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---Special Antenna Edition---

The Bi-Monthly Magazine of the Redcliffe and Districts Radio Club Inc.

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Amateur Radio Stations VK4RC & VK4IZ

Secretary Peter VK4TAA in action with "sniffer"

From the Editor

Greetings to all Club members, radio enthusiasts, family supporters and friends.

Welcome to this first edition of QRM for 2006. We must begin by congratulating the group of club members who began studying for the Foundation Licence at the close of last year and have recently completed the course. At the time of writing, four have completed all examination requirements and have applied for licences, and two have sat for and were successful in the theory exam, and are expected soon to complete the practical exam requirements. This edition of QRM is dedicated to all of them, who we all hope will soon have their licenses and be joining us on air. Consequently, this edition contains some articles on antennas which have been reprinted from previous editions of QRM. We hope all our prospective new licensees will find some good ideas in these articles to help them get started. As most amateurs know, antennas can be costly and complex, but they don't have to be. It is an area where "doing it yourself" can help control costs and be educational and fun. So, be prepared to have a go. And don't be afraid to ask questions and read up on the subject.

Following a recent decision by the Executive, and some hard work by several volunteers making up new "sniffers", the Club has resumed regular "foxhunts" on the last Monday night of each month. The first one was held on the 23rd of last month (January), and is reported in our lead article by Reg (VK4KMP). This is a fun activity which should appeal to all age groups. It can also give us some exercise, which the shack activities of our hobby don't often give us much opportunity for. Another important Club activity is contests and the next big one is the John Moyle Field Day, 18-19th March. Please be part of this if you possible can. It is good fun and good experience, especially for beginning amateurs, and you don't have to hold a licence to participate. See information page 3, and contact Andy (VK4KY) for details.

In this Edition

Club Raffles

A special thanks to Bob Mount (VK4LA) from all Club members for his valuable contribution in running the Club raffles. The raffles raise valuable funds for our Club, help keep membership subscriptions low, as well as providing a bit of fun. Please continue to support Bob and your Club by participating in these raffles in the coming year.

CLUB FOX HUNT REPORT

by **Reg Page (VK4KMP)**

Fox hunting is the sport of locating a hidden transmitter using sensitive hand held radio receivers with directional antennas. It is like orienteering with headphones. The transmitter is known as the "fox" and the directional receivers "sniffers". The aim of the sport is to be the first person to locate the "fox".

The club is planning a series of fox hunts are planned on a trial basis for the last Monday of each month. First of the revived series took place on Monday 23rd night involving five cars and more than 10 enthusiastic members participating.

Two "hunts" were conducted with the fox being hidden in easy to find locations for this occasion.

The home brew club kit sniffers performed well but hunters found that a vehicle mounted beam antenna was almost essential to pin point the general location of the fox.

Results

Hunt 1
First: Charlie VK4YZ, *Second* Chris Day and *Third* Graeme VK4JGH

Hunt 2
First Graeme VK4JGH, *Second* Charlie VK4YZ and *Third* Peter VK4YRU

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Important Information about John Moyle Field Day Contest

Contest starts: 11am 18th March finishes 11am 19th March

Where : Camp site no 6 at Murrenbong, off Scout road, Petrie, See the map over leaf.
Off the Dayboro Rd, turn right into Scout Rd, Turn Left into the scouts 1st gate. The property is clearly marked. The gate may be open or closed but will not be locked…. The camp sites are marked & we will be at no 6.

We will be setting up radios & antennas on all bands. This will be a lot work & we need assistance setting up & dismantling along with operators on air during the event.

You do not need to be a licensed amateur, as you will be using the club call sign under guidance of licensed operators.

We will have some people setting up on Friday 17th March from around lunch time. The more we set up on the Friday the easier the competition days will be. We will still be setting up Saturday morning. Each radio station requires a tent along with the radio gear plus lights & power.

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2004/05 COMMITTEE MEMBERS & CLUB DIRECTORY

President	Peter Breed VK4PB	Phone: 3889 5464
1st Vice President	Steve Pearson VK4KCK	Phone: 3284 8975
2nd Vice President	Charles Strong VK4YZ	Phone: 5495 1565
Secretary	Peter Richardson VK4TAA	Phone: 3261 4225
Treasurer	Glenn Wood VK4TGW	Phone: 3351 4295

Meetings: EVERY MONDAY with regular guest speakers and ongoing projects
Time: 1930hrs (local)

WHERE: Redcliffe and Districts Radio Club clubhouse - Cnr Klinger Rd & Macfarlae St, Kippa Ring

Clubhouse: Open every Monday evening 1930hrs (local) INCLUDING PUBLIC HOLIDAYS

2nd Monday of each month : General Members Discussion Meeting

CLUB NETS: Sunday evenings at 1900K 2m on 146.925MHz Redcliffe repeater VK4RRC and 1945K 80m 3.618 MHz ± QRM VK4RC Net control : Q5 weekly broadcast, Tuesday evenings, Redcliffe UHF repeater 438MHz : 27 MHz, channel 20, 27.205 MHz LSB, Thursday at 8pm

REDCLIFFE and DISTRICTS RADIO CLUB Inc.
PO Box 20, WOODY POINT QLD 4019

EXAMS:	John VK4WX & Laurie VK4BLE
NET_1:	Sunday 1900K 146.925
NET_2:	Sunday 1945K 3.618
REPEATERS:	VK4RRC VR 146.925, 438.325

Contributions to Editor QRM - Alan Jenner VK4KZ
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Forthcoming Events

- General business meeting, 2nd Monday of month
- Foxhunts, 4th Monday of each month
- Wednesday activities – mornings 8.30am each fortnight
- Trivia Nights every Wednesday evening on 70 cm repeater, 7.15pm for check-ins
- John Moyle Field Day, Murrenbong Scout Camp, 19/20th March

Continued from page 3

Things to bring.

Ropes,
Power leads & adapter boards (heavy duty)
Incandescent lights for radio setups, tables & chairs for the radio stations.

The club BBQ will be on site for use by members.
An on site portable toilet will be supplied.

You should bring the following as a starter

Chair, camping table & equipment for overnight stay if doing so
Tent for overnight sleeping.
Food & Drinks as required.
Water, not sure of quantity onsite
Mosquito repellent
Pens to write down the contacts you take. Log books will be supplied

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HF on the GO for 2004

*by **Doug McDonald** (VK4KET)*

Reprinted from QRM, December 2003

I was going to tell you all about the modifications to the Yaesu FT101E, but they're not complete yet and something more important has turned up. 'What?' You may well ask, but remember its almost Christmas and with the new year there will be a heap more hams wanting to use HF. If they're that way inclined they will have a working radio and won't need to service their 101, but they might need an antenna and if they can afford, perhaps a tuner (ATU, not the fishy tuna variety) for Christmas.

Half Wave Dipole

If you can't afford an ATU, then you will have to pick an antenna with an impedance close to 50 ohms, as most of today's amateur transmitters are designed to match best with 50 ohms.

As luck would have it, a simple **Half Wave Dipole**, when centre fed and sufficiently high off the ground, has an impedance of **53 ohms**. So you cut the dipole to match the frequency on which you need to transmit. This means that you are putting all your transmitted power into the antenna system without any losses in a tuner unit, and the system is very efficient, for reception as well as transmission.

If you ever listen to the Coral Coast Net on 7.060 MHz at 7.00am you might find VK4BQ (Gordon) comes through loud and clear and hears all stations in some of the worst conditions. He runs using a dipole cut to the frequency connected directly to the set (no tuner, no balun).

