

Audio Solutions Guide

Analog and Digital Amplifiers, Data Converters, Digital Signal Processors, Interface, Power Management

1Q 2005



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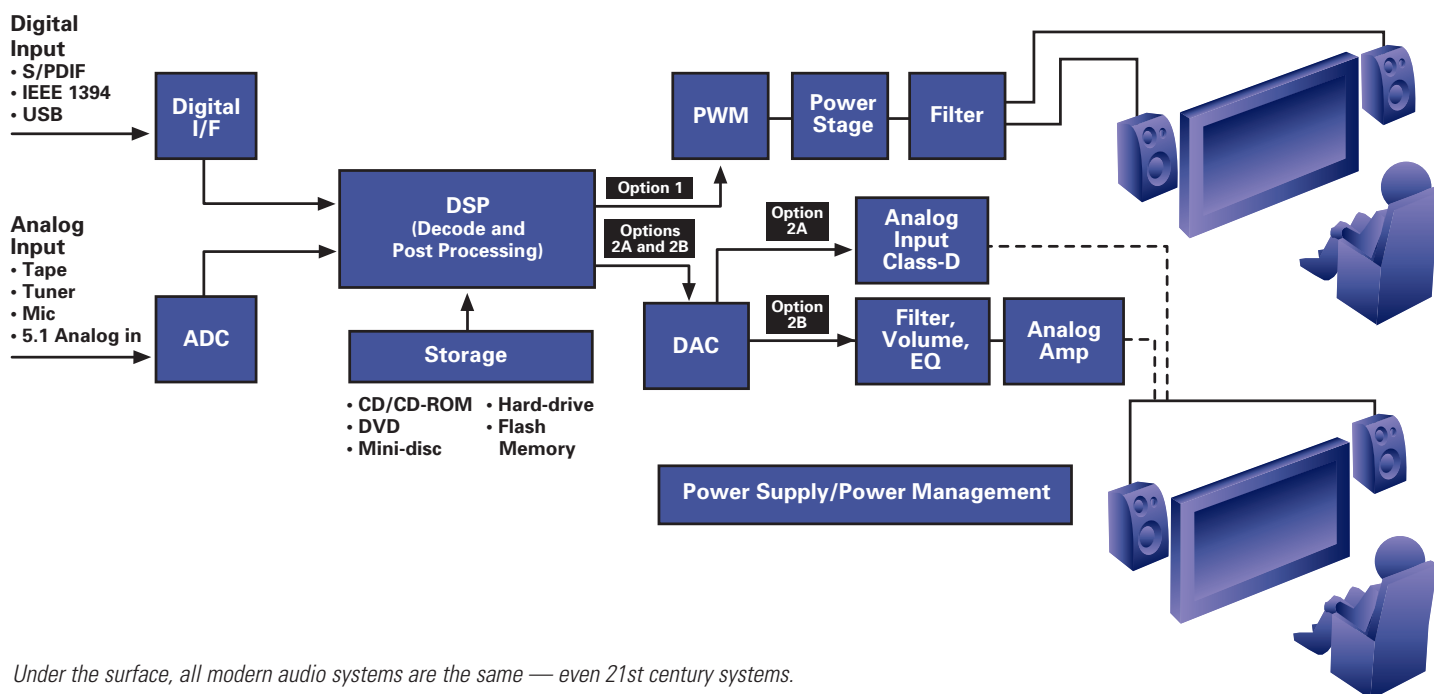
In today's marketplace for audio equipment, designers are challenged to satisfy very demanding consumers who expect high-quality, multifunction audio products that are cost competitive and feature rich. Consumers expect the very best listening experience from any audio format, any source and from both home and mobile audio systems. This places a great deal of pressure on designers to minimize engineering tradeoffs while quickly bringing new and compelling audio products to market.

In response to the needs of audio designers, TI offers all-digital audio components as well as digital+analog audio solutions. Programmable components with performance headroom and design

flexibility give designers the ability to build audio systems with more functionality and a true, lifelike sound experience at a competitive cost.

Get to market fast with TI's analog and DSP solutions for audio applications. TI provides the silicon, software, systems expertise and support for the entire audio signal chain. From industry-leading DSPs and high-performance analog to logic and an extended portfolio of application software, TI delivers the most reliable, scalable and power-efficient solutions for the most complex to the simplest audio designs.

Please read on to find out more about TI's solutions for audio applications.



Under the surface, all modern audio systems are the same — even 21st century systems.



AV Receivers

To Know More

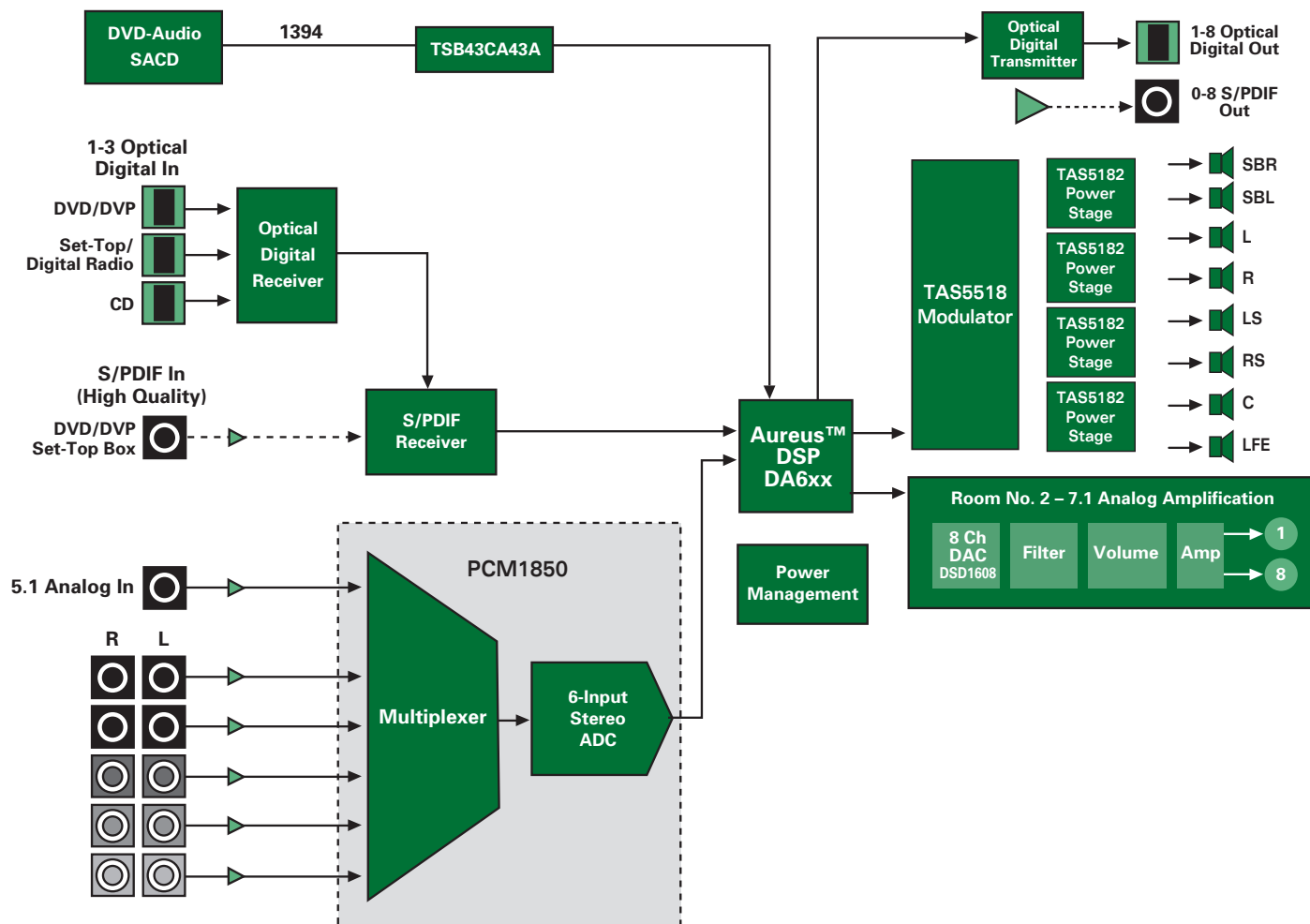
For detailed information about TI products:

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High-quality digital audio formats, such as DVD-audio and SACD, present AV receiver system designers with many engineering challenges. Digital connectivity, content protection, compatibility with new decoding standards and the need for fast data rates with

superior analog performance throughout the entire audio signal chain require careful attention to semiconductor device selection, power supply design and PCB layout.

TI enables AV end equipment to take advantage of these formats and deliver not only the highest performance, but also the most cost-effective solutions to the consumer. The highest quality DVD-Audio data rate of 192 kHz can be sent across a single 1394 cable connected to an AV receiver, offering high-quality digital audio in a system that's easy to set up. The Aureus™ audio DSP provides the processing power to handle the myriad of decoding formats. TI's Burr-Brown audio data converter products offer the full range of performance, enabling both high-end and cost-sensitive systems. PurePath Digital™ power amplifier solutions preserve the original quality of the source and deliver high power in a sleek form factor.



Block Diagram of Typical AV Receiver



8-Channel, 110-dB Digital Audio PWM Processor TAS5518

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TAS5518

The TAS5518 is an eight-channel digital pulse width modulator (PWM) that provides superior dynamic range performance and a high level of system integration. Typical dynamic range in a well-designed system is 110 dB and the power supply volume control (PSVC) feature provides up to 24 dB of additional dynamic range at normal listening levels.

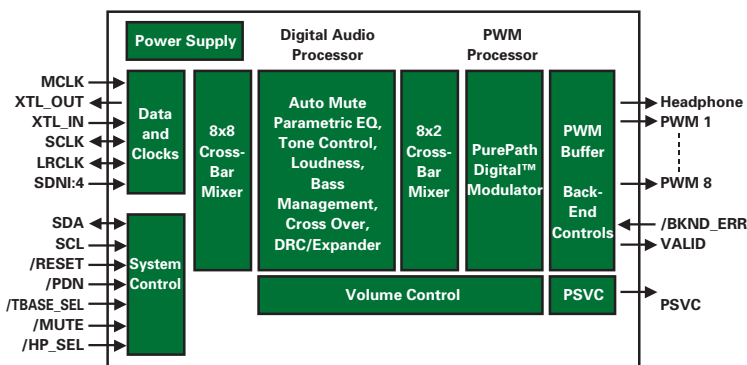


Key Features

- 8-channel PWM with 110-dB dynamic range
- Record-line and headphone outputs
- High-performance 48-bit data path audio processing
- Bass management
- Tone control
- Seven cascaded second order bi-quad per channel
- Loudness control
- Triple slope DRC/expander
- +36 to -100 dB volume control
- Programmable soft volume
- Extensive input and output mixing support
- Power supply volume control
- < 0.1% THD+N (typ with TAS5182)
- 32- to 192-kHz sampling rates supported
- 16-, 20- or 24-bit input format
- Click and pop free
- Intelligent AM interference solution

Applications

- AV receivers
- DVD receivers



TAS5518 Block Diagram

Stereo Digital Amplifier Power Stage Controller TAS5182

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TAS5182

The TAS5182 is TI's high-power stereo digital audio amplifying gate driver, able to deliver continuous 150-W RMS at less than 0.1% THD+N. With its industry leading efficiency, the TAS5182 is the premier choice for high-power and audio precision amplifiers.

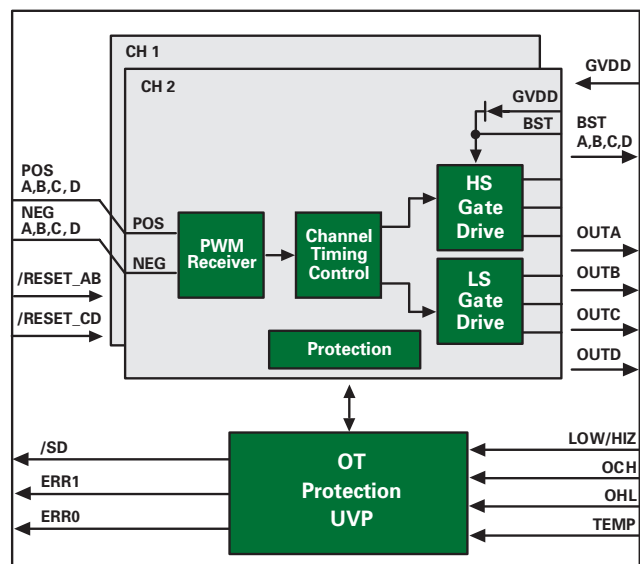


Key Features

- Stereo H-Bridge driver
- High-power output:
 - 150 W, 4 RMS, < 0.1% THD+N
 - 100 W, 6 RMS, < 0.1% THD+N
 - 90 W, 8 RMS, < 0.2% THD+N
- THD+N < 0.10% full power range 20-20 kHz
- Self-protection design (including under-voltage, over-temperature, and short-circuit protection) with error reporting
- High audio performance
 - 110-dB SNR when used with TAS5518
 - 0.1% THD+N (typ)
- 32- to 192-kHz sampling rates supported
- Low EMI design passes regulatory requirements
- Click and pop free

Applications

- AV receivers
- DVD receivers
- Powered subwoofers
- Mini/micro components
- Digital automotive amps



TAS5182 Block Diagram



AV Receivers

8-Channel PCM-/DSD-Compatible DAC DSD1608

For datasheets, samples and app reports visit:
www.ti.com/sc/device/DSD1608

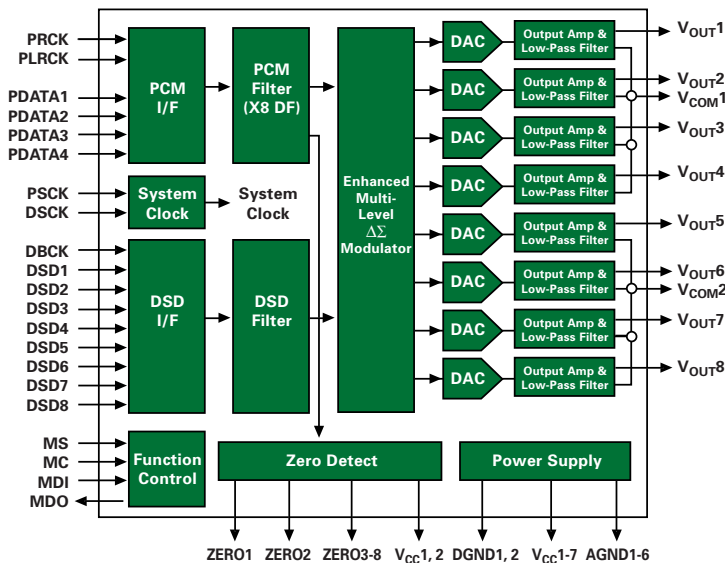
The DSD1608 is an eight-channel PCM-/DSD-compatible DAC. The DSD1608 supports the new TDMCA mode, which allows eight channels of audio data and all control commands to share a single interface. This conserves port resources, simplifies board design and shortens prototyping time. If TDMCA or dedicated DSD support are not required, the six-channel PCM1606 or eight-channel PCM1608 are also available.

Key Features

- Data word length: 16/18/20/24 bits for PCM, direct stream for DSD
- Sampling rate (f_s):
 - Up to 192 kHz for PCM format
 - 2.8224 MHz (64 X 44.1 kHz) for DSD format
- 8-channel single-ended voltage output
- System clock: 128 f_s , 192 f_s , 256 f_s , 384 f_s , 512 f_s or 768 f_s for PCM; 256 f_s , 384 f_s , 512 f_s or 768 f_s for DSD
- Analog performance (at $V_{CC} = 5$ V, PCM/DSD mode)
 - DYR: 105 dB, SNR: 105 dB, THD+N: 0.002%
 - Full-scale output: 4.0 Vpp
- 8X oversampling digital filter included (PCM format only)
- Package: 52-pin TQFP

Applications

- Universal AV players
- Super audio CD players
- Car audio systems



DSD1608 Block Diagram

Stereo ADC with Input Multiplexer PCM1850 and PCM1851

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/PCM1850 and www.ti.com/sc/device/PCM1851

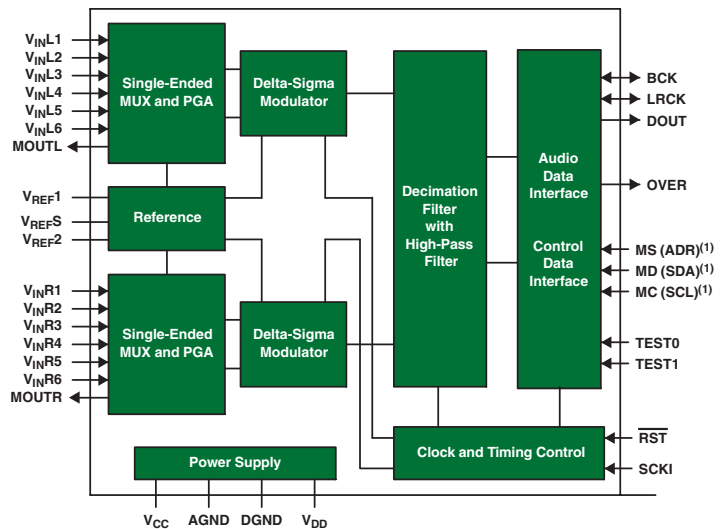
The PCM1850 is a high-performance, low-cost stereo analog-to-digital converter that features an input multiplexer (MUX) and wide-range programmable gain amplifier (PGA). The input MUX allows the user to connect up to six stereo sources, which may be selected through SPI (PCM1850) or I²C (PCM1851) control interfaces.

Key Features

- Input multiplexer, six stereo channels
- PGA gain: +11 to -11 dB range, 0.5 dB step
- SNR: 100 dB (typ)
- SPI (PCM1850) or I²C (PCM1851) control
- Sampling rate: 16 to 96 kHz
- System clock: 256 f_s , 384 f_s , 512 f_s or 768 f_s
- +5 V for analog, +3.3 V for digital
- Package: 32-pin TQFP, Pb-free

Applications

- DVD recorders
- AV amp receivers
- CD recorders
- MD recorders
- Multitrack receivers



(1) PCM1850 (PCM1851)

PCM1850 Block Diagram



Second-Generation, IEEE 1394a Integrated Link/PHY

TSB43CA43A and TSB43CB43A

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TSB43CA43A and

www.ti.com/sc/device/TSB43CB43A

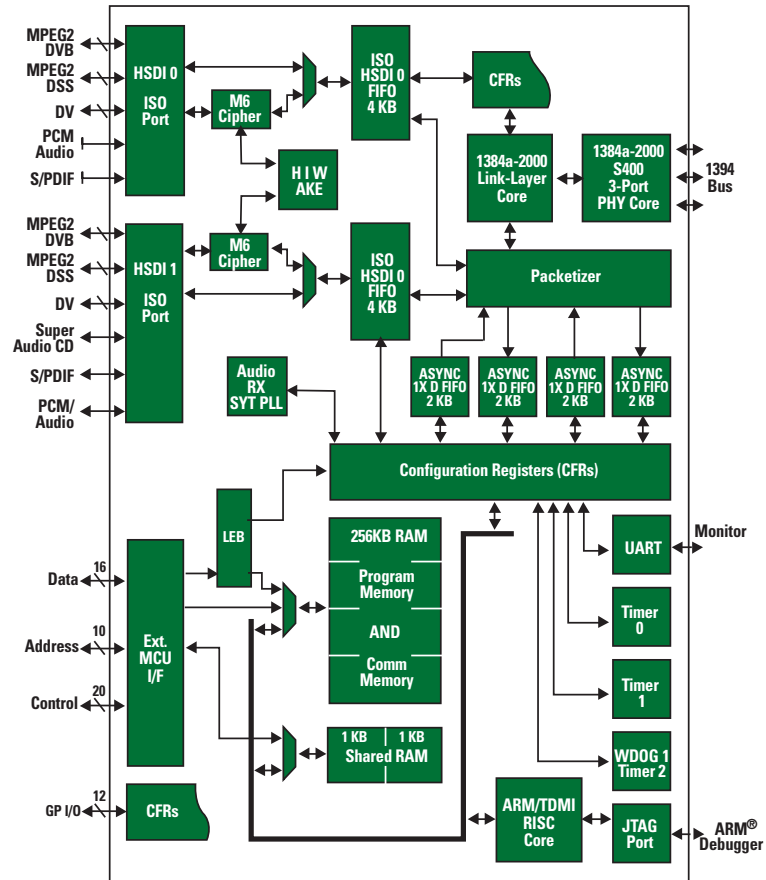
The TSB43CA43A content-protected (5C) and TSB43CB43A (non-5C) are highly integrated 1394 audio solutions that enable a simple one-cable digital connection between audio components. Audio over 1394 can support high sample rates, multiple channels, and even 5C streaming between a DVD-Audio/SACD player and an AV receiver.

Key Features

- Integrated 3-port 400-Mbps 1394a PHY
- DTCP content protection enabled with two 5C ciphers and hardware AKE acceleration
- Support for IEC61883, including MPEG2, DirecTV (DSS), DV and audio (A&M)
- Integrated programmable ARM® processor with 256K bytes of internal program memory
- Dual high-speed data interfaces and 16K FIFO
- Audio support (IEC61883-6 formatting)
- Audio formats supported
 - IEC 60958/IEC 61937
 - Multibit linear audio (raw audio and DVD audio)
 - SACD
- Audio interfaces supported
 - S/PDIF
 - I²S
 - MLPCM interface
- Low-power modes
- Package: 176-pin BGA (TSB43CA43A), 176-pin LQFP (TSB43CB43A)

Applications

- AV receivers
- DVD and CD players
- Speakers and powered subwoofers



TSB43CA43A Block Diagram



DVD Receivers

To Know More

For detailed information about TI products:

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PCM1680: Cost-Effective, 8-Channel DAC	12
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Other TI Products for This Market:

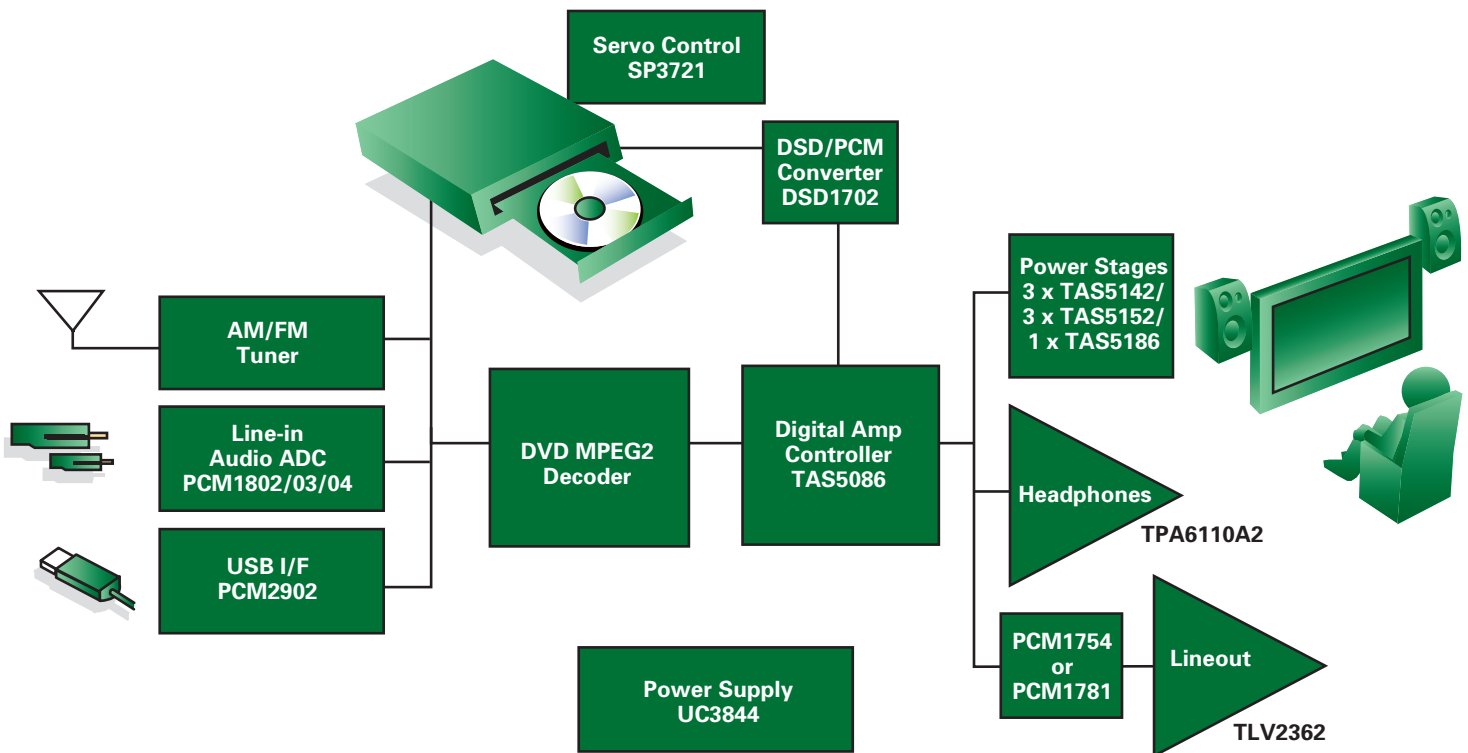
 TPA6110A2: See www.ti.com/sc/device/TPA6110A2

As digital living room devices proliferate, consumers are moving beyond stand-alone DVD players and embracing integrated entertainment solutions such as DVD receivers used in home theater in a box (HTiB). HTiBs represent unique challenges and opportunities for consumer electronics manufacturers to replicate the theater experience in sleek form factors in tune with consumers' home environments. The audio technology provided by TI powers the HTiBs' capabilities, replicating the thundering bass and extremes in dynamic range of the theater experience.

TI's PurePath Digital™ audio amplifier, with its unmatched power efficiency and pristine audio performance, provides consumer electronics manufacturers the ability to integrate the performance and power levels of expensive and bulky amplifiers into sleek consumer-oriented equipment.

TI Solutions for All Key Power Levels

Power Level (RMS, FTC power rating)	Configuration	PWM Processor	Power Stage(s)
120-200 W	5.1: 5 x 30 W + 60 W	TAS5086	TAS5186
300W	5.1: 40Wx5 + 100W	TAS5086 or TAS5508	TAS5142x2
400W	5.1: 45Wx4+110Wx2	TAS5086 or TAS5508	TAS5152x2
500W	5.1: 5x75 W + 125 W	TAS5086 or TAS5508	TAS5152x3
600W	5.1: 100Wx6	TAS5086 or TAS5508	TAS5142x3
1000W	7.1: 125Wx8	TAS5086 or TAS5508	TAS5152x4



DVD Receiver Block Diagram



Single-Ended Analog Input Stereo ADC

PCM1802

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/PCM1802

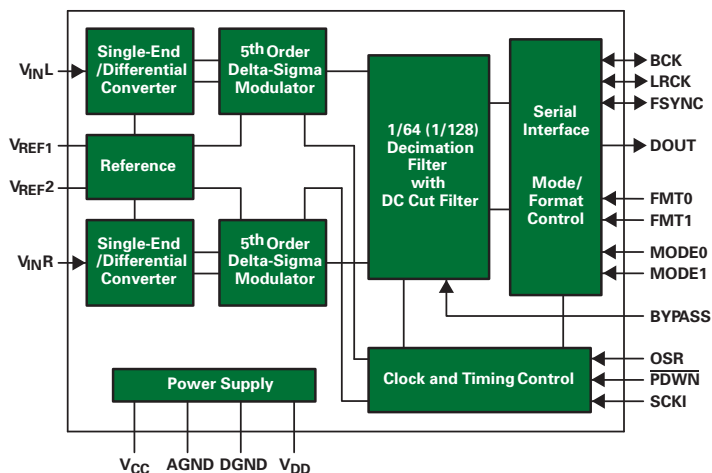
The PCM1802 is a high-performance, low-cost, single-chip stereo analog-to-digital converter with single-ended analog voltage input. It uses a delta-sigma modulator with 64-/128-times oversampling and includes a digital decimation filter and HPF (low cut filter), which removes the dc component of the input signal. For various applications, the PCM1802 supports master and slave modes and four data formats in serial interface. The PCM1802 is suitable for a wide variety of cost-sensitive consumer applications where good performance, 5-V analog supply and 3.3-V digital supply operation are required.

Key Features

- 24-bit delta-sigma stereo ADC
- Single-ended voltage input: 3 Vpp
- Antialiasing filter included
- High performance:
 - THD+N: 96 dB (typ)
 - SNR: 105 dB (typ)
 - Dynamic range: 105 dB (typ)
- Sampling rate: 16 to 96 kHz
- System clock: 256 f_s, 384 f_s, 512 f_s or 768 f_s
- Dual power supplies: 5 V for analog, 3.3 V for digital
- Package: 20-pin SSOP, Pb-free

Applications

- AV amp receivers
- MD players
- CD recorders
- Multitrack receivers
- Electric musical instruments



PCM1802 Block Diagram

Cost-Effective Stereo ADC for DVD

PCM1803

Get datasheets and app reports at: www.ti.com/sc/device/PCM1803

PREVIEW

* The PCM1803 is a cost-effective, high-performance single-chip stereo analog-to-digital converter with single-ended inputs. It uses a delta-sigma modulator with 64-/128-times oversampling and includes both digital decimation and high-pass filters.

