# THE

# QUEENSLAND

# VHF'er

**The Newsletter of the Brisbane VHF Group**

**No 3 November 2006**

**Brisbane VHF Group "Executive" are:**

President: Doug Friend, VK4OE, Tel-07 3391 5526,
E-mail: friends@squirrel.com.au

Secretary and beacon-repeater licensee: Jason Morris, VK4YOL, 10 Geraldine Street, Wavell Heights Brisbane, QLD 4012 Tel-07 3256 8712, E-mail: JV.MORRIS@bigpond.com.au

Treasurer: Paul Mead, VK4ZEM, Tel-07 3378 1206

Meetings are held on the fourth Wednesday of each month (except December) at the home of Rob Bathgate, VK4ZDX. E-mail: vk4zdx@cyberone.com.au Tel-07 3395 2232, 53 Arrol Street, Camp Hill, Brisbane, starting around 7:30 p.m.

Newsletter editor: Graham Selwood, VK4SG, 26 Flynn Dr Warwick QLD 4370
Tel-07 4667 1229, E-mail: graham.selwood@det.qld.gov.au

**The Brisbane VHF Group are responsible for the following:**

## Beacons

VK4RTT **144.440** MHz - 25 Watts – Location: QG53TC Bunya Mountains – Status: operational

VK4RBB **432.440** MHz - 8 Watts – Location: QG62MN Murarrie, Brisbane – Status: operational

VK4RBB **1296.440** MHz - 8 Watts – Location: QG62MN Murarrie, Brisbane – Status: operational

VK4RBB **2403.440** MHz - 2 Watts – Location: QG62MN Murarrie, Brisbane – Status: operational

VK4RBB **10368.440** MHz - 1 Watt – Location: Murarrie, Brisbane – Status: planned for early in 2007

## Repeaters

VK4RBN **147.000** MHz (600 KHz negative offset) – Location: Mt Glorious – Status: operational

VK4RBC **438.525** MHz (5 MHz negative offset) - Location: Mt Coot-tha – Status: operational

## Table of Contents

## Editors Chat

Welcome to the Third issue of “The Queensland VHF’er”

The aim of the Brisbane VHF Group is to promote the use of all modes of communication on all bands VHF and above.

We posted out about 40 paper copies of issue two to past and present member of the group, and a further 124 have been e mailed to locations all over the world.

This third issue has been provided to all the members of the Brisbane VHF group. If you are reading a borrowed copy and wish to receive your own copy (and become a member of the group), the fees are only $10 per annum, a bargain by any standards. So fill in the form on the back page and get your $10 off to our Secretary.

In this issue we have some interesting information from the EME conference in Wurzburg, both in the way of technical info and some of the “political” background that seems to unfortunately follow major meetings these days.

Kent WA5VJB shares with us some of his experiences with antenna testing, Dick K2RIW has some very interesting things to say about side lobes/antenna gain and Phil VK4CDI gives us some insight into his EME station. Doug VK4OE returns with his informative column and I have re-published an excellent article by Alan VK6PG on computer noises.

I have been given some good copy but I am always on the lookout for more. If you have anything of interest that you can share with fellow hams (Rough notes and/or photo’s will do - I can put the words together) please e mail me at graham.selwood@det.qld.gov.au. The “worth a click” inserts are by courtesy of John VK4TJ and are typical of the little “filler” items that are so valuable in a newsletter such as this.

This third issue contains articles gleaned from various sources, and full acknowledgement is given to the author and source (where known). But in this age of litigation and refusal to accept responsibility for one’s own actions, I am told that some form of disclaimer is necessary to prevent the incompetent and the unwary from holding the author, editor and members of the group liable for the consequences of using any of the information contained in this magazine to injure or harm themselves, their equipment or any third party. You must accept that any consequences that occur through following any information in this magazine are entirely your own responsibility.

Having said all that, I hope you enjoy reading the following articles, and learn something of value to this great hobby of ours.

Graham VK4SG

*Worth a click:* **Blue LED Mixer.** Fascinating! By simply substituting blue LED’s for the diodes in a typical doubly-balanced mixer and upping the drive level, performance in strong signal environments improves dramatically. Why blue? Because they have the highest Vf of all available diodes. And yes, they do glow a pretty blue when you’ve got the drive right. Back to the days of yore when you tuned your valve finals through a viewing screen for “just a touch of red”!
http://www.fpqrp.com/BBITS/bb0304.pdf

# Amateur Satellites – Hamsats – OSCAR what's it all about? (Part 3)

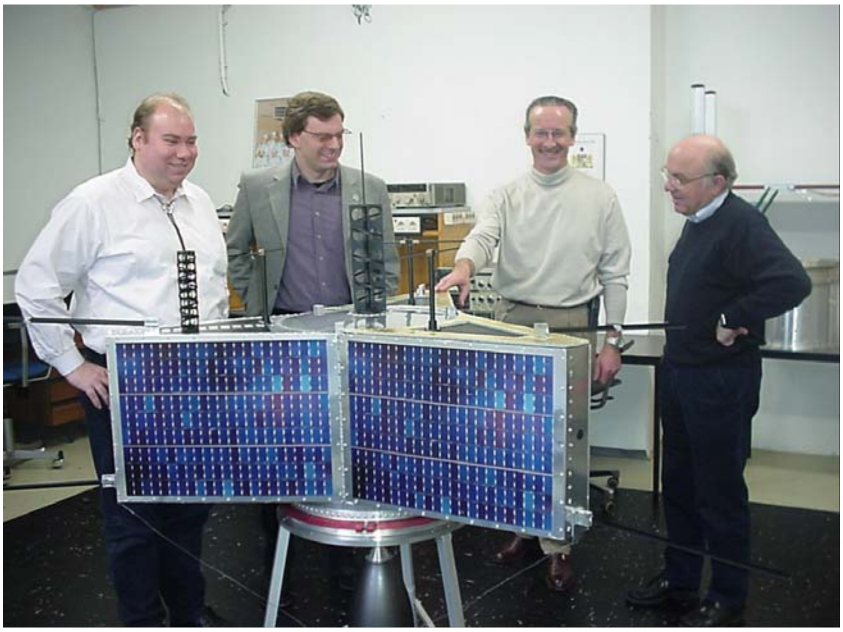
A basic introduction – **Graham VK4SG**

Last edition we talked about using a computer program to track the satellites, and looked at operating using the satellites as a "repeater in the sky". Today we are going to look at one of the new **H**igh **E**arth **O**rbit (**HEO**) satellites due for launch soon (proposed first half of next year)

The **AMSAT-DL** (German) Satellite was originally scheduled for launch in March 2006; it was postponed until Oct 13 2006. That has now been revised to March 2007. The launcher will be ARIANE-5, launched from the Kourou (Guyana) Space Center, at the top of South America.

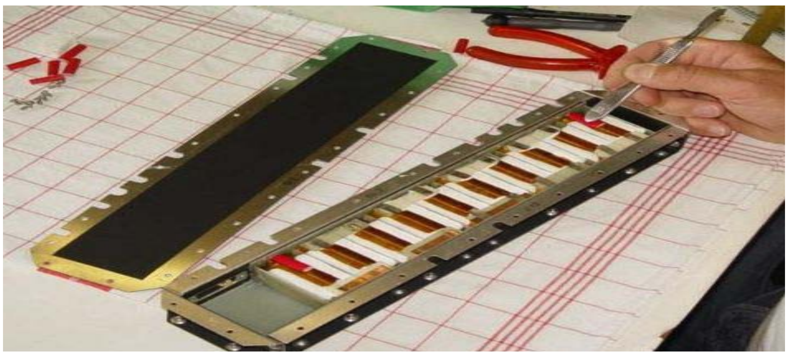
**Phase 3E Objectives**
Providing long range and long duration communication performance to amateur radio using a powerful high-performance satellite concept, based on previous Phase 3 satellites (AO-10, AO-13 & AO-40).
To test and qualify advanced hardware for P5-A (Mars mission circa 2009) and other future AMSAT spacecrafts. For further info refer to: http://www.amsat-dl.org

This is what the satellite looks like with some of the very happy design team looking quietly confident

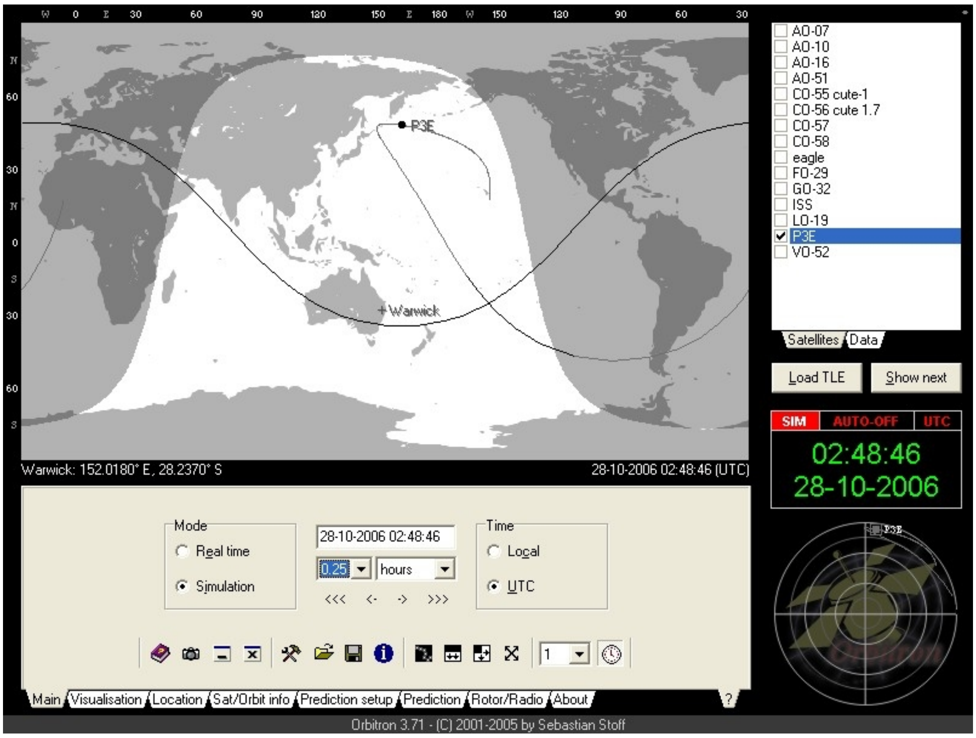


**Basic data**
Mass at lift-off: 150 kg, mass in orbit: 90 kg. Dimensions Height 50cm / Span 1.30m
Spin stabilized @ 20 – 40 rpm.
Propulsion 220 N engine (Atrium/EADS), Propellant 25.8 ltr MON, 24.7 ltr MMH pressurized by Helium bottle, 2 ltr He at 400 bar.
Main-Battery 10 cells Ni-Mh 13 Ah capacity (P3-C was 7 Ah)

Batteries were carefully cycled and tested for "matched" cells. Main flight battery including main test battery is already finished.
Two sets of Aux flight batteries are finished. One set will be provided for KiwiSat (AMSAT-Australia).



**Proposed** **H**igh **E**arth **O**rbit, 2000km perigee, 44000km apogee, 50° Incl.

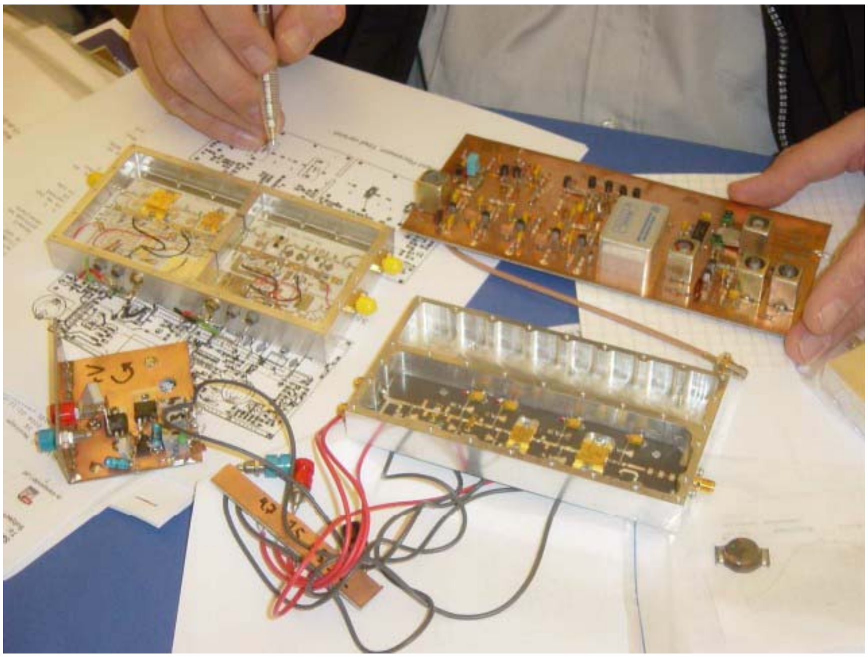



You can see from the Orbitron image the satellite is available from Paris to New York to Sydney and all other countries north of the solid line. N.Y. would loose it in about 20 mins but Spain and the Med would come on line.

The Keperlian elements for the proposed orbit are as follows:

P3E
1 55002U 05055B   06215.60600000 -.00000001  00000-0  10000-4 0    25
2 55002  48.7459 176.4760 7509770 242.6730   0.0000  1.71429000 08609

Put these into your TLE (two line element) files in your satellite program and have a look at just how long you will be able to talk to your favorite country.



The image at right shows the X band (10.3 GHz) transmitter and the 29 MHz receiver both built by Michael Fletcher OH2AUE

All of the receiver and transmitter units have been built and have been thoroughly "soak" tested prior to installation in the chassis

Many different modes of operation will be available on this satellite the three most common will be:

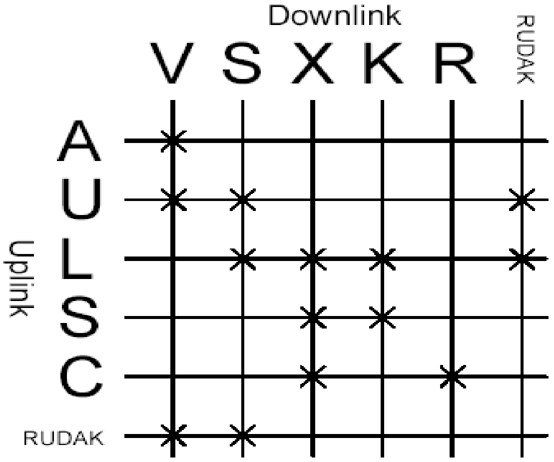
Mode UV (70cm Uplink, 2m Downlink, max. 60 Watt PEP)
Mode US (70cm Uplink,. 13cm Downlink, max. 38 Watt PEP)
Mode LS (23cm Uplink, 13cm Downlink, max. 38 Watt PEP)

But as you can see modes A (29MHz), C (5.7GHz), X (10.4GHz), K (24.04GHz) & R (47.08GHz) are also catered for. The software in the satellite computer simply chooses the uplink/downlink combinations as shown in the matrix below

If the controllers wished they could set certain days of the month aside for testing (for example) modes L/X and S/X which would mean a 10GHz downlink.

