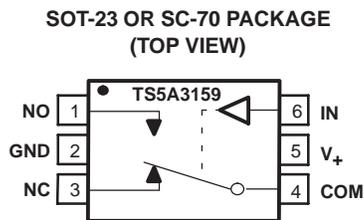


Description

The TS5A3159 is a single-pole double-throw (SPDT) analog switch that is designed to operate from 1.65 V to 5.5 V. The device offers a low ON-state resistance and an excellent ON-resistance, matching with the break-before-make feature to prevent signal distortion during the transferring of a signal from one channel to another. The device has an excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications.

Applications

- Cell Phones
- PDAs
- Portable Instrumentation



FUNCTION TABLE

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

Features

- Specified Break-Before-Make Switching
- Low ON-State Resistance (1 Ω)
- Control Inputs Are 5-V Tolerant
- Low Charge Injection
- Excellent ON-Resistance Matching
- Low Total Harmonic Distortion
- 1.65-V to 5.5-V Single-Supply Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
 - 2000-V Human-Body Model (A114-B, Class II)
 - 1000-V Charged-Device Model (C101)

Summary of Characteristics

$V_+ = 5\text{ V}$ and $T_A = 25\text{ }^\circ\text{C}$

| | |
|--|---|
| Configuration | 2:1 Multiplexer/ Demultiplexer (1 × SPDT) |
| Number of channels | 1 |
| ON-state resistance (r_{ON}) | 1.1 Ω |
| ON-state resistance match (Δr_{ON}) | 0.1 Ω |
| ON-state resistance flatness ($r_{ON(\text{flat})}$) | 0.15 Ω |
| Turn on/turn off time (t_{ON}/t_{OFF}) | 20 ns/15 ns |
| Break-before-make time (t_{BBM}) | 12 ns |
| Charge injection (Q_C) | 36 pC |
| Bandwidth (BW) | 100 MHz |
| OFF isolation (O_{ISO}) | -65 dB at 1 MHz |
| Crosstalk (X_{TALK}) | -65 dB at 1 MHz |
| Total harmonic distortion (THD) | 0.01% |
| Leakage current ($I_{NO(OFF)}/I_{NC(OFF)}$) | ±20 nA |
| Package option | 6-pin DBV or DCK |



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.

TS5A3159

1-Ω SPDT ANALOG SWITCH

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ORDERING INFORMATION

| T _A | PACKAGE ⁽¹⁾ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING ⁽²⁾ |
|----------------|----------------------------------|---------------|-----------------------|---------------------------------|
| –40°C to 85°C | SOT (SOT-23) – DBV | Tape and reel | TS5A3159DBVR | JA8_ |
| | SOT (SC-70) – DCK ⁽²⁾ | Tape and reel | TS5A3159DCKR | JA_ |

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

(2) DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.

Absolute Maximum Ratings⁽¹⁾

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

| | | MIN | MAX | UNIT |
|------------------------------------|--|---|----------------------|------------|
| V ₊ | Supply voltage range ⁽²⁾ | –0.5 | 6.5 | V |
| V _{NO} , V _{COM} | Analog voltage range ⁽²⁾⁽³⁾⁽⁴⁾ | –0.5 | V ₊ + 0.5 | V |
| I _{I/OK} | Analog port diode current | V _{NO} , V _{COM} < 0 or V _{NO} , V _{COM} > V ₊ | | ±50 mA |
| I _{NO} , I _{COM} | ON–state switch current | V _{NO} , V _{COM} = 0 to V ₊ | | ±200 mA |
| | ON–state peak switch current ⁽⁵⁾ | | | ±400 mA |
| V _{IN} | Digital input voltage range ⁽²⁾⁽³⁾ | –0.5 | 6.5 | V |
| I _{IJK} | Digital input clamp current | V _{IN} < 0 | | –50 mA |
| | Continuous current through V ₊ or GND | | | ±100 mA |
| θ _{JA} | Package thermal impedance ⁽⁶⁾ | | | 165 °C |
| 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) All voltages are with respect to ground, unless otherwise specified.

(3) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(4) This value is limited to 5.5 V maximum.

(5) Pulse at 1 ms duration < 10% duty cycle.

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

Electrical Characteristics for 5-V Supply
 $V_+ = 4.5\text{ V to }5.5\text{ V}$ and $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP(1) | MAX | UNIT | |
|--|----------------------------|--|---------------------------|-------|-------|--------|-------|----------|---------------|
| Analog Switch | | | | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | | | 0 | | V_+ | V | |
| Peak ON resistance | r_{peak} | $0 \leq V_{NO} \text{ or } V_{NC} \leq V_+, I_{COM} = -30\text{ mA},$ | Switch ON, See Figure 11 | 25°C | 4.5 V | 1 | 1.5 | Ω | |
| | | | | Full | | 1.5 | | | |
| ON-state resistance | r_{on} | $V_{NO} \text{ or } V_{NC} = 2.5\text{ V}, I_{COM} = -30\text{ mA},$ | Switch ON, See Figure 11 | 25°C | 4.5 V | 0.75 | 1.1 | Ω | |
| | | | | Full | | 1.1 | | | |
| ON-state resistance match between channels | Δr_{on} | $V_{NO} \text{ or } V_{NC} = 2.5\text{ V}, I_{COM} = -30\text{ mA},$ | Switch ON, See Figure 11 | 25°C | 4.5 V | 0.1 | | Ω | |
| ON-state resistance flatness | $r_{on(Flat)}$ | $0 \leq V_{NO} \text{ or } V_{NC} \leq V_+, I_{COM} = -30\text{ mA},$ | Switch ON, See Figure 11 | 25°C | 4.5 V | 0.233 | | Ω | |
| | | $V_{NO} \text{ or } V_{NC} = 1\text{ V}, 1.5\text{ V}, 2.5\text{ V}, I_{COM} = -30\text{ mA},$ | | 25°C | | 0.15 | | | |
| NC, NO OFF leakage current | $I_{NC(OFF)}, I_{NO(OFF)}$ | $V_{NC} \text{ or } V_{NO} = 4.5\text{ V}, V_{COM} = 0,$ | Switch OFF, See Figure 12 | 25°C | 5.5 V | -2 | 0.2 | 2 | nA |
| | | | | Full | | -20 | 20 | | |
| NC, NO ON leakage current | $I_{NC(ON)}, I_{NO(ON)}$ | $V_{NC} \text{ or } V_{NO} = 4.5\text{ V}, V_{COM} = \text{Open},$ | Switch ON, See Figure 13 | 25°C | 5.5 V | -4 | 2.8 | 4 | nA |
| | | | | Full | | -40 | 40 | | |
| COM ON leakage current | $I_{COM(ON)}$ | $V_{NC} \text{ or } V_{NO} = 4.5\text{ V or Open}, V_{COM} = 4.5\text{ V},$ | Switch ON, See Figure 13 | 25°C | 5.5 V | -4 | 0.47 | 4 | nA |
| | | | | Full | | -40 | 40 | | |
| Digital Inputs (IN) | | | | | | | | | |
| Input logic high | V_{IH} | | | Full | | 2.4 | | 5.5 | V |
| Input logic low | V_{IL} | | | Full | | 0 | | 0.8 | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 5.5\text{ V or }0$ | | Full | 5.5 V | -1 | | 1 | μA |

(1) $T_A = 25^\circ\text{C}$

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Electrical Characteristics for 5-V Supply (continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|---------------------------|----------------------------------|---|---|-------|-------------------|------|--------|---------------|------|
| Dynamic | | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = V_+$, $R_L = 50\ \Omega$, | $C_L = 35\ \text{pF}$, See Figure 15 | 25°C | 4.5 V to 5.5 V | 20 | 35 | 40 | ns |
| | | | | Full | | | | | |
| Turn-off time | t_{OFF} | $V_{COM} = V_+$, $R_L = 50\ \Omega$, | $C_L = 35\ \text{pF}$, See Figure 15 | 25°C | 4.5 V to 5.5 V | 15 | 20 | 35 | ns |
| | | | | Full | | | | | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, | $C_L = 35\ \text{pF}$, See Figure 16 | 25°C | 4.5 V to 5.5 V | 1 | 12 | 14.5 | ns |
| | | | | Full | | | | | |
| Charge injection | Q_C | $C_L = 1\ \text{nF}$, $V_{GEN} = 0\ \text{V}$, | See Figure 20 | 25°C | 5 V | 36 | | pC | |
| NC, NO OFF capacitance | $C_{NC(OFF)}$, $C_{NO(OFF)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch OFF, | See Figure 14 | 25°C | 5 V | 23 | | pF | |
| NC, NO ON capacitance | $C_{NC(ON)}$, $C_{NO(ON)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch ON, | See Figure 14 | 25°C | 5 V | 84 | | pF | |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, | See Figure 14 | 25°C | 5 V | 84 | | pF | |
| Digital input capacitance | C_{IN} | $V_{IN} = V_+$ or GND, | See Figure 14 | 25°C | 5 V | 2.1 | | pF | |
| Bandwidth | BW | $R_L = 50\ \Omega$, Switch ON, | See Figure 17 | 25°C | 5 V | 100 | | MHz | |
| OFF isolation | O_{ISO} | $R_L = 50\ \Omega$, $f = 1\ \text{MHz}$, | Switch OFF, See Figure 18 | 25°C | 5 V | -65 | | dB | |
| Crosstalk | X_{TALK} | $R_L = 50\ \Omega$, $f = 1\ \text{MHz}$, | Switch ON, See Figure 19 | 25°C | 5 V | -65 | | dB | |
| Total harmonic distortion | THD | $R_L = 600\ \Omega$, $C_L = 50\ \text{pF}$, | $f = 600\ \text{Hz to }20\ \text{kHz}$, See Figure 21 | 25°C | 5 V | 0.01 | | % | |
| Supply | | | | | | | | | |
| Positive supply current | I_+ | $V_{IN} = V_+$ or GND, | Switch ON or OFF | Full | 5.5 V | 0.1 | | μA | |

