

# Audio Products From TI

12/20/2016

# Agenda

- TI Audio Overview: Products, Support Tools and Resources
- New Product Technologies:
  - Industry's First 2.1MHz Class-D amplifier for Automotive
  - Digital Input Class-D
  - Inductor Free Class-D
  - Idle Current reduction in Class-D
  - Smart Amplifiers for IoT Applications
  - High-end Class-D Amplifiers for Premium Audio

# TI Audio Products & Applications

## Low Power Audio

### Products

- Low Power Audio
- Low Power Smart Amps

### Applications

- Smartphones, tablets, wearables
- Portable Wireless speakers, notebooks
- Automotive haptics, body
- Industrial HMI, building automation, buzzers
- Valves, flow control, nanopositioning



## Mid Power & Converters

### Products

- Mid Power Audio Amps
- Automotive Audio Amps
- Audio Converters and Audio Interfaces

### Applications

- TV, Dock, Soundbar, AVR
- Part-time portable Wireless Speakers, notebooks
- Infotainment, Aftermarket, eCall, Cluster, Safety, Body
- Telecom infrastructure, musical instruments, building automation



## High Power Audio

### Products

- High Power Amps
- Automotive High Power Amps

### Applications

- Home theater in a box, AVR
- Wired Wireless speakers, soundbars
- Multimedia stand alone devices
- Automotive external amplifier and aftermarket



# Visit ti.com/audio for all your audio needs!

Products  
(by parameter)

TI Home > Audio

## Audio

Overview Applications Tools & software Technical documents Support & training Smart amp

### Product Tree

- High-Power Audio Amplifiers (>50W) (43)
  - Analog Input Class-D (16)
  - PWM Input Class-D (22)
  - Modulators (5)
- Mid-Power Audio Amplifiers (5-50W) (92)
  - Analog Input Amplifiers (49)
  - Digital I2S Input Class-D (43)
- Low-Power Audio Amplifiers (<5W) (116)
  - Speaker Amplifier Piezo (2)
  - Speaker Amplifier Class AB/Class D (82)
  - Headphone Amplifier (25)
  - 2V/3Vrms Line Driver (7)
- Audio Converters (154)
  - Audio ADC (23)
  - Audio CODEC (58)
  - Audio DAC (60)

## TI Audio. We're listening.

More than 30 years of proven audio innovation with best-in-class systems expertise.

### Evaluate and select the right audio solution

#### Audio Subsystem Diagrams

The Audio subsystem diagrams show the functional blocks for a particular end equipment and provide device recommendations as well as important design considerations.

[Learn more >](#)

#### Audio Selection Tool

The Audio Selection Tool steps you through a virtual decision tree, narrowing the options to the products that best fit your specifications.

[Learn more >](#)

**Systems**  
Featured Products for Audio

**Products**  
(Simple selection tool)

# Audio Support & Training at ti.com/audio



## Support Videos

Videos

**TAS6424-Q1: 75-W 2.1 MHz digital input 4-channel automotive Class-D audio amplifier**

00:00 03:13

TEXAS INSTRUMENTS

- TAS6424-Q1: 75-W 2.1 MHz d...**  
TAS6424-Q1 is the industry's first 2.1 MHz Class-D audio amplifier specifically designed for automotive applications. Supporting high-resolu...
- PurePath™ Studio Graphical...**  
A step-by-step guide to downloading and installing TI's PurePath™ Studio software for audio evaluation modules. This video features the T...
- PCM186x: High Performanc...**  
See how the PCM186x and Energysense can simplify your system power management by setting specific thresholds for either sleep o...
- TA S5421-Q1 Overview**  
The TAS5421-Q1 audio class D amplifier combines high fidelity audio and best in class automotive EMC performance with load dump protect...

e2e  
deyisupport

## Audio Design Support



Ask questions, share knowledge, solve problems with fellow engineers.

- Audio Amplifiers
- Audio Converters

## Read Audio blogs

How switching above the AM band eases automotive Class-D amplifier EMC designs

Mon, 05 Dec 2016 10:00:00 GMT

How do automotive cabin sound-enhancement systems work?

Wed, 28 Sep 2016 17:10:00 GMT

USB Type-C audio: Do I need to buy a new pair of headphones?

Thu, 07 Jul 2016 15:57:00 GMT

Blogs

- Training videos at: <https://training.ti.com/search-catalog/categories/audio>

# What do we design?



## Design for High-Resolution Audio

Designed for 96kHz / 24bit and 192kHz / 24bit high definition audio systems



## Unrivaed Audio Performance

Lowest output noise and lowest THD from any Class-D



## Optimized Energy Performance

Optimized to be efficient no matter the active output power, Highest power output to idle-loss ratio ever



## Smallest Solution Size

Integrated modulator, FETs, and protection reduce the size and cost of the solution

# Audio Format Trends

Audio download and streaming services are moving towards Hi-Res audio formats like FLAC



