

December 2007

Volume 8, Issue 4

ANODE

Inside this issue:

Editor's Comments	1
The Chairman's Christmas Message	1
Equipment for VHF/UHF dx. From SM5BSZ's Home Page	4

Editor's Comments

**Volume 8, Issue 4
December 2007**

Another wet weekend - good for projects.

My project for this weekend is of course the Anode. But you could have built a lightning detector during the weekend. Or a simple signal generator for 20 metres (see below). I could have told you all that it was going to be a 'good' storm on Saturday, if you had asked me. If you want to see the rain forming in the clouds:-

http://metsys.weathersa.co.za/aircraft_map_gt.html

Remembering the eighties

You could have warned us all about the 'unseasonal rain' etc. I think the rain is normal for this time of year, don't you?

{ All our C.A.T's are busy right now... }

Fed up with the waiting for Adobe's reader to load?

Try Foxit software's reader. It loads in a flash and navigate a pdf fast. Get it at:- <http://www.foxitsoftware.com/>

Where to put up all the pictures

One of the advantages of 'belonging'
(continued on page 2)

The Chairman's Christmas Message

Festive Greeting to all WRARC Members from the Chairman

Dear Members,

As we finish 2007 and look forward to 2008 with trepidation over Interest rate increases and the rise of Machine Gun Zuma I thought I big thank you from your chairman and committee would help soften the blow :-)

2007 has been an interesting year , We have unfortunately lost members to the Big Shack in the sky but also seen new members added.

Successful Radio marshalling at several cycle events, Club participation in many DX contests including the

SARL Field day and very well run Flea Markets at the club.

Our finances are looking stable and accessible under our new Treasurer and at last our VHF/UHF radios are being fixed should anyone want to try out a station in a VHF/UHF contest.

In February next year we will be going outside of Johannesburg for the 1st leg of the SARL Field day and hopefully this will be the first of many weekend outings for all club members to join in on.

So it just leaves me to say a BIG THANK YOU to all WRARC members because without you we don't have a
(continued on page 2)

Special points of interest:

- Contact details on back page (updated)
- Next Ham-Comp is at 13:00 on the 15th December.

Editor's rants and raves - comments

(continued from page 1)

to the Google fraternity is the storage that is available for free. My favourite picture organiser is Picasa and it now offers to store and show off your pictures. If you want to see all the pictures taken by me at the club and others about the club, go to:-

http://picasaweb.google.co.uk/brockjk/Amateur_Radio_Pics

LinRad

My statement to the club about the use of 80486's for digital signal processing being underpowered appears to be wrong. This guy - Leif Asbrink - used 80486's to do the morse and ssb reception. So the veteran pc's can still be used for something. Want to try one? Visit the

next Ham-Comp meeting on the 15th of December at 13:00. The constructor's meeting follows at 14:30. Take a look at Leif's site:-

<http://www.nitehawk.com/sm5bsz/linuxdsp/linroot.htm>

FBB

For those concerned with packet radio bulletin board systems:-

<http://www.f6fbb.org/>

On using LinFBB (FBB for Linux)

Quote: "I still administer one DosFBB database in the SRV (Amateur Radio Union of Vojvodina,

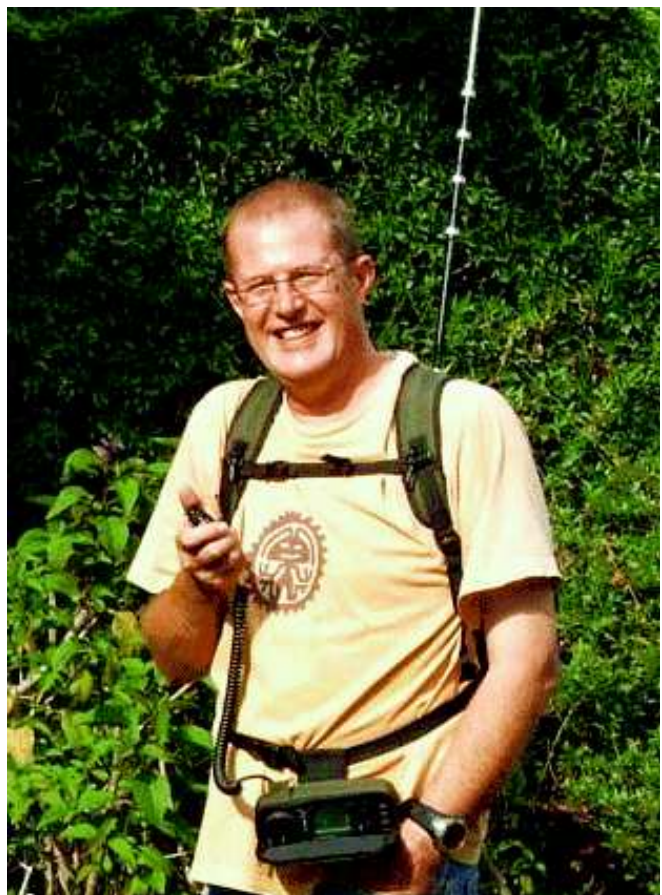
(Continued on page 3)

