

# Low Power Smart Amps

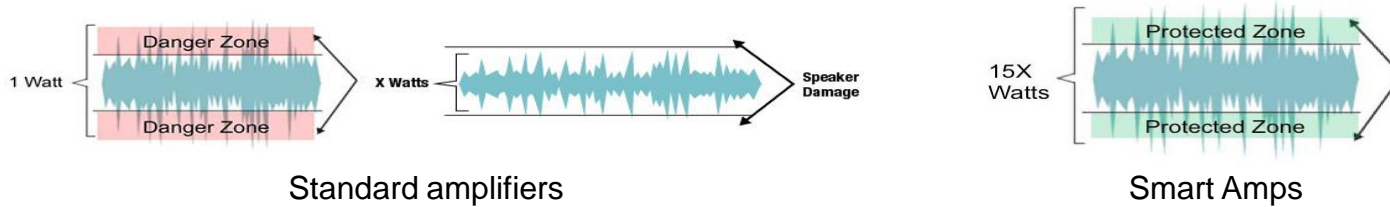
Speaker Protection for Mobile and Building Automation

January, 2017

SLYW059

# Smart Amp technology

- Built upon TI's amplifier technology with advanced modeling and algorithms to get the best sound from your micro-speaker while protecting 100% of the time
- Smart Amps utilize voltage and current sensing to continually monitor your micro-speaker operation in order to drive output enabling audio peaks for better audio quality



- Voltage and current sensing enables protection from both over-excursion and voice-coil temperature heating
- Understanding of target speaker required to safely produce quality audio without damage
- Full verification, reliability and production steps needed for full protection

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# TI Smart Amp Solutions

## Integrated Smart Amps

- Complete system on chip includes:
  - Low-noise DAC
  - Class-D Amplifier
  - I/V sense feedback
  - Low-latency DSP
- All speaker protection processing done on-chip
- Highly flexible solution only requires I2S input
- Reduced time to market

## Non-Integrated Smart Amps

- Class-D Amplifier with I/V sense and low noise DAC
- Speaker protection algorithm resides on host processor
- Lower cost implementation
- Integration on either host or codec is possible
- Combinations of integrated and non-integrated can be utilized for low cost stereo implementations

**TI is the only provider of both integrated and non-integrated Smart Amps!**

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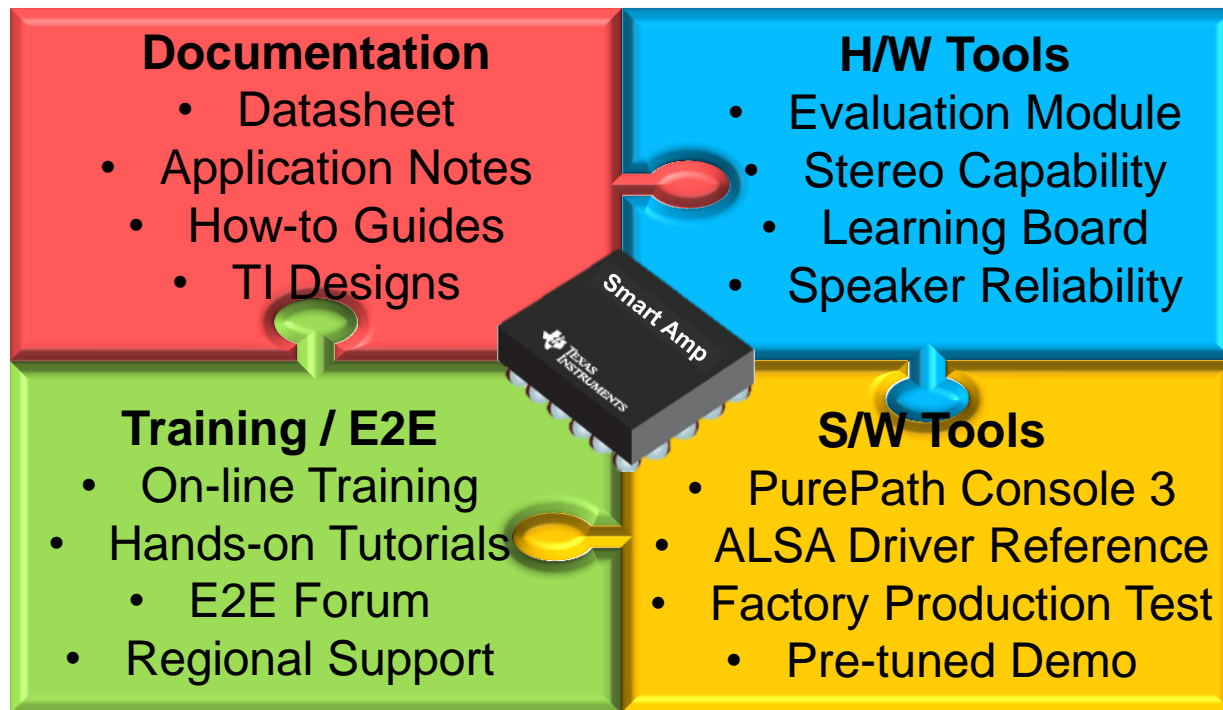
# PurePath Console 3 (PPC3)