# TI is your partner for all audio applications!

From most cost-effective to highest performance

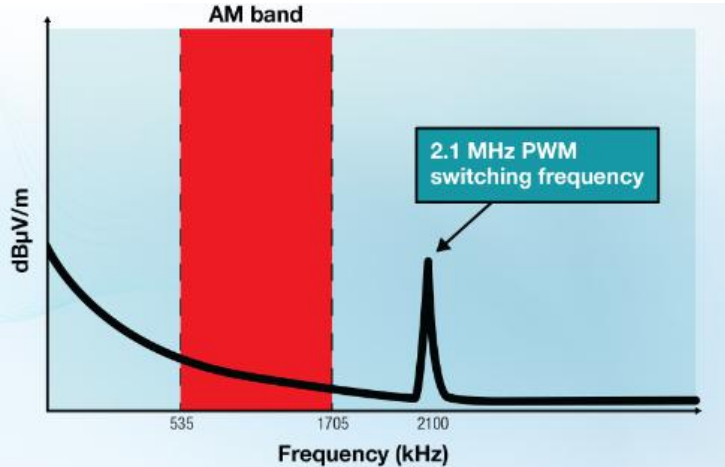


# New Product Highlights

**The first 2.1-MHz Class-D audio amplifier**

**TAS6424-Q1**

# Key features and benefits



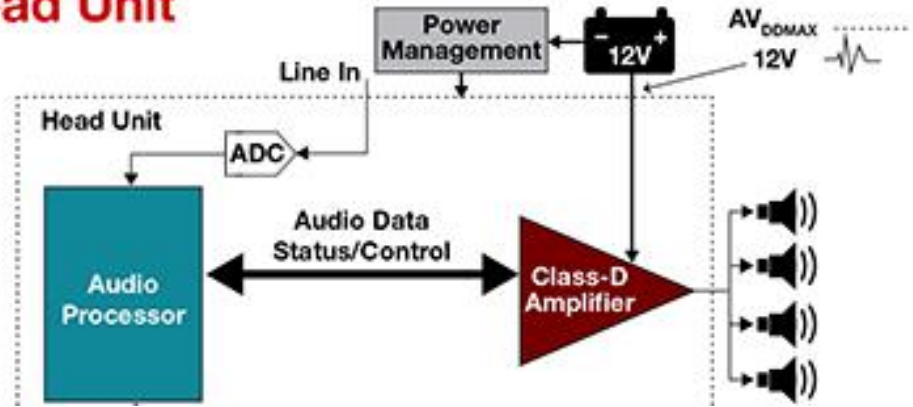
- Industry's first 2.1 MHz PWM switching frequency
  - Switches above the AM band, eliminating the need for complex EMI avoidance schemes
- Industry's smallest four-channel Class-D design
  - High-fidelity audio quality with 96 kHz high resolution digital input
- Rich, integrated functionality
  - Enables the use of smaller external filters and eliminates up to 18 external components, reducing system size up to 75 percent
- Low impedance support
  - Remains stable while driving speakers with impedance of 2 ohm to maintain high audio quality
- 4.5 V to 26.4 V supply voltage
  - Supports start-stop without additional power supply components

# TAS6424-Q1: The details

Learn more about TI's [proven audio innovation](#):

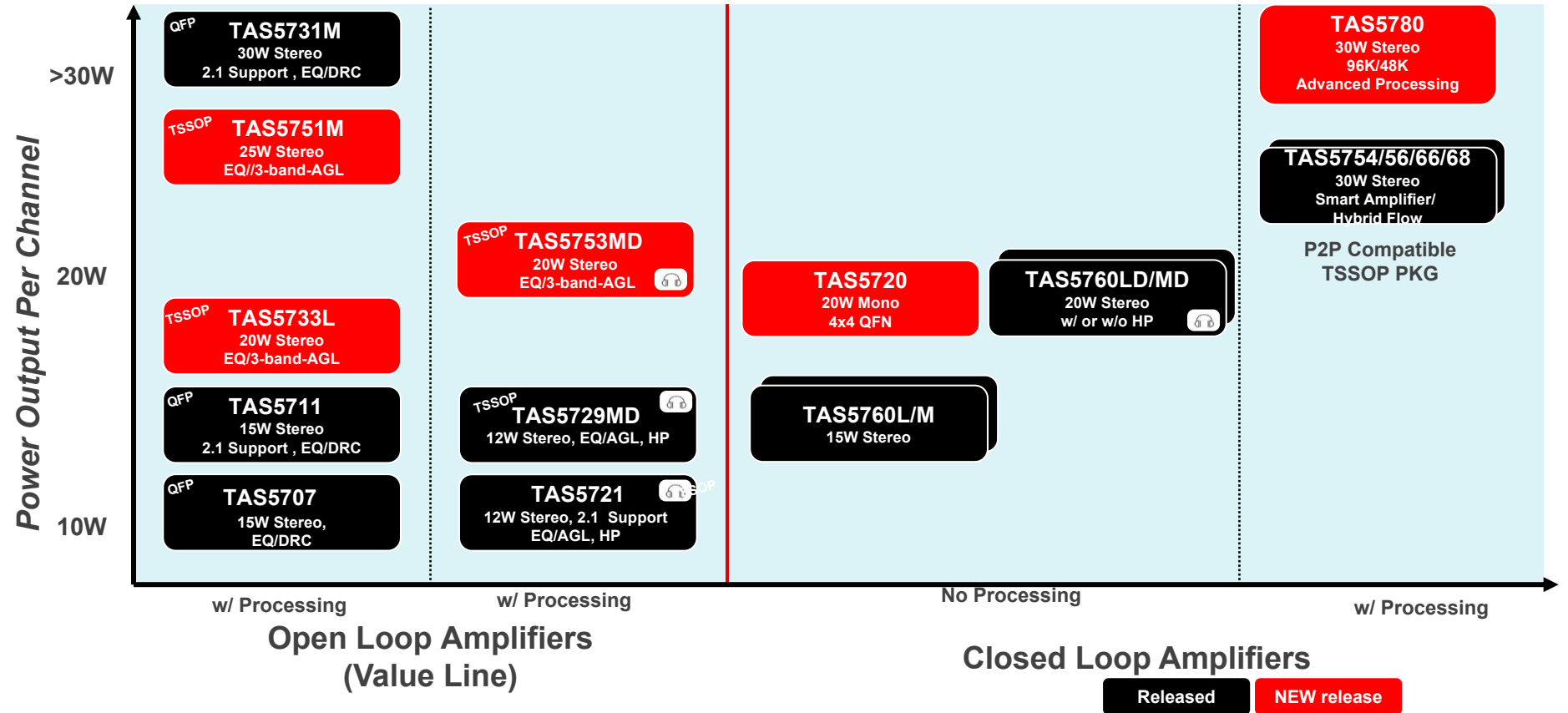
- Download the [TAS6424-Q1 data sheet](#).
- Watch a short video that outlines the [benefits of TAS6424-Q1](#).
- Request a [TAS6424-Q1 evaluation module](#)
- Read the latest Blog [Switching above the AM band](#)

