

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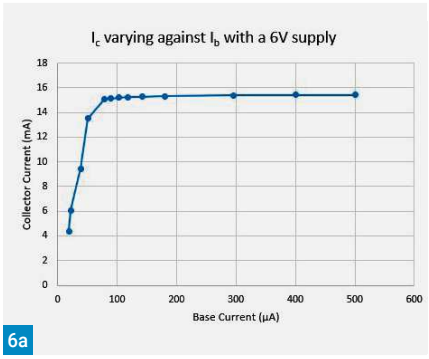
So Why isn't This a Switch?

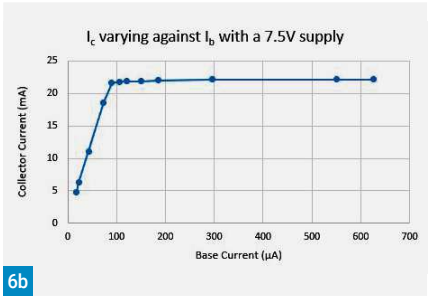
A mechanical switch passes as much current as the load wants to draw. No voltage arises across the switch and no power is wasted. If a load wants 5A at 12V, a correctly-rated switch will deliver that.

In Fig. 2d above that isn't true. The potential on the emitter is less than the supply and the transistor limits LED current. For a proper switch, something more controllable is needed.

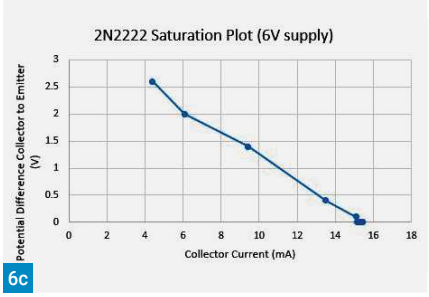
See **Fig. 5**. This is the same from the base's point of view, but R2 and the LED have moved to the collector side of the transistor.



6a



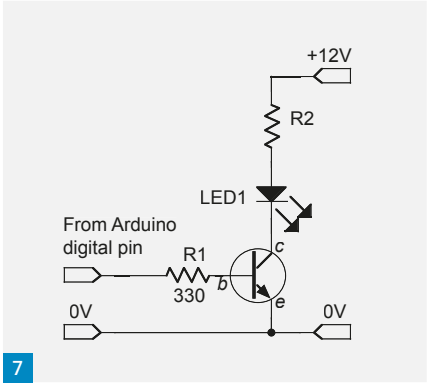
6b



6c

With the emitter at ground potential, the PD across R1 has increased. By varying R1 – I used resistors ranging from 2kΩ to 470kΩ – the base current can be set. A corresponding collector current passes directly through the load, causing a voltage drop across it and reducing the potential on the collector.

Figs. 6a and **6b** show the I_c to I_b relationship I got when I tested this. Running off 6V, I_c rises with I_b, quickly reaching much larger values than in the



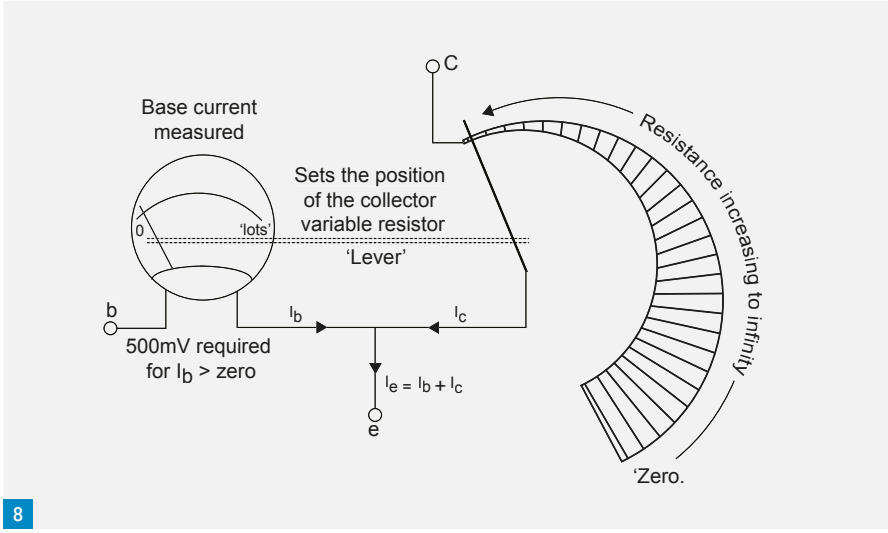


Fig. 7: The final circuit, meeting the specified requirements. Fig. 8: A model of transistor behaviour.

emitter-follower circuit. But at around 15 mA, I_c hits a plateau.

