

TLV237x 500 μ A/Ch、3MHz、レール・ツー・レール入力および出力 オペアンプ、シャットダウン搭載

1 特長

- レール・ツー・レール入出力
- 広い帯域幅: 3MHz
- 高いスルー・レート: 2.4V/ μ s
- 高い出力駆動能力: 105mA
- 電源電圧範囲: 2.7V~16V
- 消費電流: 550 μ A/チャンネル
- 低電力シャットダウン・モード
 - $I_{DD}(SHDN)$: 25 μ A/チャンネル
- 入力バイアス電流: 1pA
- 入力ノイズ電圧: 39nV/ \sqrt{Hz}
- ユニティ・ゲイン安定
- 規定温度範囲:
 - -40 $^{\circ}$ C~+125 $^{\circ}$ C (産業用グレード)
- 超小型のパッケージ
 - 5または6ピンSOT-23 (TLV2370、TLV2371)
 - 8または10ピンVSSOP (TLV2372、TLV2373)

2 アプリケーション

- 白物家電
- ハンドヘルド・テスト機器
- 携帯用血糖値測定器
- リモート・センシング
- アクティブ・フィルタ
- 産業用オートメーション
- バッテリ駆動の電子機器

3 概要

TLV237x単一電源オペアンプには、レール・ツー・レール入力および出力機能があります。TLV237xは、最低2.7Vの電源電圧で動作し、拡張工業用温度範囲に対応し、レール・ツー・レール出力機能が追加されています。

TLV237xは、わずか550 μ Aの消費電流で、3MHzの帯域幅に対応します。推奨の最大電源電圧は16Vで、各種の充電可能セルにより動作できます(\pm 8V電源から、最低 \pm 1.35Vまで)。

CMOS入力により、高インピーダンスのセンサ・インターフェイスを使用でき、低電圧での動作から、バッテリー駆動のアプリケーションにおいてTLC227xの代替品として理想的です。レール・ツー・レール入力段により、さらに多用途に使用可能です。TLV237xは、TIから続々と新製品が販売されているRRIOデバイスの7番目の製品で、最高16Vのレールから優れたAC性能で動作する最初の製品です。

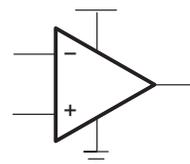
すべての製品がPDIPおよびSOICで供給され、シングルは小型のSOT-23パッケージ、デュアルはMSOP、クワッドはTSSOPパッケージで供給されます。TLV237xは2.7Vで動作するため、リチウムイオン・バッテリー駆動のシステムや、TIのMSP430など、現在利用可能な多くのMicropowerマイクロコントローラの動作電源電圧範囲と互換です。

製品情報⁽¹⁾

| 型番 | パッケージ | 本体サイズ(公称) |
|---------|------------|-------------------------|
| TLV237x | PDIP (8) | 9.81mm \times 6.35mm |
| | PDIP (14) | 19.30mm \times 6.35mm |
| | SOIC (8) | 4.90mm \times 3.91mm |
| | SOIC (14) | 8.65mm \times 3.91mm |
| | TSSOP (14) | 5.00mm \times 4.40mm |
| | TSSOP (16) | |
| | SOT-23 (6) | 2.90mm \times 1.60mm |
| | SOT-23 (5) | |
| | VSSOP (8) | 3.00mm \times 3.00mm |
| | VSSOP (10) | |

(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。

オペアンプ



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4 改訂履歴

| Revision E (May 2016) から Revision F に変更 | Page |
|--|------|
| • Changed names of pins 2 and 3 in TLV2372 D, DGK, and P packages pinout diagram | 5 |

| Revision D (January 2005) から Revision E に変更 | Page |
|---|------|
| • 「ESD定格」の表、「機能説明」セクション、「デバイスの機能モード」セクション、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージ、および注文情報」セクションを追加 | 1 |
| • Deleted <i>TLV2370 and TLV2371 Available Options, TLV2372 AND TLV2373 Available Options, and TLV2374 and TLV2375 Available Options</i> tables | 3 |
| • Deleted <i>Continuous total power dissipation and lead temperature</i> specifications from <i>Absolute Maximum Ratings</i> table ... | 9 |
| • Deleted <i>Dissipation Ratings</i> table | 17 |

5 Device Comparison Tables

Table 1. Selection of Signal Amplifier Products⁽¹⁾

| DEVICE | V _{DD} (V) | V _{IO} (μ V) | I _Q /Ch (μ A) | I _{IB} (pA) | GBW (MHz) | SR (V/ μ s) | SHUTDOWN | RAIL-TO-RAIL | SINGLES, DUALS, QUADS |
|---------|------------------------|-------------------------------|----------------------------------|-------------------------|--------------|--------------------|----------|--------------|-----------------------------|
| TLV237x | 2.7 to 16 | 500 | 550 | 1 | 3 | 2.4 | Yes | I/O | S, D, Q |
| TLC227x | 4 to 16 | 300 | 1100 | 1 | 2.2 | 3.6 | — | O | D, Q |
| TLV27x | 2.7 to 16 | 500 | 550 | 1 | 3 | 2.4 | — | O | S, D, Q |
| TLC27x | 3 to 16 | 1100 | 675 | 1 | 1.7 | 3.6 | — | — | S, D, Q |
| TLV246x | 2.7 to 16 | 150 | 550 | 1300 | 6.4 | 1.6 | Yes | I/O | S, D, Q |
| TLV247x | 2.7 to 16 | 250 | 600 | 2 | 2.8 | 1.5 | Yes | I/O | S, D, Q |
| TLV244x | 2.7 to 10 | 300 | 725 | 1 | 1.8 | 1.4 | — | O | D, Q |

(1) Typical values measured at 5 V and 25°C.

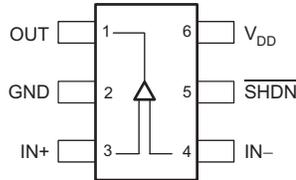
Table 2. Family Package Table⁽¹⁾

| DEVICE | NUMBER OF CHANNELS | PACKAGE TYPES | | | | | SHUTDOWN | UNIVERSAL EVM BOARD |
|---------|--------------------|---------------|------|--------|-------|------|----------|------------------------------------|
| | | PDIP | SOIC | SOT-23 | TSSOP | MSOP | | |
| TLV2370 | 1 | 8 | 8 | 6 | — | — | Yes | See the <i>EVM Selection Guide</i> |
| TLV2371 | 1 | 8 | 8 | 5 | — | — | — | |
| TLV2372 | 2 | 8 | 8 | — | — | 8 | — | |
| TLV2373 | 2 | 14 | 14 | — | — | 10 | Yes | |
| TLV2374 | 4 | 14 | 14 | — | 14 | — | — | |
| TLV2375 | 4 | 16 | 16 | — | 16 | — | Yes | |

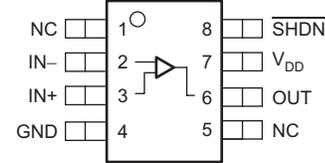
(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

6 Pin Configuration and Functions

**TLV2370 DBV Package
 6-Pin SOT-23
 Top View**



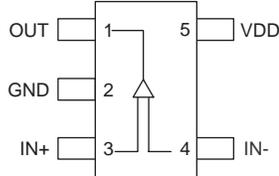
**TLV2370 D and P Packages
 8-Pin SOIC and PDIP
 Top View**



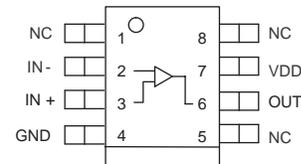
Pin Functions: TLV2370

| NAME | PIN | | I/O | DESCRIPTION |
|-----------------|--------|------------|-----|---|
| | SOT-23 | SOIC, PDIP | | |
| GND | 2 | 4 | — | Ground connection |
| IN- | 4 | 2 | I | Negative (inverting) input |
| IN+ | 3 | 3 | I | Positive (noninverting) input |
| NC | — | 1, 5 | — | No internal connection (can be left floating) |
| OUT | 1 | 6 | O | Output |
| SHDN | 5 | 8 | I | Shutdown control (active low, can be left floating) |
| V _{DD} | 6 | 7 | — | Positive power supply |

**TLV2371 DBV Package
 5-Pin SOT-23
 Top View**



**TLV2371 D and P Packages
 8-Pin SOIC and PDIP
 Top View**

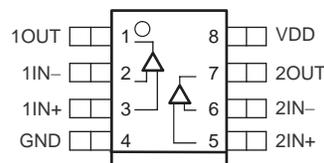


NC- no internal connection

Pin Functions: TLV2371

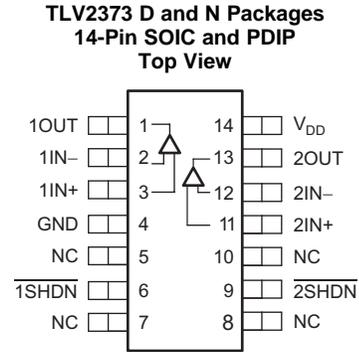
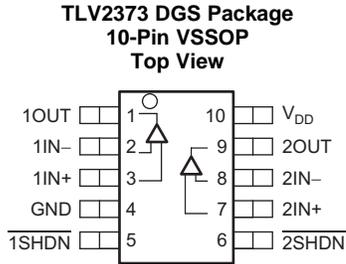
| NAME | PIN | | I/O | DESCRIPTION |
|-----------------|--------|------------|-----|---|
| | SOT-23 | SOIC, PDIP | | |
| GND | 2 | 4 | — | Ground connection |
| IN- | 4 | 2 | I | Negative (inverting) input |
| IN+ | 3 | 3 | I | Positive (noninverting) input |
| NC | — | 1, 5, 8 | — | No internal connection (can be left floating) |
| OUT | 1 | 6 | O | Output |
| V _{DD} | 5 | 7 | — | Positive power supply |

**TLV2372 D, DGK, and P Packages
 8-Pin SOIC, VSSOP, and PDIP
 Top View**



Pin Functions: TLV2372

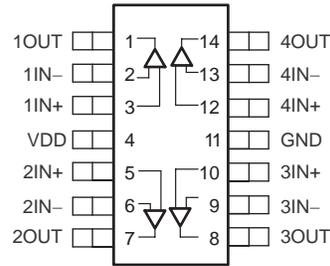
| PIN | | I/O | DESCRIPTION |
|-----------------|----------------------|-----|-------------------------------|
| NAME | SOIC, VSSOP, PDIP | | |
| GND | 4 | — | Ground connection |
| 1IN– | 2 | I | Inverting input, channel 1 |
| 1IN+ | 3 | I | Noninverting input, channel 1 |
| 2IN– | 6 | I | Inverting input, channel 2 |
| 2IN+ | 5 | I | Noninverting input, channel 2 |
| 1OUT | 1 | O | Output, channel 1 |
| 2OUT | 7 | O | Output, channel 2 |
| V _{DD} | 8 | — | Positive power supply |



Pin Functions: TLV2373

| NAME | PIN | | I/O | DESCRIPTION |
|---------------------|-------------|-------|-----|---|
| | SOIC, PDIP | VSSOP | | |
| GND | 4 | 4 | — | Ground connection |
| 1IN- | 2 | 2 | I | Inverting input, channel 1 |
| 1IN+ | 3 | 3 | I | Noninverting input, channel 1 |
| 2IN- | 12 | 8 | I | Inverting input, channel 2 |
| 2IN+ | 11 | 7 | I | Noninverting input, channel 2 |
| 1OUT | 1 | 1 | O | Output, channel 1 |
| 2OUT | 13 | 9 | O | Output, channel 2 |
| $\overline{1}$ SHDN | 6 | 5 | I | Shutdown control, channel 1, (active low, can be left floating) |
| $\overline{2}$ SHDN | 9 | 6 | I | Shutdown control, channel 2, (active low, can be left floating) |
| V _{DD} | 14 | 10 | — | Positive power supply |
| NC | 5, 7, 8, 10 | — | — | No internal connection (can be left floating) |

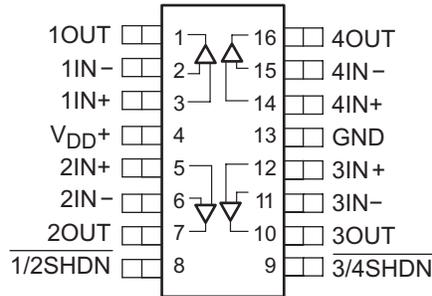
TLV2374 D, N, and PW Packages
14-Pin SOIC, PDIP, and TSSOP
Top View



Pin Functions: TLV2374

| PIN | | I/O | DESCRIPTION |
|-----------------|-------------------|-----|-------------------------------|
| NAME | SOIC, PDIP, TSSOP | | |
| GND | 11 | — | Ground connection |
| 1IN- | 2 | I | Inverting input, channel 1 |
| 1IN+ | 3 | I | Noninverting input, channel 1 |
| 2IN- | 6 | I | Inverting input, channel 2 |
| 2IN+ | 5 | I | Noninverting input, channel 2 |
| 3IN- | 9 | I | Inverting input, channel 3 |
| 3IN+ | 10 | I | Noninverting input, channel 3 |
| 4IN- | 13 | I | Inverting input, channel 4 |
| 4IN+ | 12 | I | Noninverting input, channel 4 |
| 1OUT | 1 | O | Output, channel 1 |
| 2OUT | 7 | O | Output, channel 2 |
| 3OUT | 8 | O | Output, channel 3 |
| 4OUT | 14 | O | Output, channel 4 |
| V _{DD} | 4 | — | Positive power supply |

TLV2375 D, N, and PW Packages
 16-Pin SOIC, PDIP, and TSSOP
 Top View



Pin Functions: TLV2375

| PIN | | I/O | DESCRIPTION |
|-----------------------|-------------------|-----|--|
| NAME | SOIC, PDIP, TSSOP | | |
| GND | 13 | — | Ground connection |
| 1IN- | 2 | I | Inverting input, channel 1 |
| 2IN- | 6 | I | Inverting input, channel 2 |
| 3IN- | 11 | I | Inverting input, channel 3 |
| 4IN- | 15 | I | Inverting input, channel 4 |
| 1IN+ | 3 | I | Noninverting input, channel 1 |
| 2IN+ | 5 | I | Noninverting input, channel 2 |
| 3IN+ | 12 | I | Noninverting input, channel 3 |
| 4IN+ | 14 | I | Noninverting input, channel 4 |
| 1OUT | 1 | O | Output, channel 1 |
| 2OUT | 7 | O | Output, channel 2 |
| 3OUT | 10 | O | Output, channel 3 |
| 4OUT | 16 | O | Output, channel 4 |
| $\overline{1/2}$ SHDN | 8 | I | Shutdown control, channels 1 and 2, (active low, can be left floating) |
| $\overline{3/4}$ SHDN | 9 | I | Shutdown control, channels 3 and 4, (active low, can be left floating) |
| V _{DD} | 4 | — | Positive power supply |

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|-------------|--|-----------|----------------|------|
| Voltage | Supply voltage, V_{DD} ⁽²⁾ | | 16.5 | V |
| | Differential input voltage, V_{ID} | $-V_{DD}$ | V_{DD} | |
| | Input voltage, V_I ⁽²⁾ | -0.2 | $V_{DD} + 0.2$ | |
| Current | Input current, I_{IN} | -10 | 10 | mA |
| | Output current, I_O | -100 | 100 | |
| Temperature | Operating free-air temperature, T_A : I-suffix | -40 | 125 | °C |
| | Maximum junction temperature, T_J | | 150 | |
| | Storage temperature, T_{stg} | -65 | 150 | |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* 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 Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to GND.

7.2 Recommended Operating Conditions

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

| | | MIN | MAX | UNIT |
|---|---------------|------------|----------|------|
| Supply voltage, V_{DD} | Single supply | 2.7 | 16 | V |
| | Split supply | ± 1.35 | ± 8 | |
| Common-mode input voltage, V_{CM} | | 0 | V_{DD} | V |
| Operating free-air temperature, T_A | I-suffix | -40 | 125 | °C |
| Turnon voltage (shutdown pin voltage level), $V_{(ON)}$, relative to GND pin voltage | | | 2 | V |
| Turnoff (shutdown pin voltage level), $V_{(OFF)}$, relative to GND pin voltage | | 0.8 | | V |

7.3 Thermal Information: TLV2370

| THERMAL METRIC ⁽¹⁾ | | TLV2370 | | | UNIT |
|-------------------------------|--|--------------|----------|----------|------|
| | | DBV (SOT-23) | D (SOIC) | P (PDIP) | |
| | | 6 PINS | 8 PINS | 8 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 228.5 | 138.4 | 49.2 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 99.1 | 89.5 | 39.4 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 54.6 | 78.6 | 26.4 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 7.7 | 29.9 | 15.4 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 53.8 | 78.1 | 26.3 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

7.4 Thermal Information: TLV2371

| THERMAL METRIC ⁽¹⁾ | | TLV2371 | | | UNIT |
|-------------------------------|--|--------------|----------|----------|------|
| | | DBV (SOT-23) | D (SOIC) | P (PDIP) | |
| | | 5 PINS | 8 PINS | 8 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 228.5 | 138.4 | 49.2 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 99.1 | 89.5 | 39.4 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 54.6 | 78.6 | 26.4 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 7.7 | 29.9 | 15.4 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 53.8 | 78.1 | 26.3 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

7.5 Thermal Information: TLV2372

| THERMAL METRIC ⁽¹⁾ | | TLV2372 | | | UNIT |
|-------------------------------|--|----------|-------------|----------|------|
| | | D (SOIC) | DGK (VSSOP) | P (PDIP) | |
| | | 8 PINS | 8 PINS | 8 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 138.4 | 191.2 | 49.2 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 89.5 | 61.9 | 39.4 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 78.6 | 111.9 | 26.4 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 29.9 | 5.1 | 15.4 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 78.1 | 110.2 | 26.3 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

7.6 Thermal Information: TLV2373

| THERMAL METRIC ⁽¹⁾ | | TLV2373 | | | UNIT |
|-------------------------------|--|-------------|----------|----------|------|
| | | DGS (VSSOP) | D (SOIC) | P (PDIP) | |
| | | 10 PINS | 14 PINS | 14 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 166.5 | 67 | 66.3 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 41.8 | 24.1 | 20.5 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 86.1 | 22.5 | 26.8 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 1.5 | 2.2 | 2.1 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 84.7 | 22.1 | 26.2 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

7.7 Thermal Information: TLV2374

| THERMAL METRIC ⁽¹⁾ | | TLV2374 | | | UNIT |
|-------------------------------|--|----------|----------|------------|------|
| | | D (SOIC) | N (PDIP) | PW (TSSOP) | |
| | | 14 PINS | 14 PINS | 14 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 67 | 66.3 | 121 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 24.1 | 20.5 | 49.4 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 22.5 | 26.8 | 62.8 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 2.2 | 2.1 | 5.9 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 22.1 | 26.2 | 62.2 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

7.8 Thermal Information: TLV2375

| THERMAL METRIC ⁽¹⁾ | | TLV2375 | | | UNIT |
|-------------------------------|--|----------|----------|------------|------|
| | | D (SOIC) | N (PDIP) | PW (TSSOP) | |
| | | 16 PINS | 16 PINS | 16 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 83 | 55.8 | 115.6 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 44 | 43.1 | 50.5 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 40.5 | 35.8 | 60.7 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 11.5 | 27.9 | 7.4 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 40.2 | 35.7 | 60.1 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

7.9 Electrical Characteristics

at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.7\text{ V}$, 5 V , and 15 V (unless otherwise noted).

