Put it together in an evening:

Simple tester for SCRs & PUTs

Here's a simple tester for any common thyristor device, whether it's an SCR, an SCS or a PUT. It checks whether they're shorted, open or damaged, and also gives a rough idea of sensitivity. It will cost you less than twenty dollars, and you should be able to put together in a couple of hours at most.

by IAN POGSON

It's not easy to test thyristor-type devices with a conventional transistor tester. You can do it, but it usually involves quite a bit of fiddling around. Even then the result can be anything but conclusive.

The same applies with a multimeter. You can use it to test a thyristor in makeshift fashion, but the result will still be rather unsatisfying. You really need a tester that is especially suited for testing thyristor devices — like the little unit described here.

It uses only a handful of parts, all of them easy to get and low in price, and they all fit together in a neat little utility box. Yet with it you can test silicon controlled rectifiers (SCRs), silicon controlled switches (SCSs) and "programmable unijunctions" (PUTs), which are really complementary SCRs.

There's no expensive meter movement, just a low-cost LED indicator. But by flicking a couple of switches and pressing a button or two, you can easily tell if a thyristor is open, shorted, has an open gate or is basically OK — all the basic tests. You can also get a rough idea whether the device is sensitive or not.

Actually the circuit of the tester has been developed from an idea we published in the Circuit and Design Ideas column of the March 1979 issue, sent in by reader Mr L. Murokami of Tennyson, South Australia. The idea seemed a good one, so we decided to elaborate upon it so as to provide for SCS and PUT devices as well as SCRs.

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

$17.00

This includes sales tax.

We have also made it possible to test for a larger number of possible faults.

The circuit diagram shows how these things have been done. As you can see, the anode (A) and cathode (K) of the thyristor being tested are connected in series with a LED and a protective 390ohm resistor across a 9V battery. If the device has a cathode gate (KG), like an SCR or SCS or an anode gate (AG), like an SCS or PUT, these are normally tied to their respective main electrodes by 100ohm resistors. So if the device is normal and not shorted, it should not conduct when the battery switch is turned on.

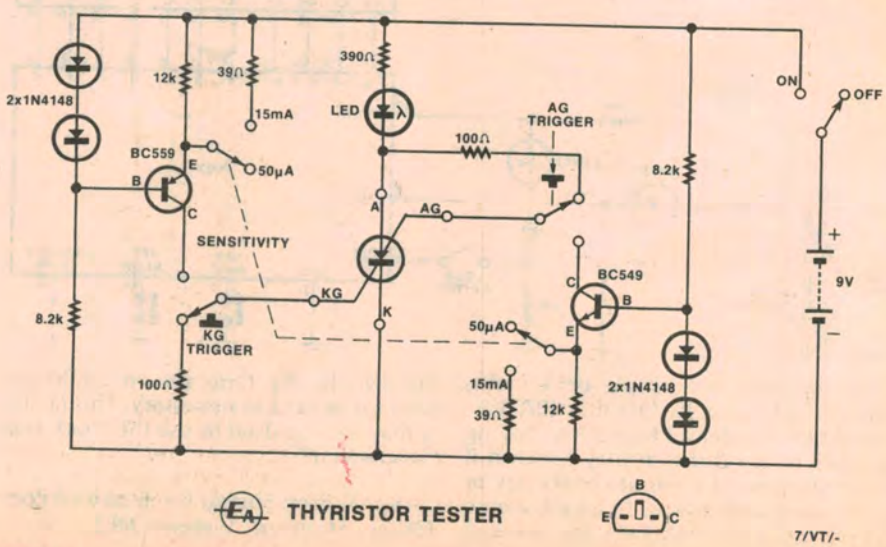
To test if the device is capable of being triggered into conduction, current can be fed into one gate or the other by pressing either the "KG trigger" or "AG trigger" test buttons. In either case the trigger current is supplied by a current

