



Volume 32 No. 4
February 2023
S.A. Group
Newsletter

Who is this man in the white suit.... Demonstrating something on an AMPEX 2-inch multi-track audio suite?

He was an engineer and inventor, and we have all listened to the results of his work..... Sadly, it is 10 years ago that he passed away..... Who was he?



"To be an inventor, you have to be willing to live with a sense of uncertainty, to work in this darkness and grope towards an answer, to put up with anxiety about whether there is an answer."

Who was he? Look inside for the feature article on this man's work.

Historical Radio Society of Australia Inc. – S.A. Group

Web Site: www.hrsasa.asn.au

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Planned meetings for the next few months:

Sunday 26th February 2023

1:00pm to 3:30pm

Electrical Safety Day

As members, we hope you would never work on a radio that is plugged into the wall and powered on. Vintage radios not only operate from 240 volts AC mains, but they produce up to 400 volts DC as well.

Both can be lethal. TV sets have about 15,000 volts! Even battery valve radios and TVs operate at high voltages and currents.

At today's meeting we will look at the Australian regulations and explore some practical ways to deal with many of the dangers, such as "live" chassis radios, plugs, transformers, various and adaptors, and explore some of the "Myths" around electrical circuitry.

Also – we will be launching the 2023 Amplifier Building Competition.

To be held at:

St. Cyprian's Church Hall, North Adelaide

Wednesday 8th March 2023

12noon for 12:30pm start

Members Lunch

Earl Of Leicester Hotel, 85 Leicester Street,
Parkside, SA,

Sunday 26th March

1:00pm to 4:00pm

AUCTION

This will be one of our regular club auctions.
Please note: you must be a current, financial member of the society to participate in the actions.

Please contact the Secretary if you would like to book a table

To be held at:

**St. Cyprian's Church Hall
70 Melbourne Street, North Adelaide, SA, 5007**

Sunday 16 April
1:00pm to 3:30pm

TUTOR ASSISTANCE WORKSHOP

Bring along your own project and get free help from one of our three "experts".
Three workstations will be set up around the hall, and each expert will work with 3 or 4 people so 12 places are available.

Contact the secretary to book your timeslot.
This is an extra meeting to our main programme, but members are welcome to attend as observers.

To be held at:
St. Cyprian's Church Hall
70 Melbourne Street, North Adelaide, SA, 5007

Sunday 30th April
1:00pm to 3:30pm

AWA "SHOW and TELL" DAY

As we did last year with *EDDYSTONE Day* and *ASTOR Day*, members are asked to bring along their AWA restorations. They could include domestic radios, TV's, Comms receivers, Military radios/transceivers.....anything with that AWA badge.

To be held at:
St Cyprian's Church Hall
70 Melbourne Street, North Adelaide, SA, 5007

NOTE: The Christmas Lunch will be held on Saturday 16th December (not 18th December.)

Wanted to Buy, Sell, or Exchange

Are you looking for a hard-to-get part? A strange knob, or a replacement coil? Have an item that you'd like to sell? Why not place a free, classified advertisement on our website? Go to the TRADING POST page of our website at: <https://hrsasa.asn.au/page-16/> and have a look at what's on offer right now and help a fellow member. It changes frequently. *Why not make use of this resource yourself?*

Wanted:

Claire Baker is STILL on the scrounge for old 'plug-packs'
(Needed for items at the ETSA Museum)

If you have any "plug-packs" that are surplus to requirements, can you please pass them on to Claire.

From: Mobile phones; old computers; kid's toys.... etc/.

It doesn't matter about voltage or style.

Claire can be contacted on Ph 0473 444 784. - Thank you.



President's "Banter"!

From our President, Graham Dicker.

President's monthly stories from the past (and other ramblings)



Well, here we are - another year of projects! It's now time to dust off the soldering iron and clear that backlog of restoration projects. My project from the past is a "Kits R Us" one from 1990. While also being a bit dusty it still holds its own, even with today's many solutions. Also, with the potential amplifier competition coming up later this year to mark 100 years in broadcasting in SA, who knows, it may be a useful audio project - a single dual FET preamp.

