Low Power Headphone Amplifier Overview

Class AB, D & G Solutions

Audio Portfolio

Texas Instruments' complete line of audio products feature over 2000 devices within our DAC, ADC, CODEC, AMP, Line driver, Interface, USB Audio, and other product families.

ADC

HW / SW Controlled

1.8-3.3-5V Power

Audio PLL

Energy Sense

#ADC	1-4
SNR	92-123dB
PWR	17-600mW

Packages: 5.3 - 144mm^2

1K: $0.80 - $8.55

AMP

Stereo/Mono
Class AB & D w/Boost

Analog Input

Low Power options w/ PurePath$^{\text{TM}}$

Inputs	1-6
Output Power	0.35-400W

Packages: 2 - 517mm^2

1K: $0.26 - $10.75

CODEC

Power and Performance Optimized

Integrated Amplifiers

Integrated DSP

#ADC/DAC	0-6 / 1-8
ADC/DAC SNR	72-112dB
PWR	6.7mw +

Packages: 7.8 - 170mm^2

1K: $1.23 - $19.25

DAC

Current Output, Voltage Output, 2VRMS Output, Delta Sigma
Integrated Amplifiers

DSP integration

#DAC	1-8
SNR	92-127dB
THD (%)	0.0004-0.04

Packages: 6.4 - 144mm^2

1K: $0.89 - $11.18

Smart AMP

Low and Mid Power Amplifiers with Smart Speaker Protection

Integrated IV Sense, Excursion and Temp sensing options

Output	7.5 – 50W
PSRR	75 dB
Inputs	Analog/Dig.

Packages: 7.5 - 76mm^2

1K: $1.39 - $3.75

Low Power Headphone Amplifier Features

- Class AB and G amplifier solutions
- DirectPath (ground-centered outputs)
- Output power from 25 – 150mW
- Flexible inputs/outputs
  - Differential and SE options
- Ultra-low shutdown power modes
- Numerous Integrated features
  - Filter-free outputs, I2C Programmability, Selectable Gain, Volume control, Digital microphone input, Charge pump, secondary ADC
- Multiple packaging options
  - As small as 1.6mm^2
  - wCSP, QFP, TSSOP, MSOP, SOIC

DirectPath™

Issues

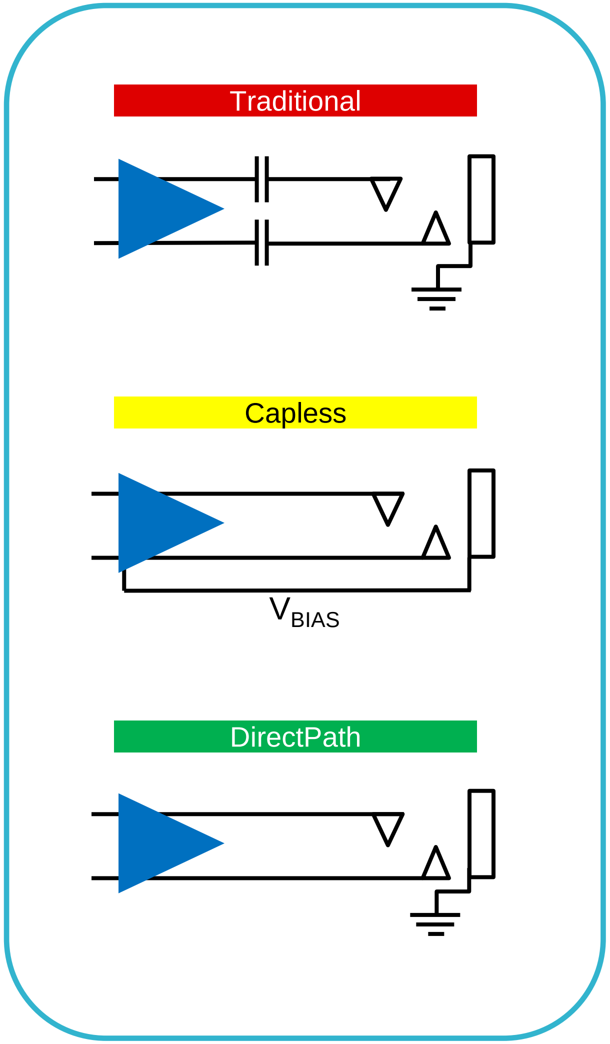
- Many amplifiers utilize a single +3.3V or +5V supply
- These supplies require a DC-biased amplifier output to insure undistorted output
- Utilizing DC-blocking capacitors between the speaker and amplifier creates a high-pass filter and equates to poor bass response

Solutions

- TI provides both capless and DirectPath technology to eliminate these DC-blocking capacitors
- Capless solutions create a virtual ground for the headphone connector. Both amplifier outputs then have a VDD/2 bias ensuring that no DC passes through a speaker
- DirectPath technology provides an internal charge pump which creates a negative power rail inside the device. The device can then be powered by a bipolar supply and have an output based to ground.

