TAS6511-Q1 - 50W, 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
  - Up to 7A channel output current
  - 28W (14.4V, 4Ω, 10% THD+N)
  - 50W (14.4V, 2Ω, 10% THD+N)
- Audio Performance
  - THD+N <0.02% (4Ω, 1W, 1kHz)
  - 108dB SNR
  - Output noise: 41μV_{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 TAS6511-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 28W (14.4V, 4Ω, 10% THD+N) and up to 50W (14.4V, 2Ω, 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.

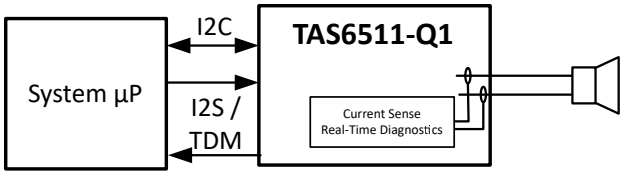
TAS6511-Q1 can monitor the output current, PVDD voltage, and temperature of the device and can report this data through TDM or I2S. The integrated DSP of the TAS6511-Q1 enables advanced protection features such as PVDD foldback, thermal foldback, and Speaker Guard™ Pro power limiter. The DSP also enables 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 package, enabling a heatsink-free audio amplifier design.

Packaging Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
TAS6511-Q1	HTSSOP (28)	6.4mm × 9.7mm

(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

Table of Contents

4 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 solutions are listed below.

4.1 Device Support

4.2 Documentation Support

4.2.1 Related Documentation

4.3 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.

4.4 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.

4.5 Trademarks

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4.6 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.

4.7 Glossary

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

5 Revision History

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

DATE	REVISION	NOTES
December 2023	*	Initial Release

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TAS6511QPWPRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	TAS6511	Samples

(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 <=1000ppm 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.

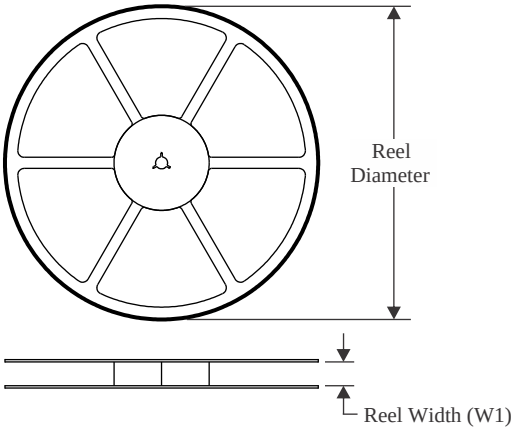
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

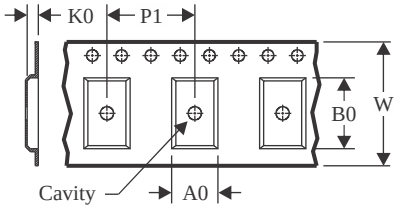
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

