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The AWA 693P 3-Band 8-Transistor Portable

. . . the transition from valves to transistors

The AWA 693P is an impressive 3-band 8-transistor set that was manufactured by AWA in Australia during the early 1960s. It doesn't use a PC board but instead employs point-to-point wiring, just like the valve radios of that era.

TRANSISTORS WERE introduced into domestic radios in Australia around 1958. I can actually remember the first transistor set that I owned, a pocket Sony.

By today's standards, this set was a poor performer and was only suitable for receiving stations in the near vicinity. Its main drawback was that it generated a fair amount of noise due to the germanium transistors used.

By about 1960, Australian manufacturers were producing quite reasonable transistor radios. However, although Japanese sets were by then using PC boards (of greatly varying quality), Australian manufacturers took longer to make the transition. In fact, some Australian manufacturers didn't use PC boards until well into the early 1960s.

As a result, some early Australian-made transistor sets were built just like valve sets, with components wired point-to-point. Some even used sockets for the transistors, just as valve sets used sockets. However, Australian manufacturers did eventually move over to PC boards – the benefits of using PC boards were simply too great to ignore, especially in terms of cost and ease of assembly.

The AWA 693P

The AWA 693P 8-transistor radio featured here is one such Australian-made set that used valve-radio construction techniques. It is a well-made 3-band receiver that was manufactured some time around 1960.

In keeping with the era, it is housed in a wooden cabinet covered with leather and leatherette. It is similar in size to the valve receivers it was intended to replace and was no lightweight either, tipping the scales at a hefty 7.2kg (ie, about the same as a valve set).

Inside, the circuit used two second-generation PNP germanium transistors for the critical RF and autodyne converter stages, while all the other

