

Atmel Corporation



2006 All Format DVD System-On-Chip

Max Bathaee

Director of Marketing

Network Storage products





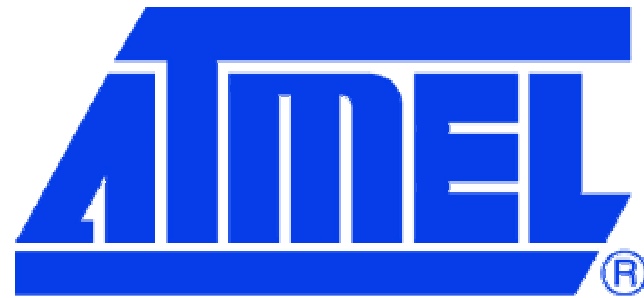
Atmel Corporation

**A 0.13 μ m CMOS SoC for
All Format Blue and Red Laser DVD
Front-end Digital Signal Processor**



Agenda

- **About Atmel**
- **DVD team and Organization and Products**
 - **LDD IC, PDIC, Motor Driver, DVD SoC**
- **DVD-SOC Features of the chip**
 - **Overview**
 - **Read Channel**
 - **Controller**
 - **Servo**
 - **Firmware**
 - **Test & Deliverable**



Corporate Overview

www.atmel.com

Everywhere You Are ®





Wide Application Focus

Atmel aims its products at a wide range of applications in high-growth markets:

- **Consumer**
- **Computer/ Networking**
- **Communications**
- **Security/ Smart Cards**
- **Automotive**
- **Industrial/ Medical/ Military/ Aerospace**



Market Diversity

Product Lines

General-Purpose ← → Application-Specific

Non Volatile Memories	Microcontrollers	ASICs	Secure Solutions	Communications Solutions
	80C51 (8-bit CISC)	Customer Specific ASICs	Secure MCU	ZigBee™
	AVR® (8-bit RISC)	Rad. Hard ASICs	Contactless Card	RF Products
	ARM® (32-bit RISC)	FPGA Conversion	Secure Memory	GSM/ CDMA Cell Phone
Flash		ASSPs	Smart Card Reader	GPS Chipset
		USB	RFID	Cordless Phone
DataFlash®	AVR32 (32-bit RISC)	GPS Baseband	Trusted Platform Module	Analog/ Digital Audio Broadcast
		Power Management	Biometric ICs	Car Access
		Broadband Data Conversion	FingerChip®	Tire Pressure Metering
			Multimedia ICs	RF Remote Control
			Voice-over-IP (VoIP)	License Free
			Storage Interface	Imaging ICs
			Sound Processing (Dream™)	CCD/ CMOS Image Capture
			MP3 Player	Image Processors
			DVD/CD Writer/ Player	Integrated Digital Camera Module
			Video	
EEPROM/ Serial EEPROM	High-reliability MCUs (32-bit Power PC)	Automotive ICs		
		CAN / LIN Networking		
		Automotive Sensors		
		Driver ICs		
		Watchdog ICs		
		Single-function ICs		
	Diopsis™ (Floating Point VLIW DSP)			

Common IP Blocks: MCU/ DSP Cores & Peripherals, Standard Interfaces, Analog, Power Management, Embedded Nonvolatile Memory, RAM, ROM

Foundry Services: SiGe Bipolar/ BiCMOS, BCDMOS/BCD-on-SOI, CMOS

Facilities

8000 employees worldwide

- **San Jose, USA**
 - Corporate Headquarters, Test, R&D
- **Colorado Springs, USA**
 - 0.25-micron 6-inch Wafer Fab, Test, R&D
- **Rousset, France**
 - 0.13-micron 8-inch Wafer Fab, Test, R&D
- **Heilbronn, Germany**
 - 0.5-micron 6-inch SiGe/ Bipolar/ BiCMOS/ BCDMOS Wafer Fab, Test, R&D
- **North Tyneside, England**
 - 0.13-micron 8-inch Wafer Fab, R&D
- **Grenoble, France**
 - CCD Fab, Assembly, R&D
- **Philippines**
 - Assembly, Test



Atmel Corporate Headquarters, San Jose

Atmel also uses fabrication sub-contractors to ensure the best technology mix in its products

