TEXAS INSTRUMENTS

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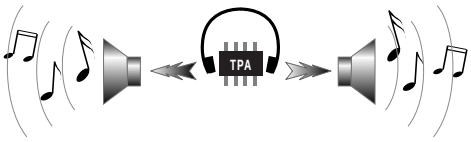
Volume 1

Sine ON

AUDIO POWER AMPLIFIERS



Plug-n-Play Platform Provides Easy Evaluation of All TI Audio Power Amplifiers

Plug-n-Play evaluation kit with TPA0102, DC/DC converter, and microphone mixer modular EVMs.

Texas Instruments is now offering designers an innovative way to evaluate audio power amplifiers. With the new Plug-n-Play concept, engineers can plug in various device modules and play them through the TI evaluation platform to evaluate our entire line of audio power amplifiers.

The Plug-n-Play Base Kit includes an evaluation platform, two 3-W speakers, audio input cable, speaker wire and data manual. The Plug-n-Play Evaluation platform is the heart of the kit, providing the interface to all modular EVMs, the stereo speakers and headphones, audio source and power supply. The platform has three dedicated sockets for testing either two mono audio power amplifiers or one stereo amplifier. There is also a socket for driving headphones, allowing the user to evaluate stereo speaker and headphone drive simultaneously. Provided is a "signal conditioning" section for the user to tailor the platform to their particular application or for use with the microphone/mixer EVM. The platform includes industry standard connectors for the speakers, headphones, power supply, and audio source (CD, tape, etc.) making the system very flexible. For designers of

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Inside:

Plug-n-Play Platform Provides Easy Evaluation of All TI Audio Power Amplifiers

(continued from cover)

battery powered applications, the platform includes a socket for a 9-V battery, which can be used with our high efficiency DC/DC converter EVM to produce either a 3.3-V or 5-V supply for low voltage audio power amplifiers.

The Plug-n-Play platform is compatible with all of TI's current audio power amplifier EVMs. The following modular EVMs are currently available:

TPA4860 - 1-W bridged-tied load (BTL) mono audio power amplifier with headphone interface logic. **($50)**

TPA4861 - 1-W bridged-tied load (BTL) mono audio power amplifier with shutdown in an 8-pin SOIC. **($50)**

TPA302 - 300-mW single-ended (SE) headphone driver with shutdown. **($50)**

TPA0102 - 1.5-W single chip stereo speaker and headphone solution in a PowerPAD TSSOP. **($70)**

TPA1517 - 6-W single-ended stereo audio power amplifier in a PowerPAD SOIC package. **($70)**

DC/DC Converter - A dc-dc buck converter which provides a 5-V or 3.3-V output at up to 2.5 A with an input voltage range of 5.5 V to 12 V. The PWM controller is a TL5001 operating at a nominal frequency of 275 kHz. The TL5001 is configured for a maximum duty cycle of 100% and has short circuit protection built-in. **($70)**

Microphone Mixer - Designed to provide basic volume control and a microphone interface to the Plug-n-Play platform. The module uses a low noise TLC2274 quad CMOS rail-to-rail output op amp. **($70)**

All modules plug directly into the platform. No soldering is needed. This allows the designer to evaluate several different audio power amplifier products with minimal work. This significantly decreases preparation time and allows more time for actual evaluation. Plus, future TI audio power amplifiers will be compatible, allowing you to use this platform as a basis for easy evaluation in the future.

EVM

AT A GLANCE

- All EVM modules plug into platform, no soldering or tools required.
- Input/output jacks available for easy connection to audio source and external speakers.
- Compatible with TPA4860, TPA4861, TPA302, TPA0102, and TPA1517 EVMs.

Audio Power Amplifier Plug-n-Play Basekit (no amplifiers):
➤ $150.00

Audio Power Amp Plug-n-Play Professional Kit (Includes all available EVMs):
➤ $350.00

Individual EVMs range from:
➤ $50.00–$70.00

You can call us at 1-800-477-8924 x5800 to order any or all of the above EVMs.