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------------------------|---|--|--|------|------|------------------------------|
| DC PERFORMANCE | | | | | | |
| V_{OS} | Input offset voltage | At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $V_O = V_{DD}/2$, $R_S = 50\ \Omega$ | | 2 | 4.5 | mV |
| | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $V_O = V_{DD}/2$, $R_S = 50\ \Omega$ | | | 6 | mV |
| dV_{OS}/dT | Offset voltage drift | At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $V_O = V_{DD}/2$, $R_S = 50\ \Omega$ | | 2 | | $\mu\text{V}/^\circ\text{C}$ |
| CMRR | Common-mode rejection ratio | $V_{DD} = 2.7\text{ V}$, $R_S = 50\ \Omega$ | $V_{IC} = 0$ to V_{DD} | 50 | 68 | dB |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = 0$ to V_{DD} | 49 | | |
| | | | $V_{IC} = 0$ to $V_{DD} - 1.35\text{ V}$ | 56 | 70 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = 0$ to $V_{DD} - 1.35\text{ V}$ | 54 | | |
| | | $V_{DD} = 5\text{ V}$, $R_S = 50\ \Omega$ | $V_{IC} = 0$ to V_{DD} | 55 | 72 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = 0$ to V_{DD} | 54 | | |
| | | | $V_{IC} = 0$ to $V_{DD} - 1.35\text{ V}$ | 67 | 80 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = 0$ to $V_{DD} - 1.35\text{ V}$ | 64 | | |
| | | $V_{DD} = 15\text{ V}$, $R_S = 50\ \Omega$ | $V_{IC} = 0$ to V_{DD} | 64 | 82 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = 0$ to V_{DD} | 63 | | |
| | | | $V_{IC} = 0$ to $V_{DD} - 1.35\text{ V}$ | 67 | 84 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = 0$ to $V_{DD} - 1.35\text{ V}$ | 66 | | |
| A_{VD} | Large-signal differential voltage amplification | $V_{DD} = 2.7\text{ V}$, $V_{O(PP)} = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ | | 98 | 106 | dB |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 76 | | |
| | | $V_{DD} = 5\text{ V}$, $V_{O(PP)} = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ | | 100 | 110 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 86 | | |
| | | $V_{DD} = 15\text{ V}$, $V_{O(PP)} = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ | | 81 | 83 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 79 | | |
| INPUT CHARACTERISTICS | | | | | | |
| I_{OS} | Input offset current | $V_{DD} = 15\text{ V}$, $V_{IC} = V_O = V_{DD}/2$ | | 1 | 60 | pA |
| | | | At $T_A = 70^\circ\text{C}$ | | 100 | |
| | | | At $T_A = 125^\circ\text{C}$ | | 1000 | |
| I_B | Input bias current | $V_{DD} = 15\text{ V}$, $V_{IC} = V_O = V_{DD}/2$ | | 1 | 60 | pA |
| | | | At $T_A = 70^\circ\text{C}$ | | 100 | |
| | | | At $T_A = 125^\circ\text{C}$ | | 1000 | |
| | Differential input resistance | | | 1000 | | $\text{G}\Omega$ |
| | Common-mode input capacitance | $f = 21\text{ kHz}$ | | 8 | | pF |

Electrical Characteristics (continued)

 at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.7\text{ V}$, 5 V , and 15 V (unless otherwise noted).

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------------------|-----------------|-----|-----|-----|------|
| OUTPUT CHARACTERISTICS | | | | | |

Electrical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.7\text{ V}$, 5 V , and 15 V (unless otherwise noted).

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|---------------------------|---|-------|-------|------|------|
| V_{OH} | High-level output voltage | $V_{DD} = 2.7\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -1\text{ mA}$ | 2.55 | 2.58 | | |
| | | $V_{DD} = 2.7\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -1\text{ mA}$ | 2.48 | | | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -1\text{ mA}$ | 4.9 | 4.93 | | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -1\text{ mA}$ | 4.85 | | | |
| | | $V_{DD} = 15\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -1\text{ mA}$ | 14.92 | 14.96 | | |
| | | $V_{DD} = 15\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -1\text{ mA}$ | 14.9 | | | |
| | | $V_{DD} = 2.7\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -5\text{ mA}$ | 1.9 | 2 | | V |
| | | $V_{DD} = 2.7\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -5\text{ mA}$ | 1.6 | | | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -5\text{ mA}$ | 4.6 | 4.68 | | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -5\text{ mA}$ | 4.5 | | | |
| | | $V_{DD} = 15\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -5\text{ mA}$ | 14.7 | 14.8 | | |
| | | $V_{DD} = 15\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OH} = -5\text{ mA}$ | 14.6 | | | |
| V_{OL} | Low-level output voltage | $V_{DD} = 2.7\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 1\text{ mA}$ | | 0.1 | 0.15 | |
| | | $V_{DD} = 2.7\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 1\text{ mA}$ | | | 0.22 | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 1\text{ mA}$ | | 0.05 | 0.1 | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 1\text{ mA}$ | | | 0.15 | |
| | | $V_{DD} = 15\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 1\text{ mA}$ | | 0.05 | 0.08 | |
| | | $V_{DD} = 15\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 1\text{ mA}$ | | | 0.1 | |
| | | $V_{DD} = 2.7\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 5\text{ mA}$ | | 0.52 | 0.7 | V |
| | | $V_{DD} = 2.7\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 5\text{ mA}$ | | | 1.1 | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 5\text{ mA}$ | | 0.28 | 0.4 | |
| | | $V_{DD} = 5\text{ V}$ At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 5\text{ mA}$ | | | 0.5 | |

Electrical Characteristics (continued)

 at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.7\text{ V}$, 5 V , and 15 V (unless otherwise noted).

| PARAMETER | TEST CONDITIONS | At $T_A = 25^\circ\text{C}$, $V_{IC} = V_{DD}/2$, $I_{OL} = 5\text{ mA}$ | | | UNIT |
|----------------------|---|--|-----|------|------|
| | | MIN | TYP | MAX | |
| | $V_{DD} = 15\text{ V}$ | | | 0.35 | |
| I_O Output current | $V_{DD} = 2.7\text{ V}$, $V_O = 0.5\text{ V}$ from rail | Positive rail | | 4 | mA |
| | | Negative rail | | 5 | |
| | $V_{DD} = 5\text{ V}$, $V_O = 0.5\text{ V}$ from rail | Positive rail | | 7 | |
| | | Negative rail | | 8 | |
| | $V_{DD} = 15\text{ V}$, $V_O = 0.5\text{ V}$ from rail | Positive rail | | 16 | |
| | | Negative rail | | 15 | |

Electrical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.7\text{ V}$, 5 V , and 15 V (unless otherwise noted).

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|--|---|---|---|-----|------|-----|------------------------|
| POWER SUPPLY | | | | | | | |
| I_{DD} | Supply current (per channel) | $V_{DD} = 2.7\text{ V}$, $V_O = V_{DD}/2$ | | | 470 | 560 | μA |
| | | $V_{DD} = 5\text{ V}$, $V_O = V_{DD}/2$ | | | 550 | 660 | |
| | | $V_{DD} = 15\text{ V}$, $V_O = V_{DD}/2$ | At $T_A = 25^\circ\text{C}$ | | | 750 | |
| At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | | | 1200 | | |
| PSRR | Power-supply rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$) | $V_{DD} = 2.7\text{ V}$ to 15 V , $V_{IC} = V_{DD}/2$, no load | At $T_A = 25^\circ\text{C}$ | | 70 | 80 | dB |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | 65 | | |
| DYNAMIC PERFORMANCE | | | | | | | |
| UGBW | Unity gain bandwidth | $V_{DD} = 2.7\text{ V}$ | $R_L = 2\text{ k}\Omega$, $C_L = 10\text{ pF}$ | | | 2.4 | MHz |
| | | $V_{DD} = 5\text{ V}$ to 15 V | $R_L = 2\text{ k}\Omega$, $C_L = 10\text{ pF}$ | | | 3 | |
| SR | Slew rate at unity gain | $V_{DD} = 2.7\text{ V}$ | At $T_A = 25^\circ\text{C}$, $V_{O(PP)} = V_{DD}/2$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$ | | 1.4 | 2 | $\text{V}/\mu\text{s}$ |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{O(PP)} = V_{DD}/2$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$ | | 1 | | |
| | | $V_{DD} = 5\text{ V}$ | At $T_A = 25^\circ\text{C}$, $V_{O(PP)} = V_{DD}/2$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$ | | 1.6 | 2.4 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{O(PP)} = V_{DD}/2$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$ | | 1.2 | | |
| $V_{DD} = 15\text{ V}$ | At $T_A = 25^\circ\text{C}$, $V_{O(PP)} = V_{DD}/2$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$ | | 1.9 | 2.1 | | | |
| | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{O(PP)} = V_{DD}/2$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$ | | 1.4 | | | | |
| ϕ_m | Phase margin | $R_L = 2\text{ k}\Omega$, $C_L = 100\text{ pF}$ | | | 65 | | $^\circ$ |
| | Gain margin | $R_L = 2\text{ k}\Omega$, $C_L = 10\text{ pF}$ | | | 18 | | dB |
| t_s | Settling time | $V_{DD} = 2.7\text{ V}$, $V_{(STEP)PP} = 1\text{ V}$, $A_V = -1$, $C_L = 10\text{ pF}$, $R_L = 2\text{ k}\Omega$, 0.1% | | | 2.9 | | μs |
| | | $V_{DD} = 5\text{ V}$, 15 V , $V_{(STEP)PP} = 1\text{ V}$, $A_V = -1$, $C_L = 47\text{ pF}$, $R_L = 2\text{ k}\Omega$, 0.1% | | | 2 | | |

Electrical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.7\text{ V}$, 5 V , and 15 V (unless otherwise noted).

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|--------------------------------------|---|--|---|-----|-------|-----|------------------------------|
| NOISE, DISTORTION PERFORMANCE | | | | | | | |
| THD + N | Total harmonic distortion plus noise | $V_{DD} = 2.7\text{ V}$ | $V_{O(PP)} = V_{DD}/2\text{ V}$, $R_L = 2\text{ k}\Omega$, $f = 10\text{ kHz}$, $A_V = 1$ | | 0.02% | | |
| | | | $V_{O(PP)} = V_{DD}/2\text{ V}$, $R_L = 2\text{ k}\Omega$, $f = 10\text{ kHz}$, $A_V = 10$ | | 0.05% | | |
| | | | $V_{O(PP)} = V_{DD}/2\text{ V}$, $R_L = 2\text{ k}\Omega$, $f = 10\text{ kHz}$, $A_V = 100$ | | 0.18% | | |
| | | $V_{DD} = 5\text{ V}$, 15 V | $V_{O(PP)} = V_{DD}/2\text{ V}$, $R_L = 2\text{ k}\Omega$, $f = 10\text{ kHz}$, $A_V = 1$ | | 0.02% | | |
| | | | $V_{O(PP)} = V_{DD}/2\text{ V}$, $R_L = 2\text{ k}\Omega$, $f = 10\text{ kHz}$, $A_V = 10$ | | 0.09% | | |
| | | | $V_{O(PP)} = V_{DD}/2\text{ V}$, $R_L = 2\text{ k}\Omega$, $f = 10\text{ kHz}$, $A_V = 100$ | | 0.5% | | |
| V_n | Equivalent input noise voltage | $f = 1\text{ kHz}$ | | | 39 | | $\text{nV}/\sqrt{\text{Hz}}$ |
| | | $f = 10\text{ kHz}$ | | | 35 | | |
| I_n | Equivalent input noise current | $f = 1\text{ kHz}$ | | | 0.6 | | $\text{fA}/\sqrt{\text{Hz}}$ |
| SHUTDOWN CHARACTERISTICS | | | | | | | |
| $I_{DD(\text{SHDN})}$ | Supply current in shutdown mode (TLV2370, TLV2373, TLV2375) (per channel) | $V_{DD} = 2.7\text{ V}$, 5 V , $\text{SHDN} = 0\text{ V}$ | At $T_A = 25^\circ\text{C}$ | | 25 | 30 | μA |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 35 | |
| | | $V_{DD} = 15\text{ V}$, $\text{SHDN} = 0\text{ V}$ | At $T_A = 25^\circ\text{C}$ | | 40 | 45 | |
| | | | At $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 50 | |
| $t_{(\text{on})}$ | Amplifier turnon time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$ | | | 0.8 | | μs |
| $t_{(\text{off})}$ | Amplifier turnoff time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$ | | | 1 | | μs |

(1) Disable time and enable time are defined as the interval between application of the logic signal to the SHDN terminal and the point at which the supply current has reached one half of its final value.

8 Typical Characteristics

Table 3. Table of Graphs

| | | | FIGURE |
|----------------|--|------------------------------|-------------------------------|
| V_{IO} | Input offset voltage | vs Common-mode input voltage | Figure 1, Figure 2, Figure 3 |
| CMRR | Common-mode rejection ratio | vs Frequency | Figure 4 |
| | Input bias and offset current | vs Free-air temperature | Figure 5 |
| V_{OL} | Low-level output voltage | vs Low-level output current | Figure 6, Figure 8, Figure 10 |
| V_{OH} | High-level output voltage | vs High-level output current | Figure 7, Figure 9, Figure 11 |
| $V_{O(PP)}$ | Peak-to-peak output voltage | vs Frequency | Figure 12 |
| I_{DD} | Supply current | vs Supply voltage | Figure 13 |
| PSRR | Power supply rejection ratio | vs Frequency | Figure 14 |
| A_{VD} | Differential voltage gain and phase | vs Frequency | Figure 15 |
| | Gain-bandwidth product | vs Free-air temperature | Figure 16 |
| SR | Slew rate | vs Supply voltage | Figure 17 |
| | | vs Free-air temperature | Figure 18 |
| ϕ_m | Phase margin | vs Capacitive load | Figure 19 |
| V_n | Equivalent input noise voltage | vs Frequency | Figure 20 |
| | Voltage-follower large-signal pulse response | | Figure 21, Figure 22 |
| | Voltage-follower small-signal pulse response | | Figure 23 |
| | Inverting large-signal response | | Figure 24, Figure 25 |
| | Inverting small-signal response | | Figure 26 |
| | Crosstalk | vs Frequency | Figure 27 |
| | Shutdown forward & reverse isolation | vs Frequency | Figure 28 |
| $I_{DD(SHDN)}$ | Shutdown supply current | vs Supply voltage | Figure 29 |
| $I_{DD(SHDN)}$ | Shutdown pin leakage current | vs Shutdown pin voltage | Figure 30 |
| $I_{DD(SHDN)}$ | Shutdown supply current, output voltage | vs Time | Figure 31, Figure 32 |

