RadCom

THE RADIO SOCIETY OF GREAT BRITAIN MEMBERS' MAGAZINE. WWW.RSGB.ORG

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36 metres of premium-quality antenna elevation

0611

Horwood House
Elegant surroundings for the RSGB Convention

Build this
Current mode choke balun for the low bands

Sport Radio
It's National Field Day this month

Electric winches
Goodwinch elevation and luffing winches reviewed

RadCom

THE RADIO SOCIETY OF GREAT BRITAIN'S MEMBERS' MAGAZINE

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The magnificent Luso tower from the front cover extended to its full height. Carrying an Optibeam 804020 antenna, it dominates at the QTH of EA3AKP. You could save 53% on a similar tower – see p19.

Photos: EA3AKP.

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IF strip from FET "tetrodes" – p27

RSGB AGM 2011

Nearly 100 members registered for the RSGB 2011 AGM, held on 14 May in the comfortable surroundings of the Menzies Mickelover Court Hotel on the outskirts of Derby.

The meeting, chaired by RSGB President Dave Wilson, MOOBW, supported by Acting General Manager Don Beattie, G3BJ, Honorary Treasurer Bob Dingle, GOOCB and Honorary Company Secretary Rupert Thorogood, G3KKT, was held as part of a full day of discussions about RSGB and amateur radio. The formal AGM took just 35 minutes, covering the business required under the calling notice, involving discussions on the accounts and approval of the appointment of auditors together with other administrative matters. This was followed by the presentation of trophies and awards that are in the gift of the Board. an address by the President covering the achievements of the RSGB in 2010 and the outlook for 2011. In his talk, Dave Wilson explained the many achievements of RSGB in 2010 but also highlighted a number of challenges the Society faces.

Much of the discussion on future outlook was deferred until the afternoon session, when Dave Wilson and Don Beattie gave a presentation on the issues facing the Society. They explained that recent events had provided the stimulus to take a fresh look at the financial position of the Society, the decision-making processes and processes of governance. The Board has determined that fundamental changes are needed in the way the Society operates and accepts that some decisions in the past could have been more soundly researched. Present projections show the RSGB making a loss in 2011 and 2012 and the meeting was told that the Board was determined to avoid this. Cash reserves had been depleted, primarily as a result of the Bletchley Park project, which would also place a significant operating cost load on the Society in future years. At the same time it was difficult to fund the GB4FUN project, which is currently not programmed to be on the road in 2011. In view of the remaining work to be done on BP, and to give the Society the opportunity to fully explore sponsorship and funding for the Society's educational outreach activities, the decision has been taken to postpone the opening of the National Radio Centre until January 2012.

The President and Acting General Manager then explained that the Board intended to ask a small group of external advisors, who are radio amateurs and have in-depth experience of business management and governance structures, to work with the Board in quickly completing the on-going Vision and Strategy work, developing the way ahead for the RSGB and proposing a new structure of Governance for the Society. All these proposals would be subject to discussion with those in the Society who had a view to offer. The proposals would most likely require approval at an EGM later in the year. The Board will keep the membership fully involved in these discussions via the website and in *RadCom*.

Dave Wilson concluded by explaining that the Board saw a once-in-a-lifetime opportunity to reshape RSGB for the 21st century and was determined to grasp it.

The meeting then made a number of comments – virtually all supportive – about the presentation that had been given, making a number of practical proposals about how to improve member services and prepare the Society for the future. Whilst the President and Acting General Manager had presented a challenging and difficult picture of the issues facing the Society, members present clearly felt that the Board had been right to be open about these. and offered support and practical help on the way ahead. We will continue to act upon some of the comments made at the AGM and welcome Members' input and views on all matters regarding the future of the RSGB.

This session was followed by a short presentation by RSGB Board member John Gould. G3WKL. He explained progress on the Vision and Strategy work. which started in mid-2010 with the National Amateur Radio Survey and was continuing with analysis, discussion groups, focus groups and scenario evaluation to arrive at a consensus on the future direction for the Society and its future governance structure. Once the data has been fully analysed we will bring you the results via *RadCom* and the website.

The afternoon also provided an opportunity for the President and others to answer questions from the floor on general matters concerning RSGB and its services. ▸▸

CONGRATULATIONS

To the following members whom our records show as having reached 50 or 60 years' continuous membership of the RSGB.

60 years

REW Marshall	G8HLE

50 years

Mr E L Masters	G0KRT
Mr J Holstead	G3OZC
Mr J L Green	G3PYF
Mr G F Wilks	G8DVJ
Mr J A Fuge	VP9FI

The questions ranged over number of topics including:

- the QSL bureau (where an in-depth review of service levels and costs is already under way)
- training and training materials (where some interesting and practical proposals were made by questioners)
- funding for examinations in cases of hardship
- subscription policy
- availability of *RadCom* on the web
- difficulties in reallocating club calls when, eg the licensee ceases to be a club member (the Society will discuss this with Ofcom)
- creating a transmit power 'level playing field' with the rest of Europe (again this will be reviewed with Ofcom).

The afternoon meeting ended shortly after 16.00 and was followed later in the day by an informal amateur radio dinner, giving the opportunity to talk in a relaxed atmosphere about the many challenges facing the hobby in the 21st century.

QSL Matters

Writing this copy the day after the Royal Wedding, we know that 2,421 personal requests were made by amateurs to include the magic R in their callsign. Did you know that the R prefix was previously used in 1995 to celebrate VE-day and cards for that event still arrive (as recently as last week) so sorting can be a little tricky!

To manage the expected influx for the next 3 years or so, it has proved vital to open a separate sub group for R cards. Fortunately, Martin Coles, G0VXC has kindly accepted the challenge of distributing R cards in the UK. NoV holders wishing to receive cards need to deposit separate, C5 size, stamped and numbered envelopes with him, clearly showing the special callsign in the top left hand corner. To avoid sorting confusions, Royal Wedding QSL confirmations will not be re-directed via the home callsign or QSL manager even if written on the card. If you want to receive your cards, contact Martin. G0VXC (QTHR as per the *RSGB Yearbook* and RSGB member's website). GB-Royal Wedding stations operated by clubs should lodge envelopes with the GB-events manager M0LXT in the same way.

It would also greatly help us if all active stations would write a large callsign-appropriate R on the rear of their QSL package when posting. Please be sure to band all UK destination cards separately for easy sorting, as per usual the Yearbook instructions.

CONTEST CALLS – SUB MANAGER CHANGE. Rose Bunce, M1EBN, the QSL volunteer for one of the largest QSL groups (Abbreviated and single letter Contest calls) is retiring after 10 years in charge. The Society and contest community owe Rose a debt of gratitude for his dedication and commitment, handling this busy call series. His place is being taken by Graham Morris, M0AXO, whose contacts details are as per the *RSGB Yearbook* and in the members section of the RSGB website.

G0V – NEW MANAGER. A new QSL sub manager has been appointed for the G0V series. John Joll, G0TQT now holds both the G0U and V series as a single group. Details can be found on the RSGB website. G0V call holders need to send new envelopes to John as soon as possible.

Region 1 Club of the Year

The Region 1 Club of the Year trophy was presented by Jason O'Neill, GM7VRB, Deputy Regional Manager for DRM District 13 to Bob Glasgow, GM4UY, Chairman of the Cockenzie & Port Seton ARC at the Annual GMDX Convention at Stirling in April. Jason stood in for Len Paget, GM0ONX who is the Regional Manager for Region 1.

Welcome

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 C Cain, 2E0CGC
Mr C Norris, 2E0CMK
Mr J Jex, 2E0JEX
Mr K O'Hara, 2E0MPO
Mr R James, 2E0ONO
Mr W Johnson, 2E0WAJ
Mrs B Shackleton, 2E0YKS
Mr D J Butler, 2E1IJK
Mr P H Dower, 2M0UTH
Mr R Bradshaw, 2W0UXW
Mr G G Garcia, EA1FBF
Mr M Bowthorpe, G0CUZ
Mr B Styles, G3NSD
Mr D Shaw, G3PCL
Mr E W Law, G4CVW
Mr J Ness, G8XKW
Mr K W Hunt, K1KWH
Mr K Simmons. K5UHF
Mr T R Wilson, KD8DEG
Mr R E Wineburgh, KF5JKM
Mr A E Johnston, KF5KDE
Mr G J Strong, K0OQ
Mrs G Joyce, M0EBP
Mr G Hickford, M0GRA
Mr N Ubonis, M0NPQ
Mr P Keeler, M1CNG
Mr J Branch, M1EVC
Mr A Birkhead, M3BCM
Mr J E Woolley, M3YSK
Mr A Northall, M6AQQ
Mr T Newman, M6AQW
Mr D Yakub, M6DIL
Mr JR Martin, M6EAM
Mr NAJ Baker, M6FTY
Mr SJ Shone, M6HCJ
Mrs E White, M6LBW
Mr W Morrell, M6ULZ
Mr L K Humphreys, M6YMR
Mr T Darrah, MI6AOX
Mr N Jenkinson, MI6PUX
Mr A F O'Neill, MM6ARN
Mr D Lee, MM6BMD
Ms H N Ross, MM6HLZ
Na-Fir-Chlis ARC, MS0NFC
Mr J Somerville, MW0XHO
Mr Y Janssen, ON4CY
Mr J P Systems, PA1JPS
Mrs E D Swift, RS195403
Mr H Forster, RS199606
Mr A Snook, RS207774
Mr J Powell, RS208010
Mr M Phillips, RS208033
Mr J Breen, RS208035
Mr A Armstrong, RS208039
Mr S Fox, RS208052
Mr M Sijbolts-Withaar, RS208065
Mr G Burns, RS208066
Mr M Fitzjohn, RS208069
Mr P Holmes, RS208080
Mr D Thomson, RS208095
Mr J Snaith. RS208096
Mrs K Streeter, RS208115
Mr R Unsworth, RS208125
Mr J Noon, RS208152
Mrs A McInnes, RS208225
Mr G Atkins, W0CGR
Mr J R Repetti, WJ1R
Mr C J Alcaide, WP4OIO

Our apologies to Mr B Jones, M00XO who was inadvertently missed from the new members list in February.

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

Eden Valley RS, G0ANT
Mr J W Goodwin, G0NBH
Mr G Skupski, G0VMA
Mr A D Hill, G0XBA
Mr D F Ash, G1BWW
Mrs C M Clark, G1GQJ
Mr T Ryder, G1MMI
Mr M J Human, G1MPC
Mr R J Bonar, G1ONV
Mr F Anderson, G1OPZ
Mr M D Hudson, G1WMJ
Mr A B Allchin, G4JGH
Mr G J Lowe, G4NHS
Mr P J Osborne, G4RPF
Mr D M Surgey, G6MBF
Mr R Holt, G6OLS
Mr SAW Al-Kattan, G6SFE
Mr P L Tasker, G6VBJ
Mr R J Paul, G7KMZ
Mr J D Jenkins, G8KHS
Wolverhampton ARS, G8TA
Mr G N White, G8YOJ
Mr P I Davies, G8ZPD
Mr P G Johnstone, GM0KMJ
Mr I M Macdonald, GM7JED
Mr J E Squire. GW0AGZ
Mr J Bulpin, GW0BNN
Miss D Nichol, M0FDY
Mr T Mondragon, M0GLO
Mr D W Swift, M3LKK
Mr C Shackleton. M5AEH
Mr S J Gillespie, MI0GTA
Mr J D Gwilliam, MW0GWL
Mr J P McMullen, RS172885
Mr N Bryan, RS178247
Wrexham & D Raynet Group, RS95364

AGM Awards

At the recent RSGB AGM, a number of awards were presented. The Norman Keith Adams prize was awarded to David Starkie, G4AKC for the most original article published in *RadCom* in 2010 – HF Bicycle and Pedestrian Mobile. The Courtney-Price trophy was awarded to Richard Marshall, G3SBA for his work on intermodulation in PLT notches. This was acclaimed by ITU-R Working Party 1A as a very valuable contribution to the work of ITU-R. The Ostermeyer Trophy for the best article in *RadCom* for home construction equipment during 2010 was awarded to Glenn Loake, G0GBI, for his Portable Fishing Rod Antenna.

The Bennet Award for the best antenna article in published in *RadCom* was awarded to Peter Dodd, G3LDO for his long-standing contribution on antennas, their measurement and explanations. The RAYNET Trophy was awarded to Cathy Clark, G1GQJ for her major contribution to the work of RAYNET. The Founders Trophy was awarded to Rod Wilkinson, G3TXA, for services to amateur licensing. The Fraser Shepperd Award for research into microwave applications in radio was given to Howard Long, G6LVB, for his work on the FUNcube and the FUNcube Dongle.

The Don Cameron Award, G4STT was awarded to Steve Hartley, G0FUW for his outstanding contribution to low power operation. Finally, one of the RSGB's most prestigious trophies, the Calcutta Cup, was awarded to Tim Ellam, VE6SH, President of the IARU, for services to IARU and outstanding service to international friendship.

Cathy Clark, G1GQJ.

Howard Long, G6LVB.

Tim Ellam, VE6SH.

Amateur Radio Observation Service

At the last Board meeting, Brian Reay, G8OSN was appointed to lead the Amateur Radio Observation Service. AROS is an advisory and reporting service of the RSGB that is intended to assist radio amateurs and others who may be affected by problems that occur within the amateur bands or that develop on other frequencies as a result of amateur transmissions. The service investigates reports of licence infringements, or instances of poor operating practice that might bring the amateur service into disrepute. Reports, complaints and associated supplementary information are accepted from any source and the content of each communication is regarded as confidential material. Brian has e-mailed all Observers for whom he has a current e-mail address. If you are an Observer and have not received an e-mail from Brian regarding his appointment, please e-mail him on aros@rsgb.org.uk. Those interested in becoming an Observer should also contact Brian using that e-mail address.

London 2012

As expected, the RSGB has been approached by Ofcom to help determine sections of the 70cm amateur band that could be released for a limited period around the London 2012 Games next year. As a secondary user of the band, we as radio amateurs have no specific rights to any of those frequencies. Rather than just imposing changes, Ofcom has approached the Society in the spirit of cooperation to work together to solve the problem. The RSGB intends to work constructively on this matter to reach agreement with Ofcom on the segments that can be released on a temporary basis. Ofcom has given clear and unambiguous assurance that the segments used will be returned once the London 2012 Games are over.

The RSGB is looking closely at how the spectrum is used in the designated geographical areas in and around London, Weymouth and South Essex in order to minimise the impact. We will be responding to Ofcom shortly. The RSGB's response is being coordinated within the RSGB Spectrum Forum by Murray Niman, G6JYB.

Region 8 Club of the Year

A Lisnaskea High School pupil and County Fermanagh's youngest radio amateur, Gemma, MI6GDM was chosen by Lough Erne ARC to accept its Regional Club of the Year award presented by RSGB Past President Angus Annan, MM1CCR, at the Club's 30th Anniversary Rally. MM1CCR said, "This anniversary rally is in the SHARE Centre, which is also celebrating its thirtieth anniversary. Amateur Radio is a wonderful hobby for anybody with limited mobility or visually impaired. This fits well with SHARE's aim that able bodied and disabled people of all ages share outdoor and other pursuits - that now can include amateur radio. This work by SHARE and the Club is an example to all." Lough Erne subsequently came runners up in the National Club of the Year, which was announced at the recent AGM.

National Club of the Year

The National Club of the Year title was awarded at the recent RSGB AGM. The award is sponsored by Waters & Stanton plc and, in 2010, the 3rd placed club was Bolton Wireless Club, 2nd place went to Loughe Erne Amateur Radio Club and the winner of the title was Reading & District Amateur Radio Club. You will be learning more about these clubs in a future edition of *RadCom*.

Bolton Wireless Club.

Lough Erne ARC.

Reading & District ARC.

Caithness Anniversary

In Caithness, in 1961, the Dounreay Fast Reactor (DFR) was being prepared to export the world's first fast reactor produced electricity to the National Grid. The same year, a few local enthusiasts and some scientists and engineers from Dounreay decided start an amateur radio club, the Caithness Amateur Radio Society (CARS). The first meeting was held on 21 February, and Geoff Woffinden GM3COV (SK) was elected President. Fifty years on, DFR is in the process of being decommissioned, but CARS is still going strong.

CARS recently celebrated their Golden Jubilee with a dinner at the Nethercliffe Hotel in Wick, which turned into a double celebration as it was announced that for the second year in succession CARS had won the RSGB Club of the Year award for Region 2. If you would like to know more about the club, call in to the exhibition or one of the club meetings. If you see the club caravan at a local event you are invited drop in to say hello!

QRP transceivers

The YouKits HB-1A-MK3 transceiver offers CW transmit on 40m & 20m and up to 7 watts output, receiver coverage is 5 to 16MHz continuous. It includes a digital display, built-in CW keyer with auto CQ and switched bandwidth filters. Designed very much with the portable QRP operator in mind, it can be run from internal cells or external 12V. This radio is sold in the USA under the TenTec banner. The Chinese factory has now appointed Waters and Stanton as their exclusive UK distributor and this radio will be the first of a range of HF models available from this company. Details at www.wsplc.com.

Birthday celebrations

Midland Amateur Radio Society Past President Madge Palmer, G0JBK celebrated her 88th birthday at a recent MARS meeting. The cake was made and presented by the social secretary Jackie, 2E0JRF.

Braintree Construction Nights

In February and March, some the club members brought in and worked on their current constructional projects, under the spotlight of the other members. This was useful exercise as it allowed the exchange of advice, with the hope of encouraging more of members to do some construction. One of the items constructed was the RF Sniffer as featured in the recent *RadCom*. In April the hotly-contested construction contest is held.

Later in March, the club held a short talk night. Melvin, G0EMK talked about the evolution of handheld dual-band radios. Howard, G6LXK talked about repairing test equipment and David, G3PEN talked about salvaging components from scrap units and testing them.

Milton Keynes ARS Talk

The mansion at Bletchley Park was the venue for Rob Mannion's visit to Milton Keynes. Rob, G3XFD, Editor of *Practical Wireless*, gave an interesting and informative talk to a full house that consisted of members of MKARS, Bedford, Shefford and the Dunstable radio clubs. The talk covered the life and times of Rob leading to the history of PW, it was an excellent evening that was enjoyed by all.

NEWS IN BRIEF

• The Cornish Radio Amateur Club has changed its meeting night and venue. They now meet at Gweal-An-Top School, School Lane, Redruth TR15 2ER. The next meeting is Thursday 2 June at 7.30pm when there is a talk on the growing of crystals by Mr L Harding. Further information from Steven, G7VOH on 01209 844939.

QSL Communications

Jayne and Graham of QSL Communications have decided to retire and they have now closed their doors for the last time. They would like to thank all past and present customers for their support over their 27 years in business. They say it is time to put their motor home to good use and do some travelling. No doubt they will pop into radio rallies if they are in the area and say hello!

They started by printing QSL cards which grew, exporting all around the world and attending approximately 40 radio rallies a year. After a few years they decided to expand and take on the major radio agencies and moved to a factory unit/shop, where they have been ever since. Jayne and Graham say that they will now have the chance to go on the radio themselves which they have had little time for in the past few years. Maybe get to talk to the many people they have met over the years, as well as make new friends. That is if they are not volunteered into looking after the 5 young grandchildren especially in the school holidays.

We wish them a long and happy retirement.

Lough Erne Passes

All nine candidates passed the Intermediate examination after a course run by Lough Erne Amateur Radio Club in the SHARE Centre, Co Fermanagh, Northern Ireland. This course began last November but was abandoned in severe winter weather. It resumed over three very busy February weekends with the examination on the third Sunday afternoon. These nine Intermediate successes represent a 35% progression to date from last year's 26 Foundation successes after two courses in 2010. The Club hopes yet more will follow in the footsteps of Ciarán, 2I0OFN, Billy, 2I0WMC, Iain, 2I0GHY, Jamie 2I0MFB, Jonathan, 2I0PPW, Raymond, 2I0RMD, Robert, 2I0RWL, Tommy, 2I0RVH and William 2I0EKN. These new Intermediate licensees will each receive a congratulations certificate at the Lough Erne Pearl Anniversary Rally in SHARE on 17 April.

Behind the scenes

In March, ten members of the Mid Somerset Amateur Radio Club (based in Shepton Mallet, Somerset) were treated to an extended behind the scenes tour of the Rampisham Down transmitter station in Dorset. The station is currently operated by Babcock International Group and provides short wave transmission facilities for broadcasters such as Deutsche Welle and BBC World Service. At the time of the visit the station was not radiating any signals, so members were able to climb inside some of the Marconi 500kW senders and see the components of these incredible transmitters at very close range. Thanks to Station Engineer Tim Bandy for his time and hospitality.

M6 Scout makes A1 DX Contact

A major stir was caused in the Brede Steam ARS shack on the first Tuesday of the school holidays (12 April), when the youngest member, Isabelle Adkin, M6IJA, trying her luck on the 15m band for the first time, managed to get a voice contact with Angola! Just as bird watchers will travel miles to spot a rare bird, radio hams will go to all lengths possible for that illusive contact with a 'rare' country and believe me, they don't come much rarer than Angola. Everyone in the shack was agog! Here was the club's first ever voice contact with Angola and it had been achieved by a 12 year old Scout using nothing more than a simple wire antenna (a Carolina Windom) – no beams, no rotators, just 40 or so yards of copper wire and a heck of a lot of good luck! The contact, with D2AM, has been the talk of the club ever since.

Science week

Bolton Wireless Club was invited by St James CE Primary School, Westhoughton, Bolton, to kick off their Science Week on 11 March. The national event is organised by the British Science Association and the theme was 'Communication'. The Club helped pupils realise how dependent we are on radio and how it works.

Practical KS2 class activities included: 'The open mic' – speaking on the two portable club radio stations G0BWC/A and G1ONE/A; 'The digital revolution' – cracking the Morse Code with flashlights, keys and Phil Tulga's music programme; 'My mobile phone won't work!' – experiments in blocking electromagnetic waves; 'Look no batteries!' – making the world's first radio, 'Secret Agents' – callsigns with phonetics using walkie talkies and 'The International Space Station' – an illustrated talk given by Ross, G6GVI, just before the ISS made its overhead pass. Children witnessed the sound of live transmission of APRS packets and decoding on the computer.

120 children recorded experiments, Morse code messages and invented callsigns on specially prepared worksheets and teachers were given class packs of follow up information. A further 60 Y4 pupils were given a guided tour of the facility.

Excited minds, smiling faces, active fingers, brave mic use, thoughtful questions and complimentary staff sums up a productive day for pupils.

It was another great team effort with volunteer BWC members on site and at home on the air in QSO with pupils.

DXtreme Station Log

DXtreme Software has released a new version of its popular logging program for amateur radio operators: *DXtreme Station Log - Multimedia Edition™ Version 7.0*. Like other logging programs, *DXtreme Station Log* lets hams log their contacts and import ADIF files from popular contest programs. It also provides multimedia and advanced functions. For more information about *DXtreme Station Log - Multimedia Edition V7.0*, visit www.dxtreme.com, or contact Bob Raymond, NE1I, via bobraymond@dxtreme.com.

NEWS IN BRIEF

• The Reading and District Amateur Radio Club will be operating a special event station for Museums on the Air on 18 and 19 June at the QTH of the Museum of Berkshire Aviation, Mohawk Way, Woodley, using the callsign GB2MBA.

