Ordering Number: EP94E

SANYO

DVD-ROM/R/RW and CD-ROM/R/RW Devices

'05-01

SANYO

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URL: http://www.semic.sanyo.co.jp/index_e.htm

This catalog provides information as of January, 2005.

Specifications and information herein are subject to change without notice.

Printed in Japan / January 2005 3k OTE

R100

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Yes, we have

SANYO has the Technology and Devices Required by DVD-ROM/R/RW and CD-ROM/R/RW Products

SANYO has developed DVD-Dual system-on-chip ICs that integrate DVD-ROM decoder and DVD-R/RW encoder on the same chip based on SANYO technologies refined through extensive experience developing CD-ROM and CD-R/RW ICs.

SANYO is committed to early support of the latest recording technologies, such as its BURN-Proof® and DVD-R/RW technologies, to assist our customers development of their optical disc products.

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■ Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

Notes on Package Types and Naming
The package names used in this documentation are designed to indicate rough classification of the packages used, and do not necessarily indicate the formal name of each individual package.
Refer to the delivery specifications document for the particular product for the package dimensions figure and the formal name of the package.

A separate manufacturing license based on the DVD standards is required when creating a new DVD system product.

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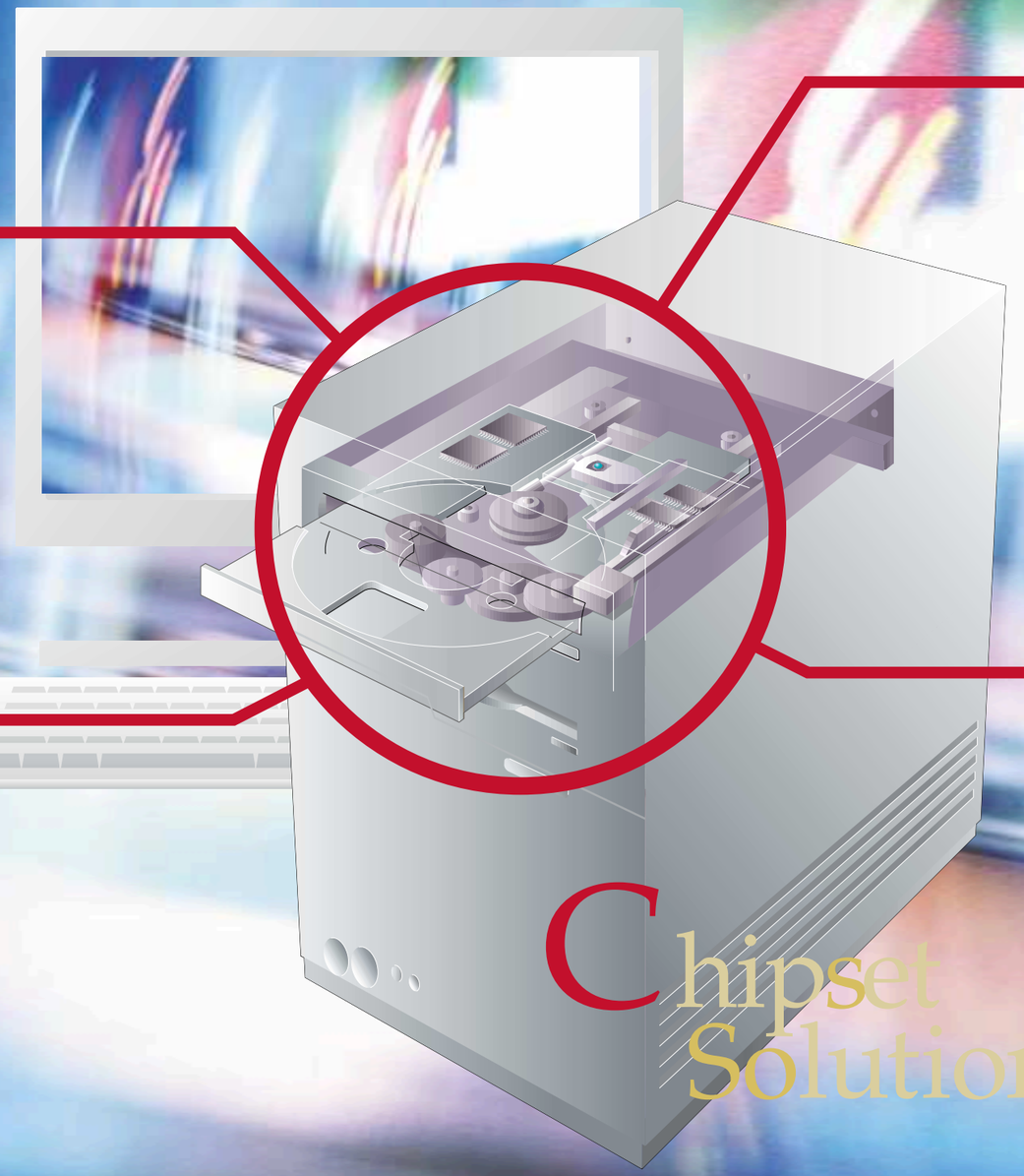
BURN-Proof® stands for Proof against Buffer UnderRuN Error, not for proof against burning.

Innovative spirit giving birth to new trends

Chip Set Solutions: Collections of SANYO's Perfected Technologies

Optical disc drives have flourished with the growth of multimedia. This explosive growth has brought with it demand for increased performance, new functionality, and greater ease of use. SANYO responds with chip set solutions consisting of all the necessary devices based on the company's unique technology.

Best Solution



Single-Chip Solutions that Support DVD-ROM and DVD-RAM

☛P.06

DVD-Dual System ICs

SANYO provides an extensive lineup of ICs that include SANYO DSP cores and servo firmware to flexibly support DVD, CD-ROM, and CD-R/RW media.

DVD-Dual ICs

DVD±R/RW: 12× write speed, DVD-ROM 16× playback
CD-R/RW/ROM: 48×/32×/48× speeds

LC897491 New product ☛P.08

DVD±R/RW: 16× write speed, 16× DVD-ROM playback
CD-R/RW/ROM: 52×/32×/52× speeds

LC897492 Under development ☛P.08

Includes SANYO's BURN Proof Technology High-Speed Playback and Write

☛P.12

CD-R/RW Encoder & Decoder

All necessary functions for CD-R/RW drive integrated on a single chip to achieve the system simplification

- Support for high-speed reads and writes
- Broad host interface support
- Built-in intelligent functions

Complete compatibility with ATAPI standards

52× playback and 52× writes

LC898095 ☛P.12

Extensive Lineup to Support User Needs

☛P.28

Motor Driver ICs

Offering custom-specification products tailored to users' needs

- High-output, high-gain actuator drivers
- Loading motor drivers using low-saturation vertical PNP
- Spindle motor drivers providing precise rotation
- Spindle and actuator drivers integrated on a single chip

Large-Capacity On-Chip Flash Memory

☛P.24

Flash Microcontrollers

The on-board programming and software data storage functions give these microcontrollers a degree of flexibility that is unthinkable with mask ROM microcontrollers.

8-bit flash microcontroller

Built-in 128 Kbytes of flash EEPROM

LC87F5JC8A Under development ☛P.24

Built-in 128 Kbytes of flash EEPROM

LC87F5CC8A Under development ☛P.24

LC87F5DC8A Under development ☛P.24

32-bit RISC Microcontroller

On-chip 512 Kbytes flash EEPROM

LC67F5104A ☛P.22

Built-in USB interface 8-bit flash microcontroller

On-chip 128 Kbytes flash EEPROM

LC87F16C8A New product ☛P.27

On-chip 128 Kbytes flash EEPROM

LC87F10C8A New product ☛P.27

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SANYO's ASSP differentiation in both multi-function and performance

SANYO Technologies Underpinning DVD-ROM/R/RW and CD-ROM/R/RW Drive Development

Best Solution

Functionality and performance of optical disc drives are improved by acceleration technology, recording control technology by the write strategy circuit and ATIP circuits, and by digital servo technology. Integration levels are increasing even further due to even higher precision fabrication technologies, and continuing research for the development of optical disc drives including DVDs, such as enhancing the variety of different host interface functions.

Constituent Technologies

Single-Chip Solutions Moving Optical Disc Drives Forward

Based upon the CD-ROM decoders achieved by the unique advanced technology, SANYO has developed ICs supporting a full complement of host interfaces. At the same time, it developed chipset solutions combining such functions as CD decoders, servo ICs, and the encoders required for writable versions of CD/CD-ROM technology.
Now that the industry is shifting to DVD-ROM, we continue to answer the need for streamlined optical disc drive designs with single-chip solutions building upon these core optical disc drive technologies and using precision fabrication of such ASIC macros as memory, analog-to-digital converters, digital-to-analog converters, and phased locked loops.

Boosting the Functionality and Performance of Optical Disc Drives

Higher rotational speeds

- SANYO digital signal processing technology now offers realtime error correction for playback speeds high.
- SANYO servo technology provides precision control over disc speed.

Recording control

- SANYO has boosted the performance of the ATIP servo, write strategy circuit, and other components of the recording control system.