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 3.3-V Supply
 $V_+ = 3\text{ V to }3.6\text{ V}$ and $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|--|----------------------------|--|------------------------------|-------|-------|-------|--------|-------|---------------|
| Analog Switch | | | | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | | | | 0 | | V_+ | V |
| Peak ON-state resistance | r_{peak} | $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -24\text{ mA}$, | Switch ON, See Figure 11 | 25°C | 3 V | 1.35 | | 2.1 | Ω |
| | | | | Full | | | | 2.1 | |
| ON-state resistance | r_{on} | V_{NO} or $V_{NC} = 2\text{ V}$, $I_{COM} = -24\text{ mA}$, | Switch ON, See Figure 11 | 25°C | 3 V | 1.15 | | 1.5 | Ω |
| | | | | Full | | | | 1.5 | |
| ON-state resistance match between channels | Δr_{on} | V_{NO} or $V_{NC} = 2\text{ V}, 0.8\text{ V}$, $I_{COM} = -24\text{ mA}$, | Switch ON, See Figure 11 | 25°C | 3 V | 0.11 | | | Ω |
| ON-state resistance flatness | $r_{on(Flat)}$ | $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -24\text{ mA}$, | Switch ON, See Figure 11 | 25°C | 3 V | 0.225 | | | Ω |
| | | V_{NO} or $V_{NC} = 2\text{ V}, 0.8\text{ V}$, $I_{COM} = -24\text{ mA}$, | | 25°C | | 0.25 | | | |
| NC, NO OFF leakage current | $I_{NC(OFF)}, I_{NO(OFF)}$ | V_{NC} or $V_{NO} = 3\text{ V}$, $V_{COM} = 0$, | Switch OFF, See Figure 12 | 25°C | 3.6 V | 0.2 | | | nA |
| NC, NO ON leakage current | $I_{NC(ON)}, I_{NO(ON)}$ | V_{NC} or $V_{NO} = 3\text{ V}$, $V_{COM} = \text{Open}$, | Switch ON, See Figure 13 | 25°C | 3.6 V | 2.8 | | | nA |
| COM ON leakage current | $I_{COM(ON)}$ | V_{NC} or $V_{NO} = 3\text{ V}$ or Open, $V_{COM} = 3\text{ V}$, | Switch ON, See Figure 13 | 25°C | 3.6 V | 0.47 | | | nA |
| Digital Inputs (IN) | | | | | | | | | |
| Input logic high | V_{IH} | | | Full | | 2 | | 5.5 | V |
| Input logic low | V_{IL} | | | Full | | 0 | 0.6 | | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 5.5\text{ V}$ or 0 | | Full | 3.6 V | -1 | | 1 | μA |

 (1) $T_A = 25^\circ\text{C}$

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Electrical Characteristics for 3.3-V Supply (continued)

(V_+ = 3 V to 3.6 V and T_A = -40 °C to 85 °C) (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|---------------------------|----------------------------------|--|--|-------|-----------------|-------|--------|-----|---------------|
| Dynamic | | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = V_+$, $R_L = 50 \Omega$, | $C_L = 35 \text{ pF}$, See Figure 15 | 25°C | 3 V to 3.6 V | 30 | 40 | 40 | ns |
| | | | | Full | | | | | |
| Turn-off time | t_{OFF} | $V_{COM} = V_+$, $R_L = 50 \Omega$, | $C_L = 35 \text{ pF}$, See Figure 15 | 25°C | 3 V to 3.6 V | 20 | 25 | 25 | ns |
| | | | | Full | | | | | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50 \Omega$, | $C_L = 35 \text{ pF}$, See Figure 16 | 25°C | 3 V to 3.6 V | 1 | 21 | 29 | ns |
| | | | | Full | | | | | |
| Charge injection | Q_C | $C_L = 1 \text{ nF}$, $V_{GEN} = 0 \text{ V}$, | See Figure 20 | 25°C | 3.3 V | 20 | | | pC |
| NC, NO OFF capacitance | $C_{NC(OFF)}$, $C_{NO(OFF)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch OFF, | See Figure 14 | 25°C | 3.3 V | 23 | | | pF |
| NC, NO ON capacitance | $C_{NC(ON)}$, $C_{NO(ON)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch ON, | See Figure 14 | 25°C | 3.3V | 84 | | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, | See Figure 14 | 25°C | 3.3 V | 84 | | | pF |
| Digital input capacitance | C_{IN} | $V_{IN} = V_+$ or GND, | See Figure 14 | 25°C | 3.3 V | 2.1 | | | pF |
| Bandwidth | BW | $R_L = 50 \Omega$, Switch ON, | See Figure 17 | 25°C | 3.3 V | 100 | | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50 \Omega$, $f = 1 \text{ MHz}$, | Switch OFF, See Figure 18 | 25°C | 3.3 V | -65 | | | dB |
| Crosstalk | X_{TALK} | $R_L = 50 \Omega$, $f = 1 \text{ MHz}$, | Switch ON, See Figure 19 | 25°C | 3.3 V | -65 | | | dB |
| Total harmonic distortion | THD | $R_L = 600 \Omega$, $C_L = 50 \text{ pF}$, | $f = 600 \text{ Hz}$ to 20 kHz, See Figure 21 | 25°C | 3.3 V | 0.015 | | | % |
| Supply | | | | | | | | | |
| Positive supply current | I_+ | $V_{IN} = V_+$ or GND, | Switch ON or OFF | Full | 3.6 V | 0.1 | | | μA |

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 2.5-V Supply
 $V_+ = 2.3 \text{ V to } 2.7 \text{ V}$ and $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|--|----------------------------|--|------------------------------|-------|-------|---------|--------|----------|---------------|
| Analog Switch | | | | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | | | | 0 | | V_+ | V |
| Peak ON-state resistance | r_{peak} | $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -8 \text{ mA}$, | Switch ON, See Figure 11 | 25°C | 2.5 V | 1.7 2.7 | | 2.7 | Ω |
| | | | | Full | | | | | |
| ON-state resistance | r_{on} | V_{NO} or $V_{NC} = 1.8 \text{ V}$, $I_{COM} = -8 \text{ mA}$, | Switch ON, See Figure 11 | 25°C | 2.5 V | 1.45 2 | | 2 | Ω |
| | | | | Full | | | | | |
| ON-state resistance match between channels | Δr_{on} | V_{NO} or $V_{NC} = 0.8 \text{ V}, 1.8 \text{ V}$, $I_{COM} = -8 \text{ mA}$, | Switch ON, See Figure 11 | 25°C | 2.5 V | 0.7 | | Ω | |
| ON-state resistance flatness | $r_{on(Flat)}$ | $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -8 \text{ mA}$, | Switch ON, See Figure 11 | 25°C | 2.5 V | 0.5 | | Ω | |
| | | V_{NO} or $V_{NC} = 0.8 \text{ V}, 1.8 \text{ V}$, $I_{COM} = -8 \text{ mA}$, | | 25°C | | 0.45 | | | |
| NC, NO Off leakage current | $I_{NC(OFF)}, I_{NO(OFF)}$ | V_{NC} or $V_{NO} = 2.3 \text{ V}$, $V_{COM} = 0$, | Switch OFF, See Figure 12 | 25°C | 2.7 V | 0.2 | | nA | |
| NC, NO On leakage current | $I_{NC(ON)}, I_{NO(ON)}$ | V_{NC} or $V_{NO} = 2.3 \text{ V}$, $V_{COM} = \text{Open}$, | Switch ON, See Figure 13 | 25°C | 2.7 V | 2.8 | | nA | |
| COM On leakage current | $I_{COM(ON)}$ | V_{NC} or $V_{NO} = 2.3 \text{ V}$ or Open, $V_{COM} = 2.3 \text{ V}$, | Switch ON, See Figure 13 | 25°C | 2.7 V | 0.47 | | nA | |
| Digital Inputs (IN) | | | | | | | | | |
| Input logic high | V_{IH} | | | Full | | 1.8 | | 5.5 | V |
| Input logic low | V_{IL} | | | Full | | 0 | 0.6 | | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 5.5 \text{ V}$ or 0 | | Full | 2.7 V | -1 | | 1 | μA |