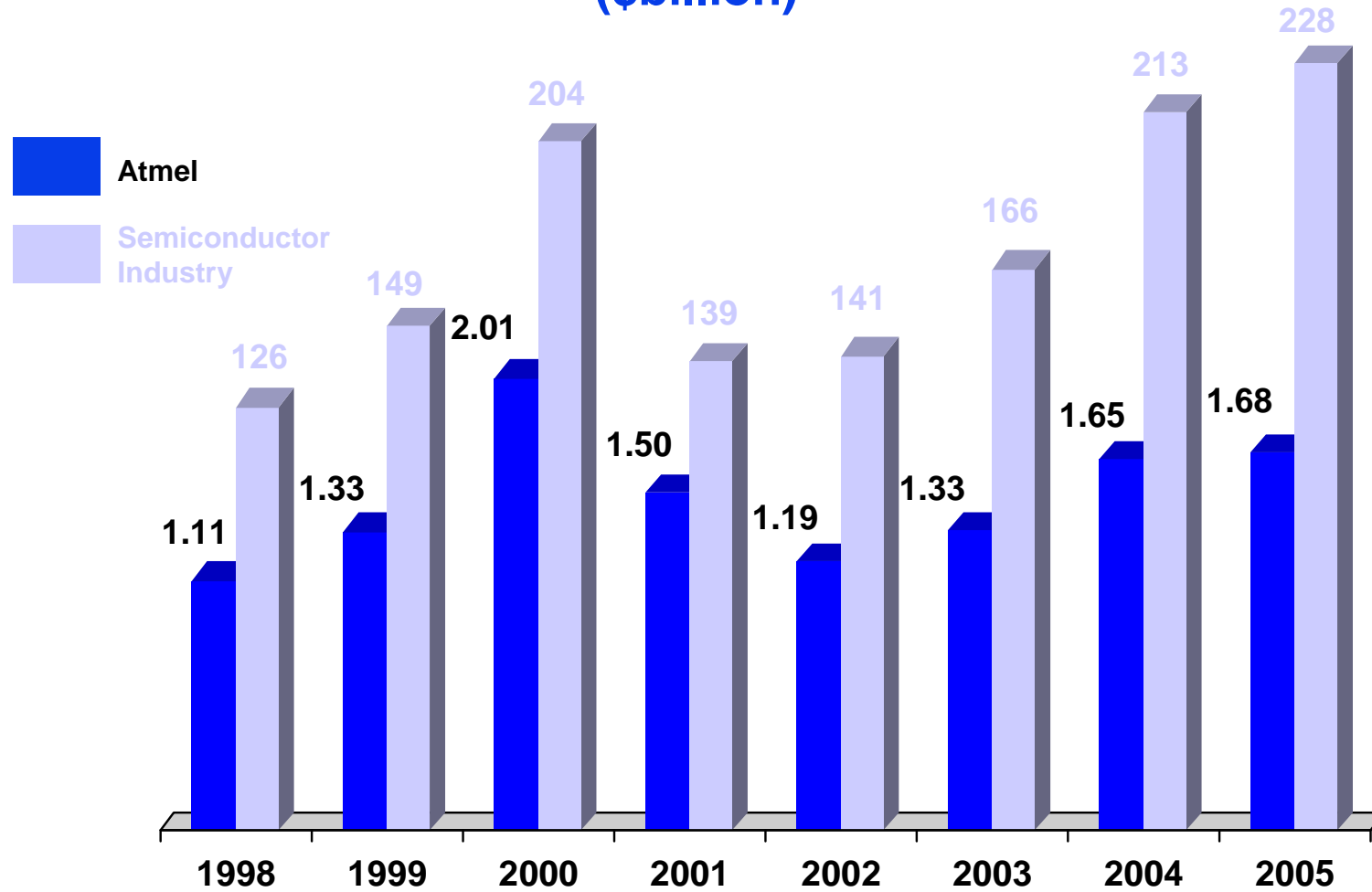


27 Design Centers

- Shanghai,
- Tokyo
- Berkeley,
- Colorado Springs,
- Columbia,
- Raleigh,
- San Jose,
- Chicago,
- Camberley,
- East Kilbride,
- North Tyneside,
- Helsinki,
- Stockholm,
- Trondheim,
- Grenoble,
- Nantes,
- Paris,
- Rousset,
- Lisbon,
- Milan,
- Patras,
- Duisberg,
- Dresden,
- Heilbronn,
- Ulm,
- Bucarest,
- Semur-en-Auxois,

(22 Sales Offices Worldwide)

Revenue Performance (\$billion)



Sources: Atmel Quarterly Earnings Reports,
Semiconductor Industry Association

October 11, 2006

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Manufacturing Facility: USA

Colorado Springs

- **6-inch (150mm) Wafer Fabrication Plant**
- **Processes: CMOS, NVM, BiCMOS, SiGe BiCMOS**
- **Technologies: 0.5 μ m, 0.35 μ m, 0.25 μ m**
- **Fabrication, Test, Research & Development**



Manufacturing Facilities: France

Rousset

- **Process: CMOS, SiGe BiCMOS, NVM, Mixed**
- **Wafer Size: 8-inch (200mm)**
- **Technology: 0.35 μ m, 0.25 μ m, 0.18 μ m, 0.13 μ m**
- **Embedded NVM R&D: 90nm , 65nm**
- **Fabrication, Test, Product R&D**
- **Fully Equipped Capacity: 10,000 wafers/ week**





Manufacturing Facilities: Germany/ UK



Heilbronn, Germany

- **Process: SiGe, Bipolar, BiCMOS, BCDMOS**
- **Wafer Size: 6-inch (150mm)**
- **Technology: 0.5 μ m**
- **Fabrication, Product R&D**



