Vintage Radio

By Ian Batty

Stromberg-Carlson's 78T11/79T11 transistor set

The 78T11 was Stromberg-Carlson's first Australian-made transistor set. It was a 7-transistor design built onto a metal chassis with point-to-point wiring and it offered excellent performance.

STROMBERG-CARLSON'S US parent commenced operation in 1894, when Alexander Graham Bell's patent for the telephone expired. At the time, Stromberg and Carlson worked for the Bell Telephone Company (later AT&T) and they each invested $500 to begin manufacturing equipment, primarily subscriber sets ("home" and business telephones) for sale to independent companies. Their home base was in Chicago and Stromberg-Carlson quickly established a reputation for reliable equipment and stable prices.

Stromberg-Carlson Australia bore little resemblance to its American parent. The company began by importing receivers from the United States in 1927, before commencing local manufacture in 1928. Their radios mostly used local components.

Stromberg-Carlson made components both for their own radio receivers and for sets made by other companies. Their brands included Stromberg-Carlson, Audiola and Crosley. Between 1939 and 1945 Stromberg-Carlson continued with radio manufacture, though at a much slower rate. They also produced telephones and telephone switchboards for the Australian Army.

With the advent of television in the mid-1950s, Stromberg-Carlson also tried to establish itself in that market but failed to make inroads. The 1958-1959 78T11/79T11 transistor radio sets described here were among their last Australian products.

Main features

The 78T11/79T11s are both large sets and fall into a category that I think of as "picnic portables". The 78T11 was Stromberg-Carlson's first transistor set and was released in 1958, a year after Australia's very first transistor radio, AWA's model 891. In terms of styling, the 78T11 resembles both Sony's early TR72 and Raytheon's 8TP which also had top-mounted controls.

Unlike the Sony's simple dial, the 78T11 offers a slow-motion tuning drive, albeit using a rather "agricultural" spindle that (when it works) drives the tuning knob's rim via a rubber grommet.

The back of the case flips open to reveal the circuitry. Like many sets of its day, it uses a pressed-and-stamped steel chassis, with the low-power transistors mounted through the chassis in rubber grommets. By contrast, the two output transistors are mounted in heatsink flags which are screwed to the chassis.

The various connections are made using a combination of tagstrips and point-to-point wiring. The components used were something of a mixed bag – the IF coils are the slim rectangular Philips types, the capacitors are a mix of UCC and Philips electrolytics and the bypasses are AEE "microcaps", mostly the brown variety. The low-power transistors are all in the familiar black-painted "bullet" outline, so it's safe to assume they're from Philips. The same goes for the demodulator diode (D1).

A large tuning-gang with identi-

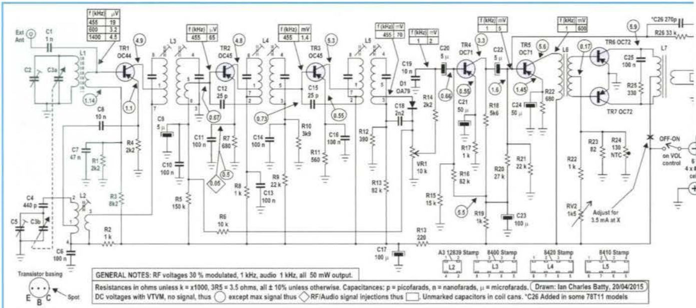


Fig.1: the circuit is a fairly-conventional 7-transistor superhet design. TR1 is the converter stage, TR2 & TR3 are IF amplifiers, D1 is the demodulator and TR4-TR7 the audio amplifier stage.

cal sections is mounted at one end of the chassis, adjacent to a 5-inch Rola loudspeaker. As with the audio transformers used in the set, it's about the same size as those used in various valve portables of the era. In fact, judging by the parts used, it appears that the application circuits in Philips' "Miniwatt" handbook of 1957 were used as a guide by Stromberg-Carlson's designers.

The bias adjustment for the output stage is a real oddity. It's a slider-type wirewound resistor with a 10W rating and I suspect that the principal criterion for its use was availability rather than its power rating.

A date stamp on the audio driver transformer (9 May 1958) places this particular set near the beginning of the production run.

Circuit description

The "Transistor Seven", as the set was called, was issued in two versions: the 78T11 portable and the very similar 79T11 with switching for an external car radio aerial. This article describes the 78T11 and any component differences between the two are noted in the text.