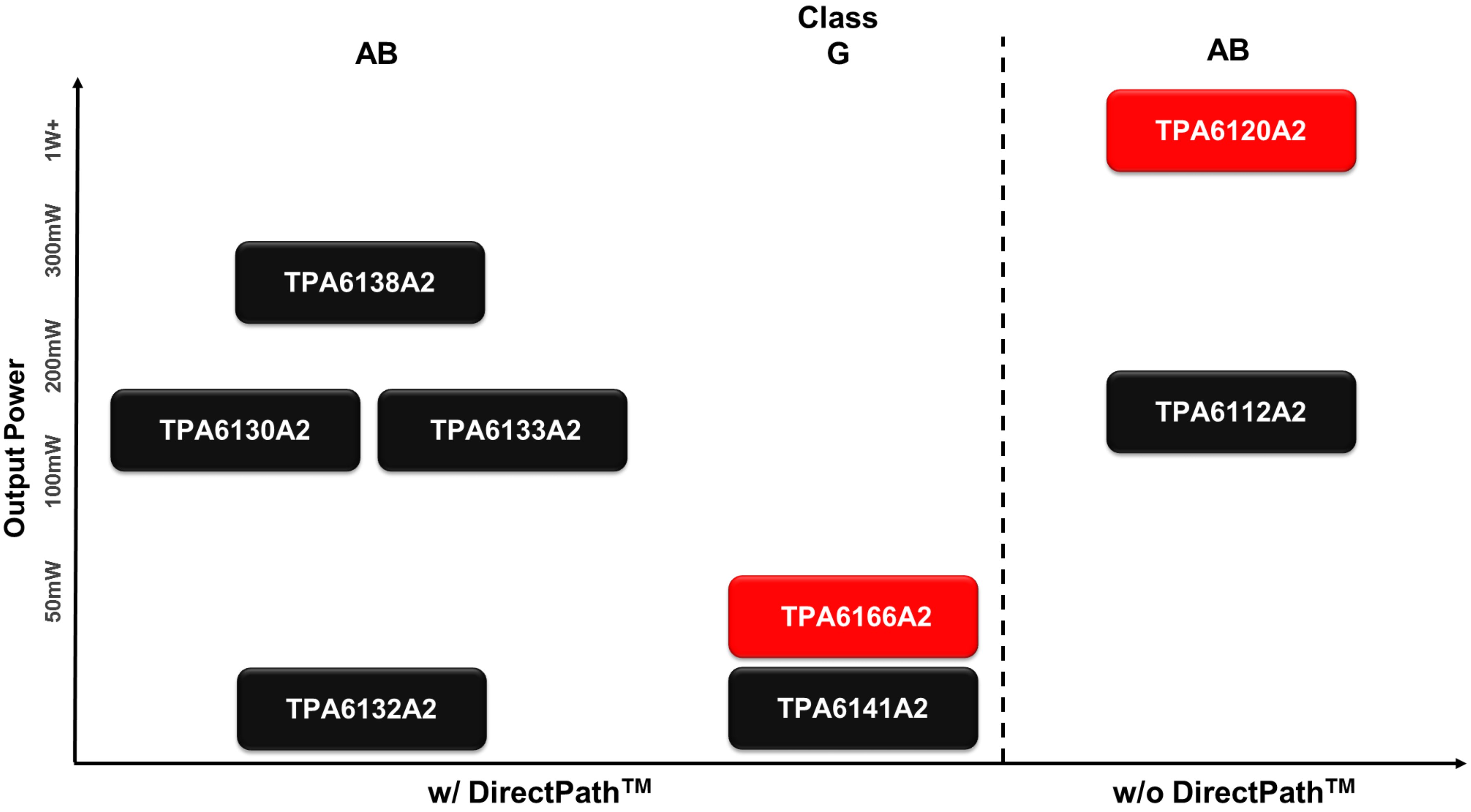
Benefits

- Smaller board space
- Lower cost
- Better sound / more bass



Low Power Headphone Audio Amplifiers

EXISTING
NEW
ROADMAP



Additional Low power headphone amplifier solutions are available.
These are our most popular!

DirectPath^{TM} Class-AB Headphone Amplifiers

(Ground-Centered Outputs)

	Output Power (mW)	PSRR (dB)	SNR (dB)	Supply Current (mA)	Special Features	Package
TPA6138A2 Texas Instruments	25	80	96	14	Active-mute Control	TSSOP: 20-pin 5x6mm 0.65mm pitch
TPA6133A2 Texas Instruments	138	109	93	4.2	GPIO Control for Shutdown	QFP: 20-pin 4x4mm 0.5mm pitch
TPA6132A2 Texas Instruments	25	100	100	2.1	Selectable Gain	QFN: 16-pin 3x3mm 0.5mm pitch
TPA6130A2 Texas Instruments	138	109	98	4	I2C Volume Control	▣ BGA: 16-ball 2x2mm 0.5mm pitch

▣ Other packages available

TPA6138A2

25mW Class-AB Amplifier with DirectPath$^{\text{TM}}$

Features

- 25mW output power into 32Ω at 3.3V
- DirectPath Ground-Referenced Outputs
- Differential Inputs
- Active mute control
- External Under-voltage Mute
- Integrated charge pump
- PW: 14-pin, 4.5 x 5mm, 0.65mm pitch TSSOP

Benefits

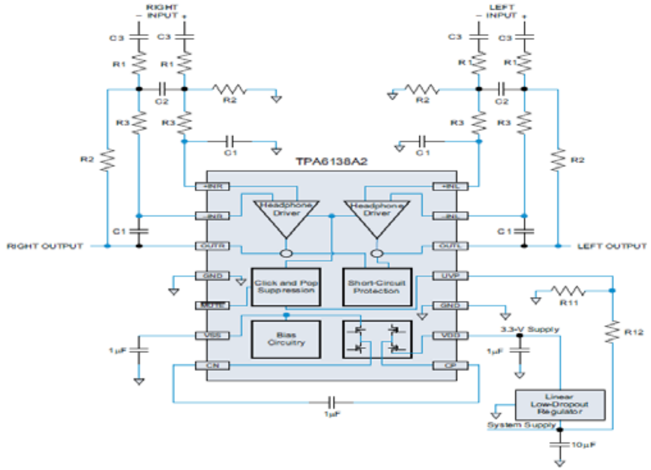
- Louder audio than the leading competition
- Eliminates DC blocking caps
- Better noise rejection = better audio quality
- Pop-free audio On/Off control
- Output mute upon power supply removal
- Remove split-rail power requirement

