

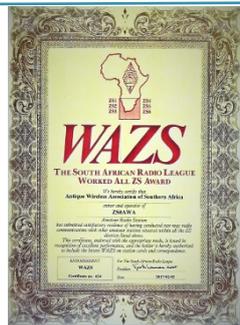


# Newsletter

The Antique Wireless Association of Southern Africa

# 162

January 2020



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### AWA Committee:

- \* President—Renato ZS6REN
- \* Acting Vice-President—John ZS1WJ
- \* Technical Advisor—Rad ZS6RAD
- \* Secretary/PRO—Andy ZS6ADY
- \* KZN—Don ZS5DR
- \* WC—John ZS1WJ
- \* Historian—Oliver ZS6OG

## Reflections:

Welcome to 2020.

May it be a year full of warmth and glow produced by many valves and very little smoke.

Renato ZS6REN officially takes over as our New President and we wish him many happy hours of figuring out topics for the Saturday morning nets, and all the best for his tenure.

It has been an exciting year for the AWA which has shown tremendous growth again over the past 12 months. It just goes to show, there is still a large interest in valve technology and items of the past era's.

For those of you who are particularly interested in old test equipment as well, there is the Vintage Test Equipment Group on Facebook, and there are often some very interesting articles published there.

I must admit that the tech-

nical side of many of these pieces of equipment elude me terribly as I am sure I don't have the brain capacity to cope with all of it. But non the less, it still is very interesting.

We want to encourage so many of you who used to listen in on the Saturday morning net to join us again.

Propagation may not always be in your favour, but we are available through so many forms and frequencies now, (see the list on the last page) that it really should not be a problem for anyone to join us. If Richard F4WCD (ex ZS6TF) can join us all the way from France, and Kevin LB... (ZS6KAT) from Oslo, then it should be easy for our ZS stations to join us.

We are hoping to have a few more activities this year involving the SAIEE museum. If you would like

to get involved in running the shack at SAIEE on a regular basis, we would like to hear from you.

We are hoping to run some basic courses on maintaining your antique equipment and using the correct test equipment to do this.

So as good as what 2019 has been, we are hoping that 2020 will be an even better one.

The level of expectancy of what you can achieve in amateur radio, can only be determined by yourself and how much you are prepared to put into it.

Here's to a healthy, happy and prosperous 2020 to each and every one of you. Thank you for all your support over the last year from each of us in the team.

Best 73

DE Andy ZS6ADY

## Wikipedia

**Radio Propagation:** Line-of-sight refers to radio waves which travel directly in a line from the transmitting antenna to the receiving antenna. It does not necessarily require a cleared sight path; at lower frequencies radio waves can pass through buildings, foliage and other obstructions. This is the most common propagation mode at VHF and above, and the only possible mode at microwave frequencies and above. On the surface of the Earth, line of sight propagation is limited by the visual horizon to about 40 miles (64 km). This is the method used by cell phones, cordless phones, walkie-talkies, wireless networks, point-to-point microwave radio relay links, FM and television broadcasting and radar. Satellite communication uses longer line-of-sight paths; for example home satellite dishes receive signals from communication satellites 22,000 miles (35,000 km) above the Earth, and ground stations can communicate with spacecraft billions of miles from Earth.

Ground plane reflection effects are an important factor in VHF line of sight propagation. The interference between the direct beam line-of-sight and the ground reflected beam often leads to an effective inverse-fourth-power (1/distance<sup>4</sup>) law for ground-plane limited radiation.

## HF Happenings

Apart from the celebration of SARL 95 in 2020, it is also 200 years since the arrival of the 1820 Settlers in South Africa. On 17 March 1820, the first Settler ship arrived in Cape Town. About 60 different parties landed in Algoa Bay between April and June 1820. They were granted farms near the village of Bathurst in the Eastern Cape and other settlements in the area. A group of the 1820 Settlers continued on to Natal. Here is an opportunity for a Club to activate a special event station to celebrate this event.

