

## 0.75-Ω SPDT ANALOG SWITCH WITH INPUT LOGIC TRANSLATION

 Check for Samples: [TS5A6542](#)

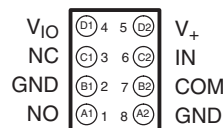
### FEATURES

- Specified Break-Before-Make Switching
- Low ON-State Resistance (0.75 Ω Max)
- Control Inputs Referenced to  $V_{IO}$
- Low Charge Injection
- Excellent ON-State Resistance Matching
- Low Total Harmonic Distortion (THD)
- 2.25-V to 5.5-V Power Supply ( $V_+$ )
- 1.65-V to 1.95-V Logic Supply ( $V_{IO}$ )
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
  - 4000-V Human-Body Model (A114-B, Class II)
  - 1000-V Charged-Device Model (C101)
  - 400-V Machine Model (A115-A)

- COM Port to GND
  - 8000-V Human-Body Model (A114-B, Class II)
  - ±15-kV Contact Discharge (IEC 61000-4-2)

### APPLICATIONS

- Cell Phones
- PDAs
- Portable Instrumentation

**YZP PACKAGE  
(BOTTOM VIEW)**


### DESCRIPTION/ORDERING INFORMATION

The TS5A6542 is a single-pole double-throw (SPDT) analog switch that is designed to operate from 2.25 V to 5.5 V. The device offers a low ON-state resistance with an excellent channel-to-channel ON-state resistance matching, and the break-before-make feature to prevent signal distortion during the transferring of a signal from one path to another. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications.

The TS5A6542 has a separate logic supply pin ( $V_{IO}$ ) that is characterized to operate from 1.65 V to 1.95 V.  $V_{IO}$  powers the control circuitry, which allows the TS5A6542 to be controlled by 1.8-V signals.

**Table 1. ORDERING INFORMATION<sup>(1)</sup>**

| $T_A$         | PACKAGE <sup>(2)</sup>  |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING <sup>(3)</sup> |
|---------------|---|---------------|-----------------------|---------------------------------|
| –40°C to 85°C | NanoFree™ – WCSP (DSBGA)<br>0.23-mm Large Bump – YZP<br>(Pb-free) | Tape and reel | TS5A6542YZPR          | ___ JH7                         |

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

(2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

(3) YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the wafer fab/assembly site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

**SUMMARY OF CHARACTERISTICS<sup>(1)</sup>**

|   |   |
|---|---|
| Configuration                                   | 2:1 Multiplexer/Demultiplexer<br>(1 × SPDT) |
| Number of channels                              | 1   |
| ON-state resistance ( $r_{on}$ )                | 0.75 $\Omega$ max                           |
| ON-state resistance match ( $\Delta r_{on}$ )   | 0.1 $\Omega$ max                            |
| ON-state resistance flatness ( $r_{on(flat)}$ ) | 0.1 $\Omega$ max                            |
| Turn-on/turn-off time ( $t_{ON}/t_{OFF}$ )      | 25 ns/20 ns                                 |
| Charge injection ( $Q_C$ )                      | 15 pC                                       |
| Bandwidth (BW)                                  | 43 MHz                                      |
| OFF isolation ( $O_{ISO}$ )                     | -63 dB at 1 MHz                             |
| Crosstalk ( $X_{TALK}$ )                        | -63 dB at 1 MHz                             |
| Total harmonic distortion (THD)                 | 0.004%                                      |
| Leakage current ( $I_{NO(OFF)}/I_{NC(OFF)}$ )   | 20 nA                                       |
| Package option                                  | 8-pin WCSP                                  |

(1)  $V_+ = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ **FUNCTION TABLE**

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

**ABSOLUTE MAXIMUM RATINGS<sup>(1) (2)</sup>**

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

|                                   |  |  | <b>MIN</b> | <b>MAX</b>  | <b>UNIT</b> |
|-----------------------------------|--|--|------------|-------------|-------------|
| $V_+$<br>$V_{IO}$                 | Supply voltage range <sup>(3)</sup>            |  | -0.5       | 6.5         | V           |
| $V_{NC}$<br>$V_{NO}$<br>$V_{COM}$ | Analog voltage range <sup>(3) (4) (5)</sup>    |  | -0.5       | $V_+ + 0.5$ | V           |
| $I_{I/OK}$                        | Analog port diode current <sup>(6)</sup>       | $V_{NO}, V_{COM} < 0$ or $V_{NO}, V_{COM} > V_+$ | -50        | 50          | mA          |
| $I_{NC}$<br>$I_{NO}$<br>$I_{COM}$ | On-state switch current                        | $V_{NO}, V_{COM} = 0$ to $V_+$                   | -450       | 450         | mA          |
|                                   | On-state peak switch current <sup>(7)</sup>    |  | -700       | 700         |             |
| $V_I$                             | Digital input voltage range <sup>(3) (4)</sup> |  | -0.5       | 6.5         | V           |
| $I_{IK}$                          | Digital input clamp current                    | $V_I < 0$  | -50        |             | mA          |
| $I_+$<br>$I_{GND}$                | Continuous current through $V_+$ or GND        |  | -100       | 100         | mA          |
| $T_{stg}$                         | Storage temperature range                      |  | -65        | 150         | °C          |

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

**THERMAL IMPEDANCE RATINGS**

|               |  |             |     | <b>UNIT</b> |
|---------------|--|-------------|-----|-------------|
| $\theta_{JA}$ | Package thermal impedance <sup>(1)</sup> | YZP package | 102 | °C/W        |

- (1) The package thermal impedance is calculated in accordance with JESD 51-7.

**ELECTRICAL CHARACTERISTICS FOR 5-V SUPPLY<sup>(1)</sup>**

V<sub>+</sub> = 4.5 V to 5.5 V, V<sub>IO</sub> = 1.65 V to 1.95 V, T<sub>A</sub> = –40°C to 85°C (unless otherwise noted)