East Yorkshire Demonstration Station

East Yorkshire Repeater Group was asked to put on an amateur radio demonstration by the leaders of the Hedon (Hull) Youth Club. The original event was postponed due to the heavy snow last December and was rescheduled to coincide with National Science and Engineering Week. It took place on 21 March and snow once again provided an opportunity to use repeaters as a lifeline between Yorkshire / Lincolnshire 4x4 Response and the Hull and East Yorkshire Primary Care Trust.

The Youth Club was shown the RSGB video and various methods of communication from CW to D-Star were demonstrated before presenting a challenge between Morse Code and Text Messaging – Morse narrowly winning the day (despite predictive text and the keyboard skills of modern youth).

Despite the makeshift random wire dipole made from a 20m reel of figure-of-8 speaker wire supported on an Army surplus Clansman mast, the Kenwood TS-590 provided them with excellent coverage. The first contact on 40m was into Iceland; the audience learned how to pronounce the name of the famous Icelandic Volcano – Eyjafjallajökull.

Overall, the European stations were very receptive of the young audience and they had plenty of QSOs with everyone having the opportunity to have a go!

Far left Cllr Di Storr, (2nd from right) Mario Brashill, G2DPA, and Dave Proctor, M0IOK. (Photo: Andy Russell, G0VRM).

GB2FX at Landguard Fort

The Felixstowe & District ARS recently attended a Volunteering Festival at Landguard Fort in Felixstowe, demonstrating a wide range of radio equipment to visitors using the callsign GB2FX. Members of F&DARS, RSGB and RAYNET were on hand to answer the many questions and enquiries about the technical, training, licensing and volunteering aspects of the amateur radio hobby.

Braintree Amateur Radio Society

The annual Braintree Amateur Radio Society construction contest was held with a wide range of entries from the club members. The first two entries were made by Edwin, G0LPO and they were a 'RF sniffer' for the HF bands, based on the *RadCom* project, and a Morse practice oscillator that had an ingenious design that allowed for two practice CW keys to be fitted, one for the pupil and one for the tutor. The next two entries came from Howard, G6LXK and this time it comprised of an RF Return Loss Bridge and a BITX20 20m SSB transceiver kit fitted into an old PMR radio case. Next was an entry from John, M5AJB, this again was the *RadCom* RF Sniffer for the HF bands. This time John had even gone to the trouble of constructing the case for the device himself. It was made from carefully cut and assembled sections of double-sided copper PCB. The final entry was from Dave, G3PEN, this was a range of projects that Dave had built dating back to the 1960s. The largest of these was a power distribution system that is shortly going to be installed in Dave's shack.

As usual the voting was carried out by all the members present on the night - each entry being given a score out of a maximum of ten. The results were extremely close with the three top places all being within a few points of each other; the winners being Howard, G6LXK, for his 20m SSB transceiver, Edwin, G0LPO, for his Practice Morse Oscillator and Howard, G6LXK, for his Return Loss Bridge. Howard, G6LXK, retains the trophy for another year.

T32C DXpedition

CDXC is running a raffle in support of the T32C DXpedition. There is one prize – a Yaesu FT-950 transceiver that sells for around £1,290. This is sponsored by Martin Lynch & Sons, Nevada Radio and Yaesu UK. ML&S is also supplying a 30A power supply, a MyDEL MP-30SW111. Tickets are priced at £1 each in books of 10. 1,500 books have been printed. RSGB members in the UK who are not CDXC members are able to buy tickets through CDXC members. Contact the promoter Neville Cheadle, G3NUG for details, via g3nug@btinternet.com or phone 01568 750 560.

The draw will take place on 26 August just prior to the DXpedition. Details are on the CDXC web page www.cdxc.org.uk under the heading T32C Raffle.

GB6COD

The Royal Naval Amateur Radio Society will run a Special Event station at the open day in HMS Collingwood on Saturday 4 June. The callsign to be used is GB6COD, Collingwood Open Day. The station will be operational on all amateur bands from 1.8MHz to 440MHz. The Society headquarters station will be open for viewing from 9.30am to 6pm on the day. A number of demonstrations will be taking place using amateur radio and amateur television. The open day will feature the Royal Navy Field Gun Competition. Additional attractions will include a display from the Royal Marines Band, Collingwood, a free funfair and much more. Advance tickets will be available from Gosport and Fareham Tourist Information Offices and Portsmouth News Offices from May 2011.

Woodhouse Park Amateur Radio

A stalwart team of ex-Scouters and amateur radio enthusiasts devote many hours each year working with Scouts, Cub scouts, Beavers, Guides and Brownies explaining how radios work and what being an amateur radio enthusiast is all about. Groups of youngsters, usually camping at the Scout Camp at Woodhouse. book sessions lasting around 30 minutes, where the team explain what is involved and how radios work, followed by a question and answer session. Then the youngsters are sent out onto the camp site with the Club's two-way handheld radios where they have much fun calling each other. At the end of the session certificates are awarded to all participants. Where required, the youngsters can continue to complete proficiency badge work and can also continue to gain their Foundation licence.

So far during the last 12 months, in excess of 720 youngsters have passed through the doors of the communications shack.

Some of the participants at a recent weekend event for cadets.

NEWS IN BRIEF

• Adrian, 2E0SDR has just started The Software Defined Radio Club (www.softwaredefinedradio.co.uk). The idea is to create a global community dedicated to the technology of software defined radio and membership is free. The site is being run as a dedicated Portal with all members being able to add content to the site.

Duplex Technology

In the USA, Stanford researchers have developed wireless technology for faster, more efficient communication networks. It allows wireless signals to be sent and received simultaneously on a single channel. Their research could help build faster, more efficient communication networks, at least doubling the speed of existing networks. If you'd like to read more about this, check out http://news.stanford.edu/news/2011/february/duplex-radio-transmission-021411.html.

Mid Ulster Exam Success

The Mid Ulster Amateur Radio Club wish to congratulate the latest candidates who passed their Intermediate exam. This was a large class, who enjoyed both the fun banter and the hands on learning. Tutored by Alex, MI0MVP and assisted by a group of dedicated volunteers within the club, this was an extremely successful class, with many hoping to enjoy their new 2I0 status very shortly on the bands.

Midlands 80th Anniversary

As part of the 80th year of the Midland Amateur Radio Society will be holding an open day at the club QTH, from 10am to 4pm on the 25 June. Plans are for refreshments, meet the training staff and there will be stalls and operating using GB80TH. More information from the club website at www.radioclubs.net/mars.

Foundation Success

Stevenage & District ARS had success earlier this year with their Foundation Exam candidates. Left to right are Rob, Anthony, Chris, M6ZKX and Darren. The stress of the exam took its toll!

Ludlow ATC 333 Squadron plays host

Ludlow ATC recently opened its doors to two cadets from Leominster ATC 151 squadron, Flt Sgts Lort and Washbrook. They joined Explorer Scout Callum Monteith-Roberts from Ludlow with six cadets from 333 Ludlow Squadron for a weekend Amateur Radio Foundation Course.

In addition, two trainers attended from the Telford and District Amateur Radio Society; retired RAF Warrant Officer (Comms) Mike Street, G3JKX, Lead Instructor and Rich Brown, MORKY, Instructor.

Lead Instructor Mike Street commented that it was the first time in many years that he had been to an ATC squadron and memories of both his time in the ATC and in the full-time RAF were reawakened. Maybe seeing the cadets in the RAF uniform had something to do with it!

Two other local amateurs facilitated the on-air practicals; Alan Richards, G7RHF from Clee St Margaret and Chris Small, MOMTS from Hope Bagot.

Ludlow ATC is open, Tuesdays and Fridays from 7 to 9.30pm for prospective cadets over 13 years of age. The squadron is located in the Smithfield Car Park off Lower Galdeford, SY8 1RT. The contact e-mail is oc.333@aircadets.org. New cadets are warmly welcomed at any time.

On the left Rich Brown MORKY, Cadets and Scout from Ludlow, Cadets from Leominster and on the right Retired RAF Warrant Officer and Lead Instructor, Mike Street G3JKX. Photo by David, G4OYX, CI Comms 333 Squadron.

100% pass mark

In March, Simon Melton passed his Foundation exam with 100% pass mark at the York Radio Club. The instructors and other club members wish him well in his new hobby.

Essex CW Club Memorial Trophy

The Essex CW Club Memorial Trophy has been awarded to Colin, M1OCN for his outstanding progress in learning the Morse code during the CW classes offered by Andrew, G0IBN during 2010. The Trophy was donated to ECWARC by the family of the late Peter Hale, G4OAD and has been fully refurbished by G0IBN over many months during last year.

The award was presented to Colin by ECWARC chairman Steve, G4ZUL. ECWARC would like to thank the Chelmsford ARS for their help and support in making this possible.

Essex CW Club is a unique group supporting and encouraging the learning and use of Morse code. Details at www.essexcw.org.uk.

Fast Tracking to the Full Licence

At the start of October 2010 Midland Amateur Radio Society received an e-mail from Adrian Cresswell wanting to go from no licence to the advanced licence as quickly as possible. So after a couple of classes he sat the Foundation exam on 3 November 2010 and passed with ease and became M6AIY. Not having the time to use the callsign he went and sat the Intermediate on 15 December 2010 and again passed gaining the callsign 2E0CEL. But this was still not enough for him and on 1 February 2011 he sat the Advanced exam and passed, he now holds the callsign MOMPH. This is a record in the MARS club and would be nice to know if any readers know anyone who has gone from no licence to Full licence in 91 days.

Antenna Analyser

The MFJ-266 covers HF, VHF and UHF amateur and commercial frequencies. It also displays SWR, complex impedance, and impedance magnitude simultaneously, all on the same LCD screen. You can use it to measure capacitance, inductance, field strength, frequency and to generate test signals. It is a junior version of the ever-popular MFJ-269 but priced at £339.95 inc VAT. Details at www.wsplc.com.

Exam Success at Kilmarnock & Loudon ARC

Since the beginning of the year, new members of Kilmarnock & Loudon Amateur Radio Club have been studying towards their Foundation licence exam. Their hard work has paid off and instructors Allan, GM3OZB, Frank, GM6JEP, Len, GM0ONX and Barry, GM3YEH, would like to congratulate them on their success.

Pictured are left to right Colin, Arran, Kenny, and Bruce.

Another recent success is Arran who achieved his Foundation licence and now has MM6ARN for his callsign.

Excalibur Pro

Winradio will be launching their new Excalibur Pro Software Defined Receiver at Friedrichshafen in June this year. The new Pro version builds on their very successful Excalibur receiver and adds an extended digital down-converted bandwidth along with configurable bandpass filtering.

The Excalibur Pro features continuous coverage from 9kHz through to 50MHz using a high grade 16-bit 100 million samples per second (MSPS) digital to analogue converter. The front end is extremely robust with a high linearity amplifier, a switchable 0-21dB attenuator and a pre-selector with up to 119 different filter combinations. The Excalibur Pro boasts a dynamic range of 107dB and a frequency stability of 0.5ppm. One of the other significant development has been the addition of a 4MHz DDC (Digitally Down Converted) bandwidth that's available for recording and demodulation.

The WiNRADiO WR-G33DDC will be available directly after Friedrichshafen with a recommended sale price of €1,469.

NEWS IN BRIEF

• Nicolas, M1HOG from the Stevenage Club has published a free application for Android phones. Called *Repeater* it easily finds amateur radio repeaters across the UK using your Android phone. Read more at https://market.android.com/details?id=com.zbm2.repeater&feature=search_result.

New Repeater

L-R. Andy Russell, G0VRM and RSGB DRM Mario Brashill, G2DPA.

The East Yorkshire Repeater Group has a new 70cm D-Star repeater, GB7HU, in East Yorkshire. The new service is the culmination of several years of planning by their committee, along with a successful grant of £9,466 received from the National Lottery (Big Lottery fund). The group has also purchased several D-Star transceivers, a high quality generator for use with emergency communications in East Yorkshire. GB7HU was switched on by the RSGB DRM for East Yorkshire, Mario Brashill, G2DPA. The first contact was made by the NOV holder, Andy Russell, G0VRM with Clive Reynolds, G3GJA and Lyndon Reynolds, M0LDR.

Bittern DX annual dinner and prizegiving

Keith Martin,G0GFQ, past secretary and one of the founder members of Bittern DXers, showed that he had lost none of his old skill by scooping three of the most coveted trophies awarded by the club at their recent annual dinner and prizegiving. Despite fierce competition Keith, who spends life confined to a wheel chair, won the Bittern DX Chaser Cup, given to the person who 'works' more countries in a calendar year than anyone else. In addition he also won the club's data trophy at the event and the HF trophy. Keith, not surprisingly, was also announced again as the winner of the Lifetime HF Bands certificate with an overall score of 1119 countries worked on all bands.

Linda, G0AJJ of North Walsham collected two trophies at the prizegiving and Ken, M6KAH won the data low power award.

NEWS IN BRIEF

• Callington Amateur Radio Society will be holding another Foundation course and exam starting on Thursday 15 September 2011. The course will run from 7 to 9pm each Thursday for 5 weeks, with the exam during the final session. For further details please contact Chris Harris 07973418371 or e-mail g7udx@me.com.

Award Presentation

Norfolk Amateur Radio Club held its annual AGM and award presentation inApril. The awards were presented by the Club President Malcolm, G3PDH and included Best Newcomer, Speaker of the Year, plus there was a Youth Award, President's Cup, Committee Cup, Koblenz Plate and many more.

Interviewer Inspired

Last year the Chelmsford Amateur Radio Society was asked by the UK Digital TV and Technology Podcast, FrequencyCast, for an interview. It was about the special event station, GB90MZX, that was commemorating the 90th anniversary of the historic Dame Nellie Melba broadcast from the Marconi factory in New Street, Chelmsford on 15 June 1920.

The CARS Chairman John, G8DET, gave the interview to Pete Sipple from FrequencyCast in the Oaklands Museum, Chelmsford, where the commemorative station had been set up. During the interview John discussed amateur radio, Marconi and even mentioned the interference caused by PLT devices. Pete was so inspired by discussing amateur radio with John that he decided to take up the hobby and enrolled in the next CARS Foundation course held in the Danbury Village Hall near Chelmsford. Having successfully completed the CARS course Pete is now licensed as M6PSI and says he's thoroughly enjoying the hobby.

Buildathon at QRPiC 2011!

The Bath Buildathon team led by Steve, G0FUW will be supervising construction at this year's QRP in the Country event being held at Tim Walford G3PCJ's Upton Bridge Farm, Long Sutton, Somerset TA10 9NJ on 17 July. The project will be a Cary Regen receiver. In its simplest form the Cary is a single band RX for 80, 160 or the medium wave band; but there is also a 3 band option for 20, 40 and 80m – see the Walford Electronics website for more details. Those wishing to take part should send payment by cheque or Paypal to Walford Electronics at Tim's address. The cost is £40 for the 3 band version and construction is expected to take 3 to 4 hours, so there will be time for you to see the other attractions. The closing date for entries is 4 July. Places are limited so book early.

AMSAT-UK FUNcube Yahoo Group

In less than 6 months the AMSAT-UK FUNcube Yahoo group (http://groups.yahoo.com/group/FUNcube) has attracted over a thousand members. Set up by Rob, M0TFO the group covers both the FUNcube 70cm/2m Satellite currently under construction and the popular FUNcube Dongle 64-1700MHz Software Defined Receiver. The Dongle was developed to provide a low cost means of receiving the FUNcube satellite but with its wide frequency range users have found a variety of uses for it. As well the Yahoo group Rob also runs the AMSAT-UK Facebook page.

Thanks to Adam, M0HKY FUNcube information is now also available on Twitter (http://twitter.com/FUNcubeUK), which has proved to be a fast and efficient means of getting news out direct to peoples PCs and mobiles. As well as the online presence AMSAT-UK also produce a quarterly colour A4 printed newsletter, OSCAR News, packed full of information on amateur satellites.

Wouxun handy with 70 & 144MHz!

Wouxun have launched yet another new model. The KG-UVD1P/L is identical to the original UVD1P but instead of offering 70cm & 2m, the new /L version packs the 4m and 2m band side-by-side. It will be available in June 2011 at an introductory price of £99.99 including VAT. As usual with handhelds from Wouxon it comes supplied with a 5W lithium ion battery pack, 240V/12V base charger, battery clip, antenna and handbook. For more information contact ML&S at www.hamradio.co.uk.

Valves Wanted

A new volunteer led Reconstruction Project is taking shape at Bletchley Park using WWII technology and, in particular, International Octal based valves coupled with encrypting and deciphering equipment. As with many such projects funds are limited and hardware donations would be welcome.

There is however one particular problem, in that many of a somewhat unusual valve are required. These are 6C8G, a double triode with one of the grids brought out to a top cap. If anybody has any to donate the volunteers would be very grateful. Contact John Harper by e-mail to bombe@jharper.demon.co.uk.

GB0CMR

Hinckley Hospital Radio on the Air

PHOTO 1: GB0CMR antenna outside the Castle Mead Radio studio (in the roof space above the wards).

ANNIVERSARY CELEBRATIONS. The news piece from Norman, MOJEC in *RadCom* earlier in the year, encouraging amateurs to help celebrate 85 years of hospital radio in 2011 spurred BBC announcer Jim Lee into action. Although he is not a hospital broadcaster any more, Jim, G4AEH is a Trustee of Castle Mead Radio (CMR) in Hinckley in Leicestershire.

On the presentation team is Jerry, G3WTD and, together, Jim and Jerry approached the station management to gauge interest. The chairman and station manager turned out to be very enthusiastic and saw it as an excellent way to spread the word about hospital radio in general and CMR in particular. Coincidentally, 2011 is CMR's 21st anniversary. The station that used to pride itself on being Britain's smallest hospital radio station started in 1990 in a broom cupboard. Since 1994 it has had an impressive couple of well-equipped studios at the top of the old hospital building.

INTO A REALITY. While formal permission was awaited from the hospital authorities, Jim and Jerry, G3WTD set about making the idea a reality.

"We decided that we'd follow Norman, MOJEC's idea of running the special event over two weeks – one prior to and one during Hospital Radio Week at the end of March," said Jim, G4AEH. He had started in hospital radio over 30 years ago, leading to regular announcing duties these days on BBC stations like Radio 4, Radio 4 Extra and the BBC World Service.

"Being realistic, we knew we couldn't do it on our own, so we approached John Rogers, MOJAV, secretary of the Hinckley Amateur and Electronics Society (HARES) to see if club members would be interested in helping."

It turned out that MOJAV, who is also RSGB DRM R131, was keen to help. Not only was CMR a great comfort when both his parents were seriously ill in hospital, he saw the special event station as an opportunity for some much-needed operating practice for members he is training towards their Foundation and Intermediate licences. HARES may not be the biggest club in the country but it has built up an impressive collection of equipment and antennas for Field Days and its own special event stations over the years. Everything was put at GB0CMR's disposal.

GETTING ON THE AIR. The evening before the event was to start on 19 March, a small group from CMR and HARES gathered at the studios to put the station together. Two trapped dipoles, a long wire and a dual band collinear were erected on a flat roof adjacent to the studio suite by club member Vinny. MOTAV, a scaffolder by profession - just the man for the job.

In the office adjacent to the studios, the club's FT-847 was set up on the long wire and collinear. Icom UK had very kindly loaned the group a rather gorgeous IC-7600 complete with PSU and desk mic. This was attached to the trap dipoles.

"With the tremendous co-operation of HARES, CMR, Icom, Ofcom and hospital management it couldn't have gone better," says Jim, G4AEH. That's not to say that once the station got on air there weren't a few problems.

QRM. "The timescale meant that we were unable to do the EMC tests we'd hope to do. Being in an old hospital building we expected that most of the interference would be caused to our receivers. And that turned out to be the case. RF getting into the studio monitors was easily solved with the help of Bob, G8BFF in isolating the cause. We switched off the amps!"

More difficult to solve was QRM from at least three sources – CCTV cameras in the hospital, an air-conditioning filtration plant on the roof and, most serious of all, the 100 volt line that took the audio from the studios to adjacent hospital buildings. Disappointingly, they all combined to give constant 20 over 9 noise levels on 40m and 80m, spoiling inter-G working. The good news was that the other HF bands were clear and the IC-7600 and dipoles worked well into the Falklands, North and South America, Indonesia, Australia and all over Europe.

SUCCESSFUL EVENT. It was a fun event for all concerned. It's not often that your average G4 or 2E0 finds himself at the mercy of massive pile-ups but that's how things turned out when GB0CMR did manage to get on 40m. Hundreds of contacts were made, including a couple with the only other special event station

PHOTO 2: Jim Lee G4AEH working the pile up on 40m picking calls out from the QRM.

Special Event Stations

Is your club taking part with in a special event station? If so, we will be happy to publicise it in RadCom, on GB2RS and on the RSGB website beforehand and include a brief report after the event. If you look at the News pages of this edition you'll find announcements and reports of three special event stations; there's a feature on GB200NHC on page 50 - and there are over 30 more special event stations listed for June on page 89.

Remember, also, the purpose of a special event station is to introduce members of the public to amateur radio - it is not about attracting juicy DX by waving your unusual callsign around the bands. Always make sure that the site is attractive to and accessible for members of the public. You should also ensure that there is at least one member of the team on hand at all times who is not playing radio but ready and able to explain what is going on to visitors. And get those visitors involved - let them pass a greetings message to a distant station. When you operate a special event station you are an ambassador for amateur radio; conduct yourself accordingly.

Finally, if you plan to QSL, remember that all incoming GB QSLs are handled by Mrs Davina Williams, M0XLT, 20 Neale Close, Wollaston NN29 7UT, e-mail qsltrek@hotmail.co.uk. Make sure you lodge plenty of stamped envelopes with her - GB cards CANNOT be bureau-routed via any other callsign.

PHOTO 3: Bob Bennett, G8BFF and Mark Burrows, 2E0SBM working the HARES club rig on 2m.

PHOTO 4: Jerry Davis G3WTD getting to grips with IC7600 kindly loaned by Icom UK.

we knew to be on air – GB8HBW in Newbury with Norman, M0JEC at the controls. Norman even offered to look after our QSL cards.

All in all, hospital radio, CMR, up and coming radio amateurs in Hinckley and even a few old-timers all got a great deal out of it. Given the number of contacts made with radio amateurs who had links to hospital radio. perhaps next time we can look forward to a lot more special event stations?

MORE TO COME. GB0CMR was only the first of a number of special events that HARES has planned for this year, including Churches on the Air (COTA) from Breedon on the Hill, Railways on the Air (ROTA) from Shackerstone Station and British Inland Waterways on the Air (BiWOTA) from The Waterways Festival at Shobnall Fields, Burton-upon-Trent, the brainchild of John M0JAV, on 29-31 July.