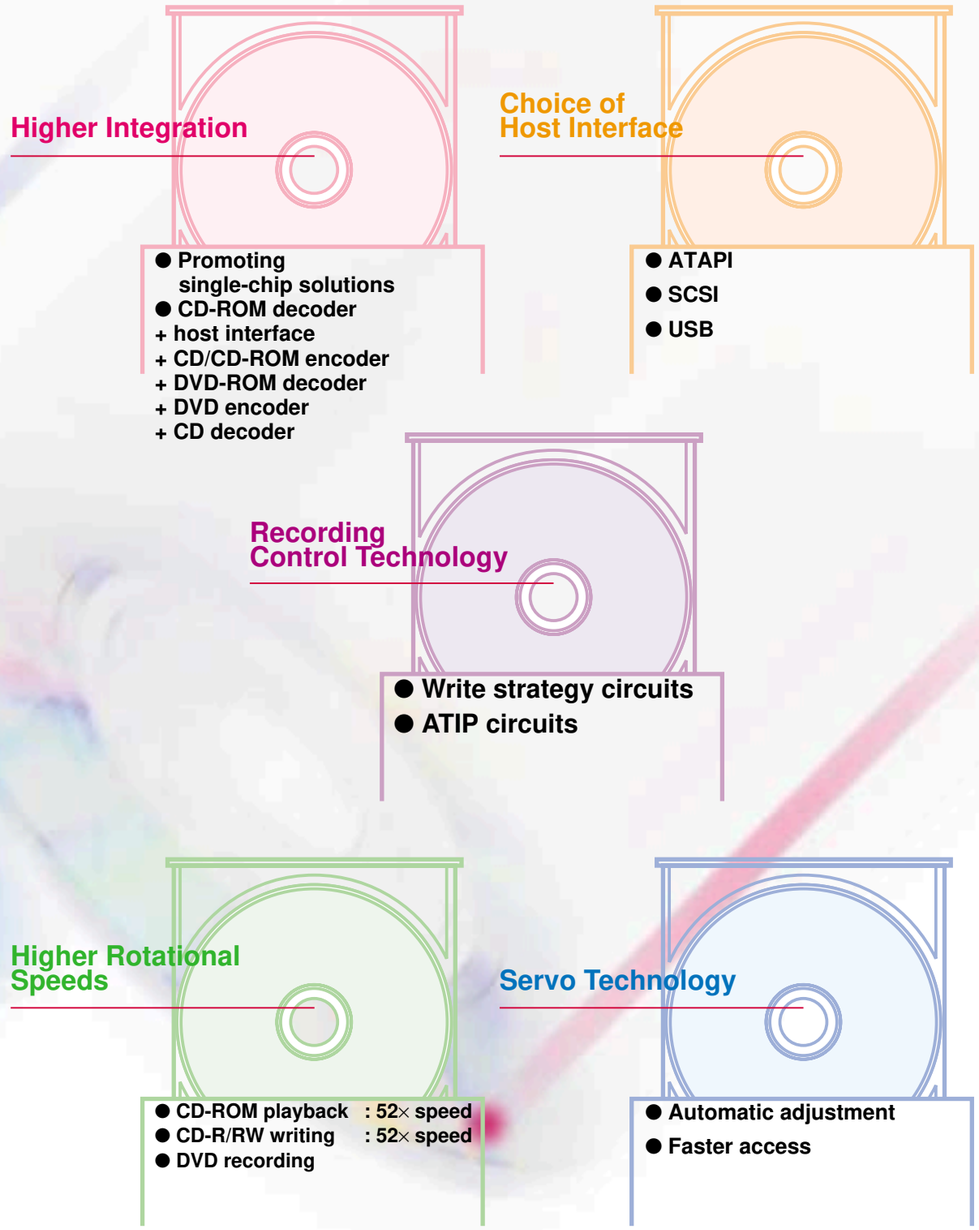
Host interfaces

- SANYO is promoting improved transfer speeds at the same time as supporting diversifying host interfaces.

Large-capacity on-chip flash memory

- Includes an even larger flash memory system to support the increasingly complex firmware required for combo drive.

SANYO is applying these advances to enhancing the functionality and performance of DVD-ROM drives as well.

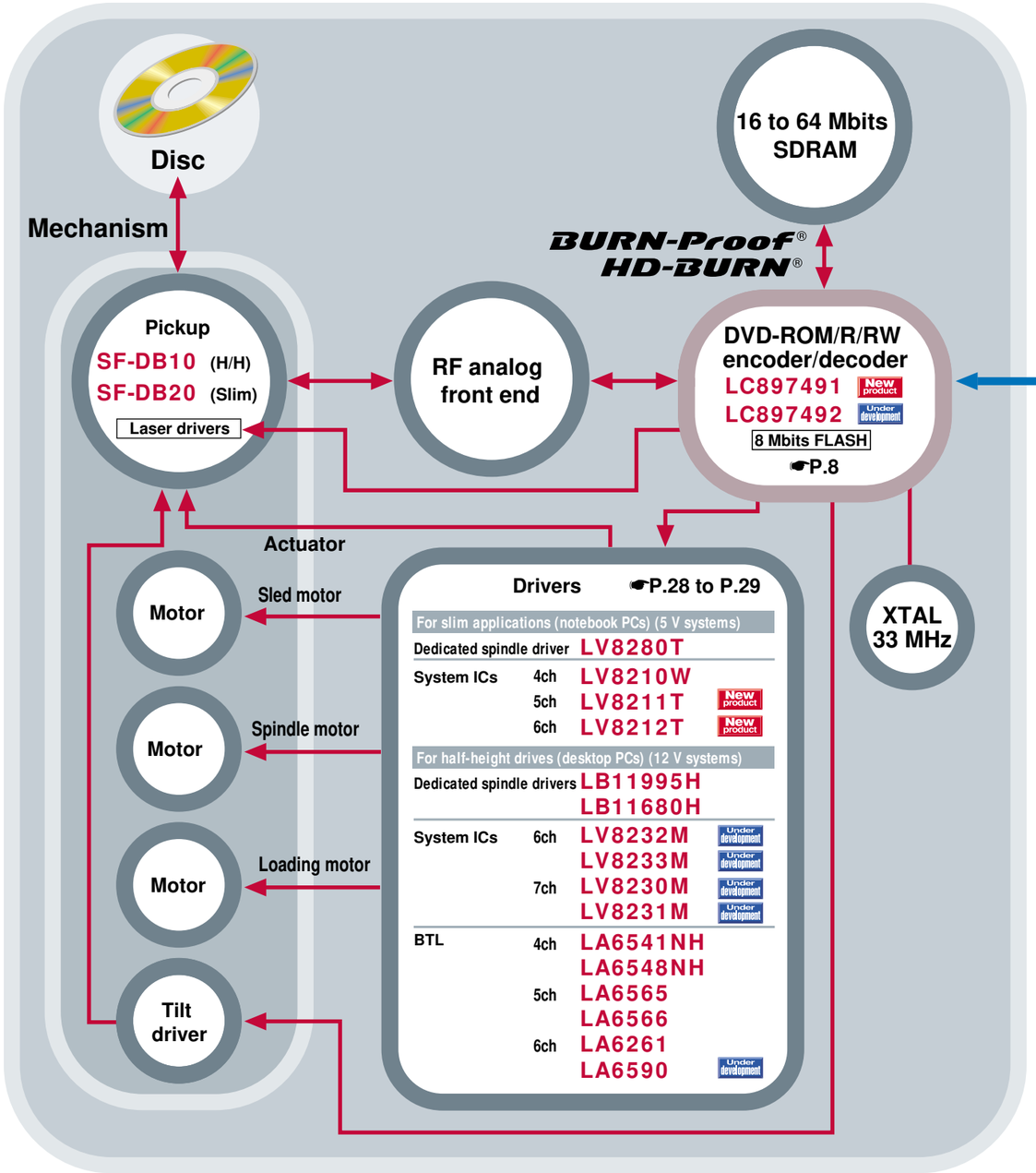


DVD-Dual System Chipsets

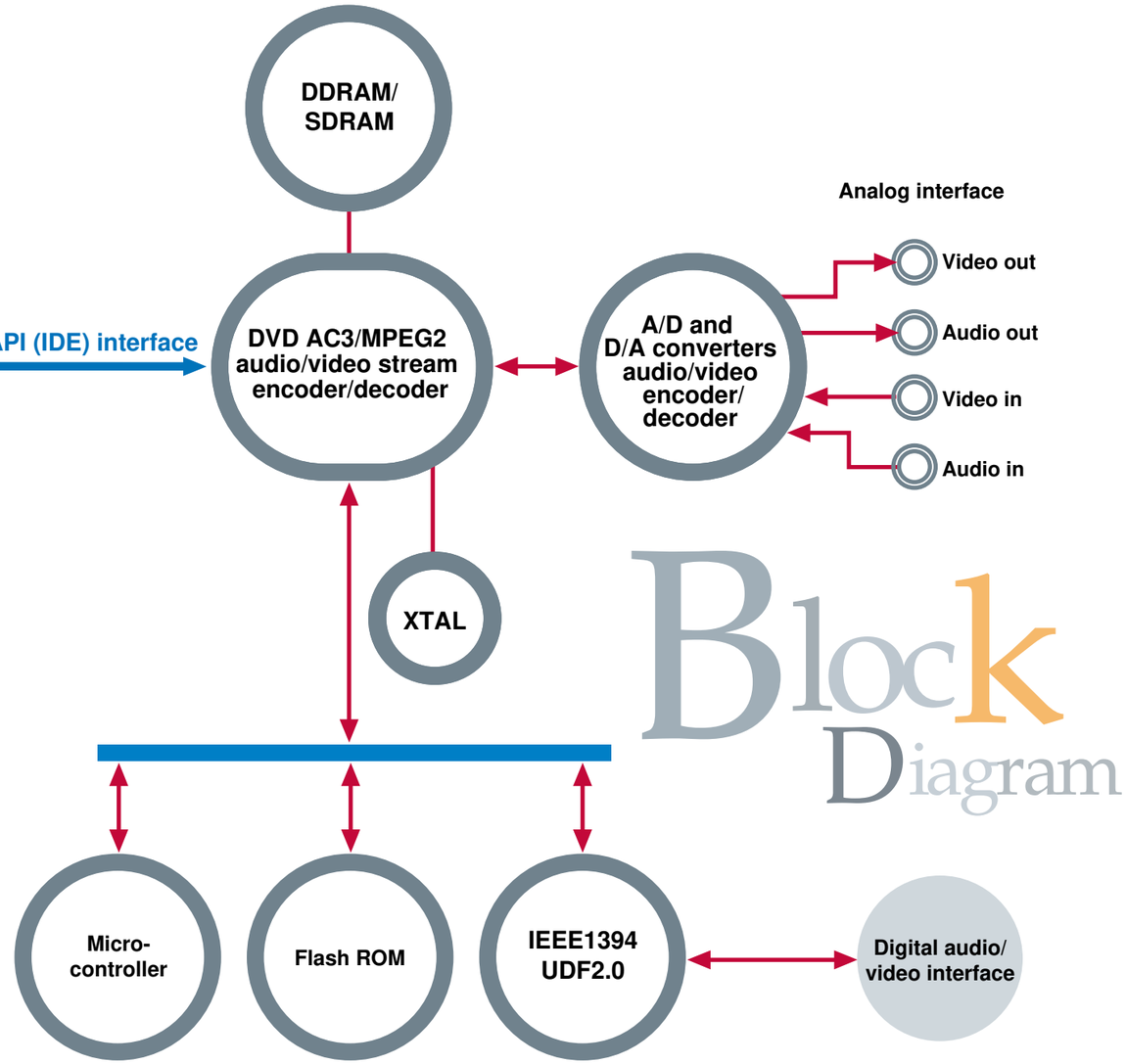
SANYO has now developed DVD-Dual ICs that integrate on a single chip both SANYO's unique CD technologies refined through extensive experience with dedicated CD-ROM and CD-R/RW ICs as well as DVD-ROM decoder and DVD-R/RW encoder functions.
These ICs support our customers' optical disc drive development efforts.