The length (L) of each arm of the dipole is determined by the formula

L =71.25/f metres or L=232/f feet

The above length estimates were derived from formulae in the Novice Operators Theory Book by Graeme Scott, VK2KE. They are about 1% lower than those from the ARRL Handbook (1990), but if plastic insulated wire is used in the dipole the length may have to be reduced by 3 to 5% to account for the

increased overall capacitance, provided due to the dielectric constant of the insulating material, which can give a length change of between 1.0 and 1.66 feet for an L of 33.14 feet estimated for a frequency of f = 7.060 MHz.

For various frequencies the various lengths L of single arm (quarter wave) of the half wave dipole are provided below:

Band (m)	Frequency (MHz) lower	L (m)	Frequency (MHz) upper	L (m)
160	1.800	39.58	1.875	38.00
80	3.500	20.36	3.800	18.75
40	7.000	10.18	7.300	9.76
30	10.10	7.05	10.15	7.02
20	14.00	5.09	14.35	4.97
17	18.068	3.94	18.168	3.92
15	21.00	3.39	21.45	3.32
12	24.89	2.86	24.99	2.85
10	28.0	2.54	29.7	2.40

The Mighty G5 RV

If you have a tuner and want a general purpose HF antenna, a **'G5 RV'** named after the call sign of the inventor, is a handy dipole to make. I have seen several recipes but the one I made came from the ARRL 1990 Handbook.

You need two dipole arms each 51ft long (I made mine from 2.5mm 7strand insulated earth wire). These are connected at the centre to each side of a piece of black 300 ohm TV strap which is 29.5 ft long. At the other end of the TV strap you solder a length (>68 ft) of 50 ohm coaxial cable and finally you connect a tuner.

For best operation the TV strap should dangle vertically below the dipole for 20 ft or more (my one only drops 12ft at present and still works well). If you have lots of coax to spare getting to the shack, then make about 8 – 10 turns of coax, taped at a diameter of 6 inches near where the TV strap joins the coax. This provides an HF choke which helps clean up any antenna transmitted radiation which may be absorbed by the coax. This antenna works well.

Arnold VK4AX has a G5 RV he has used for years. While replacing his antenna poles, we operated the antenna 6 feet off the ground with excellent results. My G5RV is currently suspended by 3 palm trees and is 12ft up and going well, but will be going higher, because I still can't get the signals that the people with high, frequency cut dipoles can.

One must also remember that to comply with EMR regulations these dipoles may have to be up about 33ft or 10m apart from which, you get the best response from your antenna if it is more than half a wave length off the ground.

If you can't stretch your G5RV the full 102 feet required, then its OK to let the ends of each arm dangle. Up to 20% of each arm, or 10 feet can drop vertically without significant change to the antennas output. This means you only need a space 82 feet long, or if you're on the move you can dangle the end over a gum tree 'cause they didn't grow far enough apart.

The Loop Antenna

A full wave loop antenna is as it says, a one wavelength piece of wire connected directly to 50 ohm coax. If the loop is maintained horizontal and raised about 40 feet off the ground, you can get low noise local and DX transmissions with no problems.

At its resonant frequency, you can transmit direct through the antenna but for other frequencies a tuner may be necessary.

For 3.5 MHz the total loop length is 272 feet of wire and for 7 MHz the length is 142 feet. A square form of side ¼ of the above lengths is the usual way to set up a loop, but maximum area in the loop would require a circular area. The above loop lengths would also perform as half wave loops for 160m and 80m bands respectively.

Insulators

If you're hard up for insulators and don't know what to do, hop down to the local supermarket and buy a cheap set of polyethylene chopping boards. They carve up well and after boring a few holes in the right place, you get an insulator that lasts a long time.

Don't tie your antenna up too tight, as it tends to stretch the wire, and strong winds can bend trees and poles in all sorts of directions. So it may pay to have one end of your antenna supported through a pulley with a weighted line to allow for change in your trees or poles positions, or use a piece of bungie cord to give elasticity to the set up.

All these antennas are relatively simple to construct and often the hardest part is getting it up (the antenna in the air that is). But with a long piece of string, a bow and arrow or a slingshot it's amazing what fun you can have during the Christmas break. So GIVE IT A GO!!

With that I hope you all have a HFfy DXmas and a communicative new year.

Doug McDonald VK4 KET QRM

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Experience with an 80 metre U – Dipole and Z Match Tuner

by **Alan Jenner** (VK4KZ)

Reprinted from QRM Feb/April 2004

"What to start with" for a new amateur about to get going on HF is always a good question to begin a clubroom discussion. But like many questions, there is no single answer. This article reports on one possible solution which just might suit your needs.

Introduction

When I first got my novice license in late 2001, it took me some time to get on air. I had purchased a (pretty old) Kenwood TS820S. It was old but in near perfect condition and with a digital readout. It was an ideal radio for a novice, but what to connect the 50Ω output socket to? The choices seemed bewildering, but I was lucky to have come across two articles that seemed to answer my question. One was written by Steve Ireland (VK6VZ) for the (unhappily now defunct) Radio and Communications magazine [1]. The other appeared in Amateur Radio [2] and was penned by Lloyd Butler (VK5BR).

Antenna/Feedline Choices

Asking the question "what should I use for an HF antenna" will usually get as many answers as there are people on hand to reply. Some believe only in single band dipoles, some like quads, beams and so on. For multiband operation, an obvious choice is the G5RV [3,4,5], a very popular and reliable choice.

For feedlines, some will say it must be coaxial cable to avoid noise and proximity effects. Others say open wire is good because it is low loss and is balanced, so connects well to a dipole. In what follows, I give you my (lucky) choice, because I had had no experience and was relying purely on what others had said.

The 80 Meter U – Dipole

This simple wire antenna described by Steve Ireland in Reference 1 is cut for approximately 3.6 MHz, pretty close to 40 m in total length. The antenna works for the higher bands because these frequencies are roughly multiples of 3.5 MHz. The exact length is not critical. However, the dipole arms do not run the full 20 m per side (you would need a 40 m yard plus space for guys which few people are lucky enough to have). Each arm goes 10 m, then bends at right angles to form an overall U shape. This is the basic structure but there can be many variations on this as given in Reference 1.

After the 90° bend the arms are sloped down towards the ground, but the high voltage ends must be kept out of reach for safety reasons – not less than 3 m. Remember that the ends of a dipole which is a multiple of half a wave length is the high voltage point.

For the antenna conductor itself, 7/.029" or 2.5 mm^2 stranded PVC insulated copper earthwire was used, as recommended in Reference 1. A 100 m roll from an electrical wholesaler is the best way to purchase it. It will cost about $40 or so, but per metre from a hardware store will be much more expensive. The left over can be stored for future repairs or shared with someone else. Many people choose solid conductor, but it tends to fatigue and break regardless of the claimed advantages. However, the earthwire is admittedly rather heavy and can put quite a bit of tension on the supporting masts. There are advantages and disadvantages of either choice.

The antenna could be strung from trees, but I used two 10 m steel masts, each made from 2 pieces of telescoping tube 6 m long, with 2 m of overlap. These masts were then guyed at the top and about halfway down, and supported the dipole arms from the feedpoint centre. Two 3 m masts then took the sloping "U" arms. The area occupied by the antenna was 20M by something a bit less than 10 m (due to the downward slope of the U arms). Further space allowance is also needed for guying, but this can be to the side of a house, fence, shed or to "star pickets" in the ground.

