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TALKING ELECTRONICS®

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Issue No 14



CONTINUITY TESTER

- * INPUT/OUTPUT BOARD FOR THE TEC
- * MICROCOMP-1 PART II



CRYSTAL OSCILLATOR



CO-ORDINATOR



GUITAR PRACTICE AMP

TALKING ELECTRONICS

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Editorial...

Vol. 1 No: 14.

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A week may be a long time in politics, but so it is too in electronics.

Today's super seller may be tomorrows forgotten wonder.

Take the rise and fall of the Personal Computer.

From a tentative start, the PC rose rapidly to become one of the most popular sales lines ever. The market seemed insatiable. As fast as a new model was released, it was snapped up.

But then the crunch came. The bubble burst and saturation occurred. The boom of last week turned into the fizz of this week.

How or why the abrupt end occurred, nobody seems to know. Everyone got caught. The biggest losers were the importers. With thousands of boxed computers lying in their warehouses, many have just let them sit; waiting and hoping for a change in the market.

Even though we can buy a model with twice the features, cheaper than last year, nobody wants them.

Maybe it was the realisation that the personal computer is really little more than a glorified games machine, that started a nationwide re-think. Or was it the improvement in graphics on the arcade machines, that made their graphics look so purile?

In any case, the secondary effect of the slump has been to create an absolute glut of chips on the open market.

All those used in one or more of the popular computers are now available by the million!

To clear this back-log, chip production has slowed to a mere trickle and prices have fallen to a level below the actual cost of manufacture.

A 64k DRAM can now be bought in small quantities for 4c less than production cost!

Sadly, the slump is exactly as we predicted.

Computers failed to interface to the real world and although they appeared exciting within themselves, they could not be readily connected to external appliances and gadgets.

Had someone produced a universal interface consisting of say a robot arm, a telephone interface and an alarm system, the capability of the PC would have been extended enormously and its popularity would still be with us.

Until someone comes up with a useful adaptor like this, I cannot see things improving.

We at TE are just as keen as you to see a turn around, as the TEC computer and Microcomp are ideally suited to interfacing to a robot arm.

The only thing holding things up is the non-availability of gearboxes and motors etc.

Let's hope someone has the foresight to produce a range of mechanical units at an economical price so that our ideas for automatics and robotics can come to fruition.

As soon as something comes along, we will be the first to let you know.

Colin Mitchell

PUBLISHER

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ADVERTISING (03) 584 2386

For all those who have asked to see a shot of me, I have reluctantly included this recent pose. See, I'm just a normal balding, existentialist.



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COVER PHOTO: The cover photo shows a Z-80 sitting on a micro-photograph of the internal workings.