- Single, easy to use tool for Smart Amp integration
- Always up to date with notifications for platform / application updates
- Step by step wizard for speaker characterization
- SmartEQ for quick tuning evaluation
- 10 Bi-quads & 3 band prioritization for manual tuning adjustments
- Track temperature and excursion performance during verification
- Built-in audio player and tuning snapshots
- In-system tuning capable



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# Smart Amp Complete Product Support



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# 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



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TEXAS INSTRUMENTS

# Smart Amps With Integrated Processing

## TAS2555

5.7W Smart Amp w/ Integrated DSP

- Fully integrated smart amp solution includes on-chip DSP
- Built-in speaker current and voltage sensing
  - Full speaker protection while maximizing sound quality and SPL
- Class-D Amplifier (@ 4.2V / 1% THD+N)
  - 5.7W output power into 4Ω
  - 3.8W output power into 8Ω
- 8.5V Multi-level Class-H boost converter
  - Highly efficient (87% @ 700mW/8 Ω)
- Industry's best analog performance:
  - Idle Channel Noise of 15.9uV
  - 111dB SNR
  - THD-N at -90dB
  - PSRR 110dB
- 3.47 mm x 3.23 mm, 42-ball WCSP

LPSA1.0 Algo



TAS2555 is leading IV Speaker Protection Solution for PCs

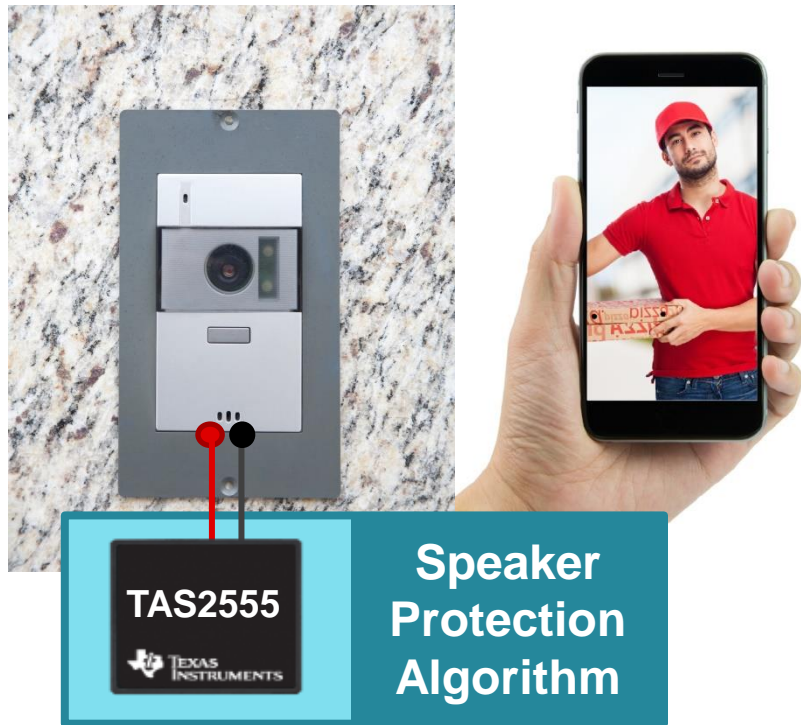
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# Integrated Smart Amps: Connected Home

## 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

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# 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

The screenshot shows the Texas Instruments website interface. At the top is the TI logo and a search bar. Below is a navigation bar with links: Products, Applications & designs, Tools & software, Support & community, Sample & buy, and About TI. The main content area displays the product page for the TAS2555, which is a 5.7W Class-D Mono Audio Amplifier with Speaker Protection. A red arrow points from the text 'TAS2555 Product Brief - Features/Package' to the 'Sample & buy' link in the navigation bar. Another red arrow points from the text 'Registration Link' to the 'Request TAS2555' link in the 'Special note' section. The page also includes tabs for 'Description & parameters', 'Online datasheet', 'Technical documents', 'Tools & software', 'Sample & buy', 'Compare', 'Quality & packaging', and 'Support & community'. The 'Description' section provides a brief overview of the device, and the 'Features' section lists key specifications.

