LSI Logic DiMeNsion™ 8600
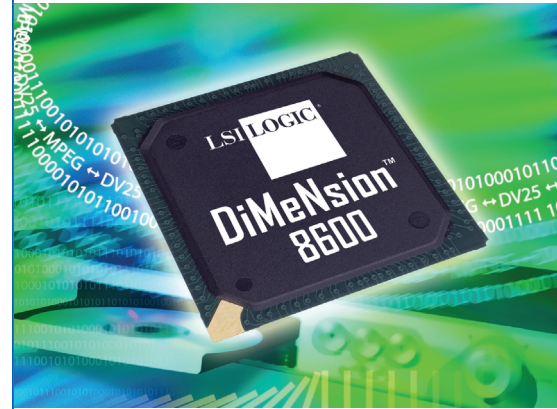## DVD Recorder System Processor

DiMeNsion™

OVERVIEW

The LSI Logic DiMeNsion™ 8600 (DMN-8600) is the world's first fully integrated DVD recorder system processor. Based on LSI Logic's DoMiNo™ architecture, the DiMeNsion family of products is intended for demanding, yet cost-sensitive, single-stream A/V codec applications in consumer electronics products.

The DMN-8600 represents a true system-on-a-chip solution, reducing cost, design complexity, power consumption, and time-to-market through its high level of system integration and its use of LSI Logic's C-Ware™ software environment. The DMN-8600 supports MPEG-1, MPEG-2, and DV-25 encoding, decoding, transrating and transcoding. The DMN-8600 also supports DVD playback, recording, and simultaneous encoding and playback of DVD streams to optical disc, enabling digital video recording (DVR)/timeshifting applications to be developed on DVD-RAM, DVD-RW, DVD+RW, and other recording drives. The DMN-8600 represents a quantum leap in performance, allowing multiple A/V streams to execute simultaneously.

With its embedded, dual 32-bit RISC-based host processors with dedicated DSP units, the DMN-8600 delivers up to 600 MIPS of processing power. This allows the DMN-8600 to simultaneously handle multiple A/V processing functions while managing all system control tasks, eliminating the need for an external host CPU. The DMN-8600 also integrates a dedicated video processor and motion estimation engine that enables advanced image processing tasks. LSI Logic's proprietary TrueScan Pro™ de-interlacing and TrueView Pro™ input video filtering algorithms leverage these processing elements to deliver the highest quality images available in the market. The DMN-8600 also performs all audio processing tasks, supporting industry standard audio encoding and decoding formats, as well as audio post-processing tasks such as 3D audio effects and bass management functions.

The DMN-8600 is compatible with LSI Logic's C-Ware architecture,which provides hardware abstraction and an object-oriented programming environment that is reusable across LSI Logic DoMiNo- and ZiVA™-based consumer digital video products. C-Ware is implemented in standard ANSI C/C++, provides certified software library components and standardized API. C-Ware is compatible with WindRiver Systems® VxWorks RTOS and is compatible with commercially available software development tools.

TARGET APPLICATIONS

- Low cost DVD recorders
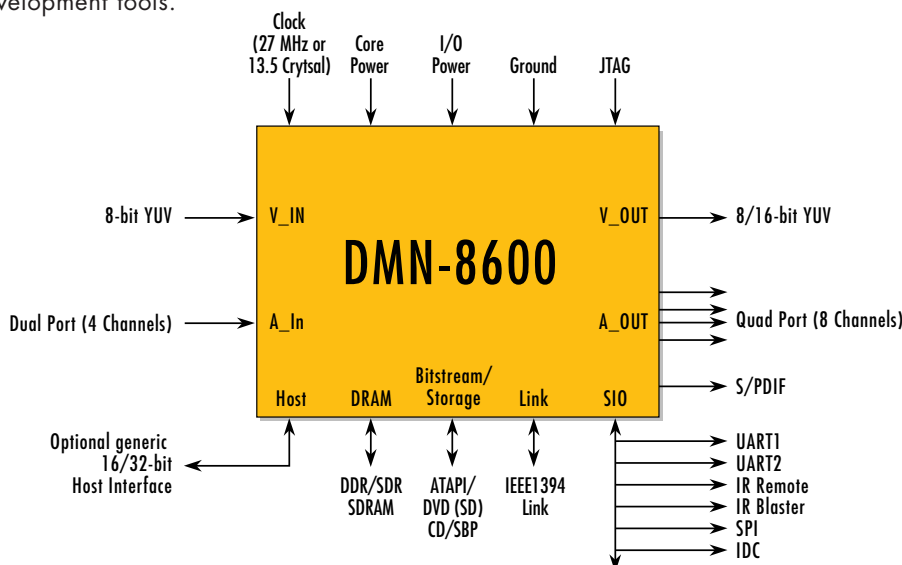
- Digital video recorders (DVRs)

