

Audio Solutions Guide

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

1Q 2007




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TI Worldwide Technical Support

Internet

TI Semiconductor Product Information Center Home Page

support.ti.com

TI Semiconductor KnowledgeBase Home Page

support.ti.com/sc/knowledgebase

Product Information Centers

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Australia	1-800-999-084	Malaysia	1-800-80-3973
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Hong Kong	800-96-5941	Philippines	1-800-765-7404
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Audio Systems Overview



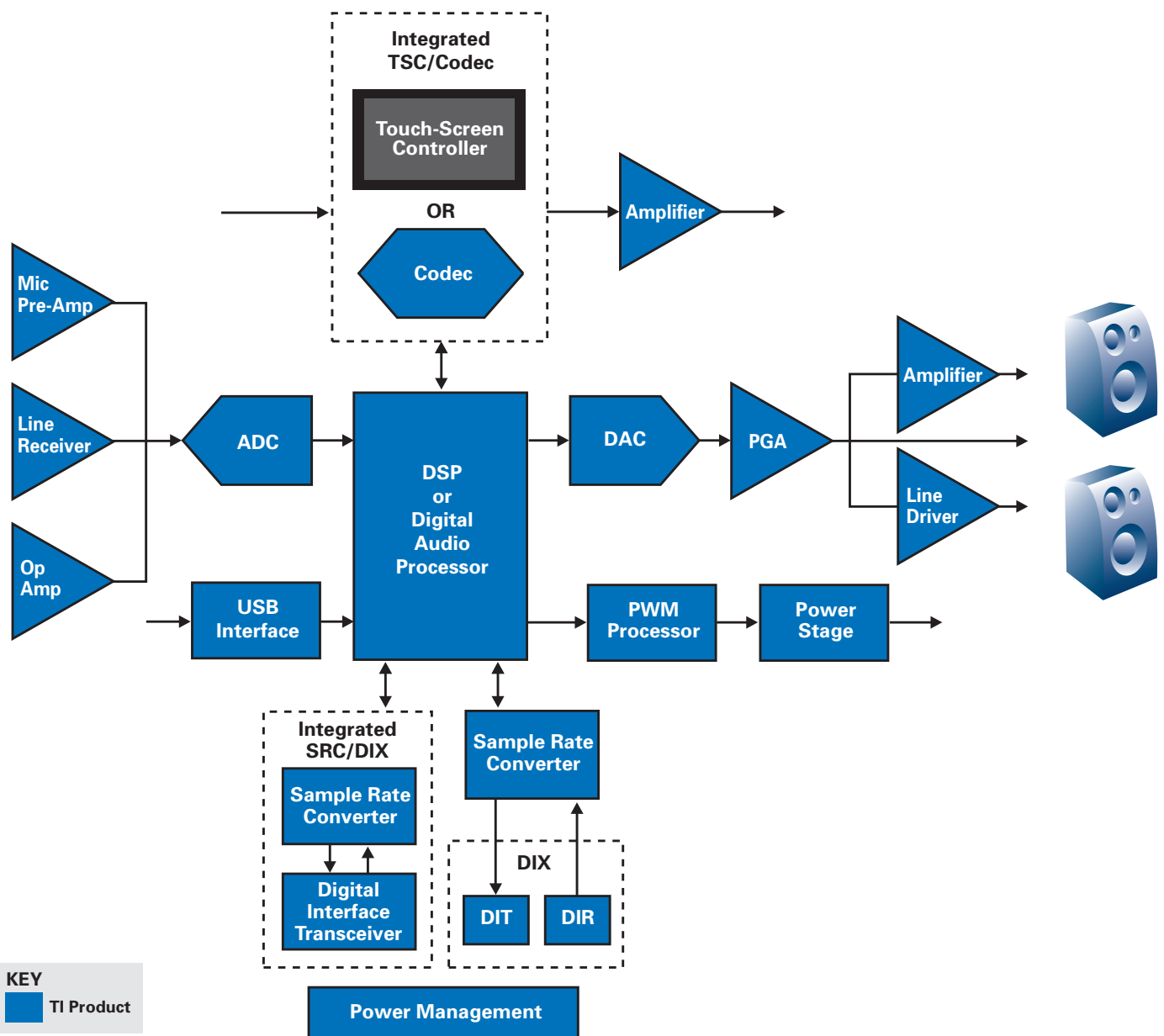
Today's consumers demand high-quality multifunction audio products that are cost competitive and feature rich. They expect their audio to be high fidelity and crystal clear regardless of the format or source and regardless of whether they're at home or on the go.

Texas Instruments helps meet consumer demand through our portfolio of all-digital audio components as well as our digital+analog audio solutions. Programmable components with performance headroom and design flexibility help you build audio systems with true, lifelike sound and broad functionality at a competitive cost.

TI provides the silicon, software, application knowledge and support for the entire audio signal chain, helping you get to market fast.

From industry-leading DSPs and high-performance analog to logic and an extended portfolio of application software, TI delivers the most reliable, scaleable and power-efficient solutions for both simple and complex audio designs alike.

This latest Audio Solutions Guide makes it easier than ever for you to explore TI's audio portfolio. In each product category, we now feature complete details about one key device and follow that with a list of related devices. We've also added a section of system block diagrams organized by end application: digital TV, wireless handset, mini-speakers and more. As always, you'll find detailed selection tables to help you refine your decisions.



Audio systems require a wide array of analog and digital support components.



Digital Signal Processors

Floating-Point Digital Signal Processor TMS320C67xx

www.ti.com/floatingpointdsps

Key Features

- 100% code-compatible DSPs priced as low as \$5.75
- Advanced VLIW architecture
- Up to eight 32-bit instructions executed each cycle
- Eight independent, multi-purpose functional units and up to sixty-four 32-bit registers
- Industry's most advanced DSP C compiler and assembly optimizer maximize efficiency and performance

C672x™ DSP

- Lowest price floating-point device on the market
- Sixty-four 32-bit registers
- Large (32-KB) program cache
- Flexible boot options
- dMAX DMA engine tuned for audio performance

C671x™ DSP

- L1/L2 cache architecture
- Thirty-two 32-bit registers
- EDMA DMA engine

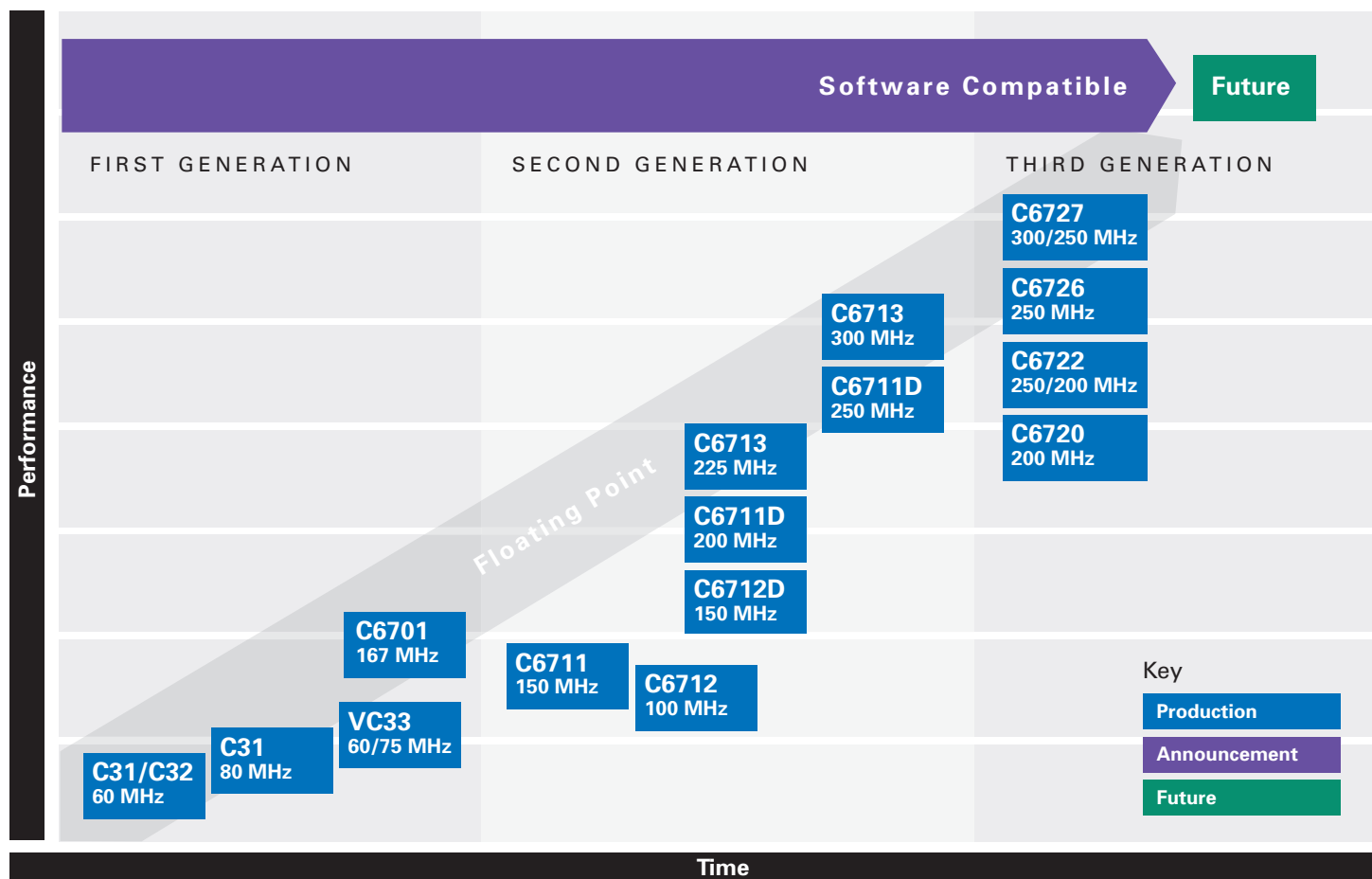
Applications

- Professional audio products, mixers, audio synthesis
- Instrument/amplifier modeling
- Audio conferencing
- Audio broadcast
- Emerging audio applications in biometrics, medical, industrial, digital imaging, speech recognition and voice-over packet

To Know More

- For a complete list of **TMS320C67xx Floating-Point DSPs**, see the Selection Guide on page 27.

TMS320C6000™ Floating-Point DSP Roadmap



Digital Audio Processors



Digital Audio Processor
TAS3208/4

www.ti.com/sc/device/TAS3208
www.ti.com/sc/device/TAS3204

The TAS3208 is a powerful cost-efficient, 8-channel, 48-bit digital audio processor with an 8051 WARP MCU and single-cycle 76-bit (48x28) multiply-accumulate operation. It enables equalization, tone and volume control as well as dynamic range control. The TAS3208 supports a range of algorithms, including matrix decoding, sound enhancement and surround sound, and it has integrated high-performance ADC/DAC.

Key Features

- 48-bit audio DSP with 8051 WARP MCU
- 76-bit (48x28) precision single-cycle multiply
- 135-MHz clock rate (2,816 cycles @ 48 Fs)
- Integrated ADC/DAC
- 10 stereo analog inputs and four stereo analog outputs + headphone output
 - TAS3204: Three stereo analog inputs, two stereo analog outputs and no headphone output
- I²S master/slave clock 32- to 48-kHz data
- Three stereo digital inputs and two stereo digital outputs (one output can be PCM or SPDIF)
 - TAS3204: Two stereo digital inputs

Applications

- Flat-panel display TVs (see System Block Diagram on page 21)
- Digital TVs
- Mini docking stations (see System Block Diagram on page 22)

To Know More

- For a complete list of **Digital Audio Processors**, see the Selection Guide on page 27.

Digital Audio Processors

TAS3103A	TAS3108	TAS3204	TAS3208
<ul style="list-style-type: none">• 4/3 input/output channels• 135-MHz, 48-bit DSP• 3-D effects, volume, treble/bass, DRC, EQ control• Fully configurable	<ul style="list-style-type: none">• 8 channels• 135-MHz, 48-bit fully programmable DSP• Graphical design tool	<ul style="list-style-type: none">• 2 stereo audio ADCs• 2 stereo audio DACs• 3/2 stereo analog input/output channels• 135-MHz, 48-bit fully programmable DSP• Graphical design tool	<ul style="list-style-type: none">• 1 stereo audio ADC• 3 stereo audio DACs• 10/4 stereo analog inputs/outputs + HP out• 135-MHz, 48-bit, fully programmable DSP• Graphical design tool
FEATURED PRODUCTS			
Key			
Integrated ADC/DAC			
Stand-Alone DSP			



Analog-to-Digital Converters

124-dB Professional 2-Channel ADC

PCM4222 **PREVIEW***

www.ti.com/sc/device/PCM4222

Audio ADCs are used in applications ranging from portable MP3 player docking stations to professional multichannel mixing consoles.

The PCM4222 is TI's next-generation audio ADC and offers the best performance with the lowest power consumption in the industry. With modulator, PCM and DSD outputs, the PCM4222 enables superior design flexibility. TI's advanced silicon technology provides 124 dB of dynamic range with only 305 mW of power consumption, enabling multiple channels without consuming the entire system's heat budget. Added functionality such as TDM ports also supports multichannel designs.

Key Features

- 124-dB dynamic-range output makes this the world's highest performance ADC
- Multiple format output (modulator, DSD and PCM) allowing development of custom digital filters
 - 124-dB 6-bit modulator output
 - 123-dB DSD output
 - 123-dB PCM output
- Multichannel TDM mode enables flexibility in system partitioning
- 305 mW power consumption at 48 kHz

Applications

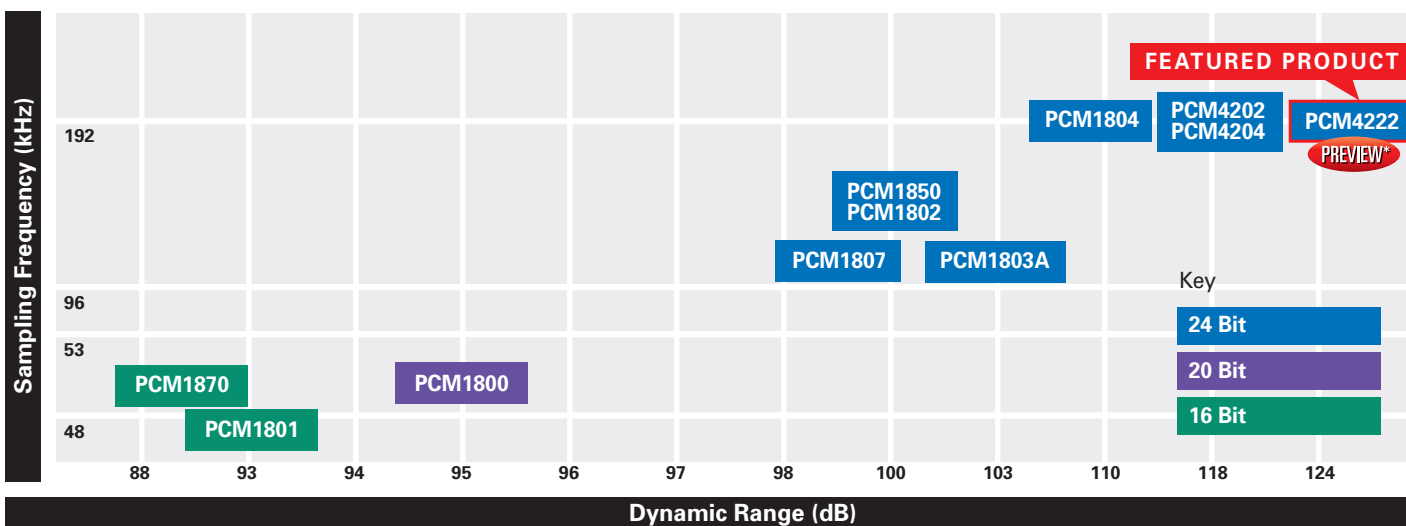
- Mixing consoles
- Musical instruments
- High-end AV
- Audio recording equipment
- Live-audio broadcasts

To Know More

- For a complete list of **A/D Converters**, see the Selection Guide on page 29.

* Expected release April 2007

Audio A/D Converters



Digital-to-Analog Converters



16-Bit Low-Power Stereo Audio DAC with Analog Input, Headphone, Class-D Speaker Amp

PCM1777 PREVIEW*

Audio DACs are used in applications ranging from MP3, DVD and CD players to professional-grade PC audio interfaces and AV receivers. Functions such as headphone amplifiers and audio processors are often integrated into the audio DAC.

The PCM1777 is a low-power stereo DAC that integrates stereo Class-D speaker amplifiers. It also offers multiple audio functions such as programmable gain control and a sound effects processor. It is pin-for-pin-compatible and control-register-compatible with the PCM3793 and PCM3794 stereo codecs, simplifying product family designs.

Key Features

- Dynamic range of 93 dB with only 7 mW of power consumption
- 700-mW stereo Class-D speaker amplifier
- 40-mW stereo headphone amplifier
- 3-band tone control and 3-D sound effects, volume control and automatic level control, all easily programmed over I²C or SPI

Applications

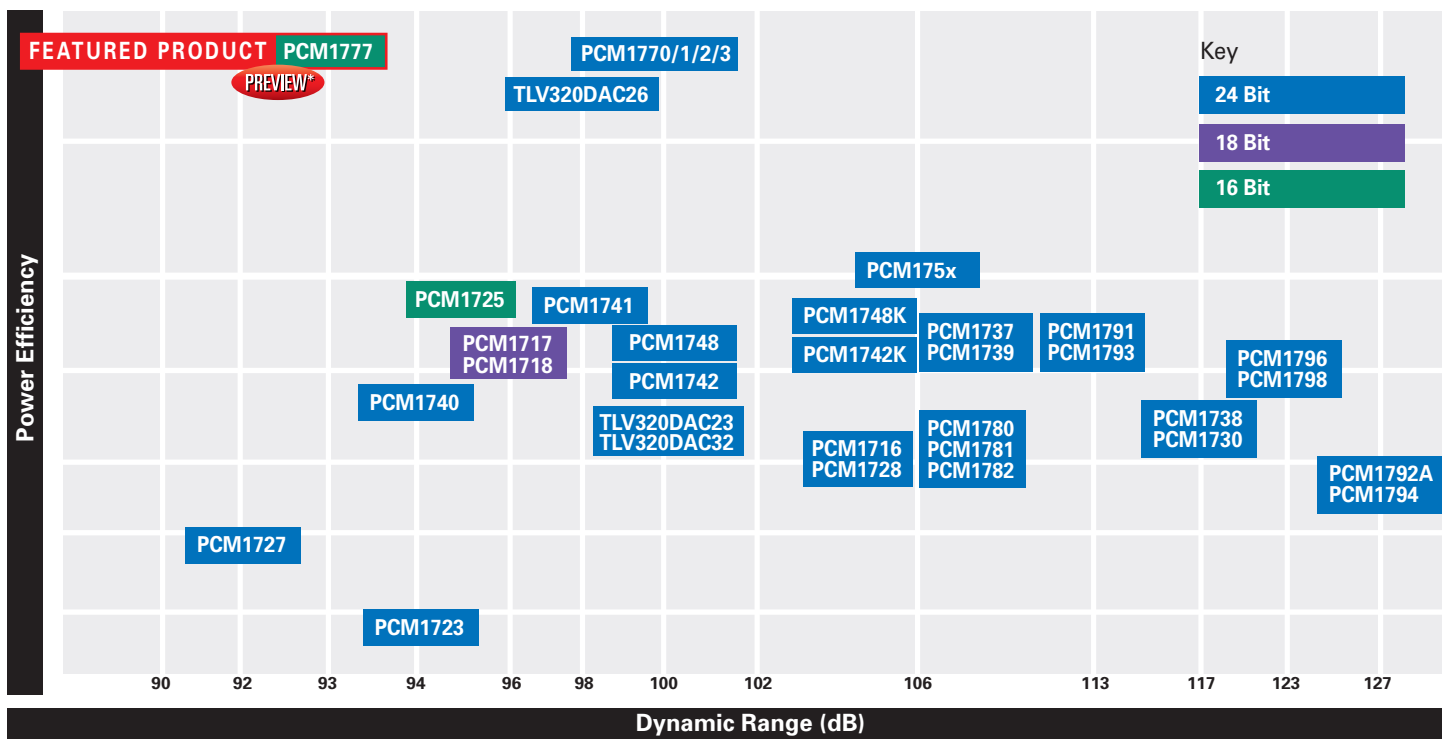
- Portable audio players
- Cellular phones
- Video camcorders
- Digital still cameras with video capabilities (see System Block Diagram on page 26)

To Know More

- For a complete list of **D/A Converters**, see the Selection Guide on page 29.

* Expected release June 2007

Audio D/A Converters





Touch-Screen Controllers

Audio Codec with Touch-Screen Controller

TSC2111

www.ti.com/sc/device/TSC2111

A touch screen requires a controller, and the integration of the controller into the audio codec further reduces footprint. The TSC2111 is a good example of a codec with a touch-screen controller that's compatible with the popular four-wire touch screen.