 (1) $T_A = 25^\circ\text{C}$

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Electrical Characteristics for 2.5-V Supply (continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|---------------------------|----------------------------------|--|-------|-------------------|-------|--------|-----|---------------|
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = V_+$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, See Figure 15 | 25°C | 2.3 V to 2.7 V | 40 | 55 | 70 | ns |
| | | | Full | | | | | |
| Turn-off time | t_{OFF} | $V_{COM} = V_+$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, See Figure 15 | 25°C | 2.3 V to 2.7 V | 30 | 40 | 55 | ns |
| | | | Full | | | | | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, See Figure 16 | 25°C | 2.3 V to 2.7 V | 1 | 33 | 39 | ns |
| | | | Full | | | | | |
| Charge injection | Q_C | $C_L = 1\text{ nF}$, $V_{GEN} = 0\text{ V}$, See Figure 20 | 25°C | 2.5 V | 13 | | | pC |
| NC, NO OFF capacitance | $C_{NC(OFF)}$, $C_{NO(OFF)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch OFF, See Figure 14 | 25°C | 2.5 V | 23 | | | pF |
| NC, NO ON capacitance | $C_{NC(ON)}$, $C_{NO(ON)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch ON, See Figure 14 | 25°C | 2.5V | 84 | | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, See Figure 14 | 25°C | 2.5 V | 84 | | | pF |
| Digital input capacitance | C_{IN} | $V_{IN} = V_+$ or GND, See Figure 14 | 25°C | 2.5 V | 2.1 | | | pF |
| Bandwidth | BW | $R_L = 50\ \Omega$, Switch ON, See Figure 17 | 25°C | 2.5 V | 100 | | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50\ \Omega$, $f = 1\text{ MHz}$, Switch OFF, See Figure 18 | 25°C | 2.5 V | -64 | | | dB |
| Crosstalk | X_{TALK} | $R_L = 50\ \Omega$, $f = 1\text{ MHz}$, Switch ON, See Figure 19 | 25°C | 2.5 V | -64 | | | dB |
| Total harmonic distortion | THD | $R_L = 600\ \Omega$, $C_L = 50\text{ pF}$, $f = 600\text{ Hz to }20\text{ kHz}$, See Figure 21 | 25°C | 2.5 V | 0.025 | | | % |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_{IN} = V_+$ or GND, Switch ON or OFF | Full | 2.7 V | 0.1 | | | μA |

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 1.8-V Supply
 $V_+ = 1.65\text{ V to }1.95\text{ V}$ and $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|--|----------------------------|---|------------------------------|------------------------------|--------|----------------------------|-------|---------------|
| Analog Switch | | | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | | | 0 | | V_+ | V |
| Peak ON-state resistance | r_{peak} | $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -2\text{ mA}$, | Switch ON, See Figure 11 | 25°C Full | 1.8 V | 4 | 4.9 | Ω |
| ON-state resistance | r_{on} | V_{NO} or $V_{NC} = 1.5\text{ V}$, $I_{COM} = -2\text{ mA}$, | Switch ON, See Figure 11 | 25°C Full | 1.8 V | 1.7 | 3.2 | Ω |
| ON-state resistance match between channels | Δr_{on} | V_{NO} or $V_{NC} = 0.6\text{ V}, 1.5\text{ V}$, $I_{COM} = -2\text{ mA}$, | Switch ON, See Figure 11 | 25°C Full | 1.8 V | 0.7 | | Ω |
| ON-state resistance flatness | $r_{on(flat)}$ | $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -2\text{ mA}$, V_{NO} or $V_{NC} = 0.6\text{ V}, 1.5\text{ V}$, $I_{COM} = -2\text{ mA}$, | Switch ON, See Figure 11 | 25°C Full 25°C Full | 1.8 V | 1.85 1.85 0.9 0.9 | | Ω |
| NC, NO Off leakage current | $I_{NC(OFF)}, I_{NO(OFF)}$ | V_{NC} or $V_{NO} = 1.65\text{ V}$, $V_{COM} = 0$, | Switch OFF, See Figure 12 | 25°C | 1.95 V | 0.2 | | nA |
| NC, NO On leakage current | $I_{NC(ON)}, I_{NO(ON)}$ | V_{NC} or $V_{NO} = 1.65\text{ V}$, $V_{COM} = \text{Open}$, | Switch ON, See Figure 13 | 25°C | 1.95 V | 2.8 | | nA |
| COM On leakage current | $I_{COM(ON)}$ | V_{NC} or $V_{NO} = 1.65\text{ V}$ or Open, $V_{COM} = 1.65\text{ V}$, | Switch ON, See Figure 13 | 25°C | 1.95 V | 0.47 | | nA |
| Digital Inputs (IN) | | | | | | | | |
| Input logic high | V_{IH} | | | Full | | 1.5 | 5.5 | V |
| Input logic low | V_{IL} | | | Full | | 0 | 0.6 | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 5.5\text{ V}$ or 0 | | Full | 1.95 V | -1 | 1 | μA |

(1) $T_A = 25^\circ\text{C}$

TS5A3159

1-Ω SPDT ANALOG SWITCH

SCDS174B – AUGUST 2004 – REVISED MAY 2005

Electrical Characteristics for 1.8-V Supply (continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | T_A | V_+ | MIN | TYP(1) | MAX | UNIT |
|---------------------------|----------------------------------|---|--|-------|---------------------|-----|--------|-----|---------------|
| Dynamic | | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = V_+$, $R_L = 50\ \Omega$, | $C_L = 35\ \text{pF}$, See Figure 15 | 25°C | 1.65 V to 1.95 V | 65 | 70 | 95 | ns |
| | | | | Full | | | | | |
| Turn-off time | t_{OFF} | $V_{COM} = V_+$, $R_L = 50\ \Omega$, | $C_L = 35\ \text{pF}$, See Figure 15 | 25°C | 1.65 V to 1.95 V | 40 | 55 | 70 | ns |
| | | | | Full | | | | | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, | $C_L = 35\ \text{pF}$, See Figure 16 | 25°C | 1.65 V to 1.95 V | 1 | 60 | 72 | ns |
| | | | | Full | | | | | |
| Charge injection | Q_C | $C_L = 1\ \text{nF}$, $V_{GEN} = 0\ \text{V}$, | See Figure 20 | 25°C | 1.8 V | 13 | | | pC |
| NC, NO OFF capacitance | $C_{NC(OFF)}$, $C_{NO(OFF)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch OFF, | See Figure 14 | 25°C | 1.8 V | 23 | | | pF |
| NC, NO ON capacitance | $C_{NC(ON)}$, $C_{NO(ON)}$ | V_{NC} or $V_{NO} = V_+$ or GND, Switch ON, | See Figure 14 | 25°C | 1.8V | 84 | | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, | See Figure 14 | 25°C | 1.8 V | 84 | | | pF |
| Digital input capacitance | C_{IN} | $V_{IN} = V_+$ or GND, | See Figure 14 | 25°C | 1.8 V | 2.1 | | | pF |
| Bandwidth | BW | $R_L = 50\ \Omega$, Switch ON, | See Figure 17 | 25°C | 1.8 V | 100 | | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50\ \Omega$, $f = 1\ \text{MHz}$, | Switch OFF, See Figure 18 | 25°C | 1.8 V | -63 | | | dB |
| Crosstalk | X_{TALK} | $R_L = 50\ \Omega$, $f = 1\ \text{MHz}$, | Switch ON, See Figure 19 | 25°C | 1.8 V | -63 | | | dB |
| Supply | | | | | | | | | |
| Positive supply current | I_+ | $V_{IN} = V_+$ or GND, | Switch ON or OFF | Full | 1.95 V | 0.1 | | | μA |

