Vintage Radio

By John Carr

The AWA B30: a transistor radio just like grandma's

The AWA B30 transistor radio is built into a leather case and has just two controls: a large handspan dial and roller volume/power switch at top left.

I VIVIDLY RECALL my grandmother listening to her little AWA transistor radio. It was an AWA model B30, an early solid-state design using germanium transistors, and it was her constant companion.

The AWA B30 doesn't quite fit into the pocket-size category and nor does it rate as a mantel radio. Instead, it's a portable radio that's easily carried around without effort and it was perfect for grandma.

I remember having to occasionally change the set's battery for her, as her engineering skills didn't extend to that task. Other members of the family did likewise as required. I sometimes wonder what happened to her radio and my memories of it were recently revived again when I received one of these sets for repair.

The basic design

The AWA B30 was quite a small set by the standards at that time, a handspan dial and a roller volume/power switch being the only controls. Inside, the parts were mounted on a small PCB and the set had a 70mm-diameter loudspeaker. The case is covered in "genuine leather", according to a label on the base.

The original battery was a long 9V pack which was mounted under the PCB. These batteries are no longer available but can be replaced by a 9V type 216, as typically used in smoke alarms. I usually replace the battery plug with a snap connector to suit the type 216 and always fit an alkaline battery, as these are now available quite cheaply and have quite a long life in this application.

A piece of plastic foam can be cut to fill the large space left when installing this battery type, to hold it in place and stop it from rattling around inside the case.

The manufacturer's specifications state the set's dimensions as 4-5/8 inches (117mm) high, 7-3/16 inches (182mm) wide and 2-1/8 inches (54mm) deep, while the weight is two pounds (a bit less than 1kg). The set uses a standard 455kHz IF (intermediate frequency) stage and tunes the AM broadcast band range from 525-1650kHz.

At the time, Australian radio manufacturers were under considerable pressure to produce low-cost radios and TVs in order to compete with Asian imports (mostly from Japan). This little radio demonstrates just how well the AWA engineers met that design goal, as the set's performance is excellent, especially given its relatively simple circuit.

Basically, the set's main limitation is its modest 150mW power output and its tiny 70mm speaker. As a result, it's easily driven into audio overload on a strong signal although it's probably satisfactory for its intended use.

Circuit details

The circuit design is fairly conventional and uses seven PNP germanium transistors – see Fig.1. It consists of a 2N412 mixer/oscillator (VT1) followed by two 2N1634 IF amplifiers (VT2 & VT3) and then an audio amplifier stage consisting of three 2N408s (VT4-VT6).

The signal is picked up by the large loopstick antenna (TR1) and is tuned by variable capacitor C1 which is one section of the 2-gang tuning capacitor. The other section (C5) is connected across the local oscillator coil (TR2) and tunes the local oscillator frequency.

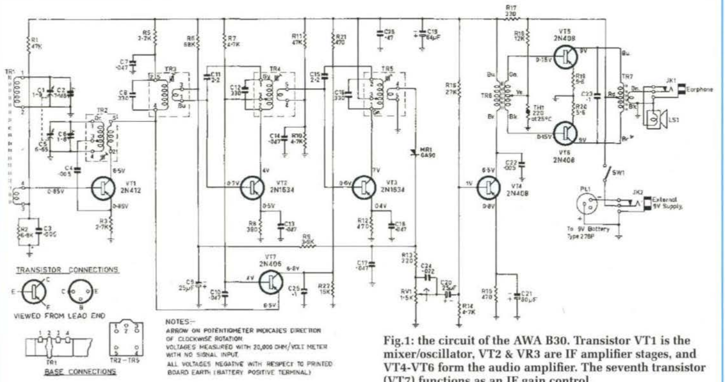

Fig.1: the circuit of the AWA B30. Transistor VT1 is the mixer/oscillator, VT2 & VR3 are IF amplifier stages, and VT4-VT6 form the audio amplifier. The seventh transistor (VT7) functions as an IF gain control.

The resulting 455kHz IF signal from the mixer/oscillator is fed to IF transformer TR3 and then to IF transformers TR4 & TR5, via IF amplifier stages VT2 & VT3. The signal is then fed from TR5 to the detector diode which is a germanium type OA90 and the detected audio then fed to volume control RV1 via a 220Ω resistor (R13).

In addition, the output from the detector is filtered using R9 (3.9kΩ) and C9 (25μF) to provide the AGC signal. This is then applied to the base of VT2 via IF transformer TR3's secondary.

The first 2N408 transistor (VT4) is used as an audio preamplifier and this drives a phase-splitter transformer (TR6) and then two more 2N408s (VT5 & VT6) which operate in push-pull. This push-pull output stage then drives the speaker via another centre-tapped transformer (TR7). A headphone socket (JK1) is wired in parallel with the speaker and automatically switches the speaker out of circuit when a set of headphones is plugged in.

The seventh transistor in the circuit (VT7) is a 2N406 and this serves as an IF gain control.

A voltage divider consisting of a 12kΩ resistor and an NTC thermistor (TH1) provides the base bias for the output stage. As its temperature increases, the thermistor's resistance falls and the bias automatically reduces. This ensures a fairly constant quiescent collector current in the output stage regardless of temperature changes and eliminates the possibility of damage due to thermal runaway.

The two 5.6Ω emitter resistors provide some local feedback and help balance the differing gains in the two output transistors.

