Product Number Index

2000 Product Guide

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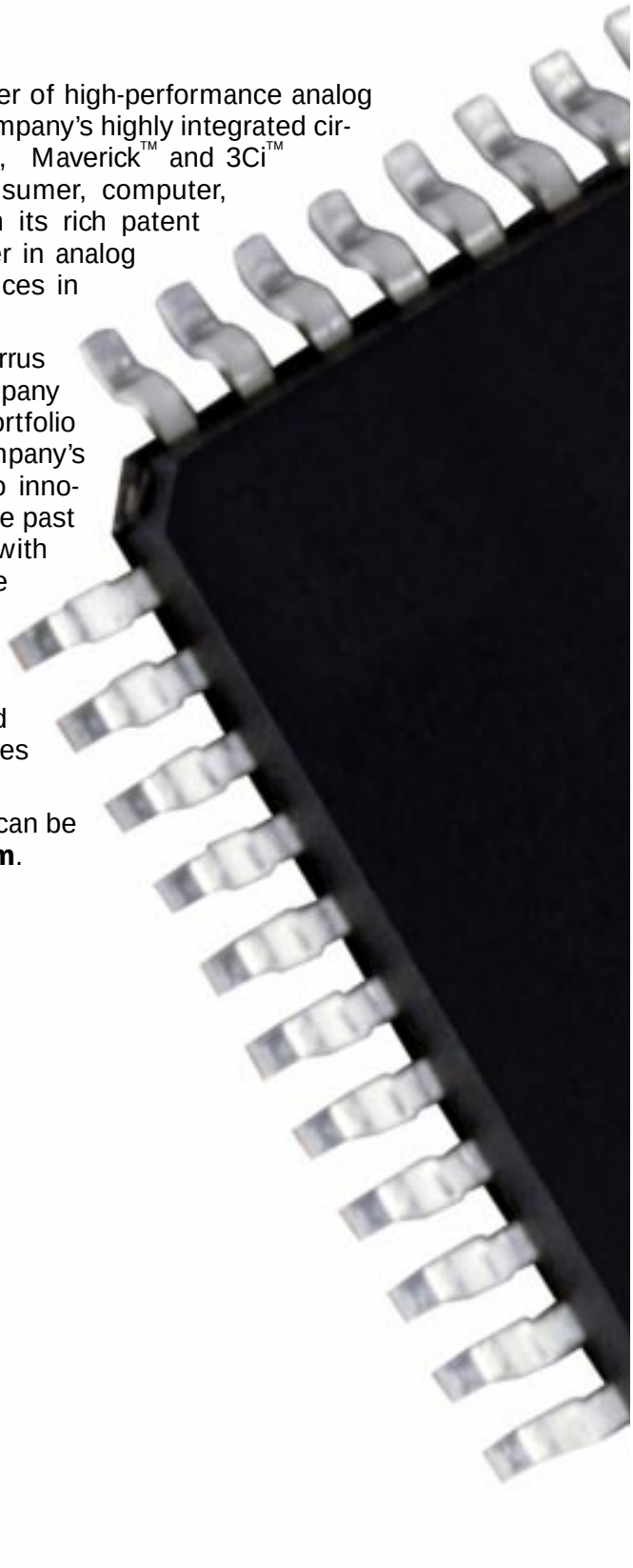
Corporate Overview



Cirrus Logic, Inc. (Nasdaq: CRUS) is a premier supplier of high-performance analog circuits and advanced mixed-signal chip solutions. The company's highly integrated circuits, sold under its own name as well as the Crystal®, Maverick™ and 3Ci™ product brand, enable system-level applications in consumer, computer, communications and industrial markets. Capitalizing on its rich patent portfolio, Cirrus Logic is emerging as a worldwide leader in analog processing and DSP solutions for entertainment appliances in the Internet age.

With more than 900 patents (issued and pending), Cirrus Logic's portfolio of inventions is substantial, and the company continues to expand its rich intellectual property portfolio through major R&D investments. Nearly half of the company's patents involve mixed-signal technology, which is key to innovating highly integrated system-on-chip solutions. Over the past decade, Cirrus Logic has achieved 76-plus industry firsts with its product introductions. Many of these innovations have set new industry standards within their respective markets.

Cirrus Logic operates from headquarters in Fremont, California and major sites in Austin, Texas and Broomfield, Colorado. Internationally, the company operates from offices in Europe, Japan, and Asia Pacific.

More information about Cirrus Logic and its products can be accessed at the company's Internet site: **www.cirrus.com**.

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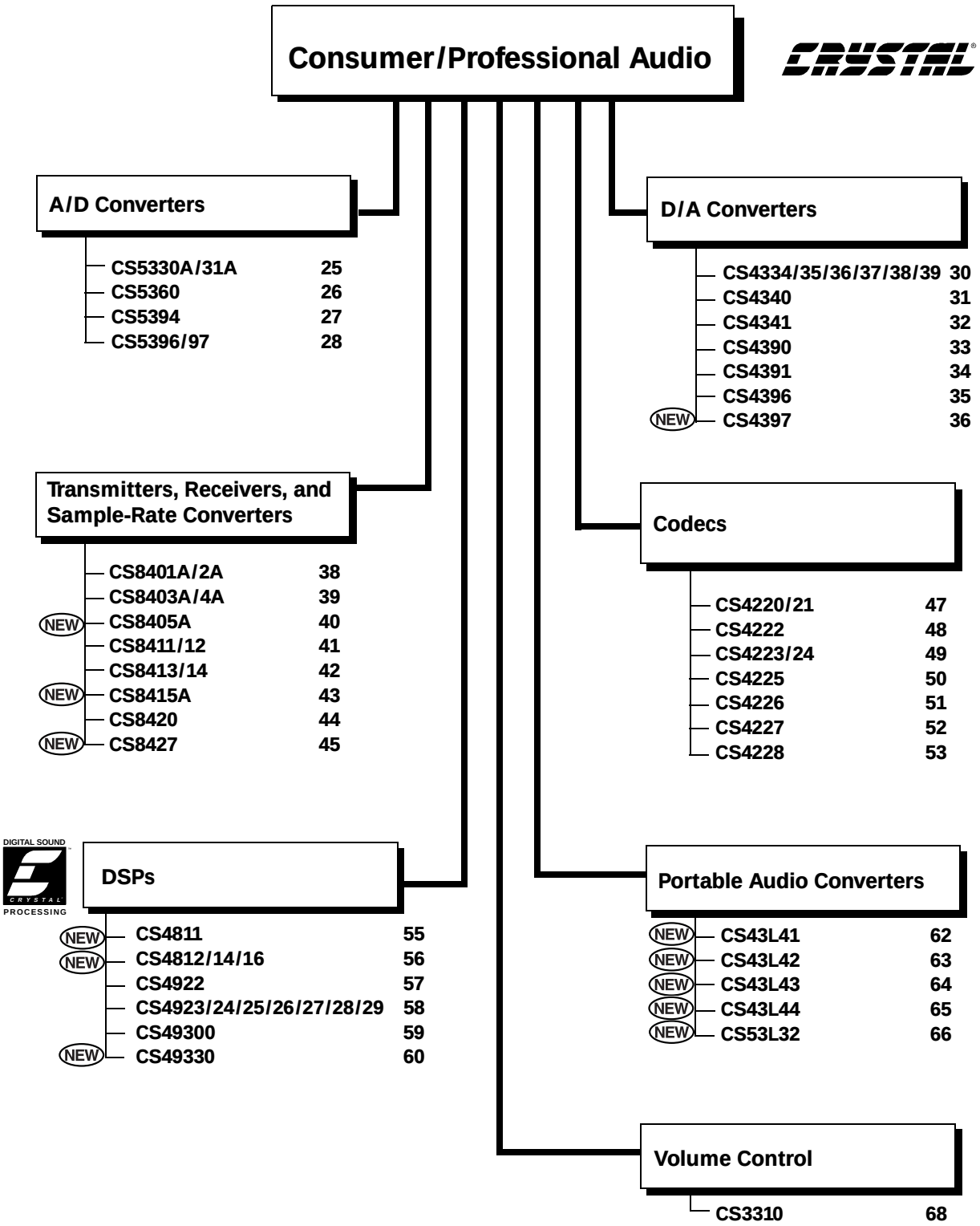
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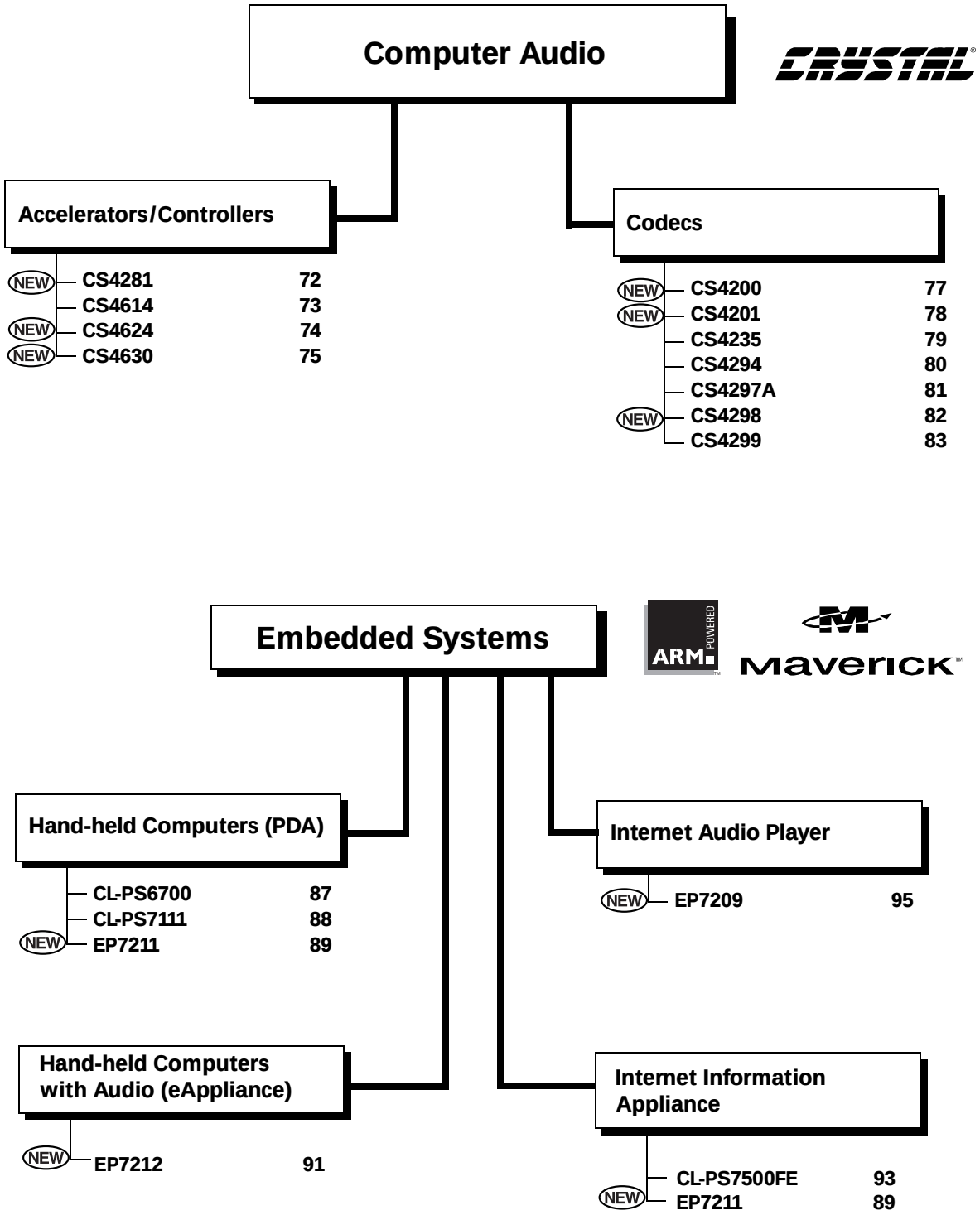
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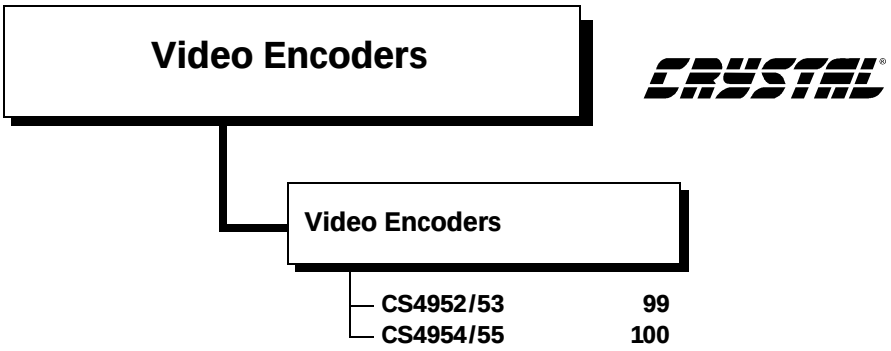
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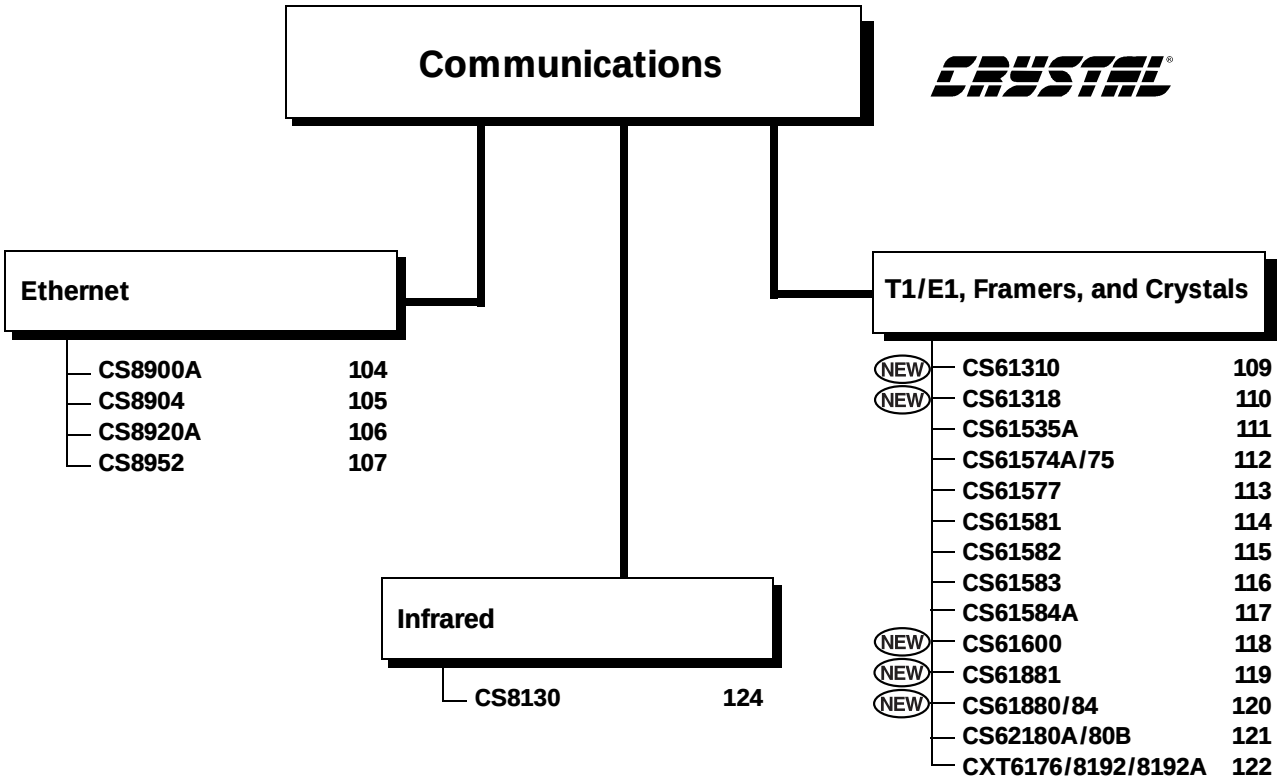
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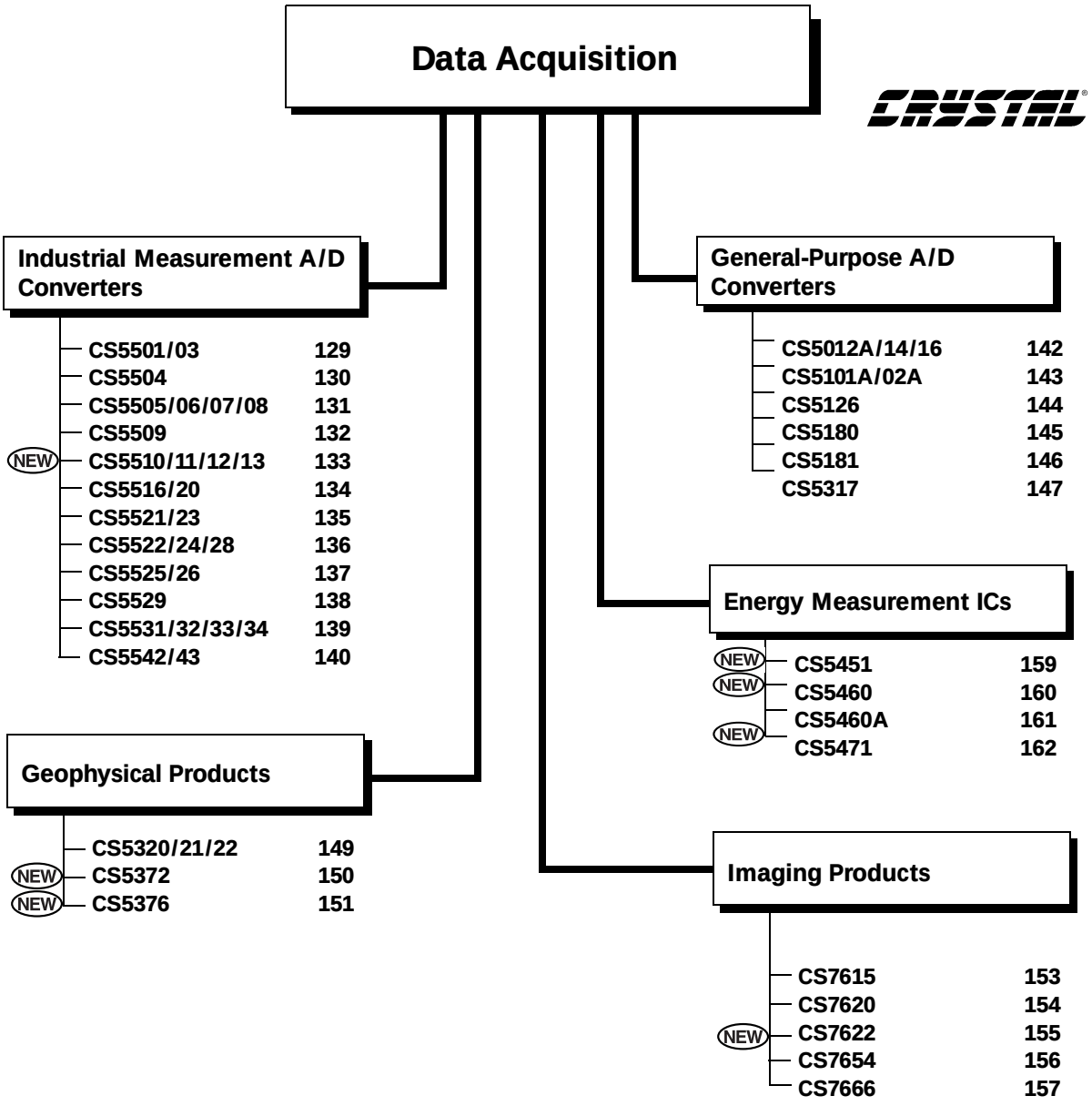
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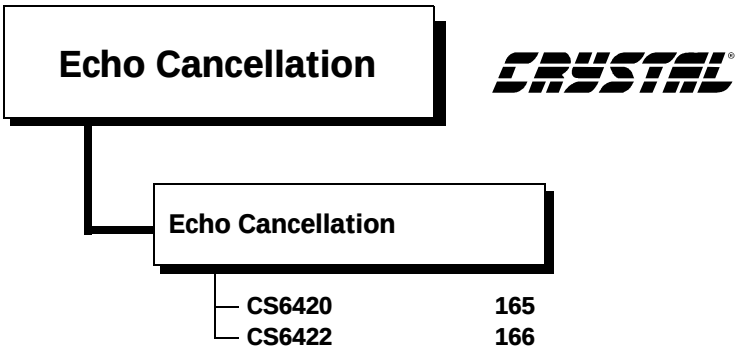
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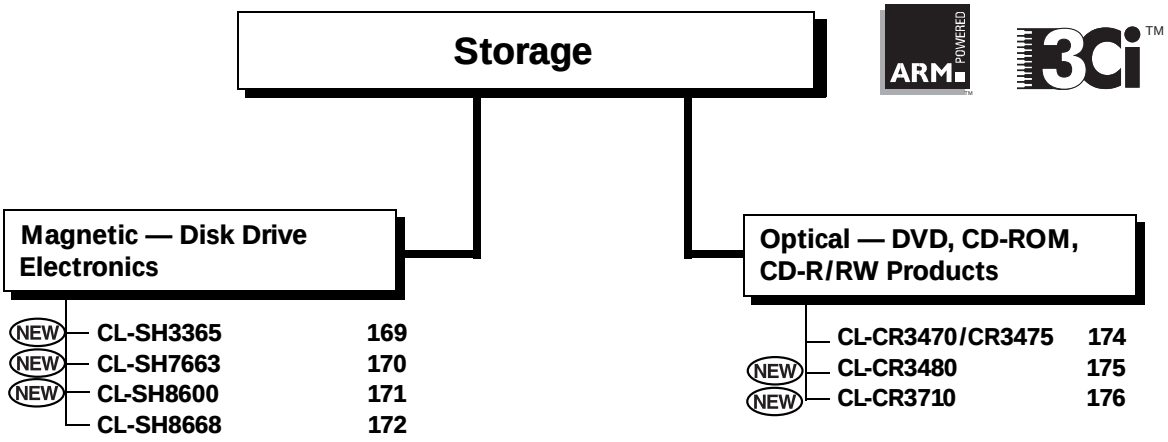
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Consumer/Professional Audio

Cirrus Logic is the leading supplier of complete digital audio solutions for professional, consumer, and automotive applications. These products address the needs of both high-performance professional audio systems and high-volume consumer applications.

The company's Crystal® consumer/professional audio products are known for their pioneering work in delta sigma (ΔΣ) conversion and their system-level solutions. Cirrus Logic offers advanced solutions for:

1) DSP audio decoding
2) audio conversion, including ADCs, DACs and codecs
3) digital audio communications, including AES/EBU transmitters and receivers
4) signal conditioning, including volume control

Audio A/D Converters

Cirrus Logic's patented ΔΣ conversion technology has become the industry-standard technique for audio A/D conversion. The company offers a broad audio A/D converter product line consisting of 16-bit to 24-bit audio A/D converters.

The CS5330A and CS5331A are complete stereo audio A/D converters in 8-pin SOIC packages. These devices specify 18-bit resolution and 94-dB dynamic range and are targeted at consumer applications. The CS5334 and CS5335 are 20-bit resolution ADCs which offer the optimal price/performance solution for 20-bit digital audio systems.

The CS5334 and CS5335 are pin-compatible with the 24-bit 105 dB CS5360, offering an easy upgrade to 24 bits. These devices also feature peak signal level detection which enables the implementation of a low-cost input-level metering function.

The CS5394 and CS5396 are the highest performance audio A/D converters. The CS5396 is the first audio A/D converter to break the 120 dB dynamic range barrier. Based on a proprietary 7^{th}-order ΔΣ modulator, the performance of these devices is enabling the transition of high-performance analog audio systems to digital signal processing (DSP) based systems. The CS5396 also supports the emerging double sample rate 96 kHz standard.

Audio D/A Converters

Cirrus Logic's Crystal audio D/A converter product family introduced the first ΔΣ, audio D/A converter with integrated switched-capacitor analog filter in 1991. This technology breakthrough has enabled ΔΣ D/A conversion to penetrate high-volume consumer applications such as portable CD, car audio, and set-top player applications. The Crystal D/A converter product family consists of 16-bit to 24-bit D/A converter products offering 94 dB to 115 dB signal-to-noise ratio.

The CS4330, CS4331, and CS4333 are the only ΔΣ D/A converters packaged in 8-pin SOIC packages. These space-saving devices are complete solutions integrating the interpolation filter, D/A conversion, and switched-capacitor analog filtering. These 8-pin devices are also specified for 2.7 V to 5.5 V operation making them ideal for portable audio systems.

The CS4327 and CS4329 are highly integrated 20-bit, audio D/A converters offering 101 dB and 105 dB dynamic range, respectively. The 24-bit CS4390 offers dynamic range at 106 dB. These devices feature on-board mute and de-emphasis for 32, 44.1, and 48 kHz applications.

With the introduction of the CS4396 and CS4397, Crystal reclaims the 120 dB dynamic range lead. Both devices support the new 192 KHz DVD-audio sampling rates. The CS4397 adds support for SACD DSD bitstreams for a truly universal converter.

Audio Transmitters, Receivers, and Sample-Rate Converters

Cirrus Logic's Crystal digital audio interface products have emerged as the industry standard for high-performance digital audio systems. The CS8411 and CS8412 receivers support both the professional (AES/EBU) and consumer (S/PDIF) interface standards, and with a unique phase-locked loop design offer the lowest jitter clock recovery available. These devices, in addition to the CS8401A and CS8402A transmitters, offer a highly integrated transmitter/receiver pair for a variety of professional/consumer applications.

Cirrus Logic has also introduced digital audio transmitter (CS8403A, CS8404A) and receiver (CS8413, CS8414) products supporting the emerging 96 kHz standard. In addition to these discrete transmitter/receiver products, Cirrus Logic also offers a highly integrated AES/SPDIF receiver/transmitter with sample-rate converter, the CS8420. Pin-compatible family members include receiver-only (CS8415A), transmitter-only (CS8405A), and transceiver (CS8427) versions. The 8415A includes a 7-1 input MUX for ease-of-handling multiple inputs.

Audio Codecs

The CS4220/21 and CS4223/24 are highly integrated, 24-bit audio codecs providing stereo ADCs and stereo DACs using $\Delta\Sigma$ conversion techniques. These codecs offer a dynamic range of 100 dB and 105 dB, and include an analog volume control capable of 113.5 dB attenuation in 0.5 dB resolution.

For home theater systems, car audio systems, and other multi-channel applications, Cirrus Logic offers the CS4226, CS4227, and CS4228. These six-channel Surround Sound codecs range from 20-bit to 24-bit ADCs and DACs, and up to 96 kHz sample rates. The CS4222 20-bit stereo audio codec with analog volume control is designed for reverb processors, musical instruments, DAT and multi-track recorders. The CS4225 16-bit digital audio conversion system is ideal for automotive applications.

Audio DSPs

Crystal branded audio DSP products are currently in great demand for several high growth digital entertainment IC markets. Design-in success has been achieved by implementing "Market Specific Processor"™ technology which includes an optimized programmable DSP IC and unique DSP firmware for applications including: Digital TV Set-Top Boxes, Audio Video Receivers, DVD Players, Digital Multi-Media Speakers and new product offerings currently in development.

Fundamental to the overall MSP™ solution, Crystal DSPs are supported with numerous factory firm-wares addressing various popular processing requirements such as audio decompression, filtering, down-mixing, MPEG systems/transport hooks, speaker virtualization, room effects, and bass and treble control etc. More specifically Crystal/Cirrus Logic provide a complete platform for implementing licensed audio technologies including:

Dolby Digital	MPEG-4 AAC
Dolby Surround Pro-Logic	DVD Audio
Dolby Virtual	DTS
Circle Surround	THX
Windows Media Audio	QSOUND
Meridian Loss Less Packing MLP	HDCD
VMAX and Logic 7	MPEG-2
MPEG-1 and MP-3	G-729A

Portable Audio Converters

The new Crystal Portable Audio Data Converter product line has been developed to meet the performance, integration, and cost requirements of today's portable digital audio devices. Every data converter in the product family adds value to portable product designs by combining a high level of integration of analog and mixed signal functional blocks with small, low-pin-count packages. These new low-pin-count solutions are smaller and more cost effective than existing solutions, plus they consume less power.

The CS53L32 offers a 2:1 input MUX, microphone preamplifier, and a stereo A/D converter in a 20-pin TSSOP package. The entire CS53L32 system runs from a 1.8 V to 3.3 V supply. These features make it the ideal solution for portable digital audio products that support both voice and music recording. Such products include MP3 and MD players, digital camcorders, and PDAs.

The Portable D/A Converter product family includes the CS43L41, CS43L42, CS43L43, and CS43L44. The CS43L41 is a low power D/A converter that operates from a minimum supply of 2.4 V. The CS43L44 is a low power D/A converter that runs from a 1.8 V to 3.3 V supply and it offers digital effects including dynamic bass and treble boost along with dynamic range compression, limiting, and volume control. The CS43L42 and the CS43L43 provide a low voltage D/A converter along with an integrated analog volume control, headphone amplifier, and digital effects. The CS43L42 offers line outputs and headphone outputs while the CS43L43 offers headphone outputs only. The CS43L41, CS43L43, and CS43L44 are all available in a low profile 16-pin TSSOP package and the CS43L42 is available in a small 24-pin TSSOP package. These portable D/A converter products are ideal for battery powered digital audio devices such as MP3 and MD players, mobile phones, digital camcorders, portable DVD players, and PDAs.

Volume Control

The CS3310 is a complete stereo digital volume control featuring a 16-bit serial interface that controls two independent, low distortion audio channels. This device is ideal for setting the input level to an audio A/D converter or as an output volume control following a D/A converter. The CS3310 includes an array of well-matched resistors and a low noise active output stage that is capable of driving a 600 Ω load. The total adjustable range of 127 dB is achieved through 95.5 dB of attenuation and 31.5 dB of gain in 0.5 dB step resolution. The device specifies 116 dB dynamic range and 0.001% THD+N, and operation from a ±5 V power supply.

Computer Audio

Cirrus Logic's Crystal audio solutions lead the PC audio industry in quality and integration and include a complete line of stereo audio codecs, audio subsystems, PCI audio accelerators, and wavetable music synthesizers. These devices are targeted primarily for PCs, workstations, and other PC technology-based products. Crystal multimedia audio products are true systems in silicon, supported by a comprehensive set of software for all major operating systems, and feature such state-of-the-art technologies as DVD, Dolby Digital™ AC-3®, PC 99, and AC '97 compliance. Applications for Cirrus Logic's multimedia audio products include CD-quality audio for desktop and portable computers, high-speed modems, PC-based multi-channel audio recording and editing, music and sound-effect synthesizers, and speech recognition and synthesis.

Multimedia Accelerators

Cirrus Logic offers mainstream audio processors to provide full 3D sound effects for the PCI bus: the CS4614 and CS4624. The CS4630 is a high-performance upgrade that features unparalleled performance for hardware acceleration of Windows 95®, DirectSound®, DirectSound3D®, DirectInput® and wavetable synthesis. The CS4281 is a PCI bus audio controller with FM synthesis and legacy support.

Multimedia Codecs

The CS4297A is a fully compliant AC '97 stereo audio codec designed for PC multimedia systems, including desktop, portable and entertainment PCs where high-quality audio is required. The CS4299 features hardware sample rate converters and software drives to enable a complete soft

audio solution. The CS4200 and CS4201 are upgrades to the CS4297A and CS4299 that add a headphone amplifier.

Multimedia Systems

The CS4294 is a four channel AC '97 codec, and the CS4298 is a stereo AC '97 audio codec with a two-channel modem front end codec. The CS4235 is a low-cost ISA audio system.

Embedded Systems

Cirrus Logic's market specific processor (MSP) solution fully leverage the company's mixed-signal expertise and are used in a wide variety of consumer products, including Internet appliances, smart phones, screen phones, game boxes, hand-held digital assistants, two-way messaging devices, and portable Internet audio decoders, such as MP3 players. By combining its intellectual property with the open ARM® architecture, Cirrus Logic offers development kits for market specific solutions.

The EP7209, designed for portable Internet audio applications, is the first chip on the market to support both MP3 and Microsoft® WMA standards. For ultra-low power applications in hand-held computing applications, the EP7211 is ideal for fast time-to-market designs. The latest member of the family, the EP7212, is designed to address the convergence of digital Internet audio and PDAs.

The CL-PS7111 offers the industry's first sub-50 mW system-on-chip solution (SOC), enabling a new class of low-power hand-held computing products. The CL-PS7500FE is Cirrus Logic's highly integrated ARM-based system-on-chip solution for the information appliance market and is among the industry's lowest cost options for creating products that provide graphics-based access to information on the Internet or local area networks (LANs).

TV Encoders and Macrovision®

The CS4952 and CS4953 are the first TV encoder products designed for applications in DBS set-top boxes, video-CD players, DVD players, and cable set-top boxes. The CS4953 is one of the first two commercially available products to fully support Macrovision Version 7, a feature required for all DVD players representing the latest version of Macrovision anti-copy protection technology. Both products ensure exceptional video performance, following in the tradition of Cirrus Logic's mixed-signal design excellence.

Communications

Cirrus Logic is a world leader in the development and marketing of high-performance, mixed-signal and digital communication solutions. Cirrus provides state-of-the-art ICs that use on-chip digital processing to achieve unprecedented analog performance and integration. These patented design techniques and architectures are known as SMART*Analog*™.

Cirrus Logic's Crystal® brand SMART*Analog*™ solutions are at the forefront of communications technologies. Cirrus Logic's ARM-based and mixed-signal technologies combine low-power, high-performance processors into a wide variety of custom solutions to provide the total system-on-chip.

Telecom

The Crystal Telecom group has lead the industry in T1/E1 products since introducing the industry's first CMOS T1 line interface unit (LIU) in 1986 (CS61544). That leadership has continued over the years with accomplishments such as establishing the industry-standard pin-out for single-channel, short-haul LIUs (CS61574 and CS61574A families). Recently, the CS61581 long-haul/short-haul T1/E1 LIU and the CS61584A dual-channel T1/E1 short-haul LIU were the first products in the industry to meet

stringent European TBR-12 and TBR-13 jitter specifications without requiring a frequency-pullable quartz crystal.

Today's Crystal LIU product line includes devices that offer crystal-less jitter attenuation and the smallest board area per port requirements available in the industry. Arbitrary waveform generation and matched impedance drivers further reduce T1/E1 solution costs and virtually eliminate the aggravation associated with design reuse.

Cirrus Logic's Crystal framers feature full compliance with industry specifications and test methodologies, and offer layout-efficient serial ports for control and interface.

Ethernet

Cirrus Logic uses innovative, robust, mixed-signal architectures to deliver the industry's highest performance Ethernet transceivers. The CS8952 10/100 Mbps Ethernet transceiver achieves outstanding performance rates: 4ns transmit peak-to-jitter, 12 dB greater NEXT margin over the leading competitor and operation in environments with up to 16 dBm noise and with cable lengths in excess of 160 m. The CS8952 expands on the success of the CS8904 quad 10BASE-T transceiver, which is the device of choice of major network suppliers of high-volume switching platforms. Crystal Ethernet Drivers are also available for every major operating system.

Infrared

Cirrus Logic offers the Crystal CS8130, an infrared transceiver for IrDA and other infrared applications. The receive channel includes on-chip high gain PIN diode amplifier, IrDA, HP-SIR, 500 kHz Amplitude Shift Keying (ASK) and TV remote compatible decoder, and data pulse stretcher. The transmit path includes IrDA, HP-SIR, 500 kHz ASK and TV remote compatible encoder, and LED drivers. The computer data port is standard UART TxD and RxD compatible, and operates from 1200 to 115200 baud. An on-chip baud rate generator is provided.

External PIN diode and transmit LED(s) are required. A control mode is provided to allow easy UART programming on different modes.

Data Acquisition

Cirrus Logic's Crystal Data Acquisition Products encompass a broad range of general-purpose analog-to-digital converters (ADCs), precision industrial measurement devices, power management ICs, and application-specific data converters. These products span a throughput speed range from 0.1 Hz sampling, for DC and low-frequency AC signal analysis, to 10 MHz sampling for image processing (10 MHz sampling). Cirrus Logic's data acquisition products use advanced IC architectures that simplify overall system design while enhancing performance and significantly reducing manufacturing costs. Applications for general-purpose and measurement ADCs include industrial automation, instrumentation, medical, military, geophysical, and communications.

Industrial Measurement ADCs

Cirrus Logic's broad line of Crystal industrial measurement devices, based on ΔΣ architectures, combine data conversion with on-chip digital signal processing to perform sophisticated filtering of the analog input. The result is a single device that replaces a significant amount of expensive discrete analog glue circuitry used for signal conditioning. These devices range from very simple ADC-only devices to highly integrated data acquisition subsystems incorporating an ADC, a programmable-gain amplifier, a multiplexor, and a sophisticated microcontroller interface. New additions to this product line include the world's lowest noise ADC family (CS5531/32/33/34), ideal for sensors with low-level output signals, and a very cost-effective line of precision 8-pin ADCs (CS5510/11/12/13). Manufacturers of industrial data-acquisition systems can choose from a variety of cost-effective, precision ADC solu-

tions well suited to such applications as temperature measurement, pressure measurement, and weigh scales.

General-Purpose ADCs

Cirrus Logic's Crystal general-purpose ADCs are more accurate and stable than any alternative solution. Traditional data converters require regular equipment calibration by service technicians to adjust for drift in analog components. Integrated digital correction architectures make Cirrus Logic's SMART *Analog* products self-calibrating, dramatically reducing maintenance requirements. These devices are highly dependable throughout their operating temperature range.

Imaging ADCs

The Crystal CS7620, CS7621, and CS7622 are the world's best ADCs for digital still camera applications using a CCD imager. They provide better performance, lower overall power consumption and are more cost-effective than any competitive device. A unique feature, DRX™, incorporated into the CS7620 and CS7622 permits the user to extend the dynamic range of the camera, which dramatically improves the ability to capture high-contrast pictures that contain both dark and brightly lit areas.

Other Crystal imaging devices include the CS7615 A/D and the CS7666, CS7654 DSPs for video cameras.

Energy Measurement ICs

The New Crystal Energy Measurement Product Line today consists of the CS5460A "Power Meter on a Chip" and the CS5451 analog front end (AFE) for 3-phase industrial power measurement applications. The CS5460A provides the user with a cost-effective single chip solution for virtually any energy measurement application. It incorporates precision ADCs for both voltage and current measurement, and a high-speed calculation engine that can provide energy data in a number of different formats, e.g. Instantaneous, RMS, and power factor, etc. The CS5460A can be configured for use without a microcontroller in a stand-alone mode, greatly simplifying design complexity for applications that don't require downstream signal processing. This provides a residential power meter solution significantly more cost effective than traditional electromechanical meters.

Geophysical Products

With the introduction of the first 24-bit, monolithic, $\Delta\Sigma$ ADC in 1989, Cirrus Logic's Crystal Product Group pioneered the high-resolution technology used in today's equipment for the geophysical, oil, and gas exploration markets. Crystal $\Delta\Sigma$ topology has delivered repeatable manufacturing, ease-of-use, and lower operating costs to users while providing the highest fidelity seismic signal. The CS5321 modulator and CS5322 digital filter comprise the most widely used solution for geophysical data acquisition today. Now, the new, dual-channel CS5372 modulator and 4-channel CS5376 filter provide the most cost-effective solution for 4-component and other multi-channel applications.

Echo Cancellation

Cirrus Logic's Crystal echo cancellers combine the best of Crystal DSP technology with state-of-the-art codec technology. The versatile echo cancellers are applicable in desktop telephony, cellular phone car kits and video-conferencing. These products offer royalty-free, embedded algorithms that support network echo cancellation, as well as acoustic echo cancellation. They are easy-to-use and configurable to accommodate a wide variety of customer applications and specifications.

Storage

Cirrus Logic has demonstrated technology leadership in mass storage for more than 10 years by providing our customers with industry-leading standard and customized solutions for magnetic, optical, and removable drive electronics. Innovative, award-winning products are designed using a robust methodology, resulting in the right solutions at the right time for our customers' market window. Cirrus Logic will also integrate customer intellectual property, thus providing the best mixed-signal solution in CMOS for their application.

With over 900 patents (issued and pending), Cirrus Logic's inventions are substantial. In Storage alone, there are nearly 150 issued patents.

Our technologists and designers are mass storage professionals who propel drive technology forward through innovative ideas and proven methodologies. Many of their patented ideas have been published in technical journals and periodicals, and our storage scientists have authored several books. In fact, we wrote the book on ECC, and it is still in use today (*Practical Error Correction Design For Engineers*, Second Edition, Neal Glover and Trent Dudley).

Magnetic Storage – Industry-Leading Analog and Signal Processing Solutions

With Cirrus Logic, magnetic storage manufacturers have a single source for high-performance and small-form-factor disk drive controllers, PRML read/write channels, and drive electronics platforms. Our controllers have superior patented ECC and are available with several host interfaces. We were the first with PRML read/write channels, and continue to lead in BER (bit error rate) and overall performance. Our industry-leading, 3Ci integrated drive electronics platform provides all of the key functional components on a single chip: the controller, read/write channel, and microcontroller, for the most cost-effective and best-performing solution in the industry.

Optical Storage – Industry-Leading CD-R/RW and DVD Solutions

Cirrus Logic is the market leader in CD-R/RW solutions, with our encoder/decoder controllers in most major CD-R drives available today. We are quickly propelling the technology forward from CD-ROM to CD-R/RW, enabling the industry to benefit from our systems expertise and patented ECC capabilities.

We provide the most highly integrated and highest performance DVD drive product for both the DVD-ROM and DVD-player markets. Our DVD solutions include a PRML read/write channel, patented DVD ECC, RF Amp and servo control processor. Cirrus Logic was the first to introduce a single-chip DVD solution.

Industry Firsts

Year	Industry Firsts Since IPO	
1999	— 1st to offer a 1394 system-on-chip solution for audio/video drives — 1st supplier of a 1394 hard disk controller with integrated PHY and Link — 1st to offer a single-chip audio automotive solution that supports both DTS (Digital Theater Sound) and HDCD (High Definition Compatible Digital) — 1st to offer audio DSP solution for universal DVD players — 1st firmware support of advanced "Circle Surround" technology from SRS Labs	— 1st to provide THX® (Lucasfilm) post processing capabilities in mass market solution — 1st to offer an Internet audio solution that supports both MP3 and Microsoft's Windows Media Audio — 1st to offer power meter-on-a-chip solution for residential metering — 1st 0.25-micron single-ship disk drive electronics solution
1998	— 1st to offer Ultra ATA66 system-on-chip solution for hard disk drives — 1st CD-R/W chip to support 40x read and 10x write disc speeds — 1st supplier of single-chip hard disk drive solution (read-channel + HDC + microcontroller) — 1st to license ARM9 core — 1st supplier of a single-chip DVD drive solution — 1st DVD solution to integrate PRML technology	— 1st DVD drive solution to support 4.5x DVD — 1st sample rate converter to integrate a transmitter — 1st sample rate converter capable of supporting from 8 kHz to 96 kHz standard rates — 1st universal T1/E1 LIU to meet CTR-12 Jitter specifications — 1st 96-kHz digital audio transmitters and receivers — 1st multi-standard audio decoder for both DTS and Dolby Digital
1997	— 1st sub-50mW ARM-based system-on-chip — 1st 120-dB audio analog to digital converter (ADC) — 1st to integrate a PCI interface into a four-channel communications controller — 1st ATAPI CD-ROM decoder to support 45X disc speeds — 1st PCI 3D audio accelerator — 1st to sample an Accelerated Graphics Port (AGP) 3D graphics accelerator	— 1st multi-channel, multi-standard audio decoder for both Dolby Digital and MPEG-2 — 1st x2 controllerless modem chipset with integrated PCI interface — 1st ATAPI CD-ROM to support 24x disc speeds — 1st to integrate Ultra DMA33 into a CD-ROM decoder — 1st single-chip Dolby AC-3 audio accelerator
1996	— 1st to incorporate QXpander 3D audio technology in a single-chip audio subsystem — 1st ATAPI CD-Recordable/Rewritable chip to support — 18x read and 8x record disc speeds — 1st Quad Ethernet interface to include on-board filters — 1st video encoder to support Macrovision's Revision 7 for DVD players	— 1st single-chip wavetable synthesizer — 1st graphics accelerator to run multiple concurrent video windows — 1st video/graphics accelerator to deploy the Rambus memory architecture in the PC industry
1995	— 1st to introduce a graphics accelerator with X and Y interpolation — 1st single-chip graphics accelerator to incorporate both 2D and video	— 1st LCD graphics accelerator to incorporate both 2D and video onto a single chip

Industry Firsts *(cont.)*

Year	Industry Firsts Since IPO	
1994	— 1st V.32b modem chipset to combine data/fax/voice on a sound card — 1st to integrate video and graphics in a PC — 1st DOS games, Plug-and-Play audio codec — 1st mixed-voltage PCI-to-PCMCIA host adapter	— 1st single-chip GUIX device with PCI bus interface and 64-bit performance — 1st single-chip solution to perform audio decompression in compliance with MPEG and Dolby AC-2 standards
1993	— 1st reference design to combine audio and graphics on a single-board — 1st two-chip data/fax/voice modem solution to integrate PCMCIA interface — 1st to combine a 2-bit NRZ, full data streaming, automatic task file management, and logical block addressing on a single chip	— 1st to introduce digital synchronous partial-response-maximum-likelihood (PRML) read-channel for hard-disk drives — 1st single-chip audio decoding system — 1st to support both 40-MHz (NRZ) disk transfer rates and a 10 Mbyte/sec. Fast SCSI-2 standard — 1st single-chip PCMCIA host adapter — 1st disk drive controller for PCMCIA
1992	— 1st 32-bit Super VGA LCD graphics accelerator — 1st ISA bus codec with mixer and Windows drivers — 1st high-performance wavetable synthesizer	— 1st to integrate a RAMDAC into the graphics accelerator — 1st two-chip solution for the magneto-optical disk drives
1991	— 1st 3.3-volt LCD graphics controller — 1st to enable a graphics chip to simultaneously drive an LCD and CRT (SimulSCAN™) — 1st two-chip data/fax/voice modem solution	— 1st to introduce a product with video-in-a-window — 1st to develop single-chip hard-disk drive controller that could be embedded onto the drive — 1st to implement on-the-fly 88-bit Reed-Solomon code
1990	— 1st 16-bit stereo audio codec — 1st company to supply high-integration controllers optimized for embedded intelligence in Winchester drives — 1st to introduce graphics co-processors for laser printers	— 1st to apply a RISC-based architecture to a multi-channel data communications chips — 1st to introduce a hardware-compatible VGA controller — 1st to offer low-power, CMOS Ethernet/Cheapernet Transceiver
1989	— 1st $\Delta\Sigma$ ADC for digital audio	— 1st to develop single-chip hard-disk drive controller that could be embedded onto the drive
1988	— 1st company to supply high-integration controllers optimized for embedded intelligence in Winchester drives	

Cirrus Logic currently holds more than 900 patents (issued and pending), a number of which have set new industry standards across diverse market segments. Approximately half of these patents involve mixed-signal technology.

Consumer/Professional Audio

A/D Converters

D/A Converters

Transmitters, Receivers, and Sample-Rate Converters

Codecs

DIGITAL SOUND CRYSTAL PROCESSING

DSPs

Portable Audio Converters

Volume Control

Consumer/Professional Audio

Selection Table

Product Selection Specifications					Product
Converters					
16/18 Bit	DAC	2.7 V	48 kHz	94 dB	CS4330/1/3
		5 V		94 dB	CS4330/1/3
	ADC			94 dB	CS5330A/31A
	CODEC			2 ADCs, 4 DACs	CS4225
20 Bit	DAC			100 dB	CS4327
			96 kHz	96 dB	CS4337
	ADC		48 kHz	100 dB	CS5334
				105 dB	CS5335
	STEREO CODEC	2 DACs		99 dB ADC, 99 dB DAC	CS4222
24 Bit	DAC		48 kHz	106 dB	CS4390
			96 kHz	101 dB	CS4340
				101 dB with Volume Control	CS4341
			192 kHz	108 dB	CS4391
			96 kHz	96 dB	CS4334/35/36/39
			192 kHz	120 dB	CS4396
				120 dB	CS4397
	ADC		48 kHz	117 dB	CS5394
				105 dB	CS5360
			96 kHz	120 dB Standard	CS5396
				120 dB Non-Aliasing	CS5397
	CODEC		48 kHz	100 dB	CS4220
				100 dB with Volume Control	CS4221
				105 dB	CS4223
				105 dB with Volume Control	CS4224
			96 kHz, Low-Voltage, Headphone Amp	96 dB	CS4250
			96 kHz	108 dB DAC	CS4228
Surround Sound	CODEC	6 DACs	48 kHz, S/PDIF Receiver	95 dB ADC, 98 dB DAC	CS4226
			48 kHz, No Receiver	95 dB ADC, 98 dB DAC	CS4227
			96 kHz	103 dB ADC, 103 dB DAC	CS4228
Interface					
Transceiver			96 kHz	Parallel µ-Cont Stand-Alone	CS8427
Sample Rate Converter with Transceiver				Parallel µ-Cont	CS8420
Receiver			48 kHz	Stand-alone	CS8412
				Parallel µ-Cont	CS8411
			96 kHz	Stand-alone	CS8414
				Parallel µ-Cont	CS8413
				Parallel µ-Cont Stand-alone	CS8415A
Transmitter			48 kHz	Stand-alone	CS8402A
				Parallel µ-Cont	CS8401A
			96 kHz	Stand-alone	CS8404A
				Parallel µ-Cont	CS8403A
				Parallel µ-Cont Stand-alone	CS8405A

Selection Table *(cont.)*

Product Selection Specifications				Product
DSP				
Mono Reverb/Effects Processor				CS4811
Stereo Variable Multi-Effects Processor				CS4812
Stereo Audio Decoder		MPEG	On-Chip DAC	CS4922
		AC-3 (Stereo or limited Multi-Channel)		CS4924
		AAC		CS4229
Multi-Channel Audio Decoder		AC-3/Pro-Logic		CS4923
		AC-3/MPEG 5.1		CS4925
		AC-3/DTS		CS4926
		MPEG 5.1		CS4927
		DTS		CS4928
		AC-3, MPEG 5.1, DTS, MLP, AAC		CS493XX
Digital Mixer Solution				CS49330
Car Audio Processor				CS49330
Portable Audio				
D/A Converter				CS42L50
	2.4 V	16-Pin TSSOP		CS43L41
		Headphone output and line output		CS43L42
		Headphone output only		CS43L43
	1.8 V to 3.3 V	Line output only		CS43L44
A/D Converter		2:1 MUX, Mic pre-amplifier		CS53L32
Volume Control				
116 dB, +31.5 dB Gain, -95.5 dB Attenuation, 0.5 dB Step Size			Digitally Controlled	CS3310

Consumer/Professional Audio

A/D Converters

Specification Table

Part	Resolution (bits)	SNR (dB)	Dynamic Range (dB)	THD+N (dB)	Sample Rate (kHz)	Analog I/O	Power Supply (V)	Package	Comments
CS5330A/31A	18	94	94	-84	48	Single-ended	+5	8 SOIC	
CS5360	24	105	105	-95	48	Differential	+5	20 SSOP	CS5334/5 pin-compatible
CS5394	24	117	117	-103	48	Differential	+5	28 SOIC	CS5396 pin-compatible
CS5396	24	120	120	-105	96/48	Differential	+5	28 SOIC	Standard filter
CS5397	24	120	120	-105	96/48	Differential	+5	28 SOIC	Non-aliasing filter

CS5330A/31A

8-Pin, Stereo A/D Converters

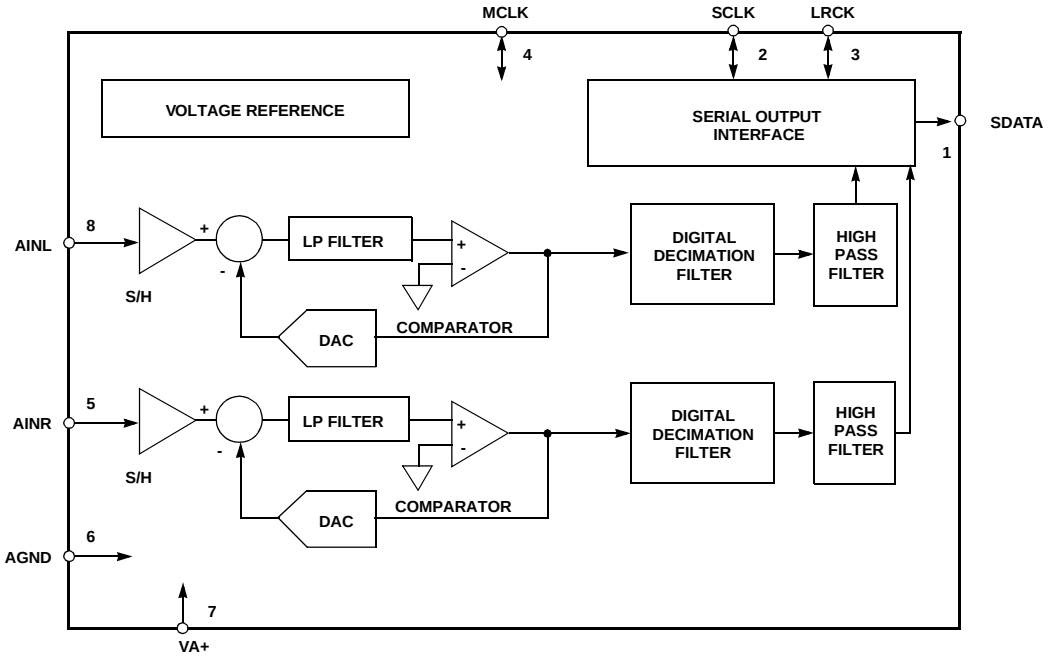
- **Single +5 V power supply**
- **18-bit resolution**
- **94 dB dynamic range**
- **Linear phase digital anti-alias filtering**
  - — 0.05 dB passband ripple
  - — 80 dB stopband rejection
- **Low power dissipation: 150 mW**
  - — Power-down mode for portable applications
- **Complete CMOS stereo A/D system**
  - — Delta sigma (ΔΣ) ADCs
  - — Digital anti-alias filtering
  - — S/H circuitry and voltage reference
- **Adjustable system sampling rates**
- **Ordering information** (described on pg.198)
  - — CS5330A-KS 8-Pin SOIC
  - — CS5331A-KS 8-Pin SOIC
  - — CS5330A-BS 8-Pin SOIC
  - — CS5331A-BS 8-Pin SOIC

The CS5330A and CS5331A are complete stereo ADCs that perform anti-alias filtering, sampling, and analog-to-digital conversion generating 18-bit values for both left and right inputs in serial form. The output sample rate can be adjusted infinitely between 2 and 50 kHz.

The CS5330A/31A ADCs operate from a single +5 V supply and require only 150 mW for normal operation, making it ideal for battery-powered applications.

These ADCs use ΔΣ modulation with 128x oversampling, followed by digital filtering and decimation, which removes the need for an external anti-alias filter. The linear-phase digital filter has a passband to 21.7 kHz, 0.05 dB passband ripple, and >80 dB stopband rejection. These devices also contain a high-pass filter to remove DC offsets.

These devices are available in a 0.208-inch wide, 8-pin, surface-mount package.



CS5360

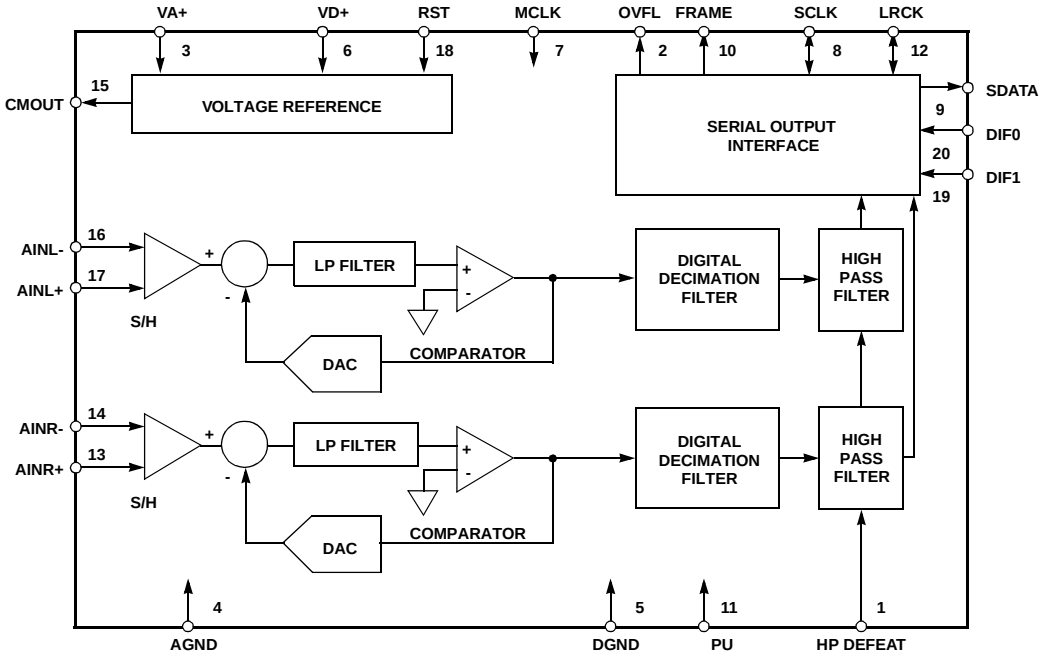
24-Bit, Stereo A/D Converter

- **24-bit digital output**
- **105 dB dynamic range**
- **-95 dB THD+N**
- **128x oversampling**
- **Fully differential inputs**
- **Linear phase digital anti-alias filtering**
  - — 21.7 kHz passband (Fs = 48 kHz)
  - — 85 dB stopband attenuation
  - — 0.0025 dB passband ripple
- **High-pass filter — DC offset removal**
- **Pin-compatible with CS5334 and CS5335**
- **Peak-signal level detector**
  - — High-resolution and bar-graph modes
- **Ordering information** (described on pg.198)
  - — CS5360-KS 20-Pin SSOP

The CS5360 is a two-channel, single +5 V supply, 24-bit ADC for digital audio systems. The CS5360 performs sampling, analog-to-digital conversion, and anti-alias filtering, generating 24-bit values for both left and right inputs in serial form. The output word rate can be up to 50 kHz per channel.

The CS5360 uses 4th-order, ΔΣ modulation with 128x oversampling followed by digital filtering and decimation, which removes the need for an external anti-alias filter. This ADC uses a differential architecture that provides excellent noise rejection.

The CS5360 has a filter passband to 21.7 kHz. The filter has linear phase, 0.0025 dB passband ripple, and >85 dB stopband rejection. An on-chip high-pass filter is also included to remove DC offsets.



CS5394

117 dB, 48 kHz Audio A/D Converter

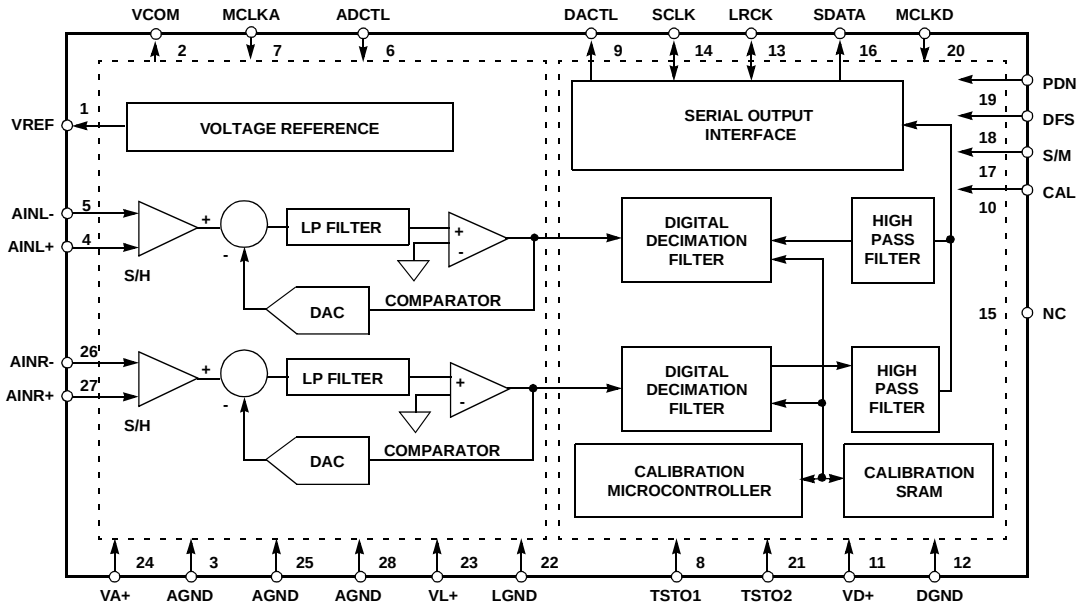
- **24-bit resolution**
- **Complete CMOS stereo A/D system**
  - — Delta sigma (ΔΣ) ADCs
  - — Digital anti-alias filtering
  - — S/H circuitry and voltage reference
- **Adjustable system sampling rates**
- **117 dB dynamic range (A-weighted)**
- **-103 dB THD + N**
- **Differential analog circuitry**
- **Internal 64x oversampling**
- **Linear phase digital anti-alias filtering**
  - — >117 dB stopband attenuation
- **Single +5 V power supply**
- **Power-down mode**
- **Ordering information** (described on pg.198)
  - — CS5394-KS 28-Pin SOIC

The CS5394 is a complete ADC for stereo digital audio systems. The device performs sampling, analog-to-digital conversion, and anti-alias filtering, generating 24-bit values for both left and right inputs in serial form. The output sample rate can be up to 50 kHz per channel.

The CS5394 uses 7th-order, ΔΣ modulation with 64x oversampling followed by digital filtering and decimation, which removes the need for an external anti-alias filter. The ADC uses a differential architecture that provides excellent noise rejection.

The CS5394 has a linear phase filter with passband of DC to 22.1 kHz, 0.005 dB passband ripple, and >117 dB stopband rejection.

The CS5394 is targeted for the highest performance professional audio systems requiring wide dynamic range, negligible distortion, and low noise.



CS5396/97

120 dB, 96 kHz Audio A/D Converters

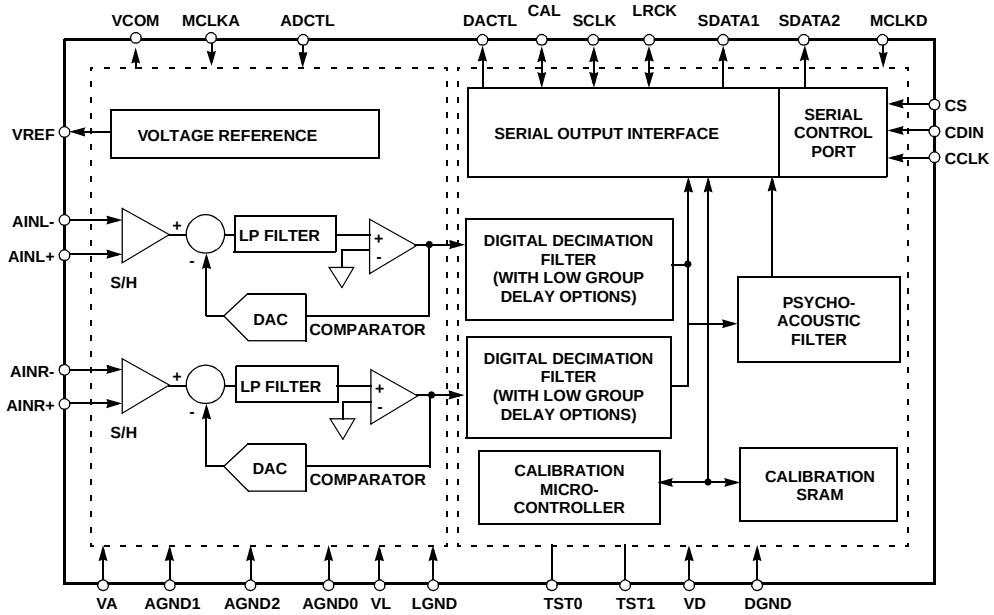
- **24-bit conversion**
- **120 dB dynamic range (A-weighted)**
- **-105 dB THD + N**
- **Complete CMOS stereo A/D system**
  - — Delta-sigma (ΔΣ) ADCs
  - — Digital anti-alias filtering
  - — S/H circuitry and voltage reference
- **CS5396 — digital filter optimized for audio**
- **CS5397 — non-aliasing digital filter**
- **Adjustable system sampling rates**
- **Differential analog architecture**
- **Linear phase digital anti-alias filtering**
- **Single +5 V power supply**
- **Ordering information** (described on pg.198)
  - — CS5396-KS 28-Pin SOIC
  - — CS5397-KS 28-Pin SOIC

The CS5396 and CS5397 are complete ADCs for stereo digital audio systems. They perform sampling, analog-to-digital conversion, and anti-alias filtering, generating 24-bit values for both left and right inputs in serial form at sample rates up to 100 kHz per channel.

The CS5396/97 ADCs use a patented 7th-order, tri-level ΔΣ modulator followed by digital filtering and decimation, which removes the need for an external anti-alias filter. The ADCs use a differential architecture that provides excellent noise rejection.

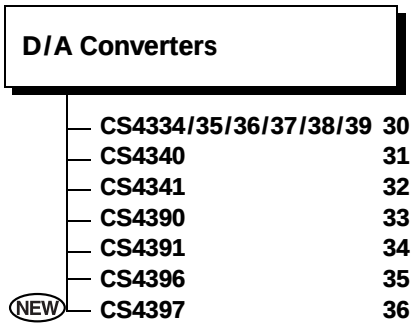
The CS5396 has a linear phase filter optimized for audio applications with ±0.005 dB passband ripple and >117 dB stopband rejection. The CS5397 has a non-aliasing filter response with ±0.005 passband ripple and >117 dB stopband attenuation.

The CS5396/97 ADCs are targeted for the highest performance professional audio systems requiring wide dynamic range, negligible distortion, and low noise.



Consumer/Professional Audio

D/A Converters



Specification Table

Part	Resolution (bits)	SNR (dB)	Dynamic Range (dB)	THD+N (dB)	Sample Rate (kHz)	Analog I/O	Power Supply (V)	Package	Comments
CS4334 CS4335 CS4336 CS4337 CS4338 CS4339	16-24	96	96	-88	96/48	Single-ended	+5	8 SOIC	0.150” wide package
CS4340	24	102	102	-90	96	Single-ended	+2.7 to +5	16 SOIC	Stand-alone mode
CS4341	24	102	102	-90	96	Single-ended	+2.7 to +5	16 SOIC	Digital volume control
CS4390	24	115	106	-97	48	Differential	+5	20 SSOP/PDIP	CS4329 pin-compatible
CS4391	24	108	108	-96	192	Differential	+2.4 to +5	20 SOIC/SSOP	DSD interface, volume control
CS4396	24	120	120	-100	192	Differential	+3, +5	28 SSOP	
CS4397	24	120	120	-100	192	Differential	+3, +5	28 SOIC	DSD and HDCD support

CS4334/35/36/37/38/39

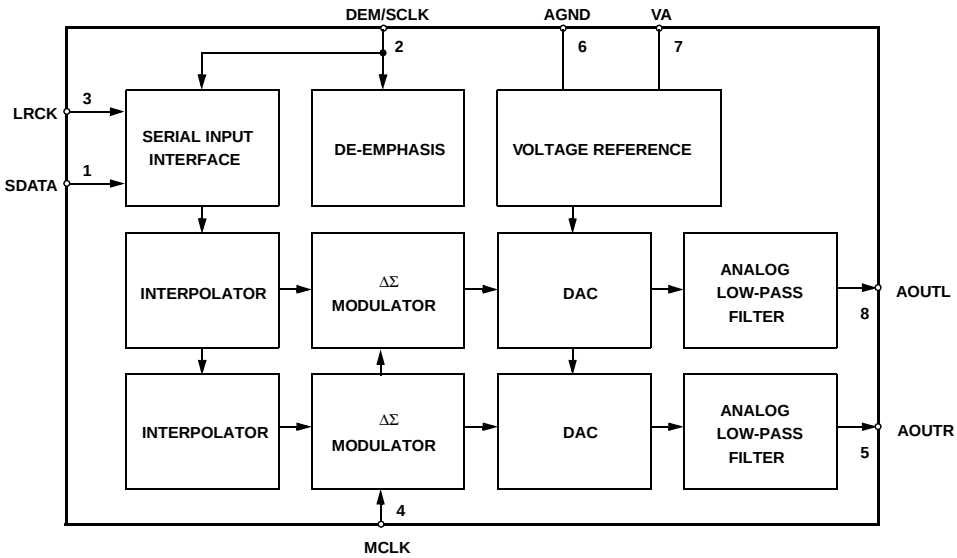
8-Pin, 24-Bit, 96 kHz Stereo D/A Converters

- **Complete stereo dac system: interpolation, D/A, output analog filtering**
- **24-Bit conversion**
- **96 dB dynamic range**
- **-88 dB THD+N**
- **Low clock jitter sensitivity**
- **Single +5 V power supply**
- **Filtered line level outputs**
- **On-chip digital de-emphasis**
- **PopGuard® technology**
- **Functionally compatible with CS4330/31/33**
- **Ordering information** (described on pg.198)
  - — CS4334-KS 8-Pin SOIC
  - — CS4335-KS 8-Pin SOIC
  - — CS4336-KS 8-Pin SOIC
  - — CS4337-KS 8-Pin SOIC
  - — CS4338-KS 8-Pin SOIC
  - — CS4339-KS 8-Pin SOIC
  - — CS4334-BS 8-Pin SOIC
  - — CS4335-BS 8-Pin SOIC
  - — CS4336-BS 8-Pin SOIC
  - — CS4337-BS 8-Pin SOIC
  - — CS4338-BS 8-Pin SOIC
  - — CS4339-BS 8-Pin SOIC

The CS4334 family members are complete, stereo digital-to-analog output systems including interpolation, 1-bit D/A conversion, and output analog filtering in an 8-pin package. The CS4334/35/36/37/38/39 support all major audio data interface formats, and the individual devices differ only in the supported interface format.

The CS4334 family is based on ΔΣ modulation, where the modulator output controls the reference voltage input to an ultra-linear analog low-pass filter. This architecture allows for infinite adjustment of sample rate between 2 kHz and 100 kHz simply by changing the master clock frequency.

The CS4334 family contains on-chip digital de-emphasis, operates from a single +5 V power supply, and requires minimal support circuitry. These features are ideal for set-top boxes, DVD players, SVCD players, and A/V receivers.



