# WATTS

01-2011

Year 81 + 1m

Monthly newsletter of the Pretoria Amateur Radio Club
Maandelikse nuusbrief van die Pretoria Amateur Radio Klub.



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## R7 facing storm at the retreat of Danny ZS6AW and Antoinette ZR6D at Waterberg

## In this issue / In hierdie uitgawe



## Next Meeting

Date: Wed 12 Jan 2011
Time: 19:30 for 20:00

Building #4
University of Pretoria.
S/E corner University and Lynnwood roads

# PARC Management team / Bestuurspan Aug. 2010 - Aug. 2011

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# Minutes of the monthly club meeting of the Pretoria Amateur Radio Club NB: The meeting was cancelled for the December holidays 2010.

## Birthdays Jan. Verjaarsdae

05 Pierre ZS6PJH
06 Carmyn, daughter of Gary ZR6GK
06 Brendan ZS6BW, Son of Peter ZS6PJ
08 Darren ZR6TY, son of Selma and Joe ZS6TB
13 Carol, lv van Hein ZS6Q
20 Errol ZR6VDR
20 Theresa, dogter van Magriet en Tobie ZS6ZX
23 Mark ZS6USA
25 Magriet, lv van Tobie ZS6ZX
31 Elize, lv van Pieter ZS6PA

## Jan. Anniversaries Herdenkings

03 Magriet and Tobie ZS6ZX ( ? )
05 Louise and Alm,ro ZS6LDP (20 )
07 Doreen ZR6DDB and Johan ZS6JHB ( 22 )
20 Helga and Hans-Peter ZS6AJS ( 50 )

## Joys and Sorrows | Lief en Leed

Molly ZR6MOL has become unwell again during the Christmas period.

## Diary | Dagboek (UTC times)

| | | |
|---|---|---|
| **Jan** | 08-09 | Hunting Lions on the Air 00:00-24:00 |
| | 09 | DARC 10m Contest 09:00-10:59 |
| | 12 | SARL Office re-opens |
| | 15-16 | Hungarian DX Contest 12:00-12:00 |
| | 20 | Deadline for2011 RAE bursary submissions |
| | 28-30 | CQ 160m Contest CW 22:00-21:59 |
| | 29-30 | REF Contest CW 06:00-18:00 |
| | | UBA Contest SSB 13:00-13:00 |
| | 30 | Deadline Construction Competition phase 1 |

## ZS7 Antarctica operation

Gerard de Jong, ZS6KX, departed on board the SA Agulhas from Cape Town Harbour at 14:00 on 8 December 2010 for Antarctica.

If possible, he intends operating from the Sanae IV Base. He will initially operate as ZS7/ZS6KX as departure was at short notice. A full ZS7 call sign will be allocated some time later. Arrival will be on 22 December.

## Snippets | Brokkies

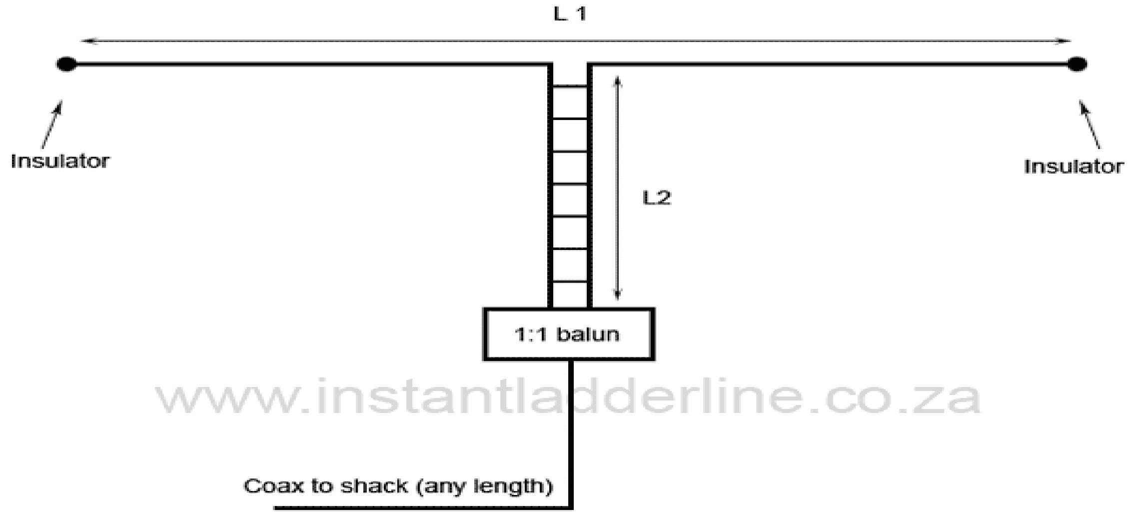
**6m is coming alive! – monitor 50,200 MHz and beam south.**

