

TVS2201 22V双方向フラット・クランプ・サージ保護デバイス

1 特長

- 産業用信号ライン向け1kV、42ΩのIEC 61000-4-5サージ・テストに耐える保護機能
- 双方向極性により、バイポーラ信号処理や誤配線に対して保護
- クランプ電圧：29.6V（サージ電流30A（8/20μs）時）
- スタンドオフ電圧：±22V
- 小型の3mm×3mm² SONフットプリント
- 125°Cで30A、8/20μsのサージ電流の反復ストライクを5,000回吸収
- 強力なサージ保護
 - IEC61000-4-5（8/20μs）: 30A
 - IEC61643-321（10/1000μs）: 4A
- 低リーク電流
 - 27°Cで2nA（標準値）
 - 85°Cで330nA（最大値）
- 低容量: 62pF
- レベル4 IEC 61000-4-2に準拠したESD保護機能を内蔵

2 アプリケーション

- 産業用センサI/O
- PLC I/Oモジュール
- アナログ入力
- 家電製品
- 医療用機器
- USB Type-CのV_{BUS}保護

3 概要

TVS2201デバイスは、最大30AのIEC 61000-4-5フォルト電流をシャントし、大電力の過渡事象や落雷からシステムを保護します。このデバイスは、一般的な産業用信号線のEMC要件である、42Ωのインピーダンスで結合した1kVのIEC 61000-4-5開路電圧に耐えます。TVS2201は帰還機構を使用して、フォルト中の正確なフラット・クランプを確保し、システムがさらされる電圧を、従来型のTVSダイオードよりも低く保ちます。厳格な電圧レギュレーションにより、設計者は許容電圧が低いシステム部品でも安心して選択でき、堅牢性を損なうことなくシステムのコストと複雑性を低減できます。TVS2201は±22Vの範囲で動作するため、逆配線に対する保護を必要とするシステムでも動作できます。

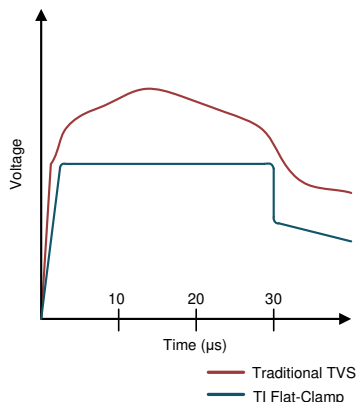
さらに、TVS2201はスペースの制約が厳しいアプリケーション用に設計された小型のSONフットプリントで供給されるため、標準のSMAおよびSMBパッケージと比較して大幅なサイズ低減が可能です。デバイスのリーク電流と静電容量が小さいため、保護するラインへの影響も最小限に抑えられます。製品のライフサイクル全体にわたる堅牢な保護を確保するため、TIはTVS2201をテストし、125°Cで5000回の反復サージに対してデバイス性能に変化がないことを確認しています。

製品情報⁽¹⁾

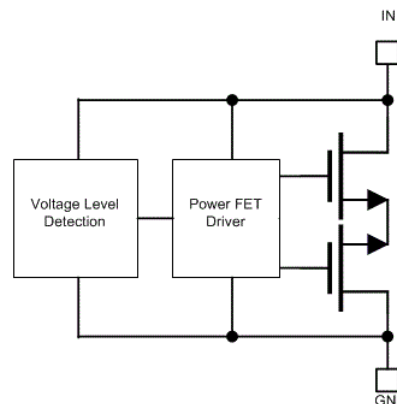
| 型番 | パッケージ | 本体サイズ(公称) |
|---------|---------|---------------|
| TVS2201 | SON (8) | 3.00mm×3.00mm |

(1) 提供されているすべてのパッケージについては、データシートの末尾にある注文情報を参照してください。

8/20μsのサージ・イベントに対する電圧クランプの応答



機能ブロック図



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4 改訂履歴

2018年9月発行のものから更新

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5 概要（続き）

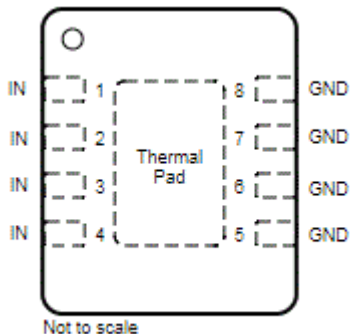
TVS2201はTIのフラット・クランプ・サージ・デバイス・ファミリの製品です。フラット・クランプ・ファミリの詳細については、『[効率的なシステム保護のためのフラット・クランプ・サージ保護技術](#)』ホワイト・ペーパーを参照してください。

6 Device Comparison Table

| DEVICE | V_{rwm} | V_{clamp} at I_{pp} | I_{pp} (8/20 μ s) | Leakage at V_{rwm} | POLARITY | Package |
|-------------------------|-----------|-------------------------|-------------------------|----------------------|----------------|-------------------------|
| TVS0500 | 5 | 9.2 V | 43 A | 0.07 nA | Unidirectional | DRV (SON-6) |
| TVS0701 | 7 | 11 V | 30 A | 0.25 nA | Bidirectional | DRB (SON-8) |
| TVS1400 | 14 | 18.6 V | 43 A | 2 nA | Unidirectional | DRV (SON-6) |
| TVS1401 | 14 | 20.5 V | 30 A | 1.1 nA | Bidirectional | DRB (SON-8) |
| TVS1800 | 18 | 22.8 V | 40 A | 0.3 nA | Unidirectional | DRV (SON-6) |
| TVS1801 | 18 | 27.4 V | 30 A | 0.4 nA | Bidirectional | DRB (SON-8) |
| TVS2200 | 22 | 27.7 V | 40 A | 3.2 nA | Unidirectional | DRV (SON-6) |
| TVS2201 | 22 | 29.6 V | 30 A | 2 nA | Bidirectional | DRB (SON-8) |
| TVS2700 | 27 | 32.5 V | 40 A | 1.7 nA | Unidirectional | DRV (SON-6) |
| TVS2701 | 27 | 34 V | 27 A | 0.8 nA | Bidirectional | DRB (SON-8) |
| TVS3300 | 33 | 38 V | 35 A | 19 nA | Unidirectional | DRV (SON-6), YZF (WCSP) |
| TVS3301 | 33 | 40 V | 27 A | 2.5 nA | Bidirectional | DRB (SON-8) |