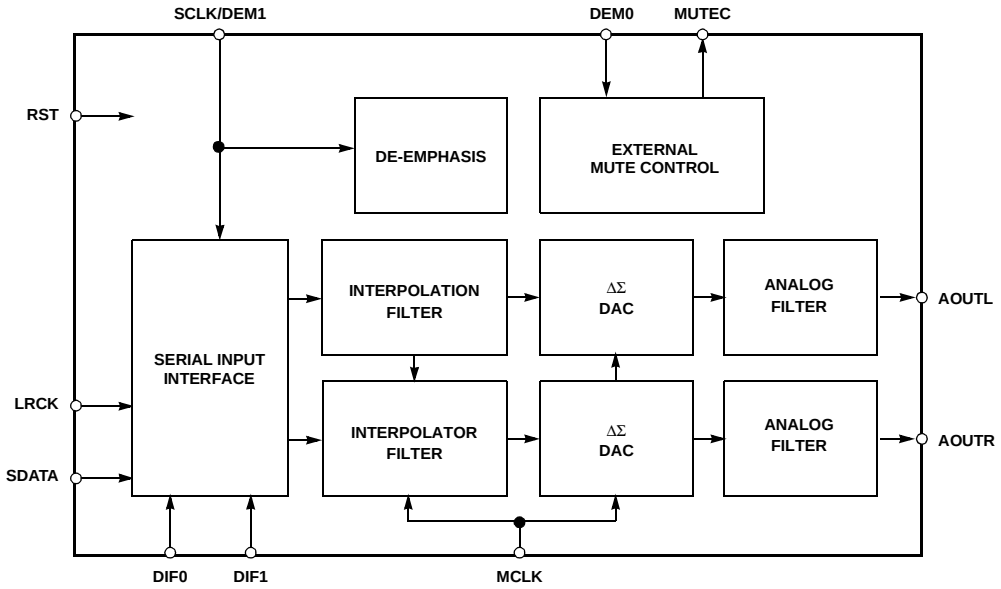
CS4340

24-Bit, 96 kHz Stereo DAC for Audio

- **Complete stereo DAC system: interpolation, D/A, output analog filtering**
- **102 dB dynamic range**
- **88 dB THD+N**
- **Low clock jitter sensitivity**
- **+3 V to +5 V power supply**
- **Filtered line level outputs**
- **On-chip digital de-emphasis for 32, 44.1, and 48 kHz**
- **30 mW with 3 V supply**
- **PopGuard® Technology**
- **Ordering information** (described on pg.198)
  — CS4340-KS 16-Pin SOIC

The CS4340 is a complete stereo digital-to-analog system including digital interpolation, fourth-order ΔΣ digital-to-analog conversion, digital de-emphasis, and switched capacitor analog filtering. The advantages of this architecture include: ideal differential linearity, no distortion mechanisms due to resistor matching errors, no linearity drift over time, and temperature and a high tolerance to clock jitter.

The CS4340 accepts data at audio sample rates from 2 kHz to 100 kHz, consumes very little power, and operates over a wide power supply range. The features of the CS4340 are ideal for DVD players, CD players and set-top box systems.



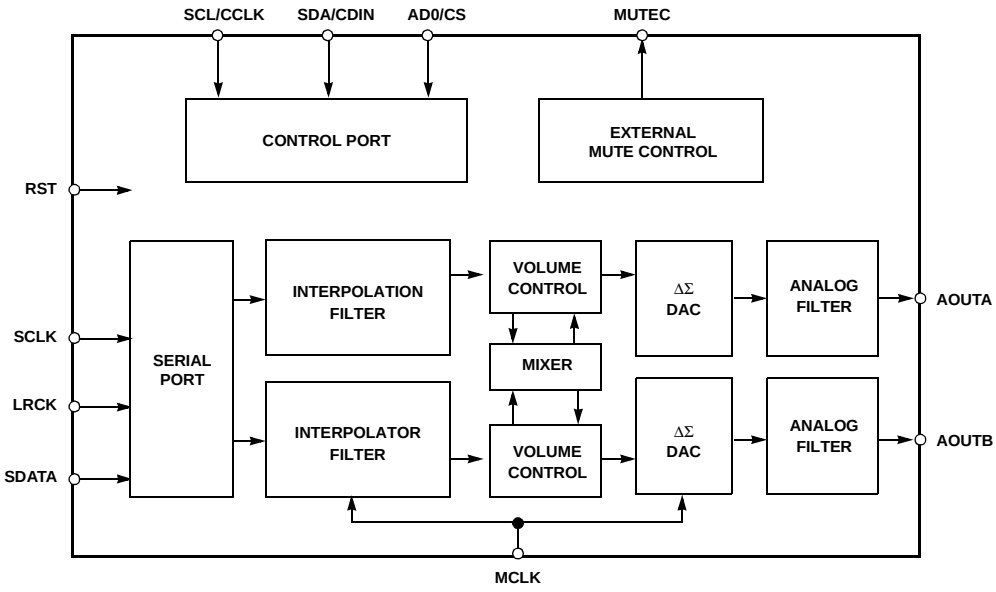
CS4341

24-Bit, 96 kHz Stereo DAC with Volume Control

- **Complete stereo DAC system: interpolation, D/A, output analog filtering**
- **ATAPI mixing**
- **102 dB dynamic range**
- **88 dBFS THD+N**
- **Low clock jitter sensitivity**
- **+3 V to +5 V Power Supply**
- **Filtered line level outputs**
- **On-chip digital de-emphasis for 32, 44.1, and 48 kHz**
- **Digital volume control with soft ramp**
  - — 94 dB attenuation
  - — 1 dB step size
  - — Zero crossing click-free transitions
- **30 mW with 3 V supply**
- **PopGuard® technology**
- **Ordering information** (described on pg.198)
  - — CS4341-KS 16-Pin SOIC

The CS4341 is a complete stereo digital-to-analog system including digital interpolation, fourth-order ΔΣ digital-to-analog conversion, digital de-emphasis, volume control, channel mixing, and analog filtering. The advantages of this architecture include: ideal differential linearity, no distortion mechanisms due to resistor matching errors, no linearity drift over time and temperature, and a high tolerance to clock jitter.

The CS4341 accepts data at audio sample rates from 2 kHz to 100 kHz, consumes very little power and operates over a wide power supply range. These features are ideal for DVD, A/V receiver, and set-top box systems.



CS4390

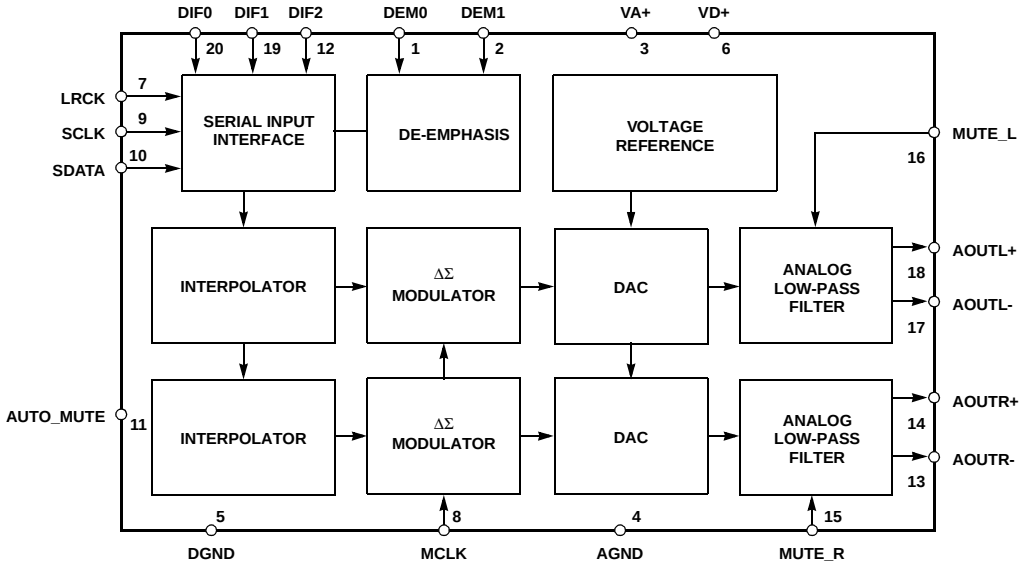
24-Bit, Stereo D/A Converter

- **24-bit conversion**
- **115 dB signal-to-noise-ratio (EIAJ)**
- **106 dB dynamic range**
- **-97 dB THD+N**
- **128x oversampling**
- **Low clock jitter sensitivity**
- **Filtered line-level outputs**
  - — Linear phase filtering
  - — Zero phase error between channels
- **Adjustable system sampling rates**
- **Digital de-emphasis for 32, 44.1, and 48 kHz**
- **Pin-compatible with CS4329**
- **Ordering information** (described on pg.198)
  - — CS4390-KP 20-Pin PDIP
  - — CS4390-KS 20-Pin SSOP

The CS4390 is a complete stereo digital-to-analog output system. In addition to the traditional D/A function, the CS4390 includes a digital interpolation filter followed by 128x oversampled ΔΣ modulator. The modulator output controls the reference voltage input to an ultra-linear analog low-pass filter. This architecture allows for infinite adjustment of sample rate between 1 and 50 kHz while maintaining linear phase response simply by changing the master clock frequency.

The CS4390 includes an extremely flexible serial port that uses mode select pins to support multiple interface formats.

The master clock can be either 256, 384, or 512 times the input sample rate, supporting various audio environments.



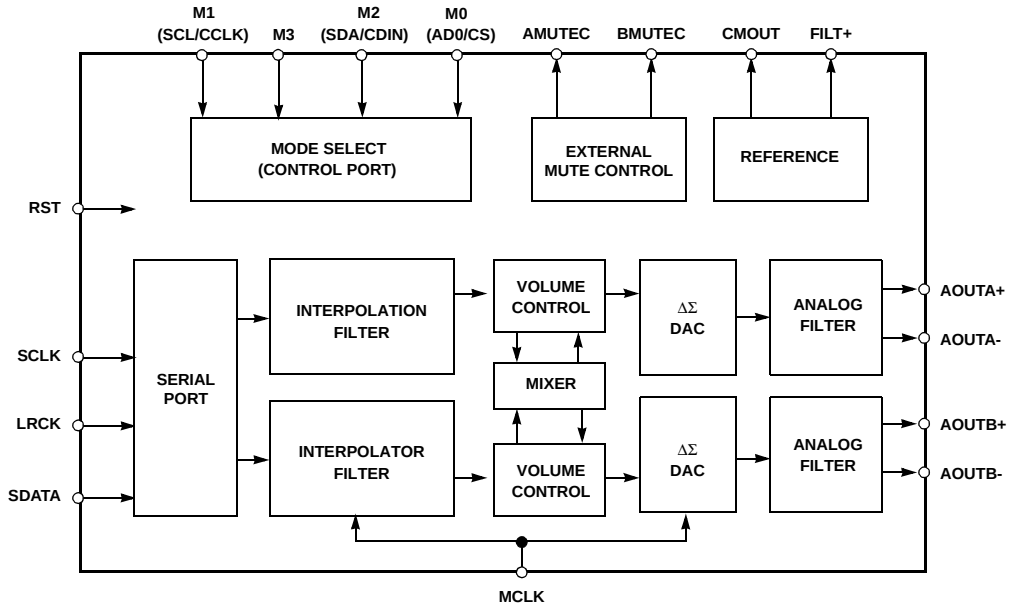
CS4391

24-Bit, 192 kHz Stereo DAC with Volume Control

- **Complete stereo DAC system: interpolation, D/A, output analog filtering**
- **108 dB dynamic range**
- **97 dB THD+N**
- **Direct stream digital mode**
- **Low clock jitter sensitivity**
- **+5 V to +3 V power supply**
- **ATAPI mixing**
- **On-chip digital de-emphasis for 32, 44.1, and 48 kHz**
- **Volume control with soft ramp**
  - — 119 dB attenuation
  - — 1 dB step size
  - — Zero crossing click-free transitions
- **36 mW with 3 V supply**
- **Direct interface with 5 V to 1.8 V logic**
- **Ordering information** (described on pg.198)
  - — CS4391-KS 20-Pin SOIC
  - — CS4391-KZ 20-Pin TSSOP

The CS4391 is a complete stereo digital-to-analog system including digital interpolation, fourth-order ΔΣ digital-to-analog conversion, digital de-emphasis, volume control, channel mixing, and analog filtering. The advantages of this architecture include: ideal differential linearity, no distortion mechanisms due to resistor matching errors, no linearity drift over time and temperature, and a high tolerance to clock jitter.

The CS4391 accepts PCM data at sample rates from 2 kHz to 192 kHz, DSD audio data, consumes very little power, and operates over a wide power supply range. These features are ideal for DVD, A/V receivers, CD and set-top box systems.

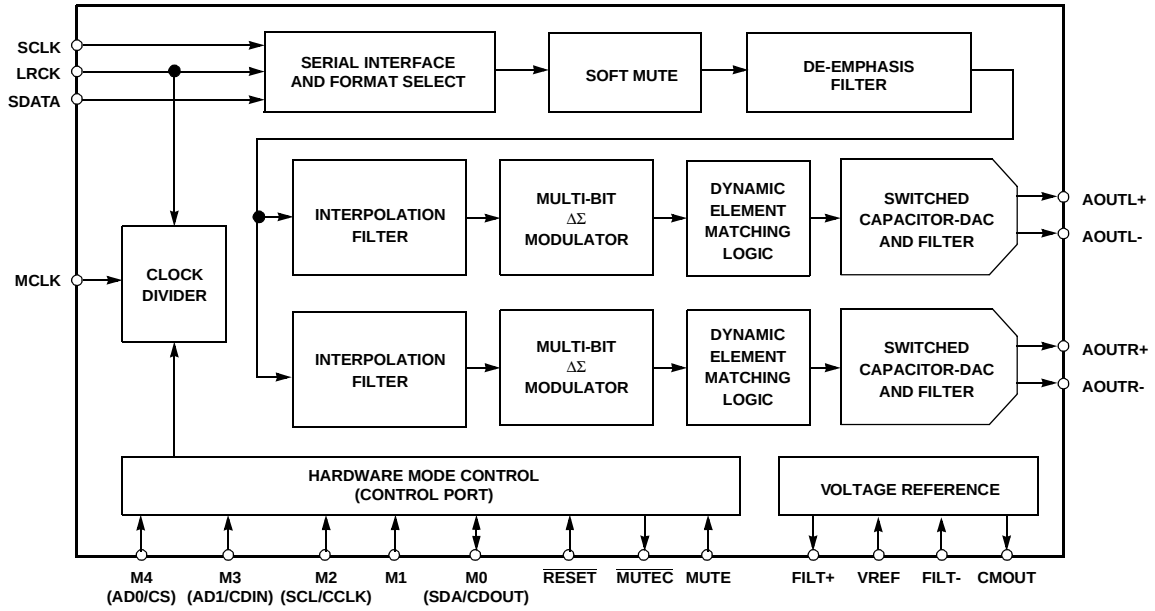


CS4396

24-Bit, 192 kHz D/A Converter for Digital Audio

- **24-Bit conversion**
- **Up to 192 kHz sample rates**
- **120 dB dynamic range**
- **-100 dB THD+N**
- **Advanced dynamic-element matching**
- **Low clock jitter sensitivity**
- **Digital de-emphasis for 32 kHz, 44.1 kHz and 48 kHz**
- **External reference input**
- **Ordering information** (described on pg.198)
  — CS4396-KS 28-pin Plastic SOIC

The CS4396 is a complete high performance 24-bit 48/96/192 kHz stereo digital-to-analog conversion system. The device includes a digital interpolation filter followed by a oversampled multi-bit ΔΣ modulator which drives dynamic-element-matching (DEM) selection logic. The output from the DEM block controls the input to a multi-element switched capacitor DAC/low-pass filter, with fully-differential outputs. This multi-bit architecture features significantly lower out-of-band noise and jitter sensitivity than traditional 1-bit designs, and the advanced DEM guarantees low noise and distortion at all signal levels.



CS4397

24-Bit, Multi-Standard D/A Converter for Digital Audio

- **24-bit conversion**
- **Up to 192 kHz sample rates**
- **120 dB dynamic range**
- **-100 dB THD+N**
- **Supports PCM, DSD, and external interpolation filters**
- **Advanced dynamic-element matching**
- **Low clock jitter sensitivity**
- **Digital de-emphasis for 32 kHz, 44.1 kHz, and 48 kHz**
- **External reference input**
- **Ordering information** (described on pg.198)
  — CS4397-KS 28-pin Plastic SOIC

The CS4397 is a complete high performance 24-bit 48/96/192 kHz stereo digital-to-analog conversion system. The device includes a digital interpolation filter followed by a oversampled multi-bit ΔΣ modulator which drives dynamic-element-matching (DEM) selection logic. The output from the DEM block controls the input to a multi-element switched capacitor DAC/low-pass filter, with fully-differential outputs. This multi-bit architecture features significantly lower out-of-band noise and jitter sensitivity than traditional 1-bit designs, and the advanced DEM guarantees low noise and distortion at all signal levels.

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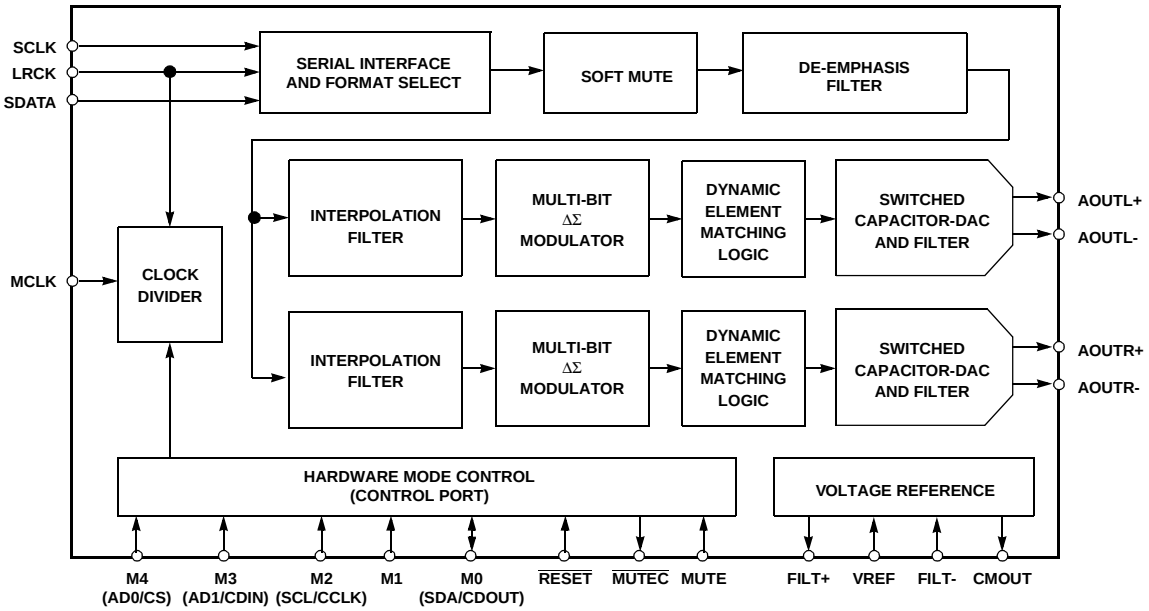


Consumer/Professional Audio

Transmitters, Receivers, and Sample-Rate Converters

Transmitters, Receivers, and Sample-Rate Converters

Specification Table

Part	Receiver	Transmitter	SRC	AES/EBU	S/PDIF, IEC958, EIAJ, CP-340	96 kHz Sample Rate	Host Interface	Channel Status Buffer Memory	Power (mW)	Package
CS8401A		✔		✔	✔		✔	✔		24 SOIC/PDIP
CS8402A		✔		✔	✔	✔				24 SOIC/PDIP
CS8403A		✔		✔	✔	✔	✔	✔		24 SOIC
CS8404A		✔		✔	✔					24 SOIC
CS8405A		✔		✔	✔	✔	✔	✔		28 SOIC/TSSOP
CS8411	✔			✔	✔		✔	✔		28 SOIC/PDIP
CS8412	✔			✔	✔					28 SOIC/PDIP
CS8413	✔			✔	✔	✔	✔	✔		28 SOIC
CS8414	✔			✔	✔	✔				28 SOIC
CS8415A	✔			✔	✔	✔	✔	✔		28 SOIC/TSSOP
CS8420	✔	✔	✔	✔	✔	✔	✔	✔		28 SOIC
CS8427	✔	✔		✔	✔	✔	✔	✔		28 SOIC/TSSOP

CS8401A/2A

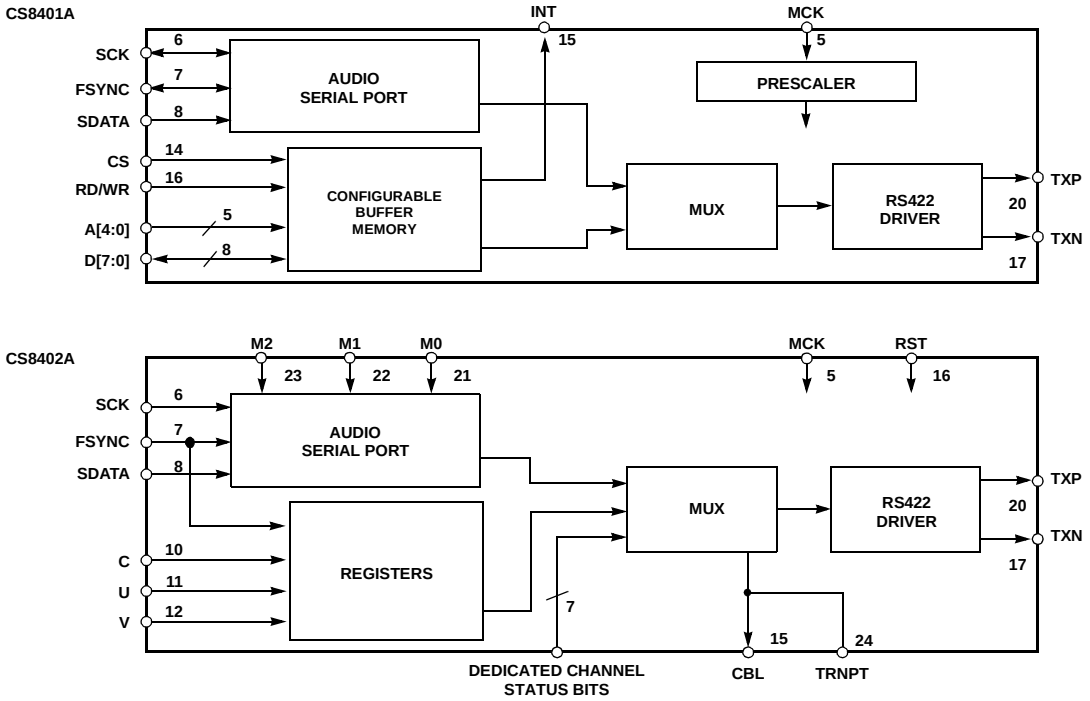
Digital Audio Transmitters

- **Monolithic digital audio interface transmitter**
- **Supports AES/EBU, IEC 958, S/PDIF, and EIAJ CP-340 professional and consumer formats**
- **Host mode and stand-alone modes**
- **Generates CRC codes and parity bits**
- **On-chip RS422 line driver**
- **Configurable buffer memory (CS8401A)**
- **Transparent mode allows direct connection of CS8402A and CS8412 or CS8401A and CS8411**
- **Ordering information** (described on pg.198)
  - — CS8401A-CP 24-Pin 0.3” PDIP
  - — CS8401A-IP 24-Pin 0.3” PDIP
  - — CS8401A-CS 24-Pin SOIC
  - — CS8401A-IS 24-Pin SOIC
  - — CS8402A-CP 24-Pin 0.3” PDIP
  - — CS8402A-IP 24-Pin 0.3” PDIP
  - — CS8402A-CS 24-Pin SOIC
  - — CS8402A-IS 24-Pin SOIC

The CS8401A and CS8402A are monolithic CMOS devices that encode and transmit audio data according to the AES/EBU, IEC 958, S/PDIF, and EIAJ CP-340 interface standards. The CS8401A/CS8402A accept audio and digital data, which is then multiplexed, encoded, and driven onto a cable. The audio serial port is double buffered and capable of supporting a wide variety of formats.

The CS8401A has a configurable internal buffer memory, loaded over a parallel port, which can be used to buffer channel status, auxiliary data, and/or user data.

The CS8402A multiplexes the channel, user, and validity data directly from serial input pins with dedicated input pins for the most important channel status bits.



CS8403A/4A

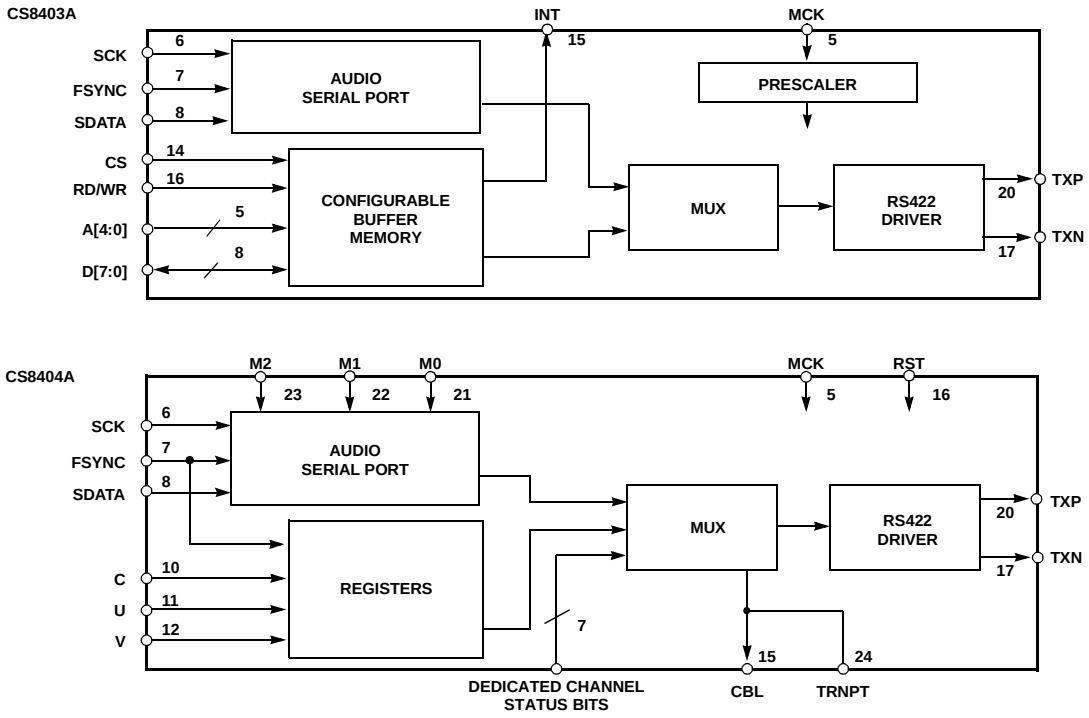
96 kHz Digital Audio Transmitters

- **Sample rates up to 108 kHz**
- **Supports AES/EBU, IEC 958, S/PDIF, and EIAJ CP-340 professional and consumer formats**
- **Generates CRC codes and parity bits**
- **On-chip RS422 line driver**
- **Configurable buffer memory (CS8403A)**
- **Transparent mode allows direct connection of CS8404A and CS8414 or CS8403A and CS8413**
- **Pin compatible with CS8401A and CS8402A**
- **Ordering information** (described on pg.198)
  - — CS8403A-CS 24-Pin SOIC
  - — CS8404A-CS 24-Pin SOIC

The CS8403A and CS8404A are digital audio transmitters that support 96 kHz sample rate operation. The devices encode and transmit audio data according to the AES/EBU, IEC958, S/PDIF, and EIAJ CP-340 interface standards. The CS8403A and CS8404A accept audio and digital data, which is then multiplexed, encoded, and driven onto a cable. The audio serial port is double buffered and capable of supporting a wide variety of formats.

The CS8403A has a configurable internal buffer memory, loaded over a parallel port, which can be used to buffer channel status, auxiliary data, and/or user data.

The CS8404A multiplexes the channel, user, and validity data directly from serial input pins with dedicated input pins for the most important channel status bits.



CS8405A

96 kHz Digital Audio Interface Transmitter

- **+3 to +5 V Digital Supply**
- **Complete EIAJ CP1201, IEC-60958, AES3, S/PDIF compatible transmitter**
- **On-chip C and U bit buffer memory allows block sized updates**
- **Flexible 3-wire serial digital audio input port**
- **Up to 96 kHz frame rate**
- **Microcontroller write access to Channel Status and User data**
- **On-chip differential line driver**
- **Generates CRC codes and parity bits**
- **Stand-alone mode allows use without a microcontroller**
- **Ordering information** (described on pg.198)
  - — CS8405A-CS 28-pin SOIC
  - — CS8405A-CZ 28-pin TSSOP

The CS8405A is a monolithic CMOS device which encodes and transmits audio data according to the AES3, IEC60958, S/PDIF, and EIAJ CP1201 interface standards. The CS8405A accepts audio and digital data, which is then multiplexed, encoded, and driven onto a cable.

The audio data is input via a configurable, 3-wire input port. The channel status and user data are input via an SPI or I^2C® microcontroller port, and may be assembled in block sized buffers.

For systems with no microcontroller, a stand-alone mode allows direct access to channel status and user data pins.

Target applications include CD-R, DAT, DVD, MD, and VTR equipment, mixing consoles, digital audio transmission equipment, high quality D/A and A/D converters, effects processors, set-top TV boxes, and computer audio systems.

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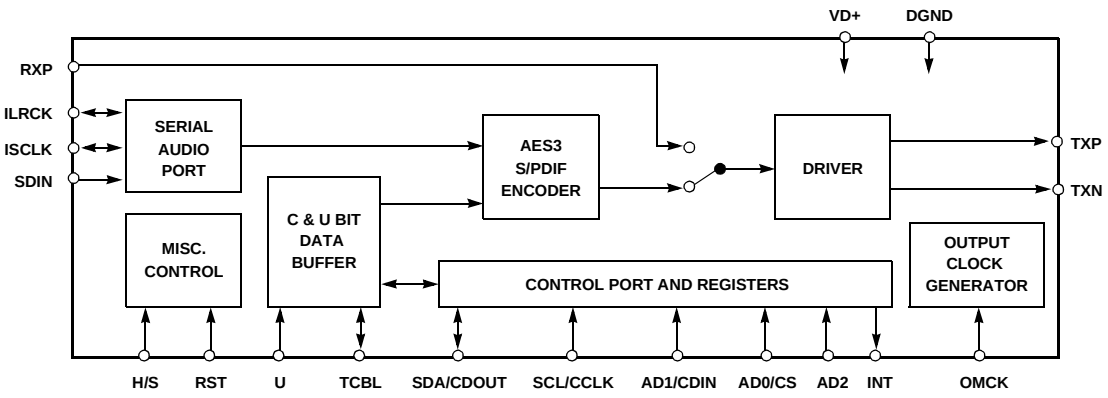


CS8411/12

Digital Audio Receivers

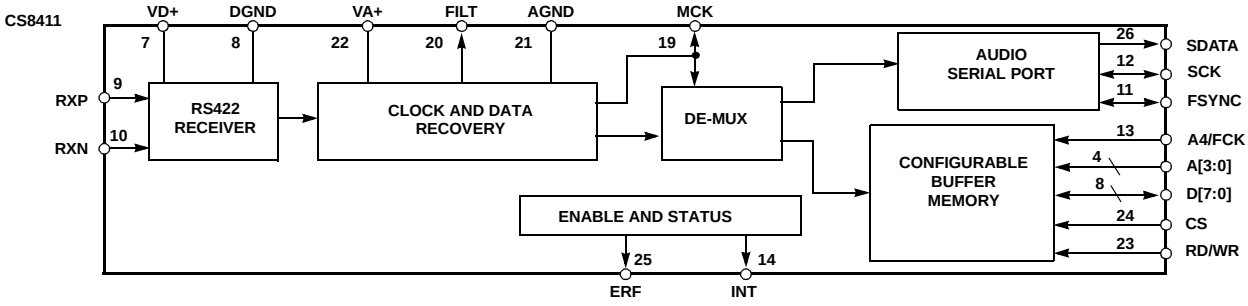
- **Monolithic CMOS receiver**
- **Low-jitter, on-chip clock recovery**
  - — 256xFs output clock provided
- **Supports AES/EBU, IEC 958, S/PDIF, and EIAJ CP-340 professional and consumer formats**
- **Extensive error reporting**
  - — Repeat last sample on error option
- **On-chip RS422 line receiver**
- **Configurable buffer memory (CS8411)**
- **Ordering information** (described on pg.198)

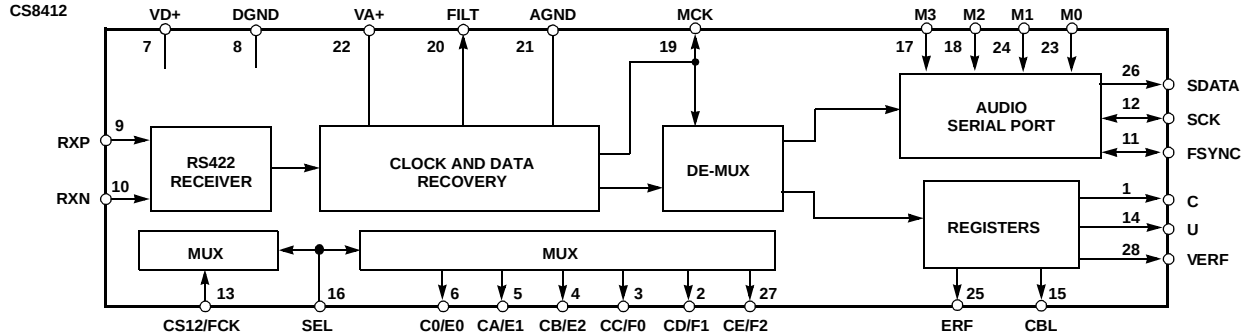
— CS8411-CP	28-Pin 0.6” PDIP
— CS8411-IP	28-Pin 0.6” PDIP
— CS8411-CS	28-Pin SOIC
— CS8411-IS	28-Pin SOIC
— CS8411-CP	28-Pin 0.6” PDIP
— CS8411-IP	28-Pin 0.6” PDIP
— CS8411-CS	28-Pin SOIC
— CS8411-IS	28-Pin SOIC

The CS8411 and CS8412 are monolithic CMOS devices that receive and decode audio data according to the AES/EBU, IEC 958, S/PDIF, and EIAJ CP-340 interface standards. The CS8411/12 receive data from a transmission line, recover the clock and synchronization signals, and de-multiplex the audio and digital data. Differential or single-ended inputs can be decoded.

The CS8411 has a configurable internal buffer memory, read over a parallel port, which can be used to buffer channel status, auxiliary data, and/or user data.

The CS8412 de-multiplexes the channel, user, and validity data directly to serial output pins with dedicated output pins for the most important channel status bits.





CS8413/14

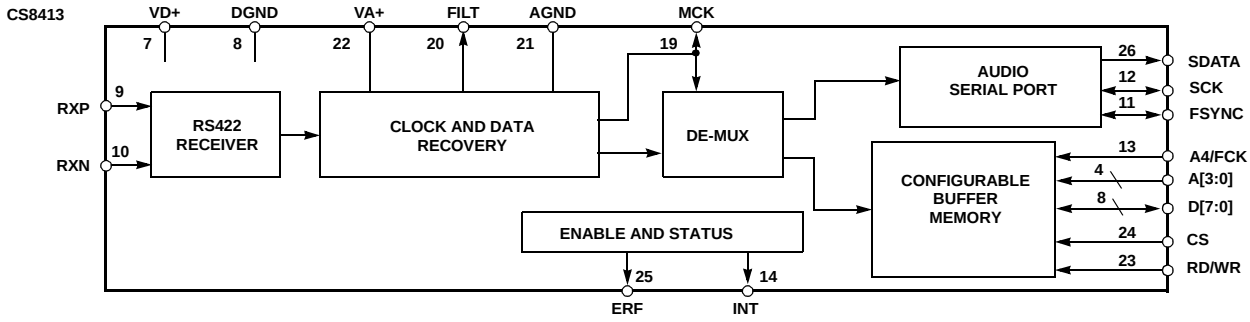
96 kHz Digital Audio Receivers

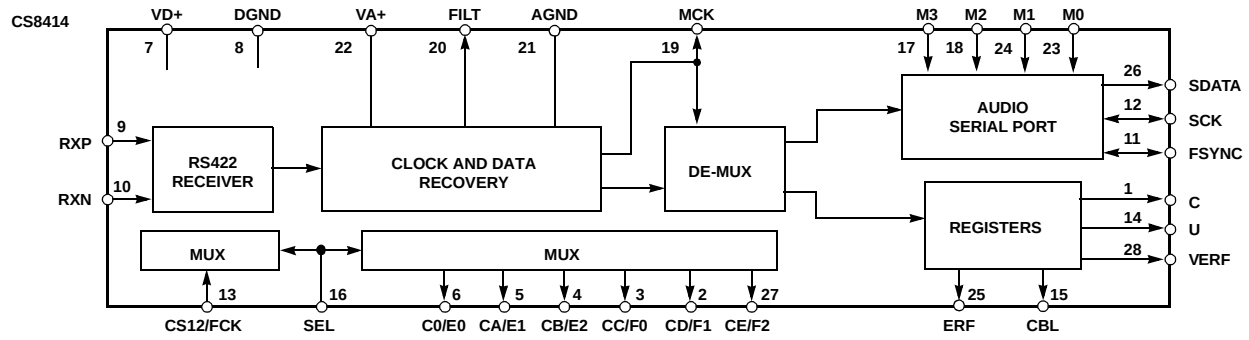
- **Sample rates to >100 kHz**
- **Low-jitter, on-chip clock recovery**
  - — 256xFs output clock provided
- **Supports AES/EBU, IEC 958, S/PDIF, and EIAJ CP340/1201 professional and consumer formats**
- **Extensive error reporting**
  - — Repeat last sample on error option
- **On-chip RS422 line receiver**
- **Configurable buffer memory (CS8413)**
- **Pin compatible with CS8411 and CS8412**
- **Ordering information** (described on pg.198)
  - — CS8413-CS 28-Pin SOIC
  - — CS8414-CS 28-Pin SOIC

The CS8413 and CS8414 are monolithic CMOS devices that receive and decode audio data up to 96 kHz according to the AES/EBU, IEC958, S/PDIF, and EIAJ CP340/1201 interface standards. The CS8413 and CS8414 receive data from a transmission line, recover the clock and synchronization signals, and de-multiplex the audio and digital data. Differential or single-ended inputs can be decoded.

The CS8413 has a configurable internal buffer memory, read over a parallel port, which can be used to buffer channel status, auxiliary data, and/or user data.

The CS8414 de-multiplexes the channel, user, and validity data directly to serial output pins with dedicated output pins for the most important channel status bits.





CS8415A

96 kHz Digital Audio Interface Receiver

- **+3 V to +5 V digital supply**
- **Complete EIAJ CP1201, IEC-60958, AES3, S/PDIF compatible receiver**
- **7:1 S/PDIF MUX**
- **Flexible 3-wire serial digital output port**
- **8 kHz to 96 kHz sample frequency range**
- **Low jitter clock recovery**
- **Pin and microcontroller read access to channel status and user data**
- **Microcontroller and stand-alone modes**
- **Differential cable receiver**
- **On-chip channel status and user data buffer memory**
- **Auto-detection of compressed audio input streams**
- **Decodes Q CD sub-code**
- **OMCK system clock mode**
- **Ordering information** (described on pg.198)
  - — CS8415A-CS 28-pin SOIC
  - — CS8415A-CZ 28-pin TSSOP

The CS8415A is a monolithic CMOS device which receives and decodes one of 7 channels of audio data according to the IEC60958, S/PDIF, and EIAJ CP1201 interface standards or one channel of AES3 data. The CS8415A has a serial digital audio output port and comprehensive control ability via a 4-wire microcontroller port. Channel status and user data are assembled in block-sized buffers, making read access easy.

A low jitter clock recovery mechanism yields a very clean recovered clock from the incoming AES3 stream.

Stand-alone operation allows systems with no microcontroller to operate the CS8415A with dedicated output pins for channel status data.

Target applications include AVR, CD-R, DAT, DVD, Multimedia Speakers, MD and VTR equipment, mixing consoles, digital audio transmission equipment, high quality D/A and A/D converters, effects processors, set-top box and computer audio systems.

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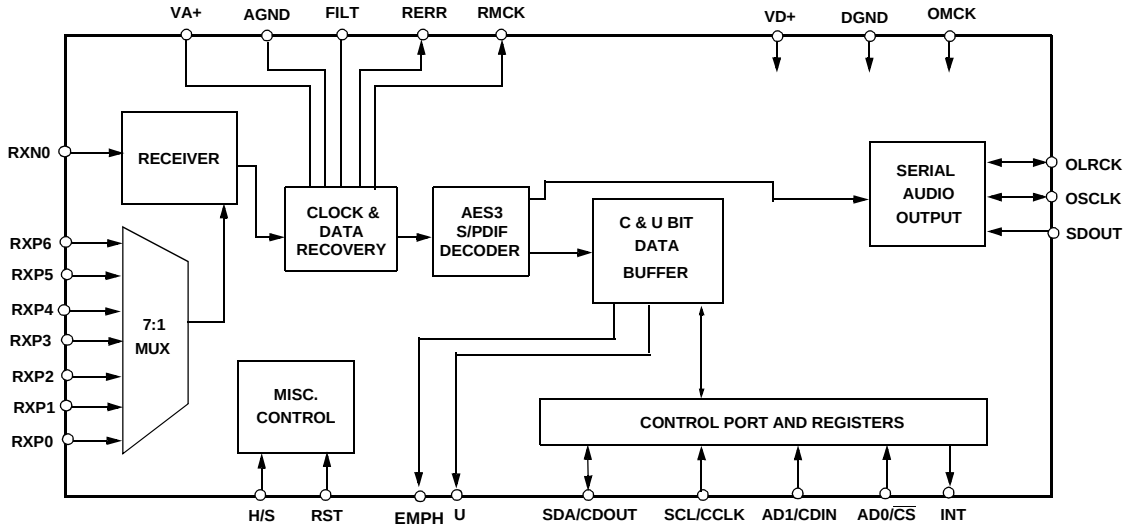


CS8420

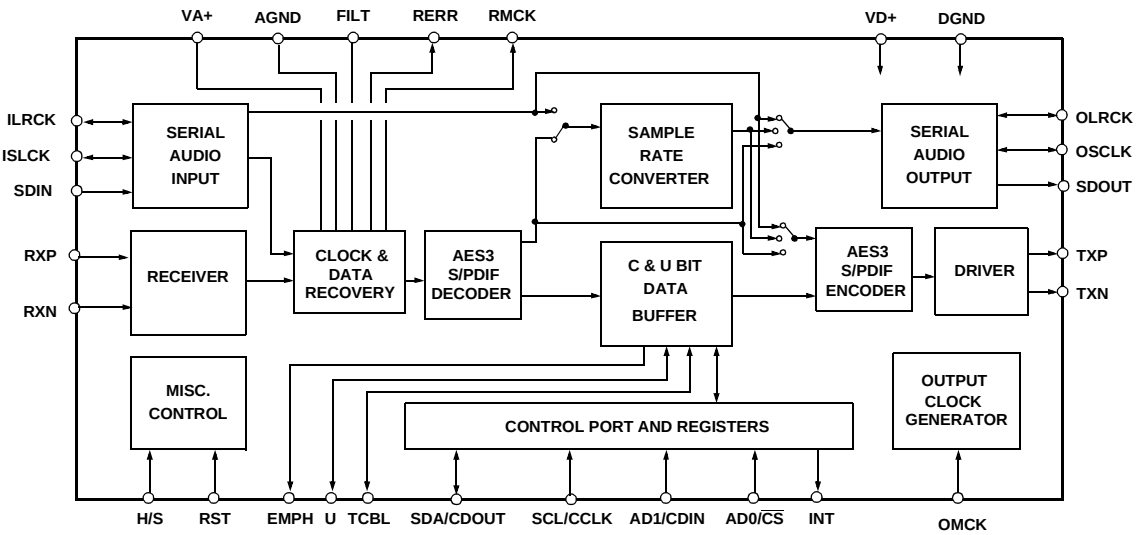
Digital Audio Sample Rate Converter

- **Complete IEC60958, AES3, S/PDIF, EIAJ CP1201 compatible transceiver with asynchronous sample rate converter**
- **Flexible 3-wire serial digital i/o ports**
- **8 kHz to 108 kHz sample rate range**
- **1:3 and 3:1 maximum input to output sample rate ratio**
- **128 dB dynamic range**
- **-117 dB THD+N at 1 kHz**
- **Excellent performance at almost a 1:1 ratio**
- **Excellent clock jitter rejection**
- **24 bit I/O words**
- **Pin and micro-controller read/write access to channel status and user data**
- **Micro-controller and stand-alone modes**
- **Ordering information** (described on pg.198)
  — CS8420-CS 28-Pin SOIC

The CS8420 is a stereo digital audio sample rate converter (SRC) with AES3 type and serial digital audio inputs, AES3 type and serial digital audio outputs, along with comprehensive control ability via a 4-wire microcontroller port. Channel status and user data can be assembled in block-sized buffers, making read/modify/write cycles easy.

Digital audio inputs and outputs may be 24, 20, or 16 bits. The input data can be completely asynchronous to the output data, with the output data being synchronous to an external system clock.

Target applications include CD-R, DAT, MD, DVD and VTR equipment, mixing consoles, digital audio transmission equipment, high quality D/A and A/D converters, effects processors and computer audio systems.



CS8427

96 kHz Digital Audio Interface Transceiver

- **Complete EIAJ CP1201, IEC-60958, AES3, S/PDIF compatible transceiver**
- **+3 V to +5 V digital supply**
- **Flexible 3-wire serial digital I/O ports**
- **Adjustable sample rate up to 96 kHz**
- **Low jitter clock recovery**
- **Pin and microcontroller read/write access to channel status and user data**
- **Microcontroller and stand-alone modes**
- **Differential cable driver and receiver**
- **On-chip channel status and user data buffer memory provides block reads and writes**
- **OMCK system clock mode**
- **Decodes audio CD Q sub-code**
- **Ordering information** (described on pg.198)
  - — CS8427-CS 28-pin SOIC
  - — CS8427-CZ 28-pin TSSOP

The CS8427 is a stereo digital audio transceiver with AES3 and serial digital audio inputs, AES3 and serial digital audio outputs, along with comprehensive control ability via a 4-wire microcontroller port. Channel status and user data are assembled in block-sized buffers, making read/modify/write cycles easy.

A low jitter clock recovery mechanism yields a very clean recovered clock from the incoming AES3 stream.

Target applications include CD-R, DAT, MD and VTR equipment, mixing consoles, digital audio transmission equipment, high quality D/A and A/D converters, effects processors, set-top box and computer audio systems.

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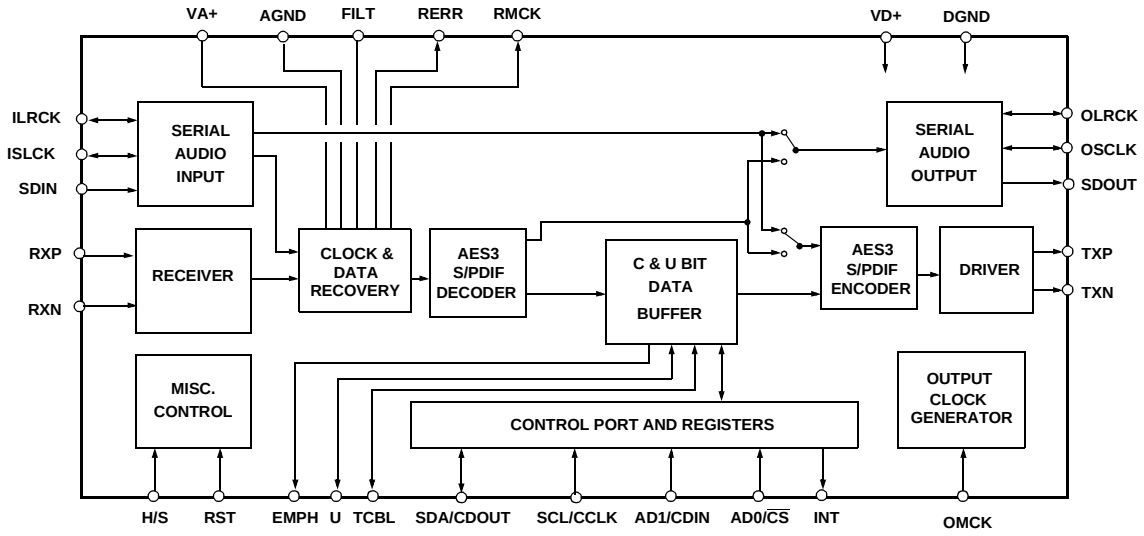


Consumer/Professional Audio

Codecs

Specification Table

Part	Resolution (bits)	SNR (dB)	Dynamic Range (dB)	THD+N (dB)	Sample Rate (kHz)	Analog I/O	Power Supply (V)	Package	Comments
CS4220	24	110	100 DACs 100 ADCs	-88 DACs -90 ADCs	48	Single-ended DACs Differential ADCs	+5	28 SSOP	2 DACs, 2 ADCs, Stand-alone mode
CS4221	24	110	100 DACs 100 ADCs	-88 DACs -90 ADCs	48	Single-ended DACs Differential ADCs	+5	28 SSOP	2 DACs, 2 ADCs, Analog volume control
CS4222	20	110	99 DACs 99 ADCs	-90 DACs -88 ADCs	48	Differential	+5	28 SSOP	2 DACs, 2 ADCs
CS4223	24	110	105 DACs 105 ADCs	-95 DACs -95 ADCs	48	Single-ended DACs Differential ADCs	+5	28 SSOP	2 DACs, 2 ADCs, Stand-alone mode
CS4224	24	110	105 DACs 105 ADCs	-95 DACs -95 ADCs	48	Single-ended DACs Differential ADCs	+5	28 SSOP	2 DACs, 2 ADCs, Analog volume control
CS4225	16	>100	98 DACs 95 ADCs	-90 DACs -88 ADCs	48	Single-ended DACs Differential ADCs	+5	44 TQFP	4 DACs, 2 ADCs
CS4226	20	108	98 DACs 95 ADCs	-88 DACs -88 ADCs	48	Single-ended DACs Single-ended or differential ADCs	+5	44 TQFP	6 DACs, 3 ADCs, S/PDIF Receiver
CS4227	20	108	98 DACs 95 ADCs	-88 DACs -90 ADCs	48	Single-ended DACs Differential ADCs	+5	44 TQFP	6 DACs, 3 ADCs
CS4228	24	103	102 DACs 102 ADCs	-88 DACs -90 ADCs	96	Single-ended DACs Differential ADCs	+5	28 SSOP	6 DACs, 2 ADCs, Volume control

CS4220/21

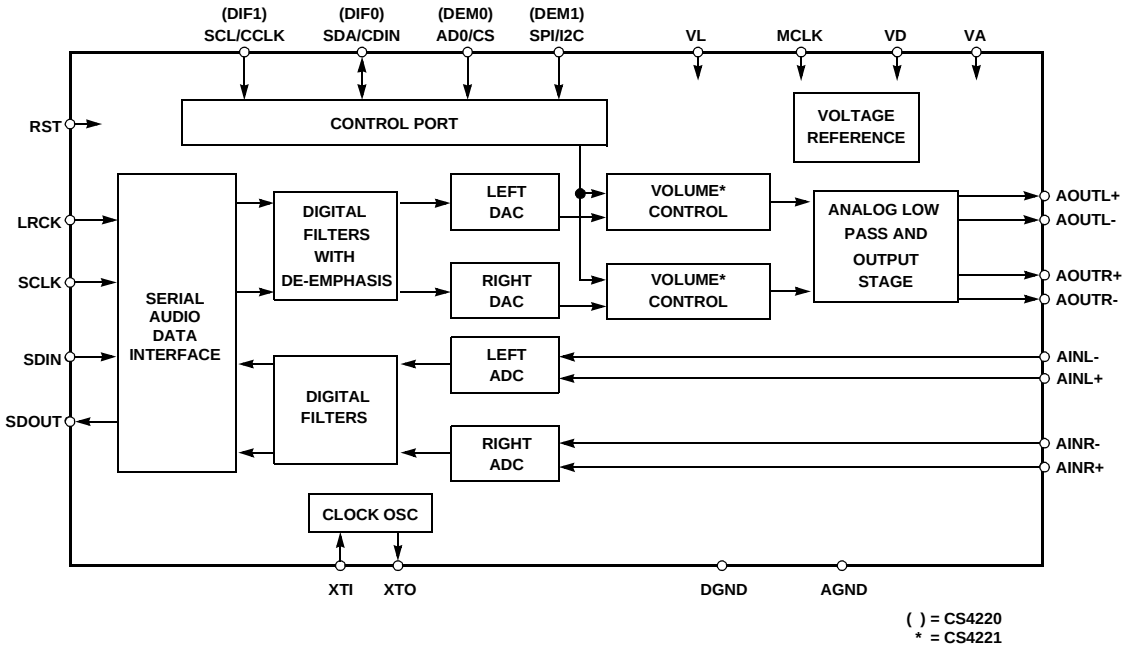
24-Bit Stereo Audio Codecs with Volume Control

- **100 dB dynamic range ADCs**
- **100 dB dynamic range DACs**
- **110 dB DAC signal-to-noise ratio (EIAJ)**
- **Analog volume control (CS4221 only)**
- **Single-ended/differential inputs**
- **Differential outputs**
- **On-chip anti-aliasing and output smoothing filters**
- **De-emphasis for 32, 44.1, and 48 kHz**
- **Supports Master and Slave modes**
- **Single +5 V power supply**
- **On-chip crystal oscillator**
- **3.0 to 5.0 V digital interface**
- **Ordering information** (described on pg.198)
  - — CS4220-KS 28-Pin SSOP
  - — CS4221-KS 28-Pin SSOP

The CS4220 and CS4221 are highly integrated, high-performance, 24-bit, audio codecs providing stereo ADCs and stereo DACs using ΔΣ conversion techniques. The devices operate from a single +5 V power supply and feature low power consumption. Selectable de-emphasis filter for 32, 44.1, and 48 kHz sample rates is also included.

The CS4220/21 codecs also include an analog volume control capable of 113.5 dB attenuation in 0.5 dB resolution. The analog volume control architecture preserves dynamic range during attenuation. Volume control changes are implemented using a soft-ramping or zero-crossing technique.

Applications include reverb processors, musical instruments, DAT, and multi-track recorders.



CS4222

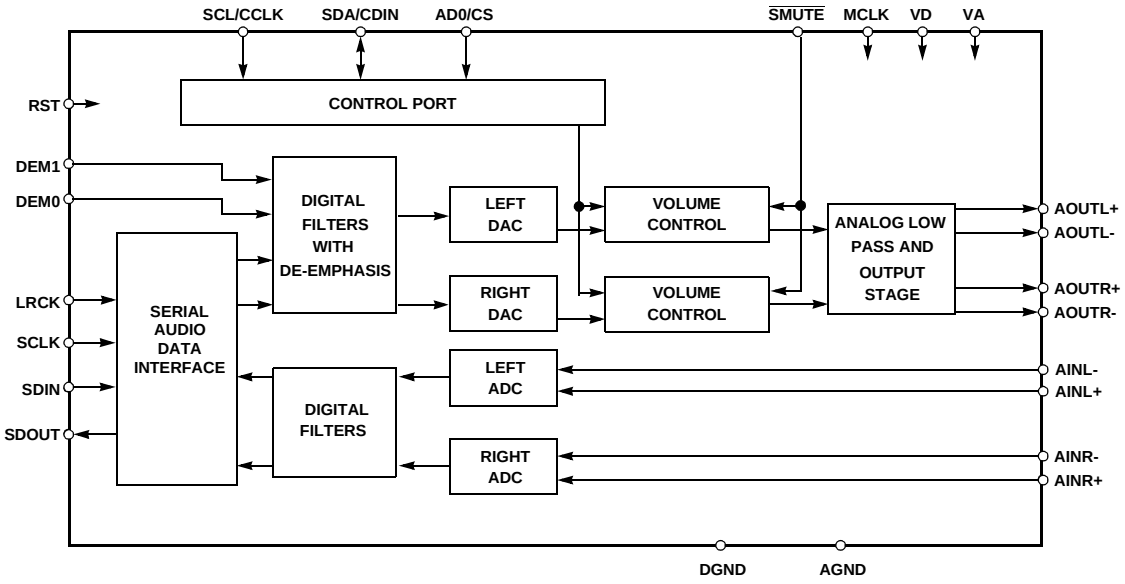
20-Bit Stereo Audio Codec with Analog Volume Control

- **99 dB 20-bit ADCs**
- **99 dB 20-bit DACs**
- **110 dB DAC signal-to-noise ratio (EIAJ)**
- **Analog volume control**
  - — 0.5 dB step resolution
  - — 113.5 dB attenuation
- **Soft mute capability**
- **Differential inputs/outputs**
- **On-chip anti-aliasing and output smoothing filters**
- **De-emphasis for 32, 44.1 and 48 kHz**
- **Stand-alone or control port mode**
- **Single +5 V power supply**
- **Ordering information** (described on pg.198)
  - — CS4222-KS 28-Pin SSOP

The CS4222 is a highly integrated, high-performance, 20-bit, audio codec providing stereo ADCs and stereo DACs using ΔΣ conversion techniques. The device operates from a single +5 V power supply, and features low power consumption. Selectable de-emphasis filter for 32, 44.1, and 48 kHz sample rates is also included.

The CS4222 includes an analog volume control capable of 113.5 dB attenuation in 0.5 dB resolution. The analog volume control architecture preserves dynamic range during attenuation. Volume control changes are implemented using a "soft" ramping or zero crossing technique.

Applications include reverb processors, musical instruments, DAT, and multi-track recorders.



CS4223/24

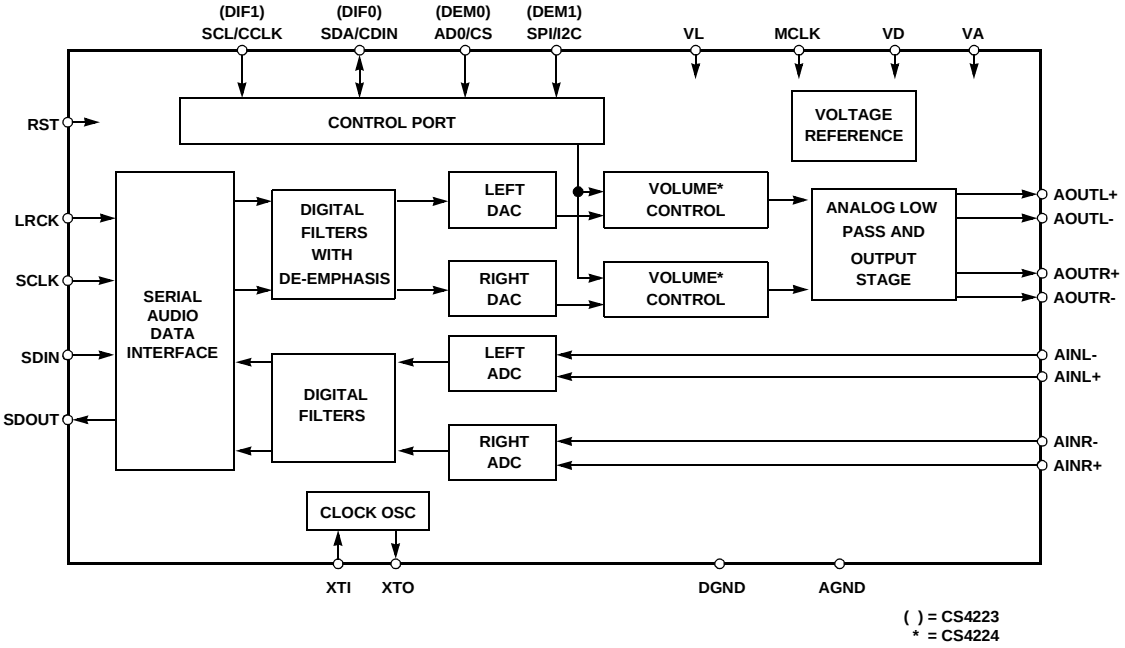
24-Bit, 105 dB Audio Codecs with Volume Control

- **105 dB dynamic range ADCs**
- **105 dB dynamic range DACs**
- **110 dB DAC signal-to-noise ratio (EIAJ)**
- **Analog volume control (CS4224 only)**
- **Single-ended/differential inputs**
- **Differential outputs**
- **On-chip anti-aliasing and output smoothing filters**
- **De-emphasis for 32, 44.1, and 48 kHz**
- **Supports Master and Slave modes**
- **Single +5 V power supply**
- **On-chip crystal oscillator**
- **3.0 to 5.0 V digital interface**
- **Ordering information** (described on pg.198)
  - — CS4223-KS 28-Pin SSOP
  - — CS4224-KS 28-Pin SSOP

The CS4223 and CS4224 are highly integrated, high-performance, 24-bit, audio codecs providing stereo ADCs and stereo DACs using ΔΣ conversion techniques. The devices operate from a single +5 V power supply and feature low power consumption. Selectable de-emphasis filter for 32, 44.1, and 48 kHz sample rates is also included.

The CS4223/24 codecs also include an analog volume control capable of 113.5 dB attenuation in 0.5 dB resolution. The analog volume control architecture preserves dynamic range during attenuation. Volume control changes are implemented using a soft-ramping or zero-crossing technique.

Applications include reverb processors, musical instruments, DAT, and multi-track recorders.

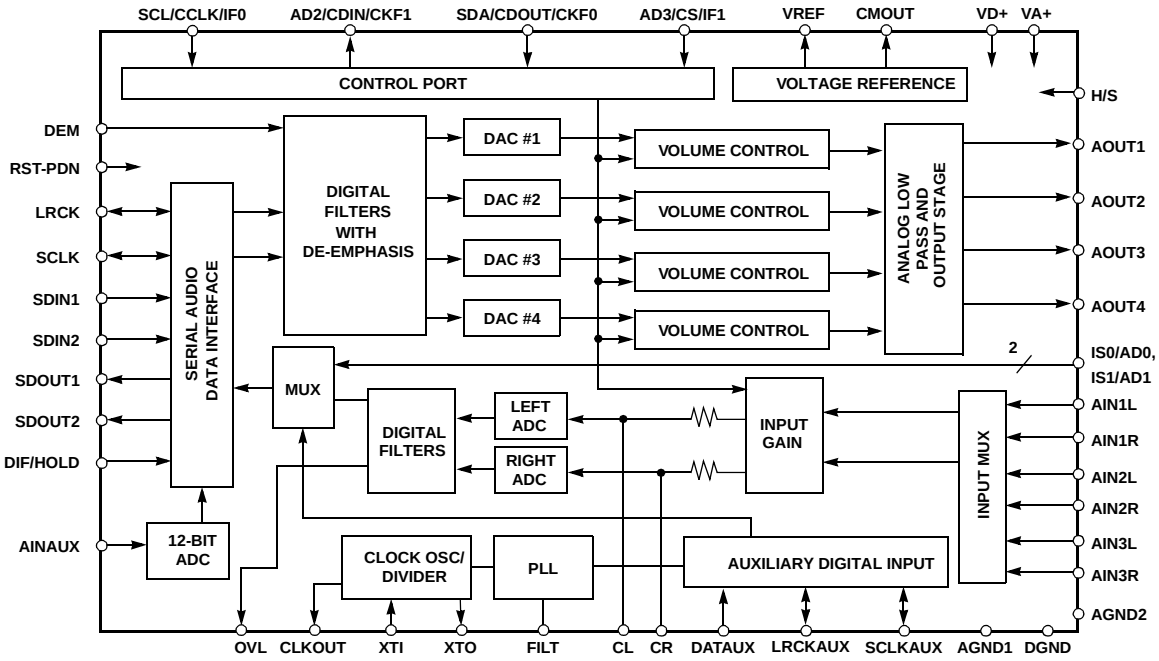


CS4225

Digital Audio Conversion System

- **Stereo 16-bit ADCs**
- **Quad 16-bit DACs**
- **Sample rates from 4 kHz to 50 kHz**
- **>100 dB DAC signal-to-noise ratio**
- **Variable bandwidth auxiliary 12-bit A/D**
- **Programmable input gain and output attenuation**
- **+5 V power supply**
- **On-chip anti-aliasing and output smoothing filters**
- **Error correction and de-emphasis**
- **Ordering information** (described on pg.198)
  - — CS4225-KL 44-Pin PLCC
  - — CS4225-BL 44-Pin PLCC

The CS4225 is a single-chip, stereo ADC and quad DAC using ΔΣ conversion techniques. Applications include CD-quality music, FM radio quality music, and telephone-quality speech. Four D/A converters make the CS4225 ideal for surround sound and automotive applications.

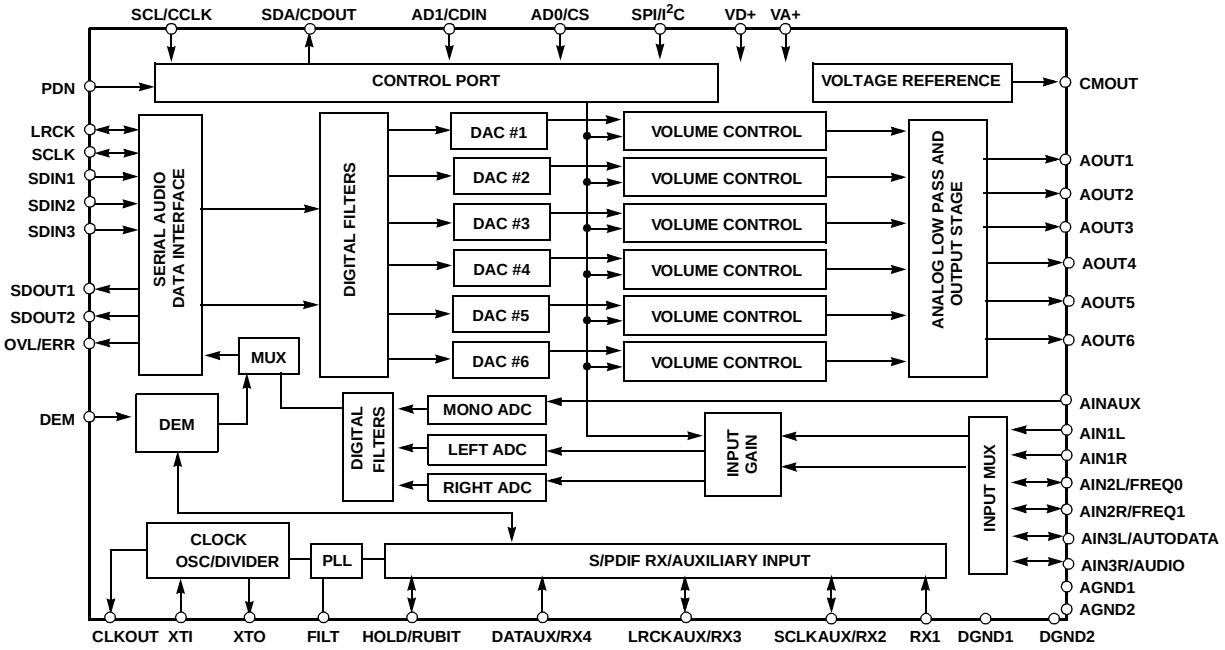


CS4226

Surround Sound Codec

- **Stereo 20-bit ADCs**
- **Six 20-bit DACs**
- **S/PDIF receiver**
  — AC-3® and MPEG auto-detect capability
- **108 dB DAC signal-to-noise ratio (EIAJ)**
- **Mono 20-bit A/D converter**
- **Programmable input gain and output attenuation**
- **On-chip anti-aliasing and output smoothing filters**
- **De-emphasis for 32 kHz, 44.1 kHz, 48 kHz**
- **Ordering information** (described on pg.198)
  — CS4226-KQ 44-Pin TQFP
  — CS4226-BQ 44-Pin TQFP

The CS4226 is a single-chip codec providing stereo ADC and six DACs using ΔΣ conversion techniques. This +5 V device also contains volume control which is independently selectable for each of the six D/A channels. An S/PDIF receiver is included as a digital input channel. Applications include Dolby® Pro-logic™, THX®, Dolby Digital™ AC-3® home theater systems, DSP-based car audio systems, and other multi-channel applications.

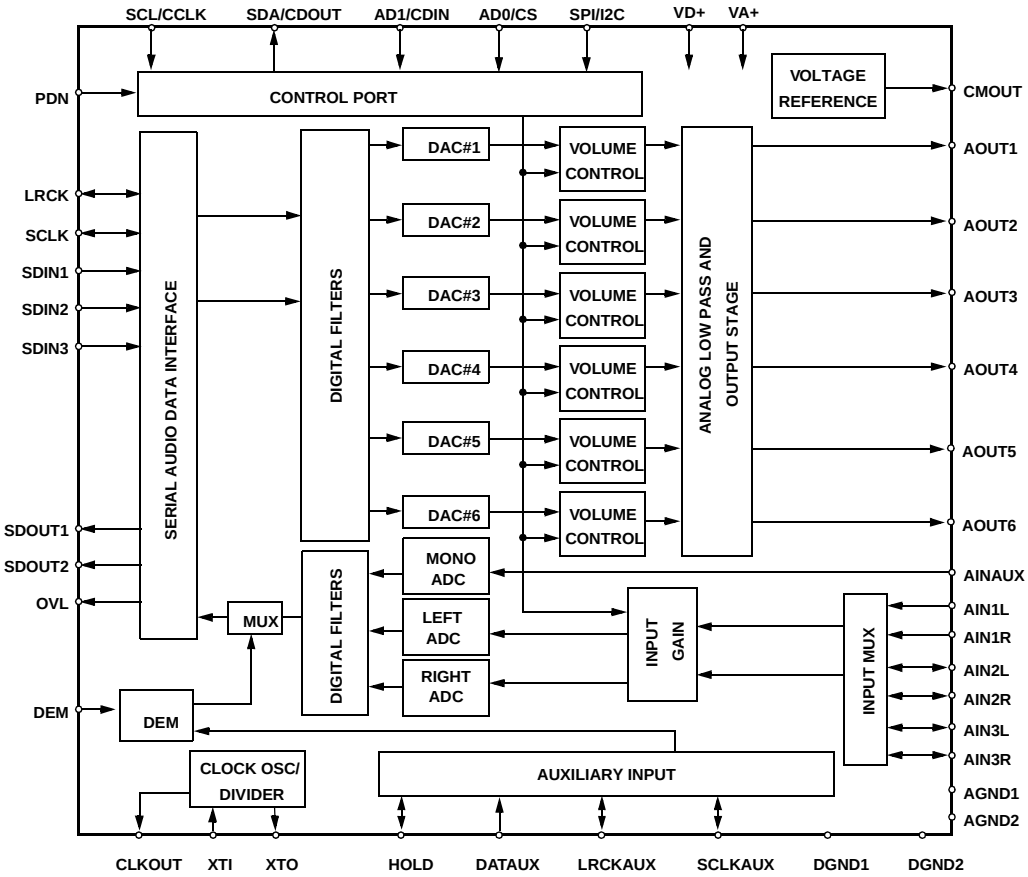


CS4227

Six-Channel, 20-Bit Codec

- **Stereo 20-bit A/D converters**
- **Six 20-bit D/A converters**
- **108 dB DAC signal-to-noise ratio (EIAJ)**
- **Mono 20-bit A/D converter**
- **Programmable input gain and output attenuation**
- **On-chip anti-aliasing and output smoothing filters**
- **De-emphasis for 32 kHz, 44.1 kHz, 48 kHz**
- **Ordering information** (described on pg.198)
  - — CS4227-KQ 44-Pin TQFP
  - — CS4227-BQ 44-Pin TQFP

The CS4227 is a single-chip codec providing stereo analog-to-digital and six digital-to-analog converters using ΔΣ conversion techniques. This +5 V device also contains volume controls that are independently selectable for each of the six D/A channels. Applications include Dolby® Pro-logic™, THX®, Dolby Digital AC-3™ home theater systems, DSP based car audio systems, and other multi-channel applications.