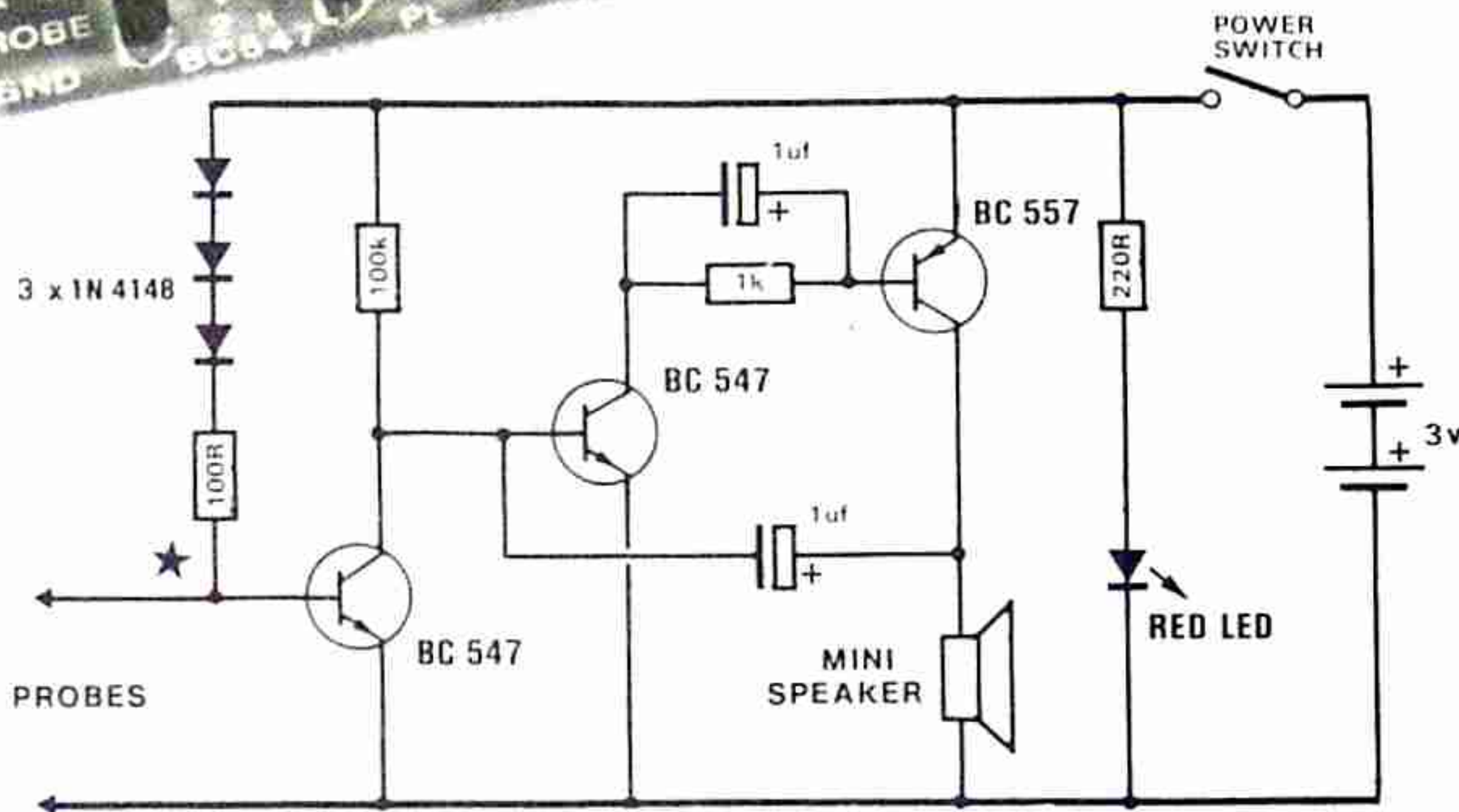
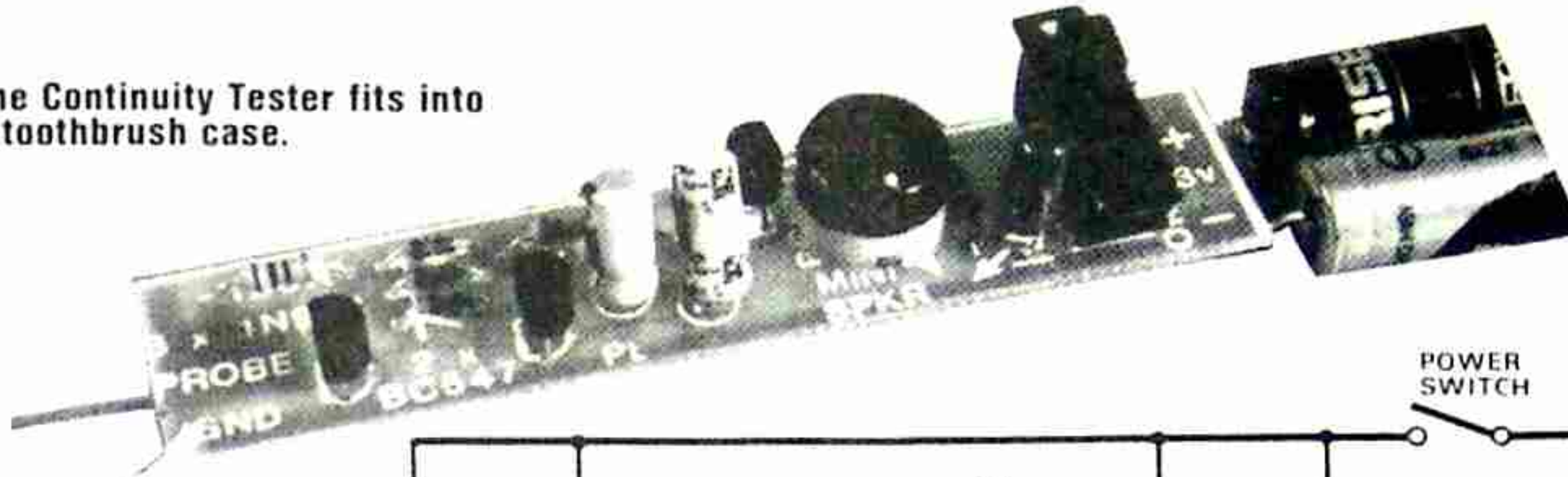
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CONTINUITY TESTER

Kit of parts: \$5.60
PC Board: \$2.10
Complete: \$7.70

THE THIRD IN OUR 'TEST PROBE' TRIO...