7 Pin Configuration and Functions

**DRB Package
8-Pin SON
Top View**



Pin Functions

| PIN | | TYPE | DESCRIPTION |
|-------|---------------------|------|--------------------------------------|
| NAME | DRB | | |
| IN | 1, 2, 3, 4 | IN | Surge Protected Channel |
| GND | 5, 6, 7, 8 | GND | Ground |
| FLOAT | Exposed Thermal Pad | NC | Exposed Thermal Pad Must Be Floating |

8 Specifications

8.1 Absolute Maximum Ratings

 $T_A = 27^\circ\text{C}$ (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|---------------|--|-----|----------|------------------|
| Maximum Surge | IEC 61000-4-5 Current (8/20 μs), $T_A < 125^\circ\text{C}$ | | ± 30 | A |
| | IEC 61000-4-5 Power (8/20 μs) | | 850 | W |
| | IEC 61643-321 Current (10/1000 μs) | | ± 4 | A |
| | IEC 61643-321 Power (10/1000 μs) | | 120 | W |
| EFT | IEC 61000-4-4 EFT Protection | | ± 80 | A |
| I_{BR} | DC Current | | 30 | mA |
| T_A | Ambient Operating Temperature | -40 | 125 | $^\circ\text{C}$ |
| T_{stg} | Storage Temperature | -65 | 150 | $^\circ\text{C}$ |

(1) Stresses beyond those listed under *Absolute Maximum Rating* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8.2 ESD Ratings - JEDEC

| | | | VALUE | UNIT |
|-------------|-------------------------|--|------------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | ± 2000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ± 500 | |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

8.3 ESD Ratings - IEC

| | | | VALUE | UNIT |
|-------------|-------------------------|---------------------------------|----------|------|
| $V_{(ESD)}$ | Electrostatic discharge | IEC 61000-4-2 contact discharge | ± 8 | kV |
| | | IEC 61000-4-2 air-gap discharge | ± 15 | |

8.4 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | NOM | MAX | UNIT |
|-----------|---------------------------|-----|----------|-----|------|
| V_{RWM} | Reverse Stand-Off Voltage | | ± 22 | | V |

8.5 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | TVS2201 | UNIT |
|-------------------------------|--|-----------|---------------------------|
| | | DRB (SON) | |
| | | 8 PINS | |
| R_{qJA} | Junction-to-ambient thermal resistance | 52 | $^\circ\text{C}/\text{W}$ |
| $R_{qJC(top)}$ | Junction-to-case (top) thermal resistance | 56.1 | $^\circ\text{C}/\text{W}$ |
| R_{qJB} | Junction-to-board thermal resistance | 24.9 | $^\circ\text{C}/\text{W}$ |
| Y_{JT} | Junction-to-top characterization parameter | 2.1 | $^\circ\text{C}/\text{W}$ |
| Y_{JB} | Junction-to-board characterization parameter | 24.8 | $^\circ\text{C}/\text{W}$ |
| $R_{qJC(bot)}$ | Junction-to-case (bottom) thermal resistance | 9.8 | $^\circ\text{C}/\text{W}$ |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

8.6 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------|----------------------------------|--|------|------|------|------|
| I _{LEAK} | Leakage Current | Measured at V _{IN} = ±V _{RWM} , T _A = 27°C | | 2 | 27 | nA |
| | | Measured at V _{IN} = ±V _{RWM} , T _A = 85°C | | | 330 | |
| V _{BR} | Break-down Voltage | I _{IN} = ±1mA | 25.1 | 26.6 | | V |
| V _{CLAMP} | Clamp Voltage | ±I _{pp} IEC 61000-4-5 Surge (8/20 μs), V _{IN} = 0 V before surge, T _A = 27°C | | 29.6 | 30.7 | V |
| | | Max ±I _{pp} IEC 61000-4-5 Surge (8/20 μs), V _{IN} = ±V _{RWM} before surge, T _A = 125°C | | 30.5 | 32.7 | |
| R _{DYN} | 8/20 μs surge dynamic resistance | Calculated from V _{CLAMP} at .5*I _{PP} and I _{PP} surge current, T _A = 25°C | | 40 | | mΩ |
| C _{IN} | Input pin capacitance | V _{IN} = V _{RWM} , f = 1 MHz, 30 mV _{pp} , IO to GND | | 62 | | pF |
| SR | Maximum Slew Rate | 0-±V _{RWM} rising edge, sweep rise time and measure slew rate when I _{PEAK} = 1 mA, T _A = 27°C | | 2.5 | | V/μs |
| | | 0-±V _{RWM} rising edge, sweep rise time and measure slew rate when I _{PEAK} = 1 mA, T _A = 85°C | | 1.0 | | |

