PowerPC 750 Speeds Up, Powers Down

Motorola Boosts Speed of 750 to 366 MHz While Lowering Power

by Keith Diefendorff

Taking advantage of its latest process technology, Motorola has announced the availability of three new versions of its PowerPC 750 (G3) microprocessor (see MPR 2/17/97, p. 10). The new 750s will be offered at up to 366 MHz, whereas the previous top end was 300 MHz. The most impressive aspect of the new parts is their significantly lower power consumption—47% lower than the previous versions.

The magic was performed by replacing the transistors in the current 750, which is implemented in Motorola's 0.27-micron HyperMOS 3 (HIP3) process, with transistors from its 0.25-micron HIP4 process. The new hybrid process, called HIP3.4, still uses the HIP3 metal layers, so it does not affect die size. But the new transistors are faster and operate at 1.9 V rather than 2.6 V, accounting for the new parts' lower power.

Motorola could have rendered the 750 in pure HIP4 to reduce die size, but the 67-mm^2 part is already so tiny that it would hardly pay off. The company is not planning to deploy the current 750 in its 0.22-micron copper HIP5 process, preferring to reserve that process for the G4 processor it will announce at Microprocessor Forum in October and for a rumored enhanced version of the 750.

In HIP 3.4, Motorola might coax the 750 to 400 MHz, but not much further. This signals the end of the line for the current 750 on the desktop, where continual speed improvements are required to remain viable. But with its new processes, Motorola is hoping to quickly migrate desktop and notebook customers to the enhanced 750 and to the G4.

IBM is following a different strategy. With its withdrawal from Somerset (see MPR 6/22/98, p. 4), IBM declined to produce the G4 but will instead deploy high-frequency 750s in its CMOS 7S-SOI process next year (see MPR 8/24/98, p. 12). While G4 will have AltiVec to boost its media-processing horsepower, the market appeal of raw frequency cannot be ignored, and Motorola will have to strain to get its processors up to the speeds IBM will achieve with its SOI-based 750.

Other than its higher speed and lower power, Motorola's new 750 is otherwise unchanged. Both the old and new parts use a 360-pin CBGA and have 3.3-V I/O. The new HIP3.4 silicon will also be provided as a 740, which lacks the backside cache bus, in a 255-pin CBGA at 300 MHz.

As Table 1 shows, Motorola estimates the SPECint95 (base) of the new 366-MHz 750 at 16.1, 2% better than Intel's 400-MHz Pentium II. The 750's SPECfp95 (base) is 9.9, 13% lower than Pentium II-400's, presumably due to the fact that the 750's floating-point unit is not fully pipelined. But just as PowerPC catches up to Pentium II, Intel raised the bar with its new 450-MHz Pentium II (see MPR 8/24/98, p. 1).

While the 750 doesn't quite match the top Pentium II in performance, its power consumption and die size are both about half of Pentium II's. The 5.8-W maximum power consumption of the high-end 750 is easily within the power envelope of a notebook computer; a Mobile Pentium II would have to be throttled to below 200 MHz to match the 750's power consumption.

According to the MDR Cost Model, the 750's 67-mm^2 die size gives it a 40% lower manufacturing cost than the 131-mm^2 Pentium II. Motorola, however, is apparently quite proud of the new 750—maybe too proud—asking $595 dollars for the 366-MHz unit (in 1,000 unit quantities).

While Apple gets a deeper volume discount than the 10–12% that high-volume Intel customers receive, and while the 750's low power warrants some premium, a $595 price tag—slightly higher than the Pentium II-400's—still seems a bit high. Considering its lower market demand and low manufacturing costs, it's hard to see how such a price can be justified. Perhaps Motorola is beginning to believe Apple's TV ads, which claim the 750 (G3) is up to twice as fast as Pentium II.

Aside from its too-high price, the new 750 should give a nice little boost to Apple's product lines, especially its PowerBook series, which could then legitimately claim performance equal to a high-end Intel desktop machine. That assumes, of course, that Apple can assimilate the new parts on a less-than-glacial time scale—a capability not previously demonstrated. Luckily, Motorola is actively developing a high-end embedded market for the 750. M

	PowerPC 750				Pentium II
Feature	**300 MHz**	**300 MHz**	**333 MHz**	**366 MHz**	**400 MHz**
Process	HIP3 0.27µ 5M	HIP3.4 0.25µ 5M	HIP3.4 0.25µ 5M	HIP3.4 0.25µ 5M	P856 0.25µ 4M
Die Size	67 mm^2	67 mm^2	67 mm^2	67 mm^2	131 mm^2
Cache Size	32K/32K	32K/32K	32K/32K	32K/32K	16K/16K
Issue Rate	3 instr	3 instr	3 instr	3 instr	3 instr
I/O Voltage (max)	3.3 V	3.3 V	3.3 V	3.3 V	2.5 V
Supply Voltage	2.6 V	1.9 V	1.9 V	1.9 V	2.0 V
Power (max)	8.9 W	4.8 W	5.3 W	5.8 W	23.5 W
SPECint95 (base)	13.3 int	13.3 int	14.7 int	16.1 int	15.8 int
SPECfp95 (base)	8.8 fp	8.8 fp	9.5 fp	9.9 fp	11.4 fp
System Bus (max)	100 MHz	100 MHz	100 MHz	100 MHz	100 MHz
Package	CBGA-360	CBGA-360	CBGA-360	CBGA-360	PBGA-528
Est. Mfg. Cost*	$40	$40	$40	$40	$65
List Price	$315	$345	$450	$595	$589

Table 1. Motorola's new 750 has performance similar to that of a 400-MHz Pentium II but at fraction of the power. (Source: vendors except *MDR estimate)