Vintage Radio

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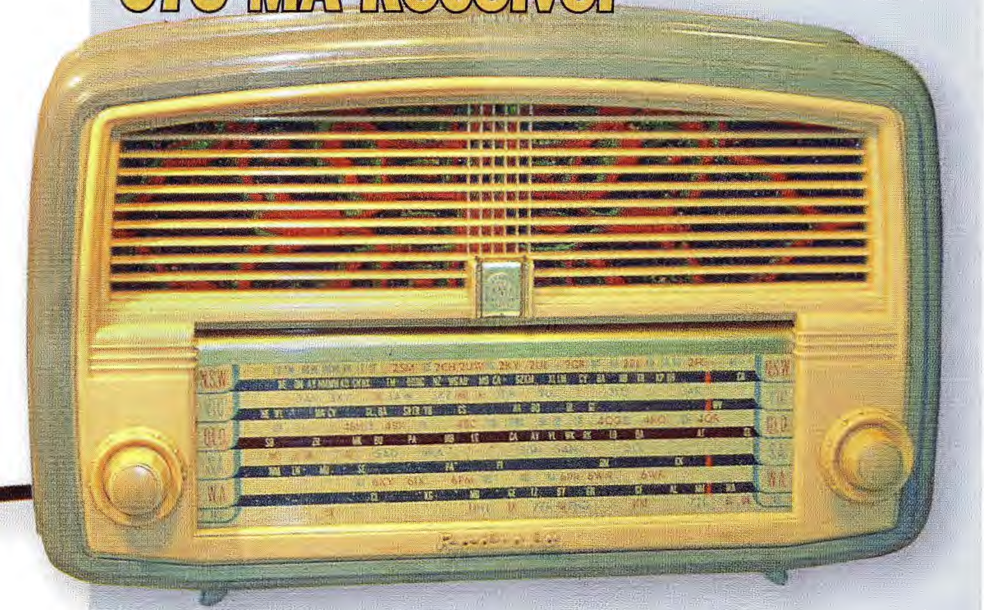
A look at the Radiola Model 573-MA Receiver



Manufactured in the early 1950s, the AWA model 573-MA is a 5-valve superhet, designed for the 540-1600kHz broadcast band. It features an attractive plastic case and a large straight line dial with stations for all Australian states clearly marked.

BEFORE THE INTRODUCTION of television to Australia in 1956, radio and gramophone records were a prime source of entertainment. Typically, a household would have a radio and maybe a gramophone in the lounge room and the family would gather in the evening to listen to the radio or records.

With the war some years away and economic conditions improving, the dream of having several radios in the household became a reality for many. In addition to mains receivers, there were battery-powered portable sets but these were expensive to run and a good many did not work all that well.

The Radiola Model 573-MA operates from mains power and requires only 40W. Furthermore, this set has a very effective inbuilt antenna and can be shifted around to wherever there is a power outlet without having to install an antenna wire. This could be the kitchen, the bedroom or the outside workshop.

The set was manufactured by Amalgamated Wireless (Australasia) Ltd and the valves by their associated company, AWV. The valves were new to Australian technicians at the time and were much smaller than their predecessors which had octal and other plastic bases. They were of all-glass construction, with seven pins at one end providing all the connections.

Circuit details

Fig.1 shows the circuit diagram of the set. It's a superheterodyne design with five valves: a frequency changer (V1), an intermediate frequency (IF) amplifier (V2), a detector/audio amplifier (V3), an audio power amplifier (V4) and a rectifier (V5). It's pretty much a standard line-up for medium-wave receivers designed at the time.

There are a few special features about the design. These include a ferrite rod antenna, a neutralising circuit for the IF amplifier, simple rather than delayed AGC (automatic gain control) and a negative feedback circuit with associated treble cut and boost.

The frequency changer is a 6BE6 which has a simplified geometry in order to fit all the connections within the 7-pin limitation (the screen grid serves as the plate for the local oscillator). This valve actually provides more conversion gain when used on the broadcast band than some earlier octal based types.