- Home media servers

Figure 1: DMN™-8600 I/Os

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The Communications Company™

DEVICE FEATURES:

The highly integrated DMN-8600 features the following:

- Dual 150 MIPS RISC architecture with integrated audio DSPs, I-cache and memory, host functions

- 2D graphics engine with DVD sub-picture decode and 32-bit RGBA

- Flexible video and motion estimation processors

- High-performance memory controller with a 32-bit data bus for support of 8-64 MB of external SDR/DDR/SDRAM

- IEEE1394 link layer (with 5C copy protection)

- MPEG-2 MP@ML codec

- DV-25 codec

- TrueView Pro™ temporal filtering for pre-encode noise filtering

- TrueScan Pro™ de-interlacing for progressive display output

- Real-time VBR encoding

- External generic host bus interface

- Serial I/O interface controller for infrared port, general-purpose serial I/O, modem, etc.

- Storage device interface controller for IDE/ATAPI devices or non-ATAPI devices (low-cost optical loaders)

With the highest level of integration, broadest feature set, best image quality, and configurable software development environment, the LSI Logic DMN-8600 brings unprecedented features to DVD recorder applications. It also optimizes time-to-market and system cost performance for consumer electronics manufacturers.

CAPABILITIES

The DMN-8600 delivers four times the processing performance of previous generation video codecs. The DMN-8600 has been optimized for performance-critical functions at the bit- and pixel-operations level with firmware that has been optimized for performance and scalability. This balance delivers the flexibility needed to cut time-to-market and lower development cost.

The DMN-8600 is capable of a high degree of concurrency. Examples of this are simultaneous encoding and decoding in MPEG-2 MP@ML format, simultaneous decoding to MPEG-2 MP@ML and transcoding to DV-25, multi-angle view decoding, DV-25 to MPEG-2 with zero delay preview, CD-DA to MP3 transcoding, as well as IEEE1394 transport stream muxing and demuxing.

SYSTEM DESIGN

The DMN-8600's high level of integration drastically reduces system component count, and consequently system cost. Figure 2 shows a block diagram of an advanced DVD recorder based on DMN-8600.

The DMN-8600 has an on-chip ATAPI controller that supports read-only DVD ROM drives, rewriteable DVD drives (DVD-RAM, DVD-RW, or DVD+RW), or IDE compatible hard disk drives. The DMN-8600 is able to record a single input from a TV tuner, a standard analog input, the IEEE1394 link, or the ATAPI interface, in MPEG-1, MPEG-2 or DV-25 format. Similarly, it is capable of decoding all standard DVD/VCD/SVCD/MP3 formats (including DVD-Audio) and sending the result to the video and audio output.

The built-in support for progressive video (54 MHz) enables 480P video output. A DV-25 camcorder may be hooked up to the IEEE1394 port for transcoding to MPEG-2 format.
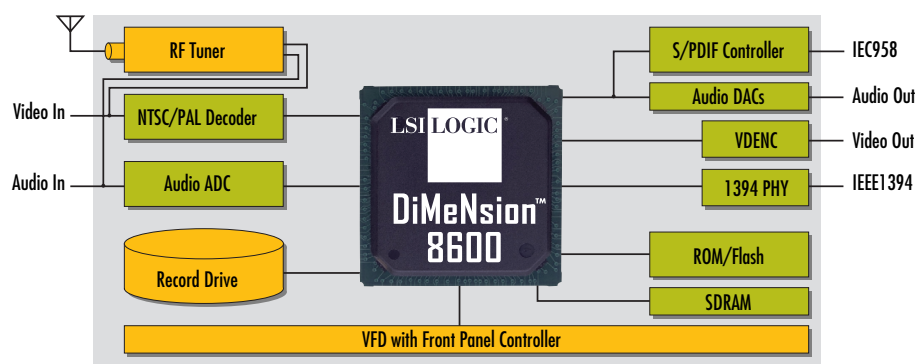

