

TAS6501-Q1, 15W, 2MHz Digital Input 1-Channel Automotive Heatsink-Free Class-D **Audio Amplifier with Current Sense and Real-time Load Diagnostics**

1 Features

- AEC-Q100 qualified for automotive applications
 - Temperature grade 1: -40°C to +125°C, T_A
- General operation
 - 4.5V to 19V supply voltage, 40V load dump
 - Support for 1.8V and 3.3V I/O's
 - I²C control with 8 address options
 - <0.5W idle power loss at 14.4V, <5uA max PVDD shutdown loss
- Output current sensing via I²S or TDM
 - No need for external circuitry
- Real-time load diagnostics
 - Monitor output conditions while playing audio
 - Open load, Shorted load, Short-to-power, Short-to-ground detection
- Integrated DSP processing
 - Thermal monitoring and foldback
 - PVDD monitoring and foldback
 - Clip detection
 - Low Latency Path, >70% reduced signal delay
- DC and AC Standby load diagnostics
- Audio inputs
 - I²S and TDM support up to TDM16
 - Input sample rates: 16, 32, 44.1, 48, 96, 192kHz
- Audio outputs
 - 384kHz to 2MHz configurable output switching frequency
 - 15W (14.4V, 4Ω, 10% THD+N)
- Audio Performance
 - THD+N <0.02% (4Ω, 1W, 1kHz)
 - 105dB SNR
 - Output noise: 41µV_{RMS} at 14.4V, A-weighting
- Protection
 - Output short protection
 - Speaker GuardTM Pro power limiter
 - Configurable overtemperature warning and shutdown
 - I²C temperature and supply voltage readout
 - DC offset, undervoltage and overvoltage
- Easily meet CISPR25-L5 EMC specification
 - Advanced spread-spectrum

2 Applications

- Acoustic vehicle alerting system (AVAS)
- Emergency call (eCall)
- Automotive head unit
- Telematics control unit
- Automotive cluster display

3 Description

The TAS6501-Q1 is a mono-channel, digital-input, Class-D audio amplifier that supports 2MHz switching frequency enabling a cost and size-optimized singlechannel audio amplifier design. The device operates from 4.5V to 19V and delivers up to 15W (14.4V, 4Ω , 10% THD+N). The device integrates DC and AC load diagnostics to determine the status of the connected load before enabling the output stage. Additionally, the device can monitor the output load condition while in PLAY mode with or without audio using real-time load diagnostics which operates independently from the host and audio input.

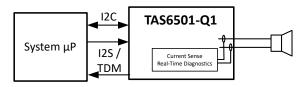
TAS6501-Q1 can monitor the output current, PVDD voltage, and temperature of the device and can report this data through TDM or I2S. The integrated DSP of the TAS6501-Q1 enables advanced protection features such as PVDD foldback, thermal foldback, and Speaker Guard™ Pro power limiter. The DSP also enables an additional low-latency signal path, providing up to 70% faster signal processing at 48kHz for time-sensitive Active Noise Cancellation (ANC) and Road Noise Cancellation (RNC) applications.

The device is available in a small pad-down TSSOP and QFN with wettable flanks packages, enabling a heatsink-free audio amplifier design.

Packaging Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾				
TAS6501-Q1	HTSSOP (28)	6.4mm × 9.7mm				
	VQFN (24)	4mm × 4mm				

- For more information, see Mechanical, Packaging, and Orderable Information.
- The package size (length × width) is a nominal value and (2) includes pins, where applicable.



Simplified Diagram



4 Device Comparison

Table 4-1. Related Class-D Audio Amplifiers

Device	Channel Current Limit (Typ)	Output Power / 10% THD+N		
	Channel Current Limit (199)	4Ω / 14.4V		
TAS6501-Q1	3.7A	15W		
TAS6511-Q1	7.3A	30W		

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5 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop designs are listed below.

5.1 Device Support

5.2 Documentation Support

5.2.1 Related Documentation

5.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

5.4 Support Resources

TI E2E[™] support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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5.5 Trademarks

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5.6 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

5.7 Glossary

TI Glossary

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

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
September 2025	*	Initial Release

7 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.

www.ti.com 14-Oct-2025

PACKAGING INFORMATION

Orderable part number	Status	Material type	Package Pins	Package qty Carrier	RoHS	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
						(4)	(5)		
TAS6501QRGERQ1	Active	Production	VQFN (RGE) 24	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TAS6501

⁽¹⁾ Status: For more details on status, see our product life cycle.