## Head Unit



See the TAS6424-Q1 at CES in TI's booth at LVCC North Hall, #N118.

# Digital Input Mid-Power Consumer Class-D Amplifiers

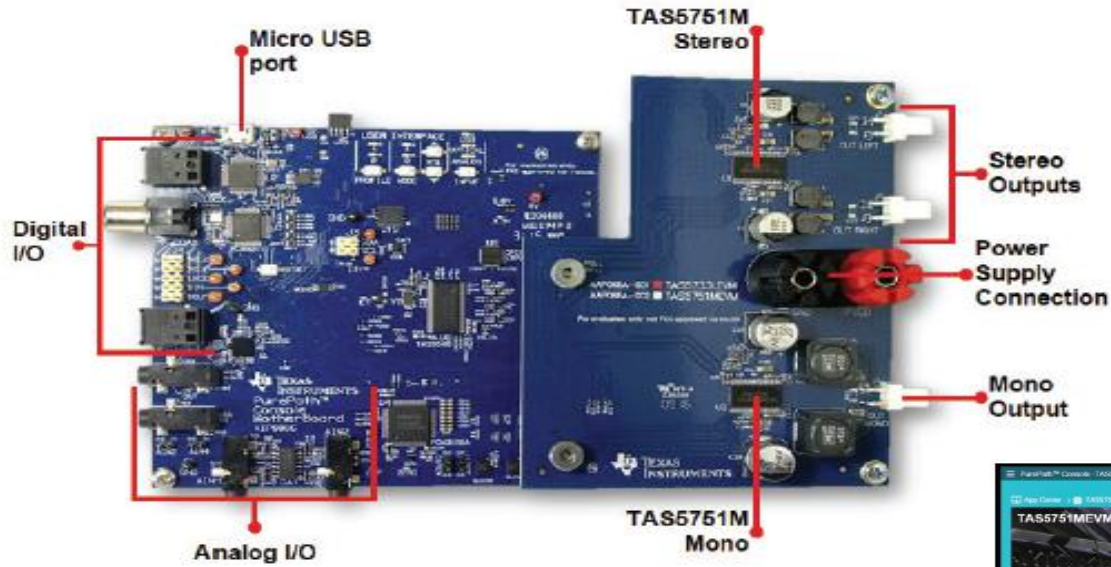


# New Digital Input “Value Line” Amplifiers

	TAS5707	TAS5711	TAS5733L	TAS5751M	TAS5753MD
Supply Range (V)	8-26	8-26	8-16.5	8-26.4	8-26.4
Output Power (W) BTL into 8Ω	20	20	15	35	35
DSP Features	14 BQ 1-band DRC	21 BQ 1+1band DRC	30BQ 3+1 band DRC	30BQ 3+1 band DRC	30BQ 3+1 band DRC
Extra Features	N/A	PBTL+2.1	PBTL	PBTL	PBTL + HP
P2P	*	*	**	**	X
Package	HTQFP	HTQFP	HTSSOP	HTSSOP	HTSSOP
BOM Cost	Low	Low	Lower	Lower	Lower

