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AN INTRODUCTION TO AMATEUR RADIO - FOR BEGINNERS OF ALL AGES

RADIO

D-I-Y

PROJECTS:

6M TRANSMITTER PROJECT

BUILD YOUR OWN DELTA LOOP

WATER LEVEL METER

PKTCOMM REVIEW

PLUS:

FEATURES

NEWS

ON THE AIR

A3 POSTER

D-i-Y RADIO

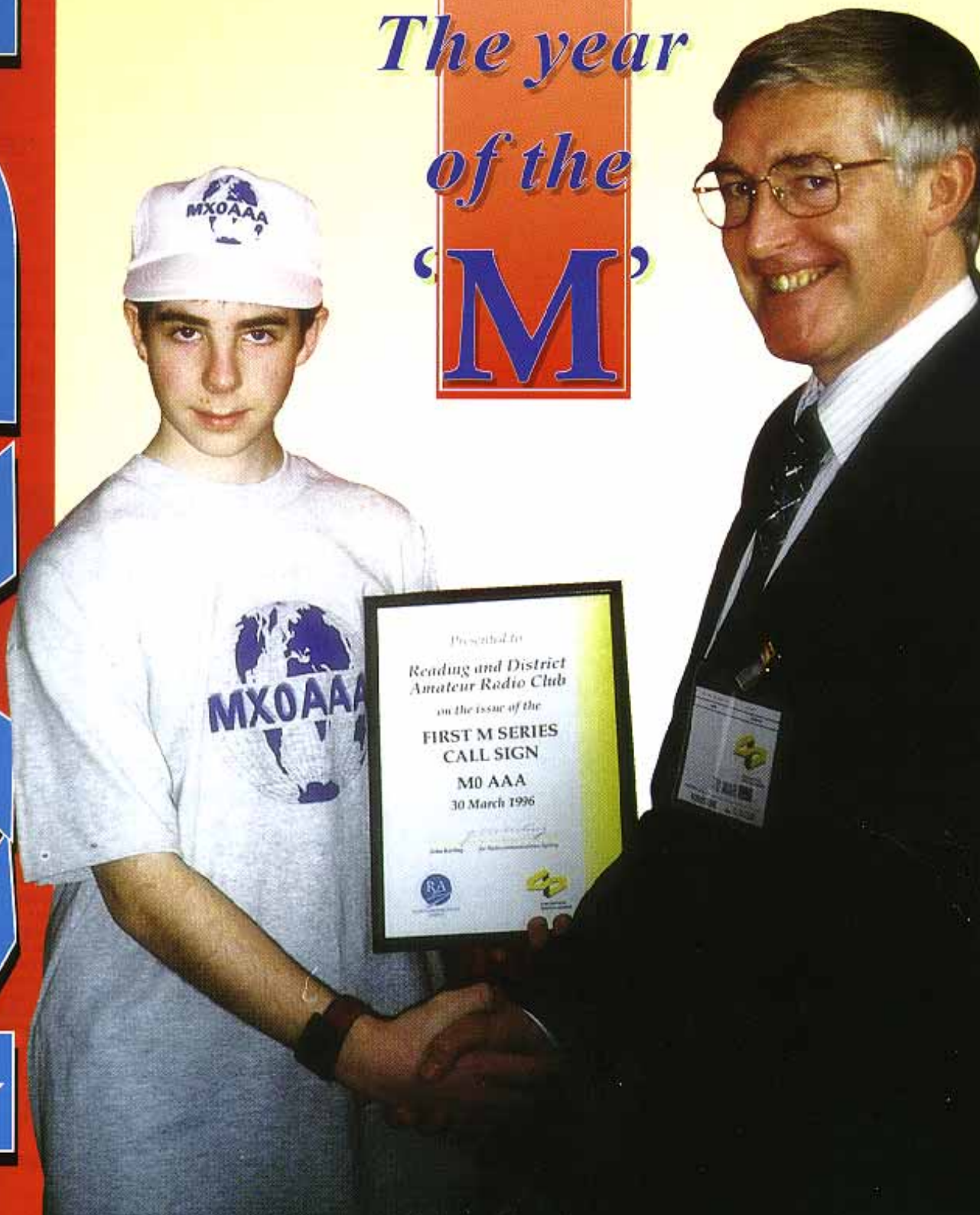
AN INTRODUCTION TO AMATEUR RADIO - FOR BEGINNERS OF ALL AGES

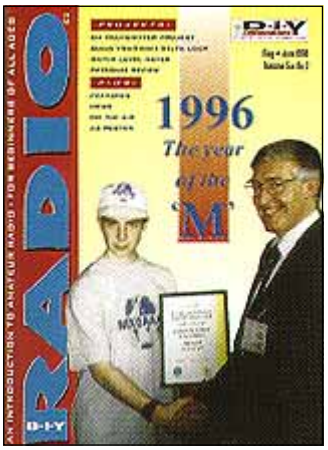
May • June 1996

Volume Six: No 3

1996

The year of the 'M'





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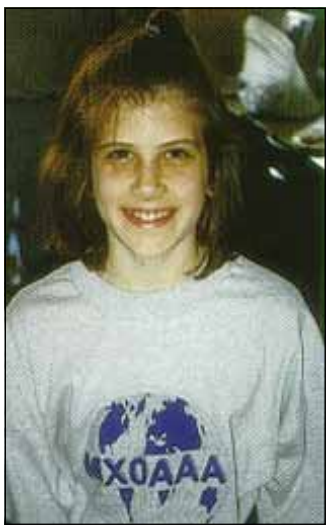
FOR THE MORE EXPERIENCED (3 soldering irons)

Over 2000 people entered a competition in our sister magazine *Radio Communication* to win a £1200 Icom IC-706. The draw for the transceiver, donated by Martin Lynch & Son, took place at the RSGB London Amateur Radio and Computer Show on 10 March. Lucky winner was Steve Whitt, G8KDL, who is shown here with the tiny transceiver (on right of picture) in his shack in Buxhall, Suffolk.



Nine-year old *D-i-Y Radio* reader Katie Cannon, 2E0ACY, was among the Reading & DARC members who attended the 'M' callsign ceremony in Bristol (see news story opposite). She has recently taken over her father Tom's Novice callsign, Tom having 'upgraded' to become G0VQR. See the letter from Tom on page 22.

Comment

MEMBERSHIP of the RSGB's Junior HamClub is on the up and up. This isn't surprising, because at just £10 a year it does provide excellent value for those under 18. The normal subscription rate for *D-i-Y Radio* is £9 per year, so for just £1 extra you get almost all the benefits of RSGB membership: 15% off all RSGB publications (this could easily save you your annual membership fee!), use of the QSL Bureau, participation in RSGB contests, and access to a wide range of technical advice provided by the RSGB's large band of volunteer experts.

Don't forget the RSGB Headquarters Open Day on Saturday 4 May. There will be guided tours of the HQ building, you'll be able to see how *D-i-Y Radio* and *Radio Communication* are produced, and there will be some real bargains on offer too! You don't have to be an RSGB member to come along; all are welcome. The address is shown at the bottom of this page, or for further information contact RSGB Sales and Marketing Manager Marcia Brimson, 2E1DAY, on 01707 659015.

We are very pleased to be able to report the link-up between the ATC radio training scheme and the amateur radio Novice licence scheme (see page 3). Wouldn't it be marvellous if all 40,000 ATC cadets took out Novice licences? Now there's a thought!

Mike Dennison, G3XDV
Editor

Managing Editor: Mike Dennison; Production Editor: Jennifer Crocker; Technical Editor: Peter Dodd; Technical Illustrator: Bob Ryan; News Ed: Steve Lowe; Prod Asst: Wai-Yee Man; Secretary: Samantha Ralph. *D-i-Y RADIO* is published six times a year by the Radio Society of Great Britain, Lambda House, Cranborne Road, Potters Bar, Herts. Filmset by JJ Typographics Ltd. Printed by Southernprint (Web Offset) Ltd. ISSN No: 0959-843X.

AMATEUR RADIO IN SPACE

SAREX, THE Shuttle Amateur Radio EXperiment, will fly again in June. It is planned that Shuttle flight STS-78 on *Columbia* will take off on 27 June for a 16-day flight. American astronauts Susan Helms, KC7NHZ, and Charles Brady, N4BQW, and Canadian Robert Thirsk, VA3CSA, are scheduled to be on board. They will have both 2m FM and packet radio equipment with them.

During SAREX missions, astronauts will make scheduled contacts with schools and family members, and will have random contacts with other amateur radio operators.

ICARE '96 CONFERENCE

THE SECOND international conference promoting the use of amateur radio in education takes place in Berlin from 24 to 27 July. The conference is being organised for ICARE by Hilary Claytonsmith, G4JKS, with the assistance of Sieghard Scheffczyk, DL7USR. ICARE, the International Council for Amateur Radio in Education, now has representatives in 20 countries and delegates from many of these are expected to attend the Berlin conference.

● GOOD LUCK TO all sitting the May 1996 RAE. This is the 50th anniversary of the RAE, which first took place on Wednesday 8 May 1946 between 7.00 and 10.00pm at a number of technical colleges throughout the country.

The Year of the 'M'

AT A ceremony held on 30 March, the first regular 'M' series callsigns were presented. All new full licences issued from 1 April now have the prefix M0 (Class A) or M1 (Class B). The secondary letters remain unchanged, so stations in Scotland are MM1 or MM0, club stations in Wales may use MC1 or MC0 and so on. The reason for the change is that the G callsign series were close to running out.

Subscription Services Ltd, who issue licences on behalf of the RA, hosted the ceremony at their Bristol offices. Staff from SSL's Radio Licensing Unit and the Radiocommunications Agency were on hand to see John Keeling, the RA's Head of Special Applications, present framed certificates to the holders of M0AAA and M1AAA.

The front cover shows John Keeling presenting the M0AAA certificate to Ben Clarkson, G7WHO, who accepted it on behalf of the Reading and District Amateur Radio Club. The club has a wide range of activities for Novices and young people: Ben is formerly 2E1DHA and received his present callsign on his 14th birthday. The new M callsign (using the club prefix MX0) was aired from 0001 on 1 April in an operation sponsored by Yaesu (UK) - see *The Log Book* on page 16.

Ian Oliver from London was presented with a similar certificate for his new callsign, M1AAA.

ATC AND RSGB FORGE AMATEUR RADIO LINK

The Air Cadet Radio Training Document being launched at the RSGB London Amateur Radio and Computer Show. From left to right: Ray Degg, G0JOD; Flt Lt Malcolm Wood, G7VRT; Sqn Ldr Tony King; RSGB General Manager Peter Kirby, G0TWW; Hilary Claytonsmith, G4JKS, of the RSGB Training and Education Committee.

A NEW AIR Training Corps (ATC) Radio Training Document was launched at the RSGB London Amateur Radio and Computer Show on 10 March. The new scheme marked the end of nearly five years of intensive negotiation and hard work by a dedicated team from the ATC and the RSGB.

The RSGB was approached by the ATC radio advisor, Sqn Ldr Tony King, in 1991 with the idea of combining the communications training already being practised in the ATC with the amateur radio Novice licence training scheme. In those days, once an Air Training Cadet left the service, he would have to drop his radio activities. Now, under the new scheme, cadets are encouraged to continue training with an amateur radio Novice instructor once they have completed the ATC's own courses, and then to take out a Novice licence. Around 40,000 cadets now have the opportunity to qualify for a civilian qualification which will allow them to continue their radio activities into adult life.

● THE NATIONAL Vintage Communications Fair takes place at NEC in Birmingham on 5 May from 10.30am - 5.00pm. Entrance is £5. For further details, write to NVCF '96, 2 - 4 Brook St, Bampton, Devon EX16 9LY.

● BECAUSE OF THE IRA bombing of Canary Wharf, the RA has a new address: Radio-communications Agency, 11th Floor, New Kingsbeam House, 22 Upper Ground, London SE1 9SA. The telephone number is: 0171 211 0160.

Keys items of RSGB News for HamClub Members

● THE HUNT IS ON for this year's Young Amateur of the Year. Contact the RSGB Marketing and Sales Manager, Marcia Brimson, 2E1DAY, for full details.