For technical support, call 972-644-5580

To order documentation, call 1-800-477-8924, ext.3229

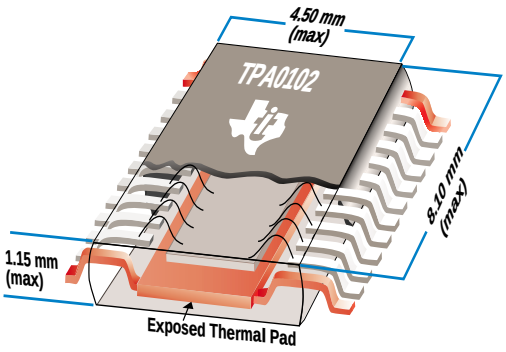
TI's PowerPAD Package Offers Increased Thermal Performance

One big issue that plagues designers who use audio power amplifiers is heat dissipation. If not properly handled, this can seriously hinder either audio power amplifier or system performance. More importantly, with industry trends leaning towards smaller and smaller systems, smaller packages are expected to dissipate more heat.

To address this, Texas Instruments has introduced its patented PowerPAD package. The PowerPAD package uses an exposed thermal pad, which can be directly soldered to your printed circuit board enabling greater design flexibility and increased thermal performance in a standard surface mount package. This improved performance permits higher clock speeds, more compact systems, and more aggressive design criteria.

The PowerPAD packages are available in several standard surface mount configurations. They can be mounted using standard printed circuit board assembly techniques, and removed and replaced using standard repair procedures. This eliminates extra assembly time normally associated with many high thermal performance packages.

This innovative method allows us to provide audio solutions in a much smaller package than competitive devices.



Cross Section view of the 24-pin PowerPAD Package

For more information, a PowerPAD application note can be accessed at the following web address: www-s.ti.com/sc/psheets/slma002/slma002.pdf.

AT A GLANCE

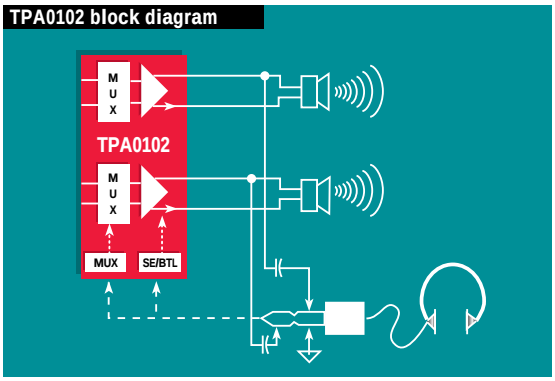
- Package provides exposed thermal pad for increased thermal conduction.
- Exposed thermal pad is mounted on PCB using standard assembly techniques.
- PowerPAD is available in several standard surface mount configurations.
- TPA0102, TPA0103, and TPA1517 offered in the PowerPAD package.

Lowest Distortion 1.5-W Stereo Audio Amplifier

The TPA0102 is a complete stereo audio solution in a single package. The device offers two BTL (bridged-tied load) channels that can deliver 1.5 W of continuous power per channel into 4-Ω loads from a 5-V supply. This is achieved with less than 0.05% THD+N, making it the lowest distortion single-chip solution in the industry for low voltage systems. For applications where speakers are driven as BTL and the line outputs (often headphones) are required to be single ended (SE), the TPA0102 automatically switches into single ended mode delivering up to 500 mW of output power per channel when the SE/BTL input is activated. The TPA0102 provides high power supply rejection (75 dB) for increased fidelity. It is characterized at 3.3-V and 5-V operation and offers shutdown for power-sensitive applications.

The TPA0102 also has an integrated MUX on board to allow two sets of stereo inputs to the amplifier. This is especially valuable when both speakers and headphones are being driven since they may require different signal conditioning to provide the best possible sound to the user.

