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Cover image:
The Yaesu FT-891 HF and 6m mobile transceiver. Photo courtesy of Yaesu UK.

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

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The online *RadCom* is at www.rsgb.org/radcom/
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/

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Presidential review of contesting progress

The Board has asked the current President, Nick Henwood, G3RWF, to conduct a short consultation leading to a report on progress made since the Presidential Contest Review of 2015. He will look at its original aims, the progress that has been achieved so far and suggestions for future priorities and action. There will be an online Member questionnaire in addition to discussion with the Contest Committees and other groups wishing to make an input. Further details will be published on the RSGB website and the intention is to report by early April.

The Board wishes to thank the volunteers of the Contest Committees for their continuing hard work and commitment on behalf of Members to make contesting both enjoyable and challenging.

Consultation on RSGB future

Lots of people have views on what the RSGB should do, and what they should not do, and here is your chance to have your say.

The Board has been working with strategy expert Chris Deacon, G4IFX, the Leadership Team and Headquarters Staff to develop a strategy for the next 5 years. That work has been boiled down into a one-page strategy with a narrative to explain the context and background and we would now like your views. You can view the draft strategy and the narrative at www.rsgb.org/strategyreview

We have set up an online survey where you can say whether or not you agree with the draft strategy and if not, what is missing, or what should not be included. This consultation has already been advertised on GB2RS and social media so this is a reminder to make your views known by Sunday 5 March. If you would need a paper version of the questionnaire, please call the General Manager's office at HQ on 01234 832 700.

If you have not already done so, please take part in the consultation exercise; we need to hear your views.

Steve Hartley, G0FUW
Chairman of the Board

Clubs, Groups, Teams… spice up your club life

Recently, amateurs have found many new ways of getting together to share their hobby – and ways of spicing up very traditional clubs with innovative ways of doing things.

RSGB President Nick Henwood, G3RWF, has got Board support to highlight some of the best things that are going on. Whether you are a long established club, a group meeting in a pub, a special interest group or even a virtual club, he would like to know what is special about your way of linking amateurs with a shared enthusiasm. The RSGB Board would then like to share those ideas more widely.

If you have a major success, something special to mention or would like to help with this project, please contact Nick via president@rsgb.org.uk

GB16YOTA activity

Chertsey radio club hosted GB16YOTA on behalf of the 6th Staines Scout troop. James, M0JFP ran the station on 21 December. Around 40 Beavers, Cubs and Scouts got on the air and they are now well on their way to getting their Communicators badge. The club plans to finish the work with the youngster in early 2017. They made a few contacts on the day and got a message sent via the FUNcube1 satellite.

Sidmouth ARS also put GB16YOTA on the air in December. At the beginning of the month Matthew, M6MTI passed his Intermediate exam – he made the initial call to the ISS from Kings School, Ottery St Mary on 9 May. He's also part of the Kings School radio society (M0KSO) and the club has helped with that too. A Foundation course for 15 pupils will be starting in the New Year, so all driven by the ARISS / RSGB initiative.

RAYNET Trademark Withdrawal

The RSGB has for many years held both the UK and European RAYNET Wordmark and Trademarks associated with emergency communication. The previous affiliation arrangements allowed groups either affiliated directly with the RSGB or via the Radio Amateur Emergency Network to use the Wordmark and Trademarks. Under the recent MoU signed between the RSGB and RAYNET-UK, the RSGB has agreed to exclusively licence the Workmark and Trademarks held by the RSGB to RAYNET-UK and as such those groups who elect not to affiliate to RAYNET-UK will no longer be authorised to use these trademarks.

Honour Roll: G8QM

In error, Mr V J Flowers, G8QM was missed from the Honour Roll in February's *RadCom*. He has been a Member since October 1935, a total of 81 years (as of 31 December 2016). The RSGB would like to commend G8QM on his length of Membership and apologises unreservedly for the error in missing his entry. He is the longest-serving Member in the current Honour Roll.

YOTA 2017

New Super Supporters agree to help

More people, groups and companies are agreeing to become supporters of YOTA 2017, the international youth event that the RSGB will be hosting at Gilwell Park in August. We are pleased to announce that another two new super supporters have joined us in supporting this prestigious international event.

New Supporters

Martin Lynch & Sons. ML&S are not only a proud sponsor of the RSGB Convention, they have also now agreed to become a supporter of YOTA 2017. ML&S are always keen to support amateur radio activity and see that helping youth orientated events is a way to ensure the future of the hobby. ML&S see themselves as the 'World's Favourite Ham Store' and that reaching out to the 23 countries involved in YOTA 2017 is an ideal way to reach the future of amateur radio across the world.

National Hamfest. It is not only companies that are becoming a super supporter of YOTA 2017 and we are pleased to say that the organisers of the National Hamfest also see the value of investing in youth activity in amateur radio. The National Hamfest is therefore donating some of the income from the Newark event on the 29-30 September to the YOTA event in August. As the premier UK rally, the National Hamfest is pleased to be part of the group that are supporting YOTA 2017 and are hoping that other events up and down the country will join them supporting the event.

We have other donors too and would like to specifically thank Moonraker UK who have signed up as a supporter. Moonraker are a leading supplier of antennas and we may well be making use of their equipment during the event. We continue to receive generous donations from individuals but unfortunately we can't name them all here but we do thank for their kind support and they are all honoured at our website www.rsgb.org/yota

If you haven't done so yet, don't forget you or your club can help the RSGB in the staging of the event by making a donation via www.rsgb.org/yotasupporter

Train the trainers

The RSGB Train the Trainers course that took place on 21 January was delighted to welcome Jón Th Jónsson, TF3JA, Chairman of the Icelandic Radio Amateurs, who travelled from Rekjavik to attend. The event was organised by South East Tutors and hosted by Cray Valley Radio Society. Jon explained that he is working hard to bring young people into the hobby in Iceland and attending Train the Trainers also gave him the opportunity to share ideas with 20 other delegates from clubs around the south east who are actively involved in licence training.

RSGB AGM 22 April 2017

The Society is pleased to announce that the RSGB AGM 2017 will take place at the Angel Hotel, Castle St, Cardiff CF10 1SZ on 22 April 2017. Full details including the Calling Notice, CVs of prospective candidates, 2016 accounts, committee reports and voting paperwork will be in the April *RadCom*.

Trophies and awards for presentation at the 2016 AGM.

More 60m permissions – Slovenia and Niger

Slovenia: Tine, S50A, reports that the Slovenian telecoms regulator, AKOS, has given permission for use of the 60m band in Slovenia. First of all a temporary three-month licence (11 January – 11 April 2017) is being issued to all Slovenian amateurs who apply for it. The allocation is the WRC-15 one from 5351.5 to 5366.5kHz with 15W EIRP. It is hoped that in three months the administration will adopt the regulation fully that will be valid for all. Use of the IARU Region 1 60m band plan is recommended.

Niger: Whilst in a meeting with officials of the Niger telecoms regulator, ARTP, to discuss his March 5U5R DXpedition, Antonio, EA5RM was informed that 60m access in the country to all Niger amateurs was now possible under the WRC-15 allocation of 5351.5 – 5366.5kHz and its subsequent footnote.

The 5U5R DXpedition 60m activity is expected to be around 5360kHz using CW and SSB. Unfortunately access to 6m is not possible for the DXpedition that takes place from 8 – 21 March using all other bands and all modes.

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 J Bazley G3HCT

60 years
Mr D Johnson G3MPN

50 years
Mr D L Gallop G3LXQ
Mr J Darrington G3WHL
Mr I Davidson G4KDW
Mr F Baxter GM3VEY
Mr P Jones GW4HAT

YOTA 2017 to involve more young people than ever

Plans for YOTA 2017 at Gilwell Park are progressing. The IARU YOTA team had a very difficult job in selecting the countries to be represented; they had more applications than we can fit into the venue. To allow as many as possible to take part they decided to reduce the size of each Team to three, including a young Team Leader. This resulted in twenty seven Region 1 countries and Japan being offered places. It seems the Japanese team will be looking at how the YOTA camp works to see if the idea can be exported to Region 3. The IARU team also raised the minimum age for attendance at YOTA camps to fifteen and asked that all Team Leaders be under thirty years of age.
You can support the event by visiting www.rsgb.org/yotasupporter

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 S M Gallagher-Willmer, 2E1CYT
Mr L Hopgood, 2E0DYY
Mr M Lewis, 2E0EZG
Mr G Allbright, 2E0GMK
Mr S Harding, 2E0PPF
Mr C Coles, 2E0XFL
Mr E Heidt, AC8VK
Ms J Ellsworth, AI6TK
Mr T Kamp, DF5JL
Mr P J Brookes, G0DFK
Rev. Dr. R Hinder, G3SCB
Mr R Smith, G4GDG
Mr M Deverill, G6VHA
Mr J Richardson, G7CUD
Mr R Maynard, G7JSG
Mr G Ratcliffe, G8WPX
Mr D Ingram, GM1OIN
Mr P Antliff, GW0SOO
Mr P Thompson, GW1MIL
Mrs G Steward, K3ND
Mr R Kunath, K9AO
Mr R Lovely, KE8BSL
Prof S Sawilowsky, KE8CMQ
Mr B Comer, KI7IGK
Mr G Werner, KK6AYK
Mr R Lassiter, KK6SMF
Dr A Morris, M0CWX
Mr A Iqbal, M0DDS
Mr R Jones, M0ORD
Mr I Vinton, M0PJV
Mr D Bines, M0RHG
Mr C Allen, M0VPN
Mr O Fallon, M0WTL
Mr P Carpenter, M0ZVB
Mr M Whitehall, M1CID
Mr A Riches, M3UAR
Mr L Preece, M5GWH
Mr K Bell, M6APS
Mr C Whitehall, M6CUG
Mr G Turnbull, M6GSN
Mr H Broadhurst, M6HBE
Mr L Evans, M6HVD
Mr S Crawley, M6HWF
Mr R Hammond, M6HXN
Mr J Howarth, M6HZU
Mr G Stamp, M6IBP
Mr M Hathaway, M6IEK
Mr E O'Neill, M6IGA
Mr R Joynes, M6IGE
Mr D Drummond, M6IGR
Mr D Addison, M6IHP
Mr R Hunter, M6IHS
Miss M German, M6IHU
Mr D Faulkner, M6IIB
Mr P Netherton, M6IJI
Mr C Partington, M6IJT
Mr J Drea, M6JQE
Mr J Boyd, M6JVD
Mr D Bloomfield, M6KIO
Mr B Elms-Lester, M6KSX
Mr N Thompson, M6NBY
Mr N Gabbani, M6NGB
Mr C Naylor, M6NZN
Mr S de Koster, M6SYI
Mr A Berner, M6VME
Mr D Wilkinson, M6WHQ
Mr M Doherty, M6XBQ
Mr D Evans, M6XME
Mr J Middleton, MD6YJM
Jersey Scouts ARC, MH0JIS
Mr B Smollet, MM6BWS
Mr D Burt, MW0XRT
Mr M Trow, MW6IHX
Mr R Simpkins, N2OW
Mr T Caldecott, N4ENG
Mr M Bligh, N4XH
Mr P van Hooydonck, ON5PVH
Mr J Holford, RS311192
Mr J Crowe, RS311216
Mr S Marsh, RS311339
Mr M Terry, RS311385
Mr G Auld, RS311414
Mr J Rushton, RS311419
Mr G Hammond, RS311422
Mr J Fryd, RS311429
Mr M McDonald, RS311430
Mr D Prince, RS311433
Mr K Rangaswamy, RS311441
Mr W Taylor, RS311446
Mr D Buckley, RS311462
Mr C Mackay, RS311472
Mr P Franklin, RS311485
Mr L Anderson, RS311487
Mr J Jarvis, RS311490
Mr D Maitland, RS311521
Mr G Coltman, RS311524
Mr K Swift, RS311569
Mr C Whitham, RS311582
Mr M Dinch, RS311594
Mr S Lawrance, RS311596
Mr A Wood, RS311599
Mr J Walton, RS311611
Mr R Trapmore, RS311656
Mr V Dolzhenko, RS311679
Mr G Robertson, RS311680
Mr M Hall, RS311691
Mr J Westlake, RS311692
Mr R Clark, RS311710
Mr D Walsh, RS311716
Mr A Lee, RS311750
Mr A Bond, RS311753
Mr A Ghosh, VU2GKB
Mr P Carpenter, W4RTX
Mr M Obrien, W6MOB
Mr D Crocker, W6VYC
Mr S Low, ZL1SKL

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

Mr P Kerton, 2E0INT
Mr N Price, 2M0NOP
Mr J B S Bertran, EA3NJ
Mr J Lorente, EA5EQ
Mr J A Smith, G0FKF
Mr C R Beesley-Reynolds, G0UFP
Mr A Fawcett, G0VGN
Mr I Beech, G1IRB
Mr R L Brown, G1ZOB
Mr G M Sifford, G4TGG
Mr N Moorcraft, G4XCS
Mr C J Eagling, G6PMD
Mr S R Thompson, G7IFB
West Kent Raynet, G7TYR
Mr S M Outen, GW0DWQ
Mr W Williams, GW1FWC
Mr I C Dudley, GW3YRP
Mr A Zagni, I2KBD
Mr R H Foll, K5MOG
Mr A P Moffatt, M0FAT
Mr P Laws, M0IKQ
Mr P J Galer, M0PJG
Mr S P Davies, M0SPD
Mr J E Woolley, M0WTT
Castle House School RC, M1DLX
Mr J Woodman, M1PRO
Mr P Howell, M3EYG
Mr M Pratchett, M3NTR
Mr R M Cunningham, MD0MAN
Ms R Wadey, MI0RYL
Mr I McCallum, MM0IMC
Mr G Round, MW6PYH
Mr S Ijskes, PA9TV

NEW TITLE

Dxing on the Edge

The Thrill of 160 Meters

Jeff Briggs, K1ZM

For many radio amateurs operating on TopBand or 160m is endlessly challenging, exciting and intriguing. Building on the success of his first edition, author Jeff Briggs, K1ZM, well known as a TopBand expert, has extended a book that will appeal to all who operate TopBand or are just wondering what is possible on this fascinating band.

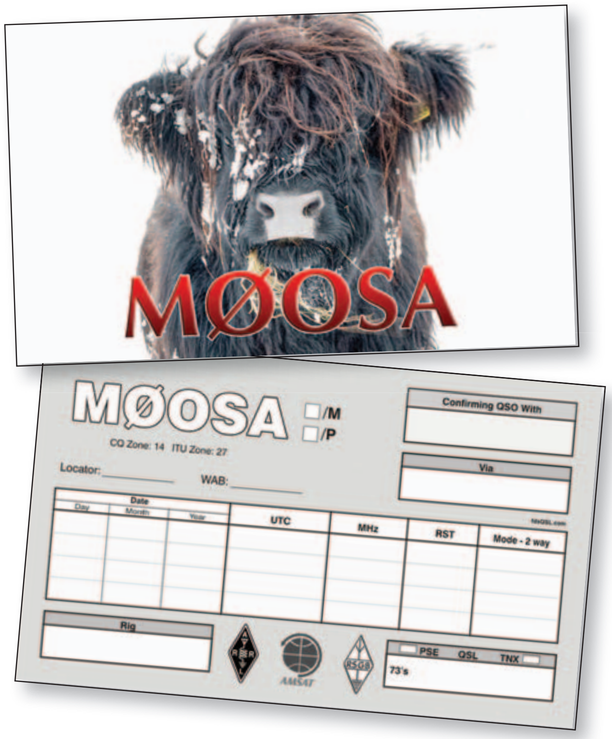
This is a specially produced RSGB edition of a US classic that brings the best of 160m operating experience to everyone. The book covers how the chronology of DXing on 160m across the years and the personalities involved. Aside from detailed historical information, the author describes many practical antennas and operating techniques that can lead to success on TopBand. Successful DXing can though be accomplished even from the trickiest environment and the book includes lots of neat tricks and hints that will help you work the rare ones In the 42 page colour section are new chapters for 'Modern "Off the Shelf" Transmit Solutions', 'Modern Receive Solutions for Smaller Properties' and more.

Beware though. TopBand can be addictive and as a true-blue 160m fan you might well find yourself actually enjoying listening to static crashes, waking up just before dawn for three months just trying to make that seemingly impossible TopBand DX QSO. K1ZM has written this book for anyone interested in the history and practice and most of all the enjoyment to be found on 160m.

Size: 222 x 286mm, 256 pages,
ISBN: 9781 9101 9333 4
Non Members' Price: £15.99,
RSGB Members' Price: £13.59

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

QSL Matters



Here's the QSL card of the first of the winners of the QSL-Quiz held at the National Hamfest. David has designed a most appropriate, tongue-in-cheek card for M0OSA. Eco-friendly, he's incorporated space for more than one QSO on the reverse and, most pleasing to us, followed the convention of destination call top right, with a Via box below, making for quick and easy international sorting.

Our postal provider has increased their charges by more than 14% to some destinations and this is the biggest yearly increase for a very long time. It makes it more important than ever to check that your QSL card is wanted at the other end to save unnecessary costs and wastage. Stephany, G1LAT now handles the Single letter, Contest-call cards and was surprised that her latest recycling bundle of uncollected cards was around 3,000 (almost 10kg). Feedback from the G3G-L grouping shows that of the 335 callsigns in the group, only 94 have envelopes lodged. Please make sure that your QSL sub manager has the necessary envelope.

QSL Bureau sub manager for the G7 group, Chris Flanagan, G7NRO, changed his address some time ago. The Post Office divert on his mail has now expired. Some Members are still using his old address to send collection envelopes that he may not now receive. This is perhaps a timely reminder to check the details of your QSL sub manager, details can be found under the 'Operating' drop down on the main RSGB website.

Online Advanced Examinations

Further to December's announcement regarding online Advanced exams, a new document entitled *Online Advanced Exams* has just been placed under the 'Examination Announcement' tab, which is in the Training part of the website. The document includes more detail regarding timing of the pilot phase of the project and also includes an FAQ section that, hopefully, answers most of the questions Exam Secretaries and candidates are likely to raise. For full details see http://rsgb.org/main/clubs-training/examination-announcements/
For more details contact Dave Wilson, M0OBW, the RSGB's Examination Quality Assurance Manger, by email to eqam@rsgb.org.uk

2017 RSGB Band Plans

The 2017 Band Plans appear on page 38. In principle there is only one main (and quite important) change, in 5MHz, though there are several smaller changes that arose last June from the interim IARU Region 1 meeting in Vienna that updated 80m and 30m and VHF WSPR. The always-up-to-date master Band Plans are on the RSGB website at http://rsgb.org/main/operating/band-plans/ and include a detailed change note history plus other notes.

5MHz: The UK allocation at 5MHz is a unique and complex band (effectively a collection of 'bandlets'). Out-of-band operation is a risk for the unwary, so do take care. Audio offsets added to nominal radio setting can easily put transmissions out of band. AROS and the Primary User continue to note such occurrences, which must be avoided.

On 1 January 2017 several countries obtained access to the 5351.5 – 5366.5kHz WRC-15 allocation. At present there is no UK Licence change, so it is also vital to realise that we do NOT have access to the full 15kHz segment and there must be no UK transmissions in the 'missing' frequencies to amateurs in other countries that *do* have the new WRC allocation.

Importantly, this year a new 'Note 4' has been added to the RSGB 5MHz Band Plan. This stipulates that all intra-UK contacts be removed from the WRC segment if at all possible, and to use the other capacity we have in 5MHz. This aligns with the provisional IARU band plan for efficient use of that limited segment.

Whilst the Society has enquired of Ofcom with respect to the WRC segment, we have no desire to see a reduction in UK power and frequency privileges down to what the WRC allocation entails, so that aspect may take some time to fully resolve.

General: Band plans evolve over time. Whilst this year's changes are modest, we do expect changes next year based on the outcome of the September 2017 IARU Region 1 Conference, for which the Society has an ongoing consultation on its Forums.

Please ensure you only refer or link to the current band plans on the RSGB website and remove any older copies you have locally. Unfortunately we still note some personal and club websites carry older copies and unofficial usage charts. As these inevitably age, their obsolete guidance eventually becomes counter-productive.

The up-to-date band plan, including the master Excel file, is on the Operating section of the RSGB website – and if you are unsure, by all means contact the relevant Spectrum Manager:

- **For HF:** hf.manager@rsgb.org.uk,
- **For VHF:** vhf.manager@rsgb.org.uk or
- **For microwaves:** mw.manager@rsgb.org.uk

Murray Niman, G6JYB
RSGB Spectrum Chair
spectrum.chairman@rsgb.org.uk

NEW TITLE

RSGB Archive 1925-1939

RadCom magazine or its predecessors such as the T&R Bulletin have been published since 1925. This brand new volume of our archive discs covers the years 1925 to 1939. This period covered the huge developments in the science and practice of amateur radio. From the developments of spark transmitters and valves, the change from Metres to Mega Cycles (and later back again), reports of the formation of the IARU and its early work, the use of country prefixes for the first time and so much more is all included here. There is an absolute treasure trove of astounding material, such as a 1925 remote control system for your radio, radio experiments in aircraft & moving trains, to name just a few.

Presented in the easy to use PDF format there are thousands of pages here covering the equipment construction, antennas, operating reports, new techniques and even the social aspects of the 1920s and 30s. Completing the RSGB archive this DVD provides a unique insight into the early days of the RSGB, amateur radio and is absolutely fascinating reading for anyone.

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FROM FREE P&P
on orders over £30. See Page 76

New Elecraft stockist

NEVADA, as part of the International Ham Stores Group, will now be stocking the full range of Elecraft transceivers, accessories and amplifiers. They will be selling both kits and fully assembled equipment. The Elecraft range will also be on display at their Portsmouth showrooms for customers to see and test out. www.nevadarado.co.uk

2m activity afternoon, 25 March

On Saturday 25 March, Thurrock Acorns ARC in Essex will be running a 2m activity afternoon. The goal is to encourage amateurs to use 2m on this day and to try and work their stations as well as others who have joined in on the activity day. They will have four stations operational on the band from 1pm to 5pm, working FM, SSB, CW and SSTV. The club station, GX4HKO, is based in Grays, close to the River Thames and the Dartford Crossing, and the other station will also be based close to Grays. The last time they organised this event late in 2016 they contacted over 70 stations and are hoping to increase that total this time.

Acom amplifiers

Seen here is Krasi, LZ1QU, one of four ML&S workshop engineers specialising in RF amplifiers, when he visited the Acom manufacturing plant and headquarters in Bulgaria. Acom specialise in the production of high power linear amplifiers, sold in the UK by Martin Lynch & Sons. Acom employ 100 staff, have three production facilities and distribute worldwide. There are some exciting new amplifiers due for 2017 that will be announced later in the year. Left to right are Alex Kraboychev (mechanical design engineer), Emil Mihailov (RF design engineer) Krasimir Kostov, LZ1QU (ML&S Workshop RF Engineer) and Vassil Vassilev, LZ1JK (Acom President).

Nominate for 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. Candidates for the award may be one or more of the following: Authors of publications related to CW, CW recruiters, trainers, mentors, coaches and instructors, Public advocates of CW, Organisers of CW activities. Designers and inventors who advance the art or practice of CW or Other contributors to the art or practice of CW. 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 2017 and include name(s) and callsign(s) (if applicable) of nominee(s), and complete contact information including their postal address(es), email address(es), and telephone number(s); a detailed explanation supporting nominee qualifications according to the criteria; name, telephone number, email address, and call sign (if applicable) of the person submitting the nomination. A plaque will be presented at Dayton Hamvention. If the recipient(s) is/are not present, it will be sent to them.

Radio Officers Association

The Radio Officers Association was formed in 1995 as a membership organisation with two principal aims: to seek out, honour and preserve the distinguished history of marine radio and to provide former radio officers with the means to share their experiences. Membership of the ROA is open to those who have served as radio officers in a merchant navy, coast radio stations and civil aviation. The weekly Thursday net commences with a CQ call by MX0ROA on 3538kHz at 7.30pm. If conditions are too bad to run the net on this frequency, another try is made on 1827kHz ± QRM. More information is at www.radioofficers.com

UBA Spring Contest

The Belgian national society UBA invites all radio amateurs to take part in the 34th UBA Spring Contest on the four Sundays in March. The first HF section is on 60m CW between 0700 and 1100UTC on the 5th. the first VHF session is on 2m using SSB/CW between 0700 and 100UTC on the 12th. The second HF session is 80m SSB between 0700 and 1100UTC on the 19th and the final session is on the 26th with 6m SSB, also between 0700 and 1100UTC. Only contacts with ON stations are valid. The logs (via e-mail) must arrive at latest 2 weeks after each contest date. For full rules go to www.uba.be/en/hf/contest-rules/spring-contest

New exhibitions

Bletchley Park has a new exhibition, Off Duty: High Spirits in Low Times, opening on 30 March. It gives insight into what Codebreakers and other personnel got up to in their spare time. Then, on 14 May, they open the Bill Tutte exhibition, celebrating the mathematician's achievements and legacy.

GB1SWC at the Beacon Museum

The Beacon Museum, Whitehaven will host a variety of special events throughout the weekend of 11 and 12 March to support local charity Samaritans of West Cumbria and to raise awareness of the work undertaken by Samaritans. In addition to the scheduled exhibits on display, members of the RSGB will operate GB1SWC. other activities will include live tracking of the International Space Station and demonstrations such as a Morse code game and the sending and receiving of television pictures and digital information over radio waves. If radio conditions are favourable, members of the public will also be invited to exchange greeting messages on air with licensed stations. For more information visit www.qrz.com/db/GB1SWC

Warehouse space for new stock

The International Ham Stores Group has almost finished the warehouse facilities in Portsmouth. It will mean plenty of storage of both existing and new brands and it will be stocked and ready for operation by the end of April 2017. They will continue supply all amateurs directly in addition to providing their dealer network with over 10,000 products from stock. The photo shows Justin Jonson, G0KSC, Group Operations Director for the International Ham Stores Group (L) and Phil Jeffery, Nevada Commercial Manager starting the task of preparing space.

TX Factor episode 14 out now

TX Factor is the UK's only TV show dedicated to amateur radio. It is sponsored by the RSGB and Martin Lynch & Sons. The latest episode – Episode 14 – is now available at www.txfactor.co.uk (or search for TX Factor on YouTube). In Episode 14 the team visit the RSGB's National Hamfest 2016 where Bob stumps up some hard-earned cash to buy a wartime wireless set from his boyhood past – a No 38 set AFV. A future show will detail whether he's managed to get it to work! The 14th show also features the second part of the series on Propagation. In this episode Steve Nichols, G0KYA discusses how 'space weather' affects our ability to communicate on the HF bands and what we can expect during the current period of sunspot minima. Professor Philip Willis, M0PHI of the RSGB's Training and Education Committee has the latest updates on the 'Train the Trainers' initiative and the switch from the RCF to the RSGB as the body overseeing the UK amateur radio licence examinations. The show also follows up on the recent news that Radio Amateurs' Emergency Network has become incorporated with RAYNET. Cathy Clark, G1GQJ explains how the organisation is faring in today's high-tech world. Special downloads are available for clubs who would like to screen the episode at club nights: email the team via info@txfactor.co.uk to find out more.

New antennas planned

MFJ Enterprises and InnovAntennas Limited have announced a partnership that will increase the availability of InnovAntennas' smaller antennas in addition to providing a new and up to date range of computer optimised directional antennas for Hy-Gain and Cushcraft. It is expected that the first in this new line of antennas will be available by the spring of 2017. See www.innovantennas.com

OH dear!

In the Portuguese and Finnish 60m licence changes news item on page 8 of January's *RadCom* there was a small but significant error. In the second paragraph it said "all OK stations will get permission..." when it should have read "all OH stations will get permission…". Our apologies for the keyboard problems.

St Patrick's Day Award Station

Between 16 and 18 March, Grey Point Fort ARS will be operating a St Patrick's Day award station between 10am and 6pm. Operating from Grey Point Fort, Fort Road BT19 1PU the club will be one of the St Patrick's Day stations needed for the SPD award. See http://stpatrickaward.webs.com/about-the-event for full details of the award and the number of qualifying station you need to work.

RAYNET groups active

North Anglia RAYNET was requested by West Norfolk Emergency Planning unit to assist with communications on 12 January. This was to support operations in the Hunstanton/Heacham/Snettisham areas relating to high tides. In the end, due to changes in forecasts and weather, the planned deployment did not take place. However, members remained on standby as further activity is planned for the tides on the 13th. The situation in Essex continued to deteriorate and Essex members were deployed (see the report on page 15).

Beko amplifiers

The International Ham Stores Group is now stocking Beko Elektronik amplifiers after being granted sole reseller status in the UK and Ireland. BEKO-Elektronik (BEKO) are known for their VHF/UHF amplifiers including the HLV-1000, a 1kW 2m amplifier that can be supplied with input drive levels to suit the individual user. These can be as low as 7dBm to 25 watts to deliver the full 1kW output. BEKO amplifiers will, therefore, compliment major radio brands supplied by IHSG such as Elecraft, Flex Radio and Expert Electronics, all of which have low power output at VHF/UHF. Model variants are available for 2m, 70cm and 23cm and the range is completed by a 50/70MHz dual band amplifier, the HLV- 950, which provides 1kW on 50MHz with around 60% of the total 50MHz output being available on 70MHz. All BEKO models will be available for purchase via all IHSG websites (Nevada, InnovAntennas, Waters & Stanton and JayCee Electronics Scotland).

New Products

DAIWA SWR Power Meters

Nevada Radio is the official UK importer for Daiwa and there is a new range of meters for 2017.

The CN-901 series are professional units covering from 1.8 to 525MHz with an extra-large cross meter display. They measure both peak (PEP) and average power, up to 3kW. The range is offered with either N type of SO239 type sockets, depending on model.

The lower cost CN-501 series are for general purpose use in the shack and read up to 2kW power levels (peak and average), with cross needle metering for easy instant SWR readings.

The photo shows the new CN-901 HP that covers 1.8 – 200MHz, three power levels 20W/200W/2kW and has SO230 sockets. The meter sells for £129.95.

Full details of all the range are on www.nevadaradio.co.uk or telephone 02392 313 090.

Third generation LFA Yagi

Justin Johnson, G0KSC, of InnovAntennas Limited, part of IHSG, has launched a third generation LFA Yagi, the LFA-3. There are 4, 5, 6, 7 element versions so far – the photo shows the 4-element 50MHz version with a 3.9m long boom delivering 10.74dBi (8.6dBd) and over 23dB F/B while still providing stability in wet weather and an ultra-low noise pattern. A full range of these low noise Yagis will be launched throughout 2017 so keep an eye on the website www.innovantennas.com for the latest information. Prices range from around £300 including VAT.

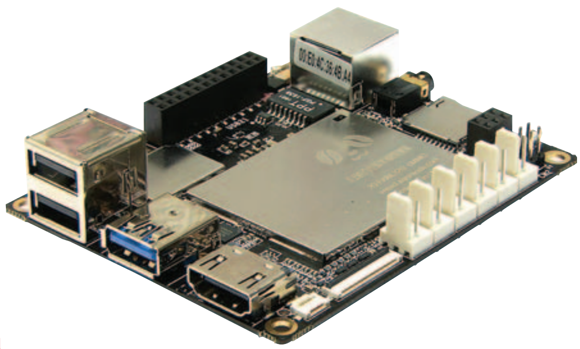
A 5-element 70cm Yagi

M0CVO Antennas has announced they are sole UK dealer for several VHF and UHF items from Bloomice Antennas. These are the dual band mobile magnetic mount antenna (Duo Mini), a 5 element 70cm Yagi with 9dBi gain (see photo, priced at £40.95) suitable for home or /P operations and the UHF Mini, a small vertical antenna for 70cm. Full details of all of these can be found on the website www.m0cvoantennas.com

PicoAPRS transceiver

This palm-sized PicoAPRS kit is claimed to be the world's smallest APRS transceiver with a TNC. This tiny unit measures just 33 x 58 x 24mm and includes a 1W/0.5W 145MHz transceiver, GPS, OLED display, lithium ion battery and ATmega 1284p processor. The kit is supplied with all the PCBs populated and tested, you just have to connect and assemble them into the case. The PicoAPRS has a myriad of APRS related uses including use as a tracker and as a KISS protocol TNC. The kit is available from Martin Lynch & Sons, see www.hamradio.com

Latte Panda



The Latte Panda is an extremely compact and complete Windows 10 PC and development board in a package that's not much bigger than a Raspberry Pi. At its heart is an Intel Atom Quad Core processor running at 1.8GHz with 32 or 64GB of flash memory and 2-4GB of RAM. Windows 10 is pre-installed and working so you just need to purchase a licence key. One of the things that make the Latte Panda board different is the inclusion of an Arduino coprocessor (Leonardo) so you can use existing Arduino code to control external hardware around the shack. Connectivity is also well provided with USB-3, USB-2, 100Mbps Ethernet, Wi-Fi, Bluetooth 4.0 and plenty of GPIO ports. The Latte Panda is available from ML&S Ltd at an introductory price of £199.95 inclusive of VAT at 20%. www.hamradio.com/lattepanda

Essex RAYNET deployed

Essex RAYNET was deployed to support Tendring District Council following severe flood warnings for the Essex coast in January.

Essex RAYNET at Control, Tendring District Council, Weeley.

Alerts from the Environment Agency warned of a 'risk to life' in parts of the county, resulting in a sizable deployment from the emergency services, council departments and numerous volunteer organisations.

Essex RAYNET members had been kept apprised of likely poor weather, as warnings from the Met Office had been circulated earlier in the week. In the early hours of Thursday 12 January, Essex RAYNET were given notice that assistance may be required. All members were alerted to be on possible standby, to charge batteries and ready their equipment. Later on Thursday morning, Essex RAYNET was officially notified by Tendring District Council, via the Essex Civil Protection and Emergency Management Team, that their support was required. Members started to deploy to the council's offices in Weeley. Within a few hours, a Control station was operational at Tendring District Council's DERC (District Emergency Response Centre), with cross-band repeaters active for local coverage, and county-wide for members en-route to the incident.

Essex RAYNET's primary involvement was to support Tendring District Council who were coordinating the evacuation of a potential 2,500 residents from Jaywick. An emergency rest centre was opened at the nearby Tendring Education Centre, with a team also at Frobisher School to support evacuation. Essex RAYNET quickly deployed a team to each location making use of a cross-band repeater for robust communication back to Control at the council offices in Weeley.

Essex RAYNET was also deployed to the Forward Command Point, which was the central command for the police and fire and rescue teams. A large number of emergency vehicles were gathering at this point for operational briefings, before deployment to Jaywick. In the run-up to the expected tidal surge, most of the effort was contacting the residents (with police knocking on over 2,000 doors, leafleting and media), and preparing to evacuate the most vulnerable to a rest centre.

Essex RAYNET was active through the night, and a small number of residents had already settled in for the night at the primary rest centre. Some of the RAYNET team were able to take shifts in getting a few hours shut-eye on inflatable mattresses ahead of a busy morning.

Media interest in the event was very high, with satellite trucks and radio cars from BBC and Sky in attendance, as well as local and national print media arriving from Thursday into Friday. The evacuation was in full flow from 7am on Friday, but after a few hours, it became clear that the tides and high wind predicted for midday were likely to be less severe. As teams were preparing to scale back the operation, the Environment Agency reported that the latest information was that midnight high tide was of greater concern than midday. With the prospect of overnight floods and rescue operations, the operation ramped up again.

By this point, most of the emergency services, council officials, volunteers and RAYNET members had been active for 24 hours, and a call was put out for additional RAYNET members to assist. As it was a working day, many members were unable to attend immediately, and a call for assistance from nearby RAYNET organisations was made. Essex RAYNET received offers of help from RAYNET groups in Suffolk, Southwest Hertfordshire and Medway, in addition to mid Herts. In the end, enough Essex RAYNET volunteers were able to support the event. RAYNET's national emergency planning team were also kept informed and monitored the situation throughout.

Evacuation activities continued through Friday evening. At the peak, 230 residents from Jaywick heeded the advice to gather at the rest centre, some bringing their pets. Fortunately for all concerned, the predicted midnight tidal surge didn't happen, and residents returned home on Saturday morning. Essex RAYNET were stood down a few hours later, with some members having been active for over 40 hours, and looking forward to a decent sleep on Saturday.

Sixteen members of Essex RAYNET were in attendance in a support role, and were deployed as part of Tendring District Council's contingency plans. The team expended a total of 332 man hours over the two days. Mobile phone coverage in parts of the affected area was not great and, had the worst happened, it would likely have been necessary for a significant amount of message handling to be done by the RAYNET team. Numerous important messages were passed by RAYNET during the operation, and operators were able to keep council official and volunteers aware of events taking place at other key locations without tying up landline and mobiles.

Incidents like this serve to highlight the need for volunteers to be available to assist communities in times of need. If you have an amateur radio licence, volunteering for RAYNET is a great way to put your skills to good use. For more about Essex RAYNET, go to www.essexraynet.org.uk, or nationally, go to www.raynet-uk.net

Pete Sipple, M0PSX
raynet@essexham.co.uk

The 80th RSGB Commonwealth Contest

The RSGB's Commonwealth Contest is one of the longest running contests in the world, with 2017 being the 80th time it has taken place.

Jim, G3VDB operated from the Maldives as 8Q7EJ. It was a holiday style operation as well as an entry in the Commonwealth Contest.

A little bit of history

In 1927, Captain Hampson, G3JV suggested that the RSGB should form some kind of British Empire Radio League to put it on a par with the ARRL and the IARU. Later that year the phrase British Empire Radio Union was added to the name of the Society as a sub-title with the aim of enlarging the scope of the Society. The next few years, though the work of Arthur Watts, G6UN, Geoffrey Thomas, G5YJ and Gerald Marcuse, G6NM, BERU grew in strength and scope. An award was devised, the Worked British Empire certificate, for two way contact with an Empire station on each of the five continents. Within months, 50 certificates were issued.

In June 1930, Arthur Watts suggested that BERU representatives around the world should send birthday greetings over the air to the Society's Patron (HRH The Prince of Wales KG). The Society received a letter that read, *"I am desired by the Prince of Wales to convey through you to the Council and members of the Radio Society of Great Britain, His Royal Highnesses' thanks for their birthday congratulations which he greatly appreciated…"*

Later that year the New Zealand ARTS suggested an annual Empire Radio Day and it was from that suggestion that the first BERU contest was launched. The first one created quite a stir in the press both home and abroad. It promotes contacts between stations in the UK & Crown Dependencies (UK&CD), Commonwealth and Mandated Territories, something that hasn't changed throughout the years.

The Rose Bowl trophy for the contest's winner was bought in 1931 by donations from Members.

In 1932, the first UK winner was Freddie Miles, G5ML, and there wasn't another UK-based winner until 1950 when Rusty, G5WP won the title. It's not an easy contest to win from the UK!

Peter, G3LET visited a snowy Prince Edward Island and the super station of Jeff, VY2ZM.

The 80th Commonwealth Contest

The 80th Commonwealth Contest will take place from 1000UTC on 11 March to 1000UTC on 12 March. To celebrate the 80th contest there is a prize draw, thanks to Kent Engineering, Martin Lynch & Sons and the RSGB. A replica, made by Kent Keys, of the original key used by Morse in his 1844 demonstration that became the reference for key designs over many years and has changed little to this day. The RSGB have offered a RSGB Millenium Key and a RSGB Vibroplex Centenary key. Three draws will take place for Commonwealth entrants from each of the three IARU regions: 1 Europe and Africa, 2 North and South America and 3 Australia, Asia, New Zealand and Pacific. The sponsors of the three prizes are Martin Lynch and Sons (Region 1), Kent Engineering (Region 1) and the RSGB (Regions 2 and 3).

For each region the call of every entrant making 10 or more valid QSOs will be entered into the prize draw the number of times they make a valid QSO, up to a maximum of 80 entries. For example an entrant making 5 QSOs would be not be entered in the draw, an entrant making 15 QSOs would be awarded 15 entries, an entrant making 80 QSOs would be awarded 80 entries, and any entrant making 81 or more valid QSOs would also be awarded 80 entries in the draw.