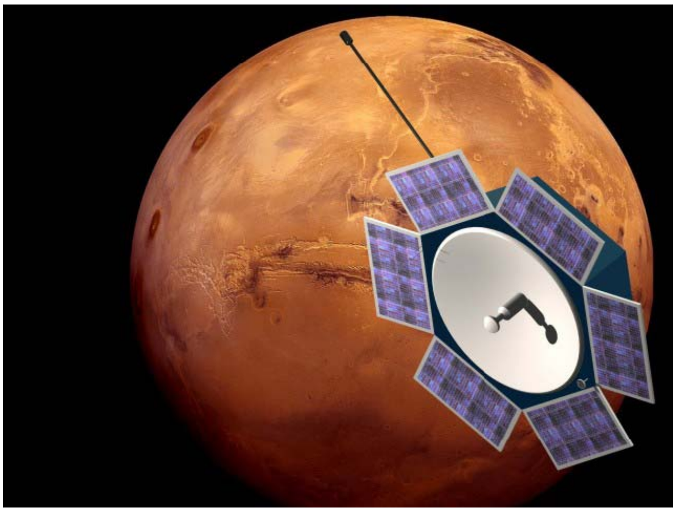
There have been many hams around the world waiting for a signal on 10GHz that they could access for long periods of time. This will certainly mean a lot more activity on 10, 24 and 47 GHz (the new frontier?) The phase 5 Satellites (Mars Explorer) will probably use these 3 bands as their main modes as the creep of commercial operations continues ever upwards in frequency.

But having said that, Mode A/V is also included. So the HF transmitter on 29 MHz with a 2 Meter receiver is well within the capabilities of most hams



P3E-Mode-Matrix

And what will the phase 5 satellite look like as it orbits around Mars in 2009?



Next Issue: The Eagle Express

*Worth a click:* **One man's obsession with chasing radio aurora.** Jeff, KGØVL, has logged hundred's of thousands of kilometers on some pretty rough roads to test current thinking about aurora as a mode of radio propagation. Along the way, he's collected a stunning gallery of visual aurora photographs. Check it out at: http://www.kg0vl.com/

*Worth a click:* **Custom ham radio maps centred on your QTH.** NA3D & NV3Z have created a clever program that creates maps for you in real time customised around your requirements. Grid square chasers, for example, can show all the Eastern Australian grids they are likely to work, with or without distances and beam headings: http://www.wm7d.net/az_proj

*Once again, an interesting article has just arrived from Richard Knadle (Dick) K2RIW and I just have to use it in this issue. I have included the original e mail from Dick as well to explain the circumstances. One thing is for sure, whenever Dick writes an article, we all learn something new. - Graham*

VK4SG de K2RIW 2006/11/16
Dear Graham,   The article about "Perfect Impedance Matching of a Yagi" was very nicely laid out in your September issue.

On 2006/08/20 you sent me an article entitled "Identify the Guilty.doc" in which it was mentioned that the DL6WU Yagi Designs have "mediocre sidelobes".  I believe those DL6WU Side Lobe Levels are ALMOST IDEAL -- explained below.

There are many Yagi builders and designers who believe it is desirable for the first Side Lobes to be at -20 or -25 dB.  Mr. L. B. CEBIK, W4RNL (for instance), has fallen into this trap, and has published a hundred pages of extensive computer simulations where such Side Lobe levels were studied.

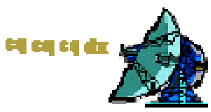
You can (almost) easily tune the Side Lobes to be very low, but you will always sacrifice Gain in the process.  This "Airy Disk" phenomenon is quite opposite to common sense.

To explain what level of Side Lobes is Ideal, I have included an article, "Maximum Dish Efficiency", on the subject.  It probably should be entitled, "Maximum Dish and Yagi Efficiency".  This article has been published in the UK, and in the US, during the last year, and it has received no rebuttals, and many compliments.  Therefore, it has been "Peer Reviewed" -- Hi.

Keep up the good work.  You have an EXCELLENT Magazine.  I hope your VK readers appreciate the work that goes into such a project. If you decide to publish the enclosed article, please send me a copy.

I'm also SLOWLY creating an article (with a different slant) on the proper stacking distance for best performance.

73 es Good VHF/UHF/SHF/EME DX,
Dick, K2RIW



# MAXIMUM DISH EFFICIENCY AND THE BEST ANTENNA SIDELOBE LEVELS

By **Dick Knadle, K2RIW** 06/04/05

**INTRODUCTION:** What follows is long winded, but it is intended as a mini-tutorial that I hope will give some microwavers a better understanding about the highly misunderstood area of Maximizing Gain, Aperture Efficiency, Properly Feeding Parabolas, and the Proper Sidelobe Levels that must be present in a properly operating high efficiency aperture-type antenna.

**THE FORMULA:** The most important factor that determines the achievable Gain of a microwave antenna is its **area**. The formula that is the bedrock of the antenna measuring/designing industry and science is:

Gain = (4*Pi*Ae) / (Lambda^2)

Where:
Ae = Effective Area, often 55% of the Physical Area
Pi = 3.1416
Lambda = Wavelength in the same units as Ae

**GAIN EQUALS AREA:** When you study that formula you can come to an interesting conclusion; at a fixed frequency everything is a constant except the Ae. Therefore Gain equals a Constant x Area. ***If you want to double the Gain of your antenna (that's a +3.01 dB Gain increase) you have to double its effective area.***

**ILLUMINATION:** All of the above assumes that you are properly illuminating that new area you added. In most Parabolic Dish situations (offset and center fed) that Gain is maximized when you choose a feed horn that has the -10 dB pattern fall at the edge of the illuminated surface (including the extra path length to the edge). That will usually give you a Dish with an Aperture Efficiency of about 55 to 60%.

**100% EFFICIENCY?** You can almost achieve a 100% Aperture Efficiency. All you have to do is design a feed horn that illuminates every square inch of the dish with the same power, and have that power abruptly fall off to zero at the edge of the dish (no spill over). To have that much control of the feeds Primary Pattern will require a properly-fed, Cluster Feed, Phased Array of about 1,000 elements, and that feed assembly will be about 30 wavelengths in diameter. If you are working with a Dish that is 120 wavelengths in diameter, this is almost do-able.

**A REAL DISH:** Since many of our antennas are only 20 wavelengths in diameter, that approach is not practical. You would end up with more gain in the feed horn assembly, than in the whole Dish antenna system. You would be better off just aiming the feed at the target and eliminating the Dish reflector.

**APERTURE EFFICIENCY:** The subject of Dish aperture efficiency is highly misunderstood. Most amateurs (and engineers) believe that the lack of 100% Aperture Efficiency, or 100% Main Lobe Efficiency, represents a true Power Loss (it does not), and that the "lost power" is in the sidelobes (it is not).

**THERE IS NO LOSS:** In reasonably-constructed 55% aperture efficiency Parabolic Dish antenna system, if you apply 100 watts to that antenna, 99.9 watts will be radiated into space. Aperture Efficiency (surface efficiency) is a measure of the True Gain of your antenna versus the theoretically achievable Gain of an antenna of equal area. The desirable 100% aperture efficiency will only be achieved when:

1/ The complete surface is illuminated with the exact same number of watts per square inch.
2/ There is no phase error on any of those square inches -- this means no bumps in the reflector, and no feed horn phase errors in the Primary Pattern.
3/ And there is no spill-over energy being wasted.

**WHAT'S PRACTICAL?** You can either loose a lot of sleep fretting over how you are going to make your aperture efficiency go from 55% up to 65%, or you can simply add another foot to the diameter to the Parabolic Reflector (and properly illuminate it) -- both may yield the same gain increase. The second approach is much faster, cheaper, and practical.

**MANY ANTENNAS HAVE 100%?** The world is filled up with Parabolic Antennas that have an aperture efficiency of about 98% -- they are called "Diffraction Limited" Telescopes. My 8 inch diameter telescope has about that aperture efficiency. It achieves this because the Parabolic Reflector is 370,000 wavelengths in diameter, and the Feed Horn (the Eye Piece) does create the desirable Primary Pattern; it is 9,000 wavelengths in diameter, which allows it to do that.

**SIDELOBES vs. EFFICIENCY:** Here is the real kicker concerning sidelobes and sidelobe "wasted" energy. A Diffraction Limited telescope could be described as one where the Parabolic Reflector has about 1/20 wavelength accuracy, and the rest of the optical system is working properly. That telescope could easily have an Aperture Efficiency of 98%. That's the highest Gain you are ever going to get out of that available area. But now, let's see what it is really doing.

**THE AIRY DISC:** As all astronomers know, every Diffraction Limited telescope creates a "picture" (the antenna pattern) that contains an Airy Disc. That means that around every star in the image you will see some dim rings (the sidelobes). The Airy Disk is present in all diffraction limited optics systems (and in all antenna patterns). A proper Airy Disk does not represent a system error. However, if a system error is present, the Airy Disk will change in a characteristic way that's beautifully pictured in Suiter's book, *"Star Testing Astronomical Telescopes: A Manual for Optical Evaluation and Adjustment" by Harold Richard Suiter, $29.95 at Amazon.com.*

**HOW MUCH POWER IN THOSE SIDELOBES?** From my Melles Griot "Optics Guide 5" catalog, in the section entitled Fundamental Optics, they say that the Diffraction Limited Airy disc will have a Central Maximum region relative intensity of 1.0 (that's the antenna's main lobe at bore sight), and 83.8% of the energy is located there. The first ring (I call this the 1st sidelobe), will have a relative intensity of 0.0175 (I call this -17.57 dB), and will contain 7.2% of the energy. The second ring relative intensity will be 0.0042 (I call this -23.77 dB), and will contain 2.8% of the energy. The 3rd ring intensity is 0.0016 (I call this -27.96 dB), containing 1.5% energy. The 4th ring is 0.0008 (I call this -30.97 dB), containing 1.0% energy, and a bunch more dimmer rings with less and less energy (the remaining 3.7%).

**100% APERTURE EFFICIENCY CHARACTERISTICS:** Now let's review those last statements. A Diffraction Limited 100% aperture efficient telescope has 83.8 % of the received energy located in the main lobe, 7.2% of the received energy located in the first sidelobe, 2.8% of the received energy is located in the second sidelobe, and 1.5% of the received energy is located in the 3rd sidelobe, etc. These are the best numbers you are ever going to get from a perfect, round aperture, that is not an infinite number of wavelengths in diameter.

**REMOVE THE SIDELOBES, NO WAY!** There are an amazing number of amateurs and engineers out there who are dreaming about getting rid of ***ALL*** of those side lobes and their "wasted" energy. This is a ***VERY FUTILE EFFORT.*** When a circular aperture ***HAS*** 100% aperture efficiency, it ***WILL HAVE*** sidelobes that are exactly that strong (-17.57 dB [1$^{st}$ sidelobe], -23.77 dB [2$^{nd}$ sidelobe], -27.96 dB [3$^{rd}$ sidelobe], etc.) and the amount of energy in each of those sidelobes WILL BE exactly the numbers indicated (7.2%, 2.8%, 1.5%, etc.).

**REAL DESIGNS:** You can definitely design an antenna with weaker sidelobes; but it ***WILL HAVE*** less Gain. You can design an antenna with stronger sidelobes; and it also ***WILL HAVE*** less Gain.

***You can then design a low loss (no pads) circular aperture antenna with exactly those magic sidelobe levels; and it will have the MAXIMUM GAIN for that size aperture***

.

**IS THIS REASONABLE?** Of course this doesn't seem to make sense, but that's the way "Mother Nature" and Diffraction Limiter 100% aperture efficiency antennas (and telescopes) behave. Those sidelobes are the result of the abrupt change in the illumination taper at the edge of the aperture – Mother Nature reacts to them by creating sidelobes. You could slowly taper the energy as you approach the edge of the aperture; that will decrease the abruptness of the illumination taper and it will lower the sidelobes, but the available Gain will decrease when you do this. You can't have it both ways (maximum Gain and no sidelobes).

**SO LET'S STOP THE INSANITY:** It's time us microwavers, amateurs, engineers, and interested scientists stop seeking Maximum Gain antennas that have minuscule sidelobes; it isn't going to happen.

At least I can say: ***It's not going to happen in THIS universe, which operates with THIS SET of the Laws of Physics*** that determine our antenna patterns by using what the mathematicians call Window Functions -- that's the way you feed an aperture.

**THE YAGI CONNECTION:** A well tuned long Yagi antenna has a nearly circular aperture with a nearly uniform aperture distribution. It is interesting to note that such a Yagi usually has a set of sidelobes that are very nearly -17.5, -23.8, -27.9, and -30.9 dB. I think we have been looking at the Yagi antenna's "Airy disc" for a long time, we just didn't give it that name.

**DISH COMPARISON:** A well tuned Parabolic Dish antenna has weaker sidelobes than these, simply because the best available feed horns need to use an Amplitude Taper of -10 dB at the Dish perimeter.

**GOOD OPTICS BOOKS:** For those microwavers who wish to dig deeper and try to understand this material I recommend reading some of the better optics books. I soon recognized that the guys who have gotten the subject of High Aperture Efficiency down to a science are the optics people. They can easily do this because their "parabolic antennas" frequently are more than 100,000 wavelengths in diameter. Their "feed horn" is called the eyepiece. Their books can give us a lot of insight into what is really achievable with our microwave antennas.

**THE REFERENCE:** Here is what I believe is one of the best books on optics. It's modern, well illustrated with computer-generated graphics and photos, and it's in its 3rd edition: Eugene Hecht, "Optics", Addison-Wesley, 3rd edition, 1998. It's much nicer than the classic, Born and Wolfe, "Principles of Optics", Cambridge University Press, seventh edition, 1999.

**AIRY DISC DEFINITION:** Chapter 5, page 228 of Hecht says: "Because an instrument can only collect a portion of the incident wave front to be reformed into an image, there will always be diffraction: the light will deviate from straight-line propagation and spread out somewhat in the image plane. When an optical system with a circular aperture receives plane waves, rather than there being an image "point", the light actually spreads out into a tiny circular spot (called the Airy disc, containing about 84% of the energy), surrounded by very faint rings. The radius of the Airy disc determines the overlapping of neighboring images and therefore the resolution. That's why an imaging system that is as perfect as possible is referred to as Diffraction Limited. For a perfect instrument, the ideal theoretical angular resolution is given by the radius of the Airy disc, which is [1.22 x Lambda / D] radians (this is the Rayleigh criteria). Another way to present the angular resolution is [2.52 x 10^5 x Lambda / D] arc-seconds". (I added the parenthesis).

Good VHF/UHF/SHF/EHF/EME DX, **Dick, K2RIW** http://www.consult-li.com/listings/RKnadle.htm

We as weak signal DX enthusiasts should be mindful of the function of the calling frequencies ie 144.100 MHz. Working DX on 2m is difficult enough, but it is made very difficult by the use of the frequencies for local rag chews. A few brief comments on .100 are not going to worry anybody but please can some consideration be given especially at this time of the year when DX prospects are at their highest. Just because nothing is heard from your QTH, does not mean that another ham 10 or 100Km away is not in contact with a ZL at the very moment you choose to start a local contact.