(1) $T_A = 25^\circ\text{C}$

TYPICAL PERFORMANCE

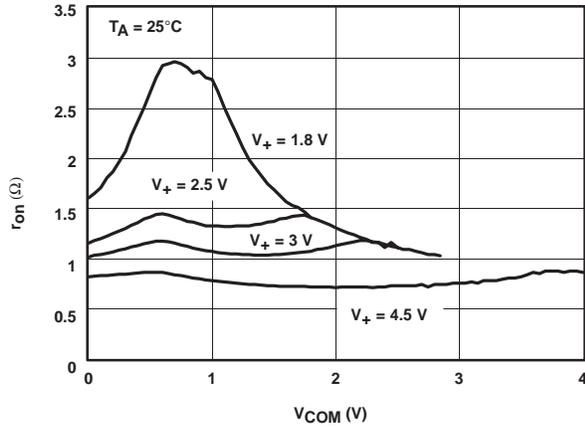


Figure 1. r_{on} vs V_{COM}

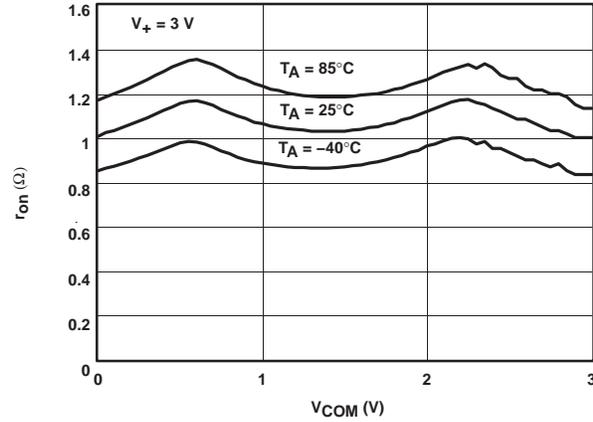


Figure 2. r_{on} vs V_{COM}

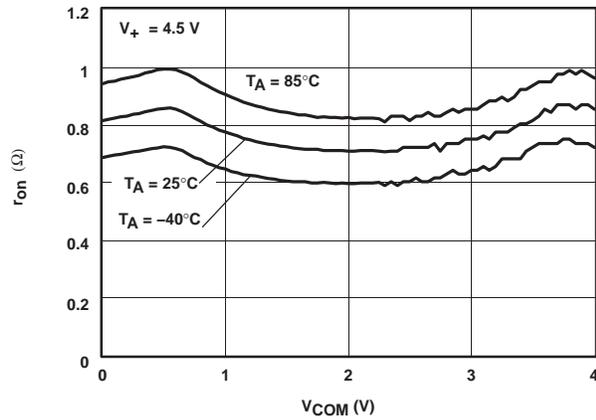


Figure 3. r_{on} vs V_{COM}

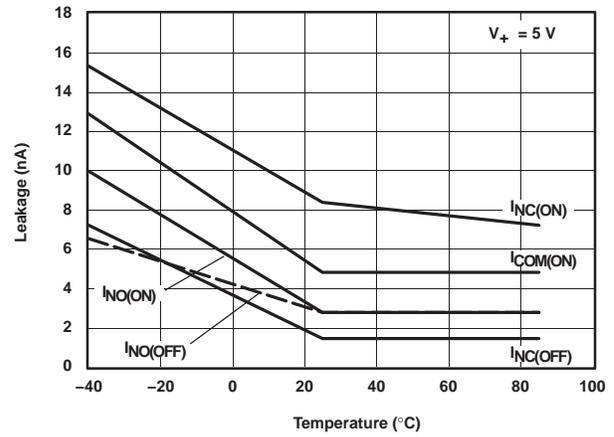


Figure 4. Leakage Current vs Temperature

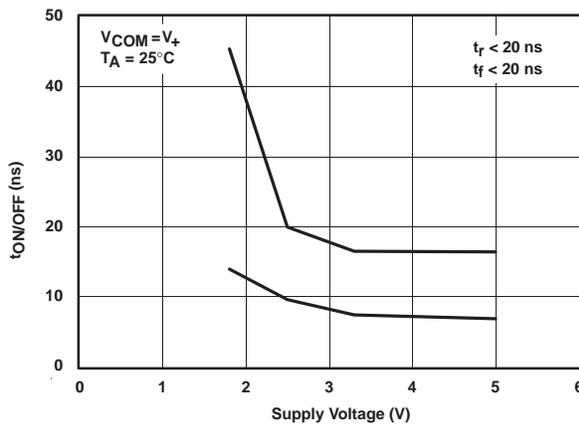


Figure 5. $t_{ON/OFF}$ vs V_+

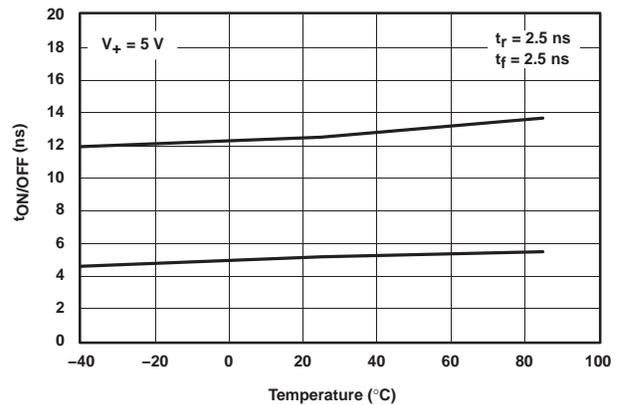


Figure 6. $t_{ON/OFF}$ vs Temperature

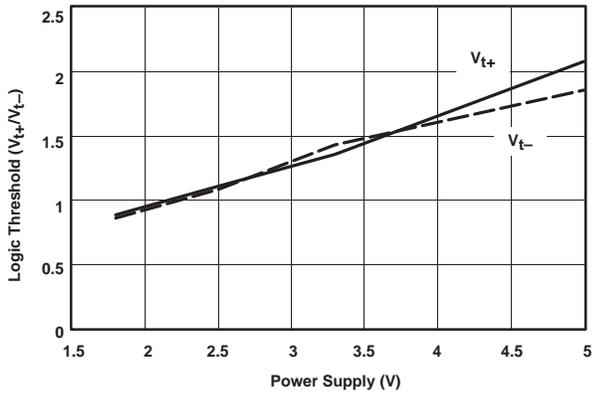


Figure 7. Logic Threshold vs Power Supply

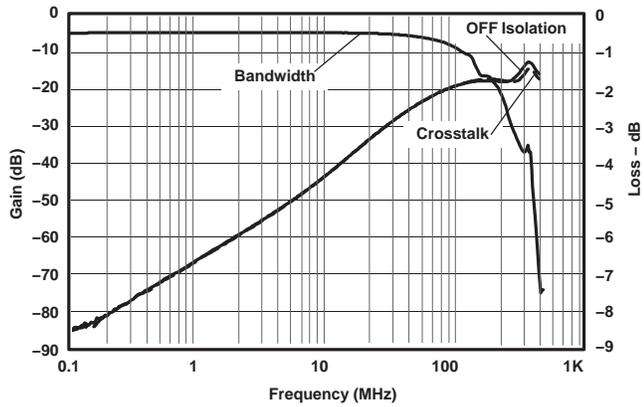


Figure 8. Frequency Response

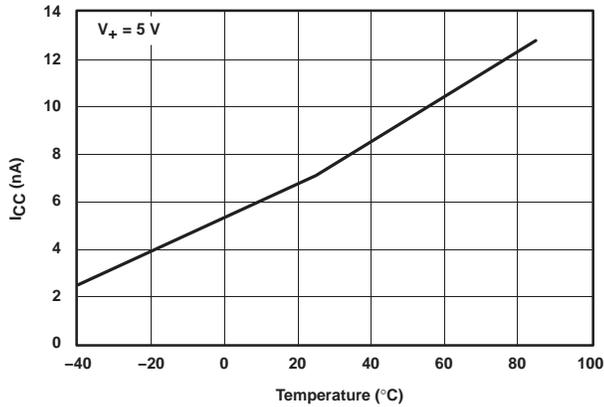


Figure 9. Power-Supply Current vs Temperature

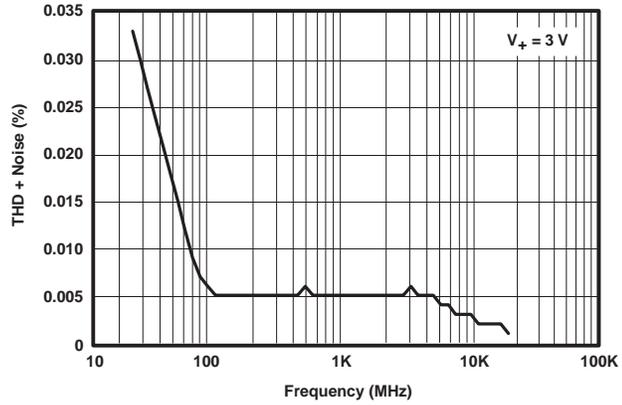


Figure 10. Total Harmonic Distortion (THD) vs Frequency

PIN DESCRIPTION

| PIN NUMBER | NAME | DESCRIPTION |
|------------|----------------|---|
| 1 | NO | Normally-open terminal |
| 2 | GND | Digital ground |
| 3 | NC | Normally-closed terminal |
| 4 | COM | Common terminal |
| 5 | V ₊ | Power supply |
| 6 | IN | Digital control pin to connect COM terminal to NO or NC terminals |

PARAMETER DESCRIPTION

| SYMBOL | DESCRIPTION |
|-----------------------------------|--|
| V _{COM} | Voltage at COM |
| V _{NC} | Voltage at NC |
| V _{NO} | Voltage at NO |
| r _{on} | Resistance between COM and NC or COM and NO ports, when the channel is ON |
| r _{peak} | Peak ON-state resistance over a specified voltage range |
| Δr _{on} | Difference of r _{on} between channels |
| r _{on(flat)} | Difference between the maximum and minimum value of r _{on} in a channel over the specified range of conditions |
| I _{NC(OFF)} | Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the OFF state under worst-case input and output conditions |
| I _{NO(OFF)} | Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state under worst-case input and output conditions |
| I _{NC(ON)} | Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the ON state and the output (COM) being open |
| I _{NO(ON)} | Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the ON state and the output (COM) being open |
| I _{COM(ON)} | Leakage current measured at the COM port, with the corresponding channel (COM to NO or COM to NC) in the ON state and the output (NC or NO) being open |
| V _{IH} | Minimum input voltage for logic high for the control input (IN) |
| V _{IL} | Minimum input voltage for logic low for the control input (IN) |
| V _{IN} | Voltage at IN |
| I _{IH} , I _{IL} | Leakage current measured at IN |
| t _{ON} | Turn-on time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog outputs (COM, NC, or NO) signal, when the switch is turning ON. |
| t _{OFF} | Turn-off time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog outputs (COM, NC, or NO) signal, when the switch is turning OFF. |
| t _{BBM} | Break-before-make time. This parameter is measured under the specified range of conditions and by the propagation delay between the output of two adjacent analog channels (NC and NO), when the control signal changes state. |
| Q _C | Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (NC, NO, or COM) output. This is measured in coulomb (C) and measured by the total charge induced due to switching of the control input. Charge injection, Q _C = C _L × ΔV _O , C _L is the load capacitance, and ΔV _O is the change in analog output voltage. |