Both the 78T11 and 79T11 use OC-series transistors throughout, beginning with an OC44 converter (TR1) – see Fig.1. This converter uses collector-emitter feedback to give minimal local oscillator radiation. A 440pF padder capacitor (490pF in the 79T11) across one section of the gang sets the local oscillator range to the standard 990-2060kHz range for broadcast-band reception.

Since the OC44 is configured as a self-excited converter, no AGC is applied. The output from the converter feeds the 1st IF transformer (L3) via a double-tuned IF transformer with tapped primary and secondary windings.

The 78T11 has a permanently-connected aerial socket which goes directly to the base of TR1. By contrast, the 79T11, which is purpose-built as a car/portable set, has an antenna changeover switch. This selects either a fully-matched antenna coil that's coupled to a car radio antenna (for car use) or an internal ferrite rod for portable use.

Each antenna coil (car and portable) has its own trimmer. The car antenna coil uses capacitive and inductive coupling to give maximum signal pick-up, necessary because of the short antenna that car sets usually connect to.

The first IF amplifier's OC45 (TR2) has AGC applied via its base bias network. In addition, neutralisation is ap-

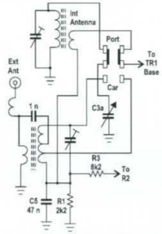


Fig.2: a changeover switch in the 79T11 enabled it to select between its internal antenna & an external car radio antenna. This circuit replaced the shaded area in Fig.1.

The controls for the Stromberg-Carlson 78T11/79T11 are mounted on the top of the case, with the volume control at left and the tuning control at right. The tuning wheel's rim is driven via a rubber grommet attached to a small knob.

plied from a tap on the primary of the second IF transformer (the 79T11 takes its neutralisation from the second IF transformer's secondary). Even though the 78T11's first IF has a double-tuned primary and secondary, the first IF transistor (TR2) gets its signal from a tertiary winding on this IF transformer (L3). By contrast, the 79T11 uses the more conventional tapping on the first IF's secondary.

As shown on Fig.1, the 78T11's second IF transformer (L4) is double-tuned, with tapped primary and secondary windings. Once again, the 79T11 uses a different arrangement – its second IF uses a tuned and tapped primary, while its secondary is un-tuned and untapped.

IF amplifier TR3 operates with fixed bias and has neutralisation applied from a tap on the third IF transformer's primary (the 79T11 takes its neutralisation from the third IF's secondary). This third IF transformer (L5) is double-tuned and has tapped primary and secondary windings. The 79T11 differs yet again in that its secondary is un-tuned and untapped.

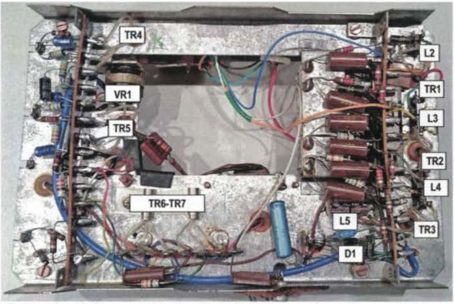
Diode D1 demodulates the IF signal and also supplies the AGC. As shown, the AGC line feeds back to TR2's base via R6 and the tertiary winding in L3. TR2's bias is set by R12 & R13 and this also applies a small forward bias voltage to D1, thereby increasing its sensitivity.

The demodulated output from D1 is positive-going and the AGC action results in strong signals reducing the bias on TR2. This in turn reduces its gain and keeps the audio output fairly constant with varying signal strengths.

Audio output stage

The audio section is a conventional 4-transistor design based on preamplifier stage TR4, driver stage TR5 and Class B push-pull output stage TR6 & TR7. As shown, the drive from TR5 is coupled to the output stage via centre-tapped transformer L6 which acts as a phase splitter. The push-pull output stage then drives the loudspeaker via centre-tapped transformer L7.

Feedback is applied from the speaker back to the base of driver stage TR5 via R26 & C26 in parallel. In common with other Australian designs, the output stage bias is adjustable, in this case via trimpot RV2, and is temperature-compensated using R24, a 130Ω thermistor.



The circuit is built on a metal chassis, with tagstrips and point-to-point wiring. Transistors TR1-TR5 are mounted through the chassis in rubber grommets, while output transistors TR6 & TR7 are secured in place using flag heatsinks.

One unusual design aspect is that the output stage transistors (TR6 & TR7) have no emitter resistor(s). It's more common to see either two low-value emitter resistors of about 10Ω or a single shared emitter resistor of similar value. These normally help reduce output stage distortion and provide some extra temperature compensation but have been omitted from this design.