8.7 Typical Characteristics

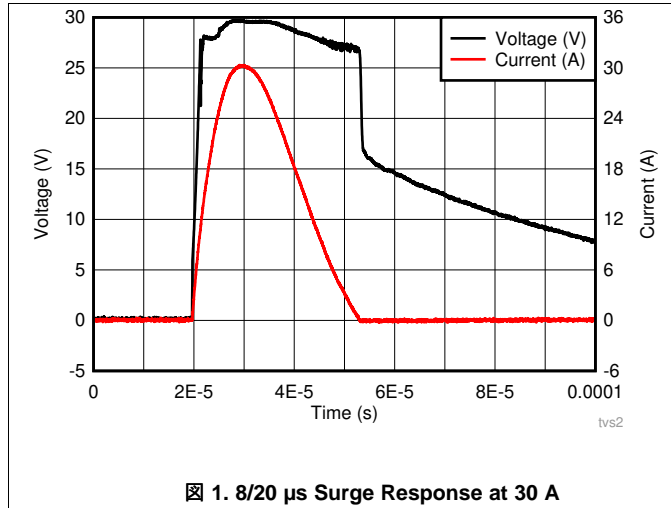


Fig 1. 8/20 μ s Surge Response at 30 A

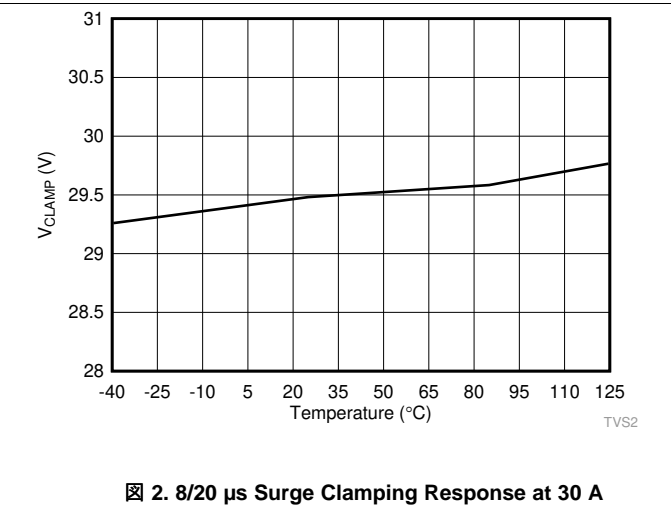
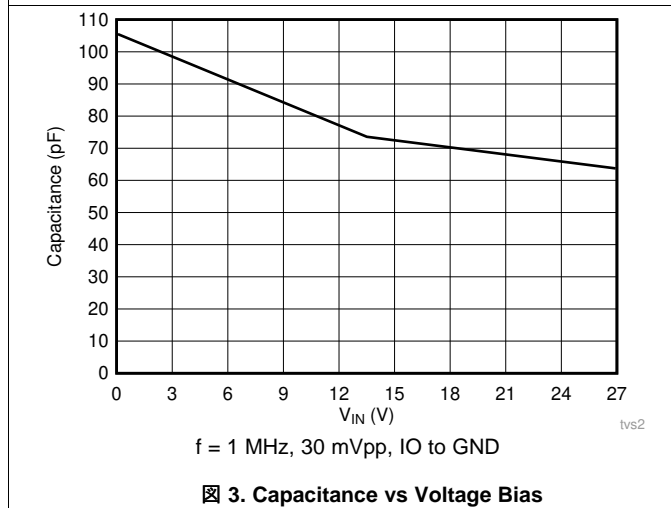


