FEATURE - PART 1

The (R)evolution of Portable Audio

The new Apple A16 Bionic chip inside the iPhone 14 has almost 16 billion transistors.

In this new six-part series, Darren Yates *looks back over a century of portable audio, from its humble beginnings to hitching a ride to the moon, from spies to planes, vacuum tubes to the iPhone.*

Above: Workers at the Radio Corporation factory in Melbourne put Astor radios together in 1934.

Below: The AWA Radiophone was a 'sealed' radio set sold in Australia in 1923 (Image credit: Museums Victoria/412154/ CC-BY-4.0).

Australians have long been technology pioneers and this year, we celebrate the official centenary of public radio broadcasting in Australia, when radio station 2SB – better known today as 'ABC Radio Sydney' – notches up a century of continuous broadcasting in November. Over those 100 years, we've seen audio technology evolve from the mantelpiece to the earpiece, from the radio-valve or 'vacuum tube' to the iPhone. Over the next six parts, we'll look back at how the evolution of technology itself enabled the miniaturisation of audio devices, with the arrival of new inventions that mirrored and changed popular culture. We'll go under-cover, fly to the moon and arrive at what many consider the pinnacle of modern portable audio – the smartphone. But this month, we go back to the 1920s, as Australia discovers radio...

This is radio...

Australians got their first taste of full-time radio on 23 November 1923 when Sydney Broadcasters Ltd powered up their amplitude-modulated (AM) radio transmitter at 8pm and began broadcasting to the Sydney region. However, it wasn't the first station to receive a broadcasting license – that honour went to Farmer & Co, owners of the big Farmer's department store in Sydney. Radio 2FC was likely still building its transmitter and studios inside Her Majesty's Theatre when 2SB got the jump and 2FC didn't begin transmitting until some weeks later.

But what were listeners listening on? In those early days, you were either rich enough to afford an imported set, or you were intrepid enough to build your own (much like PC enthusiasts). But either way, radio sets were only portable in so far as you could physically lift them, with most early powered models taking up a sizeable space on the mantel piece.

However, not only did you need a license to transmit, you also needed a license to own a radio set – yep, you had to pay for the privilege of listening to radio. What's more, your radio set was also locked or 'sealed' – you could only listen to the stations you were licensed to. Plus, on top of all that, you also had to pay a government license. Radio inspectors would roam the streets on the prowl for illicit radios and those listeners who couldn't produce a license were often prosecuted in the courts. Fines were said to be as high as 20-pounds (approximately $1,500 today) if convicted. With reports that only 1,400 listeners had signed up by the end of 1923, the system was an unmitigated disaster. The following year, the 'sealed' system was scrapped – radio sets could now tune into any station, but the licensing

system largely remained. Stations at the time were grouped as either 'Class A' (license-funded) or 'Class B' (advertising-funded or 'commercial'). By 1929, all class-A stations were taken over by the Australian government and in 1932, collectively became the Australian Broadcasting Commission (ABC).

The first Australian start-ups

Radio was the first great technology boom in Australia and saw the rise of the first-generation of tech start-ups. In Sydney, Airzone began as a manufacturer of 'no power required' crystal radio sets in 1925 and Kriesler kicked off the following year. Meanwhile, Melbourne saw Radio Corporation start building 'Astor' brand radios in 1926, with Breville launching in 1932.

Still, radio imports into the country were 'big business' at the time and this did little to help the local industry get off the ground – the Australian government decided to help things along, introducing import tariffs in 1930. It had the desired effect with local production rapidly expanded to meet the growing demand. Dutch giant Philips, for example, opened a local radio factory in Sydney in 1933.

Thermionic or electronic valves ('vacuum tubes' in the U.S.) were as important then as computer CPUs are today and the growing demand for radio meant Australia needed to make its own valves. The Amalgamated Wireless Valve (AWV) company began doing so in 1933 and importantly, launched into development of new power-efficient valves by the mid-1930s. At the same time, events around the world were unfolding that would soon make locally-made components invaluable.

Portable or trans-portable?

Today's CPU technology is manufactured in labs so clean even the dust gets in by appointment-only. But tech in the 1930s was largely hand-made – that meant that most radio sets were at least large enough to sit on the mantelpiece or in many cases, were designed to be eye-catching floor-standing furniture pieces with art-deco style, often with a big 10-inch (250mm)-diameter speaker.

