Heathkit of the Month:
by Bob Eckweiler, AF6C

Heathkit

Heathkit CT-1
In Circuit Capaci-Tester

Introduction:
When troubleshooting equipment, capacitors can be difficult to check while in the circuit. Removing one lead of a component just to do a measurement can be time consuming. Thus a piece of test equipment that can check capacitors without having to first disconnect them can expedite servicing tremendously.

The Heathkit CT-1:
In 1957 Heathkit came out with the CT-1 in-circuit capacitor checker to which they gave the moniker "Capaci-Tester". The CT-1 originally sold for $7.95.

The CT-1 checks a capacitor for an open, shorted or intermittent condition. Capacitors above 50 µµfd (picofarads) can be checked for an open condition when shunted by a low in-circuit resistance (greater than 30Ω above 350 µµfd, 400Ω between 100 and 350 µµfd and 2,000Ω between 50 and 100 µµfd). Capacitors up to 20 µfd can be checked for shorts when shunted by at least 10Ω. The tester is not recommended for checking electrolytic capacitors.

Operation:
The Capaci-Tester is easy to use. It is important that the device under test be turned off AND unplugged from any power source. The CT-1 comes with a pair of test leads, one red and one black, each with a banana plug on one end and an alligator clip on the other. The test leads are clipped across the capacitor to be tested, noting that the black test lead is grounded within the CT-1.

The CT-1 has only one control, a five-position rotary switch. In the center position the CT-1 is powered off. The two positions right of center

Figure 1: The Heathkit CT-1

are for testing for a shorted condition, and the two positions left of center are for testing for an open condition. Immediately on either side of the center position is a position marked **CHECK**. In these positions the CT-1 is powered on and the eye-tube indicator confirms the selected test's circuitry is working; also on the short check side any residual voltage on the capacitor under test is discharged. The far left and far right switch positions are marked **TEST** and perform the actual test. These two switch positions are momentary only, with the switch spring-loaded to move back into its nearest check position when released.

The indicator is a "magic-eye" tube that has a phosphorescent green circular indicator. A

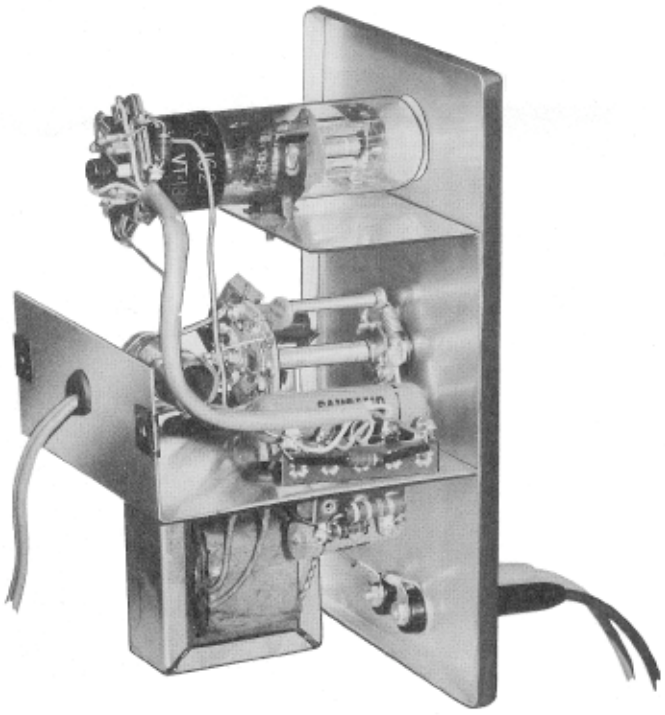

Figure 2: Inside the Heathkit CT-1

shadow wedge is shown on the indicator which can vary from about 90° to just a small line, and provides the indication.

For either test, if the eye-tube closes then the capacitor is okay. However if the eye-tube remains open or only partially closes then the capacitor needs to be replaced (or at least checked further). If the indicator fluctuates, it is an indication that the capacitor is intermittent.