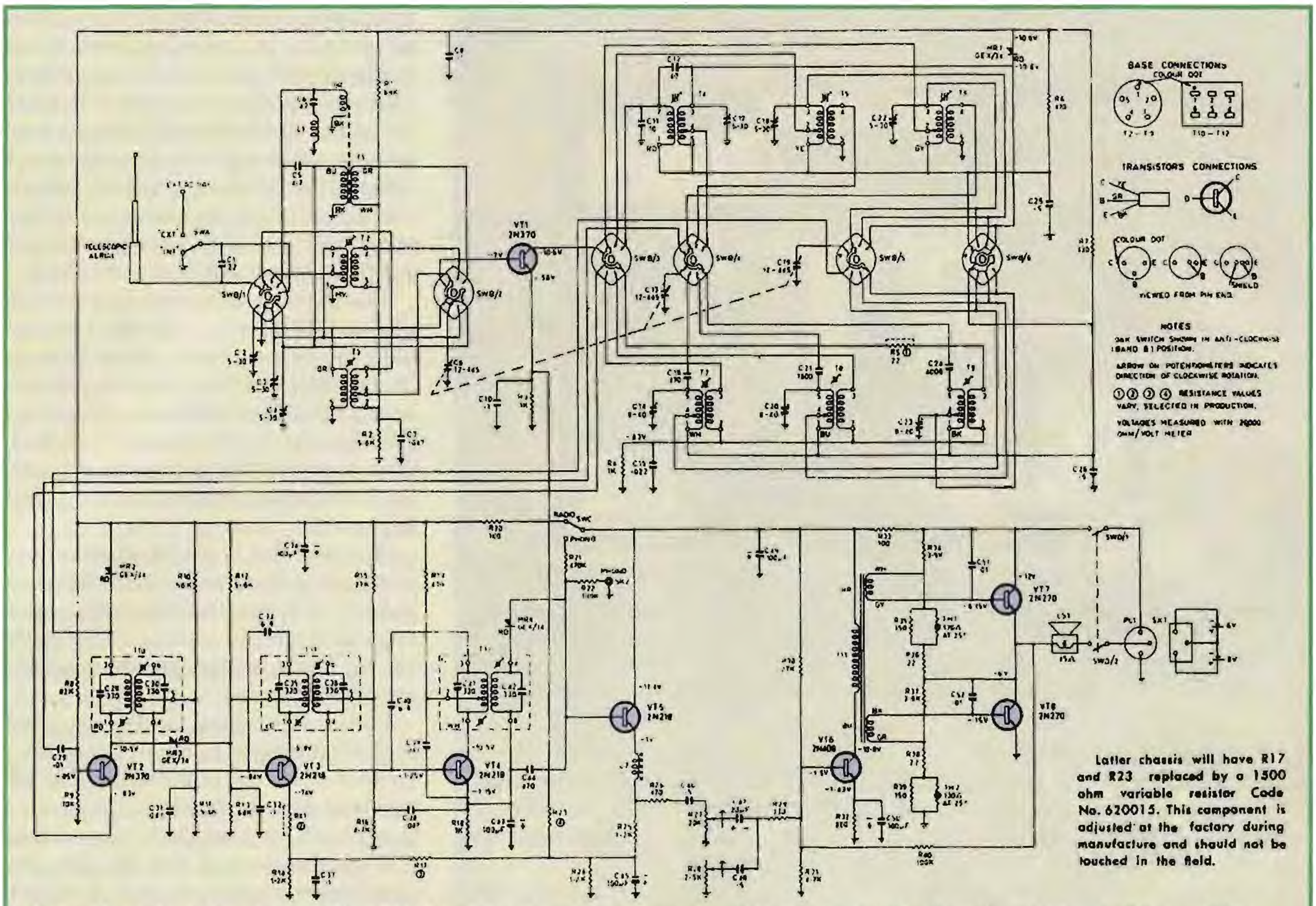


Fig.1: the circuit is a conventional 8-transistor superhet design, with transistor VT1 functioning as an RF amplifier stage, VT2 as the converter, VT3 & VT4 as IF amplifiers and VT5-VT8 as the audio stages. Diode MR4 is the detector.

stages used first-generation germanium transistors. It also used an internal telescopic antenna but there are also terminals on the rear so that an external antenna and earth can be connected for improved performance. In addition, terminals are provided to allow a portable turntable to be connected to the audio input of the receiver.

The latter feature was probably rarely used. Battery powered turntables of that era were thin on the ground and their quality left much to be desired.

Lantern batteries

Power for the set is derived from two 509 lantern batteries connected in series to give a 12V supply. In addition, the junction of the two batteries provides a centre-tap for the audio output stage, so that it could be used without an output transformer. However, this meant that the speaker had to be a non-standard type with a 45-ohm voice coil to match the transistor output stage.

Because of the size of the batteries, their life is quite good in this set and is somewhere in the region of hundreds of hours.

Tuning range

The tuning range of this set is quite useful, particularly for those living in more remote areas. As well as the broadcast band ((530-1650kHz), there are also two shortwave bands covering 2-6MHz and 6-18MHz.

Normally, portable receivers which cover these latter ranges have rather direct tuning. This can make tuning to shortwave stations rather difficult but this problem has been solved in the AWA 693P. In this set, the dial-drive is a 2-speed type. Once the station has been roughly tuned, it is then tuned in the opposite direction. This engages the "slow-motion" reduction tuning mechanism, allowing the station to be easily fine-tuned.

It's interesting to note that lifting the front cover of the receiver to access the controls reveals the Royal Flying Doctor Service shortwave frequencies. These are attached to the inside of the panel along with a map of the world with the various time zones listed.

The set is quite a good performer on shortwave too, thanks to the inclusion of a radio frequency (RF) stage in the front-end. In fact, this receiver can be considered a serious replacement for the much earlier 7-band AWA valve receivers.

Circuit details

The circuit (see Fig.1) is really quite conventional for a set of that era. As shown, the antenna input consists of a network that allows the use of either the in-built telescopic antenna or an external long-wire antenna on all bands.

On the broadcast band, a loop-stick antenna is used most of the time but connecting a long-wire antenna can boost the performance of the loop-stick in difficult reception areas. Note that the broadcast band input also has a series tuned intermediate frequency (IF) rejection circuit (L1, C6) across

This is the view inside the back of the set with the two 6V lantern batteries in place. Note the point-to-point wiring and the components around the band-change switch at top left.

the tuned antenna loop-stick winding. This is intended to prevent maritime radio transmissions close to 455kHz from breaking through into the IF amplifier stage.

RF transistor VT1 (2N370) amplifies the input signal from the antenna and passes it via further tuned circuits to an autodyne converter stage based on VT2 (2N370). The output from this stage is then applied to the first IF transformer and thence to a 2-stage IF amplifier consisting of transistors VT3 & VT4 (2N218). Both stages are neutralised by C33 & C40 respectively.

From there, the signal passes to a detector and AGC diode (MR4), after which the detected signal is fed to VT5 (2N218). This stage acts as both an AGC amplifier and first audio amplifier. The resulting AGC is directly applied to VT3 and VT1 and also from VT3 to the first two IF transformers via MR3 to control the gain through the amplifier.

The detected audio signal at the emitter of VT5 is fed through an RF choke (L2) to filter out any remaining IF signals in the audio. The audio is then applied via volume control R27 and tone control R28 to audio driver stage VT6 (2N408).

VT6 is turn feeds a driver transformer with three windings. One goes to the collector lead of VT6, while the other two drive the base leads of output transistor pair VT7 and VT8 (2N270).

