

Oscilloscope Probing of PC133/Rambus Circuits

By Michael Yen

The introduction of the PC133 Front Side Bus and Rambus raises the CPU/DRAM clock rate on PC motherboards to 133MHz and 400MHz. For evaluating/debugging such high speed digital circuits, the signal waveforms and AC characteristics must be accurately displayed and analyzed by an oscilloscope.

Because of the high slew rate of rise/fall times at a high clock frequency, it is often the case that the high speed signal displayed on a scope is not the real signal on the circuit. As a result, such critical parameters in a test report as waveform, rise/fall times and jitter measurements become erroneous and meaningless.

A 4-GHz or higher speed oscilloscope is preferred. However the probing technique used is also very critical in high speed measurement for the following reasons:

- 1) **Probe Load:** A typical load at the destination of a signal may be only 5 pF. A scope probe by itself may have a 10 pF load. When probing the signal, adding a 10 pF load to the typical 5pF load results in a 15 pF load to the signal driver. It is obvious that the signal waveform will be different because the signal loading is tripled. This effect was not seen at 66MHz and 100MHz circuits, because the period time of a 133MHz or higher frequency clock is much shorter. Therefore, for a PC133/Rambus circuit, it is recommended that an active probe with a nearly no load be used.
- 2) **Probe's Ground Connection:** For any probing, it is important to ensure that the scope has exactly the same ground as the circuit ground. The ground of a probe has to be properly connected with the ground of the circuit under test. Most scopes provide a "ground clip" near the probe tip for easily making a clip-connection to the ground of the circuit under test. The ground clip is about 3 inches long.

This 3-inch ground clip causes all the problems in PC133/Rambus measurements, for the following reasons. a) The high speed electromagnetic field coupling at the 3-inch ground clip can cause the signal waveform to change and increase jitter data drastically. b) On the circuit board, the ground, which is at a distance of 3 inches, may have more high frequency ground noise than the real ground that is located near the target signal pin. Therefore using the ground clip provided by the scope is not recommended.

For a proper ground connection, a grounding probe located only about one-half inch from the signal probe tip should be used, as shown in Figure 1. The grounding probe, which is mechanically flexible, can reach and probe a ground pin located near the target signal pin, as shown on the circuit board in Figure 2.

Using the above discussed probing techniques for PC133/Rambus high speed digital circuits, the signal waveform acquired on a scope will be much more accurate. The jitter data analyzed by the scope with jitter software will also be more consistent. By eliminating such confusing test data resulting from EMI or poor ground connection, test results will be more accurate, reliable and understandable.

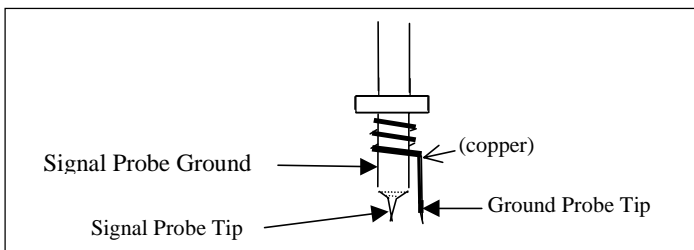


Figure 1. Signal Probe Tip and Nearby Ground Probe Tip

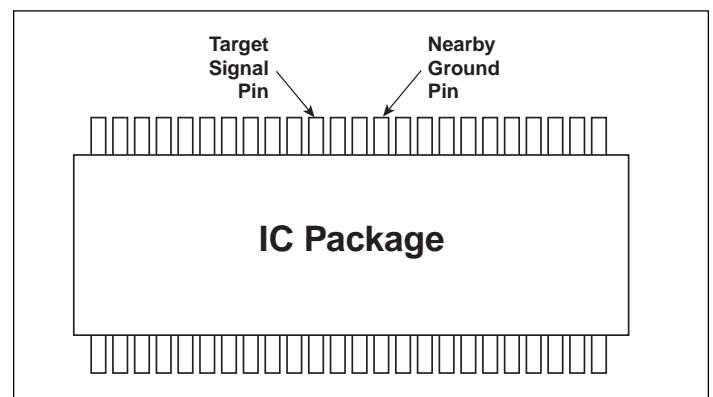


Figure 2. Ground Probe Tip Probes a Ground Pin Near the Target Signal Pin