Key Features

- 4-wire touch-screen controller + on-chip processor
- 400-mW, 8- Ω mono speaker amplifier
- 82-mW, 32- Ω cellular phone earpiece amplifier
- 44-mW, 16- Ω stereo headphone amplifier
- Stereo 88-dB ADC and 90-dB DAC
- Programmable audio processor (bass, treble and 3-D)
- Integrated mic bias, preamp and AGC for low system cost
- Integrated PLL for flexible audio clock generation
- 12-bit SAR ADC for battery and temp measurement
- Audio interface: I²S, L-R justified, DSP
- Control interface: SPI
- Packaging: 48-pin QFN (7x7 mm)

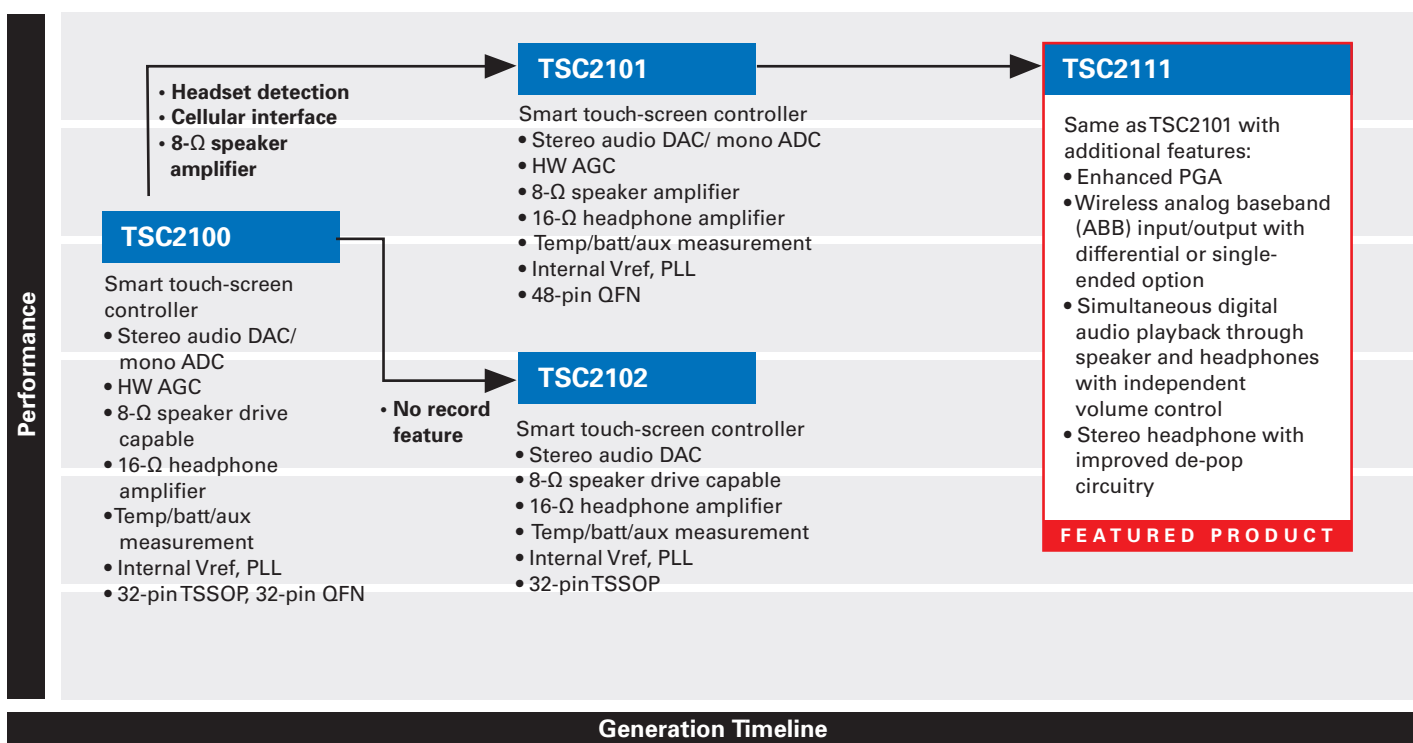
Applications

- Smart phones
- PDAs
- Portable media players (see System Block Diagram on page 24)

To Know More

- For a complete list of **Touch-Screen Controllers**, see the Selection Guide on page 30.

Touch-Screen Controllers



Portable Audio Codecs



Audio Codecs Increase Performance and Battery Life

PCM3793/4

www.ti.com/sc/device/PCM3793

www.ti.com/sc/device/PCM3794

Portable audio systems typically have a digital applications processor that performs video and/or audio encoding and decoding. Audio codecs provide an interface from that digital processor to the outside world. At the heart of the codec are the ADCs and DACs that perform the conversion. Other functions that are often integrated into an audio codec include microphone amplifiers, headphone and speaker drivers, and sound processing such as EQ adjustment and 3-D effects.

The PCM3793 is an excellent example of a very new portable audio codec that strikes the balance between low power consumption and good signal to noise. It includes the additional benefit of integrated efficient stereo Class-D speaker amplifiers further extending precious battery life.

Key Features

- 7-mW stereo 48-kbps playback for low power consumption
- Highly efficient 700-mW class-D speaker amplifiers
- Stereo 90-dB ADC and 93-dB DAC for low noise
- Programmable audio processor (bass, treble and 3-D)
- Notch filter for reduction of digital still camera lens motor noise
- Differential input for low noise
- Integrated mic bias, preamp and AGC for low system cost
- Audio interface: I²S, L-R justified, DSP
- Control interface: I²C and SPI
- Packaging: 32-pin QFN (5x5 mm)

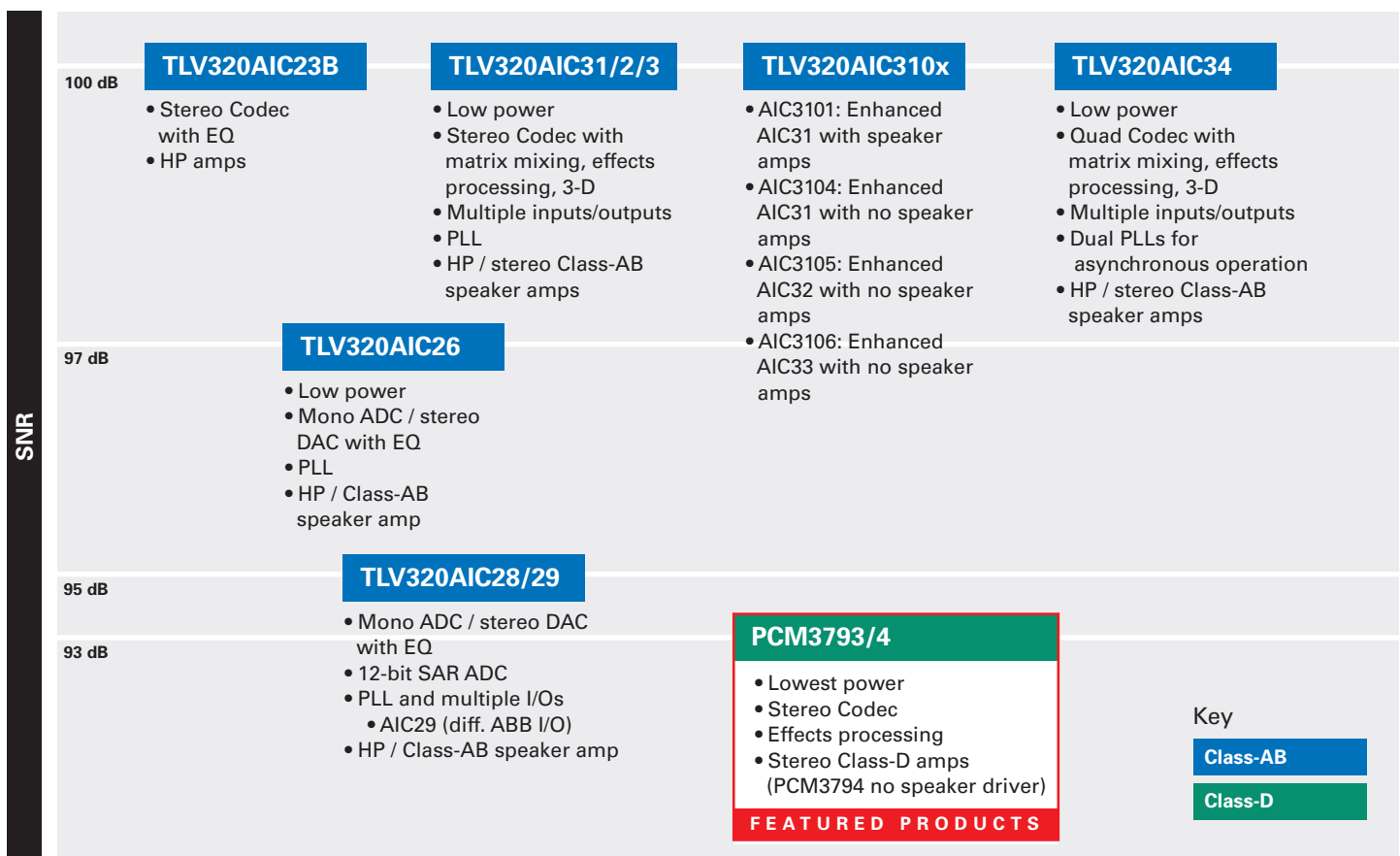
Applications

- Portable media players (see System Block Diagram on page 24)
- Digital still cameras (see System Block Diagram on page 26)

To Know More

- For a complete list of **Codecs**, see the Selection Guides on pages 30 and 31.

Portable Audio Codecs





Codecs with USB Interface

Stereo Audio Codec with USB Interface PCM2906

www.ti.com/sc/device/PCM2906

As computers become more central to home entertainment, the ability to stream audio between computers and external hardware is becoming more common. TI has developed two main families of products that allow designers to quickly and easily integrate USB audio functionality into their designs. The TAS1020B and the TUSB3200A both feature programmable USB audio interfaces. These I²S-compatible USB 1.1-based devices are capable of 24 bits at 48 kHz. Both devices are based on the well-known 8052 core for ease of programming.

The PCM29xx and PCM27xx are fully plug-and-play compatible, allowing designers to add an extra stereo audio interface to their product, be it a home stereo, digital speaker system or even a stereo I/O soundcard.

Key Features

- Driverless plug-and-play functionality
- S/PDIF I/O supporting 16 bits at 48 kHz
- Uses SpAct™ architecture, TI's unique system that recovers the audio clock from USB packet data.

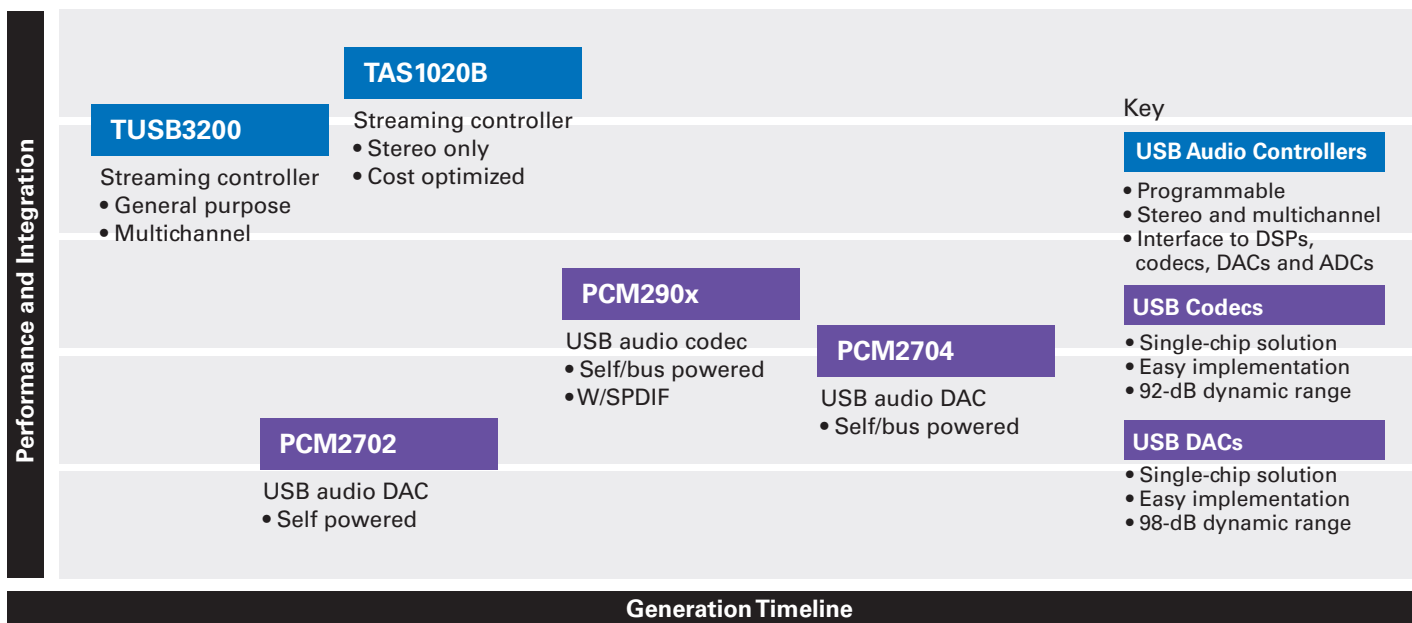
Applications

- USB audio speakers
- USB headsets
- USB monitors

To Know More

- For a complete list of **USB Codecs**, see the Selection Guide on page 32.

Stereo Audio Codecs with USB Interface



S/PDIF Transceivers and Sample Rate Converters



Sample Rate Converter Provides Product Integration and Performance

SRC4392

www.ti.com/sc/device/SRC4392

Consumers are increasingly connecting the components of their home entertainment systems digitally. Systems run at various sampling rates, though, ranging from 44.1 kHz all the way up to 216 kHz. TI's sample rate converters, combined with our various S/PDIF (AES3) interface devices, offer limitless interfacing options at any sampling rate.

TI's SRC product range is based on two different cores: a 144-dB dynamic range core and a lower performance 128-dB core. These cores are then used throughout our products, which range from devices offering complete integration of S/PDIF transceivers and sample rate conversion to devices featuring up to four channels of SRC.

TI's SRC4392 combo sample rate converter offers a complete interface for your design, with completely routable S/PDIF I/O along with sample rate conversion and two audio serial ports, all capable of supporting 216 kHz, providing optimal product integration without sacrificing performance.

Key Features

- Complete S/PDIF I/O interface with integrated sample rate conversion up to 216 kHz
- Highly flexible internal router enables you to configure the signal chain without compromise.
- Generate system clocks from the DSP, from DIR or internally.
- SPI or I²C control

Applications

- Digital audio recorders and mixing desks
- Digital audio interface for computers
- Digital audio routers and distribution systems

To Know More

- For a complete list of **Interface and Sample Rate Converters**, see the Selection Guide on page 32.

S/PDIF Interface Products and Sample Rate Converters

Performance	SRC4192/3		SRC4194		SRC4382		SRC4392	
	<ul style="list-style-type: none">• 24 bit, stereo, 212-kHz Fs• 144-dB dynamic range• -140-dB THD+N• 28-pin SSOP		<ul style="list-style-type: none">• 24 bit, 4 channel, 212-kHz Fs• 144-dB dynamic range• -140-dB THD+N• 64-pin TQFP				<ul style="list-style-type: none">• 2-channel combo SRC and DIX• 144-dB dynamic range• -140-dB THD+N• 48-pin TQFP	
	SRC4190		SRC4184				FEATURED PRODUCT	
	<ul style="list-style-type: none">• 24 bit, stereo, 212-kHz Fs• 128-dB dynamic range• -125-dB THD+N• 28-pin SSOP		<ul style="list-style-type: none">• 24 bit, 4 channel, 212-kHz Fs• 128-dB dynamic range• -125-dB THD+N• 64-pin TQFP					
					DIX4192			
					<ul style="list-style-type: none">• Pro S/PDIF/AES3 transceiver• Up to 24 bit, stereo, 216 kHz• 48-pin TQFP			
			DIT4192		DIR9001		Key	
			DIT4096		<ul style="list-style-type: none">• S/PDIF/AES3 receiver• DIR1703 replacement• Up to 24 bit, stereo, 96 kHz		SRC	
			<ul style="list-style-type: none">• Pro S/PDIF/AES3 transmitter• Up to 24 bit, stereo, 96 kHz and 192 kHz• 28-pin TSSOP				SRC - Sample Rate Converter	
							S/PDIF, AES/EBU	
						DIT - S/PDIF and AES/EBU Transmitter		
						DIR - S/PDIF and AES/EBU Receiver		
						DIX - S/PDIF and AES/EBU Transceiver		
						Combo SRC		
Integration Ease								



Professional Audio Microphone Preamplifiers

Digitally Controlled Microphone Preamplifier IC PGA2500

www.ti.com/sc/device/PGA2500

All audio production requires transferring acoustic information into an electronic medium. To avoid interference and help process signals through analog and digital circuitry, gain is added to the microphone signal to increase the ratio between the audio signal itself and the noise floor inherent in the circuit to follow. A mic preamp typically brings the tiny μV microphone signal up to line level or higher for processing.

Microphones usually have balanced outputs to help remove external interference from the tiny signals being transferred. Mic preamps should be matched so that both sides of the differential signal are given equal gain while rejecting any common mode signals. When the whole mic preamp is in one piece of silicon then all parts can be matched so that they track equally with temperature, maintaining balance in almost all conditions.

Combining leading analog circuitry with digital control, the PGA2500 is the world's only digitally controlled mic preamp IC, enabling designers to create remotely controlled microphone preamps with higher performance in a smaller space.

Key Features

- Fully differential analog I/O enables low levels of interference and seamless connection to differential ADCs.
- Four general-purpose outputs allow the control of signal chain switches and relays for phase, pad, phantom and more.
- Includes DC servo and Vcom input for minimum DC offset error and direct connection to ADCs.

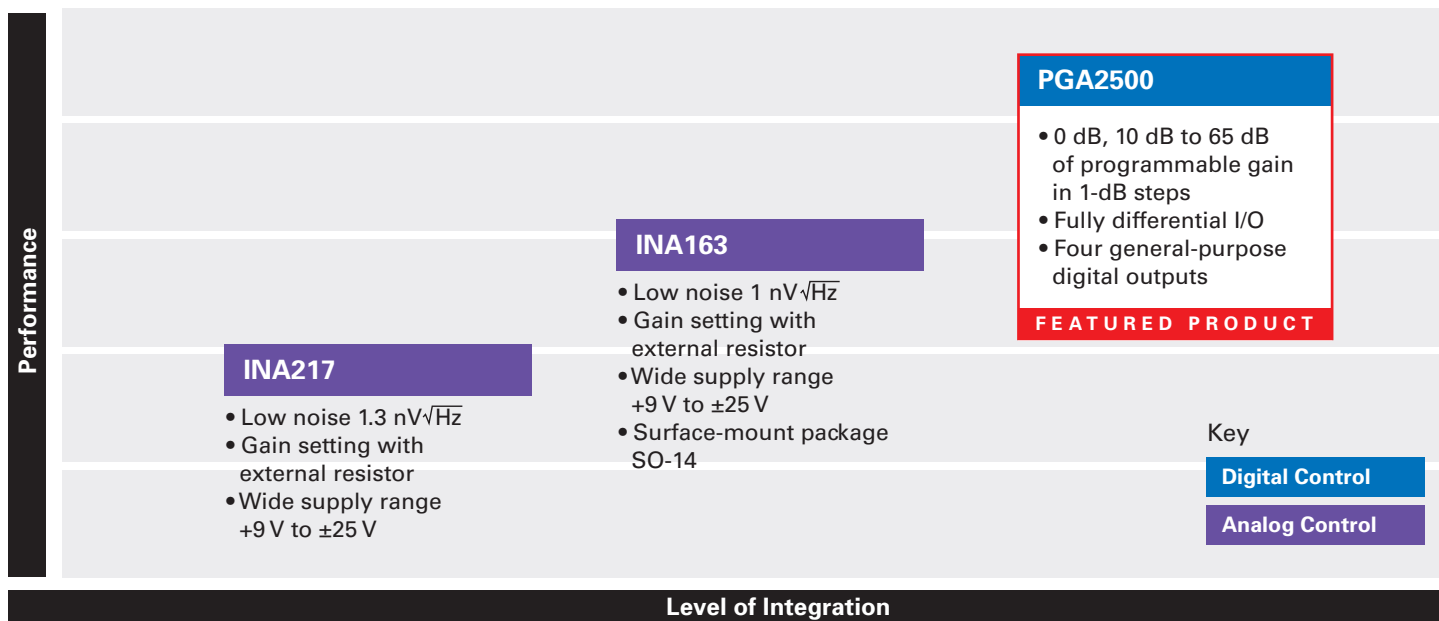
Applications

- Microphone preamplifiers
- Digital mixers and recorders
- Digital snakes

To Know More

- For a complete list of **Microphone Preamplifiers**, see the Selection Guide on page 36.

Professional Audio Analog Microphone Preamplifiers



Line Drivers/Receivers and Signal Conditioning Amplifiers



High-Performance, Fully Differential Audio Op Amp OPA1632

www.ti.com/sc/device/OPA1632

Gain, attenuation and filtering are fundamental in all audio processing. TI has a long history in op amps, instrumentation amplifiers and line drivers/receivers, ranging from the OPA627 through to the ultra-low-noise OPA1632. TI's range of line drivers and receivers are among the workhorses of the audio industry, driving signals from system to system in home, studio and broadcast applications.

TI recently released the OPA1632, a fully differential operational amplifier aimed at gain-scaling and interfacing to high-performance ADCs. The OPA1632's low THD+N and $\pm 16\text{-V}$ supply rail make it an ideal signal chain op amp for maintaining true balance throughout your system.

Key Features

- True balanced architecture: balanced input and output converts single-ended input to balanced differential output.
- GBW of 180 MHz and very fast slew rate of 50 V/ μs produce exceptionally low distortion.
- Very low input noise of 1.3 nV/ $\sqrt{\text{Hz}}$ ensures maximum signal-to-noise ratio and dynamic range.