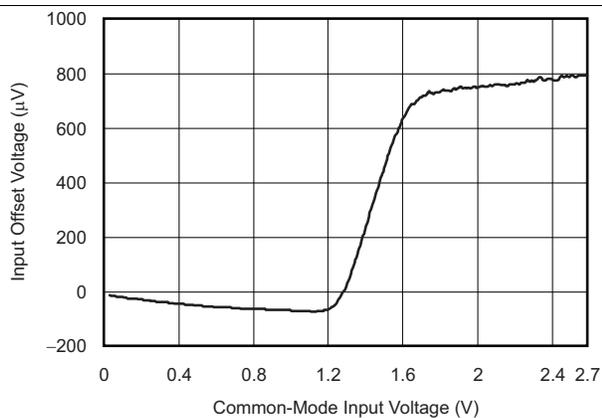


Figure 1. Input Offset Voltage vs Common-Mode Input Voltage

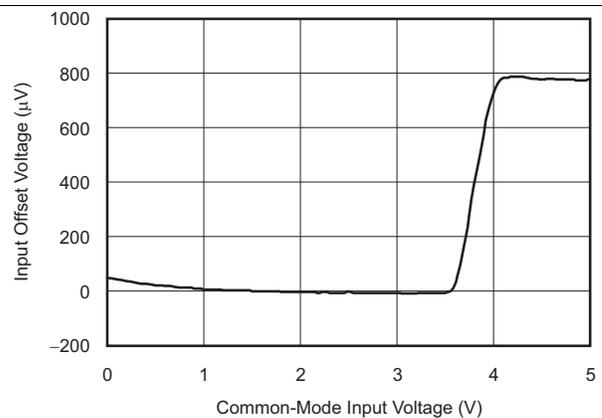


Figure 2. Input Offset Voltage vs Common-Mode Input Voltage

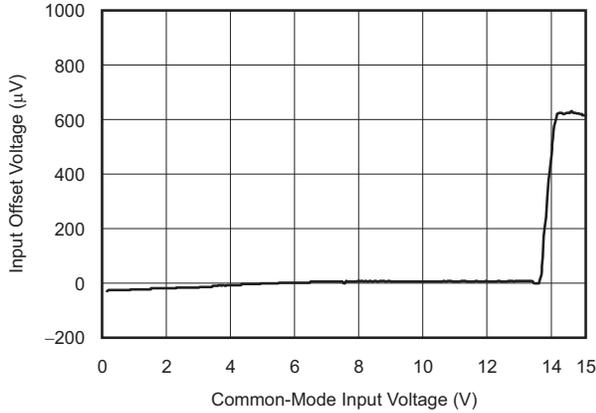


Figure 3. Input Offset Voltage vs Common-Mode Input Voltage

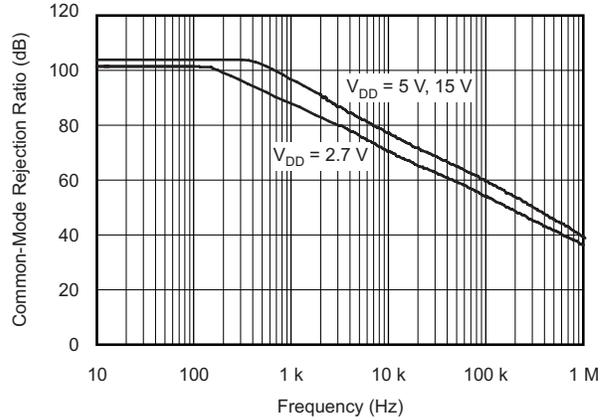


Figure 4. Common-Mode Rejection Ratio vs Frequency

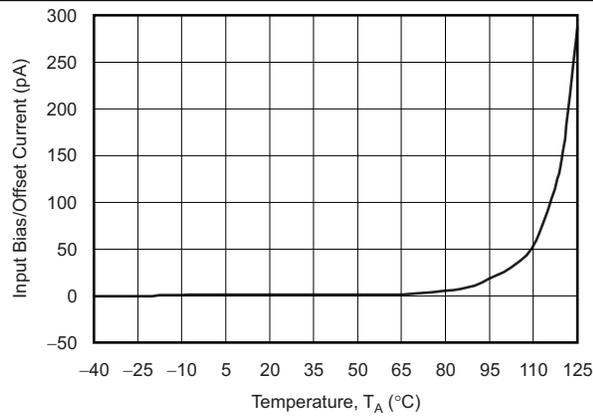


Figure 5. Input Bias or Offset Current vs Free-Air Temperature

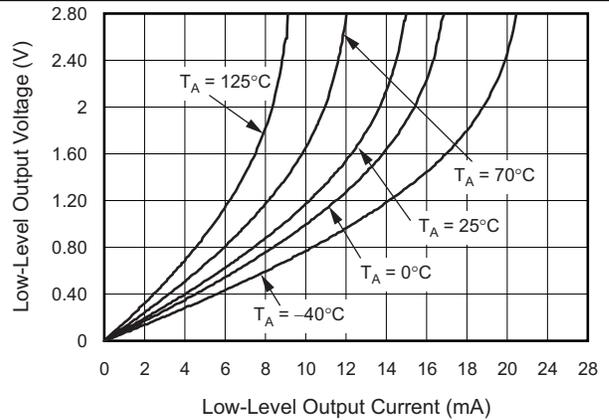


Figure 6. Low-Level Output Voltage vs Low-Level Output Current

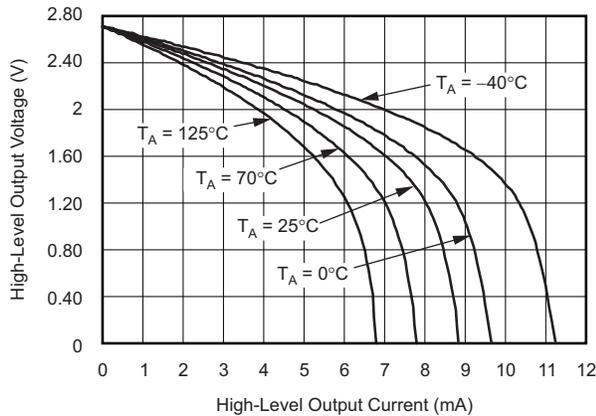


Figure 7. High-Level Output Voltage vs High-Level Output Current

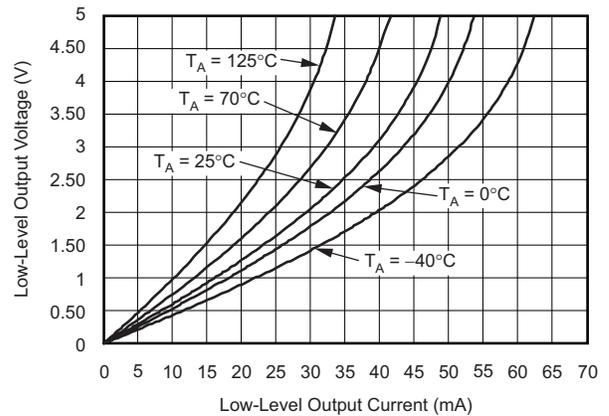


Figure 8. Low-Level Output Voltage vs Low-Level Output Current

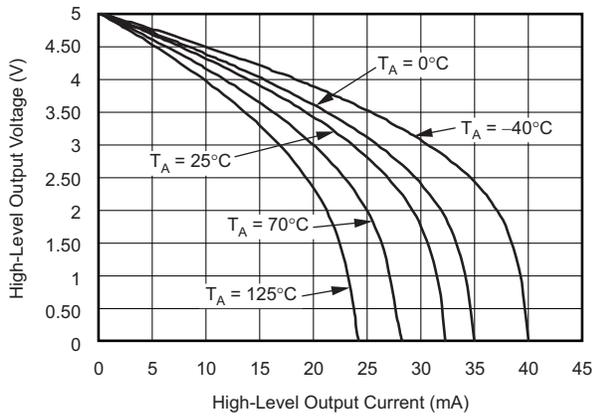


Figure 9. High-Level Output Voltage vs High-Level Output Current

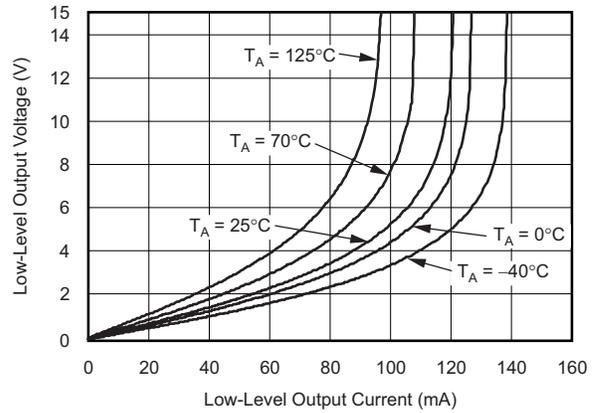


Figure 10. Low-Level Output Voltage vs Low-Level Output Current

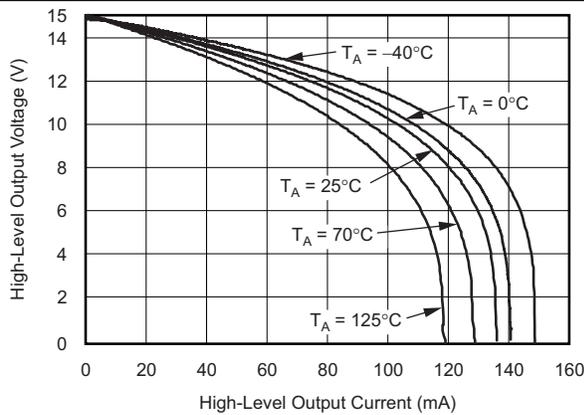


Figure 11. High-Level Output Voltage vs High-Level Output Current

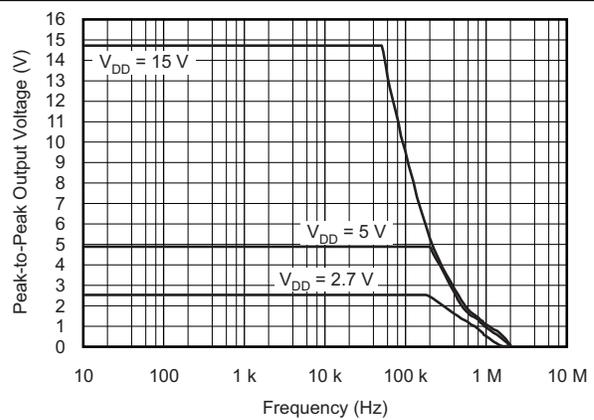


Figure 12. Peak-to-Peak Output Voltage vs Frequency

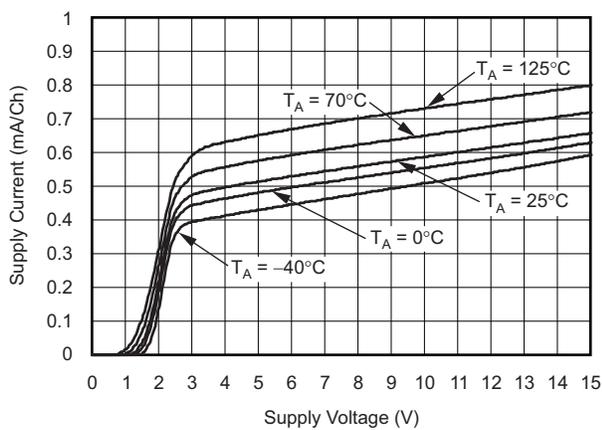


Figure 13. Supply Current vs Supply Voltage

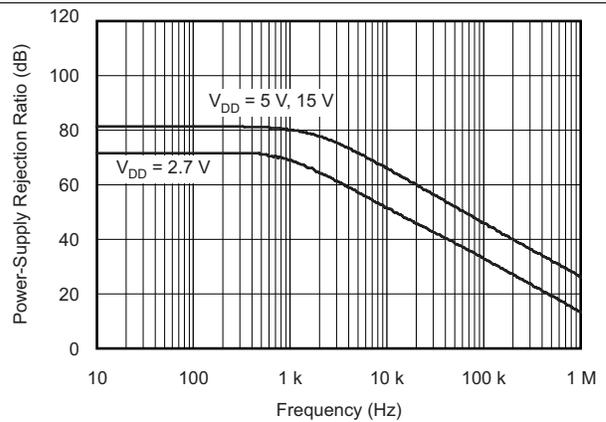


Figure 14. Power Supply Rejection Ratio vs Frequency

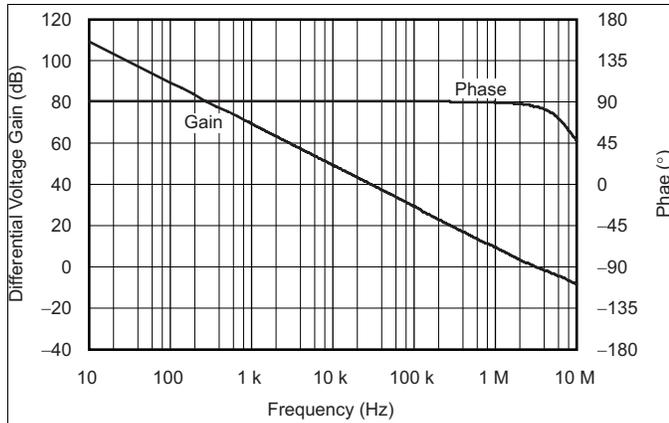


Figure 15. Differential Voltage Gain and Phase vs Frequency

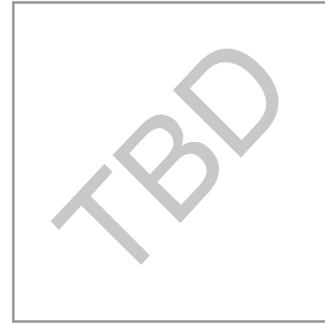


Figure 16. Gain Bandwidth Product vs Free-Air Temperature

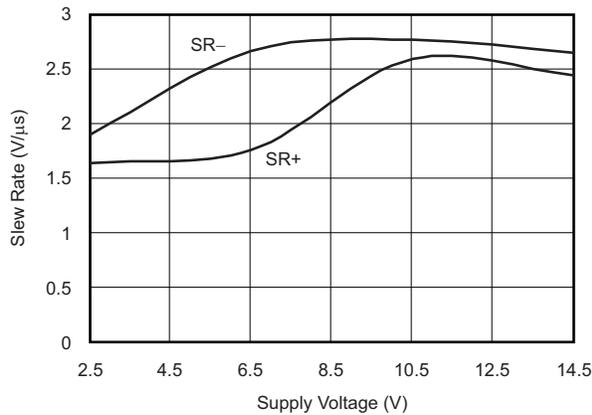


Figure 17. Slew Rate vs Supply Voltage

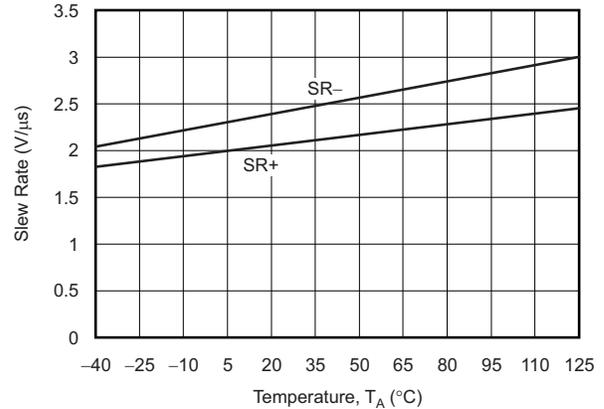


Figure 18. Slew Rate vs Free-Air Temperature

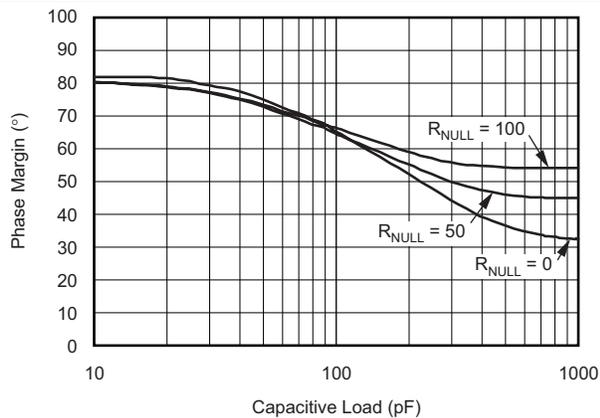


Figure 19. Phase Margin vs Capacitive Load

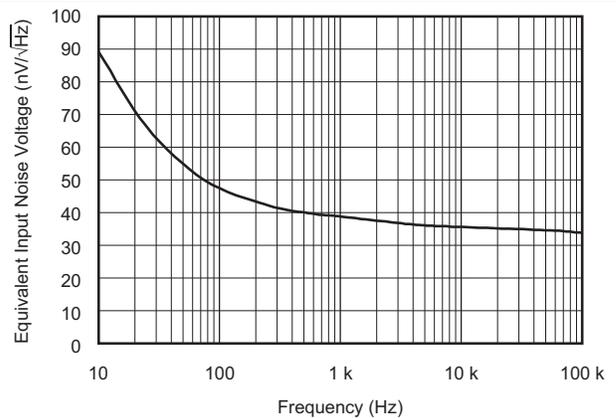


Figure 20. Equivalent Input Noise Voltage vs Frequency

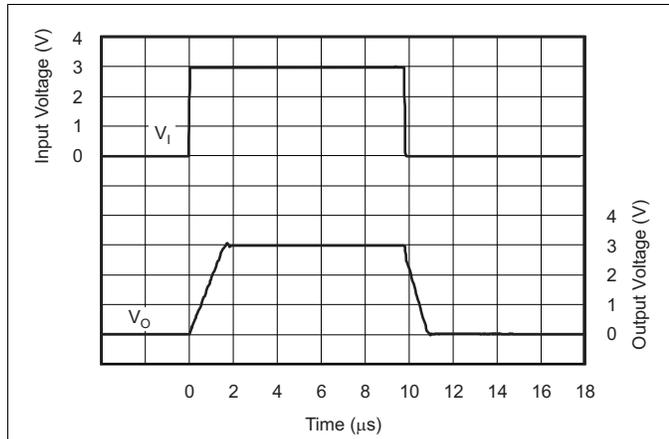


Figure 21. Voltage-Follower Large-Signal Pulse Response

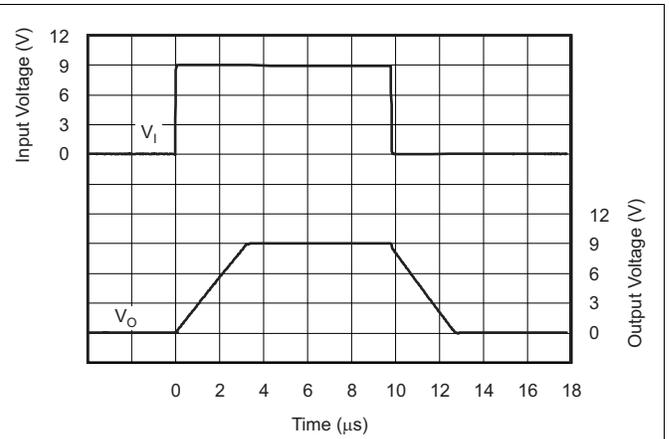


Figure 22. Voltage-Follower Large-Signal Pulse Response

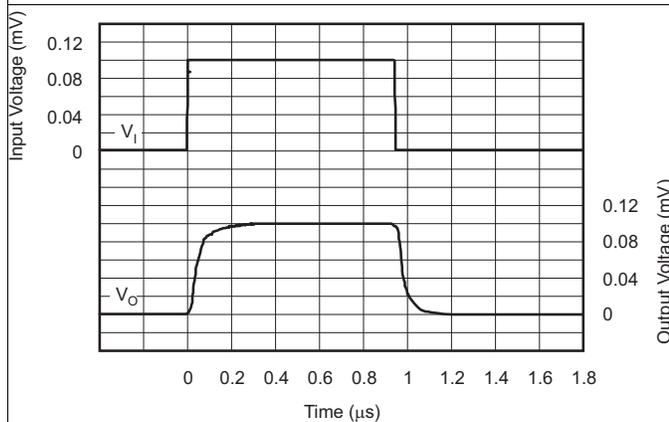


Figure 23. Voltage-Follower Small-Signal Pulse Response

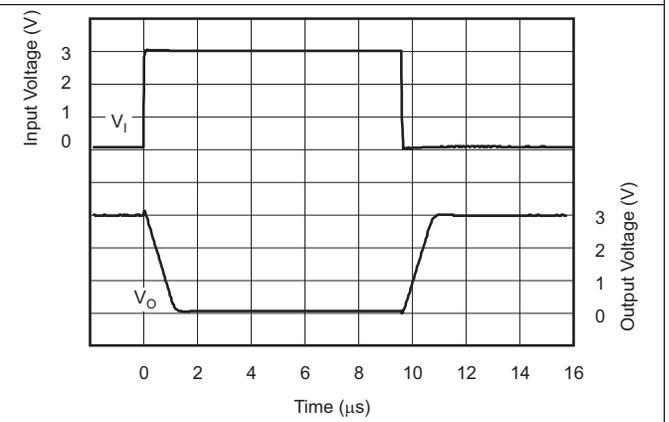


Figure 24. Inverting Large-Signal Response

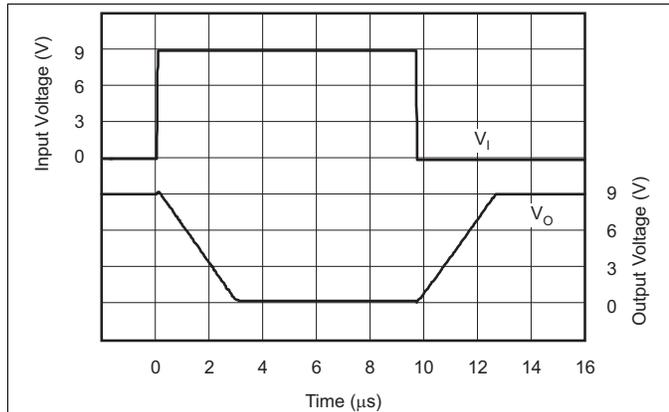


Figure 25. Inverting Large-Signal Response

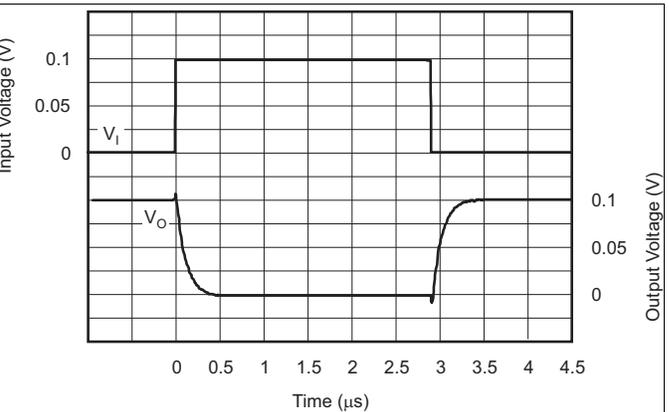


Figure 26. Inverting Small-Signal Response

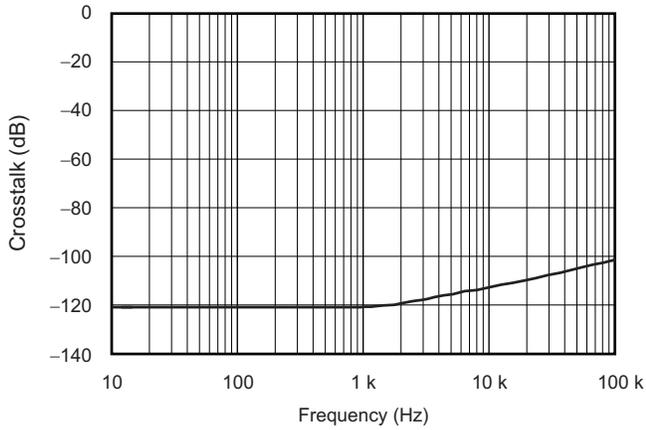


Figure 27. Crosstalk vs Frequency

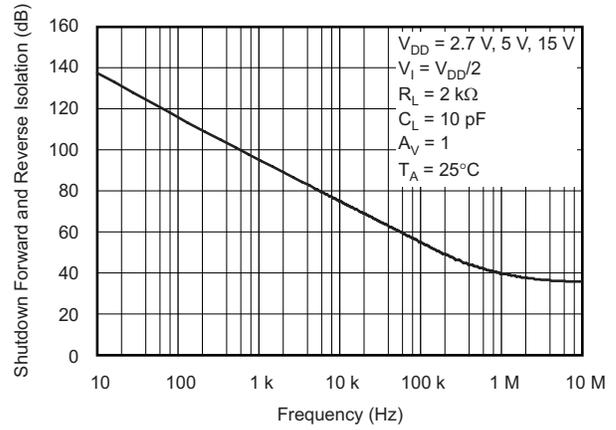


Figure 28. Shutdown Forward and Reverse Isolation vs Frequency

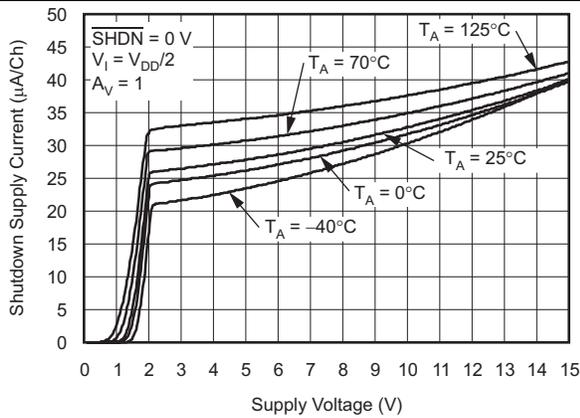


Figure 29. Shutdown Supply Current vs Supply Voltage

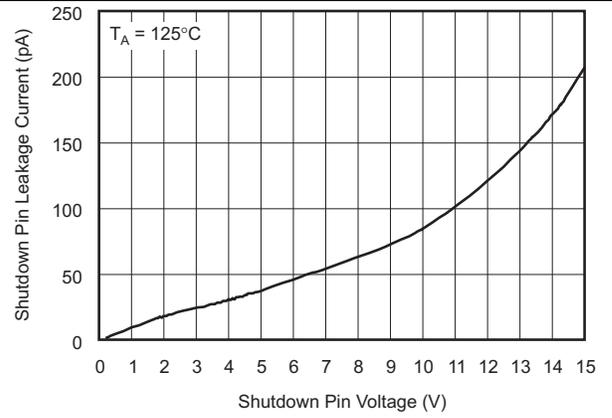
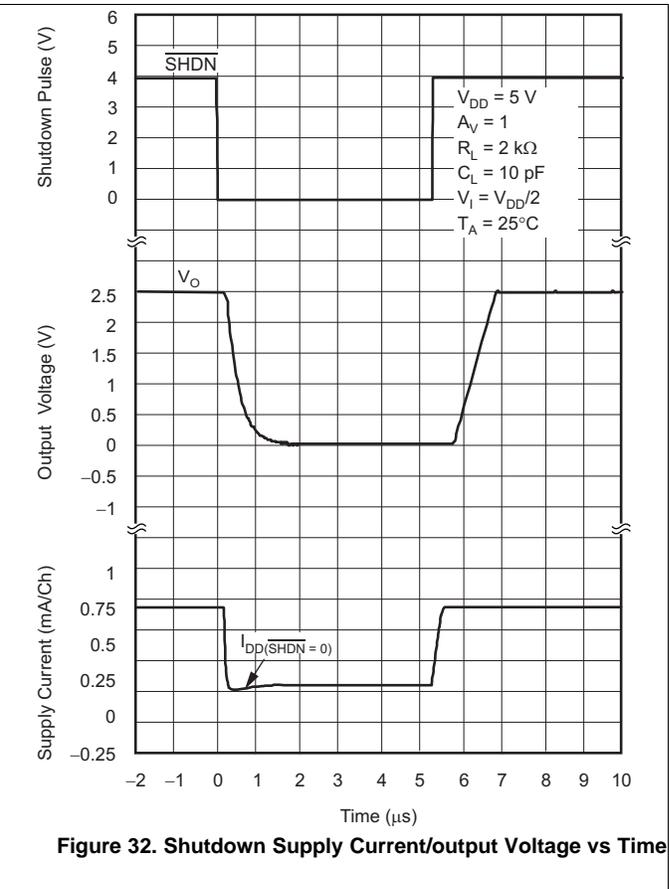
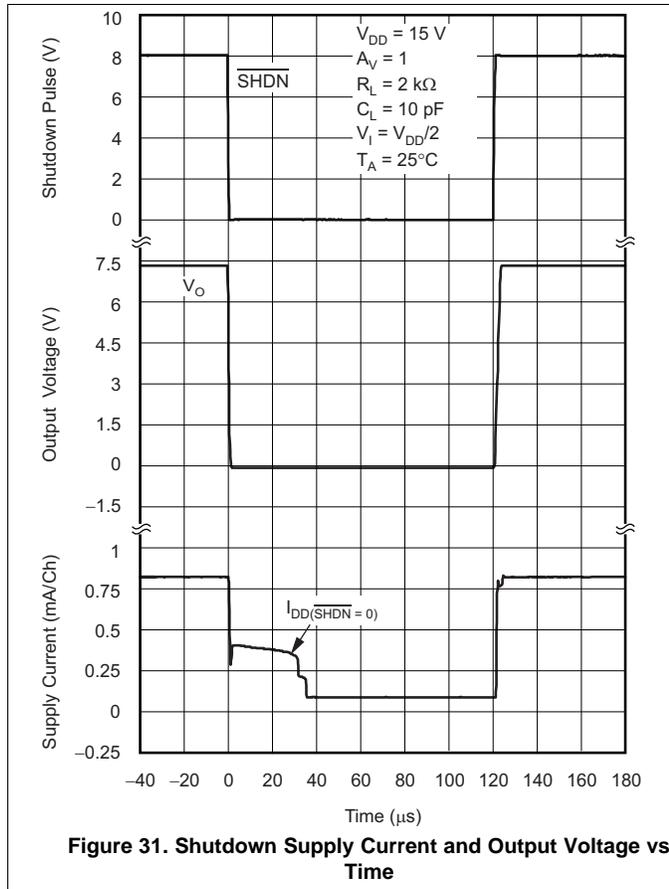


Figure 30. Shutdown Pin Leakage Current vs Shutdown Pin Voltage



9.3 Feature Description

9.3.1 Rail-to-Rail Input Operation

The TLV237x input stage consists of two differential transistor pairs (NMOS and PMOS) that operate together to achieve rail-to-rail input operation. The transition point between these two pairs are shown in [Figure 1](#), [Figure 2](#), and [Figure 3](#) for a 2.7-V, 5-V, and 15-V supply. As the common-mode input voltage approaches the positive supply rail, the input pair switches from the PMOS differential pair to the NMOS differential pair. This transition occurs approximately 1.35 V from the positive rail and results in a change in offset voltage due to different device characteristics between the NMOS and PMOS pairs. If the input signal to the device is large enough to swing between both rails, this transition results in a reduction in common-mode rejection ratio (CMRR). If the input signal does not swing between both rails, bias the signal in the region where only one input pair is active. This is the region in [Figure 1](#) and [Figure 3](#) where the offset voltage varies slightly across the input range and optimal CMRR can be achieved. This has the greatest impact when operating from a 2.7-V supply voltage.

9.3.2 Driving a Capacitive Load

When the amplifier is configured in this manner, capacitive loading directly on the output decreases the device phase margin leading to high frequency ringing or oscillations. Therefore, for capacitive loads of greater than 10 pF, TI recommends placing a resistor in series (R_{NULL}) with the output of the amplifier, as shown in [Figure 33](#). A minimum value of 20 Ω works well for most applications.

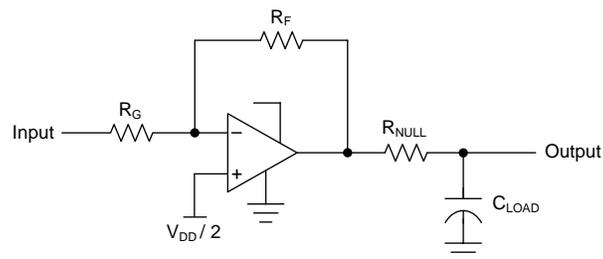
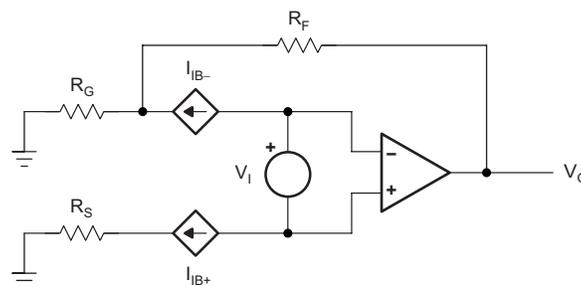


Figure 33. Driving a Capacitive Load

9.3.3 Offset Voltage

The output offset voltage (V_{OO}) is the sum of the input offset voltage (V_{IO}) and input bias currents (I_{IB}) times the corresponding gains. [Figure 34](#) is used to calculate the output offset voltage. Note that this does not include other parameters that can affect the offset voltage, such as PSRR and CMRR.



$$V_{OO} = V_{IO} \left[1 + \left(\frac{R_F}{R_G} \right) \right] \pm I_{IB+} R_S \left[1 + \left(\frac{R_F}{R_G} \right) \right] \pm I_{IB-} R_F$$

Figure 34. Output Offset Voltage Model

Feature Description (continued)

9.3.4 General Configurations

When receiving low-level signals, limiting the bandwidth of the incoming signals into the system is often required. The simplest way to accomplish this is to place an RC filter at the noninverting terminal. To accomplish this, place an RC filter at the noninverting terminal (see Figure 35).

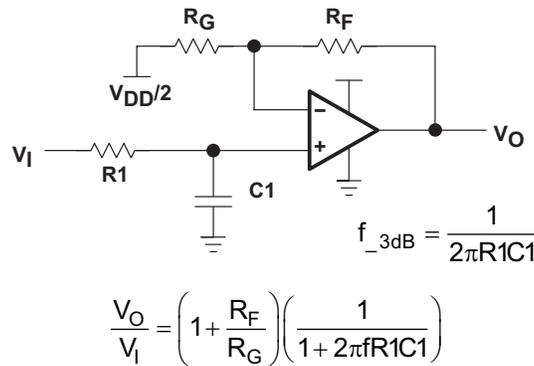


Figure 35. Single-Pole Low-Pass Filter

If even more attenuation is required, a multiple pole filter is required. The Sallen-key filter is used for this task. For best results, the amplifier must have a bandwidth that is eight to 10 times the filter frequency bandwidth. Failure to do this results in phase shift of the amplifier.

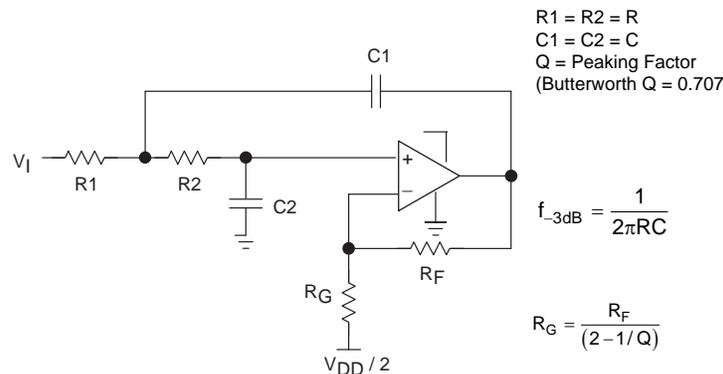


Figure 36. 2-Pole, Low-Pass, Sallen-Key Filter

9.3.5 Shutdown Function

Three members of the TLV237x family (TLV2370, TLV2373, and TLV2375) have a shutdown terminal for conserving battery life in portable applications. When the shutdown terminal is tied low, the supply current is reduced to 25 μA /channel, the amplifier is disabled, and the outputs are placed in a high impedance mode. To enable the amplifier, the shutdown terminal can either be left floating or pulled high. When the shutdown terminal is left floating, take care to ensure that parasitic leakage current at the shutdown terminal does not inadvertently place the operational amplifier into shutdown.

9.4 Device Functional Modes

The TLV2371, TLV2372, and TLV2374 have a single functional mode. These devices are operable as long as the power-supply voltage is between 2.7 V (± 1.35 V) and 16 V (± 8 V).

