

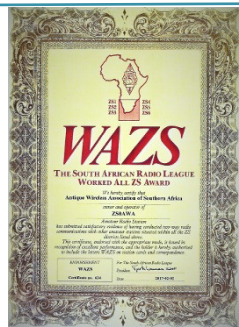


Newsletter

The Antique Wireless Association of Southern Africa

158

September 2019



Inside this issue:

HF Happenings	2-4
Voltage Multiplier	4-7
R1155	8
SMPS Interference	
SK Items	9
Notices	10 - 11

AWA Committee:

- * President and Western Cape—John ZS1WJ
- * VicePresident—Renato ZS6REN
- * Technical Advisor—Rad ZS6RAD
- * Secretary/PRO—Andy ZS6ADY
- * KZN—Don ZS5DR
- * Historian—Oliver ZS6OG
- * Member—Jacques ZS6JPS

Reflections:

I can feel the sounds of the end of the year coming on already. That gentle rumbling that you don't hear in the ear, but deep down in the depths of your body.

My, how this year has gone by. It seems like just the other day that we were all talking about a New Year and how we wished all well for it and that it would be a good year, and now we are already staring down the barrel at the end of another one.

The time is coming for a new President and perhaps a new committee to support him in his endeavours to keep the biggest radio club in SA going. Yes, and we can say that quite openly. We have gone from strength to strength and sit with the largest membership.

Next year will see our 17th year since inception and who would ever have thought it would go this

far ? I keep saying that same thing every year, but its true.

“The time has come the Walrus said, to speak of many things....” Our Saturday morning nets have kept us going over this entire period of time and the subjects that are chosen for discussion always bring a great amount of discussion that we are sure are enjoyed by many. The bands have been up and down over the years, sometimes encouraging participation, other times keeping people away. We have lost many of our members who have gone SK, but many more have joined the ranks to cause our membership to swell. Its encouraging to see many new members, still relatively young, taking an interest in the old boatanchors.

I think that the founding members, made a very wise

decision to open up the AWA from the Collins Collectors Association, because that's where it all started.

Today we all bear witness to that decision every time we use the call sign ZSOAWA, or go on to the website and leave messages or swops or attend fleamarkets with our AWA badges on or give talks at clubs about valve radios or get involved in CW on a Saturday afternoon.

The difference we have made in amateur radio in SA, and further, has to be felt far and wide, because we are involved in so many different aspects of amateur radio and have made our presence felt in amateur radio.

So to each of you, I lift my hat and say “Thank you for your participation. You really do make a difference”.

Best 73
DE Andy ZS6ADY

WIKIPEDIA

Radio propagation is the behaviour of radio waves as they travel, or are propagated, from one point to another, or into various parts of the atmosphere. As a form of electromagnetic radiation, like light waves, radio waves are affected by the phenomena of reflection, refraction, diffraction, absorption, polarization, and scattering. Understanding the effects of varying conditions on radio propagation has many practical applications, from choosing frequencies for international shortwave broadcasters, to designing reliable mobile telephone systems, to radio navigation, to operation of radar systems.

Several different types of propagation are used in practical radio transmission systems. Line-of-sight propagation means radio waves which travel in a straight line from the transmitting antenna to the receiving antenna. Line of sight transmission is used to medium range radio transmission such as cell phones, cordless phones, walkie-talkies, wireless networks, FM radio and television broadcasting and radar, and satellite communication, such as satellite television. Line-of-sight transmission on the surface of the Earth is limited to the distance to the visual horizon, which depends on the height of transmitting and receiving antennas. It is the only propagation method possible at microwave frequencies and above. At microwave frequencies, moisture in the atmosphere (rain fade) can degrade transmission.

At lower frequencies in the MF, LF, and VLF bands, due to diffraction radio waves can bend over obstacles like hills, and travel beyond the horizon as surface waves which follow the contour of the Earth. These are called ground waves. AM broadcasting stations use ground waves to cover their listening areas. As the frequency gets lower, the attenuation with distance decreases, so very low frequency (VLF) and extremely low frequency (ELF) ground waves can be used to communicate worldwide. VLF and ELF waves can penetrate significant distances through water and earth, and these frequencies are used for mine communication and military communication with submerged submarines.

HF Happenings:

Google Earth

Francesco, IV3TMM has prepared the KMZ files for showing CQ and ITU zones on Google Earth and made them available for download on <https://g7vjr.org/>.