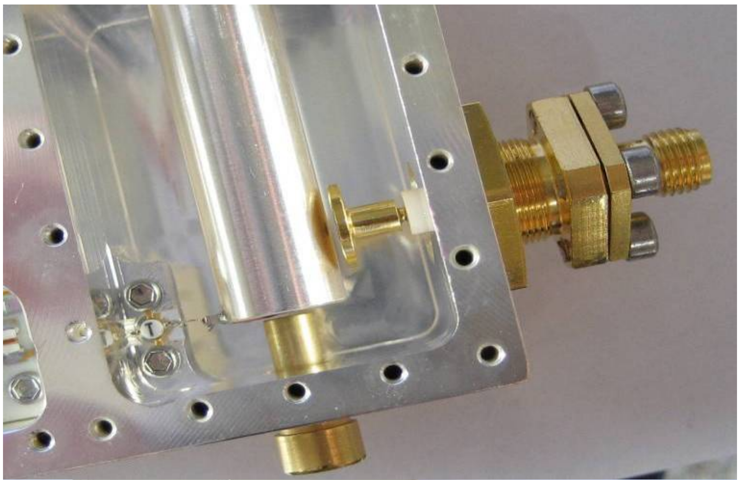
Reports have been sent to me to ask (some would say/have said demand!!) that the frequency should be kept clear at all times except for its primary function. The argument (overheard recently & at other times in the past) that local QSO's on the call frequency "will alert DX that the band is open", are total nonsense. As an experienced DX 'er said to me recently: Try it on 50.110 MHz during prime time & see what happens!

Reports of local contacts of over 20 minutes have been made & the results would have been just as successful lower or higher in the band! The regulations for the Ross Hull VHF/UHF Contest now state that (prolonged) use of calling frequencies will result in penalties! So please avoid using them except for their intended use!

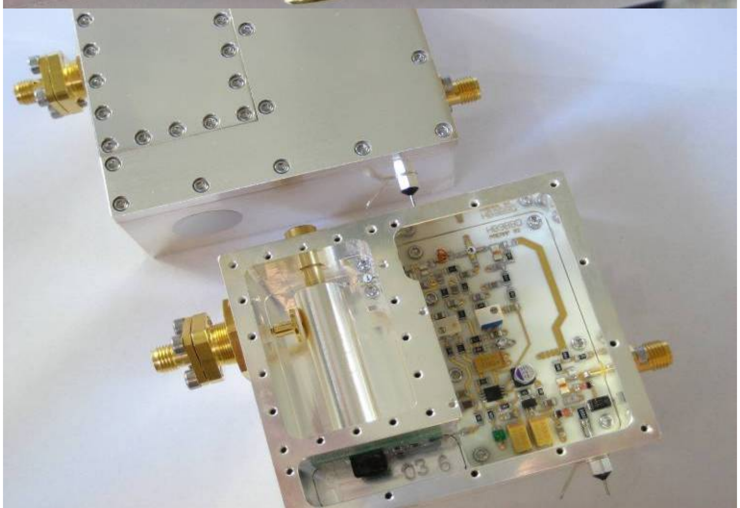
There was a time in my life (Between wife #1 and #2) when I met a very attractive lady (blonde) whom I spend quite a period of time getting to know very well. She had quite a lot going for her in the looks department but I likened her to one of those glass and chromium skyscrapers that appear in most large cities (they look very attractive but in her case the lift didn't get to the top floor!).

Since that period in my life there have been many other cases where function simply hasn't followed form, and I have been waiting to find something of beauty that also functions exceptionally well.

***Well cast your peepers on this, both beauty and form in the one package***



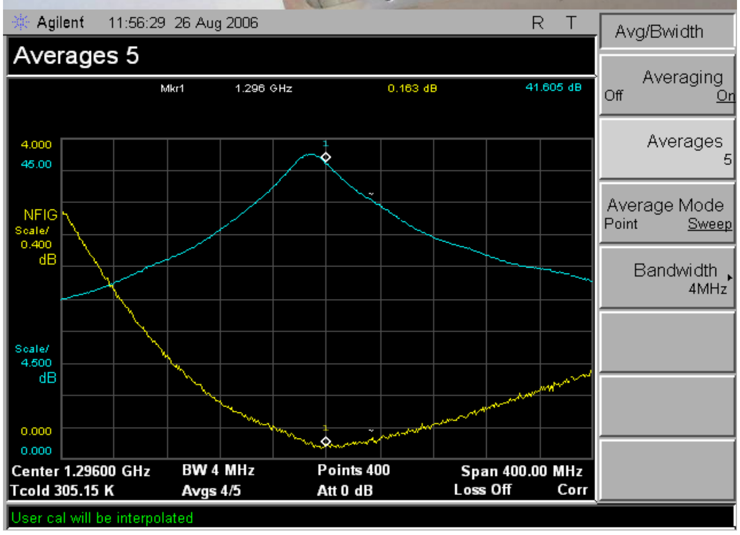
This work of art is a 23cm (1296MHz) pre-amp made by HB9BBD. He took it to the recent EME conference in Germany for noise figure measurements.



As you can see, the cavity and GaAsFET are both in the one chamber, with the control circuitry in the other.

Silver and gold plating abounds

But does it work……Does it heck!




How about **41.605 dB gain**

With a noise figure of **0.163 dB**

I would love to have a 144 MHz pre-amp with that noise figure, let alone a 1296 one!

Congratulations to HB9BBD for producing such a quality piece of gear and if you ever want someone to do a long term test, well, I might just be persuaded!

# ANTENNA MEASURING NOTES

By **Kent Britain WA5VJB** (updated Oct 2006)

*Before we start on the serious technical stuff, I thought you might like to see how Kent conducts lateral movement and vibration tests on his home antennas – Graham*

*Note however the effective use of guy wires on the H frame*

**Since 1987 I have set up my portable antenna range at 26 Conferences measuring well over 1500 antennas, mainly in the .9 to 24 GHz range. Here are some of my observations.**

## The Feed is not at the focus of the dish:

First off, I have NEVER been able to calculate the focal point of my dish, mount the feed, and have the antenna optimized. NEVER! It always seems I have to move the feed in towards the dish a bit to tweak things up.
But out of the antenna range things are far worse. About half of the dishes have the feed off by as much as 50% in distance!

A chap comes up with a 2 ft. dish and about a .35 f/d. The feed is sticking out 3 ft from dish!
“But that's where I calculated the focus to be!" is always the answer. I haven't found out what in the $D^2$ /16c equation throws them, but we see it all the time.
Another problem is the rounded edge on most dishes. They measure the physical diameter of the dish, not the diameter of the actual parabolic surface. That outer cm or so of many dishes is not usable and should not be used in the F/d calculations. And I won’t even start on the complications of calculating the actual phase center of the feed.

I have always been able to pick up a dB or two tweaking the focus and 6 dB or so has been the typical improvement at the conferences when the feed is movable and we can optimize its position. And finally come the 25% or so really bad ones. The "dish" was not parabolic, the feed wasn't resonate in the ham band, the focus was miscalculated by 3 feet (on a 2 ft dish!), using a grid dish on 3cm (and 3cm spacing on the wires), and so on. As I said, typically 25% or so of the dish antennas tested at these conferences are just air cooled dummy loads.

Most of these really bad ones are usually the prime focus dishes. With the offset dishes, you usually have a pretty good idea where the feed was for a starting point if you had saved all the parts. But the ham feeds will usually have a different phase center, so we're back to seeing several dB of improvement moving the feed around a few millimeters.

The antenna range is also a good spot to figure out where the antenna is pointing. Build up some kind of mechanical sight, or mount a telescopic sight on the edge of the offset dish. (Top edge works well too) Peak up the signal, and sight in on the source. An optical sight can be very useful when portable.

On Yagi and Quad loop type antenna, the builder has often used a different diameter boom, or different size elements, or even replaced a round boom with a square boom. In each case there was no attempt to use corrections factors. (50/50 chance they would have gone in the wrong direction anyway!) Again a large percentage of these antennas are not close to what the owners are expecting in the way of performance.

If you tested all the microwave antennas in England, I am sure very few of the antennas would have the dB's you have been optimistically using in your range calculations.
Interestingly both the UK and ZL groups left the Microwave Update antenna range saying, "This antenna measuring is not all that hard" and are both looking at setting up antenna ranges back home.

## *Now we will explain how it is not necessarily complicated to set up an antenna range.*

Equipment required:

**RF Source**
**Source Antenna**
**Reference Antenna**
**Detector**
**Open Space**

**RF Source 1000Hz vs. CW:**

Many of my first antenna range set-ups used just a CW source, a reference horn, and a power meter. Hold up the power sensor and horn, measure power, attach the antenna to be measured, and the difference in dB power is the difference in dB gain.

This works, but you really have some dynamic range problems. The power sensor is not very sensitive, so you have to run a fair amount of power and use a short range. But it does work.
Just make sure you have at least 10 dB more power than the noise floor of the power meter, otherwise you run into (Signal + Noise) / Noise problems. I have been able to make pretty good measurements with 10 to 30 milliwatts sources into 20 dB gain antennas on 6cm and 3 cm. Horns were measured at about 5 Meters, dish antennas at about 10 Meters from the source.

**Generating 1000 Hz:**

I have a Wavetek 3001 500 MHz synthesized signal generator I haul to the antenna range. Most RF generators already have a 1000 Hz AM setting. So up to 500 MHz I just set the generator to max output, 1000 Hz AM and drive a source antenna with it.

On 902 MHz, I set the generator to 451 MHz and drive two sides of a mixer, this doubles to 902 MHz which goes through a filter and into a 20 dB gain amp. This gives me about 100 milliwatts to work with.

On 1296 MHz I set the generator to 432 MHz, horribly overdrive a small brick amp, filter the 3rd harmonic, and drive a second brick amp. Again about 100 milliwatts to work with.

On 2304 MHz, I set the generator to 384 MHz, again horribly overdrive a small brick amp, filter the 6th harmonic, and drive a second brick amp. This gives me about 75 milliwatts to work with, and there is a second similar unit for 2400 MHz.

For 3456 MHz I again use a brick amp (Hand picked this one) driven with 432 MHz and run the 8th harmonic through an interdigital filter. A second brick amp brings this up to 10 milliwatts or so.

On 5.7 GHz, 10.3 GHz, and 24.1, GHz I use Gunn sources driving PIN Diodes.

Sometimes I use a 555 timer circuit AA5C built up for me, other times I just drag along a function generator and directly drive the PIN Diodes. On 47 GHz I have a 23.5 GHz Gunn source driving a doubler out of an old HP 940A. I modulate a PIN diode on the 23.5 GHz source.
So a lot of ways to generate a 1000 Hz modulated RF source. Of course if I had a Signal Generator actually on these frequencies, or even a sweeper with an external modulation input, I would use it.

On 80 GHz, my Gunn source has a modulator built into its' commercial power supply.

**Source Antenna:**

You will need an antenna at the source end. It's nice if the antenna has a fair amount of gain and over the years I have used everything from Coffee Can horns, to 2 ft dish antennas on 3 cm. Over the years I have migrated to multiband antennas at the source, just to speed set-up and less stuff to haul about. Ridged horns work well, some the multiband dish feeds work well too. While it is nice for the source antenna to have gain, it is not necessary and I am a firm believer is using what works. (More on the type of antenna to use in the Open Area section).

**Detectors/terminations:**

At the receiver end we need a simple diode detector to demodulate the 1000Hz AM signal. I normally use a standard Type N Input diode detector. Now, most of these detectors in the US do not contain any kind of terminations. So they don't look like a 50 load, but rather have very complex input impedance. Just put a 6 dB pad on the input of the detector. 10 dB works better, 20 dB has too much loss, and the input is pretty much 50? For the higher bands, the simple diode detector mounted in WG works well.

**Receiver:**

If you are using CW and a Power Meter, then this is your receiver. If you are using 1000 Hz, then you need an HP-415, HP416, or the Marconi Type 6593A. Many other companies also make these 1000 Hz "SWR Indicators". These are simply an audio meter tuned to 1000 Hz with a high accuracy meter scale. I have also used General Microwave and NARDA versions of the HP415 and they work just as well.
Note: The HP415E needs 9 Volts to run, 16 volts to run in the expanded scale mode. It only pulls about 5 ma, so I will wire in two 9volt dry cell batteries and can run it for hours and hours on the antenna range.

**Reference Antenna:**

The most important part of the antenna range is an antenna you know the gain of.
The hand of God, or someone with a crayon, has written the gain of the antenna on a calibration sticker, or Post-it-Note.

We measure how much signal the Reference antenna collected, and if the antenna being tested collects 3.2 dB more signal, then it has 3.2 dB more gain than the Reference.
On all bands above 900 MHz, I use horn antennas as the reference. In several cases I was fortunate to acquire Std. Gain Horns, and the gain of a horn antenna can be easily calculated with high accuracy.

But like any ham activity, absolute gain numbers are not as important as optimizing the antenna. We will spend hours tweaking the output of a power amp, or the NF of a Pre-amp, and we know the equipment is not calibrated for the frequency we are using. But Max Power Out is still Max Power Out whether it is 68 Milliwatts, or 92 Milliwatts, it's all we can squeeze out of that circuit. Same for the antennas.

You move the feed around, try several feeds, and so on, even if the range errors are a dB or 2, we have maximized the performance of the antenna and been able to compare the relative performance of different antennas.

Again if the real gain of the antenna is 29.6 dBi or 30.4 dBi is all academic, we have squeezed everything we can out of the antenna. (Or thrown it in the rubbish bin!)

**Audio out:**

The solid state HP- 415's have a "Recorder Out" connector on the back. I usually connect a small audio amp with a speaker to this connector. The raw 1000 Hz can be amplified to drive a speaker.

***Several good reasons to listen to the audio signal***
It's nice to peak the antenna on a audio signal, especially when you're holding the dish with one hand, moving the feed with another hand, and holding the detector with the third hand .... You know what I mean.

And it is especially good when there might be interference Some time back I was testing an L-Band Helix for possible use on Phase 3-D. The meter was jumping all over the scale; there were several peaks away from the source, and a constant erratic noise floor on the meter. After some time I connected the audio amp and figured out the problem in nano seconds. Loud video buzz! The long helix was acting like a 1/4 wave whip on TV Channel 4! All further testing included either a 1269 MHz filter or an isolator. I have had similar problems testing Log Periodics that do not have the back ends of the booms terminated. At our Central States VHF Conference we typically have the 50-450 MHz and the 900+ MHz ranges running at the same time. Listening to the tones lets us easily tell when that 1296 MHz rhombic is also working as a 144 MHz antenna. (Our 1000 Hz tones are hardly phased locked)

**Open Area:**

30 to 40 Meters is nice, but I have often set up in more confined areas of 10 to 20 Meters. But I try to avoid areas near walls that might cause reflections. Given a choice, I set up on grass (easier on my feet) but parking lots can also be used.

The whole idea is to find an area where you have a consistent signal about the same size as the capture area of the antenna. i.e. a bit bigger than the biggest antenna you plan to test. Our greatest source of error is having the signal level on one edge of the dish stronger than on the other edge of the dish.

