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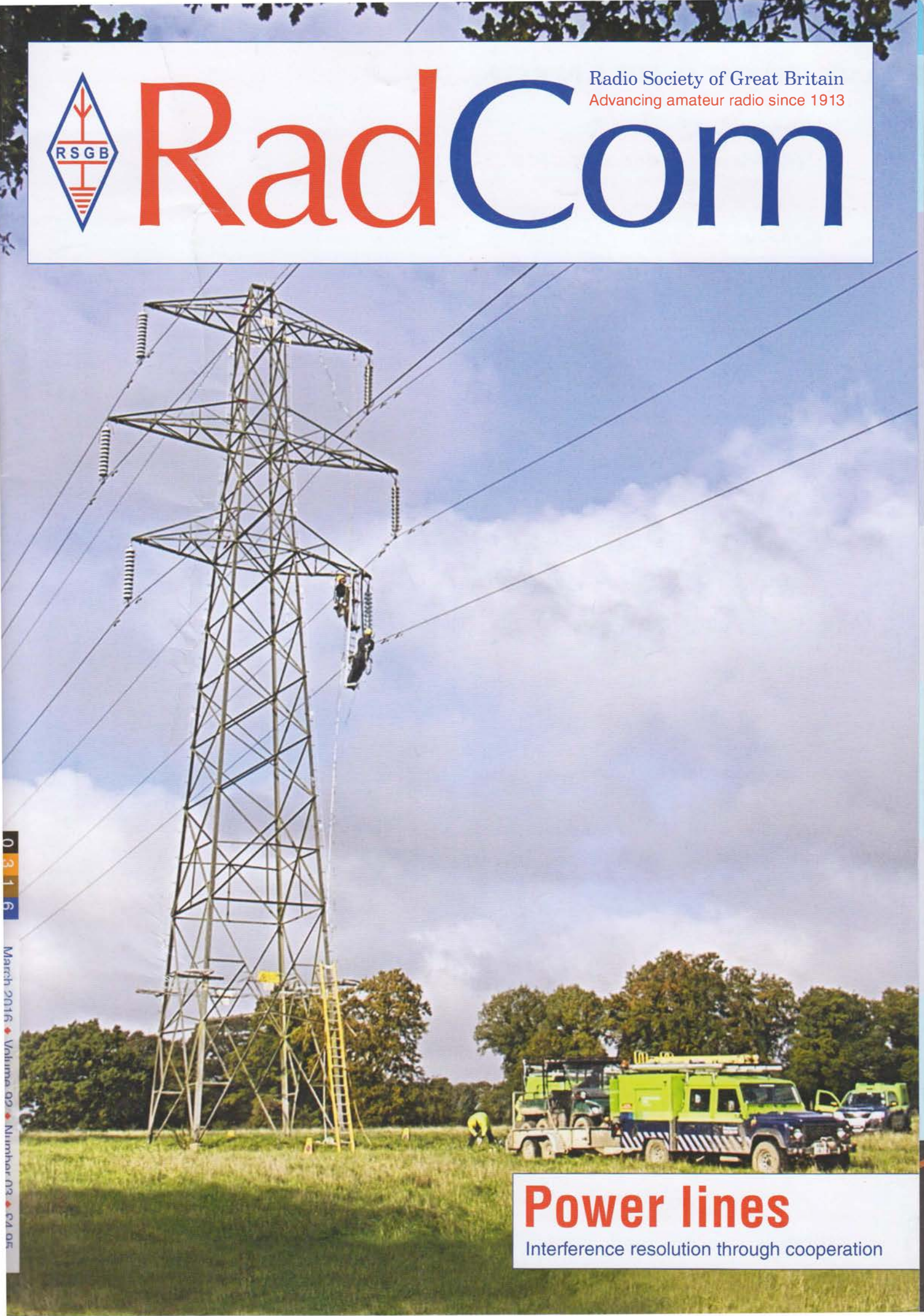

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The IC-7300 features an integrated wide frequency automatic antenna tuner making it ideal for field operation. The radio provides 100W output power on HF/6m bands and 50W on 4m.

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The IC-7100 offers 100W from 160m/6m, 50W from 4m/2m and 35W output on 70cm. Not only do you receive a large touch screen display, but it is also D-STAR ready and no SD card is needed.

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Icom's HF/6m IC-7700 transceiver has a 110dB dynamic range and +40dBm 3rd order intercept point. It also has two independent DSP units for better accuracy and reliability.

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The Icom IC-5100E is a D-STAR and FM ready dual band transceiver. It includes touch screen technology, DV dual watch and DPlus reflector linking capability.

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IC-7851

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Icom's IC-9100 is a HF/VHF/UHF transceiver that includes D-Star options. It offers 100W output on all bands up to 2m, whilst on 70cms you get a healthy 75W.

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The TS-990S is a HF/6m, 5W-200W transceiver that has dual TFT display. Features include: +40dBm intercept point RX, 2 TFT colour display screens and 3 DSP processors.

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TS-590SG

The TS-590SG is a HF/6m, 100W transceiver that includes: DSP auto ATU 12V USB, TX/RX equaliser DSP, on screen CW decoder, tri-colour display and an extended digital IF filter selection.

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TS-480SAT

Kenwood's TS-480SAT is a HF/6m all mode transceiver and is equipped with a built in automatic tuner. It has a 100W output and features an electronic memory keyer.

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TM-V71E

The TM-V71E is a 2m VHF/UHF FM mobile transceiver with EchoLink functionality. It also includes: dual channel watch, 1010 memories and advanced IP.

£299.95C

TM-D710GE

The TM-D710GE is a VHF/UHF transceiver with APRS, TNC and built in GPS.

£479.95C

TM-281E

Kenwood's TM-281E is a rugged and reliable VHF 65/25W mobile transceiver with MC-59 RX 2.2m - 1.7m.

£169.95C

TS-2000X

The TS-2000X transceiver offers 100W on HF, 6m/2m and 50W on 70cm. It also includes 300 memory, a built in ATU and dual channel receivers.

£1,529.95D

TS-2000E

The TS-2000E is a HF 6m/2m/70cm all mode transceiver. It features dual channel receivers, a built in ATU and 300 memory channels.

£1,329.95D

Justin Johnson G0KSC

DEMO ANY RADIO AT EUROPE'S BIGGEST DEDICATED HAM RADIO DEMONSTRATION CENTRE:

Sales growth at W&S has been substantial through 2015 which has been largely due to our make-over and shack conversion into Europe's largest dedicated ham radio demonstration centre. Having dispensed with all TV and audio equipment, we are now solely focused on ham radio equipment both as a wholesaler to the UK's ham radio shops and dealers and direct to end users.

W&S are the UK's official importers of many popular ham radio brands which includes: MFJ, Ameritron, Cushcraft, Elecraft, Apache Labs, Heil and Diamond to name a few along with our own brand, Watson and we will be adding to this list very soon. The new SunSDR has now arrived in the UK and will be reviewed within RadCom very soon. If you would like to try this and all top brand radios available today, there is only one place you can do this in the UK on decent antenna systems. Call me and I will personally show you around!

Pay us a visit and check out our amazing demo facility

Carriage charges - A-£4, B-£5, C-£8.50, D-£11.

MFJ

MFJ-939 Auto Antenna Tuner

Compatible with Kenwood, Icom and Yaesu.

REVIEWED PAGE 20

The MFJ-939 is a discrete automatic antenna tuner that tunes your antenna as you tune your radio, whilst keeping SWR low. It tunes your coax fed or random wire antenna 160m - 10m from 2W QRP to full 200W SSB/CW.

£149.95C

Waters and Stanton UK Official MFJ Importers

MFJ-1786X & 1788X
Super HI-Q Loop Antenna

MFJ's tiny 36 inch diameter loop antenna lets you operate 30m - 10m continuously, including the WARC bands! It can handle up to 150W and is incredibly easy to use.
The MFJ-1788X is similar to the 1786X, however it has a frequency coverage of 40m - 15m instead.

MFJ-1786X: £449.95C
MFJ-1788X: £489.95C

MFJ-902B
Travel Antenna Tuner

The MFJ-902B is a 80m - 6m 150W travel antenna tuner. Built with real air variable capacitors (600V, 322 pF) and three stacked powder iron toroids to handle real power, not just QRP. It's bypass switch allows you to bypass your tuner when you don't need it.

£109.95C

MFJ-226
Antenna Analyser

The MFJ-226 is a VNA antenna analyser that covers from 1MHz - 230MHz at 1Hz resolution. Not only does it have two frequency modes (single and swept) but it has 32 memories and can store OSL calibrations.

£329.95C

MFJ-259C
SWR Analyser

The MFJ-259C is a HF/VHF SWR analyser. It gives you a complete picture of your antenna's performance and you can read your antenna's SWR and complex impedance 530KHz to 230MHz continuously with no gaps.

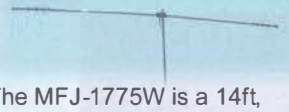
£249.95C

MFJ-225
Antenna Analyser

The MFJ-225 is an antenna analyser that has all the standard functions, plus a built in LCD display, 2 ports for VNA and USB and it doesn't require calibration.

£299.95C

MFJ-1775W
Rotable Dipole



The MFJ-1775W is a 14ft, 12/17/30/60m rotable dipole with a turning radius of 7ft and allows you to operate on all WARC bands.

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Yaesu Wires-X HRI-200

Yaesu's Wire-X HRI 200 is a wide-coverage internet repeater enhancement system that enables internet to RF communications.

FTM-100DE Transceiver

The Yaesu FTM-100DE is a dual band mobile transceiver, which closely follows the 'System Fusion' strategy.

Selectable Free Gift with FT-DX1200

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FT-DX1200 Transceiver

The FT-DX1200 provides up to 100W on SSB, CW, FM and AM and a rugged, highly articulated balanced receiver circuit configuration. It allows for communication on 160m - 6m.

Yaesu FFT-1

The FFT-1 adds an AF-FFT scope function, PSK & RTTY encode plus CW, PSK & RTTY decode features to the FT-DX1200.

Free Snapshot Microphone

Purchase an FTM-400DE, FTM-400XDE or FT-2DE and receive a MH-85A11U snapshot microphone.

DR-1XE Installation Support/Cashback

Any repeater group / repeater keeper / radio club that successfully installs a DR-1XE and meets qualifying criteria for at least 30 days after installation is entitled to receive a £400 cashback.

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ANAN 100E

The Apache Labs ANAN-100E is a 100W HF/6m SDR multi-mode transceiver that can support up to 7 receivers at a time. **£1,959.95D**

ANAN 100DE

The Apache Labs ANAN-100DE is a 100W HF/6m SDR multi-mode transceiver with dual ADC and full duplex operation. **£2,849.95D**

ANAN 10EE

The Apache Labs ANAN-10EE is a HF/6m all mode SDR transceiver. It is also an ideal entry level DDC/DUC SDR transceiver. **£999.95D**

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The NW Digital Thumb DV is a portable dongle that provides access to D-Star and AMBE encoding/ decoding.

It can connect to your Flex 6000 series radio, PC, laptop or tablet.

£99.95B

FLEX RADIO
OFFICIAL IMPORTER

Flex 6700

The FLEX-6700 is a HF/6m transceiver, which is capable of displaying up to 6 independent slice receivers at any one time.

£5,749.95D

Flex 6500

The FLEX-6500 is a HF/6m transceiver, which features up to 4 independent slice receivers and plug & play technology.

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The Flex control is an interface for the Flex-5000/3000/ 1500 and the Flex 6000 series.

It features a knob on the console with programmable function buttons. **£109.95D**

Flex 6300

The FLEX-6300 provides an entry point into SDR radio operations from CW to the latest digital modes.

£1,969.95D

Maestro 6000 Control Console

Checkout our latest Maestro YouTube video!

The Flex Maestro is an intuitive, plug-and-play control console that directs operation of any FLEX-6000 signature series transceiver without the need of a traditional PC. Whether you are the most serious contest operator, DX chaser, rag chewer or you just love to "play radio," Maestro is fun and easy to operate.

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Colibri DDC

The Colibri DDC is a small sized receiver intended to receive signal in HF frequency band. Not only can it work on computers, but it can reduce additional noise of analog cascades. **£479.95C**

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The SunSDR2 PRO transceiver is designed for advanced use in HF and VHF bands. Even the most experienced operator will be surprised by its capabilities.

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SunSDR MB1 Transceiver

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The DUC/DDC transceiver MB1 is a new generation of amateur radio. This unique radio combines a classic design with advanced DUC/DDC SDR technology.

The operator receives a fully functional workstation in one case, which is started by pressing just one button!

Go to **www.wsplc.com** for further details.

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See page 3 for full contact details.

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Cover image: SEPD engineers replacing suspect insulators on a 132kV power line. Photo: Brian Coleman, G4NNS.

RadCom THE RADIO SOCIETY OF GREAT BRITAIN'S MEMBERS' MAGAZINE

Managing Editor: Elaine Richards, G4LFM, elaine.richards@rsgb.org.uk
Technical Editor: Giles Read, G1MFG, giles.read@rsgb.org.uk
Layout and Design: Kevin Williams, M6CYB, kevin.williams@rsgb.org.uk

All contributions and correspondence concerning *RadCom* should be posted to: *RadCom* Editor, 3 Abbey Court, Fraser Road, Priory Business Park, Bedford MK44 3WH
Phone 01234 832 700, fax 01234 831 496, radcom@rsgb.org.uk

RadCom is published by the Radio Society of Great Britain as its official journal and is sent free and post paid to all Members of the Society. **The April edition of *RadCom* is expected to arrive with most Members by 23 March, although this can take up to a week longer in some cases; international deliveries can take longer still.**

All material in *RadCom* is subject to editing for length, clarity, style, punctuation, grammar, legality & taste. Articles for *RadCom* are accepted on the strict understanding that they are previously unpublished and not currently on offer to any other publication. Unless otherwise indicated the RSGB has purchased all rights to published articles. No responsibility can be assumed for the return of unsolicited material.

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Technical supplement *RadCom Plus* is available to RSGB Members online at www.rsgb.org/radcom-plus
RadCom Basics for Members new to the hobby can be found at www.rsgb.org/radcom-basics/

The RSGB is on Twitter @theRSGB

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Encouraging Youth

Rather than a gentle ramping down as my term as President comes to its conclusion life is as busy as ever due, in no small part, to the very exciting school contacts with Tim Peake aboard the ISS, the related Buildathon activities and YOTA month becoming a fixture in our annual calendar. These provide a focus on the next generation of amateurs as well as opportunities for media coverage and we hope some spin-off leading to careers in our science, technology and engineering base, all made possible by RSGB volunteers working closely with our affiliated clubs.

I have long been a fan of the Raspberry Pi, mostly because it was aimed at young people, doing what the BBC Micro did for highlighting software coding back in the 1980s, so I was delighted to see the article by John, G0UCP (page 16) showing what can be done with the Pi on 30m using WSPR.

With a small team of volunteers, the analysis of the Amateur Radio Survey is coming on well but a couple of things already stand out. One is the value that people place on equipment reviews in RadCom and the other is our EMC activity. All our reviewers put a lot of effort into their work and the article on the SRDPlay Receive Spectrum Processor (page 44) by Mike, G4WNC is no exception. Initial findings from the Survey suggest that too many EMC problems are going unreported, so please read John, M0JAV's article on VDSL Interference (page 80) and do some simple checks. If you detect problems, let the EMC committee know.

Finally, I would like to thank those who have volunteered to lead the Society over the next few years by standing for election either as a Board Member or Regional Manager. You will see a number of our elected positions have been filled unopposed so the new Board and Regional Council are already taking shape. In particular, the Society will have a new President, Nick Henwood, G3RWF, who will succeed me at the AGM in Glasgow.

73,

John, G3WKL

IARU Interim Meeting

Papers for the forthcoming IARU Region 1 interim meeting that will be held in April are now available. Topics include HF, VHF/Microwave and EMC matters. Comments from UK amateurs are invited via the RSGB IARU Consultations forum, which includes guidance and links to the papers.

In total there are over 60 papers across C4-HF, C5-VHF/Microwave and C7-EMC (C5-HF is the largest set, with 41 papers). Band planning, spectrum, contest rules and EMC interference are the most common subjects, along with specialist issues on APRS, WSPR and VDSL interference. The 'Welcome' messages on the three main forum threads give links for the material and a list of paper titles.

Comments are requested in good time before 10 March so that the Society positions can be confirmed prior the IARU meeting. Details are at http://rsgb.org/main/rsgb-consultations/iaru-consultations/

International Women's Day

The YL France team and DARC's YL group are organising an international YL-Activity to celebrate International Women's Day from 0700 to 1100UTC on 6 March using the 40 and 80m bands on SSB and CW. The points per QSO for YLs are 3 points for every YL contact and 1 point for every OM contact. OM entries are 2 points for every YL contact and 0 points for OM contacts. All who submit their log will receive a participant's award in .pdf format free of charge. Participants from the UK (and other countries) should send their log to Sophie, F4DHQ (f4dhq@orange.fr), Germany stations should send their log to Christiane, DL4CR (dl4cr@darc.de). Logs should be in chronological order and must contain QSO date, time (in UTC), band, mode, call of QSO partner, name of the YL, RST and the points claimed. The deadline for logs and award claims is 1 May.

Subtitled Youth Video

In response to requests from affiliated clubs, a subtitled version of *Amateur Radio – a hobby for the 21st Century* is now available for download from the RSGB website via tinyurl.com/RSGB-AR21C or http://rsgb.org/main/get-started-in-amateur-radio/amateur-radio-a-hobby-for-the-21st-century/ This may be helpful when the video is shown in a noisy environment.

2016 Band Plans

In contrast to 2015, when Ofcom licence and IARU changes were quite extensive, the 2016 band plans feature relatively few changes. Modest updates from ongoing alignments of repeaters and gateways by ETCC and other editorial changes are the main amendments.

However, we do note from correspondence that some amateurs have not digested the full extent of the changes in 2015 and earlier. The Excel master on the RSGB website has detailed change notes that can guide readers.

The HF updates for 2016 are largely confined to FM usage in the 29MHz band where our improved alignment of gateways and repeaters with IARU Region 1 now enables a simplification. An extra licence note regarding power limitations in 1.8MHz has also been added. We would stress that there is no change to 5MHz where UK licence conditions continue to apply – though we are conscious of the WRC-15 outcome.

VHF/UHF changes are largely confined to 70cm where we have been able to clarify FM-analogue or digital voice usage in some of the gateway and repeater segments as part of ongoing ETCC work. Licence notes regarding power limits have been supplemented in the 50 and 70MHz bands.

Band plans are living entities and evolve over time. Please ensure you only refer or link to the current ones on the RSGB website and remove any older ones you have locally. Unfortunately we still note some websites and unofficial usage charts have obsolete information and urge that these are removed. The up to date band plan, including the master Excel files, can be found on the Operating section of the RSGB website – and if you are unsure, by all means contact the relevant Spectrum Manager: hf.manager@rsgb.org.uk, vhf.manager@rsgb.org.uk or mw.manager@rsgb.org.uk

Murray Niman, G6JYB, RSGB Spectrum Chair

ARISS Contacts

Confirmation has been received that, subject to final preparations going well, seven more schools will have the opportunity to speak to Tim Peake, GB1SS on the ISS via amateur radio. During a 10 minute window when the ISS passes over the UK, an amateur radio contact will be established with Tim and students will be able to ask him questions about his life and work on board the ISS. The following list shows the best timing information available when we went to press. The exact dates and times are only notified by NASA about 10 days beforehand, so detailed information will be included in GB2RS, the RSGB website and social media as it becomes available.

The transmissions from the ISS can be heard on the usual downlink frequency of 145.800MHz. The uplink frequencies are subject to change and will not be published.

- Between 22 and 28 February – City of Norwich Schools, Norwich, GB2CNS
- Between 29 February and 6 March – Powys Combined Schools Powys, GB4PCS
- Between 18 and 24 April – St Richard's College, Bexhill on Sea, GB4SRC
- Between 18 and 24 April – Wellesley House School, Broadstairs, GB1WHS

Photo courtesy NASA

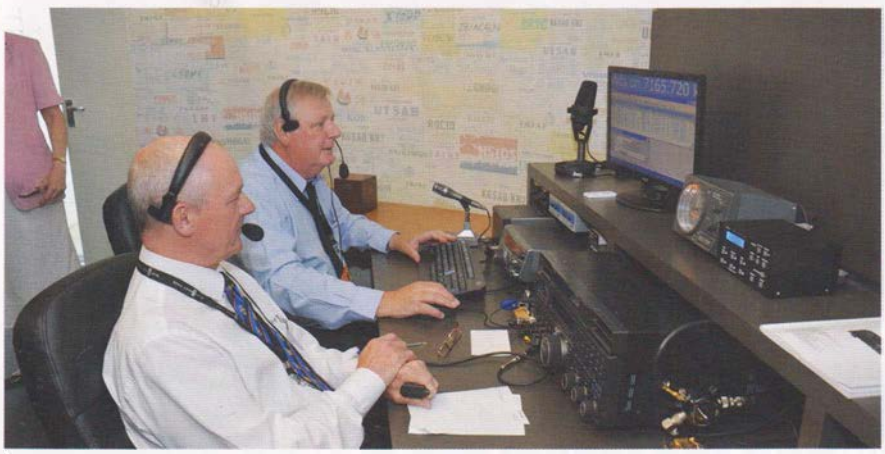
- Between 25 April and 1 May – The Derby High School, Bury, GB1DHS
- Between 2 May and 8 May – Ashfield Primary School, Otley, GB1APS
- Between 9 May and 15 May – The Kings School, Ottery St Mary, GB1OSM

The Future for 5MHz Beacons

From August 2002, UK amateurs could apply for an NoV to conduct experiments on specific channels at 5MHz. From this was born the RSGB 5MHz Experiment and as part of this activity the Society organised the commissioning of three beacons on 5,290kHz. The primary purpose of providing propagation data over a sunspot cycle has been completed and over 1.5 million records are stored in the Experiment's database. Marcus, G0IJZ has used the data for a number of different analyses, several of which have been presented at professional international conferences as well as to form articles for *RadCom*. There might be some interest in continuing with this beacon activity, not least for operators to view the combination of current beacon reception with ionosonde and X-ray data on Nick, G4IRX's 5MHz Comparison Website at http://g4irx.nowindows.net/wp/fivemegs/5mhz-comparisons. Your views are sought on the future of these beacons as are offers to provide the necessary technical support. A Forum (http://forums.thersgb.org/index.php) for the 5MHz Beacon Forum has been opened for your comments. Offers of technical support please to Ian, G4FSU, RSGB HF Manager via email to ian.greenshields@gmail.com

In recognising that this marks the end of the beacon component of the RSGB 5MHz Experiment we would all thank Andy, G4JNT and Peter, G3PLX who provided the technical elements; Mike, M0MJW, John, G3WGV and Donnie, GM0HTH, our three Beacon Keepers, and others like Marcus, G0IJZ and those that participated in the data collection. We hope that many who use 5MHz in the future will continue to use the band to experiment as it is a fascinating part of the radio spectrum. John Gould, G3WKL, President & Ian Greenshields, G4FSU, HF Manager

Volunteers Needed for the National Radio Centre



The National Radio Centre (NRC) at Bletchley Park needs more volunteers to explain amateur radio to the public and demonstrate the HF and VHF stations at GB3RS. The station is normally open on Wednesdays to Sundays but the Society would like to extend this to 7-day opening if it can.

There are likely to be gaps in the schedule from time to time throughout the week so if you think you may be able to help for as little as one day per month then please contact gm.dept@rsgb.org.uk

Reasonable travel expenses will be reimbursed. NRC volunteers also become Bletchley Park Volunteers and are thus entitled to a range of benefits including 4 free admission tickets each year for their friends and discounts in the Bletchley Park shop.

QSL Matters

Last month we showed you a breakdown of how the bureau handled more than a million cards in 2015. What we couldn't show is how recent or historic some of those cards were. All QSL bureaux can only work with what they receive from other countries or from their own members. Incoming card dates vary wildly, from QSOs a matter of weeks old to those several years ago. What if the other station is now inactive or no longer wants the card?

For example, last month's overseas incoming contained several cards from one station dated 2002 and, in the same package, were hundreds for a city anniversary in 2009 and thousands for a contest in 2010.

On the subject of special stations, in 2015 we began seeing some calls not fitting the current UK callsign sequences and for which we had no prior warning or contact details. Most have numbers such as 100, 75, 50, 14 etc but were not listed against Members' or clubs' callsigns. Members and clubs are reminded that such calls must be traceable on the RSGB Membership Database, to avoid the cards automatically getting discarded and sent for recycling. Please would affiliated clubs in particular, ensure that all their callsigns are shown on their record and not just against the record of the person who holds the licence.

What's important to our sorters is that a club's and name and unique affiliation number can be quickly traced. If yours isn't shown this way, please visit the RSGB website or call Membership Services (01234 732 700 option 2) to amend the details.

The bureau is still looking for a replacement volunteer to cover the G1 and G2 call sign series. It has around 800 member callsigns, some inactive and others not currently collecting.

There are many active stations in Scotland but as yet we have received no expressions of interest to take on the valuable work of distributing QSL cards to the GM4-8 community. Tom Wylie, GM4FDM is anxious to step down and we would love to hear particularly from amateurs in Scotland with an interest in QSLing, keen to help.

If you are interested in these volunteering opportunities, have some free time, space, and basic computer skills and would like to support the work of the bureau, please email us via qsl@rsgb.org.uk

ISS Stop Press

The International Space Station (ISS) contact with Oasis Academy, Brightstowe (North Bristol) has been given their date. The contact will take place on Friday 19 February, commencing at 1423UTC. Students have already completed a Buildathon, thanks to Shirehampton ARC, and are looking forward to the actual contact.

Congratulations

To the following Members whom our records show as having reached 70, 60 or 50 years' continuous Membership of the RSGB.

70 years	
Mr M Warriner	G0TTG
Mr P V Pugh	G2CQX
S Hampshire ITS	G3DIT
60 years	
Bury RS	G3BRS
Mr K Day	G3LDJ
Medway ARTS	G5MW
50 years	
Mr C Draper	G3TSK

AROS Volunteers Wanted

The Amateur Radio Observation Service (AROS) is the advisory and reporting service of the RSGB with the primary purpose of monitoring the amateur radio spectrum and discouraging operating practices which might bring the hobby into disrepute. It relies on a team of observers to gather evidence on issues confidentially reported to them, and we would welcome applications from Members interested in joining our team of volunteers. Applications from the West of England, South Wales and the London area are particularly welcome. Please email aros@rsgb.org.uk for further information or to apply.

Have you seen the RSGB's first video for 2016?

Over 1,000 Members volunteer for the RSGB in a wide variety of roles. What motivates them and what do they get out of it? Find out from the RSGB's new video – go to www.rsgb.org/volunteer-video to see it on our website, or view it on the RSGB YouTube channel. If you'd like a copy to show at your club, please contact us.

In the video Andy Roberts, M0GYK, Diana Smith, M6FIO and Graham Parry, G7OSR explain why they enjoy volunteering at the NRC. They're looking for more Members to join their team so get in touch if you want to find out more. In this issue of *RadCom* you'll also find information about vacancies on the AROS Observer team and for QSL Sub-managers, if you'd prefer a more home-based role.

So if you've got some spare time, would like to help others within the amateur radio community, or would like to shape the future of the hobby, watch the video then take a look at the volunteering section in 'About us' on our website, www.rsgb.org – see what inspires you!

NEW

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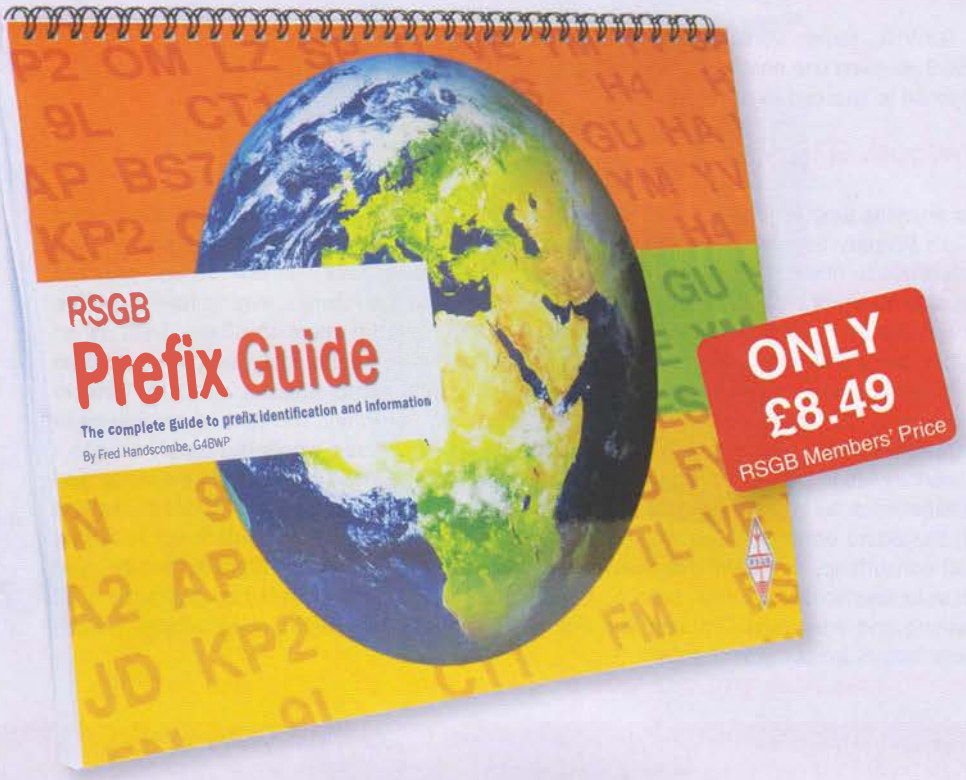
(Over £30 See Page 78 For Details)



RSGB Prefix guide

12th Edition

by Fred Handscombe, G4BWP

The RSGB Prefix Guide is simply the very latest amateur radio prefix information available and a lot more besides.

Fully updated with all the very latest changes in the amateur radio world, the *RSGB Prefix Guide* is the best guide available for amateur radio prefixes and it is now in a new easy to read colour format.

This latest edition of the *RSGB Prefix Guide* has had a 'makeover' and now uses colour to make listings clearer and easier to use than ever before. Still retaining its popular lay-flat design this is one of the most useful and useable books in amateur radio. Fully updated there are the usual series of changes to prefix listings including many detailed items such as the additional K1N prefix for Navassa Island and United Nations call 4U2U. Not only are the listings comprehensive but they are provided with a huge range of additional information covering references for continent, CQ Zone, DXCC, IOTA, ITU Zone, Latitude & Longitude and a whole lot more. Readers will find comprehensive lists of DXCC deleted entities, Russian & CIS entities and even the popular DXCC checklist is here. There is the very latest information on various award programmes including IOTA, CQ WAZ, DXCC, WAS and others. There is also an index of countries and their callsign allocations divided by continent as are more detailed listings for the wide range of RSGB awards.

From the basic "what was that Call?" question through to research for an elusive award, this book provides what is needed. If you are interested in DX, awards or simply operate the HF bands the *RSGB Prefix Guide* is the book for you.

ISBN: 9781 9101 9318 1
Size: 297x210mm (landscape), 80 pages
Non Members: £9.99
RSGB Members: £8.49

E&OE *(All prices shown plus p&p)*

RSGB SHOP
Radio Society of Great Britain www.rsgbshop.org
3 Abbey Court, Priory Business Park, Bedford, MK44 3WH. Tel: 01234 832 700 Fax: 01234 831 496

Election Results

John Gould, G3WKL, retires from his role of President at the RSGB AGM in April. The RSGB received one nomination for the post, G3RWF, who is therefore elected unopposed to succeed him.

Nick Henwood, G3RWF

After years of enjoying amateur radio, I now have an opportunity to help promote, develop and protect it – the RSGB's Primary Strategy. The Society has both to meet the needs of current Members and ensure its relevance to newcomers, of whatever age. That is a tough task – to cherish and promote present enthusiasms while being bold enough to innovate to ensure a future... and to have fun! The RSGB must not become a legacy organisation. Amateur radio has far more to offer – both as an absorbing hobby and a scientific activity. I came into amateur radio as a schoolboy because it intrigued me. That fascination remains. Challenge is the key, not perpetual compromise. I am committed to listening to Members, vintage or youthful, about what they want from their Society and continuing to lead by example on the air. I am a self-taught radio amateur; enjoying it as a wonderful supplement to a mainstream working life in education. Originally a teacher, I was Director of Education in Somerset and Kent – good experience for representing the Society, speaking out for it, listening to its Members and working with the Board on its strategic management. I also have private sector experience including my own small consultancy company. For thirty years I was a TA officer (Royal Signals) and enjoyed working with volunteer soldiers. I have been on boards of three companies limited by guarantee – all providing training and education. Training and education, and working with young people, remain critical success factors for our great hobby.

The RSGB would like to welcome to the RSGB family the following new Members who have joined their voice to ours and are helping to keep the RSGB strong.

Mr W Hooley, 2E1FCV
Mr J Barnes, 2E0EVB
Mr M Rose, 2E0LJZ
Mr J Wilson, 2E0WLN
Mr M Hauser, 2E0XOR
Mr C Jonas, 2E0ZCJ
Mr S Chisholm, 2M0EVS
Mrs S Moore, 2M0TXN
Mr G Bennett, BRS39337
Mr D Forestier, F5RRS
Mr P Christophe, F6IVT
Mr P Martin, G0NWI
Mr H Keene, G1GBO
Mr J Griffiths, G1UVY
Mr D Justice, G3PYL
Mr J Robson, G4GBY
Miss R Mills, G6AMY
Mr B Hayward, G6ISO
Mr C ONeill, G7VMX
Mr C Nadig, HB9ZHK
Mr S Miller, KD2ED
Mr R Bedsole, KG5KBT
Mr M Drzewinski, M0IHV
Mr J Lynn, M0JRL
Mr I Macfarlane, M0TSA
Mr T Whitehouse, M0VAH
Mr N Curran, M0VOM
Mr T Chan, M0WJN
Mr O Smith, M1OJS
Mr P Atherton, M3PMA
Mr R Sage, M6FWV
Mr T Cash, M6FZX
Mr C Ogidih, M6GGX
Mr J O'Donnell ,M6GHJ
Miss M Strange, M6GJF
Miss J Paine, M6GJL
Miss E Wilkinson, M6GJQ
Mr T Garrett, M6GJY
Mr G Trotman, M6GTZ
Mr D Rushworth, M6HYO
Mr I Graham, M6IBF
Mr S Brown, M6ISB
Mr J Philps, M6JND
Mr I Whiteley, M6KDZ
Mr A Purnell, M6KTP
Miss J Leigh, M6LPJ
Mr S Elliott, M6MYH
Mr N Tennant, M6NVT
Mr P Peachey, M6PKB
Miss P Gupta, M6POG
Mr R Harris, M6RIZ
Mr M Feast, M6SMX
Mr A Forbes-Perry, M6WEK
Mr P Hodges, M6XYA
Mr I J Candy, MM0HRI
Mr I Blackstock, MM6FPY
Mr D Goodfellow, MM6FXZ
Mr R James, MM6GHX
Mr T Rogers, MM6IHQ
Mr S Leo, MW0HID
Mr E W Parry, MW6EYU
Mr A Middleton, MW6FRW
Mr A Garcia, N3KOO
Mr G C Benson, N8RU
Mr A Hoebeke, ON4MHO
Mr C Kobborg, OZ1DCZ
Mr W Weggelaar, PA3WEG
Mr B Davies, RS206114
Mr K Pollard, RS306925
Mr R Brown, RS307108
Mr A Pires, RS307140
Mr R Austen, RS307151
Mrs C Austen, RS307154
Mr C Marcus, RS307155
Mr R Primus, RS307157
Mr J Faulks, RS307165
Mr A Hicks, RS307189
Mr A Perfect, RS307201
Mr A Carder, RS307202
Mr S Stevens, RS307214
Mr K Holloway, RS307229
Mr D Firth, RS307236
Mr P McKetty, RS307237
Mr I McKinnon, RS307269
Mr M Siddall, RS307283
Mr O Spurway, RS307285
Mr R Brown, RS307286
Mr A Delahunty, RS307295
Mr B Lee, RS307296
Mr R Walker, RS307303
Miss C Wallwork, RS307310
Mr C Williams, RS307329
Lib of Electronic Science & Tech Univ of Chin, RS307341
Mr M Hibbins, RS307360
Mr P Mongan, RS307379
Bishop M George, RS307381
Mr S Biagioni, RS307412
Mr M Avesten, SA5BLB
Skovde ARC, SK6EI
Mr L Eriksson, SM4HNG
Mr W A Burgess, VE3CRU
Mr J Borthen, VK6KDX
Mr M Lacy, W5TXR
Mr F C Tieber, WA9FCN

The RSGB would like to welcome back the following Members who have rejoined the Society.

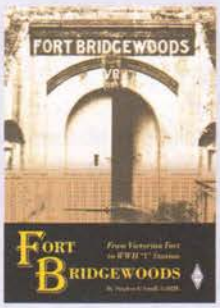
Mr D M Waters, G8LHS
Mr J Clark-McIntyre, 2E0JCM
Mr G Finney, 2E0TPP
Mr M Bryans, 2E0UMB
Mr F Kemmerer, AB1OC
Mr J A Daramy, G0EWI
Mr K G Bailey, G0GZV
Mr N D Cummings, G0IMQ
Mr B V Wilson, G0JOG
Mr V E Fletcher, G0NEC
Mr S Mutkin, G0STV
Mr S W Harrison, G0TOQ
Mr R G Bailey, G0VFS
Mr D Herbert, G0VXE
Mr C J R Lawrence, G1JHB
Mr T Roxby, G1LPS
Mr R R Winterburn, G1NSB
Mr R E Walsh, G1TYY
Mr S D Clements, G1YBB
Mr S John, G4JFK
Mr J Young John, G4KZD
Mr P Harling, G4LDD
Mr R C Hewitt, G4MHJ
Mr K H Smith, G4PFD
Mr D East, G4PWM
Mrs K East, G4UNF
Mr C G Denham, G4VLL
Mr J Goodley, G6EXF
Mr A Hayes, G6ISD
Brimham CG, G6MC
Mr J C Mead, G6TDW
Mr R L Preston, G6YGB
Mr F Hall, G8IQA
Mr C West-Bulford, G8JXU
Mr I P Wood, G8MBV
Mr V M Addidle, GI3VHM
Mr B F Shaw, GW4GAS
Mr D Hendricks, KI6DS
Mr R E Ridley, M0AZO
Mr D Anderson, M0DTR
Mr D Armstrong, M0EMS
Mr G Bean, M0YAZ
Mr A Wellman, M1BPS
Mr D J Beck, M1DIB
Mr R V Silvester, M6RVS
Mr R Weaver, M6XJK
Mr R Hyslop, MM0PFR
Mr T M D MacDonald, MM3GOE
Mr D E Walters, MW0DEW
Mr D P Williams, MW1EPI
Mr M Mogutov, RL3AA
Mr R P Calvert, RS91152
Mr R M Swickis, VE7BZR
Dr B G Rae, ZL4RAE

NEW

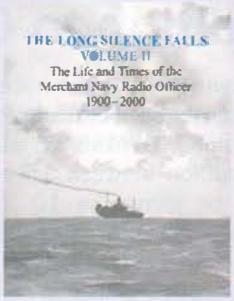
P&P FROM FREE
(Over £30 See Page 78 For Details)

Other Historical Books

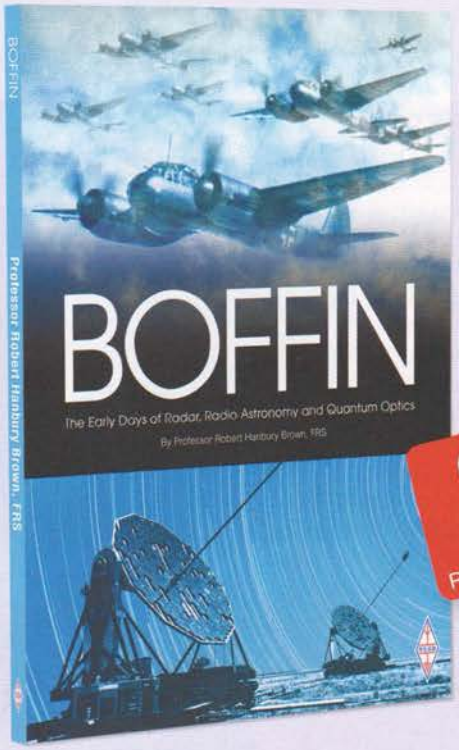
The Birth of British Radar
Size 174x240mm, 128 pages
ISBN: 9781 9050 8675 7
Price: £9.99



Fort Bridgewoods
Size: 174x240, 144 pages,
ISBN: 9781 9101 9309 9
Non Members' Price £11.99
RSGB Members' Price £10.19



The Long Silence Falls - Vol II
Size 225x280mm, 376 pages
Non Members' Price £24.99
RSGB Members' Price £21.24



ONLY £11.04
RSGB Members' Price

Boffin

The Early Days of Radar, Radio Astronomy and Quantum Optics

By Professor Robert Hanbury Brown, FRS

Professor Robert Hanbury Brown was one of the most important figures in the development of radar and of observational astronomy that the UK has ever produced. This fascinating autobiography provides a unique account of the history of radar in WWII and the development of radio astronomy in the post war years.

Boffin traces the evolution of radar from the static Home Chain used in the Battle of Britain to the inclusion of the first airborne radars used in aircraft for night-fighting. The book covers his work on the polarisation of radio waves, crucial in determining the optimum configuration of the radar aerials on all the early air-to-surface equipment operated by Coastal Command. Air-to-surface radar played a huge role in the detection of surfaced submarines and the winning of the 'Battle of the Atlantic'. In 1942, Hanbury Brown was seconded to the US Naval Research Laboratory in Washington, and working in conditions of great secrecy, he continued the development of the Eureka and Rebecca airborne radar programme.

Post war Hanbury Brown was involved in the early days in the development of Jodrell Bank. Sir Bernard Lovell commented that without Hanbury Brown it was unlikely that the Jodrell Bank Radio telescope would ever have been built. *Boffin* describes this period and his later work where Hanbury Brown became perhaps best known for his invention of the optical intensity interferometer. Working with other well-known figures in astronomy such as Cyril Hazard and Richard Twiss he was involved in many great advances. Using an optical interferometer he measured for the first time pulsars and quasars. Working in the Australian outback in the 1960s he designed and built an optical interferometer, a device with mirrors 23ft in diameter moving on a circular railway 600ft across.

Professor Robert Hanbury Brown was one of the brightest engineers of the time and *Boffin* provides his personal story and that of the development of Radar in WWII and the development of Radio Astronomy. This book is thoroughly recommended reading for anyone interested Radar, Astronomy and much besides.

Size: 174 x 240mm, 176 pages
ISBN: 9781 9101 9317 4
Non Members' Price: £12.99
RSGB Members' Price: £11.04

Also available on amazonkindle

E&OE (All prices shown plus p&p)

ARDF Events

Several Amateur Radio Direction Finding events take place in the next few weeks. On 20 March, G4KWQ is organising an event at Cannock in the West Midlands. On 10 April, G3ORY is running an event at Swadlincote. Finally, from 6 to 9 May the 3-day ARDF Festival takes place in Wyre Forest. Details about these events can be found on the RSGB website at www.nationalradiocentre.co.uk/ardf/

The CWops Award

The purpose of this yearly award is to recognise individuals, groups, or organisations that have made the greatest contribution(s) toward advancing the art or practice of radio communications by Morse code.

Nominations may be made by anyone (not limited to CWops members) and should be emailed to awards@cwops.org with a copy to secretary@cwops.org. In order to be considered, a nomination must be received by 15 April.

Full details of the nomination process and the details that must be included can be found at www.cwops.org/awards.html

A plaque will be presented at the Dayton Hamvention. If the recipient is not present, it will be sent to them.

History in the Making

On 3 February 2005 at 1253UTC, 1132 Sqn Air Cadets Stalham, Norfolk spoke to Commander Leroy Chiao on the International Space Station. The link lasted for 9 minutes 24 seconds. The callsigns were GB2ATC and NA1SS. The contact was made possible by Terry, G4PSH in cooperation with NASA and the RSGB. It is something that the 11 Cadets who took part will never forget.

Eleven years later (January 2016) we have Tim Peake as one of the crew and he used the callsign GB1SS. The students who get to talk to Tim over the next few months will, no doubt, never forget either.

I4XCC Memorial Award

Claudio Maracci I4XCC was a very active amateur for many years and his various successes included wins in the 1994 and 1996 Marconi Memorial Contest. The organisers of that contest decided to create an I4XCC Memorial Award for 2015 for the Single Operator that madethe best DX during the contest.

There were 676 valid logs in the single operator category and 147 in the multi operator category, including several well-known VHF operators from the UK. Congratulations to John, G4ZTR who wins the I4XCC Memorial Award. The full results can be found at http://tinyurl.com/j9onhdc

WRTC 2018

The 2018 World Radiosport Team Championship (WRTC2018) will be hosted in Germany for the first time. In this world championship of top contesters, the participants must qualify in a number of contests in previous years. In order to give every active amateur a chance to participate, WRTC 2018 has launched the WWQR (Worked WRTC Qualification Regions) award program. The areas targeted to be worked correspond to the world-wide regions from where the participants in WRTC2018 come.

All the rules and other details can be found at http://tinyurl.com/zplmqv6

Special Event Stations

Between 26 March and 22 April, Harlow and District Amateur Radio Society will be activating **GB0HAF** from Hunsdon Airfield for RAFARS Airfields on the Air. Operation will be on HF and 2m and on various days throughout the NoV. More details available on QRZ.com or from Colin, by email to g0mgu@hotmail.co.uk

Mid Ulster Amateur Radio Club is celebrating its 50th anniversary with a special event callsign, **GB50MU**. Running from 1 to 30 April, anytime fro 9am to midnight. Club members would like to work as many UK stations as possible. Full details are at www.muarc.com/

RTTY DXpedition to GD

The Isle of Man (GD) has not necessarily seen much activity on RTTY and PSK for a while now. John, GW4SKA is planning a RTTY DXpedition between 15 and 23 March. He'll be using the 10 to 80m bands mainly RTTY but some PSK too if time allows. The equipment will be a TS-590S, Acom 600S amplifier, hexbeam, wires and verticals for the lower bands. He will be using the callsign GD4SKA. John will also be working the BARTG HF RTTY contest on 19 and 20 March using the callsign GD0A. There will be a daily log upload to Club Log. QSLs for both calls will be handled by Charles, M0OXO with OQRS preferred, although direct or bureau will also be facilitated.

New Radios for New Licensees

On 26 January, Tony, M0TNY from Martin Lynch & Sons Ltd and Mark, M0DXR from Kenwood UK visited Sandringham School in St Albans. A presentation and demonstration was made to Polly, M6POG, Emma, M6GJQ and Jessica, M6LPJ, the school's newly licenced amateurs who previously had made the initial contact with Tim Peake aboard the ISS. The girls had placed orders for Kenwood's TH-K20e VHF handies with ML&S and have been looking forward to being active on the bands with their own equipment. Tony and Mark would like to thank headmaster, Alan Gray, G4DJX, for his hospitality and wish Sandringham School amateurs the best for the future! Rumour has it that 15 more students from the school will be taking their licence exams as a result of the interest from the ISS contact.

St Patrick's Day Award

On 17 March, St Patrick's Day, amateurs worldwide are encouraged to get on the air with stations taking part in the annual St Patrick's Award. There are awards for taking part as a St Patrick's Day station, contacting 10 or 5 special stations from a fixed or mobile location respectively and logging 10 stations as a short wave listener. If you would like to find out more details or to register a station for the day, then go to http://stpatrickaward.webs.com/

Getting to Grips with Exam Questions

Would you like to learn how the Examiners set questions and be able to take these skills back to your club?

Club trainers are constantly challenged with the task of preparing practice questions that meet the needs of the syllabus and their students. Members of the Exam Group, led by the Chief Examiner, Alan Betts, will be holding a one day seminar at the Martin Lynch and Sons Ham Radio Training Academy in Staines on 12 March. This is an opportunity for all those involved in training and who have confidence in their radio theory to learn how to write good questions. A short presentation will be followed by informal work in small groups to develop skills and generate novel ideas for future development. It is expected that those attending will also write questions solely for use in the examinations. For further details please email question.workshop@rsgb.org.uk

Bringing History to Life

Mark, G4NOE recently helped at his daughter's school for Maths Day. As well as talking about Alan Turing's contribution to cracking the Engima code, he took the opportunity to mention the work of the Y stations and show an example of a typical radio used at the Y stations. The HRO in the photo is part of his collection of radios from the same era. His daughter, Jessamy, dressed up as Alan Turing as part of her school's Maths day celebration.

134GHz DX

A new UK 134GHz DX record was set by Ian, G8KQW and John, G8ACE, who achieved 35.6km on 16 January, over a line of sight path between Cheesefoot Head and Chute Causeway. The key enabler for success on this extended distance record contact was lower path loss due to less water vapour attenuation courtesy of the low temperature, 2.5°C, and dew point, 1°C. This was sufficient to overcome the ~9dB increase in free space path loss attenuation over the previous record path. Congratulations to both. More details on page 66.

LIDS

The 'Less Involved Data Society' – or LIDS CW – is a loose group of radio amateurs whose aim is to promote the use of Morse and foster an environment that is supportive and encouraging as well as light-hearted. The group is free to join and members use Twitter (@lids_cw) to chat about amateur radio, not just CW, and aim to involve amateurs from around the world. The group have recently updated their website at http://lidscw.org and can support with slow Morse (QRS) skeds and regular on air practice sessions to get you up to the speed you want to get to.

New QRP award

The 1000 Miles Per Watt award now has a new level with the introduction of the KMPW Century Club. It is awarded to those who have contacted 100 countries where each QSO would qualify for at least 1000 miles per watt. The start date for qualifying QSOs in November 2015.

The first person to be awarded this new certificate is JH1GNU who worked all 100 stations on 10MHz with CW.

Further details www.qrparci.org/

Morse history video

Well-known author Ian Poole, G3YWX has just completed a video about the history of the Morse key. We all know that the Morse key has undergone considerable development since the first Morse telegraph messages were sent and the video describes many different keys and keyers. At under 6 minutes in length, it can be seen on YouTube https://youtu.be/yw9z82COjU8

Continued on page 15

radcom@rsgb.org.uk

New Products

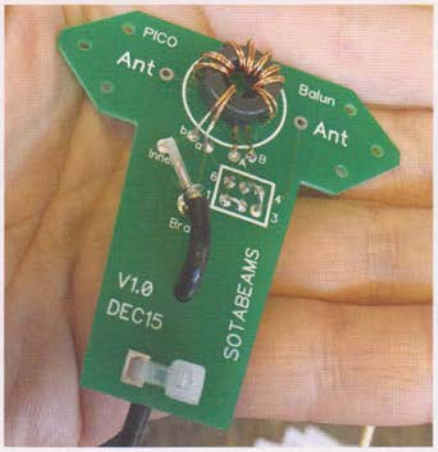
New from Sotabeams

Building on the success of their lightweight military green wire, SOTABEAMS has had a new heavier duty antenna wire manufactured. The wire is ideal for permanent installation and is rated at 1,000 watts. The wire has been specified to give a good compromise between visibility and power handling. It is supplied on convenient 50m reels, which is enough for most antenna applications and keeps the shipping costs low.