The same happens with a 7.5 V supply, but at 22mA. If I'd wanted to supply my LED with 20mA running off 6V, there is simply no value of I_b that would get me that.

This is called Saturation.

Something interesting happens at the collector too. The voltage drop across the load gradually consumes the supply voltage. **Fig. 6c** shows that as the transistor approaches saturation, the potential on the collector quickly drops to zero.

For a switch, this is more like it. At Saturation, a load sees all of the supply voltage and the base current can be the absolute minimum to do the job.

Practical example: Switch 1A with an Arduino

Imagine I wanted to manufacture a board to control a 12V 12W load – a car bulb, or a motor say or, in this case, an LED – from an Arduino.

Requirements:

Transistor that saturates at 1A collector current with a 12V supply. Base current small enough for an Arduino to cope with.

Say I find a likely transistor with Gain quoted as 150 to 450. For a one-off, I could make a circuit up and tune it to suit, but a product needs reproducibility and a standard build. So, in my design I downrate the transistor's gain – to 100, say. By doing that, even a spectacularly off-specification transistor will still work.

I also increase the projected base current to absolutely guarantee the transistor is saturated.

I_c needs to be 1A. With a transistor gain of 100, that makes I_b 10mA.

Add 30%, and that is 13mA. An Arduino's 5V digital pin can source 40mA (absolute maximum – never do this!) so this is a safe enough design. To put 13 mA into the base of the transistor I need a series resistor of about 300Ω (I hope why is obvious now).

Fig. 7 shows the final circuit.

PD across R1	PD B to E (link)	PD across R2	PD across LED	Current	LED lights?
1.7V	0V	3mV	1.6V	6.3µA	No

Table 1: Voltage and currents measured in circuit of Fig. 2a.

PD across R1	PD B to E (diode)	PD across R2	PD across LED	Current	LED lights?
1.41V	300mV	2.4mV	1.5V	5.1µA	No

Table 2: Voltages and currents measured in circuit of Fig. 2b.

PD across R1	PD Base to Emitter	PD across R2	PD across LED	Base current Ib	Collector current Ic	Potential on Collector	LED lights?
1.25V	550mV	2.2mV	1.6V	4.4µA	0V	0V	No

Table 3: Voltages and currents measured in circuit of Fig. 2c.

PD across R1	PD Base to Emitter	PD across R2	PD across LED	Base current Ib	Collector current Ic	Potential on Collector	LED lights?
590mV	600mV	270mV	1.87V	2.3µA	550µA	3.4V	Yes

Table 4: Voltages and currents measured in circuit of Fig. 2d.

Vbe	Ib	Rce	Ic	Mode
< 500mV	Zero	Infinite	Zero	Cut-Off
500mV up	Varies (under user control)	Varies inversely with Ib	Varies with Ib and is much bigger	Linear – an amplifier
500mV up	Varies (under user control)	Short circuit	Hits a maximum	Saturation – a switch

Table 5: Summary of circuit behaviour under varying conditions.

The G7ETW Basic Transistor Model

I did consider starting the piece with this, but I think it makes more sense now. The name 'transistor' is a contraction of 'transfer' and 'resistor'. **Fig. 8** shows a simple operational model I dreamed up. There are much better ones, but this one sums up the article. See also the summary in **Table 5**.

An Apology

Well, I didn't intend the basics to take 1700 words, but I think that was worthwhile. I do recommend getting some bread-boarding and playing with a transistor. To see the currents and voltages changing I found to be surprisingly fun.

