Vintage Radio

By Rodney Champness, VK3UG

Philips 196A 4-Valve AC/ Battery Portable Receiver

Designated the 196A, this interesting little portable radio from Philips uses valves and can be run from either batteries or mains power. It was designed as a low-cost set but is still quite a good performer.

THE PHILIPS 196A was produced during the late 1950s and early 1960s, a time when many manufacturers were already designing and building transistor portables. However, many customers were reluctant to buy the transistor radios of the era, as their performance at that early stage was far from inspiring.

To overcome this reluctance, some manufacturers built both valve and transistor receivers in nearly identical cases. This allowed customers to choose the type of set that best suited their needs and also gave them time to adjust to the changeover to fully-transistorised sets.

The 196A was one such set. It's a relatively small, portable valve receiver and was manufactured right at the end of the valve era.

As can be seen from the photos, the case is a little unusual. According to the supplied information (on the inside of the set), it's made from sandstone-coloured, rippled leatherette over stiff cardboard sheets, a style that was used for many portables of the time. It measures 280mm long x 180mm high x 115mm deep and weighs around 3kg without batteries.

Note that the case isn't a perfect rectangle, so these are the greatest dimensions in any direction. And although similar in style, the later Philips 199 transistor model used a case that was slightly smaller and had pushbutton controls along the top.

The 196A valve portable has just three controls: a partly-recessed volume control at top left, a hand-span dial on the front panel and a small lever located under the lefthand end of the carrying strap. This lever controls a 3-position switch which switches the set on or off and selects between battery and AC operation.

This power switch isn't easy to see and appears to be something of an "add-on". Philips certainly could have done a much better job when it came to positioning this control.

Circuit details

The 196A's circuit is quite conventional. The front-end employs a loop-stick ferrite rod antenna and this forms a tuned circuit with one gang of the tuning capacitor. The signal is then coupled to the grid of a 1R5 pentagrid converter valve.

The local oscillator, which is also part of the 1R5, operates 455kHz higher than the signal frequency. The two signals are then mixed together and the resulting 455kHz signal fed via a double-tuned intermediate frequency (IF) transformer to a 1T4 IF amplifier pentode (the other signals from the mixer are rejected). From there, the amplified signal is fed via another double-tuned IF transformer to the detector/AGC diode in a 1S5 valve.

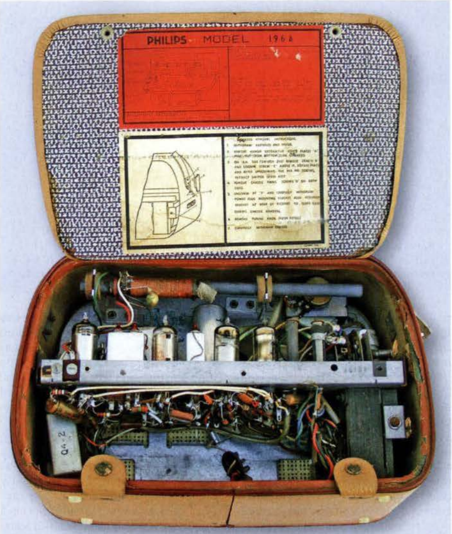
The recovered audio at the detector is then fed via the volume control to the pentode section of the 1S5 and following that to a 3V4 audio output stage. A speaker transformer in the plate circuit of the 3V4 couples the audio from the high-impedance plate circuit to the low-impedance (3.5Ω) 100mm (4-inch) loudspeaker.

In addition, the receiver employs a simple AGC system. The AGC voltage is derived from the only diode in the 1S5 and this is applied to the 1R5 in the front end. No AGC is applied to the 1T4 IF amplifier.

Because this receiver works on both battery and AC power, the valve filaments are wired in series. The current drain through them is up to 50mA at 6.5-7.5V on either batteries or AC mains.

The mains transformer has two windings: a tapped mains input and a secondary producing around 130V. A selenium half-wave rectifier is used to produce an HT voltage of nominally 90V at 10-13mA to the valve plates and 7.5V for the filaments via dropping resistors. This may not be very efficient but it ensures good filtering of the filament voltage (efficiently filtered low-voltage power supplies didn't become available until transistors became common).

The batteries are relatively small (to fit inside the case), so a life of around 100 hours would be expected. It uses a 490P 90V battery for the HT and a 717 battery that supplies 7.5V.



This is the view inside the set without the bottom chassis cover in place. The label attached to the rear cover details the chassis removal procedure. It also shows the valve locations, the alignment points and the battery details.

Cleaning & repairing the case

A comprehensive set of instructions on removing the chassis from the cabinet is pasted inside the rear cover (see photo). In fact, it's one of the most comprehensive I have seen, so full marks to Philips for this.