**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)

**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

**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- $\Omega$  Load from 4.2-V Supply
- 3.8 W at 1% THD+N and 4.5 W at 10% THD+N into 8- $\Omega$  Load from 4.2-V Supply
- Output Noise for DAC + Class-D(ICN) is 15.9  $\mu$ V

TAS2555 Product Brief  
- Features/Package

Registration Link

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# Low Power Audio Portfolio

	Products	Benefits	Target Applications
Catalog Amp	<b>Low Power Analog Input Class D Amps</b> <a href="#">TPA2028D1</a> (Mono, Smart Gain AGC/DRC) <a href="#">LM48511</a> (Mono) <a href="#">LM48411</a> (Stereo) <a href="#">TPA2010D1/11D1/37D139D1</a> (Mono) <a href="#">TPA2013/2015D1</a> ( Mono, Boosted)	<ul style="list-style-type: none"> <li>✓ Low Power Consumption (1-3W)</li> <li>✓ Suitable for battery powered applications</li> <li>✓ High quality audio for voice playback and capture</li> <li>✓ Suitable for noisy environments</li> <li>✓ Analog input with Class AB/D configurations</li> </ul>	<ul style="list-style-type: none"> <li>- Surveillance Cameras</li> <li>- Audio / Video Control System</li> <li>- Security systems</li> <li>- Video doorbell / Recorder</li> <li>- Voice Evacuation</li> <li>- Notification appliances</li> </ul>
	<b>Low Power Analog Input Class AB Amps</b> <a href="#">TPA6211A1</a> (Mono)  <a href="#">TLV320DAC3100</a> (Converter)		
Smart Amp	<a href="#">TAS2555</a> 5.7-W Class-D Mono Audio Amplifier with Class-H Boost and Speaker Sense	<ul style="list-style-type: none"> <li>✓ Integrated speaker protection</li> <li>✓ Continuous diagnostic</li> </ul>	<ul style="list-style-type: none"> <li>- Video doorbell / Recorder</li> <li>- Surveillance Cameras</li> </ul>
	<a href="#">TAS2560</a> 5.7-W Class-D Mono Audio Amplifier with Integrated I / V Sense	<ul style="list-style-type: none"> <li>✓ Smaller, lighter and more linear speakers</li> <li>✓ Lower overall system cost &amp; Better sound quality</li> </ul>	<ul style="list-style-type: none"> <li>- Audio / Video Control System</li> <li>- Security systems</li> <li>- Notification appliances</li> </ul>

	Class A/B	Class D	Class D Boosted	Class D Boosted Smart Amp
	TPA6211A1	TPA2011D1	TPA2015D1	TAS2555
Input Signals	Fully Differential / Single	Differential/ Single	Differential /Single	I2S
Input, Digital or Analog	Analog	Analog	Analog	Digital
Channels	Mono	Mono	Mono	Mono
Output Signals	Fully Differential	BTL	Differential	Fully Differential
Recommended Supply Voltage (V)	2.5-5.5	2.5-5.5	2.5-5.2/5.4-6	2.9-5.5
Output Power (W)	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
Switching Frequency (kHz)	-	250-350	560-640	1770
DC Offset Voltage (mV)	0.3	1	10	2.5
Quiescent Current (mA)	4	1.5	1.7	-
Shutdown Current (µA)	0.01	0.1	-	-
Noise Floor Gain (µV <sub>RMS</sub> )	12	20	24.8	-
PSRR (dB)	80	86	85	110
Auto-Short Circuit Recovery	No	Yes	Yes	Yes
Features	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