North Tyneside, UK

- **Process: CMOS, SiGe BiCMOS, NVM, Smart Card Technologies**
- **Wafer Size: 8-inch (200mm)**
- **Technology: 0.18 μ m, 0.13 μ m**
- **Usable Clean Room Area: 75,000 sq ft (7,500 sq m)**
- **Fully Equipped Capacity: 10,000 wafers/ week**



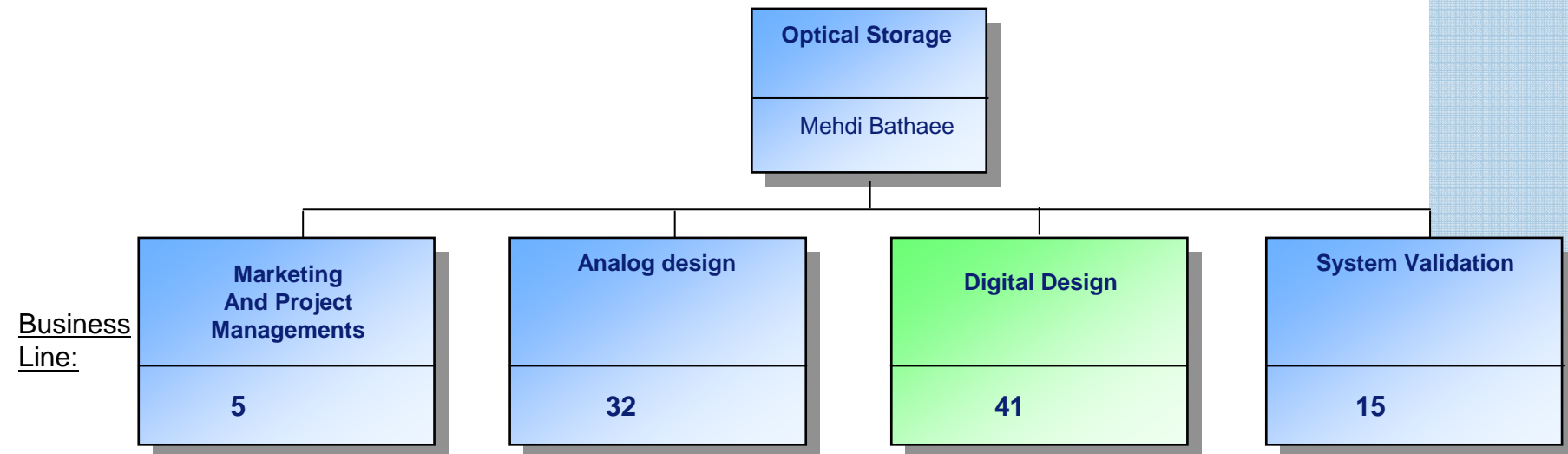
Organization

Network storage Products BU





Organizational Structure



Business Scope :

Advanced development
BD-DVD
Storage and
Connectivity
Network

- Analog Design
- Digital Channel
- Top Level Chip
- Layout design

- Digital Design
- DVD- Modules Design
- DVD Firmware
- SATA Development
- Switch Development
- Premium modules
- Layout Design

- DVD RW OPU Ref Design
- CD Modules
- DVD Modules
- SATA Ref Design



AF-DVD

(All Format DVD) SoC

For consumer and PC Application

Update





DVD-Chip set Total Solution

- LDD I.C.
- PDIC
- Motor Driver
- DVD-SOC (Read/Write Channel, Controller, UP, Servo)
- Flash
- Firmware
- Reference Design and production support