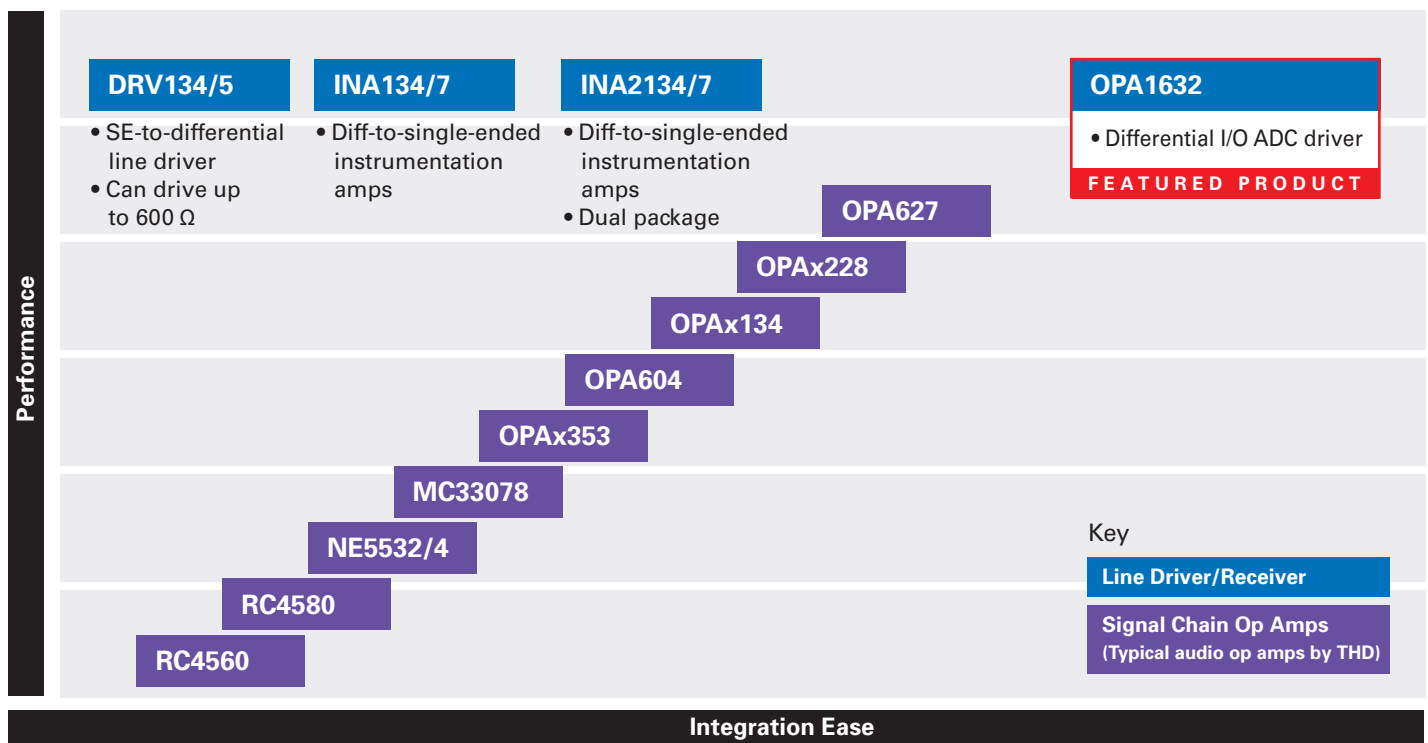
Applications

- Audio ADC drivers
- Balanced line drivers
- Balanced receivers

To Know More

- For a complete list of **Line Drivers/Receivers and Signal Conditioning Amplifiers**, see the Selection Guide on page 33.

Drivers, Receivers and Signal Chain Amplifiers





Volume Controls

Stereo Audio Volume Control
PGA2320

www.ti.com/sc/device/PGA2320

Analog volume control often carries a great advantage because, unlike digital volume control, the noise inherent in any prior processing (ADC, DSP, DAC) decreases along with the audio content. TI's analog volume controls range from ±15-V devices like the PGA2310 and PGA2320 to multichannel ±5-V devices such as the PGA4311.

The ±15-V devices are typically used on line inputs or as part of an analog signal chain, whereas ±5-V devices are often used after a DAC to attenuate typical output levels.

The PGA2320, TI's latest PGA volume control, is a technical advancement over its predecessor, the PGA2310. Using a new TI process, the PGA2320 continues to offer ±15-V supply rails in a pin-for-pin package with a lower THD+N and a lower price.

Volume Controls

Performance				
	<div>PGA2311</div> <ul style="list-style-type: none">• 120-dB dynamic range• THD+N at 1 kHz = 0.0002%• 31.5-dB to -95.5-dB attenuation• +/-5-V supplies	<div>PGA4311</div> <ul style="list-style-type: none">• 4-channel version of PGA2311• 120-dB dynamic range• THD+N at 1 kHz = 0.0002%• 31.5-dB to -95.5-dB attenuation• +/-5-V supplies	<div>PGA2310</div> <ul style="list-style-type: none">• 120-dB dynamic range• THD+N at 1 kHz = 0.0004%• 31.5-dB to -95.5-dB attenuation• +/-15-V supplies	<div>PGA2320</div> <ul style="list-style-type: none">• Improved THD+N• Same pinout as PGA2310 <div>FEATURED PRODUCT</div>
	Key			
	<div>Line Input/Output</div> <div>Attenuation up to 27 Vpp</div>			
	<div>DAC Output Attenuation</div> <div>DAC output level ~2 Vrms</div>			
Vcc Range + Integration				

Key Features

- ±15-V supply rails allow large swing signals to be attenuated.
- Pin-for-pin compatibility with the PGA2310 enables an easy upgrade path.
- Simple SPI control method for integration into DSP or microcontroller systems.
- 0.5-dB steps allow for accurate attenuation.

Applications

- Audio amplifiers
- Mixing consoles
- Multitrack recorder
- AV amplifier

To Know More

- For a complete list of **Volume Controls**, see the Selection Guide on page 33.

PurePath Digital™ PWM Processors



7.1-Channel Digital Audio PWM Processor TAS5518

www.ti.com/sc/device/TAS5518

The digital audio PWM processor is the first chip in a two-chip digital amplifier chipset. It accepts PCM data from a DSP, ADC or interface (S/PDIF) and converts the data into PWM format. It then passes this PWM data to the power stage that drives the speaker.

Some PWM processors include a digital audio processor to handle post-processing functions such as volume control, treble/bass control, EQ, bass management, compression/limiting and loudness.

Channel counts vary from stereo versions to multichannel, ideal for the 5.1, 6.1 and 7.1 markets. Software configurability and pin-for-pin compatibility allow a single board to be used for many design platforms.

Key Features

- Software configurable for 5.1-, 6.1- or 7.1-channel operation
- 110-dB dynamic range
 - Extendable to 134-dB with special power supply
- Volume, treble and bass control
- Third-party algorithms such as SRS TruSurround, BBE and QSound can be downloaded through I²C
- Channel mapping enables board reuse and eases PCB signal routing
- PWM headphone output (in 5.1-channel mode)

Applications

- DVD receivers (see System Block Diagram on page 22)
- Home theaters

To Know More

- For a complete list of **PWM Processors**, see the Selection Guide on page 34.

PurePath Digital™ PWM Processors

		TAS5518 <ul style="list-style-type: none"> • 8 channel • 48-bit audio processing • Volume, EQ, treble/bass, loudness • PSU volume control • 110-dB dynamic range FEATURED PRODUCT		TAS5086 <ul style="list-style-type: none"> • 6 channel • Volume, channel mapping • Bass management • 107-dB dynamic range
	TAS5508B <ul style="list-style-type: none"> • 8 channel • 48-bit audio processing • Volume, EQ, treble/bass, loudness • PSU volume control • 102-dB dynamic range 			
			TAS5028 <ul style="list-style-type: none"> • 8 channel • 48-bit audio processing • Volume, channel mapping • PSU volume control • 102-dB dynamic range 	
		TAS5504A <ul style="list-style-type: none"> • 4 channel • 48-bit audio processing • Volume, EQ, treble/bass, loudness • PSU volume control • 102-dB dynamic range 		
TAS5001/10/12 <ul style="list-style-type: none"> • 24 bit, stereo • 94-/96-/102-dB dynamic range • 32- to 192-kHz 				Key <ul style="list-style-type: none"> Multichannel, Pin/SW Compatible Multichannel Stereo



PurePath Digital™ Power Stages

315-W Mono and 200-W Stereo Digital Amplifier Power Stages

TAS5261/5162

www.ti.com/sc/device/TAS5261

www.ti.com/sc/device/TAS5162

A subset of class-D audio amplifiers, digital amplifiers accept a digital PCM input, enabling the audio signal to remain digital from source to output. This improves noise immunity and ensures that audio output is a crystal-clear replication of the audio source.

Digital amplifiers typically have higher power than analog-input class-D amps. TI's digital amplifier power stages range from 20 W per channel up to 300 W per channel.

Key Features

- 200 W of stereo output power per channel into 6 Ω (BTL)
 - 4X100W, 3 Ω in single-ended mode (TAS5162)
- >95% efficient at 4 Ω , lowering heat sink size and operating temperature, and extending reliability
- Two-stage over-current detector ensures current spikes due to speaker impedance versus frequency droops are handled gracefully and inaudibly.
- Power-on reset control simplifies system design by eliminating need to sequence power supply.
- Packaging: 44-pin HTSSOP and 36-pin PSOP3

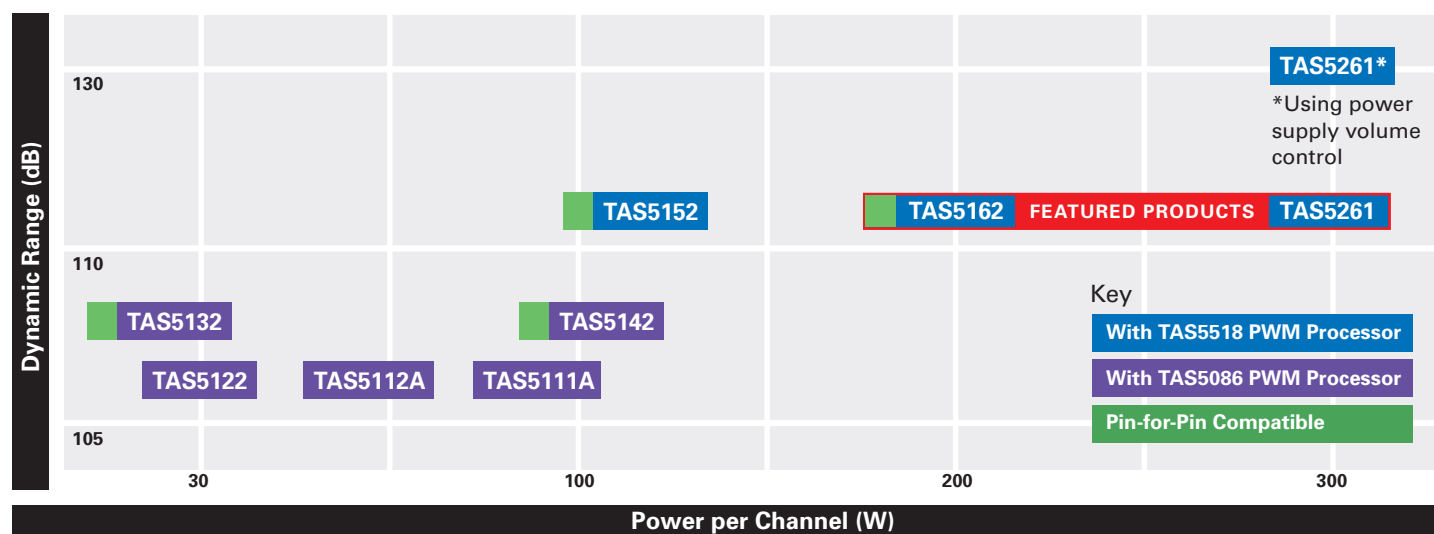
Applications

- DVD receivers (see System Block Diagram on page 22)
- Home theaters

To Know More

- For a complete list of **Power Stages**, see the Selection Guide on page 34.

PurePath Digital™ Power Stages



Class-D Audio Power Amplifiers



25-W Stereo Class-D Audio Power Amplifier with Single-Ended Outputs

TPA3120D2 PREVIEW*

www.ti.com/sc/device/TPA3120D2

Class-D amplifiers are more efficient than traditional class-AB amplifiers since they waste less power as heat. Class-D amplifiers have experienced huge growth in recent years since they provide portable audio applications with longer battery life and enable higher-power audio applications to reduce if not eliminate heat-sinking requirements.

TI continues to build on its industry-leading class-D portfolio designed for both the lower-power portable market and the higher-power segment.

The newest addition to TI's class-D higher-power portfolio is the TPA3120D2.

Key Features

- 25 W of output power per channel into 4 Ω
- 90% efficient class-D operation eliminates the need for external heat sink.
- Operation from a wide supply voltage (10-30 V) reduces the need for additional power supply.
- Four gain settings (20, 26, 32 and 36 dB) for flexible system operation
- Single-ended outputs reduce the size of the output filter.
- Packaging: 24-pin HTSSOP (PowerPAD™)

Applications

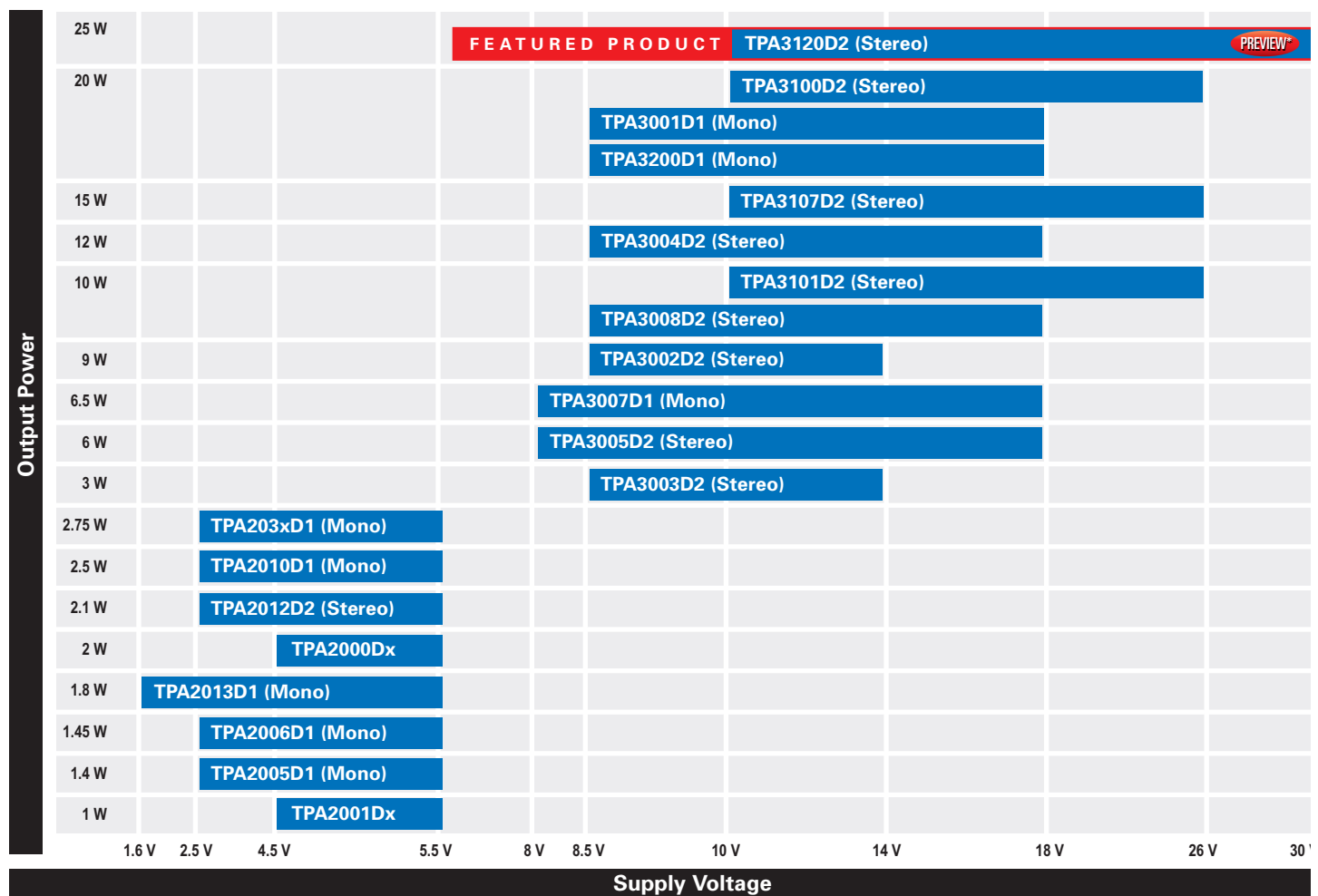
- Flat-panel TVs (see System Block Diagram on page 21)
- Home theaters

To Know More

- For a complete list of **Class-D Audio Power Amplifiers**, see the Selection Guide on page 35.

* Expected release June 2007

Class-D Audio Power Amplifiers





Class-AB Audio Power Amplifiers

2.6-W Stereo Class-AB Speaker Amplifier with DirectPath™ HP Amplifier and Integrated LDO
TPA6040A4 PREVIEW*

www.ti.com/sc/device/TPA6040A4

Class-AB speaker amplifiers, otherwise called linear amplifiers, are typically used to drive 8-, 4- and even 3-Ω loads. They are generally used in applications where cost is the main concern and where board space and battery life are less important.

As the latest addition to TI’s class-AB portfolio, the TPA6040A4 integrates a stereo class-AB speaker amplifier, a stereo DirectPath™ headphone amplifier and an LDO.

Key Features

- 2.6 W of output power per channel into 3 Ω
- DirectPath™ stereo headphone amplifier
 - Removes need for bulky DC-blocking output capacitors
 - Improves bass response
- Differential inputs on speaker amplifier provide 85 dB of CMRR, rejecting unwanted common-mode noise present on the inputs.
- Design provides 80 dB of PSRR to reject unwanted noise present on the power supply.
- Integrated LDO provides power supply for an audio codec or other external devices.
- Packaging: QFN (5x5 mm)

Applications

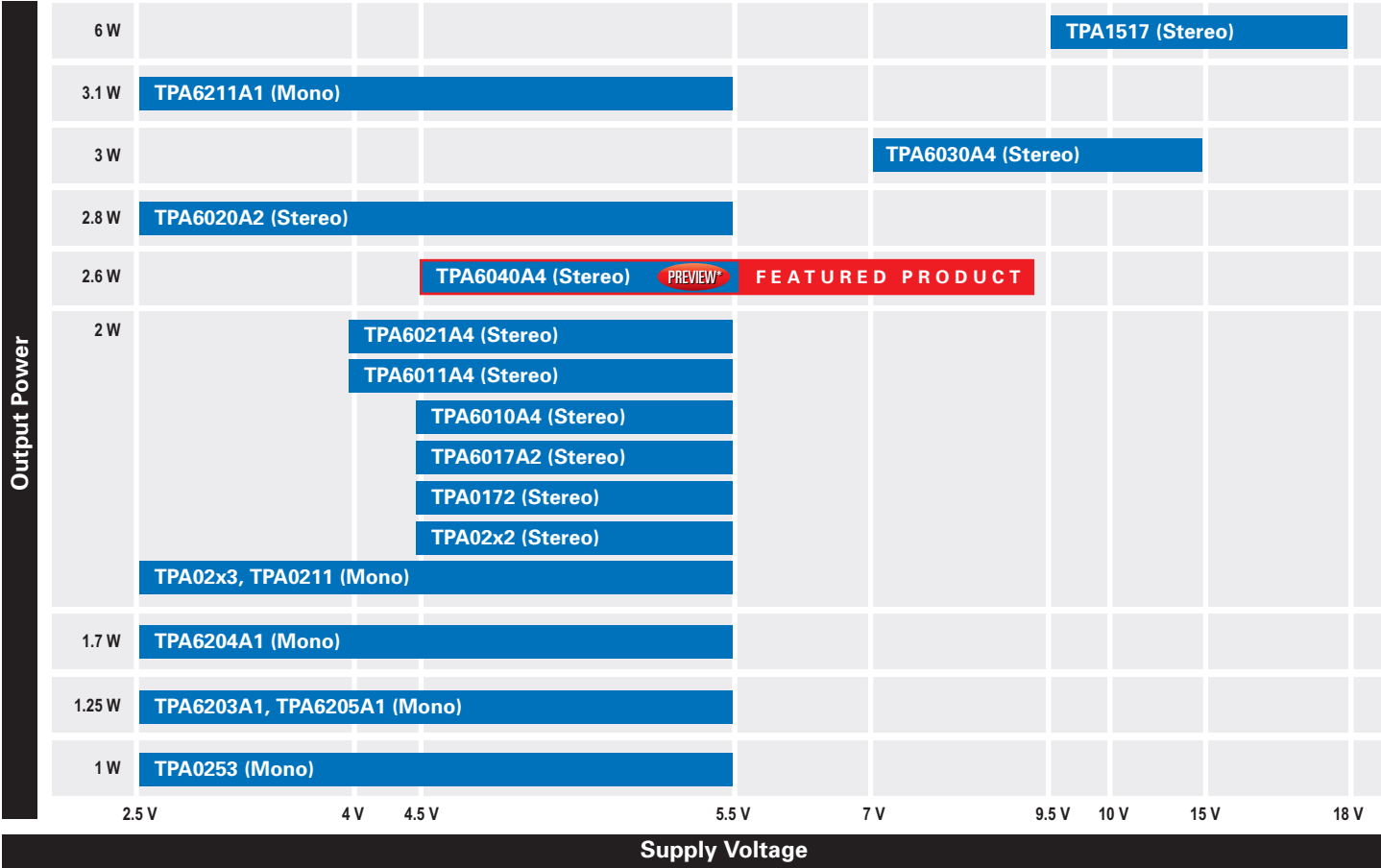
- Notebook computers (see System Block Diagram on page 23)
- Portable DVD players

To Know More

- For a complete list of **Class-AB Audio Power Amplifiers**, see the Selection Guide on page 36.