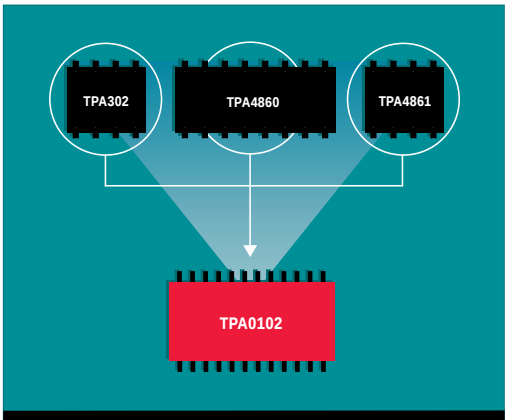
TPA0102 block diagram



TPA0102PWPLE

- $2.53 in quantities of 1000
- Available in TI's patented PowerPAD 24-pin TSSOP (PWP) package

The functionality of the TPA0102 provides a very efficient upgrade path from the TPA4860, TPA4861, and TPA302 amplifiers where three separate ICs are required for stereo speaker and headphone drive. All of these functions are integrated in an ultra thin TSSOP surface mount package saving the designer valuable board



TPA0102 reduces your solution from 3 chips to 1!

EVM

AT A GLANCE

- THD+N < 0.05% @ 1.5 W, 4-Ω load
- High PSRR: 75 dB @ 5 V, 1 kHz
- Power-saving shutdown mode (I_{DD} < 1 µA)
- Automatic switching between stereo speaker and headphone mode
- Unique stereo input MUX adds design flexibility
- Characterized for operation from –20°C to 85°C

For technical support, call 972-644-5580

To order documentation, call 1-800-477-8924, ext.3229

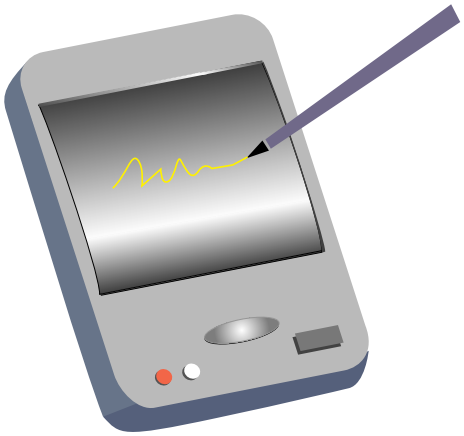
Three Channel 1.75-W Stereo Audio Power Amplifier

TPA0103PWPLE

➤ $2.53 in quantities of 1000

The TPA0103 is a stereo audio power amplifier designed to drive both a mono speaker and stereo headphones in a single package. The mono speaker channel is a Bridge-Tied Load (BTL) configuration for delivering maximum output power from PC power supplies. It provides 1.75 W into a 4-Ω load at 0.05% THD+N. The left/right channel outputs are single ended (SE) and are capable of delivering 535 mW of output power into a 4-Ω load (0.2% THD+N). When driving 32-Ω headphones, the left and right channels will provide 80 mW at 0.05% THD+N.

The TPA0103 provides high power supply rejection (80 dB) for increased fidelity. It is characterized at 3.3-V and 5-V operation and offers two types of shutdown: full shutdown where all channels are powered down, or shutdown of the mono speaker channel for muting during headphone applications. In full shutdown mode, the supply current is 5 µA making the device ideal for battery powered systems. An integrated mux on board allows for independent gain control for headphone and mono speakers.



Previously, to achieve mono speaker and stereo headphone drive, a designer would have to use a TPA4860 and TPA302. The TPA0103 provides both functions in a single 24-pin TSSOP PowerPAD package.