### Happy Birthday

Germany. Celebrating the 70<sup>th</sup> anniversary of the Deutscher Amateur Radio Club (the German IARU society), special call signs DF70DARC and DP70DARC will be active from 1 January to 31 December. QSL via the bureau, LoTW, eQSL, or direct to DK5DC; log search on Club Log. See <http://www.70darc.club/> for information on the DARC 70 Award.

The Netherlands. Special call sign PA75VERON will be activated throughout 2020 to celebrate the 75<sup>th</sup> anniversary of the Vereniging voor Experimenteel Radio Onderzoek in Nederland, the Dutch IARU society. Activity will be on 40 to 10 metres. QSL via eQSL and LoTW only.

Poland. Special call signs 3Z90PZK, HF90PZK, SN90PZK and SP90PZK will be active from 1 January to 31 December 2020 to celebrate the 90<sup>th</sup> anniversary of the Polish Amateur Radio Union (PZK, Poland's IARU Society). Active during the same period will be also HF90TPAR, HF90TPBB, HF90TPBF, HF90TPBG, HF90TPCF and HF90TPCG, the suffixes memorialize the call signs of the founding members of the Lwowski Klub Krotkofalowcow, the first amateur radio club in Poland and forefather of PZK. QSL via operator's instructions.

Switzerland. HB40HTC and HB40HC are the call signs for the Helvetia Telegraphy Club to celebrate its 40<sup>th</sup> anniversary in 2020. QSL via the bureau and LoTW. A special activity programme - the HB Open CW Activity (HB-OCWA) Award - will be in place throughout the year to mark the anniversary, help activate the special call signs and also "inspire amateur radio operators in Switzerland and elsewhere to increase CW activity on the HF bands. The intent of the award is to encourage and reward them for conducting sustained CW conversations rather than short-duration CW signal reports". See <https://hb-ocwa.ch/> for detailed information.

### Guglielmo Marconi

ARI Fidenza will use a series of special call signs throughout 2020 to commemorate twelve major events and achievements in Guglielmo Marconi's life. QSLs via IQ4FE, bureau or direct. See <http://arifidenza.hamlogs.net> for the "Marconi: Genius and Brainwave" award.

January - II4BRN Marconi's birth (1874)

February - II4MLB First radio broadcast of a musical performance: Dame Nellie Melba's song recital (1920)

March - II4MCY Foundation of the first "Marconi Company" (1897)

April - II4FTX First transatlantic radio signals transmission (1901)

May - II4TEA First radio message between the United States and the United Kingdom (1903)

June - II4REP Rescue of the ocean liner "Republic" (1909)

July - II4NBL Marconi is awarded the Nobel Prize in Physics (1909)

August - II4CLT Inauguration of the radio station at Coltano (1911)

September - II4PTN Marconi applies for his first patent (1896)

October - II4LGH Marconi switches on the lights at Sydney Town Hall from Genoa via wireless transmission (1930)

November - II4RVT Inauguration of Vatican Radio (1931)

December - II4MDY Marconi Day at Chicago World's Fair (1933)

### Calendar:

#### January 2020

1 – Download the 2020 Blue Book; New Year's Day; start of the CQ DX Marathon

3 and 4 - Quadrantids meteor shower

4 – ARRL Kids Day

4 and 5 – ARRL RTTY Roundup

15 – Provincial schools open; SARL Wednesday 80 m Club Sprint; Synopsis of papers for AMSAT SA symposium to be submitted

16 to 20 - Wolfkop Weekender, Citrusdal

17 to 19 – PEARS National VHF/UHF contest

21 - Highway ARC meeting

25 - CTARC meeting; Summer QRP Contest; Delheim Harvest Festival

25 and 26 - BARTG Sprint Contest

26 - Sani Pass Wild Flower Walk

31 - Closing date for AGM motions, Award nominations and Council nominations

## Some Contesting in January 2020

The ARRL Kids Day will be on the air on Saturday 4 January. The first leg of the SARL Wednesday 80 m Club Sprint will be on the air on Wednesday 15 January, with the PEARS National VHF/UHF contest over the weekend of 17 to 19 January. The Summer QRP contest will run on Saturday 25 January.