The new Pico Balun kit is easy-to-make and can be built to make either a high quality 1:1 current balun or a 4:1 matching transformer. The transformer is mounted on a printed circuit board that allows easy attachment of the antenna and feed line. A common mode impedance of more than 1,000Ω from 5MHz to 30MHz gives good rejection of common mode currents – the essential requirement of a balun. The Pico Balun is rated at 10 watts and weighs in at only 3 grams too!

SOTABEAMS has introduced a new end-fed half-wave tuner kit to their product range. The Pico Tuner is a miniature single-band 10 watt tuner that can be built for any band from 40 through to 10 metres. A unique tuning method makes it very easy to align and use. The Pico Tuner incorporates strain relief for the antenna and feeder system giving a very practical unit for use in the field.

For details on all these new products, go to www.sotabeams.co.uk



IF Output Buffer

The excellent and well respected Elecraft K3 series of transceivers already has an IF port available, primarily intended for connecting to the P3 panoramic display adaptor. This can also be used to connect to any SDR, which then gives you the option to use your favourite SDR software. The IF output port does suffer two disadvantages when used in this way – the output level is rather low compared to the main signal path, and there are significant levels of local oscillator signal from the K3 present.

The PA K3 is a small external buffer module that deals with both of these issues – it has a nominal 20dB gain and contains a band pass filter at 8.215MHz to prevent any LO signals reaching your SDR. It is available as an assembly kit with all SMD work completed, and the filter aligned. This leaves you to mount the PCB BNC sockets, drill the case and complete the mechanical assembly. The unit is externally powered, requiring +13.8V at approximately 10mA, and connects to the K3 IF output via a short BNC cable (not supplied).

For further information and ordering, see http://g4hup.com where you can also see the other products, including the range of PAT modules that can be fitted into virtually any rig and enable connection to an external SDR for display of the band segment you are using.

New Web Shop

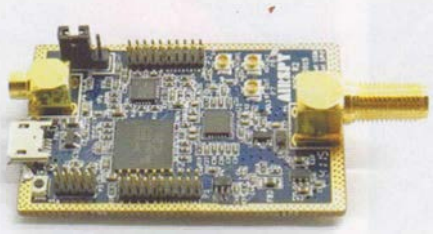
Having recently celebrated their 25,000th sale via eBay, TechnoFix UK are now proud to announce the launch of their own web shop where customers can buy direct. Responsive design makes it just as easy to shop on your phone as your desktop or tablet and the intelligent shipping calculator ensures the best postage rate for almost any mix of products. New products for 2016 include super-stable RTL-SDR USB sticks with 1ppm TCXO, SMA connectors and metal cases.

Go to www.technofix.co.uk or the new, easy-to-remember address technofix.uk for more information.

Two new products from ML&S Ltd

The new MD-380U from TyT is the latest DMR handie for use on 70cm featuring selectable 1 or 5W output and colour display. It is simple to program and ML&S are offering a free programming lead and software to the first 100 purchases. Priced at £149.95 inc VAT, more information can be found at Hamradio.uk/tyt

Another new product from ML&S is the AirSpy and SpyVerter Combo, a low cost high performance SDR receiver. Covering DC-1.8GHz with 10MHz sampling anywhere in the range it has only 3.5dB NF between 42-1GHz. Priced at £219.95, there is more information at Hamradio.uk/Airspy



Fibreglass Vertical

The Sigma Euro-Comm Ltd HF360 is an end fed vertical antenna, capable of working on the 6 to 80m bands using an ATU. The antenna can be pole mounted at ground level or elevated depending on the user's personal requirements. The antenna is rated at 400W PEP and comes with fixings and an installation guide. The antenna is fed using 50Ω coax via a SO-239 socket at the base of the unit. A 6:1 UNUN transformer is located in an IP65 weather sealed box at the bottom of the bracket section of the fibre glass elements. The antenna comes in four parts, three fibreglass poles and one stainless steel tapered whip. The transformer reduces the impedance at the feed point to a more acceptable level making the antenna much more efficient and allowing proper and easy tuning via an external ATU and automatic ATU's found in most modern radios. Priced at £129.99, go to www.sigmaeurocomm.co.uk/ for full details.

News continued from page 13

GB3BS Celebrates 40 Years

This year is the 40th anniversary of GB3BS, one of the UK's earliest UHF repeaters. Since then the total outage time is approximately 4 days, this also includes a complete site relocation in 2009. The full history and information on GB3BS and the group's other repeaters GB7BS and MB7VV can be found on the website www.gb3bs.com (or GB7BS.com)

Not our QSO

Maidstone YMCA ARS have received several email requests for QSL cards for contacts with their callsign G3TRF. This has not been used on air since the 2014 September HF SSB contest. As the club does not have a shack from which to operate at present, the only use their callsigns have is contest use, and this is mainly VHF. The club use G3WM as the contest call. The requests have been for 40m and 80m SSB contacts. So if you have a contact with G3TRF, sadly, it's unlikely to be Maidstone YMCA ARS.

WWI Wireless Stations

A report on First World War Wireless Stations was commissioned by English Heritage as part of the National Heritage Protection Plan, specifically to provide improved information for the understanding of wireless stations in England during the First World War. Through archive research, 215 sites were identified. Written by Jane Phimester, this report makes excellent reading for anyone with an interest in the history of WWI. See http://tinyurl.com/zkm2pjb

Fund Raising

Graham, MOPTD is taking part in an abseiling fund raising for prostate cancer research. It will take place at St Thomas' in London SE1 on 13 May at 6pm. As well as hoping for donations, if anyone would like a mid May Friday evening stroll along the banks of the River Thames they will be very welcome to come and cheer him on. If the abseil organisers will allow, he plans to have his handheld with him and will attempt a QSO or two whilst descending.

Donations can be made at JustGiving.com 'Graham's abseiling St Thomas' hospital', the page for this can be reached via http://tinyurl.com/hvzoz9x where you will also find Graham's very personal story of why he has chosen to raise money for this well known and extremely well respected teaching hospital.

A weak signal propagation report

On most days of the past year, starting 10 January 2015, I have set off my Raspberry Pi running WSPR on 30m first thing in the morning and shut it down last thing at night. During this period over 20,000 spots have been logged on WSPRnet from a wide range of European stations. Some days there have been hundreds of spots, some days none. All spots have been put in a database, providing the opportunity for various degrees of analysis. This article describes the system and some of these analyses – the results of one year of Raspberry Pi WSPR activity.

I'm sure most radio amateurs know what WSPR is, so let me summarise it simply as a beacon algorithm and software by Joe Taylor, K1JT, intended for propagation studies at low transmission powers [1]. Stations running Joe's software can automatically report spots to a central website [2] so that it is easy for a beacon operator to see how far his or her signal has travelled.

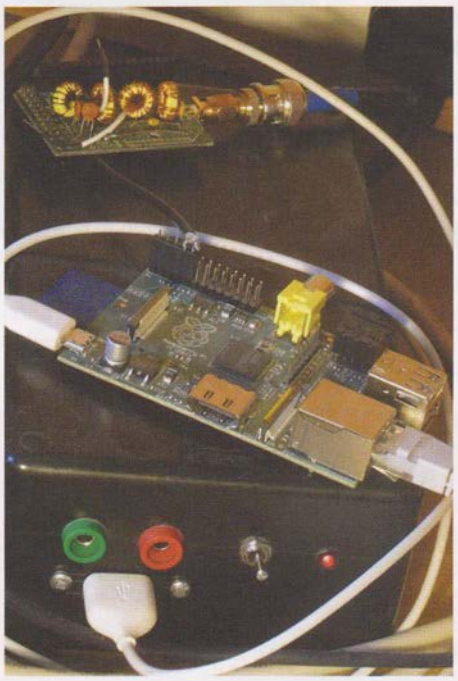


PHOTO 1: *WsprryPi* setup, perched on a linear PSU.

Similarly, almost everybody will be familiar with the Raspberry Pi computer. This is a low cost, credit card sized, fully fledged computer capable of running Linux and much software. There have been many novel 'hacks' to get the Pi to perform a variety of tricks. The one of use to radio amateurs depends on the clock generator circuit internal to the Pi that can be persuaded to put out signals anywhere up to about 250MHz on one of its general purpose I/O pins. Building on initial work applying this clock generator to RF use, there was soon software available, known as the *WsprryPi* software, to generate (but not receive) a WSPR encoded sequence anywhere in the HF spectrum [3].

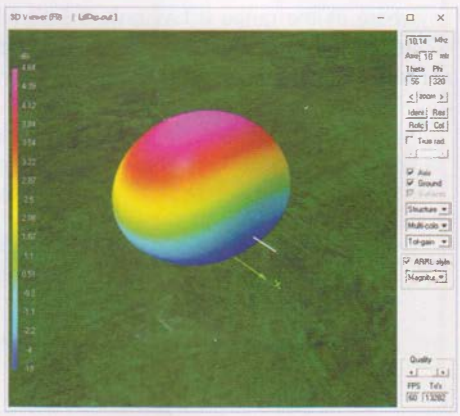


FIGURE 1: *4NEC2* 3-D calculation of the antenna pattern.

Applying the Pi

I chose the 30m band as my target for Pi WSPR. It's usually lower than the maximum usable frequency (MUF) and higher than the lowest usable frequency (LUF) so, given my basic understanding of propagation, it might be expected to provide fairly reliable results. The Pi outputs a signal of amplitude ~1.6V with a peak current of 16mA, so Ohm's Law tells us it should look into 100Ω for best power output of ~13mW. In fact the signal is fairly square at 10MHz so that when the fundamental is filtered by a low pass filter it is a bit bigger again, giving a theoretical output of ~20mW (and in practice a bit less than that, perhaps 18mW).

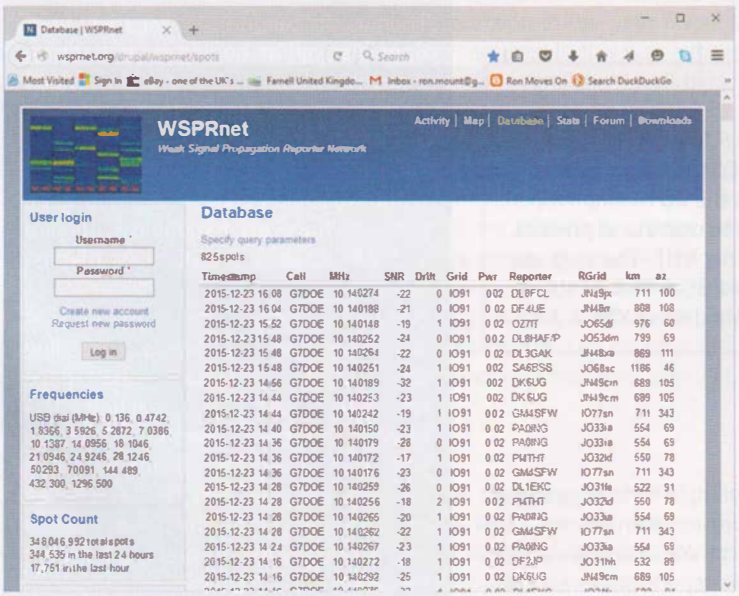


FIGURE 2: Spot format on WSPRnet.

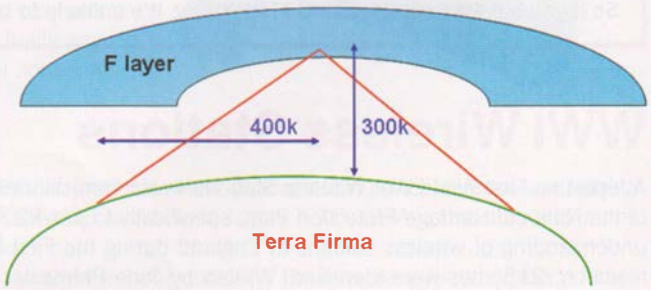


FIGURE 3: Spot geometry.

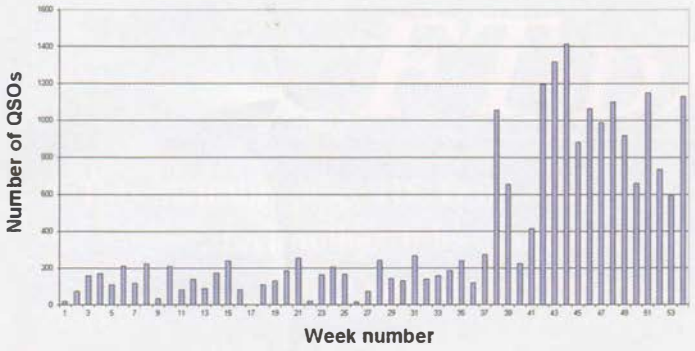


FIGURE 4: QSO count per week of year.

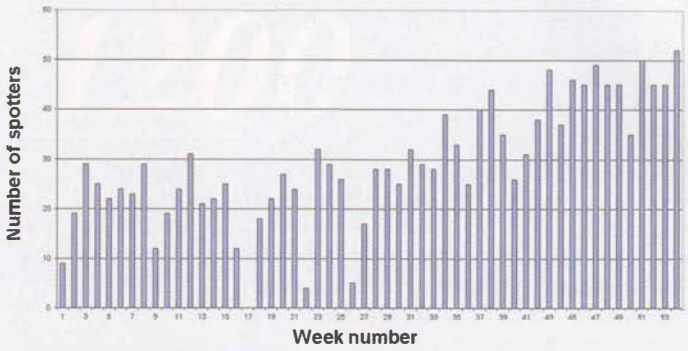


FIGURE 5: Distinct spotter count per week of year.

A low pass filter is **essential** with a source waveform so rich in harmonics and generally the standard filter designs used by Pi WSPRers are those from George Dobbs, G3RJV, of the G QRP club **[4]**.

The WSPR signal is four tones spread over a few Hertz and both stability of frequency and accuracy in timing are critical. One important aspect of running WSPR on the Pi is the power supply used. Pi users have often reported stability problems with the cheaper 'wall wart' power supplies and I started with just such a cheap PSU that had worked well enough for normal Linux use. The WSPR signal on my monitoring setup showed drifting and multiple instances on the WSPR software waterfall so, for this application, I pressed into service an old linear PSU. This allows the Pi to work reliably as a WSPR beacon.

To achieve accurate timing, the Pi is permanently connected to my home network and accesses Network Time Protocol (NTP) servers over the internet. The Pi's internal PLL clock is corrected by NTP 'from time to time' by the *WsprryPi* software and this is typically a -40ppm correction on my system. I've never quite got around to boxing up my Pi setup, as can be seen in **Photo 1**.

The antenna

The antenna is a balanced dipole with each arm coil-loaded mid-way and with a balun, designed originally for 3.5MHz. With a standard MFJ ATU, it can be tuned for most HF bands from 3.5MHz up to 50MHz. Sadly, it sits only a modest few metres off the ground, but NEC sees it as well-behaved at 10MHz, apparently – see **Figure 1**. At relevant angles of radiation the antenna gain may be taken as 0dBd – it's a dipole!

The antenna is close to omni-directional though it's not very good at low angles (so there goes the best DX!) and its prowess at near vertical incidence may not be very useful considering that the critical frequency in these parts is usually around 7MHz.

FIGURE 6: Map of spotting stations.

Data gathering

Spots accumulate on WSPRnet in the form shown in **Figure 2**. I screen scrape these into a text file every few days. I have developed an SQLite database and Python load program,

Ron Mount, G7DOE
rondmount@hotmail.com

so each month, with a bit of data tweaking, I do an upload to the database.

We will see later that the average spot is something like 800km, and we can perform some simple sums on the diagram in **Figure 3** to see the expected signal strengths involved, assuming the signal bounces off the F layer.

In the diagram, both red lines are, by simple geometry, 500km giving a total path length of 1000km. The field strength for a given power and distance is

$$E = \frac{7\sqrt{ERP}}{d} volts/m$$

where d is in metres and the effective radiated power (ERP) is in watts. Substituting,

$$E = \frac{7\sqrt{0.02}}{10^6} = 10^{-6} volts/m$$

What about the noise level? The ITU Radiocommunication Agency publishes guidelines on expected levels of noise for radio design **[5]** from which we may infer the noise figure, F_a at 10MHz as about 50dB in a city area environment and up to 20dB better (30dB) in a quiet location. Taking the first figure and assuming a reception bandwidth of 2.4kHz to a dipole antenna, the noise field strength is

$$E_n = F_a + 20\log_{10} f_{MHz} + 10\log_{10}(2400) - 98.9 \quad dB(\mu V)$$
$$= 4.9 dB(\mu V/m) \approx 1.8 \mu V/m$$

So the WSPR signal is around 0dB S/N ratio. It's surely much less because of losses arising from scattering in the ionosphere, but WSPR systems can detect down to -30dB S/N so hope remains for some contacts.

Data analysis

Table 1 gives a summary of the year's activity. The Top 10 best DX stations are listed in **Table 2** and the Top 10 most frequent spotter stations are listed in **Table 3**.

For the first three quarters of the year, the number of spots and the number of stations spotting my beacon remained fairly constant. In the final quarter of the year, the spot count shot up, with more contacts at slightly longer ranges.

I get all my spots from dawn to dusk, so these larger numbers of spots are occurring over the smaller number of daylight hours. The number of spotting stations increased but at a much slower rate. Two factors seem to be involved here. The greater average distance achieved in the last quarter nets a proportion of the extra stations but does not seem to wholly explain the increase in spotter numbers, so one concludes that there is also a genuine increase in the number of stations spotting. **Figure 4** and **Figure 5** show how these numbers have varied week by week over the year.

As a grand summary, **Figure 6** shows all spotting stations superposed on a map of Europe. I wrote a Python command line program to create an ADIF file from the WSPRnet data with one line for each distinct contact call sign and the most recent date of contact. This can be input online to produce a map **[7]**.

TABLE 1: Summary statistics.

Number of spots	20,873
Number of call signs involved	432
Most frequent spotter	DK6UG @ 689km with 5083 spots
Best DX	EA8/LA3JJ @ 2748km with 1 spot
Number of SWL spotters	8
'Big' (4-character) locator squares	113
Average spot distance	686km
Min spots on any one day	0
Max spots on any one day	369
Max number of spotters on any one day	30 (and not on the day of max spots!)

TABLE 2: Year's best DX Top 10.

Callsign	Locator	Distance (km)	Spots
EA8/LA3JJ	IL38ar	2748	1
RA3AL	KO85wn	2577	3
OH7KOLI	KP43ud	2222	1
LA9JO	JP99gb	2211	21
OH8HTG	KP34di	2127	24
OH5YR	KP30rm	2014	2
OH6GKW	KP13nt	1965	2
OH3LMN/RX	KP11wm	1874	10
OH3NE	KP11ul	1864	1
LY3G	KO05ns	1530	1

TABLE 3: Top 10 of the year's hottest spotters.

Callsign	Spots
DK6UG	5083
GM4SFW	2469
PI4THT	1998
ON7KO	1156
DK3SML	880
ON7KB	827
DF2JP	681
SM0EPX	565
OZ7IT	424
UNLIS **[6]**	374

Conclusions

This shows that 20mW goes a long way. Colleagues at our radio club running 100mW span the whole world fairly reliably, but my lower power allows us to see better the rare exceptions like LA3JJ visiting EA8 and RA3AL.

Accepting that there is little to the west of my central UK location and that some directions just plain have more radio amateurs along them than others, the response is reasonably omnidirectional, as expected from the antenna analysis. Ignoring the G stations, the best result balancing S/N ratio and distance is probably LA3JJ at 1118km for whom, at best, my low power beacon was just 2dB below the noise. Perhaps he and I could have an SSB contact with a mere 250mW if we were lucky!

Acknowledgement

I'd like to thank my XYL, G7DOF, for setting up the SQL queries to extract much of the data presented here.

WEBSEARCH

[1] http://physics.princeton.edu/pulsar/K1JT/
[2] WSPRnet.org
[3] https://github.com/JamesP6000/WsprryPi
[4] QRP filters: see www.gqrp.com/harmonic_filters.pdf
[5] Recommendation P.372-12 (07/2015), https://www.itu.int/rec/R-REC-P.372-12-201507-I/en
[6] UNLIS is a Czech SWL
[7] www.levinecentral.com/adif2map/

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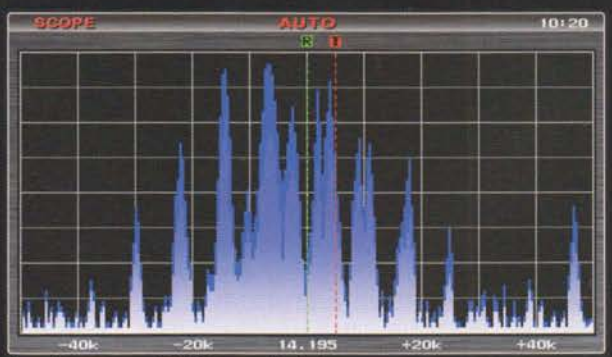
The Full Color 4.3 inch TFT display



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The MFJ-939 Auto ATU

The MFJ-939 is a small, plug-and-play 200W auto ATU that incorporates a control connection to a radio. Jeff Stanton, of Waters and Stanton told me; "It's their new competitor for LDG's plug and play type auto ATUs."

PHOTO 1: What's inside the MFJ-939 box when you open it.

When purchasing, a letter is added to the end of the model number – A for Alinco, I for Icom, K for Kenwood and Y for Yaesu – to indicate which brand (and, in the case of Yaesu, which model) of transceiver it is configured to work with. The package will also include the appropriate cable, but not an instruction manual because MFJ instruction manuals are now online and downloadable. The Icom version (MFJ-939I) was the subject of this review, but the others work in the same way.

The package

Photo 1 shows what I found upon opening the box. The tuner itself was in a polythene bag, protected by bubble wrap. Along with it was a second polythene bag containing the control cable, the 12V DC power cable and a 4mm plug to connect a long wire antenna. A printed note was included, directing the user to where the instruction manual can be viewed or downloaded, plus an MFJ catalogue.

Construction

The physical build of the MFJ-939 is fairly typical of MFJ equipment – a purpose-made aluminium case held together with self-tapping screws. In many items of MFJ equipment there are two parts, but in the '939 there are three. Outside it has the typical MFJ charcoal grey eggshell finish. The front panel has buttons labelled POWER, TUNE and ALT, plus LEDs labelled SWR and TUNE. Basically you press the TUNE button to manually start tuning and the ALT button to switch between memory banks. The SWR LED lights when the SWR is less than 1.5:1 and the Tune LED lights while tuning is in progress. The front is marked with the basic model number, ie no suffix letter.

The back (**Photo 2**) has SO-239 sockets for the antenna and transceiver connections, a wing nut ground connection, a socket for 12V DC and an RJ-45 socket for the control cable. Underneath there is a sticker to identify what brand of transceiver it came out of the factory configured to work with and four stick-on rubber feet.

Lifting the lid (**Photo 3**) shows the main PCB containing the tuner, SWR bridge and most of the control circuitry. The relays – and there are 18 of them – have 10A contacts. They are not latching relays, so they do not remain in whatever state they are if the unit is powered off. Just behind the tuner's front panel is a second PCB, connected via a ribbon cable to the main PCB. This has the front panel switches and LEDs connected to it, plus a piezo-electric sounder, the configuration jumper block and some other circuitry. Construction is a mixture of surface mount and wire ended components – basically the control circuitry is surface mount, while the tuner and the VSWR sensor use wire ended.

How it operates

Like other automatic antenna tuners, the MFJ-939 has a microprocessor at its heart. The counter and SWR sensor tell the microprocessor what the transmitting frequency and SWR are, and the microprocessor then uses an algorithm to switch relays in an L-match to find a good SWR. It has 131,072 matching solutions and when it reaches a pre-determined value it stops and stores the setting in one of its 20,000 memories, so that next time you transmit on or near that frequency it can switch back to that match quickly, without having to go through the algorithm all over again. At this point the MFJ-939 also switches the microprocessor off to minimise the generation of electrical noise.

An additional feature is that the MFJ-939 can be operated and powered remotely, with 12V DC fed along the inner of the coax from the transceiver. Some transceivers have this facility, to power external devices such as a preamp, but if yours doesn't and you don't want to run a separate DC cable, MFJ have solutions to the problem. They are the MFJ-4116 and MFJ-4117. Each of these contains a bias-T, to introduce DC onto the centre conductor, with a capacitor to prevent it being fed back into the transceiver and an inductor to prevent RF from the radio being fed into the power supply.

The MFJ-939 has built-in audio warnings and protection features. Apply too little power for it to tune and it sends QRO in Morse. Apply too much power and it sends QRT in Morse and switches to bypass mode. Expect beeping if it cannot achieve a decent SWR too.

How it worked

I connected the MFJ-939 to an Icom IC-7000 transceiver and two different HF antennas. The first was an 80m dipole, which presents anything but a good match on most bands. The second was a 40m Delta Loop, which in my configuration only presents a good match on 7MHz and 21MHz. I ran 20W for the tests. The SWRs achieved (as indicated by the SWR display of the transceiver) and the approximate initial tuning times are shown in **Table 1**. Re-tuning when returning to a band on which a match was previously found was invariably achieved within a fraction of a second of going to transmit. Only on 6m – a band for which the MFJ-939 is not

PHOTO 2: The back of the MFJ-939.

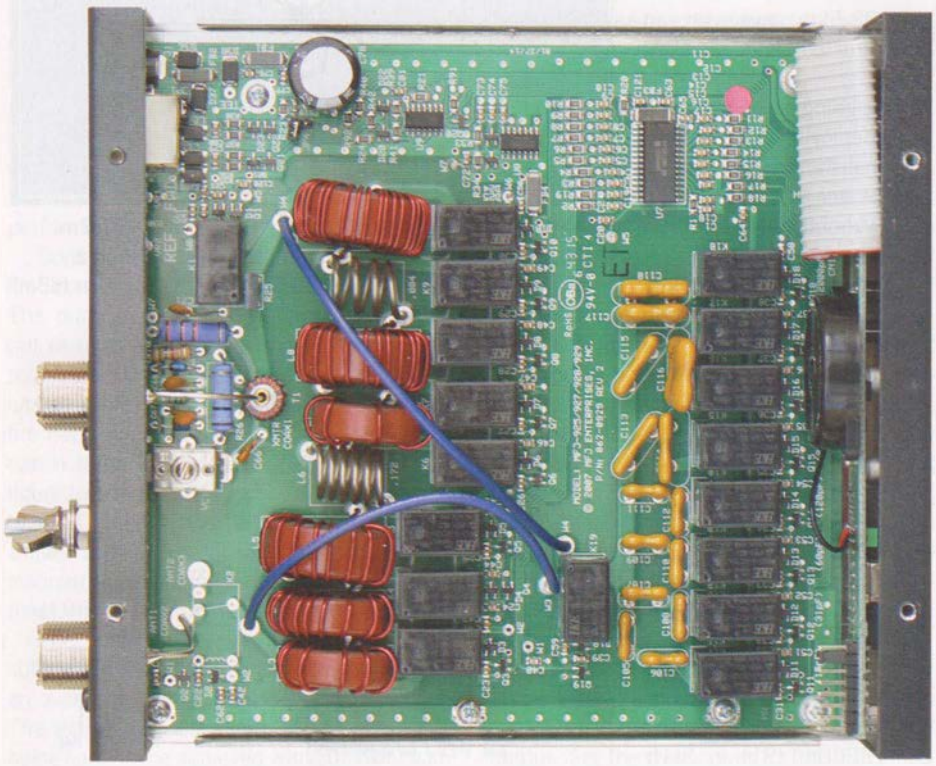

PHOTO 3: Inside the MFJ-939.

specified – and on 160m did the tuner take any appreciable time to find an initial match. I was very happy with this performance.

The only niggle I have with the MFJ-939 is the 4mm plug supplied for connecting a long wire antenna (**Photo 4**). It is very nice quality and it's easy to poke a wire through the side (or feed a wire through from the end) and screw the knurled end to trap it securely. It's the type of plug often used on loudspeaker cables. In this application the body is metal, which means that, in use, the shack end of a long wire antenna would have a live connection available to touch, if you were to reach around the back of the tuner for some reason. Even though the instruction manual says not to do this, I would use a 4mm plug with a plastic body instead.

As regards losses, these can come from two sources. Firstly, no antenna tuner is 100% efficient. There will always be some losses. In most ATUs the losses are just in the inductors, but in an auto ATU the contact resistance of the relays also comes into play. The relays in the MFJ-939 have 10 amp contacts, so the resistance and consequent losses in these should be very low. Secondly, the use of a tuner with an antenna fed with coax is very likely to lead to additional losses. There will always be some loss in a coaxial cable with a high SWR on it, especially if your antenna presents a low impedance. Longer and/or cheaper coax will be more lossy, and losses generally increase as frequency increases. This tuner can match SWRs up to 32:1, but it doesn't mean the full output of your transceiver will reach the antenna. Overall the losses may account for only a few percent of what you are transmitting, but under certain condition it could be more. The bottom line is that the less of a mismatch an ATU has to deal with, the lower the likely losses.

TABLE 1: SWR and approximate tuning times into an 80m dipole and a 40m loop.

	80m dipole		40m loop	
Band	SWR	Time (secs)	SWR	Time (secs)
1.8	1.9	5	2.1	5
3.5	1.0	1	1.5	1
7 1.1	1	1.3	1	
10	1.3	2	1.0	1
14	1.2	1	1.2	1
18	1.6	1	1.2	1
21	1.4	1	1.4	1
24	1.1	1	1.3	1
28	1.4	1	1.4	1
50	1.4	6	1.1	6

PHOTO 4: Supplied 4mm plug for a long wire.

Use with other brand transceivers

If you want to use the MFJ-939 with another supported brand of transceiver, the first thing you will need is a new control cable. The model number of all these is MFJ-5114, but a letter is added to indicate the brand of transceiver. Next you will need to reconfigure the tuner itself. This requires you to remove the lid (ten screws) and alter jumpers inside. It shouldn't take more than a few minutes and details are in the instruction manual.

So far I have not mentioned how this tuner works if you want to use it with a non-supported brand of transceiver. You can use the MFJ-939 without a transceiver control cable, but you will lose some functionality and will need to use the supplied DC power cable (or a bias-T). As long as Jumper 1 is in place, the MFJ-939 will take its power supply from the transceiver via the control cable.

Conclusion

The MFJ-939 is a product that was worked well for me. The only oversight I spotted was the metal-bodied antenna plug, but that's easy to overcome.

I would like to thank Waters and Stanton for the review model. All versions are available from W&S, priced £149.95. A different MFJ-5114 control cable will cost £22.95.

Steve White, G3ZVW
steve.g3zvw@gmail.com

High performance VHF/UHF contest stations

VHF/UHF contesting from good sites presents formidable equipment challenges if signals at the aerial noise floor are to be worked in the presence of very strong signals from nearby stations, both in and out of band.

The object of this article is to give an idea of the signal levels involved, derive the target performance for both transmitters and receivers and then present practical approaches to contest system building that have been shown to deliver excellent performance, mainly based on commercially available or easily constructed equipment. As well as considering system design to minimise non-linearity in both transmitters and receivers, approaches that minimise transmitter radiated noise and receiver reciprocal mixing – effects that limit the performance of many contest stations – will be discussed. Measured data will be used to illustrate the challenges involved.

The contest RF environment

Portable operation in VHF/UHF contests enables us to use sites and aerials that greatly enhance range, irrespective of conditions. The radio noise level at a well-chosen portable site can be 40dB lower than at an urban home location. However, there are likely to be nearby stations equally well sited giving some very strong signals. **Figure** 1 is a received peak signal spectrum plot taken at G3M in JO01NC during the 2015 2m Trophy Contest. The yellow trace is instantaneous peak signal power, while the blue trace is the peak signal power recorded over the 1 minute measurement period. The signal at the left side of the plot at level -44dBm in 444Hz measurement bandwidth (corresponding to -36dBm scaled to the 3kHz nominal bandwidth for a J3E transmission) is from a station 16.5km away on a line of sight path with some ground scatter within the Fresnel zone. This station was beaming away from G3M at the time the measurement was taken.

In addition to strong in-band signals, contesters at good sites must expect to contend with strong out-of-band signals. **Figure 2** shows out of band signal strengths measured on the 2m array at the G8DOH site in rural Oxfordshire (IO92FA). The largest signal, -27dBm, comes from an FM broadcast site 33.5km away on an unobstructed line of sight path.

Designing, constructing and deploying 'big contest stations' that will enable us to take full advantage of the site without either suffering from strong signals or causing problems to nearby stations is a real challenge. Technology that works for low power home stations is not good enough for 'big contest stations'.

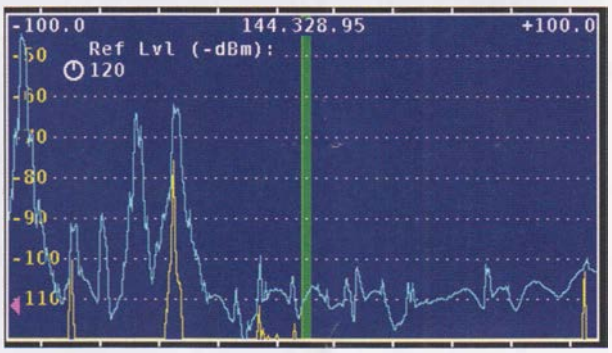

FIGURE 1: Received in-band power at G3M in JO01NC, 2m Trophy Contest 2015. Aerial gain: 17.5dBi; span: 200kHz; resolution bandwidth: 444Hz; vertical axis: received power (dBm); horizontal axis: frequency.

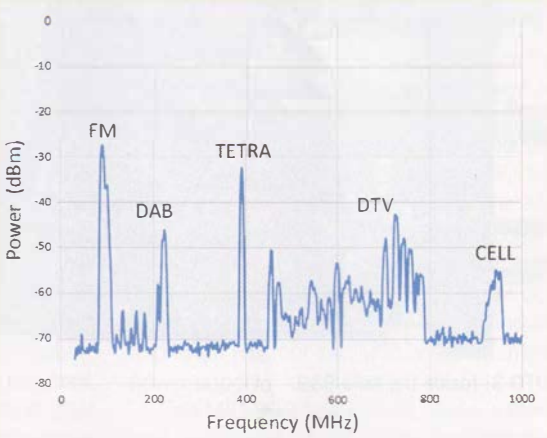

FIGURE 2: Received out-of-band power at G8DOH in IO92FA on 2 x 8-ele 2m array at 34m AGL. Resolution bandwidth 3MHz, video bandwidth 1MHz. vertical axis: received power (dBm); horizontal axis: frequency (MHz).

Effects of strong received signals

At VHF a very strong signal, S9, is defined as a receiver input level of -93dBm [1]. The background noise level at VHF/UHF at a very quiet site is around -173dBm/Hz or -138dBm (S1) in 3kHz bandwidth, using the IARU recommended 6dB/S point calibration. Our aim is to copy reliably all signals at S2 and above. In order to achieve this we need the added noise of the receiver to be about equal to the background noise level, in this case a receiver noise temperature of 290K or a noise figure of 3dB. We simultaneously need the receiver not to generate spurious signals above this noise floor despite the presence of strong in-band and out-of-band signals.

To gain an idea of the technical challenge involved in achieving this, consider the received spectrum of Figure 1. The strongest observed signal at -36dBm (3kHz bandwidth) corresponds to S9+57dB, whereas the weak S2 signal that we wish to copy is 99dB weaker. Further, should the strong station beam in our direction the signal strength will increase by a further 15 to 20dB, so that even with our station to station spacing of 16.5km a spurious-free dynamic range (SFDR) of around 120dB is required. If our receiver has multiple strong signals to deal with the performance requirement will be greater still.

Even if we engineer a receiver able to meet this requirement, to meet our reception need, the strongest station's transmitter must have no spurious output greater than -120dBc in 3kHz bandwidth (-155dBc/Hz). This is also an exacting requirement, as we shall see.

Assembling a high performance contest system

Figure 3 shows the elements of a high performance contest system. The diagram

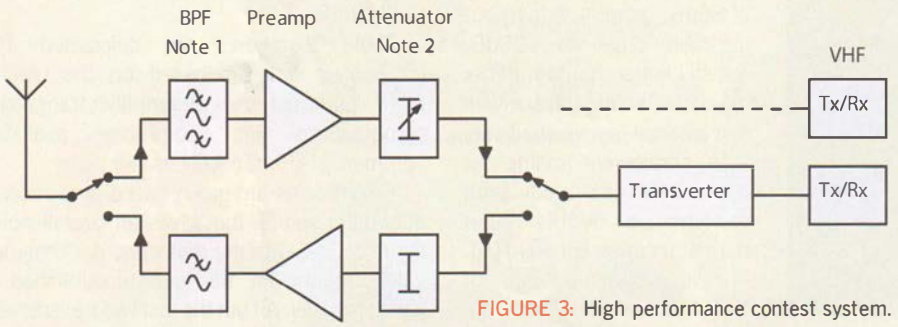

FIGURE 3: High performance contest system.
Note 1: Removes out of band signals.
Note 2: Adjust to achieve required noise figure.
Note 3: Choose to achieve correct output power without ALC action.

appears simple, but there are a number of factors that can make all the difference between very good and very poor performance.

Considering the receive path first, the first component is a bandpass filter (BPF). The purpose of this is to remove all strong out of band signals, making the task of the remainder of the receive chain that much easier. Whilst the loss in this filter increases the noise figure of the receiver, as discussed earlier there is little point in having a noise figure less than 3dB for contests (as opposed to EME work). Thus, all that is required is a filter with a loss far less than dB. Helical resonator and tuned line filters can easily meet this requirement at VHF and UHF [2].

The preamplifier is chosen to have sufficiently low noise figure to allow the goal of an overall noise figure of 3dB to be achieved. The active device chosen should allow low noise figure to be achieved with sufficient gain to overcome the noise figure of subsequent receiver stages. An excellent design for the 2m band, together with a spreadsheet to calculate the required gain value can be found in [3]. The next component, a variable attenuator, is used to adjust the system gain to give the required 3dB noise figure. An advantage of making the attenuator variable is that it can be used to adjust the trade-off between noise floor and strong signal handling. In operation, it can be set such that the noise floor is slightly increased above aerial noise and then increased temporarily to reduce receiver overload if a strong signal is making copy difficult.

The final components in the receive path are either a transverter followed by an HF transceiver or a VHF/UHF transceiver. As will be seen later, the choice here will play a crucial part in determining overall system performance.

The transmit path starts with a VHF transceiver or an HF transceiver followed by a transverter. Again, the choice here will be critical in determining system performance, as will be seen later.

The next component is a power attenuator. This is used to ensure that, at the maximum output of the transceiver or transverter, the power amplifier (PA) is still being driven within its linear operating range. This component is vital if a clean signal is to be radiated, since the ALC loops used for power control in most commercial transceivers permit considerable power overshoot on leading syllables, causing PA overload and splatter. An additional advantage of the attenuator is that it ensures that the transceiver or transverter sees a near resistive load, which minimises distortion.

How should the attenuator value be selected? The method that requires the least test equipment is to connect an accurate power meter (Bird Thruline or similar) between the PA output and a dummy load and a second accurate power meter between the PA input and the transceiver or transverter output. Set the transceiver to FM (F3E) and its output power control to zero. Then, key the transmitter, gradually turn up the power control and plot the PA output power against input power. In the linear region the output power should be linearly proportional to the input power. Having plotted points up to about 30% of the amplifier's power rating stop the test and draw a straight line through the points, extrapolating it to the amplifier's power rating. Next restart the test, increasing the input power until the output power falls below the extrapolated line by 10%. This is the 1dB output compression point. Back off the drive until the output power is 2dB (37%) less and note the input power reading, P_{max}. At this maximum drive level the amplifier is likely to be acceptably linear. Then switch the transceiver to receive, disconnect the input power meter from the PA and connect it to a dummy load. Finally, set the output power control of the transceiver to maximum, key the transceiver and note the power delivered to the load, P_{drive}. The required value of the attenuator is then given by the ratio P_{drive}/P_{max}. Several attenuators of suitable power rating can be connected in series to obtain the value required.

There are a few precautions that should be taken to ensure acceptable results. First, if the system is intended for portable operation, the test should be carried out using the generator normally used, with additional loading to allow for poor regulation under syllabic modulation in J3E operation. Second, some transverters and transceivers have higher mean outputs in J3E operation than in F3E operation. For this reason it is preferable to use a two-tone generator at the transceiver input and make the tests in J3E mode.

A more accurate method of setting the correct maximum PA drive level is to use a spectrum analyser to monitor the PA output. With suitable used microwave spectrum analysers now available cheaply on the surplus market this is the preferred method. The transceiver is driven with two-tone input and the PA drive power adjusted so that at maximum drive power the 7th order intermodulation products are <-50dB relative to each tone and higher order products fall away steeply. Following this test the spectrum analyser can be switched to peak hold mode and the system tested with speech modulation, including any speech processing which will be used, to confirm that there are no transient or ALC issues.

The final item in the transmit path is the low pass filter. Either a low pass or a band pass filter can be used here, but at the power levels required a low pass filter is usually easier to implement. The target here is to ensure that all spurious outputs are reduced to better than the ITU Table II requirement of <-69dBc for 400W power output [4]. Where stations on harmonically related bands are operated close together, as in VHF NFD, more stringent filtering may be required.

Receiver linearity

In order to receive weak signals in the presence of strong signals, careful attention to the linearity of all elements in the receive path is essential. As discussed above, strong out of band signals can be kept out of the receive path using a band pass filter at the receiver input. However, the receive path must be able to cope with strong in-band signals. The first rule is to minimise the gain ahead of the main receiver selectivity to that necessary to obtain the required noise figure of around 3dB. The receive path attenuator enables us to do this. The second rule is to ensure that the preamplifier cannot be overloaded by in-

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a.seeds@synoptika.com

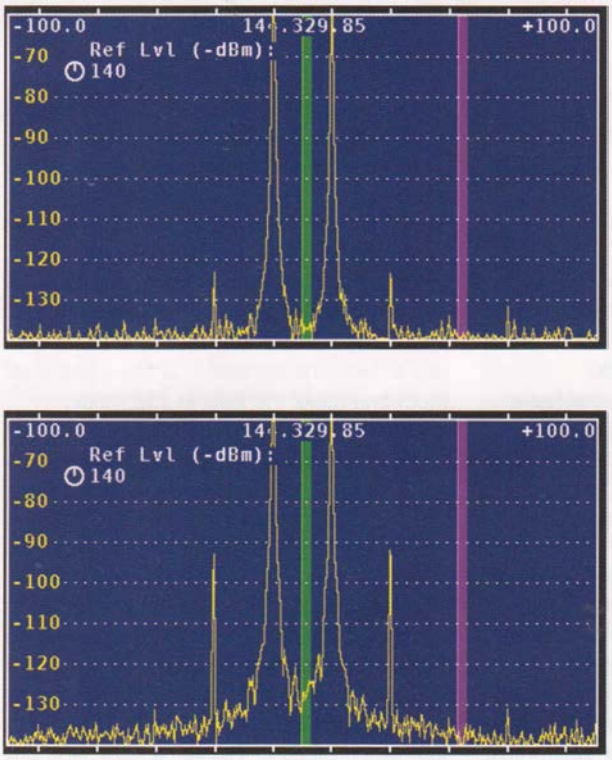

FIGURE 4: Received spectrum for two strong signals. (a) signal power -45dBm per tone; (b) -35dBm per tone. Resolution bandwidth: 444Hz. Vertical axis: received power (dBm); horizontal axis: frequency.

band signals. With typical preamplifier gains of 20dB or more and in-band signals as high as -20dBm an output 1dB compression point greater than 10dBm is a desirable goal. In-band strong signal performance will then be primarily determined by the VHF transceiver or transverter/HF transceiver combination.

To illustrate the effect of strong in-band signals, **Figure** 4 shows the received spectrum for a receiver system using a transverter and a high quality HF transceiver, the Elecraft K3.

In **Figure** 4**a** the strong in-band signals are each at a level of -45dBm and produce spurious signals spaced from the strong signals by their frequency difference – third order intermodulation products – at a level of -123dBm (S4). If these coincide with weaker wanted signals, the wanted signals will be obliterated. In **Figure 4b** the strong signals have been increased in level by 10dB to -35dBm. The third order intermodulation products have increased by 30dB to -93dBm (S9) and are now a very serious barrier to reception.

For any receiver system, we can plot the levels of spurious signals as a function of input signal. **Figure 5** shows the plot for the transverter/K3 system of Figure 4.

Extrapolating these curves to lower input signal levels, we see that spurious signals are less than our target S2 wanted signal level of -135dBm for unwanted signal levels of -49dBm or less, giving a third order spurious free dynamic range (SFDR) of 86dB, rather less than our desirable target of 120dB, but still better than a number of commercial transceivers can achieve, as we shall see.

A convenient metric for receiver intermodulation performance is the input third order intercept point [5]. This is the theoretical input signal value at which the third order intermodulation distortion product power would equal that of the signal. Extrapolating the curves of Figure 5 gives a third order intercept point of -7dBm. The third order intercept point is related to the third order SFDR by: TOI = 3/2 SFDR + NL where TOI is the receiver input third order intercept in dBm and NL is the noise floor in dBm. Substituting our target values: TOI = 3/2 x 120 + (-135) = 45dBm

To appreciate the technical challenge this implies, consider the requirement that this would place on a preamplifier of gain 20dB. Its output intercept point would need to be +65dBm. Typical amplifiers have a third order intercept that is about 10dB above the 1dB compression point, so the compression point would need to be +55dBm, or 320W – a power amplifier rather than a preamplifier! Even if this could be achieved, there are no commercially available transverters or transceivers with input intercepts high enough to make use of such performance. In practice, we have to content ourselves with lower values of TOI, but we should select equipment to obtain the highest value possible, consistent with adequate sensitivity.

In **Table 1** the calculated TOI for contest systems based on some commonly available commercial VHF transceivers is shown. The calculations are based on measured performance values for the transceivers published in ARRL reviews, corrected where necessary for changes in measurement methods [6].

The fourth column shows the TOI for contest systems using a 1dB noise figure preamplifier with attenuator adjusted to provide an overall noise figure of 3dB. TOIs vary from -20dBm to -7dBm.

Table 2 shows the calculated TOI for contest systems based on the use of high performance preamplifier/transverter combinations with commonly available commercial HF transceivers.

Calculations are again based on a receive attenuator setting that gives an overall noise figure of 3dB with the measured performance values for the HF transceivers published in ARRL reviews. All but the last two transceivers in the table give higher system TOIs than for the VHF/UHF transceivers, with best figures in the 5dBm to 9dBm region.

Radiated noise and reciprocal mixing

A very serious problem for reception of weak signals in the presence of strong in-band signals is the presence of reciprocal mixing, a receiver problem or radiated noise, a transmitter problem. A particular difficulty is that to the receiver operator their effects are indistinguishable. **Figure 6** shows the mechanisms involved.

Consider first radiated noise, the strong signal at f_{TX} is accompanied by noise sidebands that cause interference to the signal to which the receiver is tuned, f_R. The radiated noise can be caused by transmitter synthesiser phase noise, in which case it is also likely to adversely affect the receiver performance of the transmitting station. Radiated noise can also originate in the low-level amplifier stages of the transmitter, in which case receiver performance of the transmitting station may be unaffected.

Reciprocal mixing is a receiver effect caused by receiver local oscillator noise [7]. This noise mixes with a strong signal f_{TX} to cause interference to the signal to which the receiver is tuned, f_R. Transceiver synthesiser phase noise is the main cause of reciprocal mixing and a transceiver with poor reciprocal mixing performance will also have a high level

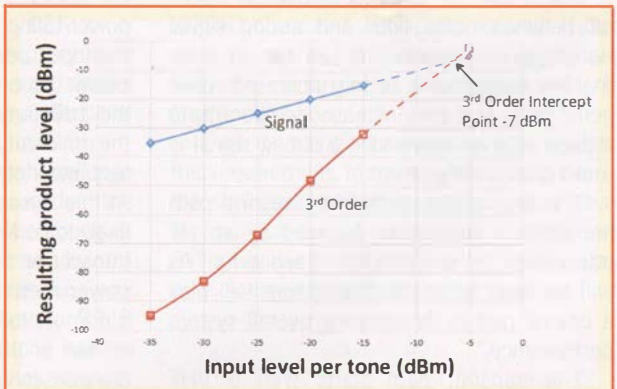

FIGURE 5: Plot of input signal and third order intermodulation product level for system of Figure 4.

