# 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
  - $I^2C$ control with 8 address options
  - <0.5W idle power loss at 14.4V, <5uA max PVDD shutdown loss
- Output current sensing via $I^2S$ 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 at 48kHz
- DC and AC Standby load diagnostics
- Audio inputs
  - $I^2S$ 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: 41$\mu V_{RMS}$ at 14.4V, A-weighting
- Protection
  - Output short protection
  - Speaker Guard™ Pro power limiter
  - Configurable overtemperature warning and shutdown
  - $I^2C$ 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 single-channel 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.

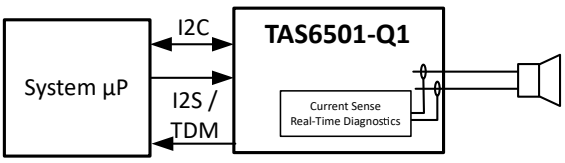
TAS6501-Q1 can monitor the output current, PVDD voltage, and temperature of the device and can report this data through TDM or I2S. The integrated DSP of the TAS6501-Q1 enables advanced protection features such as PVDD foldback, thermal foldback, and Speaker Guard™ Pro power limiter. The DSP also enables 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 |

(1) For more information, see Mechanical, Packaging, and Orderable Information.
(2) The package size (length × width) is a nominal value and 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 |
|---|---|---|
| | | 4Ω / 14.4V |
| TAS6501-Q1 | 3.7A | 15W |
| TAS6511-Q1 | 7.3A | 30W |

# 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.

Linked content is 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.

## 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.

## PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| TAS6501QRGERQ1 | Active | Production | VQFN (RGE) \| 24 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | - | TAS6501 |

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

(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.

(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.

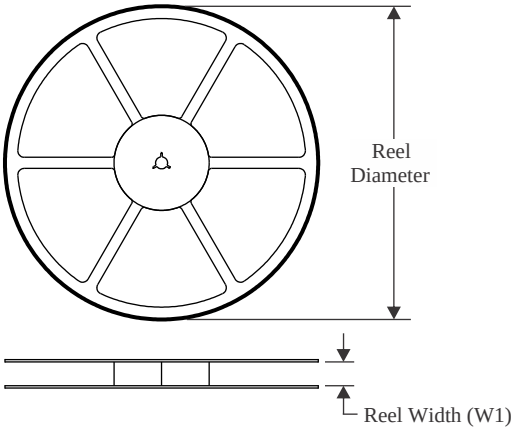
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will 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.

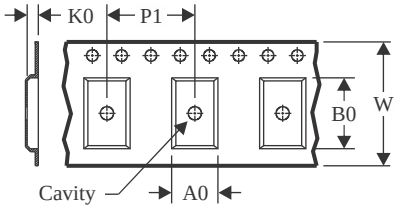
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

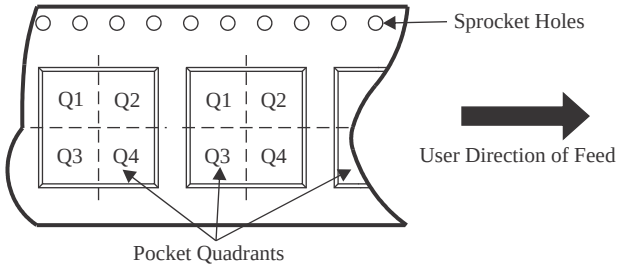



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | 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 |

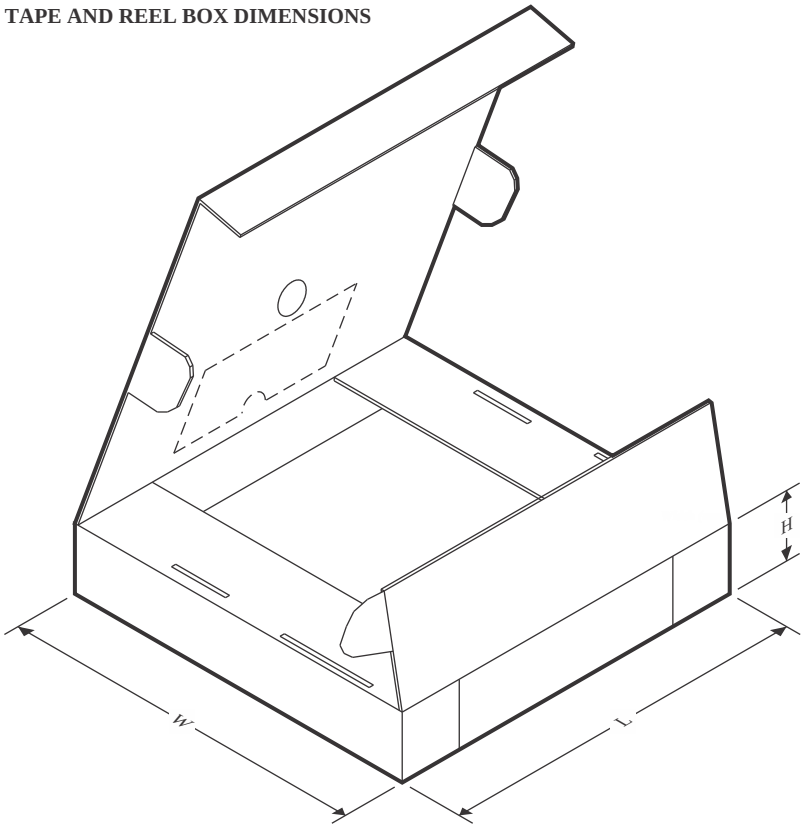
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | 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 |