I used poly ropes for guys, but this is <u>not</u> recommended unless you are prepared to replace them each year, as they are not UV proof. Other options are given in References 5 and 6.

For the centre insulator connecting the dipole arms to the feedline I used a polyethylene kitchen cutting board discarded by my XYL (never chuck anything out if it might come in handy!). Cut to a broad T-shaped affair allowed secure anchoring of the dipole conductors horizontally and the feedline vertically. Other insulators at the masts were the porcelain "egg-shell" type, because I happened to have these, but they could be made from the discarded kitchen board as above [4,5].

Feedline

If you want multiband operation from a single dipole, open wire line has significant advantages and is likely to be your best option. I made mine as recommended in Reference 1. 23/.0076'', 250V "twin flex" is split and attached to spreaders made from 9mm PVC tube to give a 50mm (2") separation. Spacers are placed about every 150mm (6"). This feedline has a characteristic impedance (Z_0) of about 400-500Ω.

The resulting feedline is strong and flexible. It takes a bit of time to make though. Again, it is more economic to purchase a 100 m roll of twin flex from an electrical wholesaler.

The feedline should come away from the antenna at right angles to the main arms for at least 10 m, and parallel to the sloping arms but in the opposite direction. It is best if possible to avoid other metallic objects such as roofing, down pipes or guttering. I had to route the line some distance under the house eaves, but this didn't seem to cause any problems. As a precaution to avoid unbalance, I put a twist in the feedline about every metre for the entire route to minimise unbalance due to proximity effects.

Antenna Tuner

There is no way you can couple an open wire feedline from a multiband dipole to a 50Ω coaxial transmitter output without an antenna tuning unit (ATU). Purists will decry this practice as generating losses. This is true, but if you want multiband operation and low SWR to your radio, you have to compromise.

I read many articles [7,8,9] about ATUs, and what I read seemed a bit daunting. They all seemed to require a roller inductor or multi-position switching of inductors. Some designs used crocodile clips to make adjustments, but I didn't like this idea for fear that a poor connection could leave the transmitter on full power feeding an open circuit. Then along came Reference 2. No roller inductors, no complex switching, no crocodile clips. This design required only a dual gang variable capacitor (2 x 20-230pF), a 20-350pF variable capacitor (these values are not critical), and a coil (actually an air cored RF transformer). Up to 100W the capacitors can be old radio types (the older the better because of larger plate spacing) and obtainable from hamfests. The coil is wound on a 3mm "perspex" support sheet. All directions for the ATU construction are given in Reference 2. And guess what? It works, and very well too.

One point worth noting. If the ATU does not want to tune up on some bands, it could be that you have chosen an "inconvenient" length of feedline. The cure is to lengthen or shorten the feedline by 1 or 2 metres. The other alternative which I found convenient, was to allow 3 or 4 metres of excess feedline length. By folding this excess "back on itself" you can effectively shorten the feedline because of field cancellation effects.

Standing Waves

Standing waves! Ooh – bad things! Or are they? For the radio transmitter they are definitely not good. The transmitter needs to "see" as near as possible a pure resistance of 50Ω. This is what the ATU does. It transforms the balanced impedance at the feedline to an unbalanced 50Ω, regardless of the frequency or feedline impedance. Another benefit of the ATU is that it attenuates unwanted harmonics, which can cause interference to other users of the band.

But what of standing waves on the open wire feedline? The antenna can present from 10 to several thousands of ohms resistance and reactance depending on frequency, conductor thickness, height above the ground, ground conductivity, etc [5]. But the feedline is say 450Ω. Sounds like a recipe for standing waves! It is! But, if the feedline is low loss and balanced, it doesn't matter all that much. Why? Because the transmitter is happy (it "sees" 50 + j0Ω) and the standing waves on the low loss balanced feedline do not dissipate or radiate significant losses. So most of your transmitter power goes where you want it to go – to be propagated by the antenna.

Conclusions

There is no correct answer to "what is the best antenna for HF?" It depends on what you want to do with it, how much room you have, what you can afford. But if you are getting started on HF, the 80 m U-dipole with the simple Z-match ATU might be the antenna system for you.

For me, this arrangement has worked both at Hendra, and now at Elimbah where I have recently moved. I have had good local and DX contacts on 20, 15 and 10 m and Australia wide contacts on 80 m and 40 m. It may not be as good as a "tribander" on 20,15,10 m but you can still work some good DX, and its much cheaper than a tribander with tower, rotator, etc. Best of all, I've had lots of fun using it.

Another advantage of the U-dipole is that it approaches an omni-directional radiation pattern. All these advantages, including low cost and the fact that you can build it yourself makes the arrangement a good contender for a HF starter.

References

1. Steve Ireland (VK6VZ): "A U for You", Radio & Communications, Jan/Feb 2001.
2. Lloyd Butler (VK5BR): "The Simple Z Match Simplified", AR June 2001, pp 6-7.
3. L. Varney: :The G5RV Multiband Antenna … Up-to-Date", the ARRL Antenna Compendium, Vol I (Newington:ARRL).
4. Doug McDonald: "HF on the GO for 2004", QRM, Dec 2003, pp 3-6. [*see page 3, this magazine*]
5. The ARRL Antenna Handbook – 18th Edition (any edition will have the required information).
6. Rob S Gurr: "Some useful Wire Antennas for HF", Amateur Radio, March 2004, pp 4-7.
7. The ARRL Handbook 2001 (and earlier editions)
8. Drew Diamond: "A Swinging Link Antenna Coupler", AR July 2000.
9. William I Orr: "Radio Handbook", 23rd edition, Howard S Sams & Co, 1989.

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Instant Gratification

by ***Bill Isdale VK4TWI***

Reprinted from QRM Feb/April 2005

When we look at one of the recently designed radios on the market today we see a wonderful product of micro electronic engineering. Many if not most of the components are surface mounted devices, put in place by machines and soldered by a wave of molten solder flowing over a circuit board in an oxygen free environment. No uncertainty has been introduced by a human hand which might be carrying some smudge of oil or some dust or simply tremble a bit. The automation of manufacturing has vastly increased the ability to deliver consistent quality and to shrink the size of components while placing them closer together, reducing unwanted losses and, for instance, stray capacitance between them.

What is delivered to us is a modern engineering marvel which performs brilliantly and is very compact and inexpensive relative to its capabilities. It is then over to us to make the best use of it.

The designers have, for instance, produced a transceiver which will operate on the amateur bands from 160 m to 70 cm and will deliver up to 100 watts into a designed load of 50 Ohms.

We have not had to try to build our own radio; we could, just to show that we are capable, build our own radios, but the realities of what can be manufactured in even a well equipped amateur's workshop would limit many of us to a simple device of modest capabilities.

Where we can shine is in exploiting the capabilities of the radio we have bought.

The radio usually comes to us ready to power up and operate. Power supplies can be built or bought to deliver what is needed, usually 12 volts or a little more of ripple free direct current. We don't need wobbly input power upsetting the radio, the only oscillations we want are the ones that are put there deliberately to produce the radio frequency output.

The critical part of our emerging radio station is going to often be what comes after the output connectors of the transceiver as to operate we must radiate and to do that we need a feed line and an antenna. This is where we have an opportunity to really excel.

