



## 0.9Ω のデュアル SPST アナログ・スイッチ 5V / 3.3V の 2 チャンネル・アナログ・スイッチ

### 1 特長

- 電源オフ・モード、 $V_+ = 0$  時に絶縁
- 低いオン抵抗(0.9Ω)
- 制御入力は5.5V許容
- 低い電荷注入
- 低い全高調波歪(THD)
- 1.65V～5.5Vの単電源で動作
- JESD 78, Class II準拠で100mA超のラッチアップ性能
- ESD性能はJESD 22に準拠しテスト済み
  - 2000V、人体モデル (A114-B, Class II)
  - 1000V、荷電デバイス・モデル (C101)

### 2 アプリケーション

- 携帯電話
- PDA
- ポータブル機器
- オーディオおよびビデオ信号のルーティング
- 低電圧のデータ収集システム
- 通信用回路
- モデム
- ハードディスク
- コンピュータ・ペリフェラル
- ワイヤレス端末およびペリフェラル

### 3 概要

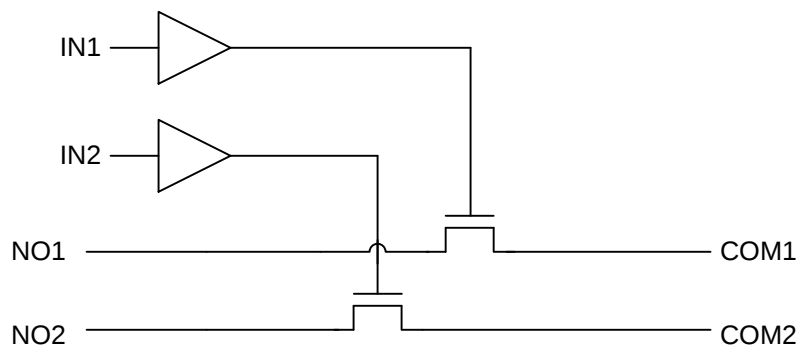
TS5A23167 はデュアルの単極単投(SPST) アナログ・スイッチで、1.65V ～ 5.5V で動作するように設計されており、オン抵抗が低い特徴があります。このデバイスは全高調波歪み(THD)特性が非常に優れており、極めて低消費電力です。これらの特長から、このデバイスは携帯用オーディオ・アプリケーションに適しています。

#### 製品情報<sup>(1)</sup>

| 型番        | パッケージ     | 本体サイズ(公称)       |
|-----------|-----------|-----------------|
| TS5A23167 | VSSOP (8) | 2.30mm×2.00mm   |
|           | DSBGA (8) | 1.25mm × 2.25mm |

(1) 提供されているすべてのパッケージについては、巻末の注文情報を参照してください。

概略回路図



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## 4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

### Revision A (September 2012) から Revision B に変更

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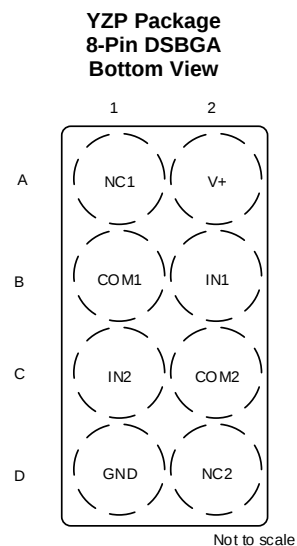
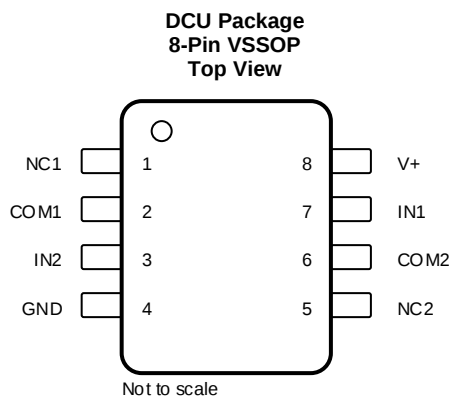
|                                                                                                                                                                            |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| • 「ピン構成および機能」セクション、「ESD 定格」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 ..... | <b>1</b> |
| • Changed the DSBGA package pin numbers .....                                                                                                                              | <b>3</b> |

### 2005年5月発行のものから更新

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|                           |          |
|---------------------------|----------|
| • パッケージ・オプションの情報を更新 ..... | <b>1</b> |
|---------------------------|----------|

## 5 Pin Configuration and Functions



### Pin Functions

| PIN  |         |           | TYPE | DESCRIPTION                              |
|------|---------|-----------|------|------------------------------------------|
| NAME | DCU NO. | DSBGA NO. |      |                                          |
| NC1  | 1       | A1        | I/O  | Normally closed                          |
| COM1 | 2       | B1        | I/O  | Common                                   |
| IN2  | 3       | C1        | GND  | Digital control pin to connect COM to NC |
| GND  | 4       | D1        | I    | Digital ground                           |
| NC2  | 5       | D2        | I    | Normally closed                          |
| COM2 | 6       | C2        | I/O  | Common                                   |
| IN1  | 7       | B2        | I/O  | Digital control pin to connect COM to NC |
| V+   | 8       | A2        | PWR  | Power Supply                             |

## 6 Specifications

### 6.1 Absolute Maximum Ratings<sup>(1) (2)</sup>

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

|                       |                                                                        | MIN                                   | MAX                        | UNIT |
|-----------------------|------------------------------------------------------------------------|---------------------------------------|----------------------------|------|
| $V_+$                 | Supply voltage range <sup>(3)</sup>                                    | −0.5                                  | 6.5                        | V    |
| $V_{NC}$<br>$V_{COM}$ | Analog voltage range <sup>(3) (4) (5)</sup>                            | −0.5                                  | $V_+ + 0.5$                | V    |
| $I_K$                 | Analog port diode current                                              | $V_{NC}, V_{COM} < 0$                 | −50                        | mA   |
| $I_{NC}$<br>$I_{COM}$ | On-state switch current<br>On-state peak switch current <sup>(6)</sup> | $V_{NC}, V_{COM} = 0 \text{ to } V_+$ | −200<br>200<br>−400<br>400 | mA   |
| $V_I$                 | Digital input voltage range <sup>(3) (4)</sup>                         | −0.5                                  | 6.5                        | V    |
| $I_{IK}$              | Digital clamp current                                                  | $V_I < 0$                             | −50                        | mA   |
| $I_+$                 | Continuous current through $V_+$                                       |                                       | 100                        | mA   |
| $I_{GND}$             | Continuous current through GND                                         | −100                                  | 100                        | mA   |
| $T_{stg}$             | Storage temperature range                                              | −65                                   | 150                        | °C   |

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum
- (3) All voltages are with respect to ground, unless otherwise specified.
- (4) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (5) This value is limited to 5.5 V maximum.
- (6) Pulse at 1-ms duration < 10% duty cycle.

### 6.2 ESD Ratings

|             |                         | VALUE                                                                          | UNIT  |
|-------------|-------------------------|--------------------------------------------------------------------------------|-------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | +2000 |
|             |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | +1000 |
|             |                         |                                                                                | V     |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

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

|           |                                | MIN  | MAX   | UNIT |
|-----------|--------------------------------|------|-------|------|
| $V_{I/O}$ | Input/output voltage           | 0    | $V_+$ | V    |
| $V_+$     | Supply voltage                 | 1.65 | 5.5   | V    |
| $V_I$     | Control Input Voltage          | 0    | 5.5   | V    |
| $T_A$     | Operating free-air temperature | −40  | 85    | °C   |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | TS5A23166   |             | UNIT |
|-------------------------------|----------------------------------------------|-------------|-------------|------|
|                               |                                              | DCU (VSSOP) | YZP (DSBGA) |      |
|                               |                                              | 8 PINS      | 8 PINS      |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 212.2       | 98.0        | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 77.6        | 1.1         | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 91.7        | 26.8        | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 7.1         | 0.6         | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 91.1        | 26.7        | °C/W |

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

## 6.5 Electrical Characteristics for 5-V Supply<sup>(1)</sup>

 $V_+ = 4.5 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                        | SYMBOL                                | TEST CONDITIONS                                                                                                                                  |                                                                 | T <sub>A</sub>               | V <sub>+</sub> | MIN  | TYP  | MAX            | UNIT |
|--------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------|----------------|------|------|----------------|------|
| Analog Switch                                    |                                       |                                                                                                                                                  |                                                                 |                              |                |      |      |                |      |
| Analog signal range                              | V <sub>COM</sub> ,<br>V <sub>NC</sub> |                                                                                                                                                  |                                                                 |                              |                | 0    |      | V <sub>+</sub> | V    |
| Peak ON resistance                               | r <sub>peak</sub>                     | 0 ≤ V <sub>NC</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −100 mA,                                                                            | Switch ON,<br>See Figure 13                                     | 25°C                         | 4.5 V          | 0.9  | 1.1  |                | Ω    |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | 1.2  |      |                |      |
| ON-state resistance                              | r <sub>on</sub>                       | V <sub>NC</sub> = 2.5 V,<br>I <sub>COM</sub> = −100 mA,                                                                                          | Switch ON,<br>See Figure 13                                     | 25°C                         | 4.5 V          | 0.75 | 0.9  |                | Ω    |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | 1    |      |                |      |
| ON-state resistance<br>match between<br>channels | Δr <sub>on</sub>                      | V <sub>NC</sub> = 2.5 V,<br>I <sub>COM</sub> = −100 mA,                                                                                          | Switch ON,<br>See Figure 13                                     | 25°C                         | 4.5 V          | 0.04 | 0.1  |                | Ω    |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | 0.1  |      |                |      |
| ON-state resistance<br>flatness                  | r <sub>on(flat)</sub>                 | 0 ≤ V <sub>NC</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −100 mA,<br><br>V <sub>NC</sub> = 1 V, 1.5 V, 2.5 V,<br>I <sub>COM</sub> = −100 mA, | Switch ON,<br>See Figure 13<br><br>Switch ON,<br>See Figure 13  | 25°C                         | 4.5 V          | 0.2  |      |                | Ω    |
|                                                  |                                       |                                                                                                                                                  |                                                                 | 25°C                         |                | 0.15 | 0.25 |                |      |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | 0.25 |      |                |      |
| NC<br>OFF leakage current                        | I <sub>NC(OFF)</sub>                  | V <sub>NC</sub> = 1 V,<br>V <sub>COM</sub> = 4.5 V,<br>or<br>V <sub>NC</sub> = 4.5 V,<br>V <sub>COM</sub> = 1 V,                                 | Switch OFF,<br>See Figure 14                                    | 25°C                         | 5.5 V          | 0 V  | 4    | 20             | nA   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | −150 |      | 150            |      |
|                                                  |                                       | I <sub>NC(PWROFF)</sub>                                                                                                                          | V <sub>NC</sub> = 0 to 5.5 V,<br>V <sub>COM</sub> = 5.5 V to 0, | Switch OFF,<br>See Figure 14 | 25°C           | 0 V  | −10  | 0.2            | 10   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         | −50            |      |      | 50             |      |
| COM<br>OFF leakage current                       | I <sub>COM(OFF)</sub>                 | V <sub>COM</sub> = 1 V,<br>V <sub>NC</sub> = 4.5 V,<br>or<br>V <sub>COM</sub> = 4.5 V,<br>V <sub>NC</sub> = 1 V,                                 | Switch OFF,<br>See Figure 14                                    | 25°C                         | 5.5 V          | 0 V  | 4    | 20             | nA   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | −150 |      | 150            |      |
|                                                  |                                       | I <sub>COM(PWROFF)</sub>                                                                                                                         | V <sub>COM</sub> = 0 to 5.5 V,<br>V <sub>NC</sub> = 5.5 V to 0, | Switch OFF,<br>See Figure 14 | 25°C           | 0 V  | −10  | 0.2            | 10   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         | −50            |      |      | 50             |      |
| NC<br>ON leakage current                         | I <sub>NC(ON)</sub>                   | V <sub>NC</sub> = 1 V,<br>V <sub>COM</sub> = Open,<br>or<br>V <sub>NC</sub> = 4.5 V,<br>V <sub>COM</sub> = Open,                                 | Switch ON,<br>See Figure 15                                     | 25°C                         | 5.5 V          | −5   | 0.4  | 5              | nA   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | −50  |      | 50             |      |
| COM<br>ON leakage current                        | I <sub>COM(ON)</sub>                  | V <sub>COM</sub> = 1 V,<br>V <sub>NC</sub> = Open,<br>or<br>V <sub>COM</sub> = 4.5 V,<br>V <sub>NC</sub> = Open,                                 | Switch ON,<br>See Figure 15                                     | 25°C                         | 5.5 V          | −5   | 0.4  | 5              | nA   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | −50  |      | 50             |      |
| Digital Control Inputs (IN1, IN2) <sup>(2)</sup> |                                       |                                                                                                                                                  |                                                                 |                              |                |      |      |                |      |
| Input logic high                                 | V <sub>IH</sub>                       |                                                                                                                                                  |                                                                 | Full                         |                | 2.4  |      | 5.5            | V    |
| Input logic low                                  | V <sub>IL</sub>                       |                                                                                                                                                  |                                                                 | Full                         |                | 0    |      | 0.8            | V    |
| Input leakage<br>current                         | I <sub>IH</sub> , I <sub>IL</sub>     | V <sub>I</sub> = 5.5 V or 0                                                                                                                      |                                                                 | 25°C                         | 5.5 V          | −2   | 0.3  | 2              | nA   |
|                                                  |                                       |                                                                                                                                                  |                                                                 | Full                         |                | −20  |      | 20             |      |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## 6.6 Electrical Characteristics for 5-V Supply<sup>(1)</sup> (continued)