The valves themselves were roughly 100-150mm tall and around 30-40mm wide – with the better models featuring as many as seven of them, 'small' as we know it today just wasn't possible. However, it didn't mean that portable radio sets didn't exist. Most were portable in so far as they could be moved from room to room. Battery-powered radios were common enough but due to their still comparatively-large power requirements, they needed at least two special batteries – a two-volt 'A' battery to provide the heating power that made the valves work, and a 'B' battery of up to 135-volts to drive the circuitry. While a 'B' battery could last many months of intermittent use, 'A' batteries required replacement more often.

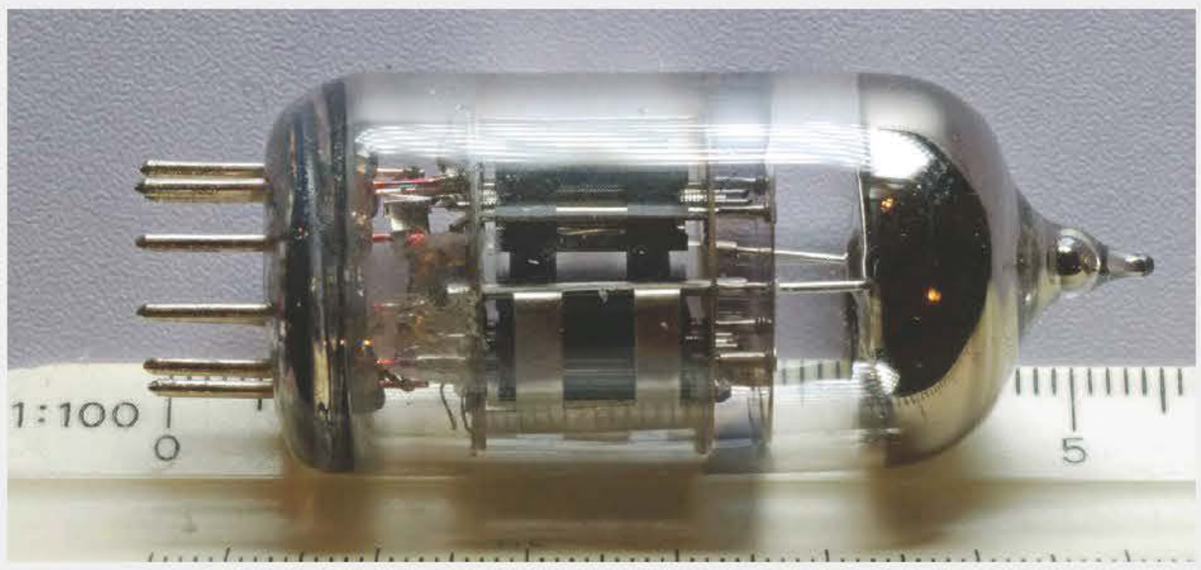
By the late-1930s, many radio sets were now AC-mains powered and simple enough to use – one knob to turn the power on, another for tuning, one for volume and often a fourth as a tone control.

> "Radio was the first great technology boom in Australia and saw the rise of the first-generation of tech start-ups."

War takes radio mobile

When Australia joined Britain and France in declaring war on Germany in September 1939, Australia's technology industry was also mobilised and turned radio from entertainment to military use. But the Japanese attack on Pearl Harbour in

Above left: The AWA Fisk Radiolette from 1936 was a popular mantel-piece radio (Image credit: Museums Victoria/412083/ CC-BY-4.0).
Above: A Swedish crystal radio set from 1922, it requires no power source, using the radiowave energy to generate sound in sensitive earphones (Image credit: Holger Ellgaard/CC-BY-3.0).



Left: The 12AX7 dual-triode valve, developed in 1947 and still made today (Image credit: Jud McCranie/ CC-BY-SA 4.0).

Above left: The Motorola SCR-536 was an iconic WWII-era radio-telephone using new miniature valves.
Above right: The Paraset 7 suitcase radio was used by Allied spies to send Morse Code messages during WWII (Image credit: Timitrius/ CC-BY-SA-2.0).

December 1941 arguably had a more salient effect, as did the fall of Singapore and the first air-raid attack on Darwin, both less than three months later. The few radio parts that were then available in Australia for radio makers and DIY hobbyists were now swallowed up by the military and buying any radio set was a difficult task. Local Australian maker Kriesler, for example, had now turned the vast bulk of its radio skills to making communications radio sets for the Royal Australian Air Force.