Special 80th certificates will be available for all entrants who make 80 QSOs or more. This will be able to be downloaded from the results pages. To be *sure* that you work enough stations to gain this certificate it's best to work more than 80 stations.

Back in 1931, a 4 stage crystal oscillator, multiplier, 100W PA, 2 valve TRF Rx with a Zeppelin, half- or full wave antenna was all it needed to win. Mind you, the contest lasted a week! For 2017, if you have some vintage gear (that's a radio with plenty of valves in it!), why not use it to get into the spirit of this historic event? Just make a note on your entry soapbox and make sure you send in a few pictures with your entry.

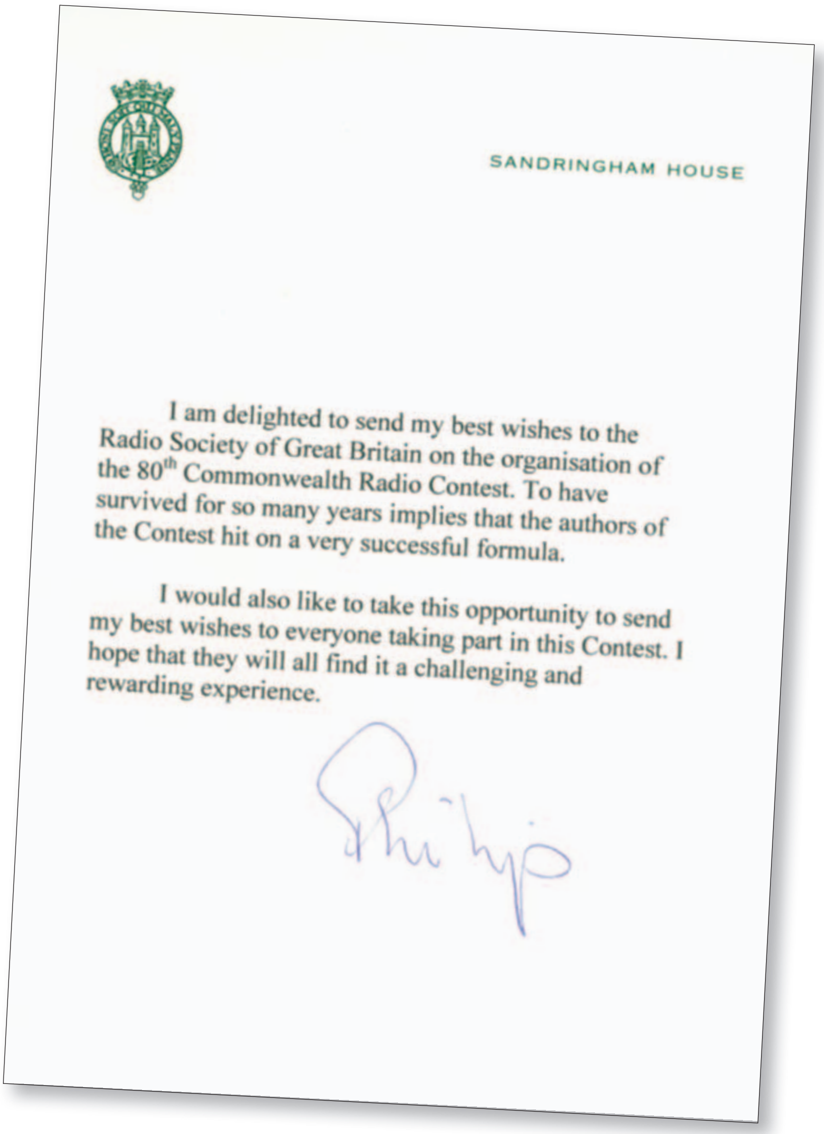
There will be a prize for each member of the highest scoring UK or NI Team in the Team competition. This will be a suitably engraved tankard for each member. There can be any number of Teams per call area with 5 entrants per Team – but you can only be members of one Team. Team members must all be in the same country/region except for the 'Rest of the Commonwealth' Team(s).The Team captain must send in calls to be used by Team members 7 days before the start of the contest. Substitutes are allowed until start time. Latitude factor = 1.78 for 2017. So get your team organised right now and send in your team calls to commonwealth.contest@rsgbcc.org

HQ stations were originally introduced to add interest during quiet periods. Commonwealth Society Headquarters stations will be active during the contest and will identify by sending 'HQ' after their serial number. For the 80th there will be HQ stations in each of the UK and NI DXCC countries:

GD80CC at MD4K (G4XUM)
GU80CC at GU4YOX (GU4YOX, GU4EON, GU4CHY)
GM80CC at GM3WUX
G80CC at G0ORH
GW80CC at GW0ETF
GI80CC at GI4DOH
GJ80CC at MJ0ASP

Only one HQ station is permitted per Commonwealth Call Area or UK&CD prefix area. Each HQ station counts as an additional call area, and entrants may contact any HQ station (including one in their own call area) for points and bonuses. Although the entire UK&CD counts as one Call Area and UK&CD stations cannot work each other, they can work the 7 separate UK&CD 'HQ' stations mentioned previously. We are encouraging VE, VK, ZL to have more HQ stations too.

The rules for the 2017 contest are at http://www.rsgbcc.org/hf/rules/2017/beru2017.shtml



SANDRINGHAM HOUSE

I am delighted to send my best wishes to the Radio Society of Great Britain on the organisation of the 80th Commonwealth Radio Contest. To have survived for so many years implies that the authors of the Contest hit on a very successful formula.

I would also like to take this opportunity to send my best wishes to everyone taking part in this Contest. I hope that they will all find it a challenging and rewarding experience.

Philip

Letter from our Patron HRH The Prince Philip, Duke of Edinburgh, KG, KT

Patron's letter

On 3 January, the RSGB received a letter from the Patron, HRH The Prince Philip, Duke of Edinburgh, KG, KT, sending best wishes for a contest that 'has survived for so many years'. He goes on to say that the contest has 'hit on a very successful formula'.

This is the latest correspondence between our Patron (both the current and previous) and the Commonwealth Contest – there have been several letters, especially in the early days, such as in 1934: 'The Prince of Wales is most grateful to BERU, Montreal Branch, for their kind greetings on his birthday'. This was a tradition that went on for several years with different branches of BERU.

Today, the RSGB is pleased that our Patron still takes an interest in amateur radio activities and hopes that this year's Commonwealth Contest is a great success.

Your entry

The closing date for this year's contest is 17 March 2017. For any questions, look at the webpages at www.berucontest.wordpress.com

I, and the other members of the Commonwealth Contest (BERU) group are on hand for advice: email me via bob@g3pjt.com

Bob Whelan, G3PJT
www.berucontest.wordpress.com

HF cave radio

I f your HF rig is your pride and joy, the idea of taking it into dark hole in the ground where it could suffer bumps and knocks, be dropped or kicked and generally at risk from getting dowsed in water or caked in mud, would surely fill you with dread. Yet this is exactly what a group of radio amateurs have been doing in their quest to better understand through-rock communication, a vital tool in cave rescue.

Experimenters have risked HF rigs in a far from ideal environment in their pursuit of improving through-rock communications for cave rescue.

Conventional cave radio

To date, cave radios have operated in the LF portion of the spectrum, typically at a frequency of 87kHz – and with some justification. To a first approximation, the absorption of radio waves in a conductive medium such as rock is proportional to the square root of frequency. The argument, therefore, has been that a low frequency is necessary to minimise absorption and thereby maximise range. While LF cave radios have provided sterling service for decades, it has to be admitted that using such low frequencies does have a serious drawbacks.

Antennas that are compact enough to be used in the close confines of a cave passage are such a small proportion of a wavelength – which is almost 3.5km at 87kHz – that they are extremely inefficient. They are typically either a small multi-turn loop or an electrically-short dipole, perhaps 20m long and grounded at the ends; such antennas barely radiate and, instead, mostly generate a near magnetic field. Unlike a radiated signal, which decays with the square of distance, the near magnetic field decays with the *cube* of distance. The upshot of this is that communication is possible in limestone to a range of a few hundred metres, or a kilometre at the most. Not only that but it's impractical to improve the situation by increasing the power. After all, to double the range requires the field strength to be increased by a factor of eight and, if the field strength is proportional to the antenna current, as is commonly the case, the power could have to be increased by a factor of 64.

It's not entirely clear how far underground the deepest caves lie. Cavers tend to define depth as the difference in elevation between the entrance and a cave's lowest point and, by that definition, the current world record holder is Krubera Cave in Georgia, which clocks in at 2,197m. However, because the entrances to deep caves are often at high elevation, with the cave following the slope of the terrain away from the entrance, the amount of rock between underground locations and the surface is often much less than the official headline depth. What we can say, though, is that in many cases, the range of a low frequency cave radio is adequate for its purpose but only if the surface station is set up at closest point on the surface. However, having to locate a surface station directly above a cave might not even be possible due to access restrictions or difficult terrain and even if it *is* possible, it's commonly far from ideal. In coordinating a rescue, for example, it's undoubtedly preferable to work from a heated vehicle than on a steep mountainside at night in a blizzard.

Reappraising HF

It was with the aim of increasing the above-ground range of cave communication systems that Robin Gape, G8DQX, Rob Gill, G8DSU, Tony Haigh, G6UMU, Jim Rattray, G0TFS, Fred Rattray, G4SPR, Chris Trayner, G4OKW and myself started experimenting with HF cave radio, a concept that isn't as unlikely as it might seem. For a start, because antennas are much more efficient radiators at these shorter wavelengths, they should be capable of generating a genuine radio signal (as opposed to the magnetic near field). This being the case, the inverse cube law of attenuation is replaced by an inverse square relationship. In turn, this means that if a signal *does* escape from the ground, it ought to be capable to travelling a lot further. This could make life a lot more comfortable for our long-suffering rescue controller plus, it has to be admitted, working in a properly equipped vehicle is more efficient and, therefore, improves the likelihood of a favourable outcome.

Before we get too carried away, though, we really need to address the subject of absorption in the rock: after all, this has always been the argument for using low frequencies. It's here, therefore, that we need to point out that the commonly-quoted formula for the absorption of a radio signal in a conductive medium is an over-simplification. In particular, it only holds true if the medium is categorised as a good conductor, a condition that depends on the frequency and the physical properties of the rock, namely its conductivity and electric permittivity. The upshot of this is that, above a certain frequency, the rising graph of attenuation against frequency starts to flatten off as attenuation becomes more dependent on permittivity than frequency. The conductivity of limestone varies considerably from area to area but, even so, we can say with confidence that it is no longer a good conductor in at least some of the HF part of the spectrum. So, while the attenuation in the rock at HF will certainly be greater than at 87kHz, it might not be nearly as high as the naïve view would suggest. It was with this realisation that work into HF cave radio began.

Preliminary tests

At the outset we were keen to get a view of the comparative performance of different HF frequencies. Experiments were carried out in several amateur bands from 3.5MHz to a perhaps unlikely-sounding 28MHz – that's two and a half orders of magnitude higher than the conventional cave radio frequency of 87kHz.

Initially using dipoles underground, the first conclusion – fairly obvious in hindsight – was that the lower the frequency, the more difficult it is to suspend the antenna in a cave passage, bearing in mind that any such antenna is of little value unless it can rapidly and easily be deployed by a rescue team. In most cave passages we were able to raise it just a couple of metres in the centre – less in low caves – with the ends sloping down to the cave floor. Needless to say, though, longer antennas for lower frequencies ended up with more of the wire effectively trailing on the ground. In addition, since cave passages are often meandering, the longer the antenna the more it would deviate from the ideal situation of being perfectly straight. Because of these difficulties, and bearing in mind that performance wasn't substantially better at 3.5MHz than 7MHz, it became clear that the initially perceived advantage of using the lowest HF frequency wasn't a practical proposition. In fact, even higher frequencies worked better than anticipated and, while 28MHz allowed communication through about 100m of limestone in one location, a decision was made to concentrate on 7MHz. In addition to the benefits already mentioned, this band had the advantage of good ground wave coverage with the consequential likelihood of having other amateurs within range to provide reports. While this has allowed us to concentrate our efforts on the one band, it's not inconceivable that other bands could be re-addressed in the future.

Rob Gill and Tony Haigh HF experimenting with HF cave radio in Kingsdale Master Cave in the Yorkshire Dales. (Photo: Gregory Collins).

Antenna options

Even on our chosen band, though, it soon became clear that a dipole – or, to be more accurate, a very shallow inverted-V antenna – really wasn't a practical proposition in most cave environments. In addition, the directional and impedance characteristics of an underground wire antenna is likely to be affected greatly by its immediate environment. There are also practical difficulties. While accepting that 7MHz antennas are significantly better than their 3.5MHz counterparts in this respect, they pose a risk to passing cavers who could be easily accosted by the neck while negotiating the confined spaces. Not only would this be unfortunate for the cavers involved – not at all ideal in a rescue scenario – but the antenna would be at constant risk of consequential damage and the radio equipment attached to it could easily be harmed, for example by being dragged into a pool of water. In addition to safety concerns, the orientation of an underground wire antenna is usually constrained by the cave passage so, if we assume the antenna has directional properties, the orientation would commonly not be ideal. So while 7MHz is still good choice because of the acceptable performance at this frequency and the manageable proportions of the surface antennas, it became clear that a more practical antenna was required underground.

FIGURE 1: WSPR transmissions on 7MHz from 100m underground were received in 9 countries. Map Data ©2016 Geo-Basis/DE-BKG (©2009), Google Inst. Geogr. Nacional.

Comparative tests at 7MHz involved the somewhat impractical and inefficient dipole to provide a reference, plus two alternatives. First up was a horizontal grounded dipole of the type that is commonly used with LF cave radios, where it is a very small percentage of a wavelength long. Similarly at 7MHz, this type of antenna wasn't cut to any particular length such as half a

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While barely practical underground, an inverted-V dipole is the antenna of choice on the surface.

Jimmy Rattray operating a surface station in contact with experimenters underground.

wavelength and, importantly, such antennas are intended to trail on the ground for all of their length so they are much less at risk from (and to) cavers. Potentially, however, they still suffer from a potentially non-ideal orientation and they often won't be straight. The second alternative was an electrically-small single turn loop antenna – specifically, one metre in diameter – that was fitted with a tuning capacitor and a tuning indicator. Tests involved using it both horizontally and vertically, the latter configuration allowing it to be rotated around its vertical axis.

Perhaps surprisingly, given its sub-optimal characteristics, the half wave dipole gave the best performance and the grounded dipole was the worst, although not by a huge margin. The loop was only slightly inferior to the dipole. Further work is planned here, with an aim of better tuning a grounded dipole to the transceiver. A particularly interesting observation, which has been reported by several other experimenters, is that a nearby surface dipole should not be orientated broadside to the underground station as would be expected. Instead, maximum signal strength is obtained when the end of the surface dipole points towards the underground station and the underground antenna is end-on to nearby surface stations. It is hypothesised that this is phenomenon results from refraction of signals at the interface between the ground and the air.

Longer range performance

Given that one of the aims of research into HF cave radio was to improve the above-ground range of a signal transmitted from underground, we were keen to discover whether this aim had been realised and so a series of tests involved dispatching a mobile surface station to survey underground signals throughout the local area. The bottom line is that two-way communication was routinely achieved between an underground station and a mobile surface station within a couple of kilometres of the cave, and the best performance for speech communication to date was over a 5.5km path. It is probable that a greater range could have been achieved but we were hampered by a low density of amateurs in the rural areas where caves are found. As encouraging as these results were, though, tests with WSPR have achieved even more impressive results.

For anyone not familiar with it, WSPR stands for Weak Signal Path Reporter and is a digital means of transmission supported by a network of amateur-operated stations worldwide that automatically post reception reports online. While by no means a fast form of communication, at 1.4648 baud, it's a whole lot faster than some forms of digital communication used by radio amateurs, suggesting that similar coding methods could, perhaps, form the basis of a practical short messaging service. So far, experimentation into WSPR from an underground location is in its early stages but, to provide a feel for what could be possible, we are able to report that an underground station in Short Drop Cave in the Yorkshire Dales was received in Liverpool, London and Southampton. Underground reception of surface stations was even more remarkable. During a ten minute session in the nearby Kingsdale Master Cave at a depth of 100 metres, signals were received from 22 stations in nine countries (**Figure 1**), the most distant being SM0JZT in Sweden at a range of 1,327km. Clearly the signals from the more distant stations would have been via sky wave propagation and, while the results are certainly interesting, they're not entirely relevant to the potential applications that are discussed later, and might even be detrimental due to increased interference.

While there's undoubtedly a degree of the typical amateur radio motivation of 'because it's there' in researching such apparently difficult propagation paths, the apparent ease by which WSPR stations can be received underground suggests a practical caving application. In the update on LF cave radio sidebar we take a look at the Black Meg 3 beacon transmitter, which allows cavers to send short messages to the surface. Arguably even more useful would be a surface-to-cave messaging service that would permit, for example, a surface party to warn their colleagues underground that torrential rain is on the way and they should get out quickly. It's speculated that HF radio might be able to form the basis of such a system using smaller ferrite receiving antennas rather than the large loops that are commonly required for LF systems. What's more, licence permitting, stations might be capable of broadcasting alerts to cavers over a large regional area.

An opportunity to participate

From the development of LF cave radios to experimentation with HF for through-rock transmission, radio amateurs have often

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been at the forefront of technology in sub-surface communication for caving. However, as this article demonstrates, there's still a lot we don't know and there is, therefore, plenty of scope for further work. If you have a passion for radio technology and enjoy the great outdoors, this exciting but challenging area of research might be just what you're looking for.

If you'd like to try your hand at cave communication – and especially HF cave radio – there's ample opportunity for innovation. However, if you're not an experienced caver then it would be unwise in the extreme to go underground unescorted. If you're interested in caving as a sport then you should make contact with a local caving club (see www.trycaving.org.uk) who will be able to take you underground while teaching you how to explore these fascinating places in safety. However, if your primary motivation for going underground is technical, you might also like to make contact with the Cave Radio & Electronics Group, CREG (http://bcra.org.uk/creg/), a special interest group of the British Cave Research Association, BCRA. CREG publishes a technical journal quarterly and organises regular field meetings as opportunities for experimentation and the exchange of ideas between like-minded people.

Loop antennas are a much more practical proposition than dipoles underground. (Photo: Gregory Collins).

LF cave radio – an update

Although our theme here is HF cave radio, since LF through-rock radio is likely to be the workhorse of the cave rescue teams for the foreseeable future, it seems appropriate to look at recent developments in this sphere too.

For several years now, the most widely used cave radio in the UK was the HeyPhone. Developed by the late John Hey, G3TDZ, this was an SSB radio operating on 87kHz and it was used by most of the UK's rescue teams. Nothing lasts forever, though, especially equipment that has been subjected to the harsh underground environment and rough handling, and after a decade or more of exemplary service, reliability issues were starting to become a concern. Fortunately, replacement technology is at hand in the form of not one but two cave radios that are now being brought into service.

Called the Nicola 3 and designed by Graham Naylor, the first alternative is a direct HeyPhone replacement – at least in its initial guise – providing inter-operability with its predecessor. Internally, though, it couldn't be more different. The Nicola 3 is a software defined radio that, potentially, offers several benefits if HeyPhone compatibility isn't an issue. In particular, it could offer frequency agility (which would make it much less prone to interference from the LORAN-C terrestrial navigational system) and alternative modulation schemes including data modes and digital speech encoding could be provided, with the potential to improve performance.

The second cave radio is Cave-Link, which was designed by Christian Ebi, HB9ZGB, Jacques Hurni, HB9OD and Felix Ziegler,

The Cave-Link system provides text-based communication between a cave and the surface.

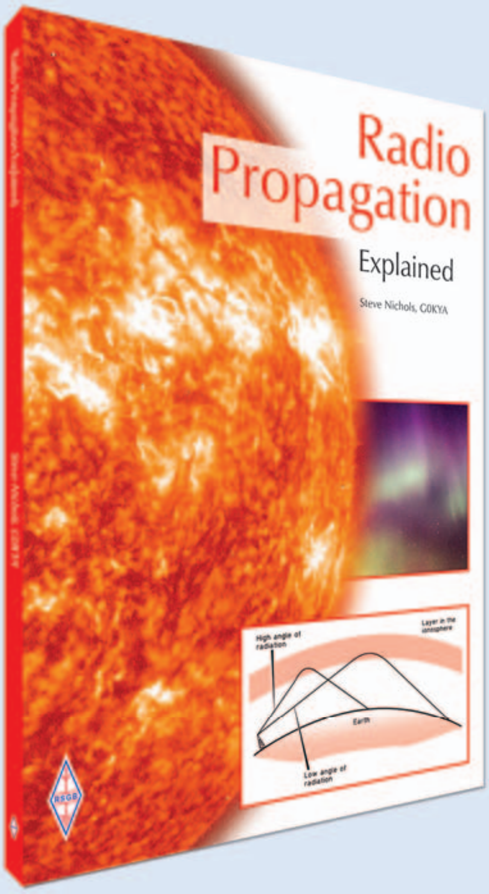
HB9CPZ of the Hölloch Cave Research Association in Switzerland. It operates in portions of the LF and VLF bands but this is about the limit to its similarity with other cave radios. Instead of speech, the Cave-Link is intended exclusively for text communication and has sophisticated facilities allowing messages to be forwarded by intermediate stations, thereby extending the range almost indefinitely. In fact, by using the optional mobile phone interface on the surface, messages can be exchanged between an underground location and mobile phones worldwide.

While quite different from those cave radios intended for rescue use, the Black Meg 3, designed by Jim and Fred Rattray, provides an example of how very simple circuitry can reap impressive results. Intended for cavers on expedition, it takes the form of an underground 87kHz beacon transmitter and loop antenna that sends pseudo More code from a cave to

Pete Allwright of the Cave Rescue Organisation demonstrates the Nicola 3 at the 2016 EuroSpeleo conference.

the surface. The transmitter operator selects one of 16 distinctive Morse-like symbols that follow a binary sequence (ie dah-dah-dah-dah, dah-dah-dah-dit, dah-dah-dit-dah etc) that have been assigned preset meanings. People on the surface with no experience of receiving true Morse are easily able to identify the symbol and look up its meaning from a table.

NEW TITLES



Radio Propagation Explained

Steve Nichols, G0KYA

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Kenwood TH-D74E

dual band digital handheld

Kenwood's new flagship handheld is the first radio equipped with both D-Star and APRS – and makes Kenwood only the second major manufacturer to embrace D-Star.

Ever since the 2nd generation of D-Star radios came with GPS as standard, people have wondered why they couldn't also include APRS. This would make the radio useful not only for use on the D-Star network, but also allowing extra functionality on the analogue side. Kenwood has now bridged that gap with the release of the TH-D74E handheld.

I first clapped eyes on the TH-D74E at Friedrichshafen in 2016, before it had even been given a model number. It was behind a Perspex case to stop anyone fiddling with it – but it was drawing a crowd, not least because of its large and colourful LCD display. Now the TH-D74E has been released and its specs are known.

PHOTO 1: The Kenwood TH-D74.

Outline specification

The TH-D74E is a handheld radio able to receive all modes (FM, AM, CW, SSB etc) between 100kHz and 524MHz (there are some small gaps in modes and coverage, for example no FM below 28MHz, but it does receive SSB/CW on 2m and 70cm). Transmit is FM and D-Star in the 2m and 70cm amateur bands. There are four power levels: 5, 2, 0.5W and 50mW. Battery life is up to 15 hours when used sporadically and/or with 50mW output power, and about 6 hours with 'normal use' at high power. Enabling the GPS reduces battery life. In one of my tests I drove from Glasgow to Cambridge with APRS SmartBeaconing in use at high power and the battery was still half-full after seven hours.

All the usual FM handheld features such as variable channel steps (including 8.33kHz on Air Band), CTCSS, tone burst, DCS, DTMF, Echolink memory dialler channels and so on. There are Tx and Rx audio equalisers, a VOX, simultaneous two-band receive with separate squelch, voice guidance and even KISS packet operation. There is a MicroSD slot that lets you store audio, memories and settings and the radio is rated as being water and dust resistant to IP54/IP55.

In the box

The TH-D74E comes with all the accessories you would normally expect. There is the radio itself, the 7.4V 1800mAh lithium-ion battery, a short rubber duck-style flexible antenna with normal polarity SMA fitting, a belt clip and a charger with UK and EU cables. The late pre-production version I received did not have instructions, a USB cable or memory card.

First impressions

Although I've used Kenwood radios before I've never owned one, so I thought that reviewing this new HT wouldn't be swayed by past experiences. In a way, my comments will be comparing the TH-D74E in the light of other manufacturers' handhelds. (I did gave the TH-D74E to a few friends who own Kenwood THD72E's and they found the feel and interface familiar.)

The first thing I found was the colour screen made navigating the menus very easy. The navigation method is simple, using the up, down, left, right and enter keys on the front. It uses a method familiar from old Nokia phones where each menu option is assigned a number, meaning if you wanted to get to the menu to set the date or time, menu number 950, you can either follow the onscreen prompts or just press 9, 5 then 0 on the keypad for fast access. This is very useful when using the manual as it navigates you to menus using such codes.

The TH-D74E has a MicroSD card slot that allows you to back up settings and load memory files, both of which can be read or modified on a computer. The settings allow configuring two additional buttons on the keypad, PF1 & PF2, plus 3 buttons on a suitable Kenwood mic (one that contains physical buttons for PF3-PF5). One configuration option for the PF3-PF5 buttons is a Screenshot option, which I used to capture some of the images for this article. You can also record audio and GPS track logs on the card.

During the review period the transmit audio was commented on many times for its roundness, even when using D-Star. The speaker on the front can be very loud if the volume is turned up fully.

Software update

When I received the TH-D74E for review it had firmware 1.01 installed. Looking at the Kenwood webpage, version 1.05 was available so I decided to update the radio to latest version. First I checked the changes between each version: Kenwood, unlike many others, produce detailed change notes so you have a good understanding of what has been altered between each version. The changes between v1.01 and v1.05 were numerous so it was only fair I used the latest v1.05 for this review.

The update process is very easy. You download an EXE file to a PC, run it and follow the instructions. A USB cable is used to connect the radio to the PC. At one stage you need to power the TH-D74E up and hold a set of buttons, but afterwards it proceeded automatically and the upgrade process worked fine for me. Kenwood also supply a driver should you need it, but as the COM hardware used for the USB serial connection is quite common, I already had the driver installed.

A full CPU reset is required afterward the update, however it's possible to save the memories, and, crucially, settings to the MicroSD card so they can be restored after the reset.

FIGURE 1: APRS active on 2m and 70cm repeater GB3PY on Band B.

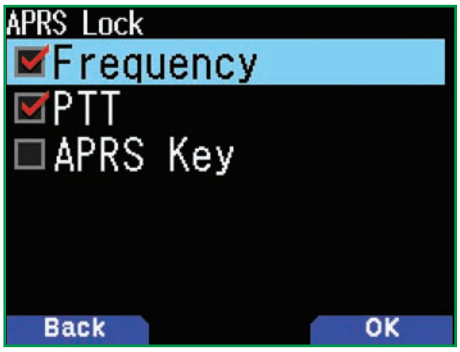

FIGURE 2: Lock options when APRS is the main band selected.

FIGURE 3: D-Star Screen in DV (direct) mode.

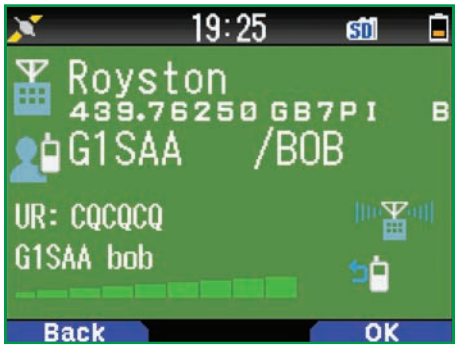

FIGURE 4: D-Star Screen in DR (repeater) mode.

D-Star digital voice

It's the inclusion of D-Star that makes the TH-D74E particularly special, and Kenwood has made D-Star very usable. Kenwood has implemented all aspects of D-Star on the TH-D74E, including voice mode, position beaconing and data mode. Kenwood has also implemented two ways to use D-Star on the TH-D74E: Simplex (DV mode) and Repeater (DR mode). Both are the same in respect to D-Star, it just makes it easier to use the radio. In each mode the TH-D74E shows details of the station currently transmitting, as shown in **Figure 3** and **Figure 4**.

In DV mode the callsigns setting used in D-Star are simplified. MY is still your callsign, programmed in the TH-D74E, UR is set to CQCQCQ but RPT1 and RPT2 are removed as they are not needed for simplex communication with another D-Star user. This makes it easier to configure the radio for simplex QSOs – and for the newcomer.

I imagine most people will work through D-Star repeaters or simplex nodes, using the mode Kenwood calls DR. In DR you can configure all the callsigns, MY, UR, RPT1 and RPT2. Again, MY is the callsign you programmed but the other three can be programmed in a multitude of ways depending upon the repeater or node you are working through. The simplest way is to use the GPS to get a list of nearby D-Star repeaters.

By default the TH-D74E comes with all D-Star repeaters and simplex nodes worldwide programmed into memory. At the time of writing (late January 2017) there were 1438 entries. The list is arranged by world region, country, then county. This list is separate from the 1000 user memories and is updated by Kenwood on a regular basis, although the user can also update it. I needed to do so for GB7PI-B, which had the old frequency of 439.9125MHz instead of the new frequency, 439.7625MHz. Using the MCP-D74 software (described later) the update took seconds.

APRS

The APRS features in the TH-D74 are extensive and have been a pleasure to use. Some earlier amateur handhelds struggle to get a GPS lock unless you are stationary outdoors with a clear sky, but the TH-D74E outclasses the competition and is able to get a GPS lock even indoors or in a moving car, usually in less than a minute. One thing I found strange and that initially caught me off guard is that the GPS icon is solid when there is no GPS lock and flashes when there is a lock; I'd prefer it to be the other way round.

The APRS modem can be set to band A, band B or the active band. **Figure 1** shows APRS being active on Band A (the top line). It's possible to set the beacon mode to one of four modes: off, PTT, auto or SmartBeaconing. The latter adjusts the beacon rate based on speed or change of direction, making your beacons much more correlated to your actual path on a map: the faster you travel the more frequent the beacons. It also sends a beacon if you change direction more than that set in the SmartBeacon settings, which is useful if you change direction by say 90 degrees (eg at a junction): the extra transmission(s) make it clear you stayed on the road and didn't take the 'agricultural route'.

In receive you can set how the decoded beacon is shown. It can be either a small notification at the top of the display or a full screen showing much more detail. Each decoded APRS beacon has four pages of information that you can navigate using the left and right keys. These pages cover the originating callsign of the beacon, their speed, direction and altitude, a compass showing direction and distance in real-time to the beacon location and finally the beacon location in latitude and longitude (along with Maidenhead locator and path). Each page shows a small compass with the heading to the beacon's location. Pressing the up and down keys scrolls thought the

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last 70 stations received on APRS. This list is also accessible by pressing the 5 (APRS) key on the keypad.

There are so many features relating to APRS I can't list them all here in this review. The TH-D74 is this is the most comprehensive APRS handheld I've ever used. It supports APRS Messaging and can create APRS Objects (fixed beacons different from your location, handy if used in say a RAYNET event and you want to highlight a location someone needs to check). Other very useful features include things like the option to re-tune to a frequency listed in a beacon Comment field, handy if a local repeater has an APRS beacon associated with it. It is possible to lock selectable features when the APRS modem is enabled, eg frequency or PTT, see **Figure 2**. Usefully, the TH-D74 can be connected to a PC over the USB cable and used as a packet/APRS modem from computer software.

Bluetooth

The addition of Bluetooth in the radio is welcome. Firstly you can use Bluetooth as a way to receive and transmit audio, using Headset Profile (HSP), with a normal Bluetooth headset. Alternatively, using Serial Port Profile (SPP) you can interface with memory software MCP-D74 to read and write memory files with a Bluetooth-equipped PC. Taking it to the next level, remote control software ARFC-D74 can also control the TH-D74E over Bluetooth. Unfortunately only one Bluetooth device can be connected at once, meaning if you wanted to control the TH-D74E from another room you'll need to find another way to transfer the audio.

MCP-D74 memory manager

As radios get ever more complex with ever more settings and an increasing number of memory channels, they become more complicated and time-consuming to program correctly. PC software can make this much more manageable and Kenwood supply, as a free download, the MCP-D74 Memory Control Program [1].

Using this program you can change every radio setting and all memory channels in a spreadsheet-like environment, as seen in **Figure 5** and **Figure 6**. You can save any frequency and mode to the memory channels. It took me a little while to realise that many memory settings (columns) were hidden by default and can be enabled using 'Display Items…' at the bottom of the memory table. Saving and loading settings is very easy, as is downloading and uploading to the radio, which can be done via USB, Bluetooth or directly to the MicroSD card.

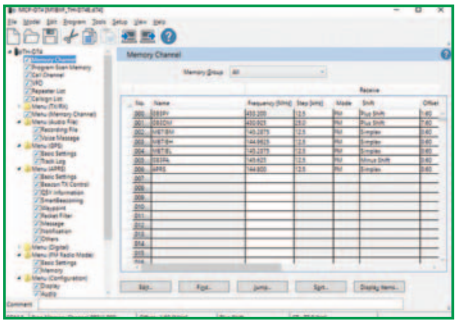

FIGURE 5: Editing memory channels in the MCP-D74 memory manager software.

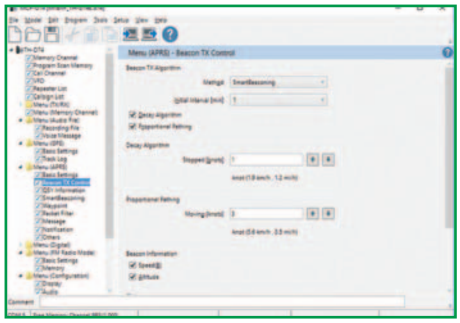

FIGURE 6: Setting APRS beacon preferences using MCP-D74.

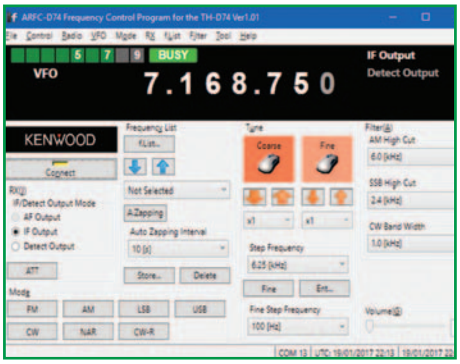

FIGURE 7: Controlling the TH-D74E using the ARFC-D74 frequency control program.

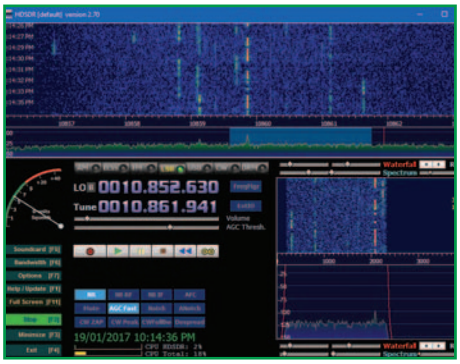

FIGURE 8: HDSDR decoding the TH-D74E IF output.

The Bluetooth connection is particularly convenient because it means you don't have to dig out a cable or card reader.

ARFC-D74 frequency control program

Kenwood has also released a very handy PC application [2] that allows you to control the TH-D74E from a PC, making it much easier to use the TH-D74E as a shortwave receiver. **Figure 7** shows it in use. ARFC-D74 controls the radio over USB or Bluetooth and, on a PC, there is a soundcard driver installed to allow audio to be sent from the TH-D74E to the PC. Note that transmit control is not supported by the ARFC-D74 software.

There are two operating modes in ARFC-D74: Detect Output and IF Output. IF Output is only 12kHz wide. In Detect Output the speaker on the radio is the output for the audio. Based on the mode and filter settings in the ARFC-D74, the same audio is sent to the PC soundcard input, which allows you to record the audio you hear. If you enable 'Listen to this device' in the Windows soundcard settings the audio will also come out your PC speakers.

In IF mode the TH-D74E outputs 12kHz of IF audio to the soundcard. The IF audio can then be opened in the SDR software of your choosing. **Figure 8** shows this mode being used to receive CW on 40m using HDSDR SDR program (ignore the frequencies shown on HDSDR).

Conclusion

The TH-D74E is a radio I'm likely to purchase sometime in the near future due to the features it supports. I really got on with the APRS side of the radio, especially the APRS messaging, but also found the wide range receiver capabilities and modes extremely useful at contests and within the shack as an on-air reference. D-Star works very well also and after working out the differences of DV and DR modes it becomes extremely intuitive to use and easy to have QSOs. With all the D-Star repeater and simplex nodes worldwide loaded as default, using the TH-D74E when travelling will be a breeze.

Thanks to Kenwood for making this radio available for review. As it was a pre-production sample I haven't tried to measure its performance, and it's possible there might be some small changes with the production version. However, as the radio's firmware is (easily) updateable, Kenwood may choose to add all sorts of new features in the future.

Websearch

[1] www.kenwood.com/i/products/info/amateur/mcpd74_e.html
[2] www.kenwood.com/i/products/info/amateur/arfcd74_e.html

ATV

I'm pleased to take over this column from Dave Mann, G8ADM, and would like to thank him for doing such a great job over the past 3 years.

146MHz ATV DX

Ever since the 146MHz allocation was released for amateur use, UK ATV enthusiasts have been trying to increase the DX record for reduced bandwidth TV (RBTV) on the band. The challenge is that the power is limited to 25W ERP (roughly 5W into a 5-ele beam) and the bandwidth is at least 150kHz. The previous record, set in early December 2016, stood at 221km. During the enhanced propagation on 28/29 December the record was broken twice. The first contact was between G8GTZ in Basingstoke (IO91KF) and G0MJW/A at Winter Hill (IO83RO) at a distance of 278km. This was followed by a contact between G8LES in Four Marks (IO91LC) and G0MJW/A at 294km. Well done to all involved.

The mode used for these contacts was 125kS/s DVB-S RBTV. The quality of the received picture can be seen in the screenshot (**Figure 1**). The indication of 15dB MER (modulation error ratio) indicates that there was at least 10dB margin on the signal.

DATV Express

The exciter used at both ends of the 146MHz contacts was the DATV Express board (**Photo 1**) **[1]**. It connects by USB to a computer and can be used to generate DVB-S, DVB-S2 and DVB-T signals anywhere in the range 100 – 2450MHz. The board was designed by a transatlantic team of enthusiasts and all the software, both for the host computer and the on-board FPGA, is written in the UK by Charles, G4GUO. The first software builds required a Linux computer, but Charles has now developed a very simple Windows version of the software that will run on most Windows 10 laptops and desktops.

So far, 217 boards have been sold to amateurs across the world and another production order is being placed. The board is sold at a price that just covers the production costs and has proved to be a great success.

The 'Portsdown' DATV transmitter

In an effort to encourage newcomers to digital amateur TV (DATV), the British Amateur Television Club is developing a Raspberry Pi-based DATV transmitter that uses a Raspberry Pi 3 with a small touchscreen. It works with either the Raspberry Pi camera or an external video camera. It is capable of generating low-level (around +5dBm, or 3mW) signals on 146MHz, 437MHz or 1255MHz.

