Smaller is not Always Better

Faultfinding on inaccessible IC connections

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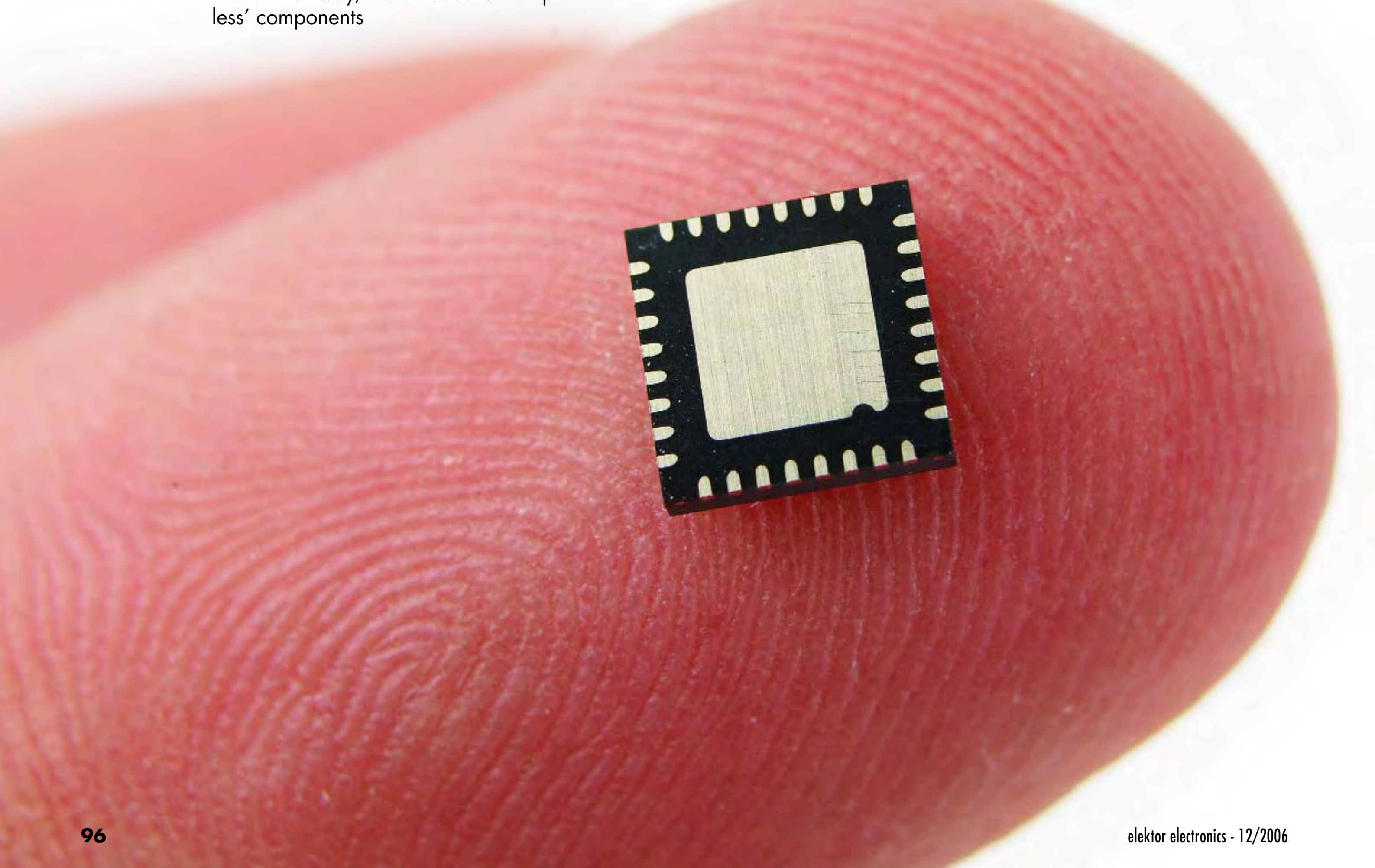
Most of our readers will appreciate that miniaturisation has brought many benefits. It is certainly the case that those small, modern mobile phones look better and are more practical than those old-fashioned bricks you had to lug around (see Retronics elsewhere in this issue). At least as long as they work. Should something go wrong, it seems hopeless to repair it, but it isn't impossible. We'll look into this in more detail here.