Intermediate frequency (IF) amplification at 455kHz is achieved using a 6BA6 which is a variable-mu pentode with AGC applied to the grid. It also has the potential for higher gain than earlier octal-based valve types. Again, looking at the circuit, early versions of the set used a cathode bias resistor without a bypass capacitor in order to reduce the gain. Later models included the bypass capacitor as well as a neutralising circuit.

The detector/amplifier stage (V3) is a 6AV6 which has two diodes and a triode in the one envelope. One diode detects the 455kHz intermediate frequency signal and at the same time provides the AGC voltage. The other diode is not used and is simply connected to earth. The triode section

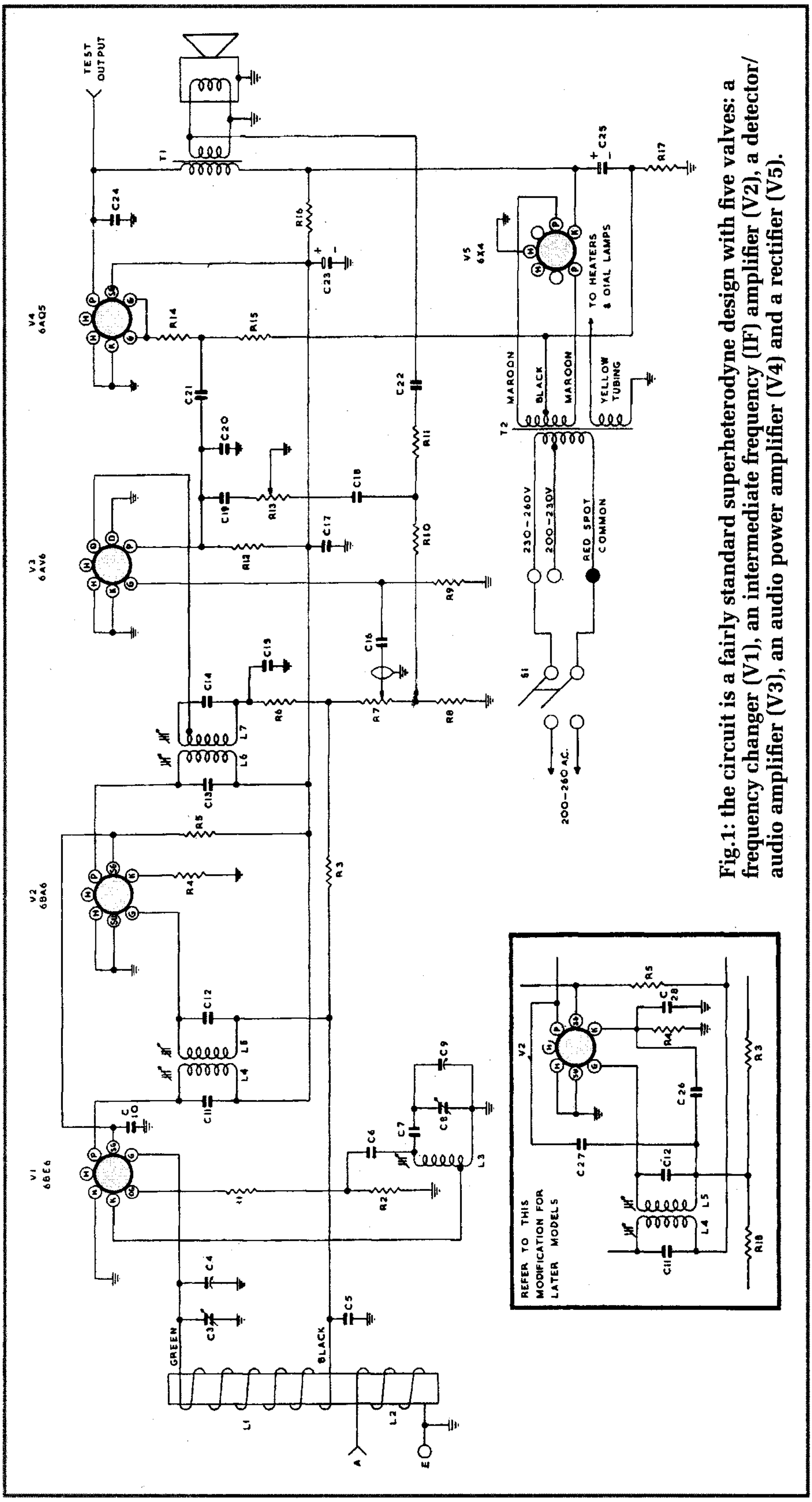
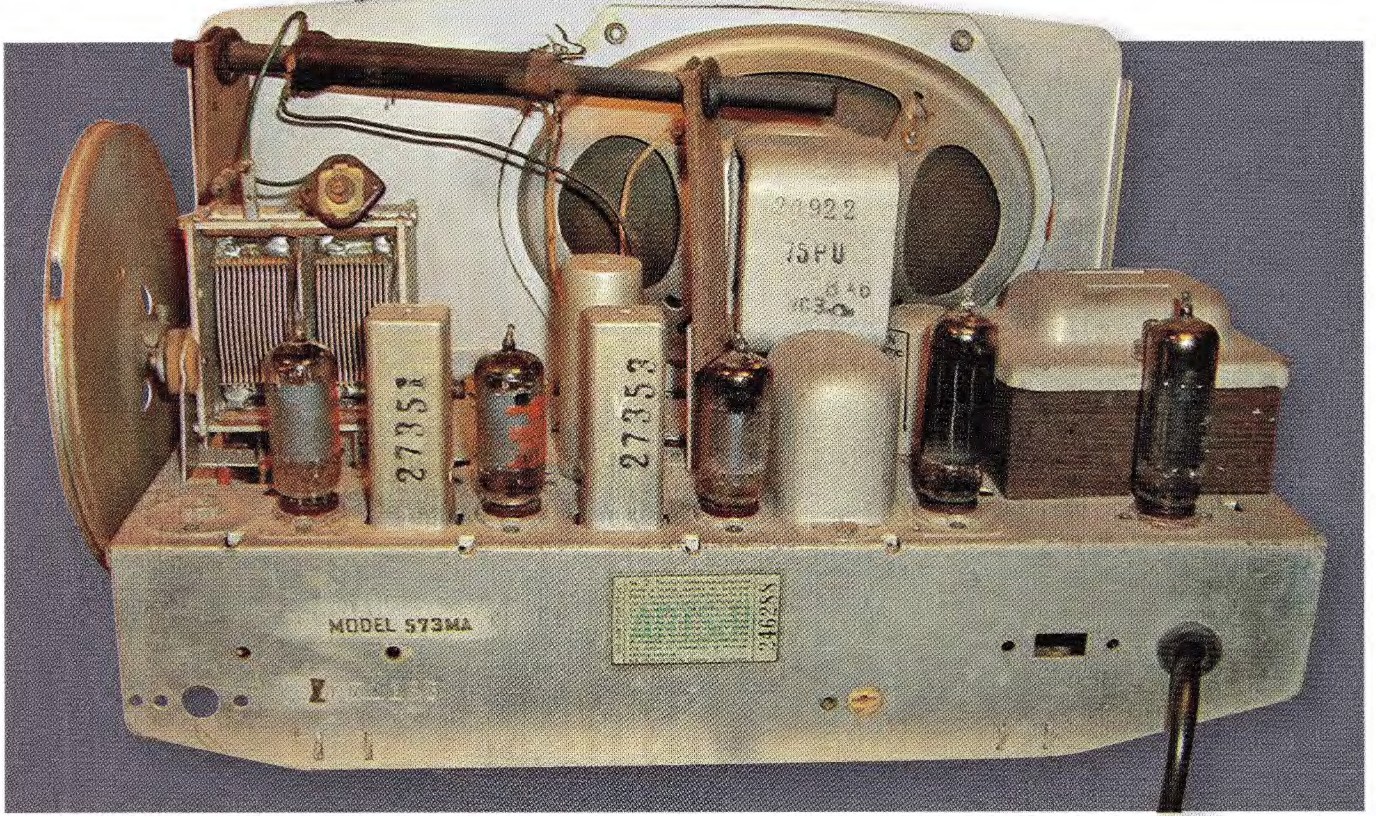


Fig.1: the circuit is a fairly standard superheterodyne design with five valves: a frequency changer (V1), an intermediate frequency (IF) amplifier (V2), a detector/ audio amplifier (V3), an audio power amplifier (V4) and a rectifier (V5).

provides substantial audio gain and is a commonly-used circuit. The grid return resistor (R9) is 10MΩ while its plate load resistor (R12) is 0.22MΩ.