| PARAMETER                                       | SYMBOL                                      | TEST CONDITIONS  | T <sub>A</sub> | V <sub>+</sub> | MIN                    | TYP  | MAX                    | UNIT |    |
|---|---|--|----------------|----------------|------------------------|------|------------------------|------|----|
| <b>Analog Switch</b>                            |   |  |                |                |                        |      |                        |      |    |
| Analog signal range                             | V <sub>COM</sub> , V <sub>NO</sub>          |  |                |                | 0                      |      | V <sub>+</sub>         | V    |    |
| ON-state resistance                             | r <sub>on</sub>                             | V <sub>NO</sub> or V <sub>NC</sub> = 2.5 V, I <sub>COM</sub> = –100 mA, Switch ON, See Figure 14   | 25°C           | 4.5 V          |                        | 0.5  | 0.75                   | Ω    |    |
|   |   |  | Full           |                |                        | 0.8  |                        |      |    |
| ON-state resistance match between channels      | Δr <sub>on</sub>                            | V <sub>NO</sub> or V <sub>NC</sub> = 2.5 V, I <sub>COM</sub> = –100 mA, Switch ON, See Figure 14   | 25°C           | 4.5 V          |                        | 0.05 | 0.1                    | Ω    |    |
|   |   |  | Full           |                |                        | 0.1  |                        |      |    |
| ON-state resistance flatness                    | r <sub>on(flat)</sub>                       | 0 ≤ (V <sub>NO</sub> or V <sub>NC</sub> ) ≤ V <sub>+</sub> , I <sub>COM</sub> = –100 mA, Switch ON, See Figure 14  | 25°C           | 4.5 V          |                        | 0.1  |                        | Ω    |    |
|   |   |  | 25°C           |                |                        | 0.1  | 0.25                   |      |    |
|   |   | Full   | 0.25           |                |                        |      |                        |      |    |
| NO, NC OFF leakage current                      | I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub> | V <sub>NO</sub> = 1 V, 4.5 V, V <sub>COM</sub> = 4.5 V, 1 V, V <sub>NC</sub> = Open, or V <sub>NC</sub> = 1 V, 4.5 V, V <sub>COM</sub> = 4.5 V, 1 V, V <sub>NO</sub> = Open, Switch OFF, See Figure 15 | 25°C           | 5.5 V          |                        | –20  | 2                      | 20   | nA |
|   |   |  | Full           |                |                        | –100 | 100                    |      |    |
| NC, NO ON leakage current                       | I <sub>NO(ON)</sub>                         | V <sub>NO</sub> = 1 V, 4.5 V, V <sub>COM</sub> , V <sub>NC</sub> = Open, or V <sub>NC</sub> = 1 V, 4.5 V, V <sub>COM</sub> , V <sub>NO</sub> = Open, Switch ON, See Figure 16                          | 25°C           | 5.5 V          |                        | –20  | 2                      | 20   | nA |
|   |   |  | Full           |                |                        | –200 | 200                    |      |    |
| COM ON leakage current                          | I <sub>COM(ON)</sub>                        | V <sub>COM</sub> = 1 V, 4.5 V, V <sub>NO</sub> and V <sub>NC</sub> = Open, or V <sub>COM</sub> = 1 V, 4.5 V, V <sub>NO</sub> or V <sub>NC</sub> = Open, See Figure 16                                  | 25°C           | 5.5 V          |                        | –20  | 2                      | 20   | nA |
|   |   |  | Full           |                |                        | –200 | 200                    |      |    |
| <b>Digital Control Input (IN)<sup>(2)</sup></b> |   |  |                |                |                        |      |                        |      |    |
| Input logic high                                | V <sub>IH</sub>                             | V <sub>IO</sub> = 1.65 V to 1.95 V   | Full           |                | 0.65 × V <sub>IO</sub> |      | V <sub>IO</sub>        | V    |    |
| Input logic low                                 | V <sub>IL</sub>                             | V <sub>IO</sub> = 1.65 V to 1.95 V   | Full           |                | 0                      |      | 0.35 × V <sub>IO</sub> | V    |    |
| Input leakage current                           | I <sub>IH</sub> , I <sub>IL</sub>           | V <sub>I</sub> = V <sub>IO</sub> or 0  | 25°C           | 5.5 V          |                        | –2   | 2                      | nA   |    |
|   |   |  | Full           |                |                        | –20  | 20                     |      |    |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum  
 (2) All unused digital inputs of the device must be held at V<sub>IO</sub> 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 FOR 5-V SUPPLY <sup>(1)</sup> (continued)**
 $V_+ = 4.5\text{ V to }5.5\text{ V}$ ,  $V_{IO} = 1.65\text{ V to }1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                 | SYMBOL                         | TEST CONDITIONS                                     | $T_A$  | $V_+$ | MIN   | TYP | MAX       | UNIT |    |
|---------------------------|--------------------------------|---|--|-------|-------|-----|-----------|------|----|
| <b>Dynamic</b>            |                                |   |  |       |       |     |           |      |    |
| Turn-on time              | $t_{ON}$                       | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,           | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 18</a>                | 25°C  | 5 V   | 1   | 12.5      | 25   | ns |
|                           |                                |   |  | Full  | 4.5 V |     |           | 30   |    |
| Turn-off time             | $t_{OFF}$                      | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,           | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 18</a>                | 25°C  | 5 V   | 1   | 9.5       | 20   | ns |
|                           |                                |   |  | Full  | 4.5 V |     |           | 25   |    |
| Break-before-make time    | $t_{BBM}$                      | $V_{NC} = V_{NO} = V_+/2$ ,<br>$R_L = 50\ \Omega$ , | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 19</a>                | 25°C  | 5 V   | 1   | 5         | 10   | ns |
|                           |                                |   |  | Full  | 4.5 V | 1   |           | 12   |    |
| Charge injection          | $Q_C$                          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,                  | $C_L = 1\text{ nF}$ ,<br>See <a href="#">Figure 23</a>                 | 25°C  | 5 V   |     | 15        | pC   |    |
| NO OFF capacitance        | $C_{NO(OFF)}$                  | $V_{NO} = V_+$ or GND,<br>Switch OFF,               | See <a href="#">Figure 17</a>  | 25°C  | 5 V   |     | 37        | pF   |    |
| NC, NO ON capacitance     | $C_{NC(ON)}$ ,<br>$C_{NO(ON)}$ | $V_{NC}$ or $V_{NO} = V_+$ or GND,<br>Switch ON,    | See <a href="#">Figure 17</a>  | 25°C  | 5 V   |     | 130       | pF   |    |
| COM ON capacitance        | $C_{COM(ON)}$                  | $V_{COM} = V_+$ or GND,<br>Switch ON,               | See <a href="#">Figure 17</a>  | 25°C  | 5 V   |     | 130       | pF   |    |
| Digital input capacitance | $C_I$                          | $V_I = V_{IO}$ or GND,                              | See <a href="#">Figure 17</a>  | 25°C  | 5 V   |     | 6.5       | pF   |    |
| Bandwidth                 | BW                             | $R_L = 50\ \Omega$ ,<br>Switch ON,                  | See <a href="#">Figure 20</a>  | 25°C  | 5 V   |     | 43        | MHz  |    |
| OFF isolation             | $O_{ISO}$                      | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,        | See <a href="#">Figure 21</a>  | 25°C  | 5 V   |     | -63       | dB   |    |
| Crosstalk                 | $X_{TALK}$                     | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,        | See <a href="#">Figure 22</a>  | 25°C  | 5 V   |     | -63       | dB   |    |
| Total harmonic distortion | THD                            | $R_L = 600\ \Omega$ ,<br>$C_L = 50\text{ pF}$ ,     | $f = 20\text{ Hz to }20\text{ kHz}$ ,<br>See <a href="#">Figure 24</a> | 25°C  | 5 V   |     | 0.00<br>4 | %    |    |
| <b>Supply</b>             |                                |   |  |       |       |     |           |      |    |
| Positive supply current   | $I_+$                          | $V_I = V_{IO}$ or GND                               | 25°C   | 5.5 V |       | 5.5 | 100       | nA   |    |
|                           |                                |   | Full   |       |       |     | 750       |      |    |

**ELECTRICAL CHARACTERISTICS FOR 3.3-V SUPPLY<sup>(1)</sup>**
 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $V_{IO} = 1.65\text{ V to }1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                       | SYMBOL                     | TEST CONDITIONS  | $T_A$  | $V_+$        | MIN   | TYP                  | MAX                  | UNIT     |
|---|----------------------------|--|--|--------------|-------|----------------------|----------------------|----------|
| <b>Analog Switch</b>                            |                            |  |  |              |       |                      |                      |          |
| Analog signal range                             | $V_{COM}, V_{NO}$          |  |  |              | 0     |                      | $V_+$                | V        |
| ON-state resistance                             | $r_{on}$                   | $V_{NO}$ or $V_{NC} = 2\text{ V}$ ,<br>$I_{COM} = -100\text{ mA}$ ,  | Switch ON,<br>See <a href="#">Figure 14</a>  | 25°C<br>Full | 3 V   | 0.75                 | 0.9<br>1.2           | $\Omega$ |
| ON-state resistance match between channels      | $\Delta r_{on}$            | $V_{NO}$ or $V_{NC} = 2\text{ V}, 0.8\text{ V}$ ,<br>$I_{COM} = -100\text{ mA}$ ,  | Switch ON,<br>See <a href="#">Figure 14</a>  | 25°C<br>Full | 3 V   | 0.1                  | 0.15<br>0.15         | $\Omega$ |
| ON-state resistance flatness                    | $r_{on(flat)}$             | $0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ ,<br>$I_{COM} = -100\text{ mA}$ ,  | Switch ON,<br>See <a href="#">Figure 14</a>  | 25°C<br>Full | 3 V   | 0.2                  | 0.1<br>0.3<br>0.3    | $\Omega$ |
| NO, NC OFF leakage current                      | $I_{NO(OFF)}, I_{NC(OFF)}$ | $V_{NO} = 1\text{ V}, 3\text{ V}$ ,<br>$V_{COM} = 3\text{ V}, 1\text{ V}$ ,<br>$V_{NC} = \text{Open}$ ,<br>or<br>$V_{NC} = 1\text{ V}, 3\text{ V}$ ,<br>$V_{COM} = 3\text{ V}, 1\text{ V}$ ,<br>$V_{NO} = \text{Open}$ , | Switch OFF,<br>See <a href="#">Figure 15</a> | 25°C<br>Full | 3.6 V | -20                  | 2<br>50              | nA       |
| NC, NO ON leakage current                       | $I_{NO(ON)}$               | $V_{NO} = 1\text{ V}, 3\text{ V}$ ,<br>$V_{NC}$ and $V_{COM} = \text{Open}$ ,<br>or<br>$V_{NC} = 1\text{ V}, 3\text{ V}$ ,<br>$V_{NO}$ and $V_{COM} = \text{Open}$ ,   | Switch ON,<br>See <a href="#">Figure 16</a>  | 25°C<br>Full | 3.6 V | -10                  | 2<br>30              | nA       |
| COM ON leakage current                          | $I_{COM(ON)}$              | $V_{COM} = 1\text{ V}$ ,<br>$V_{NO}$ and $V_{NC} = \text{Open}$ ,<br>or<br>$V_{COM} = 3\text{ V}$ ,<br>$V_{NO}$ and $V_{NC} = \text{Open}$ ,   | See <a href="#">Figure 16</a>                | 25°C<br>Full | 3.6 V | -10                  | 2<br>30              | nA       |
| <b>Digital Control Input (IN)<sup>(2)</sup></b> |                            |  |  |              |       |                      |                      |          |
| Input logic high                                | $V_{IH}$                   | $V_{IO} = 1.65\text{ V to }1.95\text{ V}$  |  | Full         |       | $0.65 \times V_{IO}$ | $V_{IO}$             | V        |
| Input logic low                                 | $V_{IL}$                   | $V_{IO} = 1.65\text{ V to }1.95\text{ V}$  |  | Full         |       | 0                    | $0.35 \times V_{IO}$ | V        |
| Input leakage current                           | $I_{IH}, I_{IL}$           | $V_I = V_{IO}$ or 0  |  | 25°C<br>Full | 3.6 V | -2                   | 2<br>20              | nA       |