Doublet antenna at six feet above ground

A practical and cheap antenna for low power on all bands

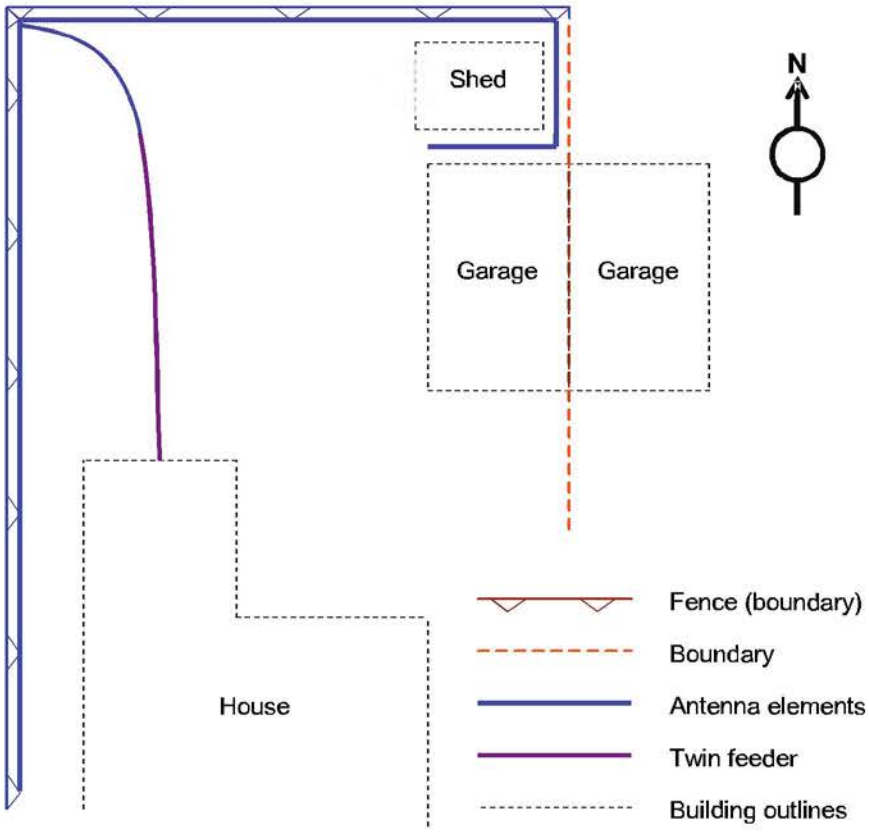


FIGURE 1: General layout of the doublet antenna that runs around my garden fence and shed.

INTRODUCTION. There must be a number of stations around the country that do not have large gardens in which to erect low frequency type antennas and who would like to operate on these bands. My own garden is a prime example so I started thinking about what I could do in order to operate on these bands.

INITIAL TRIES. My first attempt was an 80m trap dipole around my garden fence. This was only to be a temporary solution to get on the air. The antenna was made from cutting off one leg of 300Ω standard ribbon, leaving as much webbing on as possible and using drawing pins to secure this to the fence. I fed the antenna with 75Ω twin feeder back to a 1:1 balun at the ATU. The length of the antenna was reduced below the theoretical length because of the proximity of the wire to the fence and ground. Having got the trap dipole to work on 40 and 80m using the ATU, I proceeded to operate on the bands. The reports I received were encouraging but I suffered lots of QSB and received signals were not that strong. Also, the wire soon became weathered and suffered many breaks.

I attempted to get the antenna higher by running 22SWG wire down the eaves of my bungalow. The centre was just over 5m high at the feed point; the feeder was 75Ω twin approximately 6m long, leading to a 1:1 balun. The remainder of the antenna wire to the traps and beyond was approximately 2.5m above ground. This worked better and signals were stronger. However, being erected around the bungalow I suffered many problems of interference to my broadband router, computer and telephones. I then spent a considerable amount time trying to cure this interference with ferrite rings, filters and repositioning my router. I had no success, as the bungalow was in a strong RF field. My problem was made worse by the fact that my wife wanted to use the computer online while I was on the air. It was now time to consider an alternative antenna.

ALL BAND DOUBLET. I was talking to Bob, G3MSL, who eulogised about doublet antennas – he uses one himself. I gave him the maximum dimensions of my garden and he put this into his computer with modelling software. He determined that it would be possible to obtain better results from a doublet, despite it being only six feet off the ground. His findings were interesting and proved that although there would be considerable losses on the lower bands, performance would get better as I went up in frequency. So my doublet was born.

CONSTRUCTION AND INSTALLATION. My garden fence has wooden panels that drop into slots in concrete posts. The posts are six feet apart. On each post I glued a nylon furniture (cabinet) block, obtained from a DIY shop (see **Photo 1**). The blocks support 19.2m (63 feet) of 22SWG enamelled copper that I threaded through holes in the blocks. The north-south leg starts at the centre insulator at the top of my garden and runs down the garden fence. The east-west leg starts at the centre insulator and runs at right angles across the garden fence behind my shed and terminates on an insulator fixed to the end of my garage. The length of wire is not critical but try and put out as much wire for the lowest band you wish to operate on – a half wave on 80 metres in my case. I would like the antenna to be longer to work on 160m, however it works as a quarter wave with reasonable results.

At the centre insulator (see **Photo 2**) I attached about 21m (70 feet) of 300Ω slotted ribbon feeder, which runs back to my shack at about 60cm (2 feet) off the ground. Indoors, it is terminated in a 4:1 balun and a coaxial patch lead to the ATU.

PHOTO 1: A furniture block, glued to the fence post, makes a decent insulator.

PHOTO 2: The feed point: ladder line meets antenna elements at a dogbone insulator.

I use a Yaesu FC-102, which has a built-in meter. Other ATUs would work just as well.

CONCLUSION. The newly erected doublet around my garden fence seems to work quite well and the reports I am receiving are very encouraging. By putting the antenna down the garden, away from my bungalow, I no longer have any interference issues. My wife can happily play her bridge online.

Some may say that this antenna is not very efficient, but the proof is in the results. This antenna is particularly useful for someone who has restricted space, has no useable trees and is not able to erect any poles as antenna supports. The construction only requires slotted ladder line, wire and insulators. Above all, it is inconspicuous to any neighbours.

Note from the Technical Panel

Safe use of this type of antenna, low down in a small garden, is the responsibility of the individual radio amateur because it involves site-specific judgement. Anyone installing this antenna should make sure that it cannot be touched accidentally from ground level while transmitting (to control the straightforward shock hazard). It is recommended that the antenna is only used at QRP power levels, say up to 10W or so, to ensure that no-one approaching the antenna is subjected to high field strengths. The responsibility and liability for its safe use is entirely with the individual.

In spite of the author's good experience, this type of antenna remains *high-risk for EMC*.

General Purpose PIC Controller

A development board with several useful configurations

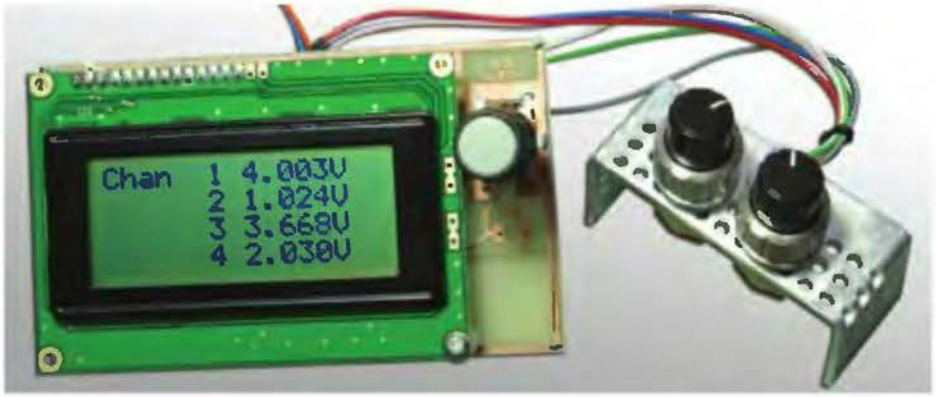


PHOTO 1: The general purpose PIC controller configured as a 4-channel voltmeter. The twin concentric pots are for demo purposes and set the four input voltages.

OVERVIEW. The PIC microcontroller is a wonderful device for radio amateurs, allowing a wide range projects to be built using one underlying basic hardware design. The chip manufacturer, Arizona Microchip [1], offer a range of devices for all sorts of applications, ranging from low pin-count devices for simple pushbutton jobs, right the way up to advanced digital signal processing.

The 'mid range' PIC16Fxxx family of devices are probably the most useful to us, as they come in a variety of packages and pin counts, are straightforward to program, have the same basic processor core and come with a variety of different on-chip peripherals. These include analogue to digital converters, timer counters, serial interfaces, EEPROM memory and various numbers of input / output pins. Some even have integrated USB interfaces.

To allow widespread adoption by amateurs and give an introduction to the use of PICs, I designed the module described here (**Photo 1**). A few standard applications have been developed in parallel, with ready-programmed PICs available for a plug-and-play solution. The fully commented source code is also available for free download. I strongly advise you to think about obtaining a PIC programmer and the free software tools to try modifying the code so it does what you want it to do. Then try writing your own applications! Details of how to obtain programmers and programming tools are at the end of the article.

But be very, very wary. PIC programming is one of the most addictive things ever invented! Once you start writing code, all thoughts of food, drink, bed and exercise stop until the project works. Been there, done that!

UNIVERSAL PIC DEVELOPMENT PLATFORM. The module is a platform designed to run PIC software to control and interface to external hardware. **Photo 2** shows a prototype. An 18 pin socket is provided for a DIL packaged PIC16F628 or 16F819 device – these are two mid-range 'workhorse' devices with most of the peripherals we will need. They can be either programmed externally, or via the in-circuit programming (ICP) interface. The board includes provision for either a two- or four-line by 16 character liquid crystal display, with holes on the board designed for direct installation of either of these. A suitable low cost 4x16 LCD module is available from **[2]**. The holes can be a convenient way to mount the whole assembly in an enclosure. Alternative LCDs or compatible displays of different dimensions can be used with a flexible jumper connection.

A rotary quadrature encoder with integral push button can be fitted to the right of the LCD for applications that require up/down tuning or entry of variable parameters in conjunction with the display. An alternative would be an off-board encoder with separate pushbutton and it is also possible to use a stepper motor with a differential line-receiver interface as described in Design Notes **[3]**.

USER INPUT / OUTPUT. The whole purpose of the module is to provide a capability for controlling or reading external hardware. For this, up to five input/output (I/O) lines are made available on an 8-pin header, along with +5V and ground connections. Depending on the choice of PIC, these connections can function as analogue inputs as well as digital I/O. Two more digital only I/O lines plus the processor reset line are accessible using the 4 way in-circuit programming header, making a total of up to seven connections for the most demanding of projects. A LED mounted on the PCB just above the rotary encoder can be allocated to one of these lines.

Example of devices that can be controlled are:

- Serially programmed synthesiser chips – requiring three or sometimes just two connections.
- Serial D/A converters for generating voltage levels defined by software, like PSUs, test equipment, audio generators
- External high resolution A/D converters – more than the 10 bits offered by the integral ADC
- Serially programmed expansion chips, like relay drivers for controlling high current external hardware. Or just shift registers like that used for the LCD. A parallel input serial output shift register like the 74HC165 can be used for reading multiple digital inputs or status lines.

All rarely need more than three I/O lines, leaving some spare for other enhancements.

ANALOGUE INPUTS. The PIC 16F819 has an internal five channel 10-bit A/D converter and provision has been made on the board for some analogue conditioning circuitry if required. The converter allows use of an external voltage reference for accurate voltage measurement so for maximum flexibility the PCB has been designed to take a MAX6004 4.096V precision voltage reference. Its output is fed to the appropriate reference pin, reducing the analogue channels to four. For less demanding voltage measurements the internal +5V supply can be defined as the reference, allowing all five analogue inputs channels. Component pads have been included on the PCB on the interface lines so users can install potential divider resistors, or filtering capacitors as needed.

CIRCUIT DESCRIPTION. The full circuit diagram is shown in **Figure 1**, which includes all the options mentioned above. Note the LCD module interface, which needs 8 parallel data lines for sending it the text to display, as well as a register select pin and a strobe signal. The ten interface connections would use up most of the PICs I/O capacity so a 74HC164 shift register is used to allow the PIC to output the data serially on two lines. The shift register converts the serial data from the PIC, in conjunction with the *Clock*, into 8 parallel outputs, with the ninth bit of data, the register select, remaining on the Data line after clocking in the 8 bits. A third *Strobe* signal from the PIC latches the information into the LCD module.

The rotary encoder uses two more of the PIC pins for its In-phase and Quadrature connections – both being needed to extract direction of rotation. The pushbutton takes

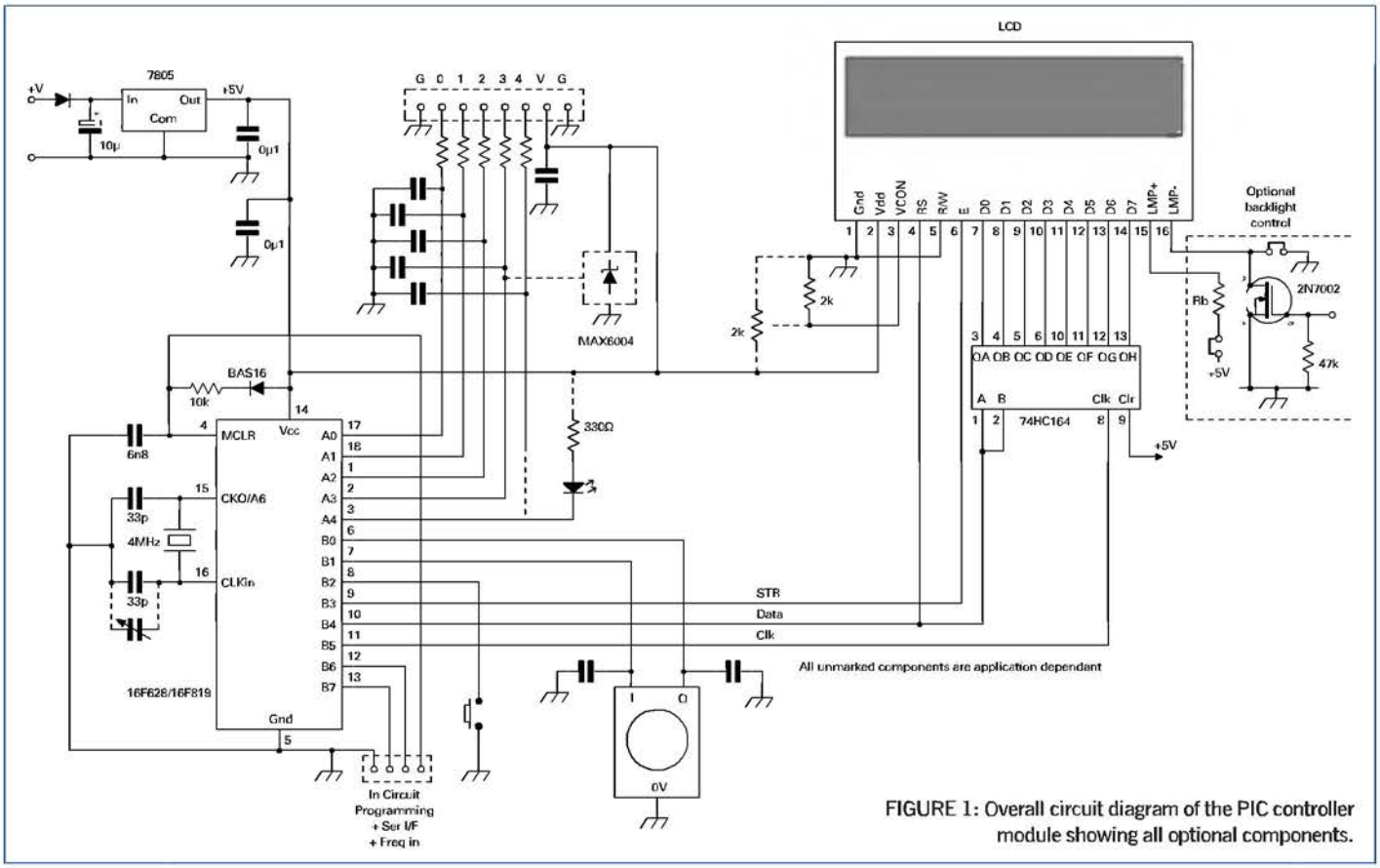


FIGURE 1: Overall circuit diagram of the PIC controller module showing all optional components.

one more. All of which means just six I/O lines are tied up with module itself, leaving the rest as user I/O. Two I/O pins are allocated to the in-circuit programming interface but are available as I/O pins on a separate header. Because of the PICs internal allocation of pins to its various peripheral components, one of these two must be used for the frequency counter, described later.

A 5V regulator and reverse protection diode provide power for the module. Although the PIC device and LCD only consume a few milliamps, a 1A regulator has been installed with a bit of PCB heaksinking to allow it to power additional hardware and/or for an LCD backlight. The high current capability allows pin and software compatible vacuum fluorescent display to be used instead. These need several hundred milliamps at 5V; one is shown in **Photo 2**. Connections to allow a FET to turn the backlight of the LCD on and off under software control are included on the PCB, but are unused at present. The LED, if installed, runs from user I/O line 5.

For analogue applications, each of the five I/O lines includes a series input resistor and a capacitor to ground for filtering. The maximum input voltage is 5V (or lower if the 4.096V reference is used) so these capacitors can be replaced with resistors to give a potential divider for higher input voltages. If filtering capacitors are still then needed, they can be piggy-backed on top of the respective shunt divider resistors.

For digital I/O, a small value resistor in the region of 200Ω in series with each connection is advisable as a current limit in case of short circuits to ground or the supply. Each pin of the PIC can safely source or sink 20mA and internal clamp diodes to Vcc and ground protect against excursions above 5V and below 0V. The PIC is a very robust microcontroller – it has to be: it was designed with applications like washing machine controllers in mind!

MODULE HARDWARE AND CONSTRUCTION.

A rear view of the PCB carrying components and connectors is shown in **Photo 3**. Apart from the DIL IC socket for the PIC and a couple of other larger ones, all components are of surface mount type using the comfortably-sized 0805 dimension for resistors and capacitors (dimensions 1.6 x 2mm). The devices are well spaced apart and assembly shouldn't present too many difficulties for the home constructor. Full construction details including board overlay with component placing can be obtained from **[4]**. The two links shown are only applicable to LCD backlighting, as is resistor Rb, and can be left out when this facility is not used.

COMPONENT AND PCB AVAILABILITY.

See [4] for full details of how to obtain the PCB. As most constructors will have their own requirements and sources of components (and with all the differing functions and configurations possible here), providing a full kits of parts is unrealistic. The PCB was designed to accept the EC11J152 type of rotary encoder with integral pushbutton, available from Farnell **[5]** - part number 165-6447. Farnell also stock everything else needed – although their LCD modules aren't particularly cheap! The ready-to-go designs require a 4 line x 16 display, like those from [2] but with changes to PIC software, any other text-based LCD with the standard 14 or 16 pin in line connections can be dropped in.

Small SMT components may present a minor problem to some. While these can be **extremely** cheap if you go to the bigger component suppliers, resistors may have to be purchased 50 at a time. Some amateurs have quite successfully recovered SMT components from scrap boards, using a blowlamp or hot air gun to remove the whole lot in one go. I often do this to get at the quite nice ICs that can sometimes be found in junk at rallies.

READY-TO-GO PROJECTS.

Several projects described are ready-to-go designs with pre-programmed PICs for plug and play operation. At the time of writing the following are operational, but may yet undergo further enhancement:

- 4 Channel Voltmeter
- Automatic VSWR and Power Indicator (separate RF head hardware needed)
- Frequency Counter – up to typically 50MHz, but may go higher
- Dual Controller for a pair of I2C programmed synthesiser chips as used in the G1MFG and similar Comtech FM TV Tx/Rx modules.

The first, a four-channel voltmeter, gives

PHOTO 2: Frequency counter display with a vacuum fluorescent display installed. (The PIC code was written for a 4 line display, so part of the text showing the gating interval is missing).

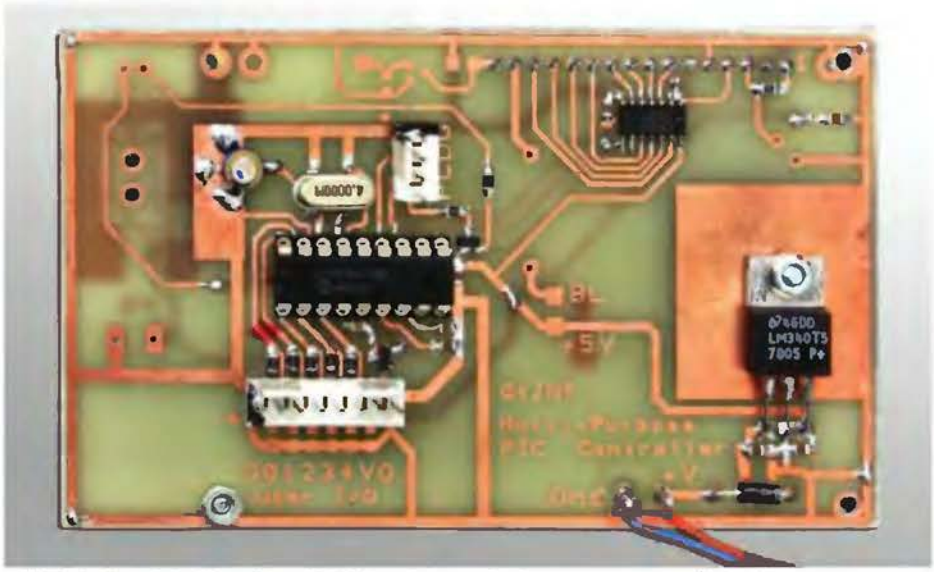


PHOTO 3: The original breadboard PCB from the rear showing components and input/output connections.

the display shown in Photo 1. The MAX6004 voltage reference is installed so the four analogue channels go to I/O pins 0, 1, 2, and 4. I/O line 3 is allocated to the reference and connected on the PCB, so its respective resistor R4 and associated capacitor should not be installed unless you need to bring the 4.096V reference out for further use .

The PIC code cycles through each channel and makes 16 successive ten-bit readings of each channel. Every read yields a value from 0 to 1023, which is proportional to V_{in}/V_{ref}. The 16 readings are added together and divided by four giving a number in the range 0 – 4092 which, provided the specified 4.096V reference is used, is equal to the voltage input in mV. This summation of 16 reading gives some averaging and increases the resolution slightly for noisy signals. Please note, though. that for steady DC voltages, the averaging does not increase resolution above the basic 1024 levels possible from 10 bits.

The display shown is from the first version produced at the time of writing, and shows just the voltage on each channel. With a 10 times potential divider on the input **[Note 1]** the value would indicate up to 40.95V. It is intended to add user-adjustable decimal point placement, or scaling, on an individual channel basis, set using the rotary encoder and/or the pushbutton then stored in the PIC non-volatile memory. See [4] for details of the latest version. Further enhancements could include differential readings, AC measurement with true RMS, and relative level in dB.

AUTOMATIC SWR BRIDGE. The two detector diodes in any SWR bridge produce two DC voltages that are related to forward and reverse RF power. Normally these are taken to an analogue meter and the scaling adjusted with a potentiometer to set the Forward reading to full scale, whereupon switching to measure Reflected power indicates the reflected signal fraction. In effect, the meter is being forced to show the ratio V_{FWD} / V_{REFL}. By connecting the two voltage outputs, instead, to two input channels of this voltmeter, then calculating the ratio between them inside the PIC, the SWR can be calculated automatically and made independent of power level. It also becomes possible to add a digital readout of actual forward power.

VSWR can be calculated directly from $(V_{FWD} + V_{REFL}) / (V_{FWD} - V_{REFL})$. Alternatively, the reflection coefficient ρ (rho) can be first calculated: $\rho = Vfwd / Vref$ Then $VSWR = (\rho + 1) / (\rho - 1)$. This latter, more complex route is chosen here as the reflection coefficient is a convenient value to have on hand for future applications.

Strictly speaking, these should be the RF voltages (RMS, or peak) but the majority of diode detectors deliver a DC level close to the peak of the RF waveform, minus any forward drop in the diodes. By using Schottky diodes this drop is in the region of 0.2 to 0.4V, low enough to ignore for practical purposes. So now $V_{DC} = V_{peak}$ and can be used directly in the VSWR calculation.