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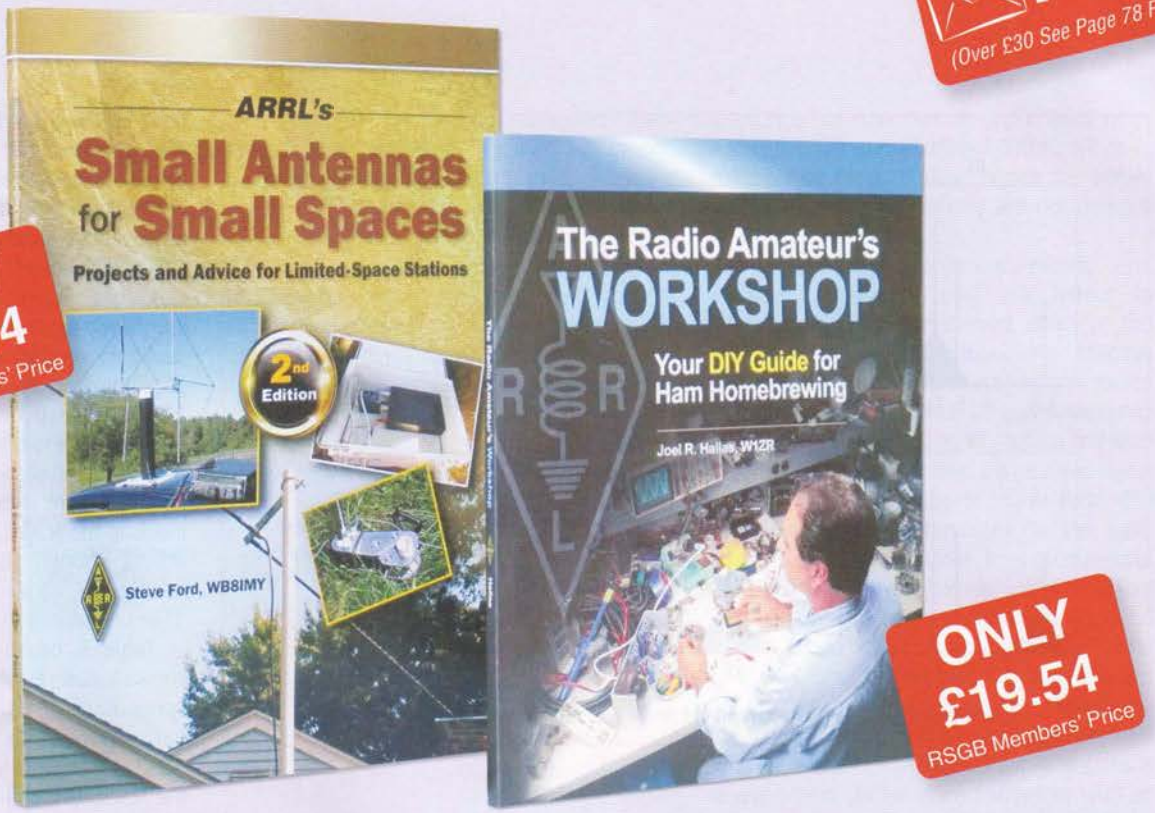

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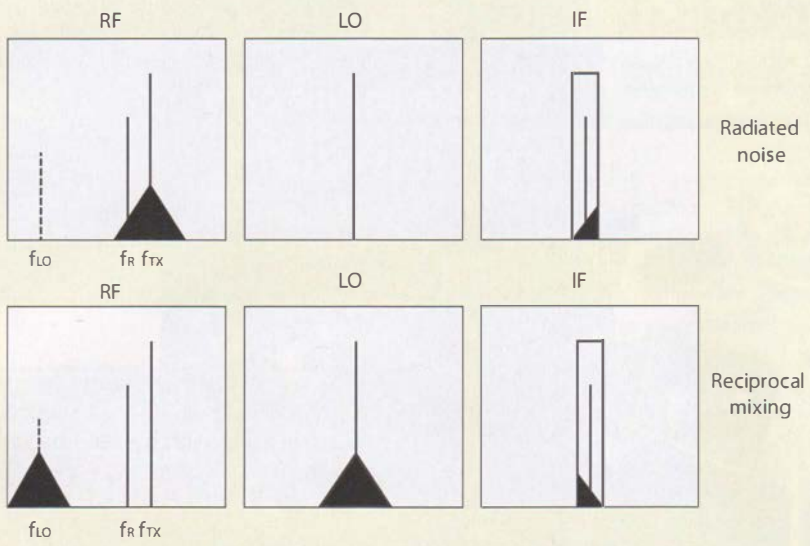

FIGURE 6: Spectra at RF, LO and IF for radiated noise and reciprocal mixing effects.

of radiated noise. Transverter local oscillators based on well-designed overtone crystal oscillators and frequency multipliers can offer phase noise better than -150dBc/Hz and so do not contribute greatly to reciprocal mixing.

Measurements of reciprocal mixing are seldom published for VHF/UHF transceivers, but the importance of this parameter has been recognised for HF transceivers. Available ARRL review measurements are given in the fifth columns of Tables 1 and 2.

The ITU Table II requirement for radiated noise corresponds to <-118dBc/Hz for offsets > 63kHz from a 400W J3E mode signal.

The Code of Practice for RSGB VHF/UHF/SHF Contests [8] recommends that transmitted spurious signals should be <-60dBc at 10kHz spacing from carrier, reducing to -100dBc at 50kHz spacing. Unfortunately, no measurement bandwidth is specified, so that this recommendation cannot be applied directly to radiated noise. If the levels are assumed to apply in the J3E mode bandwidth of 3kHz, the recommendations for noise radiation are -95dBc/Hz at 10kHz offset, reducing to -135dBc/Hz at 50kHz offset. The latter value is 20dB less stringent than would be needed to permit the reception of S2 signals without degradation from a nearby big contest station.

Figure 7 shows the measured radiated noise from a 400W output power contest system based on VHF/UHF transceivers or high performance transverters with HF transceivers.

Figure 7a shows the radiated noise spectrum for a system based on a VHF/UHF transceiver. The noise at 20kHz offset is -111dBc/Hz, within both the ITU and RSGB limits. However, at offsets greater than 50kHz the noise, whilst compliant with ITU requirements, is between 10dB and 15dB above the RSGB recommendation and between 30dB and 35dB above the level needed to allow stations at greater than 15km distances to receive S2 signals.

Figure 7b shows the radiated noise spectrum for a system based on a high performance transverter and HF transceiver. The noise at 20kHz offset is -131dBc/Hz, 20dB better than for the system using a VHF/UHF transceiver. At offsets greater than 50kHz the noise is 10dB to 15dB better than for the system using a VHF/UHF transceiver, meeting the RSGB recommendation for most offsets, though still 20dB above the level needed to allow stations at greater than 15km distances to receive S2 signals.

Table 3, based on ARRL measurements, shows values for radiated noise and discrete spurious signals for typical VHF/UHF transceivers. Only one of the transceivers listed comes within 3dB of being able to meet the RSGB Code of Practice requirement for a 3kHz measurement bandwidth.

Table 4, again based on ARRL measurements, shows values for radiated noise and discrete spurious signals for typical HF transceivers.

The first four transceivers in the table have better radiated noise performance than the VHF/UHF transceivers of Table 2, exceeding the RSGB Code of Practice requirement for a 3kHz measurement bandwidth by between 3dB and 12dB. Note also, comparing Tables 2 and 4, that there are some transceivers that have high levels of radiated noise, despite having low levels of oscillator noise and hence good reciprocal mixing performance.

Conclusion

Designing contest systems for use with large aerial arrays at good sites poses considerable

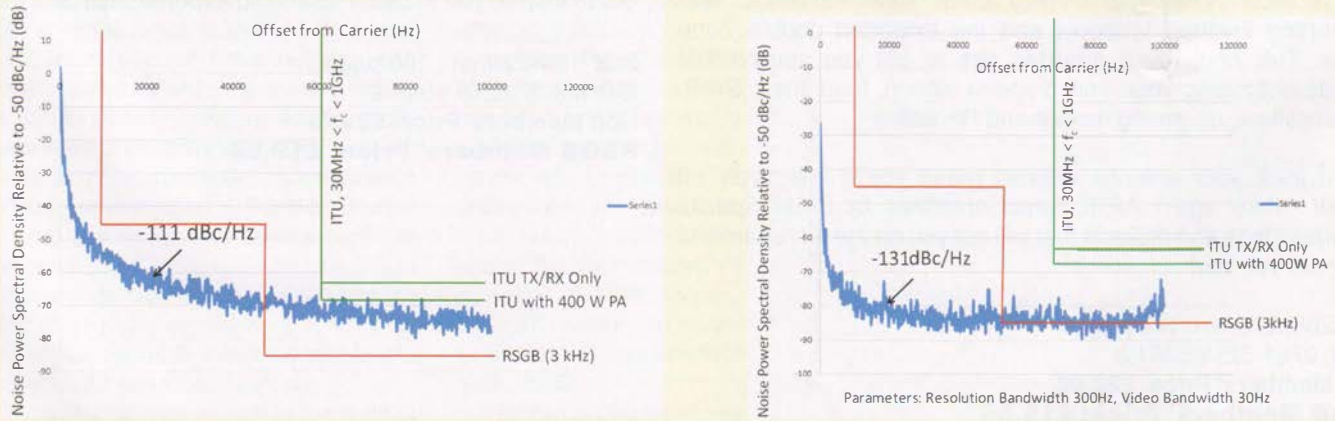

FIGURE 7: Transmitter radiated noise spectrum from 400W contest systems. Vertical axis: noise power spectral density relative to -50dBc/Hz (dB); horizontal axis: offset from carrier (Hz). (a) VHF/UHF transceiver-based system; (b) HF transceiver with transverter-based system. Parameters: resolution bandwidth 300Hz; video bandwidth 30Hz.

technical challenges. High level out-of-band received signals can and should be removed by filtering to avoid receiver overload. In-band signals pose much greater difficulties. Preamplifier outputs should be attenuated so that the system noise floor is just dominated by received noise. Use of a variable attenuator after the preamplifier enables a quick and reliable check to be made for receiver overload. If the received spurious signal reduces by more than the increase in attenuation then receiver overload is the problem. It is not currently possible with commercially available equipment to achieve the combination of a received noise limited system with input intercept point high enough to eliminate receiver overload, when two neighbouring (15km line-of-sight) big stations have aerials directed towards each other. However, a system using a high performance transverter and HF transceiver can achieve an input third order intercept point approaching 10dBm, which is sufficient to avoid overload, when the aerials of the neighbouring stations are not directed towards each other.

Problems with reciprocal mixing and transmitter radiated noise are harder to diagnose, since the perceived effect at the receiving station is identical. An effective method is to test the receiver with a signal source of known low noise, such as a well-designed overtone crystal oscillator, to confirm the level of reciprocal mixing present. If a received signal is accompanied by noise at higher level, this can then be reported reliably. In the past, transmitter radiated noise from commercial VHF/UHF transceivers has received insufficient attention from reviewers and manufacturers, so that it has become a major problem in VHF and UHF contests. Very recent transceiver designs are showing some improvement. However, if the transmit signal is to be amplified in a legal limit PA, a safer route for big contest stations is to use a high performance transverter with an HF transceiver having low transmitter radiated noise. This route also currently offers the best receive performance.

Finally, improvements in contest station transmit and receive performance allow all contest participants to increase their maximum range, thereby making VHF/UHF contesting more enjoyable for everyone.

TABLE 1: Receive performance of contest systems using typical VHF/UHF transceivers on the 144MHz band. Source: ARRL measurements.

Transceiver	Noise Figure (dB)	3rd order intercept point, 20kHz offset (dBm)	3rd order intercept point for 3dB NF (1dB NF preamp)	Rx phase noise, 20kHz offset (dBc/Hz)
IC-9100	4	-2	-7	-128
IC-910	5	-6	-13	-
TS-2000	6	-8	-15	-
IC-7000	4	-9	-15	-
FT-857	6	-9	-16	-
FT-817	7	-11	-19	-
FT-897	6	-12	-20	-

TABLE 2: Receive performance of contest systems using high performance transverters with typical HF transceivers at 14MHz. Source: ARRL measurements.

Transceiver	Noise Figure (dB)	3rd order intercept point, 20kHz offset (dBm)	3rd order intercept point for 3dB NF (1dB NF transverter)	Rx phase noise, 20kHz offset (dBc/Hz)
FTDX5000	21	41	9	-136
TS-590	16	26	7	-147
KX3	27	34	5	-147
K3	18	25	5	-143
FT-2000D	25	25	-1	-130
FT-1000MP	21	20	-2	-
Flex 6700	28	19	-10	-148
Flex 3000	27	7	-21	-141

TABLE 3: Transmitter radiated noise and spurious signals of VHF/UHF transceivers, derived from ARRL review measurements.

Transceiver	Frequency (MHz)	Radiated noise, 10kHz offset (dBc/Hz)	Radiated noise, 22kHz offset (dBc/Hz)	Radiated noise, 50kHz offset (dBc/Hz)	Discrete spurii (dBc)
IC-9100	144	-122	-128	-132	-70
IC-7000	430	-115	-120	-120	-74
TS-2000	430	-112	-120	-	-69
IC-910	144	-109	-117	-	-68
FT-857	432	-107	-117	-	-63
FT-817	432	-112	-114	-	-60
FT-897	432	-107	-114	-	-64

TABLE 4: Transmitter radiated noise and spurious signals of HF transceivers on 14MHz, derived from ARRL review measurements.

Transceiver	Radiated noise, 10kHz offset (dBc/Hz)	Radiated noise, 22kHz offset (dBc/Hz)	Radiated noise, 50kHz offset (dBc/Hz)	Discrete spurii (dBc)
Flex 6700	-143	-	-147	-59
K3	-135	-	-145	-50
TS-590S	-122	-	-138	-56
FT-1000MP	-122	-129	-	-60
FTdx5000	-130	-	-130	-54
FT-2000D	-122	-	-125	-62
KX3	-121	-	-125	-50
Flex 3000	-123	-	-123	-54

Acknowledgement

I would like to thank the American Radio Relay League (ARRL) Lab and, in particular, Bob Allison, WB1GCM, for allowing me to use the results of their product review measurements on HF and VHF/UHF transceivers in the preparation of this article. The calculations I have based on these measurements and the conclusions drawn are my own responsibility, entirely.

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Homebrew

This month, a subject that we all have to deal with from time to time: making or adjusting an enclosure, commonly known as 'chassis bashing' – a term dating from the old days of valves when almost all equipment was built on a chassis that might then be enclosed in a more attractive external case.

Screening

Much of the very earliest radio equipment was built in an open 'breadboard' style with little or no provision for RF screening. This approach was considered acceptable in the days of spark transmitters and crystal receivers. Modern receivers are packed with sensitive high-gain amplifiers, usually operating at RF, IF and audio frequencies. Without adequate screening, such receivers would be very prone to unwanted interference from strong out-of-band signals. Transmitters will also require careful screening to ensure that unwanted (spurious) signals generated within the equipment are not radiated, either directly from the transmitter components or via the aerial feedline.

Materials

In most cases, radio equipment will be in some form of metal enclosure. Commercially made gear is often housed in a steel enclosure or on an aluminium internal chassis with only the external covers made from steel. Consumer products are often in plastic enclosures with separate screening compartments for sensitive stages mounted directly on the PCB. Another screening method is to line the inside of a plastic enclosure with metal foil.

Steel is very strong, relatively cheap and well suited to mass production. To prevent corrosion, steel enclosures will need a protective coating. Internal parts are often electro-plated and external surfaces protected by a paint or vinyl coating.

Working with steel is relatively difficult for the average home constructor because of its hardness and strength. Most amateur constructors prefer to work with aluminium alloy or copper sheet. These metals are reasonably easy to drill, cut and bend.

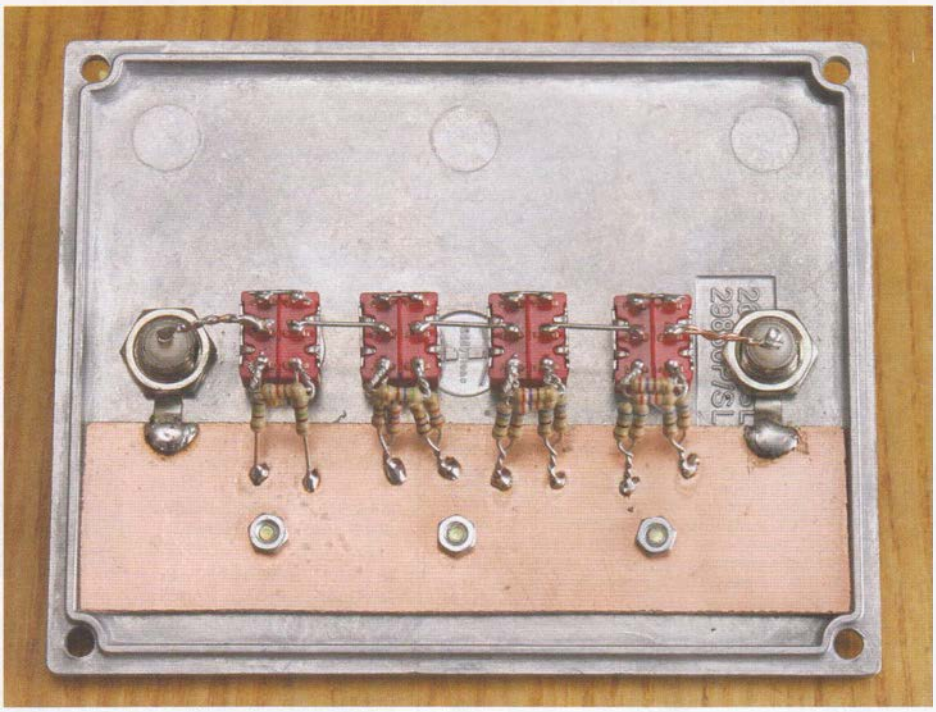

PHOTO 1: Inside the attenuator.

These are big advantages, particularly when you need to make a non-circular hole for your S-meter or frequency display LCD. Copper is easy to solder and also makes an excellent heatsink. It is rare to see a complete enclosure made from solid sheet copper, but many constructors make enclosures from fibreglass PCB laminate.

Off-the-shelf enclosures

Many of our previous projects have been built in ready-made enclosures. Four types are commonly available: plastic project boxes, standard aluminium boxes, project cases with aluminium bottom half and a vinyl clad top cover. The final type are diecast aluminium boxes (Eddystone or similar). These are quite expensive, but they have some advantages over the standard low-cost types. Eddystone type boxes are strong and very rigid. This gives great mechanical stability for a critical circuit like a VFO or VCO. The holes for the lid screws are drilled and tapped and the lid is flanged to make a good RF-tight enclosure. Diecast boxes are usually the best choice when RF screening is a high priority.

In common with the cheaper sheet aluminium boxes, most diecast enclosures are not particularly attractive to look at. Where visual appearance is a priority, project cases with a vinyl-covered steel top and aluminium front, rear and bottom panel are often the best choice.

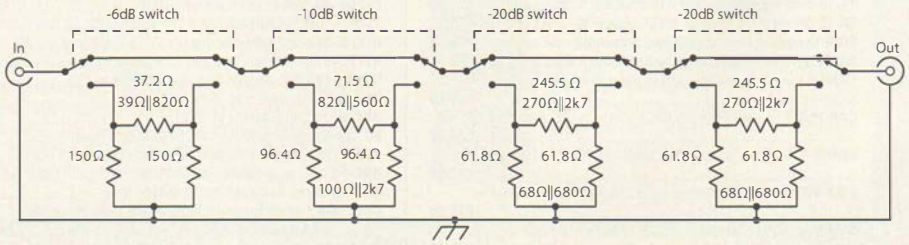

FIGURE 1: Basic step attenuator with 6, 10, 20, 20dB steps.

A 50Ω step attenuator

Figure 1 shows the schematic of a switchable attenuator. Four stages of attenuation are available. I have chosen the PI configuration with steps of 6dB, 10dB, 20dB and 20dB. Alternative values of attenuation, eg 3, 6, 12dB, may be used instead. Component values are easily calculated using formulae found in handbooks, published tables or one of the many on-line attenuator design tools.

With the exception of the 150Ω resistors in the 6dB attenuator, all resistances are made up from parallel pairs of resistors. Overall resistance and the value of the individual resistors is shown in the schematic, eg 37.2 (39 || 820) meaning 39Ω in parallel with 820Ω. I have avoided using series resistor combinations because the increased inductance of this configuration could degrade performance at HF/VHF.

The unit was built in a standard Eddystone 120 x 95 x 30mm box (Maplin N90BQ).

Regardless of whether you use a commercial or a home-made enclosure, it is a good idea to draw a template showing any holes or apertures before you start drilling or cutting. Mistakes are much easier to correct on paper than in metal.

Figure 2 shows the proposed layout for the lid of my attenuator box. There are a few practical issues to consider. Where to mount the BNC input/output connectors – top, side or bottom? Where to mount the switches, which type and how many can I use? How do I solder the resistors to ground...?

For best HF/VHF performance, the wiring should be as short and straight as possible. This means the sockets and switches should be arranged in a straight line. I have fitted all components to the lid. As an alternative, I could have mounted the sockets on the sides of the box and used miniature coax to connect to the attenuators. To ensure that the BNC sockets don't foul the flange on the underside of the lid, the 10mm diameter holes are drilled 15mm away from the edge. This leaves a centre-to-centre gap of 90mm between the sockets. Four switches will fit comfortably in this space using a hole spacing of 18mm. It should be possible to fit five switches with closer spacing.

The hole positions were marked using a pencil. Once I was satisfied that the marks were in the correct position, the six holes for the sockets and switches were drilled using a 3mm drill to make pilot holes. The final sizes were 10mm for the sockets and just over 6mm (probably ¼in) for the switches. Three additional 3mm holes were drilled to mount a strip of PCB inside the lid, which was used as a common ground for the sockets and attenuator resistors.

The switches are standard 3A double pole double throw (DPDT) types. Series

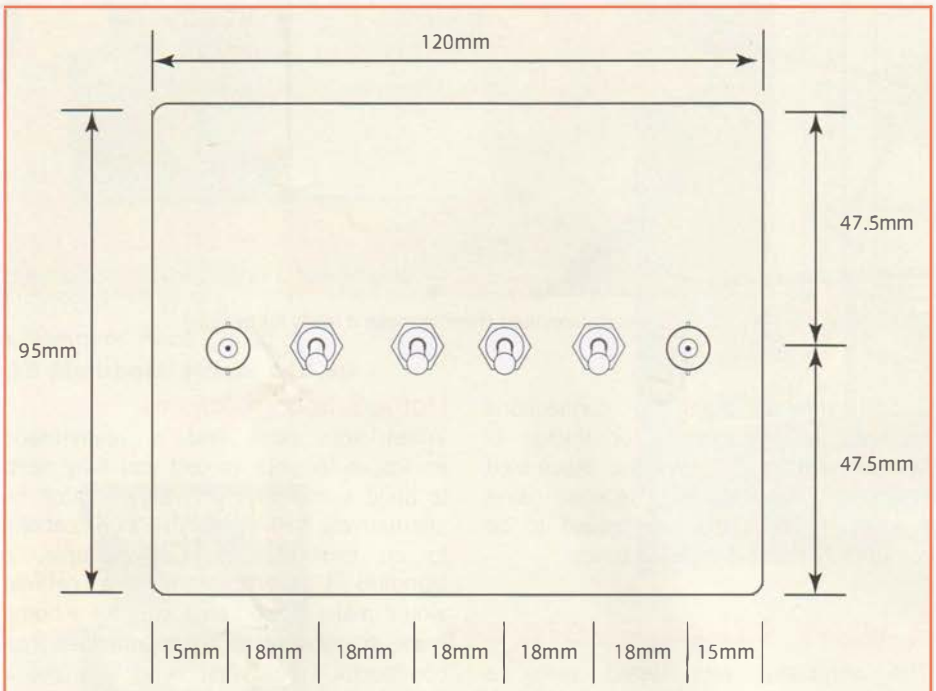

FIGURE 2: Layout plan for the attenuator box lid.

PHOTO 2: The completed attenuator in a diecast aluminium box.

PHOTO 3: Some of my most useful metalworking tools: a nibbler, hand reamer and M3 tap.

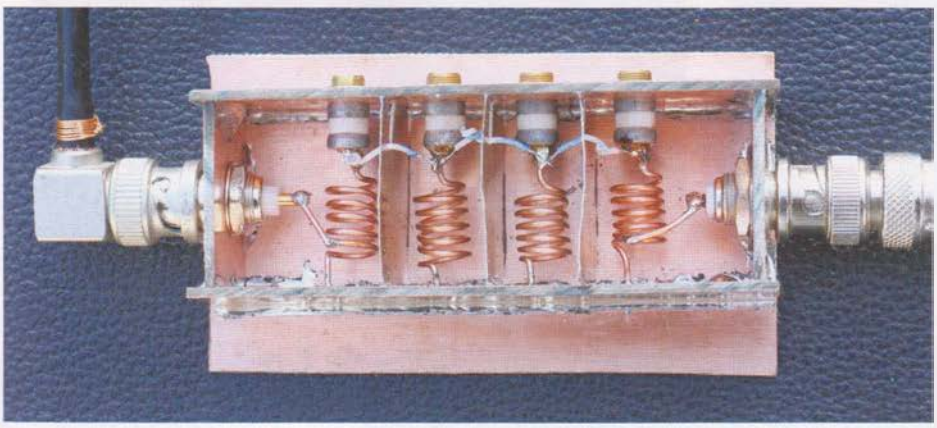

PHOTO 4: A 144MHz bandpass filter in an enclosure made from copper clad PCB material.

Eamon Skelton, EI9GQ
hbradio@eircom.net

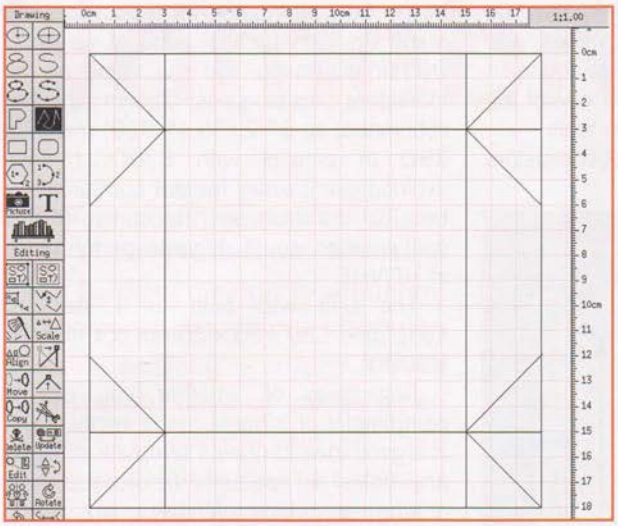

FIGURE 3: My template for the aluminium box half.

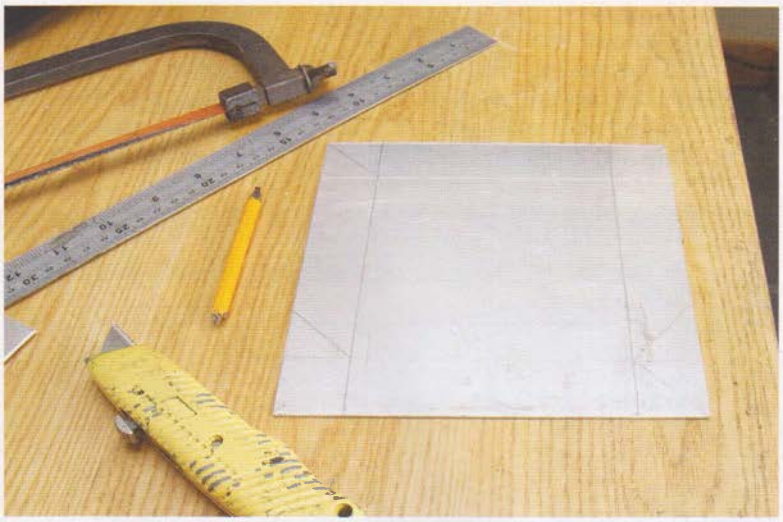

PHOTO 5: Scoring aluminium sheet to make it ready for bending.

inductance of each switch was measured at below the 0.01μH (10nH) lower limit of my inductance meter. The resistors are standard 0.25W types. You can use 1% metal film types or, if you prefer, you can use a digital multimeter to hand-pick from standard 5% tolerance resistors. Close-tolerance resistors don't cost much these days so it's hardly worth getting the multimeter out – but if you already have a stock of resistors then it's probably a different matter.

Photo 1 shows the inside of the lid, as constructed. The PCB is soldered to the tags of the BNC sockets and grounded at three other points by the mounting screws. The 13mm nut on the back of the sockets was wound up as tight as I dared so that they won't work loose in normal use. The 8mm mounting nuts for the switches were given a gentle squeeze with a spanner. Over-tightening these could damage the switch.

Stiff wire is used for connections between switches. 1mm or thicker is suitable. **Photo 2** shows the assembled attenuator. Switches were labelled using a sharp pencil. This has proved to be remarkably durable on alloy boxes.

Testing

The attenuator was tested using a signal generator and sensitive detector. Performance was accurate and consistent from DC to above 100MHz. If RF test equipment is not available, it is possible to make very accurate measurements of attenuation using a DC voltage at the input, a 50Ω load (parallel pair of 100Ω, 1% resistors) and a digital multimeter to measure the output. Attenuation is simply 20log(Vout/Vin). A 5V DC supply is ideal for this test. $5^2 \div 50 = 0.5$W, which should be a reasonably safe level for the resistors and load.

Home made enclosures

When you can't find a ready-made enclosure for your project you may need to build a complete unit from scratch or, alternatively, make extensive modifications to an existing unit. For example, a standard 19in rack mounting cabinet would make a good enclosure for a home made transceiver or linear amplifier. The constructor would just need to make a new front and rear panel with suitable holes and apertures for the various knobs, switches, meters, sockets etc.

Tools

There are a few standard hand tools that most amateurs will already have in the shack. These include a hacksaw, pliers, clamps, a vice, screwdrivers etc. In addition to these, there are a few more specialised metalworking tools than can make life a lot easier. **Photo 3** shows some of the most

PHOTO 6: Bending sheet aluminium using a vice.

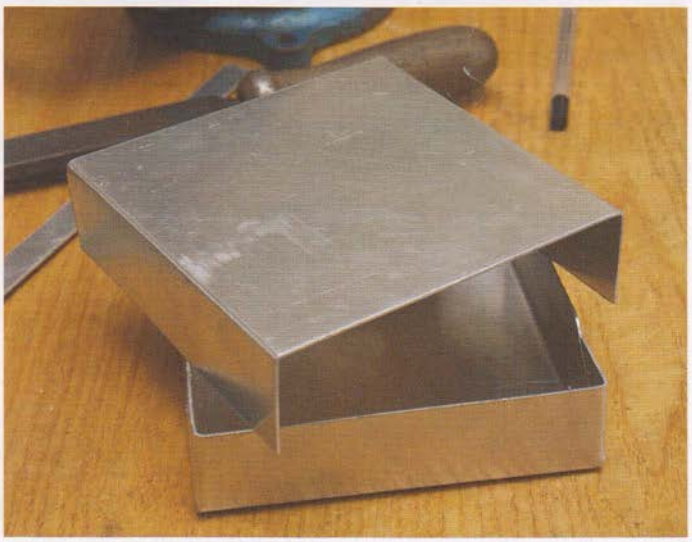

PHOTO 7: The completed box, ready for drilling and painting.

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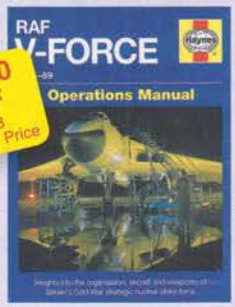

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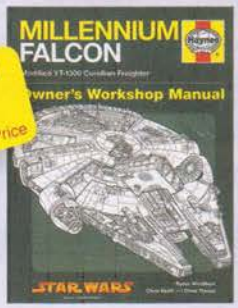

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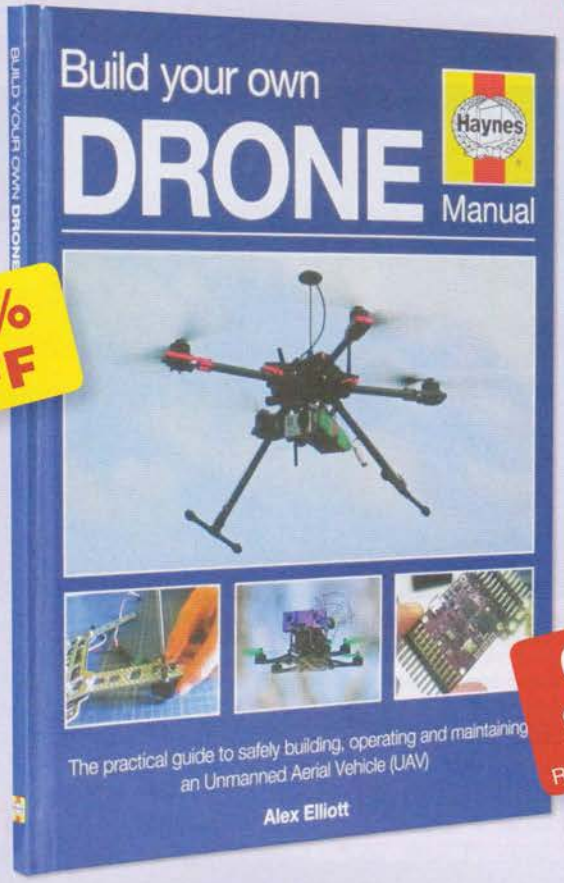

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by Alex Elliott

The new hardback *Haynes - Build Your Own Drone Manual* is a practical guide to safely building, maintain and operating an Unmanned Aerial Vehicle (UAV) with advice and step-by-step procedures to enable the reader to build a basic, affordable, DIY drone.

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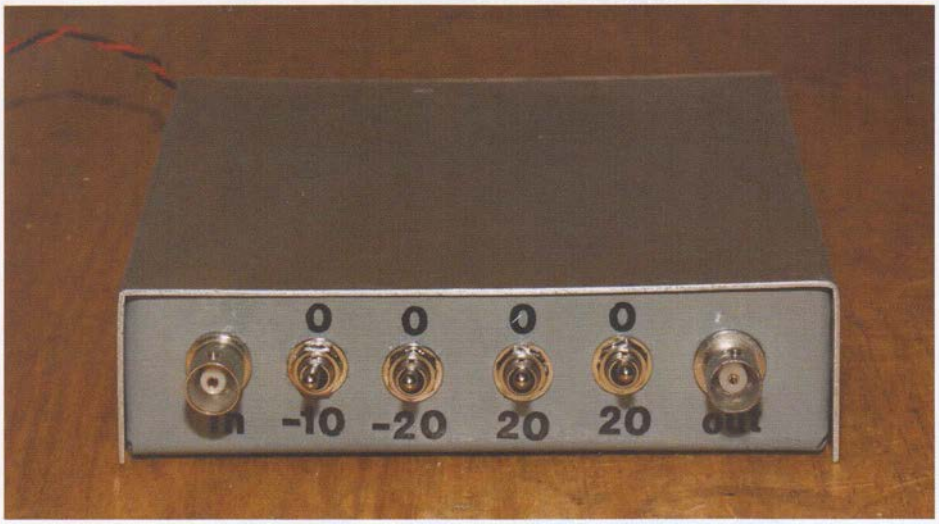

PHOTO 8: Finished project (complete with capital Os standing in for zeros!).

useful tools in my shack. Left to right: a sheet metal nibbling tool, a hand reamer, an M3 tap and handle. The nibbling tool can cut odd shapes in sheet metal or PCB laminate. Unless you have a large pillar drill with provision for large bit sizes, you will often need to drill smaller holes (say 6-10mm) and then ream them out to a larger size that is beyond the capabilities of a standard hand drill. I find the 3mm tap very useful for working with thick alloy like heatsinks in power amplifiers. It is possible to buy tap & die sets, but I have found that I rarely need any size other than M3 and I have never found any use for a die. I just bought a small tap handle and a few M3 taps from the local tool shop.

Copper clad fibreglass PCB laminate

Copper clad PCB laminate is an almost ideal material for making enclosures for radio projects. Fibreglass board is readily available, very tough, rigid and durable. It is relatively easy to cut with a saw (make sure you don't breathe the dust) and the panels are easily soldered together. Ground connections can be soldered directly to the inside of the box and this type of construction gives excellent RF screening. Despite these many advantages, PCB enclosures seem to be almost exclusive to amateur radio. **Photo 4** shows a 144MHz bandpass filter built in a PCB enclosure. See the September 2010 Homebrew for a detailed description of this project.

Home made enclosure using sheet aluminium

Our next project is a simple box made from sheet aluminium. This will be used as an enclosure for the amplifier / attenuator unit that was described last month. When building from scratch, it is particularly important to draw up a plan on paper before you start cutting metal. The box will be approximately 120 x 120 x 30mm, or slightly larger than the diecast box in the previous project.

There are a few important points to remember. Your box will be made from metal sheet with a thickness of more than 1mm. If your drawing is based on thin zero-width lines, your box will be slightly (1-2mm) bigger than expected. Take this into account when designing the box and lid.

There will inevitably be some minor imperfections in the finished product. If you keep your design symmetrical, you may have more options when things go wrong. If the front panel is damaged by a slip of the drill or file, you may be able to able to turn the box around so that the back becomes the front, meaning that the damaged panel is out of view. Panels bent by hand might not be a perfect 90° or the bend may be slightly off line. If a panel isn't a perfect fit, flip it 180° and try again.

Cutting and bending sheet aluminium

It is very difficult to get a straight edge when cutting sheet metal with a hand saw and just about impossible with a power jigsaw. Happily, there is a very simple way of achieving perfectly straight cuts and bends in sheet aluminium. To bend the sheet, the metal should be scored with a sharp knife and then bent over a sharp edge (or a bending brake if you have one). Once the metal is scored, it will show a strong tendency to bend exactly along the line of the score. To completely cut the sheet, the bend should be pushed beyond 90° and then straightened again. If this operation is repeated several times, the bend will break cleanly, leaving a straight edge. I use a steel ruler and a sharp carpet knife for scoring the metal. As this requires considerable pressure on the knife, you should take great care to avoid injury. I use a knife with a metal body because a plastic handle might break under pressure. Five strokes of the knife will make a score deep enough to allow easy bending of my 1.2mm sheet. For cutting rather than bending, I use 8-10 strokes of the knife so that a deeper score is made. **Figure 3** shows my template drawing, **Photo 5** shows the scored sheet ready for bending.

I use the edge of a workbench as a sharp edge for bending the sheet. For complex structures like a box, you will sometimes run into tricky situations where there isn't enough room to work. **Photo 6** shows how the side of the box was bent using a vice. The top of the box is a very simple U shape with just two bends. **Photo 7** shows the box parts ready for drilling, painting, labelling and assembly.

Aluminium is known as a 'problem surface'. This means that paint and adhesives don't make a good bond with it. As a result, painted aluminium tends to chip easily. Things have improved considerably in recent years. Now that vehicle bodies are often made from aluminium or zinc galvanised steel, special etching primers have become more readily available to the home constructor.

Painting and labelling your front panel

After sanding with fine wet paper (240 followed by 400) the front panel of the box was given a couple of coats of Halfords own-brand etching primer. After a couple of hours drying in a warm place (ignoring the 24 hour drying time in the primer instructions) I added a couple of coats of Rustoleum Winter Grey from a spray can. Several hours later, the Letraset rub-on labels were added and then the panel was given a couple of coats of clear lacquer.

The result was complete disaster. The lettering dissolved and ran down the panel like cheap mascara in heavy rain! As they say: more haste, less speed.

The panel was cleaned back to bare metal using thinners and the entire process started again. This time, the first layer of clear lacquer was a light 'dust-coat' that was allowed to dry for 20 minutes before applying several more light coats. Eagle-eyed readers will notice that I ran out of Letraset zeros and had to resort to using capital letter Os. The finished unit is shown in **Photo 8**.

RSGB Band Plan 2016

The following band plan is largely based on that agreed at IARU Region 1 General Conferences with some local differences on frequencies above 430MHz.

EFFECTIVE FROM 1st JANUARY 2016 UNLESS OTHERWISE SHOWN

136kHz	NECESSARY BANDWIDTH	UK USAGE
135.7-137.8kHz	200Hz	CW, QRSS and Narrowband Digital Modes

Licence Notes: Amateur Service – Secondary User. 1 watt (0dBW) ERP.
R.R. 5.67B. The use of the band 135.7-137.8kHz in Algeria, Egypt, Iran (Islamic Republic of), Iraq, Lebanon, Syrian Arab Republic Sudan, South Sudan and Tunisia is limited to fixed and maritime mobile services. The amateur service shall not be used in the above-mentioned countries in the band 135.7-137.8kHz, and this should be taken into account by the countries authorising such use. (WRC-12).

472kHz (600m)	NECESSARY BANDWIDTH	UK USAGE
IARU Region 1 does not have a formal band plan for this allocation but has a usage recommendation (Note 1).		
472-479kHz	500Hz	CW, QRSS and Narrowband Digital Modes

Note 1: Usage recommendation – 472-475kHz CW only 200Hz maximum bandwidth, 475-479kHz CW and Digimodes.
Note 2: It should be emphasised that this band is available on a non-interference basis to existing services. UK amateurs should be aware that some overseas stations may be restricted in terms of transmit frequency in order to avoid interference to nearby radio navigation service Non-Directional Beacons.
Licence Notes: Amateur Service – Secondary User. Full Licensees only, 5 watts EIRP maximum. Note that conditions regarding this band are specified by the Licence Schedule notes.
R.R. 5.80B. The use of the frequency band 472-479kHz in Algeria, Saudi Arabia, Azerbaijan, Bahrain, Belarus, China, Comoros, Djibouti, Egypt, United Arab Emirates, the Russian Federation, Iraq, Jordan, Kazakhstan, Kuwait, Lebanon, Libya, Mauritania, Oman, Uzbekistan, Qatar, Syrian Arab Republic, Kyrgyzstan, Somalia, Sudan, Tunisia and Yemen is limited to the maritime mobile and aeronautical radionavigation services. The amateur service shall not be used in the above-mentioned countries in this frequency band, and this should be taken into account by the countries authorising such use. (WRC 12).

1.8MHz (160m)	NECESSARY BANDWIDTH	UK USAGE
1,810-1,838kHz	200Hz	Telegraphy
1,838-1,840	500Hz	Narrowband Modes
1,840-1,843	2.7kHz	All Modes
1,843-2,000	2.7kHz	Telephony (Note 1), Telegraphy 1,836kHz – QRP (low power) Centre of Activity 1,960kHz – DF Contest Beacons (14dBW)

Note 1: Lowest LSB carrier frequency (dial setting) should be 1,843kHz. AX25 packet should not be used on the 1.8MHz band.
Licence Notes: 1,810-1,850kHz – Primary User: 1,810-1,830kHz on a non-interference basis to stations outside of the UK. 1,850-2,000kHz – Secondary User. 32W (15dBW) maximum.
Notes to the Band Plan: As on page 40.

3.5MHz (80m)	NECESSARY BANDWIDTH	UK USAGE
3,500-3,510kHz	200Hz	Telegraphy – Priority for Inter-Continental Operation
3,510-3,560	200Hz	Telegraphy – Contest Preferred. 3,555kHz – QRS (slow telegraphy) Centre of Activity
3,560-3,580	200Hz	Telegraphy 3,560kHz – QRP (low power) Centre of Activity
3,580-3,590	500Hz	Narrowband Modes
3,590-3,600	500Hz	Narrowband Modes – Automatically Controlled Data Stations (unattended)
3,600-3,620	2.7kHz	All Modes – Automatically Controlled Data Stations (unattended), (Note 1)
3,600-3,650	2.7kHz	All Modes – Phone Contest Preferred, (Note 1). 3,630kHz – Digital Voice Centre of Activity
3,650-3,700	2.7kHz	All Modes – Telephony, Telegraphy 3,663kHz May Be Used For UK Emergency Comms Traffic 3,690kHz SSB QRP (low power) Centre of Activity
3,700-3,800	2.7kHz	All Modes – Phone Contest Preferred 3,735kHz – Image Mode Centre of Activity 3,760kHz – IARU Region 1 Emergency Centre of Activity
3,775-3,800	2.7kHz	Priority for Inter-Continental Telephony (SSB) Operation

Note 1. Lowest LSB carrier frequency (dial setting) should be 3,603kHz.
Licence Notes: Primary User: Shared with other user services.
Notes to the Band Plan: As on page 40.

5MHz (60m)	AVAILABLE WIDTH	UK USAGE
5,258.5-5,264kHz	5.5kHz	5,262kHz – CW QRP Centre of Activity
5,276-5,284	8kHz	5,278.5kHz – May be used for UK Emergency Comms Traffic
5,288.5-5,292	3.5kHz	Beacons on 5290kHz (Note 2), WSPR
5,298-5,307	9kHz	
5,313-5,323	10kHz	5,317kHz – AM 6kHz maximum bandwidth
5,333-5,338	5kHz	
5,354-5,358	4kHz	
5,362-5,374.5	12.5kHz	5,362-5,370kHz – Digital Mode Activity in the UK
5,378-5,382	4kHz	
5,395-5,401.5	6.5kHz	
5,403.5-5,406.5	3kHz	5,403.5kHz – USB Common International Frequency

Unless indicated, usage is All Modes (necessary bandwidth to be within channel limits).
Note 1: Upper Sideband is recommended for SSB activity.
Note 2: Activity should avoid interference to the experimental beacons on 5290kHz.
Note 3: Amplitude Modulation is permitted with a maximum bandwidth of 6kHz, on frequencies with at least 6kHz available width.
Licence Notes: Full Licensees only, Secondary User, 100 watts maximum. Note that conditions on transmission bandwidth, power and antennas are specified in the Licence.
Notes to the Band Plan. As on page 40.

7MHz (40m)	NECESSARY BANDWIDTH	UK USAGE
7,000-7,040kHz	200Hz	Telegraphy – 7,030kHz QRP (low power) Centre of Activity
7,040-7,047	500Hz	Narrowband Modes (Note 2)
7,047-7,050	500Hz	Narrowband Modes, Automatically Controlled Data Stations (unattended)
7,050-7,053	2.7kHz	All Modes, Automatically Controlled Data Stations (unattended), (Note 1)
7,053-7,060	2.7kHz	All Modes, Digimodes
7,060-7,100	2.7kHz	All Modes, SSB Contest Preferred Segment Digital Voice 7,070kHz; SSB QRP Centre of Activity 7,090kHz
7,100-7,130	2.7kHz	All Modes, 7,110kHz – Region 1 Emergency Centre of Activity
7,130-7,200	2.7kHz	All Modes, SSB Contest Preferred Segment: 7,165kHz – Image Centre of Activity
7,175-7,200	2.7kHz	All Modes, Priority For Inter-Continental Operation

Note 1: Lowest LSB carrier frequency (dial setting) should be 7,053kHz.
Note 2: PSK31 activity starts from 7,040kHz. Since 2009, the narrowband modes segment starts at 7,040kHz.
Licence Notes: 7,000-7,100kHz Amateur and Amateur Satellite Service – Primary User.
7,100-7,200kHz Amateur Service – Primary User.
Notes to the Band Plan: As on page 40.

10MHz (30m)	NECESSARY BANDWIDTH	UK USAGE
10,100-10,140kHz	200Hz	Telegraphy (CW) 10,116kHz – QRP (low power) Centre of Activity
10.140-10.150	500Hz	Narrowband Modes Automatically Controlled Data Stations (unattended) should avoid the use of the 10MHz band

Licence Notes: Amateur Service – Secondary User.
Notes to the Band Plan: As on page 40.
The 10MHz band is allocated to the amateur service only on a secondary basis. The IARU has agreed that only CW and other narrow bandwidth modes are to be used on this band. Likewise the band is not to be used for contests and bulletins. SSB may be used on the 10MHz band during emergencies involving the immediate safety of life and property, and only by stations actually involved with the handling of emergency traffic. The band segment 10,120-10,140kHz may only be used for SSB transmissions in the area of Africa south of the equator during local daylight hours.

14MHz (20m)	NECESSARY BANDWIDTH	UK USAGE
14,000-14,060kHz	200Hz	Telegraphy – Contest Preferred 14,055kHz – QRS (slow telegraphy) Centre of Activity
14,060-14,070	200Hz	Telegraphy 14,060kHz – QRP (low power) Centre of Activity
14,070-14,089	500Hz	Narrowband Modes
14,089-14,099	500Hz	Narrowband Modes – Automatically Controlled Data Stations (unattended)
14,099-14,101		IBP – Reserved Exclusively for Beacons
14,101-14,112	2.7kHz	All Modes – Automatically Controlled Data Stations (unattended)
14,112-14,125	2.7kHz	All Modes (excluding digimodes)
14,125-14,300	2.7kHz	All Modes – SSB Contest Preferred Segment 14,130kHz – Digital Voice Centre of Activity 14,195 ±5kHz – Priority for DXpeditions 14,230kHz – Image Centre of Activity 14,285kHz – QRP Centre of Activity
14,300-14,350	2.7kHz	All Modes 14,300kHz – Global Emergency Centre of Activity

Licence Notes: Amateur Service – Primary User. 14,000-14,250kHz Amateur Satellite Service – Primary User.
Notes to the Band Plan: As on page 40.

18MHz (17m)	NECESSARY BANDWIDTH	UK USAGE
18,068-18,095kHz	200Hz	Telegraphy – 18,086kHz QRP (low power) Centre of Activity
18,095-18,105	500Hz	Narrowband Modes
18,105-18,109	500Hz	Narrowband Modes – Automatically Controlled Data Stations (unattended)

18,109-18,111		IBP – Reserved Exclusively for Beacons
18,111-18,120	2.7kHz	All Modes – Automatically Controlled Data Stations (unattended)
18,120-18,168	2.7kHz	All Modes, 18,130kHz – SSB QRP Centre of Activity 18,150kHz – Digital Voice Centre of Activity 18,160kHz – Global Emergency Centre of Activity

Licence Notes: Amateur and Amateur Satellite Service – Primary User. The band is not to be used for contests or bulletins.
Notes to the Band Plan: As on page 40.

21MHz (15m)	NECCESARY BANDWIDTH	UK USAGE
21,000-21,070kHz	200Hz	Telegraphy 21,055kHz – QRS (slow telegraphy) Centre of Activity 21,060kHz – QRP (low power) Centre of Activity
21,070-21,090	500Hz	Narrowband Modes
21,090-21,110	500Hz	Narrowband Modes – Automatically Controlled Data Stations (unattended)
21,110-21,120	2.7kHz	All Modes (excluding SSB) – Automatically Controlled Data Stations (unattended)
21,120-21,149	500Hz	Narrowband Modes
21,149-21,151		IBP – Reserved Exclusively For Beacons
21,151-21,450	2.7kHz	All Modes 21,180kHz – Digital Voice Centre of Activity 21,285kHz – QRP Centre of Activity 21,340kHz – Image Centre of Activity 21,360kHz – Global Emergency Centre of Activity

Licence Notes: Amateur and Amateur Satellite Service – Primary User.
Notes to the Band Plan: As on page 40.

24MHz (12m)	NECESSARY BANDWIDTH	UK USAGE
24,890-24,915kHz	200Hz	Telegraphy 24,906kHz – QRP (low power) Centre of Activity
24,915-24,925	500Hz	Narrowband Modes
24,925-24,929	500Hz	Narrowband Modes – Automatically Controlled Data Stations (unattended)
24,929-24,931		IBP – Reserved Exclusively For Beacons
24,931-24,940	2.7kHz	All Modes – Automatically Controlled Data Stations (unattended)
24,940-24,990	2.7kHz	All Modes, 24,950kHz – SSB QRP Centre of Activity 24,960kHz – Digital Voice Centre of Activity

Licence Notes: Amateur and Amateur Satellite Service – Primary User. The band is not to be used for contests or bulletins.
Notes to the Band Plan: As on page 40.