For a change, my story this month is somewhat different to my usual "*funny things that happened*". This time, it's about a repair to one of my own personal **Rola 66** tape machines originally purchased from Des Feary (ex 5KA Dee Jay about 1969).



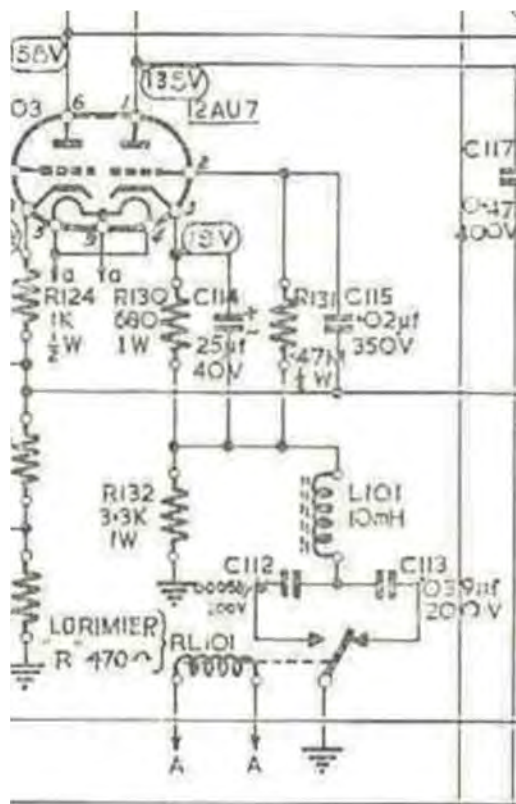
ROLA 66 Broadcast Reel-To-Reel Tape Recorder (circa 1969)

The story has its origins back in the 70's, while on holiday in Tasmania I dropped into radio station 7HO before they moved to FM back in the AM days. After a tour of the facilities, I ended up in the technical area with the chief engineer, and there was a ROLA 66 tape machine the same as my unit 7 ½ and 15 ips, full track mono - no radio tuner on the bench. This machine was being used in commercial production and while it played perfectly, recording was not without problems. It was recording with high gain sounding distorted and "dull". All the tech's there at the station "had a go over many weeks" at fixing the problem without any success. Having spent a lot of time on 66's in the past, I opened my mouth and advertised the problem should not be too hard to fix. Our tour bus was leaving in around 5 hours' time, so I figured I could fix it in that time, well, I failed dismally!!!!!! In fact, I missed the tour bus and had to catch up with the group by way of a cab to their destination. To this day, I am not sure if they managed to fix the fault.

Back to my story, same problem (identical) but this time I had another 20 years' experience and time on my hands without a tour bus to worry about.

This time with a decent audio sweep generator and a CRO it was easy to see what the record channel was doing by unplugging the bias oscillator valve and monitoring the head voltage while sweeping the record

chain. You could also unplug the record head and just check the amplifier section, the response looked nothing like a normal IEC response with low cut high boost the response was certainly distorted badly, and the turnover frequency was nothing like what it should be. The way the record amp works is, it is a normal grounded cathode amplifier with a gain of about 20 times. In the cathode circuit is an inductor and relay switched capacitors that form a series resonant circuit.



At resonance, the impedance is least and hence the negative cathode feedback least, giving more gain at this frequency. Offset against this is the rising impedance of the record head with an impedance of about 1000 ohms with low frequency response reduced with the .47uF anode coupling capacitor. At resonance, with the speed at 7 1/2ips the frequency is 6.7kHz and at 15ips the frequency is 8kHz both giving a rising gain response at these frequencies. On looking further, the plate voltage of the 12AU7 was down to 90V and on inspection it was found the cathode coupling capacitor was about 30 ohms DC resistance instead of going open which is usually the way they fail. Changing the cap solved the DC bias conditions for the stage, but things were still not right with the resonant frequency of the cathode circuit.

Doing a frequency sweep showed that it was indeed resonant, so the likelihood of a shorted turn in the inductor was a possibility. Swapping it out for a SMD choke did not help due to the different core permeability. I was now starting to scratch my head about the same fault as 20 years before. A thought came to mind.... At 15ips speed setting, the same identical poor result. Replacing both EQ capacitors was interesting, but still the fault remained. One was 39nF while the other measured 56nF not 580pF as marked on the schematic. Further checking with another set of electronics confirmed the installed value was 56nF for the low-speed setting.