Similarities and Differences

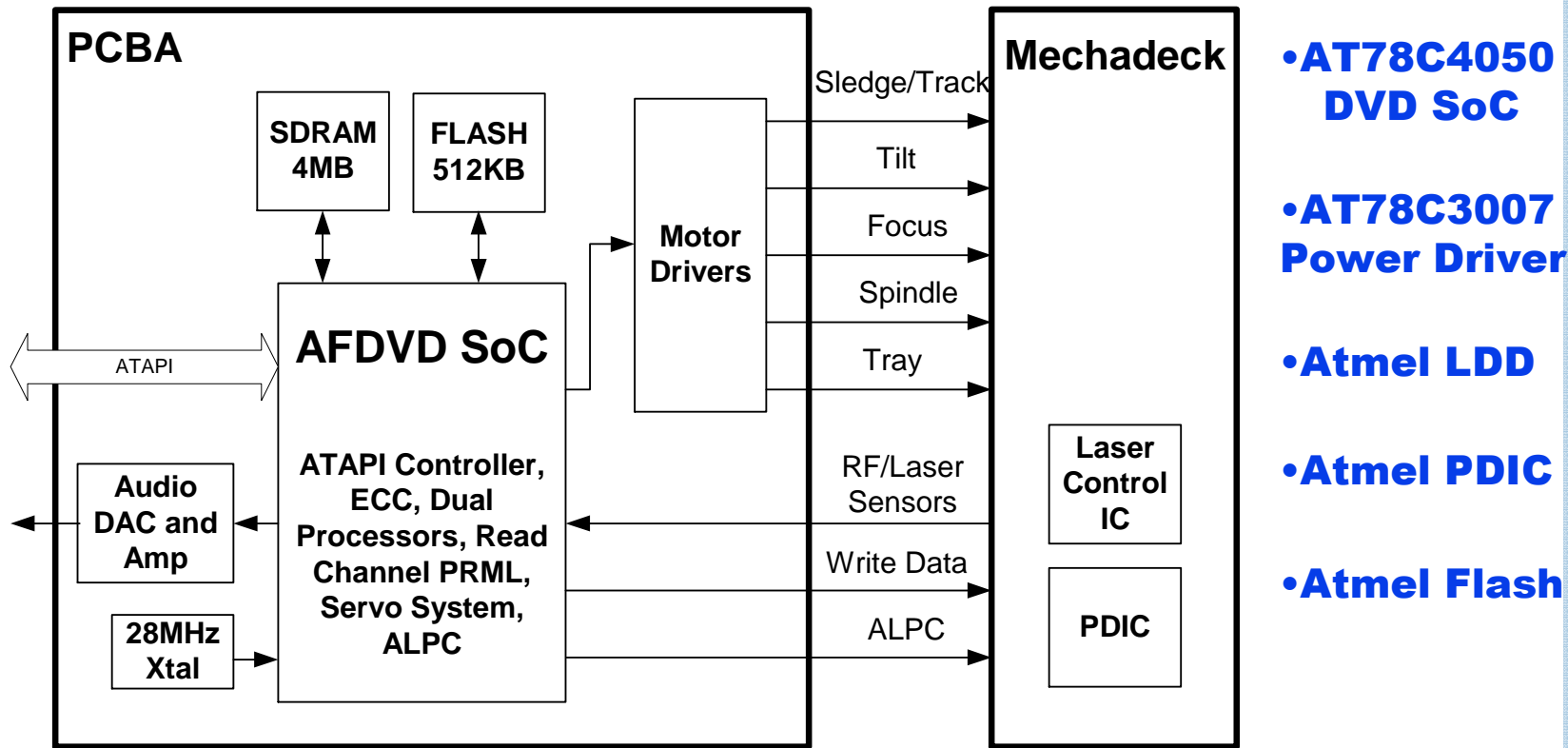
Parameter	DVD	Blu-ray	HD-DVD
Laser Wavelength	650nm	405nm	405nm
Objective Lens NA	0.6	0.85	0.65
Cover Layer Thickness	0.6mm	0.1mm	0.6mm
Number of Substrates	2 (bonded)	1 (with cover sheet)	2 (bonded)
Single Layer Capacity	4.7 Gigabytes	25GB	15GB
Dual Layer Capacity	8.5 Gigabytes	50GB	30GB
Track Pitch	0.74um	0.32um	0.4um
smallest Mark Size	0.4um	149nm	204nm
Modulation Code	EFM+	1,7PP	ETM
Channel Data Rate	26.16 Mbits/sec	66 Mbits/sec	66 Mbits/sec
User Data Rate	11 Mbits/sec	35.965 Mbits/sec	36.55 Mbits/sec
Read Channel	Slicer	PRML	PRML
ECC	PI=RS(182,172,11) PO=RS(108,192,17)	LDC=RS(248,216,33) BIS=RS(62,30,33)	PI=RS(182,172,11) PO=RS(108,192,17)
File System	UDF	BD-UDF	UDF
Copy Protection	CSS,CPRM	BD-AACS	AACS
Disc Playing Time	2 hours (single layer) 3.5 hours (dual layer)	6-9 hours of HD	4 hours AVC at 8Mbps (single layer) 8 hours (dual layer)
Video Codecs	MPEG2	MPEG2 MPEG4 AVC VC-1	MPEG-2 MPEG4 AVC VC-1
Audio Codecs	Linear PCM 2ch Dolby Digital MPEG Audio	Dolby Digital DTS, DTS-HD PCM	Linear PCM/ MLP 2ch Doby DD+ /DTS-HD MPEG Audio
Video Formats	720x480 & 720x576 50/60 SDTV	1920x1080 50/60 SDTV	1920x1080 50/60 SDTV