* Expected release April 2007

Class-AB Audio Power Amplifiers



Class-AB Headphone Audio Power Amplifiers



138-mW DirectPath™ HP Amplifier
with I²C Volume Control
TPA6130A2

www.ti.com/sc/device/TPA6130A2

Class-AB headphone amplifiers typically drive 16- or 32-Ω loads. There are three main implementations as indicated in the diagrams below:

- Traditional (DC-blocking capacitors)
- Capless (V_{BIAS} on ground sleeve)
- Charge-pump based/ground reference (DirectPath™)

The first device to be released with TI's patented DirectPath technology was the well-known TPA4411. The latest DirectPath headphone amplifier, the TPA6130A2, offers even more features and benefits.

Key Features

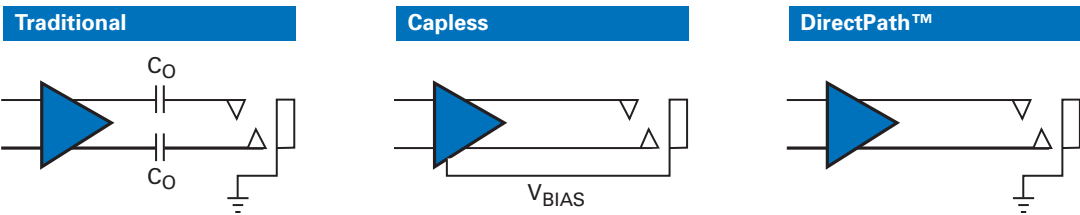
- DirectPath™ architecture
 - Removes need for bulky DC-blocking output capacitors
 - Improves bass response
- 64 levels of volume control (-59.5 to 4 dB) programmable through I²C bus for optimized SNR
- Differential inputs provide 68 dB of CMRR, rejecting unwanted common-mode noise present on the inputs.
- Design provides 109 dB of PSRR to reject unwanted noise present on the power supply.
- Wide 2.5- to 5.5-V supply range allows direct connect to battery.
- Lowest quiescent current for a DirectPath HP amplifier (4 mA) allows longer listening time.
- Packaging: WCSP (2x2 mm) and QFN (4x4 mm)

Applications

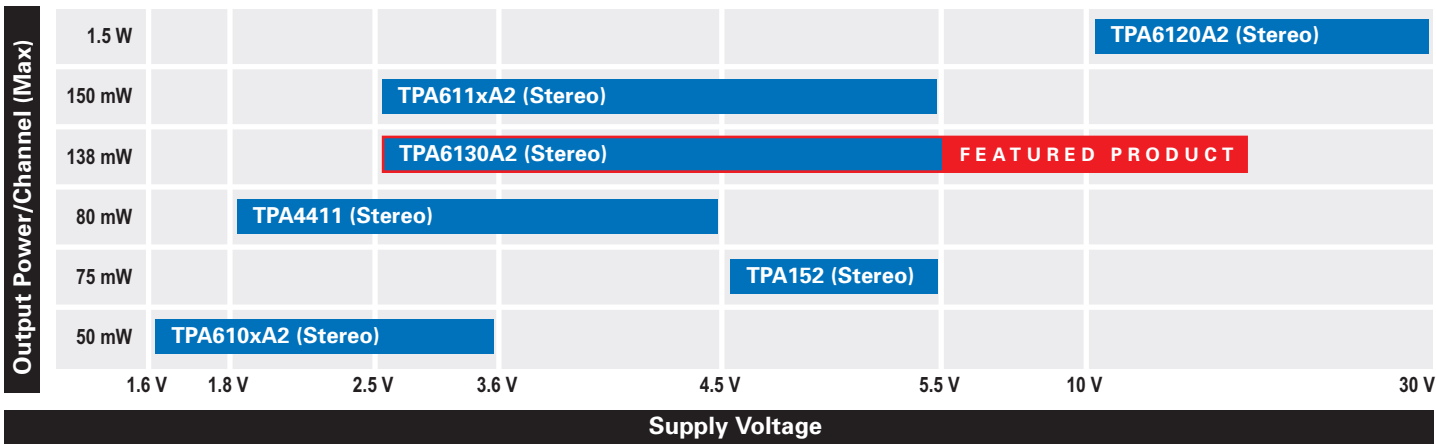
- Wireless handsets (see System Block Diagram on page 26)
- Multimedia handsets
- Portable media players (see System Block Diagram on pages 24)

To Know More

- For a complete list of **Class-AB Headphone Audio Power Amplifiers**, see the Selection Guide on page 35.

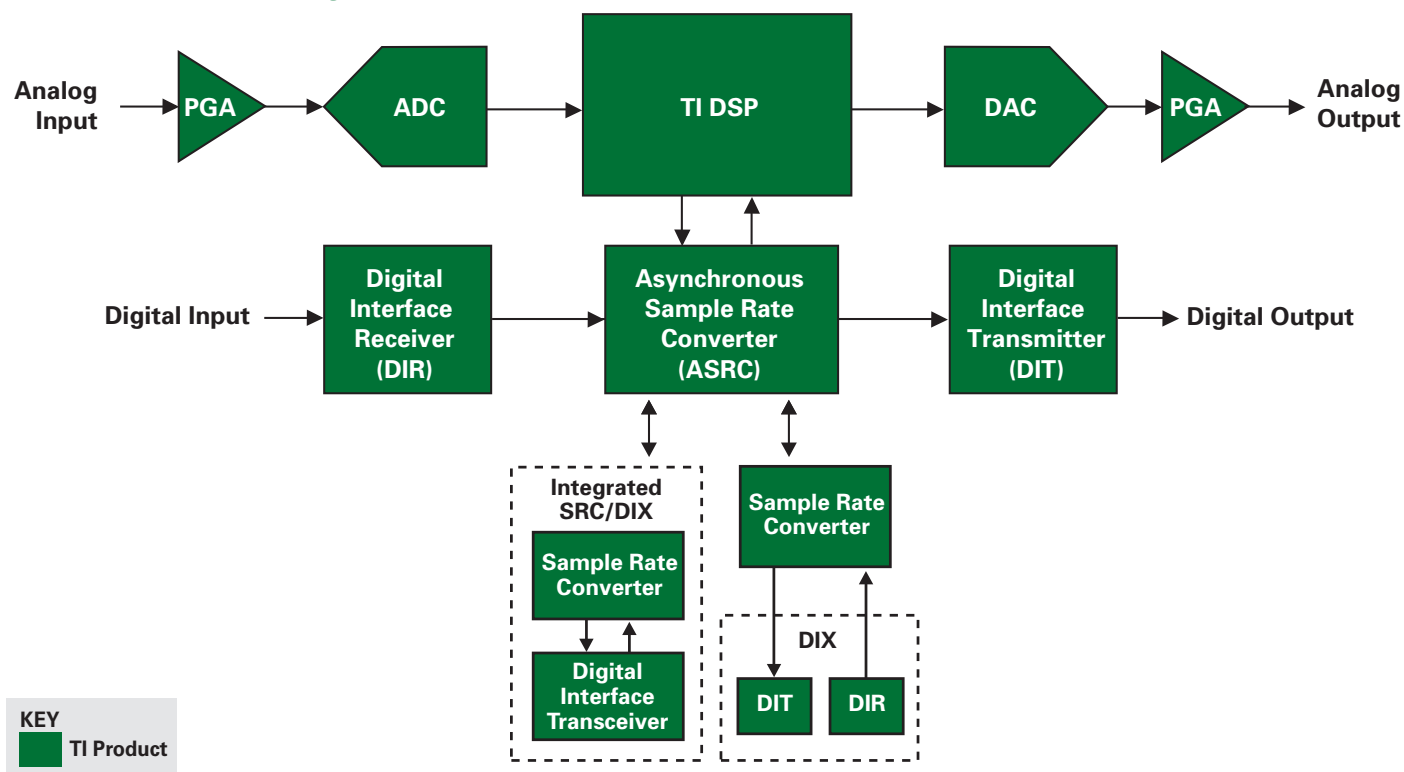


Class-AB Headphone Audio Power Amplifiers

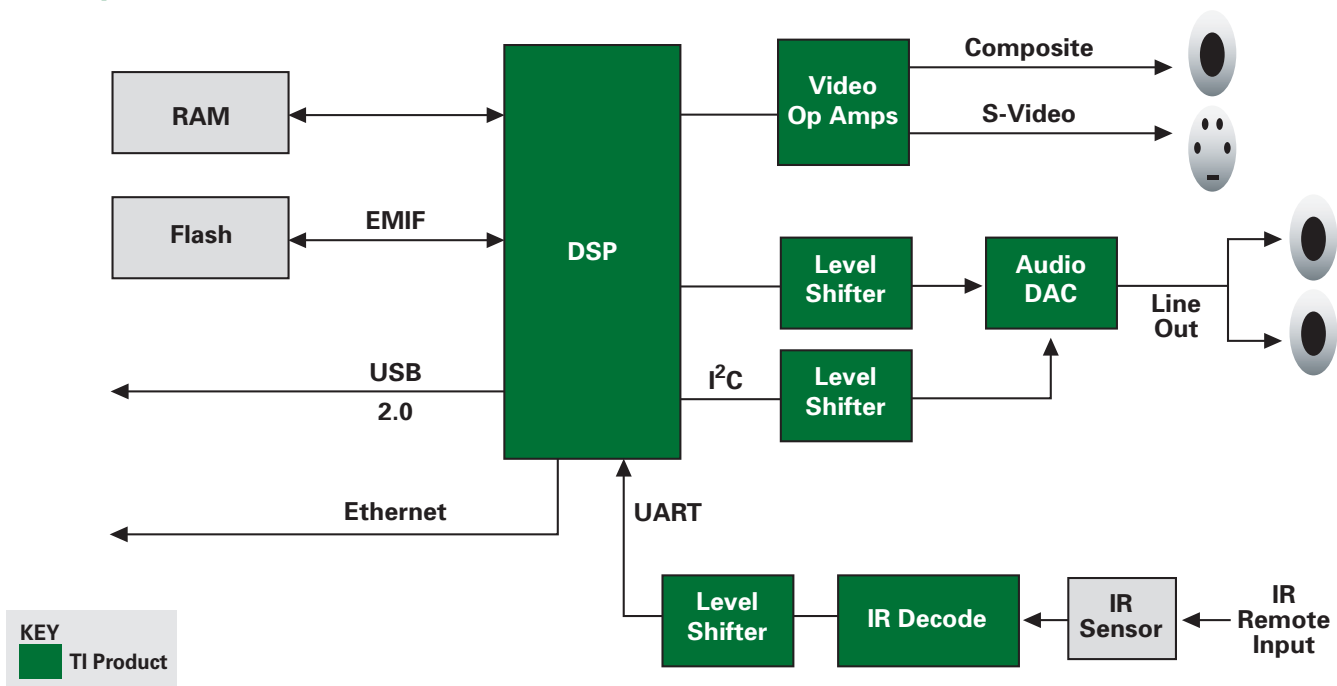




Professional Audio Signal Chain



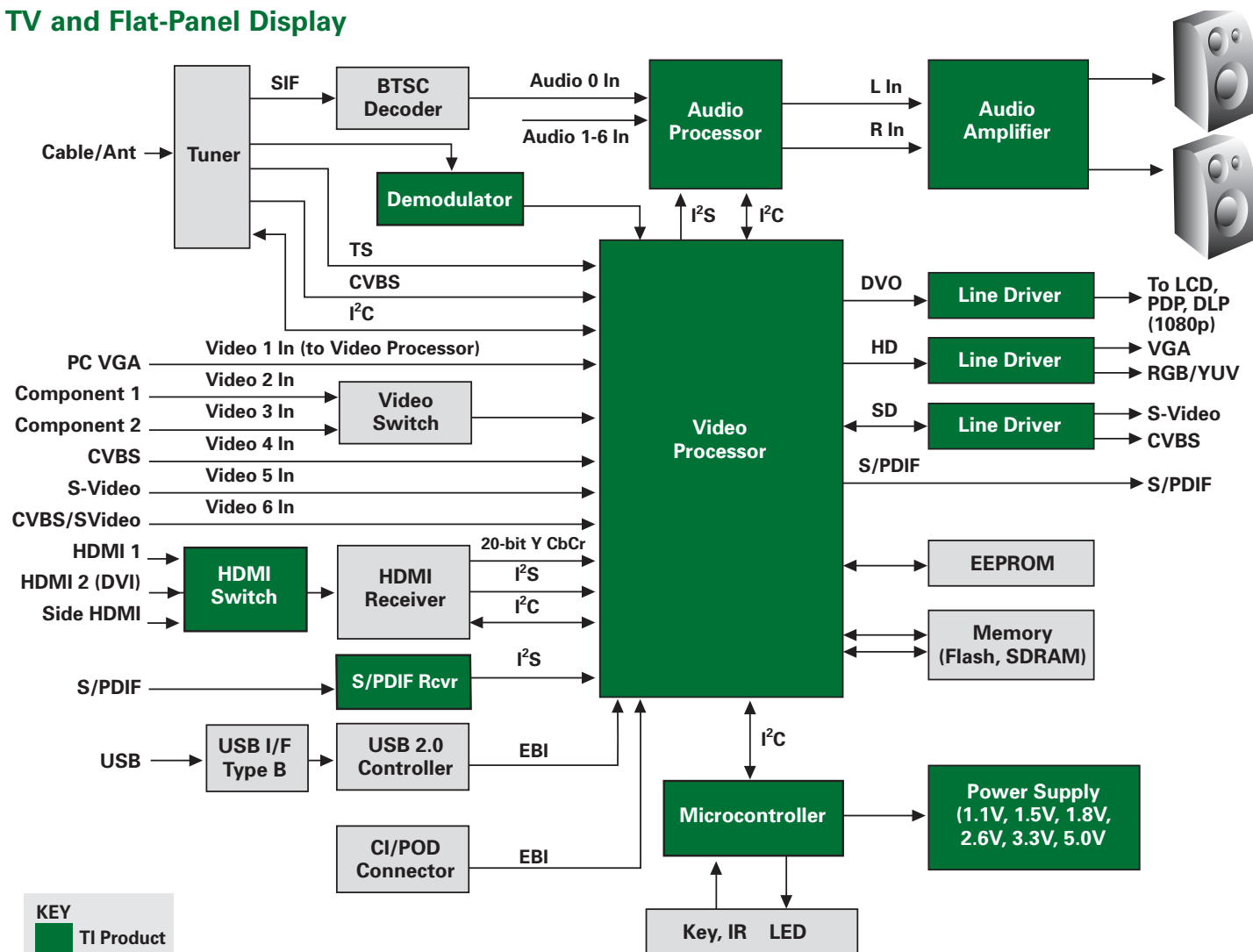
Set-Top Box



For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



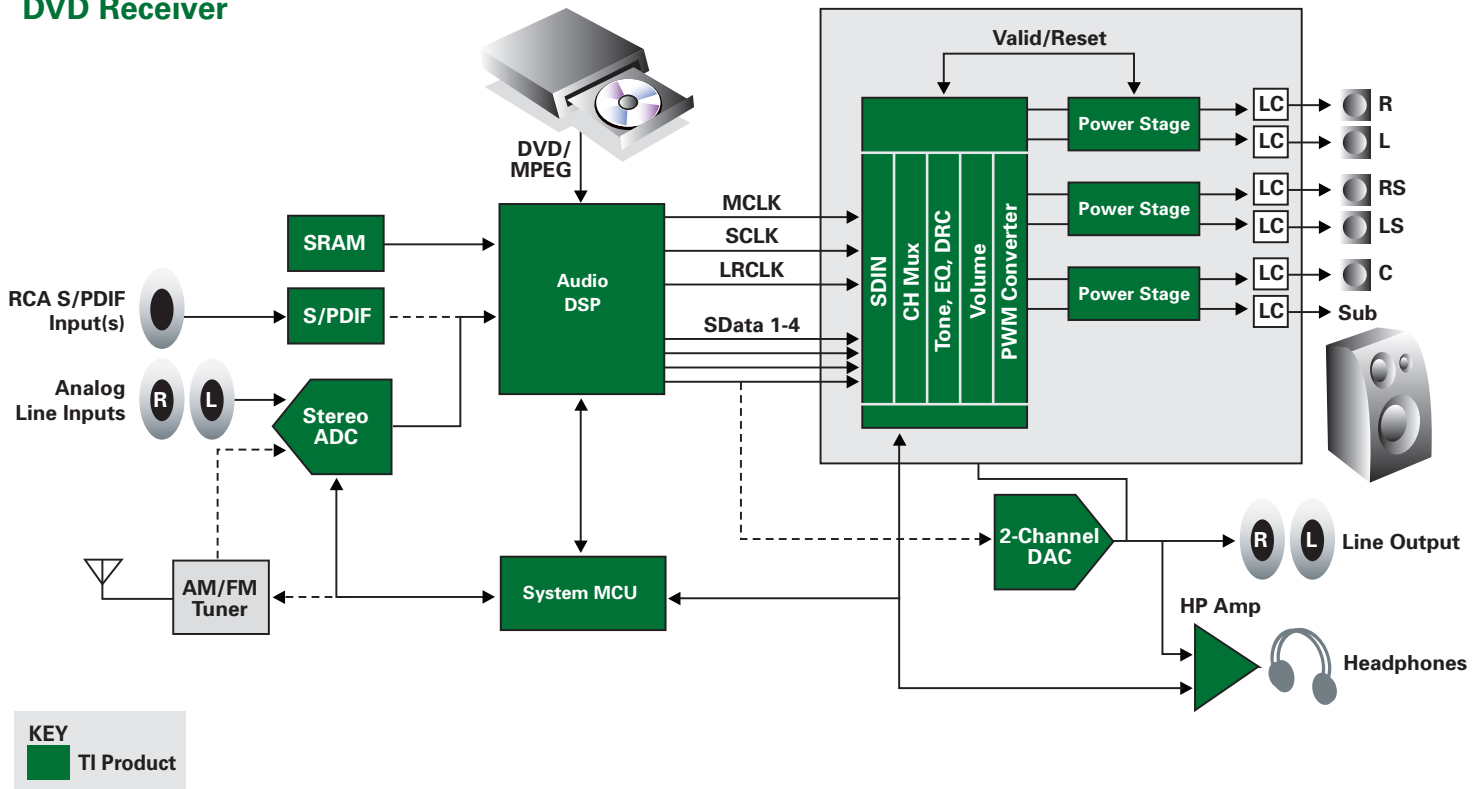
TV and Flat-Panel Display



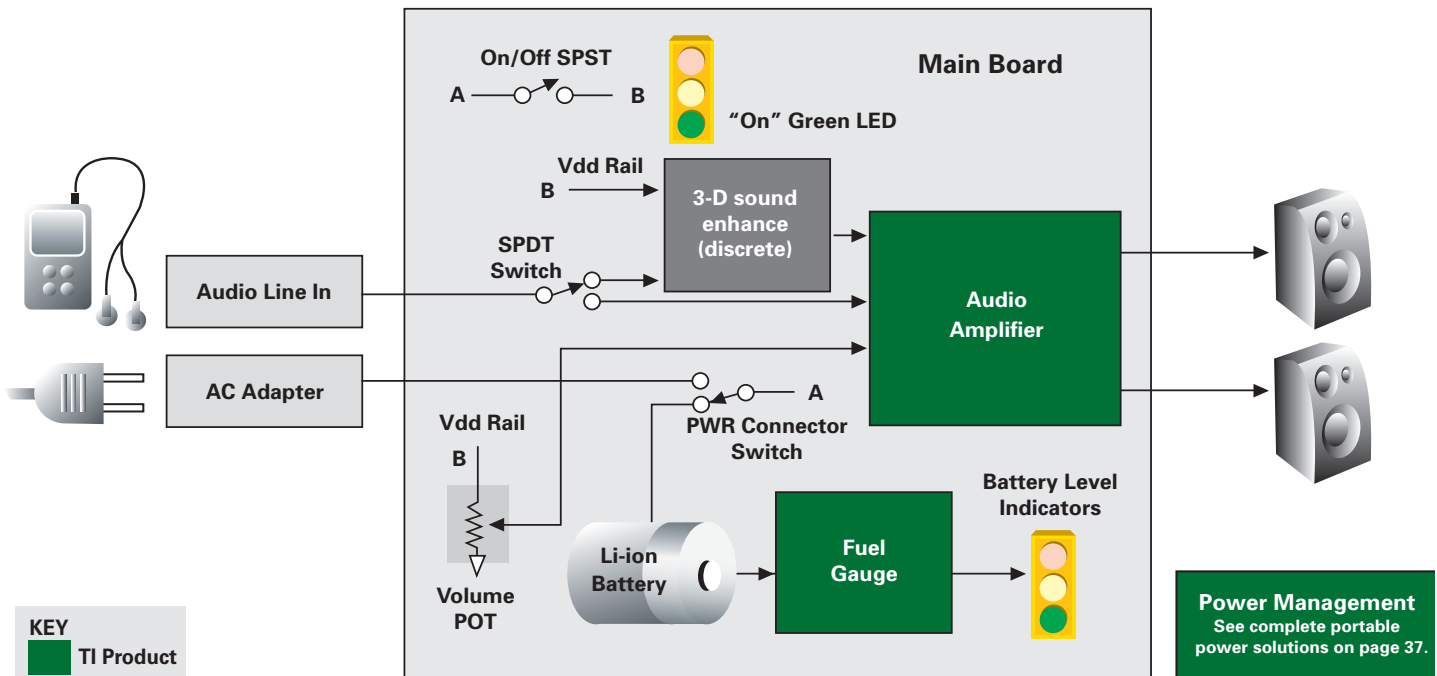
For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