### Kids Day 4 January 2020 - Lisa Leenders, PA2LS

Just in the beginning of 2020 it's time for a new Kids Day <http://www.arrl.org/kids-day>. Kids Day is generally on the first Saturday in January and the third Saturday in June. This event is especially created to promote Amateur Radio to youth. This is a moment where you can share your amateur radio hobby with your family, grandkids, friends, scouts or even to the general public. This day can be the first time for youth to experience a real radio QSO, hopefully they get interested in becoming a licensed amateur radio operator.

You could make use of this suggested exchange: Name, age, location and favourite colour. Be sure to work the same station again if an operator has changed. To draw attention, call "CQ Kids Day."

Suggested frequencies for IARU Region 1:

10 Metres: 28,350 to 28,400 MHz

15 Metres: 21,360 to 21,400 MHz

20 Metres: 14,270 to 14,300 MHz

40 Metres: 7,080 to 7,120 MHz

80 Metres: 3,650 to 3,750 MHz

Other suggested frequencies by the ARRL:

12 Metres: 24,960 to 24,980 MHz

17 Metres: 18,140 to 18,145 MHz

40 Metres: 7,270 to 7,290 MHz (*Not in the Region 1 allocation*)

80 Metres: 3,740 to 3,940 MHz (*Region 1 has up to 3,800 MHz*)

### OQRS Hints & Tips

Tim, M0URX has added a page on his website to explain how to use his Online QSL Request System, go to <https://www.m0urx.com/> and find "OQRS Hints & Tips" in the dropdown menu under "How to QSL". This is the same system used by M0OXO: "an integrated on-line bespoke Log Search, OQRS and QSL Manager application", which "offers useful tools for DXers and DXpeditions and strongly supports the QSL manager workload automating the most time consuming QSLing processes".

### Radio amateurs sign petition to add Catalonia to the DXCC

EA3FHP reports a petition on Change.org calling on the ARRL to add Catalonia to the list of DXCC entities reached 1 745 signatories on Sunday 29 December. Catalonia (Catalunya) has a level of autonomy far in excess of that enjoyed by Wales when it was added to the DXCC list. Catalonia, population 7.5 million, consists of four provinces: Barcelona, Girona, Lleida, and Tarragona. The capital and largest city is Barcelona with a population of 1,6 million. Read the EA3FHP post at <https://ea3fhp.cat/2019/12/29/1745-radio-amateurs-have-already-signed-the-petition-to-the-arrl-to-include-catalonia-in-the-dxcc-countries-list/>

The petition is bilingual, scroll down for the English text, see [www.change.org/p/american-radio-relay-league-solicit-a-l-american-radio-relay-league-que-reconegui-catalunya-com-a-entitat-dxcc](http://www.change.org/p/american-radio-relay-league-solicit-a-l-american-radio-relay-league-que-reconegui-catalunya-com-a-entitat-dxcc)

### 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](http://www.sarl.org.za/public/awards/awards.asp))

The Democratic Republic of the Congo, 9Q. Fernando, EA4BB (ex-9Q5BB, D2BB, ST2BF, TU5JL, TZ6BB, Z21BB), who has been active as 9Q6BB from the Democratic Republic of the Congo for nearly 4 years, is now QRT. He dismantled his Goma station on 18 December, after making 26 000 QSOs. QSL via W3HMK, LoTW or eQSL.

The Gambia, C5. Przemyslaw, SP3PS, who became a resident of



Gambia in 2017, will once again be active as C5SP from Sanyang between 27 December and 17 January. Activity will be on 20 to 6 metres using SSB and FT8/FT4. He will mainly call on 20 m, but will also try to run on other bands, including LF in SSB. QSL via SP3PS, direct, LoTW or eQSL.



Algeria, 7X. Members of the "Association des Radio Amateurs Tunisiens" (ARAT) are traveling to Algeria to conduct a joint Low Bands DXpedition with five members of the "Amateurs Radio Algeriens" (ARA) between 28 December and 2 January 2020. The team is led by Afif, 7X2RO and Ash, 3V8SS/KF5EYY, and will also include Ahmed, 3V1B/KG5OUE (22 years), Marwa, 3V8CB (24 years, YL), Mohamed, 7X3TL (27 years), Mohamed, 7X5FG, Redha, 7X5QB and Abdelghani, 7X2TT/M0NPT. The operators will be focusing on working as many stations as possible on 160 and 80 metres as well as the other HF bands and Satellites. Modes will be CW, SSB and FT8. QSL via 7X2RO and LoTW. There will be ClubLog Live Streaming. For more details on how to help and/or LF skeds, E-mail Ash at ash.kf5eyy@gmail.com. Your financial support will be used to cover youngsters' costs.