# The ZS6BKW antenna **6 bands (40 / 20 / 17 / 12 / 10 / 6 m.) without a tuner or traps**

Ed: **Reprinted with permission from** www.instantladderline.co.za – (check out their spreader product)

When OM Louis Varney G5RV designed his famous antenna in the 1950's, it performed excellently with the equipment of that day and age. With today's radio's, on the other hand, things are different. This led OM Brian Austin, ex ZS6BKW (now G0GSF) to redesign the G5RV, using modern antenna modeling software - something that was was not available when the G5RV was designed. He found that shortening the two legs of the G5RV dipole and lengthening the matching stub (the balanced feed line) resulted in an antenna that provides a good match to the 50 ohms impedance of today's transistorized radio's. This allows the antenna to be used on five bands without an antenna tuner! And as an added bonus, it was later discovered that the ZS6BKW antenna covers not five but six bands, as it does 6m, too, something that the original G5RV did not cover at all!

However, there is some bad news, too. On 80m and 15m the ZS6BKW design performs less well than the original G5RV, while on 30m it is just as bad. Also, the antenna's performance appears to be rather dependent on how well it is installed. If it is not high enough above ground or does not keep sufficiently clear of trees, buildings or conductive objects, performance can be affected rather seriously. However, in this respect it does not differ markedly from the original G5RV, which behaves similarly.




The horizontal part of the antenna (the dipole) can be made from electric fence wire, which is an excellent choice for this application. It has a better surface conduction and shows less corrosion than is the case with untreated steel wire, and can be put under mechanical strain without stretching over time like copper wire does. In the original G5RV design, the dipole length (L1) was 31.1m while the matching section (L2) was 10,37m of open line. In the optimized design by ZS6BKW the dipole itself is slightly shortened to a length (L1) of 28.4m, while the matching section (L2) is longer, and depends on the velocity factor of the feed line used. Different versions of this design circulate on the Internet, typically using 300 ohm tape (the type with a velocity factor of 0.85, and L2 being 11.1m) or using 450 ohm window line (with L2 being 12.2m).

However, the best, cheapest and easiest way to make the matching section is to use ladder line, which can be easily constructed using Instant Ladder Line clip-on wire spreaders. In this case L2 is 13.08m.

While various literature claims that a 1:1 (or almost 1:1 match) without a tuner on various frequencies can be achieved, this seems more due to the lossy coax used by the ham doing the measurements than the antenna's performance! (Note that because lossy coax also dampens the reflected wave, coax loss will result in a better SWR measurement at the transmitter!) In OM Brian's own 1985 publication he merely speaks of "an acceptable match", better than 2:1 on five bands, which seems much more realistic. And that is fine - better than 2:1 is more than sufficient. A 1:1 match is not required, contrary to what many hams these days believe!

The table below lists a few SWR figures that compare theoretical (calculated) values found in literature, to the measured values of the author's own ZS6BKW antenna, as well as to the G5RV. (Only theoretical values for the latter, but past measurements done on actual G5RV's show that these match the actual performance fairly well.)

| **Band** | **80** | **40** | **30** | **20** | **17** | **15** | **12** | **10** | **6** |
|---|---|---|---|---|---|---|---|---|---|
| ZS6BKW, literature | 8.3 | 1.1 | 87 | 1.2 | 1.4 | 80 | 1.2 | 1.5 | 1.5 |
| ZS6BKW, measured | >10 | 1.7 | >10 | 2 | 1.4 | >10 | 2 | 2 | 1.7 |
| G5RV | 3.2 | 4.8 | >10 | 2.5 | >10 | 6.8 | 3.6 | >10 | N/A |

(Note: these are the "best" SWR figures; they will of course vary while tuning across the band. The fact that the measured SWR values are higher than the ones in literature is probably due to "end effects".)

