WATTS 05-2017

Year 87 + 05m

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

Die afgelope PARK vlooimark by die Pretoria ou motorklub was weereens 'n suksesvolle geleentheid met heelwat tafels vol toerusting en komponente gepak. Ook was daar heerlike worsbroodjies en koffie beskikbaar. Gereed om almal te help is van links na regs Paddy Martin, Sarel Stapelberg ZS6EK, Kenny Martin ZS6KMM, en Karin Stapelberg.

Next PARC Flea Market dates for 2017 / Volgende PARK Vlooimark datums vir 2017

29 July / 29 Julie ; 28 October / 28 Oktober

For more information please listen to the Sunday Bulletins or contact Alméro Du Pisani ZS6LDP at 083-938-8955 or almero.dupisani@up.ac.za

In This Issue / In Hierdie Uitgawe

Club Meetings / Klub Vergaderings

Committee Meeting :

Wednesday the 10th of May 2017 from 19h00 at SAM

Birthdays / Verjaarsdae – May / Mei

03 Andries Scoombee ZS6SCH
06 Christopher Coetzee ZU6CC
14 Johan Momberg ZS6BPB
17 Vincent Harrison ZS6BTY
21 Lukas Dorfling ZS6LMD
25 Tjerk Lammers ZS6P (Erelid)
31 David Botha ZS6O
31 Dave Williams ZS6JW
31 George Ellis ZS6GWE

Spouse's Birthdays / Gade Verjaarsdae – May / Mei

11 Zdena, sw of Ivo Chladek ZS6AXT

Anniversaries / Herdenkings – May / Mei

01 Ria and Peter Smith-Curren ZS6PJ

Lief en Leed / Joys and Sorrows

Menno Havelaar ZS6AGC het 'n toon amputasie ondergaan. Hy sterk tans tuis aan.
Pieter Fourie ZS6CN se oogoperasie was suksesvol. Hy en Annatjie is tans met vakansie.
Tony Crowder ZS6CRO was in hospital with a severe stomach ailment and dehydration.

Birthdays / Verjaarsdae – June / Junie

22 Richard Peer ZS6UK
27 Emil Bohme ZS6EGB
26 Pieter Stronkhorst ZR6PSR

Spouse's Birthdays / Gade Verjaardae – June / Junie

01 Fiona, gade van Etienne Naude ZS6EFN
12 Louisa, gade van Jaco Cronje ZR6CMG

Anniversaries / Herdenkings – June / Junie

24 Marita and Roy Alexander ZS6MI

PARC Bulletins / PARK Bulletins

PARC Bulletins are presented on Sunday mornings at approximately 08h45, after the SARL Bulletins in English and Afrikaans, from 08h15. The Bulletin Presenters for the following two months are presented below. Please do contact the applicable presenter beforehand if you wish to make a contribution to the Bulletin. PARC Bulletins are broadcast on the 2 meter repeater on 145.725 MHz, and 70 cm on 438.025 MHz. Relays are done on 7.060 MHz by Hans Kappetijn ZS6KR and on Echolink by Johan Lehman ZS6JPL.

PARK Bulletins word op Sondar oggende aangebied om 08h45, na die SARL Bulletins in Engels en Afrikaans, vanaf 08h15. The Bulletin aanbieders vir die volgende twee maande word onder aangedui. Kontak gerus die toepaslike Bulletin leser indien u 'n bydrae tot die Bulletin wil maak. PARK Bulletins word uitgesaai op die 2 meter Herhaler op 145.725 MHz, en 70cm op 438.205 MHz. Herleidings word gedoen op 7.060 MHz deur Hans Kappetijn ZS6KR en op Echolink deur Johan Lehman ZS6JPL.

PARC Bulletin Presenters : January – May 2017			
Date	**Presenter**	**Date**	**Presenter**
~~5 March~~	~~Louis de Wet ZS6SK~~	~~23 April~~	~~Etienne Naude ZS6EFN~~
~~12 March~~	~~Almero du Pisani ZS6LDP~~	~~30 April~~	~~Tjerk Lammers ZS6P~~
~~19 March~~	~~Etienne Naude ZS6EFN~~	7 May	Johan de Bruyn ZS6JHB
~~26 March~~	~~Tjerk Lammers ZS6P~~	14 May	Louis de Wet ZS6SK
~~2 April~~	~~Johan de Bruyn ZS6JHB~~	21 May	Almero du Pisani ZS6LDP