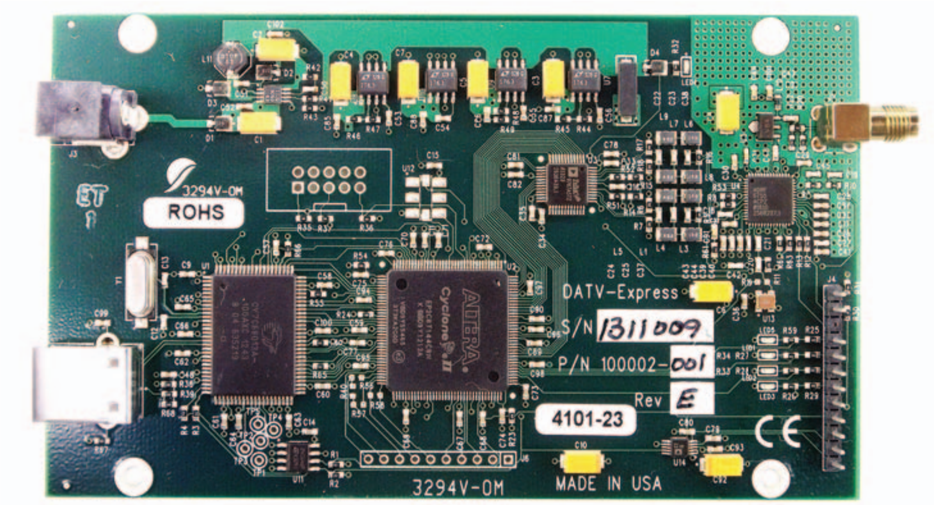

PHOTO 1: The amateur-produced DATV Express board.

In addition to the Raspberry Pi, a small ADF4351 synthesiser is used to generate the local oscillator and a modulator and filter board is used to modulate the signal. The transmitter can generate high quality 704 x 576 pixel pictures at up to 4MS/s, and can also be used at lower symbol rates for RBTV. All that is then required is a bandpass filter and a power amplifier for the band selected.

Most of the components for the Portsdown are available from catalogue suppliers or eBay. The modulator/filter board is available from the BATC shop, either as a PCB and a list of parts (which can be sent to DigiKey for them to supply), or as an assembled and tested board. Pre-programmed micro SD cards with all the software for the Raspberry Pi are also available from the BATC. Full details are on the BATC Wiki **[2]**.

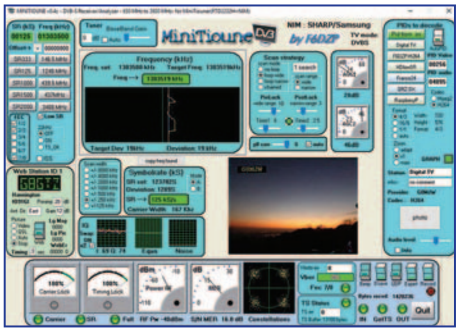

FIGURE 1: Screenshot of the MiniTioune receiving software.

Activity weekend

The next ATV Activity Weekend is on 11/12 March. Why not listen out on 144.75MHz to hear the talkback in your area? You can check the BATC Forum **[3]** for a list of the stations that are planning to be on the air.

Websearch

[1] https://datv-express.com/
[2] https://wiki.batc.tv/Portsdown_hardware
[3] http://batc.org.uk/forum/viewforum.php?f=75

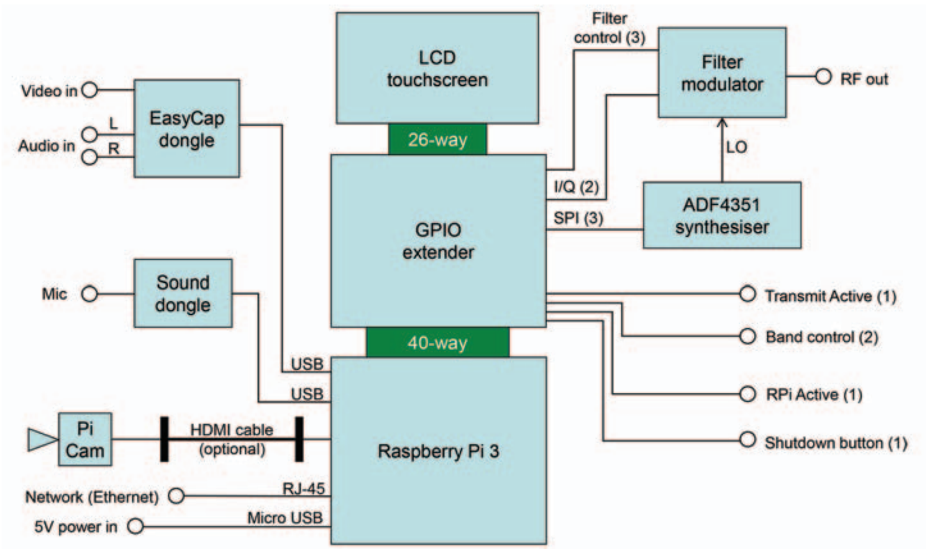

FIGURE 2: The Portsdown DATV transmitter.

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Antennas

We conclude the overview of antenna modelling using MMANA-GAL with a general overview of its performance and features.

Recap of last month's column

Last month, we used a 3-element 6m Yagi beam as a basis for a MMANA-GAL [1] antenna model in terms of:

- Showing how the antenna's dimensions could be entered as the basis for a model
- Viewing a graphical image of the antenna model
- Describing how to 'run' the antenna model
- Describing the results predicted through running the model
- Optimising the antenna model's dimensions to obtain the best results.

The results predicted were obtained from several runs of the antenna model and these are the basis of this month's description of how to examine an antenna's performance using the tool. Essentially, the following continues on where last month's column left off.

Ground effect simulations: Calculate view

The antenna model was run from the **Calculate** view and the **Free-Space** option was selected when the model was run previously.

If the **Perfect** radio button had been selected, then the application runs the model as if the antenna was above a perfectly conductive surface. Selecting the **Real** radio button runs the model with the antenna above a simulation of the ground.

When the **Real** radio button is selected, the **Ground Setup** button is also displayed. Selecting the **Ground Setup** button allows the ground's conductivity, dielectric constant, the height and distance of nearby ground features to be customised to model the local ground conditions. The height of the antenna above the ground can also be entered when the **Real** radio button is selected. The 3-element 6m Yagi beam antenna's height was set to 12m above ground level (AGL) from the pull-down list and the model was re-run.

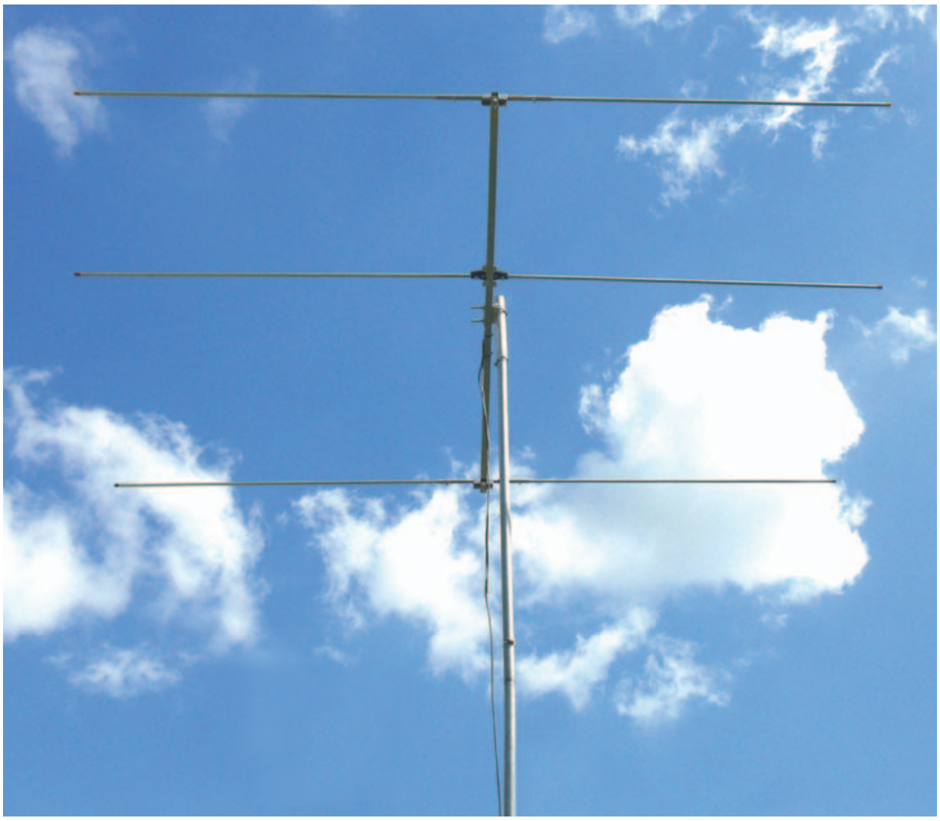
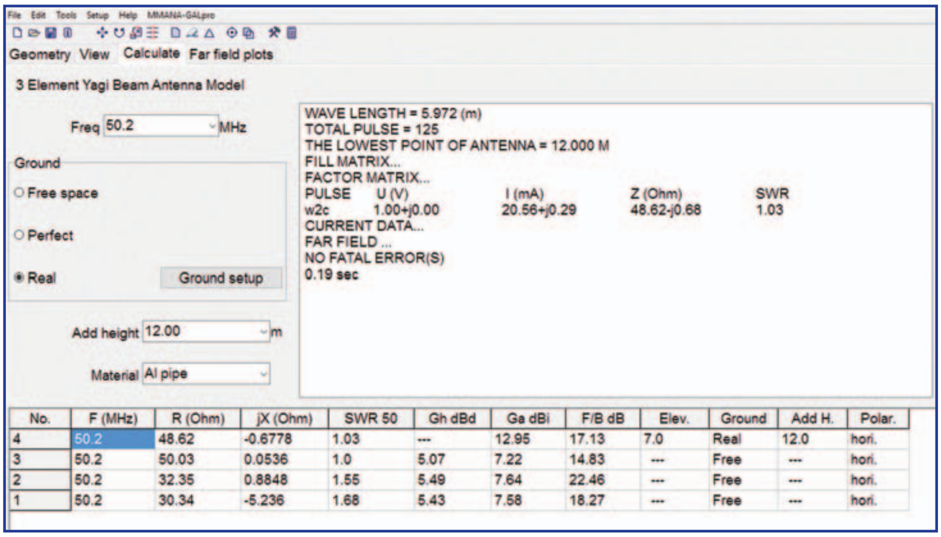


PHOTO 1: The actual 6m 3-element beam built from the model in use during the summer.



No.	F (MHz)	R (Ohm)	jX (Ohm)	SWR 50	Gh dBd	Ga dBi	F/B dB	Elev.	Ground	Add H.	Polar.
4	50.2	48.62	-0.6778	1.03	---	12.95	17.13	7.0	Real	12.0	hori.
3	50.2	50.03	0.0536	1.0	5.07	7.22	14.83	---	Free	---	hori.
2	50.2	32.35	0.8848	1.55	5.49	7.64	22.46	---	Free	---	hori.
1	50.2	30.34	-5.236	1.68	5.43	7.58	18.27	---	Free	---	hori.

FIGURE 1: Predictions gained after the model was re-run using a real ground simulation.

Figure 1 shows the results predicted from a subsequent run of the model using a simulated ground with the 3-element 6m Yagi beam antenna at a height of 12m AGL. For this re-run of the model, the default settings for the ground were used. The predicted results show SWR has marginally deteriorated to 1.03:1, the F/B ratio has risen and the gain improved by around 5dB. However, when using the model with a simulated ground (or prefect ground), the predicted gain is displayed in dBi only and is not available in dBd. This is because ground effects modify the radiation pattern of the antenna, making an accurate dBd calculation difficult to obtain.

Far Field Plots view

When an antenna model has been run, the predicted radiation pattern for the antenna can be displayed by clicking on the **Far Fields Plots** tab, as shown in **Figure 2**. The horizontal and vertical plane radiation patterns are displayed providing a graphical overview of the antenna's predicted performance. For this antenna model, the vertical plane radiation pattern prediction shows how ground effect has modified the main lobe by separating it into individual lobes. This separation effect is why it is difficult to produce a predicted gain in dBd for this antenna when modelled above the surface of the ground.

The horizontal plane radiation pattern is similar to the free-space pattern. However, the view looks down towards the antenna and does not distinguish between the lobes forming the overall radiation pattern below. The antenna was orientated along the Y axis when its dimensions were entered in the **Geometry** view. This means that the main and rear lobes are directed in the direction of the X axis as shown.

The **Far Field Plots** view includes predicted gain (in dBi), F/B ratio, feed point impedance, SWR and the elevation angle of the lower main lobe for the antenna modelled.

Far Field Plots view: 3D FF

In the **Far Field Plots** view the **3D FF** button (three Dimensional Far-Field) displays a three dimensional image of the antenna's predicted radiation pattern. **Figure 3** shows the predicted pattern for the 3-ele 6m Yagi modelled at 12m AGL. The mouse can be used to rotate the image as required and there is a zoom facility.

Predicted RF current distribution

Clicking on the **View** tab displays an image of the antenna that has been modelled and an example is shown in **Figure 4**. The modulus of the RF current SWR pattern distributed across the antenna is displayed. It is also possible to display the segments used to sample the antenna in the model. Using the mouse, the image can be rotated as required and there is a zoom facility. Clicking on a specific element allows the details of the wire to be displayed within the panel on the lower right side of the display.

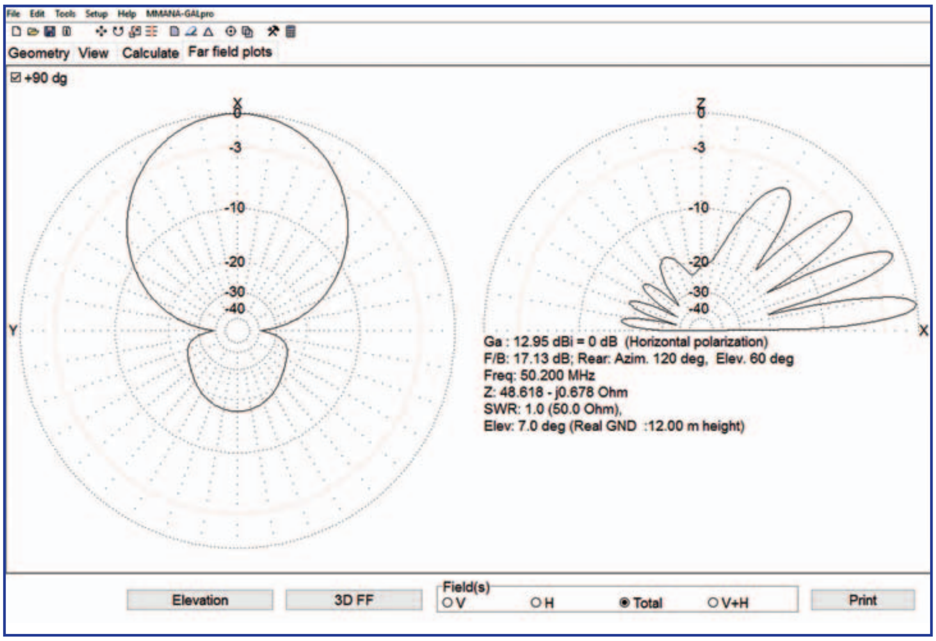


FIGURE 2: Predicted radiation pattern for the antenna modelled.

Practical 3-element 6m Yagi

Using the final set of predicted dimensions, the 3-ele 6m Yagi was built and is shown in **Photo 1**. When tested and tuned at 50.2MHz, the final physical dimensions for this antenna were:

Reflector length: 3.0m
Driven element length: 2.88m
Director element length: 2.645m.

The reflector/driven element spacing was approximately 1.08m and the driven/director spacing approximately 0.72m.

The elements were made from 12mm diameter aluminium tubing and were secured to a 25mm square boom using suitable element clamps **[2]**. A Pawsey λ/4 balun **[3]** was used to match the antenna to the 50Ω coaxial feeder cable.

The performance of this antenna was measured at 7m AGL and gave an SWR of 1:1, a measured gain of about 5dBd and a F/B ratio of about 15dB **[4]**.

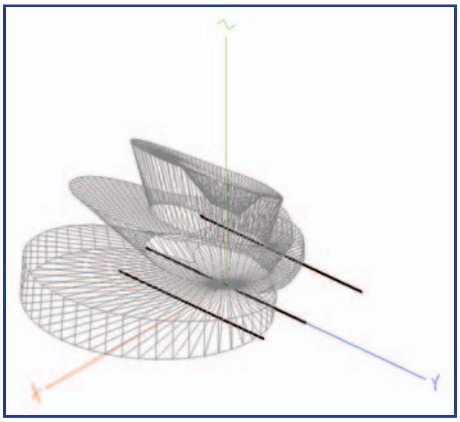


FIGURE 3: Predicted 3D radiation pattern superimposed on the 3-ele antenna modelled.

Comparing antenna models

MMANA-GAL has the facility to make comparisons of the predicted radiation patterns between antenna models. This facility is available from the **Far Fields Plots** view. With an antenna model loaded, select the **Calculate** view and enter the required settings for the antenna to be modelled and run the model as previously described. Once the model has run and the results displayed, select the **Far Fields** view to display the radiation patterns and click on the **File** button (in the top right corner of screen). This will display several options; click on the **Save Far Fields (*.mab)** option, as shown in **Figure 5**. When the **Save Far Field** panel is displayed, enter a suitable file name for the reference file and select a storage folder on the computer.

Select the **Geometry** view and load, or enter, another antenna model. Once the model has been loaded/entered, select the **Calculate** view and enter the other parameters for the antenna as previously described. Run the antenna model and when the results have been displayed, select the **Far Field Plots** view. The radiation pattern for the antenna will be displayed. Click on the **Compare** button on the top toolbar, as shown in **Figure 6**. When the **Compare** view is displayed, click on the **Load *.mab file** button circled in Figure 6. When the **View Far Field** file selection panel is displayed, navigate to the previously stored reference file and select it. The

Mike Parkin, G0JMI
email2mikeparkin@gmail.com

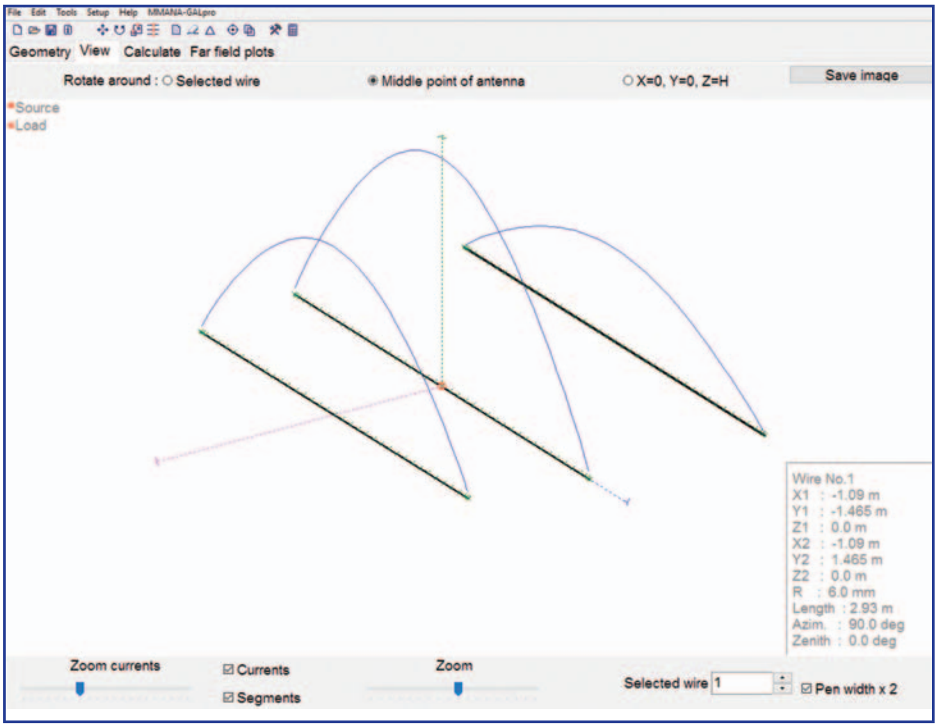


FIGURE 4: Predicted RF current distribution in the three elements.

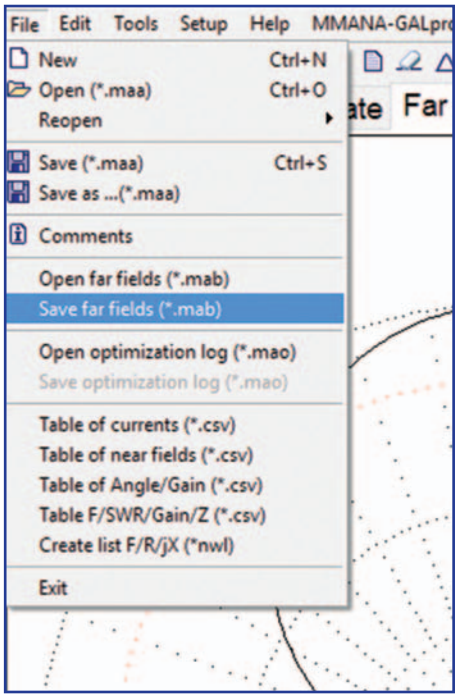


FIGURE 5: Saving the antenna model's results in preparation for making a comparison.

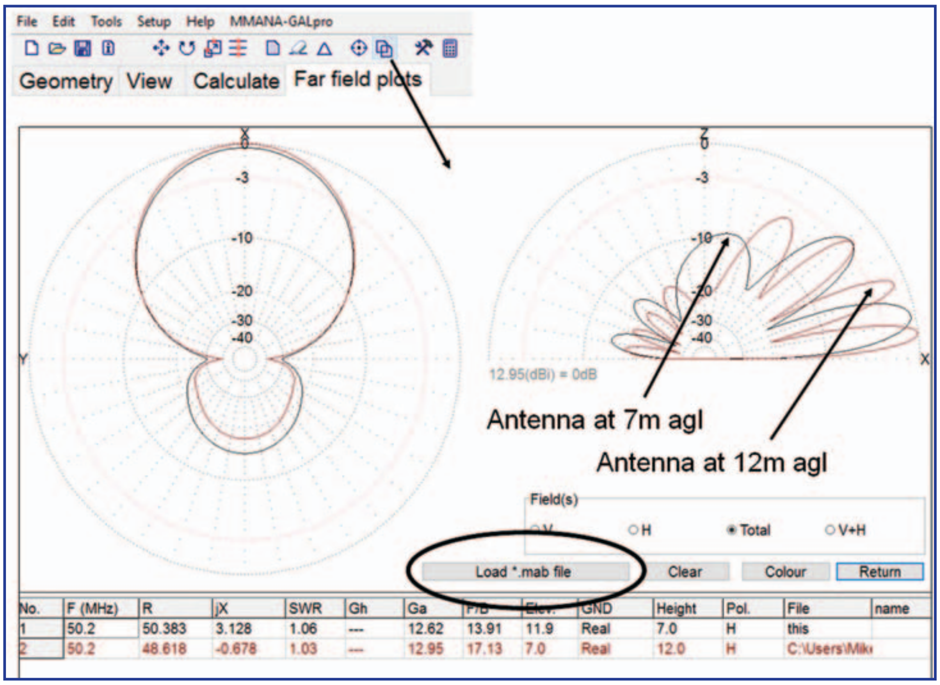


FIGURE 6: Example of the comparison between the antenna models for the 3-ele 6m Yagi at 7m and 12m above ground level (AGL).

results will then be displayed for the present and previous antenna models on the same charts to enable a comparison to be made.

The example shown in Figure 6 illustrates the radiation patterns for the 3-ele 6m Yagi modelled at 7m and then 12m AGL. The effect of the height difference on the vertical and horizontal radiation patterns can be seen in Figure 6. Clicking on the X located in the top-right corner closes the view.

Conclusion

Using a computer application to model an antenna provides a powerful and convenient approach to predicting the performance for both new and existing antenna designs. This was not a straightforward process to carry out back when the antenna's performance had to be manually calculated and then the antenna physically built and tested to obtain an indication of its performance. From the experience of modelling and then building various antennas using MMANA-GAL, the predicted dimensions are usually within ±2% of those actually used for the antenna in reality. Hopefully, this overview of the MMANA-GAL application will provide a useful guide should you decide to have a go at designing and building an antenna.

Discone antenna feedback

M0RME's foldable discone antenna described in the December 2016 Antennas has prompted several messages, which are very much appreciated. Apparently, the antenna was part of the A43R military radio communications system. Thanks to Ian Connor, G7PHD and Vin Robinson, G4JTR for providing very in-depth details of the antenna. Thanks also to Ray Fautley, G3ASG for an interesting and informative message: he designed the antenna. Finally, thanks to Stephen Small, G4HJE for his letter in January's *Last Word* where he summarised many of the details for this antenna. All this information has been passed on to Bob, M0RHE, who has also expressed his thanks and gratitude to everyone.

References

[1] MMANA-GAL basic V3.0.0.31, freeware antenna analysing application. Original code by Makoto Mori JE3HHT. MMANA-GAL basic and MMANA-GAL Pro by Alex Schewelew, DL1PBD and Igor Gontcharenko, DL2KQ. 1999 onwards.
[2] *RadCom* May 2016, Antennas (Photo 2)
[3] *RadCom* September 2016, Antennas (Figure 4)
[4] *RadCom* June 2016, Antennas

Cable management system and earth bar part 1

Many 1950s-70s HF amateur radio stations were bulky and based on tall 19 inch rack cabinets, but today a horizontal arrangement is more usual – and, dare I say it, more attractive too.

Cases of the PSU, speaker, transceiver and linear amplifier are typically placed along the bench top. In addition, a computer and one or more monitors are often included. This adds up to a considerable spread of equipment across the working area.

A linear arrangement of this sort necessitates long connecting cables for signals, control and power. These lie mostly at the back of the equipment and may also drape down behind the bench. Any new additions can result in untidy tangling, excessive length and plugs possibly pulled loose by unsupported wire loops. It is not usually very easy to reach the cables to sort them out. A confusion of cables makes it difficult to add or remove equipment. It is unsightly too.

Along with amateur radio shacks, hi-fi equipment and home cinema systems are also affected. No doubt some military, university and medical facilities suffer cable tangling disease. When earthing wires are added, further complexity results.

IMPORTANT: all references to and descriptions of safety electrical earthing in this article are for general guidance only; for specific advice the RSGB strongly advises you seek the guidance of a suitably qualified person. Readers outside the UK should also note that their local electrical arrangements may differ from those described here – Ed.

This two-part article describes a simple DIY cable management system and an earthing bar that can significantly tidy your installation and provide a solid RF earth with which to bond your radio equipment.

PHOTO 1: Earth terminal at rear of MFJ Intellituner.

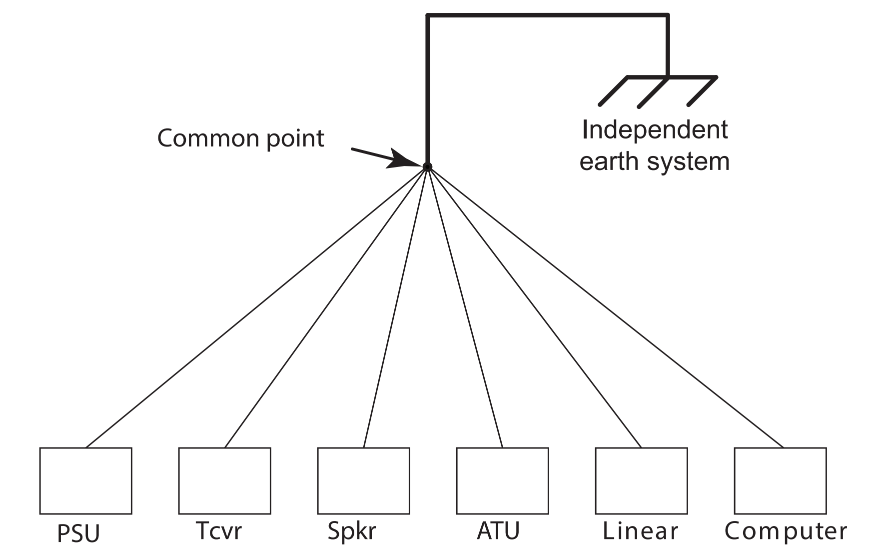


FIGURE 1: Star-connected earthing system.

The need for earthing

There are two distinct functions of earthing. First and foremost is **safety** – protective earthing. For safety, an earth core or shielding is provided with the supply. It enters the building with the mains power supply cable and/or is performed locally (on the premises). RSGB EMC leaflet 07 **[1]** contains further details of earthing systems and is of particular interest to the radio amateur. It explains the IEE Regulations (of which the latest edition and amendments should always be referred to). It includes diagrams of common earthing systems (TN-S, TN-C-S and TT) and cites useful references regarding practical installations.

Conductive casings of equipment are earthed to prevent human connection to live metal under fault conditions, which could cause injury or death. The three-core earth lead of such equipment must be connected appropriately to a three-pin plug and mains socket wired in accordance with the IEE regulations.

The second earthing function, of particular importance to amateurs, is RF earthing. This prevents leakage of interference into electrical equipment. It also prevents leakage of interference *out* from the equipment. It is the reason why many items of amateur radio equipment have a separate earth (or 'ground')

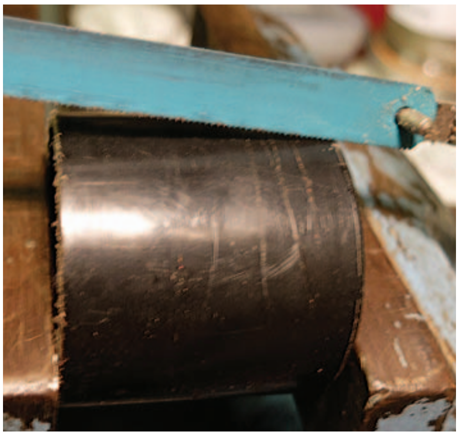


PHOTO 2: Cutting plastic ring open.

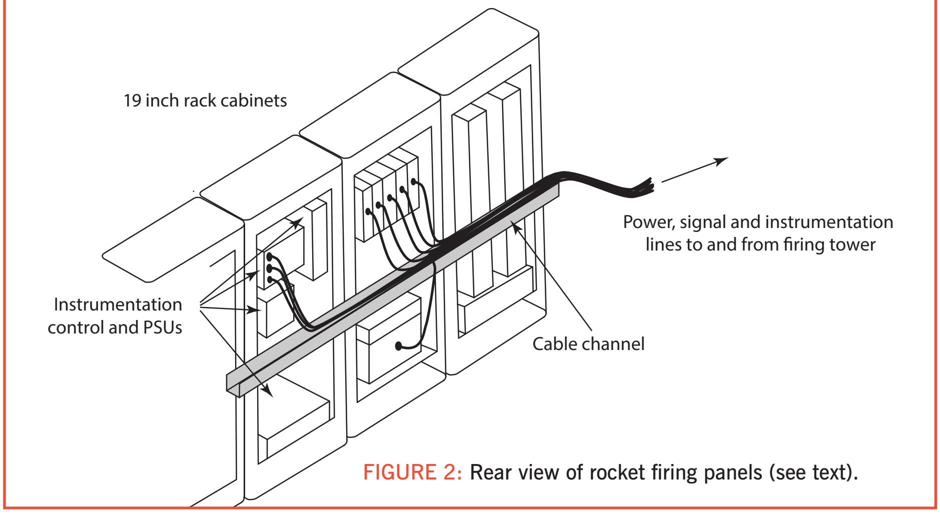


FIGURE 2: Rear view of rocket firing panels (see text).

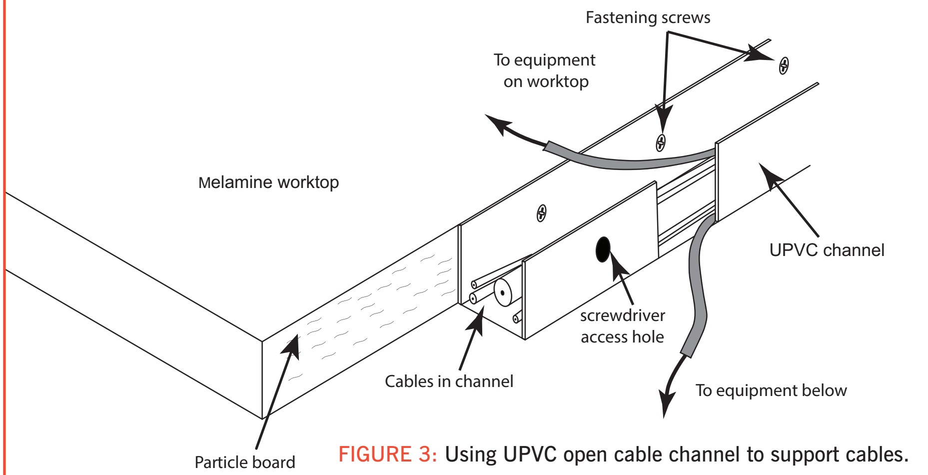


FIGURE 3: Using UPVC open cable channel to support cables.

terminal at the rear, connected directly to the casing and chassis (eg **Photo 1**). Many have wondered why it is there, especially in cases where the mains lead already includes an earth wire. Perhaps some even operate with the chassis earth terminal unconnected. Put simply, the mains earth can be a very poor RF earth indeed from the amateur radio point of view. It has considerable length, which can totally prevent operation as an RF earth at particular frequencies. It may include a noise filter, tending to block incoming and outgoing HF current flow. In addition, the domestic mains earth wire can carry plenty of interference, particularly in these days of digital electro-smog.

The subject of RF earthing could be expanded to fill a book. For present purposes it is simply stated that the earth terminal on each item of equipment should be connected to a good RF earth via the shortest possible route. Amateurs know that in some transmitter and antenna configurations, high currents flow to the earth or a ground plane, which usefully forms a 'mirror' reflecting an image of the transmitting antenna **[2]**. It follows that the earth connection for the shack should be as short and as highly-conductive to RF currents as practicable. It is worth noting that any RF earth that also provides a directly-connected, low resistance DC path to earth, whilst not primarily intended for safety purposes, can supplement the safety provided by the mains earth.

The linear arrangement of amateur equipment noted earlier largely influences how the cables and earth wires will run. The normal star-connected earth shown in **Figure 1**, ie a single wire from each equipment earth terminal to a single common point, is not ideal. The earth wires will cross over or under other, longer cables as additions or changes are made. Entanglements can result. What is really needed is a combination of systems for neat management of *both* RF earthing *and* connecting cables at the same time.

Development of a flexible cable management system

I first encountered a simple but reliable cable management system in 1964, at Sheffield University's high intensity combustion research laboratory. This facility is still evolving at Harpur Hill near Buxton, in a former WWII bomb storage facility. It comprises a number of semi-underground bunkers and associated outbuildings owned by the University **[3]**. Located well away from people, this site is the highest laboratory of its type in the UK. It is used for all the noisy, dangerous experimentation beloved of students, graduates and their Professors. It is one of a number of military bunker sites described in a book **[4]** obtainable from the RSGB bookshop.

In the control room of the rocket firing facility, a large number of full-height 19" rack units were packed with electronic equipment, much of it bought as RAF- and military surplus at £35 per ton. The largely analogue setup included multi-channel tape recorders, rotary firing programmers, CCTV, signal-conditioning units, an analogue drum memory for short term events, oscilloscopes, oscillographs and many more fascinating, now vintage, instruments and controllers. They were interconnected with power, control and signal cables.

The cable support system consisted of a single, square-section, sheet metal channel, about 10cm on each side, with no top cover. It was bolted to the rear of the rack units at waist height. **Figure 2** shows the general arrangement. Cables descended into the channel to run along to other equipment, or outside to other bunkers. They could also descend from the channel to other, lower units. This system is very simple to use and well-suited for research applications. It is quite unlike the semi-permanent racking systems commonly seen in industry. Cables

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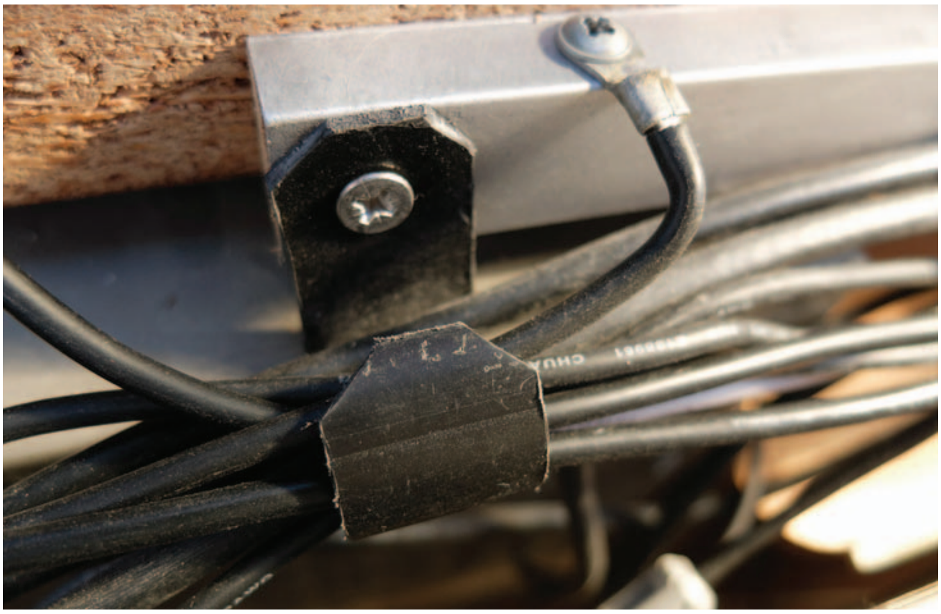

PHOTO 3: A finished J-clip, cable bundle and earthing point.

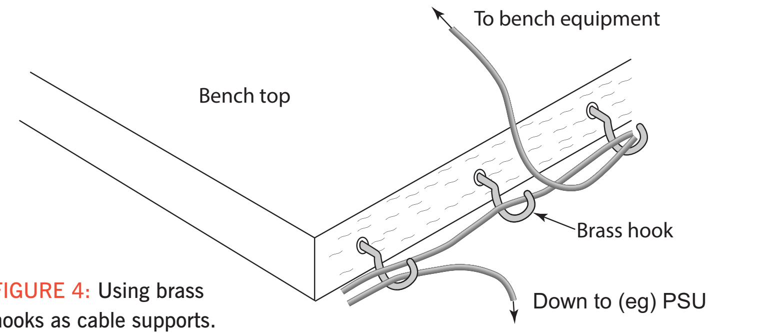

FIGURE 4: Using brass hooks as cable supports.

were easily and quickly added or removed. Plenty of space was available to walk behind the racks to make connections and lay cables – a luxury that will be absent from most amateur radio shacks! The cable-carrying channel was also good for overcurrent diagnosis. I fondly remember my Professor (Jim Swithenbank) feeling gingerly among the cables to find one, a 24V heavy current line, which was getting very hot to the touch due to a fault situation.

Profiting from this first introduction, a first attempt at cable management in the home shack used easily-obtainable white UPVC cable channel about 15mm square, running along the rear of the bench, see **Figure 3.** This was fixed with screws through appropriately-sized holes, which were drilled through both vertical walls. The need soon became evident to add slots allowing cables to emerge and descend to equipment on the floor. Other cables left the channel at any point to reach the rear of bench equipment. The channel had a clip-on lid, but this was soon discarded because it was time-consuming to fit and remove. There was no need to conceal the cables, because they were at the rear, below the bench surface and largely out of sight. This simple system worked relatively well. Problems included the need to run earth wires with the other cables and the fact that it soon became overloaded with all kinds of cables. The need to cut slots could slow installations and changes.

The next stage of development was to try nothing more complex than brass hooks. At about 150mm spacing these gave good support to the cables and allowed them to leave the bundle at virtually any point. **Figure 4** is a greatly simplified view of the arrangement. Modifications were never needed, making this an extremely simple and convenient system. Although there was no trouble with (for example) mains hum or other types of cross-interference problems, I did wonder whether the brass hooks might interact capacitively with some cables, eg unshielded twisted pairs.

The final stage of development, which has served very well for over five years to date, is based on home-made plastic J-clips.

To make a J-clip, obtain an offcut length of UPVC waste pipe. It can be about 50mm in external diameter, or larger if required. Use a saw to cut off rings approximately 30mm long. If hand sawing, hold the pipe in a vice and cut off the 30mm lengths near the jaws, so that flexure and vibration are minimised. Then grip the ends of each ring in the vice to make a longitudinal cut through the pipe wall, as shown in **Photo 2**.