CT-1 Circuit Description:
The CT-1 is a clever design. It uses one tube, the war-surplus 1629 eye-tube that was used in the ARC-5 transmitter. This tube acts as multiple rectifiers, an oscillator when testing for an open condition, an amplifier when testing for a short condition, and as an indicator for both test conditions. Figure 3 shows the schematic.

The power supply consists of only a transformer with three windings. The first provides 12 VAC filament voltage for the 1629 tube. The second winding provides 540 VAC to the plates of the tube which is self rectifying. The third winding is 55 VAC used to bias the tube.

Short Test:
When the switch is moved to the **SHORT TEST** position 60 cycle AC from the bias winding is applied through a voltage divider to the grid of the tube as well as to across the test leads. The AC voltage from the third winding is rectified by the grid and bias is created causing the eye tube to close. The test leads place the bias across the capacitor and the eye-tube remains closed as long as the capacitor shows an impedance greater than about 10Ω at 60 cps. Open capacitors will test good in the short test for an obvious reason. In the **CHECK TEST** position the switch also shorts the test leads opening the eye-tube and simulating a shorted capacitor. The phase of the bias and plate voltages must be proper for this circuit to work.

The Open Test:
When the switch is moved to the **OPEN TEST** position the 1629 tube is connected as a Hartley oscillator operating at a nominal frequency of 19 mc. (MHz). The tapped Hartley oscillator coil also has a closely coupled secondary winding shunted by the 10 μμfd capacitor. When the oscillator is active, bias is created across the 2.2 MΩ grid resistor causing the eye to close. However, the closely coupled LC circuit will normally absorb energy from the coil and stop any oscillation causing the tube-eye to open. In the **OPEN TEST** position the test leads are coupled to the secondary coil. If an open capacitor is connected across the test leads and thus the coil nothing will happen; however if there is enough capacitance across the test leads the secondary winding becomes untuned and the oscillator goes into oscillation closing the eye-tube indicator. A shorted capacitor will also indicate a not open condition, again for obvious reasons.

The Heathkit IT-22:
In 1963 the CT-1 was updated to the IT-22 which is electrically identical, but sports a new paint scheme that matches Heathkit's mid '60s test equipment styling - medium-gray and silver with red accenting. The later IT-22 sold for $10.95 in 1965 (See: Figure 4).