Please do contact Etienne Naude ZS6EFN or Jean de Villiers ZS6ARA for more information or any Bulletin arrangements

PARC SUBS : PARK LEDEGELD : FROM / VANAF : 30-06-2017

Bank	First National Bank	Ordinary Members / Gewone Lede : R160 Spouses / Pensioners : R60	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 Committee Members / Komiteelede : 2016 - 2017

Elected Members	Name	Callsign	Email Adress	Tel No	Mobile No
Chairman, Web co-ordination	Graham Reid	ZS6GJR	greid@wol.co.za	012-667-2720	083-701-0511
Vice Chairman, Repeater & Rallies	Johan de Bruyn	ZS6JHB	zs6jhb@gmail.com	012-803-9418	079-333-4107
Bulletins, RAE & Liason	Etienne Naude	ZS6EFN	etienne@afrigrid.com	012-661-6745	082-553-0542
Treasurer	Andre van Tonder	ZS6BRC	andreh.vtonder@absamail.co.za	012-361-3292	079-869-0753
Clubhouse Manager	Pieter Fourie	ZS6CN	pieterzs6cn@gmail.com	012-804-7417	082-573-7048
Social	Whitey Joubert	ZS6JJJ	zs6jjj@gmail.com	012-993-2267	072-120-4516
Secretary, Watts & RAE	Louis de Wet	ZS6SK	louis.zs6sk@gmail.com	012-349-1044	072-140-9893

Co-Opted Members	Name	Callsign	Email Adress	Tel No	Mobile No
Fleamarkets	Alméro Dupisani	ZS6LDP	almero.dupisani@up.ac.za	012-420-3779	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
Contests	Jaco Cronje	ZR6CMG	jacocronje@yahoo.com		081-474-2220
Contests	Pierre Holtzhausen	ZS6PJH	zs6pjh@telkomsa.net	012-655-0726	082-575-5799

Contests and Diary of Events – May 2017 / Kompetisies en Dagboek van Gebeure – Mei 2017 (UTC Times)	
06	**SARL Convention and AGM**
06 - 07	10-10 International Spring Contest, CW : 00h01 – 23h59
06 - 07	ARI International DX Contest : 12h00 – 11h59
13	**Antique Wireless Association Valve AM QSO Party**
14	**Antique Wireless Association Valve SSB QSO Party**
13 - 14	VOLTA WW RTTY Contest : 12h00 – 12h00
13 - 14	CQ-M International DX Contest : 12h00 – 11h59
20	**May Amateur Radio Examination**
21	**ZS3 Sprint**
20 - 21	Hi Majesty King of Spain Contest, CW : 12h00 – 12h00
20 - 21	EU PSK DX Contest : 12h00 – 12h00
25	**Closing date for articles for the June Radio ZS**
27	**AMSAT SA Space Symposium : Innovation Hub, Pretoria**
28	**SARL Digital Contest : 13h00 – 16h00**
Contests and Diary of Events – June 2017 / Kompetisies en Dagboek van Gebeure – June 2017 (UTC Times)	
03 - 04	10-10 International Open Season PSK Contest : 00h00 – 24h00
03 - 04	IARU Region 1 Field Day, CW : 15h00 – 14h59
03 - 04	RSGB National Field Day : 15h00 – 15h00
11	**Hammies Sprint**
14	RSGB 80m Club Championship, CW : 19h00 – 20h30
17	World QRP Day
17 - 18	All Asian DX Contest, CW : 00h00 – 24h00
17 - 18	Ukrainian DX Classic RTTY Contest : 12h00 – 11h59
22	RSGB 80m Club Championship, SSB : 19h00 – 20h30
22 - 26	**SARL Top Band QSO Party**
24 - 25	His Majesty King of Spain Contest, SSB : 12h00 – 12h00
28	ARRL Field Day : 18h00 – 21h00

Rally News 2017 : Tydren Nuus 2017

2017 Rally Calendar / 2017 Tydren Kalender			
***Round**	**Date**	**Province**	**Location**
3	19/20 May	Mpumalanga	Secunda
5	18/19 August	Gauteng	Bronkhorstspruit
7	21 October	Free State	Welkom

**Other rounds 4 and 6 are in Port Elizabeth and Caledon*

2017 Cross Country Championship Calendar		
Round	**Date**	**Location**
2	12/13 May	Dundee Battlefields Lodge
3	23,24 & 25 June	Jwaneng Botswana
4	28/29 July	TBC
5	15/16 September	Sun City
6	27/28 October	TBC