My intention was to cover Amplifiers, bias (designers don't let transistors self-bias in real life) and Colpitts oscillators, and I will. But that will have to be another article.

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Standards

Dear Don,

I read **Robert Dancy G3JRD's** letter in the January issue with interest, but I must take issue with the 60Hz vs 50Hz smaller lighter argument. In aircraft the AC supplies are 400Hz, which reduces the core size/weight at the expense of higher-grade silicon iron for the core. There is almost no difference between 50Hz and 60Hz in the respect of commercial transformer lamination material or transformer size/weight for a given power, but commercial transformers from the USA often overheat when attached to UK mains as they are designed for 220V AC on the primary rather than our 240V AC. Additionally, creepage and clearance requirements are different.

But to answer his question as to why all these things area as they are, I would bet on three factors – cost, state-of-the-art and avoiding other companies' patents.

John Dunton G1RXC
North Walsham, Norfolk

RF Earths, Fuses and Standards

Dear Don,

As usual, *PW* January 2021 has provided a very useful and thought-provoking issue. Thank you all very much.

I hesitate to teach the many grandfathers and grandmothers in your readership. However, may I make constructive comment on the excellent letters from **Robert G3JRD** and **Mike G1SCT**.

Robert notes that the fuse in the plug top hardly ever blows; this is to be welcomed, since this demonstrates that no fault condition has occurred. Robert correctly comments on the all too common prevalence of 13A fuses where 3A is the correct value.

Robert makes the observation that the fuse *"only (sic) protects the flexible lead"*. Oops! That is the sole purpose of a fuse, nothing else: A fuse of the correct value will rupture before the current-carrying capacity of a cable is exceeded, preventing that cable from overheating and causing a fire. (That is why there are fuses in positive and negative 12V leads used in transceivers; overcurrent in the negative lead can cause a fire under fault conditions as well.)

Fuses are of limited value in electronic equipment. Usually, any printed circuits are fried before the supply cable is overstressed, though the final PA transistors can react very quickly as fuses to protect the antenna!

In the USA domestic properties are usually served by at least two phases, allowing high power items such as tumble driers and beer coolers to be operated on 220V, thus reducing the requirement for higher currents.

The 110V units used on building sites in the UK are actually 55V to Earth, thus significantly reducing the risk of death should a single conductor be accidentally touched. This is achieved by using a centre-tapped transformer, with the centre tap bonded to Earth potential. (You can still 'get a belt' if you decide to put yourself across the110V though!)

Mike comments on the 10mm^2 cross-section earth conductor. The main earth conductor attached to the incoming Main Earth Terminal should be of a size equal to or greater than the main supply conductors and should be at least 16mm^2. 10mm^2 is used for earth bonding to other utilities.

As an illustration of the importance of earthing, I installed a 1m length of 16mm^2 Earth cable in a house. The girls of the house had been showering in a cubicle that had been 'live' for ten years, but that's another story. Two months later I discovered all the insulation melted from the16mm^2 cable and the copper a bright red colour! Two weeks prior the sub-station across the road had experienced a fault that ruptured the main Neutral. So, a fault current of about 3kA had flowed in 'my' earth conductor.

The neighbouring house had not been in receipt of my earthing ministrations and was burned to the ground! A good lesson to me on the importance of sound Earth connections. I often wonder if I should claim 'salvage' on the saved house!

As a good rule of thumb I was taught that *"no problem should be imported back into the main distribution board. All faults should be cleared locally."* i.e. Our shacks in the garden should have their own distribution board, which will clear any electrical fault at that location and not trip any protective device on the main board. This is what Mike is referring to when the PEN conductor is isolated from circuits outside of the main property.

A radio amateur engaged in self-training, construction and installation of radio equipment needs access to, or knowledge of, a plethora of skill sets, including, but not exclusively, electrical theory and practice, electronic theory and practice, antenna erection methods and safety, neighbourhood negotiation, marriage guidance.

There are few electricians with the skill set to advise radio amateurs, which is why a young person with these skills should be highly valued in the labour market.

Enjoy the hobby, it has been of great value in Covid times and I'm still learning.