Chip Sets

DVD-ROM/R/RW Drive System



Block Diagram



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Single-Chip DVD-Dual System ICs that Support ATAPI (IDE)

Devices

Demand from the rapidly expanding DVD market for a shift to DVD-Dual, which promises more stable operation and higher recording speeds, is increasing. To respond to these needs, SANYO has now developed the LC897491 12×-speed DVD-Dual drive signal-processing IC. SANYO is also now developing the LC897492, which will feature 16× speed. These products incorporate 8 Mbits of flash memory, and require no external flash memory. Since either of these products in conjunction with an RF amplifier can implement all of the signal processing unique to DVD-Dual drives with just two chips, they can support significant simplification of end product designs.

DVD-Dual System ICs that provide 8 Mbits of built-in flash memory and support DVD-ROM/±R/RW and CD-R/RW

LC897491 BURN-Proof® HD-BURN® New product

LC897492 BURN-Proof® HD-BURN® Under development

DVD Record and Playback Functions

- DVD-ROM playback at up to 16× speed
- DVD±R/RW recording: Up to 12× speed (LC897491)
  Up to 16× speed (LC897492)
- DVD-ROM clock generation PLL (read channel)
- DVD-ROM playback ECC/EDC decoder and bit descrambler
- DVD±R/RW wobble and LPP recording clock generation PLL
- DVD±R/RW ECC/EDC encoder and bit scrambler
- DVD-R/RW LPP decoder (prerecorded data read)
- DVD+R/RW ADIP decoder (prerecorded data read)
- DVD±R/RW header (ID, CPR_MAI) generation and zero padding functions
- Supports the T/40 write strategy resolution
- 2K/32K/0 link support (DVD-R/RW)
- Lossless linking support (DVD+R/RW)
- Blank area detection function (unrecorded area detection)
- Recording can be started from arbitrary positions in 1 clock cycle units referenced to LPP/data.
- Encoded data arbitrary position setting function in 1 clock cycle units referenced to LPP/data.
- BCA read
- DVD multiblock transfer and reception functions
- CSS support, bus scrambler, DVD-MAC (used by CPRM)
- 2×-speed DVD-ROM reading

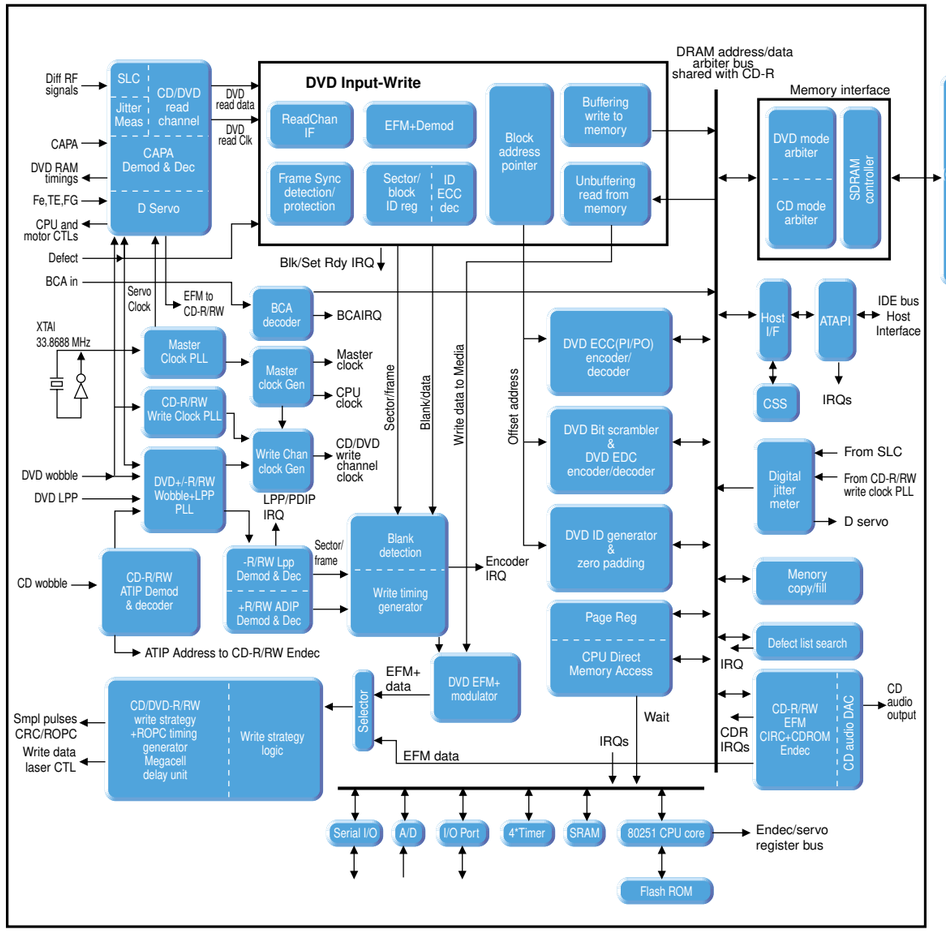
CD Record and Playback Functions

- CD-R/RW/ROM: 48×/32×/48× speeds (LC897491)
  52×/32×/52× speeds (LC897492)
- CD-ROM data and subcode data encoding and decoding
- BURN-Proof® technology
- CD analog audio output and digital audio output interfaces
- Batch transfer and multiblock transfer and reception functions
- Supports the T/32 write strategy resolution
- Support for CD-R high-density recording technology (HD-BURN®)

Shared Functions

- ATAP PIO: 16.6 MB/s, multiword DMA: 16.6 MB/s, Ultra DMA: 33 MB/s and 66 MB/s
- Up to 128 Mbits of external SDRAM
- Internal flash memory: 8 Mbits
- On-chip CPU
- Crystal oscillator: 33.8688 MHz
- Package: LQFP256
- Power supply: I/O: 3.3 V, internal: 2.5 V

LC897491/LC897492 Block Diagram



Block Diagram

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BURN-Proof® stands for Proof against Buffer UnderRuN Error, not for proof against burning.

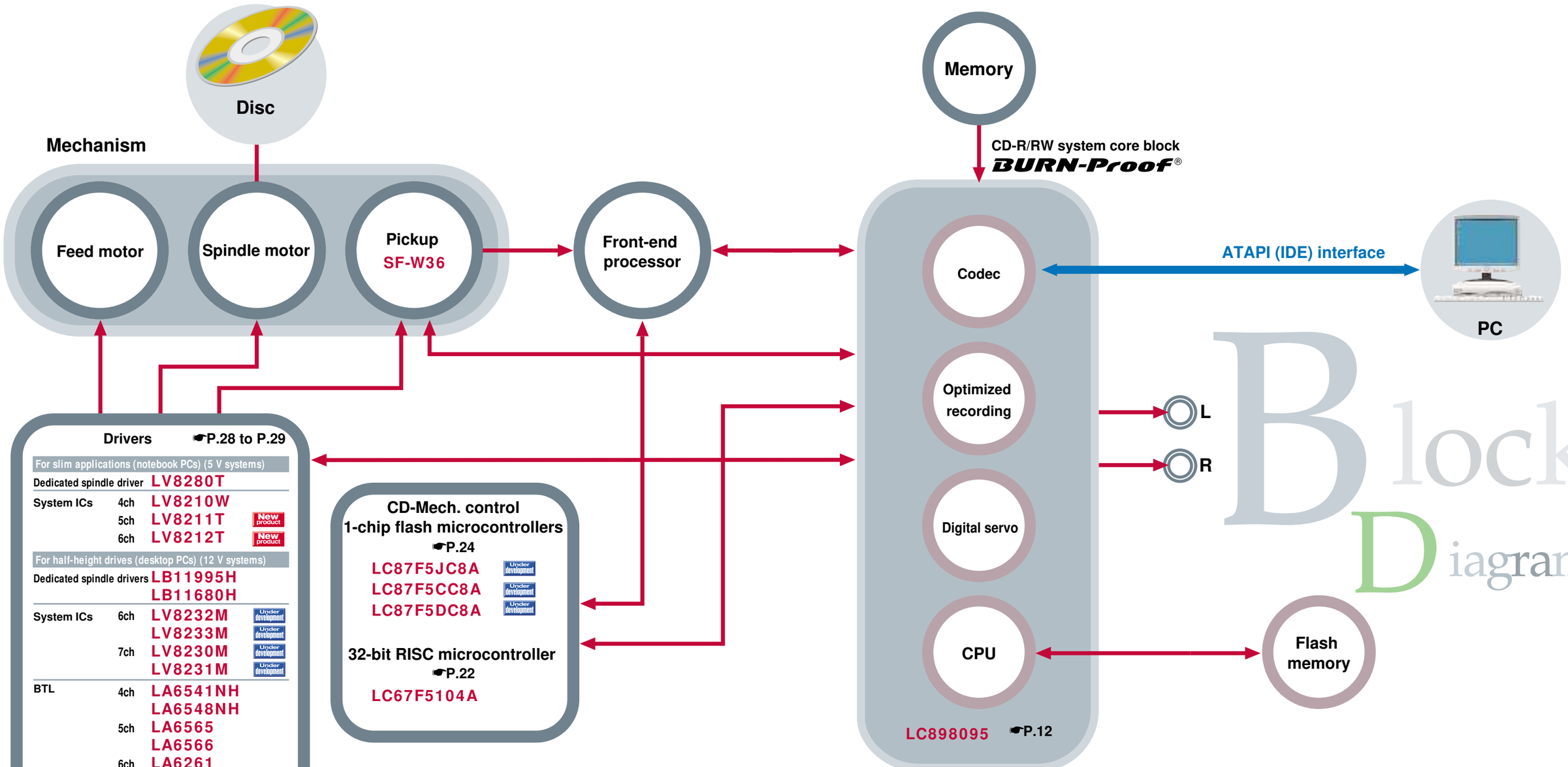
SANYO responds to diversifying product concepts for optical disc drives.