 $V_+ = 4.5 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                 | SYMBOL         | TEST CONDITIONS                                                                                              | $T_A$ | $V_+$          | MIN  | TYP       | MAX | UNIT          |
|---------------------------|----------------|--------------------------------------------------------------------------------------------------------------|-------|----------------|------|-----------|-----|---------------|
| <b>Dynamic</b>            |                |                                                                                                              |       |                |      |           |     |               |
| Turn-on time              | $t_{ON}$       | $V_{COM} = V_+$ ,<br>$R_L = 50 \Omega$ ,<br>$C_L = 35 \text{ pF}$ ,<br>See Figure 17                         | 25°C  | 5 V            | 1    | 4.5       | 7.5 | ns            |
|                           |                |                                                                                                              | Full  | 4.5 V to 5.5 V | 1    |           | 9   |               |
| Turn-off time             | $t_{OFF}$      | $V_{COM} = V_+$ ,<br>$R_L = 50 \Omega$ ,<br>$C_L = 35 \text{ pF}$ ,<br>See Figure 17                         | 25°C  | 5 V            | 4.5  | 8         | 11  | ns            |
|                           |                |                                                                                                              | Full  | 4.5 V to 5.5 V | 3.5  |           | 13  |               |
| Charge injection          | $Q_C$          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,<br>$C_L = 1 \text{ nF}$ ,<br>See Figure 21                                | 25°C  | 5 V            |      | 6         |     | pC            |
| NC OFF capacitance        | $C_{NC(OFF)}$  | $V_{NC} = V_+$ or GND,<br>Switch OFF,<br>See Figure 16                                                       | 25°C  | 5 V            |      | 19        |     | pF            |
| COM OFF capacitance       | $C_{COM(OFF)}$ | $V_{COM} = V_+$ or GND,<br>Switch OFF,<br>See Figure 16                                                      | 25°C  | 5 V            |      | 18        |     | pF            |
| NC ON capacitance         | $C_{NC(ON)}$   | $V_{NC} = V_+$ or GND,<br>Switch ON,<br>See Figure 16                                                        | 25°C  | 5 V            |      | 35.5      |     | pF            |
| COM ON capacitance        | $C_{COM(ON)}$  | $V_{COM} = V_+$ or GND,<br>Switch ON,<br>See Figure 16                                                       | 25°C  | 5 V            |      | 35.5      |     | pF            |
| Digital input capacitance | $C_I$          | $V_I = V_+$ or GND,<br>See Figure 16                                                                         | 25°C  | 5 V            |      | 2         |     | pF            |
| Bandwidth                 | BW             | $R_L = 50 \Omega$ ,<br>Switch ON,<br>See Figure 18                                                           | 25°C  | 5 V            |      | 150       |     | MHz           |
| OFF isolation             | $O_{ISO}$      | $R_L = 50 \Omega$ ,<br>$f = 1 \text{ MHz}$ ,<br>Switch OFF,<br>See Figure 19                                 | 25°C  | 5 V            |      | –62       |     | dB            |
| Crosstalk                 | $X_{TALK}$     | $R_L = 50 \Omega$ ,<br>$f = 1 \text{ MHz}$ ,<br>Switch ON,<br>See Figure 20                                  | 25°C  | 5 V            |      | –85       |     | dB            |
| Total harmonic distortion | THD            | $R_L = 600 \Omega$ ,<br>$C_L = 50 \text{ pF}$ ,<br>$f = 20 \text{ Hz to } 20 \text{ kHz}$ ,<br>See Figure 22 | 25°C  | 5 V            |      | 0.00<br>5 |     | %             |
| <b>Supply</b>             |                |                                                                                                              |       |                |      |           |     |               |
| Positive supply current   | $I_+$          | $V_I = V_+$ or GND,<br>Switch ON or OFF                                                                      | 25°C  | 5.5 V          | 0.01 | 0.1       |     | $\mu\text{A}$ |
|                           |                |                                                                                                              | Full  |                |      | 1         |     |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

## 6.7 Electrical Characteristics for 3.3-V Supply<sup>(1)</sup>

 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                              | SYMBOL            | TEST CONDITIONS                                                                                                                                   | $T_A$        | $V_+$ | MIN  | TYP  | MAX   | UNIT          |
|--------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------|------|------|-------|---------------|
| <b>Analog Switch</b>                                   |                   |                                                                                                                                                   |              |       |      |      |       |               |
| Analog signal range                                    | $V_{COM}, V_{NC}$ |                                                                                                                                                   |              |       | 0    |      | $V_+$ | V             |
| Peak ON resistance                                     | $r_{peak}$        | $0 \leq V_{NC} \leq V_+$ ,<br>$I_{COM} = -100\text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                         | 25°C<br>Full | 3 V   | 1.3  | 1.6  | 1.8   | $\Omega$      |
| ON-state resistance                                    | $r_{on}$          | $V_{NC} = 2\text{ V}$ ,<br>$I_{COM} = -100\text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                            | 25°C<br>Full | 3 V   | 1.1  | 1.5  | 1.7   | $\Omega$      |
| ON-state resistance match between channels             | $\Delta r_{on}$   | $V_{NC} = 2\text{ V}$ , $0.8\text{ V}$ ,<br>$I_{COM} = -100\text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                           | 25°C<br>Full | 3 V   | 0.04 | 0.1  | 0.1   | $\Omega$      |
| ON-state resistance flatness                           | $r_{on(flat)}$    | $0 \leq V_{NC} \leq V_+$ ,<br>$I_{COM} = -100\text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                         | 25°C<br>Full | 3 V   | 0.3  | 0.15 | 0.25  | $\Omega$      |
| NC OFF leakage current                                 | $I_{NC(OFF)}$     | $V_{NC} = 1\text{ V}$ ,<br>$V_{COM} = 3\text{ V}$ ,<br>or<br>$V_{NC} = 3\text{ V}$ ,<br>$V_{COM} = 1\text{ V}$ ,<br>Switch OFF,<br>See Figure 14  | 25°C<br>Full | 3.6 V | -5   | 0.5  | 5     | nA            |
|                                                        | $I_{NC(PWROFF)}$  | $V_{NC} = 0\text{ to }3.6\text{ V}$ ,<br>$V_{COM} = 3.6\text{ V to }0$ ,<br>Switch OFF,<br>See Figure 14                                          | 25°C<br>Full | 0 V   | -5   | 0.1  | 5     | $\mu\text{A}$ |
| COM OFF leakage current                                | $I_{COM(OFF)}$    | $V_{COM} = 1\text{ V}$ ,<br>$V_{NC} = 3\text{ V}$ ,<br>or<br>$V_{COM} = 3\text{ V}$ ,<br>$V_{NC} = 1\text{ V}$ ,<br>Switch OFF,<br>See Figure 14  | 25°C<br>Full | 3.6 V | -5   | 0.5  | 5     | nA            |
|                                                        | $I_{COM(PWROFF)}$ | $V_{COM} = 0\text{ to }3.6\text{ V}$ ,<br>$V_{NC} = 3.6\text{ V to }0$ ,<br>Switch OFF,<br>See Figure 14                                          | 25°C<br>Full | 0 V   | -5   | 0.1  | 5     | $\mu\text{A}$ |
| NC ON leakage current                                  | $I_{NC(ON)}$      | $V_{NC} = 1\text{ V}$ ,<br>$V_{COM} = \text{Open}$ ,<br>or<br>$V_{NC} = 3\text{ V}$ ,<br>$V_{COM} = \text{Open}$ ,<br>Switch ON,<br>See Figure 15 | 25°C<br>Full | 3.6 V | -2   | 0.3  | 2     | nA            |
| COM ON leakage current                                 | $I_{COM(ON)}$     | $V_{COM} = 1\text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>or<br>$V_{COM} = 3\text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>Switch ON,<br>See Figure 15 | 25°C<br>Full | 3.6 V | -2   | 0.3  | 2     | nA            |
| <b>Digital Control Inputs (IN1, IN2)<sup>(2)</sup></b> |                   |                                                                                                                                                   |              |       |      |      |       |               |
| Input logic high                                       | $V_{IH}$          |                                                                                                                                                   | Full         |       | 2    |      | 5.5   | V             |
| Input logic low                                        | $V_{IL}$          |                                                                                                                                                   | Full         |       | 0    |      | 0.8   | V             |
| Input leakage current                                  | $I_{IH}, I_{IL}$  | $V_I = 5.5\text{ V or }0$                                                                                                                         | 25°C         | 3.6 V | -2   | 0.3  | 2     | nA            |
|                                                        |                   |                                                                                                                                                   | Full         |       | -20  |      | 20    |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## 6.8 Electrical Characteristics for 3.3-V Supply<sup>(1)</sup> (continued)

 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                 | SYMBOL         | TEST CONDITIONS                                                                                           | $T_A$ | $V_+$        | MIN   | TYP  | MAX  | UNIT          |
|---------------------------|----------------|-----------------------------------------------------------------------------------------------------------|-------|--------------|-------|------|------|---------------|
| <b>Dynamic</b>            |                |                                                                                                           |       |              |       |      |      |               |
| Turn-on time              | $t_{ON}$       | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,<br>$C_L = 35\text{ pF}$ ,<br>See Figure 17                      | 25°C  | 3.3 V        | 1.5   | 5    | 9.5  | ns            |
|                           |                |                                                                                                           | Full  | 3 V to 3.6 V | 1.0   |      | 10   |               |
| Turn-off time             | $t_{OFF}$      | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,<br>$C_L = 35\text{ pF}$ ,<br>See Figure 17                      | 25°C  | 3.3 V        | 4.5   | 8.5  | 11   | ns            |
|                           |                |                                                                                                           | Full  | 3 V to 3.6 V | 3     |      | 12.5 |               |
| Charge injection          | $Q_C$          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,<br>$C_L = 1\text{ nF}$ ,<br>See Figure 21                              | 25°C  | 3.3 V        |       | 6    |      | pC            |
| NC OFF capacitance        | $C_{NC(OFF)}$  | $V_{NC} = V_+$ or GND,<br>Switch OFF,                                                                     | 25°C  | 3.3 V        |       | 19.5 |      | pF            |
| COM OFF capacitance       | $C_{COM(OFF)}$ | $V_{COM} = V_+$ or GND,<br>Switch OFF,                                                                    | 25°C  | 3.3 V        |       | 18.5 |      | pF            |
| NC ON capacitance         | $C_{NC(ON)}$   | $V_{NC} = V_+$ or GND,<br>Switch ON,                                                                      | 25°C  | 3.3 V        |       | 36   |      | pF            |
| COM ON capacitance        | $C_{COM(ON)}$  | $V_{COM} = V_+$ or GND,<br>Switch ON,                                                                     | 25°C  | 3.3 V        |       | 36   |      | pF            |
| Digital input capacitance | $C_I$          | $V_I = V_+$ or GND,                                                                                       | 25°C  | 3.3 V        |       | 2    |      | pF            |
| Bandwidth                 | BW             | $R_L = 50\ \Omega$ ,<br>Switch ON,                                                                        | 25°C  | 3.3 V        |       | 150  |      | MHz           |
| OFF isolation             | $O_{ISO}$      | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,<br>Switch OFF,<br>See Figure 19                              | 25°C  | 3.3 V        |       | –62  |      | dB            |
| Crosstalk                 | $X_{TALK}$     | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,<br>Switch ON,<br>See Figure 20                               | 25°C  | 3.3 V        |       | –85  |      | dB            |
| Total harmonic distortion | THD            | $R_L = 600\ \Omega$ ,<br>$C_L = 50\text{ pF}$ ,<br>$f = 20\text{ Hz to }20\text{ kHz}$ ,<br>See Figure 22 | 25°C  | 3.3 V        |       | 0.01 |      | %             |
| <b>Supply</b>             |                |                                                                                                           |       |              |       |      |      |               |
| Positive supply current   | $I_+$          | $V_I = V_+$ or GND,<br>Switch ON or OFF                                                                   | 25°C  | 3.6 V        | 0.001 | 0.05 |      | $\mu\text{A}$ |
|                           |                |                                                                                                           | Full  |              |       | 0.3  |      |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