DVD Receiver



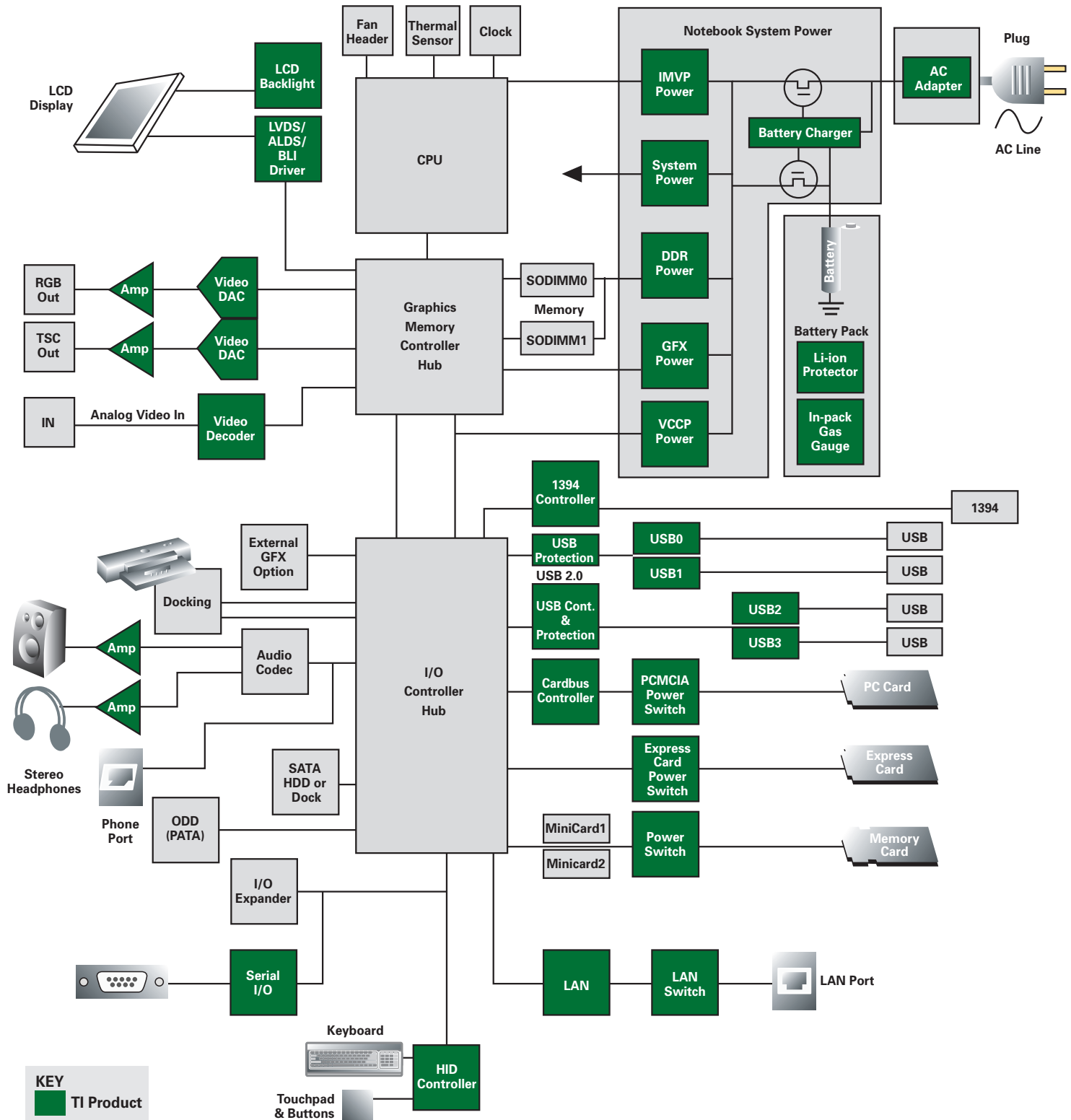
Mini-Speaker System



For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



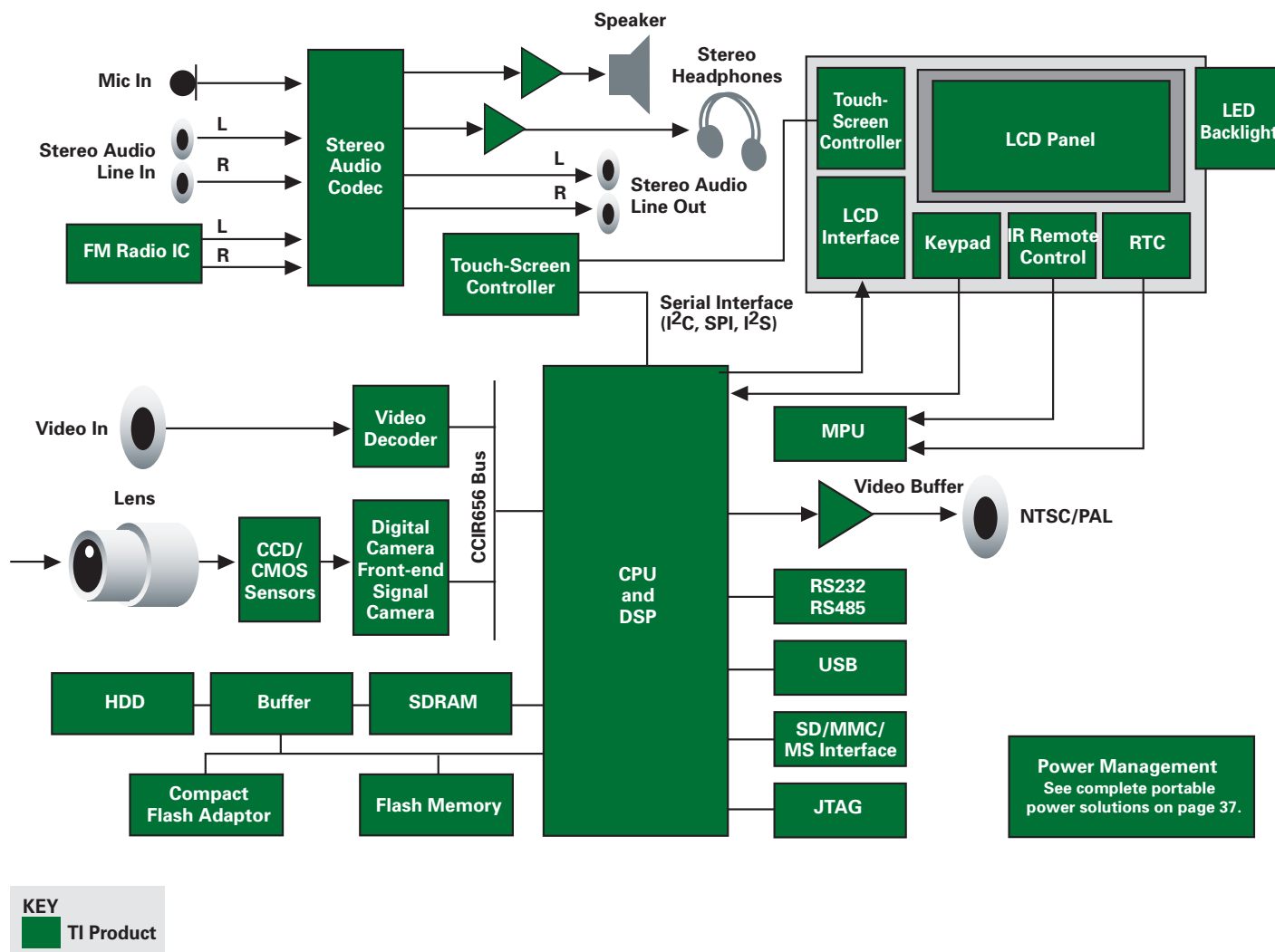
Audio for Notebook Computers



For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



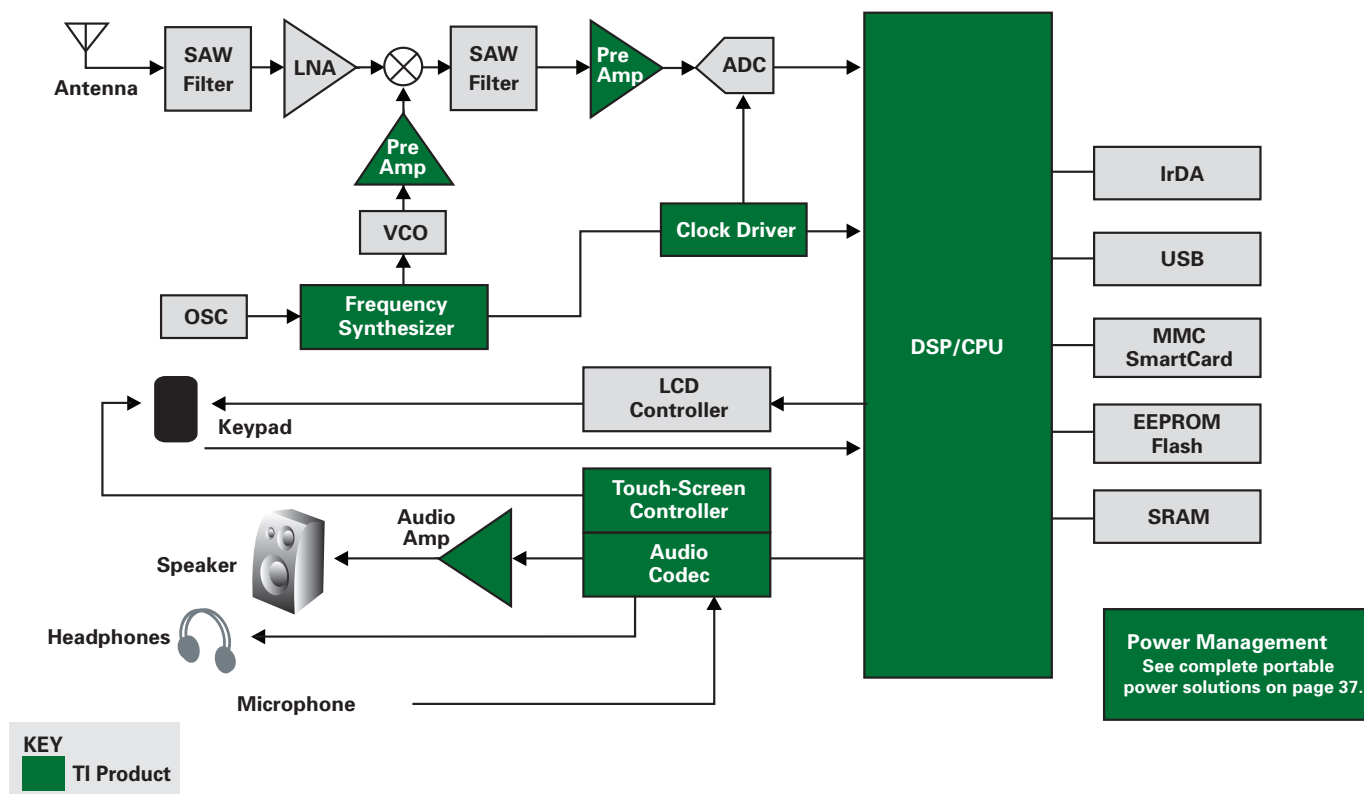
Audio for Portable Media Players



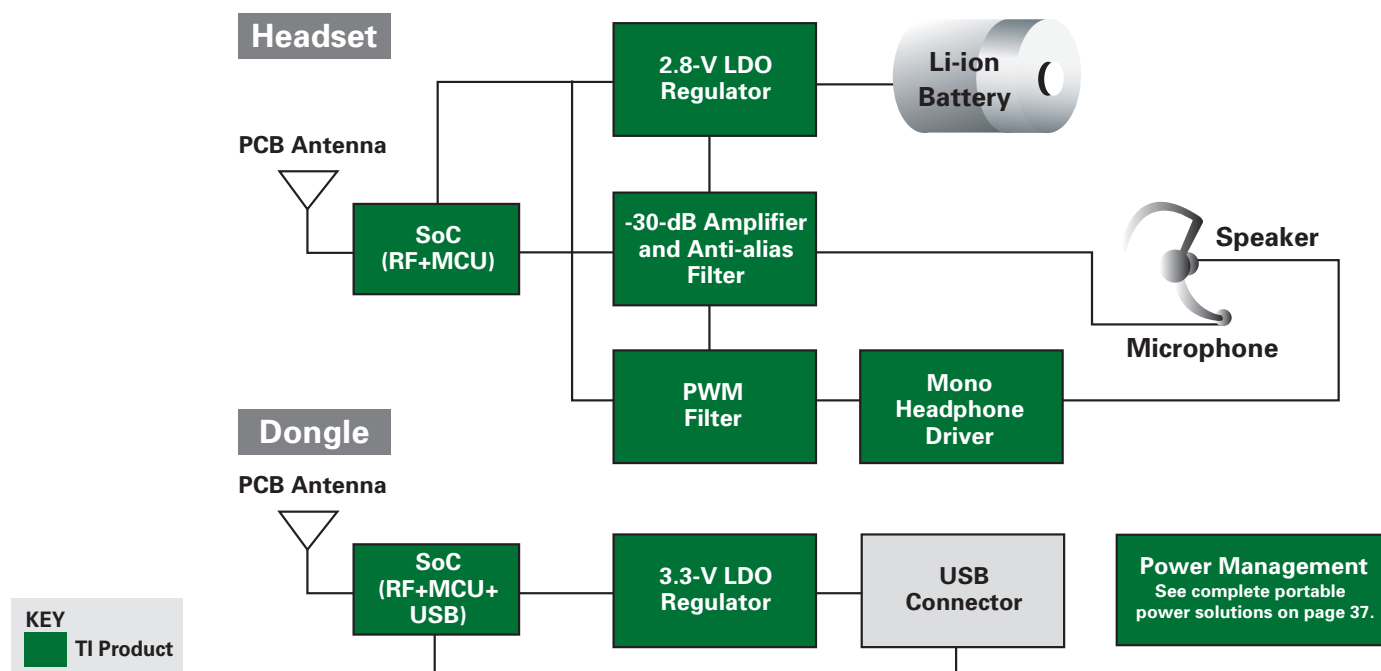
For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



Global Positioning Satellite Receiver



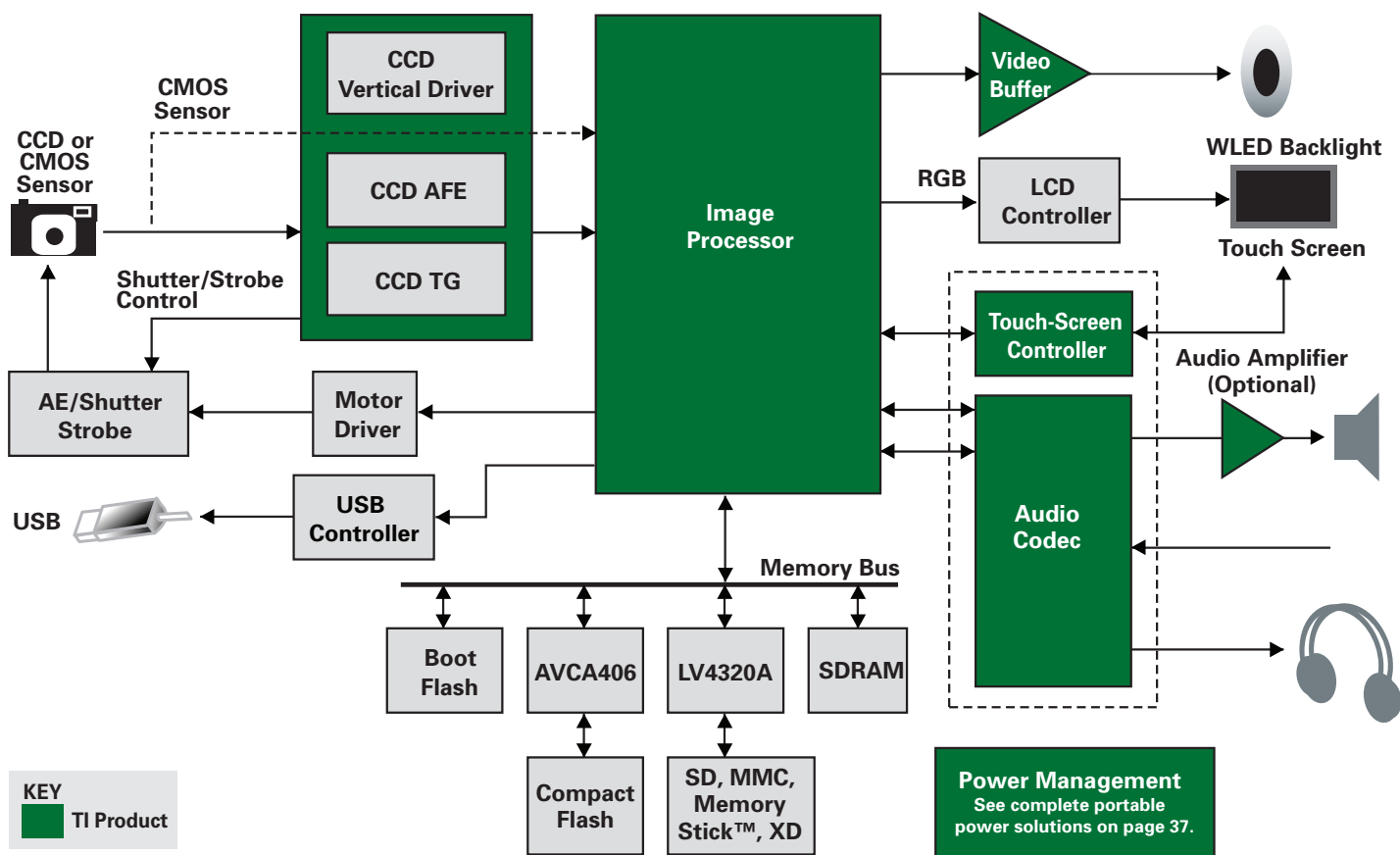
Wireless Voice over IP (VoIP)



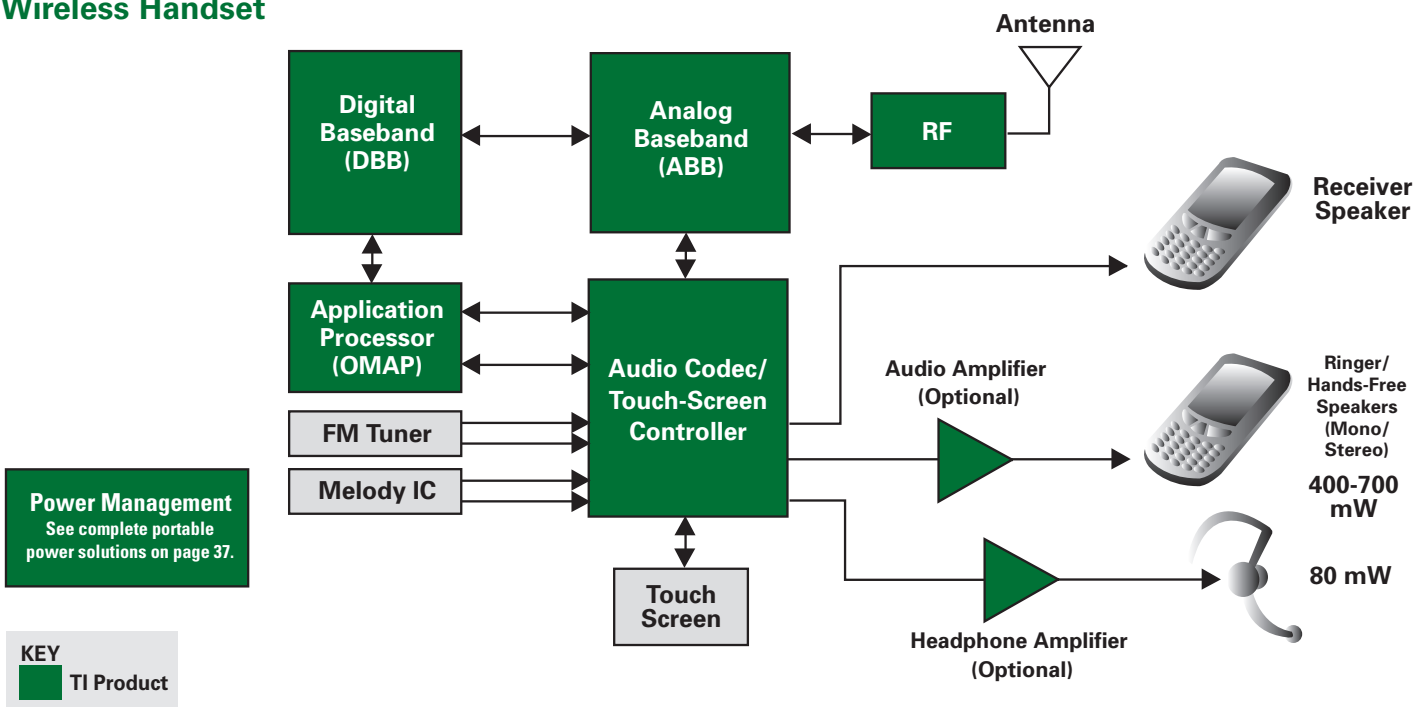
For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