Reference Design (Blue laser) Status



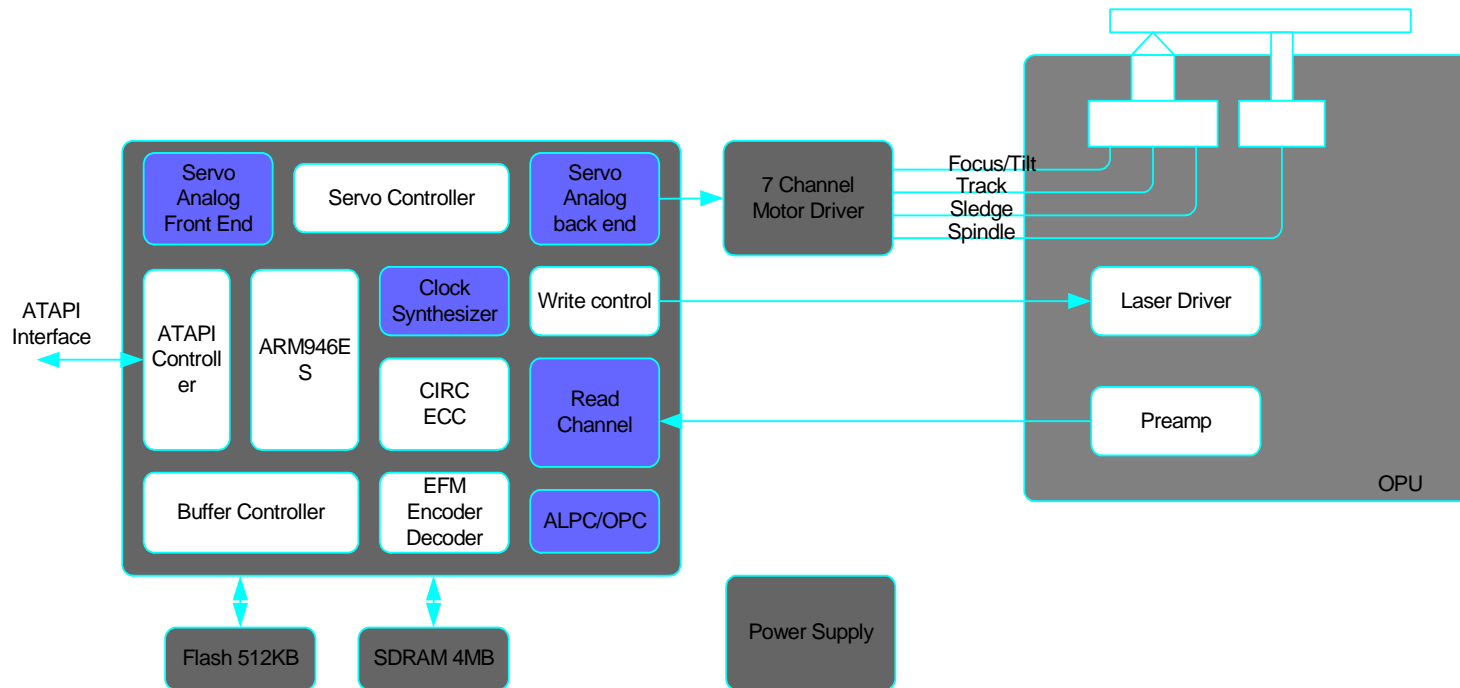


Reference Design Block Diagram

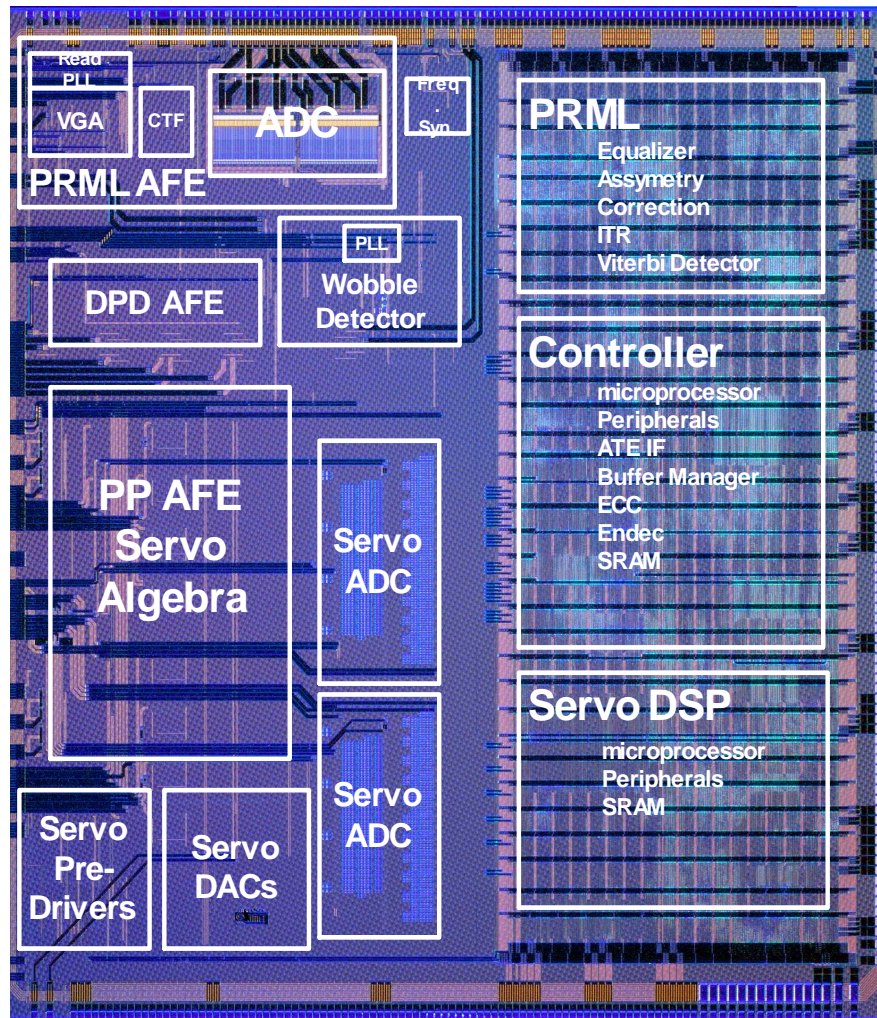


Firmware From Atmel and Customer's Own Firmware (Manufacturing Code)