Applications

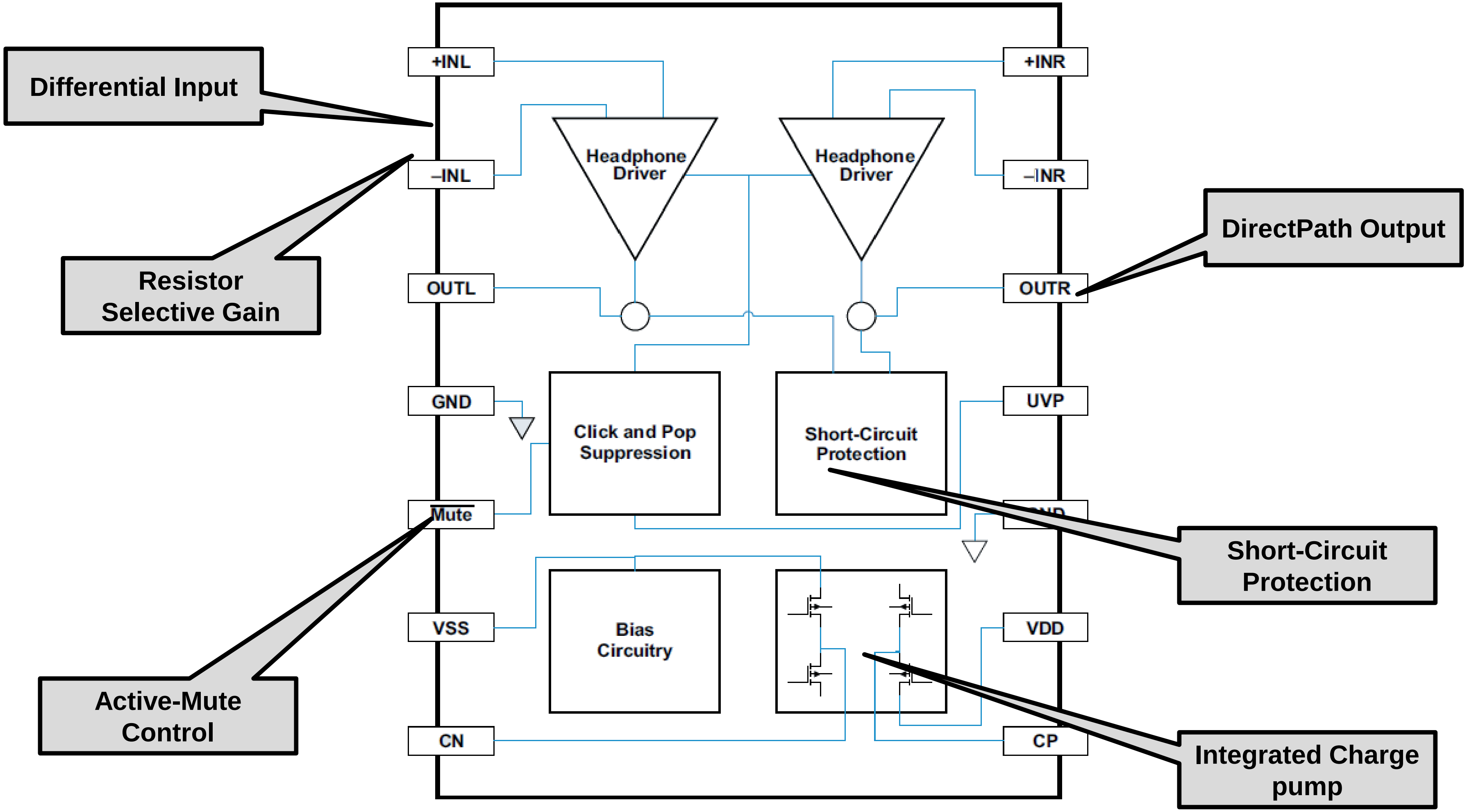
Television

Speaker Bar

STB



TPA6138A2 Block Diagram



Differential Input

Resistor Selective Gain

Active-Mute Control

DirectPath Output

Short-Circuit Protection

Integrated Charge pump

TPA6133A2 / TPA6130A2

138mW Class-AB Amplifiers with DirectPath™

Features

- 138mW output power into 16Ω at 5V
- DirectPath Ground-Referenced Outputs
- I2C Configurable (TPA6130)
- 2.5-5.5V Supply voltage
- Low supply current : 4mA at 5V
- 109dB PSRR
- RTJ: 20-pin, 4 x 4mm, 0.5mm pitch QFN
- YZH: 16-ball, 2 x 2mm, 0.5mm pitch wCSP (TPA6130A2 only)

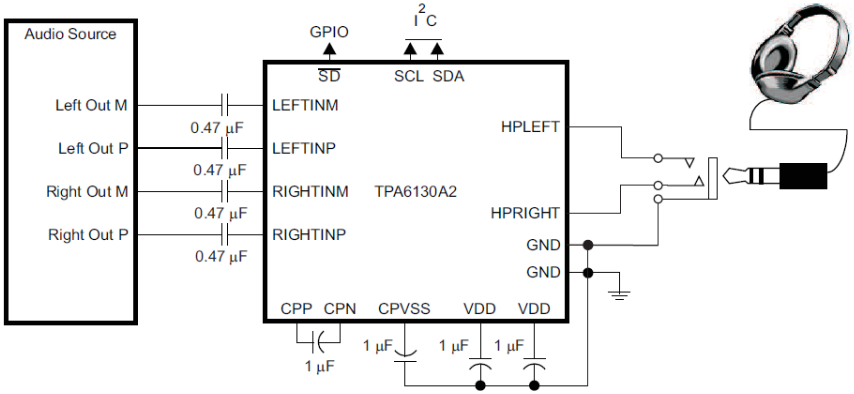
Benefits

- Louder audio than the leading competition
- Eliminates DC blocking caps
- Available with or without I2C control
- Covers the power supply rails typically available in portable systems
- Low power consumption for battery-powered applications
- Enables direct-to-battery connections