Fig 2. 8/20 μ s Surge Clamping Response at 30 A



f = 1 MHz, 30 mVpp, IO to GND

Fig 3. Capacitance vs Voltage Bias

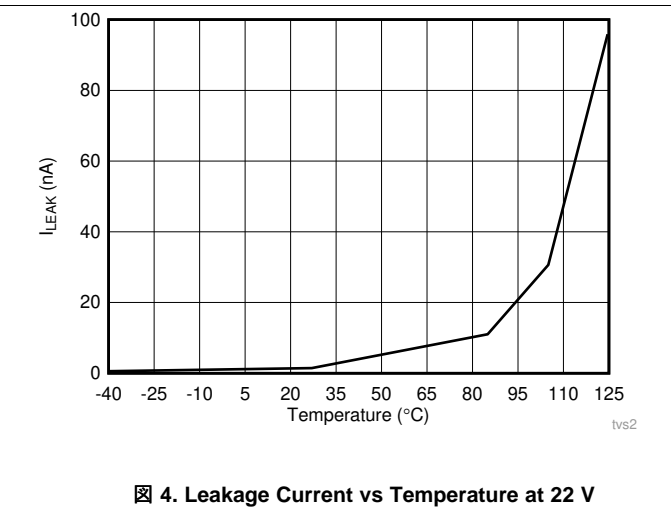


Fig 4. Leakage Current vs Temperature at 22 V

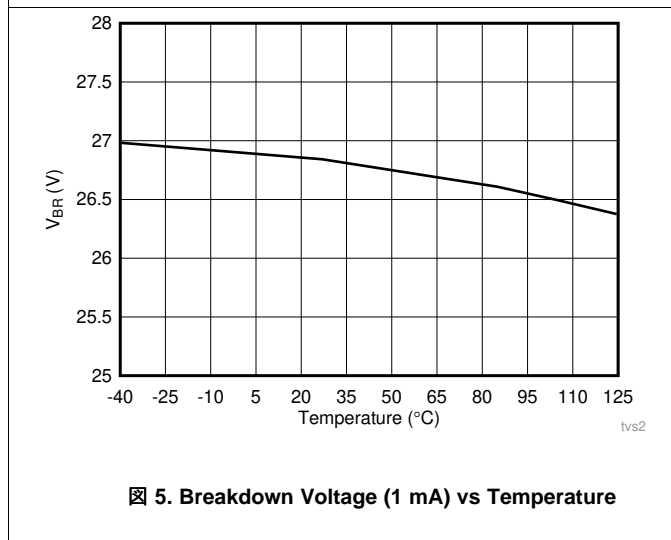


Fig 5. Breakdown Voltage (1 mA) vs Temperature

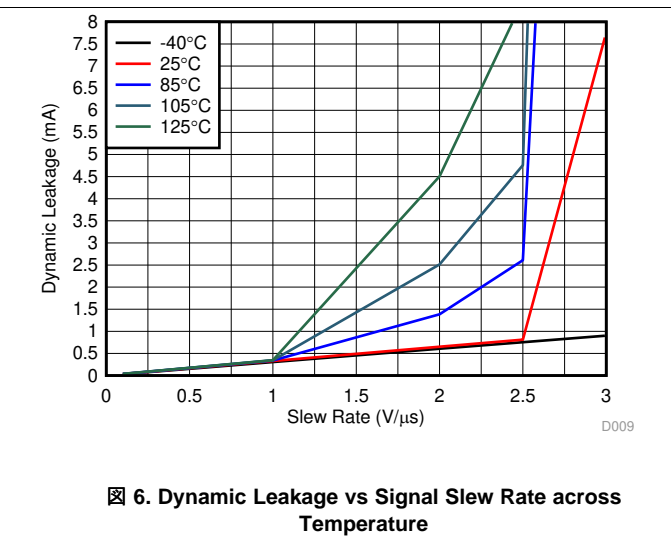


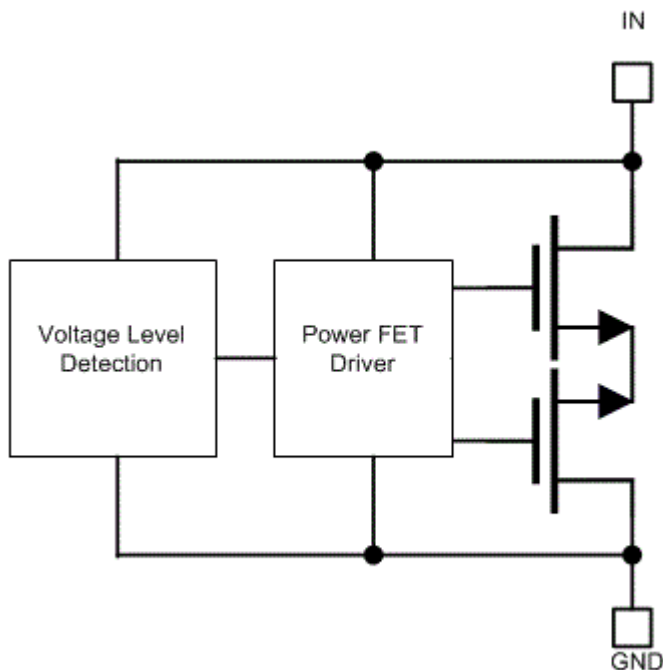
Fig 6. Dynamic Leakage vs Signal Slew Rate across Temperature

9 Detailed Description

9.1 Overview

The TVS2201 is a bidirectional precision clamp with two integrated FETs driven by a feedback loop to tightly regulate the input voltage during an overvoltage event. This feedback loop leads to a very low dynamic resistance, giving a flat clamping voltage during transient overvoltage events like a surge.

9.2 Functional Block Diagram



9.3 Feature Description

The TVS2201 is a precision clamp that handles 30 A of IEC 61000-4-5 8/20 μ s surge pulse. The flat clamping feature helps keep the clamping voltage very low to keep the downstream circuits from being stressed. The flat clamping feature can also help end-equipment designers save cost by opening up the possibility to use lower-cost, lower voltage tolerant downstream ICs. This device provides a bidirectional operating range, with a symmetrical V_{RWM} of ± 22 V, designed for applications that have bipolar input signals or that must withstand reverse wiring conditions. The TVS2201 has minimal leakage at V_{RWM} , designed for applications where low leakage and power dissipation is a necessity. Built in IEC 61000-4-2 and IEC 61000-4-4 ratings make it a robust protection solution for ESD and EFT events and the TVS2201 wide ambient temperature range of -40°C to $+125^{\circ}\text{C}$ enables usage in harsh industrial environments.

9.4 Device Functional Modes

9.4.1 Protection Specifications

The TVS2201 is specified according to both the IEC 61000-4-5 and IEC 61643-321 standards. This enables usage in systems regardless of which standard is required by relevant product standards or best matches measured fault conditions. The IEC 61000-4-5 standard requires protection against a pulse with a rise time of 8 μ s and a half-length of 20 μ s, while the IEC 61643-321 standard requires protection against a much longer pulse with a rise time of 10 μ s and a half-length of 1000 μ s.

Device Functional Modes (continued)

The positive and negative surges are imposed to the TVS2201 by a combination wave generator (CWG) with a 2-Ω coupling resistor at different peak voltage levels. For powered-on transient tests that need power supply bias, inductances are used to decouple the transient stress and protect the power supply. The TVS2201 is post-tested by assuring that there is no shift in device breakdown or leakage at V_{RWM} .