Australia's work on power-efficient valves during the 1930s was an important step, but for communications to become truly 'portable', those large valves had to be shrunk. In 1941, the giant Radio Corporation of America (RCA) launched the first of a new 'miniature' valve type. Just as Intel and AMD label or group their CPUs by their respective processor sockets, such LGA1700 and AM4, broader valve families were also known by their sockets. The new 'B7G' valves couldn't deliver the power of older and larger 'octal' types, but they made carrying them light-work. Again, the B7G valves were like mobile-class CPUs – not as powerful as desktop CPUs, but more battery-friendly.

One of the most iconic applications of the new miniature valves during the war was inside the Motorola BC-611/ SCR-536 field-radiotelephone – look close enough and you'll see one in most American WWII movies. They used military versions of B7G miniature valves. Motorola (and other makers under license) reportedly manufactured over 130,000 BC-611s between 1941 and the end of the war. They featured in all of the U.S.'s key European campaigns, from North Africa to Normandy.

Nevertheless, some of the most remarkable design work of the war occurred behind enemy lines.

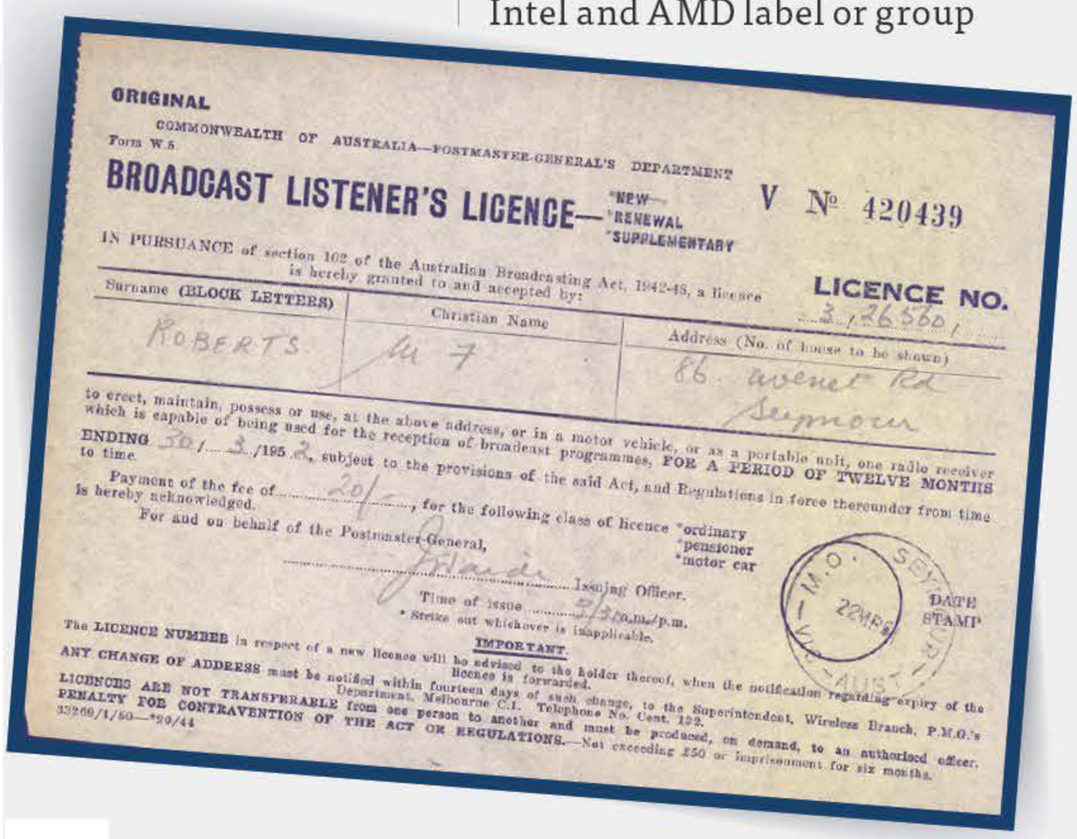
Winnie the War Winner

One of those designs was created by the signalmen of 'Sparrow Force', an Australian independent company of commandos operating on the island of Timor during WWII.

The day after Japanese planes bombed Darwin on 19 February 1942, its land forces invaded the island and its capital, Dili. Vastly outnumbered, the Australians escaped into the mountains, but without a transmitter to reach Australia and help, their future looked bleak. Signaller Max Loveless had been a radio-technician in Hobart before the war and when a Dutch officer arrived in their camp lugging what turned out to be just a beat-up commercial broadcast radio receiver, Loveless thought there were still enough worthwhile parts there to have a crack at making a rudimentary transmitter to raise Australia.