● AN RSGB REGIONAL Open Forum meeting will take place on 26 May at Rivenhall Village Hall, Church Road, Rivenhall, Witham, Essex. Further details can be obtained from Fred Stewart, G0CSF, Shingles, Ingleborough Ln, St Marys Platt, Sevenoaks, Kent TN15 8JU.

● VISIT RSGB HQ on our Annual Open Day on Saturday 4 May. Have a guided tour of the RSGB HQ building, and visit the National Amateur Radio Museum and Library. We are open from 10.00am to 4.00pm. Further information from Marcia Brimson, 2E1DAY, on 01707 659015.

● AT THE RSGB COUNCIL meeting on 13 January, I J Kyle, GI8AYZ, was elected Executive Vice-President for 1996; J C Hall, G3KVA, was confirmed in the post of Company Secretary for a further year; and M Harrison, G3USF, was appointed Chairman of the Propagation Studies Committee. A request for funding to an amount of £2590 to encourage IARU-style 80m ARDF activities was approved.

● THE RSGB LIAISON Officer is the first link between the membership and RSGB Council. All RLO terms of office expire at the end of 1996 and elections will therefore take place later this year. Interested parties can obtain more information from their RLO or Zonal Council member.

● PETER SHEPPARD, G4EJP, was installed as the 62nd President of the RSGB at a ceremony in Hull on 13 January. The ceremony was attended by some 70 members and guests including the Presidents of our sister Societies in Ireland, France, Belgium, the Netherlands and Germany.

● GOOD NEWS FOR kit manufacturers! The RSGB EMC Committee has received answers from the DTI to questions about amateur radio kits and the new EU EMC Directive. These indicate that such kits are *exempt* from the Directive.

● AT AN RSGB meeting with the Radiocommunications Agency on 11 March, proposals from the City and Guilds for changes to the RAE were discussed. Following representations by the RSGB, these proposals have been put on hold pending further discussions.

● RSGB HQ IN Potters Bar will be open between 10.00am and 4.00pm on the third Saturday of the month: 18 May and 15 June. Morse tests are available on demand between 11.00am and 12.30pm.

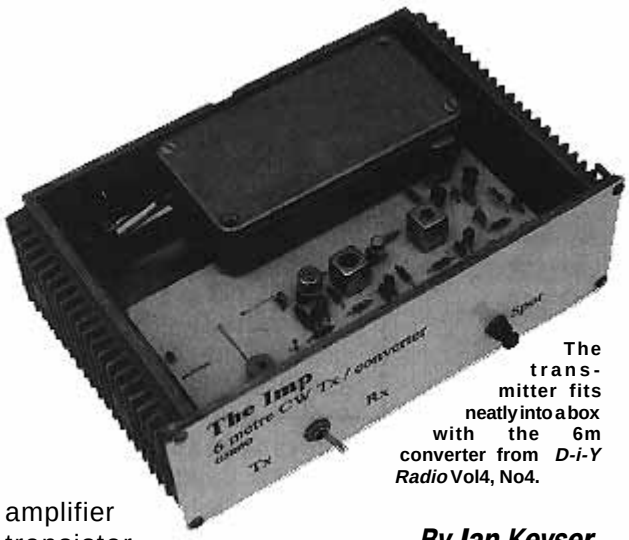
● CITY & GUILDS has issued a report on the March 1996 Novice Radio Amateurs' Examination. Any member wishing to receive a copy should write to Lynnette Ranger, 2E1EKT, at RSGB HQ, enclosing a 19p SASE.

● AS A RESULT of negotiations between the RSGB and the Radiocommunications Agency, the RSGB's Licensing Advisory Committee reports that an amateur allocation around 73kHz is getting nearer. Discussions on the actual terms of licensing are continuing.

● THE RSGB IS TO create a new Full Committee of the Society to look after the Islands on the Air (IOTA) awards programme, with administration being handled at HQ. Roger Balister, G3KMA, has been appointed IOTA Manager and the HQ IOTA Co-ordinator is Eva Telenius-Lowe.

Further information on these stories may be obtained from the D-i-Y Radio *Editorial Office - call 01707 659015.*

A 6M Transmitter



The transmitter fits neatly into a box with the 6m converter from *D-i-Y Radio* Vol4, No4.

By Ian Keyser, G3ROO

THIS IS A simple 50MHz transmitter for CW operation. The circuit, shown in **Fig 1**, is simple, sure-fire and only needs a test meter to set it up.

BUTLER OSCILLATOR

I HAVE USED STANDARD components but modified T2, by removing the ferrite cup from the coil former as we did for the converter, see *D-i-Y Radio* Vol 4, No 4. However, in this design the slug *is* used. The former should be soldered in the board and then the can pushed over the base making sure that the two lugs pass through the holes. The lugs are then soldered to the ground plane on the underside of the board.

A simplified Butler circuit was chosen for the oscillator as this can be used in the fundamental mode or on the third or fifth overtone just by changing the tuned circuit. In fundamental mode the crystal oscillates on its natural resonant frequency whereas in overtone mode it oscillates at approx three or five times this frequency. It is forced to do so by only allowing feedback in the oscillator to exist at the third or fifth overtone frequency. Note that the third overtone frequency of an 8MHz crystal will not be exactly on 24MHz but up to 20kHz off. The crystal oscillates on its third overtone so we can either use fundamental crystals in the 8MHz range or overtone ones in the 25MHz range.

The oscillator output from the link winding on transformer T1 is fed to the base of TR3. The 22Ω resistor suppresses parasitic oscillations, as does the ferrite bead on the collector lead of the transistor. This stage is a doubler and turns the 25MHz oscillator signal into 50MHz at the collector tuned circuit (second harmonic) – hence the name 'doubler'.

MATCHING BY ETCHING

T2 COUPLES THE 50MHz signal to the base of the power amplifier transistor, and the 50MHz energy is developed across a 10µH RF Choke in the collector lead. The output tuned circuit (L1) is etched onto the PCB. Tests on three transmitters gave second harmonic suppression (at 100MHz) of 32dB. In other words, an output power at 100MHz of less than 100µW – a very low level.

After building the transmitter (see **Figs 2** and **3** for layout and PCB details), it's time to tune it up. To make this easy, I've included two test points TP1 and TP2. If you don't have a dummy load and power meter, solder a small pea bulb between the aerial output and ground. Then short the key pin to ground, and apply 12 volts between the +12V pin and

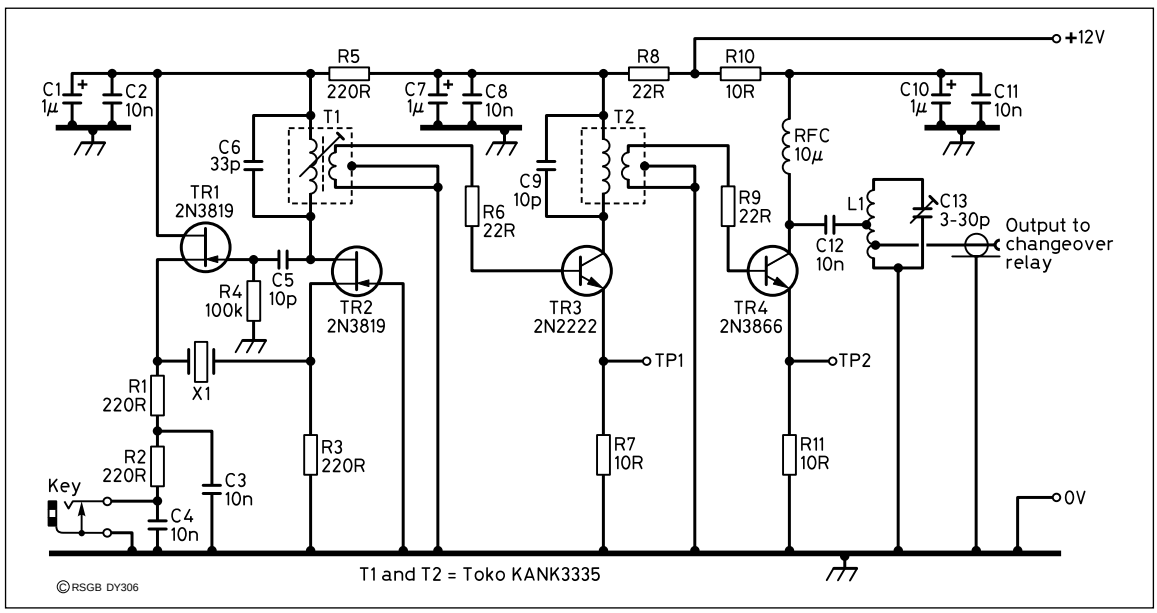


Fig 1: The 50MHz transmitter circuit diagram. TP1 and TP2 are included to assist in setting up the transmitter; see text.

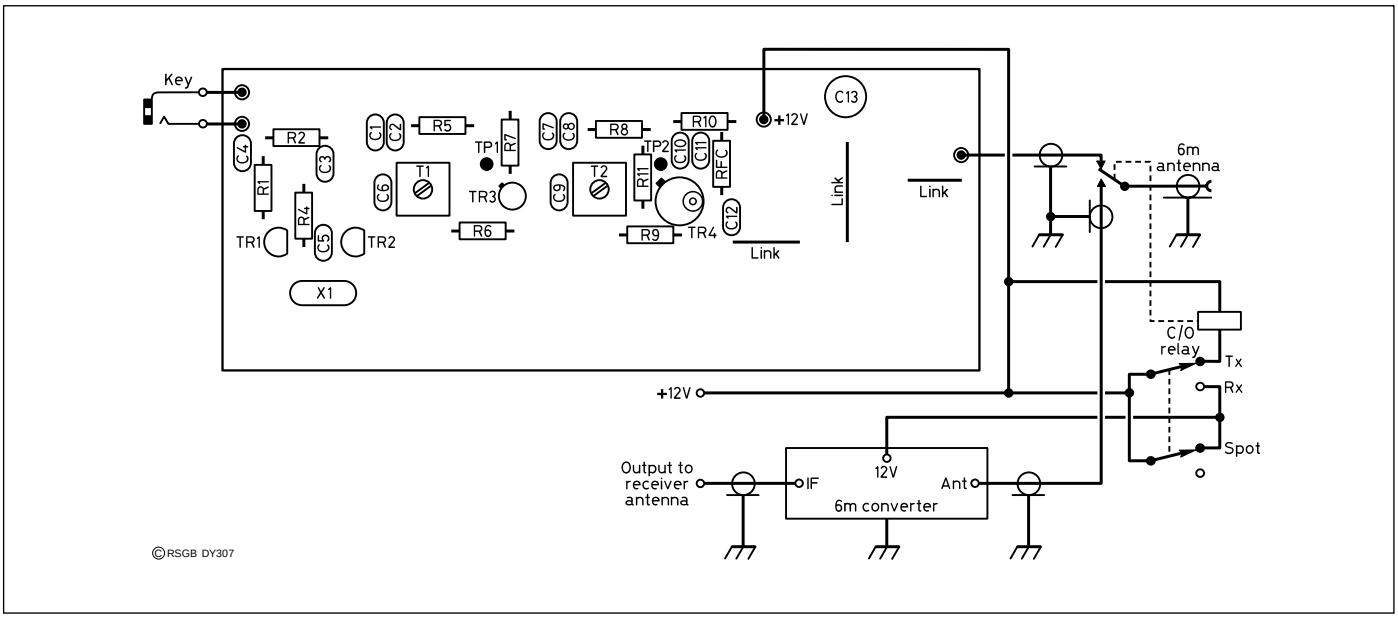


Fig 2: Layout of the components and antenna changeover relay. This is also shown with the 6m converter; see text.

ground. Connect your test meter (on its lowest voltage range) between ground and TP1. Next, using a trimming tool, unscrew the core of T1 until it nearly falls out, then slowly wind it in until a voltage appears on your meter. Peak the core for maximum and you should get between 0.5 and 1 volt. Now transfer your meter probe to TP2 and adjust T2 in the same way as T1 – you should peak on TP2 to about 1 to 1.5 volts. Now remove the meter and slowly tune C13 watching the lamp, peak for maximum brilliance, it is pretty dim as you only have 100mW, but in the past I have worked across the Atlantic on 10mW CW!

CW is fun to use, and contrary to popular belief Morse is not difficult to learn and can give much pleasure. Whether it's the other side of town or an exotic DX station, the contact can be made with much lower power than with speech modes.

