Portable Speaker Amplifier Overview

Class AB & D 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 - 144mm²

1K: $0.80 - $8.55

AMP

Stereo/Mono
Class AB & D w/Boost

Analog Input

Low Power options w/ PurePath™

Inputs	1-6
Output Power	0.35-400W

Packages: 2 - 517mm²

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 - 170mm²

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 - 144mm²

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 - 76mm²

1K: $1.39 - $3.75

Portable Speaker Amplifier Features

- **Class AB & D amplifier solutions**

- **Output power from 1.45 – 3.24W**

- **Boosted Amplifiers**
  - **Class D and G Boosts**

- **Flexible inputs/outputs**
  - **Differential and SE options**

- **Ultra-low shutdown power modes**

- **Numerous Integrated features**
  - **AGC/DRC, Filter-free outputs, I2C Programmability, Low-pass filters, Volume & Gain Control**

- **Multiple packaging options**
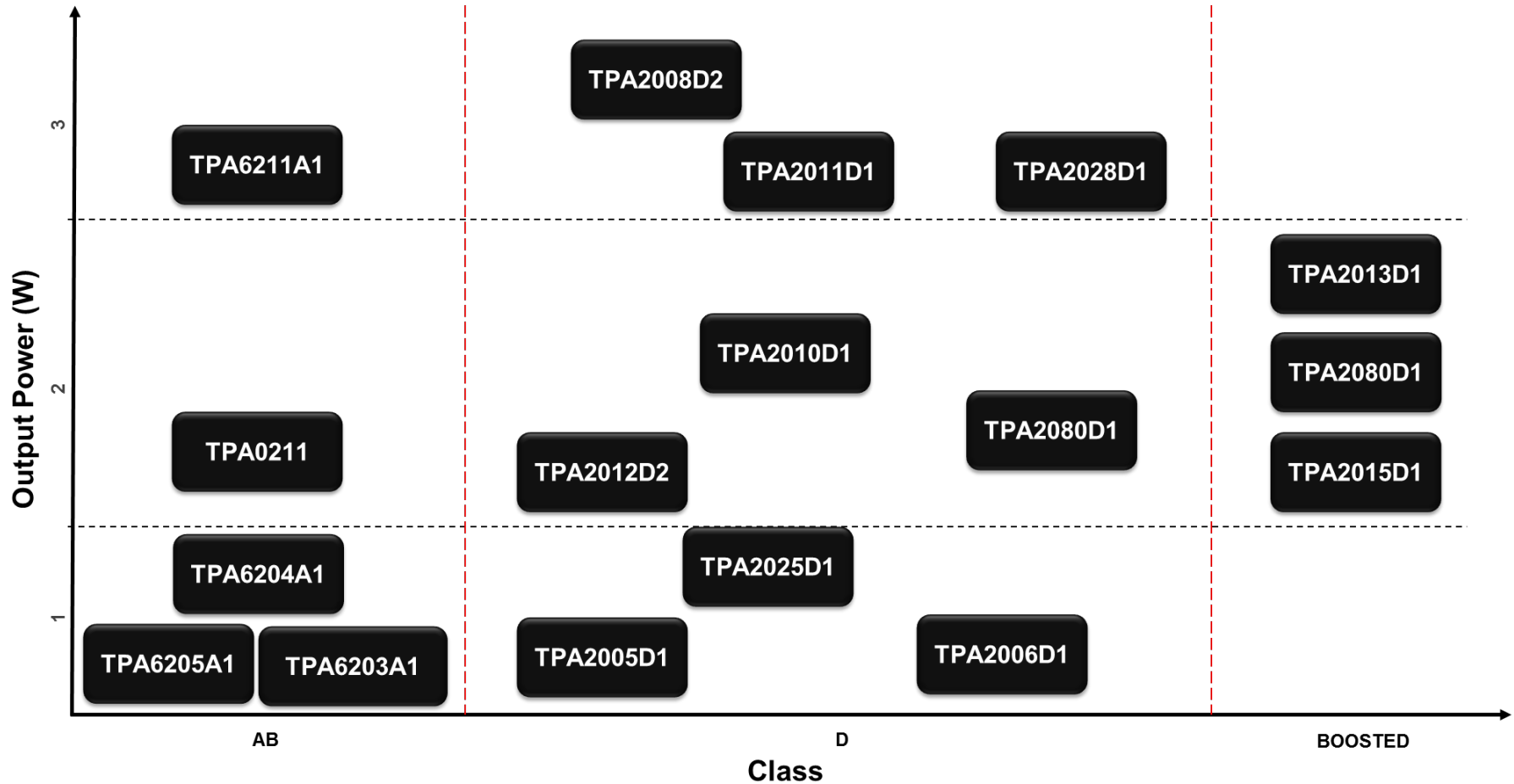 - **As small as 1.2mm^2**
  - **wCSP, BGA, QFP, TSSOP**

Portable Speaker Audio Amplifiers

EXISTING NEW ROADMAP

Output Power (W) / Class

- TPA6211A1
- TPA2008D2
- TPA2011D1
- TPA2028D1
- TPA2013D1
- TPA2010D1
- TPA2080D1
- TPA0211
- TPA2012D2
- TPA2080D1
- TPA2015D1
- TPA6204A1
- TPA2025D1
- TPA6205A1
- TPA6203A1
- TPA2005D1
- TPA2006D1

Axis labels: AB, D, BOOSTED

**Additional Low-power Amplifier solutions are available.
These are our most popular!**

TEXAS INSTRUMENTS

Portable Speaker Mono Class-D Amplifiers

	Output Power (W)	PSRR (dB)	Gain (dB)	Shutdown Current (uA)	Special Features	Package (mm)
TPA2028D1	3	80	-28 to 30	0.2	AGC/DRC	wCSP:9-ball 1.7x1.7mm 0.5mm pitch
TPA2011D1	3.24	86	Resistor Selectable	0.1	4ms Start-up	wCSP: 9-ball 1.2x1.2mm 0.4mm pitch
TPA2010D1	2.5	75	Resistor Selectable	0.5	1ms Start-up	wCSP: 9-ball 1.5x1.5mm 0.5mm pitch
TPA2006D1	1.45	75	Resistor Selectable	0.5	1.8V Shutdown	QFN: 8-pin 3x3mm 0.65mm pitch
TPA2005D1	1.45	75	Resistor Selectable	0.5	9ms Start-up	◘ BGA: 15-ball 2.6x2.6mm 0.5mm pitch