Vincent, F4BKV has updated the KMZ file containing all IOTA groups including the six new ones. The new version (iota-v-3.kmz) can be downloaded from <https://iota-world.org/> (click on "Downloads" in the drop-down menu under "Programme Information").

African DX

Contacts with stations on the African continent count towards the SARL's All Africa Award (www.sarl.org.za/public/awards/awards.asp)

Burundi, 9U. Francesco, IV3TMM operates as 9U3TMM from Bujumbura between 31 August and 17 September. He will be active on 60 to 6 m using SSB, FT8, and RTTY. QSL via IV3TMM via the bureau and LoTW.

Somalia, 6O7O. Ken, LA7GIA, reports [edited]: "I will be active from Somalia between 14 and 28 September on all bands 160 to 10 m mainly on CW. Activity on other modes (SSB, FT8) will be limited and on 1 or 2 bands only. This trip has proved to be very difficult to plan, but finally after 3 site visits all details are sorted out. I have all permits in hand – and look forward to returning to Somalia after 18 months. I will particularly focus on working NA this time, as well low bands. I have some good vertical low band antennas, and some good RX antennas. The RX antennas will hopefully be located far away from noise sources. There will be a guard protecting the beverages 24/7. Please follow my instructions when it comes to calling for geographical areas. Because there is a very short opening to NA on low bands, in particular western part of

NA. If there is propagation, I will only call for NA when we approach my sunrise. EU will have the best conditions and shall try to work me during their evening time on low bands. Please carefully note the QSO and QSL policy mentioned on my Web page. Free and fast LoTW is only for the good first class operators who can follow the QSO policy and DX code of conduct. I have some additional security related expenses like an armoured car, armed guards, etc. If you would like to contribute to protecting the low band antennas from being stolen, cut or moved – make a donation to PayPal (kenneth@opskar.no). Anyone who donates in advance before the DXpedition end will receive direct QSL and express LoTW! This time I would also like to offer you the possibility to donate to a humanitarian fundraiser for the Norwegian organization Sabona who helps children in Africa. Please use the same PayPal address but indicate your call and that it is meant as humanitarian donation. Please look for more info on my Web page (<https://www.la7gia.com/where-next/>). QSL via M0OXO. Logs will be uploaded to ClubLog. Also, make sure you read Ken's "QSO & QSL Policy" on his Web page.

The Gambia, C5. Don, G3XTT, will once again be active as C56DF from The Gambia, but this time in CQ WW DX CW Contest (23 and 24 November). Look for operation before and maybe after the contest. Activity will be on various bands, probably all CW like last time using low power (IC-7300 and wires) from a rooftop apartment. He will, of course, upload logs to LoTW and ClubLog, but possibly only after his return to the UK. QSL direct to Don's home callsign or via ClubLog's OQRS.

African Islands

IOTA Frequencies

CW: 28 040 24 920 21 040 18 098 14 040 10 114 7 030 3 530 kHz

SSB: 28 560 28 460 24 950 21 260 18 128 14 260 7 055 3 760 kHz

Ascension Island, ZD8. Steve, WB4GHY, is currently on Ascension Island on a work detail. Look for him to possibly

Calendar:

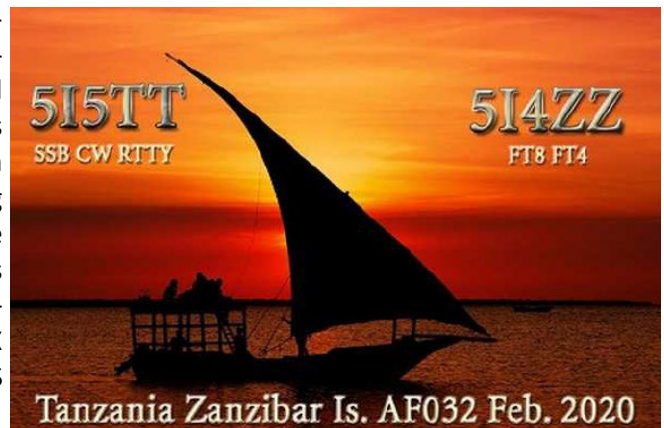
September

- 1 - JARL Ham Fair, Tokyo; National Harbour Week starts
- 2 - Closing date HF CW logs
- 6 to 8 – Ceres Railway West Coast Trip
- 7 – the West Rand Flea Market
- 7 and 8 - Region 1 SSB and RSGB SSB Field Days
- 8 to 15 – SA National Parks Week
- 14 and 15 – the SARL National Field Day; Churches and Chapels on The Air
- 15 – RAE Registration closes
- 16 - World Ozone Day
- 17 - Highway ARC Monthly Meeting
- 18 - The Battle of Square Hill - 18 September 1918; the SARL 80 m Club Sprint
- 20 - Provincial schools close
- 20 to 22 – the 2019 Darling Wildflower Festival
- 21 and 22 - All Africa DX contest; SARL VHF/UHF Digital contest; Railways on the Air
- 21 to 24 – Magoebaskloof Spring Festival
- 22 - Spring Equinox
- 23 - Closing date for NFD logs
- 24 - National Braai Day / Heritage Day
- 26 to 29 - SA Bull Run, Vanwyksvlei
- 26 - World Maritime Day
- 27 - World Tourism Day
- 27 and 28 – Fish River Canoe Marathon,

be active on various days as ZD8SC. The length of his stay is unknown. Activity will be on 80 to 10 metres on SSB only using an IC-7000 to a directional antenna. QSL via WB4GHY or LoTW.

Tristan Da Cunha, ZD9. (Emergency Fund Appeal). Steve, G4EDG/ZD9CW, reports [edited]: "On July 18/19th, Tristan suffered a terrifying storm, the worst for nearly twenty years. Severe damage was suffered by residential, administration buildings as well as to the school and fish processing factory. Thankfully nobody was injured, but life on the island has been severely affected and work is in progress to repair the buildings. Materials for this task are on their way from South Africa on the MV Edinburgh, the same boat that took me to the island last year for my ZD9CW operation, a rough journey of seven days. Perhaps DXers would consider donating to help with the daunting task of restoring Tristan to some sort of normality." For more details and on how you can help, see <https://www.justgiving.com/campaign/tristanemergencyfund>

Cape Verde, D4. Harald, DF2WO, will once again be active as D44TWO from Praia, Santiago Island (AF-005), between 29 September and 13 October. Activity will be holiday style on 160 to 10 metres using CW, SSB and the Digital modes. He states that he works mostly on the Digital modes (FT8, PSK31, JT65 and RTTY) and slow CW. It was reported this past week that "he has been working hard in the last few months getting his Satellite station working and is now confident he will use it from Cabo Verde. He will be using an Icom 7300, 2 transverters with 3 watts output on ES-Hail using the QO-100 Geostationary Satellite." He will also have a FT-450D into a homemade HEX BEAM and a dipole for 40 metres. QSL via M0OXO (OQRS available).



4U1UN

The following update was posted to the United Nations Amateur Radio Club's Facebook page on 25 August, "We are receiving a lot of messages regarding the lack of 4U1UN (United Nation Amateur Radio Club) activity on the bands. We will try to clear some things about the current Club's activities. Many of you do not know that after the renovation of the UNHQ building in New York, the room dedicated to the recreation area, on the 41st floor, in which the 4U1UN radio equipment was located, was transferred to the special UN unit - Broadcast and Conference Support Section. That room now is allocated to professional communications equipment. This was the only room technically suitable to be used for installing our gear, with easy access to the roof but after renovation it became off-limits for any other services, except BCSS.

Please do not think that UNARC members gave up and are doing nothing - believe me, almost daily communication has not been interrupted for the past seven years. After the successful activity of 4U70UN back in 2015, with the support of the UN Administration, we were able to secure a tiny 20-square-foot room for the Club's needs on the ground floor of the building. For obvious reasons, no one will give us the opportunity to run a separate coaxial cable from the ground floor to the 41st floor. Considering the fact that the room, allocated for the Club, can be transferred to any other place at any time, we have developed a project for installing a remote station on the 41st floor. The main difficulty in quick implementation of such project at the UNHQ is not political, but administrative and organizational. The BCSS is responsible for the security for all the UN communications equipment. They provide the entire UN communication (including emergency etc.) to all UN field locations around the World. There are communication repeaters, satellite links and other equipment, access to which is strictly limited. Only security personnel, authorized by this service, have permission to be there. Coordination of access to this room for club members (UN staff) at such a high level, takes several months to be approved, and the time allowed for work is limited to only one or two hours per visit. If it were not for BCSS support, nothing would have been possible at all, even the placement of the beacon station and antenna! Imagine that you want to put a remotely controlled and unsupervised amateur radio station in the server room of the White House special communications service, and you will get the picture. Every time we get access - we are accompanied by representatives of three different UN services, and only because none of us is giving up - the process of returning the UN amateur radio station in the air, although slowly, continues.