The PIC makes 16 readings of each of the forward and return DC voltages, which are summed to give a pair of 14 bit values. The Forward reading is divided by the Reflected value to obtain the reflection coefficient, ρ. The VSWR is then calculated as shown above. As the PIC can only work with integer maths, scaling factors of 65536 (16 bits) are liberally sprinkled around the calculation indiscriminately, to raise numbers up to useable values. This is not the time or place to go into the full PIC code for the calculations. but the source code is fully documented [4] with all the important routines in their own blocks.

POWER. VSWR calculation is absolute, as it is the ratio between two identically derived quantities. With a properly matched load RF power is given by V_{RMS}^2 / Zo (Zo is usually 50Ω), so we now need an absolute voltage level rather than just a ratio. Assume, for example, our RF detector delivers a rectified DC level of $V_{RF(peak)}$ divided by a scaling, or coupling factor, K.
For a sinewave, $V_{peak} = V_{RMS} * \sqrt{2}$
so our DC level, $V_{DC} = \sqrt{2} * V_{RMS} / K$
(again ignoring diode drop), or
$V_{RMS} = V_{DC} * K / \sqrt{2}$.

Plugging this into the equation for power gives us: $P_{RF} = V_{DC}^2 * K^2 / Zo / 2$.

If we know the voltage division ratio K in the detector we can get a reasonably accurate value for the actual RF power delivered to the load by squaring the Forward reading and multiplying by the appropriate values.

RF DETECTOR HEAD. The circuit diagram of a VSWR detector head suitable for the HF range and beyond is shown in **Figure 2**. This is typical of that inside many SWR bridges. A current transformer is made up from a high-permeability ferrite toroid with a single turn primary formed by the main conductor passing though the middle of the core. N turns are wound on to form the secondary winding. The result is that a current equal to I_{RF} / N is driven through each of the pair of resistors of value R so that the voltage

across each resistor is then I_{RF} / N * R. The voltage developed across each of the two resistors is identical in value but shifted in phase by 180°. This current-related voltage is referred to as V_I.

A voltage divider is made up from two capacitors, C1 and C2. Resistors could be used, but at high power levels they could get hot so the lossless capacitor divider is usually preferred. The 10k resistor just serves as a DC path for the diode current. The voltage division ratio D is equal to C1 / (C1 + C2). In a system with characteristic impedance Zo, we know from Ohm's Law that, with a perfectly matched load, $V_{RF} = I_{RF} * Zo$, so by choosing D and N appropriately, we can arrange for this tapped down voltage to be equal to that delivered from the current transformer *when the load is terminated with the characteristic impedance* Zo. By adding each of the two out-of-phase current-derived voltages to the tapped down voltage (shown on Figure 2 as V_V), one will subtract and cancel, the other will double in value when the bridge is balanced.

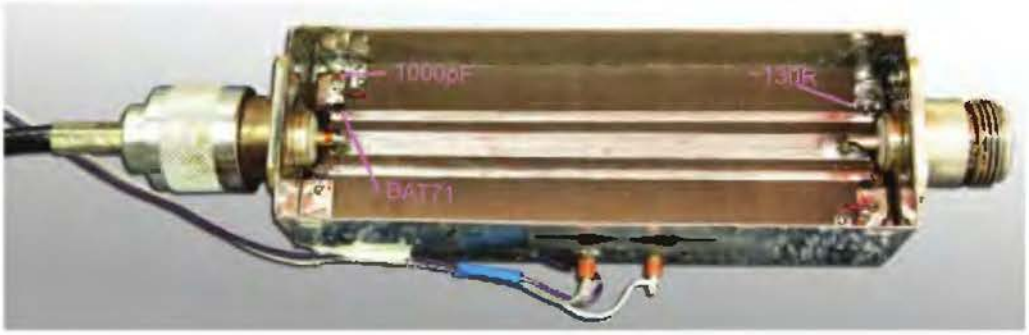


PHOTO 4: VHF high power SWR head (see text).

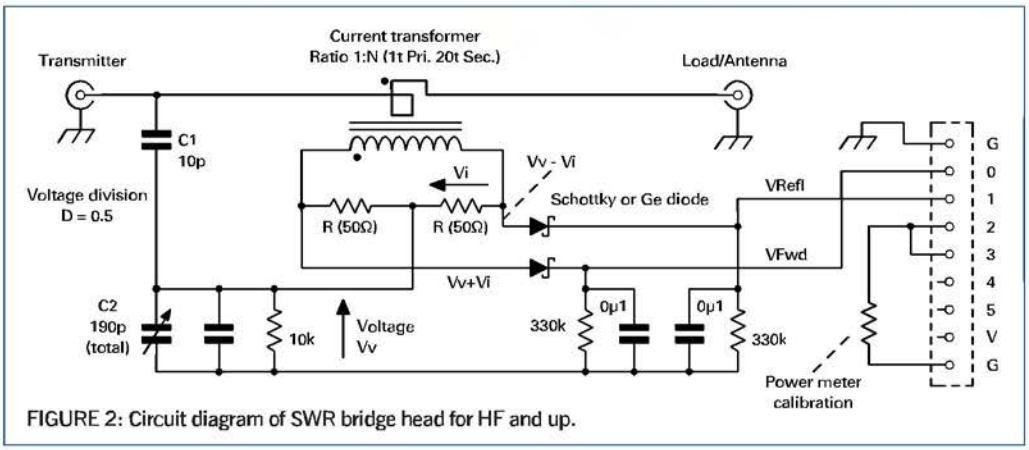


FIGURE 2: Circuit diagram of SWR bridge head for HF and up.

The condition for balance is when $V_{RF} * D = I_{RF} / N * R$. With a load equal to Zo $V_{RF} = I_{RF} * Zo$ so V_{RF} cancels, leaving D = R / (N * Zo). D, N and R can now be chosen to satisfy this equation for a particular Zo (let's keep to 50Ω), but they can still be selected over a wide range to suit power level and practicality. The values shown bracketed in Figure 2 show a 'nice' set of values, R = 50Ω, N = 20 and D = 0.05. The balance equation is satisfied since 50 / (20 * 50) = 0.05.

For any mismatched load, V_I is no longer equal to V_{RF}/K and a new pair of voltages are generated by the two additions **[Note 2]**. These are the V_{FWD} and V_{REF} we need for the VSWR calculation and can be rectified as shown and fed to the PIC module as analogue channels 0 and 1 respectively. The result of summing the two voltages means that, with a matched load, V_{FWD} is now $2 * V_{RF} * D$, being the sum of both the (equal) terms. This results in the factor K needed for the RF power calculation. In fact, K = 2/D.

The voltage divider ratio D = 0.05 gives a value for K of 10. 10W of RF in a 50Ω load will result in V_{FWD} = 2.23V RMS, supplying about 3.1V rectified DC. For higher power designs, either D, N and K can be altered or the rectified voltages can be divided down to fit into the 0 - 4.095V range for the A/D converter.

UHF AND MICROWAVE DETECTOR HEADS.

At the higher frequencies, transformer-based RF heads like that shown become impractical and transmission line based ones are usually chosen. These are rarely possible to design from first principles and a certain amount of trial and error (suck-it-and-see) is involved with their setting up, balancing and calibration. In particular, even when balanced, the voltage division K is unknown and, more often than not, frequency dependent. So, absolute power calculation can become fraught. But with access to a calibrated power meter, measurements can be made and the calibration factors be worked out; DC levels can then be adjusted by potentiometers. For more information on suitable detector heads take a look in the test equipment sections of the various VHF and Microwave publications. As an example, **Photo 4** shows a homebrew SWR head built for monitoring a QRO solid state VHF transmitter. This gives a DC output of around 7V for 166W of RF at 70MHz, which has to be reduced in a potential divider before going to the A/D converter.

By the time this appears in print, it intended that the scaling factor for absolute power measurement will be made user-adjustable: a third analogue input being used to inject a 'calibration' voltage which the PIC interprets as a scaling factor. Setting the value this way allows several different RF heads to be used with the same PIC code without reprogramming the PIC itself for different power calibration values – each head can carry its own calibration voltage setting resistor. The 4.096V reference is brought out via R4 on the module to the channel 3 header pin. A single external resistor to ground, specific to each head unit, then sets the correct calibration voltage that is applied to analogue channel 3. Connections are shown in Figure 2.

FREQUENCY COUNTER.

Both the 16F628 and 16F819 PIC devices include counter timers that can be used as the basis of a frequency meter; asynchronous counters that can be clocked at high speed. TIMER1 is a 16 bit counter that can be driven from the RB6 input line. This connection is brought out on the 4-way header otherwise used for in-circuit programming – the pin labelled 'C'. The input goes via a Schmitt trigger buffer within the PIC, so the waveform to be measured does not even have to be converted to true logic levels. All that is required is to bias the input at half supply voltage and AC couple the RF, as shown in **Figure 3.**

The PIC data sheet specifies an upper limit of 20MHz for the timers, but I have had them running satisfactorily to a bit over 80MHz. Many users report success up to 70MHz, so full HF band coverage can reasonably be assumed and most likely up to 50MHz will be possible. An RF input level of +8dBm or greater was needed to ensure reliable operation. Peak-to-peak amplitude must be high enough to traverse the two Schmitt trigger voltage thresholds.

The PIC software first resets the TIMER1 value to zero and enables the counting. After a precise gate period, defined by the PIC clock and internal instruction loops, the counter is stopped and the total number of counts read out. The 16 bit TIMER1 register is extended by software monitoring its overflow into a 32 bit count. The maximum count of 2^{32}, which

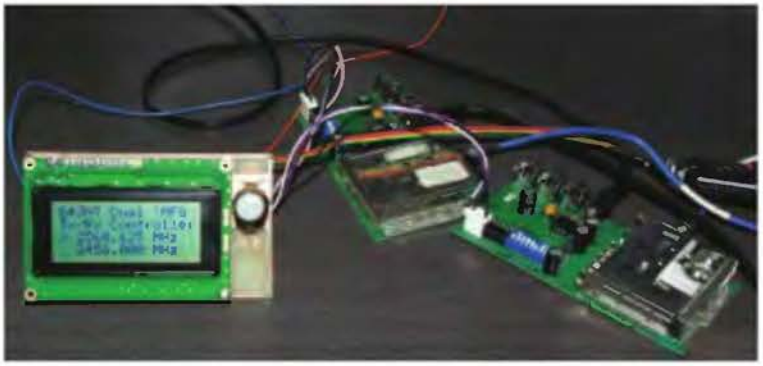


PHOTO 5: I²C synthesiser controller.

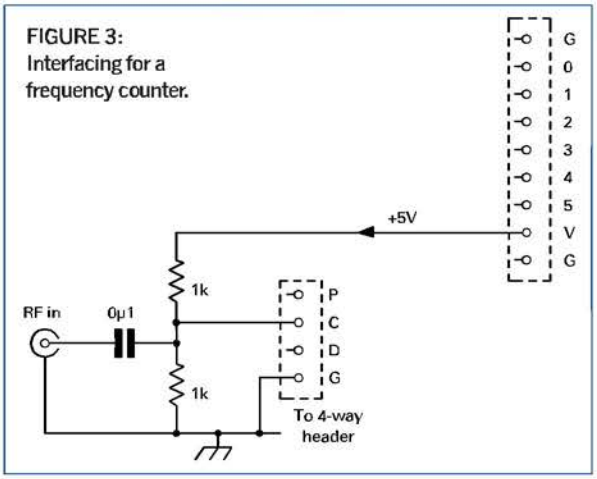


FIGURE 3: Interfacing for a frequency counter.

is around 4 billion, is more than enough for a 70MHz signal to be measured in a 10s window if necessary.

Photo 2 shows the frequency counter display. The gate time – and readout resolution - can be cycled though the values 10ms, 100ms and 1s by repeatedly pressing the pushbutton. An IF offset can be programmed into semi-permanent non-volatile memory by holding the pushbutton down while switching on, or resetting the module. When the IF offset display appears, operate the rotary encoder to choose your desired value, either positive or negative. When selected, press the pushbutton to store into memory and resume normal frequency meter operation. This IF offset will be preserved until it is changed using the same procedure.

SYNTHESISER CONTROLLER. The last plug-and-play design is of a more specialist nature. It will control two independent synthesiser chips of the TSA5505, SP5505, or U6239 type that use an I²C two-wire bus **[6]** for programming. Such devices are in widespread use for TV, satellite and cable TV tuners, and many of the 1.3 and 2.4GHz Rx and Tx modules. This design was specifically intended for control of a pair of G1MFG FM TV tuner modules, allowing, for example, independent tuning for transmit and receive. Ports A0-3 are configured for digital operation (use a low value resistor in series with each for protection) and connected to the synthesiser chip SCL and SDA programming lines according to **Table 1**. On the G1MFG TV modules, the existing PIC is removed so the connections from the controller can conveniently be made pins 1 and 2 on the now-empty IC socket.

Photo 5 shows the controller in operation. Freq 1 or Freq 2 are selected in turn and may be altered in 125kHz or 4MHz steps. Selection is made by repeated pressing the pushbutton to cycle though each frequency tuning option. IF Offset and upper / lower tuning limits for each module can be set by holding the pushbutton down while powering on or resetting the controller, then following the prompts. 23cm receivers generally run the LO 479.5MHz high; 13cm receivers are 479.5MHz low.

PIC PROGRAMMING. The ready-to-go projects described are all very well as examples of the power of the PIC microcontroller to do an infinite variety of tasks, but to get the most out of them, and this development module, you really need to be ale to programme your own. This takes two stages:

PROGRAMMING THE DEVICE ITSELF. This is the process of actually loading the code into the chip using a hardware programmer. Just being able to do this will enable you to download the latest version of any code and use it, with well as new applications as soon as they are published. Without being able to 'blow' PIC devices, you will be forced to purchase ready-programmed chips, which usually cost a lot, are not amenable to upgrades and hardly ever to customisation and are very tedious for designers to have to supply. We get unhappy having to do it – and charge a lot accordingly!

All you need is a PIC programmer and software to drive it. There are many homebrew designs out there; several have been mentioned in *RadCom* over the years but I advise paying a bit more and getting the Microchip PicKit 2 programmer. This will handle every PIC they make, is ensured of all upgrades and comes with full support from the chip manufacturers themselves – who better? Nearly all the component suppliers sell the PicKit and it can often be found at special discount prices. You load in the .HEX file, click the Write button and get a fully functional chip a few seconds later.

WRITING YOUR OWN CODE. This is where the fun really starts; all you need initially is the MPASM assembler software and the PIC Include, or support, files for the devices of choice. They can be downloaded from [1], although it may be necessary to download the full MPLAB development suite which can be quite large. Also a text editor to actually write the source code, or .ASM files. *Notepad* or *Wordpad* is quite adequate.

At least, that is all you need for writing in assembler code – my own personal choice after many years of PIC programming. Initially, study the .ASM files provided – they may look incomprehensible to start with but are mostly well commented. As you compare the instructions their description in the PIC data sheets, it will hopefully begin to make sense. A lot of reference data will be needed – driving LCD modules is an art form of its own, but everything can be found on the web with little search effort needed.

Alternatively, there are high level programming languages like Basic and C for PIC programming, which is the route chosen by many, especially those coming into programming via an educational route. Having never used high level PIC languages, I can't say how good the code produced is, but its safe to assume it will end up a lot bigger, may not always fit onto these workhorse devices, and I'll bet the frequency counter described here couldn't have been written using a high level language. The PIC DDS described in the April Design Notes certainly couldn't

WEBSEARCH

[1] Arizona Microchip - www.microchip.com
[2] Low Cost LCD modules - Kevin, G3AAF, Kevin@avery03.fsnet.co.uk
[3] "Rotary Encoders on the cheap". Design Notes, *RadCom* December 2010
[4] Full construction details of the PIC module, PCBs, PICs, software downloads including source code - www.g4jnt.com/PIC_Controller.htm
[5] Farnell - www.farnell.co.uk
[6] I2C bus - http://en.wikipedia.org/wiki/I2c

[NOTE 1] A 10 times potential divider cannot be made with just two individual standard E24 value resistors, but 9.1k in parallel with 820k at the top (for a total of 9.0001k) and 1k in the bottom is a solution that even with 0.1% close tolerance resistors gives a negligible error.

A 100 times divider can use 3 x 33k in series, working against 1k at the bottom. Having three input resistors in series means that the voltage across each can be reduced – advisable when measuring up to 409V to keep power dissipation down.

[NOTE 2] It is possible to show mathematically that even for reactive loads, provided V_{FWD} and V_{REF} are treated as complex numbers, the equations hold and the complex load impedance can be calculated from the result. Both phase and amplitude of the output waveforms do have to be measured.

Homebrew

This month we build IF amplifiers, a product detector and an audio amp for the HF transceiver project

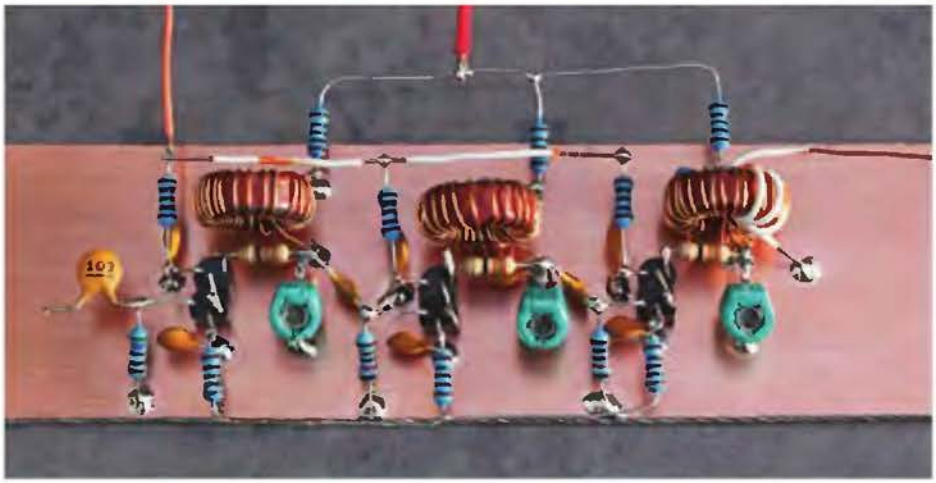


PHOTO 1: JFET cascode IF strip built dead-bug style.

HISTORY. The 'superhet' (supersonic-heterodyne or superheterodyne) receiver was developed during the First World War. Edwin Armstrong is generally credited with the invention of the superhet. Armstrong also invented the regenerative receiver, super-regenerative receiver and developed the first FM radio systems. Before the invention of the superhet, radio receivers used the newly invented triode valve as RF amplifiers and audio amplifiers. The amplification provided by the triode valve resulted in a huge improvement in the sensitivity of radio receivers. Valves from this era had useful gain at audio frequencies and some gain at LF/MF, but they had little or no gain at shorter wavelengths. Reception of weak signals was only possible at the low end of the RF spectrum using TRF (tuned radio frequency) receivers. These receivers had multiple stages of RF amplification. Each stage was tuned to the frequency of the incoming signal so that the selectivity of the receiver was defined by the bandwidth of the RF amplifier stages. Receivers from this era suffered from poor sensitivity and a lack of selectivity. The superhet provided a perfect solution to both problems. Short wave signals could be converted to a lower (intermediate) frequency where they were easily amplified by the triode valves of the day. The IF amplifiers also provided the main selectivity of the receiver. As the intermediate frequency was fixed at a constant value, there was no need to re-tune the IF when the receiver was tuned to a new frequency. The following text from Armstrong's patent application gives a very clear description of the superhet receiver.

"This new method of reception consists in converting the frequency of the incoming oscillations down to some predetermined and lower value of readily amplifiable high frequency current and passing the converted current into an amplifier which is adjusted to operate well at this predetermined frequency. After passing through the amplifier, these oscillations are detected and indicated in the usual manner."

The full text of Armstrong's US patent is available on the web [1]. This was one of the most important developments in the history of radio. The superhet allowed HF and VHF signals to benefit from the high gain and good selectivity of IF amplifiers operating at relatively low frequencies. The superhet had been the dominant radio receiver architecture for almost a century. The great majority of TV, broadcast radio, commercial and amateur radio receivers in use today are superhets.

The back end of a superhet is essentially the same as a TRF set. A set of tuned amplifiers is followed by the detector and audio amplifier stages. The superhet front end adds a frequency changer consisting of a local oscillator and mixer.

A superhet front end usually has one or more RF tuned circuits that are used to suppress the IF image and other unwanted signals like direct IF breakthrough. The superhet may also have one or more stages of RF amplification. Some of the more complicated superhet receivers have several stages of frequency conversion from RF to first IF, first IF to second IF and so on. Armstrong's superhet patent proposes a double conversion receiver with a first IF of 1MHz and a second IF of 100kHz.

Early triode valves had relatively large inter-electrode capacitance. The anode to grid capacitance was particularly troublesome because it results in negative feedback that limits gain at higher frequencies. This capacitance is effectively multiplied by the gain of the valve (the Miller effect). Later developments in valve design improved anode to grid isolation by placing a fourth electrode (screen grid) between the anode and control grid. Many textbook references describe Miller effect in triode valves, but any inverting amplifier with capacitive coupling from output to input will show increased capacitance (Miller capacitance) due to amplifier gain. Semiconductor devices designed for use in VHF/UHF amplifiers have low values of collector to base capacitance (in the case of bipolar transistors) or low gate to channel capacitance (FETs).

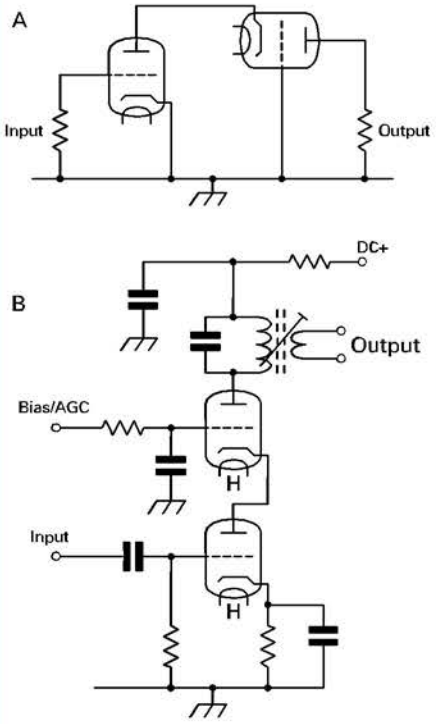


FIGURE 1: (A) Basic 'cascode' configuration, omitting supply and bias components. (B) Practical cascode amplifier with tuned output stage, as typically used in an IF amplifier.

