

# TS5A23166 0.9Ω 双 SPST 模拟开关

## 5V 和 3.3V 双通道模拟开关

### 1 特性

- 在断电模式中提供了隔离,  $V_{+} = 0$
- 低导通电阻 (0.9Ω)
- 控制输入可承受 5.5V 电压
- 低电荷注入
- 出色的导通状态电阻匹配
- 低总谐波失真 (THD)
- 1.65V 至 5.5V 单电源运行
- 闩锁性能超过 100mA, 符合 JESD 78 II 类规范
- 静电放电 (ESD) 性能测试符合 JESD 22 标准
  - 2000V 人体放电模型 (A114-B, II 类)
  - 1000V 充电器件模型 (C101)

### 2 应用

- 手机
- 便携式仪表
- 音频和视频信号路由
- 低压数据采集系统
- 通信电路
- 调制解调器
- 硬盘
- 计算机外设
- 无线终端和外设

### 3 说明

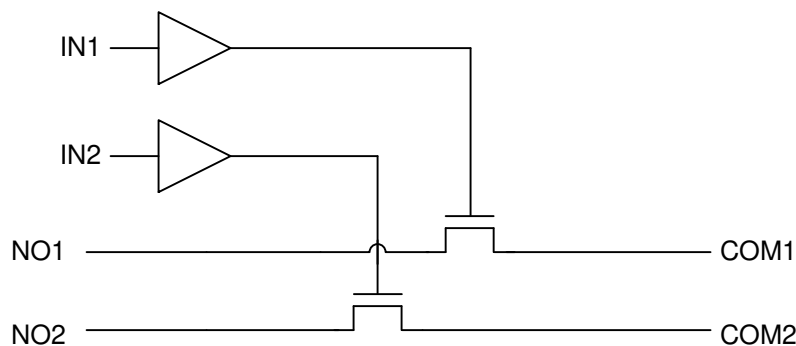
TS5A23166 器件是一款双单刀单掷 (SPST) 模拟开关, 工作电压范围为 1.65V 至 5.5V。TS5A23166 器件具有较低的通态电阻和出色的通道间通态电阻匹配功能。TS5A23166 器件具有出色的总谐波失真 (THD) 性能和极低的功耗。这些特性再加上低功耗性能, 使得这款器件适合于便携式音频应用。

器件信息<sup>(1)</sup>

| 器件型号      | 封装                   | 封装尺寸 (标称值)      |
|-----------|----------------------|-----------------|
| TS5A23166 | 超薄小外形尺寸封装 (VSSOP)(8) | 2.30mm × 2.00mm |
|           | DSBGA (8)            | 1.91mm × 0.91mm |

(1) 如需了解所有可用封装, 请参阅数据表末尾的可订购产品附录。

简化原理图



## 目录

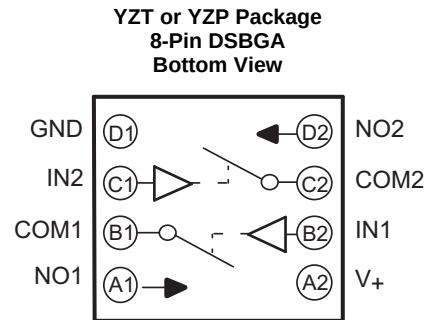
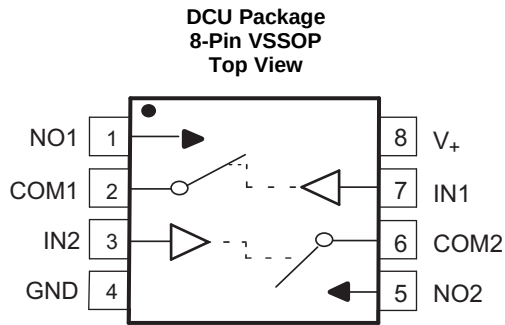
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## 4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

|                                                                                                                           |             |
|---------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Changes from Revision I (March 2018) to Revision J</b> .....                                                           | <b>Page</b> |
| • Changed the <i>Thermal Information</i> table .....                                                                      | 4           |
| <b>Changes from Revision H (May 2015) to Revision I</b> .....                                                             | <b>Page</b> |
| • Added Note: "Not tested in production" to leakage current at 25°C in the <i>Electrical Characteristics</i> tables ..... | 4           |
| <b>Changes from Revision G (February 2013) to Revision H</b> .....                                                        | <b>Page</b> |
| • 添加了引脚配置和功能 部分、ESD 额定值 表、特性 说明 部分、器件功能模式、应用和 实施 部分、电源建议 部分、布局 部分、器件和文档支持 部分以及机械、封装和可订购信息 部分 .....                        | 1           |
| • 将文档更新为新的 TI 数据表格式 - 无规格更改。 .....                                                                                        | 1           |
| • 删除了订购信息 表。 .....                                                                                                        | 1           |
| <b>Changes from Revision F (September 2012) to Revision G</b> .....                                                       | <b>Page</b> |
| • Changed pin numbers for YZT or YZP package pinout. ....                                                                 | 3           |

## 5 Pin Configuration and Functions



### Pin Functions

| PIN  |           |           | TYPE | DESCRIPTION                                     |
|------|-----------|-----------|------|-------------------------------------------------|
| NAME | TSSOP NO. | DSBGA NO. |      |                                                 |
| COM1 | 2         | B1        | I/O  | Common port for switch 1                        |
| COM2 | 6         | C2        | I/O  | Common port for switch 2                        |
| GND  | 4         | D1        | GND  | Ground                                          |
| IN1  | 7         | B2        | I    | Active-high control pin connecting NO1 to COM1. |
| IN2  | 3         | C1        | I    | Active-high control pin connecting NO2 to COM2. |
| NO1  | 1         | A1        | I/O  | Normally open switch path 1                     |
| NO2  | 5         | D2        | I/O  | Normally open switch path 2                     |
| V+   | 8         | A2        | PWR  | Power supply pin                                |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)(2)</sup>

|                                     |                                             |                                                          | MIN  | MAX                  | UNIT |
|-------------------------------------|---------------------------------------------|----------------------------------------------------------|------|----------------------|------|
| V <sub>+</sub>                      | Supply voltage <sup>(3)</sup>               |                                                          | −0.5 | 6.5                  | V    |
| V <sub>NO</sub><br>V <sub>COM</sub> | Analog voltage <sup>(3)(4)(5)</sup>         |                                                          | −0.5 | V <sub>+</sub> + 0.5 | V    |
| I <sub>K</sub>                      | Analog port diode current                   | V <sub>NO</sub> , V <sub>COM</sub> < 0                   | −50  |                      | mA   |
| I <sub>NO</sub><br>I <sub>COM</sub> | ON-state switch current                     | V <sub>NO</sub> , V <sub>COM</sub> = 0 to V <sub>+</sub> | −200 | 200                  | mA   |
|                                     | ON-state peak switch current <sup>(6)</sup> | V <sub>NO</sub> , V <sub>COM</sub> = 0 to V <sub>+</sub> | −400 | 400                  | mA   |
| V <sub>I</sub>                      | Digital input voltage <sup>(3)(4)</sup>     |                                                          | −0.5 | 6.5                  | V    |
| I <sub>IK</sub>                     | Digital input clamp current                 | V <sub>I</sub> < 0                                       | −50  |                      | mA   |
| I <sub>+</sub>                      | Continuous current through V <sub>+</sub>   |                                                          |      | 100                  | mA   |
| I <sub>GND</sub>                    | Continuous current through GND              |                                                          | −100 | 100                  | mA   |

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

(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 |
|------------------|--------------------------------|------|-------|------|
| $V_{\text{I/O}}$ | Input/output voltage           | 0    | $V_+$ | V    |
| $V_+$            | Supply voltage                 | 1.65 | 5.5   | V    |
| $V_{\text{I}}$   | Control Input Voltage          | 0    | 5.5   | V    |
| $T_{\text{A}}$   | Operating free-air temperature | –40  | 85    | °C   |

## 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup>                                        | TS5A23166   |             |             | UNIT |
|----------------------------------------------------------------------|-------------|-------------|-------------|------|
|                                                                      | DCU (VSSOP) | YZP (DSBGA) | YZT (DSBGA) |      |
|                                                                      | 8 PINS      | 8 PINS      | 8 PINS      |      |
| $R_{\theta\text{JA}}$ Junction-to-ambient thermal resistance         | 212.2       | 99.9        | 99.7        | °C/W |
| $R_{\theta\text{JC(top)}}$ Junction-to-case (top) thermal resistance | 77.6        | 1.0         | 1.4         | °C/W |
| $R_{\theta\text{JB}}$ Junction-to-board thermal resistance           | 91.7        | 27.8        | 27.8        | °C/W |
| $\phi_{\text{JT}}$ Junction-to-top characterization parameter        | 7.1         | 0.4         | 0.5         | °C/W |
| $\phi_{\text{JB}}$ Junction-to-board characterization parameter      | 91.1        | 27.8        | 27.7        | °C/W |

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

## 6.5 Electrical Characteristics: 5-V Supply

$V_+ = 4.5 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_{\text{A}} = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER                             |                                                  | TEST CONDITIONS                                                                                                  |                                              | T <sub>A</sub> | V <sub>+</sub> | MIN  | TYP  | MAX               | UNIT |
|---------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------|----------------|------|------|-------------------|------|
| Analog Switch                         |                                                  |                                                                                                                  |                                              |                |                |      |      |                   |      |
| V <sub>COM</sub> ,<br>V <sub>NO</sub> |                                                  | Analog signal                                                                                                    |                                              |                |                | 0    |      | V <sub>+</sub>    | V    |
| r <sub>peak</sub>                     | Peak ON resistance                               | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −100 mA,                                            | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 4.5 V          | 0.9  | 1.1  |                   | Ω    |
|                                       |                                                  |                                                                                                                  |                                              | Full           |                |      | 1.2  |                   |      |
| r <sub>on</sub>                       | ON-state resistance                              | V <sub>NO</sub> = 2.5 V,<br>I <sub>COM</sub> = −100 mA,                                                          | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 4.5 V          | 0.75 | 0.9  |                   | Ω    |
|                                       |                                                  |                                                                                                                  |                                              | Full           |                |      | 1    |                   |      |
| Δr <sub>on</sub>                      | ON-state resistance<br>match between<br>channels | V <sub>NO</sub> = 2.5 V,<br>I <sub>COM</sub> = −100 mA,                                                          | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 4.5 V          | 0.04 | 0.1  |                   | Ω    |
|                                       |                                                  |                                                                                                                  |                                              | Full           |                |      | 0.1  |                   |      |
| r <sub>on(flat)</sub>                 | ON-state resistance<br>flatness                  | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −100 mA,                                            | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 4.5 V          | 0.2  |      |                   | Ω    |
|                                       |                                                  |                                                                                                                  |                                              | 25°C           |                | 0.15 | 0.25 |                   |      |
|                                       |                                                  | Full                                                                                                             |                                              | 0.25           |                |      |      |                   |      |
| I <sub>NO(OFF)</sub>                  | NO<br>OFF leakage current                        | V <sub>NO</sub> = 1 V,<br>V <sub>COM</sub> = 4.5 V,<br>or<br>V <sub>NO</sub> = 4.5 V,<br>V <sub>COM</sub> = 1 V, | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 5.5 V          | 0 V  | 4    | 20 <sup>(2)</sup> | nA   |
|                                       |                                                  |                                                                                                                  |                                              | Full           |                | −150 |      | 150               |      |
| I <sub>NO(PWROFF)</sub>               |                                                  | V <sub>NO</sub> = 0 to 5.5 V,<br>V <sub>COM</sub> = 5.5 V to 0,                                                  | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 0 V            | −10  | 0.2  | 10 <sup>(2)</sup> | μA   |
|                                       |                                                  |                                                                                                                  |                                              | Full           |                | −50  |      | 50                |      |

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

(2) Not tested in production.