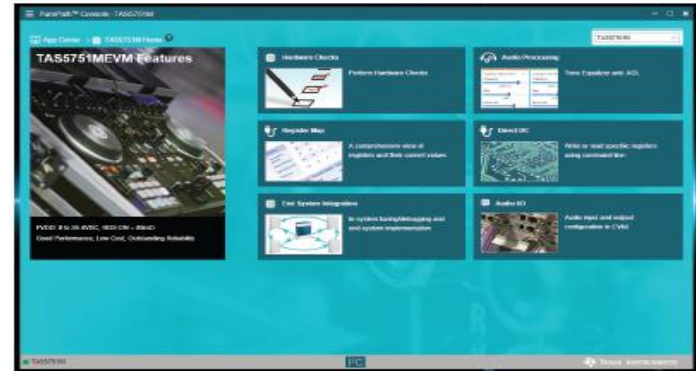
Best for new designs

# Easy-to-use Tools – TAS5733L TAS5751M



EVM Board

PurePath Console 3  
GUI



# Analog Input Class-D Value Line

	TPA3110/3	TPA3140/4	TPA3136/7
Supply Range (V)	8-26	4.5-14.4	4.5-14.4
Output Power (W)	15/6	10/6	10/6
AGL Control	Limiter	Threshold Attack/release	Limiter
PBTL Mode	Y	Y	Y
EMI Performance	Baseline	>10dB better	>10dB better
P2P	Y	N	Y
Package	HTSSOP	HTSSOP	HTSSOP
BOM Cost	Low	Lowest	Lowest

Best for new designs



# TPA3136D2

## Inductor Free Class-D Audio Amplifier

### Features

- Inductor Free operation
- Power Limiter Speaker Guard
- Closed Loop Power Stage
- Speaker Guard DC Protection
- Very Low Idle Losses
- Low Voltage Support
- 28 pin TSSOP package Support

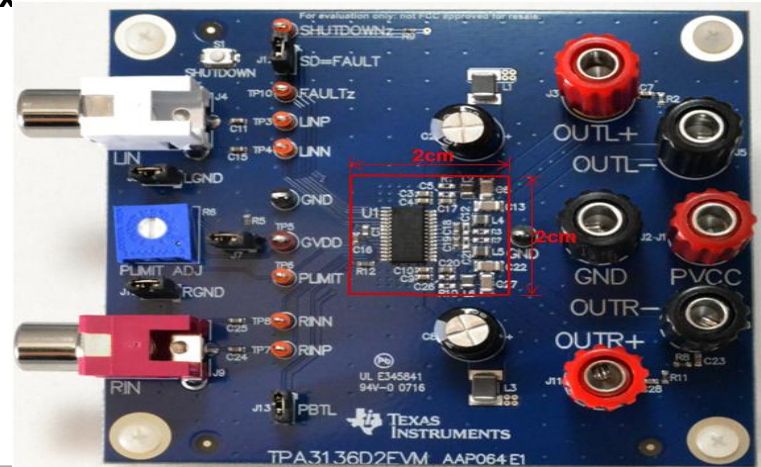
TPA3137 is 6Wx2

### Applications

- TV
- BT Speakers
- Wireless Speakers
- Mini Speakers
- USB Speakers
- Musical instruments

### Benefits

- Very Low BOM cost and small board space
- Speaker protection
- High Fidelity Audio, Low PSRR
- Protect speaker against DC failure
- Ideal for battery operation
- Works for 12V and 2S battery systems
- Flexibility



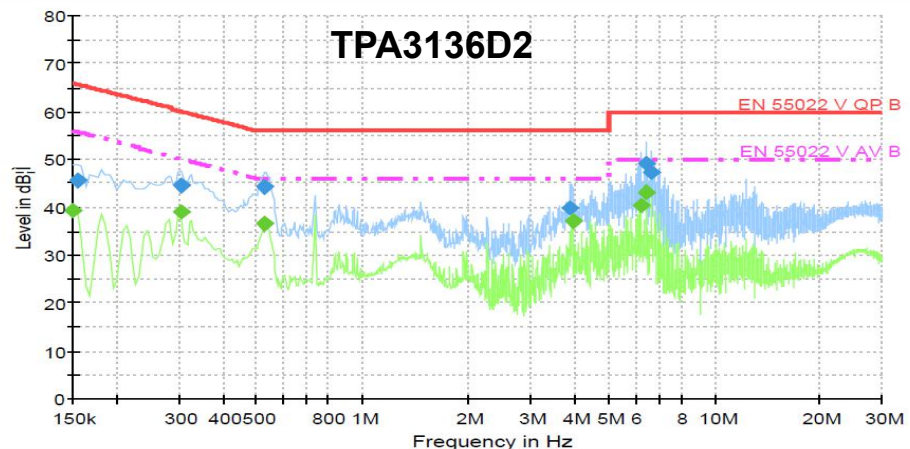
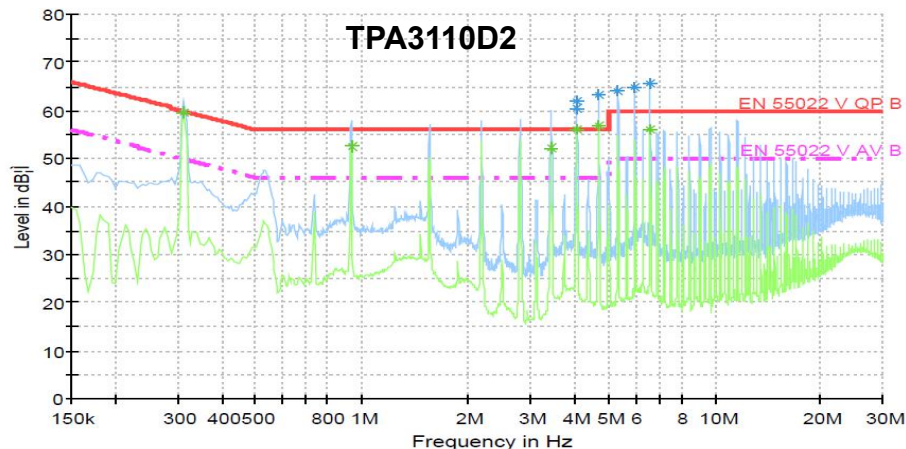
# TPA3136 EMI Improvement

Vs Previous Generation

(Filter=600ohm@100MHz bead+2.2nF capacitor)

EN55022 B

EN55022 B



20dB improvement!