The set featured here had obviously had a hard life up until the time it was pensioned off. Some of the trim on the case had come loose and there were (and still are) several paint marks on it as well. It was also quite grimy on the outside.

Having removed the chassis, I removed the plastic grille from inside the escutcheon, by levering it away from the case with a broad-bladed screwdriver (it had been attached with contact adhesive). That done, I set about giving it a thorough clean.

I usually place plastic and Bakelite cabinets in a laundry tub with warm soapy water and scrub them clean with a nail brush. However, that's not possible with a thick cardboard-lined case, as water will damage the cardboard.

Instead, I simply dampen the outside of the case with soapy water and then scrub it clean. With continued scrubbing, the cabinets usually come up looking quite good, just as it did in this case. The plastic grille and the volume control knob were then cleaned by immersing them in soapy water and scrubbing them with a nail brush. These parts, along with the case, were then placed in the sun to dry.

Once the cabinet had dried, I tried lightly scrubbing the paint splashes with some acetone and while that helped remove some of the paint, I also managed to go through the original paintwork in one or two places. It's no big deal and I will try touching up these areas with paint when I have time.

Having cleaned the cabinet, I realigned the trims around the plastic grill, filled the gaps with contact adhesive and clamped the trims in place. This took quite some time, as I had to allow the adhesive to set in each spot where it was applied, before moving onto the next piece.

Finally, the two covers that go over the ends of the handle were quite dull and grimy. I rubbed automotive cut and polish on them and used a small screwdriver to push the polishing cloth into the grooves in the covers to achieve an excellent result.

Overhauling the electronics

The inside of the set was quite clean apart from some loose dust on various components. Unlike many other sets of this era, there was no sign of any rust or other corrosion.

As a result, a quick dust-out with a 12mm paint brush was all that was required to clean the circuit components and the chassis.

Having got rid of the dust, it was

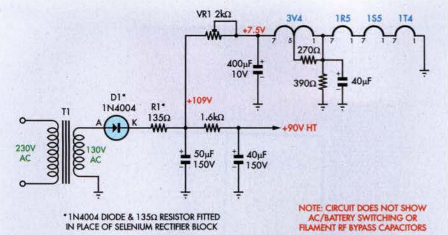


Fig.1: a simplified circuit of the power supply, showing how the 90V HT rail and the filament supply rail are derived. The original selenium block rectifier has been replaced by a 1N4004 silicon diode and a 135Ω resistor.

now time to overhaul the electronics. I began by using a high-voltage insulation tester to check for leakage between the primary of the mains transformer and both the chassis and the secondary winding. There was no discernible leakage, even with the tester set to 1000V.

That done, I checked the continuity of all the battery valve filaments using a DMM and found that they were all intact. These filaments are quite delicate so care is needed to ensure that the correct filament voltages are applied.

As stated above, this set uses a half-wave selenium rectifier block and this is bolted to the chassis. They are not very efficient and do get quite hot. In addition, their impedance tends to go high, which lowers the loaded output voltage considerably.

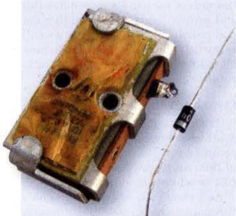
As a result, I applied mains power to the set and checked to see whether the output voltages from the power supply were indeed around 7.5V and 90V. This showed that the filament voltage was around 3.5V, while the high tension (HT) was just 65V. These readings were both much too low and from experience, it pointed to the selenium rectifier being faulty.

I decided to leave the existing rectifier block in place and connect a 1N4004 diode in series with a 3.3kΩ resistor across it. This gave slightly higher voltages out of the power supply but they were still too low so I progressively reduced the 3.3kΩ resistor in series with the diode until I got the correct voltages.

Unfortunately, while I was wiring these parts in place, one of the lugs broke away from the selenium rectifier block. As a result, it was removed and a small tagstrip fitted in its place, with the diode and resistor wired to it. The series resistor value came down to 135Ω before I got the correct voltages for the filaments and plate supplies (ie, 7.5V and 90V). In practice, this 135Ω resistor was made up of using a 180Ω 5W wirewound resistor and a parallel 470Ω 1W carbon resistor.

Fitting a 135Ω resistor in series with the diode means that the circuit more closely mimics the characteristics of a selenium rectifier.

Keep in mind that a 1N4004 diode has a peak inverse voltage (PIV) rating of 400V volts. With a 130V secondary transformer voltage, the peak voltage applied to the 1N4004 is around 130 x 2.8 = 364V. I usually take the transformer voltage and multiply it by three to give me the PIV plus a small margin for spikes on the power supply line but if in doubt, always use a diode with a higher PIV rating.