28MHz (10m)	NECESSARY BANDWIDTH	UK USAGE
28,000-28,070kHz	200Hz	Telegraphy 28,055kHz – QRS (slow telegraphy) Centre of Activity 28,060kHz – QRP (low power) Centre of Activity
28,070-28,120	500Hz	Narrowband Modes
28,120-28,150	500Hz	Narrowband Modes – Automatically Controlled Data Stations (unattended)
28,150-28,190	500Hz	Narrowband Modes
28,190-28,199		IBP – Regional Time Shared Beacons
28,199-28,201		IBP – World Wide Time Shared Beacons
28,201-28,225		IBP – Continuous-Duty Beacons
28,225-28,300	2.7kHz	All Modes – Beacons
28,300-28,320	2.7kHz	All Modes – Automatically Controlled Data Stations (unattended)
28,320-29,000	2.7kHz	28,330kHz – Digital Voice Centre of Activity 28,360kHz – QRP Centre of Activity 28,680kHz – Image Centre of Activity
29,000-29,100	6kHz	All Modes
29,100-29,200	6kHz	All Modes – FM Simplex – 10kHz Channels
29,200-29,300	6kHz	All Modes – Automatically Controlled Data Stations (unattended) 29,270kHz – Internet Gateways Channel 29,280kHz – UK Internet Voice Gateway (unattended) 29,290kHz – UK Internet Voice Gateway (unattended)
29,300-29,510	6kHz	Satellite Links
29,510-29,520	Guard Channel	
29,520-29,590	6kHz	All Modes – FM Repeater Inputs (RH1-RH8)
29,600	6kHz	All Modes – FM Calling Channel
29,610	6kHz	All Modes – FM Simplex Repeater (parrot) – input and output
29,620-29,700	6kHz	All Modes – FM Repeater Outputs (RH1-RH8)

Licence Notes: Amateur and Amateur Satellite Service – Primary User: 26dBW permitted. Beacons may be established for DF competitions except within 50km of NGR SK985640 (Waddington).
Notes to the Band Plan: As on page 40.

50MHz (6m)	NECESSARY BANDWIDTH	UK USAGE
50.000-50.100MHz	500Hz	Telegraphy Only (except for Beacon Project) (Note 2)
		50.000-50.030MHz reserved for future Synchronised Beacon Project (Note 2) Region 1: 50.000-50.010; Region 2: 50.010-50.020; Region 3: 50.020-50.030
		50.050MHz – Future International Centre of Activity 50.090MHz – Inter-Continental DX Centre of Activity (Note 1)
50.100-50.200	2.7kHz	SSB/Telegraphy – International Preferred 50.100-50.130MHz – Inter-Continental DX Telegraphy & SSB (Note 1) 50.110MHz – Inter-Continental DX Centre of Activity 50.130-50.200MHz – General International Telegraphy & SSB 50.150MHz – International Centre of Activity
50.200-50.300	2.7kHz	SSB/Telegraphy – General Usage 50.285MHz – Crossband Centre of Activity
50.300-50.400	2.7kHz	MGM/Narrowband/Telegraphy 50.305MHz – PSK Centre of Activity 50.310-50.320MHz – EME 50.320-50.380MHz – MS
50.400-50.500		Propagation Beacons only 50.401MHz – WSPR beacons ±500Hz
50.500-52.000	12.5kHz	All Modes 50.510MHz – SSTV (AFSK) 50.520MHz – Internet Voice Gateway (10kHz channels), (IARU common channel) 50.530MHz – Internet Voice Gateway (10kHz channels), (IARU common channel) 50.540MHz – Internet Voice Gateway (10kHz channels), (IARU common channel) 50.550MHz – Image/Fax working frequency 50.600MHz – RTTY (FSK) 50.620-50.750MHz – Digital communications 50.630MHz – Digital Voice (DV) calling 50.710-50.890MHz – FM/DV Repeater Outputs (10kHz channel spacing) 51.210-51.390MHz – FM/DV Repeater Inputs (10kHz channel spacing) (Note 4) 51.410-51.590MHz – FM/DV Simplex (Note 3) (Note 4) 51.510MHz – FM Calling Frequency 51.530MHz – GB2RS News Broadcast and Slow Morse 51.650 & 51.750MHz – See Note 5 (25kHz aligned) 51.770 & 51.790MHz – See Note 5 51.810-51.990MHz – FM/DV Repeater Outputs (IARU aligned channels)

Note 1: Only to be used between stations in different continents (not for intra-European QSOs).
Note 2: 50.0-50.1MHz is currently shared with Propagation Beacons. These are due to be migrated by Aug 2014 to 50.4-50.5MHz, to create more space for Telegraphy and a new Synchronised Beacon Project.
Note 3: 20kHz channel spacing. Channel centre frequencies start at 51.430MHz.
Note 4: Embedded data traffic is allowed with digital voice (DV).
Note 5: May be used for Emergency Communications and Community Events.
Licence Notes: Amateur Service 50.0-51.0MHz – Primary User. Amateur Service 51.0-52.0MHz – Secondary User. 100W (20dBW) maximum. Available on the basis on non-interference to other services (inside or outside the UK).
Notes to the Band Plan: As on page 40.

70MHz (4m)	NECESSARY BANDWIDTH	UK USAGE (NOTE 1)
70.000-70.090MHz	1kHz	Propagation Beacons Only
70.090-70.100	1kHz	Personal Beacons 70.091MHz – WSPR Beacons ±500Hz
70.100-70.250	2.7kHz	Narrowband Modes 70.185MHz – Cross-band Activity Centre 70.200MHz – CW/SSB Calling 70.250MHz – MS Calling
70.250-70.294	12kHz	All Modes 70.260MHz – AM/FM Calling 70.270MHz MGM Centre of Activity
70.294-70.500	12kHz	All Modes Channelised Operations Using 12.5kHz Spacing 70.3000MHz 70.3125MHz – Digital Modes 70.3250MHz – DX Cluster 70.3375MHz – Digital Modes 70.3500MHz – Internet Voice Gateway (Note 2) 70.3625MHz – Internet Voice Gateway 70.3750MHz – See Note 2 70.3875MHz – Internet Voice Gateway 70.4000MHz – See Note 2 70.4125MHz – Internet Voice Gateway 70.4250MHz – FM Simplex – used by GB2RS news broadcast 70.4375MHz – Digital Modes (special projects) 70.4500MHz – FM Calling 70.4625MHz – Digital Modes 70.4750MHz 70.4875MHz – Digital Modes

Note 1: Usage by operators in other countries may be influenced by restrictions in their national allocations.
Note 2: May be used for Emergency Communications and Community Events.
Licence Notes: Amateur Service 70.0-70.5MHz – Secondary User: 160W (22dBW) maximum. Available on the basis of non-interference to other services (inside or outside the UK).
Notes to the Band Plan: As on page 40.

144MHz (2m)	NECESSARY BANDWIDTH	UK USAGE
144.000-144.025MHz	2700Hz	All Modes – including Satellite Downlinks
144.025-144.110	500Hz	Telegraphy (including EME CW) 144.050MHz – Telegraphy Centre of Activity 144.100MHz – Random MS Telegraphy Calling, (Note 1)
144.110-144.150	500Hz	Telegraphy and MGM 144.138MHz – PSK31 Centre of Activity EME MGM Activity (Note 7)
144.150-144.180	2700Hz	Telegraphy, MGM and SSB
144.180-144.360	2700Hz	Telegraphy and SSB 144.175MHz – Microwave Talk-back 144.195-144.205MHz – Random MS SSB 144.200MHz – Random MS SSB Calling Frequency 144.250MHz – GB2RS News Broadcast and Slow Morse 144.260MHz – USB. (Note 10) 144.300MHz – SSB Centre of Activity

144.360-144.399	2700Hz	Telegraphy, MGM, SSB 144.370MHz – MGM Calling Frequency
144.400-144.490		Propagation Beacons only
144.490-144.500		144.492MHz – ±500Hz WSPR beacons and beacon guard band
144.500-144.794	20kHz	All Modes (Note 8) 144.500MHz – Image Modes Centre (SSTV, FAX, etc) 144.600MHz – Data Centre of Activity (MGM, RTTY, etc) 144.6125MHz – UK Digital Voice (DV) Calling (Note 9) 144.625-144.675MHz – See Note 10 144.750MHz – ATV Talk-back 144.775-144.794MHz – See Note 10
144.794-144.990	12kHz	MGM Digital Communications (Note 15) 144.800-144.9875MHz – MGM/Digital Communications 144.8000MHz – Unconnected Nets – APRS, UiView etc (Note 14) 144.8125MHz – DV Internet Voice Gateway 144.8250MHz – DV Internet Voice Gateway 144.8375MHz – DV Internet Voice Gateway 144.8500MHz – DV Internet Voice Gateway 144.8625MHz – DV Internet Voice Gateway 144.9250MHz – TCP/IP Usage 144.9375MHz – AX25 Usage 144.9500MHz – AX25 Usage 144.9625MHz – FM Internet Voice Gateway 144.9750MHz, 144.9875MHz To Be Decided (Note 11)
144.990-145.1935	12kHz	FM/DV RV48-RV63 Repeater Input Exclusive (Note 2 & 5)
145.200	12kHz	FM/DV Space Communications (eg ISS) – Earth-to-Space 145.2000MHz – (Note 4 & 10)
145.200-145.5935	12kHz	FM/DV V16-V48 – FM/DV Simplex (Note 3, 5 & 6) 145.2250MHz – See Note 10 145.2375MHz – FM Internet Voice Gateway (IARU common channel) 145.2500MHz – Used for Slow Morse Transmissions 145.2875MHz – FM Internet Voice Gateway (IARU common channel) 145.3375MHz – FM Internet Voice Gateway (IARU common channel) 145.5000MHz – FM Calling (Note 12) 145.5250MHz – Used for GB2RS News Broadcast. 145.5500MHz – Used for Rally/exhibition Talk-in 145.5750MHz, 145.5875MHz (Note 11)
145.5935-145.7935	12kHz	FM/DV RV48-RV63 – Repeater Output (Note 2)
145.800	12kHz	FM/DV Space Communications (eg ISS) – Space-Earth
145.806-146.000	12kHz	All Modes – Satellite Exclusive

Note 1: Meteor scatter operation can take place up to 26kHz higher than the reference frequency.
Note 2: 12.5kHz channels numbered RV48-RV63. RV48 input = 145.000MHz, output = 145.600MHz.
Note 3: 12.5kHz simplex channels numbered V16-V46. V16 = 145.200MHz.
Note 4: Emergency Communications Groups utilising this frequency should take steps to avoid interference to ISS operations in non-emergency situations.
Note 5: Embedded data traffic is allowed with digital voice (DV).
Note 6: Simplex use only – no DV gateways.
Note 7: EME activity using MGM is commonly practiced between 144.110-144.160MHz.
Note 8: Amplitude Modulation (AM) is acceptable within the All Modes segment. AM usage is typically found on 144.550MHz. Users should consider adjacent channel activity when selecting operating frequencies.
Note 9: In other countries IARU Region 1 recommends 145.375MHz.
Note 10: May be used for Emergency Communications and Community Events.
Note 11: May be used for repeaters in other IARU Region 1 countries.
Note 12: DV users are asked not to use this channel, and use 144.6125MHz for calling.
Note 13: Not used.
Note 14: 144.800 use should be NBFM to avoid interference to 144.8125 DV Gateways.
Licence Notes: Amateur Service and Amateur Satellite Service – Primary User. Beacons may be established for DF competitions except within 50km of TA 012869 (Scarborough).
Notes to the Band Plan: As on page 40.

146MHz IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
146.000-146.900MHz	500kHz	Wideband Digital Modes (High speed data, DATV etc) 146.500MHz Centre frequency for wideband modes (Note 1)
146.900-147.000MHz	12kHz	Narrowband Digital Modes including Digital Voice 146.900 146.9125 146.925 146.9375 Not available in/near Scotland (see Licence Notes & NoV terms) 146.9500 146.9625 146.9750 146.9875

Note 1: Users of wideband modes must ensure their spectral emissions are contained with the band limits.
Licence Notes: Full Licensees only, with NoV, 25W ERP max – not available in the Isle of Man or Channel Isles. Note that additional restrictions on geographic location, antenna height and upper frequency limit are specified by the NoV terms.
It should be emphasised that this band is UK-specific and is available on a non-interference basis to existing services. Upper Band limit 147.000MHz (or 146.93750 where applicable) are absolute limits and not centre frequencies. The absolute band frequency limit in or within 40km of Scotland is 146.93750MHz – see NoV schedule
Notes to the Band Plan: As on page 40.

430MHz (70cm) IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
430.0000-431.9810MHz	20kHz	430.0125-430.0750MHz – FM Internet Voice Gateways (Notes 7, 8)
All Modes		430.4000-430.7750 – UK DV 9MHz Split Repeaters – inputs
Digital Links 430.6000-430.9250		430.8000MHz – 7.6MHz Talk-through (Note 10)
Digital Repeaters		430.8250-430.9750MHz – RU66-RU78 7.6MHz Split Repeaters – outputs See Licence Exclusion Note; 431-432MHz 430.9900-431.9000MHz – Digital Communications 431.0750-431.1750MHz – DV Internet Voice Gateways (Note 8)
432.0000-432.1000 Telegraphy MGM	500Hz	432.0000-432.0250MHz – Moonbounce (EME) 432.0500MHz – Telegraphy Centre of Activity 432.0880MHz – PSK31 Centre of Activity
432.1000-432.4000 SSB, Telegraphy MGM	2700Hz	432.2000MHz – SSB Centre of Activity 432.3500MHz – Microwave Talk-back (Europe) 432.3700MHz – FSK441 Calling Frequency
432.4000-432.5000 Beacons Exclusive	500Hz	Propagation Beacons only
432.5000-432.9940 All Modes Non-channelised	25kHz (Note 11)	432.5000MHz – Narrowband SSTV Activity Centre 432.6250-432.6750MHz Digital Communications (25kHz channels) 432.7750MHz 1.6MHz Talk-through – Base TX (Note 10)
432.9940-433.3810	25kHz	433.0000-433.3750MHz (RB0-RB15) – RU240-RU270
FM repeater outputs in UK only (Note 1)	(Note 11)	FM/DV Repeater Outputs (25kHz channels) in UK Only
433.3940-433.5810	25kHz	433.4000MHz U272 – IARU Region 1 SSTV (FM/AFSK)
	(Note 11)	433.4250MHz U274
FM/DV (Notes 12, 13) Simplex Channels		433.450MHz U276 (Note 5) 433.4750MHz U278 433.5000MHz U280 – FM Calling Channel 433.5250MHz U282 433.5500MHz U284 – Used for Rally/Exhibition Talk-in 433.5750MHz U286
433.6000-434.0000 All Modes 433.800MHz for APRS where 144.800MHz cannot be used	25kHz (Note 11)	433.6250-6750MHz – Digital Communications (25kHz channels) 433.700MHz (Note 10) 433.7250-433.7750MHz (Note 10) 433.8000-434.2500MHz – Digital Communications
434.000-434.5940	25kHz	433.9500-434.0500MHz – Internet Voice Gateways (Note 8)
	(Note 11)	434.3750MHz 1.6MHz Talk-through – Mobile TX (Note 10) 434.4750-434.5250MHz – Internet Voice Gateways (Note 8)
434.5940-434.9810	25kHz	434.6000-434.9750MHz (RB0-RB15) RU240-RU270
FM repeater inputs in UK only & ATV (Note 4)	(Note 11)	FM/DV Repeater Inputs (25kHz channels) in UK Only (Note 12)
435.0000-438.0000	20kHz	Satellites and Fast Scan TV (Note 4) 437.0000 – Experimental DATV Centre of Activity (Note 14)
438.0000-440.0000	25kHz	438.0250-438.1750MHz – IARU Region 1 Digital Communications
All Modes	(Note 11)	438.2000-439.4250MHz (Note 1) 438.4000MHz – 7.6MHz Talk-through (Note 10) 438.4250-438.5750MHz RU66-RU78 – 7.6MHz Split Repeaters – inputs 438.6125MHz – UK DV calling (Note 12) (Note 13) 439.6000-440.0000MHz – Digital Communications 439.400-439.775MHz – UK DV 9MHz split repeaters - Outputs

Note 1: In Switzerland, Germany and Austria, repeater inputs are 431.050-431.825MHz with 25kHz spacing and outputs 438.650-439.425MHz. In Belgium, France and the Netherlands repeater outputs are 430.025-430.375MHz with 12.5kHz spacing and inputs at 431.625-431.975MHz. In other European countries repeater inputs are 433.000-433.375MHz with 25kHz spacing and outputs at 434.600-434.975MHz, ie the reverse of the UK allocation.
Note 4: ATV carrier frequencies shall be chosen to avoid interference to other users, in particular the satellite service and repeater inputs.
Note 5: In other countries IARU Region 1 recommends 433.450MHz for DV calling.
Note 7: Users must accept interference from repeater output channels in France and the Netherlands at 430.025-430.575MHz. Users with sites that allow propagation to other countries (notably France and the Netherlands) must survey the proposed frequency before use to ensure that they will not cause interference to users in those countries.
Note 8: All internet voice gateways: 12.5kHz channels, maximum deviation ±2.4kHz, maximum effective radiated power 5W (7dBW), attended only operation in the presence of the NoV holder.
Note 10: May be used for Emergency Communications and Community Events.
Note 11: IARU Region 1 recommended maximum bandwidths are 12.5 or 20kHz.
Note 12: Embedded data traffic is allowed with digital voice (DV).
Note 13: Simplex use only - no DV gateways.
Note 14: QPSK 2 Mega-symbols/second maximum recommended.
Licence Notes: Amateur Service – Secondary User. Amateur Satellite Service: 435-438MHz – Secondary User. Exclusion: 431-432MHz not available within 100km radius of Charing Cross, London. Power Restriction 430-432MHz is 40 watts effective radiated power maximum.
Notes to the Band Plan: As on page 40.

1.3GHz (23cm)	NECESSARY BANDWIDTH	UK USAGE
1240.000-1240.500MHz	2700Hz	Alternative Narrowband Segment – see Note 7 – 1240.00-1240.750MHz
1240.500-1240.750		Alternative Propagation Beacon Segment
1240.750-1241.000	20kHz	FM/DV Repeater Inputs
1241.000-1241.750	150kHz	DD High Speed Digital Data – 5 x 150kHz channels
All Modes		1241.075, 1241.225, 1241.375, 1241.525, 1241.675MHz (±75kHz)
1241.750-1242.000 All Modes 1242.000-1249.000	20kHz	25kHz Channels available for FM/DV use 1241.775-1241.975MHz TV Repeaters (Note 9)

ATV		New DATV Repeater Inputs Original ATV Repeater Inputs: 1248, 1249
1249.000-1249.250	20kHz	FM/DV Repeater Outputs, 25kHz Channels (Note 9) 1249.025-1249.225MHz
1250.00		In order to prevent interference to Primary Users, caution must be exercised prior to using 1250-1290MHz in the UK
1260.000-1270.000		Amateur Satellite Service – Earth to Space Uplinks Only
Satellites 1290.000		
1290.994-1291.481	20kHz	FM/DV Repeater Inputs (Note 5) 1291.000-1291.375MHz (RM0-RM15) 25kHz spacing
1291.494-1296.000 All Modes	All Modes	
All Modes 1296.000-1296.150 Telegraphy, MGM 1296.150-1296.800 Telegraphy, SSB & MGM (Note 1)	500Hz 2700Hz	Preferred Narrowband segment 1296.000-1296.025MHz – Moonbounce 1296.138MHz – PSK31 Centre of Activity 1296.200MHz – Narrowband Centre of Activity 1296.400-1296.600MHz – Linear Transponder Input 1296.500MHz – Image Mode Centre of Activity (SSTV, FAX etc) 1296.600MHz – Narrowband Data Centre of Activity (MGM, RTTY etc) 1296.600-1296.700MHz – Linear Transponder Output
1296.800-1296.994		1296.750-1296.800MHz – Local Beacons, 10W ERP max 1296.800-1296.990MHz – Propagation Beacons only
		Beacons exclusive
1296.994-1297.481	20kHz	FM/DV Repeater Outputs (Note 5) 1297.000-1297.375MHz (RM0-RM15)
1297.494-1297.981 FM/DV simplex (Notes 2, 5, 6)	20kHz	FM/DV Simplex ((Notes 2, 5 & 6)) 25kHz spacing 1297.500-1297.750MHz (SM20-SM30) 1297.725MHz – Digital Voice (DV) Calling (IARU recommended) 1297.900-1297.975MHz – FM Internet Voice Gateways (IARU common channels, 25kHz)
1298.000-1299.000 All Modes	20kHz	All Modes General mixed analogue or digital use in channels 1298.025-1298.975MHz (RS1-RS39)
1299.000-1299.750 All Modes	150kHz	DD High Speed Digital Data – 5 x 150kHz channels 1299.075, 1299.225, 1299.375, 1299.525, 1299.675MHz (±75kHz)
1299.750-1300.000 All Modes	20kHz	25kHz Channels Available for FM/DV use 1299.775-1299.975MHz
1300.000-1325.000 ATV		TV Repeaters (UK only) (Note 9) New DATV Repeater Outputs Original ATV Repeater Outputs: 1308.0, 1310.0, 1311.5, 1312.0, 1316.0, 1318.5MHz

Note 1: Local traffic using narrowband modes should operate between 1296.500-1296.800MHz during contests and band openings.
Note 2: Stations in countries that do not have access to 1298-1300MHz may also use the FM simplex segment for digital communications.
Note 3: IARU Region 1 recommended maximum bandwidth is 20kHz. See also Note 7.
Note 4: deleted.
Note 5: Embedded data traffic is allowed with digital voice (DV).
Note 6: Simplex use only – no DV gateways.
Note 7: 1240.000-1240.750 has been designated by IARU as an alternative centre for narrowband activity and beacons. Operations in this range should be on a flexible basis to enable coordinated activation of this alternate usage.
Note 8: The band 1240-1300MHz is subject to major replanning. Contact the Microwave Manager for further information.
Note 9: Repeaters and Migration to DATV, inc option for new DATV simplex are subject to further development and coordination.
Note 10: QPSK 4 Mega-symbols/second maximum recommended.
Licence Notes: Amateur Service – Secondary User. Amateur Satellite Service: 1,260-1,270MHz – Secondary User Earth to Space only. In the sub-band 1,298-1,300MHz unattended operation is not allowed within 50km of SS206127 (Bude), SE202577 (Harrogate), or in Northern Ireland.
Notes to the Band Plan: As on page 40.

2.3-2.302GHz IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
Access to this band requires an appropriate NoV, which is available to Full licensees only. Please note that the current NoVs last for up to three years prior to expiry.		
2300.000-2300.400MHz	2.7kHz	Narrowband Modes (including CW, SSB, MGM) 2300.350-2300.400MHz Attended Beacons
2300.400-2301.800MHz	500kHz	Wideband Modes (NBFM, DV, Data, DATV, etc) Note 1
2301.800-2302.000MHz	2.7kHz	Narrowband modes (including CW, SSB, MGM) EME Usage

Note 1: Users of wideband modes must ensure their spectral emissions are contained within the band limits.
Note 2: Full licensees only with NoV, 400 watts maximum, not available in the Isle of Man or Channel isles. Note additional restrictions on usage are specified by the NoV terms. It should be emphasised that this is UK-specific and is available on a non interference basis to exisiting services.
Notes to the Band Plan: As on page 40.

2.3GHz (13cm) IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
2,310.000-2,320.000MHz (National band plans)	200kHz	2,310.000-2,310.500MHz – Repeater links 2,311.000-2,315.000MHz – High speed data Preferred Narrowband Segment
2,320.000-2,320.150	500Hz	2,320.000-2,320.025MHz – Moonbounce
2,320.150-2,320.800	2.7kHz	2,320.200MHz – SSB Centre of Activity
2,320.800-2,321.000		2,320.750-2,320.800MHz – Local Beacons, 10W ERP max 2,320.800-2,320.990MHz – Propagation Beacons Only
Beacons exclusive 2321.000-2322.000 2,322.000-2,350.000 2,390.000-2,400.000 2,400.000-2,450.000MHz Satellites	20kHz	FM/DV. See also Note 1 Wideband Modes including Data, ATV All Modes 2,435.000MHz ATV Repeater Outputs 2,440.000MHz ATV Repeater Outputs

Note 1: Stations in countries which do not have access to the All Modes section 2,322-2,390MHz, use the simplex and repeater segment 2,320-2,322MHz for data transmission.
Note 2: Stations in countries that do not have access to the narrowband segment 2,320-2,322MHz, use the alternative narrowband segment 2,304-2,306MHz and 2,308-2,310MHz.
Note 3: The segment 2,433-2,443MHz may be used for ATV if no satellite is using the segment.
Licence Notes: Amateur Service – Secondary User. Users must accept interference from ISM users. Amateur Satellite Service: 2,400-2,450MHz – Secondary User. Users must accept interference from ISM users. Operation in 2310-2350 and 2390-2400 MHz are subject to specific conditions and guidance In the sub-bands 2,310.000-2,310.4125 and 2,392-2,450MHz unattended operation is not allowed within 50km of SS206127 (Bude) or SE202577 (Harrogate). ISM = Industrial, scientific and medical.
Notes to the Band Plan: As on page 40.

3.4GHz (9cm) IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
3,400.000-3,401.000MHz	2.7kHz	Narrowband Modes (including CW, SSB, MGM, EME) 3,400.100MHz – Centre of Activity (Note 1)
3,400.800-3,400.995		3,400.750-3,400.800MHz – Local Beacons, 10W ERP max 3,400.800-3,400.995MHz – Propagation Beacons Only
Propagation Beacons 3,400.000-3,401.000MHz 3,402.000-3,410.000 All Modes (Notes 2, 3)	200kHz	3,401.000-3,402.000MHz Data, Remote Control Wideband Modes including DATV Repeater Outputs

Note 1: EME has migrated from 3456MHz to 3400MHz to promote harmonised usage and activity.
Note 2: Stations in many European countries have access to 3400-3410MHz as permitted by ECA Table Footnote EU17.
Note 3: Amateur Satellite downlinks planned.
Licence Notes: Amateur Service – Secondary User. Subject to specific conditions and guidance.
Notes to the Band Plan: As on page 40.

5.7GHz (6cm) IARU Recommendation	UK USAGE
5,650.000-5,668.000MHz Satellite Uplinks 5,650.000-5,670.000 Narrowband CW/EME/SSB 5,670.000-5,680.000 All Modes 5,755.000-5,760.000 All Modes 5,760.000-5,762.000 Narrowband CW/EME/SSB	Amateur Satellite Service – Earth to Space Only 5,668.200MHz – Alternative Centre of Activity 5,668.8MHz – Beacons 5,760.100MHz – Current Centre of Activity
5760.800-5760.995	5,760.750-5,760.800MHz – Local Beacons, 10W ERP max 5,760.800-5,760.995MHz – Propagation Beacons only
Propagation Beacons 5,762.000-5,765.000 All Modes 5,820.000-5,830.000 All Modes 5,830.000-5,850.000 Satellite Downlinks	Amateur Satellite Service – Space to Earth Only

Licence Notes: Amateur Service: 5,650-5,680MHz – Secondary User. 5,755-5,765 and 5,820-5,850MHz – Secondary User. Users must accept interference from ISM users. Amateur Satellite Service: 5,650-5,670MHz and 5,830-5,850MHz – Secondary User. Users must accept interference from ISM users. Unattended operation is permitted for remote control, digital modes and beacons, except in the sub-bands 5,670-5,680MHz within 50km of SS206127 (Bude) and SE202577 (Harrogate). ISM = Industrial, scientific and medical.
Notes to the Band Plan: As on page 40.

10GHz (3cm) IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
10,000.000-10,125.000MHz All Modes		Note 4 10,065MHz ATV Repeater Outputs
10,225.000-10,250.000 All Modes 10,250.000-10,350.000 Digital Modes 10,350.000-10,368.000		10,240MHz ATV Repeaters 10,352.5-10,368MHz Wideband Modes (Note 2)
All Modes 10,368-10,370MHz Narrowband Telegraphy EME/SSB	2.7kHz	10,368-10,370 Narrowband Modes (Note 3) 10,368.1MHz Centre of Activity
10,368.800-10,368.995		10,368.750-10,368.800MHz – Local Beacons, 10W ERP max 10,368.800-10,368.995MHz – Propagation Beacons Only
Propagation Beacons 10,370.000-10,450.000 All Modes 10,450.000-10,475.000 All Modes & Satellites		10,371MHz Voice Repeaters Rx 10,425 ATV Repeaters 10,400-10,475MHz Unattended Operation 10,450-10,452MHz Alternative Narrowband Segment (Note 3) 10,471MHz Voice Repeaters Tx

10,475.000-10,500.000
All Modes and satellites — Amateur Satellite Service ONLY

Note 1: Deleted.
Note 2: Wideband FM is preferred between 10,350-10,400MHz to encourage compatibility between narrowband systems.
Note 3: 10,450MHz is used as an alternative narrowband segment in countires where 10,368MHz is not available.
Note 4: 10,000-10,125MHz is subject to increased Primary user utilisation and NoV restrictions.
Note 5: 10,475-10,500MHz is allocated ONLY to the Amateur Satellite Service and NOT to the Amateur Service.
Licence Notes: Amateur Service – Secondary User. Foundation licensees 1 watt maximum. Amateur Satellite Service: 10,450-10,500MHz – Secondary User. Unattended operation is permitted for remote control, digital modes and beacons except in the sub-bands 10,000-10,125MHz within 50km of SO916223 (Cheltenham), SS206127 (Bude), SK985640 (Waddington) and SE202577 (Harrogate).
Notes to the Band Plan: As on page 40.

24GHz (12mm) IARU Recommendation	UK USAGE
24,000.000-24,050.000MHz Satellites	24.025MHz Preferred Operating Frequency for Wideband Equipment
	24,048.2MHz – Narrowband Centre of Activity
	24,048.750-24,048.800MHz – Local Beacons, 10W ERP max
24,048.800-24,048.995 Propagation Beacons	24,048.800-24,048.995MHz – Propagation Beacons Only
24,050.000-24,250.000 All Modes	

Licence Notes: Amateur Service: 24,000-24,050MHz – Primary User: Users must accept interference from ISM users. 24,050-24,150MHz – Secondary User. May only be used with the written permission of Ofcom. Users must accept interference from ISM users. 24,150-24,250MHz – Secondary User. Users must accept interference from ISM users. Amateur Satellite Service: 24,000-24,050MHz – Primary User: Users must accept interference from ISM users. Unattended operation is permitted for remote control, digital modes and beacons, except in the sub-bands 24,000-24,050MHz within 50km of SK985640 (Waddington) and SE202577 (Harrogate).
ISM = Industrial, scientific and medical.
Notes to the Band Plan: As on page 40.

47GHz (6mm) IARU Recommendation	UK USAGE
47,000.000-47,200.000MHz 47,088.000-47,090.000 Narrowband Segment	47,088.2MHz – Centre of Narrowband Activity
47,000.000-47,200.000MHz 47,088.000-47,090.000 Narrowband Segment	47,088.2MHz – Centre of Narrowband Activity

Licence Notes: Amateur Service and Amateur Satellite Service – Primary User. Unattended operation is permitted for remote control, digital modes and beacons, except within 50km of SK985640 (Waddington) and SE202577 (Harrogate).
Notes to the Band Plan: As on page 40.

76GHz (4mm) IARU Recommendation	UK USAGE
75,500-76,000MHz All Modes (preferred) 76,000.000-77,500.000 All Modes	75,976.200MHz – IARU Region 1 Preferred Centre of Activity
77,500-78,000 All Modes (preferred) 78,000-81,000 All Modes	77,500.200MHz – Alternative IARU Recommended Narrowband Segment

Licence Notes:
75,500-75,875MHz Amateur Service and Amateur Satellite Service – Secondary User.
75,875-76,000MHz Amateur Service and Amateur Satellite Service – Primary User.
76,000-77,500MHz Amateur Service and Amateur Satellite Service – Secondary User.
77,500-78,000MHz Amateur Service and Amateur Satellite Service – Primary User.
78,000-81,000MHz Amateur service and Amateur Satellite Service – Secondary User.
Unattended operation is permitted for remote control, digital modes and beacons, except within 50km of SK985640 (Waddington) and SE202577 (Harrogate).
Notes to the Band Plan: As on page 40.

134GHz (2mm) IARU Recommendation	UK USAGE
134,000-134,928MHz All Modes	
134,928 -134,930 Narrowband Modes	IARU Region 1 Preferred Centre of Activity
	134.928.800-134.928.990 – Propagation Beacons Only
134,930 -136,000 All Modes	

Licence Notes: 134,000-136,000MHz Amateur Service and Amateur Satellite Service – Primary User. Unattended operation is permitted for remote control, digital modes and beacons, except within 50km of SK985640 (Waddington) and SE202577 (Harrogate).

THE FOLLOWING BANDS ARE ALSO ALLOCATED TO THE AMATEUR SERVICE AND THE AMATEUR SATELLITE SERVICE

122,250-123,000MHz – Amateur Service only, Secondary User
136,000-141,000MHz – Secondary User
241,000-248,000MHz – Secondary User
248,000-250,000MHz – Primary User
Notes to the Band Plan: As on page 40.

NOTES TO THE BAND PLAN

ITU-R Recommendation SM.328 (extract)

Necessary bandwidth: For a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Foundation and Intermediate Licence holders are advised to check their Licences for the permitted power limits and conditions applicable to their class of Licence.

All Modes: CW, SSB and those modes listed as Centres of Activity, plus AM. Consideration should be given to adjacent channel users.

Image Modes: Any analogue or digital image modes within the appropriate bandwidth, for example SSTV and FAX.

Narrowband Modes: All modes using up to 500Hz bandwidth, including CW, RTTY, PSK, etc.

Digimodes: Any digital mode used within the appropriate bandwidth, for example RTTY, PSK, MT63, etc.

Sideband usage: Below 10MHz use lower sideband (LSB), above 10MHz use upper sideband (USB). Note the lowest dial settings for LSB Voice modes are 1843, 3603 and 7043kHz on 160, 80 and 40m. Note that on (5MHz) USB is used.

Amplitude Modulation (AM): AM with a bandwidth greater than 2.7kHz is acceptable in the All Modes segments provided users consider adjacent channel activity when selecting operating frequencies (Davos 2005).

Extended SSB (eSSB): Extended SSB (eSSB) is only acceptable in the All Modes segments provided users consider adjacent channel activity when selecting operating frequencies.

Digital Voice (DV): Users of Digital Voice (DV) should check that the channel is not in use by other modes (CT08_C5_Rec20).

FM Repeater & Gateway Access: CTCSS Access is recommended. Toneburst access is being withdrawn in line with IARU-R1 recommendations.

Beacons Propagation Beacon Sub-bands are highlighted – please avoid transmitting in them!

MGM: Machine Generated Modes indicates those transmission modes relying fully on computer processing such as RTTY, AMTOR, PSK31, JTxx, FSK441 and the like. This does not include Digital Voice (DV) or Digital Data (DD).

WSPR: Above 30MHz, WSPR frequencies in the band plan are the centre of the transmitted frequency (not the suppressed carrier frequency or the VFO dial setting).

CW QSOs are accepted across all bands, except within beacon segments (Recommendation DV05_C4_Rec_13).

Contest activity shall not take place on the 10, 18 and 24MHz (30, 17 and 12m) bands.

Non-contesting radio amateurs are recommended to use the contest-free HF bands (30, 17 and 12m) during the largest international contests (DV05_C4_Rev_07).

The term 'automatically controlled data stations' include Store and Forward stations.

Transmitting Frequencies: The announced frequencies in the band plan are understood as 'transmitted frequencies' (not those of the suppressed carrier!).

Unmanned transmitting stations: IARU member societies are requested to limit this activity on the HF bands. It is recommended that any unmanned transmitting stations on HF shall only be activated under operator control except for beacons agreed with the IARU Region 1 Beacon Coordinator, or specially licensed experimental stations.

472-479kHz: Access is available to Full licensees only - see licence schedule for additional conditions.

1.8MHz: Radio amateurs in countries that have a SSB allocation ONLY below 1840kHz, may continue to use it, but the National Societies in those countries are requested to take all necessary steps with their licence administrations to adjust phone allocations in accordance with the Region 1 Band Plan (UBA – Davos 2005).

3.5MHz: Inter-Continental operations should be given priority in the segments 3500-3510kHz and 3775- 3800kHz. Where no DX traffic is involved, the contest segments should not include 3500-3510kHz or 3775-3800kHz. Member societies will be permitted to set other (lower) limits for national contests (within these limits). 3510-3600kHz may be used for unmanned ARDF beacons (CW, A1A) (Recommendation DV05_C4_Rec_12). Member societies should approach their national telecommunication authorities and ask them not to allocate frequencies other than amateur stations in the band segment that IARU has assigned to Inter-Continental long distance traffic.

5MHz: Access is available to Full licensees only- see licence schedule for additional conditions.

7MHz: The band segment 7040-7060kHz may be used for automatic controlled data stations (unattended) traffic in the areas of Africa south from the equator during local daylight hours. Where no DX traffic is involved, the contest segment should not include 7,175-7,200kHz.

10MHz: SSB may be used during emergencies involving the immediate safety of life and property and only by stations actually involved in the handling of emergency traffic.
The band segment 10120kHz to 10140kHz may be used for SSB transmissions in the area of Africa south of the equator during local daylight hours.
News bulletins on any mode should not be transmitted on the 10MHz band.

28MHz: Member societies should advise operators not to transmit on frequencies between 29.3 and 29.51MHz to avoid interference to amateur satellite downlinks.

Experimentation with NBFM Packet Radio on 29MHz band: Preferred operating frequencies on each 10kHz from 29.210 to 29.290MHz inclusive should be used. A deviation of ±2.5kHz being used with 2.5kHz as maximum modulation frequency.

146-147MHz & 2300-2302MHz
Access to these bands requires an appropriate NoV, which is available to Full licensees only.

430MHz
The use of Amplitude Modulation (AM) is acceptable in the all modes segments but users are asked to consider

1.3GHz
The band is subject to re-planning. It is also shared with air traffic radar.

2.3GHz (2310-2350 & 2390-2400MHz)
Operation is subject to specific licence conditions and guidance - see also the Ofcom PSSR statement.

3.4GHz (3400-3410MHz)
Operation is subject to specific licence conditions and guidance - see also the Ofcom PSSR statement.

ATV

CQ-TV 250

We mentioned *CQ-TV* no 250 last time. That special edition of the magazine was well received. It concentrates on the latest home construction of reduced bandwidth systems (RBTV), article on how to start an amateur television station and much more. The BATC was formed in 1947 and the first *CQ-TV* that I read was when I became a member in the spring of 1958, I was just 18 years old. John Tanner was the editor, having taken over from Mike Barlow. So it's quite amazing that *CQ-TV* 250 has just been published. When I retired, I re-joined the committee and I am still helping to run the club. I hope that you will be able to read this special edition.

RBTV

Peter, G8DKC reports that the GB3GV repeater in Leicestershire now has an additional input to receive RBTV on 146.5MHz. This is a very useful facility so that you can check your transmission when nobody is about. To transmit in the extended part of the 2m band requires a NoV to your Full licence [1].

Amateur television aboard the International Space Station

Tim Peake, KG5BVI, is now aboard the ISS and has operated the amateur voice transmitter to contact several schools. His aim was to get the ATV video transmitter operational and he may well have done so with the help of the BATC ground crew by the time you read this. See [2] for the latest mission information. When the ISS ATV transmitter is operational you can view the pictures via the BATC streaming site [3].

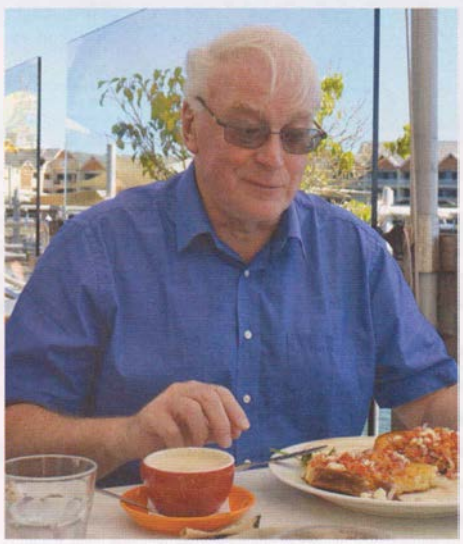

PHOTO 1: Peter Blakeborough, G3PYB (SK).

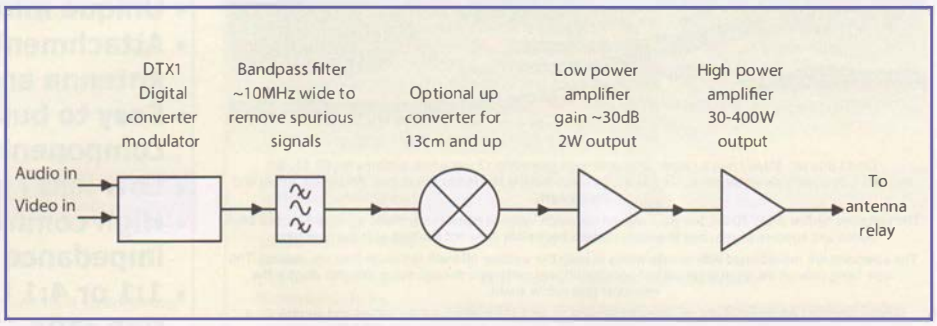

FIGURE 1: Block diagram of a digital ATV transmitter.

Getting the bits to make a digital TV transmitter

I am often asked where to get the parts to assemble a digital TV transmitter. Figure 1 shows the parts required, plus a power supply of course. On 70cm we normally use 2MS/sec and 4MS/sec on the higher bands. For NBTV bands below 70cm see the BATC website [4]. The bandpass filer is just to remove any harmonics or out of band products and is not very critical. Parts for a transmitter can be found at [5] [6] [7] [8] [9]. Most people use solid state PAs with LDMOS power transistors, which are more efficient than valves and operate at lower voltages. Let me know how you get on.

Peter, G3PYB, SK

Peter Blakeborough, G3PYB had a lifelong interest in amateur television. He passed away in hospital on 8 January 2016 after a serious heart attack over the Christmas holiday. Peter was President of the BATC for many years. He was full of energy and has been highly involved in the hobby. More recently he constructed equipment for reduced bandwidth TV on the 146-147.5MHz band.

Peter was born in Scarborough in 1945 and joined the BBC as a trainee in the late 1960s. I first met him on the air when he lived near the Crystal Palace BBC transmitter and we regularly exchanged pictures on 70cm AM ATV. Later I worked with Peter in the early 1970s in Andover. Later that decade he moved back to YTV in Leeds, where he ran the installation and maintenance department. Peter made good use of the Emley Moor 1000ft tower, where he installed an ATV repeater and various microwave beacons. In the 1980s Peter and family moved down to Portsmouth when he was a director of Wood and Douglas.

Peter was very interested in microwaves and built CW/SSB equipment for bands up to 76GHz. I worked him on 437MHz, 3.4GHz and 10GHz all-digital ATV in 2004/5 when he went portable on the Surrey hills. This was fairly revolutionary in those days. Peter also ran the new GB3IV ATV repeater at Collingwood, Portsmouth.

I knew Peter for over 50 years. He will be sadly missed by the amateur community. We wish his wife, Sandy and their children, Russell and Lucy all the very best for their future.

Rallies

The next few rallies also showing ATV are Norbreck (Blackpool) on 10 April, Kempton Park on 17 April, Norden (Rochdale) on 21 May and Dunstable Downs on 22 May.

WEBSEARCH

[1] www.rsgb.org/nov
[2] http://principia.ariss.org/
[3] www.batc.tv
[4] www.batc.org.uk
[5] www.minikits.com.au/
[6] www.kuhne-electronic.de/en/
[7] www.dg0ve.de/en/
[8] www.id-elektronik.de/en/
[9] www.thedxshop.com/

Dave Mann, G8ADM
g8adm@gb3bh.com

Election Results

Board Elections

This year there were two vacancies for directly-elected Directors. Two nominations were received and, therefore, both candidates are elected unopposed and will join the Board after the AGM in April.

Len Paget, GM0ONX

I have been a Board member and Board link for the Regional Team, Emergency Communications and the Planning Advisory Committee since 2013. As a former Regional Manager I understand the importance of the work of the whole Regional Team who strive to support Members locally and ensure their voices are heard. As their Board link I have ensured that the Regional Team's voice and that of their Members is fully represented and considered at Board level. Amateur radio's ability to provide communications in times of need is an important service to many user services and the wider community. However the current 'two RAYNET' model does not make best use of the wealth of talent within both groups and causes confusion to both to user services and radio amateurs alike. In 2013 I sought and was given Board support to initiate discussions with RAEN on forming a unified RAYNET. A joint working group made up of members from RAEN and RSGB RAYNET has been formed and will be bringing forward proposals to achieve this. The Planning Advisory Committee continues its support of members with planning issues and I am actively involved in this as a planning panel member dealing with Scottish planning applications, appeals and enforcement notices. As well as my responsibilities as Board link, I play a full part in all other Board activities.

Dr Stewart Bryant, G3YSX

I have been honoured to serve the Members of the RSGB this past three years as a nominated Board member. I will strive to continue the construction of an RSGB that engages with its Members to build an organisation that satisfies their amateur radio needs both now and into the future within a sound commercial framework. As many of you will know contesting has recently been through some challenging times. In my view we now have a structure that allows us to focus on the needs of the various contest communities and to build on and develop the world class operational system that has been developed to support one of the largest programme of contests ever put in place. The new organisation will continue to engage with the contest community to develop contests to satisfy the diverse needs of the contest community. As a Board member I will seek to ensure that both contest participants and contest volunteers continue to have the full support of the Board. The RSGB faces a number of challenges due to personnel changes in key positions. This turnover is an expected part of the evolution of any organisation, and brings in the opportunity for fresh blood and new ideas. However, it is important that a measure of continuity in leadership is provided to provide the necessary context in which it operates.

Regional Elections

In this year's Regional elections there were Regional Manager vacancies for nine Regions (Regions 1, 2, 3, 4, 6, 7, 8, 9 and 13). The following have been elected unopposed, their appointment starts after the AGM. There will a ballot for Region 4, details of which will be in the April *RadCom*.

Marcus Hazel McGown, MM0ZIF

Region 1. I am a family man whose entire family share an interest in amateur radio; my XYL is licenced as MM6YWF. We've been involved in the hobby for a number of years now, most notably as the First Aid support at NARSA's Norbreck rally and, in the current year, Regional and Awards Manager.

Kath Wilson, M1CNY

Region 3. I look forward to continue to be able to help and support the radio clubs up and down the Region, likewise for amateurs and those people wishing to become amateurs in the North West and indeed in other parts of the country. I regularly attend the various radio rallies in Region 3, which provides a great opportunity to chat to amateurs regarding their issues and concerns, that includes non Members of the RSGB as well as Members.

Ceri Lloyd Jones, 2W0LJC

Region 6. I've always been interested in the world of radio. I joined RSGB in the 90s after calling on a neighbour who has Full licence. There is a small group in Denbigh where we meet once a week in the local wireless museum. I was a member of local hospital radio for many years, presenting a radio request show, fundraising and doing outside broadcasts. My aim is to visit all clubs in the area, find out what they do and work out if there a way to bring new members and be active.

Philip Hosey, MI0MSO

Region 8. I wish to begin by thanking those who have nominated me for the position of RSGB Manager for Region 8. I will make myself available to all clubs and amateurs in the Region to represent them at local and national level. I will continue to promote and champion the service that amateur radio provides to the whole community. I will represent radio amateurs honestly and strive to develop the Society and its Membership in the widest context while respecting the opinions of all.

Tom O'Reilly, G0NSY

Region 9. I am currently RSGB DRM 91. My interests in communications started by listening to worldwide radio stations and the versions of news events reported and the political versions broadcast in many languages. I have been an RSGB Member since I became G1NSY. I then joined Hillingdon ARS and then The Radio Society of Harrow with whom I passed the Morse test and became G0NSY.

James Stevenson, G0EJQ

Region 13. Through a planned programme of regular club visits, coordinated with the respective DRMs, I intend to make myself known to as many Members as possible. My aim will be to encourage amateurs in my Region to join the RSGB, send welcoming letters to new Members and to advise them of what the RSGB in general, and me and my team in particular, can do help them with any amateur radio related problems and to support them in their radio activities.

SDRPlay

PHOTO 1: The SDRPlay RSP is impressive for what it does, not what it looks like.

The SDRPlay Receive Spectrum Processor has recently been reduced in price. But just what does this equipment have to offer?

When the SDRPlay Receive Spectrum Processor (RSP) first appeared, the manufacturers were hoping to be able to reduce the price of future models if there were sufficient sales volumes. True to their word, SDRPlay has been reduced from its original £175 to the current price of just £118.80 including VAT at 20%. The SDRPlay RSP has also benefitted from a control software upgrade that removes the previous spectrum gap and provides continuous coverage from 100kHz through to 2GHz with up to 8MHz of I/Q bandwidth and 12-bit analogue to digital converters (ADC).

Setting up

The SDRPlay RSP is supplied nicely packaged with just the receiver hardware and no interconnecting leads. The lack of leads is not really a problem as most of us are inundated with USB leads – I'm sure they breed when you keep them in a drawer! The computer connection requires a single USB-A to USB-B lead. This carries the DC power for the SDRPlay RSP as well as the I/Q and receiver control data. Due to the high data rates you will need to use a USB 2.0 or faster port. The original SDRPlay RSP used an F type connector for the antenna but the new model now uses a more convenient 50Ω SMA connector. Given the very wide frequency range of the SDRPlay, most installations will need some form of external antenna switching so you will need to budget for that.

Before connecting SDRPlay RSP to the PC, there were a few preliminary steps that needed to be completed. The setup process was very well documented using a simple, step-by-step process on the SDRPlay website. The first stage was to make sure my Windows 7 installation was up to date. This was followed by downloading the appropriate SDRPlay RSP drivers. This stage also doubled as product registration as I had to enter my name and SDRPlay RSP serial number before I could download the files.

The next step in the process was to select the SDR receiver software. There are currently three choices, *SDR Sharp*, *HDSDR* and *SDR-Console*. These were all available via links on the SDRPlay website. I wanted to use all three packages so I also had to download a plugin for *SDR Sharp* and an EXTIO DLL (Dynamic Link Library) file for *HDSDR*. *SDR-Console* has fully integrated SDRPlay RSP support so I just had to install the program. The purpose of the plugin and EXTIO file is to translate the SDR software commands into the appropriate commands for the hardware, ie change frequency, I/Q bandwidth, etc. As you will see later, the SDRPlay RSP gives the user access to a wide range of hardware adjustments and the plugins provide access to these adjustments via the SDR software. Once each installation completed, I was presented with a page providing links to further help, which included a dedicated SDRPlay forum as well as their Twitter and Facebook links.

When all the software and plugins were installed, I connected the SDRPlay RSP unit. Windows recognised it and installed the appropriate driver so I was ready to start.