Still no change in results until the penny dropped... there was no difference between the two speed settings. The culprit turned out to be a set of stuck together relay contacts, effectively putting both capacitors in parallel! No wonder things just did not work out. I changed out the relay for a modern spare. Problem solved, estimated time an entire day. What it proves is ***you are never as smart as you think you are, Mr. Murphy always has the upper hand.***

- ***Graham Dicker.***

Component Corner

Many new members are probably wondering where to obtain components and valves. The following is a list in order of preference:

HRSA-SA Group Shop: We are working towards a publishable catalogue. Contact our Shopkeeper, Rob Olding on 0422-096-341 to enquire, or place an order. Rob's email address is: shop@hrsasa.asn.au

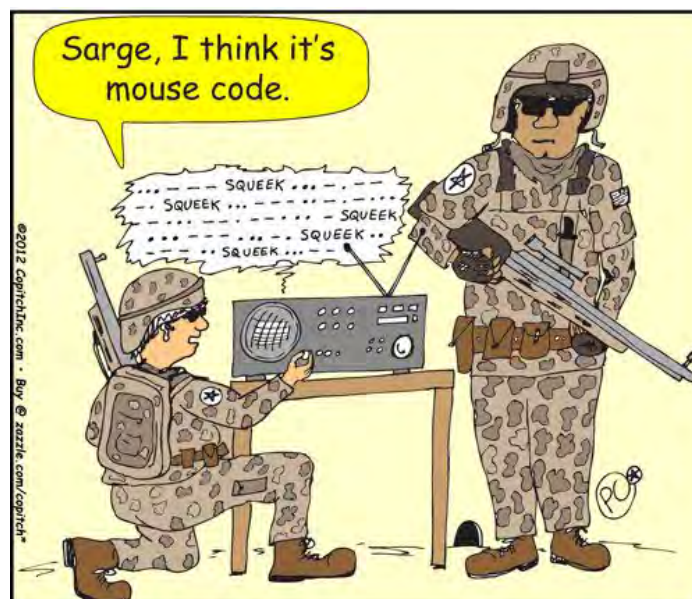
AZTRONICS, 170 Sturt Street, Adelaide. Houses the HRSA-SA Group valve bank and modern components. They will source components for members. Great supporters of the HRSASA.

HRSA Melbourne (see *Radio Waves*) Houses the Victorian HRSA valve bank and odd passive components and kits, plus resource books written especially for members.

WES Components, Sydney. The catalogue is viewable on-line, and orders can be placed through the Shop Keeper or Secretary, as the SA Group has an account, through which we get "trade discount". Go to: <https://www.wes.com.au> to see all their products.

Photo Gallery:

Members Lunch at the Reepham Hotel – Wednesday 11th January 2023



Cover Story:

An engineer/inventor whose work we have all “heard”.

Ray Dolby, the Engineer Who Revamped Sound Technology

By Lianne Frith (Reproduced from: <https://www.allaboutcircuits.com>)

Before his name became a brand and a household word, Ray Dolby was a pioneer in noise reduction technology. His innovations revolutionized the audio and entertainment industries.

Even today, the name Dolby is synonymous with multi-channel surround sound systems. The fact is that the American engineer and inventor revolutionized sound technology and much of what happens to improve the sound of entertainment can be traced back to his efforts.



Ray Dolby at work in his lab. (Image courtesy of Dolby Laboratories)

Who was Ray Dolby?

Ray Dolby was born on June 18, 1933, in Portland, Oregon. A musician from a young age, he took a keen interest in sound and how it worked. He also developed a fondness for movies and photography. On meeting Alex Poniatoff, founder of tape-recording company AMPEX, Dolby soon had his first part-time job and began developing a greater understanding of audio technology.