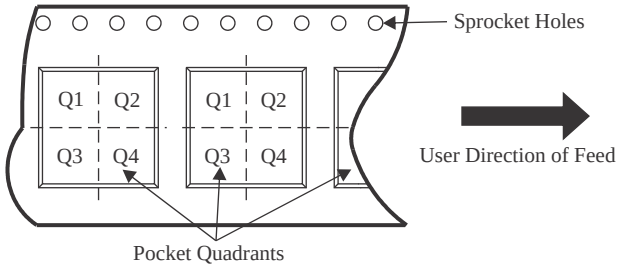


TAPE DIMENSIONS



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

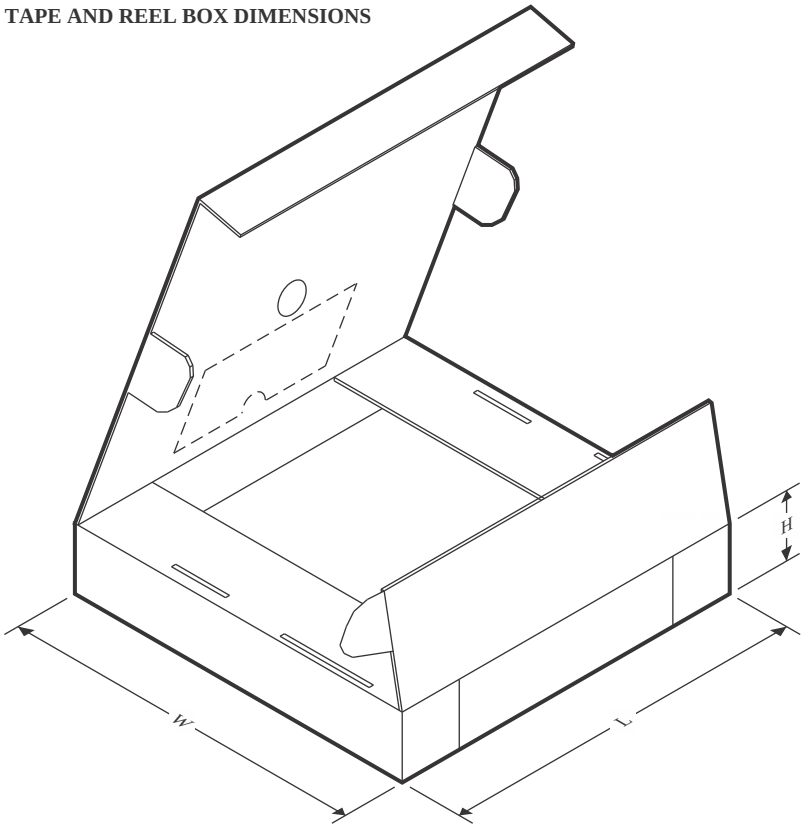
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TAS6511QPWPRQ1	HTSSOP	PWP	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TAS6511QPWPRQ1	HTSSOP	PWP	28	2000	356.0	356.0	35.0