The Cockcroft-Walton voltage multiplier

John ZS5JF

Introduction

Many electronic engineers have heard of this special voltage multiplier and it finds widespread applications where a relatively low ac voltage needs to be converted into a dc voltage of a much higher voltage. What a lot of people don't know is how it came to be invented. To answer that we have to go back to the early 1930s in England.

Who was Cockcroft-Walton?

Well, despite some beliefs it wasn't a single person having a double barrelled name but two separate scientists working at Cambridge University under the eminent New Zealand scientist Sir Ernest Rutherford. John Cockcroft (later Sir) was a British post graduate student and Ernest Walton was an Irish student and between them they made one of the greatest breakthroughs in atomic science. So much so that jointly they were awarded the Nobel Prize for their work.

So if they were working on atomic science, why invent the voltage multiplier?

There is an old saying "*Necessity is the mother of invention*" and this is a classic example of that saying.

Early work on atomic science laid the groundwork for what scientists believed was how the atom was made up. At the time the accepted model was it consisted of just three parts. These are the nucleus, the proton and the electron. But nobody had successfully proven this was the case. Today we now know there are far more parts to an atom, quarks, and the mysterious Higgs Boson, which has only very recently been proven to exist.

Theory at the time was still vague and Rutherford wanted to prove or disprove the current concept of what an atom consisted of, hoping to find a new element hitherto unknown.

It was already known that electrons orbit the nucleus and are negatively charged particles. Simple atoms such as Hydrogen have but a single electron. To balance this negative charge the other two parts, the proton and the neutron, between them have an identical but opposite charge. The neutron as the name suggests is a neutral part and has neither positive or negative charge. The simplest way to envisage the structure of an atom is to draw an analogy with Earth.

The centre of the Earth consists of a molten core of liquid iron, this constitutes the majority of the mass. Around the core is a crust of rocky material adding to the total mass. A satellite flying around Earth is the electron(s). So the core is the neutron, the crust is the proton and the satellite is the electron(s). Simple logic defines the atom as a sphere.

The neutron being neutral should not react to a charge, but the proton is positively charged and the electron is negatively charged. The neutron hence takes no part in the electrical part of the atom. It was already known that electrons can be readily coerced out of orbit by a relatively low positive voltage on a charged electrode. This is known as an anode. Even a few volts will cause electrons in the outer orbits to "*jump ship*" and stick to the anode. The flow of electric current is the result of electrons moving from one point to another, which has to be a positively charged anode. By the 1930s thermionic valves were common place items which utilised electron flow, but the deeper mysteries of the atom and particularly the neutron, which is part of the nucleus were not fully understood.

If the anode is made negative the electrons are repelled and are not able to jump the small distance. This basic theory is how rectifiers work when an ac voltage is applied. Heating the atom up makes the electrons more mobile and can be imagined like steam hovering above boiling water.

To attract an electron is hence a simple task. But attracting a proton is not so simple. For electrons you need very little voltage, but to rip the proton away from the nucleus leaving just the neutron requires much higher voltage, which has to be negative. The electrons won't go near another negatively charged "*anode*".

Rutherford had performed some basic calculations and his theory suggested that if one could develop at least 1MV it might be possible to rip an atom asunder into its basic parts. This later became known as "*Splitting the atom*". What he couldn't predict

ALLIED'S *Special Bargain*

SUPPLEMENT NO. 148



**Knight
Pushbutton
Tape Recorder**
Page 22

ONLY **\$89⁹⁵**



ONLY
\$15⁹⁵

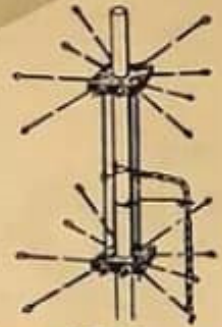
Knight Geiger Counter Kit
Page 2

hundreds of values



**FM-AM Radio
Chassis**
Page 18

ONLY **\$31⁹⁵**



ONLY
\$19⁹⁵

All-Channel TV Antenna
Page 4

new electronic products



ONLY
\$24⁹⁵

Grommes Hi-Fi Amplifier
Page 24



ALLIED RADIO

100 N. WESTERN AVE. • CHICAGO 80, ILLINOIS • PHONE HAYmarket 1-6800

is whether the nucleus with the neutron would remain attached to the proton or be left behind. As it turned out it was ripped away and just the pure proton was captured, leaving the neutron to be observed in more detail.