Digital Still Camera



Wireless Handset



For the latest information on end-equipment system block diagrams, visit: www.ti.com/applications



TMS320C67x™ DSP Generation — Floating-Point DSPs														
Device	RAM (Bytes) Data/Prog	McBSP	McASP	DMA	COM	SPI/ I ² C	MHz	Cycle (ns)	MFLOPS	Typical Activity Total Internal Power (W) (Full Device Speed)	Voltage (V)		Package(s)	Price ¹
											Core	I/O		
TMS320C6720BRFP200⁵	32K/64/384K ⁷	—	2	dMAX ³	—	2/2	200	5	1200	0.8	1.2	3.3	144 PQFP, 22 mm	6.50
TMS320C6712BDGP150	4K/4K/64K ²	2	—	16 ³	—	—	150	6.7	900	0.7	1.2	3.3	272 BGA, 27 mm	13.15
TMS320C6722BRFP200 ^{4,5}	32K/128K/384K ⁷	—	2	dMAX	—	2/2	200	5	1200	0.8	1.2	3.3	144 PQFP, 22 mm	10.15
TMS320C6722BRFPA225 ^{4,5,6}	32K/128K/384K ⁷	—	2	dMAX	—	2/2	225	4.4	1350	0.8	1.2	3.3	144 PQFP, 22 mm	11.75
TMS320C6722BRFP250 ^{4,5}	32K/128K/384K ⁷	—	2	dMAX	—	2/2	250	4	1500	0.9	1.2	3.3	144 PQFP, 22 mm	11.75
TMS320C6726BRFPA225 ^{4,5,6}	32K/256K/384K ⁷	—	3 ⁸	dMAX	—	2/2	225	4.4	1350	0.8	1.2	3.3	144 PQFP, 22 mm	15.20
TMS320C6726BRFP266 ^{4,5}	32K/256K/384K ⁷	—	3 ⁸	dMAX	—	2/2	266	3.75	1600	0.9	1.2	3.3	144 PQFP, 22 mm	15.20
TMS320C6713BPYP200	4K/4K/256K ²	2 ⁹	2 ⁹	16 ³	HPI/16	—	200	5	1200	1.0	1.2	3.3	208 TQFP, 28 mm	19.30
TMS320C6727BZDHA250 ^{4,5,6}	32K/256K/384K ⁷	—	3	dMAX	UHPI	2/2	250	4	1500	1.0	1.2	3.3	256 BGA, 17 mm	19.00
TMS320C6727BZDH275 ^{4,5}	32K/256K/384K ⁷	—	3	dMAX	UHPI	2/2	275	3.6	1650	1.0	1.2	3.3	256 BGA, 17 mm	19.00
TMS320C6727BZDH300 ^{4,5,10}	32K/256K/384K ⁷	—	3	dMAX	UHPI	2/2	300	3.3	1800	1.1	1.2	3.3	256 BGA, 17 mm	21.50
TMS320C6701GJC150	64K/64K	2	—	4	HPI/16	—	120	6.7	900	1.3	1.8	3.3	352 BGA, 35 mm	82.25
TMSC6701GJC16719V	64K/64K	2	—	4	HPI/16	—	167	6	1000	1.4	1.9	3.3	352 BGA, 35 mm	124.70

¹ Prices are quoted in U.S. dollars and represent year 2007 suggested resale pricing. All prices are subject to change.

New products are listed in **bold red**.

Customers are advised to obtain the most current and complete pricing information from

TI prior to placing orders. TI may verify final pricing prior to accepting any order.

² Format represents cache memory architecture: [data cache] / [program cache] / [unified cache]

³ Enhanced DMA.

⁴ Extended temperature versions available for C6722, C6726, C6727, C6713, C6711D DSPs.

⁵ RFP and ZDH packages are Pb-Free.

⁶ The "A" designation is for industrial temperature range.

⁷ Format represents program cache/program or data memory/ROM.

⁸ McASP2 DIT only.

⁹ 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.

¹⁰ Also available in 256-pin BGA, 17-mm (GDH) package.

Note: All devices include two timers.

Note: Enhanced plastic and military DSP versions are available for selected DSPs.

Digital Audio Processors								
Device	Description	MIPs	Processing Bits/ Accumulator	I/O Max Resolution	Dynamic Range (dB)	Audio Controls	Package	Price ¹
TAS3103A	4/3 Digital Inputs/Outputs, Fully Configurable	540	48/76	32 Bits	N/A	Volume, Bass, Treble, Loudness, DRC, Mixing, Delay, 3-D Effects, Biquad Filters	PSOP-32	4.15
TAS3108	8/8 Digital Inputs/Outputs, Fully Programmable	540	48/76	32 Bits	N/A	Volume, Bass, Treble, Loudness, DRC, Mixing, Delay, 3-D Effects, Biquad Filters	TSSOP-38	5.10
TAS3204	Integrated ADC/DAC, 3/2 Stereo Analog Inputs/Outputs, Fully Programmable	540	48/76	24 Bits	101/105	Volume, Bass, Treble, Loudness, DRC, Mixing, Delay, 3-D Effects, Biquad Filters	TQFP-64	TBD
TAS3208	Integrated ADC/DAC, 10/3 Stereo Analog Inputs/Outputs + HP Out, Fully Programmable	540	48/76	24 Bits	93/96	Volume, Bass, Treble, Loudness, DRC, Mixing, Delay, 3-D Effects, Biquad Filters	TQFP-100	TBD

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

New products are listed in **bold red**.



Processors

DaVinci™ Digital Media Processors

Device	CPU	Frequency (MHz)	L1/ SRAM (Bytes)	L2/ SRAM (Bytes)	ROM (Bytes)	External Memory I/F	EDMA	Video Ports (Configurable)	Serial I/F	Connectivity I/F	Program/ Data Storage	Voltage (V) Core I/O	Packaging	Price ¹
TMS320DM6446BZWT	1 C64x+, 1 ARM9, DaVinci Video	594 (DSP) 297 (ARM)	112 K (DSP) 40 K (ARM)	64 K (DSP)	16 K (ARM)	1 16-/8-Bit EMIFA 1 32-/16-Bit DDR2	64 Ch	1 Input, 1 Output	ASP, I ² C, SPI, 3 UARTs	USB 2.0, VLYNQ™, 10/100 EMAC	Async SRAM, DDR2 SDRAM, NAND Flash, SmartMedia/xD	1.2 1.8/ 3.3	361 BGA, 16 ↔ 16 mm	39.50
TMS320DM6443BZWT	1 C64x+, 1 ARM9, DaVinci Video	594 (DSP) 297 (ARM)	112 K (DSP) 40 K (ARM)	64 K (DSP)	16 K (ARM)	1 16-/8-Bit EMIFA 1 32-/16-Bit DDR2	64 Ch	1 Output	ASP, I ² C, SPI, 3 UARTs	USB 2.0, VLYNQ, 10/100 EMAC	Async SRAM, DDR2 SDRAM, NAND Flash, SmartMedia/xD	1.2 1.8/ 3.3	361 BGA, 16 ↔ 16 mm	33.85
TMS320DM6441ZWT	1 C64x+, 1 ARM9, DaVinci Video	513/405 (DSP) 256/202 (ARM)	112 K (DSP) 40 K (ARM)	64 K (DSP)	16 K (ARM)	1 16-/8-Bit EMIFA 1 32-/16-Bit DDR2	64 Ch	1 Input, 1 Output	ASP, I ² C, SPI, 3 UARTs	USB 2.0, VLYNQ™, 10/100 EMAC	Async SRAM, DDR2 SDRAM, NAND Flash, SmartMedia/xD	1.2/ 1.05 1.8/ 3.3	361 BGA, 16 ↔ 16 mm	27.05
TMX320DM6431	1 C64x+, DaVinci Video	300	64 K	64 K	64 K	1 8-Bit EMIFA, 1 16-Bit DDR2	64 Ch	1 Input	McASP, I ² C, 1 UART, 1 McBSP, 1 HECC	10/100 EMAC	Async SRAM, DDR2 SDRAM, NAND Flash	1.05 1.8/ 3.3	361 BGA 16 ↔ 16 mm, 376 BGA 23 ↔ 23 mm	11.25
TMX320DM6433	1 C64x+, DaVinci Video	400 500 600	112 K	128 K	64 K	1 8-Bit EMIFA, 1 16-/32-Bit DDR2	64 Ch	1 Output	McASP, 1 McBSP, I ² C, 1 UART	32-Bit PCI, VLYNQ, 10/100 EMAC, 16-Bit HPI	Async SRAM, DDR2 SDRAM, NAND Flash	1.05/ 1.2 1.8/ 3.3	361 BGA 16 ↔ 16 mm, 376 BGA 23 ↔ 23 mm	15.75 16.65 18.50
TMX320DM6435	1 C64x+, DaVinci Video	400 500 600	112 K	128 K	64 K	1 8-Bit EMIFA, 1 16-/32-Bit DDR2	64 Ch	1 Input	McASP, I ² C, 1 McBSP, 2 UARTs, 1 HECC	VLYNQ, 10/100 EMAC, 16-Bit HPI	Async SRAM, DDR2 SDRAM, NAND Flash	1.05/ 1.2 1.8/ 3.3	361 BGA 16 ↔ 16 mm, 376 BGA 23 ↔ 23 mm	16.30 17.25 19.15
TMX320DM6437	1 C64x+, DaVinci Video	400 500 600	112K	128 K	64 K	1 8-Bit EMIFA, 1 16-/32-Bit DDR2	64 Ch	1 Input, 1 Output	McASP, I ² C, 1 HECC 2 McBSPs, 2 UARTs	32-Bit PCI, VLYNQ, 10/100 EMAC, 16-Bit HPI	Async SRAM, DDR2 SDRAM, NAND Flash	1.05/ 1.2 1.8/ 3.3	361 BGA 16 ↔ 16 mm, 376 BGA 23 ↔ 23 mm	22.05 23.35 25.93

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

New products are listed in **bold red**.



Audio ADCs							
Device	Description	Dynamic Range (dB)	Sampling Rate (kHz) (max)	Audio Data Format	Power Supply (V)	Package(s)	Price ¹
PCM1850/1	Stereo ADC w/2 x 6 Input MUX and PGA, SPI (1850) and I ² C (1851) Control	101	96	Normal, I ² S	+3.3 and +5	TQFP-32	4.80
PCM1807/8	Stereo ADC, SE Input, Mute w/Fade, SPI Control, S/W (1807) H/W (1808) Controlled	101	96	I ² S, L	+3.5 and +5	TSSOP-14	1.00
PCM1803A	Stereo ADC, SE Input, High Pass Filter	103	96	Normal, I ² S	+3.5 and +5	SSOP-20	1.10
PCM1802	Stereo ADC, SE Input	105	96	Normal, I ² S	+3.3 and +5	SSOP-20	3.35
PCM1804	Stereo ADC, Fully Differential, High Pass Filter	112	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	3.95
PCM1870	Stereo ADC, SE Input, Digital Filter, Very Low Power Consumption	90	50	Normal, I ² S, DSP	+2.4 and +3.6	QFN-24	1.80
PCM4204	4-Channel, High-Performance $\Delta\Sigma$ ADC, PCM or DSD, High Pass Filter	118	216	Normal, I ² S, DSD, TDM	+3.3 and +5	TQFP-64	7.95
PCM4202	Stereo, High-Performance $\Delta\Sigma$ ADC, PCM or DSD, High Pass Filter	118	216	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	4.95
PCM4201	Mono, High-Performance $\Delta\Sigma$ ADC, PCM or DSD, High Pass Filter, Wide Digital Supply Range, Low Power Dissipation	112	108	Normal, DSP	+3.3 and +5	TSSOP-16	2.50
PCM4222	2-Channel, High-Performance $\Delta\Sigma$ ADC	124	216	6-Bit Modulator, DSD, Normal, I ² S, TDM	+3.3 and +4	TQFP-48	14.95
PCM4220	2-Channel, High-Performance $\Delta\Sigma$ ADC	123	216	Normal, I ² S, TDM	+3.3 and +4	TQFP-48	9.95
Audio DACs							
PCM1780/81/82	Stereo with Volume Control, Software (1780/82) and Hardware (1781), Open-Drain Output Zero Flag (1782), Improved Jitter Performance	106	192	Normal, I ² S	+5	SSOP-16	1.10
PCM1753/54/55	Stereo with Volume Control, Software (1753/55) and Hardware (1754), Open-Drain Output Zero Flag (1755)	106	192	Normal, I ² S	+5	SSOP-16	0.98
PCM1770/1	Stereo with Integrated Headphone Driver, Software (1770) and Hardware (1771) Controlled	98	48	Normal, I ² S	+1.6 to +3.6	TSSOP-16, QFN-20	1.90
PCM1772/3	Stereo with Integrated Line Out, Software (1772) and Hardware (1773) Controlled	98	48	Normal, I ² S	+1.6 to +3.6	TSSOP-16, QFN-20	1.90
PCM1738/30	Stereo Advanced Segment DAC, Soft Mute (1730), 2 Optional Operation Modes (1738): External Filter and DSD Decoder for SACD Playback and Digital Attenuation	117	192	Normal, I ² S, DSD	+3.3 and +5	SSOP-28	5.00
PCM1791A	Stereo Advanced Segment, Optional DSD Format, External Filter and DSP Interface, SPI/I ² C Controlled, Differential Current Output: 3.2 mA p-p	112	192	Normal, I ² S	+3.3 and +5	SSOP-28	3.00
PCM1792A	Stereo, Optional DSD Format, External Filter and DSP Interface, SPI/I ² C, Differential Current Output: 7.8 mA p-p	132	192	Standard, I ² S, L	+3.3 and +5	SSOP-28	13.00
PCM1796/8	Stereo Advanced Segment, 123dB Dynamic Range, TDMCA Serial Interface (1798)	123	192	Standard, I ² S, L	+3.5 and +5	SSOP-28	6.50
PCM1606	6-Channel, Low Cost CMOS, Multilevel	103	192	Normal, I ² S	+5	SSOP-20	2.48
PCM1608	8-Channel, Highly Integrated DAC, Higher SNR	105	192	Normal, I ² S	+3.3 and +5	LQFP-48	4.10
PCM1680	8-Channel, Low Cost DAC, Improved Jitter Performance, Pin Compatible with PCM1780	103	192	Normal, I ² S	+5	SSOP-24	2.60
DSD1608	8-Channel, Enhanced Multiformat $\Delta\Sigma$ DAC, Supports DSD with TDMCA	108	192	Normal, I ² S, DSD	+3.3 and +5	TQFP-52	5.68
PCM4104	4-Channel, High Performance, Sampling Rate up to 216kHz, H/W or S/W Controlled	118	216	Normal, I ² S, TDM	+3.3 and +5	TQFP-48	4.95
PCM1791A	Stereo Advanced Segment DAC, Optional DSD Format, External Filter and DSP Interface, SPI/I ² C Differential Current Output: 3.2 mA p-p	113	192	Normal, I ² S, TDMCA	+3.3 and +5	SSOP-28	3.15
PCM1793	Stereo Advanced Segment DAC, Balanced Voltage Outputs, Improved Clock Jitter	113	192	Normal, I ² S, Left Justified	+3.3 and +5	SSOP-28	3.15
TLV320DAC23	I ² C and SPI Control with Headphone Amp, P _{diss} = 23 mW	100	96	Normal, I ² S, DSP	+1.5 to +3.3	VFBGA-80, TSSOP-28, QFN-28	2.00
TLV320DAC26	Integrated PLL, SPI Control, Speaker/Headphone Amp, P _{diss} = 11 mW	97	53	Normal, I ² S, DSP	+2.7 to +3.6	QFN-32	2.95
TLV320DAC32	Low-Power Stereo DAC with PLL and Stereo HP/Speaker Amplifiers	95	96	Normal, I ² S, DSP, TDM	+2.7 to +3.6	QFN-32	2.75
PCM1777	Low-Power Stereo DAC with Stereo HP and Class-D Speaker Amplifiers	93	50	Normal, I ² S, DSP	+2.4 to +3.6	QFN-32	TBD

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

Preview products are listed in **bold blue**.



Data Converters and Codecs

Touch-Screen Controllers with Audio

Device	Description	Resolution (Bits) (max)	Dynamic Range (dB)	Sampling Rate (kHz) (max)	Configuration	Audio Data Format	Power Supply (V)	Package(s)	Price ¹
TSC2100	4-Wire Touch-Screen Interface, Low Power, Lower Cost, Stereo DAC, Mono ADC, Integrated PLL, Speaker/HP Amp	24	97	53	Mono/Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-32, TSSOP-32	3.95
TSC2101/ TSC2111	4-Wire Touch-Screen Interface, Low Power, Stereo DAC, Mono ADC, Integrated PLL, Speaker/HP Amp, Additional Inputs and Outputs (TSC2111 – Differential)	24	95	53	Mono/Stereo	Normal, I ² S, DSP	+2.7 to 3.6	QFN-48	4.95
TSC2102	4-Wire Touch-Screen Interface, Low Power, Stereo DAC, Integrated PLL, Speaker/HP Amp, Low Cost	24	97	53	Stereo	Normal, I ² S, DSP	+2.7 to 3.6	TSSOP-32	3.70
TSC2301	4-Wire Touch-Screen Interface, Low Power, Stereo DAC, Stereo ADC, Integrated PLL, HP Amp, 4 x 4 Keypad Interface	20	98	48	Stereo/Stereo	Normal, I ² S	+2.7 to 3.6	TQFP-64, BGA-120	4.95
TSC2302	4-Wire Touch-Screen Interface, Low Power, Stereo DAC, Stereo ADC, Integrated PLL, HP Amp	20	98	48	Stereo/Stereo	Normal, I ² S	+2.7 to 3.6	QFN-48	4.50
TSC2300	4-Wire Touch-Screen Interface, Low Power, Stereo DAC, Mono ADC, Integrated PLL	20	98	48	Mono/Stereo	Normal, I ² S	+2.7 to 3.6	TQFP-64	4.75

Voiceband Codecs

Device	Description	Sample Rate (kHz)	Number of Input Channels	SNR (dB)	Interface	Analog Supply	Logic Supply	Power Supply (mW) (typ)	Package(s)	Price ¹
AIC111	Lowest Power, 20-Bit	40	1	87	SPI, DSP	1.1 to 1.5	1.1 to 3.3	0.46	QFN-32, FlipChip	4.14
TLV320AIC12K	Low Power, Mono Codec, 16-Bit, 26ksps Voiceband Codec with 8Ω Driver	26	1	90	I ² C, S ² C, DSP	1.65 to 1.95/2.7 to 3.6	1.1 to 3.6	10	TSSOP-30	2.90
TLV320AIC14K	Low Power, Mono Codec, 16-Bit 26ksps Voiceband Codec	26	1	90	I ² C, S ² C, DSP	1.65 to 1.95/2.7 to 3.6	1.1 to 3.6	10	TSSOP-30	2.45
TLV320AIC20K	Low Power, Stereo Codec, 16-Bit 26ksps Voiceband Codec with 8Ω Driver	26	2	90	I ² C, S ² C, DSP	1.65 to 1.95/2.7 to 3.6	1.1 to 3.6	20	TQFP-48	3.70
TLV320AIC24K	Low Power, Stereo Codec, 16-Bit 26ksps Voiceband Codec	26	2	90	I ² C, S ² C, DSP	1.65 to 1.95/2.7 to 3.6	1.1 to 3.6	20	TQFP-48	3.55

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



Low-Power Audio Codecs								
Device	Description	Resolution (Bits) (max)	Dynamic Range (dB)	Sampling Rate (kHz) (max)	Audio Data Format	Power Supply (V)	Package(s)	Price ¹
TLV320AIC34	Low-Power Quad Stereo (4-Channel) Codec, 12 Inputs (Mic/Line), 14 Outputs (Line/HP/Speaker), 2 PLLs and Audio Serial Buses Allow Fully Asynchronous Simultaneous Codec Operation	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	BGA-87	TBD
TLV320AIC3101	Low-Power Stereo Codec, Integrated PLL, 6 Inputs (Mic/Line), 6 Outputs (Line/HP/Speaker), Notch Filtering, PowerTune™ (Adj. SNR vs. Power Consumption), Low-Power Analog Bypass	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-32	TBD
TLV320AIC3104	Low-Power Stereo Codec, Integrated PLL, 6 Inputs (Mic/Line), 6 Outputs (Line/HP), Notch Filtering, PowerTune (Adj. SNR vs. Power Consumption), Low-Power Analog Bypass	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-32	TBD
TLV320AIC3105	Low-Power Stereo Codec, Integrated PLL, 6 SE Inputs (Mic/Line), 6 Outputs (Line/HP), Notch Filtering, PowerTune (Adj. SNR vs. Power Consumption), Low-Power Analog Bypass	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-32	TBD
TLV320AIC3106	Low-Power Stereo Codec, Integrated PLL, 10 Inputs (Mic/Line), 7 Outputs (Line/HP), Notch Filtering, PowerTune (Adj. SNR vs. Power Consumption), Low-Power Analog Bypass	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-32, BGA-80	TBD
TLV320AIC33	Low-Power Stereo Codec, Integrated PLL, 6 Inputs, 3 Line Out and Speaker/HP Outputs	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-48, BGA-80	3.95
TLV320AIC31/32	Low-Power Stereo Codec, Integrated PLL, 6 Inputs (AIC32-6 Single-Ended, AIC31-2 Differential and 2 Single Ended) 2 Line Out and Speaker/HP Outputs	32	100	96	Normal, I ² S, DSP, TDM	+2.7 to 3.6	QFN-32	3.45
TLV320AIC23B	Low-Power, Lower Cost, Stereo Codec with Headphone Amps	24	100	96	I ² S, L, R	+2.7 to 3.3	VFBGA-80, TSSOP-28, QFN-28	3.00
TLV320AIC28/29	Low-Power, Stereo DAC, Mono ADC, Integrated PLL, Speaker/HP Amp, Additional Inputs and Outputs (AIC29 – Differential)	24	98	53	Normal, I ² S, DSP	+2.7 to 3.6	QFN-48	3.95/3.45
TLV320AIC26	Low-Power, Lower Cost, Stereo DAC, Mono ADC, Integrated PLL, Speaker/HP Amp	24	97	53	Normal, I ² S, DSP	+2.7 to 3.6	QFN-32	3.25
PCM3000	Stereo Audio Codec 18-Bits, Serial Interface, Software Controlled	18	98	48	Normal, I ² S, DSP	+4.5 to 5.5	SSOP-28	3.45
PCM3001	Stereo Audio Codec 18-Bits, Serial Interface, Hardware Controlled	18	98	48	Normal, I ² S, DSP	+4.5 to 5.5	SSOP-28	3.45
PCM3006	Low-Power, 3V Supply, Stereo Codec, Hardware Controlled	16	93	48	Normal	+2.7 to 3.6	SSOP-24	3.45
PCM3008	Low-Power, 2.4V Single Supply, Stereo Codec, Low-Cost, Hardware Controlled	16	88	48	Normal, I ² S	+2.1 to 3.6	TSSOP-16	3.10
PCM3793	Ultra Low-Power Stereo Codec, 6 Inputs (Mic/Line), 3 Outputs (Line/HP/Class-D Speaker)	16	93	48	Normal, I ² S, DSP	+2.4 to 3.6	QFN-32	4.50
PCM3794	Ultra Low-Power Stereo Codec, 6 Inputs (Mic/Line), 5 Outputs (Line/HP)	16	93	48	Normal, I ² S, DSP	+2.4 to 3.6	QFN-32	4.25

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

Preview products are listed in **bold blue**. New products are listed in **bold red**.