Now we can exploit the thermoplastic nature of the pipe rings. Use an electric hot air gun of the type used to strip paint (not a hair dryer; they are not hot enough). Set its heat output to soften (not melt or burn) the plastic. Some practice may be required to achieve the optimum effect. Patiently play the hot air jet onto one side of the ring, keeping the jet moving all over, until it softens but does not distort the plastic. Grip the softened side of the ring in a vice, flattening it. Alternatively, clamp it between two pieces of wood and leave to cool down. The plastic will set permanently into a J-shape. Now finish the J-clip. Remove the sharp corners by cutting them off at 45 degrees. Any sharp edges can be removed using a file or sharp knife. Finally, a fastening hole is drilled and countersunk into the now-straight limb of the J-clip. By further use of the 'soften and clamp' technique, the end of the J-clip can be modified to a clasping or a relieved profile. It is possible that you may derive artistic pride from this newly-acquired forming skill. A finished J-clip is shown in its working position at the end of an earth bar in **Photo 3**.

The clip so produced will not cut through cables; it cannot corrode and will not interact with currents flowing in the cables. It is somewhat springy, so can grip a fat cable bundle resiliently. Cables are laid loosely into the clip, or are bunched tightly by a suitable clip profile. They are simply laid parallel, without twisting around the bundle or threading into it. They are easily added until the clip is full and can easily be pulled out in the future as necessary. It is convenient at this point to see how the earth bar was developed, before describing its combination with the J-clips.

Next time we conclude with the development and construction of the low impedance RF earth bar.

Websearch

[1] *Protective Multiple Earthing and the Radio Amateur EMC-07*, http://rsgb.org/main/files/2012/11/EMC07-final.pdf

[2] https://en.wikipedia.org/wiki/Ground_plane

[3] www.sheffield.ac.uk/cbe/research/envenergyeng/facilities

[4] *Second World War Secret Bunkers* by Nick Catford, obtainable from RSGB Bookshop

NEW TITLE

The RSGB Vintage Rig Guide

Edited by Steve White, G3ZVW

Amateur radio equipment saw great changes from the 1960s onwards with the arrival of solid state designs and there is plenty of superb equipment from the latter decades of the 20th century available in the second-hand market. This brand new publication focuses on the amateur radio equipment from these decades in the same format as the popular *RSGB Rig Guide*, describing the basic information about the equipment along with when it was first made and what it may be worth.

Covering the mid-1960s to 1990s, the *RSGB Vintage Rig Guide* covers the equipment from manufacturers that were never in the standard *RSGB Rig Guide,* along with the items that have been discontinued from the listings in early editions of that publication. Therefore manufacturers such as Drake, Heathkit and KW are now included for the first time. There are brief synopses of all the manufacturers and a useful guide on what to smell, feel and look for when buying vintage radio equipment. Details of over 300 receivers, transmitters, transceivers and linear amplifiers are included as are likely trade-in and second-hand prices from dealers.

If you are interested in vintage amateur radio equipment because you have some, are interested in restoring something or you want to know its likely market price, this book provides a valuable insight. Recommend reading for anyone interested in old equipment.

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Price: £5.99 post free (UK only)

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RSGB Band Plan 2017

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 2017 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 42.

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
3,560-3,570	200Hz	Telegraphy 3,560kHz – QRP (low power) Centre of Activity
3,570-3,580	200Hz	Narrowband Modes
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
3,700-3,775	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	All modes - Phone contest preferred 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 42.

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.
Note 4: Contacts within the UK should avoid the WRC-15 allocation if possible
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 42.

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 42.

10MHz (30m)	NECESSARY BANDWIDTH	UK USAGE
10,100-10,130kHz	200Hz	Telegraphy (CW) 10,116kHz – QRP (low power) Centre of Activity
10,130-10,150	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 42.
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 42.

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 42.

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 42.

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 42.

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	All modes 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 42.

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
50.500-52.000	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 42.

70MHz (4m)	NECESSARY BANDWIDTH	UK USAGE (NOTE 1)
70.000-70.090MHz	1kHz	Propagation Beacons Only
70.090-70.100	1kHz	Personal Beacons
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 42.

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		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 42.

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 42.

430MHz (70cm) IARU Recommendation	NECESSARY BANDWIDTH	UK USAGE
430.0000-431.9810MHz All Modes	20kHz	430.0125-430.0750MHz – FM Internet Voice Gateways (Notes 7, 8) 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 FM repeater outputs in UK only (Note 1)	25kHz (Note 11)	433.0000-433.3750MHz (RB0-RB15) – RU240-RU270 FM/DV Repeater Outputs (25kHz channels) in UK Only
433.3940-433.5810 FM/DV (Notes 12, 13) Simplex Channels	25kHz (Note 11)	433.4000MHz U272 – IARU Region 1 SSTV (FM/AFSK) 433.4250MHz U274 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 (Note 11)	433.9500-434.0500MHz – Internet Voice Gateways (Note 8) 434.3750MHz 1.6MHz Talk-through – Mobile TX (Note 10) 434.4750-434.5250MHz – Internet Voice Gateways (Note 8)
434.5940-434.9810 FM repeater inputs in UK only & ATV (Note 4)	25kHz (Note 11)	434.6000-434.9750MHz (RB0-RB15) RU240-RU270 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 All Modes	25kHz (Note 11)	438.0250-438.1750MHz – IARU Region 1 Digital Communications 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 42.

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 All Modes	150kHz	DD High Speed Digital Data – 5 x 150kHz channels 1241.075, 1241.225, 1241.375, 1241.525, 1241.675MHz (±75kHz)
1241.750-1242.000 All Modes	20kHz	25kHz Channels available for FM/DV use 1241.775-1241.975MHz
1242.000-1249.000		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 Satellites		Amateur Satellite Service – Earth to Space Uplinks Only
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		Preferred Narrowband segment
1296.000-1296.150 Telegraphy, MGM	500Hz	1296.000-1296.025MHz – Moonbounce 1296.138MHz – PSK31 Centre of Activity
1296.150-1296.800 Telegraphy, SSB & MGM (Note 1)	2700Hz	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 1296.750-1296.800MHz – Local Beacons, 10W ERP max
1296.800-1296.994		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 42.

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 42.

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 2,320.750-2,320.800MHz – Local Beacons, 10W ERP max
2,320.800-2,321.000		2,320.800-2,320.990MHz – Propagation Beacons Only
Beacons exclusive 2321.000-2322.000 2,322.000-2,350.000	20kHz	FM/DV. See also Note 1 Wideband Modes including Data, ATV
2,390.000-2,400.000 2,400.000-2,450.000MHz Satellites		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 42.

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) 3,400.750-3,400.800MHz – Local Beacons, 10W ERP max
3,400.800-3,400.995		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 42.

5.7GHz (6cm) IARU Recommendation	UK USAGE
5,650.000-5,668.000MHz Satellite Uplinks	Amateur Satellite Service – Earth to Space Only
5,650.000-5,670.000 Narrowband CW/EME/SSB	5,668.200MHz – Alternative Centre of Activity 5,668.8MHz – Beacons
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	5,760.100MHz – Current Centre of Activity 5,760.750-5,760.800MHz – Local Beacons, 10W ERP max
5760.800-5760.995 Propagation Beacons	5,760.800-5,760.995MHz – Propagation Beacons only
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 42.

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		10,240MHz ATV Repeaters
10,250.000-10,350.000 Digital Modes		
10,350.000-10,368.000 All Modes		10,352.5-10,368MHz Wideband Modes (Note 2)
10,368-10,370MHz Narrowband Telegraphy EME/SSB	2.7kHz	10,368-10,370 Narrowband Modes (Note 3) 10,368.1MHz Centre of Activity 10,368.750-10,368.800MHz – Local Beacons, 10W ERP max
10,368.800-10,368.995 Propagation Beacons		10,368.800-10,368.995MHz – Propagation Beacons Only
10,370.000-10,450.000 All Modes		10,371MHz Voice Repeaters Rx 10,425 ATV Repeaters
10,450.000-10,475.000 All Modes & Satellites		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 42.

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 42.

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

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 42.

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

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 42.

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 42.

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.

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Count on us!

HF

The ionosphere was particularly feeble at the start of January and the AFS contests showed little short skip propagation on 7MHz even at the start around 1400. The critical frequency appeared to drop below 3.5MHz by the end of each event leaving contestants working only into continental Europe where most people didn't know there was a contest on.

G7UFI's pedestrian mobile trolley next to his car.

Later in the month four new sunspot groups popped up and the solar flux index hit the high 80s leading to some E-W propagation up to 15m but in general we can expect mainly N-S propagation on the higher bands for the next few years.

The CQWW 160m contest took place at the end of January and leading UK stations managed around 1500 QSOs including many US and Caribbean stations. Japanese stations seem to have been very thin on the ground this year and best DX from the UK was typically Peru to the south-west and Indonesia to the east. I think the best DX to the north-west was probably Arizona and Utah though one G station may have managed California.

A new propagation prediction website is available at www.predtest.uk thanks to the efforts of a team including HZ1JW, M0WMT and G4FKH. This is based on a new ITU propagation model so it will be interesting to see how it compares with the results from www.voacap.com.

Plans seem to be afoot for a new HF satellite with a 30kHz linear transponder from 15m to 10m. I haven't seen an indication of a launch date yet but presumably it will provide some interest during sunspot minimum. See aprs.org/hfsat.html for details.

I must thank Peter Chadwick, G3RZP for pointing out an interesting article by Carl, K9LA, in the latest edition of the *National Contest Journal* published by the ARRL. Carl notes that the sun's declining magnetic field at solar minimum allows more cosmic rays to reach the Earth, and that these cosmic rays are a major source of ionisation at low levels in the ionosphere where electrons tend to absorb rather than reflect LF signals. He suggests 160m enthusiasts may be disappointed if they are hoping for great things over the next few years. I'm not entirely convinced. Night-time cosmic rays might be less influenced by solar magnetism than daytime ones. Does any *RadCom* reader have more data on this?

QEX, another of the ARRL's specialist publications, recently (Jan/Feb issue) contained a couple of articles of interest to students of propagation. Flavio, IK3XTV measured the strength of simultaneous long path and short path signals from another European station and concluded that the 3dB difference strongly indicated a ducting mechanism for the long path signal. And Tom, N5EG described how to make an ionosonde using equipment and software available to amateur operators.

The month of March sees the CDXC LF Challenge; a competition to work as many DXCC entities as possible on 7MHz and below. Each entity counts only once so there is no advantage from working it on each band and indeed you probably only need 40 and 80m to win. The winning score last year was 147 entities and was achieved by G5LP. While on the subject of CDXC there should still be time to book for their annual dinner and afternoon conference to be held in Reading on 18 March. Check www.cdxc.org.uk for more details.

Further north, the GMDX committee is organising its annual convention and dinner at the usual location in Stirling on 1 April. See www.gmdx.org.uk for more information on the programme and booking arrangements.

DXpeditions

G3XAQ, G3VMW, G4BWP, 5B4AGN, M0PCB and G6MC will be active from Ghana as 9G5X from 7-21 March. They will be QRV on all modes using three Elecraft K3 rigs to KPA-500 amplifiers. They will have two Spiderbeams on their hotel roof plus various wire antennas. The QTH is on a small hill on a five acre site. Look for them on CW, SSB and RTTY on 160-10m. A reliable internet connection should allow twice daily log uploads to Club Log and the leader board feature will be enabled. You are encouraged to work them on as many bands and modes as possible. QSL via M0OXO's OQRS system but they will also upload to Logbook of the World. See www.ossett.net/9g5x for more information.

Eleven EI operators plan to be active from Nepal as 9N7EI with up to 5 stations for 9 consecutive days in the 8-20 March window. Look for activity from 80-10m with IC-7300 radios + linear amps and beams. See www.9n7ei.com for more information.

A multinational team will be on the air from Niamey, Niger, as 5U5R from 8-21 March. They will be on all bands from 160 to 6m on SSB, CW and RTTY.

A large team from the Radio Club of Provins (F6KOP) will be active from Ivory Coast from 9-19 March (callsign TBA). They will operate CW, SSB, RTTY and PSK on 160-6m with five stations. See https://tu2017dx.wordpress.com/ for more details.

Paul, VE3AXT will be active as V31AX from Belize until 7 March. W0MU will be in the same country and QRV as V31MU until 28 February. He will be joined by G0DVJ, who will be QRV as V31DV until about the 24th.

Barrie, G7UFI in his shack.

Bob, VP8LP is a beacon from the South Atlantic on HF and a regular contact for GB3RS and GB2IWM.

IOTA

M0IDA, M0VFC and M1ACB will be active from Little Harbour Cay one of the Berry Islands (NA-054) from approximately 5-10 March. They hope to use the callsign C6APY, and will be active with up to three stations simultaneously on 40-10m, CW, SSB and RTTY. They hope to be beaconing on WSPR when the stations are otherwise inactive. They will also be active on satellites, though UK contacts will only be possible on low-elevation passes of FO-29.

LA2US should be QRV from Hopen Island (EU-063) as JW2US for about another four months. He likes CW near the IOTA frequencies and lower band edges. Equipment is an FT-450D, an Expert 1K-FA amp and a Windom.

The Myanmar IOTA DXpedition led by Derek, G3KHZ is delayed while the operators wait for a green light from the local authorities.

Neil, VA7DX, Keith, VE7KW, Madison, W5MJ and Bob, W5RF will be active as TX5T from Raivavae (OC-114) in the Austral Islands from 20 February to 3 March.

Members of the Palos Verdes Club will operate as K6PV/6 from Santa Catalina Island (NA-066) on 23-26 February. They expect most activity to be on 40, 30, 20 and 17m, but will use the higher bands if they are open. Catalina is one of my favourite operating spots – just 20 miles or so off the coast of Los Angeles and a completely different world. Ferries go every hour or two from Long Beach and San Pedro.

Michael, DF8AN will be QRV as CE0Z/DF8AN from Robinson Crusoe Island in Juan Fernandez (SA-005) from 21-24 February, mainly on CW and digital modes.

Tim, LW9EOC will be QRV as 5J0NA from San Andres Island (NA-033) from 13 February to 29 March and will be joined by AA4NC, AJ9C, HK6F and WJ2O at various times.

Sho, JA7HMZ, will be QRV as V63DX from Pohnpei (OC-010) from 17-24 February.

A large group of Indonesian operators will be active as YE0S from the Seribu Islands (OC-177), from 20-27 March. For more information see www.qrz.com/db/ye0s

TABLE 1: 2017 Worked DXCC Entities (ranked by All). Showing Top 3 from British Isles table in Club Log plus submitted scores or Club Log scores of recent correspondents where available.

Call	CW	SSB	Data	All
G3TBK	150	19	1	150
G4PTJ	135	55	0	144
G5LP	97	0	105	142
G3PXT	21	67	92	117
GI4DOH	83	0	39	87
G4XEX	16	26	56	82
G4IDL	69	0	0	69
G3HQT	48			48

Correspondence

Tom, G4IDL has had intermittently high SWR on his hexbeam and will be looking into the problem when the weather warms up. Meanwhile with 200W to that beam he found on CW: 17m – FY5KE, 6Y4K, A93JE, PJ2/K8ND, 7Z1HL; 20m – KP4CPC, HV0A, 5R8UI, RI1ANA, 7X3WPL, 9K2MU; 30m – 6Z4DHI (Liberia), CT8/UA4WHX, TF3JB; 40m – A62A, 9M2TO, ZLs, CT8/UA4WHX, KC4/N2TA (Antarctica), JAs (many), A45XR, PY2ZEA, EA9HU, OY1CT, VK3FY/DU8, Ws, VO1MP, XW3DT, ZB2TT, S01WS, JW2US, FK8CE, TA1PB, CO8LY and 7V7V.

Table 2: Forthcoming DX activity.

Until 26 Feb	7P8EUDXF
Until 7 March	V31AX
Jan-Feb 2017	E51MAF Nth Cooks
13 Feb – 3 March	Raivavae by US ops
13 Feb – 29 March	5J0NA
13-26 Feb	XX9D
15-21 Feb	PY2QI/PY0F
17-24 Feb	V63DX
18 Feb – early Mar	HK0 by AA4NC
20 Feb – 3 March	TX5T
21-24 Feb	CE0Z/DF8AN
23-26 Feb	K6PV/6
Feb – March	Arctic Legends IOTA trip
5-10 March	C6APY (NA-054)
7-21 March	9G5X
8-20 March	9N7EI
8-21 March	5U5R
9-19 March	TU by F group
10-19 March	E51KTA
20-27 March	YE0S (OC-177)
15-25 May?	VK9MAV (OC-267)
20-24 July	AS-069
28-30 July	VA2NDX/VY0 (NA-173)
End July	RI0LI (AS-022)
End July	RA70AA (AS-070)
12-16 October	VK5CE/8 (OC-198)

Peter, G4XEX has had to move his antenna off the picnic table in his garden so is planning a year off DX chasing. He may investigate data modes on 160 using his 100ft wire fed via an unun that he calls his leaky dummy load. He worked: 15m – ZS6C (data); 17m – C5YK, 4S7VG, RI1ANC, TU5MH; 20m – 5R8IC, XE1IM, HI3TEJ, FG5FI, VU2NKS & V53DX.

Gordon, G3PXT made 900 QSOs by late January including: 17m – 7V7V, 7Z1HL, A41NN, A61HA, A93JA, C5YK, CN8AM, CX2AQ, EA8JK, HZ1BL, LU2JCW, PY2s, PZ5RA, S01WS, VA2WLD, VUs, ZA5G, RI1AND; 20m – 3B9FR, 3DA0AY, 3V8BC, 4S6NCH, 4X4FD, 7X3WPL, 9H1ML, A41NN, A61CP, A71AE, AP2AM, BG0BAC, C5YK, CE4SFG, CN8YZ, COs, D44TBT, FG5BZ, FR4OM, H2X, HI8/KB1KKE, HS0ZBS, J79WTA, JA1LDG, LUs, PJ2LS, PYs, TG9ANF, VK4CC, VP8LP, VUs, VY2ZM, ZS6s; 30m – CN8CK, VK3SIM, 3A2MW; 40m – 4O7CC, 7V7V, 7X3WPL, 9M6XRO, A41MS, A61QQ, A71YY, FR4OM, HK1F, JAs, T77s, VKs, VUs, YBs, ZL1BRL, and ZSs.

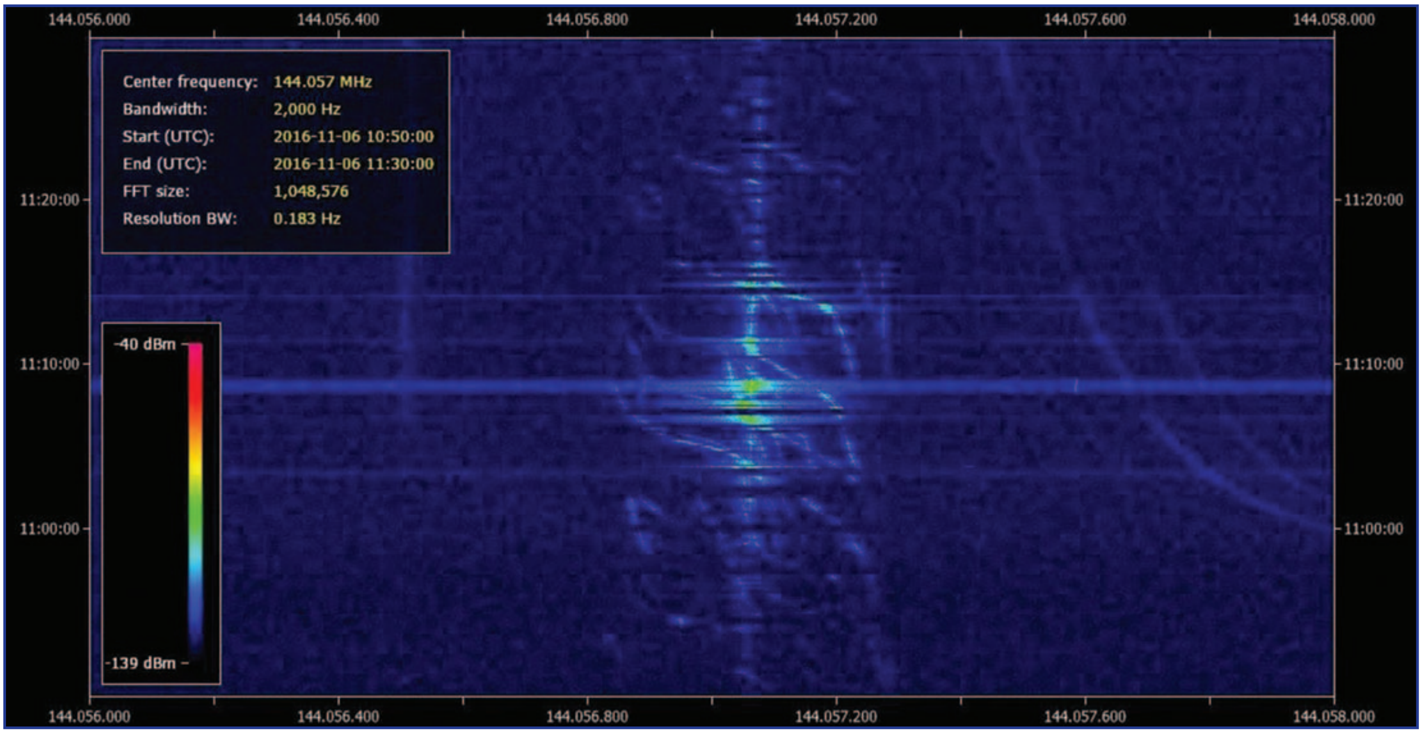
Peter, G3HQT, found: 17m – TU5MH; 20m – HV0A, PJ4LS; 40m – 6Y4K.

Barrie, G7UFI retired to Norfolk for a quieter way of life but found that the area around his new garage shack wasn't at all quiet from a radio point of view. So his solution was to go out and about pedestrian mobile on the beach at Hunstanton with his transceiver, battery and vertical antenna all mounted on a small trolley. He found a lot of 20m DX including VP8LP, ZL1BD, VK2CPC, VK2BSY, VK4KPB and YI3WHR.

Finally – thanks as always to my correspondents, to DX-World, 425 DX News and Daily DX.

Martin Atherton, G3ZAY
g3zay@btinternet.com

VHF/UHF



The G4XZL SDR data file of G3MEH aircraft scatter multipath.

January is not really known for its potential of good tropo openings but, in the second half of the month, a persistent high pressure once again hung over the North Sea, extending through to the Skagerrak and Baltic Sea. Propagation was good mostly from the southern area of the UK with some selective ducting reaching further up the country.

The Quadrantids meteor shower peak also coincided with a strong solar wind stream on 3-4 January. Consolidating in the E layer, aurora can have a dramatic effect on signal propagation via MS from northern latitudes with an almost 'dead zone' north of the oval boundary. As a consequence, Auroral E openings can occur that, unlike southerly direction Es, can have considerable Doppler warble on the signal. Some Winter Es also was also in evidence, which was welcome for stations trying to increase their scores in the UK Six Metre Group Winter Marathon that ended on 31 January. Many VHF/UHF operators are looking forward to the Spring when, hopefully, conditions and weather will improve. February and March have the potential for Atlantic driven storms so 'Antenna Watch' will be in force.

Christmas and New Year

The week between Christmas and New Year at GM3PPE (IO75) produced several good examples of Winter Es, with an excellent opening to Europe on Boxing Day. Starting at 1200UTC, stations in France, Italy, Germany, Austria and Hungary were all coming through with good signals. HG8QU (KN06), OE5FSL (JN68) and DC5PAD (JN58) were the best of the bunch. Towards the end of the week there were a number of short Es openings, for example SP3OCC (JO92DF) was a solid signal on the 30th. The Quadrantids meteor shower in early January, while not as intense or long lived as the Geminids, produced good signals from southern UK and Ireland, the Channel Islands, GJ0JSY, Jersey, and GU8FBO, Guernsey (both IO89), as well as mainland Europe, DH8WE (JO50). A few days later, on 6 January, there was a mix of Es and meteor scatter with very strong signals from Scandinavia, OH6WD (KP23) and OF1MN (KP10), and northern Germany, DL5WG (JO52). The new MSK144 digital mode is proving a real winner for meteor scatter, with QSOs possible just about every day. Patience is required, for example 40 minutes was required to complete with GW4MBN (IO71), but with many stations throughout Europe active daily, the chance of a random meteor QSO is good.

Andrew, G4XZL commented on the January VHF/UHF column about copying interesting AS (aircraft scatter) signals during the November 2016 144MHz Marconi CW contest. He told me, "I was listening on the Sunday morning and heard some very distorted CW from G3MEH. From my location in locator square IO90IU, Roger is about 110km away on a direct beam heading of 24°. I was beaming east at the time, so somewhat off from the direct path. I was listening on an SDR (software defined radio) and happened to be recording the scattered signal. Afterwards I produced a high resolution waterfall plot from the IQ recording, and found that it clearly shows multiple reflections from aircraft and hence is the reason for the distorted CW. It wasn't Roger! The maximum Doppler is about 200Hz, which is consistent with a typical aircraft speed of around 460mph, presumably flying somewhere over the Channel. The software used to produce the plot from the recorded IQ file was SDR Analyser from Simon Brown, part of his r-radio software suite, it's a very useful way of analysing signals." Andrew says he will continue testing with reception on SDR, with more information to follow.

Gordon, G3PXT reports making good use

of his Expert 1.3K amplifier on 6m. Since its delivery, the band has become a different place with Gordon being able to work meteor scatter contacts on a regular basis. January is pretty much a dull month for DX on many VHF bands but, with the lack of any Winter Sporadic-E, Gordon logged the following DF9OX, DH8WE, DJ4MM, DL5DSM, EA2ARD, EI3KD, EI4DQ, G0LFF, G3LDI, G4FUF, G8BCG, GI4SNA, GW4BVE, GW4MBN, IK4ISR, M0CGL, OK2BRD, ON3CF, OZ3ZW, OZ7D, SP2QOT and SP3OCC. Gordon has already worked 12 DXCC entities this year and is looking forward to the Sporadic-E season and some warmer weather. He also has a masthead preamp to fit to the system and a new run of Ultraflex 10 to connect to his new unusual 'tree mounted antenna' .The 2-ele InnovAntenna quad is nestled within his willow tree so it will be interesting to see the results when spring and full leafage appear. The G3PXT station has also taken advantage of the new MSK144 software developed originally as a successor to the WSJT programme FSK441, which although seems to have been developed for 2m propagation seems to work well on the lower VHF bands as well like 4 and 6m.

MSK144 software

This software is available packaged within two downloads. The new release of WSJT –X.1.7.0 contains the following packages WSJT-X: Modes JT4, JT9, JT65, WSPR, Echo, WSJT: Modes JTMS, FSK441, ISCAT, JT6M, JT65, JT4, Echo, CW, WSPR: For testing potential propagation paths using low-power transmissions, MAP65 for EME on VHF and higher frequencies and WSPR-X, an experimental version of WSPR, including the slow mode WSPR-15. Installable end-user packages are posted on the K1JT website **[1]**. LZ2HV has also developed a package that contains some of the WST –X key elements and can be found for download on his website **[2]**.

Meteor scatter operation

The advances in PC/software solutions for using meteor scatter (MS) has really come on leaps and bounds since the late 1990s. Winding back even further to the late 1970s, my first MS non SSB QSO was made in 1978 via high speed CW (HSCW). This didn't mean trying to hand key CW sent at 40-50 words per minute but significantly faster to take advantage of the available pings and bursts to make a QSO. Meteor scatter data rates were measured in letters per minute (lpm). This was equated to the normal words per minute bench mark by a simple conversion. Assuming 5 letters per word as an average based on the word PARIS it was calculated that 600 lpm equated to 120 words per minute – and 1000 lpm to 200 wpm and so on.

One thing that has survived the test of time is the reporting system that has changed little since its inception. The ubiquitous '26' report still stands today; the only real change is the method of receiving and transmitting and the length of periods used.

When I started HSCW MS in 1978 skeds could be potential marathons. The standard sked length was one or two hours, determined at the beginning of the test. One would think at this length every sked would be successful. Sadly this wasn't the case and there was no ON4KST chat to converse via the internet, whether to stop or continue. Generally once a sked was set at a predetermined length then that was it – if it didn't complete then it didn't complete and keen operators would try again, but always stayed to the bitter end.

How did we set up a sked? With no internet or PCs in 1978, sked requests resorted to mail and the very popular 20m VHF net on a Saturday and Sunday morning. The frequency 14.345MHz hosted many stations requesting skeds and discussing recently made tests.

It was protocol during a sked to keep written records of how many pings and bursts were received and this was a hot topic of conversation during the 20 VHF net QSOs.

Sked's set up via mail were more problematic. First, the cost of the postage and you weren't sure whether the intended recipient actually received the letter, let alone whether he could make the sked or not. With many VHF-and-above licences in the era, operation on HF wasn't usually possible to confirm the sked – it could be a case of listening to white noise for ages at the sked time, waiting for a ping or burst. It is surreal to see current skeds being made via ON4KST chat and giving up after 10-15 minutes or less due to no reflections. Patience was always the watch word in HSCW days!

The very first set up at this QTH included a memory keyer developed by Max, PE1AVU that could achieve up to 800 lpm and a fearsome Grundig reel to reel tape recorder that had a mechanical speed reduction. This made such a noise in operation that it usually woke my parents up during the night time skeds! The desire for higher speeds to maximise information transfer during the pings and bursts was paramount and in the early 1980s much better equipment was available but really still preceding the PC era.

Timing was also a key factor usually done by digital timepiece synchronised with the BT speaking clock! In those days with a sked of 2 hours the odd few seconds here and there didn't really matter.

Faster memory keyers and more adequate cassette tape recorders boosted the ability to send and receive to over 1000 lpm, with the Philips D6150 and Samson keyers being widely used. This still needed some modification to achieve top speed but the difference was well worthwhile.

A further stumbling block was how to key the transmitter. Many rigs like FT-221R, TS-700, TS-780, IC-211E etc were incapable of keying such speeds through the standard CW jack on the rig. The switching transistors used were simply not quick enough to switch the key strokes, so another solution was found, feeding audio into the microphone socket from the keying device side tone. A rough solution but in those days it worked, although the signal quality was rather questionable.

A major development on receive was the development of the well known digital tape recorder (DTR) by Dithmar, DF7KF. A little tricky to operate but 2000 lpm could be decoded and in its day it was groundbreaking.

A PC solution followed with the advent on Windows 98/2000. MSDSP was written by Tihomir Heidelberg, 9A4GL, and became very popular among HSCW operators. With a digital clock and GUI the operator only needed to mark the spots and save the bursts to replay from the buffer. Transmit data is adjusted as required and the speed could be made up to 10,000 lpm, which opened up new horizons in MS operating with quicker skeds and maximising data transfer. Development of this software reduced the requirement for two-hour skeds, thank goodness.

A full description of the software can be viewed on the W8WN and Nitehawk websites, **[3]** and **[4]**. It's not hard to see the resemblance with current day systems!

Interesting reading on the development of Joe Taylor's wonderful software can be found as far back as 2002 **[5]** in the World Above 50MHz *QST* article that shows how JT44 came on the scene and has seen continuous improvement to WSJT 10 and WSJT-X to the present day.

Sign off

Once again thanks to all the contributors this month and hope that February is calm month weather wise. I will still be on 'antenna & weather watch' at this QTH. Please send in as many activity reports as possible by 3rd weekend of the month.

Websearch

[1] http://physics.princeton.edu/pulsar/K1JT/
[2] http://lz2hv.org/mshv
[3] www.qsl.net/w8wn/hscw/msdsp.html
[4] www.nitehawk.com/rasmit/hsms-intro1.html
[5] http://physics.princeton.edu/pulsar/K1JT/WSJT_QST_Jun2002.pdf

Richard Staples, G4HGI
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GHz Bands

Galileo E6 band and 1.3GHz

We have a new potential signal source to deal with in the 1.3GHz band, with the switch-on of the E6 band of the European Galileo global navigation system. It is centred on 1278.75MHz and the transmitted BPSK spectrum has a bandwidth of ±20MHz. As of December 2016, the system has 18 of its 30 satellites in orbit and on 15 December 2016 started offering early operational capability. It is expected to reach full operational capability in 2019 and the complete 30 satellite Galileo system of 24 operational and 6 active spares is expected by 2020.

The project has been a long one and, back in 2006, Peter, G3LTF wrote a paper **[1]** approximating the levels of signal to be expected. His conclusions were that, "the Galileo signal at the Earth's surface is very weak and spread over a wide bandwidth, and will only be a source of interference to EME stations with large antennas. As a typical 23cm EME system uses a large, typically >3m, antenna, the satellite will only be present in the beam for a short time. The Galileo signal is planned to be -128dBm as received by a right hand circular polarisation (RHCP) antenna and spread over 40MHz. A 3m dish has 30dBi gain and a typical receive sensitivity would be -152dBm for a 500Hz bandwidth. The bandwidth restriction means that the received power is -128dBm - 49dB = -177dBm. The antenna gain increases this to -147dBm. However, fortunately the EME standard is for left hand circular polarisation (LHCP) on receive and so there is an additional attenuation of the cross-polarisation performance of the dish and feed, typically 20dB. Thus, the operator will not experience a noise increase. With a 10m dish the increase will just be noticeable." So, there you have it. It seems that the potential for problems from this Primary User in 23cm to us are vanishingly small.

PHOTO 1: PA3FXB, ON7UN, ON4BCB and many others at the PA Microwaves 'Heelweg' meeting.

Heelweg PA microwaves meeting

I joined a group of UK microwavers braving the January weather to visit the Netherlands for the PA-microwaves Heelweg meeting **[2]**. We took the Friday/Sunday overnight car ferry from Harwich and stayed in a local hotel on the Saturday night. This year's meeting returned to the newly refurbished Café Zal de vos in Westendorp near the German border. The refurbishment has made the venue larger and lighter and allowed more space for trading stands and test facilities. This meeting is always a good source of GHz parts and equipment, not to mention good for socialising and networking. Roger, G8CUB came away with two 'ready to go' 24GHz TWTs and power supplies for his future 24GHz EME project and I picked up a set of built and tested PCBs for the excellent standalone OE5JFL Moon tracker and dish controller **[3]**. **Photo 1** shows the test area with (front right) Jan, PA3FXB talking to ON7UN and ON4BCB, the team behind the ON0EME 'Moon beacon'. Traders included Hartwig RF **[4]** from Germany run by Rudiger, DK6JL, HUPrf **[5]** and G8FEK RF design **[6]**, as well as several others.

Beacon news

The new Cleeve Common 47GHz beacon, GB3CCX (IO81XW81) is running well. Dave, G4FRE (IO82UC) reports that it is copyable from home at 539 using a Pasolink RX and 20dB horn. He then went portable to IO82UA, where the signal was 579. On a trip to South Wales he stopped off at Talywain (IO81KR) and the beacon was 519 over an 80km path using the Pasolink with a 250mm dish. This is the ODX so far for the beacon. On the way back he stopped off at the Blorenge car park (IO81LS) and it was a good 559 at 73km with the same setup.

G3LRP SK

I was sad to hear from G3PHO that Peter Ackley, G3LRP passed away a few days before Christmas. He was in his early 80s, a quiet and reserved man but an avid and active microwaver who would help anyone if he could. He operated on all the bands up to 24GHz and supplied most of the modules for the GB3KEU 5.7GHz beacon, which is soon to be re-sited at the Finningley ARS HQ. In 2005 he was only the third station I worked over 150km on 10GHz. I went on to work him on most bands above 144MHz. For many years, he kept a twice daily sked with Ralph, G4ALY in Cornwall, during which they would work each other on every microwave band from 1296MHz to 10GHz, usually on CW using aircraft scatter. Peter's log book must be a veritable history of microwave propagation along that 400km+ path! Rest in peace, Peter.

Finally

Spring is close so get on the GHz bands and keep reports and technical snippets coming in to me by email. Why not join the conversation on Twitter @g4bao and @ukghz using the hashtag #GHz_bands?

Websearch

[1] www.southgatearc.org/articles/galileo.htm
[2] www.pamicrowaves.nl/website/
[3] www.qsl.net/oe5jfl/ant_cont.htm
[4] www.hartwig-rf.de/
[5] http://huprf.com/huprf/
[6] http://g8fek.com/index.html

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YAESU FT-60E Twin band Handie.
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YAESU FT-1XE Dual Band Full Digital Handie.
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YAESU VX-6E 2/70 handie. **ML&S: £149.95**

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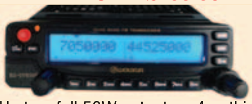

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DPD

HF F-Layer Propagation Predictions for March 2017

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	663.....2666	465321235666	115433445621	..35545551..	..1355542...	...223321...	...11111....	.....11.....
*** Asia								
Yakutsk	2.......1332	2331	...111......	....2.......	....	....	....	....
Tokyo	........22..	......13432.	....112232..	....11......	....	....	....	....
Singapore	2221	34332	......24421.	.....1232...	.....121....	....	....	....
Hyderabad	2.......2333	2......24433	......13331.	......231...	.....121....	......1.....	....	....
Tel Aviv	551.....1555	554....14555	115311135522	..5433345...	...444431...	...11121....	....	....
*** Oceania								
Wellington	........2...	...111234...	...233334...	...122212...	....11......	....	....	....
Well (ZL) (LP)	....	..3.........	113......11.	.........2..	....	....	....	....
Perth	........111.	.......2433.	......13321.	......122...	.....1......	....	....	....
Sydney	........11..	......1343..	.....12332..	.....1221...	....	....	....	....
Melbourne (LP)	....	..13........	...31.......	...21.......	....	....	....	....
Honolulu	...1........	..131.......	...11.......	....	....	....	....	....
Honolulu (LP)	....	....	....	........2...	........2...	........1...	....	....
W. Samoa	....	...21.......	...1222.....	....122.....	......1.....	....	....	....
*** Africa								
Mauritius	2........322	3......24433	1......34321	.......331..	.......21...	.......1....	....	....
Johanesburg	22.......233	33......4544	11......4432	.......243..	......123...	.....1122...	.......1....	....
Ibadan	544......445	5552....2555	52531..13553	..14322345..	...4333341..	...243343...	....1111....	....
Nairobi	33......1333	442.....3444	1.3.....4441	..12...242..	...211232...	......11....	....	....
Canary Isles	6663.....466	66652...2566	656642234666	211644445621	...65555541.	...3555552..	...1233331..	...122222...
*** S. America								
Buenos Aires	222........2	3332......33	2112......21	.........1..	....	....	....	....
Rio de Janeiro	333........3	4331.....233	2221.....332	........131.	....1...11..	........1...	....	....
Lima	2221........	3223......12	...2......1.	....	....	....	....	....
Caracas	3332.......3	33331.....23	...12.....2.	.....1...1..	.....2111...	....	....	....
*** N. America								
Guatemala	2222........	3213.......2	...2......1.	....	....	....	....	....
New Orleans	3332.......1	31131......2	..........1.	....	....	....	....	....
Washington	44431......3	432221....23	.....211112.	.....21222..	......223...	....	....	....
Quebec	3443......13	311.1....123	.......1121.	.....11122..	........1...	....	....	....
Anchorage	..2.........	..1.........	........11..	....	....	....	....	....
Vancouver	.232........	...1........	....	....	....	....	....	....
San Francisco	.222........	1112........	....	....	....	....	....	....
San Fran (LP)	....	....	....	.......1....	.......1....	.......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 & May are respectively (SIDC classical method – Waldmeier's standard) 26, 25 & 25 and (combined method) 36, 34 & 32. The provisional mean sunspot number for January was 28.5. The daily maximum / minimum numbers were 74 on 21 January and 0 on 4-11 January.

Technical

Radio frequency interference

Many amateurs will be aware that radio frequency interference (RFI) is increasing, particularly from modern electronic devices and green energy devices.