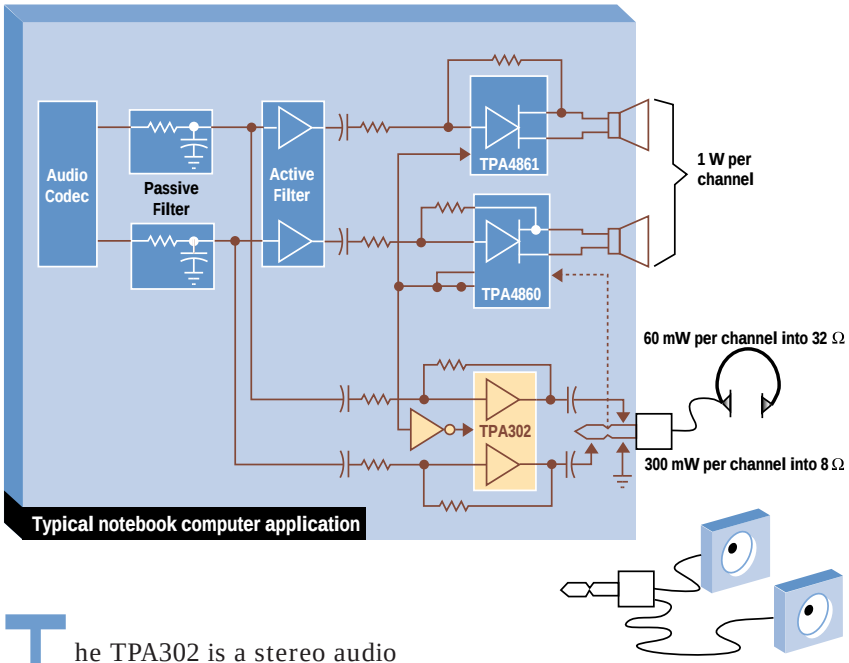
This functionality makes the TPA0103 an ideal choice for desktop computers, personal digital assistants (PDA), and consumer electronics.

AT A GLANCE

- 1.75-W BTL center channel
- 535-mW stereo channels
- <0.05% THD+N at full power
- Specified at 3.3 V and 5 V
- Shutdown control I_{DD} = 5 µA typ
- Characterized for operation from –25°C to 85°C

Read Sine-On online and download datasheets at: www.ti.com/sc/sine-on

300-mW Stereo Audio Power Amplifier Offers 0.06% THD+N



EVM

SAMPLE PACK

AT A GLANCE

- High output power
- 300 mW into 8 Ω @ 5 V
- 80 mW into 32 Ω @ 5 V
- <0.06% for 250 mW, 8 Ω, 5 V
- Low supply current… 5 mA (max)
- Shutdown control… I_{DD} < 1 µA
- Short circuit and thermal protection
- Fully specified at 3.3 V and 5 V

The TPA302 is a stereo audio power amplifier specifically designed to drive 32-Ω headphones and small 8-Ω unpowered speakers. The TPA302 is capable of delivering 250 mW of continuous average power into an 8-Ω load at 0.06% THD+N or up to 300 mW at 1% THD+N. For headphone applications, the TPA302 delivers 60 mW of continuous average power with less than 0.06% THD+N.

The TPA302 requires only 5 mA (max) of supply current. It offers shutdown control for extending battery life. In shutdown mode the supply current is less than 1 µA and along with 5-V and 3.3-V operation, make the device ideal for battery powered low voltage applications. The TPA302 also provides internal short circuit and thermal protection.

In notebook computer applications, the designer now has a complete stereo audio solution available from Texas Instruments. The TPA302, along with the TPA4860 and TPA4861, offers stereo speaker and headphone drive. This gives the designer high quality sound from a PC power supply.

TPA302D

- $1.19 in quantities of 1000
- Available in 8-pin SOIC package

For technical support, call 972-644-5580

To order documentation, call 1-800-477-8924, ext.3229

Designers Benefit from Advance in Audio Amplifier Evaluation Tools

The Audio Power Analysis Program, only available from Texas Instruments, gives designers for the first time the ability to simulate real world audio amplifier operation. This program calculates actual power dissipation and power system requirements that until now have been overestimated with tonal analysis. By replacing tones with real music, the program gives insight into how audio systems truly operate.