GENERIC PACKAGE VIEW

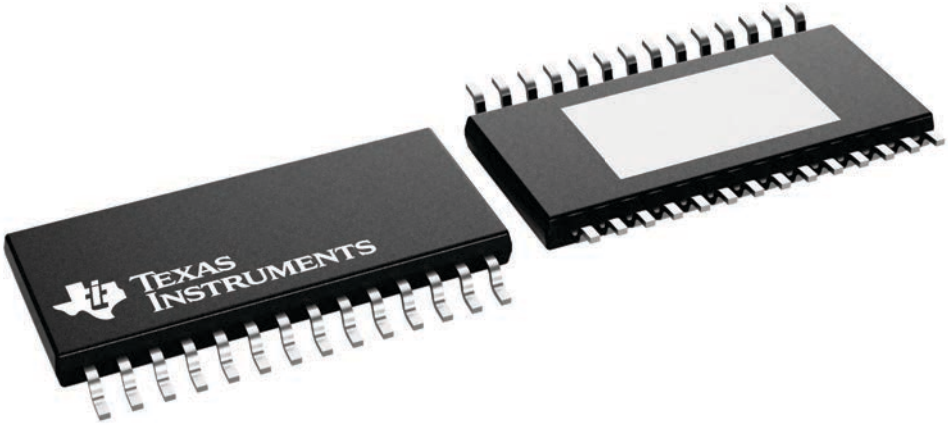
PWP 28

PowerPAD™ TSSOP - 1.2 mm max height

4.4 x 9.7, 0.65 mm pitch

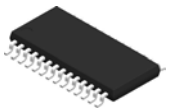
SMALL OUTLINE PACKAGE

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



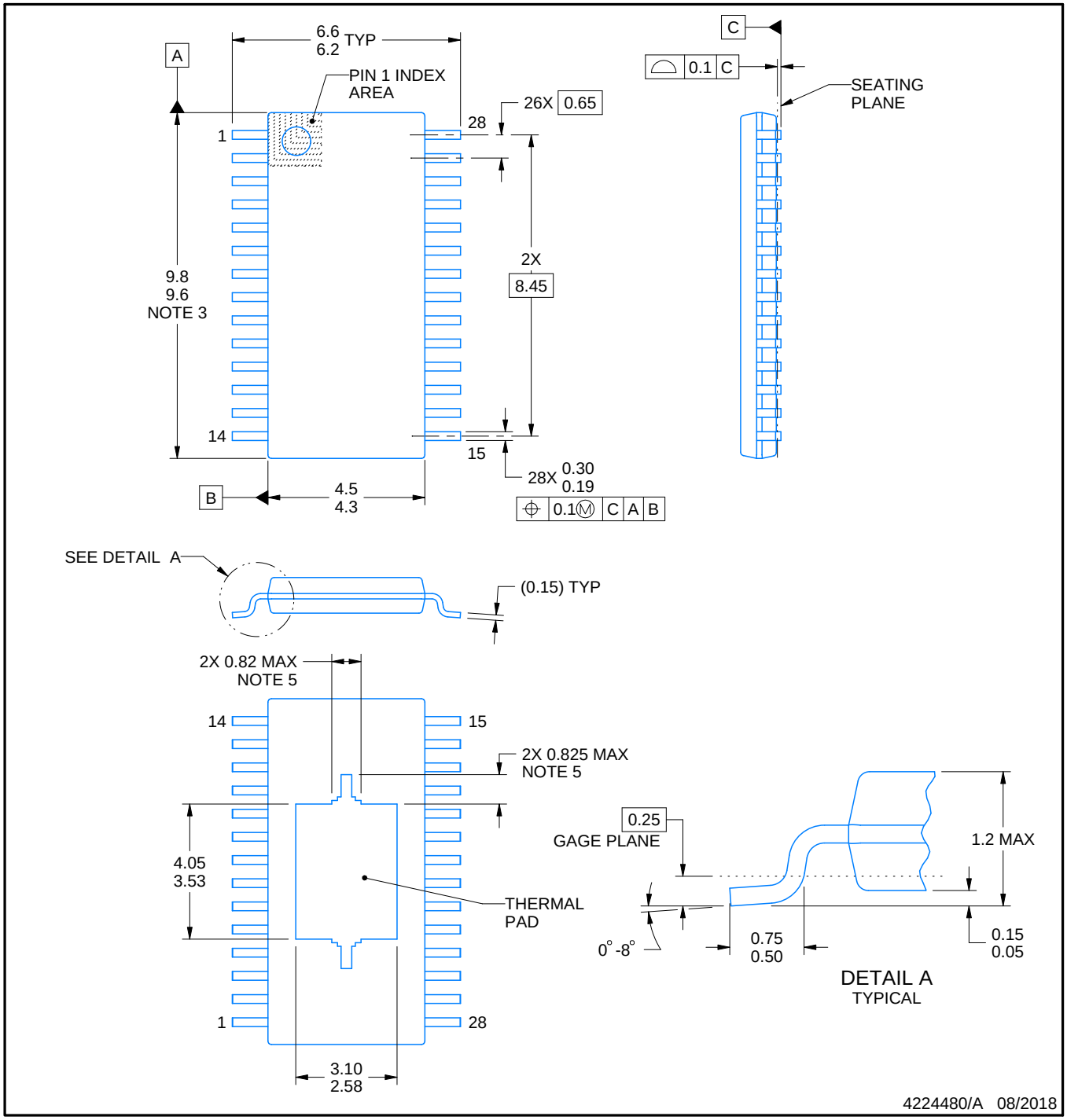
PACKAGE OUTLINE

PWP0028M



PowerPAD™ TSSOP - 1.2 mm max height

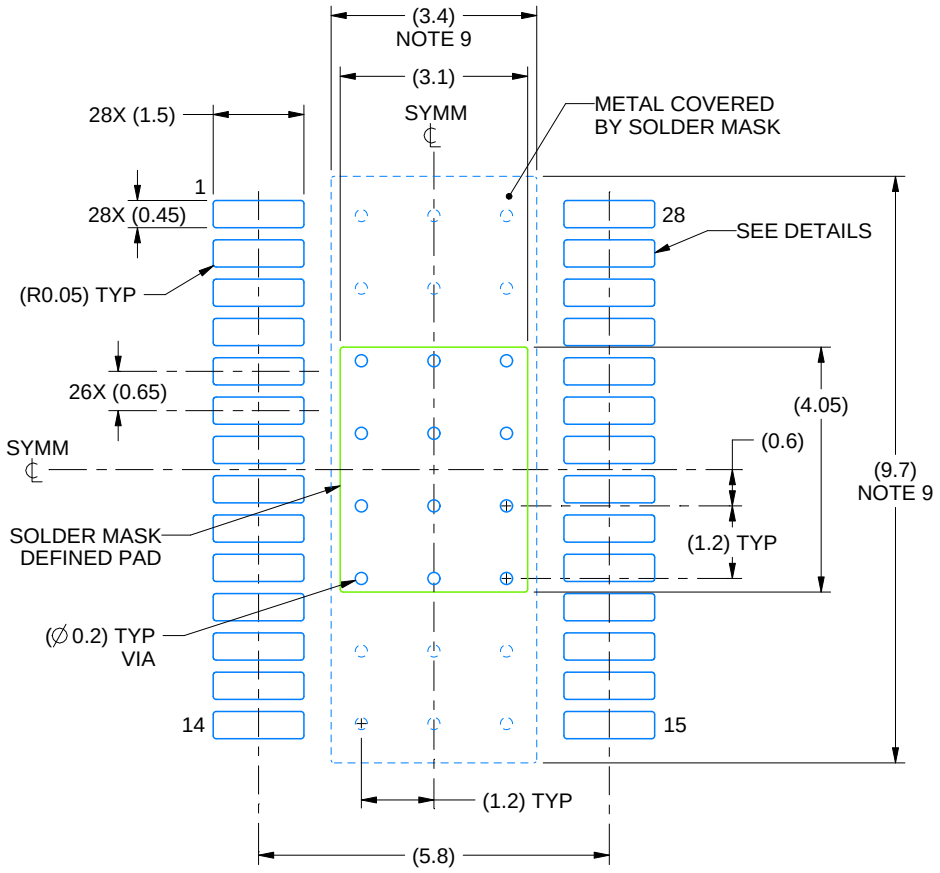
SMALL OUTLINE PACKAGE



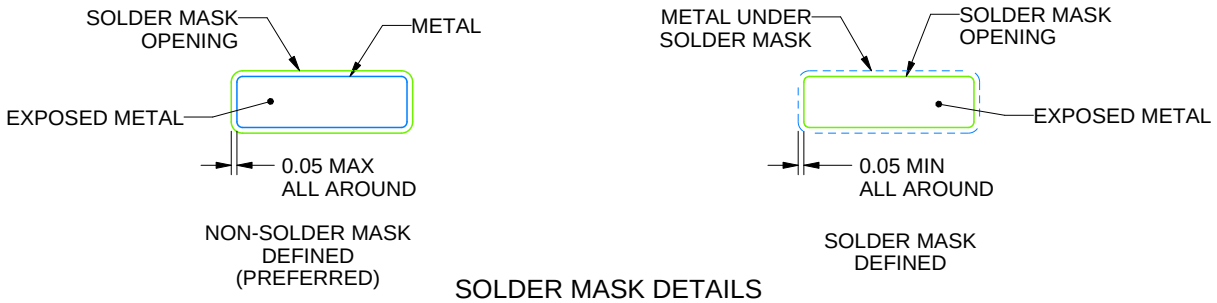
PowerPAD is a trademark of Texas Instruments.

