

# Cirrus Logic Makes Music With ARM

## EP7212 Maverick Processor Has Digital-Audio Interface for MP3 Players

by Tom R. Halfhill

MP3 is music to Cirrus Logic's ears—and a potentially lucrative business opportunity. The company's new EP7212 Maverick chip is an application-specific standard product (ASSP) for mobile information appliances that need digital-audio capabilities. Cirrus is aiming Maverick at next-generation products that can download and play audio files from the Internet, in addition to performing the more common tasks expected of handheld computers.

Essentially, Maverick combines the functions of two other ASSPs introduced by Cirrus earlier this year: the EP7209, a processor for portable digital-audio players, and the EP7211, a processor for mobile information appliances. All three chips are based on a 74-MHz ARM720T core (see [MPR 4/20/98, p. 10](#)), which has an 8K unified primary cache, Thumb code compression, and an MMU compatible with Windows CE. Table 1 compares these chips.

### Digital Music Keeps Changing Its Tune

Designing an ASSP for a product category as new as Internet audio seems like a risky strategy. But Cahners In-Stat analyst Mike Paxton predicts that sales of portable Internet-audio products will triple next year, from an estimated 850,000 units in 1999 to 2.8 million units in 2000. As Figure 1 shows, Paxton expects sales to triple again by the end of 2002.

Cirrus believes the ability to download and play audio files will soon become a standard feature of mobile information appliances. One obstacle, however, is that digital-audio specifications are in flux, which argues for a programmable solution that's upgradable in the field.

MP3 (MPEG-2 Layer 3) is today's de facto audio standard, due mainly to the wide variety of software MP3 players for PCs that are available on the Web. But the prospect of a radically new distribution method that bypasses traditional

retail channels has alarmed the music industry, especially because MP3 files are not copy protected. This has led to proposals for encrypted digital-audio formats, such as the music industry's Secure Digital Music Initiative (SDMI) and Microsoft's Windows Media Technologies.

All this uncertainty over standards makes a fixed-function solution riskier than an upgradable device. For example, Diamond's revolutionary Rio PMP300—a portable MP3 player that had to survive a legal challenge to reach consumers—can't play anything but MP3 files, because the audio-decoding software is in ROM. A fixed-function ASIC would be risky for the same reason, not to mention that an ASIC takes one or two years to develop, which is an eternity in the fast-changing world of Internet audio.

Cirrus's answer is a "market-specific processor" (MSP)—the company's term for an ASSP that's built around a general-purpose CPU core but didn't originate as a customer-specific ASIC. It's a programmable chip, not a state machine, so it allows an Internet-connected portable player to download new software to keep pace with evolving standards. And the CPU can run other kinds of software as well, so the product doesn't have to be a single-purpose device. Cirrus envisions a future of Palm-type devices that are productivity tools as well as entertainment appliances.

### Intelligent Integration

Maverick's ARM720T core is based on a popular architecture that is well supported by development tools and embedded operating systems. Typical power consumption at 74 MHz is 150 mW at 2.5 V (with 3.3-V-tolerant I/O), which is within the power envelope of palmtop computers. Cirrus is manufacturing the chip on a 0.25-micron IC process at its fab in Fishkill, New York.

As Figure 2 shows, Cirrus has surrounded the ARM core with an appropriate range of integrated peripherals.

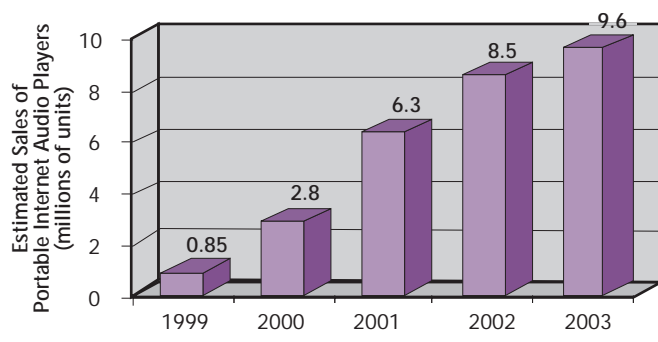


Figure 1. Sales of portable Internet-audio players are projected to grow strongly over the next four years. (Source: Cahners In-Stat)

Feature	EP7212	EP7211	EP7209
CPU Core	ARM720T	ARM720T	ARM720T
Clock Speed (max)	74 MHz	74 MHz	74 MHz
LCD Controller?	Yes	Yes	Yes
SRAM Buffer	37.5K	37.5K	37.5K
DRAM Controller?	Yes	Yes	No
Audio Interface?	Yes	No	Yes
Power (typical @ 74 MHz)	150 mW	150 mW	150 mW
Power (MP3 playback only)	90 mW	N/A	90 mW
10K Price (LQFP)	\$18.49	\$17.49	\$13.99
10K Price (PBGA)	\$21.99	\$20.99	\$17.49
First Availability	4Q99	3Q99	3Q99

Table 1. Cirrus Logic's EP72xx processors are a closely related family of integrated chips for mobile embedded applications. N/A = not applicable.

The most useful features are the digital-audio interface, an LCD controller (which supports  $1,024 \times n$ -pixel resolution, with four bits of gray scale), a DRAM controller, on-chip boot ROM, an IrDA 1.0 infrared interface, a 32-bit I/O bus (which requires only a \$2.50 physical-layer chip to implement a USB interface), and an assortment of other I/O (including two UARTs, 27 general-purpose I/O lines, and four synchronous serial ports). The current device supports either EDO or fast-page mode DRAM; Cirrus plans to introduce a Maverick chip with an SDRAM controller in 1Q00.