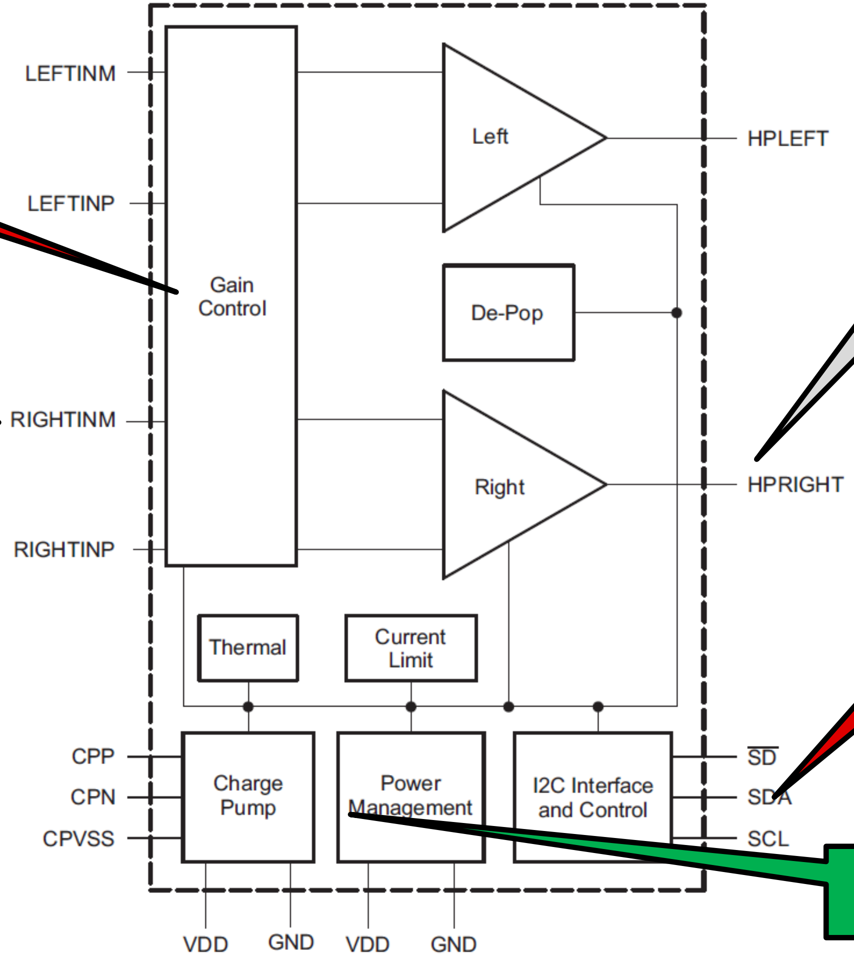
Applications

Notebook PCs

Docking Stations



TPA6133A2 / TPA6130A2 Block Diagram



TPA6130A2 Only

TPA6133A2 Only

64-step Volume Control

Differential Inputs

DirectPath Output

I2C Bus Control

GPIO Control for Shutdown

TPA6132A2

25mW Class-AB Amplifier with DirectPath^{TM}

Features

- 25mW output power into 16Ω at 2.3V
- DirectPath Ground-Referenced Outputs
- Selectable Gain (-6,0,3,6dB)
- 2.3-5.5V Supply voltage
- Low supply current : 2.1mA at 2.3V
- 100dB PSRR
- RTE: 16-pin, 3 x 3mm, 0.5mm pitch QFN

Benefits

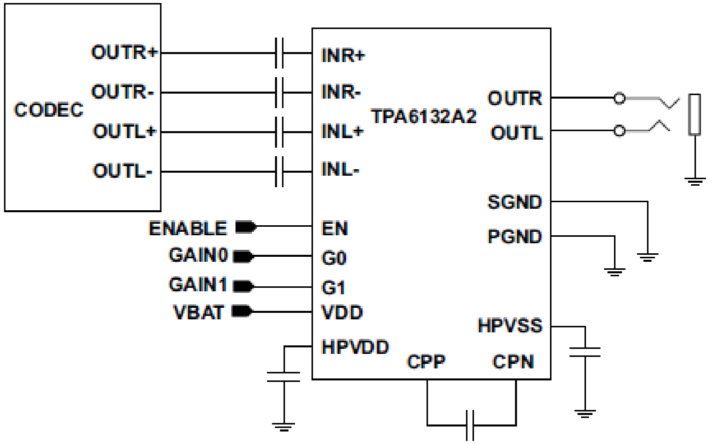
- Loud and Low power option
- Eliminates DC blocking caps
- Customize to your applications
- Covers the power supply rails typically available in portable systems
- Low power consumption for battery-powered applications
- Enables direct-to-battery connections