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

| PARAMETER                                        |                              | TEST CONDITIONS                                                                                                                                                      |  | T <sub>A</sub> | V <sub>+</sub> | MIN  | TYP    | MAX               | UNIT |
|--------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------|----------------|------|--------|-------------------|------|
| I <sub>COM(OFF)</sub>                            | COM<br>OFF leakage current   | V <sub>COM</sub> = 1 V,<br>V <sub>NO</sub> = 4.5 V,<br>or<br>V <sub>COM</sub> = 4.5 V,<br>V <sub>NO</sub> = 1 V,<br><br>Switch OFF,<br>see <a href="#">Figure 12</a> |  | 25°C           | 5.5 V          | 0 V  | 4      | 20 <sup>(2)</sup> | nA   |
|                                                  |                              |                                                                                                                                                                      |  | Full           |                | –150 |        | 150               |      |
| I <sub>COM(PWROFF)</sub>                         |                              | V <sub>COM</sub> = 0 to 5.5 V,<br>V <sub>NO</sub> = 5.5 V to 0,<br><br>Switch OFF,<br>see <a href="#">Figure 12</a>                                                  |  | 25°C           | 0 V            | –10  | 0.2    | 10 <sup>(2)</sup> | μA   |
|                                                  |                              |                                                                                                                                                                      |  | Full           |                | –50  |        | 50                |      |
| I <sub>NO(ON)</sub>                              | NO<br>ON leakage current     | V <sub>NO</sub> = 1 V,<br>V <sub>COM</sub> = Open,<br>or<br>V <sub>NO</sub> = 4.5 V,<br>V <sub>COM</sub> = Open,<br><br>Switch ON,<br>see <a href="#">Figure 13</a>  |  | 25°C           | 5.5 V          | –5   | 0.4    | 5 <sup>(2)</sup>  | nA   |
|                                                  |                              |                                                                                                                                                                      |  | Full           |                | –50  |        | 50                |      |
| I <sub>COM(ON)</sub>                             | COM<br>ON leakage current    | V <sub>COM</sub> = 1 V,<br>V <sub>NO</sub> = Open,<br>or<br>V <sub>COM</sub> = 4.5 V,<br>V <sub>NO</sub> = Open,<br><br>Switch ON,<br>see <a href="#">Figure 13</a>  |  | 25°C           | 5.5 V          | –5   | 0.4    | 5 <sup>(2)</sup>  | nA   |
|                                                  |                              |                                                                                                                                                                      |  | Full           |                | –50  |        | 50                |      |
| Digital Control Inputs (IN1, IN2) <sup>(3)</sup> |                              |                                                                                                                                                                      |  |                |                |      |        |                   |      |
| V <sub>IH</sub>                                  | Input logic high             |                                                                                                                                                                      |  | Full           |                | 2.4  |        | 5.5               | V    |
| V <sub>IL</sub>                                  | Input logic low              |                                                                                                                                                                      |  | Full           |                | 0    |        | 0.8               | V    |
| I <sub>IH</sub> , I <sub>IL</sub>                | Input leakage current        | V <sub>I</sub> = 5.5 V or 0                                                                                                                                          |  | 25°C           | 5.5 V          | –2   | 0.3    | 2                 | nA   |
|                                                  |                              |                                                                                                                                                                      |  | Full           |                | –20  |        | 20                |      |
| Dynamic                                          |                              |                                                                                                                                                                      |  |                |                |      |        |                   |      |
| Q <sub>C</sub>                                   | Charge injection             | V <sub>GEN</sub> = 0,<br>R <sub>GEN</sub> = 0,<br><br>C <sub>L</sub> = 1 nF,<br>see <a href="#">Figure 19</a>                                                        |  | 25°C           | 5 V            |      | 6      |                   | pC   |
| C <sub>NO(OFF)</sub>                             | NO<br>OFF capacitance        | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch OFF,<br>See <a href="#">Figure 14</a>                                                                             |  | 25°C           | 5 V            |      | 19     |                   | pF   |
| C <sub>COM(OFF)</sub>                            | COM<br>OFF capacitance       | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch OFF,<br>See <a href="#">Figure 14</a>                                                                            |  | 25°C           | 5 V            |      | 18     |                   | pF   |
| C <sub>NO(ON)</sub>                              | NO<br>ON capacitance         | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch ON,<br>See <a href="#">Figure 14</a>                                                                              |  | 25°C           | 5 V            |      | 35.5   |                   | pF   |
| C <sub>COM(ON)</sub>                             | COM<br>ON capacitance        | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch ON,<br>See <a href="#">Figure 14</a>                                                                             |  | 25°C           | 5 V            |      | 35.5   |                   | pF   |
| C <sub>I</sub>                                   | Digital input<br>capacitance | V <sub>I</sub> = V <sub>+</sub> or GND,<br>See <a href="#">Figure 14</a>                                                                                             |  | 25°C           | 5 V            |      | 2      |                   | pF   |
| BW                                               | Bandwidth                    | R <sub>L</sub> = 50 Ω,<br>Switch ON,<br>See <a href="#">Figure 16</a>                                                                                                |  | 25°C           | 5 V            |      | 150    |                   | MHz  |
| O <sub>ISO</sub>                                 | OFF isolation                | R <sub>L</sub> = 50 Ω,<br>f = 1 MHz,<br>Switch OFF,<br>see <a href="#">Figure 17</a>                                                                                 |  | 25°C           | 5 V            |      | –62    |                   | dB   |
| X <sub>TALK</sub>                                | Crosstalk                    | R <sub>L</sub> = 50 Ω,<br>f = 1 MHz,<br>Switch ON,<br>see <a href="#">Figure 18</a>                                                                                  |  | 25°C           | 5 V            |      | –85    |                   | dB   |
| THD                                              | Total harmonic<br>distortion | R <sub>L</sub> = 600 Ω,<br>C <sub>L</sub> = 50 pF,<br><br>f = 20 Hz to 20<br>kHz,<br>see <a href="#">Figure 20</a>                                                   |  | 25°C           | 5 V            |      | 0.005% |                   |      |
| Supply                                           |                              |                                                                                                                                                                      |  |                |                |      |        |                   |      |
| I <sub>+</sub>                                   | Positive supply<br>current   | V <sub>I</sub> = V <sub>+</sub> or GND,<br><br>Switch ON or<br>OFF                                                                                                   |  | 25°C           | 5.5 V          |      | 0.01   | 0.1               | μA   |
|                                                  |                              |                                                                                                                                                                      |  | Full           |                |      |        | 1                 |      |

(3) 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: 3.3-V Supply

 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER                                              |                                            | TEST CONDITIONS                                                                                                |                                              | T <sub>A</sub> | V <sub>+</sub> | MIN  | TYP  | MAX              | UNIT |
|--------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------|----------------|------|------|------------------|------|
| Analog Switch                                          |                                            |                                                                                                                |                                              |                |                |      |      |                  |      |
| V <sub>COM</sub> , V <sub>NO</sub> Analog signal range |                                            |                                                                                                                |                                              |                |                | 0    |      | V <sub>+</sub>   | V    |
| r <sub>peak</sub>                                      | Peak ON resistance                         | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −100 mA,                                          | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 3 V            | 1.3  | 1.6  |                  | Ω    |
|                                                        |                                            |                                                                                                                |                                              | Full           |                |      | 1.8  |                  |      |
| r <sub>on</sub>                                        | ON-state resistance                        | V <sub>NO</sub> = 2 V,<br>I <sub>COM</sub> = −100 mA,                                                          | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 3 V            | 1.1  | 1.5  |                  | Ω    |
|                                                        |                                            |                                                                                                                |                                              | Full           |                |      | 1.7  |                  |      |
| Δr <sub>on</sub>                                       | ON-state resistance match between channels | V <sub>NO</sub> = 2 V, 0.8 V,<br>I <sub>COM</sub> = −100 mA,                                                   | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 3 V            | 0.04 | 0.1  |                  | Ω    |
|                                                        |                                            |                                                                                                                |                                              | Full           |                |      | 0.1  |                  |      |
| r <sub>on(flat)</sub>                                  | ON-state resistance flatness               | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −100 mA                                           | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 3 V            | 0.3  |      |                  | Ω    |
|                                                        |                                            |                                                                                                                |                                              | 25°C           |                | 0.15 | 0.25 |                  |      |
|                                                        |                                            | Full                                                                                                           |                                              | 0.25           |                |      |      |                  |      |
| I <sub>NO(OFF)</sub>                                   | NO OFF leakage current                     | V <sub>NO</sub> = 1 V, V <sub>COM</sub> = 3 V,<br>or<br>V <sub>NO</sub> = 3 V, V <sub>COM</sub> = 1 V,         | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 3.6 V          | −5   | 0.5  | 5 <sup>(2)</sup> | nA   |
|                                                        |                                            |                                                                                                                |                                              | Full           |                | −50  |      | 50               |      |
| I <sub>NO(PWROFF)</sub>                                |                                            | V <sub>NO</sub> = 0 to 3.6 V,<br>V <sub>COM</sub> = 3.6 V to 0,                                                | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 0 V            | −5   | 0.1  | 5 <sup>(2)</sup> | μA   |
|                                                        |                                            |                                                                                                                |                                              | Full           |                | −25  |      | 25               |      |
| I <sub>COM(OFF)</sub>                                  | COM OFF leakage current                    | V <sub>COM</sub> = 1 V, V <sub>NO</sub> = 3 V,<br>or<br>V <sub>COM</sub> = 3 V, V <sub>NO</sub> = 1 V,         | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 3.6 V          | −5   | 0.5  | 5 <sup>(2)</sup> | nA   |
|                                                        |                                            |                                                                                                                |                                              | Full           |                | −50  |      | 50               |      |
| I <sub>COM(PWROFF)</sub>                               |                                            | V <sub>COM</sub> = 0 to 3.6 V,<br>V <sub>NO</sub> = 3.6 V to 0,                                                | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 0 V            | −5   | 0.1  | 5 <sup>(2)</sup> | μA   |
|                                                        |                                            |                                                                                                                |                                              | Full           |                | −25  |      | 25               |      |
| I <sub>NO(ON)</sub>                                    | NO ON leakage current                      | V <sub>NO</sub> = 1 V,<br>V <sub>COM</sub> = Open,<br>or<br>V <sub>NO</sub> = 3 V,<br>V <sub>COM</sub> = Open, | Switch ON,<br>see <a href="#">Figure 13</a>  | 25°C           | 3.6 V          | −2   | 0.3  | 2 <sup>(2)</sup> | nA   |
|                                                        |                                            |                                                                                                                |                                              | Full           |                | −20  |      | 20               |      |
| I <sub>COM(ON)</sub>                                   | COM ON leakage current                     | V <sub>COM</sub> = 1 V,<br>V <sub>NO</sub> = Open,<br>or<br>V <sub>COM</sub> = 3 V,<br>V <sub>NO</sub> = Open, | Switch ON,<br>see <a href="#">Figure 13</a>  | 25°C           | 3.6 V          | −2   | 0.3  | 2 <sup>(2)</sup> | nA   |
|                                                        |                                            |                                                                                                                |                                              | Full           |                | −20  |      | 20               |      |
| Digital Control Inputs (IN1, IN2) <sup>(3)</sup>       |                                            |                                                                                                                |                                              |                |                |      |      |                  |      |
| V <sub>IH</sub>                                        | Input logic high                           |                                                                                                                |                                              | Full           |                | 2    |      | 5.5              | V    |
| V <sub>IL</sub>                                        | Input logic low                            |                                                                                                                |                                              | Full           |                | 0    |      | 0.8              | V    |
| I <sub>IH</sub> , I <sub>IL</sub>                      | Input leakage current                      | V <sub>I</sub> = 5.5 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) Not tested in production.

(3) 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](#).

## Electrical Characteristics: 3.3-V Supply (continued)

 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER             |                              | TEST CONDITIONS                                          |                                                         | T <sub>A</sub> | V <sub>+</sub> | MIN | TYP   | MAX  | UNIT |
|-----------------------|------------------------------|----------------------------------------------------------|---------------------------------------------------------|----------------|----------------|-----|-------|------|------|
| Dynamic               |                              |                                                          |                                                         |                |                |     |       |      |      |
| Q <sub>C</sub>        | Charge injection             | V <sub>GEN</sub> = 0,<br>R <sub>GEN</sub> = 0,           | C <sub>L</sub> = 1 nF,<br>see <a href="#">Figure 19</a> | 25°C           | 5 V            |     | 6     |      | pC   |
| C <sub>NO(OFF)</sub>  | NO<br>OFF capacitance        | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch OFF,  | See <a href="#">Figure 14</a>                           | 25°C           | 3.3 V          |     | 19.5  |      | pF   |
| C <sub>COM(OFF)</sub> | COM<br>OFF capacitance       | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch OFF, | See <a href="#">Figure 14</a>                           | 25°C           | 3.3 V          |     | 18.5  |      | pF   |
| C <sub>NO(ON)</sub>   | NO<br>ON capacitance         | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch ON,   | See <a href="#">Figure 14</a>                           | 25°C           | 3.3 V          |     | 36    |      | pF   |
| C <sub>COM(ON)</sub>  | COM<br>ON capacitance        | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch ON,  | See <a href="#">Figure 14</a>                           | 25°C           | 3.3 V          |     | 36    |      | pF   |
| C <sub>I</sub>        | Digital input<br>capacitance | V <sub>I</sub> = V <sub>+</sub> or GND,                  | See <a href="#">Figure 14</a>                           | 25°C           | 3.3 V          |     | 2     |      | pF   |
| BW                    | Bandwidth                    | R <sub>L</sub> = 50 Ω,<br>Switch ON,                     | See <a href="#">Figure 16</a>                           | 25°C           | 3.3 V          |     | 150   |      | MHz  |
| O <sub>ISO</sub>      | OFF isolation                | R <sub>L</sub> = 50 Ω,<br>f = 1 MHz,                     | Switch OFF,<br>see <a href="#">Figure 17</a>            | 25°C           | 3.3 V          |     | −62   |      | dB   |
| X <sub>TALK</sub>     | Crosstalk                    | R <sub>L</sub> = 50 Ω,<br>f = 1 MHz,                     | Switch ON,<br>see <a href="#">Figure 18</a>             | 25°C           | 3.3 V          |     | −85   |      | dB   |
| THD                   | Total harmonic<br>distortion | R <sub>L</sub> = 600 Ω,<br>C <sub>L</sub> = 50 pF,       | f = 20 Hz to 20 kHz,<br>see <a href="#">Figure 20</a>   | 25°C           | 3.3 V          |     | 0.01% |      |      |
| Supply                |                              |                                                          |                                                         |                |                |     |       |      |      |
| I <sub>+</sub>        | Positive supply<br>current   | V <sub>I</sub> = V <sub>+</sub> or GND,                  | Switch ON or OFF                                        | 25°C           | 3.6 V          |     | 0.001 | 0.05 | μA   |
|                       |                              |                                                          |                                                         | Full           |                |     | 0.3   |      |      |

