WATTS

07-2016
Year 86 + 7m

Monthly Newsletter of the Pretoria Amateur Radio Club
Maandelikse Nuusbrief van die Pretoria Amateur Radio Klub

PARC, PO Box 73696, Lynnwood Ridge 0040, RSA
http://www.parc.org.za @ zs6pta@zs6pta.org.za

Bulletins : 145.725 MHz on Sundays / Sondae at 08:45
Relays: 1.840, 3.700, 7.066, 10.135, 14.235, 51.400, 438.825, 1297 MHz
Activated frequencies are announced prior to bulletins
Swopshop : 2m and 7.066 MHz live on-air after bulletins
Bulletin repeats on Mondays / herhalings op Maandae : 2m 19:45

Fritz Sutherland (Jnr) ZS6SFJ and Fritz Sutherland (Snr) ZS6SF at the SA AMSAT Symposium

In This Issue / In Hierdie Uitgawe

Club Meetings / Klub Vergaderings

Club Social Meeting :

Saturday 2nd of July 2016 from 14h00 at SAM

Committee Meeting :

Tuesday 14th of July 2016 from 19h00 at SAM

PARC Fleamarket and Annual General Meeting : 27 August 2016

The next Pretoria Amateur Radio Club Fleamarket and Annual General Meeting will both take place on the 27th of August at the Pretoria Old Motor Club, Keuning Street, Silverton.

The Fleamarket will commence from 07h00. Please do contact Almero du Pisani ZS6LDP (almero.dupisani@up.ac.za 083-938-8955) for more information or to book a table, or if you wish to donate any old equipment to PARC. The AGM will commence from 11h30. It will be followed by a bring-and-braai. PARC will supply salads for the event. Proxy and Nomination forms are available on page 3 of this Issue of Watts. Please do contact Johan de Bruyn ZS6JHB for more information at 079-333-4107.

PARC Committee Members / Komiteelede : 2015 - 2016

Elected Members					
Chairman, Social & Rallies	Johan de Bruyn	ZS6JHB	zs6jhb@gmail.com	012-803-7385	079-333-4107
Vice Chairman, Contests	Pierre Holtzhausen	ZS6PJH	zs6pjh@telkomsa.net	012-655-0726	082-575-5799
Treasurer	Andre van Tonder	ZS6BRC	andreh.vtonder@absamail.co.za	012-361-3292	082-467-0287
Web co-ordination	Graham Reid	ZR6GJR	greid@wol.co.za		083-701-0511
Competitions	Jaco Cronje	ZR6CMG	jacocronje@yahoo.com		081-474-2220
Clubhouse & Contests	Whitey Joubert	ZS6JJJ	zs6jjj@gmail.com		072-120-4516
WATTS, RAE & Clubhouse	Louis de Wet	ZS6SK	louis.zs6sk@gmail.com	012-349-1044	072-140-9893
Co-Opted Members					
Fleamarkets	Alméro Dupisani	ZS6LDP	almero.dupisani@up.ac.za		083-938-8955
Auditor	Tony Crowder	ZS6CRO	tcrowder@telkomsa.net	011-672-3311	
Historian, Archives, Awards	Tjerk Lammers	ZS6P	zs6p@iafrica.com	012-809-0006	083-976-4387

Birthdays – July / Verjaarsdae – Julie

01 Avida Bresler ZS6AVB
06 Helen Newton ZR6HN
13 Pieter Human ZS6PA
17 Jan (Pine) Pienaar ZS6OB
19 Theo Bresler ZS6TVB
20 Roy Newton ZS6XN
22 Roxanne, dogter van Sylvia en Tjerk Lammers ZS6P
26 Frank Schneider ZS6GE
29 Lian McAllister ZS5IE

Spouse's Birthdays – July / Julie

01 Avida ZS6AVB, sw of Theo Bresler ZS6TVB
12 Sharmaine, sw of Louis de Wet ZS6SK
17 Lyn, sw of Andre van Tonder ZS6BRC
17 Judy, sw of David Bazil Botha ZS6DBB
19 Theo ZS6TVB, husband of Avida Bresler ZS6AVB
29 Ria, sw of Peter Smith ZS6PJ

