THE WEST RAND AMATEUR RADIO CLUB



September 2007
Volume 8, Issue 1

# ANODE

**Inside this issue:**



## Editor's Comments

**Volume 8 Issue 1**
**September 2007**

**A new email address for the club**
We have a new email address for the club - it is:

zs6wr@gmail.com

**Cooling on your PC gone awry?**

A North Carolina teenager who decided the best way to cool his Xbox's overheating power supply was to stick it in a bowl of water was knocked unconscious by the resulting electric shock and earned himself a trip to hospital with "minor burns to his right hand and foot".

[Probably a suitable candidate for the Darwin Awards.]

**A "Local" Frequency Standard**

You have an extremely accurate "Frequency Standard" transmitted all around you - the SABC TV transmissions. The line scan frequency is the easiest to use as it is only 15625 Hertz. This can be 'picked up' using a loop of wire placed against the rear of the television set. This means that you don't have to open the television set.

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## Project Inspire, A VLF Space Shuttle Experiment

**Special points of interest:**

- Contact details on back page (updated)
- Next Ham-Comp is at 13:00 on the 18th August.

Build a simple receiver to explore the wonders of the 60,000 meter band!

by Jim Ericson KG6EK

Tired of hearing the same old stuff on your radio? Do you tend to think of 160 meters as the -bottom of the band"? This article will discuss both man-made and natural radio activity between 100 Hz and 10 kHz, the absolute bottom end of the VLF (Very Low Frequency) spectrum. If we call 5 kHz the centre of the band, we're talking about a 60,000 meter wavelength! I will describe a simple and inexpensive (under $40 - that's 2 million Zim dollars) VLF receiver design, and present some ideas on how you can participate with space scientists in scientific data gathering involving VLF propagation (and possibly share some of your ham radio expertise with U.S. high school students and other experimenters) during a March 1992 space shuttle experiment. Letters inviting participation in the listening experiment have already gone out to 10,000 high school physics classes in the U. S., and both amateurs and private experimenters are also being invited to participate.

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# Editor's rants and raves - comments

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(See the above section) The frequency is accurate as it originates from a rubidium standard used inside the SABC. This "standard" frequency used to be referred to the National Standard Frequency provided by the CSIR. I was informed in the 1980's that the differerence was of the order of 10^-23 (10 to the power -23). To most of us that means that it has an equivalent accuracy.

Due to the national coverage of the SABC, this will function quite happily over most of the South Africa. This method however, has the advantage of being 'low cost' and generally available. An alternative to this method is the use of the clock frequency used internally by the GPS system. The GPS satellite network may suffer outages due to sun storm activity and availablity of satellites. Not everyone can afford a GPS either.

This 'locked' signal can then be used to 'pull' a 1 or 10 Megahertz crystal oscillator. A simple block diagram is shown below. The circuitry can be CMOS as the frequencies involved are not high. A suitable phase detector is the 4046 chip, which has been used before for phase locking radios to a crystal oscillator.

Whilst the frequency standard used by the SABC TV transmission can be traced back to the "Standard Frequency" for South Africa. Un-

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# Project Inspire, A VLF Space Shuttle Experiment

*(continued from page 1)*

**A Quick History**

The story begins in World War 1 Europe, where both sides used telephones for trench communications. Soon the vacuum tube came along, opening the way for high gain amplification. Each side began intercepting-leakage-from the other's telephone communications by using amplifiers connected to widely separated ground rods. Electronic Counter Measures were born! Evidently this system worked quite well most of the time, but now and then strange falling notes filled the monitors' headsets, sounding like phantom shells passing overhead.

German scientist H. Barkhausen was assigned to fix this interference problem. He was unsuccessful, but he became intrigued by the mystery. He and other researchers picked at it for years, and by the late 1920s there was general agreement that lightning was responsible for these 'whistlers'. But it was not until the 1950s that the exact mechanism was found.

As researchers learned, lightning is an enormous spark discharge which produces a broad spectrum of radio energy in which all frequencies appear at once, from hundreds of hertz through hundreds of MHz. However, scientists discovered that a large percentage of lightning's effective radio energy is concentrated in the 1 to 20 kHz region, loosely defined as VLF.