Inside story

The SDRPlay RSP employs two Mirics SDR devices to provide its wide frequency coverage, see **Figure 1**. The first stage uses the Mirics MSi001 tuner chip that was originally designed for use in broadcast radio and TV receivers covering all bands from LF to UHF. This same chip is used in the FUNcube Dongle Pro+ and the CommRadio CR1, so it has a good pedigree. Although the MSi001 is digitally controlled, it is actually an analogue tuner that uses conventional mixing techniques to produce baseband or low IF analogue I/Q outputs. Starting from the antenna input, the range from 0-60MHz is fed via RF switches and filters to the AM port of the MSi001. This 0-60MHz range is split into three filter banks (0-12MHz,

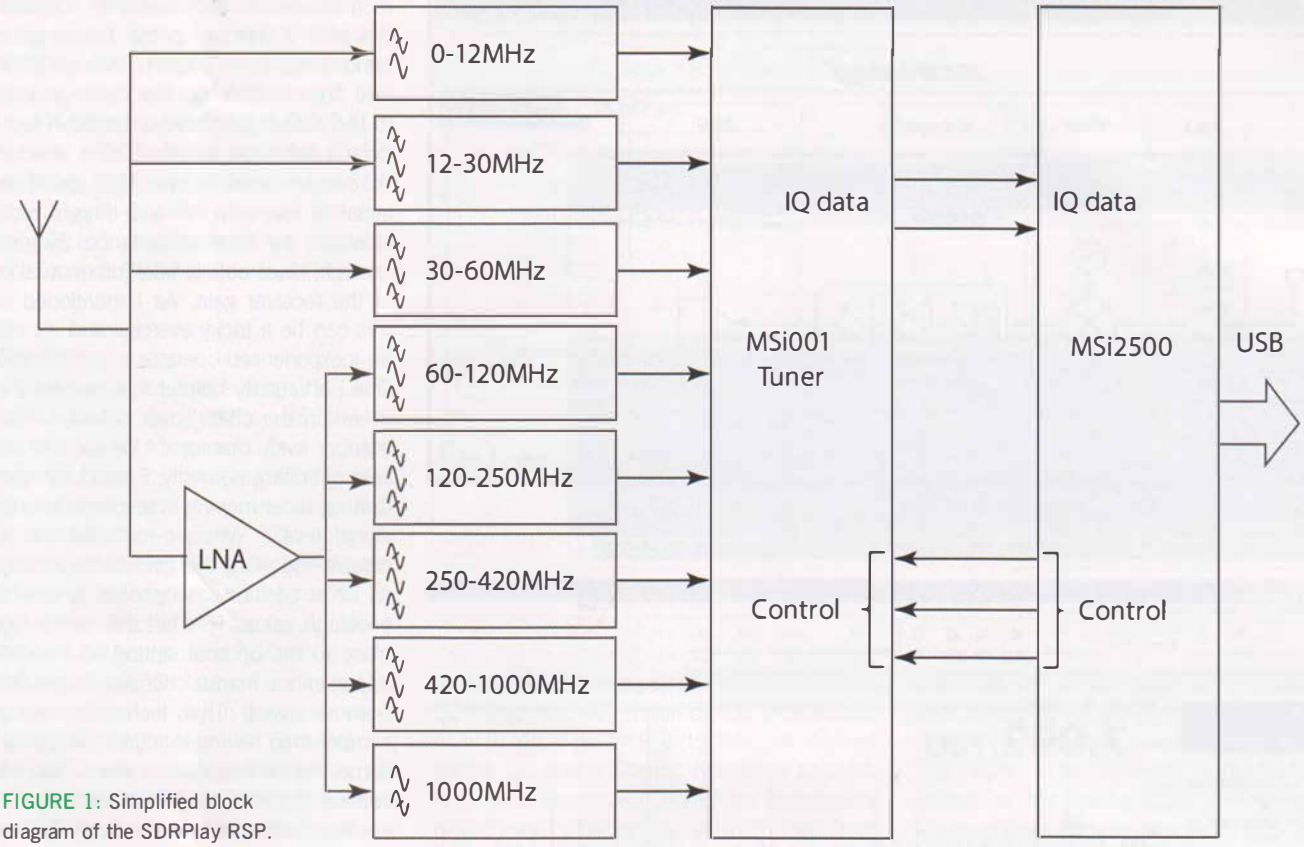

FIGURE 1: Simplified block diagram of the SDRPlay RSP.

12-30MHz and 30-60MHz). Frequencies above 60MHz are routed via a GaAs MMIC low noise amplifier (LNA) that can be set to provide up to 20dB of gain. The LNA is followed by further RF switches that route the signal to a bank of five filters for 60-120MHz, 120-250MHz, 250-420MHz, 420-1000MHz and a 1000MHz high-pass filter. These filtered bands are applied to appropriate inputs on the MSi001 tuner chip.

The analogue I/Q outputs from the tuner are applied to a Mirics MSi2500, which contains a microcontroller, clock oscillator, frequency synthesiser, USB controller, DSP processor and the all-important ADCs. The MSi2500 produces 12-bit digital I/Q samples that are passed via the on-board digital signal processor (DSP) to the USB controller for transmission to the PC. The microcontroller also manages the SPI communications link that's used to control the filter switching and a number of other receive parameters.

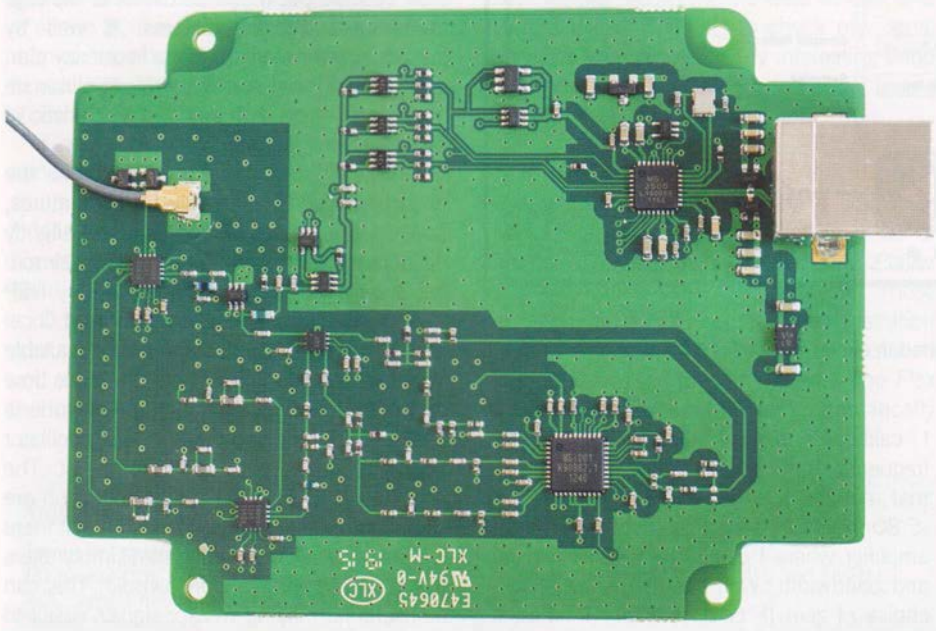

PHOTO 2: The tiny components inside the SDRPlay RSP form an extremely versatile and useful SDR receiver. On the left is the low noise amplifier; bottom right is the MSI001 SDR 'brain' and top right is the USB interface.

Receiver control interface

The SDRPlay RSP features a detailed control interface similar to that available with other SDR hardware. Although it's great to have access to the additional controls, they need to be used with care or you can compromise the receive performance. If you do lose your way, the interface has a useful Load Defaults button that will restore the factory settings.

Let's have a closer look at what's provided. I've shown a screen shot, **Figure 2**, of the control panel provided by the EXTIO DLL file used with *HDSDR* as this is the only software that provides access to all the SDRPlay's features. The first point to get to grips with is the SDRPlay RSP gain adjustments as they are all based around gain reduction. The assumption is that the receiver starts at maximum gain and gain reduction is applied to different stages in order to obtain the best

Mike Richards, G4WNC
mike@photobyte.org

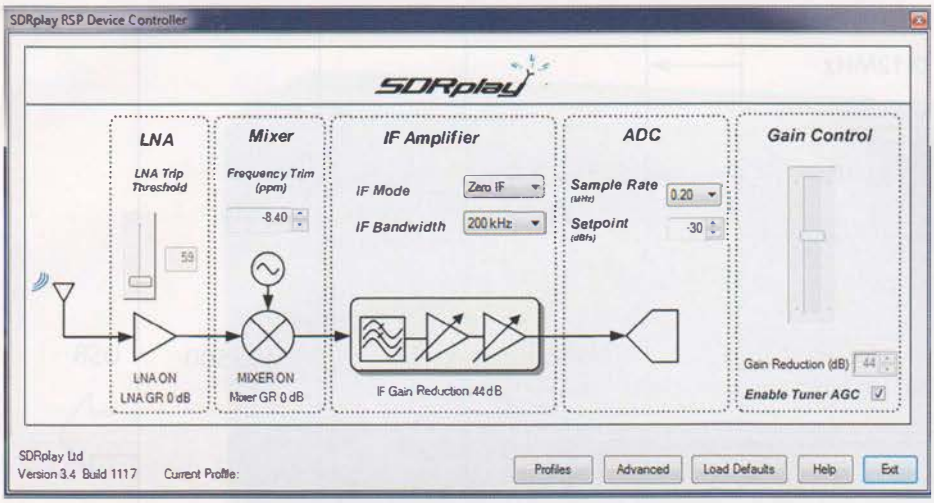

FIGURE 2: SDRPlay RSP control panel in *HDSDR*.

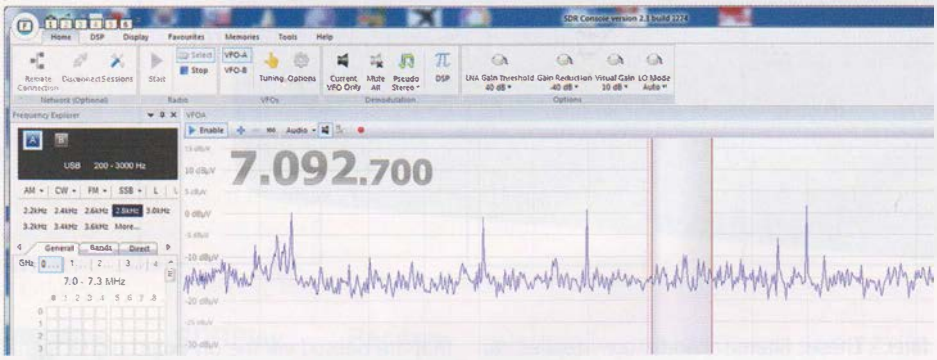

FIGURE 3: SDRPlay RSP controls integrated into *SDR-Console*.

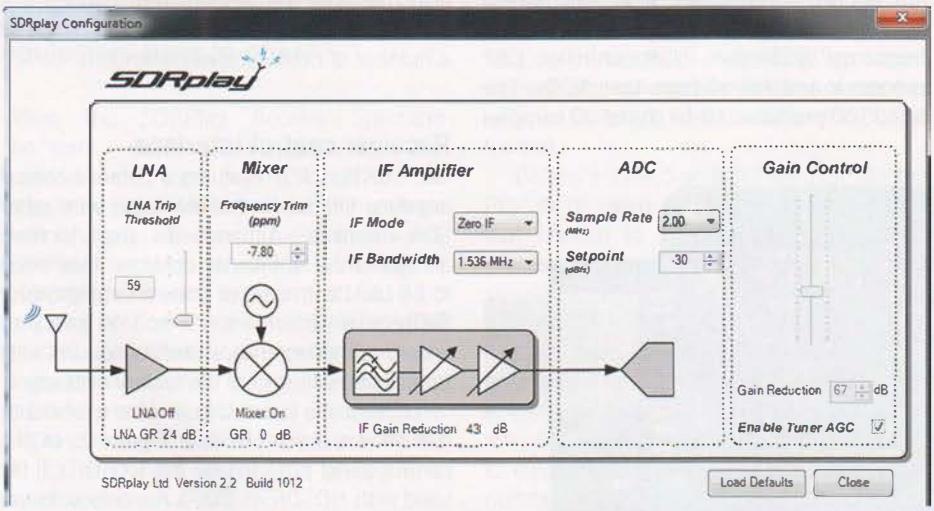

FIGURE 4: The SDRPlay RSP controls as they appeared in earlier versions of *SDR Sharp*.

overall performance. It might seem a bit odd at first but it does provide an effective way to manage the AGC.

Starting from the left, the first section contains the LNA trip threshold that sets the amount of overall receiver gain reduction before the LNA is switched out. Next comes the mixer stage where I was able to trim the frequency of the reference oscillator to get the tuning spot-on. For the review model, I calibrated against the RWM standard frequency transmission on 9.996MHz and that required a very small correction of just -5.80 ppm. The next section was the IF amplifier where I could choose the IF mode and bandwidth. With the IF mode, I had a choice of zero IF or one of four IF presets. Whilst the low IF has the benefit of avoiding the central spike that's common to all zero IF receivers, it also restricts the I/Q bandwidth to a maximum of 1.536MHz. Changing to the zero IF opens up the full range of I/Q bandwidths from 200kHz through to 8MHz. The final section, on the right, gave access to the overall gain control for SDRPlay. In its default state, the tuner's AGC is selected and the receiver uses its own AGC algorithm with separate loops for RF and IF gain reduction to obtain the best performance. By removing the tick, I was able to take full manual control of the receiver gain. As I mentioned earlier, this can be a tricky exercise and it's easy for an inexperienced operator to get in a muddle. One particularly helpful feature was the way in which the changeover between AGC and manual was managed. When the receiver was operating normally, I could see the Gain Control slider moving in response to changing signal levels. When I removed the tick to disable the AGC, the gain slider remained in its latest position, as opposed to reverting to a default value. This left the receiver gain at close to the optimal setting so I could then apply minor manual tweaks to get the best from a signal. That technique was much simpler than having to adjust everything from some nominal default value. The *HDSDR* version of the control interface has a couple of useful extras that are not currently available in the other SDR systems. The first was the facility to save receiver configuration settings as Profiles that could be recalled at a later date. Using this system, I could optimise the SDRPlay's settings for a particular band and antenna combination and then recall the same settings with a couple of mouse clicks. The second bonus was the Advanced section that gave me access to the receiver's local oscillator plan and DC offset compensation. Access to the local oscillator plan might seem a bit obscure but it can be useful to manage troublesome image problems. It was by customising the local oscillator frequency plan that the SDRPlay team were able to eliminate the coverage gap that was a characteristic of the early SDRPlay RSP firmware.

Whilst *HDSDR* provides access to the widest range of SDRPlay RSP features, *SDR-Console* and *SDR Sharp* offer a slightly different range of controls. With *SDR-Console* (v2.3 build 2274), control of SDRPlay RSP is fully integrated and the gain and local oscillator plan adjustments are available from the Home tab, see **Figure 3**. At the time of writing, *SDR-Console* did not include a control to trim the DRPlay RSP local oscillator frequency but this is on the to-do list. The LNA threshold and overall gain reduction are similar to the other implementations but there is a new Visual Gain setting that simply alters the displayed level in *SDR-console*. This can be useful for making weaker signals easier to view. The final SDRPlay RSP control was the selection of local oscillator plans as found in the *HDSDR*.

The situation with *SDR Sharp* has changed with the latest build, v1.0.0.1430 and the SDRPlay RSP plugin no longer works. However, I keep copies of downloaded files so I had a previous version (v1.0.0.1410) that I could use for the review. I've shown the SDRPlay RSP control panel from *SDR Sharp* in **Figure 4** where you can see that all the gain reduction controls are available plus the local oscillator frequency trimming.

On the air

With continuous coverage from 100kHz through to 2GHz, the SDRPlay RSP has a myriad of uses in the shack. As a general coverage receiver it works remarkably well with a sensitivity and dynamic range that easily exceeds the popular RTL dongles. As with most wide range receivers, the band filtering is fairly broad so I had to be mindful of the effect of any strong signals in the passband. The included AGC did a good job of preventing ADC overload and was able to cope with 40m activity in the presence of very strong broadcast signals. These strong signals did cause some desensitisation but that is to be expected. Detailed specifications of the SDRPlay's chipset can be found on the SDRPlay site and its on-air performance was certainly very good. The ability to select I/Q bandwidths of up to 8MHz is particularly useful. For the HF bands I generally use narrower bandwidths as 8MHz of HF bandwidth contains far too much information to be very useful. For me, the best technique is to adjust the I/Q bandwidth to be around the same as the band segment I'm monitoring. For example, when working on 20m, I set the SDRPlay RSP to a 600kHz bandwidth. The panoramic display then gives me sight of all the 20m activity and, on a decent sized monitor, you can use the waterfall display to recognise the different types of signal, as shown in **Figure 5**.

Moving on to VHF/UHF, the wider I/Q bandwidths become extremely useful for spotting activity. With a 2MHz setting on 144MHz you can monitor the entire band. Similarly, you can see most of the 70cm band with the 8MHz I/Q setting.

One other popular use for SDRs is as a panoramic display for your main rig. For this you need an IF output from somewhere near the front end of the rig's receive section. The amount of spectrum you can observe with an SDR depends very much on the architecture of your rig. The trick is to take an IF feed before too much filtering has been applied. A Google search will reveal an assortment of techniques for extracting an IF feed from most popular rigs.

I generally prefer to operate with an SDR connected to a separate antenna and my favourite is the Wellbrook ALA1530+ Imperium loop antenna. This is a very compact antenna with excellent performance from 50kHz through to 30MHz. By using SDRPlay RSP with an external antenna I can use it as an off-air monitor of my own signal whilst also monitoring band activity. As an added bonus, all the SDR packages listed here let me record the I/Q data to disk and I often use that facility to check my signal and to keep a record of any interesting band activity.

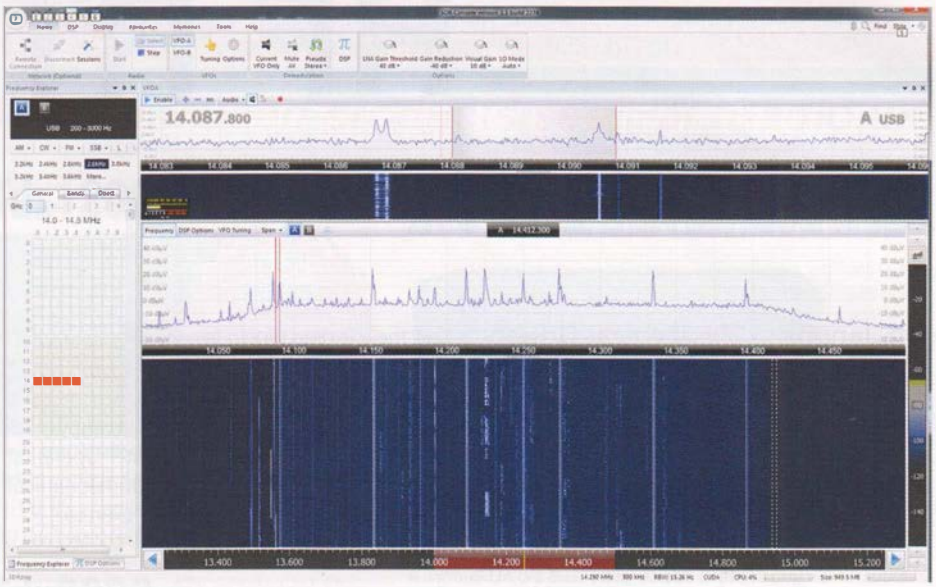

FIGURE 5: Example of 20m activity shown by the SDRPlay RSP running in *SDR-Console*.

Bonus software

The team at SDRPlay include a couple of Mirics software packages that may be of interest. They are the *FlexTV FMDAB Player* and the Mirics *SDR Tools* software. These are intended as development/demonstration tools so no support is offered. I installed and used both of these programs. The *Flex* player worked well for me and automatically searched out all the local DAB multiplexes and presented a simple program list so I could find and tune to stations very easily. The SDR tools software provides direct access to the configurable settings of the Mirics chipset and are only likely to be of use to those that are designing or experimenting with this chipset.

Summary

The SDRPlay RSP is an extremely versatile and useful SDR receiver that has a multitude of uses around the shack. The performance was a good step up from the RTL dongles and the wide and variable I/Q bandwidth was a particularly useful feature. Like many SDR hardware systems, SDRPlay RSP relies on the support of third party software developers but I know that the team at SDRPlay have been working closely with the developers to ensure continuing support. The SDRPlay RSP is available direct from the SDRPlay online shop at www.sdrplay.com priced at £118.80 inclusive of VAT at 20%. My thanks to SDRPlay for the load of the review model.

Stop press: As this article was going to print, the SDRPlay team launched a new EXTIO plugin and API for the SDRPlay. Version 1.8.0 includes an improved gain map and automatic, post tuner, DC offset correction and I/Q compensation. This almost completely eliminates the DC centre spike and reduces in-band images that can occur in the presence of strong signals. The increased IF gain control plus the facility to disable the LNA provide vital additional controls for dealing with strong signals. The new EXTIO and API are available for download from www.sdrplay.com

TABLE 1: Specification extract.

Frequency range	100kHz to 2GHz continuous
I/Q bandwidths	200kHz, 300kHz, 600kHz, 1.536MHz, 5MHz, 6MHz, 7MHz and 8MHz
ADC sample frequency	2MSPS to 10.66MSPS
Typical Noise Figure	12.0dB at 10MHz, 4.5dB at 100MHz, 3.5dB at 600MHz, 4.0dB at 1800MHz
Antenna connection	SMA 50Ω
USB	USB 2.0 type B

The BARTG HF RTTY Contest

In January 1965 the first British Amateur Radio Teledata Group's HF RTTY Contest was announced. It has taken place on the same weekend in March ever since, but it's not just technology that has changed over that time, even the Group's name has. Here is some of its history and growth.

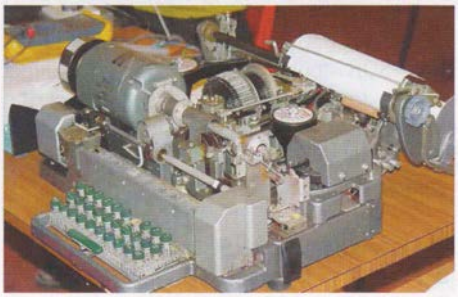

PHOTO 1: A Creed 7B teleprinter. Only a couple of hundred moving parts.

BARTG President (and Contest Manager from 1990 to 2014) John, GW4SKA explains; "RTTY had been used in Great Britain since 1954, becoming more popular as surplus teleprinters became available. Other countries were still catching up. In 1965, Swedish amateurs were allowed to use RTTY on 80m and the first activity was reported from Hungary.

"The first BARTG HF Contest attracted 68 logs and was won by Jean, FG7XT who worked nineteen countries in five continents for a score of 45,000 points. Many logs came from North America, where RTTY was more common than in Britain.

"A notable entry in that first contest was from Roger, G3LDI who is now Chairman of BARTG and still a keen contester. Roger was to have some difficulties in the 1966 contest, as teleprinters often suffered problems. Much adjustment was needed with feeler gauges and spring tension gauges; settings changed as machines got hot and pre-punched CQ tapes got torn." A typical teleprinter of the time was the Creed 7B (**Photo 1**). They were big, heavy, noisy (unless you had a silence cover fitted, which made them even bigger), and the 7B didn't include a paper tape punch or tape reader for what these days we would call macros. Moreover they needed a separate modem and an 80-0-80V power supply as well as mains electricity to operate. Operating on RTTY in the days of electromechanical equipment was far from a trivial exercise!

Computers take over

"By 1975 the winning score was up to 222,000 points and another well known RTTY contester, Mike, K4GMH was in the results. By the mid eighties the number of entries started to rapidly increase, due to the arrival of affordable home computers." These included the Commodore Pet and Sinclair ZX Spectrum, for which RTTY programs were specifically written. "Participation grew and in 1990 Frank, W3LPL won the single operator section with the first score of over a million points. By 1993 many of the logs were computer generated from logging software such as from WF1B, though log checking and scoring still had to be done manually by the contest manager." It was, after all, still before the days that many people had access to the internet, so entries would have been posted, not emailed or submitted to a website robot.

"Over the next ten years the BARTG contest steadily increased in popularity and size. 1998 saw more than 1000 stations active in the test, rising to over 1500 by 2000. Conditions were outstanding in the 2000 contest, with Don, AA5AU and Ron, K5DJ setting a new multi-op record of over 4 million points. After reaching their first target of 2 million, they just kept raising the target and pushing! A new 'expert' class was introduced in 2001, with the aim of separating the SO2R stations from the smaller ones. This works by enforcing a band change limitation, effectively removing the 2-radio guys from the normal SOAB class.

"In 2006 a new 6-hour class was introduced, which helped the number of entries go above 650. By now many of the logs were in Cabrillo format, which allowed much better checking and scoring. Manual checking of logs (now up to 750) was finally ended in 2014, with the introduction of automated reception and scoring software.

2015 saw around 800 logs received and over 3000 stations taking part in the longest running RTTY contest of them all, the BARTG HF RTTY Contest. Despite that, at least one station is still using a mechanical teleprinter!"

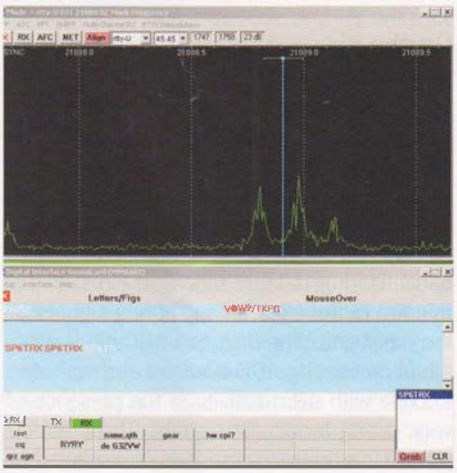

PHOTO 2: *MMVARI* screen, while receiving RTTY.

RTTY contesting today

So how difficult is it to get going on RTTY these days? The short answer is that it's very, very easy. Modern personal computers contain a sound card, so that's the modem taken care of. There are plenty of software packages that can be downloaded, such as *MMTTY*, *MMVARI* (**Photo 2**), *2Tone*, *TrueTTY* and *Ham Radio Deluxe*. Any of those plus an audio patch lead between your computer and transceiver should have you up and running on AFSK RTTY in no time. There are also several standalone datamodes controllers available. If you check the band plans for the RTTY parts of the bands you should be able to hear stations any time a band is open.

Make a note of the date and time of the BARTG HF Contest in your diary (0200 on 19 March to 0200 on the 21st), check the rules on the BARTG website and decide which section you want to enter, then get on and see what you can work. You might be pleasantly surprised at the results. Finally, please don't forget to submit an entry, even if you only make a few QSOs.

Steve White, G3ZVW
steve.g3zvw@gmail.com

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A practical easy to use Dual Bander with remote head.

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Latest 2/70 D-Star Touch Screen Transceiver from Icom. Bluetooth connectivity and second station control through an Android device.

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Rugged Alloy Case

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HUSTLER

Hustler are one of America's oldest manufacturers of Ham Radio antennas. The famous "White Whips" have been seen on many cars operating HF mobile. Their HF base range of 4, 5 or 6-BTV antennas are probably the easiest to assemble and get going and of course are ground mounted, operating with just an earth spike mounted close to the base.

See web for full listing!

Base Station Range
Free standing, max 7.3m tall, 1kW

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The full mobile and base range and accessories available from stock, including the high power 1kW mobile range.

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This tool prepares RG-8, RG-213, 9913F7, LMR-400 (not LMR-400UF) and other similar size coax cable for installation of a PL-259 connector - or DXE-N1001S two-piece Type N connector (requires a slight additional trimming of the cable center conductor length).

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Watching ARDF competition on YouTube

Videos on YouTube are now a popular way of conveying ideas and techniques. Amateur Radio Direction Finding is no exception and in his YouTube offering, Andrew, G4KWQ gives an overview of what to expect in an ARDF competition.

Screen shot from Andrew's short video showing him taking a bearing.

The URL for Andrew's video is www.youtube.com/watch?v=whTb5BoQrjw In it he explains the basic concept of the classic ARDF competition using the IARU rules and then goes on to show how the competitor builds up a mental picture of the approximate transmitter locations as he or she moves through the area. The video shows the importance of taking VHF bearings from an elevated location in order to reduce the adverse effects of multi-path propagation. In the video he is using a receiver with an audio S-meter that gives a higher pitched tone as the signal strength increases. Using a thumb compass and knowing where he is on the map, he plots approximate bearings freehand on the map. At VHF, the bearings are subject to this order of inaccuracy anyway, so the approach is adequate and time efficient.

The video focuses on just two transmitters out of the total of five that would normally be deployed and shows how he, initially, concentrates on the loudest of the two signals since that transmitter is probably closer to the start. When he stops to take a bearing, notice that he does this at a track crossing giving him more directions in which he can then run after getting the new information from an updated bearing.

Andrew is seen building up information about the location of transmitter 1 as he closes down on transmitter 2. When transmitter 2 'fires up' with a strong signal, he then tries to run it down while it is on the air. This calls for a short burst of physical activity to make the most of the 60 second long transmission. The tone from his audio S-meter gets higher and higher as he approaches the transmitter until he spots the orange and white marker placed at the transmitter location.

At competition speed it is quite normal for competitors to return having located all the transmitters without actually setting eyes on any one of the actual transmitters but only the co-located markers. Andrew uses electronic 'punching' at the transmitter to prove that he has visited the site. The electronic box at the transmitter 'writes' its identity and the time to the chip that Andrew carries attached to his finger and this data is downloaded at the end to give not just the total time taken and the identity of the transmitters visited, but also a complete set of split times for the time taken between each of the transmitters.

For a full set of five transmitters the process is repeated three more times. In reality by the time the second transmitter is located the competitor will have a fair idea of the location of the remaining three from bearings taken earlier.

Other videos

ARDF is very strong in Eastern Europe and there are plenty of videos in Russian, Bulgarian, Serbo-Croat etc on YouTube but there are couple of others you might like to watch if Andrew's video has sparked an interest with you.

Gary, KN4AQ of the US based 'Amateur Radio Video News' has posted a professional grade video he made of the 2006 US ARDF Championships in North Carolina. This is a 40 minute epic and you might spot some of the three Brits who travelled over there for the event. There is a six minute pre-view at www.youtube.com/watch?v=UPLWCc_rDqk or to watch the full version that has recently been made freely available then go to www.youtube.com/watch?v=y-tLH0Hz08g

There is not a great deal about technique and tactics but there is a lot about the general feel of the competition that took place in the William B Umstead State Park at Raleigh North Carolina.

The Russian video is also very professionally produced. It has a rather unusual introduction but otherwise is interesting and good to see plenty of young people taking part.

The URL for this 11 minute video is www.youtube.com/watch?v=tl4HztSY8Mo

Support and loan equipment

If watching one or more of these videos inspires you to want to try ARDF go to the RSGB website (radio sport>ardf>events) for more information. DF receivers are available on loan but please contact the event organiser beforehand to ensure that one is brought to the event for your use!

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Antennas

Although many factors can affect an antenna's installation at a given location, a key consideration is the physical space available because this influences the actual size of the antenna. Therefore, this month's Antennas column examines a shorter G5RV derivative and summarises the magnetic loop antenna made by John Corkett, M0XXF.

PHOTO 1: Mast mounted dipole centre.

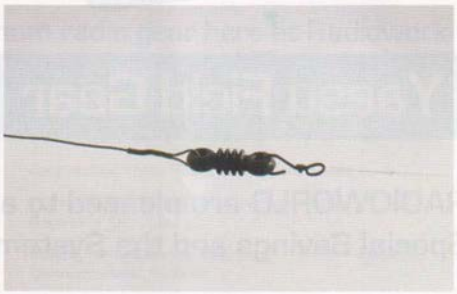

PHOTO 2: Wire span end termination.

The G5RV antenna revisited

The G5RV antenna [1] remains a popular HF bands antenna widely used by radio amateurs around the globe. This antenna was devised by Louis Varney, G5RV around 1946 when he was looking for a solution to getting his station back on the air following the restoration of amateur transmitting licenses. One of Louis' interests was operating on 20m and his design was based on this requirement.

A G5RV antenna is often thought of as a wire span of 31.1m (102ft) long that is centrally fed using about 10.34m (34ft) of ladder line cable. This configuration is often referred to as the 'full-size G5RV' and covers the bands from 80m to 10m. Another version of the antenna is the 'half-size' G5RV, where the wire span's length is 15.55m (51ft) and is centrally fed using about 5.17m (17ft) of ladder line cable and covers the bands from 40m to 10m.

The G5RV design is based on a wire span that is three electrical half wavelengths long at a desired frequency, centrally fed by a balanced line that is half an electrical wavelength long at the same frequency [2]. Using the units G5RV worked in, the length of the wire span (allowing for the velocity factor) is given by:

length (ft) = 492x(n-0.05)/f(MHz).

For the full-size G5RV, where f = 14.15MHz and n = 3 half wavelengths, this gives:

length (ft) = 492x(3-0.05)/14.15MHz

= 102.57ft (31.26m).

In the interests of keeping things straightforward and since the whole system is brought into resonance using an aerial tuning unit (ATU), the antenna's wire span is cut to 102ft (31.1m).

The length of the air spaced ladder line feeder (in feet) at 14.15MHz (using a 0.98 velocity factor) is (0.98)x(492/14.15MHz) = 34ft (10.34m).

The wire span's centre impedance at 14.15MHz is about 100Ω and the half wavelength ladder line acts as a 1:1 impedance transformer, presenting this impedance at its end. Therefore, if a 50Ω feeder cable is connected to the ladder line there will be a mismatch, however this will be low (about 2:1) and well within the tuning capabilities of the ATU, enabling a good match to be seen by the transceiver.

Connecting an unbalanced coaxial cable to the end of the balanced ladder line will require an arrangement to minimise common mode currents that flow on the outer of the coaxial cable's screen conductor. There are several balanced-unbalanced techniques available to overcome common mode current problems [3]. One uncomplicated method is to use a current choke made from about ten 30cm loops of the coaxial cable (held together with cable ties) and located as close to the coaxial cable's connection with the balanced ladder line as possible [4].

The calculations for the half-size G5RV are similar to the larger version outlined earlier. However, using a frequency of 28.5MHz gives a wire span of 51ft (15.55m) in length with an air-spaced ladder line of 17ft (5.16m) long.

For both the full- and half-size G5RV antennas, if other types of balanced line feeders are used the ladder line length may be different, because the line's velocity factors will be different. For example, often the length of the balanced line can reduce to typically 9.3m for the full-size G5RV and 4.65m for the half-sized G5RV antenna when other types of balanced line are used.

Both of these are still comparatively large antennas and may not fit within the space available in the average garden. However, it is possible to use the G5RV calculations to make a smaller antenna, based on 6m rather than 20m for example.

Taking 50.15MHz (6m band) as the design frequency and using the formulae described earlier,

Wire span = 492.(3-0.05)/50.15MHz

= 28.94ft (8.82m)

Feeder = (0.98).(492/50.15)

= 9.81ft (2.93m)

A prototype antenna was constructed using these dimensions using 5A-rated insulated stranded copper wire and 300Ω ladder line. The wire span was set up about 4m above the ground with a mast supporting the centre. Fishing line was attached to the wire span ends and fastened to anchor points to keep the antenna taut. The centre used for the antenna was similar to that described

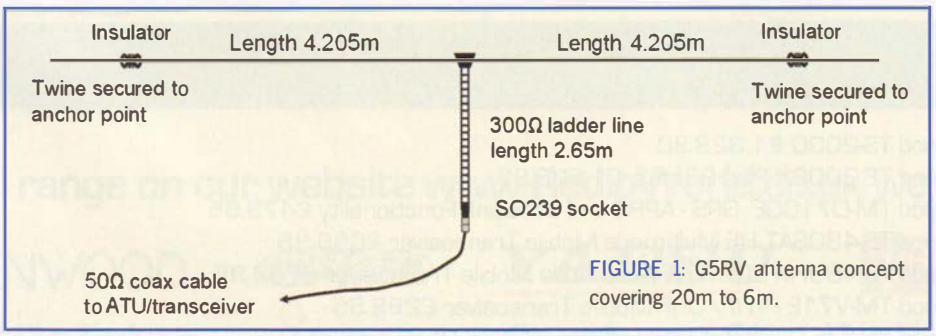

FIGURE 1: G5RV antenna concept covering 20m to 6m.

PHOTO 3: Ladder line SO259 termination.

last month [5] and made using a length of PVC. This is illustrated in **Photo 1**.

Having first signed on in CW, the antenna was tested using an RF power of about 10W at 50.155MHz and monitored using an SWR meter. About 8m of 50Ω coaxial cable was used to connect the SWR meter to the end of the antenna's ladder line, allowing the SWR meter to be situated with the transceiver in the shack.

Initially, the wire span was found to be too long and the ends were folded back on themselves by equal amounts until the lowest SWR was observed. Then dog-bone insulators were added and the ends trimmed to length and terminated as illustrated in **Photo 2**.

To further improve the match, the length of the 300Ω ladder line was trimmed about 5mm at a time until the best SWR was achieved (1.2:1). Having completed the testing, the transmissions were signed off (in CW) to close down.

These adjustments resulted in a wire span of 8.41m and a ladder line of 2.65m. **Figure 1** illustrates the antenna.

To terminate the end of the ladder line, a short length of 20mm diameter conduit was passed over the end. Then the ladder line's conductors were soldered to centre and outer of an SO239 single-hole socket. The conduit was slid back over the soldered joints and held firmly against the base of the socket using insulation tape. With the SO239 socket firmly held vertically and the ladder line extending above, sufficient epoxy resin was poured into the space between the ladder line and the conduit's interior and allowed to set, forming a waterproof joint. Once set, the insulation tape was removed. **Photo 3** illustrates this arrangement.

This G5RV derivative antenna was operated without an ATU on the 6m band using 10W SSB/CW. Many stations were worked across Europe during the Sporadic-E Season, ranging from OY9JD (Faroe Islands) to IS0DCR (Sardinia). Using an ATU to match the antenna allowed operation using 100W on the 20m, 17m, 15m, 12m and 10m bands and enabled various stations to be worked including CN8VY/PY2 (Brazil), A92IO (UAE), VA3UU (Canada), W8TIE (USA) and CO9LY (Cuba).

This antenna has a span-length of 8.41m (28ft), making it close to a quarter of the size of a full-size G5RV and allowing it to be installed in a relatively small space compared with its larger brethren. It is not really practical to use this version on 40m and 80m, however it does allow operation from 20m through to 6m.

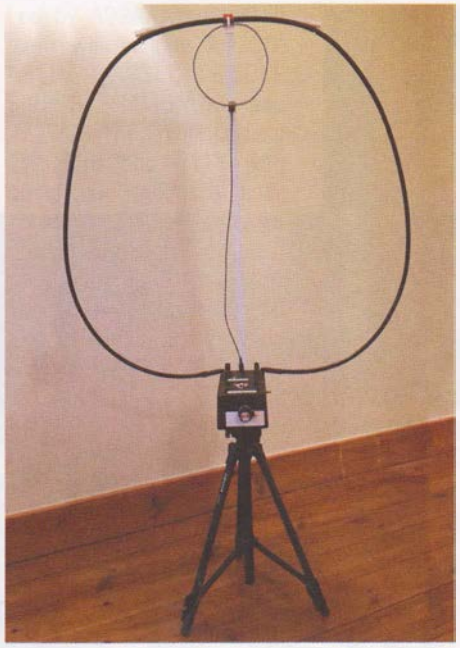

PHOTO 4: MOXXF magnetic loop based on the G4ILO design.

A homebrew magnetic loop

John Corkett, MOXXF has passed to me details of the magnetic loop he has recently made based on the G4ILO 'Wonder Loop' design [6]. John was interested in an antenna that could be readily constructed using standard tools, required a minimum of space to accommodate it and could be taken out portable as and when required.

After looking at several designs, John decided to build a magnetic loop, mainly for use on 20m. This resulted in the antenna having a primary loop diameter of about 80cm and a smaller inner loop diameter of about 16cm.

The construction of the antenna is not described in detail here, however the primary loop was made using a modified 2.5m length of RG213 coaxial cable with the outer braid forming the antenna. A short section of the inner conductor/insulation was removed at each end and the ends insulated. Then, the outer braid was drawn over the ends and a ring terminal soldered to each end.

Using a suitable plastic box to hold the antenna's tuning capacitor, pillar-terminals were added to the outside to enable the primary loop to be connected. Internally, the pillar-terminals' ends were connected to the capacitor's terminals using heavier gauge insulated wire (able to cope with about 20 amps), with these terminations soldered.

The inner loop carries a lower current compared to the primary loop and was made from 5A rated copper single core insulated wire. This loop was connected to a length of RG-174 50Ω coaxial cable that was run through the plastic box and terminated on a BNC socket mounted on the side. This arrangement allowed the antenna to be connected to the transceiver using a convenient length of coaxial cable.

A central support was added made from white plastic conduit to support the primary loop and inner loop that were hung from a plastic hook.

For ease of portability, the antenna was attached to a camera tripod as illustrated in **Photo 4**. A length of RG-58 coaxial cable was used to connect the antenna to the transceiver. This arrangement ensured that the operator and the transceiver were at a suitable distance from the antenna when in transmit mode.

A heavier duty air-spaced tuning capacitor was used for the antenna and this handled CW RF signals up to 20W on 20m and 17m during testing. With the antenna tuned, LY3X was the first station to be worked, on 17m, using 10W of SSB.

John made numerous contacts on 20m from his QTH near Portsmouth in the first three months using the antenna, primarily running PSK31. Contacts made range from RV6AFG (in the east) to ISOFDW (in the south), SM5ML (in the north) to CT4RC (in the south west).

John's magnetic loop is a fine example of how homebrewed equipment can achieve great results while being built using standard tools and a good soldering iron. The physical size of this HF antenna means that the space required to set it up is not really an issue.

References

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[3] *Radio Communication Handbook 12th edition*, edited by Mike Dennison, G3XDV and Mike Browne, G3DIH. Section 14, Transmission Lines, pages 14.12 to 14.17, Peter Dodd, G3LDO

[4] *Radio Communication Handbook 12th edition*, Section 15, Practical HF Antennas, pages 15.8 to 15.9, Peter Dodd, G3LDO

[5] *RadCom* February 2016, Antennas, pages 30 to 31

[6] The G4ILO Wonder Loop, www.g4ilo.com/wonder-loop.html, Julian Moss, G4ILO

Mike Parkin, G0JMI
email2mikeparkin@gmail.com

HF

Conditions were reasonable in January. Solar flux numbers kept above 100 and there were only a few days when K was 5 or higher.

3D2AG in his shack on Rotuma.

It was a busy month for DXpeditions, beginning with ZL9A from the new IOTA (and rare DXCC entity) Antipodes Island. Signal strengths were good and pileups not too big. Propagation to the UK was helped by the phenomenon of antipodal focussing where signals emitted from the opposite point on the globe converge on your QTH from all directions. Were the ionosphere equally good in all directions then beams would not be needed, but in practice some paths are closed so directional antennas do help. The 4-man team led by VE3LYC with VK5CE, SQ8X & KD1CT made 8650 QSOs and contacted over 130 different UK stations.

The K5P operation from Palmyra Island south of Hawaii was a bit of a disappointment as the team of 9 operators managed only 11% of their 75,000 QSOs with European stations. This was perhaps to be expected as the short path over the North Pole is very poor in January, and the short and long paths both cross the auroral zones so are easily disrupted by even minor geomagnetic disturbances of which there were several during the expedition. The best times seem to have been around 1700-1800UTC on 20m, and 1600-1700UTC on 30m and 40m. The morning short path opening on 20m never materialised and there were no UK QSOs on 160m or on 15m and up. The leading UK stations were G3XHZ and G8DX with 9 band/mode slots.

Down in Antarctica, the Intrepid DX Group members more than lived up to their name with their activation of the South Sandwich Islands as VP8STI. The path due south from the UK is a good one and QSOs were made on all bands from 160 to 10m. 55% of the 55,000 VP8STI QSOs were with Europe and leading UK stations had around 17 band/mode slots. It was the turn of Asian stations to be frustrated by propagation as only 7% of QSOs were made with them. The team's CW operators were noted many times on the cluster for their efficient working of the pile-ups. Activity on the final day was disrupted by a storm that wrecked antennas and tents and then by an emergency evacuation to the ship when ice threatened to block the bay. Equipment was safely recovered the following day and the team pressed on to the vicinity of the old whaling station at Husvik on South Georgia from where they are QRV as I write.

Another Pacific rarity was activated in January by Antoine, 3D2AG who was QRV from the island of Rotuma – a separate DXCC entity from the main islands of Fiji. Antoine made 8,000 QSOs on a variety of modes. I hadn't realised that the 3D2R DXpedition in 2011 trained some operators at the local school and that a club call 3D2RI was QRV for a few years. Sadly the expertise there has been lost so Antoine collected and answered the outstanding direct QSL requests. He reports that efforts are being made to revive interest at the school.

These DXpeditions revealed the darker side of European pile-ups with huge numbers of stations continuing to call even after a DX operator had gone back to a completely different callsign. On CW there is little excuse as, with full or semi break-in capability, people should generally be able to stop calling immediately the DX transmits as he won't be calling them if they are still in mid-call. The other side of the coin was that I often heard the DXpedition ops calling someone two or three times before getting a reply. This really slowed things down as did those who repeated their callsigns and sent something like "UR RST 599 599 VY 73 DE ....." instead of "5NN TU" which was all that was needed.

Deliberate QRM on the DX frequencies was a problem at times and I am still hoping that one day a few of the European government monitoring stations will combine forces to convict the worst offenders. In the meantime my advice is to completely ignore any QRM and if necessary try another band or mode. If they get no reaction to their antics most of the QRMers quickly give up.

The Northern California DX Foundation beacon at KH6RS in Hawaii has recently been repaired so I would be very interested in any reports of it being heard over the next few months – particularly long path on the higher HF bands around 0900UTC. Check www.ncdxf.org/beacon/beaconschedule.html for more information about the full set of beacons with their timings and frequencies.

There are a number of DX events in the next few months including the GMDX Convention in Stirling (9 April), and the Visalia DX Convention (15-17 April).

DXpeditions

A UK team of 5 operators (G0VJG, M0TGV, G4FAL, G4LDL and GM0WED) will be QRV from Botswana as A25UK from 13-28 April on 160-10m SSB, CW and RTTY. They will have linears, beams and a 40m 4-square.

Bruno, HB9BEI is expecting to be QRV holiday style from Sao Tome and Principe from 25 February to 25 March as S9BK on SSB and digital modes. His plans call for Sao Tome (AF-023) from 25 February to 7 March then Principe (AF-044) from 7-12 March, returning to Sao Tome from 12-25 March. He'll be running high power into a folding hexbeam or a dipole.

A Norwegian team including LB2TB,

LB1GB, LA9DFA, and LA7GNA, plans to be QRV from the Cocos Keeling Islands (OC-003) as VK9CK from 15-26 March. See dipperdx.com/cocos2016/

Eric, KV1J will be returning to Miquelon (NA-032) as FP/KV1J for his tenth trip to the island, from 17-29 March. He plans to be on 160-10 primarily on SSB and RTTY with some CW and other digital modes and will be active in the BARTG RTTY, Russian DX and the CQ WPX SSB contests. See www.kv1j.com/fp/mar16.html

OH2IS will be QRV as V26IS from Antigua (NA-100) from 21 February to 4 March on 7MHz and up.

LA7GIA will be QRV as 3C7GIA from Malabo Island (AF-010) from 4-13 March. He'll be active on 80-10m; with a two element beam on 10-20m, a vertical on 10-40m and an 80m dipole. See la7gia.com/3c7gia/ for more information.

Sho, JA7HMZ will be active from Pohnpei (OC-010) as V63DX from 19-24 February on 160-6m. He will sign V6A in the ARRL CW contest.

DK2AMM, DL6JGN, GM4FDM, and PA3EWP will be active as TX7EU (www.marquesas2016.de) from Nuku Hiva in the Marquesas Islands (OC-027) on 2-15 March. They will operate CW, SSB and digital modes on 40-10m with two stations and a focus on the high bands. This could be a good test for 20m long path around 1600UTC.

T32CO, T32FS, T32LJ, T32MU, T32SB, T32TR and T32WW will be active from Christmas Island (OC-024) on 1-16 March. This team of seven will operate CW, SSB and digital modes on 160-10m with four stations. T32WW will be QRV for the ARRL DX SSB Contest.

IOTA

The Bahrain Amateur Radio Group is all set to conduct the first ever activation of the Hawar Islands (AS-202) from 28 April to 1 May. Led by A92AA, the A91HI team will include A4100, A61DJ, A93LT, EI5GM, EI9FBB, MM0NDX and 7Z100. They will operate CW, SSB and RTTY with up to four stations at peak times. See A91HI.com for more information.

Herbert, DK2BR will be active from Con Son Island (AS-130) in the South China Sea as 3W2BR from 10 to 26 March. He will have 100W to a range of verticals.

VK5MAV and VK5CE will be active from Breaksea Island (OC-243) from 29 February to 3 March. They will be QRV as VK5MAV/6 (CW) and VK5CE/6 (SSB) with two stations on 40, 20, 15 and 10m. QSL via home calls. More information at oc243.blogspot.com.au.

The ZL9A team outside their shack on Antipodes Island (SQ8X, VE3LYC, KD1CT and VK5CE).

Correspondence

Last month I asked whether people preferred to see callsigns or country names in these reports. The response wasn't very big but there was a small majority in favour of callsigns – though with some clarification where a call could be used from a number of different DXCCs (as with VP8). I will therefore move more towards callsigns in future.

Tom, G4IDL spent a lot of time successfully chasing the VP8s. He found (all on CW): 12m – South Africa, Angola, Ethiopia, Laos, South Sandwich and Greenland; 15m – Antarctica, Madagascar, Ethiopia, Gabon, Kenya, and the Caribbean; 17m – Antarctica, South Sandwich, South Georgia, Sri Lanka, Rodrigues, Togo, Thailand, Greenland and the Caribbean; 20m – South Cooks, Western Sahara, Rodrigues, Gabon and Mauritius; 30m – Egypt, Bahrain & West Malaysia; 40m – Mauritius; 80m – Curacao.

Gordon, G3PXT clocked up 1500 QSOs in January and found: various short skip (or backscatter) EU stations on 10m; on 12m – Senegal; 15m – New Zealand, China, South Africa, Gabon, UAE, Qatar and the Caribbean; 17m – Rodrigues, Senegal and the Caribbean; 20m – Indonesia, Japan, Rodrigues, Surinam, and Qatar: 40m – USA, South Africa and various Middle East stations.

Peter, G3HQT was not too disappointed by his failure to find K5P on Palmyra as he worked KP6AA many years ago with a basic transmitter and BC312 receiver. He did manage a number of other DX QSOs including: on 10m CW Namibia; 12m PSK Senegal; 15m CW Rodrigues and Chile; 17m CW – West Malaysia and South Sandwich; 20m RTTY – Qatar and Indonesia; and 40m CW – Western Sahara.

Fred, G3SVK says his antennas need some maintenance but he was able to get on a couple of bands and worked: on 20m – 4J90UD, JI2AVY, 5R8UI, 3B8HC, 3B9FR and VP8STI; 40m - 6Y4K, 8P6NX, FG/UT6UD, TZ4AM, 4K4K, TR8CA, SU1SK, PJ2/K8ND, PY0F/PP1CZ, VU2PHD, VP8STI, 9J2BO, TZ4AM, RI1ANR (Antarctica), TI2OY and 4V1TL.

Thanks

As always to my correspondents, to DX-World, 425 DX News and Daily DX.

