

Portable CD Internet Audio Playback

Overview

The portable Internet audio market has exploded with a wide range of products and formats. These products create a whole host of opportunities for consumers and challenges for designers.

Freescale Semiconductor's comprehensive hardware and system solutions are engineered to help reduce overall system cost and speed time-to-market. The portable Internet audio devices vary widely depending on the storage format.

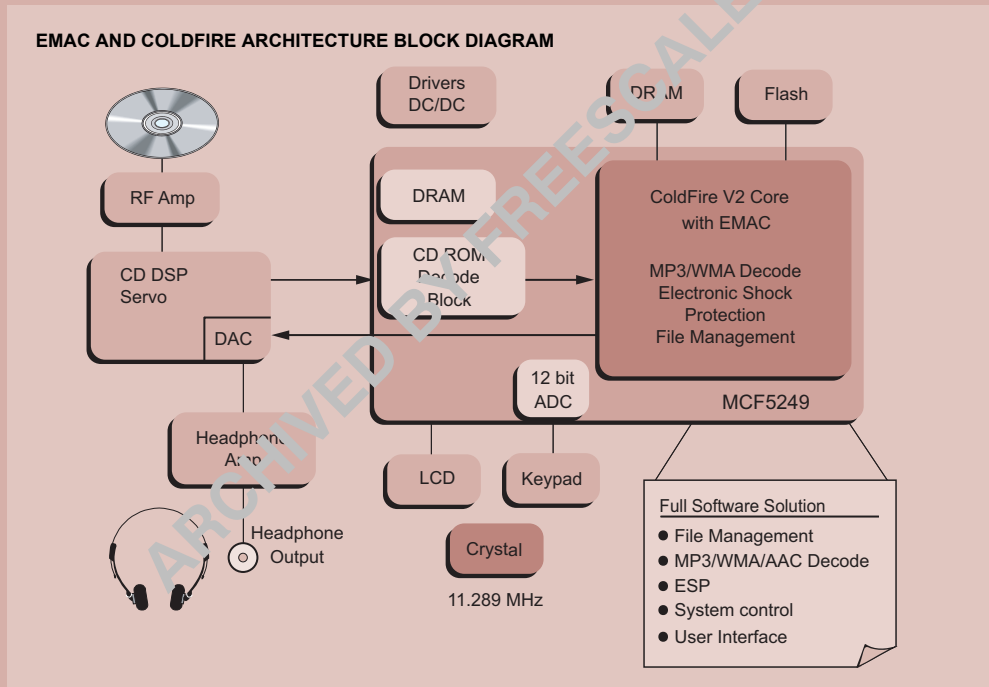
The availability of recordable CD drives at consumer price points is providing new opportunities for the compact disc format.

Its relatively low cost offering high-storage capacity, together with its compatibility with existing playback systems, may make the CD the ultimate MP3 music medium. A single read/write CD typically costs less than a dollar and can contain over ten hours of music in MP3 format.

Compressed audio is written onto CDs as a file on a CD-ROM, so MP3 CD players must be able to read CD-R/W discs, and perform CD-ROM decode and file management as well as decode MP3, WMA, AAC and any new formats that are derived.

Key Benefits

- > Provides relatively low cost and high storage capacity
- > Offers compatibility with existing playback systems in use all over the world
- > Designed to provide a compact engine for control code processing with variable length RISC architecture
- > Offers powerful digital signal processing ability
- > Capable of extremely efficient processing of certain audio algorithms
- > Hard disk drive protection through acceleration sensor freefall and drop detection to park the hard drive, saving information



Freescale Ordering Information

Part Number	Product Highlights	Additional Information
MCF5249	ColdFire V2 Processor Core 125 (Dhrystone 2.1) MIPS at 140 MHz 8K byte instruction cache 96K byte SRAM, eMAC unit	www.freescale.com
MMA6260Q	1.5g, 50 Hz XY-Axis Acceleration sensor	www.freescale.com
MMA6261Q	1.5g, 300 Hz XY-Axis Acceleration sensor	www.freescale.com
MMA6262Q	1.5g, 150 Hz XY-Axis Acceleration sensor	www.freescale.com
MMA6263Q	1.5g, 900 Hz XY-Axis Acceleration sensor	www.freescale.com

Note: Search on the listed part number.

Design Challenges

Standard compact disc (CD-DA) and compressed audio (MP3, WMA, etc.) playback digital audio systems share the requirement for significant amounts of control processing as well as digital audio signal processing. Control processing includes file management, data buffering, system control, and user interface control.