**VLF Punches Through the Ionosphere!**

VLF static bursts caused by lightning propagate with great efficiency in the waveguide formed by the earth's surface and the lower regions of the ionosphere. Mostly it sounds just like the static you hear on an AM radio receiver. But if you listen closely, you'll sometimes find that somewhere below 10 kHz the static crackles become liquid "pings" or 'whistles' brief musical notes.

Today, the mechanism for this effect is well understood. Radio signals propagating through a non-vacuum medium become dispersed. This means that the higher frequencies travel a little faster than the lower frequencies. A lightning burst starts out as all frequencies at once and propagation in the earth ionosphere

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# Editor's rants and raves - comments

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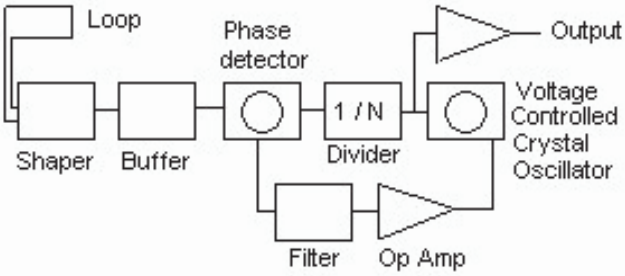
fortunately a "Time Standard" cannot. So a clock run by the "local standard" will never lose or gain time by any perceptable amount. Unfortunately it will probably never indicate the "correct time"! Remember the old quip about the clocks that lost a second a day and the other was stopped?




[*For a Wiki definition of 'time standard', go to; http://en.wikipedia.org/wiki/Time_standard*]

**Time Standards in Africa**

So what? You may ask. In Africa the accurate time of day is not relevant. Well the measurement of time has some vital purposes. Aircraft navigation is one of them. For if you cannot measure how far you have travelled, you will need to know your speed and last known position as well as the elapsed time. Not too difficult when using a GPS system, but if the GPS is out of commission...

Intriguingly in the UK, the best selling items of a "scientific" nature are the clocks that synchronise to the 60kHz signal transmitted from Anthorn. It used to be Rugby but was moved more centrally quite recently. Unfortunately even this is way out of range for South Africa.

Our local stations ZUO and ZSC which supposedly transmit on 2.5MHz, 5.0MHz and 4.291MHz as well as 8.461kHz are either not heard or ignored for a variety of reasons. Can you remember ever hearing these stations?

[*The Americans still run WWV check out the NIST Station WWV.*
*Go to; http://tf.nist.gov/stations/www.html*]

**Use the Internet**

Of course we have the Internet these days. So you can obtain an accurate time signal from various servers on the net using the Network Time Protocol. Well you could if your firewall allowed you. With a huge number of people connecting in Europe recently, it was possible for the router manufacturers to set the time in firmware. The router can be programmed in factory to use NTP to access a "time server" when it connects to the Internet. Only problem there was that the designers chose an obscure time server at a university which had a slow and paid-for connection. The massive number of routers all over Europe that enquired the time from the server, took up all the bandwidth. Costing the university a fortune.

[*There are local as well as overseas "Time Servers". The list is at; http://www.ntp.org/*
*Local time servers and information; http://www.time.za.net/*
*Rhodes University; http://noticeboard.ru.ac.za/post.5505513*]

What do you do when you have the "right time" on your PC? How do you set your clocks to the same time? No automatic synchronisation is available yet. So you are left with a clock on screen and good reaction time, setting buttons or dials...