The selenium rectifier is shown here at left, together with the diode that replaced it.

Because the voltages are not that high in battery sets, I decided to run the set for a short time to see whether I could get it to operate before replacing any leaky paper capacitors. There was no output but touching the volume control produced a "blurt" from the speaker. I then wriggled the valves in their sockets and this produced some loud crackles.

As a result, I switched the set off, removed the valves and sprayed each socket with Inox (a spray lubricant, cleaner). I then reinserted the valves, slightly rocking them from side-to-side as I did so to clean any corrosion off the pins. With power reapplied, the set then worked but the audio output sounded quite unpleasant.

At that stage, I quickly switched the set off again. It was important to keep this test short, to ensure that no damage to the valves occurred.

Having proved that it worked (in a fashion), it was now time to replace any leaky paper capacitors that might affect the set's operation. In the end, I replaced all these capacitors except for a 100nF low-tension RF bypass and a 4.7nF top-cut filter on the plate of the 3V4. The capacitors that were removed had between 1.5MΩ and 7MΩ of leakage resistance, so it was no wonder that the audio was distorted.

This receiver is generally quite good to work on but sometimes you have to dig down through up to three layers of components to get at the parts. As a result, it can take quite some time to replace or test some components – not that you have to do that often.

Mains power lead

The mains power lead is a 2-wire (figure-8) type with a moulded 2-pin mains plug and a 2-pin socket that plugs into the side of the receiver. It isn't practical to replace the lead with a 3-core lead and the set is largely double insulated anyway. In fact, if the power switch had a plastic recessed type knob, it would probably comply with the latest electrical safety standards.

In the meantime, the set can be used with a 1:1 (230V-to-230V) isolation transformer.

Unlike this set, some sets of the era were designed to run from both AC and DC mains supplies (ie, 200-250V AC/DC) and so didn't use a power transformer. These particular sets were "hot chassis" (ie, the chassis and various components operated at mains voltages) so extreme care was needed in servicing them, otherwise electrocution was a distinct possibility.

Power supply

Fig.1 shows a simplified circuit of the power supply used in the Philips 196A. The output from the rectifier and its series 135Ω resistor is filtered using a 50μF electrolytic capacitor and is then fed via a 1.6kΩ resistor to provide the 90V HT supply rail. This rail is further filtered using 40μF electrolytic capacitor.

By contrast, the filaments are fed from the 109V rail via an adjustable 2kΩ wirewound resistor (set at 1.95kΩ ohms in this set) which reduces the voltage to 7.5V at 50mA. A 400μF electrolytic capacitor filters the filament voltage which is then applied to the 3V4. It's then filtered using another 40μF electrolytic capacitor before being fed to the filaments of the remaining valves which are in more critical sections of the receiver.

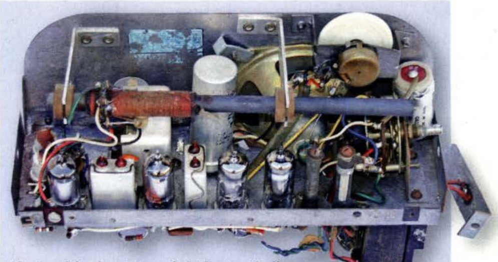
Typically, the valve filaments were wired in series so that the total filament current remained at 50mA. This applied whether four or five valves were used, with a 7.5V filament supply used for a 4-valve set and a 9V supply for a 5-valve receiver.

In addition, the filament circuit has a 270Ω resistor across one half of the 3V4's filament (pin 1 to pin 5), with a 390Ω resistor then connected to chassis. For those unfamiliar with series-connected filament circuits, this may appear to be a rather strange arrangement.

The first thing to realise here is that the plate and screen currents of a filament valve go through the filament to earth, thereby increasing the filament current by the sum of these two currents. As a result, the 270Ω resistor is included across half the filament of the 3V4 so that the currents flowing through both sections are the same.

The 3V4, which is the audio output valve, draws around 7-9mA and so this extra current is "bled" to earth (chassis) via the 390Ω resistor, thus keeping the current through the filaments of the 1R5, 1T4 and 1S5 valves close to 50mA. Without this bleed resistor, the current through these filaments could go as high as 60mA.

As a result, the voltage across each filament is kept close to the required 1.5V.



The top of the chassis is neatly laid out, with all parts readily accessible. The rotary switch at right provides on/off switching and selects between battery and mains power.

By contrast with the top side, many of the parts under the chassis are difficult to access. This view shows the chassis after restoration, with all but two of the paper capacitors replaced.

Because these remaining valves have a current drain of just 1-2mA, it's not usually considered necessary to balance the current through their filaments (and thus the voltage across them), although some designs do include this.

