Vintage Radio

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The Astor P7G 8-Transistor AM Portable Radio

Australian manufacturers built some excellent transistor radios during the early-to-mid-1960s. The Astor P7G was one such set. It boasted no less than eight transistors and even included an RF stage to lower noise and boost sensitivity.

DOMESTIC TRANSISTOR RADIO manufacture in Australia commenced in the late 1950s. The first sets were built in much the same way as valve radios. Point-to-point wiring was common (ie, they didn't use printed circuit boards) and in some cases, the transistors were plugged into sockets just like valves had always been installed.

By contrast, the Japanese started with crude printed circuit boards (PCBs) right from the onset of transistorised receiver manufacture. As a result, Australian manufacturers initially lagged behind the Japanese in their construction techniques before adopting phenolic printed circuit boards.

Like many, I wasn't initially all that keen on PCBs as it was often difficult to be sure which track a particular component was wired to. Instead of following point-to-point wiring, you had to try to work out the connections by examining both sides of the board and this could be rather difficult on a tightly-packed board.

Apart from that, early PCBs also suffered from a number of drawbacks. They were somewhat hygroscopic (ie, they absorbed moisture), were easily charred if components overheated and the copper tracks lifted off the board if too much heat was used during soldering.

Hairline cracks in the tracks were also common and caused many intermittent faults. They were almost impossible to see and if a serviceman suspected such a problem, the cure was to run solder right along the suspect track. This sometimes involved laying a very thin wire strand along the suspect track and soldering it at various intervals until the fault vanished.

These servicing techniques largely overcame the problems with early boards. And of course, as time went by, the various issues were addressed and the quality and durability of the boards improved.

Japanese receivers

The performance of the early Japanese transistors receivers wasn't all that good. They were noisy and not very sensitive and that situation continued for many years.

Of course, the Japanese were catering for a world market where listeners generally lived close to local radio stations. By contrast, many Australians lived some distance away from radio stations, so sensitivity was important.

As a result, Australian manufacturers produced many sensitive, low-noise receivers to suit the domestic market. However, despite their technical superiority, they eventually lost the battle for market share due to the low cost of imported receivers. As a result, domestic receiver production slowed and eventually ceased in the 1970s.