# TPA3128D2



P2P with TPA3118

## Ultra low idle loss Class-D Audio Amplifier

### Features

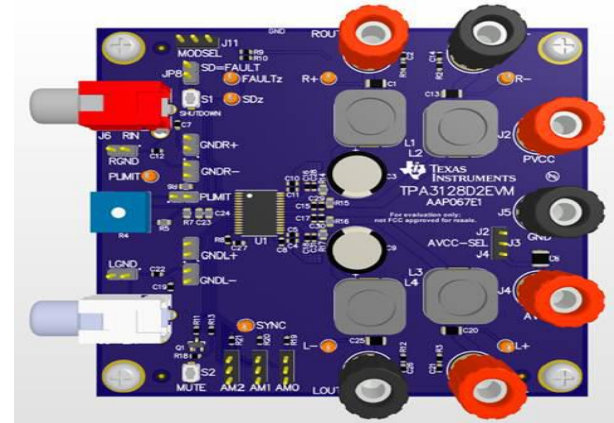
- deliver 2X30W into 8 ohm load
- Support Novel Hybrid mode Saves Power
- P2P compatible with TPA3118
- Lower idle and shut down current
- Lower idle loss (300KHZ Fsw supported)
- Improved radiative EMI
- Separate AVCC/PVCC supply
- Individual channel shutdown

### Benefits

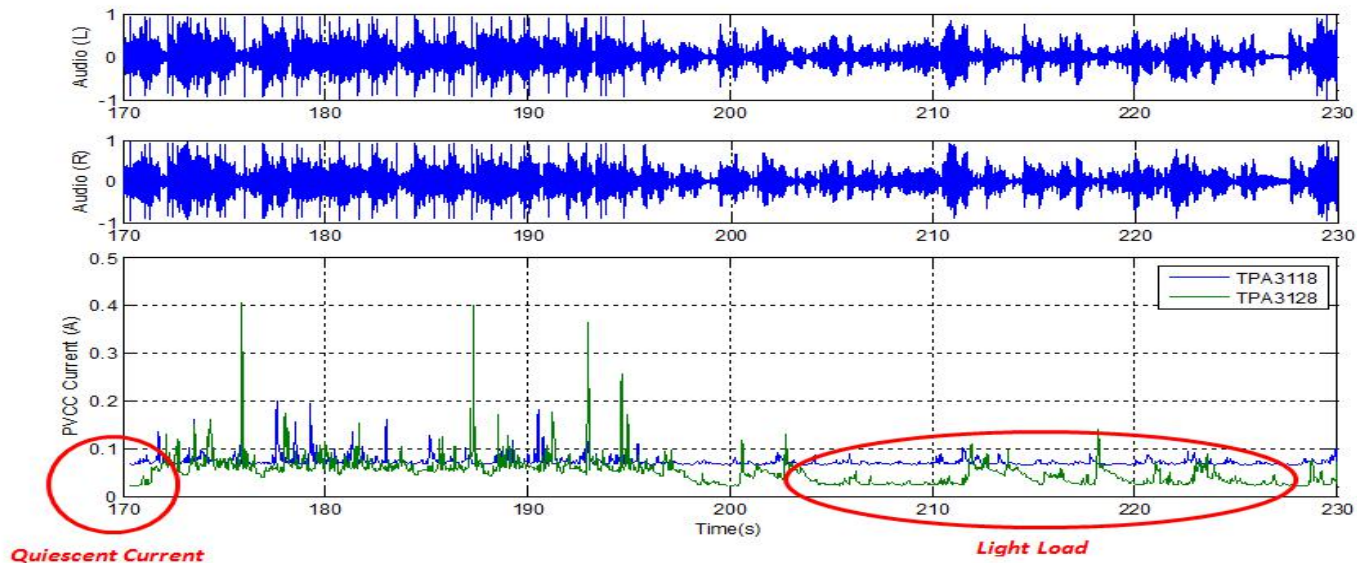
- Longer battery time
- Speaker protection
- High Fidelity Audio, Low PSRR
- Protect speaker against DC failure
- Ideal for battery operation
- Works for 12V and 2S battery systems
- Flexibility

### Applications

- TV
- BT Speakers
- Wireless Speakers
- Mini Speakers
- USB Speakers
- Musical instruments



## Novel Hybrid Mode Saves Power Compared to BD Mode



Music under Test: Toni Braxton - I Love Me Some Him 02:50-03:50

Overall power consumption drops by **30.7%** (from 4.33As to 3.00As), which means users can enjoy music for **1.4x** of time\*.