CD-R/RW System Chipsets

Chip sets that achieve significant simplifications in the recoding system by providing ATIP decoding and CLV servo functions and a write strategy circuit.

Chip Sets

Block Diagram



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Includes SANYO's BURN-Proof® Technology — High-Speed Playback and Write Performance

52× Playback, 52× Write CD-R/RW Encoder and Decoder ICs

ICs that achieve significant simplifications in CD-R/RW drives by integrating all the functions required for write operations, including ATIP servo functions, digital servo functions, an ATAPI interface circuit, on a single chip.

ATAPI Interface 52× Playback, 52× Write CD-R/RW Encoder and Decoder IC

LC898095

BURN-Proof®

Functions

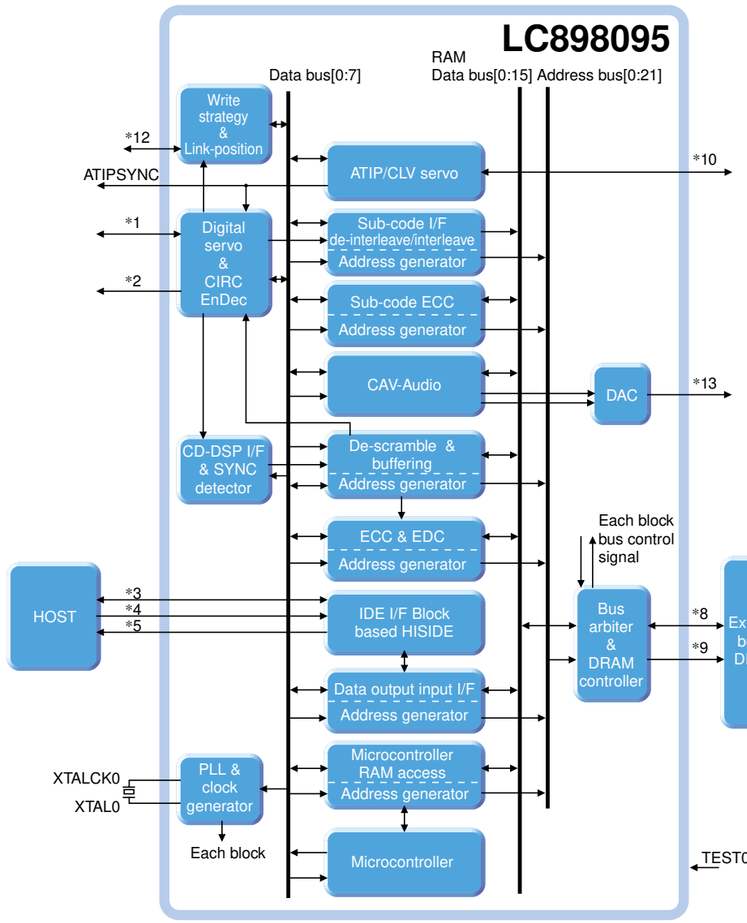
- CD-ROM decoding and encoding functions
- CD decoding and encoding functions
- Pit and wobble CLV servo functions
- ATAPI interface (includes the register block)
- CAV-audio function
- CD-TEXT support
- Built-in CPU(80251)
- Subcode decoding and encoding functions
- ATIP demodulating/decoding functions
- Write strategy function (CD-R/RW)
- BURN-Proof® technology
- CAV recording functions
- Buffer RAM mapping function
- Package: LQFP256

Features

- ECC and EDC correction/addition for CD-ROM data
- Decoding and encoding for subcode data
- Servo control implemented in a digital servo system
- CLV/CAV servo control using ATIP data
- ATIP decoding function and CRC check function
- A random EFM signal can be output for PCA use.
- A high-precision write strategy signal can be output (supports 52×-speed CD-R and 24×-speed CD-RW)
- Buffer RAM can be accessed by the built-in microcontroller through the LC898095.
- Built-in ATAPI interface (with Ultra DMA modes 0, 1, and 2 support)
- Supports 52×-speed decoding and 52×-speed encoding (Operating frequency 33.8688 MHz)
- Transfer rates: Up to 16.6 MB/s whenPIO mode used (with IORDY), up to 33 MB/s when Ultra DMA used (with DMARQ).
- CD main channel, C2 flag and subcode areas within external buffer RAM can arbitrarily be set by the user.
- Batch transfer function (Function which sends CD main channel, C2 flag, subcode, etc. all at once.)
- Multiblock transfer function (Function which automatically sends multiple blocks at once.)
- The flash ROM access time can be changed with configuration settings.
- Register-based CPU that features registers that can be accessed in byte, word, and double-word units.
- Source code compatible with the Intel 8051, full compatibility with the Intel 80251.
- High-speed instruction fetch using 16-bit fetch, page mode fetch, and prefetch operations.
- General-purpose 7-input 8-bit A/D converter and 6-input 8-bit D/A converter
- General-purpose I/O ports (24 ports) and LED drive ports (2 ports)
- Provides a pin for command connection with the AFE (This pin is also used for general-purpose serial data transfer.)
- Supports stepping motors.

LC 898095

Block Diagram



*1 DSLB(PN96) to FR(PN123), AD0(PN127) to SPDO(PN142), SHOCK(PN147) to PCK2(PN155)
*2 SUBSYNC
*3 DD0 to DD15, $\overline{DASP}$, $\overline{PDIAG}$
*4 $\overline{CS1FX}$, $\overline{CS3FX}$, DA0 to DA2, $\overline{DIOR}$, $\overline{DIOW}$, $\overline{DMACK}$
*5 DMARQ, HINTRQ, $\overline{IOCS16}$, IORDY
*6 $\overline{RD}$, $\overline{WR}$, SUA0 to SUA7, $\overline{CS}$
*7 D0 to D7
*8 IO0 to IO15
*9 RA0 to RA9, $\overline{RAS0}$, $\overline{RAS1}$, $\overline{RAS2}$, $\overline{CAS0}$, $\overline{CAS1}$, $\overline{OE}$, $\overline{UWE}$, $\overline{LWE}$
*10 WOBBLE, BIDATA, BICLK
*12 WRITE, SSP2/1, RAPC, WAPC, H11T0, LDH, TEST2/1, WDAT, NWDAT, EFMG
*13 LOUT, ROUT

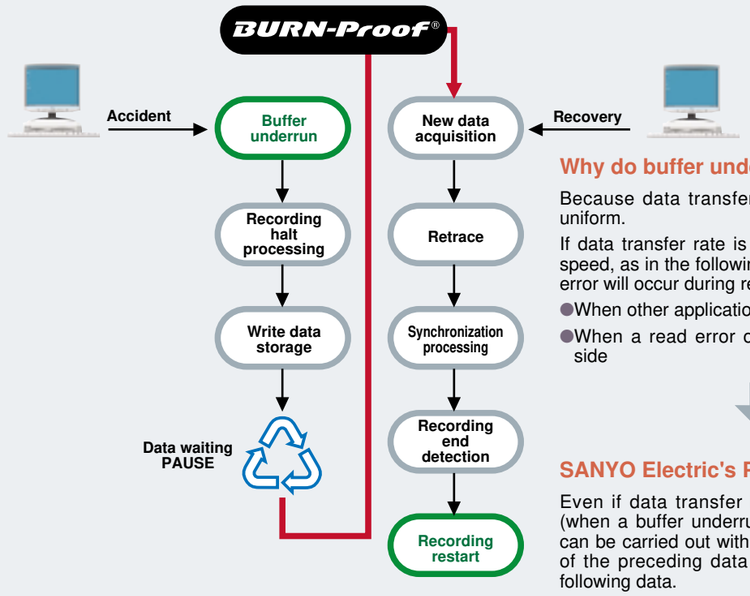
BURN-Proof® is a registered trademark of SANYO Electric Co., Ltd.
BURN-Proof® stands for Proof against Buffer UnderRuN Error, not for proof against burning.

BURN-Proof® and HD-BURN®

BURN-Proof®

SANYO, the world-leader in high-speed recording CD-R/RW products, has developed a revolutionary technology that solves the problem of buffer underrun errors during CD-R/RW recording. This technology eliminates the previously intractable problem of write failures due to buffer underrun errors, and enables CD-R writes to be executed with complete dependability.
Industry standardization of this technology is moving ahead, and it will be coming into wide use under the name BURN (Buffer Under Run)-Proof.

In order to create a CD-DA/CD-ROM compatible disc, the CD-R must record receive data continuously on the disc. If data transfer is interrupted for some reason, a buffer underrun error will occur, and the resulting disc will not be readable by a CD-ROM drive.



Why do buffer underrun errors occur?

Because data transfer from the host PC is not uniform.

If data transfer rate is slower than the recording speed, as in the following cases, a buffer underrun error will occur during recording.

- When other application software is started
- When a read error occurs on the data source side

SANYO Electric's Proposal

Even if data transfer is temporarily interrupted (when a buffer underrun error occurs), recording can be carried out with no seam between the end of the preceding data and the beginning of the following data.

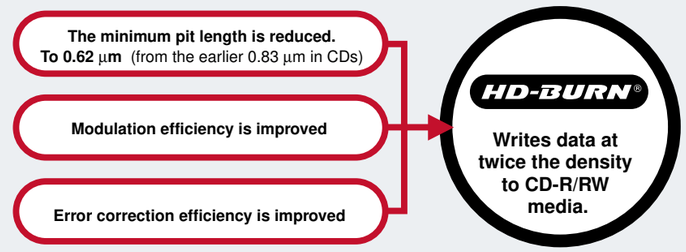
Features of BURN-Proof Function

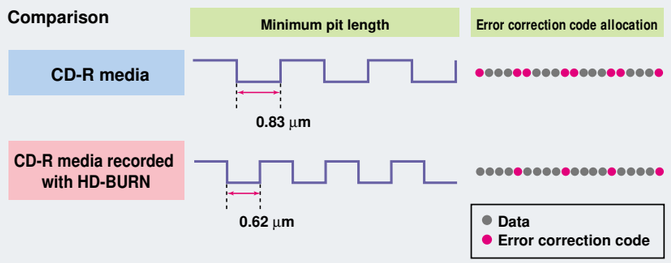
1. A recording error does not occur, and data is guaranteed, in the event of a buffer underrun error
2. CD-R recording is easily possible regardless of the personal computer environment
3. Multitasking can be carried out during CD-R/RW recording
4. Failures of disc direct back-up from a CD-ROM drive to a CD-RW drive are greatly reduced

HD-BURN®

High-Density CD-R Recording Technology

HD-BURN is a high-density recording technology that allows 1.4 GB, twice the normal capacity, to be stored on a single CD-R media. Discs created with the HD-BURN technology are highly compatible with existing DVD player technology, and can be read on most players simply by updating the firmware. HD-BURN technology, which responds to needs for greater flexibility and lower priced data recording, show great promise as a supplementary function for CD-R and DVD recording systems.