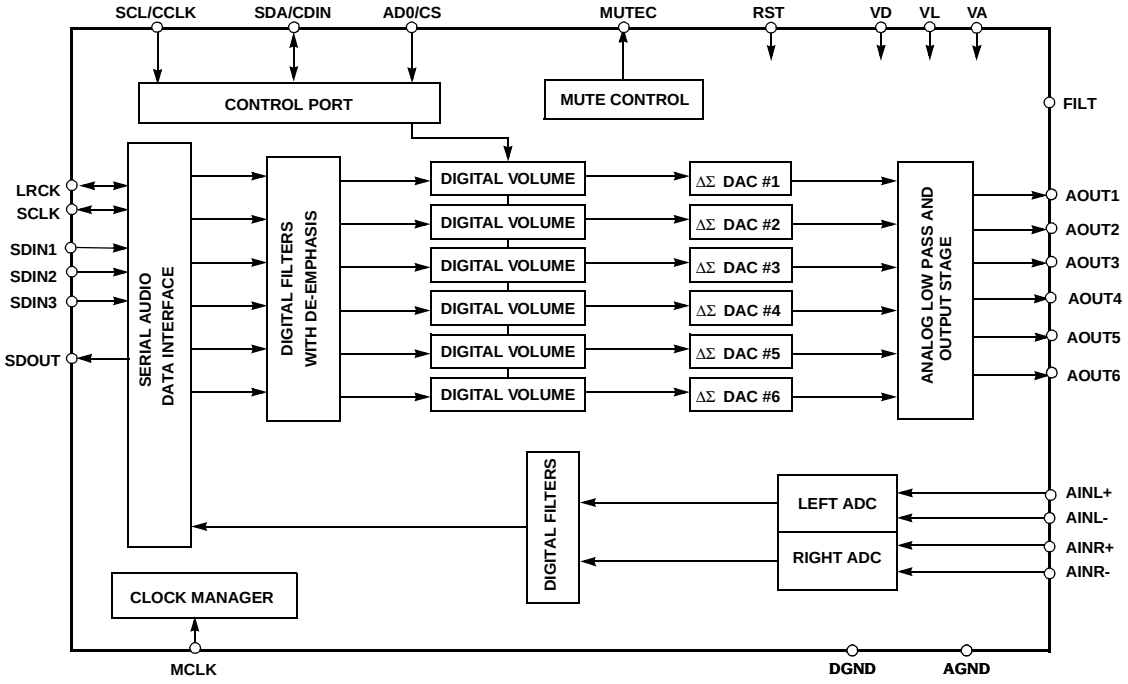
CS4228

Six-Channel, 24-Bit/96 kHz Codec

- **Two 24-bit A/D converters**
  - — 102 dB dynamic range
  - — 90 dB THD+N
- **Six 24-bit D/A converters**
  - — 103 dB dynamic range and SNR
  - — 90 dB THD+N
- **Sample rates up to 100 kHz**
- **Pop-free digital output volume controls**
  - — 90.5 dB range, 0.5 dB resolution (182 levels)
  - — Variable smooth ramp rate, 0.125 dB steps
- **Mute control pin for off-chip muting circuits**
- **On-chip anti-alias and output filters**
- **De-emphasis filters for 32, 44.1 and 48 kHz**
- **Ordering information** (described on pg.198)
  - — CS4228-KS 28-Pin SSOP

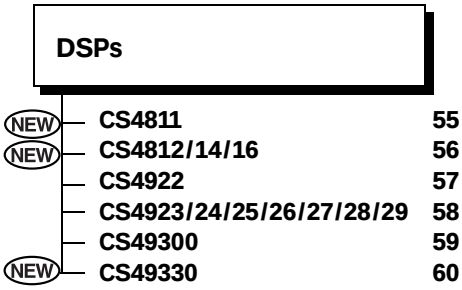
The CS4228 codec provides two analog-to-digital and six digital-to-analog ΔΣ converters, along with volume controls, in a compact +5 / +3.3 V, 28-pin SSOP device. Combined with an IEC958 (SPDIF) receiver (like the CS8414) and surround sound decoder (such as one of the CS492x or CS493xx families), it is ideal for use in DVD player, A/V receiver and car audio systems supporting multiple standards such as Dolby Digital AC-3, AAC, DTS, Dolby ProLogic, THX, and MPEG.

A flexible serial audio interface allows operation in Left Justified, Right Justified, I^2S, or One Line Data modes.



Consumer/Professional Audio

DSPs



CRYSTAL®
DIGITAL SOUND
CRYSTAL
PROCESSING

Specification Table

Part	Spring Reverb Emulation	Digital Reverbs	Fixed Multi-Effects	Variable Effects	Stereo Effects	Stereo Crossover	Low-Cost Digital Mixer	Car Audio Processor	
CS4811	✔	✔	✔						
CS4812	✔	✔	✔	✔	✔				
CS4816						✔			
CS49330		✔	✔	✔	✔	✔	✔	✔	
STB DSP	**Dolby Digital (AC-3)**	**Stereo Only OUt**	**MP-3**	**MPEG 1 and 2**	**MPEG 5.1**	**SPDIF Out**	**DAC CLK PLL**	**AAC 5.1**	**G.729A**
CS4923	✔		TBD	✔		✔	✔		TBD
CS4924	✔	✔	TBD	✔		✔	✔		TBD
CS4925	✔		TBD	✔	✔	✔	✔		TBD
CS49310	✔		✔	✔	✔	✔	✔	✔	TBD
CS49311			✔	✔	✔	✔	✔	✔	TBD
CS49312	✔		✔	✔	✔	✔	✔		TBD
CS4922		✔		✔			✔		✔
AVR DSP	**Dolby Digital (AC-3)**	**AC-3 ROM**	**DTS**	**DTS ROM**	**MPEG 5.1**	**COS**	**COS ROMed**	**AAC 5.1**	
CS4923	✔								
CS4925	✔				✔	✔			
CS49325	✔	✔			✔	✔	✔		
CS4926	✔		✔			✔			
CS49326	✔	✔	✔	✔	✔	✔	✔		
CS49329	✔		✔		✔	✔		✔	
DVD DSP	**Dolby Digital (AC-3)**	**AC-3 ROM**	**DTS**	**DTS ROM**	**MPEG 5.1**	**COS**	**COS ROMed**	**MLP**	
CS4923	✔					✔			
CS4925	✔				✔	✔			
CS49325	✔	✔			✔	✔	✔		
CS4926	✔		✔			✔			
CS49326	✔	✔	✔	✔	✔	✔	✔		
CS49300	✔		✔		✔	✔		✔	
CS49301	✔				✔	✔		✔	

CS4811

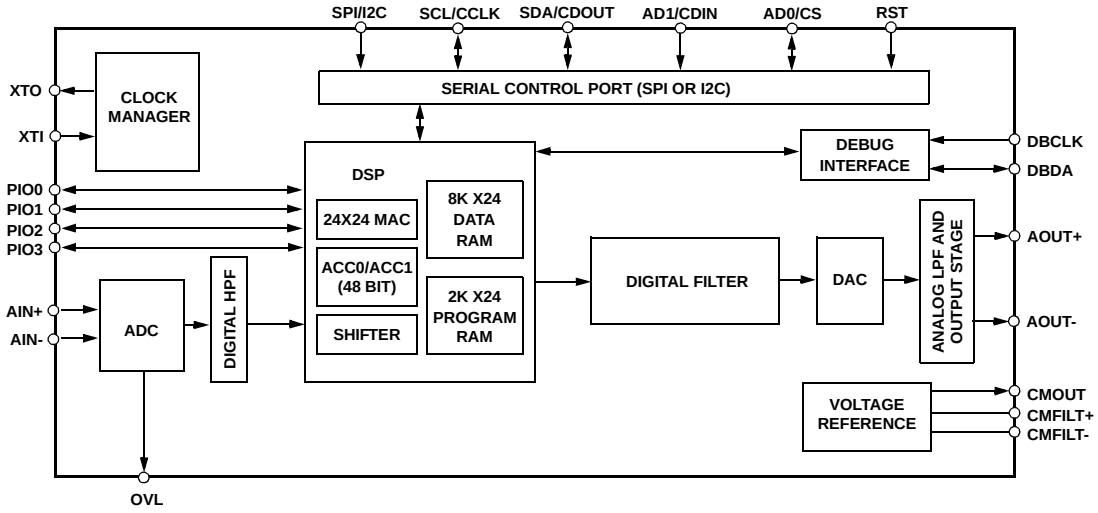
Audio DSP + Codec

- **Single-chip Audio Processing Solution**
  - — 16.9 MIPS, 24-bit fixed point DSP
  - — One 24-bit ΔΣ ADC with 100 dB dyn. range
  - — One 24-bit ΔΣ DAC with 100 dB dyn. range
  - — Large on-chip data RAM
  - — On-chip program RAM
  - — Single +5V supply operation
- **100-pin metric quad flat pack (MQFP)**
- **Ordering information** (described on pg.198)
  - — CS4811-KM 100-pin MQFP

The CS4811 is a complete audio system on a chip. It is a low-cost version of the CS4816 which includes a powerful DSP with considerable on-chip program and data memory and a high performance codec capable of 50 kHz sampling rates. A flexible serial control port allows interfacing to compact and low cost serial EEPROM for stand-alone operation. Other features such as single +5V operation simplify system design.

The CS4811, combined with application specific DSP firmware from Crystal, provides an ideal solution for a variety of monaural audio processing applications such as digital replacement of spring reverberators in guitar amplifiers or embedded digital effects processing for low cost mixing consoles or karaoke systems.

NEW



CS4812/14/16

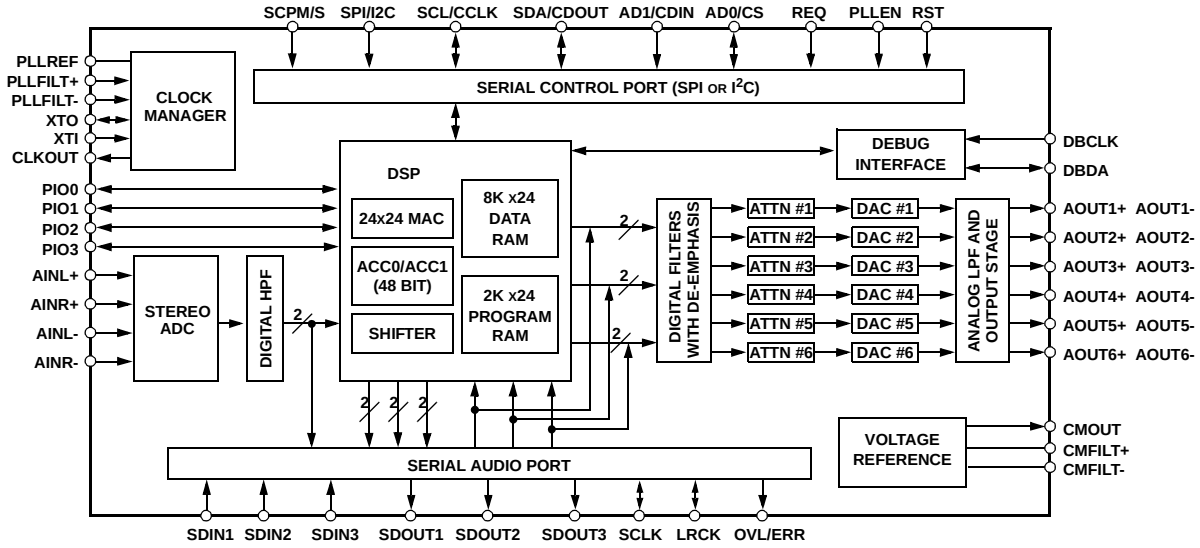
Audio DSP + Codec

- **Single-chip audio processing solution**
  - — 18 MIPS, 24-bit fixed point DSP
  - — Two 24-bit ΔΣ ADCs w/ 100 dB DR
  - — Two/four/six 24-bit ΔΣ DACs with 100 dB DR
  - — Large on-chip data RAM
  - — on-chip program RAM
  - — Digital attenuators
  - — Serial digital audio port with up to 6 inputs and 6 outputs
  - — Flexible serial control port
  - — On-chip PLL with clock manager
  - — Single +5 V supply operation
- **100-pin metric MQFP package**
- **Ordering information** (described on pg.198)
  - — CS4812/14/16-KM 100-pin MQFP

The CS4812, CS4814, and CS4816 are complete audio systems-on-chip. Each device includes a powerful DSP with considerable on-chip program and data memory, two ADCs and up to six DACs capable of 48 kHz sampling rates. The serial audio port allows flexible combinations of internal converters and external digital audio peripherals. A digital attenuator is integrated into the on-chip DACs. A full-featured serial control port allows interfacing to an external host controller or a serial EEPROM for stand-alone operation. Other features such as an on-chip PLL, and single +5 V operation, make these parts easy to design into a system.

The CS4812/14/16, combined with application DSP firmware from Crystal, provides an ideal solution for a variety of audio processing applications such as digital replacement of spring reverberators in guitar amplifiers, embedded digital multi-effects processing for guitar amps, low cost mixing consoles, or karaoke systems.

NEW



CS4922

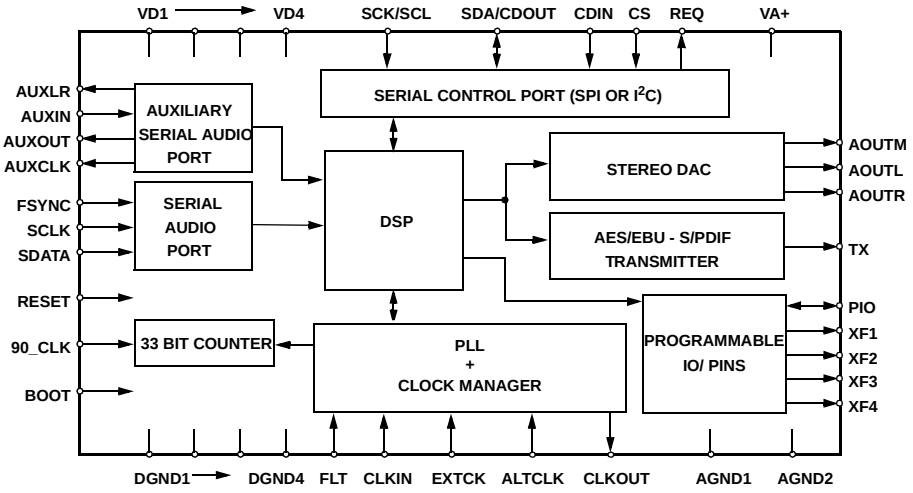
MPEG/G.729A Audio Decoder System

- **DSP optimized for audio decode, 24-bit fixed point with 48-bit accumulator**
- **On-chip functional blocks include:**
  - — DSP with RAM and ROM memories
  - — CD quality stereo DAC with output filtering
  - — Mono output and digital volume control
  - — S/PDIF transmitter, bidirectional PCM audio port
  - — Internal phase locked loop for clocking
  - — Dedicated compressed serial input interface
- **MPEG-1 and MPEG-2 layers 1 and 2 with all sample/bit rates and ancillary data support**
- **MPEG-1 and MPEG-2 packetized audio stream and elementary stream input**
- **G.729A audio decode**
- **PCM synthesis for auxiliary audio**
- **Pin compatibility with CS4920A and primary feature/firmware compatible**
- **+5 Volt only CMOS, 44 pin PLCC**
- **Ordering information** (described on pg.198)
  - — CS4922-CL 44-Pin PLCC

The CS4922 is a complete audio decompression subsystem implemented in a single high integration mixed signal CMOS chip. The CS4922 has been widely used in direct broadcast system set-top boxes and proprietary embedded systems which pull compressed audio from local system memory.

The CS4922 is tailored to include the necessary hardware and firmware to ensure proper audio/video synchronization for MPEG-2 audio decompression. In addition to audio decoding, this programmable DSP solution provides robust error concealment and features implementations like ancillary data support and PCM synthesis.

The CS4922 can also support the decode of other compression standards such as G.729A with a separate download image. The flexible architecture of the CS4922 provides the ability to mix compressed audio with data from the auxiliary PCM port.



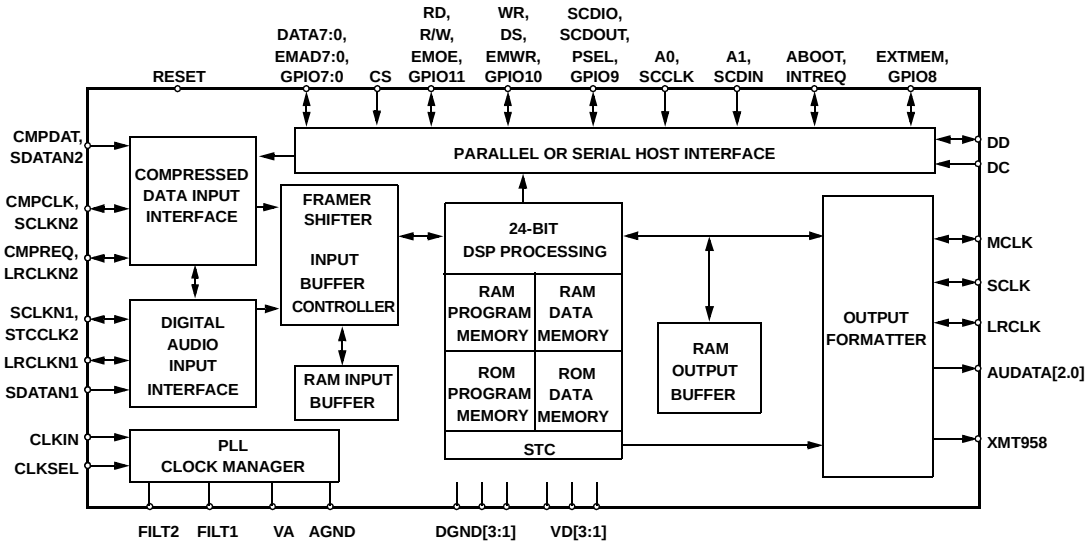
CS4923/24/25/26/27/28/29

Multi-Channel Digital Audio Decoders

- **CS4923/24/25/26/27/28 features**
  - — Optional virtual 3D output
  - — Simulated SURROUND AND PROGRAMMABLE EFFECTS
  - — Real time autodetection of Dolby Digital®, DTS®, MPEG multi-channel and PCM
  - — Flexible 6-channel master or slave output
- **CS4923/24/25/26/27/28/29 features**
  - — IEC60958/61937 transmitter for compressed-data or linear-PCM output
  - — Dedicated 8 kilobyte input buffer
  - — DAC clock via analog phase-locked loop
  - — Dedicated byte wide or serial host interface
  - — Multiple compressed data input modes
  - — PES layer decode for A/V synchronization
  - — 96 kHz-capable PCM I/O, master or slave
  - — Optional external memory and auto-boot
  - — +3.3 V CMOS low-power, 44-pin package
- **CS4923/24/25/26 features**
  - — Capable of Dolby Digital® Group A Performance
  - — Dolby bass manager and crossover filters
  - — Dolby Surround Pro Logic® Decoding
- **CS4925/27: MPEG-2 multi-channel decoder**
- **CS4926/28: DTS multi-channel decoder**
- **CS4929: AAC 2-channel (low complexity) and MPEG-2 stereo decoder**
- **Ordering information** (described on pg.198)
  - — CS4923xx-CL 44-Pin PLCC

The CS4923/24/25/26/27/28 is a family of multi-channel digital audio decoders, with the exception of the CS4929 as the only stereo digital audio decoder. The CS4923/24/25/26 are designed for Dolby Digital and MPEG-2 Stereo decoding. In addition the CS4925 adds MPEG-2 multi-channel decoding capability and the CS4926 provides DTS decoding. The CS4927 is an MPEG-2 multi-channel decoder and the CS4928 is a DTS multi-channel decoder. The CS4929 is an AAC 2-channel and MPEG-2 stereo decoder. Each one of the CS4923/24/25/26/27/28/29 provides a complete and flexible solution for multi-channel (or stereo in the case of the CS4929) audio decoding in home A/V receiver/amplifiers, DVD movie players, out-board decoders, laser-disc players, HDTV sets, head-end decoders, set-top boxes, and similar products.

Cirrus Logic's Crystal Audio Division provides a complete set of audio decoder and auxiliary audio DSP application programs for various applications. For all complementary analog and digital audio I/O, Crystal Audio also provides a complete set of high-quality audio peripherals including: multimedia CODECs, stereo A/D and D/A converters and IEC60958 interfaces. Of special note, the CS4226 is a complementary CODEC providing a digital receiver, stereo A/D converters, and six 20-bit DACs in one package.



CS49300

Multi-Standard Audio Decoder Family

- **DVD audio subfamily: CS4930X**
  - — PES layer decode for A/V sync
  - — Meridian Lossless Packing (MLP)
  - — Dolby Digital™
  - — MPEG Multi-Channel
  - — DTS decoding
  - — Parts supporting all or subsets of the above standards
- **Broadcast subfamily: CS4931X**
  - — PES layer decode for A/V sync
  - — MPEG Advanced Audio Coding Algorithm (AAC)
  - — MPEG Multi-Channel
  - — Dolby Digital
  - — Parts supporting all or subsets of the above standards
- **Audio/video receiver subfamily: CS4932X**
  - — Dolby Digital with integrated code
  - — MPEG Multi-Channel
  - — DTS decoding with integrated DTS tables and code
  - — Parts supporting all or subsets of the above standards
- **Features are a super-set of the CS4923/24/25/26/27/28 family with the following enhancements:**
  - — 8-channel output, including dual zone output capability
  - — Supports up to 192 kHz Fs @ 24-bit throughput
  - — Increased memory/MIPs
  - — SRAM Interface for increased delay and buffer capability

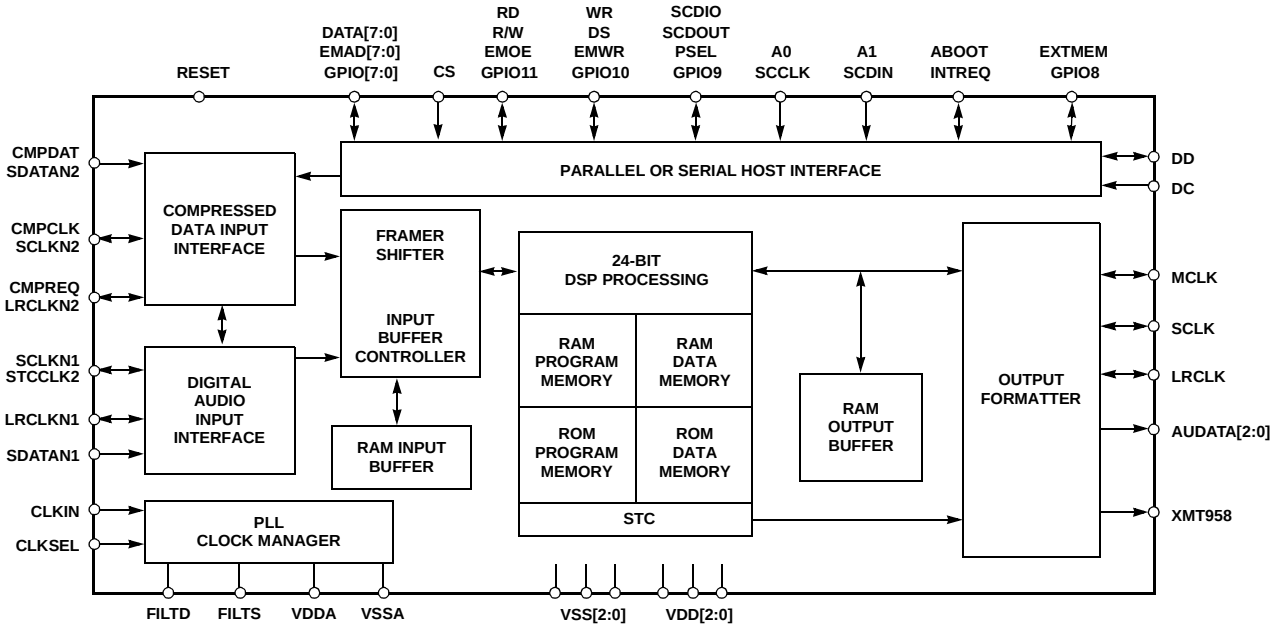
- **Ordering information** (described on pg.198)

— CS493002-CL	44-Pin PLCC
— CS493102-CL	44-Pin PLCC
— CS493253-CL	44-Pin PLCC
— CS493263-CL	44-Pin PLCC
— CS493292-CL	44-Pin PLCC

The CS493XX is a family of multichannel audio decoders intended to supersede the CS4923/24/25/26/27/28 family as the leader of audio decoding in both the DVD, broadcast, and receiver markets. The family will be split into parts tailored for each of these distinct market segments.

For the DVD market, parts will be offered which support Meridian Lossless Packing (MLP), Dolby Digital, MPEG Multi-Channel, DTS, and subsets thereof. For the receiver market, parts will be offered which support Dolby Digital, MPEG Multi-Channel, DTS, and subsets thereof. For the broadcast market, parts will be offered which support Dolby Digital, MPEG Advanced Audio Coding (AAC), and MPEG Multi-Channel.

Under the Crystal brand, Cirrus Logic is the only single supplier of high-performance 24-bit multi-standard audio DSP decoders, DSP firmware, and high-resolution data converters. This combination of DSPs, system firmware, and data converters simplify rapid creation of world-class high-fidelity products.



CS49330

Universal Audio DSP ASIC

- **Supports 24-bit throughput to 192 kHz Fs**
- **Internal DSP controlled PLL for DSP and DAC clocks**
- **4-in 8-out physical serial audio channels**
- **Software support for time multiplexed I/O channels**
- **Master or slave I/O clocking**
- **IEC60958 SPDIF output**
- **86 MIPs consumer temperature and 60 MIPs extended temperature**
- **Large on-chip program and data RAM memories**
- **High speed external SRAM multiplexed interface**
- **Serial or parallel host interface**
- **General purpose host interface**
- **+3.3 Volt CMOS low-power, 44-pin package**
- **Ordering information** (described on pg.198)
  - — CS493332-CL 44-Pin PLCC

The CS493330 is a programmable 24-bit audio DSP processor that can be targeted into high volume markets with specialized Crystal created DSP firmwares.

Current applications already ported to the CS49330 include:

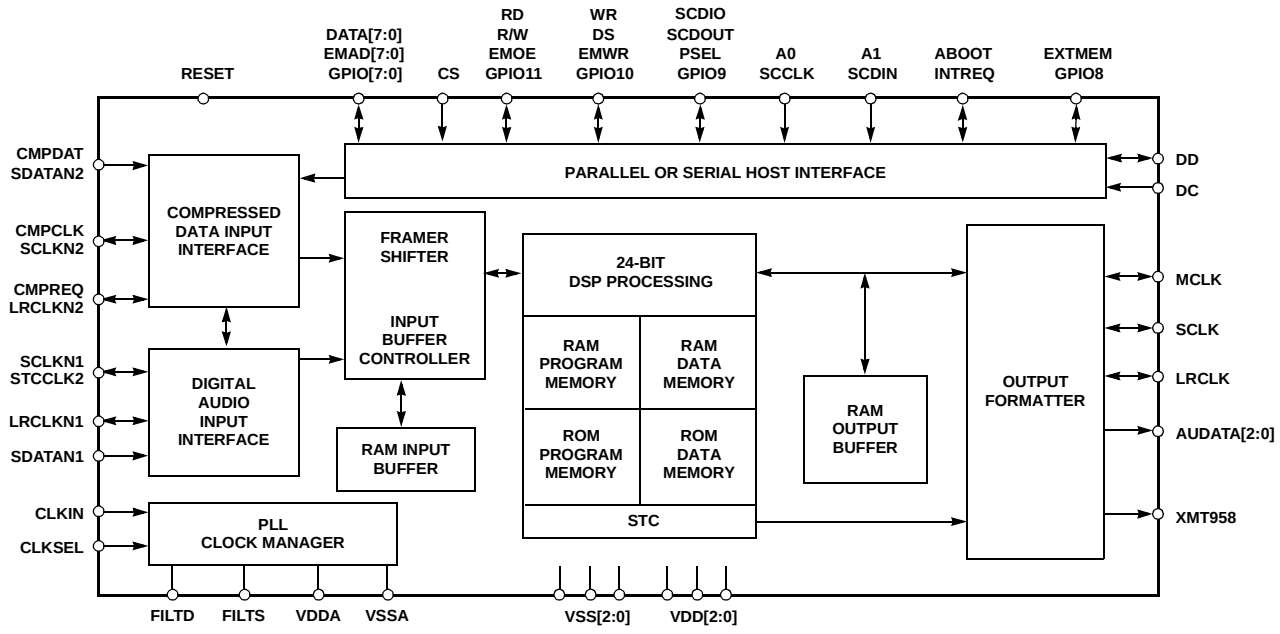
- — THX surround multi-channel processing
- — Multi-zone AV receiver controller
- — Car audio head-unit processing
- — Digital audio cross-over and equalizer filters
- — Professional audio mixing
- — Audio time alignment controller

Future applications being planned:

- — Single chip stereo audio encoder (MP-3 + DD)
- — CD-R audio data controller
- — BTSC stereo encoding/decoding
- — Customer specific features
- — High-power PWM amplifier pre-processor

Under the Crystal brand, Cirrus Logic is the only single supplier of high performance audio DSP's, DSP firmware, high resolution data converters and a complete family of serial interface products. This combination of audio components allows Cirrus to be your one-stop-shop for all audio technologies.

NEW



Consumer/Professional Audio

Portable Audio Converters

Portable Audio Converters

Specification Table

Part	Resolution (bits)	SNR (dB)	Dynamic Range (dB)	THD+N (dB)	Sample Rate (kHz)	Analog I/O	Power Supply (V)	Package	Comments
CS43L41	24	102	102	-89	96	Single-ended	2.4 to 5	16 TSSOP	Digital volume control
CS43L42	24	94	94	-88	96	Single-ended	1.8 to 3.3	24 TSSOP	Headphone and Line
CS43L43	24	94	94	-76	96	Single-ended	1.8 to 3.3	16 TSSOP	Headphone only
CS43L44	24	94	94	-88	96	Single-ended	1.8 to 3.3	16 TSSOP	Line only
CS53L32	24	88	98	-88	100	Single-ended	1.8 to 3.3	20 TSSOP	

CS43L41

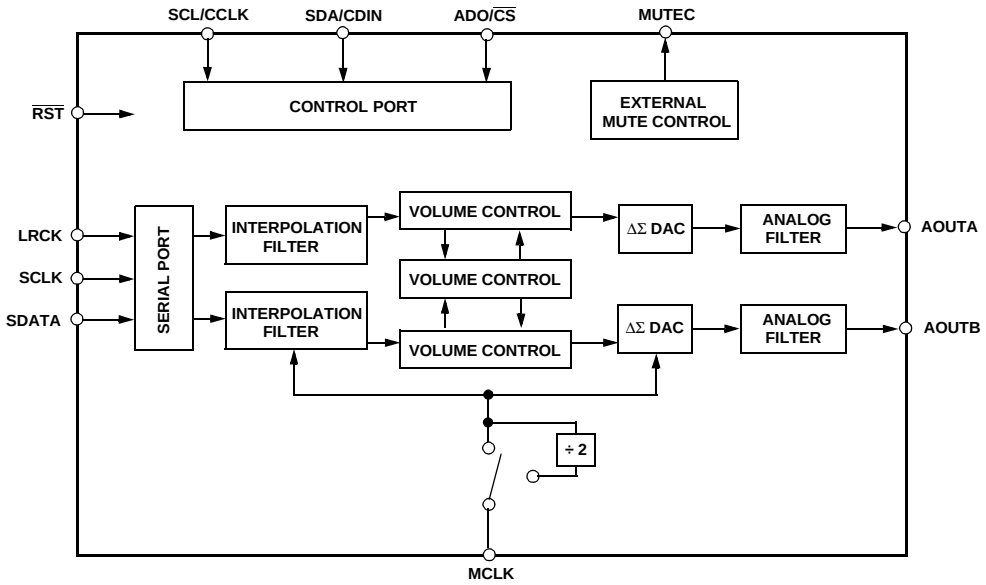
Low Power 24-Bit, 96 kHz DAC with Volume Control

- **Complete stereo DAC system: interpolation, D/A, output analog filtering**
- **ATAPI mixing**
- **102 dB dynamic range**
- **88 dBFS THD+N**
- **Low clock jitter sensitivity**
- **+2.4 V to +5 V power supply**
- **Filtered line level outputs**
- **On-chip digital de-emphasis for 32, 44.1, and 48 kHz**
- **Digital volume control with soft ramp**
  - — 94 dB attenuation
  - — 1 dB step size
  - — Zero crossing click-free transitions
- **24 mW with 2.4 V supply**
- **PopGuard® technology**
- **Ordering information** (described on pg.198)
  - — CS43L41-KZ 16-pin TSSOP

The CS43L41 is a complete stereo digital-to-analog system including digital interpolation, fourth-order ΔΣ digital-to-analog conversion, digital de-emphasis, volume control, channel mixing, and analog filtering. The advantages of this architecture include: ideal differential linearity, no distortion mechanisms due to resistor matching errors, no linearity drift over time and temperature, and a high tolerance to clock jitter.

The CS43L41 accepts data at audio sample rates from 2 kHz to 100 kHz, consumes very little power, and operates over a wide power supply range. These features are ideal for portable DVD, portable MP3, Mini-Disc, and mobile phones.

NEW



CS43L42

Low Voltage, Stereo DAC with Headphone Amp

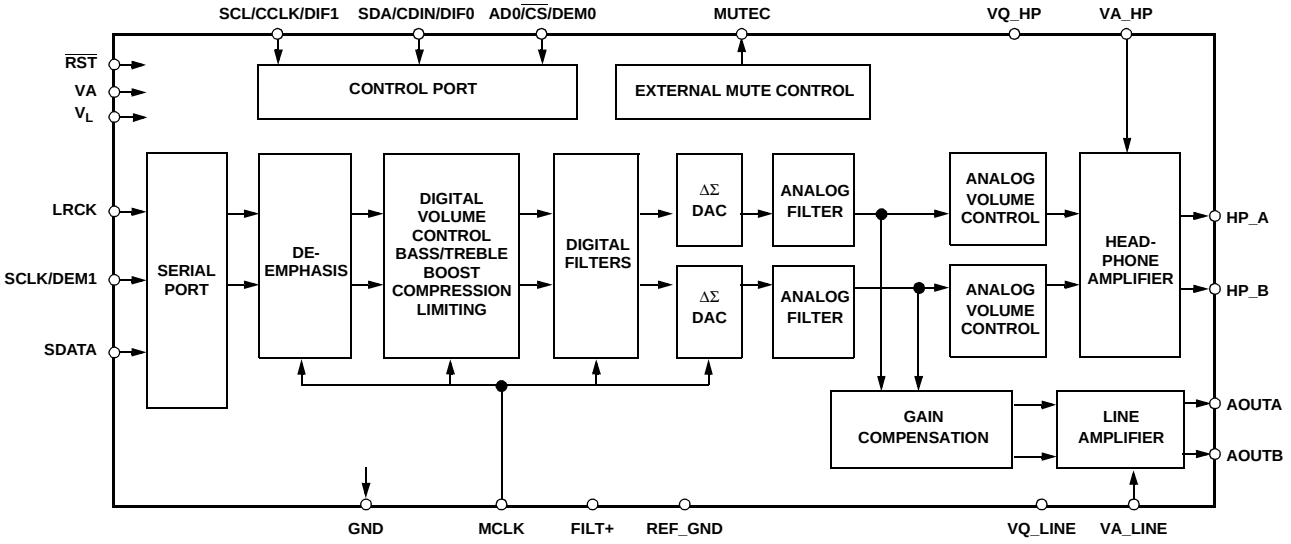
- **1.8 to 3.3 Volt supply**
- **24-Bit conversion / 96 kHz sample rate**
- **94 dB dynamic range at 3 V supply**
- **-88 dB THD+N**
- **Low power consumption**
- **Digital volume control**
  - — 96 dB attenuation, 1 dB step size
- **Digital bass and treble boost**
  - — Selectable corner frequencies
  - — Up to 12 dB boost in 1 dB increments
- **Peak signal limiting to prevent clipping**
- **De-emphasis for 32 kHz, 44.1 kHz, and 48 kHz**
- **Headphone amplifier**
  - — -85 dB THD+N
  - — Up to 25 mW_{rms} power output into 16 Ω load
  - — 25 dB analog attenuation and mute
  - — Zero crossing click free level transitions
- **ATAPI mixing functions**
- **PopGuard® technology**
- **Ordering information** (described on pg.198)
  - — CS43L42-KZ 24-pin TSSOP

The CS43L42 is a complete stereo digital-to-analog output system including interpolation, 1-bit D/A conversion, analog filtering, volume control, line level outputs, and a headphone amplifier, in a 24-pin TSSOP package.

The CS43L42 is based on ΔΣ modulation, where the modulator output controls the reference voltage input to an ultra-linear analog low-pass filter. This architecture allows infinite adjustment of the sample rate between 2 kHz and 100 kHz simply by changing the master clock frequency.

The CS43L42 contains on-chip digital bass and treble boost, peak signal limiting, and de-emphasis. The CS43L42 operates from a +1.8 V to +3.6 V supply and consumes only 23 mW of power with a 1.8 V supply with the line amplifier powered-down. These features are ideal for portable CD, MP3 and MD players and other portable playback systems that require extremely low power consumption.

NEW



CS43L43

Low Voltage, Stereo DAC with Headphone Amp

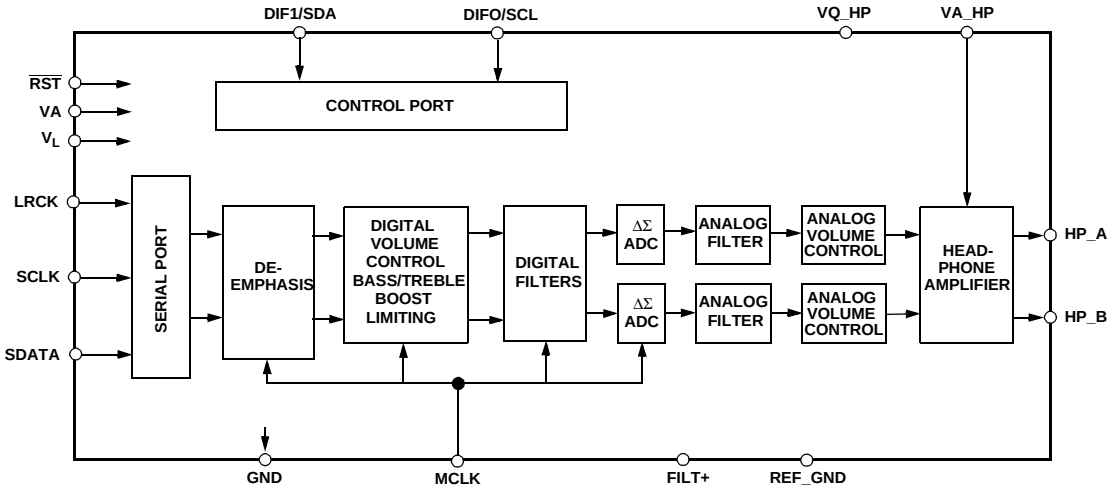
- **1.8 to 3.3 Volt supply**
- **24-Bit conversion / 96 kHz sample rate**
- **94 dB dynamic range at 3 V supply**
- **-85 dB THD+N**
- **Low power consumption**
- **Digital volume control**
  - — 96 dB attenuation, 1 dB step size
- **Digital bass and treble boost**
  - — Selectable corner frequencies
  - — Up to 12 dB boost in 1 dB increments
- **Peak signal limiting to prevent clipping**
- **De-emphasis for 32 kHz, 44.1 kHz, and 48 kHz**
- **Headphone amplifier**
  - — Up to 25 mW_{rms} power output into 16 Ω load
  - — 25 dB analog attenuation and mute
  - — Zero crossing click free level transitions
- **ATAPI mixing functions**
- **PopGuard® technology**
- **Ordering information** (described on pg.198)
  - — CS43L43-KZ 16-pin TSSOP

The CS43L43 is a complete stereo digital-to-analog output system including interpolation, 1-bit D/A conversion, analog filtering, volume control, and a headphone amplifier, in a 16-pin TSSOP package.

The CS43L43 is based on ΔΣ modulation, where the modulator output controls the reference voltage input to an ultra-linear analog low-pass filter. This architecture allows infinite adjustment of the sample rate between 2 kHz and 100 kHz simply by changing the master clock frequency.

The CS43L43 contains on-chip digital bass and treble boost, dynamic range limiting and de-emphasis. The CS43L43 operates from a +1.8 V to +3.3 V supply and consumes only 16 mW of power with a 1.8 V supply. These features are ideal for portable CD, MP3 and MD players and other portable playback systems that require extremely low power consumption.

NEW



CS43L44

Low Voltage, Stereo DAC

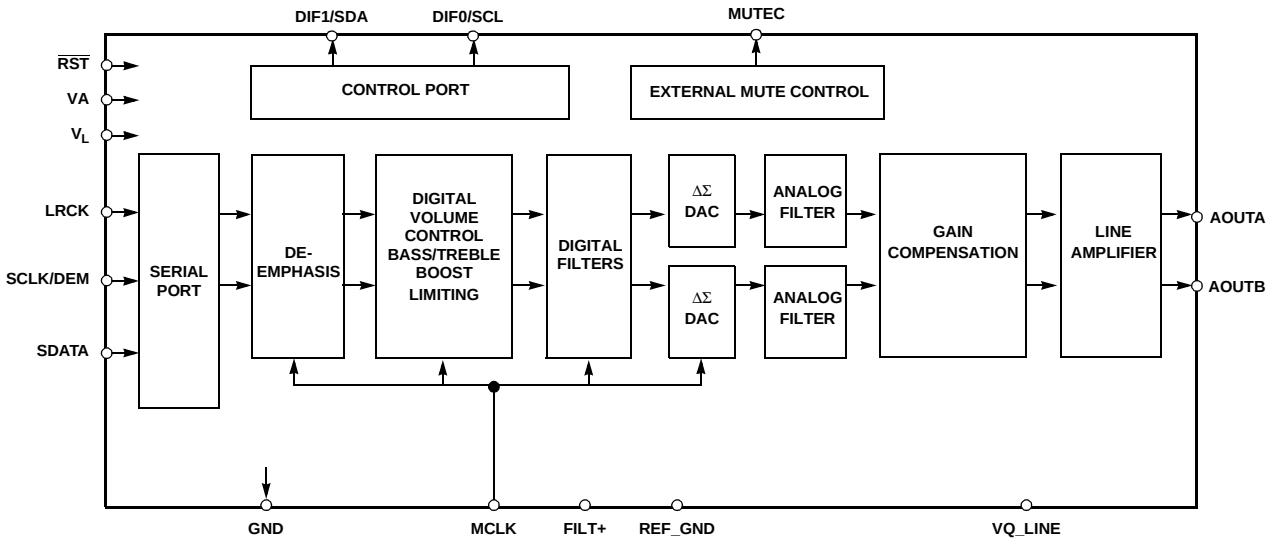
- **1.8 to 3.3 Volt supply**
- **24-bit conversion / 96 kHz sample rate**
- **94 dB dynamic range at 3 V supply**
- **-88 dB THD+N**
- **Low power consumption**
- **Digital volume control**
  - — 96 dB attenuation, 1 dB step size
- **Digital bass and treble boost**
  - — Selectable corner frequencies
  - — Up to 12 dB boost in 1 dB increments
- **Peak signal limiting to prevent clipping**
- **De-emphasis for 32 kHz, 44.1 kHz, and 48 kHz**
- **ATAPI mixing functions**
- **PopGuard® technology**
- **Ordering information** (described on pg.198)
  - — CS43L44-KZ 16-Pin TSSOP

The CS43L44 is a complete stereo digital-to-analog output system including interpolation, 1-bit D/A conversion, analog filtering, volume control and line level outputs, in a 16-pin TSSOP package.

The CS43L44 is based on ΔΣ modulation, where the modulator output controls the reference voltage input to an ultra-linear analog low-pass filter. This architecture allows infinite adjustment of the sample rate between 2 kHz and 100 kHz simply by changing the master clock frequency.

The CS43L44 contains on-chip digital bass and treble boost, peak signal limiting, and de-emphasis. The CS43L44 operates from a +1.8 V to +3.3 V supply and consumes only 23 mW of power with a 1.8 V supply. These features are ideal for portable CD, MP3 and MD players and other portable playback systems that require extremely low power consumption.

NEW



CS53L32

Low Voltage, Stereo A/D Converter

- **1.8 to 3.3 volt supply**
- **24-bit conversion / 96 kHz sample rate**
- **98 dB dynamic range at 3 V supply**
- **-88 dBFS THD+N**
- **Low power consumption**
  - — 9.7 mW at 1.8 V
- **Up to 32 dB gain**
  - — 20 dB gain step
  - — 12 dB variable input gain, 1 dB steps
  - — Changes made at zero crossings
- **Stereo inputs**
- **Digital volume control**
  - — 96 dB attenuation, 1 dB step size
  - — Mute
  - — Soft ramping
- **2:1 input mux**
- **Ordering information** (described on pg.198)
  - — CS53L32-KZ 20-pin TSSOP

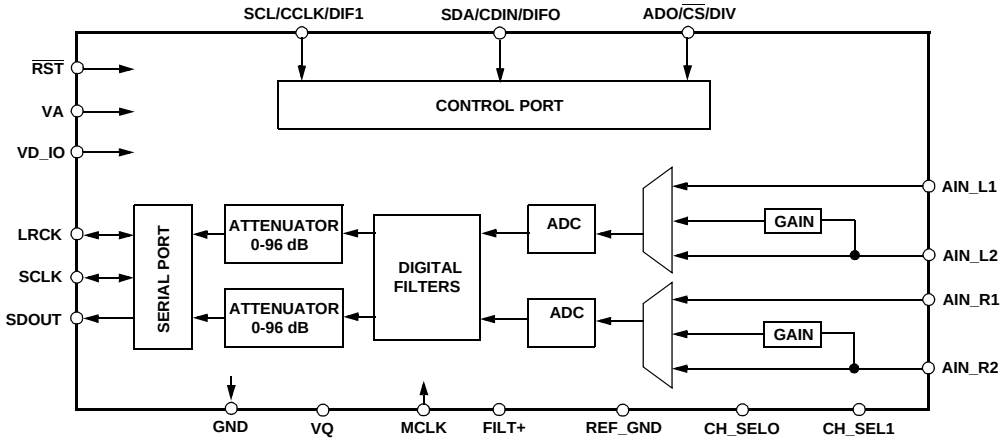
The CS53L32 is a highly integrated, 24-bit, 96 kHz audio ADC providing stereo analog-to-digital converters using ΔΣ conversion techniques. This device includes volume control and line level inputs in a 20-pin TSSOP package.

The CS53L32 is based on ΔΣ modulation allowing infinite adjustment of the sample rate between 2 kHz and 100 kHz simply by changing the master clock frequency.

The CS53L32 contains adjustable analog gain, a 2:1 input mux, and digital attenuation.

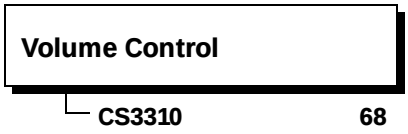
The CS53L32 operates from a +1.8 V to +3.3 V supply. These features are ideal for portable MP3 players, MD recorders/players, digital camcorders, PDAs, set-top boxes, and other portable systems that require extremely low power consumption in a minimum of space.

NEW



Consumer/Professional Audio

Volume Control



Specification Table

Part	Resolution (bits)	SNR (dB)	Dynamic Range (dB)	THD+N (dB)	Sample Rate (kHz)	Analog I/O	Power Supply (V)	Package	Comments
CS3310	N/A	N/A	116	-100	N/A	Single-ended	±5	16 SOIC	+31.5 dB gain / - 95.5 dB attenuation, 0.5 db step

CS3310

Stereo Digital Volume Control

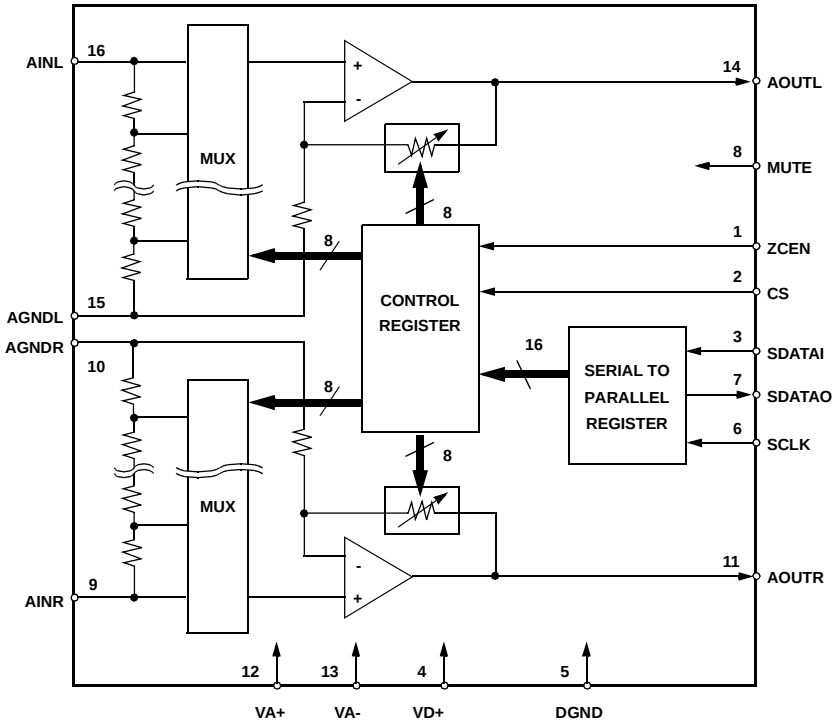
- **Complete digital volume control**
  - — 2 independent channels
  - — Serial control
  - — 0.5 dB step size
- **Wide adjustable range**
  - — -95.5 dB attenuation
  - — +31.5 dB gain
- **Low distortion and noise**
  - — 0.001% THD+N
  - — 116 dB dynamic range
- **Noise-free level transitions**
- **Channel-to-channel crosstalk better than 110 dB**
- **Ordering information** (described on pg.198)
  - — CS3310-KP 16-Pin PDIP
  - — CS3310-KS 16-Pin SOIC

The CS3310 is a complete stereo digital volume control designed specifically for audio systems. It features a 16-bit serial interface that controls two independent, low-distortion audio channels.

The CS3310 includes an array of well-matched resistors and a low-noise active output stage that is capable of driving a 600 Ω load. A total adjustable range of 127 dB, in 0.5 dB steps, is achieved through 95.5 dB of attenuation and 31.5 dB of gain.

The simple 3-wire interface provides daisy-chaining of multiple CS3310's for multi-channel audio systems.

The device operates from ±5 V supplies and has an input/output voltage range of ±3.75 V.



Computer Audio

Accelerators/Controllers

Codecs

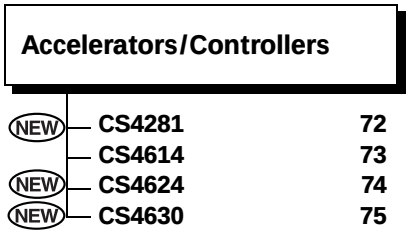
Computer Audio

Selection Table

Product Selection Specifications				Product
Converters				
AC '97	CODEC		20-bit Stereo DAC, 18-bit Stereo ADC	CS4200
		Sample Rate Converter	20-bit Stereo DAC, 18-bit Stereo ADC	CS4201
		48 kHz	20-bit Quad DAC, 18-bit Quad ADC	CS4294
			20-bit Stereo DAC, 18-bit Stereo ADC	CS4297A
		48 kHz	20-bit Input, 18-bit Output Stereo and Modem	CS4298
		Sample Rate Converter	20-bit Stereo DAC, 18-bit Stereo ADC	CS4299
Interface				
PCI bus			FM Synth	CS4281
DSP				
PCI DSP				CS4614
			Adds ZV Port, S/PDIF I/O	CS4624
			Adds memory, faster speed	CS4630

Computer Audio

Accelerators/Controllers



Specification Table

Part				
CS4281	PCI Bus	Legacy Compatibility		100 MQFP, 100 TQFP
CS4614	PCI Bus	Direct Sound Acceleration		100 MQFP
CS4224	PCI Bus	S/PDIF I/O and ZV Port		128 TQFP
CS4630	PCI Bus	Faster, more memory	Wake on ring	128 TQFP

CS4281

CrystalClear™ PCI Audio Interface

- **Full DOS games compatibility via PC/PCI, DDMA, and CrystalClear legacy support**
- **PCI version 2.1 Bus Master**
- **PC '98 and PC '99 compliance**
- **MPU-401 interface, FM synthesizer, and game port**
- **Full duplex operation**
- **Hardware volume control**
- **Windows 95®, 98 (WDM), Windows NT® 4.0, Windows NT 5.0 (WDM) Drivers**
- **Advanced power management (PPMI)**
- **Digital docking solution with AC '97 2.0 codec**
- **Support for multi-channel audio output**
- **Hardware sample rate converters**
- **Pin-compatible with CS4614 and CS4280-CM**
- **Ordering information** (described on pg.198)
  - — CS4281-CM 100-Pin MQFP
  - — CS4281-CQ 100-Pin TQFP

The CS4281 is a PCI audio controller with integrated legacy games support suitable for desktop and notebook PC designs. When combined with driver software and an AC '97 codec such as the CS4297A, this device provides a complete high quality audio solution. Legacy compatibility is achieved via PC-PCI, DDMA, and CrystalClear Legacy Support. The product includes an integrated FM synthesizer and Plug-and-Play interface. In addition, the CS4281 offers hardware volume control and power management features. WDM drivers provide support for Windows 98® and Windows NT®. When used with the CS4297A, the CS4281 is fully compliant with Microsoft's PC '98 and PC '99 audio requirements. In the 100-pin MQFP package, the CS4281 is pin-compatible with the CS4614 and CS4280-CM.

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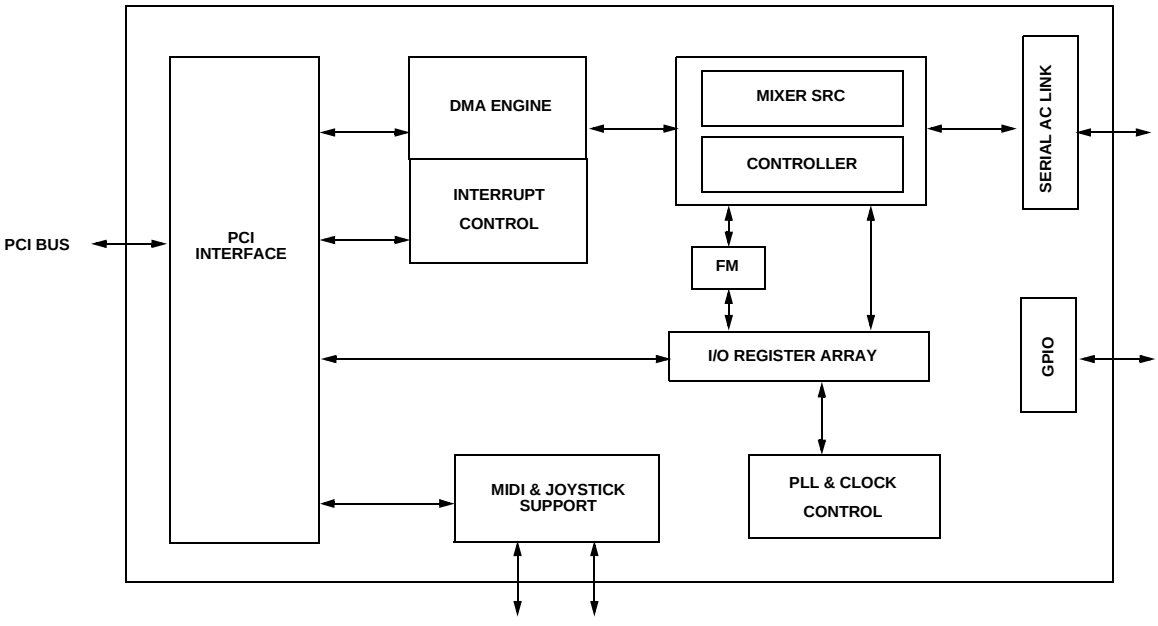


CS4614

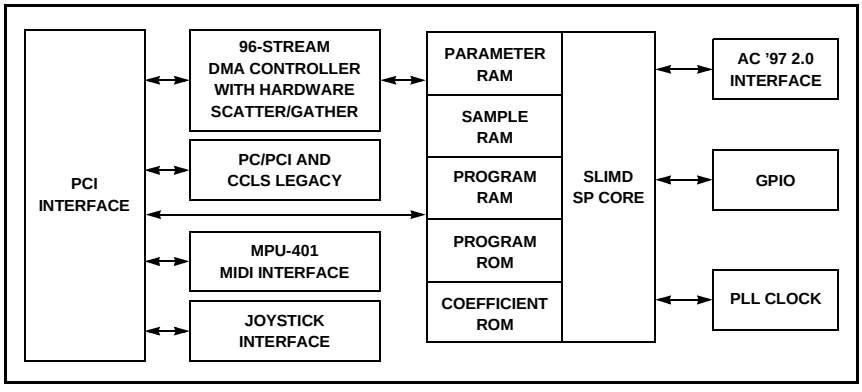
SoundFusion® PCI Audio Accelerator

- **255 MIP SLIMD™ DSP architecture**
- **DirectX™ 5.0 3D-positional audio**
- **Fat labs approved 64-voice wavetable synthesis with effects**
- **NetMeeting™ AEC hardware acceleration**
- **High-quality hardware sample rate conversion (90+ dB dynamic range)**
- **PC/PCI legacy support**
- **DDMA legacy support**
- **Crystal® legacy support (CCLS™)**
- **PCI 2.1-compliant PCI interface**
- **96-stream DMA interface with hardware scatter/gather support**
- **PCI power management (D0 through D3 hot), APM 1.2, and ACPI 1.0 support**
- **AC '97 2.0 link codec interface**
- **DirectInput™ joystick interface**
- **MPU-401 MIDI input/output interface**
- **3.3 V power supply (5 V tolerant I/O)**
- **Ordering information** (described on pg.198)
  — CS4614-CM 100-Pin MQFP

The CS4614 is a high-performance pin-compatible upgrade to the 100-pin CS4610/CS4611 PCI audio accelerators. With the added legacy compatibility modes, the CS4614 enables real mode, DOS-compatible, PCI-only audio subsystems. The CS4614, with application and driver software, provides a complete system solution for hardware acceleration of Windows '95 DirectSound®, DirectSound3D®, DirectInput, and wavetable synthesis. WDM drivers provide support for both Windows '98 and Windows NT 5.0.

The CS4614 is based on the Crystal SP (Stream Processor) DSP core. The SP core is optimized for digital audio processing and is powerful enough to handle complex signal processing tasks, such as 3D-positional audio. The SP core is supported by a bus mastering PCI interface and built-in dedicated DMA engine with hardware scatter-gather support. These functions ensure extremely efficient transfer of audio data streams to and from host-based memory buffers, thus minimizing host CPU loading.

The all-digital CS4614 supports a variety of audio I/O configurations including a direct connection to the Crystal CS4297 AC '97 codec. PC/PCI, DDMA, and Crystal legacy support provide PCI-only legacy games compatibility.



CS4624

CrystalClear™ SoundFusion® PCI Audio Accelerator

- **255 MIPs SLIMD DSP architecture**
- **DirectSound 3D® positional audio**
- **EAX™ and A3D™ positional standards**
- **Unlimited-voice wavetable synthesis with effects including DLS support**
- **Acoustic echo cancellation hardware acceleration for net meeting**
- **10-band graphic equalization**
- **4-channel output capability**
- **High quality hardware sample rate conversion (90+ dB dynamic range)**
- **PC/PCI legacy support**
- **DDMA legacy support**
- **CrystalClear Legacy Support (CCLS)**
- **PCI 2.1 compliant PCI interface**
- **96-stream DMA interface with hardware scatter/gather support**
- **PCI power management (D0 through D3 Hot), APM 1.2, and ACPI 1.0 support**
- **AC '97 2.1 link codec interface**
- **Secondary AC '97 1.0/2.1 link codec interface for multi-channel and digital docking support**
- **Asynchronous digital serial interface (ZV Port)**
- **S/PDIF digital input and output interfaces supporting both PCM and AC3 encoded 5.1 channel formats**
- **MPU-401 MIDI input/output interface**
- **3.3 V power supply (5 V tolerant I/O)**
- **PC 99 compliant**
- **Ordering information** (described on pg.198)

  — CS4624-CQ 128-Pin TQFP

The CS4624 is a high performance 128-pin PCI audio accelerator. With the added legacy compatibility modes, the CS4624 enables real mode DOS compatibility within PCI-only audio subsystems. This device, combined with application and driver software, provides a complete system solution for hardware acceleration of Windows 95® DirectSound®, DirectSound3D, DirectInput™, and Wavetable Synthesis. WDM drivers provide support for both Windows 98 and Windows NT 5.0.

The CS4624 is based on the Cirrus Logic CrystalClear Stream Processor (SP) DSP core. The SP core is optimized for digital audio processing, and is powerful enough to handle complex signal processing tasks with ease. The SP core is supported by a bus mastering PCI interface and a built-in dedicated DMA engine with hardware scatter-gather support. These support functions ensure extremely efficient transfer of audio data streams to and from host-based memory buffers, providing a system solution with maximum performance and minimal host CPU loading.

The all-digital CS4624 supports a variety of audio I/O configurations including direct connection to the CrystalClear CS4297A AC '97 Codec. A secondary AC '97 2.0 interface provides support for multi-channel and digital docking solutions. Added extended I/O supports DAA control for modem applications.

Consumer Digital input and output (S/PDIF) interfaces support both PCM and compressed 5.1 digital data formats.

PC/PCI, DDMA, and CrystalClear Legacy support provide PCI-only legacy games compatibility.

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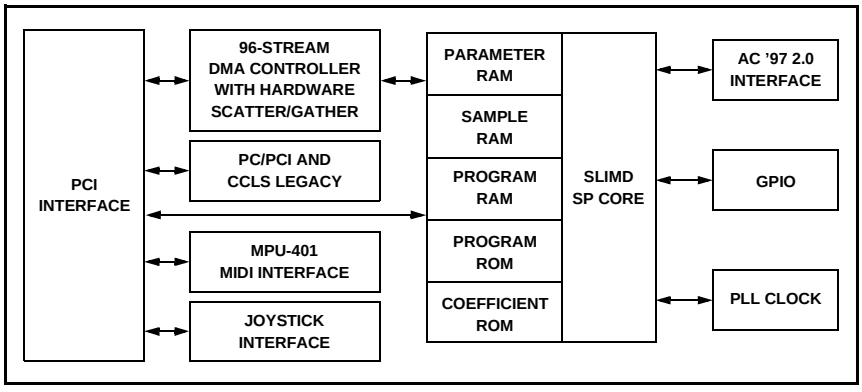

CS4630

CrystalClear™ SoundFusion® PCI Audio Accelerator

- **420 MIPs SLIMD™ DSP architecture with increased internal memory for greater performance**
- **Hardware acceleration for Microsoft DirectSound® and DirectSound3D® Positional Audio**
- **Sensaura™ 3-D, 2- or 4-channel audio**
- **EAX™ 1.0 enhanced environmental audio standard**
- **Unlimited-voice wavetable synthesis with effects including DLS support**
- **Acoustic echo cancellation hardware acceleration for NetMeeting™**
- **10-band graphic equalization**
- **High quality hardware sample rate conversion (90+ dB dynamic range)**
- **PC/PCI, DDMA, and CrystalClear Legacy Support (CCLS™)**
- **PCI 2.1 compliant PCI interface**
- **Full-duplex, 128-stream DMA interface with hardware scatter/gather support**
- **PCI power management (D0 through $D3_{cold}$), APM 1.2, and ACPI 1.0**
- **Power Management Event (PME#) generation within D0-$D3_{cold}$**
- **Dual AC '97 2.1 codec interface**
- **Asynchronous digital serial interface (ZV Port)**
- **S/PDIF digital input and output support for PCM and AC3 encoded 5.1 channel formats**
- **DirectInput™ joystick and MPU-401 MIDI in/out**
- **3.3 V / 2.5 V power supply (5 V tolerant I/O)**
- **PC 98 and PC 99 compliant**
- **Ordering information** (described on pg.198)
  — CS4630-CM 128-Pin MQFP

The CS4630 is a high performance upgrade to the CS4624 PCI audio accelerator. With support for legacy compatibility modes, the CS4630 enables real mode DOS compatibility within PCI-only audio subsystems. This device, combined with application and driver software, provides a complete system solution for hardware acceleration of Microsoft's DirectSound, DirectSound3D, DirectInput, and Wavetable Synthesis. WDM drivers provide support for both Windows 98® and Windows 2000®.

The CS4630 is based on the Cirrus Logic CrystalClear™ Stream Processor (SP) DSP core. The SP core is optimized for digital audio processing, and is powerful enough to handle complex signal processing tasks such as Sensaura 3D, 4-channel output, and hardware wavetable synthesis. The SP core is supported by a bus mastering PCI interface and a built-in dedicated DMA engine with hardware scatter-gather support. These support functions ensure extremely efficient transfer of audio data streams to and from host-based memory buffers, providing a system solution with maximum performance and minimal host CPU loading.

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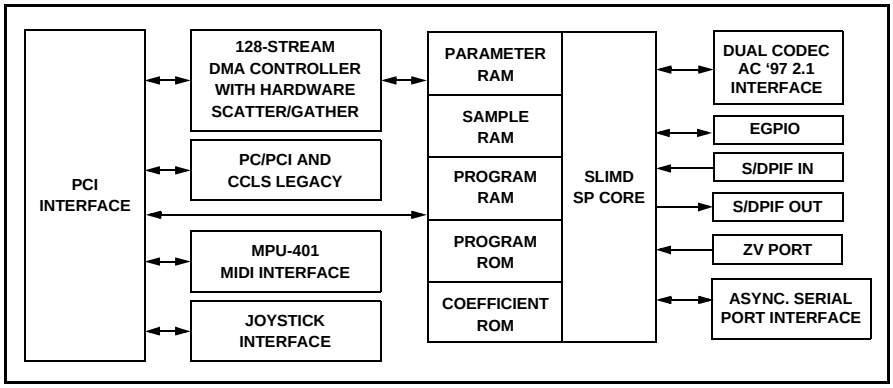
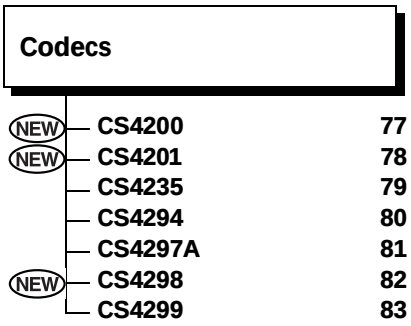


Computer Audio

Codecs



Specification Table

Part	Bus	Converters	Output	Feature	Package
CS4200	AC '97	20-Bit Quad DAC 18-Bit Stereo ADC	S/PDIF, Headphone Amp		48 TQFP
CS4201	AC '97	20-Bit Quad DAC 18-Bit Stereo ADC	S/PDIF Headphone Amp	Sample Rate Converter	48 TQFP
CS4235	ISA	16-Bit DAC and ADC			100 TQFP
CS4294	AC '97	20-Bit Quad DAC 18-Bit Stereo ADC	4 Channel		48 TQFP
CS4297A	AC '97	20-Bit Stereo DAC 18-Bit Stereo ADC	S/PDIF		48 TQFP
CS4298	AMC '97	20-Bit Input 18-Bit Output Stereo and Modem	S/PDIF		64 TQFP
CS4299	AC '97	20-Bit Stereo DAC 18-Bit Stereo ADC	S/PDIF	Sample Rate Converter	48 TQFP

CS4200

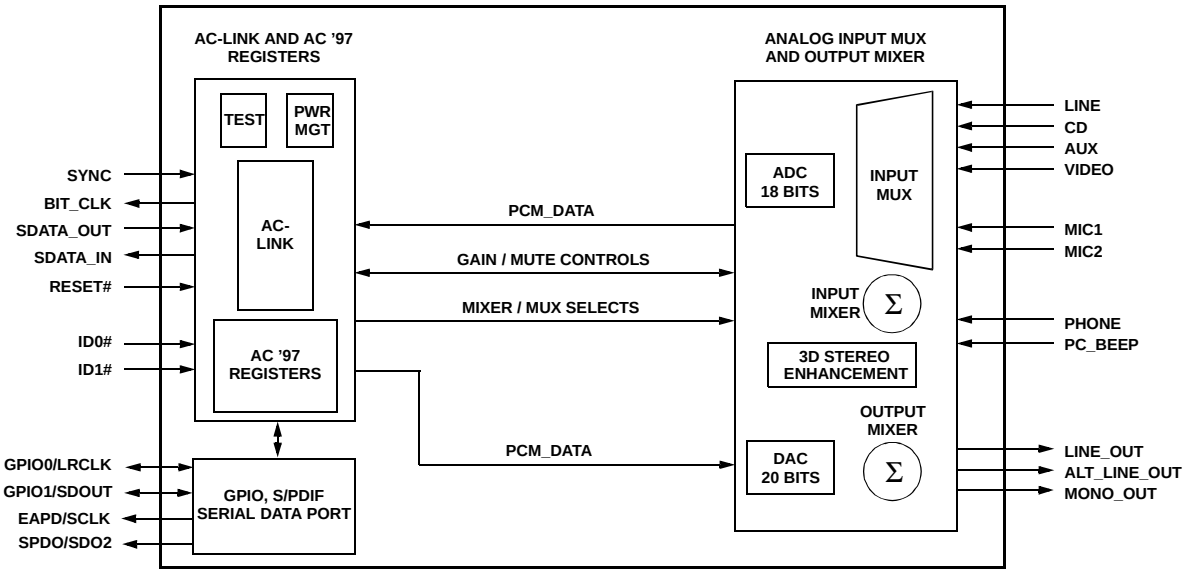
CrystalClear™ Audio Codec '97 With Headphone Amplifier

- **Integrated High-Performance Headphone Amplifier**
- **On-board PLL for use With External Clock Sources**
- **Sample Rate Converters**
- **S/PDIF Digital Audio Output**
- **AC '97 2.1 Compatible**
- **Industry Leading Mixed Signal Technology**
- **20-bit Stereo Digital to Analog Converters and 18-bit Stereo Analog to Digital Converters**
- **Four Analog Line-level Stereo Inputs for Connection from LINE IN, CD, VIDEO, and AUX**
- **Two Analog Line-level Mono Inputs for Modem Subsystem and Internal PC Beeper**
- **Dual Microphone Inputs**
- **High Quality Pseudo Differential CD Input**
- **Separate Stereo Line-level Output**
- **Extensive Power Management Support**
- **Meets or Exceeds Microsoft's PC 99 Audio Performance Requirements**
- **CrystalClear 3D Stereo Enhancement**
- **Ordering information** (described on pg.198)
  - — CS4200-KQ 48-Pin TQFP
  - — CS4200-JQ 48-Pin TQFP

The CS4200 is an AC '97 2.1 compatible stereo audio codec designed for PC multimedia systems. Using the industry-leading CrystalClear ΔΣ and mixed signal technology, the CS4200 paves the way for PC 98 and PC 99-compliant desktop, portable, and entertainment PCs, where high-quality audio is required.

The CS4200, when coupled with a PCI audio accelerator or core logic supporting the AC '97 interface, implements a cost-effective, superior quality, audio solution. The CS4200 surpasses audio quality standards such as PC 98, PC 99, and AC '97 2.1.