> "Their first effort failed, but a second more powerful design, built on a kerosene tin, miraculously transmitted a signal that reached Darwin on the evening of 19 April 1942."

Their first effort failed, but a second more powerful design, built on a kerosene tin, miraculously transmitted a signal that reached Darwin on the evening of 19 April 1942. It was even more remarkable given the few tools they had – a small tomahawk axe, a screwdriver and a pair of pliers. It even featured parts scrounged during night-time clandestine raids within sight of Japanese forces. After headquarters had confirmed their identity, the company's requests for boots and ammunition – and very likely, a new working radio – were actioned. This unruly pile of tech parts had saved the day and became affectionately known as 'Winnie the War Winner'. What's more, 'Winnie' made it out of


ORIGINAL
COMMONWEALTH OF AUSTRALIA—POSTMASTER-GENERAL'S DEPARTMENT
Form W.5.
BROADCAST LISTENER'S LICENCE— *NEW *RENEWAL *SUPPLEMENTARY
V № 420439
IN PURSUANCE of section 102 of the Australian Broadcasting Act, 1942-48, a licence is hereby granted to and accepted by:
LICENCE NO. 3/26560
Surname (BLOCK LETTERS): ROBERTS
Christian Name: M 7
Address (No. of house to be shown): 86 Avenue Rd Seymour
to erect, maintain, possess or use, at the above address, or in a motor vehicle, or as a portable unit, one radio receiver which is capable of being used for the reception of broadcast programmes, FOR A PERIOD OF TWELVE MONTHS ENDING 30/3/1952, subject to the provisions of the said Act, and Regulations in force thereunder from time to time.
Payment of the fee of 20/- for the following class of licence *ordinary *pensioner *motor car is hereby acknowledged.
For and on behalf of the Postmaster-General,
Issuing Officer.
Time of issue 2/3 p.m./p.m.
* Strike out whichever is inapplicable.
IMPORTANT.
The LICENCE NUMBER in respect of a new licence will be advised to the holder thereof, when the notification regarding expiry of the licence is forwarded.
ANY CHANGE OF ADDRESS must be notified within fourteen days of such change, to the Superintendent, Wireless Branch, P.M.G.'s Department, Melbourne C.1. Telephone No. Cent. 122.
LICENCES ARE NOT TRANSFERABLE from one person to another and must be produced, on demand, to an authorised officer.
PENALTY FOR CONTRAVENTION OF THE ACT OR REGULATIONS.—Not exceeding £50 or imprisonment for six months.
33269/1/50—*20/44
M.O. SEYMOUR 22 APR 52 VIC. AUST.
DATE STAMP

Left: For many years, a broadcast listener's license was require to listen to radio in Australia (image credit: Moya McFadzean/Museums Victoria/15789/CC-BY-4.0).

Timor, back to Australia and today, is regularly on display at the Australian War Memorial.

It's an incredible story and one that shows Australian ingenuity at its finest, but given the scale of miniaturisation today, you have to wonder whether a similar feat could ever be achieved again.

Spy Radio

While 'Winnie' was built out of scrounged parts, portable radio-transceivers were an important part of espionage and resistance groups during the war. In some respects, valves are just complicated light-bulbs and like light-bulbs, they were largely made from a glass envelope or tube, which didn't take much to shatter if you dropped them. To improve their ruggedness, military equipment typically used metal envelopes instead of glass.

These appeared in what are often called 'spy radio sets'. One such radio was the 'Paraset', so-called as it was dropped by parachute to waiting agents and resistance groups. These radios were housed in standard rectangle suitcases of the era. However, to keep the weight down, the Paraset also only had enough electronics inside to send and receive the 'dits' and 'dahs' of Morse Code. Voice communication wasn't always an affordable luxury. Nevertheless, the need to have communications with agents behind enemy lines brought the development of portable radios to the fore.

Entertainment goes mobile…

With the war finally over by September 1945, radio technology returned to more peaceful pursuits and like many other areas of endeavour, electronics was about to take advantage of war-time developments. Pre-war radio sets weighed as much as a desktop PC, but in late-1946, a new breed of 'miniature' valves began arriving onto the market – one of the first being the 12AX7. Developed by RCA (Radio Corporation of America), it measured little more than 60mm x 20mm in size, but featured two amplifying elements or 'triodes', a bit like having a dual-core processor, able to do two different things at once. These were known by their 'B9A' socket and in combination with the smaller 'B7G' models from the war, radio sets of the 1950s became actual 'portable' devices, shrinking from overweight toolboxes to breadbox and more fashionable carry-bag sized units.