PARAMETER DESCRIPTION (continued)

| SYMBOL | DESCRIPTION |
|---------------|--|
| $C_{NC(OFF)}$ | Capacitance at the NC port when the corresponding channel (NC to COM) is OFF |
| $C_{NO(OFF)}$ | Capacitance at the NO port when the corresponding channel (NO to COM) is OFF |
| $C_{NC(ON)}$ | Capacitance at the NC port when the corresponding channel (NC to COM) is ON |
| $C_{NO(ON)}$ | Capacitance at the NO port when the corresponding channel (NO to COM) is ON |
| $C_{COM(ON)}$ | Capacitance at the COM port when the corresponding channel (COM to NC or COM to NO) is ON |
| C_{IN} | Capacitance of IN |
| O_{ISO} | OFF isolation of the switch is a measurement OFF-state switch impedance. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM or NO to COM) in the OFF state. |
| X_{TALK} | Crosstalk is a measurement of unwanted signal coupling from an ON channel to an OFF channel (NC to NO or NO to NC). This is measured in a specific frequency and in dB. |
| BW | Bandwidth of the switch. This is the frequency in which the gain of an ON channel is -3 dB below the DC gain. |
| I_+ | Static power-supply current with the control (IN) pin at V_+ or GND |
| ΔI_+ | This is the increase in I_+ for each control (IN) input that is at the specified voltage, rather than at V_+ or GND. |

PARAMETER MEASUREMENT INFORMATION

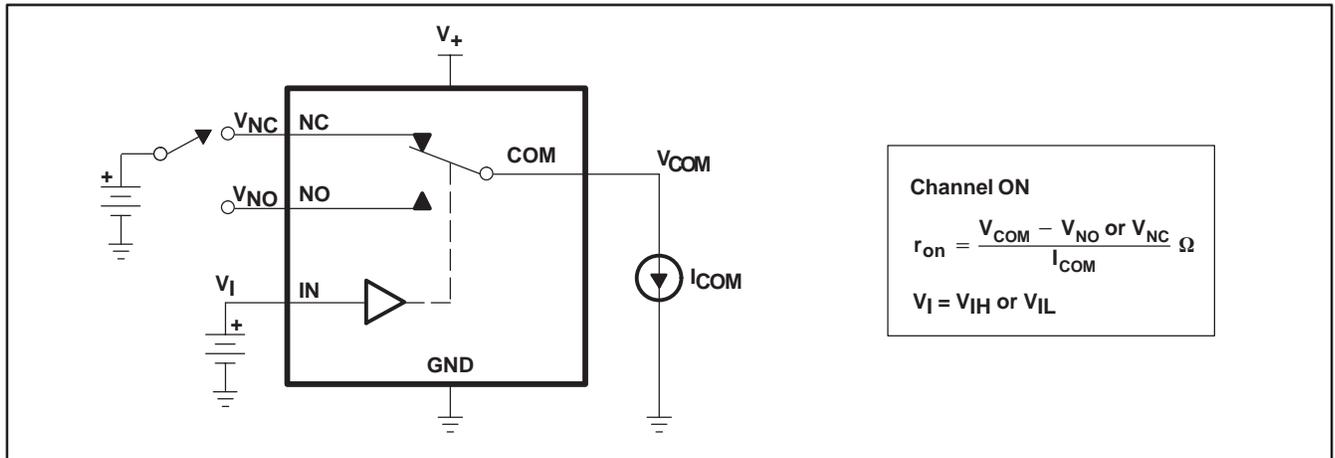


Figure 11. ON-State Resistance (r_{on})

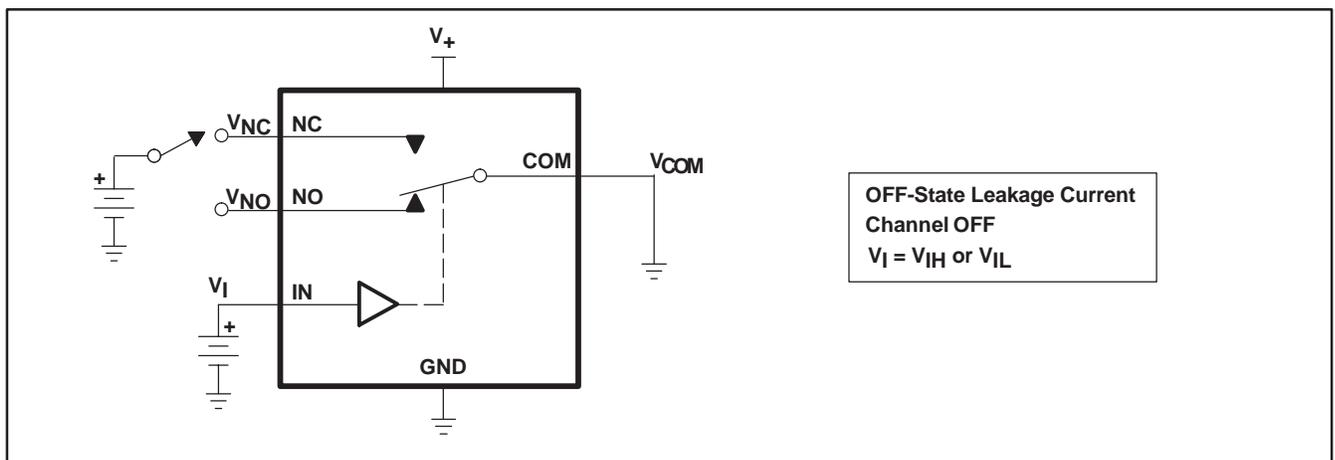


Figure 12. OFF-State Leakage Current ($I_{NC(OFF)}$, $I_{NO(OFF)}$)

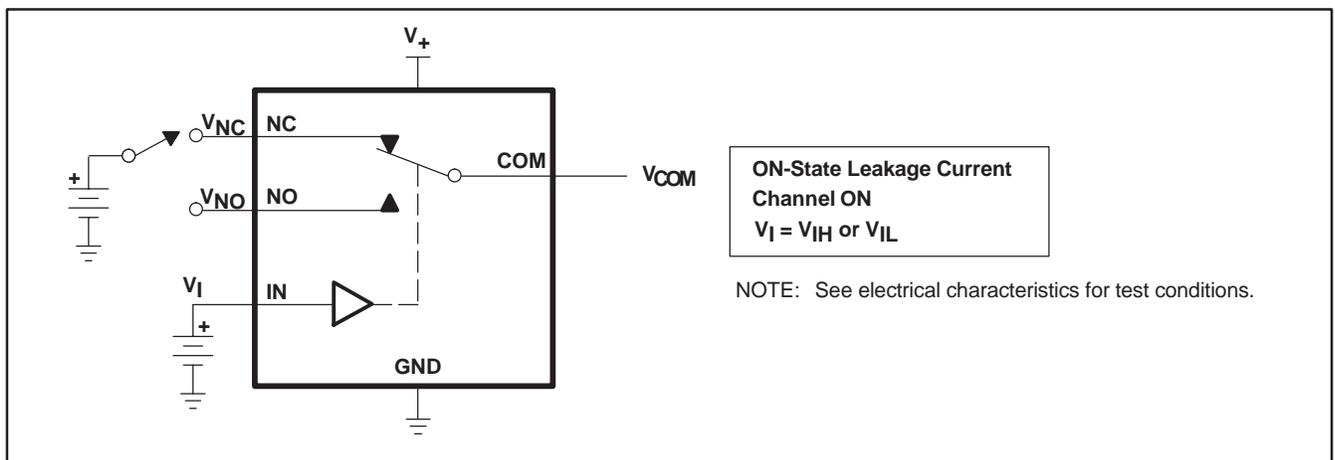


Figure 13. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$, $I_{NO(ON)}$)

