VLSI Technology

VT21702 ThunderBird 128™

3D PCI Audio Accelerator

QSOUND

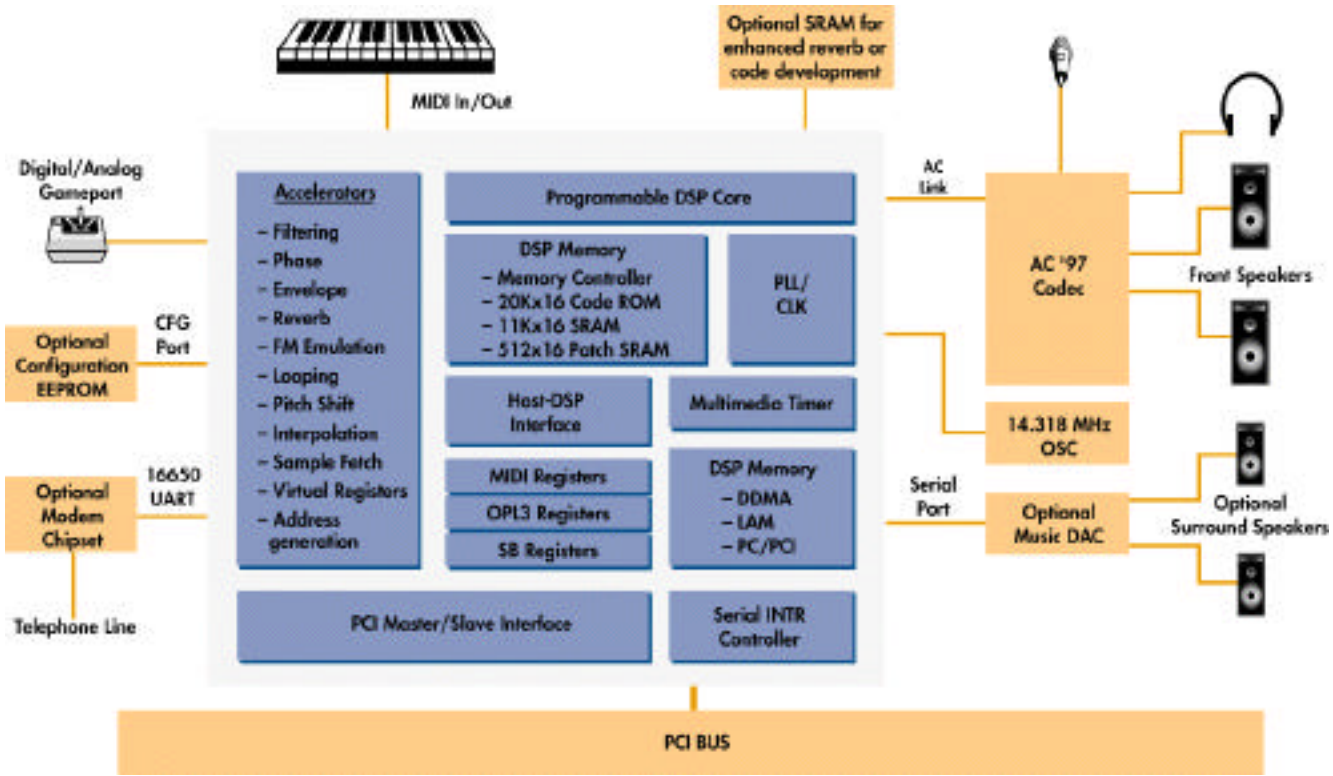
OVERVIEW

The VT21702 ThunderBird 128™ is a high performance PCI audio accelerator jointly developed by QSound Labs and VLSI Technology. It combines the most compelling 3D and music synthesis technologies available with the powerful yet cost effective ActiMedia™ DSP architecture. Full H/W acceleration of all 3D audio, music synthesis, DirectSound™ and game port functions guarantees exceptional system performance. Unmatched concurrency is demonstrated by the unique ability to simultaneously perform wavetable synthesis, positional 3D and special effects on each of sixty-four independent CD quality streams without burden to the host CPU. Three available PCI DMA modes assure full SoundBlaster™ compatibility even in DOS without additional hardware. The Intel AC97 architecture provides high audio quality using a low cost AC97 codec. System implementation cost is further minimized by an integrated modem UART, a serial stereo DAC port for multi-channel output and utilization of system memory for all wavetable sample and digital audio buffers.