Twin-unit or 'dual' valves became ever more popular, reducing the size and cost of new designs. But with the invention of the transistor in 1947, the demise of the valve, whilst not immediate, was all but sealed. Nevertheless, valves are still being made today and are highly sought after by guitarists the world over, one of the most valued (and valuable) still in production is the 12AX7.

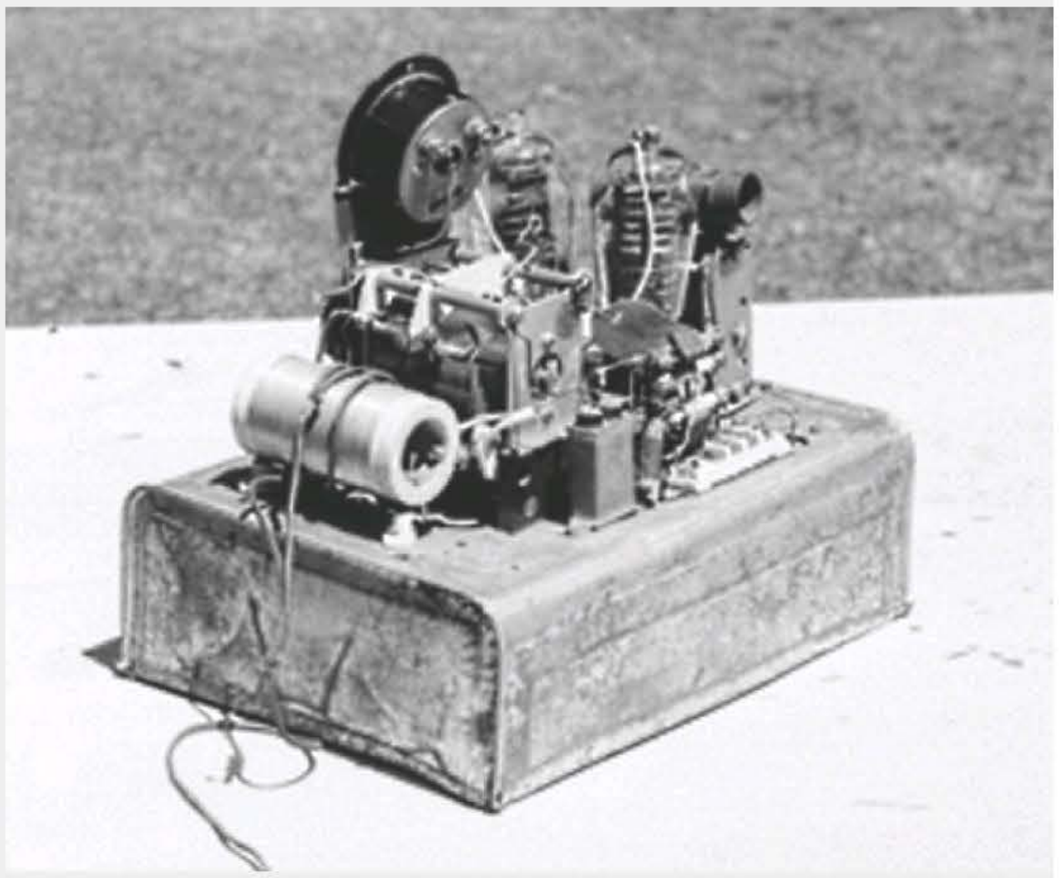
… but a new revolution is coming

By 1945, radio continued to be the only source of spoken news and programmed home entertainment in Australia (TV was still more than a decade away).