# TPA6211A1

## 3.1W Mono, Fully Differential, Class-A/B Audio Amplifier

### Features

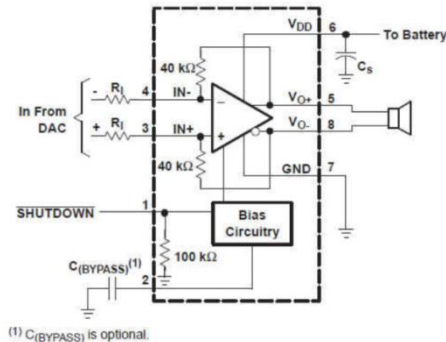
- 3.1W Output Power
- Fully differential inputs/outputs
- Low Supply current: 4mA Typical / 0.01mA Shutdown
- Small package and small BOM (3 ext. components)
- -80dB PSRR and 2.5 – 5.5V Supply Voltage; -63dB CMRR
- DRB: 8-pin, 3 x 3mm, 0.65mm pitch QFN

### Benefits

- Drive 3Ω speakers @ 5V
- Better audio from source to speaker
- Low power consumption
- Requires only 20mm<sup>2</sup> total PCB space
- Direct battery operation
- Input capacitors not required

### Applications

Handset: Smartphone  
Consumer Audio Electronics



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# TPA2011D1

## 3.2W Class-D Audio Amp with Short-Circuit Protection

### Features

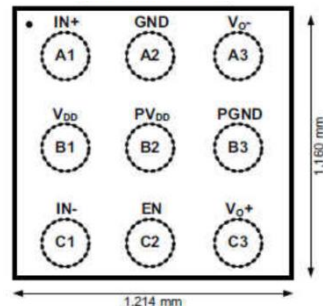
- Integrated DAC Noise Filter
- 3.2 W into 4 W at 5.0 V (10% THD)
- 2.5 V to 5.5 V supply voltage
- Fully differential inputs
- High efficiency ~95%
- 1.5mA Quiescent Current (3.6V supply)

### Benefits

- Reduces DAC out-of-band noise by 82% without external filter
- 22% Louder audio than current generation of mono Class-D speaker
- Direct connection to battery
- Excellent system noise rejection
- Improves battery life

### Applications

Handset: Multimedia  
GPS: Personal Navigation Device  
Portable Media Player



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# TPA2015D1

## 2W Class-D Audio Amplifier with Adaptive Boost and Battery Tracking SpeakerGuard AGC

### Features

- 2.0 W into 8Ω at 3.6 V (6% THD)
- Battery tracking SpeakerGuard and AGC
- Fixed Gain settings (6, 15, 20dB)
- Supply Voltage: 2.3V to 5.2V
- Up to 95 PSRR
- YZH: 16-ball, 2 x 2mm, 0.5 mm pitch wCSP

### 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

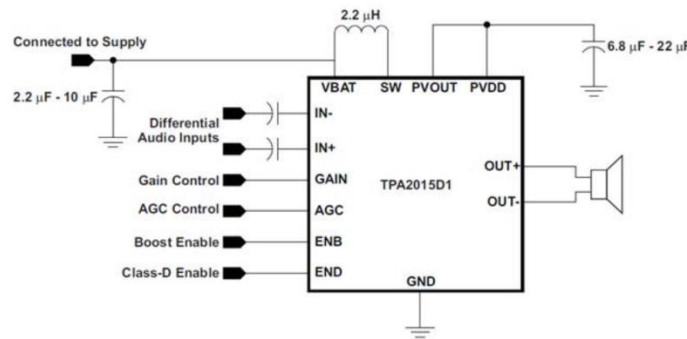
Handset: Smartphone

Notebook PC

Docking Station

Personal Navigation Devices

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# TAS2555

## 5.7W Class-D Smart Amplifier System on Chip

### Features

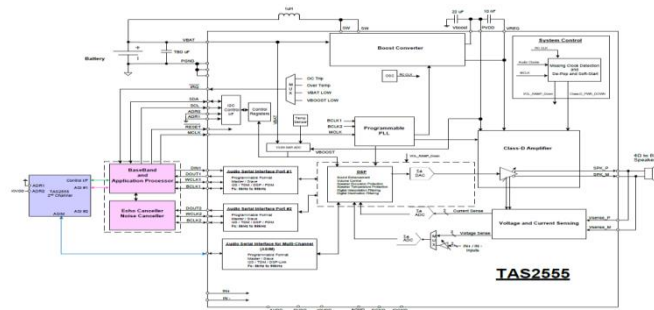
- Low noise DAC with Class D Amplifier
  - 3.8W output power into 8 $\Omega$  at 4.2V (1% THD+N)
  - 5.7W output power into 4 $\Omega$  at 4.2V (1% THD+N)
- ICN (DAC + Class-D) 15.5 $\mu$ V
- Integrated Multi-level Class-H Boost converter
- System on Chip with built-in Real-time DSP
- Support for Stereo Applications
- On-chip brown out detection
- Noise/Echo Cancellation (8, 16, 24kHz)
- Built-in Automatic Gain Control
- I2C or SPI control interfaces
- Small 3.2 x 3.5mm, 0.5mm, 42-ball WCSP