## 6.7 Electrical Characteristics: 2.5-V Supply

 $V_+ = 2.3\text{ V to }2.7\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER                          |                                            | TEST CONDITIONS                                                                                                      |                                              | T <sub>A</sub> | V <sub>+</sub> | MIN  | TYP  | MAX              | UNIT |
|------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------|----------------|------|------|------------------|------|
| Analog Switch                      |                                            |                                                                                                                      |                                              |                |                |      |      |                  |      |
| V <sub>COM</sub> , V <sub>NO</sub> | Analog signal range                        |                                                                                                                      |                                              |                |                | 0    |      | V <sub>+</sub>   | V    |
| r <sub>peak</sub>                  | Peak ON resistance                         | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −8 mA,                                                  | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 2.3 V          | 1.8  |      | 2.4              | Ω    |
|                                    |                                            |                                                                                                                      |                                              | Full           |                |      | 2.6  |                  |      |
| r <sub>on</sub>                    | ON-state resistance                        | V <sub>NO</sub> = 1.8 V,<br>I <sub>COM</sub> = −8 mA,                                                                | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 2.3 V          | 1.2  |      | 2.1              | Ω    |
|                                    |                                            |                                                                                                                      |                                              | Full           |                |      | 2.4  |                  |      |
| Δr <sub>on</sub>                   | ON-state resistance match between channels | V <sub>NO</sub> = 1.8 V, 0.8 V,<br>I <sub>COM</sub> = −8 mA,                                                         | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 2.3 V          | 0.04 |      | 0.15             | Ω    |
|                                    |                                            |                                                                                                                      |                                              | Full           |                |      | 0.15 |                  |      |
| r <sub>on(flat)</sub>              | ON-state resistance flatness               | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −8 mA,                                                  | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           | 2.3 V          | 0.7  |      |                  | Ω    |
|                                    |                                            | V <sub>NO</sub> = 1.8 V, 0.8 V,<br>I <sub>COM</sub> = −8 mA,                                                         | Switch ON,<br>see <a href="#">Figure 11</a>  | 25°C           |                | 0.4  |      | 0.6              |      |
|                                    |                                            |                                                                                                                      |                                              | Full           |                |      | 0.6  |                  |      |
| I <sub>NO(OFF)</sub>               | NO OFF leakage current                     | V <sub>NO</sub> = 0.5 V,<br>V <sub>COM</sub> = 2.3 V,<br>or<br>V <sub>NO</sub> = 2.3 V,<br>V <sub>COM</sub> = 0.5 V, | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 2.7 V          | −5   | 0.3  | 5 <sup>(2)</sup> | nA   |
|                                    |                                            |                                                                                                                      |                                              | Full           |                | −50  |      | 50               |      |
| I <sub>NO(PWROFF)</sub>            |                                            | V <sub>NO</sub> = 0 to 2.7 V,<br>V <sub>COM</sub> = 2.7 V to 0,                                                      | Switch OFF,<br>see <a href="#">Figure 12</a> | 25°C           | 0 V            | −2   | 0.05 | 2 <sup>(2)</sup> | μA   |
|                                    |                                            |                                                                                                                      |                                              | Full           |                |      | −15  |                  |      |

(1) The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

(2) Not tested in production.

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

| PARAMETER                         |                                 | TEST CONDITIONS                                                                                                      |                                                         | T <sub>A</sub> | V <sub>+</sub> | MIN | TYP   | MAX              | UNIT |
|-----------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------|----------------|-----|-------|------------------|------|
| I <sub>COM(OFF)</sub>             | COM<br>OFF leakage<br>current   | V <sub>NO</sub> = 2.3 V,<br>V <sub>COM</sub> = 0.5 V,<br>or<br>V <sub>NO</sub> = 0.5 V,<br>V <sub>COM</sub> = 2.3 V, | Switch OFF,<br>see <a href="#">Figure 12</a>            | 25°C           | 2.7 V          | -5  | 0.3   | 5 <sup>(2)</sup> | nA   |
|                                   |                                 |                                                                                                                      |                                                         | Full           |                | -50 | 50    |                  |      |
| I <sub>COM(PWROFF)</sub>          |                                 | V <sub>COM</sub> = 0 to 2.7 V,<br>V <sub>NO</sub> = 2.7 V to 0,                                                      | Switch OFF,<br>see <a href="#">Figure 12</a>            | 25°C           | 0 V            | -2  | 0.05  | 2 <sup>(2)</sup> | μA   |
|                                   |                                 |                                                                                                                      |                                                         | Full           |                | -15 | 15    |                  |      |
| I <sub>NO(ON)</sub>               | NO<br>ON leakage<br>current     | V <sub>NO</sub> = 0.5 V,<br>V <sub>COM</sub> = Open,<br>or<br>V <sub>NO</sub> = 2.3 V,<br>V <sub>COM</sub> = Open,   | Switch ON,<br>see <a href="#">Figure 13</a>             | 25°C           | 2.7 V          | -2  | 0.3   | 2 <sup>(2)</sup> | nA   |
|                                   |                                 |                                                                                                                      |                                                         | Full           |                | -20 | 20    |                  |      |
| I <sub>COM(ON)</sub>              | COM<br>ON leakage<br>current    | V <sub>COM</sub> = 0.5 V,<br>V <sub>NO</sub> = Open,<br>or<br>V <sub>COM</sub> = 2.3 V,<br>V <sub>NO</sub> = Open,   | Switch ON,<br>see <a href="#">Figure 13</a>             | 25°C           | 2.7 V          | -2  | 0.3   | 2 <sup>(2)</sup> | nA   |
|                                   |                                 |                                                                                                                      |                                                         | Full           |                | -20 | 20    |                  |      |
| Digital Control Inputs (IN1, IN2) |                                 |                                                                                                                      |                                                         |                |                |     |       |                  |      |
| V <sub>IH</sub>                   | Input logic high                |                                                                                                                      |                                                         | Full           |                | 1.8 |       | 5.5              | V    |
| V <sub>IL</sub>                   | Input logic low                 |                                                                                                                      |                                                         | Full           |                | 0   |       | 0.6              | V    |
| I <sub>IH</sub> , I <sub>IL</sub> | Input leakage<br>current        | V <sub>I</sub> = 5.5 V or 0                                                                                          |                                                         | 25°C           | 2.7 V          | -2  | 0.3   | 2                | nA   |
|                                   |                                 |                                                                                                                      |                                                         | Full           |                | -20 | 20    |                  |      |
| Dynamic                           |                                 |                                                                                                                      |                                                         |                |                |     |       |                  |      |
| Q <sub>C</sub>                    | Charge<br>injection             | V <sub>GEN</sub> = 0,<br>R <sub>GEN</sub> = 0,                                                                       | C <sub>L</sub> = 1 nF,<br>see <a href="#">Figure 19</a> | 25°C           | 2.5 V          |     | 4     |                  | pC   |
| C <sub>NO(OFF)</sub>              | NO<br>OFF<br>capacitance        | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch OFF,                                                              | See <a href="#">Figure 14</a>                           | 25°C           | 2.5 V          |     | 19.5  |                  | pF   |
| C <sub>COM(OFF)</sub>             | COM<br>OFF<br>capacitance       | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch OFF,                                                             | See <a href="#">Figure 14</a>                           | 25°C           | 2.5 V          |     | 18.5  |                  | pF   |
| C <sub>NQ(ON)</sub>               | NO<br>ON<br>capacitance         | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch ON,                                                               | See <a href="#">Figure 14</a>                           | 25°C           | 2.5 V          |     | 36.5  |                  | pF   |
| C <sub>COM(ON)</sub>              | COM<br>ON<br>capacitance        | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch ON,                                                              | See <a href="#">Figure 14</a>                           | 25°C           | 2.5 V          |     | 36.5  |                  | pF   |
| C <sub>I</sub>                    | Digital input<br>capacitance    | V <sub>I</sub> = V <sub>+</sub> or GND,                                                                              | See <a href="#">Figure 14</a>                           | 25°C           | 2.5 V          |     | 2     |                  | pF   |
| BW                                | Bandwidth                       | R <sub>L</sub> = 50 Ω,<br>Switch ON,                                                                                 | See <a href="#">Figure 16</a>                           | 25°C           | 2.5 V          |     | 150   |                  | MHz  |
| O <sub>ISO</sub>                  | OFF isolation                   | R <sub>L</sub> = 50 Ω,<br>f = 1 MHz,                                                                                 | Switch OFF,<br>see <a href="#">Figure 17</a>            | 25°C           | 2.5 V          |     | -62   |                  | dB   |
| X <sub>TALK</sub>                 | Crosstalk                       | R <sub>L</sub> = 50 Ω,<br>f = 1 MHz,                                                                                 | Switch ON,<br>see <a href="#">Figure 18</a>             | 25°C           | 2.5 V          |     | -85   |                  | dB   |
| THD                               | Total<br>harmonic<br>distortion | R <sub>L</sub> = 600 Ω,<br>C <sub>L</sub> = 50 pF,                                                                   | f = 20 Hz to 20 kHz,<br>see <a href="#">Figure 20</a>   | 25°C           | 2.5 V          |     | 0.02% |                  |      |
| Supply                            |                                 |                                                                                                                      |                                                         |                |                |     |       |                  |      |
| I <sub>+</sub>                    | Positive supply<br>current      | V <sub>I</sub> = V <sub>+</sub> or GND,                                                                              | Switch ON or OFF                                        | 25°C           | 2.7 V          |     | 0.001 | 0.02             | μA   |
|                                   |                                 |                                                                                                                      |                                                         | Full           |                |     | 0.25  |                  |      |



## 6.8 Electrical Characteristics: 1.8-V Supply

 $V_+ = 1.65 \text{ V to } 1.95 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER                          |                                            | TEST CONDITIONS                                                                                                        |                                                         | T <sub>A</sub> | V <sub>+</sub> | MIN  | TYP  | MAX              | UNIT |
|------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------|----------------|------|------|------------------|------|
| Analog Switch                      |                                            |                                                                                                                        |                                                         |                |                |      |      |                  |      |
| V <sub>COM</sub> , V <sub>NO</sub> | Analog signal range                        |                                                                                                                        |                                                         |                |                | 0    |      | V <sub>+</sub>   | V    |
| r <sub>peak</sub>                  | Peak ON resistance                         | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −2 mA,                                                    | Switch ON,<br>see <a href="#">Figure 11</a>             | 25°C           | 1.65 V         | 4.2  |      | 25               | Ω    |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                |      |      |                  | 30   |
| r <sub>on</sub>                    | ON-state resistance                        | V <sub>NO</sub> = 0.6 V, 1.5 V,<br>I <sub>COM</sub> = −2 mA,                                                           | Switch ON,<br>see <a href="#">Figure 11</a>             | 25°C           | 1.65 V         | 1.6  |      | 3.9              | Ω    |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                |      |      |                  | 4    |
| Δr <sub>on</sub>                   | ON-state resistance match between channels | V <sub>NO</sub> = 1.5 V,<br>I <sub>COM</sub> = −2 mA,                                                                  | Switch ON,<br>see <a href="#">Figure 11</a>             | 25°C           | 1.65 V         | 0.04 |      | 0.2              | Ω    |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                |      |      |                  |      |
| r <sub>on(flat)</sub>              | ON-state resistance flatness               | 0 ≤ V <sub>NO</sub> ≤ V <sub>+</sub> ,<br>I <sub>COM</sub> = −2 mA,                                                    | Switch ON,<br>see <a href="#">Figure 11</a>             | 25°C           | 1.65 V         | 2.8  |      |                  | Ω    |
|                                    |                                            | V <sub>NO</sub> = 0.6 V, 1.5 V,<br>I <sub>COM</sub> = −2 mA,                                                           | Switch ON,<br>see <a href="#">Figure 11</a>             | 25°C           |                | 4.1  | 22   |                  |      |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                |      |      | 27               |      |
| I <sub>NO(OFF)</sub>               | NO OFF leakage current                     | V <sub>NO</sub> = 0.3 V,<br>V <sub>COM</sub> = 1.65 V,<br>or<br>V <sub>NO</sub> = 1.65 V,<br>V <sub>COM</sub> = 0.3 V, | Switch OFF,<br>see <a href="#">Figure 12</a>            | 25°C           | 1.95 V         | −5   | 0.3  | 5 <sup>(2)</sup> | nA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −50  |      | 50               |      |
| I <sub>NO(PWROFF)</sub>            |                                            | V <sub>NO</sub> = 0 to 1.95 V,<br>V <sub>COM</sub> = 1.95 V to 0,                                                      | Switch OFF,<br>see <a href="#">Figure 12</a>            | 25°C           | 0 V            | −2   | 0.05 | 2 <sup>(2)</sup> | μA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −10  |      | 10               |      |
| I <sub>COM(OFF)</sub>              | COM OFF leakage current                    | V <sub>NO</sub> = 1.65 V,<br>V <sub>COM</sub> = 0.3 V,<br>or<br>V <sub>NO</sub> = 0.3 V,<br>V <sub>COM</sub> = 1.65 V, | Switch OFF,<br>see <a href="#">Figure 12</a>            | 25°C           | 1.95 V         | −5   | 0.3  | 5 <sup>(2)</sup> | nA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −50  |      | 50               |      |
| I <sub>COM(PWROFF)</sub>           |                                            | V <sub>COM</sub> = 0 to 1.95 V,<br>V <sub>NO</sub> = 1.95 V to 0,                                                      | Switch OFF,<br>see <a href="#">Figure 12</a>            | 25°C           | 0 V            | −2   | 0.05 | (2)2             | μA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −10  |      | 10               |      |
| I <sub>NO(ON)</sub>                | NO ON leakage current                      | V <sub>NO</sub> = 0.3 V,<br>V <sub>COM</sub> = Open,<br>or<br>V <sub>NO</sub> = 1.65 V,<br>V <sub>COM</sub> = Open,    | Switch ON,<br>see <a href="#">Figure 13</a>             | 25°C           | 1.95 V         | −2   | 0.3  | 2 <sup>(2)</sup> | nA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −20  |      | 20               |      |
| I <sub>COM(ON)</sub>               | COM ON leakage current                     | V <sub>NO</sub> = Open,<br>V <sub>COM</sub> = 0.3 V,<br>or<br>V <sub>NO</sub> = Open,<br>V <sub>COM</sub> = 1.65 V,    | Switch ON,<br>see <a href="#">Figure 13</a>             | 25°C           | 1.95 V         | −2   | 0.3  | 2                | nA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −20  |      | 20               |      |
| Digital Control Inputs (IN1, IN2)  |                                            |                                                                                                                        |                                                         |                |                |      |      |                  |      |
| V <sub>IH</sub>                    | Input logic high                           |                                                                                                                        |                                                         | Full           |                | 1.5  |      | 5.5              | V    |
| V <sub>IL</sub>                    | Input logic low                            |                                                                                                                        |                                                         | Full           |                | 0    |      | 0.6              | V    |
| I <sub>IH</sub> , I <sub>IL</sub>  | Input leakage current                      | V <sub>I</sub> = 5.5 V or 0                                                                                            |                                                         | 25°C           | 1.95 V         | −2   | 0.3  | 2                | μA   |
|                                    |                                            |                                                                                                                        |                                                         | Full           |                | −20  |      | 20               |      |
| Dynamic                            |                                            |                                                                                                                        |                                                         |                |                |      |      |                  |      |
| Q <sub>C</sub>                     | Charge injection                           | V <sub>GEN</sub> = 0,<br>R <sub>GEN</sub> = 0,                                                                         | C <sub>L</sub> = 1 nF,<br>see <a href="#">Figure 19</a> | 25°C           | 1.8 V          |      | 2    |                  | pC   |
| C <sub>NO(OFF)</sub>               | NO OFF capacitance                         | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch OFF,                                                                | See <a href="#">Figure 14</a>                           | 25°C           | 1.8 V          |      | 19.5 |                  | pF   |
| C <sub>COM(OFF)</sub>              | COM OFF capacitance                        | V <sub>COM</sub> = V <sub>+</sub> or GND,<br>Switch OFF,                                                               | See <a href="#">Figure 14</a>                           | 25°C           | 1.8 V          |      | 18.5 |                  | pF   |
| C <sub>NO(ON)</sub>                | NO ON capacitance                          | V <sub>NO</sub> = V <sub>+</sub> or GND,<br>Switch ON,                                                                 | See <a href="#">Figure 14</a>                           | 25°C           | 1.8 V          |      | 36.5 |                  | pF   |

(1) The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

(2) Not tested in production.