A lot of "religious debate" on whether or not to use a balun between the coax and the matching section has taken place over the years. Most of it is based upon OM Varney's own remarks on the subject, and experiments by other hams. However, Varney's statement that he did not notice any difference with or without a balun, and the conclusion that one is therefore better off without one, date from the 1960's and apply to the equipment of that era. Many hams, meanwhile, have experimented with 4:1 voltage baluns, which introduce a mismatch because the feed point impedance of the matching stub is much close to 50 than to 200 ohms.

The fact of the matter is that any way you look at it, it is never a good idea to attach an unbalanced coaxial cable directly to a balanced load (which this antenna is). It introduces unbalanced currents in a balanced system, thus causing it to perform wildly different from what theory predicts, not to mention the fact that it causes shield currents in the coax, resulting in RF in the shack and TVI. A proper 1:1 current balun (.e. a choke) between the coax and the balanced antenna feed point is therefore recommended.

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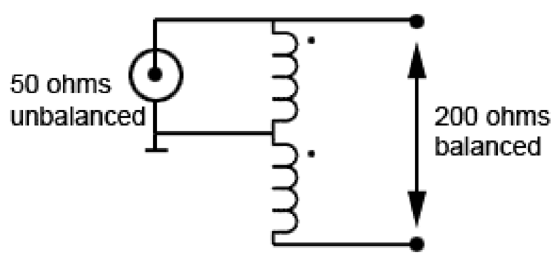
## Everything you always wanted to know about baluns but were afraid to ask

The antenna terminal on a modern radio is coaxial (usually a PL259 connector) and therefore unbalanced. The radio chassis sits at zero potential (if all is well, that is) and the center pin of the coaxial connector carries the RF signal. A dipole antenna, on the other hand, which is often used for HF operation, is a balanced antenna. Simply connecting an unbalanced system to a balanced system is never a good idea! If coaxial cable is involved, its shield will carry strong RF currents which will be radiated where they will do the least good. This will cause RF in the shack, TVI, etc. The radio's chassis and everything connected to it will be "hot", resulting in blistered fingers due to RF burns.

Obviously some conversion from unbalanced to balanced is required in order to connect these two different systems. Enter the balun. As the name (bal-un) implies, a balun matches a balanced system to an unbalanced one. In addition to that, baluns can (but not necessarily do) perform impedance transformation as well. The 4:1 balun, which matches a 50 ohms unbalanced radio to a 200 ohms balanced dipole, is a popular example.

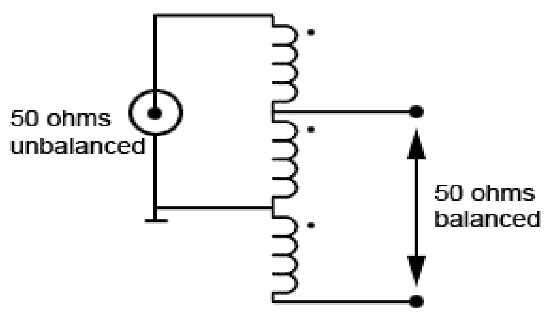
**Voltage vs. current baluns**

Baluns can employ either one of two principles. On the one hand there are *voltage baluns*, which are essentially auto-transformers. On the other hand there are *current baluns* which are based upon the principle of suppressing or neutralizing common-mode currents. And in-depth treatment of the theories behind the various balun systems and how they interact with feed lines is beyond the scope of this article. Instead, let's have a look at the four baluns that are most common in practice, and see how they compare.