Indien u sou belangstel om met radio ondersteuning betrokke te raak, kontak gerus vir Johan de Bruyn ZS6JHB by 079-333-4107 of zs6jhb@gmail.com

Solid State Relays Part 1 : Extract from www.phidgets.com by Hans ZS6KR

Introduction

Solid state relays (SSRs) turn on or off the power being supplied to other devices, in a similar fashion as a physical switch and have the following advantages:

- SSRs produce less EMI during operation due to the absence of contact arcing.
- No contact wear or burn and if properly used, last for millions of cycles.
- SSR's have no contact bounce and are silent.
- SSRs turn on and off faster than mechanical relays (≈1ms compared to ≈10ms).
- SSRs are less susceptible to physical vibrations than mechanical relays.
- SSR's are more expensive than electromechanical relays.
- SSR's will dissipate 1-2% of the energy in the form of heat.

How SSRs Work

The control inputs are connected internally to an opto-coupler which is connected to transistors which open or close the load circuit and power connected to it. Control of an SSR is no more complicated than turning an LED on and off. The challenge is to pick an appropriate type of SSR for your application. There is no single SSR perfect for all applications. When an SSR fails, it most often fails permanently closed. This is because when the transistor inside fails due to excessive current or heat, it will usually short out, allowing current to pass through unimpeded. This means that as long as the power supply remains on, the load will be powered, possibly creating a fire or safety hazard.

Identify your voltage and current

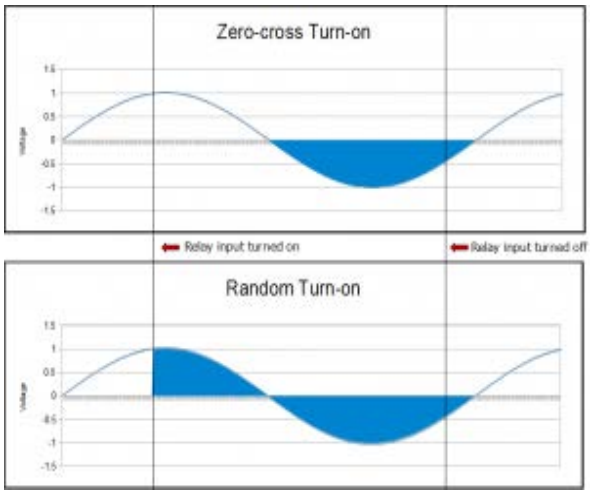
First, determine whether you need to switch AC or DC voltage. Next, determine the maximum number of volts you will be switching. If you are switching DC, particularly with batteries, assume your voltage is at least 25% more than what your battery is rated for. Even larger fluctuations occur on AC, but AC SSRs are designed to handle these surges. Typical AC voltage from a wall socket is usually 220VAC. The current drawn by your load when turned on affects how large of an SSR you need, and how hot it will be when it is in use. Determine the Average Load Current by: Watts/operating voltage.

Next, you need to know the current drawn by your load when it is first turned on. Many loads demand a huge inrush of current when the load is first turned on. This places a significant amount of stress on the electronics inside the SSR. It's very difficult to measure the Surge Current itself, so we use a multiplier based on your device type. Surge Current is also referred to as **inrush current**.

Surge Current Multiplier	
Application	**Multiplier**
Incandescent Light Bulbs	X6
Motors	X6
LED's	X1
Complex Electronics i.e. Motor Controllers, Phidgets	X6
Fluorescent Light Fixtures (AC Only)	X10
Transformers	X20
Heaters	X1

Gradual Dimming: If you want to dim it gradually, you can use a proportional control SSR. They are able to reduce the average power to the load gradually, in proportion to the strength of the input signal.

There is no such thing as a perfectly resistive load - but a load has to be very inductive to cause zero crossing SSRs to malfunction. SSRs are designed to either turn on immediately (**Random Turn On**), or wait until the next 'alternation' of the voltage (**Zero Crossing**). Zero Crossing SSRs create less electromagnetic 'noise' when they turn on. They are best used with resistive loads - Zero Crossing SSRs are not able to turn off some inductive loads.



This graph shows the difference between zero-cross and random turn-on.

The blue line represents the oscillating voltage of an AC load, and the shaded areas represent the sections when the relay is turned on and letting current pass through.

