



# AWA Newsletter

# 87

April 2013

Affiliated  
to the  
SARL



Antique  
Wireless Association  
of Southern Africa

### Inside this issue:

CW Net	2
SSB Activity	2
AM	2
AM Part Two	3-6
Presidents Corner	6-7
AWA 10th Celebration	8
Notices	8

### AWA Committee:

- \* President—Richard ZS6TF
- \* Technical Advisor—Rad ZS6RAD
- \* Secretary/PRO—Andy ZS6ADY
- \* Western Cape—John ZS1WJ

## Reflections:

I was chatting with someone the other day and they told me how they came from CB in to Amateur Radio.

This of course got me thinking back to my first CB radio. It was a 9 channel AM rig which I bought on one of my trips to PE from the Northern Cape.

Very soon however, I came to realise how inadequate this rig actually was, firstly with its limitations of being an AM only rig and then living in the NC where distances were to the extreme.

Of course it did not take long to upgrade to a 40 channel AM/SSB rig and then to have a Tokyo Hi-Power linear under the seat of the car.

This then got me to thinking how it is that even through my Amateur Radio career, I have been purchasing radio's and then only to

find it also has its limitations and then looking around for the next best thing.

The only difference was, as with most, the toys just became more expensive.

I was fortunate in that the first Amateur rig I actually purchased was long after I had completed my first 200 CW contacts and had moved on to Phone. I then needed something that was easier to tune and one that I did not have to synchronise Tx and Rx and find you were always out on frequency.

Even as the toys progressed and became more expensive, there was always the next latest version that would come out with even more bells and whistles than the last one. And so the process began again, until I finally started to realise the old adage of "beauty is in the eye

of the beholder".

Once I got myself over that, I started to see again the beauty of the old valve rigs and that the inadequacies of these rigs was actually their strong points.

Who needs to have voice synthesizers, processors, automatic antenna tuning, digital readouts etc, etc, when you can do it all yourself, manually.

It brought back the fun into Amateur Radio.

I love it when someone says to me over the air, "you are .00092 off frequency". It means they are where I was a good number of years ago.

Maybe one day they too will change their minds and see the beauty and hear the difference, in valve radio.

Best 73

DE Andy ZS6ADY

## WIKIPEDIA

**Frequency** is the number of occurrences of a repeating event per unit time. It is also referred to as **temporal frequency**. The **period** is the duration of one cycle in a repeating event, so the period is the reciprocal of the frequency. For example, if a newborn baby's heart beats at a frequency of 120 times a minute, its period (the interval between beats) is half a second.

For **cyclical** processes, such as **rotation**, **oscillations**, or **waves**, frequency is defined as a number of cycles per unit time. In **physics** and **engineering** disciplines, such as **optics**, **acoustics**, and **radio**, frequency is usually denoted by a Latin letter *f* or by a Greek letter  $\nu$  (**nu**).

For counts per a time interval, the **SI** unit, the unit of frequency is the **hertz** (Hz), named after the German physicist **Heinrich Hertz**: 1 Hz means that an event repeats once per **second**. A previous name for this unit was **cycles per second**.

A traditional unit of measure used with rotating mechanical devices is **revolutions per minute**, abbreviated **RPM**. 60 RPM equals one hertz.<sup>[1]</sup>

The period, usually denoted by *T*, is the length of time taken by one cycle, and is the **reciprocal** of the frequency *f*:

## CW Net:

I find it very interesting these days, to read about all the different ways those who have a passion for CW are trying to interest those who have an inkling towards CW or maybe are not directly interested at all.

On the SARL Forum, one can regularly read a thread which has been created around CW or some form of creating interest for CW.

Whether this actually has any impact on the “non-CW operator” or not, is difficult to tell.

As this column in the Newsletter probably falls in to the same category, it would be interesting to hear if all of this propoganda has had any effect at all ?

Personally, I continue my quest for CW contacts on 40m to achieve my WAZS-100. Even here, I am not sure whether it is an impossible quest or not.

The problem, as always, lies in getting the QSO's confirmed through some form of QSL, either on the SARL E-QSL site, or by hard copy card.

Whichever way it happens, it is not an easy task.

Had I done this in the early days when I started my CW career, it probably would have proved as difficult. Making the contacts was the easy part, all 200 of them. Getting them confirmed was something else.