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

(2) All unused digital inputs of the device must be held at  $V_{IO}$  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 FOR 3.3-V SUPPLY <sup>(1)</sup> (continued)**
 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $V_{IO} = 1.65\text{ V to }1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                 | SYMBOL                         | TEST CONDITIONS                                     | $T_A$  | $V_+$ | MIN   | TYP | MAX       | UNIT |    |
|---------------------------|--------------------------------|---|--|-------|-------|-----|-----------|------|----|
| <b>Dynamic</b>            |                                |   |  |       |       |     |           |      |    |
| Turn-on time              | $t_{ON}$                       | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,           | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 18</a>                | 25°C  | 3.3 V | 5   | 15        | 30   | ns |
|                           |                                |   |  | Full  | 3 V   | 3   |           | 35   |    |
| Turn-off time             | $t_{OFF}$                      | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,           | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 18</a>                | 25°C  | 3.3 V | 1   | 9         | 20   | ns |
|                           |                                |   |  | Full  | 3 V   | 1   |           | 25   |    |
| Break-before-make time    | $t_{BBM}$                      | $V_{NC} = V_{NO} = V_+/2$ ,<br>$R_L = 50\ \Omega$ , | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 19</a>                | 25°C  | 3.3 V | 1   | 8         | 13   | ns |
|                           |                                |   |  | Full  | 3 V   | 1   |           | 15   |    |
| Charge injection          | $Q_C$                          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,                  | $C_L = 1\text{ nF}$ ,<br>See <a href="#">Figure 23</a>                 | 25°C  | 3.3V  |     | 6.5       | pC   |    |
| NO OFF capacitance        | $C_{NO(OFF)}$                  | $V_{NO} = V_+$ or GND,<br>Switch OFF,               | See <a href="#">Figure 17</a>  | 25°C  | 3.3 V |     | 38        | pF   |    |
| NC, NO ON capacitance     | $C_{NC(ON)}$ ,<br>$C_{NO(ON)}$ | $V_{NC}$ or $V_{NO} = V_+$ or GND,<br>Switch ON,    | See <a href="#">Figure 17</a>  | 25°C  | 3.3 V |     | 133       | pF   |    |
| COM ON capacitance        | $C_{COM(ON)}$                  | $V_{COM} = V_+$ or GND,<br>Switch ON,               | See <a href="#">Figure 17</a>  | 25°C  | 3.3 V |     | 133       | pF   |    |
| Digital input capacitance | $C_I$                          | $V_I = V_{IO}$ or GND,                              | See <a href="#">Figure 17</a>  | 25°C  | 3.3 V |     | 6.5       | pF   |    |
| Bandwidth                 | BW                             | $R_L = 50\ \Omega$ ,<br>Switch ON,                  | See <a href="#">Figure 20</a>  | 25°C  | 3.3 V |     | 42        | MHz  |    |
| OFF isolation             | $O_{ISO}$                      | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,        | See <a href="#">Figure 21</a>  | 25°C  | 3.3 V |     | -63       | dB   |    |
| Crosstalk                 | $X_{TALK}$                     | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,        | See <a href="#">Figure 22</a>  | 25°C  | 3.3 V |     | -63       | dB   |    |
| Total harmonic distortion | THD                            | $R_L = 600\ \Omega$ ,<br>$C_L = 50\text{ pF}$ ,     | $f = 20\text{ Hz to }20\text{ kHz}$ ,<br>See <a href="#">Figure 24</a> | 25°C  | 3.3 V |     | 0.00<br>4 | %    |    |
| <b>Supply</b>             |                                |   |  |       |       |     |           |      |    |
| Positive supply current   | $I_+$                          | $V_I = V_{IO}$ or GND                               | 25°C   | 3.6 V |       | 10  | 50        | nA   |    |
|                           |                                |   | Full   |       |       |     | 300       |      |    |

**ELECTRICAL CHARACTERISTICS FOR 2.5-V SUPPLY<sup>(1)</sup>**

V<sub>+</sub> = 2.25 V to 2.75 V, V<sub>IO</sub> = 1.65 V to 1.95 V, T<sub>A</sub> = –40°C to 85°C (unless otherwise noted)

| PARAMETER                                       | SYMBOL                                      | TEST CONDITIONS  | T <sub>A</sub> | V <sub>+</sub> | MIN                    | TYP | MAX                    | UNIT |
|---|---|--|----------------|----------------|------------------------|-----|------------------------|------|
| <b>Analog Switch</b>                            |   |  |                |                |                        |     |                        |      |
| Analog signal range                             | V <sub>COM</sub> , V <sub>NO</sub>          |  |                |                | 0                      |     | V <sub>+</sub>         | V    |
| ON-state resistance                             | r <sub>on</sub>                             | V <sub>NO</sub> or V <sub>NC</sub> = 1.8 V, I <sub>COM</sub> = –100 mA, Switch ON, See Figure 14   | 25°C           | 2.25 V         | 1                      |     | 1.3                    | Ω    |
|   |   |  | Full           |                |                        |     | 1.6                    |      |
| ON-state resistance match between channels      | Δr <sub>on</sub>                            | V <sub>NO</sub> or V <sub>NC</sub> = 1.8 V, 0.8 V, I <sub>COM</sub> = –100 mA, Switch ON, See Figure 14  | 25°C           | 2.25 V         | 0.15                   |     | 0.2                    | Ω    |
|   |   |  | Full           |                |                        |     | 0.2                    |      |
| ON-state resistance flatness                    | r <sub>on(flat)</sub>                       | 0 ≤ (V <sub>NO</sub> or V <sub>NC</sub> ) ≤ V <sub>+</sub> , I <sub>COM</sub> = –100 mA, Switch ON, See Figure 14  | 25°C           | 2.25 V         | 0.5                    |     |                        | Ω    |
|   |   |  | Full           |                |                        |     | 0.6                    |      |
| NO, NC OFF leakage current                      | I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub> | V <sub>NO</sub> = 0.5 V, 2.2 V, V <sub>COM</sub> = 2.2 V, 0.5 V, V <sub>NC</sub> = Open, or V <sub>NC</sub> = 0.5 V, 2.2 V, V <sub>COM</sub> = 2.2 V, 0.5 V, V <sub>NO</sub> = Open, Switch OFF, See Figure 15 | 25°C           | 2.75 V         | –20                    | 2   | 20                     | nA   |
|   |   |  | Full           |                | –50                    |     | 50                     |      |
| NC, NO ON leakage current                       | I <sub>NO(ON)</sub>                         | V <sub>NO</sub> = 0.5 V, 2.2 V, V <sub>NC</sub> and V <sub>COM</sub> = Open, or V <sub>NC</sub> = 2.2 V, 0.5 V, V <sub>NO</sub> and V <sub>COM</sub> = Open, Switch ON, See Figure 16                          | 25°C           | 2.75 V         | –10                    | 2   | 10                     | nA   |
|   |   |  | Full           |                | –20                    |     | 20                     |      |
| COM ON leakage current                          | I <sub>COM(ON)</sub>                        | V <sub>COM</sub> = 0.5 V, V <sub>NO</sub> and V <sub>NC</sub> = Open, or V <sub>COM</sub> = 2.2 V, V <sub>NO</sub> and V <sub>NC</sub> = Open, Switch ON, See Figure 16  | 25°C           | 2.75 V         | –10                    | 2   | 10                     | nA   |
|   |   |  | Full           |                | –20                    |     | 20                     |      |
| <b>Digital Control Input (IN)<sup>(2)</sup></b> |   |  |                |                |                        |     |                        |      |
| Input logic high                                | V <sub>IH</sub>                             | V <sub>IO</sub> = 1.65 V to 1.95 V   | Full           |                | 0.65 × V <sub>IO</sub> |     | V <sub>IO</sub>        | V    |
| Input logic low                                 | V <sub>IL</sub>                             | V <sub>IO</sub> = 1.65 V to 1.95 V   | Full           |                | 0                      |     | 0.35 × V <sub>IO</sub> | V    |
| Input leakage current                           | I <sub>IH</sub> , I <sub>IL</sub>           | V <sub>I</sub> = V <sub>IO</sub> or 0  | 25°C           | 2.75 V         | –2                     |     | 2                      | nA   |
|   |   |  | Full           |                | –20                    |     | 20                     |      |