Applications

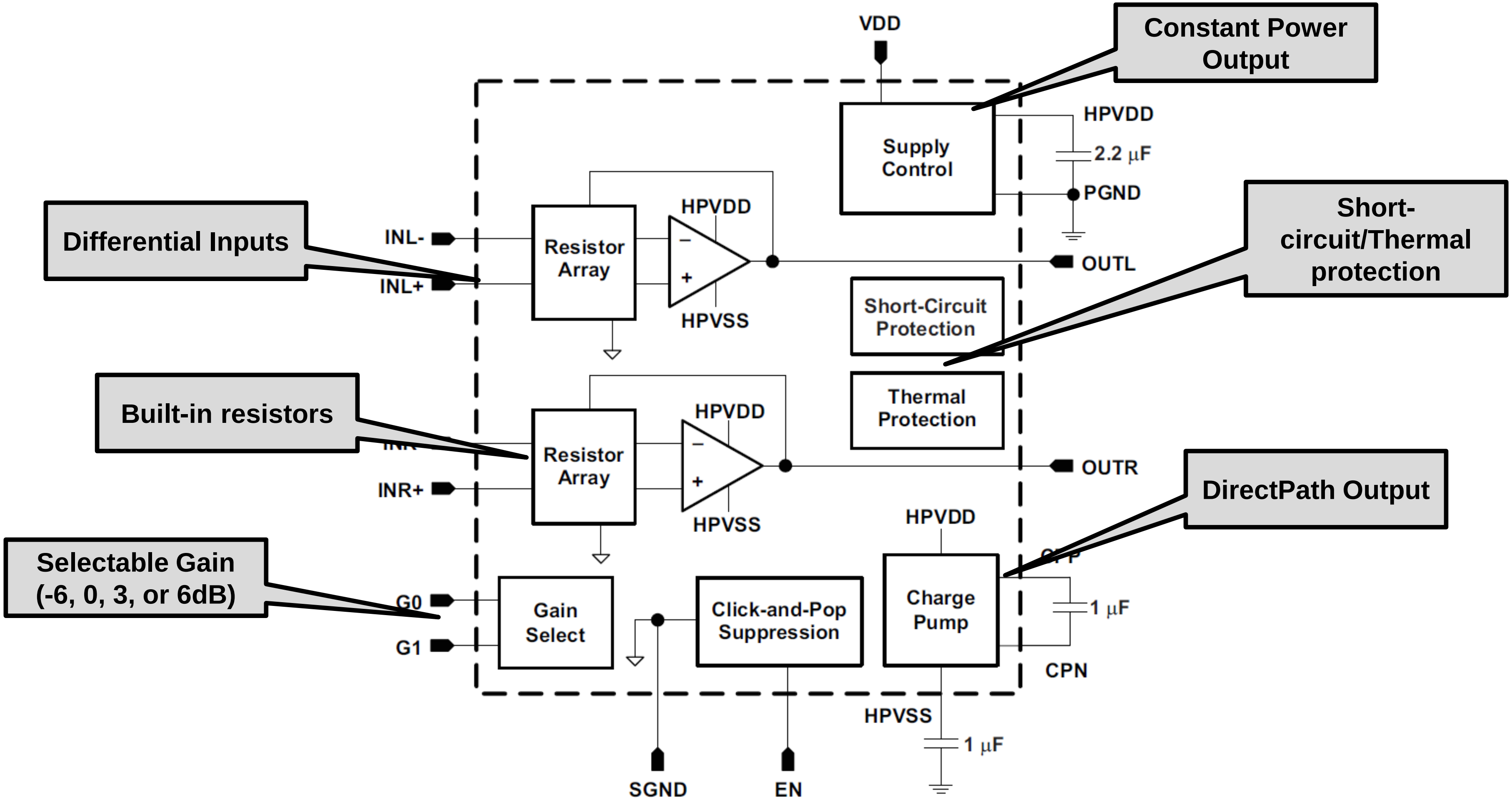
Handsets

Notebook PCs

Docking Stations



TPA6132A2 Block Diagram



Constant Power Output

Differential Inputs

Short-circuit/Thermal protection

Built-in resistors

DirectPath Output

Selectable Gain (-6, 0, 3, or 6dB)

DirectPath™ Class-G Headphone Amplifiers

	Output Power (mW)	PSRR (dB)	SNR (dB)	Supply Voltage (V)	Special Features	Package
TPA6166A2 Texas Instruments	30	91		1.7 – 1.9	Jack Detection - Mic Pre-AMP	wCSP: 25-ball 2.5x2.5mm 0.4mm pitch
TPA6141A2 Texas Instruments	32	105	105	2.5 - 5.5	Selectable Gain	wCSP: 16-ball 1.6x1.6mm 0.4mm pitch

TPA6166A2

DirectPath^{TM} Class-G Amplifier with Jack Detection

Features

- Class-G Amp w/ 30mW/Ch into 32Ω
- DirectPath Ground-Referenced Outputs
- -42 to +6dB volume control
- Differential Microphone Pre-Amp
  - Two programmable Gains
- Advanced Accessory detection
- Secondary ADC for passive multi-button support
- I2C Control
- YFF: 25-ball, 2.5 x 2.5mm, 0.4mm pitch wCSP

Benefits

- Maximizes battery life
- Eliminates DC blocking caps
- 1dB steps and control for each channel
- Removes requirement of external AC coupling capacitor
- Easily determine attached devices and customize settings
- Ability to use low-power passive buttons for wakeup purposes
- Standard inter-chip communication