These devices contribute to an ever-increasing background noise level that is the electronic equivalent of smog. This RFI degrades amateur radio reception and obstructs many weak signals. Ofcom is required by the Wireless Telegraphy Act to provide advice and assistance to complainants of interference. To act Ofcom requires evidence of "actual Harmful Interference" (HI).

Ofcom also requires the person whose equipment is suffering RFI to have taken all reasonable steps to minimise the impact of that RFI. They also try to ensure that public interest is served in a balanced, transparent, proportional and accountable way. Hence it is important that we record and report RFI correctly to get effective action.

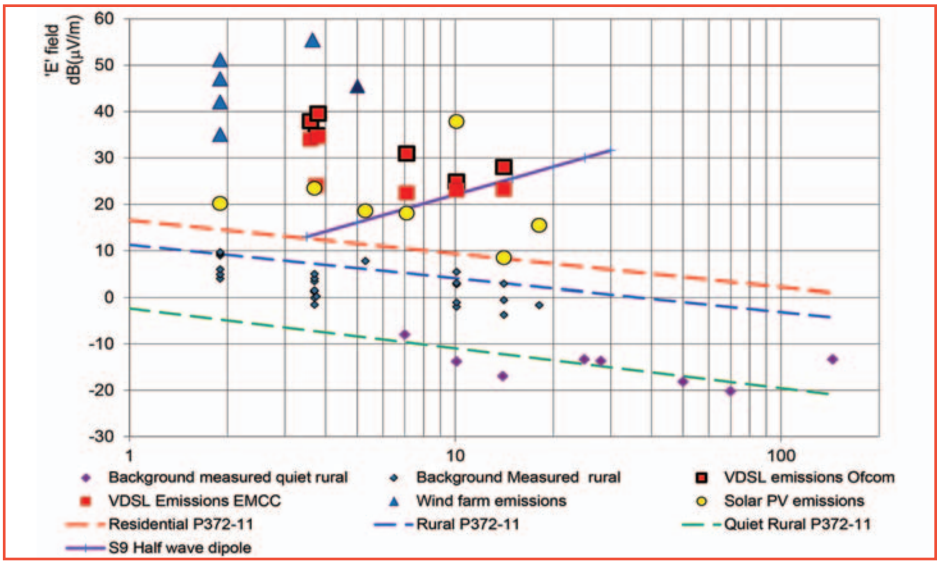

FIGURE 1: Emerging sources of RFI measured at locations causing problems to HF reception compared with expected background noise levels. The dotted lines are from P372-11 and represent the median man-made noise measured on a vertical monopole for quiet rural, rural and residential environments. The symbols represent measurements made by the EMCC of background, solar PV, VDSL and wind turbine generated RFI. All measurements are RMS normalised to 9kHz bandwidth at 3m from the source where possible. For comparison S9 (50μV into 50Ω) from a half wave dipole is shown as a solid purple line. RFI varies from 10 to 50dB above the rural noise levels and the highest level is S9+40dB.

Recording and identifying HI

HI is defined in the Wireless Telegraphy Act as RFI that "degrades, obstructs, or repeatedly interrupts anything being broadcast or otherwise transmitted" lawfully by wireless telegraphy or endangers functioning of radio navigation or other safety service. To get action on HI you will need to record evidence, locate and if possible identify the source. Then take steps to minimise its impact on your reception. Evidence that can help demonstrate RFI is Harmful includes:

- logging comparisons of reception at two close sites, one with RFI and the other without
- logging log readings before and after RFI started
- temporarily turning off the RFI source (if possible) and prove that reception is possible in the absence of the HI.

Logs need to record what you cannot receive but you can prove is there. Ofcom use the severity and scale of any potential or actual harm to decide which reports to investigate. Actual RFI levels can be calculated if the antenna factor and receiver sensitivity are known. If emission limits exist for the interfering device, then we can determine whether these have been exceeded. The RSGB ElectroMagnetic Compatibility Committee (EMCC) will advise how you can make these measurements. Remember you need to show that without the HI communication would have been possible.

Next, where possible, the source of HI should be located and identified. Noting the times of HI can help. You can often locate the source with a portable receiver with a small whip antenna. As you move towards the source signal level increases. Then you can reduce the whip size and keep searching until you identify the source. If a cable appears to be the problem, a clip-on current transformer or a small loop antenna can pinpoint on which wire the signal is strongest. It will also allow the signal characteristics to be recorded on a spectrum analyser or SDR. Comparison of this recording with an RFI signature database will help to identify the type of interference and perhaps find the culprit apparatus. Beware though; people often find their RFI is coming from several

TABLE 1: Amateur bands, corresponding VDSL bands and special use frequencies.

Amateur band	Frequency range	VDSL band	Special sub bands
LF	135.7 to 137.8kHz	U0 0.025 to 0.138MHz	
MF	472 to 479kHz	D1 0.138	
160m	1.81 to 2MHz	to	
80m	3.5 to 3.75MHz	D1 3.75MHz	3.76 IARU R1 emergency centre of activity
80m	3.75 to 3.8MHz	U1 3.75 to 5.2MHz	3.775 to 3.8 intercontinental telephony
60m	5.258 to 5.4605MHz	D2 5.2-8.5MHz	5.2785 UK emergency comms traffic 5.2885 to 5.292 WSPR beacons
40m	7 to 7.2MHz	D2 5.2-8.5MHz	7.110 IARU R1 emergency centre of activity
30m	10.1 to 10.15MHz	U2 8.5 to 12MHz	10.1 to 10.15 QRP and narrow band modes
20m	14 to 14.35MHz	D3 12 to 17.664MHz	14.3 to 14.35 global emergency centre

sources so compare this signature with one taken from your antenna to ensure you have located the culprit.

Armed with the logs of what cannot be heard and a good idea of the RFI source, Ofcom requires you to try to identify measures that can be taken to minimise the impact of the RFI. The best chance of success is to find a combination of steps that reduce the impact. If the cause is a neighbour's switch mode power supply or a plasma TV, then offering to help reduce the RFI may also benefit them by making their digital radio work better or by improving their internet speeds. Remember when looking for RFI you will often find several contributing sources. If the problem cannot be fixed by these actions, it will be necessary to persuade Ofcom to act. Our aim is to measure (and, if possible, to identify) RFI before reporting evidence to Ofcom. This should help Ofcom prioritise and correctly target their actions and increase the effective use of their limited resources. The EMCC is updating its website leaflets with advice on different RFI sources including how to identify and locate them and how to reduce their impact.

TABLE 2: Locations reported and RFI levels measured.

Amateur band	160m	80m	80m	60m	40m	30m	20m	Symptoms
Lowest f (MHz)	1.81	3.5	3.75	5.258	7	10.1	14	
Highest f (MHz)	2	3.75	3.8	5.408	7.2	10.15	14.35	
First 3 letters of location postcode		Field strength dB(μV/m) rms in 9 kHz						
CV4		30			10	20	30	red numbers are
							23.3	with line fault
TR19	7	12		10	10	10		Carriers 10MHz
EN5		8.24	17.9			19		
			4					
S81		23	34.5			23		
			4					
KA9		16			23	37	19	Carriers 10.1MHz
LA9		17			18			Carrier 3.7MHz
HD71		22		16			17	Carriers 7MHz
OX12		24				20		
LN12						22		
TR12		5		10		14	14.4	
EN1		34			22.4		23.2	

Further action

The EMCC plans to combine cases, collect calibrated measurements and then lobby regulators and suppliers. The more evidence we can provide the more likely they are to act. This evidence base also informs our representatives on standards bodies. To lobby Ofcom for action we need you to report RFI to us. If you need help, contact the EMC Help Desk via the RSGB website **[1]**.

The graph in **Figure 1** shows measurements made by the EMCC at reported problem locations for three new sources of RFI. Lines showing expected background levels and S9 signal strength are included for reference. These measurements are problem cases and lower levels are often seen. It is also common for other local sources like switched mode power supplies and plasma TVs to cause HI.

Measurements made of background levels at sites free from nearby interference sources are also included. This clearly demonstrates the seriousness of the impact of problem devices. Anything above the blue dotted line is a significant problem and anything above S9 the purple line is seriously degrading HF reception.

Unfortunately, for many modern RFI sources at frequencies below 30MHz, the applicable standards only specify limits for *conducted* emissions (into the power supply or telecommunication ports). Limits for interference *radiated* by these cables is not specified by standards and it depends on various factors such as cable balance. HI therefore becomes a subjective criterion that is open to different interpretations.

RSGB EMCC investigations into RFI from VDSL2 broadband

VDSL2 has spectral characteristics like white noise and is present all the time. In some locations radiated levels up to 30dB above other background noise have been measured at more than 3m from the telephone drop-wires. This can make affected amateur radio bands unusable for DX at those locations.

Table 1 shows the amateur and VDSL bands, Downstream (to user) and Upstream (from user).

There is usually a 100kHz guard zone free from RFI clearly detectable at the upstream / downstream transitions. This acts as a 'signature' to identify VDSL RFI.

The amateur bands impacted depend on distance from the fibre cabinet: closer than 300m, downstream VDSL predominates; further than 700m, upstream VDSL predominates; in between, the levels may be similar but lower than those nearer or further away. This is because upstream bands use power backoff, which reduces upstream levels when close to the cabinet, whereas downstream RFI is increased by the addition of the RFI from multiple lines when close to the cabinet. Comparisons of areas fed at these radii shows that about 50% of lines will be more than 700m from the cabinet, while about 10% will be less than 300m – the remaining 40% being between the two.

Imbalance in the twisted pair lines and crosstalk between lines vary considerably between locations. These cause common mode currents that radiate and can appear as RFI to radio apparatus. Imbalance can be resistive due to poor contacts at the multiple joints in the telephone wire, or can be reactive caused by open or short circuit stubs in the lines. Stubs can be bridge taps in the cables or phone extension wiring in the house. These give rise to standing waves analogous to the feeder in an antenna system. The extent of RFI thus depends on the signal strength, degree of crosstalk, imbalance in the lines and the length of the drop-wire (which determines the standing wave frequencies). RFI can change each time new subscribers are added, as most lines carry parasitic signals from other nearby VDSL2 lines. The proximity of the amateur antenna to the telephone drop-wires usually determines the level of RFI received. RFI is significantly lower when underground feeds to premises are used.

Investigations undertaken

The EMCC has, to date, had reports from 112 stations where VDSL2 RFI was suspected. VDSL2 RFI has been confirmed at 98 of these by looking at level changes at the upstream/downstream transition frequencies given in Table 1 and from characteristic waterfall traces (see pages 80-81 of the March 2016 *RadCom*, which explain how to identify RFI from VDSL2). At 28 locations, a retraining carrier comb was evident that repeatedly interrupted amateur reception. We believe many more amateurs are affected but have not associated VDSL2 as the cause of their raised background noise level.

The EMCC then measured field strengths at representative locations to determine the impact of VDSL2 RFI, summarised in **Table 2**. Our measurements confirm the HI on amateur radio bands varying from S8 to S9+25dB. These are also plotted and compared with background and other problem RFI sources

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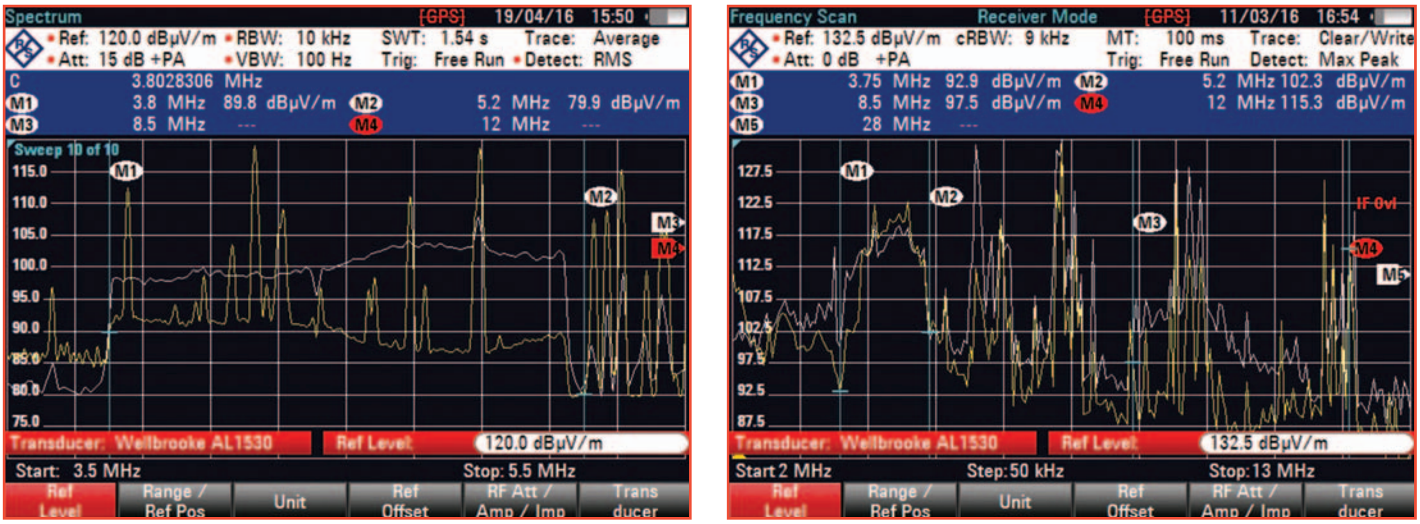

FIGURE 2: Effect of cancelling using sample of VDSL2 common mode current and an analogue noise canceller. White trace before cancellation yellow trace after cancellation 1a adjusted for upstream 1 and 1b adjusted for upstream 2 (because of variable gain of phase canceller readings are relative, not absolute).

in Figure 1. These bands have a key use for communication in times of international disaster, which is jeopardised by HI.

Whilst Harmonised EMC standards for VDSL apparatus do not set requirements on radiated emissions at HF they do limit common mode conducted emissions. There is further control of the frequencies and spectrum used as defined in the Access Network Frequency Plan (ANFP) developed by a task group involving Ofcom and Industry. In many cases, these are not sufficient to eliminate HI to amateur bands.

Ofcom visited three of the locations in Table 2 and measured similar levels to us (see Figure 1). To our astonishment, Ofcom concluded from their measurements that there was no evidence of RFI that would cause restricted use of the amateur radio frequencies at the locations tested. They felt the VDSL2 RFI level was comparable to expectations and low enough to allow signals to be received. Ofcom states that operators who are seeking to receive a weak signal from a distant source can't be guaranteed access to interference-free use of the radio spectrum. The RSGB does not accept this conclusion.

Logs taken at the selected locations show the impact of this RFI. Logs taken before and after VDSL2 installations record the impact on the number of stations receivable. Logs taken at equivalent close stations with and without VDSL2 RFI record the stations not receivable when RFI present. Logs also show communication was possible when the VDSL was turned off.

The EMCC has presented its results in a 170-page report to Ofcom and Openreach. It argues that RFI from VDSL2 seriously degrades, obstructs and, in some circumstances, repeatedly interrupts amateur radio communication. This HI raises the noise level continuously 24/7. The impact can range from loss of weak signals to complete loss of service when very high levels are present. This not only impacts the amateur bands and amateur usage but also other emergency usage of these frequencies.

We have also submitted approximately 20 cases to Openreach where there was evidence of possible line faults. Openreach have checked these and have rectified the faults they found in about 40% of those checked. In about 20% of the submitted cases amateurs could operate normally after the faults were cured. Openreach will continue to check line balance when the EMCC has confirmed VDSL2 RFI is evident (contact emc.chairman@rsgb.org.uk for further information on this process). Where this does not overcome the problem other mitigation measures are needed.

Mitigation measures tried

Various methods have been tried to reduce the RFI, including optimising receive antenna type and position (it is important to stay out of the reactive near field); filtering to reduce common mode coupling; noise reduction techniques and multi-antenna cancelation / diversity reception. At the S81 location, where nine lines crossed the property (including one that ran diagonally across it), the measured field strength on the property varied from 25 to 42 dBµV/m. The HF mast was moved to the minimum position and the secondary receive antenna (a Wellbrook loop) was located at the next lowest RFI level that was a safe distance from the transmit antennas, but the HI still obscures signals at the top end of 80m and on 30m.

An experiment used a phase canceller driven from a current clamp around the telephone line and a low noise active loop as the receive antenna; this reduced the levels by about 10dB for a single dominant line but only about 4dB when multiple lines were the source of RFI.

Another amateur has tried a combination of mitigations to reduce his interference from 25 to 12dB above normal background levels. He listed these in order of effectiveness:

- Using ferrites as common mode filters
- Shortened drop cable and installed NTE5C VDSL service specific faceplate
- Removed in house phones and extension wiring
- Relocated router close to faceplate and used high quality modem – wall plate cable.

The effectiveness of these mitigations varies with location and may show no improvement in some cases. We believe that simple effective mitigations are made difficult by varying nature of the standing wave pattern on the overhead drop-wires. We have found that fitting ferrites will induce a null at that location but a few metres away a maximum is formed that still radiates.

What does the RSGB believe should be done to reduce VDSL2 RFI?

A written Ministerial Statement recorded in *Hansard* 16/12/03 stated that "the operators of ADSL have made a voluntary commitment to take all reasonable steps to resolve any interference problems that do arise."

RSGB is pleased that Openreach has investigated cases brought to their attention and acted to resolve network faults found.

We are in discussions with Openreach on remaining RFI problems and we have requested the following, which we believe are reasonable steps to resolve the reported interference problems:

Continued on page 61

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Design Notes

Phase locked loops

In a recent thread on the RSGBTech Yahoo Group there was a long discussion about the merits of different PLL filtering schemes and how phase noise and stability were all interacting. Partly for his own understanding and as an aide-memoire, Peter, G3PLX put together the following 'plain man's description' of the basic PLL process and how its filtering requirements can be derived from first principles. As one who was first introduced to PLLs from a formal, purely theoretical control theory route, this description of Peter's came as a breath of fresh air – nearly forty years after my original lecture notes on PLLs (which I still have).

"**Figure 1** shows the elements of a phase-lock-loop. If we think of a simple PLL, one that is locking a potentially drifty voltage-controlled-oscillator (VCO) onto a known stable reference signal on the same frequency, then we can think of the PLL as behaving like a narrow bandpass filter in the path from the reference input to the output, and a narrow notch filter in the path from the VCO input to the output, both filters on the reference frequency. This analogy of a PLL as a pair of narrow filters isn't quite right. The PLL is only working on the phase information in the signals it processes, not the amplitude information.

"Note that the notch filter in the VCO-to-output effectively has infinite depth at zero frequency offset, but since it is only notching the phase information, the output amplitude remains constant. 'Infinite notch depth in the phase information at zero frequency offset' is just another way of saying that the VCO frequency is perfectly stable.

"If the reference signal is noisy, in that it has unwanted components either side of the intended frequency, then we can use a PLL to clean it up. We do this by designing the PLL with a bandwidth low enough to reject the unwanted components.

"If the VCO is noisy, in that it has unwanted components either side of the intended frequency, then we can use a PLL to clean *that* up. The VCO is always locked to the reference (the PLL 'notch' removes the noise at zero frequency offset) but there may be some low frequency noise each side that we can't tolerate. We can reduce this by designing the PLL with a bandwidth wide enough to notch out the unwanted components.

"When we learnt about frequency modulation we were told that the modulation index is equal to the frequency deviation divided by the modulation frequency. In fact 'modulation index' is another name for phase shift in radians. If our VCO swings by K_VHz for every volt change on the varicap line, and we put a 1 volt sinewave at a frequency F onto the varicap line, the VCO output phase will therefore swing by K_V/F radians. If our phase

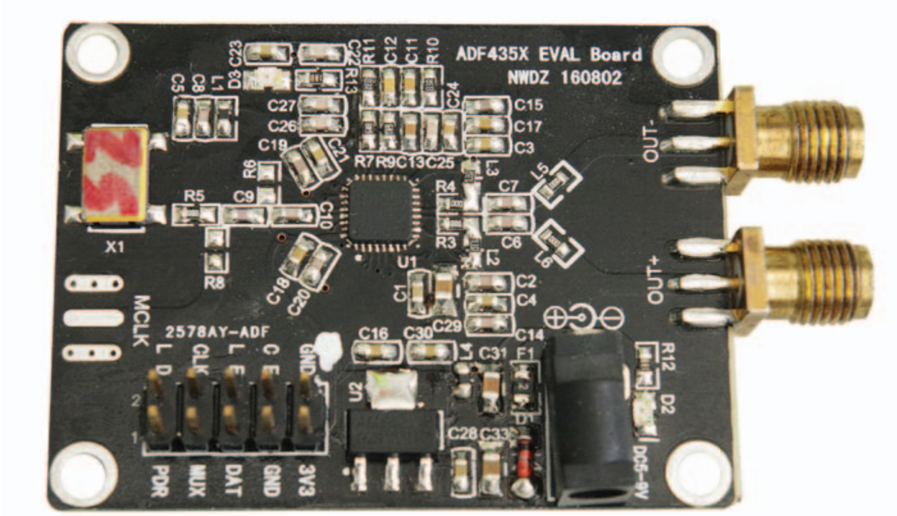

PHOTO 1: Typical low cost ADF4351 fractional-N synthesiser module that can be picked up on eBay.

discriminator output changes by Kp volts for a phase shift at the input of 1 radian and we think of the VCO cascaded with the phase discriminator, the overall gain is thus Kp*K_V/F. At frequencies lower than Kp*K_V the overall gain will be greater than 1, and at frequencies higher than Kp*K_V the gain will be less than 1.

"If we now connect the output of the phase detector output voltage to the VCO varicap line, the loop locks. The closed loop gain in the reference-to-output path will be unity at frequencies below K_V*Kp and K_V*Kp/F at frequencies above K_V*Kp. That is to say, the VCO phase follows the reference phase at frequencies below Kp*K_V and the sensitivity of the VCO to variations in the reference phase drops at 6dB/octave above that. The equivalent bandpass filter in the reference-to-output path is thus like a single tuned circuit with a bandwidth of K_V*Kp Hz.

"We can improve on this by adding an RC lowpass filter at the phase discriminator output, to roll off its response at high frequencies. This increases the stop-band slope, and hence the rejection of phase noise on the reference input, to 12dB/octave. However, there's a snag. We must not let the extra roll-off frequency get too close to the closed-loop cutoff frequency, or the modified frequency response rises before it starts to fall at the 12dB/octave rate. The loop is showing signs of instability. As a rule of thumb, putting the extra roll-off frequency at 3 times the closed-loop cut-off frequency results in a 1dB rise in the response before it starts to drop. The equivalent bandpass filter in the reference-to-output path is thus like a double tuned circuit which is slightly over-coupled.

"In addition to the benefit of increased rejection of reference input noise, the extra RC filter may help where the VCO is divided down to a low reference frequency and there may be some ripple at the reference frequency superimposed on the phase discriminator output. Too much reference ripple getting to the varicap line would show as sidebands each side of the VCO frequency.

"In the VCO-to-output path, the PLL behaves as a notch filter with the same 3dB bandwidth as the reference-to-output bandpass filter but 'inside out'. Inside the notch stopband, phase noise on the VCO is rejected by 6dB/octave. That is to say, the noise rejection is 6dB at Kp*K_V/2 Hz away from the VCO frequency, 12dB at K_V*Kp/4, and so on. We can improve this slope, by means of a 'low frequency boost' in the phase discriminator output. Making the gain rise at 6dB/octave below Kp*K_V increases the notch rejection slope from 6dB/octave to 12dB/octave. This will improve the rejection of close-in VCO phase noise and also speeds up the time taken for the loop to lock, for example after a step change in frequency in a synthesiser. This low frequency boost is usually done by an integrator. Again, we need to be careful not to let the corner frequency of this boost get too close to K_V*Kp or the modified frequency response shows a peak just outside the notch. The same rule of thumb applies – keep the corner frequency below 1/3 of Kp*K_V and the peak won't be more than 1dB.

"When used in conjunction with a phase/frequency discriminator such as the 4046, this last technique makes it possible to let the VCO cover a wide range but lock with a narrow bandwidth

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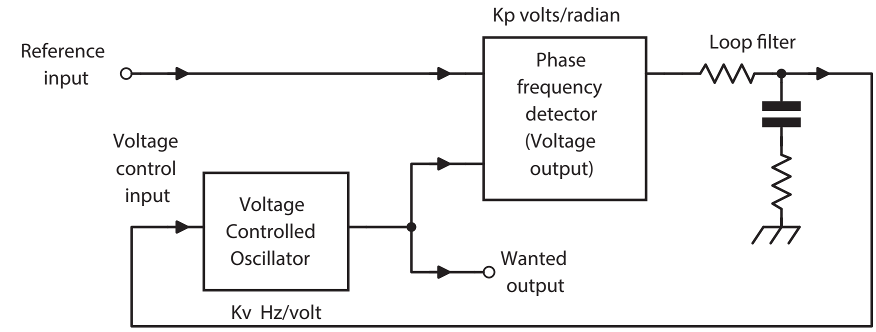

FIGURE 1: Phase locked loop overall concept, showing the stages discussed in the text.

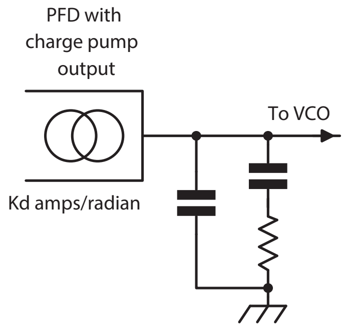

FIGURE 2: Loop filter components when the phase detector has a current pump output.

anywhere within the range. This makes it easy to design a PLL with a programmable frequency divider in the VCO path and lock it over a wide range, as in a synthesiser. The phase-frequency discriminator also has the useful property that the reference frequency ripple vanishes to zero as the phase error settles to zero. By providing such a discriminator with a constant current output rather than an output voltage, the low frequency boost integrator and the high frequency roll-off can be implemented with just two capacitors and one resistor, as in **Figure 2**."

Pitfalls with the latest PLL chips

The latest generation of single chip PLLs are incredibly versatile, having a VCO on board and needing just the chip, a controller and a few decoupling and loop filter components for a complete system. One that is popular on low cost development modules is the AD4351, as shown in **Photo 1**. This is a fractional-N design **[1]** with internal VCO tuning 2.2 to 4.4GHz. An output divider of up to 64 allows arbitrary frequencies to be generated anywhere from 35MHz to 4400MHz.

However, such a wide-tuning internal VCO comes at a price. It clearly cannot be continuously tuned with one single voltage swing over such a large range. Any attempt to do so would end up with a VCO that was horribly noisy and twitchy, with even just nanovolts of noise on the control input contributing to frequency jitter. Instead, the VCO is tuned over a relatively narrow range, as little as a few hundred MHz for a 0 – 3V swing. Internally, capacitors and other resonator elements are switched in to preset the tuning *close* to what is wanted, meaning the entire range is covered in a series of sawtooth-shaped steps. To set the correct values of these pre-tune components, the chip's internal system needs to know the frequency it will have to operate and, although this may seem a bit odd, it doesn't have a clue what this is going to be! All the chip 'knows' is the register settings – it has no idea what the reference input is, or what VCO frequency it is being asked to run at.

So two additional steps are now needed. Firstly, the reference frequency, to the nearest MHz, is supplied by the user and stored in the registers. This allows the device to orientate itself roughly around the correct settings. Secondly, the chip goes through a VCO calibration phase where it uses this 'knowledge' of the reference frequency to measure its own VCO and select the optimum pre-tuning based on the register values. So these have to have been already loaded before calibration can get underway. To do the internal calibration, the loop clearly cannot be locked and the VCO has to swing widely for the chip to measure it and decide on the optimum pre-tune. So there is a period when the VCO is uncontrolled and, if supplying external hardware, will generate wideband spurious signals.

The calibration procedure usually only takes a few microseconds and, for fixed frequency operation, goes unnoticed. The problems come when we want frequency agility, repeatedly reprogramming the chip to change frequency. Both the LMX2541 and ADF4351 devices do a VCO recalibration when the final register is loaded. For the LMX2541 this is *Reg0*, which contains the fractional divider (F) value – the very one we are most likely to want to change to give small frequency shifts. This is an absolute disaster if the chip is being used for generating multi-frequency modulation such as JT65. Wideband microsecond-wide glitches every time it hops are very definitely unacceptable.

Fortunately, with the LMX2541, there is a workaround. Recalling that the frequency generated by a fractional-N synthesiser is given by $F_{VCO} = F_{COMP} * (N + F / D)$, fine frequency adjustments can be made by changing either F *or* D. The value for F is stored in *Reg0* (which generates a recalibration every time it is changed – whether needed or not). But D, the denominator, is stored in another register *Reg2,* which can be changed on its own and doesn't go through a recalibration phase every time it is reprogrammed. So *Reg2* programming has become the norm for MFSK modes using the LMX2541. The ADF4351 is unsuited to many MFSK modes as its tuning resolution is significantly coarser – which is probably just as well, as there appears to be no way of setting it without generating a recalibration each time. Fortunately, with the very latest synthesiser chips with internal VCOs going up to 8GHz or more, the manufacturers have recognised this problem and now allow a bit to be set that disables the recalibration procedure. This comes with a warning that "it should only be done if frequency changes are very small". Our change of few hundred Hz at several MHz or GHz certainly fulfils this requirement!

Reference

[1] The principles behind fractional-N frequency synthesis were described in the April 2012 Design Notes, with a follow-up in the November 2012 edition

Continued from page 58

A Activate VDSL2 notching. VDSL2 apparatus includes provision for notching to stop interference to amateur radio bands. Upstream band interference should be removed by universally notching 10.1 to 10.15MHz with guard-bands and by increasing the D1 to U1 transition guard-band by 50kHz to always protect the 3.7 to 3.8MHz emergency frequencies. Downstream should be protected by selective notching of the 3.5, 5, 7 and 14MHz amateur bands at affected premises.

B Arrange for relocation of overhead drop wires when the needed separation from amateur antennas cannot be achieved by the amateur moving his antennas.

C Implement notching in G.fast (an ultrafast broadband product that will replace VDSL2). This should be notched *from the start* to prevent spreading the RFI to 106MHz and possibly 212MHz later.

D Badly affected locations should have fibre to the premises (FTTP) installed in place of VDSL2 by Openreach; this should eliminate RFI.

Thanks to the volunteers from the EMCC who undertook these investigations.

Websearch

[1] rsgb.org/main/technical/emc/i-am-experiencing-interference

Sport Radio

This month the longest-running of all RSGB contests takes place.

The first HF contest of the month is a datamodes session of the 80m Club Championships, on the 6th. Next is the granddaddy of contests, the Commonwealth Contest being 80 this year. 24 hours of CW on the weekend of 11-12th. **Photo 1** shows most of the station components used from Grenada last year by Bob, J43G (G3PJT), including a homebrew 100W amp and Elecraft KX3. It's back to the 80m Club Championships for the rest of the month, with CW on the 25th and SSB on the 23rd.

Spring might have only just begun, but traditionally a good number of people head for the hills and operate portable in the 144/432MHz Contest on Saturday/Sunday 4/5th. On the 7th the 1-hour 2m FMAC is followed by the 2m UKAC. Two days later on the 9th, the 6m UKAC takes place. The 4m Cumulative series continues on the morning of the 12th. It will be the second of five. For the remainder of the month we're in the domain of the Activity Contests. On the 14th the 70cm FMAC is followed by the 70cm UKAC and on the 16th the 4m FMAC is followed by the 4m UKAC. The final two UKACs of the month are 23cm on the 21st and SHF on the 28th.

PHOTO 1: Bob, J43G (G3PJT) Commonwealth Contest station components.

An SSB session of the UKEICC series of 80m contests takes place on the 1st. If you take part don't forget to upload your log within an hour of the finish time. There are two major American-run SSB contests in March. The first is the ARRL International DX SSB, which runs for the full 48 hours of the weekend of 4-5th. Work US stations in the contiguous 48 States, plus Canadians. Send a signal report and your transmit power. US and Canadian stations send a signal report and a State/Province abbreviation. The UK Microwave Group (UKuG) series of Low Band contests begins on the 5th. One week later the Worked All Britain (WAB) 80m Phone Contest takes place on the evening of Sunday 12th. Exchange a signal report, serial number and your WAB area (the first, second, third and sixth digits of your station's Ordnance Survey map reference). The British Amateur Radio Teledata Group (BARTG) HF RTTY Contest runs for 48 hours, starting at 0200 on the 18th. There have been rule changes this year, so please refer to the Group's website for them. BARTG have also introduced a new championship into their contests, to find 'Diddler of the Year'. There will be two championship Tables, one for Single Operator Experts (SOE) and one for Single Operator All Bands (SOAB). See the website for details. The Russian DX Contest runs for 24 hours starting 1200 on the 18th. There are lots of entry categories, mostly for single ops. To take advantage of bands that aren't open at the same time (eg 15m and 80m), single-operator stations are permitted to make two single band entries. The second American run contest is the CQ Worldwide Worked All Prefix (WPX) SSB, which runs for the full 48 hours of the weekend of 25-26th. In this contest everyone can work everyone. Exchange a report and serial number. To round-out the month the UKEICC 80m series continues with a CW session on the 29th.

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RSGB HF Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Mon 6 Mar	80m Club Championships	2000-2130	Data	3.5	RST + SN
Sat-Sun 11-12 Mar	Commonwealth Contest *	1000-1000	CW	3.5-28	RST + SN (HQ stations also send "HQ")
Wed 15 Mar	80m Club Championships	2000-2130	CW	3.5	RST + SN
Thu 23 Mar	80m Club Championships	2000-2130	SSB	3.5	RS + SN

RSGB VHF Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Sat-Sun 4-5 Mar	144/432MHz +	1400-1400	All	144/432	RS(T) + SN + Locator
Tue 7 Mar	144MHz FMAC	1800-2000	FM	144	RS(T) + SN + Locator
Tue 7 Mar	144MHz UKAC	2000-2230	All	144	RS(T) + SN + Locator
Thu 9 Mar	50MHz UKAC	2000-2230	All	50	RS(T) + SN + Locator
Sun 12 Mar	70MHz Cumulative #2	1000-1200	All	70	RS(T) + SN + Locator
Tue 14 Mar	432MHz FMAC	1900-2000	FM	432	RS(T) + SN + Locator
Tue 14 Mar	432MHz UKAC	2000-2230	All	432	RS(T) + SN + Locator
Thu 16 Mar	70MHz FMAC	1900-2000	FM	70	RS(T) + SN + Locator
Thu 16 Mar	70MHz UKAC	2000-2230	All	70	RS(T) + SN + Locator
Tue 21 Mar	1.3GHz UKAC	2000-2230	All	1.3	RS(T) + SN + Locator
Tue 28 Mar	SHF UKAC	2000-2230 ~	All	2.3-10GHz	RS(T) + SN + Locator

Best of the Rest Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange (info)
Wed 1 Mar	UKEICC 80m	2000-2100	SSB	3.5	4-character Locator
Sat-Sun 4-5 Mar	ARRL International DX	0000-2359	SSB	1.8-28	RS + Tx power (Ws send State, VEs Province)
Sun 5 Mar	UKuG Low Band #1	1000-1600	All	1.3-3.4GHz	RS(T) + SN + Locator
Sun 12 Mar	WAB 80m Phone	1800-2200	SSB	3.5	RS + SN + WAB area
Sat-Mon 18-20 Mar	BARTG HF RTTY Contest	0200-0200	RTTY	3.5-28	RST + SN + time
Sat-Sun 18-19 Mar	Russian DX	1200-1200	CW, SSB	1.8-28	RS(T) + SN (Russians send Oblast code)
Sun 25-26 Mar	CQWW WPX SSB	0000-2359	SSB	1.8-28	RS + SN
Wed 29 Mar	UKEICC 80m	2000-2100	CW	3.5	4-character Locator

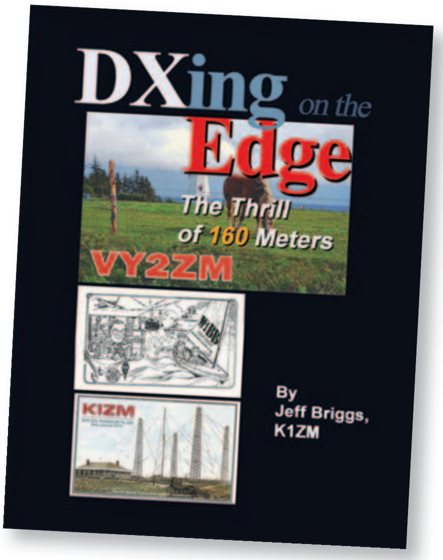
* HF Championship event. + VHF Championship event. ~ Different bands start at different times. For all the latest RSGB contest information and results, visit www.rsgbcc.org

Book Review

Top Band beckons…

DXing On The Edge

by Jeff Briggs, K1ZM



I enjoy coming up on Top Band from time to time. I've no pretensions to have a DX station, although when I've run WSPR I have been spotted in a few interesting places. However, this book showed me how 160m *should* be done – and indeed how it *has been* done since, well, forever, really. Subtitled "The Thrill of 160 Metres", this is the second edition of a well-established book that hails from America. It's worth noting that although this is an RSGB printing, the original spellings and idiom have been retained: it's 160 meters all the way.

The author, Jeff Briggs, K1ZM is well-known in DXing and particularly 160m circles. He gave a fascinating, lively and well-attended talk at the 2016 RSGB Convention that, fortunately, was videoed. RSGB Members can see this talk (and many others) at www.rsgb.org/video

The author starts with his early days listening to 160m with a three-wire rhombic at 100 feet (30m) above ground level and how he now spends his time in Cape Cod chasing 160m DX. There's a brief discussion of propagation, which observes that signal absorption is higher on 1.8MHz than on any other HF band, leading to weaker signals, how the short dusk and dawn DX openings rigidly limit operating times and deep fading (QSB) adds to the fun. Early on we are told that DXing on Top Band is not for the faint-hearted!

The book gives a personal view of the history of 160m DXing and its milestones, equipment then and now, and much more. We see some fabulous – and huge – amateur antennas: full-size loops, Beverages, phased arrays and more, plus lots of people, shack and QTH photos. Many of the locations are stunning, even if viewed only from the viewpoint of picturesqueness. We also learn of people like KH6CC, whose big 160m amplifier requires its own diesel-powered generator.

The curtain *seems* to fall with a fabulous photographic potpourri. However, in a remarkable embodiment of "But wait – there's more!", it's followed by what appears to be a whole extra book – 160 Meter DXing in the New Millennium – complete with its own title page, Foreword and Acknowledgements, and in colour too. This updates the original 1997 book to 2016 and comprises chapters that cover modern Tx and Rx solutions and DXing techniques for Solar Cycle 24.

Whilst many of this book's presumptions are way beyond the average British amateur's small back garden and legal limit of 32W across most of Top Band, it is a celebration of what *can* be achieved on 160m given time, determination and skill.

ISBN 9781 9101 9333 4
256 pages, 222 x 286mm
Non-Members' price: £15.99
Members' price: £13.59

RSGB journal archive 1925-1939

Many people will know that the back library of *RadCom* (and its predecessor titles, *Radio Communication*, *RSGB Bulletin*, *T&R Bulletin* and so on) stretches back a long way. In recent years annual CDs have been released that contain the previous 12 months' issues, and for earlier years (1939-2010) in multi-year sets. Now, for the first time, the earliest editions have been scanned and are available as a set. This means it's now possible to own a complete electronic archive of the RSGB monthly magazine, all the way to volume 1 issue 1 in July 1925.

The scans have been made from a complete set of original magazines and are of the highest available quality. Where possible, optical character recognition has been used, which makes the text searchable.

These early magazines offer an unique insight into the very early days of amateur radio and the Society. The formerly-missing 14 years of archive material provides a wealth of information and is a fascinating read; it's amazing how some themes that were being explored even back in the 1920s still have resonance today. For anyone with even the remotest interest in how amateur radio 'grew up', this archive is an absolute must-have.