System Block Diagram



AT78C4050 Floorplan





DVD SoC Outline

- **Format Supported:**
 - Blu-Ray, -ROM/-R/-RE,
 - HDDVD- ROM/-RAM/-R,
 - DVD-ROM;
 - DVD-R, -RW;
 - DVD+R, +RW;
 - CD-ROM Mode 1;
 - CD-ROM Mode 2;
 - CD-ROM XA Mode 2 Form 1;
 - CD-ROM XA Mode 2 Form 2;
 - CD-DA;
 - CD-R; CD-RW;



SoC Speeds

- **Maximum read / write speeds of:**
 - **BD-DVD-ROM / -R/-RE** **8x**
 - **HD DVD-ROM /-R/-RAM** **5x / 5x**
 - **DVD-ROM** **16x**
 - **DVD+R/ +RW / DL** **16x / 16x**
 - **DVD-R/ -RW / DL** **16x / 16x**
 - **CD-ROM** **56x**
 - **CD-R /-RW** **52x / 48x**



Features

- **0.13um CMOS technology**
- **550 Mb/s PRML read channel**
- **Dual processors for data path and servo**
- **External Flash and SDRAM interface**
- **Error correction of all format DVDs**
- **Buffer Management**
- **RLL Endec for EFM, EFM+, ETM, 17PP**
- **Auto Laser power control loop, OPC, ROPC**



SoC Functional Blocks

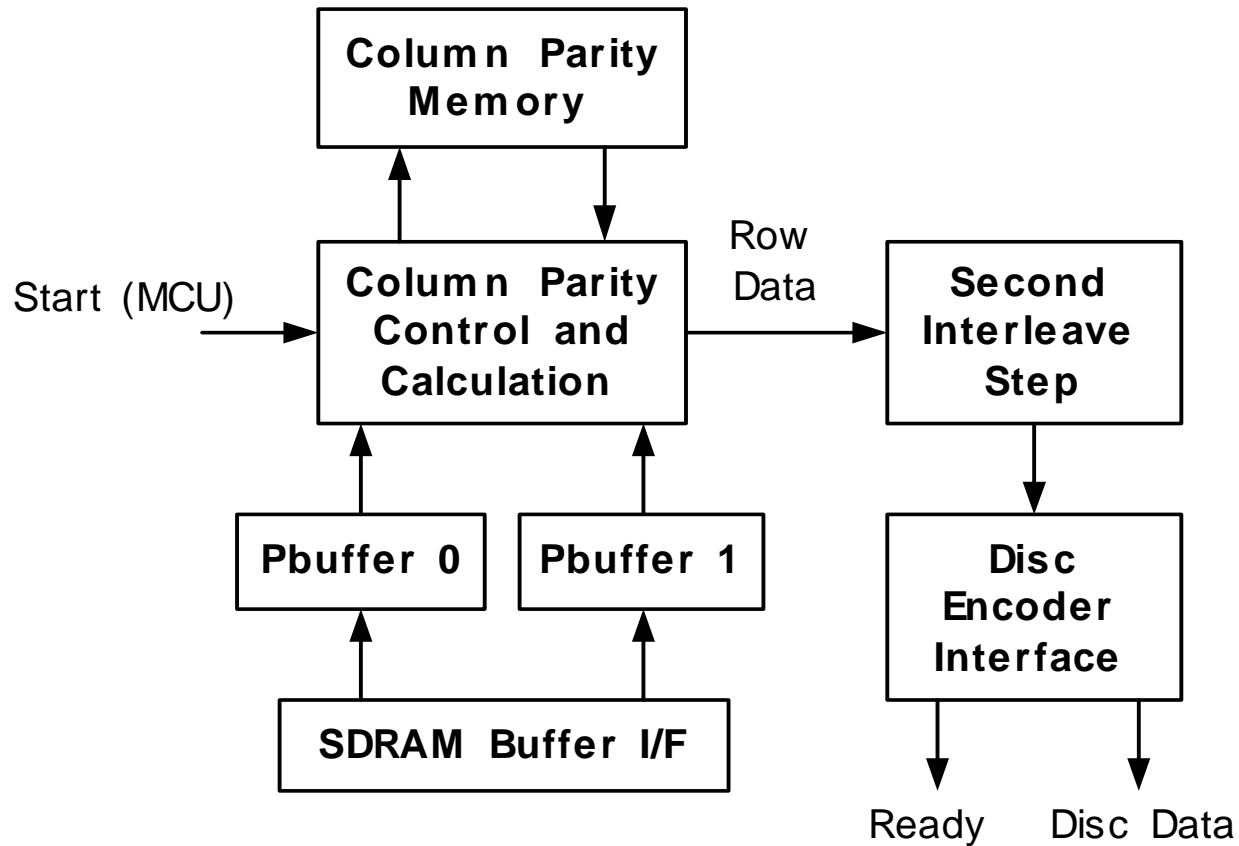
- **PRML read channel**
- **ENDEC and error correction (ECC)**
- **Buffer manager**
- **Dual processor for ATAPI and servo system**
- **Servo controller analog front-end, and drivers**
- **Wobble and pre-pit detection**
- **Laser power control loops**
- **Test and channel quality measurement**