The TLV2370, TLV2373, and TLV2375 are likewise operational as long as the power-supply voltage is between 2.7 V (± 1.35 V) and 16 V (± 8 V), additionally these devices also have a shutdown capability. When the shutdown control pin is driven below 0.8 V above ground, the device is in shutdown. If the shutdown control pin voltage is driven to greater than 2 V above ground, the device is in its normal operating mode. See [Shutdown Function](#) for additional information regarding shutdown operation.

10 Application and Implementation

NOTE

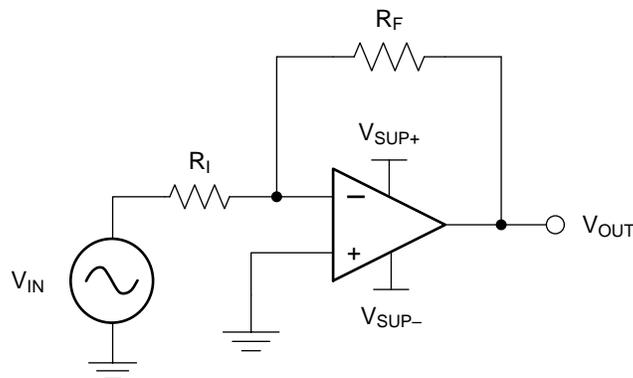
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

10.1 Application Information

When designing for low power, choose system components carefully. To minimize current consumption, select large-value resistors. Any resistors react with stray capacitance in the circuit and the input capacitance of the operational amplifier. These parasitic RC combinations affect the stability of the overall system. Use of a feedback capacitor assures stability and limits overshoot or gain peaking.

10.2 Typical Application

A typical application for an operational amplifier is an inverting amplifier, as [Figure 37](#) shows. An inverting amplifier takes a positive voltage on the input and outputs a signal inverted to the input, ~~making~~ **which results in** a negative voltage of the same magnitude. In the same manner, the amplifier makes negative input voltages positive on the output. ~~In addition, amplification can be added by selecting~~ **Select** the input resistor (R_I) and the feedback resistor (R_F) **to add amplification.**



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Figure 37. Application Schematic

Typical Application (continued)

10.2.1 Design Requirements

The selected supply voltage must be larger than the input voltage range and the desired output range. Consider the limits of the input common-mode range (V_{CM}) and the output voltage swing to the rails (V_O). For example, this application scales a signal of ± 0.5 V (1 V) to ± 1.8 V (3.6 V). Setting the supply at ± 2.5 V is sufficient to accommodate this application.

10.2.2 Detailed Design Procedure

Determine the gain required by the inverting amplifier using [Equation 1](#) and [Equation 2](#):

$$A_V = \frac{V_{OUT}}{V_{IN}} \tag{1}$$

$$A_V = \frac{1.8}{-0.5} = -3.6 \tag{2}$$

When the desired gain is determined, choose a value for R_I or R_F . Choosing a value in the $k\Omega$ range is desirable for general-purpose applications because the amplifier circuit uses currents in the milliamp range. This milliamp current range ensures the device does not draw too much current. The trade-off is that very large resistors (100s of $k\Omega$) draw the smallest current but generate the highest noise. Very small resistors (100s of Ω) generate low noise but draw high current. This example uses 10 $k\Omega$ for R_I , meaning 36 $k\Omega$ is used for R_F . These values are determined by [Equation 3](#):

$$A_V = -\frac{R_F}{R_I} \tag{3}$$

10.2.3 Application Curve

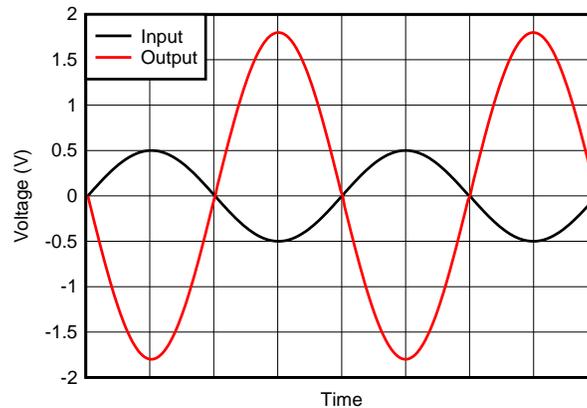


Figure 38. Inverting Amplifier Input and Output

11 Power Supply Recommendations

The TLV237x family is specified for operation from 2.7 V to 16 V (± 1.35 V to ± 8 V); many specifications apply from -40°C to $+125^{\circ}\text{C}$. The *Typical Characteristics* presents parameters that can exhibit significant variance with regard to operating voltage or temperature.

CAUTION

Supply voltages larger than 16 V can permanently damage the device (see the *Absolute Maximum Ratings* table).

Place 0.1- μF bypass capacitors close to the power-supply pins to reduce errors coupling in from noisy or high-impedance power supplies. For more detailed information on bypass capacitor placement, see *Layout*.

12 Layout

12.1 Layout Guidelines

To achieve the levels of high performance of the TLV237x, follow proper printed-circuit board design techniques. A general set of guidelines is shown in the following list:

- Ground planes: TI highly recommends using a ground plane on the board to provide all components with a low inductive ground connection. However, in the areas of the amplifier inputs and output, the ground plane can be removed to minimize the stray capacitance.
- Proper power supply decoupling: Use a 6.8- μF tantalum capacitor in parallel with a 0.1- μF ceramic capacitor on each supply ~~terminal~~ pin. It may be possible to share the tantalum among several amplifiers depending on the application ~~terminal~~, ~~but a 0.1- μF ceramic capacitor must always be used on the supply terminal of every amplifier.~~ Always use a 0.1- μF ceramic capacitor on the supply pin of every amplifier. In addition, the 0.1- μF capacitor must be placed as close ~~to the supply terminal~~ to the supply pin as possible. ~~as possible to the supply terminal~~. As this distance increases, the inductance in the connecting trace makes the capacitor less effective. The designer must strive for distances of less than 0.1 inches between the device power ~~terminals~~ pins and the ceramic capacitors.
- Sockets: Sockets can be used but are not recommended. The additional lead inductance in the socket pins often lead to stability problems. ~~Surface-mount packages soldered directly to the printed-circuit board is the best implementation.~~ For best results, solder the surface mount packages directly to the printed circuit board.
- Short trace runs and compact part placements: Optimum high performance is achieved when stray series inductance are minimized. To realize this, the circuit layout must be made as compact as possible, which minimizes the length of all trace runs. Pay particular attention to the inverting input of the amplifier. The length of the inverting input must be kept as short as possible. This helps to minimize stray capacitance at the input of the amplifier.
- Surface-mount passive components: Using surface-mount passive components is recommended for high performance amplifier circuits for several reasons. First, because of the low lead inductance of surface-mount components, the problem with stray series inductance is reduced. Second, the small size of surface-mount components naturally leads to a more compact layout, which minimizes stray inductance and capacitance. TI recommends that lead lengths are kept as short as possible if leaded components are used.

12.2 Layout Example

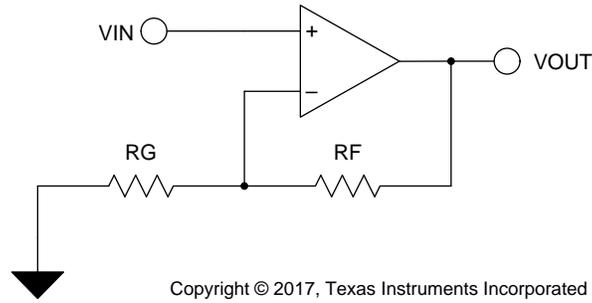


Figure 39. Schematic Representation

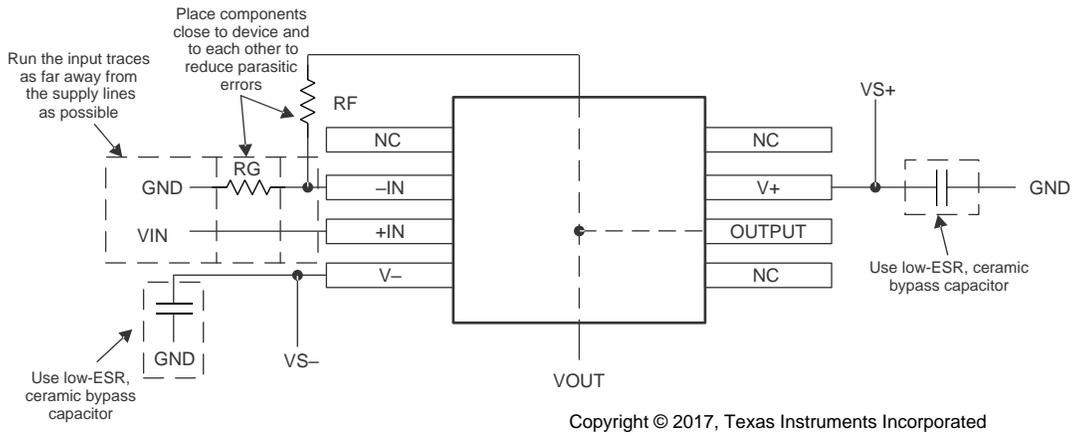


Figure 40. Operational Amplifier Board Layout for Noninverting Configuration

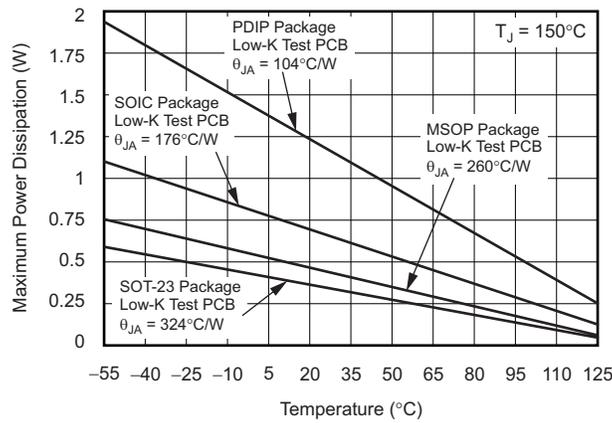
12.3 Power Dissipation Considerations

For a given θ_{JA} value, the maximum power dissipation is shown in Figure 41 and is calculated by Equation 4:

$$P_D = \left[\frac{T_{MAX} - T_A}{\theta_{JA}} \right]$$

where

- P_D = Maximum power dissipation of TLV237x IC (watts)
- T_{MAX} = Absolute maximum junction temperature (150°C)
- T_A = Free-ambient air temperature (°C)
- $\theta_{JA} = \theta_{JC}$ (Thermal coefficient from junction to case) + θ_{CA} (Thermal coefficient from case to ambient air (°C/W)) (4)



Results are with no air flow and using JEDEC Standard Low-K test PCB.