The options are many in theory but may be substantially limited in practice. The best place for an antenna will be high above electrically conductive and therefore radio-reflective ground. Those who live in a salt marsh on top of a mountain will have a major natural advantage. Living by the sea will also be advantageous. Otherwise we will simply do the best that our location allows.

Height is important, to get clear of the interference of objects such as houses and to allow the radio waves to begin propagating in clear space. There is going to be a significant loss to our signal if it is absorbed by, for instance, our house which is full of pipes and wires.

Some people may find that the solution for them is to erect a tower which takes their antenna array up into the clear. There will be considerable expense involved with this and, I am bound to say, that for some reason not everyone thinks towers are pleasing to look at.

There are other options for putting up an antenna, among them using a skyhook in the form of a tree or perhaps a patriotic flagpole or simply a light, strong and cheap bamboo pole.

An antenna can be a well engineered commercial model or we can achieve a lot for a small outlay of cash by building our own.

The ideal antenna will be compact, light, durable and inexpensive and radiate efficiently from say 160 m to 70 cm. For anyone waiting to read how to build it you will have to wait a little longer because I don't

know. I suspect that when someone works this out the word will travel very fast. For the present, I am going to look at how to achieve quite a lot for a little.

Many antenna designs of great elegance are available to achieve multi-band performance. Naturally enough they represent a number of compromises, sometimes requiring an antenna tuner to bring them to where they can be made to seem to present a 50 Ohm purely resistive load to the radio so that it can operate into them. Radios are designed to operate into that particular standard load and their performance will degrade if they are not operated as designed.

What I am going to consider is how to get on the air quickly and inexpensively with good results. In order to do this it will be necessary to accept that no single antenna will provide good results across the bands that our radio can handle. It is best to choose the bands where we want to operate and provide an antenna which does well there. It is much more achievable to design and build an antenna which performs well on one band than to try to make something operate on a number of different bands. The laws of physics are simply unable to be broken.

At present, the sun is becoming relatively quiet as it approaches the low point in its 11 year cycle of sunspot activity. A quieter sun means less ionisation of the upper atmosphere and less reflectivity to high frequency radio waves. However, we do know that the 20 m band provides the best overall reliability for

long distance communication and will work quite well at present. If we build an antenna for 20 m then we will be able to expect some results. The part of the 20 m band used for single side band voice communication is around 14.2 MHz so an antenna designed to work there will get us to where there will be operators active.

Putting up an antenna which is resonant at the frequency we wish to operate at will produce a high return for our efforts. Resonance is easily achieved, we simply build an antenna of the right size. The reward is that it reacts to signals of that frequency very strongly, giving very good performance both radiating and receiving. There is no need for an antenna tuner to mimic for the radio what load it is designed to operate into and no loss from the antenna tuner itself. An antenna tuner, after all, despite its name, does not tune the antenna. Why would we think that, just because of its name? What it actually does is allow an antenna to be used outside of the frequency range it was designed for by varying the inductance and capacitance it presents to the radio so that the radio is presented with a mixture of those qualities that are equal to a 50 Ohm purely resistive load, into which the radio is designed to operate. The result is to make it possible to use the wrong antenna, not to make that antenna the correct size for its task.

The wavelength we wish to radiate and to receive will determine the size of the antenna. The formula for finding the size of the antenna is the speed of the electrical energy in free space divided by the frequency in MHz. Conveniently, mathematically this is 299.7925, most people just use 300, divided by, in this case, 14.2. The resulting figure is divided by 2 which gives half a wavelength in free space, and then that figure multiplied by .96 to allow for the reduced speed of the energy flow in the radiator, here a piece of copper wire. Copper is used as it is an excellent conductor. Gold is better but too soft and just a little expensive.

Doing the math gives us 10.14 m as the length of a half wave antenna for 14.2 MHz. The antenna design I am suggesting is a dipole so each side of the dipole will be 5.07 m long. Resonance is achieved from the quarter wave elements.

The dipole, if in clear air for half a wavelength around it, will present a 72 Ohm resistive load. This isn't perfect but it is very good. It will, if connected to our transmitter, not radiate perfectly but will present standing waves, voltage peaks and troughs, along the feed line from the transmitter. This is not a problem so long as the situation is minimised. The ratio of the standing waves, the SWR, can be calculated from 72 divided by 50, which is 1.44. Such a SWR is not a problem and the transmitter will be able to work well with it.

Do not be tempted to adjust the length of the radiating elements to try to improve the SWR, it cannot be better than 1.44 due to the nature of the antenna, and that is a good figure.

The energy surging into the antenna at the radio frequency it is designed for produces a field which, in view of the size of the antenna which it has to occupy, just does not have time to collapse back into the antenna again when the oscillation is on its down-swing, it is still in space around the antenna when the next surge comes in and, since like forces repel, it is pushed away from the antenna, off to see the world at the speed of light.

We have of course to get the energy from the transmitter to the dipole. The ladder-type line works a treat, with very little loss. For many people, however, the co-axial line is more convenient. Ladder line is inherently balanced, the fields around the 2 conductors are in balance and do not radiate. That takes place when, in effect, the 2 conductors are peeled apart to make the diploe, they cannot reach each other to remain in balance and so are radiated. With co-axial cable, the 2 conductors are inherently in an unbalanced position, one inside the other with insulation between them. There will be a tendency for energy to leak back along the shielding braid of the cable instead of being radiated as designed by the antenna. The transmission line becomes an unintended part of the antenna and will mess up our calculations. Fortunately this is easily cured.

The radio frequency energy can be stopped from escaping down the shield of the co-axial cable by adding an inductance which will oppose it. A balun, a balanced to unbalanced transformer, will keep the

balanced antenna from being degraded by the unbalanced feed line. Baluns can be bought or made. For present purposes a simple and effective choke balun can be constructed by coiling up the transmission line into about 4 turns just below where it feeds the antenna. About 4 turns to form a circle around 200 mm in diameter will choke off the flow of energy back along the cable shielding. The coil can be maintained in shape with, for instance, some small cable ties, the black ones which can survive outside fairly well.

For a big gain in simplicity and performance, we can exploit the fact that a co-axial cable will present its designed impedance, 50 Ohms, when its length happens to be half the wavelength of the signal it is carrying. It may not be possible to build to this length and still join your operating position to the antenna location but if it can be done it is a simple and effective way to match the radio to its feed line. For our antenna, the half wave length is 10.14m. Bearing in mind that co-axial cable, because of its design, has a velocity factor of, commonly, .66, it is necessary to find .66 of 10.14 m , which is 6.69 m. A feed line of that length will not add any complexity of its own but will simply allow the transmitter to "see" the 72 Ohms at the antenna. Producing a 1.44 SWR, it works very well. There is no need for an antenna tuner and a simple and effective resonant antenna has been achieved.

The dipole radiates in a doughnut shaped pattern from the wire so that it can be imagined as a doughnut with the wire running through the hole in the middle. This makes it directional in that it works best to its sides. This can be taken into account in positioning it.

A key construction element is the join between the dipole and the co-axial line. An inexpensive connector such as the panel socket square mount SO 239 costs under $3 and will take a connector from the feed line and allow the 2 sides of the dipole to be joined to it, one to its centre connector and the other to one of its holes meant to take screws. The gauge of the wire for the dipole can be what will solder easily to the connector and is as large as convenient so it has some strength. Each end of the dipole can be wrapped onto a plastic insulator such as is available inexpensively, usually in packages of more than we really need, at produce shops which sell them for use in electric stock fences. An insulator can be placed in the centre to take the strain of each side of the dipole and the wire can then be taken down to the connector so that the soldered joint does not have to take any strain. The weight of the co-axial cable, hanging vertically below, can also be taken by some insulating cord, a nylon shoe lace works well, that passes through the spare holes in the connector and ties onto the central insulator. Some self-amalgamating tape can be used to try to keep rain out of the connector. The measurements of each side of the dipole can be taken from the join to the connector to the furthest point out on the ends, using a tape

measure and disregarding the fact that the wire is twisted up in places for mechanical reasons, it is the overall length of the wire as you are looking at it that counts.