PRML (Partial Response Maximum Likelihood) Read Channel

- Encode user data in order to match the power spectrum of the written signal to the channel response
- Provide an interface between controller and optical unit for read and write processes
- Process the read signal in order to compensate effects of the optical disc.
- Develop a maximum likelihood sequence detection based on the Viterbi detector
- Decode the read signal in order to recover user data

BD ECC Encoder



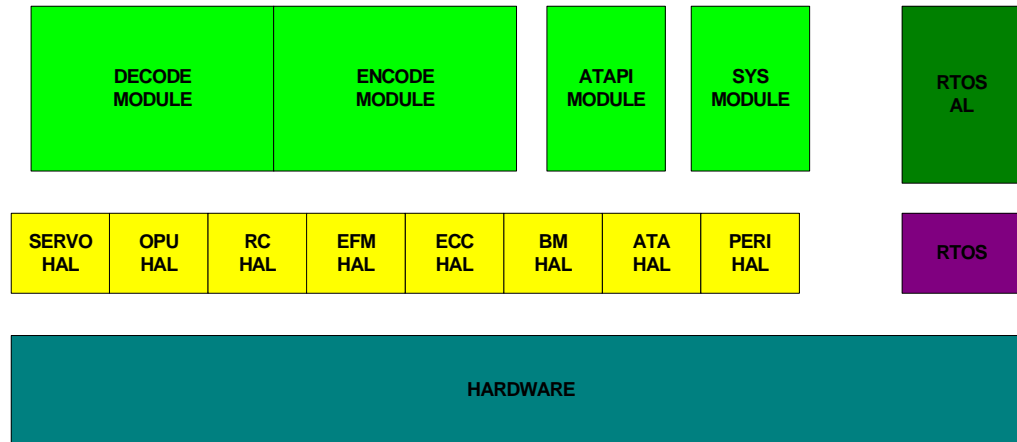
Servo Controller

- Servo processing unit, ARM946ES core,
- Peripheral units such as GPIO,
- Interrupt controller
- System controller
- Timer/Counter
- The dedicated logic for servo control
 - DPD (Differential Phase Detector) module for track error signal
 - SPINDLE module for speed counter and run out interrupt producing,
 - IIR, SLICER and TRACK COUNTER module for track crossing count
 - IIR_3C_DETEC module which is a 3-channel signal switch IIR filter, to detect media, defect, recorded/unrecorded interrupt.

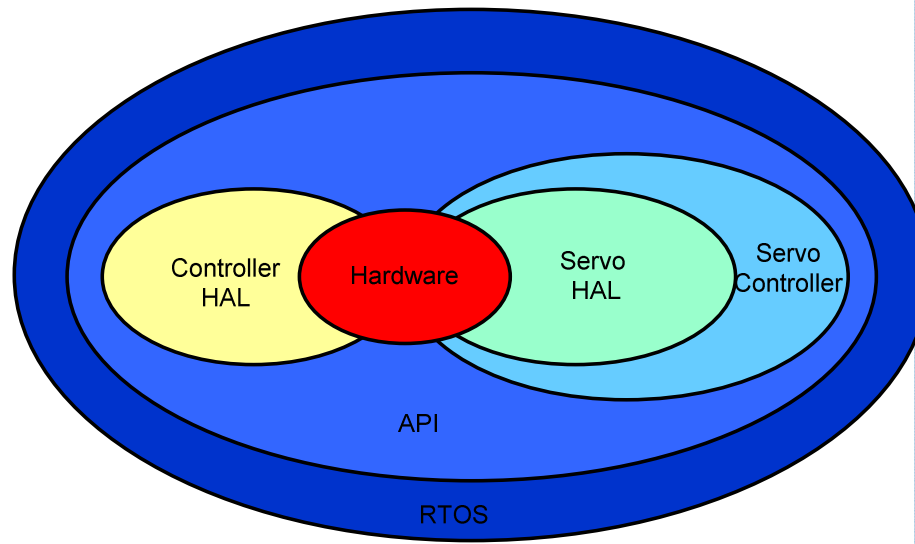
AT78C4050 Interface

- Interface with many standard **OPUs** with current or voltage output.
- Dedicated interface to **OPU with write strategy**.
- Built in Beta (radial) tilt control channel.
- Support stepper/DC sledge motor.
- Collimator motor control
- Support Alpha (tangential) tilt control
- Dedicated DAC for Liquid Crystal plate type Spherical aberration compensation.
- Interface with ATMEL 7 channel **motor controller** (AT78C3007)
- External 2MB/4MB/8MB/16MB **SDRAM**
- Support 2MB parallel or **serial flash**