As shown, these two output transistors are wired in series and each has a thermistor in its base-bias circuit to stabilise the quiescent current against variations in temperature. Germanium transistors are particularly sensitive to heat and will draw considerably more current as the transistor junction temperature rises unless precautions are taken. If the current rises to any extent, a runaway situation can occur where more and more current is drawn until the transistor finally destroys itself.

The emitter-collector junction of VT7 & VT8 drive the speaker's voice coil, the other side of which goes to the centre tap of the power supply. Assuming that the output transistors and their base bias networks are matched, then there will be no current through the loudspeaker when no audio signal is present.

At least, that's the ideal situation. In practice, there will always be some current through the speaker's voice coil but this will be very small if there are no faults in the class-B amplifier output stage.

Conversely, when audio is applied to the transistors, one will draw more current while the other will be cut off and will draw no current. This means that the DC voltage at the junction of the transistors and the speaker can vary between nearly 0V and -12V with reference to the chassis with the volume control set for maximum output.

This in turn means that the amplifier side of the speaker coil can vary between -6V and +6V with reference to the other side of the speaker voice coil (which is connected to the midpoint of the battery pack). Of course, at normal listening levels, the voltage excursions are much less severe.

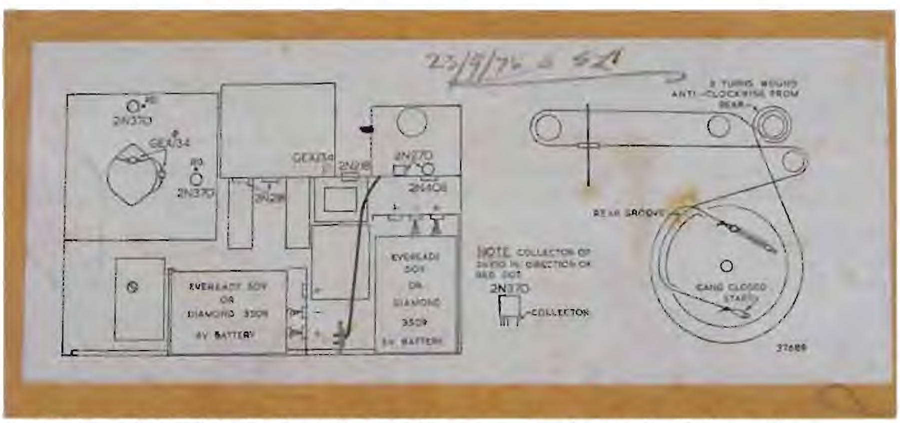
Finally, to reduce the distortion in the class-B output stage, negative feedback is applied to the base of VT6 via a 100kΩ resistor (R40).

The overhaul

My first impressions of this set when it was loaned to me was that it had had a hard life. The leatherette, leather surfaces and the metal grill of the cabinet all showed signs of wear.

The first job in the restoration was to remove the chassis from the cabinet. This proved to be quite easy. First, the back of the set is removed by undoing a single screw. The batteries are then removed, after which you undo three screws from the base of the cabinet and unplug the internal whip antenna.

The chassis and battery holder are then simply slid out of the cabinet.



A label on the inside-back of the set gives some basic service information, including the transistor types and locations plus the dial-cord arrangement.

The set's owner was uncertain as to whether or not it was working, so I obtained a couple of 6V 509 lantern batteries, slipped them into their holders and switched the set on. Well, the set did work but its performance was woeful. It was quite insensitive, picking up very few stations, and its audio output was quite distorted. In short, it sounded rather sick so it was time for some troubleshooting

I began by measuring the voltages around the front-end of the set but could only get 5-6V where I should have been measuring close to 12V. As a result, I checked the batteries and found that one was open circuit, even though it was brand new!

With a good battery fitted in its place, the set sounded much more like it should. The distortion had gone but it was still not performing at all well in terms of sensitivity. As a result, I checked the alignment of the IF amplifier stages but found that they were near enough to spot on.

RF alignment

It was a different story with the RF and converter stages and the oscillator tuned circuits. A cursory examination revealed that one Philips trimmer was missing its adjustment cap, an extra capacitor had been fitted across the broadcast-band oscillator coil and the core of the oscillator coil was sitting much further out of the coil than I would have expected.

This all indicated that the front-end had been tweaked by someone who clearly didn't know what they were doing.

The oscillator tuned circuit on each of the shortwave bands appeared to be reasonably accurate, so I first concentrated on aligning the RF and antenna circuits. First, a Leader (LSG11) signal generator was pressed into service to determine the tuning range on each band. That done, I then adjusted each coil and trimmer capacitor for best signal (or maximum noise). And what an improvement that made – the performance on the shortwave bands was now quite good.

According to the service information for this set, the broadcast band is normally aligned first. However, I left it until last as it appeared to have more problems than the shortwave bands. The tuning range was well out and stations were appearing in the wrong locations on the dial.

