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.

**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.

Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative before using any SANYO products described or contained herein.

SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

Specifications of any and all SANYO products described or contained herein stipulate the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

SANYO Electric Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safety design, redundant design, and structural design.

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The package names used in this documentation are designed to indicate rough classification of the product. Refer to the delivery specifications document for the particular product for the package dimensions, pin-count, and functions of each individual package. The package names used in this documentation are designed to indicate rough classification of the product. Refer to the delivery specifications document for the particular product for the package dimensions, pin-count, and functions of each individual package.

Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the “Delivery Specification” for the SANYO product that you intend to use.

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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.

Innovative spirit giving birth to new trends

Chip Set Solutions: Collections of SANYO’s Perfected Technologies

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 System ICs**

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

**LC897491**

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

**LC897492**

**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**

**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**
    - **LC87F5CC8A**
    - **LC87F5DC8A**

- **32-bit RISC Microcontroller**
  - On-chip 512 Kbytes flash EEPROM
    - **LC67F5104A**

- **Motor Driver ICs**

  - **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

- **CD-R/RW Encoder & Decoder**

  Complete compatibility with ATAPI standards
  - 52×: playback and 52×: writes

**Flash products are licensed from Silicon Storage Technology, Inc., (USA), and manufactured and sold by SANYO Electric Co., Ltd.**
SANYO’s ASSP differentiation in both multi-function and performance

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

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.

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

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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.
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.

**DVD-Dual System Chipsets**

DVD-ROM/R/RW Drive System

**Chip Sets**

**Responding to Diversifying Optical Disc Drive Product Concepts**
Single-Chip DVD-ROM and DVD-R/RW Solutions

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

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
LC897492

**DVD Record and Playback Functions**
- Supports the T/40 write strategy resolution
- Supports the T/32 write strategy resolution
- Supports 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**
- Supports for CD-R high-density recording technology (HD-BURN®)
- 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

**Shared Functions**
- ATAPI PIO: 16.6 Mbits, multword DMA: 16.6 Mbits, Ultra DMA: 33 Mbits and 66 Mbits
- Up to 128 Mbits of external SDRAM
- Internal flash memory: 8 Mbits
- On-chip CPU
- Crystal oscillator: 33.6688 MHz
- Package: LQFP256
- Power supply: I/O: 3.3 V, internal: 2.5 V
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.

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**Optimized recording**

**Digital servo**

**CPU**

**Flash memory**

**Memory**

**Codec**

**ATAPI (IDE) interface**

**PC**

**CD-R/RW system core block**

---

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**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.
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.

**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 52x-speed CD-R and 24x-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 52x-speed decoding and 52x-speed encoding (Operating frequency 33.8688 MHz).
- Transfer rates: Up to 16.6 MB/s when PIO mode used (supports 52x-speed CD-R/W and CD-RW).
- Supports stepping motors.
- Supports 52x-speed decoding and 52x-speed encoding (Operating frequency 33.8688 MHz).
- Transfer rates: Up to 16.6 MB/s when PIO mode used (supports 52x-speed CD-R/W and CD-RW).
- Supports stepping motors.

**Functions**
- CD-ROM decoding and encoding functions
- CD decoding and encoding functions
- Pit and wobble CLV servo functions
- ATAPI interface (includes the register block)
- ATIP audio function
- CAV text support
- Built-in CPU (80251)
- Buffer RAM can be accessed by the built-in
- ATIP decoding function and CRC check function
- General-purpose I/O ports (24 ports) and LED drive ports
- Pit and wobble CLV servo functions
- CLV/CAV servo control using ATIP data
- 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 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
- Supports stepping motors.
- Decoding and encoding for subcode data
- ATIP decoding function and CRC check function
- A random EFM signal can be output for PCA use.
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- Supports stepping motors.

**Diagram**
- LC898095
- ATAPI Interface 52x Playback, 52x Write

---

*LC898095 is a registered trademark of SANYO Electric Co., Ltd.*

*BURN-Proof* stands for Proof against B (burning) error, not for proof against burning.
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.