As you can see, the random turn-on SSR immediately opens when activated, while the zero-cross turn-on SSR waits until the voltage crosses zero before opening.

If your load is inductive, you need to choose a **Random Turn On** relay. If your load is resistive, choose a **Zero Crossing** relay.

Inductive and Resistive Loads	
Application	**Load Type**
Incandescent Light Bulbs	Resistive
Fluorescent Light Fixtures	Inductive or Resistive*
Motors	Inductive
Transformers	Inductive
Heaters	Resistive
Computers / Electronics	Resistive
AC/DC Power Supplies (brick heavy type)	Inductive
AC/DC Power Supplies (lightweight switchers)	Resistive

For fluorescent light fixtures, older units (magnetic ballast) may be inductive, and newer units often resistive (electronic ballast)

Choosing your AC SSR: Now that you have identified your Operating Voltage, Average and Surge Current, and your load type (inductive or resistive), you can create a short list of relays whose

- **Maximum Load Voltage** are greater than or equal to your operating voltage,
- **Maximum Surge Current** are greater than or equal to your surge current, and
- **Load type** matches what you chose for random turn on/zero crossing.

Now compare the **Max. Load Current without Heatsink** value for the SSRs on your list to your Average Load Current. If your Average Load Current is greater, you may need a heatsink.

At this point, you know the SSR you need.

Part II next month.

Radio Support during Crisis Incidents : Johan ZS6JHB

The people who keep communication lines open when disaster strikes are looking for new talent.

That's amateur radio clubs, and they're increasingly filled by people above the age of 50, who would like to prepare the following generation to help in a crisis, says Mike Johnson, emergency management co-ordinator for Cumberland County.

"We have so much technology that we rely on, and when it's taken away, it creates a problem," Johnson said Thursday. "There's no question we need new blood."
Once licensed, amateur radio operators — or HAM operators — can "set up a radio with a 12-volt battery and transmit to the world, to let them know how things are," Johnson said.

In a crisis, if the servers that look after cellphone and landline transmission are down, "getting hold of emergency responders gets to be difficult, because people who live in,

say, a 661 prefix can't call a 667 prefix, so they can't get through to the emergency service," Johnson said.

So in Cumberland County, for example, " (HAM) radio members go to the various fire departments where we've already arranged equipment," Johnson said.

"We broadcast to the public: If you have an emergency, please call the local fire department. From the local fire department that information is passed on to the amateur radio member, who relays it through to a central location where the appropriate organization — ambulance, fire, police — is able to respond to the incident."

That system was formalized in 2008, after a backhoe on the side of the Trans-Canada Highway in Amherst cut the fibre-optic cable, Johnson said."All digital communication east of that point to Newfoundland went down. ATMs, all 1-800 numbers, 911 — even TMR (trunk mobile radio, used by police and fire services) linking is done by Internet, so the communication between TMR towers went down.

"It was a major communication loss."

During that incident, fire departments radioed emergency calls to a central location, where the appropriate agency was notified.
That led to amateur radio clubs agreeing to provide service to several fire stations in Cumberland County and now, "they're deeply entrenched with us," Johnson said.

"They have offices in here . . . with high-frequency radios for worldwide communication, as well as VHF for local communication.

"We purchase equipment, they maintain the process. So we get a lot of free work out them and they get some equipment out of us. It works out very well."

There are about 35 people in the Westcumb Amateur Radio Club, one of 29 clubs in the Maritimes. Members share technical tips and run field days, including fox hunts, where a low-power transmitter is hidden and the person who finds it first wins a free radio.
They also help in fundraisers, such as athletic races through areas where cellphone service is not available.

PARK Vlooimark : 29 April 2017

As u die plek en die geleentheid soek om van u oortollige komponente en toerusting onstlae te raak, en weer ‘n ander Amateur te verlig van sy oortollige komponente en toerusting, dan is die PARK vlooimark net die plek! Weereens was daar op die 29ste April talle tafels volgepak beskikbaar, asook ‘n hele paar bakkies wat gelaai was met iets van alles en nog wat.

Weereens baie dankie Almero Du Pisani vir die harde werk agter die organisering van die geleentheid, asook Kenny Martin ZS6KMM en sy gade, Paddy, en Sarel Stapelberg, en sy gade, Karin, vir die heerlike wordbroodjies en koffie wat verkoop is. Die volgende vlooimark is op die 29ste Julie weer by die gebruiklike Pretoria ou motorklub. Kontak gerus vir Almero (kontak details op bladsy 1) vir meer inligting.