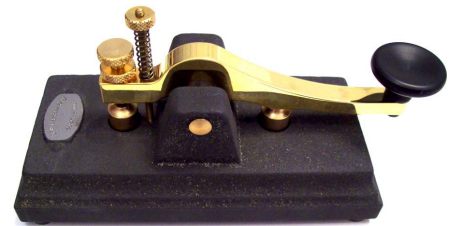
The CW net still draws it's regular attendee's and it is always good to hear those who drop in on the odd occasion, just to say hello, and then move on again.

Should you feel you want to join the nest, please don't be frightened off by some of the guys who it seems may be going a bit fast. Everyone will slow down to accommodate

those who are still getting their ears and feel of the key sorted out.

Anyone is welcome to come and join the net and we look forward to hearing many more of you thumping out your calls signs in CW.

DE ZS0AWA/CW ....-



## SSB activity:

Call ins on the SSB net have improved drastically since we started the “Topic of the Day” with an average of 20-25 calls on a Saturday morning, from the usual 15—18 we were getting.

It's obvious there are many who like to chip in and give their opinions on the topics, which Richard dreams up in the early hours of Saturday morning from reading his tea leaves, or coffee grounds.

As fruitful as this seems to be, have we caused anyone, who would usually call in, to not do so because they feel there is too much waffling on the net ? We are interested to know, so if you feel this applies to you, put fingers to keyboard and let us know.

Band conditions seem to be fairly consistent, some Saturdays they are exceptional, while others just normal. The resident static rain seems to come and go in various forms, but in general, most stations are well heard on the net.

The Western Cape net also now running on 80m on 3620 on Saturday mornings from 07:00 are also pulling in a fair amount of callers and the band seems to work well for the local stations there.

By 08:30, 40m has started to fade a bit to Div 1, but most of the stations can still be heard quite well with good reports coming in to Div 6. Some days are better than others.

We don't know how things will play out this winter, but there is always the possibility of using 80m as a local calling frequency, relayed to 40m for Div 6 stations should 40m prove to be a bit of a problem.



Drake T4X

## AM:

The AM net on 3615 from 06:00 on a Saturday morning and then on a Wednesday evening at 19:00 hours has turned out to be a well attended net.

We do not break any records, but we regularly have at least 7-8 stations on frequency on Saturdays.

Div 5 still proves to be at a loss as the band goes out quite early on a Saturday morning, but Wednesday evenings are usually good, with S9+ signals being the norm.

As winter approaches rapidly now, the band will hopefully be in much better condition with the Highveld summer storms dissipating. We hope too the winter cold fronts will not cause too much QRN.

The AWA QSO party days are also approaching and will be held on the second weekend of May (11 & 12), starting off with the AM section on the Saturday.

With the recent article on AM having been completed in this issue, we hope we will hear many more of you trying out some amplitude modulation on your rigs.

Details of this are in the 2013 contest rules which can be found on the SARL website or on the AWA Yahoo site.

So start getting some practice in on using your rig on AM and come up on the AM nets, so the time the QSO part comes around, you will be quite in to using the mode.

Remember, if you want a chance to get one of the 10 year QSL cards, this is your opportunity to do it. Make a contact with ZS0AWA and stand in line for your QSL card.



Gonset 100

# Amplitude Modulation

[http://www.w8ji.com/amplitude\\_modulation.htm](http://www.w8ji.com/amplitude_modulation.htm)

## PART 2

There are two ways to combine screen and anode modulation. One method "forces" the screen to follow modulated anode voltage by supplying the screen from voltage taken on the power amplifier side of the modulation transformer. This method is shown below:

### Components of note are:

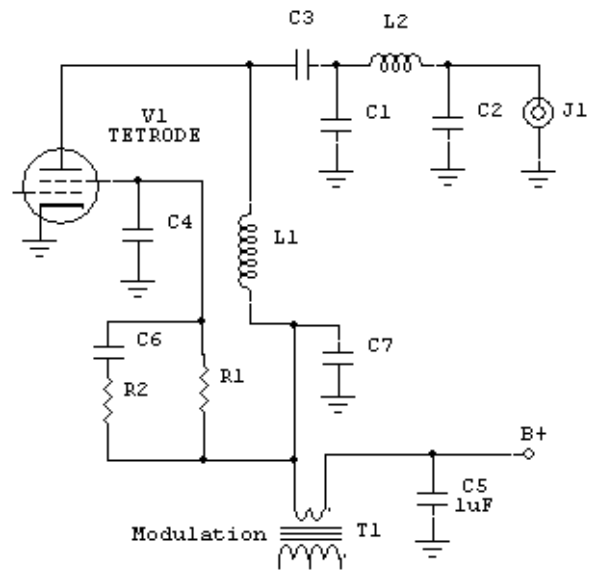
C4 (screen bypass) must have high reactance at the highest audio frequency when compared to the parallel combination of R1 and R2.

C6 (screen supply blocking capacitor) must have low reactance at the lowest audio frequency when compared to R2.

R1 determines screen operating current and voltage.

R2 is adjusted in value to provide the best audio linearity at the design value of plate and grid operating currents and voltages. This resistor determines the amount of audio supplied to the screen grid.

A second method is to let the screen self-modulate:

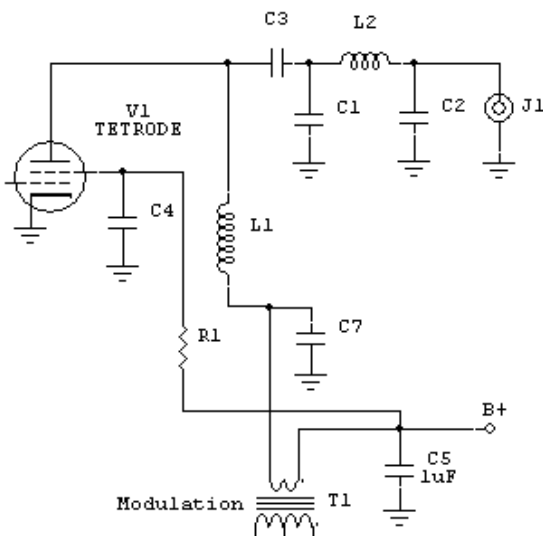


### Components of note are:

C4 (screen bypass) must have high reactance at the highest audio frequency when compared to R1.

C6 (screen supply blocking capacitor) must have low reactance at the lowest audio frequency when compared to R1.

R1 determines screen operating current and voltage. This resistor must be very high in value, probably over 5,000 ohms in most cases.