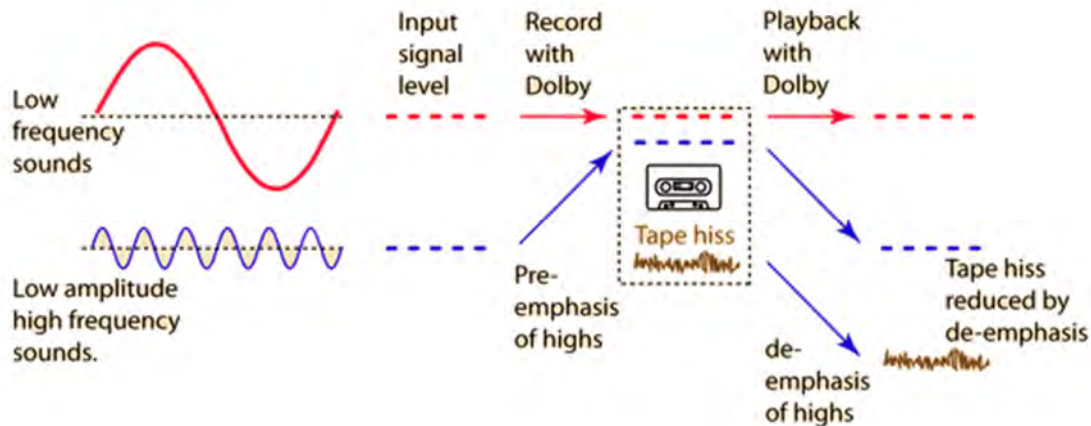
On leaving school, he studied electrical engineering at Stanford University and went on to receive a PhD in Physics from Cambridge University. During his time studying, Dolby was already working on prototypes for videotape recorder technologies at Ampex.

After he finished his studies, Dolby travelled to India as part of a United Nations team sent to set up a scientific instrumentation lab. It was there that Dolby encountered the problem of tape-hiss while recording sitar music and he dreamed up the idea for noise reduction on audio tape recordings. That very same year, 1965, motivated by the problem, he returned to England and founded his own company, Dolby Laboratories, to look for a solution.

What Technology Did Ray Dolby Create?

Dolby is best known for his noise reduction system, Dolby NR, which was developed at Dolby Laboratories in 1965. The Dolby A noise reduction system employs electronic circuitry devised to reduce tape hiss and other noise inherent in analogue audio tape recording and playback. The process involves passing sound through an encoder as it is recorded and then playing it back through a decoder.

The Dolby systems for noise reduction employ circuitry which pre-emphasizes high frequencies before they are recorded onto tape in order to make them larger than the tape hiss noise with which they compete.



The circuitry is amplitude-sensitive: only soft high-frequency sounds are emphasized. If loud high-frequency sounds were emphasized, it might drive the tape into its distortion levels. Upon playback, a matched de-emphasis circuit is employed to restore the high frequencies to their proper balance with the other part of the recorded signal with no adverse side effects, creating a crisp, clear, true sound for the listener.

Dolby A	The professional level version of the Dolby process. Used in high-speed multi-track machines.
Dolby B	The most widespread version of the Dolby process, used in most popular stereo tape decks.
Dolby C	The most recent version of the Dolby process involving double compression. The resulting tapes produce more satisfactory results if played on non-Dolby units than the A and B versions.

After this, further noise reduction systems were developed. Dolby B, C and S were designed for the consumer market, and all worked by compounding or compressing the dynamic range of sound during recording and expanding it during playback.

Dolby moved his company to San Francisco in 1967 and added manufacturing and research facilities. He then focused on developing technology for film production and other industries, including the Dolby Digital Surround Sound system.



A Dolby sound processor. (Image used courtesy of Pixabay)