NEW



CS4201

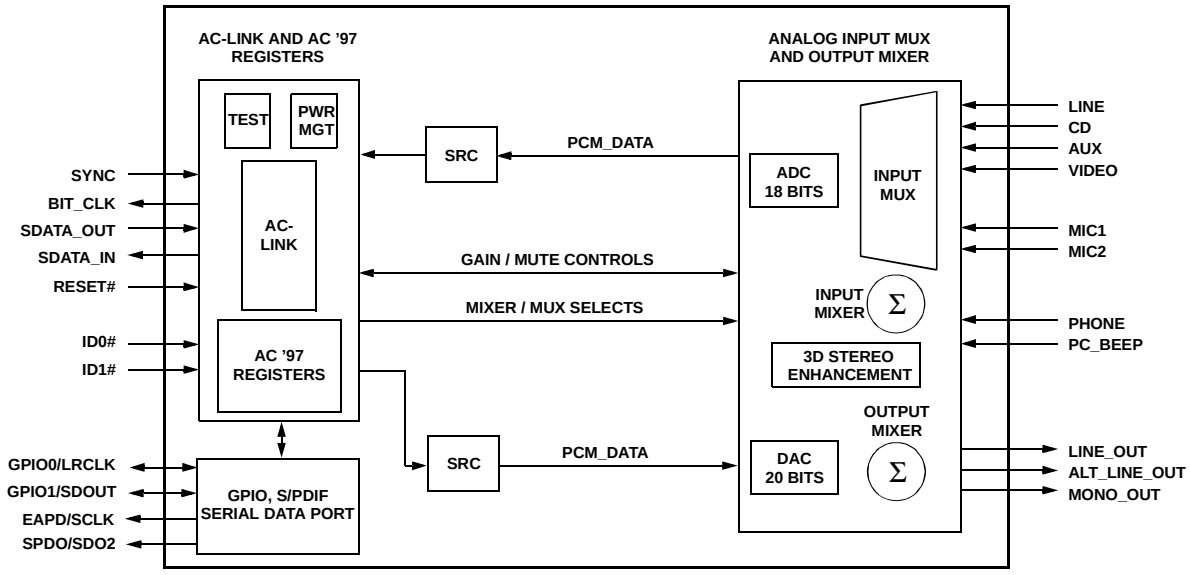
CrystalClear™ Audio Codec '97 With Headphone Amplifier

- **Integrated high-performance headphone amplifier**
- **On-board PLL for use with external clock sources**
- **Sample rate converters**
- **S/PDIF digital audio output**
- **AC '97 2.1 compatible**
- **Industry leading mixed signal technology**
- **20-bit stereo digital to analog converters and 18-bit stereo analog to digital converters**
- **Four analog line-level stereo inputs for connection from LINE IN, CD, VIDEO, and AUX**
- **Two analog line-level mono inputs for modem subsystem and internal PC beeper**
- **Dual microphone inputs**
- **High quality pseudo differential CD input**
- **Separate stereo line-level output**
- **Extensive power management support**
- **Meets or exceeds Microsoft's PC 99 audio performance requirements**
- **CrystalClear 3D stereo enhancement**
- **Ordering information** (described on pg.198)
  - — CS4201-KQ 48-Pin TQFP
  - — CS4201-JQ 48-Pin TQFP

The CS4201 is an AC '97 2.1 compatible stereo audio codec designed for PC multimedia systems. Using the industry leading CrystalClear ΔΣ and mixed signal technology, the CS4201 paves the way for PC 98 and PC 99-compliant desktop, portable, and entertainment PCs, where high-quality audio is required.

The CS4201, when coupled with a PCI audio accelerator or core logic supporting the AC '97 interface, implements a cost-effective, superior quality, audio solution. The CS4201 surpasses audio quality standards such as PC 98, PC 99, and AC '97 2.1.

NEW

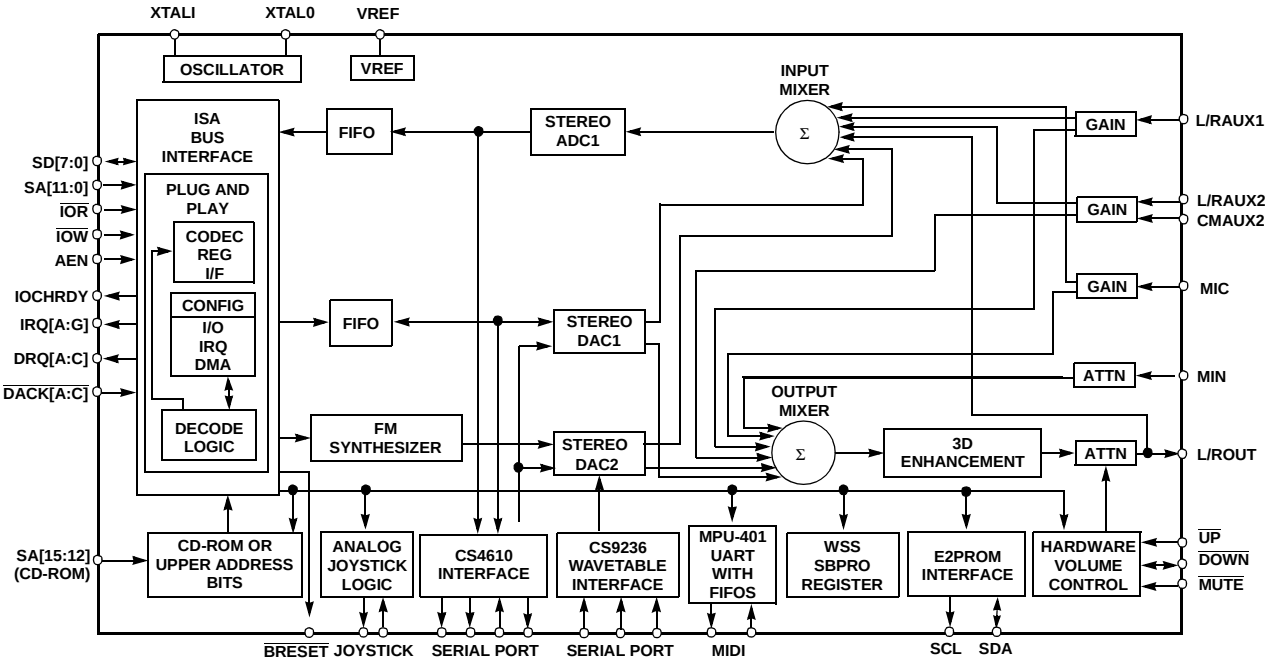


CS4235

Low-Cost ISA Audio System

- **Compatible with Sound Blaster®, Sound Blaster Pro™, and Windows Sound System™**
- **Advanced MPC3-compliant input and output mixer**
- **Enhanced stereo full-duplex operation**
- **Dual type-F DMA support**
- **Integrated Crystal® 3D stereo enhancement**
- **Industry-leading ΔΣ data converters (86 dB FS A)**
- **Internal default plug-and-play resources**
- **CS9236 wavetable interface**
- **CS4236B/CS4237B/CS4238B register-compatible**
- **Ordering information** (described on pg.198)
  - — CS4235-JQ 100-Pin TQFP
  - — CS4235-KQ 100-Pin TQFP

The CS4235 is a single-chip multimedia audio system that is pin-compatible to the CS423XB for many designs. The product includes an integrated FM synthesizer and plug-and-play interface. In addition, the CS4235 includes hardware master volume control pins as well as extensive power management and 3D sound technology. The CS4235 is fully compliant with the Microsoft Windows Sound System standard and runs software written to the Sound Blaster and Sound Blaster Pro interfaces. The CS4235 is fully compliant with Microsoft's PC 97 and PC 98 audio requirements.



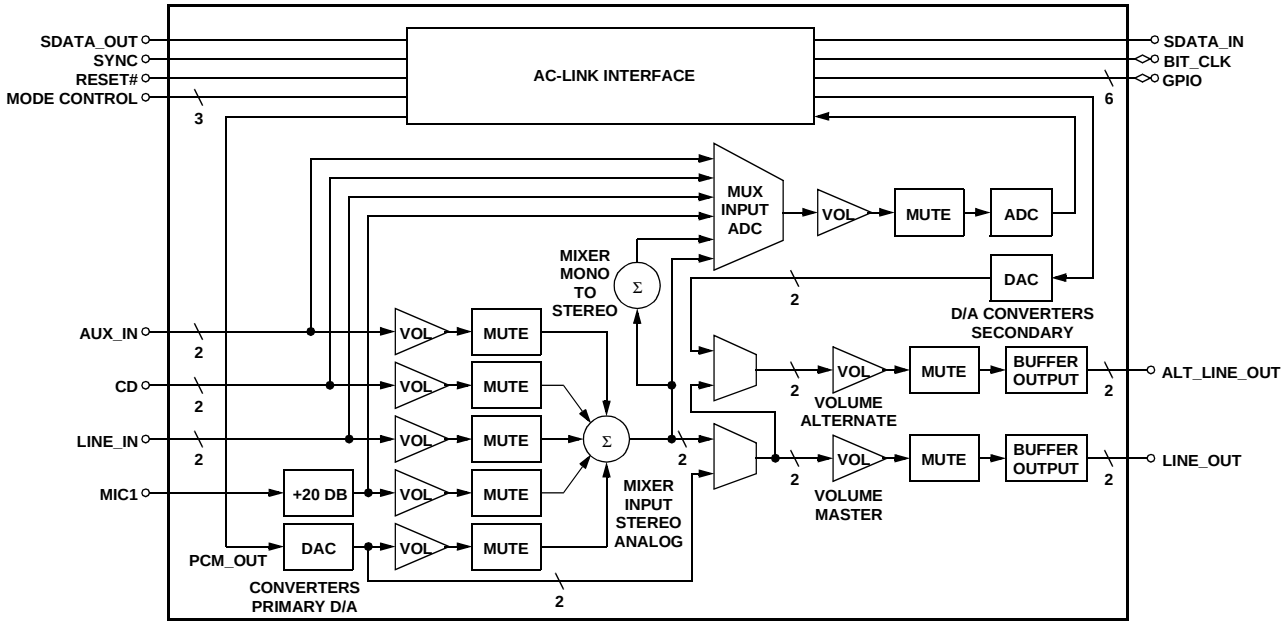
CS4294

SoundFusion® 4-Channel Audio Codec '97

- **AC '97 2.0 compliant**
- **20-bit quad output and 18-bit dual stereo input codec with fixed 48 kHz sampling rate**
- **Dedicated ADC for enhanced digital clocking**
- **Three analog line level stereo inputs for connection from LINE IN, CD, and AUX**
- **High quality pseudo-differential CD input**
- **Dual stereo line level output with independent 6-bit volume control**
- **6 general-purpose I/O pins**
- **Meets or exceeds Microsoft® PC 98 and PC 99 audio performance requirements**
- **CrystalClear™ Stereo Enhancement**
- **Ordering information** (described on pg.198)
  - — CS4294-KQ 48-Pin TQFP
  - — CS4294-JQ 48-Pin TQFP

The CS4294 is an AC '97 compliant Audio Codec designed for PC multimedia systems. Using the industry-leading CrystalClear ΔΣ and mixed signal technology, the CS4294 is ideal for PC 98-compliant desktop, notebook, and entertainment PCs, where high-quality audio features are required.

The CS4294 offers four channels of D/A and A/D conversion along with analog mixing and stereo enhancement processing. For multi-channel audio systems, the CS4294 can provide four audio channels. The CS4294 provides an enhanced digital docking mode for portable applications by providing a dedicated ADC capture path from the analog input mixer.



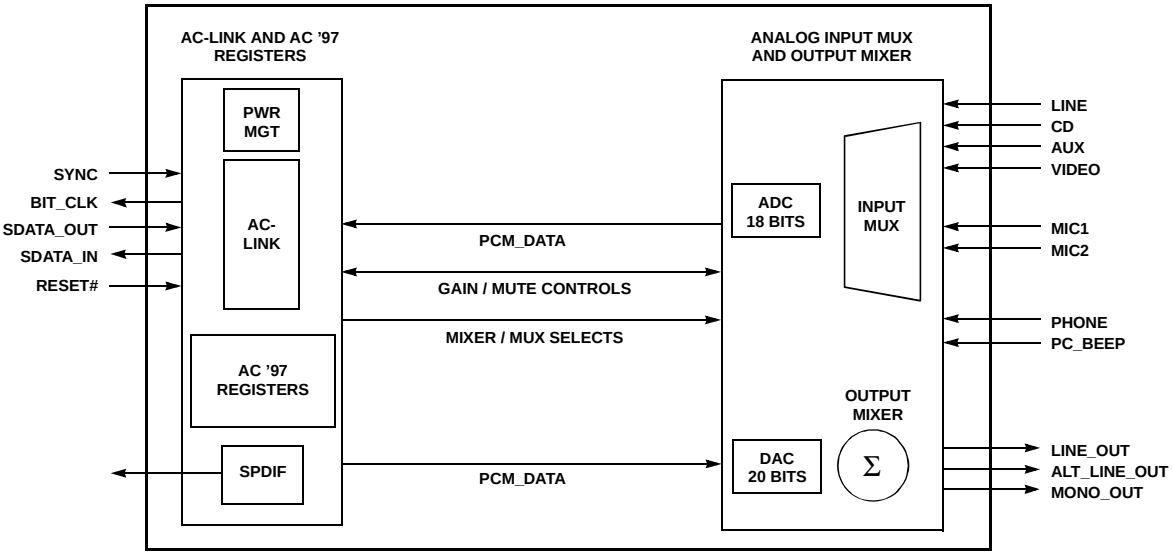
CS4297A

CrystalClear™ SoundFusion® Audio Codec '97

- **AC '97 2.1 compatible**
- **Industry-leading mixed signal technology**
- **20-bit stereo digital-to-analog converter and 18-bit stereo analog-to-digital converter**
- **Four analog line-level stereo inputs for connection from LINE IN, CD, VIDEO, and AUX**
- **Two analog line-level mono inputs for modem subsystem and internal PC beeper**
- **Mono microphone input switchable from two external sources**
- **High quality pseudo differential CD input**
- **Dual stereo line-level outputs**
- **Extensive power management support**
- **Meets or exceeds Microsoft's® PC 98 and PC 99 audio performance requirements**
- **CrystalClear 3D stereo enhancement**
- **S/PDIF digital audio output**
- **Ordering information** (described on pg.198)
  - — CS4297A-KQ 48-Pin TQFP
  - — CS4297A-JQ 48-Pin TQFP

The CS4297A is an AC '97 2.1 compatible stereo audio codec designed for PC multimedia systems. Using the industry-leading CrystalClear ΔΣ and mixed signal technology, the CS4297A paves the way for PC 98- and PC 99-compliant desktop, portable, and entertainment PCs, where high-quality audio is required.

The CS4297A, when coupled with a PCI audio accelerator or core logic supporting the AC '97 interface, implements a cost-effective, superior quality, audio solution. The CS4297A surpasses audio quality standards such as PC 98, PC 99, and AC '97 2.1.



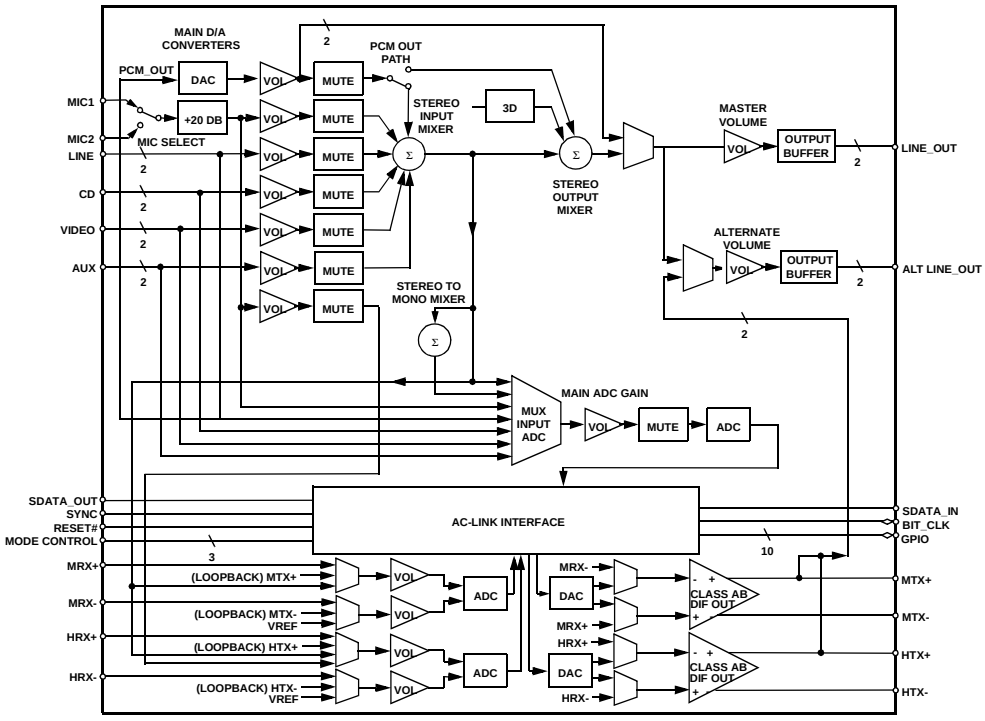
CS4298

SoundFusion® Audio/Modem Codec '97 (AMC'97)

- **AC '97 2.0 compatible**
- **20-bit stereo output and 18-bit stereo input codec with fixed 48 kHz sampling rate**
- **20-bit output and 18-bit input dual modem AFE with fixed 48 kHz sampling rate**
- **Dedicated ADC for handset or speakerphone**
- **Four analog line-level stereo inputs for connection from LINE IN, CD, VIDEO, and AUX**
- **High quality pseudo-differential CD input**
- **Dual stereo line level output with independent 6-bit volume control**
- **10 general purpose I/O pins for modem DAA controls**
- **IEC-958 digital output (S/PDIF)**
- **Meets or exceeds Microsoft's® PC 98 and PC 99 audio performance requirements**
- **CrystalClear™ 3D stereo enhancement**
- **Ordering information** (described on pg.198)
  - — CS4298-KQ 64-Pin TQFP
  - — CS4298-JQ 64-Pin TQFP

The CS4298 is an AC '97 compatible Audio/Modem Codec designed for PC multimedia systems. Using the industry-leading CrystalClear™ ΔΣ and mixed signal technology, the CS4298 is ideal for PC 98-compliant desktop, notebook, and entertainment PCs, where high-quality audio and modem features are required.The CS4298 offers four channels of D/A and A/D conversion along with analog mixing and 3D processing. For multichannel audio systems, the CS4298 can provide four audio channels. For combined audio/modem systems, the CS4298 can provide a modem AFE, voice codec, and stereo audio codec.

NEW



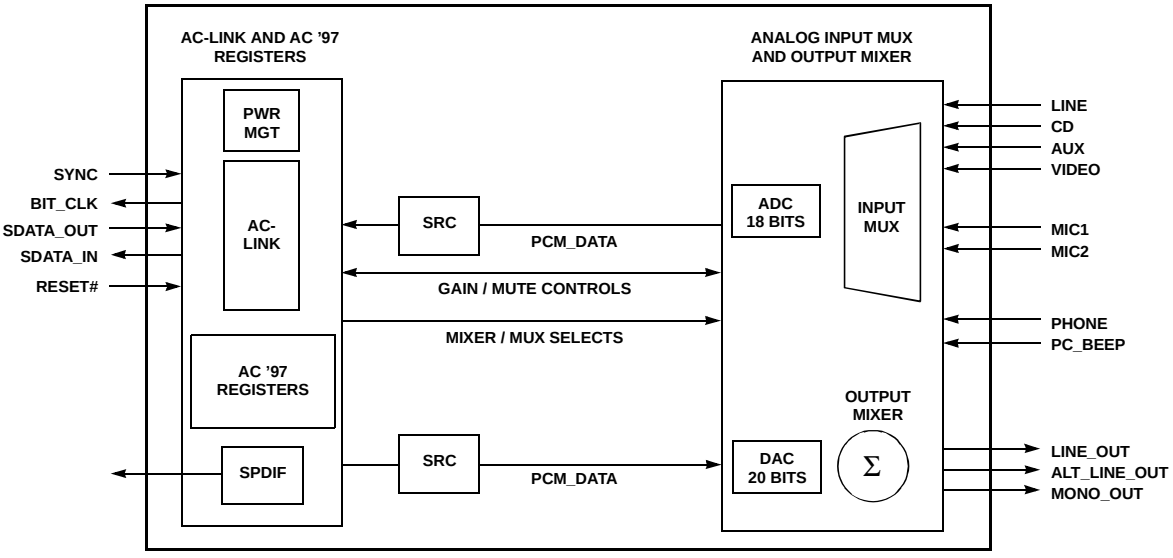
CS4299

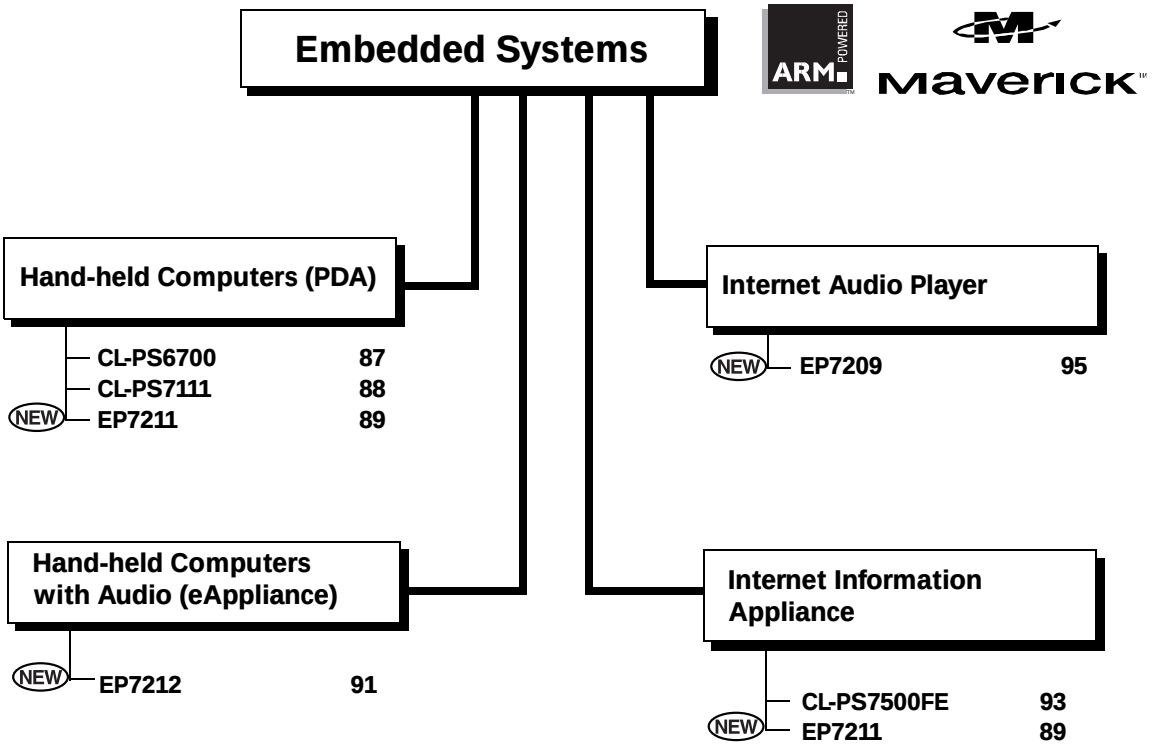
CrystalClear™ SoundFusion® Audio Codec '97

- **AC '97 2.1 compatible**
- **Industry leading mixed signal technology**
- **20-bit Stereo digital-to-analog converter and 18-bit stereo analog-to-digital converter**
- **Four analog line-level stereo inputs for connection from LINE IN, CD, VIDEO, and AUX**
- **Two analog line-level mono inputs for modem subsystem and internal PC beeper**
- **Mono microphone input switchable from two external sources**
- **High quality pseudo differential CD input**
- **Dual stereo line-level outputs**
- **Extensive power management support**
- **Meets or exceeds Microsoft's® PC 98 and PC 99 audio performance requirements**
- **CrystalClear 3D stereo enhancement**
- **S/PDIF digital audio output**
- **Ordering information** (described on pg.198)
  - — CS4299-KQ 48-Pin TQFP
  - — CS4299-JQ 48-Pin TQFP

The CS4299 is an AC '97 2.1 compatible stereo audio codec designed for PC multimedia systems. Using the industry-leading CrystalClear ΔΣ and mixed signal technology, the CS4299 paves the way for PC 98 and PC 99-compliant desktop, portable, and entertainment PCs, where high-quality audio is required.

The CS4299, when coupled with a PCI audio accelerator or core logic supporting the AC '97 interface, implements a cost-effective, superior quality, audio solution. The CS4299 surpasses audio quality standards such as PC 98, PC 99, and AC '97 2.1.

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Embedded Systems

Hand-held Computers

Hand-held Computers (PDA)

CL-PS6700

Low-Power PC Card Controller for the CL-PS7111and EP7211

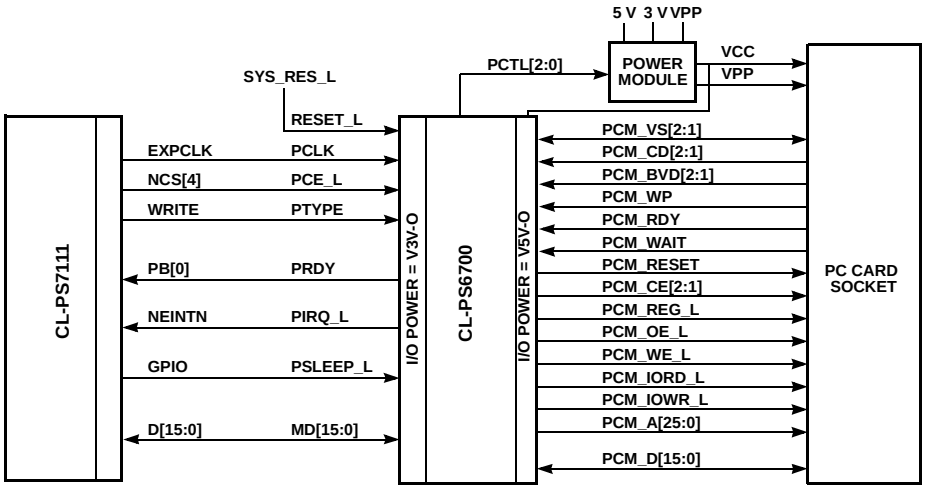
- **Direct interface to CL-PS6700 low-power microcontroller**
  - — Custom multiplexed address/data bus for low pin count
  - — Supports 13- and 18-MHz operating frequencies
- **Fully compatible with PC Card (PCMCIA) Release 2.01 specification**
- **One or two CL-PS6700s per system**
- **Low-power states**
- **Operating (25 mW, typical)**
- **Idle mode**
- **Standby (virtually zero power drain)**
- **Support for PC Card hot insertion and removal**
- **Read and write buffers**
- **Support for 3.3 V and 5 V PC Cards**
- **Endian conversion**
- **Supports the following PC Cards:**
  - — Memory-only card: flash, EPROM, or SRAM
  - — I/O card: modem and communications
  - — Cards configured as both I/O and memory
  - — DMA-capable cards (through software emulation)
- **Ordering information**
  - — CL-PS6700-VC-A 100-Pin VQFP

The CL-PS6700 connects directly to a PC Card (PCMCIA) Release 2.01 socket and has a custom interface to the CL-PS7111 microcontroller. The CL-PS7111 can support up to two CL-PS6700 devices, allowing up to two PC Card sockets per system. Addresses and data are passed to the CL-PS6700 through 16 bits of the 32-bit data bus (D[15:0]).

The PC Card socket is effectively isolated by the CL-PS6700. Except for power and ground pins, the pins on the socket only connect to the rest of the system through the CL-PS6700.

CL-PS7111-to-CL-PS6700 Interface

The PC Card interface requires a 26-bit address bus and a 16-bit data bus. The interface between the CL-PS6700 and CL-PS7111 consists of a 16-bit bus that carries the address and data information, as well as several control signals. This bus defines a two-clock address phase while the 26-bit PC Card address and 6 control bits are transferred, and a one- or two-clock data phase while one or four bytes of data are transferred. The data phase for reads can be deferred (for example, for a DMA access to the frame buffer of the CL-PS7111).



CL-PS7111

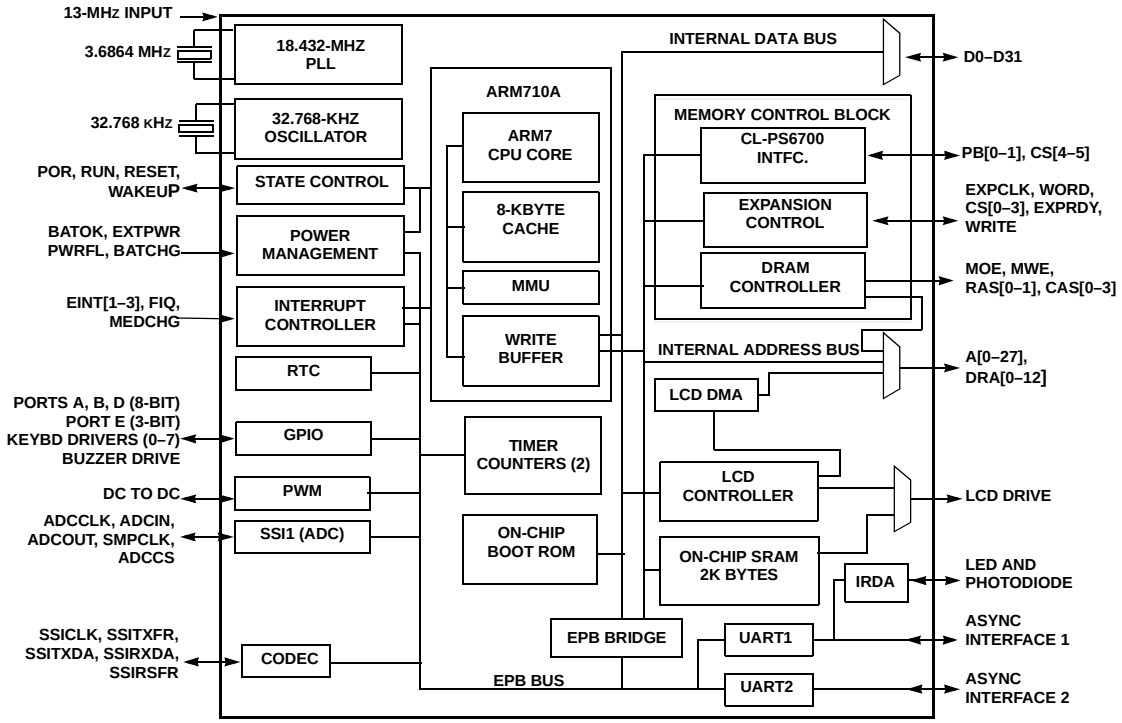
Ultra-Low-Power System-on-chip with LCD Controller

- **Performance matching 33 MHz Intel® 486-based PC**
  - — More than 5 times the performance of the Motorola "DragonBall" (MC68328)
- **Ultra low power**
  - — Designed for applications that require long battery life while using standard AA/AAA batteries or rechargeable cells
  - — Average 45 mW/66 mW in Normal Operation (2.7 V/3.3 V, 13 MHz/18.432 MHz)
  - — Average 15 mW in Idle state (clock to the CPU stopped, everything else running)
  - — Average 50 µW in Standby state (real-time clock on, everything else stopped)
- **LCD controller**
  - — Interfaces directly to a single-scan panel monochrome LCD
- **ARM710A microprocessor**
  - — ARM7 CPU
  - — 8 Kbytes of four-way set-associative cache
  - — MMU with 64-entry TLB (transition look-aside buffer)
- **DRAM controller**
  - — Supports both 16- and 32-bit-wide DRAMs
- **2 Kbytes of on-chip SRAM for fast program execution or as a frame buffer**
- **On-chip for manufacturing support boot ROM**
- **Two synchronous serial interfaces**
- **27-bit general-purpose I/O**
- **Two UARTs (16550 type)**
- **SIR (up to 115.2 kbps) infrared encoder**
- **DC-to-DC converter interface**
- **Two-timer counters**
- **Ordering information**

— CL-PS7111-CV-A	208-Pin LQFP
— CL-PS7111-CV-A	256-Ball PBGA

The CL-PS7111 is designed for ultra-low-power applications such as organizers/PDAs, two-way pagers, smart cellular phones, and industrial hand-held information appliances. The core-logic functionality of the device is built around an ARM710A microprocessor with 8 Kbytes of four-way set-associative unified cache.

At 18.432 MHz (for 3.3 V operation), the CL-PS7111 delivers roughly the same level of performance offered by a 33 MHz Intel, 486-based PC. Simply adding desired memory and peripherals to the highly integrated CL-PS7111 completes a low-power device system board. All the interface logic is integrated on chip.



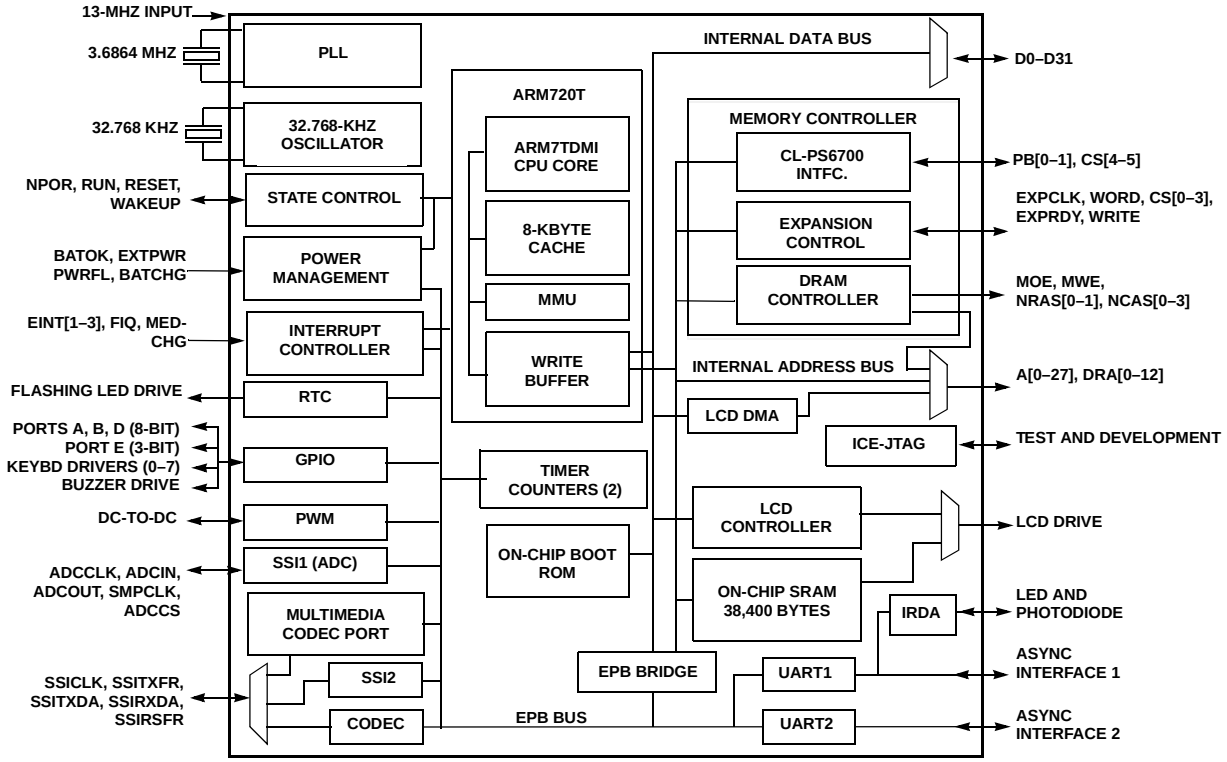
EP7211

High-Performance Ultra-Low-Power System-on-Chip with LCD Controller

- **Dynamically programmable clock speeds of 18, 36, 49, and 74 MHz at 2.5 V**
- **Performance matching 100-MHz Intel® Pentium-based PC**
- **Socket and register compatible with CL-PS7111**
- **Ultra-low-power**
- **LCD controller**
- **ARM720T processor**
  - — ARM7TDMI CPU with Thumb® code support
  - — 8 kbytes of four-way set-associative cache
  - — MMU with 64-entry TLB (transition look aside buffer)
  - — Write buffer
  - — Windows® CE enabled
- **DRAM controller**
  - — Supports both 16- and 32-bit-wide DRAMs
- **38,400 bytes of on-chip SRAM**
- **Four synchronous serial interfaces**
- **27 bits of general-purpose I/O**
- **Two UARTs (16550 type)**
- **SIR (up to 115.2 kbps) infrared encoder**
- **Two timer counters**
- **Support for up to two ultra-low-power CL-PS6700 PC Card controllers**
- **JTAG boundary scan and Embedded ICE support**
- **Ordering information** (described on pg.198)
  - — EP7211-CV-D 208-Pin LQFP
  - — EP7211-CB-D 256-Ball PBGA

The EP7211 is designed for ultra-low-power applications such as organizers/PDAs, two-way pagers, smart cellular phones, and industrial hand-held information appliances. Its core operates at only 2.5 V, while its I/O has an operating range of 2.5 V–3.3 V. Simply adding desired memory and peripherals to the highly integrated EP7211 completes a low-power system solution. All necessary interface logic is integrated on-chip.

NEW



Embedded Systems

Hand-held Computers with Audio

Hand-held Computers with Audio (eAppliance)

NEW	EP7212	91

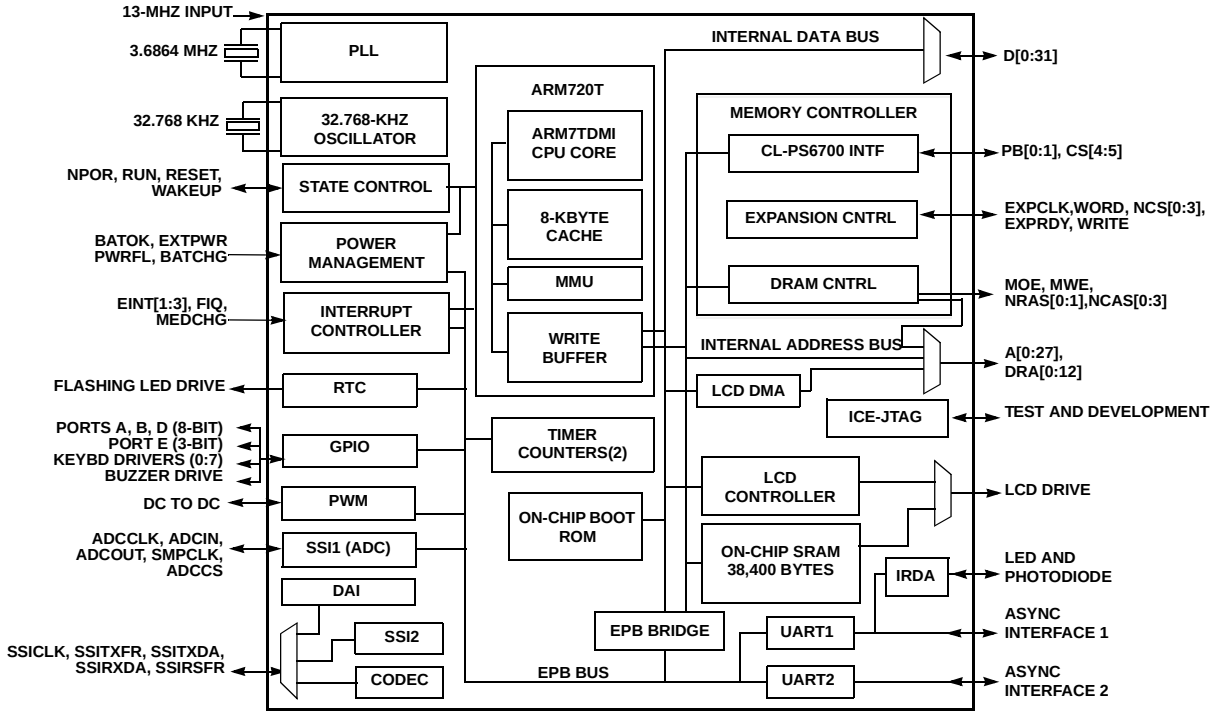
EP7212

High-Performance, Low-Power System-on-Chip

- **ARM720T processor**
  - — ARM7TDMI CPU with Thumb® code support
  - — 8 K-bytes of four-way set-associative cache
  - — MMU with 64-entry TLB (transition look-aside buffer)
  - — Write buffer
  - — Windows® CE enabled
- **Dynamically programmable clock speeds of 18, 36, 49, and 74 MHz at 2.5 V**
- **Performance matching 100-MHz Intel® Pentium-based PC**
- **Ultra low-power**
- **Advanced audio decoder/decompression capability**
  - — Allows for support of multiple audio decompression algorithms
  - — Supports MPEG 1, 2, and 2.5 layer 3 audio decoding
  - — DAI (Digital Audio Interface) providing glueless interface to low-power DACs, ADCs, and Codecs
- **LCD controller**
- **DRAM controller**
  - — Supports both 16- and 32-bit-wide DRAMs
- **38,400 bytes of on-chip SRAM**
- **Synchronous serial interface**
- **27-bits of general purpose I/O**
- **Two UARTs (16550 type)**
- **Serial Infrared encoder (up to 115.2 kbps)**
- **DC-to-DC converter interface (PWM)**
- **Two timer counters**
- **Support for up to two ultra-low-power CL-PS6700 PC Card controllers**
- **JTAG boundary and Embedded ICE® support**
- **Ordering information** (described on pg.198)
  - — EP7212-CV-D 208-Pin LQFP
  - — EP7212-CB-D 256-Ball PBGA

The EP7212 is designed for ultra-low-power applications such as organizers/PDAs, two-way pagers, smart cellular phones, or any vertical PDA device that features the added capability of digital audio decompression. Its core operates at only 2.5 V, while its I/O has an operation range of 2.5 V–3.3 V. The EP7212 integrates an interface to enable a direct connection to many low-cost, low-power, high quality audio converters. Simply adding desired memory and peripherals to the highly integrated EP7212 completes a low-power system solution.

NEW



Embedded Systems

Internet Information Appliance

Internet Information Appliance

CL-PS7500FE **93**

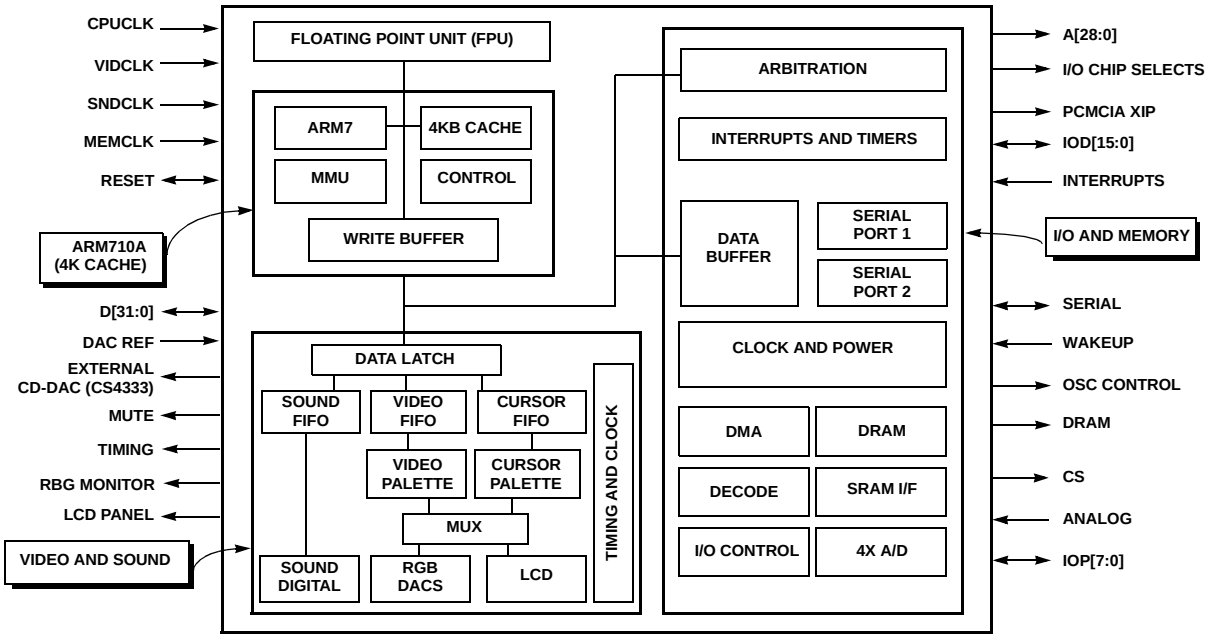
CL-PS7500FE

High-Performance System-on-Chip with CRT/LCD Controller

- **Massively integrated system-on-chip**
  - — High-speed CPU and all major system peripherals incorporated
  - — Minimized need for external components
  - — Maximum design simplicity
- **CRT/LCD controller**
- **32-bit ARM710A microprocessor**
- **Hardware FPU**
- **DRAM controller**
- **ROM/FLASH memory control**
- **Two PS/2-style serial ports**
- **16-bit PC-style I/O bus**
- **Serial CD-quality digital sound (32-bit) output**
- **Three-state power management**
- **Eight general-purpose I/O lines**
- **Four analog comparators**
- **Available in 40 and 56 MHz speed grades**
- **240-pin PQFP package**
- **Ordering information**
  - — CL-PS7500FE-QC-C 240-Pin PQFP

The CL-PS7500FE is a massively integrated general-purpose "system-on-chip" designed for a wide range of control and communications applications. Based on a low-power, high-speed ARM® RISC CPU core, the CL-PS7500FE integrates a powerful 50-MIPS processor, hardware floating point unit, memory interfaces, and a full complement of system peripherals onto a single component. This integrated component greatly simplifies system design for complex applications such as network computers, screen phones, process control systems, and instrumentation control.

Simply adding desired memory and peripherals to the highly integrated CL-PS7500FE completes a high-performance system board. All the interface logic is integrated on-chip.



Embedded Systems

Personal Audio Player

Internet Audio Player

NEW — **EP7209** **95**

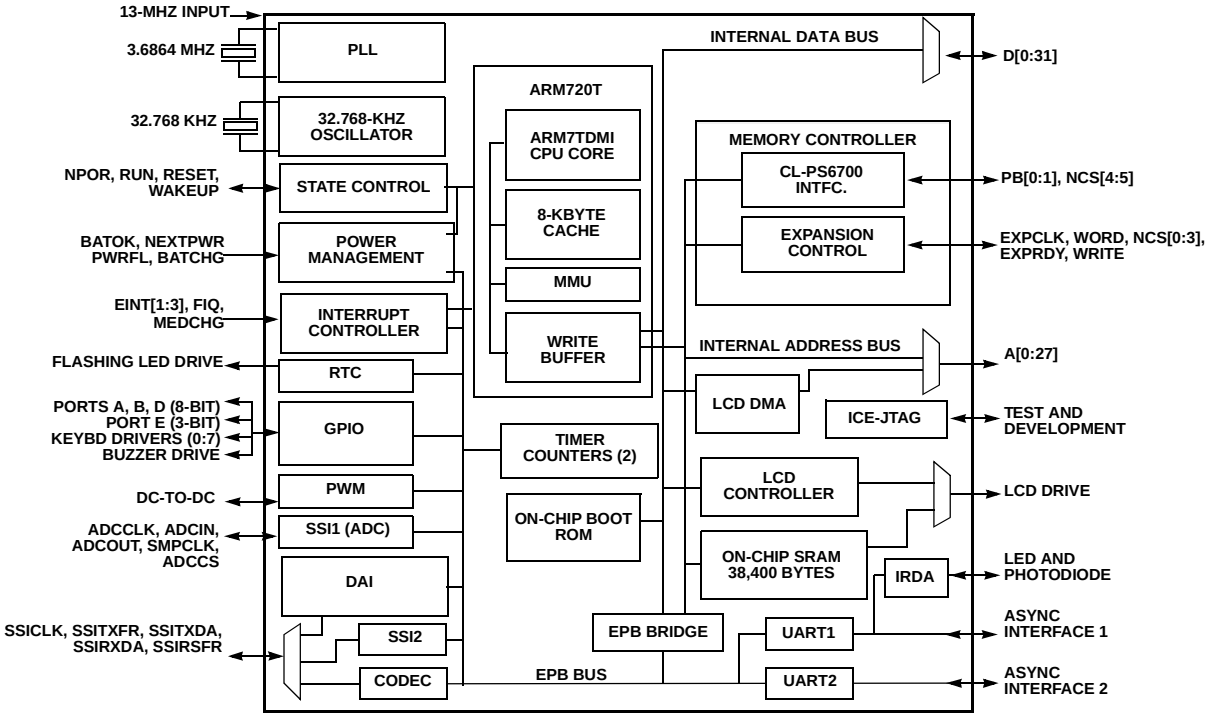
EP7209

High-Performance Ultra-Low-Power System-on-Chip with LCD Controller

- **Audio decoder system-on-chip**
  - — Allows for support of multiple audio decompression algorithms
  - — Supports MPEG 1, 2, and 2.5 layer 3 audio decoding, including ISO compliant MPEG 1 and 2 layer 3 support for all standard sample rates and bit rates
  - — DAI (Digital Audio Interface)
- **Ultra-low-power consumption for MP3 playback**
- **ARM720T processor**
  - — ARM7TDMI CPU with Thumb® code support
  - — 8 kbytes of four-way set-associative cache
  - — MMU with 64-entry TLB (transition look-aside buffer)
  - — Write Buffer
  - — Windows® CE enabled
- **Dynamically programmable clock speeds of 18, 36, 49, and 74 MHz at 2.5 V**
- **Performance matching 100 MHz Intel® Pentium-based PC**
- **LCD controller**
- **38,400 bytes (0x9600) of on-chip SRAM**
- **27-bits of general-purpose I/O**
- **SIR (up to 115.2 kbps) infrared encoder/decoder**
- **DC-to-DC converter interface (PWM)**
- **JTAG boundary scan and Embedded ICE support**
- **Ordering information** (described on pg.198)
  - — EP7209-CV-D 208-Pin LQFP
  - — EP7209-CB-D 256-Ball PBGA

The EP7209 is designed specifically for implementing audio processing algorithms in power sensitive applications. It runs a full ISO-compliant MPEG 1, 2, and 2.5 layer 3 audio decompression engine with a Cirrus Logic provided object code library. Its core operates at only 2.5 V, while its I/O has an operation range of 2.5 V-3.3 V. A portable audio decoder solution can be built with the addition of an LCD display, an audio DAC, a FLASH memory subsystem, and a small number of additional low cost components.

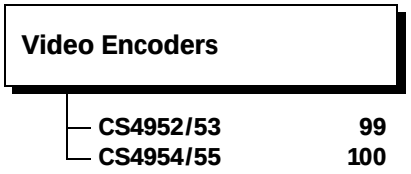
NEW



Video Encoders

Video Encoders

Video Encoders



Specification Table

Part	Resolution (bits)	# of DACs	Input Range (V)	Macrovision Ver. 7 Support	Package
CS4952	9	3	TTL		44 TQFP 44 PLCC
CS4953	9	3	TTL	✔	44 TQFP 44 PLCC
CS4954	10	6	TTL		48 TQFP
CS4955	10	6	TTL	✔	48 TQFP

CS4952/53

NTSC/PAL Digital Video Encoder

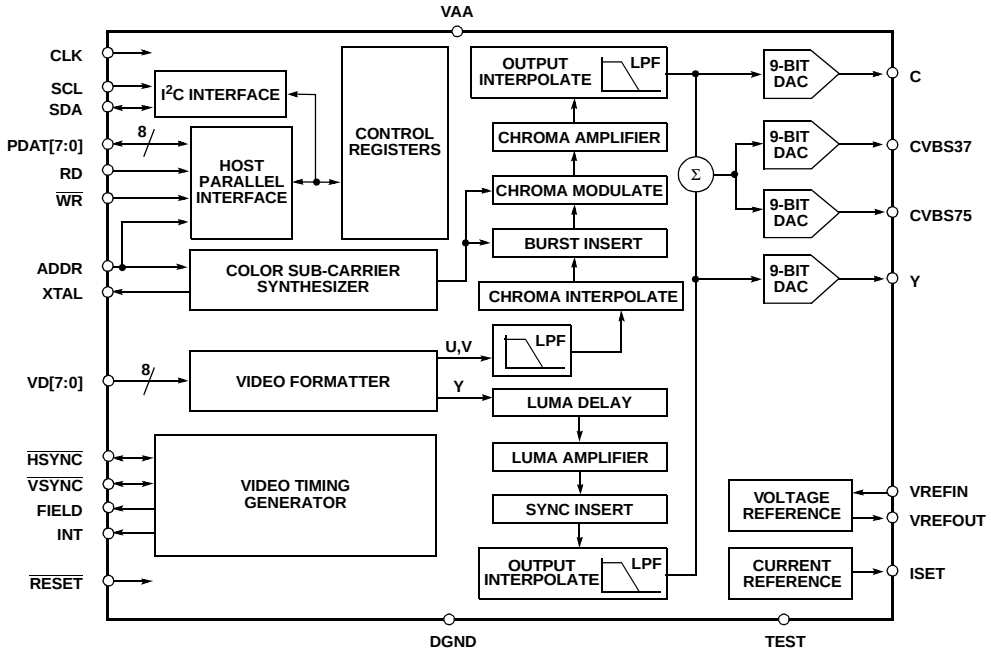
- **Simultaneous composite and S-video output**
- **Supports RS170A and CCIR601 composite output timing**
- **Multi-standard support for NTSC-M or PAL (B, D, G, H, I, M, N, Combination N)**
- **Optional progressive scan at MPEG-2 field rates**
- **CCIR656 input mode supporting EAV/SAV codes and CCIR601 master/slave input modes**
- **Stable color subcarrier for MPEG-2 systems**
- **NTSC closed-caption encoder with interrupt**
- **Supports Macrovision copy protection in CS4953 version**
- **Four 9-bit DACs (PG)**
- **Host interface configurable for parallel or I^2C-compatible operation**
- **General-purpose input and output pins**
- **Individual DAC power-down capability**
- **On-chip voltage reference generator**
- **On-chip color bar generator**
- **+5 V-only CMOS, low-power modes, and tri-state DACs**

- **Ordering information** (described on pg.198)
  - — CS4952/3-CL 44-Pin PLCC
  - — CS495/3-CQ 48-Pin TQFP

The CS4952/3 provides full conversion from YCbCr or YUV digital video formats into NTSC and PAL Composite and Y/C (S-video) analog video. Input formats can be 27 MHz, 8-bit YUV, 8-bit YCbCr, or CCIR656 with support for EAV/SAV codes. Output video can be formatted to be compatible with NTSC-M, or PAL B,D,G,H,I,M,N, and Combination N systems. Also supported is NTSC line 21 and line 284 closed caption encoding.

Four 9-bit DACs provide two channels for an S-Video output port and two composite video outputs. 2x oversampling reduces the output filter requirements and guarantees no DAC related modulation components within the specified bandwidth of any of the supported video standards.

Parallel or high-speed I^2C-compatible control interfaces are provided for flexibility in system design. The parallel interface doubles as a general-purpose I/O port when the CS4952/3 is in I^2C mode to help conserve valuable board area.



CS4954/55

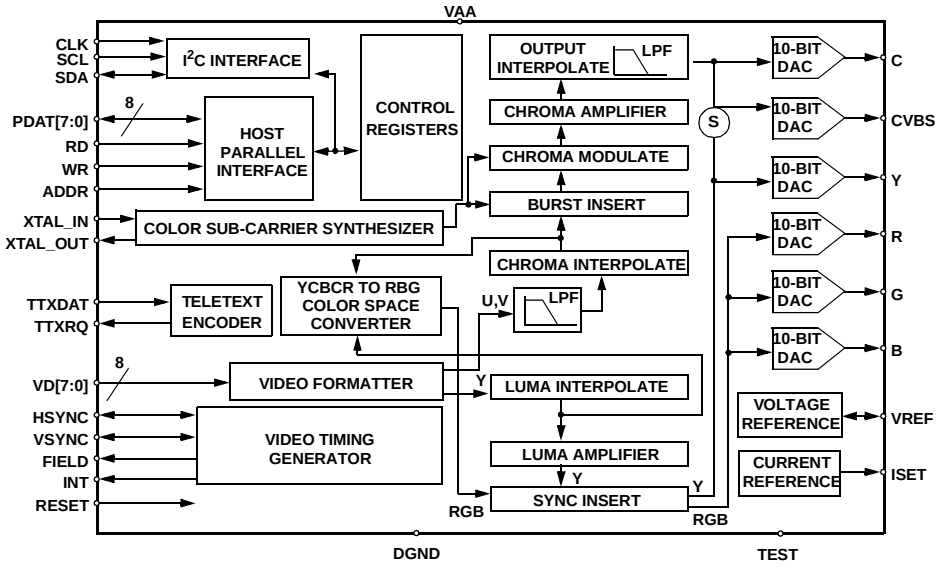
NTSC/PAL Digital Video Encoder

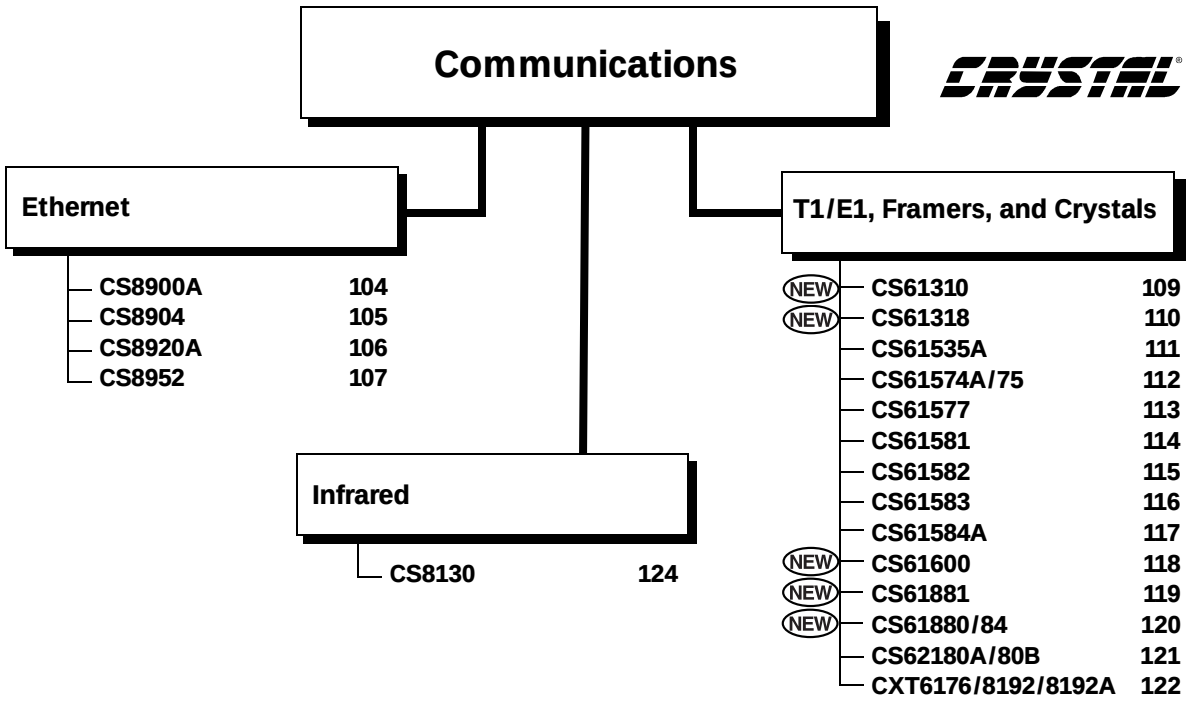
- **Six DACs providing simultaneous composite, S-video, and RGB, or Component YUV outputs**
- **Programmable DAC output currents for low impedance (37.5 Ω) and high impedance (150 Ω) loads.**
- **Multi-standard support for NTSC-M, NTSC-JAPAN, PAL (B, D, G, H, I, M, N, Combination N)**
- **ITU R.BT656 input mode supporting EAV/SAV codes and CCIR601 Master/Slave input modes**
- **Programmable HSYNC and VSYNC timing**
- **Multi-standard Teletext (Europe, NABTS, WST) support**
- **VBI encoding support**
- **Wide-Screen Signaling (WSS) support, EIA-J CPX1204**
- **NTSC closed caption encoder with interrupt**
- **CS4955 supports Macrovision copy protection Version 7**
- **Host interface configurable for parallel or I^2C compatible operation**
- **On-chip voltage reference generator**
- **+3.3 V or +5 V operation, CMOS, low-power modes, tri-state DACs**
- **Ordering information** (described on pg.198)
  - — CS4954-CQ 48-Pin TQFP
  - — CS4955-CQ 48-Pin TQFP

The CS4954/5 provides full conversion from digital video formats YCbCr or YUV into NTSC and PAL Composite, Y/C (S-video) and RGB, or YUV analog video. Input formats can be 27 MHz 8-bit YUV, 8-bit YCbCr, or ITU R.BT656 with support for EAV/SAV codes. Video output can be formatted to be compatible with NTSC-M, NTSC-J, PAL-B,D,G,H,I,M,N, and Combination N systems. Closed Caption is supported in NTSC. Teletext is supported for NTSC and PAL.

Six 10-bit DACs provide two channels for an S-Video output port, one or two composite video outputs, and three RGB or YUV outputs. Two-times oversampling reduces the output filter requirements and guarantees no DAC-related modulation components within the specified bandwidth of any of the supported video standards.

Parallel or high-speed I^2C compatible control interfaces are provided for flexibility in system design. The parallel interface doubles as a general purpose I/O port when the CS4954/5 is in I^2C mode to help conserve valuable board area.

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Communications

Selection Table

Product Selection Specifications

Ethernet						
Industrial Ethernet	PHY	10/100BASE-TX	1-channel	Switches, routers, industrial networks	675 mW	CS8952
		10BASE-T	4-channel	Switches, routers	240 mW/port	CS8904
	Controller	10BASE-T	1-channel	Embedded systems, set-top boxes, cable modems, industrial networks	150 mW	CS8900A
PnP		10BASE-T	1-channel	Ethernet PC cards	650 mW	CS8920A
T1/E1						
LIU		Short haul	8-channel	Port-dense E1 OEM systems' LIU	TBD	CS61880
				Port-dense E1 OEM systems' AFE	<100 mW/ch	CS61881
				Port-dense T1/E1 OEM systems' LIU	TBD	CS61884
			2-channel	General-purpose	250 mW/ch	CS61584A
				Stand-alone dual LIU	220 mW/ch	CS61583
				Upgrade path for CS61535A	220 mW/ch	CS61582
			1-channel	Synchronous systems	290 mW	CS61574A
				Asynchronous multiplexors	290 mW	CS61535A
				AT&T 62411 compliant	290 mW	CS61575
				Drop-in replacement for CS61574 and CS6158	400 mW	CS61577
		Long haul	Universal	Short/long haul, T1/E1 systems	430/480 mW	CS61581
			1-channel	Long haul T1 systems	390 mW	CS61310
				Long haul E1 systems	390/480 mW	CS61318
Framers						
	Framer	T1	1-channel	General-purpose	15 mW	CS62180A
						CS62180B
Jitter Attenuators						
PCM Jitter Attenuator			T1/PCM-30 jitter attenuation		50 mW	CS61600
Pullable Quartz Crystals			Provides jitter attenuation function for T1/E1 line interface units and CS61600		1544-MHz T1 applications	CXT6176
					2.048-MHz E1 applications	CXT8192
					specialized for TRB-12 E1 applications	CXT8192A

Communications

Ethernet

Ethernet

Specification Table

Product	Media Supported	Digital Interface	Number of Channels	Power Supply
CS8900A	10BASE-T	ISA, General Purpose Parallel	1	5V, 3.3V
CS8904	10BASE-T	7-wire	4	5V, 3.3V
CS8920A	10BASE-T	ISA, PnP	1	5V
CS8952	10BASE-T, 100BASE-TX, NRZ (optical)	MII	1	5 V, with support of 3.3 V digital IO

CS8900A

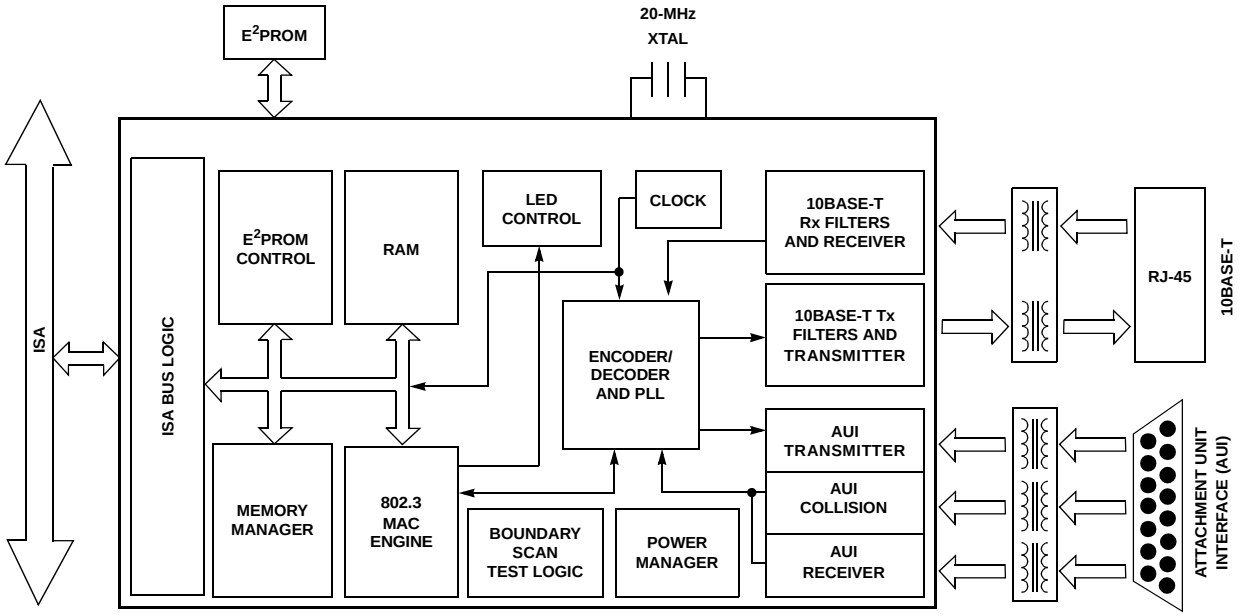
Crystal LAN™ Ethernet Controller

- **Single-Chip IEEE 802.3 Ethernet controller with direct ISA-bus interface**
- **Maximum current consumption = 55 mA (5 V supply)**
- **3 V operation**
- **Industrial temperature range**
- **Comprehensive suite of software drivers available**
- **Efficient PacketPage™ architecture operates in I/O and memory space, and as DMA slave**
- **Full-duplex operation**
- **On-chip RAM buffers transmit and receive frames**
- **10BASE-T port with analog filters, provides:**
  - — Automatic polarity detection and correction
- **AUI port for 10BASE2, 10BASE5 and 10BASE-F**
- **Programmable transmit features:**
  - — Automatic re-transmission on collision
  - — Automatic padding and CRC generation
- **Programmable receive features:**
  - — Stream Transfer™ for reduced CPU overhead
  - — Auto-switch between DMA and on-chip memory
  - — Early interrupts for frame pre-processing
  - — Automatic rejection of erroneous packets
- **EEPROM support for jumperless configuration**
- **Boot PROM support for diskless systems**
- **Boundary scan and loopback test**
- **LED drivers for link status and LAN activity**
- **Standby and suspend sleep modes**
- **Ordering information** (described on pg.198)
  - — CS8900A-CQ 100-Pin TQFP
  - — CS8900A-IQ 100-Pin TQFP
  - — CS8900A-CQ3 100-Pin TQFP
  - — CS8900A-IQ3 100-Pin TQFP

The CS8900A is a low-cost industrial-grade Ethernet controller optimized for industrial and embedded applications. Its highly integrated design includes on-chip RAM, 10Base-T transmit and receive filters, and a direct ISA-Bus interface (easily adapted to general purpose) with 24 mA drivers.

The CS8900A's PacketPage architecture allows host software to directly access the device's registers in memory mode, resulting in increased system efficiency through automatic adaptation to traffic and resources. A full suite of ready-made Crystal® drivers are available to complement the CS8900A, decreasing design risk and time.

With the CS8900A, a complete 10 Mbps Ethernet port can be implemented in 1.5 in^2 (10 cm^2) board space, making the device the low-power, low-risk, low-cost device of choice for top manufacturers of industrial and embedded Ethernet products.



CS8904

Quad Ethernet Transceiver

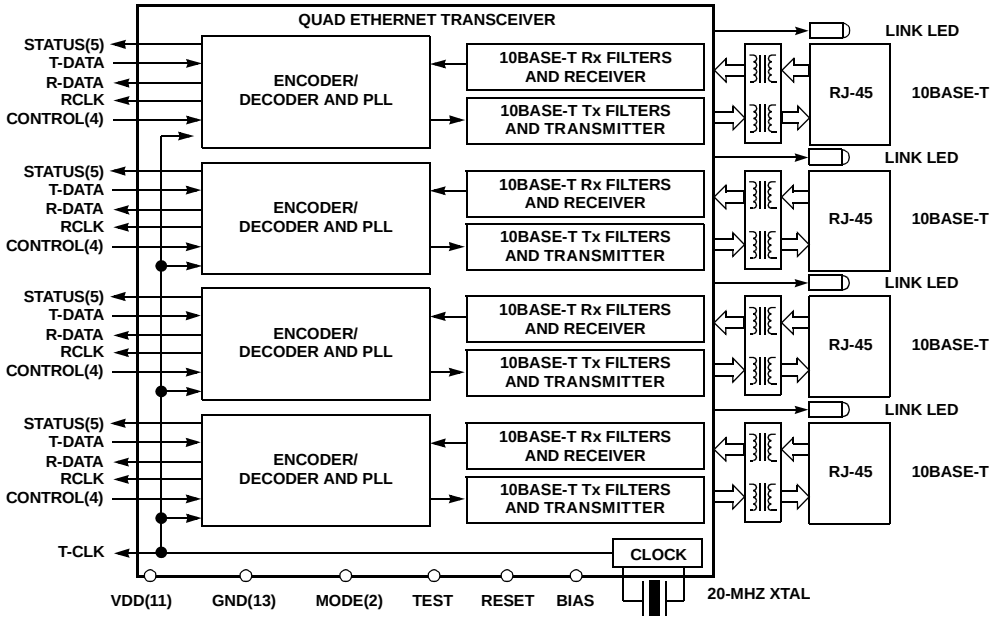
- **Single-chip quad IEEE 802.3-compliant Ethernet interface**
- **3 V and 5 V operation**
- **Full- and half-duplex operation**
- **Auto-negotiation with manual override capability**
- **Four 10BASE-T ports with integrated active analog filters**
- **Automatic polarity detection and correction**
- **Integrated Manchester encoder/decoders (ENDEC)**
- **Link status LED driver for each port**
- **Per-port control — manual duplex select (half or full), auto-negotiation select, and loopback select**
- **Per-port status — collision detect, carrier detect, jabber indication, link status, duplex status, and auto-negotiation status**
- **Commercial and industrial temperature ranges**
- **Ordering information** (described on pg.198)
  - — CS8904-CM5 100-Pin MQFP
  - — CS8904-CM3 100-Pin MQFP
  - — CS8904-IM3 100-Pin MQFP

The CS8904 combines four 10BASE-T Ethernet ENDECs and transceivers into a single low-cost device. Complete on-chip 10BASE-T transceivers and filters eliminate external components, saving valuable board space and reducing costs. Maximum design flexibility is provided by individual control and status lines for each of the four interface ports.

The CS8904 supports full-duplex operation — simultaneous transmission and reception on all ports. Auto-negotiation allows the automatic selection of either half- or full-duplex operation on a per-port basis.

On-board five-pole Butterworth active filters ensure extremely low noise and simplifies FCC Class B certification.

The CS8904 is ideally suited for cost-sensitive Ethernet switch designs. With the CS8904, engineers can design a four-port Ethernet transceiver circuit that occupies less than 1.0 square inch (6.5 sq. cm) of board space, exclusive of transformers and RJ-45 connectors.