◘ Other packages available

TEXAS INSTRUMENTS

TPA2028D1
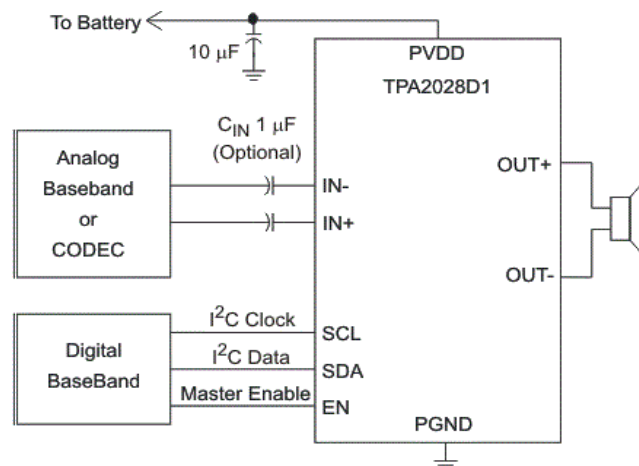## 3.0 Mono Class-D Audio Amplifier with SmartGain™

Features

- Filter-Free Class-D Architecture
- 3.0 W into 4Ω at 5.0 V (10% THD)
  0.88 W into 8 Ω at 3.6V (10%THD)
- 2.5 V to 5.5 V supply voltage
- Built-in SmartGain™ DRC/AGC function
    AGC with Limiter Function
    Programmable AGC/DRC parameters
    Fast gain-ramp AGC which is ~360x faster
- Digital I2C Control
- High PSRR: 80 dB
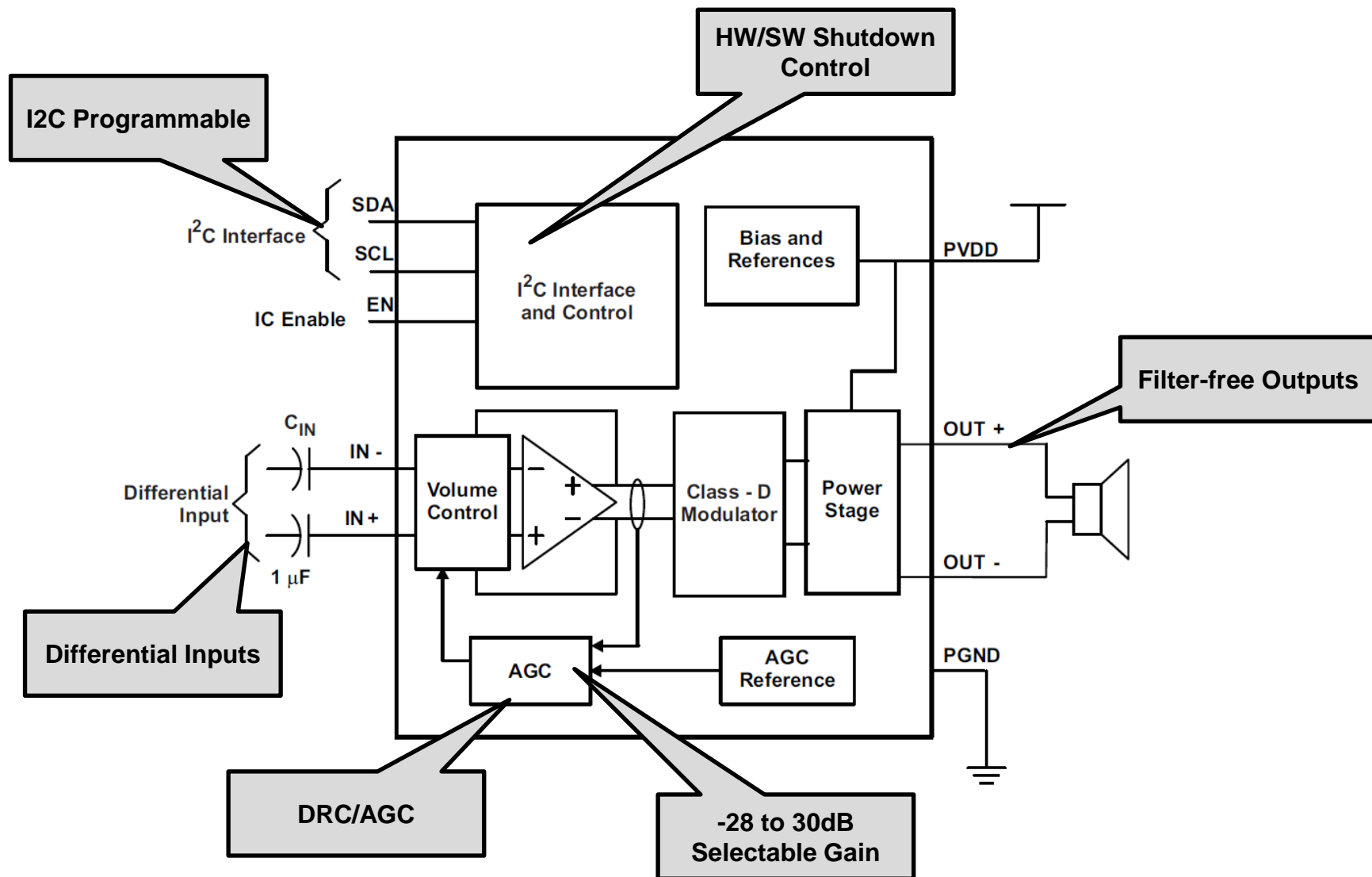- YZF: 9-pin, 1.63 x 1.63mm 0.5mm pitch wCSP

Benefits

- 2x Longer battery life compared to Class-AB
- 43% louder audio than the competition
    Drives both 4Ω and 8Ω speakers
- Direct-connect to most batteries
- Provides 43% average louder average volume without distortion
- Protects speakers from peak power damage
- Flexibility to fine-tune AGC/DRC using just 7 registers
- Customizable controls/programmability for easy interface
- Completely eliminates audible buzz at the output
- 10% smaller solution size compared to the competition