Finally, the circuit has provision to accept an external 9V power supply via jack socket JK2. The internal 9V battery is automatically switched out if an external supply is connected.

Low gain

In operation, the limits of the germanium PNP transistors used were easily reached due to their low gain and modest frequency response. In fact, the low RF frequency gain of early germanium transistors was their main limitation and it meant that two IF amplifier stages were required to achieve reasonable performance from the radio.

It's interesting to note that all the transistors in this radio were manufactured in-house under the AWV brand. Amalgamated Wireless Australasia Ltd (AWA) was a huge organisation at that time and manufactured almost all the parts used in their radios and other products. Many of these products were equal to, if not better than, similar products produced elsewhere in the world.

Servicing the set

When I received this radio, it was a 'non-goer' in that it wasn't picking up any radio stations. It also had a rather noisy volume control but at least that indicated some life in the audio section.

A common fault with all old electronic equipment is failure of the electrolytic capacitors; they dry out and go open-circuit. A visual inspection usually reveals the rubber end seal is swollen and sometimes the electrolyte paste has spewed out.

As a normal precaution with old equipment, I always start by replacing all the electrolytic capacitors and that will often restore a faulty set to normal operation. In the interests of reliability, I usually use tantalum types where possible as the cost difference is not great and they will probably never need replacing again.

If electrolytic capacitors are necessary (eg, for values above 100μF), then I always try to use 105°C capacitors as they are more reliable.

So, following my standard practice, I duly replaced all four electrolytic capacitors: C9, C19, C20 & C21. This

Most of the parts inside AWA B30 transistor radio are mounted on a densely-packed PCB. The original long 9V battery pack used in these radios is no longer available but a type 216 9V battery (wrapped in foam to stop it rattling) can be used instead.

immediately restored the radio to working order but this success was short-lived because the audio suddenly faded away until it was almost inaudible. Switching the set off and on brought it back to life again but with the same result.

Based on the symptoms, I initially thought that it must be a faulty battery but a quick check with a digital multimeter quickly disposed of that theory. The DMM indicated that the full 9V rail was still present at the on/off switch after the signal had faded.

My next test was to inject a 455kHz signal from an RF signal generator into the set. To my surprise, holding the generator leads near the loop-stick antenna suddenly restored the radio to normal operation. This was puzzling but suggested a fault in the local oscillator circuit.

All the voltages around this stage measured OK, so I decided to try replacing oscillator coupling capacitor C4 (.005μF) in case it was faulty. Old capacitors often become leaky due to a breakdown in the paper insulation that was commonly used before polystyrene capacitors became available.

Unfortunately, changing C4 made no difference, the signal again fading away within a few seconds and a 455kHz signal injection then bringing it back to life as before. As a result, all the resistors in that section were checked but were found to be within tolerance. This was going to be a challenge.

A detailed voltage check subsequently revealed a very low voltage on the collector of the first IF amplifier transistor – just 1V instead of the 4V specified on the circuit. Replacing the resistor supplying the collector circuit (R7, 4.7kΩ) did nothing and the only other component left was bypass capacitor C10, a 0.047μF ceramic type. Replacing it cured the fault and the restored normal performance.

I subsequently checked the faulty capacitor on my DMM and it measured OK, both in regards to its capacitance and its leakage resistance. So the fault was obviously evident only when a DC voltage was applied to it.

As a precaution, I now decided to replace all other capacitors of the same type, to ensure long-term reliability. This is not the first time I have experienced unusual faults in old radios due to these capacitors. They really can cause problems which can be difficult to diagnose.

By the way, these capacitors are rated at 25V, so the failure is obviously not due to over-voltage as the battery supplies just 9V. That means that the failure is in the ceramic material that's used as the dielectric.

It's also interesting to note that I haven't observed similar ceramic capacitor failures in any of the Asian-manufactured equipment that I've serviced in large numbers. The problem only seems to occur with Australian-manufactured ceramic capacitors from that era. In fact, apart from those used in Australian radios, I have always considered ceramic capacitors to be completely reliable and so I usually ignore them when diagnosing faults.

A squirt of contact cleaner on the noisy volume control cured that particular problem in the old AWA B30. As a final check, I then injected a 455kHz signal from my generator and tweaked the IF transformer alignments. This further improved the sensitivity of the radio and it turned out to be quite a good performer.

It was then just a matter of reinstalling the PCB assembly in its case and giving the leather a good clean. The accompanying photo shows the result.

Design comments

The PCB assembly in this radio is very compact, with the parts jam-packed together and the resistors standing on their ends. This can make component replacement a difficult operation. The components are also relatively large by today's standards, which further adds to the impression of a crowded circuit board.

Typically, the copper tracks on PCBs used at that time were sensitive to overheating when parts were installed or, more particularly, when they were being removed. The tracks peel away from the board laminate quite readily if too much heat is applied, so it is necessary to always use a temperature-controlled soldering tool, set as low as possible.

It's also important to work quickly, to avoid overheating the pads and tracks. I always have a good supply of solder-wick handy to speed up component removal, especially for early Australian-made equipment. After all, preventing the track from lifting in the first place is better than trying to patch a damaged track.

Asian-made equipment is less prone to PCB track damage but this warning still applies to all early PCBs. I have seen too many tracks damaged in all sorts of equipment by people who have been too enthusiastic with a soldering iron.

Finally, there is great satisfaction in getting an old radio like this going again. If you have one on a shelf in your home, why not give it a new lease of life? **SC**