South Sudan, Z8. Diya, YI1DZ has been back in Juba, South Sudan since 13 December and will remain there for "at least six months". In his spare time, he will be active as Z81D on 80 to 10 metres SSB, FT8 and maybe FT4. QSL via Club Log's OQRS, or via OM3JW. He does not use LoTW.

Senegal, 6W. Willy, ON4AVT, will once again be active as 6W7/ON4AVT some time in February 2020. His main activity will be on 60 metres using mostly FT8, with some CW and SSB, with a FT-891 with 100 watts into a HyEndFed antenna. QSL via the Bureau. For more details and updates, watch [https://www.on4avt.be/trip\\_to\\_senegal.htm](https://www.on4avt.be/trip_to_senegal.htm)

Djibouti, J2. Tom, DJ6TF, Manfred, DK1BT, Wolf, DL4WK, Annette, DL6SAK, Tom, DL7BO, Sigi, DL7DF, Frank, DL7UFR and Leszek, SP3DOI will be active from Djibouti between 4 and 16 March 2020. Their call sign is pending. They will have three stations on the air from 160 to 10 metres using CW, SSB and the Digital modes. Their equipment consists of an Elecraft K2 transceiver, three Icom IC7300 transceivers, four power amplifiers, bandpass filters, a vertical for 160 and 80 m, a 40 m loop, a 30 m loop, a Spiderbeam for 20 to 10 m, loop antennas for 20, 15 and 10 m and a beverage. Pilot station for this DXpedition is Bernd, DF3CB. QSL via DL7DF, direct or by the DARC Bureau. They will upload the full logs of the DXpedition to LoTW within 6 months after the DXpedition. For more details and updates, see <http://www.dl7df.com/j2>

## 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

Rodrigues Island, 3B9. David, F8AAN, will be active as 3B9AN or 3B9/F8AAN from Rodrigues Island (AF-017) between 9 and 18 March 2020. Activity will be on 160, 80, 40, 30, 20, 17 and 15 metres CW. QSL via his home call sign, direct or ClubLog's OQRS.

## CWOPS 10th Anniversary Celebration

A large number of affiliated club and special call signs - the latter including DQ10CWO, DR10CWO, EG4CWO, EM10CWO, IR9CWO, LZ10CWO, OL10CWO, PA10CWO, PG10CWO, SD10CWO, SF10CWO, SM10CWO, SN10CWO, TM10CWO, TM5CWO, TM6CWO, TO10CWO (Guadeloupe), VA1CWO and VC3CWO as well as many 1x1 call signs from the US - will be active between 1 and 31 January in celebration of the tenth anniversary of CWops.

Activity will be on 160, 80, 40, 20, 15 and 10 metres CW. Complete information on the award programme is on <https://cwops.org/cwops-10th-anniversary-celebration/>. CWops' goal is to bring together amateur radio operators who enjoy communicating by Morse Code, and to encourage the use of CW whether for contesting, DXing or ragchewing.

## Valve Radio Repair and Maintenance

By Paul Stenning

*I have been thinking about putting together a few articles around the Maintenance and repair of Valve Radios for some time now and have come across a series of articles that I think may fit. These of course may probably seem like old hat to some of our more seasoned repairers, but to those of you who have not tried lifting any tools to equipment, this may be a good starting point.*

*If you are a beginner with Valve Equipment, just a word of warning, please be aware at all times that Valve Radios have "High Voltage" inside and can be extremely dangerous. Should any of our seasoned readers have more information or articles they would like to pass on, please email them through to me. (Ed)*

### Tools

This section covers only those tools needed for the electrical repairs. Items required for cabinet restoration are mentioned in the relevant section.