FEATURES

- Concurrent processing of 128 audio streams
- CD quality (44.1 khz, 16-bit) wavetable synthesis of 64 voices
- 3D positioning of 64 DirectSound™ streams
- The DSP power to simultaneously perform wavetable synthesis, 3D positioning and special effects on sixty-four channels with independent sample rates and resolutions up to 48 khz, without consuming significant host bandwidth

Block Diagram



- QInteractive3D™ (QI3D™) hardware accelerated positional 3D
- QMSS™ Multi-Speaker Surround expands normal stereo to 4 channels
- QSurround® multi-channel speaker virtualization for Dolby Digital™
- QSurround® enhanced four speaker output for Dolby Digital™
- QXpander™ stereo-to-3D conversion
- Full DirectSound® and DirectSound3D™ H/W acceleration
- Full SoundBlaster™ and SoundBlaster Pro™ compatibility, even in DOS
- PCI DMA support for all major platforms utilizing PC/PCI, DDMA and LAM™
- OPL3 FM emulation
- Bi-directional MPU-401 MIDI UART
- On board modem support through integrated 16650 UART
- Dual game port with DirectInput™ digital and legacy analog modes
- 2nd generation VLSI ActiMedia™ DSP architecture
- Field upgradable firmware
- External SRAM interface for custom firmware development
- Integrated PLL with programmable DSP clock speed
- 20-bit 1µs resolution DirectX timer for video/audio synchronization
- PCI 2.1 compliant bus master/slave interface providing 10X performance increase over ISA
- DLS 1.0 and GM compliant music synthesis
- AC'97 compliant
- "Digital Ready" for stream redirection to USB and IEEE1394
- Exceeds PC98 requirements
- ACPI and "On Now" power management compliance
- Windows® 95, Windows® 98 and Windows® NT 5.0 (WDM™) drivers
- 3.3 volt operation with 5 volt tolerant I/O
- 0.35 micron TLM technology
- Cost effective 160-pin MQFP package

TRUE HARDWARE ACCELERATION

Unlike many PCI audio solutions, the ThunderBird 128™ is a true hardware accelerator. Positional 3D, music synthesis and SoundBlaster™ functions are performed on the ActiMedia™ DSP, not on the host CPU. This frees the CPU to perform other tasks, boosting graphic frame rates and raising system benchmark performance.

HIGHEST CONCURRENCY

Today's multi-media applications demand concurrent, independent audio processing of many diverse audio streams. Mainstream applications may require 32 or more synthesis voices, 20 or more sound effects positioned in 3D space concurrently with other audio stream processing. Typical PCI audio "accelerators" can position eight or less 22 khz streams and thirty-two or less synthesis voices. As soon as these concurrency limitations are exceeded other solutions place the burden of synthesis and/or 3D processing on the host CPU, degrading quality, consistency and system performance. The ThunderBird 128™ can concurrently process 64 streams. Each stream can be CD quality, each can have a different sample rate and each can include simultaneous music synthesis, positional 3D and special effects. For applications that require it, up to sixty-four additional DirectSound streams are available using QSound's uniquely efficient MMX host processing algorithms.