The the 6AQ5 valve (V4) is the familiar beam-tetrode in miniature form. It provides gain and the audio power to drive the loudspeaker. R14, a 47kΩ resistor in the grid circuit, is there as a precaution against parasitic oscilla-



Despite the set's age (about 60 years), the chassis is still in good condition. It was one of the first Australian-made sets to use the new 7-pin "miniature" valves (also Australian-made).

tions at frequencies outside the audio range. The valve must be operated in a linear mode for low distortion and negative bias is provided via R17, a 150Ω resistor in the supply line.

V5, a type 6X4, rectifies the AC output of the transformer to provide 240V DC for the plate of the 6AQ5. It also provides, via dropping resistor R16 (5kΩ), 165V DC for the screen of the 6AQ5 and the plates of the other valves.

A special feature of the 6X4 is that it has insulation between the heater and cathode elements, designed to withstand the high-tension (HT) voltage. The heater can be operated from the same supply as the heaters for the other valves, ie, with one end connected to earth.

Restoration

The old Radiola Model 573-MA receiver pictured here originally came to me complete in its plastic case and with a copy of the AWA service data. This included the specifications, circuit diagram, alignment procedure, a table showing the resistance of the various coils and transformers, and a table of the valve socket voltages.

Bearing in mind that the set was nearly 60 years old and might have had all sorts of faults, there was no question of immediately plugging it into 230VAC and switching it on.

Nothing in the service data described how to get the chassis out of the plastic case but after observation and some thought, I began by removing the knobs by pulling them straight out from the front. The back of the case proved more elusive. It is held by two screws, recessed at the top and another two screws towards the back and underneath the case. In the process of removing the back, the brackets holding the back broke away from the case. They were later repaired using epoxy cement and 3mm screws, just to make sure.

At this stage, the chassis was still firmly attached inside the front of the case by another two screws underneath the case. These were also removed and the metal chassis was then slid out of the case to reveal a broken dial cord. Fortunately, the service data includes a diagram which shows how to string the cord and attach the pointer.

A thorough visual check above and below the chassis revealed nothing out of order, apart from a generous layer of dust. As far as reasonably possible, this was carefully removed with a soft brush

Next, using a digital multimeter, the resistance of the primary winding of the power transformer was measured (see the manufacturer's table "DC Resistance Of Windings" reproduced here). This was within specification. The next measurement, the resistance between the primary and the chassis, was of the utmost importance. It was greater than 10MΩ which is very good.

In addition, the resistance of the primary of the loudspeaker transformer winding was measured to ensure the safety of the 6AQ5. If this winding goes open circuit, the screen grid of the valve will draw excessive current.

Next, the resistance between the

TABLE 1: DC RESISTANCE OF WINDINGS

Ferrite Aerial Assembly:	
Primary (L1)	<1Ω
Secondary (L2)	1Ω
Oscillator Coil (L3)	3.5Ω
IF Transformer Windings	15Ω
Power Transformer (T2):	
Primary	50Ω
Secondary	350Ω
Loudspeaker Transformer (T1):	
Primary	525Ω or 430Ω
Secondary	<1Ω

The above readings were taken on a standard chassis but it should not be assumed that a component is faulty if a slightly different reading is obtained.

high-tension line and the metal chassis was measured. It was more than 0.5MΩ which suggested that the electrolytic capacitors were possibly in reasonable condition and that it may be safe to switch on the mains power.

The 573-MA was originally fitted with a 3-pin plug and a 2-wire figure-8 power flex. This is simply not satisfactory for safety these days. So, before switching on, a 3-core flex was fitted and the earth wire securely attached to the metal chassis. This was done by crimping the earth wire to an eyelet lug which was then secured using a machine screw, nut and shakeproof washer. Do not rely on a solder joint to the chassis.