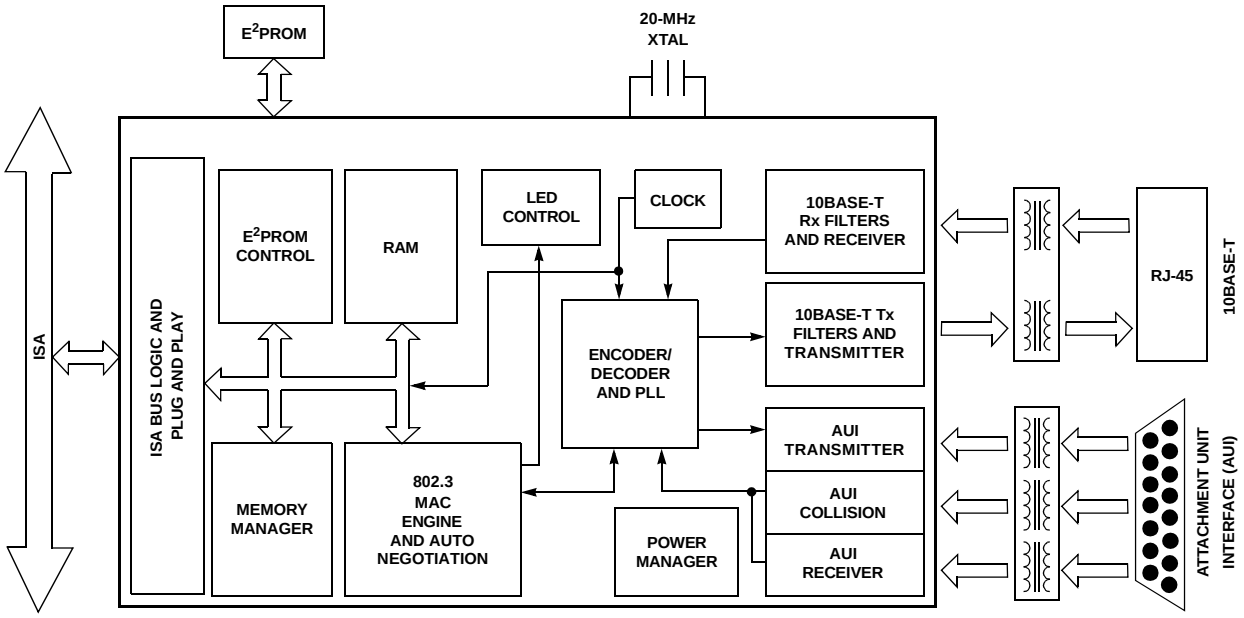
CS8920A

10 Mbps Motherboard Ethernet Controller

- **Single-chip IEEE 802.3 Ethernet controller with direct ISA bus interface**
- **Implements industry-standard plug and play**
- **Full-duplex operation**
- **Auto-negotiation of full- and half-duplex modes**
- **Recognizes received Magic Packet™ frames and requests the processor to power up**
- **Supported by complete family of device drivers**
- **Efficient PacketPage™ architecture operates in I/O and memory space, and as DMA slave**
- **On-chip RAM buffers transmit and receive frames**
- **10BASE-T port with internal analog filters**
- **AUI port for 10BASE2, 10BASE5, and 10BASE-F**
- **Programmable receive features**
  - — StreamTransfer™ for reduced CPU overhead
  - — Auto-switch between DMA and on-chip memory
  - — Early interrupts for frame preprocessing
- **Four LED drivers for link status, full duplex, and LAN activity**
- **Small 144-pin TQFP package and minimal external components (transformer, crystal, and optional EEPROM)**
- **Ordering information** (described on pg.198)
  - — CS8920A-CQ 144-Pin TQFP

The CS8920A is a low-cost Ethernet LAN controller optimized for ISA PCs. The highly integrated design eliminates the need for costly external components required by other Ethernet controllers.

The CS8920A is available in a 144-pin TQFP package ideally suited for small form-factor, cost-sensitive Ethernet applications such as desktop and portable motherboards. With the CS8920A, system engineers can design a complete plug-and-play Ethernet circuit that occupies less than 2.0 square inches (14 sq. cm) of board space.



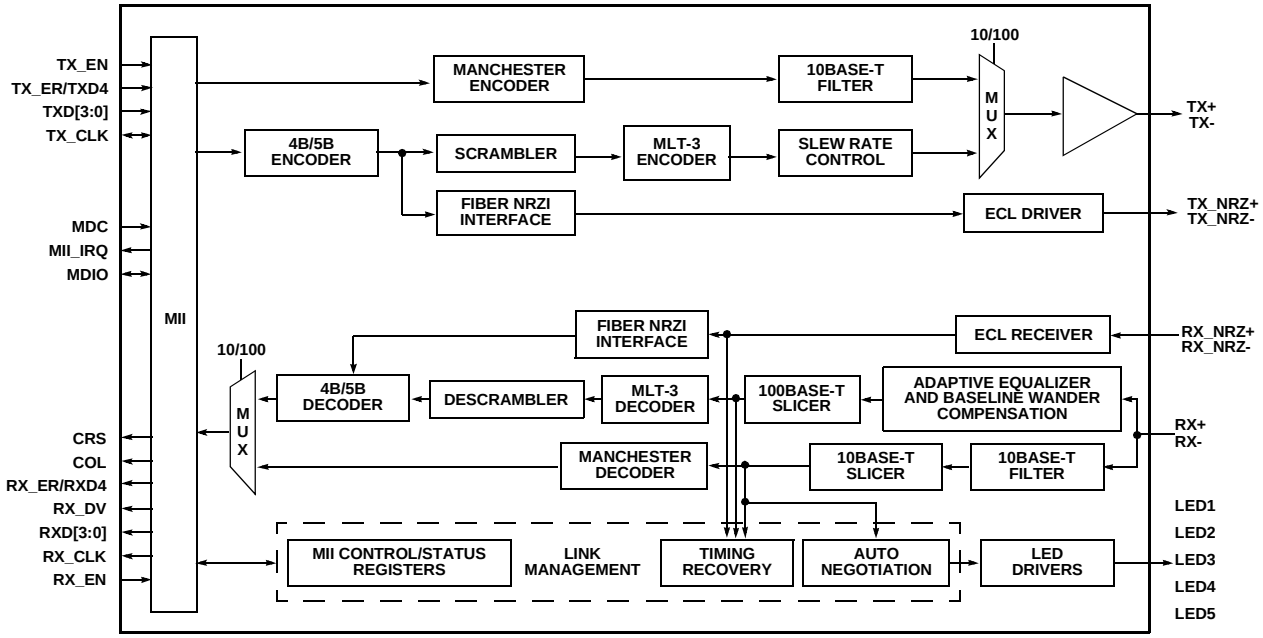
CS8952

100BASE-X and 10BASE-T Transceiver

- **Single-chip IEEE 802.3 physical interface IC for 100BASE-TX, 100BASE-FX and 10BASE-T**
- **Adaptive equalizer provides extended length operation (>160 m) with superior noise immunity and NEXT margin**
- **Extremely low transmit jitter (<400 ps)**
- **Low common mode noise on TX driver for reduced EMI problems**
- **Integrated Rx and Tx filters for 10BASE-T**
- **Compensation for back-to-back 'killer packets'**
- **Digital interfaces supported**
  - — Media-independent interface (MII) for 100BASE-X and 10BASE-T
  - — Repeater 5-bit code-group interface (100BASE-X)
  - — 10BASE-T serial interface
- **Register Set Compatible with DP83840A**
- **IEEE 802.3 auto-negotiation with next page support**
- **Five LED drivers (Link, Collision, FDX, TX, and RX)**
- **Low-power (135 mA TYP) CMOS design operates on a single 5 V supply**
- **Ordering information** (described on pg.198)
  - — CS8952-CQ 100-Pin TQFP
  - — CS8952-IQ 100-Pin TQFP

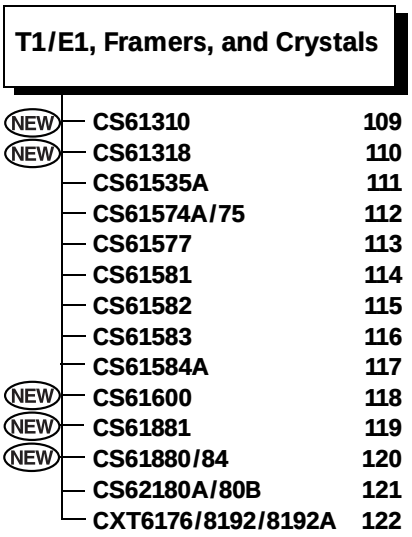
The CS8952 uses CMOS technology to deliver a high-performance, low-cost 100BASE-X/10BASE-T Physical Layer (PHY) line interface. It makes use of an adaptive equalizer optimized for noise and near end crosstalk (NEXT) immunity to extend receiver operation to cable lengths exceeding 160 m. In addition, the transmit circuitry has been designed to provide extremely low transmit jitter (<400 ps) for improved link partner performance. Also, transmit driver common mode noise was minimized to reduce EMI for simplified FCC certification.

The CS8952 incorporates a standard Media-Independent Interface (MII) for easy connection to a variety of 10 and 100 Mbps Media Access Controllers (MACs). The CS8952 also includes a pseudo-ECL interface for use with 100Base-FX fiber interconnect modules.



Communications

T1/E1, Framers, and Crystals



Specification Table

Product	Power Supply (V)	Control Modes	Line Coders	TBR-12 Compliant	Impedance Matching Line Driver	Arbitrary Waveform Option
CS61310	5.0	Host, H/W	AMI, B8ZS	N/A	No	Yes
CS61318	5.0	Host, H/W	AMI, HDB3	Yes	No	Yes
CS61535A	5.0	Host, H/W, Extended H/W	AMI, B8ZS, HDB3	No	Yes	No
CS61574A/75	5.0	Host, H/W, Extended H/W	AMI, B8ZS, HDB3	Yes*	Yes	No
CS61577	5.0	Host, H/W, Extended H/W	AMI, B8ZS, HDB3	No	No	No
CS61581	5.0	Host, H/W	AMI, B8ZS, HDB3	Yes	Yes	Yes
CS61582	5.0	Hardware	N/A	No	Yes	No
CS61583	5.0	Hardware	AMI, B8ZS, HDB3	No	Yes	No
CS61584A	3.3 or 5.0	Host and Hardware	AMI, B8ZS, HDB3	Yes	Yes	Yes
CS61881	3.3	Host, H/W	AMI, HDB3	Yes	Yes	Yes
CS61880	3.3	Hardware	AMI	N/A	Yes	No
CS61884	3.3	Host, H/W	AMI, HDB3	Yes	Yes	Yes
CS62180A/80B	Monolithic T1 Framers		encode/decode T1 framing formats		SF(D4), SLC-96® and T1DM framing	
CXT6176	Pullable Quartz Crystals		jitter attenuation for T1 LIUs		1544-MHz T1 applications	
CXT8192	Pullable Quartz Crystals		jitter attenuation for E1 LIUs		2.048-MHz E1 applications	
CXT8192A	Pullable Quartz Crystals		jitter attenuation for E1 LIUs		specialized for CTR12 E1 applications	

* Using CXT8192A for jitter attenuation

CS61310

T1 Long Haul Line Interface Unit

- **Provides long haul T1 line interface functions**
- **No crystal needed for jitter attenuation**
- **Greater than 14 dB of transmit return loss**
- **Meets AT&T 62411 jitter tolerance and attenuation requirements**
- **Meets ANSI T1.231B requirements for LOS and AIS**
- **AWG for user-programmable pulse shapes**
- **TX driver high impedance / low power control**
- **Generation and detection of loop up / loop down signaling**
- **Selectable unipolar or bipolar I/O**
- **Compliant with:**
  - — American National Standards (ANSI): T1.102, T1.105, T1.403, T1.408, and T1.231
  - — FCC Rules and Regulations: Part 68 and Part 15
  - — AT&T Publication 62411
  - — TR-NET-00499
- **Ordering information** (described on pg.198)
  - — CS61310-IL 28-Pin PLCC
  - — CS61310-IP 28-Pin PDIP

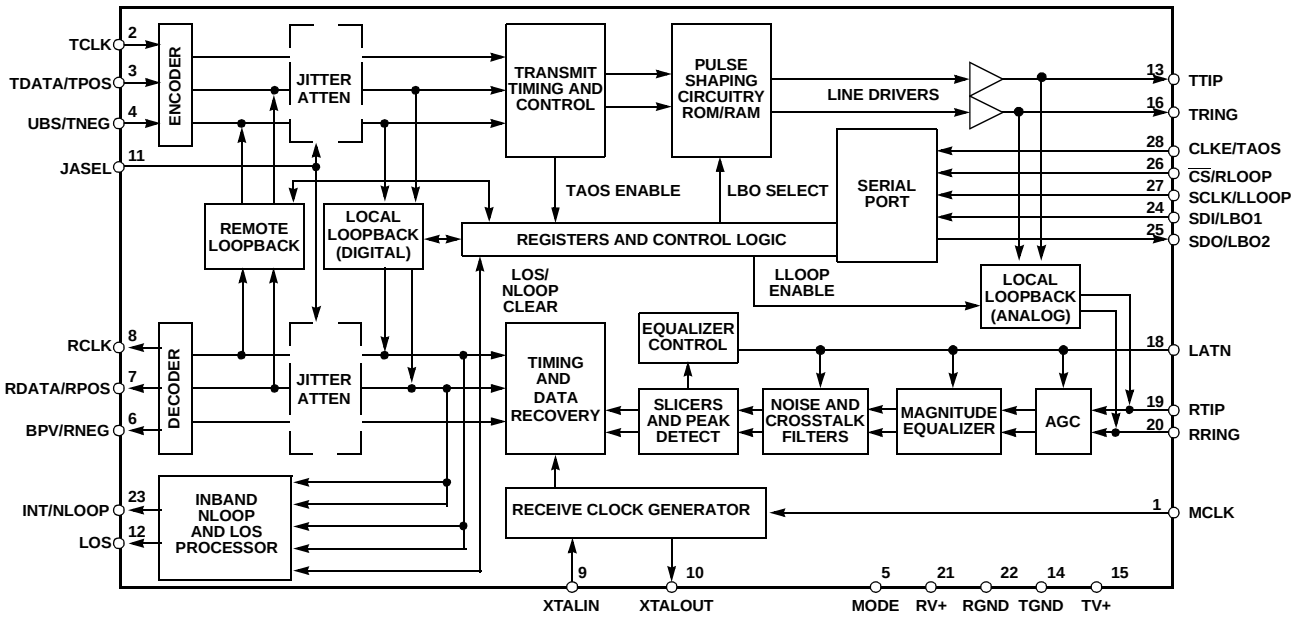
The CS61310 is a T1 primary rate line interface unit. This device combines the complete analog transmit and receive circuitry for a single, full-duplex interface at T1 rates. The CS61310 is pin and function compatible with the Level One LXT310.

Enhanced functionality is available through an extended register set interface, the Arbitrary Waveform Generator (AWG), which provides a means to create custom pulse shapes. These can be used to overcome poor quality cabling or line protection cicuitry.

The CS61310 features Crystal® crystal-less jitter attenuation. This feature is compliant to even the most stringent jitter specifications, while eliminating the need for an external crystal.

The CS61310 also features full loopback, error and line monitoring, and alarm functions compliant to the major ANSI specifications.

NEW



CS61318

E1 Long Haul Line Interface Unit

- **Provides long haul E1 line interface unit functions**
- **No crystal needed for jitter attenuation**
- **Meets TBR-12 jitter tolerance and attenuation requirements**
- **Meets ITU-T G.775 requirements for LOS and AIS**
- **Meets the BS6450 transmitter short-circuit requirements for E1 applications**
- **AWG for user-programmable pulse shapes**
- **Line quality monitoring function**
- **TX driver high impedance / low power control**
- **AIS and LOS monitoring**
- **Generation and detection of loop up / loop down signaling**
- **Selectable HDB3 encoding/decoding**
- **Selectable unipolar or bipolar I/O**
- **Compliant with:**
  - — ITU-T Recommendations: G.703, G.732, G.775, I.431
  - — ETSI ETS 300 011, 300 233, TBR 12, TBR 13
  - — TR-NET-00499
- **Ordering information** (described on pg.198)
  - — CS61318-IL 28-Pin PLCC
  - — CS61318-IP 28-Pin PDIP

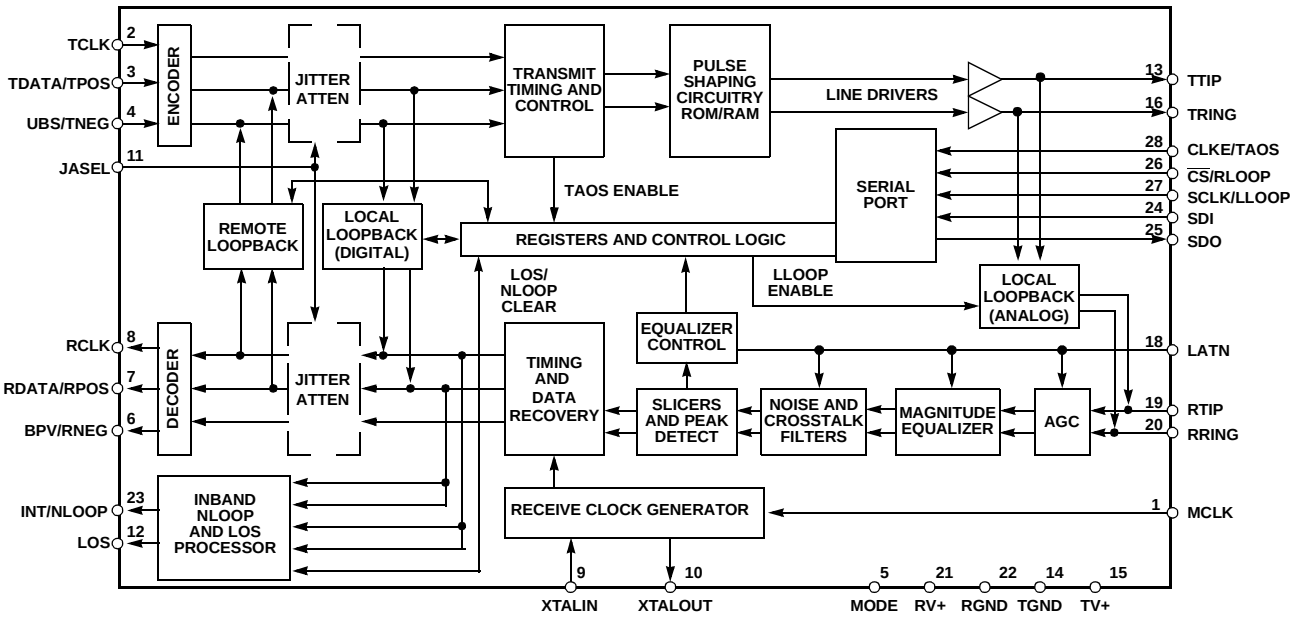
The CS61318 is an E1 primary rate line interface unit. This device combines the complete analog transmit and receive circuitry for a single, full-duplex interface E1 rates. The CS61318 is pin and function compatible with the Level One LXT318.

Enhanced functionality is available through an extended register set interface, the Arbitrary Waveform Generator (AWG), which provides a means to create custom pulse shapes. These can be used to overcome poor quality cabling or line protection circuitry.

The CS61318 features Crystal® crystal-less jitter attenuation. This feature is compliant to even the most stringent jitter specifications, while eliminating the need for an external crystal.

The CS61318 also features full loopback, error and line monitoring, and alarm functions compliant to the major ITU specifications.

NEW



CS61535A

T1/E1 Line Interface Unit

- **Analog PCM line interface for T1 and E1 applications**
- **Line driver, data, and clock recovery functions**
- **Transmit side jitter attenuation starting at 6 Hz with > 300 UI of jitter tolerance**
- **Low power consumption (typically 175 mW)**
- **B8ZS/HDB3/AMI encoders/decoders**
- **14 dB of transmitter return loss**
- **Compatible with SONET, M13, CCITT G.742, and other asynchronous muxes**
- **Ordering information** (described on pg.198)
  - — CS61535A-IP1 28-Pin PDIP
  - — CS61535A-IL1 28-Pin PLCC (j-leads)

Applications

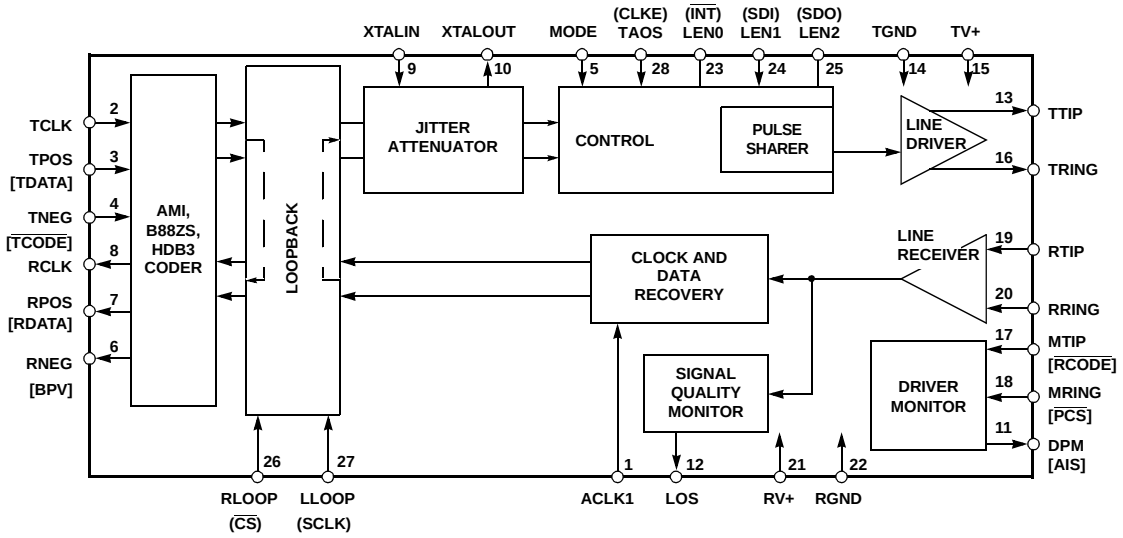
- **Interfacing network transmission equipment such as SONET multiplexor and M13 to a DSX-1 cross connect**
- **Interfacing customer premises equipment to a CSU interfacing to T1/E1 links**

The CS61535A combines the complete analog transmit and receive line interface for T1 or E1 applications in a low-power, 28-pin device operating from a +5 V supply.

This device features a transmitter jitter attenuator, making it ideal for asynchronous multiplexor systems with gapped transmit clocks. The CS61535A provides a matched, constant impedance output stage to ensure signal quality on mismatched, poorly terminated lines.

The IC uses a digital DLL clock and data recovery circuit continuously calibrated from a crystal reference to provide excellent stability and jitter tolerance.

( ) = PIN FUNCTION IN HOST MODE
[ ] = PIN FUNCTION IN EXTENDED HARDWARE MODE



CS61574A/75

T1/E1 Line Interface Unit

- **Analog transmission line interface for T1 and E1 applications**
- **Line driver, jitter attenuator, and clock recovery functions**
- **AT&T® 62411 Stratum 4 jitter compliant**
- **Low power consumption (typically 175 mW)**
- **B8ZS/HDB3/AMI encoder/decoder**
- **14 dB of transmitter return loss**
- **Ordering information** (described on pg.198)
  - — CS61575-IP1 28-Pin PDIP
  - — CS61575-IL1 28-Pin PLCC
  - — CS61574A-IP1 28-Pin PDIP
  - — CS61574A-IL1 28-Pin PLCC

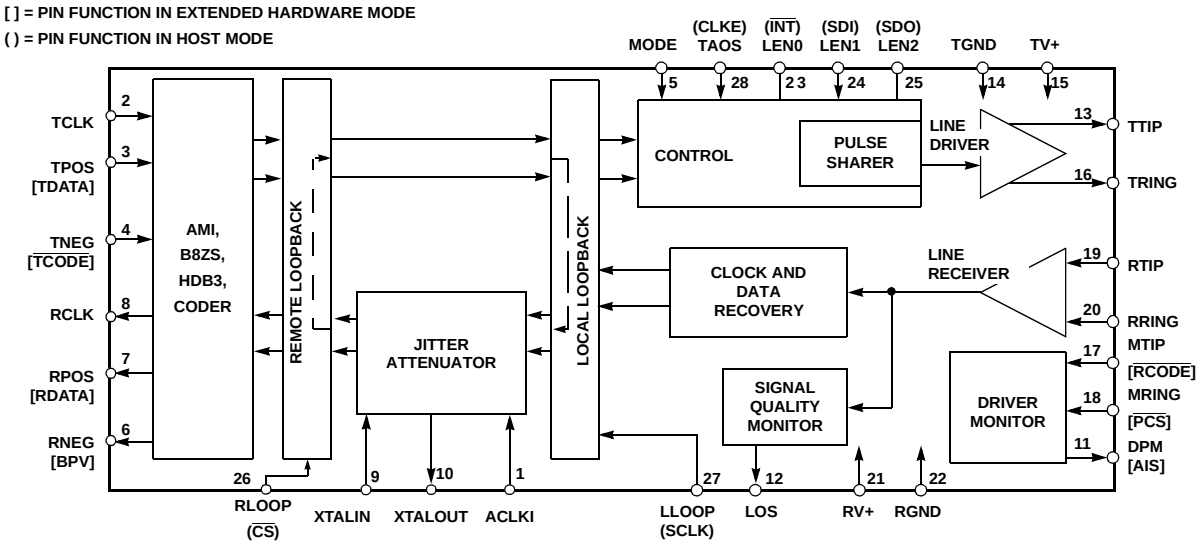
Applications

- **Interfacing network equipment such as DACS and channel banks to a DSX-1 cross connect**
- **Interfacing customer-premises equipment to a CSU**
- **Building CSUs**

The CS61574A and CS61575 combine the complete analog transmit and receive line interface for T1 or E1 applications in a low-power, 28-pin device operating from a +5 V supply. Both devices support processor-based or stand-alone operation and interface with industry-standard T1 and E1 framers.

The receiver uses a digital DLL continuously calibrated from a crystal reference to provide excellent stability and jitter tolerance. The CS61574A has a receiver jitter attenuator optimized for minimum delay in switching and transmission applications. The CS61575 attenuator is optimized for CPE applications subject to AT&T 62411 requirements.

The transmitter features internal pulse shaping and a matched constant impedance output stage to ensure signal quality on mismatched, poorly terminated lines.



CS61577

T1/E1 Line Interface Unit

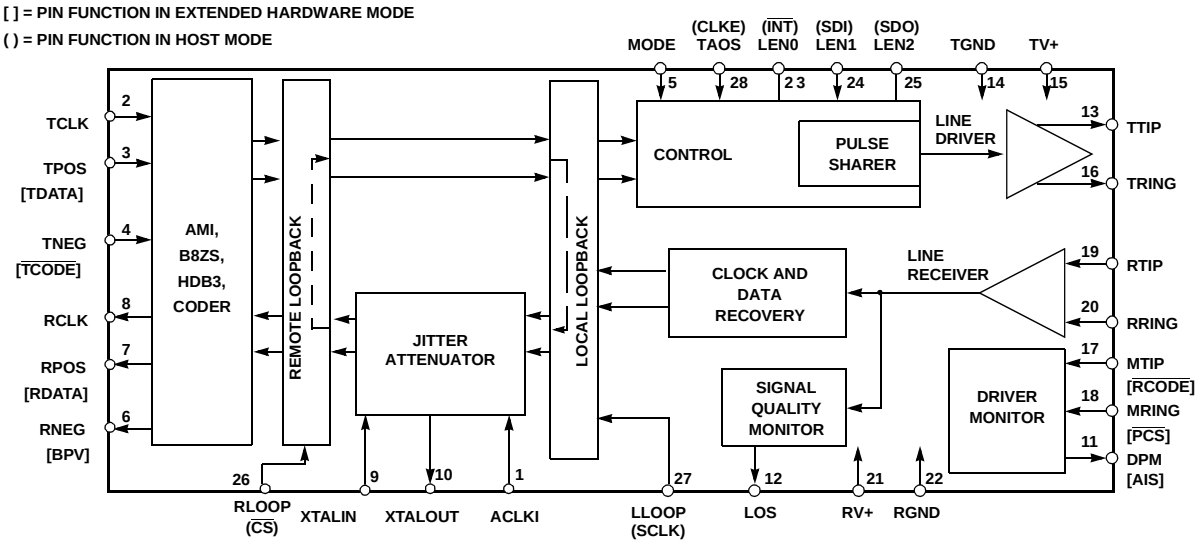
- **Provides analog transmission line interface for T1 and E1 applications**
- **Drop-in replacement for CS61574 with the following enhancements:**
  - — Lower-power consumption
  - — Transmitter short-circuit current limiting
  - — Greater transmitter immunity to line reflections
  - — Software selection between 75 Ω and 120 Ω E1 output options
  - — Internally controlled E1 pulse width
  - — B8ZS/HDB3/AMI encoder/decoder
- **Ordering information** (described on pg.198)
  - — CS61577-IP1 28-Pin PDIP
  - — CS61577-IL1 28-Pin PLCC

Applications

- **Interfacing network equipment such as DACS and channel banks to a DSX-1 cross connect**
- **Building CSUs**

The CS61577 is a drop-in replacement for the CS61574, combining the complete Crystal analog transmit and receive line interface for T1 or E1 applications in a low-power, 28-pin device operating from a +5 V supply. The CS61577 supports processor-based or stand-alone operation and interfaces with industry-standard T1 and E1 framers.

The receiver uses a digital DLL continuously calibrated from a crystal reference to provide excellent stability and jitter tolerance. The receiver includes a jitter attenuator optimized for minimum delay in switching and transmission applications. The transmitter provides internal pulse shaping to ensure compliance with T1 and E1 pulse template specifications.

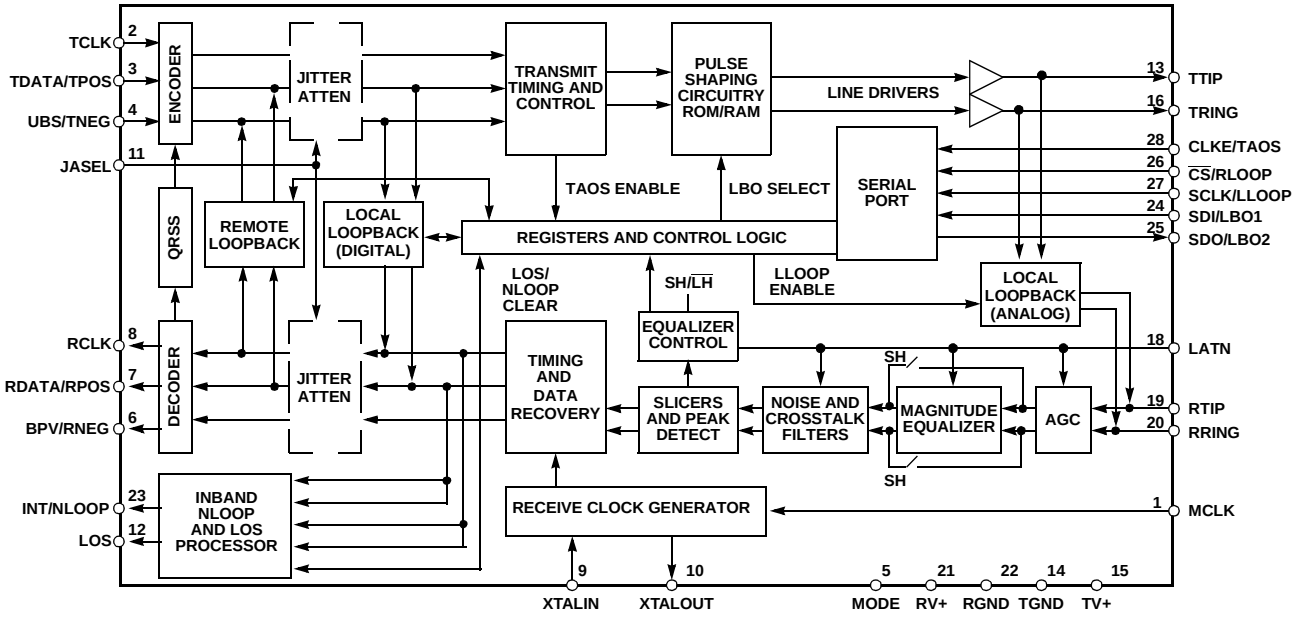


CS61581

Universal Line Interface Unit

- **Provides T1 and E1, long haul and short haul line interface functionality**
- **Provides a QRSS test signal and error detector**
- **Impedance matching line driver using a single transformer**
- **Greater than 14 dB of transmit return loss without using external resistors**
- **No crystal needed for jitter attenuation**
- **Meets AT&T® 62411 and TBR-12 jitter tolerance and attenuation requirements**
- **Meets ANSI T1.231B and ITU-T G.775 requirements for LOS and AIS**
- **Meets the BS6450 transmitter short-circuit requirements for E1 applications**
- **Compliant with:**
  - — ITU-T recommendations: G.703, G.732, G.775, and I.431
  - — American National Standards (ANSI): T1.102, T1.105, T1.403, T1.408, and T1.231
  - — FCC rules and regulations: Part 68 and Part 15
  - — AT&T publication 62411
  - — ETSI ETS 300 011, 300 233, TBR 12/13
  - — TR-NET-00499
- **Ordering information** (described on pg.198)
  - — CS61581-IL 28-Pin PLCC
  - — CS61581-IP 28-Pin PDIP

The CS61581 is a primary rate line interface unit capable of operation in both short haul (intraoffice) and long haul applications. The CS61581 combines the complete analog transmit and receive circuitry for a single, full-duplex interface at T1 and E1 rates. The device is pin and function compatible with the Level One LXT310 and LXT318 (the latter in the host mode only), and can also replace LXT359, LXT360/361. Enhanced functionality is available through an extended register set allowing short haul operation, custom pulse shape generation, QRSS pattern generation, detection and error counting, and generation and detection of loop up and loop down codes. The CS61581 features Crystal® low-power impedance-matched line drivers and crystal-less jitter attenuation.



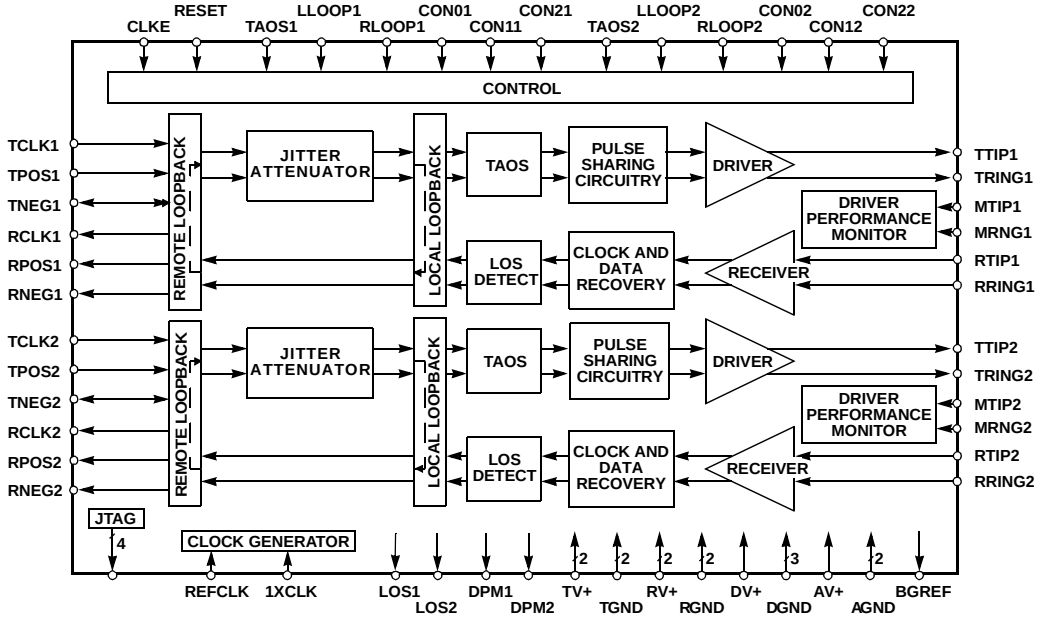
CS61582

Dual T1/E1 Line Interface Unit

- **Dual T1/E1 line interface optimized for multiplexer applications**
- **Functionally upwards compatible from CS61535A**
- **Low power consumption**
- **Transmit driver performance monitors**
- **Jitter attenuation in the transmit path**
- **Matched impedance transmit drivers**
- **Supports JTAG boundary scan**
- **Hardware control mode**
- **5 V operation**
- **Ordering information** (described on pg.198)
  — CS61582-IQ5 64-Pin TQFP

The CS61582 is a dual-line interface optimized for highly integrated T1/E1 asynchronous or synchronous multiplexer applications such as SONET and SDH. Each channel features individual control and status pins, eliminating the need for external microprocessor support. The matched impedance drivers reduce power consumption and provide substantial return loss to ensure superior T1/E1 pulse quality.

The CS61582 provides two transmitter driver performance monitor circuits and JTAG boundary scan to enhance system testability and reliability.



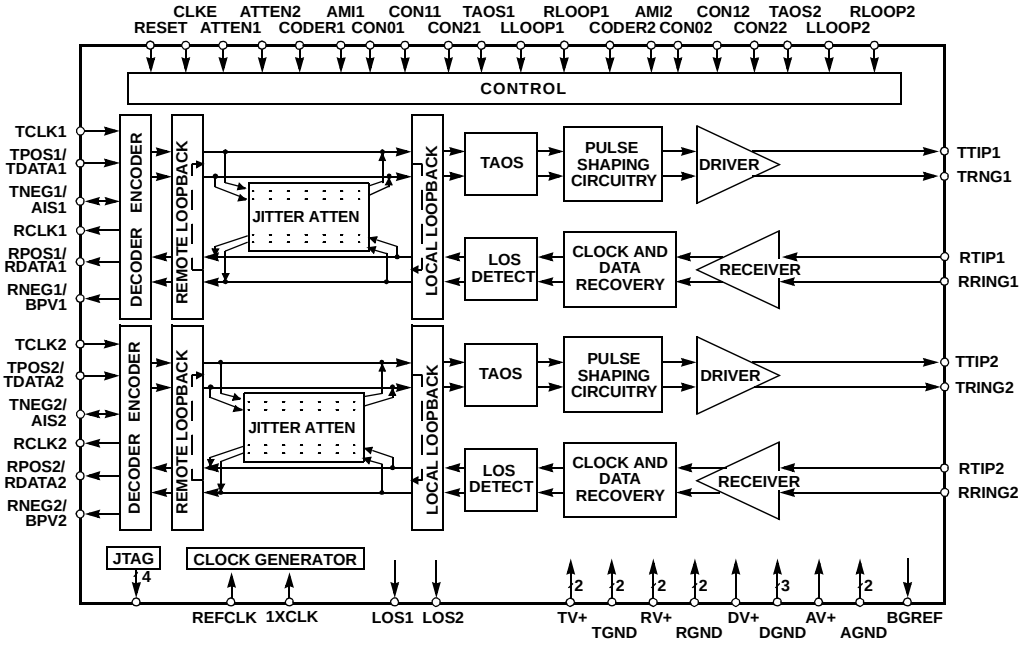
CS61583

Dual T1/E1 Line Interface Unit

- **Dual T1/E1 line interface optimized for systems that do not use T1/E1 framers**
- **Low power consumption**
- **Matched impedance transmit drivers**
- **Common transmit and receive transformers for all modes**
- **Selectable jitter attenuation for transmit or receive paths**
- **Supports JTAG boundary scan**
- **Hardware control mode**
- **5 V operation**
- **Ordering information** (described on pg.198)
  - — CS61583-IL5 68-Pin PLCC
  - — CS61583-IQ5 64-Pin TQFP

The CS61583 is a dual-line interface for T1/E1 applications and is designed for high-volume cards requiring low power and high density. Each channel features individual control and status pins, eliminating the need for external microprocessor support. The matched impedance drivers reduce power consumption and provide substantial return loss to ensure superior T1/E1 pulse quality.

The CS61583 provides JTAG boundary scan to enhance system testability and reliability.



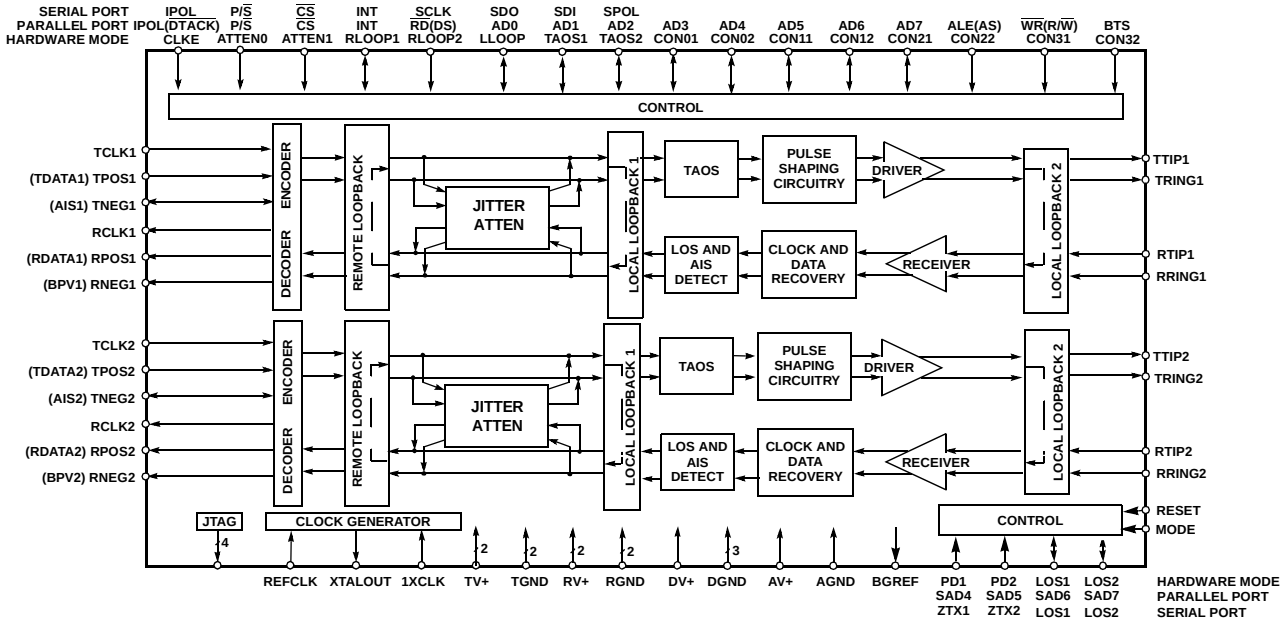
CS61584A

Dual T1/E1 Line Interface Unit

- **General-purpose dual T1/E1 line interface**
- **3.3 V and 5 V versions**
- **Crystal-less jitter attenuator meets European TBR-12 and ETSI ETS 300 011 specifications**
- **Matched impedance transmit drivers**
- **Transmit tri-state capability**
- **Common transmit and receive transformers for all modes**
- **Serial and parallel host mode operation**
- **User-customizable pulse shapes**
- **Supports JTAG boundary scan**
- **Complies with:**
  - — ITU-T recommendations: G.703, G.732, G.775, and I.431
  - — American National Standards Institute (ANSI): T1.102, T1.105, T1.403, T1.408, and T1.231
  - — FCC Rules and Regulations: Part 68 and Part 15
  - — AT&T® Publication 62411
  - — ETSI ETS 300 011, 300 233, TBR 12/13
  - — TR-NET-00499
- **Ordering information** (described on pg.198)
  - — CS61584A-IL 68-Pin PLCC
  - — CS61584A-IQ 64-Pin TQFP
  - — CS61584A-IL3 68-Pin PLCC
  - — CS61584A-IQ3 64-Pin TQFP

The CS61584A is a dual-line interface for T1/E1 applications, designed for port-dense applications requiring low power. The device is optimized for flexible microprocessor control through a serial or parallel host mode interface. Hardware mode operation is also available on this extremely space-efficient device.

Matched impedance drivers reduce power consumption and provide substantial transmitter return loss. The transmitter pulse shapes are customizable via the Arbitrary Waveform Generator to allow non-standard line loads. Crystal-less jitter attenuation complies with the most stringent standards, while eliminating external components and cost. Support of JTAG boundary scan enhances system testability and reliability, while common transformer requirements for all modes eliminates the need to plan for component changes.



CS61600

PCM Jitter Attenuator

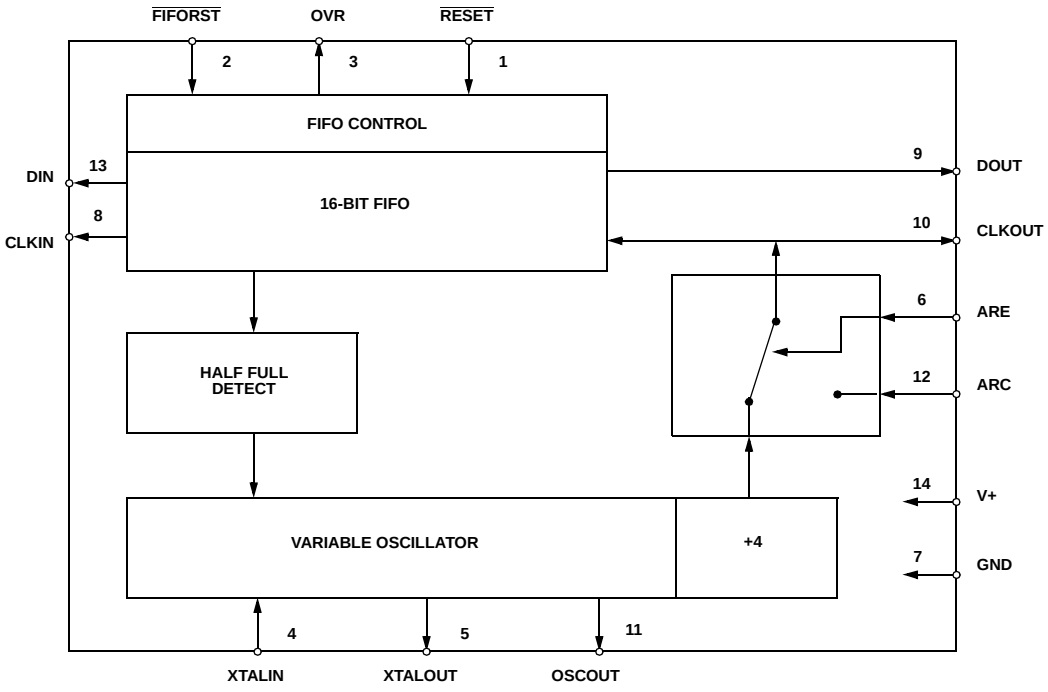
- **Unique clock-tracking circuitry filters 50 Hz or higher frequency jitter for T1 and PCM-30 applications**
- **Minimal external components required**
- **Single 5 Volt supply**
- **3 Micron CMOS for high readability and low power dissipation: 50 mW typical at 25 deg C**
- **Ordering information** (described on pg.198)
  — CS61600-IP1 14-Pin Plastic Dip

The CS61600 accepts T1 (1.544 Mb/s) or CCITT standard (2.048 Mb/s) data and clock inputs, and tolerates at least 7 (and up to 14) unit intervals, peak-to-peak, of jitter. Before outputting data and clock, jitter is attenuated using an internal clock-tracking variable oscillator and a 16-bit FIFO elastic store.

The jitter attenuation function can be determined by appropriate specification of the external crystal.

The CS61600 is transparent to data format, and is intended for application in carrier systems, switching systems, Local Area Network gateways and multiplexers.

NEW



CS61881

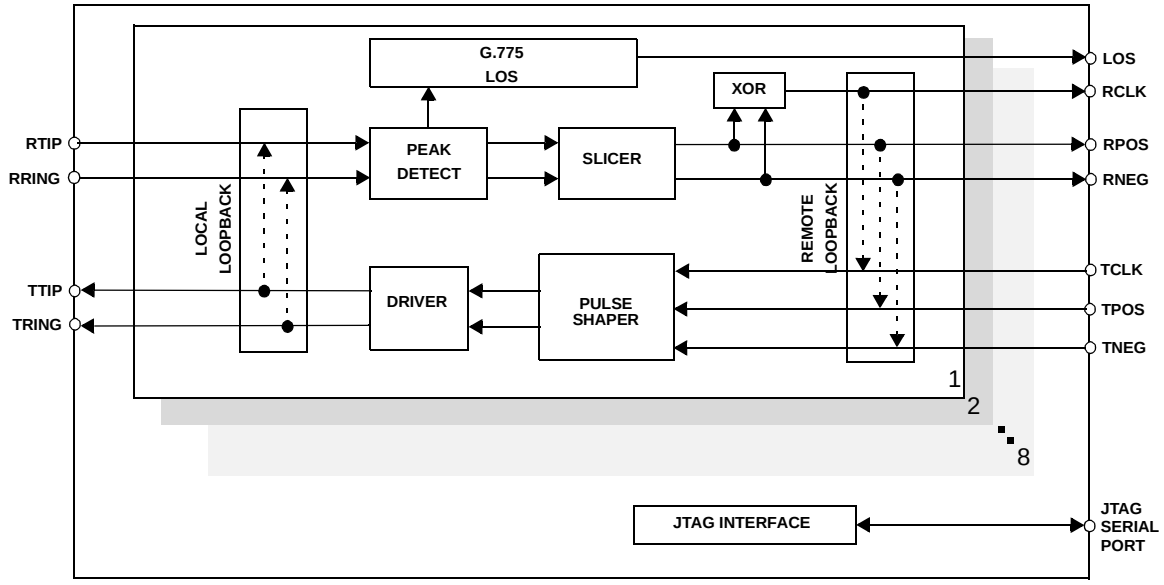
Octal E1 Analog Front End

- **Ultra low power**
- **JTAG boundary scan compliant to IEEE 1149.4**
- **True 120 Ω/75 Ω operation with no external component changes for receiver or transmitter**
- **Matched impedance transmitter**
- **Analog LOS meeting ITU G.755**
- **Single 3.3 V operation with 5 V I/O capability**
- **Local and remote loopback**
- **TX drivers with fast tri-state and power down capability**
- **Small footprints: 144-pin LQFP and 160-pin BGA**
- **Ordering information** (described on pg.198)
  - — CS61881-IQ 144-Pin LQFP
  - — CS61881-IB 160-Pin BGA

The CS61881 is an octal analog front end optimized for port-dense OEM solutions where many of the traditional LIU functions have been incorporated into the ASIC. Common pinout across the CS6188x family, impedance matching, and JTAG boundary scan provide for design reuse.

Patented matched impedance drivers in the CS61881 a lower power solution than the competition, complemented by driver tri-state and power down options. Available in ultra small packages, the CS61881 is one of the newest additions to Cirrus Logic's port-dense telecommunications solutions.

NEW



CS61880/84

Octal Line Interface Units

CS61880 E1 LIU

- **Ultra low power**
- **JTAG boundary scan compliant to IEEE 1149.4**
- **True 120 Ω/75 Ω operation with no external component changes for receiver or transmitter**
- **TBR-12/13 crystal-less jitter attenuation**
- **Matched impedance transmitter**
- **Analog LOS meeting G.755 and ETS 300 233**
- **Single 3.3 V operation with 5 V I/O capability**
- **Hardware and host mode control interfaces**
- **Local, remote, and digital loopback**
- **TX drivers with fast tristate and powerdown capability**
- **Small footprints: 144-pin LQFP and 160-pin BGA**

CS61884 T1/E1 LIU
(features in addition to CS61880)

- **Analog LOS meeting T1.231, G.755, and ETS 300 233**
- **True 120 Ω/100 Ω/75 Ω operation with no external component charges**
- **Crystal-less JA compliant to AT&T 62411, TBR-12/13**

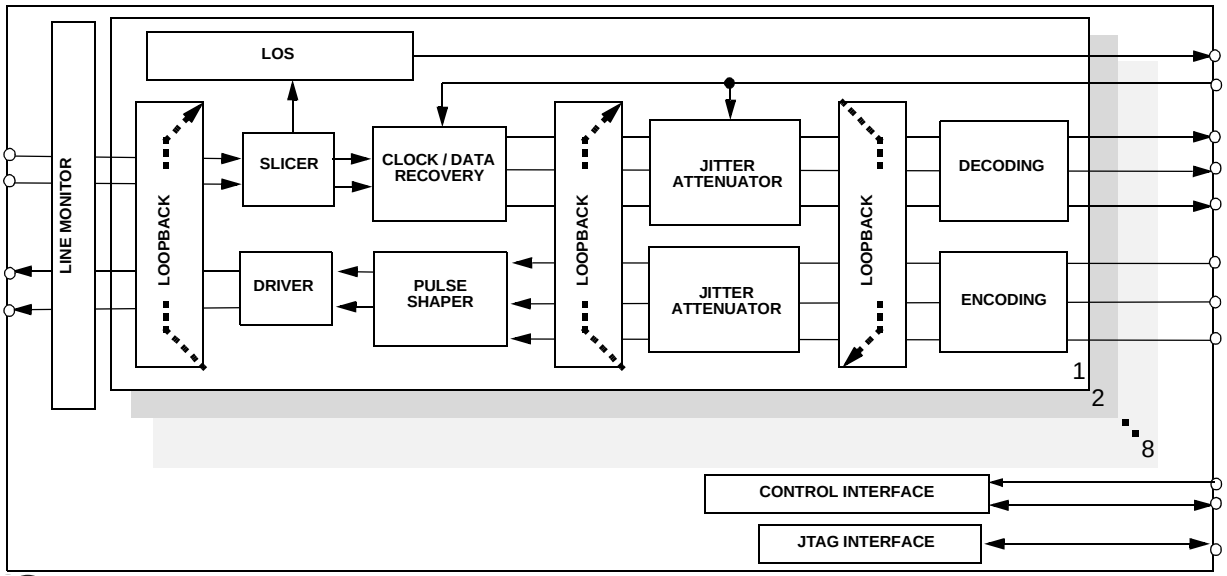
- **Ordering information** (described on pg.198)
  - — CS61880-IQ 144-Pin LQFP
  - — CS61880-IB 160-Pin BGA
  - — CS61884-IQ 144-Pin LQFP
  - — CS61884-IB 160-Pin BGA

Expanding the port-dense telecommunications offerings are the CS61880 E1 Line Interface Unit and the CS61884 T1/E1 LIU. Both devices are optimized for port-dense OEM solutions; however, the devices are more feature-rich than the CS61881.

In addition to the CS61881's features, the CS61880/84 offers crystal-less jitter attenuation that is compliant to the world's most stringent specifications while eliminating the need for a crystal, Arbitrary Waveform Generation to customize transmit pulses to overcome poor cabling or protection cicuitry, and full encoder/decoder functionality.

Available in the same ultra-small packages as and sharing common pinouts with the CS61881, the CS61880/84 are ultra small, ultra low power port-dense solutions for major OEMs.

NEW



CS62180A/80B

Enhanced T1 Framer

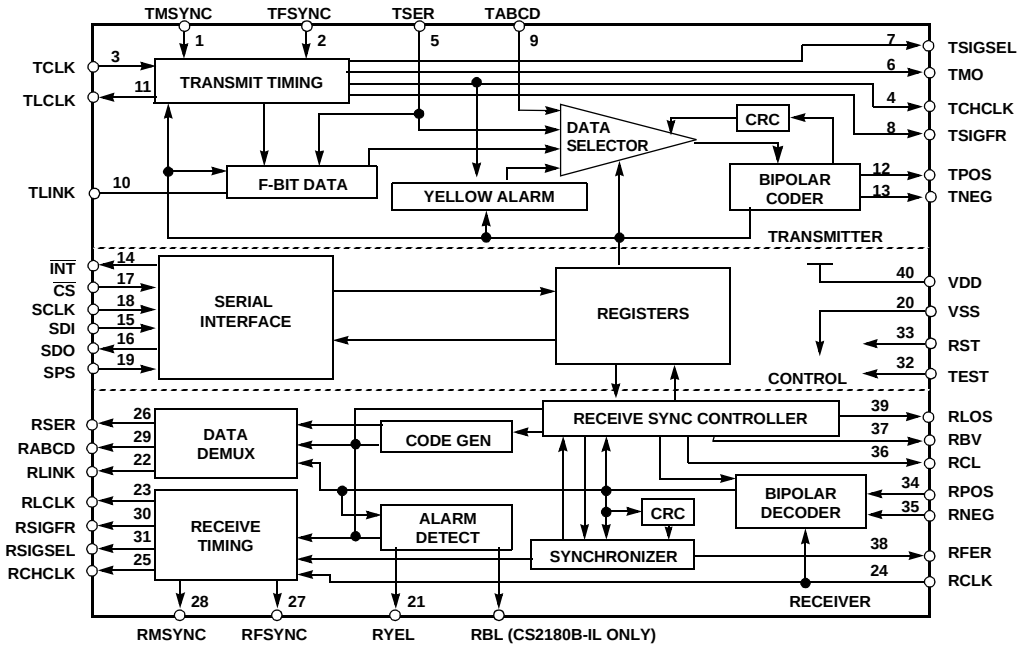
- **Monolithic T1 framing device**
- **Both framers support SF(D4®) and ESF framing formats**
- **CS62180B supports SLC-96® and T1DM framing formats**
- **CS62180B contains updated AIS and carrier loss detection criteria**
- **CS62180B is pin-compatible with CS62180A, DS2180A, and DS2180**
- **Ordering information** (described on pg.198)
  - — CS62180A-IL 44-Pin PLCC
  - — CS62180A-IP 40-Pin Plastic Dip
  - — CS62180B-IL 44-Pin PLCC
  - — CS62180B-IP 40-Pin Plastic Dip

Applications

- **T1 line cards**
- **ISDN primary rate line cards**

The CS62180A and CS62180B are monolithic CMOS devices that encode/decode T1 framing formats. These devices support bit-seven and B8ZS zero suppression, and bit-robbed signaling. Clear channel mode can be selected on a per-channel basis.

The enhanced serial interface allows the CS62180A and CS62180B to share a chip select signal and register address space with the CS61535A, CS61574A, and CS61575 line interface units.



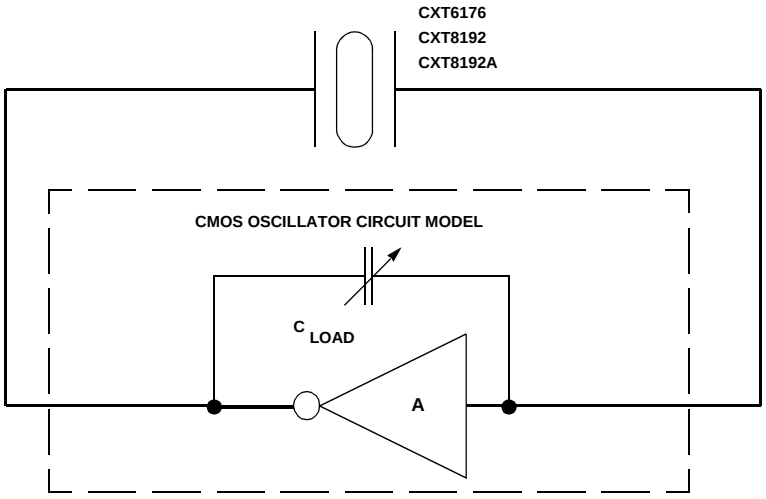
CXT6176/8192/8192A

Pullable Quartz Crystals

- **Provides jitter attenuation function for the following T1/E1 line interface units:**
  - CS61304A
  - CS61305A
  - CS61535A
  - CS61574A
  - CS61575
  - CS61577
- **Provides jitter attenuation function for the CS61600 jitter attenuator**
- **Ordering information** (described on pg.198)

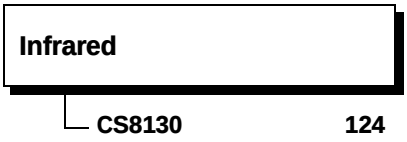
— CXT6176	HC-49
— CXT6176U	HC-49U/N
— CXT8192	HC-49
— CXT8192U	HC-49U/N
— CXT8192A	HC-49

The CXT6176 and CXT8192 pullable quartz crystals ensure proper jitter attenuation and frequency tolerance for line interface and jitter attenuator devices. The CXT6176 is designed for 1.544-MHz T1 applications. The CXT8192 is designed for 2.048-MHz E1 applications. The CXT8192A is a specialized tight-tolerance crystal that meets the TBR-12 jitter attenuation requirements for E1 applications when used with the CS61575, CS61304A, and CS61305A line interface devices.



Communications

Infrared



CS8130

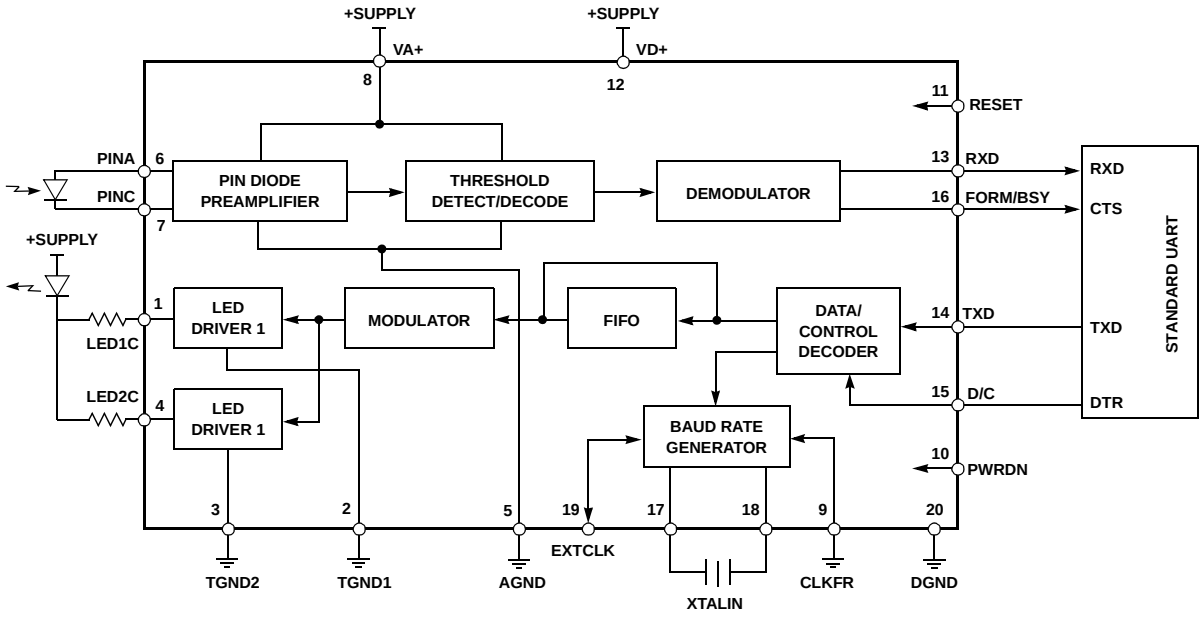
Multi-Standard Infrared Transceiver

- **Adds IR port to standard UART**
- **IrDA, HPSIR, ASK (CW), and TV remote compatible**
- **1200 bps to 115 kbps data rate**
- **Programmable transmit LED power**
- **Programmable receive threshold level**
- **Power-down mode**
- **Direct mode; no modulation**
- **Tiny 5 x 7 mm 20-pin SSOP package**
- **+2.7 V to +5.5 V supply**
- **Ordering information** (described on pg.198)
  — CS8130-CS 20-Pin SSOP

The CS8130 is a infrared transceiver integrated circuit. The receive channel includes on-chip high-gain PIN diode amplifier, IrDA, HPSIR, ASK, and TV remote compatible decoder, and data-pulse stretcher. The transmit path includes IrDA, HPSIR, ASK, and TV remote compatible encoder, and LED driver. The computer data port is standard UART TxD and RxD compatible, and operates from 1200 to 115200 baud.

An external PIN diode and transmit LED are required. A control mode is provided to allow easy UART programming of different modes.

The CS8130 operates from +2.7 V to +5.5 V power supplies.



Data Acquisition

Industrial Measurement A/D Converters

General-Purpose A/D Converters

Energy Measurement ICs

Geophysical Products

Imaging Products

Data Acquisition

Selection Table

Product Selection Specifications				Product
Industrial Measurement				
16 bit	ΔΣ ADC	Single Conversion Settling	Single channel	CS5507
				CS5509
				CS5529
			1-channel On-Chip PGIA	CS5525
			2-channel On-Chip PGIA	CS5521
			4-channel	CS5505
			4-channel On-Chip PGIA	CS5523
		Multiple Conversion Settling	Single channel	CS5501
				CS5510
				CS5511
			1-channel On-Chip PGIA	CS5516
			2-channel On-Chip PGIA	CS5531
			4-channel On-Chip PGIA	CS5533
20 bit	ΔΣ ADC	Single Conversion Settling	Single channel	CS5508
			1-channel On-Chip PGIA	CS5526
			2-channel	CS5504
			4-channel	CS5506
		Multiple Conversion Settling	Single channel	CS5503
				CS5512
				CS5513
			1-channel On-Chip PGIA	CS5520
22 bit	ΔΣ Modulator		2-channel	CS5542
	Digital Filter		8-channel	CS5543
24 bit	ΔΣ ADC	Single Conversion Settling On-Chip PGIA	2-channel	CS5522
			4-channel	CS5524
			8-channel	CS5528
		Multiple Conversion Settling	2-channel	CS5532
			4-channel	CS5534
General-purpose				
12 bit	SAR		100 kHz	CS5012A
14 bit	SAR		56 kHz	CS5014
16 bit	SAR		20 kHz	CS5102A
				CS5317
			50 kHz	CS5016
			100 kHz	CS5101A
				CS5126
	ΔΣ		8-400 kHz	CS5180
			400-625 kHz	CS5181

Selection Table *(cont.)*

Product Selection Specifications				Product
Geophysical				
24 bit	ΔΣ modulator			CS5320
				CS5321
				CS5372
	Filter			CS5322
				CS5376
Energy Measurement				
	ΔΣ ADC	Industrial 3-Phase	6-channel	CS5451
		Residential 1-Phase	2-channel	CS5460
		Residential 1-Phase	2-channel	CS5460A
		Application-Specific	2-channel	CS5471

Data Acquisition

Industrial Measurement A/D Converters

Industrial Measurement A/D Converters

Specification Table

Part	Resolution (bits)	Throughput	Integral Linearity (%FS)	Differential Linearity (±LSB)	Dynamic Range (dB)	Power Needed (mW)	Package
CS5501	16	4 kHz	0.0015%	0.125	-	25	20 PDIP, 20 SOIC
CS5503	20	4 kHz	0.0015%	NMC	-	25	
CS5504	20	20 - 200 Hz	0.0007%	NMC	-	4.4	
CS5505	16	20 - 100 Hz	0.0015%	0.25	-	3.2	24 PDIP, 24 SOIC
CS5506	20	20 - 100 Hz	0.0007%	NMC	-	3.2	
CS5507	16	20 - 100 Hz	0.0015%	0.25	-	3.2	20 PDIP, 20 SOIC
CS5508	20	20 - 100 Hz	0.0007%	NMC	-	3.2	
CS5509	16	20 - 200 Hz	0.0015%	0.25	-	1.7	16 PDIP, 16 SOIC
CS5510	16	53.5 - 212 Hz	0.0015%	NMC	-	1.5	8 SOIC
CS5511	16	100 Hz	0.0015%	NMC	-	1.5	
CS5512	20	53.5 - 326 Hz	0.0007%	NMC	-	2.0	
CS5513	20	100 Hz (typical)	0.0007%	NMC	-	2.0	
CS5516	16	60 Hz	0.0015%	0.25	-	40	24 PDIP, 24 SOIC
CS5520	20	60 Hz	0.0007%	NMC	-	40	
CS5521	16	1.88 - 400 Hz	0.0015%	NMC	-	5.5	20 PDIP, 20 SSOP
CS5522	24	1.88 - 606 Hz	0.0007%	NMC	-	5.5	
CS5523	16	1.88 - 400 Hz	0.0015%	NMC	-	5.5	24 PDIP, 24 SSOP
CS5524	24	1.88 - 606 Hz	0.0007%	NMC	-	5.5	
CS5525	16	3.75 - 606 Hz	0.0015%	NMC	-	4.0	20 PDIP, 20 SSOP
CS5526	20	3.75 - 606 Hz	0.0007%	NMC	-	4.0	
CS5528	24	1.88 - 606 Hz	0.0007%	NMC	-	5.5	24 PDIP, 24 SSOP
CS5529	16	1.88 - 303 Hz	0.0015%	NMC	-	2.5	20 PDIP, 20 SSOP
CS5531	16	7.5 - 3840 Hz	±0.0015%	NMC	-	25	
CS5532	24	7.5 - 3840 Hz	±0.0007%	NMC	-	45	
CS5533	16	7.5 - 3840 Hz	±0.007%	NMC	-	40	24 PDIP, 24 SSOP
CS5534	24	7.5 - 3840 Hz	±0.007%	NMC	-	45	24 PDIP, 24 SSOP
CS5542	22	1 kHz	0.001%	0.5	113	80	28 PLCC
CS5543	22	1 kHz	0.001%	0.5	113	75	44 PLCC

CS5501/03

Non-Aliasing, 16-Bit/20-Bit Measurement A/D Converters

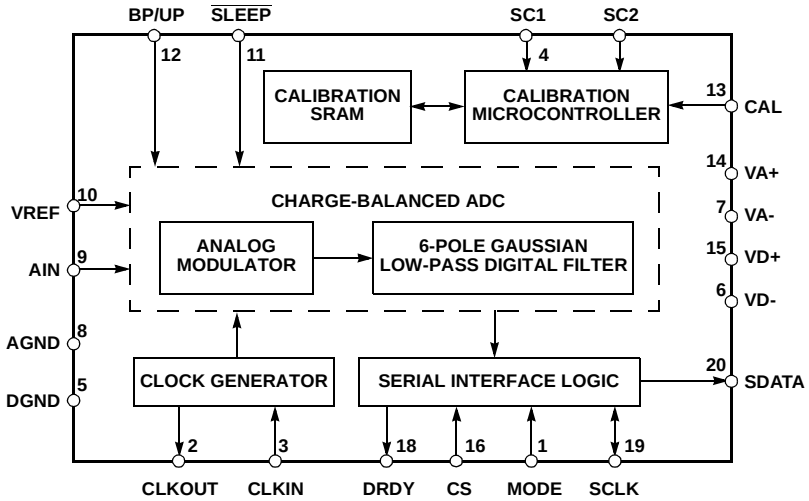
- **Monolithic CMOS ADCs with 6-pole, low-pass gaussian filter (-3 dB @ 10 Hz)**
- **Up to 4-kHz output word rates**
- **On-chip self-calibration circuitry**
  - — Linearity error: ±0.0003%
  - — Differential nonlinearity: CS5501: 16-bit no missing codes (DNL ±1/8 LSB) CS5503: 20-bit no missing codes
- **System calibration capability**
- **Flexible serial communications port**
  - — µC-compatible formats
  - — Tristate data and clock outputs
  - — UART format (CS5501 only)
- **Pin-selectable unipolar/bipolar ranges**
- **Low power consumption: 25 mW**
  - — 10 µW sleep mode for portable applications
- **Ordering information** (described on pg.198)
  - — Available in 20-pin SOIC and PDIP packages
  - — For more information, refer to the datasheet located on the CD-ROM, at www.cirrus.com, or contact your local sales representative.

The CS5501 and CS5503 are CMOS ADCs ideal for measuring low-frequency signals representing physical, chemical, and biological processes. They utilize charge-balance techniques to achieve 16-bit (CS5501) and 20-bit (CS5503) performance with up to 4 kHz word rates at very low cost.

The converters continuously sample at a rate set by the user in the form of either a CMOS clock or a crystal. On-chip digital filtering processes the data and updates the output register at up to a 4 kHz rate. The converters' low-pass, 6-pole Gaussian response filter is designed to allow corner frequency settings from 0.1 Hz to 10 Hz in the CS5501 and 0.5 Hz to 10 Hz in the CS5503. Thus, each converter rejects 50 Hz and 60 Hz line frequencies as well as any noise at spurious frequencies.

Both devices include on-chip self-calibration circuitry that can be initiated at any time or temperature to ensure offset and full-scale errors of typically less than 1/2 LSB for the CS5501 and less than 4 LSB for the CS5503. The devices can also be applied in system calibration schemes to null offset and gain errors in the input channel.

Each device's serial port offers two general-purpose modes of operation for direct interface to shift registers or synchronous serial ports of industry-standard micro-controllers. In addition, the CS5501's serial port offers a third, UART-compatible mode of asynchronous communication.