THE PARTS LIST

1 Zippy box 130mm x 68mm x 41mm
1 Front panel overlay 125mm x 62mm
1 SPDT miniature toggle switch
1 DPDT miniature toggle switch
1 Push-button switch momentary single changeover (red button)
1 Push-button switch momentary single changeover (black button)
4 Banana sockets 2-red 2-black
4 Banana plugs 2-red 2-black
4 Crocodile clips 2-red 2-black
1 LED (red) with bezel
1 PCB, 60mm x 56mm code 79TT7
4 1N4148 diodes or similar
1 BC559 transistor or similar
1 BC549 transistor or similar
1 9V battery, 216 size

RESISTORS (½W)
2 39ohms
2 100ohms
1 390ohms
2 8.2k
2 12k

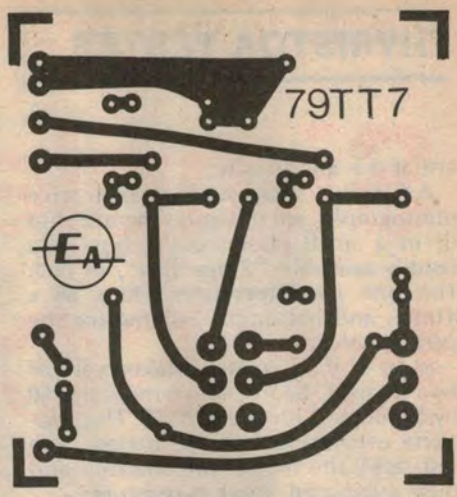
MISCELLANEOUS
Hookup wire, solder.



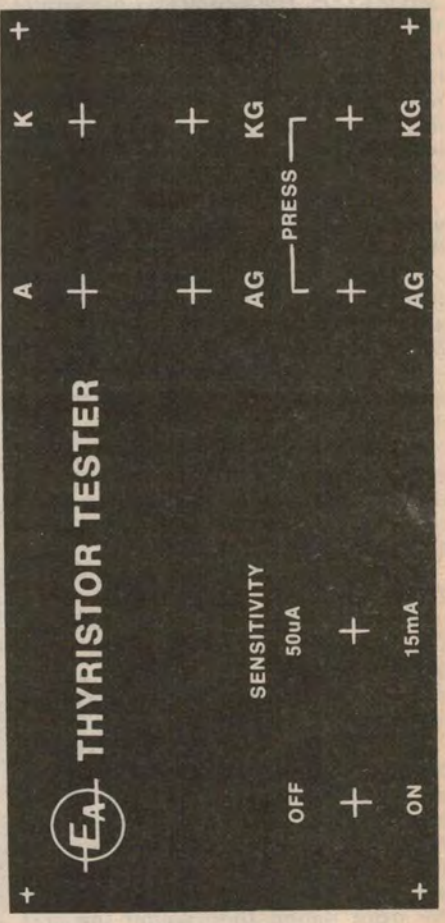
THYRISTOR TESTER

7/VT/-

Here is the finished tester, housed in a small plastic utility box. To keep cost down, a LED is used as the test indicator.



Above is the PCB pattern, while below is the artwork for the front panel of the tester. Both are actual size.



regulator circuit, using a transistor whose base voltage is stabilised by two forward-biased diodes.

Two values of emitter resistance are provided for both current regulators, so that two levels of trigger current may be selected: 50uA for sensitive low-power devices, and 15mA for higher-power devices. A two-pole switch is used for the emitter resistor selection, so that both trigger current sources are set by a single switch.