Applications

Notebook PC

Portable Navigation Devices

Wireless handsets

USB Speakers

TPA2028D1 Block Diagram

Callouts: I2C Programmable, HW/SW Shutdown Control, Filter-free Outputs, Differential Inputs, DRC/AGC, -28 to 30dB Selectable Gain

Diagram labels: SDA, SCL, EN, I^2C Interface, IC Enable, I^2C Interface and Control, Bias and References, PVDD, C_{IN}, IN -, IN +, Differential Input, 1 μF, Volume Control, Class - D Modulator, Power Stage, OUT +, OUT -, AGC, AGC Reference, PGND

TPA2011D1, TPA2010D1, TPA2006D1, TPA2005D1
Mono Class-D Audio Amplifiers

Features

- 1.45-3.24V Output power
- 1-9ms Start-up
- Resistor selectable gain
- Fully differential inputs
- Input Capacitor free
- 1.5-2.8mA Quiescent Current
- 0.1-0.5uA Shutdown current

Benefits

- Wide range of loudness
- Fast startup gets to audio sooner
- Easy to set gain to preference level
- Excellent system noise rejection
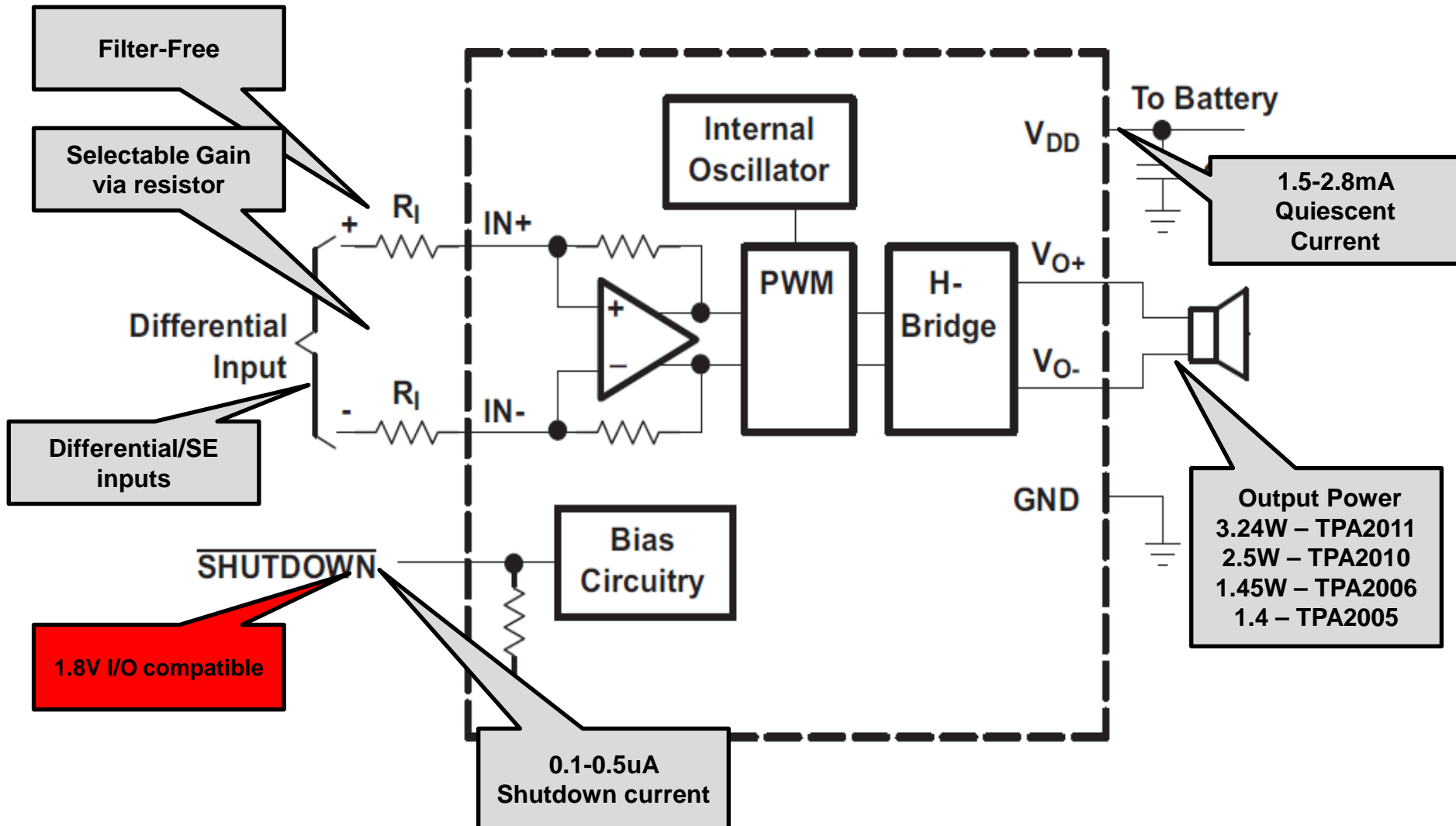- Lower cost / Smaller PCB
- Perfect for low power applications

Applications

- Wireless handsets
- Personal Navigation Devices
- Portable Audio

Package Options

Device	Package Designator	Type	Pins/ Balls	Size	Pitch
TPA2011D1	YFF	wCSP	9-ball	1.2x1.2mm	0.4mm
TPA2010D1	YZF YEF	wCSP	9-ball	1.5x1.5mm	0.5mm
TPA2006D1	DRB	QFN	8-pin	3x3mm	0.65mm
TPA2005D1	DRB ZQY DGN	QFN u*BGA PowerPAD	8-pin 15-ball 8-pin	3x3mm 2.5x2.5mm 3x5mm	0.65mm 0.5mm 0.65mm

TPA2011D1, TPA2010D1, TPA2006D1, TPA2005D1
Block Diagram

Filter-Free

Selectable Gain via resistor

Differential/SE inputs

1.8V I/O compatible

0.1-0.5uA Shutdown current

TPA2006D1 Only

1.5-2.8mA Quiescent Current

Output Power
3.24W – TPA2011
2.5W – TPA2010
1.45W – TPA2006
1.4 – TPA2005

TEXAS INSTRUMENTS

Portable Speaker Stereo Class-D Amplifiers

	Output Power (W)	PSRR (dB)	Gain (dB)	Supply Power (V)	Shutdown Current (uA)	Package
TPA2012D2	2.1	71	6,12,18,24	2.5-5.5	1.5	wCSP: 9-ball 2x2mm
TPA2008D2	3	70	DC Volume Control	4.5-5.5	1.0	PowerPAD 24-pin 7x6mm 0.65mm pitch