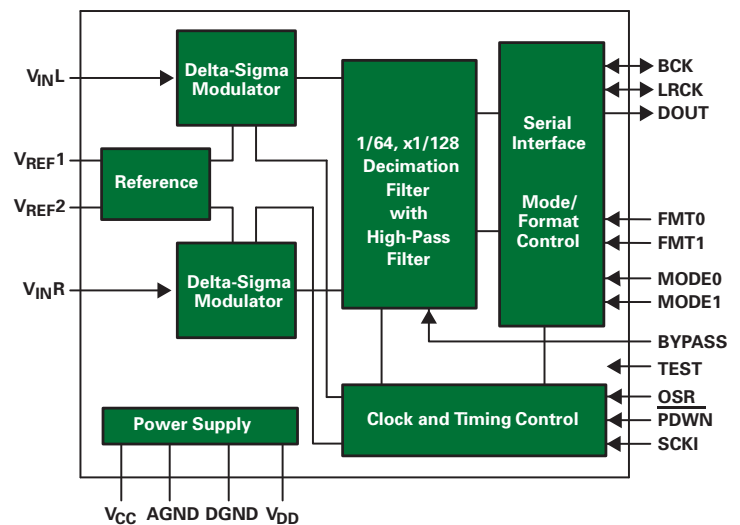
Key Features

- Single-ended voltage input: 3 Vpp
- THD+N: -95 dB
- Dynamic range and SNR: 103 dB
- Sampling rate: 16 to 96 kHz
- System clock: 256 f_s, 384 f_s, 512 f_s or 768 f_s
- Power supply: +5 V analog; +3.3 V digital
- Package: 20-pin SSOP, Pb-free

Applications

- AV amp receivers
- MD players
- CD/DVD recorders
- Multitrack receivers
- Electric musical instruments

* Expected release March 2005



PCM1803 Block Diagram



DVD Receivers

Differential Input High-Performance Stereo ADC PCM1804

Get samples, datasheets and app reports at:
www.ti.com/sc/device/PCM1804

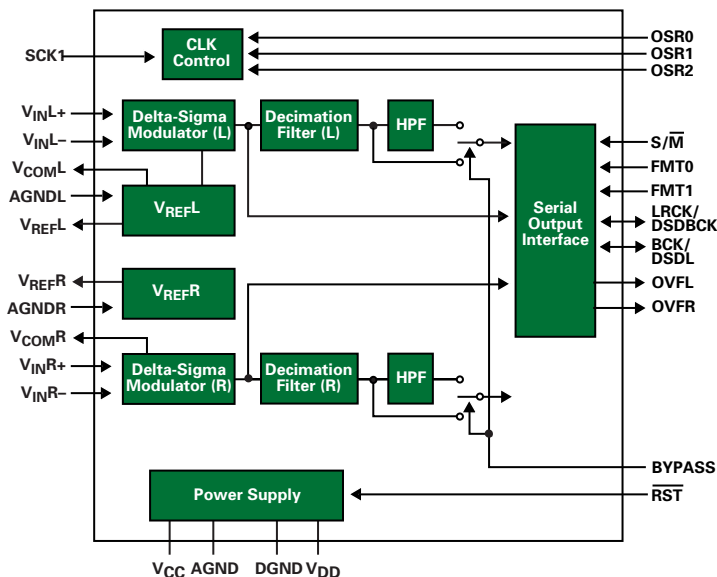
The PCM1804 is a two-channel audio ADC that offers a high level of analog performance with native single-bit DSD output capability.

Key Features

- Power dissipation 225 mW (single rate, $f_s = 48$ kHz)
- 24-bit PCM resolution, 1-bit 64 f_s DSD
- All functions set by pins, no system controller required
- Analog performance:
 - DYR: 112 dB (typ); THD+N: 0.0008% (typ)
 - Fully differential analog input: 5 V_{pp} (typ)
- Linear phase decimation filter:
 - Stop-band attenuation: -100 dB
 - Pass-band ripple: ± 0.005 dB
- Sampling frequency: 32 to 192 kHz
- PCM data format: Standard, I²S and left-justified, in master or slave mode
- Peak detection function
- High-pass filter ($f_s/48000$), can be bypassed
- System clock: 128 f_s , 192 f_s , 256 f_s , 384 f_s , 512 f_s or 768 f_s
- +5-V analog power supply, +3.3-V digital supply
- Package: 28-pin SSOP

Applications

- Integrated AV receivers
- High-quality DVD, MD and CD-RW recorders
- Musical instruments
- Digital audio workstations



PCM1804 Block Diagram

Advanced Segment Audio Stereo DAC PCM1791A

Get samples, datasheets, evaluation modules and app reports at:
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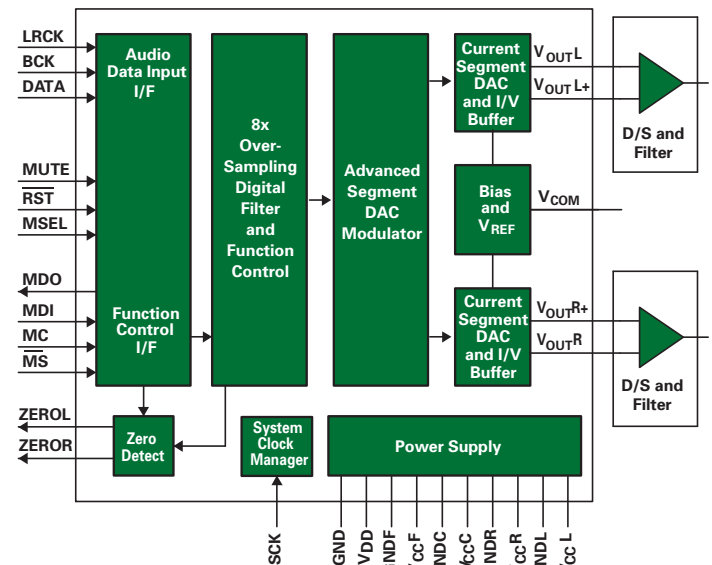
The PCM1791A is a monolithic CMOS integrated circuit that includes stereo digital-to-analog converters and support circuitry. The data converters use TI's advanced segment DAC architecture for excellent dynamic performance and improved tolerance to clock jitter.

Key Features

- 24-bit resolution
- Analog performance:
 - Dynamic range: 113 dB
 - THD+N: 0.001%
- Full-scale output: 2.1 V RMS (at post amp)
- Differential voltage output: 3.2 V_{pp}
- 8X oversampling digital filter:
 - Stop-band attenuation: -82 dB
 - Pass-band ripple: ± 0.002 dB
- Sampling frequency: 10 to 200 kHz
- System clock: 128, 192, 256, 384, 512 or 768 f_s with auto detect
- Accepts 16-, 20- and 24-bit audio data
- Data formats: standard, I²S and left-justified
- Package: 28-pin SSOP, Pb-free

Applications

- AV receivers
- DVD movie players
- SACD players
- HDTV receivers
- Car audio systems
- Digital multitrack recorders



PCM1791A Block Diagram



6-Channel Digital Audio PWM Processor TAS5086

Get datasheets at: www.ti.com/sc/device/TAS5086

PREVIEW * TAS5086 is a 6-channel digital pulse width modulator (PWM) that provides both advanced performance and a high level of system integration. TAS5086 is designed to interface seamlessly with most audio digital signal processors and MPEG decoders accepting a wide range of input data and clock formats.



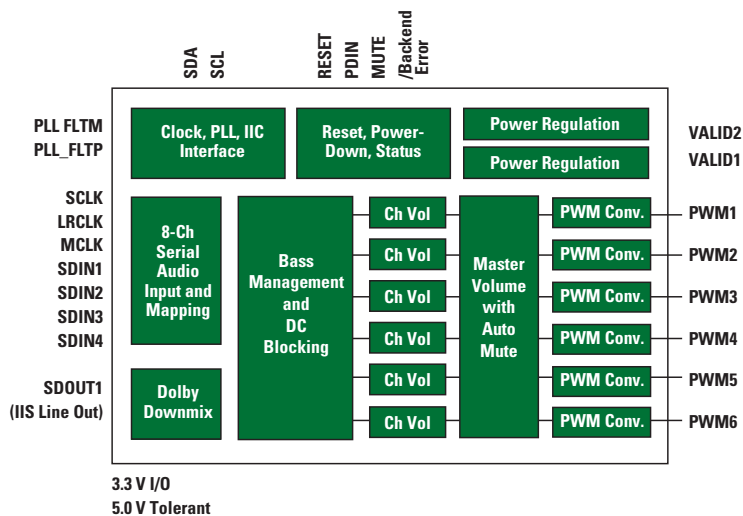
Key Features

- 6-channel PWM
- > 100-dB dynamic range
- Record-line output with down-mixing
- Headphone output
- Bass management
- +48 to -100-dB soft volume control
- Input and output muxes
- < 0.1% THD+N (typ with TAS5186)
- 32- to 192-kHz sampling rates supported
- 16-, 20- or 24-bit input format
- Low EMI design passes regulatory requirements
- Click and pop free
- Intelligent AM interference solution
- No external crystal required

Applications

- DVD receivers

* Expected release February 2005



TAS5086 Block Diagram

6-Channel, 5 x 30-W + 1 x 60-W Power Stage TAS5186

Get datasheets at: www.ti.com/sc/device/TAS5186

PREVIEW * The TAS5186 provides an industry leading complete 5.1 channel power solution with more than 200 W of total power in a single surface mount package. It is designed to drive five 6- Ω satellite speakers with a rated output power of 30 W per channel @ 10% distortion and one 3- Ω subwoofer speaker with 60 W of power. This highly integrated and compact solution is made possible by TI's PurePath Digital™ technology.



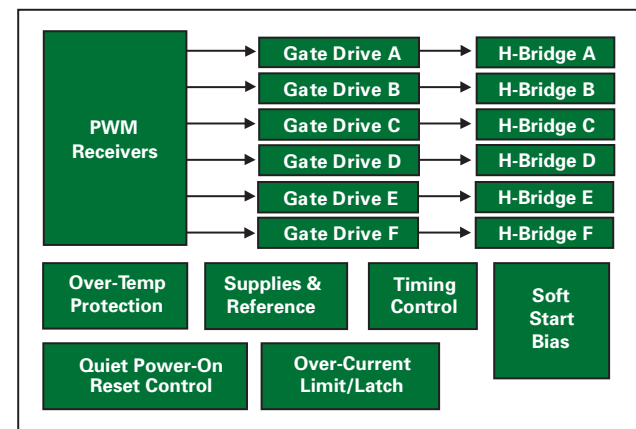
Key Features

- Six-channel power stage with 210 W of total output power @ 10% THD
 - 5 x 30 W @ 10%THD, single-ended 6- Ω load (satellites)
 - 1 x 60 W @ 10%THD, single-ended 3- Ω load (subwoofer)
- 100 dB SNR (A-weighted)
- < 0.1% THD+N @ 1 W
- < 0.5% THD+N @ 0 dBFS
- Power stage efficiency > 92% into recommended loads (SE)
- Integrated self-protection circuits: under voltage, over temperature, and short circuit
- Over current protection is programmable and has limit before latch function
- Quiet Power on Reset for protected power up without power supply sequencing
- Integrated active bias circuit to pre-charge split-cap (or DC-blocking) capacitors
- Standalone protection recovery
- EMI compliant when used with recommended system design
- Package: 44-pin HTSSOP and 44-pin SSOP

Applications

- DVD receivers

* Expected release March 2005



TAS5186 Block Diagram



DVD Receivers

2-Channel, 100-/125-W Power Stages TAS5142 and TAS5152

Get datasheets at: www.ti.com/sc/device/TAS5142 and
www.ti.com/sc/device/TAS5152

PREVIEW * The TAS5142 and TAS5152 are high-performance integrated stereo digital amplifier power stages designed to drive 4-Ω speakers at 100 W and 125 W per channel respectively. They are pin-compatible and require only a simple passive demodulation filter to deliver high-quality, high-efficiency audio amplification.



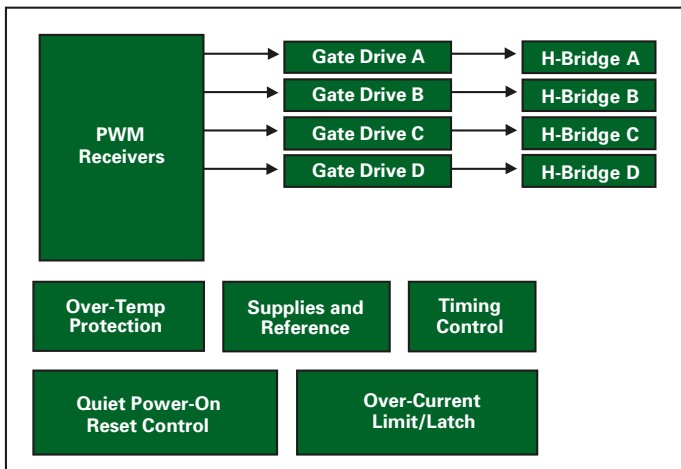
Key Features

- TAS5142 Po – 2 x 100 W @ 10% THD+N BTL into 4 Ω
- TAS5152 Po – 2 x 125 W @ 10% THD+N BTL into 4 Ω
- 100 dB (A-wtd) SNR
- < 0.1% THD+N @ 1 W
- Supports PWM frame rates of 192 to 384 kHz
- Power stage has > 90% efficiency
- Enhanced OC detection circuit allows use of smaller inductor cores
- Resistor programmable current limit enables lower-cost power supplies
- Power on Reset for protected power up without any power supply sequencing
- Self-protection design (including under-voltage, over-temperature, and short-circuit protection) with error reporting
- Stand-alone protection recovery
- Pb-free soldering supported
- EMI compliant when used with recommended system design
- Package: 36-pin SSOP

Applications

- AV receivers
- DVD receivers

* Expected release February 2005



TAS5152 Block Diagram

Cost-Effective, 8-Channel DAC PCM1680

PREVIEW * The PCM1680 is a cost-effective, eight-channel, high-performance digital-to-analog converter. Utilizing TI's enhanced multilevel delta-sigma architecture it achieves excellent signal-to-noise performance and a high tolerance to clock jitter. The PCM1680 is also footprint-compatible with the PCM1780 stereo DAC, enabling faster design time for multiple product families.

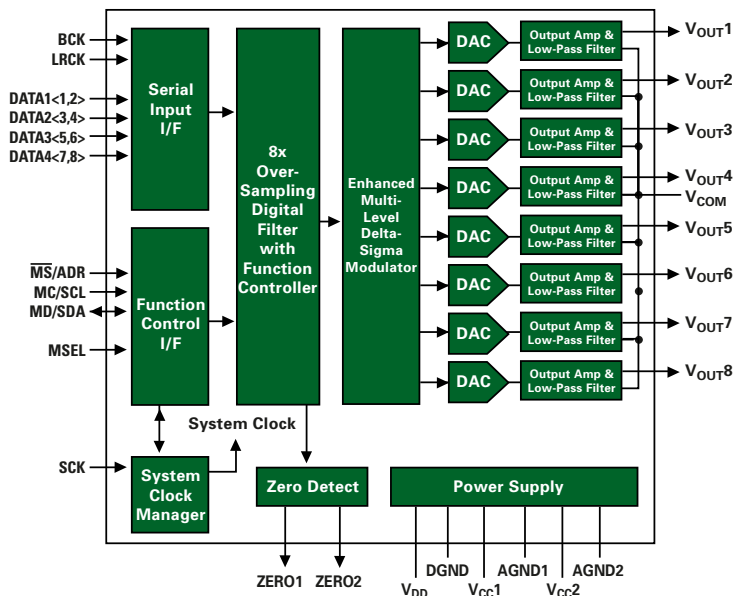
Key Features

- THD+N: 0.002%
- Dynamic range and SNR: 105 dB
- Full-scale output: 3.9 Vpp (typ)
- Single power supply: +5 V analog; +5 V digital
- Sampling rate: 5 to 200 kHz
- System clock: 128 f_s, 192 f_s, 256 f_s, 384 f_s, 512 f_s, 768 f_s or 1152 f_s
- Package: 28-pin TSSOP, Pb-free

Applications

- Integrated AV receivers
- DVD movie and audio players
- HDTV receivers

* Expected release March 2005



PCM1680 Block Diagram



High-Performance Stereo DAC Converter PCM178x

Get datasheets at: www.ti.com/sc/device/PARTNUMBER
(Replace **PARTNUMBER** with **PCM1781** or **PCM1782**)

PREVIEW

* The PCM1780/81/82 are cost-effective, high-performance stereo digital-to-analog converters.

Utilizing TI's enhanced multi-level delta-sigma architecture, they achieve excellent dynamic performance and improved tolerance to clock jitter. The PCM1780 is footprint-compatible with the PCM1680 eight-channel DAC, enabling faster design time for multiple product families.

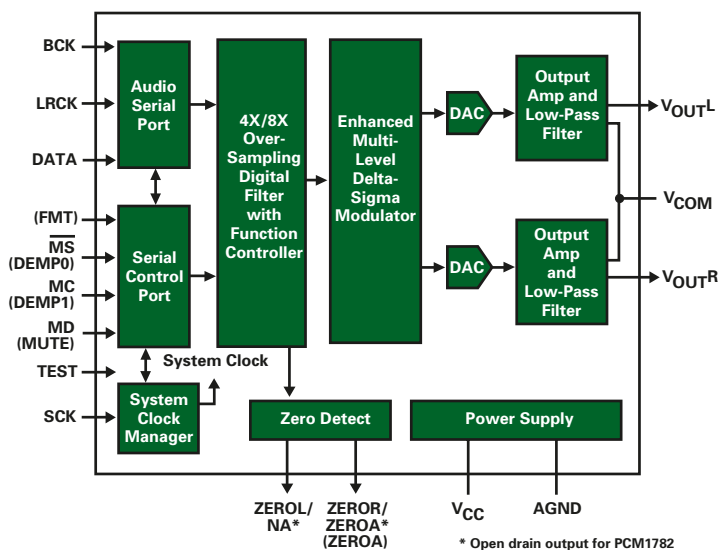
Key Features

- THD+N: 0.002%
- Dynamic range and SNR: 106 dB
- Full-scale output: 3.9 V_{pp} (typ)
- Sampling rate: 5 to 200 kHz
- System clock: 128 f_s, 192 f_s, 256 f_s, 384 f_s, 512 f_s, 768 f_s or 1152 f_s
- Single power supply: +5 V
- Package: 16-pin SSOP, Pb-free

Applications

- AV receivers
- DVD movie players
- DVD audio players
- HDTV receivers

* Expected release March 2005



PCM1780/81/82 Block Diagram

Stereo 192-kHz, 24-Bit DAC PCM1753, PCM1754 and PCM1755

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/PARTNUMBER
(Replace **PARTNUMBER** with **PCM1753**, **PCM1754** or **PCM1755**)

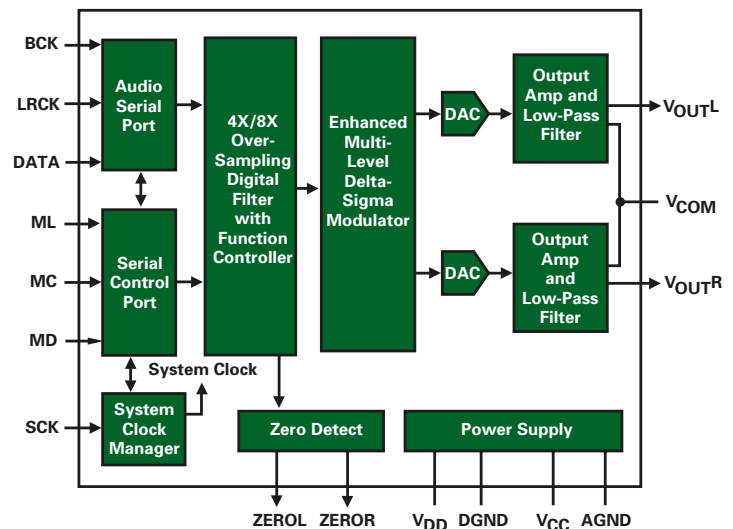
The PCM175x family offers the most cost-effective stereo DAC solution. The devices operate from a single 5-V supply and achieve excellent dynamic range and SNR performance in a small, 16-pin TSSOP package.

Key Features

- Low-cost stereo 192-kHz, 24-bit DAC
- Analog performance (at V_{CC} = 5 V):
 - DYR: 106 dB
 - THD+N: 0.002%
- 4X/8X oversampling digital filter
- Stop-band attenuation: -50 dB
- Sharp roll-off/slow roll-off selectable
- System clock: 12 V 256 f_s, 384 f_s, 512 f_s or 768 f_s auto detect
- Software (PCM1753, PCM1755) or hardware (PCM1754) control
- Package: 16-pin TSSOP

Applications

- AV receivers
- Home theater in a box



PCM175x Block Diagram



Shelf Systems/Minicompo

To Know More

For detailed information about TI products:

TAS3103: Digital Audio Processors	15
PCM270x and PCM290x: Stereo Audio DACs and Codecs with USB Interface	15

Other TI Products for This Market:

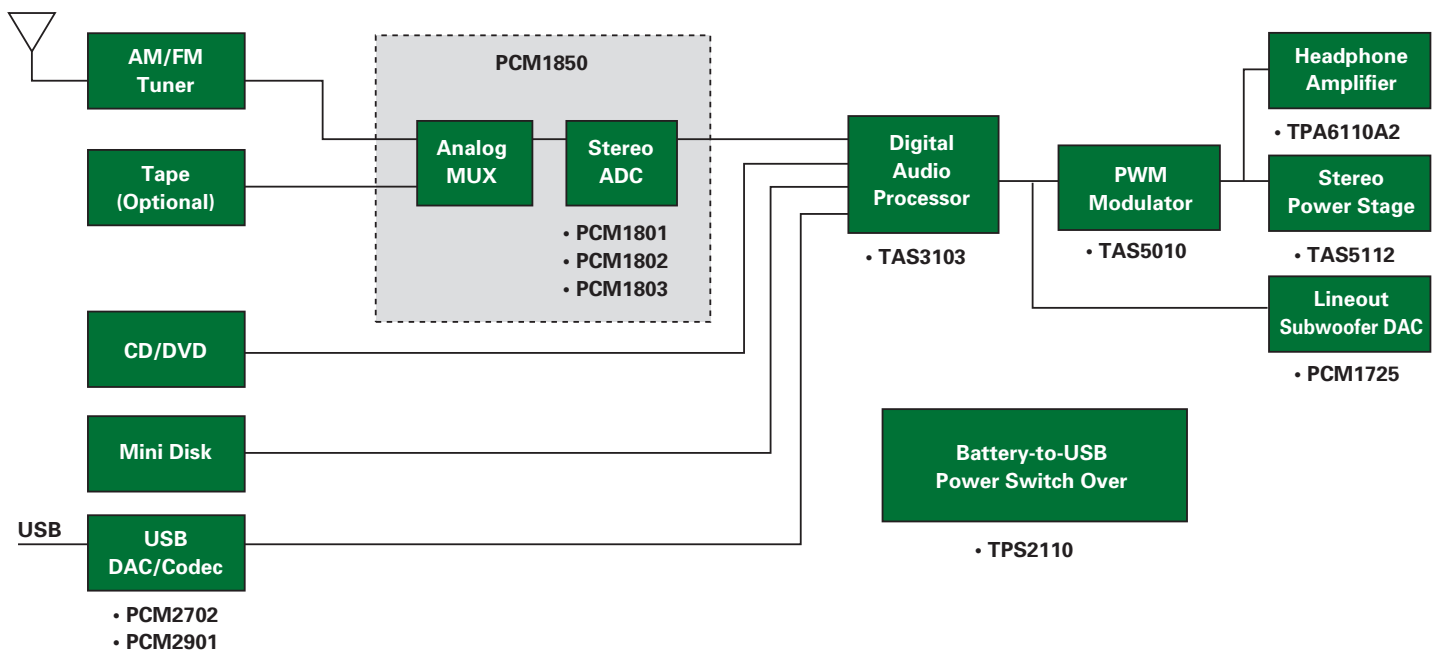
TPA6110A2: See www.ti.com/sc/device/TPA6110A2

TI is one of the few companies that can supply the broad range of products needed in today's mini-component and digital TV systems. From DACs and ADCs to advanced processing and digital amplification, TI has a solution available.

Digital TV and multichannel mini-component systems with 150 watts per channel require a highly efficient and space-saving

amplifier solution. TI's TAS5112 is the industry's smallest all-digital amplifier and can drive two channels at 30 W with a very small footprint and PCB heatsinking. TI has many PWM processors to choose from including the two-channel TAS5010 and the four-channel TAS5504.

Both digital TV and mini-component systems require a cost-effective digital audio processing solution to provide volume, treble, bass and sound effects. TI has released the TAS3103 to provide this solution at a very cost-effective price point. The TAS3103 can mux up to eight channels input and digitally process three channels. The TAS3103 can also perform sound effects such as TruSurround XT, BBE, QSound and other audio algorithms popular in the DTV and mini-compo market. With the third channel a single TAS3103 can either perform bass management on two channels or process a discrete channel. Two TAS3103 devices can gluelessly provide a complete post processing solution for 5.1 channel systems, including bass management, delay, loudness, compression and limiting.



Shelf Systems/Minicompo System Block Diagram

The basic block diagram of any shelf system/minicompo system will have not only the traditional analog sources, but also many digital sources. Using digital audio processing and digital amplification enables new product features and smaller, lighter solutions.



Digital Audio Processor TAS3103

Get datasheets and app reports at: www.ti.com/sc/device/TAS3103

The TAS3103 is a cost-effective, three-channel, 48-bit digital audio processor with a 76-bit accumulator providing 540 MIPS of audio processing. It supports sample rates from 8 to 96 kHz, and two ICs can be used for a six-channel application gluelessly.

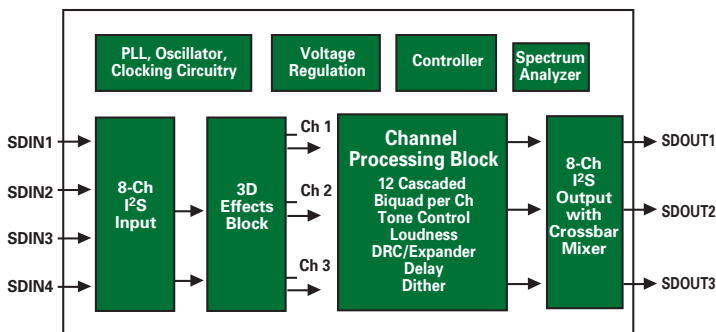


Key Features

- Eight input channels
- Three channels independently processed
- Input/output crossbar mixer
 - Channel mapping
- 3-D effects block
 - BBE, Qsound, SRS, etc.
- Full bass management
- High-performance soft-volume, treble/bass
- High-performance compression/limiting
- 42-ms delay
- 12 bi-quads per channel
- Easy-to-use PC GUI controls

Applications

- Mini/micro component systems
- Home theater post-decode processing
- Automotive headunits/amps



TAS3103 Block Diagram

Stereo Audio DACs and Codecs with USB Interface

PCM270x and PCM290x

Get datasheets and app reports at: www.ti.com/sc/device/PARTNUMBER
(Replace **PARTNUMBER** with **PCM2704**, **PCM2705**, **PCM2706**, **PCM2707** or **PCM2900**)

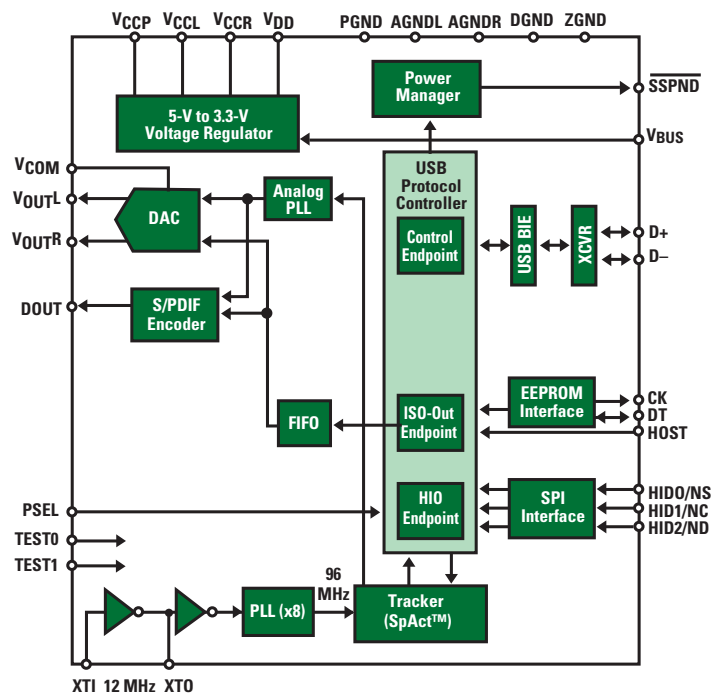
The PCM270x family of single-chip USB stereo audio DACs and the PCM290x family of single-chip USB stereo audio codecs both feature a USB compliant full-speed protocol controller and S/PDIF. These devices also employ SpAct™ architecture, TI's unique system that recovers the audio clock from USB packet data. On-chip analog PLLs with SpAct enable playback with low clock jitter.

Key Features

- On-chip USB interface
- 16-bit delta-sigma stereo
- Sampling rate:
 - DAC: 32 to 48 kHz
 - ADC: 8 to 48 kHz
- On-chip clock generator with single 12-MHz clock source
- Package: 28-pin SSOP, Pb-free

Applications

- USB audio speakers
- Audio interface boxes



PCM270x Block Diagram

→ LCD TVs, Multifunction Monitors and Plasma-Display TVs

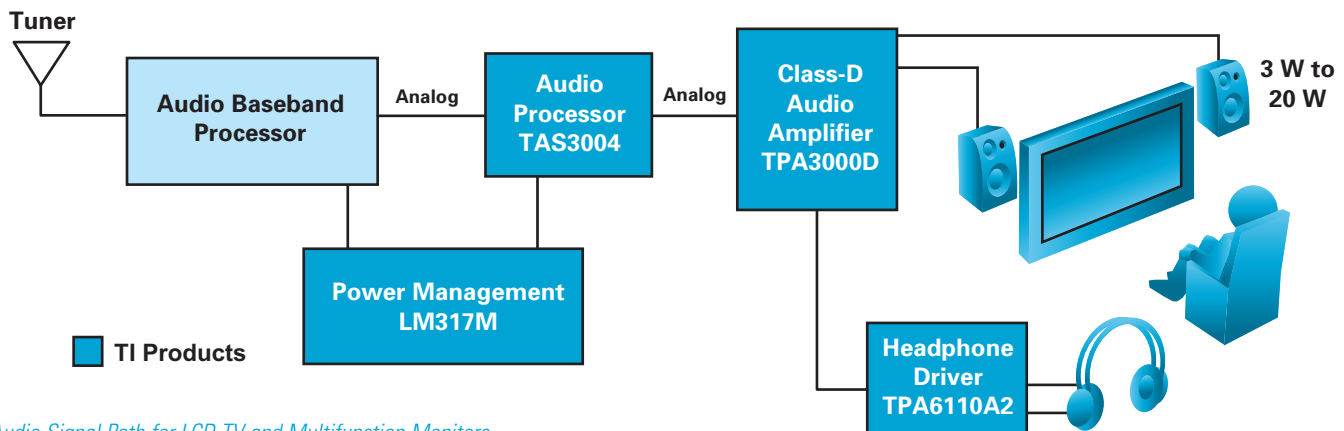
→ To Know More

For detailed information about TI products:

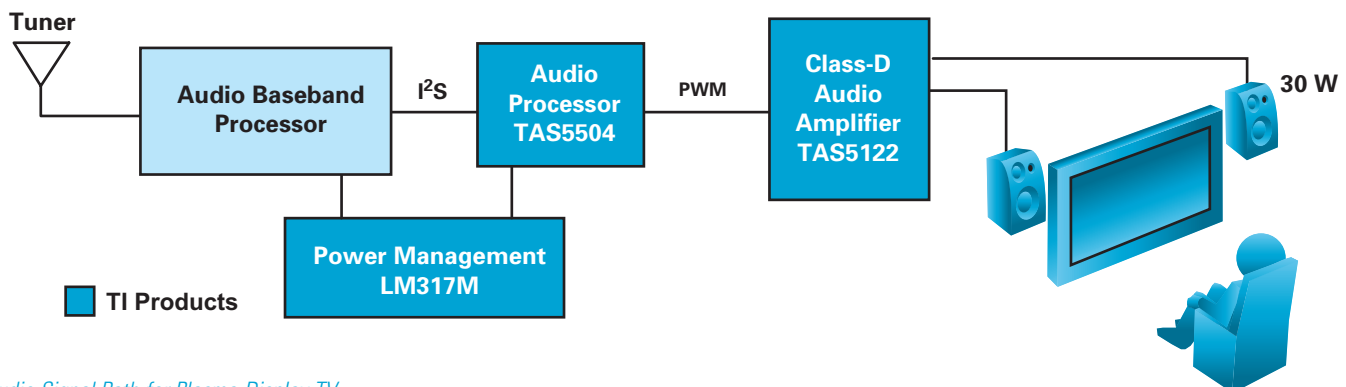
TPA3001D1: 20-W Mono Class-D Audio Amplifier	17
TPA3008D2 and TPA3005D2: 10-W Stereo Class-D Audio Amps	17
TPA6110A2: Stereo Headphone Amplifier	18
TPA3004D2 and TPA3002D2: 12-W Stereo Class-D Audio Amps	18
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TPA6030A4: 3-W Stereo Class-AB Audio Amplifier	19
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Efficient Class-D audio power amplifiers solve two main problems with higher power audio in flat-panel displays: heat and power consumption.