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

| PARAMETER            | TEST CONDITIONS                                                                                                                  | $T_A$ | $V_+$  | MIN   | TYP    | MAX  | UNIT          |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------|-------|--------|-------|--------|------|---------------|
| $C_{\text{COM(ON)}}$ | COM ON capacitance<br>$V_{\text{COM}} = V_+$ or GND, Switch ON, See Figure 14                                                    | 25°C  | 1.8 V  |       | 36.5   |      | pF            |
| $C_I$                | Digital input capacitance<br>$V_I = V_+$ or GND, See Figure 14                                                                   | 25°C  | 1.8 V  |       | 2      |      | pF            |
| BW                   | Bandwidth<br>$R_L = 50 \Omega$ , Switch ON, See Figure 16                                                                        | 25°C  | 1.8 V  |       | 150    |      | MHz           |
| $O_{\text{ISO}}$     | OFF isolation<br>$R_L = 50 \Omega$ , $f = 1 \text{ MHz}$ , Switch OFF, see Figure 17                                             | 25°C  | 1.8 V  |       | -62    |      | dB            |
| THD                  | Total harmonic distortion<br>$R_L = 600 \Omega$ , $C_L = 50 \text{ pF}$ , $f = 20 \text{ Hz to } 20 \text{ kHz}$ , see Figure 20 | 25°C  | 1.8 V  |       | 0.055% |      |               |
| <b>Supply</b>        |                                                                                                                                  |       |        |       |        |      |               |
| $I_+$                | Positive supply current<br>$V_I = V_+$ or GND, Switch ON or OFF                                                                  | 25°C  | 1.95 V | 0.001 |        | 0.01 | $\mu\text{A}$ |
|                      |                                                                                                                                  | Full  |        |       |        | 0.15 |               |

## 6.9 Switching Characteristics: 5-V Supply

 $V_+ = 4.5 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER        | TEST CONDITIONS                                                                                    | $T_A$ | $V_+$          | MIN | TYP | MAX | UNIT |
|------------------|----------------------------------------------------------------------------------------------------|-------|----------------|-----|-----|-----|------|
| <b>Dynamic</b>   |                                                                                                    |       |                |     |     |     |      |
| $t_{\text{ON}}$  | Turnon time<br>$V_{\text{COM}} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , see Figure 15  | 25°C  | 5 V            | 1   | 4.5 | 7.5 | ns   |
|                  |                                                                                                    | Full  | 4.5 V to 5.5 V | 1   |     | 9   |      |
| $t_{\text{OFF}}$ | Turnoff time<br>$V_{\text{COM}} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , see Figure 15 | 25°C  | 5 V            | 4.5 | 8   | 11  | ns   |
|                  |                                                                                                    | Full  | 4.5 V to 5.5 V | 3.5 |     | 13  |      |

(1) The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

## 6.10 Switching Characteristics: 3.3-V Supply

 $V_+ = 3 \text{ V to } 3.6 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER        | TEST CONDITIONS                                                                                    | $T_A$ | $V_+$        | MIN | TYP | MAX  | UNIT |
|------------------|----------------------------------------------------------------------------------------------------|-------|--------------|-----|-----|------|------|
| <b>Dynamic</b>   |                                                                                                    |       |              |     |     |      |      |
| $t_{\text{ON}}$  | Turnon time<br>$V_{\text{COM}} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , see Figure 15  | 25°C  | 3.3 V        | 1.5 | 5   | 9.5  | ns   |
|                  |                                                                                                    | Full  | 3 V to 3.6 V | 1   |     | 10   |      |
| $t_{\text{OFF}}$ | Turnoff time<br>$V_{\text{COM}} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , see Figure 15 | 25°C  | 3.3 V        | 4.5 | 8.5 | 11   | ns   |
|                  |                                                                                                    | Full  | 3 V to 3.6 V | 3   |     | 12.5 |      |

(1) The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

## 6.11 Switching Characteristics: 2.5-V Supply

 $V_+ = 2.3 \text{ V to } 2.7 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER        | TEST CONDITIONS                                                                                    | $T_A$ | $V_+$          | MIN | TYP | MAX  | UNIT |
|------------------|----------------------------------------------------------------------------------------------------|-------|----------------|-----|-----|------|------|
| <b>Dynamic</b>   |                                                                                                    |       |                |     |     |      |      |
| $t_{\text{ON}}$  | Turnon time<br>$V_{\text{COM}} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , see Figure 15  | 25°C  | 2.5 V          | 2   | 6   | 10   | ns   |
|                  |                                                                                                    | Full  | 2.3 V to 2.7 V | 1   |     | 12   |      |
| $t_{\text{OFF}}$ | Turnoff time<br>$V_{\text{COM}} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , see Figure 15 | 25°C  | 2.5 V          | 4.5 | 8   | 12.5 | ns   |
|                  |                                                                                                    | Full  | 2.3 V to 2.7 V | 3   |     | 15   |      |

(1) The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

## 6.12 Switching Characteristics: 1.8-V Supply

 $V_+ = 1.65\text{ V to }1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)<sup>(1)</sup>

| PARAMETER        |              | TEST CONDITIONS                                               |                                                          | T <sub>A</sub> | V <sub>+</sub>      | MIN | TYP | MAX  | UNIT |
|------------------|--------------|---------------------------------------------------------------|----------------------------------------------------------|----------------|---------------------|-----|-----|------|------|
| Dynamic          |              |                                                               |                                                          |                |                     |     |     |      |      |
| t <sub>ON</sub>  | Turnon time  | V <sub>COM</sub> = V <sub>+</sub> ,<br>R <sub>L</sub> = 50 Ω, | C <sub>L</sub> = 35 pF,<br>see <a href="#">Figure 15</a> | 25°C           | 1.8 V               | 3   | 9   | 18   | ns   |
|                  |              |                                                               |                                                          | Full           | 1.65 V to<br>1.95 V | 1   |     | 20   |      |
| t <sub>OFF</sub> | Turnoff time | V <sub>COM</sub> = V <sub>+</sub> ,<br>R <sub>L</sub> = 50 Ω, | C <sub>L</sub> = 35 pF,<br>see <a href="#">Figure 15</a> | 25°C           | 1.8 V               | 5   | 10  | 15.5 | ns   |
|                  |              |                                                               |                                                          | Full           | 1.65 V to<br>1.95 V | 4   |     | 18.5 |      |

(1) The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

## 6.13 Typical Characteristics

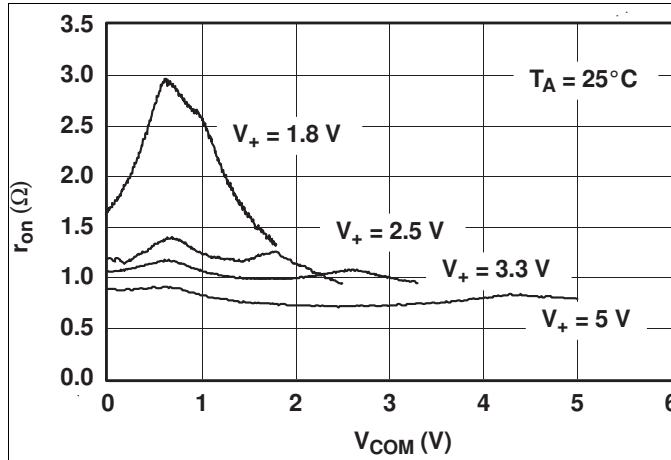


Figure 1.  $r_{on}$  vs  $V_{COM}$

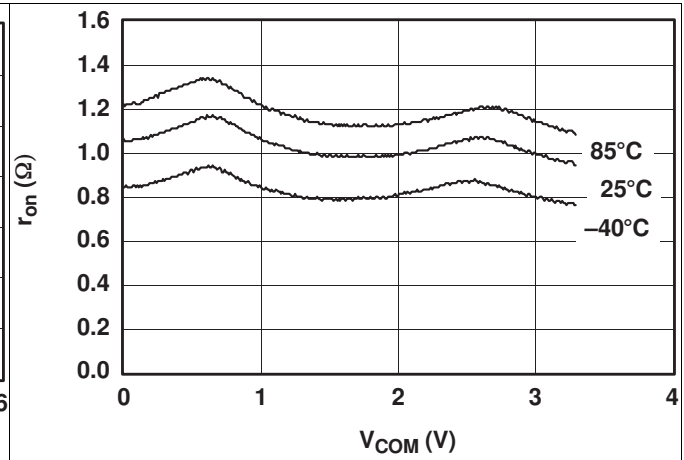


Figure 2.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 3.3$  V)

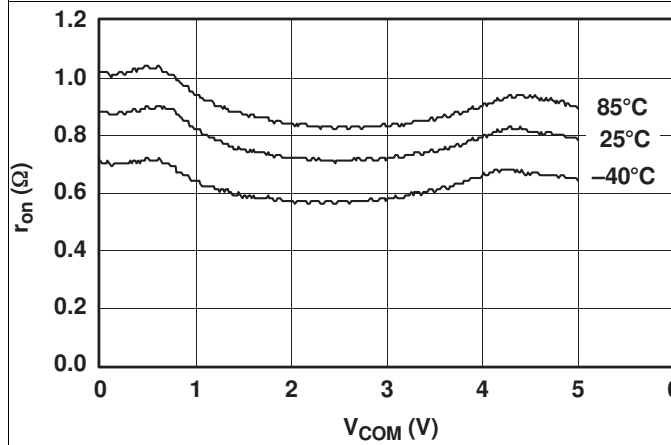


Figure 3.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 5$  V)

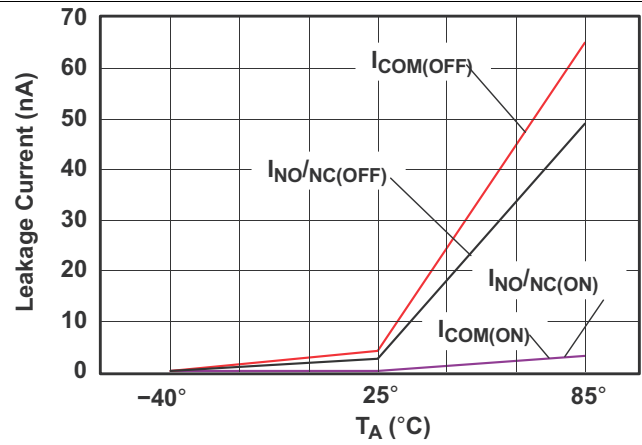


Figure 4. Leakage Current vs Temperature ( $V_+ = 5.5$  V)

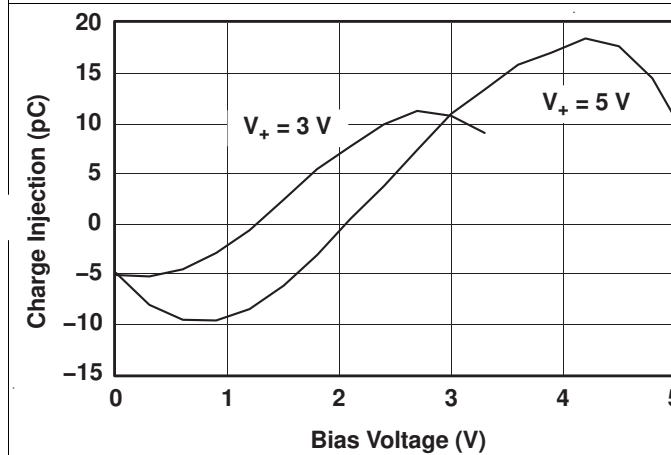


Figure 5. Charge Injection ( $Q_C$ ) vs  $V_{COM}$

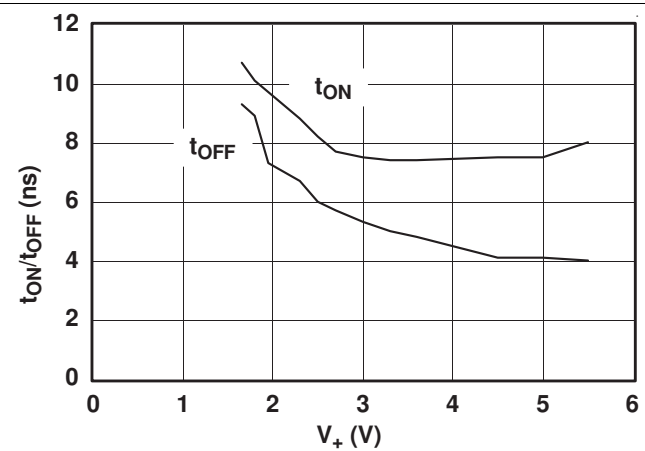


Figure 6.  $t_{ON}$  and  $t_{OFF}$  vs Supply Voltage

## Typical Characteristics (continued)

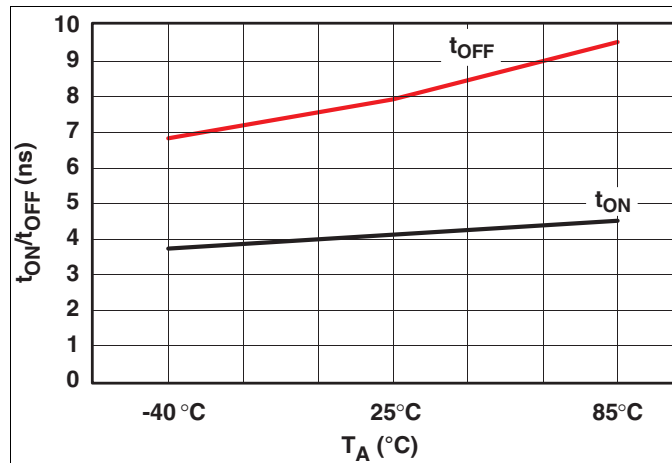


Figure 7.  $t_{ON}$  and  $t_{OFF}$  vs Temperature ( $V_+ = 5$  V)