Anniversaries / Herdenkings – July / Julie

06 Elsa and Fritz Sutherland ZS6SF
06 Julie and Paul Sterling ZS6BMF
21 Pat ZR6AVC and Frank Schneider ZS6GE

Lief en Leed / Joys and Sorrows

Andre Coetzee, ZS6GCA was involved in an accident, and had to undergo surgery. He was discharged recently.

July Birthstone: Ruby

Ruby is believed to protect the wearer from evil, signify love and passion. The deep red color is associated with war and victory. Other attributes include harmony, contentment, integrity and strength

Contests and Diary of Events – July 2016 / Kompetisies en Dagboek van Gebeure – Julie 2016 (UTC Times)	
01	RAC Canada Day Contest Contest : 00h00 – 23h59
02 - 03	Venezuelan Independent Day Contest : 00h00 – 23h59
02 - 03	Marconi Memorial HF Contest : 14h00 – 14h00
03	DARC 10-Meter Digital Contest : 11h00 – 17h00
09 - 10	IARU HF World Championship : 12h00 – 12h00
10	Youth Net
16	Winter QRP Sprint
16 - 17	CQ Worldwide VHF Contest : 18h00 – 21h00
16 - 23	IARU Region 1 YOTA Summer Camp in Austria
24	ZS2 Sprint
30	SARL Special General Meeting
30 - 31	RSGB Islands on the Air (IOTA) Contest : 12h00 – 12h00

PARC SUBS / LEDEGELD FROM / VAN 30-06-2016

Bank	First National Bank	Ordinary Members / Gewone Lede : R150 Spouses / Pensioners : R50	**Your call sign must appear as statement text!**
Branch Code	25 20 45		
Account No	546 000 426 73		

Please remit your subs in time to our Treasurer, or pay per transfer into the PARC account
Betaal asb. u ledegelde betyds aan ons Tesourier, of betaal per oorplasing in die PARC rekening

Please Note : If your Club fees are not paid up to date, birthday details cannot be displayed in Watts

PARC Annual General Meeting 2016 : PARK Jaarvergadering 2016

86th ANNUAL GENERAL MEETING
86ste ALGEMENE JAARVERGADERING
Pretoria Amateur Radio Club

Pretoria Old Motor Club
Keuning Str. Silverton

Venue	Plek
Saturday 27 August 2016	Saterdag 27 Augustus 2016
Time : 11h30	Tyd : 11h30
Agenda : To be published	Agenda : Sal gepubliseer word

NB

Nominations awaited. Latest acceptance by 20 August 2016
Nominasies word afgewag. Laatste indiening teen 20 Augustus 2016
Contact details on page 2 of WATTS / Kontakdetails op bladsy 2 van WATTS

PROXY Form (cut out) || VOLMAG Vorm (knip uit)

Only paid-up members may submit proxies || Slegs opbetaalde lede mag volmagte indien

I/Ek ……..being ZS/R/U…..... give/gee ……..……ZS/R/U……..

Proxy to vote on my behalf at the 2016 PARC AGM
Volmag om namens my te stem tydens die 2016 PARK AJV **Geteken/Signed……..……**

NOMINATION Form (cut out) || NOMINASIE Vorm (knip uit)

Committee Nominations must be in writing and signed by both the Proposer and Nominee and be handed in on **20 August 2016 at latest**. Use the Nomination Form below. The Proposer and Nominee must both be paid-up members.
Komitee Nominasies moet skriftelik wees en deur beide die Voorsteller en Voorgestelde geteken word en moet **op laaste teen 20 Augustus 2016** ingehandig word. Gebruik die Nominasievorm hieronder. Beide Voorsteller en Voorgestelde moet opbetaalde lede wees.