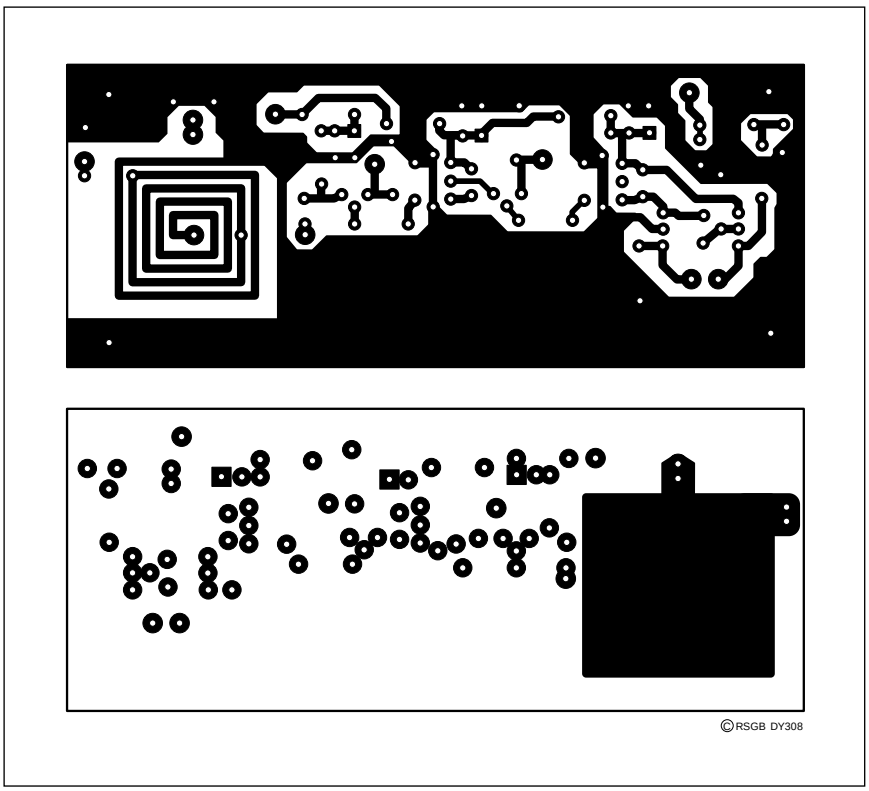


Fig 3: Printed Circuit Board: (Top) Track side showing PCB 'coil' L1. (Bottom) Ground-plane side or components side. The black areas on this side of the board are where the copper must be removed. Note that the above layout is 70% of the true size.

COMPONENTS LIST

Resistors - All 0.25W 5%

R1,R2,R3,R5	220R
R4	100k
R6,R8,R9	22R
R7,R10,R11	10R

Capacitors

C1,C7,C10	1µ0 electrolytic
C2,C3,C4,C8, C11,C12	10n ceramic
C5	10pF ceramic
C6	33pF ceramic
C9	10pF ceramic
C13	3-30pF trimmer

Inductors

T1,T2	Toko KANK3335

Semiconductors

TR1,TR2	2N3819
TR3	2N2222
TR4	2N3866

Additional items

Crystal to give final frequency between 50.080 and 50.100MHz
Printed circuit board
Key socket

KITS AND BOARDS

Kits of parts (excluding PCB) for all on-board components, including a suitable crystal, are priced at £19.95. Printed circuit boards are £2.95. Both prices include postage and packing.

Kits and boards are available from: Kanga Products, Seaview House, Crete Road East, Folkstone CB18 7EG. Tel: 0303 891106.

Water Level Alarm

By Steve Ortmayer, G4RAW

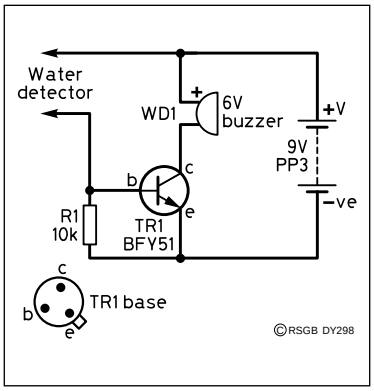


Fig 1: Circuit diagram of the water level detector.

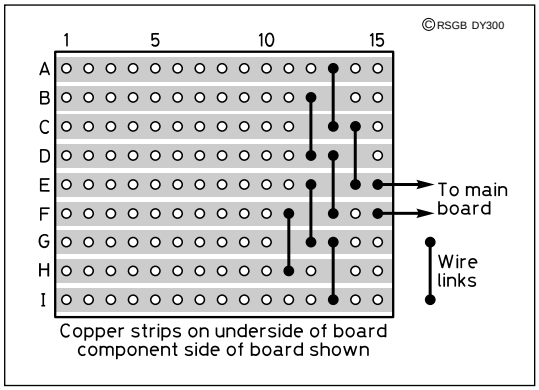


Fig 2: Layout of the main board.

"QUICK HURRY" said Dad to Norman and Nancy Novice. "Bring mops and buckets to fight the flood".

Grandad was staying with Norman and Nancy and he had fallen asleep whilst running a bath!

"What I need", said Grandad when all the mess was cleared up, "is some kind of water level alarm to tell me when the bath is full". "Perhaps" he continued, "two electronic experts could produce one" and he gave a knowing glance towards Nancy and Norman.

THE WATER LEVEL DETECTOR

THE PROJECT shown here is a device for solving the problem described above. In the circuit the 10k resistor and the detector form a voltage divider and when the water on the detector lowers its resistance enough voltage appears on the vase of the transistor to make it 'turn on' and current flows through the collector to sound the buzzer.

CONSTRUCTION

THE CIRCUIT OF THE water level detector is shown in **Fig 1**. The unit is constructed as two separate sections; a detector and the main board. The main board is constructed on plain perforated board, that is without the copper strips. The components are pushed through and soldered together beneath the board. The battery is held on with tape. An on/off switch is not necessary because the unit is switched on by simply connecting the battery.

Note that the buzzer is polarized, that is the red wire must go to the positive side as shown in **Fig 2**.

The detector is made on stripboard 15 holes by 9 holes with no breaks in the strips. Alternate strips are linked together to give a greater surface area for detecting the water as shown in **Fig 3**. The links are formed by soldering in small bits of bare 22SWG wire. The detector is joined to the main board with two core stiff wire and this allows the detector to hang over the bath or water container side with the buzzer unit of the outside. The detector is positioned at the desired maximum water level. When the water reaches this level it covers the copper strips and the electronics sound the alarm.

OTHER USES

THIS DEVICE IS QUITE useful for other situations where you need to fill containers with water, such as watering the garden when there is a hose-pipe ban. It can also be used to monitor the level of the garden pond. It could be used, with modification, to control a pump that feeds water to the pond.

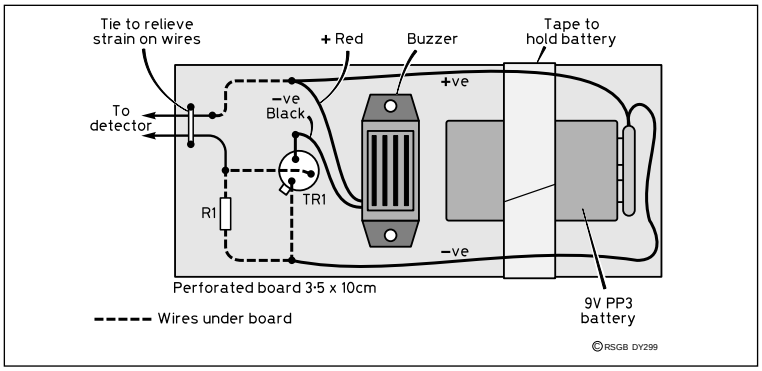


Fig 3: Water detector constructed from stripboard.

COMPONENTS

Resistors

R1 10k 1/4 watt resistor

Semiconductors

TR1 BFY51

Additional Items

WD1 6v Min buzzer note lead polarity

PP3 9v battery and Snap connector

Perforated board, 3.5 x 10cm

Strip board 15 holes by 9 holes

Build your own Delta Loop antenna

A low cost, effective and directional antenna for the HF band by Richard J Constantine, G3UGF.

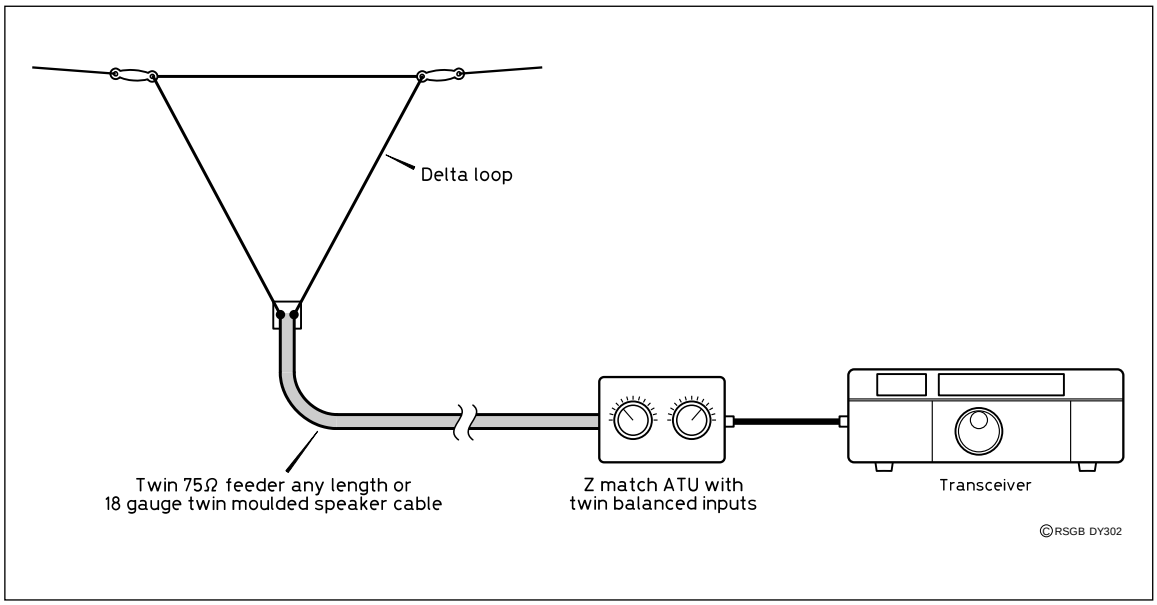


Fig 1: Multiband version of the delta loop connected to the ASTU using 75Ω twin feeder.

NOT EVERYONE has the space or height for an effective delta loop antenna for the 80 metre band, like the one used at Wainhouse Tower, by the Halifax and Rickmansworth School Radio Clubs, (see *D-i-Y Radio* Vol 6 No 1) but that doesn't mean to say that you can't experience the performance of this simple and highly effective antenna for yourself.

There seems to be something magical about bending simple wire antennas into triangular or square shapes. It gives them something extra by way of performance and many antenna designs use this to good effect.

By having both horizontal and vertical sections in its design the Delta Loop combines horizontal and vertical polarisation making it suitable for short range or long distance (DX) contacts. In addition the loop antenna is directional and I will tell you how to make use of this attribute later. This antenna is very cheap to construct so it won't break the bank.

CONSTRUCTING A 20M LOOP ANTENNA

I DECIDED TO MAKE a loop antenna for 20 metres (14MHz) because this band carries most of the amateur radio DX traffic. The band offers a chance of long distance communications and the antenna will fit easily into most small gardens.

It is very light in weight and you should aim to have the top section about 10 metres (30 feet) in the air, with the feeder point about 2 metres (6 feet) above ground. This is the ideal, but mine works well, sloping and with the feed point only 1 metre (3 feet) above ground.

All you need is a length of good wire, some polypropylene rope, insulators (home made will do) and some way of matching this 75Ω balanced antenna into a 50Ω coaxial cable, connected to your radio.

Firstly let's find our how long each leg of the triangle needs to be. I use the following formula to work out what the side lengths should be: Total wire length = 1005 divided by the frequency.

This gives the length in feet so you need to multiply the answer by 0.3048 to give the answer in metric units.

Calculators are a wonderful invention so the calculations are very easy. I have used 14.200 MHz as an example as this is about the middle of the 20 metre amateur band.