Published on DVD
ISBN: 9781 9101 9334 1
Non-Members' price: £19.99
Members' price: £16.99

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The Six Gs expedition to the Chatham Islands – ZL7G

Despite the knowledge that HF conditions into Europe could be unkind to us from the Pacific at this stage of the solar cycle, Chatham Island was chosen for our 2016 DXpedition. It was mitigated by the knowledge that, in many parts of the world, Chatham was most in demand on the LF bands, which should benefit from the lower solar activity.

Sunrise behind the 30m vertical. Photo: G4JKS.

The team and the 460kg of baggage. L to R: Don, G3XTT, Mike, G3WPH, Chris, G3SVL, Don, G3BJ, Nigel, G3TXF, Hilary, G4JKS, Justin, G4TSH. Photo: G4JKS.

Just imagine. Take a flight to the end of the earth – Auckland is just about as far as you can fly from London. Then take a 60 year-old turbo-prop aircraft on its weekly flight from Auckland over the South Pacific to a sparsely populated volcanic island. Then drive about 25 miles over dirt roads through deserted moorland country to a small headland at the extreme North-East of the island and find a very comfortable house – heated, air conditioned, with good power and an outstanding view over the ocean. That is the 'Ultimate Hideaway': our destination for the ZL7G DXpedition.

Preparation followed the usual steps of identifying a possible site on Chatham and qualifying it through numerous emails to the owner. Logistics involved updating our earlier spreadsheet model to accommodate the choice of antennas and the additional amplifiers – see below. Licensing in New Zealand is easy, and this presented no issues. The remaining challenge was to book long haul flights with enough baggage allowance to avoid some of the draconian excess baggage costs that particularly the Asian airlines impose.

We're on our way

The team members made their way to Auckland by various flight routings and enjoyed the hospitality of the excellent airport hotel whilst preparing for the flight to Chatham. We also visited Waiheke Island by boat from Auckland harbour for a relaxing day 'at ease' and then by the Thursday morning were checking in for the two-hour Air Chathams Convair 580 flight to Chatham. Arriving in the late afternoon, we were at first struck by the sparseness of vegetation and the apparent desolate nature of the island. But first impressions are misleading, as we were to find.

A forty minute drive over the dirt road to the Ultimate Hideaway had us unpacking everything an hour or so before darkness. We were very pleasantly impressed by the facilities at our accommodation – four twin bedrooms, two bathrooms, a huge lounge/diner/kitchen and a laundry. However, the antenna field was not quite as we expected and it was clear that we would need to be creative to position our antennas so that they had clear take-offs. The dip in the land above the house was somewhat more pronounced than expected, and the distance to the top of the hill rather further than planned, which would challenge the capabilities of the 950m of coaxial cable we had brought.

The antenna strategy

We had decided on elevated ground planes, as the direction of arrival of European signals at Chatham varies so much through the day.

A word about this choice. All our antennas needed to be 'hand-carryable' and also take into account the challenges of working Europe from ZL7. To get Yagis high enough to beat an elevated ground plane would require steel masts that could not be hand-carried; using a Spiderpole or similar, to carry a full size Yagi would be impractical/fragile at best.

A significant factor is the nature of propagation/takeoff from ZL7. High inverted-vees that we had used at the elevated E6GG site would be fine in the broadside direction; but one of the challenges of ZL7 is that azimuth to Europe is almost all around 360°, and we wanted to focus our effort on the UK and EU; a high inverted-vee is lossy in endfire directions so would miss large parts of our target audience. Inverted-vees are simply not suitable (too directional) for working Europe from ZL7. Similar reasoning applies to Yagis – which way should we point them? And hand carrying rotators or running out to 'armstrong' the antenna direction every QSO was not going to happen.

So with valuable help from David, G3WGN, we selected antennas with the aid of an Excel spreadsheet. To compare alternative setups, we looked at the signal-to-noise ratio for the ZL7 to G circuit as predicted by VOACAP (which includes the contribution from takeoff angle), then summed the coax loss and antenna gain (or loss) to provide an overall system gain. The spreadsheet allowed selection of antenna type (and also coax type so we could optimise loss versus weight) and review of the associated system gain. This gave some valuable insights into antenna options. Given the above constraints, the choice of elevated ground planes was probably optimum. An array of high Yagis pointed around 360° of azimuth may have been better, but that kind of freight requirement is not what the 6Gs do!

At the end of day one of antenna work, we had all the HF antennas erected, with just the 160 and 80 antennas to complete. The cabling arrangements meant that we generally only needed to take the trip up the hill to change connections once after dawn and again just before dusk.

G3BJ (left) and G3WPH at work. Photo: G4JKS.


G3SVL (right) on RTTY and G3TXF on 30m. Photo: G4JKS.

Getting going

Propagation was clearly going to be a challenge. The expedition started with a K index of 7, meaning that HF propagation was dire for the first week and the focus clearly needed to be 30m and down. The team put some 2,000 QSOs in the log on the first night, but also took time to sleep so that work could take place on the LF antennas the following day. Day 2 saw the LF antennas erected, together with their radial fields and an SAL-30 receive antenna. There was therefore eagerness to see how the LF antennas performed into Europe. It took very little time to discover that the 80m antenna was a winner, delivering a good signal into Europe and also hearing very well. The first night on LF was not good for 160m and we were a little concerned that we may again have a challenge with that band. But the second night set our minds at rest, with good numbers of Europeans, including G stations, making it into the log. Our key European openings on 160m were, of course, around the grey lines – our evening for Western Europe, and our morning for Eastern Europe. Other than these times, 80 and 160 were open to the US and Japan, providing some volume of QSOs outside greyline hours.

The stations comprised Elecraft K3 and K3S transceivers with KPA500 amplifiers together with a pair of Juma PA1000 1kW lightweight linears, which we reserved for the stations using 160m and 80m. Dunestar bandpass filters ensured we had no interstation problems. Logging was by networked Win-Test and for RTTY MMVARI with N1MM+. We positioned the four stations around a large dining table, allowing eye contact between operators, with the 'lounge' area of the room available for relaxing when not operating. This made for a very sociable environment.

A risk on any DXpedition where a site survey is not possible is noise. We were lucky – the Ultimate Hideaway was totally silent – that is once some arc welding was completed locally! It did not affect us, and we enjoyed the capability to hear right down to natural band noise.

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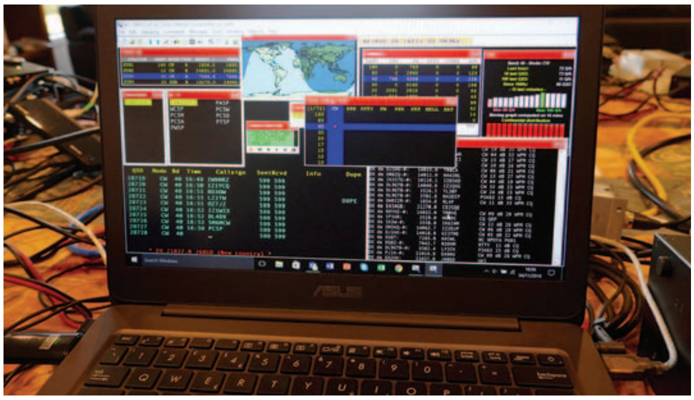
The ZL7G antennas. Photo: G4JKS.



The logging screen at ZL7G. Photo: G4JKS.

The only drawback to the Ultimate Hideaway was its remoteness. Ideal for radio, it was a self-catering location, with the round trip to the shops being over 70 miles and three hours over the dirt roads. We had the use of an MPV, which did sterling service on the various shopping trips for provisions and tourism. Self-catering presented its challenges, but Hilary, G4JKS, stepped into the role of head caterer, making the best of the limited supplies available on the island. Our host ran a fishing business and was able to provide outstanding blue cod for some meals.

The QSO count slowly climbed, but it was not until the K index dropped to more normal levels in our second week that the rate picked up on the HF bands. In the limited days available to us with good HF conditions, we probed the openings and tried to focus on HF activity. Perhaps conveniently the static levels on LF rose later in our expedition and we did not persevere with 160m outside grey line on some days to allow the station to move to 17m.

Even after the improvement in HF conditions we found, as predicted, that there was little to work during the day. Mornings were very quiet, and gave time for socialising and relaxing. Later in the afternoon, the bands started to pick up, and we progressively opened up the stations as propagation allowed. By grey line time, everything would be humming, through to dawn.

Chatham Island

Chatham is enormous. Driving the 36 miles from our QTH to the 'town', there were vistas of ranges of hills in the distance. The centre of the island is a huge lagoon ten miles across, inhabited by some 100,000 black swans. With its population of 600, the island has to be very self-reliant. As we arrived at the airport, the tourist coach had a puncture, so our host set to and helped replace the tyre, as did many others at the airport. The island is highly dependant on the air link to Auckland and the cargo boat that regularly brings in non-perishable supplies. Tourist beds are limited – there is a small hotel in Waitangi town with a restaurant and there are a few homestays. There are two shops on the whole island – within 200 metres of each other in the town. The population is centred in Waitangi, with a small medical facility, bank, café and workshops. Finding a suitable location for amateur radio is a challenge and a beach-side location is virtually impossible unless camping is on the cards.

In terms of terrain, the north of the island is generally flat moorland. With the West coast offering some great beaches with rolling surf. South of Waitangi, the countryside is hillier, with more trees and looks a lot like parts of North Yorkshire.

The weather is similar to the North of Scotland, with a lot of rain, some outstandingly clear sunny days and in the winter, even snow. The general absence of trees in the north is witness to the winds that blow across the island. Little of the island is cultivated and much is given over to sheep and cattle. The roads are generally dirt tracks, with just a paved section around Waitangi. Construction of a new runway is hoped for, as the Convair 580 will come out of service in three years, and the current airport cannot take heavier aircraft. Currently the wharf is being improved for shipping and attention will switch to the runway when that work is completed.

The people we met on the island were universally friendly and welcoming. It is a village community and it was relatively easy to find out what was happening on the island simply by going to the café! There is an FM radio transmitter relaying one of the New Zealand radio channels and internet and television are by satellite.

Our location was beautiful. From our lounge and shack we had a clear ocean view to the north, looking down on the bay at Kaingaroa. It was the sort of view to watch all day – ever changing, but yet constant. We had some extremes of weather - an early storm had our verticals in some interesting shapes yet a day or so later, we were sitting in hot sunshine and still air. It was a climate that felt strangely familiar and comfortable.

On the bands

Our equipment plans envisaged three operational stations and one spare. In view of the conditions, the team of six operators did their best to keep all four stations operational from before dusk to after dawn, when propagation was best to Europe. At other times, it was often hard to find two bands open and so the daytimes were more for sleeping, tourism and socialising. There were few HF openings to Europe where signals could be said to be 'strong' and a large proportion of the time, we found ourselves listening close to the noise level. We were pleasantly surprised that pile-up control was relatively easy, even with the quite weak signals on some bands. We asked Japan and US to stand by for long periods overnight, and the results of this show in the continental mix below.

Man-made noise levels were delightfully low with the only challenge being evenings of high static. We assessed the SAL-30 shared apex loop antenna, and came to the conclusion that any receive antenna using active devices must have band pass filtering prior to those devices to be able to operate in a multi-transmitter environment. The ZL7G location did not really allow its true potential to be realised. We were, however, hearing quite well on our main antennas and even 160m was quite manageable using the main transmitting antenna. LF static varied from light to extreme, with the latter making QSOs all but impossible.

The team shared the bands: Nigel focussed on 30m and 12m (CW, of course), Chris on 160 and RTTY, Mike on LF and RTTY, Justin and the two Dons across all bands/modes. The team celebrated each 160m QSO with the UK, with the one with Neil, G0JHC being particularly memorable.

Although not the first G in the log (that credit goes to G3XHZ), Neil had been very anxious to work us, and on the second night on 160m, it was his signal that we heard first. Chris, G3SVL and Mike, G3WPH were 'double manning' the 160m station to add a second pair of ears and a shout went up 'it's JHC'. A cheer all round and the other operators then returned to their bands.

RTTY was an interesting experience. Demand was considerable and we debated where best to offer RTTY. At E6GG and TX6G we had focused on 15m, which allowed global coverage on a single band. As RTTY awards are not band specific, all that is achieved by operating RTTY on several bands is a lot of mode dupes. But at ZL7G, 15m would not offer global coverage, given the conditions. So we decided to try to clear most of the 'local' demand (W and JA) on 15m, and then to switch the 30m CW station to RTTY for the last few days, and focus it on Europe. This worked well. MMVARI in multi-channel mode managed to make sense of a waterfall that was crammed with signals, but again callers hopped around between calls, and did not allow the full capability of multi-channel to be realised. It is a pity that WinTest does not integrate with MMVARI, as this meant that we again had to have a separate log for our RTTY QSOs.

On this DXpedition we had, for the first time, 24/7 internet access. This has several advantages. We could test the propagation through calling CQ and watching the RBN returns. We could also keep an eye on the cluster to see whether we were reported as being QRM'd (thankfully not too often) and for the first couple of nights on 160 we used the excellent ON4KST low band chat room to find out how our antenna was working. The internet access also allowed frequent log uploads to LOTW and Club Log.

TABLE 1: Breakdown by continent.

Continent	Total QSOs	%
Africa	133	0.3
Asia	13994	32.8
Europe	16418	38.4
North America	10396	24.3
Oceania	1267	3.0
South America	520	1.2
Totals	**42728**	**100.0**

Our results

Here is a summary of our efforts. 42,728 QSOs gross of which 38.4% were with Europe. We were seriously impeded on HF by the very poor conditions, and without the high K index, we should have been well ahead of 50k QSOs. **Tables 1 to 3** show the breakdown by Continent, Band/Mode and Band.

The Elecraft equipment performed flawlessly 24/7. Our Juma amplifiers delivered the requisite 1kW (our licence power limit) but made their presence known with their fan noise. It is a truism that you can't have a lightweight high power solid state PA without pumping serious quantities of air. We experimented with an Elecraft KX3 and were very impressed with the receiver's ability under the conditions we had on Chatham. The combination of a KX3 and a Juma potentially makes a very powerful and lightweight DXpedition package. 6.2kg for a 1kW station is impressive!

The choice of elevated ground plane antennas with two radials each proved to be a winner – directional antennas are not appropriate for Chatham and we were pleased with the performance of these antennas. Mike, G3WPH had done an outstanding job on antenna preparation and the pre-cut kits all delivered antennas with SWRs of 1.1:1! The challenge, as ever, with a DXpedition is the coax overhead. We took some 950m of low-loss coax, with the associated weight penalty. But we were pleased we took it all as, despite careful measurement from satellite photographs, we had j-u-s-t enough.

TABLE 2: Band/Mode breakdown.

Band	CW	PH	RTTY	Total	Total %
160	928	0	0	928	2.2%
80	3263	0	0	3263	7.6%
40	6752	952	0	7704	18.0%
30	6349	0	1554	7903	18.5%
20	5430	2627	0	8057	18.9%
17	3927	709	0	4636	10.9%
15	3651	1256	1489	6396	15.0%
12	2257	361	0	2618	6.1%
10	1078	145	0	1223	2.9%
Totals	33635	6050	3043	**42728**	

Close-down and return

It is always the case that the tear-down and repacking after a DXpedition takes less time than anticipated. But given the fact that HF conditions did not yield significant QSO numbers during daylight hours, we elected to make a start on the tear-down shortly after breakfast on our last full day. By late-afternoon we were sitting in our lounge admiring the view with everything packed up. At 5pm we adjourned to the village 'club' to have our final beers followed by a fish dinner back at the house and the following morning, we checked in for the 09.30 flight to Auckland. Given the quaint time zone of Chatham (45 minutes ahead of Auckland) we were at our Auckland airport hotel just after mid-day. A pleasant relaxing evening and the team then caught their long-haul flights for the full day journey back to the winter of the northern hemisphere, tired but content that we had done the best possible with the conditions we had been presented with.

TABLE 3: Continent by band.

Band	160	80	40	30	20	17	15	12	10	Total	Total %
AF	0	10	14	19	42	21	19	5	3	133	0.3%
AN	0	0	0	0	0	0	0	0	0	0	0.0%
AS	322	896	1979	1817	2164	1916	3060	1182	658	13994	32.8%
EU	257	1291	3641	4101	4600	1598	920	10	0	16418	38.4%
NA	300	944	1736	1757	838	875	2030	1379	537	10396	24.3%
OC	46	105	249	143	305	134	230	30	25	1267	3.0%
SA	3	17	85	66	108	92	137	12	0	520	1.2%
Totals	928	3263	7704	7903	8057	4636	6396	2618	1223	**42728**	

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Homebrew

We continue our look at home-made instruments with RF power measurement and directional power meters.

In the previous Homebrew, we looked at some simple methods for measuring RF power. It is relatively easy to make accurate measurements at modest power levels. Things may be a bit more difficult when extreme values are involved. Extreme (low or high) values of power, frequency or bandwidth all present particular challenges for the home constructor.

A typical RF power or SWR meter will use a simple diode rectifier as the RF detector. This arrangement works very well at RF levels from a few volts to a few tens of volts. Modern diodes have almost ideal characteristics for use at medium voltage levels, including fast switching (usually measured in nanoseconds), very low junction capacitance (around 1-4pF), low forward resistance and very low reverse leakage.

RF power measured at a dummy load is V^2/R, where V is the RMS voltage and R is the load resistance (usually 50Ω). As we are using a peak rather than RMS detector, this can be simplified to $V^2/(2*R)$, where V is the peak voltage. For example: $100V = 100^2/2R = 10000/100 = 100W$. Given that power is proportional to the square of the measured voltage, 200V = 400W, 300V = 900W and so on.

All semiconductor diodes have a specified maximum value for reverse voltage. For miniature RF and switching diodes, the maximum peak inverse voltage ranges from around 30V (BAT43) to 100V (1N4148). The most commonly used configuration for an RF peak voltage detector is a simple half-wave rectifier, consisting of a single diode and a capacitor. The capacitor will be charged to its peak value on positive half-cycles of the applied RF. On negative excursions of the RF sine-wave, PIV across the diode will be twice the RF peak voltage. To allow a reasonable safety margin, best practice is to use a diode with a PIV at least four times the maximum peak RF voltage.

Measuring high power

Power output from a typical amateur transmitter will typically range from a few watts to a few hundred watts. When taking direct RF voltage measurements at these power levels, the detector may see several hundred volts of RF. In the likely event that a 'special' high voltage RF diode is unobtainable, it may be possible to use a string of several standard diodes wired in series. I have used a string of four or five 1N4148 switching diodes to measure HF/VHF power in the 100W region. If you adapt this approach, remember that the combined forward voltage drop of the diodes will tend to limit accuracy, particularly when measuring at lower power levels.

The simple 50Ω resistive load and peak voltage detector is a very attractive option because it can offer consistent performance over a very wide bandwidth. For high power measurement, the alternative approach is to use some form of attenuator or coupler between the RF source and the detector. Resistive attenuators are generally well behaved over a very wide bandwidth. Couplers based on inductive or capacitive elements will tend to place limits on the bandwidth and accuracy of your measurement system.

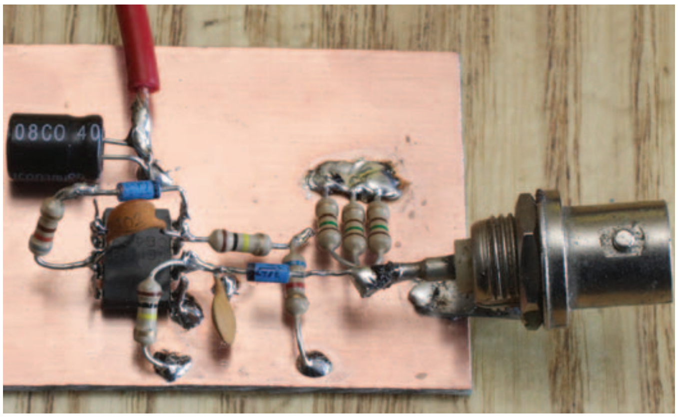

PHOTO 1: Assembled correction amplifier.

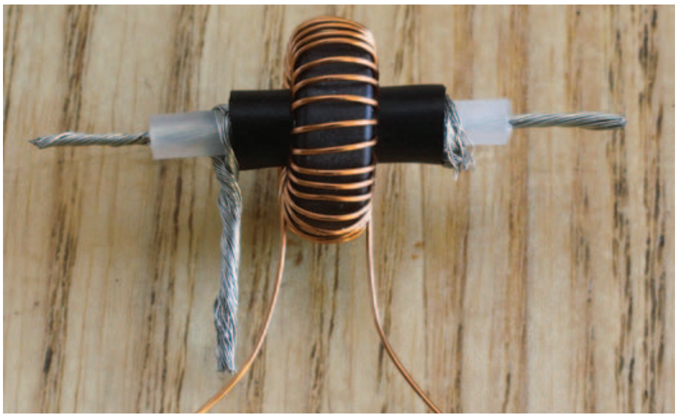

PHOTO 2: Practical configuration of a non-directional coupler.

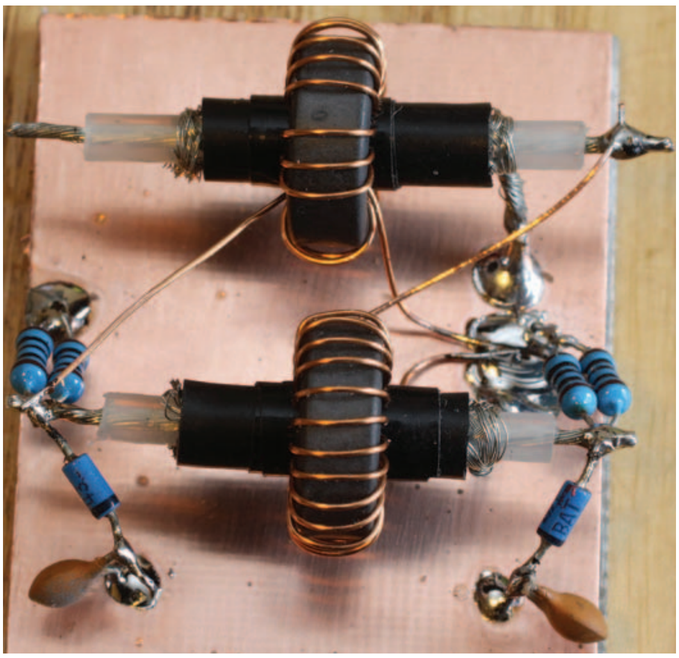

PHOTO 3: HF Tandem Match coupler.

Measuring low power

When measuring power at very low levels, it is important to consider the effects of non-linearity in the detector. A silicon diode has a forward voltage drop of about 600mV, while Schottky and germanium types drop about 200-300mV. While we may tend to consider diodes to be a perfect one-way valve that conducts in one direction and insulates in the other, real-world devices will tend to show non-ideal performance, particularly at lower power levels. Diode voltage drop will tend to be proportional to diode current. The higher the current passing through the diode, the higher the forward voltage (although theforward voltage doesn't start at zero). As a general rule, it is desirable that the detector output load should have a high resistance. Many designs use an opamp input as the detector output load. We started looking at that approach last time.

One way of improving the low power performance of a diode detector is to place an amplifier between the power source and the detector. The amplifier will increase the RF voltage to a level where the detector diode shows good linearity. Adding an amplifier will increase the complexity of the circuit, introduce the need for a DC power supply and may impose new limits on the bandwidth and dynamic range of your instrument.

As also mentioned in February, it is also possible to apply correction for the forward voltage drop of the detector diode. **Figure 1** shows a correction circuit based on an opamp and a reference diode. The 1N5711 Schottky detector and reference diodes are a matched pair. I used the diode test function of my digital multimeter to select a pair from the same batch. The devices were matched for identical V_F.

This type of amplifier would normally require a split positive/negative power supply. I was able to avoid this requirement by selecting an opamp with an output range that extends down to the negative supply rail. In practice, I have found the output will swing down to 10mV, which is close enough to zero for most practical purposes. The circuit was built dead-bug style on a strip of PCB. The assembled unit is shown in **Photo 1**. The 50Ω input resistor is made from three 150Ω metal-film resistors connected in parallel. I used a signal generator and voltmeter to establish the ideal value for the resistor that sets the reference diode current. For the initial testing, I used a 220k pot. The final circuit uses a fixed resistance of 106.8k, made from 100k in series with 6.8k. This value results in very accurate tracking between peak RF input and DC output. The DC supply for the tests was 13.8V. If required, it should be possible to use a different supply voltage, provided you don't exceed the 36V maximum rating of the device.

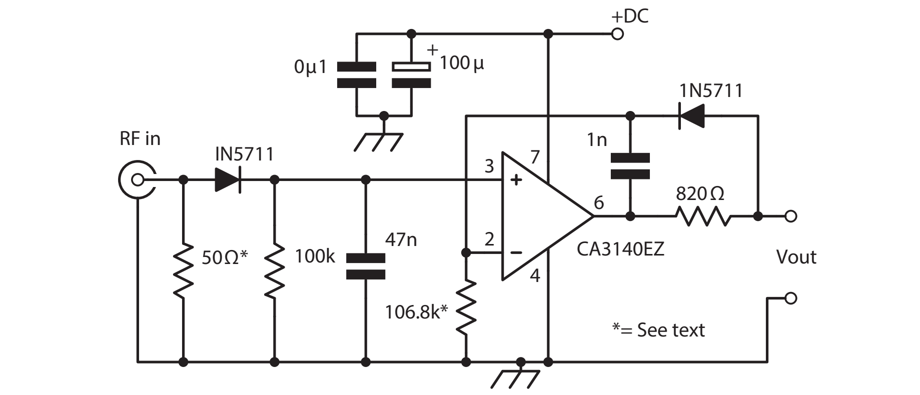

FIGURE 1: Correction circuit based on an opamp and reference diode.

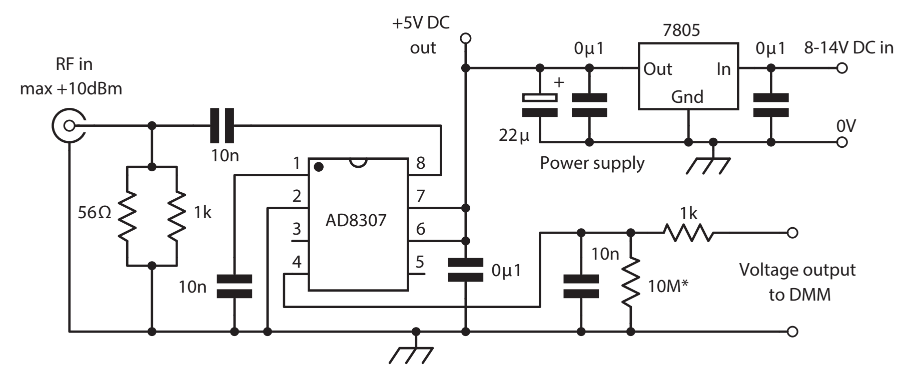

FIGURE 2: RF detector based on the AD8307.

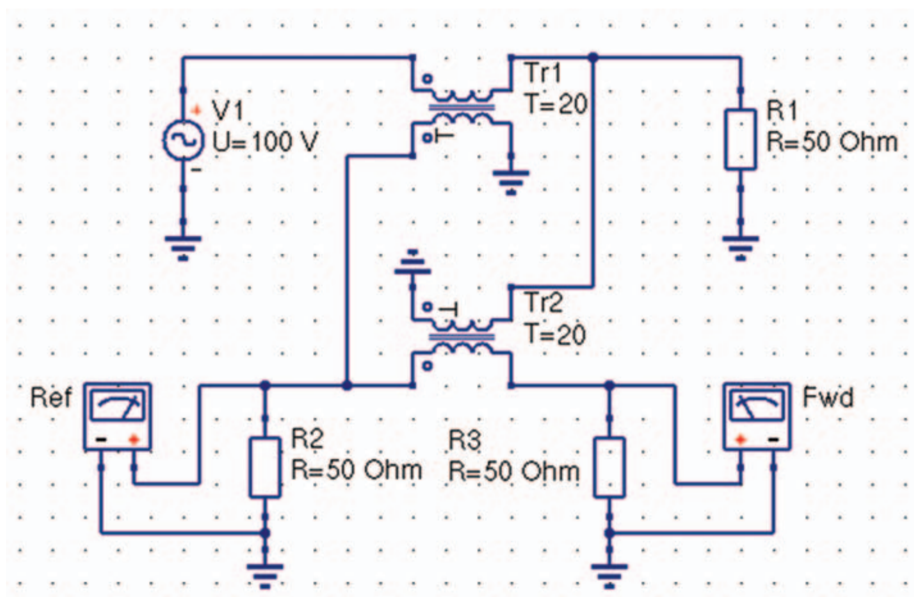

FIGURE 3: computer simulation of a directional coupler based on a pair of -26dB couplers.

Eamon Skelton, EI9GQ
hbradio@eircom.net

PHOTO 4: High voltage 3pF capacitors made from about 3cm of RG58 cable (see text).

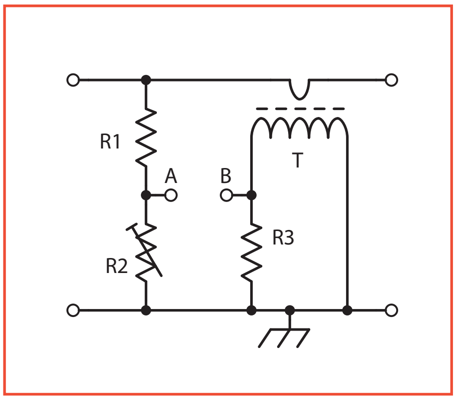

FIGURE 4: Basic operation of the Bruene coupler.

Log amplifier as an RF detector

Another form of RF detector is based on a logarithmic amplifier. One of the most popular devices for this application is the AD8307. This is a log amplifier with output voltage of 25mV per decibel (1V/40dB) of RF input. Bandwidth is 500MHz and dynamic range is greater than 80dB. Typical log-compliance accuracy is better than ±0.5dB from DC to more than 100MHz.

Figure 2 shows an RF detector based on the AD8307. The input circuit provides a 50Ω load. The 10MΩ resistor at the detector output serves no useful purpose, other than providing a convenient standoff insulator/anchor for the output wire. Tests using a signal generator, precision attenuator and digital voltmeter confirm the output produces a consistently accurate 1V = 40dB from LF to VHF.

RF couplers and directional couplers

In the February 2017 issue I described a coupler based on a toroidal transformer. A coupler of this type is easily assembled using a short length of RG58 (or similar) coax cable and an FT50-43 ferrite toroid. The coax centre conductor forms a single turn primary. The secondary winding in this case is 20 turns of enamelled copper wire (I used 0.375mm diameter but this is not critical). The outer conductor (braid) is left in place to act as an electrostatic shield between windings. Note that the shield must only be grounded at *one* end. The coupler is shown in **Photo 2** (you may also like to compare this to the drawing in February's Figure 7). The 1:20 turns ratio gives a coupling factor of 20log(20) = -26dB (power ratio of 400).

For proper operation as a current transformer, the coupled port (20T winding) must be terminated by a resistance.

Like all of the power measurement instruments described so far, this coupler is non-directional: it makes no distinction between forward and reflected power.

There are various types of directional coupler in common use. Some are frequency sensitive, so that they only are only accurate on a single band. For a typical amateur application, the ideal coupler will operate reliably over a wide bandwidth. This will allow accurate measurements on all HF frequencies and perhaps even into the low VHF region.

The two most commonly used types of directional coupler are known variously as the 'Tandem Match' and 'Bruene' (after Warren Bruene of Collins Radio). I have always liked the Tandem Match type of coupler because of its simplicity, symmetry, inherent balance and self-calibration. **Figure 3** shows a computer simulation of a directional coupler based on a pair of -26dB couplers as previously described. The two transformers are identical. T1 samples line current, while T2 samples line voltage. T2 is terminated at both ends by 50Ω resistors. When sampled line voltage and current are of equal phase and magnitude, the coupled output is reinforced at the Fwd port and cancelled at the Ref port. **Photo 3** shows a HF coupler based on this design. T1/T2 are 1T/20T. I used a small strip of black insulating tape over the outer insulation of the RG58, so that the FT50-43 toroids are a tight fit. The coupled ports are terminated by a parallel pair of 100Ω resistors (Maplin M100R 0.6W) to give 50Ω. I/O connections to T1 are via a pair of SO239 sockets. I used a BAT43 Schottky signal diode and a 47nF capacitor for the RF peak voltage detectors. An identical configuration is used for the detectors in our next project.

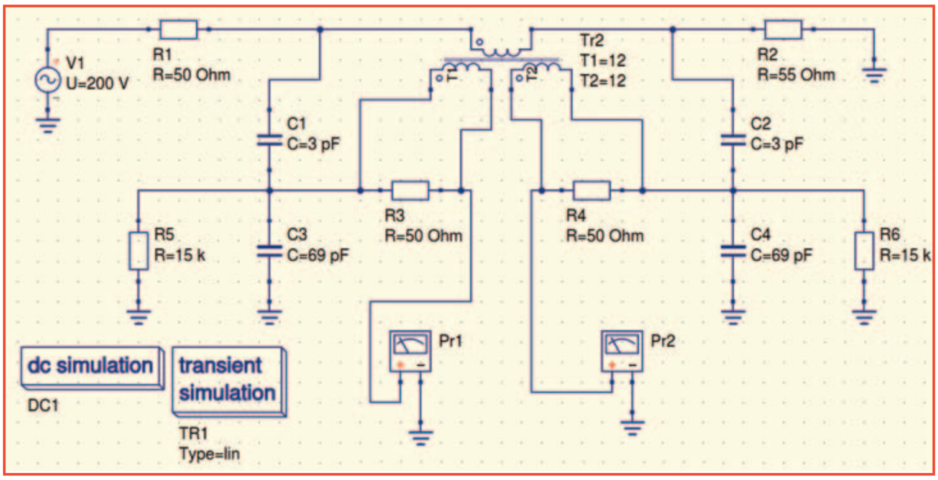

FIGURE 5: Simulation of a more advanced Bruene coupler design.

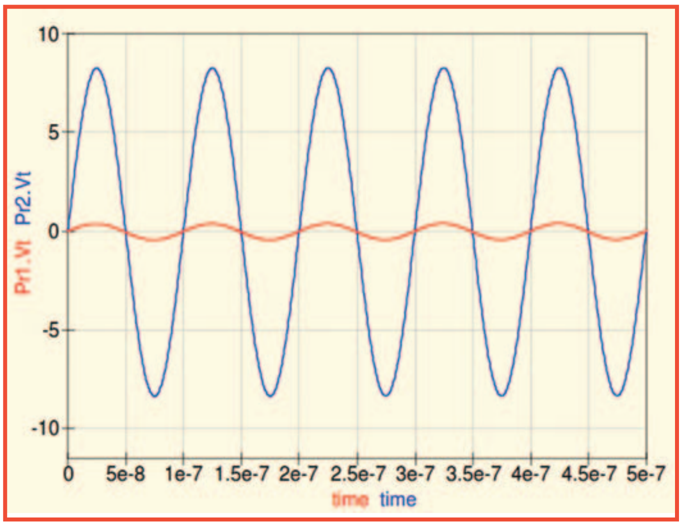

FIGURE 6: Result of simulation run on the circuit of Figure 5.

Bruene directional power/SWR meter

The basic operation of the Bruene type of coupler is shown in **Figure 4**. This circuit uses a transformer for sampling line current. Line voltage is sampled by a simple resistive divider. As with the Tandem Match version, coupled output is cancelled when line current and voltage have equal phase and magnitude. Note that this simplified example has only a single coupled output with no provision for switching between Fwd/Ref power, other than by reversing the input/output connections. The 'floating' location of the detector connections is also rather inconvenient.

Figure 5 shows a more practical configuration. This arrangement also uses a single transformer, but in this case, there are two identical output windings. The output from these is balanced against the output from an identical pair of capacitive voltage dividers. R1 represents the 50Ω signal source, R2 is the load seen at the output, in this case 55Ω (SWR=1.1:1).

Figure 6 shows a QUCS simulation of the RF voltage at the detectors. The voltage at Probe1 falls to zero when the output resistor is changed from 55 to 50Ω.

The Bruene coupler is a little more complicated than the Tandem Match and there is a need for careful adjustment to ensure the bridge is properly balanced for a 50Ω load. The practical circuit is shown in **Figure 7**. T1 is an FT50-43 toroid with RG58 coax as the primary, exactly like the previous coupler. The secondary is 12T of enamelled copper, bifilar wound on the toroid. Take two lengths of enamelled wire, twist them together so that both windings will be identical and similarly distributed on the core. Leave tails of a few cm at each end and remove the enamel insulation from the ends with a sharp knife. The 50Ω resistors are parallel pairs of 100Ω metal film.

The lower half of the voltage dividers is 69pF, made from a parallel combination of two 22pF fixed capacitors and a 40pF adjustable trimmer. The top half of the dividers calls for a 3pF capacitor with a rating of several hundred volts. Such a capacitor is not easily found in the shops but *is* readily available in the form of a short length of coax cable. Cheap generic RG58 has a capacitance that is close to 100pF per metre, a convenient 1pF/cm. I started with two lengths of just over 3cm plus a bit extra for the connecting 'tails'. This was trimmed for exactly 3pF using on my capacitance meter. As you can see from **Photo 4**, the 1pF/cm rule-of-thumb turned out to be quite accurate. The detector diodes are 1N5711 Schottky types.

This bridge can be used with a single meter for power and/or SWR, or with a pair of meters for constant monitoring of forward and reflected power. I used a single meter with switching for forward/reflected. The 200μA meter is connected in series with a 100k pot for calibration adjustment. I used the drawing software Xfig to draw suitable scales for panel meters. **Figure 8** is the standard template for my power and SWR meters. The top scale is used for reference and is not printed on the final meter scale. Before use, the bridge was adjusted 'nulled' for zero reflected power with a 50Ω dummy load connected to the output. Next, the aerial/transmitter connections were reversed, and the bridge nulled again with the switch in the Fwd position. Initial tests were done at 10-15W. The scale I'm using places the mid-point on the meter at 100W.

The SWR/power meter has been tested at up to 250W from 160m to 10m. Power readings are accurate and SWR readings have proven to be correct when checked against known mismatches. I haven't yet tested the meter at 6m due to the lack of a suitable transmitter.

Suggested reading

- The Tandem Match – An Accurate Directional Wattmeter, John Grebenkemper, *QST*, January 1987
- Radio Frequency Bridges, G3YNH, www.g3ynh.info/zdocs/bridges/index.html
- SWR and power modified Bruene bridges, F1FRV, http://f1frv.free.fr/main3h_SWR_Bridges.html

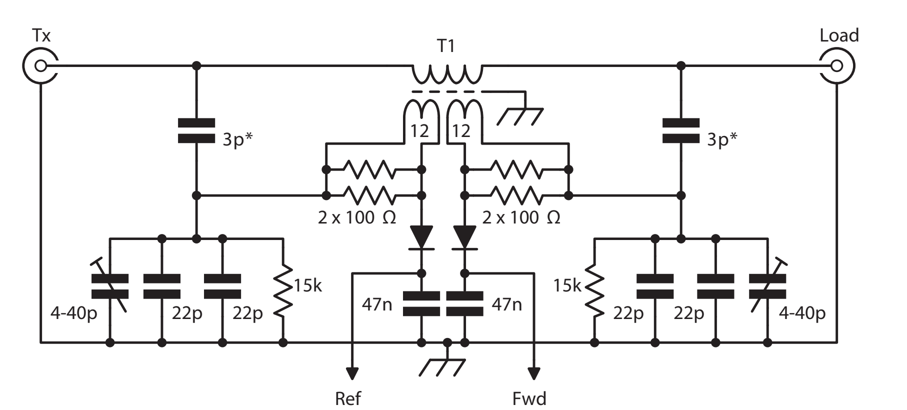

FIGURE 7: Practical circuit of a Bruene coupler.