Joining the dipole to the insulators can be done simply by twisting it a few times. When cutting the dipole you can leave about 300 mm extra on both of the lengths of wire so that you have plenty to work with and when building you can wrap the wire on the insulator until the overall length of exposed wire is the correct length and then trim off any excess. It does not matter for practical purposes that the length is partly achieved by a twisted bit of wire.

For maximum simplicity the outboard ends of wire can be twisted and perhaps soldered into a small loop, the overall length of the wire being the desired one, and the dipole can be suspended at its ends by some suitable plastic cord, providing the necessary insulation to the high voltage end of the wire and making separate end insulators unnecessary.

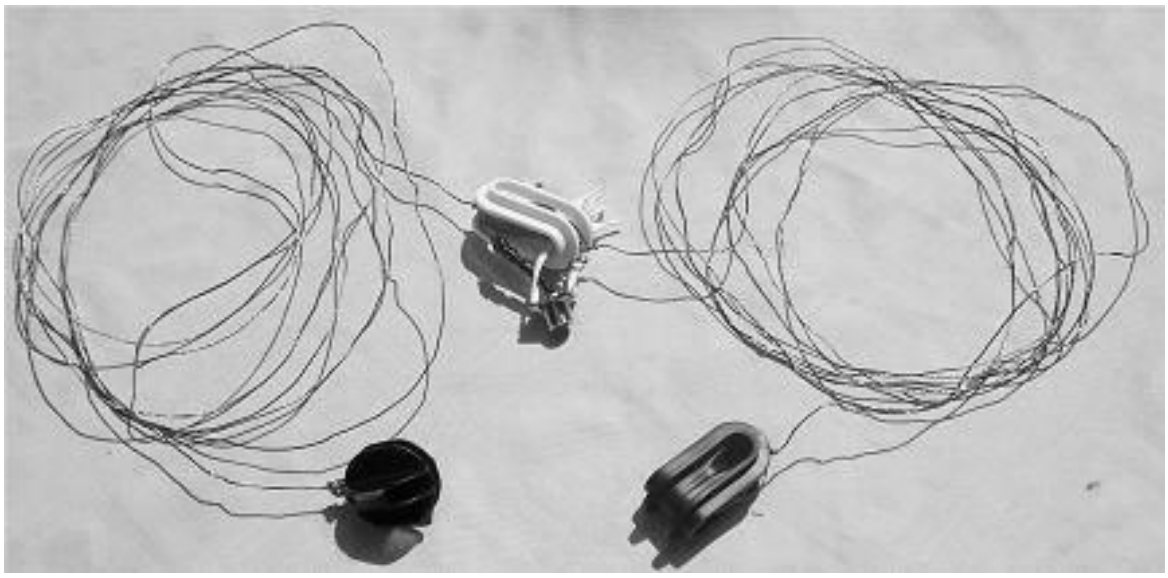
When hanging the antenna, it will be found to work best if kept clear of objects as far as possible and put up as high as possible, oriented so that its radiation pattern is in the direction you want to exploit. This will be so that the side of the wire is in the desired direction.

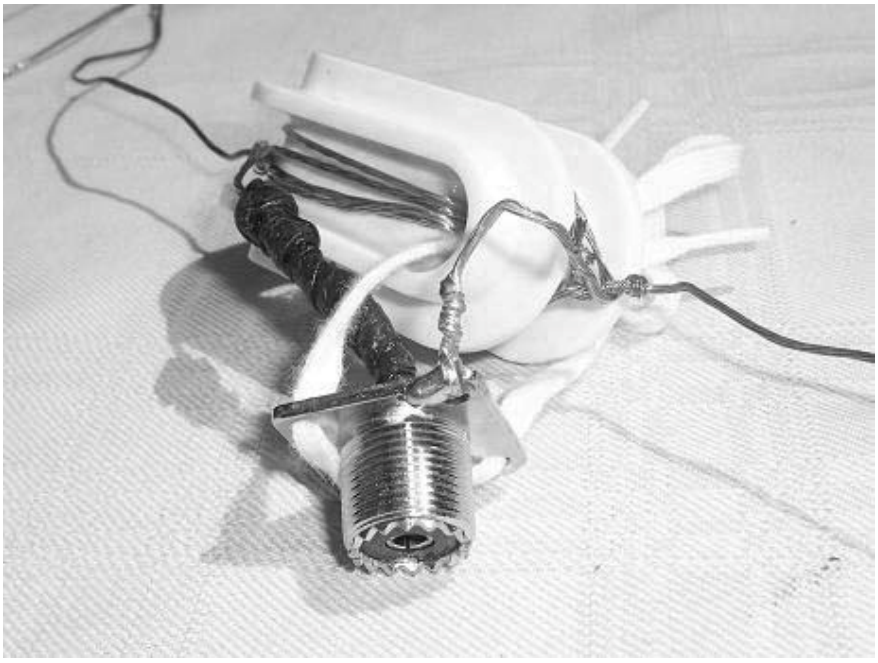
Remember to think of safety and the requirements to minimise radio frequency energy around people. Any antenna should be disconnected when not in use to avoid the danger of a lightning strike destroying the radio.

The antenna is suitable for carrying rolled up in a small bag and is useful for quickly getting on the air wherever you happen to be.

73 de Bill

VK4 TWI





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Radiated Power

*by **Bill Isdale VK4TWI***

We commonly measure power, often against some fairly arbitrary yardstick such as the rated output of a transmitter. Many high frequency radios these days are rated at 100 watts output, not because that is inherently good but just because it is what the market is looking for. Manufacturers presently deliver that as it represents the sweet spot at which consumers can be persuaded to open their wallets and buy the product.

Over time there will probably be the usual trend to bigger is better and manufacturers are likely to find the demand for more power is there as long as the price is not too steep. It isn't technically difficult to increase output power in a radio, it just increases cost, size and input power demand. But where is the power going?

Looking at a recently designed transmitter, we see an output of 100 watts and a need for 22 Amps at about 13 volts to obtain that. Looked at overall, the transmitter can be viewed as a resistance and power calculated as the product of voltage in volts and current in amperes. The formula is P=E x I. Applying that, power for the example given is 13x22=286 watts. That is what needs to be coming in to the radio in order for it to deliver 100 watts of radio frequency power at its output terminals. Where is the other 186 watts? It has been dissipated as heat and a careful touch of the heat sink will tell you just where it is going, out to warm up the world. Radio amateurs cause global warming; just keep quiet about that.

One thing is certain, we can't do anything about the heat loss in the radio, some must inevitably result from the current flows and resistances in the device. The bright side of this is that we still get our 100 watts output and the power supply simply puts the energy into the radio as required. We can easily overcome the loss by pouring more power in from our power supply. We are not being wasteful as the overall loss in the radio is the least that modern engineering can make it.