TABLE 1: 2016 Worked DXCC Entities (ranked by All). Showing Top 3 from RSGB Members table in Club Log plus submitted scores and Club Log scores of 2015 participants where available).

Call	All
G5LP	162
G3TBK	155
PJ4DX	150
G3PXT	96
G4IDL	93
G0RPM	72
G4XEX	58
CT7AGZ	51
G3HQT	48
G4CCZ	46

TABLE 2: Forthcoming DXpeditions.

Until 22 February	5V7TH
Until 22 February	K8GU in KH8
Until 28 February	Tonga A35T
Until 5 March	PZ5LP
Until 6 April	3B8/G8AFC
Until 14 April	H44MS
18 February – 4 March	3XY1T
19 – 24 February	V63DX
21 February – 4 March	V26IS
25 February – 7 March	S9BK Sao Tome
1 – 16 March	T32 ops
2 – 15 March	TX7EU
4 – 13 March	3C7GIA
7 – 12 March	S9BK Principe
10 – 26 March	3W2BR
12 – 25 March	S9BK Sao Tome
15 – 26 March	VK9CK
16 March – 8 Apr	VK0EK Heard I.
17 – 29 March	FP/KV1J
31 March – 14 Apr	Juan de Nova FT4JA
12 – 20 April	5W0XG
13 – 28 April	A25UK
23 April – 2 May	VK9NU
24 – 30 April	GS0NWM
28 April – 1 May	A91HI
22 – 29 May	GS3PYE
19 – 29 August 2016	CY9 – St Paul Island
25 Sept – 25 Oct	H40GC and H44GC

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1.8-30MHz ATU. Rated @ 1.5kW.
OUR PRICE £269.99

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500kHz-230MHz
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Case 259B £29.99

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1.8-170MHz + 70cm
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MFJ-993B 30W AUTO ATU.....£249.99
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MFJ-962D 1.5kW (metered) antenna tuner.....Sale £259.99

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For HF beams, etc. Supplied with circular display control box.
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Quality rotator for VHF/ UHF. Superb for most VHF-UHF Yagis, 3-core cable required. 3-core cable £1.50 per mtr. GS-050 stay bearing £39.99.
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YAESU FT-252

2m waterproof handie. Includes batt/chrg.
BEST BUY HANDIE
SALE £59.99

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144/430MHz Tx 5W. Rx 500kHz-1GHz (AM, FM, FMN). Includes battery/ charger.
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WOUXUN KG-UV8D

Huge blue colour display. Full duplex 144/430MHz. DTMF encode/decode. Incl's Li-Ion battery / charger.
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2m/70cm + APRS/ TNCTrue dual bander. Includes GPS unit.
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With touch screen LCD, Bluetooth connectivity. RX: 118-174MHz/375-550MHz. Dual RX (inc's GPS). SALE £479.99

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PLASTIC CAPS TO FIT ALL OUR MAST SETS

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NEW 20 FOOT SWAGED ALUMINIUM 2 INCH DIAMETER MAST SETS AS SHOWN

4 x 5 foot £59.99 — 5 x 4 foot £62.99

Any two sets £99.99

New 20 Foot 1¾" (4 x 5 foot) Swagged Mast Set: £54.99

NEW SWAGED MAST SETS

24 foot aluminium mast. 1½" – 4 sections (6ft long). **£49.99** OR 2 SETS £95.00 SALE:- 3 SETS £120

24 foot aluminium mast. 1¼" – 4 sections (6ft long). **£46.99** OR 2 SETS £92.99 SALE:- 3 SETS £120

HEAVY DUTY 30ft SWAGED MAST SET

5 sections, 2 inch x 6 foot long. Very heavy duty Aluminium.

★ STAR BUY ★ **£89.99 PER SET** (delivery £15)

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New extra heavy duty aluminium 2" mast set. 4 sections x 6 foot that slot together. **£79.99 PER SET** (delivery £15)

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18 foot (1.25 inch) (6 x 3 foot) £38.99

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CALLING ALL DIY ENTHUSIASTS

10 x 13mm diameter, 6 foot long aluminium tubes swaged at one end. (Slot together – ideal for antenna construction/repair).

13mm diameter

£4 EACH OR £30.00 FOR 10

MAST HEAD PULLEY

A simple to fit but very handy mast pulley with rope guides to avoid tangling.

(Fits up to 2" mast) **£14.99** + P&P £5.00

30m pack (4.4mm) nylon cord rope.. £15.00

Special: 50m pack (4.4mm) nylon cord £25.00
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NEW EASY FIT WALL PULLEY

Pulley will hang freely and take most rope up to 6mm. (Wall bracket not supplied).

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BARGAIN WINCH

500kg brake winch. BARGAIN PRICE

£94.99 Oel £10.00

(Now includes cable grip)

Winch wall bracket..... £22.99

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PL-259 - PL-259	1m	£16.99
PL-259 - PL-259	4m	£24.99
PL-259 - PL-259	20m	£49.99
BNC - BNC	1m	£16.99

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Heavy duty universal mount. Includes 5m cable **£39.99**

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Adjustable roof rack/window bar mount SO-239. **£19.99**

DIAMOND

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KEVLAR 3.5mm BRAID MILITARY SPEC NOW IN STOCK
Extra heavy duty (600kg bk). True Kevlar Braid. £1 per metre.

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A superb TDK 'snap fit' ferrite clamp for use in Radio/TV/ Mains/ PC/Phone etc. *Simply close shut over cables and notice the difference!* Will fit cables up to 13mm diameter. Ideal on power supply leads/mic leads/audio leads/phone leads.

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OUR MIL RG-213 IS GENUINE UK 10mm MIL SPEC COAX!

Westflex 103 x 100m £149.99

True military spec real UK coax

SALE

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HF 2V	80/40m (9m) 1kW	£319.99
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W-8010 DIAMOND SHORTENED DIPOLE

80-10m & only 19.2m long! (Up to 1.2kW) Includes 1:1 Balun. Bargain. Superb Japanese quality antenna system.

SALE **£129.99**

NEW DIAMOND BB6W

2-30MHz (250W) 6.4m long. End-fed wire antenna. Includes matching balun. Sling up & away you go.

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Amazing performance. Twin folded dipole. 2-30MHz – and it really works. No ATU required (25mts long). Supplied with 30 mtr PL-259 feeder – ready to go. If you want great transmission, look nowhere else. Japanees quality made product

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Baluns 1:1 or 4:1 or 6:1 .....£39.99 each P&P £5
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MH-31A8J 8 pin modular ..... £39.99 P&P £5
MH-48 A6J 8-pin modular (DTMF) ..... £59.99 P&P £5
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DC-4 Fits Yaesu FT-950/450/IC-7100/TS-590S/Alinco HF.. £22.99 P&P £5
DC-5 Fits Icom IC-7100, etc..... £22.99 P&P £5

QS-300

A fully adjustable deluxe desktop stand for hand-helds. Includes BNC to SO-239 lead.

£39.99. £5 p&p

QS-200

A superb, no mess, quick fit in-car holder (fits airvent) for hand-helds.

£9.99 or 2 for £15. £4 p&p.

DIAMOND YAGIS

Ready to go! No tuning required

2m/5 element	No tuning required	SO-239 (Gain: 9.1)	£47.99
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X-510N 2m/70cms (8.3/11.7db) 5.2m - N-type..... £129.00
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Del £10.00

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Diamond NR-770S (2m/70cm) 43cm (PL-259)..... £36.99
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MX-72H 144/430MHz 2 x PL-259s / 1 x SO-239 ..... £39.99
MX-72N 144/430 1 x PL-259 / 1 x N / 1 x SO-239..... £42.99
MX-72A 144/430 1 x PL-259 / 1 x N / 1 x N Sct..... £42.99
MX-62M 1.8-56MHz + 76-470MHz 2 x PL-259s / 1 x SO-239 ..... £79.99
MX-610 1.8-30MHz + 49-470MHz 2 x PL-259s / 1 x SO-239 ..... £69.99

DELUXE G5RV'S

Half size (Std) (40-10m) 55 foot..... £32.99
Half size (Deluxe) (40-10m) 55 foot..... £49.99
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Full size (Deluxe) (80-10m) 110 foot..... £59.99
In-line Choke Balun..... £39.99
Replacement Dipole Centre (open wire)..... £9.99
Replacement Dipole Centre (SO-239)..... £9.99
Replacement SO-239 to 300Ω Connector..£9.99
End Springs (pair s/s)..... £26.99
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MAX-2000

Superb vertical antenna (24ft). 3 sections. Useable from 25-30MHz (5kW PEP). 5.1dBi gain.

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NEW HB-9CV 2-ELE YAGIS

HB-6M (33 inch boom) £49.95
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COPPER ANTENNA WIRE ETC

Hard drawn (50m roll)..... £29.99 P&P £7.50
Enamelled copper wire (50m x 16 guage) ..... £24.99 P&P £7.50
Flexweave (H/duty 50m)..... £44.99 P&P £7.50
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Flexweave (PVC coated 18m) ..... £24.99 P&P £7.50
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DOUBLE THICK FERRITE RINGS

A superb quality ferrite ring with incredible properties. Ideal for "R.F.I." Width 12mm/ OD35mm. Thickness: 5mm. £4.00 each or: 6 for £18.99 or 12 for £32.99. P&P £5.00 20 for £50.00. P&P £10.50

CALLING ALL DIY ENTHUSIASTS

10 x 13mm diameter, 6 foot long aluminium tubes. Ideal for antenna construction/repair).

13mm diameter

£3 EACH OR £25.00 FOR 10

NEW POLE CONVERTERS

2 inch to 1.5 inch..... £39.99
2 inch to 1.25 inch..... £39.99
1.5 inch to 1.25 inch..... £39.99

Galvanised

METALWORK & BITS (Oel Phone)

Copper plated earth rod (4 foot) + wire clamp £19.99
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2" mast-floor base plate..... £19.99
6" stand off brackets (no U-bolts)..... £8.99
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12" T & K brackets (pair) £24.99
18" T & K brackets (pair) £28.99
24" T & K brackets (pair) £32.99
36" T & K bracked (pair) galvanised.... £46.99
U-bolts (1.5" or 2") each..... £2.00
8mm screw bolt wall fixings..... £1.80
8-nut universal clamp (2" to 2")..... £9.99
2" extra long U-bolt/clamp..... £7.49
2" crossover plate with U-bolts..... £18.99
15" long (2") sleeve joiner (1.5" also available)..... £19.99
3-way guy ring..... £9.99
4-way guy ring..... £12.99
Heavy duty guy kit (wire clamp, etc.)..... £49.99
Set of 3 heavy duty fixing spikes (~0.7m long)..... £29.99
30m pack (4.4m) 480kg B/F nylon guy..... £15.00
Roll of self-amalgamating tape 25mm x 10m..... £8.99

All our brackets are of high quality, British made and galvanised.

VHF/UHF

In stark contrast to December's riches, January was certainly a month of poor conditions and antenna systems being tied down and or assessed for storm damage.

January produced a very poor month DX wise, even though the much anticipated Quadrantids meteor shower was in evidence plus the prospect of auroral propagation. As per the meteor shower calendar on Kev, GOCHE's website, [1] the Quadrantids show a very high ZHR (Zenithal Hourly Rate) that looks appealing. However in practice the peak of the shower can be very sharp, a case of if you blink you could miss it! ON4KST Chat was alive with stations looking to set up skeds however reflections were generally not even close to 2015 that was also considered to be a poor year.

An excellent auroral opening on 20 January gave northern UK stations good DX to Scandinavia, Baltic and North European states. Once again auroral 'beacon' GM4VVX from IO78 was QRV on 144042 in CW and as always Clive was an excellent signal and worked easily from here with 25W output.

EME enthusiasts also enjoyed the REF/DUBUS EME Contest during the weekend of 23/24 January again with all the normal chat channels in operation, with emphasis on 2m operation.

On the bright side despite the poor radio and weather conditions many of the columns regular contributors are busy improving the shack end of their various systems whether that involves mopping the water from the shack to repairing waterlogged equipment and continuing home construction! This is also the situation at this QTH after a severe roof leak in the shack and equipment damage that is taking time to repair.

Band reports

Lyn, GW8JLY (IO81) confirms the poor Quadrantid MS conditions and even worse than the 2015 shower. There were some long and strong bursts but not as many as he had expected. Only 20 QSOs were completed between 2 and 4 of January with no new locators worked and no QSOs over 2000km completed either. To cap it all, the strong Aurora on 20 January didn't really reach down to Cardiff so all in all a poor month and quite disappointing. Lyn is also testing a new antenna for so looking forward to more DX.

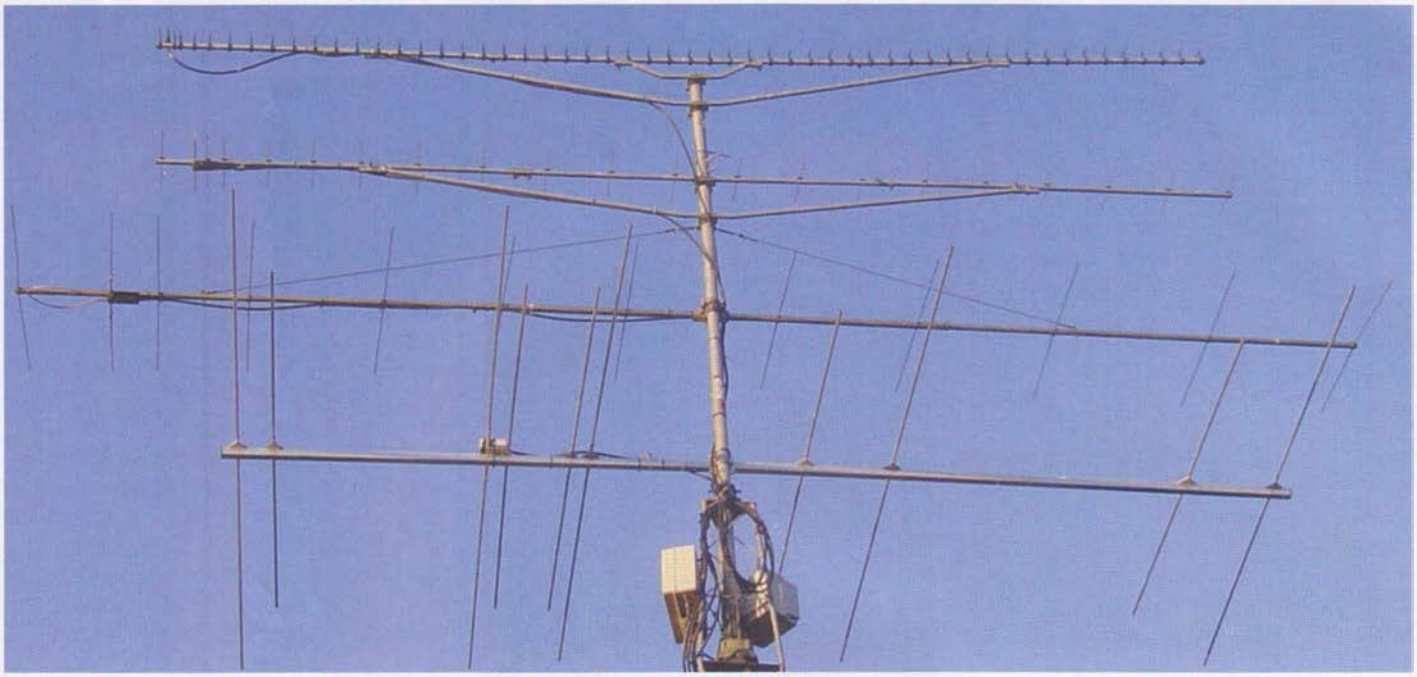
Joe, GOJJG (JO02) reports things have been rather quiet in Suffolk partly due to low aerials with all the gales. He has been road testing a recently completed G4DDK Anglian Transverter on 144MHz, and early results are good. The sun seems to have been busy; the aurora on 20 December brought LY2WR in KO24fo, as well as GM8IEM (IO78) and GM4ZJI (IO86) – GM8IEM was on SSB and the others CW. On 20 January, GM4JJJ (IO86) had at 59a but no-one else made it so far south. The 23rd saw some tropo to central and south-western France with F1CJW (JN04), F8GGD (IN96), FODZO (JN18) and F4JVG (JN16) making it in to the log. Sadly nothing of note was worked on 70cm or 23cm.

John, GW4MBN had to endure record rainfall in Pembrokeshire – raining every day since 2 November until report date of 25 January, so has been doing lots of work with sandbags! The large aurora on 20 December was sadly missed but worked SM3PXG and LA9NKA on auroral Es via SSB on 6m. Winter Es started on 2 January and he worked IK6DTB and IZ5ILX (CW) IW4AOT, IW4AOT, IK6DTB, IK7MOI, IK4DDR, ON4FI (SSB), IK4ISR, IK1EGC (JT6M). A better opening on the 3rd produced good DX contacts with IW1QEA/P, IW4BET, I6DVW, IWORDX, SQ9RFE, IW4CVS, IZ4YGY, IK4CDJ, IW4FNO, IZ1MLQ, F1GZV, DL3GD, IW4FNP, IOKIB, OE9MON, I6WJB, I4EWH, IKOOKY, IW2NRI, IZOCVN, DL1WA, IZ1OSS, HB9TWU, F1ADG, IZ5FDJ, DB9TWU, OV8FM (all in SSB). This coincided with the beginning of the Quadrantids meteor shower so John continued operations well into the following day working a few new ones on JT6M mode: DJ2QV, PAORDY, EA2BCJ, OZ5AGJ, DGOKW, IW1ACL, DK9WI, S59A and LA3EQ.

Richard, GD8EXI (IO74) comments on what caused the very strong and long lasting meteor scatter signals reported in this month's column. They could, in theory, be large single meteors or a shower of smaller ones but it is difficult to see how the intense ionisation could really last over 2 minutes, the optical equivalent not being reported. Richard has observed many meteors using the Graves Radar on 143.05MHz using a real time spectrum analyser display with good time and frequency resolution. With this set up it is possible to visualise not only the almost stationary main ionisation cloud but the much weaker Doppler shifted trail that precedes it. With the normal meteor scatter signals that last just a few seconds or less, the Doppler shifted trail and the following stationary cloud are approximately in proportion. However, on the rare occasions that he has observed longer reflections this is not the case. There are cases where you can see the ionisation cloud being topped up by the arrival of further meteors. However the most persistent and strongest reflections appear to be triggered by a single meteor with the intensity of reflection continuing to grow for a few seconds after the initial Doppler shifted trail has disappeared. With a simple ionisation model this makes little sense, why the delay? One possible explanation is that the easily ionised metal ions from the meteor start a chain reaction causing an expanding localised Sporadic-E event in air, which was just below its ionisation point already. If this is true these long events should normally occur in daylight hours, mainly in summer and be more common on the lower frequencies. Richard has only managed to observe a few long events and recorded even less, so he needs a lot more data to draw any conclusions. Email discussion continues on this very interesting point so hope to report further with more testing.

Meteor scatter monitoring

The Graves Radar System (Grand Réseau Adapté à la Veille Spatiale) is located in Dijon France (JN27si). It operates on a frequency of 143.050MHz and has been QRV since 2006. It provides an extremely potent stable signal for monitoring purposes for meteor scatter and EME. Much like our own amateur beacons, this is a 24/7 operation and although the array beams in a southern direction, excellent meteor reflections can be received in the UK and Northern Europe. Being only slightly off the bottom end of the 2m band, weak signal equipment performs well even at this frequency. Rob, PE1ITR [2] has an excellent website and detailed operations of the Graves System and Philip, GOISW also has a website dedicated to DX working and meteor scatter monitoring [3]. During meteor shower periods reception is quite easy. However, outside these periods there are always sporadic meteors entering the Earth's atmosphere and burning up in the ionosphere and leaving an ionisised trail. January, February and early March are generally very poor for sporadic meteors, however QSO's can be made on 6, 4 and 2m but more patience is required to be able to complete.



If you really get the bug for all things VHF you could end up with an antenna like at my QTH.

It is not uncommon for skeds to take up to an hour to complete often waiting for the elusive RRR Rogers to be received. The motto here is don't give up too early: even if nothing is received in the first 10 minutes of a sked, keep trying.

Station setup

I am often asked by how to assemble an effective station that would be able to operate on the VHF bands and take the first steps in operating meteor scatter by those who have not tried DX modes before. Whilst John, G4BAO's article in February 2016 *RadCom* entitled Step Up To 1296MHz focussed on 23 and 13cm, the principle at the 'business end' of the station really works just the same at lower frequencies. Attention to detail is key and the choice of antenna and cable is vital. Many stations already have a USB PC audio interface used for PSK and other digital modes. There is no problem in constructing an interface with emphasis on separating the audio streams from the PC and radio to minimise hum and audio looping. Specialising in a certain band could be a good way to go. Clearly 6m antennas can indeed be difficult to install however there are a few dual band designs that also cover 4m all on one boom. It is convention to use modes JT6M and ISCAT in the WSJT suite of software. 2m operation requires either FSK441 or JTMS modes that have a higher data transfer rate to cope with shorter bursts/pings at this frequency. It is advised to read and digest the WSJT operating manual where full details how to install and run the software are found [4]. Consider a good design, directional antenna with gain figures of 6/8dBd on 6/4 metres and 10dBd 2m. If you really get the bug for all things VHF you could end up with an antenna like at my QTH in the photo!

Murray, G6JYB advises on information regarding the GB3WSK 4m beacon. "We recently gained Primary User frequency clearance for moving the GB3WSX beacon from its old Yeovil site to a new location near Mere in Wiltshire (IO81VC). Beacon keeper is David Boniface, G3ZXX who will be issued with the NoV by Ofcom shortly; setup and installation should be implemented quickly. The beacons vital statistics are 70.007MHz, 17dBW / 50W ERP using a Yagi antenna at a fixed bearing of 70°. The clearance/NoV for this band are rare and took nearly a year to negotiate and implement with a few dB power reduction in the process."

Beaconspot

Changes to beacon frequencies and there operational status can also be a hard job to track. Observation and monitoring is just a part of VHF/UHF/SHF operating as actually making QSOs. Shorter distance beacons being copied directly or via various types of scatter, medium distance by ducting and aircraft reflection and indeed long distance via extreme propagation media like tropospheric ducting, Sporadic-E and aurora. The excellent Beaconspot project [5] is maintained by the UK Microwave Group [6] and is a tremendous resource for all VHF through to microwave frequencies with data supplied by cluster and user input. It certainly has an excellent News Update page to keep up to date with beacons coming off or going on the air and whenever a beacon is spotted on the cluster details like distance, bearing etc. It requires registration to be able to access the facilities of the site but this very worthwhile and I find of particular use the 'Spots Today' facility very handy particularly during times of Sporadic-E.

70cm activity nights

The 70cm activity nights continue with Wednesday evening being by far the most popular. The 432.200MHz calling is the start with usually 3 or 4 groups QSYing within 20-30kHz all at 1900 until 2100UTC. There are a number of regulars now on from GM right down to the home counties so please try 70cm SSB!

Sign off

Thanks to the contributors this month with a distinct lack of DX and continuing terrible weather. Deadlines for input please for the second weekend in the month thanks.

WEBSEARCH

[1] www.g0che.co.uk/ms-calendar.php
[2] www.itr-datanet.com/~pe1itr/graves/
[3] www.qsl.net/g0isw/
[4] http://physics.princeton.edu/pulsar/k1jt/index.html
[5] www.beaconspot.eu/beaconnews.php
[6] www.microwavers.org/

Richard Staples, G4HGI
g4hgi@live.com

GHz Bands

The 134GHz distance record has been broken again and we lost a 'microwaver's microwaver'. Plus, small station SSB EME.

New 134GHz distance record

Rarely a month goes by these days without news of some record-breaking QSO on the mm wave bands. Saturday 16 January saw the UK 134GHz distance record fall again as the current holders, G8KQW and G8ACE broke the record set last September. They pushed the distance up to 35.6km over a line of sight (LOS) path from Chute Causeway (IO91fh20dp) near Andover to Cheesefoot Head (IO91jb00nv) near Winchester. **Photo 1** shows the equipment used.

G8KQW writes, "Millimetre bands suffer losses due to oxygen and water vapour and whilst there is nothing we can do to mitigate attenuation due to oxygen, the attenuation due to water vapour reduces in line with dew point temperature (DPT). Operating on a very cold winter day should yield minimal water vapour attenuation. The key enabler for success on this extended distance record contact was the lower path loss due to low water vapour attenuation. DPT on 16 January 2016 was -1°C whereas on 20 September 2015 it was 14.3°C. The reduction in water vapour attenuation between the two tests was sufficient to overcome the ~9dB increase in free space path loss attenuation over the 35.6km path." See **[1]** for a full report. Great job, Ian and John. I'm looking forward to reporting on the first cross-channel 134GHz QSO soon!

Other Activity

Activity over Christmas and New Year was, in general, quite low, but with a few notable exceptions. On 3 January, while helping install the 70cm repeater GB3WA, Alan, GM0USI went 24GHz portable at Baidland Hill (IO75or). He had a 24GHz QSO with Brian, GM8BJF (IO85jv) at 99.1km. Alan reports signals were 55 each way with the usual QSB and slight scatter over the obstructed path.

The EME SSB/CW Funtest on 1.3GHz was held over the weekend of 16-17 January and this brought out plenty of activity on these modes plus high JT65C activity as a consequence. Rob, MODTS (IO94il) tweeted

PHOTO 1: The equipment used at each end of the 134GHz record QSO. Photo: G8KQW.

that he'd made seven SSB contacts via the Moon (yes, SSB!), working, PI9CAM, G3LTF, OK2DL, UA3TPW, LX1DB, I1NDP and HB9Q as well as plenty of stations on JT65C. Rob has upgraded his 1.8m dish to 3m and notes that CW EME is much easier now. He has posted a recording at **[2]** of the ON0EME Moon beacon **[3]**. With my 1.9m dish, on SSB, I worked HB9Q, who was 'loudspeaker copy', and PI9CAM, for my first SSB QSOs via 1.3GHz EME. Given the number of 'big guns' and digimodes on 1.3GHz, it's now possible to work plenty of stations with modest equipment. As an example, on Sunday 17th, Nicola, I7FNW (JN81jc) worked HB9Q on JT65C while running just 15W to 4 x 25-ele Yagis. In just a few months I'm up to 59 'initials' including 12 on CW with my little system.

In general, 1.3GHz is gaining in popularity, with new stations coming on the band all the time. Last year, UKAC entries were regularly above 60 and, local to me, Camb Hams **[4]** members G4OXY, G7SOZ and M1BXF **[5]** are getting active along with Dom, M1KTA. A well-known HF-only QRP operator, Dom is building SDR-based equipment for the 23cm band, bypassing the VHF bands completely! The homebrew challenge of the bands above 1GHz is clearly a major factor in Dom's approach so we may have a potential GHz bands hilltopper in the making here!

Beacon news

The GB3CCX Cleeve Hill group have NoVs for 10, 47, 76 and 134GHz beacons and keeper Simon, G4SGI, emailed me with an update on the first stage 47GHz beacon plans. They are attempting to accelerate development by excluding a PA so will have about 15mW into a waveguide slot array antenna. Progress at these frequencies is slow because of the lack of test equipment and the need for high standards of engineering, but the UKuG have offered assistance to the group and they aim to get something on the air by the spring. Everyone is very keen to see mm wave beacons from Cleeve Hill because it's an excellent site and is crucial to convincing Ofcom that we are serious about the mm bands.

Errata

In last month's Step Up To 1296MHz article there was a howler. At the start of the Antennas section I said, "With the tripling in frequency from 2m..." I meant, of course, "With the x9 increase in frequency from 2m..." – and the proofreader failed to pick it up. Apologies all round.

G3PYB SK

On 8 January, the GHz fraternity lost Peter Blakeborough, G3PYB, following a heart attack on Boxing Day. Peter was President of the BATC, a great experimenter and a keen exponent of 47 and 76GHz. RIP Peter.

Please keep reports and technical snippets coming in to me by email, and join the conversation on Twitter @g4bao and @ukghz using the hashtag #GHz_bands.

WEBSEARCH

[1] 134GHz record report – www.microwavers.org/?134ghz.htm
[2] ON0EME Moon beacon as received at MODTS – https://t.co/r1FDuJyefH
[3] ON0EME moon beacon – www.on0eme.org
[4] Camb- Hams – www.camb-hams.com
[5] M1BXF's 'Geekshed' – www.geekshed.co.uk/
[6] 2016 GHz bands events calendar – www.microwavers.org/events.htm

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Design Notes

An unusual little bit of circuitry came via the RSGBTech reflector, where I initially thought the writer had made an error in its description, but on subsequently querying I found was in fact correct.

Figure 1a shows a P-Channel MOSFET used for reverse polarity protection in a piece of equipment. **Figure 1b** shows a similar arrangement with the protection in the negative leg. What is wrong with it? The FETs are shown the wrong way round, and it was this aspect that I initially queried with the author; but it turned out to be correct!

To explain how this circuit works we first need to consider what a power MOSFET looks like internally. **Figure 2** shows a more accurate representation of what is actually inside the package of any power MOSFET. Apart from the FET itself, there is a normally reverse biassed diode from source to drain. This diode is intrinsic to the manufacturing process – it is not something added deliberately by the manufacturers – and it often referred to as a 'parasitic' diode. It normally doesn't get in the way of correct operation, being reverse biassed (and in some cases helps, by catching the negative transients that often occur in things like motor control applications).

Look again at **Figure 1** (either version). If the diode were not present, the output from the source would float, with the voltage on it pulled down (or up) to that on the gate – so the FET can never turn on. However, the diode initially conducts, pulling the load up close to the drain potential, so the device now turns on properly – shorting out the diode and passing full load current with only millivolts of drop. If the input polarity is swapped, the diode blocks current flow and the gate is at the wrong polarity to turn on at all, so full protection is guaranteed. A really simple reverse polarity protection scheme, well suited to high current applications provided a suitable FET is chosen.

I had never met this neat bit of circuitry before, but apparently it is widely used in consumer products to protect against reversed battery connection. For applications of up to a several amps on supplies up to 50V, a P-Channel FET such as the IRF5210 (rated at 100V 40A, 60mΩ on-resistance) is suitable, although there are many others to select from.

Basics of MOSFET RF amplifiers

Staying with power MOSFETS, we'll take a look at another way of using them in a way the manufacturers never intended – linear amplifiers at RF. Whilst there actually is a wide range of MOSFETS designed specifically for RF amplifiers, usable up to the UHF bands, these are all relatively expensive. Unless you are in the business of designing broadband high power amplifiers, they are just a bit exotic to routinely 'play' with. However, plastic cased devices designed for applications like switch mode power supplies, motor control and DC switching in cars makes these ridiculously cheap and well worth playing with – maybe even cheaper than the fuse to protect them. Nowadays they come with ratings of up to hundreds of amps and hundreds of volts, sometimes simultaneously!

Since most are designed for fast efficient low loss switching at hundreds of kHz, they clearly are going to be useable to several MHz. The main difference between these switching FETs and 'proper' RF devices is their transconductance (symbol G_M) and input gate capacitance. G_M measures the change in drain current for a change in gate voltage. A typical switching FET may go from fully-off to fully-on over a range of gate voltages from 4 to 6 volts. In the middle of this range, drain current varies (just a typical example) from, say, 1 to 10 amps for a change in gate voltage of 1V. A typical I_D vs. V_G curve can be seen in the IRF520 datasheet [1]. A transconductance of 10A per V (or 10 siemens, abbreviated to 10S) or even higher is normal over part of its range. This makes for good switching action with a small signal square wave gate drive. 'Proper' RF MOSFETS may be a bit lower, in the region of 1 to 5S, with a more linear I_D vs V_G characteristic. The increased input capacitance of switching FETs is a direct consequence of this higher G_M, their needing a larger gate geometry to achieve it.

In spite of not being designed for the task, switching MOSFETS can still be used as linear (or nearly-linear) power amplifiers for the LF and MF bands. They're certainly OK on 137kHz, 475kHz, 160 and 80m, and even into the middle HF region if this higher G_M and input C is taken into account.

Figure 3 shows a basic design using a pair of one of the most popular MOSFETS ever made, the IRF520. It's rated at 100V, 10A, 50W dissipation max and 60mΩ on-resistance. They cost as little as 45 pence each.

The first thing to consider when designing such an amplifier from scratch is the load circuitry. For a push pull amplifier, the drain of the 'opposite' or off device rises to twice the supply voltage. (This is also true of a single ended device used with a feed inductor and AC coupled output). So a 100V rated device means a supply rail of 28V offers a huge safety margin and, once the design is proven, a V_{DD} up to 35V (or even more) may be OK. For push pull amplifiers, the maximum output possible for a given V_{DD} is given by

$$P_{OUT(MAX)} = \frac{2(V_{DD} - V_{SAT})^2}{R_{LOAD}}$$

V_{SAT} is roughly $I_{MAX} * R_{DS(on)}$ so 10A and 0.2Ω = 2V. Not too bad with a 28V rail.

If we take the 50W maximum dissipation value and assume 40 to 50% efficiency overall for a linear amplifier, that suggests we can probably get 60W out from two devices in push-pull and 100W if we try really hard and are prepared to push them to their limit (and at 45p each, why *not* try thrashing them?). Plugging 60W and a 28V supply into the equation suggests a push-pull load resistance of 22.5Ω will be needed. So a transformer with a centre tapped primary and turns ratio of about 1:1.5 will be needed to transform a standard 50Ω load down to this required R_L. We won't go into details of magnetics, cores, windings and transformer design here – they are the subject of articles in their own right.

The input matching is next on the list. The data sheet suggests a gate capacitance of 330pF. If we arbitrarily choose 3.8MHz as an upper limit of operation for now, this means a reactance of 127Ω. Now, this capacitance is very non-linear: it varies with drive level, drain voltage and all sorts of things, so don't even think of trying to tune it out. All we can realistically do is to swamp it with a resistor. This is the job of the two 27Ω resistors on the gates. At lower frequencies the reactance rises and the input resistors pretty well define the input resistance. The value isn't critical, and can be selected (read that as 'played with') to optimise gain, matching and frequency response. They are decoupled on their ground side to allow DC bias to be applied.

The push pull input impedance is then given by both in series, so around 54Ω, which means a transformer ratio of 1:1 with a centre tapped secondary is perfect.

Bias needs to applied separately to each device as low cost switching FETs are never precisely matched and a different voltage is almost certain to be needed on each gate to achieve an equal standing current in each

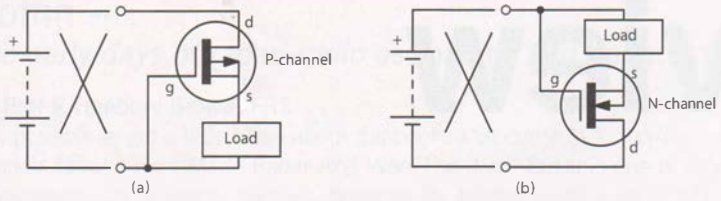


FIGURE 1: Reverse polarity protection with a power MOSFET used the 'wrong way round'.

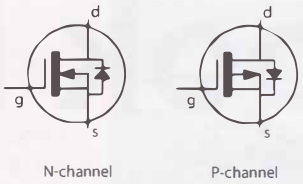


FIGURE 2: Showing the intrinsic, or 'parasitic' diode inherent in power MOSFETS.

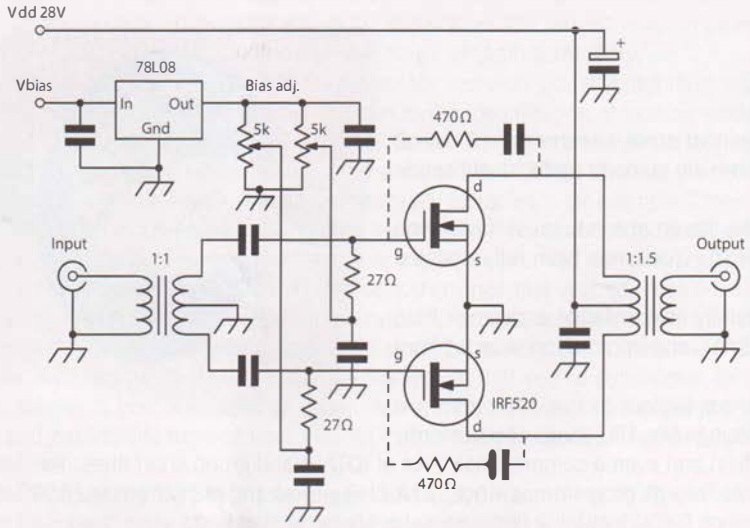


FIGURE 3: Basic 50W linear amplifier using low cost switching FETs.

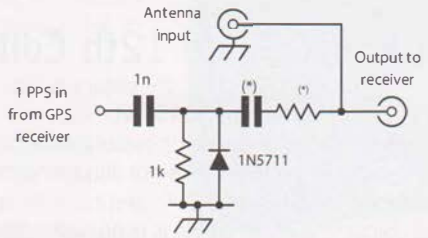


FIGURE 4: Corrected version of last month's Figure 1.

device. The two presets are adjusted to set equal standing currents of around 250mA to 1A in each device, depending on the type of operation and linearity required. Again, nothing is critical, so adjust to values that you feel work. Typical gate bias voltage is in the region of 3 – 6V. The bias supply to the presets needs to be stabilised, and a 78L08 voltage regulator serves in this position. For non critical applications no temperature compensation is needed, but Dave Bowman, G0MRF, suggested a silicon diode in series with a Schottky diode in series with the bottom of the potential divider (to give a slightly reducing gate voltage with increasing temperature) gives a good match for the majority of devices.

Reference [1] suggests that a voltage swing on each gate of about 1.7 to 2.5V will be needed, or 3.5 – 5V pk-pk, or about 1.8V RMS. In 50Ω this corresponds to a drive of just 65mW and implies an awful lot of gain is possible. Well, it can be done but won't be very linear – try it and see. A better result is achieved by adding negative feedback, which tames gain and stability, and improves linearity appreciably. Here – and this is the real beauty of MOSFET amplifiers – feedback is generated by no more than a single resistor on each device, with DC blocking capacitors; these are shown dotted in **Figure 3**. The resistor value is relatively straightforward to estimate. The *voltage* feedback ratio is given near-enough by the potential divider formed by R_{FB} and the gate swamping resistor. So, to a rough approximation, the feedback reduces voltage gain to about (R_{FB} / R_{GATE}) + 1. If we choose (= guesstimate) a value of 470Ω here, that suggests a gain of around x18 voltage at the device drains. With an output transformer step up of 1.5:1, an overall voltage gain approaching 27 ought to be possible, or 28dB. So for 50W output, a drive of 0.1W may be enough. Of course, things are never ideal and in practice the drive needed is more like 250 – 500mW. But not bad for active devices costing less than a pound! Feedback also reduces the input resistance, so the swamping resistors can go up. Play about with values and observe the result.

A full description of a practical version of this amplifier that has been tested and does indeed meet these specifications over the frequency band of 80kHz to at least 2.3MHz can be found at **[2]**. It would probably go higher in frequency but the design and ferrites were specifically chosen for LF and MF operation, so response rolls off above 4MHz. Satisfactory linear operation results up to 50W output.

DCA Pro firmware update

In the March 2013 *RadCom* I reviewed the atlas DCA Pro component analyser by Peak Electronics. Wanting to install the curve plotting software on another PC, I found I'd lost the original 512MB USB stick containing the installation software. No problem: the Peak website **[3]** had the latest version and it installed on my Windows 7 machine flawlessly. On running, it informed me the analyser's firmware needed updating, which it did automatically, flashing the new version in as soon as I OKed it.

Since I hadn't used the curve tracing for some time, it was difficult to work out exactly what had changed, but there seemed to be a few more helpful diagrams and facilities on the screen. A minor annoyance later ensued, as the new firmware now made it incompatible with the original plotting software already present on another PC. But updating that from the website, which it organised itself, went flawlessly.

Correction

Due to an editorial mishap Figure 1 in last month's Design Notes contained an error. The corrected version is shown here as **Figure 4**. [*Mea culpa* – G1MFG].

WEBSEARCH

[1] www.farnell.com/datasheets/136307.pdf – IRF520 data sheet. Figure 3 shows the gate volts vs drain current characteristic

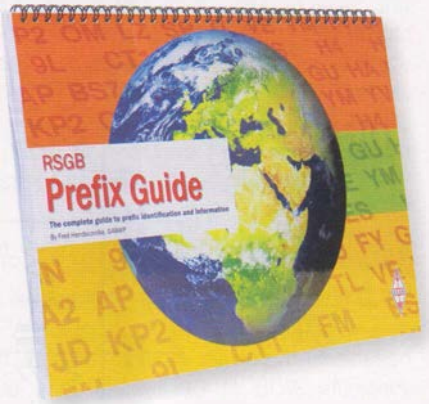
[2] www.g4jnt.com/Linear_LF_PA3.pdf – a practical version of the MOSFET amplifier described, tested for operation from 80kHz to 2MHz

[3] www.peakelec.co.uk/acatalog/dca75-dca-pro.html – scroll down for the latest software and firmware for the DCA-75 Pro component analyser

Andy Talbot, G4JNT
ac.talbot@btinternet.com

Book Review

RSGB Prefix Guide 12th Edition



Compiled by Fred Handscome, G4BWP

The *RSGB Prefix Guide* is one of those regularly updated books that always seems to sell out no matter how many we print. And it's not surprising: this is the complete guide to prefix identification and information.

Now in full colour, the *Prefix Guide* is even easier than ever to use. It's an absolute must-have if you work much beyond your own country, the 12th edition of the Prefix Guide has been fully updated to reflect the most recent changes.

Although G4BWP compiled the *Prefix Guide*, he does also gratefully acknowledge assistance from Alan, 5B4AHJ and the Club Log team, Steve, PJ4DX, Joe, WA6AXE and information sourced from the Daily DX published by W3UR.

If you've ever seen one of the earlier versions you'll know there is more to this book than just prefixes, of course. There is a huge amount of information on things like ITU zones (conveniently presented in prefix order), DXCC Entities (including deleted Entities) and even a comprehensive list of IOTA island group short titles. You'll also find details of several of the world's most prestigious amateur radio Awards programmes – not just for HF – including many from the RSGB, *CQ* magazine WAZ and Field awards, plus indispensable information on DXCC including the essential prefix/band checklist.

As usual, this edition of the *Prefix Guide* is spiral bound so it will conveniently lay flat on your shack table – either open for a double page spread or folded so you can concentrate on a single page at a time.

You probably already know if this book is for you – and if it is, there is absolutely no substitute, wherever you are in the world and whatever your experience of amateur radio.

ISBN: 9781 9101 9318 1 Size: 297x210mm (landscape), 80 pages
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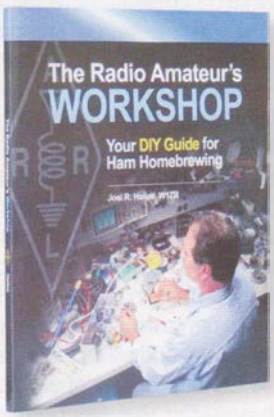
The Radio Amateur's Workshop Manual



by Joel R Hallas, W1ZR

Many of us have some basic tools and, possibly, a work space more permanent than the kitchen table. This book is all about making the best decisions about how to use what you've got, what you should get, and what to do with it.

Starting from first principles, it asks why we actually need a workshop. What's wrong with that kitchen table? Perhaps the answer appears obvious, but I suspect you'll find the comments revealing.

Next, we take a look at the basic workshop. Perhaps you'd like the latest highfalutin' ultra-analyserscope, but before that, make sure you've got a decent soldering iron and the other tools that will suit you. This leads nicely into the section on soldering, "the connection method of choice". But soldering isn't the only connection method, and others are examined.

We then move on to what you need for antenna projects, dealing with everything from wire to tubular metal. Then there's a good look at basic and advanced measuring equipment, from the traditional multimeter up to some pretty sophisticated (yet not necessarily over-expensive) gear. Finally, there's a look at the PC in the workshop, another very interesting subject.

Whether you're just setting up for the first time or are a seasoned homebrewer, I'm sure you'll find plenty of really useful information in these pages.

ISBN 978-1-62595-048-2 160 pages, 190 x 222mm
Non Members' price £22.99 Members' price £19.54

Small Antennas for Small Spaces *(2nd Edition)*

By Steve Ford, WB8IMY

When I reviewed the original version of this book in August 2011 I noted that "small spaces" apparently has a different meaning in American English – I suspect if you could fit a full-size G5RV in your back garden you wouldn't be looking for a book like this. However, if you do have a reasonable amount of space this book will show you many ways of getting good use from it; this updated second edition also looks at the issues in new ways, ranging from a 'privacy fence' stealth antenna to an extended double Zepp.

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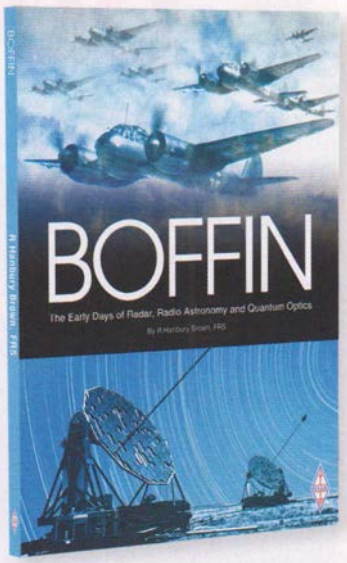
Boffin –
The early days of radar, radio astronomy and quantum optics



By Prof R Hanbury Brown, FRS

It is possible to get a little blasé about the books that come in for review – 'oh no, not another personal memoir about How I Made Radar And Won The War'. But this one is very different: it's engaging, full of excellent, dry one-line humour, presents its subject from a genuinely new position – and goes a lot further, into exciting new territories. It's also refreshing to see it spelled out that much of the early progress on radar was possible only thanks to the fact that some of the scientists were keen radio amateurs and had access to a copy of *The Radio Amateur's Handbook*.

Whilst it is refreshing to see the new light that is shone on the well-known story of radar, the second part of the book is even more engaging. It describes the almost magical development of being able to 'see' the universe with radio, through the magic of radio astronomy.

Starting with Bernard Lovell's early post-War research on reflecting radio signals from ionised meteor trails (sound familiar?) we move quickly on to the identification of 'cosmic static' by Grote Reber and the author's involvement in the fledgling Jodrell Bank. "By far the worst part of the job was soldering the coaxial cable to the new feed while perched on the top of the 126 foot tower at the centre of the paraboloid..."

Discoveries were many, though painstakingly extracted – for example it took 90 nights to conduct the first radio map of the Andromeda Nebula, work that a modern telescope could do in an hour. But they were trailblazing days and we get a real sense of the adventure. We learn how quasars were discovered for the first time, of fundamental research into optical science that was so revolutionary and divisive that "if science had a Pope we would have been excommunicated". We also meet some wonderful eccentrics, like the brilliant mathematician with a habit of bursting into Wagnerian song whilst deep in thought, and discover how a two-year visit to Australia turned into a 27-year stay.

As you read this book you really get the feeling that you've gone down the pub, got a table in the corner and the author chatting away to you, talking to you like you're an equal. More importantly, you never get the sense that he's talking down to you in any way. I really enjoyed it – and particularly the odd lines like "All I can remember about it is that it had a stupendous number of knobs with which it was very unwise to twiddle..."

ISBN 9781 9101 9317 4 176 pages, 174 x 240mm
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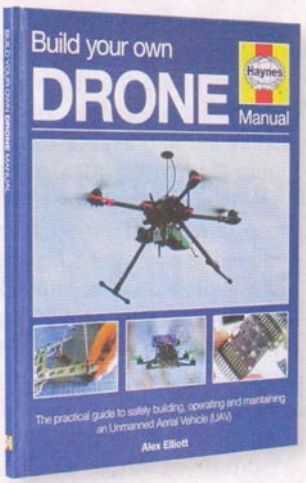
Build your own Drone



by Alex Elliott

With all the 'buzz' surrounding drones, this is quite a timely (and fascinating) book. I've often looked at the various quadcopters on offer – from the £20 toys on eBay through the well-advertised Parrot AR drones to the £1000-plus professional class – and wondered: what is really going on under the covers? Well, now I know.

Beginning with a fascinating description of the history of drones (which starts, would you believe, with mile-long steam-powered flights in the 1890s), we move on to a detailed discussion of the different types of drone. It had never really crossed my mind that there were so many: not just fixed-wing and quadcopter, but all manner of variations from single propeller ducted fan designs through to ten or more heavy-lift propellers for professional movie cameras and more. There is also more than a passing distinction made between the military (lethal and non-lethal) and now-common enthusiasts' models. One of the questions addressed early on is whether to get an off the shelf model or to make your own. I'd never considered self-build, but it turns out that most of the difficult stuff is done with ready-made components and it really is a practical proposition.

But the question still remains, what *use* is a drone? It turns out that there are quite a lot of applications that I'd never considered, ranging from 3-D terrain mapping through to chasing poachers in Africa and even the widely-advertised (but perhaps not yet practical) immediate deliveries from multinational online retailers.

Back to my original question, getting under the covers. Now we get into the real meat of the book, with a very detailed consideration and description of all the parts – from the basic airframe to motor performance, calculating the run-time of batteries, radio control, first-person view and much more. I found the sub-sections on autopilots and gimballed camera mounts particularly interesting because I didn't know just how clever these things have got. I learned quite a lot, some of which I'm sure I'll put into use elsewhere. The really surprising thing is that a modern drone autopilot the size of a matchbox provides many of the same functions of the Saturn V Instrument Unit that took Apollo astronauts into orbit – except that was 6.6m in diameter, around 0.9m high and weighed almost two tons. That's progress!

Now we get to put what we've learned to good use: the author describes – in detail – how to build three different drones. These are an aerial photography drone with a gimbal (stabilised) camera mount, a mini first person view (live TV images) quadcopter and a fixed wing drone with a fully-featured autopilot that lets is fly entirely on its own from takeoff to landing. Impressive stuff. The book concludes with a look at safety information – learning to fly, the law and so on – and a couple of carefully-chosen appendices of useful information.

This is a fabulously well illustrated book. The author writes clearly and concisely and supports his text with just the right number of extremely high quality photographs that were obviously taken specifically for this book. I've learned a lot by reading it and it has really whetted my appetite for drones. Whether I'm actually any closer to building or buying anything is a moot point, but I am definitely better informed and greatly enthused. Whether you are highly technical or a complete beginner, I'm sure you'll get a great deal from this book. Highly recommended.

ISBN 978 0 85733 813 6 156 pages, 276 x 214mm
Non-Members' price £22.99 Members' price £16.99 (26% OFF)

Giles Read, G1MFG
giles.read@rsgb.org.uk

Resolution of a power line interference problem

I live in a rural area that is normally blessed with a relatively low noise level on all bands. There is a 132kV power line with the usual 2 x 3 phases to the north, about 250 metres from my aerials at its closest point.

PHOTO 1: SEPD engineers replacing the suspect insulators on the pylon.