### Benefits

- Louder and clearer audio
- Maximizes energy efficiency without audio compromise
- Smart Amplifier algorithm does not require external processor
- Use an additional TAS2555 for stereo sound
- Reduces audio output to minimize battery drain during periods of low battery voltage
- Perfect for speakerphone/headphone applications
- Minimizes clipping events
- Standard interfaces capable of programming all features
- Space-saving package fits multiple applications form-factor requirements

### Applications

Handset/Smartphone  
Tablet  
Notebook PC  
Speakerphone



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# Headphone Audio Amplifiers

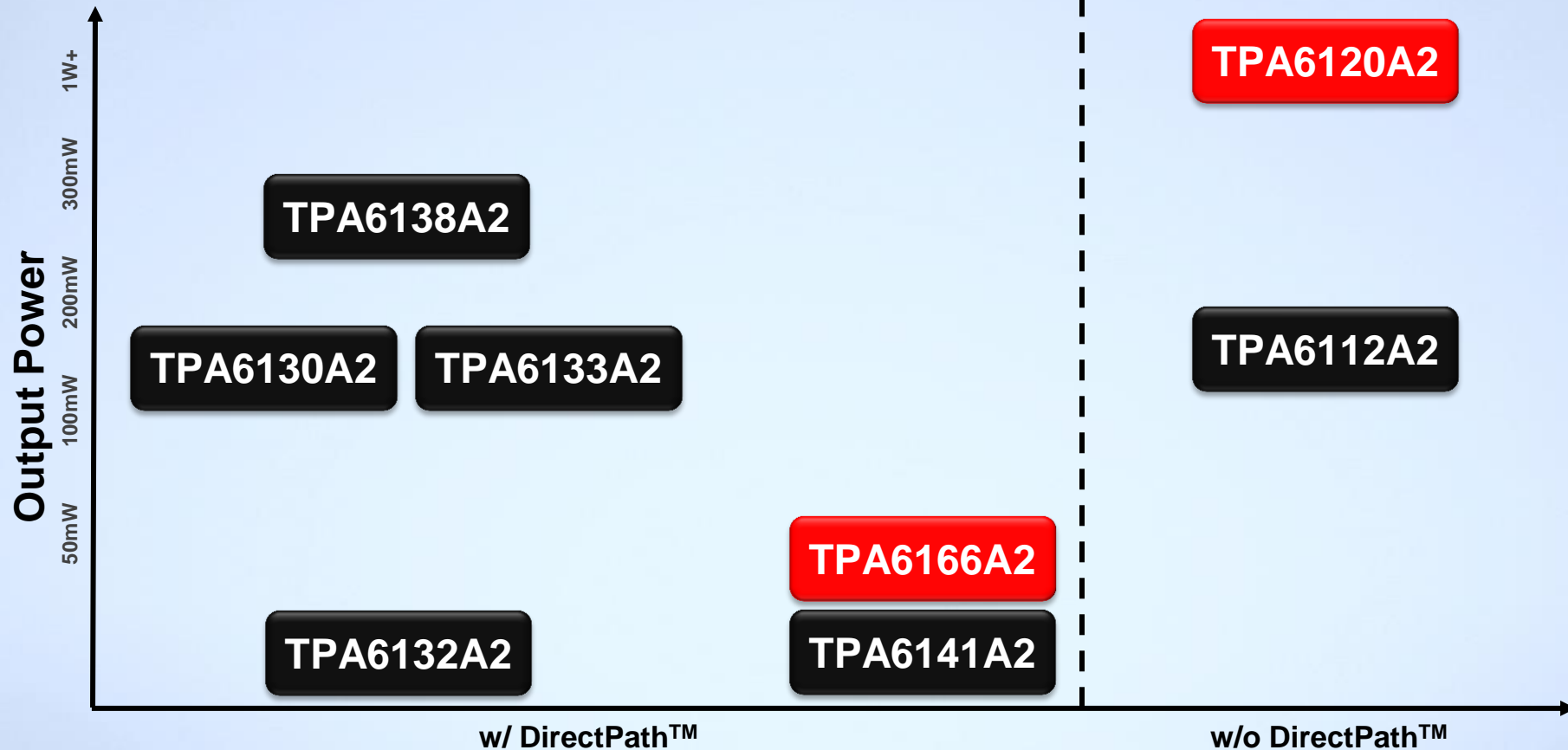
EXISTING

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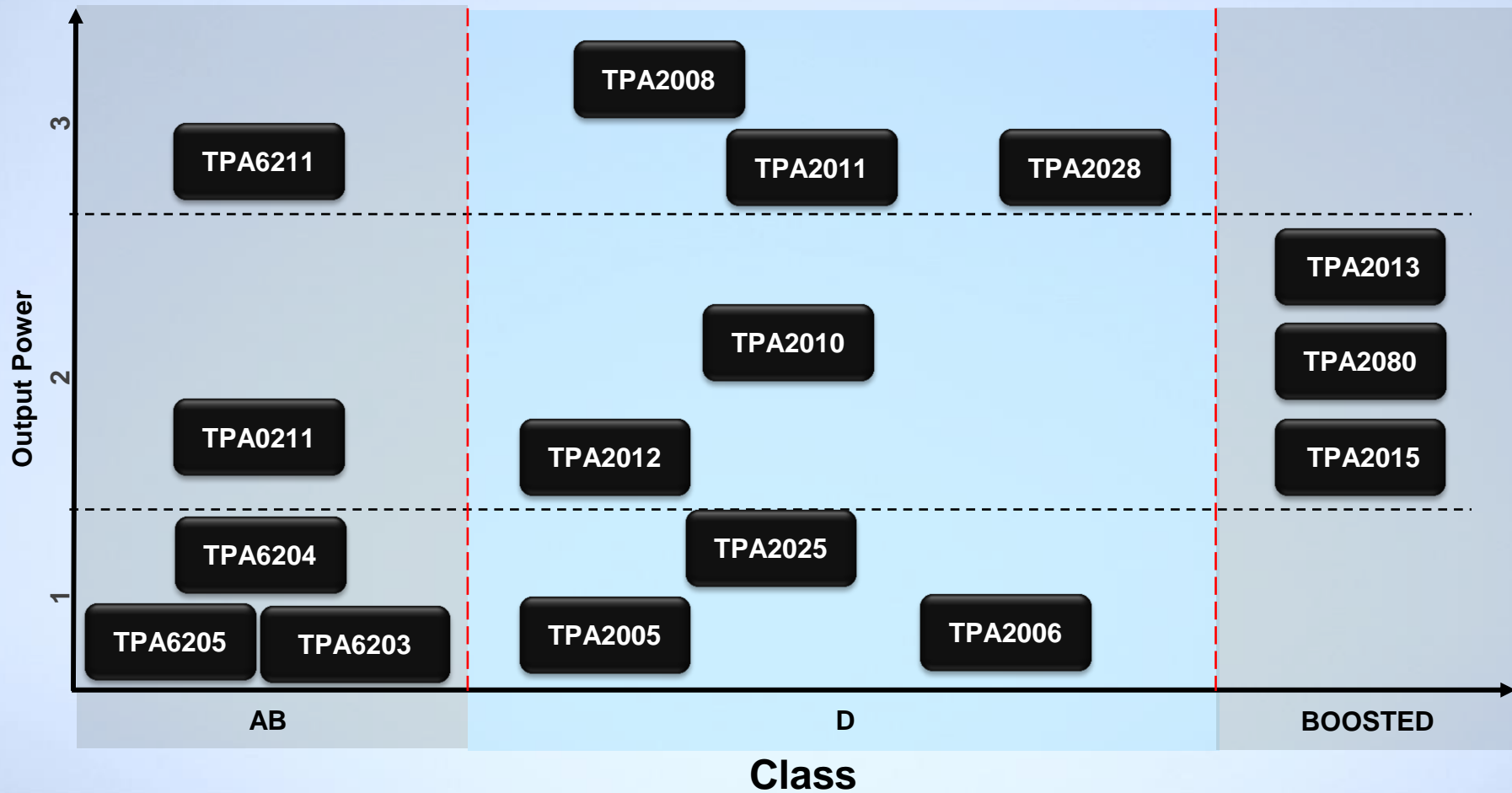
Class  
G