**You can set your own PC to get NTP time signals.**

If you are behind a firewall (which I hope you are if you are using a Microsoft product), your firewall must allow UDP packets to go out to port 123 and allow UDP packets to return from port 123 to your machine. Most proper firewalls (PIX,

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# Project Inspire, A VLF Space Shuttle Experiment

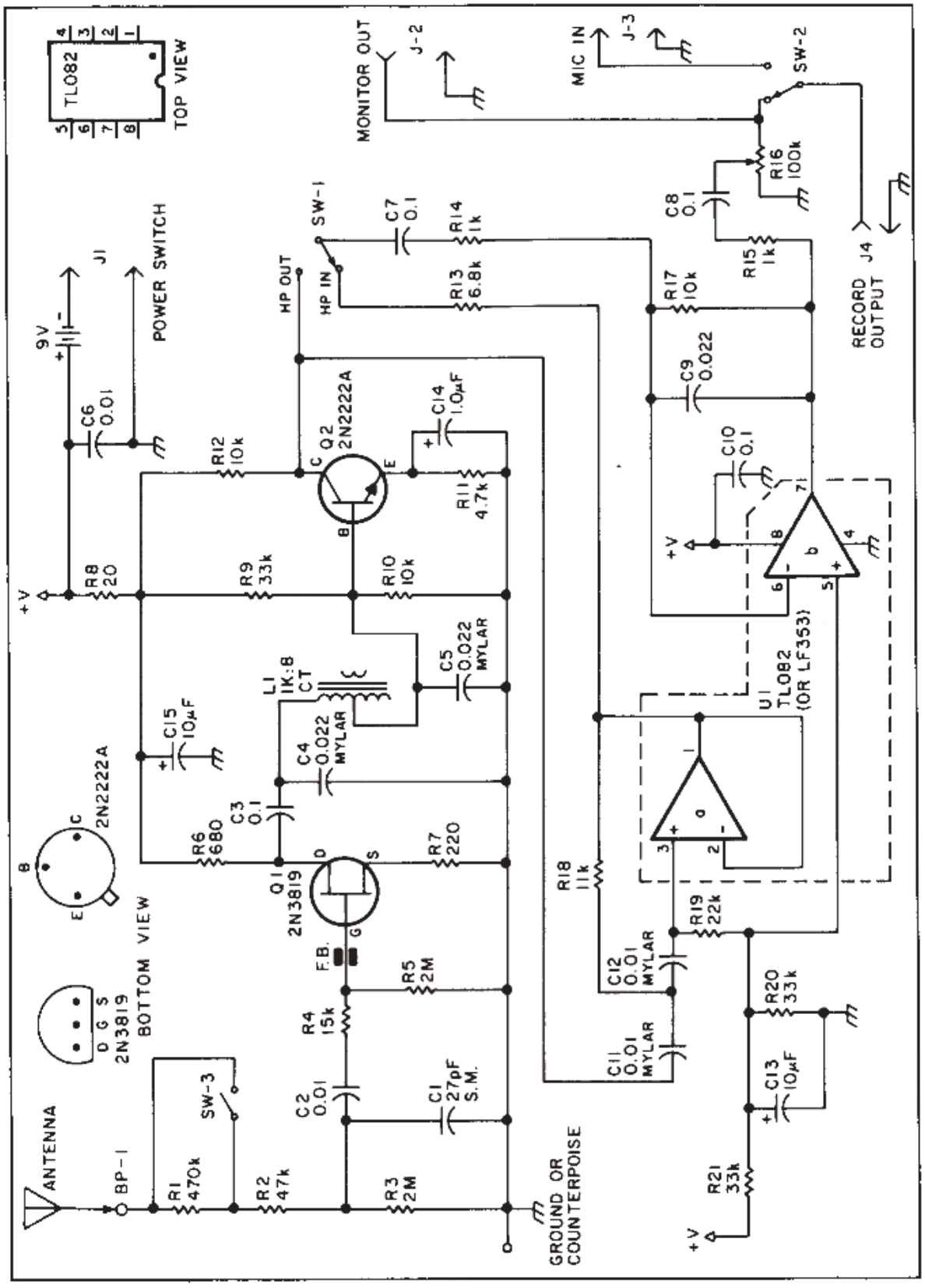


*Figure 1. Schematic for the RS4 VLF receiver.*

# Project Inspire, A VLF Space Shuttle Experiment

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waveguide effectively spreads the frequency components to produce audible "pings" at the lowest frequencies. By measuring this dispersion, investigators can calculate just how far the signals have travelled.