## 6.9 Electrical Characteristics for 2.5-V Supply<sup>(1)</sup>

 $V_+ = 2.3 \text{ V to } 2.7 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                              | SYMBOL            | TEST CONDITIONS                                                                                                                                      | $T_A$        | $V_+$ | MIN  | TYP  | MAX   | UNIT          |
|--------------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------|------|------|-------|---------------|
| <b>Analog Switch</b>                                   |                   |                                                                                                                                                      |              |       |      |      |       |               |
| Analog signal range                                    | $V_{COM}, V_{NC}$ |                                                                                                                                                      |              | 2.3 V | 0    |      | $V_+$ | V             |
| Peak ON resistance                                     | $r_{peak}$        | $0 \leq V_{NC} \leq V_+$ ,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                           | 25°C<br>Full | 2.3 V | 1.8  | 2.4  | 2.6   | $\Omega$      |
| ON-state resistance                                    | $r_{on}$          | $V_{NC} = 2 \text{ V}$ ,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                             | 25°C<br>Full | 2.3 V | 1.2  | 2.1  | 2.4   | $\Omega$      |
| ON-state resistance match between channels             | $\Delta r_{on}$   | $V_{NC} = 2 \text{ V}$ , 0.8 V,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                      | 25°C<br>Full | 2.3 V | 0.04 | 0.15 | 0.15  | $\Omega$      |
| ON-state resistance flatness                           | $r_{on(flat)}$    | $0 \leq V_{NC} \leq V_+$ ,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                           | 25°C<br>Full | 2.3 V | 0.7  | 0.4  | 0.6   | $\Omega$      |
| NC OFF leakage current                                 | $I_{NC(OFF)}$     | $V_{NC} = 1 \text{ V}$ ,<br>$V_{COM} = 3 \text{ V}$ ,<br>or<br>$V_{NC} = 3 \text{ V}$ ,<br>$V_{COM} = 1 \text{ V}$ ,<br>Switch OFF,<br>See Figure 14 | 25°C<br>Full | 2.7 V | -5   | 0.3  | 5     | nA            |
|                                                        | $I_{NC(PWROFF)}$  | $V_{NC} = 0 \text{ to } 3.6 \text{ V}$ ,<br>$V_{COM} = 3.6 \text{ V to } 0$ ,<br>Switch OFF,<br>See Figure 14                                        | 25°C<br>Full | 0 V   | -2   | 0.05 | 2     | $\mu\text{A}$ |
| COM OFF leakage current                                | $I_{COM(OFF)}$    | $V_{COM} = 1 \text{ V}$ ,<br>$V_{NC} = 3 \text{ V}$ ,<br>or<br>$V_{COM} = 3 \text{ V}$ ,<br>$V_{NC} = 1 \text{ V}$ ,<br>Switch OFF,<br>See Figure 14 | 25°C<br>Full | 2.7 V | -5   | 0.3  | 5     | nA            |
|                                                        | $I_{COM(PWROFF)}$ | $V_{COM} = 0 \text{ to } 3.6 \text{ V}$ ,<br>$V_{NC} = 3.6 \text{ V to } 0$ ,<br>Switch OFF,<br>See Figure 14                                        | 25°C<br>Full | 0 V   | -2   | 0.05 | 2     | $\mu\text{A}$ |
| NC ON leakage current                                  | $I_{NC(ON)}$      | $V_{NC} = 1 \text{ V}$ ,<br>$V_{COM} = \text{Open}$ ,<br>or<br>$V_{NC} = 3 \text{ V}$ ,<br>$V_{COM} = \text{Open}$ ,<br>Switch ON,<br>See Figure 15  | 25°C<br>Full | 2.7 V | -2   | 0.3  | 2     | nA            |
| COM ON leakage current                                 | $I_{COM(ON)}$     | $V_{COM} = 1 \text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>or<br>$V_{COM} = 3 \text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>Switch ON,<br>See Figure 15  | 25°C<br>Full | 2.7 V | -2   | 0.3  | 2     | nA            |
| <b>Digital Control Inputs (IN1, IN2)<sup>(2)</sup></b> |                   |                                                                                                                                                      |              |       |      |      |       |               |
| Input logic high                                       | $V_{IH}$          |                                                                                                                                                      | Full         |       | 1.8  |      | 5.5   | V             |
| Input logic low                                        | $V_{IL}$          |                                                                                                                                                      | Full         |       | 0    |      | 0.6   | V             |
| Input leakage current                                  | $I_{IH}, I_{IL}$  | $V_I = 5.5 \text{ V or } 0$                                                                                                                          | 25°C         | 2.7 V | -2   | 0.3  | 2     | nA            |
|                                                        |                   |                                                                                                                                                      | Full         |       | -20  |      | 20    |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## 6.10 Electrical Characteristics for 2.5-V Supply<sup>(1)</sup> (continued)

 $V_+ = 2.3 \text{ V to } 2.7 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                    | SYMBOL         | TEST CONDITIONS                                                                                              | $T_A$ | $V_+$             | MIN | TYP   | MAX  | UNIT          |
|------------------------------|----------------|--------------------------------------------------------------------------------------------------------------|-------|-------------------|-----|-------|------|---------------|
| <b>Dynamic</b>               |                |                                                                                                              |       |                   |     |       |      |               |
| Turn-on time                 | $t_{ON}$       | $V_{COM} = V_+$ ,<br>$R_L = 50 \Omega$ ,<br>$C_L = 35 \text{ pF}$ ,<br>See Figure 17                         | 25°C  | 2.5 V             | 2   | 6     | 10   | ns            |
|                              |                |                                                                                                              | Full  | 2.3 V to<br>2.7 V | 1   |       | 12   |               |
| Turn-off time                | $t_{OFF}$      | $V_{COM} = V_+$ ,<br>$R_L = 50 \Omega$ ,<br>$C_L = 35 \text{ pF}$ ,<br>See Figure 17                         | 25°C  | 2.5 V             | 4.5 | 8     | 12.5 | ns            |
|                              |                |                                                                                                              | Full  | 2.3 V to<br>2.7 V | 3   |       | 15   |               |
| Charge injection             | $Q_C$          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,<br>$C_L = 1 \text{ nF}$ ,<br>See Figure 21                                | 25°C  | 2.5 V             |     | 4     |      | pC            |
| NC<br>OFF capacitance        | $C_{NC(OFF)}$  | $V_{NC} = V_+$ or GND,<br>Switch OFF,<br>See Figure 16                                                       | 25°C  | 2.5 V             |     | 19.5  |      | pF            |
| COM<br>OFF capacitance       | $C_{COM(OFF)}$ | $V_{COM} = V_+$ or GND,<br>Switch OFF,<br>See Figure 16                                                      | 25°C  | 2.5 V             |     | 18.5  |      | pF            |
| NC<br>ON capacitance         | $C_{NC(ON)}$   | $V_{NC} = V_+$ or GND,<br>Switch ON,<br>See Figure 16                                                        | 25°C  | 2.5 V             |     | 36.5  |      | pF            |
| COM<br>ON capacitance        | $C_{COM(ON)}$  | $V_{COM} = V_+$ or GND,<br>Switch ON,<br>See Figure 16                                                       | 25°C  | 2.5 V             |     | 36.5  |      | pF            |
| Digital input<br>capacitance | $C_I$          | $V_I = V_+$ or GND,<br>See Figure 16                                                                         | 25°C  | 2.5 V             |     | 2     |      | pF            |
| Bandwidth                    | BW             | $R_L = 50 \Omega$ ,<br>Switch ON,<br>See Figure 18                                                           | 25°C  | 2.5 V             |     | 150   |      | MHz           |
| OFF isolation                | $O_{ISO}$      | $R_L = 50 \Omega$ ,<br>$f = 1 \text{ MHz}$ ,<br>Switch OFF,<br>See Figure 19                                 | 25°C  | 2.5 V             |     | –62   |      | dB            |
| Crosstalk                    | $X_{TALK}$     | $R_L = 50 \Omega$ ,<br>$f = 1 \text{ MHz}$ ,<br>Switch ON,<br>See Figure 20                                  | 25°C  | 3.3 V             |     | –85   |      | dB            |
| Total harmonic<br>distortion | THD            | $R_L = 600 \Omega$ ,<br>$C_L = 50 \text{ pF}$ ,<br>$f = 20 \text{ Hz to } 20 \text{ kHz}$ ,<br>See Figure 22 | 25°C  | 2.5 V             |     | 0.02  |      | %             |
| <b>Supply</b>                |                |                                                                                                              |       |                   |     |       |      |               |
| Positive supply<br>current   | $I_+$          | $V_I = V_+$ or GND,<br>Switch ON or OFF                                                                      | 25°C  | 2.7 V             |     | 0.001 | 0.02 | $\mu\text{A}$ |
|                              |                |                                                                                                              | Full  |                   |     |       | 0.25 |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

## 6.11 Electrical Characteristics for 1.8-V Supply<sup>(1)</sup>

 $V_+ = 1.65 \text{ V to } 1.95 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted))

| PARAMETER                                              | SYMBOL            | TEST CONDITIONS                                                                                                                                      | $T_A$        | $V_+$  | MIN  | TYP | MAX   | UNIT          |
|--------------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|------|-----|-------|---------------|
| <b>Analog Switch</b>                                   |                   |                                                                                                                                                      |              |        |      |     |       |               |
| Analog signal range                                    | $V_{COM}, V_{NC}$ |                                                                                                                                                      |              |        | 0    |     | $V_+$ | V             |
| Peak ON resistance                                     | $r_{peak}$        | $0 \leq V_{NC} \leq V_+$ ,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                           | 25°C<br>Full | 1.65 V | 4.2  |     | 25    | $\Omega$      |
| ON-state resistance                                    | $r_{on}$          | $V_{NC} = 2 \text{ V}$ ,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                             | 25°C<br>Full | 1.65 V | 1.6  |     | 3.9   | $\Omega$      |
| ON-state resistance match between channels             | $\Delta r_{on}$   | $V_{NC} = 2 \text{ V}$ , 0.8 V,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                      | 25°C<br>Full | 1.65 V | 0.04 |     | 0.2   | $\Omega$      |
| ON-state resistance flatness                           | $r_{on(flat)}$    | $0 \leq V_{NC} \leq V_+$ ,<br>$I_{COM} = -100 \text{ mA}$ ,<br>Switch ON,<br>See Figure 13                                                           | 25°C<br>Full | 1.65 V | 2.8  |     |       | $\Omega$      |
| NC OFF leakage current                                 | $I_{NC(OFF)}$     | $V_{NC} = 1 \text{ V}$ ,<br>$V_{COM} = 3 \text{ V}$ ,<br>or<br>$V_{NC} = 3 \text{ V}$ ,<br>$V_{COM} = 1 \text{ V}$ ,<br>Switch OFF,<br>See Figure 14 | 25°C<br>Full | 1.95 V | -5   |     | 5     | nA            |
|                                                        | $I_{NC(PWROFF)}$  | $V_{NC} = 0 \text{ to } 3.6 \text{ V}$ ,<br>$V_{COM} = 3.6 \text{ V to } 0$ ,<br>Switch OFF,<br>See Figure 14                                        | 25°C<br>Full | 0 V    | -2   |     | 2     | $\mu\text{A}$ |
| COM OFF leakage current                                | $I_{COM(OFF)}$    | $V_{COM} = 1 \text{ V}$ ,<br>$V_{NC} = 3 \text{ V}$ ,<br>or<br>$V_{COM} = 3 \text{ V}$ ,<br>$V_{NC} = 1 \text{ V}$ ,<br>Switch OFF,<br>See Figure 14 | 25°C<br>Full | 1.95 V | -5   |     | 5     | nA            |
|                                                        | $I_{COM(PWROFF)}$ | $V_{COM} = 0 \text{ to } 3.6 \text{ V}$ ,<br>$V_{NC} = 3.6 \text{ V to } 0$ ,<br>Switch OFF,<br>See Figure 14                                        | 25°C<br>Full | 0 V    | -2   |     | 2     | $\mu\text{A}$ |
| NC ON leakage current                                  | $I_{NC(ON)}$      | $V_{NC} = 1 \text{ V}$ ,<br>$V_{COM} = \text{Open}$ ,<br>or<br>$V_{NC} = 3 \text{ V}$ ,<br>$V_{COM} = \text{Open}$ ,<br>Switch ON,<br>See Figure 15  | 25°C<br>Full | 1.95 V | -2   |     | 2     | nA            |
| COM ON leakage current                                 | $I_{COM(ON)}$     | $V_{COM} = 1 \text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>or<br>$V_{COM} = 3 \text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>Switch ON,<br>See Figure 15  | 25°C<br>Full | 1.95 V | -2   |     | 2     | nA            |
| <b>Digital Control Inputs (IN1, IN2)<sup>(2)</sup></b> |                   |                                                                                                                                                      |              |        |      |     |       |               |
| Input logic high                                       | $V_{IH}$          |                                                                                                                                                      | Full         |        | 1.5  |     | 5.5   | V             |
| Input logic low                                        | $V_{IL}$          |                                                                                                                                                      | Full         |        | 0    |     | 0.6   | V             |
| Input leakage current                                  | $I_{IH}, I_{IL}$  | $V_I = 5.5 \text{ V or } 0$                                                                                                                          | 25°C         | 1.95 V | -2   | 0.3 | 2     | nA            |
|                                                        |                   |                                                                                                                                                      | Full         |        | -20  |     | 20    |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## 6.12 Electrical Characteristics for 1.8-V Supply<sup>(1)</sup> (continued)