Figure 41. Maximum Power Dissipation vs Free-Air Temperature

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。

『[EVM選択ガイド](#)』(SLOU060)

13.2 関連リンク

次の表に、クイック・アクセス・リンクを示します。カテゴリには、技術資料、サポートおよびコミュニティ・リソース、ツールとソフトウェア、およびご注文へのクイック・アクセスが含まれます。

表 4. 関連リンク

| 製品 | プロダクト・フォルダ | ご注文はこちら | 技術資料 | ツールとソフトウェア | サポートとコミュニティ |
|---------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| TLV2370 | ここをクリック |
| TLV2371 | ここをクリック |
| TLV2372 | ここをクリック |
| TLV2373 | ここをクリック |
| TLV2374 | ここをクリック |
| TLV2375 | ここをクリック |

13.3 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。右上の隅にある「通知を受け取る」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。

13.4 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](#).

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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。

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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。

13.7 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 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) |
|------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLV2370ID | Obsolete | Production | SOIC (D) 8 | - | - | Call TI | Call TI | -40 to 125 | 2370I |
| TLV2370IDBVR | Active | Production | SOT-23 (DBV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVR.A | Active | Production | SOT-23 (DBV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVR.B | Active | Production | SOT-23 (DBV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVR1G4 | Active | Production | SOT-23 (DBV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVR1G4.A | Active | Production | SOT-23 (DBV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVR1G4.B | Active | Production | SOT-23 (DBV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVT | Active | Production | SOT-23 (DBV) 6 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVT.A | Active | Production | SOT-23 (DBV) 6 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDBVT.B | Active | Production | SOT-23 (DBV) 6 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBFI |
| TLV2370IDR | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2370I |
| TLV2370IDR.B | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2370I |
| TLV2370IP | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2370I |
| TLV2370IP.B | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2370I |
| TLV2371ID | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2371I |
| TLV2371ID.B | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2371I |
| TLV2371IDBVR | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBGI |
| TLV2371IDBVR.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBGI |
| TLV2371IDBVT | Active | Production | SOT-23 (DBV) 5 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBGI |
| TLV2371IDBVT.B | Active | Production | SOT-23 (DBV) 5 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VBGI |
| TLV2371IDG4 | Active | Production | SOIC (D) 8 | 75 TUBE | - | Call TI | Call TI | -40 to 125 | |
| TLV2371IDR | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2371I |
| TLV2371IDR.B | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2371I |
| TLV2371IDRG4 | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | - | Call TI | Call TI | -40 to 125 | |
| TLV2371IP | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2371I |
| TLV2371IP.B | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2371I |
| TLV2371IPE4 | Active | Production | PDIP (P) 8 | 50 TUBE | - | Call TI | Call TI | -40 to 125 | |
| TLV2372ID | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2372I |
| TLV2372ID.A | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2372I |

| 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) |
|------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLV2372ID.B | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2372I |
| TLV2372IDGK | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | APG |
| TLV2372IDGK.A | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | APG |
| TLV2372IDGK.B | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | APG |
| TLV2372IDGKG4 | Active | Production | VSSOP (DGK) 8 | 80 TUBE | - | Call TI | Call TI | -40 to 125 | |
| TLV2372IDGKR | Active | Production | VSSOP (DGK) 8 | 2500 LARGE T&R | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | APG |
| TLV2372IDGKR.A | Active | Production | VSSOP (DGK) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | APG |
| TLV2372IDGKR.B | Active | Production | VSSOP (DGK) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | APG |
| TLV2372IDR | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2372I |
| TLV2372IDR.A | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2372I |
| TLV2372IDR.B | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2372I |
| TLV2372IDRG4 | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | - | Call TI | Call TI | -40 to 125 | |
| TLV2372IP | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2372I |
| TLV2372IP.A | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2372I |
| TLV2372IP.B | Active | Production | PDIP (P) 8 | 50 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2372I |
| TLV2372IPE4 | Active | Production | PDIP (P) 8 | 50 TUBE | - | Call TI | Call TI | -40 to 125 | |
| TLV2373ID | Obsolete | Production | SOIC (D) 14 | - | - | Call TI | Call TI | -40 to 125 | 2373I |
| TLV2373IDGS | Active | Production | VSSOP (DGS) 10 | 80 TUBE | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | API |
| TLV2373IDGS.A | Active | Production | VSSOP (DGS) 10 | 80 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | API |
| TLV2373IDGS.B | Active | Production | VSSOP (DGS) 10 | 80 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | API |
| TLV2373IDGSR | Active | Production | VSSOP (DGS) 10 | 2500 LARGE T&R | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | API |
| TLV2373IDGSR.A | Active | Production | VSSOP (DGS) 10 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | API |
| TLV2373IDGSR.B | Active | Production | VSSOP (DGS) 10 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | API |
| TLV2373IDGSRG4 | Active | Production | VSSOP (DGS) 10 | 2500 LARGE T&R | - | Call TI | Call TI | -40 to 125 | |
| TLV2373IDR | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2373I |
| TLV2373IDR.A | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2373I |
| TLV2373IDR.B | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2373I |
| TLV2373IN | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | TLV2373I |
| TLV2373IN.A | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | TLV2373I |
| TLV2374ID | Active | Production | SOIC (D) 14 | 50 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374ID.A | Active | Production | SOIC (D) 14 | 50 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |

| 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) |
|-----------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLV2374ID.B | Active | Production | SOIC (D) 14 | 50 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IDG4 | Active | Production | SOIC (D) 14 | 50 TUBE | - | Call TI | Call TI | -40 to 125 | |
| TLV2374IDR | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IDR.A | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IDR.B | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IN | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2374I |
| TLV2374IN.A | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2374I |
| TLV2374IN.B | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2374I |
| TLV2374IPW | Active | Production | TSSOP (PW) 14 | 90 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IPW.A | Active | Production | TSSOP (PW) 14 | 90 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IPW.B | Active | Production | TSSOP (PW) 14 | 90 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IPWR | Active | Production | TSSOP (PW) 14 | 2000 LARGE T&R | Yes | NIPDAU SN | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IPWR.A | Active | Production | TSSOP (PW) 14 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IPWR.B | Active | Production | TSSOP (PW) 14 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2374I |
| TLV2374IPWRG4 | Active | Production | TSSOP (PW) 14 | 2000 LARGE T&R | - | Call TI | Call TI | -40 to 125 | |
| TLV2375ID | Active | Production | SOIC (D) 16 | 40 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375ID.A | Active | Production | SOIC (D) 16 | 40 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375ID.B | Active | Production | SOIC (D) 16 | 40 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IDR | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IDR.A | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IDR.B | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IN | Active | Production | PDIP (N) 16 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2375I |
| TLV2375IN.A | Active | Production | PDIP (N) 16 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2375I |
| TLV2375IN.B | Active | Production | PDIP (N) 16 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 125 | 2375I |
| TLV2375IPW | Active | Production | TSSOP (PW) 16 | 90 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IPW.A | Active | Production | TSSOP (PW) 16 | 90 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IPW.B | Active | Production | TSSOP (PW) 16 | 90 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IPWR | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IPWR.A | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IPWR.B | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2375I |
| TLV2375IPWRG4 | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | - | Call TI | Call TI | -40 to 125 | |

- (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.

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.

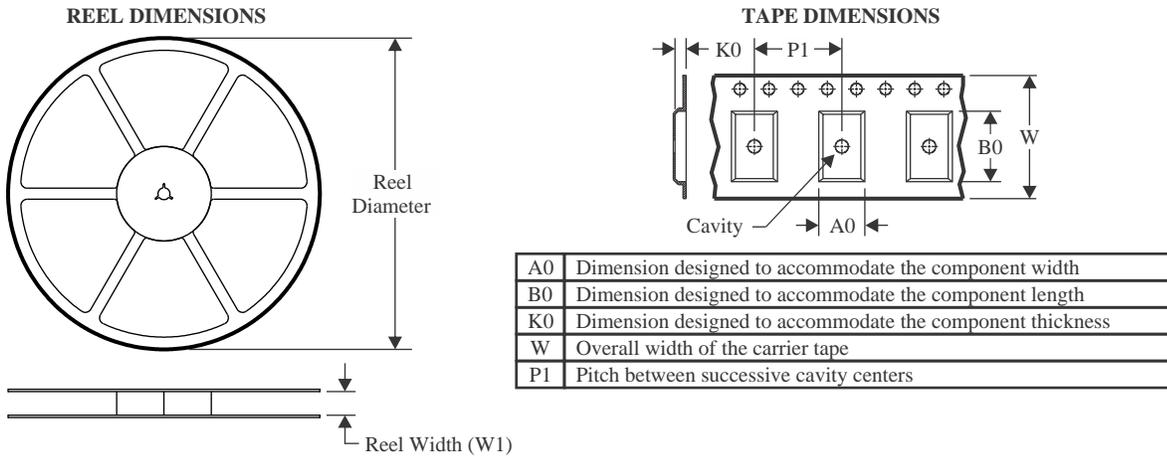
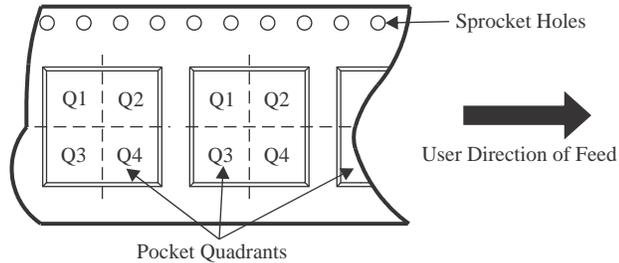
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TLV2371, TLV2372, TLV2374 :

- Automotive : [TLV2371-Q1](#), [TLV2372-Q1](#), [TLV2374-Q1](#)
- Enhanced Product : [TLV2374-EP](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

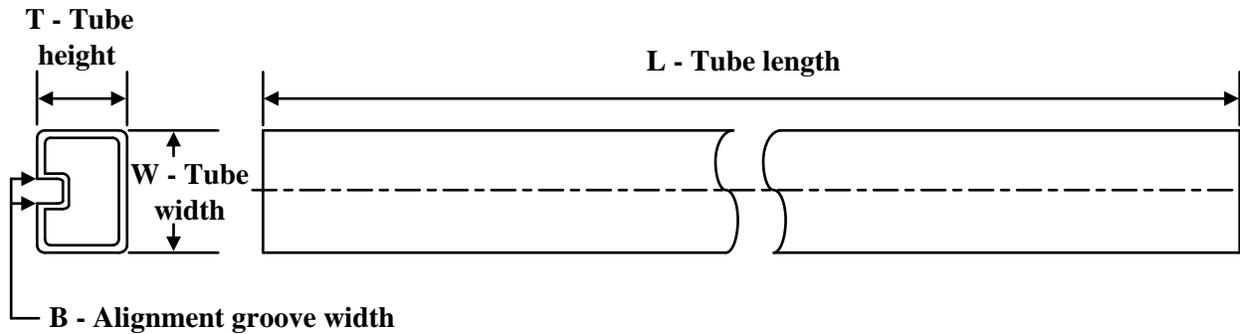
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV2370IDBVR | SOT-23 | DBV | 6 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV2370IDBVR1G4 | SOT-23 | DBV | 6 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV2370IDBVT | SOT-23 | DBV | 6 | 250 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV2370IDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TLV2371IDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV2371IDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV2371IDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TLV2372IDGKR | VSSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TLV2372IDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TLV2373IDGSR | VSSOP | DGS | 10 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TLV2373IDGSR | VSSOP | DGS | 10 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TLV2373IDR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| TLV2374IDR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| TLV2374IPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TLV2374IPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TLV2375IDR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |

| 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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV2375IPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV2370IDBVR | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV2370IDBVR1G4 | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV2370IDBVT | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| TLV2370IDR | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| TLV2371IDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV2371IDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV2371IDR | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| TLV2372IDGKR | VSSOP | DGK | 8 | 2500 | 364.0 | 364.0 | 27.0 |
| TLV2372IDR | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| TLV2373IDGSR | VSSOP | DGS | 10 | 2500 | 358.0 | 335.0 | 35.0 |
| TLV2373IDGSR | VSSOP | DGS | 10 | 2500 | 364.0 | 364.0 | 27.0 |
| TLV2373IDR | SOIC | D | 14 | 2500 | 353.0 | 353.0 | 32.0 |
| TLV2374IDR | SOIC | D | 14 | 2500 | 353.0 | 353.0 | 32.0 |
| TLV2374IPWR | TSSOP | PW | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| TLV2374IPWR | TSSOP | PW | 14 | 2000 | 353.0 | 353.0 | 32.0 |
| TLV2375IDR | SOIC | D | 16 | 2500 | 353.0 | 353.0 | 32.0 |
| TLV2375IPWR | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| TLV2370IP | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2370IP.B | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2371ID | D | SOIC | 8 | 75 | 507 | 8 | 3940 | 4.32 |
| TLV2371ID.B | D | SOIC | 8 | 75 | 507 | 8 | 3940 | 4.32 |
| TLV2371IP | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2371IP.B | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2372ID | D | SOIC | 8 | 75 | 507 | 8 | 3940 | 4.32 |
| TLV2372ID.A | D | SOIC | 8 | 75 | 507 | 8 | 3940 | 4.32 |
| TLV2372ID.B | D | SOIC | 8 | 75 | 507 | 8 | 3940 | 4.32 |
| TLV2372IDGK | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| TLV2372IDGK.A | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| TLV2372IDGK.B | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| TLV2372IP | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2372IP.A | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2372IP.B | P | PDIP | 8 | 50 | 506 | 13.97 | 11230 | 4.32 |
| TLV2373IDGS | DGS | VSSOP | 10 | 80 | 330 | 6.55 | 500 | 2.88 |
| TLV2373IDGS.A | DGS | VSSOP | 10 | 80 | 330 | 6.55 | 500 | 2.88 |
| TLV2373IDGS.B | DGS | VSSOP | 10 | 80 | 330 | 6.55 | 500 | 2.88 |
| TLV2373IN | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2373IN.A | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2374ID | D | SOIC | 14 | 50 | 507 | 8 | 3940 | 4.32 |
| TLV2374ID.A | D | SOIC | 14 | 50 | 507 | 8 | 3940 | 4.32 |
| TLV2374ID.B | D | SOIC | 14 | 50 | 507 | 8 | 3940 | 4.32 |
| TLV2374IN | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2374IN.A | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2374IN.B | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2374IPW | PW | TSSOP | 14 | 90 | 530 | 10.2 | 3600 | 3.5 |
| TLV2374IPW.A | PW | TSSOP | 14 | 90 | 530 | 10.2 | 3600 | 3.5 |
| TLV2374IPW.B | PW | TSSOP | 14 | 90 | 530 | 10.2 | 3600 | 3.5 |

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|--------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| TLV2375ID | D | SOIC | 16 | 40 | 507 | 8 | 3940 | 4.32 |
| TLV2375ID.A | D | SOIC | 16 | 40 | 507 | 8 | 3940 | 4.32 |
| TLV2375ID.B | D | SOIC | 16 | 40 | 507 | 8 | 3940 | 4.32 |
| TLV2375IN | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2375IN.A | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2375IN.B | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| TLV2375IPW | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |
| TLV2375IPW.A | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |
| TLV2375IPW.B | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |

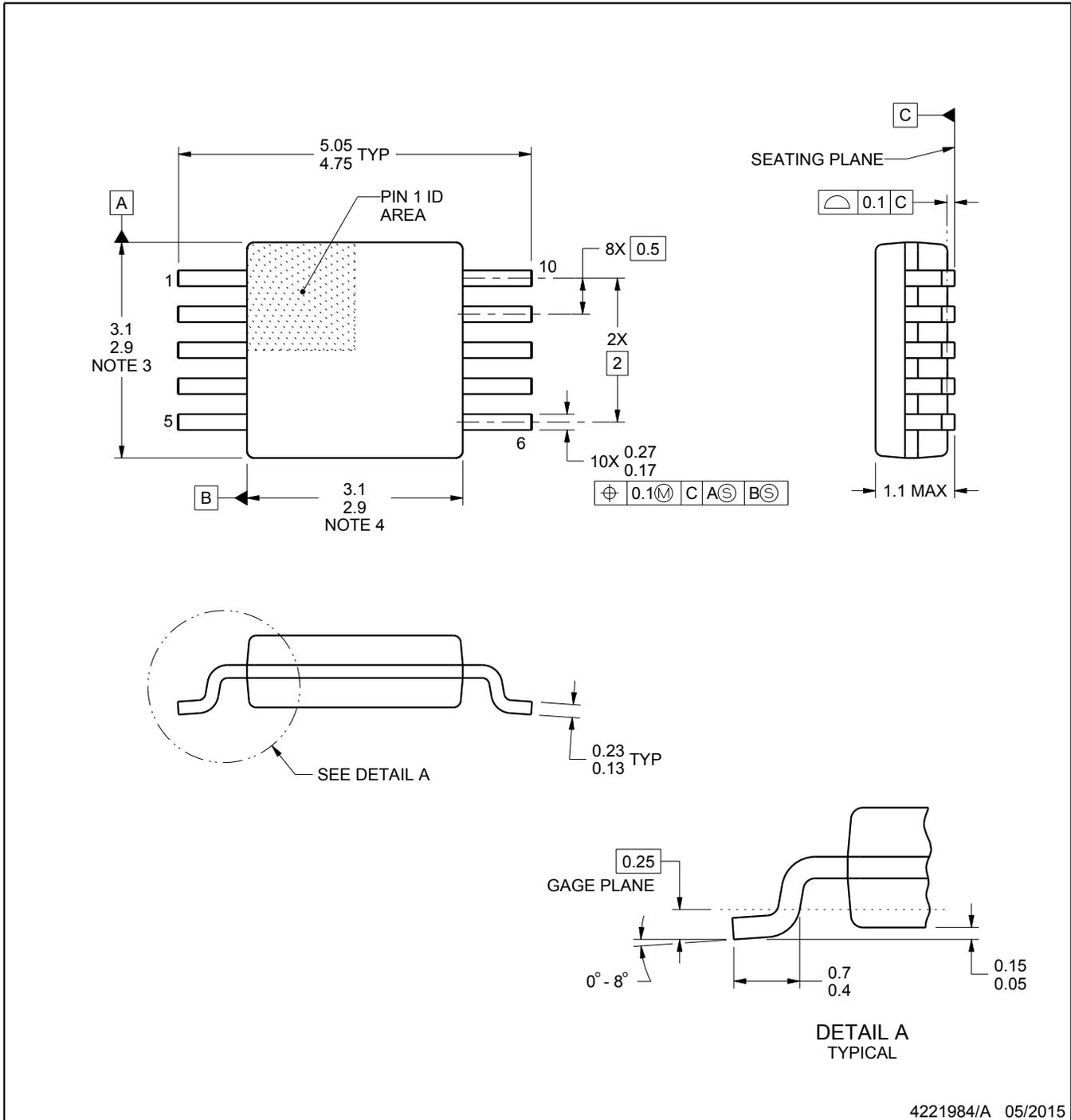
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PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4221984/A 05/2015

NOTES:

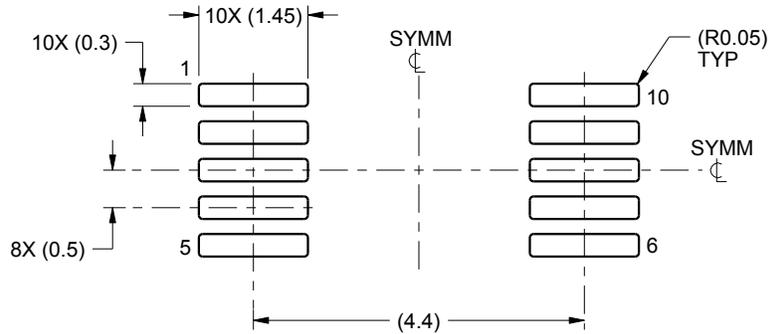
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187, variation BA.

