

TPA6304-Q1 45-W, 2.1-MHz Analog Input 4-Channel Automotive Class-D Audio Amplifier with Load Dump Protection and I²C Diagnostics

1 Features

- Highest efficiency
 - Significantly more efficient than Class-AB
 - Reduce thermal solution with 75% less heat dissipation than Class-AB
- Start/stop operation down to 4.5 V
- AEC-Q100 Qualified for automotive applications:
 - Temperature grade 1: –40°C to 125°C T_A
 - HBM ESD Classification level 2
 - CDM ESD Classification level C4B
- 27 W, 10% THD into 4 Ω at 14.4 V
 - Drives 4 Ω and 2 Ω loads
- Load diagnostics
 - Output open, shorted load
 - Output-to-battery or ground shorts
 - Tweeter connected
- Designed to meet CISPR25-L5 EMC specification
 - Class-D at 2.1 MHz, no AM interference
 - Spread Spectrum mode
- Protection
 - 40 V Load dump
 - Output short protection
 - DC offset and over temperature
 - Fortuitous open ground and power tolerant
- Audio inputs
 - 4 Channel single-ended analog input
 - 10 dB, 16 dB or 28 dB Gain option
- Supports parallel channel drive (PBTL)
- Audio performance into 4 Ω at 14.4 V, 1 kHz
 - THD+N < 0.1%
 - 42 μV_{RMS} Output Noise
 - 75 dB PSRR
 - Efficiency > 80%
- Special features
 - Programmable clip detection
 - Load current limiter
 - Thermal gain foldback
 - Fast and autonomous startup diagnostics
 - AC load impedance measurement with < 10 mA load current

2 Applications

- [Automotive head units](#)
- [Automotive external amplifier modules](#)

3 Description

The TPA6304-Q1 device is a four-channel analog-input Class-D audio amplifier that implements a 2.1 MHz PWM switching frequency that enables a cost optimized solution in a very small 2.7 cm² PCB size, high impedance single ended inputs and full operation down to 4.5 V for start/stop events.

The TPA6304-Q1 Class-D audio amplifier has an optimal design for use in entry level automotive head units that provide analog audio input signals as part of their system design. The Class-D topology dramatically improves efficiency over traditional linear amplifier solutions.

The output switching frequency can be set either above the AM band, which eliminates the AM band interference and reduces output filter size and cost, or below AM band to further optimize efficiency.

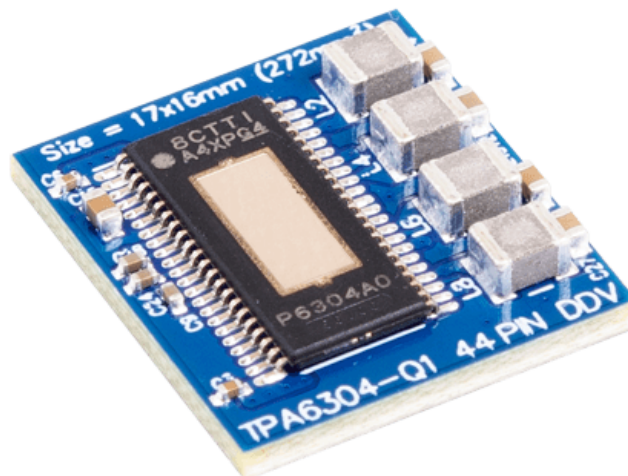
The device is offered in a 44 pin HTSSOP package with the exposed thermal pad up.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|-------------|--------------------|
| TPA6304-Q1 | HTSSOP (44) | 14.00 mm x 6.10 mm |

(1) For all available packages, see the orderable addendum at the end of the datasheet.

Reference Board



4 Device and Documentation Support

4.1 Documentation Support

4.1.1 Related Documentation

For related documentation see the following:

[PurePath™ Console 3](#) Graphical Development Suite

4.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

4.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

E2E Audio Amplifier Forum *TI's Engineer-to-Engineer (E2E) Community for Audio Amplifiers*. Created to foster collaboration among engineers. Ask questions and receive answers in real-time.

4.4 Trademarks

PurePath, E2E are trademarks of Texas Instruments. All other trademarks are the property of their respective owners.

4.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

4.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

5 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|-------------------------|----------------------|--------------|-------------------------|---------|
| PTPA6304QDDVRQ1 | ACTIVE | HTSSOP | DDV | 44 | 2000 | TBD | Call TI | Call TI | -40 to 125 | | Samples |
| TPA6304QDDVRQ1 | PREVIEW | HTSSOP | DDV | 44 | 2000 | TBD | Call TI | Call TI | -40 to 125 | | |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=100ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

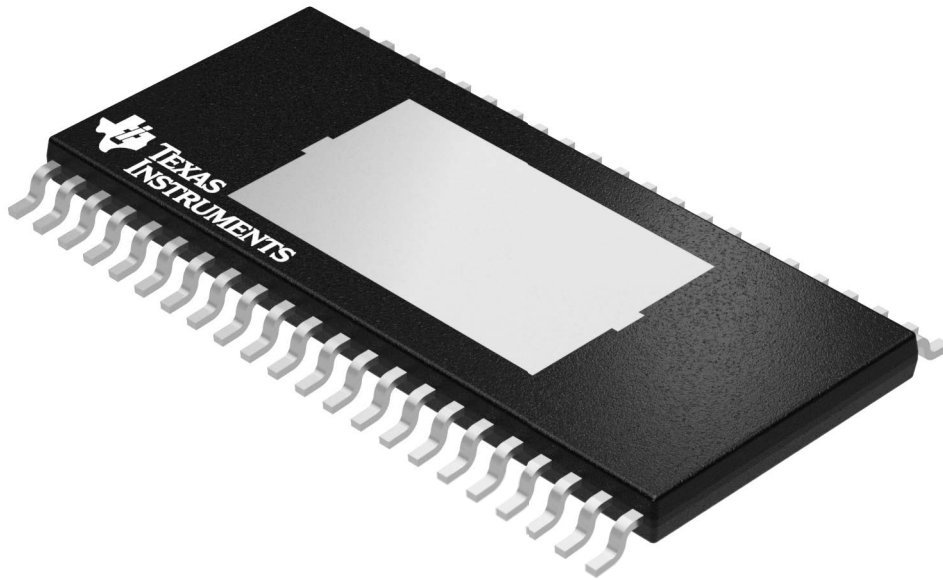
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2019, Texas Instruments Incorporated