Proposer: ZS Signature:
Voorsteller:……..ZR…… Handtekening:……
ZU

NOMINEE GENOMINEERDE	CALLSIGN ROEPSEIN	NOMINATION ACCEPTED NOMINASIE AANVAAR
1		
2		
3		
4		

Welcome to the interesting world of VHF/2m operation: Jaco Cronje ZR6CMG

Operating on 2m VHF, a very interesting frequency band allocated to Radio Amateurs can be much more than just using the repeaters. It depends on how motivated you are to take your specific interests and goals to be able to work long distances and eventually even make EME contacts.

Working DX on HF bands can be as simple as throwing a wire antenna into a tree and with good band conditions log a list of stations with 5/9 reports. However on VHF it is not that easy, more work will be required to build yagi antennas with high gain, you will find that you need more than just 10-20watt TX power and need to have a rotator to turn your antenna. It is a lot more work and skill that is required BUT the reward of achieving distances of a few hundred kilometers or even working stations on the other side of the world via earth moon earth (EME) makes all the planning and station improvements worth the effort.

The most common mode on VHF is FM with a lot of repeaters in strategic locations to provide the best possible coverage. The antennas normally used for repeater work is vertically polarized and can reach repeaters about 70km away. If you want to work repeaters further away you will need to resort to vertically polarized yagi. You can start with the vertical antenna you have by utilizing it on simplex FM frequencies, like 145.500 and even SSTV, CW and packet can be work via the same antenna system.

The existing vertical antennas can also be used on single side band by moving down to 144.300 USB were the guys works long distances. Some of the bigger stations can be worked over much longer distances. The myth that you must have big antenna systems and high power amplifiers before working on SSB 2m is incorrect even with 10 watts output and a properly adjusted and optimized antenna system you will be totally surprised on how far you are able to work stations on simplex.

The vertical antenna is a good starting point to get a feeling for SSB. In the last few weeks various stations from the Pretoria area worked stations in Krugersdorp and Kempton Park on regular activity evenings, starting around 19H30 on 145.500 FM vertical and then usually move over to 144.300 SSB to have QSO'S with the team in Kempton Park. The activities are usually on Tuesday and Thursday evenings.

The group has also experimented with horizontal polarized yagis and was pleasantly surprised with the improvement it made on the distances they were able to work and receiving good reports that normally was very difficult to achieve with a standard vertical antenna. QSO'S between Pretoria and ZS6CBQ in Krugersdorp was difficult even though Carl ZS6CBQ was using a vertical 10 element yagi. When horizontal antennas were installed and tested these stations managed to have wonderful QSO'S with signal reports of between 5/7 and 5/9.

There is a clear indication that horizontal polarized antennas are providing further distances than what is achievable by vertical antennas. We are encouraging more operators to install small horizontal yagis, or even a horizontal loop antenna and it will certainly open up a new world on VHF.

On Saturdays and Sunday mornings from around 06H00 Carl ZS6CBQ is hosting the SSB VHF net from Krugersdorp with a wide attendance from Bloemfontein, Bethlehem, Kriel, Secunda, Florida, Krugersdorp, Pretoria, Rustenburg and Phalaborwa. Some of these

stations are more than 400km away and are worked on a regular basis by stations with good modern designed yagi's using about 150 watts. The net is a good opportunity to test the performance of your station. When the very far stations are on the air, every station on the net will have a chance to see if they can make contact and exchange signal reports. You can read the success story of Rickus ZS4A in Radio ZS. He joined the VHF group less than a year ago with a weak signal in the noise. Rickus improved his station to a point where most stations in Gauteng can work him on week-ends, a distance of about 250km.

He improved his antenna system to a point where he is now regularly working EME stations and has logged nearly 70 stations in a few months. He did this without spending lots of money.

Below are a few points to consider while planning or upgrading your station to work on VHF.