Some of the English lads were looking at me pretty funny while I was waving a horn antenna all over the parking lot at uWave Update. (The US guys had seen me do this before.) Up, Down, Left, Right, Back up a bit. The antenna range is not pre-planned geometry; I am just looking for an area about 1 meter by 1 meter where the signal level varies less than 1 dB. When I find it, I put some kind of marker on the ground, and then tell everyone how high to hold their antennas.

I gave up on elevated ranges a few years ago. I almost always set up with the source antenna (Usually a horn) sitting right on the ground. Thus the antenna and its' reflected image are virtually the same point. Sometimes the horn is sitting on a sheet of metal, sometimes it's sitting on a sheet of absorber. Sheets of the Carbon loaded foam work well if you don't have an Eccosorb. Also the sheet of magnetic material that hold advertising to your fridge work well as Iron loaded absorber.
The sheet metal gives me a little more signal, the absorber usually gives me a cleaner test area. Although there is no hard fast rule here, I just use what ever works best . If there is a nice consistent signal area, we start measuring antennas!

**Measurement technique:**

***Substitution:*** Measuring itself if simple and quick. Hold up the reference antenna, set the meter to a convenient spot, attach the sensor to the antenna to be tested, hold it at the same spot, take a reading, and calculate the difference. I normally carry some kind of marking pen and write the results on the antenna. We usually have someone else standing around with pen and paper making a more complete record, but the guys seem to like having an "Official Result" right on the antenna rather than trying to remembering it, or waiting a month until someone publishes the results.

***Dynamic Range:*** One pitfall is the dynamic range of the SWR Indicator or power meter. You like to keep less than 10 dB difference between the antennas under test. So don't use a dipole as the reference for a 30 dB gain antenna measurement. First of all the meters have errors the further you stretch them. Secondly the capture areas of the two antennas will be quite different.

A large number of secondary problems occur when testing antenna with vastly different capture areas. With the 415's or 6593's you want to keep them down in the 30, 40 or 50 dB ranges. Higher than 30 usually means the diode is driven out of the square law region, in the 60's the signal will be pretty noisy. These meters will also work with bolometer mounts. Now you could use all the scales with a bolo, but the bolo is less sensitive than a diode mount and you will need more signal.

The 6593 can be used to directly compare 2 antennas, but this means you will need to find a larger measurement area, bigger than both antennas, to make your measurements. This is easy enough on 50 MHz - 432 MHz, but much more difficult on the microwave bands. I haven't used a 6593, but going over one in G4DDK's garage, it sure looked like a natural for antenna ranges.

**Results:**

Oh it was fun in the early years deflating egos. "Well, a 5 element Yagi would have 12 dB gain, using quad elements adds 2 dB, and a corner reflector would have 10 dB, so by combing a Yagi, Quad, and corner reflector, my super antenna has 24 dB GAIN!" Yea, sure, here's the detector. (6 dBi if he was lucky!).

Over the years the wild claims have died down, and better, more consistent designs are showing up. And we have developed a bit of a tradition of seeing what kind of strange antennas we can show up with and still get good results. And a sprit of experimentation has developed where guys are not afraid to show up with a dish, 8 feeds, and find out which one works best. Typically at the CSVHFS antenna contests we will measure 100 to 125 different combinations of antennas.

There have been a few fun ones; I particularly remember KB0HH spending several years trying to optimize a scalar feed. With excellent form, his cowboy boot sent the feed over 30 meters down the range!

**Circular Polarization:**

We usually get a few CP antennas to test. Normally I just measure the gain, rotate the antenna 90 degrees, measure the gain, average the numbers add 3 dB, and label the gain dBiC.

Ideally, the gain does not change as the test antenna is rotated. If gain only varies 1 dB I'll congratulate the builder, if it varies 3 dB I'll still call it CP, more than 3 dB and we'll start looking at ways to fix/repair/improve the antenna. This is especially a problem with some of the "Short" Helix dish feeds that have become popular lately. It is very difficult to properly generate a CP wave in only 2 wire turns.

At an AMSAT Conference we set up the antenna range and only 4 of the 8 Helix antennas had gain along the axis of the antenna! Of the 4 with gain, only 2 were within 3 dB of circularity. And yes, 1 of the 2 had been brought by James Miller G3RUH.

The AMSAT lads have been passing around the idea that Helix antennas are easy to build and fool proof. Tests of dozens of Helix antennas say they are WRONG.
AMSAT writers perhaps have the worse habit of coping articles. A guy writes an article about a Helix that is copied from an article that was copied from an article....... And over the last 5 generations of this design, each writer/builder has substituted materials, slightly changed dimensions, and NEVER tested the antenna.

**Log Periodics:**

LP's can also be difficult to test, especially the ones that do not terminate the back of the booms. The antenna picks up fundamental and harmonic frequencies equally well. They also tend to pick up more local interference. A clean source and monitoring the 1000 Hz audio will usually keep you out of trouble. The unterminated LP's tend to act like a big capacitor and pick up noise from the mains and a lot of other garbage. All my current LP designs terminate the back of the booms; it just cleans up so many problems.

**Higher Bands:**

In my job, we have been doing some radiometry work between 90 and 110 GHz. Yes, I modulate the Impatt amp with 1000 Hz and do all sorts of tests with the HP 415. It's a system that works well for antenna testing on all bands.   **Kent WA5VJB** kent@jts.net

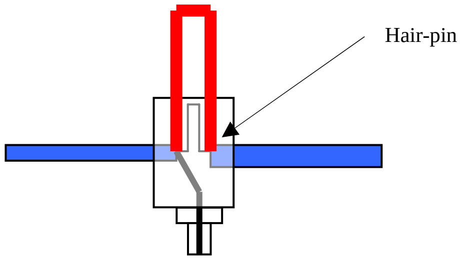
*This article was published as a paper at the recent EME conference. I have made minor changes to the English translation from the original article http://home.tiscali.nl/pa0ply/t-match.htm. It is an excellent example of practical matching techniques - Graham*

# MATCHING OF A 432 MHz YAGI by PA0PLY

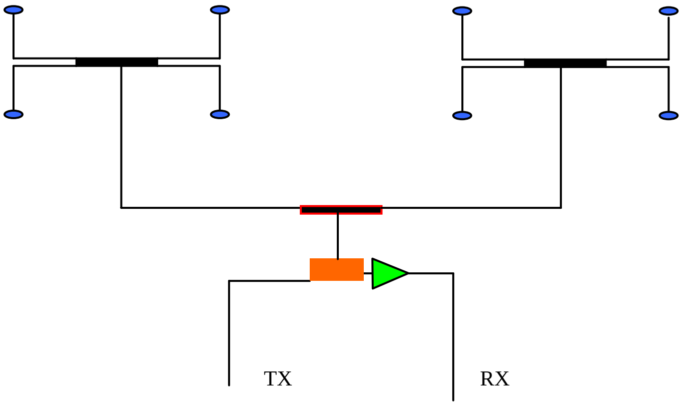
Several years ago when starting EME, I decided to use relatively short antennas. Based on a DL6WU design, I modified the length to less than 3 meters. Using YO- software the final typical parameters were as follows:

| | |
|---|---|
| Length: | 2.98m (4.2 Lambda) |
| Gain: | 14.36 dBd |
| F/B ratio: | 36.7 dB |
| Impedance: | 10.8 – j45.2 |
| VSWR: | 1.04 |

To prepare a good match for the feeder, a hairpin construction was suggested in combination with a 1:4 Balun.




After some mechanical difficulties, a group of 8 antennas was completed. The antenna configuration is shown below.



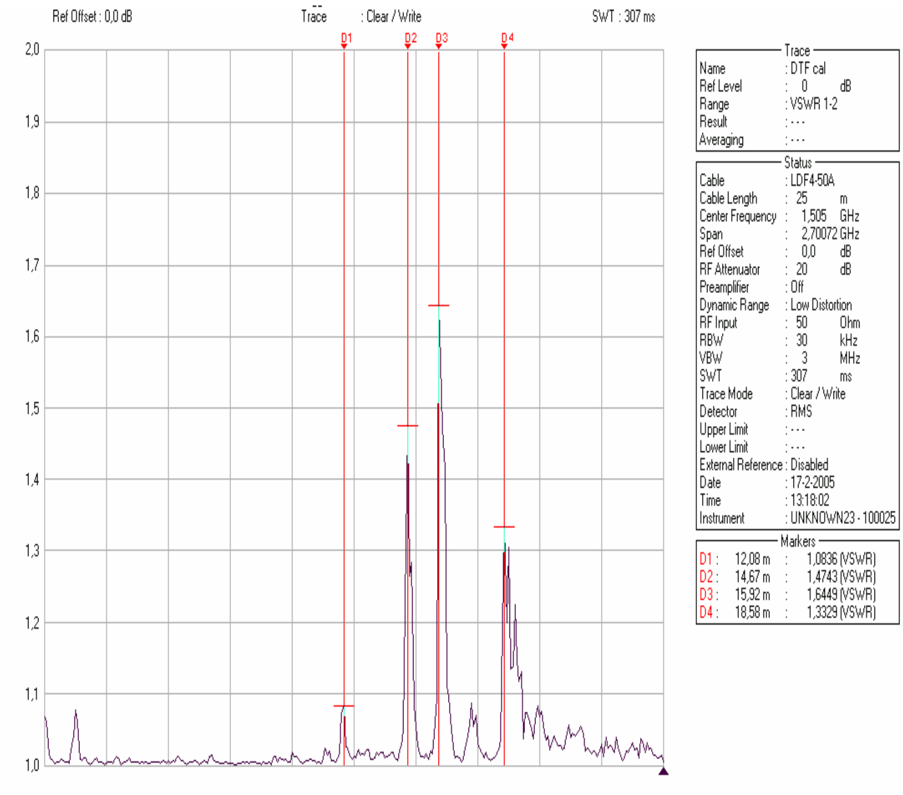

These antennas were used successfully over a period of more then 4 years. Unfortunately the performance of the array decreased slowly over some time. Further investigation of this problem was badly needed. Although the VSWR became better and better, my signals became weaker and weaker, while fewer stations were heard.

**Time-domain measurement**

Using a time-domain spectrum analyzer (R&S FSH-3) we found possible problems.
The graph below shows four points, D1-4, with higher VSWR values.

| | |
|---|---|
| D1 | Bird coupler – mast mounted |
| D2 | 2-way splitter |
| D3 | 4-way splitter |
| D4 | Antennas |

Without further dismantling the entire antenna array, it is virtually impossible to check each section / antenna individually. From experience I knew the feeder matching was a potential problem area, so was the construction of the 4-way splitters. D4 indicated a VSWR of 1.3, while D3 shows 1.6. Since these points are the result of a combination of various items, I suspect serious problems here. Based on this I decided to replace both the splitters as well as the dipole systems for all antennas.

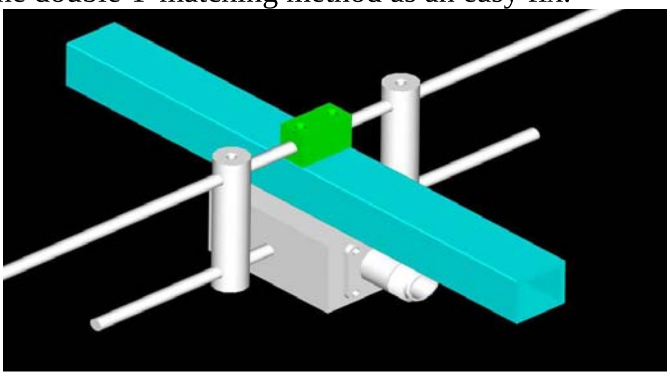



**Dipole matching**

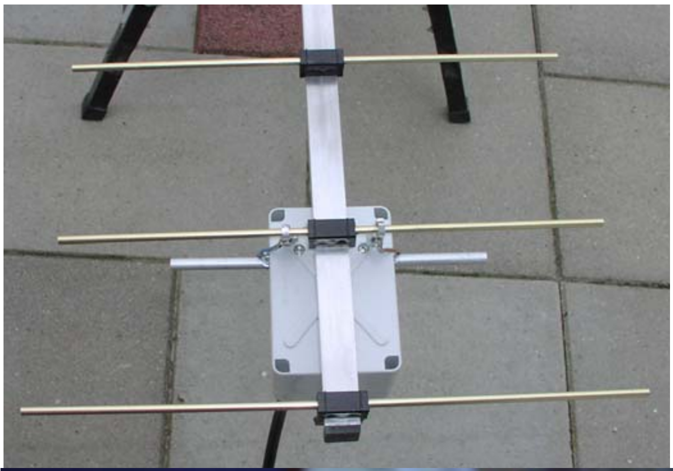
The choice of a hairpin matching circuit allows an easy method for matching a wide range of impedances. However there are several negative issues for this type of matching as well. A hairpin mach uses a small inductive short between the two legs of the dipole.
Due to this induction, the actual length of the dipole elements will have to be shorter to create a good match. The shorter elements are not an optimal transformer to the further elements of the antenna and thus a loss of energy will appear here. The hairpin between the dipole also absorbs energy which is another point of RF loss. Furthermore the impedance at the feedpoint is very low and matching became very critical. Talking to expert antenna designers, the low impedance should have been avoided to ensure an easier matching. Changing the first director position with respect to the feeder point was suggested to meet the 50 Ohm impedance (F9FT method).

Since I had already constructed all my antennas this was not felt as a good solution for my problem. I felt that changing element positions could affect the polar plot and other performances. Discussing my problem with various other hams, I was directed to the double T-matching method as an easy fix.

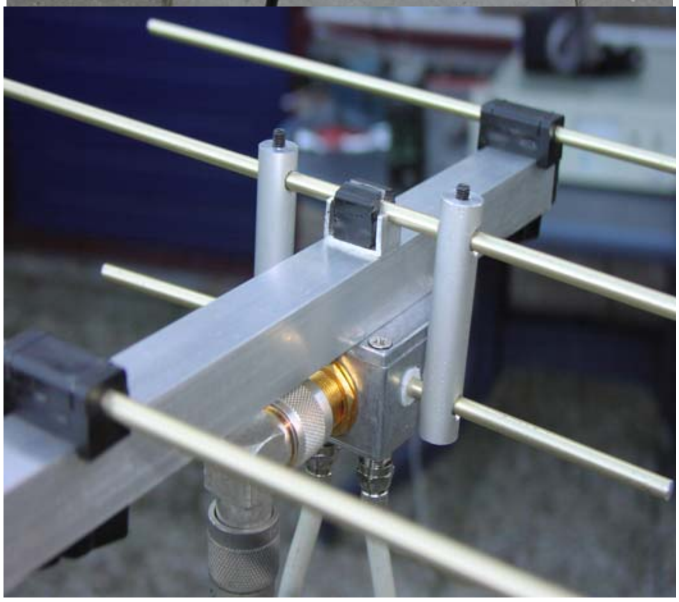
This method was used for example in the M$^2$ (Formerly KLM) yagi designs. The low impedance is transformed to a much higher impedance. Since very low currents flow, minimal losses will occur. The dipole element is designed for maximum length, which ensures maximum transfer of the RF energy.



I decided to construct another yagi, similar to my EME antenna's to run some testing for matching.