# High Power Amps

## Speaker Protection for Mobile and Building Automation

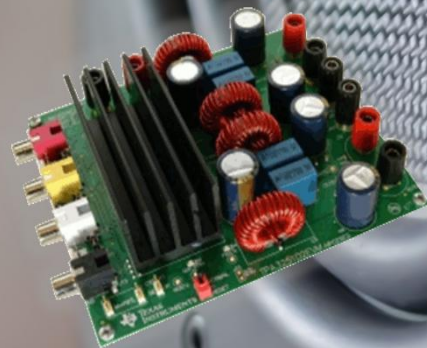
[For more information about TI audio click here](#)

# Experience the TPA32xx

- Experience the most realistic sound on the market

Device	Max Power to BTL/Ch (W) Stereo	Max Power to PBTL (W) Mono
<b>TPA3255</b>	315	605
<b>TPA3251</b>	220	355
<b>TPA3250</b>	130	190
<b>TPA3245</b>	145	230
<b>TPA3244</b>	110	160

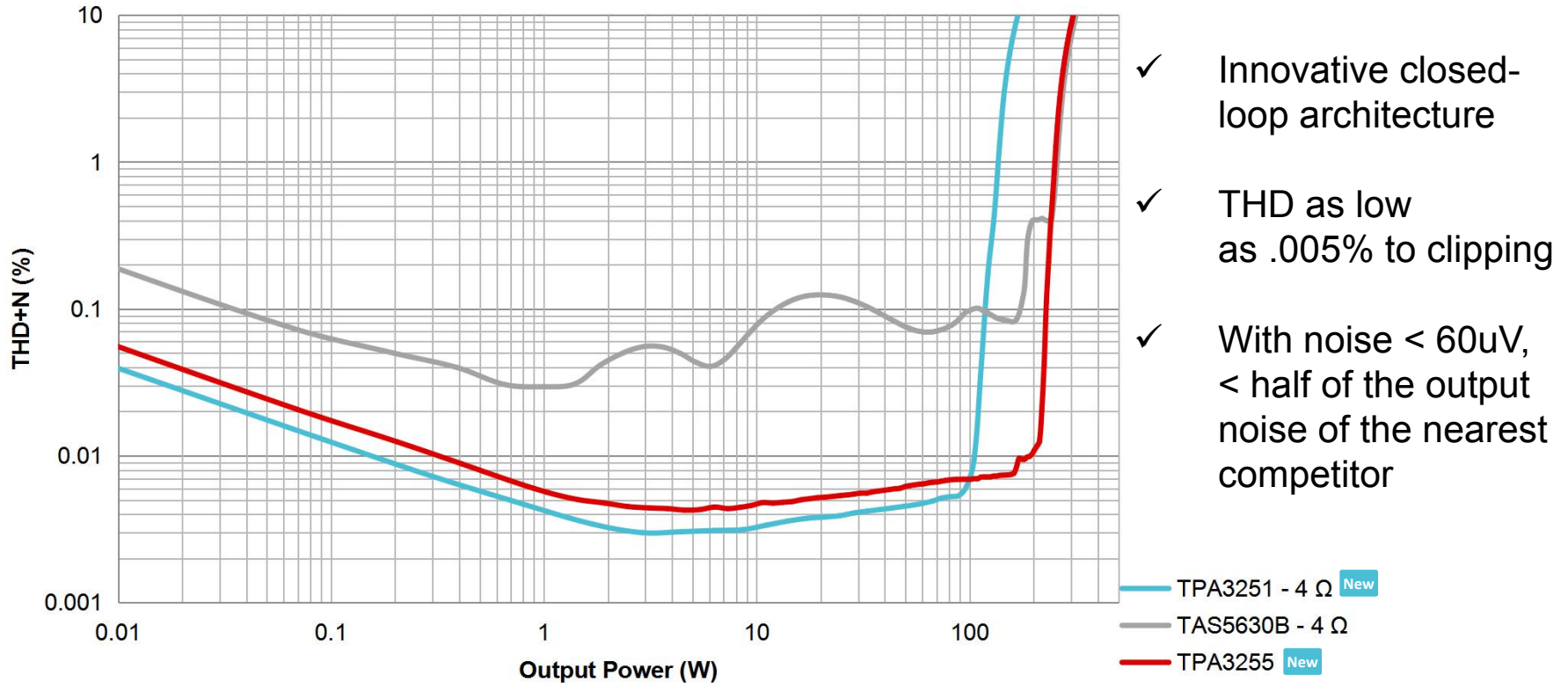
- Best Noise & THD Performance  
< 0.001% THD, < 60uV noise
- EVM Includes:
  - TPA32xx Device
  - Output Filter & passive components optimized for superb performance
- Ask about a demo at your location





# Unrivalled Audio Performance & Power

TPA32xx – THD+N vs Output Power - BTL Single Channel



# Smallest Solution Size – Integrated Protection

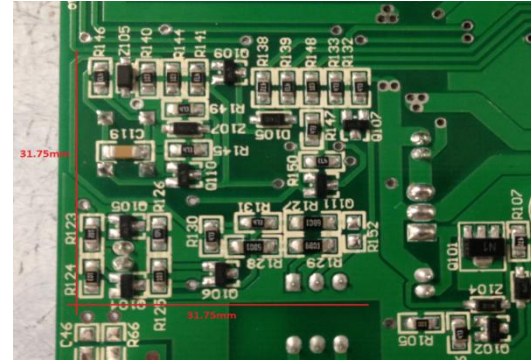
Save space, component costs and assembly costs