The Chairman's Christmas Message

(continued from page 1)

club Merry Christmas and a Prosperous New Year and I look forward to seeing you all on the first Monday in January 2008 (the 7th)

Stuart Baynes ZS6OUN Chairman WRARC



PS

QRP @ 10w using a portable set up = Bugger all contacts Hi

Editor's rants and raves - comments

(Continued from page 2)

a part of SRJ). It is DosFBB v7.00g23 that runs on a 486DX computer with 16 MB of RAM and Hercules b/w graphics. Since December 1999, it runs without any re-boot (excepting some power failures)." [Doesn't have a UPS, does he?]

"I have also used DosFBB v5.15c on a 286/12 box at home. Five years ago, when I got better box, Pentium I at 166 MHz with 32 MB of RAM and VGA colour graphics, I switched to a Windows version of FBB ("WinFBB")."

The quotes are from another ham's work; FBB Packet-radio BBS mini-HOWTO by Miroslav "Misko" Skoric, YT7MPB

You can find this work and others on:-
http://tldp.org/sorted_howtos_title.html

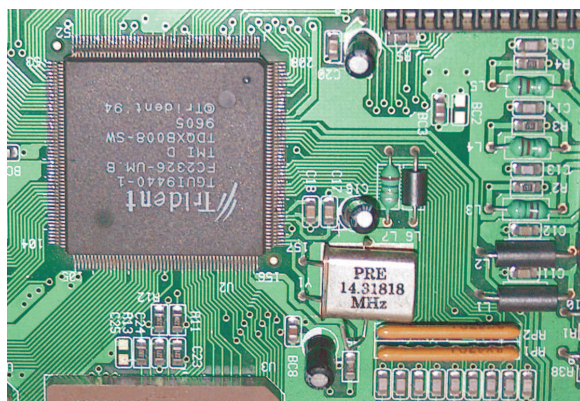
Wet wet wet

With the so-called 'unseasonal rain' we have been having, the club's web site has been going up and down like...

Please remember I live very close to a 150 metre tall mast that acts a lightning rod for the whole area. When I hear thunder, I don't think Zebra's, I unplug.

Component Mining

With the reduced production of electronic components and the ever-increasing cost of compo-



nents. It is now time to scavenge all the bits from old electronic waste.

The broken VGA display adapter shown here has donated quite a few bits and includes a crystal of 14,31818 MHz. This crystal can be used in a small signal source to test 20 metre receivers.

This oscillator can be the same as the one I put in the Anode earlier this year. The one for testing crystals.

So how to sideband modulate it? I will put a circuit together for the Electronic enthusiast's meeting. You can all try your hand at this. The working unit will be given to Roy to try out.

Looking back | forward

Looking back on this year, I see dirty, dingy Ms Windows. Lots of problems with malware and no support for the older reliable windows. M\$ has even killed the IM Santa! See the Register for details.

Looking forward I see multiple core processors taking the Pc's hardware into the realm of what used to be Cray Supercomputers. Coupled with the rapid take-up of Open Source software and systems, its going to be a bumpy ride for M\$.

How about building a MP3 Juke box at home this year? Or a Linux home server? See you at Ham-Comp.

Have a good and great Christmas.

Best wishes from John Brock (formerly ZS6BZF)
[Editor in chief and perpetuity!]



SM5BSZ Home Page - EQUIPMENT FOR VHF DX

(July 25 2007)

Update information and complete list of files for this site

Since 1961, I have been a radio amateur, and all the time my interest has been DX on 144 MHz, and in particular equipment designed for this purpose. On this site I try to share some of my experiences in designing and building equipment for VHF long distance communication.

The primary location is at <http://www.sm5bsz.com/index.htm>

There are two complete mirror sites. One in Europe <http://g7rau.demon.co.uk/sm5bsz/index.htm> supplied by G7RAU Dave and one in the USA <http://nitehawk.com/sm5bsz/index.htm> supplied by W6/PA0ZN Rein.