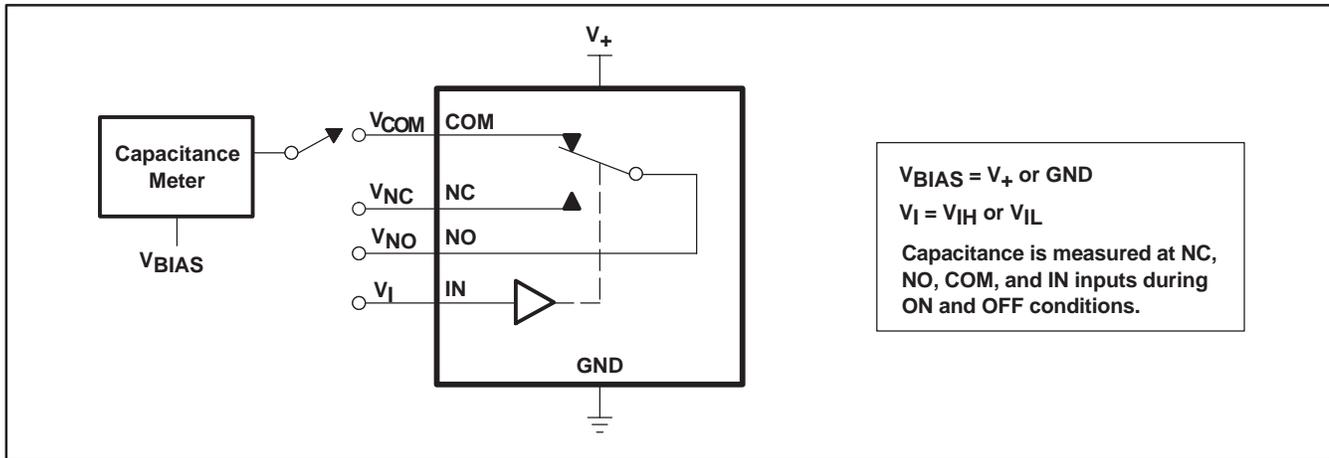
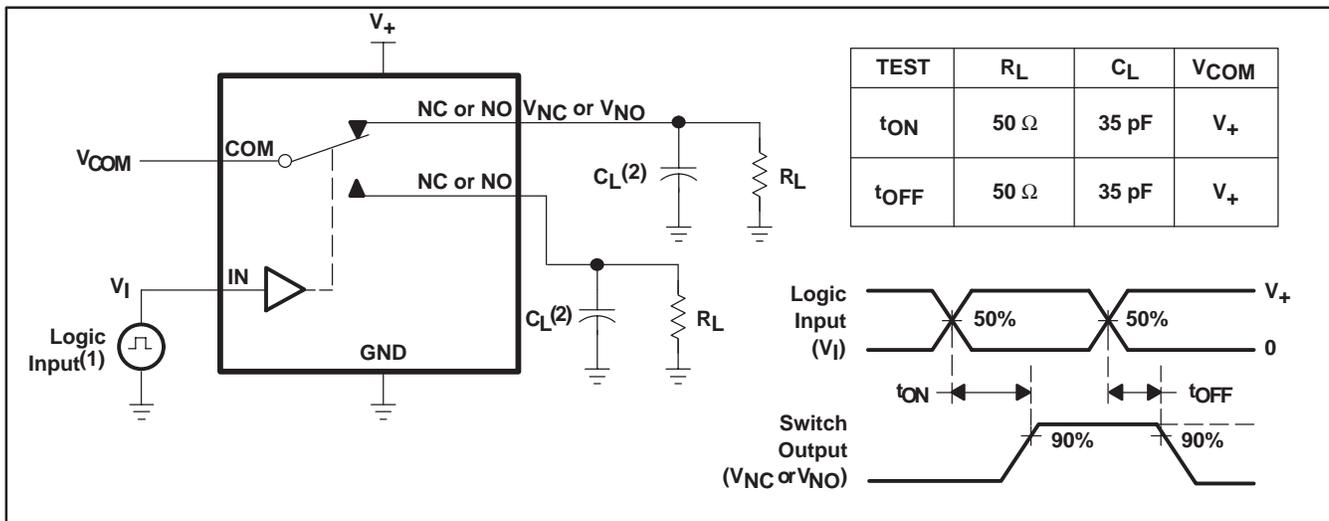
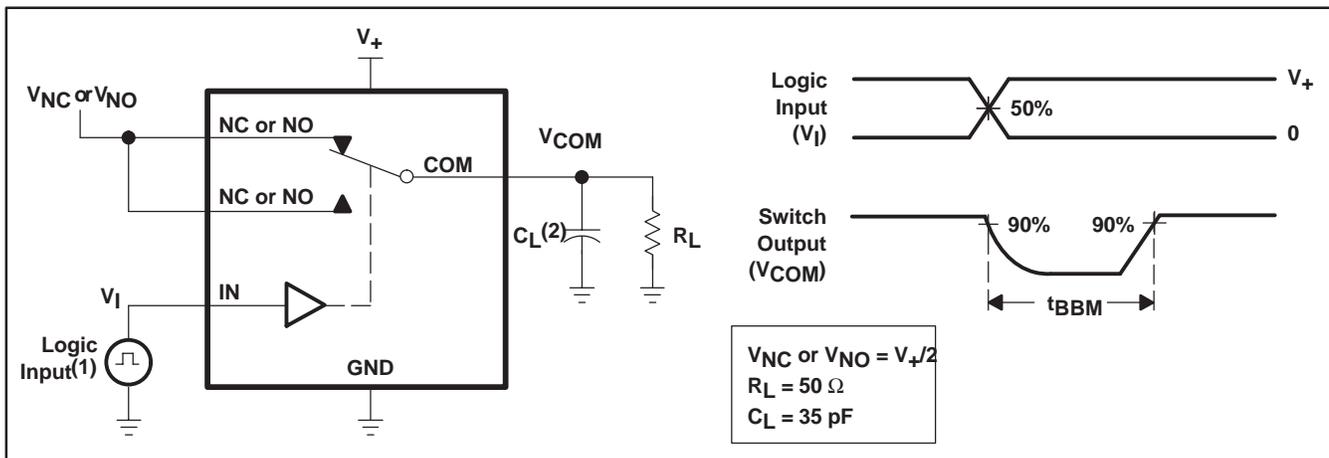


Figure 14. Capacitance (C_I , $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NO(OFF)}$, $C_{NC(ON)}$, $C_{NO(ON)}$)



- (1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, ZO = 50 Ω, tr < 5 ns, tf < 5 ns.
 (2) CL includes probe and jig capacitance.

Figure 15. Turn-On (tON) and Turn-Off Time (tOFF)



- (1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, ZO = 50 Ω, tr < 5 ns, tf < 5 ns.
 (2) CL includes probe and jig capacitance.

Figure 16. Break-Before-Make Time (tBBM)

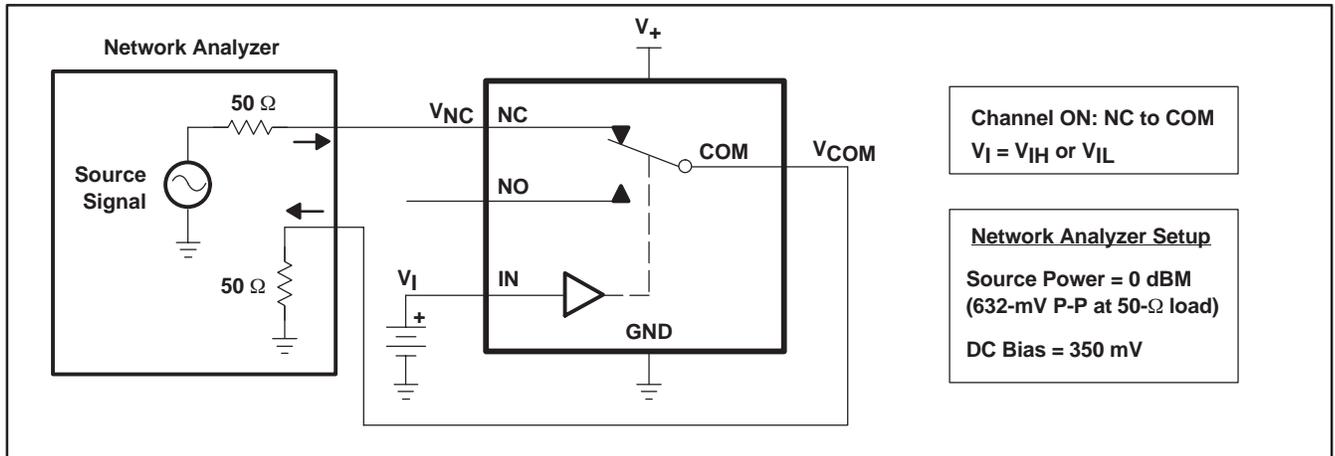


Figure 17. Bandwidth (BW)

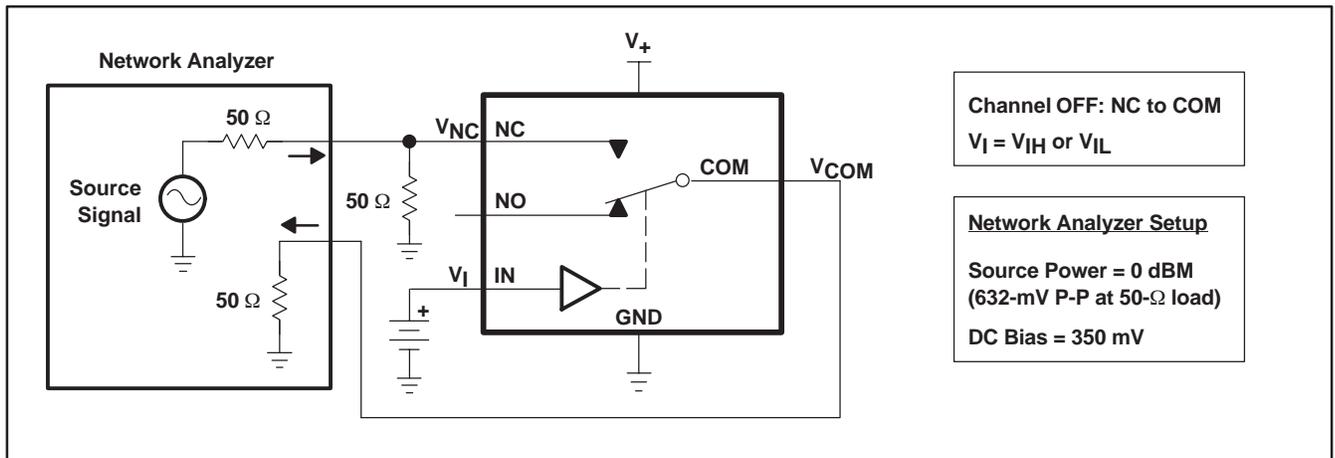


Figure 18. OFF Isolation (O_{ISO})