◘ Other packages available

TEXAS INSTRUMENTS

TPA2012D2
2.1W Stereo Class-D Amplifier

Features

- 2.1W/Ch into 4Ω at 5V
- Only two external components required
- Independent shutdown for each channel
- Selectable Gain via G0 / G1 pins
- 2.5-5.5V supply
- YZH: 16-ball, 2 x 2mm, 0.5mm pitch wCSP
- RTJ: 20-pin, 4 x 4mm, 0.5mm pitch QFN

Benefits

- High Audio Quality
- Filter Free design
- Selective power down features
- 6,12,18,24 dB for optimal gain settings
- Wide range of supply to fit multiple applications
- Small, board-space saving packages

Applications

Notebook PC

Portable Radio

Educational Toys

USB Speakers

V_{DD}

AIC3254

TPA2012D2

OUTR+
OUTR-

OUTL+
OUTL-
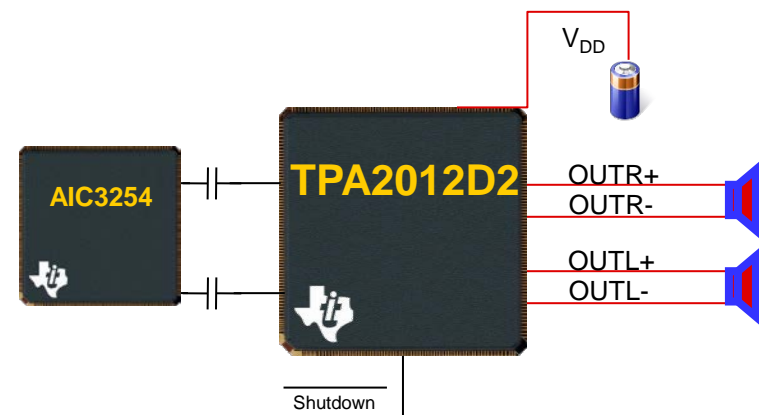
Shutdown

TPA2012D2 Block Diagram
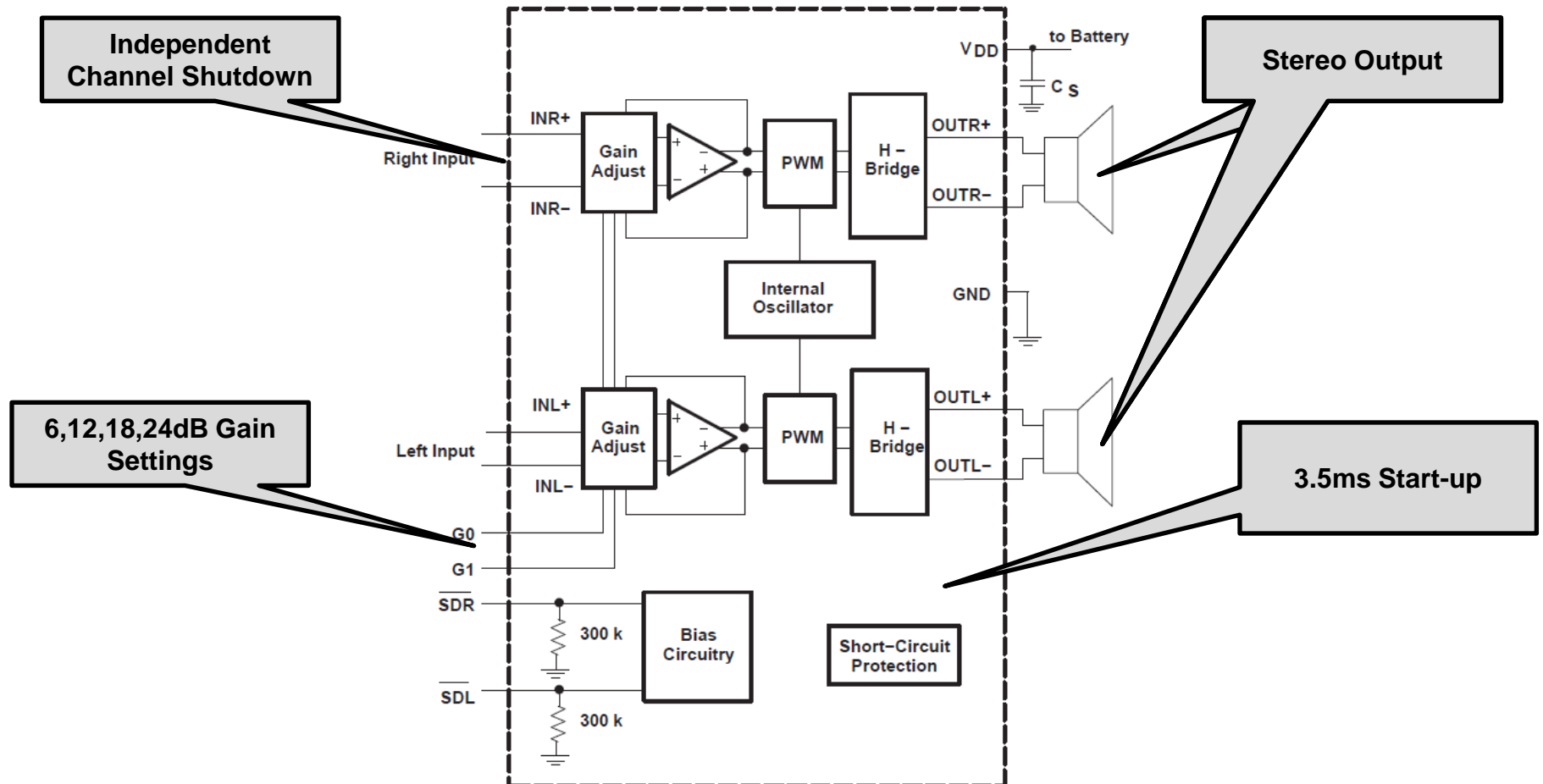
TPA2008D2

3W Stereo Class-D Amplifier w/ DC Volume Control

Features

- 3W/Ch into 3Ω at 5V
- Filter-free Output
- DC Volume Control w/ 2-dB steps
- Shutdown control limits current to 1uA
- Low-Supply Voltage Detection
- PWP: 24-pin, 7 x 6mm, 0.65mm pitch PowerPAD