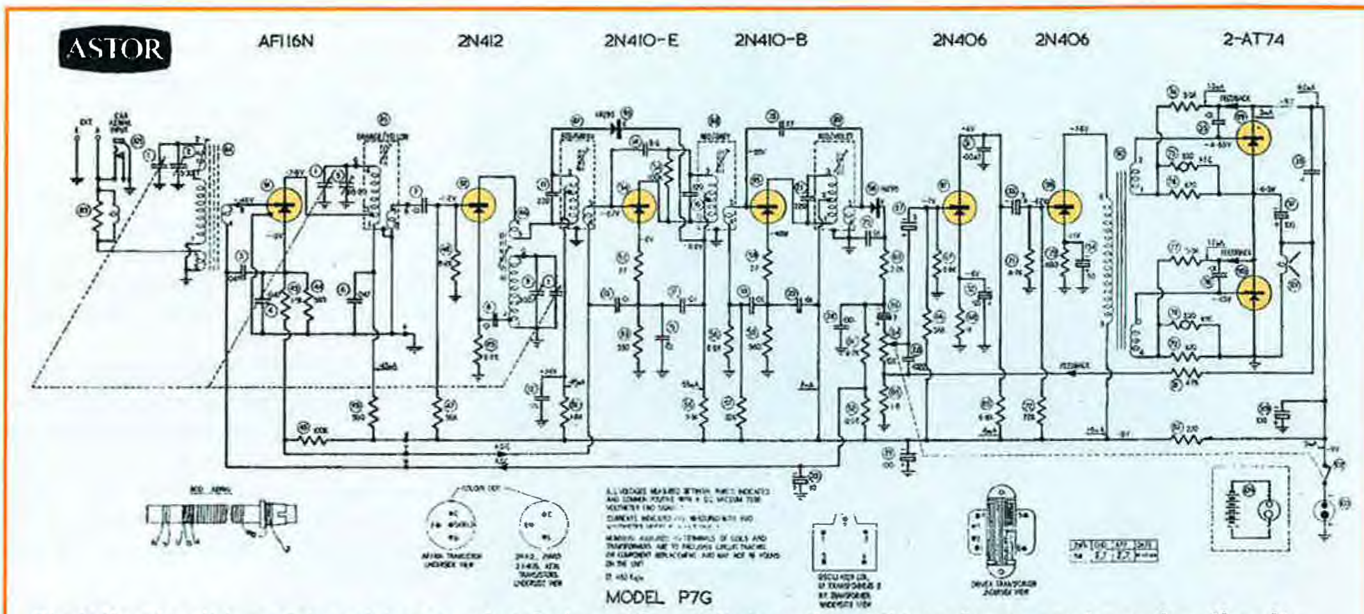


Fig.1: the circuit is an 8-transistor superhet design with an RF stage, three IF transformers and a push-pull audio output stage. It uses an internal loopstick antenna but provision is also made for an external antenna.

There was no point making receivers if no one bought them, even if they were superior in many respects!

Astor P7G transistor receiver

One good-quality Australian set from the early transistor era was the Astor P7G. This was an 8-transistor broadcast band portable and was produced around 1965.

I came across the Astor P7G receiver described here at a swap meet. On inspection, I found it to be quite clean both inside and out and because it had an RF (radio frequency) stage, I thought that it would be a very good performer.

The 276-P battery had been left in the set but had not leaked and no corrosion was evident. So as a bonus I got a battery that I could use for display purposes.

As shown in the photos, the set is housed in a stitched brown leatherette case which measures 250 x 180 x 80mm (W x H x D) although this doesn't include the handle and knobs. It weighs a hefty 2.2kg with the battery installed.

The dial scale is a normal slide-rule type and the tuning was still firm and positive, so the dial system was well thought out and executed. The tuning control is at the right-hand end of the cabinet while the on-off volume control is at the other end.

Like many sets of this calibre, it has provision for an external antenna and earth via two flat-headed screws on the top edge of the back panel. In addition, for those who wanted to use the set in a car, Astor provided a socket to suit a car radio antenna cable at the left-hand end of the cabinet, below the volume control.

To gain access to the battery, it is necessary to loosen a flat-headed screw at the lower edge of the back of the cabinet and then lift the back flap up. The 276-P 9V battery is held in place by a small clip arrangement, which is easily sprung open to allow the battery to be removed.

Another excellent feature is that all the alignment adjustments are accessible without taking the chassis out of the cabinet. In addition, most of the alignment points are marked either with colours or numbers which are also shown on the circuit.

Circuit details

Fig.1 shows the circuit details of the Astor P7G. As stated, it's an 8-transistor design that includes an RF stage to ensure good sensitivity and low noise. As such, it outperforms almost all Japanese transistor receivers of the same era.

The input circuit consists of a ferrite-rod loopstick antenna measuring 12.7mm in diameter and 203mm long. This has three windings on it, with the tunable winding spread along about half its length. One end of this winding is earthed, while the other has another, much smaller coil wired in series with it.

