journey to restore a real Apollo Guidance Computer to working condition.

Michael Kingsford Gray,
Adelaide, SA.

How a vibrator works

Readers of the Vintage Radio article "Kriesler Farm Radio model 31-2" (September 2019; siliconchip.com.au/Article/11930) should be made aware that the circuit diagram in Fig.2 "Operation of a Synchronous Vibrator" is incorrect.

As drawn, the vibrator would not work. The energizing winding is shown continuously powered from the battery; with this connection, the reed would simply 'pole' to one side and never release. The correct circuit diagram is to be found as Fig.32.2 in the Radiotron Designers Handbook (Fourth Edition) on page 1203.

A further error is in the caption to Fig.2, in which the capacitor shown is referred to as a "filter capacitor". This is actually known as a "timing capacitor"; its value is chosen to resonate with the inductance of the transformer.

For more information on vibrators refer to my article "Refurbishing a Vibrator" in the HRSA journal Radio Waves Number 149, July 2019 (page 28).

Ross Stell,
Kogarah, NSW.

Response: you are right that there is

an error in Fig.2, but it is more subtle than you suggest. The vibrator reed should have been shown in a central position, not making contact on either side. This is how the reed actually rests when power is not applied, and a vibrator with this configuration will (and does) work.

This mistake was unfortunately introduced when it was re-drawn for publication; the original diagram supplied by Graham Parslow was correct.

Regarding the so-called "timing capacitor", Ian Batty comments: the vibrator's operating frequency is determined by the stiffness of the reed, the mass of the electromagnetic tip that responds to the coil's magnetic field and the magnetic flux created by the current through the coil. External components have no important effect on the frequency.

The buffer capacitor (erroneously called the "timing" capacitor in some incorrect descriptions) is a critical protective component. It is ***not*** *there to resonate with the transformer. Resonance would cause the system to act like the tank circuit in a Class-C power amplifier, converting current pulses into sinewaves.*

Any check of the supply to a vibrator-supply rectifier will show it to be substantially square. In fact, for highest efficiency, we want a square wave at the rectifier.

At some point in each half-cycle, the reed makes no electrical contact; there is a brief 'dead-band' between the time the contacts on the reed break connection with one fixed contact and re-make connection with the opposite fixed contact. For this brief period, the transformer primary current falls to zero. This collapses the transformer's magnetic field near-instantaneously.

This, according to Lenz's Law, creates a very large voltage surge. This is how Kettering ignition systems work in petrol engines, to generate the high voltages needed for a spark plug from a low-voltage supply.

If allowed to occur, these voltage spikes would drastically shorten the vibrator contact's lives and create massive interference, if not causing insulation breakdowns on the secondary side. The buffer capacitor damps these voltage spikes. It's commonly a 1.6kV-rated type for this reason.

You may see sets with buffer caps on the primary and secondary, but it's more common for them to be on the secondary where a lower (more practical) capacitor value can be used.

One of my mates who works on vintage car radios has seen buffer capacitors fail, leading to vibrator destruction. He advises routine replacement if a set is in for service, as an insurance policy against future failures. Some of these capacitors are 50~60 years old now.

Ground symbol does not necessarily indicate Earth

I have noticed that you have used the standard Earth symbol (⏚) incorrectly in some cases. It is normally used to denote an 'Earth' connection, ie, connected to an Earth stake in the ground for a protective function. In our power systems (TN-C-S), the Earth connection is bonded to the Neutral side of a transformer. As such, it is safe to touch. In fact, we may do so many times a day, for instance, when opening the refrigerator, dishwasher etc.

In the Universal Dimmer project (February 2019; siliconchip.com.au/Series/332), it is used to show a common connection on the schematic. If you consider this is nearly at Active potential with respect to Earth, it is not at a safe potential to touch. If this were a battery piece of equipment, one could argue that it does not matter. But in this case, it could be misleading and dangerous.

This is akin to using a green/yellow wire for an Active conductor, strictly forbidden by AS/NZS 3000! I suggest that a different method be used to show the 0V rail, for example, an inverted "T" with a 0V designator.

Thanks to you and your staff on the excellent magazine, it is always interesting to read.

Lindsay Freund,
Para Vista, SA.

John Clarke responds: it is true that the ground symbol that we use to indicate the 'common' connection in our circuits started as indicating an Earth connection.

But that is not how it has been used for many decades now. Since the days of valve radios, it has generally been recognised as being a way of simplifying a circuit drawing, so that common connections do not have to be drawn as lines.

This is the first complaint that we have received about using the ground symbol for non-Earthed points since I started working at Electronics Australia in 1979. We have done many mains projects since then, some of which had grounds tied to (or near) Active.

I can see how it may be possible to get the impression that these points in the circuit are connected to Earth. But we make a clear distinction in our diagrams by using the chassis Earth symbol to indicate Earth, and reserving the ground symbol as a wiring common symbol.

The inverted "T" that you have suggested could be misconstrued as safe for similar reasons. It is just an abbreviated form of the ground symbol.

I do not consider the ground symbol that we use as synonymous with using the green/yellow Earth wire for a live connection. The green/yellow Earth wire is legislated as only being used for Earth connections, and we fully agree with that. But the legislation does not extend to the use of symbols in circuit diagrams. It leaves symbol conventions up to the people drawing the diagrams.

We could draw common circuit connections differently when they are floating, but any new common symbol (such as inverted T) would need to have a warning if the voltage on that connection is liable to be unsafe.

One option would be to continue using the ground symbol for low-voltage circuits and the inverted T for high-voltage common, with the voltage warning next to it. We will consider whether that is necessary the next time we design a project with a high-voltage common rail.

Colour video from the moon landings

The letter from Alan Hughes in your September issue on colour video of the US moon landings (Mailbag, page 8) reminded me of my experiences at the time, working for ABC Sydney. It was a long time ago, so some of the details may be a little off, but this is how I recall it happening.

For the second US moon landing (Apollo 12, November 1969), they took with them an unusually small colour TV camera. The modern method for making single-tube colour cameras (the dual-colour fine line optical filter) hadn't been thought of then.

It takes about 1000 litres of rocket fuel to get one kilo into orbit, and more still to the moon. So the propulsion team said there was no way the astronauts were taking a heavy three-tube colour camera along.