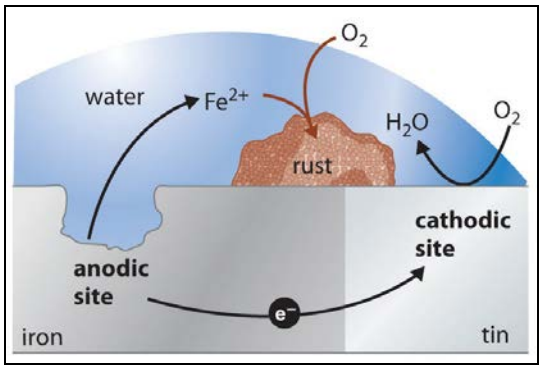






Galvanic Corrosion : Part 2

In the previous edition of Watts, we touched on the basics of corrosion, and the chemical process that take place in a piece of iron being corroded. In the case where two pieces of dissimilar metal (for instance iron and copper) are electrically connected to each other, a phenomenon called galvanic, or bi-metal corrosion takes place if moisture, or any other conducting electrolyte is present. This results in an enhanced and aggressive corrosion of one metal (Eg. Iron-Fe) at the joint area, and with a partial, or complete protection of the other metal (Eg. Tin-Sn) (Figure below).



A number of examples exist where two dissimilar metals are in close contact to prevent corrosion. To prevent the corrosion of Iron, a layer of chromium is deposited onto faucets or car bumpers to protect the inner iron layer. "Tin cans" that keep foods are made of steel coated with a thin layer of tin on the inside. Both chromium and tin are not intrinsically resistant to corrosion, but both form protective oxide coatings.

In the case of corrugated steel roofing, a coating or layer of galvanized zinc provides protection against corrosion. However, when the coating is partially damaged, both zinc and the underlying steel are exposed to the aggressive environment. Fortunately, the zinc is attacked, while the underlying steel is protected. However, when the zinc layer (or coupon) is consumed, will the steel be attacked and consumed.

The ultimate question subsequently is: "why does one material or metal corrode faster than another"? The reason for this is that materials (metals) have different electric (or corrosion) potentials, which is the main driving force for galvanic corrosion. The "corrosion potentials" of any two metals in a corrosive environment will determine the direction of the transfer of electrons. Electron transfer will take place from a metal with a (more) negative potential (less noble) to a metal with a more positive potential (noble).

Standard Electrode Potentials in Aqueous Solution at 25°C	
Cathode (Reduction) Half Reaction	**Standard Potential E^o (Volts)**
$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$	-2.38
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	-1.66
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	-0.76
$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$	-0.74
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	-0.41
$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$	-0.40
$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	-0.23
$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$	-0.14
$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	-0.13
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	0.34
$Ag^{+}(aq) + e^- \rightarrow Ag(s)$	0.80

The full list of Standard Electrode Potentials is quite extensive, but for this purpose, a number of elements were selected, illustration the corrosion potential differences between them. In this table, it is clear that Fe^{2+} (E^o = -0.41V) is more easily oxidized than tin Sn^{2+} (E^o = -0.14V). Subsequently, the more corrosion resistant tin will accelerate the corrosion of iron by acting as the cathode, and providing a large surface area for the reduction of oxygen. A damaged tin can is an example, which rusts up quite rapidly. In older homes where copper and iron pipes were connected to each other, the less easily oxidized copper (E^o = 0.34V) acts as the cathode, causing a rapid corrosion of iron at the contact point.

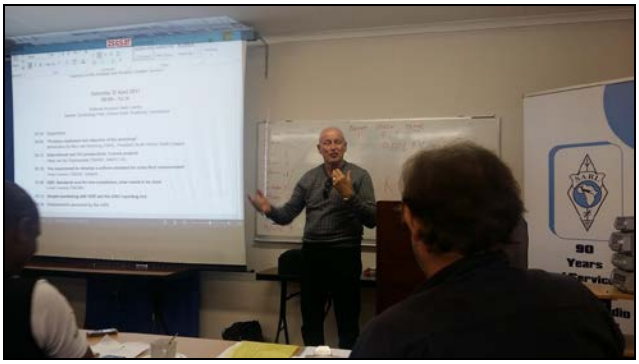
Fortunately, the relationship between iron and zinc is the opposite as with iron and tin, which enables us to protect iron from corrosion by an approach called cathodic protection. In this case, the more reactive zinc (E^o = -0.76V) becomes the anode, and iron becomes the cathode. This prevents the oxidation of iron and protects the iron from corrosion. This takes place by the following reactions:

Cathode: $O_2(g) + 4^{e-} + 4H^+(aq) \rightarrow 2H_2O(\ell)$
Anode: $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$
Overall: $2Zn(s) + O_2(g) + 4H^+(aq) \rightarrow 2Zn^{2+}(aq) + 2H_2O(\ell)$

The more reactive zinc reacts with oxygen and dissolves, thereby "sacrificing" itself to protect the iron object. Cathodic protection is the underlying principle of galvanized steel, commonly used on steel structures, underground pipes, vehicles, etc. More on protection techniques in next month's edition.

SARL Workshop : Increasing RF Noise Floor Level

The South African Radio League Workshop, in association with AMSAT SA, on *"The increasing RF Noise Floor Level and it's impact on Radio Communication with particular reference to the Amateur and Amateur Satellite Service"* was held at the SARL headquarters on the 22nd of April 2017. Nico van Rensburg ZS6QL (SARL President) opened the gathering with a problem statement and outlined the objectives of this workshop. Nico defined the problem of omnipresent EM "smog" especially in urban areas across the entire frequency range, from long wave to microwaves. Hans called for (i) the development of a coordinated program managed by a sub-group, (ii) establishment of a monitoring system of background RF noise, (iii) consider mitigation methods to deal with man-made noise affecting amateur radio frequencies, and (iv) emphasize RF noise more in the RAE syllabus.



Hans van de Groenendaal ZS6AKV (AMSAT SA), reporting on *International and ITU perspectives*, stated that in an ITU discussion, that the problem of the increase of the RF Floor across all bands has been discussed as long as 20 years, but that no definite international standard system for RF noise measurement is in place. No benchmark exists by which means RF noise is to be measured, and to which level. Currently, SARL is in co-operation with the SABS TC73 working group and ICASA to address this problem, and establish the monitoring group within the Amateur Radio community.

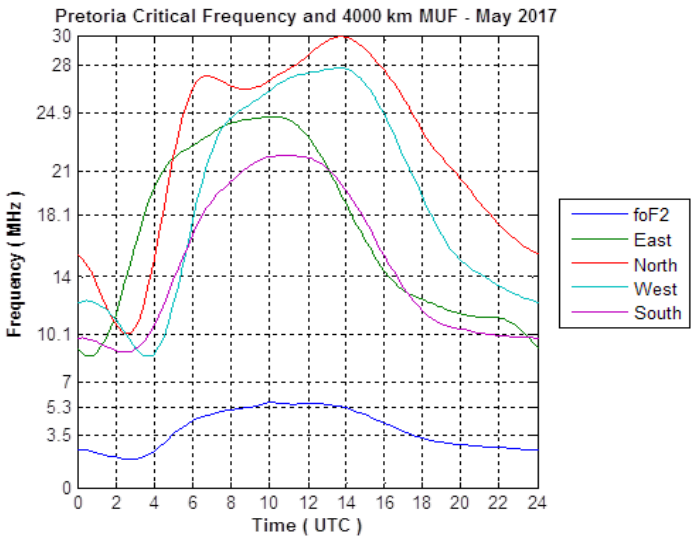
Jaap Lourens ZS6SAI, (Sentech) presented a paper *"The requirement to develop a uniform standard for noise floor measurement"*, listing the major sources of EM noise which include electric fences, power lines, switch-mode power supplies, street lamps, signage and neon lights, LED light sources, digital system routers, long distance OTH radars, and others. His full paper appeared in the latest newsletter (May 2017) of the Antique Wireless Association, and can be downloaded at http://www.awasa.org.za/Newsletters/2017/130May17.pdf .

Leon Lessing ZS6LMG reporting on "*EMC Standards and the non-compliance, what needs to be done"* reported on various South African Standards, which included SANS 214-1 : CISPR13 for interference prevention by household appliances, electrical tools and similar apparatus, SANS 215 : CISPR15 for electrical lighting (including LED lights), which appear to become a major problem, SANS 222 : CISPR22 for Information Technology equipment, and SANS 50065-1 for low frequency (3kHz – 148kHz) sources such as geyser controllers etc. Currently, SABS certification focuses on product safety, but there is an awareness being created to take RF noise generation into consideration as well.