The Continuity Tester fits into a toothbrush case.



CONTINUITY TESTER CIRCUIT

The continuity tester is the third and final piece of test equipment in the 'test probe' trio.

On the face of it, a continuity tester seems pretty unimportant and you may be tempted to use a multimeter for the job.

But 'horses for courses' is what I always say. The right tool for the application. A multimeter might be alright for some applications but if you are troubled with a nasty fault in a digital project, the continuity tester is faster, better and easier to use than anything else.

It is specially designed for the job and has three very interesting features.

Firstly it gives an audible indication so that you can keep your eyes on the job. This is important when making a continuity check between adjacent pins of a 40 pin IC or on a closely packed bus network such as the data or address bus.

You cannot afford to take your eyes off the board as either the probe will slip off the track or you will miss one of the lines!

Secondly, its response-time is very brief so that you can make contact in a sweeping or stroking motion so that a number of lines can be swept in the one operation.

And thirdly, the continuity tester responds only to a definite short circuit or one in which the resistance is 150 ohms or less.

It will not respond at all to values above 180 ohms and most important it will not respond to the voltage drop across a diode.

This is where the multimeter falls down.

When you are measuring between some of the lines in a digital circuit, the impedance will be quite low or a protection diode will be in the circuit.

PARTS LIST

- 1 - 100R ¼watt
- 1 - 120R (for mod.)
- 1 - 220R
- 1 - 1k
- 1 - 100k
- 2 - 1uF electro
- 3 - 1N 4148 diode
- 2 - BC 547 transistors
- 1 - BC 557 transistor
- 1 - 5mm red LED
- 1 - Mini speaker
- 1 - DPDT slide switch (or SPDT)
- 2 - AAA cells
- 1 - paper clip
- 10cm tinned copper wire
- 50cm Hook-up flex
- 1 - CONTINUITY TESTER PC BOARD

The resultant reading on a multimeter will be low (nearly full-scale deflection) but it will be difficult for you to determine if the meter is picking up the voltage drop across a diode or detecting a very low resistance. Apart from this, the time taken for the needle to swing across to its final reading, makes the multimeter approach very slow.

The continuity tester eliminates these problems.

We have found it invaluable for diagnosing the TEC's that have come in for repair. Most of the problems have been shorts between lands or open connections in one of the buses.

This is how we use the tester:

Once we have established that the fault lies in the trackwork (all the chips have been replaced and the system remains dead) we test each pin of the Z-80 against every other pin of the chip. This is actually 40x40 tests and by using the continuity tester it is simplified to only a few operations.

Firstly place the wander lead on pin 1. With the tester turned ON, start at the top of the other side of the chip and quickly wipe the probe down the 20 pins. Repeat for pins 20 to 1. The only time you will hear a beep is when the two probes

touch. If a short beep is heard at any stage during the test you should go back and determine if the two lines are joined or if a fault exists.

Continue this procedure with pins 2, 3, 4 etc and very soon you will have covered all 40 pins.

By doing this you will have also covered the bus lines on the EPROM and RAM, however they can be individually checked if you like.

The next part of the diagnosis is to check the continuity of each line in the data and address bus. For this you will need a circuit diagram and pin-out data. Start at data line D0 and check D0 on the EPROM and also the RAM. If a tone is heard, the line is continuous.

It is essential to carry out all these checks as you don't know the exact location of the fault and most faults will be found with a systematic approach.

HOW THE CIRCUIT WORKS

As we have mentioned above, the circuit detects resistance values of 150 ohms or less between the probes and allows an oscillator to turn ON and produce a tone in the mini speaker.

A LED is also included on the board to indicate when the unit is switched ON as the electronics consume about 2-4mA and thus the battery would eventually go flat if the tester were left on for long periods.

Actually the circuit doesn't detect resistance at all. It detects threshold voltage across the base-emitter junction of a gating transistor.