**The 4:1 voltage balun** is the most commonly found balun. The voltage balun (also known as the "Ruthroff" balun) is actually a simple transformer. Current from the unbalanced terminal (the center pin of the coax) is fed directly to one of the balanced terminals, and runs through the top half of the transformer windings as well. This induces a similar current in the bottom half of the transformer windings, but because the top of the bottom transformer half is at zero potential, the lower balanced terminal develops a voltage equal but opposite to the upper one.

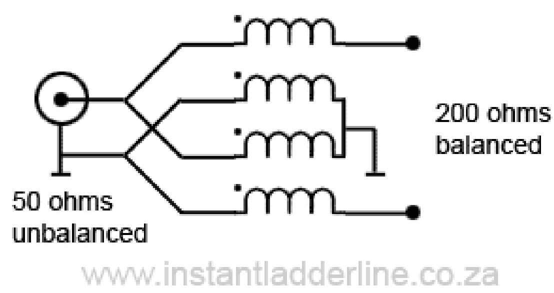
While this design is the most common one, it is by no means the best! The main problem is its flawed symmetry. The impedance of the top half of the transformer is switched in parallel with the (typically 50 ohms) impedance connected to the unbalanced terminal, while the lower half of the transformer is not. Especially at higher frequencies, where the inductance of the transformer windings increases, this means that the voltage developed across the upper transformer half is loaded by the unbalanced input impedance, and therefore drops. This is not true for the lower half of the transformer. As a result the signal across the balanced terminals is far less balanced for higher frequencies. *This unbalance will cause a balanced feed line to radiate RF.*




**The 1:1 voltage balun** is a variety on the previous one. Here the current drawn from the unbalanced terminal (the center pin of the coax) is fed not through one but through two transformer windings in series. The upper balanced terminal is connected to the connection point of the two windings. The third (bottom) transformer winding forms an arrangement similar to the one described above. In this configuration the amplitude of the unbalanced signal is equal to that of the balanced signal, since both of them are developed across the same number of transformer windings. In the 4:1 voltage balun the balanced signal was developed across twice the number of windings compared with the unbalanced signal, which means (this being a transformer) that the voltage is doubled while the current is halved, resulting in an impedance transformation factor of 4:1. The 1:1 balun performs neither voltage nor current transformation, hence the impedance transformation factor is 1:1. It does, however, experience the same problems with flawed symmetry and the resulting unbalance at higher frequencies!


**The 1:1 current balun** is also known as the Guanella balun or a choke. This is one of the simplest baluns. It is based on suppression of the common mode current in the feed line. The current through the upper winding induces an equal but opposite current in the bottom one, with a voltage developed across the

bottom winding equal and opposite to the one across the top. This annuls the voltage on the bottom balanced terminal, thus keeping the chassis of the unbalanced side at zero potential. In practice this balun often takes the form of a coaxial cable wound into a coil. Its main disadvantage is that its efficiency depends entirely on the coil inductance, which should be infinite in order to achieve 100% suppression of feed line common mode currents. In the real world this inductance is finite and frequently low, which limits the efficacy of this balun.




**The 4:1 current balun** (Guanella balun) may look a bit confusing, but in fact isn't all that hard to understand. It consists essentially of two 1:1 Guanella (current) baluns, the unbalanced sides of which have been switched in parallel, while the balanced sides are in series. This means that both 1:1 baluns will each develop the same voltage on the right hand side as on the left hand side (they have a transformation factor of 1:1 after all) but because on the balanced side these two voltages are switched in series, the voltage on that side doubles. With twice the voltage (and therefore half the current) at the balanced side, the result is a 4:1 impedance transformation. Both 1:1 baluns which make up the 4:1 variety may be wound on different cores, or on the same core. The main disadvantage of this particular balun is that the characteristic impedance of the windings themselves should be twice that of the unbalanced impedance and half that of the balanced impedance. In other words, in order to get a 1:1 SWR at the 50 ohms side, the characteristic impedance of the windings ideally should be exactly 100 ohms, which is extremely hard to achieve in practice. On the other hand, while the SWR meter may not show a 1:1 match with a dummy load, the symmetry of the signals at the balanced end of this balun will always be 100%, which cannot be said for the other three balun designs shown above!