When using tonal analysis to measure amplifier operation characteristics, general relationships between these tones and different types of music have to be assumed. This leads to overcompensation in the audio power system because of the values that are used. The Audio Power Analysis Program allows the system designer to accurately account for the audio amplifier's needs in the system and then specifically design in the needed requirements.

The Audio Power Analysis Program uses .wav format files to calculate power, heat and current at every point in a waveform. Files of this format containing any user-recorded signals, music, voice or sounds can be used to accurately represent end product use. By taking advantage of modern technological advances in microprocessors, the CPU now efficiently handles all of the complicated equations used in measuring characteristics of the amplifier and test clips.

The Audio Power Analysis Program makes an excellent companion for another audio amplifier support tool, the Plug-n-Play evaluation kit. Used in conjunction, these tools invite designers to a new method of designing the best audio systems possible.

In today's modern designs, cost, heat, space, and weight are all major concerns. Any reduction in unnecessary power management and supply componentry allows for smaller, lighter and more cost-effective solutions to be designed. The Audio Power Analysis Program allows designers to extend battery lives, reduce transformer size and offer better power management options because of the new found application accuracy.

You can access more information about the Audio Power Analysis Program and download the software at: www.ti.com/sc/apasw

AT A GLANCE

- Calculates actual output power, amplifier efficiency, power dissipation and distortion and die temperatures for real world applications
- User can define amplifier parameters or choose current TI Audio Power Amplifiers
- Uses standard .wav files
- Any power level system can be tested, from mW to kW
- Accurately calculates system requirements, no more estimating

Read Sine-On online and download datasheets at: www.ti.com/sc/sine-on

6-W Stereo Audio Power Amplifier In PowerPAD Package

AT A GLANCE

- High output power 6-W output (10% THD+N) 5-W output (1% THD+N)
- High PSRR (65 dB, 1 kHz)
- Mute and standby operation
- Wide V_{CC} range (9.5 V – 18 V)
- Alternative to the TDA1517

The TPA1517 is a stereo audio power amplifier capable of delivering 6 W per channel of continuous average power into a 4-Ω load at 10% THD+N or 5 W at 1% THD+N. The single supply audio power amplifier operates with a wide supply voltage range from 9.5 V to 18 V. It offers high PSRR (65 dB@1 kHz) for increased fidelity in noisy environments like desktop computers. The amplifier features a mute/standby function for extended life in battery powered systems and is designed for sound card and multimedia applications.

The TPA1517 in the 20-pin DIP package (NE) is a low cost alternative to the TDA1517. The TPA1517 is also available in TI's patented PowerPAD 20-pin SOIC (DWP) package.

TPA1517DWP

- $1.17 in quantities of 1000

TPA1517NE

- $1.11 in quantities of 1000
- Available in 20-pin PowerPAD

1-W BTL Audio Power Amplifiers

AT A GLANCE

- 1 W continuous average power into an 8-Ω load
- Low supply current – 3.5 μA typ
- High PSRR–56 dB typ @ 1 kHz
- Low voice band THD+N –0.2% typ
- Low shutdown mode current – 0.6 μA typ

The TPA4860 and TPA4861 are CMOS audio power amplifiers designed primarily for bridge mode operation in notebook, cellular and other hand-held audio systems. The TPA486x family are capable of delivering 1 W of continuous average power into an 8-Ω load at less than 0.2% THD+N. The Bridge Tied Load (BTL) configuration eliminates the need for external coupling capacitors on the output in most applications. The gain is externally configured by using two resistors and does not require compensation for settings of 2 to 20. Both amplifiers feature a shutdown function for power sensitive applications as well as internal thermal and short circuit protection. The TPA4860 also includes headphone interface logic circuitry to facilitate headphone applications. The TPA4860 and TPA4861 are available in 16-pin and 8-pin SOIC surface mount packages. Both parts are specified at 3.3 V and 5 V.