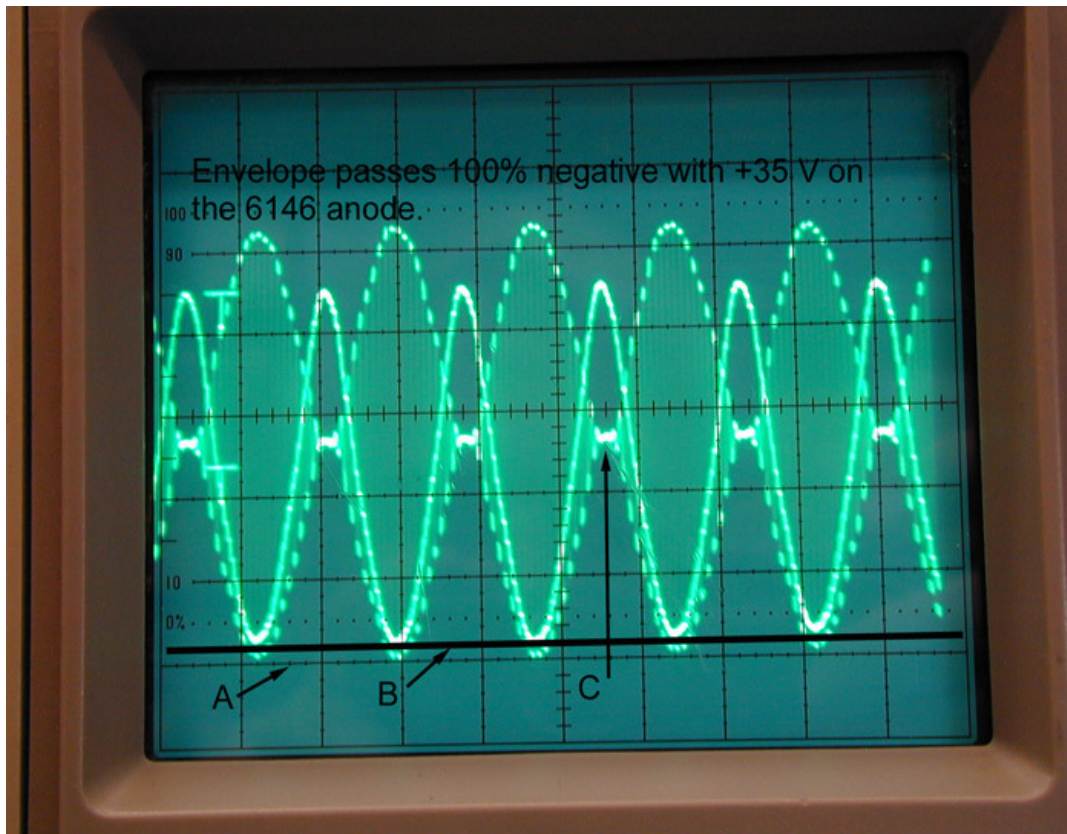


If the resistor cannot be made high in value, a series choke that has very high reactance across the audio spectrum must be added in series with R1. R1 is often compromised in value to provide the best audio linearity at the design value of plate and grid operating currents and voltages. This resistor determines the amount of audio supplied to the screen grid.

Self-modulation of the screen works because screen current varies with anode voltage. The screen system, in effect, becomes a constant current supply for the screen grid. As the plate modulator pushes anode voltage higher, screen current decreases. Decreased screen current causes screen voltage to increase. This system, when a series resistor is used, normally requires the screen supply voltage to be at least 50% higher than required. With a screen choke, the screen supply voltage can be equal to the desired screen operating voltage. For a 6146 with the resistor method of supplying constant current, the screen source voltage should be at least 300 volts. Screen voltage is often sourced from the anode supply line.

Since the tetrode (or pentode) stage is both screen *and* anode modulated, high voltage supplied to the anode system does not reach double carrier voltage on 100% positive peaks. More important, and a point many people seem to miss, is the modulated anode source voltage does not reach zero for 100% negative peaks! If a negative peak limiting circuit is installed in the modulator system of a "plate modulated" tetrode (or pentode), the stage will normally go well beyond 100% negative peaks without crossing over to negative voltage.

The scope display below is a good typical representation of modulator voltage supplied to the 6146 power amplifier in a Johnson Ranger II. The thin single-line trace is the modulated high voltage supplied to a Johnson Ranger II, along with the dash outlined RF envelope.



Scope graticule line "A" was set for zero anode voltage. Line B is approximately 40 volts positive for the modulated anode supply voltage. Point C shows the RF envelope cutting completely off (over-modulation) even though modulated high voltage never goes below 40 volts positive.

There is an important lesson to be learned from this. Some articles claim a negative peak limiter, or blocking diode, can be used to prevent over-modulation on negative peaks. That claim is clearly false because a properly configured 6146 (or any other tetrode) reaches 100% negative peaks while the anode is still significantly positive. In the case of the Johnson Viking Ranger a properly designed negative peak limiter would hold the anode at least at 40 volts positive, and have filtering to round the transition off and not create sharp waveform edges near the negative limits. This is almost impossible to do at high levels. It would be much better accomplished in low level stages.

#### **Efficiency Modulation (Grid Modulation and Low Level modulation with Linear Amplifiers)**

There are two basic systems that use efficiency modulation, grid modulation and linear amplifiers. When we vary current in a device, we normally do not have a square law power response. With fixed coupling to the load, if we match at full peak power, lower drive levels cause a reduction in efficiency. This is because, unlike with plate modulation, anode supply voltage does not vary. With a conventional deep class-C triode with plate modulation, the output device acts presents a constant time-averaged resistance to the modulator. If the modulator doubles anode voltage, anode current also doubles. Since anode voltage and anode current changes in the same proportion, they maintain the same ratio. Anode impedance is  $E/I$ , and if the ratio remains constant the anode RF impedance also remains constant. The output device sees the same match (or mismatch) at zero modulation as the output device sees at modulation positive peaks or modulation negative peaks, and with the same conduction angle efficiency remains the same.