Features of the HD-BURN Technology

1. Records twice the amount of data on standard commercial CD-R media.
2. Uses the CLV recording technique. In HD-BURN mode, the player writes at up to 36× speed (relative to normal speed CD-ROM), and reads at up to 80× speed.
3. This IC includes the BURN-Proof function (see page 15) and prevents write errors due to buffer underrun.
4. Includes DVD video format authoring functions, including file conversion from the DV format.
5. Can write data to commercial CD-RW media at a CD-ROM speed of 24× in HD-BURN mode.

*: The HD-BURN function operates with the following CD-R writing application software: "B's GOLD" (BHA Corporation) and "Nero" (Ahead Software).

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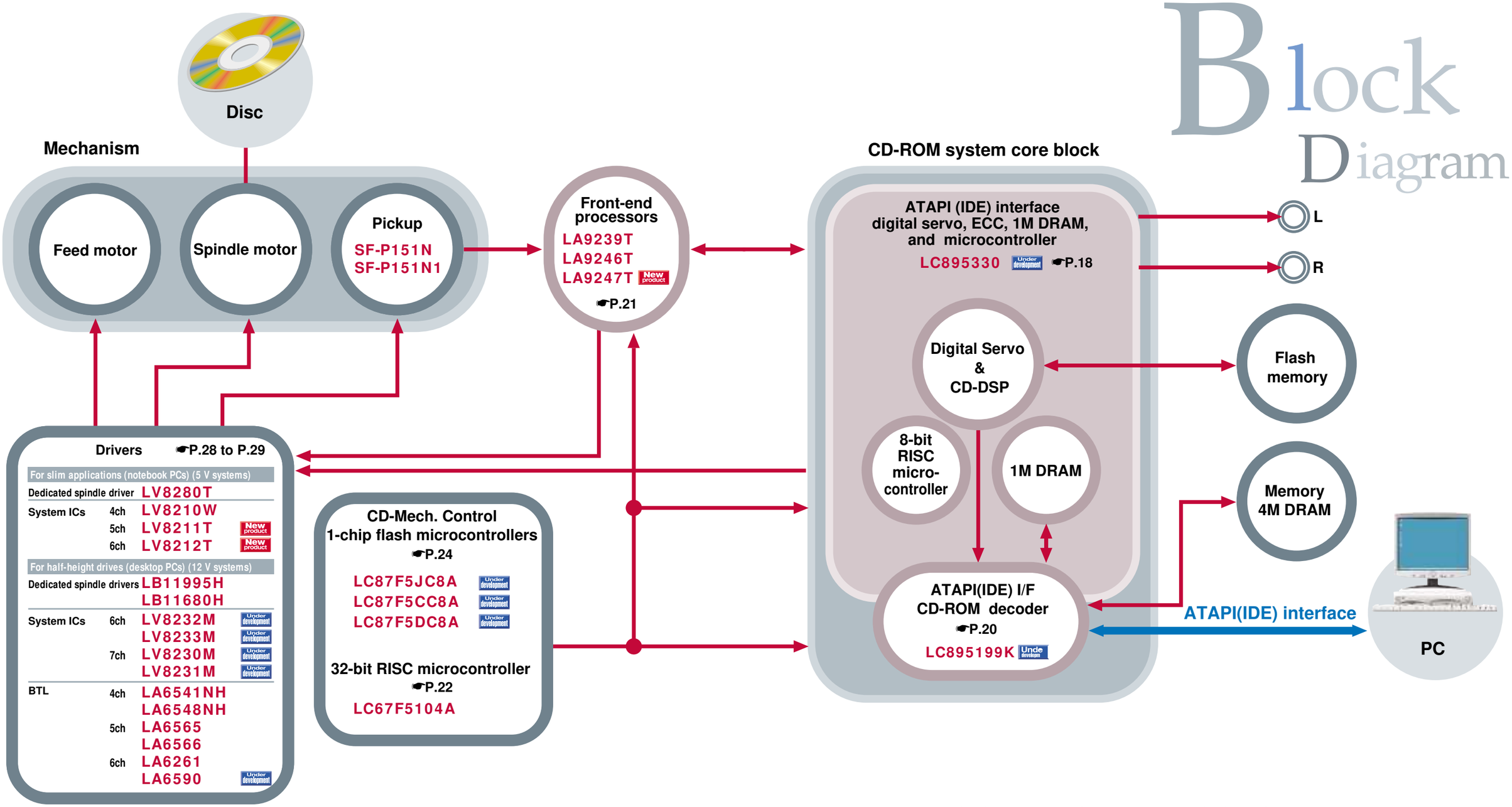
SANYO responds to diversifying product concepts for optical disc drives.

CD-ROM System Chipsets

Complete conformity to ATAPI-related standards. We have achieved high-speed CAV control CD-ROM.

Chip Sets

Block Diagram



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Decoder ICs for 48× ATAPI (IDE) CD-ROM Drives

Only SANYO, the first to commercialize ICs combining CD-ROM decoding and error correction functions, offers such a broad lineup covering so many needs.

48× ATAPI (IDE) CD-ROM Decoder and CD-DSP IC with Built-in Digital Servo and Microcontroller

LC895330

Under development

CD-DSP block

- 48× complete CAV possible
- Frame synchronization signals are detected, protected and interpolated, ensuring stable data readout.
- EFM signal is demodulated and converted to 8-bit symbol data.
- After subcode Q signal is subjected to a CRC check, it is output to microprocessor via parallel I/O.
- Performs the unscrambling and deinterleaving operations that reorder the demodulated EFM signal to the stipulated order.
- Detection, correction and flag processing of error signals (C1: dual, C2: quadruple)
- C2 flag is set after comparing C1 flag and C2 check results, and signal interpolation and muting is carried out by the C2 flag.
- Muting function that provides both zero-cross muting and soft muting.
- Independent digital attenuators for the left and right channels (8-bit precision). This attenuator function provides both direct attenuation and soft attenuation.
- Bilingual support
- Digital audio interface that supports both CLV and CAV playback.
- Digital de-emphasis
- 8× oversampling and digital filtering
- Digital to analog converter (PWM output)

CD-ROM decoder, ATAPI (IDE) I/F block

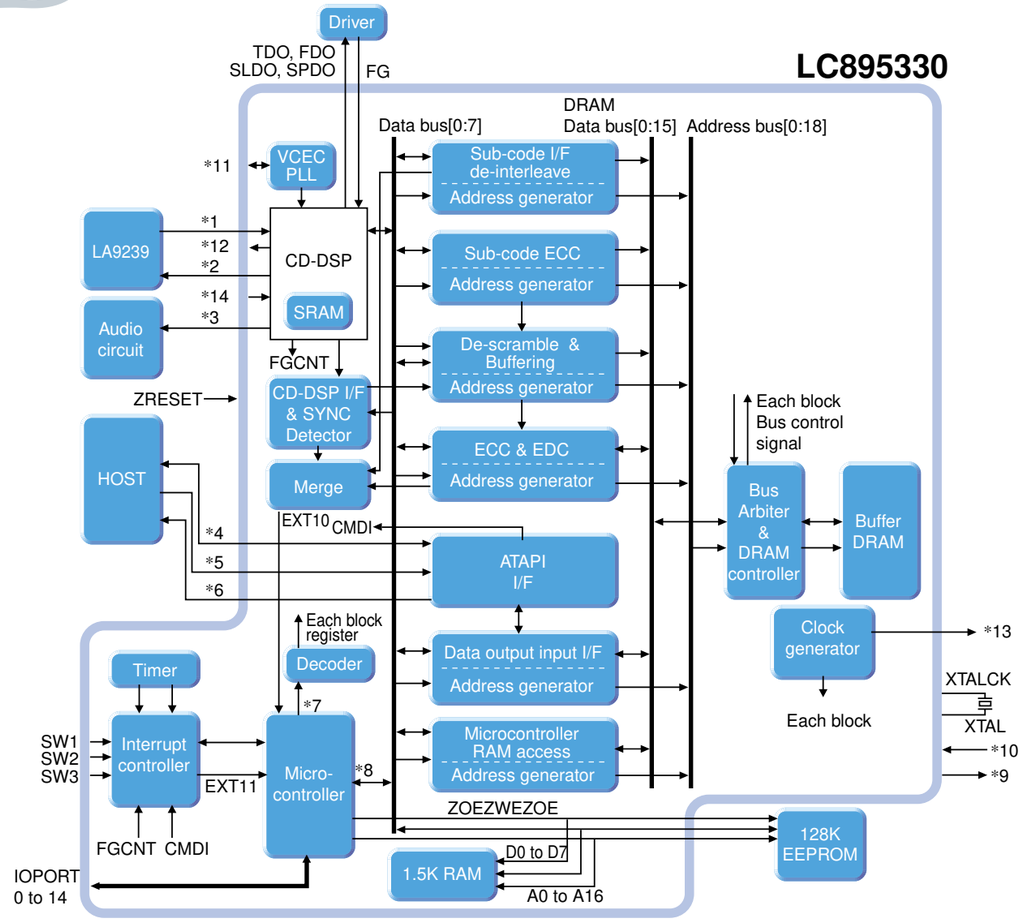
- ATAPI (IDE) interface
- 1-Mbit EDO-DRAM
- CD main channel, C2 flag and subcode areas within on-chip buffer DRAM can arbitrarily be set by the user.
- Batch transfer function (Function which sends CD main channel, C2 flag, subcode, etc. all at once.)
- Multiblock transfer function (Function which automatically sends multiple blocks at once.)
- CAV-audio function
- Subcode P-W buffering function (No-ECC) and CD-TEXT support
- Ultra DMA MODE 2, MODE 1, MODE 0 support