 $V_+ = 1.65 \text{ V to } 1.95 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                    | SYMBOL         | TEST CONDITIONS                                                                                            | $T_A$ | $V_+$               | MIN       | TYP       | MAX  | UNIT          |
|------------------------------|----------------|------------------------------------------------------------------------------------------------------------|-------|---------------------|-----------|-----------|------|---------------|
| <b>Dynamic</b>               |                |                                                                                                            |       |                     |           |           |      |               |
| Turn-on time                 | $t_{ON}$       | $V_{COM} = V_+$ ,<br>$R_L = 50 \Omega$ ,<br>$C_L = 35 \text{ pF}$ ,<br>See Figure 17                       | 25°C  | 1.8 V               | 3         | 9         | 18   | ns            |
|                              |                |                                                                                                            | Full  | 1.65 V to<br>1.95 V | 1         |           | 20   |               |
| Turn-off time                | $t_{OFF}$      | $V_{COM} = V_+$ ,<br>$R_L = 50 \Omega$ ,<br>$C_L = 35 \text{ pF}$ ,<br>See Figure 17                       | 25°C  | 1.8 V               | 5         | 10        | 15.5 | ns            |
|                              |                |                                                                                                            | Full  | 1.65 V to<br>1.95 V | 4         |           | 18.5 |               |
| Charge injection             | $Q_C$          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,<br>$C_L = 1 \text{ nF}$ ,<br>See Figure 21                              | 25°C  | 1.8 V               |           | 2         |      | pC            |
| NC<br>OFF capacitance        | $C_{NC(OFF)}$  | $V_{NC} = V_+$ or GND,<br>Switch OFF,<br>See Figure 16                                                     | 25°C  | 1.8 V               |           | 19.5      |      | pF            |
| COM<br>OFF capacitance       | $C_{COM(OFF)}$ | $V_{COM} = V_+$ or GND,<br>Switch OFF,<br>See Figure 16                                                    | 25°C  | 1.8 V               |           | 18.5      |      | pF            |
| NC<br>ON capacitance         | $C_{NC(ON)}$   | $V_{NC} = V_+$ or GND,<br>Switch ON,<br>See Figure 16                                                      | 25°C  | 1.8 V               |           | 36.5      |      | pF            |
| COM<br>ON capacitance        | $C_{COM(ON)}$  | $V_{COM} = V_+$ or GND,<br>Switch ON,<br>See Figure 16                                                     | 25°C  | 1.8 V               |           | 36.5      |      | pF            |
| Digital input<br>capacitance | $C_I$          | $V_I = V_+$ or GND,<br>See Figure 16                                                                       | 25°C  | 1.8 V               |           | 2         |      | pF            |
| Bandwidth                    | BW             | $R_L = 50 \Omega$ ,<br>Switch ON,<br>See Figure 18                                                         | 25°C  | 1.8 V               |           | 150       |      | MHz           |
| OFF isolation                | $O_{ISO}$      | $R_L = 50 \Omega$ ,<br>$f = 1 \text{ MHz}$ ,<br>Switch OFF,<br>See Figure 19                               | 25°C  | 1.8 V               |           | –62       |      | dB            |
| Crosstalk                    | $X_{TALK}$     | $R_L = 50 \Omega$ ,<br>$f = 1 \text{ MHz}$ ,<br>Switch ON,<br>See Figure 20                                | 25°C  | 1.8 V               |           | –85       |      | dB            |
| Total harmonic<br>distortion | THD            | $R_L = 600 \Omega$ ,<br>$C_L = 50 \text{ pF}$ ,<br>$f = 20 \text{ Hz to } 20 \text{ kHz}$<br>See Figure 22 | 25°C  | 1.8 V               |           | 0.05<br>5 |      | %             |
| <b>Supply</b>                |                |                                                                                                            |       |                     |           |           |      |               |
| Positive supply<br>current   | $I_+$          | $V_I = V_+$ or GND,<br>Switch ON or OFF                                                                    | 25°C  | 1.95 V              | 0.00<br>1 | 0.01      |      | $\mu\text{A}$ |
|                              |                |                                                                                                            | Full  |                     |           | 0.15      |      |               |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

## 6.13 Typical Characteristics

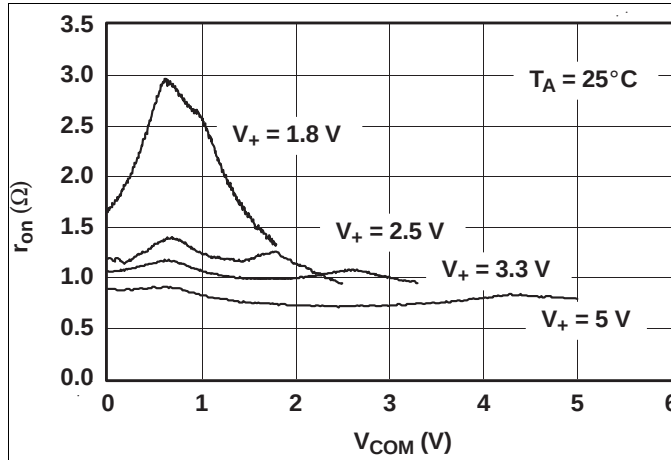


Figure 1.  $r_{on}$  vs  $V_{COM}$

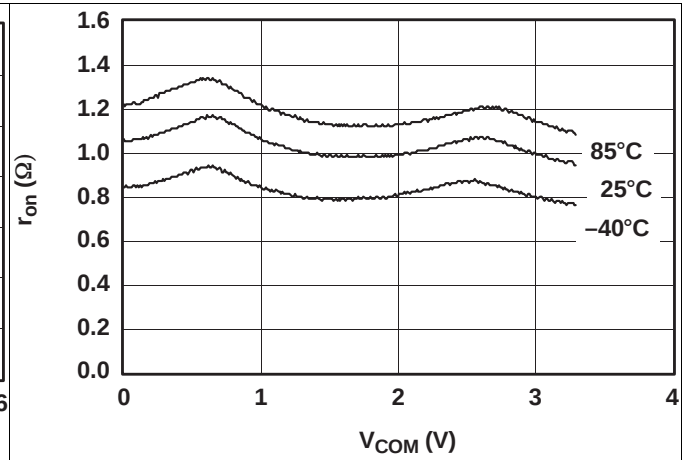


Figure 2.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 3.3$  V)

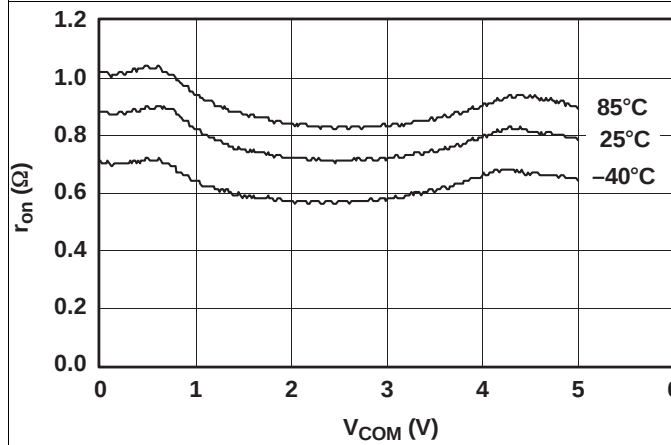


Figure 3.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 5$  V)

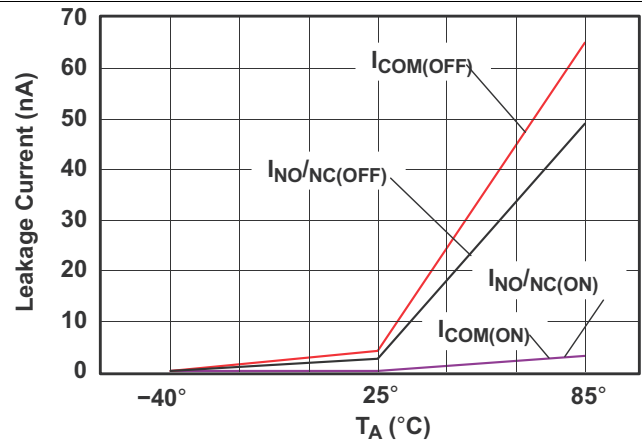


Figure 4. Leakage Current vs Temperature ( $V_+ = 5.5$  V)

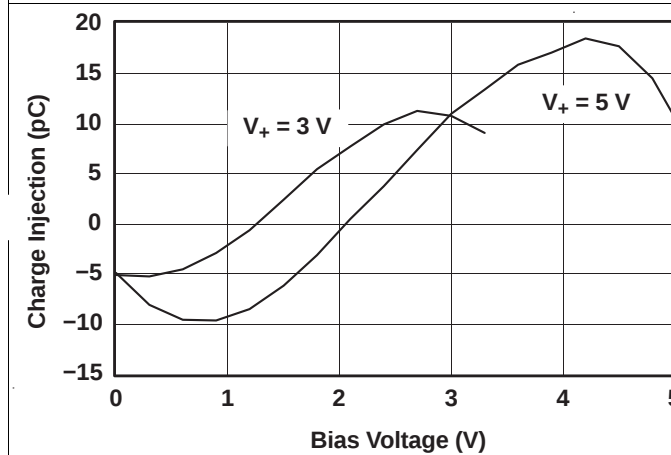


Figure 5. Charge Injection ( $Q_C$ ) vs  $V_{COM}$

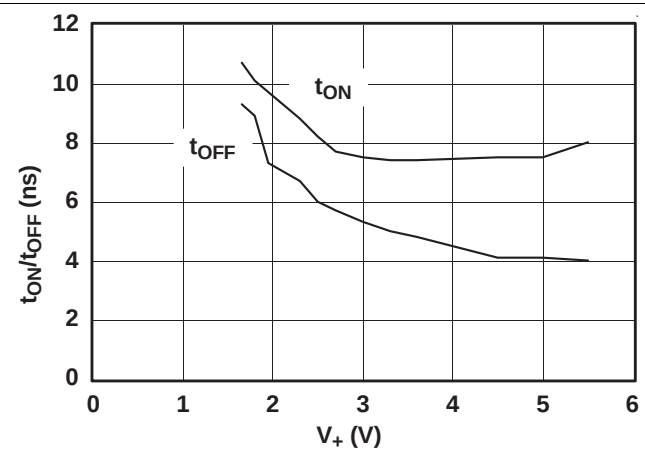


Figure 6.  $t_{ON}$  and  $t_{OFF}$  vs Supply Voltage

## Typical Characteristics (continued)

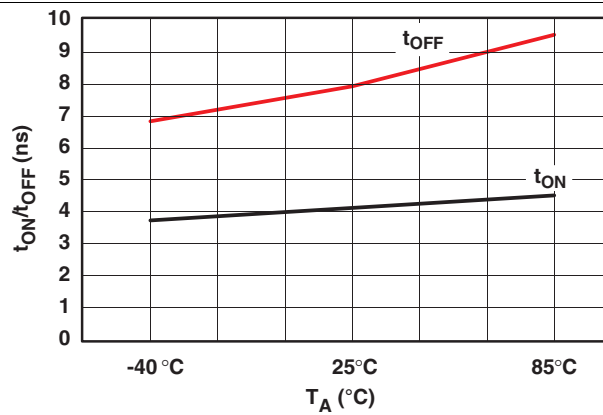


Figure 7. t<sub>ON</sub> and t<sub>OFF</sub> vs Temperature (V<sub>+</sub> = 5 V)

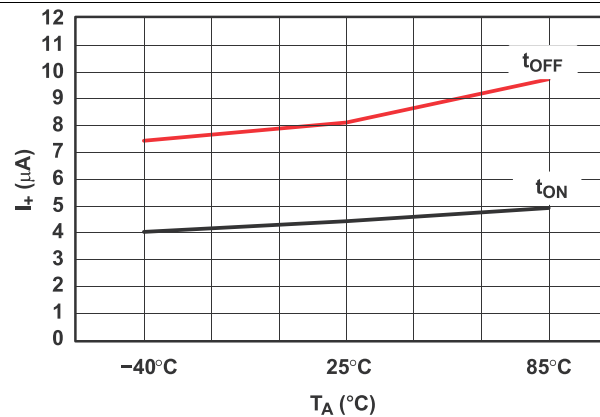


Figure 8. t<sub>ON</sub> and t<sub>OFF</sub> vs Temperature (V<sub>+</sub> = 5 V)

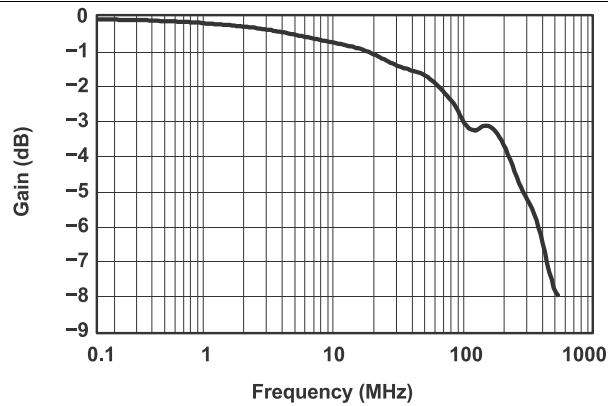


Figure 9. Bandwidth (V<sub>+</sub> = 5 V)

