An In-Circuit Component Tester

Build this useful accessory for your CRO

When servicing faulty equipment involving printed circuit boards, have you ever wished that you could make specific tests on certain components without removing them from the board. Here is a little device which will go at least some of the way towards this ideal. It can be made up for a few dollars and in a very short time.

by IAN POGSON

This interesting little device had its origin in the US Navy and was later published in "QST". We thought it was interesting enough to make up and present it to readers. Apart from its uses in being able to check components while they are still in circuit, it can be a good exercise in some theory.

The idea of having a piece of test equipment which can check the quality of components still in circuit is an attractive one. If this can be done, much time can be saved removing suspect components for testing. This very simple device can test resistors, capacitors, inductors, diodes, transistors etc while still in circuit.

Basically, it consists of a step down transformer, giving just a few volts from the 240V mains. This low voltage is further divided down to about one volt by means of a resistive voltage divider and applied to the vertical and horizontal amplifiers of a CRO. Two test probes are provided to apply this low voltage through a 1k resistor which limits the current through any component to a maximum of 1mA.

With such a low voltage and with the limited current, the chance of damaging any components is virtually eliminated.

If it seems that we have arrived at the ultimate in test equipment of this kind, let me hasten to point out that this is not so. The tests which are possible will indicate whether a component is good or bad in rather broad terms.

Another point which cannot be overlooked is that a CRO is a necessary part of the test setup. Fortunately however, many readers have access to a suitable CRO.

Before proceeding to show how this device can be used in practice, perhaps a look at the theory of operation may be of interest.

From the circuit, we can see that the low AC voltage appearing across the 100 ohm resistor is connected to the vertical and horizontal amplifiers of the CRO. With one end of the 1k resistor at earth or reference potential and with the probes open circuit, the input to the vertical amplifier is at earth potential and the voltage at the other end of the 100 ohm resistor is fed to the horizontal amplifier to produce a horizontal trace on the CRO screen.

When we short-circuit the two probes, the horizontal amplifier input will be shorted to earth but the other end of the 100 ohm resistor connected to the vertical input is now shunted by the 1k resistor to produce a vertical trace on the CRO screen.

Other than the open-circuit and short-circuit condition just outlined, any other measurements will fall somewhere between these two extremes. A resistor will give a trace somewhere between horizontal and vertical, depending on its value.

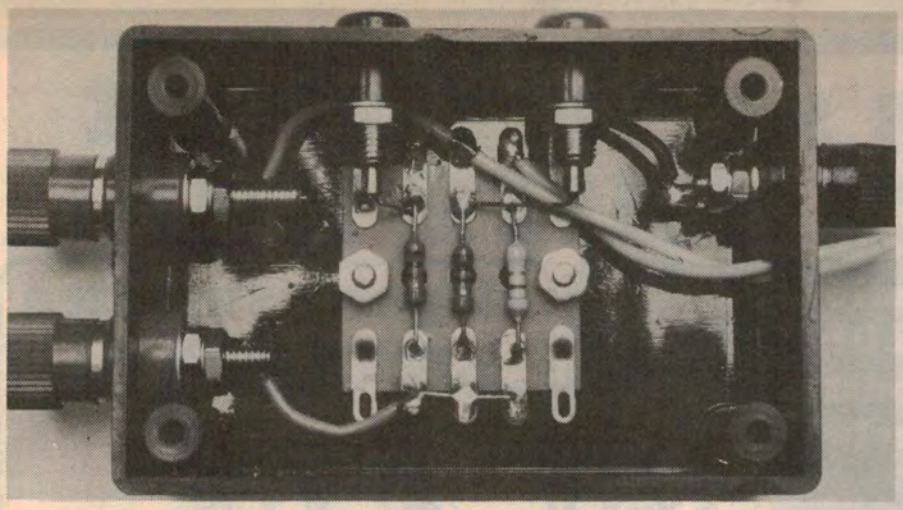
Reactive components such as capacitors and inductors, produce a phase shift between the horizontal and vertical components, giving an elliptical trace on the screen, with the shape and orientation depending on the amount of reactance of the particular component. Small values of capacitance give an ellipse with a horizontal major axis, whereas a small value of inductance gives an ellipse with a vertical major axis.