So, in our case, 1005 divided by 14.2 = 70.775 ft (70ft 9in). As there are three sides to the loop each side = 23ft 7in.

To convert these lengths to metres multiply 70.775 by 0.3048 = 21.58 metres. This means that each of the three sides is 7.2m long.

To measure this out I used two metal tent pegs, on the lawn, checking the distance between two of them carefully several times. Before winding the antenna wire around them, enough to make the three sides, I marked the lengths with tape and also allowed an amount over at each end, to be trimmed down, in order to make the shortest possible connections.

Insulators were placed on the two top corners, secured by

making them a tight fit, through the insulator holes, with PVC tape and a dustbin liner tie or plastic tie wrap.

Having laid the antenna out on the ground, the support rope was then attached to each of the top two insulators, made from a flat strip of thick plastic, with holes in either end.

A simple alternative to this would be to use a single long rope with the top section of the antenna taped to it, avoiding the need for insulators. I have seen this done as a temporary measure and it prevents the wire from stretching; however, I thought that it may change the performance of the antenna, when it became wet.

CONNECTING THE ANTENNA TO THE RADIO

NOW FOR THE INTERESTING bit, how to connect the loop to the radio in the most efficient way. This can be done in one of two ways.

1. If you are lucky enough to have an ASTU (Antenna System Tuning Unit) with a balanced input connection, such as the famous Z match design, all you need is a length of twin cable soldered to the ends of the wire and on to the two terminals of your ASTU, as shown in **Fig 1**.

2. Another way is to buy one of the many commercially made, 1:1 ferrite cored baluns. An example is shown in **Fig 2**. These will work over the whole range of amateur and commercial short wave frequencies and once bought can be used again and again.

However, as the antenna is for a single band there is a much more simple answer to the problem of matching the antenna to the 50Ω coaxial cable needed to connect to your radio.

Simply make your own tuned frequency balun, with a length of plastic water pipe, 250mm (10in) long with 7.5mm holes drilled in each end plus a tuned length of good quality TV coaxial antenna cable, which is 75Ω. The construction of this antenna is shown in **Fig 3**.

For best results and widest tuning range on your radio, use the brown type cable which has a full metal earth braid. The cheaper TV cable is often black and has a metal foil with a braid wire. This will work but the traditional cable is better.

Now reach for the calculator again; the length of TV cable you will need, for our chosen frequency of 14.2MHz, can be found by:

Cable length = 234 divided by 14.2MHz x cable velocity factor = 16.5 x 0.75 = 12.4ft.

For metric = 12.4 x 0.3048 = 3.8cm.

Cut the TV cable to length taking care to mark an extra 3 or 4cm to allow for cable stripping and connection. The construction of this balun is shown in **Fig 4**.

Drill a hole straight through the plastic 4cm diameter plumber's tubing and pass one end of the coax through it.

Tightly wrap the cable round the tube, until it is almost all used up. Then drill another hole straight through the tube and push the remaining cable straight through the tube. It will now hold itself in place, whilst you drill two similar holes near to the top edge, on to which the two ends of the wires are tied, before being connected and sealed with tape.

For extra insulation, I found two rings from old key fobs, fastened them through the holes in the tube and then through the holes in two insulators.

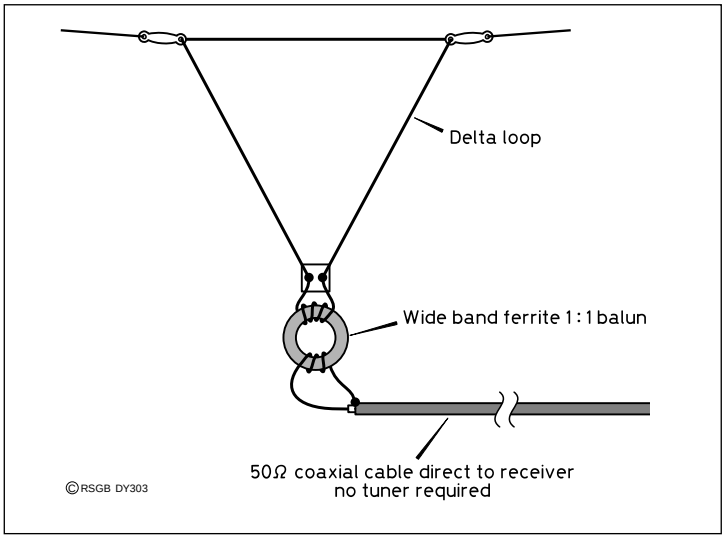


Fig 2: Multiband version of the delta loop using 75Ω coaxial cable. This arrangement requires an ASTU if used as a multi band antenna.

USING THE ANTENNA

THE DELTA LOOP IS a directional antenna, like a simple beam, giving best performance when the loop is facing the station you wish to contact or hear, see Fig 3. This makes it ideal for 'pointing' at a favourite direction, such as Australia,

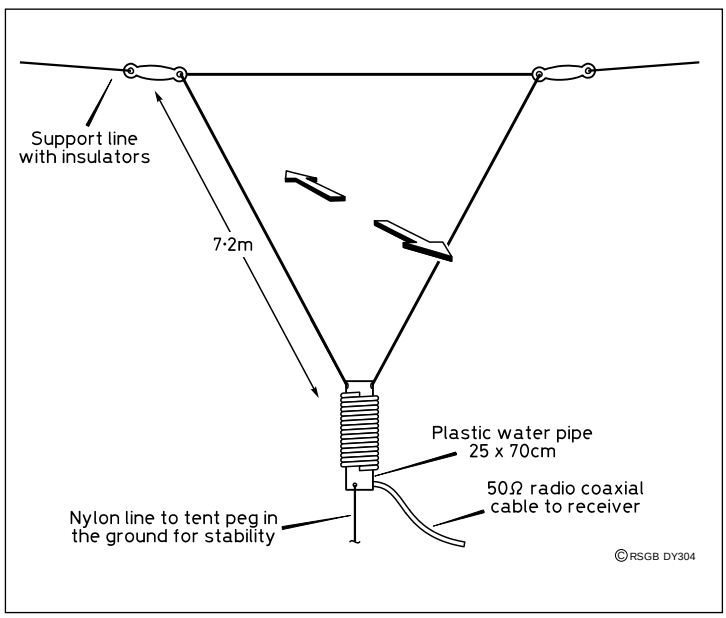


Fig 3: Single band version of the loop antenna using a coaxial balun. The direction of maximum signal strength is indicated by the arrows.

Peak District Special Event

by David Hill, G7MMQ

THE PEAK Project was born late in 1993 after the South Notts Amateur Radio Club (SNARC) was asked "Would you like to provide a special event station for Peak '95?" After a detailed question and answer session we said "yes". The team included Julie Brown, G0SOU; Trevor Pendleton, G4IRH; Ray Roulstone, G0SOM; Gary Bishop, G7RTF and me. Later we were joined by Chris Burbanks, G3SJJ, and Robert Gill, G1AHV. We had some 18 months to arrange everything; plenty of time, or so we thought - how wrong we were!

PEAK CAMPS

PEAK CAMPS ARE only held every five years in the grounds of Chatsworth House in the Derbyshire Peak District. Peak '95 was to be a Scout and Guide camp for one week during July 1995, in fact it would become home for approximately 7000 Scouts and Guides from all over the world. We were to provide an amateur radio station that would give them a good insight into amateur radio, whilst also giving them the chance to obtain their Communicator Badge. After obtaining the callsign GB2PIC (Peak International Camp) we started acquiring equipment for the station.

EQUIPMENT

WE HAD OUR own 60ft trailer-mounted tower and three-element beam for 10, 15 and 20m, so antennas were not a problem. Letters were sent to several organisations asking for the loan of equipment. Strumech Versatower offered an 80ft trailer tower and Yaesu UK said we could have the use of a transceiver, although in the end we didn't need to borrow a transceiver. Tiedata of Derby provided four computers which we networked using *NA* contest logging software. This enabled two stations to log simultaneously into one file, whilst the other two computers displayed information on stations being contacted to our visitors. In addition, connection to the DX *PacketCluster* was available. The two HF stations eventually consisted of a Yaesu FT-990 transceiver with Kenwood TL-922 linear amplifier to a three-element beam for 20, 15 and 10 metres, and a Yaesu FT-1000 transceiver to a 40/80m trap dipole.

Thousands of Scouts and Guides received an introduction to amateur radio at Peak '95

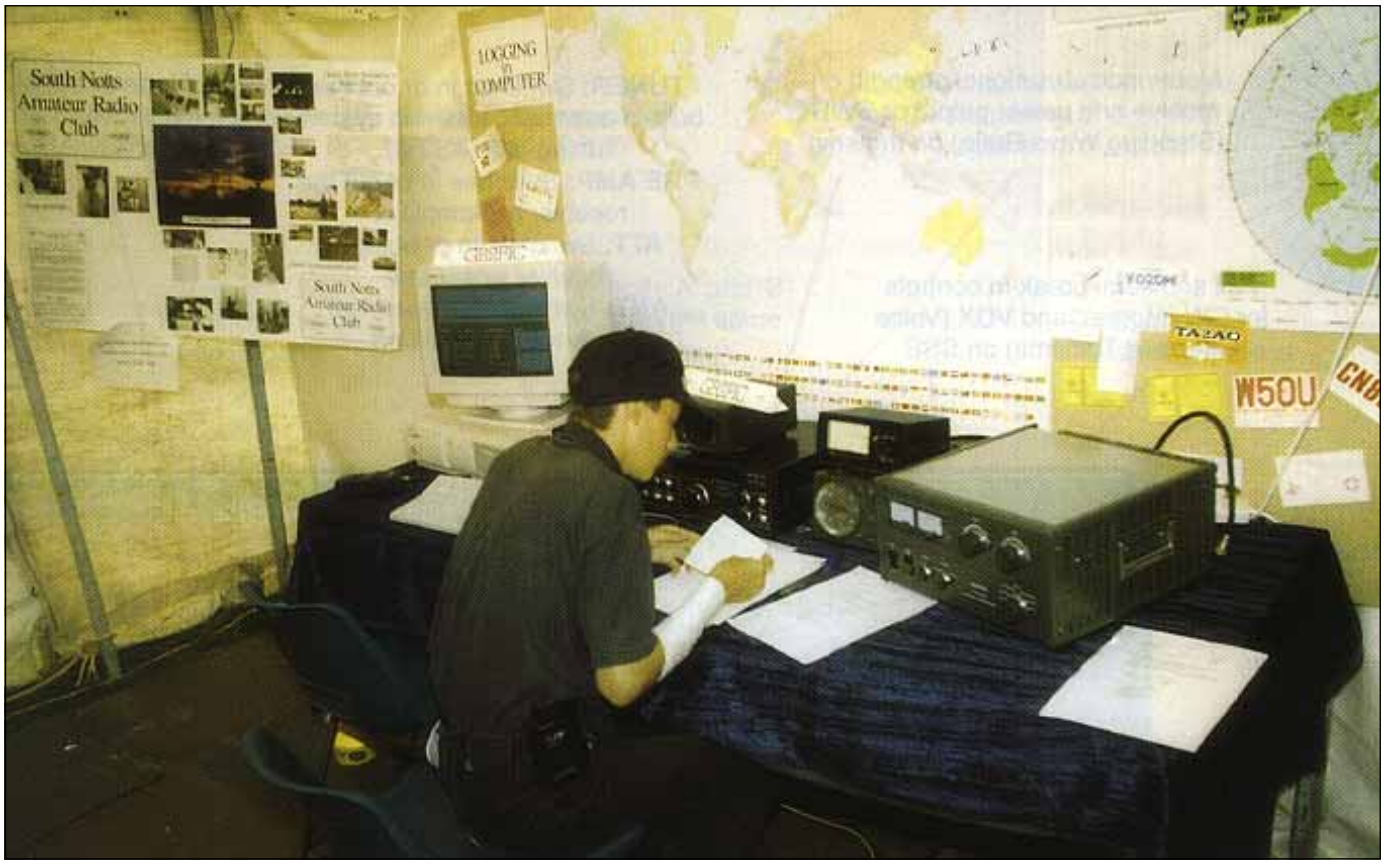
SNARC's 60ft mobile tower being manoeuvred into position at the Peak '95 camp in the grounds of Chatsworth House, Derbyshire.