In addition, a cable clamp was fitted to secure the mains flex in place, along with a grommet where the cable exits the metal chassis. This ensures that the outer insulation of the mains cord is not damaged by external strain.

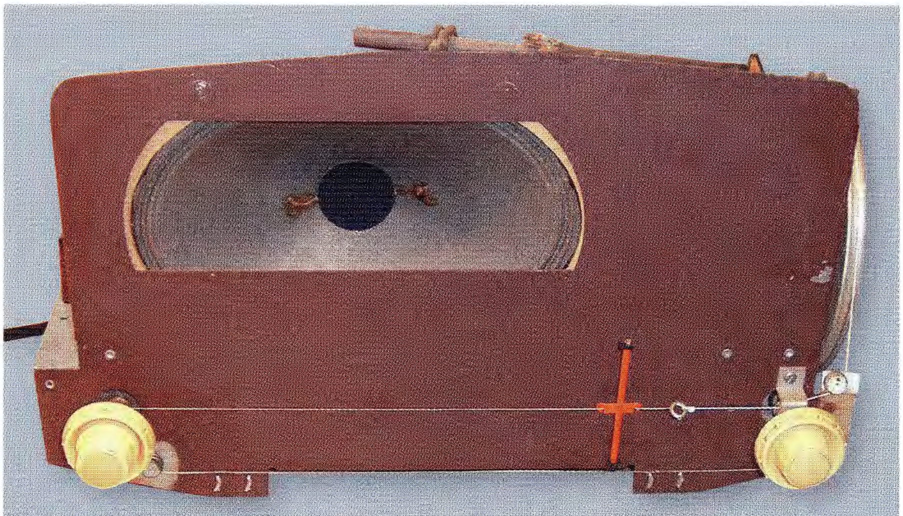
With the above precautions, a fault in the primary power circuit will either cause the earth leakage circuit breaker at the switchboard to disconnect the power or will cause the fuse to blow, thus ensuring safety.

Surprise, surprise. With the power applied, the set worked perfectly, receiving all local and one or two distance stations in daylight! Not a single component was changed and not a single adjustment moved. What a contrast with the recent experience with the Hotpoint J35DE receiver (SILICON CHIP, July-September 2011)

The service data states that "all adjusting screws are sealed". Except for the aerial trimmer (C3, 27pF), it means exactly what it says.

Performance

I was left no alternative but to resort to the "big guns" in the form of laboratory instruments to get some quantitative idea of performance. The signal gathering performance of the ferrite rod antenna is not easy to measure, It's basically a function of the volume of the rod and the "Q" factor.



The reddish-brown metal plate at the front of the set is used as a crude baffle for the oval-shaped loudspeaker

It is possible to arrange a known field strength using a signal generator and an inductor placed at a specified distance from the ferrite rod. However, this is fairly cumbersome and is hardly justified when weak station performance has been demonstrated.

The manufacturer's alignment table states "a coil comprising three turns of 16-gauge DCC wire and about 12 inches (30cm) in diameter should be connected between the terminals of the test instrument, placed concentric with the rod aerial and distant not less than 1 foot from it." No expected sensitivity figures or settings of the AWA modulated oscillator are given.

My aim was to measure the bandwidth of the intermediate frequency (IF) channel and the overall audio response of the set. To do this, a laboratory RF signal generator and an audio signal generator were pressed into service.

Unfortunately, the AWA arrangement would make it very difficult to maintain constant coupling between the RF generator and the ferrite antenna. To circumvent this, I simply wound three turns of hook-up wire around the end of the ferrite rod. The relative signal strength was measured using a digital multimeter connected between the junction of R3 and R18 and earth. Obviously, the circuit was detuned but this does not make any difference to the intermediate and audio response.

For most local stations, without the signal generator connected, the meter read about -4V. Bear in mind that the ferrite rod antenna is directional and has least signal gathering capacity when pointed end-on in the direction of the station. However, the reserve of sensitivity is considerable and when turning the chassis around while tuned to local stations, the minimum pick-up orientation is usually noticed only by a slight increase in background noise.