Microcontroller block

- Intel 8051 equivalent microcontroller
- The built-in Intel 8051 equivalent core is, on average, eight times faster than the original Intel 8051.
- Performs 16-bit calculations.
- Timer 0.1 circuits
- Program download function for external flash memory

- Package: LQFP176

Block Diagram



*1 EFMIN, EFMIN2, PH, BH, FE, TE, TES, RREC
*2 RHLD, TSH, EQS, GHS, LDON, FBAL, TBAL, TOFST, SGC
*3 LOUT, ROUT, DOUT
*4 DD0 to DD15, ZDASP, ZPDIAG
*5 ZCS 1FX, ZCS 3FX, DA0 to DA2, ZDIOR, ZDIOW, ZDMACK, ZHRST, CSEL
*6 DMARQ, HINTRQ, ZIOCS16, IORDY
*7 ZRD, ZWR, ZCS, MCK, SUA0 to SUA7
*8 D0 to D7
*9 CRCERR/FLOCK, HFLO/WRQ/DIR/TLOCK, FSEQ, FSX/LRCK/FV, EFLG/CK2/PRF, C2F/PCK, EFMOUT
*10 TEST0 to TEST2
*11 PCKISTF, PCKIFTP, PDO, POS1 to POS3, FR
*12 SLCO0 to SLCO3, JITC, DSLB, PHC, BHC
*13 PLL1
*14 SLCIT1 to SLCIT2, AD1, VREF, CSS

Decoder ICs for 40× ATAPI (IDE) CD-ROM Drives

Only SANYO, the first to commercialize ICs combining CD-ROM decoding and error correction functions, offers such a broad lineup covering so many needs.

Decoder IC for 40× ATAPI (IDE) CD-ROM Drives

LC895199K

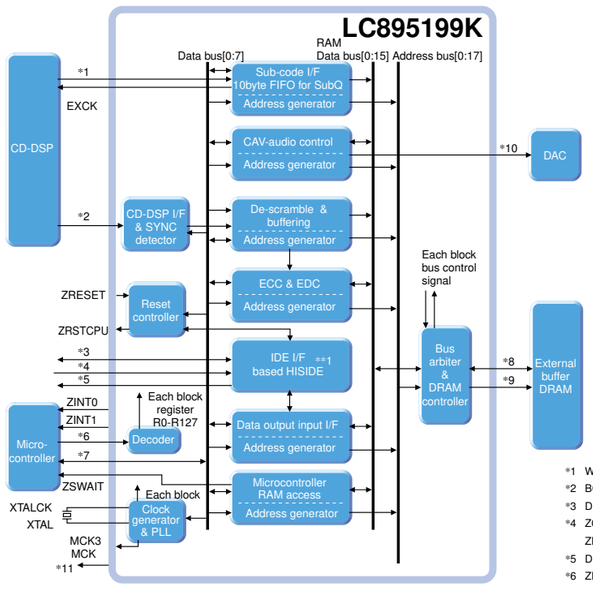
Under development

Functions

- CD-ROM ECC functions
- Subcode reading functions
- ATAPI(IDE) interface (register block and other components)
- CAV audio playback function

Features

- ATAPI (IDE) interface
- 40× capable — EDO-DRAM (×16, 50 ns) used; 16.6 Mbytes/s (with IORDY); Operating frequency 33.8688 MHz
- 40× capable — EDO-DRAM (×16, 35 ns) used; 16.6 Mbytes/s (without IORDY); Operating frequency 33.8688 MHz
- 24× capable — EDO-DRAM (×16, 50 ns) used; 16.6 Mbytes/s (without IORDY); Operating frequency 33.8688 MHz
- 1 Mbits to 4 Mbits of DRAM can be connected as external buffer RAM.
- CD main channel, C2 flag and subcode areas within external buffer RAM can arbitrarily be set by the user.
- Batch transfer function (Function which sends CD main channel, C2 flag, subcode, etc. all at once.)
- Multiblock transfer function (Function which automatically sends multiple blocks at once.)
- CAV-audio function
- Subcode P-W buffering function (No-ECC) and CD-TEXT support
- Ultra DMA MODE 2, MODE 1, MODE 0 support
- Package: SQFP144



Block Diagram

*1 WFCK, SBSO, SCOR
*2 BCK, SDATA, LRCK, C2PO
*3 DD0 to DD15, ZDASP, ZPDIAG
*4 ZCS1FX, ZCS3FX, DA0 to 2, ZDIOR, ZDIOW, ZDMACK, CSEL
*5 DMARQ, HINTRQ, ZIOCS16, IORDY, ZHRST
*6 ZRD, ZWR, SUA0 to 6, ZCS, CSCTRL
*7 D0 to D7
*8 IO0 to IO15
*9 RA0 to RA8, ZRAS0, ZCAS0, ZOE, ZUWE, ZLWE
*10 DBCK, DLRCK, DSDATA
*11 IOP0 to IOP7
**1 HISIDE(WD25C32) is made by WESTERN DIGITAL.

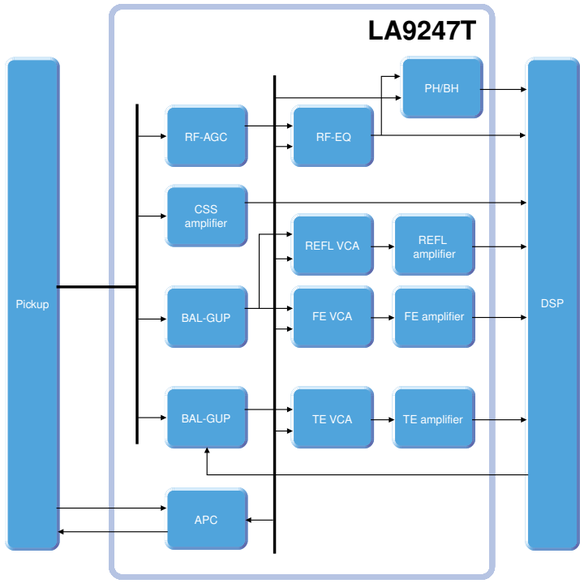
Front-End Processors

LA9239T
LA9246T
LA9247T

New product

Features

- RF amplifier (with AGC)
- RF gain amplifier (supporting CD-RW disc playback)
- RF equalizer (7 modes)
- RF hold function
- PH/BH detection
- FE amplifier (built-in VCA for balance adjustment)
- TE amplifier (built-in VCA for balance adjustment)
- Servo signal VCA circuit
- APC circuit (includes a laser power switching function)
- Sleep function
- Supply voltage: 5 V, 3.3V (only for LA9247T)
- Package: TSSOP36



Block Diagram

CD-ROM digital servo IC Series

Type number	Recommended supply voltage	Package	DSP-I/F	Pick-I/F	CD-ROM speed
LA9239T	5 V	TSSOP36	5 V	5 V (A + C), (B + D)	48×
LA9246T	5 V	TSSOP36	5 V	5 V (A + B + C + D)	48×
LA9247T New product	5 V, 3.3 V	TSSOP36	3.3 V	5 V (A + B + C + D)	52×

32-Bit RISC Microcontrollers

Devices

These microcontrollers achieve performance and functionality improvements in optical disc drives with recording technologies such as acceleration technologies and write strategy and ATIP circuits as well as digital servo technologies. Furthermore, finer design rules mean that SANYO's system on chip and system IC technologies are evolving even further.
SANYO is committed to continuing to invest in R&D to support further developments in DVD and other optical disc drives

Large On-chip Flash EEPROM Capacity

LC67 Series

ARM POWERED®

Overview

The LC67 Series products are multi-function high-speed single-chip 32-bit CMOS microcontrollers based on the ARM7TDMI® de facto industry standard CPU core. They feature large memory capacities of up to 4 Mbits of on-chip flash ROM and 128 Kbits of SRAM. These microcontrollers allocate the last 16 KB of flash ROM as a dedicated boot area to allow on-board downloading of data and code even when mounted in an end product.

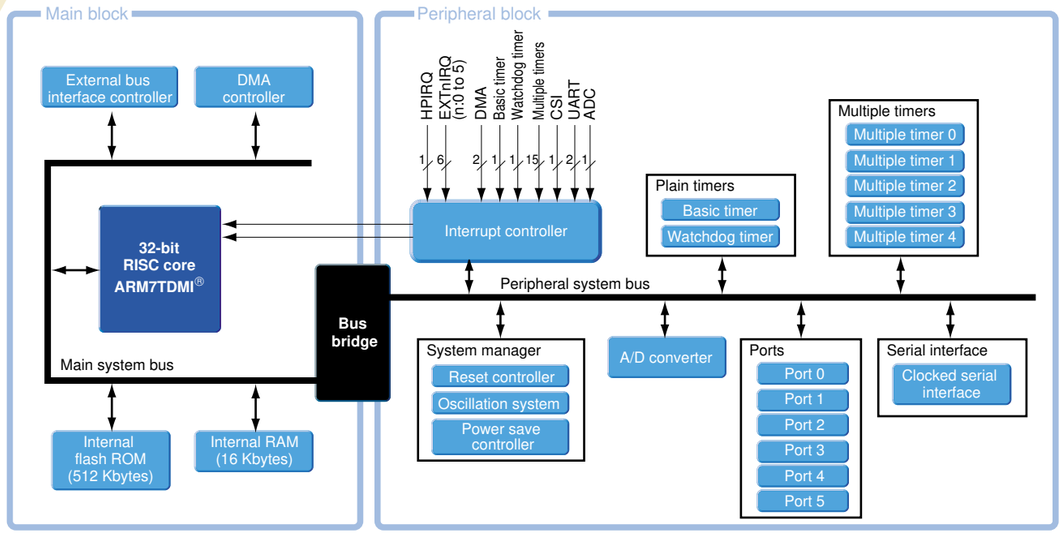
The LC67 Series are particularly well suited for control of PC peripherals, such as CD-R/RW and hard disk drives since they integrate, on the same chip, a wide range of peripheral functions, including DMA controller, interrupt controller, serial interface, UART, 8-bit A/D converter, multi-function timer, watchdog timer, and power saving functions. They also provide an external memory space consisting of four independent 16 MB areas. Chip select can be applied to each of these areas for independent control.