Power for the In-Circuit Component Tester is derived from a 4V AC plugpack supply. The device can test resistors, capacitors, inductors, diodes and transistors.

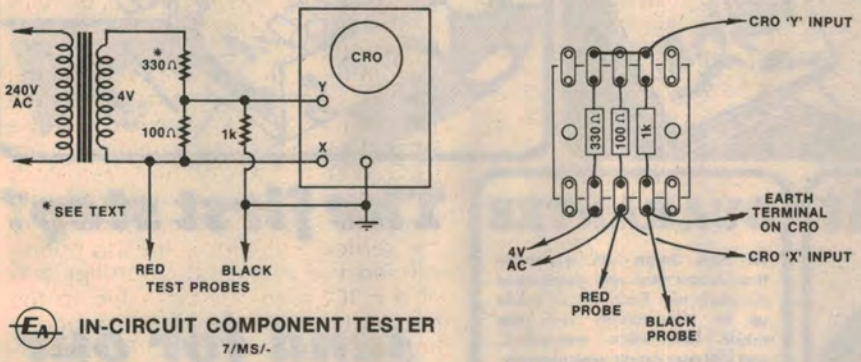
We estimate that the current cost of parts for this project is approximately

$11.00

This includes sales tax.



The prototype was built on tagstrip and housed in a plastic utility case.



The circuit (left) consists of just three resistors and a transformer power supply. The wiring diagram at right should make construction easy.

The above cases are the simple and straightforward ones. However, the number of possibilities when two or more components are combined is almost unlimited. A number of actual CRO patterns is shown here, including an example or two of more complex networks.

Construction of the tester is very simple. We mounted the three resistors on a piece of tagboard and mounted it in a plastic utility box. The various terminations are provided on three sides of the box. At one end are the terminals for the leads to the "X" and "Y" CRO amplifiers. At the other end is a terminal for the "earth" or reference line for the CRO, together with a grommet passing a twisted pair for the AC input from the transformer. On the side are a red and a black banana socket for the two test probes.

The transformer we used is a new plugpack type just released by Ferguson Transformers Pty Ltd with an output of 4VAC. The twisted pair of leads from the tester are terminated on the two screw terminals provided on the transformer. Incidentally, if you use a transformer with a different secondary voltage, then the 330-ohm resistor will have to be changed to maintain the nominal 1VAC across the 100 ohm resistor.

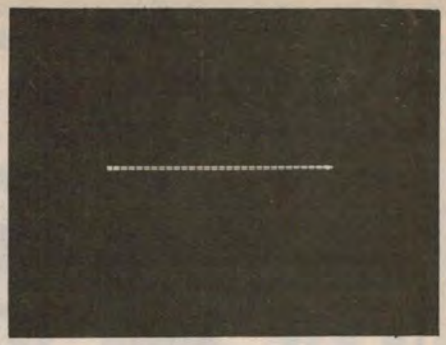
PARTS LIST

1 plastic utility box 83mm x 54mm x 28mm
3 terminals, 2-red, 1-black
2 banana sockets, 1-red, 1-black
1 rubber grommet
1 tagstrip with 5 pairs of tags
1 100-ohm ½W resistor
1 330-ohm ½W resistor (see text)
1 1k ½W resistor

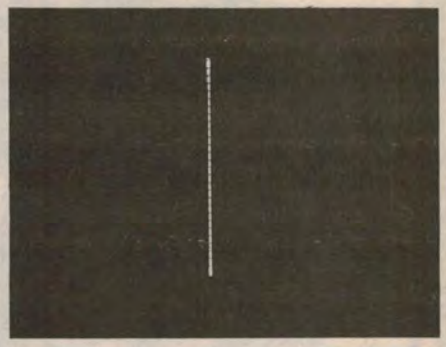
1 Ferguson plugpack transformer, PPB4/1000, or similar (see text)

Sundries: Solder, solder lugs, hookup wire, screws and nuts.