One of the most important items is a good soldering iron. Look for one rated at around 35 to 50 watts, as anything smaller will prove to be inadequate for larger tags etc. This does not need to be particularly fancy, but avoid the really cheap ones sold in DIY stores, as they tend to fail within a few weeks. Antex or Weller soldering irons are good value for money and are recommended. Weller are generally better regarded than Antex by professional users. If you already have a good lower power (15 to 25W) soldering iron, you could instead choose to supplement it with a Weller 100W soldering gun. These are trigger operated, reach working temperature within about ten seconds, and as such are ideal for use when your smaller iron cannot cope. However they are quite bulky and awkward compared to conventional irons. A good desoldering tool (solder sucker) is essential. Get the spring-loaded type, as the squeeze-ball style is not vigorous enough.

A pair of electronic wire cutters is another essential. The trouble is that good-quality professional side cutters are not cheap at around £23 - £30. If you will be using them regularly, this sort of expense is not unreasonable for a tool that will last for years if treated with care, but for occasional use something cheaper is called for. Cutters like those shown here are available for under £3 from CPC, and will give good service if looked after. Tandy and Maplin probably sell something similar. They have the added advantage that it is not too much money to lose if they are lost or broken!



A pair of larger, more substantial wire cutters are also necessary for cutting mains flex, small bolts etc. Long-nosed pliers are handy for forming component leads, holding items being soldered, and manipulating small nuts and screws in awkward corners.

A good set of new screwdrivers will make the job so much easier than a motley selection of old tools. I like the red and blue handled own-brand range sold by Woolworths; these are available singly and in sets, and are very good quality and excellent value for money. Currently a set of around 15 screwdrivers is being sold for about £10. DIY and car accessory stores will stock their own-brand products, which would also be good quality and value.



In addition, you will probably need a 5/16", 1/4" and 3/16" nut spinners (for 2BA, 4BA and 6BA nuts respectively). A small adjustable spanner is useful for releasing pot and switch nuts and other similar fixings. A set of jewellers screwdrivers are handy - the smaller sizes are ideal for bending valve holder contacts inward to tighten them, and the larger for releasing grub screws etc. Finally, a 1/2" paintbrush is helpful for removing many years build-up of dust. None of these items should cost too much if you shop around.

Another handy tool is a rechargeable power drill. The advantage of this type over the more normal electric drill is that they run at a slower, more controllable speed. The Power Devil power tools sold by Homebase and ScrewFix Direct are fairly good quality (adequate for light duty work) and good value for the money. In a similar vein there is Skil and Power/Performance (sold by B&Q). If you want something more durable and suitable for DIY work too, look at Black and Decker, Bosch or one of the other major brands.



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## Test Gear

The test equipment you need to get started is minimal. A multimeter is essential, but most electronics enthusiasts will have one already. A cheap digital type is ideal, and has the advantage of a high input impedance. Personally I do not like auto-ranging meters, because they take too long to settle. You should be able to buy something suitable from Maplin, Tandy or CPC for under 30 UK Pounds. This is the one piece of equipment I would always buy new, because they are cheap and it is not worth the risk of using a second-hand instrument that may be inaccurate or unreliable. It is also the piece of equipment you will use most often, so buy the best you can afford. I use a Maplin Precision Gold digital meter (model M810), costing around £70, which includes frequency measurement, and capacitor, diode and transistor testing facilities. These extras are more useful for testing transistor equipment, but they probably only added about £10 to the price.



Some repairers hate digital meters, and swear by analogue types. It's really a matter of personal choice. If you want to go for analogue, choose a model with a large, clear scale. A small cluttered scale will put you off analogue meters for life! The Avo 8 is the undisputed leader for vintage radio work - but they don't come cheap.