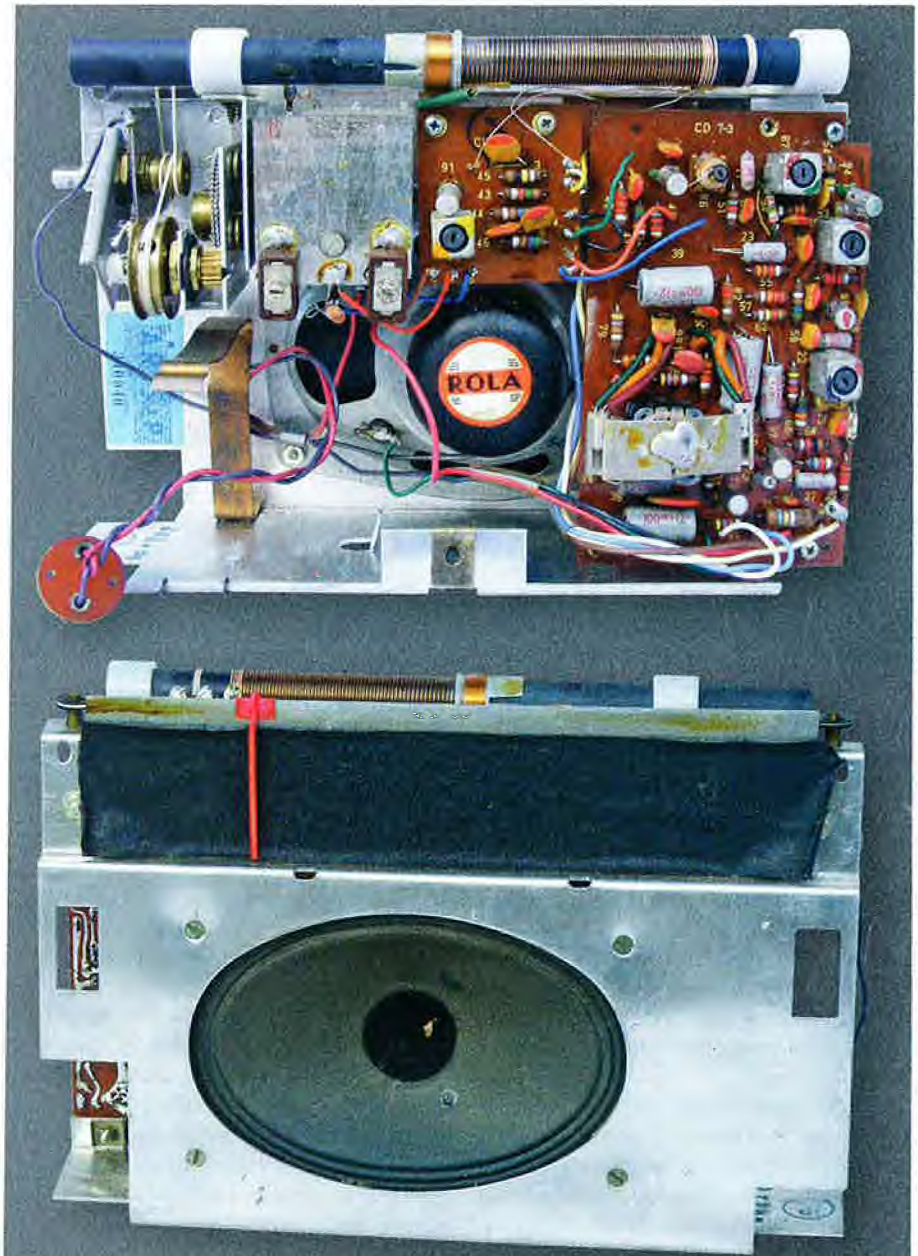
This latter winding is on a small former and is slid along the ferrite rod to tune the antenna circuit for best performance at the low-frequency end of the tuning range.

Another small winding is interwound with the tuned winding at the earthed end and this is connected to the base of the RF transistor. And finally, there is a small winding positioned about 8mm down from the earthed end of the tuned winding. This is attached to the chassis at one end, while the other end is connected via a parallel choke-resistor combination (component 83) to two antenna inputs: (1) a coaxial cable input socket for use with a car radio antenna; and (2) an input for a normal long-wire antenna which is connected to the "A" terminal on the back of the receiver's case.

Note that when "A" is used, the corresponding "E" terminal must be connected to an earth, otherwise the improvement in performance when an antenna is connected will only be slight.

It may seem strange that an RF choke and a resistor are used in series with the antenna. In fact, you would expect that this would attenuate the signal going to the coupling coil on the ferrite rod.

However, the reverse is true – it actually boosts the signal. Basically, the choke acts as a series loading coil which tunes the antenna system (assuming an "average" antenna) to just below the broadcast band. This boosts the performance at the low-frequency



Most of the circuitry is built on a main PCB, with a separate small board used for the RF stage. These are mounted on a metal chassis, along with the tuning gang, dial-drive mechanism, loopstick antenna and the loudspeaker.

end of the broadcast band, as an external antenna is usually very short compared to a tuned length.

At the high-frequency end, the antenna more nearly approaches a tuned length so the performance of the antenna is better there. In fact, the performance under some circumstances could be so enhanced that the sensitivity across the broadcast band would be very uneven.

To overcome this, the choke is shunted with a resistor. This damps the effect of the choke so that the sensitivity at the low-frequency end of the band is similar to that at the high-frequency end.