Early investigators were puzzled by the fact that nobody could find signal paths on earth that were anywhere near long enough to account for the huge amount of dispersion heard in long whistles. Eventually, new techniques including spectrum analysis helped to unravel the mysteries of whistlers. L.R.O. Storey of Cambridge University and R.A. Helliwell of Stanford University were among the widespread group which developed a new view of the earth's near-space environment, opening up the field of magnetospheric physics. As it turned out, the long dispersive whistler paths were ducts in the magnetospheric plasma which extend between the Northern and the Southern Hemispheres. These ducts (sort of like the lines you see when you sprinkle iron fillings over a bar magnet) arch to a maximum distance of several earth radii, far beyond the boundaries of our ionosphere. This explains why some 'whistlers' have a duration of several seconds when heard here on earth.

**The Antarctic Antenna Farm**

In the 1950s, researchers discovered that CW transmissions from military VLF stations sometimes triggered whistler-like events. In the 1960s, they chose Antarctica as a perfect spot for controlled whistler research. Plenty of room to put up a 40 kilometre (26 mile) VLF dipole transmitting antenna, mile-thick ice - a nice insulator to keep the antenna off the "ground, and almost no interference from AC power!

A powerful transmitter was built at Siple Station, Antarctica. In the 1970s and '80s, transmissions from Siple generated a variety of magnetospheric signals which were recorded by a monitoring station at the magnetic conjugate region near Roberval, Quebec, and by a variety of satellite monitors. These experiments have advanced scientists' understanding of the ionosphere and magnetosphere while suggesting many subjects for further research.

**The Need for More Ears**

Until recently, VLF research was carried out using only a handful of listening stations manned by the government and a few universities. In 1989, high school and amateur listening participation was invited in a joint NASA/Soviet experiment involving the Soviet satellite ACTIVE. The Soviet satellite attempted artificial stimulation of the magnetosphere by passing large 10.5 kHz currents through a 20-meter-diameter loop antenna. Unfortunately, the loop apparently deployed in a twisted configuration, and the SWR was very high. Several months of monitoring by NASA, Soviet observers, and dozens of private experimenters in the U. S. failed to produce any copy. These joint experiments were nonetheless successful in that they provided the first occasion for participation by amateurs and high school groups. The possibilities of a large network of coordinated monitors had never before been explored.

**INSPIRE 1992**

INSPIRE stands for Interactive NASA Space Physics Ionosphere Experiments. The private industry sponsors who, at this time, are coordinating with NASA include TRW Systems and Micro Power Systems in California, and MESA Art and Printing in Arizona. In March 1992, NASA plans to launch the space shuttle (STS-45) with the first mission in a series of 10 flights called ATLAS (Atmospheric Laboratory for Applications and Science). [Ed. Note: STS-45 will also be the next SAREX flight.] One of the ATLAS investigations is called SEPAC (Space Experiments with Particle Accelerators), which is an experiment involving the earth's atmosphere, ionosphere, and magnetosphere. The 7 kW SEPAC accelerator (see

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Photo A) will emit a beam of electrons modulated by a series of audio tones from 50 Hz to 7 kHz. A unique feature of the transmitter is that it does not directly utilize a metallic antenna. The modulated electron beam projected into space will become its own -virtual- antenna!