DRAMATIC 3D AUDIO

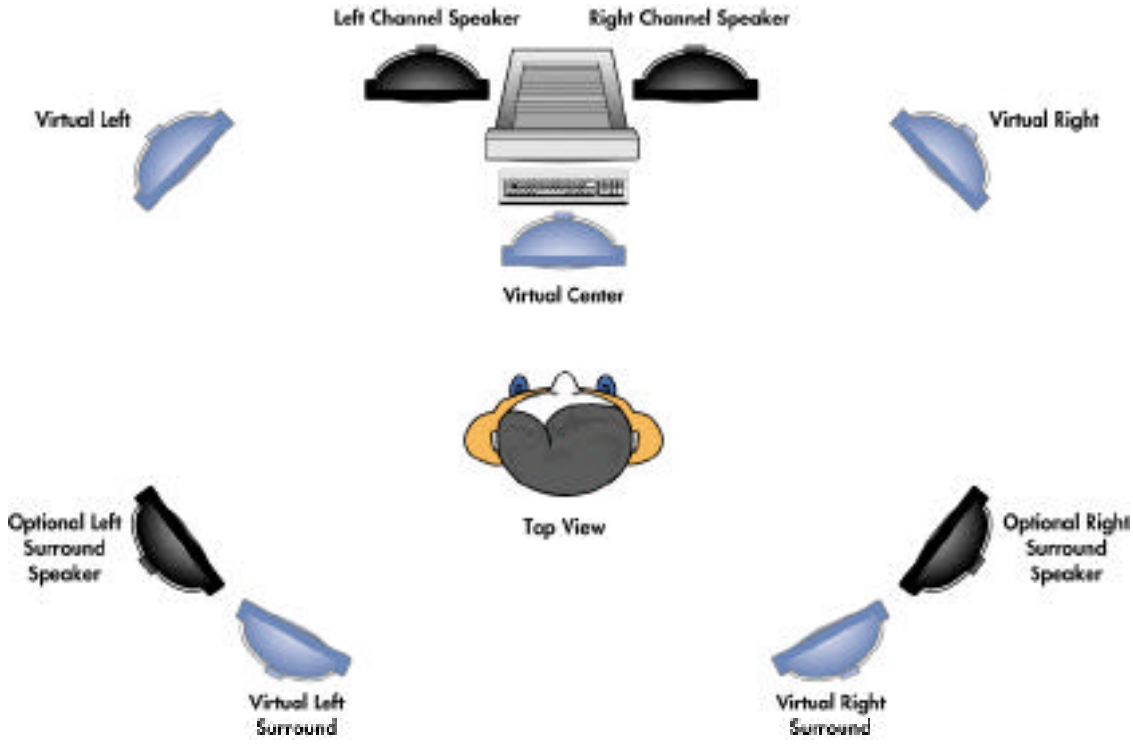
ThunderBird 128™ can interactively position each synthesis or DirectSound™ stream in 3D space around the listener using QInteractive3D™ (QI3D™), QSound's most advanced positional 3D technology. Distinct 3D engines based on HRTF and patented QSound technology are used for two speaker and headphone playback. A unique 2D to 3D positional remapping technology allows 2D audio applications to be played in full positional 3D. Stereo playback can also be enhanced using QSound's QXpander™ technology, which accepts any ordinary stereo signal and reproduces an output signal with dramatically widened stereo imaging and enhanced realism.

DVD / DOLBY DIGITAL™ VIRTUAL SPEAKER AND MULTI-CHANNEL SUPPORT

ThunderBird 128™ includes Dolby™ certified QSurround® for speaker virtualization of DVD multi-channel audio. By creating virtual speakers, QSurround® reproduces the full surround sound effect of multi-channel audio so that surround sound encoded movies and music can be enjoyed with only two speakers. For multi-channel playback, the surround channels can also be rendered using rear speakers by simply adding a serial stereo DAC.. The following diagram shows how each channel is rendered in 2 speaker virtual surround and 4 speaker surround modes. In each case the ".1" subwoofer channel is mixed into the front stereo channels for playback through the front speakers and subwoofer.

A further feature of the Thunder 128™ is the creation of 4 channel audio from normal stereo sources using QSound's latest proprietary technology, QSound Multi-Speaker Surround™ (QMSS™).