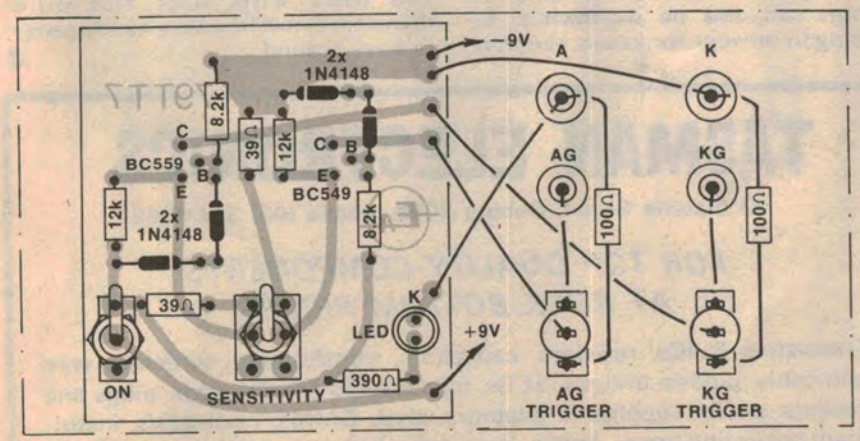
With a normal device, it should be possible to trigger it into conduction (lighting the LED) by pressing the appropriate trigger button after setting the gate current level. And the LED should remain illuminated when the trigger button is released, showing that the thyristor has indeed latched in the conductive state.

If the LED does not glow at all, and you are testing with the low level of gate current, try switching to the higher level and test again. If there is still no result, the thyristor is either entirely open circuited or (less likely) it has an open gate. If the LED glows only when the button is actually depressed, the thyristor is probably damaged and incapable of latching.

If you are testing a low-power device and it only triggers normally with the high value of gate current, it could be simply an insensitive device. Or it may be faulty, its sensitivity degraded by internal damage. The only way to tell will be to look up the manufacturer's data for the device, and see what sort of gate current it should require for reliable operation.

Needless to say, you have to press the appropriate trigger button for the type of thyristor you are testing. For an SCR, this will be the KG trigger button as this type of device has only the cathode gate connection brought out. Similarly for a PUT you would press the AG trigger button, as this type of device only has a connection to the anode gate region.

Since the SCS device is provided with both gate connections, you need to perform two separate tests — one with the KG trigger button, to test the cathode gate, and the other with the AG button to test the anode gate. Note that you cannot leave the power switch on between the tests, however, as the device will tend to latch on from the first test. So you must turn off, then back on again before trying the second test. You may also need to change the trigger current level from one test to the other, as most SCS devices are more sensitive at the cathode gate than they



The full circuit of the tester is shown at left on the facing page, with the wiring diagram above. Note that the wiring diagram is drawn from above, as if the front panel were transparent. The PC board is actually supported by the two toggle switches.

are at the anode gate.

As you can see from the photographs, we designed the tester to fit in a small plastic utility box — a readily-available "Zippy Box", in fact. The one used measures 130 x 68 x 41mm, and has ample volume for the parts involved.

Most of the circuitry is taken care of by a small PC board, which measures 60 by 56mm and is coded 79TT7. This supports everything but the battery, the test jacks, the trigger pressbuttons and their associated 100ohm resistors.

Actually the PCB does not support all of the remaining parts, but is itself supported by three of them: the power switch, the gate current selector switch and the LED. The switch lugs do most of the supporting, but this is quite adequate as the PCB is very small and the remaining parts on it have very low mass. The construction should be evident from the photographs and the wiring diagram — which is drawn as if the front panel were transparent.

To assemble the unit we suggest that you first fit all of the switches to the front panel, along with the test jacks and the LED in its bezel clip. Make sure that the power and sensitivity switches are orientated squarely, so that their lugs will mate with the holes in the PCB — but at this stage don't actually attach the PCB. Also make sure that the LED is correctly orientated, with its cathode towards the centre of the panel. The cathode lead is usually the one nearest the "flat" on the LED body, if there is one, or the shorter lead if they are of different length.

At this stage you can wire the two 100ohm resistors between the A and K test jacks and their respective buttons. Then wire the rest of the minor components on the PCB, using the wiring diagram as a guide. Make sure that the transistors are correctly orientated.