These two photos show the front and rear views of the chassis after it has been removed from the cabinet. The oval-shaped speaker is a special type with a 45-ohm voice coil.

My first suspect here was padder capacitor C16. Perhaps its value had changed or maybe the wrong one had been fitted. As a result, I disconnected one leg of C16 and tested it on the capacitance range of my multimeter. It gave the correct value so that theory bit the dust.

Next, I removed the extra capacitor that had been installed across C14. I then adjusted the oscillator circuit so that it covered the correct range. This is done by adjusting the coil at the low-frequency end of the dial and the trimmer capacitor at the high-frequency end (this has to be done several times, as each adjustment interacts with the other). However, because the rest of the RF and antenna circuits were so badly out of tune, I had to use a very high output from the signal generator in order to force signals through the set during this procedure.

Now that the oscillator was tuning correctly, it was time to look at the other tuned circuits for the broadcast band. The location of the antenna coil on the loop-stick antenna had not been altered since the set was manufactured but I decided to check it all the same.

Photo Gallery: Astor JN Dual-Wave Receiver

NICKNAMED "SYDNEY HARBOUR BRIDGE" after its smooth arch shape, the Astor JN dual-wave receiver was housed in an attractive, dark-chocolate bakelite cabinet with a faint embedded pattern. Its copious size enabled Astor to enclose a quality chassis with power and performance comparable to a radiogram, so this model is on most enthusiasts' must-have list.

An unusual feature is the roll-tuning dial. The station tuning is a normal linear action but turn the thumbnail dial and the stations from another state appear. Its interesting to note that the Victorian dial also has Devonport shown, such was the performance of the chassis with an external wire antenna (there was also lower electrical interference in the 1950s).

The valve line-up was as follows: 2x 6U7G, 6J8GA, 6B6G, 6V6GT/G and 5Y3GT/G. Photograph by Kevin Poulter for the Historical Radio Society of Australia. www.hrsa.net.au; phone (03) 9539 1117.

To do this, I tuned to the low-frequency end of the tuning range and moved my fingers close to the tuned winding on the loop-stick. The set's performance immediately improved, which indicated that the coil needed to be moved towards the centre of the loop-stick to increase its inductance.

This is easier said than done, as you first have to remove the "gunk" holding the coil in position. This was done using a sharp hobby knife, after which the coil was moved along the loop-stick to peak the performance. The coil was then secured in this new position.

The RF coil was also peaked at this time. I use an old plastic knitting needle as an alignment tool, filed down so that it has a screwdriver tip at one end (a metal screwdriver would affect the tuning).

First, I tuned to the high-frequency end of the dial and peaked the trimmers on each tuned circuit. However, I initially couldn't peak the trimmer on the loop-stick, as this was the one without its adjustment cap. Fortunately, that was easily solved by substituting one from a spare trimmer in my junk box.

With the substitute cap in place, I was then able to peak this trimmer. The RF stage could be peaked as well. I then tuned from each end of the dial to the other, readjusting the coils and trimmers until there was virtually no interaction between the adjustments.

Instability

The set was now working quite well except for some instability at about 910kHz. This was caused by the second harmonic of the IF being picked up by the loop-stick antenna. However, when the shield that normally sits between the IF amplifier and the loop-stick was put back in place, this instability disappeared. This shield piece is held in place with three metal thread screws and is bonded with flexible straps to adjoining metalwork to ensure effective shielding.

Having completed the alignment, all the trimmer adjustments were sealed in position using clear nail polish. In addition, the adjustment slugs inside the various coils were secured using a drop of bees wax (this can be easily broken free if adjustment is needed later on). A better method is to secure the cores using some very thin rubber-core "string" (for want of a better name). Unfortunately I've been unable to source any of this rubber-core string in recent years.

Final tweaks

The volume and tone controls were both noisy in operation. This is a common problem with old sets. This was solved by giving them both a squirt of Inox contact cleaner. In addition, the dial-drive pulleys and the reduction drive were each given a drop of oil to ensure smooth operation. I do this using an oil-filled hypodermic syringe with a needle attached so that I can get the oil where it needs to be (the tip of the needle is ground square to avoid accidental "jabs").

Despite the set's age, none of the resistors or capacitors required replacement. The paper capacitors may well have been leaky but this is not usually a problem in transistor circuits due to their low impedances and low operating voltages.

Finally, the leather/leatherette cabinet was spruced up using a dark tan shoe polish. This produced quite a reasonable finish although there was no way to repair the damaged leatherette

Summary

In summary, this radio is easy to work on and adjust. Its performance is quite good and during the early 1960s, it would have been one of the best transistor sets available.

This set was probably AWA's first multi-band transistor portable and they did a really good job. It doesn't use a PC board but is still a well-made set, built to valve construction standards. In short, it is well worth having in a collection. SC