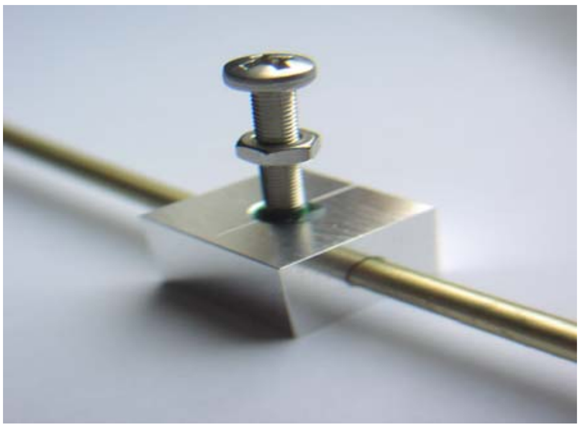


Based on the details of a double T-match for a 50Mhz antenna with almost the same low feeder impedance, a first attempt for matching was made. The length of the dipole was cut to a length which is visually in between the length of the first director and the reflector element

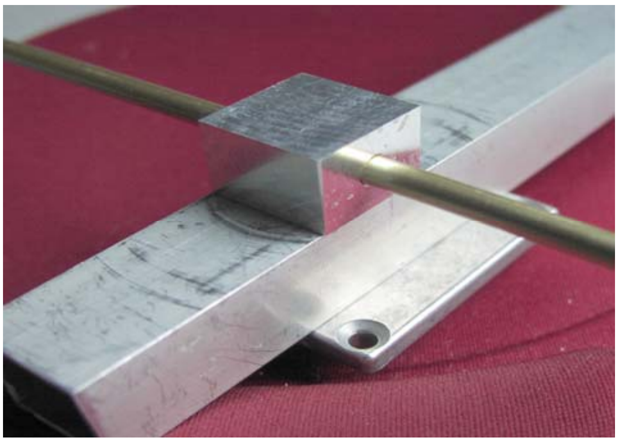


The dipole was 5mm aluminum with isolated mounting.
The parallel elements were initially 8mm diameter and mounted into a box together with a 1:4 Balun.
First tests showed the mounting box was too large as the shorting bars couldn't move far enough towards the boom center.
Scaling the distances found on the 50MHz yagi its matching point should be 2-3cm from the boom center. For this reason a new smaller mounting box was prepared allowing close to the boom adjustments. Also the parallel elements were changed to 5mm diameter. After testing the new configuration, asymmetrical positions of the shorting bars were found, while a good matching point still was still not achieved.

***The asymmetry was caused by the fact that the dipole center was isolated from the boom, allowing zero point floating. After changing to conducting block mounting, adjustments now were symmetrical.***



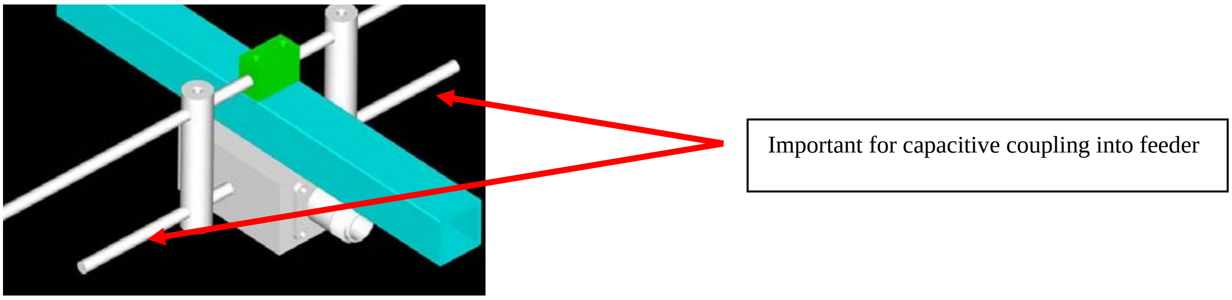
New Mounting block



Completed assembly including cover of box

Some experiments were conducted with the length of the Balun. This seems relatively non critical, even the impedance of the piece of coaxial cable did not seem to be relevant.
Using small pieces of aluminum foil, wrapped around elements an easy adjustment could be done to see what happens without cutting elements.

It turned out that the length of the parallel elements do heavily influence the total performance. Finally I had to cut 30mm of each parallel element to find a good matching. (Forward 75W // Return < 0.1W).



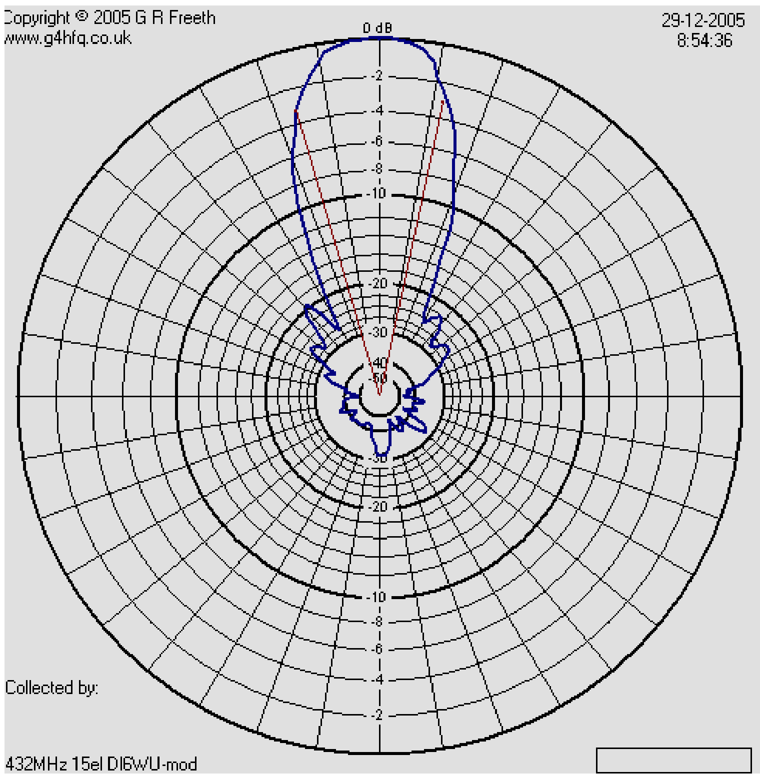

In its final configuration the antenna shows VSWR influences from the environment. Even touching or approaching the very first director could effect changes to the VSWR. With the hairpin construction I never noted such an effect.
To me it seems all elements now affect the total performance of the antenna.
Having found a good match now, the last concern was the possible impact to the antenna diagram.

**Antenna Diagram**

In order to check out the antenna diagram, I was able to test the antenna in a full anechoic EMC test chamber. The antenna was mounted about 2.5m above the absorber floor on an antenna rotor system, while a reference antenna was located about 4m away from this position. A spectrum analyzer in zero-span mode, connected to a plotter was calibrated in dB steps.
For gain estimation a dipole replaced the test antenna and its value was noted on the plot.
With the help of POLAR PLOT freeware [www.g4hfq.co.uk](http://www.g4hfq.co.uk) the figures found were converted into an antenna plot diagram.
The resulting diagram and gain compares to the values found in the YO software. The antenna diagram shows a clean diagram free from large sidelobes and a good front to back ratio, which all is essential for EME operation.

At 130 degrees a larger sidelobe was shown, which could not be explained immediately. It was generated by the antenna, as we ran another test with a different set-up in the EMC room to ensure chamber effects are avoided. So far it is assumed this lobe could be caused by the fact that the directors of the antenna are not all properly centered on the boom.

Recently I found that the isolating mounting supports were not always in the center of the elements. Unfortunately I had no chance to prove this by redoing the measurements.
Since this sidelobe is at a -30dB level compared to the mainlobe we should not be concerned.



Teflon spacers are used to guide the dipole elements trough the box.

The Balun is prepared from 75 Ohm satellite TV coaxial cable fitted with F- connectors.

The center pin of those connectors act as a mounting support for the dipole elements.

## Final notes

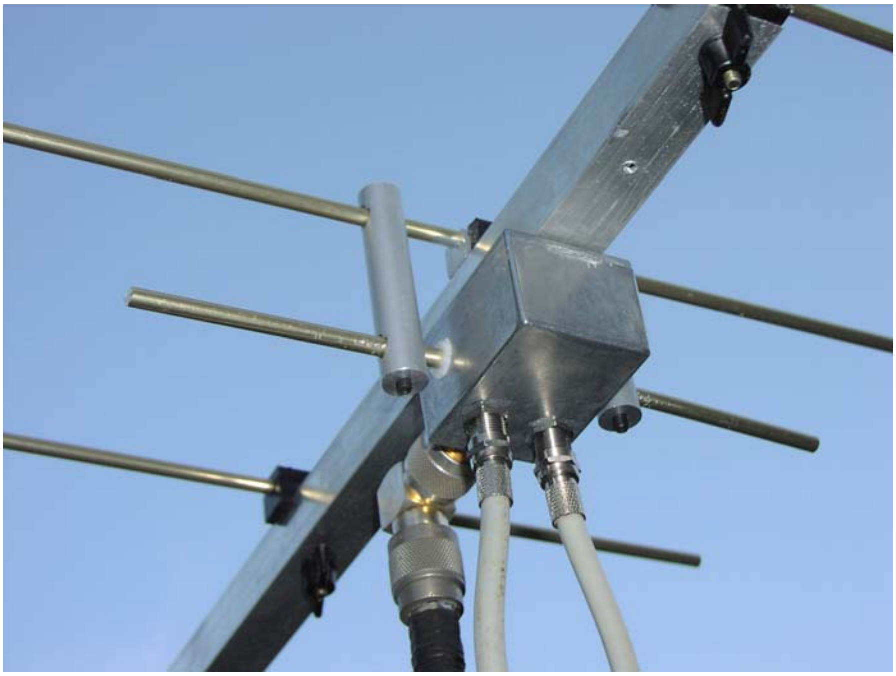
During my experiments the following observations were made:

1. Dipole/feed method doesn't influence the antenna pattern
2. Balun coax is not critical in impedance
3. Wrapping household foil is an ideal method to find effects of element lengths
4. Double T-match is a very low loss and effective matching method
5. Be aware of capacitive coupling effects at 432Mhz.

## Thanks to

The following people contributed in the above experiments:

K2RIW
PA2V
DL9KR
DL6WU
PA0JCA
PA3BWK
PA7JB
K6MYC
G4HFQ



**Final version**

*Worth a click:* **A trio of good sites for data sheets** on semiconductors, either current or obsolete:
http://www.datasheetcatalog.com/ http://www.alldatasheet.net/ http://www.datasheet4u.com/

## KNOWN POSSIBLE LONG DISTANCE VHF/UHF PROPAGATION IN AND FROM VK4

Prepared by **Doug Friend VK4OE**, with the assistance of **VK4AFL, VK4TZL and VK4ZQ**

**"Working the DX"** (i.e. making reliable communication with stations a long distance away) has long been an important component of our great hobby. Not everyone wants to work DX on VHF/UHF frequencies but, when you get close to it, pushing the limits of distance way past 100 kilometers is very very satisfying. What is a DX station depends on where you are located yourself. It also depends on what is generally considered easy to achieve on the band you are using. In the VHF/UHF realm, any path more than line-of-sight from where you are, is usually considered to be 'DX'. [In the microwave realm finding long line-of-sight paths is the order of the day, until special propagation conditions occur!]

The early years of amateur radio focused mostly on HF propagation with only a few amazing experimenters delving into the realms of 56 MHz and 112 MHz. In those years, getting anything going was an achievement in itself and some long distances were worked when Sporadic E ("$E_s$") or tropospheric ("tropo") conditions allowed. The last thirty or more years have seen enormous advances in the technology of both VHF/UHF components and antenna design which has enabled ever so much longer DX paths to be worked by other modes of propagation, through more power and an increased ability to hear weaker and weaker signals. Many more bands are available too, with greater and greater difficulty of working long distances as the frequency rises.

There are several different possible modes of enhanced propagation both within the state of Queensland and extending Interstate and out into the Pacific. Wherever you are, it's really exciting when the band opens and that there are stations at the other end to work! What follows is a summary of propagation that is known by the author to have happened at one time or another involving VHF/UHF stations in VK4. Note that:

- Queensland is a large state with a large population centre in the SE corner
- Most mountains/high hills are located along or near the Main Dividing Range roughly dividing coastal areas from inland areas
- The coastline is long and roughly straight with several provincial towns where significant population numbers reside
- There are numbers of smaller provincial towns in the vast, relatively flat inland area
- Queensland has both tropical and sub-tropical latitudes
- Queensland borders VK2, VK5 and VK8
- Adjacent countries/call areas with tropospheric propagation potential are: ZL; P29; YJ8; FK8; H44 and propagation to several VK9 islands is quite possible

### The 50 MHz Band

Within Australia, **Sporadic E** (single hop or multiple hop) is the dominant mode of DX propagation for this band. This generally occurs from approximately November through the Summer months to approximately the end of February, with a smaller Winter peak in late June/early July. As the name suggests, it occurs sporadically (i.e. not consistently) and attempting to forecast it has absorbed many amateurs' attention (professionals too!) for many years.

**$E_s$** signals can vary from weak to very strong. Weak $E_s$ openings are usually associated with long paths, e.g. stations in North Queensland may contact VK3, VK5, VK7 or ZL stations. But as an opening develops and the E layer ionisation becomes stronger, shorter and shorter paths are worked. 50 MHz can be wide open to a large area for many hours, or it can be a fun and fickle chase to work different parts of, say VK3, as the ionised area moves around and changes the way it reflects the signals back to ground. [Short 50 MHz $E_s$ is a good indicator of there also being an opening on 144 MHz but, more about that in the 144 MHz section of this review.] Double hop $E_s$ is relatively common on six metres, at times enabling paths right across the country and beyond.

**Ionospheric F2 propagation** enabling (amazingly!) around the world contacts occurs in the years close to peaks in the sunspot cycle and the chancy nature of this has led to 50 MHz being known as "the magic band". It's rather like a more exciting and fleeting version of what happens on the 10 m HF band at these times!

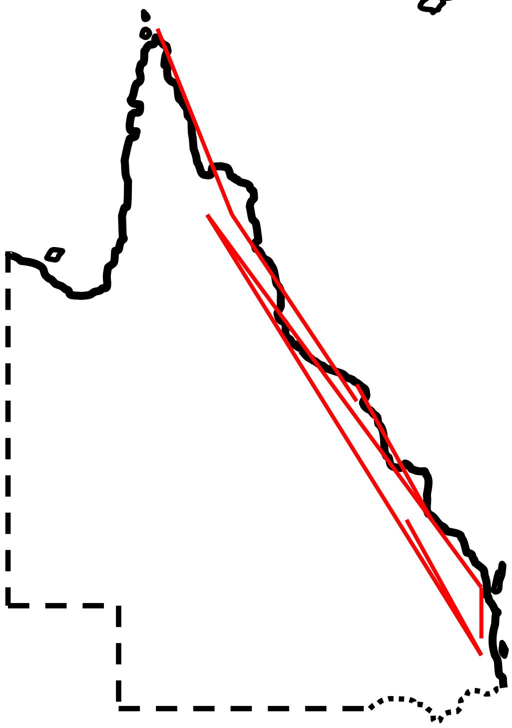
**Transequatorial** ("TEP") is a 'normal' propagation mode particularly for Northern VK4 stations enabling JA, HL, BY, RU and other Asian countries to be worked in the weeks (and sometimes months…) surrounding the March and September solar equinoxes. This is because the geometry of the path requires two reflecting bodies of high atmosphere ionisation to be located in the right place which, in turn, occurs around the times when the sun is close to halfway between Summer and Winter. Propagation paths from different parts of VK4 are generally to 'matching' areas that are approximately orthogonally North and South of the geomagnetic equator and approximately equidistantly North and South of it. So, the parts of Asia that are most commonly worked by Mt Isa, Rockhampton and Brisbane stations are generally different, although on this band there can be quite a geographical spread. That TEP varies in strength and favoured area provides exciting variations to what could otherwise come to be regarded as normal 'local' contacts (which are, in fact, over many thousands of kilometres!) The adjacent map indicates some of the known paths worked by TEP on 6m.