The digital revolution. New possibilities for the experimenter.

In the old days amateurs built their own equipment. Experimenting was a natural part of the hobby - inspired by what others did one had to try to use the parts from one's own "junk box" to do something similar or hopefully better.

With the commercial availability of the modern amateur SSB transceiver, the need for experimenting disappeared. It is not easy to design and build equipment that can compete with the commercial units. The best way to get a well performing station has long been to buy a SSB transceiver. Only very few real enthusiasts build their own receivers and transmitters.

Today the situation is becoming different. By use of simple equipment, well suited for home building, the radio signal can be moved into the digital world. Once the signal is available in digital form, a whole new world of experimentation is opened. The computer can do everything we did before using analogue circuits. Experimenting with different filter characteristics, AGC (automatic gain control), AFC

(automatic frequency control) can be done in software at no cost (except the experimenters time)

The new possibilities in interference reduction, treating different kinds of interference as signals, each one received with a digital receiver that optimises the S/N for the particular interference opens a whole new world of experiments with radio receivers that will allow reception of signals that can not be received at all with a conventional SSB transceiver.

Linrad is a free computer program that works on standard PC computers. (IBM-compatible, x86) Linrad was developed under the Linux operating system but it is available also in a version for Microsoft Windows.

Linrad receives one or two IF pass bands in digital form. Performance is determined by the hardware; the program analyzes whatever data supplied in digital form. Linrad can be used to process the analogue audio output from a conventional SSB radio or any other linear receiver with a bandwidth that can be handled by the soundcard of the computer. Linrad can also use two audio channels (stereo) to process the I/Q signal pair produced by a quadrature mixer in a direct conversion radio. In this case four audio channels are needed for 2 IF channels.

Linrad is designed for use with radio A/D converters in the future when such hardware becomes available at attractive prices. The first commercial such hardware designed for amateurs is the SDR-14, a unit that samples at 66.667 MHz with an AD6644 and reduces the sampling rate with an AD6620 to fit an USB link. Digital hardware does not behave like old fashioned analogue receivers. Conventional measurements of the intermodulation-free dynamic range, the intercept point, the point of 1 dB compression and other figures of merit are grossly misleading. This link practical performance observations for the SDR-14 shows that contrary to a conventional receiver that should

(Continued on page 5)

SM5BSZ Home Page - EQUIPMENT FOR VHF DX

(Continued from page 4)

be operated with low signal levels, a VHF-sampling receiver should be operated at high signal levels.

With the WSE converters Linrad can be used as a high performance spectrum analyzer. The frequency coverage is limited, amateur bands only and the maximum bandwidth simultaneously present on screen is about 94 kHz. Here are some high resolution spectra that demonstrate the capabilities of WSE/Linrad as a narrowband spectrum analyzer.

It is convenient to have a set of reference files containing the radio signals in digital form on the hard disk. Such files can be used for optimisation of algorithms as well as for comparing different SDR packages. The SDR data file library contains data files with various mixtures of signals and interferences as well as typical loudspeaker output files from Linrad as well as from other SDR packages to the extent others have made them available to me.

Fundamentally there is no difference between analogue and digital receivers. Both kinds have the same fundamental problems with dynamic range and spur suppression. All the new methods for combating interference have their equivalent analogue counterparts.

Here is a general discussion on radio receivers which is intended to resolve common misunderstandings and to explain how one can make sure that a receive system is properly optimized. The well known problems of low noise and dynamic range are present in digital as well as analogue circuits.

Starting with version 02.36 Linrad has a transmitter as well as a receiver. The Linrad transmitter and receiver are intended to be operated simultaneously and the operator should be able to listen while transmitting in SSB mode because the transmitter is muted during those short intervals in the speech when the voice level is low. The Linrad transmitter is currently in an early ex-

perimental stage.

Antennas

The antenna - the link between the electronics and free space - is of course the most important piece of equipment for the serious VHF amateur.

On 144 MHz, maximum gain is often the right criterion for selecting the best antenna. On higher bands clean pattern and/or low losses are more important since, for receive, gain divided by temperature, G/T is the true figure of merit. The optimum antenna is a compromise. High gain is always good, but depending on the local surroundings and the propagation mode, other factors may be more important and lead to trade off some gain in exchange for other good things.

