

*Much more than an oscilloscope . . .*

# CircuitMaster 4000M

## Precision Active Oscilloscope



The CircuitMaster 4000M from UK-based ABI Electronics is designed for testing circuit boards.

An active oscilloscope differs from a conventional (passive) oscilloscope in that the inputs can be internally driven. This is particularly useful for diagnosing electronic circuit problems.

Suppose you have a digital input to some complex IC that's suspected of causing intermittent faults. If you were to measure the voltage at the input pin with a normal oscilloscope or multimeter, you would measure close to 0V in the following three cases:

- (1) When the input was shorted to ground;
- (2) When the input was shorted to ground through a 1k $\Omega$  resistor and
- (3) When the input was shorted to ground through a 10k $\Omega$  resistor.

This is because there is negligible current flowing into the device, as its input impedance is extremely high. Hence, with a passive oscilloscope or multimeter, you would not be able to differentiate the three situations by measuring the voltage at the input pin.

With an active oscilloscope, you can differentiate the situations as follows.

In active mode, the CircuitMaster 4000 can apply a small DC current through the probe and measure the resulting voltage drop. The situation is now as in Fig 1. Since the voltage drop will be proportional to the resistance, scenarios (1)-(3) above can be differentiated quite easily according to the measured voltage drop.

### The CircuitMaster 4000M in detail

There are two analog channels accessed by BNC sockets (as in a conventional oscilloscope) and another BNC socket for an external trigger.

A 50-pin connector allows digital signals to be analysed. It is supplied with special clips (up to 40 pins) that can attach to ICs in-circuit. These are well suited to DIP ICs and modestly spaced surface-mount devices like TQFP but would be difficult to use with very fine pitch surface mount devices or BGA.

The signals are multiplexed and the voltages on all 40 pins can be acquired to internal memory. The bandwidth in this mode is naturally lower than the unit's native 100MHz due to the multiplexing.

At the rear, there is a socket for connecting the included foot switch, useful for capturing waveforms while concentrating on the PC board rather than the display of the oscilloscope.

The display is of relatively low resolution at 320x240 (quarter VGA). There is a brightness control but it didn't seem to have much effect. Fig. 2 shows a typical screenshot.

This instrument is well suited to analysing both analog and digital circuits. Up to two analog and four digital signals can be displayed simultaneously on the screen. For greater numbers of digital signals, multiplexing can be employed.

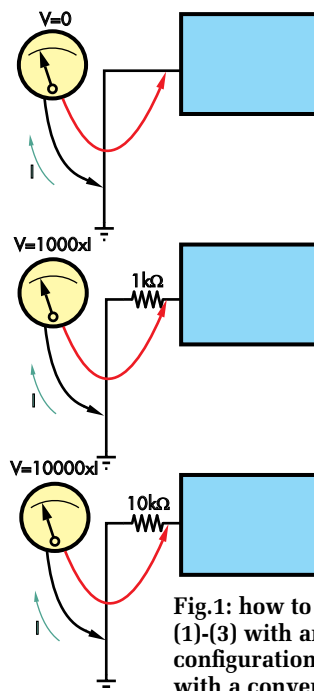
For digital circuits, TTL, CMOS and low-voltage TTL are standard options. For other logic families, the user can set the threshold voltage levels. The voltage ranges are shown on the Y-axis in different colours according to whether the signal is considered high or low (or neither – called no man's land). This is a handy feature that will quickly tell you whether your board is producing an "undefined" logic level, which could cause all sorts of unpredictable results in its operation.

It can operate in standard mode, akin to a normal passive oscilloscope but without some of the fancier options like FFT and maths functions. It also lacks an "Auto-Set" feature making it a little more difficult to use than a dedicated oscilloscope.

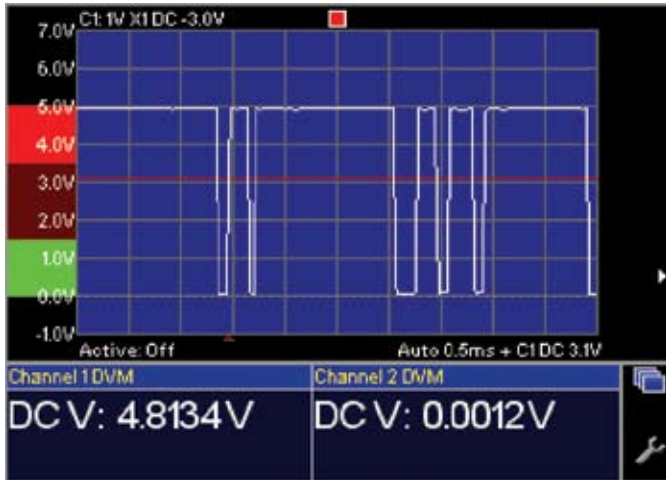
The other three modes are Active, FirmFlex and V-I curve. In FirmFlex mode, the "strength" of a node can be measured. This is a measure of its impedance. It is accomplished

by outputting a small DC current (suitable for working on powered circuit boards) and the resulting voltage drop is measured. The strength of the node is indicated on the display by its background colour, changing from yellow to red to purple as the strength of the node increases.

In Active mode, the source impedance can be set in decades from 100 $\Omega$  to 1M $\Omega$  and the signal can be DC or AC with controllable frequency and peak-to-peak amplitude. This mode is particularly handy for test-



**Fig.1: how to differentiate the three conditions (1)-(3) with an active oscilloscope. These three configurations would all measure the same with a conventional passive oscilloscope.**



**Fig.2:** this screen shot shows a TTL signal from an infrared remote control in standard mode. On the y-axis, the red represents a high level, green represents a low level and maroon represents an “undefined” logic level. The DVM (digital volt meter) display can also be seen, showing a signal level of around 4.8V.

ing circuit boards relative to a known good board. The pass/fail feature will be appreciated by test technicians. A mask can be set from a known good board and other boards can be compared to it. The target pass percentage can be set by the user.

As its name suggests, the V-I curve mode plots voltage vs current for the component under test. Its main purpose is to check that components are working correctly and it is not intended as a measurement tool as the axes are not well labelled, making precise measurements difficult. If you had a suspected faulty diode, for example, you could quickly diagnose whether it was working correctly or not using this mode. This is something that a passive oscilloscope simply cannot do.

While offering many useful features, we thought the user interface could be improved to make it a little more friendly. This is a common complaint on a lot of high-end test equipment and is mainly a problem for first-time users. As you become more aware of its features, this would cease to be such a problem.

In a similar vein, some of the default options could be improved.

In addition, the screen background is set to blue and cannot be changed. This makes it difficult to see some fine traces on the display, even if you change the colour of the trace itself. However, we have been advised that the screen background colour can be changed at the factory.

We assume that the manufacturer does provide progressive firmware upgrades, which can be done via the USB port.

In conclusion, the CircuitMaster 4000M is a valuable special-purpose instrument designed to debug a faulty circuit board in ways that a passive oscilloscope simply cannot. Few instruments possess as many test features and all of this in a compact desktop unit.

Distributed in Australia by Tekmark, the CircuitMaster 4000M retails for \$5,200 plus GST. (MG)

**Contact:**  
**Tekmark Australia**  
 Level 3, 18 Orion Rd, Lane Cove, NSW 2066  
 Ph: (02) 9911 3888 Fax: (02) 9418 8485  
 Website: [www.tekmark.net.au](http://www.tekmark.net.au)