**Balun cores: air, ferrite or powdered iron?**

**A 4:1 Ruthroff (voltage) balun on a toroid, for indoor (shack) use.**

**A 4:1 Guanella (current) balun on a single toroid, made from insulated wire and cable ties.**

Many balun designs can be found on the Internet. A number of these are "air wound" baluns, consisting of wire or coax wound across a former (e.g. a plastic tube) filled with air. This makes sense in countries where four figure power levels are legal (or at least common) since an air core is, for all practical purposes, impossible to magnetically saturate. In other countries such as South Africa, however, where 100W is the most common maximum power level, and with a happy few owning a "foot warmer" that pumps out 200 or even 400W, it is very well possible to use properly selected powdered iron or ferrite cores without causing these cores to saturate. Since the proper functioning of all baluns discussed here depends on self-induction and magnetic coupling, the higher magnetic permeability of a core is preferable to the low permeability of air. Baluns based on air cores often leave a lot to be desired, with their efficacy being limited by the low induction and loose coupling of the windings, especially on lower frequencies.

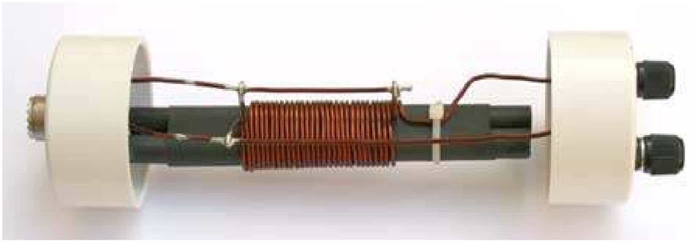
Various options are available for balun cores. The top of the range (and of course the most expensive option) is the ferrite toroid core. These can be obtained in South Africa from suppliers such as Mantech or RS components. They can be hard to find and somewhat pricey, but they *are* available. Ordering ferrite cores in larger batches may be easier than obtaining single ones, so consider making it a club project! Various ferrite mixes are available. Without going into the details of ferrites (about which many volumes have been written), an excellent all-round ferrite mix for balun cores is 4C65. The amount of power the balun can handle is in no small measure determined by the size of the toroid - the bigger, the better. In practice a 36mm toroid is more than sufficient to handle 100W, provided that the impedance mismatch isn't too great.

As an alternative to ferrite, powdered iron cores are available. These tend to be a bit cheaper than ferrites. A well-known type is the T-200. These cores have a much lower permability than the 4C65 ferrite, which means that they won't saturate as easily at higher power levels. On the other hand, the price we pay for that lower permeability is a lower induction and less tightly coupled windings.

Fortunately there is a cheap alternative to toroid cores, which can be found in just about every radio ham's junk box. These are the ferrite rods salvaged from the old ferrite "loopstick" antenna's in AM radio's! A ferrite rod with a length of 10 or 12 cm and a diameter of 10-15mm (not critical) will do very nicely for power levels up to 100W. Multiple ferrite rods can be taped together to get a chunkier core that will handle even higher power levels. If laquered copper wire is used for the windings, put some plastic tape or heat shrink tube over the ferrite for extra insulation.

**Balun construction**

Baluns can be wound on a ferrite core using insulated wire, which can be held in place with cable ties. Laquered copper wire can also be used, but this is more difficult to apply since it is less flexible. When winding laquered copper wire onto a ferrite rod, be careful not to apply too much force in shaping the wire, because ferrite rods are a brittle ceramic and break easily!



A 4:1 Ruthroff (voltage) balun wound on ferrite rods, using laquered wire. For more bandwidth the spacing between the windings should be increased. This balun will take at least 100W.

A 1:1 Guanella (current) balun, also known as a "choke", made by winding 3 layers of RG58 coax on a ferrite rod.

A choke (1:1 Guanella) balun) can be made by winding an odd number of layers of coax onto a ferrite rod. This works better than the usual method of just winding the coax into ten or twelve loops, because looped coax has as very low permeability (it is an air-wound coil) and the capacitance between both ends of the coil is very high.