The MP3 decode algorithm itself involves roughly 50 percent control-type functions while the remaining 50 percent involves signal processing. Other signal processing tasks include audio effects processing (e.g., dynamic bass boost) and digital volume control.

Typically, these systems use separate DSP and microcontroller devices to perform the signal processing and control tasks. Clearly a more efficient, lower cost solution would be to implement both tasks on a single microprocessor.

Acceleration sensors can be used to determine when a portable electronic device is falling or starts to fall. By detecting that the portable electronic is falling prior to it hitting the ground, protection mechanisms can be implemented.

Further, due to the portable nature of these devices, power consumption is a major issue. All devices in the solution must have very low power consumption in order to maximize the battery life of the audio playback device.

Finally, multimedia formats and products are evolving very quickly. Different digital audio formats are being used in different regions of the world and in different products. For example, while MPEG 1 Audio, Layer 3 (MP3) is the audio standard of the Internet, MPEG4 (MP4) AAC and windows media audio (WMA) are also growing in popularity. Due to these ever-changing formats, an initial solution could be upgraded in the field.

Freescale Semiconductor Solution

Freescale Semiconductor's ColdFire™ 32-bit microprocessor is designed to provide a compact engine for control code processing with its variable-length RISC architecture. With the addition of the enhanced multiply-accumulate (EMAC) unit, the ColdFire microprocessor also offers powerful digital signal processing ability.

Utilizing its 32-bit data paths and 48-bit accumulators, the ColdFire architecture with EMAC is capable of extremely efficient processing of certain audio algorithms. For example, the MP3 decoder running on the MCF5249 has been tested as having 18 bits¹ of accuracy compared to the ISO floating point standard implementation, equivalent to a signal to noise ratio of 108 dB.¹ Additionally, the MP3 decoder requires just 19 MHz¹ of CPU bandwidth on this device.

Software

- > **MP3 Decoder** – Using the MCF5249 feature set, the advanced MP3 decoder is engineered to require only 37 KB of memory and 19 MHz. The decoder can run from on-chip memory and is designed to require fewer CPU cycles than typical decoders. In turn, this design helps to provide longer product battery life for consumers.
- > **WMA Decoder** – A full WMA decoder is being developed to support high-medium- and low-rate files. WMA files are roughly half the size of equivalent MP3 files, allowing over 20 hours of music to be stored on a single CD.
- > **Full Function System Architecture** – Including FLEX™ operating system, user interfaces, file management (seek, intro-scan, repeat, time elapsed, program), digital bass boost, digital volume control.

Audio Peripherals

The advanced ColdFire audio peripherals developed include IIS-compatible serial ports and an IEC958/SPDIF transceiver. The on-chip TDM (time-division multiplexed) bus is designed to allow signals to be routed easily between peripherals and CPU. These audio peripherals help to provide lower system costs because external audio interface devices are not required.

¹These numbers are worst-case data, assuming single-cycle memory accesses.

Development Tools

Tool Type	Product Name	Vendor	Description
Evaluation Kit	KIT1925MMA6260Q	Freescale Semiconductor	1.5g, 50 Hz XY-Axis Evaluation Board
Evaluation Kit	KIT1925MMA6261Q	Freescale Semiconductor	1.5g, 300 Hz XY-Axis Evaluation Board
Evaluation Kit	KIT1925MMA6262Q	Freescale Semiconductor	1.5g, 150 Hz XY-Axis Evaluation Board
Evaluation Kit	KIT1925MMA6263Q	Freescale Semiconductor	1.5g, 900 Hz XY-Axis Evaluation Board
Hardware	M5206eC3, M5249C3, M5272C3, M5407C3	Freescale Semiconductor	Evaluation Board
Software	IDE-Code Warrior 3.0, Compiler-C/C++, Source Level Debugger	Metrowerks	Development and Debugging for MCF5206e, MCF5249, MCF5272, MCF5407
Software	IDE, RTOS-VxWorks, Compiler-Diab, C/C++, Simulator, Analysis Tool, H/WDebugger-VisionProbe, S/WDebugger-Singlestep/ Vision Click	Wind River Systems	Development and Debugging for MCF5206e, MCF5249, MCF5272, MCF5407
Software	IDE-Multi, Compiler-C/C++/EC++, RTOS-ThreadX, Simulator, Source Level Debugger	Green Hills Software	Development and Debugging for MCF5206e, MCF5249, MCF5272, MCF5407
Software	OS-uCLinux, Compiler-C/C++, Source Level Debugger	SnapGear	Development and Debugging for MCF5206e, MCF5249, MCF5272, MCF5407
Reference Design	RD1986MMA6260Q	Freescale Semiconductor	Three-Axis Acceleration Sensing Reference Design

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