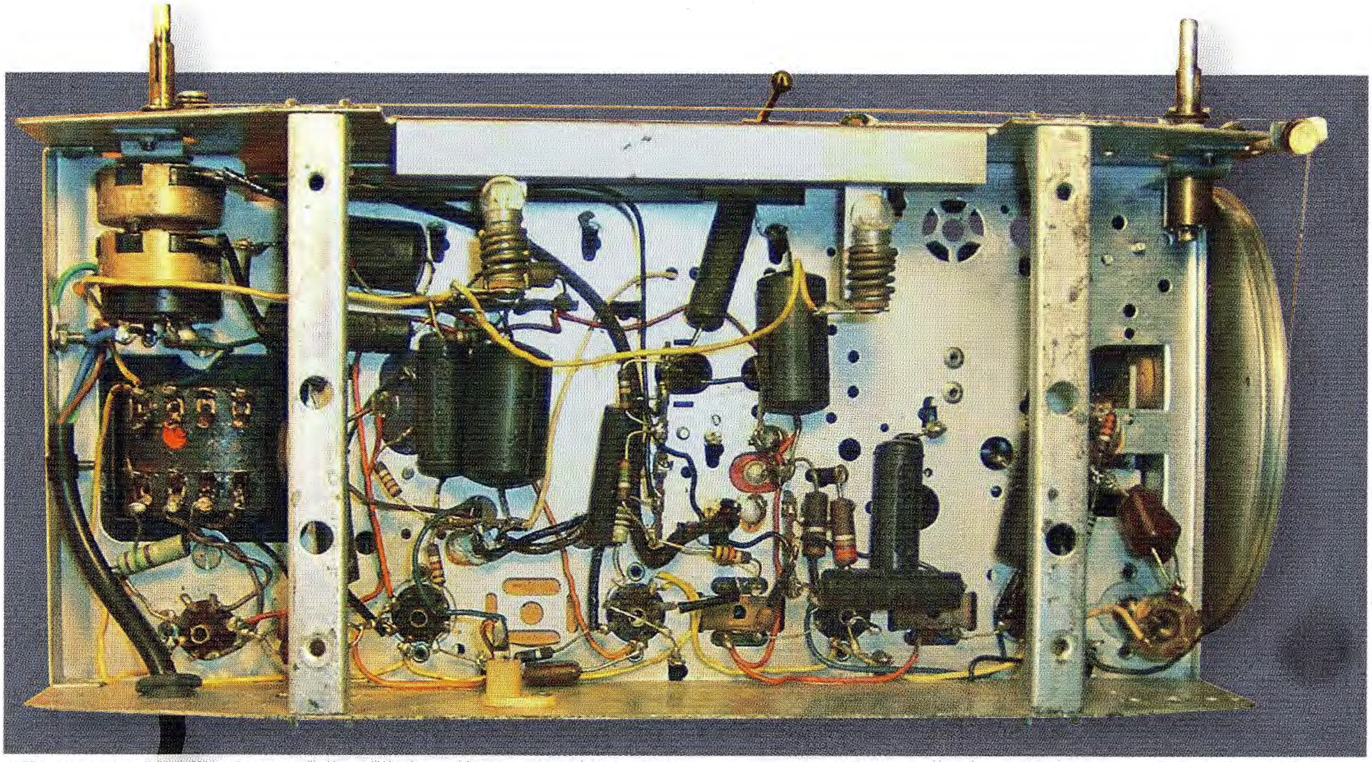
Why simple AGC?

This brings me back to an interesting point about the circuit: why did the designer choose a simple automatic gain control system when the usual delayed AGC system would have involved only a couple of inexpensive components?