Interface and Sample Rate Converters

Integrated Sample Rate Converters and S/PDIF – AES/EBU Transceivers

Device	Description	# SRC Channels	THD+N (dB)	Sample Rate (max)	Digital Audio Interface	Control Interface	Dynamic Range (dB)	AES Receive	AES Transmit	Power Supply (V)	Pin/Package	Price ¹
SRC4392	High-End Combo Sample Rate Converter	2	-140	216	AES/EBU, S/PDIF, I ² S, R, L	I ² C, SPI	144	YES	YES	1.8, 3.3	48TQFP	9.95
SRC4382	Combo Sample Rate Converter	2	-125	216	AES/EBU, S/PDIF, I ² S, R, L	I ² C, SPI	128	YES	YES	1.8, 3.3	48TQFP	7.50

Standalone Sample Rate Converters

SRC4184	4-Channel, Asynchronous Sample Rate Converter	4	-125	212	I ² S, R, L, TDM	SPI	128	—	—	1.8, 3.3	64TQFP	7.50
SRC4190	192-kHz Stereo Asynchronous Sample Rate Converters	2	-125	212	I ² S, R, L, TDM	H/W	128	—	—	3.3	28SSOP	4.50
SRC4192	High-End Sample Rate Converter	2	-140	212	I ² S, R, L, TDM	H/W	144	—	—	3.3	28SSOP	7.50
SRC4193	High-End Sample Rate Converter	2	-140	212	I ² S, R, L, TDM	SPI	144	—	—	3.3	28SSOP	8.50
SRC4194	4-Channel, Asynchronous Sample Rate Converter	4	-140	212	I ² S, R, L, TDM	SPI	144	—	—	1.8, 3.3	64TQFP	12.50

Standalone S/PDIF and AES/EBU Interfaces

DIX4192	Digital Audio Interface Transceiver	0	—	216	AES/EBU, S/PDIF, I ² S, R, L, TDM	I ² C, SPI	—	YES	YES	1.8, 3.3	48TQFP	4.95
DIT4192	192-kHz Digital Audio Transmitter	0	—	192	AES/EBU, S/PDIF, I ² S, R, L	H/W, SPI	—	NO	YES	3.3, 5	28TSSOP	2.05
DIT4096	96-kHz Digital Audio Transmitter	0	—	96	AES/EBU, S/PDIF, I ² S, R, L	H/W, SPI	—	NO	YES	3.3, 5	28TSSOP	1.55
DIR9001	96-kHz Digital Audio Receiver	0	—	96	AES/EBU, S/PDIF, I ² S, R, L	H/W	—	YES	NO	3.3	28TSSOP	1.95

USB Peripherals

Device	Speeds	Voltage (V)	Remote Wakeup	Package(s)	Description	Price ¹
TUSB3210	Full	3.3	Yes	64 LQFP	USB full-speed general-purpose device controller	2.50
TUSB3410	Full	3.3	Yes	32 LQFP	USB-to-serial converter (RS-232, RS-485)	2.25
TUSB6250	Full, High	3.3	Yes	80 TQFP	USB 2.0 high-speed, low-power ATA/ATAPI bridge solution	2.80

USB On-The-Go (OTG) Devices

Device	Speed	Voltage (V)	Local Bus Interface	Package	Description	Price ¹
TUSB6020	High	1.5, 1.8, 3.3	VLYNQ	80 MicroStar BGA™	USB 2.0 high-speed On-The-Go to VLYNQ controller	TBD

USB Transceivers

Device	Speed	Voltage (V)	Package	Singled Ended Input	Description	Price ¹
TUSB1105	Full, Low	1.6, 3.6	16RTZ, 16RGT	Yes	USB Transceivers	1.10
TUSB1106	Full, Low	1.6, 3.6	16RTZ, 16PW	No	USB Transceivers	1.10
TUSB2551	Full, Low	1.6, 3.6	14PW, 16RGT	No	USB Transceivers	Call

Stereo USB DACs

Device	Description	Resolution (Bits)	Power Supply (V)	SNR (dB) (typ)	Pd (mW) (typ)	Sampling Rate (kHz) (max)	Package	Price ¹
PCM2704	Low Power, External EEPROM Interface	16	3.3, 5	98	175	48	SSOP-28	2.95
PCM2705	Low Power, SPI Interface	16	3.3, 5	98	175	48	SSOP-28	2.95
PCM2706	Low Power, Selectable I ² C Interface/HD Mode	16	3.3, 5	98	175	48	TQFP-32	3.40
PCM2707	Low Power, SPI Interface, Selectable I ² C Interface	16	3.3, 5	98	175	48	TQFP-32	3.40

USB Codecs

Device	Description	SNR (dB) (typ)	Power Supply (V)	Pd (mW) (typ)	Sampling Rate (kHz) (max)	Package	Price ¹
PCM2900	5-V Stereo Codec	89	2.7 to 5.5	280	48	SSOP-28	4.15
PCM2901	5-V Stereo Codec, S/PDIF Interface	89	3.3	178	48	SSOP-28	4.15
PCM2902	3.3-V Stereo Codec	89	2.7 to 5.5	280	48	SSOP-28	4.50
PCM2903	3.3-V Stereo Codec, S/PDIF Interface	89	3.3	178	48	SSOP-28	4.50
PCM2904	5-V Stereo Codec, Full 500mA USB Bus Power	89	4.35 to 5.25	280	48	SSOP-28	4.15
PCM2906	5-V Stereo Codec, S/PDIF Interface, Full 500mA USB Bus Power	89	4.35 to 5.25	280	48	SSOP-28	4.50

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

Preview products are listed in **bold blue**.

Audio Amplifiers



Line Drivers							
Device	Description	Power Supply (V)	Half Power THD+N at 1kHz (%)	Slew Rate (V/μs)	GBW (MHz)	Package(s)	Price ¹
DRV134	Balanced Output, DIP Pkg., Companion to INA134 and INA137	±4.5 to ±18	0.0005	12	1.5	SOIC-16, PDIP-8	1.95
DRV135	Balanced Output, Small Pkg., Companion to INA134 and INA137	±4.5 to ±18	0.0005	12	1.5	SOIC-8	1.95

Line Receivers							
INAy134	Differential, Fixed Gain, 0dB (G=1) 1V/V	±4 to ±18	0.0005	14	3.1	PDIP-8/14, SOIC-8/14	1.05
INAy137	Differential, ±6dB (G=1/2 or 2)	±4 to ±18	0.0005	14	4	PDIP-8/14, SOIC-8/14	1.05

Signal Chain Op Amps								
Device	Description	Channel(s)	Power Supply (V)	Half Power THD+N at 1kHz (%)	Slew Rate (V/μs)	GBW (MHz)	Packages	Price ¹
OPA1632	High Performance, Fully Differential, High Speed, Wide Supply Range, Highest Gain Bandwidth	1	+5 to +32	0.00003	50	180	MSOP-8, SOIC-8	1.75
OPAy604	FET Input, Low Distortion, Single Channel, Wide Supply Range, Unity Gain Stable	1, 2	±4.5 to ±24	0.0003	25	20	PDIP-8, SOIC-8	1.05
OPAy134	High Performance, Superior Sound Quality, Ultra-Low Distortion, True FET-Input, Cost Effective Solution	1, 2, 4	±2.5 to ±18	0.00008	20	8	PDIP-8, SOIC-8/14	0.95
OPAy228	High Precision, Low Noise: 3nV/√Hz, Improved Settling Time: 5μs	1, 2, 4	±2.5 to ±18	0.00005	10	33	PDIP-8/14, SOIC-8/14	1.10
OPA627	Difet, Low Noise, Low Offset Voltage, Stable in Gains ≤ 5, Fast Settling Time: 450ns to 0.01%	1	±4.5 to ±18	0.00003	55	16	PDIP-8, SOIC-8	12.25
OPAy353	High Speed, Single Supply, Rail-to-Rail, Small Package, Unity Gain Stable	1, 2, 4	2.7 to 5.5	0.0006	22	44	MSOP-8, SOIC-8/16, 5SOT-23, SSOP/QSOP-16	1.00
MC33078	Dual High Speed Bipolar, Dual Supply Operation, Skew Rate of 7V/μs Typ., Input Noise Voltage of 4.5nV/√Hz	2	±10 to ±36	—	7	16	MSOP-8, PDIP-8, SOIC-8	0.30
NE5532A/4A	Low Noise, Input Noise Voltage of 3.5nV/√Hz (553A) and 5nV/√Hz (5532A), High Slew Rate of 13V/μs Typ (5534A) and 9V/μs (5534A)	2/1	±3 to ±20	—	9/13	10	PDIP-8, SO-8, SOIC-8	0.68
RC4560	Dual, High Gain, Wide Bandwidth, Capable of Driving 20 V Peak-to-Peak into 400-Ω Loads	2	±2 to ±18	0.05	5.5	15	PDIP-8, SOIC-8, TSSOP-8	0.41
RC4580	Dual, Lower Noise, High Gain, Wide Bandwidth, Capable of Driving 20 V Peak-to-Peak into 400-Ω Loads	2	±2 to ±18	0.0005	5	12	PDIP-8, SOIC-8, TSSOP-8	0.41

y Denotes dual and/or quad versions available.

Volume Controls								
Device	Description	Dynamic Range (dB)	Half Power THD+N at 1kHz (%)	Crosstalk at 1kHz (dBFS)	Power Supply (V)	Voltage Swing (VPP)	Package(s)	Price ¹
PGA2310	±15V, DIP Package, Pin Compatible with PGA2311, Voltage Swing of 27 Vpp	120	0.0004	−126	±15	27	SOL-16, DIP-16	9.95
PGA2320	±15V, Improved THD, Pin Compatible with PGA2310, Voltage Swing of 28 Vpp	120	0.0003	−126	±15	27	SOL-16	7.95
PGA2311U ²	2-Channel, ±5V, Low Inter-Channel Crosstalk, Voltage Swing of 7.5 Vpp	120	0.0002	−130	±5	7.5	SOL-16, DIP-16	3.95
PGA4311U ²	4-Channel, ±5V, Low Inter-Channel Crosstalk, Voltage Swing of 7.5 Vpp	120	0.0002	−130	±5	7.5	SOP-28	5.95

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

²U indicates U-Grade devices.



Audio Amplifiers and Low-Power RF

PurePath Digital™ PWM Processors

Device	Description	Frequency (MHz)	Dynamic Range (dB)	Half Power THD+N at 1kHz (%)	Resolution (Bits)	Package	Price ¹
TAS5010	Stereo Modulator Only	32 to 192	96	< 0.08	16, 20, 24	TQFP-48	3.00
TAS5012	Stereo Modulator Only with Higher Dynamic Range	32 to 192	102	< 0.06	16, 20, 24	TQFP-48	5.55
TAS5504A	4-Channel, EQ, Bass Management, Dynamic Range and Volume Control, HP Output	32 to 192	102	< 0.1	16, 20, 24	TQFP-64	3.00
TAS5508B	8-Channel, EQ, Bass Management, Dynamic Range and Volume Control, HP Output	32 to 192	100	< 0.1	16, 20, 24	TQFP-64	5.00
TAS5086	6-Channel, Bass Management, Tone and Volume Control	32 to 192	100	< 0.1	16, 20, 24	TSSOP-38	1.60
TAS5518	8-Channel, Highest Dynamic Range, Record Line and HP Outputs, DSVC adds 24-dB Dynamic Range, EQ, Bass Management, Dynamic Range and Volume Control	32 to 192	110	< 0.1	16, 20, 24	TQFP-64	7.95

PurePath Digital™ Power Stages

Device	Description	Power	Channel(s)	Half Power THD+N at 1kHz (%)	Package(s)	Price ¹
TAS5261	Mono High Power	315 W (4 Ω)	1	0.05	SSOP-36	5.25
TAS5162	Stereo High Power	200 W (6 Ω)	2	0.05	SSOP-36, HTSSOP-44	TBD
TAS5152	High Power, Pin Compatible with TAS5142	125 W (4 Ω)	2	0.1	SSOP-36	4.30
TAS5121	Mono High Power	100 W (4 Ω)	1	0.05	SSOP-36	3.00
TAS5142	High Power, Pin Compatible with TAS5152	100 W (4 Ω)	2	0.1	SSOP-36, HTSSOP-44	3.30
TAS5182	Controller Only, For Use with External FETs	100 W (6 Ω)	2	0.15	HTSSOP-56	5.30
TAS5111A	Mono Medium Power	70 W (4 Ω)	1	0.025	HTSSOP-32	2.40
TAS5112A	Stereo Medium Power	50 W (6 Ω)	2	0.025	HTSSOP-56	4.00
TAS5186A	Highest Integration Power Stage	30/60 W (6/3 Ω)	6	0.07	HTSSOP-44	5.10
TAS5122	Stereo Low Power	30 W (6 Ω)	2	0.05	HTSSOP-56	3.15
TAS5132	Stereo Low Power	25 W (6 Ω)	2	0.03	HTSSOP-44	1.95

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

New products are listed in **bold red**.

Low-Power RF Product Comparison Guide for 2.4 GHz

Features/Product	CC2500	CC2510	CC2511
Product Type	Transceiver	SoC (RF+MCU)	SoC (RF+MCU+USB)
Programmable Frequency, MHz	2400 – 2483	2400 – 2483	2400 – 2483.5
Frequency Resolution	427 Hz	427 Hz	427 Hz
Operating Supply Voltage	1.8 – 3.6 V	2.0 – 3.6 V	2 – 3.6 V
Current Consumption (RX)	12.8 mA	22 mA	22 mA
Current Consumption (TX, 0 dBm)	21.6 mA	23 mA	23 mA
Data Rate (max)	500 kbps	500 kbps	500 kbps
Receiver Sensitivity	-89 dBm at 250 kbps, BER = 10 ⁻³ -99 dBm at 10 kbps	-88 at 250 kbps, BER = 10 ⁻³ -98 dBm at 10 kbps	-88 at 250 kbps, BER = 10 ⁻³ -98 dBm at 10 kbps
Programmable Output Power Range	-30 to 1 dBm	-30 to 1 dBm	-30 to 1 dBm
Multichannel Systems/FHSS	Yes	Yes	Yes
RSSI Output	Digital	Digital	Digital
Integrated Bit Synchronizer	Yes	Yes	Yes
Integrated Packet Handling	Yes	Yes	Yes
Data Buffering	64 bytes (TX), 64 bytes (RX)	128 bytes (TX), 128 bytes (RX), DMA	128 bytes (TX), 128 bytes (RX), DMA
Internal RF switch/IF Filter	Yes	Yes	Yes
RF Chip Interface	Differential	Differential	Differential
Package Type	QLP-20, 4x4 mm	QLP-36, 6x6 mm	QLP-36, 6x6 mm
Complies with EN 300 220, FCC, CFR 47, part 15 and ARIB STD-T66	Yes	Yes	Yes
Integrated Microcontroller	-	Yes	Yes
Voltage Regulator	1.8 – 3.6 V input voltage	2.0 – 3.6 V input voltage	2.0 – 3.6 V input voltage
IEEE 802.15.4 Compliant	-	-	-
Hardware MAC Encryption/Authentication	-	-	-
Program Memory	-	8/16/32 kB Flash	8/16/32 kB Flash
Data Memory	-	1/2/4 kB SRAM	1/2/4 kB SRAM
USB Interface	-	-	Yes

Audio Amplifiers



Class-D Audio Power Amplifiers										
Device	Description	Output	Power Supply (V)		Half Power	PSRR (dB)	Min. Load	Package(s)	Package	Price ¹
		Power (W)	(min)	(max)	THD+N at 1kHz (%)		Impedance (Ω)		Symbolization	
TPA3120D2	Stereo, High Output Power, Internal Gain, Single-Ended Outputs	25	10	30	0.08	55 @ 2 kHz	4	HTSSOP-24	TPA3120D2	3.20
TPA3200D1	Mono, Digital Input, High Power, Mute, Internal Gain	20	8	18	0.2	73	4	HTSSOP-44	TPA3200D1	2.95
TPA3100D2	Stereo, High Output Power, Mute, Internal Gain, Auto Re-Start, Wide Supply Voltage	20	10	26	0.1	80	4	HTQFP-48, QFN-48	TPA3100D2	3.50
TPA3001D1	Mono, High Output Power, Internal Gain, Differential Input	20	8	18	0.06	73	4	HTSSOP-24	TPA3001D1	2.50
TPA3107D2	Stereo, Class-D	15	10	26	0.08	70	6	HTQFP-64	TPA3107D2	3.35
TPA3004D2	Stereo, Volume Control	12	8.5	18	0.1	80	4	HTQFP-48	TPA3004D2	3.25
TPA3101D2	Stereo, Mute, Internal Gain, Auto Re-Start, Wide Supply Voltage	10	10	26	0.1	80	4	HTQFP-48, QFN-48	TPA3101D2	3.10
TPA3008D2	Stereo, Class-D	10	8.5	18	0.1	80	8	HTQFP-48	TPA3008D2	3.10
TPA3002D2	Stereo, Medium Power Class-D with Volume Control	9	8.5	14	0.06	80	8	HTQFP-48	TPA3002D2	3.30
TPA3007D1	Mono, Medium Power, Internal Gain	6.5	8	18	0.2	73	8	TSSOP-24	TPA3007D1	1.95
TPA3005D2	Stereo, Medium Power	6	8	18	0.1	80	8	HTQFP-48	TPA3005D2	2.95
TPA3003D2	Stereo, Volume Control, Lower Max Voltage	3	8.5	14	0.2	80	8	TQFP-48	TPA3003D2	3.00
TPA2008D2	Stereo, Medium Power, Volume Control, Ideal for Docking Stations	3	4.5	5.5	0.05	70	3	TSSOP	TPA2008D2	1.80
TPA2000D1	Mono, Internal Gain, Cost Effective Solution	2.7	2.7	5.5	0.08	77	4	TSSOP-16, BGA-48	TPA2000D1	1.05
TPA2010D1	Mono, Fully Differential, 1.45 mm x 1.45 mm WCSP Package, High Power	2.5	2.5	5.5	0.2	75	4	WCSP	AJZ (Pb)	0.55
									AKO (Pb-Free)	
TPA2000D2	Stereo, Medium Power, Ideal for Docking Stations	2.5	4.5	5.5	0.05	77	3	TSSOP	TPA2000D2	1.45
TPA2012D2	Smallest Stereo Amp in 2 mm x 2 mm WCSP Package	2.1	2.5	5.5	0.2	75	4	WCSP, QFN	AKR, AKS	0.95
TPA2032D1	Smallest Solution Size, Mono, Fully Differential, Internal Gain 2V/V	2.1	2.5	5.5	0.2	75	4	WCSP	BPX	0.55
TPA2033D1	Smallest Solution Size, Mono, Fully Differential, Internal Gain 3V/V	2.1	2.5	5.5	0.2	75	4	WCSP	BPY	0.55
TPA2034D1	Smallest Solution Size, Mono, Fully Differential, Internal Gain 4V/V	2.1	2.5	5.5	0.2	75	4	WCSP	BPZ	0.55
TPA2000D4	Stereo with Headphone Amp, Medium Power, Ideal for Docking Stations	2.5	3.7	5.5	0.1	70	4	TSSOP	TPA2000D4	1.65
TPA2013D1	Mono, Integrated Boost Converter, High and Constant Power	1.8	1.6	5.5	0.2	90	8	QFN, WCSP	BTI, BTH	1.40
TPA2006D1	Mono, Fully Differential, 1.8-V Compatible Shutdown Voltage	1.45	2.5	5.5	0.2	75	8	QFN	BTQ	0.49
TPA2005D1	Mono, Fully Differential, Most Package Options	1.4	2.5	5.5	0.2	75	8	MicroStar Junior™ BGA QFN MSOP	PB051 (Pb) AAFI (Pb-Free) BIQ BAL	0.49
TPA2001D2	Stereo, Lower Power, Ideal for Docking Stations	1.25	4.5	5.5	0.08	77	8	TSSOP	TPA2001D2	1.20
Class-AB Headphone Audio Power Amplifiers										
TPA6120A2	Stereo, Hi-Fi, Current Feedback, 80 mW into 600 Ω from a ±12 V Supply at 0.00014% THD+N	1.5	10	30	0.0005	75	32	SO-20	6120A2	1.90
TPA6112A2	Stereo, Differential Inputs, 10 μA ISD	0.15	2.5	5.5	0.25	83	8	MSOP-10	APD	0.39
TPA6111A2	Low Cost, Stereo Headphone, SOIC Package, 1 μA ISD	0.15	2.5	5.5	0.25	83	8	SOIC-8, MSOP-8	TPA6111A2, AJA	0.29
TPA6110A2	Stereo Headphone, 10 μA ISD	0.15	2.5	5.5	0.25	83	8	MSOP-8	AIZ	0.39
TPA6130A2	DirectPath™ Stereo with I ² C Volume Control	0.138	2.5	5.5	0.0055	109	16	QFN, WCSP	BSG, BRU	1.45
TPA4411	DirectPath™ Stereo, Internal Gain	0.08	1.8	4.5	0.08	80	16	DSBGA-16, QFN-20	AKT, AKQ	0.70
TPA152	Hi-Fi, Stereo, Mute	0.075	4.5	5.5	0.007	81	32	SOIC-8	TPA152	0.55
TPA6102A2	Ultra Low Voltage, Stereo, Fixed Gain (14 dB)	0.05	1.6	3.6	0.1	72	16	SOIC-8, MSOP-8	TPA6102A2	0.35
TPA6101A2	Ultra Low Voltage, Stereo, Fixed Gain (2 dB)	0.05	1.6	3.6	0.1	72	16	SOIC-8, MSOP-8	TPA6101A2, AJM	0.35
TPA6100A2	Ultra Low Voltage, Stereo, External Resistors	0.05	1.6	3.6	0.1	72	16	SOIC-8, MSOP-8	TPA6100A2, AJL	0.35

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

Preview products are listed in **bold blue**. New products are listed in **bold red**.