From the output terminals of the radio, the loss is much more within our control, subject to practical constraints which will probably mandate some compromises. The transmission line to our antenna will have some loss. In a transmission line which ends at an antenna which presents a pure resistance equal in value to the characteristic impedance of the line there won't be any voltage and current variations on the line, no standing waves, so there will be very little loss of signal energy as it is not reflecting back and forwards within the line, piling up into standing or stationery waves. There will be some loss due to resistance in the copper but with a line that has big conductors and is as short as possible, the loss will be minimised.

This is all great in theory, but in practice it soon goes awry. If we use an antenna such as a dipole then it will present a 72 Ohm impedance if it is perfectly situated, giving a standing wave ratio of 72 divided by 50; about 1.4. That is quite good and our transmitter and feed line, optimised for a 50 Ohm working load, will still perform well.

If we are using a quarter wave vertical then if it is sitting on a perfect artificial ground plane it should present a 36 Ohm load, half that of its bigger brother the dipole.

In most situations there will be some practical constraint which interferes with the ability of the antenna to radiate as it would in theory. Often there will be some nearby tree or structure or it will not be possible to raise the antenna as high as we would wish in order to get it clear of the influence of the ground.

The efficiency of our antenna will be reduced by proximity to the ground or objects which will unfortunately become a part of the total antenna system, a part that operates adversely and is acting as an air cooled dummy load.

I am not going to discuss trees or houses other than to say that they may be useful supports but that the direction of radiation should be as far from them as possible. For instance, a dipole would do much better if you run it from a tree to a pole than if it is run beside a tree which will absorb some of its radiation.

What I am going to discuss is radiation efficiency as it relates to the ground below an antenna. The ground will partly absorb radiated energy rather than perfectly reflect it and ought to be considered in calculating the efficiency of an antenna system. The percentage efficiency of an antenna is calculated by:

$$\text{Efficiency \%} = 100\ Rr / (Rr+Rl)$$

Rr is the radiation resistance of the antenna itself and Rl is the loss resistance of the ground. To illustrate, suppose a quarter wave vertical antenna has a 36 Ohm Rr and the ground has a 150 Ohm Rl, then antenna efficiency is $100 \times 36 / (36+150)$

$= 100 \times 36 / 186$

$= 100 \times 0.19$

$= 19\%$

This is not encouraging. 100 watts, if delivered intact to the antenna, will result in 19 watts radiated and 81 watts applied to warming up the ground.

These figures have assumed that the radiation resistance of the ground is 150 Ohms. Unfortunately, this is not an unrealistic value. Fine sandy soil will typically have an average resistivity of between 80 and 300 Ohms per metre. Clayey gravel will average 200 to 400 and silty sand 100 to 800. Gravelly clays will average 20 to 60 and well graded gravel can be 600 to 1000 Ohms per metre.

The radiation resistance appears in series with the loss resistance. The artificial ground provided by some copper wire radials offers very high efficiency in itself but the overall antenna efficiency will be dragged down by the influence of poorly conductive ground. An antenna which is close to poorly conductive ground is going to radiate a severely diminished signal. One remedy is to elevate the antenna a quarter wave above the ground to effectively eliminate its influence.

The fact that radiation resistance and loss resistance are in series offers another way to get improved results. If the antenna has a large radiation resistance in relation to the loss resistance it will operate more efficiently.

Consider the half wave vertical antenna; these are sometimes rather loosely referred to as being ground independent. This is a little misleading as what is really going on is that the radiation resistance of the antenna element itself is so high that the additional component from the ground is a small proportion of the total resistance and so does not drag the efficiency down very much. Over a perfectly conducting ground this antenna will have a radiation resistance of 1000 Ohms. Applying the formula to determine its efficiency when on ground with 150 Ohms per metre resistance gives this result:

$\text{Efficiency \%} = 100 \times 1000 / (1000+150)$

$= 100 \times 1000 / 1150$

$= 100 \times 0.8695$

$= 87\%$

This is a much better result. It is a whole lot better than the 19% of the quarter wave vertical on the same ground plus it has double the physical size and therefore double the capture area to receive signals.

To take a different example; if a quarter wave vertical has a 3 or 4 radial ground plane of quarter wavelength radials angled down 45 degrees below the horizontal so as to increase its impedance to 50 Ohms and is elevated at least a quarter wavelength above the ground so that the artificial ground is fully effective then the efficiency of that antenna would be:

100 x 50 / (50 + 0.1)
= 100 x 50 / 50.1
= 100 x 0.998
= 99.8%

For the purposes of illustration I have chosen a value for resistance of the ground plane that is perhaps a little high but will be approximately correct; copper wire is an excellent conductor. The actual value will depend on the length and gauge of the copper wires used for the artificial ground as well as their number. For present purposes it is not necessary to work it out exactly. The point is that over average ground a dipole will radiate less efficiently than a half wave vertical or a quarter wave ground plane antenna which by its design avoids the real ground and substitutes an electrically good one.

Applying the efficiency calculation to a ground with low average resistivity such as clay where about 30 Ohms per metre could be achieved yields the following for a dipole with the expected Rr of 72 Ohms:

Efficiency % = 100 x 72 / (72 + 30)
= 100 x 72 / 102
= 100 x 0.70
= 70%

The same dipole over 150 Ohm ground would be:

= 100 x 72 / (72+150)
= 100 x 72 / 222
= 100 x 0.32
= 32%

If the ground under the dipole is somewhere in the middle of the figures which I have used, which is probably typical, then it may be expected to be 50% efficient. The remainder of the energy fed to the antenna will be lost as heat into the ground. A quick fix would be to water the ground under the dipole in order to improve its conductivity.

Overall, the efficiency of the quarter wave vertical antenna with an artificial ground plane is very attractive and the half wave vertical could be a good choice in some locations as it occupies very little space although it will need a low loss impedance matching transformer, a balun, at its feed point. Such a balun would typically have an expected loss of only 1 to 2%.

The principles we have considered will apply regardless of the frequency which the antenna has been designed for, but naturally antennas for lower frequencies will be physically larger and a quarter wave ground plane antenna with quarter wave length radials and mounted at least a quarter wave length in the air will be a little cumbersome and will become impractical for most locations for frequencies much below about 14 MHz. The half wave vertical, of course, could be a space saving solution for some locations.

None of the antennas we have considered should be ruled in or out of themselves, what is used will depend on the circumstances at each location where we must weigh the advantages and disadvantages of different designs to come up with what is the best compromise. The illustration shows a simple antenna for 70 cms. A quarter wave ground plane made from a SO239 panel mount socket costing under $3. The ground plane is made from some copper wire that was on hand and the radiator from copper wire of the thickness which would fit into the hollow pin on the connector and so attach easily. The overall height of the radiator is 95% of what would be a quarter wave length in free space to allow for the velocity factor and the small loop at the top is there so that the antenna can be suspended from a thin cord and hauled up as high as possible over a suitable object such as a tree limb.

To make the same thing for frequencies down to 20 metres will be practical in some locations, especially if there is a skyhook in the form of a tree to suspend it from. The radiator can be hung vertically and the radials made of flexible wire and pulled out to 45 degrees by non conductive cord which is then tied into

position by use of a convenient tree limb or even a garden stake into the ground. Keeping the radiator and ground plane elements a quarter wave length clear of anything will maximise the efficiency of the antenna, allowing it to approach the 99% level.