Benefits

- High Audio Quality
- No Output Filter saves up to 30%
- -38 to 20dB volume control
- Perfect for line or battery applications
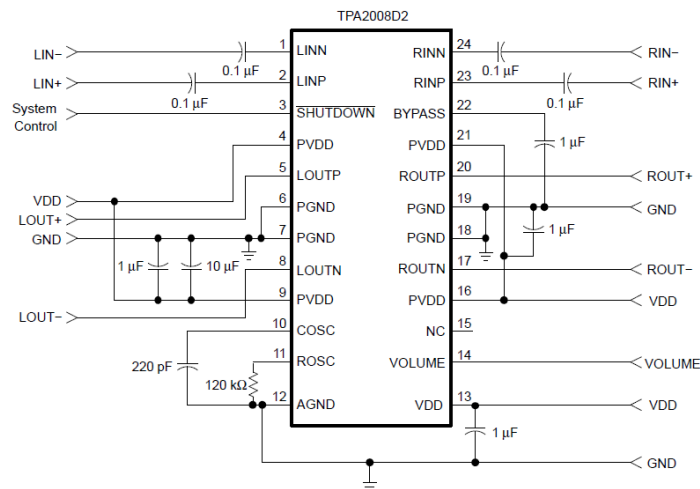- Auto shutdown to conserve power for critical applications
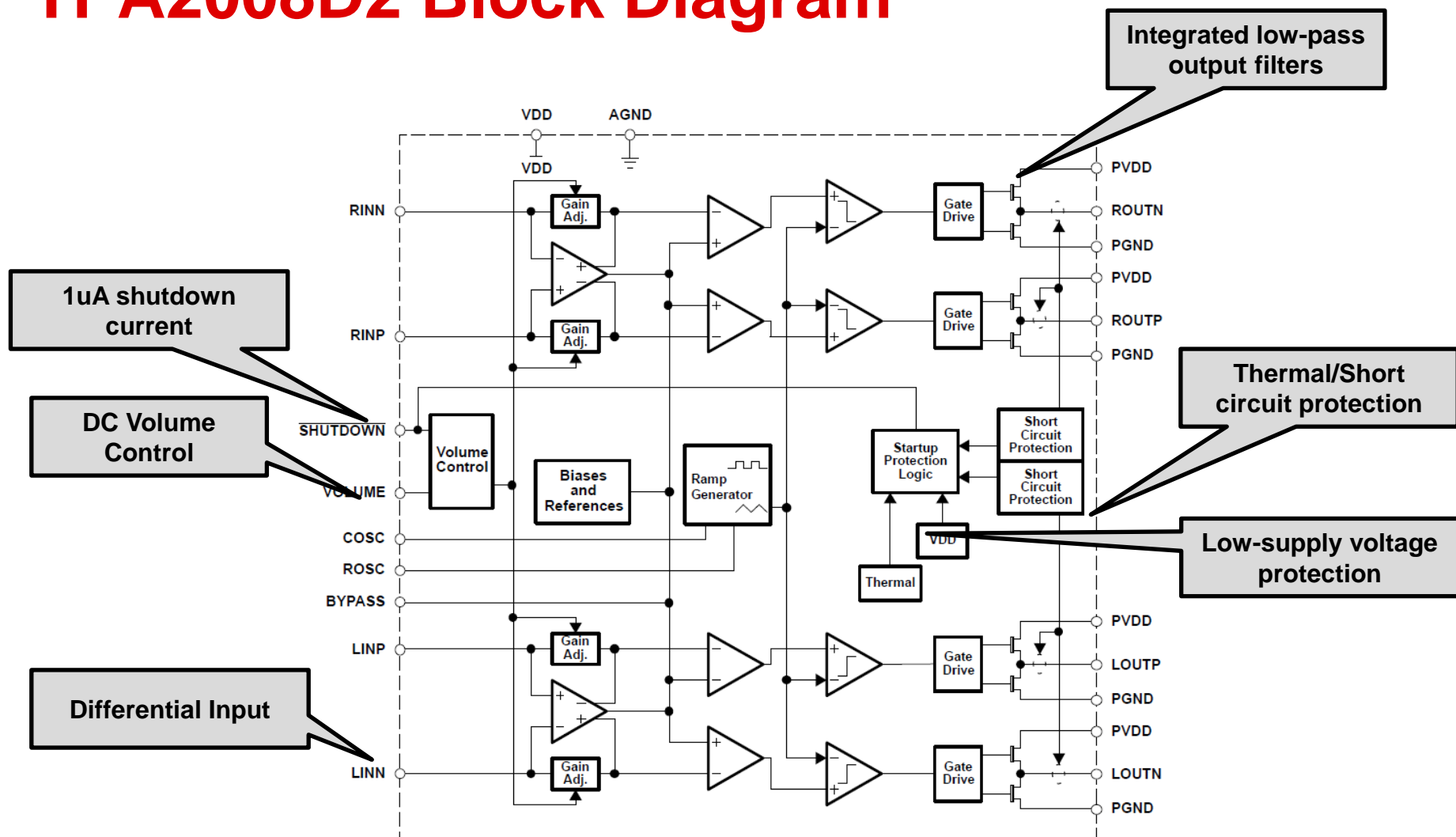
Applications

Projectors

Monitors

Powered Speakers

Battery Operated or Space-constrained electronics

TPA2008D2 Block Diagram

Portable Speaker Boosted Class-D Amplifiers

	Boost	Output Power (W)	PSRR (dB)	Gain (dB)	Special Features	Package
TPA2080D1	Class G (5.75 V)	2.2	62.5	20	AGC	wCSP: 12-ball 1.5x2mm 0.5mm pitch
TPA2025D1		1.9	90	20	AGC	wCSP: 12-ball 1.5x2mm 0.5mm pitch
TPA2015D1	Class D (5.5V)	2	85	6, 15.5, 20	AGC	wCSP: 16-ball 2x2mm 0.5mm pitch
TPA2013D1		2.7	95			⊡ CSP: 16-ball 2x2mm 0.5mm pitch