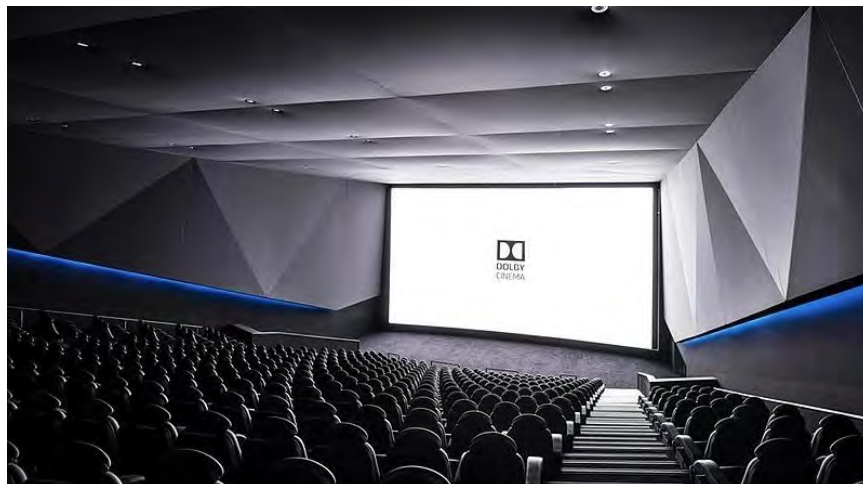
In more recent years, Dolby Labs has developed digital technologies, including home theatre systems, digital music file transmission systems and sound technologies for gaming. Ray Dolby retired in 2009 to focus on philanthropy. He sadly passed away in 2013. His technology still lies at the heart of these modern audio systems.

Dolby Revolutionizes the Audio World

The release of Dolby B in 1968 coincided with the first car radio cassette deck and the Sony Walkman, thereby contributing to the popularisation of the compact cassette. When Advent designed one of the first cassette tapes for high fidelity, noise reduction was one way to fix the problems of background noise.

Once the original reel-to-reel high fidelity tape recorders were replaced by cassette decks for home use, the Dolby B became widely accepted.

Decca Records first used the Dolby system and by 1967 major record labels, including RCA and MCA, were also using it. It wasn't long before the Dolby name was known throughout the recording industry.



The original Dolby cinema in Barcelona, Spain. (Image used courtesy of [Wikimedia Commons](#))

Then in 1971, the first movie was released with Dolby sound, revolutionising the cinema industry. The music was rendered more enjoyable and set the trend for what was to follow. In 1976, movie audiences experienced Dolby Stereo with four channels using magnetic technology.

It was Dolby's clever use of matrix decoding technology that gave cinemas a way to generate surround sound on stereo systems from the same optical print on which the film was recorded.

Ray Dolby's Greatest Achievements

Ray Dolby was never satisfied with a sound experience that wasn't realistic, exciting and enjoyable, and thanks to him, we get to enjoy these qualities throughout the film and music industry today, both at the theatre and at home.



Ray Dolby (left) is inducted into the National Inventors Hall of Fame. NIHF president Rick Nydegger (center); United States Patent Office's Anne Chasser (right).

While his greatest achievements were clearly his sound systems, he also has Emmys, Grammys, Oscars and a posthumous star on the Hollywood Walk of Fame to his name.

During his lifetime, Dolby earned more than 50 US patents and his company remains a place where scientists and engineers revel in pushing the limits of sight and sound for all of us to enjoy.

SUMMARY: Dolby Surround systems at a glance

Over the years Dolby has introduced several surround sound systems. Their differences are explained below.

Decoder	Encoder	Year	Description	Channels
Dolby Stereo	Dolby MP Matrix	1975	Cinema use with optical technology. Uses Dolby A for noise reduction. 4:2 encoded for 35mm film and 2:4 decoded back to 4.0 by Dolby Stereo Processor. Discrete Magnetic 6-Track variant for 70mm.	FL FR with C and MonoSurround matrixed
Dolby Surround	"	1982	Consumer Variant of Dolby Stereo. Original Decoder utilized a simple passive L-R Circuit with Delay and Phantom Center for 3-Channel Decoding.	FL FR and MonoSurround matrixed
Dolby Stereo SR	Dolby MP Matrix	1986	Addition of Dolby SR Noise Reduction to Dolby Stereo for Enhanced Fidelity and Dynamic Range.	FL FR with C and MonoSurround matrixed
Dolby Pro-Logic	"	1986 Modern 1987	Reference Active Matrix 2:4 Decoder (Cat No. 150) for Dolby Stereo and Dolby Surround. Accurately Decodes Lt/Rt to Recover the LCRS 4.0 Surround.	FL FR with C and MonoSurround matrixed
Dolby Digital	AC-3	1986 Modern 1992 Film 1995 Laser Disc	Discrete channel encoder/decoder. Pro Logic Decoder can be used for downmixed stereo inputs.	FL FR C SL SR SUB