Hans van de Groenendaal ZS6AKV concluded the workshop with a presentation on *"Simple monitoring with SDR and the IARU reporting tool"* discussing the methodology with which the RF noise floor can be measured on a continuous basis from home using SDR by a group of Radio Amateurs. The aims (below) of the working group which was established beforehand were re-worked before closure, and a follow-up date set for a re-convening of this group.

- Developing and action plan
- Creating awareness of the issues
- Working with ICASA and SABS TC73
- Forming a permanent work group

Should you be interested in participating in the activities of this group, please do contact Hans van de Groenendaal ZS6AKV at sarlregwg@sarl.org.za .



Long Term HF Propagation for May 2017

DX Operating

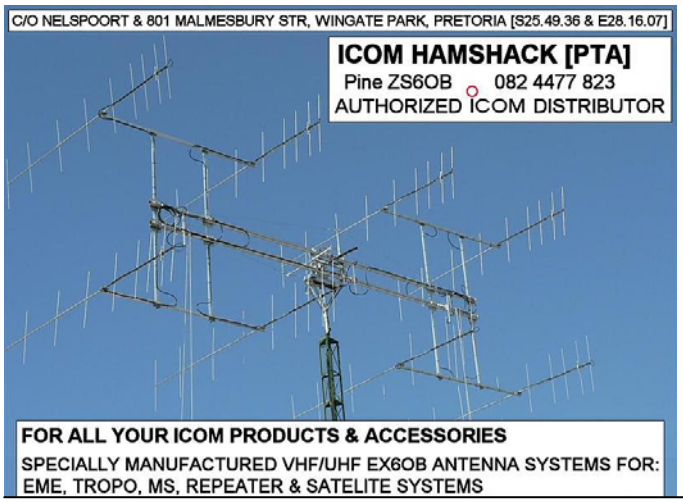
The graph shows the 4000 km maximum useable frequency (MUF) to the East, North, West and South from Pretoria for the first hop using the F2 layer.

Local Operating

The F2 critical frequency (foF2) is the maximum F-layer frequency for short range communications.

For worldwide propagation see:
http://www.parc.org.za/index.php?page=propagation

Courtesy Vincent ZS6BTY



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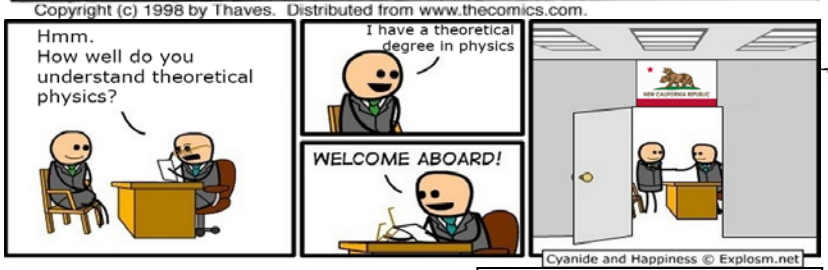
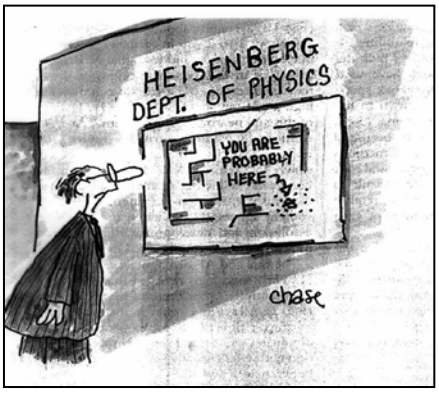
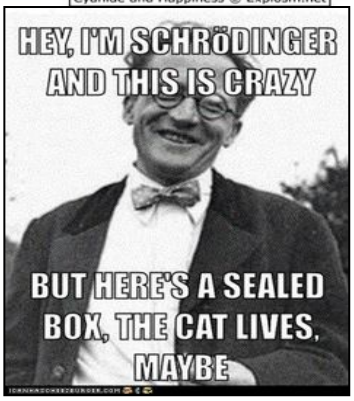
- 30A DC switching supplies
- 30A DC Anderson Power Poles
- Connectors RF and Audio
- Plug-in triple sequential industrial timers

Contact Hans at 012-333-2612 or 072-204-3991

"And you're quite sure it's just a hypothetical cat?"







"Good morning and welcome to the Wonders of Physics."