Pin Compatible

⊡ Other packages available

TEXAS INSTRUMENTS

TPA2080D1 / TPA2025D1
Stereo Class-D Amplifiers w/ Class-G Boost

Features

- Built-in Automatic Gain Control (AGC)
- Integrated 5.75V Boost Converter (Class-G)
- Up to 90 dB PSRR (TPA2080D1: 62.5dB)
- Integrated Input Low Pass Filter
- YZG: 12-pin, 2 x 1.5 mm, 0.5 mm pitch wCSP

Benefits

- Prevents speaker damage and reduces distortion
- Generates high output power from low VBAT
- Rejects power supply noise avoiding "buzz" on amplifier outputs
- Rejects out-of-band noise from Codec/DAC by 30 dB
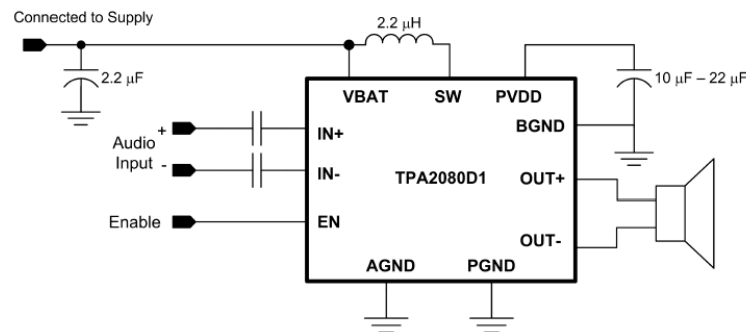- Very small footprint
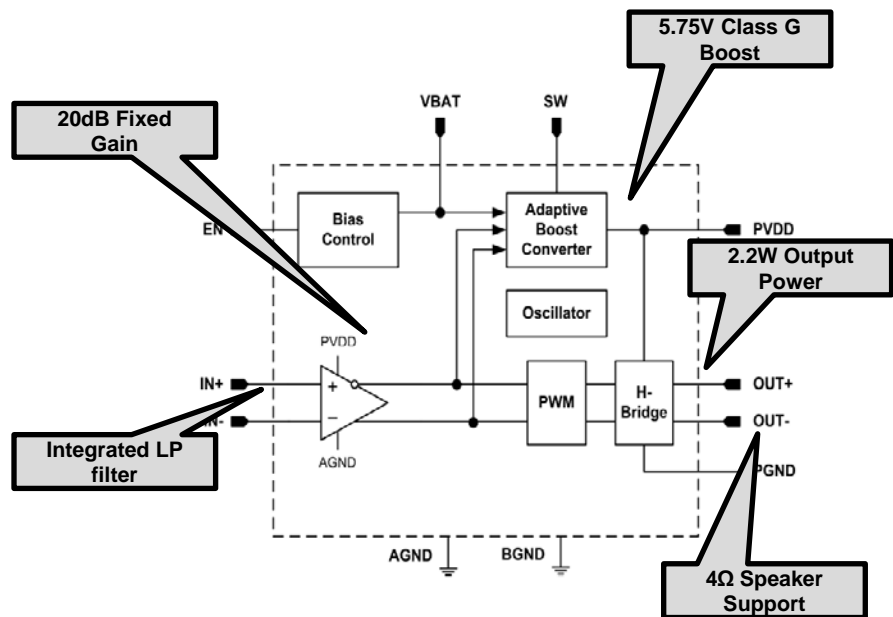
Applications

Projectors

Monitors

Powered Speakers
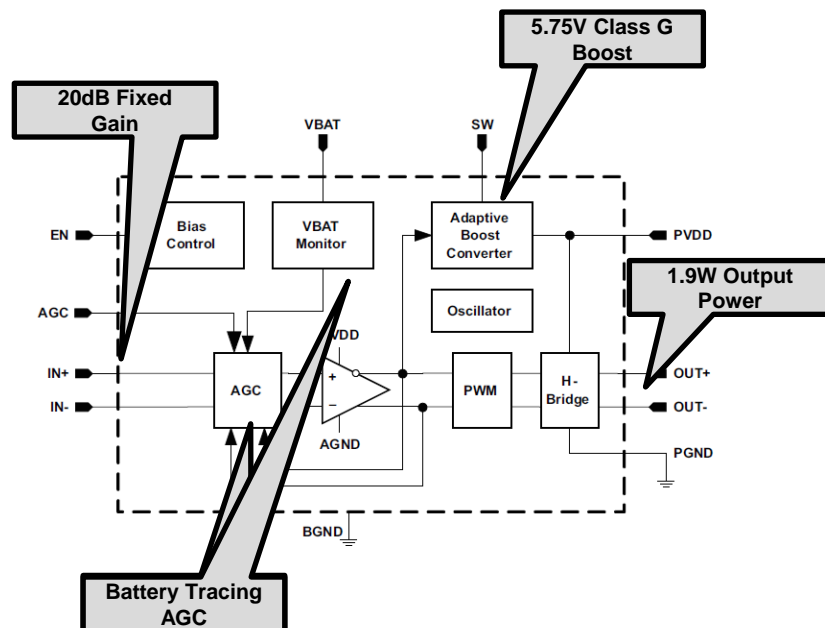
Battery Operated or Space-constrained electronics

TPA2080D1 / TPA2025D1 Block Diagrams

TPA2015D1 / TPA2013D1
Stereo Class-D Amplifiers w/ Class-D Boost
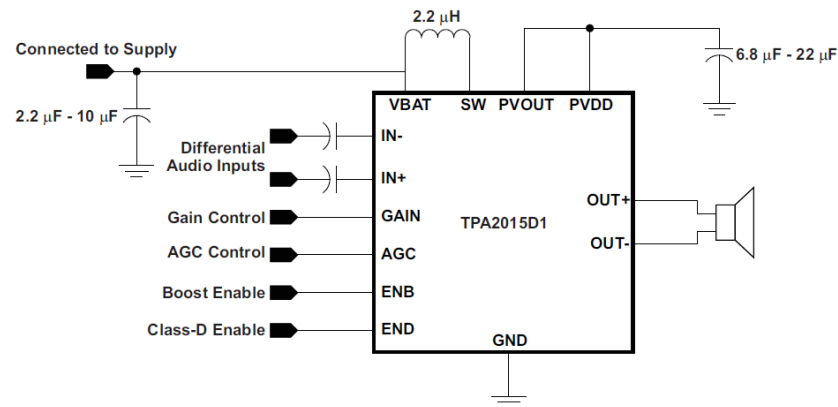
Features