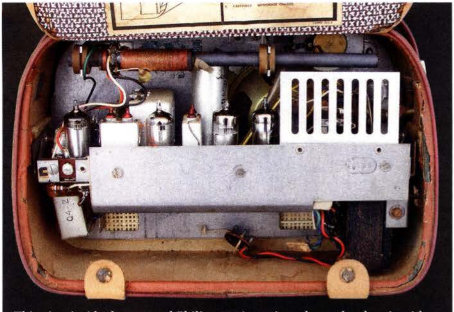
During the course of my checks, I found that the 1R5's filament voltage was around 1.65V, which is much too high for the valve to have a long life. The reason was simple enough – the 390Ω resistor had been incorrectly wired to pin 1 of the 1R5 instead of pin 7. Once this had been corrected, the filament voltage came down to the correct 1.5V. Manufacturers in those days did make wiring mistakes. Sometimes they are obvious, sometimes not.

There is also one potentially serious problem with this type of power supply. If a valve filament goes open circuit, the voltage at the filament feed point (7.5V in this set) will quickly rise to well over 100V. As a result, the 400μF 10V electrolytic capacitor across this rail will soon succumb and could even explode.

Alignment

Having corrected the filament supply wiring error, the next step was to check the alignment.

I began by tweaking the 455kHz IF transformers for maximum audio output and found that they were quite close to their correct settings. I then checked the oscillator setting by tuning from one end of the band to the other and found that it was close



This view inside the restored Philips 196A receiver shows the chassis with the bottom cover in place. The 7.5V and 90V batteries fit into the available space beneath this cover.

enough to not warrant adjustment.

The next step was to slide the tuned coil along the ferrite rod antenna to tweak the performance at the low-frequency end of the dial. Once again, very little adjustment was needed. I then tuned the set to around 1500kHz and adjusted the antenna tuned circuit trimmer capacitor. It too was close to its optimum setting.

Finally, I resealed the adjustments by re-melting the original sealing wax using a soldering iron.

The set now turned in an excellent performance, especially considering that it only has four valves. And with an external antenna and earth connected, the stations romped home.

An intermittent problem

Unfortunately, the set still had a problem. Although it generally worked quite well, it would also occasionally go completely dead. And to make matter worse, the fault was intermittent.

I checked the voltages at various point around the circuit when it was dead and also when it was working and they were all correct in both situations. I could also get a healthy blurt from the speaker if I touched the top of the volume control, which indicated that the audio section was working.

I then checked the front-end of the receiver and although it appeared that the 1R5 was oscillating, it wasn't producing any 455kHz output according to my tuned signal tracer.

Suspecting a faulty valve, I replaced both the 1R5 and the 1T4 but that didn't cure the problem and subsequent tests proved that they were OK. I then found that when I wriggled these valves around in their sockets, the set would come good. As a result, I re-cleaned the contacts as it appeared that there may have still been some corrosion on either the valve pins or the socket pins.

Many of the parts under the chassis are "buried" two or three layers down, which can make replacement difficult and time-consuming.

Once that was done, the set worked quite well for some time but then suddenly went dead again. This time, there was no blurt from the speaker when I touched the volume control, so the fault lay in the audio circuitry.

Using a signal tracer, I quickly determined that the receiver was working right up to the output of the speaker transformer. I then checked the speaker and it also tested OK, with around 3Ω of resistance across the voice coil. This was rather puzzling as the fault had to be here somewhere, so I re-tested the voice coil a few times and found that it had intermittent continuity.

Eventually, I traced the fault to the spot where the flexible wire joins to the voice coil winding on the speaker cone. Unfortunately I couldn't repair it, so a new speaker had to be fitted.

Removing the speaker is straightforward. The first step is to disconnect the wiring to it, after which the front panel is separated from the chassis by removing four screws. It's then just a matter of undoing the four screws that hold the 100mm speaker in position and sliding it out.

I didn't have a Rola speaker in my spare parts bin but another, slightly smaller speaker which I had rescued from old equipment did fit. And that cured the intermittent fault once and for all.

Summary

Although the Philips 196A is a rather utilitarian receiver, it's still quite pleasant to use. It doesn't have the appeal of a beautifully-restored timber cabinet receiver but it's a somewhat unusual set that's worth having in any collection.

It works quite well, especially considering that it's a battery/mains portable set with just four valves. It's also quite compact and the instructions inside the case are extremely helpful when it comes to servicing.

Finally, despite its age, there were relatively few problems – just a dud selenium rectifier, some dirty valve sockets, a small wiring error and an intermittent speaker voice coil. Fortunately, the 1R5 valve in the front end had survived having a higher-than normal voltage across its filament. SC