1) Always try to use the best possible feed line use LMR 400 instead of RG58 you will minimize your cable loss and more power will reach your antenna.
2) Keep your feed line as short as possible to minimize feed line loss.
3) Try and minimize connections/joints e.g. Take your SWR meter out of line try to connect the antenna directly to the radio.
4) Use an antenna analyzer try to get the antenna feed point as close to 50Ohm as possible.
5) Improve you antenna by building a yagi and installed it horizontal

We are currently in the process of compiling a list of projects to be built and activities to plan for the near future. So far there are some interest in CW classes, SSTV, Digital modes, antenna rotators and antenna build days. We are also planning a braai and to get a guest speaker to give advice on how to setup your station for VHF contesting.
We hope to hear you all on VHF.

For any questions/information please contact Jaco ZR6CMG 0814742220.

The origin of "Lid"

Extracted form an old Radcomm by Hans Kappetijn ZS6KR

In Morse Code the expression "lid" is still used today to describe another operator who has poor or inconsiderate operating procedures.

When Morse Code was in its infancy it was intended that the characters should be printed onto paper tape and read as dots and dashes from there, but it soon became apparent that operators were learning to decode directly from the clicks of the machinery marking the tape.

This lead to the development of the sounder whereby the operator could more conveniently interpret the letters and numbers.

Experienced operators could distinguish the sound of their instrument in the general noise of 40 or 50 other sounders in a busy telegraph office!

Newly qualified operators gave their sounders a more distinctive sound by placing the lid of a tobacco tin on the armature.

"Lid" then became a term for inexperienced operators and has now evolved into a term of abuse for poor operators!

When everything else fails, amateur radio will still be there

Article submitted by Johan ZS6JHB, written by Rupert Goodwins (UK), posted on the arstechnica website on the 19th of June 2016.

It's a good time to be technical. Maker communities are thriving around the world, tools and materials to create and adapt are cheaper and more powerful now than ever, and open source hardware, software, and information mean that if you can think it, you can learn how to do it and then make it happen.

For one group of technological explorers, this is more than just a golden age of opportunity: it's providing the means to save one of the oldest traditions in electronic invention and self-education, one that helped shape the modern world: amateur radio.

Radio amateurs get a sweet deal, with effectively free access to many gigahertz of the same radio spectrum that companies pay billions for. They've earned it. Throughout the history of electronics, they've been at the borders of the possible, trying out ideas that commerce or government deem impossible or pointless—and making them work. Here's one example of hundreds: Allied military comms in World War II needed a way to reliably control the radios used by front-line forces, replacing tuning knobs with channel switches. Hams had the answer ready and waiting—quartz crystal oscillators. (Those are part of computing history, too. You're probably using about 10 of them right now).

The trouble with making a success of frontier territory is that it doesn't stay frontier for long. As radio hams colonised new frequencies and new methods, government and commercial interests wanted in (and they got in). What was useless yesterday can be very desirable today, and a lot of the ham bands in the once-fallow UHF and microwave spectrum now look very tempting for wireless data, satellite downlinks, and the constant chatter of the Internet of Things. Some attacks on amateur spectrum have been repelled, others have succeeded. More are on the way.

It has looked a losing battle at times, as the relevance of amateur radio seemingly faded with the advent of the Internet and cheap digital technology to play with. Radio hams looked like yesterday's people, as relevant as steam engine enthusiasts in the age of spaceflight. Who cares if they lose their spectrum if the rest of us can stream more HD cat videos as a result?

There's enough truth in that to make it dangerous. A large cohort of hams just want to play with radios and talk to their pals, but that attitude masks four things that amateur radio still does that can't be easily replaced.

Start with STEM. In the days of valve radios, it was a standard rite of passage for 10 year olds to take them apart and find out how they worked. The likes of Richard Feynman, Claude Shannon, and Robert Noyce all started that way. Good luck taking the back off an iPhone, kids—but the whole path from simple radio receivers to megabit interplanetary communication is still there. Amateur radio will take you every step, bypassing barriers and making connections. There's a reason ham radio is aboard the International Space Station. Then, there's backup. Take the European HAMNET, for example. That's a four-thousand-node high speed data network covering a large part of continental Europe and providing full IP connectivity at megabit speeds. It connects to the Internet—ham radio owns 16 million IPV4 addresses, believe it or not—but is independent of it, doing its own robust and flexible routing. If the Internet was to go away, HAMNET would still be running.