EXAMPLE BOARD LAYOUT

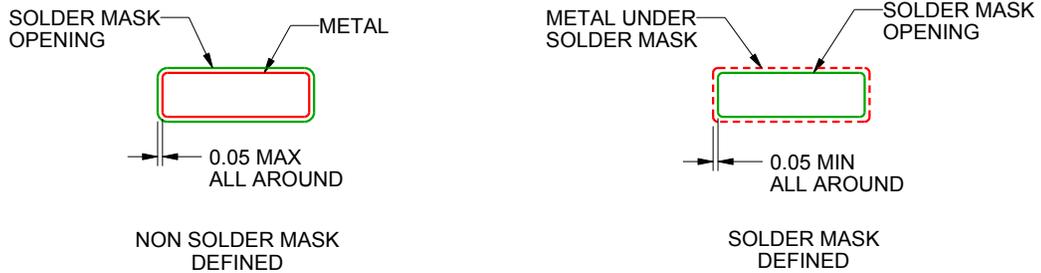
DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:10X



SOLDER MASK DETAILS
NOT TO SCALE

4221984/A 05/2015

NOTES: (continued)

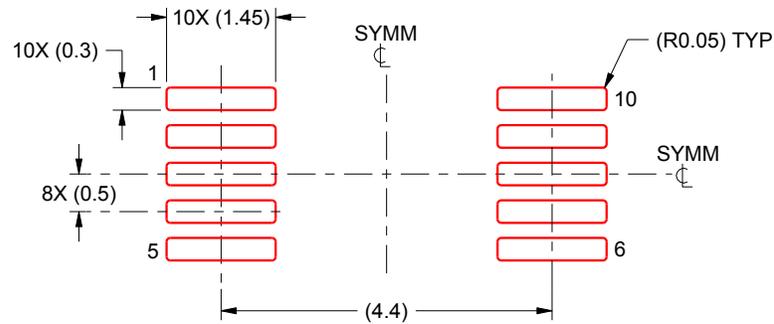
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE

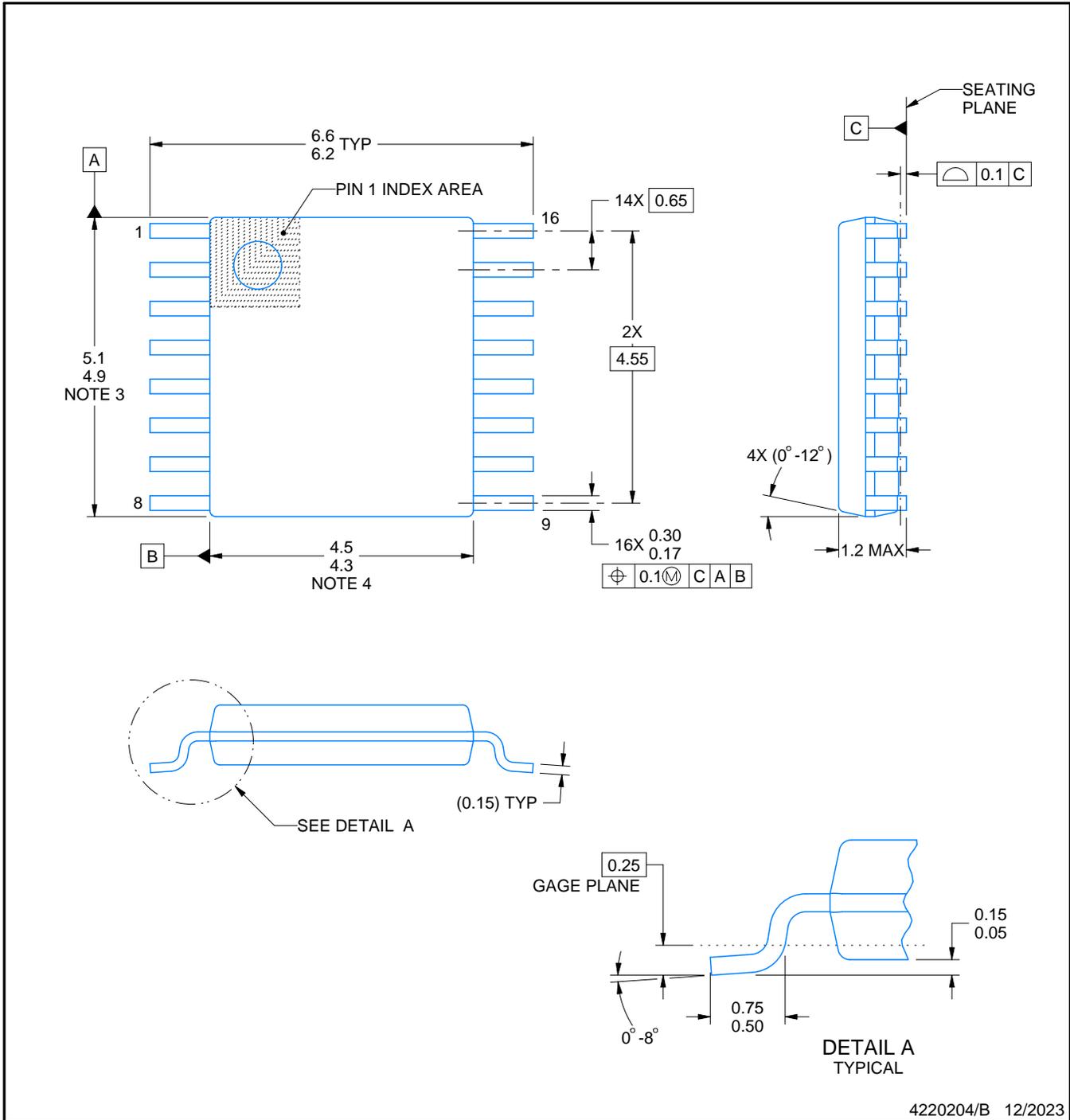


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:10X

4221984/A 05/2015

NOTES: (continued)

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



NOTES:

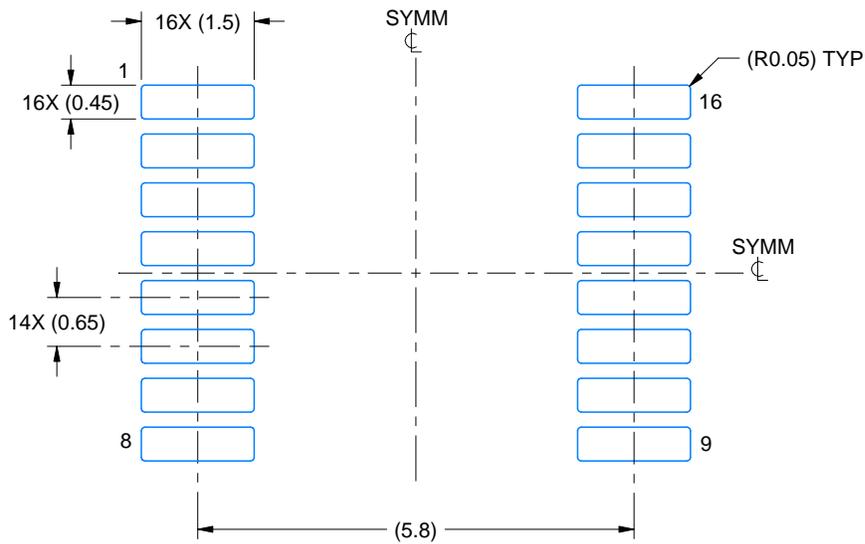
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

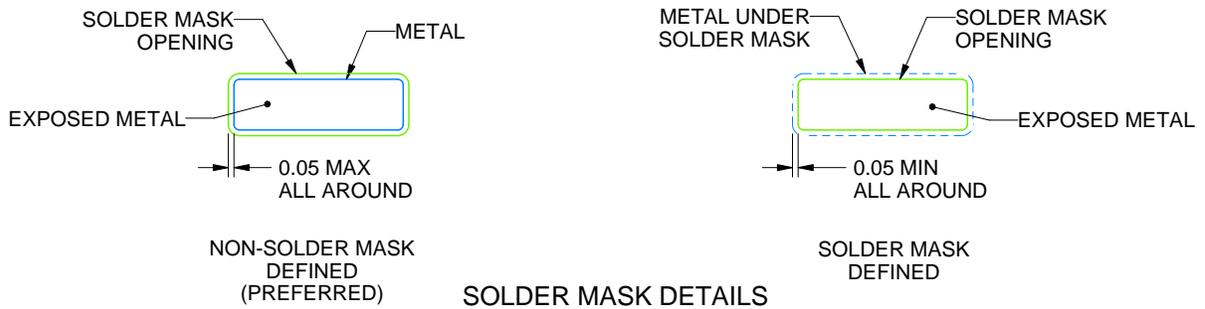
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

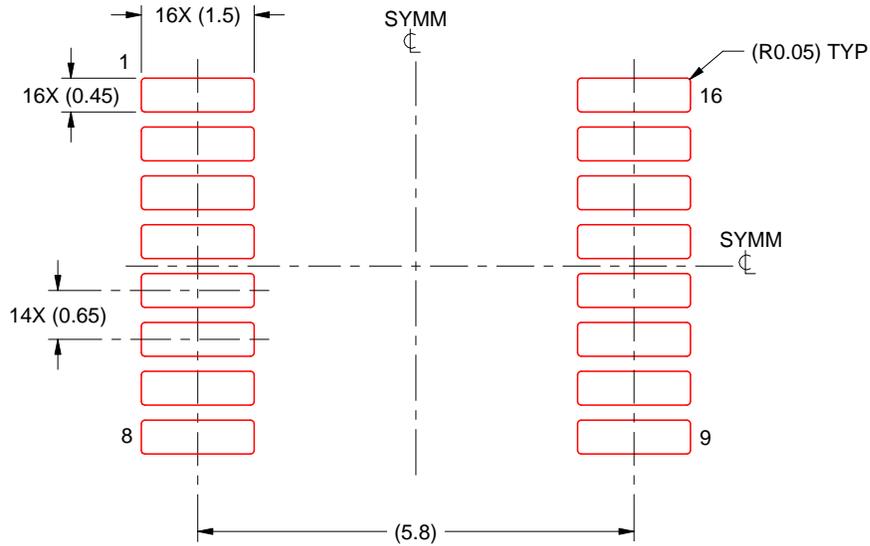
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

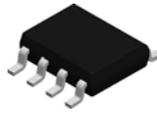


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/B 12/2023

NOTES: (continued)

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

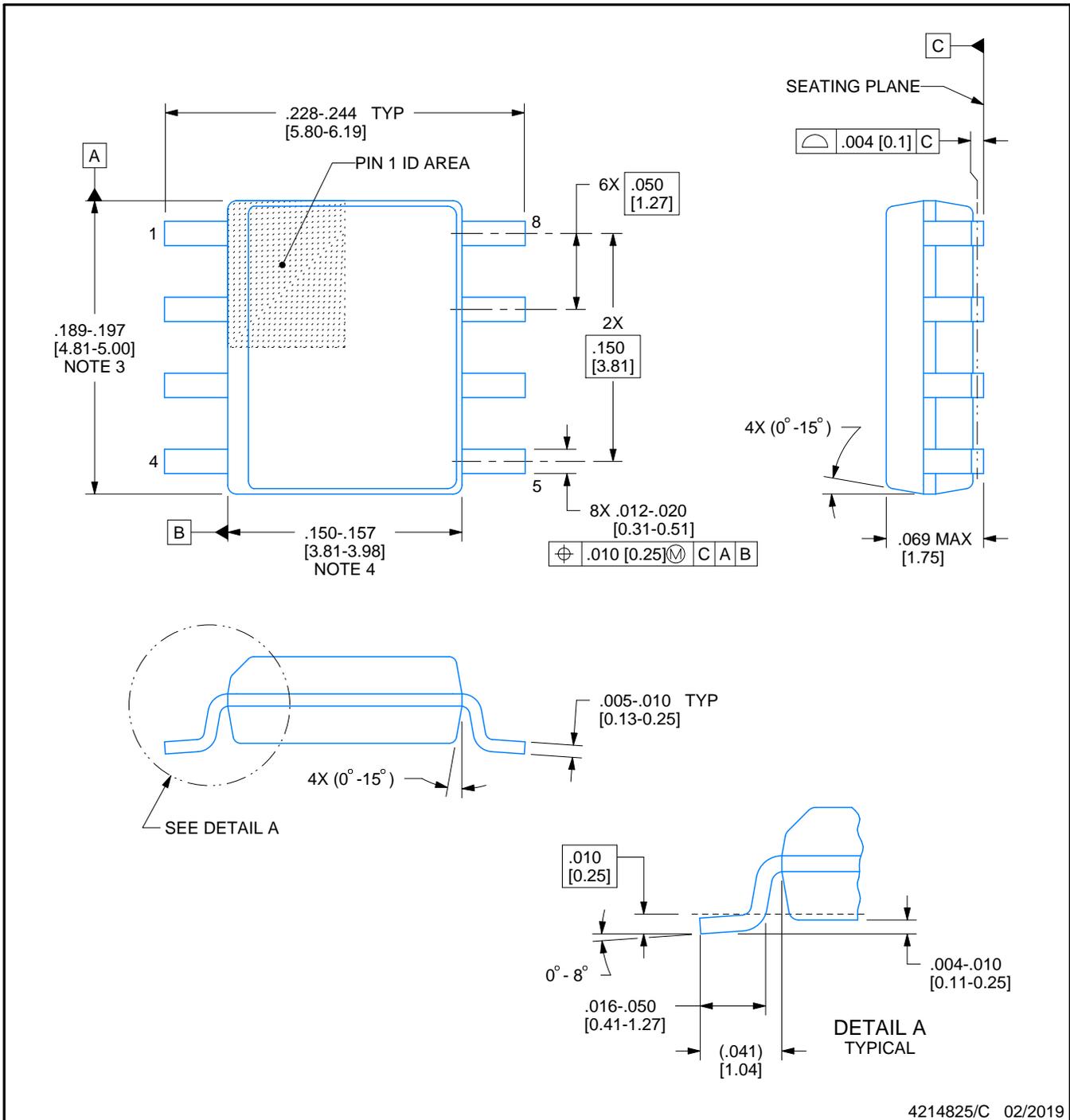


D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

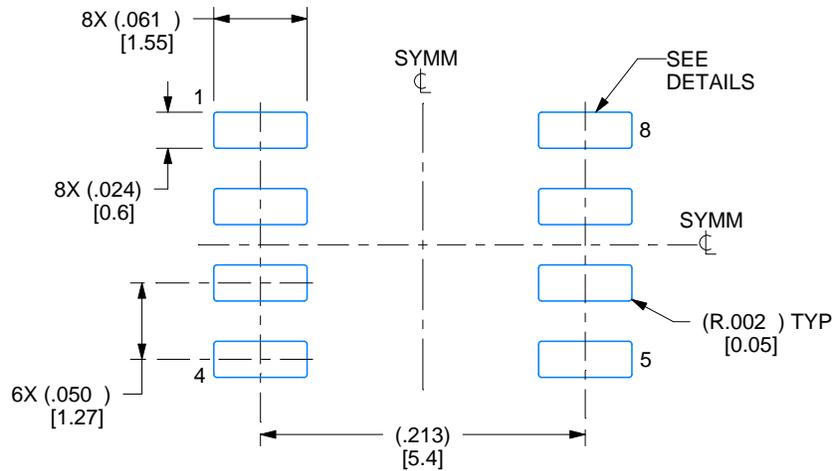
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed $.006$ [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

EXAMPLE BOARD LAYOUT

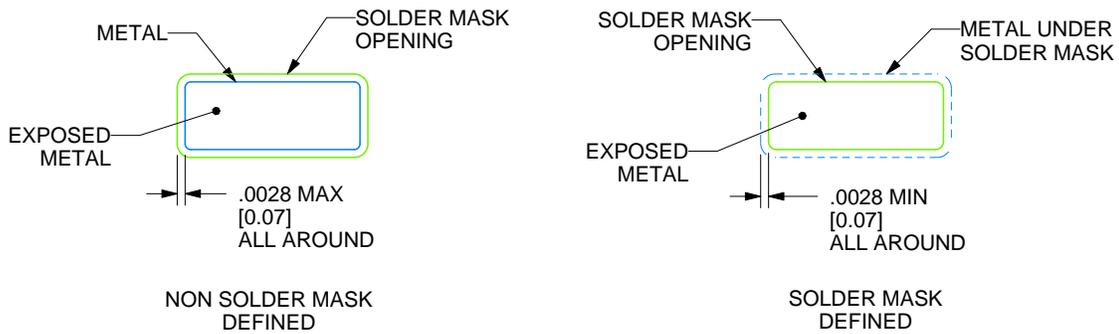
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

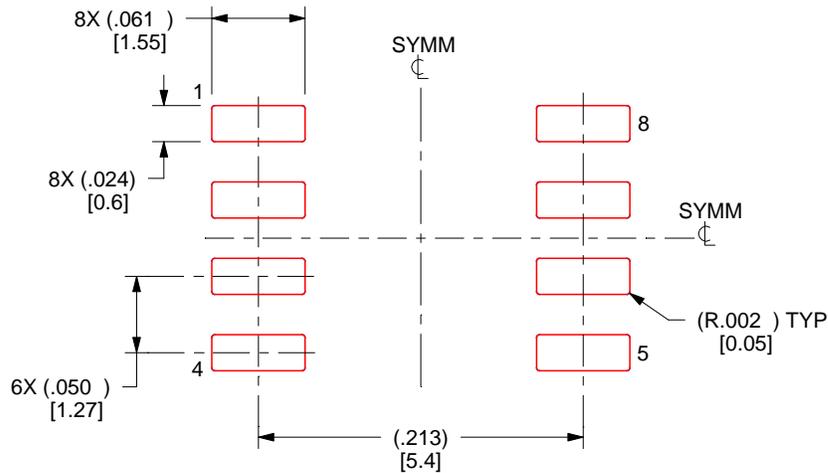
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

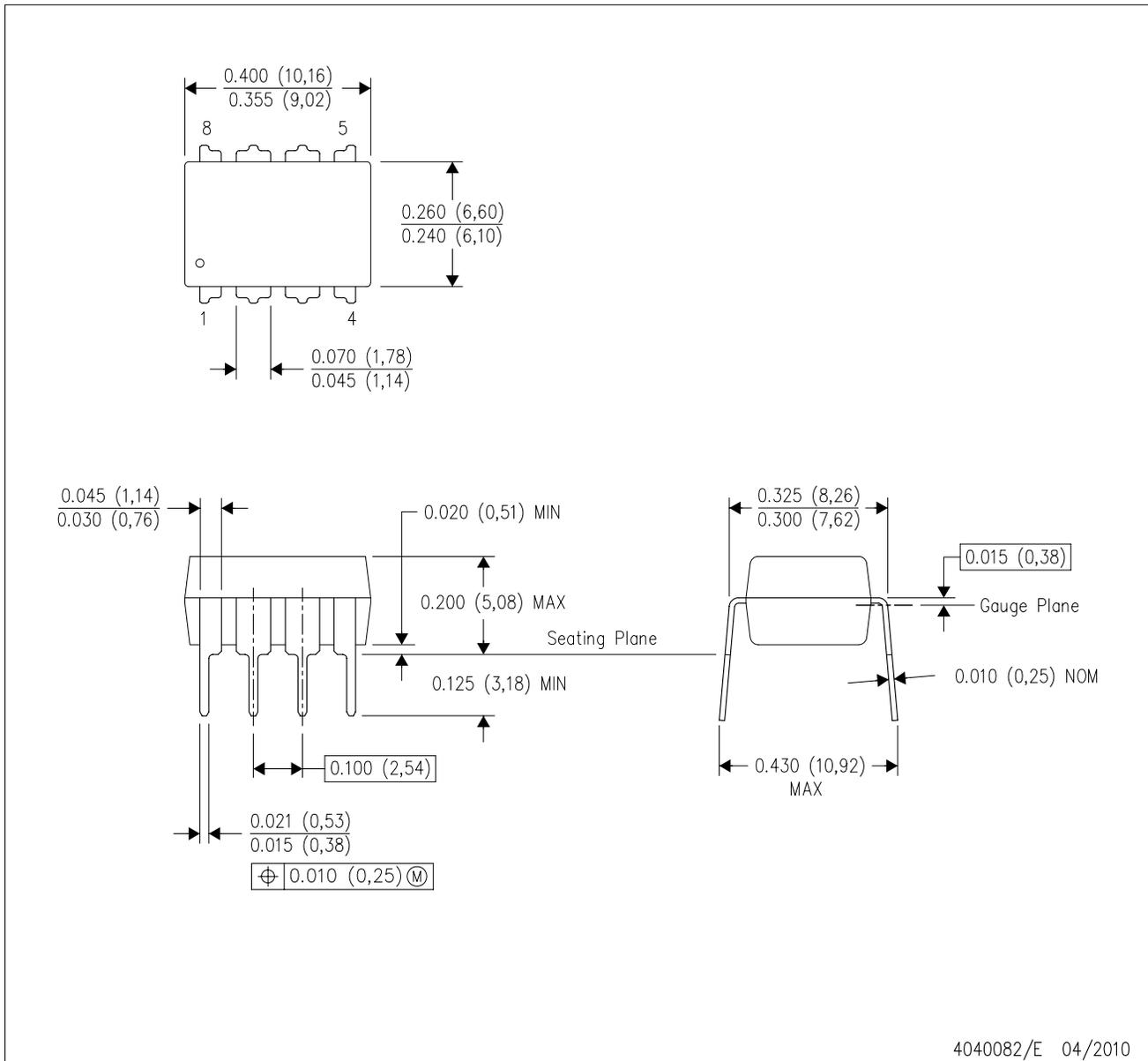
4214825/C 02/2019

NOTES: (continued)