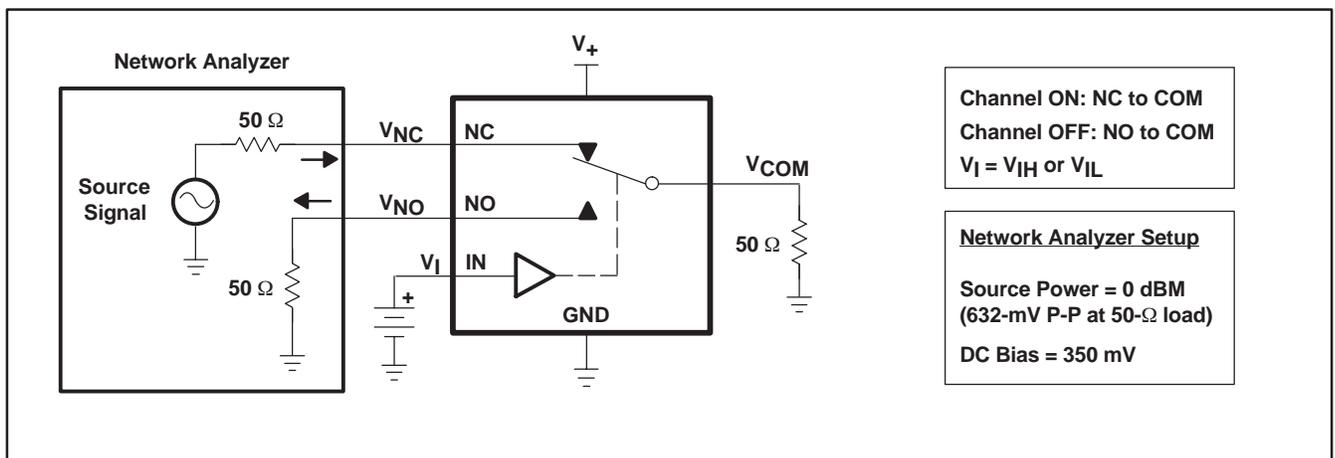
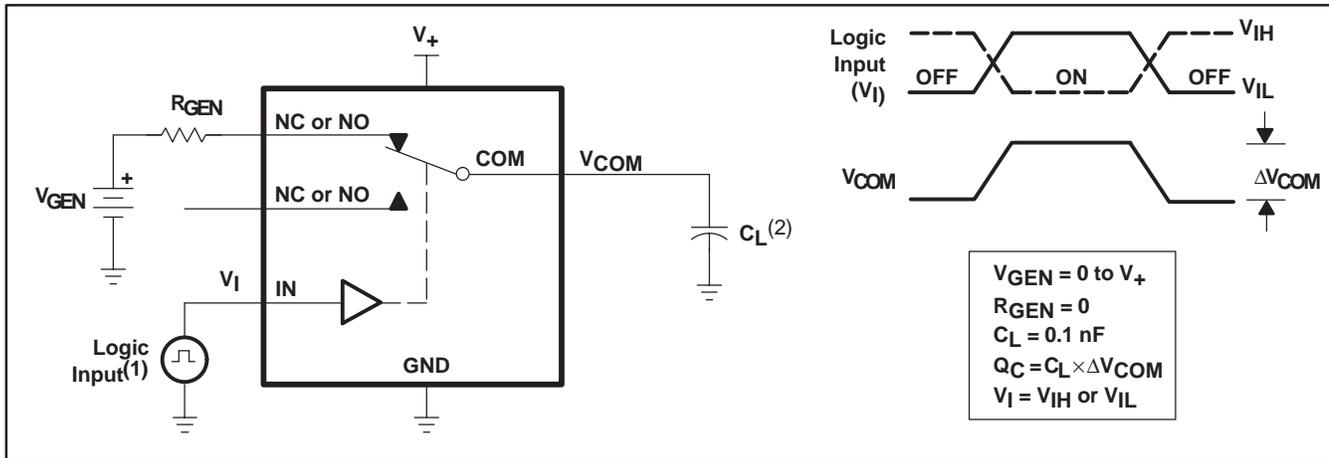
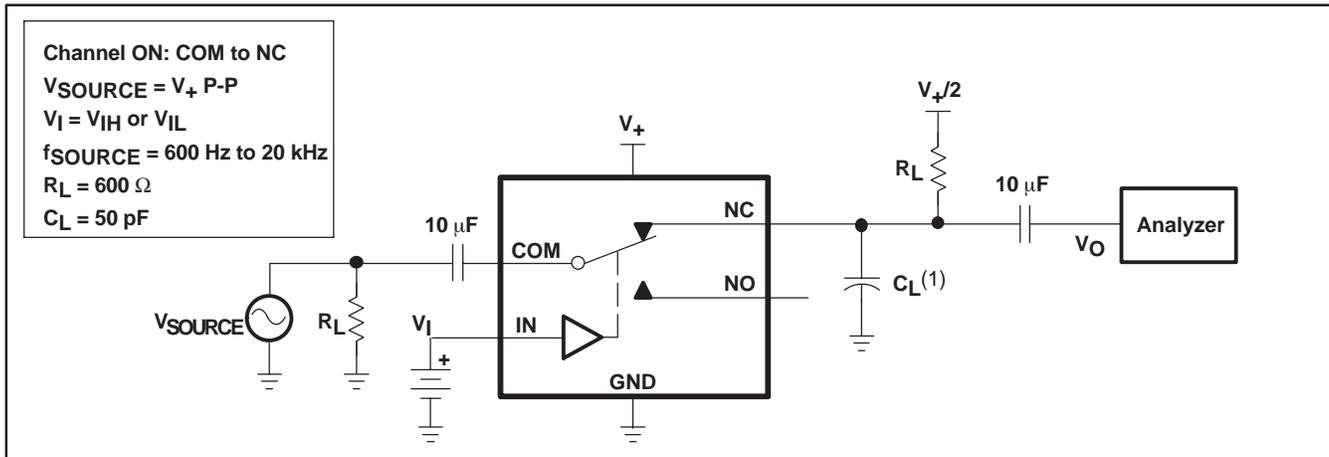


Figure 19. Crosstalk (X_{TALK})



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

Figure 20. Charge Injection (Q_C)



- (1) C_L includes probe and jig capacitance.

Figure 21. Total Harmonic Distortion (THD)

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TS5A3159DBVR | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DBVRE4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DBVRG4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DBVT | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DBVTE4 | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DBVTG4 | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DCKRE4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DCKRG4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3159DCKT | ACTIVE | SC70 | DCK | 6 | 250 | TBD | Call TI | Call TI |
| TS5A3159DCKTE4 | ACTIVE | SC70 | DCK | 6 | 250 | TBD | Call TI | Call TI |
| TS5A3159DCKTG4 | ACTIVE | SC70 | DCK | 6 | 250 | TBD | Call TI | Call TI |

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

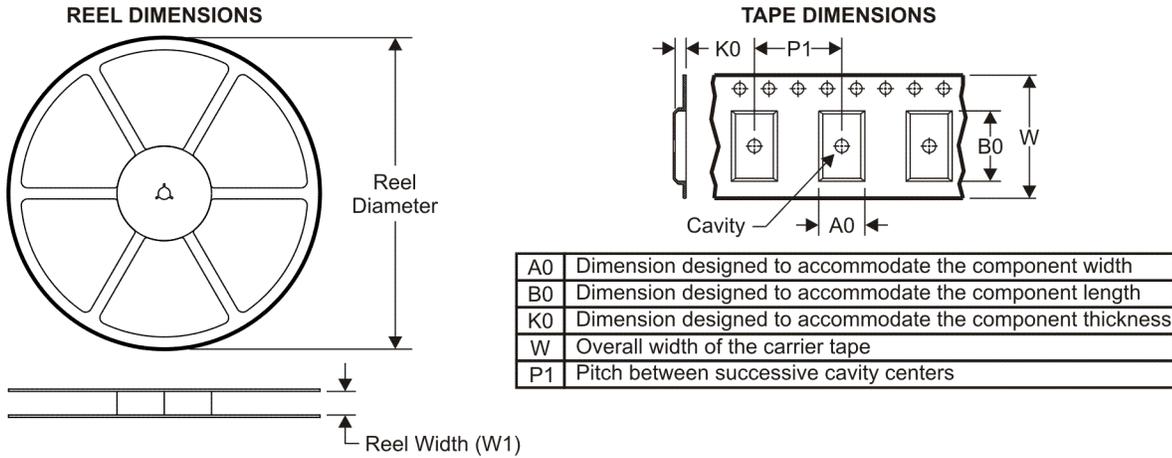
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

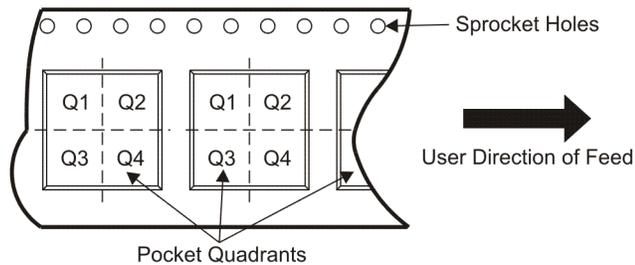
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TAPE AND REEL INFORMATION