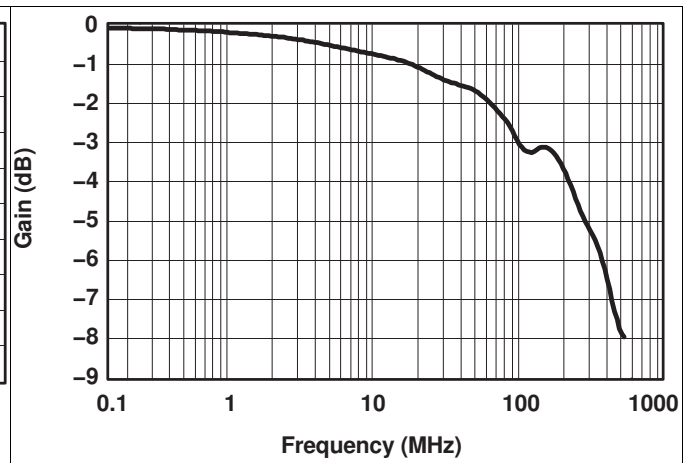


Figure 8. Bandwidth ( $V_+ = 5$  V)

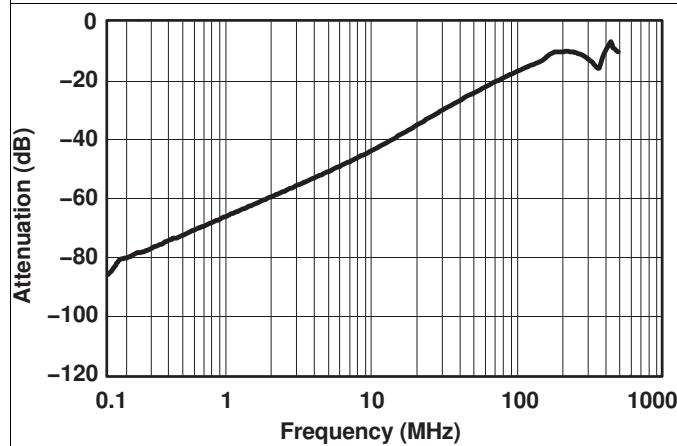


Figure 9. OFF Isolation and Crosstalk ( $V_+ = 5$  V)

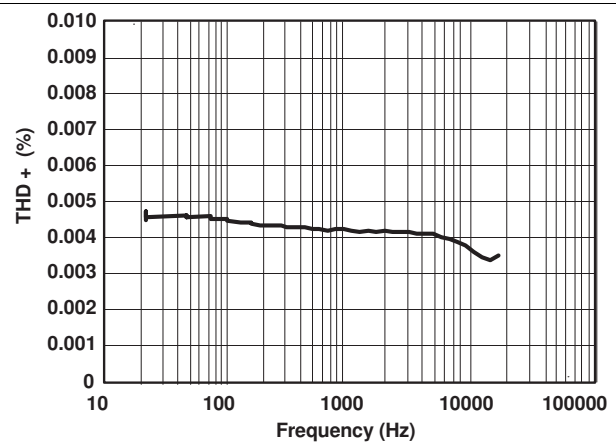
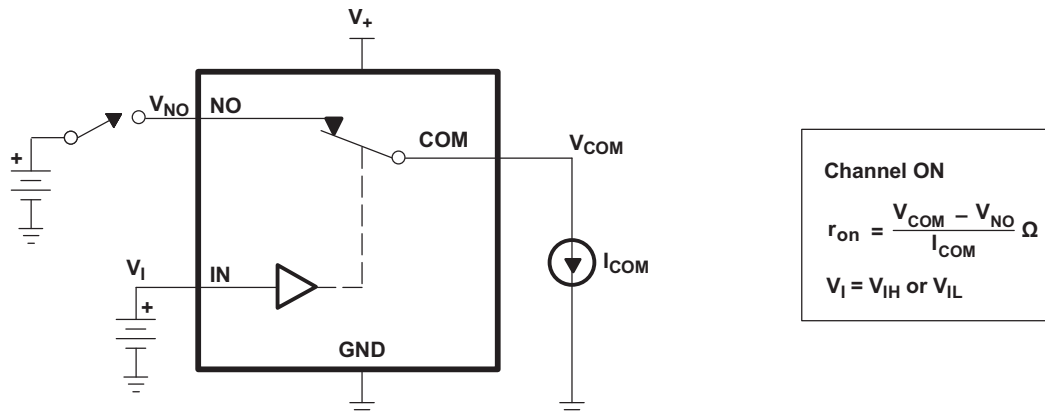
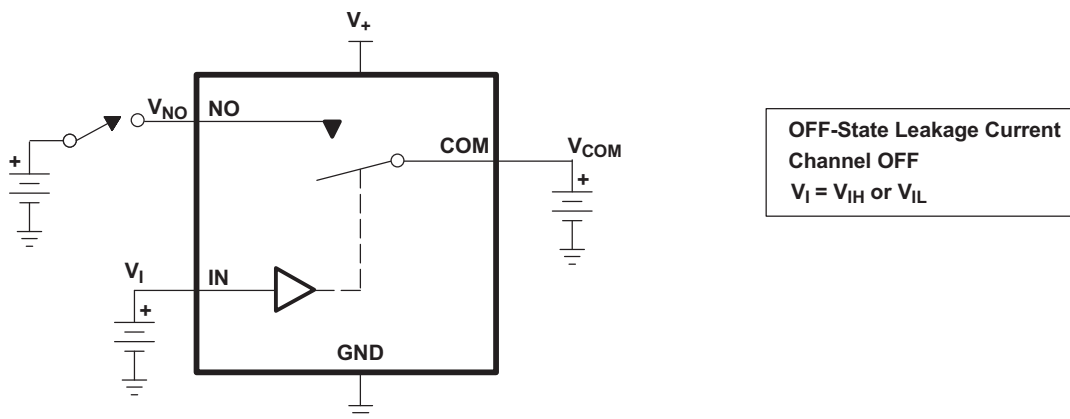


Figure 10. Total Harmonic Distortion vs Frequency

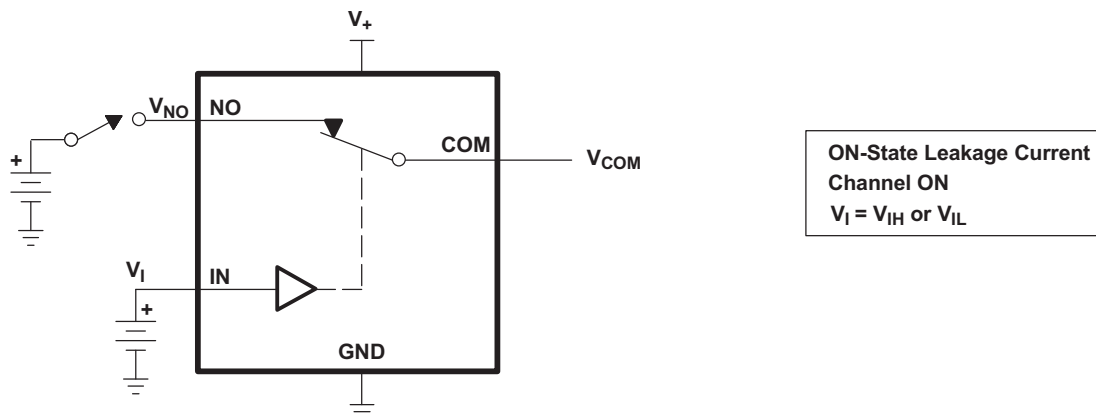
## 7 Parameter Measurement Information



**Figure 11. ON-State Resistance ( $r_{on}$ )**



**Figure 12. OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NC(OFF)}$ ,  $I_{COM(PWROFF)}$ ,  $I_{NC(PWR(F))}$ )**



**Figure 13. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ )**

## Parameter Measurement Information (continued)

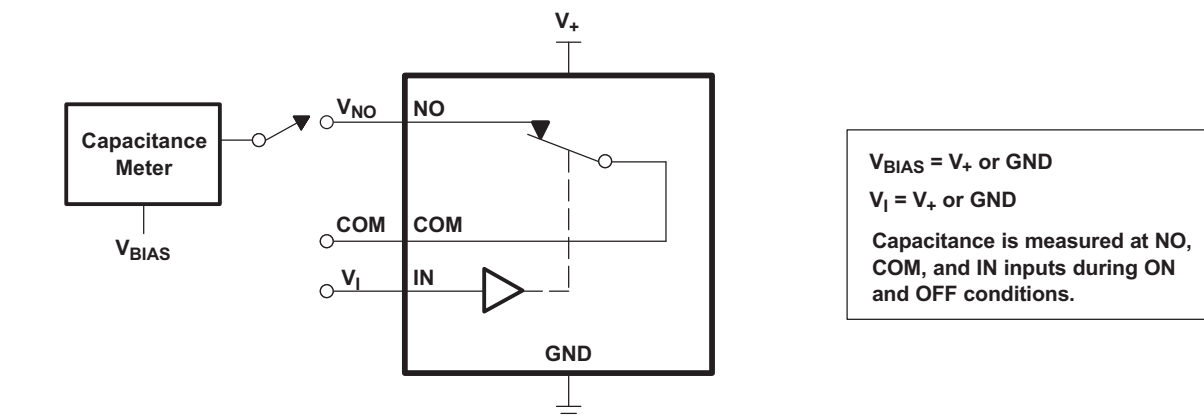
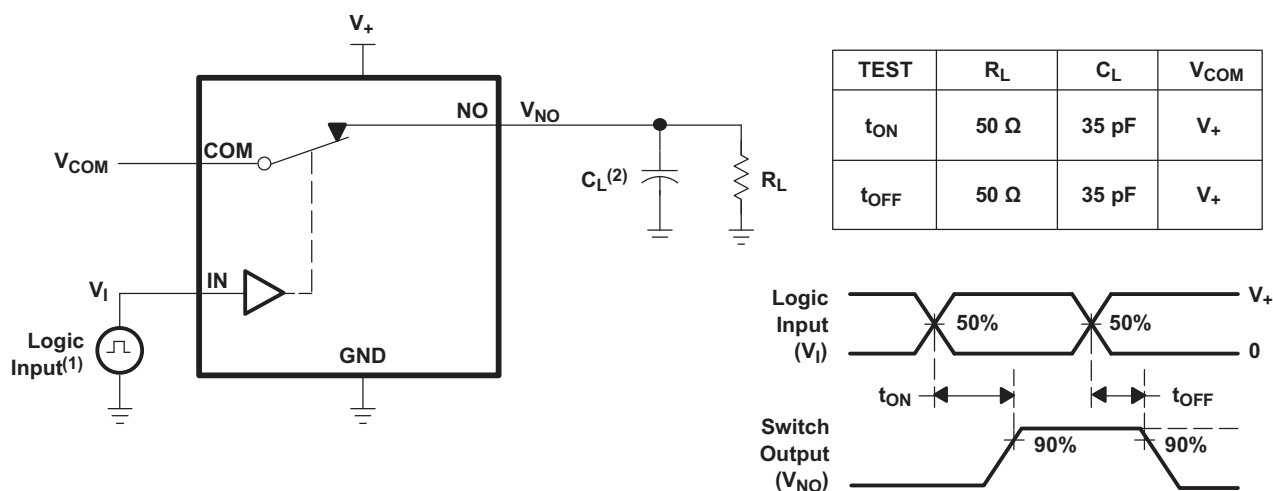


Figure 14. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NC(ON)}$ )



- (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 15. Turnon ( $t_{ON}$ ) and Turnoff Time ( $t_{OFF}$ )