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

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE

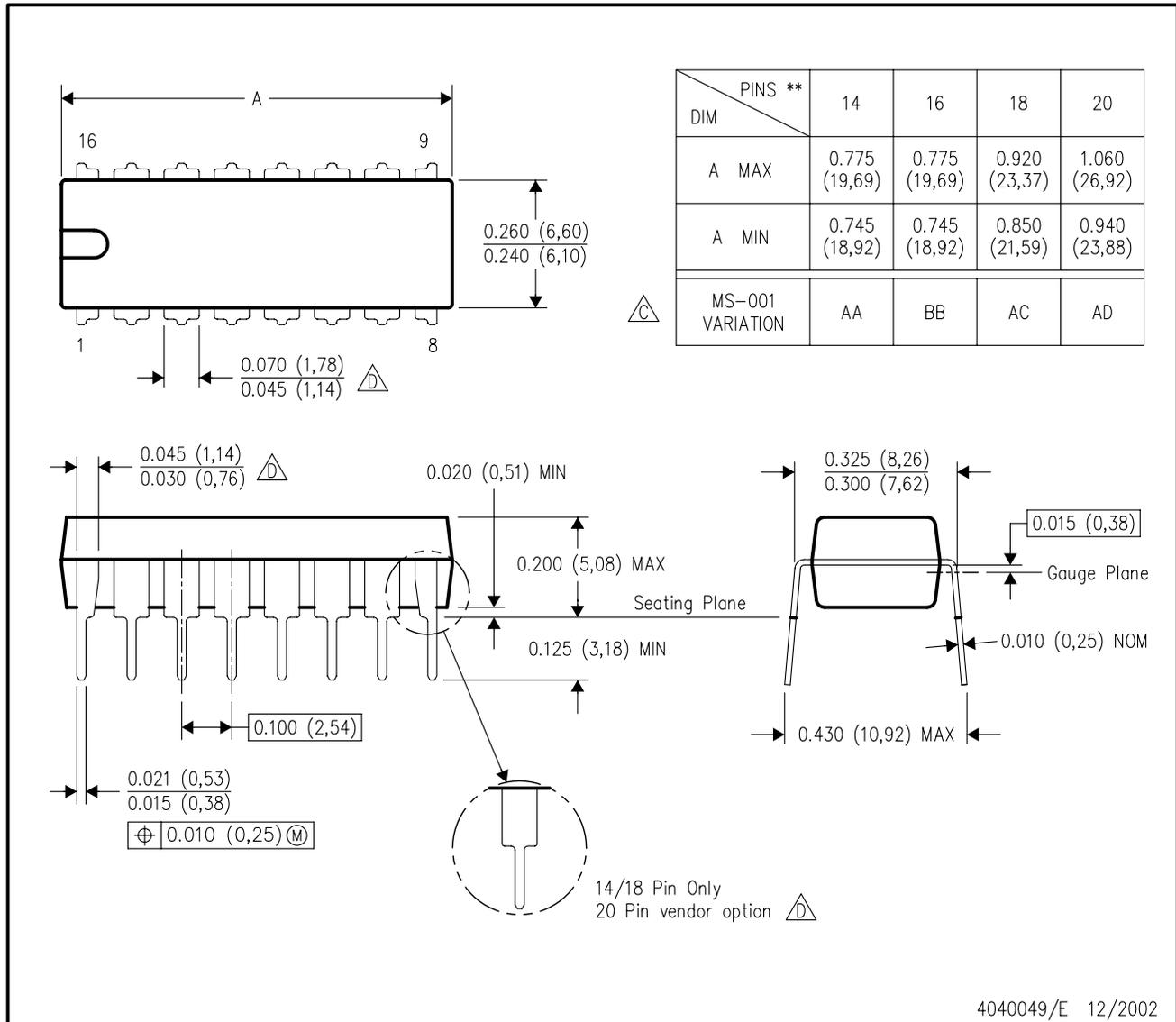


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MS-001 variation BA.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



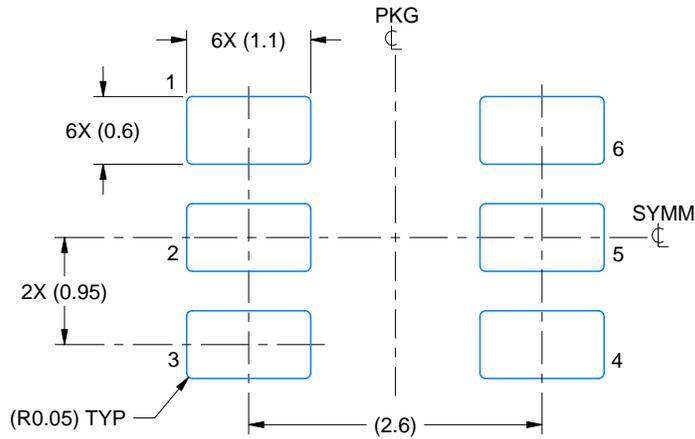
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

EXAMPLE BOARD LAYOUT

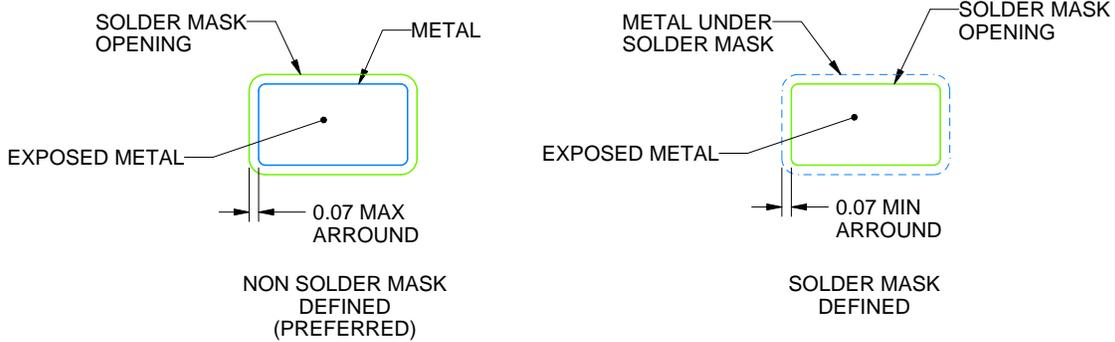
DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

4214840/G 08/2024

NOTES: (continued)

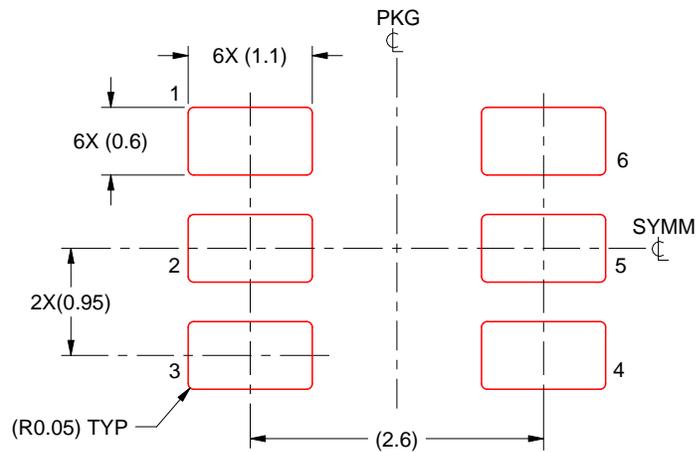
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR

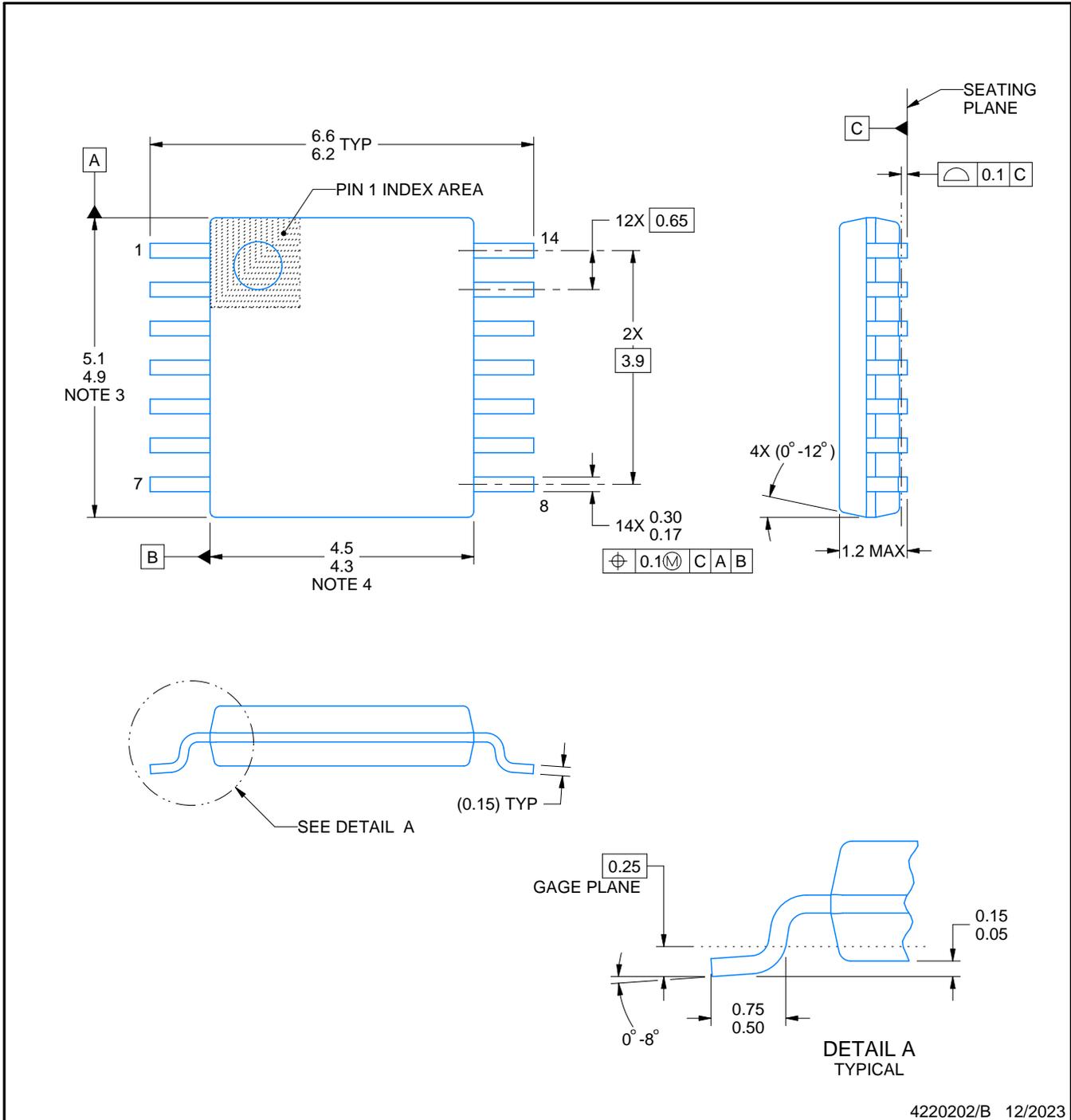


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214840/G 08/2024

NOTES: (continued)

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



4220202/B 12/2023

NOTES:

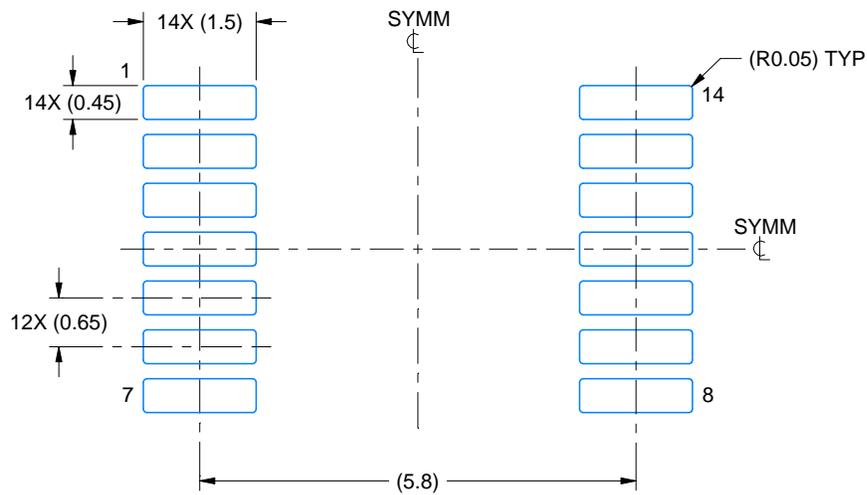
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

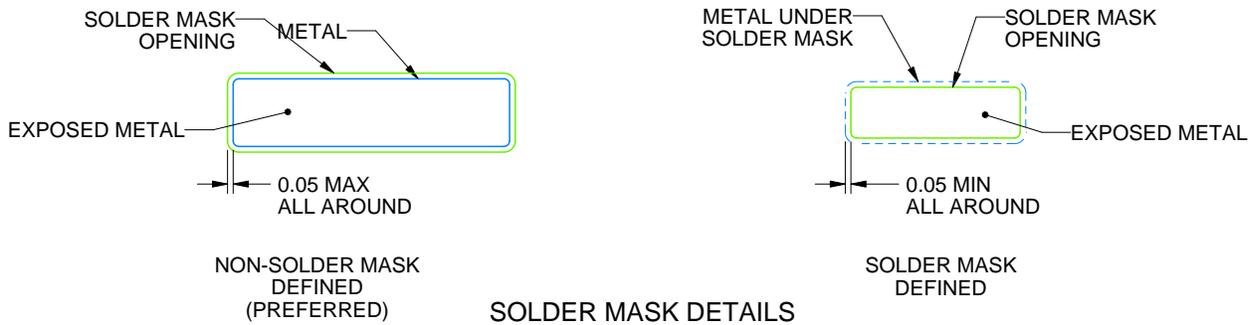
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220202/B 12/2023

NOTES: (continued)

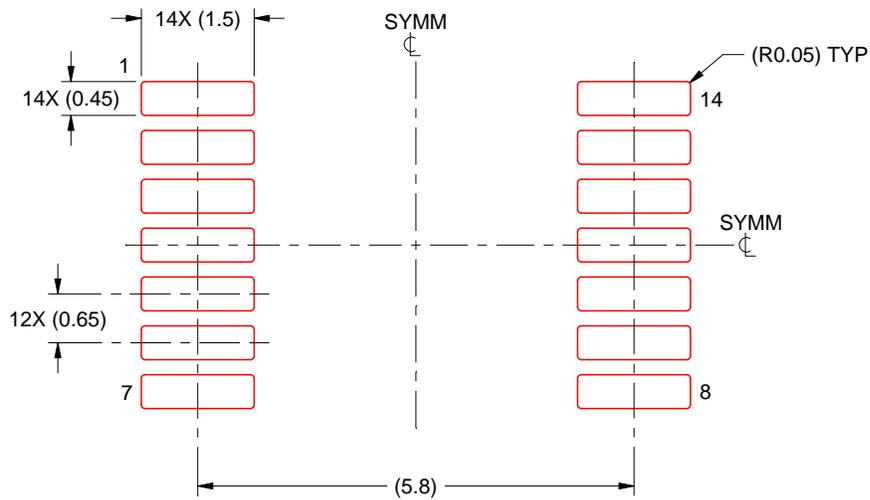
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

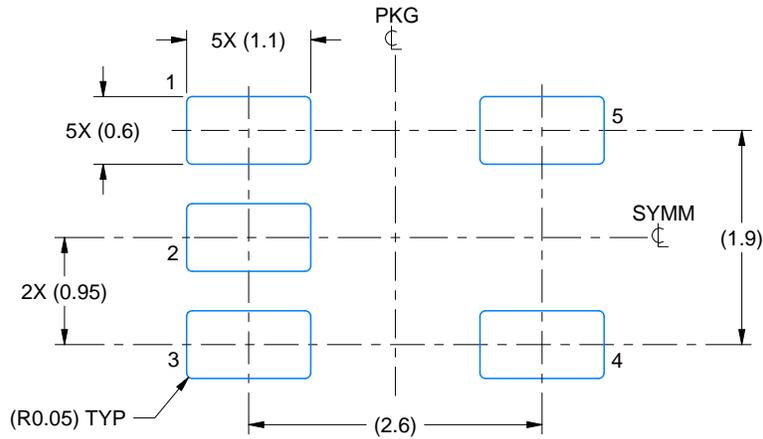
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

EXAMPLE BOARD LAYOUT

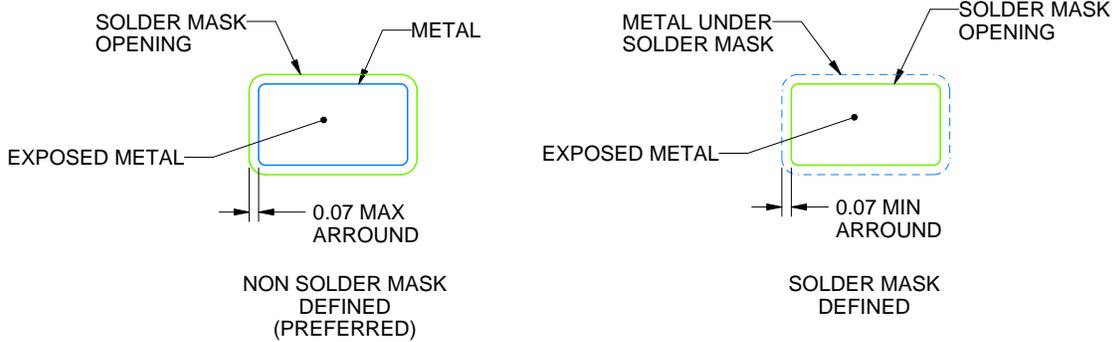
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

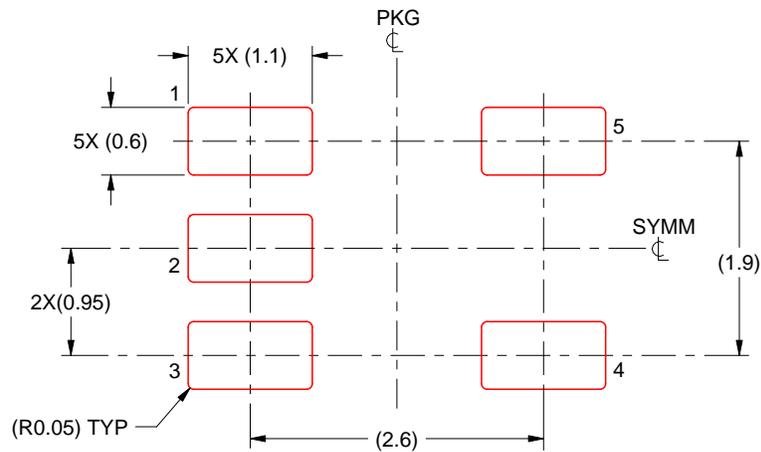
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