View on the *arstechnica* website a video of Tim Peak on board the ISS, describing how he communicates with school children using ham radio.

The same's true of nearly all ham radio infrastructure. When everything else fails (power, comms, roads), ham radio is still there. These days it can even be a full-fat digital medium.

This independence gives ham radio a further edge. It is vigorously non-commercial and non-governmental, and by law the format has to be open—encryption is almost completely forbidden. It's open to all nations (and nearly all allow it). It has survived war, dictatorships, disaster, and CB radio. If you want to use the airwaves, then provided you can pass a simple technical test and pay a nominal admin fee, you don't need any further permission. Increasingly, that means unique creations that can't happen any other way, like global free-to-access digital voice radio networks and international automated satellite tracking and data systems.

This resurgence has helped amateur radio keep its place at the negotiating table with regulators and lawmakers. It's kept the world full of active expertise in wireless, one of the major drivers of modern IT and also one of the guarantors that things like commercial cellular networks are constantly checked for abuse. Those radio hackers at the Def Con and Blackhat conferences who gleefully expose the flaws and backdoors in your mobile phone will usually be active ham radio geeks.

It's also a lot of fun. Nobody has to be a radio amateur, but if you want to use radio inventively, understand how it works, or need to create a communications link that doesn't conform to other people's limits or require their permission, it's there for you. Be there for it.

Rupert Goodwins started out as an engineer working for Clive Sinclair, Alan Sugar, and some other 1980s startups. He is now a technology journalist who's written and broadcast about the digital world for more than thirty years. You can follow him on Twitter at @rupertg.

Discovering losses on DC supply wiring : Hans ZS6KR

Having worked with some commercial heavy current DC supplies I always wondered why the connected wiring had to look like welding cable compared to that supplied with ham radios. When Googling "wire gauge – current" there is a multitude of data and found *Powerstream.com* an immediately useful site.

Apart from a comprehensive table it also has a calculator for any length and any gauge or thickness.
What I found very relevant to Ham radio is current data for short runs ("chassis wiring") and long runs. The figures for these two differ widely as it is all about (voltage) power loss and consequent waste by heating.
HF 100W ham radios are generally supplied with a 12 AWG twin cable which maybe up to 1,5m long.
Let us leave the effect of fuses etc out of the discussion at the moment.
I have prepared some typical results for various wire gauges per meter. Using the calculator in feet I converted the loss per 3 feet to loss per meter by multiplying by 1,083. (1m= about 39/36 inches)

AWG solid	Dia Cu mm	Area Cu mm^2	"Chassis wiring" Amp rating	Volt loss /m for 20A DC double path	Power loss W/m for 20A DC
4	5,2	21,2	135	0,037	0,73
6	4,1	13,2	101	0,049	1,0
8	3,3	5,18	73	0,083	1,6
10	2,5	4,91	55	0,133	2,6
12	2,0	3,14	41	0,212	4,2
14	1,6	2,00	32	0,337	6,8

This may not look like much but on 1,5m of 12AWG wire (max for 30A power Poles) you can loose 0,32V and probably as much on the double fusing, your Power Poles and DC input socket combined.
If so, there is 6,3W of heat each on the 1,5m cable and other hardware with a round trip current of 20A.
The input DC power loss to the radio can then be some 12W.
In practice it is difficult to measure the *actual DC radio input* but if the covers are off the measured voltage after the radio DC connector to the PA could be down more.
Nevertheless you measure 100W RF peak or CW output with your wattmeter! Your radio PA efficiency is thus sufficient and probably designed to function well with even 1V less inside the radio.