Dolby Digital Surround EX	AC-3	1999	6.1 or 7.1 Surround via Matrix Encoding of Ls/Rs Channels in 5.1. Remains backwards compatible with standard 5.1 digital.	FL FR C SL SR (with matrixed RearMono) SUB [non-discrete 7.1: BackLeft and BackRight]
Dolby Pro Logic II	N/A	2000	Upmixes non-Encoded Stereo to Surround 5.1. Can also be used to decode Dolby Surround for 5.1 Playback. Consumer Decoders often include specific Movie, Music, or Game modes.	FL FR C SL SR SUB
Dolby Pro Logic IIx	N/A	2002	Extension to PLII. Enhancement of either Stereo, Dolby Surround, Dolby Digital 5.1 to 6.1 or 7.1. Decodes Dolby Digital EX to 6.1 or 7.1. Retains Movie, Music, or Game modes in Consumer Products.	FL FR C SL SR SUB Left Back and Right Back
Dolby Digital Plus	Enhanced AC-3	2006	Lossy compression codec; 48 kHz sampling frequency, 20-bit word length; supports data rates of 32 kbit/s – 6 Mbit/s, scalable, including 768 kbit/s – 1.5 Mbit/s on high-definition optical discs, typically, and 256 kbit/s for broadcast and online. 1.0- to 7.1-channel support for current media applications; extensible to 16 channels; discrete. Backward compatible with Dolby Digital through S/PDIF connection up to 640 kbit/s. Supports Dolby Metadata.	FL FR C SL SR SUB Left Back and Right Back
Dolby TrueHD	MLP	2006	Lossless compression codec; supports 44.1 kHz to 192 kHz sampling frequency up to 24-bit word length; supports variable data rate up to 18 Mbit/s; maximum channel support is 16 channels as presently deployed. Higher bitrate than Dolby Digital Plus. Blu-ray Disc channel support up to eight channels of 96 kHz/24-bit audio; six channels (5.1) up to 192 kHz/24-bit; and two- to six-channel support up to 192 kHz/24-bit maximum bit rate up to the maximum of 18 Mbit/s.	
Dolby Pro Logic IIz	N/A	2009	Extension to PLIIx. Decodes Stereo, Dolby Surround or Discrete 5.1/6.1/7.1 to 7.1 Height or Full 9.1 with the addition of Front Height Channels. Last Pro Logic Branded Decoder from Dolby.	L, C, R, Ls, Rs, Lrs (Left Back), Rrs (Right Back), LFE, Lvh and Rvh
Dolby Atmos	N/A	2012	Expands on existing surround sound systems by adding height channels, allowing sounds to be interpreted as three-dimensional objects. 7.1.4 Dolby Atmos system is a conventional 7.1 layout with four overhead or Dolby Atmos enabled speakers.	

...oooOOOooo...



Meet Colin Windsor:

From time to time we like to feature members that we've probably met many times but know very little about.

This month we would like you to meet Colin, he's been a regular attendee at meetings for 9 or 10 years.

Now well into his retirement from work as a radio and TV Technician, he still has that mischievous twinkle in his eye, and many stories to tell.....

Over the next few editions of our Newsletter, we will publish a few stories that he has been willing to share. *(There are a few others that he's told our editor but is a bit reluctant to share them just yet....)*

Did you know that Colin is also quite an accomplished yachtsman? For many years he was a crewman on various well-known yachts working in and out of the Royal SA Yacht Squadron and the Cruising Yacht Club of SA at Outer Harbour. Behind him on the mantelpiece is a scale model of one of his favourite yacht designs. But first, we have to go back to the beginning.....

Tales from TV servicing in Sydney - 1958 **By Colin Windsor**

Starting in 1954, I did my initial training at the **Weapons Research Establishment** and completed a Radio Technicians' course at W.R.E. Salisbury and at Woomera. I then applied for a job with **Dixon Primer TV** over in Sydney. Five or six of us applied and we were all accepted. Two of us were sent over to Sydney straight away to be taught the three stages of the business as they saw it namely: (1) pickup and delivery of TV's (2) installation of antenna and systems and (3) repairing faulty TV's.