Screen modulation, control grid modulation, or linear amplifiers all have a constant anode or collector voltage. This means output device impedance, or  $E/I$  of the output device, varies over the audio cycle. The device has highest current on modulation positive peaks, and lowest current on modulation negative peaks. This means the mismatch between the output device and the load varies over the modulation cycle. The normal tuning procedure is to match the output device at maximum positive modulation peak. As the modulation positive peak is reduced the output device has a higher impedance, and this mismatches the device to the tank. The result is a reduction in efficiency as the system moves below the peak positive modulation level, reaching minimum efficiency at maximum negative peak.

The approximate rule with 100% modulation is device carrier efficiency is half of the device positive peak efficiency. Let's say we have about 70% efficiency at the anode of a tube with 4% tank and other losses for 66% total efficiency. At carrier, plate efficiency will be about 35%. With tank losses of 4% we have an overall efficiency of 31%. This means on carrier 2/3 of the plate input power will be heat, or twice as much heat as carrier power into the tank. With 500 watts PEP output on modulation peaks, the tube anode dissipates about 375 watts of heat.

This is true for screen modulation or linear amplifiers!

Many linear amplifiers with high conduction angles only have about 50% efficiency on peaks, plus the normal procedure is to slightly over-couple to ensure linearity on occasional exceptionally high peaks. This means with an unmodulated carrier, that same amplifier might be down around 25% plate efficiency. A safe **general rule** for linear amplifiers is output device power dissipation is three times the carrier power when amplifying the unmodulated carrier.

This means a legal-limit AM linear could have about 1125 watts dissipation during carrier conditions of 375 watts, and on positive modulation peaks output power will be about 1500 watts with 1500 watts of short-term dissipation. This is a reasonable safe estimate.

If a conventional AM linear or screen modulated stage is making more than half the peak efficiency on carrier, odds are very good it has excessive distortion and splatter.

### **Linear Amplifiers on AM, or the Difference between Low Level and High Level Modulation**

It may not seem like it at first glance, but grid modulation and linear amplifiers use similar principles. As such, they can be discussed together.

Low level modulation often has much less distortion and more fidelity than high level modulation of tetrodes, and more faithfully reproduces the audio input. It is much easier to have low-distortion high-fidelity audio using low-level modulation. To be sure, some of the cleanest AM BC transmitters ever built were low level modulated systems. Unfortunately the low efficiency resulted in high energy consumption, causing most stations to use more energy efficient high level modulation.

The sole shortfall with linear amplifier or grid modulation schemes is efficiency. In order to reproduce the input faithfully, the amplifier has to be loaded to handle the PEAK power. This is normally four times the carrier power (or more in some cases). This is because the linear has to be "efficiency modulated". A safe estimate is 25% carrier efficiency. This means your amp would be making three times the heat as carrier power. An SB220 can safely handle about 500 watts of steady dissipation (inadequate airflow to fully use the tubes) so it is safe at 125 watts carrier when properly tuned.

Very few amplifiers can safely handle legal limit AM. Legal limit AM requires 375 watts of carrier power, and three times carrier power would be a safe power amplifier dissipation estimate for carrier-level heat dissipation. Typically, with a 375-watt carrier, over 1100 watts of heat is produced. This takes a lot of air and a 1200-watt or higher plate dissipation tube. An 8877 at full rated airflow, or a 3CX1200 series tube, would work.

A rig certainly does NOT need to be plate modulated to sound perfect, and as a matter of fact most amateur plate modulated transmitters have terrible distortion as a percentage of modulation. It's just that most people can't actually hear the distortion, they listen to and enjoy the frequency response and might actually "like" a little distortion, and they confuse distortion with good sound. Contrary to popular myth, there is no difference in the sound of any AM transmitter when amplified in a properly tuned and operated linear amplifier. This is because a properly tuned and operated linear, be it a Heath SB220 or anything else, has much less modulation distortion than the typical boat anchor rig. The real problem with a linear is NOT the sound. The real problem is *heat* caused by poor carrier efficiency.