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum  
 (2) All unused digital inputs of the device must be held at V<sub>IO</sub> 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 FOR 2.5-V SUPPLY <sup>(1)</sup> (continued)**
 $V_+ = 2.25\text{ V to } 2.75\text{ V}$ ,  $V_{IO} = 1.65\text{ V to } 1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                 | SYMBOL                         | TEST CONDITIONS                                     | $T_A$   | $V_+$  | MIN    | TYP | MAX       | UNIT |    |
|---------------------------|--------------------------------|---|---|--------|--------|-----|-----------|------|----|
| <b>Dynamic</b>            |                                |   |   |        |        |     |           |      |    |
| Turn-on time              | $t_{ON}$                       | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,           | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 18</a>                 | 25°C   | 2.5 V  | 5   | 20        | 35   | ns |
|                           |                                |   |   | Full   | 2.25 V | 5   |           | 40   |    |
| Turn-off time             | $t_{OFF}$                      | $V_{COM} = V_+$ ,<br>$R_L = 50\ \Omega$ ,           | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 18</a>                 | 25°C   | 2.5 V  | 2   | 10        | 20   | ns |
|                           |                                |   |   | Full   | 2.25 V | 2   |           | 25   |    |
| Break-before-make time    | $t_{BBM}$                      | $V_{NC} = V_{NO} = V_+/2$ ,<br>$R_L = 50\ \Omega$ , | $C_L = 35\text{ pF}$ ,<br>See <a href="#">Figure 19</a>                 | 25°C   | 2.5 V  | 1   | 11        | 20   | ns |
|                           |                                |   |   | Full   | 2.25 V | 1   |           | 25   |    |
| Charge injection          | $Q_C$                          | $V_{GEN} = 0$ ,<br>$R_{GEN} = 0$ ,                  | $C_L = 1\text{ nF}$ ,<br>See <a href="#">Figure 23</a>                  | 25°C   | 2.5 V  |     | 5         | pC   |    |
| NO OFF capacitance        | $C_{NO(OFF)}$                  | $V_{NO} = V_+$ or GND,<br>Switch OFF,               | See <a href="#">Figure 17</a>   | 25°C   | 2.5 V  |     | 38        | pF   |    |
| NC, NO ON capacitance     | $C_{NC(ON)}$ ,<br>$C_{NO(ON)}$ | $V_{NC}$ or $V_{NO} = V_+$ or GND,<br>Switch ON,    | See <a href="#">Figure 17</a>   | 25°C   | 2.5 V  |     | 135       | pF   |    |
| COM ON capacitance        | $C_{COM(ON)}$                  | $V_{COM} = V_+$ or GND,<br>Switch ON,               | See <a href="#">Figure 17</a>   | 25°C   | 2.5 V  |     | 135       | pF   |    |
| Digital input capacitance | $C_I$                          | $V_I = V_{IO}$ or GND,                              | See <a href="#">Figure 17</a>   | 25°C   | 2.5 V  |     | 6.5       | pF   |    |
| Bandwidth                 | BW                             | $R_L = 50\ \Omega$ ,<br>Switch ON,                  | See <a href="#">Figure 20</a>   | 25°C   | 2.5 V  |     | 40        | MHz  |    |
| OFF isolation             | $O_{ISO}$                      | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,        | See <a href="#">Figure 21</a>   | 25°C   | 2.5 V  |     | -63       | dB   |    |
| Crosstalk                 | $X_{TALK}$                     | $R_L = 50\ \Omega$ ,<br>$f = 1\text{ MHz}$ ,        | See <a href="#">Figure 22</a>   | 25°C   | 2.5 V  |     | -63       | dB   |    |
| Total harmonic distortion | THD                            | $R_L = 600\ \Omega$ ,<br>$C_L = 50\text{ pF}$ ,     | $f = 20\text{ Hz to } 20\text{ kHz}$ ,<br>See <a href="#">Figure 24</a> | 25°C   | 2.5 V  |     | 0.00<br>8 | %    |    |
| <b>Supply</b>             |                                |   |   |        |        |     |           |      |    |
| Positive supply current   | $I_+$                          | $V_I = V_{IO}$ or GND                               | 25°C  | 2.75 V |        | 10  | 25        | nA   |    |
|                           |                                |   | Full  |        |        |     | 100       |      |    |

TYPICAL PERFORMANCE

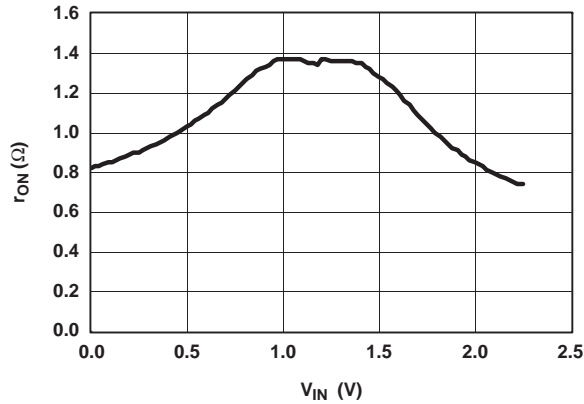


Figure 1.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 2.5\text{ V}$ )

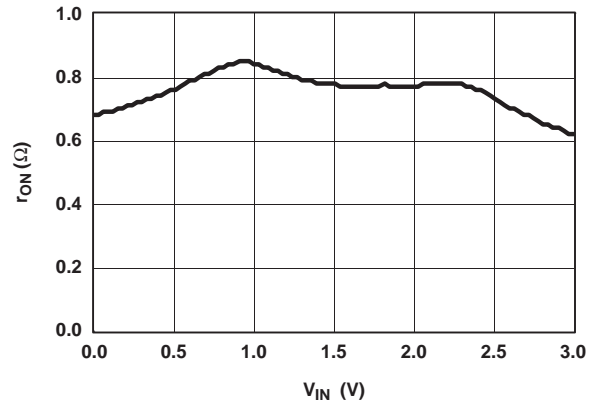


Figure 2.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 3.3\text{ V}$ )

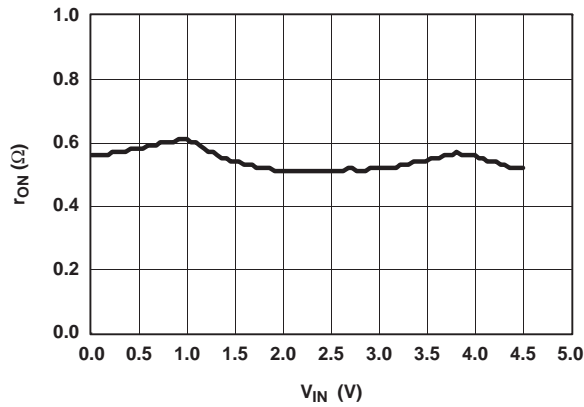


Figure 3.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 5\text{ V}$ )