Target Applications Using LC67 Series

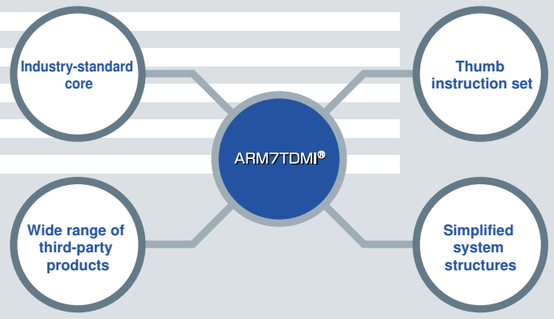
LC67 Series

	LC67F5106A (New product)	LC67F5104A
Package	TQFP100	
Operating supply voltage	Internal: 2.5 V, I/O, A/D converter: 3.3 V	
Flash ROM	6 Mbits	4 Mbits
SRAM	256 Kbits	128 Kbits
Maximum operating speed	18 MHz	
Number of I/O pins	68 I/O pins, 8 input pins	
Number of interrupts	External: 7, internal: 23	
Timers	16 bits × 5 channels (multifunction timer), 16 bits × 1 channel (basic timer)	
SIO	One channel	
UART	One channel	
A/D converter	Eight-channel 8-bit A/D converter	
DMAC	Two channels	
Power saving function	Sleep and standby modes	

Block Diagram



Features of ARM7TDMI®



Development Environment
- Flash writer: Ando AF-9708
- Emulator: Yokogawa Digital Computer Corporation ADVICE (PW920)
  Sofia Systems Co., Ltd. UniSTAC

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8-Bit Flash Microcontrollers

Devices

SANYO's LC87 Series of 8-bit microcontrollers features a rich instruction set. A high-speed parallel interface, serial I/O with automatic transfer, and high-speed computation make the LC87 microcontrollers ideal for CD-ROM/R/RW drives and similar embedded control applications. The flash memory versions support onboard rewriting of memory contents, providing flexibility that helps shorten development times for application systems.

LC87 Series

Overview

The LC87 Series products are multifunction high-speed 8-bit single-chip CMOS microcontrollers that provide a rich set of multiply and divide and 16-bit access instructions. They are based on the LC87 core, which features a 256K program ROM space. The flash memory versions support on-board rewriting of memory contents, providing flexibility that helps shorten development times for application systems.

The LC875 Series consists of single-chip microcontrollers with a broad range of the functionality necessary for real-time equipment control systems: high speed CPU core, ROM, RAM, parallel interface, 8-bit analog-to-digital converter, 16-bit timer/counters with input capture, 16-bit timer/counters configurable for PWM output, clock timers, watchdog timers, two 8-bit serial I/O channels with automatic transfer functions, asynchronous/synchronous serial I/O, 12-bit PWM, I/O ports, rich types of interrupt, and standby modes of operation.

Features

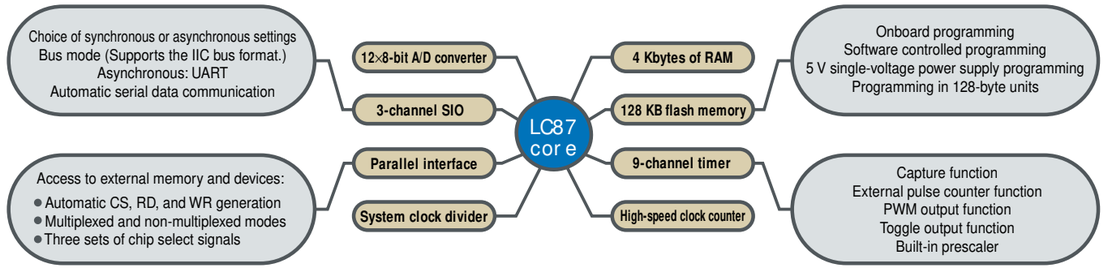
- 16 to 256 Kbytes of ROM
- 1024 to 8192 bytes of RAM
- 8-bit analog-to-digital converters with 12 channels
- 16-bit timer/counter 0 with input capture and four operating modes
  - Mode 0: Two 8-bit timers with 8-bit programmable prescalers
  - Mode 1: 8-bit timer with 8-bit programmable prescaler plus 8-bit counter
  - Mode 2: 16-bit timer with 8-bit programmable prescaler
  - Mode 3: 16-bit counter
- 16-bit timer/counter 1 with four operating modes
  - Mode 0: 8-bit timer plus 8-bit timer/counter
  - Mode 1: Two 8-bit PWM outputs
  - Mode 2: 16-bit timer/counter
  - Mode 3: 16-bit timer with PWM output from lower 8 bits
- Four 8-bit timers with 6-bit programmable prescalers
- 14-bit clock timer
- Watchdog timer (requires external RC circuit)
- Two 8-bit serial I/O channels with automatic transfer function for up to 32 bytes
  - Two 8-bit baud rate generators
  - Maximum clock of 4/3 t_{CYC}
- One 8-bit synchronous/asynchronous SIO channel
  - Asynchronous clock: 8 to 2048 t_{CYC}
  - Synchronous clock: 2 to 512 t_{CYC}
- Two 12-bit PWM outputs
- Remote control receive circuit
- Broad interrupt support
  - 21 interrupt sources (7 external + 14 internal) and 10 vectors (LC87F52C8A)
  - 3-level multiplexed interrupt support
- Standby modes: HALT, HOLD, and clock HOLD
- High-speed operation
  - Minimum cycle time: 0.3 µs (bus cycle 0.1 µs)
  - Bit manipulation instruction cycle for registers and RAM: 0.3 µs
- Highly orthogonal instruction set (LC87 Series)
  - Powerful multiply/divide instructions: 24 × 16, 24/16, 16 × 8, 16/8
  - Additional 16-bit instructions
- Support for additional ROM
  - The LC87 core supports up to 256 Kbytes of program ROM, 64 Kbytes of RAM for calculations and stack, and 16 Mbytes for data memory.
- On-board programming
  - The flash ROM versions in the LC87 Series permit rewriting of the on-board ROM with a single power supply even after the chip has been mounted on the circuit board.

*: The products presented in this section are representative examples.

For further details, refer to SANYO's microcontroller catalogs and the data sheets for the individual products.

Built-in: 256 Kbytes of Flash EEPROM

LC87F5CC8A



Type Number	ROM [bits]	RAM [bits]	Operating suply voltage range VDD [V]	Ports	Features: Interrupt Internal	Features: Interrupt External	Features: Serial I/O	Features: Maximum number of timers	Features: A/D converter	Delivery format
✻ LC875J48C	48K × 8	2048 × 9	2.5 to 5.5	55	14	7	Synchronus: Two 8-bit channels with automatic transter support Asyncronous/syncronous: Two 8-bit channels	8 bits × 8 For realtime clock × 1	8 bits × 11	QFP64 TQFP64
✻ LC875J56C	56K × 8									
✻ LC875J64C	64K × 8									
✻ LC87F5JC8A	128K × 8 (Flash)	4096 × 9								
✻ LC875D48C	48K × 8	2048 × 9	2.5 to 5.5	71	14	8	Synchronus: Two 8-bit channels with automatic transter support Asyncronous/syncronous: Three 8-bit channels	8 bits × 8 For realtime clock × 1	8 bits × 15	QFP80 (14 × 14) (14 × 20) TQFP80
✻ LC875D56C	56K × 8									
✻ LC875D64C	64K × 8									
✻ LC875D72B	72K × 8	4096 × 9								
✻ LC875D80B	80K × 8									
✻ LC875D96B	96K × 8									
✻ LC87F5DC8A	128K × 8 (Flash)									
☆ LC875BH4A	176K × 8	4096 × 9	2.5 to 6.0	89	19	7	Synchronus: Three 8-bit channels with automatic transter support Asyncronous/syncronous: Two 8-bit channels with bus support	8 bits × 8 For realtime clock × 1	8 bits × 12	QFP100 TQFP100
☆ LC875BJ0A	192K × 8									
☆ LC875BM2A	224K × 8									
☆ LC875BP4A	256K × 8									
✻ LC875C48C	48K × 8	2048 × 9	2.5 to 5.5	89	14	8	Synchronus: Two 8-bit channels with automatic transter support Asyncronous/syncronous: Three 8-bit channels	8 bits × 8 For realtime clock × 1	8 bits × 15	QFP100 TQFP100
✻ LC875C56C	56K × 8									
✻ LC875C64C	64K × 8									
✻ LC875C72B	72K × 8	4096 × 9								
✻ LC875C80B	80K × 8									
✻ LC875C96B	96K × 8									
✻ LC87F5CC8A	128K × 8 (Flash)									

☆: New product ✻: Under development

Flash memory products are licensed from Silicon Storage Technology, Inc. (USA), and manufactured and sold by SANYO Electric Co.,Ltd.

Large-capacity Flash Memory and Conformance with the USB 1.1 Standard

Flash Microcontrollers with On-Chip USB Interface Engine

Devices

These microcontrollers feature the ability to reload software while installed in the end product by downloading over a USB interface using SANYO's flash memory onboard programming system and a USB interface that conforms to version 1.1 of the USB standard. These microcontrollers also provide on-chip USB regulator and system clock PLL circuits for reduced parts counts in end products.

Overview

The LC87 series are a line of products that feature an on-chip USB interface engine.

- Full-speed models: LC87F10C8A, LC87F16C8A

This series includes models that feature onboard programming, self-programming in 128-byte units, USB port voltage 3.3 V regulator circuit, large-capacity FIFO, and other features.

- The LC87F10C8A features on-chip debugger support

Features

- Built-in USB interface engine
- Built-in flash program ROM allows programs to be reloaded.
- Programs can be updated from a personal computer using the USB interface.
- Extensive lineup including the LC87F1XXX and LC8715 Series full-speed versions
- The USB data area (FIFO buffer) is mapped to the microcontroller RAM area.
- Minimum instruction execution time: 250 ns (at 12MHz)
- 12-channel 8-bit A/D converter
- Built-in PWM ports (2 to 4 ports)
- One or two powerful 16-bit timer circuits that can be used as two 8-bit timers.
- Clock counter divider (uses an external 32 kHz crystal oscillator)
- Powerful 10-level interrupt function supports 29 sources
- High-speed multiply and divide instructions: For example, a 16 bit × 8 bit multiply takes 5 t_{CYC}.
- Noise rejection circuit for remote control signal reception
- Watchdog timer (uses an external RC circuit)

Type number	ROM [bits]	RAM [bits]	Operating suply voltage range V_{DD} [V]	Ports Pins	Other functions					Endpoints	Delivery format
					Interrupt		Serial I/O	Maximum number of timers	A/D converter		
					Internal	External					
☆ **LC87F16C8A**	128K× 8 (Flash)	8192 × 9	2.7 to 3.6	39	22	9	Synchronus: 8-bit channel × 2 with automatic transter support Asyncronous/syncronous: 8-bit channel × 1 with bus support	8 bits × 8 For realtime clock × 1	8 bits × 8	9	QFP48 SQFP48
☆ **LC87F10C8A**	128K× 8 (Flash)	8192 × 9	2.7 to 3.6	55			Synchronus: 8-bit channel × 3 with automatic transter support Asyncronous/syncronous: 8-bit channel × 1 with bus support		8 bits × 8	9	QFP64 SQFP64

☆: New product

*: The products presented in this section are representative examples.
For further details, refer to SANYO's microcontroller catalogs and the data sheets for the individual products.