The low heat dissipation eliminates the need for large heat sinks. The low power consumption helps reduce the AC/DC power supply size and cost. Together, these benefits help keep the flat-panel display as thin and light as possible.



Audio Signal Path for LCD TV and Multifunction Monitors



Audio Signal Path for Plasma-Display TV

LCD TVs, Multifunction Monitors and Plasma-Display TVs



20-W Mono Class-D Audio Amplifier TPA3001D1

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA3001D1

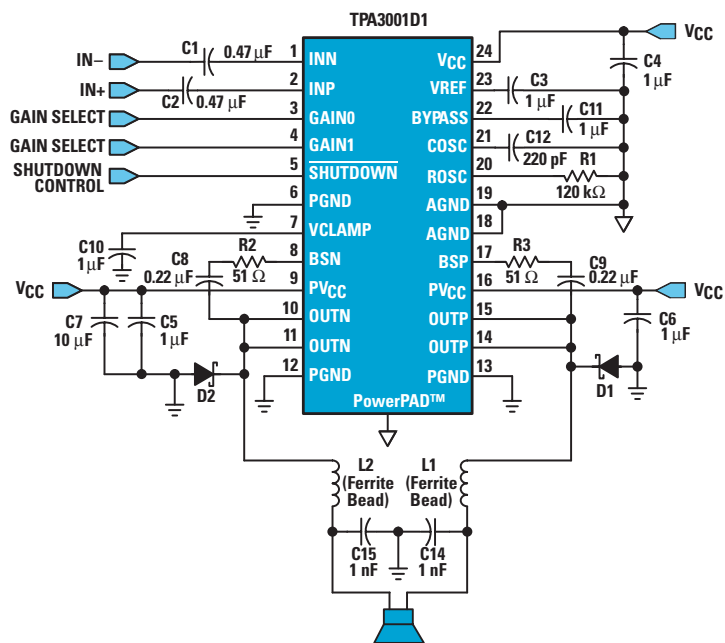
The TPA3001D1 is an analog-input Class-D audio power amplifier that will drive 20 W mono into 8- Ω speakers without a heat sink or large output filter components.

Key Features

- 20 W mono into 8 Ω from 18 V at 10% THD+N
- Filter-free modulation
 - Filter not required for efficiency or audio quality, but a low-cost ferrite bead will reduce EMI
 - Improved efficiency
 - Improved SNR: 102 dB
- Full short-circuit and thermal protection
- Integrated gain settings
- Low supply current: 8 mA from 12 V

Applications

- Plasma displays
- Large screen LCD TVs



TPA3001D1 Typical Application Circuit

10-W Stereo Class-D Audio Amplifiers TPA3008D2 and TPA3005D2

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA3008D2 and

www.ti.com/sc/device/TPA3005D2

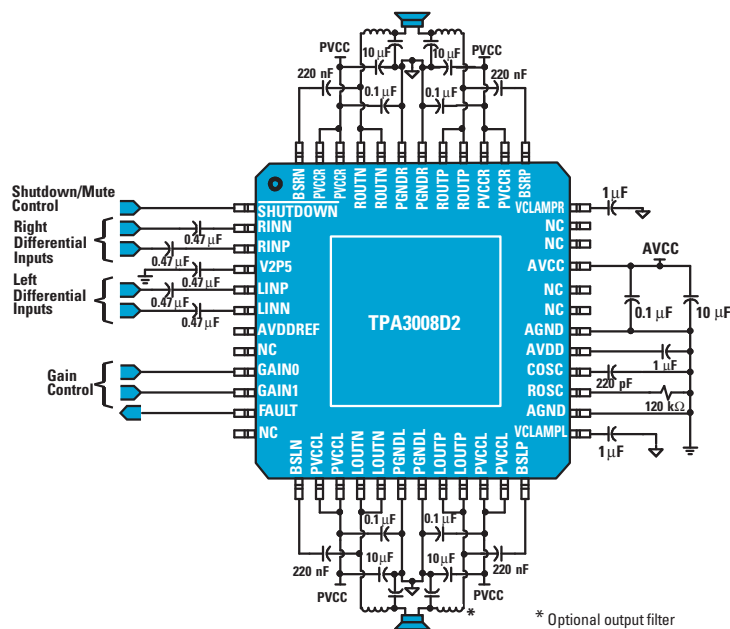
The TPA3008D2 and TPA3005D2 are analog-input Class-D audio power amplifiers that drive 10 W stereo and 6 W stereo, respectively, into speakers without a heat sink or large output filter components. The TPA3008D2 features an auto recovery that restarts the device after a short-circuit condition is removed.

Key Features

- TPA3008D2: 10 W stereo into 16 Ω from 17 V at 10% THD+N
- TPA3005D2: 6 W stereo into 8 Ω from 12 V at 10% THD+N
- Filter-free modulation
 - Filter not required for efficiency or audio quality, but a low-cost ferrite bead will reduce EMI
 - Improved efficiency: 92% maximum
 - Improved SNR: 97 dB
- Integrated gain settings
- Auto recovery (TPA3008D2)
- Stereo TPA3000D amplifiers pin compatible

Applications

- LCD TVs 17" to 23"



TPA3008D2 Typical Application Circuit

* Optional output filter for EMI suppression

→ LCD TVs, Multifunction Monitors and Plasma-Display TVs

Stereo Headphone Amplifier

TPA6110A2

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA6110A2

The TPA6110A2 is a stereo headphone driver designed to connect directly to the TPA3004D2 or TPA3002D2 with minimal external components. The integrated depop circuitry nulls "pops" and "clicks" during startup and shutdown transitions.

Key Features

- 150 mW stereo into 16 Ω from 4.5 V with < 0.1% THD+N
- Full short-circuit and thermal protection
- Excellent depop circuitry
- Low supply current: 1.5 mA from 5 V

Applications

- Large screen multifunction monitors and LCD TVs
- Portable DVD players

12-W Stereo Class-D Audio Amplifiers

TPA3004D2 and TPA3002D2

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA3004D2 and

www.ti.com/sc/device/TPA3002D2

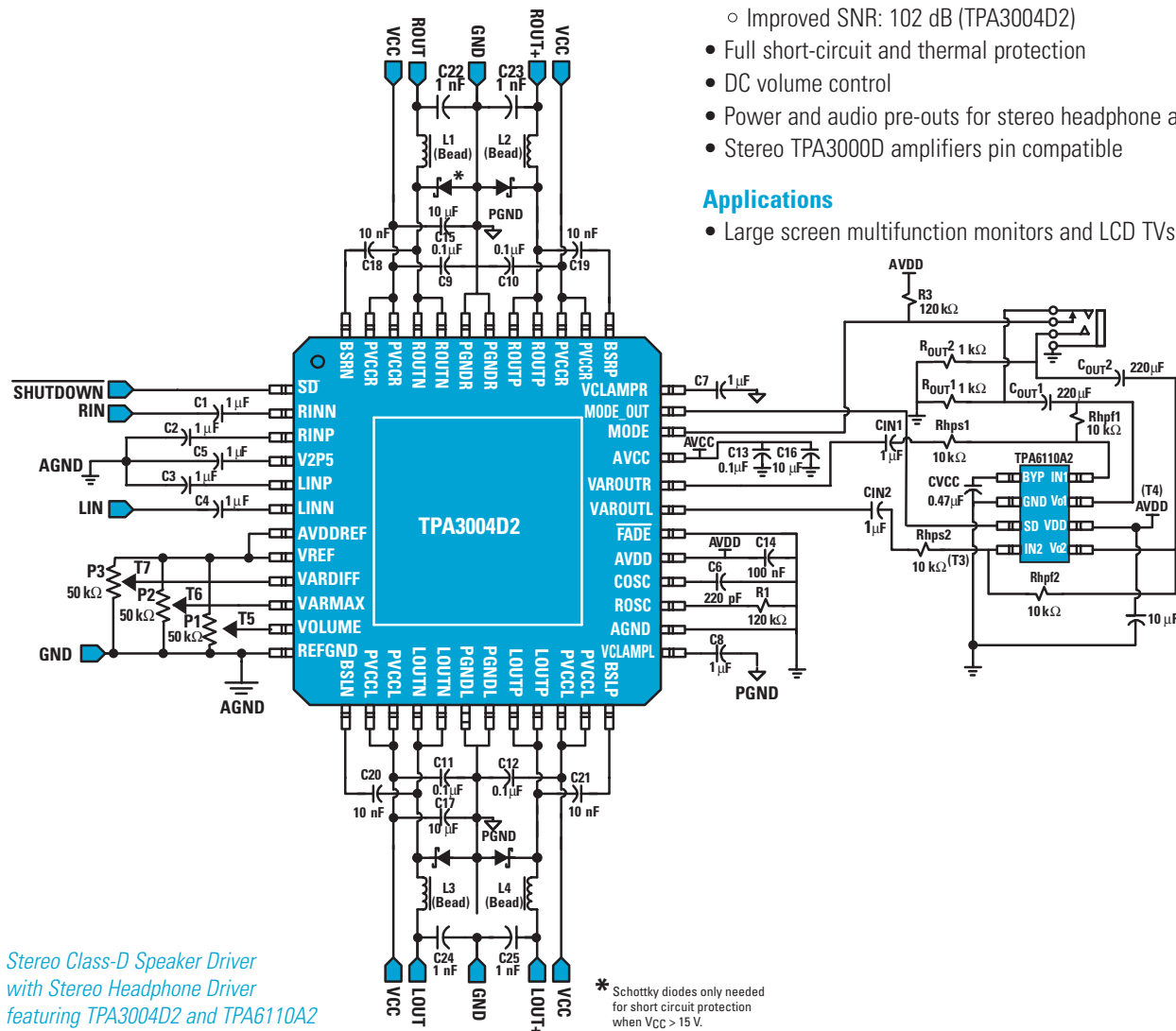
The TPA3004D2 and TPA3002D2 are analog-input Class-D audio power amplifiers that will drive 12 W stereo and 9 W stereo, respectively, into 8- Ω speakers without a heat sink or large output filter components. Integrated DC volume control and pre-outs for stereo headphone drive make these two amplifiers extremely versatile.

Key Features

- TPA3004D2: 12 W stereo into 8 Ω from 15 V at 10% THD+N
- TPA3002D2: 9 W stereo into 8 Ω from 12 V at 10% THD+N
- Filter-free modulation
 - Filter not required for efficiency or audio quality, but a low-cost ferrite bead will reduce EMI
 - Improved efficiency
 - Improved SNR: 102 dB (TPA3004D2)
- Full short-circuit and thermal protection
- DC volume control
- Power and audio pre-outs for stereo headphone amp
- Stereo TPA3000D amplifiers pin compatible

Applications

- Large screen multifunction monitors and LCD TVs



Stereo Class-D Speaker Driver with Stereo Headphone Driver featuring TPA3004D2 and TPA6110A2

LCD TVs, Multifunction Monitors and Plasma-Display TVs



3-W Stereo Class-D Audio Amplifier TPA2008D2

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA2008D2

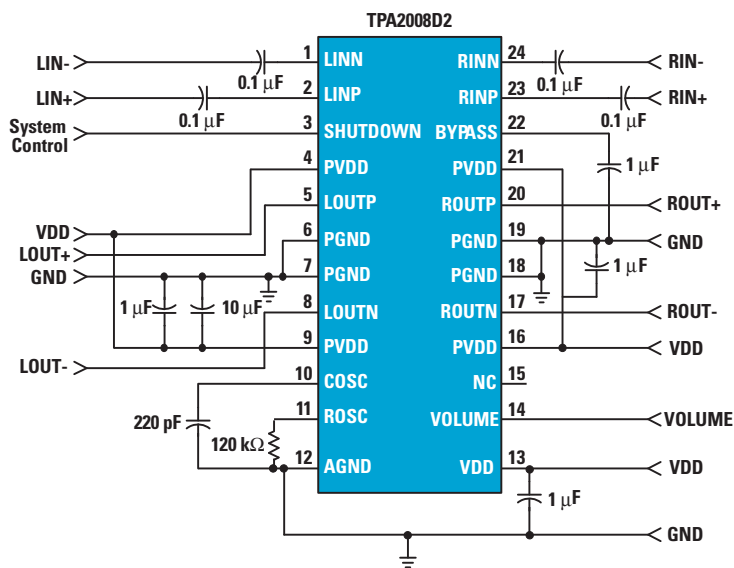
The TPA2008D2 is an analog-input Class-D audio power amplifier that will drive 3 W stereo into 3- Ω speakers without a heat sink or large output filter components. The output power level and integrated DC volume control are ideal for multifunction monitors (MFM's).

Key Features

- 3 W stereo into 3 Ω from 5 V with 10% THD+N
- Filter-free modulation
 - Filter not required for efficiency or audio quality, but a low-cost ferrite bead will reduce EMI
 - Improved efficiency
 - Improved SNR: 96 dB
- Full short-circuit and thermal protection
- DC volume control

Applications

- Multifunction monitors
- LCD TVs



TPA2008D2 Typical Application Circuit

3-W Stereo Class-AB Audio Amplifier TPA6030A4

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA6030A4

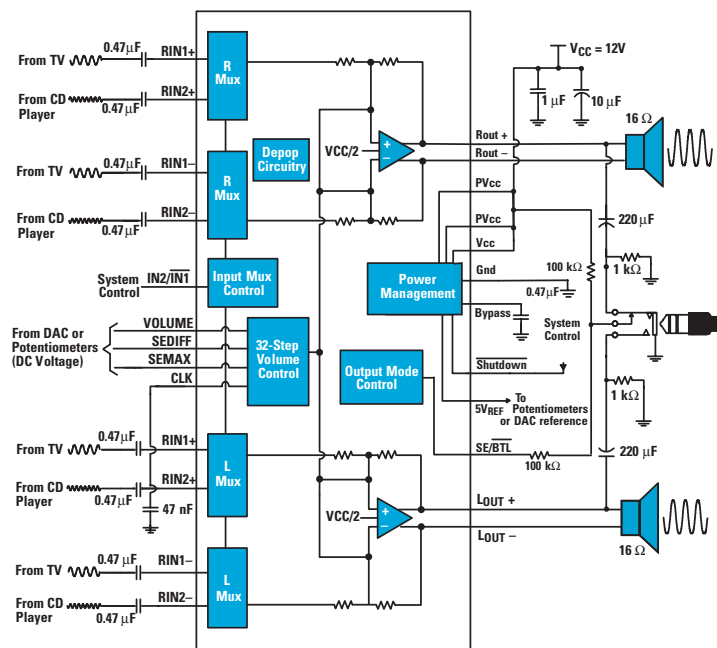
The TPA6030A4 is a fully integrated stereo speaker, stereo headphone and DC volume control audio solution. Features like integrated depop circuitry that nulls "pops" and "clicks" during startup and shutdown transitions and 12-V operation make the TPA6030A4 ideal for multifunction monitors (MFM's).

Key Features

- 3 W stereo into 16 Ω from 12 V with 10% THD+N
- Supply voltage range: 7 V to 15 V
- Integrated stereo headphone driver
- DC volume control
- Excellent depop circuitry
- Full short-circuit and thermal protection
- Integrated gain set to 1.5 V/V

Applications

- Multifunction monitors
- LCD TVs



TPA6030A4 Typical Application Circuit

→ LCD TVs, Multifunction Monitors and Plasma-Display TVs

3-W Stereo Class-AB Audio Amplifier

TPA6011A4

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA6011A4

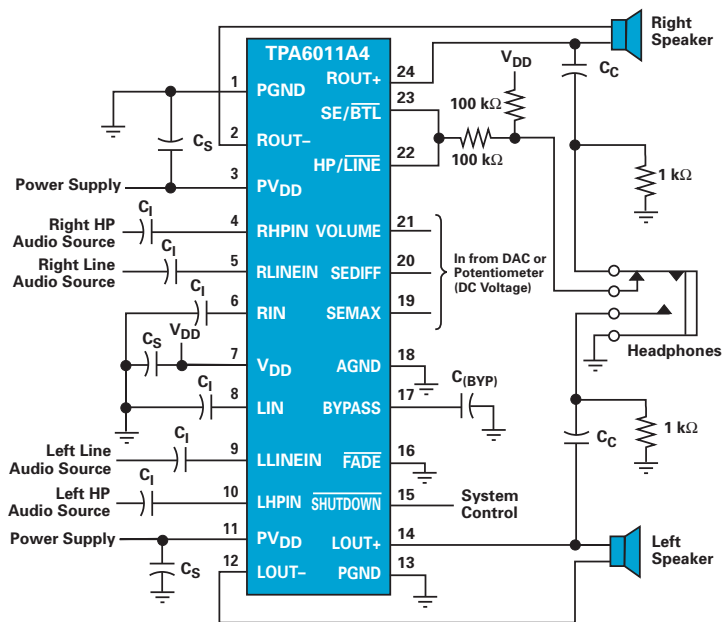
The TPA6011A4 is similar to the TPA6030A4 in functionality, but operates from a 5.5-V supply instead of a 12-V supply. Robust output power, integrated stereo headphone drive and DC volume control make the TPA6011A4 well suited for multifunction monitor (MFM) applications.

Key Features

- 3 W stereo into 3 Ω from 5.5 V with 10% THD+N
- DC volume control
- Integrated stereo headphone drive
- Input stereo MUX
- Full short-circuit and thermal protection

Applications

- Multifunction monitors
- LCD TVs



TPA6011A4 Typical Application Circuit

Cap-Free Stereo Headphone Amplifier

TPA4411

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA4411

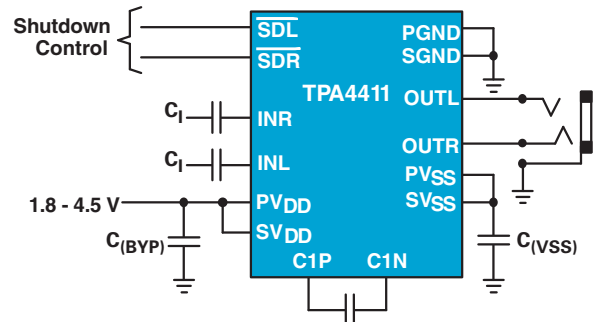
The TPA4411 is a stereo headphone driver that eliminates the need for large (often expensive) output capacitors required by other headphone amplifiers to block DC voltages.

Key Features

- 80 mW stereo into 16 Ω from 4.5 V with < 1% THD+N
- Ground referenced outputs
 - Eliminates need for DC blocking capacitors (i.e. cap-free operation)
 - Saves space and cost
 - Improves low frequency (i.e. bass) response
 - Greatly reduces “pop” and “click” noise during startup and shutdown transitions
- Full short-circuit and thermal protection
- Integrated gain set to 1.5 V/V

Applications

- Multifunction monitors
- LCD TVs
- Portable DVD players
- Cellular phones



TPA4411 Typical Application Circuit

LCD TVs, Multifunction Monitors and Plasma-Display TVs



4-Channel I²S to PWM Processor
TAS5504

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TAS5504

The TAS5504 is a four-channel digital pulse width modulator that provides advanced performance and high level system integration. It is designed to interface seamlessly using four stereo serial audio inputs accepting a wide range of formats.

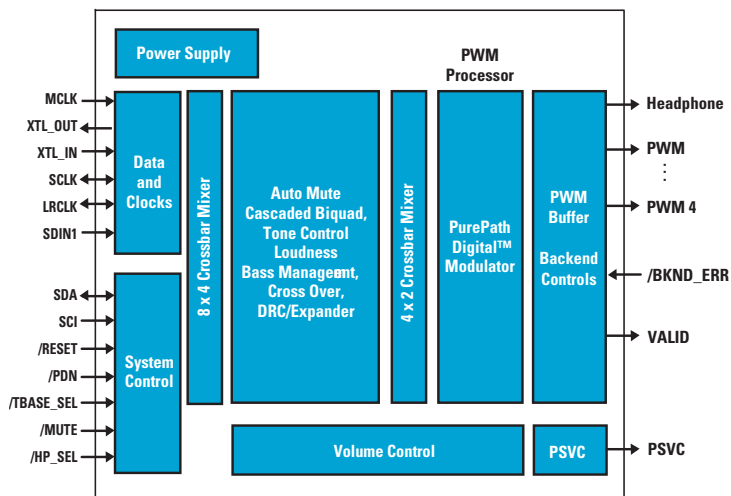


Key Features

- 4-channel digital audio PWM processor
 - I²S inputs
 - PWM output
- Supply voltage: 3.3 V
 - Inputs are 5-V tolerant
- High-performance digital audio (DAP)
- 48-bit audio processing
- Dynamic range: > 102 dB
- Sampling rates: 32 to 192 kHz
- Two bass and treble tone controls

Applications

- Plasma TVs



TAS5504 Typical Application Circuit

30-W Digital Amplifier Power Stage
TAS5122

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TAS5122

The TAS5122 is a digital-input power stage designed to drive 30 W into stereo speakers with no large external heat sinks. The device incorporates TI's PurePath Digital™ technology and is used in conjunction with a digital audio PWM processor and a simple passive demodulation filter to deliver high-quality, high-efficiency, true-digital audio amplification.

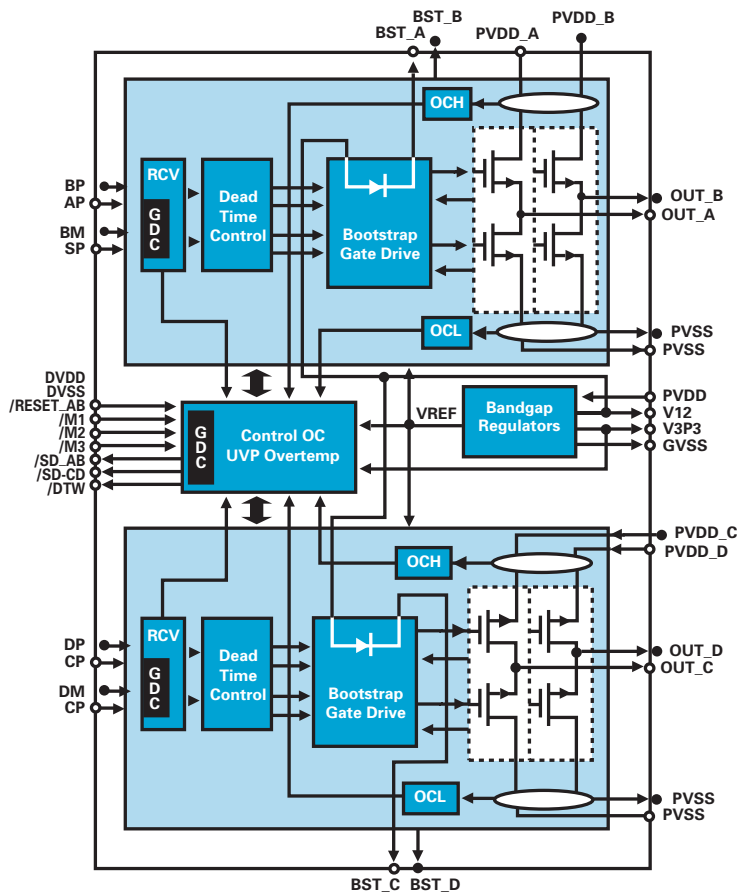


Key Features

- 30 W stereo into 6 Ω from 23 V with < 0.4% THD+N
- Greater than 90% efficient
- 95 dB maximum dynamic range
- Full short-circuit, under-voltage and thermal protection with reporting

Applications

- Plasma TVs



TAS5122 Block Diagram

→ LCD TVs, Multifunction Monitors and Plasma-Display TVs

Digital Audio Processor with Codec TAS3004

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TAS3004

The TAS3004 device is a system-on-a-chip that replaces conventional analog equalization to perform digital parametric equalization, dynamic range compression and loudness contour. This device also provides high-quality, soft digital volume, bass and treble control.

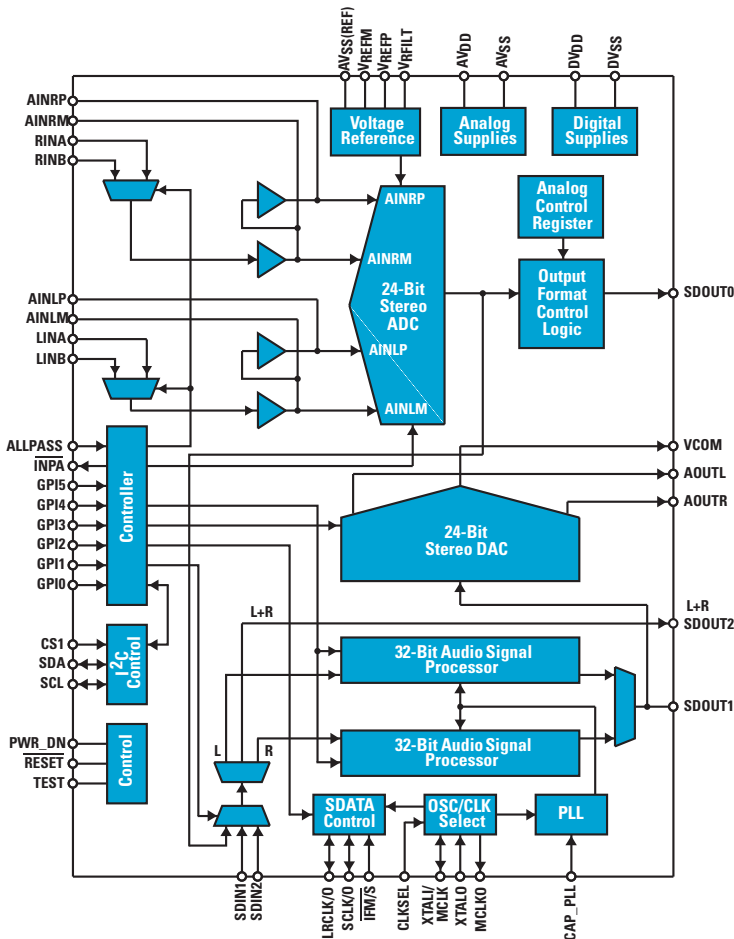


Key Features

- I²C control
 - Seven band parametric equalization
 - Digital bass and treble control
 - Digital volume control
 - Loudness contour/dynamic bass
- Analog audio input and output
- Voltage supply: 3.3 V
- Sampling rates: 32 kHz, 44.1 kHz or 48 kHz

Applications

- LCD TVs



TAS3004 Block Diagram

3-Terminal Adjustable Regulator LM317M

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/LM317M

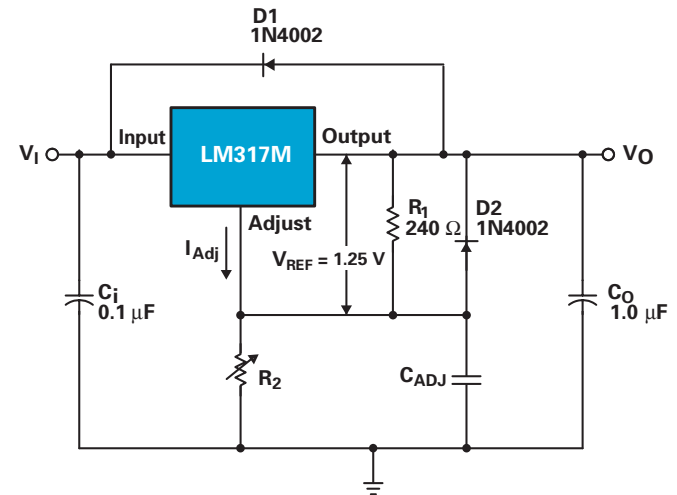
The LM317M is an adjustable 3-terminal positive-voltage regulator capable of supplying more than 500 mA over an output-voltage range of 1.25 V to 37 V. The LM317M is exceptionally easy to use and requires only two external resistors to set the output voltage. Both line and load regulation are better than standard fixed regulators.

Key Features

- Output voltage: 1.2 V to 37 V
- Output current: > 500 mA
- Internal short-circuit current limiting
- Thermal overload protection

Applications

- LCD TVs
- Multifunction monitors
- Plasma TVs



LM317M Typical Application Circuit

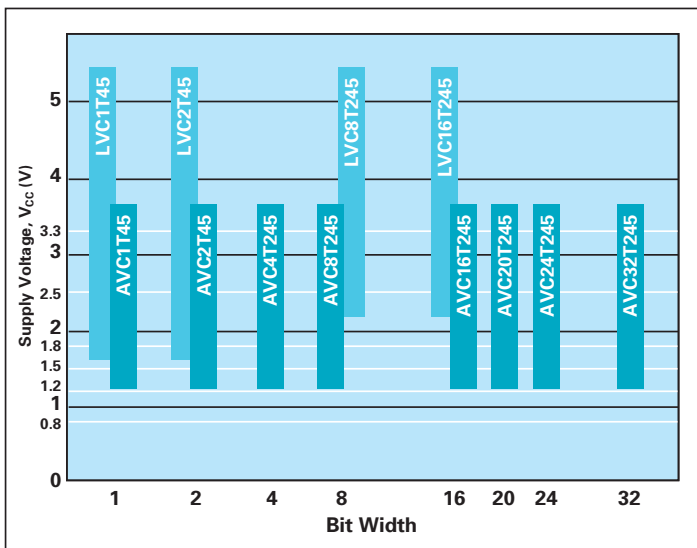
LCD TVs, Multifunction Monitors and Plasma-Display TVs



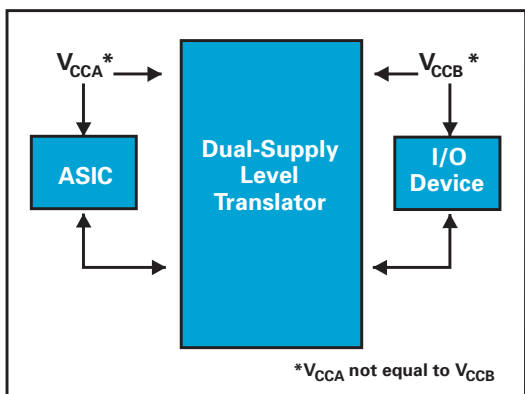
Dual-Supply Level Translators
SN74AVCXT245 and SN74LVCXT245

Get samples, datasheets and app reports at: www.ti.com/trans

Dual-supply level shifters are the ideal solution for bidirectional level translation. These devices have two separate V_{CC} supplies, one for each port (V_{CCA} and V_{CCB}), which gives them flexibility to operate in mixed-mode applications. These dual-supply devices allow for bidirectional level translation between different voltage nodes from 1.2 V to 3.6 V and 1.65 V to 5.5 V. TI also offers a wide range of bit-width options.