TAPE AND REEL BOX DIMENSIONS



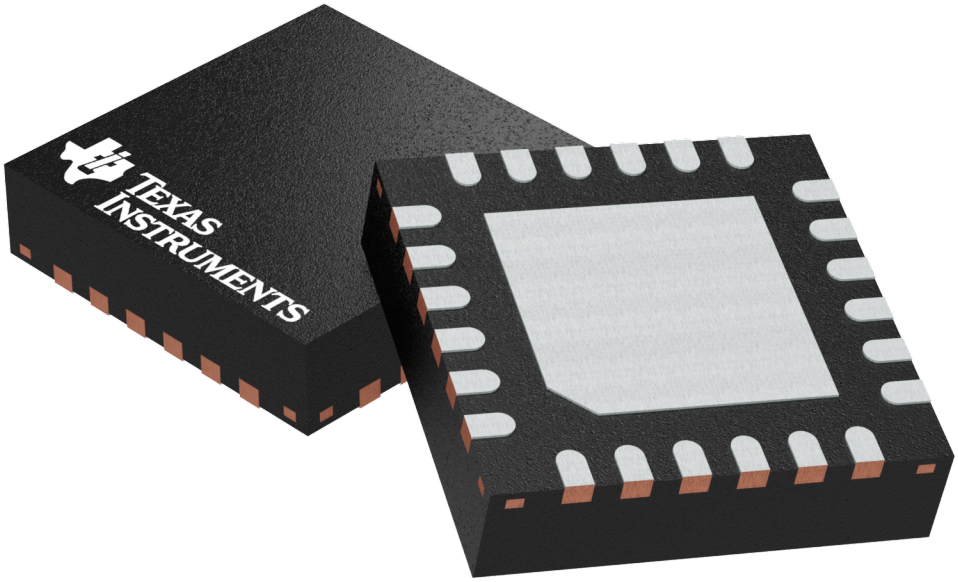

*All dimensions are nominal

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

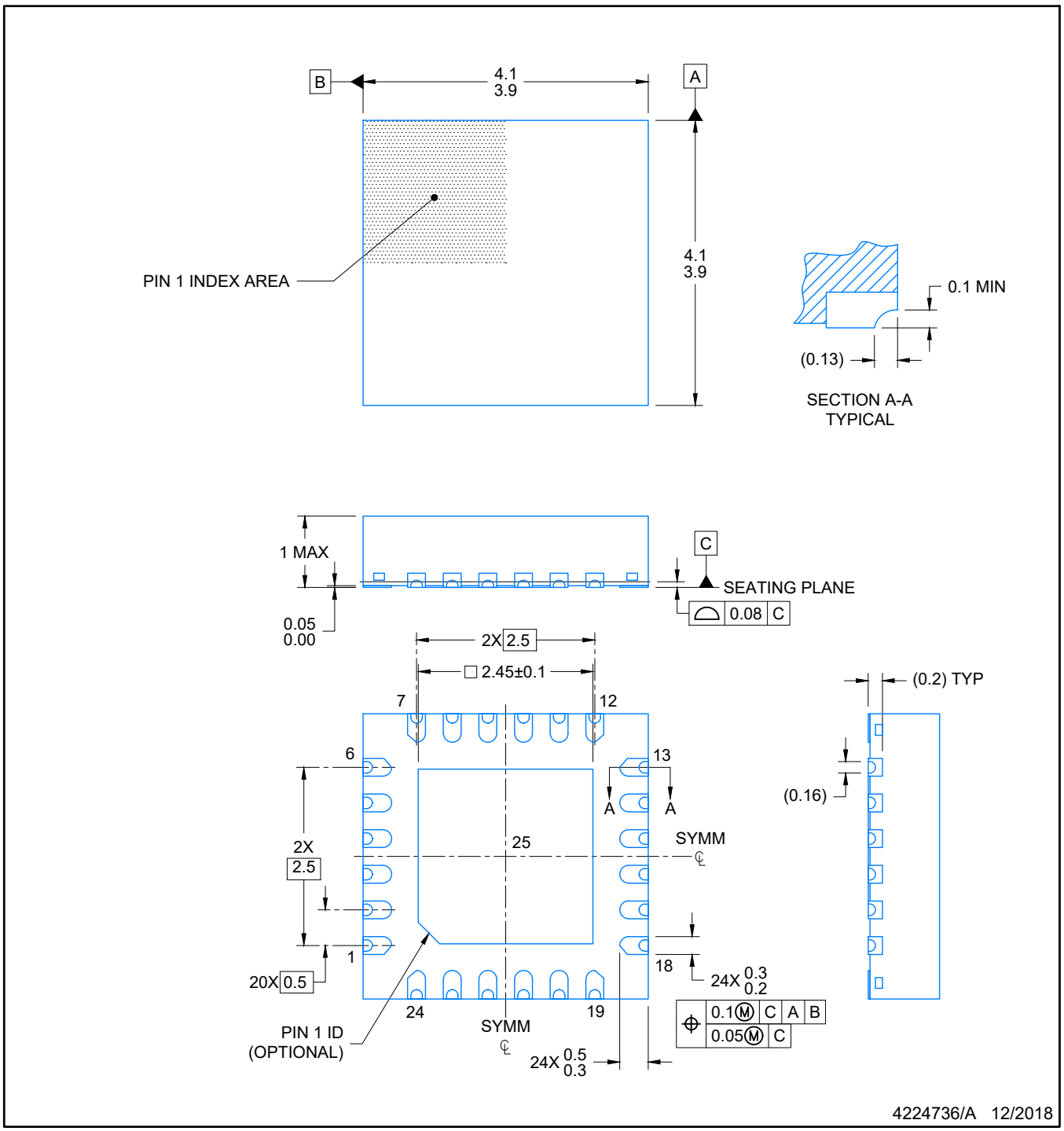
# RGE 24

# VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

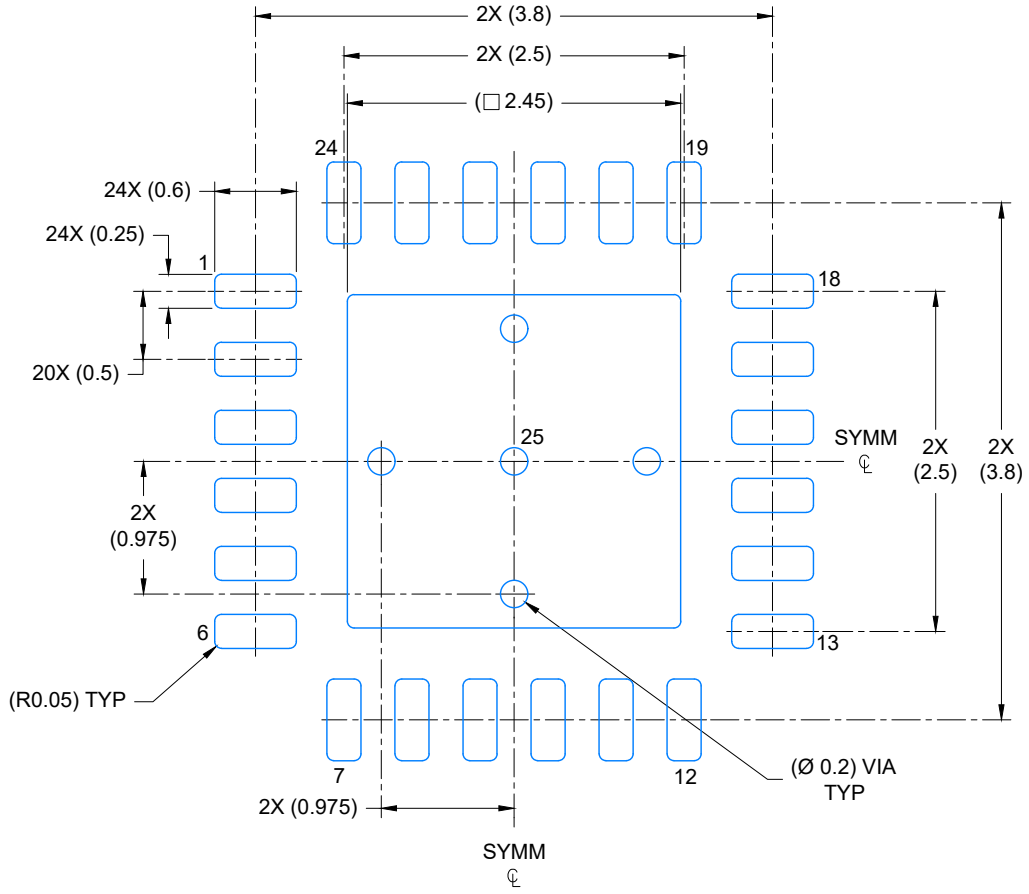