CS5504

Low-Power, 20-Bit A/D Converter

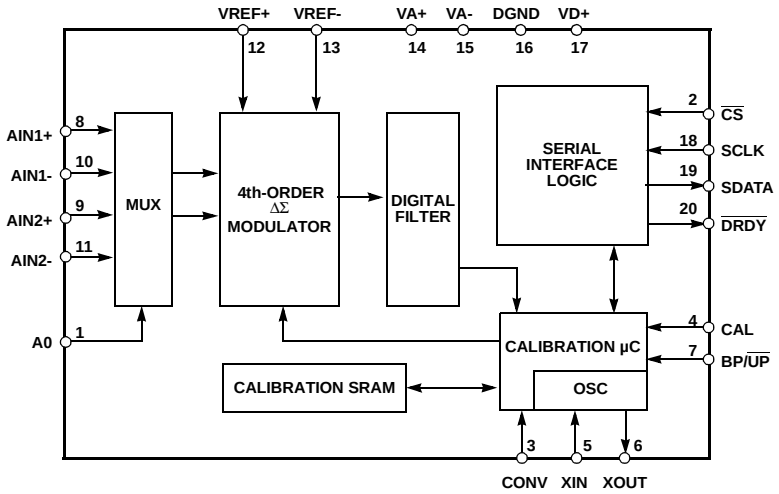
- **Delta-sigma (ΔΣ) ADC**
  - — 20-bit no missing codes
  - — Linearity error: ±0.0007% FS
- **Two differential inputs**
  - — Pin-selectable unipolar/bipolar ranges
  - — Common mode rejection
    105 dB at dc
    120 dB at 50, 60 Hz
- **Either 5 V or 3.3 V digital interface**
- **On-chip self-calibration circuitry**
- **Output update word rates up to 200 per second**
- **Low power consumption: 4.4 mW**
- **Ordering information** (described on pg.198)
  - — CS5504-BP 20-Pin PDIP
  - — CS5504-BS 20-Pin SOIC

The CS5504 is a 2-channel, fully differential 20-bit, serial-output CMOS ADC. The CS5504 uses charge-balanced ΔΣ techniques to provide a low-cost, high-resolution measurement at output word rates up to 200 samples per second.

The on-chip digital filter offers superior line rejection at 50 Hz and 60 Hz when the device is operated from a 32.768 kHz clock (output word rate = 20 Hz).

The CS5504 has on-chip self-calibration circuitry which can be initiated at any time or temperature to ensure minimum offset and full-scale errors.

Low power, high resolution, and small package size make the CS5504 an ideal solution for loop-powered transmitters, panel meters, weigh scales and battery-powered instruments.



CS5505/06/07/08

Very-Low-Power, 16-Bit/20-Bit A/D Converters

- **Very low power consumption**
  - — Single-supply +5 V operation: 1.7 mW
  - — Dual-supply ±5 V operation: 3.2 mW
- **Offers superior performance to VFCs and multi-slope integrating ADCs**
- **Differential inputs**
  - — Single-channel (CS5507/08) and
  - — Four-channel (CS5505/06)
  - — Pseudo-differential versions
- **Either 5 V or 3.3 V digital interface**
- **Linearity error**
  - — ±0.0015% FS (16-bit CS5505/07)
  - — ±0.0007% FS (20-bit CS5506/08)
- **Output update rates up to 100 per second**
- **Flexible serial port**
- **Pin-selectable unipolar/bipolar ranges**
- **Ordering information** (described on pg.198)

— CS5505-AP	24-Pin 0.3” Plastic DIP
— CS5505-AS	24-Pin 0.3” SOIC
— CS5506-BP	24-Pin 0.3” Plastic DIP
— CS5506-BS	24-Pin 0.3” SOIC
— CS5507-AP	20-Pin 0.3” Plastic DIP
— CS5507-AS	20-Pin 0.3” SOIC
— CS5507-SD	20-Pin 0.3” CerDIP
— CS5508-BP	20-Pin 0.3” Plastic DIP
— CS5508-BS	20-Pin 0.3” SOIC
— CS5509-SD	20-Pin 0.3” CerDIP

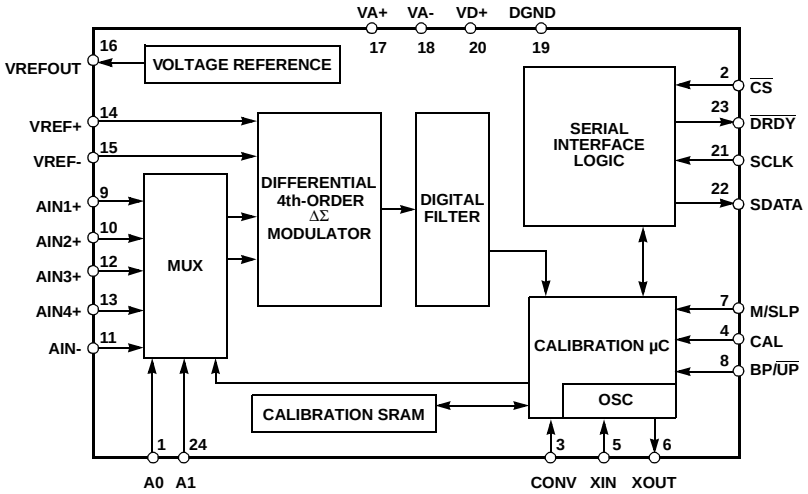
The CS5505/06/07/08 family of low-power CMOS ADCs are ideal for measuring low-frequency signals representing physical, chemical, and biological processes.

The CS5507/08 have single-channel differential analog and reference inputs while the CS5505/06 have four pseudo-differential analog input channels. The CS5505/06/07/08 have a 16-bit output word. The CS5506/08 have a 20-bit output word. The CS5505/06/07/08 sample upon command up to 100 output updates per second.

The on-chip digital filter offers superior line rejection at 50 and 60 Hz when the device is operated from a 32.768 kHz clock (output word rate = 20 Hz).

The CS5505/06/07/08 include on-chip self-calibration circuitry that can be initiated at any time or temperature to ensure minimum offset and full-scale errors.

The CS5505/06/07/08 serial port offers two general-purpose modes for the direct interface to shift registers or synchronous serial ports of industry-standard microcontrollers.



CS5505 (16-BIT) AND CS5506 (20-BIT) SHOWN

CS5509

Single-Supply, 16-Bit A/D Converter

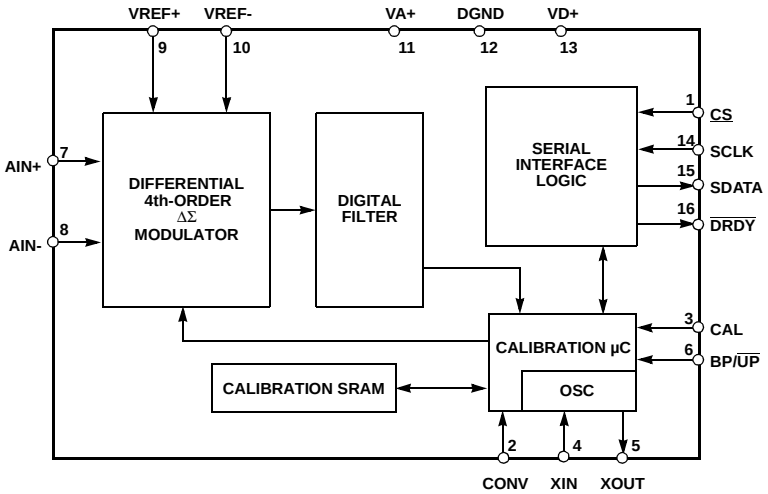
- **Delta-sigma (ΔΣ) ADC**
  - 16-bit no missing codes
  - Linearity error: ±0.0015% FS
- **Differential input**
  - Pin-selectable unipolar/bipolar ranges
  - Common mode rejection
    105 dB at dc
    120 dB at 50, 60 Hz
- **Either 5 V or 3.3 V digital interface**
- **On-chip self-calibration circuitry**
- **Output update word rates up to 200 per second**
- **Ultra low power: 1.7 mW**
- **Ordering information** (described on pg.198)
  - CS5509-AS 16-Pin PDIP
  - CS5509-AS 16-Pin SOIC

The CS5509 is a single-supply, 16-bit, serial-output CMOS ADC. The CS5509 uses charge-balanced ΔΣ techniques to provide a low-cost, high-resolution measurement at output word rates up to 200 samples per second.

The on-chip digital filter offers superior line rejection at 50 Hz and 60 Hz when the device is operated from a 32.768 kHz clock (output word rate = 20 Hz).

The CS5509 has on-chip self-calibration circuitry that can be initiated at any time or temperature to ensure minimum offset and full-scale errors.

Low power, high resolution and small package size make the CS5509 an ideal solution for loop-powered transmitters, panel meters, weigh scales and battery-powered instruments.



CS5510/11/12/13

16 and 20-Bit, 8-Pin ΔΣ ADC

- **Delta-sigma (ΔΣ) analog-to-digital converter**
  - — Linearity error: 0.0015% FS
  - — Noise-free resolution: up to 17-Bits
  - — Differential bipolar analog inputs
  - — V_{REF} input range from 250 mV to 5 V
  - — 50/60 Hz simultaneous rejection (CS5510/12)
  - — 16 to 326 Hz output word rate
  - — On-chip oscillator (CS5511/13)
  - — Power supply configurations:
  - — V+ = 5 V, V- = 0 V
  - — Multiple dual supply arrangements
- **Low power consumption**
  - — Normal mode, 2.5 mW
  - — Sleep mode, 10 μW
- **Low-cost, compact, 8-pin package**
- **Ordering information** (described on pg.198)

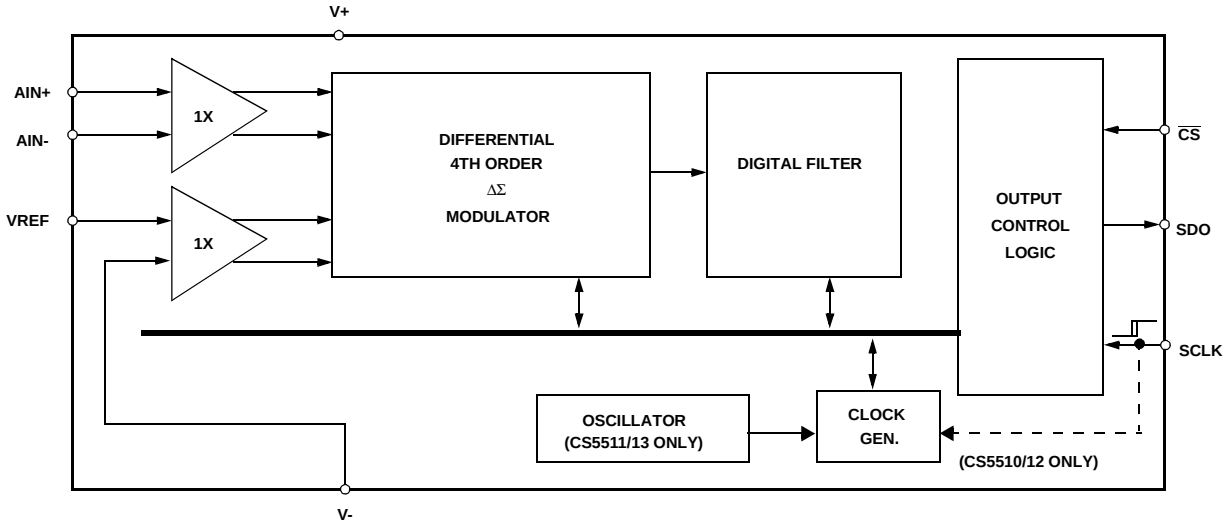
— CS5510-AS	8-Pin 0.209" SOIC
— CS5511-AS	8-Pin 0.209" SOIC
— CS5512-BS	8-Pin 0.209" SOIC
— CS5513-BS	8-Pin 0.209" SOIC

The 16-bit CS5510/11 and the 20-bit CS5512/13 are low-cost, easy-to-use, DC measurement, ΔΣ, Analog-to-Digital Converters (ADCs) that are available in space efficient 8-pin SOIC packages. The ADCs include a fourth order ΔΣ modulator and a digital filter. The filter in the CS5510/12 simultaneously rejects both 50 and 60 Hz line noise, provides better than 80 dB of rejection between 47 Hz to 63 Hz, and outputs conversion words at 53.5 Hz (SCLK = 32.768 kHz). The CS5511/13 include an on-chip oscillator which eliminates the need for an external clock source.

The CS5510/11/12/13 ADCs are designed to operate from a single +5 V supply or various dual supply configurations and are optimized to digitize bipolar signals in industrial applications.

Low power, a compact pinout, and ease of use make these products ideal solutions for isolated and non-isolated applications.

NEW



CS5516/20

16-Bit/20-Bit Bridge Transducer A/D Converters

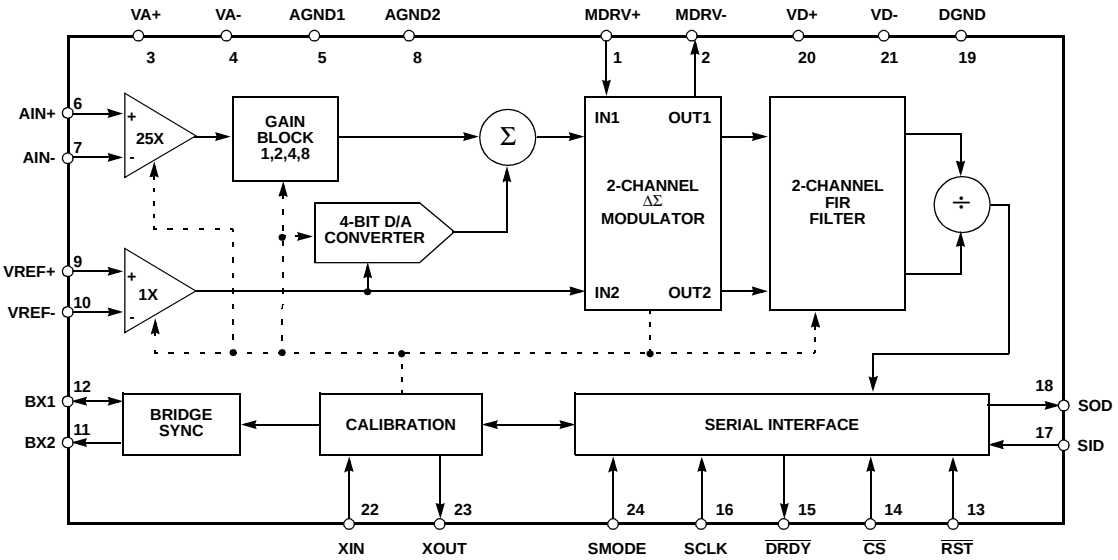
- **On-chip instrumentation amplifier**
- **On-chip programmable gain amplifier**
- **On-chip 4-bit D/A for offset removal**
- **Dynamic excitation options**
- **Linearity error: 0.0015% FS 20-bit no missing codes**
- **CMRR at 50/60 Hz >200 dB**
- **System calibration capability with calibration read/write option**
- **3-, 4-, or 5-wire serial communications port**
- **Low power consumption: 40 mW (10 μW standby mode for portable applications)**
- **Ordering information** (described on pg.198)
  - — CS5516-AP 24-Pin 0.3" PDIP
  - — CS5516-AS 24-Pin 0.3" SOIC
  - — CS5520-BP 24-Pin 0.3" PDIP
  - — CS5520-BS 24-Pin 0.3" SOIC

The CS5516 and CS5520 are complete solutions for digitizing low-level signals from strain gauges, load cells, and pressure transducers. Any family of mV-output transducers, including those requiring bridge excitation, can be interfaced directly to the CS5516 or CS5520. The devices offer an on-chip software-programmable instrumentation amplifier block, choice of DC or AC bridge excitation, and software-selectable reference and signal demodulation.

The CS5516 uses ΔΣ modulation to achieve 16-bit resolution at output word rates up to 60 Hz. The CS5520 achieves 20-bit resolution at word rates up to 60 Hz.

The CS5516 and CS5520 sample at a rate set by the user in the form of either an external CMOS clock or a crystal. On-chip digital filtering provides rejection of all frequencies above 12 Hz for a 4.096 MHz clock.

The CS5516 and CS5520 include system calibration to null offset and gain errors in the input channel. The digital values associated with the system calibration can be written to, or read from, the calibration RAM locations at any time via the serial communications port. The 4-bit DC offset DAC, in conjunction with digital correction, is initially used to zero the input offset value.



CS5521/23

2- or 4-Channel 16-Bit Buffered ΔΣ Multi-Range ADC

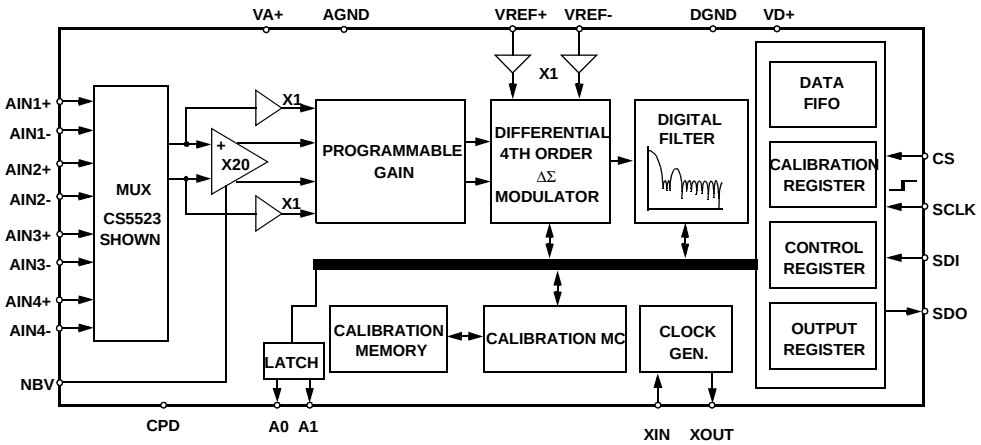
- **Delta-sigma (ΔΣ) A/D converter**
  - — Linearity error: 0.0015% FS
- **Buffered bipolar/unipolar input ranges**
  - — 25 mV, 55 mV, 100 mV, 1 V, 2.5 V and 5 V
- **Chopper stabilized instrumentation amplifier**
- **On-chip charge pump drive circuitry**
- **Differential multiplexer**
- **Conversion data FIFO**
- **Programmable/auto channel sequencer**
- **2-bit output latch**
- **Simple three-wire serial interface**
  - — SPI™ and Microwire™ Compatible
  - — Schmitt Trigger on Serial Clock (SCLK)
- **Output settles in one conversion cycle**
- **50/60 Hz ±3 Hz simultaneous rejection**
- **Buffered V_{REF} with +5 V input capability**
- **System and self-calibration with R/W registers per channel**
- **Single +5 V analog supply +3.0 V or +5 V digital supply**
- **Power consumption: 5.5 mW - 1.8 mW in 1 V, 2.5 V and 5 V input ranges**
- **Ordering information** (described on pg.198)
  - — CS5521-AP 20-Pin 0.3” Skinny PDIP
  - — CS5521-AS 20-Pin 0.2” SSOP
  - — CS5523-AP 24-Pin 0.3” Skinny PDIP
  - — CS5523-AS 24-Pin 0.2” SSOP

The 16-bit CS5521/23 are highly integrated ΔΣ A/D converters which include an instrumentation amplifier, a PGA (programmable gain amplifier), a multi-channel multiplexer, digital filters, and self- and system-calibration circuitry.

The chips are designed to provide their own negative supply which enables their on-chip instrumentation amplifiers to measure bipolar ground-referenced signals less-than or equal to ±100 mV.

The digital filters provide programmable output update rates of 1.88 Hz, 3.76 Hz, 7.51 Hz, 15 Hz, 30 Hz, 61.6 Hz, 84.5 Hz, and 101.1 Hz when operating from a 32 kHz crystal. The CS5521/23 are capable of producing output update rates up to 394 Hz with a 130 kHz clock. The filters are designed to settle to full accuracy for the selected output update rate within one conversion cycle. When operated at word rates of 15 Hz or less, the digital filters reject both 50 and 60 Hz line interference ±3 Hz simultaneously.

Low-power, single-conversion settling time, programmable output rates, and the ability to handle negative input signals make these single supply products ideal solutions for isolated and non-isolated applications.



CS5522/24/28

2-, 4-, or 8-Channel, 24-Bit Buffered ΔΣ Multi-Range ADC

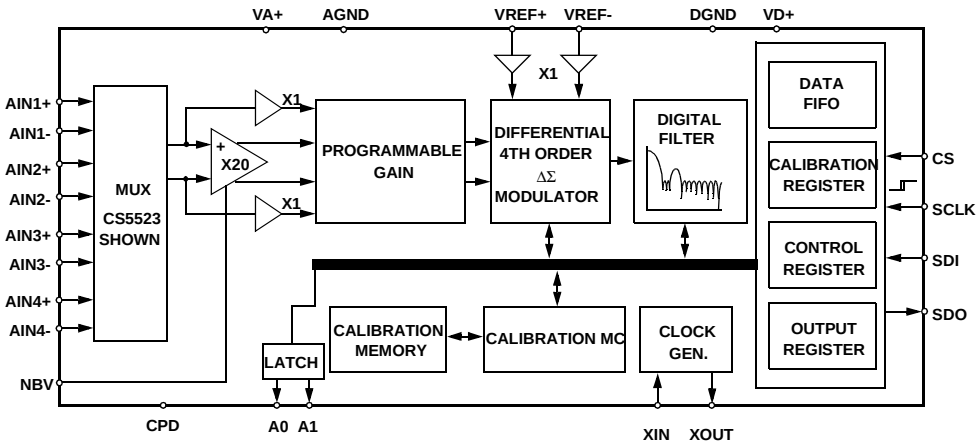
- **Delta-sigma (ΔΣ) A/D converter**
  - — Linearity error: 0.0007% FS
  - — Noise-free resolution: 18-bits
- **Buffered bipolar/unipolar input ranges**
  - — 25 mV, 55 mV, 100 mV, 1 V, 2.5 V and 5 V
- **Chopper stabilized instrumentation amplifier**
- **On-chip charge pump drive circuitry**
- **Multiplexer**
- **Conversion data FIFO**
- **Programmable/auto channel sequencer**
- **2-bit output latch**
- **Simple three-wire serial interface**
  - — SPI™ and Microwire™ Compatible
  - — Schmitt Trigger on Serial Clock (SCLK)
- **Output settles in one conversion cycle**
- **50/60 Hz ±3 Hz simultaneous rejection**
- **Buffered V_{REF} with +5 V input capability**
- **System and self-calibration with R/W registers per channel**
- **Single +5 V analog supply +3.0 V or +5 V digital supply**
- **Low power mode consumption: 5.5 mW**
- **Ordering information** (described on pg.198)
  - — CS5522-AP 20-Pin 0.3” Skinny PDIP
  - — CS5522-AS 20-Pin 0.2” SSOP
  - — CS5524-AP 24-Pin 0.3” Skinny PDIP
  - — CS5524-AS 24-Pin 0.2” SSOP
  - — CS5528-AP 24-Pin 0.3” Skinny PDIP
  - — CS5528-AS 24-Pin 0.2” SSOP

The 24-bit CS5522/24/28 are highly integrated ΔΣ A/D converters which include an instrumentation amplifier, a PGA (programmable gain amplifier), a multi-channel multiplexer, digital filters, and self and system calibration circuitry.

The chips are designed to provide their own negative supply which enables their on-chip instrumentation amplifiers to measure bipolar ground-referenced signals less-than or equal to ±100 mV.

The digital filters provide programmable output update rates of 1.88 Hz, 3.76 Hz, 7.51 Hz, 15 Hz, 30 Hz, 61.6 Hz, 84.5 Hz, and 101.1 Hz when operating from a 32 kHz crystal. The CS5522/24/28 are capable of producing output update rates up to 606 Hz with a 200 kHz clock. The filters are designed to settle to full accuracy for the selected output update rate within one conversion cycle. When operated at word rates of 15 Hz or less, the digital filters reject both 50 and 60 Hz line interference ±3 Hz simultaneously.

Low-power, single-conversion settling time, programmable output rates, and the ability to handle negative input signals make these single supply products ideal solutions for isolated and non-isolated applications.



CS5525/26

16-Bit/20-Bit Multi-Range A/D Converters with 4-Bit Latch

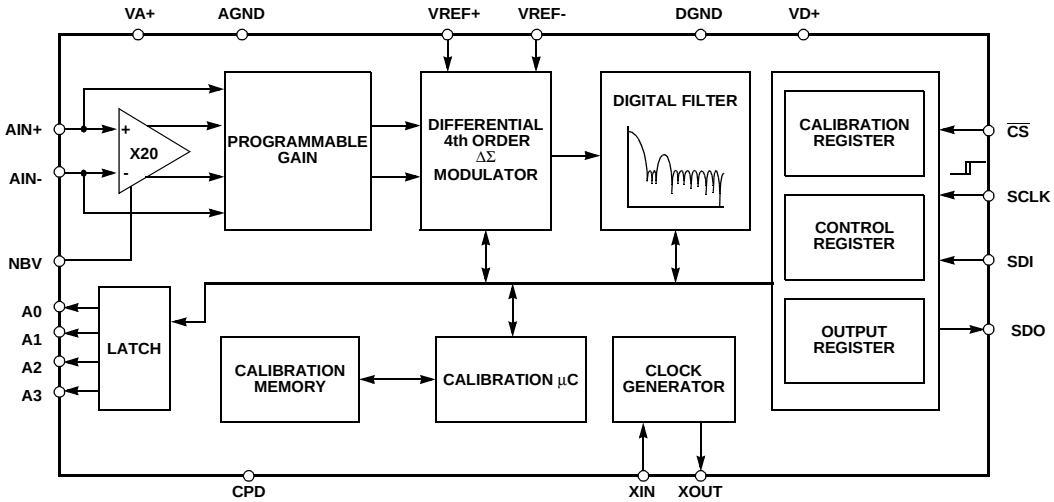
- **Delta-sigma (ΔΣ) ADCs**
  - — Linearity error: 0.0015% / 0.0007% FS
  - — Noise-free resolution: 18-bits
- **Bipolar/unipolar input ranges**
  - — 25 mV, 55 mV, 100 mV, 1 V, 2.5 V, and 5 V
- **Chopper-stabilized instrumentation amplifier**
  - — 100 pA input/leakage current
- **On-chip charge pump drive circuitry**
- **4-bit output latch**
- **Simple three-wire serial interface**
  - — SPI™ and Microwire™ compatible
  - — Schmitt Trigger on serial clock (SCLK)
- **Output settles in one conversion cycle**
- **System and self-calibration with read/write registers**
- **Single +5 V analog supply**
  +3.0 V or +5 V digital supply
- **Low power mode consumption: 4 mW**
  - — 1.8 mW in 1 V, 2.5 V, and 5 V input ranges
- **Ordering information** (described on pg.198)
  - — CS5525-AP 20-Pin 0.3” PDIP
  - — CS5525-AS 20-Pin 0.2” SSOP
  - — CS5526-BP 20-Pin 0.3” PDIP
  - — CS5526-BS 20-Pin 0.2” SSOP

The 16-bit CS5525 and the 20-bit CS5526 are highly integrated ΔΣ ADCs that include an instrumentation amplifier, a PGA (programmable gain amplifier), a digital filter, and self- and system-calibration circuitry.

The chip is designed to provide its own negative supply that allows the on-chip instrumentation amplifier to measure bipolar ground-referenced signals ≤±100 mV. By directly supplying NBV with -2.5 V and with VA+ at 5 V, ±2.5-V signals (with respect to ground) can be measured.

The digital filter is programmable with output update rates between 3.76 Hz to 202 Hz (XIN = 32.768 kHz). Output word rates can be increased by approximately 3x by using XIN = 100 kHz. The filter is designed to settle to full accuracy for the selected output update rate in one conversion cycle. When operated at word rates of 15 Hz or less (XIN = 32.768 kHz), the filter rejects both 50 Hz ±3 Hz, and 60 Hz ±3 Hz simultaneously.

Low-power, single-conversion settling time, programmable output rates, and the ability to handle negative input signals make this single supply product an ideal solution for isolated and non-isolated applications.



CS5529

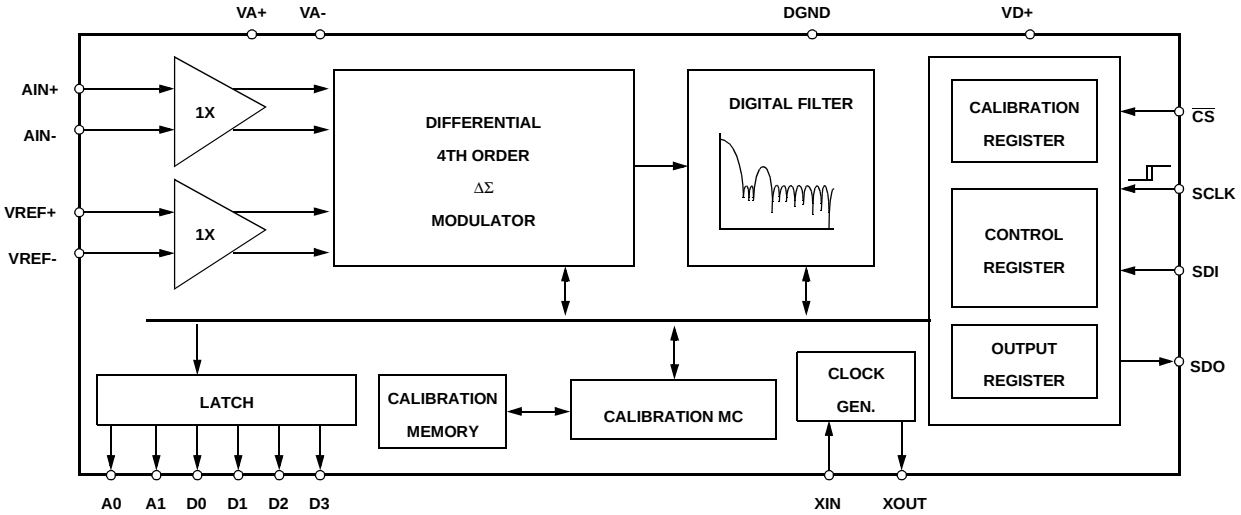
16-Bit, Programmable ΔΣ ADC with 6-Bit Latch

- **Delta-sigma (ΔΣ) analog-to-digital converter**
  - — Linearity error: 0.0015% FS
  - — Noise free resolution: 16-Bits
- **2.5 V bipolar/unipolar buffered input range**
- **6-bit output latch**
- **Eight digital filters**
  - — Selectable output word rates
  - — Output settles in one conversion cycle
  - — 50/60 Hz ±3 Hz simultaneous rejection
- **Simple three-wire serial interface**
  - — SPI™ and Microwire™ Compatible
  - — Schmitt Trigger on Serial Clock (SCLK)
- **System/self-calibration with R/W registers**
- **Power supply configurations**
  - — VA+ = +5 V; VA- = 0 V; VD+ = +3 V to +5 V
  - — VA+ = +2.5 V; VA- = -2.5 V; VD+ = +3 V to +5 V
- **Low power consumption: 2.5 mW**
- **Ordering information** (described on pg.198)
  - — CS5529-AP 20-Pin 0.3" PDIP
  - — CS5529-AS 20-Pin 0.2" SSOP

The 16-bit CS5529 is a low-power programmable ΔΣ Analog-to-Digital Converter (ADC) which includes coarse/fine charge buffers, a fourth order ΔΣ modulator, a calibration microcontroller, a digital filter with programmable decimation rates, a 6-bit output latch, and a three-wire serial interface. The ADC is designed to operate from single or dual analog supplies and a single digital supply.

The digital filter is programmable with output update rates between 1.88 Hz to 101 Hz. These output rates are specified for XIN = 32.768 kHz. Output word rates can be increased by approximately 3X by using XIN = 100 kHz. The filter is designed to settle to full accuracy for the selected output word rate in one conversion. When operated at word rates of 15 Hz or less, the filter rejects both 50 Hz and 60 Hz simultaneously.

Low-power, single-conversion settling time, programmable output rates, and the ability to handle negative input signals make this single or dual supply product an ideal solution for isolated and non-isolated applications.



CS5531/32/33/34

16-Bit and 24-Bit ADCs with Ultra Low Noise PGIA

- **Chopper-stabilized PGIA (programmable gain instrumentation amplifier, 1x to 64x)**
  - — 6 nV/√Hz @ 0.1 Hz (No 1/f noise)
  - — <500 pA input current with gains >1
- **Delta sigma (ΔΣ) analog-to-digital converter**
  - — Linearity error: 0.0007% FS
  - — Noise-free resolution: Up to 23 bits
- **Two or four channel differential MUX**
- **Scalable input span via calibration**
  - — 5 mV to 5 V
- **Scalable V_{REF} input: up to analog supply**
- **On-chip guard drive output buffer**
- **Simple three-wire serial interface**
  - — SPI® and Microwire™ Compatible
  - — Schmitt Trigger on Serial Clock (SCLK)
- **R/W calibration registers per channel**
- **Selectable word rates: 7.5 Hz to 3,840 Hz**
- **Power supply configurations**
  - — VA+ = +5 V; VA- = 0 V; VD+ = +3 V to +5 V
  - — VA+ = +2.5 V; VA- = -2.5 V; VD+ = +3 V to +5 V
  - — VA+ = +3 V; VA- = -3 V; VD+ = +3 V
- **Ordering information** (described on pg.198)

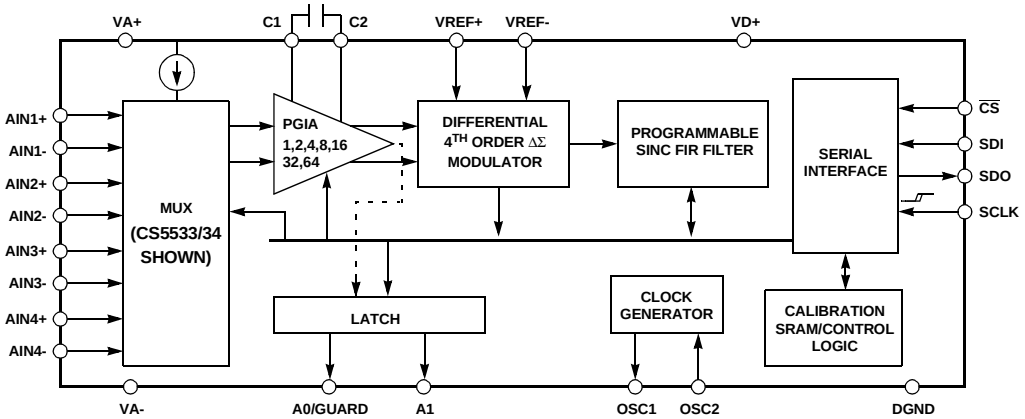
— CS5531-AS	20-pin 0.2" Plastic SSOP
— CS5533-AS	24-pin 0.2" Plastic SSOP
— CS5532-AS	20-pin 0.2" Plastic SSOP
— CS5532-BS	20-pin 0.2" Plastic SSOP
— CS5534-AS	24-pin 0.2" Plastic SSOP
— CS5534-BS	24-pin 0.2" Plastic SSOP

The CS5531/32/33/34 are highly integrated ΔΣ Analog-to-Digital Converters (ADCs) which use charge-balance techniques to achieve 16-bit (CS5531/33) and 24-bit (CS5532/34) performance. The ADCs are optimized for measuring low-level unipolar or bipolar signals in weigh scale, process control, scientific, and medical applications.

To accommodate these applications, the ADCs come as either two-channel (CS5531/32) or four-channel (CS5533/34) devices and include a very low-noise chopper-stabilized instrumentation amplifier (6 nV/√Hz @ 0.1 Hz) with selectable gains of 1×, 2×, 4×, 8×, 16×, 32×, and 64×. These ADCs also include a fourth order ΔΣ modulator followed by a digital filter which provides ten selectable output word rates of 7.5 Hz, 15 Hz, 30 Hz, 60 Hz, 120 Hz, 240 Hz, 480 Hz, 960 Hz, 1.92 kHz, and 3.84 kHz (MCLK = 4.9152 MHz).

To ease communication between the ADCs and a micro-controller, the converters include a simple three-wire serial interface which is SPI™ and Microwire™ compatible with a Schmitt Trigger input on the serial clock (SCLK).

High dynamic range, programmable output rates, and flexible power supply options makes these ADCs ideal solutions for weigh scale and process control applications.



CS5542/43

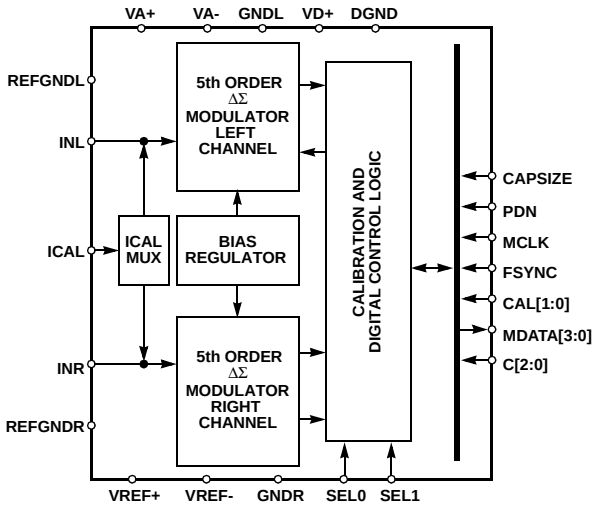
22-Bit, Multi-Channel ΔΣ A/D Converter Chipset

- **Delta-sigma (ΔΣ) architecture:**
  - — 5th-order modulator
  - — 22-bit resolution
- **DC accuracy (f_{BW} = 250 Hz):**
  - — Integral linearity: ±0.001% FS
  - — Differential linearity: ±0.5 LSBs
  - — RMS noise: 1.1 pA_{RMS}
- **Pin-selectable input range:**
  - — ±400 nA to ±2.5 μA full scale
- **8-channel digital FIR filter**
- **Self-calibration of offset and gain**
- **Low power: 50 mW per channel for 8-channel system**
- **Ordering information** (described on pg.198)
  - — CS5542-KL 28-Pin PLCC
  - — CS5543-KL 28-Pin PLCC

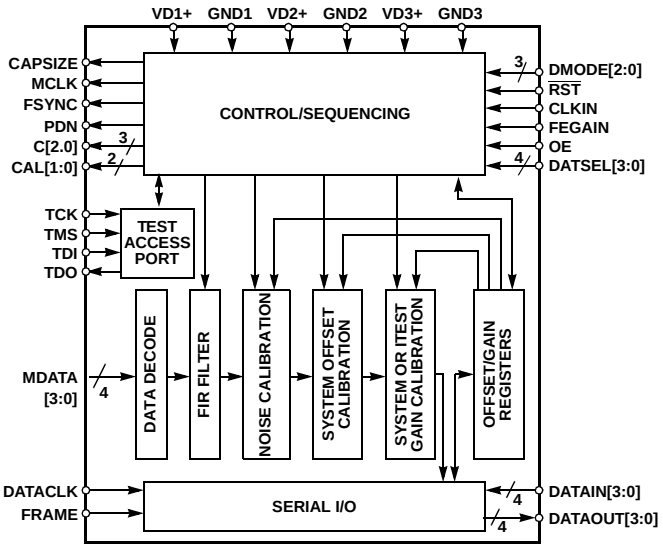
The CS5542/43 chipset is designed to be a complete current measurement data acquisition system. The CS5542 is a 22-bit, 2-channel, 5th-order ΔΣ modulator. The CS5543 is a monolithic CMOS, 8-channel digital FIR filter designed to be used with up to four CS5542s forming an 8-channel system. The complete system is capable of cascading up to 1024 channels.

The system supports 22-bit measurement resolution with output conversion rates up to 1 kHz per channel. JTAG boundary-scan capability is available to facilitate self-test at the system level.

Typical applications for the CS5542/43 system are environmental monitoring, process control systems, color sensing, light measurement, chemical analyzers, and photo-diode transducer applications.



CS5542



CS5543

Data Acquisition

General-Purpose A/D Converters

General-Purpose A/D Converters

Specification Table

Part	Resolution (bits)	Throughput (kHz)	Integral Linearity (%FS)	Differential Linearity (±LSB)	Dynamic Range (dB)	Power Needed (mW)	Package
CS5012A	12	100 kHz	0.006%	0.25	73	150	40 PDIP, 40 PLCC, 40 LCC
CS5014	14	56 kHz	0.002%	0.25	83	150	
CS5016	16	50 kHz	0.001%	NMC	92	150	
CS5101A	16	100 kHz	0.0015%	NMC	92	280	28 PDIP, 28 PLCC, 28 LCC
CS5102A	16	20 kHz	0.0015%	NMC	92	44	
CS5126	16	100 kHz	0.0015%	NMC	92	280	
CS5180	16	8 to 400 kHz	±2 LSB	±0.5	96	300	28 PLCC
CS5181	16	625 KHz	±2 LSB	±0.5	96	400	
CS5317	16	20 kHz	-	NMC	84	220	18 PDIP, 20 SOIC

CS5012A/14/16

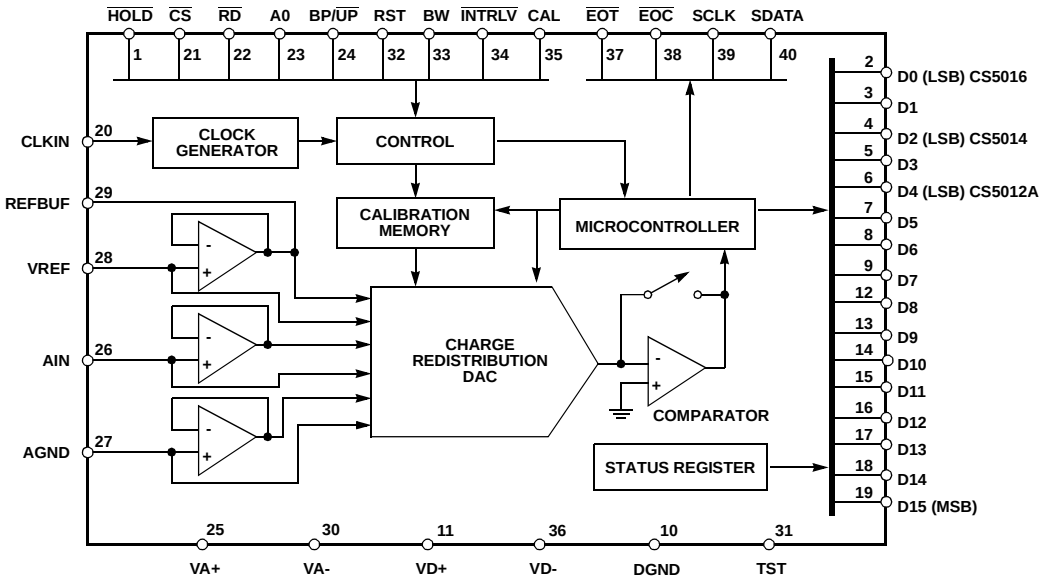
12-, 14-, and 16-Bit, Self-Calibrating A/D Converters

- **Monolithic CMOS ADCs**
  - — Microprocessor compatible
  - — Parallel and serial output
  - — Inherent track/hold input
- **True 12-, 14-, and 16-bit precision**
- **Conversion times:**
  - — CS5016 16.25 µs
  - — CS5014 14.25 µs
  - — CS5012A 7.20 µs
- **Self-calibration maintains accuracy over time and temperature**
- **Low power dissipation: 150 mW**
- **Low distortion**
- **Ordering information** (described on pg.198)
  - — Available in 40/44-pin PLCC and PDIP packages
  - — For more information, refer to the datasheet located on the CD-ROM, at www.cirrus.com, or contact your local sales representative.

The CS5012A/14/16 are 12-, 14-, and 16-bit monolithic ADCs with conversion times of 7.2 µs, 14.25 µs and 16.25 µs. Unique self-calibration circuitry insures excellent linearity and differential non-linearity, with no missing codes. Offset and full-scale errors are kept within 1/2 LSB (CS5012A/14) and 1 LSB (CS5016), eliminating the need for calibration. Unipolar and bipolar input ranges are digitally selectable.

The pin-compatible CS5012A/14/16 consist of a DAC, conversion and calibration microcontroller, oscillator, comparator, microprocessor compatible tri-state I/O, and calibration circuitry. The input track-and-hold, inherent to the devices' sampling architecture, acquires the input signal after each conversion using a fast slewing on-chip buffer amplifier. This allows throughput rates up to 100 kHz (CS5012A), 56 kHz (CS5014), and 50 kHz (CS5016).

An evaluation board (CDB5012/14/16) is available, which allows fast evaluation of ADC performance.



CS5101A/02A

16-Bit, 100/20-kHz A/D Converters

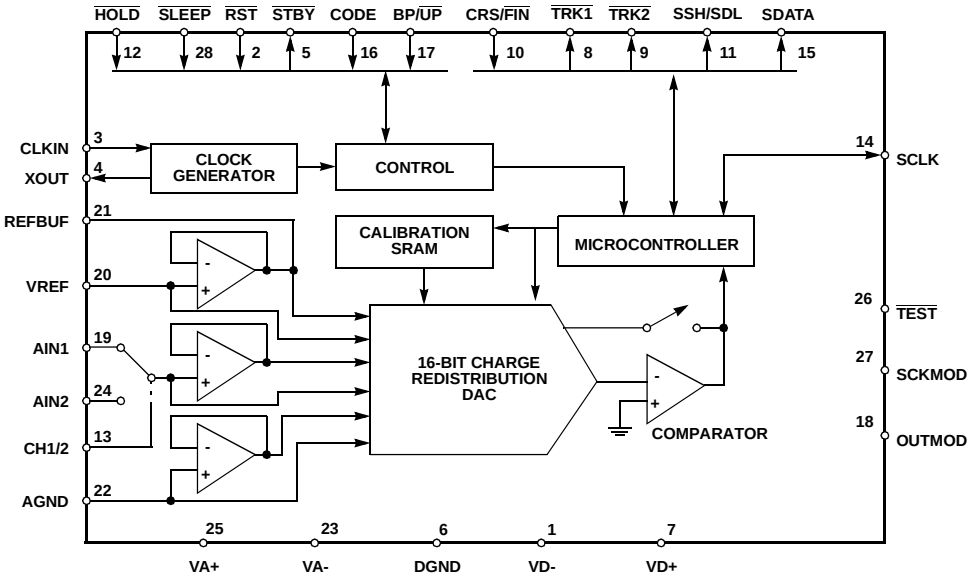
- **Monolithic CMOS ADCs**
  - — Inherent sampling architecture
  - — 2-channel input multiplexer
  - — Flexible serial output port
- **Ultra-low distortion**
  - — S/(N+D): 92 dB
  - — THD: 0.001%
- **Conversion time**
  - — CS5101A: 8 µs
  - — CS5102A: 40 µs
- **Linearity error: ±0.001% FS**
  - — Guaranteed no missing codes
- **Self-calibration maintains accuracy**
  - — Over time and temperature
- **Low power consumption**
  - — CS5101A: 320 mW
  - — CS5102A: 44 mW
  - — Power-down mode: < 1 mW
- **Ordering information** (described on pg.198)
  - — Available in 28-pin PLCC and PDIP packages
  - — For more information, refer to the datasheet located on the CD-ROM, at www.cirrus.com, or contact your local sales representative.

The CS5101A and CS5102A are 16-bit monolithic CMOS ADCs capable of 100 kHz (CS5101A) and 20 kHz (CS5102A) throughput. The CS5102A's low power consumption of 44 mW, coupled with a power-down mode, makes it particularly suitable for battery-powered operation.

On-chip self-calibration circuitry achieves nonlinearity of ±0.001% of FS and guarantees 16-bit no missing codes over the entire specified temperature range. Superior linearity also leads to 92 dB S/(N+D) with harmonics below -100 dB. Offset and full-scale errors are minimized during the calibration cycle, eliminating the need for external trimming.

The CS5101A and CS5102A each consist of a 2-channel input multiplexer, DAC, conversion and calibration microcontroller, clock generator, comparator, and serial communications port. The inherent sampling architecture of the device eliminates the need for an external track and hold amplifier.

The converters' 16-bit data output is in serial form with either binary or two's complement coding. Three output timing modes are available for easy interfacing to microcontrollers and shift registers. Unipolar and bipolar input ranges are digitally selectable.



CS5126

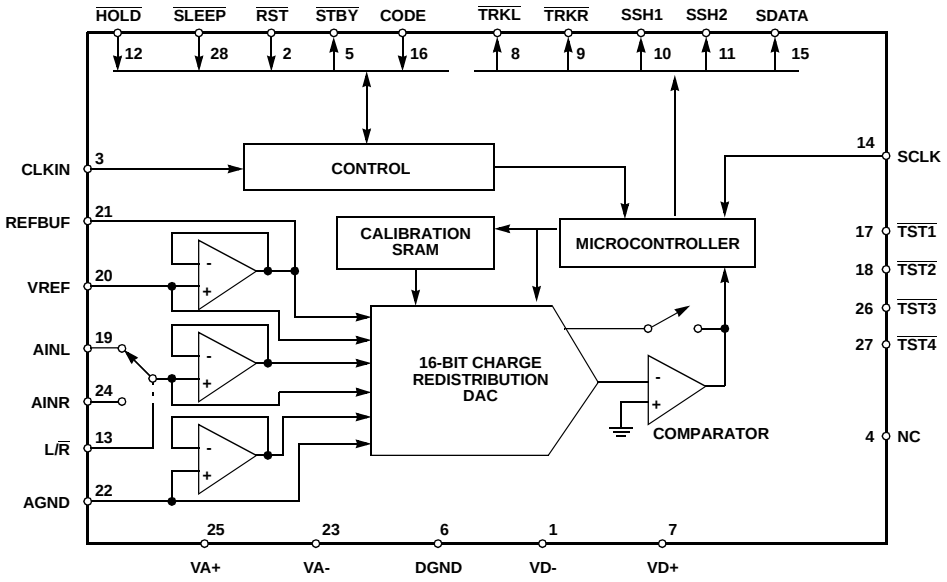
16-Bit, Stereo A/D Converter for Digital Audio

- **Monolithic CMOS ADC**
  - — Inherent sampling architecture
  - — Stereo or monaural capability
  - — Serial output
- **Monaural sampling rates up to 100 kHz**
  - — 50-kHz/channel stereo sampling
- **Signal-to-(noise + distortion): 92 dB**
- **Dynamic range: 92 dB**
  - — 95 dB in 2x oversampling schemes
- **Interchannel isolation: 90 dB**
- **2s complement or binary coding**
- **Low power dissipation: 260 mW**
  - — Power-down mode for portable applications
- **Ordering information** (described on pg.198)
  - — CS5126-KP 28-Pin PDIP
  - — CS5126-KL 28-Pin PLCC

The CS5126 CMOS ADC is an ideal front end for stereo or monaural digital audio systems. The CS5126 can be configured to handle two channels at up to 50 kHz sampling per channel, or it can be configured to sample one channel at rates up to 100 kHz.

The CS5126 executes a successive approximation algorithm using a charge redistribution architecture. On-chip self-calibration circuitry has 18-bit resolution thus avoiding any degradation in performance with low-level signals. The charge redistribution technique also provides an inherent sampling function that avoids the need for external sample/hold amplifiers.

Signal-to-(noise + distortion) in stereo operation is 92 dB, and is dominated by internal broadband noise (1/2 LSB rms). When the CS5126 is configured for 2x oversampling, digital post-filtering bandlimits this white noise to 20 kHz, increasing dynamic range to 95 dB.



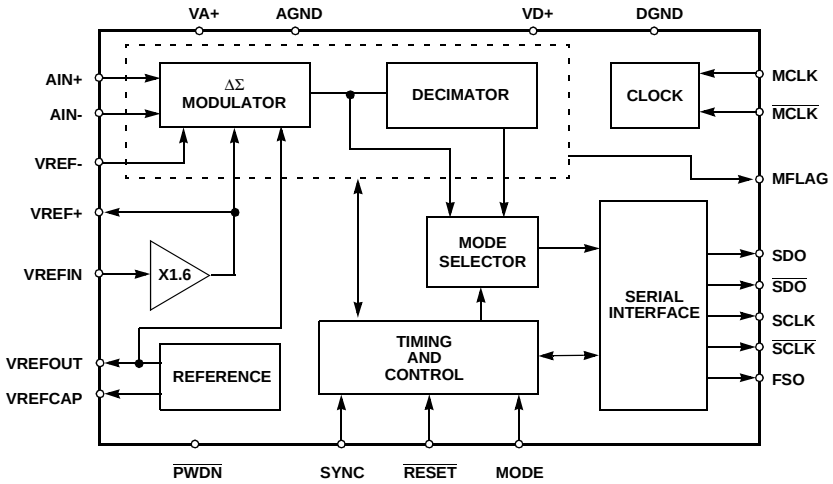
CS5180

ΔΣ Modulator and 8 kHz to 400 kHz 16-Bit ADC

- **16-bit delta-sigma (ΔΣ) A/D converter**
- **Fully differential input with 4.0 V_{pp} range**
- **Dynamic range: 93 dB**
- **Spurious free dynamic range: 96 dB**
- **Total harmonic distortion: -95 dB @ 22 kHz**
- **Up to 400 kHz output word rate**
- **No missing codes**
- **Non-aliasing low-pass digital filter**
- **High speed 3-wire serial interface**
- **Supply options:**
  - — VA+ = 5 V, VD+ = 5 V, 690 mW
  - — VA+ = 5 V, VD+ = 3 V, 368 mW
- **Modulator output mode**
  - — Power down mode
- **Ordering information** (described on pg.198)
  - — CS5180-BL 28-Pin PLCC
  - — CS5180-BQ 44-Pin TQFP

The CS5180 is a fully calibrated high-speed ΔΣ analog-to-digital converter, capable of 400 kSamples/second output word rate (OWR). The OWR scales with the master clock. It consists of a 5th order ΔΣ modulator, decimation filter, and serial interface. The chip can use the 2.375 V on-chip voltage reference, or an external 2.5 V reference. The input voltage range is 1.6 × VREFIN Vpp fully differential. Multiple CS5180s can be fully synchronized in multi-channel applications with a SYNC signal. The part has a power-down mode to minimize power consumption at times of system inactivity. The high speed digital I/O lines have complementary signals to help reduce radiated noise from traces on the PC board. The CS5180 can also be operated in modulator-only mode which provides the ΔΣ modulator bitstream as the output.

Applications include sonar, process control, medical instrumentation, ATE instrumentation, PC data acquisition, and communications.

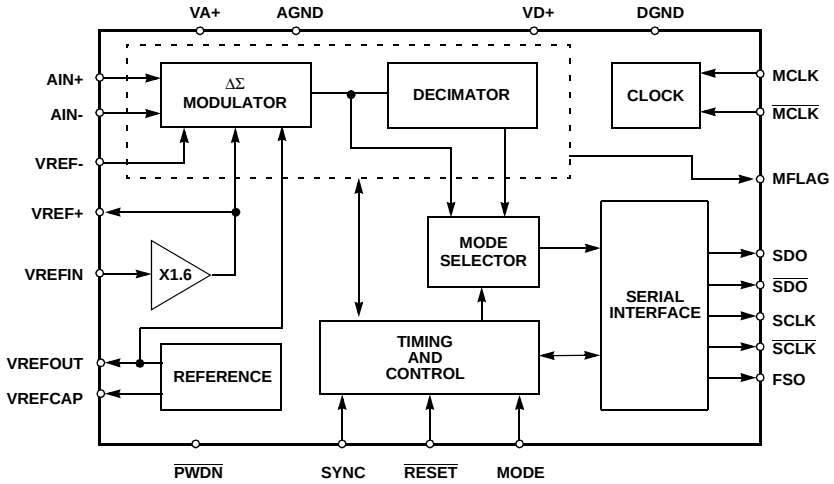


CS5181

ΔΣ Modulator and 400 kHz to 625 kHz 16-Bit ADC

- **16-Bit delta-sigma (ΔΣ) A/D converter**
- **Fully differential input with 4.0 V_{pp} range**
- **Dynamic range: 93 dB**
- **Spurious free dynamic range: 90 dBc**
- **Harmonic distortion: 89 dB**
- **Up to 625 kHz output word rate**
- **No missing codes**
- **Non-aliasing low-pass digital filter**
- **High speed 3-wire serial interface**
- **Supply requirements:**
  - — VA+ = 5 V, VD+ = 3.3 V: 570 mW
- **Modulator output mode**
  - — Power-down mode
- **Ordering information** (described on pg.198)
  - — CS5181-BL 28-Pin PLCC
  - — CS5181-BQ 44-Pin TQFP

The CS5181 is a fully calibrated high-speed ΔΣ analog-to-digital converter, capable of 625 kSamples/second output word rate (OWR). The OWR scales with the master clock. It consists of a 5th order ΔΣ modulator, decimation filter, and serial interface. The chip can use the 2.375 V on-chip voltage reference, or an external 2.5 V reference. The input voltage range is 1.6 × VREFIN Vpp fully differential. Multiple CS5181s can be fully synchronized in multi-channel applications with a sync signal. The part has a power-down mode to minimize power consumption at times of system inactivity. The high speed digital I/O lines have complementary signals to help reduce radiated noise from traces on the PC board layout. The CS5181 can also be operated in modulator-only mode which provides the ΔΣ modulator bitstream as the output.



CS5317

16-Bit, 20 kHz Oversampling A/D Converter

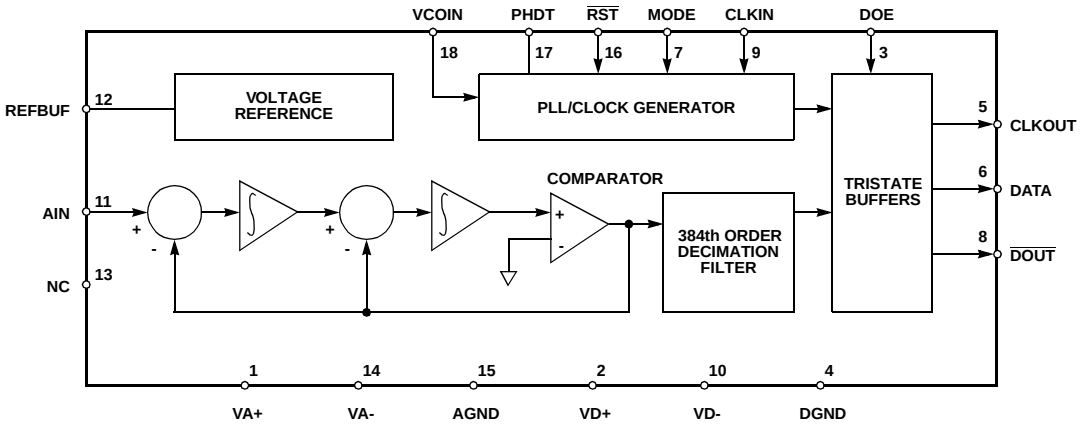
- **Complete voiceband DSP front-end**
  - — 16-bit ADC
  - — Internal track and hold amplifier
  - — On-chip voltage reference
  - — Linear-phase digital filter
- **On-chip PLL for simplified output phase locking in modem applications**
- **84 dB dynamic range**
- **80 dB total harmonic distortion**
- **Output word rates up to 20 kHz**
- **DSP-compatible serial interface**
- **Low power dissipation: 220 mW**
- **Ordering information** (described on pg.198)
  - — CS5317-KP 18-Pin PDIP
  - — CS5317-KS 20-Pin SOIC

The CS5317 is an ideal analog front end for voiceband signal processing applications such as high-performance modems, passive sonar, and voice recognition systems. It includes a 16-bit ADC with an internal track and hold amplifier, a voltage reference, and a linear-phase digital filter.

An on-chip PLL (phased-lock loop) circuit simplifies the CS5317's use in applications where the output word rate must be locked to an external sampling signal.

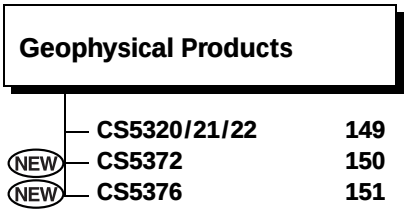
The CS5317 uses ΔΣ modulation to achieve 16-bit output word rates up to 20 kHz. The ΔΣ technique utilizes oversampling followed by a digital filtering and decimation process. The combination of oversampling and digital filtering greatly eases antialias requirements. Thus, the CS5317 offers 84 dB dynamic range and 80 dB THD and signal bandwidths up to 10 kHz at a fraction of the cost of hybrid and discrete solutions.

The CS5317's advanced CMOS construction provides low power consumption of 220 mW and the inherent reliability of monolithic devices.



Data Acquisition

Geophysical Products



Specification Table

Part	Resolution (bits)	Dynamic Range (dB)	Input Range (V)	Power Consumption (mW)	Conversion Method	Package
CS5320	24	120	±4.5	55	106	28 PLCC
CS5321	24	120	±4.5	55	115	
CS5322	-	-	-	11	-	
CS5372	24	124	±2.5	25	120: CS5372-CS 115: CS5372-BS	24 SSOP
CS5376	-	-	-	<6	-	64 TQFP

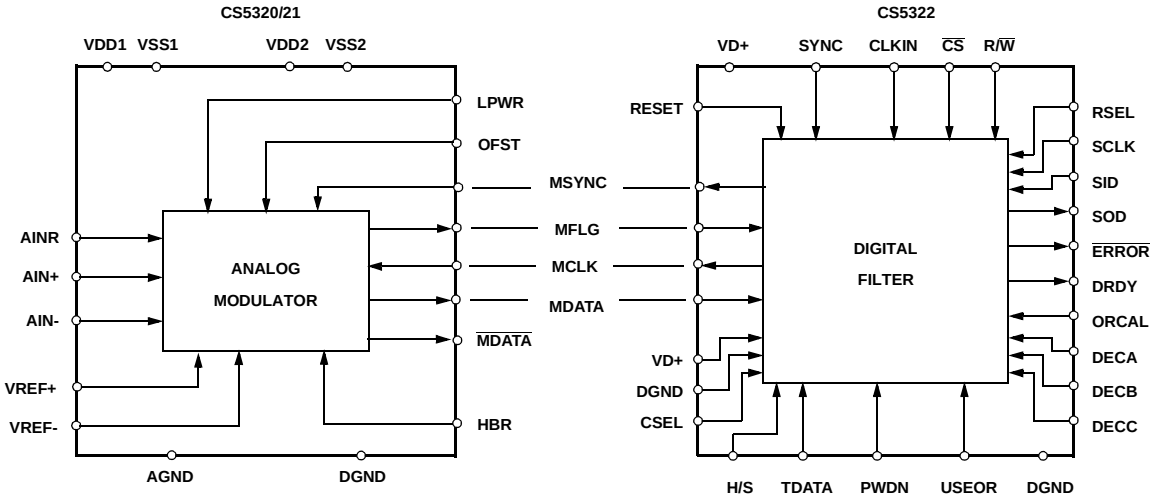
CS5320/21/22

24-Bit Variable Bandwidth A/D Converter Chipset

- **CMOS A/D converter chipset**
- **Dynamic range**
  - — 130 dB @ 25 Hz bandwidth
  - — 121 dB @ 411 Hz bandwidth
- **ΔΣ architecture**
  - — Fourth-order modulator
  - — Variable oversampling: 64X to 4096X
  - — Internal track-and-hold amplifier
- **CS5321 signal-to-distortion: 115 dB**
- **Clock jitter tolerant architecture**
- **Input voltage range: ±4.5 V**
- **Flexible filter chip**
  - — Hardware or software selectable options
  - — Seven selectable filter corners (-3 dB) frequencies: 25, 51, 102, 205, 411, 824 and 1650 Hz
- **Low power dissipation: <100 mW**
- **Ordering information** (described on pg.198)
  - — CS5320/21/22 28-Pin PLCC
  - — CS5320-KL1 CS5320-KL/CS5322-KL Chipset
  - — CS5321-KL1 CS5321-BL/CS5322-KL Chipset
  - — CS5321-BL1 CS5321-BL/CS5322-BL Chipset

The CS5320/22 and CS5321/22 Chipsets function as a unique A/D converter intended for very high resolution measurement of signals below 1500 Hz. The CS5320/22 Chipset is a cost-effective commercial grade solution for applications which require a high dynamic range A/D converter. The chipsets perform sampling, A/D conversion, and anti-alias filtering.

The CS5320 and CS5321 use ΔΣ modulation to produce highly accurate conversions. The ΔΣ modulator oversamples, virtually eliminating the need for external analog anti-alias filters. The CS5322 linear-phase FIR digital filter decimates the output to any one of seven selectable update periods: 16, 8, 4, 2, 1, 0.5 and 0.25 milliseconds. Data is output from the digital filter in a 24-bit serial format.



CS5372

Dual High Performance ΔΣ Modulators

- **Fourth-order delta-sigma (ΔΣ) architecture**
- **Clock jitter tolerant architecture**
- **Dynamic range**
  - — 124 dB @ 411 Hz bandwidth
  - — 121 dB @ 822 Hz bandwidth
- **Available in two grades**
  - — SDR = 120 dB for CS5372-CS
  - — SDR = 115 dB for CS5372-BS
- **Input voltage range: 2.5 V**
- **25 mW per channel**
- **Differential inputs to enhance dynamic range**
- **Power supply configurations**
  - — VA+ = +5 V; VA- = 0 V; VD+ = +3 V to +5 V
  - — VA+ = +2.5 V; VA- = -2.5 V; VD+ = +3 V to +5 V
  - — VA+ = +3 V; VA- = -3 V; VD+ = +3 V
- **Ordering information** (described on pg.198)
  - — CS5372 - CS 24-pin SSOP
  - — CS5372 - BS 24-pin SSOP

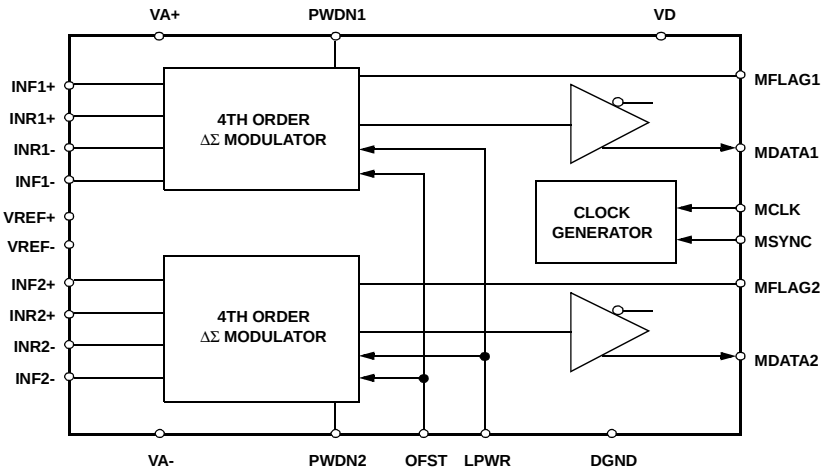
The CS5372 is a dual high dynamic range, fourth-order ΔΣ modulator intended for geophysical and sonar applications. Used in combination with the CS5376 digital filter, a unique high resolution A/D system results.

The CS5372 is available in two grades: BS and CS. The BS grade provides a signal-to-distortion ratio (SDR) performance equivalent to the CS5321, while the CS grade exceeds the SDR performance of the CS5321. Both the BS and CS grades provide a higher dynamic range than the CS5321, while consuming less power per channel. In addition to exceptional performance, the CS5372 BS and CS modulators are available in a much smaller package than the CS5321, thus providing the benefit of a multi-channel solution with a much smaller footprint.

The CS5372 generates an oversampled serial bit stream at 512 kbits per second operating with a clock frequency of 2.048 MHz.

The CS5372 can be operated in two power modes. In Normal mode (LPWR = 0) power consumption is 50 mW. In Low Power mode (LPWR = 1) power consumption is 30 mW. The CS5372 also provides the capability of powering down the modulators independently.

NEW



CS5376

Low Power Multi-Function Decimation Filter

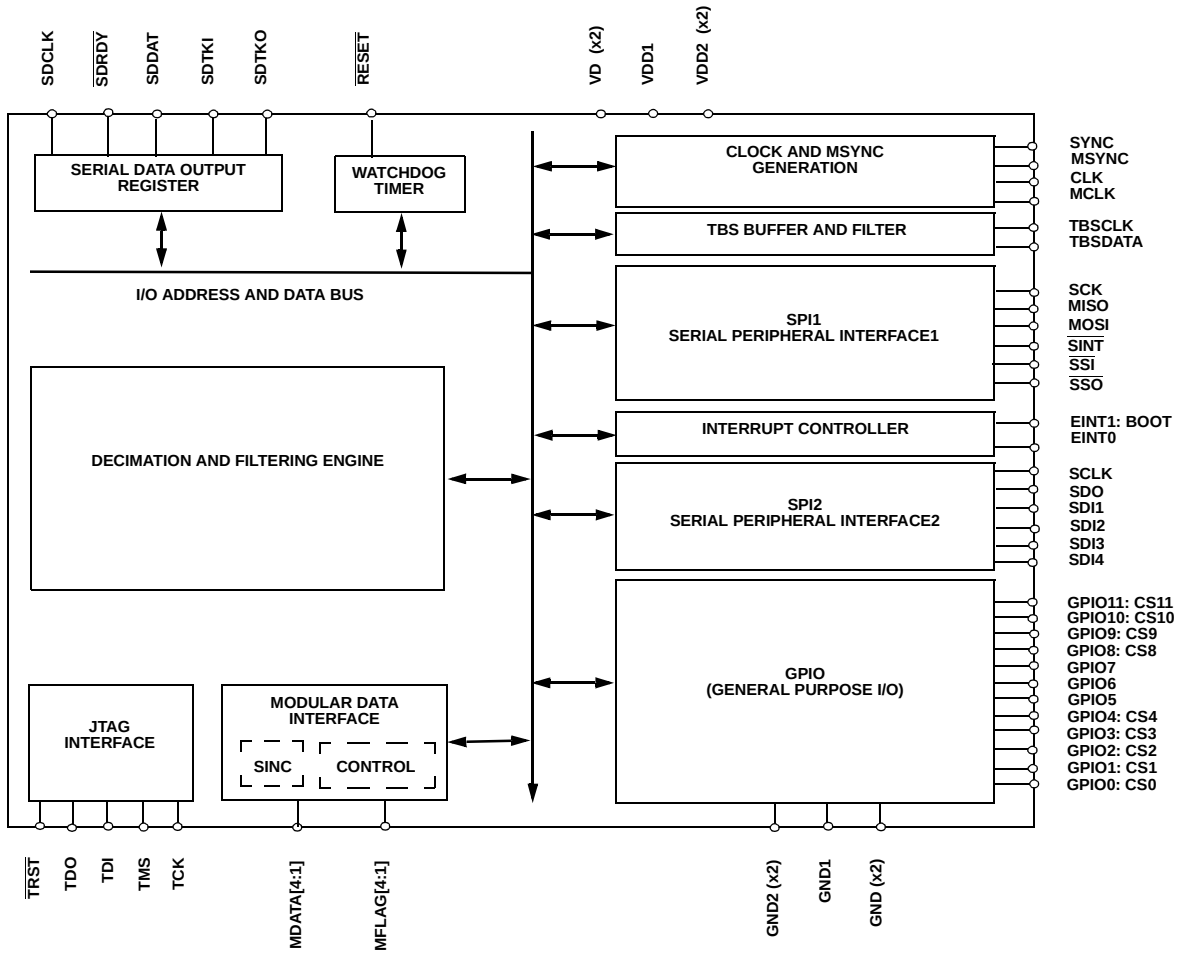
- **1 to 4 channel selectable decimation filters**
- **Programmable hardware SINC filters**
- **SPI control port with boot capabilities**
- **Selectable clock rates**
- **Multi-function high speed data output interface**
- **DAC test bit stream generator (TBS)**
- **3.0 V/5.0 V operation**
- **Low power: < 6mW/channel**
- **ROM-based self-test functions**
- **IEEE JTAG standard 1149.1 test access port**
- **Ordering information** (described on pg.198)

— CS5376-BS 64-pin TQFP

The CS5376 is a Multi-Function Digital Filter utilizing a low-power signal processing architecture with additional hardware features to achieve efficient filtering for up to four ΔΣ modulators. Digital filter coefficients will be supplied for the Filter/Decimation Engine and can be loaded into the CS5376 via the SPI control port. These will include linear and minimum phase filters at a variety of output word rates.