In addition, the TVS2201 has been tested according to IEC 61000-4-5 to pass a ±1-kV surge test through a 42-Ω coupling resistor and a 0.5-μF capacitor. This test is a common test requirement for industrial signal I/O lines and the TVS2201 precision clamp can be used in applications that have that requirement.

The TVS2201 integrates IEC 61000-4-2 level 4 ESD Protection and 80 A of IEC 61000-4-4 EFT Protection. These combine to ensure that the device can protect against most common transient test requirements.

For more information on TI's test methods for Surge, ESD, and EFT testing, refer to the [IEC 61000-4-x Tests for TI's Protection Devices](#) application report.

9.4.2 Reliability Testing

To ensure device reliability, the TVS2201 is characterized against 5000 repetitive pulses of 25-A IEC 61000-4-5 8/20-μs surge pulses at 125°C. The test is performed with less than 10 seconds between each pulse at high temperature to simulate worst-case scenarios for fault regulation. After each surge pulse, the TVS2201 clamping voltage, breakdown voltage, and leakage are recorded to ensure that there is no variation or performance degradation. By ensuring robust, reliable, high temperature protection, the TVS2201 enables fault protection in applications that must withstand years of continuous operation with no performance change.

9.4.3 Zero Derating

Unlike traditional diodes, the TVS2201 has zero derating of maximum power dissipation and ensures robust performance up to 125°C. Traditional TVS diodes lose up to 50% of their current carrying capability when at high temperatures, so a surge pulse above 85°C ambient can cause failures that are not seen at room temperature. The TVS2201 prevents this so the designer can see the surge protection regardless of temperature. Because of this, Flat-Clamp devices can provide robust protection against surge pulses that occur at high ambient temperatures, as shown in TI's [TVS Surge Protection in High-Temperature Environments](#) application report.

9.4.4 Bidirectional Operation

The TVS2201 is a bidirectional TVS with a symmetrical operating region. This allows for operation with positive and negative voltages, rather than just positive voltages like the unidirectional TVS2200. This allows for single chip protection for applications where the signal is expected to operate below 0 V or where there is a need to withstand a large common-mode voltage. In addition, there is a system requirement to be able to withstand reverse wiring conditions, in many cases where a high voltage signal is accidentally applied to the system ground and a ground is accidentally applied to the input terminal. This causes a large reverse voltage on the TVS diode that the device must be able to withstand. The TVS2201 is designed to not break down or see failures under reverse wiring conditions, for applications that must withstand these miswiring issues.

注

If the applied signal is not expected to go below 0 V, a unidirectional device will clamp much lower in the reverse direction and should be used. In this case, the recommended device would be the TVS2200.

9.4.5 Transient Performance

During large transient swings, the TVS2201 will begin clamping the input signal to protect downstream conditions. While this prevents damage during fault conditions, it can cause leakage when the intended input signal has a fast slew rate. To keep power dissipation low and remove the chance of signal distortion, TI recommendeds that the designer keep the slew rate of any input signal on the TVS2201 below 2.5 V/μs at room temperature and below 1.0 V/μs at 85°C shown in [Figure 6](#). Faster slew rates will cause the device to clamp the input signal and draw current through the device for a few microseconds, increasing the rise time of the signal. This will not cause any harm to the system or to the device, however it can cause device overheating if the fast input voltage swings occur regularly.

10 Application and Implementation

注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

10.1 Application Information

The TVS2201 can be used to protect any power, analog, or digital signal from transient fault conditions caused by the environment or other electrical components.

10.2 Typical Application

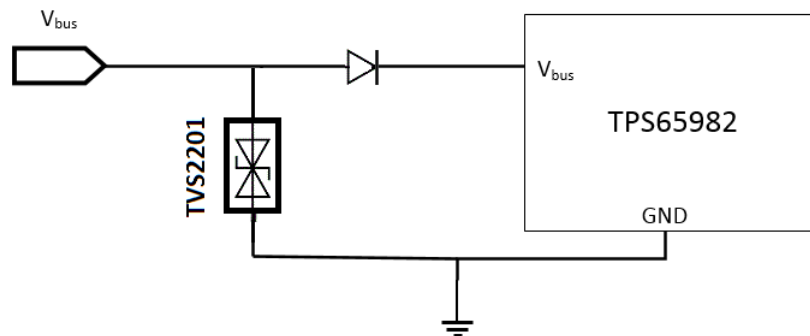


图 7. TVS2201 Application Schematic

10.2.1 Design Requirements

A typical operation for the TVS2201 would be protecting a USB Type-C V_{BUS} input, with a nominal input voltage of 20 V and a required withstand of 22 V, shown in 图 7. In this example, a TVS2201 is protecting the input to a TPS65982 Type-C Port Controller. Without any input protection, this input voltage will rise to hundreds of volts for multiple microseconds, and violate the absolute maximum input voltage and harm the device if a surge event is caused by lightning, coupling, hot-swap ringing, or any other fault condition. This customer is adding additional surge protection on the V_{BUS} line because they are worried about faulty connectors causing power spikes, and in addition wants to have protection against mechanical shorts in the connector that could possibly apply -20 V to the V_{BUS} line.

10.2.2 Detailed Design Procedure

If the TVS2201 is in place to protect the device, the voltage will rise to the breakdown of the diode at 26.6 V, during a surge event. The TVS2201 will then turn on to shunt the surge current to ground. With the low dynamic resistance of the TVS2201, even large amounts of surge current will have minimal impact on the clamping voltage. The dynamic resistance of the TVS2201 is around 40 m Ω , which means a 25-A surge current will cause a voltage raise of $25 \text{ A} \times 40 \text{ m}\Omega = 1 \text{ V}$. Because the device turns on at 26.6 V, this means the input will be exposed to a maximum of $26.6 \text{ V} + 1 \text{ V} = 27.6 \text{ V}$ during surge pulses, robustly protecting the USB Type-C port.