Baluns are generally easy to build. If they are intended for outdoor use, they need to be weatherproofed. A good way to do this is to use plastic drain pipe, which can be cheaply obtained from a local plumber, along with matching end caps. Baluns wound on ferrite rods can be housed in pieces of pipe with a length of 10-20cm (depending on the size of the rod) while toroids may be housed in short sections of pipe which essentially only serve to hold two end caps tightly together. A small amount of silicone sealant can provide further waterproofing. Use as little sealant as possible, so that you can remove the end caps later if repairs or changes should be necessary.

Baluns for indoor use can be housed in just about any enclosure that is on hand. Plastic is preferable, though. If metal housings are used, ensure that all wires and cores are kept well clear of any metal parts.

**Winding diagrams**

On the website are generic winding diagrams for typical balun types. The number of windings is intended as a starting point only. The ideal number depends on the desired frequencies and bandwidth, as well as on the core material used, i.e. the ferrite or powdered iron mix. The bandwidth can be changed by varying the spacing between the windings. Some experimentation may be necessary.

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## Are plasma TVs killing radio? - **RSGB appeals for evidence**

Posted in Wireless, 12th August 2010

(Ed: Similar problems were reported some time ago by Dutch hams in their newsgroups)

The Radio Society of Great Britain is asking anyone with a plasma TV to let it know if they've had trouble getting Radio 4 lately.

The Radio Society of Great Britain represents the radio ham community, though it sees itself as having a wider remit. When not organising competitions to see who has the biggest beard can transmit a 10MHz signal furthest, the RSGB tries to protect the interests of radio users of all kinds by tracking possible causes of interference, which prompts its latest appeal.

Recently the interference effort has been focused on mains networking kit - people running Ethernet signals over in-home electrical wires - but the Society reckons that plasma TVs are another source of interference worthy of greater attention.

Anecdotal stories abound of plasmas putting out interference below 30MHz, and even extending into the higher frequencies where commercial radio can be found, but the Society is trying to cast a wider net to see if it's a genuine problem.

The plan is to make a presentation to CISPR (the International Special Committee on Radio Interference) in the next few weeks if enough complaints can be accumulated - so if you've got a plasma and you think it's plotting against your radio, drop the RSGB a line at plasma.tv@rsgb.org.uk.

## An old but useful idea for a sensitive field strength meter (WW March 1978)

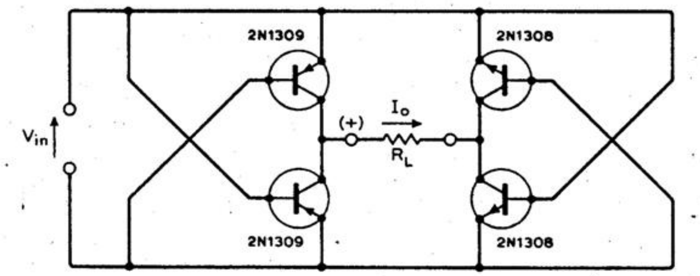
### Cross coupled transistor bridge

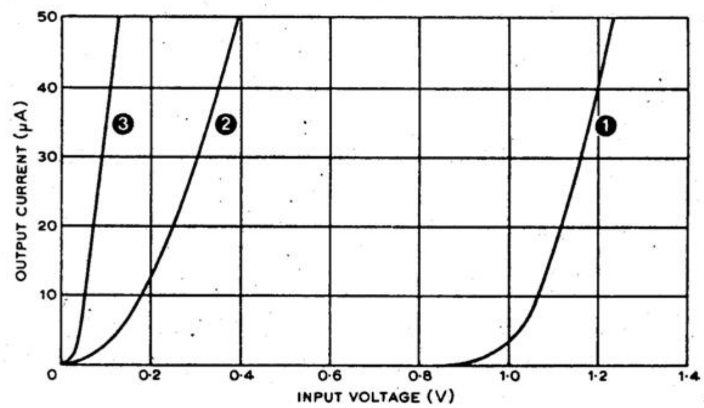
THIS circuit shows a full wave rectifying bridge which has an off-set voltage an order smaller than conventional diode bridges.