The table below is from http://www.3905ccn.com/files/pdf/mobile_installation_clinic.pdf which gives common practice figures for various applications. These figures are more conservative by 60% of the chassis wiring figures above *but still have the same losses per meter.*

Generally accepted current ratings:

10 Amps	18 gauge
15 Amps	14 gauge
20 Amps	12 gauge
30 Amps	10 gauge
45 Amps	8 gauge
60 Amps	6 gauge
80 Amps	4 gauge
100 Amps	2 gauge
125 Amps	1 gauge
150 Amps	0 gauge

When you notice considerable output power loss at full output don't always blame the radio.
It can be to your advantage to clean up connectors and fuse holders as these are the supply variables whilst the cable is always a fixed loss.
Poor mechanical pressure can create enough heat to burn off or corrode any contact plating.
Have you seen a melted fuse holder or felt a hot connector?
Bad environment can also be a factor.
Always inspect and maintain your DC power feed for optimum efficiency as it is all too often taken for granted that it needs no attention.

Amateur Radio's first geostationary satellite

The SA AMSAT Symposium held on the 28th of May 2016 at the Innovation Hub, Pretoria, once again proved to be a very interesting and informative event for radio hams and anyone interested in satellite communications. Several speakers made presentations and included the following:

- **The New AMSAT SA** : Hans van de Groenendaal ZS6AKV
- **Es'hailSat-2** : Hannes Coetzee ZS6BZP
- **Towards cost effective STEM missions** : Johan Erasmus
- **Software Defined Radio** : Deon Coetzee ZS1DE
- **Decision framework for the CubeSat nanosatellite** : Francois Oberholzer
- **Wizard-Blocks Tower BalloonSats** : Willie Taljaard ZS6WBT
- **Women in STEM** : Carla de Klerk, Medo

The contributions on the Kletskous microsatellite was lead by Hannes Coetzee ZS6BZP, and included various speakers, which inlcuded the following:

- **Update on the Kletskous VHF/UHF Transponder** : Jacques Roux
- **Electronic Power Systems : Evolving to a second prototype** : Fritz Sutherland ZS6SFJ
- **Controlling Kletskous** : Brian McKenzie ZS6BMD
- **Designing and building the space frame** : Deon Coetzee ZS1DE
- **Stabilisation and Solar Panels** : Frik Wolff ZS6FZ
- **AMSAT SA Outreach** : Nico van Rensburg ZS6QL
- **Financing, sponsorships and launch opportunities** : Hans van de Groenendaal ZS6AKV

Hannes Coetzee ZS6BZP on Es'hailSat-2

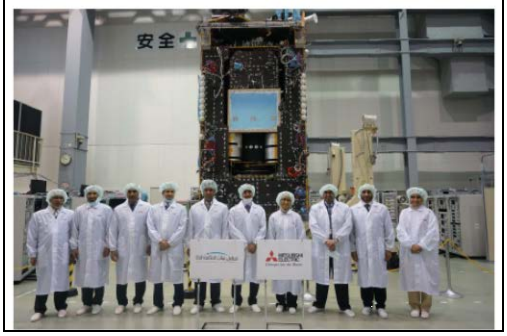
The presentation by Hannes Coetzee in particular discussed the interesting prospects following the launch of the Qatar Satellite Company's Es'hailSat-2 in the period between December 2016, and the first quarter of 2017. The satellite will carry an AMSAT linear transponder as a secondary payload, providing radio amateurs the first opportunity to gain access to a geostationary satellite.