Applications

Handsets
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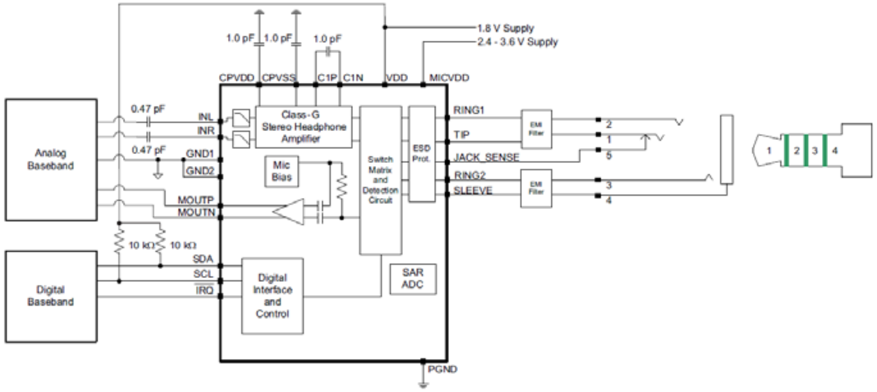
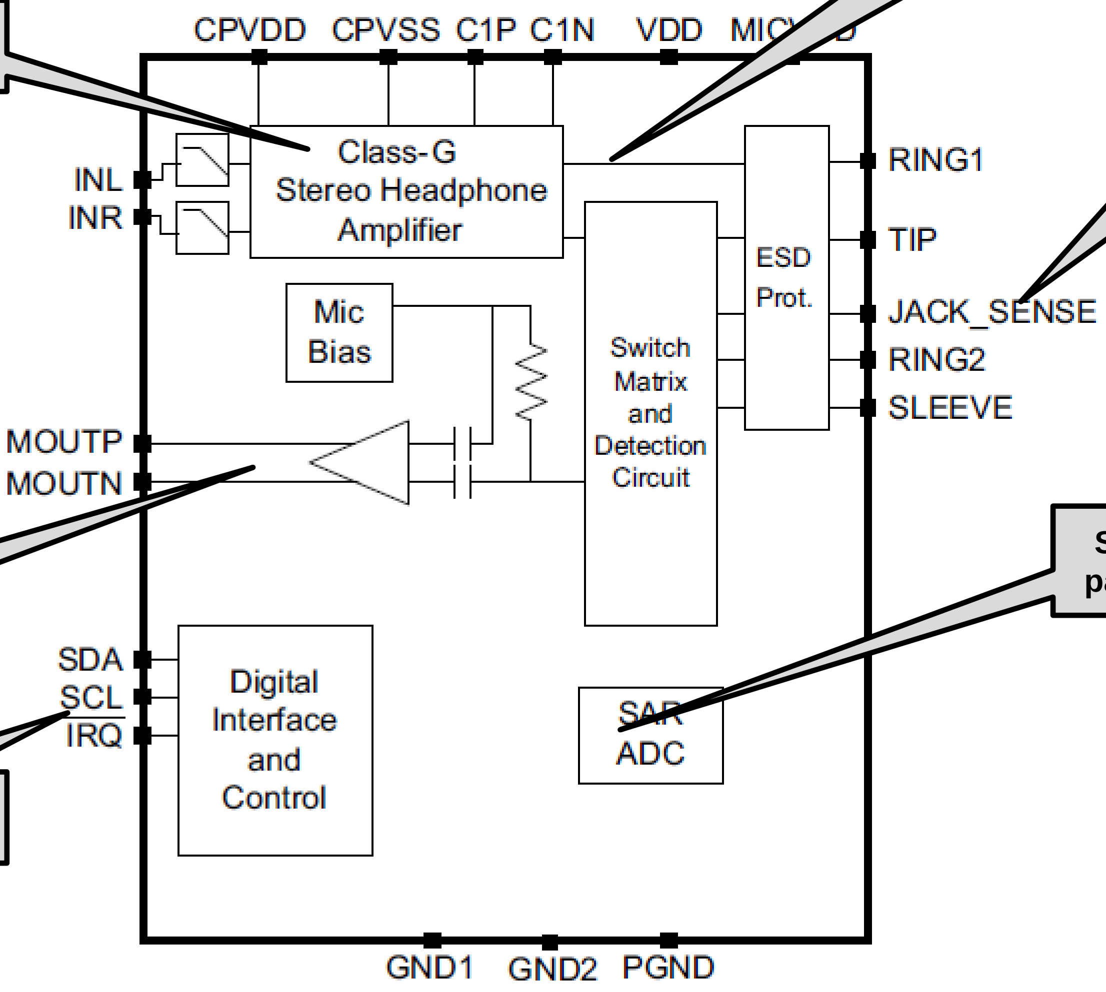
Notebook PCs
Docking Stations



TPA6166A2 Block Diagram



Class G Amplifier

Volume Control

Jack Detection / Sense

Mic Pre-Amp

Secondary ADC for passive multi-button

I2C interface

TPA6141A2

DirectPath^{TM} Class-G Amplifier with Gain Select

Features

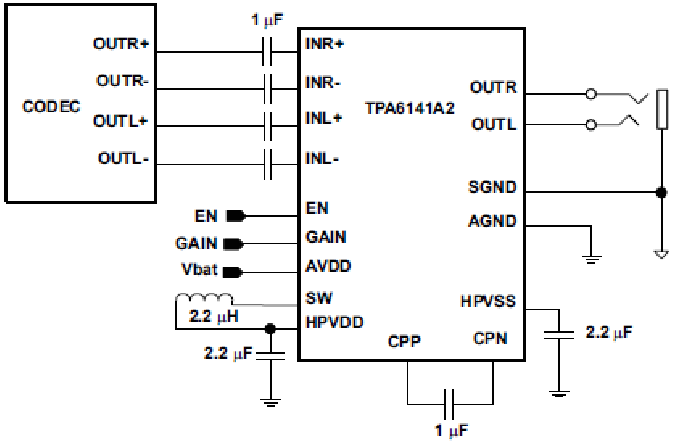
- Class-G Amp w/ 32mW/Ch into 32Ω
- DirectPath Ground-Referenced Outputs
- Differential Inputs with integrated low-pass filter
- 2.5-5.5V supply voltage
- Gain Control
- Ground Sense Pin
- YFF: 16-ball, 1.6 x 1.6mm, 0.4mm pitch wCSP