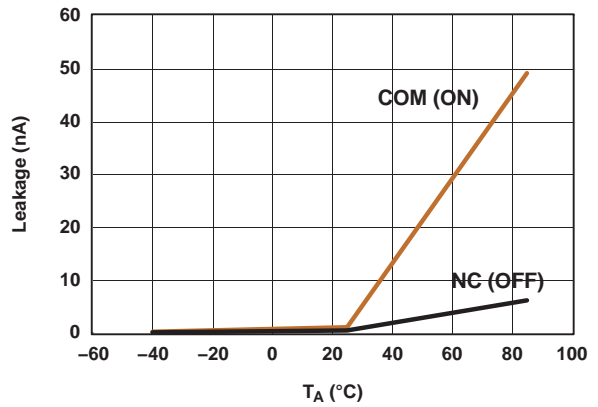


Figure 4. Leakage Current vs Temperature ( $V_+ = 5\text{ V}$ )

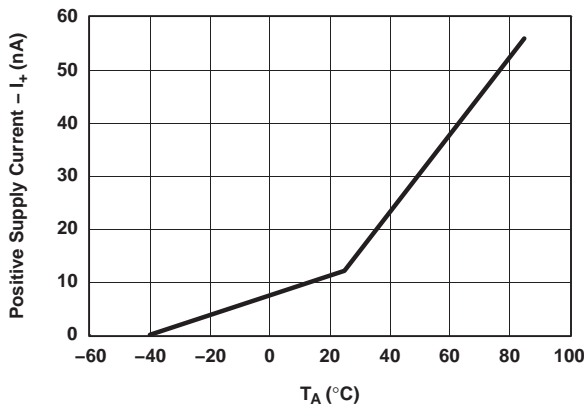


Figure 5.  $I_+$  vs Temperature ( $V_+ = 5\text{ V}$ )

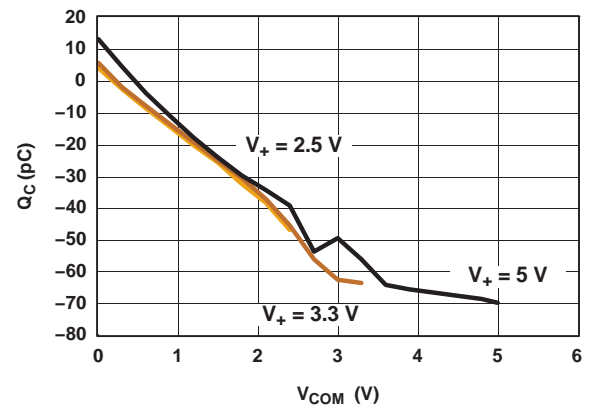


Figure 6. Charge Injection ( $Q_C$ ) vs  $V_{COM}$

TYPICAL PERFORMANCE (continued)

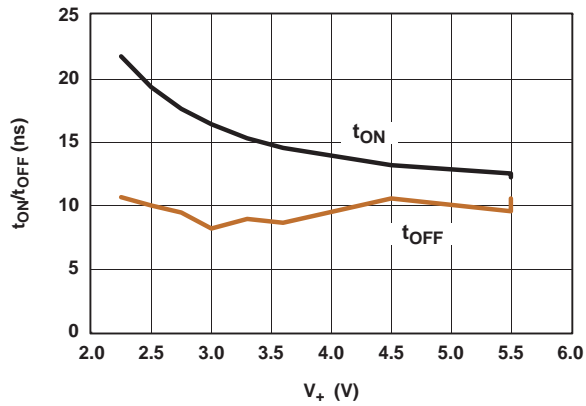


Figure 7. t<sub>ON</sub>/t<sub>OFF</sub> vs Supply Voltage

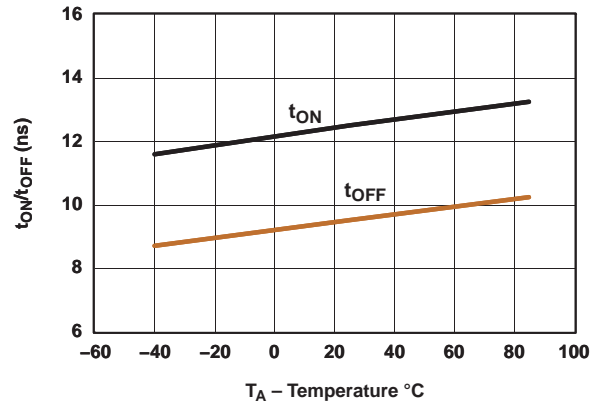


Figure 8. t<sub>ON</sub>/t<sub>OFF</sub> vs Temperature (V<sub>+</sub> = 5 V)

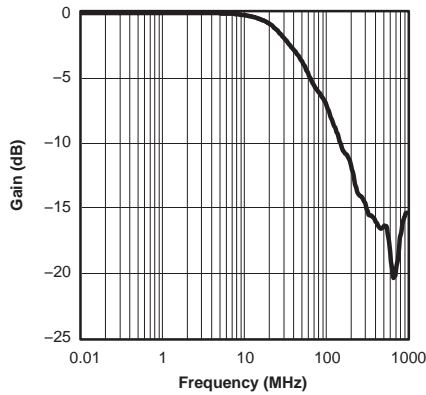


Figure 9. Gain vs Frequency (V<sub>+</sub> = 5 V)

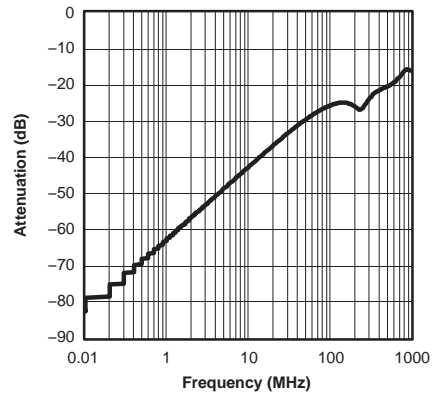


Figure 10. Crosstalk vs Frequency (V<sub>+</sub> = 5 V)

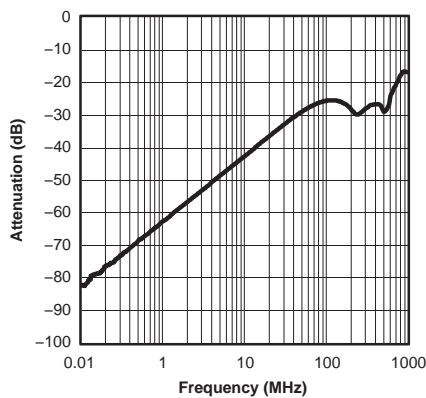


Figure 11. OFF Isolation vs Frequency (V<sub>+</sub> = 5 V)

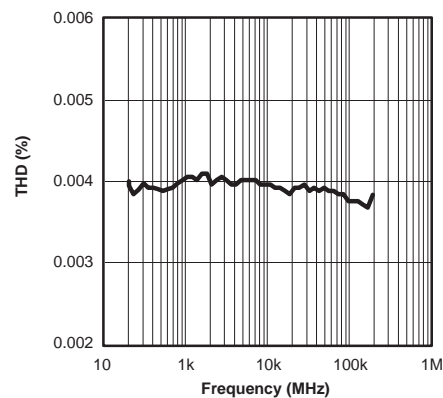
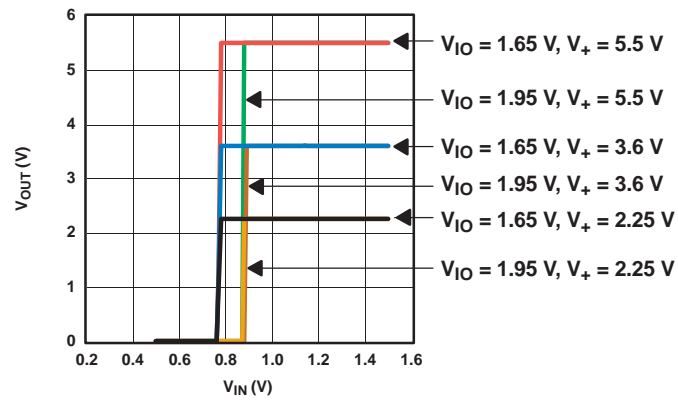


Figure 12. Total Harmonic Distortion vs Frequency (V<sub>+</sub> = 2.5 V)

