

Overclockers Should Thank Intel

CPU Maker Makes Remarkers Tougher But Leaves Hobbyists Alone



Intel has long been concerned about people who try to run their chips faster than the rated clock speed. If someone overclocks a 333-MHz Celeron instead of buying a 450-MHz Pentium II, Intel loses about \$300. Intel has just developed the ultimate weapon to stop these overclockers dead in their tracks—but has chosen not to deploy it.

Overclocking exists for two reasons. First, a processor is designed to run at its rated clock speed for its entire expected lifetime, even in worst-case temperature and voltage conditions. As a result, a brand-new processor has frequency headroom at nominal voltage and temperature. In the past, Intel built plenty of headroom into its chips to improve yield, but more recently the company has tried to wring every last bit of clock speed from its chips.

The second factor aiding overclocking is Intel's control of the distribution of clock speeds through its pricing model. The speed distribution in the fab often doesn't match the price-based demand curve. To meet demand in this situation, Intel takes fast parts and sells them as a slower speed grade. Such a part can easily be overclocked, as it is designed to run faster than its label indicates. A favorite of overclockers is Celeron, a part that typically yields at 400 MHz or more but that Intel sells at rated speeds as low as 333 MHz.

Many processors can be overclocked safely, but only to a point; beyond this the chip becomes unreliable. Finding this point can be difficult, as an overstressed CPU can silently corrupt data—or simply crash. Raising the bus speed can cause similar problems with other system components. For these reasons, overclocking voids the product warranty.

Some hobbyists are willing to take their chances with crashes and warranty problems. They buy cheap CPUs and run them at high speeds, saving hundreds of dollars while building systems that are often faster than any legitimate PC.

What really concerns Intel, however, is that some PC buyers are getting overclocked CPUs unknowingly. They (and in many cases their PC vendors) are victims of remarkers, criminals who acquire Intel chips, relabel them with higher clock speeds, and sell them. Although this fraudulent activity is illegal, it can be very profitable, as the relabeled chips can be sold for hundreds of dollars more than their original cost.

After finding that remarkers could easily scrape off and repaint the labels on its chips, Intel added features to its recent products to dissuade overclocking. Older Pentium II CPUs read their bus-clock multiplier from signals on the module. Celeron and newer Pentium II processors have their

clock multiplier hard-coded in the chip. Although these techniques were aimed at stopping remarkers, they have also made it more difficult for hobbyists to overclock chips.

Unfortunately, encoding the clock speed on the module proved too easy to get around. Both remarkers and hobbyists developed techniques to rewire the module to fool an older Pentium II into running faster. Even new parts can be overclocked merely by increasing the bus speed along with the CPU speed. This is particularly simple with Celeron, which is designed for a pedestrian 66-MHz bus clock.

Intel's newest weapon is simple but effective. The clock speed of a Pentium III is encoded inside the CPU. This feat has been difficult in the past, because the clock speed is not determined until after the chip has been fabricated and tested. But with the same post-fabrication technique used to program the processor serial number, the clock speed can also be stored in the chip, where it cannot be tampered with. This speed rating will eventually be inside all Intel processors.

The company is distributing a utility (<http://support.intel.com/support/processors/tools/frequencyid>) that interrogates the rated clock speed and compares it with the current clock setting. This utility can be used by anyone buying a Pentium III chip or PC to immediately spot overclocking. The tool should help potential victims of remarkers and assist law-enforcement officials in detecting shipments of remarked chips.

Before Pentium III's introduction, rumors had spread that it would be impossible to overclock. That is not the case, but only because Intel chose not to stop overclocking. The company could have built a governor into Pentium III that would compare its operating speed to the preprogrammed limit and shut it down (or slow it down) if overclocked. The operating speed could be calculated using an internal RC network calibrated at the factory. Designed properly, such a governor would be impossible to hack, as it would exist entirely within the silicon structure of the chip. This design would make overclocking a thing of the past.

Intel has decided not to take this draconian step—yet. It feels that overclocking, if restricted to the hobbyist community, is not a major problem. But the company wants to stop remarkers, because the failure of a remarked CPU damages the perception of the Intel brand. Reporting the chip's rated speed is a big step forward. Hobbyists should be thankful that Intel has chosen not to enforce the speed limit. □