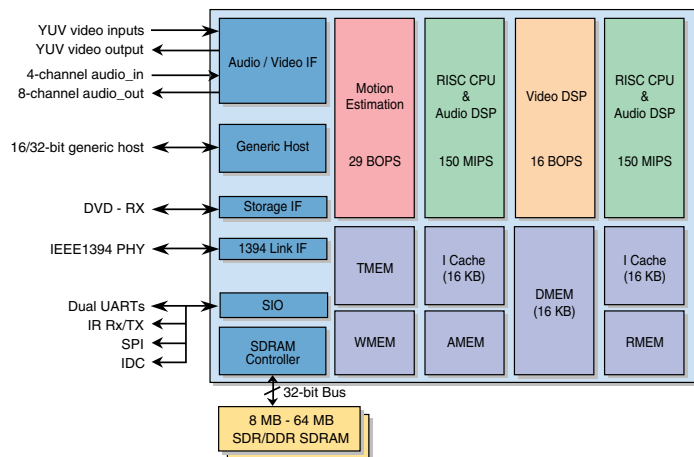*Figure 2: DMN™-8600 DVD Recorder System Design Based on DMN™-8600*

Figure 3: DMN™-8600 Architecture

Diagram labels:
- YUV video inputs
- YUV video output
- 4-channel audio_in
- 8-channel audio_out
- 16/32-bit generic host
- DVD - RX
- IEEE1394 PHY
- Dual UARTs
- IR Rx/TX
- SPI
- IDC
- Audio / Video IF
- Generic Host
- Storage IF
- 1394 Link IF
- SIO
- SDRAM Controller
- Motion Estimation 29 BOPS
- RISC CPU & Audio DSP 150 MIPS
- Video DSP 16 BOPS
- RISC CPU & Audio DSP 150 MIPS
- TMEM
- I Cache (16 KB)
- I Cache (16 KB)
- WMEM
- AMEM
- DMEM (16 KB)
- RMEM
- 32-bit Bus
- 8 MB - 64 MB SDR/DDR SDRAM

INTERNAL ARCHITECTURE DETAILS

The DMN-8600 can accomplish very compute-intensive signal processing tasks because it integrates multiple high-performance processing modules on a single chip.

RISC Engine

Two 32-bit SPARC processors perform all of the following functions: system processing, audio processing, and high-level flow control and and decision-making tasks for video processing, and 2D graphics processing.

Video DSP

As a highly integrated processor engine, the DMN-8600 is designed to implement motion-compensated, block-DCT-based video compression algorithms. To this end, the DMN-8600 includes a video DSP and motion estimation (ME) coprocessor that off-loads compute-intensive tasks from the SPARC processors.

Motion Estimation Coprocessor

The programmable ME coprocessor has a throughput of 29 billion arithmetic operations per second (BOPS). It takes the ME commands from the SPARC processor and generates results for each target.

Video DSP Coprocessor

The video DSP coprocessor performs vector memory-to-memory instructions. This improves code density and off-loads the SPARC processors. Its 64 Kbyte data memory is double-buffered (two banks) to allow concurrent DMA and DSP operations. Some of the functions that the DSP coprocessor performs include: de-telecine, activity measures, motion compensation, adaptive temporal and de-interlace filtering, linear filtering/decimation, DCT/IDCT (up to 12 bits), quantization/dequantization, and variable length encoding/decoding. The video DSP coprocessor operates at approximately 16 BOPS.

Audio Processing

The audio processing hardware is physically integrated into each SPARC processor. The hardware consists of two parallel 64-bit MAC units with 32-bit precision, and a DSP instruction set to support efficient encoding and decoding of a wide variety of audio algorithms, including MPEG-1 Layer 2, DTS, MP3, Dolby Digital™, AAC, MLP, and WMA. In addition, audio special effects such as 3D audio, Dolby ProLogic™, echo, harmonizing, bass management, FIR and IIR filters are supported. Each SPARC processor can execute two instructions in parallel, a MAC operation (DSP instruction) and a regular SPARC processor instruction.