ON WITH THE SHOW

ALL OF A sudden the event was upon us and we were nearly ready. Many nights of midnight-oil burning were put in to complete everything on time. The station was to be located in a 30 x 30ft marquee situated near the main arena on the top of a hill. I arrived at midday on the Thursday with our tower in tow. The Strumech tower had been collected by the organisers and was waiting for us next to the tent, but that was all there was - no power, no chairs, no tables, no anything! One by one, the team arrived and things started to happen. On enquiring about the power, which was required to enable the station to be set up and to run the freezer, we were told "It may be available some time tomorrow, the cable isn't laid yet". He pointed in the direction of a 200m drum of three-phase armoured cable. After determining where they wanted it, we routed it to our site from the main generator. In due course, all the rest of the specified equipment arrived.

YOUNG COMMUNICATORS

BY SATURDAY, GB2PIC was up and running and, as this was a sort of free-for-all day, there was a steady throughput of youngsters. Sunday was Cubs', Brownies' and parents' day, so



Novice licence-holder 2E1BUY at one of the two HF stations at GB2PIC.

we were very busy. As there were in the region of 10,000 people on site it seemed at times as though the whole of the camp was visiting us. The rest of the week saw a steady flow of Scouts and Guides taking their Communicator Badges.

Thanks to help from the Scout and Guide leaders with the Communicator Badges, we were able to prepare posters and handouts which advised the young people that the badge could be achieved on site, within the week, if they put in enough work. We also obtained a supply of badges so that once the award had been achieved they could leave with the badge.

THE BADGES

QUALIFYING FOR THE Communicator Badge involved logging 25 stations, giving an example of a greetings message, knowing the phonetic alphabet, knowing the most common Q codes, learning about propagation and how radio waves travel, being able to recognise prefixes from Great Britain and abroad and knowing the basic licence regulations.

We had also recruited help from several more amateurs and everyone was kept busy all day explaining propagation, testing on Q codes, phonetics and much more. One young man, upon being handed his badge, punched the air shouting "yes! yes!" He then sped off down the field at full speed only to stop, do a little jig, punch the air again and yell "yes! yes! yes!" I think he was quite pleased!

In the evening, we opened the station to the camp staff. We made contacts with amateurs whose families were at the camp and with other camps which were on air, including a station at the World Scout Jamboree in Holland, PA6WSJ. We also made contact with SM5SOL, the father of a Scout from Sweden who was staying on camp. Most evenings we had quite a gathering of amateurs and short wave listeners in the marquee.

We also had a Morse reader and viewer set up, which seemed to be quite addictive, as we virtually had to lift Scouts and Guides from it and evict them at closing time. In the end we awarded over 70 badges and worked 518 stations.

The members of South Notts Amateur Radio Club would like to thank everyone who loaned us equipment and those who gave their time and experience. Without them, there would be several hundred children who would not have had any contact with amateur radio at all. Our thanks also to everyone who called GB2PIC and made the event the joy that it was, proving that the magic of radio is still alive and well. The generosity of the many stations who were willing to listen to, and take messages from, the Scouts and Guides was greatly appreciated. We will QSL 100% via the bureau or direct to SNARC at PO Box 4, Clifton, Nottingham NG11 9DE and would appreciate SWL reports.

AMATEUR RADIO - IN CONTROL

Meter indicates signal strength on receive and power output or SWR (Standing Wave Ratio) on transmit

TUNER: Switches in or out the built-in automatic antenna system tuning unit (ASTU)
PRE AMP: Switches in or out the receiver pre-amplifier
ATT: Switches in or out the receiver attenuator
ANT: Switches between two antenna connections

Mode switches, to switch between SSB, CW, CW Narrow, AM and FM

Main frequency display, in this case indicating that VFO 'A' is in use and is on 50.110MHz USB

Switches between VFO 'A' and VFO 'B'

Causes the transceiver to transmit on the frequency of one VFO and receive on the other

Full and semi break-in controls for CW (Morse), and VOX (Voice Operated Transmit) on SSB

Receive LED, illuminated when on receive

Transmit LED, illuminated when on transmit

Puts both 'A' and 'B' VFOs on the same frequency

Memory and scanning buttons

Main power on/off switch

Memory channel switch (up or down)

Manual push-to-transmit button

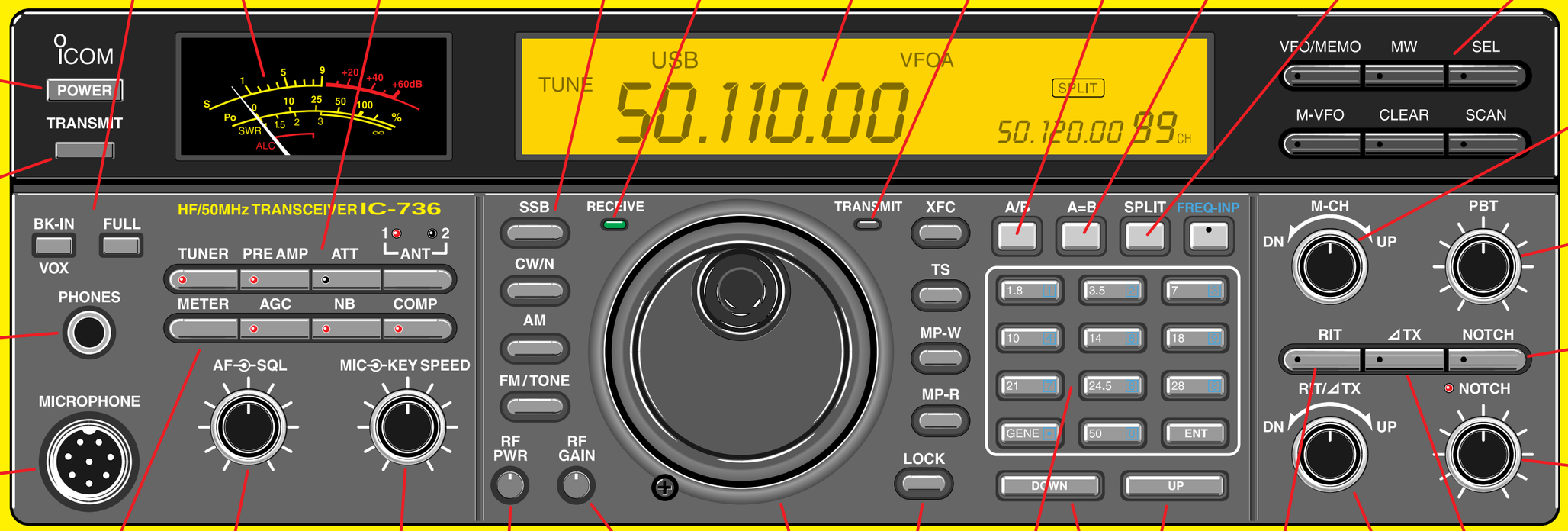
Pass Band Tuning

Jack socket for headphones

Receiver notch filter on/off button

Microphone socket

Adjusts the frequency of the receiver notch filter



METER: Switches the meter between measuring power output and SWR (Standing Wave Ratio) on transmit
AGC: Switches the receiver Automatic Gain Control from fast to slow
NB: Switches the receiver Noise Blanker in or out
COMP: Switches the transmitter's microphone compressor in or out

Inner control is AF Gain, or volume control; the outer is a 'squelch' control

Inner control is the Microphone Gain (or sensitivity) control; the outer controls the speed of the built-in automatic CW (Morse) keyer

Adjusts the transmitter output power from minimum to maximum

Receiver RF (Radio Frequency) gain, or sensitivity, control

Main tuning control knob

Dial lock

Band switches

Switches transceiver up or down in frequency

Receiver Incremental Tuning on/off button

Adjusts the receiver and /or transmitter slightly up or down in frequency compared with the main tuning knob position

Transmitter Incremental Tuning on/off button

Many HF and VHF transceivers can look very complicated at first glance. However, all the controls have a logical function, and these are described above with the aid of the drawing of an Icom IC-736 transceiver, which covers all the HF bands (1.8 - 28MHz) plus the 6m (50MHz) band.

D-i-Y RADIO
RSGB, Lambda House, Cranborne Road, Potters Bar, Herts EN6 3JE

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Go to next page

Packet Radio on a Shoestring

Connect yourself to a worldwide network - without the phone bills.

PACKET RADIO connects your computer to others via your radio station (see opposite for an explanation of this popular part of amateur radio). The usual way to get on to the packet radio network is to connect a Terminal Node Controller (TNC) between your radio and your computer. The TNC contains a modem and its own computer which controls the transfer of files (or parts of files known as packets). By letting the TNC do all of the work, your computer can be very simple - a dumb terminal or, perhaps, a Sinclair Spectrum. The bad news is that TNCs cost upwards of £130 new.

INTELLIGENCE

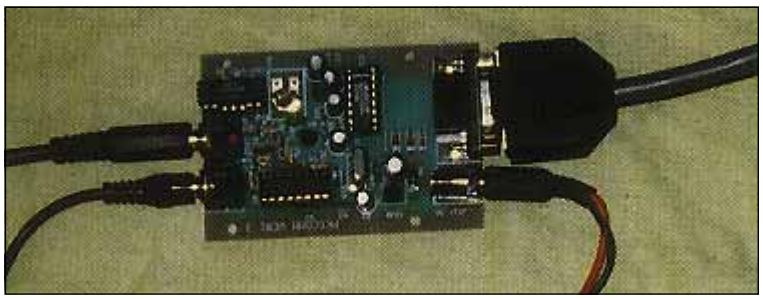
BUT COMPUTERS HAVE advanced so much recently that it is very common for a radio shack to include a fast PC with a colour screen. So why not save money and let the computer do all of the work? With the right software, all you need to buy is a special modem.

CommSLab produce PKTCOMM, an "enhanced Baycom / Graphic Packet compatible modem". This means that it will work with Baycom software and others described as 'Baycom compatible', including Graphic Packet (GP) which CommSLab can supply free of charge.

The PKTCOMM modem, which measures just 80 x 55mm, is available for less than £30 as a kit, though for an extra £10 it can be supplied ready-built. The modem can be powered via the computer's COM port but a separate 12V supply is recommended.

In its cheapest form, PKTCOMM comes as a complete kit of parts, including the printed circuit board (PCB). Plugs for power and audio are included, but not the plugs which go into your radio. Also not included is the RS232 lead to connect to your computer; this can cost several pounds. A box is available from CommSLab, but it is not essential.

The PKTCOMM costs £29.95 in kit form, £39.95 ready-built, and £45.95 built and boxed.



SYSTEM REQUIREMENTS

Computer: A 286 or better, with at least 1MB RAM, a hard disk, a 3.5in diskette drive, an EGA or VGA graphics card and at least DOS 2.0. A mouse is not essential.

Radio: VHF or UHF NBFM (a hand-held is fine).

THE BUILD UP

SEVEN A4 PAGES of constructional details are included with the kit. These deal with general construction techniques, how to connect, test and set up the modem, and a suggested order of construction. Helpful inclusions are: a full components list, several diagrams illustrating how to identify various components and how to insert them in the PCB, RS232 cable details, component layout, a resistor colour code chart and a circuit diagram.

Very few tools are required but it is important to get the right ones to avoid making a mess of the PCB. You will need a fine point soldering iron, some miniature long-nosed pliers and miniature side-cutters. For those with less than perfect sight, a magnifying glass can help in identifying the small resistors and in checking your soldering.

It took a week of evenings - an hour or so at a time - to complete the project. It is possible to build it quicker, and all in one go, but mistakes can easily be made and with these tiny components it isn't always easy to put things right. By following the instructions carefully, the modem worked first time.

CONNECTIONS

FOUR LEADS MUST be made up or bought. One connects the modem to 12V DC - the supply powering your radio will do. Another goes to your computer's serial port (eg COM1 or COM2). And the other two join to the radio's loudspeaker and microphone sockets.

It is important to find out how your transmitter's push-to-talk (PTT) works, as PKTCOMM gives two options: normal earth-going and a 'make' connection as used on Icom handhelds.

SOFTWARE

SEVERAL TYPES OF Baycom compatible software may be used with PKTCOMM. We used Graphic Packet which comes on a single 3.5in diskette. The program has a very attractive screen, split between displaying sent and received text. At the top right hand corner is a clock and at the bottom of the screen is a menu giving several options in the form of icons.