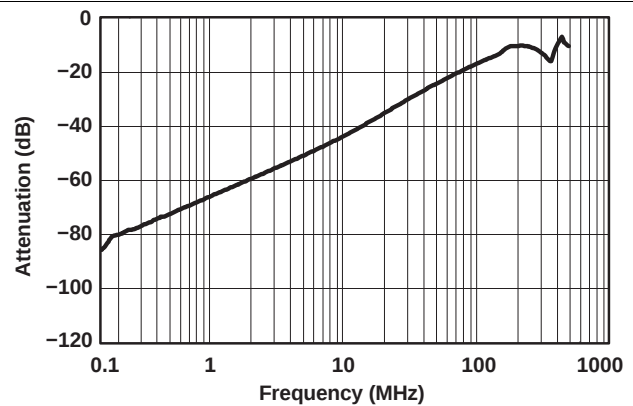


Figure 10. OFF Isolation and Crosstalk (V<sub>+</sub> = 5 V)

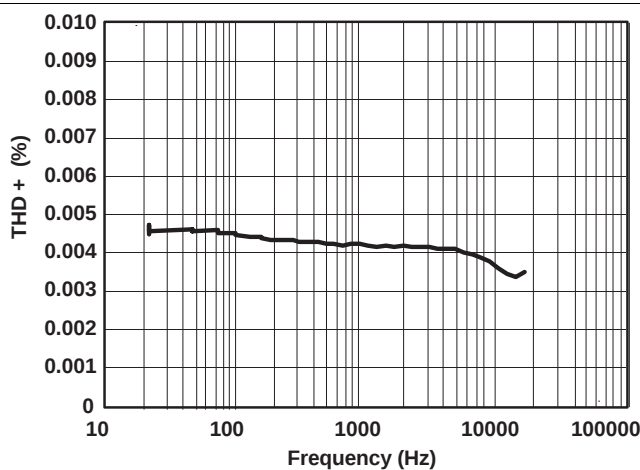


Figure 11. Total Harmonic Distortion vs Frequency

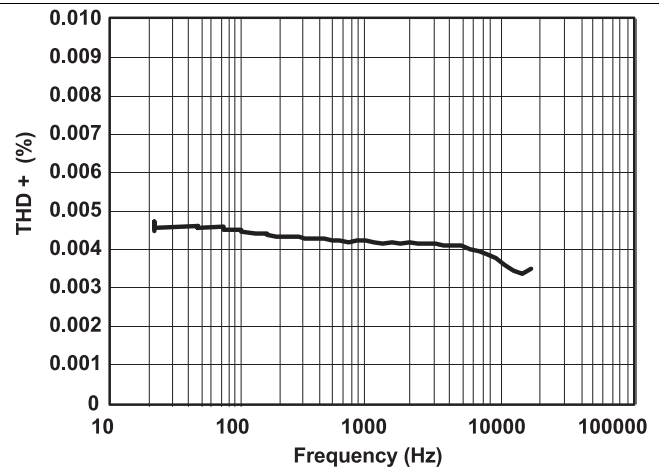


Figure 12. Total Harmonic Distortion vs Frequency (V<sub>+</sub> = 5 V)

## Typical Characteristics (continued)

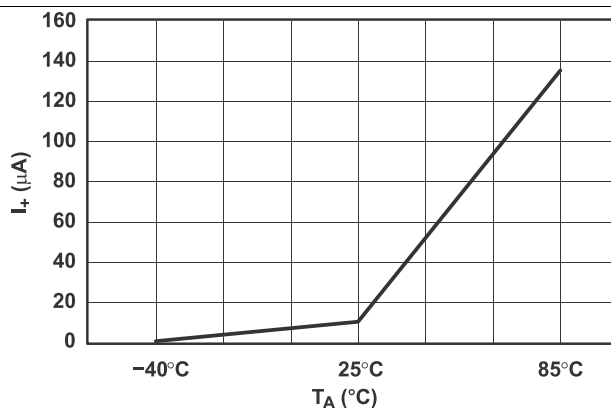


Figure 13. Power-Supply Current vs Temperature ( $V_+ = 5\text{ V}$ )

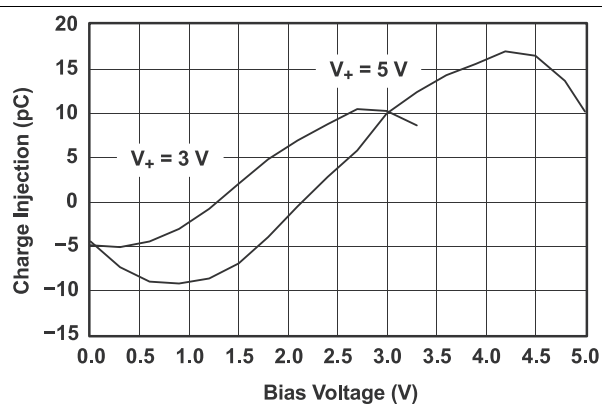


Figure 14. Charge Injection ( $Q_C$ ) vs  $V_{COM}$

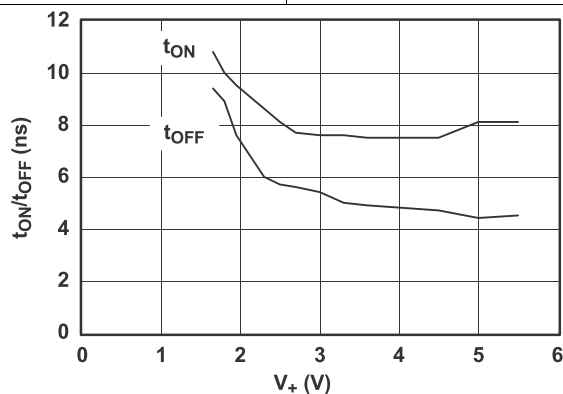


Figure 15.  $t_{ON}$  and  $t_{OFF}$  vs Supply Voltage

## 7 Parameter Measurement Information

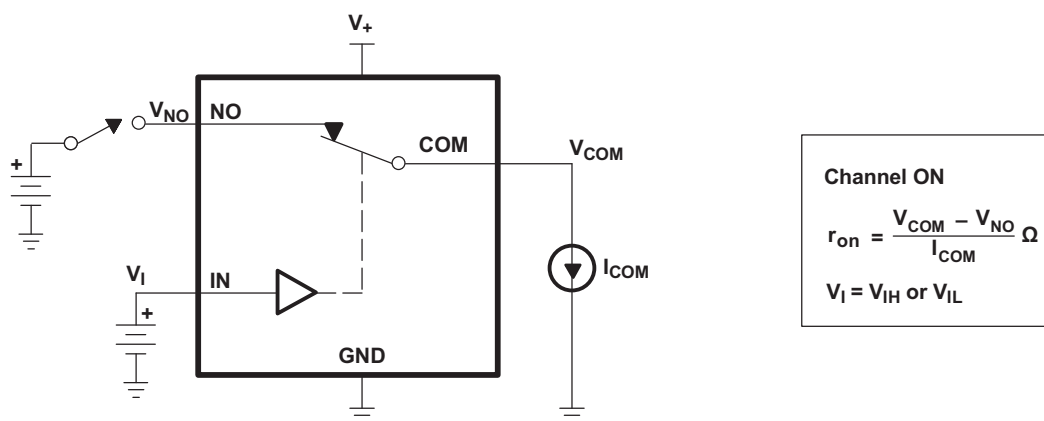
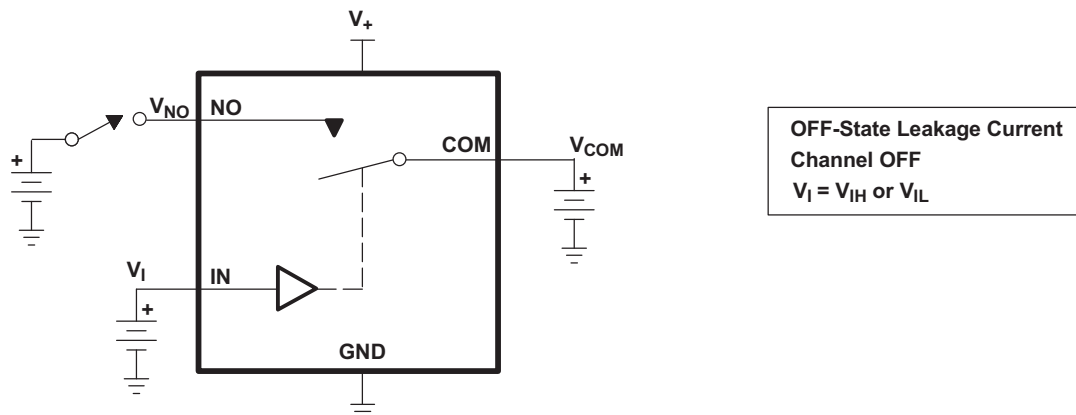
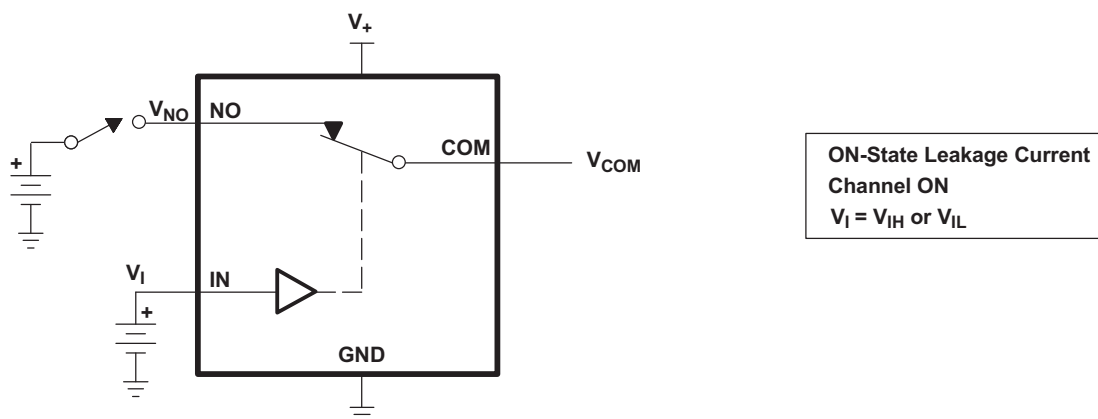


Figure 16. ON-State Resistance ( $r_{on}$ )

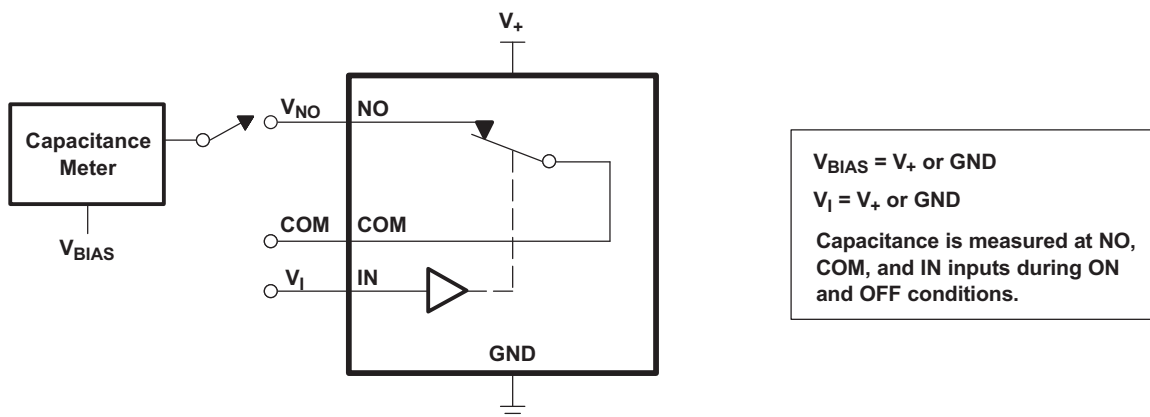
## Parameter Measurement Information (continued)



**Figure 17. OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NC(OFF)}$ ,  $I_{COM(PWROFF)}$ ,  $I_{NC(PWROFF)}$ )**

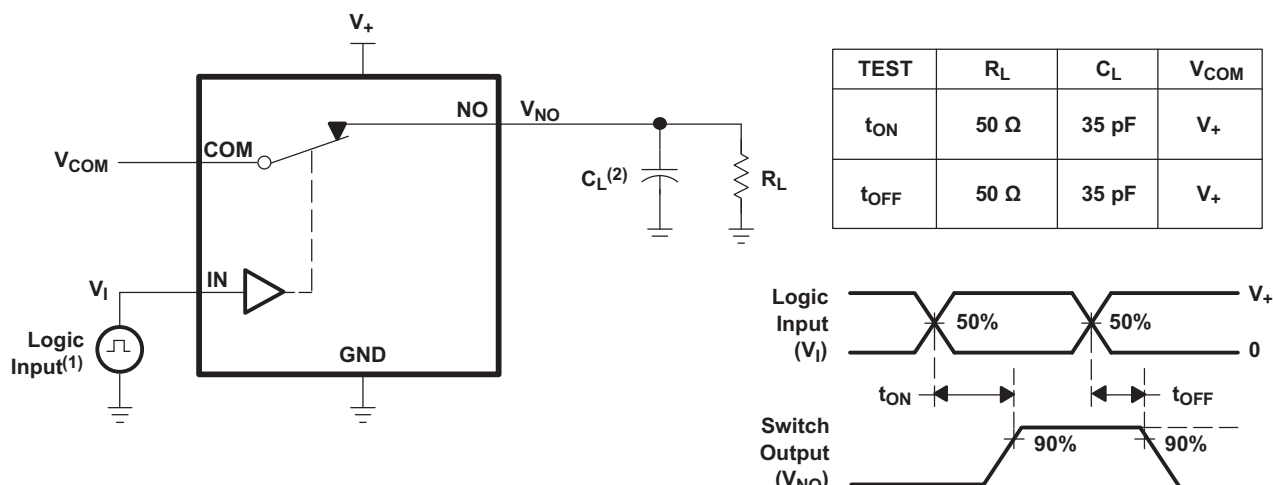


**Figure 18. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ )**



**Figure 19. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NC(ON)}$ )**

## Parameter Measurement Information (continued)



- (1) All input pulses are supplied by generators having the following characteristics:  
PRR  $\leq$  10 MHz,  $Z_O = 50 \Omega$ ,  $t_r < 5$  ns,  $t_f < 5$  ns.
- (2)  $C_L$  includes probe and jig capacitance.