Have you ever wondered why it is that when you're looking for a place on a map, you often find it nearer the edge? That is because the edge of a map takes up a much larger area than you would expect. For example, say you have a map of 1 by 1 m. Half the area of this map is taken up by a square in the middle with dimensions of 70 by 70 cm, and the other half is taken up by a strip along the edge, which is just 15 cm wide. It doesn't seem much, a strip of just 15 cm, but in practice you find yourself staring at those wretched 15 centimetres for half the time…

In a similar way, the introduction of 'pinless' components has had a big impact on miniaturisation. The space taken up by the pins along the edge is just wasted space really. It would be much better if we could mount the ICs right next to each other, with all connections made on the underside. The so-called 'Square Packs' have therefore proved to be very popular (see main photo). The area gained becomes relatively bigger as the chips get smaller. This is because the connecting pins are of a fixed size, so smaller chips have a relatively larger area



taken up by the pins compared to larger chips. The difference in area can be as much as a factor of two. Just like our example with the map, a lot of area is 'lost' by the use of connecting pins along the edge.

One of the main rules in faultfinding is that you should always take measurements at the pins of components. After all, you can never be certain that there is a perfect connection between the pin and the PCB track. With square packs it is no longer possible to physically access these connections, so we have to find some other way. However, all is not lost when you're unsure of one of these connections. Although you can't directly access this connection, you can use a handy trick to test the connection with a multimeter (!). This technique also comes in very handy for those of you who solder SMDs, for example, with our SMD Oven from the January 2006 issue. When the circuit works straight away there is nothing to worry about, otherwise there is a possibility that there is a bad connection between one of the pads underneath a square pack (or another difficult to reach IC) and the IC itself. Even boards manufactured on an industrial scale have a certain percentage of failures, and with some patience and a bit of luck it is possible to repair these PCBs.

Most multimeters have a setting that measures diode properties. In this setting the forward voltage drop of the diode is measured when a small test current (usually about 1 mA) is passed through it. That's exactly what we're looking for. First, check that your multimeter comes equipped with this setting (**Figure 1**). Then try it out with a normal silicon diode and then a Schottky diode. These should give readings of about 0.65 and 0.35 V respectively.

And now for the big trick: how can we use the diode-test setting of a multimeter to check the connection of a pin that is inaccessible? Fortunately, virtually every pin on an IC has protection diodes built in (there are a few exceptions, such as oscillator circuits and open-collector outputs). Usually, there is a reverse-biased diode between the pin and ground, and another between the pin and the positive supply (**Figure 2**). We therefore connect the **positive** probe of the multimeter to the ground of the circuit and connect the **negative** probe to the track going to the pin. When there is a good connection between the track and the chip we get a measurement of the internal protection diode and the meter usually gives a reading of about 0.6 to 0.7 V. On the other hand, if there is an open circuit the meter won't give a reading. It is fairly obvious that when the fault is in the ground connection to the IC, all measurements to the pins will show a faulty connection.

Unfortunately, the readings don't always give a clear-cut result. This is because the track doesn't only go to the suspect pin, but also to other components, and these extra connections will often influence the measurement. You should therefore refer to the circuit diagram and estimate how much of an effect these connections have (**Figure 3**). If there is a high-impedance resistor or FET then they can be ignored. Should the track go to another pin on an IC then it is impossible to know from which pin you're measuring the protection diode. In such cases you're left with just one option: you have to (temporarily) cut the track.

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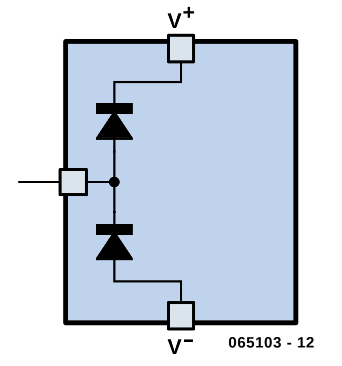

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