## TPA3251 with integrated protection

- Clipping Detection
- Over-current protection
- Cycle-by-Cycle Current Limit
- Over temperature Warning (OTW)
- Over temperature Shutdown (OTE)
- Under voltage
- DC Protection (BTL)
- Pin to Pin short (PPSC)

**No additional components required**

## Compared with a discrete Class-D



Protection Circuitry: 31.75mm x 31.75mm

**1008 mm<sup>2</sup>**

Additional Component Area



# Low Power Amps

## Speaker Protection for Mobile and Building Automation

[For more information about TI audio click here](#)

# Where to find Low Power Audio Amps

## Building Automation

Thermostat



Video Doorbell



Video Surveillance



Smart Lock



## EPOS



## Automotive

Telematics – Navigation + eCALL



## Other Industrial

Land Mobile Radio



# Cost & Performance

	Class A/B	Class D	Class D Boosted	Class D Boosted Smart Amp
	<b>TPA6211A1</b>	<b>TPA2011D1</b>	<b>TPA2015D1</b>	<b>TAS2555</b>
<b>Input Signals</b>	Fully Differential / Single	Differential/ Single	Differential /Single	I2S
<b>Input, Digital or Analog</b>	Analog	Analog	Analog	Digital
<b>Channels</b>	Mono	Mono	Mono	Mono
<b>Output Signals</b>	Fully Differential	BTL	Differential	Fully Differential
<b>Recommended Supply Voltage (V)</b>	2.5-5.5	2.5-5.5	2.5-5.2/5.4-6	2.9-5.5
<b>Output Power (W)</b>	2.45   2.22   1.36	3.24   2.57   1.80   1.46	1.2   1.5   1.7	3.7   4.5   5
<b>Switching Frequency (kHz)</b>	-	250-350	560-640	1770
<b>DC Offset Voltage (mV)</b>	0.3	1	10	2.5
<b>Quiescent Current (mA)</b>	4	1.5	1.7	-
<b>Shutdown Current (µA)</b>	0.01	0.1	-	-
<b>Noise Floor Gain (µV<sub>RMS</sub>)</b>	12	20	24.8	-
<b>PSRR (dB)</b>	80	86	85	110
<b>Auto-Short Circuit Recovery</b>	No	Yes	Yes	Yes
<b>Features</b>	Minimal pop and only 20mm PCB board size.	Mono. Auto-recovering short circuit protection	Mono. Adaptive boost and battery tracking SpeakerGuard SGC	Integrated speaker protection

# Smart Amp technology

Smart Amp | Mid-Power x

www.ti.com/lscds/ti/analog/audio/smart-amp.page

Overview Applications Tools & software Technical documents Support & training **Smart amp**

## Smart amp

### Smart Amp Overview

- What are TI Smart Amps?
- Conventional vs Smart Amp systems
- How do Smart Amps protect?
- Features & benefits of Smart Amps

[Learn more >](#)

### Mid-power Smart Amps (5-50W)

- What is a mid-power Smart Amp?
- Architecture
- Parametric and product data

[Learn more >](#)

### Low-power Smart Amps (<5W)

- What is a low-power Smart Amp?
- Architecture
- Parametric and product data

[Learn more >](#)

### PurePath™ Console 3

- What is PurePath™ Console 3?

[Learn more >](#)

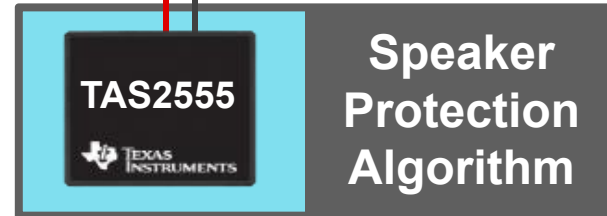
www.ti.com/lscds/ti/analog/audio/smart-amp.page#lowpower

<http://www.ti.com/lscds/ti/analog/audio/smart-amp.page>

# Integrated Smart Amps: Connected Home

## Value Proposition

- Double the SPL without changing product appearance or speaker location
- Speaker protection
- Advanced tuning with Smart EQ features
- Matches peak energy to signal
- Low quiescent and standby current
- Well matched for wireless and battery powered systems
- Possible cost savings in transducer



**Increased customer satisfaction and peace of mind**

# Gaining access to TAS2555 Materials

- TAS2555 information on TI.com is limited to first page of datasheet and package information
- Access to complete Design-In resources is monitored and approved to known customers and partners

TI Home > Semiconductors > Audio > Low-Power Amplifier > Speaker Amplifier Class AB/Class D >

## TAS2555 (ACTIVE)

### 5.7W Class-D Mono Audio Amplifier with Speaker Protection

[TAS2555 5.7-W Class-D Mono Audio Amplifier with Class-H Boost and Speaker Sense \(Rev. A\)](#)

**Description & parameters** | [Online datasheet](#) | [Technical documents](#) | [Tools & software](#) | [Sample & buy](#) | [Compare](#) | [Quality & packaging](#) | [Support & community](#)

[Description](#) | [Features](#) | [Parameters](#) | [Diagrams](#) | [Related end equipment](#) | [Companion products](#)

#### Special note

To request a full datasheet or other design resources: [Request TAS2555](#)

#### Description

The TAS2555 is a state-of-the-art Class-D audio amplifier which is a full system on a Chip (SoC). The device features a ultra low-noise audio DAC and Class-D power amplifier which incorporates speaker voltage and current sensing feedback. An on-chip, low-latency DSP supports Texas Instruments SmartAmp speaker protection algorithms to maximizes loudness while maintaining safe speaker conditions.