Graphic packet will allow you to connect to several stations simultaneously, can transmit a beacon and acts as a digipeater (packet repeater). It displays a list of the stations it has heard recently (MHEARD), and allows monitoring of all heard packets or, using the SPY facility, just the packets addressed to one station. A simple text editor is provided and received messages can be saved and/or printed. It is also possible to send and receive text or binary files.

GP is extremely easy to install and to use, though its full range of facilities are too great to describe here.

NETWORKED

ONCE ALL OF THE LEADS had been made up and Graphic Packet installed, it was time to go on the air. The first - and most important - thing to do with any new packet radio installation is to check that it knows your callsign. The callsign will be transmitted automatically with every burst, or packet, of information, so it must be right.

Using a 386SX, with VGA screen, and an FT-290R on the 2 metre band, the combination of PKTCOMM and GP was very effective. It was simple to 'connect' to another station and chat, as well as to log on to a bulletin board system (BBS) to send and read messages.

From time to time a piece of text was printed twice on screen; this is very rare indeed with a TNC and may mean that if you are really serious about error-free communication (such as downloading programmes) a TNC would be more suitable.

CONCLUSION

THE MAIN FEATURE of PKTCOMM is its cheapness. From as little as £29.95, and using free software, this really is an inexpensive way to explore the world of packet radio.

How does PKTCOMM and GP compare to a TNC? Most of the facilities on a standard TNC are implemented, including digipeating. A disadvantage is that it ties up your computer whilst in use, but for most uses this is not a problem as any incoming messages are stored by your local BBS station for reading later. And if, eventually, you find this arrangement limiting, you can always pass on your PKTCOMM modem to another beginner and invest in a sophisticated TNC.

PKTCOMM is available from CommSLab Ltd, PO Box 19 Erith, Kent DA8 1LH, who are thanked for supplying the review unit.

WHERE TO FIND PACKET

Listen with an NBFM receiver for 'bursts' of signal - sounding like BRRRRRP - on 144.650, 144.675, 432.650, and 432.675MHz. You will also hear stations identifying their transmissions in Morse code from time to time.

Packet Radio

A Worldwide Network and No Phone Bills . . .

PACKET RADIO is the name radio amateurs give to the method of passing error-free files and E-mail messages between computers. Using a huge network of radio links, some permanent and some temporary, it is possible to communicate with licensed amateurs all over the world, and you don't need a Morse test to do it. Even using low power on the 70cm band, once you have linked to your local 'node', you can be connected to the world.

Like any large network, don't expect instant response. Using radio can be a lot slower than using a telephone line because you are sharing frequencies with many other stations but because of the clever way in which packet radio works (a system known as AX25), you don't hear the other stations and the only effect they have on your contact is to slow it down.

Packet is so-called because each message is transmitted in short bursts (packets) of a few characters at a time, and the next few are transmitted only when the receiving station has confirmed that the first have been received properly.

To find out more about packet radio, ask at your local radio club or on a repeater, or buy a book. But of course you will learn most by joining in the fun yourself.

We will describe the many features of packet radio in a future *D-i-Y Radio*.

2's Company

News and Reports from Novice Licensees

PAUL DENNISON, 2E1DBI, improved on his previous year's score in the RSGB 432MHz FM contest by using the corner reflector antenna described in the September - October 1995 edition of *D-i-Y Radio.* He made 23 contacts from a good portable location high on the Dunstable Downs to take third place in the open section of the 1995 contest. Paul is looking forward to improving his score even further in this year's event.

The RSGB London Amateur Radio and Computer Show on 9 / 10 March was the source of many a bargain. Here, Christopher Whitaker, 2E1BCW, shows his latest acquisition: a 70cm 'ZL Special'.

Participants in the October 1995 RSGB UHF / SHF Contest were treated to some superb conditions on all bands right up to 24GHz! Two Novices took part in the single operator section: T Quantrill, 2E1BMU, who came in third place out of 10 entries on 1.3GHz and in ninth place overall, and Steve Sugden, 2E1AXO/P, in 13th place with 169 points scored on 432MHz.

Steve Sugden, 2E1AXO, also figured well in the RSGB 432MHz Cumulative Contest in October, November and December last year, and won a certificate for being the highest-placed Novice entrant. Steve used a 19-element Yagi aerial to give him a 'best DX' contact of 223km.

NETHERLANDS CALLING

J KOEKKOEK, PA3FDW, has written to say that he and PA3GKY will be actively looking for UK Novice stations on 10 metres SSB this summer. He suggests using 28435kHz as a Sporadic-E propagation calling frequency. PA3FDW, PA3GKY and other amateurs in the Netherlands will therefore be actively monitoring this frequency during the Sporadic-E 'season'.

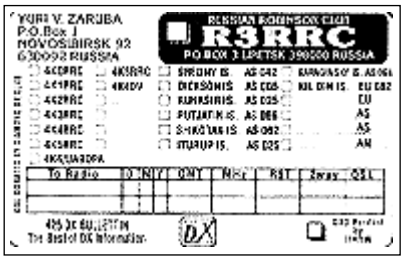
Sporadic-E (or 'Es') propagation can occur on 10 metres at any stage in the sunspot cycle and at any time of year, but is most prevalent during the summer months, from roughly May to August [see also the notes about Sporadic-E on 6m in *Band by Band* opposite - *Ed*]. Es provides strong signals, even from low power stations, making it an ideal mode of propagation for use by Novices.

PA3FDW and PA3GKY are particularly looking for Novices in Northern Ireland, the Isle of Man, Jersey and Guernsey, but would also be very pleased to receive calls from 2E0, 2M0 and 2W0 stations! If you would like to set up a 'sked' and pre-arrange a contact, write to J Koekkoek, PA3FDW, PO Box 2040, 6460 CA Kerkrade, Netherlands.

THE LOG BOOK

IN THE LAST *Log Book* (*D-i-Y Radio* March-April 96) we mentioned the **RSGB Islands on the Air (IOTA) Awards**, which are becoming increasingly popular. Most weekends throughout the summer, a number of operations can be heard which are activating islands specifically for the IOTA awards. Listen around 21260, 7055 and especially 14260kHz at almost any time for IOTA activity. **Gianni Varetto, I1HYW,** is a director of the **Diamond DX Club** in Italy and is very supportive of the IOTA awards. He kindly sent in samples of QSL cards, shown here, which the Diamond DX Club has helped to pay for.

The very first of the new 'M' series of callsigns, **M0AAA,** was activated by the Reading and District Amateur Radio Club at 0001BST on 1 April [see page 3 - *Ed*]. Anyone listening on 3705kHz at that time would have heard **MX0AAA** (the MX prefix is for club stations in England) calling CQ. The start of their operation coincided with the last hour of the ***CQ* WPX SSB contest,** in which different prefixes provide the multipliers and therefore increase entrants' scores considerably. MX0AAA will have provided a unique prefix to those contesters lucky or skilful enough to have found the station in the one hour before the end of the contest.



The Russian Robinson Club was formed to activate Russian islands, many of which also count for the RSGB IOTA awards. Here is a QSL showing a number of callsigns and islands in Europe and Asia which they have activated.

For those unfamiliar with the hundreds of prefixes used in the world, the ***RSGB World***

Band by Band

The Amateur Radio Spectrum: The 6 metre Band

SIX metres, the 50MHz band, is the lowest of the VHF (Very High Frequency) bands. The full band of 50.0 - 52.0MHz is available to all four classes of UK amateur: full and Novice, A and B. The upper half of the band (51 - 52MHz) is allocated on a **Secondary** basis only and the power limit for full licensees is restricted to 20dBW (equivalent to 100 watts). The power limit for Novice licensees is, of course, 3W output over the whole band. The band is available on the basis of non-interference to other services, including those outside the UK.

The 6m band can be a very exciting band for all classes of operator. It provides the possibility of world-wide contacts with low power using speech, Morse and digital modes. As with 10 metres (see *Band by Band, D-i-Y Radio* March - April 1996), the 6m band is very much influenced by **solar activity**. During **sunspot minimum** years (as at present) almost all long-distance signals will be by **Sporadic-E propagation**. This usually occurs in the summer months and provides strong signals from areas such as central and southern Europe. During **sunspot maximum** years, which will occur once again in a few year's time, strong signals can be expected from even greater distances, including North and South America, the Middle East, Asia and Africa.

Badger Boards (tel: 0121 384 2473) produces a 3W output 6m transceiver kit, the **Piccolo**, whilst for those who prefer to operate ready-built equipment **AKD** Ltd (tel: 01438 351710) makes a 6m FM transceiver with switchable power output of 25 and 5 watts for less than £200.

Activity on 6m is generally quite low during sunspot minimum years, although plenty of activity can be expected during contests. The first RSGB 50MHz 'Backpackers' contest of 1996 takes place between 1300 and 1700UTC on 1 June.

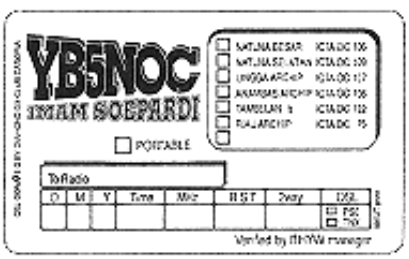
BAND FACTS

Allocation:	
50.000 - 52.000MHz	(50 - 51MHz Primary, 51 - 52MHz Secondary)
Band Plan:	
50.000 - 50.100MHz	CW (Morse) only
50.100 - 50.500MHz	SSB and CW (Morse) only
50.500 - 52.000MHz	All permitted modes
UK Activity:	
50.020 - 50.080MHz	Beacons
50.090	CW (Morse) Calling frequency
50.100 - 50.130MHz	For intercontinental contacts only
50.110	Intercontinental calling frequency
50.200MHz	SSB Calling frequency
50.300MHz	CW (Morse) Meteor scatter calling frequency
50.350MHz	SSB Meteor scatter calling frequency
50.510MHz	Slow-Scan TV
50.550MHz	Fax
50.600MHz	RTTY
50.630 - 50.750MHz	Packet radio (20kHz channels)
51.210MHz	Emergency communications
51.410 - 51.950MHz	FM
51.510MHz	FM Calling frequency
51.530MHz	Used by GB2RS news and GB2CW slow Morse broadcasts
51.940 - 52.000MHz	Emergency communications

THE LOG BOOK

Prefix Map is the answer. This is a huge (119 x 82cm) full-colour wall map showing most of the prefixes used by amateur stations around the world. It is sold on the RSGB stand at rallies for £2.50 - and now for *D-i-Y Radio* readers who take advantage of our **special offer** it is available for just £1.50 including postage and packing. Send in the coupon on page 23 with your order.

The **RSGB Slow Speed Cumulative Contests** provide useful 'real-life' practice sessions for anyone wishing to improve their Morse skills. The final session of the spring cumulative contest is on Friday 3 May, from 1900 to 2030UTC, between 3540 and 3580kHz. All Morse should be at 12WPM or less, and never any faster than the other station is sending.



QSL card from Imam Soepardi, YB5NOC, from Indonesia, showing six of the IOTA island groups which he has activated. Like the R3RRC QSL shown opposite, this card was sponsored by the Italian Diamond DX Club.

This year's RSGB **432MHz FM contest** takes place on 23 June. Conditions last year were very good, with participants making a number of long distance contacts. Best 'DX' for **Paul Dennison, 2E1DBI,** was a contact to the **Netherlands** of over 450km. This is a great contest for Class A or B Novices, as many will already have the appropriate equipment, ie a 70cm 'handheld' transceiver. Couple this to an antenna with gain, such as the corner reflector antenna used by Paul (*D-i-Y Radio* September-October 95) and be prepared for a lot of fun.

Static Electricity Again

By John, GW4HWR, Chairman RSGB Training & Education Committee

SOME OF THE effects of friction between materials were described in an earlier column. *D-i-Y Radio* Vol 3, No 5, if you have access to back numbers why not look it up.

This time a rather different view of the subject is examined. Everyone will have experienced the 'shock' when stroking a cat or dog on a dry frosty day, or then rather more painful one when sliding out of a car and then touching the door handle. These shocks are due to quite high voltages being generated by friction and are examples of static electricity. These high voltages can have disastrous effects on some types of electronic equipment.