Antennas can be optimized for maximum gain by a least squares fitting of the radiation pattern to a desired radiation pattern (zero in all directions except forward !!) It is trivial to add extra equations in the least squares fit to improve G/T, F/B, efficiency, impedance or anything else that the computer can extract from the antenna model. This optimization method is convergent - there is only one optimum design for each set of design criteria. Theory, software and hints on how to design, build and verify high performance antennas should contain everything you need to make your own optimum design.

The 2SA13 is an antenna designed for general purpose usage as a four-stack of cross polarised antennas on 144 MHz. Look here for all details on the development of the 2SA13 antenna

Polarisation

Polarisation is by convention horizontal for DX work at VHF. In some propagation modes, e.g. aurora and sporadic E, the polarisation plane may twist due to Faraday rotation, and in EME the polarisation plane may twist due to purely geometrical reasons as well. Fast switching of polarisation, as well as different polarisation for

(continued on page 6)

SM5BSZ Home Page - EQUIPMENT FOR VHF DX

(continued from page 5)

transmit and receive is very useful in these propagation modes.

Crossed yagi antennas may be used for fast and independent switching of TX and RX polarisation. Look at Electronic Polarisation Control for hints on several ways to make good use of crossed yagi systems. Of course the same methods apply equally well to feed horns or any other antenna with two orthogonal polarisations.

With cross yagi antennas, it is important to make sure that the two orthogonal parts really are orthogonal. Look here for more info and some NEC simulations. How to calibrate an adjustable polarisation antenna

Filters

Particularly for EME, very narrow CW filters may be useful. If you have access to old-fashioned calibrator crystals - use two for this high performance Narrow Filter with 2 * 100 kHz Calibrator X-tals.

If you prefer to use more modern technology look at Sliding FFT and DSP Filtering. This section describes part of the system I am currently using for EME and tries to explain why this method is equivalent to the use of several conventional DSP filters at different frequencies - where the computer continuously selects the best one.

In my opinion the best weak signal communication mode is morse telegraphy, so this mode, CW is the only mode I use on VHF. There are different opinions on what is the best way to receive weak CW signals, some use an ordinary SSB type filter, and others use narrow filters of different kinds. Here is my personal experience in listening to weak CW signals and some examples: demonstration with audio and spectrograms how a weak EME signal sounds with different kinds of filtering.

Look here for a description of my old

TMS320C25 EME system and some audio file examples of typical EME signals as they reach my head phones.

As an example of my 1998 system using a 200MHz Pentium (with MMX) look at and listen to the signals from EL2RL, a really weak EME signal. Another example of a rally weak signal is 8J1RL

Computers allow all sorts of interesting experiments. It is well known that an EME signal is about 300Hz wide at 10GHz because of the different doppler shifts from different reflection points on the moon. On 144MHz the EME signal is much narrower than one would expect from the frequency ratio. Look here bandwidth measurements of a continuous wave reflected off the moon for an experiment that clearly demonstrates that two different reflection types are present.

Another example of a computer experiment is shown here: 25W emitted from single 10 element yagi detected via EME using only 4x14 elements

PC software project

The very fast development of digital technology has not only made my dedicated hardware (TMS320C25 with 100ns RAM) obsolete. My first generation PC receiver for MS-DOS is also becoming obsolete. It was written using Watcom C and it works only with "old" computers. There is no support for modern screens and the mouse has to be a serial mouse. The MS-DOS package has served well a few years but for the future an environment where the hardware drivers are outside the radio software will prevent the DSP radio from becoming obsolete so quickly.

I am currently working on a new DSP radio package. This time the system is designed for flexibility so it can be used for many different combinations of computers, A/D boards and analog radio circuitry. The platform is Linux and

(Continued on page 7)

SM5BSZ Home Page - EQUIPMENT FOR VHF DX

(Continued from page 6)

the package will typically operate with a 486 computer together with a conventional SSB receiver as the minimum configuration. The current high end operation is with a 4-channel 96kHz A/D board and a Pentium III providing nearly 2 x 90kHz of useful signal bandwidth in a direct conversion configuration (stereo for two antennas).

The LINUX PC-radio for Intel platforms will be continuously upgraded to show various aspects of digital radio processing and how they are implemented in the dsp package. The Linux PC-radio is not designed for VHF weak signal only. It is very flexible and designed to accommodate routines for all radio communication modes on all frequency bands.

Linrad is the new name for the LINUX PC-radio since July 2001.