In addition, the TVS2201 provides protection against reverse voltage application that could accidentally be caused by shorts between pins. If -20 V is applied to the V_{BUS} pin, the TPS65982 will not be harmed because the series diode will prevent the voltage from being applied to the input, and the TVS2201 will not shunt current because the reverse working voltage is -22 V. If the TVS2200 or a unidirectional device is used in this case, a -20 -V short would cause the device to shunt current until it fails.

Typical Application (continued)

Finally, the small size of the device also improves fault protection by lowering the effect of fault current coupling onto neighboring traces. The small form factor of the TVS2201 allows the device to be placed extremely close to the input connector, which lowers the length of the path fault current going through the system compared to larger protection solutions.

10.2.3 Application Curves

When a surge is applied to the system with the TVS2201, the device will clamp the overvoltage as shown in [Figure 8](#).

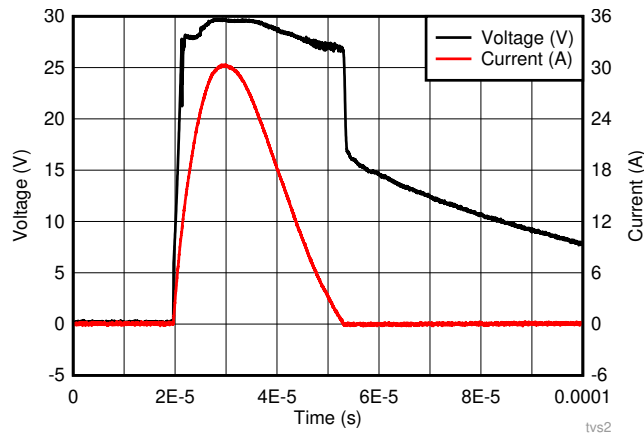


Figure 8. TVS2201 Surge Clamping at 30 A

11 Power Supply Recommendations

The TVS2201 is a clamping device so there is no need to power it. To ensure the device functions properly do not violate the recommended V_{IN} voltage range (-22 V to 22 V).

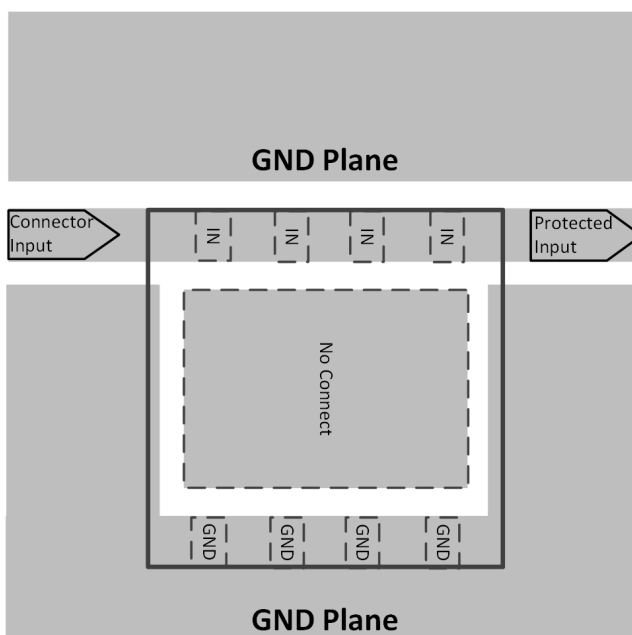
12 Layout

12.1 Layout Guidelines

The optimum placement is close to the connector. EMI during an ESD event can couple from the tested trace to other nearby unprotected traces, which could result in system failures. The PCB designer must minimize the possibility of EMI coupling by keeping all unprotected traces away from protected traces between the TVS and the connector. Route the protected traces straight. Use rounded corners with the largest radii possible to eliminate any sharp corners on the protected traces between the TVS2201 and the connector. Electric fields tend to build up on corners, which could increase EMI coupling.

Ensure that the thermal pad on the layout is floating rather than grounded. Grounding the thermal pad will impede the operating range of the TVS2201, and can cause failures when the applied voltage is negative. A floating thermal pad allows the maximum operating range without sacrificing any transient performance.

12.2 Layout Example



9. TVS2201 Layout

13 デバイスおよびドキュメントのサポート

13.1 ドキュメントのサポート

13.1.1 関連資料

関連資料については、以下を参照してください。

- 『効率的なシステム保護のためのフラット・クランプ・サージ保護技術』
- 『TI の保護デバイスに対する IEC 61000-4-x テスト』
- 『高温環境での TVS サージ保護』

13.2 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、ti.comのデバイス製品フォルダを開いてください。右上の「アラートを受け取る」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

13.3 コミュニティ・リソース

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™オンライン・コミュニティ *TIのE2E (Engineer-to-Engineer)* コミュニティ。エンジニア間の共同作業を促進するために開設されたものです。e2e.ti.comでは、他のエンジニアに質問し、知識を共有し、アイデアを検討して、問題解決に役立てることができます。

設計サポート *TIの設計サポート* 役に立つE2Eフォーラムや、設計サポート・ツールをすばやく見つけることができます。技術サポート用の連絡先情報も参照できます。

13.4 商標

E2E is a trademark of Texas Instruments.

13.5 静電気放電に関する注意事項



すべての集積回路は、適切なESD保護方法を用いて、取扱いと保存を行うようにして下さい。

静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

13.6 Glossary

[SLYZ022](#) — *TI Glossary*.