**TYPICAL PERFORMANCE (continued)**



**Figure 13.  $V_{IO}$  Thresholds**

PARAMETER MEASUREMENT INFORMATION

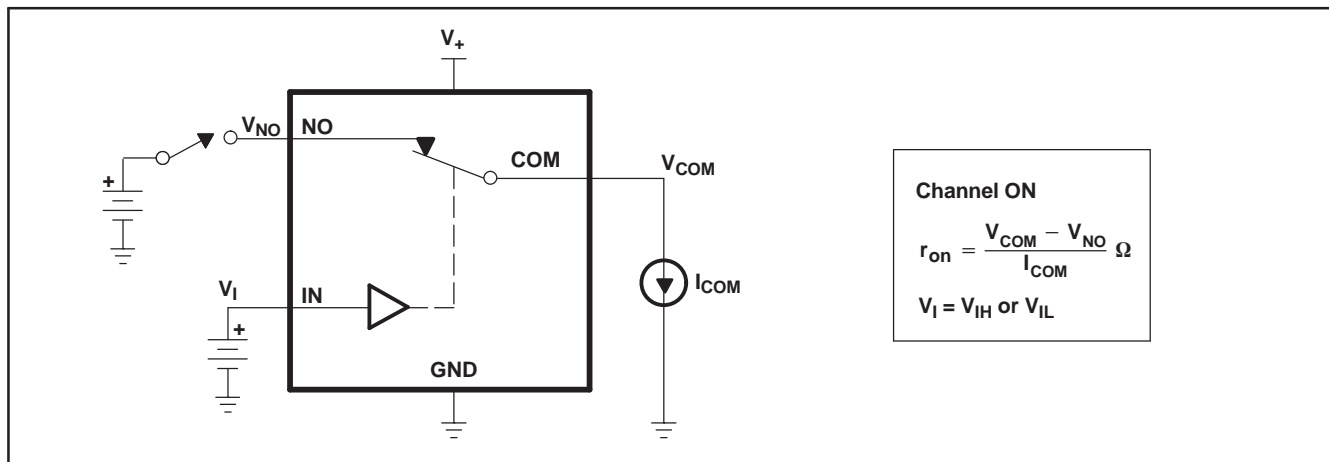


Figure 14. ON-State Resistance ( $r_{on}$ )

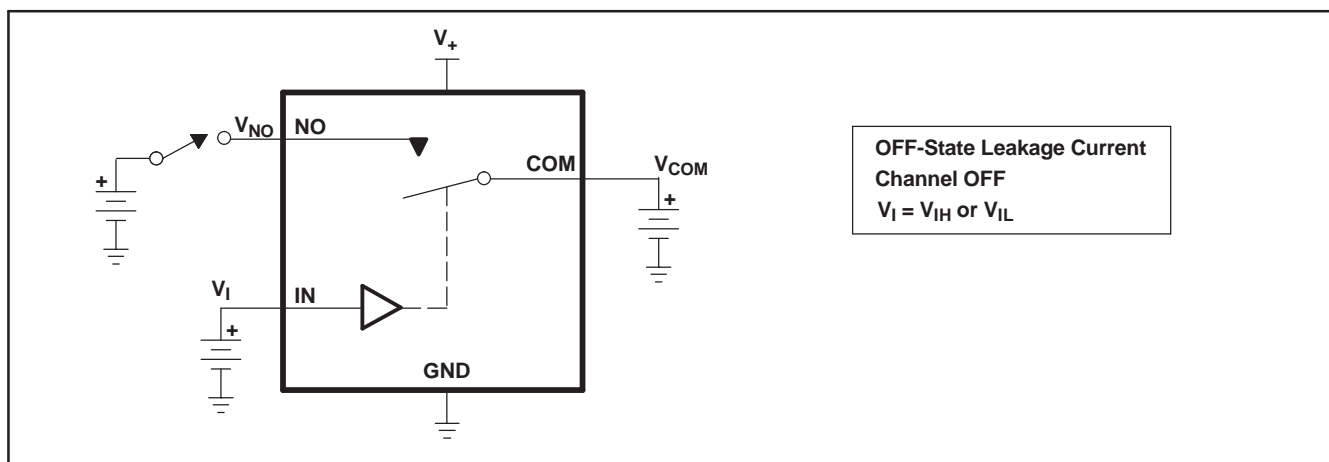


Figure 15. OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NC(OFF)}$ ,  $I_{COM(PWROFF)}$ ,  $I_{NC(PWRFF)}$ )

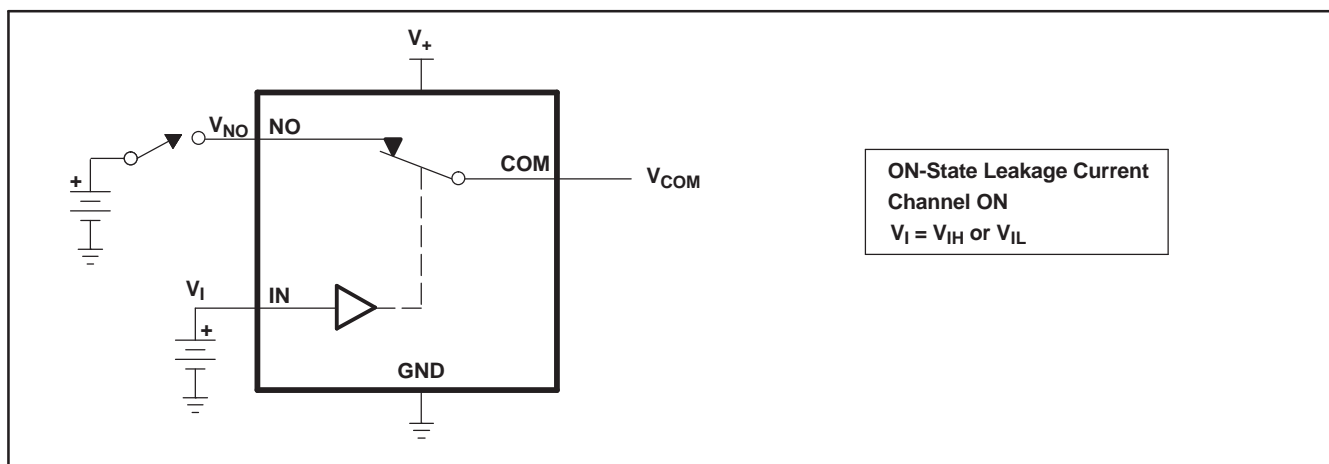
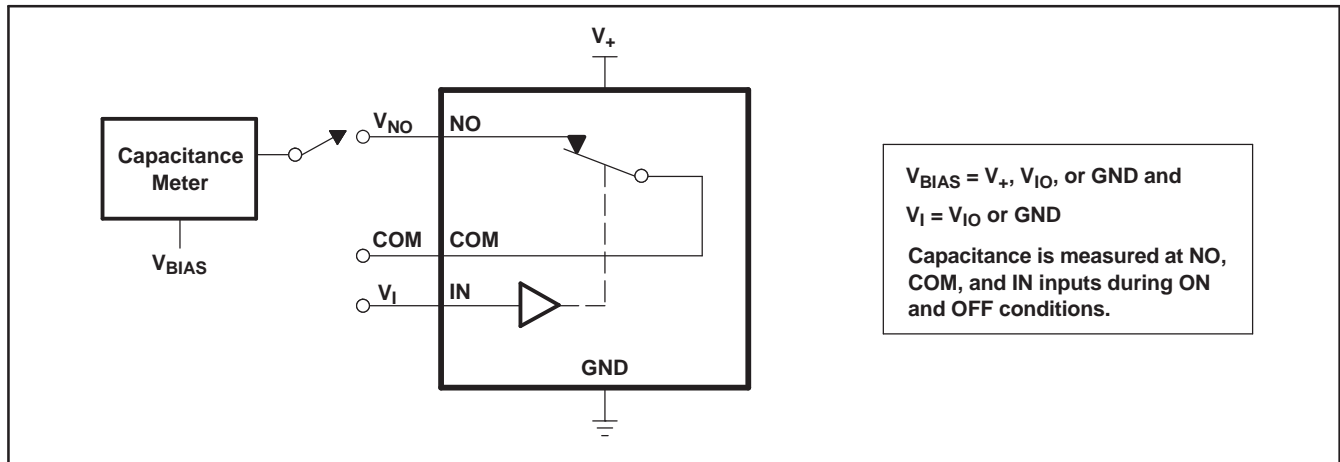
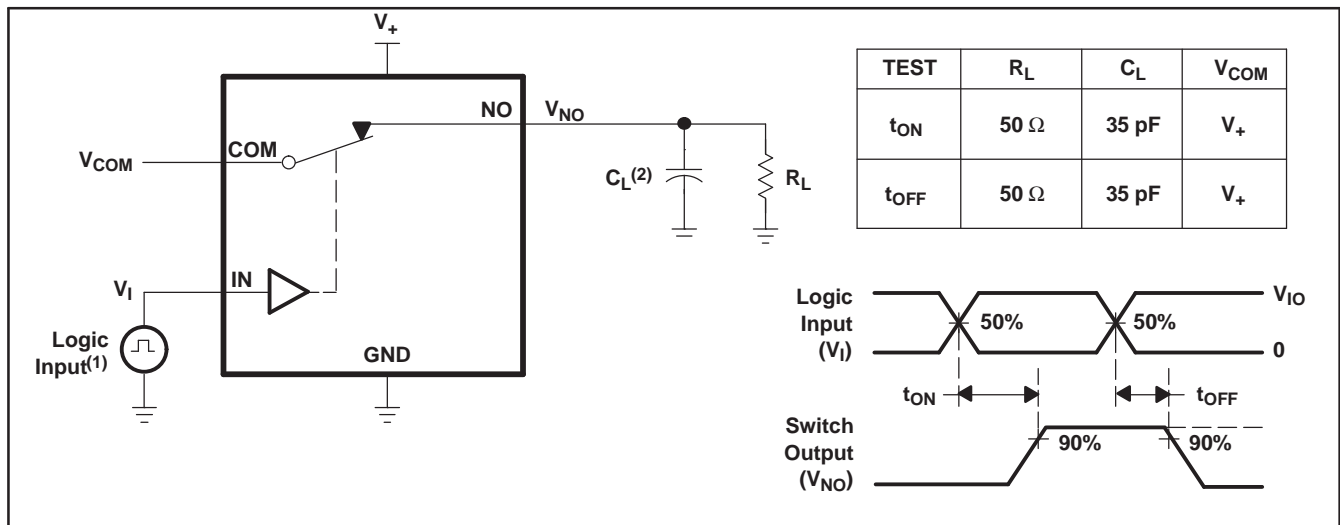