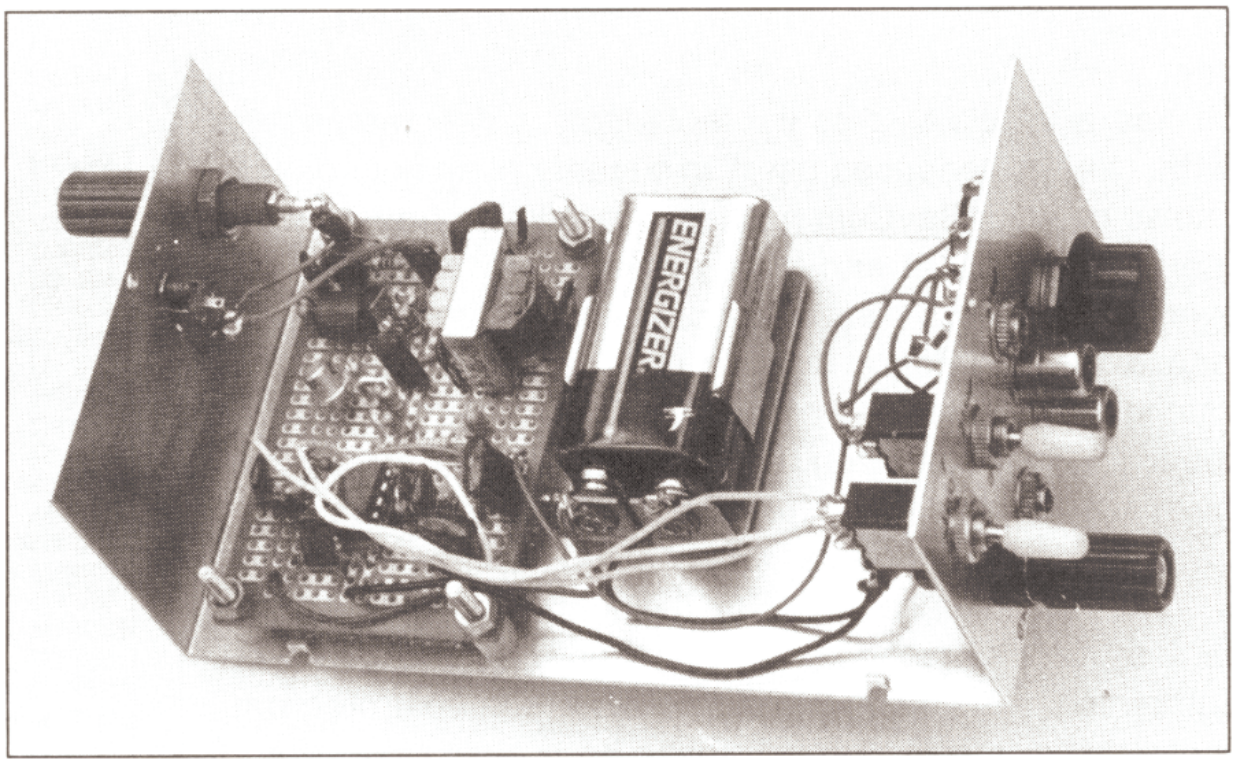


*Photo A. The RS-4 VLF receiver layout, using perfboard construction technique. (Photo by Mike Mideke WB6EER.)*

SEPAC will use coordinated high school and amateur experimenter teams to listen and tape record the radio waves. The locations where the transmissions can be detected will define the -footprint- of the signal, an impossible task without a large number of participants.

**How to Hear Audio Frequency "Radio" Waves**

Radio signals in the VI-F region occur at frequencies ranging from a few hundred hertz to something above 10 kHz. These frequencies are readily accessible to human hearing but, even so, they are not directly audible. Why? Because they are electromagnetic events which do not produce the mechanical vibrations in the air that our ears need to detect them as sound.

In order to hear these waves, we must convert their electromagnetic activity to acoustical vibration. Conversion is done with a transducer-a simple amplifier connected to a loudspeaker or headphones-that uses the electrical energy to move air molecules to produce an audible sound.

**Building a Practical VLF Receiver**

It is fortunate that very simple and inexpensive

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# Project Inspire, A VLF Space Shuttle Experiment

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circuits can be used to hear and record both natural and man-made VLF signals. Beginners can build them; it is not necessary to understand the theory of operation in order to make equipment that works very well.

The receiver described here has been dubbed the RS-4 by its designer, amateur experimenter Michael Mideke WB6EER. The identical design (in kit form) will be constructed and used by the participating high school physics classes. All essential components are listed in the current Radio Shack catalogue.

The receiver uses a FET input stage to transform the extremely high impedance of a short (1 to 10 foot) antenna to a more practical value.

A low-pass filter rolls off frequencies above 7 kHz in order to prevent overloading from high power OMEGA radio-navigational signals at 10.2 kHz and above. The active high pass filter (controlled by SW-1) significantly rolls off frequencies below 1 kHz, helping to reduce the hum from 60 Hz power line harmonics. A ferrite bead (Amidon FB901-43, available from Amidon Associates, 12033 Otsego Street, North Hollywood CA 91607) in the FET gate circuit helps prevent overloading by radar and TV. Resistor R1 should be shorted via SW-3 when using an antenna longer than about 30 feet. A switch and jack are included to allow the operator to use a microphone for insertion of time marks and commentary while recording.