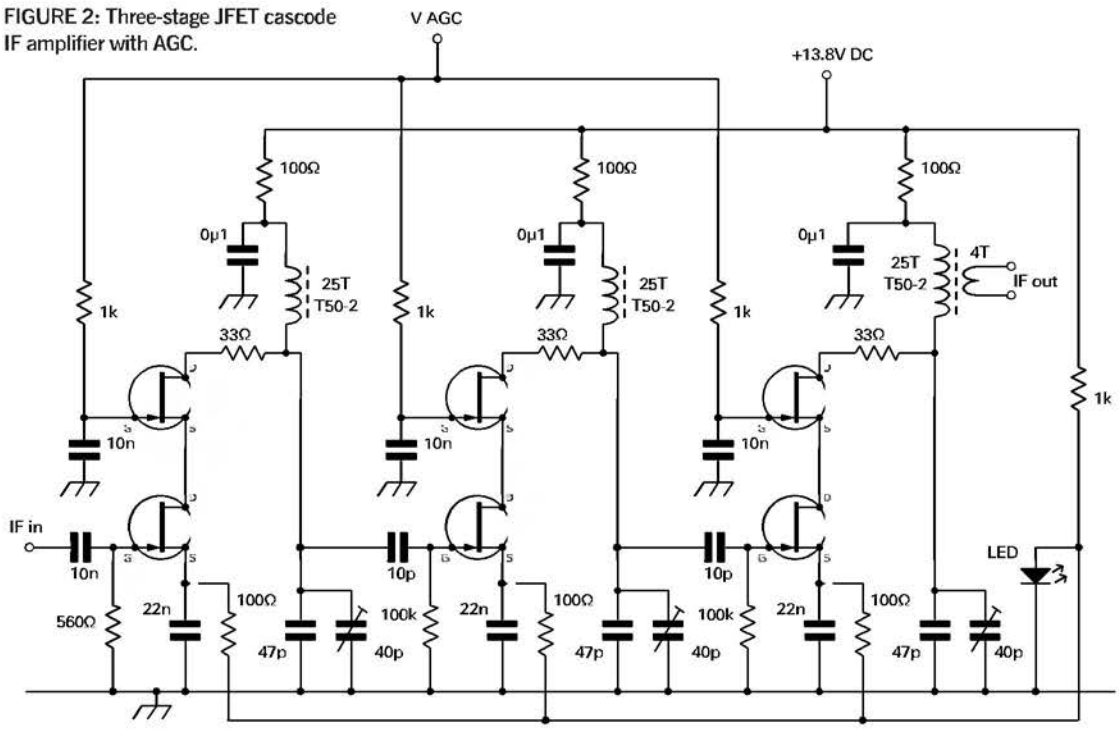


FIGURE 2: Three-stage JFET cascode IF amplifier with AGC.

Some circuit configurations are not prone to increased input capacitance due to Miller effect. One such configuration is the common base amplifier. This is a non-inverting amplifier with relatively low gain and good isolation between the input and output circuits. The common base configuration was widely used in early transistor based VHF/UHF TV and radio receivers. The FET equivalent is the common gate amplifier. The valve equivalent is the grounded grid (GG) amplifier.

The 'cascode' amplifier is one of those magic circuits that provides all the advantages of a common emitter/source/cathode amplifier and none of the disadvantages. The cascode is a two stage amplifier consisting of a common cathode (or, depending on the device, emitter or source) amplifier as the first stage and a common grid/base/gate amplifier as the second stage. This configuration offers a relatively high input impedance, excellent input/output isolation (low reverse gain), high gain and/or wide bandwidth. **Figure 1** shows a cascode amplifier based on a pair of triode valves. The simplified circuit at **A** shows a cascode amplifier with DC bias and coupling components excluded. The first stage is a common cathode amplifier with the input signal applied to the grid and the output signal taken from the anode.

The second stage is a grounded grid amplifier with the signal from the first stage applied to the cathode and the output taken from the anode. You would expect a two stage (cascade) amplifier to have a very substantial power gain somewhere in the region of 2x20dB = 40dB or perhaps even more. But because of the severe mismatch between the high output impedance of the first stage and the low input impedance of the second stage, the gain of a typical cascode amplifier is reduced to about 20-25dB. It is this reduced gain and improved I/O isolation due to the buffering action of the second stage that leads to greatly reduced Miller effect and, consequently, lower input capacitance. The circuit at **Figure 1 B** shows a complete cascode amplifier with a tuned output stage, as typically used in an IF amplifier. This circuit was often based on a double-triode valve like the ECC88 that had two triodes in a single envelope. Gain control is applied by varying the voltage applied to the grid of the second stage. As we will see later, this circuit is not just of historic interest. Many modern electronic circuits are based on cascode amplifiers using transistors and FETs in both discrete and integrated circuit form. The FET equivalent of the triode cascode is identical to Figure 1 B except that JFETs are used instead of the triode valves. A cascode made from a pair of bipolar transistors will have slightly different biasing arrangements. It is also possible to make a cascode amplifier using a mix of different devices. One popular arrangement uses a JFET in the first (bottom) stage and a bipolar transistor in the second (top) stage. Dual-gate (DG), four terminal devices like the DG MOSFET and DG GaAsFET are internally configured as cascode structures having a single channel and two gates.

So far, I have used the IF amplifier strip from the LF/MF receiver (Homebrew, January 2010) for testing the front end modules of the HF transceiver project. This has worked well in practice, but I would like to try a few other options before I settle on a final design. The 2N3904 transistors used in this IF amplifier work very well in the LF/MF receiver, but they are certainly not state of the art in terms of signal to noise ratio. Using transistors that

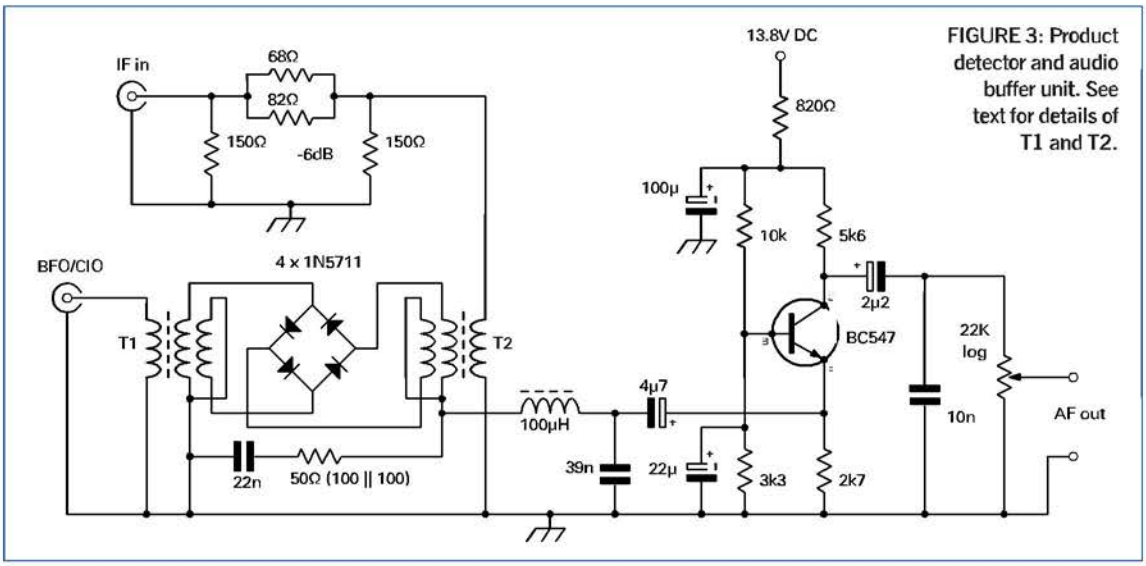


FIGURE 3: Product detector and audio buffer unit. See text for details of T1 and T2.

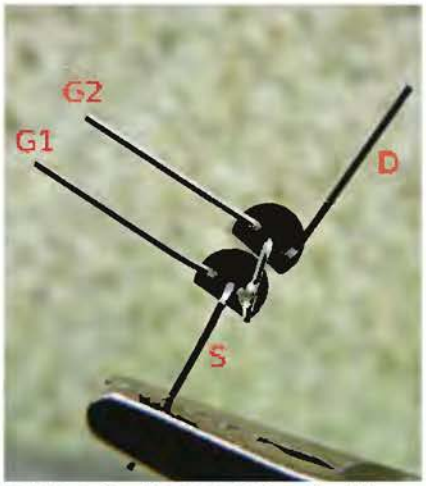


PHOTO 2: Two MPF102 JFETs soldered in cascode form.

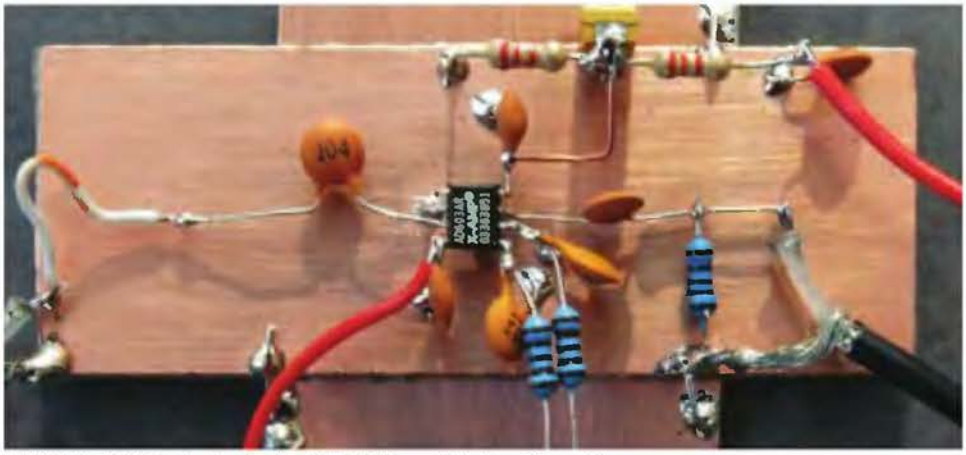


PHOTO 3: Initial test setup for the AD603 IF amplifier (see Figure 5).

are designed for low noise RF amplification may lead to improved performance, especially on the higher HF bands.

The quietest IF amp I have ever built was based on a pair of BF981 dual-gate MOSFETS (Homebrew, April/May 2006). It should be possible to achieve similar performance using JFET cascode amplifiers.

A JFET CASCODE IF AMPLIFIER. This month's first project is an IF amplifier strip consisting of three JFET cascode amplifiers. The amplifier schematic is shown in **Figure 2**. I used six MPF102 JFETs in my prototype circuit. I did try using a BF245A only in the first stage (bottom half of the first cascode) but this didn't make a measurable difference to the performance of the amplifier. The datasheet for the BF245A specifies a noise figure of 1.5dB at 100MHz for a common source amplifier with gate resistance of 1kΩ. This is rather good performance, better than we could expect from a standard bipolar transistor like the 2N3904 used in the previous design.

CASCODE IF AMP CONSTRUCTION. The amplifier was built in the usual dead-bug style on a strip of copper PCB laminate (**Photo 1**). Each cascode pair of FETs was soldered together as shown in **Photo 2**. I started by building a single cascode stage to do the initial tests and measurements. Gain at 10.7MHz was measured at 20-24dB for each cascode pair. +5 to +6V on the AGC input gave maximum gain. AGC control range is very limited unless some positive bias is placed on the source of the lower FET. I used an LED as a poor man's Zener diode. The forward voltage drop across the LED is about 2.3V. The inductor for the L/C tuned circuit in each amplifier is 25 turns of 0.375mm (not critical) enamelled copper on a T50-2 powdered iron toroid. The inductor in the final stage also has a 4 turn coupling winding for driving the 50Ω input of the product detector.

The complete IF strip shows a gain of 70dB at 10.7MHz, falling to around 0dB as the AGC line voltage approaches zero volts. **Table 1** shows amplifier gain vs control voltage.

TABLE 1: IF strip gain vs AGC voltage.

AGC V	Gain
6.00V	70dB
1.93V	60dB
1.33V	50dB
1.07V	40dB
0.76V	30dB
0.52V	20dB
0.29V	10dB
0.07V	0dB

A simple diode double balanced mixer (DBM) was used as the product detector (PD). This is followed by a common-base audio amplifier. The schematic of the PD and audio unit is shown in **Figure 3**. T1 and T2 in the product detector are each 10 trifilar turns of 0.375mm enamelled copper on a FT37-43 ferrite toroid. I used four 1N5711 Schottky diodes that I matched for forward voltage drop using a digital multimeter.

I tested the IF strip using last month's RF front end, the BPF unit plus the audio power amplifier shown in **Figure 4**. I used a 10k pot

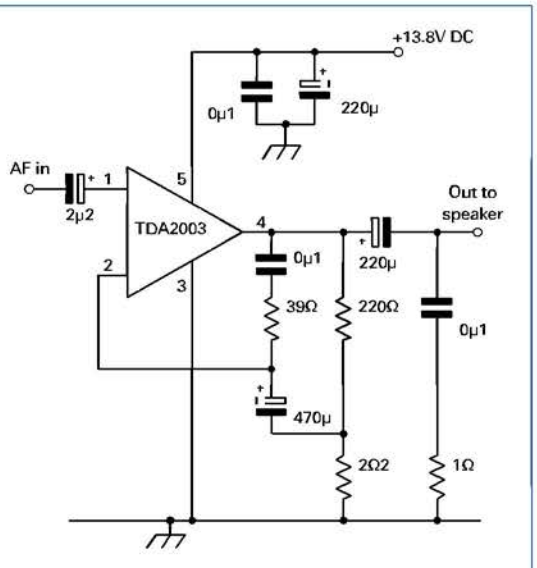
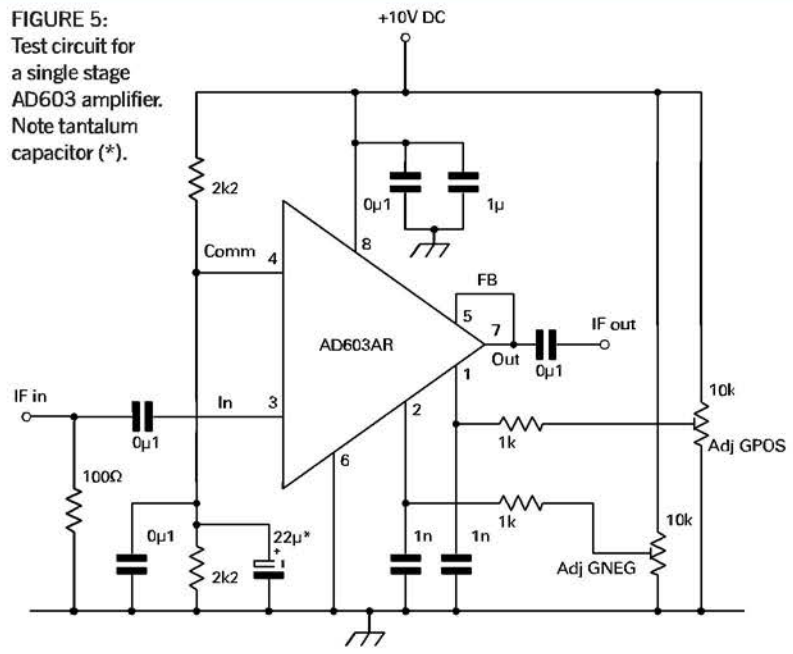


FIGURE 4: Simple yet effective audio amplifier based on the inexpensive TDA2003.

FIGURE 5: Test circuit for a single stage AD603 amplifier. Note tantalum capacitor (*).



across the 13.8V power supply to provide the AGC line voltage for these tests. The amplifier performed very well. Many DX signals were heard on the HF bands without the benefit of an RF amplifier. The IF gain seemed slightly excessive for most situations, so I placed a 6dB attenuator between the IF strip output and the input of the PD. The attenuator is shown in the PD schematic, Figure 3.

IC IF STRIP. The next project is another IF strip based on the Analog Devices AD603 variable gain amplifier IC. Most IF amplifiers use some non-linear element for gain control. The AGC system of most FET and valve IF amplifiers varies the gain of each controlled stage by varying the bias voltage. This method often leads to reduced linearity of the IF amplifier when input signals are at a high level. The AD603 takes a different approach, using a fixed gain RF/IF amplifier preceded by a variable attenuator. The broadband RF amplifier uses an opamp style negative feedback network. This offers several possible configurations for the fixed gain stage. The default configuration gives a maximum gain of around 40dB. If the output and feedback (FB) pins of the IC are strapped together, the gain is reduced to 31dB. The gain control system gives a control range from 0dB to 42dB. The really nice feature of this amplifier is that the relationship between control voltage and gain/attenuation in dB is linear. The gain of the amplifier is controlled at a rate of 40dB per volt or 25mV per decibel of gain reduction. This results in an amplifier with accurate and predictable gain. It also provides smooth and accurate AGC action. Because the passive attenuator precedes the amplifier, there will never be a situation where very strong signals are applied to the amplifier input. Strong signals within the IF passband will cause the AGC to increase the attenuation value. This is an ideal situation because the amplifier shows maximum linearity at minimum gain when input signals are at a high level. **Figure 5** shows my test circuit for a single stage AD603 amplifier. My first prototype didn't have a link between pin 5 and 7 so that the gain was 40dB and the control range was 40dB to 0dB. With the FB link in place, the gain range is +31dB to -11dB. I used a surface mount AD603AR in a dead bug circuit. This amplifier is shown in **Photo 3**. The measured performance of the amplifier was exactly in line with the data sheet figures. The amplifier has a gain of 40dB (without FB link) and control range of just over 40dB. The 100Ω resistor across the input gives an RF/IF input impedance close to 50Ω. The amplifier normally uses a split power supply of ±5V. As this would be quite inconvenient, I biased the common input (pin 4) to half the supply voltage so that a single-ended 10V DC supply can be used. **Figure 6** shows the 10V DC supply regulator.

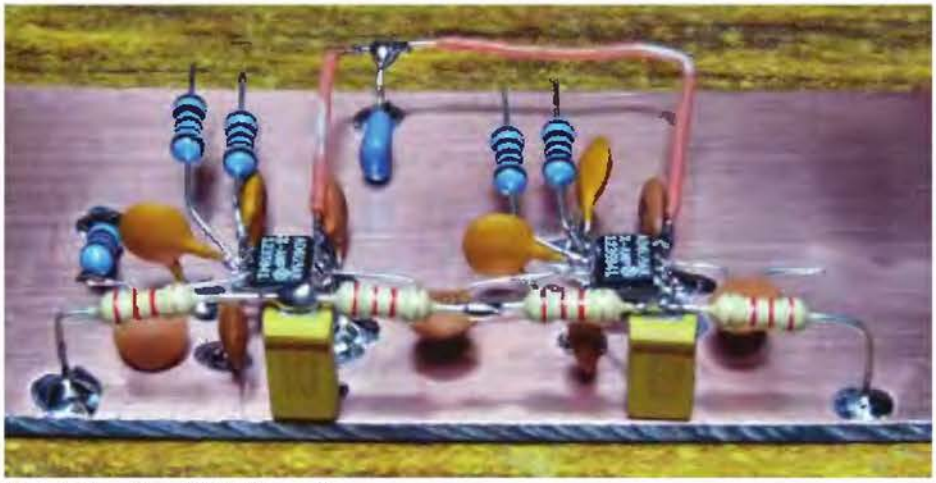


Photo 4: Two-stage AD603 IF amplifier.

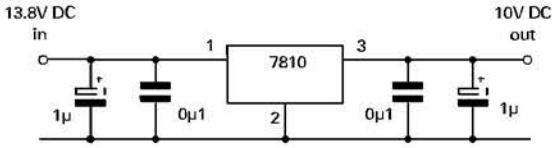


FIGURE 6: 10V DC supply regulator.

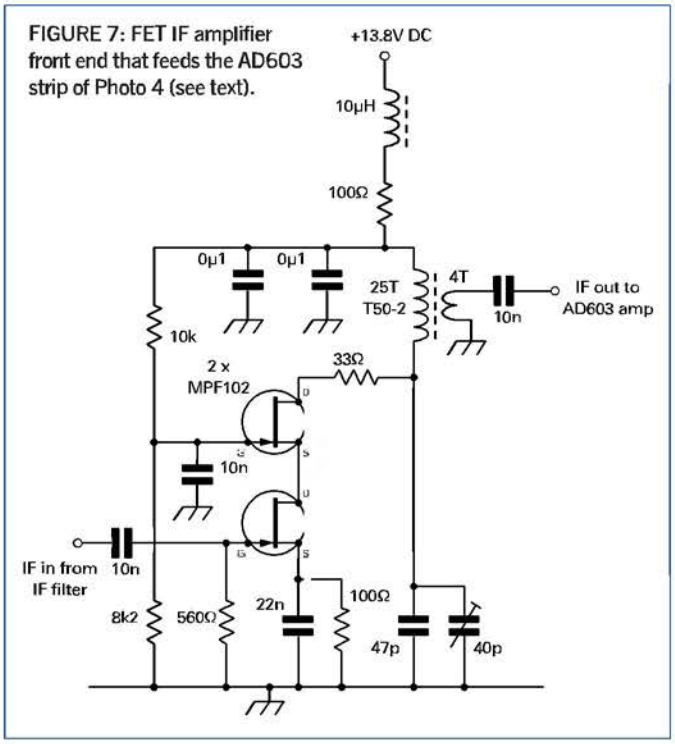


FIGURE 7: FET IF amplifier front end that feeds the AD603 strip of Photo 4 (see text).

The noise figure of the AD603 is around 9dB when the amplifier is at maximum gain (31dB mode). The data sheet graph shows NF rising to NF=19dB at 20dB gain. This suggests that input NF degrades at a rate which is equal to the gain reduction value. To overcome this limitation, I decided to use a FET cascode as the first IF amplifier. This will be followed by a pair of AD603 amps. The FET amplifier is shown in **Figure 7**. This is identical to the amplifiers in Figure 2 except that no AGC is applied to this version. The finished IF strip has the JFET cascode as the first stage, and the AD603 amp as the second and third stages. Each of the AD603 amps is identical to the test circuit in Figure 5. The AD603 amplifiers are shown in **Photo 4**.

TESTING. My original circuit did not have the FB link in place. This gives a total IF strip gain of more than 100dB and the amplifier proved to be unstable. At maximum gain, the circuit was 'taking off' at around 300kHz. This instability was cured by improved power supply decoupling at pin 8. I used a 1µF capacitor in parallel with the 100nF DC decoupling capacitor recommended in the datasheet. To reduce LF gain, the 100nF coupling capacitor between the two AD603 amplifiers was reduced to 1nF. These modifications had no effect on amplifier gain at 10.7MHz.

I used the PD/AF unit from Figure 3 for my listening tests. The AGC strip was well behaved except that the total IF gain was wildly excessive. Strapping pin 5 to pin 7 of both AD603s reduced the IF strip gain to a more reasonable 80dB (or slightly less because of the 6dB fixed attenuator at the PD input). Audio samples of my listening tests on 17m can be found at http://homepage.eircom.net/~ei9gq/JA3EGZ.mp3 and http://homepage.eircom.net/~ei9gq/VE3DDB.mp3. These recordings were made without any RF amplification.

WEBSEARCH

[1] www.freepatentsonline.com/1342885.pdf

Antennas

The Coupled-Resonator multiband antenna

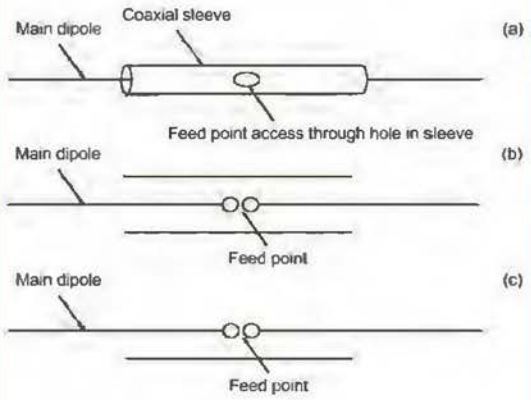


FIGURE 1: Evolution of the Coupled-Resonator antenna. (a) Coaxial sleeve dipole. (b) Open Sleeve dipole, where two outer conductors make an 'open sleeve'. (c) Coupled-Resonator dipole, where the dual band effect is achieved with a single conductor. (illustration after *The ARRL Antenna Book*, 21st Edition).