- 2.0 W into 8Ω at 3.6 V (6% THD)
- 8 and 4Ω (TPA2013D1 only) Speaker Support
- Battery tracking SpeakerGuard and AGC (TPA2015D1 Only)
- Fixed Gain settings (6, 15, 20dB)
- Supply voltage
  - TPA2015D1: 2.3V to 5.2V
  - TPA2013D1: 1.8V to 5.5V
- Up to 95 PSRR
- YZH: 16-ball, 2 x 2mm, 0.5 mm pitch wCSP
- RGP: 20-ball, 4 x 4mm, 0.5mm pitch QFN (TPA2013D1 Only)

Benefits

- 36% Louder audio than the leading competition
- Connect to popular speakers
- Prevents early shutdown at low battery voltages(<3v) and protects speakers by preventing clipping
- Direct connection to Li-Ion/future battery technologies
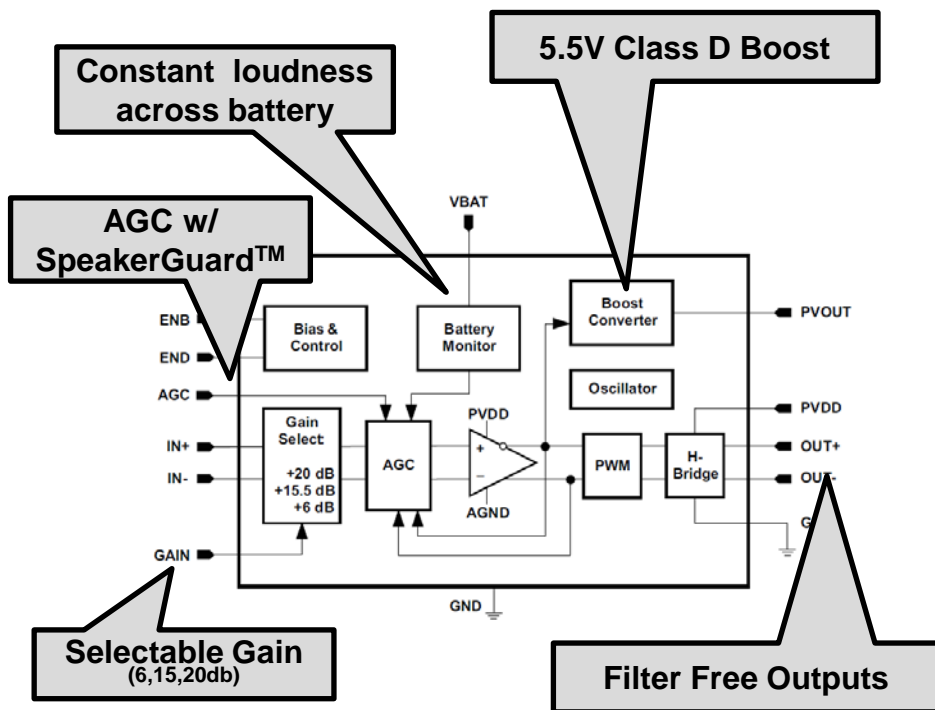- Eliminates noise
- Smaller package size than the competition

Applications

Smartphone

Personal Navigation Devices

Notebook PCs

Docking Stations

TPA2015D1 / TPA2013D1 Block Diagrams

Portable Speaker Class-AB Amplifiers

	Output Power (W)	PSRR (dB)	Supply Current (mA)	Impedance Minimum (Ω)	Shutdown Current (uA)	Package	
TPA6211A1	3.1	85	4	3	.01	QFN: 8-pin 3 x 3mm 0.65mm pitch	
TPA0211	2	58	4	4	1	PowerPad: 8-pin 3 x 5mm 0.65mm pitch	Pin Compatible
TPA6205A1	1.25	90	1.7	8	.01	QFN: 8-pin 3 x 3mm 0.65mm pitch	
TPA6204A1	1.7	85	4	8	.01	QFN: 8-pin 3 x 3mm 0.65mm pitch	
TPA6203A1	1.25	90	1.7	8	.01	BGA: 8-ball 2 x 2mm 0.5mm pitch	

TEXAS INSTRUMENTS

TPA0211 / TPA6204A1
Mono Class-AB Amplifiers

Features

- 2.0W (TPA0211) and 1.7W (TPA6204A1) Output Power
- 2.5-5.5V Supply voltage
- Low supply current : 4mA at 5V
- Low Shutdown current: <1uA
- Resistor variable Gain
- 8 and 4Ω (TPA0211 only) Speaker Support
- Up to 85 PSRR
- DGN: 8-pin, 3 x 5mm, 0.65mm pitch PowerPAD (TPA0211)
- DRB: 8-pin, 3 x 3mm, 0.65mm pitch QFN (TPA6204A1)

Benefits

- Louder audio than the leading competition
- Direct connection to Li-Ion/future battery technologies
- Low power consumption for battery-powered applications
- Flexible gain for your project
- Connect to popular speakers
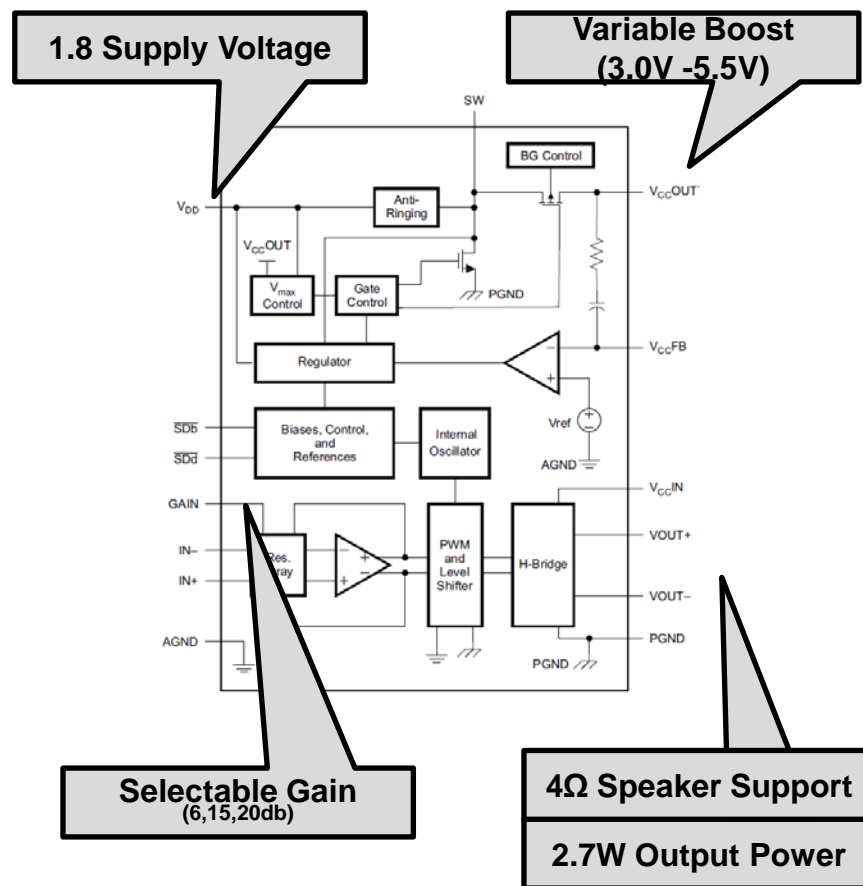- Eliminates noise