- (3) RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.
- (4) Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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⁽²⁾ Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TAS6501QRGERQ1	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

PACKAGE MATERIALS INFORMATION

www.ti.com 22-Sep-2025



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins SPQ		Length (mm)	Width (mm)	Height (mm)	
TAS6501QRGERQ1	VQFN	RGE	24	3000	367.0	367.0	35.0	

PLASTIC QUAD FLATPACK - NO LEAD

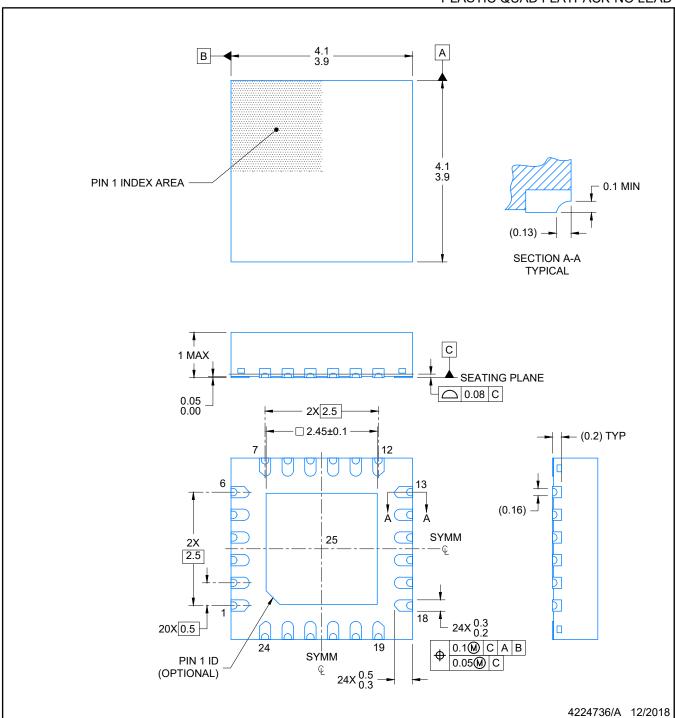


Images above are just a representation of the package family, actual package may vary. Refer to the product data sheet for package details.

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PLASTIC QUAD FLATPACK-NO LEAD

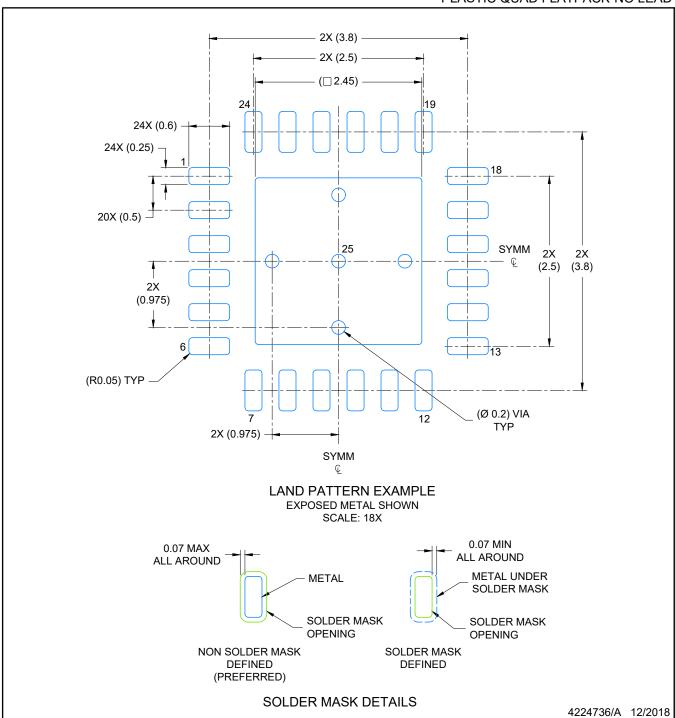


NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- 2. This drawing is subject to change without notice.
- 3. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.



PLASTIC QUAD FLATPACK-NO LEAD

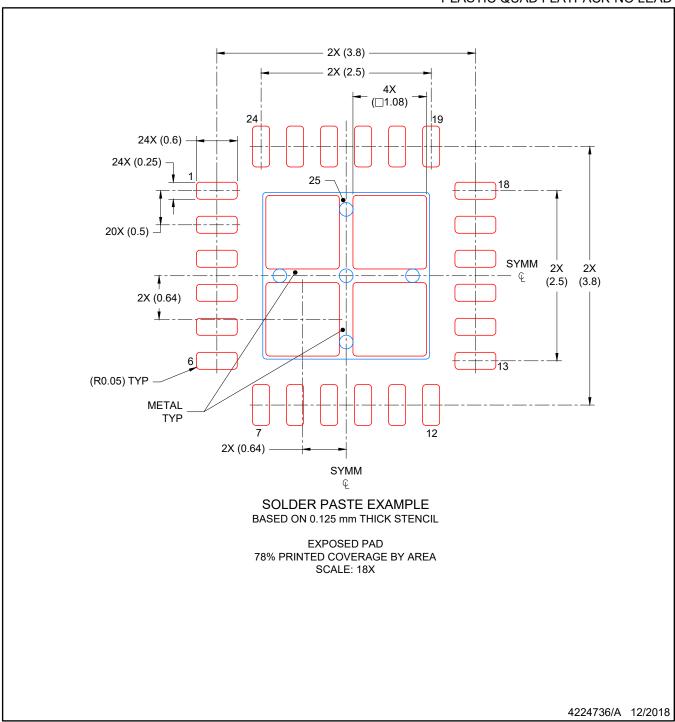


NOTES: (continued)

- 4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- 5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



PLASTIC QUAD FLATPACK-NO LEAD



NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



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