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

14 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

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 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| TVS2201DRBR | ACTIVE | SON | DRB | 8 | 3000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | 1PVP | 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.

OBSELETE: 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.

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TAPE AND REEL INFORMATION

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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TVS2201DRBR | SON | DRB | 8 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TVS2201DRBR | SON | DRB | 8 | 3000 | 338.0 | 355.0 | 50.0 |

DRB 8

GENERIC PACKAGE VIEW

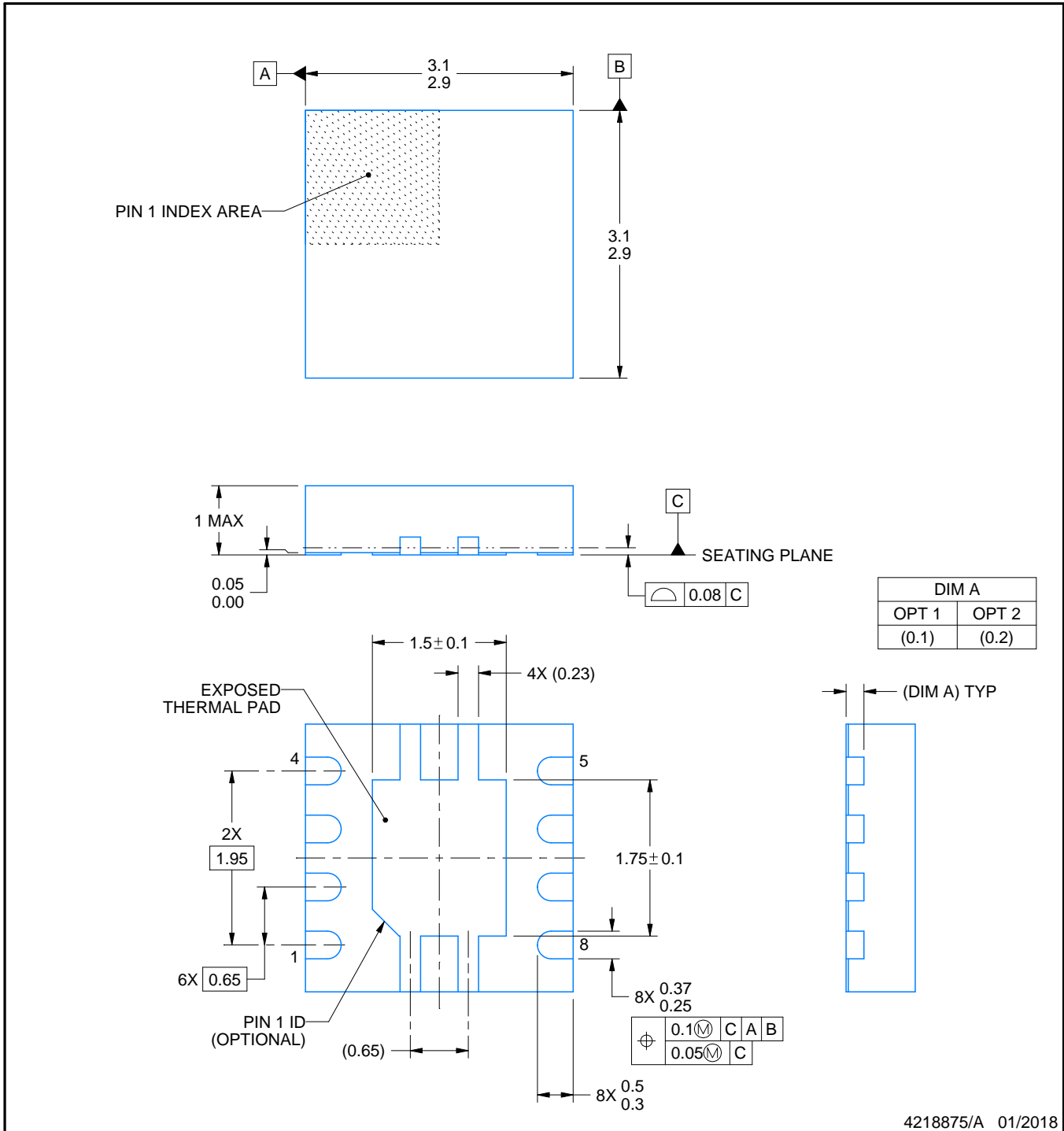
VSON - 1 mm max height

PLASTIC SMALL OUTLINE - 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.

4203482/L



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NOTES:

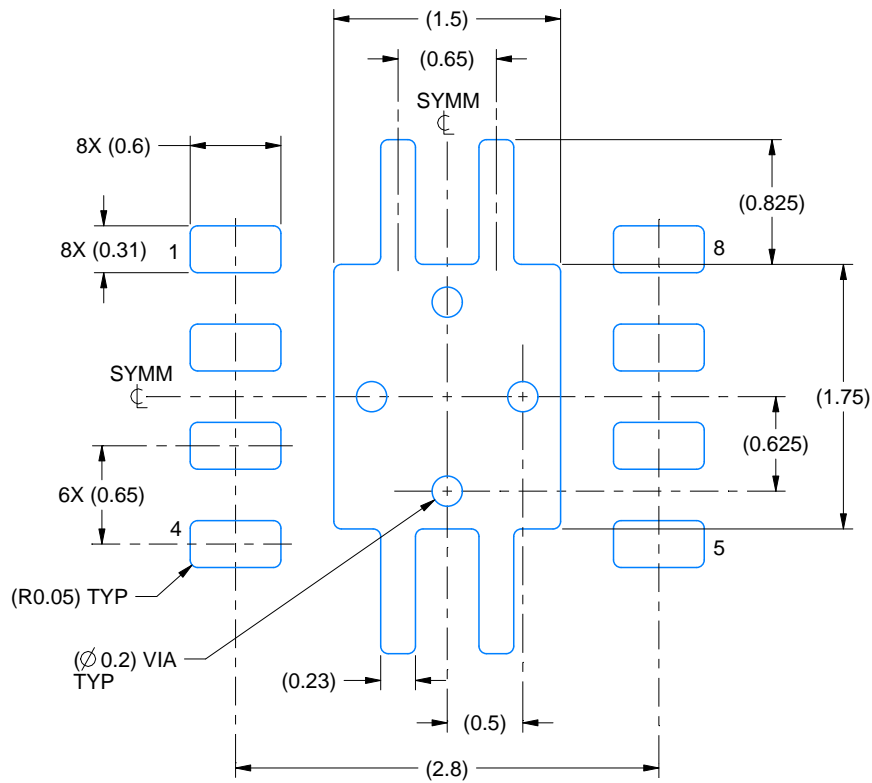
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

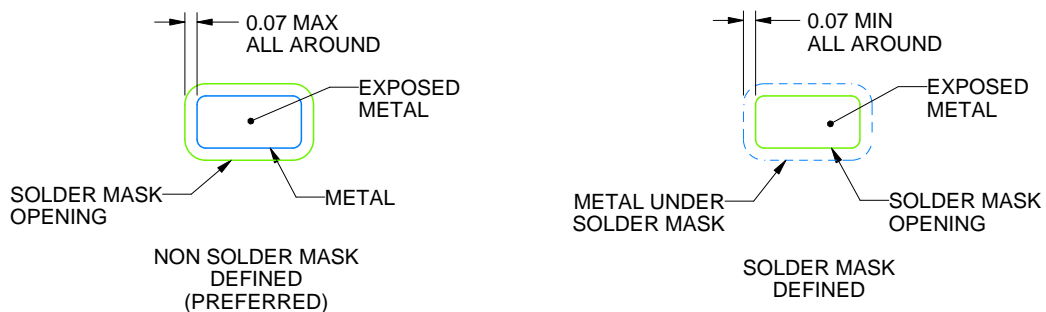
DRB0008A

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:20X



SOLDER MASK DETAILS

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NOTES: (continued)

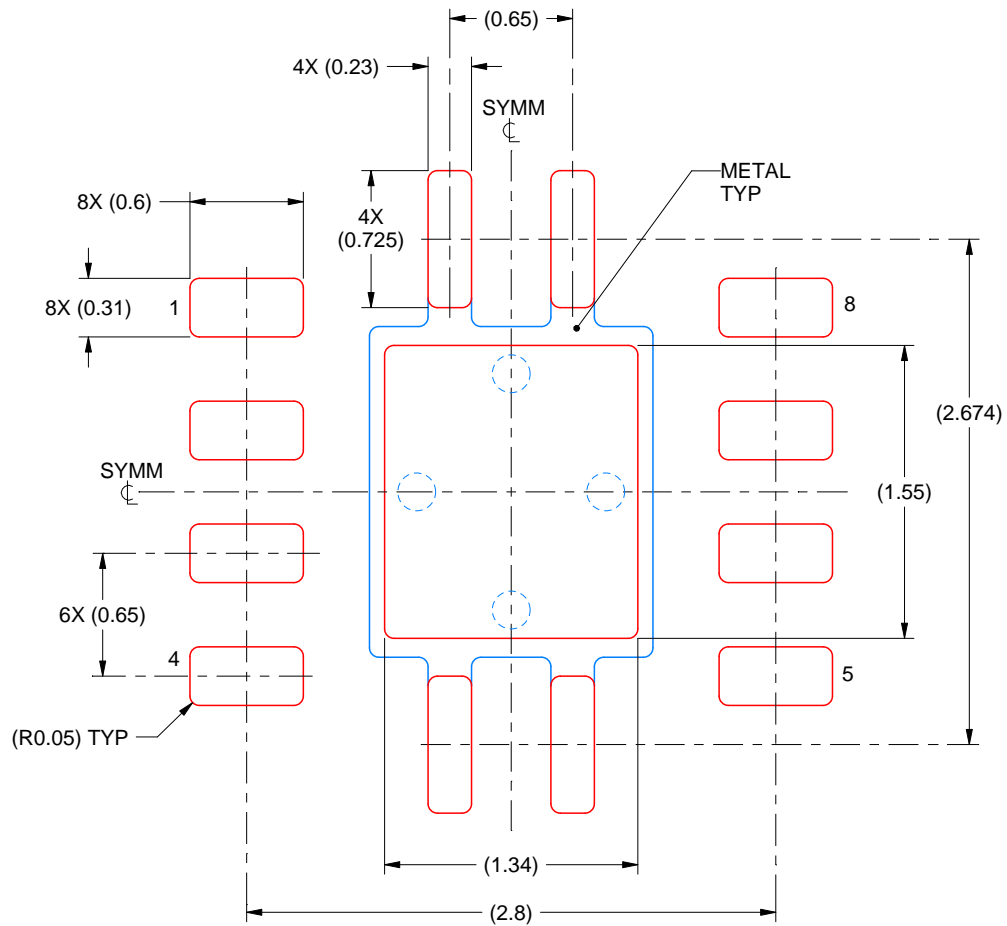
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DRB0008A

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
84% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

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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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