AT78C4050A Firmware



Layered Design



Reference Design (Blue laser) Status



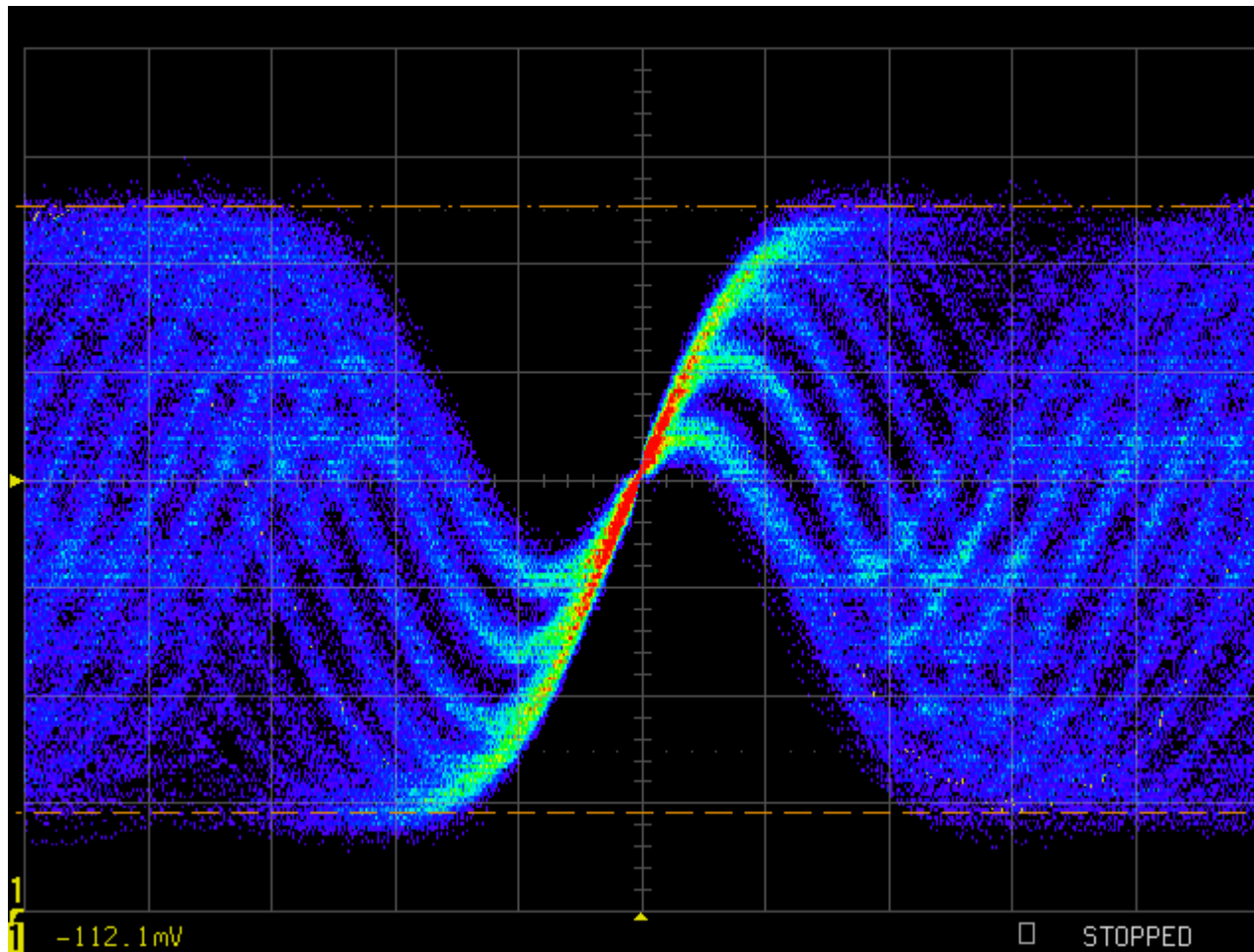


Reference Design (Red laser) Status

- Reference design based on red and Blue laser OPU
- Dedicated Servo Control Algorithm
- Supports DVD+R/RW, DVD-R/RW, DVD ROM, CD-R/RW, CD-ROM
- **SATA interface** with AT78C5010 Host/Device Bridge
- Passed ABEX Eccentric, Defect, Vertical Deviation test discs for Red Laser



Eye Diagram for Blue Laser Media





Summary

- **AFDVD-SoC has been successfully fabricated, and is a system level solution for all formats of red and blue laser**
- **All analog and digital functions are included and fully functional**
- **PRML read channel obtains low BER at high speed to improve the performance**
- **Various optical units, laser driver controllers, PDICs, and spindle/actuator chips can be seamlessly interfaced and can be provided through Atmel**



Thank you