RECAP. In the March Antennas I described building a computer model of a multiband antenna using EZNEC. I created a basic dipole (I will call this the main dipole) and tested its performance, with and without ground. I then added an extra band element and made a further check before connecting it to the main dipole and found that the antenna exhibited a dual band characteristic. I then added a further band element, again without connecting it to the main dipole and the antenna had a tri-band characteristic. At the time I promised to write about this interesting multiband arrangement – so here goes.

HISTORY. A little research shows that this antenna multiband principle has been around since the late 1940s. A comprehensive description of a multiband antenna using close coupled elements by Gary Breed, K9AY, appears in **[1]** and **[2]**. In its original form it was apparently known as the coaxial sleeve antenna, which covered two frequency bands. This was achieved by surrounding a dipole or monopole with a cylindrical tube resonant at the higher of the desired frequencies as shown in **Figure 1(a)**. In the 1950s, one antenna manufacturer apparently marketed a two-band antenna based on this design.

However, experimenters soon determined that two conductors at the second frequency, placed on either side of the main dipole or monopole, would make a skeleton representation of a cylinder (**Figure 1(b)**). This was called the open-sleeve antenna. The Hy-Gain Explorer tribander uses this method in its driven element to obtain resonance in the 10 metre band. Later, a few antenna developers found that these extra conductors did not need to be added in pairs and that a single conductor at each frequency could add the extra resonance (**Figure 1(c)**). This is the method used by Force 12 in some of their multiband antennas. I seem to recall seeing a BBC Band 1/ITV television antenna using this technique.

EXPERIMENTAL SETUP. I decided to examine this technique using the AIM4170 and made a simple dipole arrangement using old TV/VHF radio antenna hardware as shown in **Photo 1**. A coupling arrangement using a PL259 was necessary to allow calibration of the coax feed to the dipole, so that the feed impedance at the antenna could be examined. Next, an additional element was added to the boom using an arrangement that would allow the alternative elements to be tested and the spacing between the dipole and this additional element to be adjusted. The general test arrangement is shown in **Photo 2**.

The element lengths were not specially selected and it was only by chance that the lengths fitted to the dipole caused it to resonate at just over 51MHz. The lengths of various parasitic elements selected for the tests were judged to fall between 60 and 100MHz. To this end the AIM4170 was programmed to scan between 40 and 100MHz and the coax feed calibrated for this range of frequencies.

The first measurement used a 20mm diameter parasitic element spaced 80mm (centre to centre) from the dipole and the result is shown in **Figure 2**. The blue marker has been placed over the parasitic element resonance. The frequency, 72.38MHz and the impedance, around 70Ω, are shown on the right hand side of the display. The driven element also has an impedance of around 70Ω so that the minimum SWR for both elements is no better than 1.4:1. Note that the impedance graphs are set to Zmag (green) and Theta (purple). The more familiar impedance equivalent R ± j is displayed on the right hand side.

The spacing between the parasitic element and the dipole was adjusted to 60mm. This resulted in an impedance of 57Ω at 73MHz with very little change at 51MHz, as shown in **Figure 3**. Clearly this arrangement would make a simple 50/70MHz dual band antenna with a dipole matched to 50Ω and a parasitic element of the appropriate length. It should be possible to make the antenna also cover 144MHz with an additional parasitic element although this was not tried at the time.

It is obvious from these experiments that there are three variables that affect the performance of the parasitic element: the conductor diameter, the conductor length and the position relative to the driven element. While this is no problem with the construction of a VHF antenna such as the one shown in Photo 2, K9AY has proposed it as solution for a multiband wire antenna for the HF bands. Such an arrangement does have the difficulty of maintaining the critical spacing required between the driven element and the parasitic elements, as K9AY admits. Nevertheless, such antennas have found favour with some amateurs.

FEEDBACK. Andy Malbon, G8MIA, emailed me to say, "I have read your article on multiband dipole antennas in *RadCom*. You ask if anyone has tried using the Coupled-Resonator Antenna described in *The ARRL Antenna Book*. I have been using one for over a year and find it a very competent antenna as it is resonant on all the design bands.

"I use an Excel spreadsheet to calculate the wire spacing and wire length. For the higher bands (12m and 10m) I use smaller diameter wire so they sit between the resonators for 17m and 15m but this means the bandwidth is narrower on these bands. Length of the resonators is critical and much time was spent getting the lengths right! The main problem is keeping the wires at the correct distance apart so lightweight spacers are used every 0.5m and the wires are kept taut."

However, not everyone found this arrangement successful. I monitored a QRZ Forum on the internet on the subject of the Coupled Resonator antenna. EA3GC built a K9AY Coupled Resonator Dipole for 28-21-14MHz (as described on page 7-22 of *The ARRL Antenna Book*). It consisted of three dipoles made of enamelled copper wire 1.5mm diameter. The 14MHz dipole was fed at its centre with RG58 coax and the 21 and 28MHz dipoles were coupled to the 14MHz by just placing them parallel to it using plastic spreaders, at a distance of 28 and 35mm respectively. The 14MHz dipole was fed via a common mode RF choke

PHOTO 1: Construction of a two-band Coupled-Resonator antenna allowing easy adjustment of the element spacing.

PHOTO 2: Test arrangement showing the antenna under test, the AIM4170 and the laptop computer.

consisting of some turns of the coax line.

EA3GC noted that the antenna performed fairly well but the SWR results were poor as shown below.

On 28MHz the SWR bandwidth was very narrow band (but a figure not given)
On 21MHz the SWR was 3.1 at 21.0MHz and 1.25 at 21.45MHz
On 14MHz the SWR was 3, being fairly flat from 14.0 to 14.35MHz

This was the best that could be achieved after a lot of pruning. EA3GC asked if anyone could help.

Jerry, K4SAV answered, saying "The 10m dipole is too far away from the 20m dipole to obtain a 50Ω impedance on 10m with that size wire. The 15m dipole placed 28mm below the 20m dipole should give an OK match on 15m, but a spacing of 40mm would be better. The 10m dipole needs to be about 15mm above the 20m dipole to give a good match. These numbers don't agree with the tables in the article because there is a lot of interaction between the three elements.

"With the size wire you are using, this antenna will have a very narrow bandwidth, especially on 10m where it will probably be no more than 400kHz for less than 2:1 SWR. If you build this out of 1in (25mm) diameter tubing, the bandwidth (SWR < 2.0) on 10m will go to about 650kHz and the spacings will go to about 18cm and 14cm for 15 and 10m".

K9AY makes the statement that this antenna is easily simulated with EZNEC as I did when investigating multiband antennas a few months ago but I was only checking to see if the antenna would work in principle and not overly concerned with the actual impedance presented on each band. It is a very difficult antenna to model correctly and, as K9AY admits, you need to use lots of segments, carefully aligned. You also need to test the model for errors.

AE6TY has come up with an interesting arrangement that uses only one extra element to provide a reasonable match for most of the HF bands. He goes on to say, "I read with interest your article in the March 2011 *RadCom* on multi-band antennas. You indicated in your article that you would be interested in hearing from folks who use a Coupled-Resonator antenna. I use a two element version. The larger of the two is a 69ft (21m) Off Centre Fed dipole fed at the 1/3rd point. The second element is 49ft

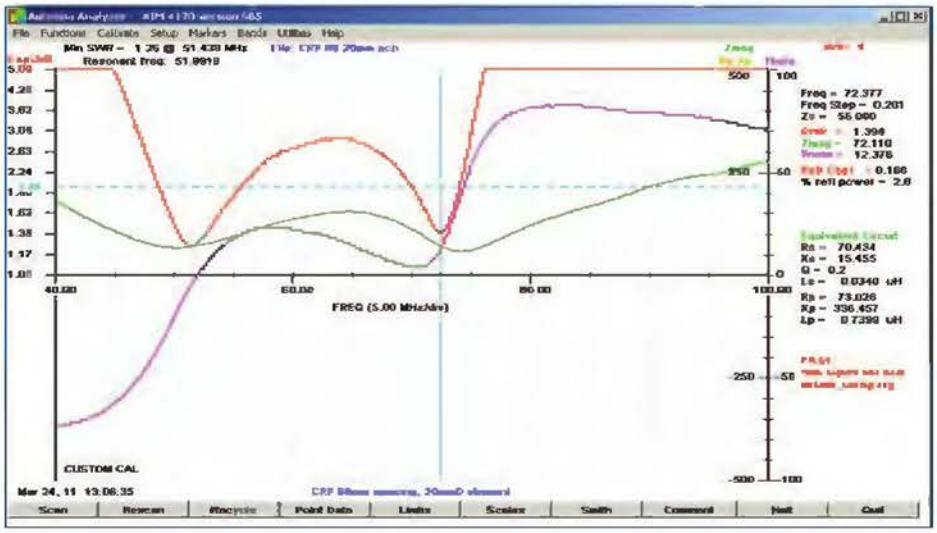


FIGURE 2: A measurement of the Coupled-Resonator antenna shown in Photo 2 using the AIM4170 and an element spacing of 80mm. The blue marker has been placed over the parasitic element resonance and the parameters measured at this point are displayed on the right.

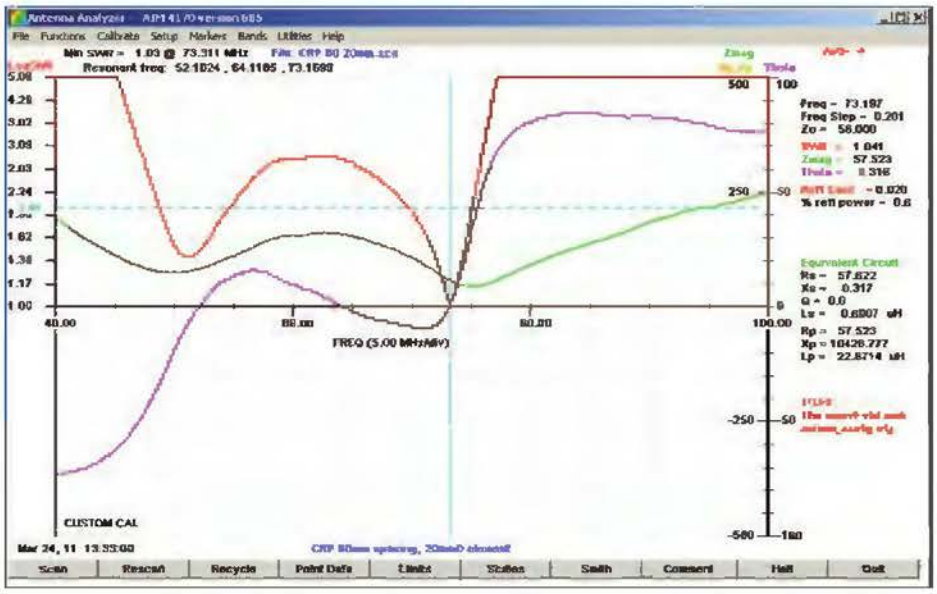


FIGURE 3: A second measurement with the element spacing reduced to 60mm.

(14.9m) long and is also Off Centre. The longer element gets me 7, 14 and 28MHz. The shorter one gives me 10 and 20MHz (roughly!) and the antenna is fed via a 4:1 current balun at the feed point as shown in **Figure 4**. These lengths get me close and a built in antenna tuner gets me the rest of the way. I have found that, over time, getting more than a few elements resonating at a chosen frequency and at the correct impedance is difficult.

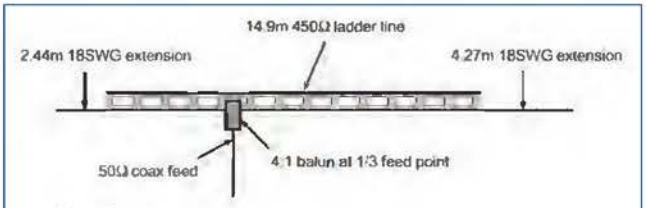


FIGURE 4: Details of AE6TY's Off-Centre Fed Coupled-Resonator antenna constructed using 14.9m of ladder-line with wire extensions (not to scale).

"This is why I use Off-Centre Fed Dipoles; they give me the even harmonics and cut the number of elements significantly. I get 5 workable bands with just two elements. The ladder line ensures that the two elements are spaced correctly."

FINALLY. My view is that you can circumvent all these impedance problems of a wire Coupled-Resonator HF antenna by just connecting all the elements to the feeder as shown in Figure 2 of March 2011 Antennas. However, the Coupled-Resonator principle does seem an excellent way of adding an additional VHF band to an existing VHF antenna without disturbing the characteristics of the original antenna.

REFERENCES

[1] The Coupled-Resonator Principle: A Flexible Method for Multiband Antennas. Gary Breed, K9AY, *The ARRL Antenna Compendium, Vol 5.*
[2] *ARRL Antenna Book, 21st Edition.*

Design Notes

Direction finding

DOPPLER SCAN DIRECTION FINDING. Imagine an antenna travelling around a circle at 1000 rotations per second. The circle has a diameter of 0.4 metre and the antenna is receiving a single carrier on 145MHz from a station located some distance away. The rotation serves to alternately move the antenna towards and then away from the source 1000 times per second with the result that the received carrier has a Doppler shift imparted onto it. The instantaneous frequency shift is at its greatest when the direction to the transmitter source is tangential to the sides of the circle where the component of the velocity is at its greatest. At 90° away. where the rotation passes a radial line from the centre to the transmitter, the instantaneous Doppler frequency shift is zero. Overall, a 1kHz sinusoidal tone has been imposed on the received carrier and, if the signal is now connected to any standard FM receiver, the tone will demodulated just like any other FM signal and will appear on the audio output

The absolute amplitude at each point in the 1kHz cycle of the recovered audio signal is directly proportional to the instantaneous Doppler shift which, as shown above, is directly related to where in the rotational cycle the antenna sits in relation to the line of bearing to the transmitter. So now, if we can compare the phase of the demodulated tone with the rotational position of the antenna, we can determine the bearing of the source. This is the basis of Doppler scan DF.

Since we clearly can't actually rotate a 2m antenna around a circle at this speed (60,000RPM!) we need a way to synthesise the rotation electrically. This can be done by building an array of identical antennas mounted around the circumference of the circle and then sequentially switching the feed from one to the next to simulate rotation. The demodulated tone now becomes a step approximation to the wanted sinusoid, but these appear as audio harmonics and are filtered out. More importantly, by comparing the phase of the recovered audio with the waveform used to switch the antennas we can directly determine our line of bearing.

A FEW SUMS. We do need to be sure there will be enough Doppler frequency shift to be able to demodulate properly, so, a back-of-envelope calculation first:

At 145MHz, wavelength = 2.07m
Diameter of the circle (arbitrarily chosen) = 0.4m
Rate of rotation (audio tone) = 1kHz

In one half cycle, the antenna is moved from one side of the circle to the other, a distance of 0.4m in a time of 500µs. If it were to be moved in a straight line across the centre of the circle, the effective velocity would therefore be 800m/s. But as the antenna follows a circular path, the peak velocity, at the edge of the circle, is given by

π * 0.4m * 1000Hz = 1257m/s

At 145MHz, this gives a Doppler shift of 1257 / 2.998*106 * 145MHz = 608Hz, which is the peak deviation of the demodulated FM audio tone. This is perfectly within the range of a standard FM demodulator set up for 12.5kHz channel spacing.

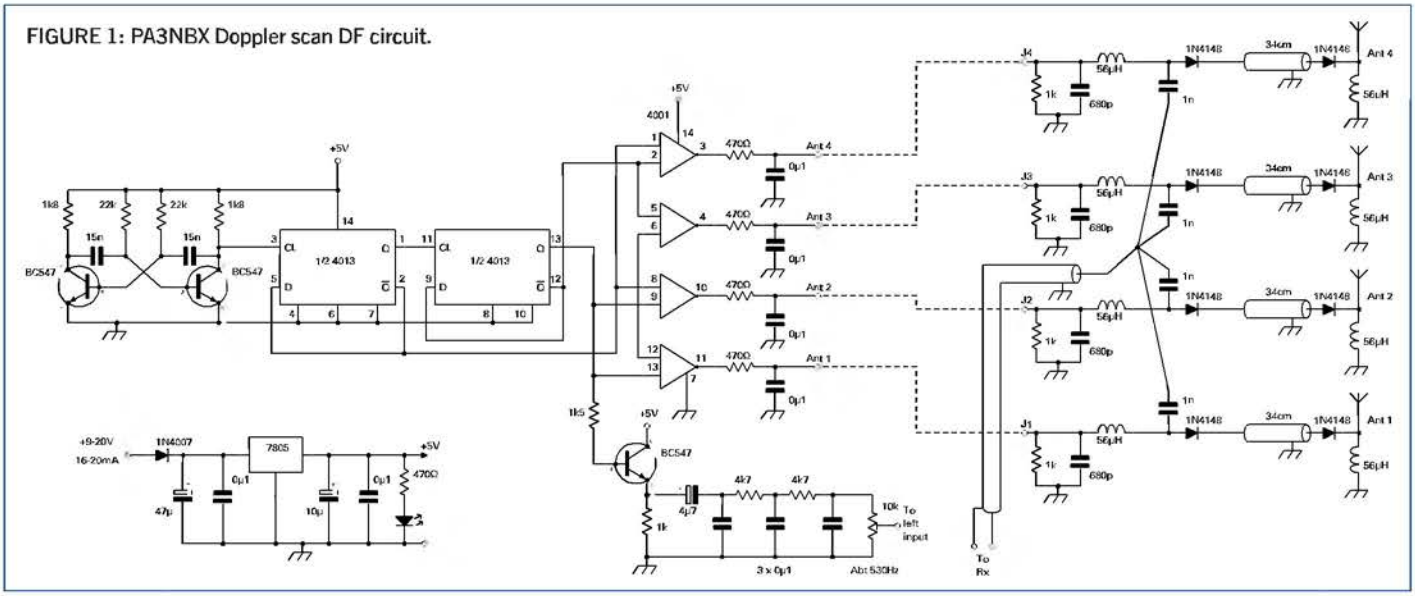
How many antenna elements do we need? To describe a circle, we have to have at least three and preferably more to get a decent approximation and reduce harmonics of the tone due to the steps. Four antennas in a square is a suitable compromise that is easy to drive. More elements would be preferable for a better quality sinusoidal modulation, but the hardware becomes unwieldy.

As the antennas are relatively close to each other in wavelength terms (0.4m at 145MHz is only 0.2λ) we need to make sure that, as we switch between them, the rest of the antenna elements – those not in use – do not influence the one currently switched in. This is done by making all other elements non resonant by simply ensuring they are open circuit. An open circuited dipole consists of two free space quarter waves that have next to no influence at the operating frequency. An open circuit monopole over a ground plane behaves similarly. If the two halves were shorted to make a half wave, or a monopole grounded, the resulting element would then act exactly as a reflector does in a Yagi and have a massive effect on the pattern, destroying the desired rotational effect.

And what about the processing? Years ago. before digital signal processing, when Doppler scan first appeared, the phase comparison had to be done in dedicated hardware with complex audio filtering to remove the switching transients. But now PCs, soundcards and DSP make that side of things a lot easier.

A PRACTICAL DOPPLER SCAN SYSTEM. Lodewijk Baars, PA3NBX, has designed what he describes as a 'Super Simple Sound Doppler Finder', built with an array of four antennas mounted at the corners of a square. A multivibrator provides a master clock, followed by a binary counter and logic gates to deliver sequential one-of-four drive signals

FIGURE 1: PA3NBX Doppler scan DF circuit.



that switch each antenna in turn onto the RF output. The circuit is shown in **Figure 1**. An output is taken from the counter and filtered to provide an audio reference used to determine the phase of the demodulated audio. This reference signal is fed into the left-hand channel of a stereo PC soundcard. The antenna switch assembly is on the right of Figure 1. For each antenna element, a pair of diodes one at each end of the coax feeder are switched together. One diode of each pair, the one at the antenna, ensures the element is open circuited when not in use, killing off any resonance in order to minimise coupling. The second diode controls the RF path to the common summing point. All four coax feeds needs to be of the same length to make sure there is a constant phase shift from each element to the common point, although the absolute length of the feeds is non-critical. The common point goes to a NBFM receiver tuned to the frequency of interest, the audio output from this being connected to the right-hand input of the soundcard.

Software running on the PC extracts the recovered audio, compares its phase with the reference and calculates a line of bearing which is shown on a polar display (**Figure 2**). Initial calibration is needed, using a test signal on a shift due to audio filtering in the receiver, but the software allows for a calibration procedure.

Full constructional details, including PCB layout and the free software can be found from the club site of PI4WAG **[1]**.

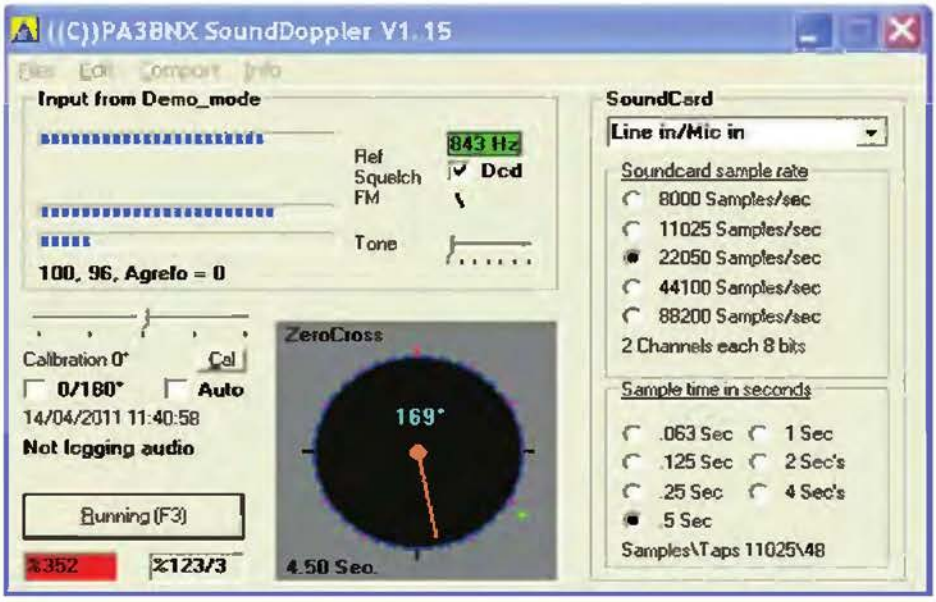


FIGURE 2: PA3NBX SoundDoppler display.

SOME DOPPLER SCAN LIMITATIONS.

The Doppler scan technique works perfectly when the received signal is a plain carrier, or at least has modulation where the carrier plus fixed frequency Doppler tone can be extracted. Voice signals usually give satisfactory results. But, if the signal being DFed carries a modulation type that itself has demodulated tonal components, such as data transmissions, then extracting the relatively low amplitude Doppler tone is less reliable.

Also, multipath such as reflections and incidental Doppler from moving vehicles can distort the plot. However, Doppler scan does work well given these limitation and practical Doppler scan systems can be seen in many places – take a look at the periphery of an airport and spot the VHF Doppler scan arrays there, or a coastguard hut overlooking the sea. Such arrays could have 24 or more elements leading to a higher quality DF result that closely approximates a true circular rotation. You may also have noticed four-square arrays on some police cars.

One final limitation that is not too important for amateur uses, but is important when trying to capture short burst signals, is the processing time. As the DSP works on an audio tone, it has to average over many cycles to obtain the phase estimate so the signal may have to be up for at least a few seconds.