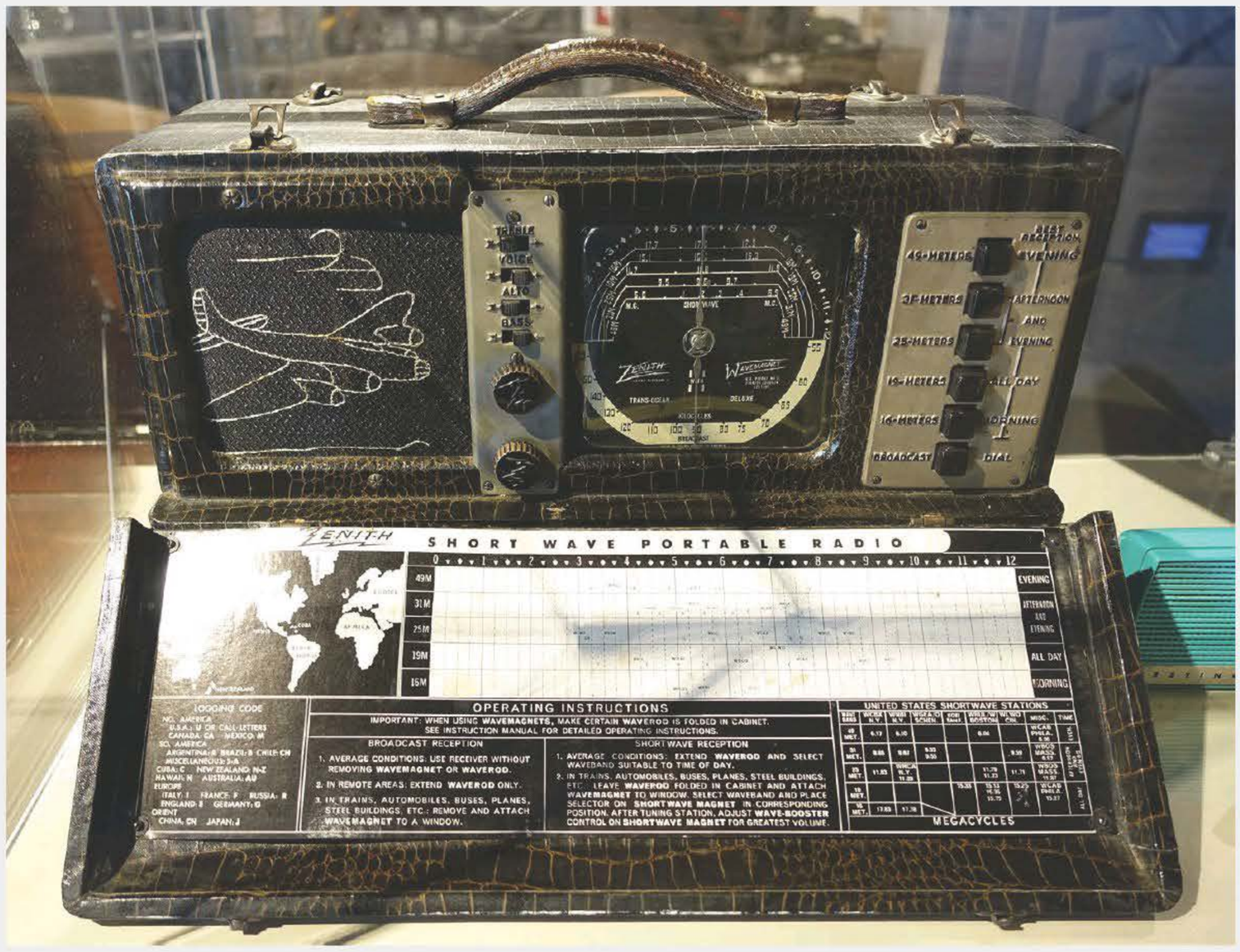
For those creating that content, there were two choices – have your actors or musicians in a studio performing 'live' or play a recording from a phonograph record. Consumer-grade 10-inch (250mm) records of the 1930s/40s had a rotation speed of 78 revolutions per minute (RPM) and barely three minutes' play time each side. Larger 16-inch (400mm) transcription discs running at 33.3RPM gave 30 minutes per disc, but even so, it's said that listeners could still tell whether a band was 'live' or being played off a record.

Nevertheless, those '78' records had created pop culture icons of musicians such as Louis Armstrong, Bing Crosby and Glenn Miller. But with the end of the war in 1945, no practical system for high-fidelity delayed transmission of audio yet existed. Or did it?

Next time, we rewind the clock to 1941, pause there and begin playback of a then-secret technology development that revolutionised the second-half of the 20th century, as we fast-forward our way from war-time discoveries to making a trip to the moon and seeing pop-culture get 'wired for sound' and all the change that brought. ■



Above: Winnie the War Winner, a radio transmitter built in the jungles of Timor during 1942 (Image credit: Australian War Memorial/060348).



Below: The Zenith Trans-Oceanic portable radio sold 35,000 units in three months to April 1942.