Dolby Digital™ Multi-channel Playback Modes



CD OUALITY WAVETABLE SYNTHESIS

The ThunderBird 128™ provides true CD quality wavetable synthesis at 44.1 khz and 16-bit resolution. All wavetable samples are stored in system memory enabling the use of up to 16 MB sample sets. The wavetable synthesizer is DLS 1.0 (Down Loadable Sound) compliant to allow exchange of sample sets and the use of application specific or user generated samples. A studio quality 4 MB GM sample set is supplied and optional 1 MB and 2 MB PC quality sample sets are available for applications with extreme system memory constraints.

Synthesis of all 64 voices is performed by the ActiMedia™ DSP to guarantee consistent playback and to avoid CPU consumption. Each voice can be positioned 360 degrees around the listener using MIDI commands. Individually controlled reverb, chorus and filtering can also be applied to each voice.

ACTIMEDIA™ ARCHITECTURE

The ActiMedia™ architecture combines the strengths of both programmable and fixed function DSP architectures. It's programmable DSP processor enables custom features, field upgrade and ease of development. An array of gate efficient fixed function DSP processors (accelerators) operate in parallel with the programmable DSP, providing an extremely high performance-to-cost ratio. Unlike fixed point DSP's that must use a single resolution for all audio processing, each accelerator is designed with the optimal resolution for its function. This preserves audio integrity without the cost of a high resolution or floating point DSP implementation. The result is the performance, quality and concurrency that would require 10 times the MIPS on a DSP of classical architecture.

DIGITAL MODE DUAL GAME PORT

The S/W polling used by analog game port can consume 10% of the host CPU. ThunderBird 128™ utilizes a digital operating mode that can eliminate S/W polling resulting in significantly improved system performance during game play. Joystick buttons can be polled or interrupt driven

to further enhance performance. A default analog mode is provided to assure compatibility with DOS and other non- DirectInput™ applications.

MODEM AND TELE-GAMING SUPPORT

On board modem support is provided via an integrated 16650 UART. This capability plus the full duplex audio capability make the ThunderBird 128™ the ideal solution for tele-gaming applications.

PCI INTERFACE

The ThunderBird 128™ is a PCI 2.1 compliant multi-function device, including audio, game port and 16650 UART (modem) functions capable of bursting at 132 MB data rates. The high bandwidth and low latency of the PCI bus eliminates the need for host based processing and external local memory and actually reduces PCI bus consumption of each audio stream by a factor of 10 compared to ISA solutions. Because the PCI and CPU busses are no longer locked during slow ISA DMA transactions system performance is improved as much as 20%. All I/O space is remappable creating a true "Plug and Play" device.

INTEGRATED I/O AND PERIPHERALS

ThunderBird 128™ includes all the required features to implement a PC audio sound and telecommunications solution with minimal chip count. I/O capabilities include an AC Link for an AC97 codec, DAC serial port for multi-channel or low cost playback applications, MPU-401 UART with MIDI IN and MIDI OUT connections for external keyboard, sequencer, synthesizer or other MIDI devices, 16650 UART for modem or other serial connections, I 2C configuration port for storage of Subsystem/Vendor ID's and other data in serial EEPROM, Dual Game port, a single 14.318 MHz oscillator input that supports the PLL and 3 general purpose I/O's for control and monitoring of external devices.

A programmable serial IRQ controller capable of serializing interrupts or implementing them as PCI interrupts is also provided to support Common Architecture requirements. A 20-bit, 1µs resolution timer is provided for DirectX™ audio/video synchronization.

LOWER IMPLEMENTATION AND CUSTOMER SUPPORT COST

Because the ThunderBird 128™ provides support for both audio and modem functionality the need for an ISA bus is completely eliminated. The integrated 16650 modem UART and serial DAC ports also eliminate the need for a more expensive AC97 2.0 codec or multiple codecs to achieve modem and multi-channel speaker output. The "Plug and Play" benefits of a PCI device can dramatically reduce customer support costs.

POWER MANAGEMENT

The ThunderBird 128™ includes localized clock control and full event monitoring including interrupts, I/O, and software events. Independent power down control of the PLL, DSP and codec is provided and PCI CLKRUN protocol is supported. ThunderBird 128™ is fully ACPI and "On Now" compliant.

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LIFE SUPPORT APPLICATIONS:
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