Devices known as MOS (Metal Oxide Silicon) are most liable to damage. The transistor called an IGFET, a field effect transistor with an insulated gate, is a simple example. The gate (input) is not physically connected to what can be thought of as the base, but is insulated from it by an extremely thin layer of silicon dioxide (glass). This gives the device a very high input impedance so that almost no current is drawn from the signal source. It also means that the input is very easily damaged by static electricity. The voltage can build up and because of the extremely high impedance, the charge cannot leak away.

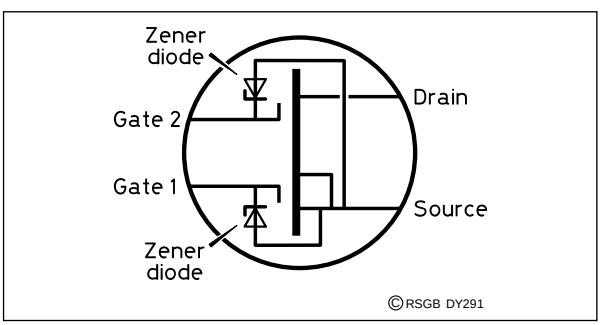


Fig 1: how the Zener diodes in a IGFET are arranged. Note that they are not normally shown on a diagram.

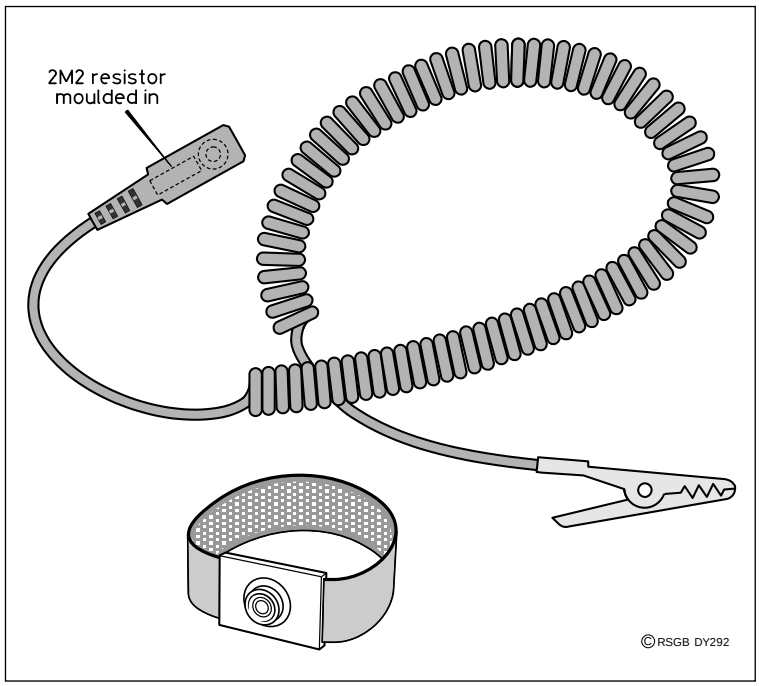


Fig 2: A wrist strap anti-static lead. One end is slipped over the wrist and the other end clipped to an earth point.

Nowadays, in most simple devices the input is internally protected by means of a Zener diode, connected from gate to source. **Fig 1** shows how the Zener diodes are arranged but they are not normally shown on a diagram. ICs which are protected in this way will usually have a 'B' at the end of the type number. If there is a build up of voltage on the gate the Zener diode becomes conductive at about 20 volts and so prevents any further increase in voltage. In the large scale integrated circuits used in computers and similar devices this protection is not generally used for two reasons. The Zener diodes take up space within the chip and secondly they tend to slow down the switching actions. Neither of these effects are desirable in modern computers.

If you remove the cover from your computer, the moment it comes off CMOS devices are at risk. If it is necessary to remove a card from the machine then the risk goes up many times.

There are a number of important precautions which must be taken by anyone who needs to gain access to the inside of a computing device (this is also true of many other modern electronic devices, such as hi-fi amplifiers).

1) Never work on open equipment while it is switched on.
2) Leave the mains plug in the socket, this ensures that the equipment is earthed. NOTE - this applies only to computing equipment with a totally enclosed power supply - with all other equipment the mains plug should be disconnected.
3) Don't touch the pins of ICs or the connectors to a removable card.
4) Earth yourself. Ideally this should be done by using a

special wrist band and lead as shown in **Fig 2**. One end is slipped over the wrist and the other end clipped to the chassis of the computer. An alternative is a home-made lead which is made up as shown in **Fig 3**. Note the 1MΩ resistor connected to the crocodile clip. This will ensure that any current flowing through you is limited to a very low value if you touch the wrong point. One clip should be connected to the computer chassis and the other to the metal wrist strap of a wrist watch.

5) Make sure that your soldering iron is earthed. Don't touch parts of the circuit with a terminal screwdriver which has a handle made of very good insulation material because this will allow the blade to be charged to quite a high voltage. If it is necessary to use the screwdriver to touch some part of the circuit, earth the blade by means of a short piece of wire.
6) Don't be tempted to 'dust off' the tops of ICs by rubbing them with your finger. This is almost a reflex action which must be resisted.

If it becomes necessary to remove a CMOS IC, very great care is needed. If it is soldered in - let someone else remove it. If it is in a holder, lift it carefully, a little at a time, at each end - *do not* touch the pins. Immediately it is out of the socket press it into a piece of aluminium foil or the special foam which usually comes with the device.

In spite of these warnings you should be prepared to undertake simple tasks inside equipment but the precautions must *always* be taken.

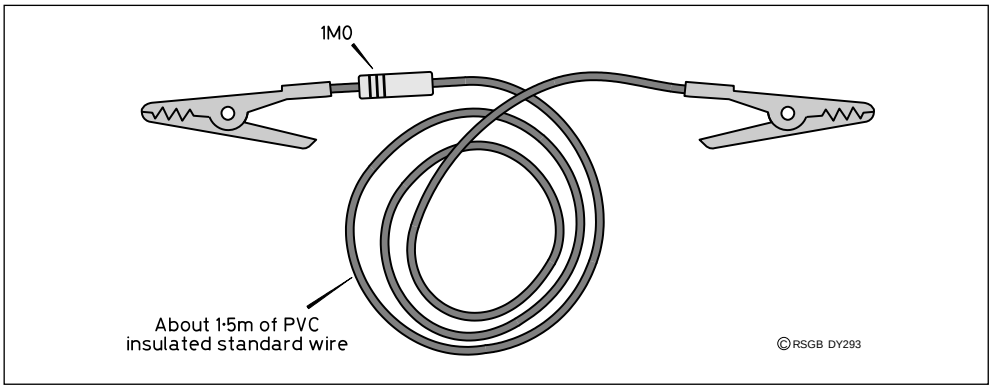


Fig 3: A home made anti-static earth lead.

9

South Africa or the Pacific.

To test this, I decided to try firstly for Canada.

With the aid of a compass and a great circle map of the world, as shown in the *Radio Communications Handbook*, I was able to point the Delta Loop in the most effective direction, almost at will.

I fixed one end of the insulated support line to the highest point I could reach, on my house and used any other support I could find to hold up the other side. These included, at various times, trees, another building, a pole tied to a fence or the back of the garage.

I was amazed to find that this simple steering of the antenna, made all the difference, firstly to reception and then transmission.

It regularly produced signals, in the wanted directions, two S points, on my receiver S meter, more than a choice of other antennas, which included a wire, a dipole and a vertical.

Beaming the loop through the house itself I made it first call to Toronto, Canada, with a report of Readability 5 and Signal strength 5, which pleased me very much for an antenna costing less the £5.00 to make.

I hope that you will try this amazing antenna, which, using the formulae given can be quickly made for almost any band that interests you, such as HF aircraft, short wave broadcast, marine or any amateur band, garden space permitting.

One final tip, if you are using ordinary stranded, electrical wire it will stretch after a week or so, under its own weight and mainly due to the weight of the balun. This will cause the antenna to work better lower than the original centre frequency. This is not a problem: all you do is lower the antenna, re-measure it and cut to size.

Once you are happy with its performance, in your chosen direction, why not re make the antenna using pre-stretched or hard drawn wire.

Do try it, you will be surprised, I promise you, I was!

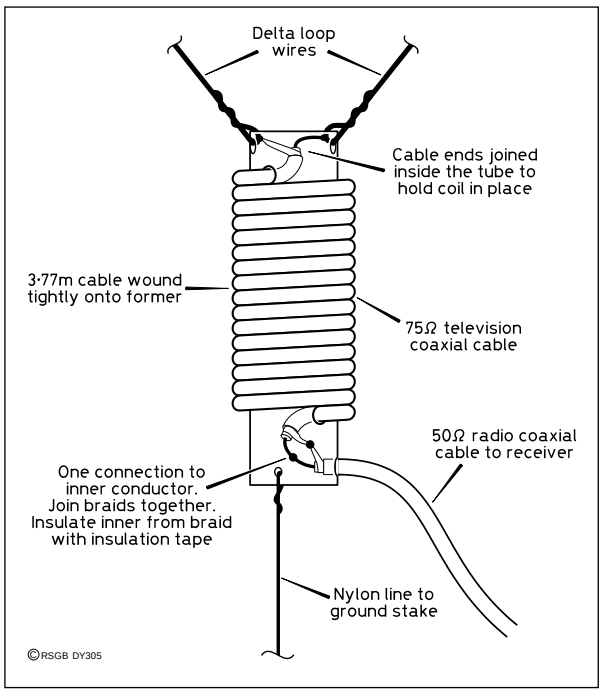


Fig 4: Detail of the 20metre band coaxial balun.

Digital Methods in Electronics

By Ian Poole, G3YWX

THERE IS A growing trend towards making more electronic equipment digital. With computer technology developing at an ever increasing rate this is hardly surprising. Digital techniques are now moving into areas which might not normally be thought of as prime areas for this type of technology. Hi-fi and signal processing sections of radio receivers are two areas which spring to mind.

ANALOGUE AND DIGITAL

THERE ARE TWO DIFFERENT types of signal which are used in electronic circuits. The first is an analogue signal. This is one which can vary continuously, and does not have any discrete steps. An example of an analogue signal is the sine wave shown in **Fig 1**. The sounds we hear are analogue waveforms. Hi-fi amplifiers amplify analogue waveforms and the circuits within portable radios treat the radio signals as analogue signals.

Digital signals are different to analogue ones. They are handled by computers which only recognise two states, logic 0 and logic 1. These are represented by two voltages, 'low' and 'high'. The 'low' state is usually zero volts and the most common voltage for the 'high' state is five volts.

A typical digital waveform is shown in **Fig 2**. This can be seen to change between the low and high states at various intervals.

Computers use what is called the binary system to handle numbers. Each number is represented by a series of ones and zeros. The decimal number one is represented by a digital one.

However, there is no direct equivalent for two. In the same way that the number ten is represented by a one and a zero, ie no units and one ten, the binary equivalent of two is represented by a one and a zero. Three becomes one one, ie two plus one, and then four becomes one zero zero as shown in **Table 1**. Although this system gives much longer numbers than the decimal one it is possible to represent any number in this fashion, and computers with their two states can handle them.

Decimal	Binary
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

Table 1: Binary and Decimal Numbers

CONVERTING TO DIGITAL

IN ORDER TO BE able to represent analogue waveforms in a digital manner it is necessary to convert them into a suitable digital format. This is done by sampling the waveform at regular intervals as shown in **Fig 3**. At each sampling point the waveform is monitored to take a reading of the voltage. This is converted into a digital number by the use of a circuit called a digital to analogue converter.

When it is instructed, this circuit takes a note of the voltage at its input and converts it into a digital number, placing the information at its output to be

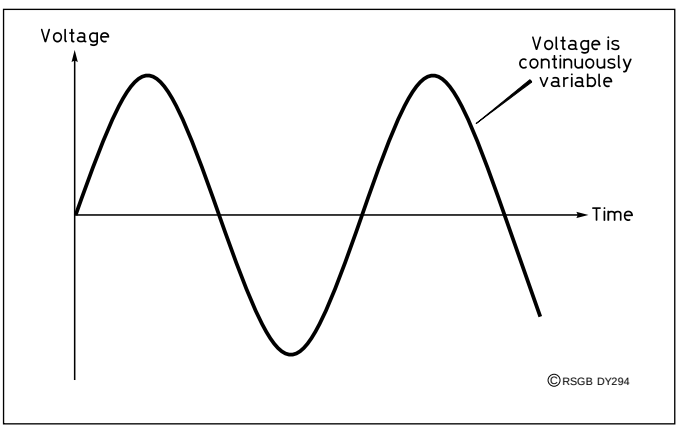


Fig 1: A sine wave.

