

Intel Unveils Low-Power 486SX for PDAs

Hummingbird, Intel's First Embedded 486, Gets Quiet Introduction

by Michael Slater

Intel has finally unveiled its long-rumored low-power 486 processor, code-named Hummingbird. This device was once aimed at notebook computers and WinPad PDAs, but as the notebook market moved to Pentium and Microsoft abandoned the WinPad operating system, Intel shifted its plans to the embedded market. The CPU vendor is working with customers in Japan that are developing various handheld devices using this processor, but these devices will be fixed-function organizers rather than full-featured PDAs. Intel is focusing its initial efforts in Japan but will begin more active promotion in the U.S. later this year.

The chip is offered in two versions: the 486SXSF, which has a 32-bit data bus, and the 486GXSF, with a 16-bit data bus. (The chips are also called the Ultra-Low Power 486SX and 486GX.) Both are offered in a 176-pin Thin Quad Flat Pack (TQFP), a new package for the 486 line. Because of pin-count limitations, the 486SXSF drops the parity signals.

The 16-bit bus causes a performance drop of less than 20% on SPECint92 relative to the 32-bit version. The reduced system cost, size, and power consumption of the narrow bus will make it popular.

To cut power consumption, the 'SF chips use a modified 486 core that automatically shuts down unused parts of the chip on a cycle-by-cycle basis. (The same technique reduces Pentium's power consumption in the P54C design.) In addition, the chips provide separate power pins for the I/O pads and the core. The I/O pads always operate at 3.3 V, while the core can operate as low as 2 V in the GXSF and 2.4 V in the SXSF.

One design change in the new chips is the use of a differential delay line in the clock circuitry. This allows the chips to use a 1× clock input without the long delays required for an analog PLL, which is used in the standard 486 chip, to settle after a change in input frequency.

486 Performance, 386 Battery Life

At 2.0 V, the GXSF has a maximum clock rate of 16 MHz and a typical power rating of less than 150 mW. The maximum clock rate increases to 20 MHz at 2.2 V, 25 MHz at 2.4 V, and 33 MHz at 2.7 V. At the top clock rate, typical power consumption is 515 mW for either device. (Although the two versions are just bonding options of one chip, the 16-bit device should have slightly lower power consumption due to the smaller number of bus lines being switched, but this is not reflected in the

specifications.) These ratings help the chip deliver 486 performance at 386 power levels.

The 'SF chips are built in Intel's mature 0.8-micron CMOS process, so they use depreciated fabs that are no longer useful for PC microprocessors. As Intel has done with its 386 core, the company plans to next year introduce more highly integrated parts for the embedded market with the 486 core.

Intel has been working with chip-set, BIOS, and development-tool vendors to provide support for the chips. Most PC chip-set vendors drop products as the PC market moves to newer processors, so Intel has had to find vendors willing to focus on embedded applications. Seiko-Epson is offering a chip set for the new 486 chips that runs at voltages down to 2.2 V.

Intel is currently sampling the parts but does not expect to achieve full production until 2Q96. Despite their embedded positioning, the chips carry prices similar to PC processors: \$72 for the SXSF and \$67 for the lower-performance GXSF, both for 33-MHz versions. Intel appears unwilling to undercut its 486 price structure for these parts. The high prices, lack of publicity, and long production ramp indicate that Intel is not interested in pushing the 486 into high-volume embedded designs at this time.

Embedded applications that require a 486 but not low power would do better with Texas Instruments' 486 processors, which are much less expensive than Intel's. National's embedded 486 (*see 091201.PDF*) offers limited x86 compatibility at even lower prices. For designers who aren't wedded to the x86 architecture, chips from the ARM, Hitachi SuperH, Motorola ColdFire, or NEC V800 families provide comparable performance at much lower prices than Intel's, and some offer superior integration. Intel's low-power 486 chips are narrowly targeted at portable products that require full x86 compatibility; for these devices, the new chips offer a significant performance boost over the 386. ♦

Price & Availability

The 486SXSF and 486GXSF are currently sampling, with limited production scheduled for 1Q96 and full volume production in 2Q96. At 33 MHz, the SXSF sells for \$72 and the GXSF for \$67, both in quantities of 1,000. Both are available in a 176-pin TQFP, and the GXSF is also available as a bare die. For more information, contact your local Intel sales office.