As my principal interests are in the microwave bands for both terrestrial and EME operation I didn't consider the proximity of these lines would be a problem and until recently it has not been so. I use 2m for talkback when operating on the microwave bands, operate on 2m and 4m from time to time and very occasionally venture onto 160m, for which I have a rather low dipole. I had not noticed any significant QRM from the power lines on any band.

One day this summer I noticed some quite strong (S7) interference on 2m that 'beamed up' to the north west. I used AM demodulation of the 144MHz signal to display the interference using *Spectran* (see **Figure 1**), which also recorded an audio .WAV file. The peaks at 100Hz intervals are those one would expect from a 50Hz arc, conducting on both half cycles. The spectral display shows the intermittent nature of the interference, with about 20 seconds showing on the waterfall display. The signal was very much in evidence on 2m and 4m but there was little sign of it on 160m. I did not make comprehensive observations across the RF spectrum.

In the direction that the QRM peaked there are a few houses at distances of between 150 and 250 metres and I initially expected one of those would prove to be the source. So I set out on foot with an FT-817 tuned to 144MHz and a hand held 5 element Yagi to track it down. It was soon clear that the interference was not coming from any of these houses but from one of the 132kV pylons beyond them, a distance of about 400m from my home antennas. I was able to get a good cross bearing from the public lane about 100m from the tower. Later, having spoken with the land owner, a neighbour, I approached within about 20m of the tower without radio gear, to listen and look to see if I could identify precisely where the interference was coming from. But there was nothing to see or hear, none of the fizzing sounds that can sometimes be heard near HV insulators. It would be unsafe to take an antenna or mast close to a high voltage line and I doubt I could DF the source accurately enough to identify it more precisely.

The interference was intermittent and could not be related to any particular time of day or to weather conditions. I repeated the direction finding exercise several times when the interference was present to confirm that it was always coming from one particular pylon.

In due course I contacted the local energy distributor, Southern Electric Power Distribution (SEPD) via their 24h emergency call centre (0800 072 7282) and suggested that this interference could be a sign of an insulator failing. I was able to identify the pylon by a number on a plate near the top of the tower. A certain amount of explanation was necessary before my report was escalated to the appropriate level. In due course someone from SEPD visited and I was able to provide a bit more information. A second visit was made by one of the SEPD's Project Managers, who also happens to be a licenced amateur so he was quickly on the case. As this interference indicated arcing that could lead to failure of the insulator, he told me that he would schedule a network shutdown and replace the oldest insulators. Those on one side of the pylon had been replaced more recently. If the interference continued, he would repeat the process and replace the newer ones too.

The insulators were changed on 15 October 2015 and the SEPD Power Distribution Project Manager came over to let me know it was happening, so I was able to take a picture of the process – see **Photo 1**.

I think key features of this story include that it was not approached as a complaint about interference but as a suggestion that a possible fault was developing. Although the interference was intermittent and did not seem to relate to weather conditions or time of day, I had recorded it and was able to provide a spectral display clearly showing the 50/100Hz nature of the interference. Care was taken to DF the

source, latterly with the landowner's permission, and the investigation was conducted without approaching the line closely or endangering myself or others. The process was repeated several times to minimise the possibility of error. The pylon, which was not my closest, was also clearly identified to SEPD using the number on the plate on top. Although I had not studied the full RF spectrum of the interference, the fact that it was strongest on 2m and 4m might have been related to the length of the faulty insulator.

SEPD clearly took the report seriously and carried appropriate and preventative maintenance that may well have avoided a network breakdown. To date there is no sign of the interference returning. If I have any more updates I'll post them on my website, http://myweb.tiscali.co.uk/g4nns/

Brian Coleman, G4NNS
brian-coleman@tiscali.co.uk

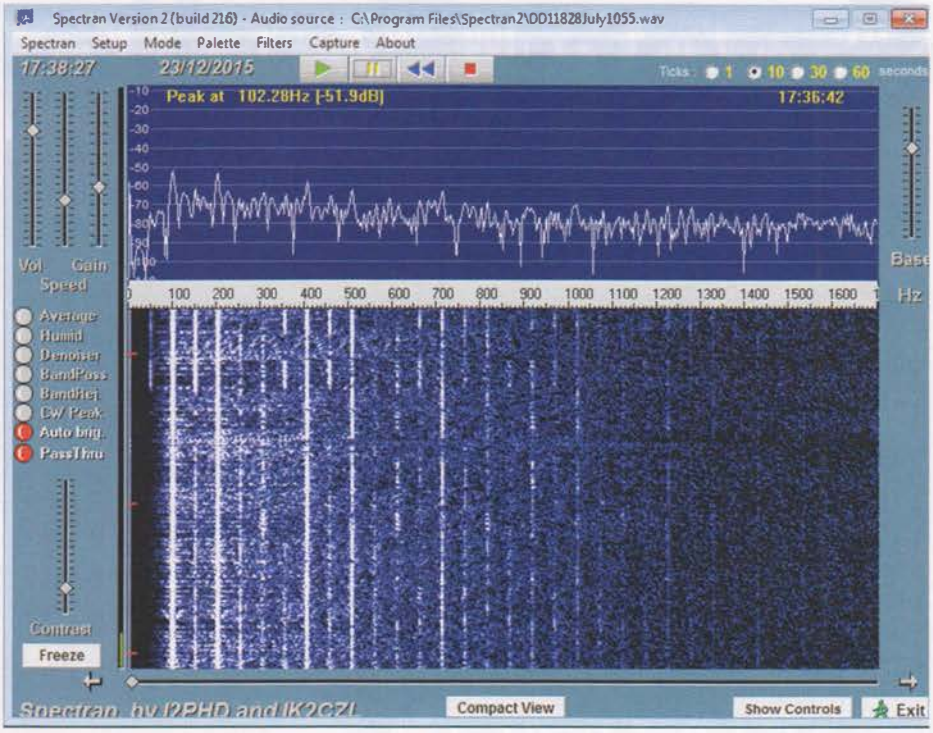


FIGURE 1: SPECTRAN display of the interference.

Sport Radio

Several major International HF contests take place around the time of the equinox.

March is the second month of the 2016 80m Club Championship series. The order in which the sessions take place rotates every month, so this month we begin with datamodes on the 7th. The Commonwealth Contest runs for 24 hours from 10am on the 12th. There should be several Commonwealth countries active that you don't hear every day and, because non-Commonwealth countries don't enter this contest, the pile-ups for the rare ones should be less, making them easier for the average station (100W and a doublet) to work. Then it's back to the 80m Club Championships, with CW on the 16th and SSB on the 24th.

The VHF month begins with a 2m session of the UKACs on the 1st. It's followed by the 144/432MHz Contest, which takes place for 24 hours over the weekend of 5-6th. In this one there are 6-hour sections for Single-op Fixed and Others, plus 24-hour sections for Open, Single-op Fixed, and Single-op Other stations. Following the 70cm UKAC on the 8th we have the second session of the 4m Cumulatives, on Sunday 13th. There will be three more cumulative sessions across the coming months. For the remainder of this month it's UKACs: 23cm on the 15th; 6m+SHF on the 22nd and a 4m session on the 29th.

PHOTO 1: Bob, M0KLO operating as GM6X from the GM2V contest station in WPX SSB 2015.

There's a CW session of the UKEICC 80m series on the 2nd. Exchange the first four digits of your Locator and upload your log within an hour of the end of the contest. It is followed by the SSB leg of the ARRL International DX Contest, which takes place for the entire 48 hours of 5th-6th. The CW leg took place last month, so please see February's column for more information. On the 6th, the first of five UKuG Low Band contests takes place. The bands for this one are 23cm, 13cm and 9cm. The Worked All Britain 80m Phone Contest runs for four hours on the evening of the 13th. Exchange a signal report, serial number and your WAB area (the first, second, third and sixth digits of your 8-digit National Grid Reference). For 24 hours over the 19-20th the Russian DX Contest takes place. There are numerous entry categories, for single- and multi-band, single- and multi-mode, multi-op, various power levels, clubs, etc. An interesting aspect of this event is the possibility of submitting *two* single-band entries, eg 15m and 80m. Work everyone and send a signal report and serial number, but expect Russian stations to send you a signal report and a 2-letter Oblast code. The 48-hour long BARTG HF RTTY Contest starts at 2am on Saturday 19th. The exchange is a signal report, serial number and the time. Another huge contest takes place for 48-hours over the weekend of 26-27th. This time it's the CQ WorldWide Worked All Prefix SSB (see **Photo 1**). In addition to all the common prefixes, expect to hear plenty of interesting and obscure ones. The HF contesting bands will be busy, all weekend. The final contest of the month is a CW session of the UKEICC 80m series, on Wednesday 30th.

Steve White, G3ZVW
steve.g3zvw@gmail.com

RSGB HF Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Mar 7	80m Club Championships	2000-2130	Data	3.5	RST + SN
Mar 12-13	Commonwealth Contest *	1000-1000	CW	3.5-28	RST + SN (HQ stations also send "HQ")
Mar 16	80m Club Championships	2000-2130	CW	3.5	RST + SN
Mar 24	80m Club Championships	2000-2130	SSB	3.5	RS + SN

RSGB VHF Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Mar 1	144MHz UKAC	2000-2230	All	144	RS(T) + SN + Locator
Mar 5-6	144/432MHz +	1400-1400	All	144/432	RS(T) + SN + Locator
Mar 8	432MHz UKAC	2000-2230	All	432	RS(T) + SN + Locator
Mar 13	70MHz Cumulative #2	1000-1200	All	70	RS(T) + SN + Locator
Mar 15	1.3GHz UKAC	2000-2230	All	1.3	RS(T) + SN + Locator
Mar 22	50MHz UKAC	2000-2230	All	50	RS(T) + SN + Locator
Mar 22	SHF UKAC	2000-2230 ~	All	2.3-10G	RS(T) + SN + Locator
Mar 29	70MHz UKAC	1900-2130	All	70	RS(T) + SN + Locator

Best of the Rest Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange (info)
Mar 2	UKEICC 80m	2000-2100	SSB	3.5	4-character Locator
Mar 5-6	ARRL International DX	0000-2359	SSB	1.8-28	RS + Tx power (Ws send State, VEs Province)
Mar 6	UKuG Low Band #1	1000-1600	All	1.3-3.4G	RS(T) + SN + Locator
Mar 13	WAB 80m Phone	1800-2200	SSB	3.5	RS + SN + WAB area
Mar 19-20	Russian DX	1200-1200	CW, SSB	1.8-28	RS(T) + SN (Russians send Oblast code)
Mar 19-21	BARTG HF RTTY Contest	0200-0200	RTTY	3.5-28	RST + SN + time
Mar 26-27	CQWW WPX SSB	0000-2359	SSB	1.8-28	RS + SN
Mar 30	UKEICC 80m	2000-2100	CW	3.5	4-character Locator

Italics indicate that only provisional information was available. * HF Championship event. + VHF Championship event. ~ Different bands start at different times.
For all the latest RSGB contest information and results, visit www.rsgbcc.org

Special event station GB125SL

Celebrating the 125th anniversary of Stan Laurel, Furness ARS organised a special event station.

Arthur Stanley Jefferson (who would find international fame as Stan Laurel) was born on 16 June 1890 in Argyle Street, Ulverston in the North West of England. His father, also called Arthur, was a British showman and, as a result, the young Stan was raised in the British music halls. At the age of 20 he made his first trip to America with the Fred Karno musical comedy troupe, which also included Charlie Chaplin, where he started work in the movies. By the 1920s, at the Hal Roach studios, Laurel found his comedy partner, Oliver Hardy, and one of the best loved comedy film duos was born.

Laurel & Hardy went on to make over 100 films together, including *Way out West*, *Tit for Tat*, *Sons of the Desert*, *A Chump at Oxford*, *Saps at Sea* and *Swiss Miss* to name a few.

In 1961, Stan Laurel received a Lifetime Achievement Oscar for his pioneering work in film comedy (during his career he had been an actor, writer and director), he also has a star on the Hollywood Walk of Fame at 7021 Hollywood Blvd.

Furness ARS members erecting the tower.

Putting on a station

Furness ARS is a fairly typical UK radio club, with around 30 licensed members. It was in September 2014 that the idea was first put forward by club member Chris, M0KPW (a keen Laurel & Hardy fan) for putting on a special events station to commemorate the 125th anniversary since the birth of Stan Laurel. What better way to celebrate one of Cumbria's most famous sons?

Initially the plan was to operate the station from the Laurel & Hardy Museum in Ulverston and approaches were made to secure interest and permission. As 2015 marked 800 years since Magna Carta, it was decided that Furness ARS would also run a special events station to commemorate this, GB8CMC, from 13 to 26 June. After looking at the practicalities of running what could potentially be two big special events stations at the same time, we decided against running GB125SL from the Laurel & Hardy Museum in Ulverston and instead ran both stations from Gleaston Water Mill – which is just a few miles away. We did consider separate stations, but the logistics of a reasonably small club setting up and manning two stations (with high power rigs, antennas and manpower) was simply not feasible. So a plan was hatched to create a 'shack' that we could share between both stations.

Chris, M0KPW operating GB125SL, with Clive, 2E0EVD logging.

Very special callsign

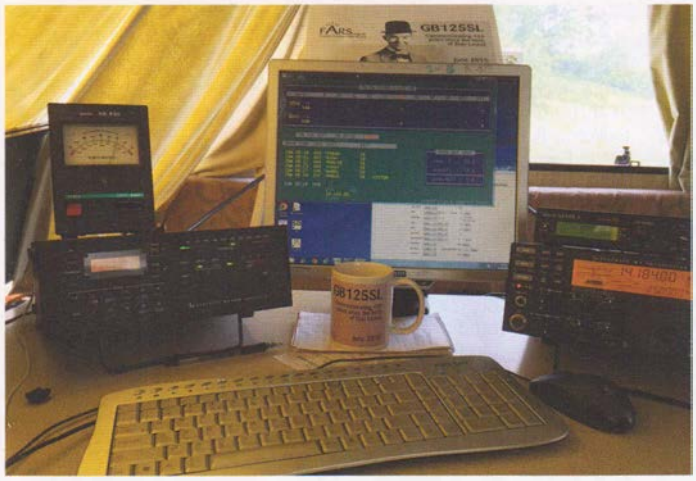
It was decided from the outset that we wanted to have an extra special callsign, especially given the popularity of Laurel & Hardy worldwide. So we sought to obtain GB125SL (125 Stan Laurel). We knew we would need letters of support to accompany our Ofcom NoV application for this non standard request, so contact was made with our local MP and a letter of support was soon obtained. We also contacted a number of 'Sons of the Deserts' tents. The 'Sons of the Deserts' is the world wide appreciation society for Laurel & Hardy and each faction is referred to as a 'Tent'. After a flurry of emails and phone calls, a number of letters of support were received. Ofcom were very supportive of our application and with the NoV form completed and the letters of support included, we received the agreed NoV for GB125SL for 28 days starting on 1 June 2015.

We planned to run the Magna Carta station from 12 to 15 and then from June 17 to 26 June. As Stan Laurel's birthday would have been on 16 June we obviously wanted to be active that day. We also planned to run GB125SL on 27 and 28 June. The reality was that GB125SL was operated every day of the NoV, if only for a couple of hours in the evenings.

A commemorative QSL cards was designed by Bill, G4USW, a QRZ.com page was created by Chris, M0KPW (which received over 9000 look ups), as were pages on our club's website [1].

Publicity

Leading up to the activation the thought of publicity came to mind. An email was sent to the RSGB to request that they listed our station on their Facebook page leading up



Part of the GB125SL station at Gleaston Water Mill. A selection of other rigs were also used.

Hexbeam antenna with rotator on the tower.

to the 16th, a few post were also made on other Facebook groups. An email was sent to GB2RS for inclusion in the Sunday morning broadcasts and we were fortunate to receive two announcements during the month (we worked a couple of GB2RS news readers who were looking out for us after reading out our event!). The last option was contacting the team behind the Southgate ARC news website [2], who agreed to publish the press release we had prepared and this was then syndicated around many other websites... as is the power of the world wide web!

Operation

For the majority of the special event stations that we run through the year we operate a modest station running 100W into the club's Kenwood TS-570D with a doublet or dipole antenna. But as we were running what we hoped would be much sought after stations we wanted to a more substantial station to give a better chance of making as many QSOs as possible. This was one of the main reasons for choosing Gleaston Water Mill as the site for the station – owned by club member Mike, G8ALE and his wife, the Water Mill allowed for setting up a station in the club's caravan for the whole month of June. A team of club volunteers, varying from octogenarians to teenagers arrived to set up and erect the club's elderly but reliable tower. Guy ropes and halyards had been cut and expertly spliced for eyes and eyelets as necessary.

The tower held a multi band Hex Beam and rotator (loaned by a club member) as well as a W3DZZ trapped dipole for the lower bands. Rigs consisted of an Elecraft K3 and KPA500 linear amp (again, loaned by a club member) that was used for the first few weeks, allowing for up to 400W. Logging was done with SD logger, an excellent and easy to use logging program. Other rigs used was the club's Kenwood TS-570D and a club member's Yaesu FT-950, running 100W with no linear, but holding their own and keeping the QSO count up as the month went on.

Band conditions in June started well, but soon became dire following some major sun activity, with some days having virtually no activity at all. Conditions on Tuesday the 16th were reasonable and a start was made at 9am with a CQ on 20m, and we clocked up 425 QSOs until going QRT around 17.30. A great number of pile ups were worked with the station being very sought after at times, so this resulted in contest style QSOs. But at other times more leisurely QSOs were had where a great deal of information could be passed.

There wasn't much DX worked, most was in Europe (with the exception of a few JAs, PYs, and W/Ks) but all stations were very pleased to work us and learn that Stan Laurel was born locally – the perception from Europe was that he was American!

The other main days of operation were 27 and 28 June, where conditions were quieter. Plus there was a contest right in the middle of the weekend that made securing an operating frequency difficult at times, over these two days we managed a total of 455 QSOs across 40, 17 and 20m. An exciting QSO took place on the Saturday afternoon, when a distant relative of Stan Laurel was worked, this really was the icing on the cake of a good weekend. The rest of the month was made up of anything from 5 to 100 QSOs a day, just when time allowed to be in the shack, usually later in the evenings.

A number of comments and messages were received during the course of the 28 days, including the following from an Italian station, 'I grew up with films in Italy, they were called 'Stanlio E Olio'. Thanks for the beautiful memory'. Whilst an American station said, 'I watched the Laurel and Hardy movies and laughed myself silly. Thanks for the QSO'.

The target set for GB125SL was 1890 QSOs, that equated to the year Stan Laurel was born. In total 1971 QSOs were made with GB125SL, most on SSB. **Table 1** shows the top 10 countries worked, with the full details available at [1].

TABLE 1: Top 10 countries worked by GB125SL

England	311
Germany	261
Italy	214
European Russia	120
Spain	94
Poland	90
France	80
Netherlands	63
Czech Republic	47
USA	37

Websearch

[1] www.fars.org.uk/GB125SL.php
[2] www.southgatearc.org/

Chris Leviston, M0KPW
chris.leviston@yahoo.co.uk

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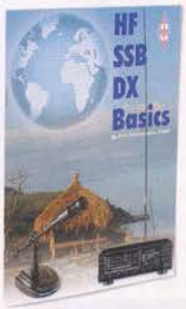

HF SSB DX Basics

By Steve Telenius-Lowe, PJ4DX

Contacting far flung parts of the world (DX) on the High Frequencies (HF) on single sideband (SSB) is one of the enduring fascinations of amateur radio. *HF SSB DX Basics* provides a practical guide to making the most of this endlessly fascinating area of operation.

Author and DXer Steve Telenius-Lowe dispels the myths about huge antennas and high power in an easy to understand way.

HF SSB DX Basics is for anyone interested in operating in this hugely satisfying area of amateur radio by providing advice and practical steps to get you started and much more.

Size: 174 x 240mm, 96 pages, ISBN: 9781 9101 9315 0 **Non Members' Price: £8.99 RSGB Members' Price: £7.64**

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VDSL interference to HF radio

Since the RSGB Convention in 2014, the EMC Committee (EMCC) have started validating reports of interference on the HF bands from VDSL broadband systems (Very high bit rate Digital Subscriber Line). We have confirmed 68 cases.

The 2015 RSGB Amateur Radio Survey indicates many amateurs believe they suffer from this, but less than 1% report the issue to the EMC Committee. Knowing the full extent of the problem allows us to lobby Ofcom and suppliers more effectively so please report EMC problems.

VDSL delivers broadband to over 5 million UK subscribers. It is available in over 80% of properties in the UK supplied directly by BT or by others like Sky broadband, Talk Talk, Plusnet as resellers. VDSL or FTTC (Fibre To The Cabinet) uses fibre-optic for high speed data between the cabinet and the exchange. Equipment in the cabinet then sends data signals over the twisted pair telephone lines to the premises. The telephone lines may be underground or overhead or, most likely, a combination of both. Normally problems only occur from overhead distribution.

Please check your QTH and report any problems you see to us by email to emc.chairman@rsgb.org.uk or via the EMC matters forum http://forums.thersgb.org/index.php?threads/vdsl-emission-investigation.84/

How do I detect interference from VDSL?

The emissions from VDSL are continuous and often indistinguishable from white (pink) noise. As a consequence, many people see a significant increase in noise levels at HF but do not know the cause.

Since the VDSL service sends data even when not in use, the noise is permanent. VDSL2 downstream and upstream bands alternate and the easiest way to detect VDSL is to look for level changes at the band transitions shown in Figure 1.

Tuning around these frequencies and listening while watching the S-meter will

FIGURE 1: VDSL2 downstream and upstream bands alternate and the easiest way to detect VDSL is to look for level changes at the band transitions.

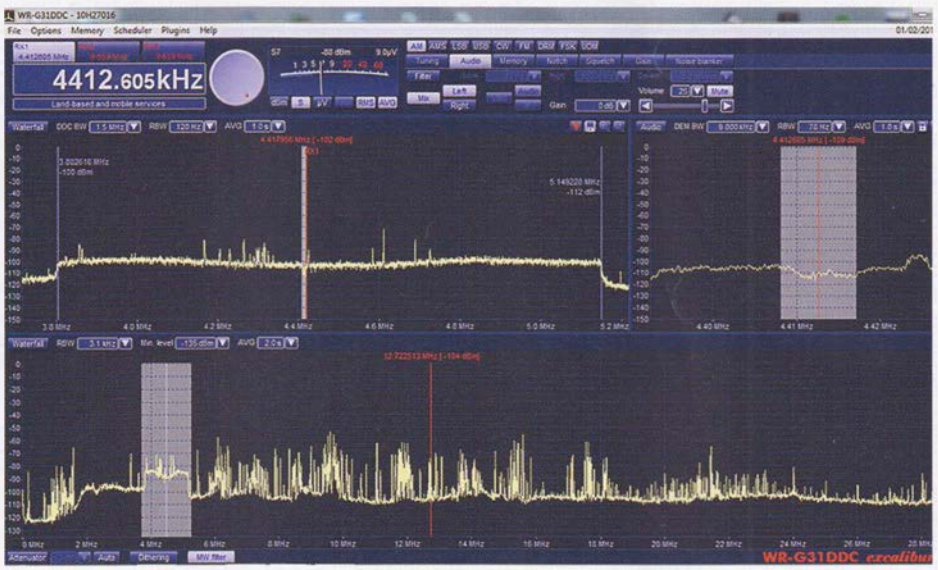

FIGURE 2: A typical SDR spectrum for VDSL bands D1 and U1 note the 10dB rise in level at 3.8MHz and the 15dB drop at 5.2MHz. U1 is stronger than D2 at this location.

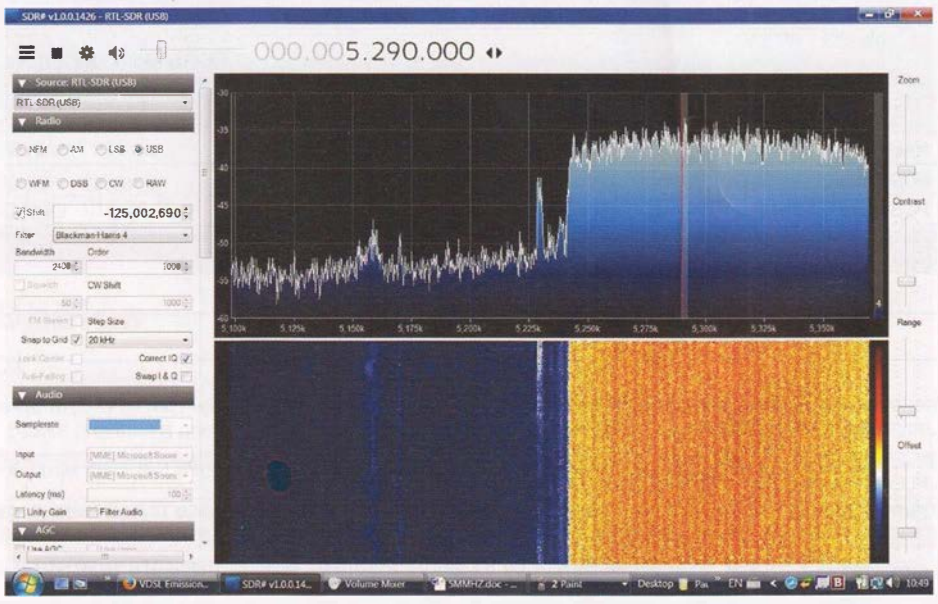

FIGURE 3: Showing spectrum and waterfall at a different location. Note the 12dB rise at 5.2MHz indicating D2 is stronger than U1. The 4.325kHz striping, which is characteristic of VDSL2, is also visible in the waterfall. Screendump courtesy Paul Dumpleton, M0XDX.

show a noise step if there is VDSL interference. The signal first drops just before the transition (~50kHz) then raises after the transition. Typical SDR spectra for VDSL2 bands are shown in **Figures 2**, **3** and **4**. Note the band which is louder changes from one location to another. Typical levels of drop and rise are shown in **Table 1** (actual levels can be 30dB above background).

In many locations the noise seen is the summation of contributions from different VDSL lines. This can be shown by taking measurements using a portable antenna and moving from under one line to under another.

If the VDSL signal is not getting through the system enters a retraining mode and sends carriers exactly 4kHz apart as shown in **Figure 5**. This often happens either side of the transmission frequency and the carriers can remain for tens of minutes. Continuous interference may mean they are there all the time.

For further details see Leaflet 15 on the RSGB website http://rsgb.org/main/technical/emc/emc-publications-and-leaflets/ This tells you what information we need you to report and suggests some mitigation measures you can try. We are still investigating ways of minimising this interference. If you would like to help us with these investigations please contact me at directly via m0jav@rsgb.org.uk.

John Rogers, M0JAV
Chairman EMC Committee RSGB
m0jav@rsgb.org.uk

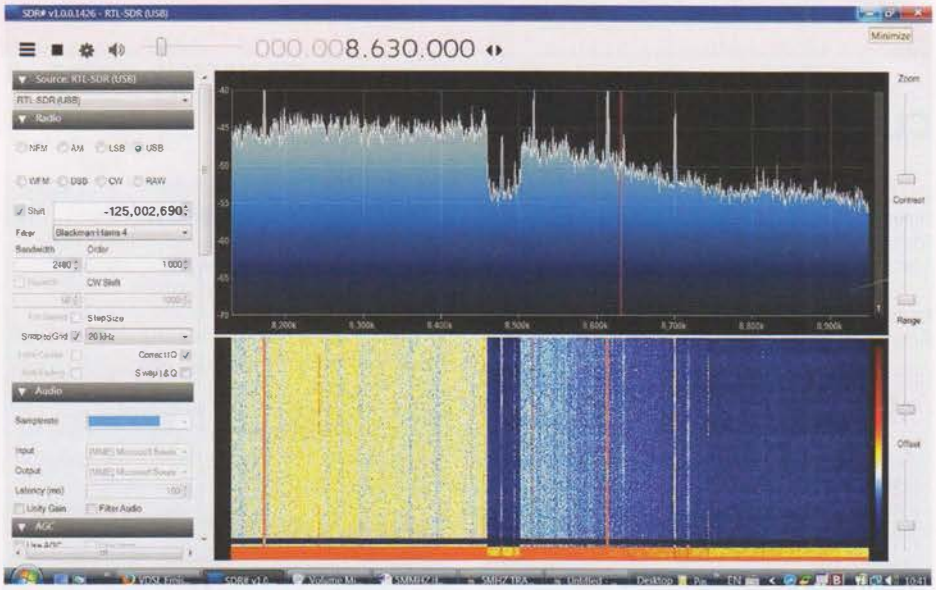

FIGURE 4: Shows the guard-band between D2 and U2. The steady drop off in level within U2 is from the receiving antenna characteristics. Screendump courtesy Paul Dumpleton, M0XDX.

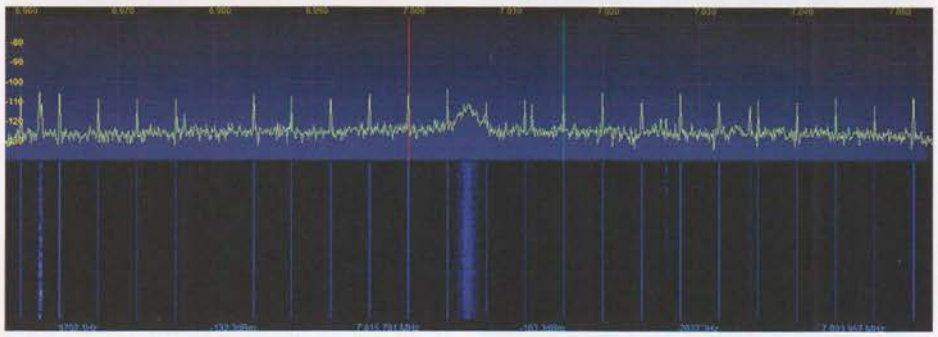

FIGURE 5: This shows the comb of carriers that occur when the system is training.

TABLE 1: Typical levels of drop just before the transition and rise after the transition.

VDSL Band	U0		D1		U1		D2		U2		D3	
f MHz	0.03	0.133	0.143	3.700	3.800	5.15	5.25	8.45	8.55	11.95	12.05	17.664
% reported cases	0%		48%		42%		42%		55%		25%	
Typical Change			+10dB	-7dB	+10dB	-10dB	+11dB	-10dB	+10dB	-7dB	+6dB	-12dB

Please send news reports to radcom@rsgb.org.uk. To get future events listed here and put on GB2RS, email details of your meetings as early as possible to radcom@RSGB.org.uk Include your club name, RSGB Region number, contact name, callsign & phone number, date and details of meeting. Example: Fraser Road Radio Club, Region 9, Graham, G0NBI, 01234 832 700, 29 Oct, On the Air. We normally acknowledge all submissions within 3 working days: if you don't hear from us, please phone. We don't normally print 'closed', 'TBA' or 'every Tuesday'-type entries. The deadline for the April edition is 25 February and for the May issue it's 31 March. For GB2RS, the deadline is 10am on the Thursday of the week of broadcast.

CLUB EVENTS CALENDAR

INTERNATIONAL

Pafos Radio Club, Cyprus,
Richard, 5B4AJG, 00 357 97 857 891,
5b4ajg@gmail.com www.cyhams.org

International federation of Railway Radio Amateurs (FIRAC) www.firac.org.uk

NATIONAL

Amateur Radio Caravan and Camping Club
membership@arcc.org.uk, www.arcc.org.uk
Net every Tuesday and Thursday 3.770 at 8pm
Caravan rally this month: Chipping Norton

AMSAT-UK
http://amsat-uk.org/
Open net every Sunday, 10am, 3.780MHz (±), sometimes QSY to 40m (~7.1) due to condx

British Amateur Radio Teledata Group
bartg@bartg.org.uk, www.bartg.org.uk
Membership is open to anyone interested in amateur radio datacoms. Datacoms contests and awards organised.

British Railways Amateur Radio Society
John, M0ZAA, m0zaa@brars.info
www.brars.info
2016 is Golden Jubilee year
Membership open to anyone interested in amateur radio and railways

Civil Service Amateur Radio Society
Weekly net every Tuesday, 8pm, 3.763MHz

Radio Amateur Old Timers' Association
MemSec@RAOTA.org, www.RAOTA.org
Membership is open to anyone active in amateur radio. Maintaining the traditions and spirit of amateur radio. Nets on Wednesday 3.763MHz at 1000, 1.963MHz at 2100, Thursday 7.163MHz at 1100, 3.763MHz at 1930 and Sunday 3.763MHz at 1000.

Travelling Wave Contest Group
secretary@twcg.org.uk, www.twcg.org.uk
Friendly contest group for those who want to be involved with contesting, but who don't have a local club or whose club isn't active in contesting, from anywhere in the UK.

REGION 1: SCOTLAND SOUTH & WESTERN ISLES

Regional Manager: Marcus Hazel-Mcgown, MM0ZIF, RM1@rsgb.org.uk

Cockenzie & Port Seton ARC
Bob, GM4UYZ, 01875 811 723
4 Normal club night
13 On-air activity day
18 Construction night

Lothians RS
Mike, MM0MLB,
secretary@lothiansradiosociety.com
9 HF antennas in the hills, Andy, MM0FMF
23 A rig sequencer for £10, Pete, GM4BYF

Stirling & District ARS
Myles, MM0MYL, 0789 047 7516
3, 10, 17, 24, 31 Operating, talk and training
6, 13, 20, 2710.30am construction, projects and training

REGION 2: SCOTLAND NORTH & NORTHERN ISLES

Regional Manager: Denny Morrison, GM1BAN, RM2@rsgb.org.uk

Aberdeen ARS
Fred, GM3ALZ, 01975 651 365
3 Junk sale
10 Grampian Repeater Group AGM
17 Club photos from the last 70 years
24 Talk
31 Construction & on the air

Glenrothes & DRC
Tam, MM0TGB, 0775 352 6498
2 Radio related DVD
9 Antenna modelling
16 Construction operating (Leven)
23 ASW/radio comms
30 Club night

REGION 3: NORTH WEST

Regional Manager: Kath Wilson, M1CNY, RM3@rsgb.org.uk

Bolton Wireless Club
boltonwireless@gmail.com
14 HF Propagation, Steve, G0YKA
28 Closed

Mid-Cheshire ARS
Peter, G8HAV, 01606 553 401
2 Discussion on tents for contests
9 Accurate power measurement, G8ATB
16 HF/VHF on air evening
23 Committee meeting
30 Beer transportation

South Manchester R&CC
Ron, G3SVW, 01619 693 999
3 One-to-one Morse Lessons, Ron, G3SVW
10 Magnetic Loop Aerials, Brian, M0XAG
17 Bring and Tell evening
21 Monday Technical Forum
24 Beyond the Advanced, discussion
31 Surplus equipment sale

Stockport RS
Heather, M6HNS, 0750 690 4422
1 Radio night
7, 14 Intermediate course
10 Club net
15 NARSA prep with SRS Blackpool Team
22 Skills night
26-27 CQ WW WPX SSB 48hr contest (Peak Contest Group)

REGION 4: NORTH EAST

Regional Manager: Nigel Ferguson, G0BPK RM4@rsgb.org.uk

Bishop Auckland RAC
Mark, G0GFG, 01388 747497
3 Normal club night; training

Denby Dale RC
Darran, G0BWB, 0797 442 3227
2 Noise generators
9 Night on the air
13 WAB 80m Contest 1800-2200
15 Shooting night (note: not a Wednesday and NOT at Pie Hall)
16 Surplus sale
23 Night on the air
30 Real Ale night at The Star, Lockwood Road, Huddersfield

Hambleton ARS
Tony, G3MAE, 01609 881 530
9 Operating night
23 Data modes configuration, Brian, G3VGZ

Sheffield & District Wireless Society
Krystyna, 2E0KSH, 07884 065 375
2 Operating from DU9, David, M0GDX
9, 23 Social night
16 Designing low power portable silicon chips, Andrew Lambert
30 Meal out

Sheffield ARC
David, G6DCT, littlewood20@btinternet.com
7 Shack night operating M0RCU
14 Club night
21 Space exploration part 1, Ian, G0OUG
28 Closed

REGION 5: WEST MIDLANDS

Regional Manager: Martyn Vincent, G3UKV RM5@rsgb.org.uk

Central Radio Amateur Circle
Martin, G1TYV, 0794 802 7994
3 General meeting
5 Intermediate training and Morse
12 Intermediate exam
19 Morse
26 Foundation training

Cheltenham ARA
Derek, G3NKS, 01242 241 099
1, 8, 15, 22, 29 QRS CW, 3540-3550 8pm to 9pm
4-14 Spring Challenge, work CARA members
15 Lunch, book with G3YJE
17 Constructors' exhibition

Coventry ARS
John, G8SEQ, 0795 877 7363
4 RSGB President John Gould, G4WKL
7, 14, 21, 28 Open Net 8pm 145.375MHz FM and or 7.16MHz ± QRM
11, 18 Club Project Construction Night
25 President's Night

Gloucester AR&ES
Anne, 2E1GKY, 01242 699 595 daytime
2, 9, 16, 23, 30 Net, 7.30pm, 145.500 then move to 145.550 or nearest clear channel
7 Aviation electronics, Algy, 2E0LGW
14 Informal evening and general operating
21 Aviation engineering, Mike, G0UWU
28 Outdoor operating from Crickley Hill

Malvern Hills RAC
Dave, G4IDF, 01905 351 568
8 Optical communication, Chris, M0OLO
23 Informal

Midland ARS
Norman, G8BHE, 0780 807 8003
2 Open meeting, shack on the air and training classes
9 Committee meeting and training classes
16 Planning outside events and rally visits; training classes
20 Visit to Wythall Radio Rally
23 General meeting, shack on the air and training classes
30 Easter egg special, ragchew and training classes

Mid-Warwickshire ARS
Don, G4CYG, 01926 424 465
8 AGM
22 Used equipment & book sale/exchange

Nuneaton & District ARC
Neil, 2E0NEI, info@ndarc.co.uk
1 2m UKAC
3, 10, 17, 24, 31 Club net, 145.475MHz, 9.30pm
4 Pint & chat night (see website for details)
8 70cm UKAC
18 Antenna workshop
22 6m UKAC

Salop ARS
salopamateurradio@gmail.com
2, 9, 16, 23, 30 CW Net 4.30pm, 144.070MHz; club net 8.30pm, GB3LH
3 Natter night / committee meeting
10, 17 Natter night
24 CHIRP software for radio programming, Eamonn, M0MEB
31 Shack night with G3SRT on the air

South Birmingham RS
Gemma, M6GKG,
gemmagordon.m6gkg@gmail.com
1, 8, 15, 22, 29 Coffee morning in the shack, 11am, Visitors welcome
3, 10, 17, 24, 31 Training classes with G8OWL
4, 11 Sorting goods for Wythall Rally
7 Work in the shack
14 Work in the shack + planning rally stand
19 Loading trailer for Wythall Rally
20 Club stand at Wythall Rally
21 Unloading trailer and rally debrief
25 Checking equipment for field day
28 Closed

Stratford upon Avon & District RS
Clive, G0CHO, 01608 664 488
14 Early British radar and the Battle of Britain, Paul
28 Video

Sutton Coldfield ARS
Robert Bird, spirit.guide@hotmail.co.uk
7, 21, 28 Open net on ±145.250MHz from 7.30pm
13 Visit to Wythall Rally
14 Club meeting
15 Open net on 70.475MHz FM from 7.30pm
29 DMR open net, GB7FW slot/local2 from 7.30pm

REGION 6: NORTH WALES

Regional Manager: Liz Cabban, GW0ETU
RM6@rsgb.org.uk

Dragon ARC
Stewart, GW0ETF, 07833 620 733
7 Refurbishing an Atlanta receiver, John, GW3VVC
21 Discussion night/club matters

Wrexham ARS
Eifion, mw6eyu@gmail.com
1 AGM

REGION 7: SOUTH WALES

Regional Manager: Jimmy Sneddon, MW0EQL
RM7@rsgb.org.uk

Aberystwyth & DARS
Ray, GW7AGG, 01970 611 853
10 The eclipse and other research by the University team
31 Net on 145.500 then 145.550MHz

Llanelli ARS
Craig, MW0MXT, 01269 845 773
1 GB4SDD on the air (special event for St David's Day)
7 GB4SDD on the air & club raffle
14 GB4SDD on the air & DVD night
21 GB4SDD on the air & junk sale
28 Closed

REGION 8: NORTHERN IRELAND

Regional Manager: Philip Hosey, MI0MSO
RM8@rsgb.org.uk

Greenisland Electronics ARS
Ken, GI6KDN, 0747 580 0015
7 Digital mobile radio, John, GI4BWM

Mid Ulster ARC
Dave, muarc.secretary@yahoo.co.uk
1 Open social night
15 Club antenna build night followed by tea and crumpets

REGION 9: LONDON & THAMES VALLEY

Regional Manager: Larry Smith, G4OXY
RM9@rsgb.org.uk

Bracknell ARC
Andy, M0HAK, andy@m0hak.co.uk
2, 16, 23, 30 Club net starting at 8pm, 145.375MHz
9 Club night

Burnham Beeches RC
Dave, G4XDU, 01628 625 720
7 AGM followed by wine & nibbles
21 Logging programs, G0SKA / G4XDU

Edgware & DRS
Mike, G4RNW, 02 08950 0658
10 Station on the air
24 Preparing for 6m Es, Steve, G0PQB

Harwell ARS
Malcolm, G8NRP, 01235 524 844
10 Show and tell evening

Newbury & DARS
Rob, G4LMW, 01635 862 737
23 Construction contest

Reading & DARC
Pete, G8FRC, 01189 695 697
10 Transmission lines explained, Alan Parkin of Alton Antenna Arrays
24 Spring junk sale

Shefford & District ARS
Paul, G1GSN, 0787 668 5827
3 AGM
10 Principles of fire investigation, Martin, M6SCI
17 Local industry, Brian, G8GHR and Ian, G3ORG
24 Maundy Thursday
31 Bats in beds, Dr Gill Clough

Southgate ARC
Mr K Mendum, G8RPA, g8rpa@arrl.net
9 Spring surplus/junk sale

Verulam ARC
Peter, G4HSO, g3v@btinternet.com
10 Social with GB3VH repeater group, 7.30pm, Rose and Crown, Sandridge
15 Practical evening by Greg, M0PPG

REGION 10: SOUTH & SOUTH EAST

Regional Manager: Michael Senior, G4EFO
RM10@rsgb.org.uk

Basingstoke ARC
Peter, G0KQA, 01256 414 454
17 Amateur radio on the ISS, Tim Peake on a TV near you, Noel, G8GTZ

Bromley & DARS
Andy, G4WGZ, 01689 878 089
2, 9, 16, 23, 30 Club net, 145.500MHz (and QSY), 9pm
13 Intermediate course and exam
15 Fix-it evening

Coulsdon ATS
Mike Buckley, M1CCF, 020 8654 2582
14 RAYNET presentation by Ian Jackson, G8RWH South London Co-ordinator

Crawley ARC
John, G3VLH, 01342 714 402
23 British amateurs' equipment from the late 1940s to the 70s, Keith, G3VKW

Cray Valley RS
Richard, G7GLW, 0783 171 5797
3 Construction contest
17 Movie talk, Paul, G4DCV

Darenth Valley RS
Mike, G8AXA, 01689 856 935
9 On the air & FT-897 operation, Mark, G8PHN
23 The story of bringing the Canadian Lancaster to England

Dorking & DRS
David, M6DJB, djb.abraxas@btinternet.com
22 My time at the BBC, Tony Crake, G0OVA

Eastbourne Electronics & Radio Club
Peter, g4urt@btinternet.com
14 Project/demo
28 Closed

Echelford ARS
John, G4GSC, 01784 451 898
10 Construction contest
24 On air/CW practice/bring & buy/natter night

Hastings E&RC
Gordon, 01424 431 909,
23 Spectrum utilisation efficiency – 4G and beyond, Ian Clark

Hilderstone R&EC
Ian, M6WFI, hilderstoneclub@gmail.com
10 Natter night
11 British Science Week at Wellesley House school
13 Dover Rally
24 Talk

Horndean & DARC
Stuart, G0FYX, 02392 472 846
3 Natter night/social evening
17 HMS Belfast, Doug, G4BEQ

Horsham ARC
Alistair G3ZBU, 0785 526 8666
3 Club meeting and junk sale
17 Social at the Star Inn, Rusper

Itchen Valley ARC
Quintin, M1ENU, 02380 787 799
4, 18 Club net on 145.525MHz, 8pm
11 AGM
25 Members' forum

Mid-Sussex ARS
Sue, G6YPY, 01273 845 103
4, 18 Radio night and table top sale
11 Bat talk by Amanda Millar

Surrey Radio Contact Club
John, G8IYS, 020 8657 0454
3, 10, 17, 24, 31 Net, 70.300MHz 8pm
4, 11, 18, 25 Net, 145.350MHz 8pm
6, 13, 20, 27 Net, 1905kHz, 9.30am
7 Spring Surplus Equipment Sale
21 Chat & fix-it, John, G8MNY

Sutton & Cheam RS
John, G0BWV, 0208 644 9945
17 The GB3XP repeater project, Neil, M0ZEY

Worthing & DARC
Al, M0OAL, information@wadarc.org.uk
2 Kit night
3, 10, 17, 24, 31 40m net, 11am
6 Sunday breakfast, 9am
6, 13, 20, 27 80m net, 7.30am
7, 14, 21, 28 2m net, 7.30pm
9, 30 Club evening
15 Committee meeting
16 A bit of a secret, Bryan, G3GVB
23 Quiz night

REGION 11: SOUTH WEST & CHANNEL ISLES

Regional Manager: Pam Helliwell, G7SME
RM11@rsgb.org.uk

Callington ARS
John, G4PBN, 01822 835 834
2 Club night and rally preparation
20 Callington Rally

Cornish RAC
Steve, G7VOH, 01209 844 939
2 Committee meeting
3 Main meeting
17 Club evening

Exeter ARS
Nick, M0NRJ, 01363 775 756
1 GB3EX UHF repeater net, 7.45pm
8 GB3EW VHF repeater net, 7.45pm
14 Choosing the club's QSO logging software, Linden, M0TCF
15, 22, 29 Club net, 145.575MHz, 7.45pm

Mid-Somerset ARC
David, G8BFV, 01749 670 085
8 Work on shack/planning for British Science Week

North Bristol ARC
Mat, G7FBD, g7fbd@gb3bs.com
4 USB SDR Dongle panadapter talk part 2
6, 13, 20, 27 Open net on GB3BS, 7-8pm, SouthWest Cluster experimental DMR open net (Slot 2, Talk Group 950), 6-7pm, GB7AA, GB7BS, GB7FI, GB7JB, GB7SD and GB7DR plus GB7CW, GB7KT and GB7MJ. The organisers wish to point out that the SouthWest Cluster network is independent of the DMR-marc network
11, 18 Relax and chat evening + operating & training
25 Closed

Poldhu ARC
Keith, G0WYS, 01326 574 441
8 The St Erth WW2 DF station, Mike Griffiths

Saltash & DARC
Mark, M0WMB, 01752 215 546
3 Submarine life, Kit Keathy
17 Operating

South Bristol ARC
Andrew, G7KNA, 0783 869 5471
3 Maritime radio, Martin, 2E0EUW
10 DVD Night - The Secret War Episode 4 of 6
17 Table top sale, no trading before 8pm
24 DX Challenge Martin, 2E0EUW
31 Open house and on air night

Torbay ARS
Dave, G6FSP, g6fsp@tars.org.uk
4 Club night
11 Club night with business meeting
18 Presentation night
25 Closed

Yeovil ARC
Rodney, M0RGE, 01935 825 791
3 The Rybakov aerial, G3ICO
10 Mini talks
17 Tuned circuits, G3MYM
24 Morse practice, G3MYM
31 Station on the air

REGION 12: EAST & EAST ANGLIA

Regional Manager: Steve Thomas, M1ACB
RM12@rsgb.org.uk

Cambridge & DARC
David, M0ZEB, 01353 778 093
11 5MHz NVIS propagation, Marcus, G0IJZ

Chelmsford ARS
secretary@g0mwt.org.uk
1 Planning permission by Peter, M0PSD
21 Skills night at Danbury Village Hall

Colchester Radio Amateurs
Stefan M0XLB, 0777 161 6676
19 SWR theory

Felixstowe & DARS
Paul, G4YQC, pjw@btinternet.com
7 Essex CW ARC visit
21 Members' show & tell

Norfolk ARC
Chris, G0DWV, 01603 898 678
2 Home construction competition
9 Codes and ciphers by Eddie Erbes
16 Informal
23 Forum
30 Informal / Bright Sparks

South Essex ARS
Terry, G1FBW, 0798 607 0040
8 Talk with Roland, M0BDB County Controller of RAYNET and Steve, M1ACB, RSGB Regional Manager

Thanet Radio and Electronics Club
targradio@outlook.com
4 Club night
11, 25 Club net on GB3DA
18 Construction evening

Thurrock Acorns ARC
Gordon, 2E0ELI, acorns@taarc.co.uk
25 AGM and social evening
26 Essex 2m activity afternoon
17 To the moon and back, Sam Jewell, G4DDK
24 Informal / Bright Sparks

Norfolk Coast ARS
Steve, G3PND, info@norfolkcoastamateurs.co.uk
4 Constructing baluns
11 Phased vertical antennas
18 Satellite operation
25 Planning 2016 events

South Essex ARS
Terry, G1FBW, 0798 607 0040
7 Canvey Radio and Electronics Rally

Thurrock Acorns ARC
Gordon, 2E0ELI, acorns@taarc.co.uk
16 Con-fused-d? Steve, G4HXK

REGION 13: EAST MIDLANDS

Regional Manager: Steve Boden, G4XCK
RM13@rsgb.org.uk

Lincoln Short-Wave Club
Pam, G4STO, 01427 788 356
1, 8, 15, 22, 29 UK Club Contests
2, 19 Shack activities and G5FZ on the air
3 Club net via GB3LM, 8pm
5 Saturday surgery + G5FZ on the air
9 Demonstration of digital modes
10, 17, 24, 31 Club net 145.325MHz, 8pm
12, 16, 26 Shack activities + G6COL on the air
21 Committee meeting
23 Formal meeting
30 UKCC
30 Arduino, Ian, G4XFC

Loughborough & DARC
Chris, G1ETZ, 01509 504 319
1 Baluns, Andrew, G7SEG
8 Internet video night
15 Construction night
22 Vintage computers show and tell
29 Practical evening

Melton Mowbray ARS
Brian, M0YBX, 0777 265 9622
18 Software for hardware 2

RAF Waddington ARC
Bob, G3VCA, 0797 116 6250
7, 14, 21, 28 Club net, 145.325MHz, 8pm

South Normanton Alfreton & DARC
A Lawrence, 2E0BQS, 0115 930 7322
7 Talk by Ray Dring
14 Natter night
21 Junk sale
28 Informal bar meeting

Spalding & DARS
Graham, G8NWC, 01775 760 832
18 High altitude balloons, Andrew, M0NRD

Worksop ARS
Paul, M0PJA, 0789 062 6684
1, 8, 15, 22, 29 Club night, UKAC
3 Talk on sport radio
6 YPF exam + Advanced training
10, 24, 31 Technical night, construction, CW tuition, radio operation, data modes
13, 20 Advanced training
17 HF propagation & VOAprop revisited; technical night
18-20 Camping weekend
30 Meal at the Lock Keeper

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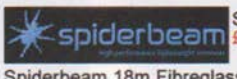
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EVENTS ROUNDUP

REGION 2: SCOTLAND NORTH & NORTHERN ISLES

Dundee ARC would like to congratulate their newest members Maria, MM6GYL, Rolfe, MM6GHX, Wayne, MM6GID and George, MM6GZS on passing their Foundation licence.