**Tropo** is in there as well for six metres, but it's not so well explored because the other propagation modes achieve so much longer QSO paths. Nevertheless, compared to 144 MHz tropo, 50 MHz tropo seems to allow contacts to happen better over the hills and dales. And 50 MHz tropo is possible to Pacific islands by over-the-water ducting – the only problem is that it is not well explored and/or reported.

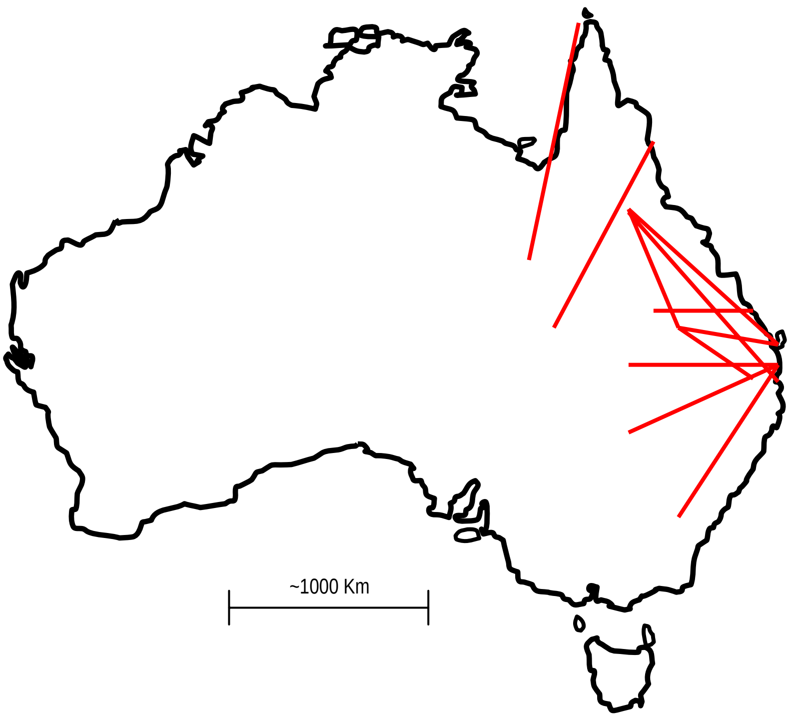
## The 144 MHz Band

All of the following are known propagation modes for this band:

- Coastal Tropo
- Inland Tropo
- Pacific and Tasman tropo
- Sporadic E
- Aircraft Enhancement
- Meteor Scatter
- Trans Equatorial Propagation (TEP)



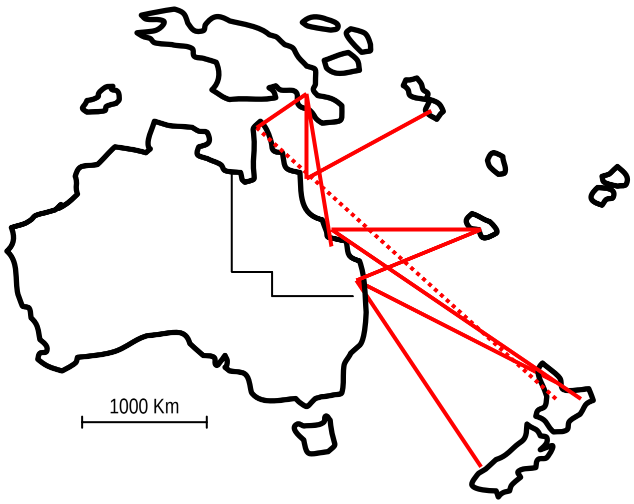
**Coastal Tropo** on 2 metres obviously can be to the North or to the South of wherever you are located. The adjacent map shows the extent of the paths that have been worked within Queensland, which is actually right up and down the Queensland coastline.




To the South, when there is a coastal tropo opening, stations are frequently worked well down into NSW, with the most distant known to be to the Wollongong area South of Sydney. (No map illustrating this point.)

**Inland Tropo** on 2 metres, both within and beyond VK4, can be and has been quite extensive at times. A map of the whole country is the only way to do justice to what is known to have been achieved.

**Pacific and Tasman Tropo** has extended at times to ZL (both North and South Islands), FK8, YJ8, H44, VK9 and P29, as demonstrated by the adjacent map. Different parts of VK4 have been involved at times, but this propagation is not always to the same area each time it occurs.

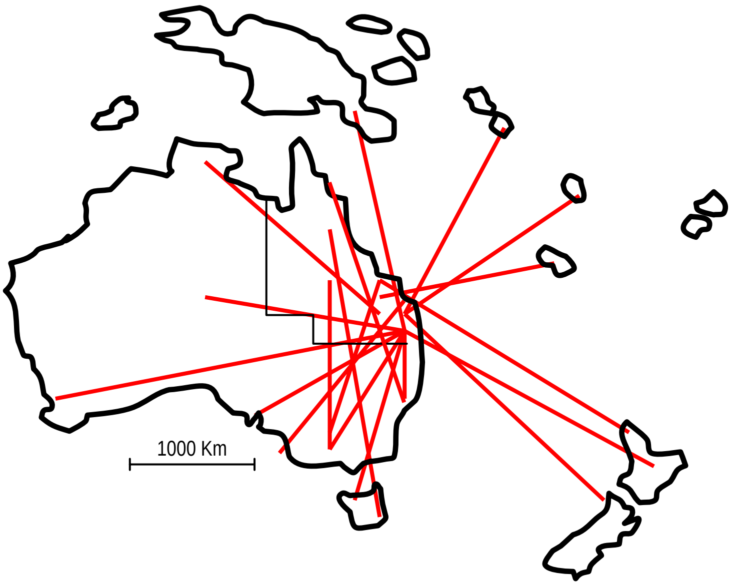



This propagation occurs most commonly in the warmer months when there is a strong slow-moving high pressure system centered off the Queensland or NSW coast, with an appropriately shaped extended ridge that facilitates formation of the duct that allows propagation to occur over such long distances. Signals can be from weak to very strong, even over 1000 and 2000 Km paths. Of course, VK2 to ZL has a higher frequency of occurrence than between VK4 and ZL, but we in VK4 usually enjoy this once or twice per year.

The dotted line represents one report from a VHF-interested amateur (VK4ACG) who lived on Thursday Island for several years who often used to work stations down the Queensland coast (see the coastal tropo map) who reported also hearing signals from New Zealand from time to time – no QSO's, only received signals!

**Working Sporadic E** ("$E_s$") propagation on two metres is a very exciting activity. This is due to the chance nature of 2 m $E_s$ openings and the often fleeting way that propagation occurs to any one location (much more fickle than on six metres). However, it can be that propagation remains strong to one area of the country for an hour or two, or even longer – wow!

When E layer ionization that enables 2 m $E_s$ propagation is weak, $E_s$ is over long distances, say Northern VK4 to VK7. As ionization gets stronger the signals become stronger, paths worked get shorter and shorter and the area(s) covered become broader. In a good opening it is not uncommon for Southern VK4 stations to be able to work VK2, VK3, VK5, VK7 and Northern VK4, sometimes some of them at the same time. Openings to VK8 are governed more by the number and activity of VK8 stations on the band.




One report is known of a double hop $E_s$ contact with a VK6 station (VK4ZQ some years ago). At that time there was extensive Eastern state $E_s$ and there was also some VK5 to VK6 $E_s$ propagation around. These two happening together on this band is a rare occurrence!

As mentioned in the 6 m section, predicting 2 m $E_s$ from 6 m $E_s$ is possible by gauging the shortening of 6 m 'skip' distances. If you can hear stations loudly on 6 m from, say, 300 or 400 or 500 Km away, the ionization is probably becoming strong enough for 2 m propagation. This may involve the stations in question but, more often than not, 144 MHz will be starting to open over a longer path from somewhere else to somewhere else, like N'thn VK4 to VK7. In these circumstances anything can happen so you have to be on the air, listening and calling to get results. And short snappy QSO's are the best strategy here – the band can open and then close again whilst a long call is in progress!

**Aircraft Enhancement** of DX signals on 2 m is well established as an operating mode. The place that propagation favours is the result of regular flights by commercial passenger jets along well-established paths, usually between capital cities. Maximum DX is around 1000 Km due to the typical altitude at which the aircraft fly and the geometry of the way signals are reflected. Periods of reflection can be from about 30 seconds to about ten minutes, and successive aircraft on the same path can make an opening seem longer. Best distances known are from Hervey Bay (VK4TZL) to Sydney (VK2ZAB et al.) with shorter distances more common, say between Brisbane/Toowoomba and VK2 stations North of Sydney.

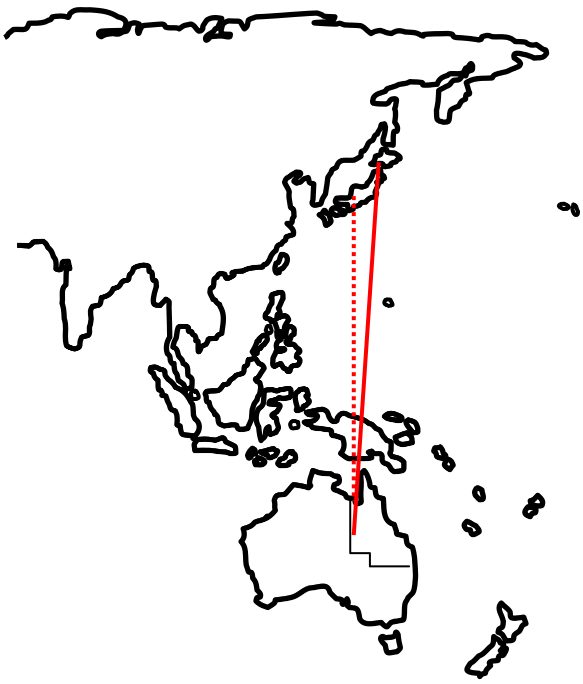
An aspect of aircraft enhancement that hasn't been much explored is the presence of reliable paths within VK4, due either to internal VK4 flights or international flights to or from Asian destinations as they pass over VK4. From a portable location near Stanthorpe in S'thn Qld, the writer has experienced short contacts at the same time of the day with a station (VK4LE) who used to be very active from a property East of Springsure.

**Meteor Scatter** ("MS") on two metres used to be a tricky and challenging exercise, except during meteor showers. There are random meteors arriving from space and burning up in the earth's upper atmosphere all the time but, from time to time, earth passes through a patch of cosmic dust that is the orbit of one comet or another, leading to what is known as a meteor shower. As each meteor burns up, a trail of ionization is produced which may be strongly or weakly ionised, depending on the size of the rock, its direction and its speed relative to the earth itself moving through space. The visible meteor trails we may see at night are fewer in number than the number of 'burns' that enable VHF radio propagation and, whilst it is not often pursued, this propagation mode is more reliable on 6 m than on 2 m. Some signs of reflection have been reported from Europe on 70 cm but two metres is the main band where MS is practised. The tricky and fast-talking older ways of running contacts have given way to computer assisted methods and numbers of VK4 stations participate in MS propagation at times.

Have you ever been listening to the national 2 m calling frequency and suddenly, out of the white noise, up pops a half or one second burst of voice from interstate? Well, just imagine what it may be like during one of the big meteor showers. The writer well remembers the early hours of one week-day November morning a few years ago when the Leonids were predicted to be the best shower that Australia has ever experienced. Truly, the low end of 144 MHz was like 20 m usually is on a Sunday afternoon, with many VK3, VK5 and VK7 stations audible from Brisbane, all due to reflections from multiple meteors and some of them obviously large with long lasting radio reflections. And this was 4 a.m. to 6 a.m. on a week day morning!

The normal extent of what's possible here is governed by the typical height at which meteors burn up and produce their ionised trails. Paths that are approximately North-South are more likely than other directions. Thus, from VK4, the range on 2 m is usually limited to VK3, VK5 and VK7, and early in the morning (unsociable hours for some!) is the most productive time of day. It's interesting that, due to the location of earth in our solar system and our galaxy, the Northern Hemisphere gets many more openings than we do down South.

**Trans-Equatorial Propagation** on 2 m is an amazing extension of what is more easily achievable on 6 m. The only 2 m TEP contacts that have been made from VK4 were conducted several years ago. By way of example, the national record for a 2 m DX contact is VK4BFO in Mt Isa to JI7DMB in Hokkaido, N'thn Japan by TEP propagation on 15/04/91, a distance of 6763 Km, the solid line on the adjacent map.



Steve, VK4ZSH and Allan VK4KAZ (now VK4EME) paved the way during the 1980's by exploring what's possible by TEP from places close to the Gulf of Carpentaria (Cloncurry) to JA when there was good 6 m TEP present (the dotted line).

2 m TEP propagation paths are more strictly defined by their geometry North and South of the geomagnetic equator. Steve has always said that there will continue to be opportunities for exploring TEP paths over longer distances by placing oneself in the Western Qld outback at places that match even more Northerly population centres on Hokkaido island in Japan.

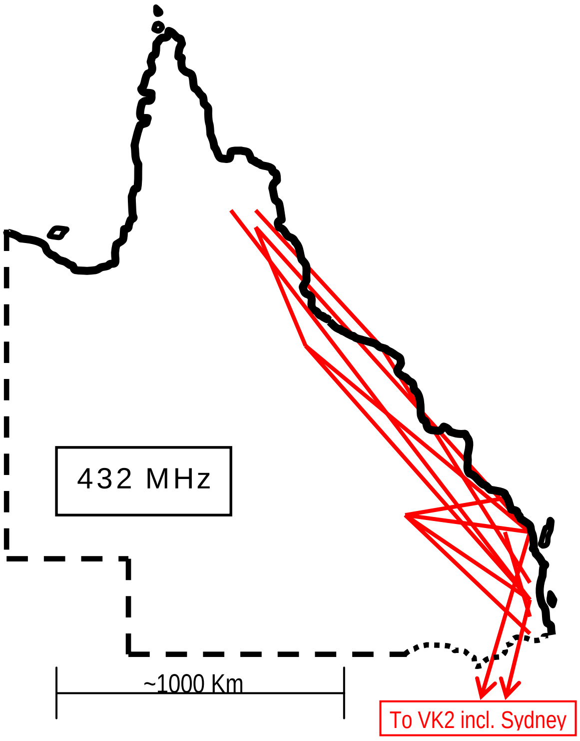
And on a related tack, VK8 stations in the Darwin area often are in contact with Southern JA stations on 2 m, usually working them using FM as though they are locals!