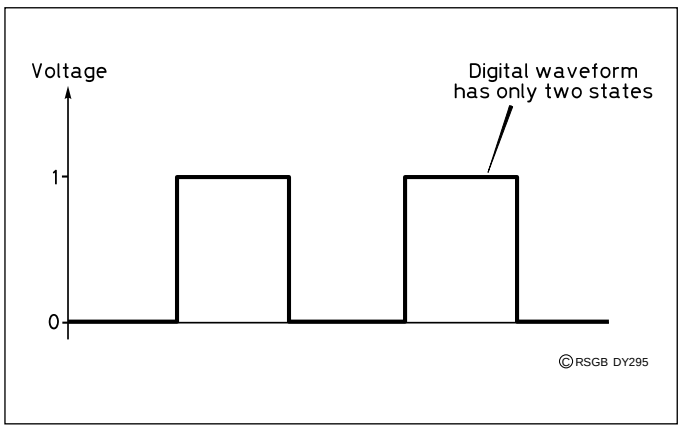


Fig 2: A Digital waveform - serial data.

read by other circuitry. This data will remain unchanged until the next trigger instructing the circuit to take another sample when the process is repeated. These digital to analogue converters are often called D to A converters or sometimes D2A converters.

Once the signal has been processed it is usually necessary to turn it back into an analogue format. It may need to be amplified by an audio amplifier and fed into a loudspeaker so that it can be heard. In other uses an analogue voltage may be needed for a variety of reasons. This function is performed by a circuit called an analogue to digital converter (A to D or A2D converter).

It is essentially the reverse of the D to A converter, although the circuitry used inside the integrated circuit is somewhat different. When the digital data is placed on its input and the relevant trigger is given, the data is converted into an analogue voltage.

Any voltage which has been reconstituted in this way consists of a large number of voltage steps as shown in **Fig 4**. Although it may appear as though the waveform is not represented correctly, the steps are made so small that they are not noticed.

Also the small inaccuracies introduced by the steps is much less than the inaccuracies of the analogue circuitry which would have otherwise been used.

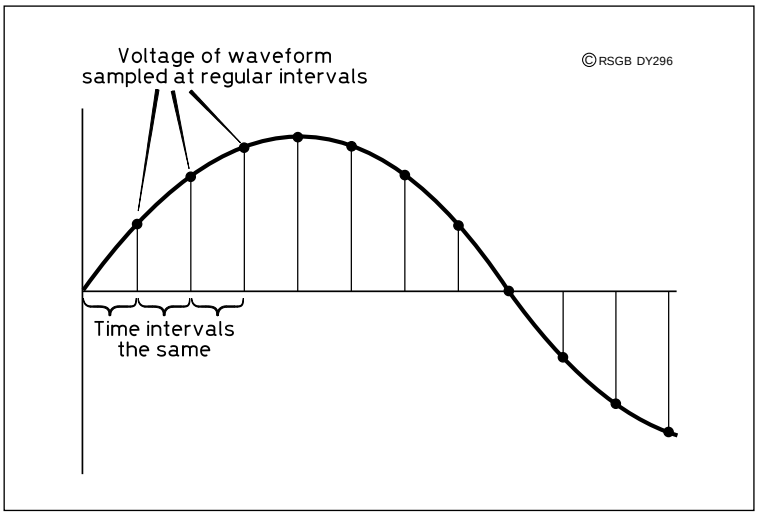


Fig 3: Sampling an analogue waveform.

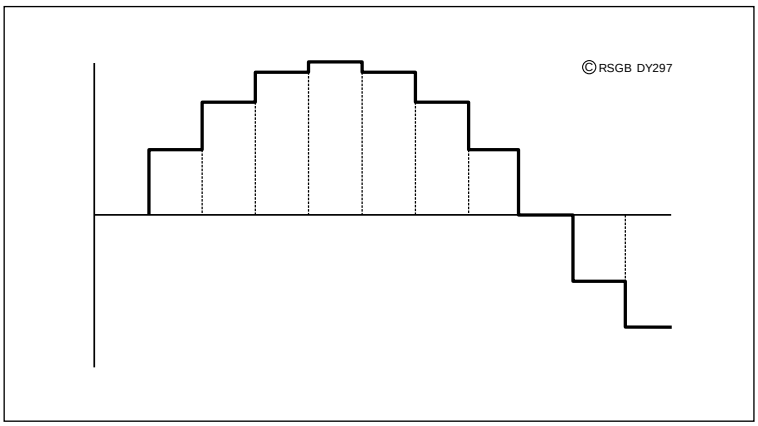


Fig 4: A reconstituted waveform.

USES OF DIGITAL METHODS

DIGITAL METHODS OF storing and processing analogue signals are being used in an increasing number of areas. Compact discs, which are renowned for their high quality, store the sound signals in a digital format. Digital Audio Tapes (DAT) have not yet made much of an inroad into compact cassette territory but their time may well come. Recording studios also prefer to handle their recordings in a digital format. Not only is the sound quality better, but editing is made much easier because it can all be done using a computer.

Digital techniques are now being used in many other areas of electronics and communications. The BBC and ITV have been transmitting NICAM digital audio for television sound for a few years now, and again the quality has been proved to be far better than the analogue equivalent. Recently the BBC started Digital Audio Broadcasts (DAB) to give a new high quality radio network. Although still very much in its infancy this type of transmission has proved to be far superior to even the VHF/FM transmissions.

In terms of amateur radio, a number of new transceivers are using digital signal processing or DSP in their receive sections to perform many of the functions within the set, including filtering and demodulation. Specialised high speed processors are used for this purpose, and it is found that by handling the signals in a digital fashion it is possible to achieve better filtering and demodulation.

In view of the advantages of digital techniques it appears that in the next few years far more of today's analogue technology will become digitised.

Readers' Letters

Keep sending your letters and photographs to:
The Editor, D-i-Y Radio, RSGB, Lambda House, Cranborne Road, Potters Bar, Herts, EN6 3JE, and we will send a pen to the sender of each letter published.

WORKING TOGETHER

AS A NEW subscriber to *D-i-Y Radio*, I would like to say what a superb publication for beginners it is. March-April *D-i-Y Radio* ran a super story on page 3 about the blind Novice Brian Tutty, 2E1DEU, who by using his CB and amateur radio equipment helped out when a boat with two fishermen on board had engine problems and was lost in dense fog.

I am a radio engineer of Sheppey 09 Emergency Unit and I would very much like to liaise with a local Raynet operator if they so wished, as I think we both have our part to play for the local community.

As a point of interest, the cavities in the 70cm repeater at Thanet were made by myself, a CB user.

B J Shelford

INDIAN PEN-PAL

IT OCCURRED to me that *D-i-Y Radio* probably has exactly the type of reader who might want to write to Dinesh Kumar, a 22 year old MSc Electronics student and Radio amateur. He would like a pen-pal in the UK. If you are an approximate contemporary please drop him a line: K N Dinesh Kumar IV SEM, MSc Electronics, Cusat, Kochi-22, Kerala, South India, DIN - 682 022.

Dinesh wrote to me because somebody had told him I was a B.Eng student. I am, but I am also 46!

Ian Wye, G0OKY

GIRLS MAKE DAD PROUD

MY DAUGHTER Katie passed the NRAE last December. She passed the 5WPM Morse test at seven years old. Katie, who is still only nine years old, will soon be taking over my old Novice callsign 2E0ACY. I am now G0VQR. My other daughter Eve passed the 5WPM Morse test at the age of 11. Watch out for Katie in the QRS tests this year.

Tom Cannon, G0VQR

4 MAY

Dont Miss it

RSGB HQ OPEN DAY

D-iar-Y MAY - JUNE

MAY

1	AGCW - DL QRP Contest, 1300 - 1900UTC, CW.
2 - 7	Amateur Radio Caravan and Camping Club Rally. Details 01462 811208.
3	RSGB Slow Speed Cumulative (80m) Contest, 1900 - 2030UTC, CW.
4	10GHz Trophy Contest, 1400 - 2200UTC.
	432MHz Trophy Contest, 1400 - 2200UTC.
4	RSGB HQ Open Day - See page 4 for details.
4 / 5	Danish SSTV Contest, 0000 - 2400UTC.
	RSGB 432MHz-248GHz Contest, 1400 - 1400UTC.
5	Anglo-Scottish Rally. Details 01573 226372.
5	National Vintage Communications Fair. Details 01398 331532.
6	Dartmoor Radio Rally. Details 01822 852586.
6	Mid Cheshire ARS Rally. Details 01606 77787 (evenings).
12	RSGB 24GHz Cumulative Contest.
12	Drayton Manor Radio & Computer Rally. Details 0121 443 1189 (evenings).
17 - 19	Dayton Hamvention, Ohio, USA. Details 001 513 276 6931.
18	RSGB HQ Saturday Opening, Lambda House, Cranborne Road, Potters Bar, Herts. 10.00am to 4.00pm. Details 01707 659015.
18 / 19	RSGB144MHz Contest, 1400 - 1400UTC.
18 / 19	RSGB 144MHz 6 hour single op contest, 1400 - 1400UTC.
18 / 19	Baltic Contest, 2100 - 0200UTC, SSB/CW.
18 / 19	Yeovil Club Amateur Radio Convention. Details 01935 813054.
19	Dunstable Downs RC Amateur Radio Car Boot Sale. Details 01582 613899.
19	RSGB First 144MHz Backpackers Contest, 1100 - 1500UTC.
19	Mid Ulster ARC Rally. Details 01693 61298.
19	Trafford Rally. Details 0161 748 9804.
24 - 27	Amateur Radio Caravan and Camping Club Rally - Details 01462 811208.
25 / 26	*CQ* WPX CW Contest, 0000 - 2400UTC.
25 / 26	Plymouth RC Carnival. Details 01752 563222.
26	East Suffolk Wireless Revival. Details 01394 271257.
26	RSGB 10GHz Cumulative Contest, 0900 - 2100UTC.
26	YU DX Contest, 1200 - 1200UTC, SSB/CW.

JUNE

1	RSGB 50MHz Trophy Contest, 1400 - 2200UTC.
1	RSGB 1st 50MHz Backpackers Contest, 1300 -1700UTC.
1 / 2	RSGB National Field Day Contest, 1500 - 1500UTC, CW.
	IARU 50MHz Contest, 1400 - 1400UTC.
2	Northern Mobile Rally. Details 01765 640229.
2	Spalding & DARS Radio and Computer Fair. Details 01775 722940.
7 / 9	Amateur Radio Caravan and Camping Club Rally. Details 01462 811208.
9	Aldershot Amateur Radio Rally. Details 01252 837860.
9	Elvaston Castle National Mobile Radio Rally. Details 01332 720976. For trade enquiries 01332 662896 (after 7pm).
9	RSGB 70MHz CW Contest, 0900 - 1200UTC.
15	Royal Naval ARS Annual Mobile Rally. Details 01705 379265.
15	RSGB HQ Saturday Opening, Lambda House, Cranborne Road, Potters Bar, Herts. 10.00am to 4.00pm. Details 01707 659015.
16	Barford Rally. Details 01953 607594.
16	Denby Dale ARS Annual Rally. Details 01484 861782.
16	Newbury Boot Sale. Details 01488 682814.
16	Newport ARS Junk Sale. Details 01633 661998.
16	RSGB Second 144MHz Backpackers Contest, 0900 - 1300UTC.
21 - 23	Amateur Radio Caravan and Camping Club Rally. Details 01462 811208.
22 / 23	RSGB Summer 1.8MHz Contest, 2100 - 0000UTC, CW.
23	RSGB 432MHz FM Contest, 1800 - 2200UTC.
28 / 30	Friedrichshafen HamRadio '96. Details 0049 7541 7080.
30	39th Longleat Amateur Radio and Electronics Fair. Details 0117 9402950.
30	RSGB 10GHz Cumulative Contest.

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