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. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.
5. Features may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X

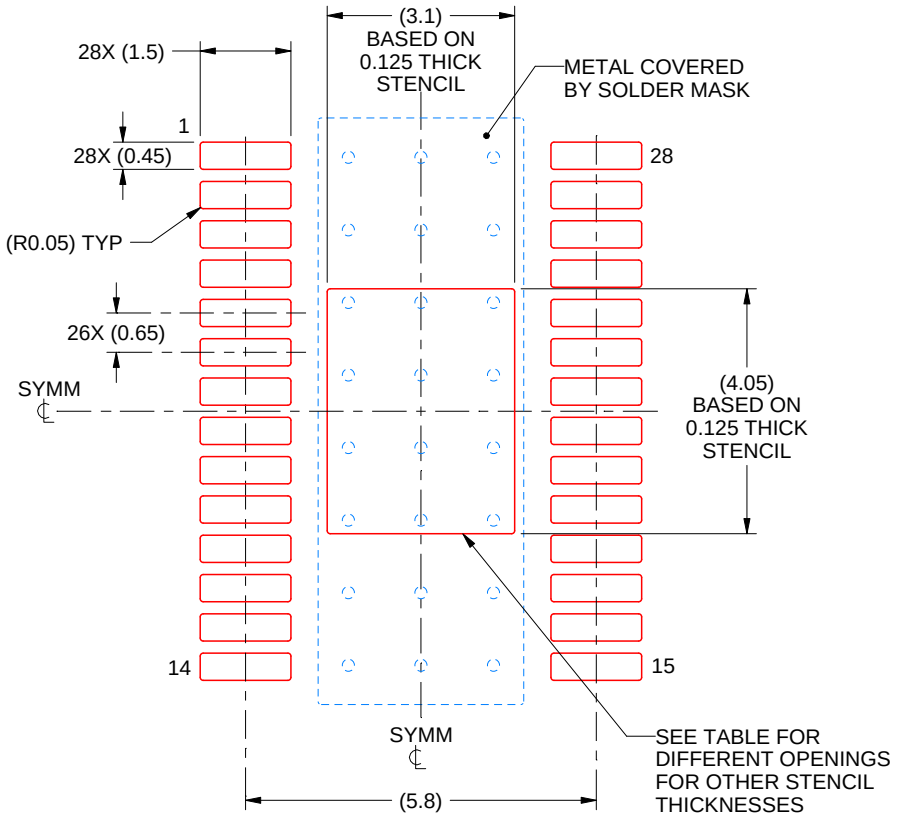


SOLDER MASK DETAILS

4224480/A 08/2018

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 8X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	3.47 X 4.53
0.125	3.10 X 4.05 (SHOWN)
0.15	2.83 X 3.70
0.175	2.62 X 3.42

4224480/A 08/2018

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

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