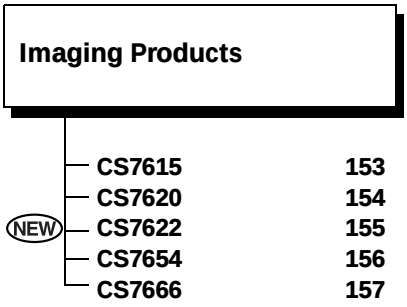
The CS5376 incorporates a 24-bit Test Generator that produces a 1-bit ΔΣ modulated output. The CS5376 also has 12 bits of general purpose I/O for hardware setup and control.The CS5376 also has a second SPI port for controlling external peripherals.

NEW



Data Acquisition

Imaging Products



Specification Table

Part	Resolution (bits)	Dynamic Range (dB)	*CCD Saturation (V)	Power Needed (mW) Standby	Peak	Package	Comments
CS7615	10	53	1.6	650		44 TQFP	Primarily for low-resolution CCD, video- camera applications. Integrated timing generator
CS7620	10**	72	0.5, 1.07, 1.6	0.125	375	64 TQFP	Primarily for high-resolution progressive- scan CCD, still-camera applications. Integrated timing generator
CS7622	10**	72	0.3-1 (100 mV increments)	0.083	214	32 TQFP	Primarily for high-resolution progressive-scan CCD, still-camera applications. Integrated timing generator
CS7654	Imaging DSP		Digital Color Processor with Video Encoder			64 TQFP	Primarily for video cameras requiring analog outputs to TV. Applications include industrial and security cameras.
CS7666	Imaging DSP		Digital Color Processor			64 TQFP	Primarily for video cameras requiring digital outputs. Applications include digital security cameras and PC cameras.

* CCD saturation voltage represents the maximum output voltage of CCDs in maximum lighting conditions. This represents the full-scale input voltage of the A/D for CS7620 and is programmable to accommodate saturation voltages of different CCDs.
** Up to 13-Bits with DRX.

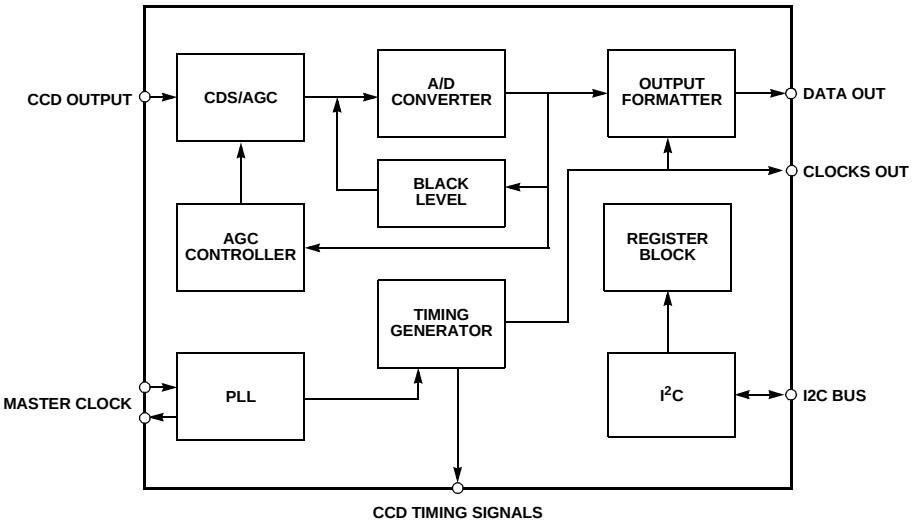
CS7615

10-bit A/D Programmable Timing Generator for Interlaced CCDs

- **10-bit A/D converter**
- **Multi-sync CCD timing generator, handles imagers up to 1000 pixels wide**
- **Integrated correlated double sampler**
- **38 dB automatic analog gain control**
- **Up to 90 dB total gain adjust range**
- **Closed-loop 'fuzzy' AGC/exposure**
- **Code '16' black level clamp**
- **I^2C control bus**
- **Four-phase vertical CCD timing signals**
- **No CCD buffer amplifier required**
- **Master clock or crystal controlled**
- **Ordering information** (described on pg.198)
  — CS7615-KQ 44-Pin TQFP

The CS7615 is a low-power analog front-end processor for standard four-color interline transfer CCD imagers. The architecture includes a correlated double sampler, AGC amplifier, black-level clamp, 10-bit ADC, and a complete multi-sync CCD timing generator. The analog CCD imager output can be directly connected to the CS7615 input, which does not require an external buffer amplifier. The pixel data is double-sampled for improved noise performance, and gain adjusted prior to being digitized by the ADC. Feedback from the ADC holds the image black level at code-16 (assumes 8-bit data path), easing ITU-601 compliance issues. The multi-sync CCD timing generator is programmed through the I^2C bus, and can be used with a wide range of interline transfer CCD imagers up to 1000 pixels wide. The CS7615 supports full ITU-601 compliance for imagers up to 720 pixels wide, and is compatible with both NTSC and PAL timing.

The CS7615 is designed to be used along with the CS7665 digital color-space processor for CCD cameras.



CS7620

10-Bit A/D with DRX™ Technology, an Integrated Timing Generator, and DACs

- **13-bit A/D conversion using DRX™ technology**
- **Backlight compensation**
- **Supports three input ranges of 0.53 V, 1.07 V, and 1.60 V**
- **Multi-sync CCD timing generator**
- **High resolution output mode**
- **Low resolution (preview) output mode for LCD driver**
- **Integrated correlated double sampler**
- **Digital black level clamp**
- **Digital outputs selectable for 13, 12, or 10 bits**
- **Two integrated general purpose DACs**
- **Low power consumption**
- **Power down mode**
- **High speed serial interface**
- **Supports a large variety of clock input frequencies**
- **Low power mode option**
- **Ordering information** (described on pg.198)

— CS7620-IQ	64-Pin TQFP

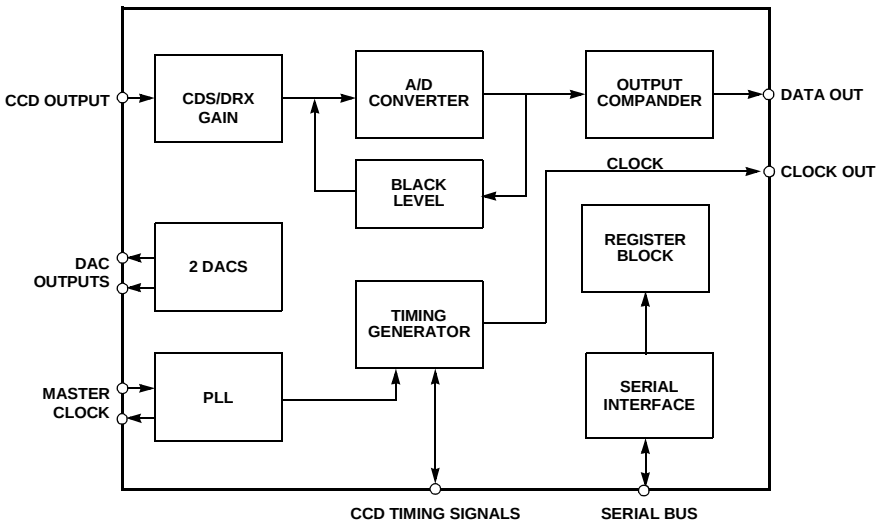
The CS7620 is a low-power analog front-end processor for interline or frame transfer CCD imagers. Main applications include digital still image cameras with up to 8k×8k pixels.

The architecture includes a correlated double sampler, black level clamp and a 13-bit A/D conversion module using patented DRX technology. In addition, the chip contains a timing generator, which supports common CCDs from IBM®, and Polaroid®. For CCDs using different timing signals, the internal timing generator can be bypassed.

There are 2 general-purpose DACs available which can be used to drive motors for iris and shutter control.

Chip parameters can be programmed using a high speed 4-wire asynchronous digital interface.

The chip outputs digitized CCD data in either 13-bit, 12-bit or 10-bit format. 10-bit outputs are generated from the 13-bit A/D output by a programmable companding curve.



CS7622

10-bit A/D with DRX™ Technology for 13-bit Performance

- **13-bit A/D conversion using DRX™ technology**
- **Backlight compensation**
- **Supports full scale analog input voltage ranges from 300 mV to 1 V in 100 mV increments**
- **High Resolution output mode**
- **Low resolution (preview) output mode for LCD driver**
- **Integrated correlated double sampler**
- **Digital black level clamp**
- **Digital outputs selectable for 13, 12, or 10 Bits**
- **Low power consumption**
- **Power down mode**
- **High speed serial interface**
- **Supports a large variety of clock input frequencies**
- **Low power mode option**
- **Ordering information** (described on pg.198)
  — CS7622-KQ 32-Pin TQFP

The CS7622 is a low-power analog front-end processor for interline or frame transfer CCD imagers. Main applications include digital still image cameras and video cameras.

The architecture includes a correlated double sampler, black level clamp and a 13-bit A/D conversion module using patented DRX technology.

Chip parameters can be programmed using a high speed 4-wire asynchronous digital interface.

The chip outputs digitized CCD data in either 13-bit, 12-bit or 10-bit format. 10-bit outputs are generated from the 13-bit A/D output by a programmable companding curve.

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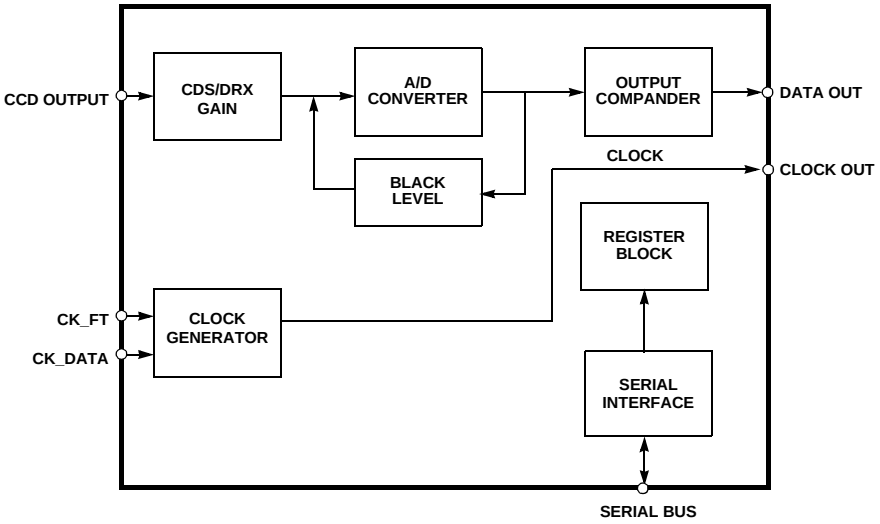


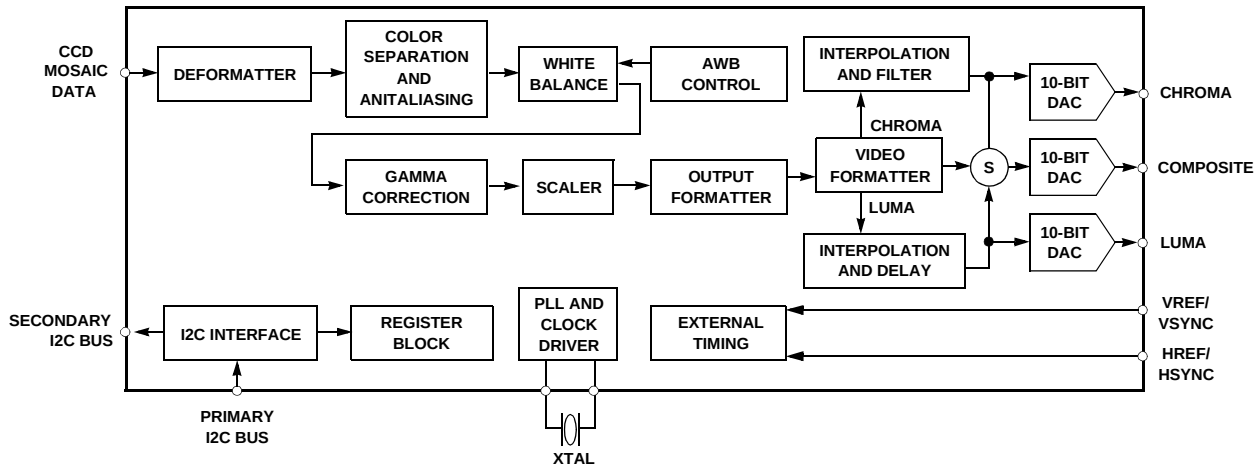
CS7654

Video Camera DSP with Composite Video Output

- **ITU-601 compliant image formatting**
- **ITU-656 and SMPTE-125/M transports**
- **I^2C CONTROL INTERFACE**
- **Limited secondary I^2C bus master**
- **Automatic white balance**
- **Programmable gamma correction**
- **Programmable interpolation**
- **Programmable luma gain and saturation control**
- **Fully programmable color separation matrix coefficients**
- **Supports up to 1440, active pixels per line, with no limitation on vertical size**
- **Programmable "chroma kill" circuit**
- **Highly integrated for low part count cameras**
- **Three DACs providing simultaneous composite, S-video outputs**
- **Multi-standard support for NTSC-M, NTSC-JAPAN, PAL (B, D, G, H, I, M, N, Combination N)**
- **On-chip voltage reference generator modes, tri-state DACs and power down mode.**
- **Ordering information** (described on pg.198)

  — CS7654-KQ 64-Pin TQFP

The CS7654 is a low-power Digital Color-Space Processor for CCD cameras. It provides all the necessary digital image processing for standard four-color interline transfer CCD imagers. The CS7654 processes the magenta, yellow, cyan, and green (MYCG) CCD imager data into YCrCb formatted component digital video and into analog PAL or NTSC. Internal processing includes color separation, automatic white balance, user programmable gamma correction, programmable scaling (interpolation), digital output formatting and encoding function for analog output. Also, a special "Chroma Kill" circuit eliminates false colors during saturation. Video output can be formatted to be compatible with NTSC-M, NTSC-J, PAL-B,D,G,H,I,M,N, and Combination N systems. Closed Caption is supported in NTSC. Three 10-bit DACs provide two channels for an S-Video output port and one composite video outputs.A High-speed I^2C compatible control interface is provided for in system design. A general-purpose I/O port is also available to help conserve valuable board space and to provide up to eight "boot" configurations.The CS7654 is designed to work directly with the CS7615 CCD Imager Analog Processor.



CS7666

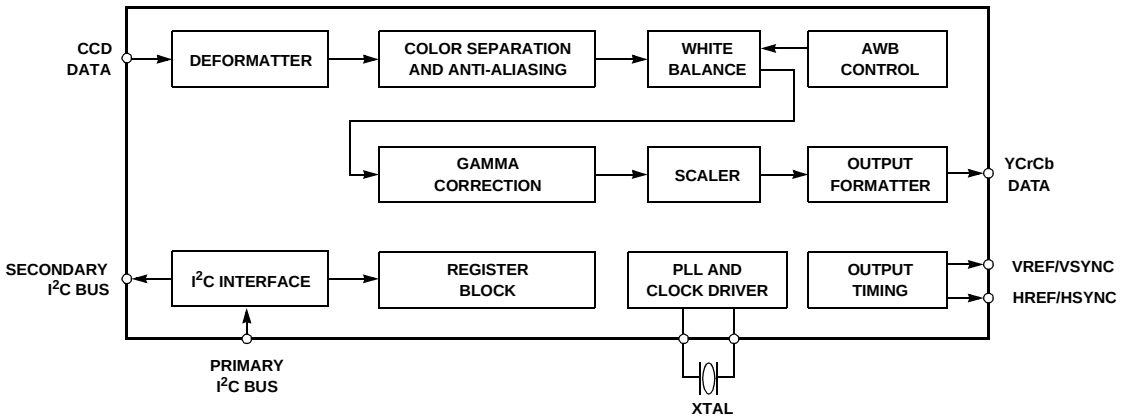
Video Camera DSP with Digital Output

- **ITU-601 compliant image formatting**
- **ITU-656 and SMPTE-125/M transport**
- **Provides separate HREF and VREF (or alternately HSYNC and VSYNC) signals**
- **I^2C control interface**
- **Limited secondary I^2C bus master**
- **Automatic white balance**
- **Programmable gamma correction**
- **Programmable interpolation**
- **Advanced color anti-aliasing filter**
- **Programmable luma gain and saturation control**
- **Fully programmable color separation matrix coefficients**
- **Supports images up to 1440 pixels wide with no limitation on vertical size**
- **Pin and software compatible with the CS7665**
- **Programmable 'color killer' circuit**
- **Highly integrated for low-part-count cameras**
- **Ordering information** (described on pg.198)
  — CS7666-KQ 64-Pin TQFP

The CS7666 is a low-power digital color-space processor for CCD cameras. It provides all necessary digital image processing for standard four-color interline transfer CCD imagers. The CS7666 processes the magenta, yellow, cyan, and green (MYCG) CCD imager data into YCrCb-formatted component digital video. Internal processing includes color separation, automatic white balance, user-programmable gamma correction, programmable scaling (interpolation), and output formatting.

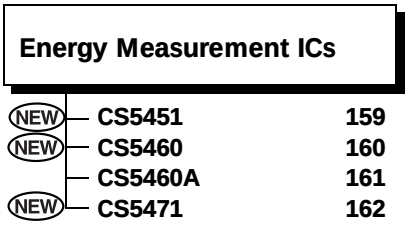
The CS7666 employs an advanced false color detection circuit and color filter to reduce, or eliminate, incorrect color and "color noise" associated with high spatial frequency images. Also, a special "color killer" circuit eliminates false colors during saturation. The digital output of the CS7666 can be configured to comply with ITU-601, ITU-656 and SMPTE-125/M standards. Additionally, HREF and VREF (or HSYNC and VSYNC) output pins are provided to support older analog video encoders and the current ZV-Port definition. The CS7666 can support horizontal line widths of up to 1440 pixels. It has no limitations on the number of vertical lines it can support.

The CS7666 is designed to work directly with the CS7615 CCD imager analog processor, and is a drop-in replacement for the CS7665.



Data Acquisition

Energy Measurement ICs



Specification Table

Part	Channels	Accuracy	On-chip DSP	Power Consumption	Calibration	Package
CS5451	6	0.1% of reading	No	20 mW	No	28-SSOP
CS5460	2	0.1% of reading	Yes	15 mW	Yes	24-SSOP
CS5460A	2	0.1% of reading	Yes	15 mW	Yes	24-SSOP
CS5471	2	0.1% of reading	No	10 mW	No	20-SSOP

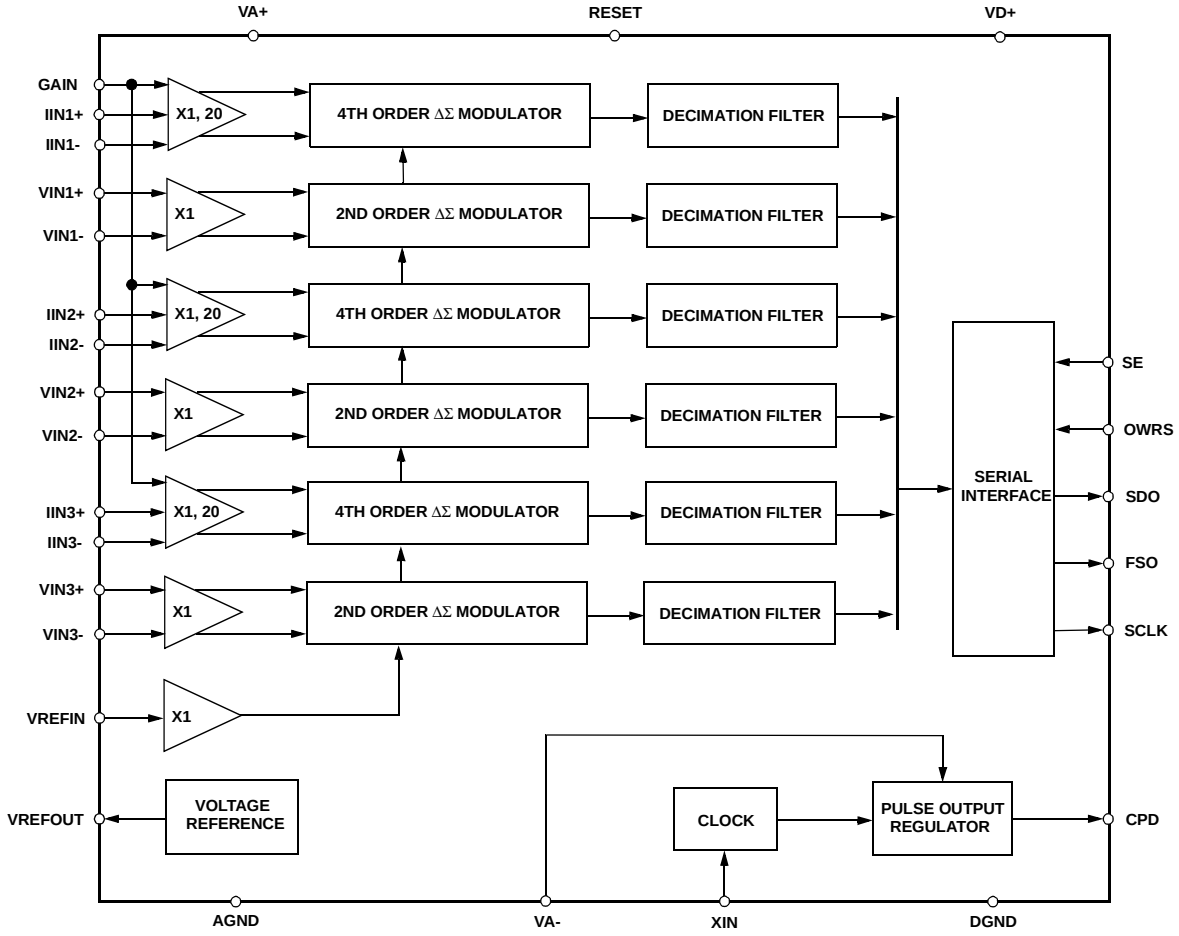
CS5451

Six-Channel ΔΣ Analog-to-Digital Converter

- **Synchronous sampling**
- **On-chip 1.2 V reference (25 ppm/°C typ)**
- **Power supply configurations:**
  - — VA+ = +3 V; VA- = -2 V; VD+ = +3 V
  - — Supply tolerances ±10%
- **Power consumption**
  - — 20 mW typical at VD+ = +3 V
- **Simple four-wire serial interface**
  - — High-speed DMA capability
- **Charge pump driver output generates negative power supply**
- **Ground-referenced bipolar inputs**
- **Ordering information** (described on pg.198)
  - — CS5451-BS 28-pin SSOP

The CS5451 is a highly integrated ΔΣ Analog-to-Digital Converter (ADC) developed for the Power Measurement Industry. The CS5451 combines six ΔΣ ADCs, decimation filters, and a serial interface on a single chip. The CS5451 interfaces directly to a current transformer or shunt to measure current, and resistive divider or transformer to measure voltage. The product features a serial interface for communication with a micro-controller or DSP. The product is initialized and fully functional upon reset, and includes a Voltage Reference.

NEW

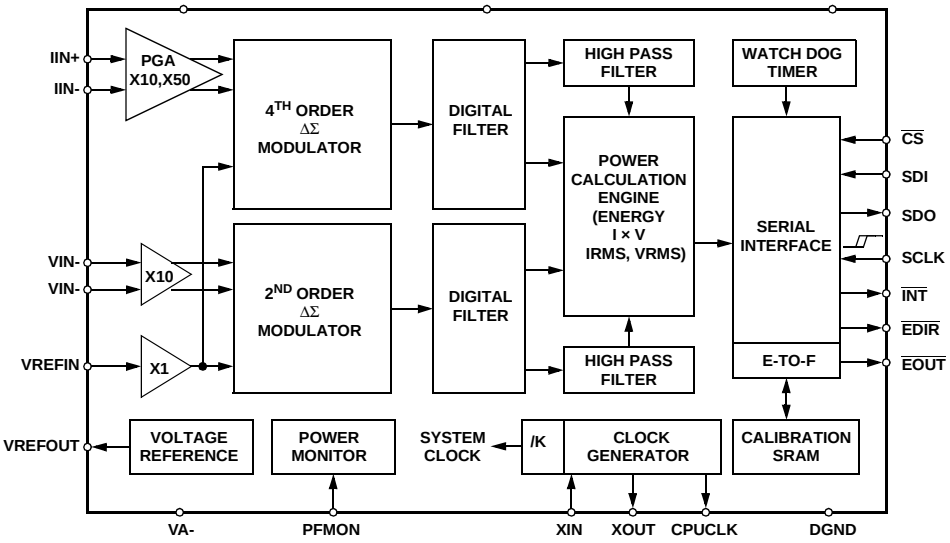


CS5460

Single Phase Bi-Directional Power/Energy IC

- **Energy data linearity: 0.1% of reading over 1000:1 dynamic range**
- **On-chip functions: energy, I * V, I_{RMS} and V_{RMS}, energy to pulse-rate conversion**
- **Complies with IEC 687/1036, JIS**
- **Power consumption <12 mW**
- **Interface optimized for shunt sensor**
- **Phase compensation**
- **Ground-referenced signals with single supply**
- **System calibration**
- **On-chip 2.5 V reference (25 ppm/°C typ)**
- **Simple three-wire serial interface**
- **Watch dog timer**
- **Power supply monitor**
- **Power supply configurations**
  - — VA+ = +5 V; VA- = 0V; VD+ = +3 V to +5 V
  - — VA+ = +2.5 V; VA- = -2.5 V; VD+ = +3 V
- **Ordering information** (described on pg.198)
  - — CS5460-BS 24-Pin SSOP

The CS5460 is a highly integrated ΔΣ Analog-to-Digital Converter (ADC) which combines two ΔΣ ADCs, high speed power calculation functions, and a serial interface on a single chip. It is designed to accurately measure and calculate: Energy, Instantaneous Power, IRMS, and VRMS for single phase 2 or 3-wire power meter applications. The CS5460 interfaces to a low-cost shunt or transformer to measure current, and resistive divider or transformer to measure voltage. The CS5460 features a bi-directional serial interface for communication with a micro-controller and a fixed-width programmable frequency output that is proportional to energy. The product is initialized and fully functional upon power-up, and includes facilities for system-level calibration under control of the user program.



CS5460A

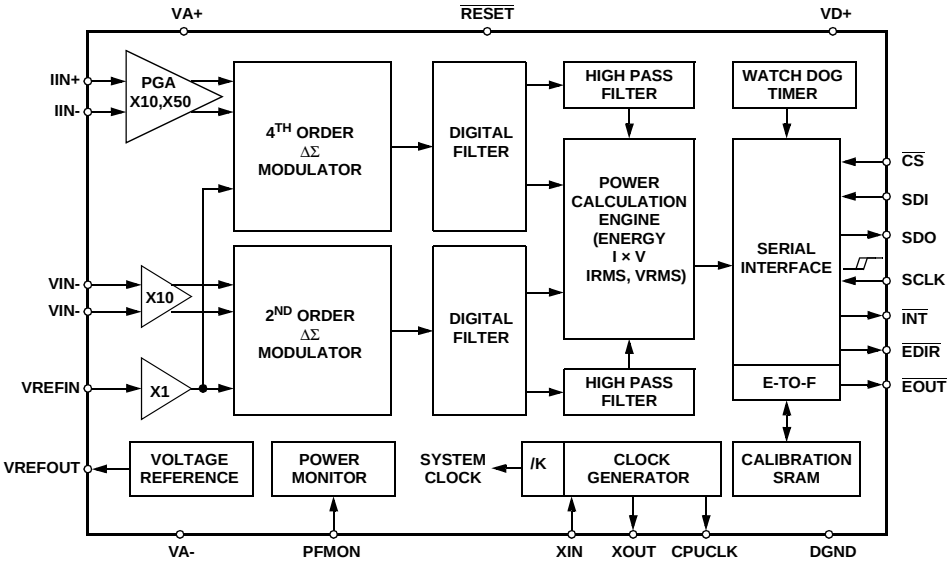
Single Phase Bi-Directional Power/Energy IC

- **Energy data linearity: 0.1% of reading over 1000:1 dynamic range**
  - — On-chip functions: energy, I ∗ V, I_{RMS} and V_{RMS}, energy to pulse-rate conversion
- **Smart Auto-boot mode from serial EEPROM with no microcontroller.**
- **AC or DC system calibration**
- **Ability to drive Mech Cunter or Stepper Motor**
- **Complies with IEC 687/1036, JIS**
- **Power consumption <12 mW**
- **Interface optimized for shunt sensor**
- **Phase compensation**
- **Ground-referenced signals with single supply**
- **On-chip 2.5 V Reference (25 ppm/℃ typ)**
- **Simple three-wire serial interface**
- **Watch dog timer**
- **Power supply monitor**
- **Power supply configurations**
  - — VA+ = +5 V; VA- = 0V; VD+ = +3 V to +5 V
  - — VA+ = +2.5 V; VA- = -2.5 V; VD+ = +3 V
- **Ordering information** (described on pg.198)
  - — CS5460A-BS 24-pin SSOP

The CS5460A is a highly integrated ΔΣ Analog-to-Digital Converter (ADC) which combines two ΔΣ ADCs, high speed power calculation functions, and a serial interface on a single chip. It is designed to accurately measure and calculate: Energy, Instantaneous Power, I_{RMS}, and V_{RMS} for single phase 2 or 3-wire power meter applications. The CS5460A interfaces to a low-cost shunt or transformer to measure current, and resistive divider or transformer to measure voltage. The CS5460A features a bi-directional serial interface for communication with a micro-controller and a fixed-width programmable frequency output that is proportional to energy. The product is initialized and fully functional upon power-up, and includes facilities for system-level calibration under control of the user program.

In Auto-Boot Mode, the CS5460A reads the calibration data and start-up instructions from an external EEPROM. In this mode, the CS5460A can work without the need for a microprocessor for low-cost metering applications.

NEW



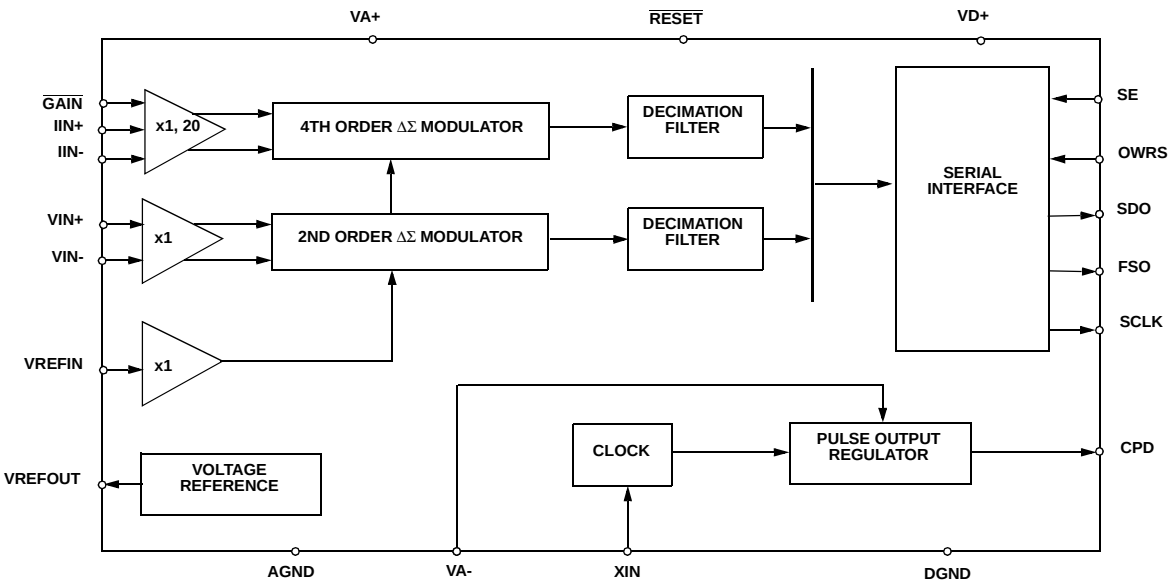
CS5471

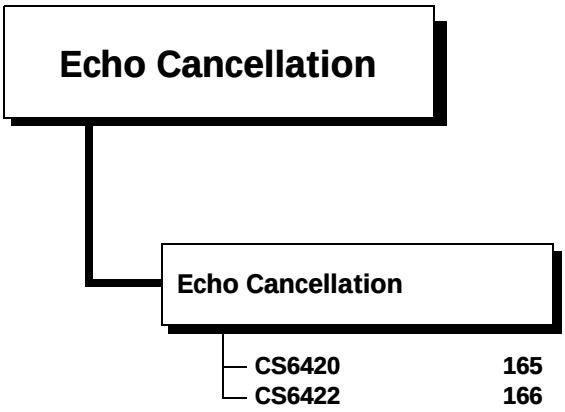
Dual-Channel ΔΣ Analog-to-Digital Converter

- **Synchronous Sampling**
- **On-chip 1.2 V reference (25 ppm/°C typ)**
- **Power supply configurations:**
  - — VA+ = +3 V; VA- = -2 V; VD+ = +3 V
  - — Supply tolerances ±10%
- **Power consumption**
  - — 10 mW Typical at VD+ = +3 V
- **Simple four-wire serial interface**
  - — High-speed DMA capability
- **Charge pump driver output generates negative power supply**
- **Ground-referenced bipolar inputs**
- **Ordering information** (described on pg.198)
  - — CS5471-BS 20-pin SSOP

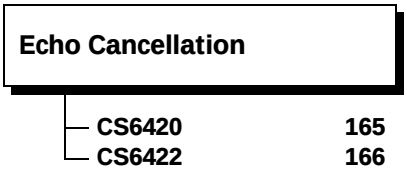
The CS5471 is a highly integrated ΔΣ Analog-to-Digital Converter (ADC) developed for the Power Measurement Industry. The CS5471 combines two ΔΣ ADCs, decimation filters, and a serial interface on a single chip. The CS5471 interfaces directly to a current transformer or shunt to measure current, and resistive divider or transformer to measure voltage. The product features a serial interface for communication with a micro-controller or DSP. The product is initialized and fully functional upon reset, and includes a Voltage Reference.

NEW




Echo Cancellation
Echo Cancellation
CS6420 165
CS6422 166

Echo Cancellation



Specification Table

Part	Dynamic Range (dB)	Input Range (V)	Power Needed (mW)	Delay Length (ms)	Package	Comments
CS6420	80	1	300	64	20 SOIC	acoustic and network canceller
CS6422	80	1	300	64	20 SOIC	enhanced feature set

CS6420

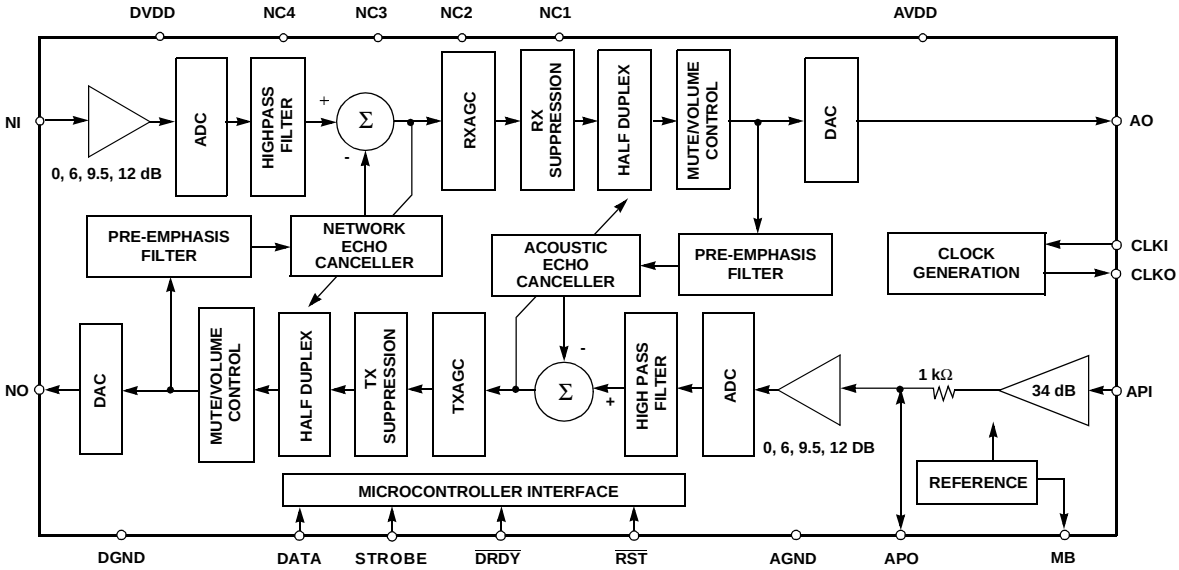
Full-Duplex Speakerphone IC

- **Single-chip, full-duplex, hands-free operation**
- **Dual channel volume controls with AGC and mute**
- **Optional 34 dB microphone pre-amplifier**
- **Dual integrated 80 dB IDR codecs**
- **Speech-trained network and acoustic echo cancellers**
- **Rx and Tx supplementary echo suppression**
- **Configurable half-duplex training mode**
- **Power-down mode**
- **Microcontroller interface**
- **Ordering information** (described on pg.198)
  — CS6420-CS 20-Pin SOIC

Most modern speakerphones use half-duplex operation, switching transmission between the far-end talker and the speakerphone user due to the acoustic coupling between the speaker and microphone being much higher in speakerphones than in mechanically-suppressed handsets.

The CS6420 enables full-duplex conversation with a single-chip solution. The CS6420 can easily replace existing half-duplex speakerphone ICs with a significant increase in conversation quality.

The CS6420 consists of telephone and audio interfaces, two codecs, and an echo-cancelling DSP.



CS6422

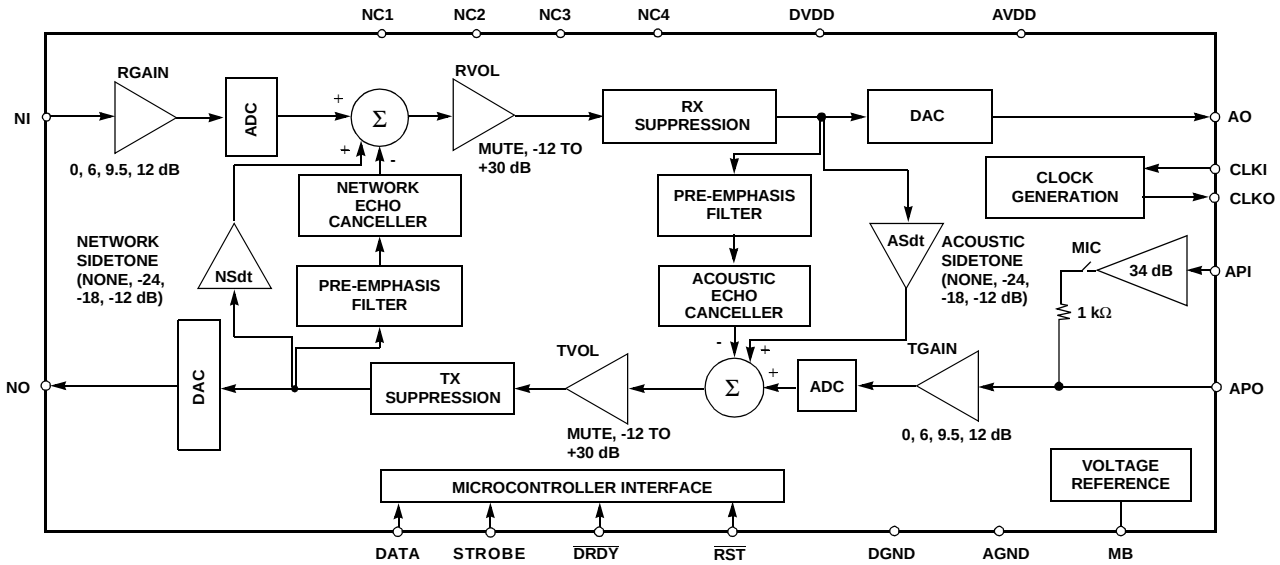
Enhanced Full-Duplex Speakerphone IC

- **Single-chip full-duplex hands-free operation**
- **Optional Tx noise guard**
- **Programmable attenuation during double-talk**
- **Optional 34 dB microphone pre-amplifier**
- **Dual channel volume controls with AGC and mute**
- **Dual integrated 80 dB IDR codecs**
- **Speech-trained network and acoustic echo cancellers**
- **Rx and Tx supplementary echo suppression**
- **Configurable half-duplex training mode**
- **Power-down mode**
- **Microcontroller interface**
- **Ordering information** (described on pg.198)
  — CS6422-CS 20-Pin SOIC

Most modern speakerphones use half-duplex operation, which alternates transmission between the far-end talker and the speakerphone user. This is done to ensure stability because acoustic coupling between the speaker and microphone is much higher in speakerphones than in handsets where coupling is mechanically suppressed.

The CS6422 enables full-duplex conversation using echo cancellation and suppression in a single-chip solution. The CS6422 can easily replace existing half-duplex speakerphone ICs with a significant increase in conversation quality.

The CS6422 consists of telephone and audio interfaces, two codecs, and an echo-cancelling DSP.



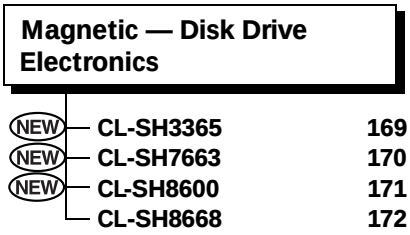
Storage

Magnetic — Disk Drive Electronics

Optical — DVD, CD-ROM, CD-R/RW Products

Storage

Magnetic — Disk Drive Electronics



CL-SH3365

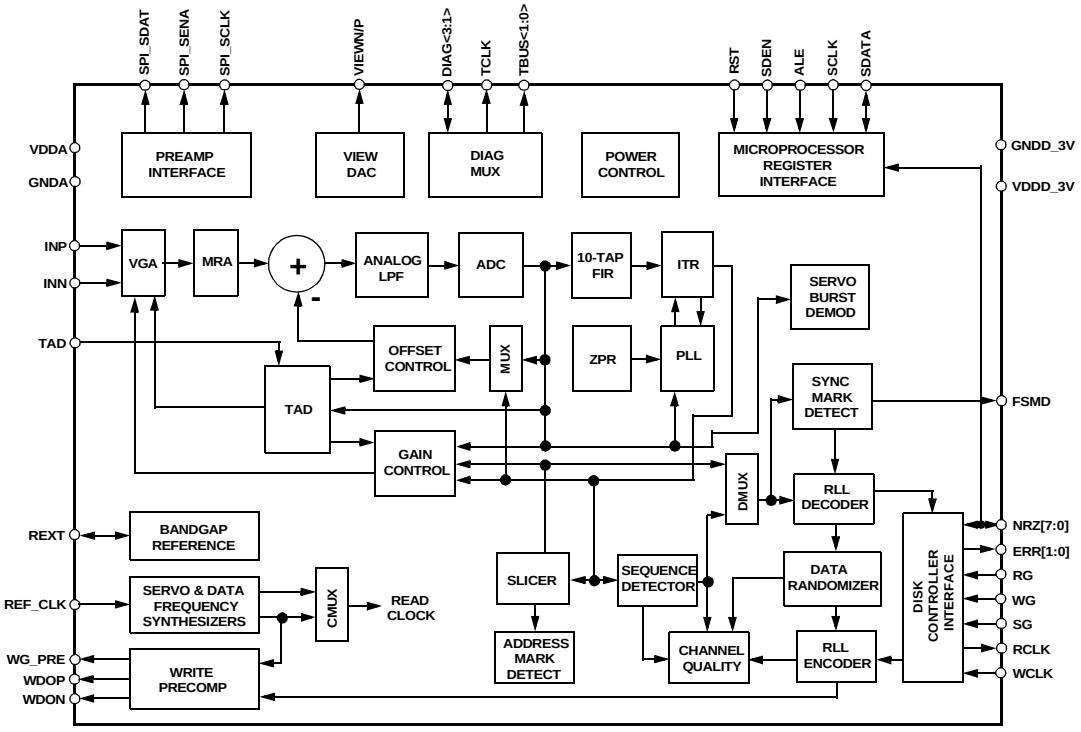
PRML Read/Write Channel

- **User data rates up to 550 Mbits/sec; servo data rate from 38-76 Mbits/sec**
- **6-bit flash ADC**
- **10-tap adaptive digital finite impulse response equalization filter**
- **Completely digital interpolated timing recovery and zero phase restart**
- **Selectable rates of 24/25, 48/51, and 48/52 d=0 RLL encoder/decoder allows higher user data rates and drive capacities than conventional rate 8/9 d=0 RLL systems**
- **16-state Viterbi engine with CC2 coding and selectable target that can operate with significant linear and nonlinear inter-symbol interference**
- **Digital area integration of servo positioning bursts**
- **Digital control loops can be configured with separate data and servo loop coefficients for both acquisition and tracking modes**
- **Channel-quality circuitry provides channel-tuning data for error rate estimation and performance optimization**
- **Error tolerance features matched to higher recording densities**
- **10-bit parallel NRZ data interface connects to disk controller, simultaneously providing decoded user data and correction pointers**
- **Ordering information**

The CL-SH3365 sampled-amplitude, digital read/write channel is a mixed-signal CMOS VLSI component designed to work with a disk controller and preamp to build a highly flexible, state-of-the-art, synchronous read path for high-density magnetic disk drives.

The CL-SH3365 offers a convolutional code-enhanced EPR4 partial response sequence detector, which provides a 1.0 to 2.0 dB performance benefit over conventional EPR4 detectors at user data rates up to 550 Mbits/second.

NEW



CL-SH7663

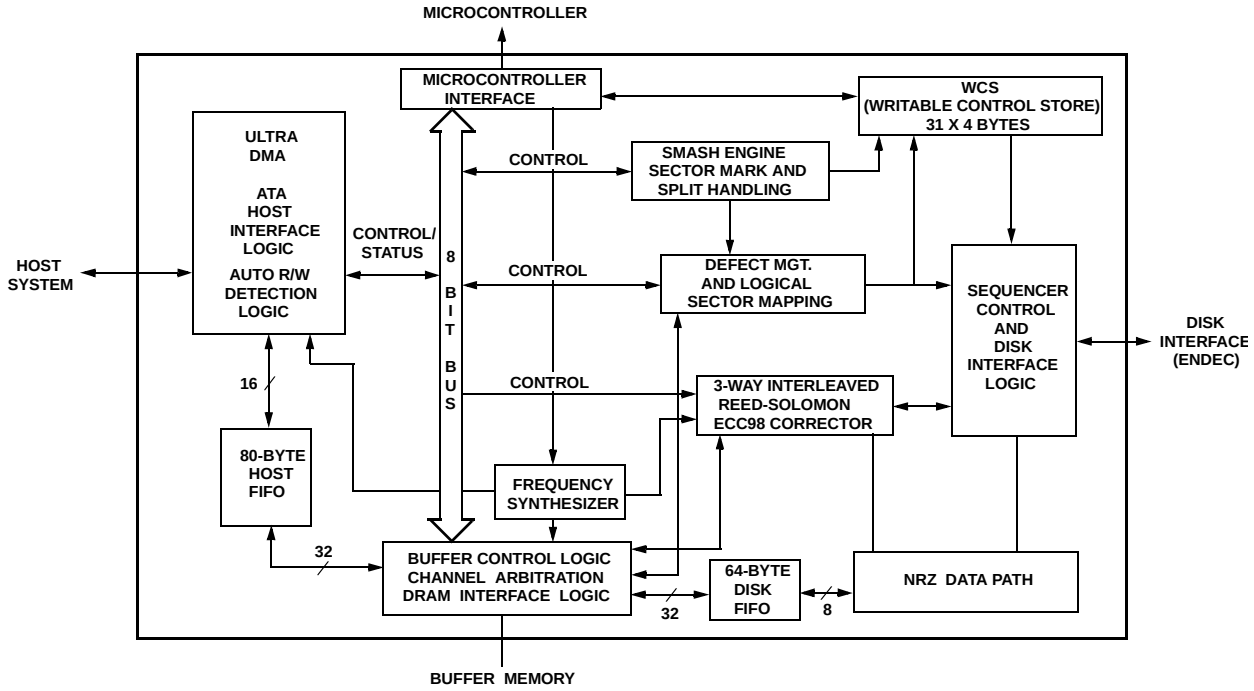
Advanced Architecture ATA-66 Disk Controller

- **Ultra DMA 66 (66.6 Mbytes/sec)**
- **ID-less architecture – proprietary SMASH engine**
- **Defect management and logical sector mapping**
- **SDRAM support: Maximum 111.3 Mbytes/sec bandwidth**
- **8-bit NRZ disk interface**
  - — 340 Mbits/sec (42.5 Mbytes/sec.) maximum disk data rate
- **Advanced data integrity capabilities**
  - — 3-way interleaved ECC with 21 bytes correctable per sector on-the-fly, and erasure pointer support
- **Automated ATA host interface processing**
  - — Hardware support for auto multi-sector write, auto sequential write, and auto sequential read commands
  - — Host selection interrupt generation without system clock
- **Supports 1023 sectors per track**
- **Frequency synthesizer that generates internal buffer, host, system, and correction clocks**

The CL-SH7663 is a member of the latest generation of advanced disk controllers from Cirrus Logic. The device offers the ID-less architecture plus advanced data integrity features required by the error characteristics of high-density disk drive technology. The CL-SH7663 provides a high-bandwidth solution using SDRAMs or EDO DRAMs to enable high-performance host and disk transfer rates.

The CL-SH7663 provides a large portion of the hardware necessary to build an ATA disk drive controller board. The device is typically configured with buffer memory and a microcontroller (with system RAM and ROM) to create a complete ATA disk drive controller. The CL-SH7663 design combines ID-less architecture with advanced data integrity features, a sector formatter, eight-channel buffer arbitration logic, a high speed microcontroller interface, and hardware ATA host interface support.

NEW



CL-SH8600

2Ci™ Integrated ATA Drive Electronics

ATA Disk Controller

- **Ultra DMA 66 support (66.6 Mbytes/sec)**
- **ID-less architecture**
- **Direct buffer access by CPU**
- **8-bit NRZ disk data rate – 340 Mbits/sec**
- **Advanced ECC capabilities**
  - — Up to 30 random/60 thermal asperity error bytes correctable on-the-fly per sector

Read Channel

- **Disk data rate – 300 Mbits/sec**
- **New CC2 Detector technology**
- **6-bit flash ADC**
- **Selectable rates of 24/25, 48/51, and 48/52 d=0 RLL encoder/decoder**
- **Enhanced PR4 partial response detector**

General

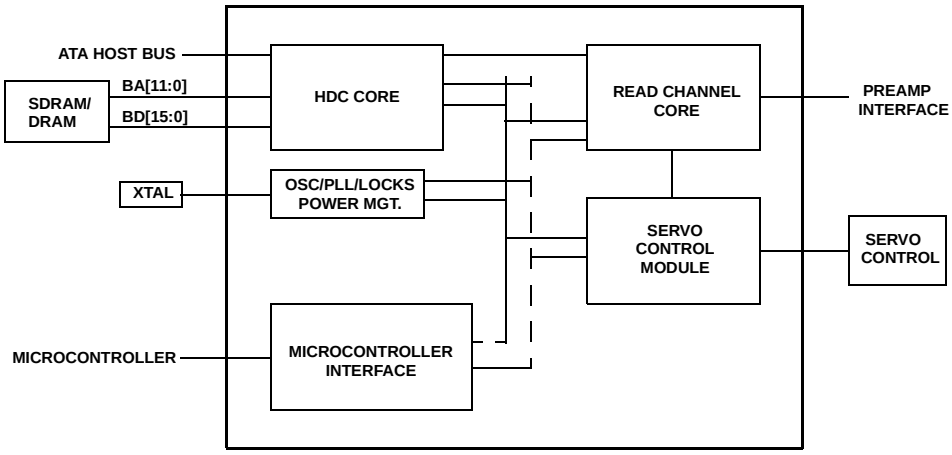
- **Servo logic**
- **3.3 Volt I/O, 2.5 Volt core, 0.25-micron design**

The CL-SH8600 (or 2Ci) is a high-performance ATA disk controller and read channel. The CL-SH8600, combined with a microcontroller, FLASH memory, DRAM buffer memory, preamplifier, and power drivers comprise a complete drive electronics solution for ATA disk drives.

The hard disk controller logic offers full hardware support of the ID-less architecture, including automatic sector pulse generation, logical sector mapping and on-track defect management. The advanced ECC logic provides up to 30 bytes random error correction per sector, or 60 error bytes per sector using on-the-fly erasure pointer correction.

The read channel logic is a sampled amplitude digital read/write channel that provides a highly flexible, state-of-the-art, synchronous read path for high-density magnetic disk drives. In addition, this block has a programmable architecture and calibration feature that allows the channel parameters to be tuned to characteristics of each drive, head, and zone. High disk data rates — up to 300 Mbps. (for the channel) — and erasure pointers are supported.

NEW



CL-SH8668

3Ci™ Integrated ATA Drive Electronics

Microcontroller

- **ARM7TDMI 32-bit RISC processor**
- **Internal and external memory**
- **JTAG boundary scan**

ATA Disk Controller

- **Ultra DMA 66 support (66.6 Mbytes/sec)**
- **ID-less architecture**
- **Direct buffer access by CPU**
- **8-bit NRZ disk data rate — 340 Mbits/sec**
- **Advanced ECC capabilities**

Read Channel

- **Disk data rate up to 330 Mbits/sec**
- **Digitally controlled VGA (variable gain amplifier)**
- **Fourth-order analog LPF (low-pass filter)**
- **Enhanced PR4 partial response detector**
- **Thermal asperity detection and correction**
- **Ten-tap adaptive digital FIR filter**

General

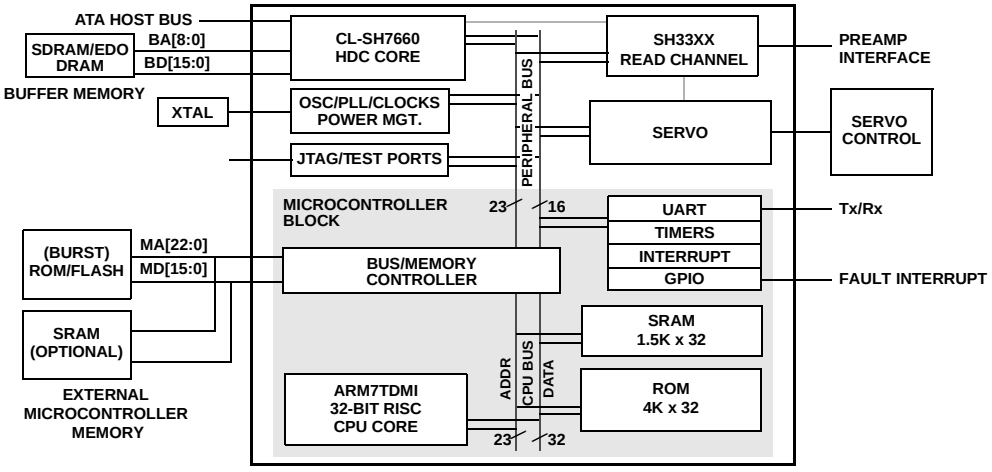
- **Servo logic**
- **3.3 Volt, 0.35 micron design**

The CL-SH8668 is a high-performance, low-cost, integrated microcontroller, ATA disk controller, and read channel. The CL-SH8668, FLASH memory, DRAM buffer memory, preamplifier, and power drivers comprise a complete drive electronics solution for ATA disk drives.

The ARM® core operates on both 16- and 32-bit instructions, providing complete management of servo, spindle control, disk controller and miscellaneous drive functions. 16-bit instructions reduce firmware code size while 32-bit instructions support time-critical functions such as servo processing and interrupt handling.

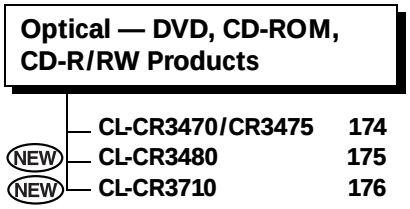
The hard disk controller logic offers full hardware support of the ID-less architecture, including automatic sector pulse generation, logical sector mapping and on-track defect management. Buffer bandwidth using SDRAM of up to 111.3 Mbytes/sec can sustain host data rates of 66.6 Mbytes/sec in Ultra DMA mode 2 and disk data rates up to 330 Mbits/sec.

Advanced ECC logic provides 1-byte error correction and can correct a single-burst errors of 116 bits or a double-burst errors of 81 and 73 bits, respectively, on-the-fly. Higher ECC correction power can be achieved with off-line firmware correction and erasure pointer support. The read channel logic is a sampled amplitude digital read/write channel that provides a highly flexible, state-of-the-art, synchronous read path for high-density magnetic disk drives.



Storage

Optical — DVD, CD-ROM, CD-R/RW Products



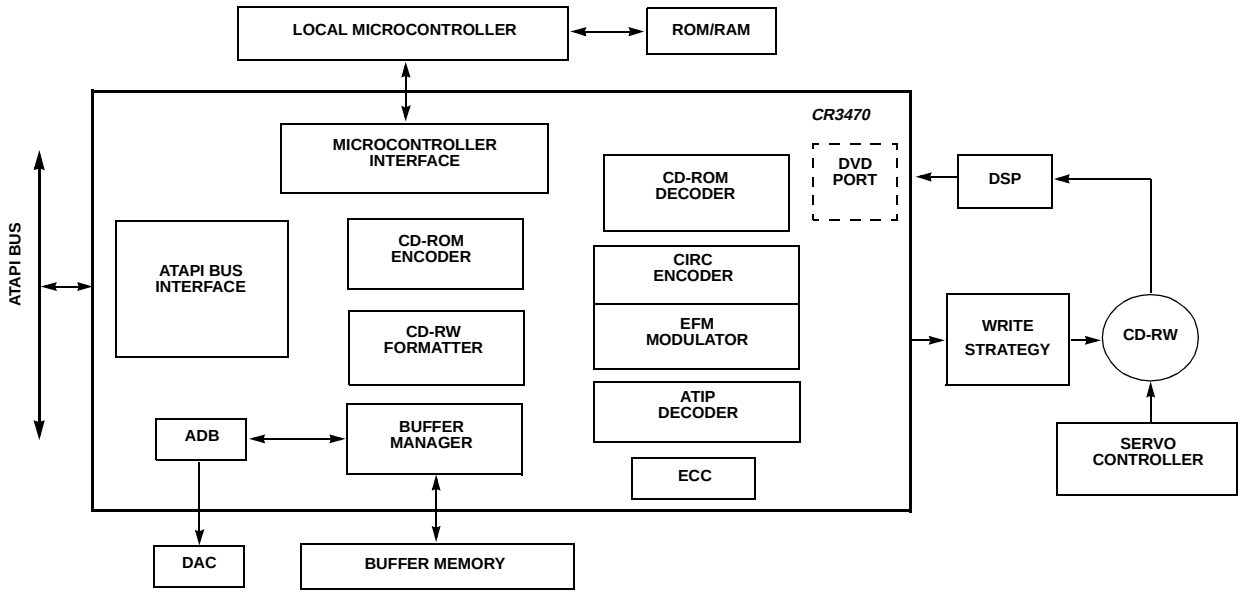
CL-CR3470/CR3475

ATAPI CD-R/RW Encoder/Decoder

- **Single-chip integration of CD-ROM decoder, CD-ROM encoder, CIRC encoder, EFM modulator, ATIP decoder, buffer manager, and ATAPI interface**
- **DVD port support (CL-CR3475 only)**
- **Supports up to 12x encoding speed**
- **40x decoding speed**
- **Supports disc speeds up to 65 MHz MCLK**
- **Supports fast page mode or EDO DRAM**
- **Supports Ultra ATA 33 data transfer protocol with data rate up to 33.3 Mbytes/sec**
- **Real-time CD-ROM layered ECC error correction with programmable number of P- and Q-word corrections per sector (up to 64 total)**
- **Supports ADB (Audio Data Buffering) for CD-DA data**
- **Supports CD-Text mode format**
- **Low-power, highly efficient 0.35-micron CMOS technology in a 144- or 176-pin LQFP package**

The CL-CR3470 and CL-CR3475 are single-chip, high-performance, highly integrated ATAPI interface devices for the CD-R/RW (CD-Recordable/CD-Re-writable) market. The CL-CR3470 and CL-CR3475 integrate CD-ROM decoder, CIRC encoder, EFM modulation, ATIP decoder, buffer manager, and ATAPI interface logic. In addition to its CD-Re-writable capability, the CL-CR3475 features a DVD port enabling drive manufacturers to develop a drive that reads DVD, CD-ROM, CD-R, and CD-RW.

The CL-CR3470 and CL-CR3475 support up to 40x read and 12x record disc speeds, allowing customers to design a CD-RW drive with read speeds compatible with CD-ROM. All write methods are supported by the CL-CR3470 and CL-CR3475 disc-at-once, track-at-once, packet recording, and multi-session-at-once. These devices incorporate the most comprehensive error correction available in the industry, using real-time CD-ROM-layered ECC error correction with a programmable number of P/Q-word corrections per sector (up to 64 total).



CL-CR3480

ATAPI CD-R/RW Encoder/Decoder

- **Single-chip integration of CD-ROM decoder, CD-ROM encoder, CIRC encoder, EFM modulator, ATIP decoder, buffer manager, and ATAPI interface**
- **DVD port support**
- **Supports up to 16x encoding speed**
- **48x decoding speed**
- **Supports disc speeds up to 71 MHz MCLK**
- **Supports SDRAM**
- **Supports Ultra ATA 33 data transfer protocol with data rate up to 33.3 Mbytes/sec**
- **Supports Ultra DMA 33**
- **Real-time CD-ROM layered ECC error correction with programmable number of P- and Q-word corrections per sector (up to 64 total)**
- **Supports ADB (Audio Data Buffering) for CD-DA data**
- **Supports CD-Text mode format**
- **Low-power, highly efficient 0.25-micron CMOS technology in a 128-pin LQFP package**

The CL-CR3480 is single-chip, high-performance, highly integrated ATAPI interface device for the CD-R/CD-RW (CD-Recordable and CD-Re-writable) market. The CL-CR3480 integrates CD-ROM decoder, CIRC encoder, EFM modulation, ATIP decoder, buffer manager, and ATAPI interface logic.

The CL-CR3480 supports up to 48x read and 16x record disc speeds, allowing customers to preserve all CD/RW encode/decode electronics and firmware as the disc speed requirements increase. All write methods are supported by the CL-CR3480 disc-at-once, track-at-once, packet recording, and multi-session-at-once. These devices incorporate the most comprehensive error correction available in the industry, using real-time CD-ROM–layered ECC error correction with a programmable number of P/Q-word corrections per sector (up to 64 total). The CL-CR3480 also supports real-time subcode R-W correction in CD-DA™ mode.

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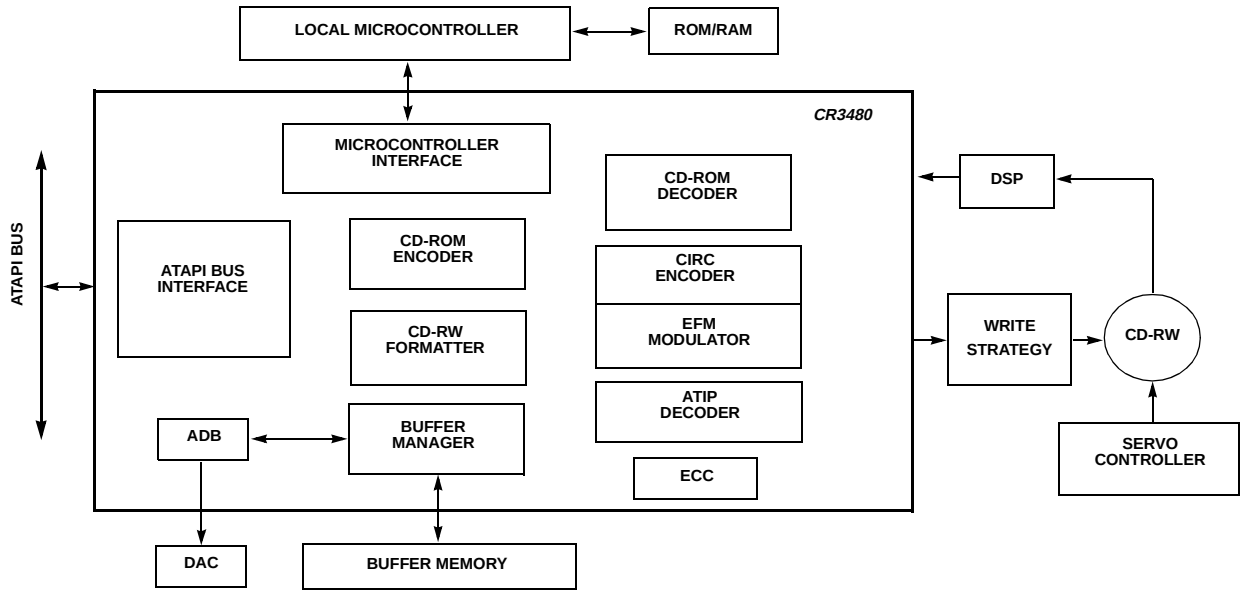


CL-CR3710

Integrated, High-Performance ATAPI DVD Drive Manager

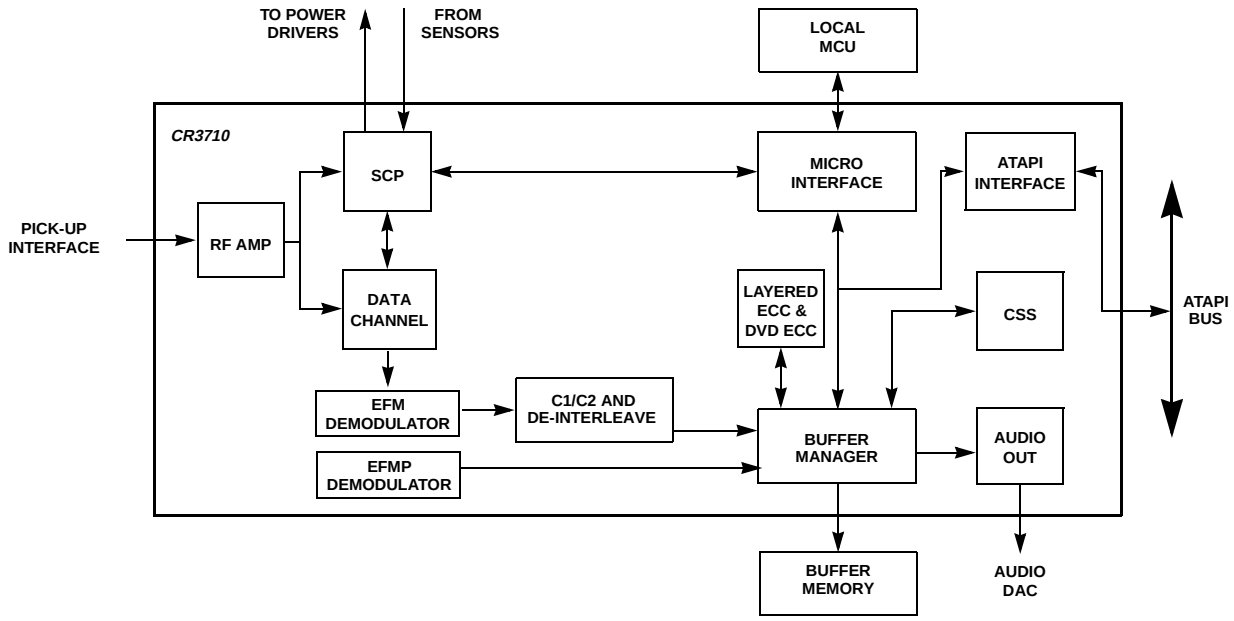
- **Integrates all required components for a complete ATAPI DVD-ROM electronics solution:**
  - — RF amp
  - — PRML Data channel
  - — Servo control processor
  - — DVD/CD decoder
  - — CSS (content scramble system)
  - — ATAPI decoder
- **Direct MPEG-2 decoder interface for DVD player applications**
- **High-performance controller supports DVD disc speeds up to 8x DVD speed, 40x CD speed**
- **Supports Ultra DMA: capable of synchronous DMA data transfer rates up to 33.3 Mbytes/sec**
- **Firmware compatible with all Cirrus Logic CD-ROM and CD-R/RW devices**
- **Low-power, highly efficient 0.35-micron CMOS technology in a 208-pin LQFP package**

The CL-CR3710 is Cirrus Logic's high-integration, high-performance ATAPI DVD drive manager. It integrates all components required for a DVD-ROM drive and can be used in a DVD player. The CL-CR3710 includes RF amp, servo control processor, data channel, DVD ECC, CSS, CD-ROM decoder, and ATAPI interface logic.

The CL-CR3710 can be configured with an audio DAC (digital-to-analog converter), external buffer memory (16-bit SDRAM), a local microcontroller with its RAM and ROM, and power drivers to create a complete DVD-ROM electronics solution. It has an integrated MPEG-2 interface and can be efficiently designed into a DVD player.

The CL-CR3710 supports DVD disc speeds up to 8x, CD-ROM disc speeds up to 40x, and Ultra DMA host speeds up to 33.3 Mbps.

NEW



Evaluation Development Tools

Cirrus Logic offers several development tools that can help a customer design-in a Cirrus Logic product. The following gives a brief description of these tools.

Reference Designs and Demonstration/Development Boards

To facilitate thorough product evaluation by our customers, we provide reference designs and customer demonstration boards for most Cirrus Logic products. These products include a fully functional evaluation board with all supporting technical documentation and software.

CDBs (Customer Demonstration Boards) are interface boards that allow a user to evaluate the performance of a particular device.

CRD (Customer Reference Design) boards are application-specific boards that serve a pre-defined function and illustrate the functionality of a particular device in a specific or pre-defined mode. These reference designs provide a complete turn-key solution and serve as a standard (a reference) for system designs. Reference design kits include schematics, Gerber files, Bill of Materials, and software when appropriate. To facilitate rapid development, customers are encouraged to copy these designs as they can serve as a spring-board for future systems.

In addition to customer demonstration/development and reference design boards, Cirrus Logic also offers the CDBCAPTURE+ and CDB Standalone boards. These tools allow for data collection (from most of the CDBs) and enhanced device evaluation via PC analysis tools.

Please contact your local Sales Representative or Distributor for more information on how to obtain Reference Design or Demonstration/Development Board kits.

Evaluation Development Tools

Schematic and Layout Review Service

Schematic & Layout Review Service

Confirm optimum schematic and layout before building your board.