[Note that this is still a path strictly orthogonal to the geomagnetic equator, just at a more Westerly longitude.]

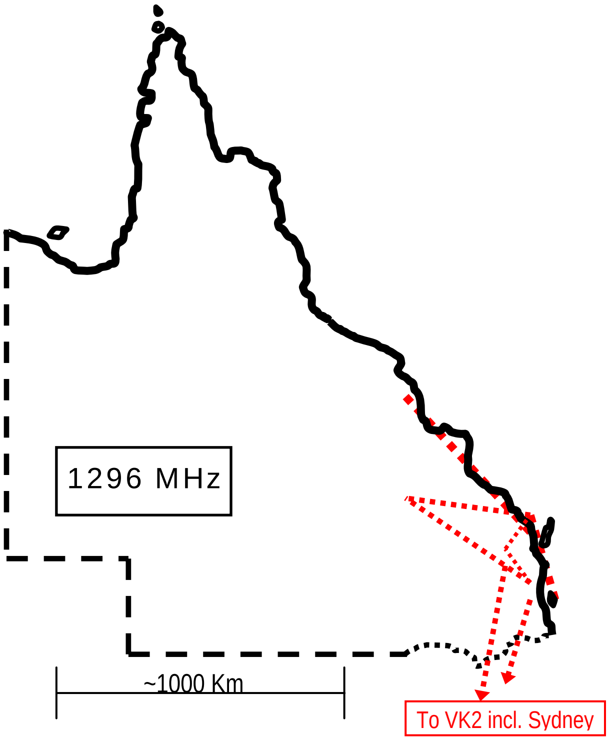
## The 432 MHz and 1296 MHz Bands

The following are known propagation modes for the 70 cm and 23 cm bands in/from VK4:

- Coastal Tropo
- Inland Tropo
- Pacific and Tasman Tropo
- Aircraft Enhancement

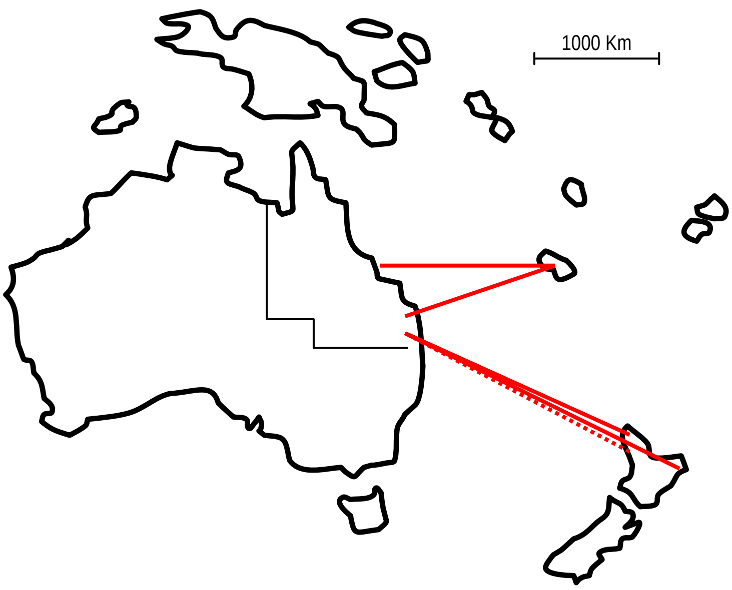



The essential difference between these two excellent UHF bands is that it is somewhat harder to work long distances on 23 cm than on 70 cm. However, it is possible to achieve higher 23 cm antenna gains in the same space than on 70 cm, so the 'gap' between them is not as wide as it might be. Presently in VK4 there are a growing number of VHF/UHF amateurs with weak signal working capabilities and several of these are located at strategically interesting distances along the coast. Interest in 23 cm in VK4 is gradually increasing!




The range covered by Coastal Tropo on these bands follows the same pattern as 144 MHz, only the distances achieved are shorter, plus there are somewhat fewer stations activating these bands. However, Inland Tropo ducting seems to have different characteristics and, as has been found in Europe on many occasions, going higher in frequency can lead to stronger signals. On both bands, many tropo contacts have been had down into VK2, but aircraft enhancement is the only way Sydney has been worked from VK4 on 1296 MHz.

When looking at what has been worked from VK4 across the Tasman, the adjacent map reveals much. In this map, 70 cm contacts are indicated by solid lines and the 23 cm path by a dotted line. VK4 to ZL is known to have been done on 23 cm by only two stations, and those were both in elevated locations, one at Maleny on the Sunshine Coast (the current VK4 distance record) and the other portable on Mt Coot-tha in Brisbane. Of course, VK2 to ZL on these bands is more frequent than from VK4.




**Future articles in this series will look at:**
(a) predicting tropo openings from BOM surface pressure charts, the Hepburn Tropo Prediction maps, and other useful weather data;
(b) portable versus home station operation;
(c) SSB versus FM for working DX
(d) microwave DX in VK4
(e) digitally enhanced contacts.

# They made it!

# YES it's QRP EME

On the 6th Sept 2006, Trevor VK4AFL and Rex VK7MO had their first confirmed QRP 1296MHz EME WSJT QSO. The improvement from the earlier 10 watts down to 5 watts and now **3** watts, was a result of the new "Super VE4MA Feed" with a septum polarizer that Rex had installed, as well as good moon conditions with the degradation close to the best possible.

When asked if they would now try for QRPp (500 milliwatts), Trevor replied: ***Rex & I have called it a day re 3w & will rest on our laurels.***

Damb good effort from the two of you and congratulations from all of us on a job well done!

**Trevor VK4AFL 3.7 meter TV Dish**

**Rex VK7MO 2.3 meter TV Dish**

# EME WITH SIMPLE ANTENNAS & EQUIPMENT

From an interview with **PHIL VK4CDI** (Toowoomba QG52xh)

*Phil, you were quite involved with ham radio a few years ago, especially with 6 meters, but gave it away for a while, and then came back with EME contacts. How did that happen?*

After being QRT for 25 years, the bug bit again and I assembled a small station. My main interest was always VHF, and before I went QRT, I had been assembling a 432 MHz moon bounce station.
The new station was put together with this in the back of my mind. 144 MHz consisted of a Kenwood TR751A and a 10 El DL6WU yagi, and John VK4TJ loaned me a 170W Brick amplifier.

*So you put up the beams, then what?*

After many wasted hours trying to get the antenna to tune, I decided to scrap it and build an 11 Element K1FO (ARRL handbook). The old boom wasn't long enough, so it became a 10 El, which still worked first time. I used this combo to work several VK2's on the AE net in the mornings. About the same time I heard about the WSJT software from Joe Taylor K1JT, so I downloaded and installed it, and started to learn how to use it. I heard that EME contacts with some of the 'big guns' were being made on 2Mx with single yagi's and 100W

Original antennas

*So with the antenna now working well on 144 MHz, what did you do next?*

I found out who the biggest station was, and made a sked with Dave W5UN. Come sked time, I pointed the antenna at the moon, set my computer time against WWV, and tuned to 144.129 MHz. Sure enough, a large spike appeared in the waterfall display of the software, and at the end of Dave's first 60 second transmit period, WSJT decoded VK4CDI W5UN EM23. As per the WSJT operating procedure, I replied with 'W5UN VK4CDI QG52 OOO'.

Unfortunately, Dave did not copy me at all for the whole 30 minutes of the sked, while I copied him every period, with his signal peaking at -13dB, speaker copy! While a complete QSO was not made, I was thrilled to even see, let alone hear, a signal. Another sked was made and several days later at 1am in the morning my first ever EME contact was completed.

*Were any more contacts made with the single antenna?*

Over the next 4 months 8 more contacts were made with most of the big guns, giving me 7 countries and 2 continents.

*All this on a single antenna with a what…5 Meter long boom? Any elevation? What type of feedline?*

4.8 Meter boom with no elevation, RG213 feedline.

*Does the lack of elevation matter?*

Well, with EME you actually get some gain when using elevations less than about 10 degrees. At my QTH I can get moonrise at around 6 degrees, and moonset down to around 2 degrees.

*No problems with noise when beaming across built-up/Industrial areas?*

Not from my QTH, although I do get severe power line noise at times.

*So what was the next step?*

Over this same period, plans were underway to improve the setup by making a masthead preamp. A tube linear was also constructed, and two 11 Element K1FO's were built and installed on a 6 Meter TV pole, manual rotation.

They were stacked vertically for ease of installation.

*How did the pre-amp and linear work?*

This is when I learned of my ability to make oscillators. It didn't matter what design or GaAsFET I used, it always turned out to be an oscillator, so the brick preamp was still going to be needed. Because of this, the tube amplifier was not brought on line as I didn't want to mix things up when it wasn't my brick!!

*How did the antennas work?*

After the 2 new antennas went up, there was a noticeable improvement in stations I could copy, and the first weekend with the new antennas provided 3 contacts, one of them country number 8. Over the next six months, 3 more countries and one continent were added to the list, with several more seen but not worked. This period included participating in one weekend of the ARRL EME contest, ending up with 5 QSO's on 144 MHz and 1 on 432 MHz.

*Was the 432 MHz contact with a single antenna?*

Yes, a K1FO 22 element on a 5 meter boom, RG213 feedline

*So what was the next evolution?*

The antennas needed to be stacked horizontally to get the maximum benefit from them, and while I was investigating mounting methods, it became apparent that if I was going to make any sought of H frame, I may as well mount another 2 yagi's on it.

This where I am today.

All K1FO Yagi's
4 x 12 element for 144
2 x 22 element for 432
No elevation control

4-50 Heliax on 432
LMR450 on 144

All with LMR400
phasing lines

Preamp ready to go up the mast, assuming the sequencer works and I don't blow another GaAsFET

But that's another story……

*So what's the total number of stations worked as of November 2006?*

On 144 MHz, 45 stations, 41 grid squares, 19 countries and 4 continents worked, with a further 30 stations, 20 countries and 2 continents heard. On 432 MHz 7 stations worked, 4 countries, 3 continents.

*What's the next change?*

Well, I just bought a new Kenwood TS2000 to replace the IC 706

*Why?*

The 706 was suffering around 40 Hz drift during a 432 EME QSO and didn't quite have enough output on 432 to properly drive my amp.

*So would you recommend anyone with a single antenna and 100 watts to try EME?*

Definitely

*Well thanks Phil for a look at your setup and for sharing your experiences with us, I'm sure you will give many of us some confidence to have a try at EME in the future. - Graham*

*Worth a click:* **BAMA – The "Boat Anchor Manual Archive".** Free pdf's of technical manuals for amateur gear and test equipment of yesteryear. Thousands listed!
http://bama.sbc.edu/

*Worth a click:* **24,000 Project Schematics!** This site claims to have links to over 24,000 small electronics projects in every conceivable category. No, I haven't counted them to see if it is true…
http://www.electronicsinfoline.com/

*This article was part of an excellent series of articles written by Alan Gibbs VK6PG and was published in Amateur Radio Magazine (WIA) circa 2000-2001 the original article (Part 19) can be downloaded from Ham Shack Computers Web:* http://www2.tpg.com.au/users/vk6pg

*Quite a few of our readers will have seen it before but I feel it is one of those reference pieces that is so very useful that no shack should be without it. – Thank you Alan for such a quality piece.*

# HAM SHACK COMPUTERS

By **Alan Gibbs VK6PG** vk6pg@tpg.com.au

## Computer Noises

**Adding a Ham Shack Computer opens new opportunities in the field of Amateur Radio – especially automation and access to the newer digital modes. However, the RF noise generated by computers can be so great that it destroys the enjoyment of the hobby. This article offers some simple tips on how to diagnose and minimise these "buzzing noises" down to a tolerable level and renew your enthusiasm in AR once more!**

Listening on any HF Amateur band, "buzz-saw" and other spurious noises (birdies) can usually be heard all over the spectrum. Some noises wander around slightly whilst others are wideband. Switching off the computer reveals a nice quiet band, and with the computer on, and the monitor switched off other spurious signals might be revealed. Some experiments must first be made to determine if the interference is coming from the computer, monitor, or both. In most cases you will never completely remove all the problems, but most attain levels below operating annoyance.

Computers are complex digital devices with a myriad of switching waveforms containing high levels of harmonic content. Square waves are everywhere, and in particular, monitor displays where switch-mode power supplies and high intensity line and field drive signals radiate intensely. Plastic monitor cases are useless in screening out these interfering waveforms. The object is to operate both the receiver and computer with a minimum of mutual interference. Start by listening with the receiver connected to the station dummy load, then with each antenna in turn.

If spurious signals are evident with the dummy load, then severe problems exist, and this is where you should start first. Be prepared for some intense detective work but in the end you will succeed. The following steps can be each tried until the interference has been reduced to an acceptable level. There are no guarantees because every computer and shack installation has its own characteristics. However, the assertive RA will win given patience and an inquiring mind.
Spend time tracking these "birdies" by drawing up a paper chart showing where they occur on the receiver dial, and whether they occur with the monitor on or off, and with which antenna etc. Once the extent is known try the following techniques in turn until the station is fully operational with the computer working normally.

**1.** Make sure you have installed a proper station ground connected to a copper earth rod just outside the shack. The rod should be driven into the ground to at least 1.5 metres. Use thick coax braid to connect the rod to a common terminal in the shack, and each item of equipment is linked to this one terminal. The more copper in the ground – the better the signal earth will be, and your station will perform better anyway!

**2.** Install an earth terminal to the computer chassis and connect to the shack earth terminal. Check for "birdies" again which should now be somewhat reduced in level.

**3.** Check with the monitor switched off. If problems exist in the monitor fit an earth terminal to the monitor chassis and connect with coax braid back to the station earth. This should further reduce the problems.

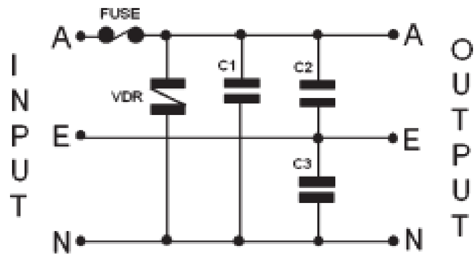
**4.** Make sure ***ALL*** your shack apparatus is connected to the common station earth with thick coax braiding covered in cheap black flexible reticulation pipe to prevent further noise by chaffing on adjacent radio equipment.

**5.** If the monitor suffers from severe radiation, remove the plastic case and carefully cover the inside of the case with aluminium kitchen foil. Contact adhesive dabbed on with an old paintbrush keeps the foil in place, use a second brush to push the foil into the profile of the case, but make sure that the foil is kept in one piece to maintain electrical conductivity over the whole area. Once done, drill through the case rear - fit a 3mm round head bolt, solder tag, serrated washer forming a solid earth connection. A short length of insulated black wire is added between the solder tag and the metal chassis of the monitor. Before assembly, check that the foil is clear of any circuitry and final re-assembly is safe. Once done, check for "birdies" again. You should be pleasantly surprised at the reduction of radiation, and the effort taken will be well worth the time consumed.