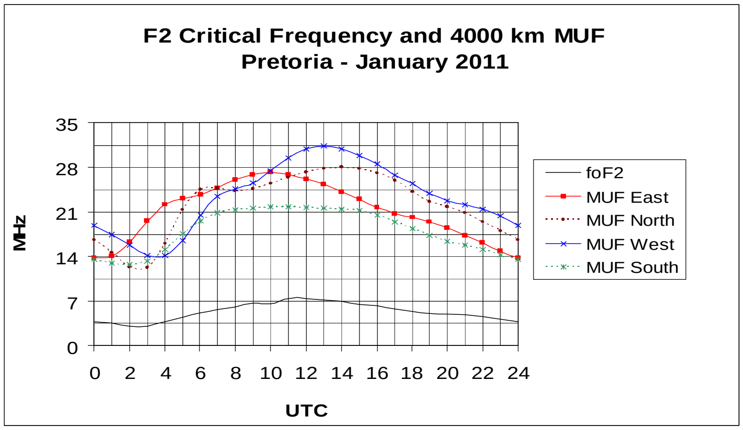
The graph shows transfer characteristics for a conventional full wave silicon diode bridge in curve 1, a germanium diode bridge in curve 2, and the cross coupled transistor bridge in curve 3. The off-set voltage of the transistor bridge is about 30mV with good linearity above the knee.

The circuit was developed for use in a simple but sensitive field strength meter. The meter is protected by the base-emitter junctions of the transistors. With the devices shown, the frequency response is up to 30MHz and the optimum value of $R_L$ is about 2kΩ.

L. D. Thomas,
Burton on Trent,
Staffs.




## Long Term HF Propagation Prediction for December 2010 courtesy ZS6BTY

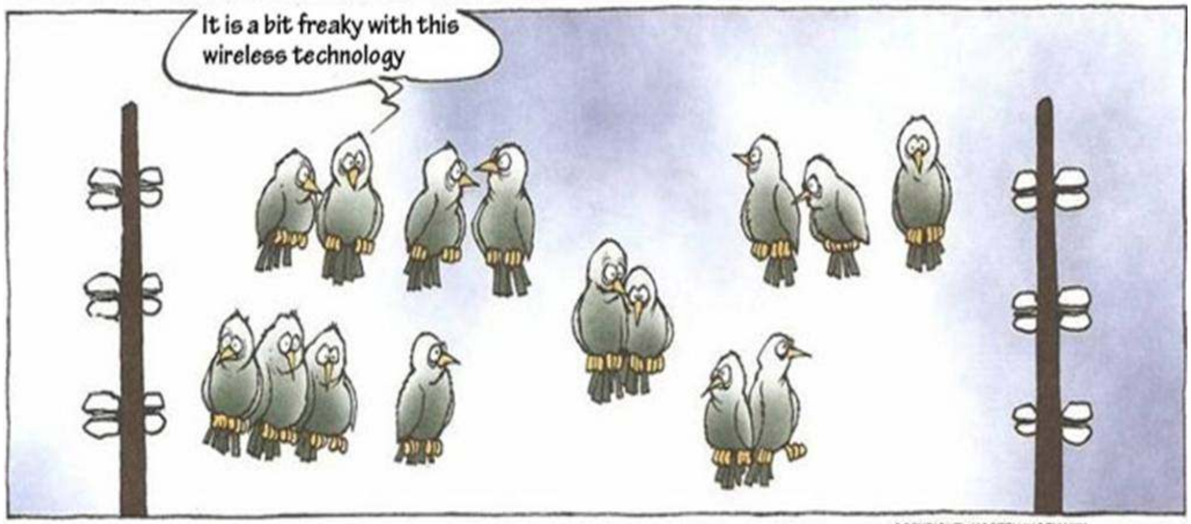
**(see also our website propagation tab)**

DX Operating

The graph shows the 4000 km maximum useable frequency (MUF) to the East, North, West and South from Pretoria for the first hop using the F2 layer.