*(For work on Transmitters, a VTVM—Vacuum Tube Volt Meter, for measuring high voltages especially from transformers— see comments from John ZS5JF after this article—Ed)*

Eventually you will need to realign the RF and IF circuits of a set, and for this you will need an RF signal generator covering the range 150KHz to about 12MHz or maybe higher, and possibly also 87MHz to 100MHz. It must also have an option to amplitude-modulate the output with an audio tone. I had an Altai unit (left) costing over one hundred pounds new, and a Heathkit unit (right) which cost me about five pounds in an auction. After a couple of basic repairs, the Heathkit works much better than the Altai - the waveform shape is better, the amplitude more consistent as the frequency is adjusted, and a greater depth of modulation is possible without significant distortion. The Altai has now been sold!

Signal generators are sometimes included in vintage radio auctions, and often sell cheaply. In a recent Radiophile auction there were about four, and all sold for less than £5 each. They may well not have been fully working, but the circuit is generally fairly simple (using just two or three valves) and should not be too difficult to repair. My Heathkit unit came from such an auction, the circuit uses two valves, and the only faults were a couple of dry joints, a noisy pot and a missing knob. I also replaced the mains flex with 3-core cable, and earthed the case.



There are designs for inexpensive basic signal generators available on the internet.

I have also designed a simple [audio output level indicator](#) for alignment purposes. This has a low cost analogue meter, which reads full scale when the audio level is about 1 Watt into a 3R speaker. I make no claims for its accuracy and linearity, but it is ideal for finding the peak position of an adjustment. You may find it convenient to build this into the same case as the signal generator. Alternatively an analogue test meter will do the same job if set to a low AC voltage or current range.

If you already own an oscilloscope you will find it useful occasionally, but it is not worth buying one for valve radio work alone. It does act as a convenient output level indicator for alignment. It's an expensive piece of kit to buy new (£300+). They do turn up regularly second-hand in vintage radio auctions, but they probably aren't fully working and are complicated instruments to repair

A Variac (variable autotransformer) would also be useful, but it is probably not worth spending the money unless you are doing many sets. Note that most variacs do NOT provide any isolation from the mains.

The same can be said for a valve tester. These are available second hand, and AVO units are generally

regarded as the best. Make sure you get a copy of the manual, and the settings for a wide range of valves with it, otherwise it will be no use to you. Copies of the manuals are on the [Valve Data CD-ROM](#).

I use a Mullard High-Speed Valve Tester that uses punched cards to set it for specific valves. It is very quick and easy to use, because they were designed for use by non-skilled shop operatives and have a scale clear enough for Joe-public to understand. It does not give such detailed information as the Avo unit (but then the Avo ones are more expensive), but is fine for simple go/no-go testing. If you are offered one of these, make sure you also get the two boxes of punched cards, the cross-reference lists and the instruction manual. Be warned that they are very heavy! I paid £25 for mine a few years ago - now you would be looking at £50 - £80.



Valve testers will sometimes condemn valves which actually work fine in a set. I tend to believe mine if it indicates internal shorts or excessive grid leakage, but take its claims of low emission with a pinch of salt, unless it's right off the bottom of the scale! Perhaps this is because Mullard wanted to sell new valves...

For occasional repairs it is cheaper (and less hassle) to get the valves tested by a dealer or fellow enthusiast who has the appropriate equipment. Many repairers manage fine without a valve tester, and rely on the results obtained in the actual set. If you have a stock of valves it is often quicker to try another one in the set than testing the suspect one. However I do find my tester useful, particularly when in doubt as to whether the valve or the set is at fault. I also like to test rectifiers and output valves as a matter of course, because serious faults here can have dramatic consequences!

A small loudspeaker in a wooden cabinet is useful when testing a chassis that has been removed from the cabinet. A speaker from an old stereo system (obtained from a car boot sale for a couple of pounds) is ideal. Use a 3 or 4 ohm unit if possible - some of the cheaper stereo systems (such as many Fidelity models) used 16 ohm speakers. I have a speaker mounted on the workshop wall, with the connections bought to a pair of terminals mounted conveniently by the bench. This allows me to get the radio's cabinet off the bench and out of the way.

For initial tests, a high voltage DC (about 250V) supply is useful. This should have a high output impedance (or a resistor in series with the output). This need not be very complex - a suitable simple design for this, described as a [capacitor reformer](#), is also included on this web site.