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

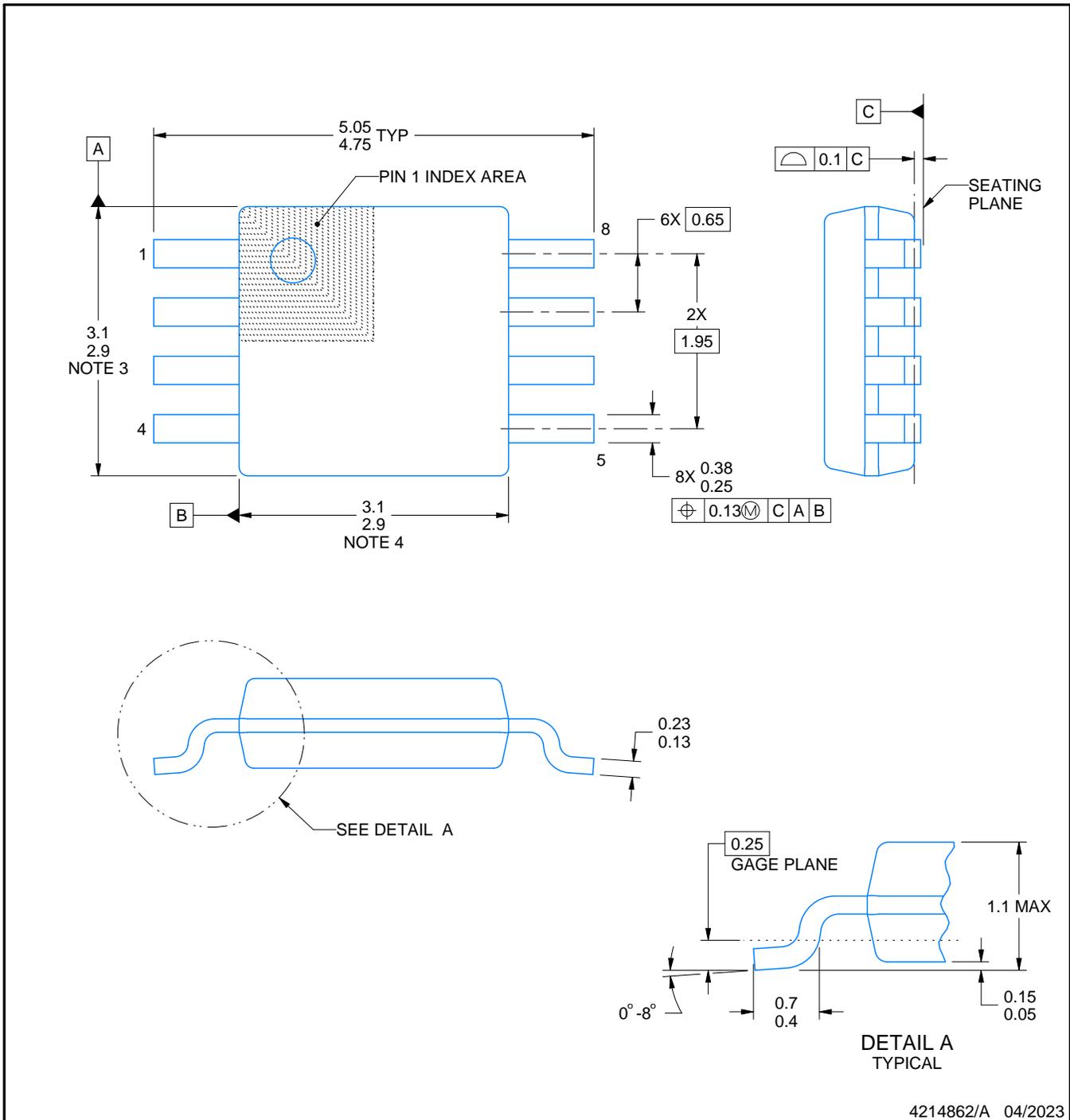
DGK0008A



PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4214862/A 04/2023

NOTES:

PowerPAD is a trademark of Texas Instruments.

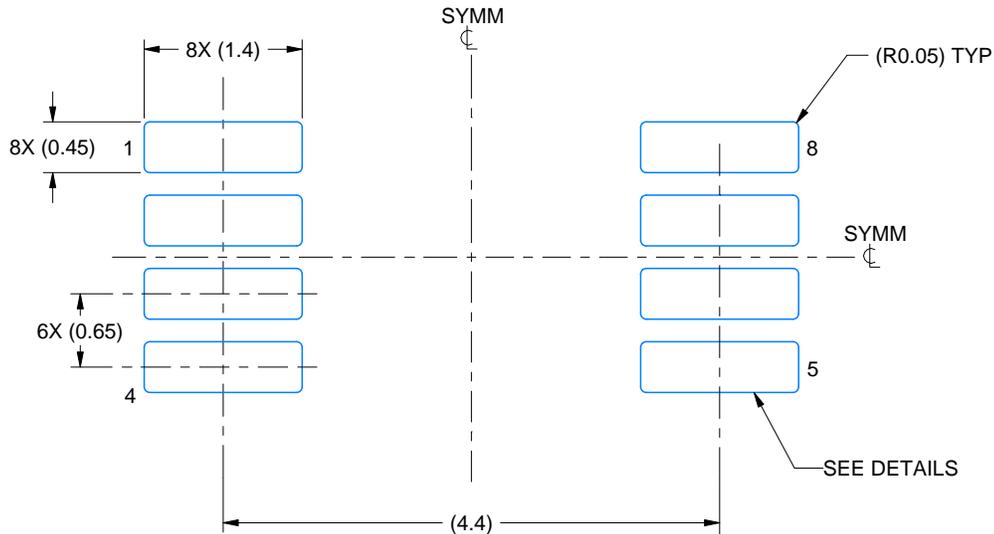
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

EXAMPLE BOARD LAYOUT

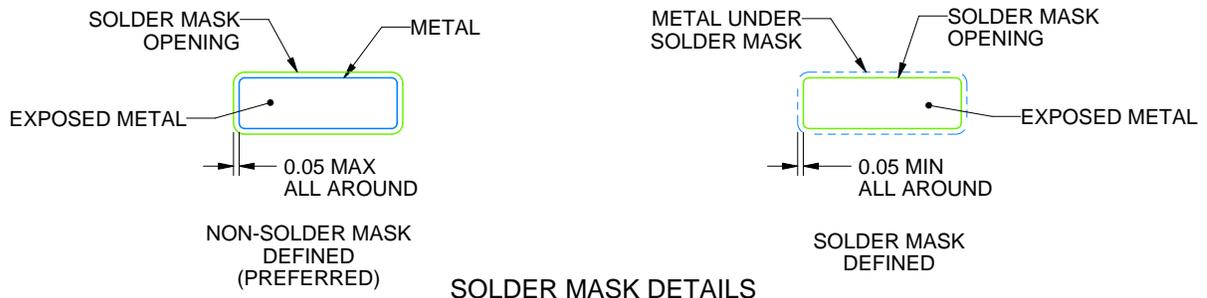
DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

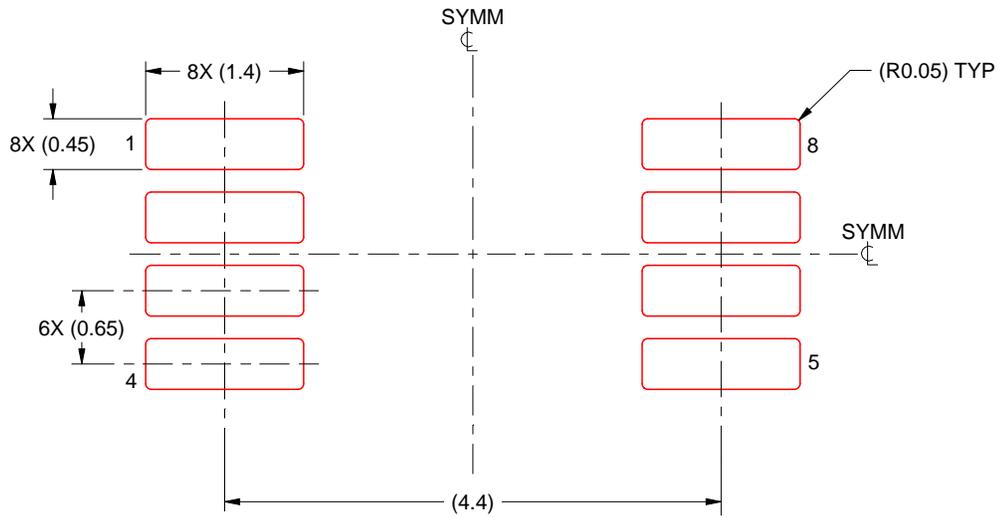
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

DGK0008A

TM VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

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.

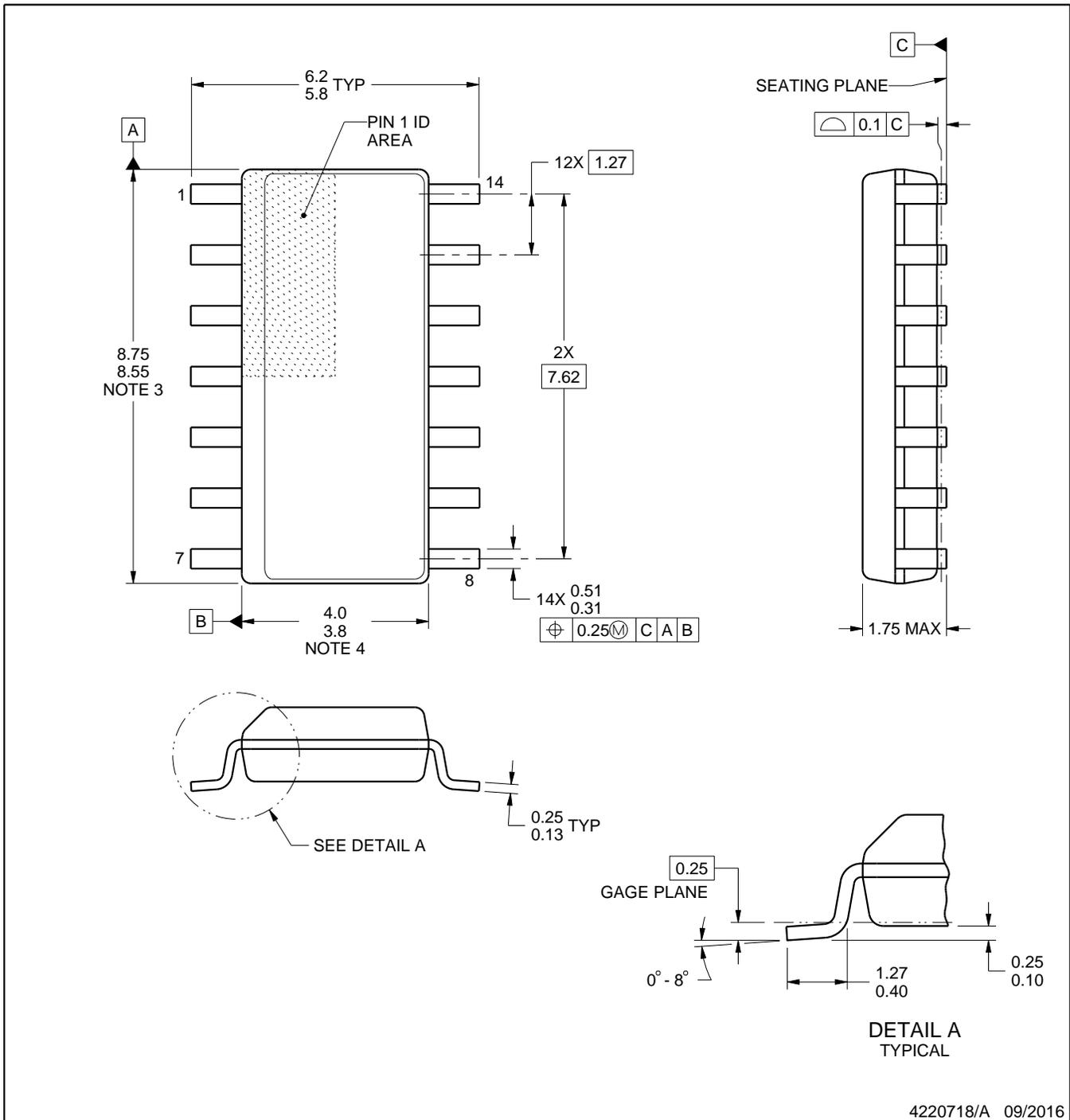
D0014A



PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES:

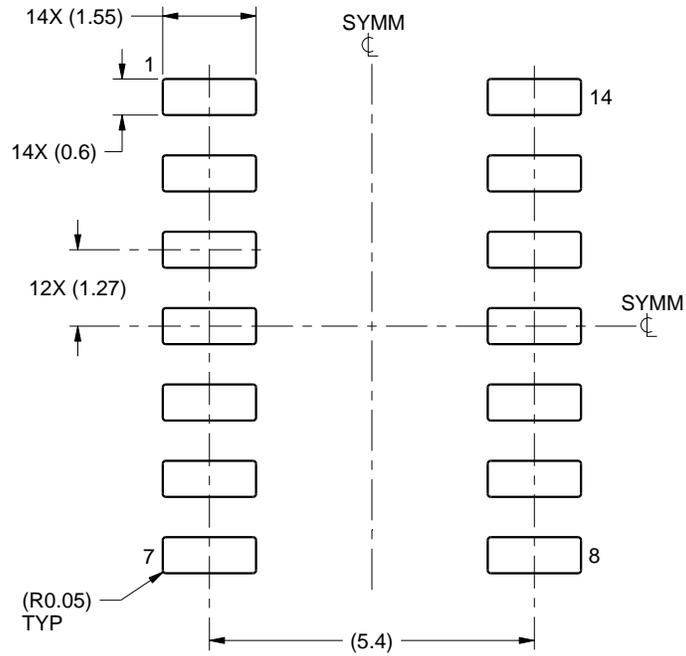
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

EXAMPLE BOARD LAYOUT

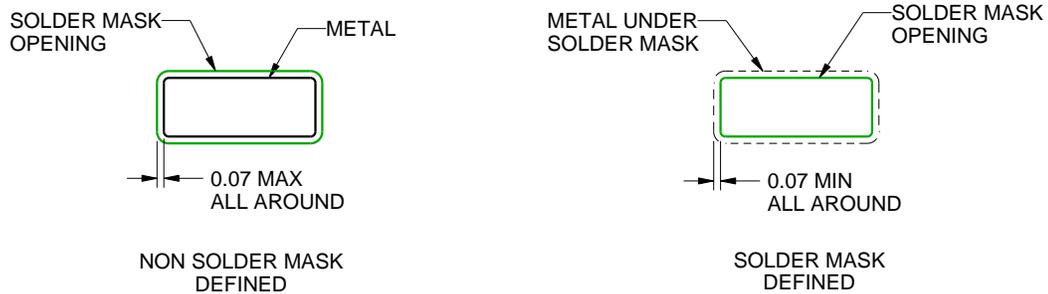
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

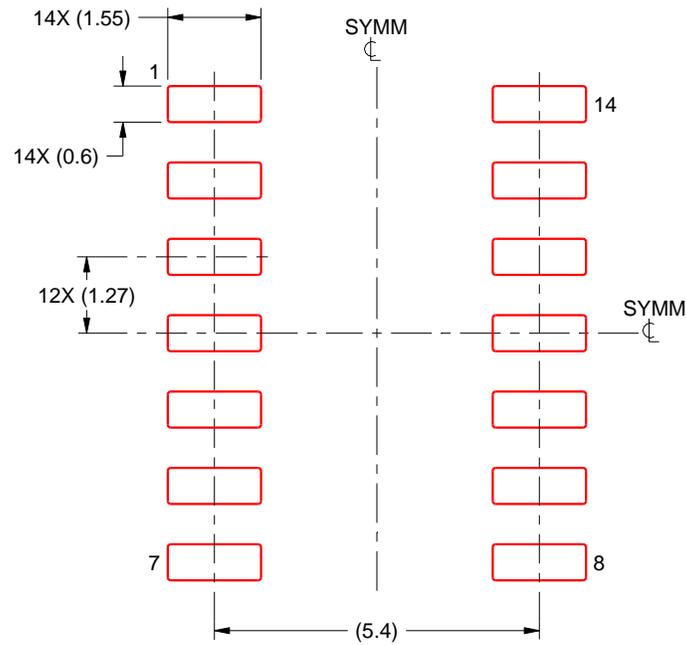
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



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

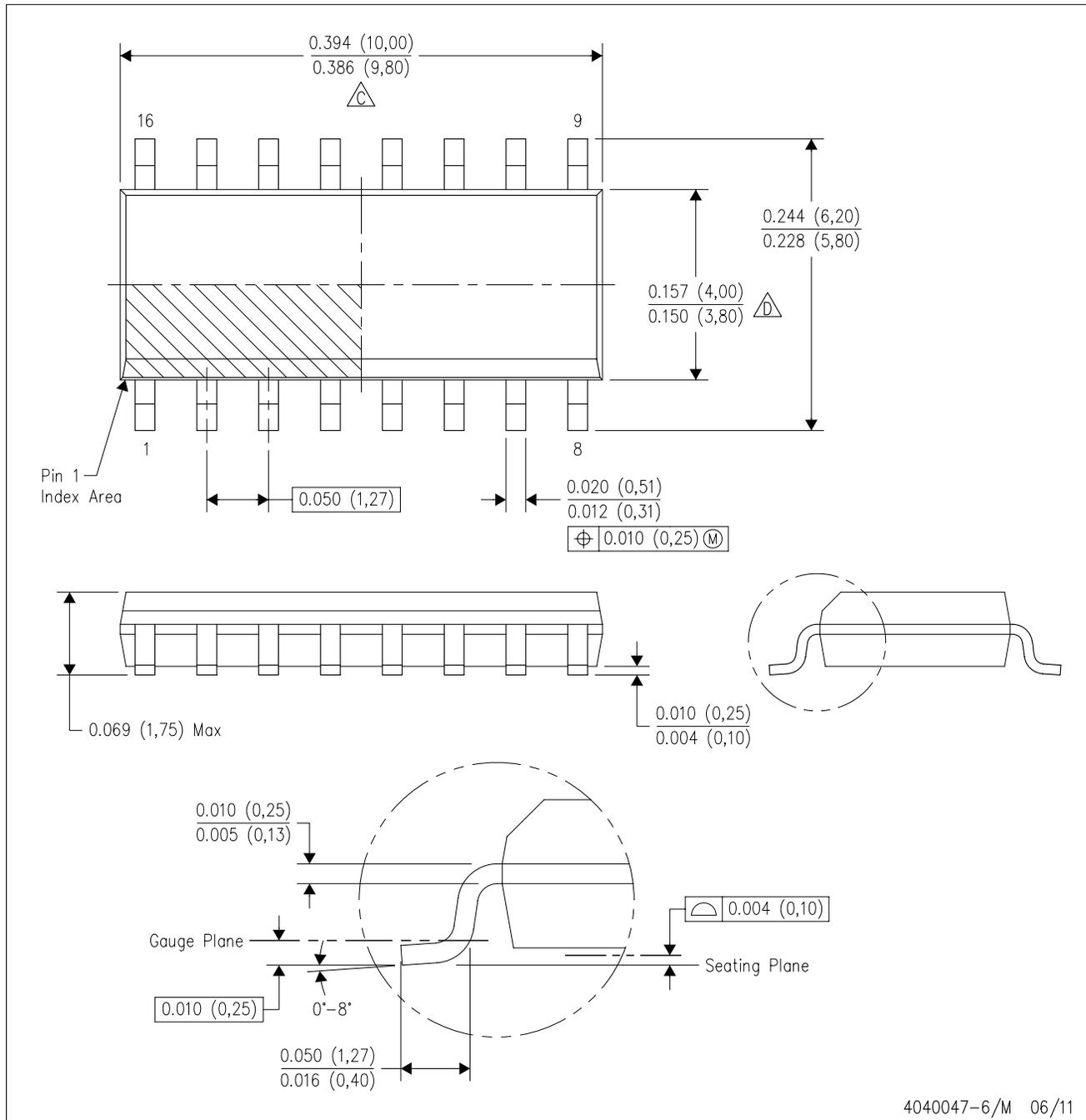
4220718/A 09/2016

NOTES: (continued)

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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

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最終更新日 : 2025 年 10 月