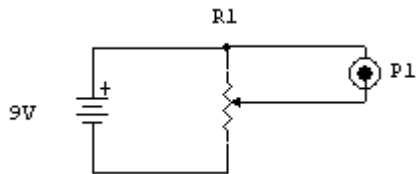
It's certainly possible to have bad low level modulation, but plate modulating a tetrode also guarantees we have to do special tuning and add "circuit tricks" to avoid significant distortion. While the plate modulated tetrode system reduces problems with loading, drive power, and heat, it does not eliminate these problems. Additionally, high-level modulation requires a high power modulation source with low distortion and adequate fidelity.

To be linear all stages must be tuned or loaded at full peak envelope power, plus a little safety factor. In other words if we are going to 1500 watts PEP output, we must load the amplifier stages to 1500 watts carrier or more! After loading at full peak power, carrier is set at less than 25% of the peak power. **Failure to do this will result in modulation distortion called "flat-topping". The result will be very wide bandwidth splatter and "downward modulation".**

If we are going to run 100 watts AM carrier, all stages must be tuned for at least 400 watts of peak power.

### **HF SSB rigs on AM**

Some newer HF transceivers are excellent on AM, with much less distortion and better fidelity than most older amateur AM rigs. The Ten-Tec Orion and the Yaesu FT-1000D are two examples of very good AM transceivers.



Peak envelope power, with 100% modulation, is four times carrier power. For 100% modulation in a 100-watt radio, a 100W PEP radio must run 25 watts or less carrier. With a 100-watt radio, peak power on voice peaks should be held to 100 watts or less.

I used an IC-751A or IC-706 ICOM on AM. The problem with that ICOM, like with many HF SSB radios, is it uses ALC to limit output power. Turning the output power down or mic control up will not increase the percentage of positive peaks. **This is because the ALC system in most SSB rigs almost always detects peak power. If we adjust carrier power to 25 watts and try to modulate 100% (100 watts), the peaks cause the radio to reduce gain until peaks are back at the 25 watt carrier power level. The positive peaks stay at 25 watts or so...and the carrier drops to 7.5 watts when modulated!**

The cure is to run the power level all the way wide open and apply an external stable negative voltage to the external ALC input. Adjust the external negative ALC until the carrier is 20-25 watts, and then the mic control until we have 100 watts on peaks using a good peak reading meter.

An external ALC carrier control can be a 9V battery across a 500k pot in a voltage divider. The positive battery lead goes to ground, and the ALC output comes from the pot wiper. P1 goes to the EXT ALC jack on the radio. Remember to disconnect the battery when using other modes or when not using the radio!

To use this circuit, run the radio's normal power control wide open. Adjust the pot for 20-25 watts carrier. Adjust the mic control for 100% modulation, or 100 watts PEP (on a 100W radio).

## PRESIDENT'S CORNER

By Richard ZS6TF

### The Reluctant Radio Amateur

My association with amateur radio can be described as 35 years of happy accidents. In my first real job I was responsible for the light current workshop and technicians for the power utility on the Zambian Copperbelt CPC and this included radio systems. I met Gill (1969) at this time and of course George, her father was a very active radio ham (VQ2GJ/9J2GJ

He used the Drake separates that he bought new out of the box (that I now have), feeding a homebrew Swiss Quad. Fortunately his HRO is also still in the collection.

I have to confess that my attitude at the time was professional disinterest and it was only when I moved to Rhodesia 6 years later to work as an electrical engineer with RISCO that I got into ham radio by accident.

I advertised a 70 MHz Pye Cambridge VHF transceiver for sale that I imported in our personal effects and I got reeled in by the long arm of the law. The excuse I gave was that I had intended to convert it to 2 metres. Back came an application form for the RAE and another for the Morse test and I was now under pressure to put my money where my mouth was. Shortly afterwards, I became licensed as ZE1FX/R (equivalent to the old ZR ie VHF only) and after my 200 CW contacts were signed off by the Post office I got my phone privilege on HF and dropped the /R. My first HF phone contact was the late OM Dudley ZE2JJ on 40M.