The first amplifying stage is an AF116N, one of the later low-noise germanium PNP RF transistors. Note that the transistor symbols used in the circuit diagram are different to those now in use. They were commonly used in the 1960s and were later superseded.

The output of the AF116N appears at its collector and is fed through a broadcast-band tuned circuit to the input of an autodyne oscillator mixer based on a 2N412 PNP transistor. The collector of this stage connects to a feedback winding for the oscillator circuit and this then goes to the primary of the first 455kHz IF transformer.

The first IF amplifier stage uses a 2N410-E. Its output is applied via the second IF transformer to a second IF amplifier, this time based on a 2N410-B. The output of this stage is then fed through a third IF transformer to the detector which is a 1N295 germanium diode.

The resulting audio output is fed via a volume control pot (which also includes an on/off switch) to the base of a 2N406 amplifier. This stage drives a second audio amplifier stage (also using a 2N406) and this in turn drives a push-pull output stage via a driver transformer.

The output stage is based on two AT74 output transistors and these drive an oval-shaped (127 x 100mm) 15-ohm loudspeaker. Negative feedback is applied from the top of the loudspeaker to the bottom of the volume control which is connected to ground via a 1.8Ω resistor (65).

Temperature compensation

Germanium transistors, particularly those used in the output stage of a receiver, need to have their standing current stabilised to prevent thermal runaway. Without this stabilisation, the transistors will draw more and more current as they heat up until eventually thermal runaway occurs and the transistors fail.

In the Astor P7G, thermal compensation is achieved using 220Ω NTC (negative temperature coefficient) thermistors (75) and (78). As the temperature of the transistor junctions increases, their resistance decreases. This in turn reduces the forward bias applied to the output transistors and thus controls the quiescent current through them under no signal conditions.

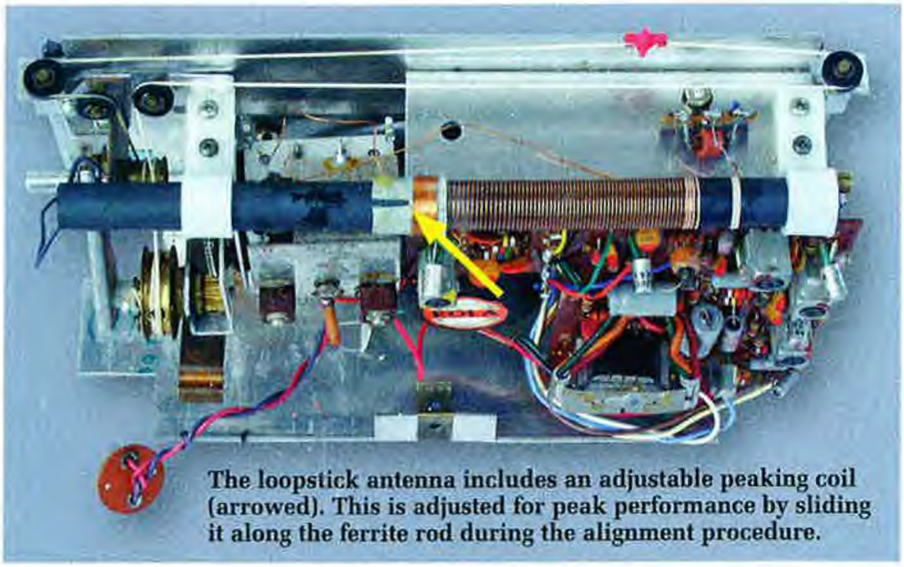
Automatic gain control

Automatic gain control (AGC) is applied in a variety of ways in transistor receivers and is usually more complex than in valve receivers. The gain of transistors can be controlled by biasing them closer to cut-off or by biasing them to draw more current (which lowers their gain).

In this receiver, increased signal levels cause the output of the detector (96) to go more positive. This in turn applies progressively more positive voltage (via a voltage divider) to the base of the PNP AF116N RF amplifier, causing it to draw less current. This stage in turn biases the following first IF amplifier stage (2N410-E), which also then draws less current.

This means that there will be less voltage drop across resistor (55) and this causes the associated 1N295 diode (93) to conduct. As a result, this diode acts as a variable shunt across the first IF transformer and thus reduces the signal level applied to the first amplifier IF stage.

