



White Paper

Automotive USB Connectivity for Portable Devices

Freescale's ColdFire® MCF5251 USB Solution



Overview

To reduce the technical issues and bill of materials cost of adding USB connectivity to automotive head units, Freescale Semiconductor has introduced a fully AEC-Q100 qualified version of its ColdFire® MCF5251 audio processor and associated reference software solution.

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Automotive Audio Challenges

In 2005, annual sales of portable media players (PMPs) such as the Apple iPod™ and other hard drive and NAND flash-based devices topped 140 million units and are expected to surpass 280 million units by the end of 2010¹. With media capacities of 1 GB to 60 GB common in the market today, consumers can listen to most if not all of their entire music collection from a single device. And as with any consumer product, the market is constantly evolving, adding new services such as subscription music from providers such as Napster, Real Networks, Yahoo! and MTV where users can download as much content as they want from a number of different artists and genres. While these new products and services bring tremendous entertainment value to the consumer, they also bring numerous challenges when interfacing to another ubiquitous music playback device: the car radio.

While PMPs come in a wide array of form factors and media sizes, the common thread that bonds nearly all of these devices is the ability to connect to a PC using standard USB protocols. The obvious path to supporting these devices is to add a USB host to existing car radios. However, the technical challenges and costs can be substantial when factors such as external memory requirements, multiple USB protocols and a variety of audio decoders are taken into account to ensure that the car's head unit supports as many portable devices as possible.

To reduce the technical issues and bill of materials cost of adding USB connectivity to automotive head units, Freescale Semiconductor has introduced a fully AEC-Q100 qualified version of its ColdFire® MCF5251 audio processor and associated reference software solution.

Mass Storage Class Protocol

The most common USB protocol used in portable media players is also implemented in other devices such as USB flash drives and portable hard disk drives (HDD). Mass storage class (MSC) devices are represented on the PC as an external drive, and PMPs using MSC can act as simple data storage devices. This also allows consumers to place data files on the device that can be transferred to other PCs. While MSC has become somewhat ubiquitous, supporting it in an embedded host system such as a car radio is not as simple as it may seem.

PCs have been supporting MSC devices without the need to load external drivers since the launch of Microsoft Windows® ME. A driver released for Microsoft Windows 98 required over 600 KB of program space. This was beyond the scope of many embedded systems, where entire programs typically range from 512 KB to 2 MB. While MSC was specified by the USB Implementers Forum (USB IF), the actual specification is open to the developer's interpretation, particularly when the device being developed does not undergo USB-IF certification. Many manufacturers of PMPs and flash drives often trade USB-IF certification for faster time to market and other value-added factors.

When the first USB High Speed devices came on the market, there was value in the High Speed USB logo which indicated successful certification. Today, High Speed USB devices are the rule rather than the exception, and companies generally do not undergo formal certification. Instead, they often choose to test in-house to save cost and time.

MCF5251 Certification

Freescale has certified its ColdFire MCF5251 hardware and software solution at a USB-IF certified independent test laboratory to ensure the highest level of interoperability with other USB-IF certified devices. To cover more extreme cases where the slave device is not certified, Freescale tests numerous Flash drives and PMPs to ensure compatibility with Freescale reference software. Additionally, if a new device comes to market and is not supported, Freescale offers a maintenance program to add that support. This allows for a wide window of MSC device support, with updates for new products that may come to market in the future. Freescale's reference software for the ColdFire MCF5251 audio processor helps ensure that customers' automotive designs—which can take one to two years to develop—can support the latest MSC devices and PMPs through software upgrades.

¹ *Portable Digital Audio Players: Market Growth Exceeds Expectations*, In-Stat Inc., April 2006