Figure 20. Turnon ( $t_{ON}$ ) and Turnoff Time ( $t_{OFF}$ )

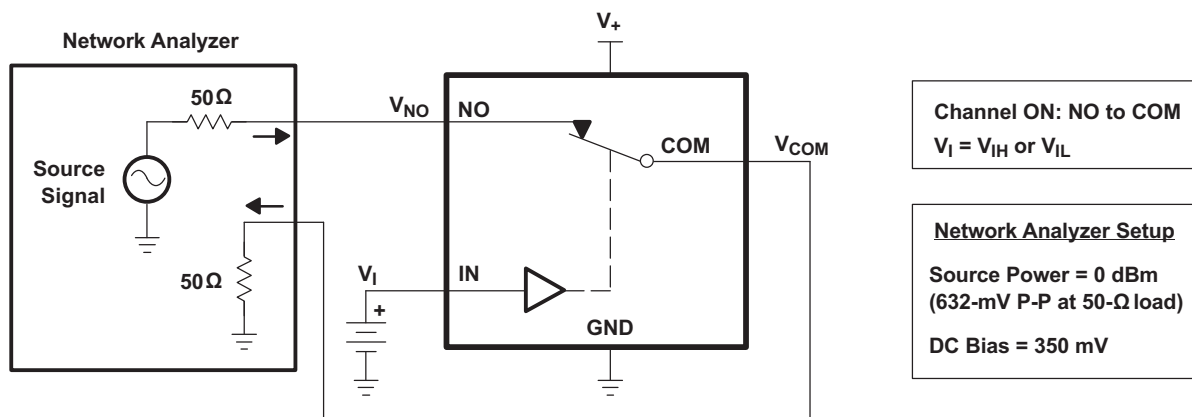


Figure 21. Bandwidth (BW)

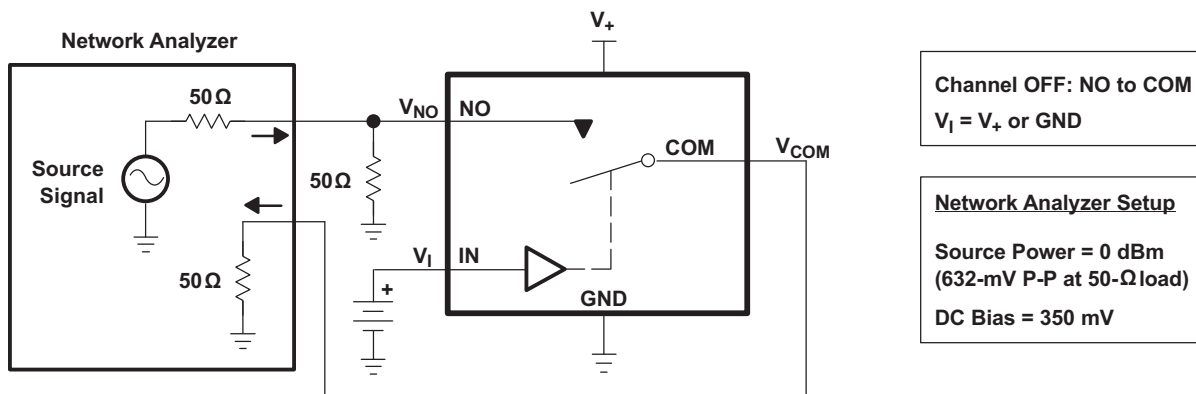
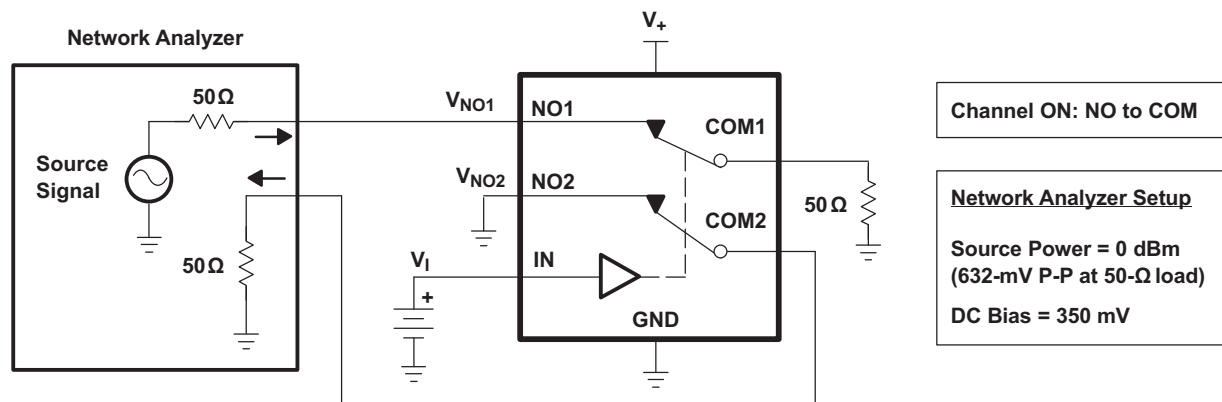
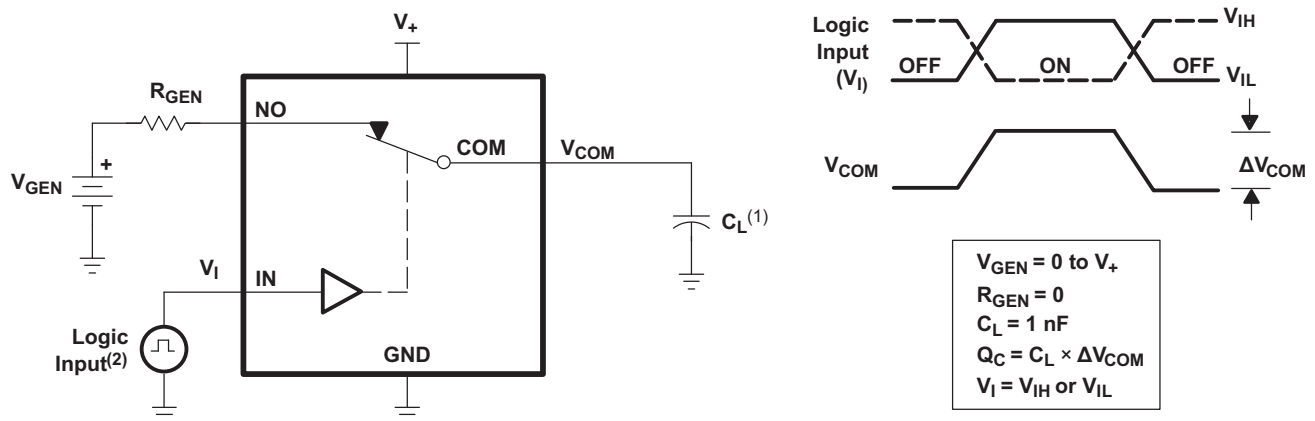


Figure 22. OFF Isolation ( $O_{ISO}$ )

## Parameter Measurement Information (continued)

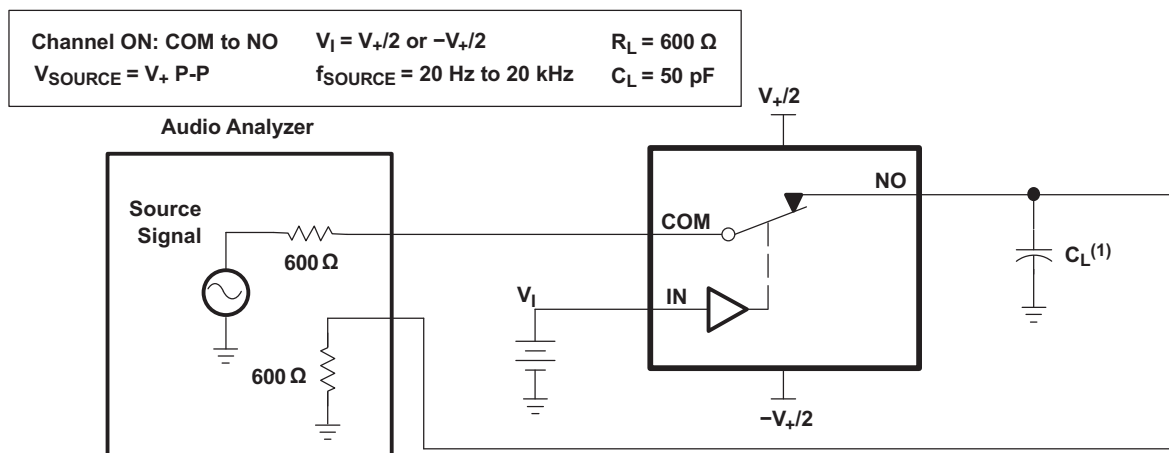


**Figure 23. Crosstalk ( $X_{TALK}$ )**



- (1)  $C_L$  includes probe and jig capacitance.
- (2) All input pulses are supplied by generators having the following characteristics:  
 PRR  $\leq$  10 MHz,  $Z_O = 50 \Omega$ ,  $t_r < 5$  ns,  $t_f < 5$  ns.

**Figure 24. Charge Injection ( $Q_C$ )**



- (1)  $C_L$  includes probe and jig capacitance.

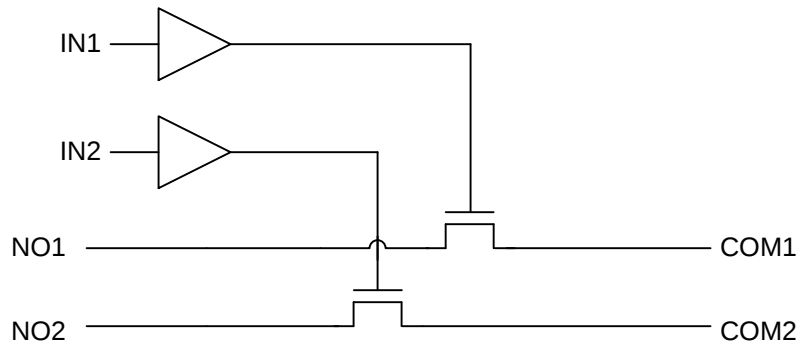
**Figure 25. Total Harmonic Distortion (THD)**

## 8 Detailed Description

### 8.1 Overview

The TS5A23167 is a dual single-pole single-throw (SPST) analog switch that is designed to operate from 1.65 V to 5.5 V. The device offers a low ON-state resistance. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications. [表 2](#) shows the descriptions of each parameter specified in the datasheet.

### 8.2 Functional Block Diagram



### 8.3 Feature Description

Tolerant control inputs allow 5-V logic levels to be present on the IN pin at any value of  $V_{CC}$ . Low ON-resistance allows minimal signal distortion through device.

### 8.4 Device Functional Modes

[Table 1](#) shows the functional modes for TS5A23167.

**Table 1. Function Table**

| IN | NO TO COM,<br>COM TO NO |
|----|-------------------------|
| L  | OFF                     |
| H  | ON                      |

## 9 Application and Implementation

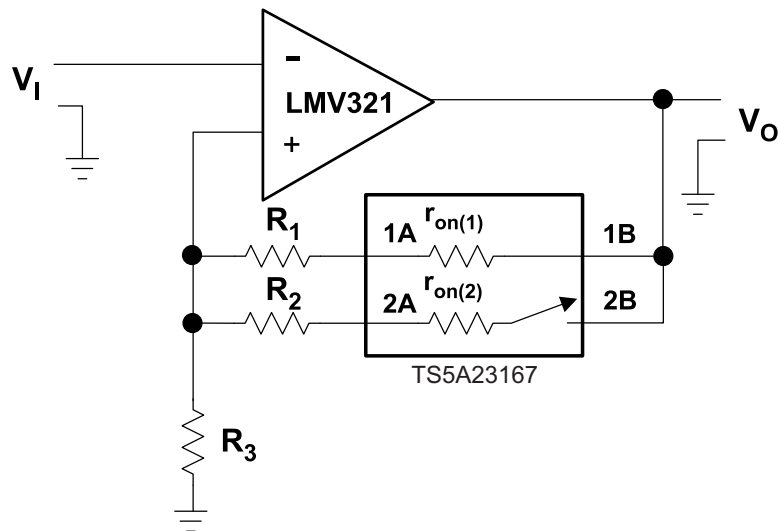
### NOTE

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.