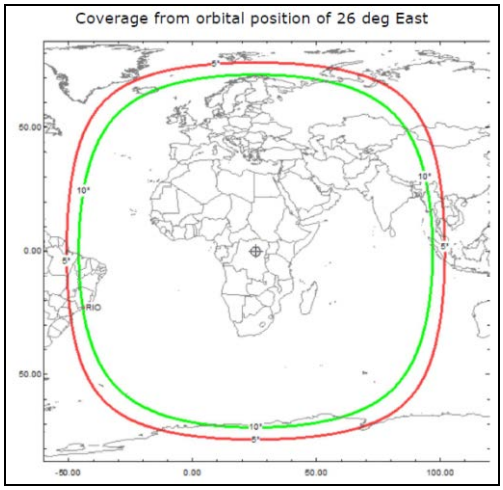
Es'hailSat سهيل سات
Qatar Satellite Company الشركة القطرية للأقمار الصناعية

AMSAT P4-A

First geostationary amateur radio transponder (incl. DATV) on *Es'hail-2*

AMSAT-DL





The Es'hailSat-2 satellite will be "parked" at a distance of 35 786km above the equator at 25.5°East, nearly due North from Pretoria and Johannesburg (28°E).

Frequencies narrow band (NB) transponder (bandwidth 250 kHz:

Uplink	2400.050 MHz	2400.300 MHz	RHCP
Downlink	10 489.550 MHz	10 489.800 MHz	Vertical

Frequencies wide band (WB) transponder (bandwidth 8 MHz:

Uplink	2401.500 MHz	2409.500 MHz	RHCP
Downlink	10 491.000 MHz	10 499.000 MHz	Horizontal

Setup for SSB communications:

RX Antenna	60-90 cm SAT-TV dish
Receiver	LNB with power injector and DVB-T dongle + SDR software, OR 3 cm LNA with down-converter to 70 cm
Transmitter	10W PEP in 60-90 cm dish plus up-converter from 144 MHz

Setup for DATV (DVB-S2) communications:

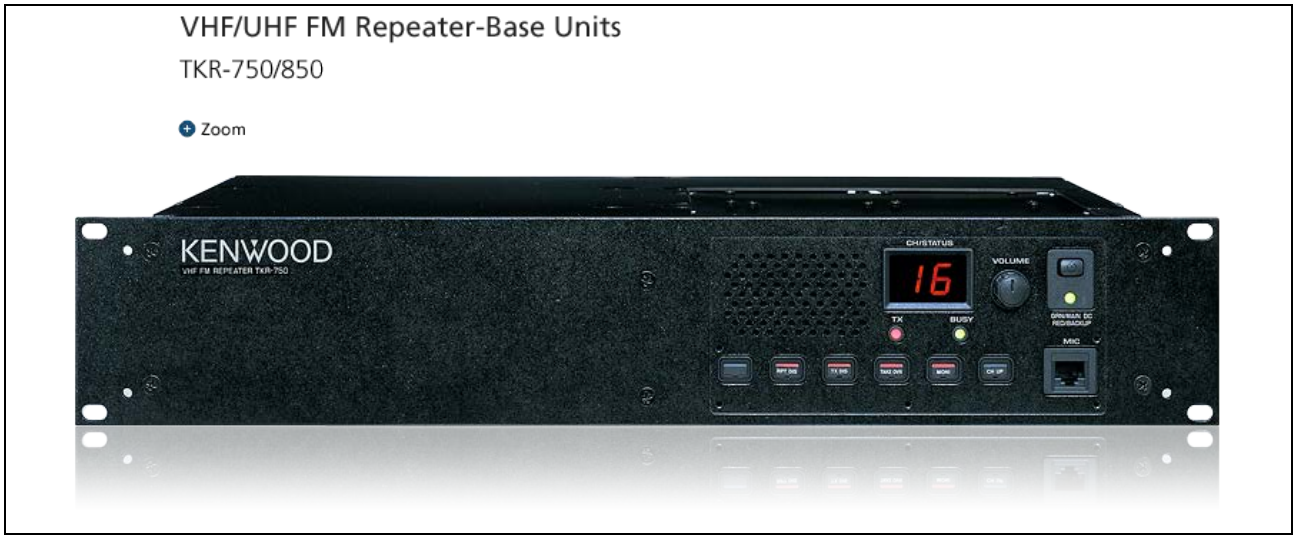
RX Antenna	60-90 cm SAT-TV dish
Receiver	Modified LNB with standard satellite receiver box (DVB-S2), OR modified LNB with PCI DVB-S2 cards for PC use
Transmitter	10W PEP in 2.4m dish plus DVB-S2 modulator

As most satellite enthusiasts already possess all mode 2m radios, they can be used to drive a linear up-converter to generate the required 2400 MHz signal. Hannes describes in his presentation the construction of the 2.4 GHz converter, and in particular the required bandpass filters or cavity resonators, constructed from plumbing copper materials.