BUTLER MATRIX DF. This technique allows a bearing to be determined in (potentially) a few microseconds. Multiple DFs can even be performed in parallel over a wide frequency band to allow frequency hopping radios to be found. The same four antenna elements (labelled North, South, East and West) are connected to the RF network and downconverter shown in **Figure 3**. The network is made from passive splitters and 90° hybrids and combines the four antenna inputs to give two RF outputs. One output is the sum of all four elements, exactly is if it was a single element in the middle of the circle and is termed the reference channel. The second output is a signal of similar amplitude to the reference but with each element phase shifted before combining. It is equivalent to (North – South) + (East – West) shifted by 90°. The result is that the phase of the RF in this channel when compared to the reference is directly related to the bearing of the source. A coherent downconverter with the same local oscillator for the two signals brings the two channels down to baseband where DSP can measure the phase.

Since there is now no deliberate audio tone introduced and the processing just has to compare the two versions of the off-air signal, this technique is virtually immune to modulation on the received signal. Also, by using wideband digitisation and FFT techniques, simultaneous DF on a bandwidth of several tens of MHz becomes feasible using the sort of high speed A/D converters and DSP chips now in common use in direct sampling SDRs. Such wide bandwidth DF techniques coupled with the wideband downconverter concept discussed last month form the basis of much of the latest generation direction finding and signal intercept facilities now used by commercial and military organisations.

WEBSEARCH

[1] www.pi4wag.nl/index.php/pseudo-doppler-radio-direction-finder

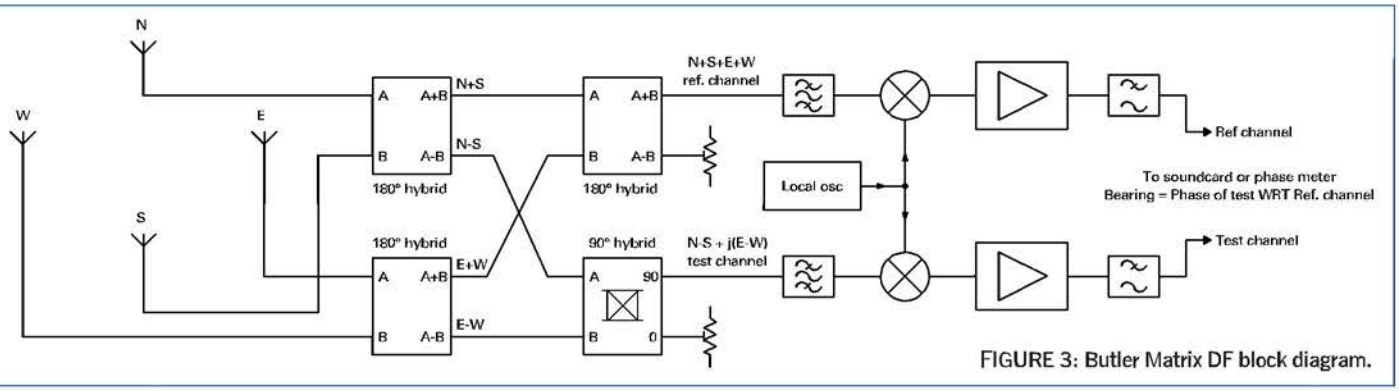


FIGURE 3: Butler Matrix DF block diagram.

Start Here

What makes a QSO valid?

QSL cards are one way of verifying that a contact took place.

INTRODUCTION. What makes a QSO valid? Often when talking to other amateurs or even interested non-amateurs we say something like "I made contact with an expedition on a Pacific Ocean island" or "I had a chat with Bob on his yacht in the English Channel yesterday". In the latter case it's fairly simple for someone to verify that the contact took place, as there presumably is a wealth of information that was exchanged. However, in the first case the contact was probably the ubiquitous "Thanks, you're 5 and 9" – in which case, have we actually made a contact? While this may seem obvious, for those working at the limits of propagation/equipment or experimenting with modes such as those used in meteor-scatter, the distinction for a valid QSO is often far from clear.

A GOOD DEFINITION OF 'A QSO'. The best definition that we've come across as an amateur is in Ian White's *The VHF/UHF DX Book*, which sadly is no longer in print. In the book, the basic requirements for a contact to have taken place are described as: "Both stations correctly receiving all of the following:

1) Both complete callsigns – your own and the other station's
2) Some other information that was not previously known
3) An acknowledgement that all of the above information has been received".

Breaking this definition down, we see that the first and last parts are seemingly innocent; both stations simply say both callsigns and confirm this by saying 'Roger' for instance. It is the second part that needs attention: what do we mean by information that was not previously known? Typically this is considered to be an exchange of signal reports: after all, you could hardly be expected to know how strong you're being received at the other end. However, in many cases such as for awards, other information often is required to be exchanged such as station locators (eg JO00dx), IOTA references, serial numbers or even the power levels used (as is the case for DX stations in the ARRL DX contest).

With the diverse range of information available on the internet it is questionable whether some of this information really is previously unknown. Not only is it possible to find locators on the internet either directly or by browsing through old records from the DX cluster but it's also conceivable that if you work a station regularly in a contest say, it's tempting to assume you copied the locator even if there was extreme fading when it was given… For this reason, when verification for awards/contest adjudication/ record setting etc is required, officials take a careful look at the times the station claim contact, the frequencies involved and the exchange of other time-dependent information such as serial numbers. This is even more important when the contact has been previously scheduled in what's known as a 'sked'. In a sked, the time and frequency for an attempt at a contact are prearranged, thus the callsigns and locations are generally already known in advance – so, accurately copying a real signal report becomes very important.

THE DXPEDITION/CONTEST QSO. So how does our definition of a QSO equate with those made with DXpedition or contest stations? Typically such a 'QSO' would look like this:

W4/M5FUN QRZ
MM6TAT
MM6TAT, you're 5 by 9 QSL
Roger, you're 5 and 9 also, thanks
Thanks, W4/M5FUN QRZ

By our definition this isn't a complete QSO, as only MM6TAT has received both callsigns. However, by stretching the definition a bit we can consider it complete as both stations were on the same frequency (and log the same time) and, further, W4/M5FUN gave his callsign frequently and clearly identified MM6TAT as the station he is working. The second and third parts of our definition are satisfied – even if by the somewhat cynical 'you're 5 and 9'. It becomes much more difficult to be sure a QSO took place if the contact is made by split frequency (see Start Here February 2010), or if W4/M5FUN for instance says 'TAT you're 5 and 9' and then MM6TAT fails to give her full callsign and/or W4/M5FUN doesn't acknowledge it. Even worse would be if W4/M5FUN does not give his callsign readily (such as at least every 2 or 3 contacts), forcing MM6TAT to guess/use the cluster/ask another station…

WHO SETS THE DEFINITION? At the heart of this discussion is that rare quality known as honesty. Whilst licence conditions dictate what information must be exchanged and how often to do so, it is up to the individual operator to decide if they really copied enough information for a valid contact. For awards and contesting the organisers normally specify in advance the additional previously unknown information required. It's then up to the organisers to request copies of logs etc from participants afterwards and confirm their accuracy via a process known as adjudication. The best adjudication processes are (relatively) transparent, allowing the participants to receive feedback as to why any contacts declared invalid.

NO QSL. What happens when you think you made a contact but the QSL card comes back Not In Log (NIL)? Sometimes it happens: you make what you believe is a valid contact, send off the QSL card to gain confirmation and a few months or years later you get a response saying 'sorry, NIL'. If the contact was dubious to start with – perhaps signals were exceptionally weak – there's not much you can do except chalk it up to experience and try and contact them again. However, if you really feel you made the contact then it's worth trying to contact the station (or QSL manager) on air again or by more usual means such as e-mail. By doing so you can check whether the station kept a log and possibly find out whether they copied your callsign correctly or if there was a particular reason for the QSO not being complete. Hopefully you can then either rectify the situation or you've learnt some valuable information for your future contacts.

TECHNOLOGY. What about Echolink and remote station access? This article wouldn't be complete without opening up a discussion point for other columns. Primarily we've discussed traditional QSOs such as those made in voice or Morse code. But what about digital modes that use forward error correction or require very few bits of data to be exchanged to construct the information? Subjects such as these are best left to a more technical column but are every bit as important to consider, particularly with the growth of digital modes being used in meteor scatter and by amateurs who have limited opportunities for large stations. Further consideration is also needed when using technology like Echolink or voice over internet, accessing gateways around the world to make QSOs. While these methods definitely have a role in amateur radio, it is important to understand what type of contact you have made. After all, if I access my local 2m repeater in Kentucky with my handheld and it's connected to the internet through to my home repeater in East Sussex and I chat to a local station, have I really made the fabled transatlantic 2m contact?

Current mode choke balun for the low bands

Prevent currents on the outside of your coax

PHOTO 1: Construction of the balun is quite straightforward.

INTRODUCTION. When a balanced antenna like a dipole is fed with an unbalanced feeder such as coaxial cable it is possible, under certain conditions, for unwanted current to flow on the outer of the coaxial cable. This can lead to radiation off the coax cable itself, which may cause RF in the shack, EMC issues and problems of noise on receive. If the antenna is directional, radiation from the coax can distort the antenna radiation pattern.

To gain a better understanding of what is actually happening, we need to look at **Figure 1**, which shows a half wave dipole connected to a coax feeder. I_1 is the current in the centre conductor, I_2 is the current flowing on the inner of the coax braid and I_3 is the current flowing on the outer of the outer shield. Ideally, no current should flow on the outer of the outer shield so I_3 should be zero. I_1 and I_2 should have equal amplitude but opposite phase and therefore no radiation should take place from the coax if it is connected to a resistive load of the same or similar characteristic impedance as the coax.

HOW COMMON MODE CURRENTS MAY OCCUR. There are a number of situations that can cause common mode currents to flow. Although we like to think of our dipole (or trap dipole) as being balanced, this may well not be the case, especially on the low bands where ends may be bent to fit the space available. My own 180ft 160m/80m trap dipole is a typical example. Although one leg is in the clear and runs to a tree in a neighbour's garden, the other leg runs over the roof of the house with one leg being slightly higher than the other. This situation probably leads to current imbalance on the antenna such that some current will flow down the outside of the coax.

If the physical length of the coax is near to a half wave (or multiple of half waves) then the outer of the outer of the coax at the antenna end will be at low impedance. This is because the outside of the sheath is always at low impedance (earth potential) when connected to the transceiver if we assume the body of the transceiver is connected to earth (as it should be). A half wave along the coax from the transceiver (with reference to the outside of the outer sheath) a low impedance will again be seen.

If we now refer back to Figure 1, current I_2 will see two paths both of low impedance. One path is into the other half of the dipole, while the other path is down the outside of the outer sheath of the coaxial cable.

If the coax were an odd multiple of physical quarter waves, the outer of the outer sheath at the antenna end would now present a high impedance. One could expect nearly all of the current I_2 to go into the other half of the dipole (if there were no imbalance in the dipole). In practice it is not always feasible or economic to make our coax multiples of a physical half wave. If we are using a trapped dipole operating on two or more bands, then optimisation of the coaxial length becomes difficult.

RF may also be picked up on the outer of the coax directly from the antenna. Ideally, the coax feeder should always run at right angles to the antenna itself and not be pulled towards the plane of the wire. An inverted V is a good example where the coax is not at right angles to the antenna.

THE CURRENT MODE CHOKE BALUN. A simple solution to minimise common mode currents from flowing down the outside of the outer sheath is to wrap the coaxial cable at the antenna end around a ferrite core such that a RF choke is formed. This RF choke will have no effect on the current flowing inside the coaxial cable (ie the centre conductor and the inner surface of the braid). But what impedance should this choke offer to common mode currents that may flow on the outer of the outer sheath? Some books have said that 1kΩ is adequate, although [1] recommends 5kΩ if possible. One commercial current balun that was supposed to be suitable for 1.8MHz to 30MHz only showed 500Ω impedance at 1.8MHz when tested using a VNA.

THEORY OF THE CHOKE BALUN. The current mode choke balun behaves as a very broad parallel tuned circuit. Many commercial all-band choke baluns are optimised to have their maximum impedances (ie parallel resonance) at around 6MHz to 8MHz. This means that they will show resistance and inductive reactance on the low side of resonance and resistance and capacitive reactance on the high side of resonance. While a balun centred around 6MHz to 8MHz will probably offer reasonable choking action between around 3.5MHz to 18MHz or 21MHz, its performance may leave something to be desired at the extremities of its range.

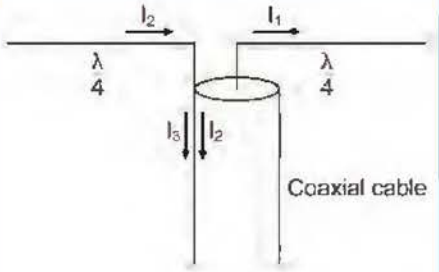


FIGURE 1: How unbalanced currents arise (see text).

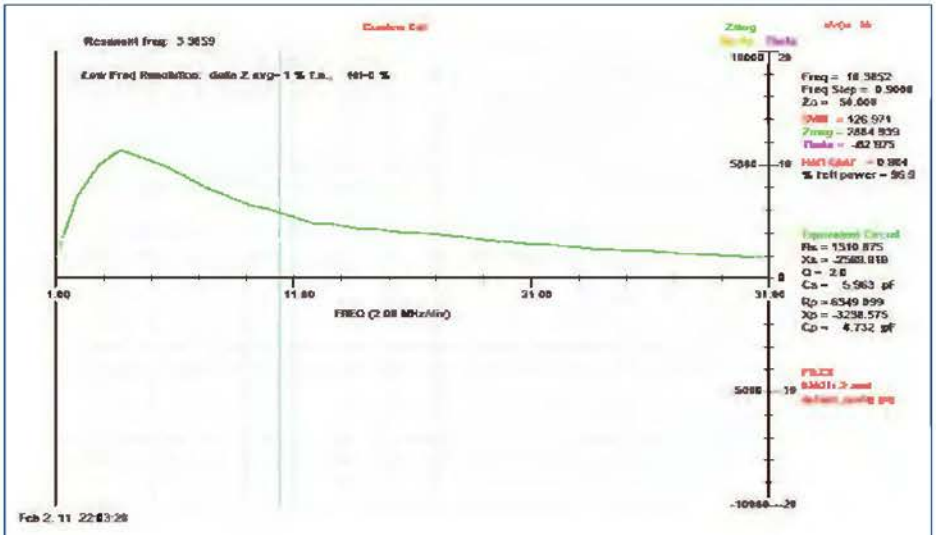


FIGURE 2: Impedance plot of the current mode balun. Maximum impedance is at about 3.3MHz.

ANALYSIS OF CHOKE BALUNS USING A VNA. A vector network analyser (VNA) is an easy way to obtain an impedance plot showing both resistive and reactive components of a choke balun across any chosen frequency range. By analysis of the plot, one can determine how effective the choking action is at various frequencies.

Although there are many references to choke baluns on the internet, I would recommend reading the material contained in [1] and **[2]** for those who want to get a more in-depth understanding of the whole topic. It was the information in [1] that led me to use the type 31 material as this offers good choking action at 1.8MHz.

I obtained a FT240-31 core **[3]** and wound 12 turns of 50Ω RG58 5mm coaxial cable on it. I first wound 6 turns, then crossed over (as shown in the photograph of the inside of the balun) and wound a further 6 turns. The reason I did this was simply to make it easier to obtain a more symmetrical layout with the input on one side and the output on the other side. It has been shown [2] that there is actually no advantage to winding the choke this way compared to a continual winding.

Figure 2 shows the VNA plot that was obtained with this choke. Maximum impedance occurs at around 3.3MHz with excellent choking action in the region of 4kΩ to 5kΩ on 1.8MHz and 3.5MHz respectively. The current balun also shows good choking action at 7MHz and 10MHz.

PRACTICAL CONSTRUCTION. I chose an IP56 rated 100 x 100 x 60mm weatherproof plastic junction box to house the balun. These boxes can be obtained from electrical trade outlets such as **[4]**. A standard SO239 socket is used for the coaxial connection, while two stainless steel M6 nuts and bolts are used to connect the antenna wires.

To provide a support anchor point for the balun I put a small piece of wood, about 20 x 30mm, inside the box and screwed a galvanised eye hook through the wall. A little sealant was smeared around the eye hook where it goes into the box to prevent the ingress of rain or moisture.

An insulator should be used to take the strain of the antenna wires, with the balun fastened to the insulator via light cord (or a strong cable tie using the eye hook).

Two small holes were drilled either side of the SO239 socket to prevent condensation from collecting inside the box. The balun should always be mounted with the SO239 socket pointing downwards.

When the coax feeder is plugged into the SO239, the whole assembly should be weatherproofed with self amalgamating tape running down the coax for a few centimetres in such a way that the weight of the coax is not taken by the PL259.

A SECOND CHOKE BALUN? In some circumstances, depending on the placement of the coax and where exactly the aerial wires run, it is possible for RF to be *induced* into the outer of the coax. This may show up as RF feedback problems in the shack and cause computers and other microprocessor controlled equipment to malfunction.

This situation is more likely to occur with an inverted V where there is a small angle between the coax feed and the aerial wire. It may also happen if the coax runs down a metal mast or tower that is itself picking up RF from the main wire antenna. If this happens, a second choke balun could be placed where the coax comes to ground or at the point where the coax goes into the shack.

Common mode currents may also occur on the outer of the coax when feeding either ground mounted or elevated verticals. It is possible for the outer of the coax to act like a radial itself. The importance of using chokes on vertical antennas is highlighted in [2]. If the coaxial cable runs across a radial field or is routed near elevated radials, RF may be induced into the coaxial feeder some distance from the antenna feed point. In situations like this a second RF choke could be placed where the coax leaves the radial field or prior to it entering the shack.

At my New Zealand QTH I run a ground mounted Hustler 6BTV vertical. I use three current chokes on the coax: at the feed point, half way down the cable after it leaves the radial field and just prior to the cable entering the house. The mains lead to the equipment is also choked. It is important to remember that by minimising common mode currents, one may also obtain an advantage on receive in terms of lowering noise pick up.

If the 1:1 choke balun described is to be used with a vertical aerial, then SO239 sockets may be used on each end of the balun, with a short patch lead running to the base of the vertical.

If the balun is housed in an aluminium enclosure, one of the SO239 sockets *must* be isolated from the case. Failure to observe this precaution would mean that there is a short circuit on the braid between the input and output of the balun, which would render it useless.

POWER HANDLING. The current balun described will easily handle the UK limit of 400W PEP provided it is used in a matched system such as a dipole, trap dipole or resonant vertical.

CONCLUSION. This common mode current choke balun gives particularly good choking action at both 1.8MHz and 3.5MHz and costs less than £15 to build. The choke balun is a very simple device and, if designed correctly, can be effective in curing many of the problems mentioned at the beginning of this article.

ACKNOWLEDGEMENT. I would like to thank Chris, G3VCR who analysed a number of choke baluns for me using his AIM 4170 VNA.

WEBSEARCH

[1] www.audiosystemsgroup.com/RFI-Ham.pdf
[2] www.w8ji.com
[3] www.sycomcomp.co.uk
[4] www.neweyandeyre.co.uk

Goodwinch TDS Tower Winches

Electric winches ease the strain of raising and luffing masts

PHOTO 1: The contents of the winch boxes - everything you need, bar the battery.

HAND WINCHING. Anybody who has ever cranked up a Strumech Versatower will attest that it isn't easy. Chris, G0DWV's own 80ft tower, with a Fulton 2500 winch, takes more than 400 turns to take it from retracted to fully extended - and your arm feels like it is dropping off after a 30-minute session like that. Plus, when you are luffing (tilting) it over, or putting it back, you need to have eyes in the back of your head to ensure that A) you are not snagging any guy wires or wire antennas and B) you're not about to bury your £2,000 Yagi in the lawn!

So when David Bowyer, M1AEI at Goodwinch in Crediton, Devon. offered two of his tower winches for review Chris was quick to jump at the chance – and roped me in to help (no pun intended).

Goodwinch specialises in all sorts of winches. David is a Land Rover fan and knows more about winches that you can fit to off-road vehicles than just about anyone else. His company specialises in 12 and 24 volt DC winches for just about every application that you can imagine, from quad bikes to huge military vehicles. He has now used his knowledge to produce a 12V winch system for radio towers that is powerful, reliable and doesn't break the bank.

The winches that he chose were his waterproof, commercial TDS Goldfish series. The pair of matching winches are similar, but one is configured for facing downwards for luffing, whereas the other facing upwards for raising and lowering.

IN OPERATION. Each winch arrived in a large, heavy-duty cardboard box. On opening the boxes up we found a length of steel tower cable, the hefty battery supply cable and some galvanised steel spacer plates for the raising and lowering model to place the winch away from the tower to miss the front vertical tube if need be. Also in the boxes were the winches themselves, mounted on robust powder-coated steel bases.

While one person could just about lift the winch, I suggest you bring in some help. It is a lot easier with two people and you'll definitely need a hand when it comes to offering the winch up to the tower and bolting it into place.

From a safety point of view it pays to have two people when lowering or raising a tower anyway – see the sidebar.

The winches are fitted with series-wound reversible motors, capable of up to 6HP. The gear ratios are 254:1, which gives raising/lowering and luffing speeds about the same as hand cranking.

The winches come with detachable quick release Anderson connectors for the 12V supply. This means that you can locate the battery at the base of the tower, put it in a nearby box or shed or remove it completely, just connecting it when you need it. You will need to buy a 12V leisure battery as well. David recommends a 75AH deep-cycle type that you can keep float charged with an intelligent charger.

David supplied lengthy 7m heavy-duty cables to allow Chris to place the battery in his shed. The conductors were 35mm^2 copper welding cable and the battery connectors were also supplied.

The winch as tested needed to have the base plate drilled by Chris' father to match the three Strumech Versatower mounting points, but David is now supplying the base plate pre-drilled for popular towers – talk to him before you order to make sure it will fit yours.

We decided to use Chris' existing tower cables as they were in good condition, but if you are in any doubt, use the new galvanised wire ones supplied by Goodwinch – it isn't worth the risk.

WINCH OPERATION. We fitted the luffing winch first and it was surprisingly easy. Once the tower was down we disconnected the cable from the manual winch, removed it and bolted the new winch in its place. The cable is secured to the winch drum with a single Allen screw, making sure that the wire rope is well secured. If you are using the existing rope that was supplied with the tower, you can go through the hole once, around the drum and back through again.

The winch operation is done using the supplied waterproof plug-in hand controller. It comes with a lengthy five metre (17 feet) lead so that you can stand well away from the tower. The control consists of a single non-latching switch marked 'Out'/'In', showing its vehicle origins.

Having wired everything up, we gingerly pressed the 'In' button and the motor whirred into action, taking up the slack cable. From then on it was easy – once the slack was

PHOTO 2: The winches are fitted with series-wound reversible motors.

PHOTO 3: The manual winch before removal.

PHOTO 4: Fitting the winches is quite easy.

PHOTO 5: Take care when raising or lowering your tower.

taken up, the winch continued, taking the tower slowly into the air.

We did notice that there is a little bit of delay (or 'run on') from releasing the button to the winch stopping as it doesn't brake immediately. But this isn't a problem – you just have to stop winching a split second before you want it to stop.

Having fitted and tested the luffing winch, which took no time at all, it was now time to fit the other for raising and lowering the tower. After unbolting the hand winch, lining up the holes between the existing mounting plate, the supplied spacers and the winch mounting plate, it was soon bolted into place ready to fit the wire rope.