Michael White G4HZG
Clay Cross, Derbyshire

RF Earths

Dear Don,

It is reassuring to read the that at least someone realises the reality of the situation in which radio amateurs are placed (*Letters*, January 2021). We are repeatedly told by the experts in antenna technology that a good RF earth is essential to the efficient functioning of many antenna systems. I have several pieces of equipment that state categorically that the equipment must be earthed but with no indication as to which earth the requirement is referring. We are repeatedly told **not** to earth our radio equipment output to a PME system and yet, as is openly evident, the

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On a Budget

Dear Don,
I have been reading **Daimon Tilley G4USI's** slightly controversial article (*PW* January 2021), that the amateur radio community, particularly those new to the hobby, should think again before splashing out on an all-dancing and all-singing transceiver from a factory located somewhere in Asia. Is Daimon aware that if this trend were to take off, shunning expensive rigs that, let's face it, in the majority of cases sound exactly the same at the other end of a QSO as rigs costing thousands of pounds, it could well cause a tsunami-like effect in the commercial amateur radio manufacturing arena?

Okay, it's not likely to happen any time soon, everyone suddenly migrating to rigs that don't look like the avionics command centre of the space shuttle, or come complete with a user manual that takes at least week and a whole packet of Paracetamol to comprehend, but just imagine if it did happen? Would amateur radio be more fun? Would we all really want to brag about how little we paid for our rigs, rather than as is the case now, bragging about how much they cost and, probably more importantly, gleefully telling every Tom, Dick and Harry that their brand new rig can perform all manner of amazing communicational tricks except, of course, until some bright spark with a brain bigger than Mount Palomar, finds a way to include a microwave oven and a coffee maker as part of a transceiver's marketing specification?

Although I do understand the laudable ethos behind Daimon's concept, and I agree with it, my concern is that unfortunately many newcomers will still gravitate to being ensnared into buying state-of-the-art amateur radio technology simply because it appears that most amateur radio operators do exactly that. And even though the Chinese brand connection has now become popular in a bigger way – cheaper prices for similar ham radio products– it's still new and still relatively expensive for some people.

I have done it myself – not buying a new transceiver for the sake of it. I decided long ago to just hang on to what I've got (refusing to be grabbed by the ear by alluring pictures in amateur magazines and frogmarched to my debit card to order a new rig). It still all works. Still does what it says on the can. And some of the rigs I own are 40+ years old. So why spend a few hundred pounds on a new whizz-bang VHF/UHF rig when all you hear most of the day is the CW announcement of where a repeater is located. I can hear that on a rig I bought 30 years ago! Ditto, eavesdropping on HF QSOs on 40m.

I don't need a £4000 rig to do that. No, but what you really do need is a decent antenna, the best you can afford, or build one yourself. And that's a strange thing? Why do people spend a small fortune on a new rig, then connect it up to a piece of wire strung up along the garden path? Beats me. I've never understood the logic of it. It's a bit like buying a Bentley and not bothering to put any fuel in the tank.

So, yes, logic does dictate that the budget rig route is the way to go for many people. Besides, there is literally tons of the stuff out there, all looking for savvy buyers. However, there is a caveat. Buying old rigs brings forth the spectre of one day switching them on and maybe one or two refusing to play ball – they no longer work! Then what happens? Because, not wishing to be alarmist, a few newcomers to the hobby don't know one end of a transistor from the other end. Whether that's a good thing or not, is open for future debate. Buying old rigs is or can be a gamble. But there again, because many old rigs are cheap, if they give up the ghost and you can't fix it, bin it and buy another one. Couldn't be easier.

One last thing, I saw on page 60 of Damion's article a big picture of his shack with two huge monitors showing what appears to be a replication of an expensive HF transceiver. SDR? And there I was thinking that Daimon had rejected cutting-edge technology. Unless of course, he purchased it at budget price?