Benefits

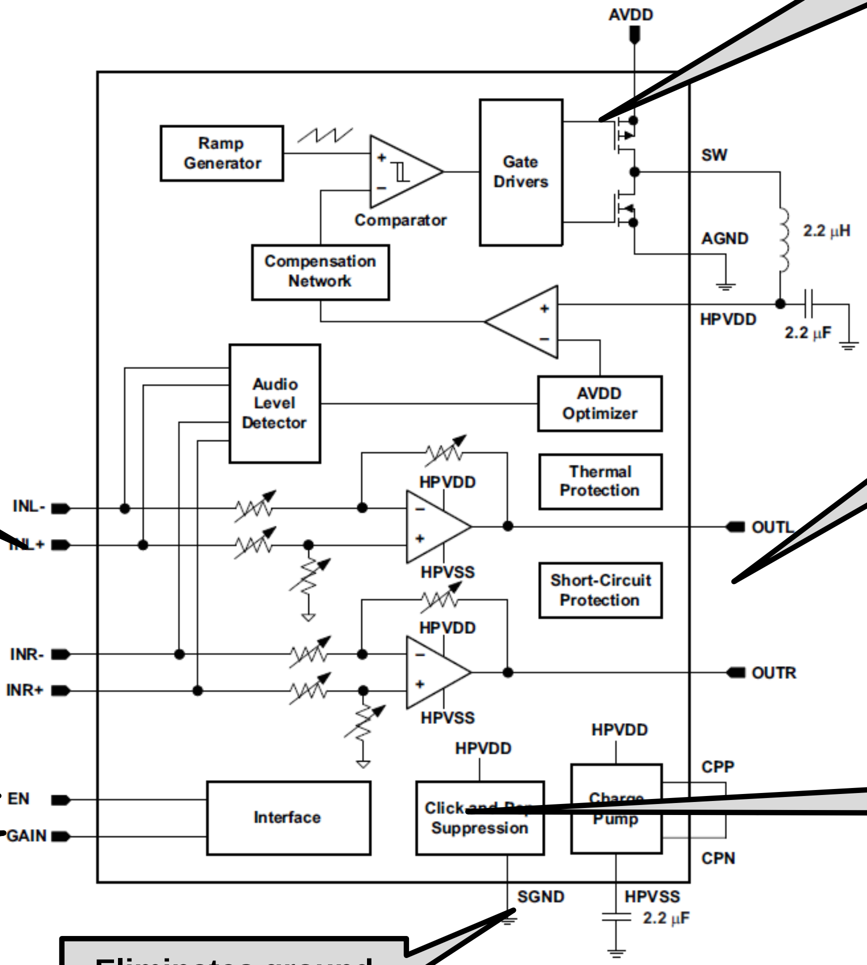
- Maximizes battery life
- Eliminates DC blocking caps
- Reduced system noise
- Covers the power supply rails typically available in portable systems
- Chose either 0 or 6dB
- Reduces ground-loop noise

Applications

Handsets
Tables
Notebook PCs
Docking Stations
Remote Control



TPA6141A2 Block Diagram



Wide 2.5-5.5V Power supply range

Differential Inputs

DirectPath Output

Shutdown current <3uA

Selectable Gain

5ms Startup from Shutdown

Eliminates ground loop noise

Class-AB Headphone Amplifiers

	Output Power (mW)	PSRR (dB)	Input	SNR (dB)	I_{SD} (Shutdown Current uA)	Package
TPA6112A2	150	83	Single-end	100	10	MSOP: 10-pin 3x5mm 0.5mm pitch
TPA6120A2	1500	75	Differential	128	N/A	QFP: 14-pin 3.5x3.5mm 0.5mm pitch

TPA6112A2

150mW Class-AB Amplifier

Features

- 150mW output power into 16Ω at 2.3V
- Differential Inputs
- 2.5-5.5V Supply voltage
- Low supply current : 1.5mA at 2.5V
  - 10uA current in Shutdown mode
- DGQ: 10-pin, 3x5mm, 0.5mm pitch MSOP

Benefits

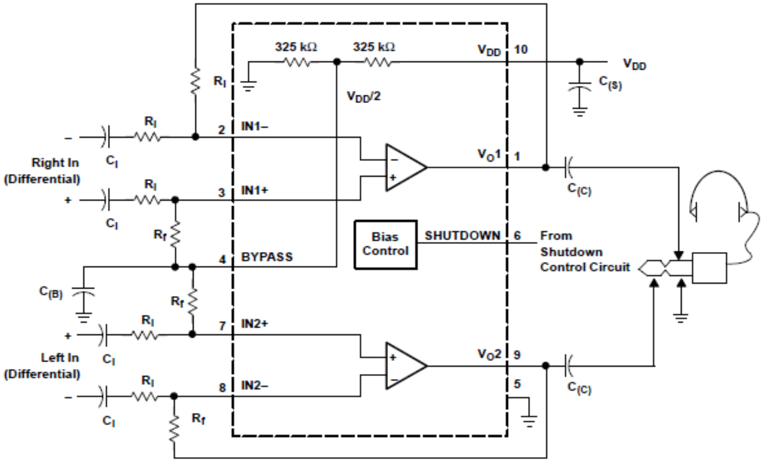
- Louder audio than the leading competition
- Increased immunity to noise
- Covers the power supply rails typically available in portable systems
- Low power consumption for battery-powered applications