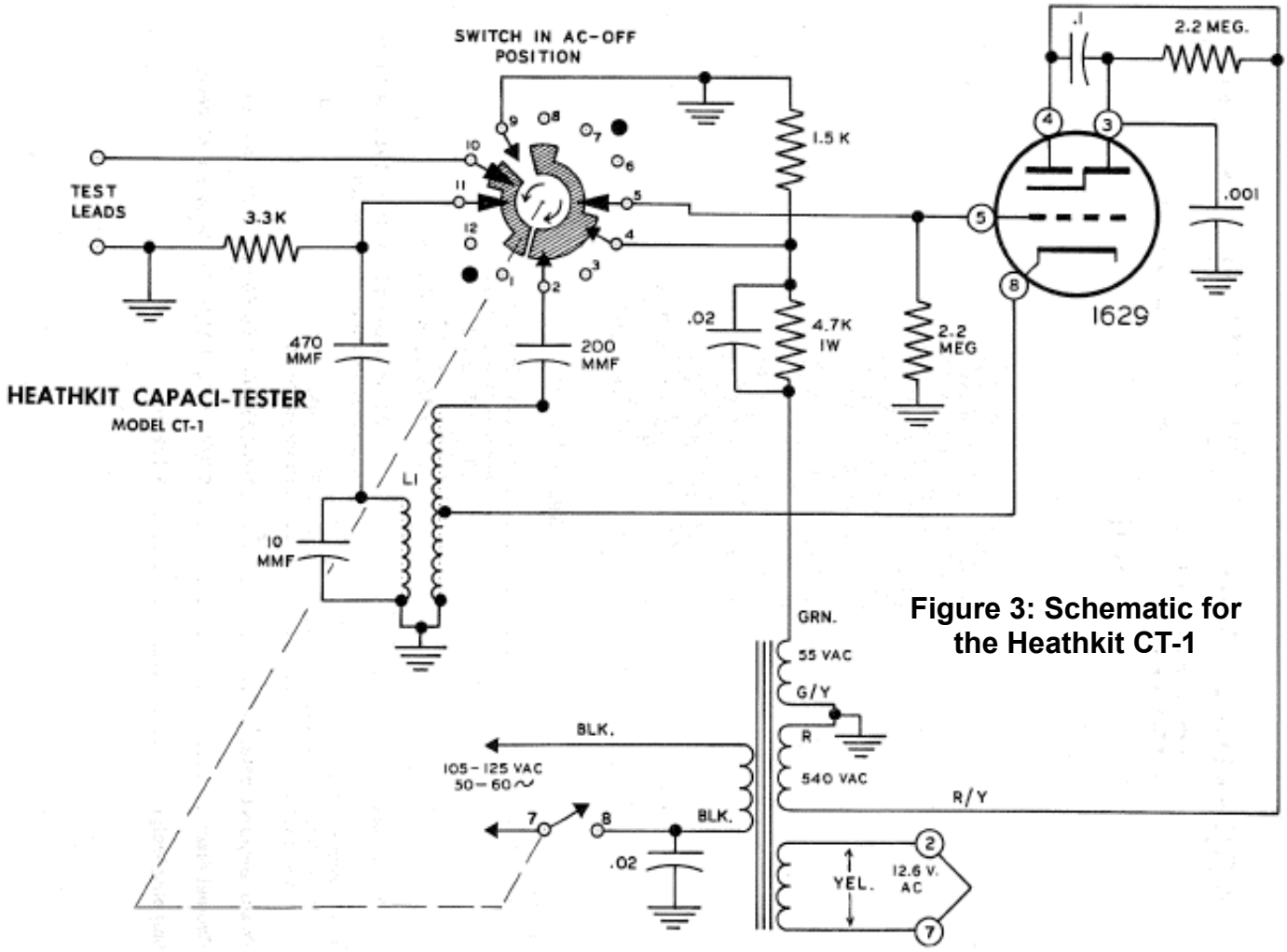

Figure 3: Schematic for the Heathkit CT-1

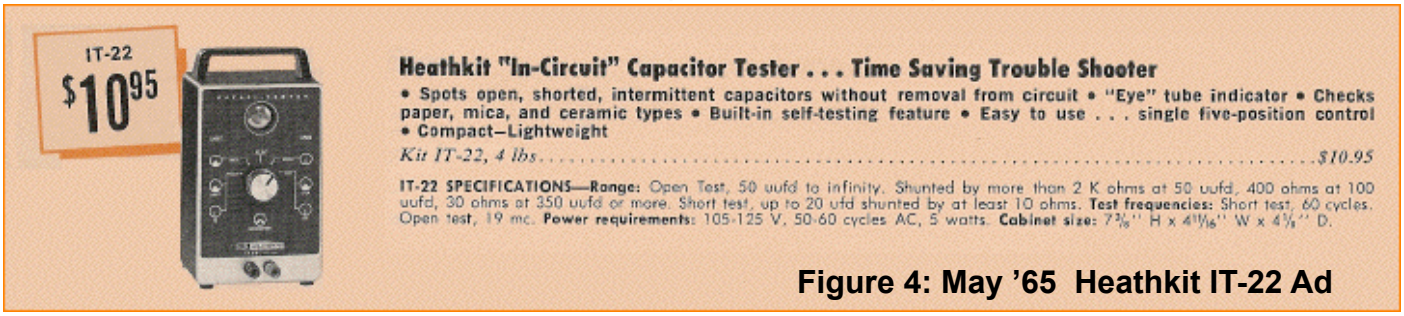

Figure 4: May '65 Heathkit IT-22 Ad

In Conclusion:

I've never owned either of these devices. However I did use one some years back in a summer job I held. They did find bad capacitors, but didn't help if the capacitor was out of tolerance. As noted in Heathkit's specifications the device is not recommended, nor reliable, testing electrolytic capacitors, especially large valued ones.

73, from AF6C

Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

Thanks - AF6C

This article originally appeared in the month year issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.