I believe that the answer is related to the ferrite rod antenna and its proximity to the power transformer. When the set is tuned away from a station, hum

TABLE 2: SOCKET VOLTAGES

Valves	Cathode To Chassis Volts	Screen Grid To Chassis Volts	Anode To Chassis Volts	Anode Current mA	Heater Volts
6BE6 Converter	–	85	165	2	6.3
6BA6 IF Amplifier	1.5	85	165	4.5	6.3
6AV6 Detector/Amplifier	–	–	80	1	6.3
6AQ5 Output	–	165	240	20	6.3
6X4 Rectifier	250	–	235/235 AC RMS	–	6.3



All parts under the chassis are easy to access. The original 2-core power cable was replaced with a 3-core cable so that the chassis could be earthed.

can be heard in the speaker. But tune to even a very weak station and the hum immediately stops. Had delayed AGC been incorporated, hum would be present on weak stations.

Another design feature of the set, unusual for the 1950s, is the negative feedback and tone control system. The feedback is taken from the secondary winding of the output transformer, via C22, R11 and R10 in series and developed across R8 (100Ω) at the lower end of the volume control (R7). In addition, the junction of R10 and R11 is connected via C18 to one end of the tone control potentiometer R13 (100kΩ). Its moving arm (wiper) is earthed, while the other end is connected to the plate of V3 via C19 (0.01μF).

When the set is first switched on, C19 bypasses the plate of the 6AV6, resulting in severe treble cut. However, with R13 fully rotated, C18 (0.25μF) is connected to ground, reducing the negative feedback at higher audio frequencies and hence providing treble boost. Very clever!

The tone control is the small knob at the front left of the set, while the volume control is the larger concentric knob behind it. The on/off switch is operated by the tone control. When you first switch on, you make the decision: leave it with a "mellow" tone or rotate the knob fully and be able to understand speech!

Audio response

The measured centre frequency of the IF amplifier is very close to 455kHz and the -6dB bandwidth is 7kHz. The overall audio response with the tone control fully clockwise is only -2dB down at 3kHz. Although this is poor compared with modern digital or FM sets, it still makes for pleasant listening. The response curves are reproduced in Fig.3.

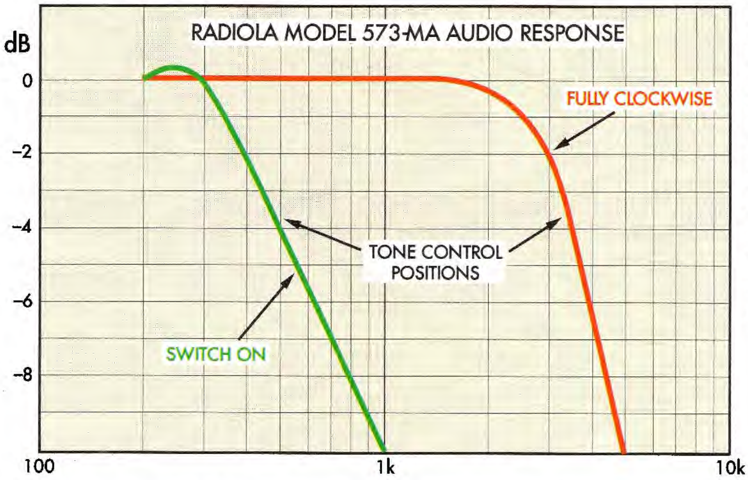


Fig.3: this graph shows the audio response of the set at switch-on and with the tone control turned fully clockwise (the on/off switch is integrated with the tone control).

The audio power output is a little less than 1W RMS at the point of clipping when fed into a 3-ohm resistive load. I double checked this and also checked the emission of the 6AQ5, as the service data sheet claims 3W undistorted. Even so, the 1W of audio is more than enough for the sensitive permanent-magnet speaker which is mounted on a metal plate. This certainly does not provide a good baffle for the lower audio tones.

So, 60 years later, are there any improvements to be made to the circuitry? Answer: none that would make a really worthwhile improvement. However, over-coupling of the 1st IF transformer and damping of the primary of the second IF (see SILICON CHIP, September 2011) would extend the audio response.

In addition, the current drain and hence heat dissipation could be reduced by slightly increasing the value of the back bias resistor (R17, 150Ω).

Finally, capacitors C17 (0.1μF), C23 (25μF electrolytic) and C25 (25μF electrolytic) were replaced in the interests of long-term reliability. SC