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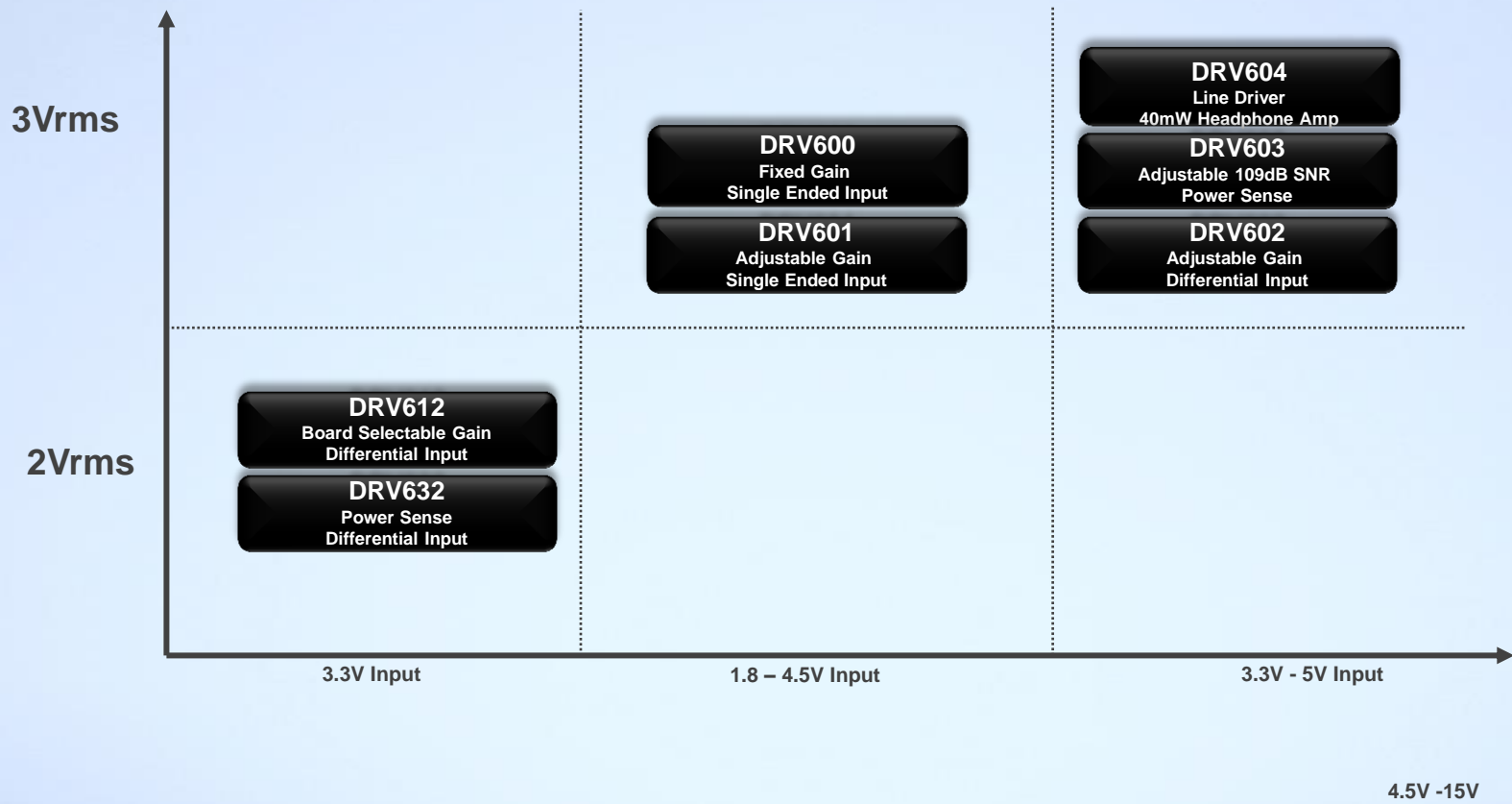


# Low Power Speaker Amplifiers

EXISTING



# Analog Line Driver Portfolio



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### Products

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Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
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Logic	<a href="http://logic.ti.com">logic.ti.com</a>
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### Applications

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Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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