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

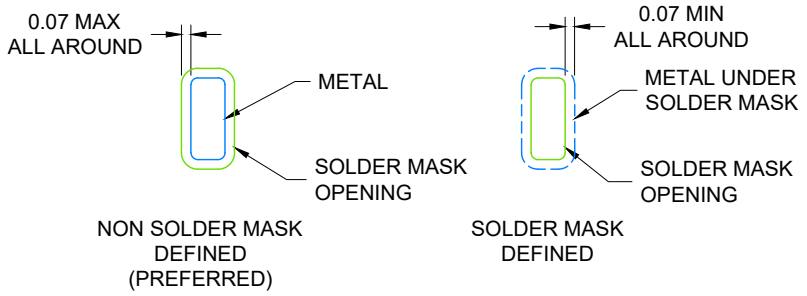



NOTES:

1. 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.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 18X




SOLDER MASK DETAILS

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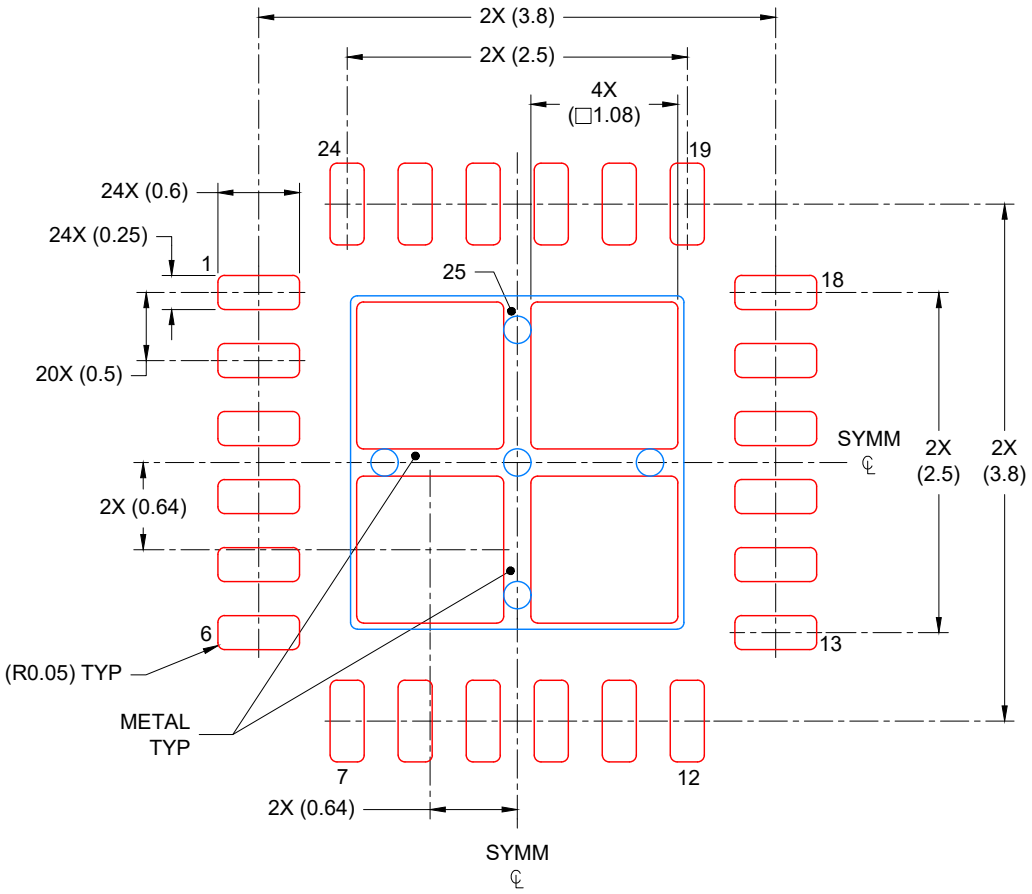
NOTES: (continued)

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.




SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
78% PRINTED COVERAGE BY AREA
SCALE: 18X

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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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