Cockcroft and Walton were given the unenviable task to design and construct a very high voltage dc supply. Ferranti Transformers had managed to make an experimental transformer which supplied 300,000 volts but that was pushing the limits of technology at the time. So with 300kV ac available how do you go about raising this to 1MV or even higher should the need arise?

Some work had already been done by engineers, notably in Germany, where a voltage multiplier was demonstrated that could double or triple the voltage, but this was at a much lower voltage. Cockcroft and Walton after some experimenting decided that a new approach was needed.

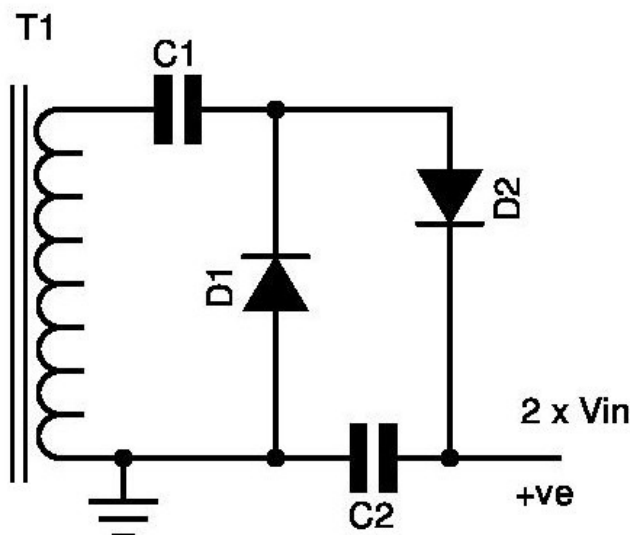
The diodes and capacitors available could not sustain the sort of voltages envisaged. Then they had a brainwave. Why not treat each voltage multiplier as a separate item and then stack one on top of the other. The highest voltage any diode or capacitor had to sustain was then just double the input voltage. And that is exactly what a Cockcroft-Walton voltage multiplier is. If you imagine a brick being 2-times the input voltage and on top of that you place another brick until you reach the height (voltage) required. Basically no diode or capacitor has to sustain more than 2-times the input voltage.

Even so the voltages were difficult and presented a serious problem with available components. The diodes were built up from many copper oxide rectifiers connected in series and the capacitors were metal plates, both immersed in oil to resist the very high voltages. Today these are available, but at the time nobody made such high voltage types.

In voltage multiplier calculations the peak voltage is normally used and not the rms. The Ferranti transformer produced 300kV peak, so a single doubler raised it to $\approx 600\text{kV}$ dc. The rectifiers and capacitors have some losses so the final voltage is a little less than what theory suggests. Each additional stages adds ≈ 2 -times the input voltage, so a two stage doubler would give ≈ 4 -times the input peak voltage, less a little due to losses and leakage currents in the components. This would produce $\approx 1.2\text{MV}$. By continuing to add more stages the voltage would go up in steps of $\approx 600\text{kV}$ per stage. Some call this a "tripler" but it is incorrect. A tripler would consist of a single doubler stage plus a non-doubler conventional half wave rectifier.

The basic building block is the voltage doubler. For a positive output design the diodes are arranged as shown below. If the output needs to be negative then all the diodes are turned around.