This makes a very effective AGC system and is very different to the AGC methods used in valve receivers.



The loopstick antenna includes an adjustable peaking coil (arrowed). This is adjusted for peak performance by sliding it along the ferrite rod during the alignment procedure.

Restoring the cabinet

Removing the chassis from the cabinet proved to be much more difficult than expected. First, I removed the two knobs, then the screw in the middle of the bottom of the cabinet that secured that section of the chassis in place. The screws securing the handle to the cabinet were then removed, along with the two "A" antenna and "E" earth screws.

That done, I attempted to remove the chassis but it seemed to be jammed in place. I thought that perhaps the car radio antenna socket was somehow fouling the chassis removal so I removed the four screws holding the main circuit board in place and lifted it out of the way. All that did was show that it wasn't the socket that was causing the problem.

It was difficult to see what was causing the problem as the chassis is tucked quite tightly into the cabinet. I then observed two screws, one in the top left-hand corner of the cabinet and another in the top right-hand corner. These two screws were buried deep in the set against the front panel.

Initially, I thought that these held the dial system in place but I was getting desperate so I removed them anyway. And that was it – the chassis could now be removed with a little encouragement, although I did have to disconnect the four wires that ran from the chassis to the antenna and earth connections.

With the chassis now out of the way, I tried cleaning the cabinet using a soft cloth dampened with water (as suggested in the service data). However, this had little impact on the 45 years of grime on the surface, so I adopted a more aggressive approach, this time using a nailbrush dipped in a solution of dishwashing liquid in warm water.

This method removed almost all the greasy gunk from the cabinet surface, after which the cabinet was left to dry in the sun. It was a matter of knowing when to stop as the inner section is made of a form of cardboard, so it was important not to get it wet.

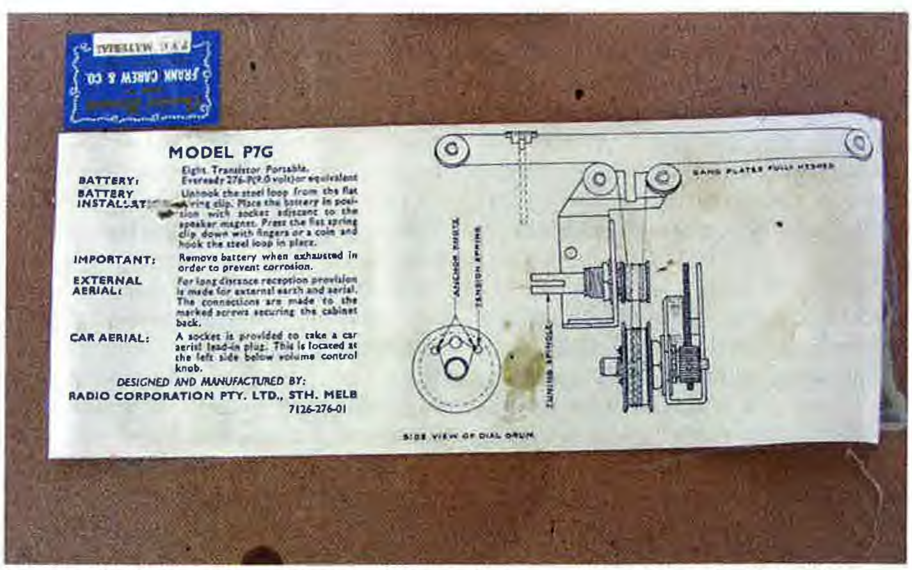
I also found a number of greasy marks and dirt along the metal front panel. This was also scrubbed using a nailbrush and it now looks very acceptable. The cabinet now looks quite good even though some of the stitching along the cabinet edges has given way over the years.

Restoring the chassis

A quick inspection revealed that the printed circuit boards were in good condition, with no sign of overheating or damaged components. It was time to see if it worked, so I connected a low-voltage variable DC power supply to the battery plug, with a milliammeter in series with one lead. I increased the voltage slowly and the current gradually increased to about 10mA at 9V which is normal.

At this stage, the receiver was working but its sensitivity wasn't good and the volume occasionally "jumped" up and down. I tapped lightly around the circuit board with the back end of a small screwdriver and the volume varied as I did so, indicating a possible dry solder joint. It was especially sensitive when I touched the third IF transformer.