Having completed the tester, it has to be set up before it can be used. To do this, the transformer is plugged into a power point and the earth lead and the "X" and "Y" leads are connected to a CRO. A pair of test prods are plugged into the banana sockets. With the transformer and CRO switched on, we are ready to make tests. To give some idea of what to expect on the CRO screen, we have reproduced some pictures which we took from our CRO screen, with various items across the test probes.



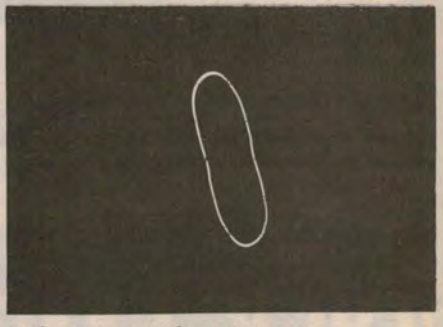
Open circuit.



Short circuit, or continuity.

1.2k resistor.

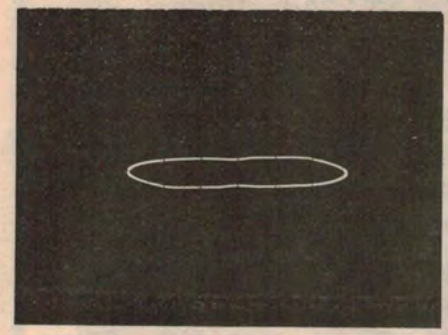
Transformer primary inductance.



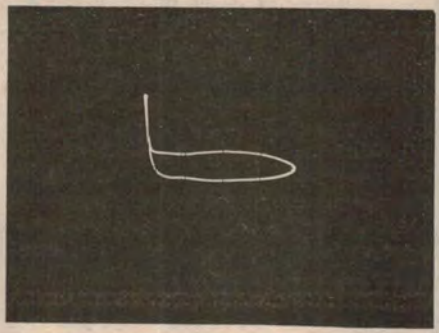
Inductance with resistance.

All CRO settings 0.5V/cm horiz. & vert.

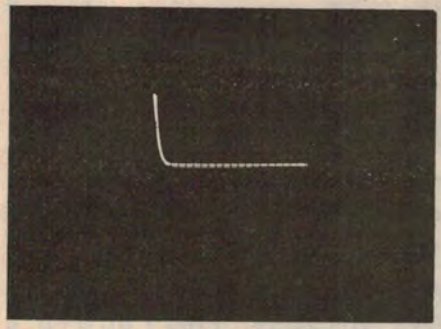
In-Circuit Component Tester



0.47uF capacitor. A larger value, say 10uF or more, would give a vertical ellipse.

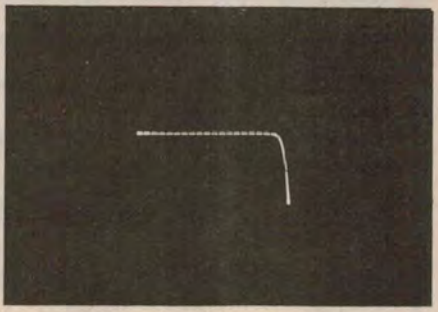


Silicon diode and parallel 0.47uF capacitor.



Forward-biased silicon diode.

Silicon diode with parallel resistor.



Reverse-biased silicon diode.

It should be pointed out that the type of CRO available will have some effect on the actual pattern which appears for any given situation. The CRO which we used was a modern one and ideal for this applicaton. It has two identical amplifiers, with no evidence of relative phase shift between them. On the other hand, if the CRO to be used does not have identical amplifiers, then the possibility of a difference in phase shift is likely. Under resistive conditions, it will look as though there is some reactance in the circuit, as with some capacitance or inductance.

If the CRO to be used only has a vertical amplifier, with direct access into the deflection plates for the horizontal component, then the likelihood of phase shift differences showing up is even higher. Also, with no gain available for the horizontal component, the pattern on the screen will possibly be quite small.