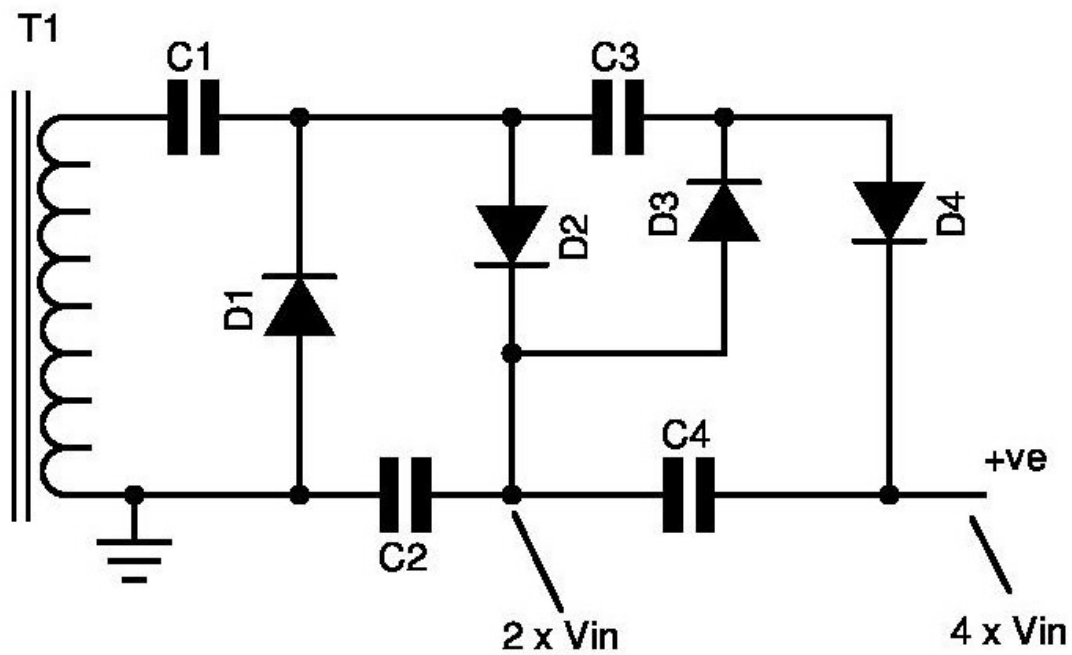
Voltage Doubler



Cockcroft-Walton Voltage Doubler

A voltage quadrupler is simply two doubler stages connected in series.

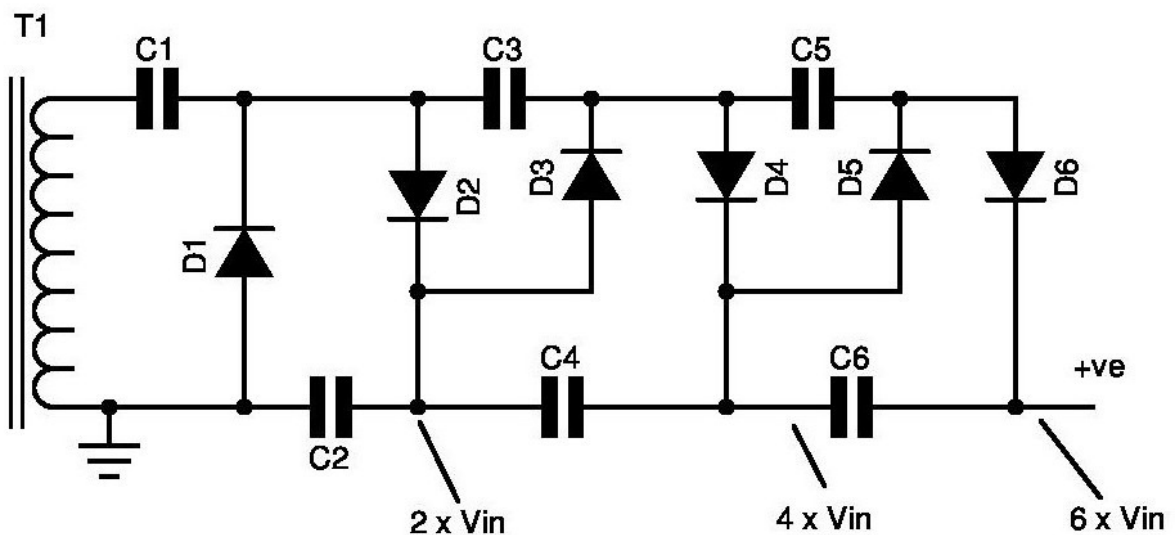
Voltage Multiplier x 4



Voltage Quadrupler

Adding a further stage gives a 6-times voltage multiplier.

Voltage Multiplier x 6



There is practically no limit to how many stages can be cascaded and this is a simple way to generate the very high voltages required by cathode ray tubes (CRTs) where the current output needed is relatively low. Every time the voltage is doubled the output current available is reduced to half the previous stage.