When the tester is in the "rest" state, the first transistor is turned ON and this inhibits the oscillator.

It gets its turn-on voltage via the 100R resistor. The 3v supply is passed through 3 diodes which drop a total of 1.9v, leaving 1.1v for the base bias.

When the transistor is turned ON, the base-emitter voltage (the junction voltage) is .7v and thus .4v is dropped across the 100R resistor. This means we have only .4v leeway for the batteries and when they drop to below 2.6v, the tester will fail to work. That's why we have to conserve battery voltage as much as possible by putting an indicator LED on the project to prevent it being left on.

0.4v across the 100R resistor delivers 4mA into the base of the gating transistor and this keeps the oscillator circuit in the OFF state.

When a resistance of 150 ohms or less is placed between base and emitter, the voltage on the base falls sufficiently to turn the transistor OFF.

This allows the 2-transistor feedback oscillator to come into operation and produce a tone in the speaker.

A diode placed between the base and emitter of the first gating transistor will have no effect on the circuit as it will allow .6v to .7v to be present across the probes and thus the first transistor will not change state. The voltage must drop to .5v or less for the circuit to change and this requires a resistance of about 200 ohms.

The two transistor feedback oscillator is set into motion by the 100k base bias resistor.

This turns on the first transistor and thus its collector voltage falls. The collector is connected to the base of the second transistor in the oscillator and this is also turned on.

The result of this action is to raise the voltage of the collector and as you can see, the mini speaker is connected to this lead. Thus a voltage appears across the speaker.

Also connected to the collector is a 1uF electrolytic and it is presently in the discharged state.

As the voltage on the collector rises, it pulls the electrolytic up with it and since it is uncharged, the other lead is pulled up too.

This causes the base of the first transistor to be turned on hard and very soon we have a situation where both transistors are SATURATED.

The next point to understand is the voltage across the electrolytic under discussion. Its negative will be at .65v and its positive will be at about 2.4v. The electro has effectively been stretched between base and rail and its important to understand that the base voltage cannot rise above .65v.

The circuit sits in this condition while the electrolytic gradually charges a little more and this causes the base of the first transistor to turn off slightly.

This is passed to the second transistor which also begins to turn off.

In a short period of time the voltage on the collector falls slightly and this drop is transferred directly the first transistor via the electrolytic. Very soon we have a situation where the first transistor is turning the second off and the second is turning the first off. Both are now completely OFF and the 100k resistor takes over to start the process again.

Each time the circuit "cycles" the speaker produces a 'click' and since these clicks are produced in rapid succession, the result is a pleasant tone.

CONSTRUCTING THE TESTER

All the components are mounted on a small PC board that is designed to fit into a toothbrush case. There are a number of suitable cases and even the small size will fit the board. At first we thought the soft type of case would not be suitable but after Paul tried it, we found it was the best. The soft plastic is more durable and will not fracture if dropped or bumped. The rigid styrene cases tended to crack very easily and one of ours was crushed under foot when it fell on the floor!

The case is the first item to purchase and it will give you a guide as to the maximum height allowable for the components. If some of the parts are too high, they can be bent over and it is important to know about this before you start.

Next you need to determine the type of switch you will be using. The board will take two sizes: a mini single pole double throw or a mini double pole double throw.

Depending on which one you intend to use, the appropriate holes must be drilled in the PC board.

Once this is done, the components can be mounted.

Start assembly at one end of the board and fit each part as you come to it. The mini speaker can be inserted either way around as it is not polarity sensitive but the LED, transistors, diodes and electrolytics must be fitted as shown. If you are not sure about the placement, don't guess, refer to data or get someone to assist you.

The probe is made from a paper clip that has been straightened at one end and bent into a hook at the other so that a strong solder connection can be made.

The two batteries are soldered to the board via short lengths of tinned copper wire. This will keep them firmly together and keep the whole assembly rigid.

The wander lead has either an alligator clip or E-Z clip attached and this allows it to be connected to one rail of the project under test so that the probe can be used to go over the rest of the board in the hunt for the fault.

When everything has been soldered in place, slide the switch ON and the LED will illuminate. Touch the two probes together and the oscillator will emit a tone.