Extended Family of Dual-Supply Level-Translation Devices



Typical Situation in which a TI Level Translator is Needed

GET TO MARKET FASTER

Bring your audio innovations to the world faster with TI silicon and support. Put the latest technical documentation, applications notes, training information and development tools at your fingertips with our free resource CD. Also available is a Digital Media CD targeted specifically for Video and Imaging innovations.

NEW RESOURCE CDs AVAILABLE
 Audio Solutions Resource CD, to order visit:
www.ti.com/tiaudio
 Digital Media Resource CD, to order visit:
www.ti.com/tivideo



→ To Know More

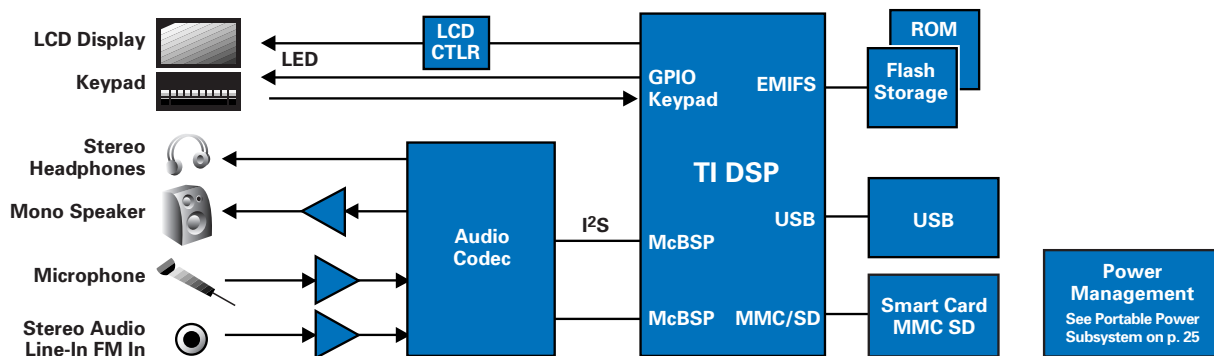
For detailed information about TI products:

TLV320AIC32 and TLV320AIC33: Low-Power, Highly Integrated Stereo Audio Codecs	26
TLV320AIC26 and TLV320DAC26: High-Performance, Low-Power Audio Converters	26
TLV320AIC28: Low-Power Audio Codec for Portable Applications	27
TLV320AIC23B: Low-Power Stereo Audio Codec	27
TS5A23157: Dual-SPDT 5-V Analog Switch	28
TS5A3159: 1- Ω Single-Pole/Double-Throw Analog Switch	28
TSB43AA82 and TSB43AA82A: 2-Port, Integrated PHY and Link-Layer Chip for PC Peripherals	29
TUSB6250: Low-Power USB 2.0-to-ATA Bridge Solution	29
PCM2910: Audio Codec with USB Interface, Mono Microphone Input and Stereo Headphone Output	30
PCM177x: Low-Voltage, Low-Power Stereo DACs	30

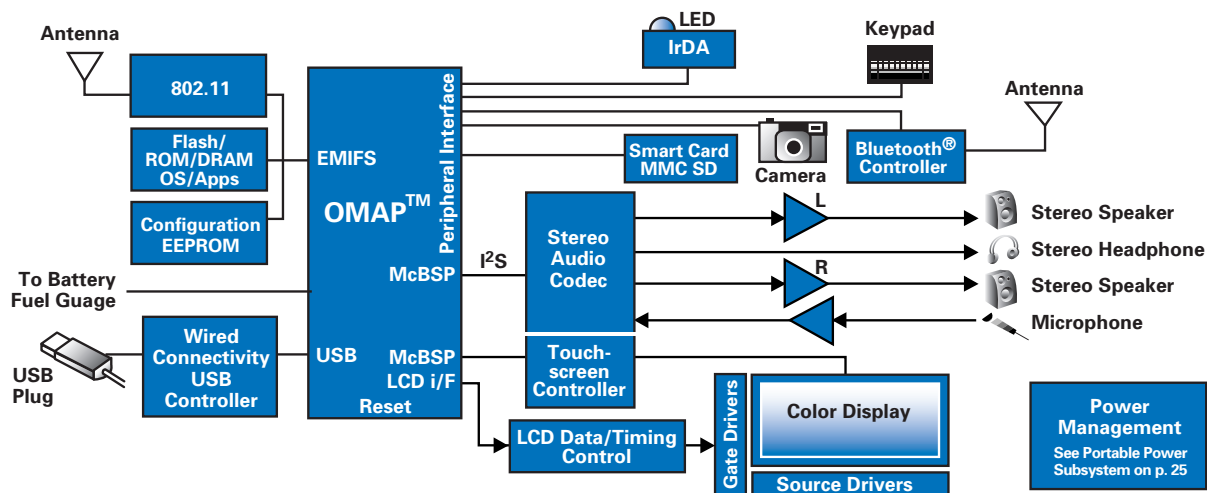
Other TI Products for This Market:

TPA4411: Cap-Free Stereo Headphone Amplifier	20
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The portable audio device space has grown significantly in recent years, due not only to the explosion of conventional audio and multimedia playback devices, but also to the integration of audio functionality into equipment that in the past had no audio capability. Not only are flash-memory and hard-disk based audio players quite common in stores today, but now audio functions are easily found in cell phones, PDAs, digital video camcorders, digital still cameras, Bluetooth® and 802.11 wireless headsets, and even portable language translators. The electrical components used in these systems also vary dramatically, including audio ADCs and DACs for conversion between analog and digital, headphone/speaker amplifiers for driving earpieces, headphones or built-in speakers, programmable DSPs for encoding/decoding compressed data in such formats as MP3, WMA or AAC, microcontrollers for handling system-level control and user interface functions, and wireless transceivers for transmission/reception of data over RF. TI offers a broad portfolio of products focused directly at portable audio equipment, with particular focus on low-power operation, since the one common factor among virtually all such systems is their dependence on battery power for operation.



MP3 Player/Recorder System Block Diagram

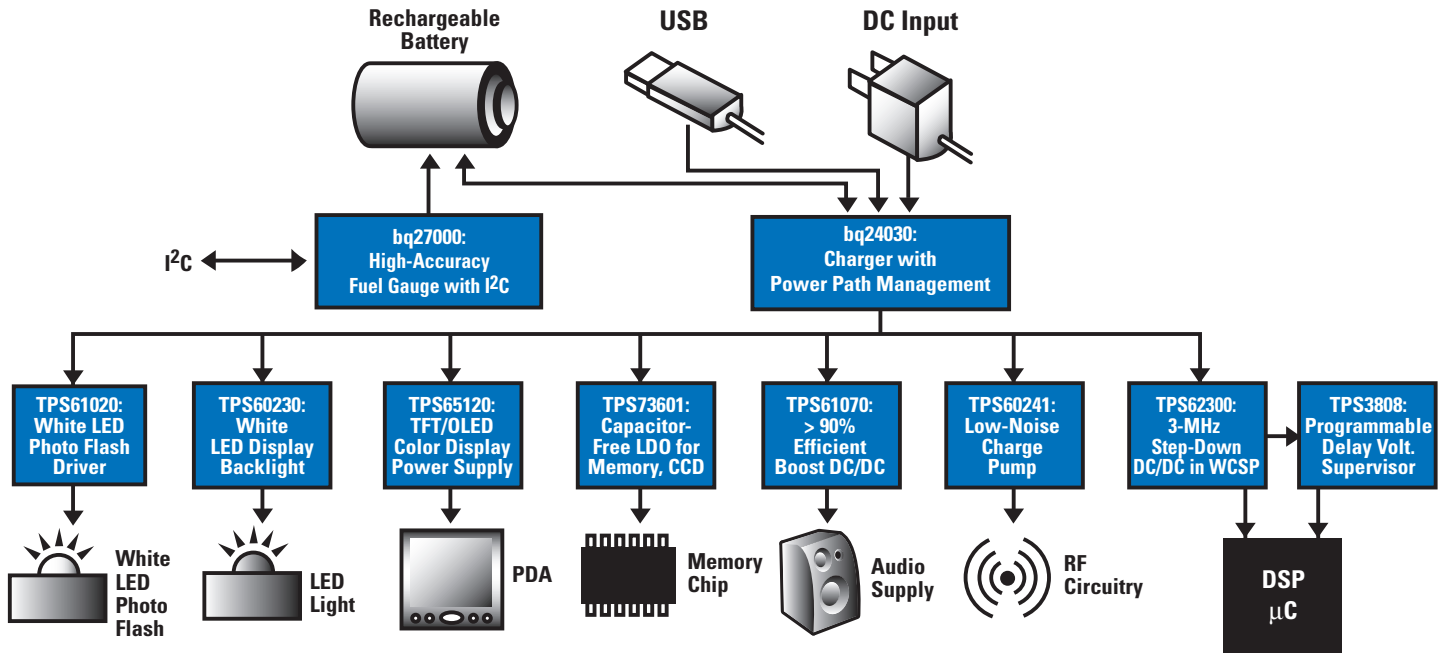


Personal Digital Assistant (PDA) System Block Diagram



Below is a subsystem block diagram that is applicable for most portable applications. Recommended TI ICs for each power management function are shown in the diagram. The table at the bottom of

the page includes additional specifications for these ICs, as well as alternative ICs within each power function category. To access TI's complete power management portfolio, go to power.ti.com



Portable Power Subsystem

Complete Portable Power Solutions

Device	Description
Battery Charger	
bq2057	1- to 2-Cell Linear Li-Ion Charge Controller in MSOP
bq24100	1- to 3-Cell Li-Ion Fully Integrated Switch-Mode Charger in QFN
bq24020	1-Cell Li-Ion Fully Integrated Charger for AC/DC Adapter and USB in QFN
bq24030	1-Cell Li-Ion Charger for AC/DC Adapter and USB with Dynamic Power Path Management in QFN
Battery Fuel Gauges	
bq27200	1- to 2-Cell Li-Ion Battery Fuel Gauge with I ² C in QFN and WCSP
bq20280	2- to 4-Cell Li-Ion SMBus Battery Fuel Gauge with Impedance Track™ Technology
DC/DC Step-Down Converters for Core and I/O	
TPS62220	400-mA, 1.25-MHz Step-Down Converter with 15-μA Quiescent Current in ThinSOT-23
TPS62300	500-mA, 3-MHz High-Accuracy Step-Down Converter with 1-μH inductor in WCSP and QFN
TPS62050	800-mA, 10-V Vin Step-Down Converter with 12-μA Quiescent Current in QFN-10
TPS62040	1.2-A, 1.25-MHz Step-Down Converter with 18-μA Quiescent Current in QFN-10
TPS64200	3-A Step-Down Controller in SOT-23
DC/DC Boost Solutions	
TPS61040	400-mA Switch Boost Converter, up to 28 V in SOT-23
TPS61070	600-mA Switch Boost Converter in ThinSOT-23 for 1- and 2-Cell Alkaline Applications
TPS61020	1.5-A Switch Boost Converter in QFN
TPS61030	4-A Switch Boost Converter in QFN
LED Backlight and Camera Flash Solutions	
TPS61042	500-mA Switch, Current-Regulated Boost Converter in QFN
TPS61060	375-mA Switch, Current-Regulated, Synchronous Boost Converter in QFN and WCSP
TPS60230	5-Channel, Current-Regulated White LED Charge Pump in QFN
TPS60231	3-Channel, Current-Regulated White LED Charge Pump in QFN
TPS65550	Xenon Flash Charger for Digital Still Cameras with Integrated IGBT Driver
TPS61020	1.5-A Switch Boost Converter in QFN for White LED Flash

Device	Description
Display Power Solutions	
TPS61045	375-mA Switch Boost Converter, up to 28 V in QFN
TPS65120	4-Channel Small Form-Factor TFT Display Power Supply in QFN
TPS65130	2-Channel, Positive/Negative Power Supply for OLED Displays in QFN
Low Dropout Regulators (LDOs)	
TPS71533	50-mA 3.2-μA Micro-Power LDO in SC-70
TPS72118	150-mA Low-Noise, Low-Vin LDO in SOT-23
TPS79301	200-mA Low-Noise, High PSRR LDO in SOT-23 and WCSP
TPS73601	400-mA Cap-Free, Reverse-Leakage Protection LDO in SOT-23 and QFN
Supply Voltage Supervisors	
TPS3808G01	2.4-μA, Programmable Delay Supply Voltage Supervisor in SOT-23
TPS3801-01	9-μA, Ultra-Small Supply Voltage Supervisor in SC-70
Complete Power Management Units	
TPS65010	1-Cell Li-Ion Charger, 1.2-A and 400-mA Step-Down Converter, 2 LDO with I ² C in QFN
TPS65500	8-Channel, Fully Integrated DC/DC Converter for Digital Still Cameras



Low-Power, Highly Integrated Stereo Audio Coders TLV320AIC32 and TLV320AIC33

PREVIEW * The TLV320AIC32/33 are highly integrated, low-power stereo coders for use in a variety of portable audio equipment. The TLV320AIC33 includes 10 analog input pins and seven output drivers and targets cellular telephony applications. The TLV320AIC32 is software-compatible to the TLV320AIC33 and includes stereo headphone and line output drivers and a mono 400-mW 8- Ω speaker driver.

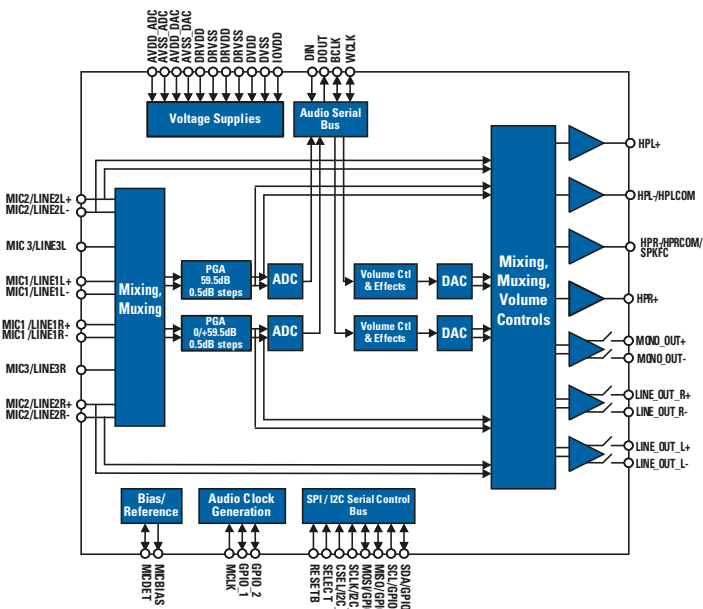
Key Features

- Stereo DAC (103 dB) and ADC (90 dB) support rates up to 96 kbps
- 103-dB stereo playback at 13 mW power dissipation
- Stereo headphone drivers and 400-mW 8- Ω speaker driver
- Stereo microphone preamps and hardware automatic gain control
- Integrated PLL for flexible audio clock generation
- Programmable digital audio bass/treble/EQ with 3-D effects
- Analog inputs are configurable as single-ended or fully-differential
- Dual I²S/PCM bus architecture with DSP and TDM modes (AIC33 only)
- Ten analog inputs, seven output drivers for easy connectivity to multiple devices in a cellular telephony system (AIC33 only)

Applications

- Cellular and smart phones
- Digital still cameras, digital video cameras
- MP3 and portable media players
- PDAs

* Expected release April 2005



TLV320AIC33 Block Diagram

High-Performance, Low-Power Audio Converters TLV320AIC26 and TLV320DAC26

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TLV320AIC26 and

www.ti.com/sc/device/TLV320DAC26

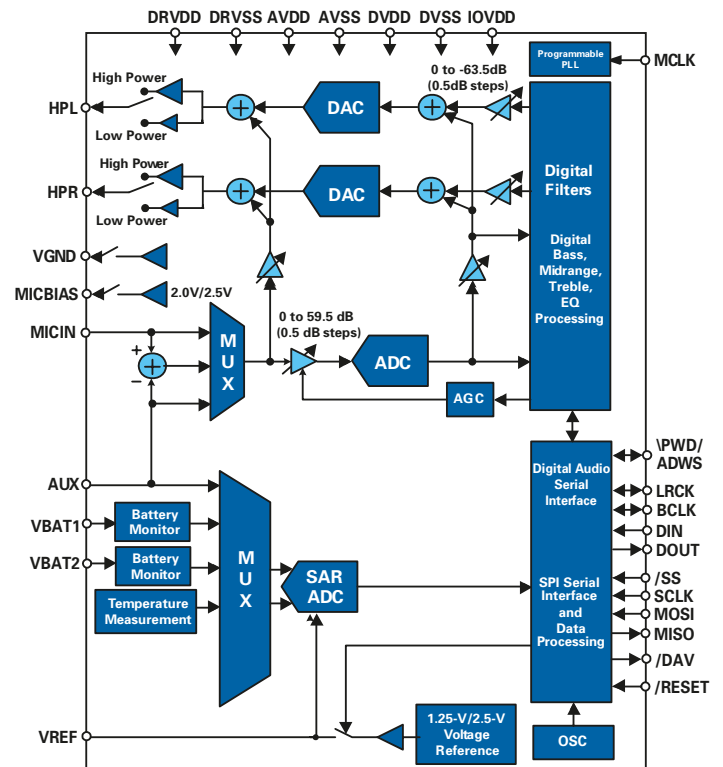
The TLV320AIC26 is a high-performance, low-power audio codec with headphone/speaker amplifier and 12-bit battery/temperature/auxiliary measurement ADC. The TLV320DAC26 is a pin- and software-compatible version of the TLV320AIC26 incorporating a stereo audio DAC and headphone/speaker amplifier.

Key Features

- Stereo DAC and mono audio ADC (AIC26) support up to 53 kbps
- 97-dB stereo playback at 11-mW power dissipation
- Audio output drivers provide 325 mW into 8 Ω , also support stereo headphones with capless output option
- Integrated PLL for flexible audio clock generation
- Programmable digital audio bass/treble/EQ/de-emphasis
- Microphone preamp and hardware automatic gain control (AIC26)
- Direct battery measurement accepts up to 6-V input (AIC26)
- On-chip temperature and auxiliary-input measurement (AIC26)

Applications

- Digital still cameras, digital video cameras
- MP3 and portable media players
- PDAs



TLV320AIC26 Block Diagram



Low-Power Audio Codec for Portable Applications TLV320AIC28

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TLV320AIC28

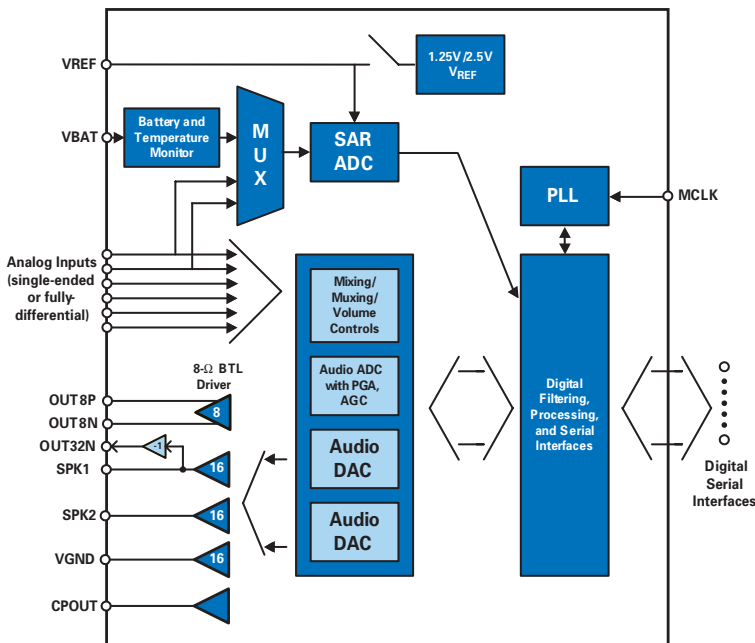
The TLV320AIC28 is a low-power, highly integrated audio codec with integrated stereo headphone amplifier, 8-Ω speaker amplifier and 12-bit battery/temperature/auxiliary measurement ADC.

Key Features

- Stereo audio DAC and mono audio ADC support rates up to 53 kbps
- Stereo headphone drivers with support for capless output configuration
- 400-mW, 8-Ω speaker amplifier with separate supply for direct Li-Ion/polymer battery connection
- Six analog inputs, five output drivers for easy connectivity to stereo or cellular headsets as well as cellular analog baseband processors
- Microphone bias, preamp and hardware automatic gain control
- Integrated PLL for flexible audio clock generation
- Programmable digital audio bass/treble/EQ/de-emphasis
- Direct battery measurement accepts up to 6-V input
- On-chip temperature and auxiliary input measurement

Applications

- Cellular smart phones
- Personal digital assistants (PDAs)



TLV320AIC28 Block Diagram

Low-Power Stereo Audio Codec TLV320AIC23B

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TLV320AIC23B



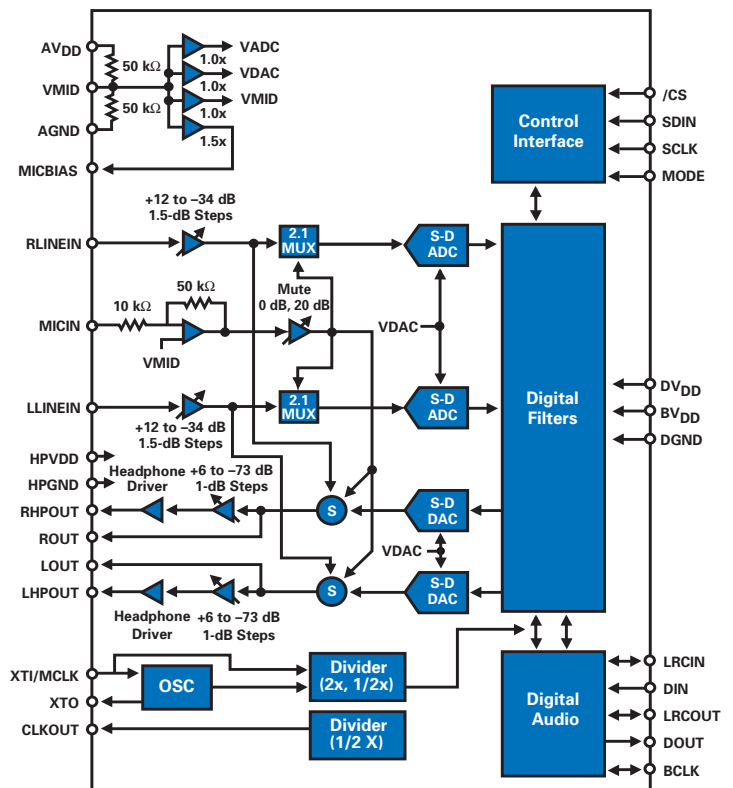
The TLV320AIC23B high-performance, low-power stereo audio codec with highly integrated functionality allows many features to fit into a small area with minimal power consumption.

Key Features

- Very low-power dissipation: 23 mW in playback mode
- 90-dB SNR ADC, 100-dB SNR DAC
- Integrated headphone amplifier: 40 mW into 16 Ω
- I²C or SPI protocol for control
- Microphone input with side-tone mixer
- Maximum sample rate of 96 kHz
- Bypass mode enables an all-analog path
- Package: small 25 mm² MicroStar BGA™ or RHD or TSSOP

Applications

- Multifunction internet audio players (portable audio players, cell phones, PDAs, digital cameras, etc.)
- Portable CD players
- Portable jukeboxes
- Portable radios and boom boxes



TLV320AIC23B Block Diagram



Dual Single-Pole/Double-Throw 5-V Analog Switch

TS5A23157

Get samples, datasheets and app reports at: www.ti.com/signalswitches

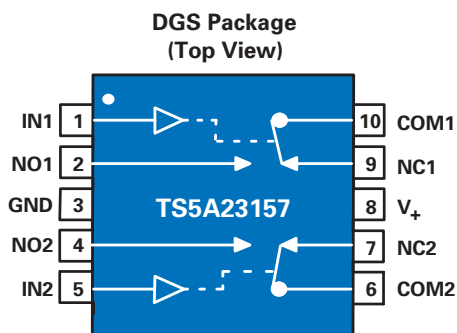
The TS5A23157 is a dual single-pole/double-throw (SPDT) analog switch designed for 1.65- to 5.5-V V_{CC} operation. The TS5A23157 can handle both analog and digital signals and permits signals with amplitudes of up to 5.5 V (peak) to be transmitted in either direction without clipping. Analog switches in the TS switch product family provide low power consumption and high speed while maintaining exceptional signal integrity. Typical applications include analog signal routing, signal gating, chopping and digital signal multiplexing/demultiplexing.

Key Features

- Passes both analog and digital signals
- Specified break-before-make switching
- Low charge injection
- Excellent on-resistance matching
- Low total harmonic distortion
- 1.8- to 5.5-V single-supply operation
- Bidirectional data flow with near-zero propagation delay
- Low power consumption (10 μ A at 1.95 V) supports portable applications
- Supports both digital and analog applications
- Low input/output capacitance minimizes loading and signal distortion

Applications

- Space-constrained PCBs (portable applications)
- Consumer electronics
- Simplify large PCB routing



TS5A23157 Package and Functional Diagram

1- Ω Single-Pole/Double-Throw Analog Switch

TS5A3159

Get datasheets and samples at www.ti.com/signalswitches

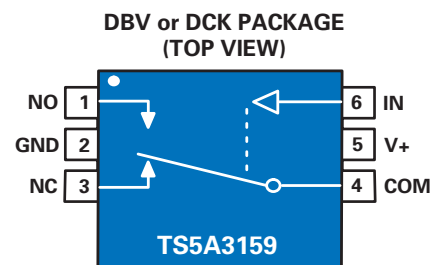
The TS5A3159 1- Ω switch improves audio fidelity and signal integrity in portable audio applications. This single-pole/double-throw (SPDT) switch is a 2:1 multiplexer/demultiplexer that provides low ON-state resistance and an excellent on-resistance matching with the break-before-make feature to prevent signal distortion during the transferring of a signal from one channel to another. The TS5A3159 can handle both analog and digital signals and permits signals with amplitudes of up to V_{CC} (peak) to be transmitted in either direction without clipping. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features along with space-saving package options such as NanoStar™ and NanoFree™ make this device suitable for portable audio applications in cell phones, PDAs and portable instrumentation.

Key Features

- Passes both analog and digital signals
- Break-before-make switching
- Low ON-state resistance (1 Ω)
- Near zero propagation delay
- Wide low-voltage operating range: 1.65 V to 5.5 V
- 100-MHz bandwidth – highest of any '3159 in the industry

Applications

- Space-constrained PCBs (portable applications)
- Consumer electronics applications
- Simplify large PCB routing
- ASIC feature "mux-in"



TS5A3159 Package and Functional Diagram



2-Port, Integrated PHY and Link-Layer Chip for 1394 PC Peripherals

TSB43AA82 and TSB43AA82A

Get datasheets at: www.ti.com/1394

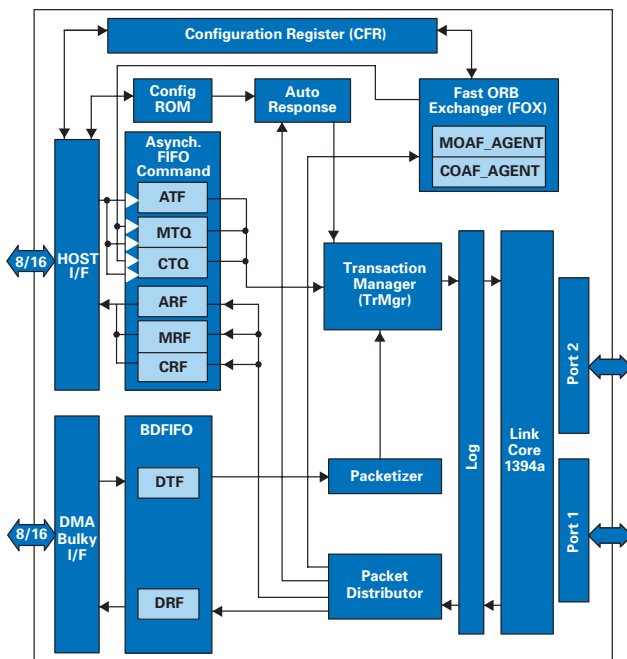
The TSB43AA82 integrated PHY and link-layer controller supports asynchronous transfers, providing a 1394 connectivity solution for high-capacity digital audio players (DAPs). This high-speed, 400-Mbps connection allows you to incorporate capacity in your DAP without sacrificing small form factor. Players like the Apple iPod® DAP use a 1.8-inch hard disk drive as the storage medium for songs and data. The TSB43AA82 will provide the high-speed link to the computer needed to load a large number of songs in a reasonable timeframe. A generic 8-/16-bit host bus interface supports parallel, multiplexed connections to the microcontroller at rates up to 40 MHz.