Noise Blankers

A good noise blanker may improve station performance a lot. It is a good idea to have several noise blankers inserted at different points along the Rx signal path. At times when there is no strong signal present on the band, a wideband noise blanker can do absolutely fantastic things - it may even remove computer spurs!!! (This is experimental, not only a theoretical idea). Look here for hints on Noise blankers

Power Amplifiers

To be successful in two way DX communication, you need a good power amplifier. Vacuum tubes are still the natural choice for high power. If you like to design an amplifier of your own, or if you have something commercial to rebuild look here for Building High Power Amplifiers

As amateurs, we often use surplus tubes. They may be brand new, but if they have been stored for many years, they should be reconditioned before use. The vacuum is gradually deteriorating over time if a tube is left on the shelf. Here is

a procedure to recondition power tubes that may decrease the risk of arcing due to poor vacuum.

Power amplifiers are often referenced as "linears", meaning linear amplifiers. To my knowledge, few amateurs run their power amplifiers in class C because a class C amplifier is far from linear and can not be used for amplification of SSB signals. In CW-mode the class C amplifier will give the same output as Class AB with much less heating of the anode because of the higher plate efficiency. This helps thermal stability, and reduces irritation among neighbours because of twinkling lights due to mains voltage variations.

It is simple and straight-forward to run an amplifier with variable class biasing by use of a grid resistor. Look here for more information on this and other aspects of power supplies for high power amplifiers.

Electronic antenna relay

PIN diodes can be used as antenna relays at high power levels on VHF. An about \$5 device, UM9415, can handle power levels of several kW continuous (key down) carrier. To listen between dots and dashes is useful in contests and during major openings. Look here for details on my High power antenna relay using PIN diodes

By recording the echoes when transmitting dots at meteor scatter speed, aurora, meteors and airplanes can be seen. Look at some typical graphs Aurora and other Echoes With Narrow Band Radar

Dynamic range

For amateurs in densely populated areas dynamic range is probably the most important aspect of the rig. Today, I do not worry since I now live in a rural area, but 15 years ago, the poor design of commercially available transceivers was the dominating problem in my efforts to work distant stations on 144MHz.

(continued on page 8)

SM5BSZ Home Page - EQUIPMENT FOR VHF DX

(continued from page 7)

In order to make my own situation better, I persuaded my neighbour amateurs to allow me to modify their rigs, and the result was a significant improvement in DX possibilities - and a series of articles. I still get questions about these articles now and then, so now they are available here:

Introduction: English // Deutsch

Modifications for TS700: English // Deutsch // Swedish

Modifications for IC211/IC245: English // Deutsch

Modifications for FT221: English // Deutsch // Swedish

Modifications for FT225: Swedish // English

Keying clicks with FT221 as an example. Perfect high speed ms keying can be done without any keying clicks. Swedish // English // Deutsch

AM keying clicks are directly related to the keying envelope waveform. For a good theoretical treatment, look at the article by Kevin Schmidt Spectral Analysis of a CW keying pulse which you can find at the W9CF links page. In case this link has become outdated you can download the article in pdf format from here with the permission from the author: [click.pdf](#) (162770 bytes) The article On the Occupied Bandwidth of CW Emissions by Doug Smith which you can find at the KF6DX site is more practical and shows the same thing. In case the link has become outdated, there is a copy here with the author's permission: On the Occupied Bandwidth by KF6DX This article also points out that the ARRL handbook has a treatment of optimum keying waveforms that is limited to envelopes formed by a single RC link. It is unfortunate that the treatment in the ARRL handbook is outdated and misleading. Keying with an exponential waveform belongs in the vacuum tube era 50 years ago when cathode keying was normal - but even then better solutions with LC filters were used.

Keying clicks are often produced by amplitude

modulation, morse code is in itself amplitude modulation and it is obvious from the links above how the shape of the RF envelope is related to the frequency spectrum in the case of pure amplitude modulation. In the real world, the transmitter frequency may be disturbed at the moment of key closure or release. If the frequency/phase modulation contains high frequencies, there will be FM keying clicks that are invisible in the RF envelope waveform. Worst case is when a VCO loses locking for a while at keydown, but phase modulation can be caused by many mechanisms. Have a look here [Keying clicks in the time domain AM and FM](#)

Amateur transceivers often use ALC to improve the average to peak power ratio by having a short time constant for the ALC. This is discussed to some extent in the KF6DX article. It is not good practise, ALC should be a safety precaution only, a circuit (TGC) that puts the peak power just below the maximum safe level and not an AM modulator that modulates the SSB signal to make the power more constant over time in a millisecond time scale while adding wideband modulation sidebands. [Click here for spectra](#), and a discussion of this problem, the main reason for splatter on the amateur bands. The abominable ALC.