Ray Howes G4OWY/G6AUW
Weymouth

(***Editor's comment***: *Thanks for this Ray. There is a lot of truth in what you say although there are reasons why amateurs may want the latest rigs – digital voice capability, enough stability for FT8, best signal handling in conditions of QRM, etc. And you make a good point about serviceability – I seem to recall that the main reason Yaesu stopped manufacturing the popular FT-1000MP MkV was that the PA transistors were no longer available. But I 100% agree that the first target for station improvement should be the antenna, although I also recognise that many amateurs are limited in what they can put up. And, of course, if we can afford it, there is a certain satisfaction in owning a nice new rig, just as in owning a nice new car or whatever.*)

manufacturers of most radio equipment on the amateur market have already made internal connections between the RF earth and the mains earth in PSUs, transceivers, etc.

You cannot win as it will happen whether you do so intentionally or not! It appears that the electricity distributors and the creators of the wiring regulations are not liaising and considering the wider consequences of their recommendations and not making their recommendations retrospectively compatible with previously installed systems. Until recently a member of a local radio club was convinced that all PSUs had a floating negative line – a resistance meter and a check of the circuit diagram proved otherwise You have done it wrongly whichever way you do it! A pig's ear or just incompetence?

We have experts in both fields pontificating at great length in written and digital forums and having to differentiate between the various wiring structures while ignoring the reality that such decisions regarding earthing are often out of our hands.

Roger Kendall G8BNE
Knaresborough

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Dear Don,
The more I read about PME the more I have questions rather than answers. **Mike G1SCT** (*Letters*, January) is correct that I avoided the subject of an antenna reaching a high voltage while being accessible to someone standing on the ground. My submission was single-minded in its intent to prevent electrocution due to the suggestion that an RF earth could be separated from protective earth (to which I gave higher priority than reducing received noise).

I'm unsure of semantics (and have difficulty finding a definitive answer in the electrical regs) but the earth bond to the ground stake is downstream of the earth-neutral separation point, so is it still regarded as a PEN conductor? What happens about supplying an electric heater in an aluminium greenhouse, which is outside the '...four walls of the property?' Mike also spots the outside-tap risk, which bothered me when I fitted one, so I did interpose plastic pipe. However, the water itself is conductive. Also, is it more dangerous if it's barrier pipe?

There is a paradox because Mike also advocates keeping RF and protective earths separate while acknowledging that *"The hazard is caused by the distributor's earth potential rising..."* Then there is the possibility that the fault current would flow through the rig's wiring and *"...melt the earth wire in the mains lead..."* Again, if the RF stake had been bonded, this wouldn't happen because there would no longer be much potential difference to cause significant current flow. Mike does confirm my assertion that an RCD in the premises is of no help in this case, since it is outside the fault loop.

As to the size of the bond, first consider its purpose. Is it to maintain the equipotential in the event of a ruptured neutral, or is it to create a low-impedance fault path that trips the distribution equipment in rapid time? If the latter, then why is this bond to be larger than those on all other parts of the installation (including metal service pipes)?

Where do we go from here (and are the RSGB and G3RZP wrong)? All I can suggest is that *PW* commissions an explanatory article by an engineer (not a technician/electrician who knows the regulations by rote but didn't devise them) familiar with both power distribution design and RF requirements. Maybe ask the RSGB and perhaps a member of the IET?
Godfrey Manning G4GLM
Edgware

(***Editor's comment***: *Thanks again Godfrey and also to Michael and Roger. It seems that this is a complex issue with arguments both ways, depending to an extent on the sort of earthing system in the house, whether 'old fashioned' or PME. I'd love to present a definitive solution and will see what I can do, but I suspect it may be easier asked than answered.)*

Useful Resources

Dear Don,
Here's a free online YouTube video on avoiding interference:
tinyurl.com/cleanshack

If you are a new user or planning to use Logbook of The World (LoTW), **Gary ZL2IFB** has put together an easy step-by-step PDF guide or should we say manual (about 33 pages with pictures) to help you use LoTW:
tinyurl.com/lotwmanual

Stealth Antennas by **Steve Nichols G0KYA**. With new build housing having small restricted gardens, then the sample book link below could prove useful to many amateur radio enthusiasts. All but the last chapter 11 included so useful tips & tricks to create stealth antennas provided free. **Reg Auckland G2PA** (SK) of Verulam ARC *"If you can't hear them, you can't work them."*
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