Firstly, I was assigned to accompany an experienced delivery guy in an old van in which we ran all over Sydney on both sides of the Harbour Bridge. When the wind was high, crossing the bridge was a scary proposition! The van would sometimes lift on one side so that you had to steer very carefully to counteract the wind. The experienced delivery guy was called Mario. He was a tough and rugged Italian bloke who was quite a character. One day, I remember, he stopped outside a delicatessen and told me to wait in the van – then he wrapped a bike chain around his fist and entered the Deli! I waited, and he returned about 5 minutes later and said *"he won't **** me off again"* - I didn't ask for any details about his visit and nothing more was said.....

We were always busy rushing from job to job, so Mario always had his foot down! One day with a heavy console TV/radio strapped in the back of the van, Mario took a sharp turn at high speed on a small humpback bridge, but the strain caused the retaining strap break, and the TV flew out the door smashed itself onto the side of the road. Mario just kept on driving and said *"Hmph...insurance job"*.

A month on deliveries was enough, so I was put with a very knowledgeable bloke, a Dutch guy who was to teach me all about antenna systems. He was about 40 years old by this stage. He told me stories about his

youth, growing up in the Netherlands during the War when their country was occupied by the Nazis. He, along with thousands of others, were used as “slave workers” by Hitler's henchmen. He loved talking to me about how they sabotaged the German war effort and never got caught. He also introduced me to yoghurt which I had never heard of before. He explained to me that it “cleans your blood”, I would tell him that “my blood is not dirty!”

On the technical side, he explained to me how standing waves can stuff up reception of a signal if you have excess cable. In those days, we used 300ohm twin feeder cable. He taught me to coil it up any excess, nice and neat. I was that knowledge that I used back here in Adelaide when other Tech's failed to cure “ghosting” and undesirable pictures on a particular channel.

My boss at that time was a retired English army major and he could be rather abrupt and scathing if you weren't up to the mark. He said to me one morning to go to a particular job, with the command, *“and don't leave until you fix it”*. The customer was an “AX1”, which meant “full cover - no charge”. A few other techs had apparently given up on this job, hence its grading of AX1. As soon as I saw the picture, I knew how to fix it and I said to the old dear who was there, *“if you make me a cup of tea, I'll fix it before you bring it in”*. She just laughed and said *“I'll be surprised if you can...”*



Well, thanks to the Dutchman, I fixed it in no time, and when I rang in to the office to say “job done”, the boss said *“I want a full report”!*

That same guy, the Dutchman, said to me one day *“this job is impossible we're supposed to get a good picture and this customer lives down below a 40-foot cliff, so our signal is zero!”* The job was to erect an antenna sitting on a 60-foot mast to clear the Cliff and roadway above. Below, the house sat on a ledge overlooking the Pacific Ocean so to get to it (if you were game

enough) you had to drive down a precarious track, hugging the left side of the cliff-face. We chose to park at the top and cart all our gear down in a little two-man manually operated lift. To quote for a job like this would have involved an enormous amount of money! The normal charge would have been about 50 pounds (\$100) but this was way too much work for a standard fee. This job would amount to at least 1000 Pounds! I had a look around, and said to my mate, *“That Gumtree is more than 60 feet high - why don't we just mount the antenna up top?”* He just laughed and said we'd need a helicopter to do that. But told him I told him that I'm very good tree climber and I could do it. This house, being located on the North Shore, meant that the transmitters at Gore Hill were only a few miles away. The pictures were perfect, the customer was happy, and the job took less than half an hour. It was the best quote that they had received, so it was smiles all round and especially from the boss who pocketed 500% more than normal fee!

More tales from Colin in our next Newsletter!

An advertisement for AWA Deep Image Portable TV. On the left is the AWA logo, a blue circle with white letters. Below it is the text "Mark of Excellence in Television, Radio, Car Radio". To the right of the logo is the text "DEEP IMAGE PORTABLE TV" in large, bold, black letters. Below that is "Manufactured and guaranteed by AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED, Australia's Own Electronics Organisation". On the right side of the advertisement are three portable television sets, labeled P1, P2, and P3 from left to right. The background is yellow.