Note that the receiver uses a jack instead of a conventional power switch. Inserting a shorted plug into the power jack completes the battery negative circuit, applying power to the unit. This approach prevents accidental turn-on of the receiver while it is being transported. (There is nothing more frustrating than pulling the receiver out of your knapsack to discover that it has gotten turned on and the battery is dead!) [Ed. Note: You can use an SPST switch in place of the jack if you so desire.]

The layout of the circuit board is not particularly critical (see the accompanying photo for suggested layout using perfboard construction). Try to keep 11 output stuff- as far as possible from the antenna input. Component values aren't critical either, but try to keep the 11 k and 22k resistors associated with Ul-A within 5% or so. Since Radio Shack doesn't supply 11 k resistors, you can parallel two 22k units, or series-connect a 10k with a 1k.

When all components (including jacks and switches) are soldered in place, it is a good idea to double-check the wiring and do some preliminary tests before mounting the board in the enclosure. The first check is to remove U 1 and connect the 9V battery to the circuit, in series with a milliammeter. It should read about 0.5 mA. If the meter indicates much more, or no current at all, something is wrong. Go back and check your work.

The second test is to disconnect the power and insert U1 in its socket (check for proper orientation). When you reconnect the battery, current consumption should be 3 to 6 mA. If it is, chances are good that everything is OK.

When the receiver is completed, raise the whip antenna a few inches and attach a ground (or several feet of wire if no ground is handy). Listen with Walkman-type headphones or a monitor amplifier, and verify that you have hum and noise. Touching the small antenna, or even moving your hand near it should increase the hum intensity. Switching the high-pass filter in and out should make a noticeable change in the sound of the output. The series antenna resistor will make little difference, whether it's in or out.

**Using the Receiver**

Even though high-pass filtering is incorporated in the receiver design, it is not a cure-all for the pervasive hum radiated by the AC power lines that dominate our modern civilization. To get

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# Project Inspire, A VLF Space Shuttle Experiment

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reasonable reception of VLF signals, you're going to need to find a site which is at least 500 meters from AC power lines. You'll also need some kind of ground or counterpoise. Usually a simple one-foot nail or spike provides enough grounding to prevent squeals in the receiver. The chassis of an automobile (engine off) also works nicely. Try the little Radio Shack whip antenna if you are in the open, and maybe a 20 to 50-foot wire if you're in the woods. You will hear some AC line hum, but if you've picked the right site you'll also hear clicks, pops and, with some patience, some whistlers!

**Alternatives to Building RS4 from Scratch**

The volunteer non-profit INSPIRE organization is offering the RS4 receiver in kit form to the high schools, and the same deal is available to radio amateurs and private experimenters. At $49.95 post-paid (plus $4.12 sales tax in CA), the kit includes:

* All components, enclosure, etched PC board, and detailed assembly instructions.
* The Beginner's Guide to Whistler Hunting, by Michael Mideke WB6EER, a 23-page history of VLF, including tips and advice on observing, describing, and recording natural and man-made signals at very low frequencies.
* A 60-minute narrated cassette tape by Mideke which samples the incredible variety of sounds that can be heard in the VLF range. Included are notes describing the audio segments, and sample spectrograms of some of the signals.
* Instructional materials designed to assist you in working with high school students to mutually learn more about natural radio and the ATLASSEPAC INSPIRE mission.
* You will also receive updates by mail about SEPAC operation schedules, and the status of the mission.

To order an INSPIRE kit, send a check made out to INSPIRE to: Bill Pine, Science Department, Chaffey High School, 1245 N. Euclid Avenue, Ontario CA 91762. If you need a receipt, or have any questions, please include an SASE. If you just want the blank PC board, it's available for $7.