TPA4860D

- $1.24 in quantities of 1000
- Available in 16-pin SOIC

TPA4861D

- $1.19 in quantities of 1000
- Available in 8-pin SOIC

Texas Instruments Audio Power Amplifier Selection Guide

Device	Description	Output Power (W)	THD+N (%) Typ	V_{CC}/V_{DD} (V) min	V_{CC}/V_{DD} (V) max	I_{CC}/I_{DD} (mA) Typ	PSRR (dB, 1 kHz) Typ	Shutdown Control	Packages	Price (1 kU)
TPA302	300 mW stereo, SE	0.3	1	2.7	5.5	4	45	✓	8-pin SOIC+	$1.19
TPA4860	1 W mono, BTL w/hp sense	1	0.2	2.7	5.5	3.5	56	✓	16-pin SOIC	$1.24
TPA4861	1 W mono, BTL	1	0.2	2.7	5.5	3.5	56	✓	8-pin SOIC+	$1.19
TPA0102	1.5 W stereo,SE/BTL	1.5	0.05	3	5.5	19	75	✓	24-pin TSSOP*	$2.53
TPA0103	1.75 W 3-channel stereo	1.75	0.05	3	5.5	19	80	✓	24-pin TSSOP*	$2.53
TPA1517	6 W stereo SE	6	10	9.5	18	30	65	✓	20-pin SOIC*/DIP+	$1.11

SE = Single Ended
BTL = Bridged-Tied Load
hp = Headphone

*** PowerPAD Package**
+ Thermally Enhanced Package

Read Sine-On online and download datasheets at: www.ti.com/sc/sine-on

Texas Instruments Audio Power Amplifier Cross Reference

Part No	Suggested TI Replacement	Vendor	Replacement Type
LM386	TPA4861/TPA302	National Semiconductor	S
LM4860	TPA4860	National Semiconductor	F
LM4861	TPA4861	National Semiconductor	F
LM4862	TPA4861	National Semiconductor	P
LM4863	TPA0102	National Semiconductor	Q
LM4880	TPA302	National Semiconductor	Q
LM1877	TPA1517	National Semiconductor	S
LM2878	TPA1517	National Semiconductor	S
LM384	TPA1517	National Semiconductor	S
TDA1517	TPA1517	Philips Electronics	F
TDA7050	TPA302	Philips Electronics	S
TDA7052A	TPA4861	Philips Electronics	S
BA7786FP-Y	TPA0102	Rohm	S
MC34119	TPA4861/TPA302	Motorola	S
NJM2076	TPA302	JRC	S
NJM2113	TPA4861	JRC	S
TEA2025	TPA0102	SGS Thomson	S

Replacement Types

F The device an EXACT EQUIVALENT in functionality and parametrics to the competitors device

P The device has the SAME FUNCTIONALITY AND PINOUT as the competitors device but is NOT an exact equivalent

Q The device has the SAME FUNCTIONALITY as the competitors device, but is not pin-for-pin and/or parametrically equivalent

S The device has SIMILAR FUNCTIONALITY but is not functionally equivalent to the competitors device

This cross reference to TI's Mixed Signal and Analog Products lists suggested replacements for many other manufacturers' devices. It is intended to be a guide only. It is the designer's responsibility to compare specifications as they relate to an application to determine if the TI device suggested is an acceptable substitute.

Texas Instruments Audio Power Amplifier Ordering Guide

TPA 0102 PWP LE

Prefix	**TPA**	
Device Number		
Package Suffix	**D**	Small Outline Integrated Circuit (SOIC)
	NE	Plastic Dual Inline Package (PDIP)
	PWP	PowerPAD Thin Shrink Small Outline Package (TSSOP)
	DWP	PowerPAD Small Outline Integrated Circuit (SOIC)
Optional Carrier Suffix	**LE**	Left-End Taped-and-Reeled
	R	Taped-and-Reeled