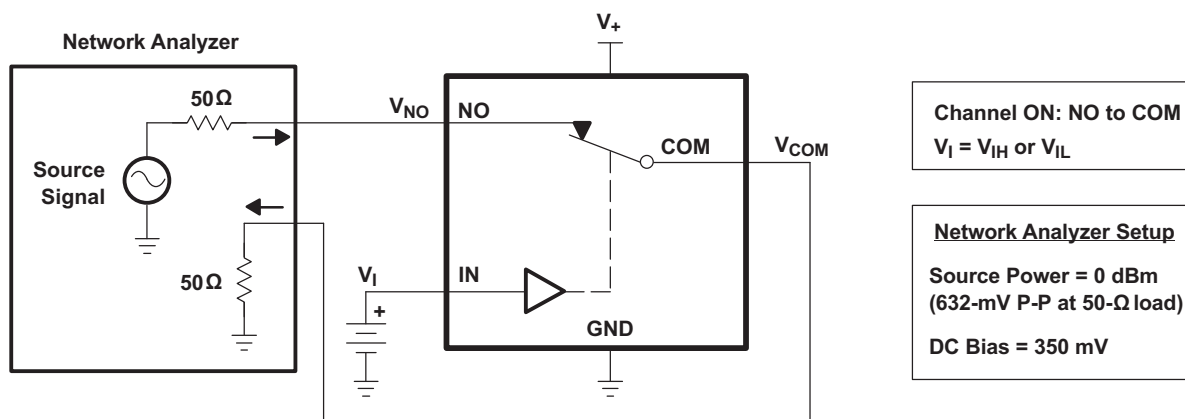
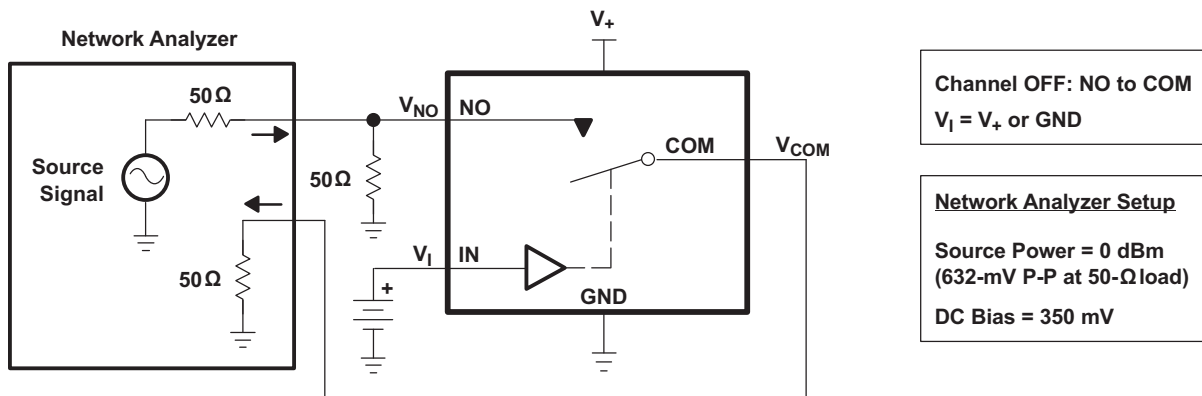
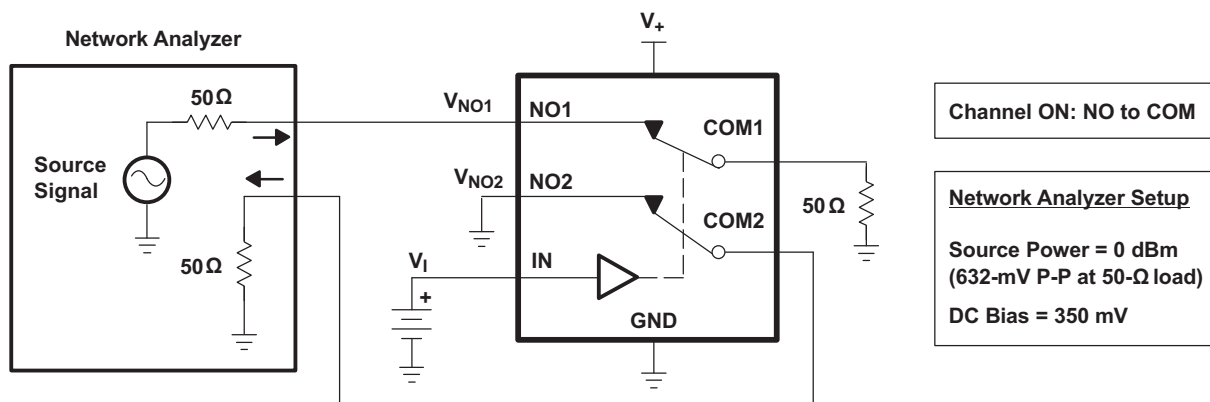


Figure 16. Bandwidth (BW)

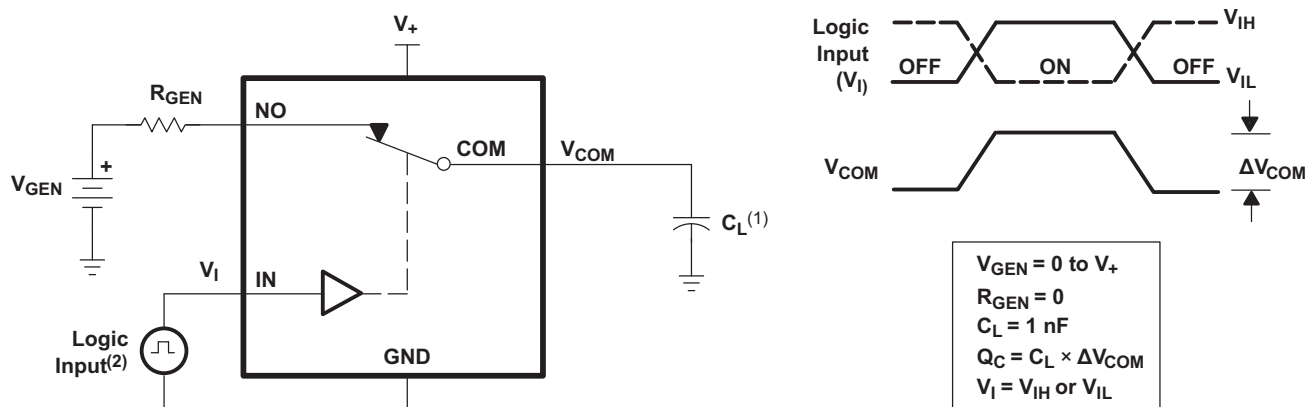
## Parameter Measurement Information (continued)



**Figure 17. OFF Isolation ( $O_{ISO}$ )**



**Figure 18. Crosstalk ( $X_{TALK}$ )**

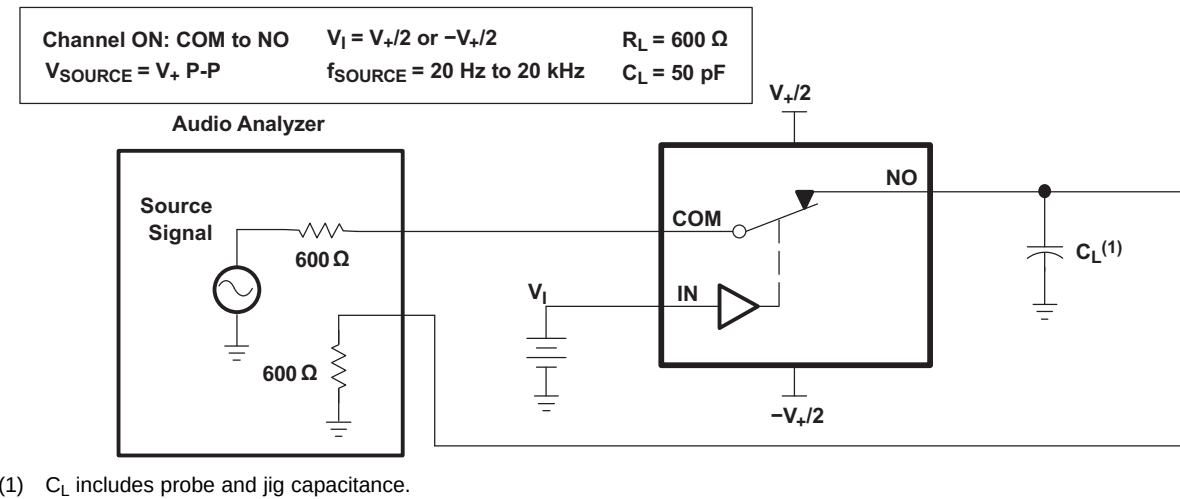


- (1)  $C_L$  includes probe and jig capacitance.
- (2) All input pulses are supplied by generators having the following characteristics:  
 $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r < 5 \text{ ns}$ ,  $t_f < 5 \text{ ns}$ .

**Figure 19. Charge Injection ( $Q_C$ )**



## Parameter Measurement Information (continued)



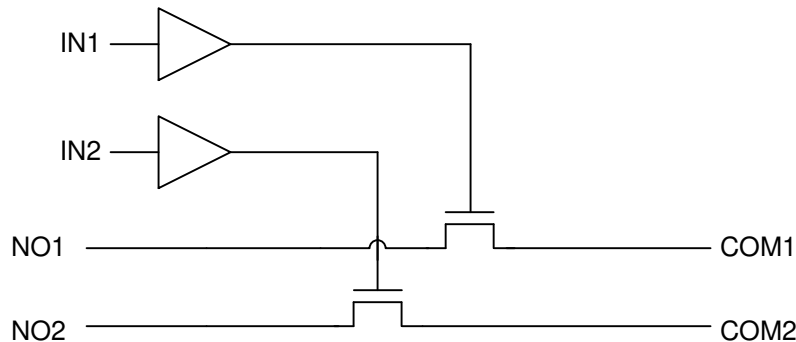
**Figure 20. Total Harmonic Distortion (THD)**

## 8 Detailed Description

### 8.1 Overview

The TS5A23166 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 TS5A23166.

**Table 1. Function Table**

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

## 9 Application and Implementation

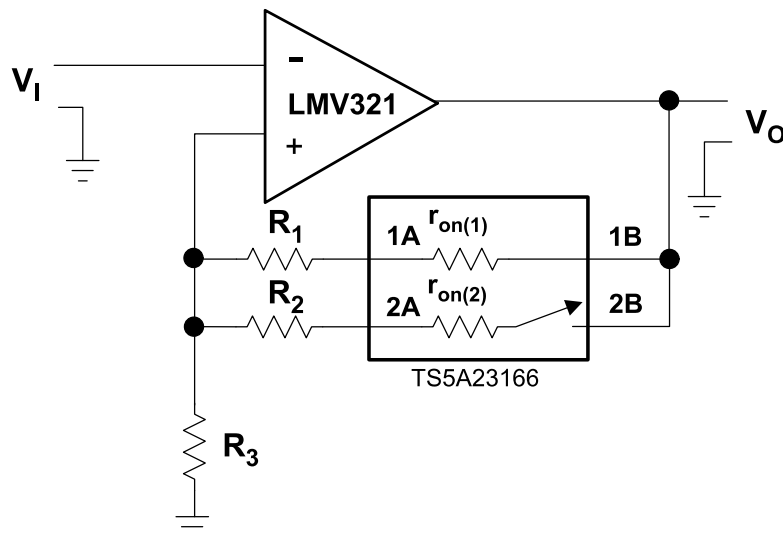
### NOTE

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 TS5A23166 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 21. 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 TS5A23166 can be ignored. The gain of op amp can be calculated as follow:

$$V_O / V_I = 1 + R_{||} / R_3 \quad (1)$$

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

#### 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

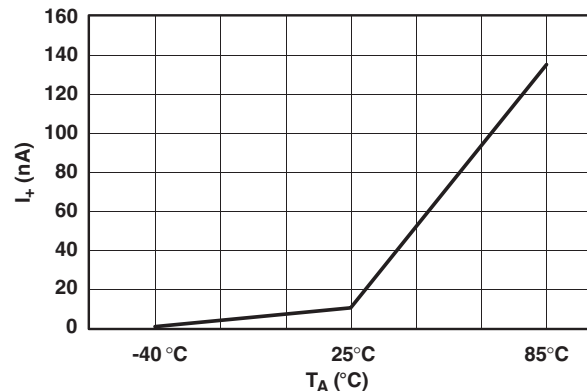


Figure 22. Power-Supply Current vs Temperature ( $V_+ = 5\text{ V}$ )

## 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 VCC 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 23](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