Finally, it's worth noting that subsequent releases (designated the 78T12, 70T11 and Wayfarer) used alloy-diffused OC170/169s in the RF/IF stages and OC74s in the output. In addition, the Wayfarer featured an inbuilt Hoffman solar battery and could also be slipped into a cradle for use as a car radio.

The electrolytic capacitors were all replaced, as was transistor TR2 which had excessive collector-base leakage.

Restoration

The first job in restoring the set involved a good clean-up. As with other sets of the era, the Stromberg 78T11 uses a leatherette case and its heavy texture had me reaching for soap and a toothbrush.

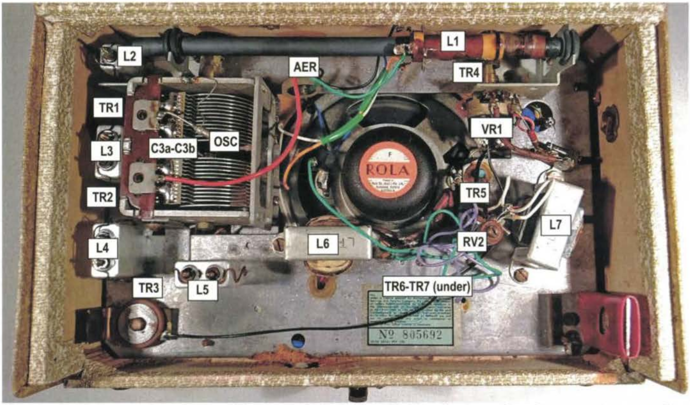
After some patient effort, it cleaned up quite nicely. The "Transistor 7" badge on the top of the case had corroded at the edges but was left in place. This set is nearly 60 years old, after all.

The knobs all had small edge cracks around their skirts but rather than use a windscreen repair kit to make the cracks invisible, they were again left as they were; it's all part of the set's patina and commensurate with its age.

Testing

Having cleaned the set up, it was time to see if it worked. It's always a good idea to increase the voltage slowly while monitoring the current when testing transistor sets, just as it is with valve sets. Admittedly, transistor sets are less likely to have disastrously leaky electrolytics (the reason for caution in valve sets) but it's possible for output stage faults to cause massive current flow, resulting in further damage.

In this set, increasing the supply voltage slowly up to 6V resulted in a current drain of around 10mA. Any-



This view inside the case shows the top of the chassis. Note the large ferrite-rod antenna, the valve-era tuning gang and the 5-inch (127mm) loudspeaker. All the parts are readily accessible and only the electrolytic capacitors and a single transistor required replacement. A few alignment adjustments then restored the set to full working order.

where from around 5-15mA is pretty normal, so this indicated that the output stage was probably OK. However, there was no sound from the set apart from a brief "click" when the power supply was connected.

It was time for some troubleshooting. First, I injected a 455kHz signal from a signal generator into the aerial coil but there was still no audio output. I then cranked the signal generator up to some tens of millivolts (mV) and this time got a barely audible, distorted tone.

This indicated that the front end could be OK, so I tried injecting an audio signal into the volume control (VR1). I found that I needed to feed in over 100mV to get anything through the audio stage and it was the same when I fed the signal directly to TR4's base.

Replacing coupling capacitors C20 & C22, along with new bypass capacitors for C21 & C24, solved the problem, with the required signal level for an audible output now reduced to just 5mV. What's more I could now receive ABC Melbourne (774kHz) and Radio National (621kHz) at reasonable volume.

Injecting 455kHz into the aerial terminal then allowed me to tweak up the IF strip. I also adjusted the oscillator coil for maximum sensitivity and this resulted in a sensitivity of just a few microvolts at the aerial terminal.

Unfortunately, when I cranked up the signal, the output first increased but then flattened off and decreased! I checked TR2's emitter voltage and found that it fell from around 0.8V to only about 0.6V at full signal, whereas it should have fallen to almost 0V due to AGC action.

The culprit turned out to be excessive collector-base leakage in TR2. This was acting as an internal bias circuit, preventing the AGC circuit from correctly reducing the bias for strong signals. Replacing TR2 fixed that problem and both TR1 & TR3 were also checked to make sure they were OK.

Leakage is a known problem with germanium transistors. A transistor may work just fine in some circuits but can cause problems in low-level gain-controlled stages and output stages. Alternatively, they can fail catastrophically due to excessive leakage current. If you work on old equipment (especially using germanium devices), a leakage tester is vital to check that the transistors are OK.