Flash memory products are licensed from Silicon Storage Technology, Inc. (USA), and manufactured and sold by SANYO Electric Co., Ltd.

USB Version 1.1 Compliant 128 Kbytes Flash Microcontroller

LC87F16C8A

New product

Features

- ROM: 131,072 × 8 bits (flash memory)
- RAM: 8,192 × 9 bits
- Timers: Two 16-bit (each usable as two 8-bit) programmable timers, four 8-bit programmable timers, one base timer.
- I/O: 50 pins (excluding the PWM outputs and filter ports)
- PWM ports: Two 12-bit PWM + one 16-bit PWM (usable as two 8-bit PWM) outputs.

*: Control is shared with the timer control.

- USB: 9 endpoints
- Instruction execution time: 250 ns (at 12 MHz)
- 12-channel A/D converter
- Watchdog timer
- Noise exclusion circuit for remote control signal reception
- Interrupts: 29 sources, 10 vector locations
- Supply voltage (oprerating range): 2.7 to 5.5 V.
- Packages: SQFP64, QFP64

USB Version 1.1 Compliant 128 Kbytes Flash Microcontroller

LC87F10C8A

New product

Features

- ROM: 131,072 × 8 bits (flash memory)
- RAM: 8,192 × 9 bits
- Timers: Two 16-bit (each usable as two 8-bit) programmable timers, four 8-bit programmable timers, one base timer.
- I/O: 55 pins (excluding the PWM outputs and filter ports)(usable as two 8-bit PWM)

*:Control is shared with the timer control

- PWM ports: Two 12-bit PWM + one 16-bit PWM
- USB: 9 endpoints
- Instruction execution time: 250 ns (at 12 MHz)
- SIO:4 channels (synchronus: three 8-bit channels, asynchronus/synchronus: one 8-bit channel)
- 12-channel A/D converter
- Watchdog timer
- Noise rejection circuit for remote control signal reception
- Supply voltage (operating range): 2.7 to 3.6V.
- Packages: TQFP64, QFP64

PC-Related Motor Driver ICs

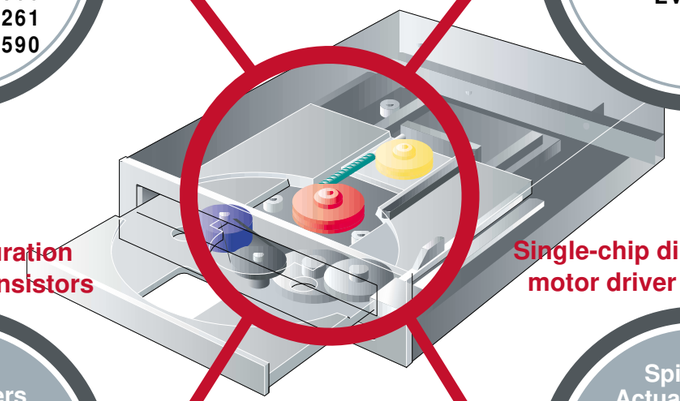
SANYO small, precise motor driver ICs, gaining high marks in a wide range of fields.
SANYO's CD-ROM system expertise makes it possible to provide custom-specification motor driver ICs fast, using the company's accumulated CAD technology, comprehensive process menu, and latest circuit technology.

High-output, high-gain actuator drivers

Actuator Drivers
- 4chBTL LA6541NH, LA6548NH
- 5chBTL LA6565, LA6566
- 6chBTL LA6261
- ✻LA6590

Spindle motor drivers providing precise rotation

Spindle Motor Drivers
- LB11995H
- LB11680H
- LV8280T



Using low-saturation vertical PNP transistors

Loading Motor Drivers
- ☆ LB1938T
- LB1930M

Single-chip direct PWM spindle motor driver + actuator driver

Spindle + Actuator Driver
- LV8210W ✻LV8231M
- ☆ LV8211T ✻LV8232M
- ☆ LV8212T ✻LV8233M
- ✻ LV8230M

☆: New product ✻: Under development

Spindle Motor Drivers

Field	Type number	Package	Supply voltage: Control system V_{DD}(V)	Supply voltage: Drive system V_{CC}(V)	Supply voltage: Motor system V_M(V)	Output current Io max (A)	Allowable power dissipation Pd max (W)	Drive type	Functions and features: Hall device FG	TSD	Notes
Half-height	**LB11995H**	HSOP28H		4 to 13.6		1.3	★1.9	Current linear	Single phase		•Switchable between FG3 pulse and single pulse operation •Two-mode current limiter
Half-height	**LB11680H**	HSOP28H	4.5 to 5.5	8 to 14		1.3	2.0	Direct PWM	Single phase	▲	•Direct PWM drive • Voltage control • Built-in current limiter
Slim	**LV8280T**	TSSOP30	4.5 to 5.5			1.0	—	PWM sensorless	Single phase or 3 phases		•Soft switching

▲ : Available ★ : Printed circuit board included

Single-Chip Spindle Motor Driver + Actuator Driver Products

Field	Type number	Package	Supply voltage: Control system V_{DD}(V)	Supply voltage: Drive system V_{CC}(V)	Supply voltage: Motor system V_M(V)	Output current Io max (A)	Allowable power dissipation Pd max (W)	Drive type	Functions and features: Hall device FG	TSD	Notes
Slim	**LV8210W**	SQFP48		4.5 to 5.5		1.0	—	PWM sensorless	Single phase or 3 phases	▲	Four driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Channels 1 to 3 are PWM BTL drivers.
Slim	☆ **LV8211T**	TQFP64J		4.5 to 5.5		1.3	—		Single phase and 3 phases	▲	Five driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Channels 1 and 2 are PWM BTL drivers, channels 3 and 4 are current feedback, PWM drive, built-in current limiter.
Slim	☆ **LV8212T**	TQFP64J		4.5 to 5.5		1.3	—		Single phase and 3 phases	▲	Six driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Channels 1 to 3 are PWM BTL drivers, channels 4 and 5 are current feedback, PWM drive, built-in current limiter.
Half-height	✻ **LV8230M**		4.0 to 5.5	4.0 to 14.0		1.5	—		Single phase or 3 phases	▲	Seven driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Three BTL driver channels and 2 sled and 1 loading driver channels are current feedback, PWM drive, built-in current limiter.
Half-height	✻ **LV8231M**		4.0 to 5.5	4.0 to 14.0		1.5	—	PWM	Single phase or 3 phases	▲	Seven driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Four BTL driver channels and 2 sled driver channels are current feedback, PWM drive, built-in current limiter.
Half-height	✻ **LV8232M**		4.0 to 5.0	4.0 to 14.0		1.5	—	PWM sensorless	Single phase or 3 phases	▲	Six driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Two BTL driver channels and 2 sled and 1 loading driver channels are current feedback, PWM drive, built-in current limiter.
Half-height	✻ **LV8233M**		4.0 to 5.0	4.0 to 14.0		1.5	—	PWM	Single phase or 3 phases	▲	Six driver channels. Spindle: Direct PWM drive, voltage control, and built-in current limiter. Actuators: Three BTL driver channels and 2 sled driver channels are current feedback, PWM drive, built-in current limiter.

▲ : Available ☆ : New product ✻ : Under development

Actuator Drivers

Field	Type number	Package	PWM input	Circuits	V_{DD} max.	Circuit configuration	CH1	CH2	CH3	CH4	CH5	CH6	Output voltage: Low saturation	Output voltage: Setting function	Op-amp	Built-in reg (External PNP-TR): Setting voltage	Built-in reg (External PNP-TR): Output on/off	Built-in reg (External PNP-TR): Reset circuit	Notes
BTL	**LA6541NH**	HSOP28H DIP30SDLP	—	4	14.0	Circuit type	BTL				—	—	—	—	—	5.0V	—	▲	• Inverted Darlington output
						Power supply✻1	VS1												
						Mute	MUTE												
BTL	**LA6548NH**	HSOP28H DIP30SDLP	—	4	14.0	Circuit type	BTL				—	—	—	—	—	3.3V	—	▲	• Inverted Darlington output
						Power supply✻1	V_{CC}												
						Mute	MUTE												
BTL	**LA6565**	HSOP36R	▲	5	14.0	Circuit type	OPE AMP + BTL				H-bridge		—	▲	▲	▲	▲	—	— • Low saturation voltage output • Settable regulator voltage
						Power supply✻1	V_{CC1}		V_{CC2}										
						Mute	MUTE1	MUTE2			—								
BTL	**LA6566**	HSOP36R	▲	5	14.0	Circuit type	BTL				H-bridge	—	—	▲	▲	—	—	—	— • Low saturation voltage output
						Power supply✻1	V_{CC1}		V_{CC2}			—							
						Mute	MUTE				—								
BTL	**LA6261**	HSOP36R	—	6	14.0	Circuit type	BTL				H-bridge		—	CH5.6 only	—	3.3V	—	—	• BTL inverted Darlington output
						Power supply✻1	V_{CC1}				V_{CC2}								
						Mute	MUTE				—								
BTL	✻ **LA6590**	HSSOP48R	▲	6	14.0	Circuit type	BTL						▲	—	▲	—	—	—	• Low saturation voltage output
						Power supply✻1	V_{CC}P1				V_{CC}P2								
						Mute	MUTE1	MUTE2	MUTE34		MUTE56								

▲ : Available ✻1 : Power supply : Output stage power supply

Motor Driver IC