REGION 3: NORTH WEST

12 members of **Furness ARS** braved the wind and rain to attend the last 'practical' meet of the year, a round table discussion on 'How I Got Into Amateur Radio'. Club members told stories and anecdotes of their time in radio and it was interesting to see so many different routes into the hobby and some similarities where the hobby had taken a back seat for a few years due to family or work commitments. Many 'old school' rigs were mentioned prompting a few nod and mutters from fellow members who had used them over the years. Some even brought props to show their time in the hobby. It was a fun and entertaining evening that may result in similar discussions in the future.

REGION 5: WEST MIDLANDS

Midland ARS celebrated more examination passes when Bryan Romans and Seb Ballard passed their Foundation licence, thanks to Paul Vickers, their tutor. Congratulations to both. The club also has a new website at www.midlandars.org.uk. The aim is to offer useful resources for amateurs new and old alongside club news and information.

The amazing interest in Tim Peake's mission on the ISS is keeping the **Hilderstone RC** busy with enquiries from schools. The pupils of Monkton C of E Primary school were thrilled to receive a message from space when they picked up the signal from a passing amateur radio satellite. They calculated the orbital period from the variations in the satellite's temperature as it passed from sunlight into the Earth's shadow, taking 97 minutes to orbit compared to Tim's 93 minutes. The club also provided three handhelds to the excited year 2 pupils of St Mildred's Primary Infant school so that they could hear Tim's voice live when he answered the pupils' questions from Sandringham school.

At the AGM in December the **Cheltenham ARA** 2016 Committee was elected: Tony, G3YYH (Chairman), Derek, G3NKS (Secretary), Peter G3YJE (Treasurer), Christopher, M0YNG, Giles, G0NXA and James, 2E0GEL. Plans for 2016 include a Spring On-the-Air Challenge, a Dinner, two fun field days, assisted construction evenings and more training courses.

REGION 8: NORTHERN IRELAND

On 17 March people worldwide will be celebrating St Patrick's Day. If you wish to join the fun on air then consider participating in the annual St Patrick Award. For more details go to http://stpatrickaward.webs.com/

Bangor & DARS held the annual quiz ably hosted by Peter, MI0HWG (quizmaster) and Merrill, GI6JGB (scorer). A great evening's entertainment was had. The March meeting is an open meeting in which the public will be invited to see something of what radio amateurs do. Already an amateur in the area? Come along and meet some old friends. www.bdars.com

In 2015, **Grey Point Fort ARS** members Phil, MI0PWH, Stephen, GI4RNP and Thomas, MI0MOD (l-r) attended a ceremony at Parliament Buildings in Stormont to receive an award for Community Contribution to Tourism in 2015 by Tourism Northern Ireland. They were nominated for this Coca Cola sponsored award by the Northern Ireland Environment Agency's local warden at Crawfordsburn Country Park for their voluntary work. This is the second national award they have received in 2015 recognising the hard work and dedication of the radio club and its members within both the local and amateur communities.

REGION 9: LONDON & THAMES VALLEY

Banbury ARS has made a donation to the local Katherine House Hospice from the proceeds of a local silent key's equipment sale. It is often difficult for close family to know how to deal with technical possessions and the club was contacted Mike Hall, 2E0MBJ's family. The photograph shows the donation of £380 being made by Mrs Hall (left) to Mrs Cross from the Hospice, accompanied by John, M1CNJ, John, G8OZH, Paul, G1BZM and Phil, M0PSC. Mike had been an active member of the club for a number of years and although the sale of personal property is always tinged with sadness it is good to see it purchased by younger members who will learn to take care of the equipment and continue put it to good use.

REGION 10: SOUTH & SOUTH EAST

The **Hastings ERC** invites anyone interested in telecommunications to their meeting on 23 March at the Taplin Centre to hear Ian Clark's talk 'Spectrum utilisation efficiency – 4G and beyond'. Ian spent 26 years with BT International responsible for maintenance, installation and design of international transmission networks and systems operating over satellite and submarine optical fibre cables. Now he specialises in radio, fibre optic transmission systems, data communications and mobile technologies including GSM, GPRS, UMTS and LTE. All are most welcome.

REGION 11: SOUTH WEST & CHANNEL ISLES

Dave, G4CXQ has retired as the chairman of Weston super Mare RS after 8 years. When he retired from Ofcom as Operations Manager for the Southwest in 2005, he rejoined the long established club when there was a membership of 6. By 2007 the club had moved into the Weston Social Club with its excellent facilities and under his leadership, membership gradually increased. The club now has 67 members. With help from colleagues he has run Foundation and Intermediate exam courses and encouraged several juniors to get their licences. He has been responsible for the club website and ensured that the club enters the various RSGB VHF CW SSB and data contests and kept the society in the public eye locally. The new chairman is Mike Jones.

Riviera ARC meets in Torquay on the 1st and 3rd Thursdays at the Acorn Community Centre, Lummaton Cross, Barton, Torquay from 7.30pm. Everyone is welcome. Nets run twice a week on 2m, details at www.rivieraarc.org.uk

REGION 12: EAST & EAST ANGLIA

The year has started well for the **Essex Ham** team with over 30 students enrolling on the 10th online Foundation course. The January Essex Skills Night marked the two-year anniversary of what has become a very popular event. Over 70 people came along for the usual mix, which this time included antenna construction, a live CW station, DMR and D-Star demos, handheld programming, an mcHF QRP transceiver, a Raspberry Pi Zero showing video highlights from 2015, as well as live APRS using a KISS TNC on an Arduino. Special appearances, courtesy of Andy, G7TKK were a rare Sinclair MK14 prototype and a Jupiter Ace computer. The photo shows the construction room with Steve, G4GHO supervising.

South Essex ARS recently completed its second Foundation training course, welcoming more amateurs to Region 12. Well done to the successful candidates and the SEARS training team.

Around 20 **Thurrock Acorns ARC** members listened to Darren, 2E0OCA give a presentation on astronomy. The lecture touched on many areas including sun spot cycles and how far a radio signal will travel around the world. He showed some pictures he had taken of Saturn, the Moon and other planets. Previously, Darren had recorded some noises from outer space that he played to the group. After the event everyone commented how interesting the talk was.

The 106 (Orsett Hundred) Air cadets are celebrating the success of four of their cadets who recently passed the Foundation exam. The cadets had to attend a weekly course and complete online modules as well as a training weekend that was organised by Thurrock Acorns ARC. Their commanding officer Flt Lt Darren Attersley RAFVR, who is also licenced, said that he was delighted to see the cadet's work hard and reach the necessary standard to pass the exams.

Last October, 12 year old Louis Newton visited Jamboree on the Air run at the 1st Grays Scout HQ. Little did Louis know the impact this visit would make on his life. While there he saw the radio equipment and the operators talking to both UK and overseas JOTA stations. As he sat there watching he became fascinated and wanted to know more and decided he wanted to obtain his licence. He embarked upon the training needed including online modules and a training weekend before taking the exam. He was ecstatic when the letter arrived advising him that he had passed and is now busy talking on the airwaves after getting his licence. His next challenge is to erect an antenna that will enable him to communicate around the globe.

Loughton & Epping Forest ARS congratulate Gavin, MOHYF, Takis, MOPNB and Alan (new callsign pending) for passing their Advanced exam and also Karl, MOZRX for passing the exam at Harwell ARS. Alan went from attending the club's 32nd Foundation course and passing the exam on 20 September to sitting and ultimately passing his Advanced exam in just 78 days. There will be an Intermediate practical assessment course and exam on 6 March. Please contact Marc for more details on 0208 502 1645.

In December candidates simultaneously sat the Advanced, Intermediate and Foundation exams at **Chelmsford ARS**. All those who sat the Foundation and Intermediate, received indicative passes there and then, whilst those who sat the Advanced had to wait a while for the results. One notable result was Kristian, 2EOSSX, who sat the exam at short notice. He was sitting in on the training sessions as an observer when he found he could have passed, if the mock exam he took had been real. He hastily arranged to sit the Advanced exam and is now MOSSK.

The end of 2015 involved a Christmas party and a natter night for **Braintree & DARS**. The party involved a quiz and plenty to eat and talk turned to the hobby. In this the club's 40th year, the construction challenge and how they can involve young people was a hot topic, which was discussed again at the natter night. In 2016, the first meeting was a natter night and a showing of TX Factor 9. This episode covered amateur radio in Essex. Later in the month was dedicated to PAT testing. Dave, G0DEC brought along test gear and, with help, got on with it. Mains extension leads, equipment power leads and anything that is connected to mains power was tested. No problems were found so all items were labelled as such ready for the special event season.

Following the success of their Intermediate Practical Workshops in 2015, Chelmsford ARS are now holding Foundation Practical Workshops spread over two Thursday evenings. These short sessions cover all the Foundation practical assessments such as Station Build Setup, VHF Radio, HF Radio and Morse. They are ideal for those who are not able to attend traditional weekly class-room based courses and may instead have opted to study at home using an online training course. http://g0mwt.org.uk/training

Dengie Hundred ARS chairman Dr David Kirkby, G4WRB gave a talk and demonstration of Virtual Computers to members. This is a real boon to those who need to work on computer controlled equipment that could be old, obsolete or indeed bang up to date. Using proprietary software such as Virtual Box, which is open sourced, another suitable computer can install and emulate other existing operating systems. The emulating computer can be switched backwards and forwards between operating systems very conveniently, emulating a selected operating system, which allows it to able to interface with old, obsolete or modern pieces of equipment that need repair or calibration for example.

REGION 13: EAST MIDLANDS

Following the AGM, South Kesteven ARS has expanded the committee appointing Stewart, M0SDM as event coordinator and Konrad, M0KVF as training officer. The club has secured a new meeting venue at the 47F Grantham ATC Squadron HQ and hope to register it as an exam centre and will soon be offering training courses. Meetings are now the first and third Friday in the month. Contact and further details are on the club website www.skars.co.uk

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Text Messaging example

DR function setting example

Repeater map example

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Classified Ads

For Sale

FIBREGLASS TUBE
High strength tube, square box, rod, and other sections all from stock in 6m lengths. Engineered Compositions, Chester. Tel: 01244 676000 e. barbara@engineered-composites.co.uk www.engineered-composites.co.uk

SINOTEL UK - AUTHORISED UK
importers of Baofeng & TYT handhelds, Xiegu X108G HF transceivers. Accessories, antennas and more. www.sinotel.co.uk, 01926-460203, sales@sinotel.co.uk

CTCSS ENCODER AND DECODER KITS,
DTMF Kits and Modules, PIC Microcontroller Development Kits. www.cstech.co.uk

NEW SUPER STABLE RTL-SDR USB STICK
with 1ppm TCXO, upgraded R820T2 tuner chip, SMA antenna connector and metal case. Buy direct from our new web shop for extra discount and options or via eBay. Windows 10 ready CAT, CI-V & programming cables and more great items at www.technofix.co.uk

Wanted

VINTAGE RADIO & VALVES WANTED
national cash settlement for silent key, shack clearouts 07552 678725, vintageradio@btinternet.com

Equipment

REPAIRS TO RECEIVERS, TRANSMITTERS
New/Old, valve/transistor. Call 07903 023437 for details: www.kent-rigs.co.uk

RELIABLE REPAIRS
For all amateur and vintage equipment. Professional service, reasonable rates. Call: 07500 474225
E: radiorepairs@btconnect.com

Aerials

M0CVO ANTENNAS
For all your amateur radio antenna needs. Full details at: www.m0cvoantennas.com

WESTERN HF 10
67ft wire dipole 160-6m, full details lookup m0bzi at: www.qrz.com buy direct: m0bzi@hotmail.co.uk or 07748331458 reviews at: http://g0kya.blogspot.com/2010_08_01_archive.html **or** http://www.eham.net/reviews/detail/9424

G4TPH MAGLOOPS BACK IN PRODUCTION.
Remote tune and manual tune models for 40m through 10m. Details at www.g4tph.com

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Miscellaneous

ALL UK STATIONS – CALL IN ON OUR 'M1CRA' CHRISTIAN NETS!
WACRAL welcomes all amateurs to our Sunday morning 'GOOD NEWS' NETS, now at 0730-0830AM on 3747Khz and, again, at 2pm on 3747or 7147Khz. Our 2m SSB net at 3pm is held on144.205. Or, do join us on Wednesday evenings at 9.30pm, 3747Khz , for nationwide Christian fellowship and relaxed chat. See www.wacral.org for more net info and WACRAL details or just call G4OPP on 01622 746650 or g4opp@wacral.org

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will pay cash and collect from anywhere call Tony - 07956 506300 Licensed explosive storage

PAFOS, CYPRUS.
Pafos, 2 bed villa. Simple HF station 300m ASL. www.domsvilla.co.uk

Computer So tware

SD - EI5DI'S CONTEST LOGGER.
Supports all RSGB HF contests and 2016 rules. €20. www.ei5di.com

Classified advertisements 58p per word (VAT inc.) with a minimum of 14 words £8.12. All classified advertisements must be prepaid. Please write clearly. No responsibility accepted for errors. Latest date for acceptance is 1st of the month prior to publication
Payment to: RSGB, 3 Abbey Court, Priory Business Park, Bedford, MK44 3WH

Advertising. All display and classified advertising enquiries (except Members' Ads, which go to memads@rsgb.org.uk) should be sent to: Chris Danby, G0DWV, Danby Advertising, Fir Trees, Hall Rd, Hainford, Norwich, Norfolk NR10 3LX
Tel/Fax 01603 898 678
e-mail adsales@rsgb.org.uk

Business Cards

Adertisers Index

RadCom

HF F-Layer Propagation Predictions for March 2016

Compiled by Gwyn Williams, G4FKH

	3.5MHz	7.0MHz	10.1MHz	14.0MHz	18.1MHz	21.0MHz	24.9MHz	28.0MHz
Time	000011111220	000011111220	000011111220	000011111220	000011111220	000011111220	000011111220	000011111220
(UTC)	246802468020	246802468020	246802468020	246802468020	246802468020	246802468020	246802468020	246802468020
*** Europe								
Moscow	76.....666	66.....666	..6.....66..	..455555621.	..25656631..	..1346642...	...123321...	...12221....
*** Asia								
Yakutsk	2.....24.3	3221...23444	..2211.1.11.	...32.....	.....	.....	.....	.....
Tokyo	.....33..	.....454..	.....23431.	....2222....	....21.....	....1.....	.....	.....
Singapore	.....3...	.....54.3	.....3553.2	.....3431..	.....2332...	.....122....	.....1.....	.....
Hyderabad	.....2..3	4.....45.4	.....454.2	..1...2441..	...11.342...	...22232....	.....11.....	.....
Tel Aviv	66.....66	66.....666	6.6.....6666	1.5544455243	..2554552...	...33333....	...11121....	.....
*** Oceania								
Wellington	.....	.....45...	...233.45...	...233.34...	...133..1...	....21.....	.....	.....
Well (ZL) (LP)	.....	..4.....	124.....	1121.....2.	...1.....1.	.....	.....	.....
Perth	.....2..	.....354..	.....4.431	.....23.2..	.....121....	.....11.....	.....	.....
Sydney	.....2..	.....4.4..	.....35.3..	.....233....	....1122....	....1.1.....	.....	.....
Melbourne (LP)	.....	..24.....	..141.....	...32.....	...21.....	.....	.....	.....
Honolulu	.....	..231.....	...321.....	....1.....	.....	.....	.....	.....
Honolulu (LP)	.....	.....	.....	.....2...	.....2...	.....2...	.....2...	.....1...
W. Samoa	.....	..1.....	....3221....	....2331....	....122.....	.....11.....	.....	.....
*** Africa								
Mauritius	.....3.3	4.....25554	2.....45433	.....4421.	.....33...	.....1121...	.....11....	.....
Johanesburg	33.....343	44.....5555	33.....5544	..1....25432	...1..1342..	...1112331..	...111222...	....1111....
Ibadan	555.....555	6563....3665	54642...4655	2.3532235531	...5433453..	...5444451..	...234432...	...122221...
Nairobi	.....4..	552.....3555	424.....4544	..422..355..	...322244...	...332342...	...12.11....	....1.....
Canary Isles	666.....66	777.....677	6666.....776	323655455753	111665566621	1..66656641.	...3666662..	...2343431..
*** S. America								
Buenos Aires	333.....3	5441.....44	3333.....33	1..2.....22.	....1....1..	.....1..11..	.....	.....
Rio de Janeiro	333.....3	555.....245	4332.....444	21.1.....431	....21.123..	....211122..	....11111...	.....1.11...
Lima	3.3.....	4434.....3	2214.....2	...2.....	.....1.....	.....	.....	.....
Caracas	4442.....3	4444.....34	21142.....32	....22...21.	.....32121..	.....3222...	.....	.....
*** N. America								
Guatemala	333.....	4334.....3	21141.....12	...1.1.....	.....111...	.....111...	.....	.....
New Orleans	3332.....1	43431.....3	...1.....1.	.....11.....	.....211...	.....	.....	.....
Washington	45541.....3	555431....24	2...32111232	.....32223..	.....23331..	.....222...	.....	.....
Quebec	.553.....3	45542....134	1...32111231	.....32233..	.....1333...	.....11...	.....	.....
Anchorage	..3.....	..3.....	.....11..	.....	.....	.....	.....	.....
Vancouver	.33.....	.2331.....1	.....	.....1...	.....	.....	.....	.....
San Francisco	.3.....	.3331.....1	1..2.....	.....	.....1...	.....	.....	.....
San Fran (LP)	.....	.....	.....	.....1....	.....2....	.....21...	.....11...	.....1....

Key: The figures represent approximate S-meter readings, whilst the colours represent expected circuit reliability. **Black** equals low to very low probability, **Blue** equals good probability and **Red** equals a strong probability. No signal is expected when a '.' is shown. The RSGB Propagation Studies Committee provides propagation predictions on the internet at **www.rsgb.org.uk/propagation/index.php**. An input power of 100W and a dipole aerial has been used in the preparation of these predictions; therefore a better equipped station should expect better results. The predicted smoothed sunspot numbers for March, April & Mary 2016 are respectively (SIDC classical method – Waldmeier's standard) 51, 49 & 45 and (combined method) 62, 62 & 62. The provisional mean sunspot number for January was 56.6. The daily maximum / minimum numbers were 95 on 9 January and 32 on 31 January.

FREE MEMBERS' ADS OF UP TO 40 WORDS

Send Members' Ads by e-mail to memads@rsgb.org.uk including your **name, callsign, contact info & location** (these details are not counted in the 40 word limit). Max 1 ad per Member per month; other important terms & conditions apply (see *RadCom* February 2016 p93).

FOR SALE

£10 SALE! Pye Hi Band Europa, BSX2 Packet TNC, 3x 25pF 10kV caps, 70cm repeater cavity, 10m FM transceiver, 30W 10M PA, BGY22 / BGY23 UHF 12V PA modules. £10 any item! Adrian, G4UVZ, 07778 523 832, adrianwhatmore248@btinternet.com (Taunton).

3-ELE STEPPIR YAGI antenna, £1500 ONO. PRO. SIS.TEL antenna rotator, £400 ONO. With 100ft cable/UR67, all currently sited on a 60ft standard Versatower. Peter, 0797 466 8239. Harold, G4LFB (Sandy).

4 SECTION TELESCOPIC, mechanically operated, motorised mast. Self supporting, square, hardened aluminium. Bottom wall thickness 5mm, SS fittings. Controlled with 12V DC motor. Fitted with 2 winches and suitable gearbox. Designed for 20m beam. Collapsed: 20ft, extends to >50ft, £275. Jon, G4BYW, 01484 540 867, g4byw@talktalk.net (Huddersfield).

60A SWITCH MODE power supply QJE PS60SW3. Surplus to requirements. As new and boxed. £85 + postage (heavy). Jonathan Kempster, M5AEO, jonathan.kempster@gmail.com (London).

CRYSTALS. 62 off, inc FT243 (21), WWII (10) (grind your own!), glass encapsulated (31), oven, sockets. Frequencies include 10kHz, 100kHz (3), 200kHz, 300kHz, 500kHz (3), 5MHz & 10MHz. £15 + £7.43 P&P. Oli Twist, G3NFY, 01643 706 823 oli.g3nfy@googlemail.com (Minehead).

CUSHCRAFT A3 10/15/20m Yagi, £150. Cushcraft A3WS 12/17m Yagi, £150. Yaesu G-1000dxc rotator, £250. All in good order. Ivor, G4YIT, 01733 840 268 (March, Cambs).

DOWN SIZING HOME, need to dispose of probably the largest junk box in the UK comprising many radio bits and pieces. Too many to list in detail. You name it, I have probably got it! Enquiries to Roger, GW3SPA on 02920 707 794, roger@albanr.fsnet.co.uk (near Cardiff).

EDDYSTONE 680X RECEIVER, £55. Eddystone 688 speaker, £65. GEC BRT 400 receiver, £65. Skanti R5000 receiver, £95. ITT 3020A receiver, £125. All working but not perfect. All ONO. Buyer inspects and collects. Rodney, 01692 630 067, rodneysparrow@btinternet.com (Norwich).

G3PAI's COTTAGE in rural Burgundy. No charge, just donate what you feel able to Combat Stress (www.combatstress.org.uk). See www.charity-cottage.org.uk for details. John, G3PAI / F5VLF, +33 386 20 25 50 (58800 CERVON).

G3YFW's STATION; untested/unused 30+ years: Icom IC-745, IC-PS15 PSU, IC-SP3, IC-AT1000, mic, ETM2 Keyer, FL30HA, leads, manuals. Little used, original boxes, £350. Codar RQ10 & CC40, £20. R206 Mk1, £80. Rare B28 (xtal Tx), £80. Collins TCS Rx/Tx, HB-PSU, £100. Keith, G3RPB, 01473 737 584, keithg3rpb@btinternet.com (collect from Woodbridge, Suffolk).

ICOM IC-28E FM mobile xcvr. Complete, but has Rx audio fault. Modified for narrow deviation. No CTCSS. FREE – buyer collects. Alastair, G3ZHZ, 01323 484 189 (QTHR, Eastbourne).

ICOM IC-4KL 1kW HF linear amplifier with remote. As new, in original box. One owner, used once (few hours) then stored. Perfect condition/working order. OFFERS. 40kg weight. Collection preferred although nearby delivery possible. Anthony Bellingan, MODEM, 0777 208 2238, admin@smartbarns.com (Egham, Surrey).

ICOM IC-7000 transceiver, with unused mobile mount, £785. Smart Power Cube SG-500, 500W HF auto PA with manufacturer's 50A PSU and fan kit, £800. Yaesu G1000DXC rotator, £300. MFJ994B 600W auto tuner, £250. Prefer buyer collects. Tony Lord, G8DQZ, 0778 532 3839, tony@g8dqz.co.uk (Suffolk)

ICOM IC-7000, VGC, remote head cable and mounting bracket, microphone, mobile mounting bracket, handle, MB-65 mount, 5MHz mod, manual, Nifty Guide, LDG ATU with cables. Original packaging, non-smoker, little used. £700 ono. Buyer collects or carriage at cost. G3ZUM, 07931 360 160, brian.lonnon@tiscali.co.uk (Birmingham).

ICOM IC-706 HF/VHF rig with DC power lead and HM103 hand mic, £250. Kenwood TM-271E VHF mobile 60/25W, £80. Both rigs excellent condition, boxed, manuals. Postage extra. Brian, G4HIY, brian.burke2@btopenworld.com, 01325 721 668 (Darlington).

ICOM IC-746 HF, VHF & 6m transceiver. Mint condition. Non smoking owner from new. Includes mic, manual, power lead, £475 + postage. Dave, G4GWG, 01942 211 397, daveg4gwg@gmail.com (Wigan).

MINT YAESU FT-1000MP MARK V. Classic top line radio, 200W power, Class-A SSB, internal ATU, interlocking digital bandwidth tracking. Elite-class DX or contest operators. Silent Key estate, radio has been checked out by Castle Electronics, passed mint. Bargain, £725. Glyn, GW0ANA, glyndxis@talktalk.net (Vale of Glamorgan).

RANGER 811H amp fitted with 572b valves. Purchased, refurbished 2 years ago, been used twice. It is in excellent condition. Purchaser must collect or arrange own transport. Offers over £700. Serial no R16810108. Peter, MOKEF, 01332 544 606, peter.m0kef@gmail.com (Derby).

SHACK CLEARANCE. Components, valves, radios, test equipment, power supplies, TNCs etc. Mostly valve era. One lot, free for collection. Pat Darragh, G3MNV, 01237 474 564 (N Devon).

SHACK/COMPUTER LAB CLEARANCE. 40 years worth of varied radio / telecomms / computer kit to re-locate – much free, or no reasonable offer refused; far too much to detail. Martin, G5FM, 01458 832 1103, g5fm@martinwheeler.net (Glastonbury).

SPE EXPERT 1K-FA linear amplifier, occasional use only, immaculate condition, £1995. Palstar AT2KD ATU, as new, £350. Prefer buyer inspects and collects. Rob Stratford, G6BDV, 01582 458 964 (Slip End).

TOPWARD 7045 40MHz scope, free to good home. Good tube and main transformer but wants attention. Mike, G3TOI, 01202 419 394 (Bournemouth).

TWO 6KD6 VALVES by Toshiba for FT401, FT501 and FT560 high power transceivers. Brand new in original boxes, old stock. £29 the pair plus P&P. David, G3ZPA, 01908 501 310 (Milton Keynes).

YAESU FC901 antenna tuner, including manual, £90, buyer collects (weight 13 lb). bhi Radio Mate for FT-817, FT-857, FT-897, £60 + P&P. Ian, GM3GTQ, 0141 563 5072 gm3gtq@yahoo.co.uk (Glasgow).

YAESU FL-50B Rx, £70. Yaesu FT/FP200 TRx/PSU, £110. Yaesu VR-5000 Rx, £350. Datong FL-1 filter, £40. Nigel, G4KZZ, 01723 890 786, nipro@btinternet.com (Filey).

YAESU FT-817ND HF/VHF/UHF transceiver plus LDG ATU, both boxed + manuals, in excellent condition, £450 ONO. Mr Ian Barber, M6IBC, 01502 567 199 (Lowestoft).

YAESU VX8E triband handy. Excellent condition, boxed with all accessories. £200 including carriage. Dave Penny, G6ZSN, 0787 8931954 (Taunton).

ZX 20-2 monobander 2-ele for 20m; just worked VK3TJK. Bought from new, £199. Fred, M0CVS, 01629 823 025 (Matlock, Derbyshire).

WANTED

BEDFORD ELECTRONICS Roamer 10. Circuit diagram and/or construction instructions needed. Disposed of mine in a clear out. Alyn, G7RSK, 01372 277 244 (Ashtead).

CUSHCRAFT R-7000 bottom trap (10m). Alan, GM3PSP, 0131 623 4580, alanjmasson@virginmedia.com (Edinburgh).

EDDYSTONE 840C CABINET (not necessarily including the front panel) to complete the restoration of my 1960s Eddystone 840C receiver. The original

RSGB MEMBERS' ADVERTISEMENTS

RSGB Members wishing to place an advertisement may do so free of charge by e-mail.
The following applies to all Members' Advertisements.
In order to qualify for free insertion, Members Ads must be submitted by e-mail to memads@rsgb.org.uk. You should receive an automatic acknowledgement almost immediately – if you don't, please phone the *RadCom* office on 01234 832 714. Ads may still be submitted by post but must be accompanied by a payment of £5 to cover administration costs.
See RadCom February page 93 for full Terms and Conditions

cabinet has had numerous holes drilled in the vicinity of the mains dropper resistor, presumably to improve ventilation. Alan, G3WXI, 014 288 1692, g3wxi@g3wxi.org (South Yorkshire).

EDDYSTONE 880 MK1, Siemens E311, Racal RA1218 to complete Rx collection. Steve, M6WAA, 07552 678 725, vintageradio@btinternet.com (Warrington).

HF GEAR, wind up mast, beam and HF vertical. Richard Collins, G7LEC, 0784 524 4029, richardacollins@hotmail.co.uk (Leeds).

HP/AGILENT POWER METER HP435/6/7/8 series. Preferable complete with sensor cable and sensor. Gerald, G8AKL, 01487 740 794, (Huntingdon).

PAIR OF SG BROWN type E headphones, any condition considered. John, G4LGX, 01423 567 390 (evenings). (Harrogate).

STRUMECH VERSATOWER 5m 20 section – identified as having a 5" face. I am in desperate need of one of these to go in my std 60ft tower. I'd even consider taking a whole tower if it has this part. Kerry, G8VR, 0771 824 4222, kerry.rochester@gmail.com (North London).

VERY TOP PRICES PAID for Denco Maxi-Q do coils in ranges as follows: Green range 1 & 2 (MW, LW), Blue range 1 (LW), Yellow range 1 (LW) ft, Red range 1 (ILW). Robert Riddington, G4IHT, 01285 841 203, robert@riddington.me.uk (Tetbury).

XP DISC. Windows XP disc to upgrade from Windows 98. Godfrey, G4GLM, 020 8958 5113, cgmm2@btinternet.com (Edgware, Middlesex).

RALLIES & EVENTS

Members of the RSGB Regional Team will be present with a bookstall (not N Ireland) at the rallies this month marked with an RSGB diamond

SPECIAL EVENT STATIONS

These callsigns are valid for use from the date given, but the period of operation may vary from 1 - 28 days before or after the event date. Operating details are provided in an abbreviated form as follows: T = 160m; L = 80 or 40m; H = HF bands (30 - 10m); V = 6 and/or 4m; 2 = 2m; 7 = 70cm; S = satellite and P = packet. Details published here are kindly provided by Ofcom (20/01/16).

Date	Callsign	Phonetics	Location	Bands	Keeper
04/03/2016	GB1SPD	Saint Patrick's Day	Omagh	TLHV27	MI1CCU
14/03/2016	GB1SPS	Sandown Primary School	Hastings	LH27	MOSSR
26/03/2016	GB0WOD	Woodley Airfield Beacon	Woodley	LH27	G1SEO

5 MARCH
LAGAN VALLEY ARS ANNUAL RALLY
Hillsborough Village Centre, 7 Ballynahinch Road, Hillsborough BT26 6AR.
Doors open at 11am.

6 MARCH
EXETER RADIO & ELECTRONICS RALLY
America Hall, De La Rue Way, Pinhoe, Exeter EX4 8PW
Doors open at 10.30am with those booking in to the Bring & Buy as well as disabled visitors gaining access from 10.15am. Admission is £2. There will be traders and a Bring & Buy. Catering is available on site. Details from Pete, G3ZVI on 07714 198374 or by email to g3zvi@yahoo.co.uk

13 MARCH
DOVER RADIO RALLY
Whitfield Village Hall, Sandwich Road, Whitfield, Dover CT16 3LY.
There will be a talk-in station. Doors open from 10am to 2pm with disabled visitors having access from 9.30am. Admission is £2. Highlights include trade stands, an auction, a Bring & Buy, special interest groups and an RSGB bookstall. There is catering available. Information from Peter Love, G0KOK on 07850 464 026 or by email to peterjlove@btinternet.com.

13 MARCH
GRANTHAM ARC RADIO & ELECTRONICS RALLY
Earlesfield Community Centre, Trent Road, Grantham NG31 7XW.
The venue has free car parking and disabled facilities. Doors open at 9.30am and admission is £3. There will be trade stands and a flea market as well as a Bring & Buy. Specialist interest groups will be in attendance and there will be an RSGB bookstall. A raffle will be held on the day. More on 0751 0271 577.[www.garc.org.uk].

19 MARCH (SATURDAY)
LAUGHARNE RADIO RALLY
Millennium Memorial Hall, Clifton St, Laugharne SA33 4QG.
Doors open from 10am to 2pm and admission is free. Disabled visitors can gain access at 9.30am. Tables are available. There will be a raffle and light refreshments on the day. Details and table bookings from Matthew, GW6KOA on 01994 427 581 or by email to matthew.twyman63@btinternet.com.

19 MARCH
DUTCH NATIONAL RADIO FLEA MARKET
Autotron, Rosmalen (Den Bosch), Netherlands.
The Autotron has its own exit with signs on the A59 motorway from 's-Hertogenbosch to Nijmegen. Doors open from 9am to 3.30pm. There are more than 330 stands and, in 2015, the show was visited by over 5,000 people. [www.radiovlooienmarkt.nl].

20 MARCH
WYTHALL RC RALLY
Wythall Radio Club HQ, Wythall Park, Silver St, Wythall B47 6LZ.
The venue has car parking as well as disabled facilities. Doors open at 9.30/10am and admission is £3.50. There will be trade stands as well as a licensed bar and catering facilities. RSGB representatives will attend but there will be no RSGB bookstall. Details from Mike on 07976 744 479 or by email to rally@g4vpd.com.
[http://wythallradioclub.co.uk].

20 MARCH
DEVON & CORNWALL REPEATER GROUP AND CALLINGTON ARS RALLY
Callington Town Hall, New Road, Callington PL17 7BD.
Doors open at 10.30am and admission is £2. More information from Roger by email to 2e0rph@gmail.com.

20 MARCH
CAUSEWAY COAST GLENS ARC RADIO RALLY
Bushmills Community Centre, 14 Dunluce Road, Bushmills, Co Antrim, Northern Ireland BT57 8QG
The venue has disabled access and suitable car parking on site. Doors open from 11am to 4pm and admission is £3. There will be trade stands, a Bring & Buy as well as an RSGB bookstall. Catering facilities are on site and there will be a raffle taking place during the day. More details from MN0CCG on 0754 492 3956 or by email to MI0LJM@hotmail.com.

3 APRIL – HACK GREEN BUNKER RALLY
10 APRIL – NARSA EXHIBITION
10 APRIL – YEOVIL QRP CONVENTION
17 APRIL – WEST LONDON RADIO & ELECTRONICS SHOW
23 APRIL – RSGB AGM
24 APRIL – CAMBRIDGE REPR GROUP RALLY
1 MAY – DAMBUSTERS HAMFEST
2 MAY – DARTMOOR RADIO CLUB RALLY
8 MAY – LOUGH ERNE AMATEUR RADIO RALLY
15 MAY – CANCELLED – NEWTON-LE-WILLOWS
15 MAY – LAMFEST
21 MAY – ROCHDALE AND DARS SUMMER FLEA MARKET INDOOR SALE
21-22 MAY – DAYTON HAMVENTION®

The RSGB website (http://rsgb.org/main/news/rallies/) shows all rallies and events we are aware of as of press deadline. **If your rally or event is not listed, TELL US ABOUT IT!** Email details to **radcom@rsgb.org.uk** and your event will appear here, on the RSGB website and, the week before, on GB2RS. It's all free! Please tell us the event details as early as possible. You should get an email acknowledgement back within 2-3 working days – if not, *we haven't recieved your information* so please phone *RadCom* Editorial on 01234 832 700 and we'll chase it up for you.

SILENT KEYS

We regret to record the passing of the following Members:

Mr F W Norton, G0ICH	18/01/2016
Mr E H Binns, G0PAJ	17/01/2016
Mr T Taylor, G0PSE	27/01/2016
Mr K J Tarrant, G1CUB	19/01/2016
Mr G Openshaw, G2BTO	06/09/2015
Mr E J Edwards, G3DHY	04/01/2016
Mr M K Dunn, GM3KTL	
Mr J F R Weston, G3LYW	
Mr S Harle, G3MEA	09/01/2016
Mr P Blakeborough, G3PYB	08/01/2016
Mr D J K Chapman, G3RLN	03/2015
Mr D F Heathershaw, G3TLI	09/01/2016
Mr J M Cooper, G3VFS	01/2016
Mr R P Rawle, G4FPJ	17/01/2016
Mr K Macleod, GM4VST	29/04/2015
Mr M J Lenzi, G7HNY	28/01/2016
Mr P W Best, G8BLS	23/12/2015
Mr C Turner, G8IVI	
Mr J M Pullen, M0BUO	
Mr D Lowe, M0IBC	05/01/2016
Mr D S Hands, CT1IZU	11/2015
Mr P W Jameson, RS174156	11/2015

SILENT KEY COLUMN ENTRIES
To notify the RSGB that a Member has passed away (and their subscription should end and they should be listed in Silent Keys), please email sales@rsgb.org.uk or telephone 01234 832 700 and then select option 1. We will need to know the deceased's name, callsign or RS number and, if possible, date of death.

OBITUARIES
Obituaries are published at www.rsgb.org/sk. Please send submissions by email (only) to sk@rsgb.org.uk. All submissions are moderated and may be edited for reasons of style, grammar, length etc. *Online obituaries are separate from the Silent Keys column.*

HOW I GOT STARTED

Phil Cragg, G3UGK

So Steve Sawyer, 2E0NHR is wondering how I got started in amateur radio. Well, it was 1959 and I was studying for my Postmaster General (PMG) ticket as a seagoing radio officer at Norwood Technical College in London. One of our tutors – sadly I've forgotten his name (well it was 56 years ago) – announced to the class that he was going to enter us all for the RAE: "Please sign here and include your cheque for the fee". As we were well into the course by this time our technical knowledge was far in excess of anything needed by this exam (don't forget that in those days it was a written exam in two parts, Technical and Regulations) so all we had to do was to learn the licence conditions. I certainly had no trouble passing the exam, but no real interest, or indeed knowledge of ham radio, so when the certificate arrived I filed it away. I did buy an R1155 ex-forces receiver though, and flung a bit of wire out of my digs window and listened with growing fascination to the locals on top band AM.

I left college, but instead of going to sea went to work in the new exciting computer industry where my embryonic interest in amateur radio lapsed. Until 1965 that is, when, still working on computers, I was idly chatting with a work colleague who happened to mentioned that he was a licensed radio amateur. I told him of my certificate, still in its filing box, and he persuaded me to go for the Morse test, which was compulsory and required a speed of 12wpm. Even though six years had passed since my college days, I still remembered my Morse – after all I had been quite proficient at 25wpm by the time I left college. So a trip to Post Office headquarters in London, a few words in plain language, and a couple of code groups at about 20wpm and I was the proud holder of a pass certificate. A few days later the licence dropped on the mat and two days later G3UGK was on the air. My only regret? That I didn't get the licence while still at college, as I would then have had a G3N— call. Oh well.

Chris, G4BGM

In the 1950s I was living, with my family, in RCAF apartments in Southern Germany. A piece of wire, scrounged from a local scrap yard, stretched from the first floor window of the bedroom I shared with my brother, to a tree behind the flats. I connected the end of this wire to the bedsprings of my brother's bed and then linked this to mine. I now had my antenna connection; a radiator provided my earth. A coil was wound on a small tube with a movable ferrite rod within it; a crystal diode was connected to one end of the coil and the other end of the crystal to an old military headset; the other side of the headset went to the unconnected side of the coil. All connections were made by twisting the wires. These assembled components, now housed in an old cigar box, awaited the joining of the earth and antenna wires to the ends of the coil. My mark 3 radio was complete.

It was winter and it was snowing heavily as I looked out of the window to the small town below. Carefully I put on the headset. Gently and slowly I moved the ferrite slug through the coil. Suddenly I heard beautifully clear music and then a German voice.

I was spellbound and ecstatic, the sound seeming to emanate from the falling snow itself. It was 1958, I was 14 and things would never be the same. This one small event, on a winter's morning, led me to a forty five year career in telecommunications.

Frank Kneebone, G6CEP

On the letters page there was a plea for what drew people into our hobby. From my own point of view it was exposure to shortwave listening on the family wireless on a Sunday morning and wondering who these people were, chatting to each other. Today this is virtually impossible and most amateurs come from knowing a friend in the hobby or perhaps an exhibition day by a local club. This reduced exposure unfortunately limits the number of newcomers. Having been introduced to amateur radio, I went on to gain my RAE and enabled me to start a career in radio and TV repairs with extra training later. Certainly, going along to my local club (25 miles away) also provided a wealth of help and encouragement.

IMPORT DUTY

Alan Walker, G4UWS

When I collected an item bought directly from Elecraft recently, I was surprised to find import duty had been charged on it. I had thought it was exempt. Though this is nothing to do with Parcel Force, they were happy to give me the correct number for querying it. This I tried to do, twice, but got nowhere with the computer that answered it. So I phoned the RSGB to see if they know of any changes to the rules. This led to a helpful conversation with Giles, G1MFG, who recommended downloading the appropriate form, filling it in and hoping for the best.

The result was a very prompt reply from HMRC with a reassessment of the charge and a few days later a cheque refunding it. So my thanks to all involved.

The form required (for something posted) is BOR286 and can be found via the search facility on www.hmrc.gov.uk I filled in every reference number I could find on the box, attached the paperwork specified and stated that I believed that kits of parts for amateur radio to be exempt from duty. It was all a lot simpler than I expected.

One small point, if you encounter the same problem, keep the box. You will need to enclose the customs label with your claim.

VECTOR AND SCALAR QUANTITIES

Steve Milner, 2E0EUR

How refreshingly nostalgic to be reminded by Dr Mark R StJ Foreman (Feb 2016) of good old vector and scalar quantities, having being taught them initially by Messrs Wood and Slater during chalkboard-filled GCE and A level physics lessons some 40 years ago. Interestingly, however, this approach seems to bring into question the classical description of one of the mechanisms leading to the production of X-ray photons, namely that of 'bremsstrahlung', a term which literally translated means 'braking radiation'. Radiology physics textbooks most commonly describe this from an energy conservation perspective, with X-ray photons arising from the rapid deceleration of fast moving electrons by a suitable target material in the X-ray tube, usually tungsten. In this process, different amounts of deceleration lead to the production of a so called 'continuous spectrum' of X-ray photons, containing a range of energies whose maximum is determined solely by the peak potential difference across the X-ray tube (kVp). Finally, the observations in respect of heat transfer in an X-ray tube, whilst correct, have omitted any reference to the type of X-ray tube used in most aspects of contemporary clinical practice, which utilises a rotating anode on a complex bearing assembly, necessitating meticulous design features to minimise heat transfer by conduction. It is in this type of X-ray tube, particularly those used in heavy duty applications such as computed tomography and angiography and typically rated at 100kW, where cooling, not only of the X-ray tube but of the entire X-ray tube housing is of the utmost importance, using design features which optimise an appropriate combination of conduction, convection and radiation.

PEAK DEVIATION

Andrew, G8BUR

Further to the request by Steve, G8SFR, I would like to ask that all stations using any form of FM on the 144MHz band, including analogue voice as well as other modes, please make a point of checking and ensuring that their Tx peak deviation is set to 2.5kHz maximum.

I regularly encounter FM voice transmissions on 2m from stations still using the long-superseded 5kHz peak deviation. This is both tedious to cope with and annoying to users of adjacent frequencies.

When such a signal is received on a rig using a narrow (12.5kHz spacing) IF filter, the squelch closes on peaks of deviation, as the signal moves out of the Rx passband, making it very difficult to copy. To work such a station, it is necessary either to switch between 'wide' for Rx and 'narrow' for Tx at every over, or, if you are lucky enough to have two VFOs and

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a 'split' facility, to set the Tx VFO to 'narrow' and the Rx VFO to 'wide'. If your rig has no 'wide' filter, such a station can be difficult and sometimes impossible to work.

Please check your peak deviation on 2m, and make sure it's set to 2.5kHz maximum, for voice as well as other modes.

THE REMOTE REVOLUTION

Brian, G3ZUM

I have just read the letter from EI5DI and was amazed at its contents! Whether one operates one's radio station locally or remotely, one is still communicating via radio! One still needs to set up the station equipment, feeder(s) and aerial(s).

What does it matter whether one turns on a function on the transceiver by physically pressing a button or clicking on a picture of one's front panel with a mouse? If he were talking about communicating solely via the internet, then his comments would be fine.

One of the great strengths of our wonderful hobby is its many facets and remote operation is just one. It also involves the 'self training' aspect of our licences in setting it all up. Not all of us are fortunate enough to have the room for aerials or may have planning restrictions and remote operation may be a good solution to continue with the hobby.

Paul Thompson, GM6MEN

I hear Paul O'Kane, readability 5.

But, going back though our history, similar statements were made – "Not real amateur radio" – about using satellites, repeaters, commercially-made amateur transceivers, military-surplus gear, anything not totally home-made. I dare say when remote control and VOIP/radio interfaces are commonplace within our hobby, the very next technological advance, be it an interface with our brainwaves or whatever, will be greeted with the same words.

Why is there a headlong rush to embrace new technology? This route has been travelled before, remember the battle between VHS and Betamax? You have only got to walk past an Apple shop moments after Apple have released a new phone to see queues of anxious people waiting to get their hands on Apple's latest phone. Ask yourself this question: do the people outside the Apple shop really need a new phone, or are they buying a new phone just because it's available?

Are radio amateurs going the same way? We've got to have it because it's new, do we want to go on the same journey that VHS and Betamax went on? If we do, two of the new technologies are going to lose out.

In time, the amateur radio community will make up its mind which way it wants to go. Then there will be many repeater groups with expensive repeaters and users with radios that they are unable to use. There will be manufactures and readers who will extol the virtues of their chosen system and claim theirs is the best – but at what cost to amateur radio in the long term?

ARE WE GOING THE SAME WAY?

Martin Rolls, 2E0MPR

Recently I looked at the repeater list on the RSGB website, I couldn't help notice the number of new repeaters using the new technologies as well as some existing repeaters that have been changed to use these technologies.

Now it looks like we have D-Star versus Fusion versus DMR.

NEW RIGS AND RIG REVIEWS

Ray J Howes, G4OWY

I've often wondered why it is that when a rig review is published in *RadCom* (February's review of a Yaesu FT-991 is no exception), the rig is shown shorn of its top and bottom covers?

What is the point of this exercise? And just how many buyers of this rig – or any other new rig for that matter, is really interested or excited by being able to view the insides of it? Who cares anymore? After all, and let's be honest, I imagine that most buyers will only be bothered about what happens on the outside rather than the insides of a new transceiver. So a front panel snap will probably suffice. Dump the inside snaps.

Ray raises an interesting point. My own feelings are that it is interesting and instructive to see the innards. How well made is it? What technologies are employed? Are there any obvious engineering advances? Are there any kludges or patch wires? Are the components up to scratch? And so it goes on.

If you have access to a copy of the July 2015 RadCom, ***take a look at the photos of the antenna tuners on pages 68 and 69. Two manual and two auto tuners are shown and, whilst each pair does fundamentally the same job, the engineering differences and component choices speak volumes. Then compare today's radios with those of yesteryear with their jam-packed discrete components and umpteen wire links, or the tag strip construction of valve gear.***

Our technology moves on, in incremental moves, and these photos show just how far we've come. I realise that black box operators may not care if their radio is powered by the latest DSP techniques or a highly trained magic aardvark but I believe a lot of people are interested.

So, what does anyone else think?
Giles Read, G1MFG,
RadCom *Technical Editor*

CRUISE SHIP MARITIME MOBILE

Andrew Churchley, G4EAQ

Further to the article by Charles Brookson, G4GBA in the December *RadCom* concerning radio operation on a cruise ship, it seems Fred Olson is quite amateur-friendly. By a strange coincidence I was listening on 80 and 40m last month and heard a G3 with a maritime mobile call. He was operating on a Fred Olsen Drilling Ship off Norway. He made a few QSOs and then had to go QRT to make way for "ship operations". It was news to me that Fred Olsen is into the offshore industry, but the Internet soon confirmed their long history in this.

How pleasing it would be if operating cruise maritime mobile became commonplace all over the oceans, so opening up a new facet of the hobby for people who would otherwise never have the opportunity. There are some cruises (G4GBA's was typical) where there are many 'at sea' days, and radio operation could be very enjoyable.

My own very limited contribution to the art was to take an Eton E5 receiver with me on a cruise. I soon found that when using its whip antenna on our balcony, this had to be orientated horizontally and at right angles to the ship's side, to receive anything. Changing the angle caused progressive attenuation of the signal, down to zero when parallel to the side. I think the ship was acting as a "vertical earth". I later learned that passengers in a nearby cabin thought I was trying a spot of fishing! I also tried a short wire up in the sports nets on top of the ship, but found it rather draughty and uncomfortable!

I have to say I am not optimistic that the big cruise lines (most of which are American owned) would be favourable to amateur operation. My limited experience suggests that anything out of the ordinary may be (very politely) refused, because it is easy to do so. I also note that G4GBA had difficulties on board, even after getting the Line's permission. It is so easy for them to suppose that interference might be caused to COMMS or NAV.

ELECRAFT

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- Adds direct USB connection.
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- Original RS-232 connections remain supported.
- Adapter cable included for full compatibility with K3 peripherals.

The Elecraft **KIO3BUPKT USB** is an audio and digital interface kit for the K3. It includes three boards: a new KIO3B main, an analogue board, an amplifier board and a digital board. It adds a USB sound/comm port and includes standard KIO3 analogue/ digital I/O.

£389.95D

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KX3 HF Transceiver

The **KX3** is the most sophisticated portable HF transceiver available. It also happens to beat almost every other base station transceiver, irrespective of price! Up to 10W output from 160m - 6m, all modes, including PSK31 and RTTY. Six channel memory CW keyer and two channel SSB memories. The display is the same size as that on the K3S, and there are auto ATU options and additional roofing filter options. To own a KX3 is to own a high performance transceiver that is just as much at home on a base station antenna as it is on a portable antenna. It has a superb dynamic range and by using SDR technology, offers cutting edge performance.

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Built: £959.95D

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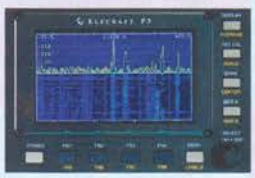
P3 Panadaptor



The **P3 Panadaptor** is the perfect panoramic display for all K3 series owners. It offers combined panoramic and a waterfall displays with a wide range of menu options to set up the P3 to suit your exact needs.

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Built: £729.95D

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The **P3TXMON** is a sensor kit that allows the P3 to display your TX wave form, VSWR and PEP.

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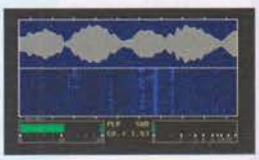
2kW sensor module: £199.95C



See page 3 for full contact details.

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See page 3 for full contact details.

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Here's **George Highton G7NOT** - collecting his FT-DX9000MP 400W flagship from ML&S this morning. He'd travelled over 300 miles just to collect his 'pride & joy'. Can't say we blame him.

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