The audio interface is a subset of the Philips I<sup>2</sup>S (inter-IC-sound) specification for digital audio. The Cirrus implementation supports a bit rate that's 128 times the CD-quality sampling rate of 44.1 KHz, which provides plenty of capacity for oversampling. This interface connects directly to the low-cost digital-to-analog converters (DACs) commonly used in digital-audio devices. Without it, the processor would need external logic with parallel FIFO buffers. This would probably cost \$3–\$4, occupy 1.5–2 square inches of board space, and consume a few hundred more milliwatts of power.

Maverick also has 37.5K of SRAM (in addition to the primary cache). This memory is intended as a frame buffer for the LCD controller, and it can buffer a  $640 \times 240$ -pixel screen with 2-bit gray scale when used for that purpose. A music player could use the SRAM as an audio buffer instead. But if the player also has an LCD panel, the frame buffer would have to be relocated to external memory, which would increase the system's overall power consumption.

Using Maverick to decode an MP3 stream requires about 40% of the CPU at 74 MHz, leaving 60% available for other tasks. By idling the core between blocks of MP3 data, a system can reduce the average power consumption to 90 mW during MP3 playback. For lighter-duty tasks, the clock can be slowed to 18, 36, or 49 MHz.

### Not the Fastest Tempo

Compared with other solutions, Maverick offers reasonable tradeoffs. Almost any Windows CE palmtop with a MIPS or SuperH processor could decode an MP3 stream by using a smaller percentage of the CPU's capacity, but at the cost of extra logic for the digital-audio interface. Still, that's a relatively small price to pay if the system needs to run more demanding software.

At the other end of the spectrum are lower-power processors that can't match Maverick's capabilities. The 3Com Palm organizers use 16-MHz 68K-series processors with power consumption in the 50-mW range—about one-third as much as the 74-MHz Maverick. But a 16-MHz 68K processor isn't powerful enough to decode an MP3 stream in real time without external help.


An ASIC custom designed for a specific Internet-audio product could no doubt integrate a more optimized mix of peripherals and features

### Price & Availability

Cirrus Logic is shipping production quantities of the EP7212 Maverick now. It costs \$18.49 in 10,000-unit quantities or \$15.95 in 100,000-unit quantities in a 208-pin LQFP package. A 256-ball PBGA version costs approximately \$3 more. For additional information, go to [www.cirrus.com/products/overviews/ep7212.html](http://www.cirrus.com/products/overviews/ep7212.html).

than Maverick. But an ASSP saves customers the nonrecurring engineering costs of developing an ASIC and gets their products to market much sooner, without sacrificing the flexibility of a programmable, general-purpose CPU.

Maverick provides additional evidence that embedded applications continue to diversify and to require more-specialized chips to meet customers' demands. At the same time, Maverick is not so highly specialized that it has no applications beyond portable Internet-audio players. It would also be an all-around good choice for a handheld organizer.

Actually, what's most impressive about Maverick is that Cirrus must have locked down the chip's design about a year ago, when Internet audio players were still a novel concept—and still in legal limbo. Unless the audio interface was an afterthought or a feature that Cirrus would have included anyway, it appears that Cirrus placed its bets early, gambling that Internet audio would be popular enough (and legal enough) to justify the development of an ASSP. In any case, Cirrus is well positioned to cash in on a revolutionary way to distribute recorded music. 

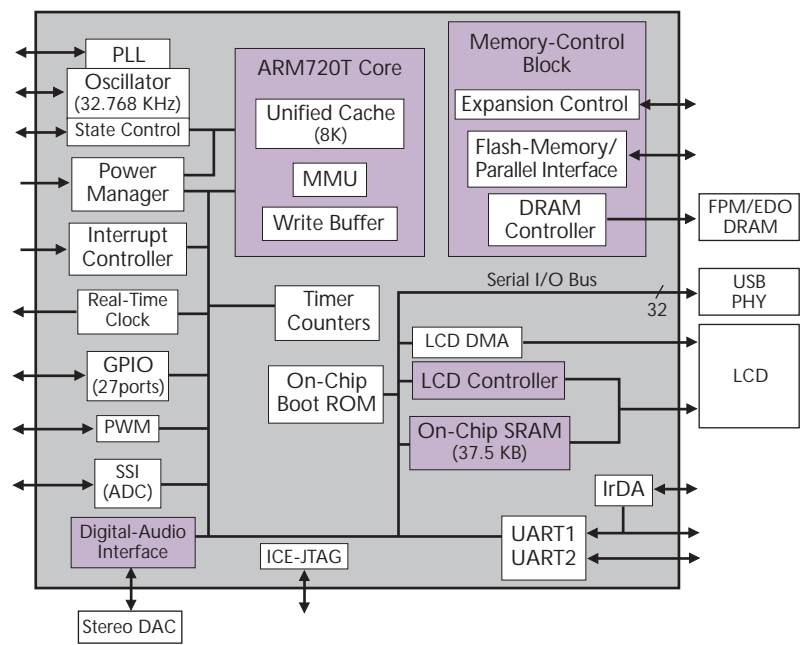


Figure 2. The EP7212 Maverick's most important features are highlighted in purple. The digital-audio interface requires a stereo DAC.