Key Features

- IEEE 1394a-2000 compliant
- Single 3.3-V supply
- Internal 1.8-V circuit reduces power consumption
- Integrated 400 Mbps, 2-port PHY
- Internal voltage regulator
- IEEE 1394 related functions:
 - Automated read response for ConfigROM register access
 - Automated single retry protocol and split transaction control

Applications

- High-capacity digital audio players
- PC and Mac peripherals



TSB43AA82 Block Diagram

Low-Power USB 2.0-to-ATA Bridge Solution TUSB6250

Get datasheets and app reports at:

www.ti.com/sc/device/TUSB6250

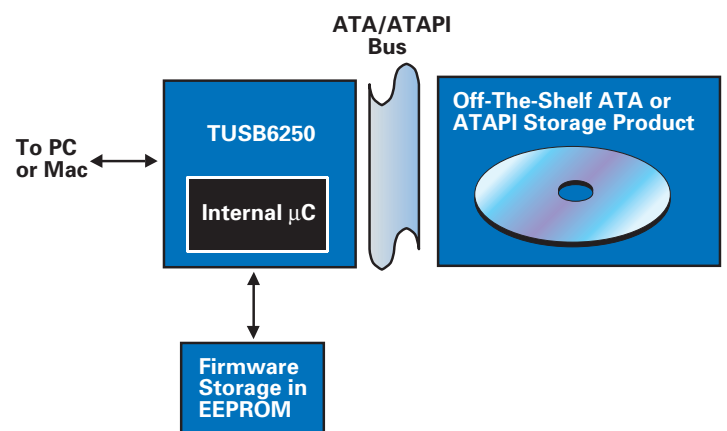
The TUSB6250 bridge for USB 2.0-compliant PC storage peripheral products provides world-class throughput, enhancing the read/write performance of high-density storage media. A highly programmable and configurable architecture allows you to make use of a wide variety of off-the-shelf ATA/ATAPI devices. Industry-leading low power consumption — just 80 mA at 3.3 V — makes cable-powered drives a reality. For self-powered drives, the TUSB6250's low power consumption provides sufficient leftover power to recharge an onboard battery. Applications include hard disk drives, as well as PC peripherals that use HDDs as their storage media (e.g. digital audio players and personal video recorders).

Key Features

- Low active power: 80 mA at 3.3 V (typ)
- Ultra-low standby power: 200 mA at 3.3 V
- Single 3.3-V supply operation with integrated 1.8-V regulator

Applications

- Hard disk drives (HDDs)
- Zip drives
- CD-RW
- DVDs
- Magneto-optical (MO) drives
- Flash card readers
- USB 2.0-based digital audio players



TUSB6250 Block Diagram



Audio Codec with USB Interface, Mono Microphone Input and Stereo Headphone Output PCM2910

PREVIEW

* The PCM2910 is TI's single-chip USB stereo audio codec with USB 2.0-compliant full-speed protocol controller and analog front end (AFE) function for headset application. The USB protocol controller works with no software code, but USB descriptors can be modified upon request. The PCM2910 employs SpAct™ architecture, TI's unique system that recovers the audio clock from USB packet data. On-chip analog PLLs with SpAct enable independent play back and record sampling rate with low clock jitter.

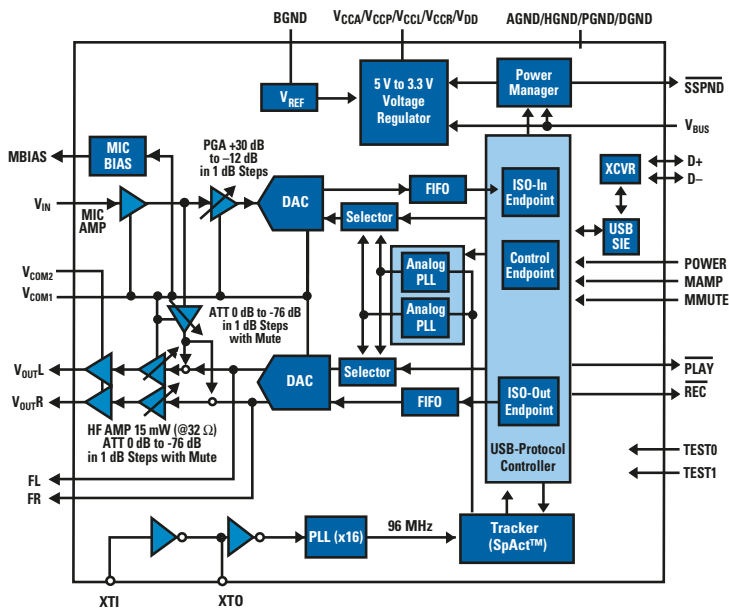
Key Features

- USB 2.0 full-speed compliant
- Mono ADC SNR: 86 dB
- Stereo HP DAC SNR: 83 dB
- On-chip clock generator: 6 MHz
- 5-V operation
- Microphone/headphone amplifier
- Package: 32-pin TQFP, Pb-free

Applications

- USB headsets
- Audio interface boxes

* Expected release March 2005



PCM2910 Block Diagram

Low-Voltage, Low-Power Stereo DACs PCM177x

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/PARTNUMBER

(Replace **PARTNUMBER** in URL with **PCM1770**, **PCM1771**, **PCM1772** or **PCM1773**)

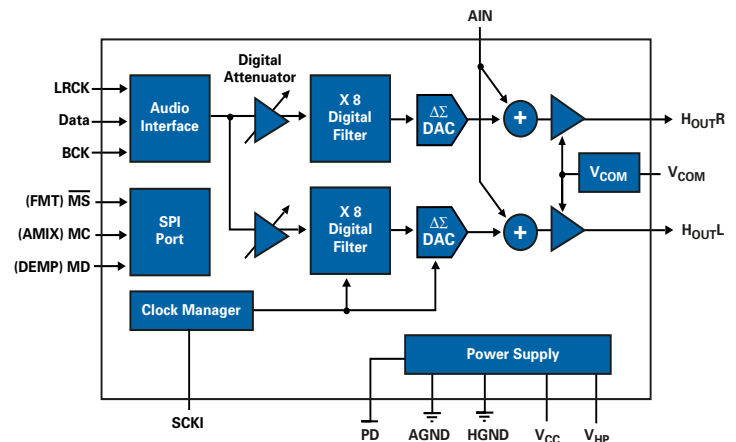
The PCM1770/1771 provide headphone drive while the PCM1772/1773 provide line output drive. The PCM1771/1773 are configured using hardware pins, while the PCM1770/1772 include a three-line software control port.

Key Features

- Dynamic range: 96 dB (typ)
- THD+N: 0.032% (typ)
- Output power at $R_L = 16 \Omega$: 10 mW (stereo), 20 mW (monaural)
- Low power dissipation:
 - 9.6 mW at V_{CC1} , $V_{HP} = 2.4 V$
 - System clock: 128 f_S, 256 f_S or 384 f_S
 - Sampling frequency: 5 to 50 kHz
- Digital attenuation:
 - 44.1-kHz digital de-emphasis
 - Digital soft mute
 - Pop-noise free circuit
 - 1.6-V to 3.6-V single power supply
- 3.3-V tolerance
- Package: 16-pin TSSOP and 20-pin VQFN (4.2 mm x 4.2 mm)

Applications

- Multifunction internet audio players (portable audio players, cell phones, PDAs, digital cameras, etc.)
- Portable CD players
- Portable jukeboxes
- Portable radios and boom boxes



PCM177x Block Diagram

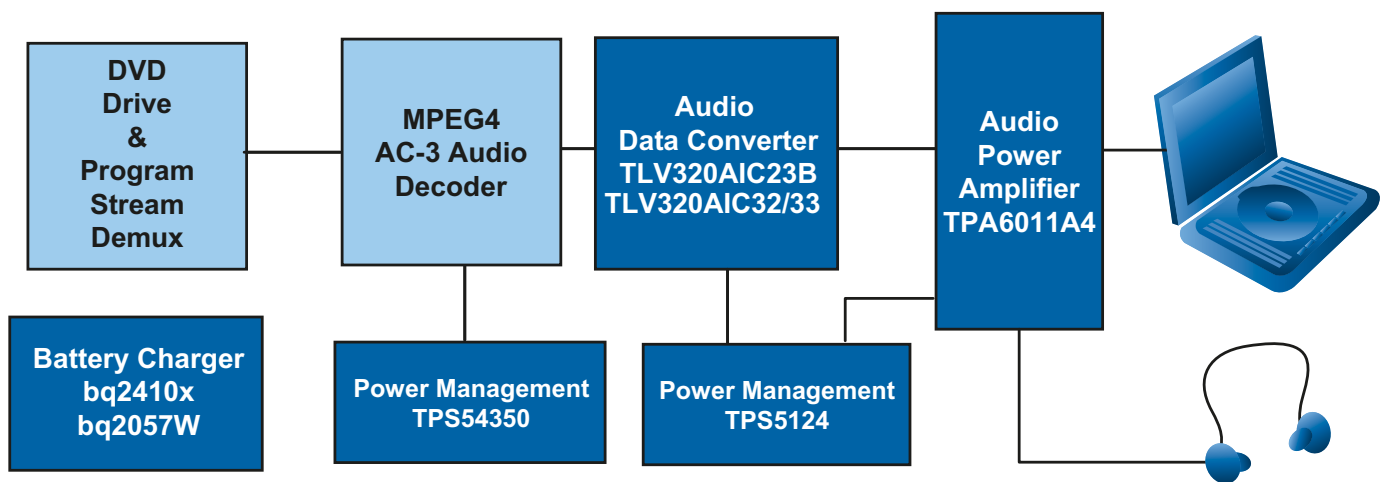
Portable DVD Players



→ To Know More	
For detailed information about TI products:	
TPA6017A2: 2-W Stereo Class-AB Amplifier	32
TPA0212 and TPA6011A4: Next-Generation Audio Power Amps Provide Integrated Gain, DC Volume and Digital Volume Control	32
TPS5124: General-Purpose, Dual-Channel Synchronous Buck DC/DC Controller	33
TPS5435x: 4.5-V to 20-V Input, 3-A Step-Down Converter	33
Other TI Products for This Market:	
PCM1754: Stereo 192-kHz, 24-Bit DAC	13
TPA4411: Cap-Free Stereo Headphone Amplifier	20
TLV320AIC32 and TLV320AIC33: Low-Power, Highly Integrated Stereo Audio Codecs	26
TLV320AIC23B: Low-Power Stereo Audio Codec	27
TPA2012D2: 2.1-W Stereo Class-D Audio Amplifier	37
TPS7014x and TPS7015x: See www.ti.com/sc/device/TPS70145	

TI supplies high-performance, cost-effective audio and power management solutions for portable DVD players. Fully integrated speaker and headphone audio power amplifiers with DC volume control and SWIFT™ power converters with integrated FETs help minimize the entire solution size.

An all new stereo Class-D audio power amplifier designed to maximize battery life is also available. Learn more about the TPA2012D2 in the smart phone section (*see p. 37*).



Audio Signal Path for Portable DVD Players

■ TI Products



Portable DVD Players

2-W Stereo Class-AB Amplifier

TPA6017A2

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA6017A2

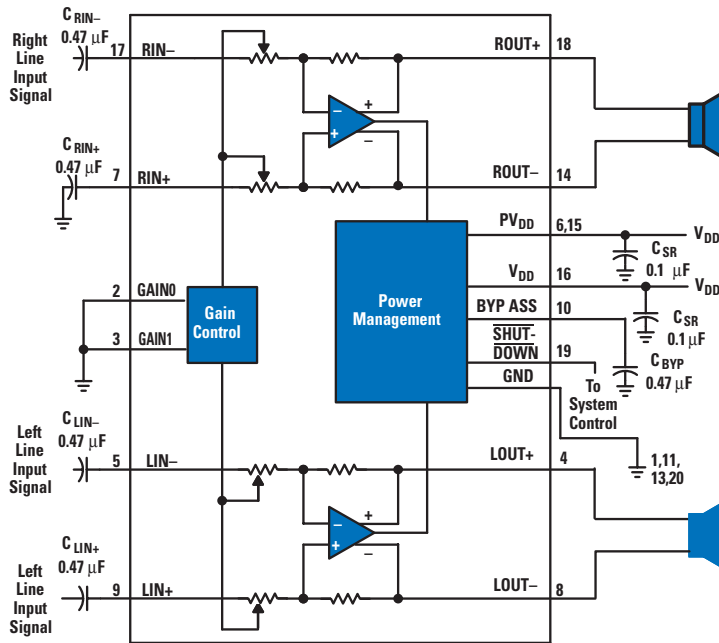
The TPA6017A2 is a stereo audio power amplifier capable of driving 2 W into 3- Ω speakers from a 20-pin TSSOP package. Integrated gain settings reduce solution size and cost further by eliminating the feedback and input resistors. Low supply current and shutdown control help maximize battery life while internal depop circuitry minimizes “pops” and “clicks” during startup and shutdown transitions.

Key Features

- 2-W stereo into 3 Ω from 5 V with < 1% THD+N
- Integrated gain settings: 6 dB, 10 dB, 15.6 dB and 21.6 dB
- Low supply current: 6 mA (typ)
- Internal depop circuitry

Applications

- Portable DVD players
- Notebook computers



TPA6017A2 Block Diagram

Next-Generation Audio Power Amps Provide Integrated Gain, DC Volume and Digital Volume Control

TPA0212 and TPA6011A4

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA0212 and www.ti.com/sc/device/TPA6011A4

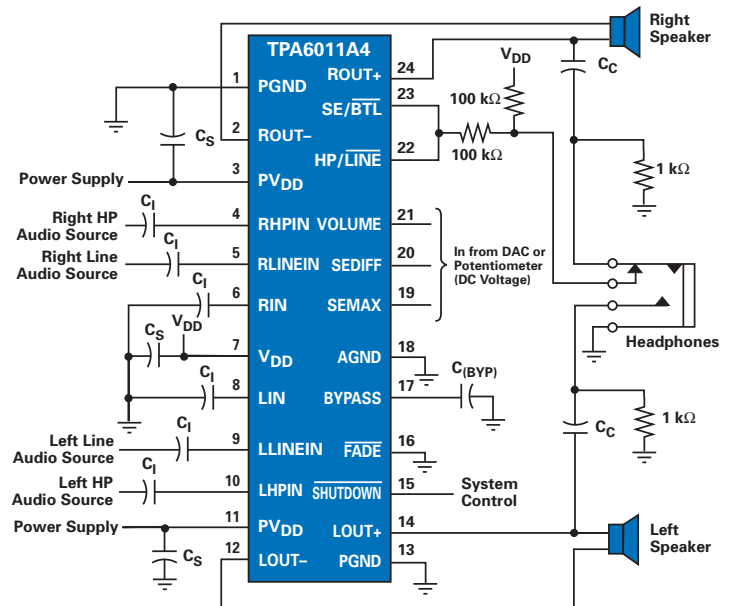
These stereo audio power amplifiers drive 2 W/channel of continuous RMS power into a 3- Ω load. These devices minimize the number of external components needed, which simplifies the design and frees up board space for other features.

Key Features

- Integrated gain settings (TPA0212)
- DC volume control (TPA6011A4)
- Digital volume control
- Differential inputs
- Integrated stereo headphones
- Stereo input MUX
- Drives 3- Ω speakers

Applications

- Portable DVD players
- Digital radios
- Notebook computers



TPA6011A4 Typical Application Circuit



General-Purpose, Dual-Channel Synchronous Buck DC/DC Controller

TPS5124

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPS5124

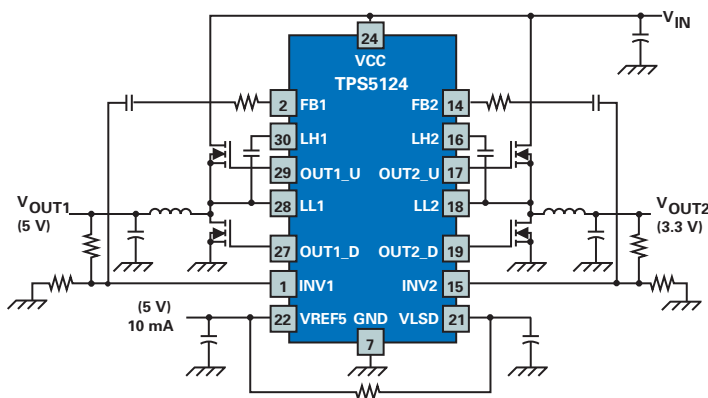
The TPS5124 is a dual independent high-efficiency synchronous step-down controller. It supports low-voltage/high-current power supply applications that use either 5-V or 12-V bus voltage. Since both controllers operate 180 degrees out-of-phase, the input current ripple is minimized resulting in a smaller input capacitance and reduced power supply cost.

Key Features

- Input voltage range 4.5 to 15 V and 6.5 to 15 V
- High efficiency—no current sense resistor required, $R_{DS(on)}$ over-current detection with temperature compensation
- Adjustable output voltage down to 0.9 V
- Voltage-mode PWM control: Maximum 500-kHz operation
- 180° out-of-phase control
- Individual standby and soft-start for each channel—easy power sequencing
- Over-voltage and under-voltage protection
- Built-in bootstrap diode
- Built-in 5-V linear regulator
- Accurate $\pm 1\%$ 0.85-V reference
- Package: 30-pin TSSOP (DBT)

Applications

- Portable DVD players
- Consumer game systems
- Digital set-top boxes
- VGA and sound boxes



TPS5124 Typical Application Circuit

4.5-V to 20-V Input, 3-A Step-Down Converter

TPS5435x

Get samples, datasheets, evaluation modules, app reports and software tools

at: www.ti.com/sc/device/TPS54350

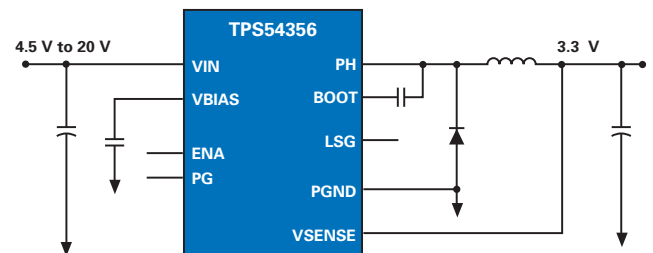
The TPS5435x family of synchronous buck PWM converters features a high-performance voltage error amplifier that enables maximum performance under transient conditions allowing flexibility in choosing output filter inductors and capacitors. Other features include an under-voltage-lockout circuit to prevent start-up until the input voltage reaches 4.5 V, an internal slow-start circuit to limit in-rush currents and a power good output to indicate valid output conditions. The synchronization feature is configurable as either input or output for easy 180° out of phase synchronization.

Key Features

- Input voltage range: 4.5 to 20 V
- 4.5-A peak MOSFET switch for high efficiency at 3-A continuous output current
- Uses external low-side MOSFET or diode
- Output voltage adjustable down to 0.9 V with 1% accuracy
- Wide PWM frequency – fixed 250 kHz, 500 kHz or adjustable 250 to 700 kHz
- Load protected by peak current limit and thermal shutdown
- Internal slow start
- Adjustable under-voltage lockout
- Synchronizes to external clock
- Package: 16-pin PowerPAD™ TSSOP

Applications

- Portable DVD players
- Computer peripherals



TPS54356 Typical Application Circuit

→ Wireless Handsets, Smart Phones and Feature Phones

→ To Know More

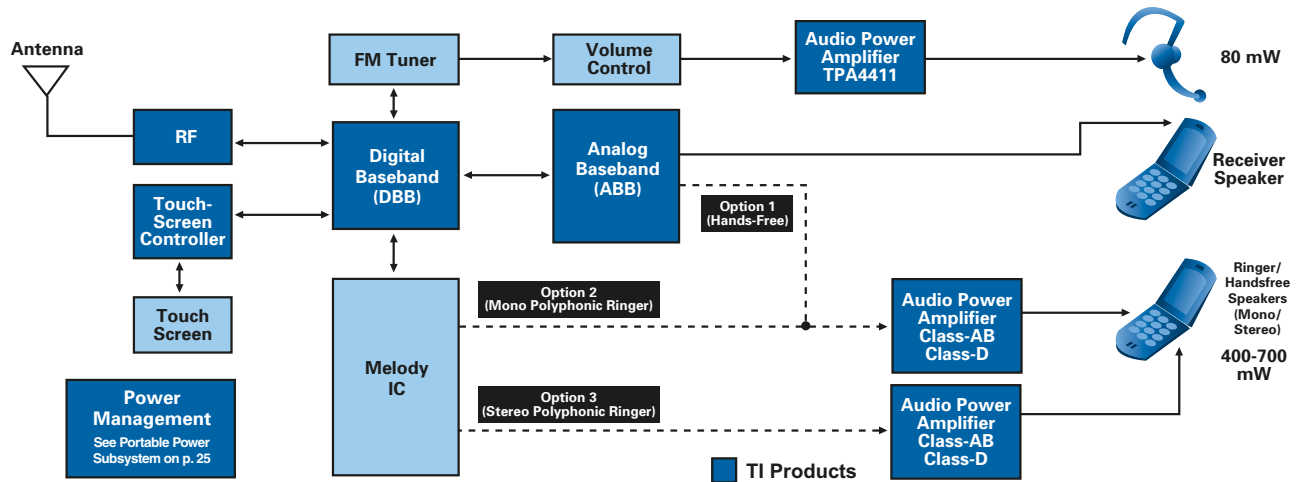
For detailed information about TI products:

TPA6203A1: 630-mW Mono Class-AB Audio Amplifier	35
TPA6204A1: 720-mW Mono Class-AB Audio Amplifier	35
TPA6211A1: 1.2-W Mono Class-AB Audio Amplifier	36
TPA2005D1: 580-mW Mono Class-D Audio Amplifier	36
TPA2010D1: 1.1-mW Mono Class-D Audio Amplifier	37
TPA2012D2: 2.1-W Stereo Class-D Audio Amplifier	37

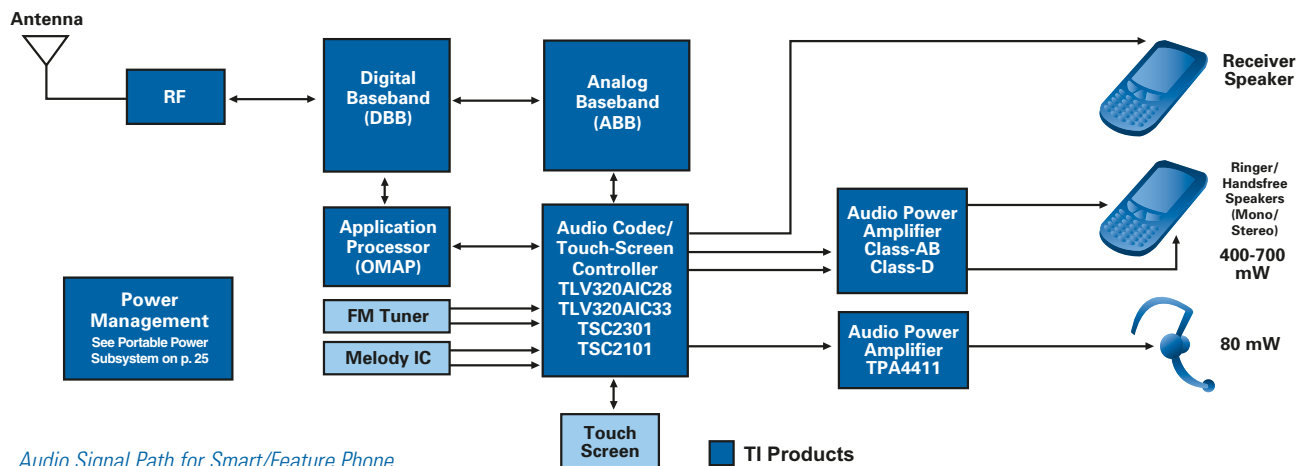
Other TI Products for This Market:

TPA4411: Cap-Free Stereo Headphone Amplifier	20
TLV320AIC32 and TLV320AIC33: Low-Power, Highly Integrated Stereo Audio Codecs	26
TLV320AIC26: High-Performance, Low-Power Audio Converters	26
TLV320AIC28: Low-Power Audio Codec for Portable Applications	27
TSC210x and TSC230x: Data Converter (Codec Sub-section) Selection Guide	48

Power-efficient Class-D audio power amplifiers solve two main problems within modern cell phones with integrated audio functionality: heat dissipation and power consumption. Lower heat dissipation means more power can be delivered to the speaker. The lower power consumption prolongs battery life. Together, these two benefits allow more sound and longer talk time in the cell phone.



Audio Signal Path for Standard Cell Phone



Audio Signal Path for Smart/Feature Phone

Wireless Handsets, Smart Phones and Feature Phones



**630-mW Mono Class-AB Audio Amplifier
TPA6203A1**

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TPA6203A1

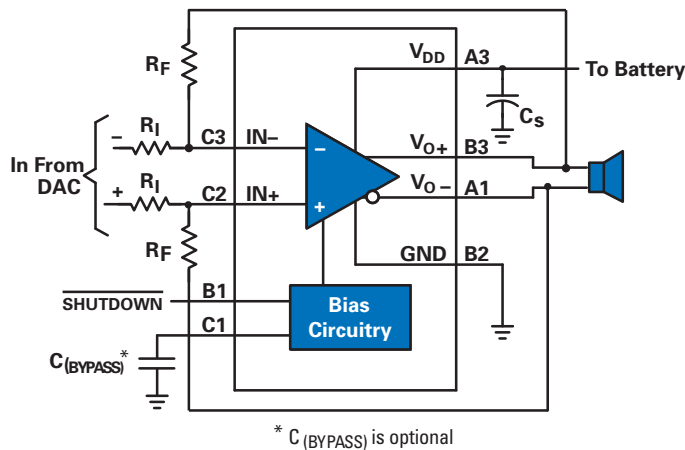
The TPA6203A1 is a mono Class-AB audio power amplifier that will drive 630 mW into an 8-Ω speaker at 3.6 V with only five external components.

Key Features

- 630 mW mono into 8 Ω from 3.6 V at 1% THD+N
- Low supply current: 1.7 mA
- Fully differential architecture
- High PSRR: 85 dB
- High CMRR: 70 dB
- Package: 2 mm x 2 mm BGA, Pb-free available

Applications

- Wireless handsets
- Smart/feature phones
- PDAs



TPA6203A1 Block Diagram

**720-mW Mono Class-AB Audio Amplifier
TPA6204A1**

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TPA6204A1

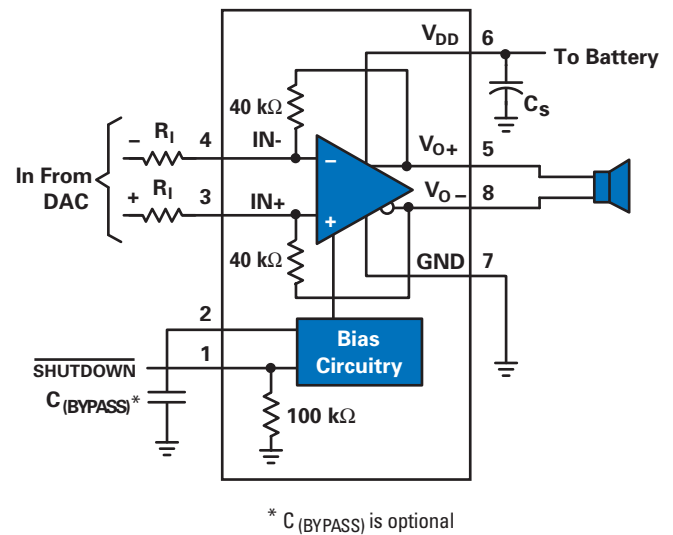
The TPA6204A1 is a mono Class-AB audio power amplifier that will drive 720 mW into an 8-Ω speaker at 3.6 V with only three external components.

Key Features

- 720 mW mono into 8 Ω from 3.6 V at 1% THD+N
- Low supply current: 4 mA
- Fully differential architecture
- High PSRR: 85 dB
- High CMRR: 63 dB
- Package: 3 mm x 3 mm QFN, Pb-free available

Applications

- Wireless handsets
- Smart/feature phones
- Cordless phones
- PDAs



TPA6204A1 Block Diagram

→ Wireless Handsets, Smart Phones and Feature Phones

1.2-W Mono Class-AB Audio Amplifier

TPA6211A1

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA6211A1

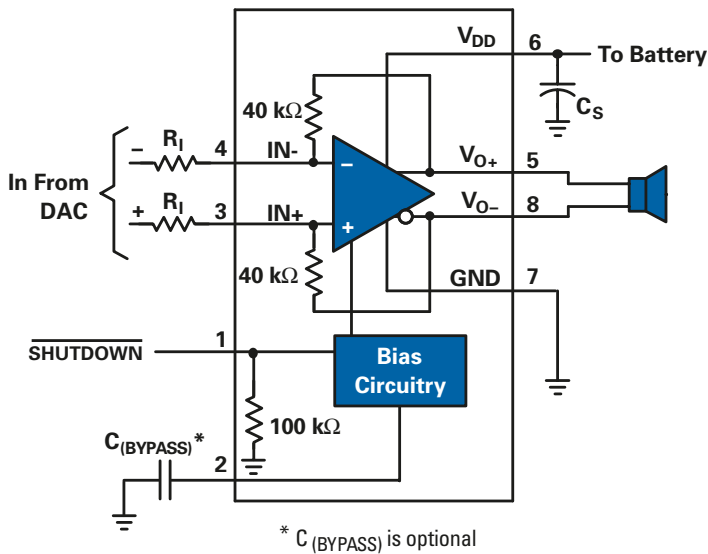
The TPA6211A1 is a mono Class-AB audio power amplifier that will drive 1.2 W into a 3- Ω speaker at 3.6 V with only three external components.

Key Features

- 1.2 W mono into 3 Ω from 3.6 V at 1% THD+N
- Low supply current: 4 mA
- Fully differential architecture
- High PSRR: 85 dB
- High CMRR: 63 dB
- Package: 3 mm x 3 mm QFN package and 3 mm x 5 mm MSOP, Pb-free available

Applications

- Wireless handsets
- Smart/feature phones
- PDAs
- Laptop subwoofers



TPA6211A1 Block Diagram

580-mW Mono Class-D Audio Amplifier

TPA2005D1

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/sc/device/TPA2005D1

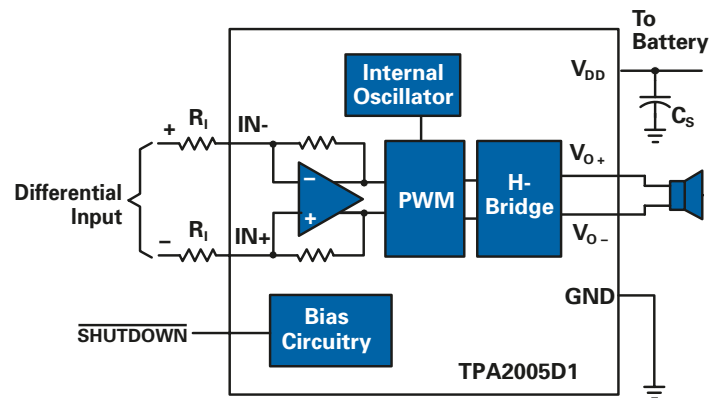
The TPA2005D1 is a mono Class-D audio power amplifier that will drive 580 mW into an 8- Ω speaker at 3.6 V with only three external components.