Local Operating

The F2 critical frequency (foF2) is the maximum frequency that will reflect when you transmit straight up. E-layer reflection is not shown.

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## Ofcom slaps down ham botherer

Drive-by signal jammer closed down

Posted in Wireless, 26th November 2010 11:17 GMT

A 63-year-old man from Hull has pleaded guilty to driving by the homes of radio hams purely for the joy of interfering with their hobby.

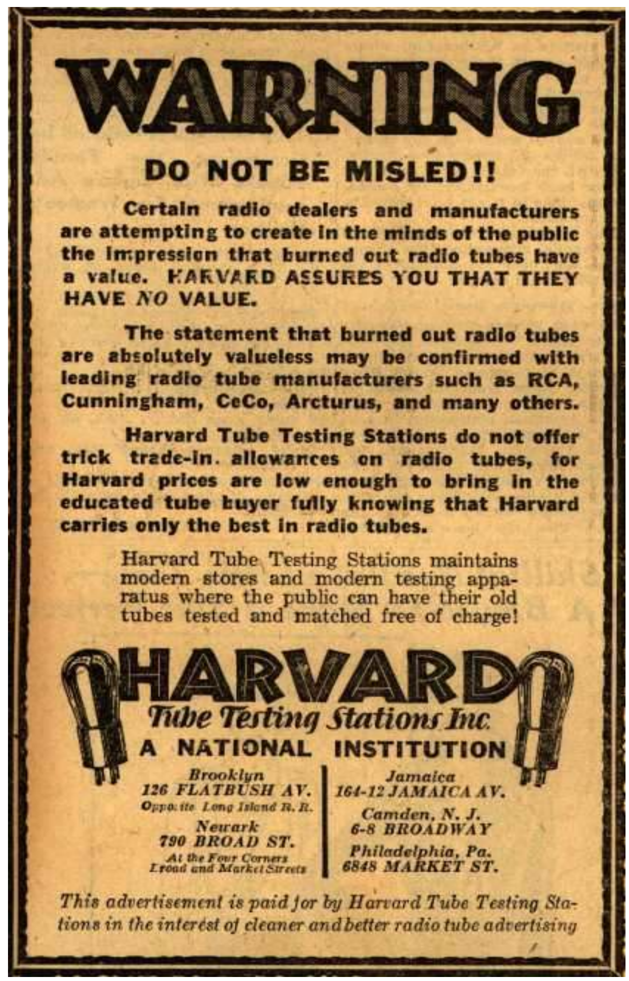
In a case brought by Ofcom, Clive McMurray appeared in Hull Crown Court and admitted operating a radio transmitter without a licence. He was given a four-month sentence suspended for 18 months as well as forfeiting his radio kit and landing a curfew preventing him from roaming the streets between 7pm and 7am at night.

Driving around in his van, Mr McMurray would park up outside the home of an operating radio ham and start jamming the signal or broadcasting his own (or both). Quite why he did this remains a mystery, but despite initially denying the charges in September he pleaded guilty on Monday.

Triangulating a radio source is pretty easy, but if it's moving around - mounted, say, in a Toyota van - then it's a good deal harder, and Ofcom has been pursuing the case since May 2009.

Operating a radio transmitter without a licence is illegal, and Ofcom has the power to prosecute in such cases (as it did this time). In most cases a stern telling off is sufficient, and such powers are reserved for shutting down pirate radio stations where confiscation of the equipment is more important than the punishment imposed.

We've no idea why Clive McMurray wanted to upset the radio hams, who are mostly harmless at worst, but hopefully he'll now find a more productive hobby, and one he can do at home.

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## The Earth's magnetic poles

A reversal of the Earth's magnetic poles would certainly make life interesting for radio amateurs. The Geomagnetic North Pole is currently moving north under the Arctic Sea at about 40 km per year, dragging the auroral oval along with it and affecting polar path propagation. While it has been 3/4 of a million years since the last reversal, no one knows whether we are overdue for a flip-flop and the field strength seems quite strong.
http://science.nasa.gov/science-news/science-atnasa/2003/29dec_magneticfield