Applications

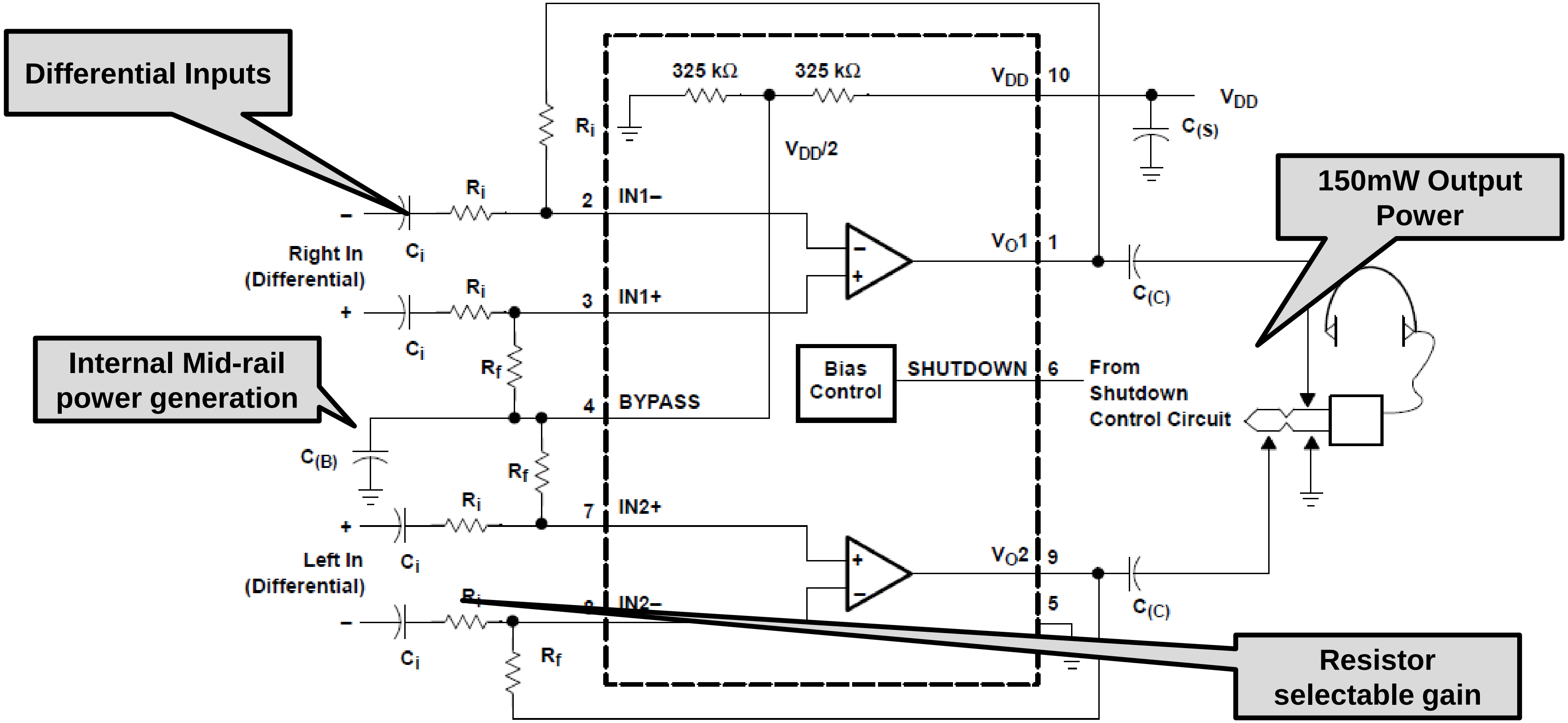
Handsets

Notebook PCs

Docking Stations



TPA6112A2 Block Diagram



Differential Inputs

Internal Mid-rail power generation

150mW Output Power

Resistor selectable gain

TPA6120A2

High Fidelity Headphone Amplifier

Features

- Current-feedback amplifier
- 128dB Signal-to-noise / 112dB THD+N
- Output Noise: 0.9uVrms
- Differential Inputs

- Independent power supplies
- RGY: 14-pin, 3.5x3.5mm, 0.5mm pitch QFP
- DWB: 20-pin, 7.5x13mm, 1.2mm pitch

Benefits

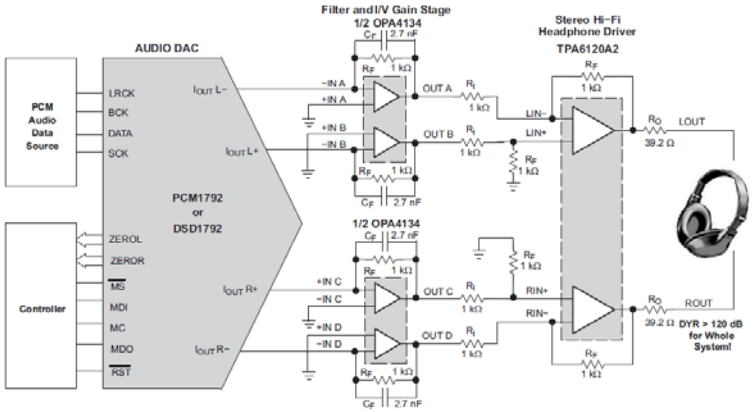
- Low voltage noise and distortion
- Highest performance amplifier
- Very low output noise
- Achieves maximum dynamic range and noise immunity
- One amplifier can be turned off to save power / Low crosstalk

Applications

HiFi Smartphone

Professional / Consumer Audio Equipment

Headphone driver



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EVM & Development Kits – Low cost, easy to use

PurePath Software – No Hassle, free software

Training videos – 24/7, anytime, anywhere

End Equipment Block Diagrams – TI Companion devices

Design

Audio Reference Designs –schematics, gerbers, etc.

Free Samples – Try before you buy (qty limits)

Models & Tools – IBIS, symbols, calculators and more

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