Key Features

- Efficient Class-D operation (84% at 400 mW)
 - Full LC filter not required for efficiency or audio quality, but a low-cost ferrite bead filter will reduce EMI
- 580 mW mono into 8 Ω from 3.6 V at 1% THD+N
- Low supply current: 2.8 mA
- Fully differential architecture
- High PSRR: 75 dB
- High CMRR: 68 dB
- Package: 2.5 mm x 2.5 mm BGA, 3 mm x 3 mm QFN and 3 mm x 5 mm MSOP; Pb-free available

Applications

- Wireless handsets
- Smart/feature phones
- PDAs



TPA2005D1 Block Diagram

Wireless Handsets, Smart Phones and Feature Phones



1.1-W Mono Class-D Audio Amplifier
TPA2010D1

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TPA2010D1

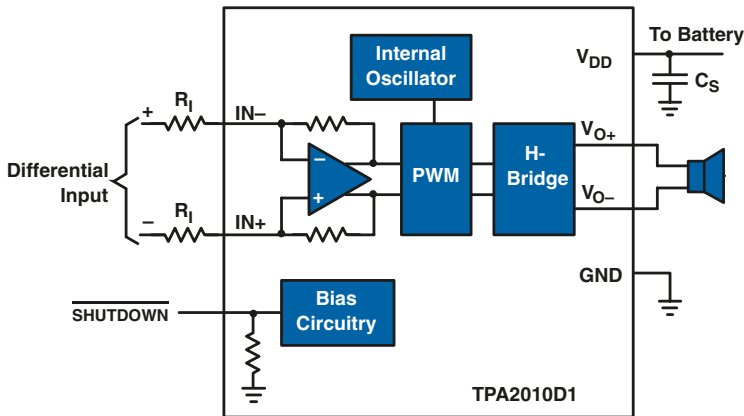
The TPA2010D1 is a mono Class-D audio power amplifier that will drive 1.1 W into a 4-Ω speaker at 3.6 V with only three external components.

Key Features

- Efficient Class-D operation (88% at 400 mW)
 - Full LC filter not required for efficiency or audio quality, but a low-cost ferrite bead filter will reduce EMI
- 1.1 W mono into 4 Ω from 3.6 V at 1% THD+N
- Low supply current: 2.8 mA
- Fully differential architecture
- High PSRR: 75 dB
- High CMRR: 68 dB
- Package: 1.45 mm x 1.45 mm WCSP, Pb-free available

Applications

- Wireless handsets
- Smart/feature phones
- PDAs



TPA2010D1 Block Diagram

2.1-W Stereo Class-D Audio Amplifier
TPA2012D2

Get samples, datasheets, evaluation modules and app reports at:
www.ti.com/sc/device/TPA2012D2

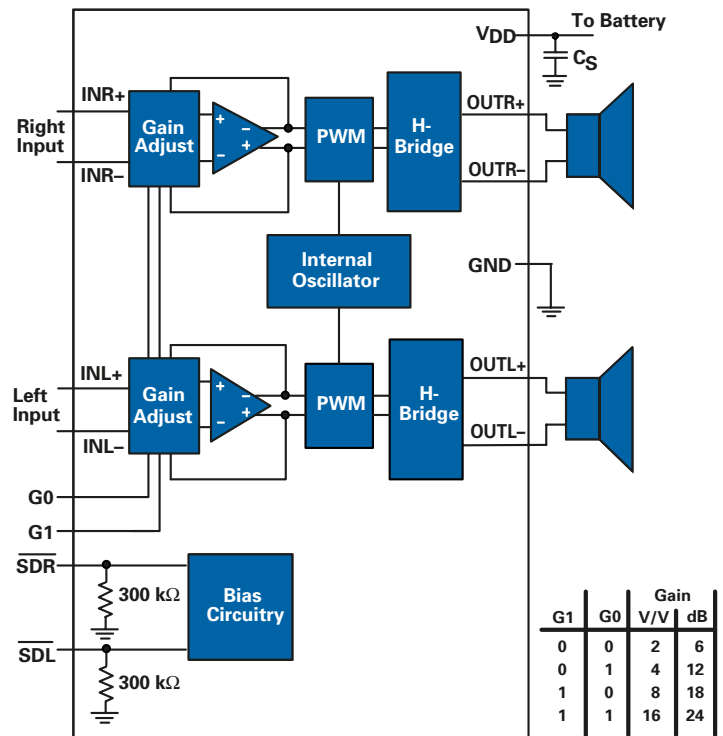
The TPA2012D2 is a stereo Class-D audio power amplifier that will drive 2.1 W into a 4-Ω speaker at 5 V with only two external components.

Key Features

- Efficient Class-D operation
 - Full LC filter not required for efficiency or audio quality, but a low-cost ferrite bead filter will reduce EMI
- 2.1 W per channel into 4 Ω from 5 V at 10% THD+N (QFN package)
- Low supply current: 6 mA
- Fully differential architecture
- Four selectable gains: 6, 12, 18 and 24 dB
- High PSRR: 77 dB (at 217 Hz)
- High CMRR: 69 dB
- Package: 2 mm x 2 mm WCSP and 4 mm x 4 mm ThinQFN (Both Pb-free)

Applications

- Wireless handsets
- Smart/feature phones
- PDAs
- Portable DVD players



TPA2012D2 Block Diagram

		Gain	
G1	G0	V/V	dB
0	0	2	6
0	1	4	12
1	0	8	18
1	1	16	24

→ To Know More

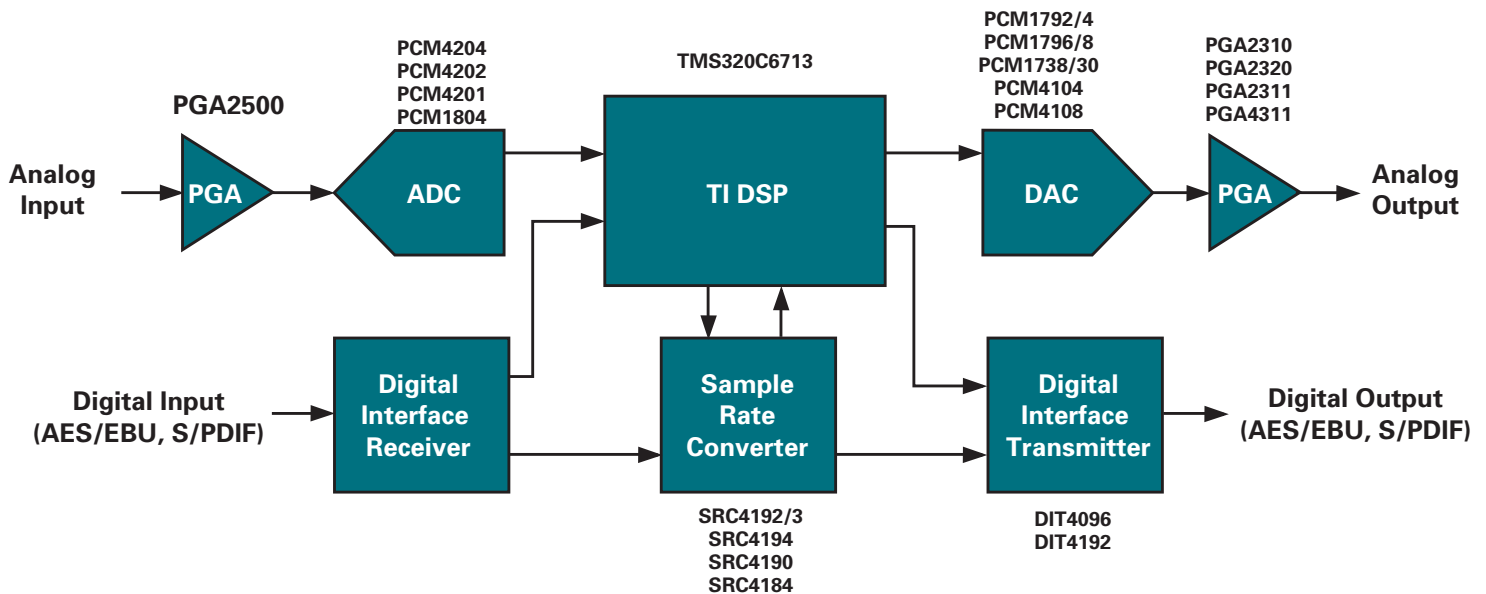
For detailed information about TI products:

TMS320C6713: Highest-Performance Floating-Point DSP for High-Quality Audio Systems	39
PGA2310/PGA2320 and PGA2311/PGA4311: High-Performance Audio Volume Controls	39
PGA2500: First Digitally Controlled Microphone Preamplifier IC	40
PCM4202 and PCM4204: High-Performance, 24-Bit, 2- and 4-Channel Stereo Audio ADCs	40
PCM4201: Low-Power, Wide Dynamic Range, 24-Bit Audio ADC for Wireless Mic/Portable Applications	41
PCM4104: High-Performance, 24-Bit, 192-kHz, 4-Channel Audio DAC	41
PCM1792: Industry's Highest-Performance Audio DAC	42
SRC419x and SRC4184: Highest-Performance Sample Rate Converter ICs	42
DIT4096 and DIT4192: Digital Audio Transmitters for Professional Studio Applications	43

Other TI Products for This Market:

TPA6120A2: See www.ti.com/sc/device/TPA6120A2

The professional audio market demands high-performance audio system solutions that are easy to use. For audio system designers, the design requirements must be satisfied across the broad range of systems that fall within the professional market segment — from the home recording equipment and electric instruments of part-time musicians to the high-quality audio and distribution infrastructure needed for sophisticated recording studios. As a result, designers of professional audio equipment are best served by a comprehensive supplier of high-performance and highly functional audio components that can be quickly designed into a wide variety of end equipments. Many of TI's advanced audio devices fulfill these requirements. For example, the TMS320C6713 DSPs are highly integrated 32-/64-bit floating-point devices that offer tremendous audio applications performance at good price points. Designers can access and harness the full performance and flexibility of this programmable DSP through TI's industry-leading development tools, including Code Composer Studio™ a proven DSP integrated development environment (IDE), a real-time DSP/BIOS™ kernel, a scalable real-time operating system, and an efficient C compiler that quickly generates optimized code. Combined with TI's advanced analog technology and high-quality audio conversion and processing products, these products provide a comprehensive tool kit for the hard-pressed system designer.



Professional Audio Signal Chain

For the latest information on TI's Professional Audio Solutions, visit www.ti.com/proaudio



Highest-Performance Floating-Point DSP for High-Quality Audio Systems

TMS320C6713

Get datasheets and app reports at: www.ti.com/sc/device/TMS320C6713

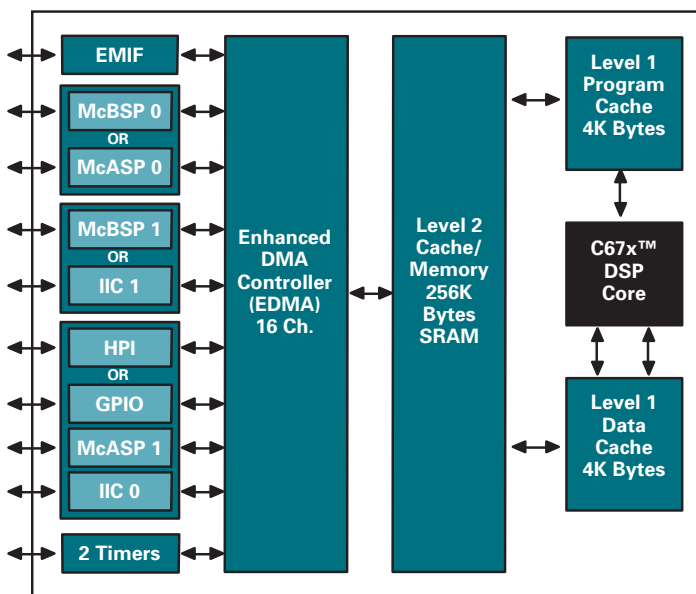
With up to 300-MHz operating speeds and integrated peripherals, the TMS320C6713 DSP offers unparalleled 32-/64-bit floating-point performance ideal for professional and high-resolution audio applications.

Key Features

- Up to 2400 MIPS/1800 MFLOPS
- Native instruction support for IEEE 754
 - 32- and 64-bit data
- L1/L2 cache memory architecture
- 32-bit external memory interface (EMIF)
- Glueless interface to SRAM, EPROM, Flash, SBSRAM and SDRAM
- Two multichannel audio serial ports (McASPs)
 - Wide variety of I²S and similar bit-stream formats supported
 - Integrated digital audio interface transmitter (DIT) supports:
 - S/PDIF, IEC60958-1, AES-3, CP-430 formats
 - Up to 16 transmit pins
 - Enhanced channel status/user data
 - Two I²C interfaces
 - 16-bit host port interface (HPI)

Applications

- Professional audio equipment: digital mixers, broadcast studio equipment, musical instruments
- High-end audio conferencing equipment
- High-end commercial audio systems



TMS320C6713 Block Diagram

High-Performance Audio Volume Controls PGA2310/PGA2320 and PGA2311/PGA4311

Get samples and datasheets at: www.ti.com/sc/device/PARTNUMBER
(Replace **PARTNUMBER** in URL with **PGA2310**, **PGA2320**, **PGA2311** or **PGA4311**)

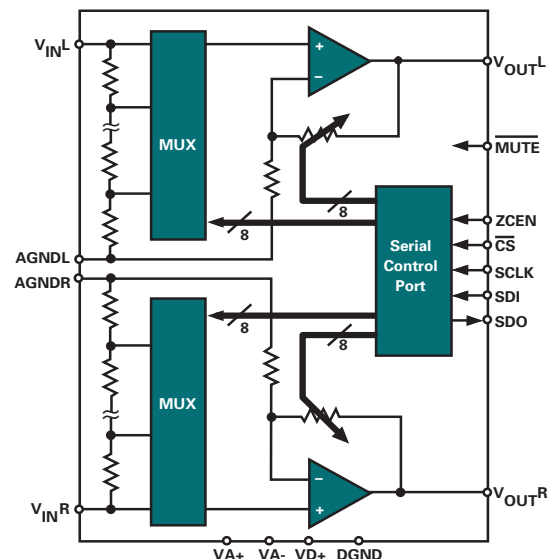
The PGA2310 is a complete stereo digitally selectable analog volume control providing high-end audio performance. It includes a 16-bit serial interface and a precision matched resistor attenuator. The PGA2311 is a CMOS version with ± 5 -V analog power supply and is pin-software-compatible with the PGA2310. The PGA4311 is a 4-channel version of the PGA2311.

Key Features

- Wide adjustable gain and attenuation range:
 - -95.5 dB of attenuation to $+31.5$ dB of gain, with 0.5-dB steps
- Noise-free level transition
- Dynamic range: 120 dB
- THD+N:
 - PGA2310/PGA2320: 0.0004% at 1 kHz
 - PGA2311U/PGA4311U (standard grade): 0.0004% at 1 kHz
 - PGA2311UA/PGA4311UA (high grade): 0.0002% at 1 kHz
- Crosstalk at 1 kHz: -126 dBFS (PGA2310); -130 dBFS (PGA2311)
- Voltage swing: 27 V_{pp} (PGA2310); 7.5 V_{pp} (PGA2311)
- Power supplies:
 - PGA2310/PGA2320: ± 15 V analog, +5 V digital
 - PGA2311/PGA4311: ± 5 V analog, +5 V digital
- Package: 16-pin SOL and DIP

Applications

- Mixers and control boards
- Broadcast equipment
- Musical instruments



PGA2310/PGA2320 and PGA2311/PGA4311 Block Diagram



Low-Power, Wide Dynamic Range, 24-Bit Audio ADC for Wireless Mic/Portable Applications PCM4201

Get datasheets at: www.ti.com/sc/device/PCM4201

PREVIEW * The PCM4201 is a low-power, 24-bit, delta-sigma audio ADC designed for portable applications, such as digital wireless microphones and battery-operated recording equipment, that require both wide dynamic range and low power consumption. The device features a 24-bit linear PCM data output, with a data format compatible with digital signal processors and digital audio interface transmitters.

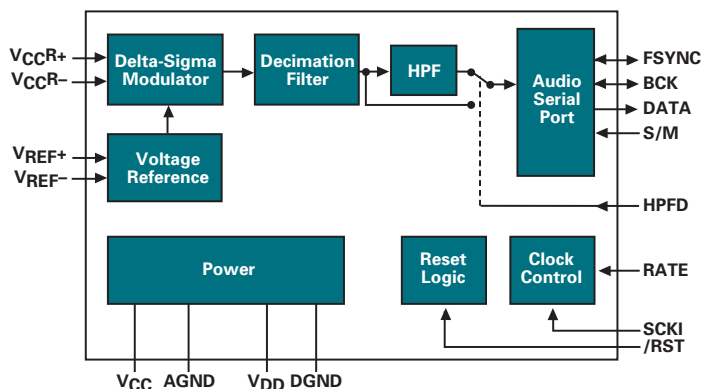
Key Features

- Dynamic range: up to 112 dB (A-weighted)
- THD+N: -103 dB
- Digital high-pass filter for DC removal
- Audio serial port:
 - Master or slave mode operation
 - 24-bit linear PCM output data
 - Left justified/DSP-compatible data format
- Three sampling modes:
 - Normal: low power operation up to $f_s = 48$ kHz with 64X oversampling
 - Normal: high-performance operation up to $f_s = 48$ kHz with 128X oversampling
 - Double speed: operation up to $f_s = 96$ kHz with 64X oversampling
- Supply voltage: +5 V analog, +3.3 V digital
- Package: 16-lead TSSOP

Applications

- Digital wireless microphones
- Portable digital recorders
- Battery-powered audio processing equipment

* Expected release June 2005



PCM4201 Block Diagram

High-Performance, 24-Bit, 192-kHz, 4-Channel Audio DAC PCM4104

Get samples, datasheets and evaluation modules at:

www.ti.com/sc/device/PCM4104

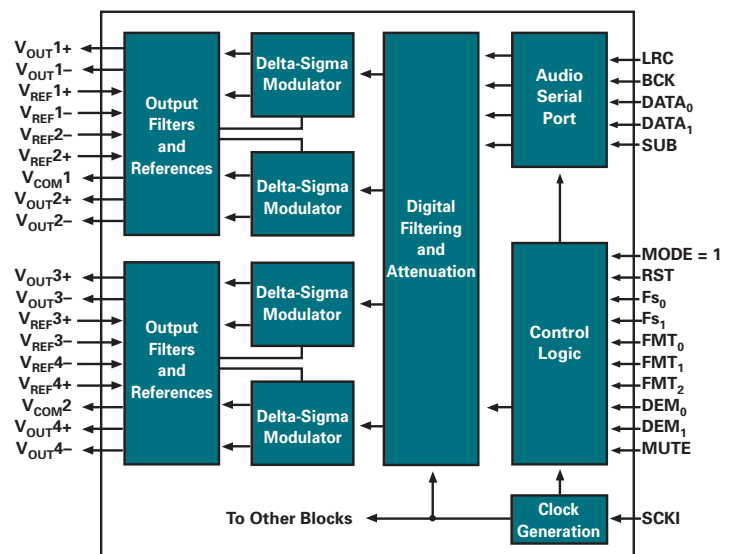
The PCM4104 is a high-performance, four-channel DAC designed for professional audio systems supporting 24-bit linear PCM data and sampling frequencies up to 192 kHz. Its 8X oversampling digital interpolation filter and multilevel, delta-sigma modulator with switched capacitor output filter provide for excellent dynamic and sonic performance as well as high tolerance to system clock phase jitter.

Key Features

- Accepts 16- to 24-bit PCM audio data
- Sampling rates up to 192 kHz
- Dynamic range: 118 dB
- THD+N: -100 dB
- Differential voltage outputs
- Standalone or software-controlled configuration
- TDM format allows easy interface to DSP serial ports
- +3.3 or +5-V supply
- Package: 48-lead TQFP

Applications

- Professional mixing consoles
- Broadcast studio equipment
- AV receivers and DVD players



PCM4104 Block Diagram



Industry's Highest-Performance Audio DAC PCM1792

Get datasheets at: www.ti.com/sc/device/PCM1792

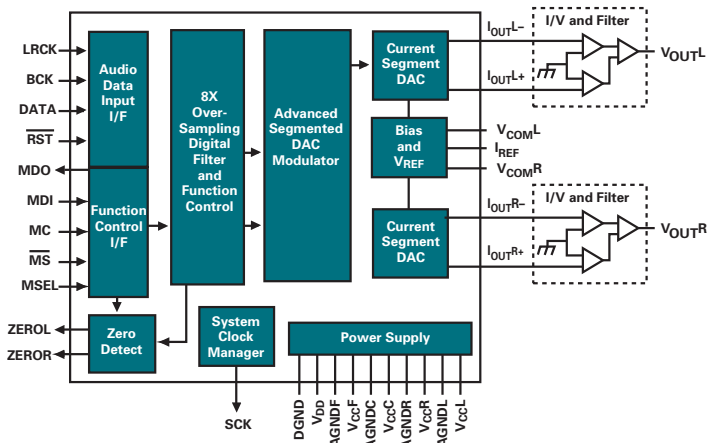
The PCM1792 utilizes TI's advanced segment DAC architecture to achieve unparalleled dynamic performance and improved tolerance to clock jitter. The PCM1792 provides balanced current outputs, allowing the user to optimize analog performance externally.

Key Features

- Analog performance:
 - Dynamic range: 126 dB (typ)
 - THD+N: 0.0003% (typ)
 - Full-scale output: 2 V rms (at post amp)
- 8X oversampling digital filter:
 - Stop-band attenuation: -130 dB
 - Pass-band ripple: ± 0.00001 dB
- Sampling frequency: 10 to 200 kHz
- 24-bit resolution
- System clock: 128, 192, 256, 384, 512 or 768 f_s with auto detect
- Accepts 16-, 20- and 24-bit audio data
- PCM data formats: standard, I²S and left justified
- DSD format interface available
- Optional interface to external digital filter or DSP available
- TDMCA or serial port (SPI/I²C)

Applications

- AV receivers
- SACD players
- DVD audio players
- HDTV receivers
- Car audio systems
- Digital multitrack recorders



PCM1792 Block Diagram

Highest-Performance Sample Rate Converter ICs SRC419x and SRC4184

Get samples and datasheets at: www.ti.com/sc/device/PARTNUMBER
(Replace **PARTNUMBER** in URL with **SRC4184**, **SRC4190**, **SRC4192**, **SRC4193** or **SRC4194**)

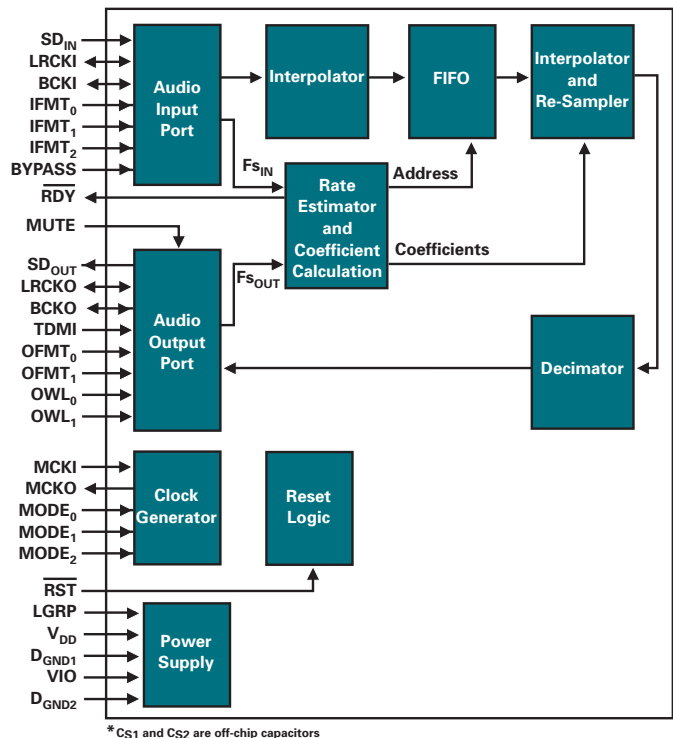
The SRC4192 and SRC4193 are asynchronous sample rate converters designed for professional audio and broadcast applications. They provide a wide input-to-output sampling ratio range with excellent dynamic range and ultra-low distortion. The SRC4192 offers pin-programmable configurations, while the SRC4193 has a three-wire port for access to control register programming.

Key Features

- Supports input/output sampling frequencies up to 212 kHz
- Automatically detects input-to-output sampling ratio
- Wide input-to-output conversion range: 1:16 to 16:1
- Dynamic range: 144 dB; THD+N: -140 dB (SRC4194)
- Standalone (SRC4192) or software controlled (SRC4193)
- SRC4190: Dynamic range: 128 dB; THD+N: -125 dB; pin compatible with SRC4192
- 4-channel versions: SRC4194 and SRC4184
- Package: 28-lead SSOP

Applications

- Professional broadcast equipment
- Recording studio consoles



SRC4192 Block Diagram



Digital Audio Transmitters for Professional Studio Applications

DIT4096 and DIT4192

Get samples and datasheets at: www.ti.com/sc/device/DIT4096
and www.ti.com/sc/device/DIT4192

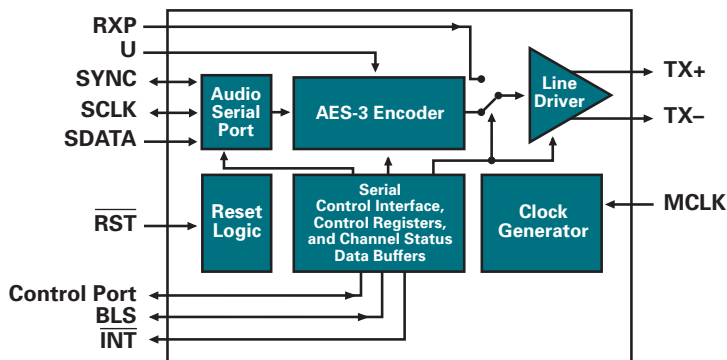
The DIT4096 and DIT4192 are digital audio transmitters designed for both professional and consumer audio applications. Both support software and hardware operation, which makes them suitable for applications with or without a microcontroller. A flexible, serial audio interface supports standard audio data formats and easy interface to audio DSP serial ports.

Key Features

- Compliant with AES-3, IEC-60958 and EIAJ CP1201 standards
- Sampling rates up to 96 kHz (DIT4096); 192 kHz (DIT4192)
- On-chip differential line driver
- Standalone or software-controlled configuration
- Core and driver supply: +5 V
- Digital I/O supply: +2.7 V to +5 V
- Package: 28-lead TSSOP

Applications

- Broadcast studio equipment
- Digital mixing consoles
- Effects processors

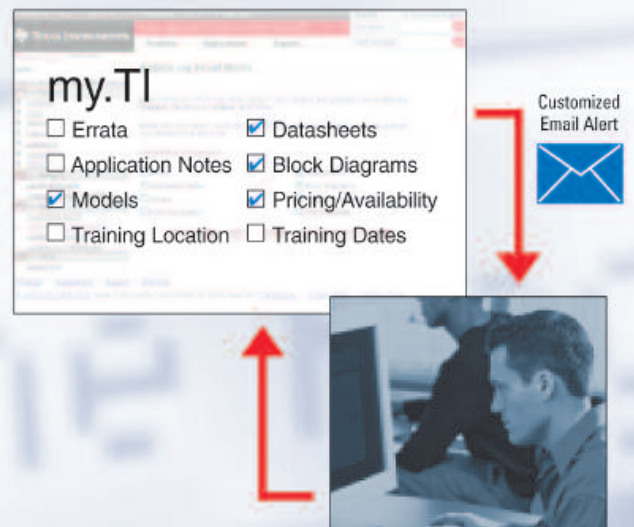


DIT4096 Software Module Block Diagram

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Audio Power Amplifiers

Audio Power Amplifiers

Device	Description	Stereo/ Mono Speaker Drive	Stereo/ Mono Head- phone Drive	Output Power (W)	V _{CC} / V _{DD} (min) & (max) (V)	Half Power THD+N at 1kHz (%)	PSRR (dB)	I _Q per Channel (typ)(mA)	I _{SD} (μA)	Min. Load Impe- dence (Ω)	Depop	Mute	Shut- down (Active Low/ High)	Internal Gain	DC Volume Control	Package(s)	Package Symbolization	Price ¹
Class-D Stereo																		
TPA3004D2	Stereo, High Power, Class-D with Volume Control	S	—	12	8.5 18	0.1	80	8.0	1	4	✓	—	L	—	✓	PHP	TPA3004D2	3.60
TPA3005D2	Stereo, Medium Power, Class-D	S	—	6	8 18	0.1	80	10.0	1	8	✓	—	L	✓	—	PHP	TPA3005D2	3.00
TPA3003D2	Stereo, Low Power, Wide Supply Voltage, Class-D	S	—	3	8.5 14	0.2	80	10.0	1	8	✓	—	L	—	✓	PHP	TPA3003D2	3.00
TPA2008D2	Stereo, High Power, 5 V, Filter-Free Class-D with Volume Control	S	—	3	4.5 5.5	0.05	70	7.0	0.05	3	✓	—	L	—	✓	TSSOP	TPA2008D2	1.80
TPA3002D2	Stereo, Medium Power Class-D with Volume Control	S	—	9	8.5 14	0.06	80	10.0	1	8	✓	—	L	—	✓	PHP	TPA3002D2	3.50
TPA2000D4	Stereo Filter-Free Class-D with Stereo Class-AB Headphone Drive	S	S	2.5	3.7 5.5	0.1	70	4.5	0.05	4	✓	—	L	✓	—	TSSOP	TPA2000D4	1.65
TPA2000D2	Stereo Filter-Free Class-D	S	—	2.5	4.5 5.5	0.05	77	4.0	1	3	✓	—	L	✓	—	TSSOP	TPA2000D2	1.45
TPA2001D2	Stereo Filter-Free Class-D	S	—	1.25	4.5 5.5	0.08	77	4.0	1	8	✓	—	L	✓	—	TSSOP	TPA2001D2	1.20
TPA2012D2	Stereo, Class-D Amplifier	S	—	2.1	2.5 5.5	1.0	75	2.8	0.5	4	✓	—	L	✓	—	WCSP QFN	AKR AKS	0.95
TPA3008D2	Stereo, Class-D Amplifier	S	—	10	8.5 18	0.1	80	11	1.6	8	✓	—	L	✓	—	HTQFP	TPA3008D2	3.10
Class-D Mono																		
TPA3001D1	Mono, High Power, Class-D	M	—	20	8 18	0.06	73	8.0	1	4	✓	—	L	✓	—	TSSOP	TPA3001D1	2.85
TPA3007D1	Mono, Medium Power, Class-D	M	—	6.5	8 18	0.2	73	8.0	1	8	✓	—	L	✓	—	PHP	TPA3007D1	1.95
TPA2010D1	Mono, Fully Differential, Filter-Free Class-D in WCSP	M	—	2.5	2.5 5.5	0.2	75	4.0	1	8	✓	—	L	—	—	WCSP	AJZ(Pb) AKO(Pb-free)	0.55
TPA2000D1	Mono Filter-Free Class-D	M	—	2.7	2.7 5.5	0.08	77	4.0	0.05	4	✓	—	L	✓	—	TSSOP	TPA2000D1	1.05
TPA2005D1	Mono, Fully Differential, Filter-Free Class-D	M	—	1.4	2.5 5.5	0.2	75	4.0	1	8	✓	—	L	—	—	MicroStar Jr.™ BGA QFN MSOP	PB051 (Pb) AAFI (Pb-free) BIQ BAL	0.49
TPA2001D1	Mono Filter-Free Class-D	M	—	1.25	2.7 5.5	0.2	72	4.0	0.05	8	✓	—	L	✓	—	TSSOP	TPA2001D1	0.75
Class-AB Stereo																		
TPA1517	Stereo, Medium Power, Class-AB	S	—	6	9.5 18	0.15	65	22.5	7	4	✓	✓	—	✓	—	SOIC, DIP	TPA1517	0.83
TPA6030A4	Wide Supply Voltage, Low Power, Class-AB	S	S	3	7 15	0.06	60	18	1	16	✓	—	L	—	✓	TSSOP	TPA6030A4	1.40
TPA6017A2	Stereo, Cost-Effective, Class-AB	S	—	2.6	4.5 5.5	0.1	77	3.0	150	3	✓	—	L	✓	—	TSSOP	TPA6017A2	0.99
TPA6011A4	Stereo, Class-AB with Volume Control and Stereo Headphone Drive	S	S	2.6	4.0 5.5	0.06	70	3.8	1	3	✓	—	L	—	✓	TSSOP	TPA6011A4	1.20
TPA6010A4	Stereo Class-AB with Stereo Headphone Drive, Volume Control and Bass Boost	S	S	2.6	4.5 5.5	0.06	67	6.0	60	3	✓	—	L	—	✓	TSSOP	TPA6010A4	2.25
TPA0252 ²	Stereo Class-AB with Stereo Headphone Drive, Volume Control Memory	S	S	2.8	4.5 5.5	0.06	67	4.5	150	3	✓	—	L	—	—	TSSOP	TPA0252	1.80
TPA0212	Stereo Class-AB with Stereo Headphone Drive and Integrated Gain	S	S	2.6	4.5 5.5	0.15	77	3.0	150	3	✓	—	L	✓	—	TSSOP	TPA0212	1.10
TPA0172 ²	Stereo Class-AB with Stereo Headphone Drive & I ² C Control	S	S	2.0	4.5 5.5	0.08	75	4.0	15	4	✓	✓	L	—	—	TSSOP	TPA0172	2.45
TPA6112A2	Stereo, Differential Input, Headphone	—	S	0.15	2.5 5.5	0.25	83	0.75	10	8	✓	—	H	—	—	MSOP	APD	0.29
TPA6111A2	Stereo Headphone, Pin Compatible with LM4880 and LM4881	—	S	0.15	2.5 5.5	0.25	83	0.75	1	8	✓	—	H	—	—	SOIC MSOP	TPA6111A2 AJA	0.29
TPA6110A2	Stereo Headphone, Pin Compatible with LM4881	—	S	0.15	2.5 5.5	0.25	83	0.75	10	8	✓	—	H	—	—	MSOP	AIZ	0.29

¹ Suggested resale price in U.S. dollars in quantities of 1,000. ² Includes digital volume control.