Again we used the existing wire rope as it was in good condition, saving both of David's wire ropes for future use.

Having secured the end of the wire rope to the winch drum in the same way as the luffing winch and taken up the slack, it was absolutely brilliant to stand back and watch the tower telescope up into the sky whilst pressing the switch down on the hand controller.

Just make sure when you are raising the tower to the top, STOP WINCHING when the flat plates line up just below the top of the first section and lower back down onto the safety flap.

When lowering, simply raise the tower again for just two or three inches and pull open the safety flap to lower the whole lot down.

As with the luffing winch. keep the wire rope slightly taut with the wraps of the wire rope laid neatly on the winch drums.

On the raising winch it is the safety flap that takes the load at whatever height, not the winch rope. On the luffing winch, the bottom safety pin locks the tower pright, not the wire rope.

When luffing down, you will need a piece of wood handy to start the tower moving over until the weight is fully taken by the wire rope and, as I said before, finger off the button a short time before you actually want it to come to rest. David recommends his TDS-8.5 tower winch system for 40' and 60' standard Strumech Versatowers at £475 plus carriage and VAT. Alternatively, for heavy duty 60', 80' & 100' towers, especially with heavy head loads, his TDS 12.0 system is more appropriate at £525 plus carriage and VAT. These prices are each for either raising / lowering or luffing applications.

I think the whole experience was best summed up by Chris' statement "It's a hell of a lot easier than doing it by hand." Too true!

If you have a tower it will make a world of difference. Our thanks to Goodwinch (www.goodwinch.com) for supplying both winches for review. The telephone number is 01363 82666; ask to speak to David.

WINCH SAFETY

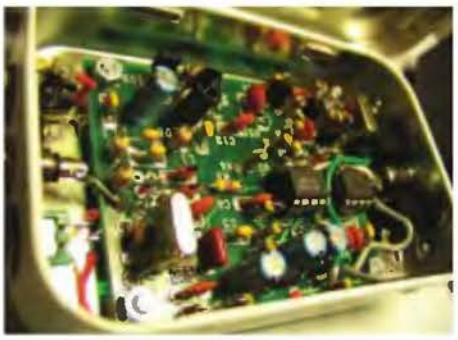
Tower and winches can be a dangerous combination and here are some safety tips:

1. When winching stand well clear of the tower and any antenna.
2. Make sure that you and anyone working with you are not standing in a dangerous position should a cable fail.
3. When lowering or raising a tower be careful to ensure that any guy wires and wires antennas do not foul or snag anything.
4. A winch is powerful – it could easily damage your tower, cable or antennas should something bind, so make sure everything is in excellent working order.
5. If you are in any doubt as to the integrity of your tower cables, replace them.
6. If possible, do not perform any winching operation on your own.

PHOTO 6: A neat installation and a lot easier than hand cranking.

QRP

How many QSOs on a PP3?



Rock-Mite transceiver built in an Altoids mint tin.

QRP CHALLENGE. In past editions of this column I have mentioned Summits on the Air (SOTA), a group that describes itself as 'an award scheme for radio amateurs and short wave listeners that encourages portable operation in mountainous areas'. I have reported on the exploits of Richard Newstead, G3CWI and other 'adventure radio' enthusiasts. Towards the end of last year on the SOTA reflector Kjell Eriksen, LA1KHA, suggested a simple QRP challenge. How many contacts can you make using a PP3 alkaline battery to power the whole station? Several SOTA members rose to the challenge, most of them using Rock-Mite transceivers. SOTA details are at www.sota.org.uk.

The Rock-Mite is a very popular little QRP transceiver kit designed and sold by Dave Benson, K1SWL, of Small Wonder Labs. In Dave's own words, "The Rock-Mite design grew out of my desire to offer a 'one-evening' CW transceiver kit that would be both affordable and easy to construct. It appeared in *QST* magazine in 2003 and, since then, it's been wildly successful. Approximately 8000 of these kits have been sold so far!" Small enough to fit in an Altoids mint tin, the Rock-Mite is a crystal-controlled direct-conversion transceiver available for 80, 40, 30 or 20 metre operation. The small 2 x 2.5 inch board contains the whole transceiver complete with on-board microcontroller for transmit/receive functions and a built in iambic keyer. The power output is 500mW (half a watt) at 12V but, vitally for the PP3 challenge, it can produce about 250mW with 9 volts. Further information at www.smallwonderlabs.com/Rockmite.htm.

Richard, G3CWI, set himself a target of 100 QSOs from the same PP3 battery. On 2 January Richard posted a note on the SOTA internet reflector to say that during his latest spell of operating he had now achieved 103 QSOs from the same PP3 battery. This had included 14 different DXCC countries. (ON, S5, OK, G, DK, I, LA, F, OE, HB9, HA, SM, 9A, EV). The battery was down to 8.5V at room temperature but he went on to achieve 133 QSOs before it no longer worked.

Richard's transceiver is homemade and was designed specially for the challenge. The receiver has a two-crystal ladder filter at signal frequency, with an NE602 mixer, low noise audio amplifier and an active lowpass filter (700Hz cut off). All the audio processing is done with CMOS opamps. The transmitter uses a crystal oscillator, bipolar buffer and amplifier driving an FET Class E power amplifier running 300mW out. It also includes an internal Tick-1 iambic keyer. The transceiver design is optimised for operation at 8.5V (roughly the mid-point of the discharge curve of an alkaline 9V PP3).

Richard's record was short lived because Kjell, LA1KHA, managed to make an amazing 240 QSOs with a single PP3/MN1604 battery. That seems to be the world record. All his contacts were made on 30m CW – many using just 70mW output power. His Rock-Mite transceiver worked until the battery was just above 6V. At the end of March 2011 the status on the PP3 Challenge was:

LA1KHA at 240 QSOs in 33 sessions with 23 DXCC countries.

G3CWI at 133 QSOs in 13 sessions with 16 DXCC countries.

These are all remarkable results for simple equipment, low power and a meagre PP3 9 volt battery!

THE G QRP CLUB CONVENTION AND BUILDATHON. Peter Zenker, DL2FI, the well known founder of QRPproject and activist in bringing amateur radio to young people in Germany has accepted an invitation to speak at the G QRP Club Annual Convention in October. The convention is on Saturday 22 October at the Rishworth School on the A672 (Ripponden) road from junction 22 on the M62. The convention will include the usual mix of component and kit traders, lectures on QRP subjects. Bring & Buy and surplus sales, with all day catering including the famous 'pie and peas' lunch. The event opens at 10am and further details and updates can be found at www.gqrp.com.

Because of circumstances beyond the organisers' control, the convention is no longer able to use the laboratories for the Buildathon and Equipment Display. Currently the plan is to move these to the Friday evening (21 October) before the convention and have a 'Constructor's Evening'. The use of a church complex some 5 miles from Rishworth has been secured. It includes a comfortable room for a Buildathon and display of homemade equipment, it also has a lounge area for people to meet and share ideas (including *PowerPoint* presentations if desired). There is a separate bar area and a light buffet is planned during the evening. The idea is to have an evening for anyone interested in radio construction – showing their projects, sharing ideas or joining the Buildathon. The Buildathon project will probably be a Z Match ATU. If you are interested in being part of the Constructor's Evening, the Buildathon or just joining fellow constructors, let George, G3RJV (g3rjv@gqrp.co.uk) or Graham, G3MFJ (g3mfj@gqrp.com) know as soon as possible.

ANOTHER LITTLE THING... Following up on the PP3 transceivers, for those interested in small, simple transceivers, W1REX of QRPme has announced a new kit called the Lil Squall. The kit is the QRPme version of the well known Pixie transceiver and designed to be a tinkerer's delight. It fits in a small size tuna can with a silk-screened solder masked board with plated through holes. There is a socket for the final transistor for easy experimenting with output power. Likewise, the feedback capacitors in the oscillator circuit have sockets, making it easy to experiment with new bands. The crystal plugs in for ease of moving the operating frequency. The low pass filter on the output is on a changeable band module so the Lil Squall can be moved about the bands. The kit comes will the parts necessary to complete the transceiver including 3 crystals on 40 metres. Further details can be found at http://qrpme.com.

The Lil Squall transceiver mounted on a tuna tin.

LA1KHA operating his PP3 station, Norwegian style in the snow.

LF

Over the pond again.

Jim's umbrella-loaded vertical and mini shack.

TRANSATLANTIC QSO. Although transatlantic signals are often seen, there hasn't been a two-way contact on 136kHz for about two years and it's still a momentous occasion when one takes place, especially when one of the stations is operating from a normal suburban garden. Mike, G3XDV, has been perfecting his system for some time and has concentrated on increasing the capacitance of the top section of his T aerial to raise its efficiency. The contact happened almost by accident when Mike got up in the small hours (don't ask why...) and saw Joe, VO1NA calling with a good signal. He replied in QRSS60 and the rest is history. The QSO took almost three hours, but there was very little QSB.

QRPP. In early May, G3XBM managed to get a 136kHz signal across to PA3CPM using only 2.4W of RF power. This is all the more remarkable when you consider that Roger has a fairly modest aerial and estimates his ERP as 50μW! He quotes the LF Today advice that "136kHz is not a band for low power transmitters" and wonders whether this should be changed for the next edition. I appreciate the superb achievement but I'll stick by the advice. Too many people have become disillusioned with LF, thinking they are going to work lots of stations with low power and a poor aerial. As I'm sure Roger will admit, it's great fun to experiment with QRP but it also takes a lot of time and effort, especially on the part of the receiving station!

9kHz TESTS CONTINUE. In the UK, G3XIZ is the biggest signal on the 'dreamers' band'. Chris started radiating on 9.09kHz in March and received reports from G3ZJO and G3XBM at about 45km, and Paul Nicholson in Todmorden at 218km. This was with his homebrew 100W TX fed via a 1.3H loading coil to his usual 40m long inverted L aerial. The drive came from a Droitwich-locked frequency reference divided down to provide an ultra-stable signal. Stability is very important when long integrating times are in use at the receiving end and Chris found that even an OCXO could seem unstable at these resolutions. Most receiving stations are running Spectrum Laboratory at a setting of QRS600, that's 10 minutes per dot!

Since the first tests, Chris has occasionally augmented his inverted L with 60m wire supported by a balloon or kite, to increase the efficiency. The increase in strength has been reported at up to 10dB. His signals, with and without balloons, are reaching further with reports coming in from G3WCD, G3XDV, M0JXM and M0BMU. He has also managed to transmit a CW ident, a 'C' in DFCW Morse code, to G3ZJO. It was a little slow, being sent at DFCW 1800, (30 minute element length) but the signal to noise ratio was around 14dB.

Also popping up on the highly sensitive receiver of Paul Nicholson, was OK2BVG at a distance of 1423km. Lubos is using a 220m long wire up at 24m but only quite low power to begin with, 25W. His coil was wound on a barrel with a bucket inside to form a variometer. The problems of making these high-inductance coils which can handle tens of kilovolts and pass an amp of current without catching fire are quite difficult and time consuming to solve!

Whilst on the subject of VLF it seems that an American proposal to regulate the spectrum down to 8.3kHz may be discussed at the World Radio Conference in 2012. The concern is to protect the operation of lightning detection systems which use 8.3 to 11.3kHz. This wouldn't necessarily be a great problem for the few amateur VLF operators, as the propagation will be substantially the same on 8 as on 8.97kHz, but it will mean even more turns on those loading coils.

A YEAR OF VLF. Stefan, DK7FC has been conducting experiments on 8.97kHz and below for more than a year now and his VLF grabber has been operational since last April. In that time he has logged signals from DF6NM, OE5ODL, OE3GHB, DJ8WX, OK2BVG, his own portable tests and spotted a hint of PA3CPM. He is still waiting for the first UK station to make it over to Heidelberg.

500kHz PORTABLE. Jim, M0BMU was out and about in late March with a 15.3m fibreglass mast supporting a top-loaded vertical radiator, loaded against four 1m ground rods. In an open field with good ground conductivity Jim was able to achieve an ERP of 8.6W with his 100W transmitter. On receive he used a single K9AY terminated loop oriented to reject noise from the nearby Brookmans Park MF transmitters and to favour European stations to the East. Throughout the day he worked 11 stations in the UK, Netherlands and Belgium, and received good signals from the German and Czech amateur beacons.

NEW GRABBER IN ROMANIA. Chris, 4X1RF, has set up a VLF and LF grabber in Bucharest. The setup is similar to his Haifa installation and has various windows showing different parts of the 136kHz band and the VLF spectrum. Find them all at http://qsl.net/4x1rf.

SUMMER TWEAKS. Now that the summer is almost upon us we must expect the static to spoil a lot of LF activity over the next few months. Perhaps now is the time to follow in Mike's footsteps and plan that new aerial system for next winter? The best efficiency will come from an aerial with the greatest possible height, commensurate with the greatest possible top-capacitance and good insulation. The two factors which govern the theoretical ERP of a 'Marconi' aerial are height and current. Height refers to average not maximum height, and the current you can deliver into the aerial depends upon the power, the earth system and the aerial's capacitance. Consider replacing a single top-wire with multiple wires at the same height, and pruning back those trees near the aerial to reduce environmental losses. Run out a few more earth wires and bang in some more stakes too. 'Every little helps' as someone once said.

Sport Radio

Some tips for portable operation, a GR2HQ preview and how to deal with duplicate QSOs

Steve Cocks, G4ZUL at the Essex CW Club's NFD station in 2010.

TRIALS AND TRIBULATIONS. With CW NFD imminent, it's worth looking back to see how one of last year's competing clubs did. Members of the Essex CW Club were active in the Restricted section, using the call G1FCW/P. Heavy rain, lightning and static crashes were suffered overnight, which spoilt the low bands; while water ingress to the antenna connector put paid to any chance of a high score. Further time was lost due to bailing water out of tent and a social BBQ on the Saturday evening. Conditions were generally poor with some strong QSB on the bands. However, the contest site near Harwich in Suffolk was excellent and the group look forward to this year's contest. The operators were Jonathan, G0DVJ, Steve, G4ZUL (pictured in **Photo 1**) and Eugene, G4FTP.

Water ingress into coax during contests seems to be a common problem. Some groups take the attitude that because equipment is only going to be in the field for a couple of days there's not much point in taking precautions – especially if the sun is shining when the station is put together. This is a mistake. Even if the weather stays dry for an entire weekend, early morning dew means that coax left on the ground usually gets wet. Now although it's quite easy to get water into coax, its practically impossible to get it all back out, so once in there – even if you don't see water dripping from the back of the rig – it gradually rots the cable, making it even more lossy when you next want to use it. But unless the outer sheath is damaged, 100% of the problem is inside the coax and may remain unseen, unless you remove a connector to check that the copper is still bright (or have a network analyser to check the loss). I would like to suggest some simple fixes for this problem.

1. As you unwind a length of coax in the field, check for damage to the other sheath. If you find any, deal with the problem there and then.
2. As soon as you put a coax plug into a coax socket outdoors, wrap the connection with self-amalgamating tape to make sure it is rainproof.
3. Instead of the ubiquitous PL259, standardise your portable setup to use BNC or N connectors. Properly fitted BNC and N connectors are waterproof, at least in the short term, whereas PL259s were never designed for outdoor use.

As regards baling out the tent, I expect all experienced ops have done it once – and, having done it once, we learn not to pitch the tent in a hollow. But a wet field cannot always be avoided, in which case it is wise to lay down some plywood sheets in the area of the operating table to prevent it, the chairs and operators from sinking and turning a contest into a mudfest.

GR2HQ. Advance notice now that for the ninth successive year a multi-operator UK team will represent the RSGB in the IARU HF Championship contest on 9-10 July. The unique feature of this event is that HQ stations representing IARU member societies may operate under a single callsign from multiple locations around the country. GR2HQ will have a total of twelve stations active on the six contest bands 1.8-28MHz, both SSB and CW.

Once again there are free award certificates available to those who contact GR2HQ, so please support our team by working the station on as many band/mode combinations as possible. The Awards are; Bronze for 3 bands/modes, Silver for 6, Gold for 9 and Platinum for 12 bands/modes. You have 24 hours to do it and the stations will be networked using high-speed Internet connections, so you can call the station on one band to find out their working frequency on another. There are also trophies for radio clubs/groups to win.

The web site www.gb7hq.com contains full details of previous years' operations (GB5HQ, GB7HQ) and the current website www.gr2hq.com has more information about the 2011 event and the Awards schemes. The IARU contest is a 24-hour event starting at 1200UTC on 9 July, and the RSGB HQ team looks forward to working as many Society members and UK amateurs as possible. Please e-mail team@gr2hq.com if you need more information.

DUPLICATE QSOs. If you're running a frequency in a contest, at some point someone is going to call you who is already in your log. All modern contesting software includes checking for 'dupes', but the question is what to do about it. In the days of hand written logs there was a penalty for not marking a duplicate contact and failing to claim zero points for it, but the Cabrillo logging standard that everyone now uses contains no concept of a dupe. We could argue the rights and wrongs of that until the cows come home, but that's the way it is. That being the case, these days it is much simpler if someone calls you who your logging software says is a dupe, to work them a second time.

What happens in the adjudication is that if the second QSO is a dupe, you will get no points for it, but if the first QSO was mis-logged by either party, scrubbed by the other station because you descended into the noise, or whatever, you will lose the points for the first QSO but get the points for the second.

The point of this item is that while you are telling the other station that you have already

RSGB HF EVENTS

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Jun 4-5	National Field Day	1500-1500	CW	1.8-28	RST + SN
Jun 6	80m Club Championships	1900-2030	Data	3.5	RST + SN
Jun 15	80m Club Championships	1900-2030	CW	3.5	RST + SN
Jun 23	80m Club Championships	1900-2030	SSB	3.5	RS + SN

RSGB VHF EVENTS

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Jun 7	144MHz UKAC	1900-2130	All	144	RS(T) + SN + Locator
Jun 12	144MHz Backpackers #2	0900-1300	All	144	RS(T) + SN + Locator
Jun 14	432MHz UKAC	1900-2130	All	432	RS(T) + SN + Locator
Jun 18-19	50MHz Trophy +	1400-1400	All	50	RS(T) + SN + Locator
Jun 21	1.3GHz UKAC	1900-2130	All	1.3	RS(T) + SN + Locator
Jun 26	70MHz Cumulative #4	1400-1600	All	70	RS(T) + SN + Locator
Jun 28	50MHz UKAC	1900-2130	All	50	RS(T) + SN + Locator
Jun 28	SHF UKAC	1900-2130	All	2.3-10G	RS(T) + SN + Locator

BEST OF THE REST EVENTS

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange (info)
Jun 4-5	UKSMG Summer E's	1200-1200	All	50	RS(T) + SN + Locator + Member Number
Jun 11-12	REF DDFM 6m	1600-1600	SSB, CW, FM	50	RS(T) + SN + Locator (first 4 digits only)
Jun 12	PW 2m Low Power	0900-1600	All	144	RS(T) + SN + Locator
Jun 18-19	*All Asian DX*	*0000-2359*	*CW*	*1.8-28*	*RST + age*
Jun 19	IRTS 80m Counties	1400-1700	SSB/CW	3.5	RS(T) + SN (EIs & GIs also give county)
Jun 19	WAB 6m Phone	0900-1500	Phone	50	RS + SN + WAB square
Jun 25-26	*XIV Marconi Memorial*	*1400-1400*	*CW*	*1.8-28*	*RST + SN*

Italics indicate that provisional information only was available at the time of writing.
*HF Championship event + VHF Championship event

For all the latest RSGB contest information and results, visit www.rsgbcc.org.

worked (and possibly debating the point), it is actually quicker to have a second QSO and move on.

From my experience, I am called predominantly a second (or even third) time by those who either don't use a computerised logging package live or key my callsign in wrongly. I'm not going to be critical of anyone's typing skills (practice improves them), but what I see as important is that QSOs are keyed in live. There's a great range of contest logging software packages available today, all downloadable and many totally free. Some will flag-up impossible callsigns (such as an O used instead of a 0) and, of course, they give you the option of working or declining a dupe. I'm not going to recommend one package above the others because I don't always use the same one myself, but what I do suggest is that if you are not using any of them live in a contest you would soon reap the rewards of more accurate logging and a greater score if you did.

THIS MONTH'S EVENTS. CW NFD is the first HF event of the month on 4-5th June. With HF propagation much improved this year, smart competing stations will be keeping a very careful listen on 10m. When it opens there will be a real feeding frenzy because – like 160m – QSOs on 10m are worth double points. NFD is followed by the penultimate sessions of 80m Club Championships, with datamodes on the 6th, CW on the 15th and SSB on the 23rd.

Moving to VHF, the first event of the month is the 2m UKAC that takes place on the 7th. On Sunday 12th low power enthusiasts will be heading for the hills again for the 2nd 144MHz Backpackers contest. We return to the UKACs on the 14th, with 70cm. The biggest RSGB VHF event of the month is undoubtedly the 50MHz Trophy, which takes place for 24 hours over the weekend of 18-19th. There will be plenty of UK portables operating, some from rarely activated squares, so unless your locator map has all the squares coloured in there's likely to be potential for working some new ones. I know its tempting fate to say anything at all on the subject, but this event is often blessed with enhanced propagation for at least part of the time, so as well as the potential to work some new UK squares, some new Continental ones might also come your way. After this we return to the UKACs, with 1.3GHz on the 21st. The penultimate 4m Cumulative contest takes place on Sunday 26th. Finally, the 50MHz and SHF UKACs take place on the 28th. Please note that, due to demand by some of the participants, the SHF UKACs have been increased in duration by 30 minutes to 2 hours 30 minutes.

Moving to non-RSGB events, the UK 6m Group's Summer E's Contest takes place for 24 hours over the weekend of 4-5th. You can participate and give points away even if you're not a member. Send a report, serial number and your locator, and expect to receive the same plus a membership number. Remember that many members of UKSMG are experts on 6m, so they're likely to hear you even if your station is far from ideal for the band. For 24-hours of the following weekend (11-12th) there's another opportunity to take part in a 6m contest, this time the REF (French) DDFM 6m. Participating French stations will add their Department number to their callsign when calling CQ, e.g. F6XYZ/71. Exchange a report, serial number and the first four digits only of your locator. Locator squares count as multipliers, so French stations will be happy to work the UK, plus there's an award for the top non-French entry. Oh, and remember that French stations operate only above 50.200MHz. The 6-hour Practical Wireless 2m Low Power Contest takes place on Sunday 12th, the first four hours of which coincides with the 2m Backpackers event. The maximum power level is 3 watts and multipliers are locator squares. The All Asian DX CW Contest runs for the full 48 hours of 18-19th. Exchange a signal report and your age (YLs may send '00'). Next comes the IRTS 80m Counties contest, on the 19th. For those outside EI/GI, work EI and GI only. Send a report and serial number, and expect to receive the same plus County. The penultimate event I'd like to publicise is the Worked All Britain 6m Phone Contest. It takes place for six hours on the 19th and coincides in part with the RSGB 50MHz Trophy Contest. It would help all participants if everyone had both their Locator (not needed for the WAB event) and WAB square (not needed for the RSGB event) available. Finally, the Marconi Memorial Contest takes place for 24 hours on the weekend of 25-26th. This CW-only event has two power categories, QRP (maximum 5 watts) and Low (maximum 100 watts). Single-op and Multi-op entries are allowed, but not single-band. Work everybody, exchange a report and serial number and remember that in this event there is a 10-minute band change rule.