Programmability

The DMN-8600 is compatible with LSI Logic's proprietary C-Ware SW develoment environment. C-Ware is an object oriented software architecture that abstracts the underlying hardware. This promotes portability and application re-usability within and across LSI Logic's product families. Figure 4 shows the basic C-Ware architecture and how it supports cross-product compatibility.

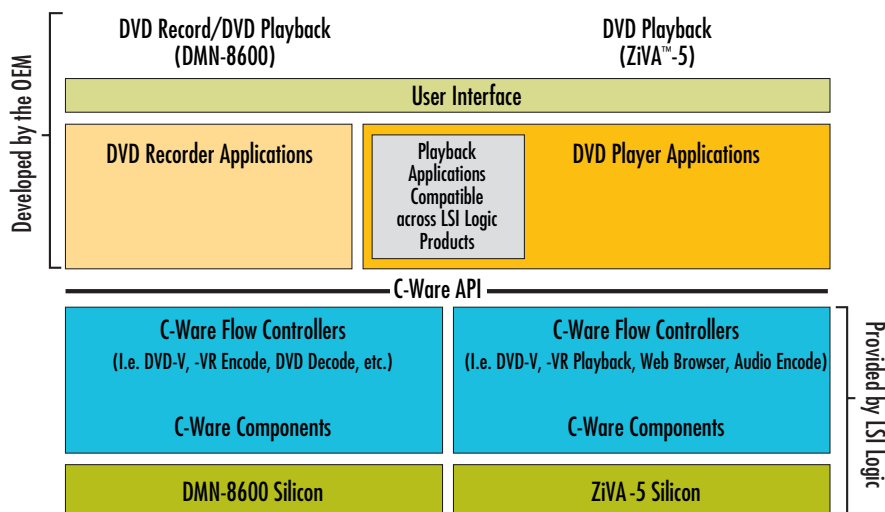# LSI Logic DiMeNsion™ 8600 DVD Recorder System Processor

Developed by the OEM

DVD Record/DVD Playback (DMN-8600)   DVD Playback (ZiVA™-5)

User Interface

DVD Recorder Applications | Playback Applications Compatible across LSI Logic Products | DVD Player Applications

C-Ware API

C-Ware Flow Controllers (I.e. DVD-V, -VR Encode, DVD Decode, etc.)

C-Ware Components

DMN-8600 Silicon

C-Ware Flow Controllers (I.e. DVD-V, -VR Playback, Web Browser, Audio Encode)

C-Ware Components

ZiVA-5 Silicon

Provided by LSI Logic

Figure 4: C-Ware™ Architecture and Cross Product Compatibility

Summary of Specifications

Video
Input	One 8-bit video stream YUV 4:2:2
Output	One 8- or 16-bit video stream YUV 4:2:2, ATSC 480P, NTSC 480I, PAL 576I

Audio
Inputs	2 channels, IDS compatible, 16-24 bits/sample
Outputs	8 channels, IDS compatible, 16-24 bits/sample, S/PDIF

I/O
Serial	2x UARTS, IEEE 1394, SPI, IR, IR Blaster, IDC
Parallel	ATAPI/DVD(SD)/SBP
1394	IEEE 1394 Compliant

Formats
A/V Codec	Single-stream, full-duplex, audio and video codec
Encode/Decode Formats	MPEG-2 MP@ML, MPEG-1, DV-25, AC-3, DDCE, MLP, AAC, DTS, MP3, WMA
File System Support	DVD-VR (RTRW), DVD-V, UDE
Encryption/Decryption	CPPM, CPRM, CSS, 5C, etc.

System
Host	16-/32-bit generic host bus, master or slave (optional) or internal host (default)
Graphics	2D, 4-32 bit/pixel RGB, 8-bit alpha channel, OSD, flicker filter and video scaler

Memory
Memory	8-64 MB of SDR or DDR SDRAM
Controller	On-chip, 32-bit wide SDRAM interface, 148.5 MHz

Physical
Input Voltages	3.3 V (5 V tolerant) I/O, 1.8 V Core, 2.5/3/3.3 V DRAM
System Clock	13.5 or 27 MHz
Operating Power	<2.7 W
Package	308 Pin BGA

JTAG
Compliance	IEEE 1149.1 compliant boundary scan and PCB assembly testing

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