Alternatively, the set may be initially powered with a 100W light bulb in series with the supply. This provides some current limiting, which can avoid expensive damage in case of a fault. It is worth mounting this lamp, together with a mains socket and a bypass switch on a piece of wood. This arrangement is described elsewhere on this web-site as a [series lamp limiter](#).



A SafeBlock or similar is a real time-saver. This simple device allows you to connect an item to the mains without having to fit a plug first. It has three coloured clips, protected by a cover. When the cover is open the live and neutral clips are isolated so the wires to the appliance can be connected safely. With the lid shut the clips, and therefore the appliance, are live. The fuse lives in the lid, making it easy to change. These units were in common use in electrical retailers some years ago, but are now largely redundant due to all new appliances being supplied with fitted plugs.

Another piece of equipment that turns up in auctions, and is useful if you can get one cheaply, is a Megger or insulation resistance tester. This instrument measures resistance up to 100M or more while applying 500V DC. It is particularly useful if you are selling restored sets and wish to make sure they are safe. The Megger I bought in a recent Radiophile auction cost me just £1, and although it is missing the battery cover, it works fine. Being transistorised there is not much to go wrong, apart from the meter movement. One day I will get around to cleaning the glue and muck off the case!



## Test Equipment John ZS5JF

A good idea is to build gently with test equipment. I started with a ropey old volt/ammeter of doubtful parentage and a clapped out Solartron 'scope and pretty much built all my own test equipment from that point on. Being an impoverished apprentice makes you do things that wealthy people would never dream about.

I have used VTVMs at the saltmine but to be honest they are more exotic and temperamental than other voltmeters. Today you can purchase a DVM (digital volt meter) that will run rings around the older VTVMs except in one parameter. That is the input resistance. Most VTVMs have a standard 10M-ohm or 11M-ohm input resistance on all the ranges. But DVMs now also have the same. There were some exotic HP VTVMs that claimed 120M-ohms but they were designed for very small signal measurement. In 99% of repairing older tube equipment a 20k-ohm per volt voltmeter is perfectly adequate. The schematics are usually annotated with "Voltage readings made using a 20k-ohm/V instrument". The fact that a newer DVM or a VTVM will read a little higher due to the reduced loading isn't normally an issue.

If you are measuring HT voltage above about 50V then a 20k-ohm meter is ok. It only becomes an issue if you are probing grid voltages of a few volts and the grid resistor is 1M-ohms or so. Then a normal voltmeter will upset the circuit you are attempting to measure.

I find some people get carried away with things like ESR meters, not one I have examined closely actually measures the true ESR but they measure the reactance or the impedance, which is quite a different story. For HV electrolytics ESR is normally irrelevant as the reactance is already so high with a typical value being used. To measure ESR you need to know what the reactance is at the measurement frequency. Using 10kHz to measure a HV electrolytic with a 350V or higher rating is daft. The important frequency is what it will see in circuit. For 50Hz mains with full wave rectification it will be 100Hz, so that is where the ESR has to be good, not at 10kHz or some other frequency.

But ESR is relative to the reactance at the operating frequency. For a 100u / 450V elco as a full wave reservoir capacitor it has a reactance of 16-ohms. If the ESR is 50% of the reactance the effective impedance in circuit is only a little higher. It would be 17.9-ohms, an increase of about 10%, which is nothing to get excited about. Typically the ESR is around 0.2 to 0.4 of the reactance for typical HV elcos in use today (The DF ratio).

So the ESR could be as high as 6.4-ohms making the impedance only 17.2-ohms, an increase of 7%. In the days of oil filled paper HV capacitors nobody ever talked about ESR. The ESR of an oil filled paper is close to zero for any value or voltage rating. The DF of the old oil filled paper caps were below 0.1 and some as low as 0.01 at 100Hz or 120Hz. To find the ESR multiply the  $X_c$  value by the DF. Modern "paper caps" for HV dc bulk storage are making a come back in a big way. If using elcos then you need plenty in series, because they are limited to 600V maximum rating by the construction method used, with all the attendant problems, but a single HV paper cap can replace them and still offer the required HV rating required.

Where ESR is important is in PWM supply with low output voltages.



VTVM



ESR Meter

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**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.

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