**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.

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

**Drivers**
- For slim applications (notebook PCs) (5 V systems)
  - Dedicated spindle driver LV8280T
  - System ICs:
    - 4ch LV8210W
    - 5ch LV8211T
    - 6ch LV8212T
- For half-height drives (desktop PCs) (12 V systems)
  - Dedicated spindle drivers LB11995H
  - System ICs:
    - 4ch LV8232M
    - 5ch LV8233M
    - 6ch LV8230M
    - 7ch LV8231M
  - BTL:
    - 4ch LA6541NH
    - 5ch LA6565
    - 6ch LA6566
    - 6ch LA6561
    - 6ch LA6590

**Front-end processors**
- LA9239T
- LA9246T
- LA9247T

**CD-ROM system core block**
- ATAPI (IDE) interface
  - digital servo, ECC, 1M DRAM, and microcontroller
  - LC895330

- 8-bit CD-DSP
  - LC895199K
  - P.20

- Digital Servo & CD-DSP
  - 1M DRAM

- 32-bit RISC microcontroller
  - LC67F5104A
  - P.22

- ATAPI (IDE) I/F
  - 4M DRAM

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High-Speed Readout and Data Transfer

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**

- **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 O 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)

- **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

- **Features**
  - 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 O signal is subjected to a CRC check, it is output to microprocessor via parallel I/O.
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  - Digital audio interface that supports both CLV and CAV playback.
  - Digital de-emphasis
  - 8× oversampling and digital filtering
  - Digital to analog converter (PWM output)

- **Features**
  - 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 O 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.
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  - 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)
High-Speed Readout and Data Transfer

### 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**

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

#### Front-End Processors

**LA9239T**

- **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)
  - Servo signal VCA circuit
  - APC circuit (includes a laser power switching function)
  - Supply voltage: 5 V, 3.3V (only for LA9247T)
  - Package: TSSOP36

**LA9246T**

**LA9247T**

### CD-ROM digital servo IC Series

<table>
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<tr>
<th>Type number</th>
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<th>Pick-I/F</th>
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<td>TSSOP36</td>
<td>5 V</td>
<td>5 V (A + C), (B + D)</td>
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<tr>
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<td>5 V</td>
<td>TSSOP36</td>
<td>5 V</td>
<td>5 V (A + B + C + D)</td>
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<td>3.3 V</td>
<td>5 V (A + B + C + D)</td>
<td>52x</td>
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</table>
Large-Capacity Integrated Flash Memory

32-Bit RISC Microcontrollers

These microcontrollers achieve performance and functionality improvements in optical disc drives with recording technologies such as acceleration technologies 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.

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, multifunction 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.

Features of ARM7TDMI®

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

The LC67 series products include flash memory technology licensed from Silicon Storage Technology, Inc. (USA).
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.

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 programable prescalers
- Mode 1: 8-bit timer with 8-bit programable prescaler plus 8-bit counter
- Mode 2: 16-bit timer with 8-bit programable prescaler
- Mode 3: 16-bit timer
- 16-bit timer/counter 1 with 4 operating modes
- 8-bit baud rate generators
- Two 8-bit PWM outputs
- Remote control receive circuit
- Watchdog timer (requires external RC circuit)
- Two 8-bit serial I/O channels with automatic transfer
- Two 8-bit PWM outputs
- Remote control receive circuit
- Built-in: 256 Kbytes of Flash EEPROM

The LC87 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

- Broad interrupt support
  - 21 interrupt sources (7 external + 14 internal) and 10 vectors (LC87F5CC8A)
  - 1-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
- Power for additional ROM
  - The LC87 core supports up to 256 Kbytes of program ROM, 64 Kbytes of RAM for calculations and stack, and 16 Kbytes 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.