SIC VITA EST CUM R1155 RECEPTORE !

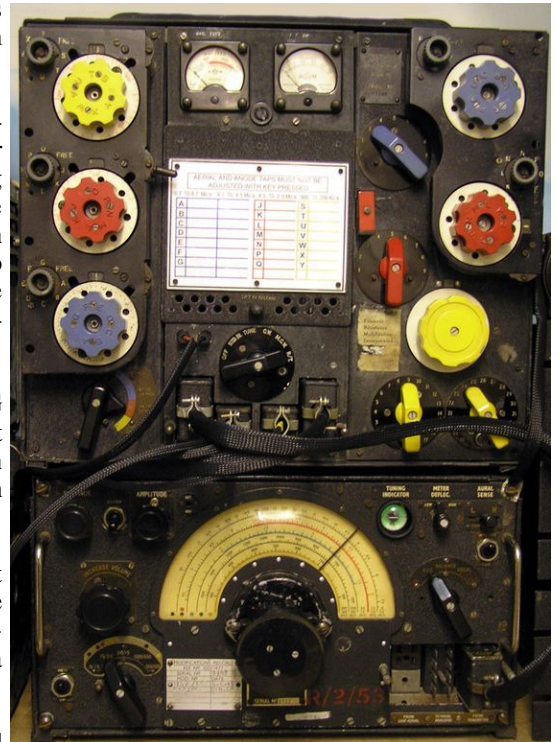
Having once owned 8 type R1155 receivers, and at present 4, the writer has some experience in dealing with these classic radio jewels, which date from WW2 and beyond.

The secret of success with the named receiver is to use the correct HT voltage : these sets operate best on a low HT of 200 to a max of 217 volts, for which they were designed. Many owners pick up a deal of trouble by using a high voltage of 250 for which they were not designed. Endless trouble will plague the operator who uses a too high voltage on the valves which causes the old vintage paper capacitors to pack up. The writer prefers to operate his receivers on a HT of 160 to 200 volts and consequently there are no leaking or o/c capacitors. and these old receivers just keep on keeping on !

The correct HF and IF valves are Marconi KTW61,62 or 63/VR100/6U7G and at a pinch a 6K7G, but the 6Q7G should not be used as detector, but rather the DL63/MHLD6/VR101 or the US 6R7G. A 6Q7G can be used in the BFO section. The VR99/X65/X66/6K8G are the correct valves to use in the converter stage.

An output valve such as the US type 6G6G can be built in, using the vacant moulded socket which housed the former DF valve, a VR102/BL63 and the VI 103/Y61/Y63 can be replaced by a US type 6U5G magic eye. At a lower HT voltage magic eyes last much longer and do not 'fade' very soon as a result of overvoltage HT.

Try these tested hints and enjoy years of happy listening on your good old R1155 receiver, an antique jewel indeed !



Mirabile dictu, but an effective bandspread can be built into your R1155 receiver :

When removing the D/F section, also replace the function rotary switch with a small JB type C804 15pf variable capacitor in series with a silver mica capacitor of 2.5 to 5 pf and solder the mica cap to the stator plates connection of the oscillator section of the t/c, being the large double spaced gang of the t/c. You will now have mechanical cum electrical bandspread, a boon to any SW listener in separating transmissions to a certain extent. It also compensates for any possible drift.

All you need : 1x 15pf JB type C804 v/c, 1x 2.5 to 5pf silver mica or moulded mica fixed cap and 1x large tuning knob to match the large, black volume control knob .It is all as simple and cheap as that !

L G Latski

SMPS Interference

Following on from our pretty informative AWA net on Saturday 10th August, I forward the following for the news letter.

SMPS (Switch Mode Power Supplies) interference is a big problem to radio hams. The following articles/URLs will show the causes of the problem and the ways to mitigate the level of interference.

<http://ka7oei.blogspot.com/2013/09/quieting-high-current-switching-power.html>

<http://ka7oei.blogspot.com/2014/08/completely-containing-switching-power.html>

<http://ka7oei.blogspot.com/2012/12/reducing-switching-supply-racket-rf.html>

<https://www.rs-online.com/designspark/pros-and-cons-of-switch-mode-power-supplies-smps>

<https://www.ukqrm.org.uk/smeps.php>

SK ITEMS FOR DISPOSAL

The AWA was approached by the daughter of a non ham silent key who kept a lot of valve radios and asked if we could assist with disposal of the items. The items are in storage in Alberton, so preferably people who can collect would be better, but if you are willing to pay transport for any items that can be arranged. Any interested parties are asked to place offers on any of the items with Andy ZS6ADY.