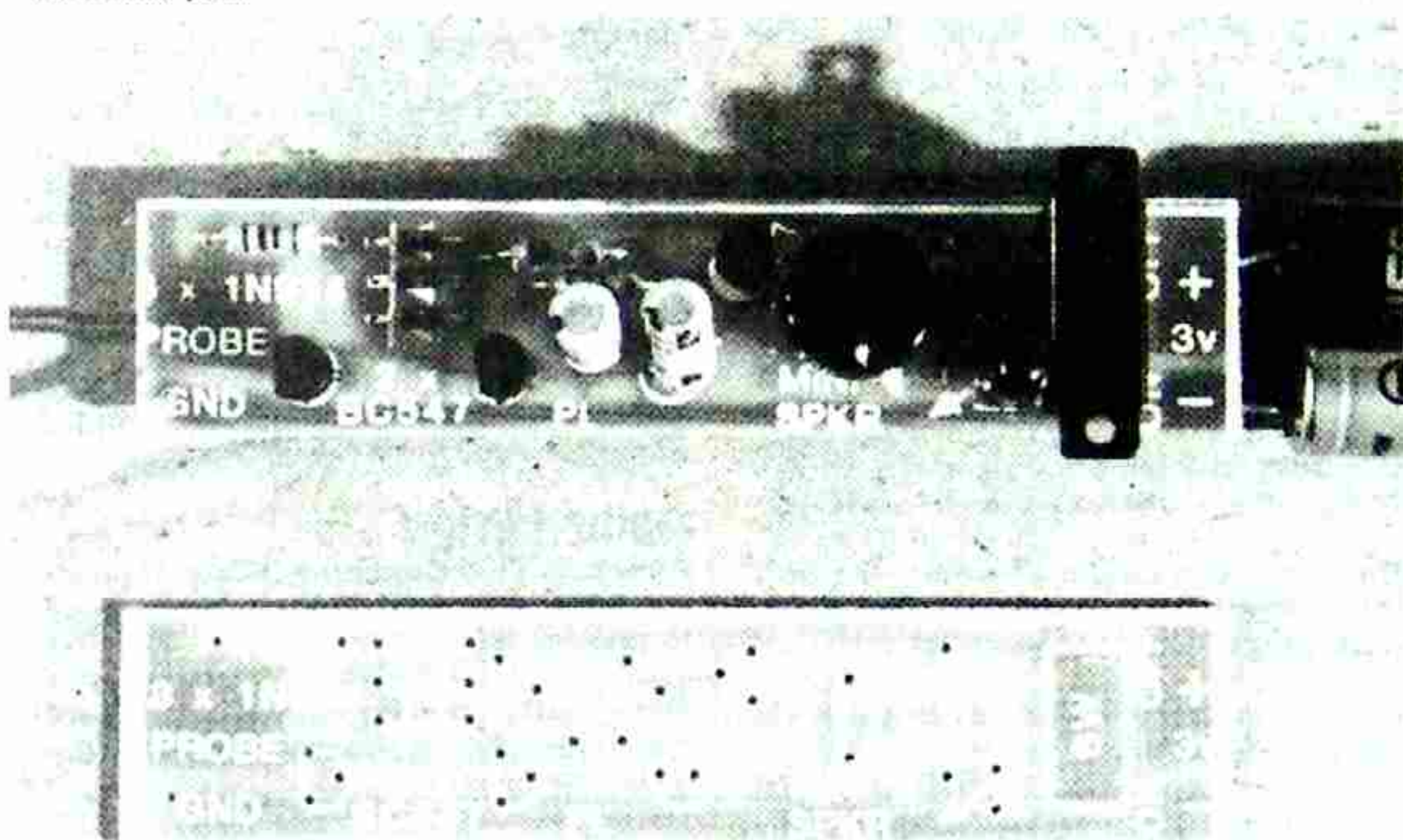
TESTING THE UNIT

You will require a diode, 180R resistor and a 220R resistor.

Place the probes across the diode, firstly one way then the other. The tone should not be heard.

Place the probes across the 180R resistor. The tone should be emitted. Place the probes across the 220R resistor. The tone should not be emitted.

You may find the tester will operate on a resistor which is one value higher or lower than this. The actual value will depend on the battery voltage and the base-emitter junction voltage of the



A close-up of the Continuity Tester and PC board before the modification to the front end. See details of this modification on page 8.

The tester can be housed in a tooth-brush case and the soft-type cases are the best as they don't crack. It can then be added to our two other pieces of test equipment to make a very valuable trio for testing digital projects, especially processor designed projects, as these will be the products of the future.