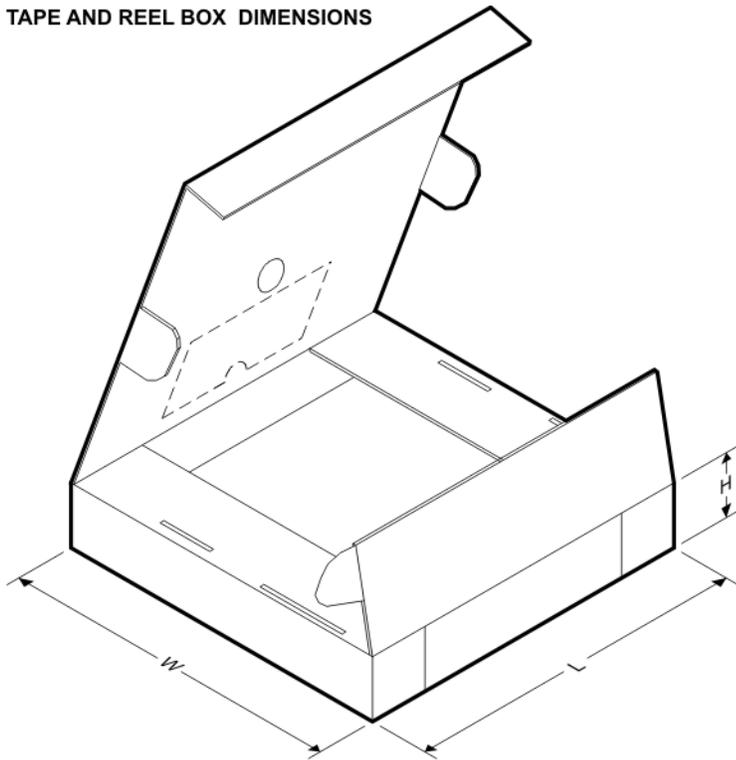
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TS5A3159DBVR | SOT-23 | DBV | 6 | 3000 | 180.0 | 9.2 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TS5A3159DBVT | SOT-23 | DBV | 6 | 250 | 180.0 | 9.2 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TS5A3159DCKR | SC70 | DCK | 6 | 3000 | 180.0 | 9.2 | 2.24 | 2.34 | 1.22 | 4.0 | 8.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS

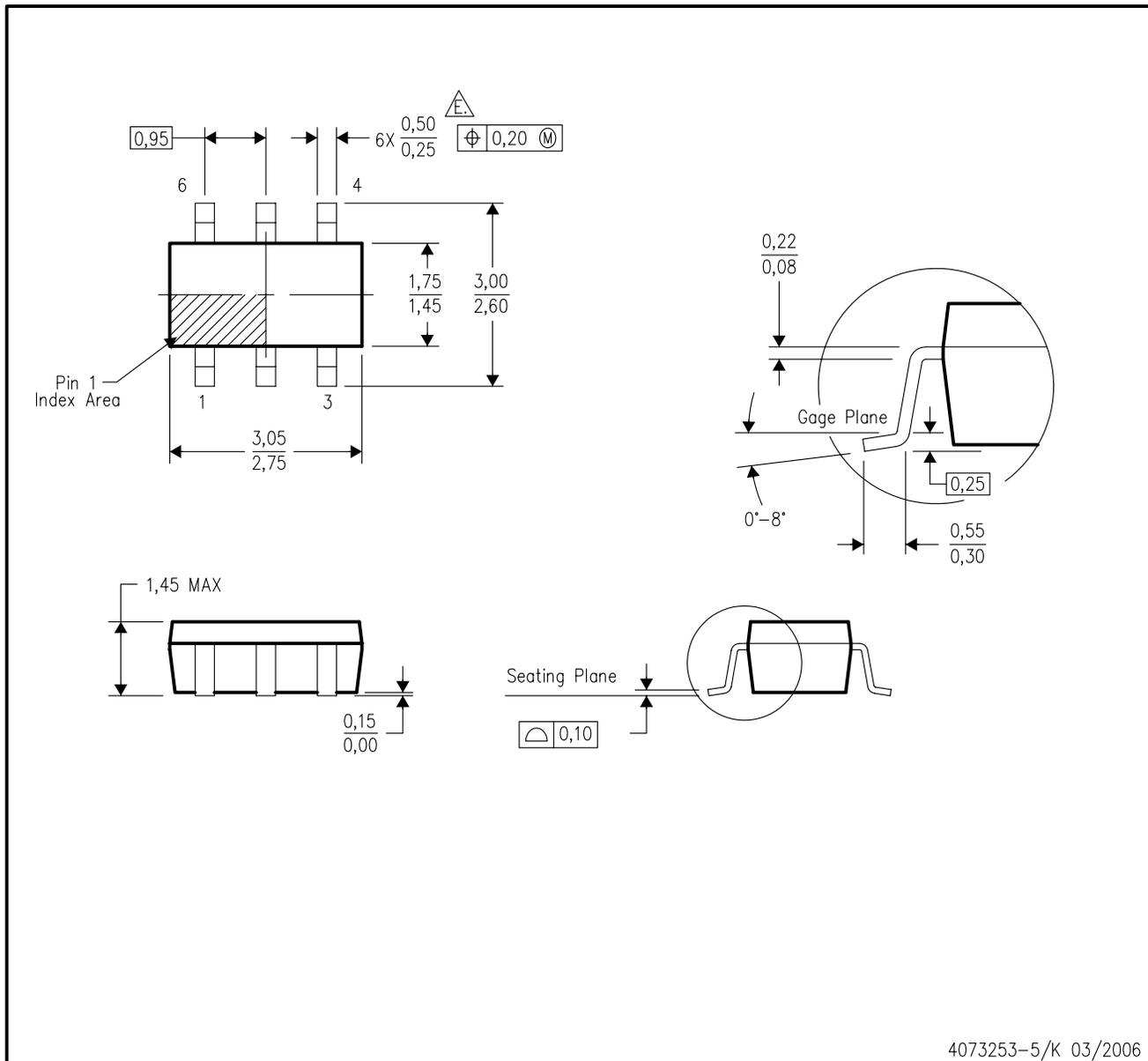


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TS5A3159DBVR | SOT-23 | DBV | 6 | 3000 | 202.0 | 201.0 | 28.0 |
| TS5A3159DBVT | SOT-23 | DBV | 6 | 250 | 202.0 | 201.0 | 28.0 |
| TS5A3159DCKR | SC70 | DCK | 6 | 3000 | 202.0 | 201.0 | 28.0 |

DBV (R-PDSO-G6)

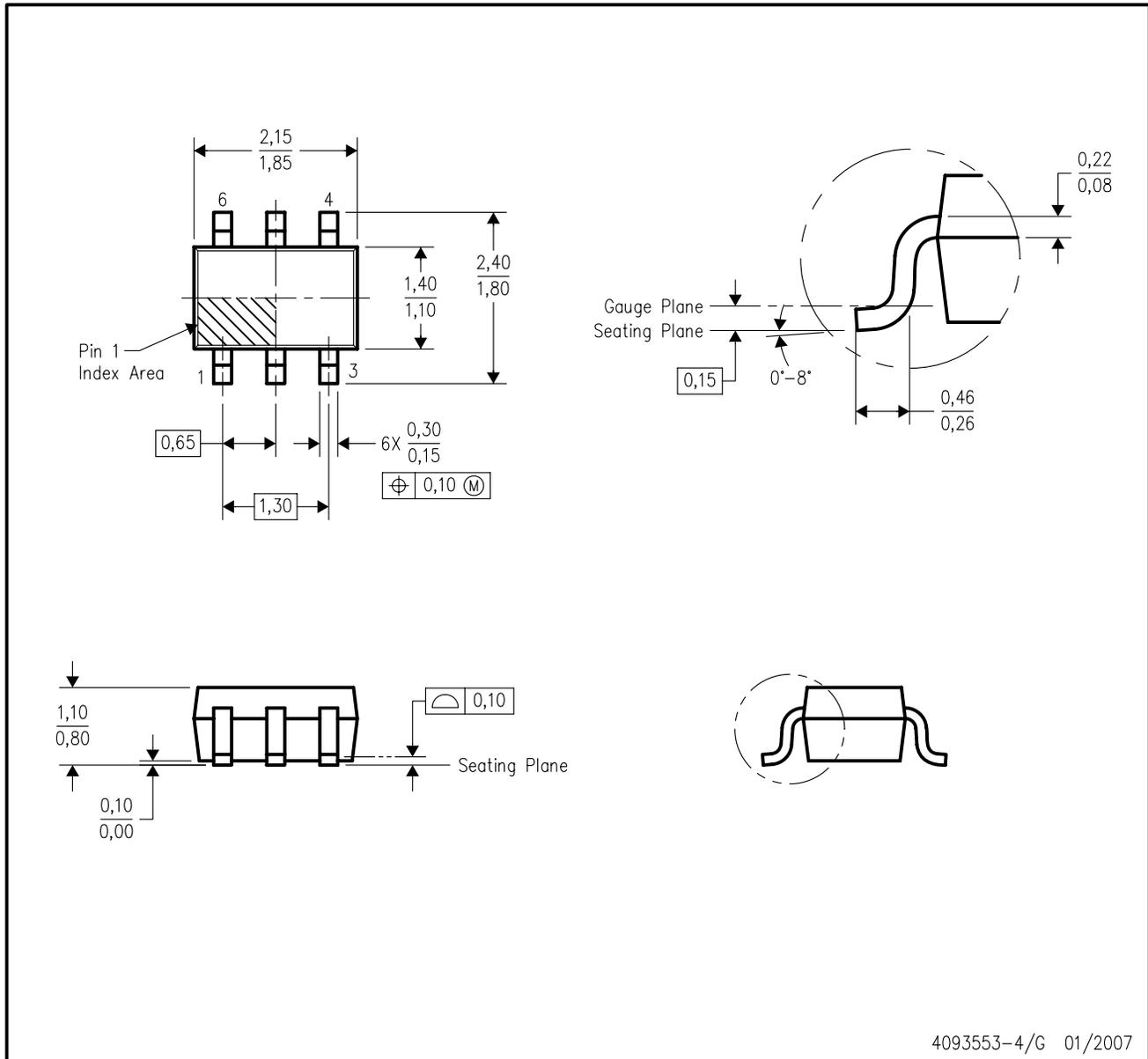
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- \triangle Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-203 variation AB.

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