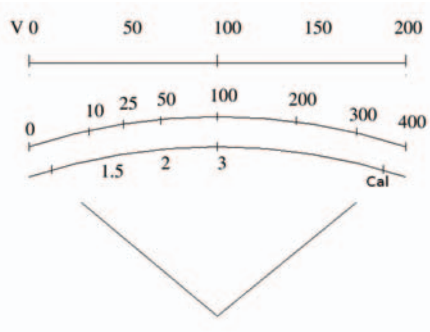

FIGURE 8: My standard Xfig template for SWR and power meter scales The horizontal line at the top is for reference only and does not get printed.

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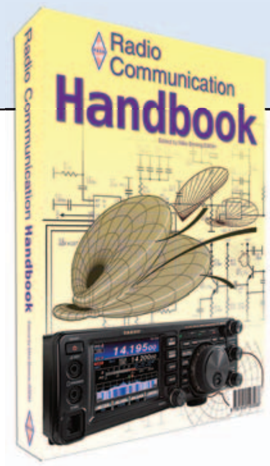

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Yaesu FT-891

HF & 50MHz Transceiver

The new Yaesu FT-891 HF transceiver.

Yaesu's latest HF transceiver is the FT-891, an ultra-compact mobile / portable design providing 100W output on the HF and 6m bands from a nominal 13.8V supply. It is similar in size and in some ways in user functionality to the long established FT-857. It does not include coverage of the VHF and UHF bands, a key appeal of the earlier radio, but it is packed with all the functions and features found on modern DSP-based transceivers and at a lower cost.

Basic functions

The FT-891 measures 155mm (w) x 52mm (h) x 218mm (d) and weighs 1.9kg. The receiver tunes from 30kHz to 56MHz, with the transmitter enabled on the amateur bands. The usual Yaesu arrangement for somewhat limited channelised transmit operation on 60m (5MHz) is included on UK and US supplied models as part of the memory bank. However, full coverage of the band can be achieved by a simple dealer modification to enable general coverage transmit operation.

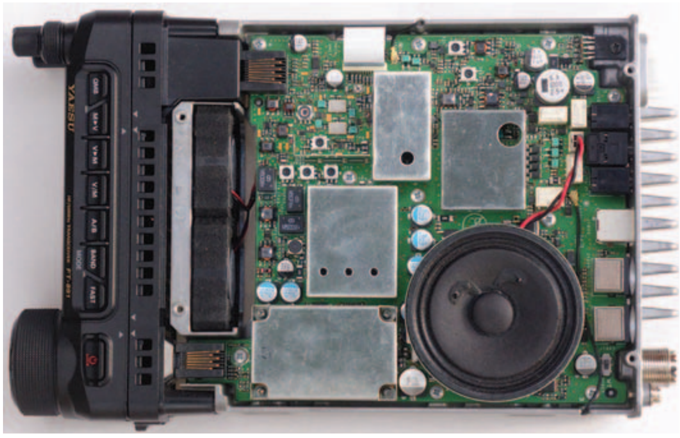
All the usual modes are provided with alternative sideband configurations set via the menu system. As usual, RTTY mode uses digital FSK data whereas DATA mode is more general and uses audio tones input on SSB or AFSK data.

There is no internal ATU provided but the FC-50 external automatic ATU is available and has been designed specifically for the FT-891. It matches in style, is similar in size and can be mounted directly under the radio for matching antennas up to 3:1 VSWR. The radio is also fully compatible with the FC-40 remote end-fed wire tuner and the ATAS-120A auto-tuned mobile antenna system.

Two manuals cover the operation of the radio. A 60-page operating manual covers the basics and a 113-page advanced manual covers the

FT-891 body and detachable front panel.

FT-891 Under the bottom cover showing power amplifier and filters.



FT-891 Under the top cover showing signal processing board.

rest. Both are available from the Yaesu website together with a CAT reference manual, firmware upgrades and USB driver software. The basic manual is also provided on paper with the radio. Although the manuals are fairly comprehensive, I found the split between them rather disorganised, some information not well covered and there are currently some errors. Hopefully these errors will be corrected soon.

Front panel

The small size of the radio rather limits the number of accessible controls and as a consequence selection of most of the functions and features is via the function screens or in menu mode. The main tuning drive is a good size at 40mm diameter with a finger indent and is smooth in operation. Two further rotary controls provide control of the AF/RF gain and a multi-function selector (MULTI). The monochrome LCD display occupying much of the panel area is clear and bright with a good viewing angle and excellent resolution. It is not a touch-screen display. Along the top of the display are the essential buttons that allow setting of the bands, modes, VFOs and memories. Along the bottom of the display are five buttons, four of which access the various functions and menu settings. The buttons are all very clear and well illuminated. By default there are three function screens accessed by toggling the F key for setting the normal functions used on SSB and CW, receive and transmit. Each screen displays up to 12 functions to be selected and adjusted as needed. A further three screens can be enabled if required to select functions related to FM operation, voice recorder and ATAS antenna setup. Three of the buttons, labelled A, B and C can be set to access any function rapidly by a single key press. In addition to the function screens the menu mode provides extensive customisation of the operating parameters of the radio. Accessed by a long push of the F key, the current firmware version allows 159 separate items to be adjusted and set.

The front panel of the FT-891 may be unclipped and mounted remotely from the main body of the radio. This enables mobile operation where space is very limited or removal when unattended to deter theft. A cable separation kit is available as an accessory. The microphone plugs into a recess in the main body of the radio, having first removed the front panel for access. Both the microphone and the separation cable use RJ connectors and the radio is provided with the traditional MH-31 hand microphone.

Rear panel

Apart from the 3.5mm headphone socket on the side of the front panel, all other connectors route to the rear. The headphone socket can also be switched to provide an external speaker output in addition to the jack for this purpose on the rear panel. There is a single antenna socket and there are two mini-DIN multiway connectors. One is for connecting an external linear amplifier or an ATU and provides coded band data. The other is for interfacing FSK and audio AFSK lines for RTTY and data mode connections. The pin numbering given for the DIN connectors in the manual current at the time of this review is misleading. The correct pinning following the DIN standard is given in the FT-991 manual, which uses an identical arrangement.

A 3.5mm jack socket is provided for the CW key and computer keying or a straight key can additionally be connected to one pin of the RTTY/DATA mini-DIN connector. A USB connection is provided for CAT control, firmware upgrading, CW keying, RTTY and PTT control but not for audio lines. A suitable USB driver is available from the Yaesu website. The optional FH-2 keypad accessory may be connected to a jack on the rear panel. This can be used as a more convenient method of transmitting pre-recorded contest messages on SSB or CW. This dual-purpose jack also provides an ALC feedback connection from an external linear amplifier, but not for both uses at the same time.

Radio design and architecture

The receiver in the FT-891 is an up-conversion triple superhet with a first IF of 69.45MHz, a second IF of 450kHz and a third IF of 24kHz feeding the DSP unit where all signal processing and filtering functions are performed. On FM, a conventional demodulator is used at the 450kHz IF. The front end uses a switchable 12dB gain preamplifier and / or a 12dB attenuator. Two roofing filters are fitted at the first IF; a 15kHz bandwidth unit on AM and FM modes and a 3kHz bandwidth unit on all other modes. Manual selection is not provided. The DSP is a 32-bit high speed floating point (3000 MIPS) device common to the FT-991 and all the recent FTDX Yaesu models. A 0.5ppm TCXO reference oscillator is fitted to ensure high stability.

The radio is constructed on two main circuit boards mounted either side of the usual diecast frame and integral heatsink. A third board in the front panel unit provides digital control. Two internal fans operate when the temperature rises, the speed increasing with temperature but even at higher speeds they are still very quiet. A contest fan mode can be enabled to provide more aggressive cooling. A 65mm speaker fits in the case top.

Features and functions

The FT-891 may be a small radio but it includes the complete set of HF functions provided in other recent Yaesu radios such as the FT-991 and FTDX series. The main tuning knob has 200 steps per revolution so with 10Hz step sizes this results in 2kHz per knob revolution, a rather slow rate on SSB. 2Hz and 5Hz steps are also selectable, with higher rates on AM and FM. A fast button increases these by a factor of 10 and faster tuning in a variety of larger step sizes is provided using the MULTI control. It is also possible to enter frequencies directly using the FH-2 keypad accessory. Twin VFOs (A/B) allowing split frequency operation, quick-split, receive and transmit clarifier, pitch control and auto-tuning on CW are all included.

Peter Hart, G3SJX
peter@g3sjx.freeserve.co.uk

The FT-891 transceiver and FC-50 ATU.

There are a total of 99 regular memories allowing tag names up to 12 characters in length and five quick memory bank stores. The usual band and memory scanning functions are also provided.

Two mode-specific settings for the IF channel bandwidth, wide or narrow, can be selected. These are settable over wide limits for SSB, CW and data modes but are fixed for AM and FM modes. The passband can be adjusted using width and shift and Yaesu's contour control function is included. An adjustable noise blanker, a tuneable IF notch, an auto-tuning multiple beat notch and a digital noise reduction system are all provided to assist in combating noise and interference. The receiver audio response can be tailored independently for each mode with the high pass and low pass roll offs adjusted separately and a CW audio peak filter is provided. Three AGC speeds and OFF may be selected for each mode, except on FM.

Transmit functions for SSB include the usual speech compressor, VOX, metering of various parameters and a transmission monitor. The power output levels can be set separately for HF and 50MHz down to 5W output and also separately for SSB, CW/DATA and AM. The overall audio bandwidth may be tailored and a three-band parametric mic equaliser allows wide adjustment of the audio characteristic. Separate settings for speech processor on and off are also provided. On CW there is the usual provision for full and semi break-in and the drop back delay is adjustable but only via the menu. A full contest keyer with message stores is included for CW and voice memory stores on SSB/AM. The message stores are best accessed using the FH-2 keypad accessory.

On FM, a full range of selective calling and repeater access facilities are provided including CTCSS tone squelch and DCS digitally coded squelch. Repeater duplex offsets are stored separately for the 28MHz and 50MHz bands.

A simple scope function provides a spectrum display of the band either side of the receive frequency with a range of selected scan widths. The scope can be set to scan once for each press of the sweep key, continuously, or every few seconds and the receiver is muted during the scan.

Measurements

The full set of measurements is given in the table. Sensitivity remains high across the whole HF range. Below 1.7MHz it reduces by 13dB and then rapidly drops below 500kHz until it is down by 50dB at 100kHz. The S-meter indicates about 2.5 to 3dB per S-unit and maintains good linearity across the whole range except on FM where it is somewhat cramped above S9. The rejection of IFs and images was around 100dB except for the second mixer image at +900kHz, which was around 70dB. The AGC attack time was fast and clean with no hole in the response unlike most DSP-based systems. The decay times were somewhat dependant on level and somewhat shorter than the set times but there is a vast range to choose from (20ms – 4s).

The front-end third order intercept and dynamic range figures are very reasonable for a radio of this type and price bracket, a little worse than the FT-991 but a noticeable improvement over the older FT-857. However, the dynamic range deteriorates substantially at close in spacings. Inband linearity was generally good and the audio looked clean. Reciprocal mixing phase noise figures are rather poor for a modern radio and similar to the FT-991 with significant variation across the bands, 28MHz being the worst. This means that the IF filter skirts tend to be masked by noise below –60dB. Front end blocking appeared to be good but measurements were limited by reciprocal mixing noise.

The transmit power output was well up to specification and the metered power level reasonably accurate. On SSB, intermodulation products were rather poor, as they were with the FT-991, although the higher order (wide band) products were reasonable. The ALC circuitry seemed to be setting the power level on the high side and reducing power to a set level of 80W made a significant improvement. The speech compressor worsened distortion products slightly. On AM, the maximum modulation depth is around 70% and appeared clean with low distortion.

The CW transmit measurements were the same as for the FT-991. The keying envelope was clean with low distortion even at high speeds and full and semi break-in gave the same results. The rise and fall times were a little sharp at both the 4ms and 2ms settings. There was no first character shortening or power overshoot at any level. In full break-in it was just possible to listen between dots at about 28 wpm. An adjustable delay to allow for linear amplifier switching is also provided.

The wideband transmitter noise output is rather poor and largely mirrors the receiver reciprocal mixing figures.

The figures in the table were measured using a supply voltage of 13.8V. The receive current consumption was about 1A and continued to function down to about 9.6V. The transmit output was down by about 10% at 12V and down to 50% at about 11V.

The radio... YAESU

Exciting New Yaesu Field Gear

HF/50 MHz 100 W All Mode Transceiver

FT-891

Actual Size

An Innovative Multi-band, Multi-mode Transceiver within an Ultra Compact Body

- Rugged construction in a Compact Mobile Package (W 155 x H 52 x D 218 mm)
- Stable 100 Watts of RF Power Output with efficient Dual Internal Fans
- Legendary Yaesu Receiver Performance
- Triple Conversion receiver with a 1st IF frequency of 69.450 MHz
- 3 kHz Roofing Filter (equipped as standard)
- Detachable Front Panel permits convenient mounting and operation
- Large Dot Matrix LCD display with Rapid Spectrum Scope
- Enhanced Operating Features:
  - Large diameter Main Tuning Dial (41 mm) with Torque adjustment
  - Pop-up Menus for quick and easy operation
  - Large Transmit /Receive indicator
  - Three Programmable Front Panel Function Keys
- Especially designed FC-50 External Antenna Tuner (Option)

YAESU The radio

YAESU UK Ltd
Unit 12 Sun Valley Business Park, Winnall Close
Winchester, Hampshire SO23 0LB

For the latest Yaesu News , visit us on the internet at www.yaesu.co.uk

On the air performance

I checked out the radio on my home station antennas and it functioned very well. Sensitivity was good on the quiet upper bands and no strong signal problems were observed on the lower bands. AM broadcast was clean but sensitivity at the lower frequencies was much less. VLF timecode transmissions were well down in the noise. The channel filters, notches, noise blanker and noise reduction system all performed very well. I can't really find fault with any of the key functions except perhaps ease of access in some cases. The audio quality and level from the internal speaker was about as good as you could expect considering the small size of the radio. I experienced a slight audio whine on the headphone output but not on the speaker or external speaker output. This has not been reported on the various web sources and I suspect it was purely only a fault on the review sample.

On transmit, the audio quality on SSB using the MH-31 microphone was good. CW break-in was clean and effective. Although the spectrum scope is only simple, it performed remarkably well and much better than those in similar previous generation radios. You can perform a scan and then tune the radio across the display identifying the various peaks or gaps. The receive frequency is shown as a cursor line on the display.

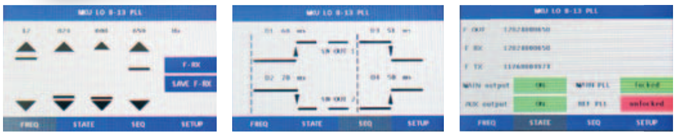
The radio is simple and straightforward to operate at the primary level with the most-often used functions. However, as with similar menu-driven radios it takes some time with the handbooks close to hand to fully appreciate all that the radio has to offer. Practice makes perfect as the saying goes. Functions that need the most access are best allocated to the ABC keys, the problem being to choose just three. These keys are not mode specific, which would help if they were, although some functions such as spectrum scope and memory storage take over these keys while they are active. Some access screens are only shown for a short period and you have to be quick to make your choice without hesitation. Band and mode selection is one such example. The function and menu access screens are very easy to read but occupy the whole of the display. Hence you cannot easily adjust the microphone gain or compression level whilst simultaneously observing the effect on the ALC or compression meter. This also makes split frequency operation awkward. However, if you allocate split and TXW to two of the ABC keys, calling in a split frequency pile-up is much easier. Some of the functions such as noise blanker, DNR, keying, breakin etc. need to be selected or deselected separately for each band.

Conclusions

The FT-891 is an effective all-round radio. It is ideal for the mobile operator or the traveller who wants a 100W radio that occupies minimal luggage space and weight. It makes an attractive radio where space is limited. It has a full set of features and functions and an excellent performance within its price range. Priced at around £600 with current deals from the usual suppliers it really is excellent value for money.

Acknowledgements

I would like to thank Yaesu UK for the loan of the radio.



Yaesu FT-891 Measured Performance

Receiver Measurements

Frequency	Sensitivity SSB 10dBs+n:n IPO	Sensitivity SSB 10dBs+n:n Preamp On	Input For S9 IPO	Input For S9 Preamp On
1.8MHz	0.4µV (-115dBm)	0.1µV (-127dBm)	80µV	20µV
3.5MHz	0.4µV (-115dBm)	0.1µV (-127dBm)	70µV	18µV
7MHz	0.4µV (-115dBm)	0.1µV (-127dBm)	80µV	20µV
10MHz	0.45µV (-114dBm)	0.11µV (-126dBm)	80µV	20µV
14MHz	0.45µV (-114dBm)	0.11µV (-126dBm)	80µV	20µV
18MHz	0.4µV (-115dBm)	0.1µV (-127dBm)	80µV	20µV
21MHz	0.4µV (-115dBm)	0.1µV (-127dBm)	80µV	20µV
24MHz	0.4µV (-115dBm)	0.1µV (-127dBm)	80µV	20µV
28MHz	0.4vV (-115dBm)	0.1µV (-127dBm)	90µV	22µV
50MHz	0.5µV (-113dBm)	0.13µV (-125dBm)	56µV	16µV

AM sensitivity (28MHz) Preamp on: 0.7µV for 10dBs+n:n at 30% mod depth
FM sensitivity (28MHz): 0.14µV for 12dB SINAD 3kHz pk deviation
AGC threshold Preamp on: 1.3µV
100dB above AGC threshold for <1dB audio output increase
AGC attack time: approx 2ms
AGC decay time: see text
Max audio at 1% distortion: 2.7W into 4 ohms, 1.7W into 8 ohms
Inband intermodulation products: -30dB to –50dB

S-Reading (7MHz)	Input Level USB IPO	Input Level USB Preamp On
S1	5.6µV	1.4µV
S3	10µV	2.5µV
S5	19µV	4.7µV
S7	40µV	10µV
S9	80µV	20µV
S9+20	800µV	200µV
S9+40	5.6mV	1.4mV
S9+60	22mV	5.6mV

Bandwidth Set To	IF Bandwidth -6dB	-50dB	-60dB
FM 16kHz	14043Hz	20278Hz	20973Hz
FM 9kHz	13530Hz	20318Hz	20883Hz
AM 9kHz	7525Hz	11206Hz	11571Hz
AM 6kHz	5268Hz	8535Hz	9537Hz
USB 2.4kHz	2413Hz	3388Hz	RM noise
CW 500Hz	497Hz	776Hz	RM noise
CW 100Hz	105Hz	353Hz	RM noise

Intermodulation (50kHz Tone Spacing) 2400Hz bandwidth USB

Frequency	IPO 3rd order intercept	IPO 2 tone dynamic range	Preamp On 3rd order intercept	Preamp On 2 tone dynamic range
1.8MHz	+18.5dBm	96dB	+6.5dBm	96dB
3.5MHz	+12.5dBm	92dB	-1dBm	91dB
7MHz	+11dBm	91dB	+0.5dBm	92dB
14MHz	+10.5dBm	90dB	-1.5dBm	90dB
21MHz	+20dBm	96dB	+8dBm	96dB
28MHz	+17dBm	94dB	+5dBm	94dB
50MHz	+14.5dBm	92dB	+2.5dBm	92dB

Close-In Intermodulation On 1.8MHz
500Hz bandwidth CW Preamp Off (IPO)

Spacing	3rd order intercept	2 tone dynamic range
1kHz	-38dBm	63dB
2kHz	-30dBm	67dB
3kHz	-16dBm	77dB
5kHz	+11.5dBm	95dB
10kHz	+18.5dBm	100dB
20kHz	+18.5dBm	100dB
50kHz	+18.5dBm	100dB

Frequency Offset	Reciprocal Mixing Dynamic Range 500Hz BW 7MHz	Reciprocal Mixing Dynamic Range 500Hz BW 21MHz	Transmit Noise 100W 7MHz	Transmit Noise 100W 21MHz
1kHz	64dB (-91dBC/Hz)	62dB (-89dBC/Hz)	-89dBC/Hz	-89dBC/Hz
2kHz	72dB (-99dBC/Hz)	68dB (-95dBC/Hz)	-96dBC/Hz	-93dBC/Hz
3kHz	77dB (-104dBC/Hz)	71dB (-98dBC/Hz)	-100dBC/Hz	-98dBC/Hz
5kHz	82dB (-109dBC/Hz)	77dB (-104dBC/Hz)	-106dBC/Hz	-104dBC/Hz
10kHz	89dB (-116dBC/Hz)	85dB (-112dBC/Hz)	-114dBC/Hz	-112dBC/Hz
15kHz	94dB (-121dBC/Hz)	90dB (-117dBC/Hz)	-118dBC/Hz	-116dBC/Hz
20kHz	97dB (-124dBC/Hz)	93dB (-120dBC/Hz)	-122dBC/Hz	-119dBC/Hz
30kHz	102dB (-129dBC/Hz)	97dB (-124dBC/Hz)	-123dBC/Hz	-121dBC/Hz
50kHz	107dB (-134dBC/Hz)	102dB (-129dBC/Hz)	-130dBC/Hz	-128dBC/Hz
100kHz	112dB (-139dBC/Hz)	107dB (-134dBC/Hz)	-134dBC/Hz	-133dBC/Hz
200kHz	116dB (-143dBC/Hz)	112dB (-139dBC/Hz)	-135dBC/Hz	-135dBC/Hz

Transmitter Measurements – 13.8V Supply

Frequency	CW Power Output	Harmonics	Intermodulation Products 3rd order	Intermodulation Products 5th order
1.8MHz	108W	-64dB	-22dB	-34dB
3.5MHz	108W	-60dB	-26dB	-38dB
7MHz	108W	-68dB	-26dB	-42dB
10MHz	109W	-62dB	-27dB	-37dB
14MHz	109W	-74dB	-26dB	-39dB
18MHz	109W	-68dB	-22dB	-36dB
21MHz	108W	-70dB	-26dB	-38dB
24MHz	106W	-75dB	-30dB	-38dB
28MHz	109W	-72dB	-26dB	-36dB
50MHz	110W	-75dB	-21dB	-32dB

Intermodulation product levels are quoted with respect to PEP.
Transmitter AF distortion: 1% or less
Microphone input sensitivity: 0.3mV for full output
FM deviation: 2.3kHz narrow / 4.6kHz wide
SSB T/R switch speed: mute-TX 30ms, TX-mute 4ms, mute-RX 36ms, RX-mute 1ms
NOTE:
All signal input voltages given as PD across antenna terminal. Unless stated otherwise, all measurements made on USB with receiver preamp switched out (IPO) and 2.4kHz IF bandwidth. CW measurements in 500Hz bandwidth.

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, Steve, M1ACB, 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 include 'closed', 'TBA' or 'every Tuesday'-type entries. The deadline for the April issue is 23 February and for May it's 23 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
Meets 3rd Thursday at DT's Bar. Visitors and holidaymakers welcome.

NATIONAL

Amateur Radio Caravan and Camping Club
membership@arcc.org.uk, www.arcc.org.uk
No rallies in March

AMSAT-UK, http://amsat-uk.org/
Open net every Sunday, 10am, 3.780MHz (±)

British Railways Amateur Radio Society
m0zaa@brars.info, www.brars.info
Net Friday 1600 on 3.685MHz

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

Radio Amateur Old Timers' Association
MemSec@RAOTA.org, www.RAOTA.org
Nets: Wed 3.763MHz 1000, 1.963MHz 2100, Thurs 7.163MHz, 1100, 3.763MHz 1930 Sun 3.763MHz 1000.

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
3 Normal club night
17 Construction night

Livingston & District ARS
Cathie, 2M0DIB, 01506 433 846
7, 28 Training
14 Talk
21 Operating/training

Lothians RS
Mike, MM0MLB, secretary@lothiansradiosociety.com
8 Radio with the Raspberry Pi, John, GM8OTI
22 Radar, Jim Forbes

West of Scotland (Glasgow) ARS
wosars@gmail.com
6, 10, 17, 24, 31 Club night

REGION 2: SCOTLAND NORTH & NORTHERN ISLES
Regional Manager: Denny Morrson, GM1BAN
RM2@rsgb.org.uk

Aberdeen ARS
Fred, GM3ALZ, 01975 651 365
2 Junk sale
9 Q&A with expert team
16 Grampian Repeater Group AGM
23 Wireless Set no 46 and D-Day Landings, Martin, GM8AGM
30 Construction and on the air

Glenrothes & District RC
Tam, MM0TGB, 0775 3526 498
1 Club night
8 Observatory visit
15 Arduino, Leven
22 Chat night
29 6m working

Grampian Repeater Group
Peter, GM1XEA, 01224 740 091
16 AGM (hosted by Aberdeen ARS)

REGION 3: NORTH WEST
Regional Manager: Kath Wilson, M1CNY, RM3@rsgb.org.uk

Bolton Wireless Club
boltonwireless@gmail.com
13 A52A Bhutan DXpedition video
27 Moxon for 6, 4 & 2m, Mick, M0ICK

Chester & District RS
Bruce, M0CVP, 01244 343 825
7 Construction competition presentations
14 Committee meeting
21 Club asset workshop and sale
28 The other man's shack

Macclesfield & District RS
Greg, M0TXX, Info@gx4mws.com
6 Shack on the air
13 Aerial traps, G3VKF
20 Video evening and on the air
27 Mobile fox hunt

Mid-Cheshire ARS
Peter, G8HAV, 0791 931 5547
1 Installing aerials and winch to the mast
8 Committee meeting
15 Amateur radio during WWII
22 Operating and using the club test equipment
29 Check newly installed aerials

South Manchester R&CC
Ron, G3SVW, 01619 693 999
2 What every shack needs
9 Measurement units
16 Aerial and propagation clinic
23 Junk sale
30 Schottky diodes, Chris, G8ZCJ

Stockport Radio Society
Heather, M6HNS, 0750 690 4422
6, 13 Intermediate course
7 UK Repeater Group talk
14 Club net, 51.550MHz FM, 7.30pm 50.270MHz SSB, 8.15pm
16 Club net, 145.375MHz, 7.30pm
20 Intermediate exam
21 Preparation for NARSA
28 Skills night

Thornton Cleveleys ARS
John, G4FRK, 01253 862 810
6 Natter night, practical, club on air
13 NARSA rally stand discussion
15 Committee meeting
20 Stacking antennas, Dave, G8KBH
27 Marine radio, M6GQG

REGION 4: NORTH EAST
Regional Manager: Ian Douglas, G7MFN, RM4@rsgb.org.uk

Angel of the North ARC
Nancy, G7UUR, 01914 770 036
6 Advanced course plus data encoding in analogue and digital signalling, Carolyn Crook
13, 20, 27 Advanced course plus on the air

Colburn & Richmondshire District ARS
Colin, 01748 876 391
9 New Lifeboats, G8PYX
23 Planning summer programme

Denby Dale RC
Darran, G0BWB, 0797 442 3227
1 Constructors' competition
8, 22 Club net, 145.575MHz FM, 8pm
12 WAB 3.5MHz Contest, Brian, G0BFJ
15 40m home brew SSB transceiver, G8BZY
29 Real ale night, The Star

Otley ARS
David, M0HLL, 01423 522 618
7 Morse class; Yaesu Fusion & repeater update
14 Intermediate course support workshop; digimodes update
21 AGM, all welcome
28 Intermediate exam

Sheffield ARC
David, G6DCT, littlewood20@btinternet.com
6, 20 Shack night
13 HF loop antenna, Michael, G4PXF
27 Club night

REGION 5: WEST MIDLANDS
Regional Manager: Martyn Vincent, G3UKV
RM5@rsgb.org.uk

Cheltenham ARA
Derek, G3NKS, 01242 241 099
7, 14, 21, 28 QRS CW, 3540-3550 8pm to 9pm
16 Construction contest
21 Lunch, book with G3YJE

Coventry ARS
John, G8SEQ, 0795 877 7363
2, 9, 16, 23, 30 Open net, 50.175MHz SSB, 8pm
2 Visit to Coventry Model Railway Club
6, 13, 20, 27 Open net, 145.375MHz FM and or 7.16MHz ± QRM SSB, 8pm
17 Digital radio workshop
24 Radio workshop
31 Open net, 145.375MHz FM

Gloucester AR&ES
Anne, 2E1GKY, 01242 699 595, daytime
4 Train the Trainers course with CARA
6 80 years of radio astronomy, Paul Hyde
13, 27 Informal evening and general operating
20 Satellite working, Tim Kirby

Malvern Hills RAC
Dave, G4IDF, 01905 351 568
14 Arduino

The next Club Calendar deadlines are 23 February and 23 March

Midland ARS
Norman, G8BHE, 0780 807 8003
1 Open meeting, shack on the air, training
8 Committee meeting, training
15 Social calendar meeting, training
19 Visit to Wythall Radio Rally
22 Open meeting, ragchew, training
29 Training; film show, Ron, M0WSN

Mid-Warwickshire ARS
Don, G4CYG, 01926 424 465
14 AGM
28 Used equipment and book sale

Nuneaton & District ARC
Neil, M0NKE, info@ndarc.co.uk
2, 9, 16, 23, 30 Club net, 145.475MHz, 9.30pm
3 Pint and chat, Harvester Nuneaton, 7.30pm
7, 14, 16 UKAC, 8pm
17 RSGB VHF propagation video, 7.30pm

Rugby ATS
Steve, G8LYB, 01788 578 940
4 Wire antennas, ununs and tuners
7, 14, 21 UK Activity Contest
11 DMR and Rugby digital repeater GB7ME
18 Shack on the air, HF and VHF
25 Rig computer interfacing, JT65HF digimode
28 Shack on the air, UHF

Salop ARS
salopamateurradio@gmail.com
1, 8, 15, 22, 29 Club net, GB3LH, 8.30pm
2 Natter night and committee meeting
7, 14, 21, 28 Club CW net, 144.070MHz, 4.30pm
9 Calibration night
16 Natter night
23 CW practice night
30 Shack night, G3SRT on the air

Solihull ARS
Paul, G8AYY, 0121 628 7383
2, 9, 23, 30 Club net, 145.450MHz, 8pm
16 Group meeting

South Birmingham RS
Gemma, M6GKG, gemmagordon.m6gkg@gmail.com
2, 9, 16, 23, 30 Training classes, Dave, G8OWL
3, 10 Sorting stock for the Wythall rally
6, 13 Review of contests for this year
7, 14, 21, 28 Shack coffee morning, 11am to 1pm, visitors welcome
17 Getting trailer ready for Wythall rally
18 Loading trailer with rally stock
19 Club stand at Wythall rally
20 Review and debrief of rally stand
27 Checking aerials
31 Open meeting and rag chew

Stratford upon Avon & District RS
Clive, G0CHO, 01608 664 488,
6, 20 Club net, 145.275MHz FM, 8pm
13 Electrical safety, John, G1AWJ
27 Reviving valve amps workshop, Harri, G1EIX

Sutton Coldfield ARS
Robert Bird, rob2e0zap@gmail.com
6, 20 Open net, 145.250MHz, 7.30pm
13, 27 Club meeting
14 Open net, 70.475 FM, 7.30pm
19 Wythall rally
28 DMR open net, GB7FW slot/local2, 7.30pm

Tamworth ARS
Richard, 2E0LLE, 0787 521 7124
1, 8, 15, 22, 29 Club net, GB3TA
2, 9, 16, 23, 30 Club night

Telford & District ARS
John, M0JZH, 0782 473 7716
1 Committee meeting and GX3ZME on the air
8 Construction competition
15 Something old (electronic related)
22 DGU talk
29 AGM

Wythall Radio Club
Chris, G0EYO, 0771 041 2819
3, 10, 17, 24, 31 Nibbles Night in the Shack 7.30pm
5, 12, 19, 26 Club net, 145.225MHz or GB3WL, 8pm
7, 14, 21, 28 Morse class, 7pm
7 Hamfest preparation
14 Committee meeting and Hamfest prep
19 Wythall rally
21 Wythall rally review and washup
28 The 3-15 Show, 8.30pm

REGION 6: NORTH WALES
Regional Manager: Ceri Lloyd Jones, 2W0LJC
RM6@rsgb.org.uk

Dragon ARC
Stewart, GW0ETF, 07833 620 733
6 Planning summer activities, special events and contests
20 The V2 and its guidance systems, Les, MW0SEC

North Wales Radio Society
Liz, GW0ETU, 0776 019 0355
2 General meeting
9 Technical topic
16 History of thermonic valves, David Crawford

Porthmadog & District ARS
Peter, GW0DFK, 0773 177 1319
16 Surplus equipment sale

REGION 7: SOUTH WALES
Regional Manager: Glyn Jones, GW0ANA, RM7@rsgb.org.uk

Aberystwyth & District ARS
Ray, GW7AGG, 01970 611 853
9 Maritime musings, Bruce, GW4XXF
23 Net on 145.500 then 145.550MHz

Chepstow & District ARS
Ollie, 2W0ZXX, 0748 182 1973
7 The GB3BS repeater, Mat, G7FBD
21 Stuck projects help night

Cleddau ARS
Heinz, MW0ECY, 0774 804 7008
3 AGM

REGION 9: LONDON & THAMES VALLEY
Regional Manager: Tom O'Reilly, G0NSY
RM9@rsgb.org.uk

Aylesbury Vale RS
avrs@rakewell.com
8 AGM

Bracknell ARC
David, M0XDF, M0XDF@Aplhadene.co.uk
1, 15, 22, 28 Open net, 145.375MHz, 8pm
14 WSJT/WSPR

Burnham Beeches RC
Charles, G0SKA, 01753 647 101
6 AGM
20 Video lecture and operating night

Newbury & District ARS
Rob, G4LMW, 0797 088 5614
5 Intermediate course, practical, revision & exam
22 System Fusion, Paul, G3WYW

Radio Society of Harrow
Linda, G7RJL, lcasey@imperial.ac.uk
3 Club night and talk
5, 12, 19, 26 Club net, 1938kHz LSB, 12 noon
6, 13, 20, 27 Club net, 145.500 then 145.350MHz FM, 8.15pm
17 Club night and activity evening
26 Outdoor event at Old Redding car park, 2-5pm

Reading & District ARC
Laurence, G2DD, 0758 470 6625,
7, 14, 21, 28 Club net, 70.425MHz FM, 8.30pm
23 Junk sale, 8pm

Shefford & District ARS
John Burnett, john@hobart-europe.co.uk
2 AGM
9 History of the turntable, Paul Schimmel
16 Britain from above, Brian Hilton
23 A final look at local industry, Brian, G8GHR
30 Junk sale

Southgate ARC
Keith, G8RPA, g8rpa@arrl.net
8 Junk sale

Verulam ARC
Greg, M0PPG, 01582 412 345
9 Social with GB3VH repeater group
21 RSGB video on Propagation

REGION 10: SOUTH & SOUTH EAST
Regional Manager: Michael Senior, G4EFO
RM10@rsgb.org.uk

Bromley & District ARS
Andy, G4WGZ, 01689 878 089
1, 8, 15, 22, 29 Club net, starting on 145.500MHz, 9pm
5, 19 Intermediate course
21 Club meeting
21 The Arduino, Andy, G4WGZ

Coulsdon ATS
Mike, M1CCF, 020 8654 2582
13 Roll your own PSBs, Matthew, M0NJX

Crawley ARC
John, G3VLH, 01342 714 402
22 Repeater developments, Paul, G7KBR

Cray Valley RS
Richard, G7GLW, 0783 171 5797
2 Construction contest
16 Fault-finding, G3OOU

Crystal Palace R&EC
Bob, G3OOU, 01737 552 170
3 Spectrum utilisation efficiency, Ian Clark

Fareham & District ARC
Chris, G7MFR, 0781 749 8772
1, 8, 22 Informal meeting
15 Home built SDR radio, G0AMS
29 Film

Hastings E&RC
Gordon, 01424 431 909,
gordon@gsweet.fsnet.co.uk
22 Forum discussion on amateur radio

Horndean & District ARC
Stuart, G0FYX, 02392 472 846
3 Natter night/social evening
17 Hampshire County Council emergency planning, Ian Hoult

Horsham ARC
Alistair, G3ZBU, 0785 526 8666
2 Junk sale
16 Social at The Selsey Arms

Mid-Sussex ARS
Sue, G6YPY, 01273 845 103
3, 31 On the air
10 Green antennas, Dennis Conway
17 Radio night and table top sale
24 Talk on Oldlands Mill

Southdown ARS
John, G3DQY 01424 424 319
1 Hailsham shack meeting, cafe meeting 12.30pm
4, 11, 18, 25 Saturday meeting
6 AGM 8pm
8, 15, 22, 29 Cafe meeting 12.30
25 Club nets: 9.50am 145.275 FM, 10.00am 7.035 CW, 12.30pm 144.300SSB\145.500FM\51.600FM

Surrey Radio Contact Club
John, G3MCX, 020 8688 3322
2, 9, 16, 23, 30 Net, 70.300MHz, 8pm
3, 10, 17, 24, 31 Net, 145.350MHz, 8pm
5, 12, 19, 26 Net 1905kHz, 9.30am
6 Surplus equipment sale
20 Chat and fix-it, John, G8MNY

REGION 11: SOUTH WEST & CHANNEL ISLES
Regional Manager: Pam Helliwell, G7SME
RM11@rsgb.org.uk

Appledore & District ARC
Alan, M6CCH, 01237 422 833
20 AGM

Bristol RSGB Group
Robin Tompson, G3TKF, robin@g3tkf.co.uk
27 Talking wires in the sky, Paul, M0HWV

Callington ARS
John, G4PBN, 01822 835 834
1 Phased vertical antenna array, G4BVB
26 Callington rally

Cornish Radio Amateur Club
Steve, G7VOH, 01209 844 939
1 Committee meeting
2 Main meeting
16 Social evening

Exeter ARS
Nick, M0NRJ, 01363 775 756
7 Club net, GB3EX, 7.45pm
8 AGM and Film Night
14, 21, 28 Club net, GB3EW, 7.45pm
22 60 metres on the 'grey line', Slade, M6SBQ

Mid-Somerset ARC
David, G8BFV, 01749 670 085,
14 Getting started on 10GHz

Riviera ARC
rivieraarc@gmail.com
2 Club night
16 Datamodes demonstration

Saltash & District ARC
Mark, M0WMB, 0781 054 8445
2, 16 Club night

South Bristol ARC
Andrew, G7KNA, 0783 869 5471
2 Using an antenna analyser
9 Practical evening
16 Cheese and wine evening
23 Spring table top sale
30 Open house and on the air night

Thornbury & South Gloucestershire ARC
Mark, 2E0RKM, 0777 629 2813
3, 10, 17, 24 VHF net

Torbay ARS
Dave, G6FSP, g6fsp@tars.org.uk
3, 17, 24 Club night
10 Club night with business meeting
31 Presentation of Club Awards

Weston Super Mare RS
Martin, G7UWI, 01934 613 094
6, 13, 27 Construction, operating & natter night
20 Video on vintage radio production

Yeovil ARC
Rodney, M0RGE, 01935 825 791
9 An ATU *does* tune the aerial, G3MYM
16 Morse practice, G3MYM
23 On the air and committee meeting

REGION 12: EAST & EAST ANGLIA
Regional Manager: Keith Haynes, G3WRO
RM12@rsgb.org.uk

Braintree & District ARS
Edwin, G0LPO, 01376 324 031
6 Rig clinic and checking club equipment
13, 27 Club net, 145.375MHz, 8pm
20 Talk by Region 12 DRM Peter Onion

Cambridge & District ARC
Ian, M0HTA, publicity@cdarc.co.uk
1, 8, 15, 22, 29 Club net, 145.550MHz FM, 8pm
5, 12, 19, 24 Club nets, 8.30am 144.180MHz USB, 10.30am 7.0875MHz LSB or 3.620MHz LSB, 11.30am 145.550MHz FM
10 Construction evening
24 Meteor scatter, Gavin, MM1BXF

Chelmsford ARS
secretary@g0mwt.org.uk
7 Classic computers, Andy Chapman, G7TKK
20 Skills night at Danbury Village Hall

Essex Ham
Pete, M0PSX, news@essexham.co.uk
4 Essex YL net, GB3DA, 8pm
5 Online Foundation course
6, 13, 27 Net on GB3DA, 8pm, chatroom and audio feed at www.essexham.net
20 Getting started table at Essex Skills Night

Felixstowe & District ARS
Paul, G4YQC, pjw@btinternet.com
6 SES planning night
20 Show and tell evening
25-26 Intermediate weekend

Norfolk ARC
Chris, G0DWV, 01603 898 308
1 Home construction competition
8 Life in BBC Outside Broadcasts, Paul Cort-Wright, G3SEM
15 Informal
22 Forum
29 Informal, table top sale and Bright Sparks

South Essex ARS
Terry, G1FBW, 0798 607 0040
14 SteppIR and other antennas, Peter Walters from W&S

Thurrock Acorns ARC
Gordon, 2E0ELI, acorns@taarc.co.uk
2, 9, 16, 23, 30 Open net, 2m FM, 7.30pm
7 SSTV 2m open net, 7.30pm
21 AGM & social evening
25 Essex 2m activity afternoon 1-5pm

REGION 13: EAST MIDLANDS
Regional Manager: Jim Stevenson, G0EJQ
RM13@rsgb.org.uk

Hinckley AR&ES
Mark, 2E0SBM, 0778 992 9730
2, 9, 16, 23, 30 Intermediate and Morse training
7, 21 UKAC
14, 16, 23 70cm/6m/4m contest

Leicester RS
Sandra, G0MCV, 0793 027 4044
2, 9, 16, 23, 30 Foundation course
6 On the air
13 On the air and committee meeting
20 Holiday operation as EA8/G4BUD/M, Barry
27 My life with the archers, John, M0CQV

Lincoln Short-Wave Club
Pam, G4STO, 01427 788 356
1, 8, 15 Club night, G5FZ/G6COL on the air
2 Club repeater net, GB3LM, 8pm
4, 11, 18, 25 Workshop and mentoring, G5FZ on the air
9, 16, 23, 30 Club net, 145.375 8pm
22 Formal meeting
29 WAB, Dave Brooks, G4IAR

Loughborough & District ARC
Chris, G1ETZ, 01509 504 319
7 Watching TX Factor
14 Annual dinner
21 Lightening protection, Keith, G0RQQ
28 Practical evening

Melton Mowbray ARS
Phil, G4LWB, 01664 567 972
17 SDRPlay and SDRUno, Phil, G4LWB

RAF Waddington ARC
Bob, G3VCA, 07971 166 250
3, 10, 17, 24, 31 Club night
6, 13, 20, 27 Club net, 145.325MHz, 8pm

South Kesteven ARS
Andrew, M0NRD, 0796 906 2859
1, 8, 15, 22, 29 Club net on GB3GR
3, 17 club meeting
10-19 Special event station for British Science Week

South Normanton Alfreton & District ARC
A Lawrence, 2E0BQS, 0115 930 7322
6 Talk
13, 27 Natter night
20 Junk sale

Welland Valley ARS
Peter, G4XEX, 01858 432 105
6 Club net, 70.475MHz FM, 8pm
20 Bring along your radio equipment night

The next deadlines are 23 February and 23 March

REGION 1: SCOTLAND SOUTH & WESTERN ISLES

Wigtownshire ARC had five students pass their Intermediate exam recently, with a 6th student who will take the next exam. Pictured are the six students, three instructors, the exam secretary and invigilator. Because of the local geography of Dumfries & Galloway, some students live up to 100 miles apart. This makes commuting to regular evening sessions quite impractical, so the club were delighted to be allowed to use Distance Learning materials from G0FUW and Bath & District ARC. The Bath Intermediate Class videos are available to all to download or watch online. The lead instructor, Clive, GM4FZH, a long-standing distance learning tutor, jumped at the chance to try out the material. The course still required three all-day workshop sessions for the practical assessments and some final coaching.