Like around 1970, when new digital technology started to become popular (the frequency synthesizer) the coming years will probably bring many digital solutions that have inadequate dynamic range performance for many situations.

Dynamic range properties are characterized differently and often incompletely, which makes it difficult to compare measurements made at different places. This link [Measuring receiver dynamic range](#) suggests how data could be presented in an unambiguous way. The measurements required to make a fair comparison between digital and analogue receivers are also discussed. The third order intermodulation performance of a receiver is often fully characterized by IP3 only. The link gives a sim-

(Continued on page 9)

SM5BSZ Home Page - EQUIPMENT FOR VHF DX

(Continued from page 8)

ple theory with some oscilloscope images showing intermodulation waveforms. There is also a discussion about precision measurements and the small deviations from the simple theory that can be observed in the FT1000D.

Here is performance data of modern transceivers. The link contains dynamic range data for a number of modern amateur transceivers both in receive and transmit mode.

Amateur transceivers often use ALC to improve the average to peak power ratio by having a short time constant for the ALC. This is not good practise, ALC should be a safety precaution only, a circuit that puts the peak power just below the maximum safe level and not an AM modulator that modulates the SSB signal to make the power more constant over time in a millisecond time scale while adding wideband modulation sidebands. Click here for spectra, and a discussion of this problem, the main reason for splatter on the amateur bands. The abominable ALC. There is of course much more severe splatter caused by operator errors, but for properly operated transmitters ALC related splatter is more problematic than splatter generated by amplifier non-linearities, this is due to inadequate design and I hope it will not be like this in new amateur transceivers. The ALC problems are closely related to power regulation. Excessive power output from the IC706MKIIG in low power mode is another problem owners of this rig should be aware of.

It should be clear from the above links that my personal opinion is that transceiver dynamic range characteristics has to be better specified and measured differently from how it has been done traditionally. The below articles that have been published in DUBUS in English and German give detailed descriptions of the problems and how to deal with them.

Receiver Dynamic Range DUBUS 4/2003, pp 9 - 39. Also in DUBUS TECHNIK VI and CQ VHF in two parts. Part 1 Fall 2004 and part 2 Winter

2005.

Transmitter Testing DUBUS 2/2004, pp 9 - 45. Also in CQ VHF in two parts. Part 1 Spring 2005 and part 2 Summer 2005.

Real life dynamic range of modern amateur transceivers DUBUS 2/2005, pp 22 - 37. Also in CQ VHF Fall 2005.

EME signals received with a huge antenna

During the 2001 ARRL EME contest I brought equipment to Tobbe, SM5FRH to make recordings of the EME signals from his array of 32 X-yagis. The recordings cover about 50% of 5 hours time (9 gigabytes). This link ARRL2001 contains information extracted from these recordings as well as links to the raw data (compressed) This material gives a very good picture of 144 MHz EME signals, how their amplitude and polarisation varies with time.

Since I have some limitations in how much time I can spend with amateur radio - and experimenting is my main interest - I do not promise to answer every E-mail that arrives in my mailbox

Certainly I will try to answer any questions about the material presented at the sm5bsz site. If you have found errors, please send an E-mail so I can make corrections.

Leif Asbrink - SM5BSZ

The West Rand Amateur Radio Club
26.14122 South - 27.91870 East

P.O. Box 562
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!

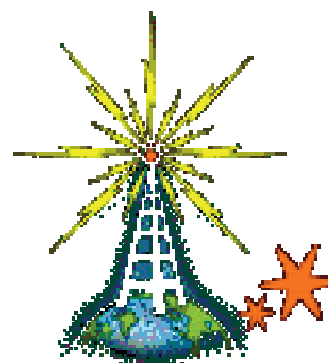
Chairman	Stuart Baynes	ZS6OUN	082 573 3359	sbaynes@iafrica.com
Vice Chairman	Ron Eva	ZR6RON		ronnie@calidus.co.za
Secretary (Anode)	John Brock	'PieRat'	011 768 1626	brockjk@gmail.com
Treasurer	Craig Woods	ZS6CRW	795 1550 (H)	craig.woods@absamail.co.za
Member	Romeo Nardini	ZS6ARQ		roshelec@global.co.za
Member	Joop Hesp	ZS6C		joophesp@absamail.co.za
Member	Geoff	ZS6GRL		glevey@gmail.com
Member (Repeater)	Phillip	ZS6PVT	083 267 3835	phillipvt@sse.co.za
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