If you decide to build the RS-4 as described in this article, but don't anticipate direct project participation, you may still want to get a copy of the Mideke booklet and audio tape. The Guide is $6 postpaid in the U.S. (plus 83C sales tax in CA), $12.50 outside North America. Write Michael Mideke at P.O. Box 123, San Simeon CA 93452-0123.

For those not interested in construction but who would like to experiment with a receiver, Conversion Research has a new VLF pocket receiver available completely assembled for $48 postpaid in the U.S. (plus $3.96 sales tax in CA). The circuit is not exactly the same as the RS-4, but it is fully effective, includes a 33-inch telescoping whip antenna and a battery, and is housed in a sturdy die cast aluminium enclosure with an on/off switch, audio gain control, and a 3.5mm jack for stereo earphones. Order from Conversion Research (Frank Cathell K3YAZ), P. 0. Box 535. Descanso CA 91916.

Project INSPIRE offers an opportunity for amateurs to be involved in a truly significant research project. To make it fully effective, we amateurs need to bridge the gap between the NASA shuttle experiment and local high schools. Pick up the phone and connect with the physics teacher at your neighbourhood high school. If he (or she) hasn't heard about INSPIRE, have them send an SASE to Bill Pine for information. Offer to help students build the kit, and maybe give some advice and assistance in searching out a remote and radio-quiet listening site for the March 1992 mission. Good hunting on 60,000 meters!

Contact Jim Ericson KG6EK at 226 Charles Street, Sunnyvale CA 94086-6063.

From: 73 Amateur Radio Today * December, 1991

# Editor's rants and raves - comments

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FreeBSD, Linux Netfilter) will allow this type of behaviour unless specifically denied by your administrator.

If you wish to experiment with this, try the following. But read about this in the 'help center' before you do this.

At the command prompt, type;

```
net stop w32time
net time /setsntp:ntp.ru.ac.za
net start w32time
exit
```

This assumes you have an NT/2000/XP style operating system. For the ones of you having Windows 98, there is no hope (according to Microsoft). But wait! You can install an NTP client program. This NTP program will get the "correct time" from a time server.

For one amateur's view of HF Time Standards go to; http://www.ac6v.com/standard.htm

And another, Radio Controlled Clock - Hans Summers;
http://www.hanssummers.com/electronics/clocks/radio/index.htm

Computer Time Services; http://www.npl.co.uk/time/research/computer_time_service/

SOUTH AFRICAN QUALIFICATIONS AUTHORITY REGISTERED UNIT STANDARD:
http://fgas.saqa.org.za/showUnitStandard.php?id=244207

**MSF Enthusiasts**
http://www.npl.co.uk/time/msf/msf_enthusiasts.html

http://www.cl.cam.ac.uk/~mgk25/time/lf-clocks/

**GPS UTC and TAI clocks**
http://www.leapsecond.com/java/gpsclock.htm

**MSF Tx**
http://www.npl.co.uk/time/msf/

**MSF Software**
http://www.rtrussell.co.uk/products/msf/msf.html

If you are interested in this further, please email me; brockjk@gmail.com

**The Anode at the Club**

If you cannot receive the Anode via the Internet and you have either a memory stick or a "stiffy disk", you will be able to copy it from the club's workstation pc at the meeting. Alternatively, if you have a WiFi enabled pc/laptop at the club, you can also copy it from the server.

See you at the meeting tomorrow night.

73
JB

**The West Rand Amateur Radio Club**
26.14122 South - 27.91870 East

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Roodepoort
1725

Phone: 082 573 3359 (Chairman)
Email: **zs6wr@gmail.com**

**Bulletins** (Sundays at …)
11h15 Start of call in of stations
11h30 Main bulletin start

**Frequencies**
439.000MHz 7.6MHz split
Input: 431.4MHz (West Rand Repeater)
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

# Radio Amateurs do it with more frequency!

| | | | | |
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| Member | Geoff | ZS6GRL | | glevey@gmail.com |
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| SARL liaison | Willem | ZS6WWJ | | marie.w@absamail.co.za |

# West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June 2005. This included the new Adobe reader. It has been updated, check with the chairman for details.

**We need your input! Email us articles, comments and suggestions please.**
**zs6wr@gmail.com**