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

Overview

The 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/W drives and similar embedded control applications. The flash memory versions support on-board rewriting of memory contents, providing flexibility that helps shorten development times for application systems.
**Large-capacity Flash Memory and Conformance with the USB 1.1 Standard**

**Flash Microcontrollers with On-Chip USB Interface Engine**

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 12 MHz)
- 12-channel 8-bit A/D converter
- High-speed multiply and divide instructions: For example, 8-bit channel × 1 with bus transfer support:
  - 1 cycle
- 8-bit channel × 9 bits with internal memory support: 3 cycles
- 8-bit channel × 9 bits with bus transfer support: 3 cycles
- 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_{CPU}.
- Noise rejection circuit for remote control signal reception
- Watchdog timer (uses an external RC circuit)
- Built-in USB interface engine
- Built-in flash program ROM allows programs to be reloaded.
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- Noise rejection circuit for remote control signal reception
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**Type number**

<table>
<thead>
<tr>
<th>Type number</th>
<th>ROM (Flash)</th>
<th>RAM (Bit)</th>
<th>Interrupt Pin</th>
<th>Port area</th>
<th>A/D converter</th>
<th>Endpoints</th>
<th>Delivery format</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC87F10C8A</td>
<td>128K x 8 (Flash)</td>
<td>8192 x 9</td>
<td>2.7 to 3.6</td>
<td>39</td>
<td>9</td>
<td>8 bits x 8</td>
<td>OFFP4</td>
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<tr>
<td>LC87F16C8A</td>
<td>256K x 8 (Flash)</td>
<td>8192 x 9</td>
<td>2.7 to 3.6</td>
<td>55</td>
<td>9</td>
<td>8 bits x 8</td>
<td>OFFP4</td>
</tr>
</tbody>
</table>

* 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.
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.

**Actuator Drivers**

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA6541NH</td>
<td>DIP30SDLP</td>
<td>—</td>
</tr>
<tr>
<td>LA6549NH</td>
<td>DIP30SDLP</td>
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<td>LA6556</td>
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<td>LA6566</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>LA6571</td>
<td>—</td>
<td>—</td>
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<tr>
<td>LB1938T</td>
<td>HSOP28H</td>
<td>—</td>
</tr>
<tr>
<td>LB1930M</td>
<td>HSOP28H</td>
<td>—</td>
</tr>
</tbody>
</table>

**Motor Drivers**

- **High-output, high-gain actuator drivers**
  - 4ch BTL
  - 5ch BTL
  - 6ch BTL

- **Spindle motor drivers providing precise rotation**
  - LA6541NH
  - LA6548NH
  - LA6566
  - LA6569
  - LB11995H
  - LB11680H
  - LV8280T

- **Using low-saturation vertical PNP transistors**
  - LB1938T
  - LB1930M

- **Single-chip direct PWM spindle motor driver + actuator driver**
  - LB11995H
  - LB11680H
  - LV8280T

**Spindle Motor Drivers**

<table>
<thead>
<tr>
<th>Field</th>
<th>Type number</th>
<th>Package</th>
<th>Supply voltage (V)</th>
<th>Input current (mA)</th>
<th>Drive type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/C</td>
<td>LV8280T</td>
<td>4.5 to 5.5</td>
<td>1.6</td>
<td>—</td>
<td>PWM</td>
<td>—</td>
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<tr>
<td>Slim</td>
<td>LV82111T</td>
<td>TOP8J</td>
<td>4.5 to 5.5</td>
<td>1.3</td>
<td>PWM</td>
<td>—</td>
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<tr>
<td>Slim</td>
<td>LV82112T</td>
<td>TOP8J</td>
<td>4.5 to 5.5</td>
<td>1.3</td>
<td>PWM</td>
<td>—</td>
</tr>
<tr>
<td>Slim</td>
<td>LV82301M</td>
<td>4.0 to 14.0</td>
<td>1.5</td>
<td>2.0</td>
<td>PWM</td>
<td>—</td>
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<td>—</td>
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<td>—</td>
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<tr>
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<td>LV8232M</td>
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**Single-Chip Spindle Motor Driver + Actuator Driver Products**

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**Actuators**

- **Actuators**: Channels 1 to 3 are PWM BTL drivers. Channels 4 and 5 are current feedback, PWM BTL drivers. Channels 6 to 8 are current feedback, PWM BTL drivers.
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