Figure 16. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ )

**PARAMETER MEASUREMENT INFORMATION (continued)**



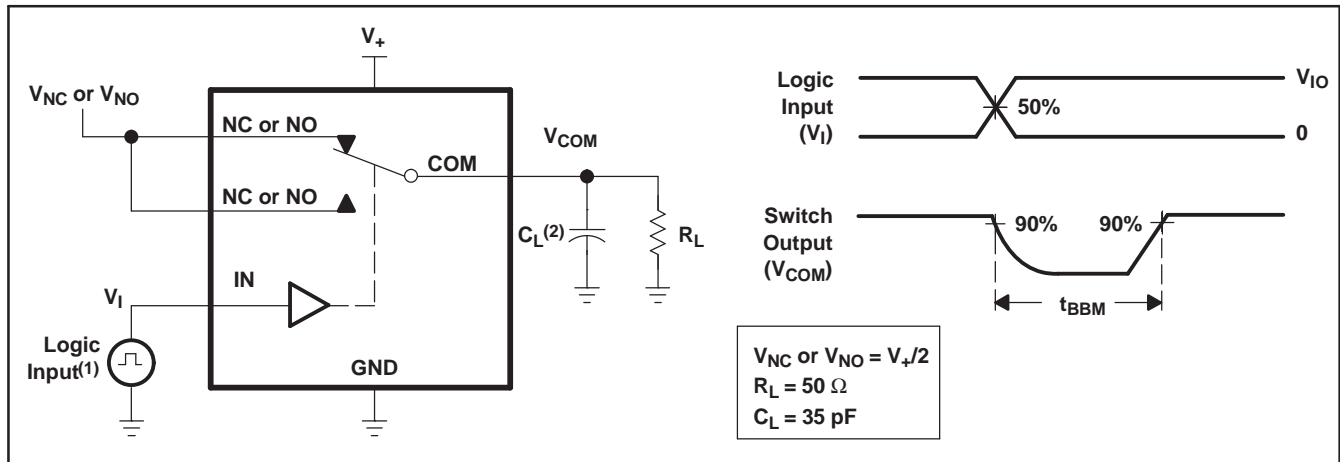
**Figure 17. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NC(ON)}$ )**



(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 18. Turn-On ( $t_{ON}$ ) and Turn-Off Time ( $t_{OFF}$ )**

PARAMETER MEASUREMENT INFORMATION (continued)



- (1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> < 5 ns, t<sub>f</sub> < 5 ns.
- (2) C<sub>L</sub> includes probe and jig capacitance.

Figure 19. Break-Before-Make Time (t<sub>BBM</sub>)

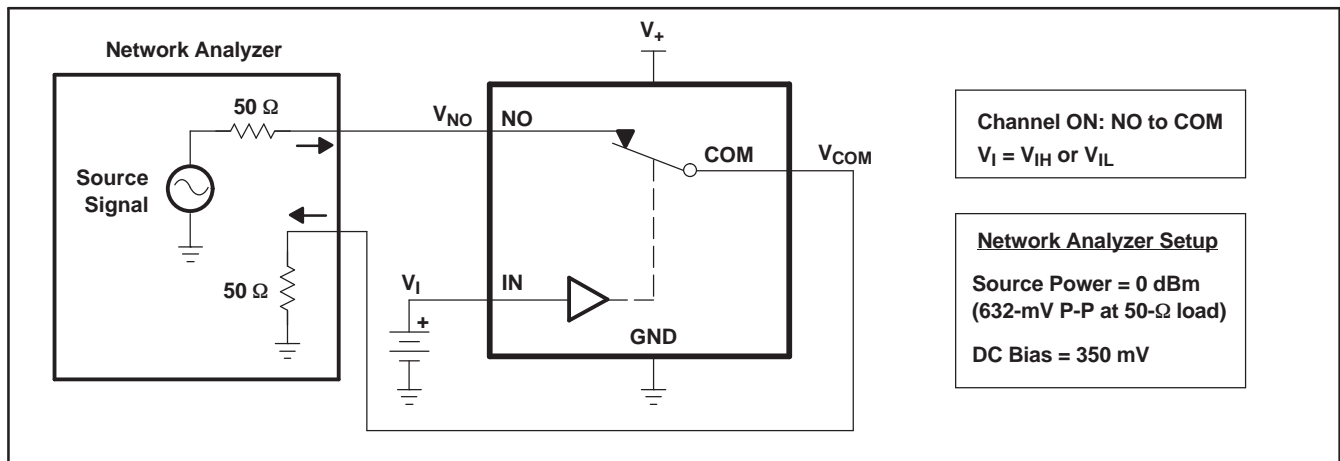
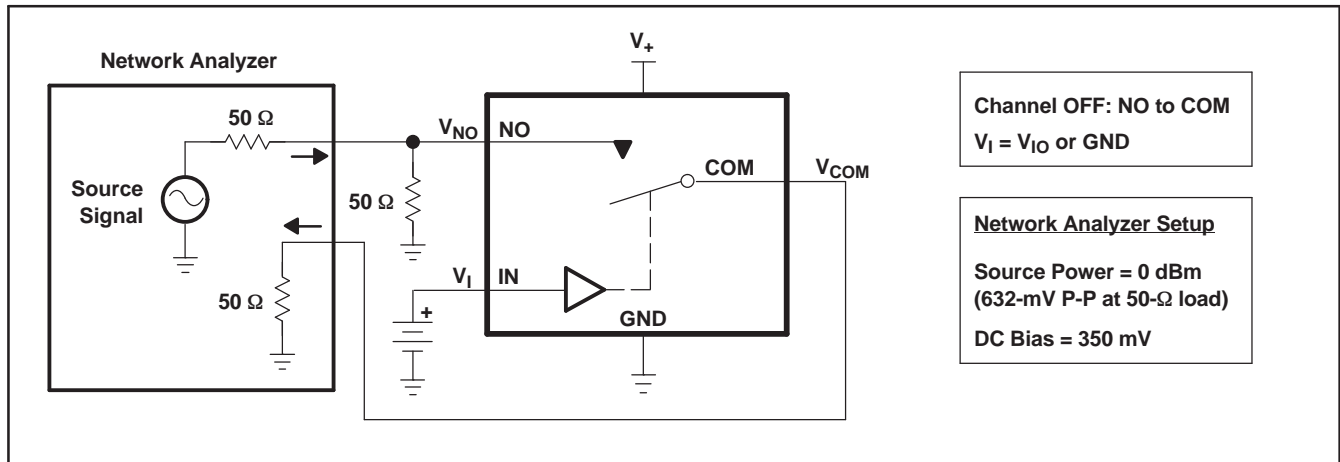
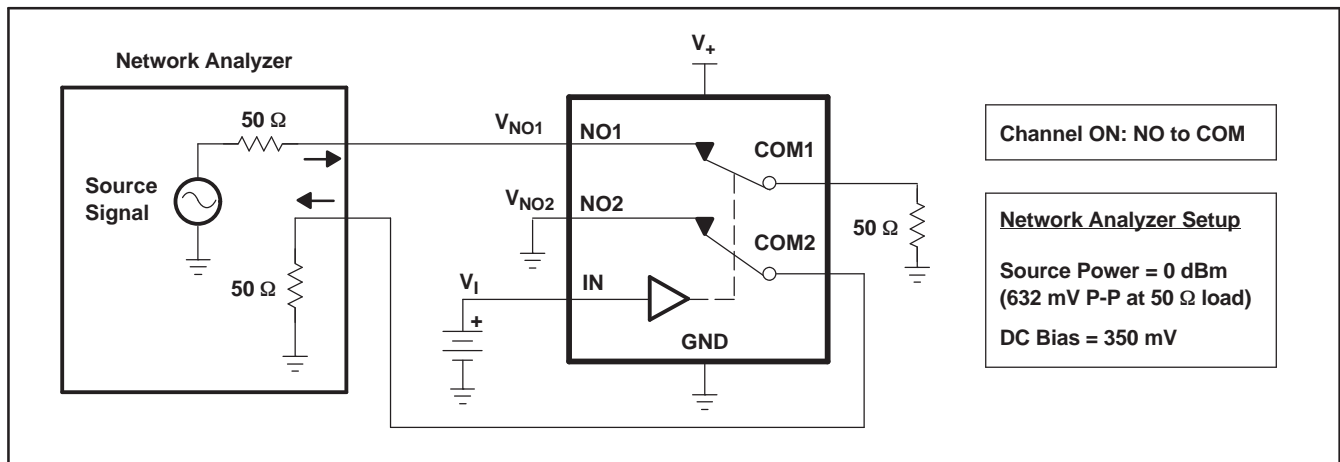