Applications

Smartphone

Notebook PCs

Docking Stations

TPA6204A1

TPA0211 / TPA6204 Block Diagrams

TPA0211

TPA6204A1

- 3V or 5V operation
- 2W Output Power
- 1uA Shutdown Current
- Single-End or BTL operation
- 4Ω Speaker Support
- Differential inputs/outputs
- Variable Boost (3.0V -5.5V)
- 2.7W Output Power
- Bypass Cap not required
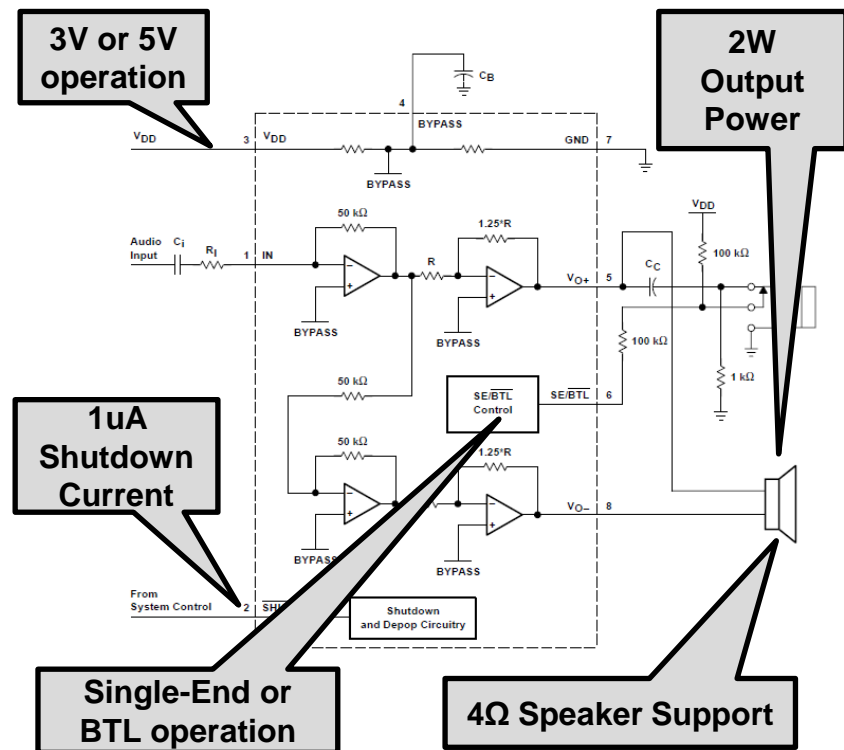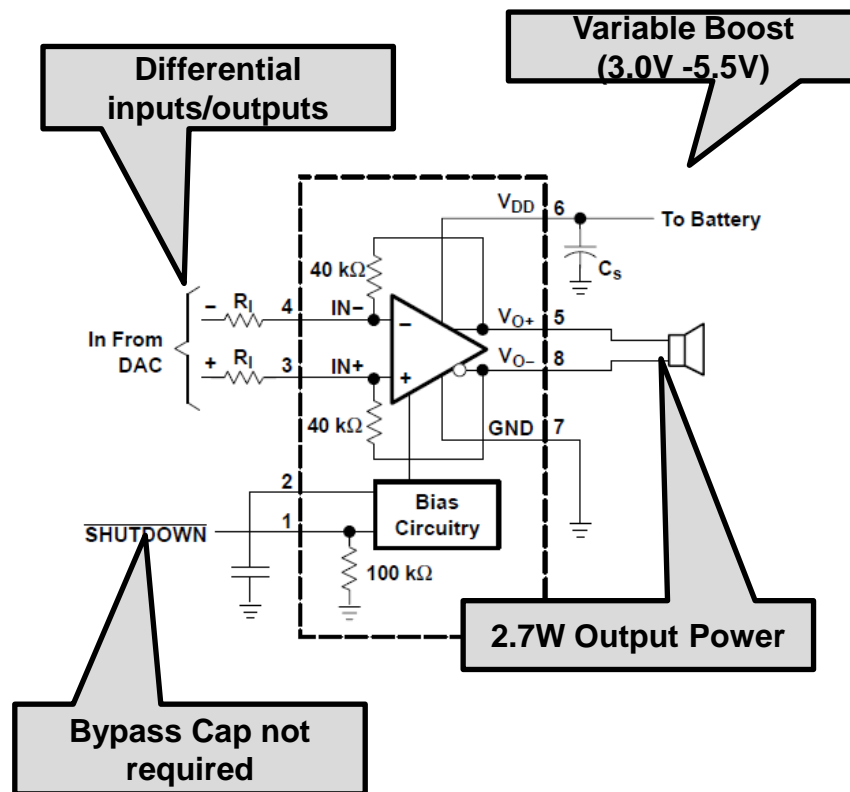
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Parametric Search – Intuitive comparison tool

Audio Selection Tool – Let us help narrow your options

Technical Documents – Datasheets, package info, etc

Evaluate

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.

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E2E Forum – Get support from TI experts & community

TEXAS INSTRUMENTS

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