1. 2 off Barlow Wadley receivers
2. 1 off Hallicrafters SX 28 receiver
3. Racal RA17 receiver
4. Akai reel to reel tape deck
5. Dynaco Stereo 80 amplifier (seems to be brand new in the box) no photo
6. AVO Valve characteristic meter
7. Approximately 100 valves in boxes NOS, all kinds and sizes
8. General electric Tombstone style radio
9. Pilot Tombstone style radio
10. A few smaller Bakelite radios, names unknown and no photos



CONTACT US:

P.O. Box 12320
Benoryn
1504

Mobile: 082 448 4368
Email: andyzs6ady@vodamail.co.za

Get your backdated issues at
[http://www.awasa.org.za/
index.php/newsletters](http://www.awasa.org.za/index.php/newsletters)

Visit our Website:
www.awasa.org.za

**Antique Wireless Association
of Southern Africa**

Mission Statement

Our aim is to facilitate, generate and maintain an interest in the location, acquisition, repair and use of yesterday's radio's and associated equipment. To encourage all like minded amateurs to do the same thus ensuring the maintenance and preservation of our amateur heritage.

Membership of this group is free and by association. Join by logging in to our website.

Notices:**Net Times and Frequencies (SAST):**

Saturday 06:00 (04:00 UTC) —AM Net—3615
Saturday 07:00 (05:00 UTC) —Western Cape SSB Net— 3630
Saturday 08:30 (06:30 UTC)— National SSB Net— 7140; Sandton repeater 145.700
Echolink—ZS0AWA-L; ZS6STN-R
Relay on 3615 for those having difficulty with local skip conditions.
Saturday 14:00 (12:00 UTC)— CW Net—7020; (3550 after 15 min if band conditions not good on 40)
Wednesday 19:00 (17:00 UTC) — AM Net—3615, band conditions permitting.

FOR DISPOSAL:

Kyokuto KDK 2m transceiver model FM144-10SXR with plug in/out bracket for mobile use. Operators instruction book included. R300.00

Contact James Fairlie ZS5ABW 033 386 7862 OR 072 179 9906

Notice of AWA AGM:

Notice is hereby given of the Antique Wireless Association of Southern Africa Annual General Meeting to be held on Saturday 09 November 2019 commencing at 09:00 at the premises of the SAIEE in Observatory Johannesburg. All members are invited to attend and join in. Voting for the next Vice President, President in waiting, will be called for as well as posts for members of the committee as per our Constitution of 2014 (revised). Should you not be able to attend but would like to put forward any nominations or suggestions for the next year, please email your suggestions to any member of the present committee.

Heathkit Challenge:

After a request by a few of the entrants in the Heathkit Challenge, the completion date has been moved out to February 2020.

Notices:

For Disposal:



Please contact Piero for prices and details.
 He also has a 9m Webb mast and 6m heavy aluminium pipe for sale.

Piero Pastorino
 14 Amelia Str east
 Dunvegan
 Edenvale
 082 341 6628
pastorinopr@gmail.com

Make	What	Model	Details
Dalwa	Power supply	PS-304	Variable PSU to 15v, 30A max
Metronx	Power supply	S3SE	Variable PSU to 32v, 8A max
Racal	Modulation Meter	9009	AM/FM Mod
Yaesu	Comm Receiver	FRG 7700	Receiver
Yaesu	Antenna Tuner	FRT 7700	Tuner
Hiachi	Oscilloscope	V 422	40 MHz, dual beam 'scope
Topward	Oscilloscope	7046	40 MHz, dual beam 'scope
Mast	9 meter	(3 X 3meter)	Tubular, triangular mast
Mast	Pole, 6 meter	Aly	Heavy duty pole

RF Power Transistors			
MRF 240	X10	ELV81	X22
2i-6090	X20	C 2830	X3
BLU 1012	X8	MRF 1845	X6
BLU 45	X3	BL F 622	X12
MRF 237	X20	C 2097	X4
SD 1127	X30	BLW 65	X4