For more information on the presentation by Hannes Coetzee and other speakers, please visit the AMSAT website at http://www.amsatsa.org.za/ . More information on the Es'hailSat-2 satellite can be found on the same website at the following address : http://www.amsatsa.org.za/P4A_Leaflet.pdf

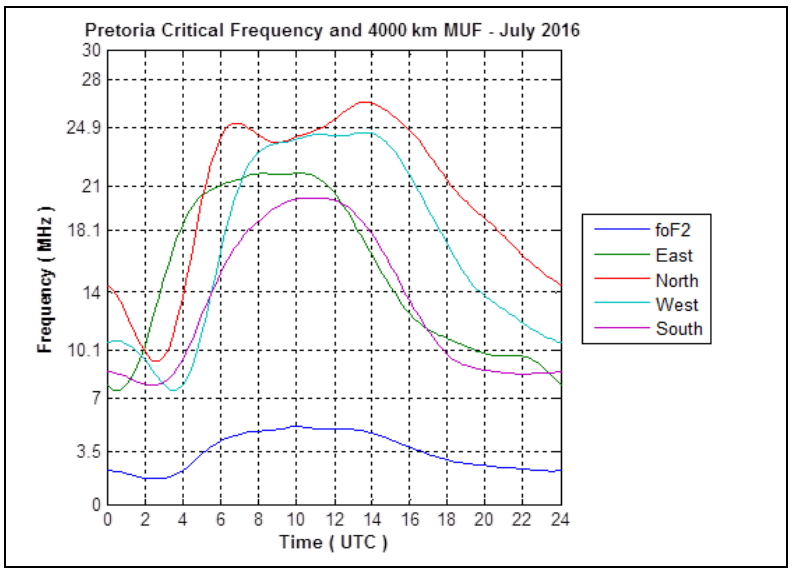
New Repeater for PARC

In order to keep up with the requirements of the PARC repeater network, a new Kenwood TKR-750 repeater was recently purchased. This repeter will be installed at the Radcliffe high site soon. As with any new transceiver, it is always great fun to unpack, as was experienced at the past PARC Club Meeting on the 2nd of July. Below are listed the technical specifications of the TKR-750.



Unpacking a new repeater is always great fun! Andre van Tonder ZS6BRC, Tjerk Lammers ZS6P, Johan de Bruyn ZS6JHB, Craig Symington ZS6RH, Richard Peer ZS6UK and Frank Schneider ZS6GE

Kenwood TKR-750 Repeater Specifications	
Frequency Range	K: 146 – 174MHz ; K2: 136 – 150MHz
Number of Channels	16 Channels
Channel Spacing	Wide: 30KHz, 25KHz ; Narrow: 15KHz, 12.5KHz
Operating Voltage	13.6V DC ± 15%
Current Drain	Standby: 0.8A Standby w/power save: 0.3A Receive: 1.2A Transmit/Receive: Less than 13A
Duty Cycle	Receive: 100% Transmit: 100% (@25W)
Frequency Stability	Less than 0.0002% at -30°C to +60°C
Antenna Impedance	50Ω
Opearting Temperature Range	-30°C to +60°C
Dimensions	483mm (W) x 88mm (H) x 340mm (D)
Weight	9.7kg



Long Term HF Propagation for July 2016

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 F-layer frequency for short range communications.

See also the Propagation tab at http://www.parc.org.za/

Courtesy Vincent ZS6BTY

Ham Radio in Philately