

FEATURES

- Low ON-State Resistance (10 Ω)
- Control Inputs Are 5-V Tolerant
- Low Charge Injection
- Excellent ON-State Resistance Matching
- Low Total Harmonic Distortion (THD)
- 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)

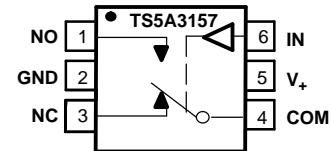
DESCRIPTION/ORDERING INFORMATION

The TS5A3157 is a single-pole double-throw (SPDT) analog switch that is designed to operate from 1.65 V to 5.5 V. This device can handle both digital and analog signals, and signals up to V_+ can be transmitted in either direction.

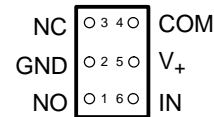
APPLICATIONS

- Sample-and-Hold Circuits
- Battery-Powered Equipment
- Audio and Video Signal Routing
- Communication Circuits

SOT-23 OR SC-70 PACKAGE
(TOP VIEW)



YZP PACKAGE
(BOTTOM VIEW)



SUMMARY OF CHARACTERISTICS⁽¹⁾

| Configuration | Single Pole Double Throw (SPDT) |
|---|---------------------------------|
| Number of channels | 1 |
| ON-state resistance (r_{on}) | 10 Ω |
| ON-state resistance match (Δr_{on}) | 0.15 Ω |
| ON-state resistance flatness ($r_{on(flat)}$) | 4 Ω |
| Turn-on/turn-off time (t_{ON}/t_{OFF}) | 5.7 ns/3.8 ns |
| Break-before-make time (t_{BBM}) | 0.5 ns |
| Charge injection (Q_C) | 7 pC |
| Bandwidth (BW) | 300 MHz |
| OFF isolation (O_{ISO}) | –65 dB at 10 MHz |
| Crosstalk (X_{TALK}) | –66 dB at 10 MHz |
| Total harmonic distortion (THD) | 0.01% |
| Leakage current ($I_{NO(OFF)}/I_{NC(OFF)}$) | ±0.1 μA |
| Power-supply current (I_+) | 10 μA |
| Package options | 6-pin DSBGA, DBV, or DCK |

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



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NanoFree is a trademark of Texas Instruments.

TS5A3157

10-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 | NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free) | Tape and reel | TS5A3157YZPR | _ _ _JC_ |
| | SOT (SOT-23) – DBV | Tape and reel | TS5A3157DBVR | JC5_ |
| | SOT (SC-70) – DCK | Tape and reel | TS5A3157DCKR | JC_ |

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

FUNCTION TABLE

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

Absolute Minimum and Maximum Ratings⁽¹⁾⁽²⁾

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

| | | MIN | MAX | UNIT |
|--|---|---|----------------------|-----------|
| V ₊ | Supply voltage range ⁽³⁾ | –0.5 | 6.5 | V |
| V _{NO} V _{NC} V _{COM} | Analog voltage range ⁽³⁾⁽⁴⁾⁽⁵⁾ | –0.5 | V ₊ + 0.5 | V |
| I _K | Analog port diode current | V _{NC} , V _{NO} , V _{COM} < 0 or V _{NO} , V _{NC} , V _{COM} > V ₊ | | –50 50 mA |
| I _{NO} I _{NC} I _{COM} | On-state switch current | V _{NC} , V _{NO} , V _{COM} = 0 to V ₊ | | –50 50 mA |
| V _I | Digital input voltage range ⁽³⁾⁽⁴⁾ | –0.5 | 6.5 | V |
| I _{IK} | Digital input clamp current | V _I < 0 | | –50 mA |
| I ₊ | Continuous current through V ₊ | –100 | 100 | mA |
| I _{GND} | Continuous current through GND | –100 | 100 | mA |
| θ _{JA} | Package thermal impedance ⁽⁶⁾ | DBV package | | 206 |
| | | DCK package | | 252 |
| | | YZP package | | 132 |
| T _{stg} | Storage temperature range | –65 | 150 | °C |

- (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
- (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) The package thermal impedance is calculated in accordance with JESD 51-7.