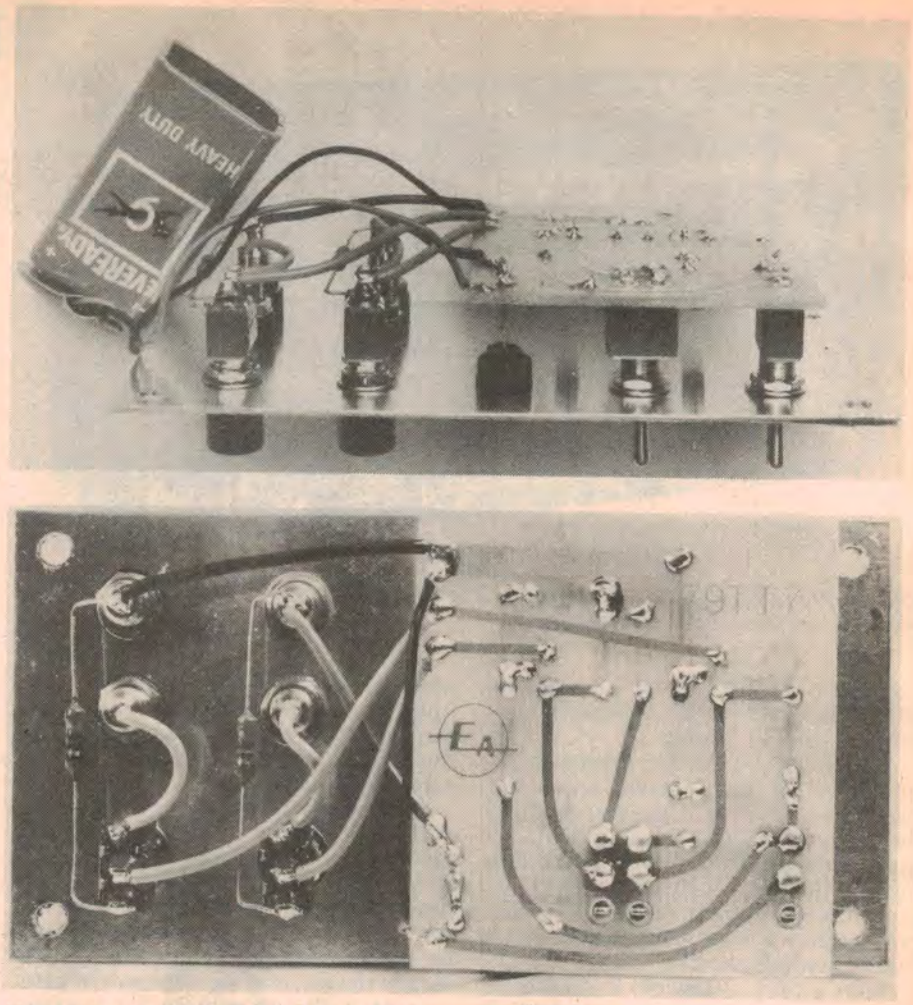
You can then offer the PCB up to the back of the switches, guiding the leads of the LED through their appropriate holes and the PCB onto the switch lugs. When it is in position, solder the switch lugs to secure the PCB in place, making sure that it is square and parallel with the front panel; then solder the LED leads and clip off any excess.

Finally you can add the wiring between the PCB and the test jacks and trigger buttons, and add the battery connector leads. You should then be ready to add the battery and try out the tester with a known good thyristor, before fitting it all into the case. Rather than make up a battery clamp, you can simply wrap the battery in a small piece of foam plastic sheet, so that it will be held gently in place under the PCB.

To make the tester easy to use, we suggest that you make up four short clipleads. These can be about 80mm long, with a banana plug at one end to mate with the test jacks and an insulated crocodile clip at the other. This will make it possible to connect rapidly to any thyristor device, whether it has leads or solder lugs.

Having the clipleads in different colours can also be worthwhile, by helping to prevent confusion. We were only able to get banana jacks, plugs and insulated clips in red and black, but even these two colours help. If you can get four different colours, so much the better.

Well, there it is. A simple little tester that will cost you very little, and can be assembled in a couple of hours. But if you work with SCRs and other thyristors, it will be a very handy gadget to have around.



Here are two views of the inside of the tester, to show how it is assembled. Note that the PCB is supported on the switch lugs, and the two 100-ohm resistors are not on the PCB.