### 9.1 Application Information

The TS5A23167 dual SPST analog switch is a basic component that could be used in any electrical system design. One example application is a gain selector, which is described in the [Typical Application](#) section.

### 9.2 Typical Application



**Figure 26. Gain-Control Circuit for OP Amplifier**

#### 9.2.1 Design Requirements

By selecting values of R1 and R2, such that  $R_x \gg r_{on(x)}$ ,  $r_{on}$  of TS5A23167 can be ignored. The gain of op amp can be calculated as follow:

$$V_o / V_i = 1 + R_{||} / R_3 \quad (1)$$

$$R_{||} = (R_1 + r_{on(1)}) || (R_2 + r_{on(2)}) \quad (2)$$

#### 9.2.2 Detailed Design Procedure

Place a switch in series with the input of the op amp. Because the op amp input impedance is very large, a switch on  $r_{on(1)}$  is irrelevant.

## Typical Application (continued)

### 9.2.3 Application Curve

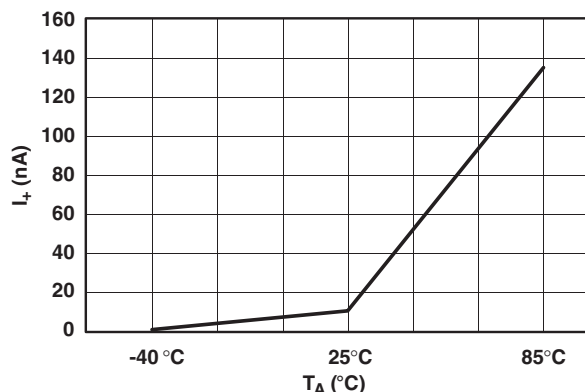


Figure 27. Power-Supply Current vs Temperature ( $V_+ = 5\text{ V}$ )

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#).

Each  $V_{CC}$  terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1- $\mu\text{F}$  bypass capacitor is recommended. If there are multiple pins labeled  $V_{CC}$ , then a 0.01- $\mu\text{F}$  or 0.022- $\mu\text{F}$  capacitor is recommended for each  $V_{CC}$  because the  $V_{CC}$  pins will be tied together internally. For devices with dual supply pins operating at different voltages, for example  $V_{CC}$  and  $V_{DD}$ , a 0.1- $\mu\text{F}$  bypass capacitor is recommended for each supply pin. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1- $\mu\text{F}$  and 1- $\mu\text{F}$  capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

## 11 Layout

### 11.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. [Figure 28](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

### 11.2 Layout Example

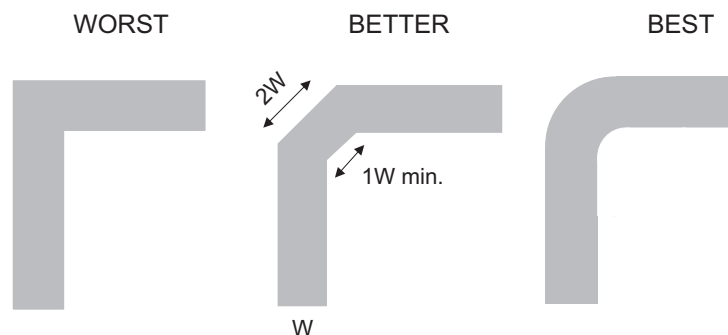


Figure 28. Trace Example

## 12 デバイスおよびドキュメントのサポート

### 12.1 デバイス・サポート

#### 12.1.1 デバイスの項目表記

**表 2. パラメータの説明**

| 記号                | 説明                                                                                                                                                                                              |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{COM}$         | COM電圧                                                                                                                                                                                           |
| $V_{NC}$          | NC電圧                                                                                                                                                                                            |
| $r_{on}$          | チャンネルがオンのときの COM と NC ポート間の抵抗                                                                                                                                                                   |
| $r_{peak}$        | 規定電圧範囲内でのピーク・オン抵抗                                                                                                                                                                               |
| $r_{on\Delta}$    | 特定デバイスでのチャンネル間の $r_{on}$ の差                                                                                                                                                                     |
| $r_{on(flat)}$    | 規定の条件の範囲における、チャンネルの $r_{on}$ の最大値と最小値との差                                                                                                                                                        |
| $I_{NC(OFF)}$     | 対応チャンネル(NCからCOM)がオフ状態のとき、NCポートで測定されるリーク電流、ワーストケースの入力および出力条件                                                                                                                                     |
| $I_{NC(PWROFF)}$  | パワーダウン状況、 $V_+ = 0$ で、NCポートで測定されるリーク電流                                                                                                                                                          |
| $I_{COM(OFF)}$    | ワーストケースの入力および出力条件で、対応チャンネル (COM から NC) がオフ状態のとき、COM ポートで測定されるリーク電流                                                                                                                              |
| $I_{COM(PWROFF)}$ | パワーダウン状況、 $V_+ = 0$ のとき、COMポートで測定されるリーク電流                                                                                                                                                       |
| $I_{NC(ON)}$      | 対応チャンネル(NCからCOM)がオン状態、出力(COM)がオープンのとき、NCポートで測定されるリーク電流                                                                                                                                          |
| $I_{COM(ON)}$     | 対応チャンネル (COM から NC) がオン状態、出力 (NC) がオープンのとき、COM ポートで測定されるリーク電流                                                                                                                                   |
| $V_{IH}$          | 制御入力(IN)の論理HIGHの最小入力電圧                                                                                                                                                                          |
| $V_{IL}$          | 制御入力(IN)の論理LOWの最大入力電圧                                                                                                                                                                           |
| $V_I$             | 制御入力(IN)の電圧                                                                                                                                                                                     |
| $I_{IH}, I_{IL}$  | 制御入力(IN)で測定されるリーク電流                                                                                                                                                                             |
| $t_{ON}$          | スイッチのターンオン時間。このパラメータは、規定された条件の範囲で、スイッチがオンになるときのデジタル制御(IN)信号とアナログ出力(COM、NC)信号との間の伝搬遅延により測定されます。                                                                                                  |
| $t_{OFF}$         | スイッチのターンオフ時間。このパラメータは、規定された条件の範囲で、スイッチがオフになるときのデジタル制御(IN)信号とアナログ出力(COM、NC)信号との間の伝搬遅延により測定されます。                                                                                                  |
| $Q_C$             | 電荷注入は、制御(IN)入力からアナログ(NC、COM)出力への、望ましくない信号のカップリングの測定値です。この値はクーロン(C)単位で、制御入力のスイッチングによって誘導される合計電荷により測定されます。電荷注入 $Q_C = C_L \times \Delta V_{COM}$ で、 $C_L$ は負荷容量、 $\Delta V_{COM}$ はアナログ出力電圧の変化です。 |
| $C_{NC(OFF)}$     | 対応チャンネル(NCからCOM)がオフのときのNCポートの容量                                                                                                                                                                 |
| $C_{COM(OFF)}$    | 対応チャンネル(COMからNC)がオフのときのCOMポートの容量                                                                                                                                                                |
| $C_{NC(ON)}$      | 対応チャンネル(NCからCOM)がオンのときのNCポートの容量                                                                                                                                                                 |
| $C_{COM(ON)}$     | 対応チャンネル(COMからNC)がオンのときのCOMポートの容量                                                                                                                                                                |
| $C_I$             | 制御入力(IN)の容量                                                                                                                                                                                     |
| $O_{ISO}$         | スイッチのオフ絶縁は、オフ状態のスイッチのインピーダンス測定値です。これは、対応チャンネル(NCからCOM)がオフ状態のとき、特定の周波数についてdB単位で測定されます。                                                                                                           |
| $X_{TALK}$        | クロストークは、オンのチャンネルから隣接するオンのチャンネルへ (NC1 から NC2 へ) の、望ましくない信号カップリングの測定値です。この値は、特定の周波数について、dB単位で測定されます。                                                                                              |
| BW                | スイッチの帯域幅。オン状態のチャンネルのゲインがDCゲインより-3dB低くなる周波数です。                                                                                                                                                   |
| THD               | 全高調波歪は、アナログ・スイッチにより発生する信号の歪みを示します。この値は、2次、3次、およびさらに高次の高調波の二乗平均(RMS)値と、基本波の絶対振幅との比として定義されます。                                                                                                     |
| $I_+$             | 制御(IN)ピンが $V_+$ またはGNDであるときの静的消費電流                                                                                                                                                              |

## 12.2 ドキュメントの更新通知を受け取る方法

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

## 12.3 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

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

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

## 12.4 商標

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

## 12.5 静電気放電に関する注意事項



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

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

## 12.6 Glossary

**SLYZ022** — *TI Glossary*.

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

## 13 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<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TS5A23167DCUR</a>   | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (JAPQ, JAPR)        |
| TS5A23167DCUR.B                 | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (JAPQ, JAPR)        |
| <a href="#">TS5A23167DCURG4</a> | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | JAPR                |
| TS5A23167DCURG4.B               | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | JAPR                |
| <a href="#">TS5A23167YZPR</a>   | Active        | Production           | DSBGA (YZP)   8 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    | J8N                 |
| TS5A23167YZPR.B                 | Active        | Production           | DSBGA (YZP)   8 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    | J8N                 |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **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.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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

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## TAPE AND REEL INFORMATION



\*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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TS5A23167DCUR   | VSSOP        | DCU             | 8    | 3000 | 180.0              | 8.4                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| TS5A23167DCUR   | VSSOP        | DCU             | 8    | 3000 | 178.0              | 9.5                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| TS5A23167DCURG4 | VSSOP        | DCU             | 8    | 3000 | 180.0              | 8.4                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| TS5A23167YZPR   | DSBGA        | YZP             | 8    | 3000 | 178.0              | 9.2                | 1.02    | 2.02    | 0.63    | 4.0     | 8.0    | Q1            |

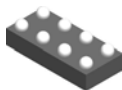
## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TS5A23167DCUR   | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| TS5A23167DCUR   | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| TS5A23167DCURG4 | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| TS5A23167YZPR   | DSBGA        | YZP             | 8    | 3000 | 220.0       | 220.0      | 35.0        |

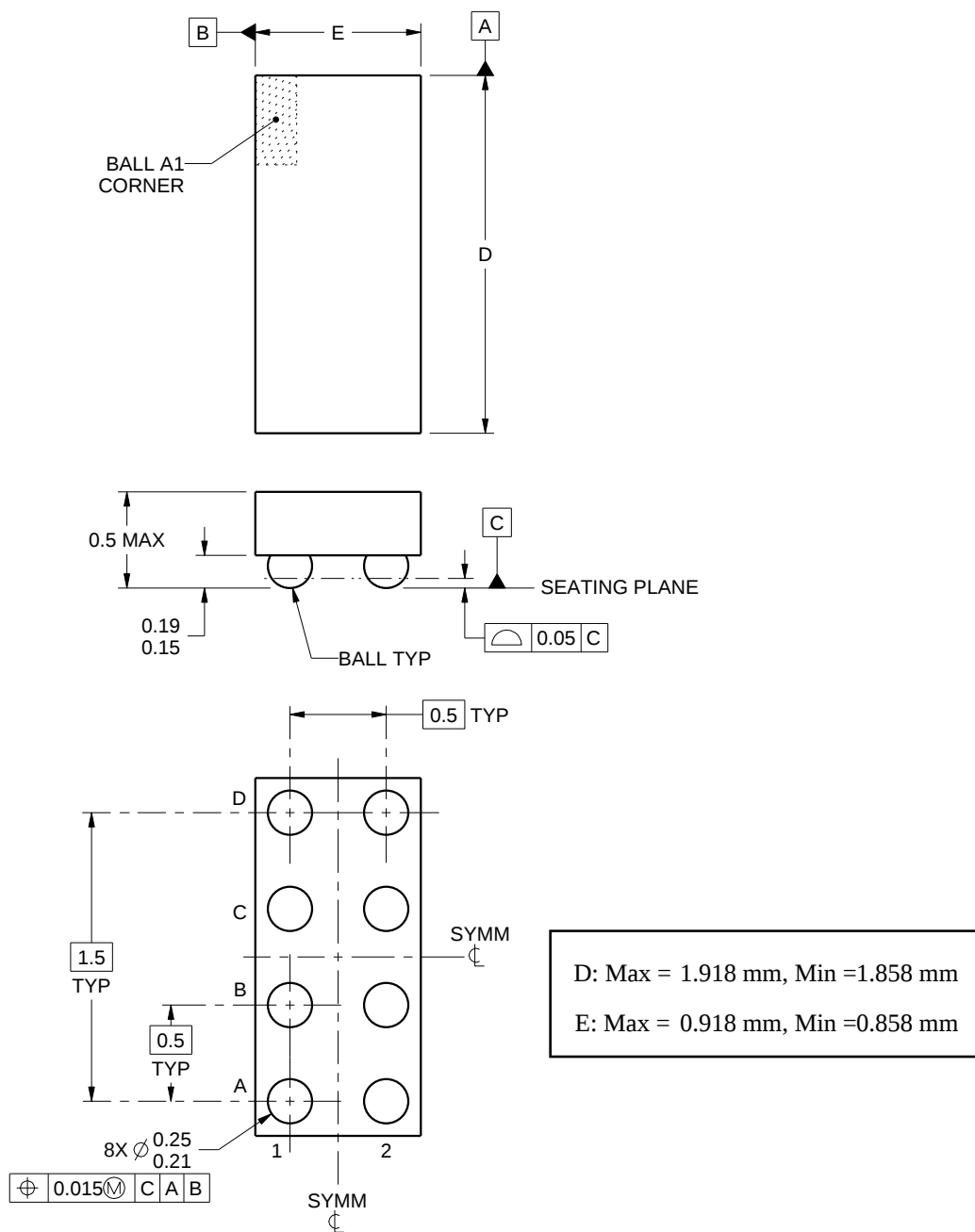
YZP0008



# PACKAGE OUTLINE

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



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## NOTES:

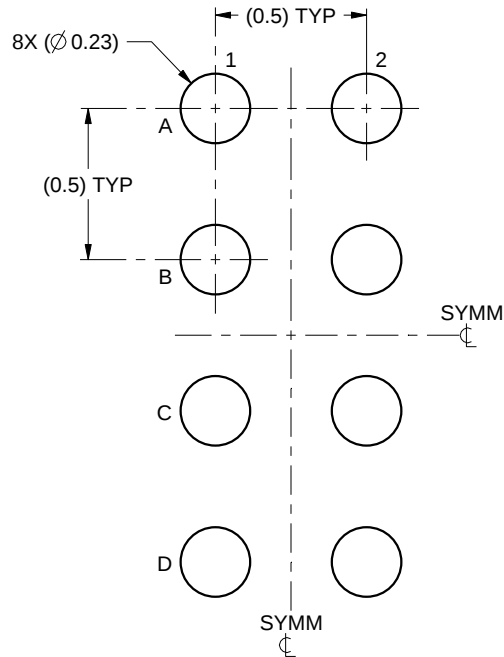
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

# EXAMPLE BOARD LAYOUT

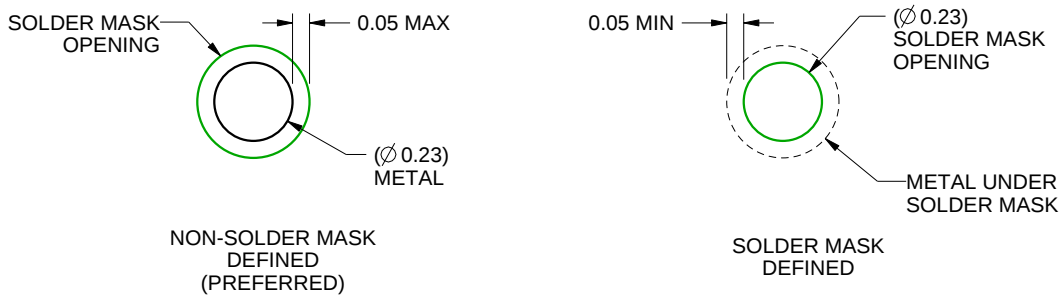
YZP0008

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:40X

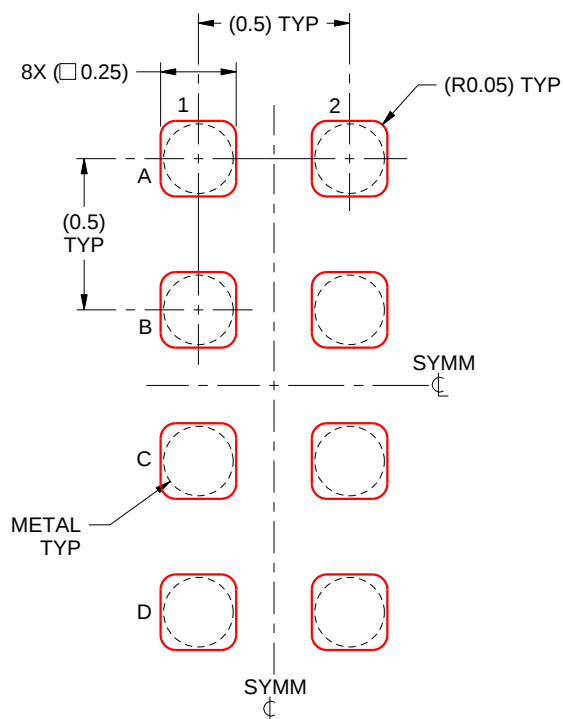


SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 ([www.ti.com/lit/snva009](http://www.ti.com/lit/snva009)).

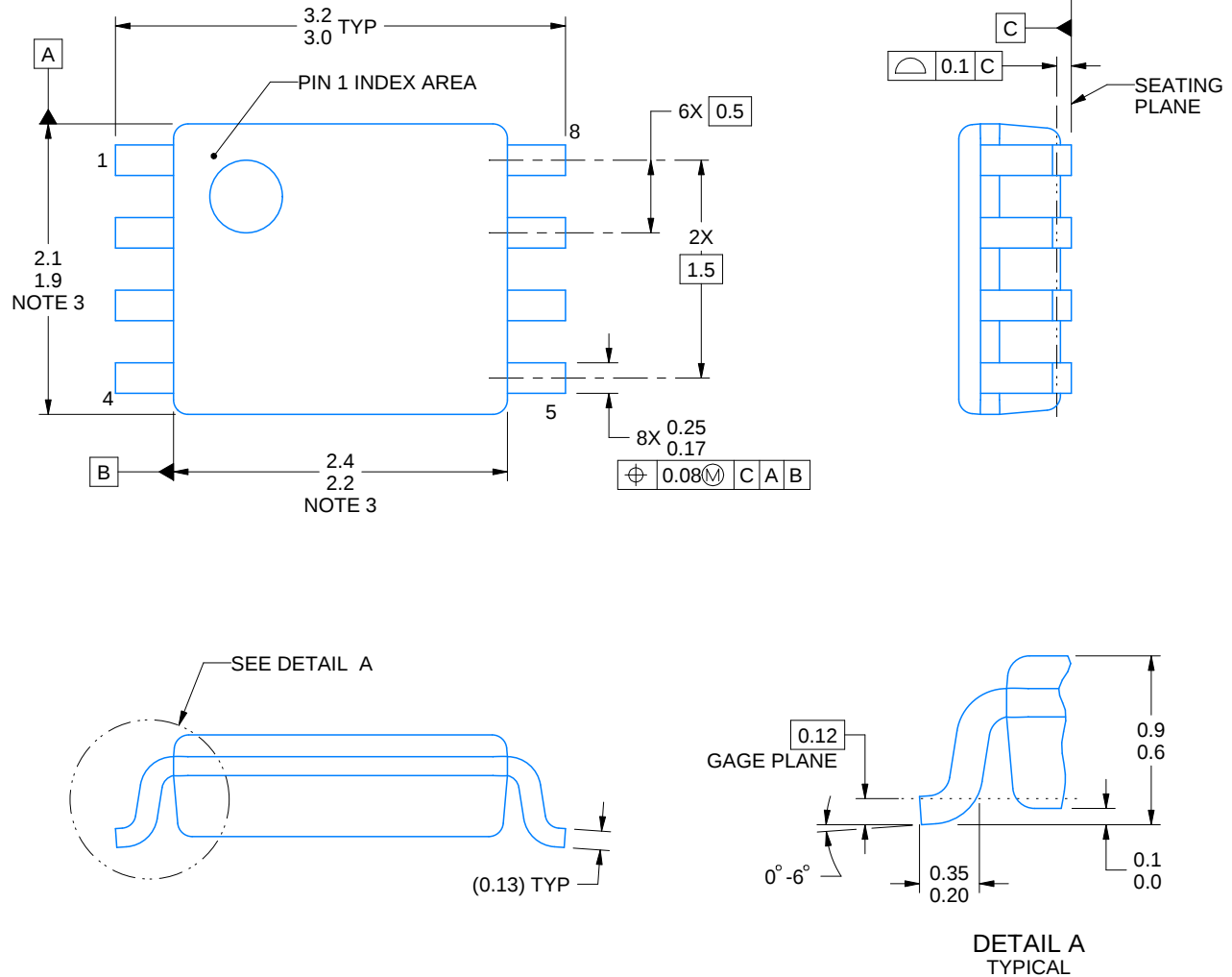


SOLDER PASTE EXAMPLE  
 BASED ON 0.1 mm THICK STENCIL  
 SCALE:40X

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NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.



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## NOTES:

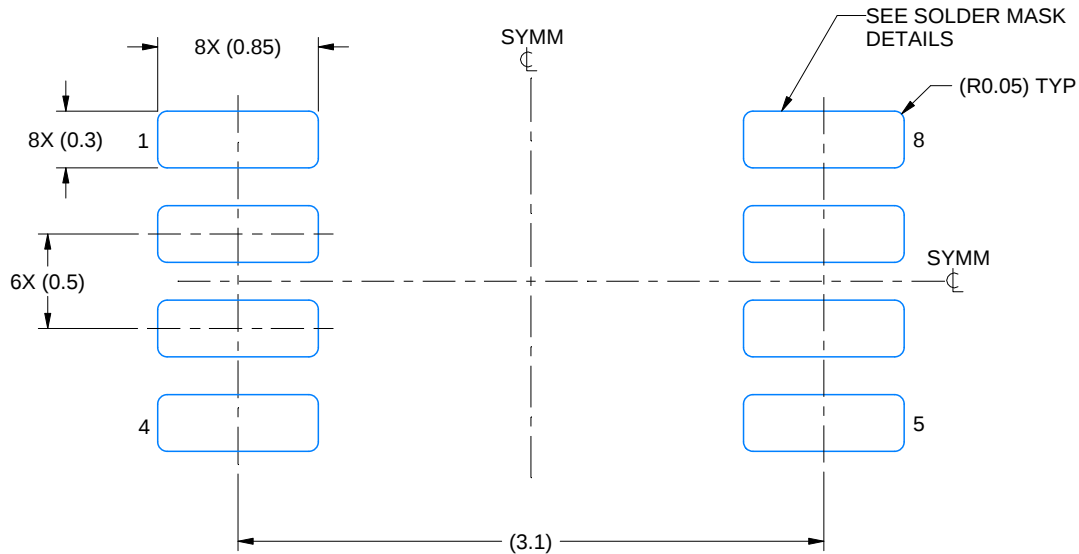
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

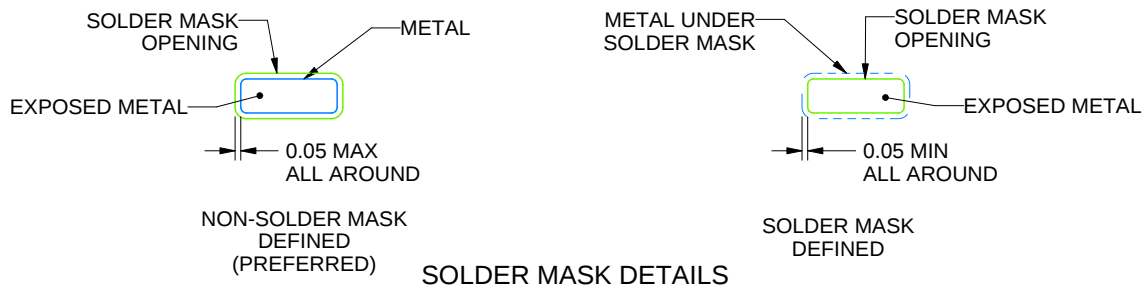
DCU0008A

VSSOP - 0.9 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 25X



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NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

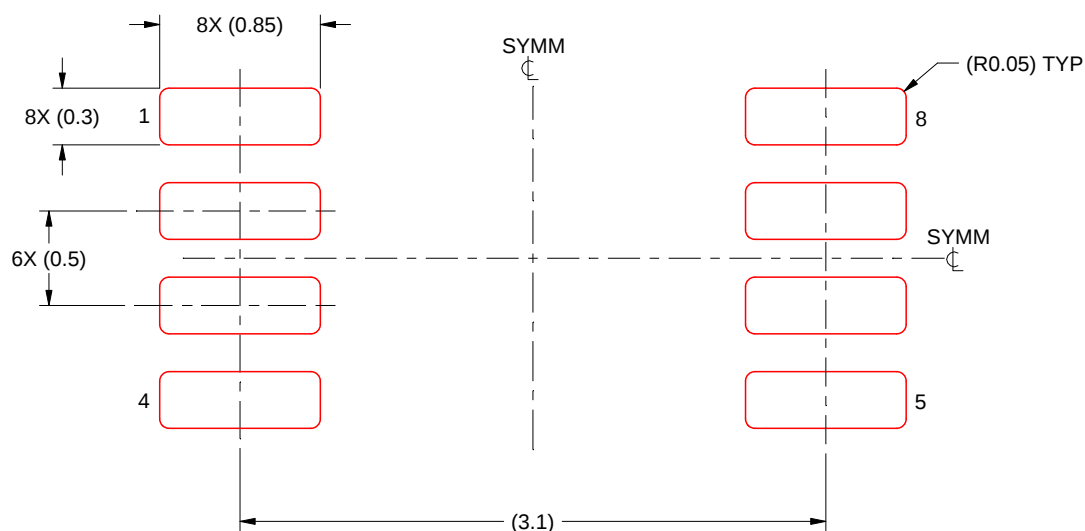
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DCU0008A

VSSOP - 0.9 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 25X

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NOTES: (continued)

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

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