Removing The Knobs

As with the Bush TR82's tuning knob, the 78T11's tuning and volume knobs must be removed carefully. In this case, I was able to remove the knobs by applying steady finger pressure but you may prefer to use several lengths of string under the knobs to spread the load. The Vintage Radio column in the September 2013 issue shows the method.

Metallic levers (such as screwdrivers) are a recipe for disaster. Don't even think of using them.

Capacitor replacement

Some (if not most) restorers regard all old capacitors as suspect – paper types will be probably leaky, while electrolytics may also be leaky and/or of low value. In their view, a complete "recap" eliminates the possibility of faulty capacitors and makes restoration more straightforward.

I generally prefer to take a more conservative approach but given that I'd found all four audio-stage electrolytics to be faulty, I went ahead and replaced the remaining electrolytics as well.

This set also had an annoying low-

How Far Do You Go With Restoration?

Old valve radios present many well-known problems for restorers. These include leaky or shorted capacitors, high or open-circuit resistors, dead or low-emission valves, open-circuit transformer windings, battery corrosion and noisy volume control pots. My own experience with all kinds of radios shows that while a set may appear to "work", a thorough examination often reveals defects that detract from its intended performance.

Now add a novel type of deterioration for early transistor sets: leakage in (mostly) germanium transistors and capacitors that allow a set to work "pretty well" but not up to its original specification. Both the 78T11 and the Pye Jetliner that I recently restored suffered AGC faults due to leakage (in a transistor and a capacitor, respectively).

Often, a restorer won't bother to troubleshoot further if it works OK on local stations. Indeed, it's up to the individual to decide just how far to go in the restoration process and whether they want the set to perform to its maximum potential. Some things to consider include: no-station current drain, distortion and current drain at full output, sensitivity, freedom from oscillation (or "howling"), the AGC action and the audio frequency response.

level "wip-wip-wip" oscillation on all volume settings. An oscilloscope check showed a trace much like the parasitic oscillation that's sometimes seen in high-gain audio and HF/VHF RF power amplifiers. The culprit was C17, the main audio bypass capacitor. A faulty AGC bypass capacitor (C9 in this set) can cause audio oscillation. It certainly did on the TR-1 set that I restored (see SILICON CHIP, September 2012).

Performance

Describing a set as being "very good for its age" can be a cheap shot but this set really is a good performer. In fact, it matches the excellent Philips 198 – it's pretty much the same design but with better audio response according to my test results.

Getting down to actual figures, at maximum gain, it needed field strengths of 30μV/m and 35μV/m for 50mW output at 600kHz and 1400kHz respectively – but with corresponding signal-to-noise (S/N) ratios of just 7dB and 5dB.

For a 20dB S/N ratio, the sensitivity at 600kHz is about 100μV/m and at 1400kHz about 150μV/m. This set's AGC action has a very early onset, so delayed AGC would have given an even better figure than my test results.

As for selectivity, this measured ±1.5kHz at -3dB and ±11.5kHz at -60dB. The AGC held the output to a 6dB increase for a signal increase of 34dB and the set needed some 40mV/m in order to go into overload.

Distortion measurements

The audio stage also performs impressively, with a frequency response from the volume pot onwards of about 45Hz to 7kHz (-3dB points). By contrast, the response from the aerial terminal to the output is about 40Hz to 2kHz. The distortion (THD) was well-controlled: 1.7% at 10mW, 3.5% at 50mW and 5.2% at the onset of clipping (160mW). At full output (about 200mW), the THD rises to some 13%.

Supply voltage

The supply voltage for the set is nominally 6V (4 x 1.5V cells). When the supply is down to just 3V, the maximum output is around 40mW for a THD of 5%, falling to about 2.6% at 10mW.

All in all, the Stromberg-Carlson 78T11 is a solid performer and is an important example of early Australian transistor radio design. If you have one, get it out and restore it to full working order.

Further Reading

For schematics, see Kevin Chant's website:

www.kevinchant.com/uploads/7/1/0/8/7108231/78t11.pdf

www.kevinchant.com/uploads/7/1/0/8/7108231/79t11.pdf

For Stromberg-Carlson's Australian history:

www.radiomuseum.org/dsp_hersteller_detail.cfm?company_id=7578

Many references also exist for the US parent. Among them, see:

www.radiomuseum.org/dsp_hersteller_detail.cfm?company_id=751 SC