Audio Power Amplifiers (Continued)

Device	Description	Stereo/ Mono Speaker Drive	Stereo/ Mono Head- phone Drive	Output Power (W)	V _{CC} / V _{DD} (min) & (max) (V)	Half Power THD+N at 1kHz (%)	PSRR (dB)	I _Q per Channel (typ)(mA)	I _{SD} (μA)	Min. Load Impe- dance (Ω)	Depop	Mute	Shut- down (Active Low/ High)	Internal Gain	DC Volume Control	Package(s)	Package Symbolization	Price ¹
Class-AB Stereo (continued)																		
TPA152	Hi-Fi, Stereo Headphone	—	S	0.075	4.5 5.5	0.007	81	2.8	—	32	✓	✓	—	—	—	SOIC	TPA152	0.53
TPA6102A2	Ultra Low Voltage, Stereo Headphone with Fixed Gain (14 dB)	—	S	0.05	1.6 3.6	0.1	72	0.32	0.05	16	✓	—	L	—	—	SOIC MSOP	TPA6102A2 AJN	0.35
TPA6101A2	Ultra Low Voltage, Stereo Headphone with Fixed Gain (2 dB)	—	S	0.05	1.6 3.6	0.1	72	0.32	0.05	16	✓	—	L	—	—	SOIC MSOP	TPA6101A2 AJM	0.35
TPA6100A2	Ultra Low Voltage Stereo Headphone	—	S	0.05	1.6 3.6	0.1	72	0.38	0.05	16	✓	—	L	—	—	SOIC MSOP	TPA6100A2 AJL	0.35
TPA4411	Cap-Free Stereo Headphone Amplifier	—	S	0.08	1.8 4.5	0.08	80	3.5	0.1	16	✓	—	L	✓	—	WCSP QFN	AKT AKQ	0.70
TPA6120A2	High-Fidelity Stereo Headphone Driver	—	S	1.5	10 30	0.0005	75	11.5	—	32	—	—	—	—	—	HSOP	TPA6120A2	1.90
Class-AB Mono																		
TPA6211A1	High Power, 5 V Mono, Class-AB, Fully Differential	M	—	3.1	2.5 5.5	0.05	85	4.0	0.01	3	✓	—	L	—	—	MSOP QFN	AYK AYN	0.55
TPA0233	Mono Class-AB with Stereo Headphone Drive—Summed Inputs	M	S	2.7	2.5 5.5	0.06	75	3.3	1	4	✓	—	L	—	—	MSOP	AEJ	1.05
TPA0213	Mono Class-AB with Stereo Headphone Drive—Separate Inputs	M	S	2.7	2.5 5.5	0.06	75	3.6	1	4	✓	—	L	—	—	MSOP	AEH	1.05
TPA0211	Mono Class-AB with Mono Headphone Drive	M	M	2.7	2.5 5.5	0.06	75	4.0	1	4	✓	—	L	—	—	MSOP	AEG	0.60
TPA6203A1	Mono, Fully Differential, Class-AB	M	—	1.5	2.5 5.5	0.06	87	1.7	0.01	8	✓	—	L	—	—	MicroStar Jr.™ BGA	AADI (Pb) AAEL (Pb-free)	0.45
TPA0253	Mono, Low Power, Class-AB with Stereo Headphone Drive—Summing Inputs	M	S	1.25	2.5 5.5	0.1	75	2.7	1	8	✓	—	L	—	—	MSOP	AEL	0.90
TPA751	Mono, Differential Input, Class-AB with Active Low Shutdown	M	—	0.9	2.5 5.5	0.15	78	1.25	0.0015	8	—	—	L	—	—	SOIC MSOP	TPA751 ATC	0.43
TPA741	Mono, Differential Input, Class-AB with Active High Shutdown and Depop	M	—	0.9	2.5 5.5	0.15	85	1.35	7	8	✓	—	H	—	—	SOIC MSOP	TPA741 AJD	0.43
TPA731	Mono, Differential Input, Class-AB with Active High Shutdown	M	—	0.9	2.5 5.5	0.15	78	1.25	0.0015	8	—	—	H	—	—	SOIC MSOP	TPA731 AJC	0.43
TPA721	Mono Class-AB with Active High Shutdown	M	—	0.9	2.5 5.5	0.15	85	1.25	7	8	✓	—	H	—	—	SOIC MSOP	TPA721 ABC	0.43
TPA711	Mono Class-AB with Mono Headphone Drive	M	M	0.9	2.5 5.5	0.15	85	1.25	7	8	✓	—	H	—	—	SOIC MSOP	TPA711 ABB	0.43
TPA6204A1	Mono Class-AB Amplifier	M	—	1.7	2.5 5.5	0.05	85	4.0	0.01	8	✓	—	L	—	—	QFN	AYJ	0.49

¹ Suggested resale price in U.S. dollars in quantities of 1,000.



Amplifiers and Linear Regulators

Amplifiers (Audio Preamps)

Device	Description	Channels	Supply Voltage	THD + N	Slew Rate (typ) (V/ μ s)	GBW (typ) (MHz)	Packages	Restrict Param.	Mkt Status	Price ¹
NE5532/A NE5534/A	Low Noise	2, 1	± 5 to ± 15	0.002	9, 13	10	PDIP, SOIC, SOP	—	—	0.36
RC4558 RC4580	Low Noise Low Noise	2 2	± 5 to ± 15 ± 2 to ± 16	— 0.0005	1.7 5	3 12	PDIP, SOIC, SOP, TSSOP PDIP, SOIC, TSSOP	—	—	0.13 0.40
TL07x/A/B TL08x/A/B	JFET-input	1, 2, 4	± 3.5 to ± 15	0.003	13	3	PDIP, SOIC, SOP, TSSOP, CFP, LCCC, CDIP	EXTERNAL	ACTIVE	0.29
TLV236x	Low Voltage, RRO	1, 2	± 1 to ± 2.5	0.004	3	7	MSOP, PDIP, SOT23, SOIC, SOP, TSSOP	—	—	0.34

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

Audio Signal Amplifiers

Device ¹	Description	Channels	Supply Voltage (V)	THD+N (%)	Slew Rate (V/ μ s)	GBW (MHz)	Package(s)	Price ²
Operational Amplifiers								
OPA1632	Differential Output ADC Driver	1	± 2.5 to ± 16	0.0003	50	170	SO, MSOP	1.75
OPAY363	1.8 V, 90 dB typ CMRR, RRIO, SHDN, SS	1, 2	1.8 to 5.5	—	5	7	SOT23, MSOP, SOIC	0.55
OPAY343	CMOS, Single Supply	1, 2, 4	2.5 to 5.5	0.0007	6	5.5	SOT23, MSOP, TSSOP, SSOP, SOIC	0.66
OPAY353	CMOS, Single Supply, High Speed	1, 2, 4	2.7 to 5.5	0.0006	22	44	SOT23, MSOP, TSSOP, SOIC	1.05
TLV246x	11 μ V/ $\sqrt{\text{Hz}}$ Noise, Low Cost, High Drive	1, 2, 4	2.7 to 6	0.004	1.6	6.4	SOT23, TSSOP, SO DIP	0.58
OPAY604	FET-Input	1, 2	± 4.5 to ± 24	0.0003	25	20	DIP, SOIC	0.91
OPAY134	FET-Input	1, 2, 4	± 2.5 to ± 18	0.00008	20	8	DIP, SOIC	0.88
OPAY227	Low Noise	1, 2, 4	± 2.5 to ± 18	0.00005	2.3	8	DIP, SOIC	1.01
OPAY228	Low Noise	1, 2, 4	± 2.5 to ± 18	0.00005	10	33	DIP, SOIC	1.01
OPAY627	Ultra-High Performance, DiFET	1	± 4.5 to ± 18	0.00003	55	16	DIP, SOIC	9.63
OPAY637	Ultra-High Performance, DiFET, $G \geq 5$	1	± 4.5 to ± 18	0.00003	135	80	DIP, SOIC	9.63
Line Drivers and Receivers								
DRV134	Professional Line Transmitter	1	± 4.5 to ± 18	0.0005	12	1.5	DIP, SOIC, SOL	1.82
DRV135	Professional Line Transmitter	1	± 4.5 to ± 18	0.0005	12	1.5	DIP, SOIC, SOL	1.82
INA134	Professional Line Receiver, Low Distortion, $G = 1$	1	± 4 to ± 18	0.0005	14	3.1	DIP, SOIC	1.00
INA2134	Dual INA134	2	± 4 to ± 18	—	14	3.1	DIP, SOIC	1.82
INA137	Professional Line Receiver, $G = 0.5$ or 2	1	± 4 to ± 18	0.0005	14	4	DIP, SOIC	0.99
INA2137	Dual INA137	2	± 4 to ± 18	0.0005	14	4	DIP, SOIC	0.99
Microphone Preamplifiers								
INA163	Low Noise, High Performance	1	± 4.5 to ± 18	0.0003	15	8	SO-14	2.35
INA166	Low Noise, Fixed Gain, 2000 V/V	1	± 4.5 to ± 18	—	15	4.5	SO-14	5.66
INA103	High Performance, Low Distortion	1	± 9 to ± 25	—	15	8	DIP, SOL-16	4.65
INA217	Low Noise	1	± 4.5 to ± 18	0.004	15	8	DIP, SOIC	2.35

¹ y indicates: no character = single, 2 = dual, 3 = triple, 4 = quad. ² Suggested resale price in U.S. dollars in quantities of 1,000.

Linear Regulators

Device	$V_{\text{OUT Nom}}$ (V)	$V_{\text{OUT}}/V_{\text{REF}}$ Tolerance Over Temp (%)	$I_{\text{OUT (max)}}$ (mA)	I_{OUT} for Regulation (min) (mA)	I_{Q} (max) (mA)	V_{do} (typ) (V)	V_{do} (max) (V)	V_{IN} (max) (V)	$V_{\text{IN}} - V_{\text{OUT}}$ (max) (V)	Price ¹
LM317, LM317M	Adj (1.2 to 37)	4	1500, 500	3.5	—	—	3	—	40	0.27
TL780-xx	5, 12, 15	2	1500	—	8	2	2 - 2.5	25, 30, 30	—	0.32
UA78xx	5, 8, 10, 12, 15, 24	5	1500	—	8	2	2 - 3	25 to 38	—	0.23
UA79xx	-5, -8, -12, -15	5	1500	—	2	1.1	2 - 2.5	-25 to 30	—	0.27

¹ Suggested resale price in U.S. dollars in quantities of 1,000.



Data Converters

Device	Description	Resolution (bits) (max)	Dynamic Range (dB)	Sampling Rate (kHz) (max)	Configuration	Audio Data Format	Power Supply (V)	Package	Price ¹
DACs									
PCM1780/81/82	Low-Cost Audio DAC w/Volume Control	24	105	192	Stereo	Normal, I ² S	+5	SSOP-16	1.10
PCM1753/54/55	Low-Cost Audio DAC w/Volume Control	24	106	192	Stereo	Normal, I ² S	+5	SSOP-16	0.98
PCM1741	Low-Cost Audio DAC w/Volume Control	24	98	96	Stereo	Normal, I ² S	+3.3	SSOP-16	1.56
PCM1742	Low-Cost Audio DAC w/Volume Control	24	100	192	Stereo	Normal, I ² S	+3.3 and +5	SSOP-16	1.72
PCM1742K	Low-Cost Audio DAC w/Volume Control	24	105	192	Stereo	Normal, I ² S	+3.3 and +5	SSOP-16	1.10
PCM1748	Low-Cost Audio DAC w/Volume Control	24	100	96	Stereo	Normal, I ² S	+3.3 and +5	SSOP-16	1.47
PCM1748K	Low-Cost Audio DAC w/Volume Control	24	105	96	Stereo	Normal, I ² S	+3.3 and +5	SSOP-16	1.67
PCM1716/28	CMOS, Multilevel ΔΣ w/Volume Control	24	106	96	Stereo	Normal, I ² S	+5	SSOP-28	2.27
PCM1737/39	CMOS, Multilevel ΔΣ w/Volume Control	24	106	192	Stereo	Normal, I ² S	+3.3 and +5	SSOP-28	3.51
PCM1720	CMOS, Multilevel ΔΣ w/Volume Control	24	96	96	Stereo	Normal, I ² S	+5	SSOP-20	1.85
PCM1717/18	Stereo Audio DAC w/ Wide Supply Range	18	96	48	Stereo	Normal, I ² S	+2.7 to +5.5	SSOP-20	3.21
PCM1719	Stereo Audio DAC w/ Headphone Amplifier	18	96	48	Stereo	Normal, I ² S	+5	SSOP-28	4.20
PCM1723	W/int. PLL, generate DAD/MPEG Clocks	24	94	96	Stereo	Normal, I ² S	+5	SSOP-24	2.20
PCM1727	W/int. Dual-PLL, for DAD/MPEG Systems	24	92	96	Stereo	Normal, I ² S	+5	SSOP-24	2.97
PCM1740	W/internal VCXO and PLL	24	94	96	Stereo	Normal, I ² S	+5	SSOP-24	2.97
PCM1725	Low-Cost Audio DAC	16	95	96	Stereo	Normal, I ² S	+5	SO-14	1.26
PCM1733	Low-Cost Audio DAC	18	95	96	Stereo	Normal, I ² S	+5	SO-14	1.26
PCM1744	Low-Cost Audio DAC	24	95	96	Stereo	I ² S	+5	SO-14	1.26
DSD1702	PCM/DSD Compatible DAC	24	106	192	Stereo	Normal, I ² S, DSD	+3.3 and +5	SSOP-20	1.85
Device	Description	Power Dissipation (mW)	DAC SNR (dB)	ADC SNR (dB)	Sampling Rate (max) (Bits)	Resolution (max)(Bits)	Power Supply (V)	Package(s)	Price ¹
TLV320DAC23	Low-Power DAC w/Headphone Amp	23	100	N/A	96	24	+1.5 to +3.3	SSOP-28	1.90
TLV320DAC26	Low-Power DAC w/ HP/Spkr Amp	11	97	N/A	53	24	+2.7 to +3.6	QFN-32	2.95
PCM1770/1	Low-Power DAC w/Headphone Amp	6.5	98	N/A	48	24	+1.6 to +3.6	TSSOP-16, VQFN-20	1.95
PCM1772/3	Low-Power DAC w/Line Amp	6.5	98	N/A	48	24	+1.6 to +3.6	TSSOP-16, VQFN-20	1.95
Device	Description	Resolution (bits) (max)	Dynamic Range (dB)	Sampling Rate (kHz) (max)	Configuration	Audio Data Format	Power Supply (V)	Package(s)	Price ¹
High-Performance DACs									
DSD1700	Mono Channel DSD DAC	—	110	—	Mono	DSD	+5	SSOP-28	10.07
PCM1704	BiCMOS, Sign Magnitude	24	112	768	Mono	Serial Latched	±5	SOIC-20	12.95
PCM1702P/U	BiCMOS, Sign Magnitude	20	110	768	Mono	Serial Latched	±5	DIP-16, SOP-20	11.78
PCM1710	CMOS, Multilevel ΔΣ	20	110	48	Stereo	Normal, I ² S	±5	SOIC-28	4.00
PCM1738	Advanced Segment	24	117	192	Stereo	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	5.00
PCM1791	Advanced Segment	24	112	192	Stereo	Normal, I ² S	+3.3 and +5	SSOP-28	3.00
PCM1792	High-Performance Audio DAC	24	132	192	Stereo	Standard, I ² S, Left Justified	+3.3 and +5	SSOP-28	13.00
PCM4104	High-Performance Audio DAC	24	117	192	4 ch	Left Justified, Rt. Just., I ² S, TDM	+3.3 and +5	TQFP-48	7.50
Multichannel DACs									
PCM1680	Low-Cost 8-Ch Audio DAC	24	103	192	8 ch	Normal, I ² S	+5	SSOP-24	2.60
PCM1608	Highly Integrated 8-Ch Audio DAC	24	100	192	8 ch	Normal, I ² S	+3.3 and +5	LQFP-48	4.10
PCM1608K	CMOS, Multilevel ΔΣ	24	105	192	8 ch	Normal, I ² S	+3.3 and +5	LQFP-48	4.66
PCM1606	Low-Cost CMOS, Multilevel ΔΣ	24	103	192	6 ch	Normal, I ² S	+5	SSOP-20	2.48
PCM1605	CMOS, Multilevel ΔΣ	24	105	192	6 ch	Normal, I ² S	+3.3 and +5	MQFP-48	4.35
PCM1604	CMOS, Multilevel ΔΣ	24	105	192	6 ch	Normal, I ² S	+3.3 and +5	LQFP-48	4.35
PCM1602	Low-Cost CMOS, Multilevel ΔΣ	24	100	192	6 ch	Normal, I ² S	+3.3 and +5	LQFP-48	3.09
PCM1602K	Low-Cost CMOS, Multilevel ΔΣ	24	105	192	6 ch	Normal, I ² S	+3.3 and +5	LQFP-48	3.49
PCM1601	CMOS, Multilevel ΔΣ	24	105	96	6 ch	Normal, I ² S	+3.3 and +5	MQFP-48	3.95
PCM1600	CMOS, Multilevel ΔΣ	24	105	96	6 ch	Normal, I ² S	+3.3 and +5	LQFP-48	3.95
DSD1608	Enhanced Multiformat ΔΣ DAC	24	108	192	8 ch	Normal, I ² S, DSD	+3.3 and +5	TQFP-52	5.68
ADCs									
PCM1850	Stereo Audio ADC w/ 2x6 input MUX	24	100	96	Stereo	Normal, I ² S	+3.3 and +5	TQFP-32	4.80
PCM1804	ΔΣ Audio ADC	24	110	192	Stereo	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	4.95
PCM1802	ΔΣ Audio ADC	24	100	96	Stereo	Normal, I ² S	+3.3 and +5	SSOP-20	3.95
PCM1800	CMOS, Multilevel DS	20	95	48	Stereo	Normal, I ² S	+5	SSOP-24	2.98
PCM1801	Low-Cost Audio ADC	16	93	48	Stereo	Normal, I ² S	+5	SO-14	2.27
PCM4202/04	High-Performance Audio ADC	24	118	192	Stereo	I ² S, DSD	+3.3 and +5	SSOP-28	7.95

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

 Preview devices are listed in **BOLD BLUE**.


Data Converters and Digital Signal Processors
Data Converters (Continued)

Device	Description	Resolution (bits) (max)	Dynamic Range (dB)	Sampling Rate (kHz) (max)	Configuration	Audio Data Format	Power Supply (V)	Package	Price ¹
Codecs									
PCM3008	Low-Power, Low-Cost Codec	16	88	48	Stereo	Normal, I ² S	+2.1 to 3.6	SSOP-16	2.95
PCM3000/1	Stereo Audio Codec	18	96	48	Stereo	Normal, I ² S	+5	SSOP-28	3.27
PCM3002/03	Low-Power Codec	20	94	48	Stereo	Normal, I ² S	+2.7 to 3.6	SSOP-24	3.27
PCM3006	Stereo Audio Codec	16	93	48	Stereo	Normal	+2.7 to 3.6	SSOP-24	3.27
PCM3500/1	Voice/Modem Mono Codec	16	88	26	Mono	DSP	+2.7 to 3.6	SSOP-24	2.49
PCM3010	High-Performance Stereo Codec	24	103	96/192	Stereo	Left Justified, I ² S, Right Justified	+3.3 and +5	SSOP-24	2.99
PCM3052A	High-Performance Stereo Codec w/ Mic Preamp, MUX, Vol Ctrl	24	100	96	Stereo	I ² S	+3.3 and +5	VQFN-32	TBD
TLV320AIC23B	Low-Power Codec w/ Headphone Amp	24	100	96	Stereo	Left Justified, I ² S, Right Justified	+1.5 to 3.3	SSOP-28	3.19
TLV320AIC26	Low-Power, Low-Cost Codec w/ Headphone/Speaker Amp	24	97	53	Mono/Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-32	3.25
TLV320AIC28	Low-Power Codec w/ Headphone/Speaker Amps	24	98	53	Mono/Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-48	3.95
TLV320AIC32	Low-Power Stereo Codec w/ Headphone/Speaker Amps	24	103	96	Stereo	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-32	TBD
TLV320AIC33	Low-Power Stereo Codec w/ Headphone/Speaker Amps	24	103	96	Stereo	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-48 BGA-80	TBD
TSC2100	Low-Power, Low-Cost Codec, Amp & Touch-Screen Controller	24	97	53	Mono/Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-32	3.95
TSC2101	Low-Power Codec w/ HP/Spkr Amp & Touch-Screen Controller	24	95	53	Mono/Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-48	4.95
TSC2102	Low-Power, Low-Cost DAC, Amp & Touch-Screen Controller	24	97	53	Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-32	3.70
TSC2301	Low-Power Codec w/ Headphone Amp & Touch-Screen Controller	20	98	48	Stereo	Normal, I ² S	+2.7 to 3.6	TQFP-64 BGA-120	4.95
TSC2302	Low-Power Codec w/ Headphone Amp & Touch-Screen Controller	20	98	48	Stereo	Normal, I ² S	+2.7 to 3.6	QFN-48	4.50
Support Products									
DF1704	Digital Interpolation Filter	24	N/A	96	Stereo	Normal, I ² S	+5	SSOP-28	10.07
DF1706	Digital Interpolation Filter	24	N/A	192	Stereo	Normal, I ² S	+3.3	SSOP-28	11.08
PLLs									
PLL1700	Multi-Clock Generator	—	150	96	—	—	+3.3 or +5	SSOP-20	1.97
PLL1705	Dual PLL Multi-Clock Generator	—	50	96	—	Parallel Control	+3.3	SSOP-20	1.20
PLL1706	Dual PLL Multi-Clock Generator	—	50	96	—	Serial Control	+3.3	SSOP-20	1.20

¹ Suggested resale price in U.S. dollars in quantities of 1,000. ² Requires Equibit™ license.

Preview devices are listed in **BOLD BLUE**.

TMS320C67x™ DSP Generation – Floating-Point DSPs

Device	RAM (Bytes) Data/Prog	McBSP	DMA	COM	MHz	Cycle (ns)	MFLOPS	Typical Activity Total Internal Power (W) (Full Device Speed)	Voltage (V)		Package	Price ¹
									Core	I/O		
TMS320C6712DGDPA150	4K/4K/64K ²	2	16 ³	—	150	6.7	900	0.7	1.2	3.3	272 BGA, 27 mm	15.26
TMS320C6711DGDPA200	4K/4K/64K ²	2	16 ³	HPI/16	200	5	1200	0.9	1.2	3.3	272 BGA, 27 mm	21.55
TMS320C6711DGDPA250	4K/4K/64K ²	2	16 ³	HPI/16	250	4	1500	TBD	1.4	3.3	272 BGA, 27 mm	21.55
TMS32C6711DGDPA167 ⁴	4K/4K/64K ²	2	16 ³	HPI/16	167	6	1000	0.9	1.2	3.3	272 BGA, 27 mm	21.55
TMS32C6713BPYP167 ⁴	4K/4K/256K ²	2 ⁵	16 ³	HPI/16	167	6	1000	1.0	1.2	3.3	208 TQFP, 28 mm	22.18
TMS32C6713BPYP200	4K/4K/256K ²	2 ⁵	16 ³	HPI/16	200	5	1200	1.0	1.2	3.3	208 TQFP, 28 mm	22.18
TMS32C6713BGDPA200 ⁴	4K/4K/256K ²	2 ⁵	16 ³	HPI/16	200	5	1200	1.2	1.2	3.3	272 BGA, 27 mm	29.14
TMS320C6713BGDPA225	4K/4K/256K ²	2 ⁵	16 ³	HPI/16	225	4.4	1350	1.2	1.2	3.3	272 BGA, 27 mm	29.14
TMS32C6713BGDPA300	4K/4K/256K ²	2 ⁵	16 ³	HPI/16	300	3.3	1800	TBD	1.4	3.3	272 BGA, 27 mm	38.75
TMS320C6701GJC150	64K/64K	2	4	HPI/16	150	6.7	900	1.3	1.8	3.3	352 BGA, 35 mm	82.24
TMS320C6701GJCA120 ⁴	64K/64K	2	4	HPI/16	120	8.3	720	1.3	1.8	3.3	352 BGA, 35 mm	94.28
TMSC6701GJC16719V	64K/64K	2	4	HPI/16	167	6	1000	1.4	1.9	3.3	352 BGA, 35 mm	124.66

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

New products appear in **BOLD RED**.

² Format represents cache memory architecture: [data cache] / [program cache] / [unified cache]. ³ Enhanced DMA.

⁴ Extended temperature device, -40 to 105°C case temperature operation. Note: All devices include two timers.

⁵ The C6713 DSP can be configured to have up to three serial ports in various McASP/McBSP combinations by not utilizing the HPI. Other configurable serial options include I²C and additional GPIO. Note: Enhanced plastic and Military DSP versions are available for selected DSPs.

Digital Audio Amplifiers and Processors and Level Translators



Digital Audio PWM Processors

Device	Channels	Sampling Frequency	Dynamic Range	Audio Controls	THD+N (% System Performance)	Bits	Package	Price ¹
TAS5026A	6	32 to 192	96	—	< 0.08	16, 20, 24	PQFP-64	7.27
TAS5036B	6	32 to 192	100	—	< 0.08	16, 20, 24	PQFP-80	13.90
TAS5010	2	32 to 192	96	—	< 0.08	16, 20, 24	PQFP-48	3.17
TAS5012	2	32 to 192	102	—	< 0.08	16, 20, 24	PQFP-48	5.89
TAS5504	4	32 to 192	102	Volume, Audio Filters	< 0.1	16, 20, 24	PQFP-64	4.30
TAS5508	8	32 to 192	100	Volume, Audio Filters	< 0.1	16, 20, 24	PQFP-64	6.30
TAS5066	6	32 to 192	98	Volume	< 0.1	16, 20, 24	PQFP-64	5.75
TAS5076	6	32 to 192	105	Volume	< 0.1	16, 20, 24	PQFP-80	12.35
TAS5086	6	32 to 192	100	Volume, Bass Mgmt.	< 0.1	16, 20, 24	TSSOP-38	TBD

¹ Suggested resale price in U.S. dollars in quantities of 1,000. ² Requires Equibit™ license.

Preview devices are listed in **BOLD BLUE**.

Digital Amplifier Power Stages

Device	Power	Channels	Sampling Frequency	THD+N	Package	Price ¹
TAS5111	70 W (4 Ω)	1	32 to 192	< 0.1	32 PowerPAD™	2.40
TAS5112	50 W (6 Ω)	2	32 to 192	< 0.1	56 PowerPAD	4.15
TAS5121	100 W (4 Ω)	1	32 to 192	< 0.1	36 PSOP	3.49
TAS5122	30 W (6 Ω)	2	32 to 102	< 0.1	56 PowerPAD	3.65
TAS5142	100 W (4 Ω)	2	192 to 384	< 0.1	36 SSOP	TBD
TAS5152	125 W (4 Ω)	2	192 to 384	< 0.1	36 SSOP	TBD
TAS5182	100 W (6 Ω)	2	32 to 192	< 0.1	56 PowerPAD	5.26
TAS5186	30/60 W (6/3 Ω)	6	32 to 192	< 0.1	44 PowerPad, 36 PSOP	TBD

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

Preview devices are listed in **BOLD BLUE**.