For our free review service, call applications engineering

(512) 445-7222

CDBCAPTURE+

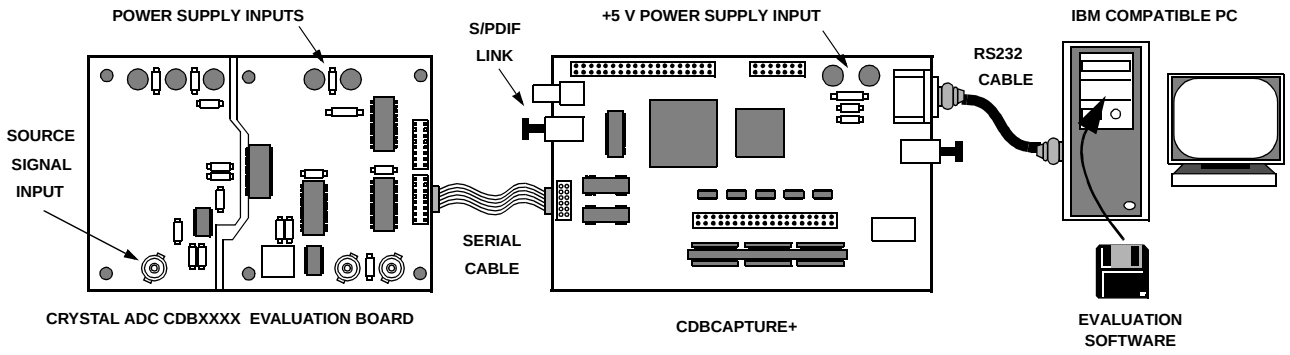
Data Capture and Interface Board for a PC

- **Versatile measurement tool used for the evaluation of Crystal® analog-to-digital converters**
- **Updatable via on-board RAM-based DSP and Altera programmable logic device**
- **Easy interface to a PC-compatible computer**
- **LabWindows® based evaluation software for data analysis**
- **Includes time domain, FFT, noise distribution histogram, and DNL analysis options**
- **Can be used to evaluate the ADC in your equipment**
- **Interfaces to the following ADC evaluation board via 10-pin serial ribbon cable**
  - — CS5012A CS5014 CS5016 CS5101A CS5102A
  - — CS5126 CS5180 CS5181 CS5317 CS5322
  - — CS5501 CS5503 CS5505 CS5506 CS5507
  - — CS5508 CS5509
- **Interfaces to the following ADC evaluation board via S/PDIF Link:**
  - — CS5330 CS5331 CS5334 CS5335
  - — CS5360 CS5390 CS5394 CS5396

The CDBCapture+ interface board is a development tool that interfaces a Crystal analog-to-digital converter to a PC-compatible computer. Digital data is collected in a high speed digital SRAM, then transferred to the PC over a serial COM port. Evaluation software is included to analyze the data and demonstrate the analog-to-digital converter's performance.

The CDBCapture+ interface board is designed to be easily interfaced to Crystal evaluation boards. Application software is loaded via the PC's serial COM port. The software adjusts the CDBCapture+ interface board for the appropriate signal timing and polarity, coding format and number of bits, thus allowing the same hardware to be used with a variety of Crystal ADCs.

Evaluation software is included with the CDBCapture+ interface board. The software was developed with National Instrument's LabWindows®, a software development system for instrument control, data acquisition, and analysis applications. The evaluation software permits time domain, frequency domain, histogram, and DNL analysis.



CDB Stand-alone

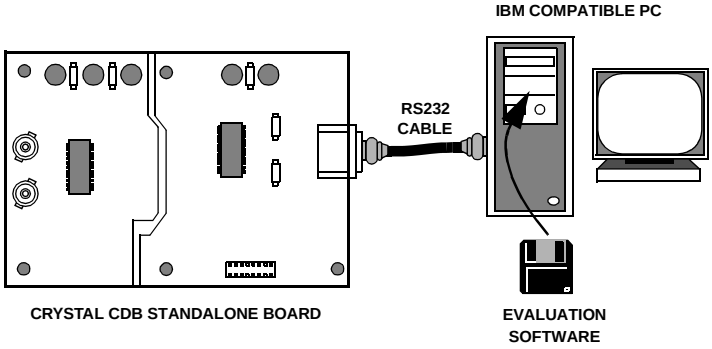
Customer Demonstration/Development and Board Support

- **Versatile measurement tool used for the evaluation of Crystal® analog-to-digital converters**
- **On-board micro-controller based digital interface**
- **Easy interface to a PC-compatible computer**
- **LabWindows® based evaluation software for data analysis**
  - — Time domain analysis
  - — Spectrum analysis (i.e. FFT analysis),
  - — Noise distribution/histogram analysis
  - — Differential nonlinearity (DNL) analysis
- **Can be used to evaluate the ADC in your equipment**
- **Stand-alone evaluation boards are available for the following products:**
  - — CS5516* CS5520*
  - — CS5521 CS5522 CS5523 CS5524 CS5528
  - — CS5531 CS5532 CS5533 CS5534

The CDB Stand-alone Evaluation Boards are development tools that interface a Crystal analog-to-digital converter to a PC-compatible computer. Conversion data is collected by a micro-controller on the evaluation board and then transferred to a PC over a serial COM port.

Evaluation software is included to analyze the data and demonstrate the analog-to-digital converter's performance. The application software is used to configure the ADCs for different setting and conversion modes. The software was developed with National Instrument's LabWindows®, a software development system for instrument control, data acquisition, and analysis applications. The evaluation software permits time domain, frequency domain, histogram, and DNL analysis.

*PC software for evaluation board does not include statistical analysis algorithms.



CRD Example

Crystal® Reference Design Boards

Crystal Reference Design boards are available for popular product configurations. Please consult your local sales office for details. The following is one example of a Crystal Reference Design board.

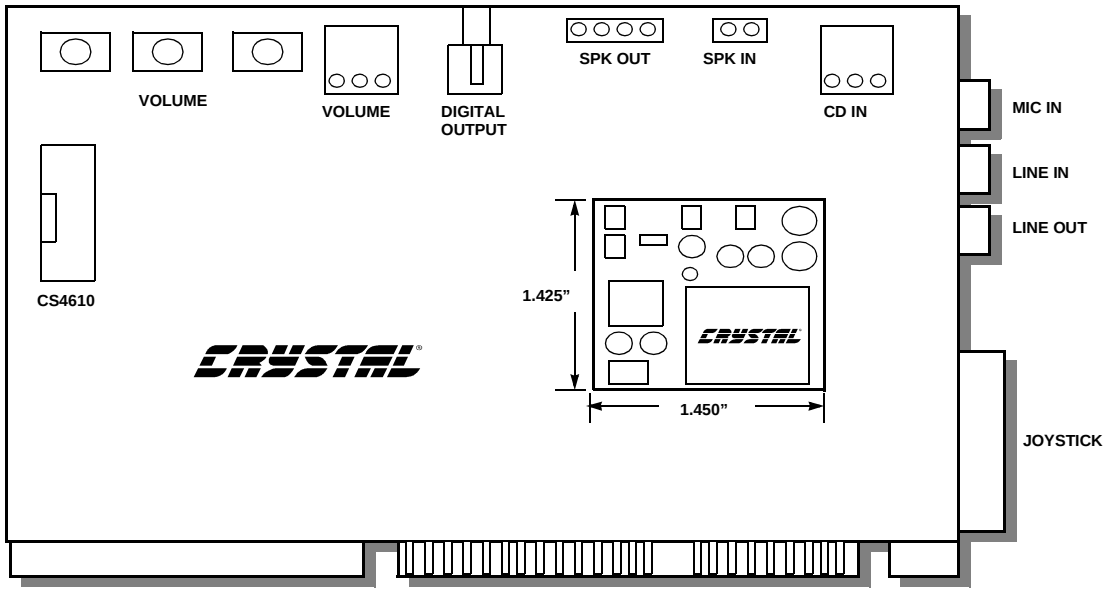
CRD4235-8

CrystalClear™16-Bit Audio Motherboard Example Design

- **WHQL™, PC 97, and PC 98 compliant**
- **Integrated FM synthesizer**
- **CrystalClear™ 3D stereo enhancement**
- **Integrated 3D-sound technology**
- **Demonstrates a 4-Layer board layout**
- **Includes a design guide section**
- **Requires only 2.0 sq. in. to implement**

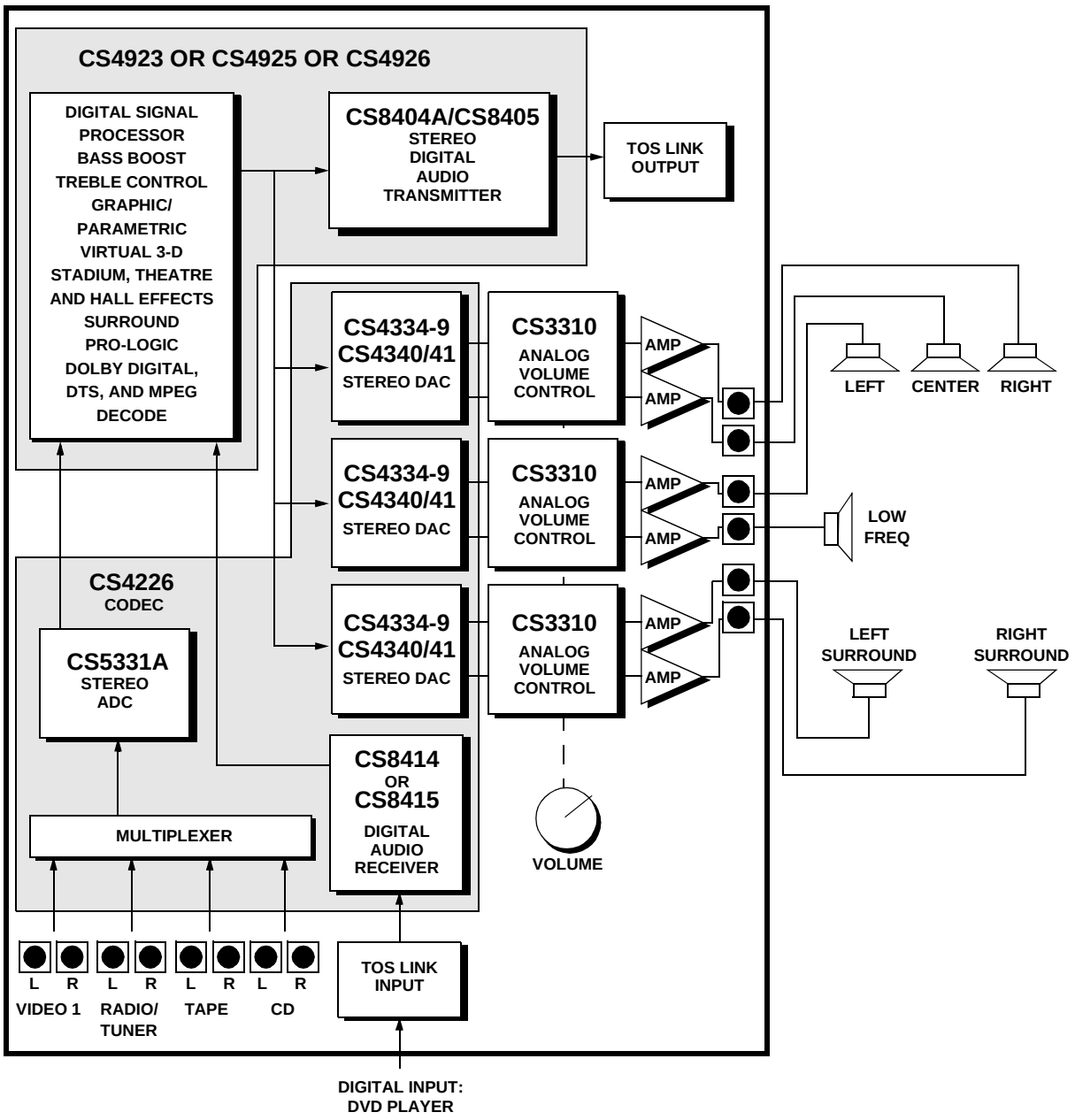
The CRD4235-8 is a CD-quality reference design that is fully MPC3-compliant and compatible with Ad Lib™, Sound Blaster Pro™, and Windows Sound System™. Based on the CrystalClear™ CS4235 audio codec, it includes internal FM synthesizer, hardware master volume control with volume mute, extensive power management, and 3D sound technology.

The CRD4235-8 operates in both Plug-and-Play compliant systems, as well as, systems that do not support Plug-and-Play. This reference design layout is representative of a typical motherboard implementation and requires only 2.0 sq. inches.

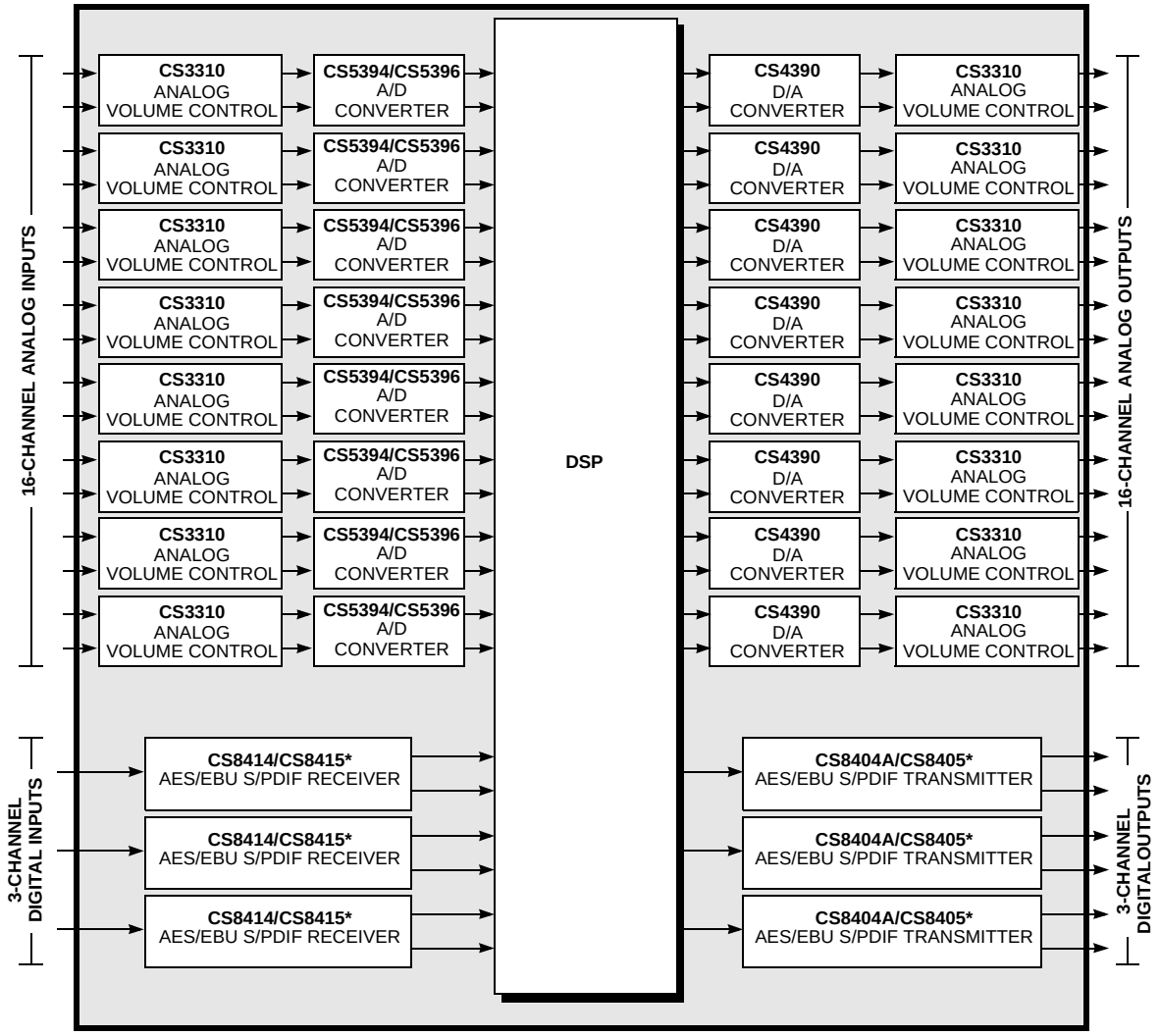


Product Applications

AV Receiver Application

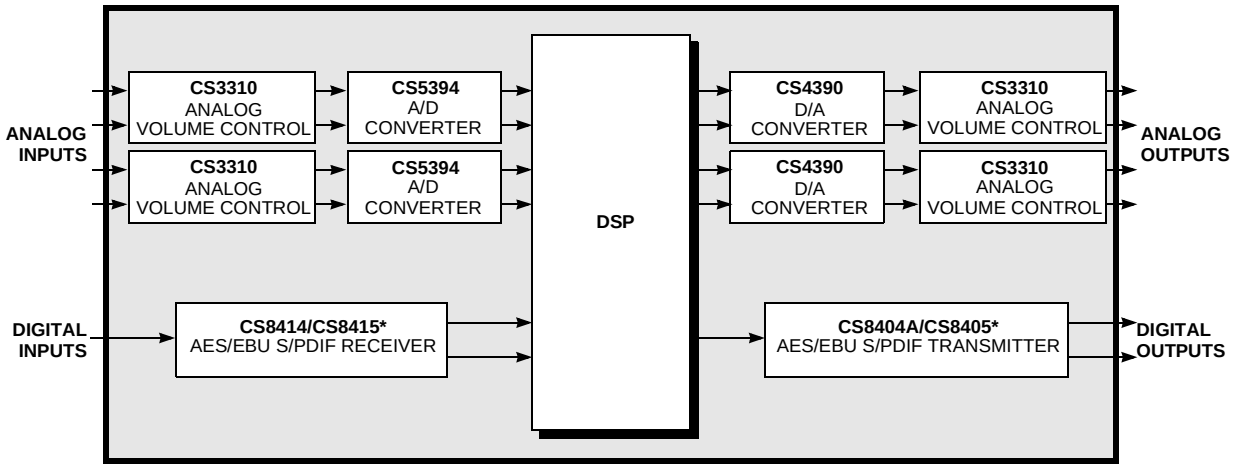


Mixing Console Application



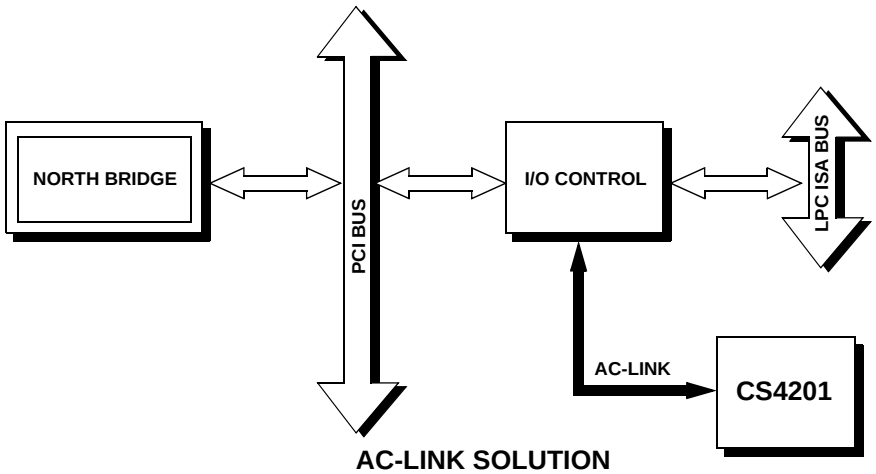
* May be replaced by **CS8420** (with Sample-Rate Converter) if asynchronous input capability is desired.

Effects Processor Application

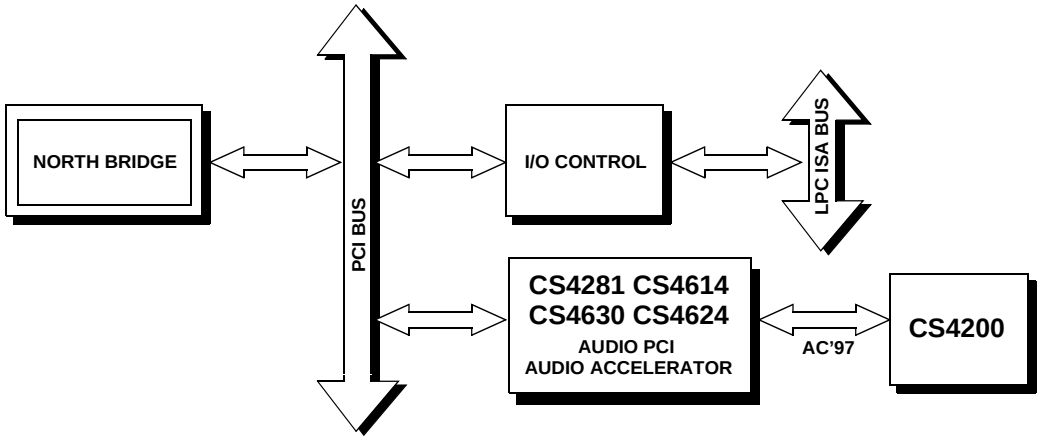


* May be replaced by CS8420 (with Sample-Rate Converter) if asynchronous input capability is desired.

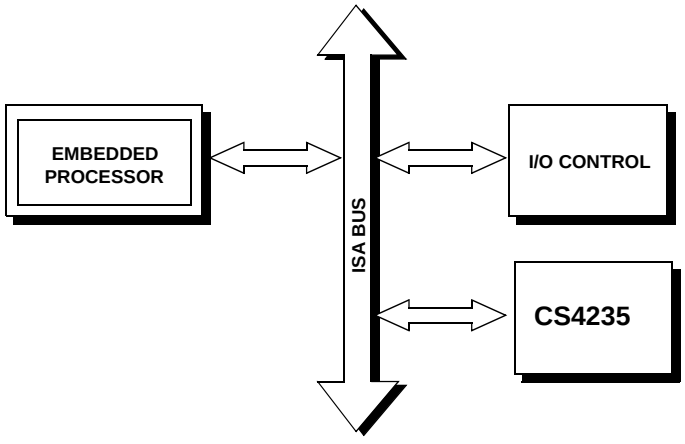
PC Audio Application



AC-LINK SOLUTION

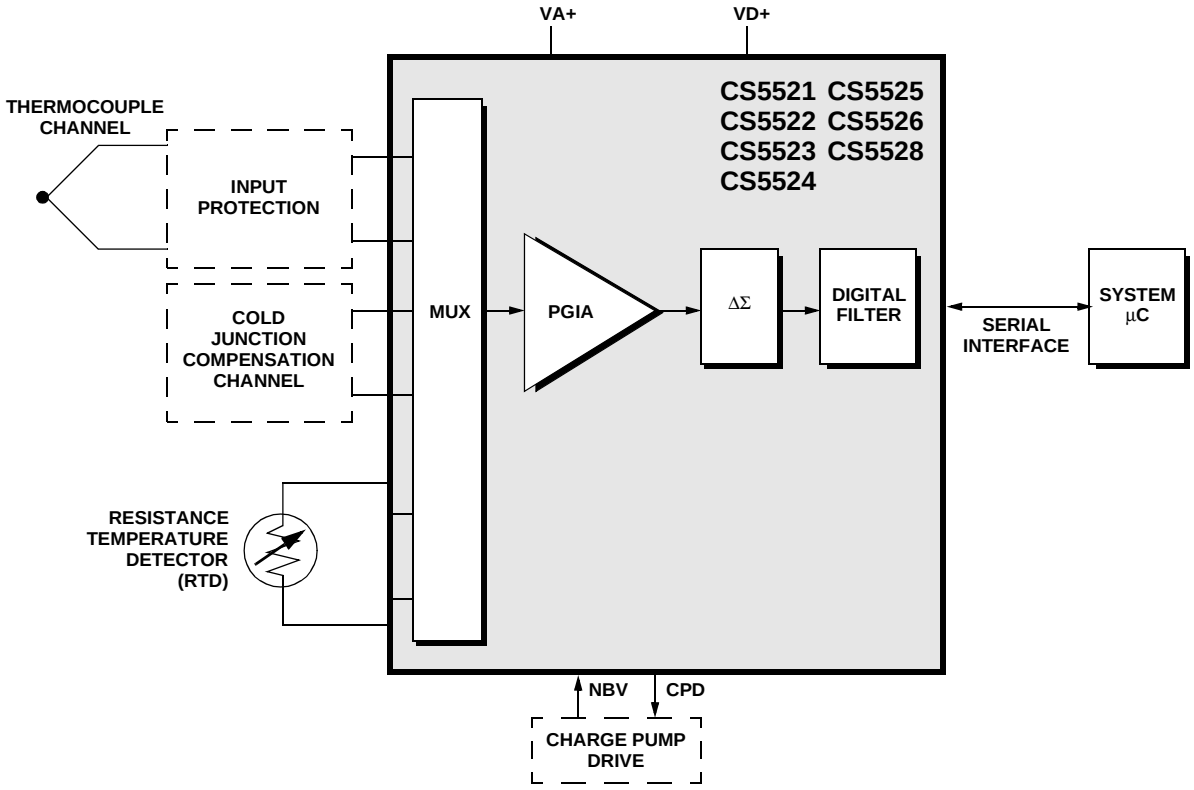


PCI AUDIO CONTROLLER WITH AC-LINK SOLUTION



AUDIO CODEC SOLUTION

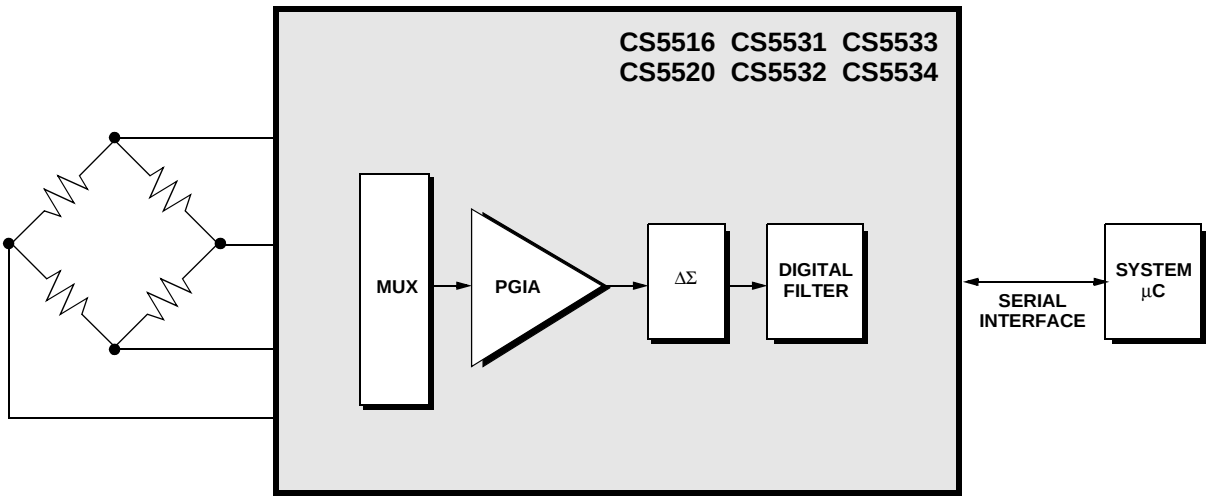
Thermocouple/RTD Application



Part Number	Resolution	Multiplexer	Page Number
CS5521	16	2-Channel	119
CS5522	24	2-Channel	120
CS5523	16	4-Channel	119
CS5524	24	4-Channel	120
CS5525	16	1-Channel	121
CS5526	20	1-Channel	121
CS5528	24	8-Channel	120

Features	Benefits
Direct sensor connection	Eliminates costly amplifiers by including chopper-stabilization amplifier
Low input current (<300 pA -40°C to +85°C)	Simplifies input protection circuitry; permits large input impedance
Negative supply	Includes an on-chip charge pump drive (-2.1 V negative supply)

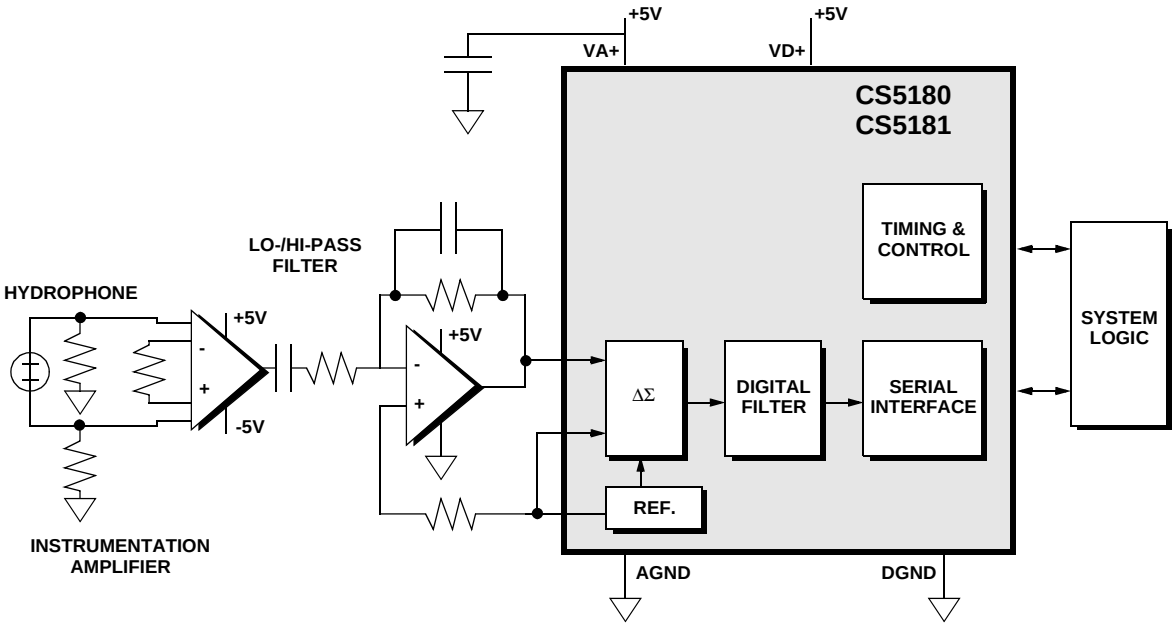
Weigh Scale Application



Part Number	Resolution	Multiplexer	Page Number
CS5516	16	1-Channel	118
CS5520	20	1-Channel	118
CS5531	16	2-Channel	123
CS5532	24	2-Channel	123
CS5533	16	4-Channel	123
CS5534	24	4-Channel	123

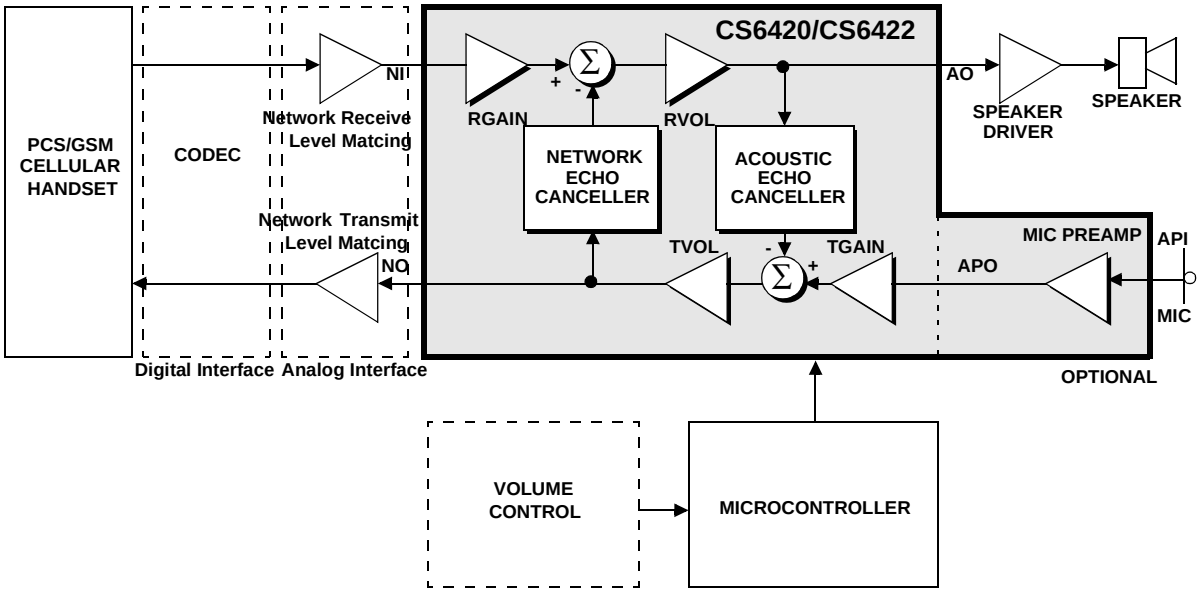
Features	Benefits
Direct sensor connection	Eliminates costly amplifiers and accommodates low-level signals
Single or dual supply excitation	Flexible power supply configuration
Zero's at output Word Rate	Eliminates aliasing effects

Sonar Application



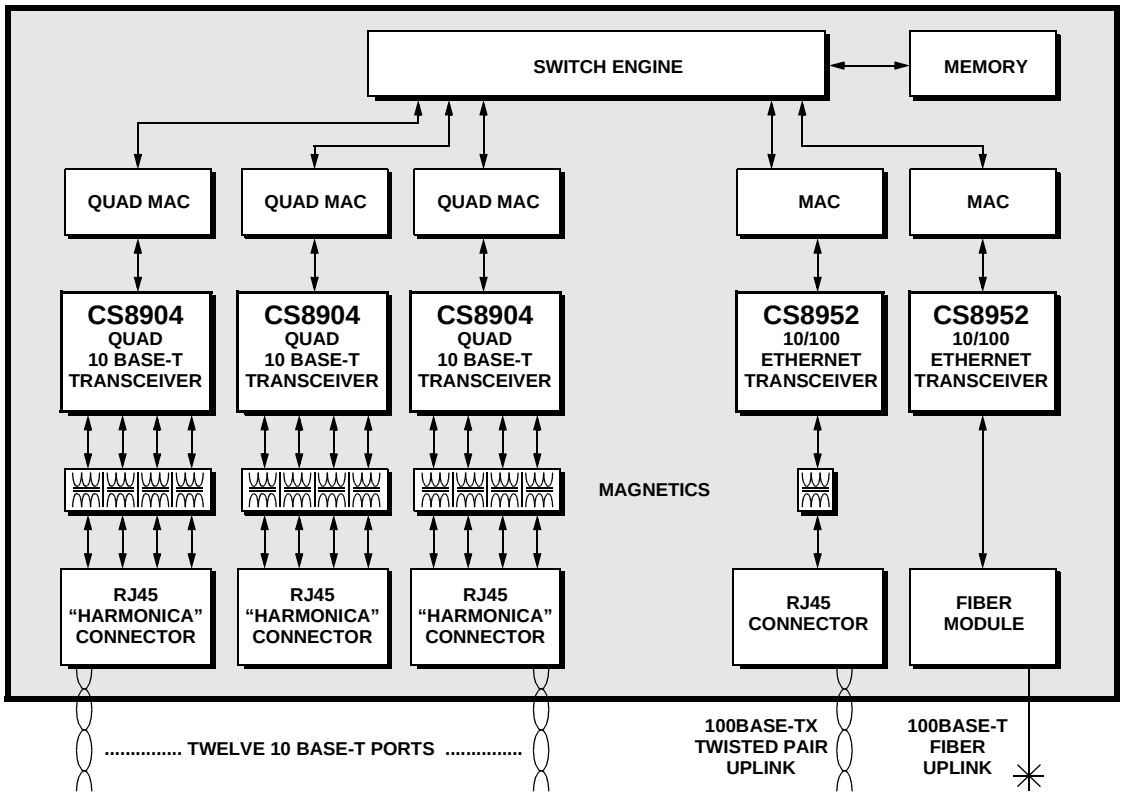
Features	Benefits
High signal-to-noise (93 dB CS5180, 91 dB CS5181)	Simplifies system design
High throughput (400 kHz CS5180, 625 kHz CS5181)	Provides 8 kHz ~ 625 kHz throughput
Anti-aliasing filter	Relaxes external anti-aliasing filter requirements
Modulator-only mode	Provides flexible filter design

Echo Cancellation in Cellular Car Kit Application

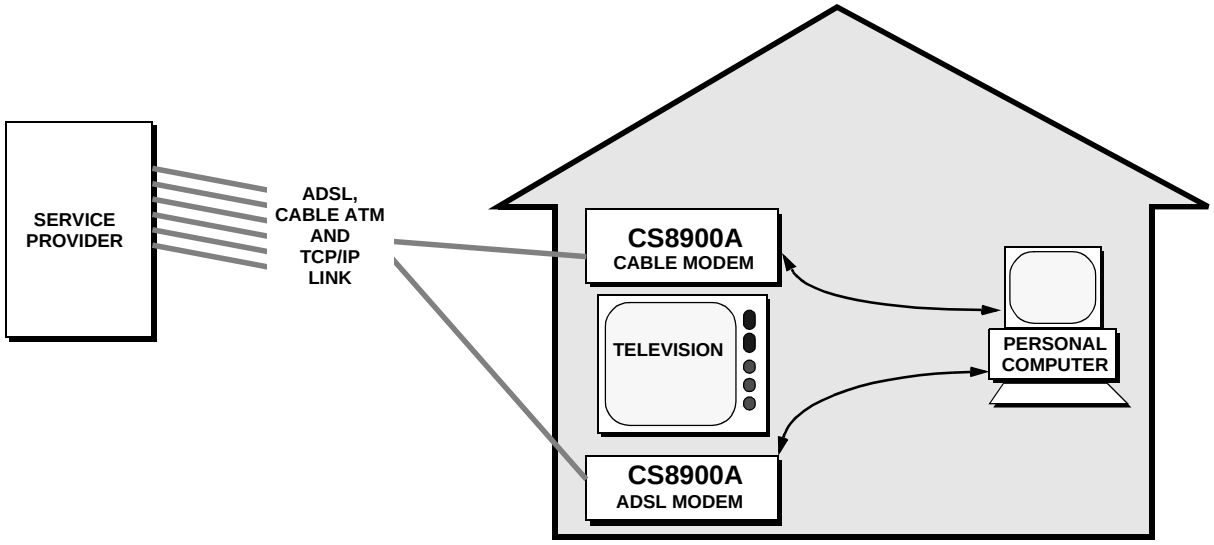


— Provides full-duplex, hands-free speaker phone operation in a car
— Simple analog connection to most cellular phones (digital interface requires inexpensive codec)
— Integrated microphone pre-amp and volume control with AGC reduce external component count and enhance call quality

LAN Switch Application

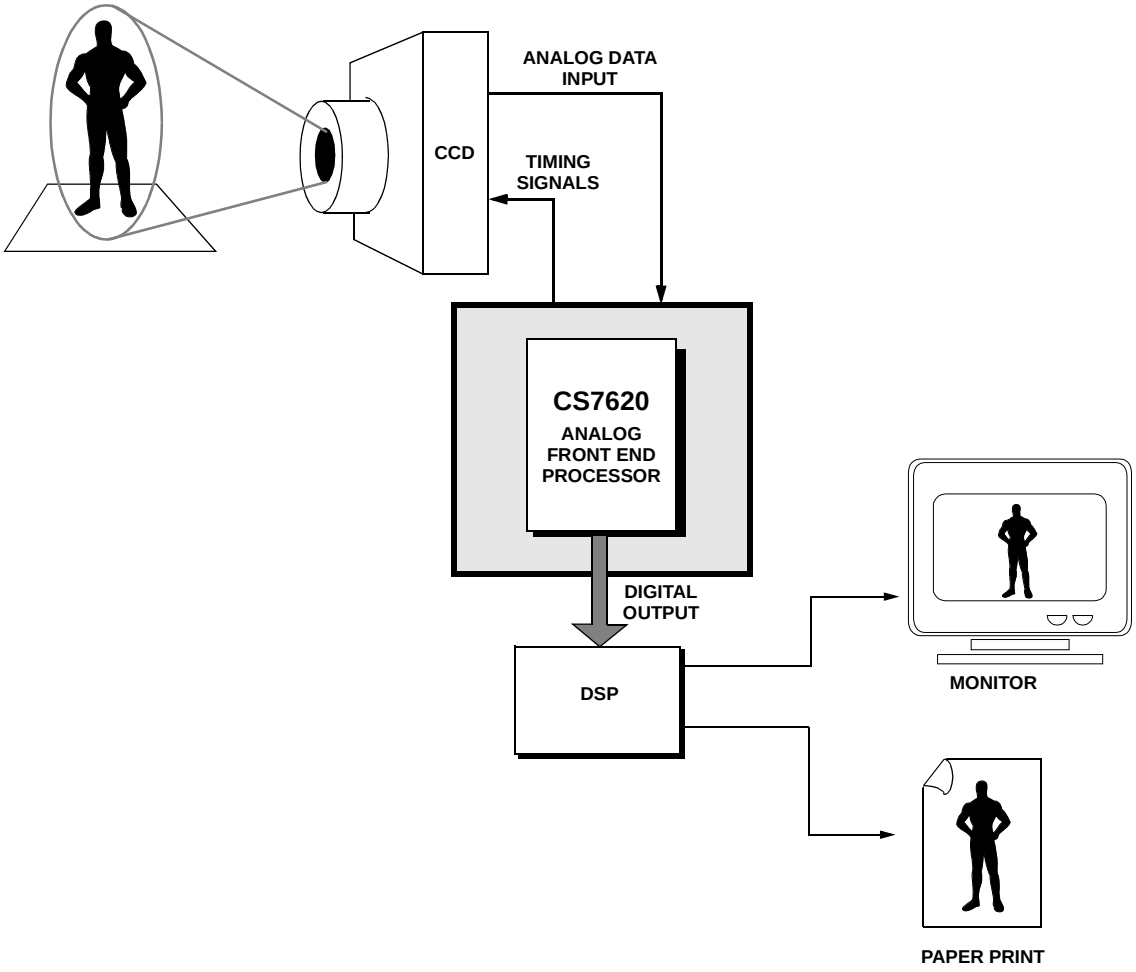


Network Set-Top and Cable Modem Application

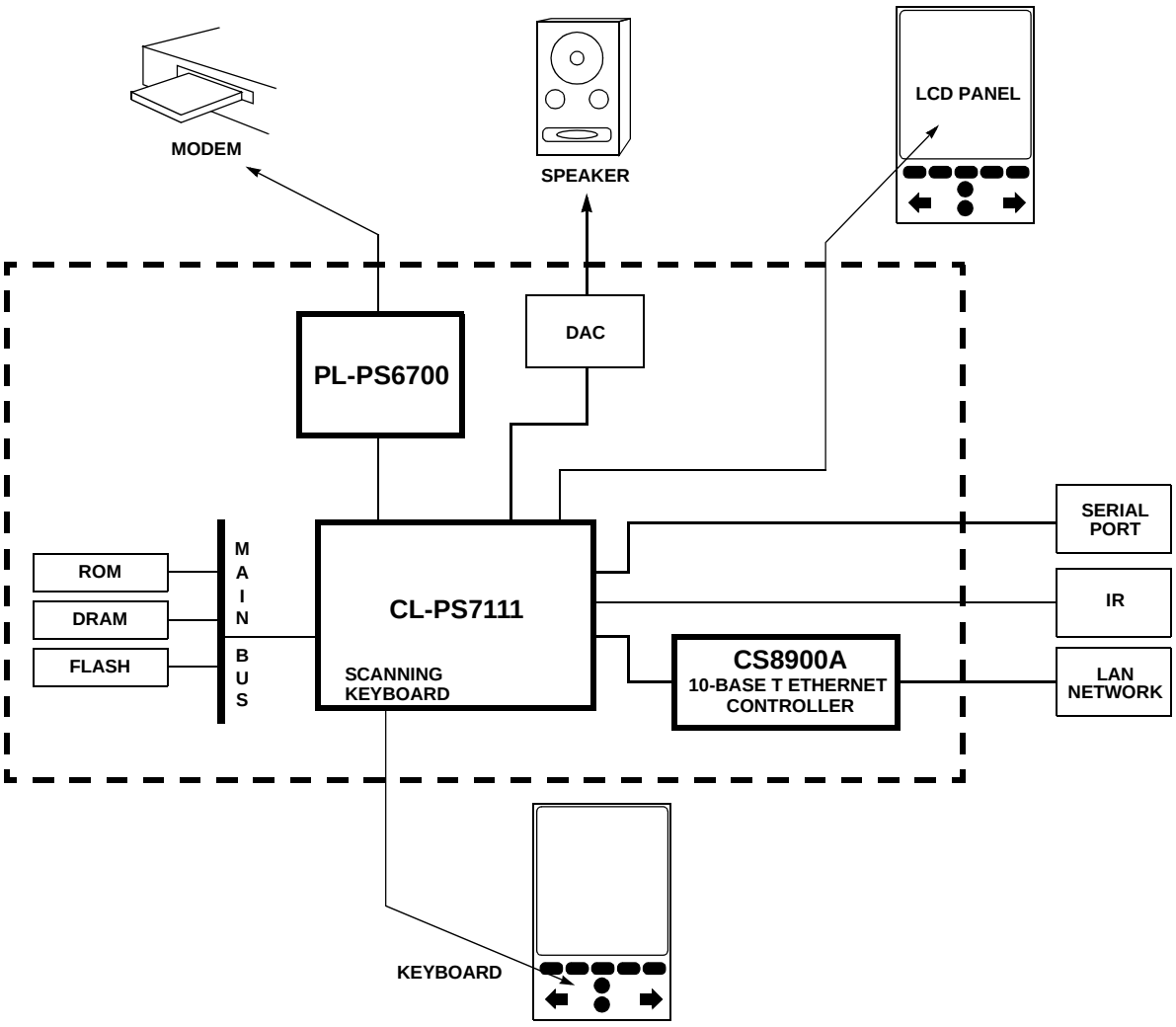


— POS KIOSKS
— Industrial Telemetry
— VOIP Phones

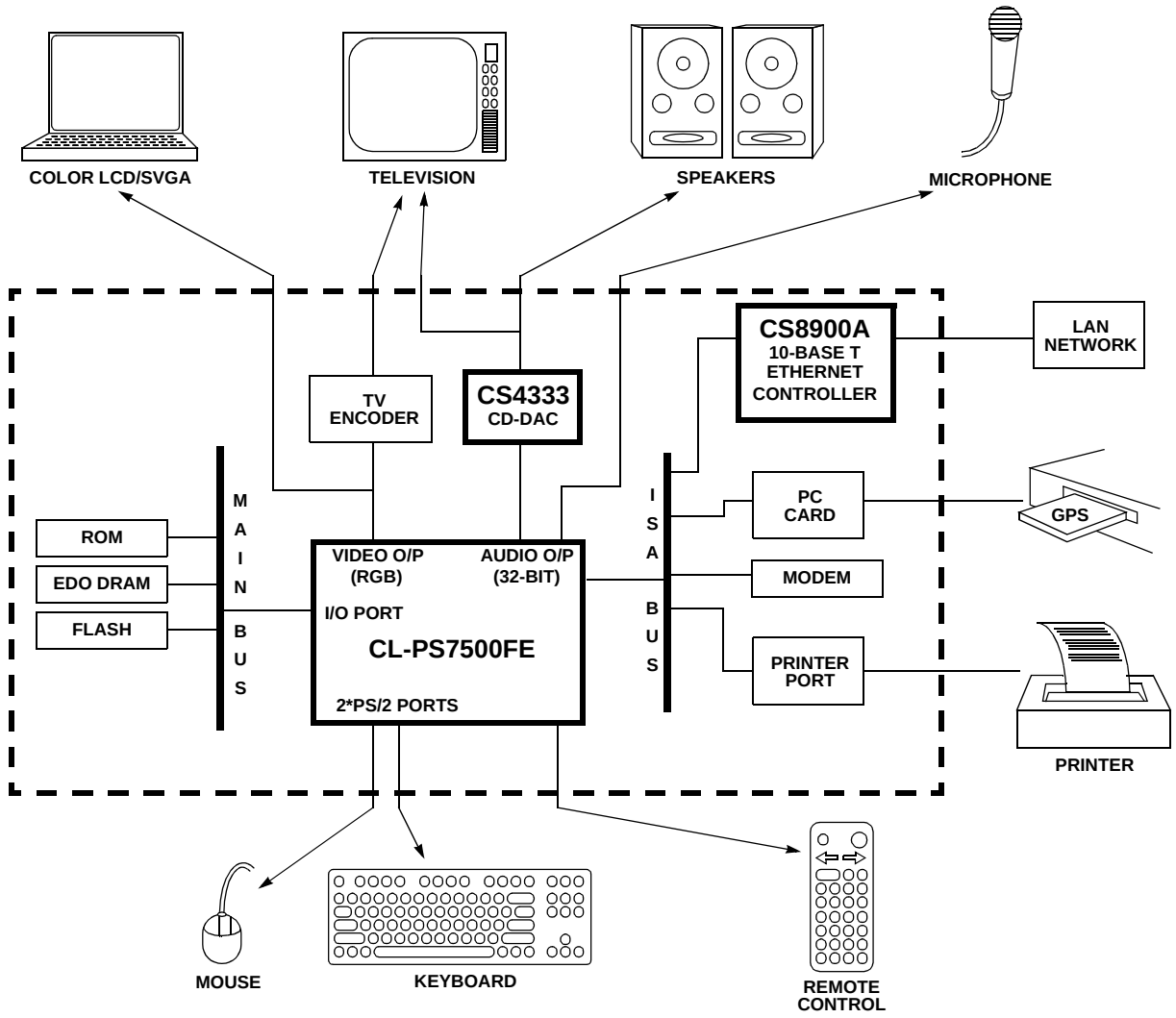
Still Camera Application



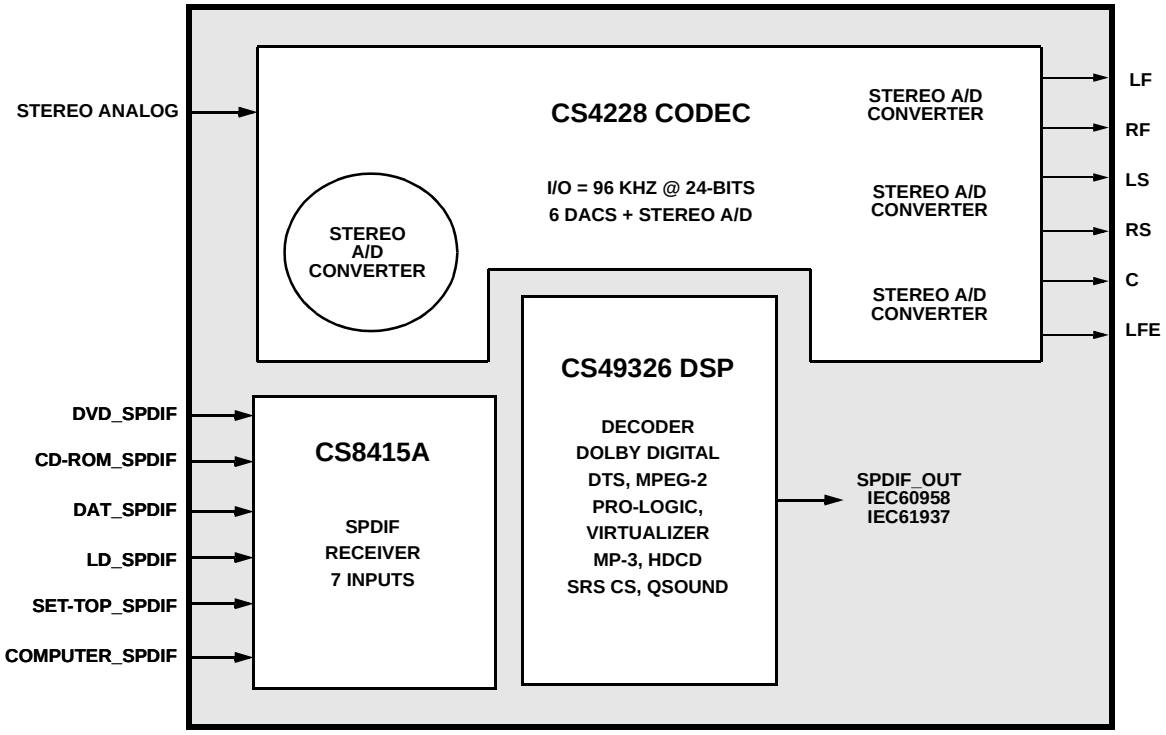
PDA Application



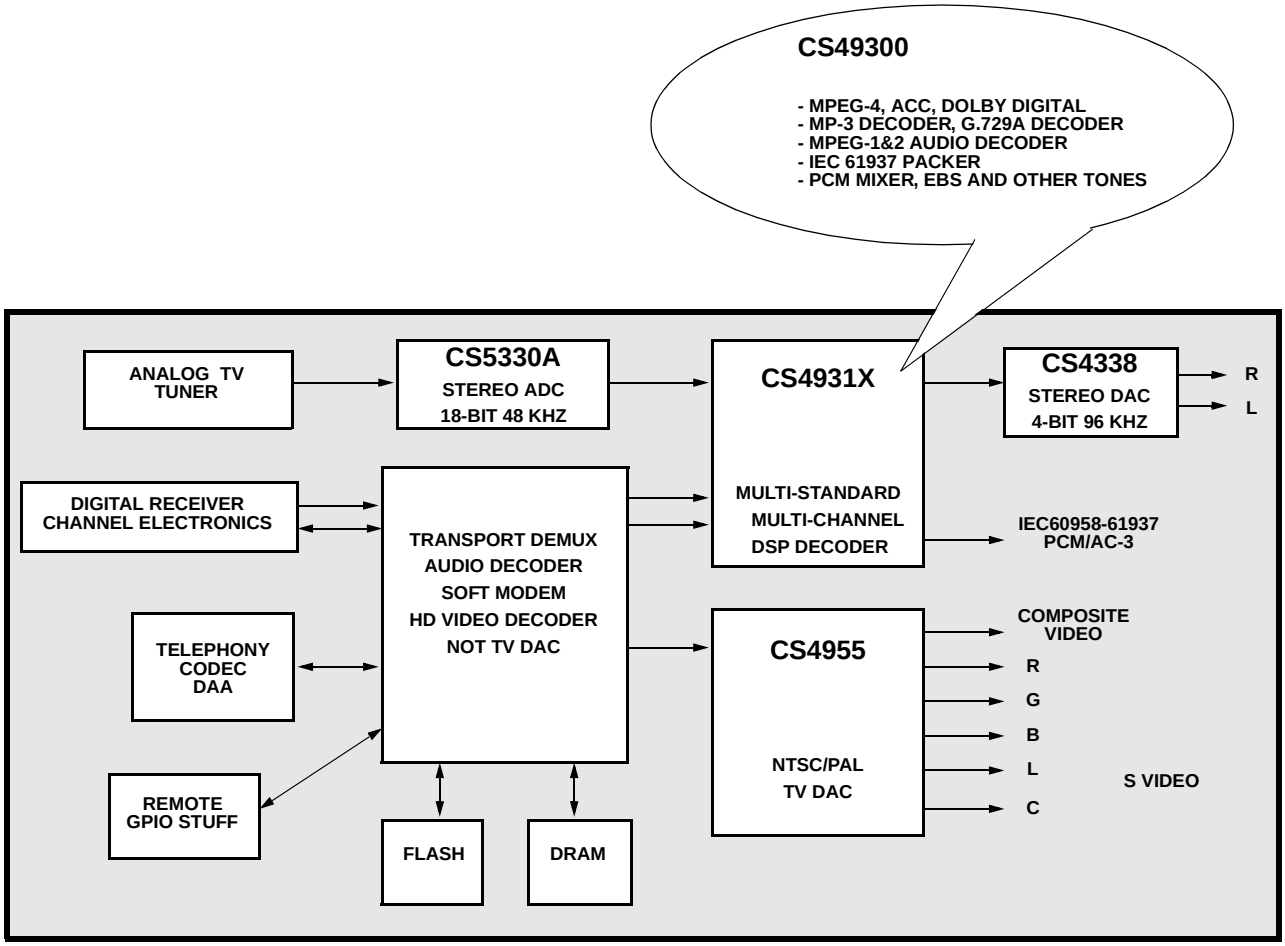
Internet Appliance Application



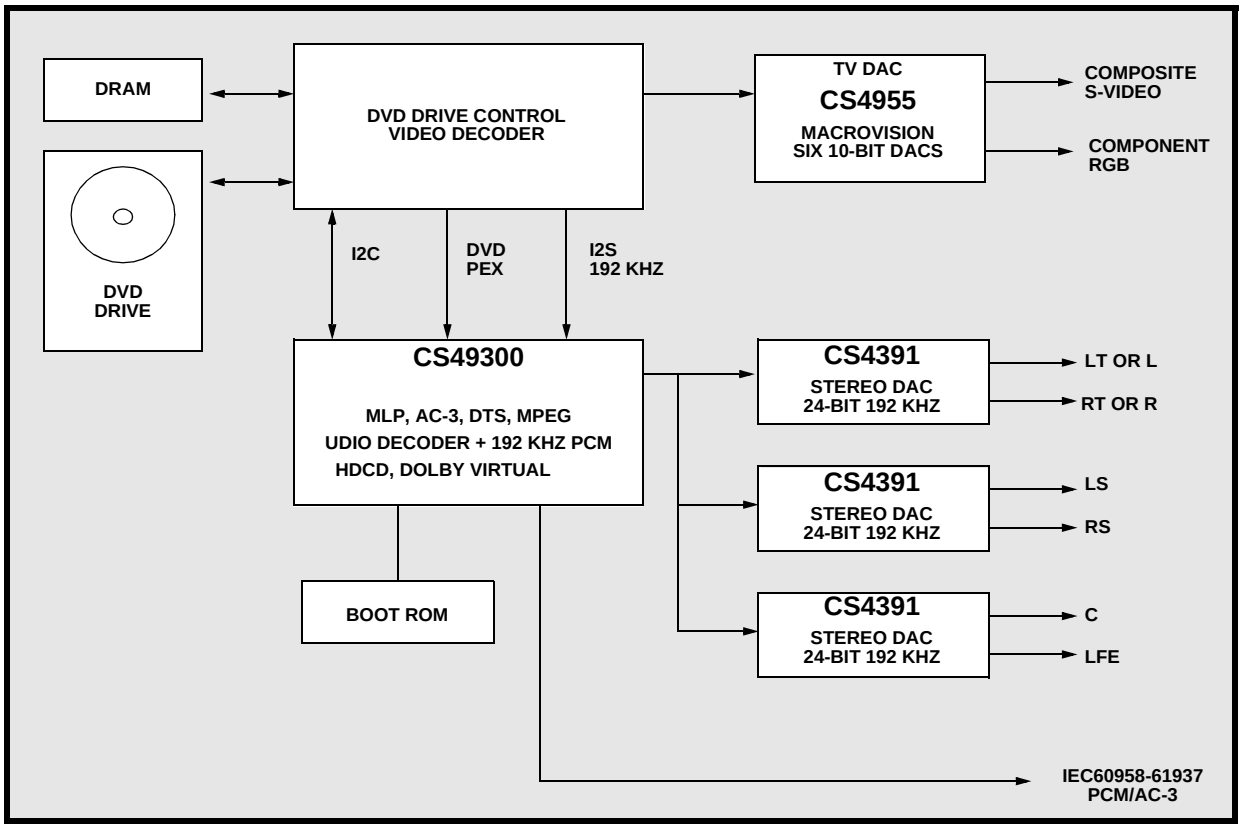
AVR Subsystem Application



Universal Set-Top Box Application



Universal DVD Audio Decoder Application



Package Type Definitions

C S X X X X X X - T P N N H

Electrical or speed specification (optional) up to 2 numeric digits
No alpha characters
See data sheet

Package code - required
Alpha characters only
No numerics

P = Plastic Dip
C = Ceramic Dip
D = Cerdip
L = Plastic Leaded Chip Carrier, J-Lead
U = Unpackaged Die
Z = TSSOP (4.4 mm)
M = Metric Quad Flat Pack

S = 0.15 and 0.3" SOIC, SSOP, 6.1 mm TSSOP
E = Ceramic LCC
J = J-Lead Ceramic Chip Carrier
G = Gullwing Ceramic Chip Carrier
Q = Plastic Quad Flat Pack (TQFP, LQFP)
W = Wafer Sale

Temperature specifications - required
Alpha characters only

Signal Conditioning/Communication:
C = 0°C to 70°C
I = -40°C to 85°C
M = -55°C to 125°C

Temperature/Accuracy - required
Alpha characters only

Data Acquisition:

Temperature	Accuracy		
	Good	Better	Best
C = 0°C to 70°C	J	K	L
I = -40°C to 85°C	A	S	C
M = -55°C to 125°C	S	T	U

Up to 6 alpha numeric digits comprise remainder of basic part number

42 = Codecs
43 = D/A Converter
46 = PCI DSPs
49 = Audio DSPs

3 = Support Circuits
6 = Telecommunications
7 = Signal Conditioning
8 = Datacommunications

50 = GP A/D Converter
51 = GP A/D Converter
53 = Signal Processing A/D Converters
54 = Energy Measurement

Crystal Semiconductor

CS = All Crystal Products
CXT = Quartz Crystal
CDB = Evaluation Board
CX = Custom Products

EP = Embedded Processor
CRD = Reference Design Kit
CK = Chip Set
CMK = Manufacturing Kit

Application Note/White Paper Library

Application notes can be obtained from the Cirrus Logic website at: **www.cirrus.com** and from the 1999 Cirrus Logic Product Guide CD-ROM, included with this publication. AES papers are located at **www.aes.org**.

AN04 : Voltage References for Crystal A/D Converters
- CS5012A/14/16
- CS5101A/02A
- CS5126

AN06 : Buffer Amplifiers for A/D Converters
- CS5012A/14/16
- CS5101A/02A
- CS5126

AN07 : Measurement and Evaluation of Pulse Shapes in T1/E1 Transmission Systems
- CS61574A/75
- CS61581

AN08 : Application Hints for the CS501X Series of A/D Converters
- CS5012A/14/16

AN10 : ΔΣ A/D Conversion Technique Overview
- CS5501/03
- CS5317

AN12 : AT&T 62411 Design Considerations Jitter and Synchronization
- CS61574A/75
- CS61581

AN16 : Jitter Attenuation Performance of the CS61575 and CS61575A PCM Line Interface Circuits
- CS61574A/75
- CS61581

AN22 : Overview of Digital Audio Interface Data Structures
- CS8401A/2A
- CS8403A/4A
- CS8411/12
- CS8413/14
- CS8420

AN27 : A Tutorial on MIDI and Wavetable Music Synthesis
- CS4235

AN28 : Precision Temperature Measurement using RTDs
- CS5516/20

AN30 : Switched-Capacitor A/D Converter Input Structures
- CS5501/03
- CS5516/20

AN31 : A Collection of Bridge Transducer Digitizer
- CS5505/06/07/08
- CS5509
- CS5516/20

AN32 : CS5516 and CS5520: Answers to Application Questions
- CS5516/20

AN33 : Clock Options for A/D Converters
- CS5501/03
- CS5504
- CS5101A/02A

AN34 : Secondary Line Protection for T1 and E1 Line Cards
- CS61535A
- CS61574A/75
- CS61577
- CS61581
- CS61582
- CS61583
- CS61584A

AN35 : The CS5504 Family Characteristics
- CS5504
- CS5505/06/07/08
- CS5509

AN36 : CS5516 and CS5520: Overcoming Errors in Bridge Transducer Measurement
- CS5516/20

AN45 : CS5504 Capture Interface
- CS5504

AN46 : CS5509 Capture Interface
- CS5509

AN53 : The CS5322 Digital Filter
- CS5320/21/22

AN70 : Minimizing Start-up Time After Coming Out of Sleep
- CS5101A/02A

AN71 : MPEG Messages
- CS4922

AN73 : Sample Procedures Sequences for CS4920A Audio MPEG Microcode
- CS4922

AN74 : Interfacing the CS5525, CS5526, and CS5529 to the 80C51 Microcontroller
- CS5525/26
- CS5529

AN75 : Using the CS5525/CS5526 in Multiplexed Applications
- CS5525/26

AN80 : Digital CCD Camera Design Guide
- CS7615
- CS7654
- CS7666

AN83 : CrystalLAN CS8900 Technical Reference Manual
- CS8900A

AN84 : Ethernet Controller Technical Reference Manual
- CS8920A

AN86 : Guidelines for Implementing Low-Cost Ethernet on the Motherboard
- CS8920A

AN87 : Technical Report: PC Wakeup Via Ethernet
- CS8920A

AN88 : Interfacing the CS5525, CS5526 and CS5529 to the PIC16F84
- CS5525/26
- CS5529

AN89 : Interfacing the CS5525, CS5526 and CS5529 to the 68HC05
- CS5525/26
- CS5529

AN90 : Quad 10BASE-T Ethernet Transceiver Technical Reference Manual
- CS8904

AN106 : Quick CS6420 Speakerphone Interface
- CS6420

AN110 : CS4235 Review Checklist
- CS4235

AN115 : CS4923/24/25/26/27/28/29 Hardware User's Guide
- CS4923/24/25/26/27/28/29

AN118: Interfacing the CS5522/24/28 to the 80C51
- CS5521/23
- CS5522/24/28

AN120 : Dolby Digital User's Guide for the CS4923/04/05/06 Family
- CS4923/24/25/26/27/28/29

AN121 : MPEG User's Guide for the CS4925
- CS4923/24/25/26/27/28/29

AN122 : DTS User's Guide for the CS4926
- CS4923/24/25/26/27/28/29

AN123 : Crystal Original Surround User's Guide for the CS4923/04/05/06 Family
- CS4923/24/25/26/27/28/29

AN124 : Frequently Asked Questions: Video and Imaging
- CS7615
- CS7654
- CS7666

AN126 : DRX™ Technology: A Cirrus Logic Development to Enhance Digital Images
- CS7620
- CS7622

AN127 : LXT970 to CS8952 Replacement Guide
- CS8952

AN130 : Interfacing the CS5522/24/28 to the PIC16C84
- CS5521/23
- CS5522/24/28

AN131 : Interfacing the CS5521/22/23/24/28 to the 68HC05
- CS5521/23
- CS5522/24/28

AN132 : Imaging Terms
- CS7615
- CS7620
- CS7654
- CS7666

AN134 : AES and SPDIF Recommended Transformers
- CS8401A/2A
- CS8403A/4A
- CS8411/12
- CS8413/14
- CS8420

AN136 : Using the CS5180 with Multiplexed Inputs
- CS5180

AN138 : Interfacing the CS4954/55 to the SX28AC Microcontroller
- CS4954/55

AN146 : AN-PS1 -- Evaluation Kit User Manual
- CL-PS7111

AN152 : Using the CS5521/23, CS5522/24/28, and CS5525/26 Charge Pump Drive for External Loads
- CS5521/23
- CS5522/24/28
- CS5525/26

AN153 : Compatibility between CS4299 and AD1881
- CS4299

AN156 : Using the CS7620/22 with CCDs
- CS7620
- CS7622

AN157 : CS7620/22 Frequently Asked Questions
- CS7620
- CS7622

AN158 : Measuring High Voltages (5 to 1,000 Volts) with the CS5521/23, CS5522/24/28, and CS5525/26 A/D Converters
- CS5521/23
- CS5522/24/28
- CS5525/26

AN159 : PLL Filter Optimization for the CS8415A, CS8420, and CS8427
- CS8415A
- CS8420

AN164 : LXT310/318 to CS61310/18 Replacement Guide
- CS61310
- CS61318

AN168 : Acoustic Path Design for Full-Duplex Cellular Hands-Free Car Kits
- CS6422

AN177 : Using JTAG for Debugging EP72XX Microcontrollers
- EP7209
- EP7211
- EP7212

AN181 : Using the Crystal® CS8900A in 8-Bit Mode
- CS8900A

White Paper Listings

Personal Computer Audio Quality Measurement white paper
- CS4235
- CS4294
- CS4297A
- CS4299

AES Publications

All AES Publications are available on the AES website at: **www.aes.org.**

A Stereo 16-bit ΔΣ A/D Converter for Digital Audio
- June 1989 JAES: AES preprint# 2724

An 18-bit Dual Channel Oversampling ΔΣ A/D Converter, with 19-bit Mono Application Example
- AES Oct 1989 New York: AES preprint# 2851

The Effects of Sampling Clock Jitter on Nyquist Sampling Analog-to-Digital Converters and on Oversampling ΔΣ ADCs
- July 1990 JAES: AES preprint# 2844

18-bit Stereo D/A Converter with Integrated Digital and Analog Filters
- Oct 1991 AES New York: AES preprint# 3113

A Family of AES/EBU Interface Devices
- 1990 AES Los Angeles: AES preprint# 2962

An 18-bit ΔΣ D/A Processor System Achieving Full-Scale THD+N>100dB,
- 1992 AES San Francisco: AES preprint# 3416

Measurement Techniques for Debugging ADC and DAC Systems
- AES 11th International Conference: "Audio Test and Measurement", Portland, OR, May 1992

How to Achieve Optimum Performance from ΔΣ A/D and D/A Converters
- Oct 1993 JAES: AES preprint# 3417

A Single Chip Stereo 16-bit A/D Converter and Quad 16-bit D/A Converter for Automotive and Consumer Applications
- 1993 AES Berlin: AES preprint# 3588

An Understanding and Implementation of the SCMS Serial Copy Management System for Digital Audio Transmission
- 1994 JAES: AES preprint# 3518

A Single Chip Audio Codec for PC Multimedia Applications
- 1993 AES New York: AES preprint# 3716

A Single Chip Stereo Volume Control,
- 1993 AES New York: AES preprint# 3759

A Single Chip DSP with D/A Converter for Broadcast Audio Decoding
- 1994 AES Amsterdam: AES preprint# 3782

A Multiprocessing Digital Sound Generator for High Polyphony Wavetable Music Synthesis
- 1994 AES Amsterdam: AES preprint# 3831

An 18-bit, 8-pin Stereo Digital-to Analog Converter
- 1994 AES San Francisco: AES preprint# 3907

An Overview of Audio Technology for the Multimedia Personal Computer
- 1994 AES San Francisco: AES preprint# 3875

A 120 dB Dynamic Range, 96 kHz, 24-bit Analog-to-Digital Converter
- Presented at the 102nd Convention of the Audio Engineering Society, March 1997: AES preprint# 4443

Techniques to Measure and Maximize the Performance of a 120 dB, 24-bit, 96 kHz A/D Integrated Circuit
- 103rd Convention of the Audio Engineering Society, September 1997: AES preprint# 4530

Towards a Digitally Interfaced Microphone Standard
- 103rd Convention of the Audio Engineering Society, September 1997: AES preprint# 4518

A Monolithic 24-bit, 96kHz Sample Rate Converter with AES3 Receiver and AES3 Transmitter
- 1998 AES San Francisco: AES preprint# 4771

Product Documentation Library

The following listed documentation is accurate at the time of printing and can be retrieved from the 2000 Cirrus Logic Product Guide CD-ROM, included with this book.

For the most current product information, documentation listings, pdf downloads, evaluation drivers, and corporate information, please visit the Cirrus Logic website at: **www.cirrus.com**.

Part Number Listing

Contact Information

The industry-leading silicon solutions of Cirrus Logic are supported and enhanced by unsurpassable product support, including technical publications, demonstration boards, reference designs, comprehensive software support, and world-class applications engineering support.

Technical Documentation Requests

Current documentation, including data sheets, product bulletins, application notes, and technical articles can be obtained from the Cirrus Logic Literature Center by phone at:

1-800-359-6414 (within the US)

1-510-249-4200 (international and domestic)

or email at:

lit@corp.cirrus.com

or download the documentation in pdf format from our website at:

http://www.cirrus.com

Documentation is also available on the 2000 Cirrus Logic Product Guide CD-ROM, included with this book. It can also be obtained by contacting the Cirrus Logic Literature Center.

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Factory Applications Support

To contact an in-house applications and technical support group, please send an email with your **name, company, phone number, and question** to the appropriate email address below. You will be contacted via email or phone, based on the nature of your question.

Computer Audio:
pc-support@cirrus.com,
888-937-2787 (within the US)
512-912-3555 (international and domestic)

Echo Cancellation:
echo@crystal.cirrus.com

Video Encoders:
tv_encoder@crystal.cirrus.com

Imaging:
imaging@crystal.cirrus.com

Ethernet:
ethernet@crystal.com

Telecommunications:
tcomm@crystal.com

Professional/Consumer Audio:
proaudio@crystal.com

Data Acquisition:
datacq@crystal.com

Storage:
magnetic@corp.cirrus.com
optical@corp.cirrus.com

Embedded PRocessors:

epdapps@crystal.cirrus.com

For all other technical support, call
510-623-8300

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FAX: 805-375-9952

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FAX: 503-620-5665

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FAX: 512-338-0196

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FAX: 847-884-6795

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FAX: 281-477-7116

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FAX: 561-395-1373

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FAX: 410-740-6961

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