With the location of the fault nar-



The inside back of the cabinet includes a diagram that shows the dial-string arrangement plus information on the battery and antenna connections.

The old Astor P7G's leatherette cabinet is still in good condition, although the stitching is starting to give way in some places. The antenna and earth terminal screws are at top right and top left respectively.

rowed down, I checked at the underside of the board using a headset magnifier. This revealed that at least one pin of the third IF transformer had a dry solder joint. It looked tarnished so I used de-soldering braid to remove the solder from all the pins of this transformer, then scraped away any tarnish until all the pins were shiny.

I then resoldered all the pins and that fixed the intermittent volume changes. There were no other problems apart from the fact that the set needed an alignment. And to do that, I first had to reinstall the chassis in the cabinet and reconnect the leads I had disconnected earlier.

With a little coaxing, the chassis slipped into place and the three retaining screws were refitted. The top corner screws were installed using a magnetic screwdriver. This allowed me to keep the screws in place at the end of the screwdriver while I carefully guided them into the cabinet.

Alignment

Assuming that the various adjustments have not been twiddled with aimlessly by someone in the past, the alignment procedure should always be straightforward.

As stated, with this set, it's possible to access all the tuning adjustments with the chassis in its cabinet. The IF section is quite easy to align – just tune the receiver to a weak station and use a small-bladed screwdriver to adjust the three slugs in the IF transformers for best performance (the metal blade of the screwdriver material does not appear to upset any of the adjustments).

In this case, only slight adjustments were necessary to tune the IF transformers for peak performance.

By contrast, the RF, antenna and oscillator adjustments need more care if accurate alignment is to be achieved. Thankfully, the dial pointer was where it was supposed to be when the gang was fully closed, otherwise I would have had to remove the chassis again to move it to its correct position.

Having checked that, I tuned to a strong station near the low-frequency end of the band and adjusted the oscillator coil so that it appeared in the correct location on the dial. I then tuned to a strong station near the high-frequency end and adjusted the wire trimmer so that the station appeared in its correct location. There is some interaction between these two adjustments, so they were repeated a few times until everything was correct.

That done, I tuned to a weak station at the low-frequency end and adjusted the RF coil and antenna peaking coils for best performance (the latter is simply slid along the ferrite rod). After that, the trimmer capacitors were peaked for best performance at the high-frequency end and this procedure was also repeated a few times until the performance was as good as could be expected.

By the way, the MSP 3-gang (and 2-gang) "padder-less" tuning capacitors used in this set and many other transistor and valve receivers of the era had to be accurately matched to the inductances and distributed capacitance in the front-end tuned circuits. If this was not done, receivers using these gangs did not track accurately.

A number of receivers didn't get this matching quite right and so suffer from this problem. Fortunately, Astor seem to have got it as close as practicable in the P7G.

Power supply

The Astor P7G was originally powered by a 276-P 9V battery which fitted in the bottom left-hand corner of the chassis, as viewed from the back. These batteries are no longer readily available but this can be solved in various transistor sets by fitting a replacement battery pack. This can simply be a single 216 9V battery if it is a very small set, or a battery can be made up using AA, C or D cells as required.

For the Astor P7G, I used a 6-pack of AA cells and soldered the leads from this battery to the 2-pin battery plug. I then covered the exposed pins of the plug with heatshrink tubing and wound insulation tape around the pack to keep it intact. Finally, the battery was installed along with some foam insulation, so that it would fit snugly.

With the 276-P, the battery life was about 300 hours but is only about 100 hours with the AA-cell pack. The current drain with no audio output is around 10mA and about 25-50mA for normal listening. It can go as high as 150mA if the volume is wound right up though.

Summary

The Astor P7G is a good example of the high-performance transistor receivers that were built by Australian manufacturers during the 1960s. In fact, its performance is similar to the more upmarket and expensive AWA B32 transistor receiver that was described in the August 2005 issue.

One curiosity is that the RF stage is built on a separate board to the rest of the receiver. It's possible that a cheaper version of this set was also available without the RF stage, although I haven't been able to confirm that.

Servicing this set is not as easy as it could have been but apart from that, it's an excellent design. SC