The device can be used easily with any processor with an I2S output and stereo

[View more](#)

#### Features

- Ultra Low-Noise Mono Boosted Class-D Amplifier
- 5.7 W at 1% THD+N and 6.9 W at 10% THD+N into 4-Ω Load from 4.2-V Supply
- 3.8 W at 1% THD+N and 4.5 W at 10% THD+N into 8-Ω Load from 4.2-V Supply
- Output Noise for DAC + Class-D(ICN) is 15.9 μV

TAS2555 Product Brief  
- Features/Package

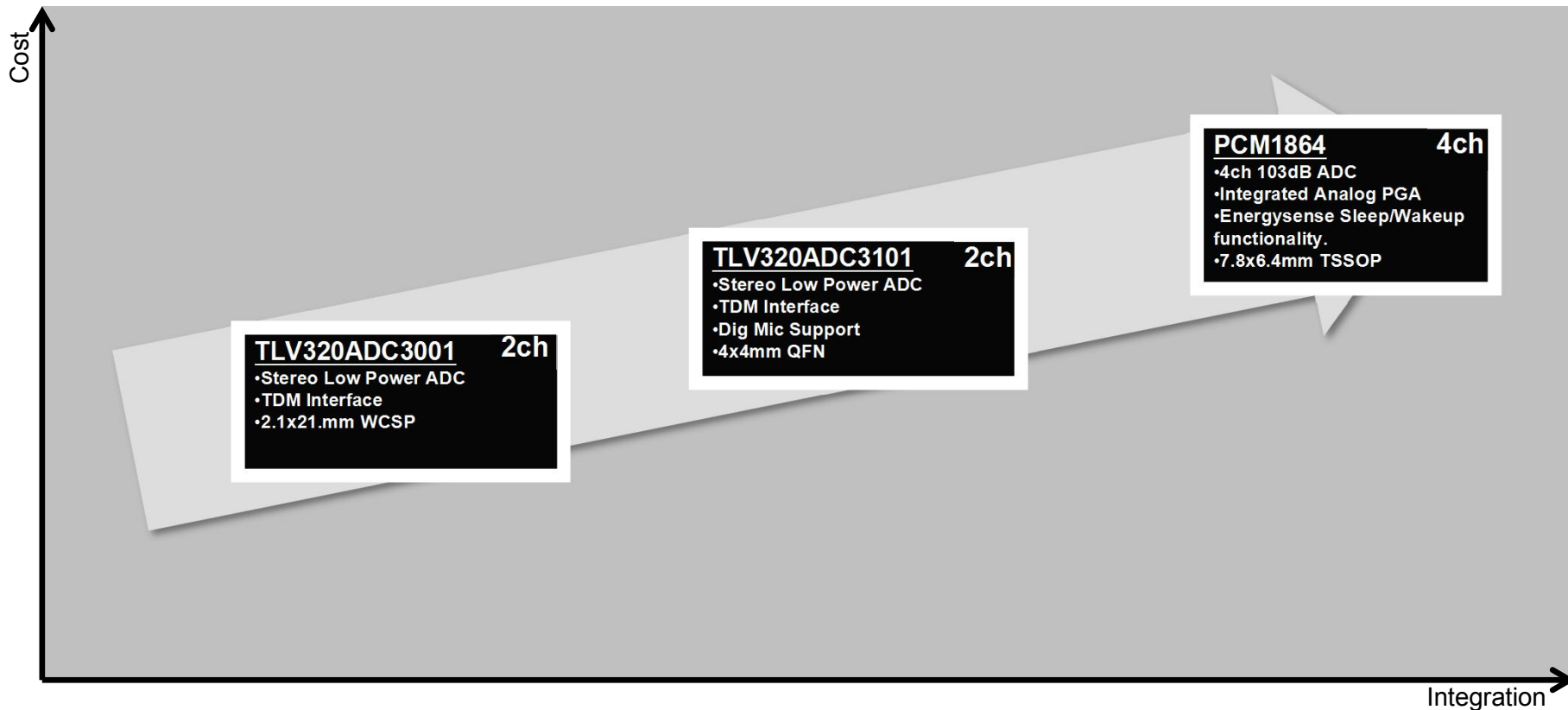
Registration Link

[For more information about TI audio click here](#)

# Voice Capture Front End

[For more information about TI audio click here](#)

# Voice Capture Front Ends (ADC's with mic pre-amps)





# Solution Comparison

## Choose **TLV320ADC3101** if:

- Power Consumption is critical
- Lowest cost for 1-2 channels
- Need 'distributed' hardware

## Choose **PCM1864** if:

- Most cost effective for 4-8 channels
- Need the best sound recording quality (SNR)

# Q & A