I remember conditions were difficult with a civil war in progress, but there were compensations, one of which was a lot of single engine aircraft flying between Redcliff and Buchwa south of Selukwe where the company was mining the top off the mountain. I usually flew with my boss, Ken, later ZS2KW (who has recently moved to Capetown), and who had been an instructor on Vampires and Hawker hunters in the RAF. He made it clear it was in my interest to learn to fly the plane in case he took a bullet which focused my mind on the task. The aircraft was a Piper Cherokee six, with retractable undercarriage and a variable pitch prop so it flew a bit like a Spitfire. Buchwa mountain stood out 2000ft above the Ingezi river valley and he would put the aircraft into a steep power climb after a fast pass over the



*9J2GJ George operating a DX100U and HRO MX during Field day 1965 at Mindola dam near Kitwe Zambia*

airstrip to clear the wildlife, almost stalling at the mountain top, and dangling the Dunlop's, spiraling gracefully earthwards into the valley below inspecting the downhill cable belt conveyor as we went by which time the reception vehicle was awaiting our arrival.

These were happy days, with the 2 element tri-band quad and the CDE AR22 rotator (still in use in Bryanston) then mounted on a 72 foot steel mast hinged at the bottom, with an even taper from 1.1 metres square at the base to 200mm at the top. I always lunched at home and would call CQ beaming stateside, and then comeback 5 minutes later to see if anybody was still calling me after the pile-up. I have an unclaimed DXCC from that time with many endorsements possible.

One day I installed a quarter wave 2m vertical antenna in another Piper and Dudley Paxton piloted me to 12000 ft with the FT 225RD, also still in my collection. We flew around for about an hour and ZE1FX/AM worked all ZE on several modes, triggered the Salisbury and Bulawayo repeaters simultaneously since they were on the same frequency, and worked into Pietersburg.

About 20 years ago I was on the point of giving up amateur radio other than occasional use for bush trips. In a weak moment I sold everything except my trusty FR225RD, FT707 and FT101ZD Mk 3, all of which I have owned from new.

One day about 6 years ago I visited a non-ham radio collector who is a well-known member of the AWA. The visit was all about old cars, Auburns in particular, but during the visit I was shown over his world class radio collection and then noticed a Marconi R1155/T1154 pair stored in a shed. The inevitable "If ever you want to dispose..." statement was made and about a year later they came into my possession kick starting a long period of re-acquaintance with, and satisfying enjoyment from my collection of iconic boat anchors and the camaraderie of the AWA.

The moral of these stories is, If the hobby gets a little stale from time to time, just cover your boat anchors up, do not consider disposing of them, and do something else for a while. The hobby will suck you back in, in a big way when you are ready.

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**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 yester-days 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.

**Notices:****Annual Open Day:**

Our Annual open Day has been postponed this year from April, to fall in with an invitation to the Kempton Park Club Flea Market on the 1st of June at the Impala Vortrekkers Centre in Allen Grove. Tables will be available for fleamarket goodies and there will be the usual display of antique radios and associated equipment. Should you want a table, please contact Selwyn ZS6SEL and let him know your requirements. (082 804 2782)

Please diarise this date on your calendar and come along and join us. (Details in the next Newsletter)

**AWA 10th Birthday.**

For those of you who have been with us from the beginning, you may just remember that it was in March 2003 that the first meeting on air of the AWA of Southern Africa was took place.

Now it is 10 years later and we are celebrating 10 years of being on the air and many various activities that take place on air. In celebration of this, we have designed a special QSL card.

In order for you to get this celebratory QSL card, you need to contact ZS0AWA during one of the QSO parties, or activity days that take place during the year. That would be the CW activity day on the 3rd and 4th of February. The AWA QSO party on AM and SSB on the 11th and 12th May and the QSO party on the 12th and 13th October.

Should you have a QSO with ZS0AWA on any of these dates, send us a QSL with a SASE and we will send you the QSL Card.



**ZS0AWA - 10**

THE OFFICIAL CALL SIGN  
OF THE SOUTHERN  
AFRICAN ANTIQUE  
WIRELESS ASSOCIATION

10<sup>TH</sup> ANNIVERSARY  
2003 - 2013

To Radio	Date	UTC	MHz	Mode	RST

Many thanks for our QSO, PSE / TNX QSL! **73 de ZS0AWA**

2003 CLIFF ZS6BOX  
2004 BUSHY ZS6M(SK)

2005 ROD ZS6RK  
2006 ANDY ZS6ADY

2007 GARY ZS6NK  
2008/9 RAD ZS6RAD

2010/11 DON ZS6DR  
2012/13 RICHARD ZS6TF