Audio Amplifiers

Class-AB Audio Power Amplifiers

Device	Description	Output Power (W)	Power Supply (V)		Half Power THD+N at 1kHz (%)	PSRR (dB)	Min. Load Impedance (Ω)	Package(s)	Package Symbolization	Price ¹
			(min)	(max)						
TPA6030A4	Stereo with Stereo HP, Wide Supply Voltage, Low Power, Volume Control, Fully Differential	3	7	15	0.06	60	16	HTSSOP-28	TPA6030A4	1.40
TPA6017A2	Stereo, Cost Effective, Internal Gain, Fully Differential	2.6	4.5	5.5	0.1	77	3	HTSSOP-20	TPA6017A2	0.99
TPA6011A4	Stereo with Stereo HP, Volume Control, Fully Differential	2.6	4	5.5	0.06	70	3	HTSSOP-24	TPA6011A4	1.20
TPA6010A4	Stereo with Stereo HP, Volume Control and Bass Boost, Fully Differential	2.6	4.5	5.5	0.06	67	3	HTSSOP-28	TPA6010A4	2.25
TPA1517	Stereo, Mute, Medium Power, Low Cost, DIP Package, Single Ended	6	9.5	18	0.15	65	4	PDIP-20, SO-20	TPA1517	0.85
TPA6021A4	Stereo with Stereo HP, Volume Control, Fully Differential	2	4	5.5	0.19	70	4	PDIP-20	TPA6021A4	1.00
TPA6020A2	Stereo, Fully Differential, Low Voltage, Smallest Package	2.8	2.5	5.5	0.05	85	3	QFN-20	RGN	1.15
TPA6040A4	Stereo with DirectPath™ HP and Integrated 4.75-V LDO	2.6	4.5	5.5	0.08	70	3	QFN-32	TPA6040A4	1.15
TPA6211A1	Mono, Fully Differential, Highest Power	3.1	2.5	5.5	0.05	85	3	MSOP, QFN	AYK, AYN	0.55
TPA6203A1	Mono, Fully Differential, Lower Cost Solution	1.5	2.5	5.5	0.06	90	8	MicroStar Junior™ BGA	AAEI (Pb)	0.45
TPA6204A1	Mono, Fully Differential, High Power	1.7	2.5	5.5	0.05	85	8	QFN	AYJ	0.49
TPA6205A1	Mono, Fully Differential, 1.8-V Compatible Shutdown Voltage	1.5	2.5	5.5	0.06	90	8	MSOP, QFN, BGA	AAPI, AA0I, AANI	0.45
TPA751	Mono, Differential Inputs, Active Low	0.9	2.5	5.5	0.15	78	8	SOIC, MSOP	TPA751, ATC	0.43
TPA731	Mono, Differential Inputs, Active High	0.9	2.5	5.5	0.15	78	8	SOIC, MSOP	TPA731, AJC	0.43
TPA721	Mono, Single Ended Inputs, Active High	0.9	2.5	5.5	0.15	85	8	SOIC, MSOP	TPA721, ABC	0.43
TPA711	Mono, Single Ended Inputs, Active High, Mono Headphone	0.9	2.5	5.5	0.15	85	8	SOIC, MSOP	TPA711, ABB	0.43
TPA0233	Mono with Stereo Headphone, Summed Inputs	2.7	2.5	5.5	0.06	75	4	MSOP	AEJ	1.05
TPA0253	Mono with Stereo Headphone, Summed Inputs	1.25	2.5	5.5	0.1	75	8	MSOP	AEL	0.90
TPA0172	Stereo with Stereo Headphone, Mute Function, I ² C Volume Control	2.0	4.5	5.5	0.08	75	4	TSSOP	TPA0172	2.45
TPA0212	Stereo with Stereo Headphone, Internal Gain, Low-Cost Computing Solution	2.6	4.5	5.5	0.15	77	3	TSSOP	TPA0212	1.10

Microphone Pre-Amplifiers

Device	Description	Gain Range (dB)	Noise (EIN), G = 30 dB	Half Power THD+N at 1kHz (%)	Power Supply (V)	Package	Price ¹
PGA2500	Digitally Controlled, Fully Differential, High Performance, Low Noise, Wide Dynamic Range, On-Chip DC Servo Loop	0 dB, and 10 dB to 65 dB in 1dB steps	-128 dBu	0.0004	±5	SSOP-28	9.95
Device	Description	Slew Rate (V/μs)	GBW (MHz)	Half Power THD+N at 1kHz (%)	Power Supply (V)	Package(s)	Price ¹
INA163	Mono, Low Noise, Low Distortion, Current Feedback, Wide Bandwidth, Wide Range of Gain	15	8	0.0003	±4.5 to ±18	SO-14	2.50
INA217	Mono, Low Noise, Low Distortion, Current Feedback, Wide Bandwidth, Wide Range of Gain	15	8	0.004	±4.5 to ±18	PDIP-8, SOIC-16	2.50

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

Preview products are listed in **bold blue**.

Portable Power Solutions



Linear Regulators (LDO)

Device	Description
TPS71501	Single Output LDO, 50mA, Adj.(1.2 to 15V), High Input Voltage, Low Quiescent Current, in SC70
TPS73101	Single Output LDO, 150mA, Adj.(1.2 to 5.5V), Low Noise, Fast Transient Response, in SOT23
TPS79901	Single Output LDO, 200mA, Adj.(1.193 to 6.5V), Low Quiescent Current, Low Noise, High PSRR, in DSBGA, TO/SOT, SON
TPS73001	Single Output LDO, 200mA, Adj.(1.5 to 5.5V), High PSRR, Low Noise, in SOT23
TPS73201	Single Output LDO, 250mA, Adj.(1.2 to 5.5V), Low Noise, Fast Transient Response, Reverse Current Protection, in SOT23, SOT223, SON
TPS70702	Dual Output LDO, 250/150mA, Adj.(1.22 to 5.5V), Fast Transient Response, PG, in 20pin TSSOP
TPS71202	Dual Output LDO, 250/250mA, Adj.(1.2 to 5.5V), High PSRR, Low Noise, in 3x3 QFN

LED Backlight and Camera Flash Solutions

TPS61041	28-V, 250-mA Switch Boost Converter in SOT-23
TPS61062	24-V, 400-mA Switch, 1-MHz Boost Converter with PWM or Digital Brightness Control in CSP
TPS60230	5-Channel, Current-Regulated White LED Charge Pump in QFN
TPS65552A	Xenon FLASH Charger for Digital Still Cameras with Integrated IGBT Driver
TPS75105	Low Dropout, Two-Bank LED Driver with PWM Brightness Control in CSP
TPS61150	Dual, 2x 27V, 700mA Switch, 1.2MHz Boost Converter with Single Inductor White LED driver (up to 2x6)
TPS61050	2-A Switch, 2-MHz, Synchronous High-Power Camera Flashlight LED Driver with I ² C in CSP

DC/DC Boost (Step-Up) Solutions

TPS61070	600mA Switch Boost Converter in ThinSOT-23 for 1- and 2-cell Alkaline Applications
TPS61020	1.5A Switch Boost Converter in QFN
TPS61030	4A Switch Boost Converter in QFN
TPS61081	27-V, 1.2-A Switch, 1.2-MHz Boost Converter, also for OLED display supply
TPS63000	96% Efficient, 1.2-A Output Current Buck/Boost Converter with 1.8-V to 5.5-V Input Voltage Range

Display Power Solutions

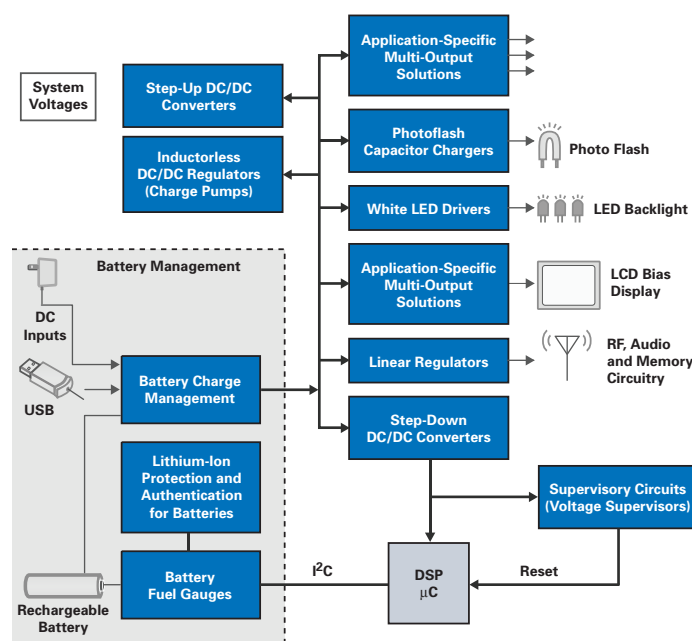
TPS61045	375mA Switch Boost Converter, up to 28V in QFN
TPS65110	28-V, 85% Efficient Boost Converter for LCD or OLED Applications
TPS65120	4-channel Small Form-Factor TFT Display Power Supply in QFN
TPS65130	2-channel, Positive/Negative Power Supply for OLED Displays in QFN

Supply Voltage Supervisors (Quick-Reference Card)

TPS3836E18	250nA, Supply Voltage Supervisor in SOT-23
TPS3808G01	2.4μA, Programmable Delay Supply Voltage Supervisor in SOT-23
TPS3110E12	1.2μA, Dual Supply Voltage Supervisor in SOT-23
TPS3806I33	3μA, Dual Supply Voltage Supervisor in SOT-23

Complete Power Management Units

TPS65020	3 DC/DC Step-Down Converters, 3 LDO (PMIC), I ² C Interface in QFN
TPS65520	6-Channel PMIC with 3 DC/DC, 3 LDOs, I ² C in 5x5 mm QFN
TPS65800	12-Channel PMIC with Li-ion Charger, 2 DC/DC, 9 LDOs, 1 wLED and 1 RGB driver, I ² C in 8x8 mm QFN
TPS65050	6-Channel PMIC with 2 DC/DC and 4 LDOs in a 4 x 4 mm QFN



Battery Chargers

Device	Description
bq2403x	1 cell in series, Dual Input, Linear, Li-Ion / Poly Charger w/ Dynamic Power Path Management in QFN
bq2406x	1 cell in series, Single Input, Linear, Li-Ion / Poly Charger w/ Thermal Regulation in QFN
bq2407x	1 cell in series, Single Input, Linear, Li-Ion / Poly Charger w/ Dynamic Power Path Management in QFN
bq2408x	1 cell in series, Single Input, Linear, Li-Ion / Poly Charger in QFN
bq2501x	1 cell in series, Dual Input, Linear, Li-Ion / Poly Charger w/ DC/DC Converter in QFN

Battery Fuel Gauges

bq27200	1 cell in series, I ² C interface, Li-Ion / Poly Fuel Gauge w/ programmable voltage EOD
bq27010	1 cell in series, HDQ interface, Li-Ion / Poly Fuel Gauge w/ programmable capacity EOD
bq20z70	2-4 cell in series, SBS compliant, Li-Ion / Poly Fuel Gauge with Impedance Track™ Technology w/no LED support
bq20z90	2-4 cell in series, SBS compliant, Li-Ion / Poly Fuel Gauge with Impedance Track™ Technology w/ LED support

Battery Authentication and Protection

bq29330	2-4 cell in series, Li-Ion / Poly Protector for bq20z70 and bq20z90
bq2941x	2-4 cell in series, Li-Ion / Poly 2nd level Protector

DC/DC Buck (Step-Down) Solutions for Core and I/O

TPS62300	500-mA, 3-MHz Step-Down DC/DC with 1-μH Inductor in QFN or CSP
TPS62040	1.2-A, 1.25-MHz Step-Down DC/DC with 18-μA Quiescent Current in 3x3 QFN
TPS62110	17-V Wide Input Voltage, 1.5-A Step-Down DC/DC in 4x4 QFN
TPS64200	3A Step-Down Controller in SOT-23
TPS62350	800-mA, 3-MHz Step-Down DC/DC with I ² C for Dynamic Voltage Scaling in CSP
TPS62400	Dual Output (400-mA and 600-mA), 2.25-MHz Step-Down DC/DC with 1-pin EasyScale Interface for dynamic voltage scaling in 3x3 QFN



Analog Switches

Device	Ron (max)	Ron Flatness (max)	Ron Mismatch (max)	V+ (V) (min)	V+ (V) (max)	ON Time (ns) (max)	OFF Time (ns) (max)	Pins / Package
SPST								
TS5A3166	0.9	0.15	—	1.65	5.5	7	11.5	5/SC70, SOT-23, WCSP
TS5A3167	0.9	0.15	—	1.65	5.5	7	11.5	5/SC70, SOT-23, WCSP
TS5A4594	8	1.5	—	2.7	5.5	17	14	5/SC70, SOT-23
TS5A4595	8	1.5	—	2.7	5.5	17	14	5/SC70, SOT-23
TS5A4596	8	1.5	—	2.7	5.5	17	14	5/SC70, SOT-23
TS5A4597	8	1.5	—	2.7	5.5	17	14	5/SC70, SOT-23
TS5A1066	10	5	—	1.65	5.5	5.5	4.5	5/SC70, SOT-23, WCSP
SPST x 2								
TS5A23166	0.9	0.25	0.1	1.65	5.5	7.5	11	8/US8, WCSP
TS5A23167	0.9	0.25	0.1	1.65	5.5	7.5	11	8/US8, WCSP
TS3A4741	0.9	0.4	0.05	1.65	3.6	14	9	8/MSOP
TS5A2066	10	5	1	1.65	5.5	5.8	3.6	8/SM8, US8, WCSP
SPST x 4								
TS3A4751	0.9	0.4	0.05	1.65	3.6	14	9	14/TSSOP
SPDT								
TS5A6542	0.75	0.25	0.25	2.25	5.5	25	20	8/WCSP
TS5A4624	0.9	0.25	0.1	1.65	5.5	22	8	6/SC70
TS5A3153	0.9	0.15	0.1	1.65	5.5	16	15	8/US8, WCSP
TS5A3154	0.9	0.15	0.1	1.65	5.5	8	12.5	8/US8, WCSP
TS5A3159A	0.9	0.25	0.1	1.65	5.5	30	20	6/SC70, SOT-23, WCSP
TS5A3159	1.1	0.15	0.1	1.65	5.5	35	20	6/SC70, SOT-23
TS5A3160	0.9	0.25	0.1	1.65	5.5	6	13	6/SC70, SOT-23
TS5A3157	10	5	0.2	1.65	5.5	8.5	6.5	6/SC70, SOT-23, WCSP
TS5A63157	10	2	0.14	1.65	5.5	5	3.4	6/SC70, SOT-23
TS5A2053	13.8	4.5	4.5	1.65	5.5	6.8	4.1	8/SM8, US8
SPDT x 2								
TS5A23159	0.9	0.25	0.1	1.65	5.5	13	8	10/MSOP, QFN
TS5A23160	0.9	0.25	0.1	1.65	5.5	5.5	10	10/MSOP
TS5A23157	10	4 (typ)	0.15 (typ)	1.65	5.5	5.7	3.8	10/MSOP, QFN
SPDT x 4								
TS3A5018	10	7	0.8	1.65	3.6	8	6.5	16/SOIC, SSOP (QSOP), TSSOP, TVSOP, QFN
SP3T								
TS5A3359	0.9	0.25	0.1	1.65	5.5	21	10.5	8/US8
TS5A3357	15	6.5 (typ)	0.1 (typ)	1.65	5.5	6.5	3.7	8/SM8, US8
SP4T x 2								
TS3A5017	12	9	2	2.3	3.6	9.5	3.5	16/SOIC, SSOP (QSOP), TSSOP, TVSOP, QFN

Connecting TI ADCs, DACs and Codecs to TI McBSPs and McASPs

Most designers now use I²S as their main method of transmitting stereo digital audio between ICs. I²S has three different signals: DATA, BIT-CLOCK (BCK) and WORDCLOCK (LRCK). The bit-clock runs at essentially the same frequency as the data, with the wordclock framing the words of 24-bit data into left channel and right channel.

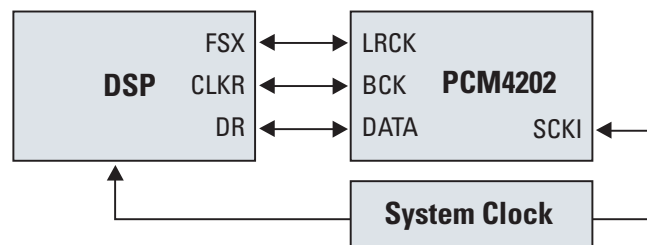
TI ADCs, DACs and codecs are all able to communicate using I²S by either being the bit-clock and wordclock master or being slave to the bit-clock and wordclock and providing data in or data out.

I²S does not allow for any kind of time-division multiplexing in its standard form. Therefore, for every three wires, only a stereo signal can be transmitted or received.

Many TI audio products use a form of time-division multiplexing to overcome this problem. Many TI DACs have a TDMCA (time-division-multiplexed command and audio) system that is connected in the same way as I²S is connected to the DSP, however the DSP's output is changed slightly and control data is added in among audio samples.

In TI's newer codecs a combination of I²S/SPI and TDM can be used to connect multiple codecs into the processor. Devices sit on the I²S or SPI bus and can be daisy-chained on a TDM bus.

TI DSPs have either a McBSP (multichannel buffered serial port) or a McASP (multichannel audio serial port), which support standard audio serial ports directly. Both the McBSP and the McASP support I²S and



Typical Audio Serial Port Connections for Left-Justified, Right-Justified and I²S Data Formats

TDM streams so that multiple channels of audio data can be streamed into the DSP, processed and then transmitted back to the multichannel DAC array.

The McASP can support data in two different clock "zones," allowing users to bring in data at one clock rate and transmit at another. The McASP also supports S/PDIF (or AES/EBU) transmission.

TI also provides driver software for its more complex audio converter products like the TLV320AIC3x family of low-power audio codecs. These feature programmable input and output gain amplifiers, mixers and sound processing. TI's development tools allow you to easily program and optimize the device in a graphical environment and then save the register map for use in your application. For more information or to order the TLV320AIC3x EVM, visit

www.ti.com/sc/device/tlv320aic33

For assistance integrating TI audio data converters with your application, contact support@ti.com

Updated Video and Imaging Solutions Guide Available

This comprehensive guide is a useful resource for developers of various video and imaging products. It includes system



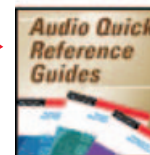
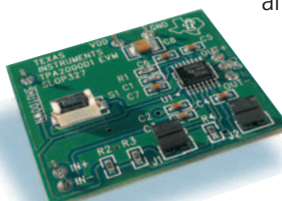
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