**6.** Once assembled, check the levels of the spurii again from your previous readings. Levels should be lower with some that are now well below the receiver noise floor. However, tests should now reveal antenna or mains born spurii. Connect a short length of RG58 coax to your receiver and terminate the far end with a 10-turn small loop of hook up wire. Use this "snoop loop" to move around the computer to determine where further problems are sourced. *(Using Spectran/DigiPan waterfall via your soundcard interface during this operation also helps greatly - Graham)*

**7.** Mains born radiation can be minimised by fitting clamp-on Ferrite Suppressors (DSE D5370) to the mains input cables nearest to the computer AND the monitor. Try another on the monitor VGA lead.
In severe cases, DSE (D5350) Antenna Balun Toroids wound with several turns of the power cable have also proved successful. Unfortunately the power plug has to be cut off so that the cable can be wound around the toroid to fill the centre hole leaving enough cable to terminate a new power plug. If no success, fit a new cable and use the modified cable on another device until the noise source is identified.

**8.** One of the most successful cures for mains born interference is to fit the following filter INSIDE the case of each piece of shack equipment: C1, C2 and C3 are 0.01mF 3kV ceramic RF bypass capacitors (DSE R2400) and the VDR is a Metal Oxide Varistor (DSE R1802) used to clip high voltage spikes. Fuses are recommended just in case the VDR breaks down under severe conditions. The whole assembly is constructed on a 3-lug, large tag strip (DSE P4804) and mounted inside the equipment near to the mains input wiring.



MAINS FILTER

This modification is vital in rural and mining areas where the supply voltage varies dramatically – and is essential where the so called "double insulated" plug packs are used with two-pin, figure eight cable – and NO EARTH is common. The writer has fitted many of these devices to electronic equipment in regional areas with huge success where the devastation was rife – especially with laptop computers that "floated above earth"!

**9.** Laptop computers have lower radiation due to the nature of flat LCD screens. However, they still suffer from "leaky" plastic cases and may be fed with internal "double insulated" two-pin mains cables. Earthing can be a problem but can be overcome by fitting a DB9 metal back shell (Jaycar PP0800) to an unused comport connected by insulated coax braiding to firmly ground the metallic case to the station earth.

**10.** TNCs, test gear, low voltage power supplies, clocks and other devices should also be checked with the receiver "snoop loop" to ensure that each device and any interconnecting wiring is not adding to the overall "birdie" problem in and around your shack installation.

**11.** Once the suggestions offered from 1-10 have each been tried, the next area will be your antenna installation. Operators with towers, rotators and big beams installed away from the operating position will be much better off than those with long wires, verticals and roof mounted antennas. Spurious radiation from unscreened rotator cables (check the rotator manufacturers' circuit diagram first to avoid error) can be minimised by fitting 0.01mF 3kV Ceramic bypass capacitors (DSE R2400). Fit the same mains filter described in 8 to the rotator power unit and ground the case by replacing the power cord with an approved 3-core cable.

**12.** Ensure that towers, masts, feeders, catenary cables and other metal objects are all firmly grounded to prevent them from re-radiating spurious "birdies" emanating from your computer(s) and other RF devices. Make sure that any antenna tuners are also firmly grounded to the station common earth system. By now your computer should be very quiet indeed, and you have gained the advantage of a more efficient Amateur Radio Station. However, in very difficult cases, some monitors are dreadful radiators! Try swapping monitors with a friend. Some can be very good, whilst others with "Low Radiation" clearly visible on the front panel can be pathetic and a mockery of modern EMC standards. Some of the better brands can be the worst radiators of spurii in the AR shack. Fortunately, desktop computers are still made in metal cases and can be properly earthed. Sometimes a poorly bonding case with badly fitting lids, sides and front panels may need to be "linked" with hook up wire to avoid radiation. If building your own computer, choose a high quality case with slotted sides and bonding strips. Ask your dealer for a peep at the inside of the case before purchase. If the lids and sides just screw together over painted metalwork – be very suspicious and move on to another dealer.

**Summary** Most of the common solutions to computer radiation have been covered. However, there are many more to be found in EMC Handbooks from around the world. There is no one solution, and success depends upon your own vigilance and patience in tracking down these problems. Use your own experience of RFI and TVI detection and you will eventually cure the problems forever – until you upgrade to yet another new computer, Hi

The writer has three fully operational computers Ethernet linked together in the shack – all operating at once with little or no spurii on any of the HF, VHF or UHF bands. DX low level received signals are enjoyed daily. However, there are many of the suggestions from this article "hanging" around the shack wiring to achieve satisfaction. Go for it and be a "birdie detective" and enjoy the wonders of the digital age in your own quiet Ham Shack. Remember that you will not totally eliminate all the interference, but you will reduce the level to an enjoyable conclusion. Lastly, harmonics from next door's television line time-base will still be detected especially on the LF bands. Not much we can do here except make sure your antenna is placed as far away as practicable and swallow your pride!

**Ham Tip:** Never build devices like PSK31 interfaces, AF filters, ATUs, DSPs and audio processors in plastic boxes. Screen everything including speaker leads, 12- volt supply leads, electronic Morse keys and the like. If you do this, your "birdie problem" will be easier to track and cure. The DigiPan waterfall (*also Spectran*) makes a superb "birdie tracker" – just try it once and you'll never ever turn back

73s de Alan, VK6PG

*Having tried to operate PSK31 using audio transformer/optical coupled interfaces with "floating" computers, I then tried the system as described by Alan with a common earth, and guess what…no birdies with greatly increased usable range- especially when most of my operating is QRP. – Graham*

# THE SOAPBOX

You can't use that mirror, we all use smoke signals here
You can't use that valve, only spark gaps and coherer contacts are valid
You can't use AM only CW works here
You can't use FM only AM is used here
You can't use that SSB duck talk here
You can't use frequencies above 300 Meters they don't work
You can't use VHF its only good for line of sight
You can't use a Dipole only a Zepp or Marconi will do

I could keep going all day but I think you get the picture……..

There are times when despite our best intensions technology/knowledge takes a step forward and we need to accept that some of our pre-conceptions are quite frankly WRONG. Technology is normally easier to accept than human knowledge. For example the evolution of sound reproduction from Wax Cylinder-Acetate Records-Vinyl-Tape-CD is well accepted by 99.99% as being a natural progression with significant improvements in quality along the way.

When it comes to assumed? knowledge, we as humans do not have a very good track record of being able to differentiate between facts and fiction. There are still people running around believing that the Earth is Flat and that Women do not have the brain capacity to be able to vote.

I guess we all have a reluctance to accept change and some of us will vigorously fight for keeping things just as they are. I suppose it's about comfort zones and stuff like that.

My point……Well just recently at the EME conference in Wurzburg Germany a prominent Amateur was going around proposing that WSJT digital modes were the "biggest con of all time" **And the really unfortunate thing is that several other hams have been saying the very same thing.**

This writer (in a very simplified way) sees the situation as thus: The new digital modes can resolve EME signals down to a (proportional WSJT) level of circa -27 to -32 dB. CW can be resolved (by a very good experienced ear) at around -19 to -23 dB, with SSB around -11 to -15 dB. The advantages of each mode are therefore obvious.

The proponents of SSB/CW EME have found that technology has made it far easier for an average Ham with good equipment to conduct a Digital Mode EME QSO.

Now some of these SSB/CW stalwarts (and I must stress *some* not all) don't like this at all. Their attitude seems to be "It's not fair I spent X years and Y dollars building up my superior station and now Joe Average ham can do it. I had to sweat for years to be able to do it. It's just not fair"

I'll bet their attitude towards the foundation licence is very similar.

So what is the argument put forward by the stalwarts? Well it's not very coherent at times but basically it's something like this:

**It's not the operator having the QSO it's the computer**
**If you can't hear it it's not a real contact**
**And the one most quoted: All the call signs are in the Computer, it just chooses one and makes the rest up, and you probably don't even need an antenna!**

Let's look at each of these and relate them to SSB/CW practices.

***It's not the operator having the QSO it's the computer***

With all digital modes you are able to use pre-programmed macro's that can be sent at a single keystroke. Just like a Memory Keyer

Most of the EME operators (all modes) use a computer for antenna tracking/moon location and degradation calculations, so it's not the operator who is positioning the antennas, it's the computer.

Most operators (all modes) use a digital waterfall or a spectrum scope monitor screen (as in all current rig front panels) to determine band occupancy, so it's the computer doing that, not the operator.

So regardless of which mode is used, most operators utilize computers for their QSO's

*(Just as an aside, in a recent HF DX CW contest in Europe an operator set up his computer to conduct fully automatic QSO's on a range of frequencies on 14 MHz. The number of QSO's and the score obtained by the* ***computer alone*** *was good enough to place it in the top 3 in the contest.)*

So any mode of operation could possibly be "operator less" if you think about it. After all we do our telephone banking with only one human involved.

***If you can't hear it it's not a real contact***

WSJT and other digital modes all use digital processing to enable decoding to occur. SSB/CW operators use active/passive filters or digital signal processing to remove unwanted "noise" to allow decoding to occur. Either way without some signal "processing" decoding would not occur.

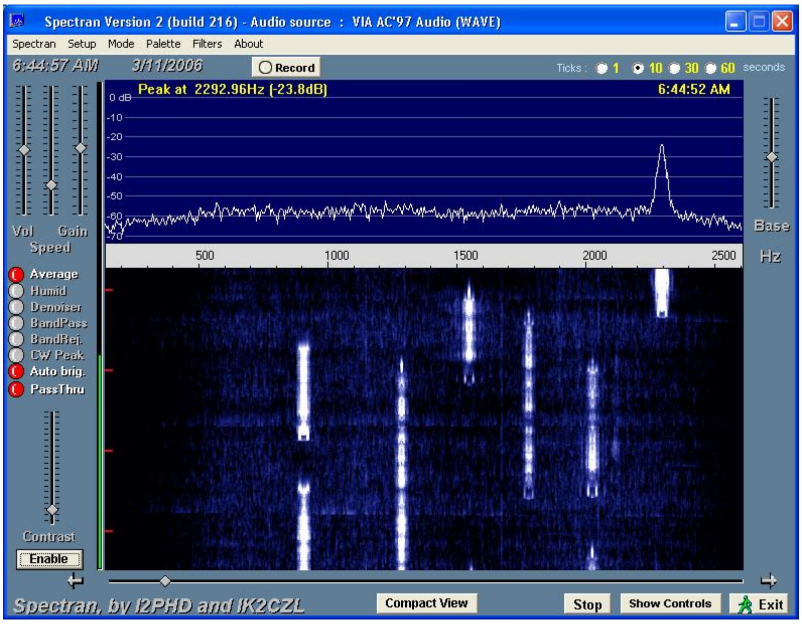
Ever listened to a DX net when the nice controller says: Jim, VK2FFFF is calling you with a 59 report, he didn't get his report, could you repeat it please? Ok, Ok, Ok. Jim, Trevor XZ4FA gives you a 59 as well. Now we know that neither station heard each other, but I'll bet QSL cards confirmed that contact.

One of my interests is PSK31 QRP on 14.070. Now you can listen on that frequency and you may hear the distinctive warbling tone and think that there is a station there. What is more likely is that there are 15 stations there, all within the 2 KHz audio bandwidth of the receiver.

Can I hear the station I am working? NO but I can see it on the waterfall. Some times there are so many stations there that I can decode 4 QSO's simultaneously within a 100Hz bandwidth. I can't hear them, I can't see them individually but I can decode them all with 100% accuracy and I have the Hard Copy to prove it.

There are 6 strong PSK31 stations on the waterfall at right, but there are also 6 other weak ones there as well. All twelve are decodable

I can probably hear 3 of them but I can decode at least 9




***All the call signs are in the Computer, it just chooses one and makes the rest up, and you probably don't even need an antenna!***

Some of the misinformed have insinuated that because a sked (or use of an Internet logger) has been arranged over the Internet, or by email/packet, then the QSO didn't really happen at all, it was all done over the Internet. This is where the "you don't need an antenna" part comes from.

The "call signs are in the computer" comes from a facility that is built into WSJT that enables a data base of active call signs of stations known to use that particular mode to be accessed and compared with calls that are decoded. If for example "W5UN" is decoded the data base can link the known locater grid square for W5UN (EM23) with the call. Another facility of the data base is that it can (for example) only allow decoding of call signs starting with a "V" to be followed with numbers 2-8 or be VE VK VP VQ VR or VU. (It knows that those are the only combinations starting with a V that are valid. It also applies to any other first letter or number combination)

If this facility is enabled (turned on) it can be used to provide a sort of filtering of "possible legitimate" call signs to occur. Once again I must stress that this facility must be turned on for this "filtering" to occur. This can be compared with using a log book with highlighted call signs, or a logger program that displays the last QSO that you had with that station, and the station details on the screen.

Unfortunately this one facility has caused the most paranoia amongst the opponents of the mode. They see it as a form of "cheating".

So looking at all the evidence, how does this writer see the situation?

*Firstly I should state my current modes of operation. I work mainly VHF/UHF weak signal and satellite modes using mainly low power or QRP. I use CW or PSK31 on HF, usually on 20 or 40 meters. I have had only 2 WSJT QSO's on VHF and sometimes use the WSJT mode FSK441 to listen in on meteor scatter in the mornings (I don't have enough power to join in) I see myself using WSJT more in the future.*

I feel that it all revolves around the ***personal integrity*** of the operators whatever mode/s of operation they choose to use on air. **Any QSO using ANY mode can be either legitimate or false, depending on the integrity of the two operators concerned.** A good example is a series of field day contacts between Doug VK4OE and myself last field day when Doug was at Taroom, 345 Km away. I knew Doug would be operating on 144.160 and 432.160 (he published these frequencies on the VHF reflector) so each period I called Doug on 144.160, we then QSY'ed to 432 for a contact there. I was only running 5 watts on each band at the time but we were able to make contact on 144 each session. On 432 however, although I heard Doug each session, he did not resolve enough of my signal on three out of five occasions for it to be deemed a legitimate contact. He certainly heard me each time, knew it was me, but neither Doug or myself deemed it to be a contact so neither of us logged it as such.

Another example is when two operators starting with high power decide to try for a QRP contact by turning down the power at each end until the lowest power to sustain the QSO is reached. The integrity of the operators decides the point of sustainability.

Whichever mode or operation is used, most operators will use the "hard copy" in a digital QSO or a digital recording with waterfall display to provide "hard evidence" that a QSO took place.

Looking at the first page in a 1971 copy of the ARRL handbook I see **The Amateur's Code**

Item 3 of 6 states: *The Amateur is Progressive…*He keeps his station abreast of science. It is built well and efficiently. His operating practice is clean and regular.

***I believe in the Amateur's code. I feel that we should all embrace new technology, or at least support and not denigrate those who endeavor to push the boundaries. - Graham VK4SG***

10 Geraldine Street, Wavell Heights
Brisbane, Queensland, 4012

# The Brisbane VHF Group

**2006/2007 Membership fees have been set at: Full Member $10**

Detach below and send cheque or money order to the Brisbane VHF Group at the address shown above.

Jason Morris VK4YOL

Honorary Secretary of the Brisbane VHF Group

Phone 07 3256 8712 JV.MORRIS@bigpond.com.au

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