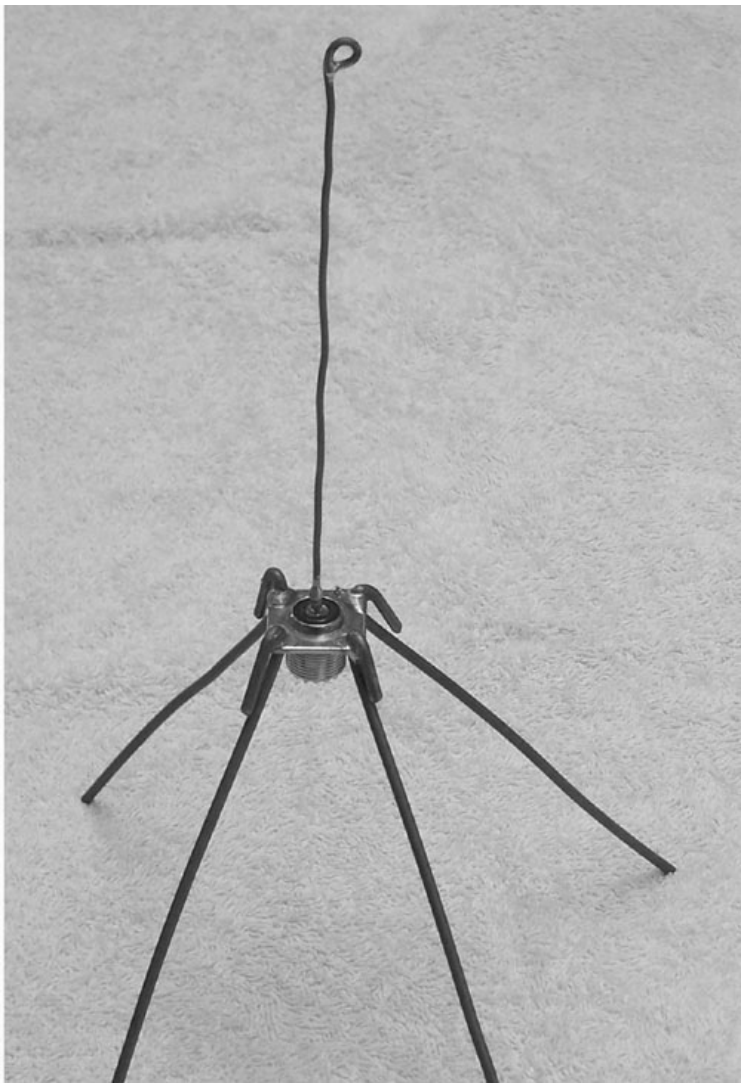
The quarter wave vertical provides a low angle of radiation for good long range performance. The tendency of man made electrical noise to be vertically polarised, as the electrical field from this antenna is, will be a consideration. Other more positive qualities of this design are high efficiency, very low cost and low visual signature.

A useful attribute of the half wave vertical is that it can be simply constructed of readily available aluminium tube, does not look like a radio antenna and if you put the correct flag on it no-one in the land will be able to successfully object to it.

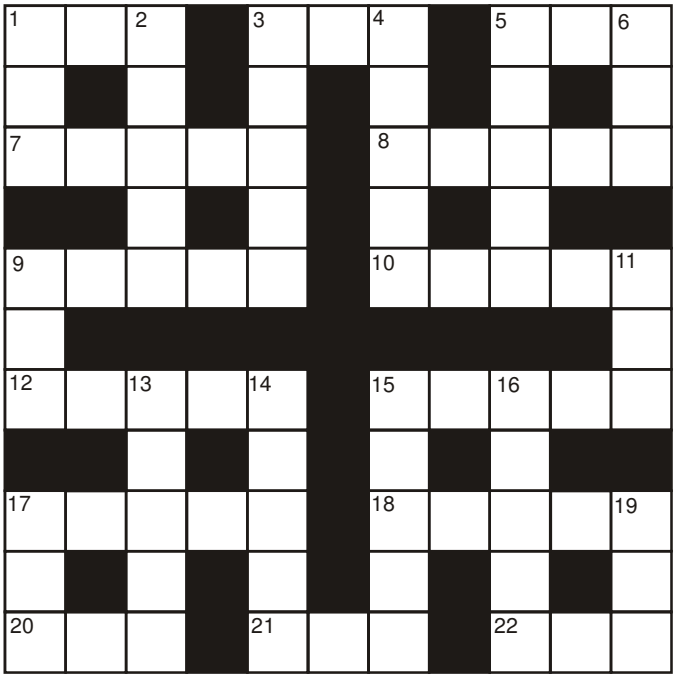
The photo was taken by my son James Isdale.

73 de Bill

VK4 TWI



R & DRC Crossword No. 10 (Solution next QRM)



R & DRC Crossword No. 9 solution

ACROSS

1 Female spouse
3 Computer component (abbrev)
5 Bands above UHF (abbrev)
7 Letter O
8 Infinitessimal region of space
9 Arrive at an answer
10 Understood (US Army practice)
12 Cannot be exceeded
15 Signal entering
17 More
18 Not true
20 Financial charge
21 Group of related objects
22 Signal report

DOWN

1 Crystal controlled oscillator (abbrev)
2 In the neighbourhood
3 Non linear trajectory
4 Above
5 Frequency excursion with modulated FM
6 Type of transistor (abbrev)
9 Radio listener (abbrev)
11 Signal report
13 MKS unit of length
14 Groups working together
15 Transistor with very high input impedance
16 Regions through which earth's axis of spin passes
17 Circuit electrical pressure
19 Australian time zone (abbrev)

---------- WIA Membership ----------

Please let the Secretary, Peter know if you have recently become a member of WIA. WIA membership of our Club members is important because we are able to derive insurance benefits. If you are not in WIA, please consider this seriously – it is our representative body.

Many thanks to Andy Wood (VK4KY) for items donated for our Club raffles

Notes from the Executive/Club Meetings

General Meeting, 12/12/05

- **Recap grant** – we have been advised we were unsuccessful for the 1st round. Application will remain for 2nd round in April.

- Peter reported that the trivia night is going well with weekly participation. This event is on Wednesday nights check-in's 7.15pm, start at 7.30pm– 438.325. This week will be the last week for this year while we take a break over Xmas

- VK4LA reported that he will follow up in person with the local business re: support in goods or donations for the club. Bob will enlist a second person when visiting the businesses.

- Graham & Margaret advised that they can organise for the club T shirts, which will have a pocket, Club Logo, your name & call sign for $35. Caps are also available for 12.50. If you supply your own shirt the embroidery is $12.50. Please let Graham or Margaret know if you require any of these.

- **Fox hunt equipment project**. Glen advises that we have 2 kits left. Which we may need to keep for Club use. We are researching the purchase of the critical Chip which looks promising. If you are interested in building one of these next year let Peter or Glen know so that we can work through the logistics.

  The executive has decided to hold regular Fox Hunts on the last Monday of each month, next year. This will be a fun nights activity where you will drive & or walk to find the fox, so get those sniffers working!

- **Dummy Load project.** We have 2 kits left at $12 for this valuable shack tool. Great Xmas pressie!

- **The activities day's.** Ken reported that between 10 & 15 people are attending. If you have time come on down & use the facilities. All tools & equipment is available for members use.

- **Publicity –** Steve & Reg are reviewing the web site.

- **Red sun rally** – The Redcliffe Club received 1st, 2nd & 3rd for the Fox hunt. We showed our sniffers to be an excellent tool in this fun event. We didn't do so well on the car rally. Our turn to run next year's event.