### 11.2 Layout Example

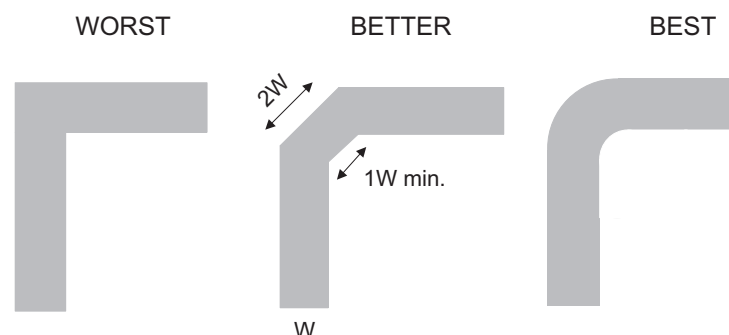


Figure 23. Trace Example

## 12 器件和文档支持

### 12.1 器件支持

#### 12.1.1 器件命名规则

表 2. 参数 说明

| 符号                | 说明                                                                                                                                                                     |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{COM}$         | COM 处的电压                                                                                                                                                               |
| $V_{NO}$          | NO 处的电压                                                                                                                                                                |
| $r_{on}$          | 通道导通时 COM 和 NO 端口之间的电阻                                                                                                                                                 |
| $r_{peak}$        | 额定电压范围的通态电阻峰值                                                                                                                                                          |
| $r_{on(Flat)}$    | 额定条件范围内, 同一通道内 $r_{on}$ 最大值与最小值之间的差值                                                                                                                                   |
| $I_{NO(OFF)}$     | 在最不理想的输入和输出条件下, 相应通道 (NO 到 COM) 处于关断状态时, 在 NO 端口测得的泄漏电流                                                                                                                |
| $I_{NO(PWROFF)}$  | 在电源关断状态下, $V_+ = 0$ 时, 在 NO 端口测量的泄漏电流                                                                                                                                  |
| $I_{COM(OFF)}$    | 在最不理想的输入和输出条件下, 相应通道 (COM 到 NO) 处于关断状态时, 在 COM 端口测得的泄漏电流                                                                                                               |
| $I_{COM(PWROFF)}$ | 在电源关断状态下, $V_+ = 0$ 时, 在 COM 端口测量的泄漏电流                                                                                                                                 |
| $I_{NO(ON)}$      | 相应通道 (NO 到 COM) 处于导通状态且输出 (COM) 处于开路状态时, 在 NO 端口测得的泄漏电流                                                                                                                |
| $I_{COM(ON)}$     | 相应通道 (COM 到 NO) 处于导通状态且输出 (NO) 处于开路状态时, 在 COM 端口测得的泄漏电流                                                                                                                |
| $V_{IH}$          | 控制输入 (IN) 逻辑高电平的最小输入电压                                                                                                                                                 |
| $V_{IL}$          | 控制输入 (IN) 逻辑低电平的最大输入电压                                                                                                                                                 |
| $V_I$             | 控制输入 (IN) 处的电压                                                                                                                                                         |
| $I_{IH}, I_{IL}$  | 控制输入 (IN) 处测量的泄漏电流                                                                                                                                                     |
| $t_{ON}$          | 开关导通时间。此参数是在特定条件范围内, 开关导通时, 通过数字控制 (IN) 信号和模拟输出 (COM 或 NO) 信号之间的传播延迟测量得出。                                                                                              |
| $t_{OFF}$         | 开关关断时间。此参数是在特定条件范围内, 开关关断时, 通过数字控制 (IN) 信号和模拟输出 (COM 或 NO) 信号之间的传播延迟测量得出。                                                                                              |
| $Q_C$             | 电荷注入是对从控制 (IN) 输入到模拟 (NO 或 COM) 输出产生的多余信号耦合的度量。电荷注入以库仑为单位, 可通过测量开关控制输入产生的总感应电荷得出该值。电荷注入, $Q_C = C_L \times \Delta V_{COM}$ , $C_L$ 是负载电容, $\Delta V_{COM}$ 是模拟输出电压的变化。 |
| $C_{NO(OFF)}$     | 相应通道 (NO 到 COM) 关断时 NO 端口的电容                                                                                                                                           |
| $C_{COM(OFF)}$    | 相应通道 (COM 到 NO) 关断时 COM 端口的电容                                                                                                                                          |
| $C_{NO(ON)}$      | 相应通道 (NO 到 COM) 导通时 NO 端口的电容                                                                                                                                           |
| $C_{COM(ON)}$     | 相应通道 (COM 到 NO) 导通时 COM 端口的电容                                                                                                                                          |
| $C_I$             | 控制输入 (IN) 电容                                                                                                                                                           |
| $O_{ISO}$         | 开关关断隔离用于衡量关断状态开关阻抗的大小。关断隔离以 dB 为单位, 当相应通道 (NO 到 COM) 处于关断状态时, 在特定频率下测量得出。                                                                                              |
| BW                | 开关带宽。这是导通通道增益低于直流增益 -3dB 时的频率。                                                                                                                                         |
| THD               | 总谐波失真用于描述由模拟开关导致的信号失真。其定义为二次、三次和更高次谐波与基波绝对幅度之比的均方根 (RMS) 值。                                                                                                            |
| $I_+$             | 静态电源电流, 以及 $V_+$ 或 GND 的控制 (IN) 引脚                                                                                                                                     |

## 12.2 接收文档更新通知

要接收文档更新通知，请导航至 [TI.com.cn](http://TI.com.cn) 上的器件产品文件夹。单击右上角的 [通知我](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

## 12.3 社区资源

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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## 12.4 商标

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All other trademarks are the property of their respective owners.

## 12.5 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

## 12.6 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 13 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此数据表的浏览器版本，请查阅左侧的导航栏。

## 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="#">TS5A23166DCUR</a>   | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (AM, JAMQ, JAMR)<br>JZ |
| TS5A23166DCUR.B                 | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (AM, JAMQ, JAMR)<br>JZ |
| <a href="#">TS5A23166DCURG4</a> | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | JAMR                   |
| TS5A23166DCURG4.B               | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | JAMR                   |
| <a href="#">TS5A23166YZPR</a>   | Active        | Production           | DSBGA (YZP)   8 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    | JMN                    |
| TS5A23166YZPR.B                 | Active        | Production           | DSBGA (YZP)   8 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    | JMN                    |
| <a href="#">TS5A23166YZTR</a>   | Active        | Production           | DSBGA (YZT)   8 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    | JMN                    |
| TS5A23166YZTR.B                 | Active        | Production           | DSBGA (YZT)   8 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    | JMN                    |

<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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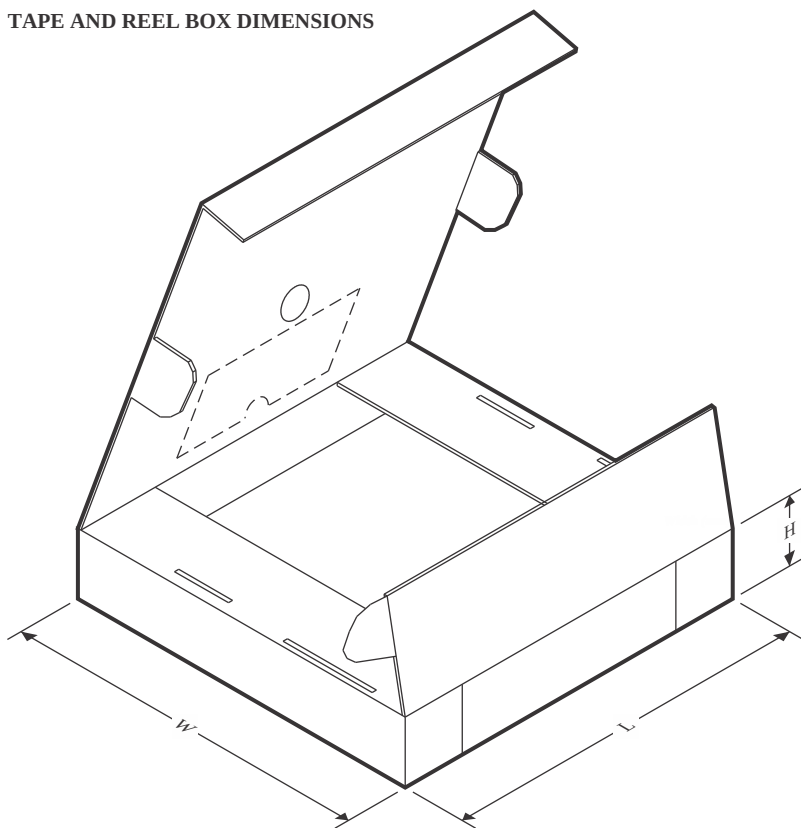
## TAPE AND REEL INFORMATION



\*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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TS5A23166DCUR   | VSSOP        | DCU             | 8    | 3000 | 178.0              | 9.5                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| TS5A23166DCURG4 | VSSOP        | DCU             | 8    | 3000 | 180.0              | 8.4                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| TS5A23166YZPR   | DSBGA        | YZP             | 8    | 3000 | 178.0              | 9.2                | 1.02    | 2.02    | 0.63    | 4.0     | 8.0    | Q1            |
| TS5A23166YZTR   | DSBGA        | YZT             | 8    | 3000 | 178.0              | 9.2                | 1.02    | 2.02    | 0.75    | 4.0     | 8.0    | Q1            |

## TAPE AND REEL BOX DIMENSIONS

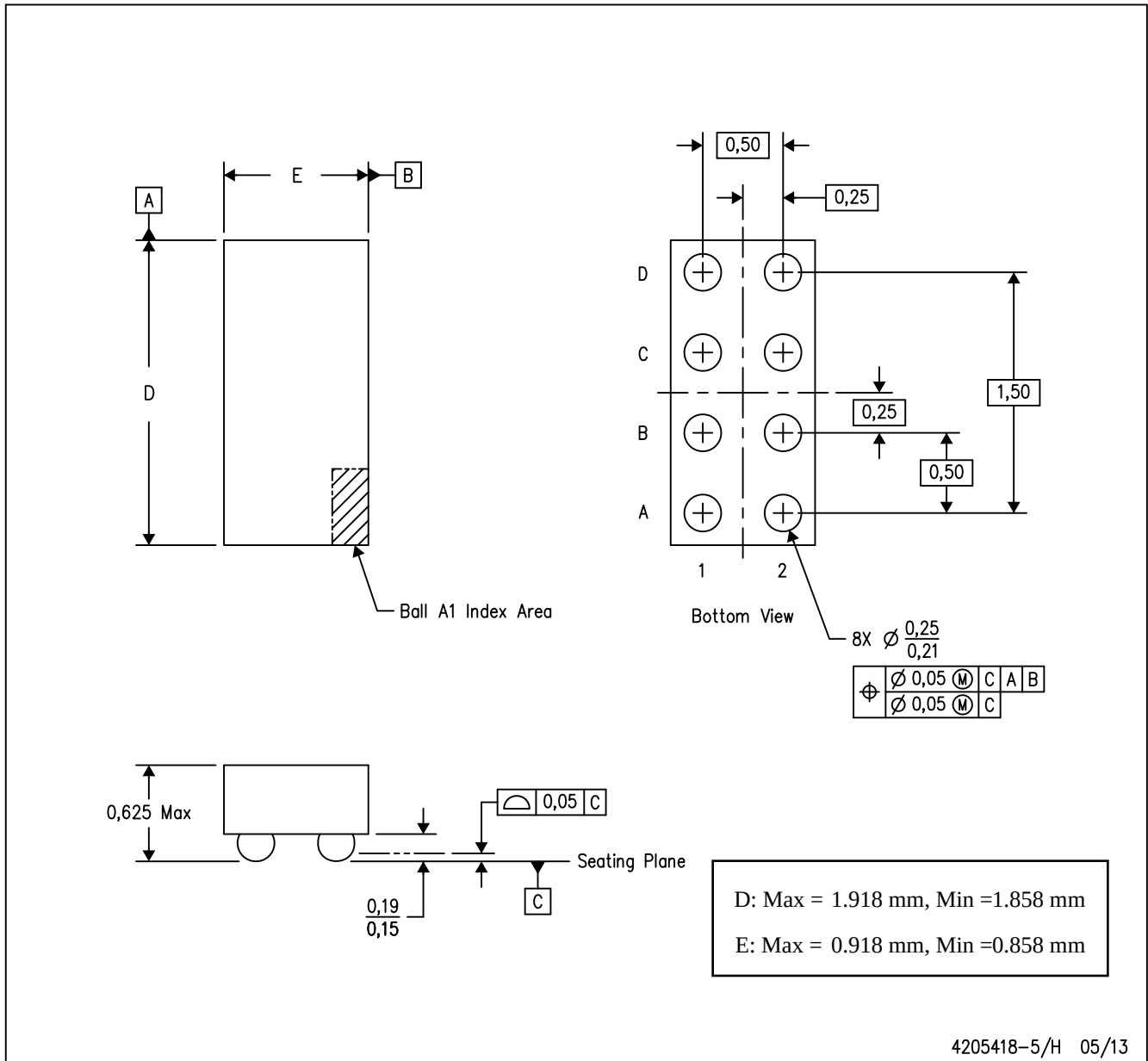


\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TS5A23166DCUR   | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| TS5A23166DCURG4 | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| TS5A23166YZPR   | DSBGA        | YZP             | 8    | 3000 | 220.0       | 220.0      | 35.0        |
| TS5A23166YZTR   | DSBGA        | YZT             | 8    | 3000 | 220.0       | 220.0      | 35.0        |

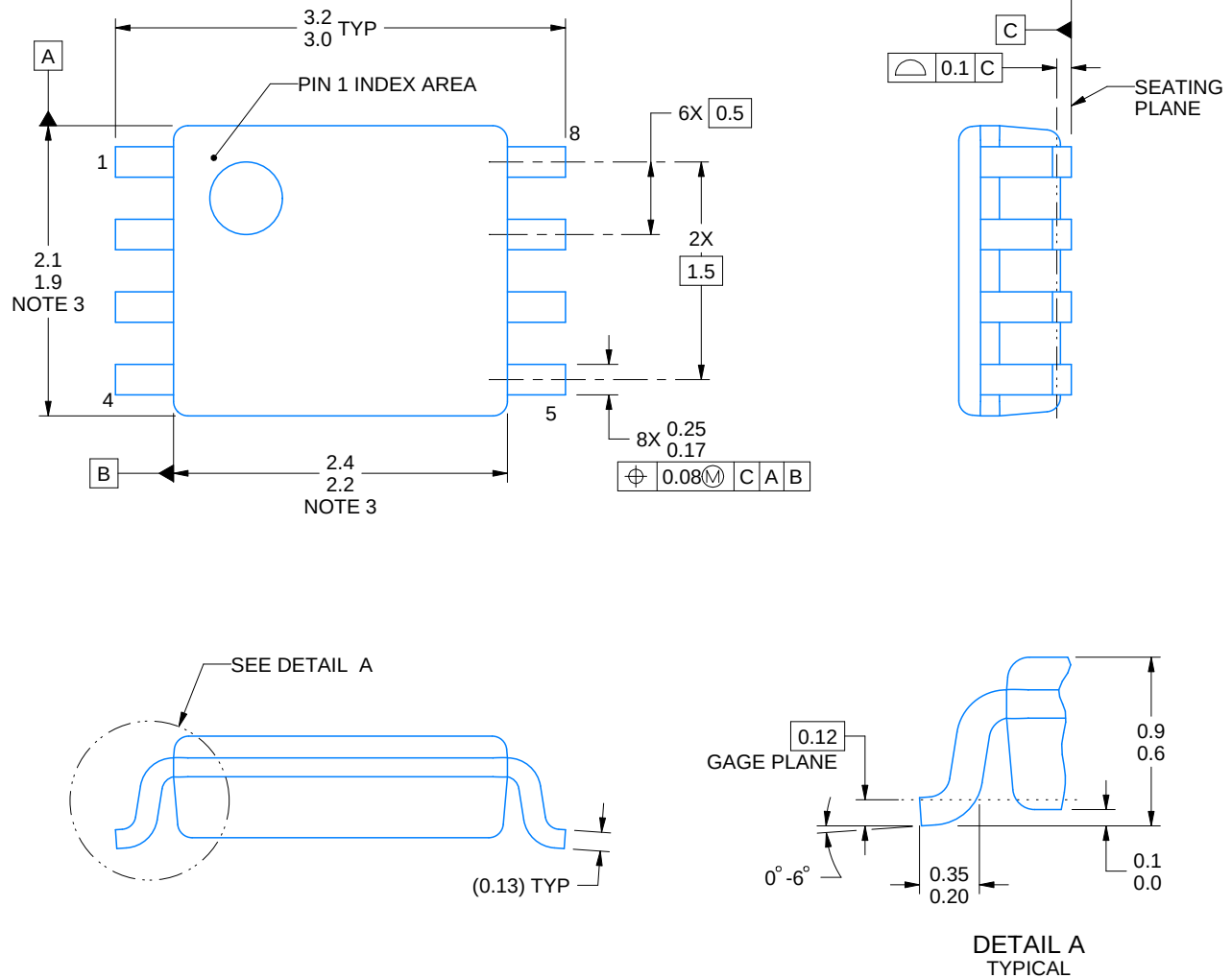
YZT (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.