REGION 3: NORTH WEST

At one of the first Furness ARS meetings of the New Year, Ivan, G3IZD and Chris, M0TES held a demonstration and comparison of two new rigs – the Icom IC-7300 and the Yaesu FT-991. Each were given 40 minutes to talk and demonstrate their rigs. Unfortunately conditions on the air were not great, so little was heard, but all the features and menus of the rigs were looked at in detail. A video camera had been set up so the controls and displays could be seen by all attending on the big screen. It was a lively discussion with a lot of questions asked, and members formed their own opinions of which was the best rig.

If you are holidaying, working or just visiting the Furness area and wish to meet some local amateurs, you will be assured of a friendly informal welcome. Details at www.fars.org.uk/

REGION 4: NORTH EAST

The results have been published for the ARRL 10m contest that Denby Dale ARS entered in 2015. They came 1st in their class in the UK and 14th outside of the USA. Not bad at all considering that the band was totally flat that day and they were operating with only 100W into a three element beam. They entered the up to 150W and no antenna restrictions class and are proud of their recent contest sucsesses. Several students have been studying hard to pass their exams and gain licences. Brianna, Ian, Jeremy, M6IHT and Andrew passed their Foundation licence. Andrew went on to also pass his Intermediate on the same day.

Bishop Auckland Radio Amateurs Club had another successful Rally (see photo above) at Spennymoor Leisure Centre in December with another great turn out. The committee and members would like to thank the traders and all who made this possible as well as the amateurs and short wave listeners who came along to support the event. The hall is booked again for Sunday 26 November, they hope to see you all again.

REGION 6: NORTH WALES

Wrexham Amateur Radio Society would like to congratulate three students from their December exams. Dave is now MW0IEH, Tony is now M0TNW and Dave is MW0XRT. There is also sad news from the club as their life president, John Roberts, GW3RBM, became Silent Key on 17 December 2016. His funeral was held at Wrexham Crematorium on 30 December and was attended by many amateurs from around the area. A sad loss to both the club and John's family.

REGION 8: NORTHERN ISLAND

Bangor & District ARS has recently acquired a state-of-the-art transceiver, the Elecraft K3. The March meeting will include a demonstration of this new rig's capability by Richard, GI4DOH and Harry, GI4JTF, two of the club's Field Day key contestants. The recent quiz resulted in a win for the 'Broons' team (Stephen, GI0HHV, Stewart, GI4OCK, Billy, GI0HSB, Norman, GI3YMY and XYL Roberta). Well done all.

REGION 12: EAST & EAST ANGLIA

In January, **Thames ARG** had a talk on Setting Up an Amateur Radio Licence Training Centre at TARG by Mark, M0IEO. Present on the night was Vic Rogers, G6BHE Deputy Regional Manger Region 12. If you would like more information on the training offered by the club, based in Canvey Island, visit www.thamesarg.org.uk/training/

Great Yarmouth Radio Club has launched its new website, replacing the one on QSL.net. You can view the new site at http://jatt1950.wixsite.com/g3yrc-gt-yarmouth-rc The club meets on the 2nd and 4th Friday of the month at 7.30pm in Bradwell Community Centre, Lords Lane, Bradwell, Great Yarmouth.

Visitors from Essex, London, Kent and Cambridgeshire attended the first Essex Skills Night of 2017, in Danbury (photo left). Over 30 of the attendees were members of Essex Ham and, at the group's table, they were able to see a review of the last 12 month's activities, pick up some Getting Started guides, watch a virtual reality satellite launch, learn about data modes and find out about Essex RAYNET's recent callout in Jaywick. Also at the Skills Night was test equipment, construction, handheld programming, the Essex CW Club and, for the first time, a demo of the LOG4OM logging package. The Essex Skills Night is a free event hosted at the Chelmsford ARS's training venue in Danbury. Events are open to all, regardless of licence level and club affiliation.

North Norfolk ARG has seen many changes over the last 30 years. From early meetings at The Crawfish pub through meetings at the QTH of the late Dr Tom Appleby, G3RZ to accommodation, the club has been involved in it all. Using an old radio truck with their own collection and donations, the club has formed a radio collection. This soon out grew itself and they moved to the Radio Hut were the group displays a large collection of military and civilian radio equipment to the public and school trips – and has done for 25 years. The museum is now the club's main time objective with members (both radio amateurs and non amateurs) meeting visitors and bringing the old radios back to life. In 2013 they needed a new home and moved to the Norfolk Tank museum at Long Stanton. The club now has a new building and the station is back on the air. The museum will be open from Easter 2017. It is not as large as collection as they once had but it is from 1936 to present with radios from many countries (see photo above). You around you can check the Norfolk Tank Museum out online at http://norfolktankmuseum.co.uk/.

Dave, G0DEC gave an update to Braintree & District ARS on RAYNET's involvement in the recent evacuation of the Essex town of Jaywick due the predicted tidal surge. Public and volunteer services had been grateful for the communication support provided. The fundamentals of portable appliance testing were reviewed, and the club's assembled equipment was visually and electrically checked and tested prior to use during the forthcoming year of special event and club meetings. The photo shows RAYNET members at the Primary Rest Centre at Tendring Education Centre, Jaywick.

Club of the year

3rd place winners

The clubs that won the 1st to 3rd placings in the large and small club categories, presented at last year's National Hamfest, all showed the judges just what it takes to make a club shine. Here's the story of the two 3rd placed clubs.

3rd place Small Club

South Kesteven ARS freely admitted that, at the start of 2015, membership had dwindled to single figures. Following a change of chairman, a concerted effort has been made by the committee and members to increase the club's activity and profile. The hard work is paying off as the club has gained new members, doubling its membership in the year.

They have participated in a variety of activities from assisting the local ATC Cadets with their Foundation certificates to operating several special event stations. Perhaps one of the most unusual events was GB2EGG at the World Egg Throwing Championships held as part of the Swaton Vintage Day show, including a high altitude balloon carrying radio trackers and a raw egg into the stratosphere. The raw egg 'into space' was featured on the front page of the *Sleaford Standard* and on the BBC News website. The Egg Throwing Federation was interviewed on BBC Radio and publicised the hobby. The subsequent unexpected recovery of the lost payload on a Dutch beach was also well publicised.

During the year, the club worked with 1st Barrowby Scout Group to allow 14 Cubs to pass messages, send practice Morse and operate a receiver to gain their communication badges. They have since been asked to help with the more advanced Scouts communication badges. GB5FSG was a JOTA SES for the 1st Foston Scout Group, Lincolnshire.

Another High Altitude Balloon launch took place at the National Hamfest – the Pig in Space balloon. The Chairman was interviewed on BBC Radio Lincolnshire and the flight featured on a number of news websites.

The club is active on social media, with an up to date website, public Facebook page and Twitter account where all society activities are publicised. They regularly send in diary dates, reports and photographs to *RadCom* for inclusion in the regional news.

3rd placed Large Club

During 2015, Telford & District ARS was involved in several training courses and exams. These have been mostly based at the home of Mike, G3JKX, with assistance from trained fellow club members. He trained 12 Foundation, 6 Intermediate and 3 Advanced during 2015 – the majority were successful. All candidates automatically become members of TDARS and are supplied with a free amateur band handheld and assistance with radios and antennas is often provided, including the loan of quality club equipment.

Telford HamFest is a major event organised by the club. It takes more than 6 months to and attracts 500+ visitors in September. 2015 included a presentation and demonstration of the Raspberry Pi.

As one of TDARS members (G0CER) has experience in the local press, his contacts and experience enable the club to maximise publicity and has resulted in several prominent features during the year. Local radio has also been used to publicise events such as HamFest. John, M0JZH has been interviewed at length for a feature on BBC Shropshire Radio covering various aspects of amateur radio. This station has the highest proportion of listeners to local radio in the area

During the year the club has been involved in a number of outside events such as Thinking Day and Jamboree on the Air when scores of younger Scouts and Guides, with their leaders, got involved in a live station, Morse and digital comms. The club also participated in Lions Wheels Day in Telford and Schools' Science Day at Ironbridge Gorge Museum when scores of students visited the display.

A Facebook account has been established at www.facebook.com/telfordhams that features many events, background information and photographs. A Twitter account has also been set up, with about 500 followers so far (twitter.com/G3ZME). The TDARS website had about 8000 hits in 2015 and is updated on a weekly basis. Finally, TDARS business cards have been printed to distribute at events.

During 2015, the club had 9 guest speakers from outside TDARS membership, plus special presentations using resources such as the RSGB archives and HF Propagation DVD.

Construction projects take a lead over the winter months and club members have built items as diverse as rig/computer interfaces, 0-30 volt PSUs, HF and VHF antennas, transistor/LCR testers, portable oscilloscope, Morse and voice keyers.

TDARS operate a voice repeater on 70cm (GB3TF), now upgraded to 'Fusion' mode, as well as 4 national microwave propagation beacons from its HQ.

RSGB
National Club Of The Year
Principal Sponsors
WATERS & STANTON

South Kesteven ARS worked with ATC cadets.

Club night at Telford & District ARS

For Sale

FIBREGLASS TUBE
High strength tube, square box, rod, and other sections stocked in 6m lengths, can be cut. Engineered Compositions, Chester. Tel: 01244 676000 e. info@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

MICROPHONES & ACCESSORIES.
Replacement microphones for a wide range of transceivers. Cables for Heil and studio microphones, headsets and mixers, PC headset adapters, PTT switches and replacement curly cords. DTMF microphones for echolink. For these and more great items go to www.technofix.uk

Sony ICF-SW55,
mint in outfit case with aerial and connector, headphones, manuals, paperwork, £250ono. Donald Baldwin (Streatham) 07985 961129.

Cards & Design

QSLERS SPECIAL OFFER
1000 full colour both sides qsl cards £45 plus postage. 07720 580968 www.QSLers.co.uk

LOW COST AND HIGH QUALITY QSL CARDS
By LZ1JZ QSL PRINT www.LZ1JZ.com

Computer Software

SD CONTEST LOGGER, €20 - EI5DI.COM
Supports RSGB 2017 rules. SDX - free Special-Event logger.

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@outlook.com 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

QUAD BAND COLINEARS.
10/6/2/70 Quad band 2.5/2.5/3.5/5.5 dbi gain only 1.2m length £59.95 ea 6/4/2/70 Quad band yes Includes 4m, 2.5/2.5/3.5/5.5 dbi gain 1.2m length £59.95 ea 2/70 Dual band 3.5/5.5 dbi gain 1.1m length only £37.95 ea. UK post £7.95.
Website: mirfield-electronics.co.uk
Email: martin.stokes@hotmail.com or
Tel: 07825549430

TYT MD380/NEW MD380 + GPS
MD380 £109.95, MD380G includes GPS facility £129.95, MD380 Li battery £14.95, speaker/mic £14.95, ear/mic £12.95, All inc post next day delivery. Website:mirfield-electronics.co.uk.
Email: martin.stokes@hotmail.com or
Tel: 07825549430

HAMTENNA UK
Manufacturers of Antennas, Baluns, Ununs and suppliers of antenna wire and accessories. Checkout Hamtenna.co.uk

Wanted

VINTAGE RADIO & VALVES WANTED
national cash settlement for silent key, shack clearouts 07552 678725, vintageradio@btinternet.com

Miscellaneous

ALL UK STATIONS – CALL IN ON OUR 'M1CRA' CHRISTIAN NETS!
WACRAL welcomes all amateurs & listeners to our Sunday morning 'GOOD NEWS' nets, now at 07300-0830 on 3.747 MHz +/- QRM and, again, at 14.00-15.00 on 7.147 MHz. Our 2m SSB net at 15.00 is held on 144.205 MHz. Or, do join us on Wednesdays 07.30 3.747 MHz +/- QRM, 10.00 on 7.147 MHz (if no contact established after 5 mins QSY to 3.747 MHz and 21.30 on 3.751 MHz, for nationwide Christian fellowship and relaxed chat. All times UTC. See www.wacral.org for more net info and WACRAL details or just call Ian G4OPP on 01622 746650 or g4opp@wacral.org

VINTAGE FIREWORK COLLECTOR
will pay cash and collect from anywhere call Tony - 07956 506300 Licensed explosive storage

Equipment

REPAIRS TO RECEIVERS, TRANSMITTERS
New/Old, valve/transistor. Call 07903 023437 for details: www.kent-rigs.co.uk

RADIO REPAIRS BY M0NKL
Icom, Yaesu, Kenwood etc, plus linear amplifiers, please contact Nick on 07770 397668 or email np262@yahoo.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

Advertisers Index

FREE MEMBERS' ADS OF UP TO 40 WORDS

Email your Members' Ad to memads@rsgb.org.uk. You must include your name, callsign, phone number, email address and location (not counted in the 40 word limit). Optionally, attach your own photo of the item (min res 800 x 600, must be in focus and well lit). Max 1 ad per Member per month; other terms & conditions also apply (see tinyurl.com/MemAdsInfo).

FOR SALE

BUDDIPOLE W3BP inc TRSB (2009), 6m Yagi kit, 4 long whips, counterpoise wire adaptor and wire, mast guying kit, VGC, £350. Vibroplex Blue Racer, thumb tab broken, vari-speed, in wooden box, £100. Palstar BT1500A balanced line tuner (2014), £450. Colin, M0XED, 01227 904 492 (Canterbury).

CIRO MAZZINI Baby loop, covers 6.6 to 29.8MHz and some of the countries that I have spoken to on 10W include Europe, Canada, USA, Japan. Reason for sale, I have just got planning permission for a mast. £900. Roger Dunnaker, M6KNY, 0121 525 7535, rdunnaker@gmail.com (West Bromwich).

CLUBS, CONTEST GROUPS, serious radio amateurs. Commander II VHF (144–148MHz) linear power amplifier. Tested – excellent condition. RF drive power 15–20W, RF output 500W. Weight 27.3kg. £1,700 OVNO. Cash only. Collection or will meet for handover. Dave, G4LQT, 0777 562 1139, g4lqt@yahoo.co.uk (Stafford).

DV4 MINI. World wide contacts on 70cm with the DV4 Mini, D-Star radio and PC. Comes with longer antenna. £65 including postage. Graham, GM4CUX. 0131 467 0807, aros21@blueyonder.co.uk (Edinburgh).

KENWOOD RZ-1 desktop/mobile scanner. 500kHz–905MHz, FM-W/FM-N/AM, internal speaker plus stereo line-out jacks, 100 memories, 13.8V DC. DC cable, manual. Excellent condition. £100. David Wilkins, G5HY, 07912 619 001, david@g5hy.com (near Ringwood, Hampshire).

KENWOOD TS-590 including accessories and 5MHz, boxed, in immaculate condition (non-smoker) – hardly used in CW… £600. Bert, G3FVO, 01908 501 845, bertie.gladwin@gmail.com (Milton Keynes).

KENWOOD TS-590SG and MC-80 desk microphone, boxed and in excellent condition. Comes with USB to serial interface, USB leads and manual, £800. Charlie, M0WYM, 01872 277 843, charlie@peartreegreen.org (Truro, Cornwall).

LDG M-1000W automatic ATU, LDG M-100 external meter, Ranger 811A linear amplifier with 811A, set of 4 new 811A, set of 4 used 572B. Amplifiers book by G3ZRS. I want £800. Come to my home for, it amp weighs 25kg. Don Hughes, G8WPL, g8wpl@yahoo.com (Stockport).

MARCONI 1960s valved equipment: HD29 xtal calibrator, HD29 monitor, HR85A 70-100MHz FM RX, HX56N AM TX 156-184MHz, HX85A 70-100MHz FM TX, HR22 HF SSB RX. Also G2DAF TX, Eddystone 898 dial. Also mains PSU, Gardner transformers 300-0-300. Offers please. Chris, G3NHL, 01326 377 233, g3nhl@zen.co.uk (Mylor, Cornwall)

MARCONI TF2600 VVM 1mV–300V FSD, 10Hz–5MHz, recently overhauled and recalibrated, £60 ONO, buyer collects. AVO TT169 transistor tester, complete, £15. Sugden Si452 distortion measuring unit, £20. STC 74616A 600Ω attenuator, 0–100dB in 0.1dB steps, £35. Mike Hall, G3USC, 01458 241 584, mikehall2@btinternet.com (Langport, Somerset).

MICROHAM MICROKEYER II DB37-FT_2000 cable, £45 inc p&p. John, G3UCQ, 01736 752 982, email@johnfarrar.plus.com (Hayle, Cornwall).

PAIR EIMAC 4CX250B/M, NOS, £150. Bases and chimneys also available. Pair Brown-Boveri Q450-1 tetrodes (cf 4-400) c/w bases, £50. 16 x Mallory 700μF/400V electrolytics, £20. Assorted mains transformers. Buyer inspects and collects. Nick, G3VNC, g3vnc@uk6.net (Cheddar).

TEN-TEC JUPITER. Latest model with ATU. Purchased from W&S. Boxed with manual, etc. As new! £995. New unused Hygain 14AVQ, boxed, with manual, £120. Terry, G3VSK, 01709 838 517 (Rotherham).

WINRADIO G305E SDR receiver, with PRO demodulator, wide FM adapter, software, handbook, antenna adapters for BNC and SO239, and PSU, £450 including postage. Suitable laptop, if required, £35 plus postage. Willy, GM3NUF, 01631 564 901, willy.wilson2@gmail.com (Oban, Argyll).

YAESU FP/FT200 TRX/PSU, £120. Yaesu FC-902 ATU, £100. Yaesu FT-625RD, £300. Yaesu VR-5000 RX, £300. Yaesu SP-901 speaker, £50. Yaesu mic, various and electronic keyers, various. DL-600 dummy load, £50. DL-1000 dummy load (oil filled), £70. Datong FL-1 filter, £40. Nigel, G4KZZ, 01723 890 786, nipro@btinternet.com (N Yorkshire).

YAESU FT-991, boxed, 16 months old, £680. Bencher Hex key, £290. bhi NEIM 1031 noise eliminator, £60. Non smoker. Dr Colyn Baillie-Searle, GD4EIP, 0762 441 3036, gd4eip@wimanx.net (Isle of Man).

WANTED

AZIMUTH ELEVATION ROTATOR combination unit, QRO linear amplifier for 70cm band. For sale: FT-221R £150; FT-707, £225, both with microphone and power lead. G4GZS, 07859 917 317, keith4gzs@hotmail.co.uk (Rugby).

CARD EXTENDER BOARDS for JRC JST-135D transceiver. Fair price and postal costs paid. Or information on supplier please. Harry, G4FEQ, 0776 934 2954, g4feq.harry@btinternet.com (near Leeds).

CW FILTER for IC 706Mk2G, FL232, FL101 or FL100 (preferred model). John, GW4LPB, 0754 645 1829 (Gwent).

EDDYSTONE 880 MK1, Siemens E311, METRIX U61 valve tester, also rectifier valves 5U4G, U52 53KU 52KU CV575 CV1071. Steve, M6WAA, 0755 267 8725, vintageradio@btinternet.com (Warrington)

RF24 AND RF26 unit, in reasonable condition please – not rusted away! Mike Giddings, G3XLB, 0151 216 2210, mikegiddings1@yahoo.com (London).

UP FOR GRABS

LARGE QUANTITY of television service manuals, circuit diagrams and common fault information. Job lot of 4 large boxes (will *not* split). Mainly 70s, 80s and 90s colour sets, some B+W, some VCRs and oddments. Mostly categorised by manufacturer or model. All makes, some rare models and much Philips, Decca, Ferguson, ITT/Nokia/Salora. Free to a good home. Collection only, by arrangement, from the Andover area (or possibly Ipswich area). Dave, 0780 252 6107 (Andover).

RALLIES & EVENTS

Members of the RSGB Regional Team will be present with a bookstall at the rallies this month marked with an RSGB diamond.

If *your* rally or event is not listed here,
PLEASE SEND US FULL INFORMATION
by email to radcom@rsgb.org.uk
to ensure it gets into *RadCom*, on the
RSGB website and read out on GB2RS News

4 MARCH 2017
LAGAN VALLEY ARS ANNUAL RALLY AND HAMFEST
Doors open at 11am. All the usual traders are expected to attend. Details from Victor, GI4LKG, Andrew, MI0BPB or Jim, GI0DVU, all QTHR.

5 MARCH 2017
EXETER RADIO & ELECTRONICS RALLY
America Hall, De La Rue Way, Pinhoe, Exeter EX4 8PW
Doors open at 10.30am with disabled visitors gaining access 15 minutes earlier. Bring & Buy book-in starts at 10.15am. Admission is £2 and there will be trade stands. Catering is available on site. Details from Pete, G3ZVI on 0771 419 8374 or by email to g3zvi@yahoo.co.uk.

12 MARCH 2017
DOVER RADIO CLUB RALLY
Whitfield Village Hall, Sandwich Road, Manley Close, Whitfield, Nr Dover CT16 3LY
Talk in on GB3KS, doors open from 10am to 1pm, entry £2. Auction starts at 12.30pm. Aaron Coote, 2E0FQR, 0771 465 4267 or aaroncoote@hotmail.co.uk.

18 MARCH 2017
LAUGHARNE RADIO RALLY
Saturday 18 March 2017.
Millennium Memorial Hall, Clifton Street, Laugharne SA33 4QG
Doors open 10am-1pm (disabled entry 15 mins early), entry £3. Tables are free, booked through Matthew, GW6KOA, 0199 4427 581 or by email to matthew.twyman63@btinternet.com.

19 MARCH 2017
32nd WYTHALL RADIO CLUB RALLY
Wythall Park, Silver Street, B47 6LZ
Parking available on site. Doors open at 10am with disabled visitors gaining access at 9.30am. Entry is £4. There will be a Bring & Buy, RSGB bookstall as well as lectures. Catering will be available on site. Contact Mike, 0797 674 4479, mike@g4vpd.com.

26 MARCH 2017
CALLINGTON RADIO RALLY
Callington Town Hall, Callington, Cornwall PL17 7BD
Doors open at 10am and admittance is £2. There will be a Bring & Buy and trade stands. Catering available on site. Ample free parking in the adjacent car park. Rally organised by the Devon & Cornwall Repeater and Callington Amateur Radio Society (CARS). More information and bookings from Roger on 07854 088 882 or via 2e0rph@gmail.com.

9 APRIL – NORTHERN AMATEUR RADIO SOCIETIES ASSOCIATION EXHIBITION

23 APRIL – 33rd YEOVIL QRP CONVENTION

30 APRIL – CAMBRIDGE REPEATER GROUP RALLY

30 APRIL – WEST LONDON RADIO AND ELECTRONICS SHOW

1 MAY – 33rd DARTMOOR RADIO RALLY

6 MAY – SOUTHERN ELECTRONICS AND RADIO FAIR

7 MAY – DAMBUSTERS HAMFEST

7 MAY – SCOTTISH AMATEUR RADIO AND ELECTRONICS CONVENTION

19–21 MAY – DAYTON HAMVENTION®

20 MAY – RADARS FLEA MARKET INDOOR SALE

28 MAY – DURHAM & DARS RADIO RALLY

4 JUNE – SPALDING & DARS ANNUAL RALLY

11 JUNE – J28 AMATEUR RADIO RALLY

11 JUNE – EAST SUFFOLK WIRELESS REVIVAL

18 JUNE – 30th NEWBURY RADIO RALLY

25 JUNE – WEST OF ENGLAND RADIO RALLY

1 JULY – BANGOR & DISTRICT ARS RALLY

8 JULY – STOCKPORT RADIO SOCIETY RALLY

9 JULY – CORNISH R A CLUB RALLY

8–9 JULY – uWAVE ROUND TABLE

14-16 JULY – HAM RADIO SHOW, FRIEDRICHSHAFEN

23 JULY – FINNINGLEY ARS RALLY

30 JULY – CHIPPENHAM & DARC RALLY

13 AUGUST – FLIGHT REFUELLING ARS HAMFEST

20 AUGUST – RUGBY ATS ANNUAL RALLY

2-3 SEPTEMBER – TELFORD HAMFEST AND G QRP CONVENTION

9 SEPTEMBER – CAISTER LIFEBOAT RADIO RALLY

10 SEPTEMBER – 44th BLACKWOOD ARS RALLY

17 SEPTEMBER – WESTON-SUPER-MARE RALLY

22–24 SEPTEMBER – WACRAL CONFERENCE AND FELLOWSHIP WEEKEND

29–30 SEPTEMBER – NATIONAL HAMFEST

13–16 OCTOBER – RSGB CONVENTION

15 OCTOBER – HOLSWORTHY ARC RALLY

22 OCTOBER – GALASHIELS RALLY

SPECIAL EVENT STATIONS

Ofcom notified the RSGB on 24/1/2017 that there are no Special Event Station NoVs for the month of March 2017 that have given consent to be publicised.

SILENT KEYS

We regret that for administrative reasons we are unable to include details of Silent Keys this time; we will include this month's details in the next edition.

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 e-mail 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

We publish obituaries at www.rsgb.org/sk
Please send submissions by e-mail (only) to sk@rsgb.org.uk. All obituaries are moderated and may be edited for reasons of style, grammar, length etc. *Online obituaries are separate from the Silent Keys column; please ensure you* also *notify* sales@rsgb.org.uk.

5 NOVEMBER – WEST LONDON RADIO AND ELECTRONICS SHOW

18 NOVEMBER – RADARS TRAD. RADIO RALLY

26 NOVEMBER – BISHOP AUCKLAND RAC RALLY

LISBON HAMFEST 2016

Colin Wilson, CT7ACG/G3VCQ

I would like to thank *RadCom* for advertising the HAMFEST in Lisbon, Portugal that, until I spotted it in *RadCom*, I and some others here had no idea was happening. Cliff, G0MMI/CT7ANG and I (plus our XYLs) decided to make the trip north from the Algarve with a shopping list from Joe, CT1JRO and a few things that we both needed. We also hoped to meet up with a few fellow hams as we rarely hear any CTs on air. Did we get a surprise! The rally was packed with radio hams and XYLs too.

It was very easy to find, just next to the Arena where we had seen Sir Rod Stewart and Adele just a few months beforehand. Parking was fairly simple, with adequate on-street parking, which was free on a Sunday, too. The entrance to the rally was free and there were many clubs from around the regions at the entrance to welcome us.

We had also arranged to meet up with one ham I know and called him to let him know we had arrived. We met with Tony, CT1FFB/ZS1AGJ who introduced us to a few others: Victor, CT1AKD/ZS6OZ, Avelino, CT2JVP/ZS6AY and also Nunes, CT1BUN. We had a long chat about DMR, which is becoming very popular here in Portugal. Thanks guys for making Cliff, our XYLs and I feel so welcome. My XYL Sharon, M3VCQ met up with a YL group and met Ana, CT2ISX and CT2KJU, so a great meeting place for sure.

We were all very impressed at the standard of the stands with I think most major players such as Yaesu, Kenwood, ACOM and Icom covered. There were many bring and buy stalls and little knickknack type stands that reminded me of the old rally days before computers! Lots of old equipment to be had – a collector's dream, I can tell you.

As always at these events, the catering let things down a little but to be fair the staff were run off their feet! Cliff and I headed for the EA Antenna stand to see Rob, who we had previously visited in his workshop over in Seville back at Easter time. Cliff had ordered a piece of data equipment (which he still cannot get working) and of course we both needed some of the usual kind of things like coax, PL259s etc. So, not breaking the bank but well worth the trip! The XYL on the other hand bought me an EA 2-ele 40m Yagi and 5-ele Yagi for six metres so I can stack it with my existing one. Nice Christmas presents! The photo shows (left to right) CT7ANG, CT1FFB, CT1AKD and CT7ACG.

60m GB2RS

Andy Keddie, M0KED

Just a word of thanks to the team who read the GB2RS news on 60m for re-scheduling to 1500 in place of 1600. The difference was quite marked propagation-wise today (22 January). The last few months have been a struggle to say the least, with the news fading away 5 or 10 minutes after starting, the fact that today the post news net attracted some 16 or so stations proves the move was the right one. Thanks once again to all involved.

The RSGB would like to take this opportunity to thank all the GB2RS newsreaders for their dedicated service to their fellow amateurs.
Steve Thomas, M1ACB
RSGB General Manager

OUR HOBBY

Richard Young, M0BGA

In the President's message (January *RadCom*) he says "…while deserving recognition as a statutory service…" etc. Clearly we do not receive this recognition from Ofcom and probably no other statutory authority. RAYNET is being reunified, we are told. Do any of the authorities care? Perhaps the real difficulty is that the radio amateur licence is generally no longer regarded with any respect by those outside the hobby. Many years ago I started studying for the PMG exam (never got over 9WPM) and the valuable knowledge I gained enabled me to pass a Scientific Civil Service job interview. Armed only with the knowledge contained in the present amateur radio syllabus I would not get far in 2017.

If we are to regain respect we must upgrade our knowledge, our practice and our technology to catch up with the real world of communication in 2017.

Start with the Exam syllabus. This needs to include far more digital techniques content while retaining some of the very fundamental RF engineering subjects. As we cannot seem to solve the present EMC problems we will need to cope with an increasingly 'dirty' RF spectrum by using some of the noise tolerant digital modes becoming available to us. Yes it will make the exams more challenging but they need to be. Please RSGB stop worrying about Membership numbers and start to think about quality.

Another difficulty is our adherence to the word 'amateur'. In its original meaning of loving something it was meaningful, but now it has come to mean something slightly inferior ("amateurish"). Unthinkable thought: drop the word "amateur". We could be known as "communicators"

I am pleased to report that the updating of the Examination syllabus at all three levels is reaching completion and is expected to be released for consultation in late March. The updated syllabus does, indeed, include references to recent technology advances in relation to amateur radio.
Ian Shepherd, G4EVK
Board Director

IT'S A LADIES' HOBBY AS WELL

Mike Kerry, GW1SXT

It was so nice to see in *RadCom* the article on the International Young Ladies Convention. Amateur radio tends to be a male dominated hobby, or so it seems, and if there is a lady's voice on the air, there can be a pile up just like for the rare DX! All the technical articles around seem to be from male writers and not just in *RadCom*. There must be more lady radio amateur operators out there, let's hear more from them – just a thought.

It is encouraging to see the success of initiatives such as the YL net hosted by Dorothy M0LMR, on Monday evenings on the GB3DA Danbury repeater giving ladies from Essex, Kent, Suffolk, London and beyond to meet up on-air. Also the work by international YL groups, including BYLARA, does much to support ladies within the hobby. We're always pleased to hear from other groups and nets in RadCom. *– **Ed***

RESPONSE TO RAIBC REQUEST

Ian Spencer, DJ0HG/G3ULO
RAIBC Audio Manager

I thought I would just write to say a big thank you for the really wide spread help that the RSGB provided via *RadCom*, GB2RS news and the various internet possibilities when we were looking for more volunteer readers recently.

In the past we have only ever managed to attract one or two new readers when we have advertised so this time I included the RSGB, *PW* and *RadioUser* – and the response has been overwhelming.

I am really grateful for the support offered by all the magazines/organisations and all have brought new readers for us but the majority came, without doubt, through the support and help of the RSGB.

To date I have had over 30 responses. 12 of them have sent sample recordings

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and are now on the Reserve Readers List, so we will at last be able to get on with a number of projects that have been on the shelf for some time awaiting a reader.

Again, many thanks to everyone at the RSGB who helped.

PLANNING SUCCESS

Russ Tribe, G4SAQ

I would like to give public thanks to Dick Elford, G0XAY of the RSGB's Planning Advisory Committee. I have just received planning permission to erect a 12 metre 'Antenna Support with Antenna' (NB not 'mast' nor 'tower') at my home. At first sight, this might not appear to be remarkable but I live in a Conservation Area.

Fortunately, my very first step in the process was to contact the RSGB to ask for assistance. My request was passed on and shortly afterwards I was contacted by Dick. At this stage I was wondering whether it was worth applying but his positive and careful advice encouraged me. I know that Dick would like me to say that, if you seek advice, you should take care to follow it!

So many thanks; I hope that he finds time to use his own equipment as well as providing more sage advice.

OFCOM'S APPROACH TO VDSL

Mark Chanter, M0WMB

Whilst reading the article on page 20 of February's *RadCom* headed 'EMC Committee Reply to Ofcom', I was surprised it had been written to make Ofcom look that they did not care about us amateur radio enthusiasts.

I have very recently had dealings with the wonderful people from Ofcom and they have been very helpful to me. I am sorry to say the advice I had from RSGB (more than two months ago) was wait and RSGB would do it on my behalf. I went against RSGB and contacted Ofcom, if I did not contact Ofcom my interference would still be with me now and still be waiting for RSGB.

Just before Christmas I made an online report that I had 20/9 of new interference. It was not long until I had a telephone call from Ofcom and was asked several questions about the problem, I told him what tests I had done. Ofcom said 'when we are in your area we will call in'.

The first time they came unfortunately I was out, but they did find a small amount of noise from BT lines. Just yesterday, 26 January, they phoned to see if I was in. Two gentlemen came to the door with a radio in hand and yes the interference was there. It did not take them long to find the problem, it was a switch mode power supply that developed a fault nearby.

Now I have 40 metres back and I am very happy. So Ofcom were very good to me and did not cost anything. I know the RSGB EMC team are volunteers and to Ofcom amateur radio enthusiasts are low down on priority, I think it's correct that the emergency services have the highest priority.

Steve Wragge, G1XOW

Ref 'Ofcom's approach to VDSL', January, having recently been in contact with Ofcom regarding a severe and obvious EMC problem from newly installed VDSL broadband installations, I was utterly dismayed to read a full-page "damage limitation" PR piece full of excuses by Mark Walls of Ofcom. In total contrast to what he claimed in the article, they are completely disinterested in VDSL interference reports.

I placed a complaint online only to be called the next day by the Duty Officer at Ofcom. He only had one thing he wanted to say: "that Ofcom do not investigate any VDSL interference reports, and I should call BT Openreach instead". As we know BT Openreach will not take calls directly from end-user subscribers, and therefore the complaint process can only be dealt with via yet another disinterested party – your Internet Service Provider.

Both Ofcom and BT Openreach are entirely complicit in creating/approving this invasive interference-causing technology, yet they both adopt Teflon shoulders by insisting that we deal with it via our Internet Service Provider. The ISP is the least able to understand or help with the issues, and is actually entirely innocent of blame (unless it's also BT of course).

I've read numerous documents from Ofcom on the subject of VDSL and the most disturbing observation is that they are trying to sweep the whole issue under the carpet by using terms like "an increased noise floor". This is a deliberate misnomer, designed to make us think that this interference is somehow unavoidable like some natural phenomenon. Obvious this is nonsense. VDSL is a real machine-generated transmission from man-made equipment, and should be dealt with as such.

Would any other source of ultra-wide-spectrum RF inference over a huge geographic area be allowed to exist, or would it quickly be shut down regardless of how many, or how few reports there had been? Why should VDSL be treated as a protected RF spectrum access right, where it obviously isn't?

Surely it's time for the public and RSGB to assume that Ofcom cannot perform their purpose in RF spectrum management. If so we need to lobby our MPs and government to get this essential public right, and national resource adequately protected for the people of this country, not corporate monopolies like BT.

Steve, we have been working with you on this and have found your mitigation attempts enlightening. I agree with all the points you make about VDSL needing to be tackled. This should be done by Ofcom under the EMC Directive which requires equipment not to cause interference that prevents radio equipment from operating as intended.

Unfortunately as you say Ofcom will not take action against VDSL or similar broadband systems because they have not included the powers to enforce against wires in their interference Regulations, more details can be found in February 2017 RadCom page 20. We continue to challenge the Ofcom stance on this issue and more details of our work on VDSL RFI can be found on page 56 of this issue of RadCom. I agree with your points about the ISP being in an impossible situation to try and resolve the problems which can stem in part from nearby lines, which may be from different ISP's. Fortunately, in your case your ISP is as concerned about this state of affairs as we are and has contacted me to ask for help and advice on how to improve their processing of this type of problem. Your case has been submitted by RSGB EMCC to Openreach for line balance checking. We will continue to work together to try to resolve these issues. We are also discussing with Openreach ways to mitigate the levels of RFI present at some locations.

John Rogers, M0JAV

Chairman RSGB EMC Committee

There are more letters on the subject of Ofcom and VDSL on the RadCom *section of the RSGB website. Go to http://rsgb.org/main/publications-archives/radcom/supplementary-information/*

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