Digital Audio Processors

Device	MPs	Processing Channels	Processing Bits/ Accumulator	I/O Resolution	Dynamic Range	Bi-quads per Channel	Compression/ Limiting	Loudness	Package	Price ¹
TAS3103	540	3	48/76	16 to 32	N/A	20	Yes	Yes	PSOP-32	3.95
TAS3002	100	2	32/56	16 to 24	100 dB	7	Yes	Yes	PQFP-48	3.36
TAS3004	100	2	32/56	16 to 24	100 dB	7	Yes	Yes	PQFP-48	3.55

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

Dual-Supply Level Translators

Device	Bit Width	V _{CCA} (V)	V _{CCB} (V)	Smallest Package
SN74AVC1T45 ¹	1	1.2 to 3.6	1.2 to 3.6	6-pin NanoStar™/NanoFree™
SN74LVC1T45	1	1.65 to 5.5	1.65 to 5.5	6-pin NanoStar/NanoFree
SN74AVC2T45 ¹	2	1.2 to 3.6	1.2 to 3.6	8-pin NanoStar/NanoFree
SN74LVC2T45	2	1.65 to 5.5	1.65 to 5.5	8-pin NanoStar/NanoFree
SN74AVC4T245¹	4	1.2 to 3.6	1.2 to 3.6	16-pin QFN
SN74AVC8T245 ¹	8	1.2 to 3.6	1.2 to 3.6	24-pin QFN
SN74LVC4245A	8	4.5 to 5.5	2.7 to 3.3	24-pin TSSOP
SN74LVC8T245¹	8	1.65 to 5.5	1.65 to 5.5	24-pin QFN
SN74LVCC3245A	8	2.3 to 3.3	2.7 to 5.5	24-pin TSSOP
SN74LVCC4245A	8	4.5 to 5.5	2.7 to 3.3	24-pin TSSOP
SN74AVC16T245¹	16	1.2 to 3.6	1.2 to 3.6	56-ball VFBGA
SN74ALVC164245	16	2.3 to 3.6	3.0 to 5.5	56-ball VFBGA
SN74AVCA164245 ¹	16	1.4 to 3.6	1.4 to 3.6	56-ball VFBGA
SN74AVCB164245 ¹	16	1.4 to 3.6	1.4 to 3.6	56-ball VFBGA
SN74LVC16T245¹	16	1.65 to 5.5	1.65 to 5.5	56-ball VFBGA
SN74AVC20T245 ¹	20	1.2 to 3.6	1.2 to 3.6	56-ball VFBGA
SN74AVC24T245¹	24	1.2 to 3.6	1.2 to 3.6	83-ball LFBGA
SN74AVC32T245¹	32	1.2 to 3.6	1.2 to 3.6	96-ball LFBGA
SN74AVCB324245 ¹	32	1.2 to 3.6	1.2 to 3.6	96-ball LFBGA

¹ Bus-hold option available.

Preview devices are listed in **BOLD BLUE**.



Interface

1394 Integrated Devices

Device	Family/Name	Voltage (V)	Data Rate (Mbps)	FIFOs	Package(s)	Description
TSB43AB21A	OHCI-Lynx	3.3	up to 400	9	128 TQFP	OHCI 1.1-compliant, 1394a link-layer controller integrated with 1394a, 400-Mbps, 1-port PHY
TSB43AB22A	OHCI-Lynx	3.3	up to 400	9	128 TQFP	OHCI 1.1-compliant, 1394a link-layer controller integrated with 1394a, 400-Mbps, 2-port PHY
TSB43AB23	OHCI-Lynx	3.3	up to 400	9	128 TQFP 144 LQFP	OHCI 1.1-compliant, 1394 link-layer controller and 1394a-2000-compliant 1-, 2- and 3-port PHY, 9-K FIFO
TSB43CA42	iceLynx-Micro	3.3	up to 400	16.5	176 BGA	iceLynx-Micro integrated 1394a link/2-port PHY with ARM® microprocessor and program memory, 5C support for consumer applications, MPEG2, DV and audio formats
TSB43CA43A	iceLynx-Micro	3.3	up to 400	16.5	176 BGA 176 LQFP	iceLynx-Micro integrated 1394a link/3-port PHY with streaming audio and 5C content protection
TSB43CB43A	iceLynx-Micro	3.3	up to 400	16.5	176 LQFP	iceLynx-Micro integrated 1394a link/3-port PHY with streaming audio

1394 Link-Layer Controllers

Device	Family/Name	Voltage (V)	Data Rate (Mbps)	FIFOs	Package	Description
TSB12LV01B	—	3.3	up to 400	2	100 TQFP	High-performance link layer with 32-bit I/F. May be cycle master; has 2-KB FIFO. PHY-link timing compliant with 1394a-2000 for data and control bus applications in backplane and cable
TSB12LV21B	PCILynxII	3.3	up to 400	4	176 LQFP	High-performance link for host or peripheral applications. 32-bit PCI I/F, 4-K FIFO, handles asynch streaming and DV applications (not supported by Microsoft® Windows®)
TSB12LV26		3.3	up to 400	9	100 TQFP	OHCI 1.0-compliant 1394a-2000 link-layer controller. 32-bit PCI I/F, 9-K FIFO, pin-compatible w/TSB12LV23
TSB12LV32	GP2Lynx	3.3	up to 400	4	100 LQFP	1394a-2000 compliant link layer for camera, printer or scanner applications. 8/16-bit host I/F, 2-K FIFO, high-speed data I/F
TSB42AA4	iceLynx	3.3	up to 400	8	128 TQFP	High-performance link for MPEG2, DirecTV and DV applications. Supports 5C copy protection 16-/32-bit host I/F, 8-K FIFO, high-speed data I/F
TSB42AA9A	StorageLynx	3.3	up to 400	4	100 TQFP	StorageLynx, Rev. A. High-performance 1394a 3.3-V link-layer controller for 1394 mass storage apps
TSB42AB4	iceLynx-DV	3.3	up to 400	8	128 TQFP	1394 link-layer controller for consumer electronics applications; drop-in compatible with TSB42AA4 but does not include copy protection
TSB82AA2	OHCI-Lynx™	3.3	up to 800	11	144 LQFP	High-performance 1394b 3.3-V OHCI 1.1+ compliant

1394 Physical Layer Controllers

Device	Ports	Voltage(s) (V)	Data Rate (Mbps)	Package(s)	Description
TSB14AA1A	1	3.3	up to 100	48 TQFP	IEEE 1394-1995, 3.3-V, 1-port, 50/100-Mbps, backplane physical-layer controller
TSB17BA1	1	3.3	up to 100	24 TSSOP	1394b-2002 1-port CAT5 (UTP5) cable transceiver for up to 100 meters, to be used with TSB41BA3
TSB41AB1	1	3.3	up to 400	48 HTQFP, 64 HTQFP	IEEE 1394a 1-port cable transceiver/arbitrator
TSB41AB2	2	3.3	up to 400	64 HTQFP	IEEE 1394a 2-port cable transceiver/arbitrator
TSB41AB3	3	3.3	up to 400	80 HTQFP	IEEE 1394a 3-port cable transceiver/arbitrator
TSB41BA3A	3	3.3	up to 400	80 TQFP	1394b-2002 3-port physical layer device
TSB41LV04A	4	3.3	up to 400	80 HTQFP	IEEE 1394a 4-port cable transceiver/arbitrator
TSB41LV06A	6	3.3	up to 400	100 HTQFP	IEEE 1394a 6-port cable transceiver/arbitrator
TSB81BA3	3	1.8, 3.3	up to 800	80 HTQFP	High-performance 1394b s800 3-port cable transceiver/arbitrator

USB Hub Controllers

Device	Speed	Ports	I ² C	Voltage (V)	Package	Description
TUSB2036	Full (1.1)	2/3	No	3.3	32 LQFP	2/3-port hub for USB with optional serial EEPROM interface
TUSB2046B	Full (1.1)	4	No	3.3	32 LQFP	4-port hub for USB with optional serial EEPROM interface
TUSB2077A	Full (1.1)	7	No	3.3	48 LQFP	7-port USB hub with optional serial EEPROM interface
TUSB2136	Full (1.1)	1/2	Yes	3.3	64 LQFP	2-port hub with integrated general-purpose function controller
TUSB5052	Full (1.1)	1-5	Yes	3.3	100 LQFP	5-port hub with integrated bridge to two serial ports

USB Peripherals

Device	Speeds	Voltage (V)	Remote Wakeup	Package	Description
TUSB3210	Full	3.3	Yes	64 LQFP	USB full-speed general-purpose device controller
TUSB3410	Full	3.3	Yes	32 LQFP	USB-to-serial converter (RS-232, RS-485)
TUSB6250	Full, High	3.3	Yes	80 TQFP	USB 2.0 high-speed, low-power ATA/ATAPI bridge solution



Microphone Preamplifiers

Device	Description	Gain Range (dB)	Noise (E_{IN} , G = 30 dB)	THD+N with Gain = 30 dB (%)	Power Supply (V)	Package	Price ¹
PGA2500	Mic Preamp	0 dB, and 10 dB to 65 dB in 1-dB steps	-128 dBu	0.0004	±5	SSOP-28	9.95

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

Volume Controls

Device	Description	Dynamic Range (dB)	THD+N at 1 kHz (%)	Crosstalk at 1 kHz (dBFS)	Power Supply (V)	Voltage Swing (Vpp)	Package(s)	Price ¹
PGA2310	BiCMOS, Stereo Audio Volume Control	120	0.0004	-126	±15	27	SOL-16, DIP-16	9.95
PGA2320	BiCMOS, Stereo Audio Volume Control	120	0.0004	-126	±15	27	SOL-16	TBD
PGA2311	CMOS, Stereo Audio Volume Control	120	0.0002	-130	±5	7.5	SOL-16, DIP-16	5.20
PGA4311	CMOS, 4-Channel Audio Volume Control	120	0.0002	-130	±5	7.5	SOP-28	8.90

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

High-Performance Audio Converters

Device	Description	Resolution (Bits)	Dynamic Range (dB)	Sampling Rate (kHz) max	Audio Data Format	Power Supply (V)	Package	Price ¹
ADCs								
PCM4204	High-Performance 4-Channel Audio ADC	24	118	192	Normal, I ² S, DSD, TDM	+3.3 and +5	TQFP-64	14.95
PCM4202	High-Performance Stereo Audio ADC	24	118	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	7.95
PCM4201	Single-Channel Low-Power ADC	24	112	96	DSP	+3.3 and +5	TSSOP-16	TBD
PCM1804	Stereo Audio ADC	24	112	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	5.20
DACs								
PCM1792/4	High-Performance Stereo Audio DAC	24	128	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	13.65
PCM1796/8	High-Performance Stereo Audio DAC	24	123	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	6.50
PCM1738/30	High-Performance Stereo Audio DAC	24	118	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	5.25
PCM4104	High-Performance 4-Channel Audio DAC	24	118	192	Normal, I ² S, TDM	+3.3 and +5	TQFP-48	7.50

¹ Suggested resale price in U.S. dollars in quantities of 1,000.

Preview devices are listed in **BOLD BLUE**.

Digital Audio Interface Products and Asynchronous Sample Rate Converters (ASRC)

Device	Description	Dynamic Range (dB)	THD+N (dB)	Input/Output Sampling Rate (kHz) (max)	Control Mode	Audio Data Format	Power Supply (V)	Package	Price ¹
Asynchronous Sample Rate Converters									
SRC4192	Highest-Performance Stereo ASRC	144	-140	212	H/W	Normal, I ² S, TDM	+3.3	SSOP-28	10.45
SRC4193	Highest-Performance Stereo ASRC	144	-140	212	S/W (SPI)	Normal, I ² S, TDM	+3.3	SSOP-28	10.45
SRC4194	Highest-Performance 4-Channel ASRC	144	-140	212	S/W (SPI), H/W	Normal, I ² S, TDM	+1.8 or +3.3	TQFP-64	17.50
SRC4190	Stereo ASRC	128	-125	212	H/W	Normal, I ² S, TDM	+3.3	SSOP-28	4.95
SRC4184	4-Channel ASRC	128	-125	212	S/W (SPI), H/W	Normal, I ² S, TDM	+1.8 or +3.3	TQFP-64	9.95
Digital Interface									
DIT4096	Digital Audio Interface Transmitter	—	—	96	S/W (SPI), H/W	AES/EBU, S/PDIF	+3.3 and +5	TSSOP-28	1.55
DIT4192	Digital Audio Interface Transmitter	—	—	192	S/W (SPI), H/W	AES/EBU, S/PDIF	+3.3 and +5	TSSOP-28	2.05

¹ Suggested resale price in U.S. dollars in quantities of 1,000.



Audio Amplifier Design Considerations

Consumers are enjoying new ways to listen to music, books and news, while demanding more flexibility, better quality and multifunction products. There is an ever-increasing demand for high-end entertainment for the everyday consumer. The market expects the best listening experience from any audio format and source, mobile or stationary and at a competitive price.

By offering flexible, cost-efficient end-to-end audio solutions, TI provides OEMs and ODMs with faster time-to-market and one-stop shopping. TI's complete audio solutions include best-in-class silicon, systems expertise, software and support. By leveraging the programmability, performance headroom and design flexibility of TI's leading DSP and analog technologies, customers have the ability to build audio products with more functionality that offer a true, lifelike sound experience at a lower overall system cost.

Design Considerations

PRIMARY

Output power: Supply voltage and load impedance limit the level of output power (i.e. volume) an audio power amp (APA) can drive. Always verify that the desired output power is theoretically possible with the equation

$$P_O = \frac{V_O^2}{R_L}$$

where V_O is the RMS voltage of the output signal and R_L is the load impedance.

Output configuration: There are two types of output configurations, single-ended (SE) and bridge-tied load (BTL). An SE configuration is where one end of the load is connected to the APA and the other end of the load is connected to ground. Used primarily in headphone applications or where the audio power amplifier and speaker are in different enclosures. A BTL configuration is where both ends of the load are connected to an APA. This configuration effectively quadruples the output power capability of the system and is used primarily in applications that are space constrained and where the APA and speaker are in the same enclosure.

Total Harmonic Distortion + Noise: Harmonic distortion is distortion at frequencies that are whole number multiples of the test tone frequency. THD+N is typically specified for rated output power at 1 kHz. Values below 0.5 percent to 0.3 percent are negligible to the untrained ear.

Points to Consider When Choosing an Audio Power Amplifier (APA)

- Is the APA driving speakers or headphones?
- What is the impedance of the headphones or speakers: 4 Ω , 8 Ω , 32 Ω ?
- Is the application stereo, mono or multichannel?
- Is the supply voltage \leq 3 V, 5 V, 12 V or \geq 18 V?
- What is the required output power?
- Is there a need for volume control?

Amplifier technology (Class-D and Class-AB): Class-D and Class-AB are the most common APAs in consumer electronics because of their great performance and low cost. Class-D amps are very efficient and provide the longest battery life and lowest heat dissipation. Class-AB amps offer the greatest selection of features (e.g. digital volume control and bass boost).

SECONDARY

Digital volume control: This input changes the gain of the APA when digital high or low pulses are applied to the UP and DOWN pins of the IC.

DC volume control: Internal gain settings that are controlled by DC voltage applied to the VOLUME pin of the IC.

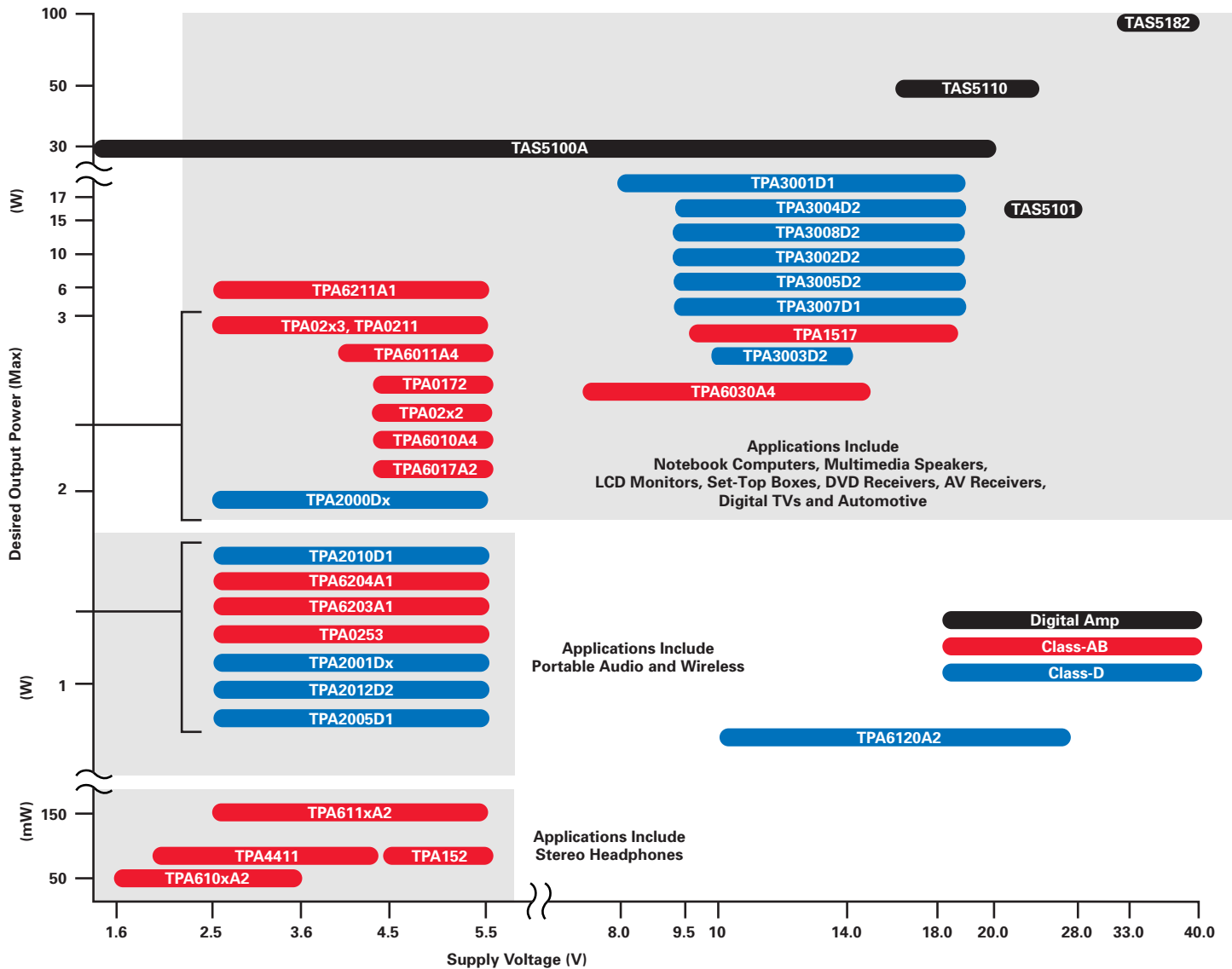
Integrated gain settings: The internal gain settings are controlled via the input pins GAIN₀ and GAIN₁ of the IC.

DEPOP: Circuitry internal to the APA. It minimizes voltage spikes when the APA turns on, off or transitions in or out of shutdown mode.

MUX: Allows two different audio sources to the APA that are controlled independently of the amplifier configuration.

Shutdown: Circuitry that places the APA in a very low power consumption standby state.

Audio Amplifier Design Considerations



Audio Power Amplifiers Product Portfolio Overview

Technical Information

TI APAs are easy to design with, requiring only a few external components.

Power supply capacitors: C_{VDD} minimizes THD by filtering off the low frequency noise and the high frequency transients.

Input capacitors: In the typical application an input capacitor, C_{IN} , is required to allow the amplifier to bias the input signal to the proper dc level for optimum operation. C_{IN} is usually in the 0.1 μ F to 10 μ F range for good low-frequency response.

Bypass capacitor: C_{BYPASS} controls the start up time and helps to reduce the THD. Typically this capacitor is ten times larger than the input decoupling capacitors (C_{IN}).

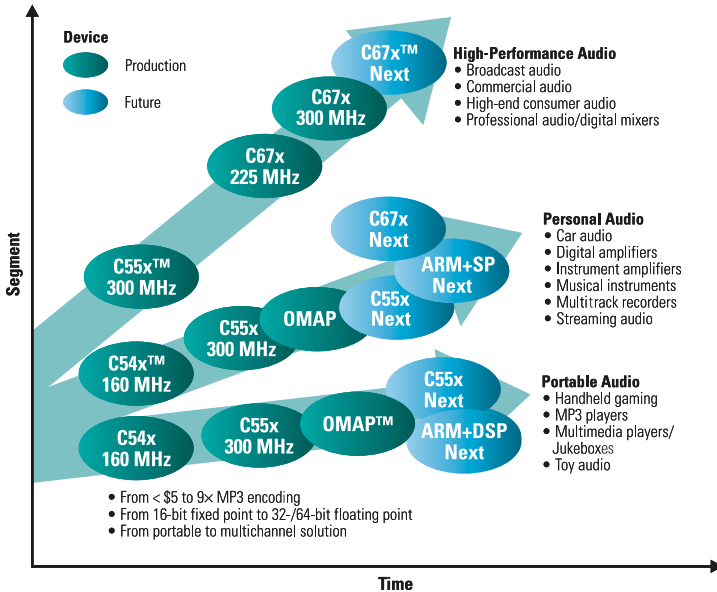
Layout: By respecting basic rules, Class-D amplifiers' layout can be made easy. Decoupling caps must be close to the device, the output loop must be small to avoid the use of a filter and the differential input traces must be kept together to limit the RF rectification. Analog V_{DD} and switching V_{DD} need to be separated back to the supply source.

Migration path: APA products are in a constant evolution moving from Class-AB mono speaker drivers to optimized stereo Class-D amplifiers with advanced features. The latest generation is the most cost effective for the application.

→ DSP Design Considerations and Audio Application Reports

TI DSP Solutions for Audio

TI provides audio solutions that are based on programmable DSP platforms and flexible analog components, allowing developers maximum flexibility in designing products that meet the needs of the



TI DSP Audio Solutions Roadmap

Application Reports for Audio

To access any of the following application reports, type the URL www.s.ti.com/sc/techlit/litnumber and replace *litnumber* with the number in the Lit Number column.

For a complete list of analog application reports, visit: analog.ti.com/appnotes

For a complete list of DSP application reports, visit: www.dspvillage.ti.com/tools

Title	Lit Number
Output Spectrum and Post-LPF Design of the PCM1710	SBAA054
A Low Noise, Low Distortion Design For Antialiasing And Anti-Imaging Filters	SBAA001
Control Port And Reset Operation SoundPlus™ Audio Converters and CODECs	SBAA032
Implementation and Applications of Current Sources and Current Receivers	SBOA046
Low Sampling Rate Operation SoundPlus Audio Data Converters and CODECs	SBAA033
Noise Sources In Applications Using Capacitive Coupled Isolated Amplifier	SBOA028
THD+N Vs. Frequency Characteristics & Spectra of the PCM1717/18/19/20/23/27	SBAA020
Digital Audio Measurements	SLAA114
System Design Considerations for True Digital Audio Amps	SLAA117
TAS5026 & TAS5036 Pseudo Code Examples	SLEA008
Single TAS3103 in 5.1 Channel Audio Systems	SLEA011
TAS3103 Equalization Filters	SLEA012
Ale Starter Guide	SLEA014
Voltage Spike Measurement Technique and Specifications	SLEA025

rapidly changing digital audio landscape. In order to enable designers of digital audio products to leverage advanced digital audio techniques, TI provides silicon, software, systems expertise and support focused on digital audio technologies.

In conjunction with its industry-leading DSP Third Party Network, TI offers eXpressDSP-compliant algorithms for audio designed to reduce system integration time and lower support and development costs. For a listing of algorithms and the third parties that make these available, visit: www.ti.com/algorithms

TI Audio Systems Benefits

- Highest performance allows room for innovation with application-specific digital entertainment solutions
- Programmability and scalability provide open-audio platforms for better differentiation
- Compact form factor for cool product designs and great sound
- Easy-to-use application-specific software and tools get you to market faster

Title	Lit Number
Power supply requirements for AV receivers	SLEA028
OMAP5910 Processor Audio System Design	SPRA970
Decoding Convolutional and Turbo Codes in 3G Wireless White Paper	SPRA878
MP3/AAC™ Player Implementation in RF3	SPRA779
Using the File Navigation API Function in an IACD System	SPRA834
Electronic Shock Protection (ESP) for CD Players That Use a C54x™ DSP	SPRA831
TMS320C6201/6701 EVM: TMS320C6000™ McBSP to Multimedia Audio Codec	SPRA477
TMS320C6000 McBSP to Voice Band Audio Processor (VBAP) Interface	SPRA489
AIC27 Example for the TMS320C5510 DSP Prototype Board	SPRA813
Implementation of AC-3 Decoder on TMS320C62x™ DSPs	SPRA724
An Audio Example Using DSP/BIOS™ Kernel	SPRA598
Interfacing TLC320AD57 Sigma-Delta Stereo ADC (in Master Mode) with TMS320C5x™ DSP	SPRA090

Evaluation Modules (EVMs)

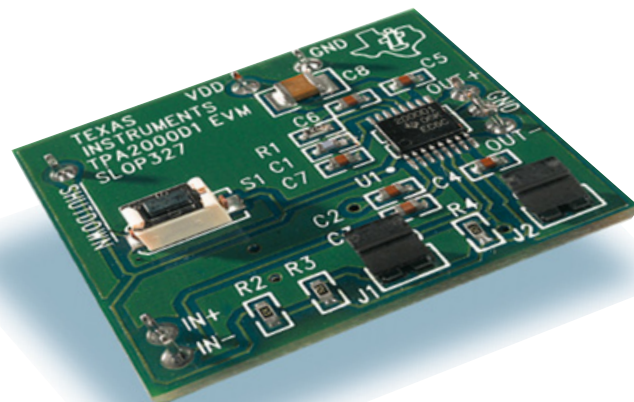


Audio Power Amplifiers

For a complete list of Audio Power Amplifier Development Boards/ Evaluation Modules (EVMs), visit: www.ti.com/audiopoweramevm

Digital Audio Amplifiers and Processors

To order any of the following evaluation modules (EVMs), please call 1-800-477-8924, ext. 5800 in North America. To order from other regions, please contact the TI Product Information Center (see listings on page 2) or your local TI distributor.



Literature Number	Description
Stereo EVMs¹	
TAS5001-5122C2EVM	TAS5001, 1xTAS5122DCA (pad-down) in BTL mode, TAS3002 2 x 30-W/6-Ω output power (< 0.2% THD+N), 94-dB signal-to-noise ratio
TAS5010-5112F2EVM	TAS5010, 1xTAS5112DFD (pad-up) in BTL mode, TAS3002 2 x 50-W/6-Ω output power (< 0.2% THD+N), 95-dB signal-to-noise ratio
Home Theater EVMs²	
TAS5066-5112F6EVM	TAS5066, 3xTAS5112DFD (pad-up) in BTL mode 6 x 50-W/6-Ω output power (< 0.2% THD+N), 97-dB signal-to-noise ratio
TAS5066-5111D6EVM	TAS5066, 6xTAS5111DAD (pad-up) in BTL mode 6 x 70-W/4-Ω output power (< 0.2% THD+N), 97-dB signal-to-noise ratio
TAS5066-5121K6EVM	TAS5066, 6xTAS5121DKD (pad-up) in BTL mode 6 x 100-W/4-Ω output power (10% THD+N), 97-dB signal-to-noise ratio
TAS5076-5182C6EVM	TAS5076, 6xTAS5182DCA (pad-down) in BTL mode 6 x 100-W/6-Ω output power (< 0.2% THD+N), 105-dB signal-to-noise ratio
TAS5508-5121K8EVM	TAS5508, 8xTAS5121DKD (pad-up) in BTL mode 8 x 105-W/4-Ω output power (10% THD+N), 102-dB signal-to-noise ratio
TAS5508-5122C6EVM	TAS5508, 2xTAS5122DCA (pad-down) in SE and BTL mode 5 x 20-W/4-Ω + 1 x 40-W/8-Ω output power (10% THD+N), 100-dB signal-to-noise ratio
TAS5028-5122C6EVM	TAS5028, 2xTAS5122DCA (pad-down) in SE and BTL mode 5 x 20-W/4-Ω + 1 x 40-W/8-Ω output power (10% THD+N), 100-dB signal-to-noise ratio
TAS5518-5182C8EVM	TAS5518, 4xTAS5182DCA (pad-down) in BTL mode 8 x 150-W/4-Ω output power (< 0.2% THD+N), 110-dB signal-to-noise ratio
TAS5508-5142K7EVM	TAS5508, 4xTAS5142DKD (pad-up) in BTL and PBTL mode 6 x 100-W/4-Ω + 1 x 150-W/3-Ω output power (10% THD+N), 102-dB signal-to-noise ratio
TAS5508-5152K7EVM	TAS5508, 4xTAS5152DKD (pad-up) in BTL and PBTL mode 6 x 125-W/4-Ω + 1 x 200-W/3-Ω output power (10% THD+N), 102-dB signal-to-noise ratio
TAS5086-5142V6EVM	TAS5086, 2xTAS5142DDV (pad-up) in SE and BTL mode 4 x 30-W/4-Ω + 2 x 60-W/8-Ω output power (10% THD+N), > 100-dB signal-to-noise ratio
TAS5086-5186V6EVM	TAS5086, 2xTAS5186DDV (pad-up) in SE mode 5 x 30-W/6-Ω + 1 x 60-W/3-Ω output power (10% THD+N), > 100-dB signal-to-noise ratio
Digital Audio Processor EVMs	
TAS3103EVM	The EVM contains two TAS3103 devices to provide processing for up to six audio channels. The board is configurable to allow full functionality of the TAS3103 digital audio processor to be evaluated.
TAS3002/4EVM	The EVM contains one TAS3002/4 device to provide processing for up to two audio channels. The board is configurable to allow full functionality of the TAS3002/4 digital audio processor to be evaluated.

¹ All Stereo EVMs include cables and PurePath™ Digital CD-ROM with the following interfaces: Digital (coaxial, optical and I²S), Analog, PC (parallel port), Banana speaker terminals.

² All Home Theater EVMs include TI multichannel EVM input board with digital (coaxial, optical and I²S), 6-ch analog and parallel port/USB (PC) interfaces, cables and PurePath Digital CD-ROM. These EVMs have the following interfaces: Control/Audio (I²C/I²S) and speaker output pin-terminals. Some EVMs have headphone, line and LFE line outputs.

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