HRSA-SA Group - Amateur Radio Call-Back Network



In 2020, when our HRSA-SA Group was unable to hold meetings due to Covid-19, a small group of licensed radio amateurs decided to hold a local call-back net.

The first broadcast was on the 26th of April 2020. Although the ban on meetings was soon lifted, the broadcasts have continued and as we approach the completion of our third year, we have had 147 broadcasts.

While the aim is primarily for HRSA members, non-members are also welcome, the more the merrier. The group has a small band of listeners who either do not have the required licence or do not have transmitting facilities. Topics generally centre around historic radio, or activities coming at HRSA events, plus a range of widely varying content, can be heard.

For those licenced amateurs and those that would like to listen to the broadcast and have the correct facilities the details are:

Wednesday Nights (each week) – Starting at 2000 hrs.

On VK5RHO repeater (Houghton/Anstey Hill) which has an input of 146.25 MHz and an output of 146.85 MHz

There are generally two full rounds and a quick “wrap-up” round.

New participants are most welcome.



So why not tune in and listen, or join in the conversation?

How to read Old Style Resistors

Over the years many methods of marking small components have evolved. In the case of resistors the colour code method is predominant. The basic colour code and colour values have remained consistent over time.

Initially most resistors were manufactured to a 20% tolerance standard and therefore no method of colour coding the tolerance was required and only three colours were needed to indicate the value. With the advent of better manufacturing techniques it became necessary to add additional colours to the code and extra stripes to the resistor to indicate the tolerance value, this also meant a change in the way the colours were applied to resistors and hence the order in which the colours were read.

Early 3 colour resistors are read in the following order:

	Body.....End.....Stripe Green (5)..Black (0)..Yellow (0000) = 500000 or 500k or .5meg
	Body.....End.....Dot Red (2)...Green (5)..Yellow (0000) = 250000 or 250k or .25meg

More modern 4 colour resistors have the colour bands side by side and are read left to right. The first band being the one that is closest to an end...the fourth band (last on right) indicating the tolerance. As a result of the improved tolerance situation a preferred value system (as in the case of capacitors) was developed, to minimise overlapping values. This preferred value system has been expanded as tolerances have been further improved, necessitating more bands to indicate the value and tolerance.

Over recent years 5 colour resistors have become common.

The two-colour charts below will assist reading of 3, 4 & 5 band resistors.

4 band coding			
1st	2nd	3rd	4th
	0	x1	
1	1	x10	
2	2	x100	2%
3	3	x1k	
4	4	x10k	
5	5	x100k	
6	6	x1M	
7	7		
8	8	Gold /10	Gold 5%
9	9	Silver /100	Silver 10%

5 band coding				
1st	2nd	3rd	4th	5th
	0	0	x1	
1	1	1	x10	1%
2	2	2	x100	2%
3	3	3	x1k	
4	4	4	x10k	
5	5	5	x100k	
6	6	6	x1M	
7	7	7		
8	8	8	Gold /10	Gold 5%
9	9	9	Silver /100	Silver 10%

This information has been adapted from Brian Smith's and Phil Storr's web pages.

**ELCOMA, Philips and MINIWATT
(From the HRSASA "Valve Bank")**

Did you know that **ELCOMA** was special division within Philips that could "tailor make" integrated circuits for customers other than for use in their own products!



We'll make up a special I.C. to meet your special need.

 When you need an integrated circuit to do a particular job, a standard I.C. may not be suitable.

Our local I.C. Design and Development Group may have the answer.

We are the largest, most diversified manufacturer of solid state devices in Australia. Our experience is not just restricted to a single assembly technique.

We can advise, design, bread board,

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ELECTRONIC COMPONENTS AND MATERIALS
DIVISION OF PHILIPS INDUSTRIES LIMITED
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2 ELECTRONICS Australia, April, 1973

ELCOMA (later known as PHILIPS ELCOMA) was the Electronic Components and Materials division, a part of Philips, and this was the name that superseded Miniwatt about the beginning of the 1970s.

The semiconductor part of the division was later "spun off" from the main company and became very successful in its own right!

The Elcoma Brief was a newsletter circulated quite widely, so it became public knowledge about their work.

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