- **Xmas Party** – went well with 25 people attending. We held a fox hunt for the kids during the afternoon which encouraged a couple to come along with their father to these fun events.

- Alan VK4KZ has run the 1st morning's training session for the foundation licence for 10 trainees. We will soon hear all these people on air when they complete their exams & receive their licence. It is expected that Alan will hold the 1st foundation exams for the Redcliffe club early in the new year. Foundation licence training coarse is 4 mornings at a total cost of $24 for members or $6 per morning session. Examinations are $25 (WIA paperwork costs), plus $5 for the club running the exam plus postage etc. If you are interested in doing your foundation licence please let Alan VK4KZ know. 07 5497 4634

- Ron advised that he has donated a number of historic items to the club. When you are next at the club have a look at this old gear. Thanks Ron!

- Reg moved that the activities day be set to the 1st & 3rd Wednesday of the month to make it easier for remembering the day. Some members mentioned that they have pension related activities on alternate Wednesdays that would get out of sync if we changed our current dates. - The motion was lost.

- From the Xmas party, the executive decided that we would research the cost of a large tarp to be used at such events. Charlie was tasked with checking prices. If anyone is able to assist with getting the tarp for a good price, please advise Charlie.

- John VK3WX reported that Ces Kenny was able to get Channel 7 news coverage for the Deception bay school training / activities with Amateur Radio. Great work Ces VK4VKC & Peter VK4HOY

- **Coming dates**: John Moyle – 3rd Weekend in March. Working bee to mow around the repeater site, Charlie will be organising this, so keep an ear out to provide some assistance.

Please note that the club will be closed on the 26th December.

NOTE: No General Meeting in January

General Meeting, 13/2/05

- **Reminder the membership fees are due.**

- Foundation books available. Cost $16.50. Get your copy from Glen.

- Gaming commission letter advising that we were unsuccessful. Our application has remained for 2nd round. A letter was also received regarding a briefing session in March. (Reg & Ken will try to attend.)

- Peter reminded the meeting that the trivia night is on Wednesday nights check-in's 7.15pm, start at 7.30pm– 438.325. Come & join in the fun

- The Fox hunt equipment project. Glen advises that we have 1 kits left. We have sourced the important chip (50) & Andy VK4KY & Peter VK4TGV are working on an upgraded PCB board to take the new chip.

- The executive has decided to hold regular Fox Hunts on the Last Monday of each month. This will be a fun nights activity where you will drive & or walk to find the fox, so get those sniffer working!

- Dummy Load project. We have 2 kits left which we will build for the club's use.

- The activities day's. Ken reported that around 10 people are attending. If you have time come on down & use the facilities. All tools & equipment is available for members use.

- Publicity Reg has upgraded the club web site. Great work & special thanks to Reg. Brad offered to host the Club web requirements on his site. Brad, Reg & Steve to work through this. Thanks Brad!

- Alan VK4KZ has run nearly completed the 1st training course for foundation licence's. 5 have completed the written exams & have started their practical exams. A number of people have enquired regarding Standard & Open licence's. If you are interested in doing ANY amateur licence please let Alan VK4KZ know. 07 5497 4634

- Charlie was tasked with checking prices on Tarps. Will need to check with Charlie later as he is on a well deserved holiday!

- **John Moyle – 18th & 19th March**. Competition starts at 11 am Saturday & finishes 11 am Sunday. We will again be sited at camp no 6 at the scouts Murenbong campsite Scout Rd Petrie. We will be setting up the site with tents radios & antennas from Midday Friday. We will be able to camp over night on site on both Friday & Saturday nights..

  We will need to know who is available & when so that we can cover all the setup tasks & operators on the 5 HF bands we will be operating on. If you can help Please Let Peter VK4TAA know.

  We need to organise our own mobile toilets & generators (hopefully through our good friends in Coats)

  We also want to spot our operators on the DX clusters. Peter VK4TGV offered A CDMA wirelss Lan & Brad also offered some alternatives. Steve VK4IT will co-ordinate this element of the operation.

- Ken reported that the local Vacuum supplier assisted with supplying a second Vacuum cleaner which we can use as spare parts for our current unit.

- After some discussion the meeting determined that the club would like to provide IRLP access. Brad offered to pay for the IRLP card & ADSL internet connection to the club rooms to allow the IRLP to be set up from the club rooms. Special thanks to Brad & his business. Steve VK4IT will work with Brad on this great initiative.

Meeting closed at 9.30pm, follow by a light supper
Thanks, Peter VK4TAA

CELEBRATIONS (*January/February*)

Birthdays: Margaret Haig (VK4MH), 27th January
Endah McDonald (XYL, VK4KET), 31st January
Bill (jnr), Eleanor & James Isdale (harmonics VK4TWI), 12th February
Allan Ewer (VK4MAN), 24th February
Kerrod Atfield (VK4TKA), 24th February

Celebrations: Bill (VK4TWI) and Anne Isdale, 6th January
Reg (VK4KMP) & Pat Page, 19th December

Congratulations and best wishes to all above.

Apologies to anyone who has been left out. If you are not on Alison's Anniversary List, please give her the details as soon as possible. Alison and Peter are currently updating the list.

---------- Contest Calendar ----------

CQ WW RTTY WPX	11/12 Feb	Asia-Pacific Sprint (CW)	11 Feb
ARRL Intl DX (CW)	18/19 Feb	ARRL Intl DX (SSB)	4/5 March
RSGB Commonwealth (CW)	18/19 March	**John Moyle Field Day** (CW/SSB/FM)	18/19 Mar
CQ WW WPX (SSB)	25/26 March	SP DX (CW0SSB)	1/2 April
Japan Intl DX (CW)	8/9 April	**Harry Angel Sprint** (CW/SSB)	22 April

Lots of Notices – please note!

AMATEUR RADIO THEORY COURSES AT RECLIFFE

If you would like to get your amateur license, or do a refresher course, you can study for the theory, regulations and practical for Foundation, Standard or Advanced at Redcliffe Radio Club. See Alan VK4KZ, Laurie VK4BLE, Kerrod VK4TWI, or anyone from the Executive. You don't have to be a Club member to participate. Special courses will also be arranged to prepare people for the Foundation License. Please let one of the above know if you wish to attend one of these. There may be limits to class sizes.

▲▲▲▲▲▲▲▲ CLUB T SHIRTS ▲▲▲▲▲▲▲▲

The Club are arranging for a new batch of T shirts. Priced at around $35, these prestigious, prized garments have the Club logo, plus your name and callsign on the pocket. Caps are also available at $12.50. Convinced that you must have one? Contact graham (VK4GJH) or Margaret (VK4MH), or anyone from the Executive to be measured up and to place your order.

Many thanks to Margaret and Graham from all those proud owners who have recently received their shirts and caps.

------ Club second hand market ------

Do you have any radio gear, components, bits and pieces you would like to sell or swap. You can advertise in QRM for free. Please call, email or send details to the QRM Editor, Alan (VK4KZ). Similarly if you want something you think someone might have, you can also advertise in QRM. Your Club is there working for you.

MAINTAINING REPEATER RADIO EQUIPMENT

The Recliffe and Districts Radio Club's VHF and UHF repeaters are available for all amateurs to use, and all are welcome to use them, however, the radio equipment must be maintained and upgraded from time to time. If you would like to make a donation towards this upkeep, it may be forwarded to: The Secretary, Redcliffe and District Radio Club Inc, PO Box 20, Woody Point, QLD, 4019.

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