NanoFree is a trademark of Texas Instruments.



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## NOTES:

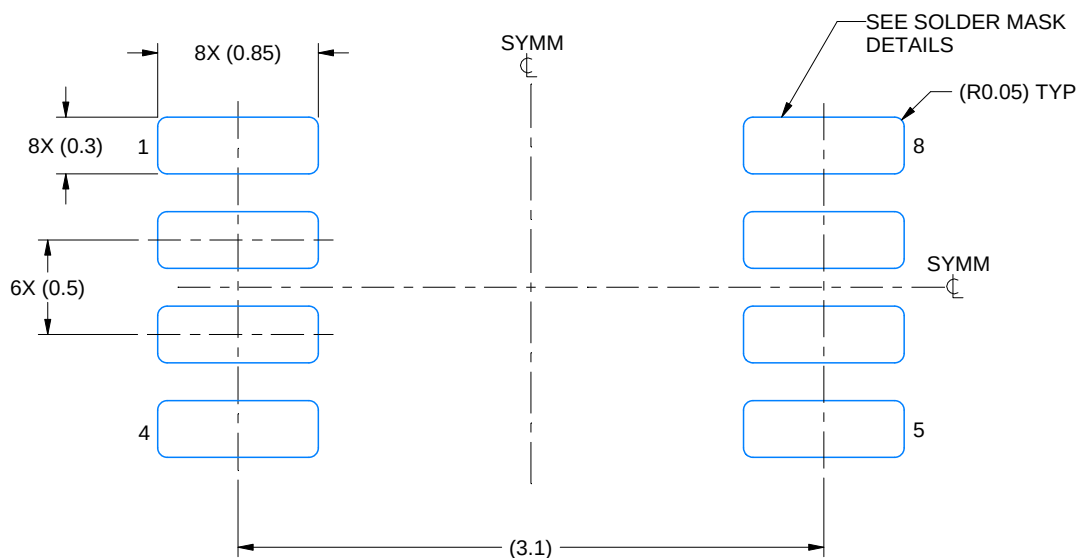
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

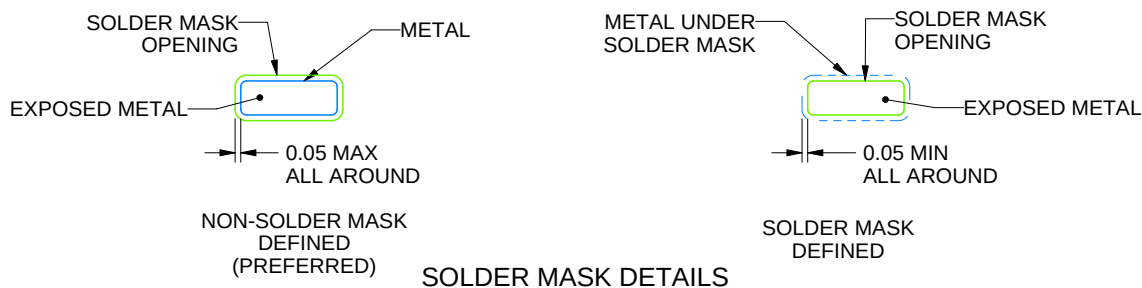
DCU0008A

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.

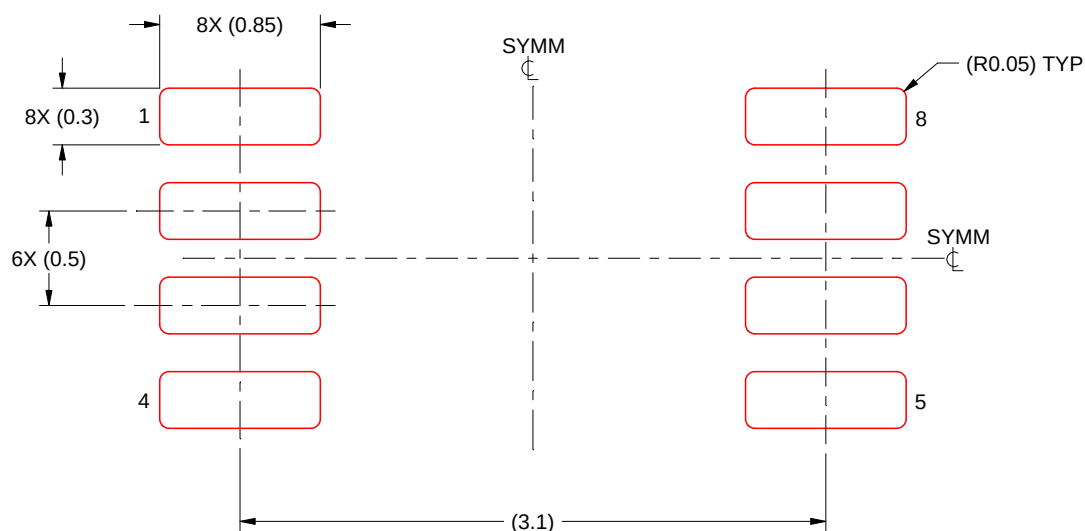
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DCU0008A

VSSOP - 0.9 mm max height

SMALL OUTLINE PACKAGE



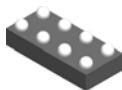
SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 25X

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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.

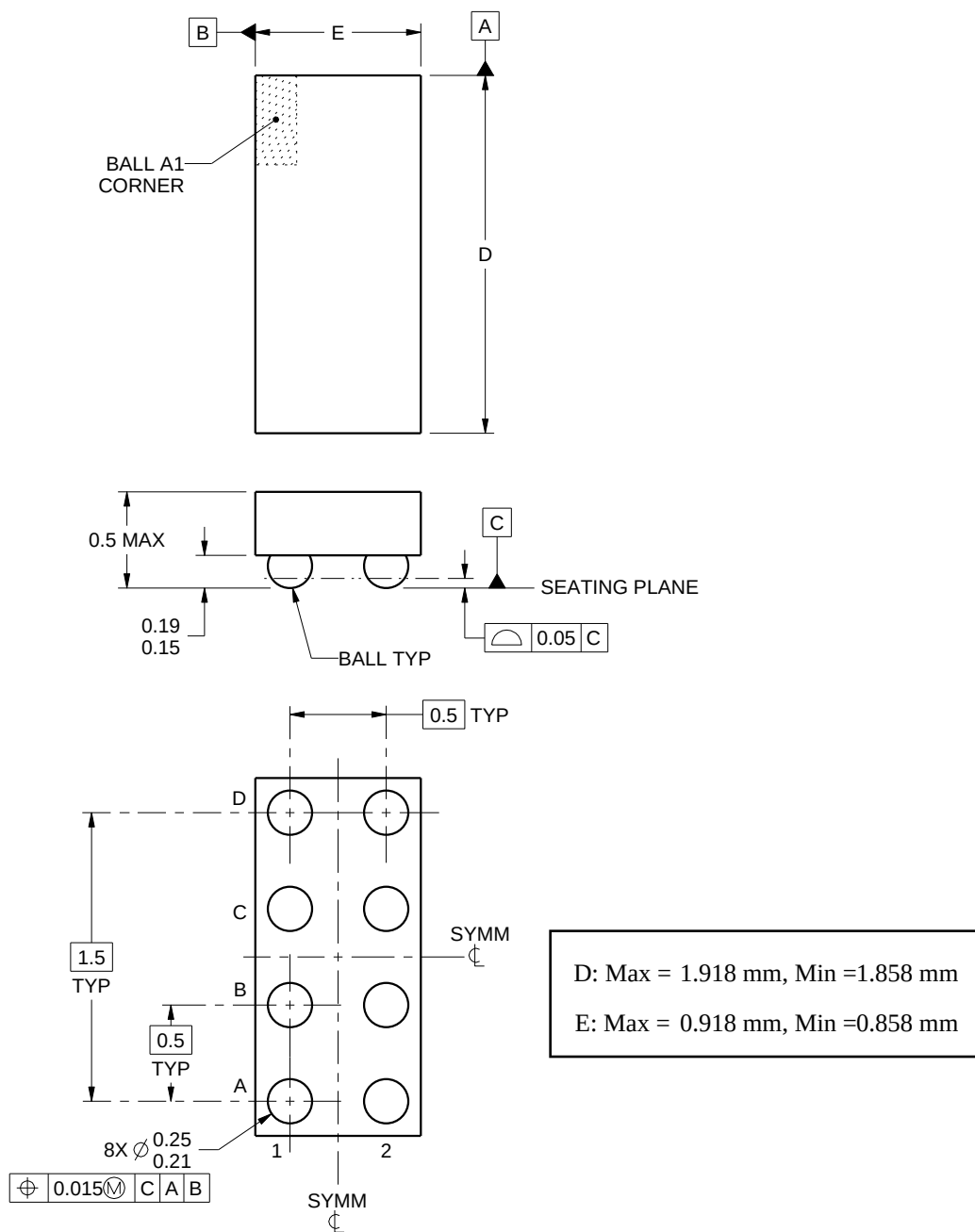
YZP0008



# PACKAGE OUTLINE

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



4223082/A 07/2016

## NOTES:

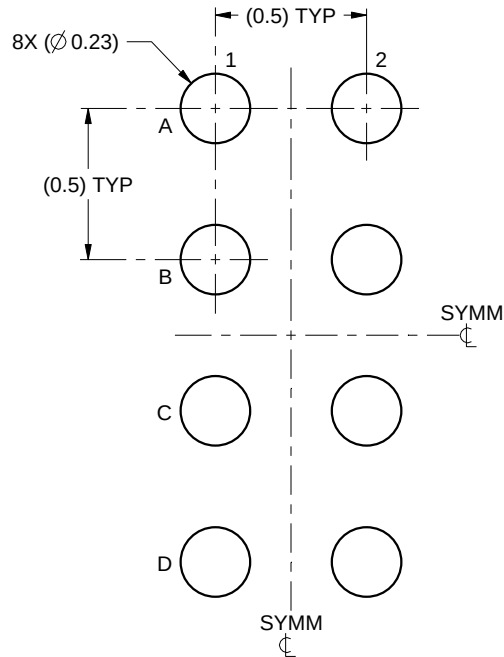
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

# EXAMPLE BOARD LAYOUT

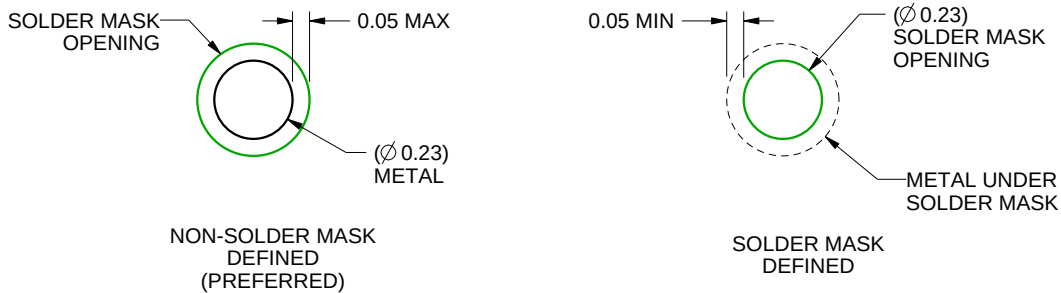
YZP0008

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:40X



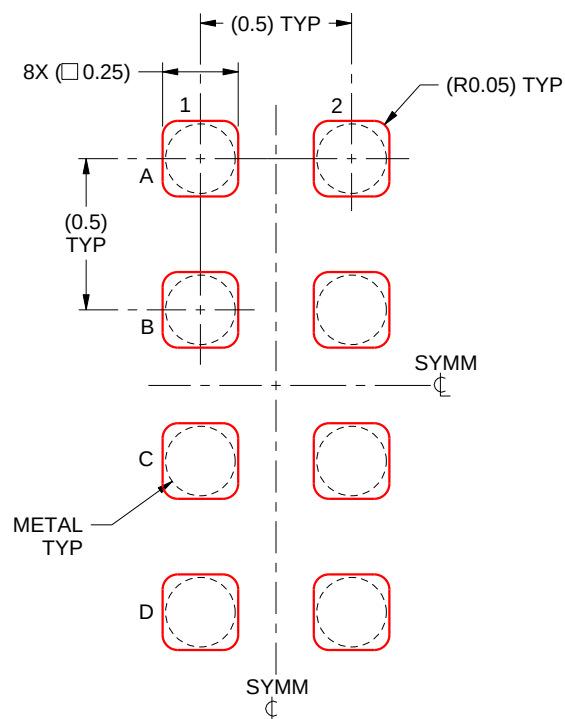
SOLDER MASK DETAILS  
NOT TO SCALE

4223082/A 07/2016

NOTES: (continued)

- 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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