Figure 20. Bandwidth (BW)

**PARAMETER MEASUREMENT INFORMATION (continued)**



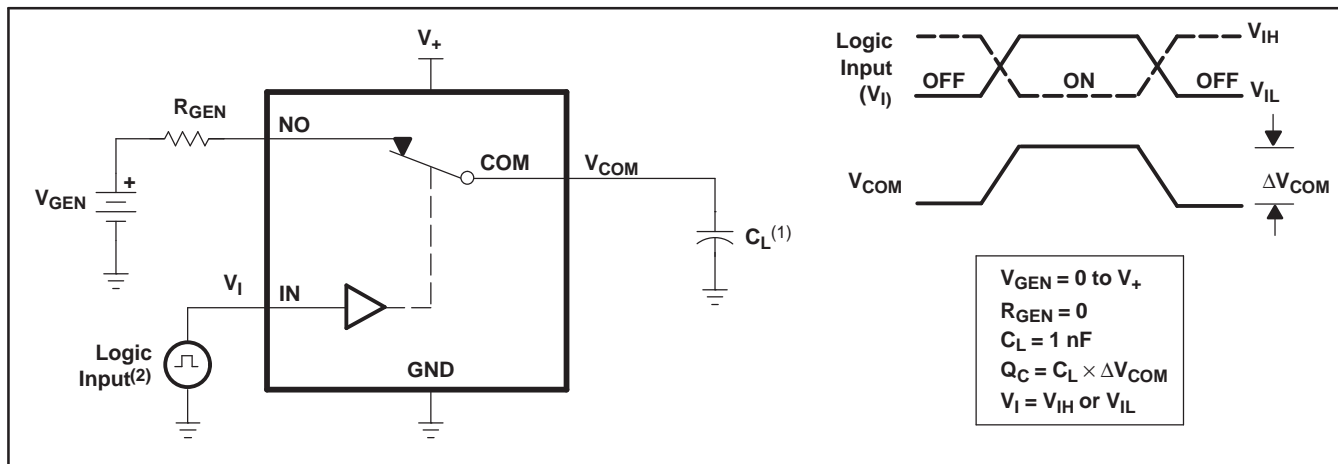
**Figure 21. OFF Isolation ( $O_{ISO}$ )**



**Figure 22. Crosstalk ( $X_{TALK}$ )**



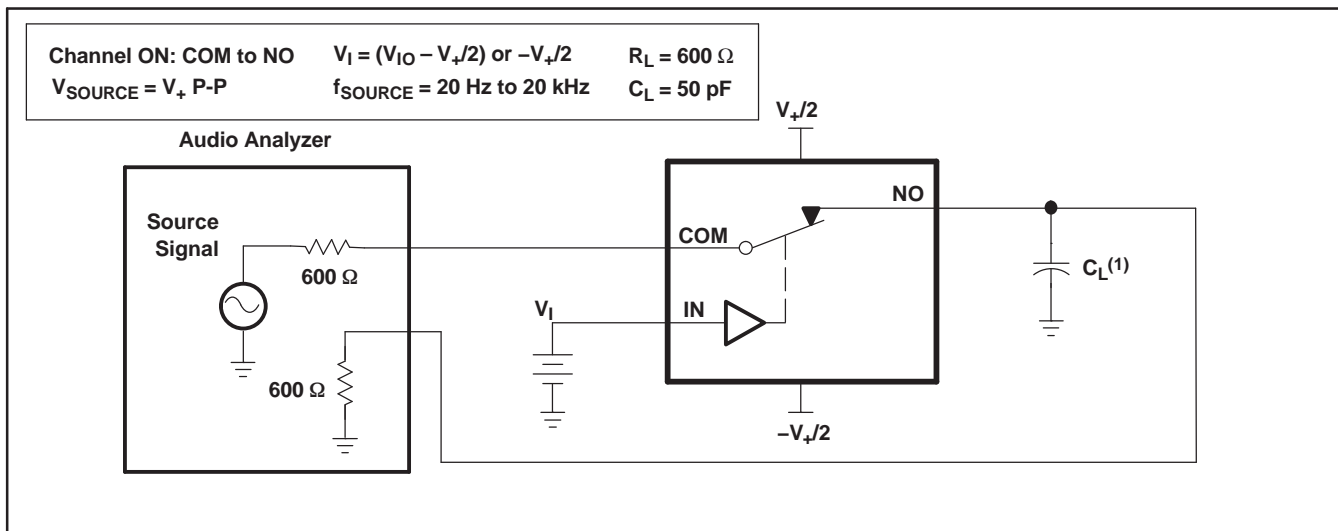
PARAMETER MEASUREMENT INFORMATION (continued)



(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 23. Charge Injection ( $Q_C$ )



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

Figure 24. Total Harmonic Distortion (THD)

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples        |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|----------------|
| TS5A6542YZPR     | ACTIVE        | DSBGA        | YZP             | 8    | 3000        | RoHS & Green    | SNAGCU                               | Level-1-260C-UNLIM   | -40 to 85    | JHN                     | <b>Samples</b> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TS5A6542YZPR | DSBGA        | YZP             | 8    | 3000 | 178.0              | 9.2                | 1.02    | 2.02    | 0.63    | 4.0     | 8.0    | Q1            |

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TS5A6542YZPR | DSBGA        | YZP             | 8    | 3000 | 220.0       | 220.0      | 35.0        |

YZP0008



# PACKAGE OUTLINE

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



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)).

# EXAMPLE STENCIL DESIGN

YZP0008

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



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

4223082/A 07/2016

NOTES: (continued)

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

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