Electrical Characteristics for 5-V Supply⁽¹⁾

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | T _A | V ₊ | MIN | TYP | MAX | UNIT |
|--|---|--|------------------------------|----------------|----------------|----------------------|------|----------------------|------|
| Analog Switch | | | | | | | | | |
| Analog signal range | V _{COM} , V _{NO} , V _{NC} | | | | | 0 | | V ₊ | V |
| ON-state resistance | r _{on} | 0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −30 mA, | Switch ON, See Figure 13 | 25°C | 4.5 V | 5.5 | | 10 | Ω |
| | | | | Full | | | | 12 | |
| ON-state resistance match between channels | Δr _{on} | V _{NO} or V _{NC} = 3.15 V, I _{COM} = −30 mA, | Switch ON, See Figure 13 | 25°C | 4.5 V | 0.15 | | 0.2 | Ω |
| | | | | Full | | | | 0.3 | |
| ON-state resistance flatness | r _{on(flat)} | 0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −30 mA, | Switch ON, See Figure 13 | 25°C | 4.5 V | 4 | | 5 | Ω |
| | | | | Full | | | | 6 | |
| NO, NC OFF leakage current | I _{NO(OFF)} , I _{NC(OFF)} | V _{NO} or V _{NC} = 1 V, V _{COM} = 4.5 V, or V _{NO} or V _{NC} = 4.5 V, V _{COM} = 1 V, | Switch OFF, See Figure 14 | 25°C | 5.5 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −0.2 | 0.1 | 0.2 | |
| NO, NC ON leakage current | I _{NO(ON)} , I _{NC(ON)} | V _{NO} = 1 V, V _{COM} = Open, or V _{NO} = 4.5 V, V _{COM} = Open, | Switch ON, See Figure 15 | 25°C | 5.5 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −0.2 | 0.1 | 0.2 | |
| COM ON leakage current | I _{COM(ON)} | V _{COM} = 1 V, V _{NO} or V _{NC} = Open, or V _{COM} = 4.5 V, V _{NO} or V _{NC} = Open, | Switch ON, See Figure 15 | 25°C | 5.5 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −0.2 | 0.1 | 0.2 | |
| Digital Control Input (IN) | | | | | | | | | |
| Input logic high | V _{IH} | | | Full | | V ₊ × 0.7 | | 5.5 | V |
| Input logic low | V _{IL} | | | Full | | 0 | | V ₊ × 0.3 | V |
| Input leakage current | I _{IH} , I _{IL} | V _I = 5.5 V or 0 | | 25°C | 5.5 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −1 | | 1 | |

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

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Electrical Characteristics for 5-V Supply⁽¹⁾ (Continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|---------------------------|----------------------------------|--|-------|----------------|-----|------|-----|---------------|
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = 3 \text{ V}$, $R_L = 300 \Omega$, $C_L = 35 \text{ pF}$, See Figure 17 | 25°C | 5 V | 1 | 6 | 8.5 | ns |
| | | | Full | 4.5 V to 5.5 V | 1 | | 9.5 | |
| Turn-off time | t_{OFF} | $V_{COM} = 3 \text{ V}$, $R_L = 300 \Omega$, $C_L = 35 \text{ pF}$, See Figure 17 | 25°C | 5 V | 1 | 3.5 | 6.5 | ns |
| | | | Full | 4.5 V to 5.5 V | 1 | | 7.5 | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50 \Omega$, $C_L = 35 \text{ pF}$, See Figure 18 | 25°C | 5 V | 1.8 | 2 | 3 | ns |
| | | | Full | 4.5 V to 5.5 V | 1.8 | | 3.5 | |
| Charge injection | Q_C | $V_{GEN} = 0$, $R_{GEN} = 0$, $C_L = 0.1 \text{ nF}$, See Figure 22 | 25°C | 5 V | | 7 | | pC |
| NO, NC OFF capacitance | $C_{NO(OFF)}$, $C_{NC(OFF)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch OFF, See Figure 16 | 25°C | 5 V | | 5.5 | | pF |
| NO, NC ON capacitance | $C_{NO(ON)}$, $C_{NC(ON)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 5 V | | 17.5 | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 5 V | | 17.5 | | pF |
| Digital input capacitance | C_I | $V_I = V_+$ or GND, See Figure 16 | 25°C | 5 V | | 2.8 | | pF |
| Bandwidth | BW | $R_L = 50 \Omega$, Switch ON, See Figure 19 | 25°C | 5 V | | 300 | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50 \Omega$, $f = 10 \text{ MHz}$, Switch OFF, See Figure 20 | 25°C | 5 V | | –65 | | dB |
| Crosstalk | X_{TALK} | $R_L = 50 \Omega$, $f = 10 \text{ MHz}$, Switch ON, See Figure 21 | 25°C | 5 V | | –66 | | dB |
| Total harmonic distortion | THD | $R_L = 600 \Omega$, $C_L = 50 \text{ pF}$, $f = 20 \text{ Hz to } 20 \text{ kHz}$, See Figure 23 | 25°C | 5 V | | 0.01 | | % |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_I = V_+$ or GND, Switch ON or OFF | 25°C | 5.5 V | | 2.5 | 5 | μA |
| | | | Full | | | | 10 | |

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

Electrical Characteristics for 3.3-V Supply⁽¹⁾

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | T _A | V ₊ | MIN | TYP | MAX | UNIT |
|--|---|--|------------------------------|----------------|----------------|----------------------|------|----------------------|------|
| Analog Switch | | | | | | | | | |
| Analog signal range | V _{COM} , V _{NO} , V _{NC} | | | | | 0 | | V ₊ | V |
| ON-state resistance | r _{on} | 0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −24 mA, | Switch ON, See Figure 13 | 25°C | 3 V | 12 | | 20 | Ω |
| | | | | Full | | | | 20 | |
| ON-state resistance match between channels | Δr _{on} | V _{NO} or V _{NC} = 2.1 V, I _{COM} = −24 mA, | Switch ON, See Figure 13 | 25°C | 3 V | 0.2 | | 0.4 | Ω |
| | | | | Full | | | | 0.3 | |
| ON-state resistance flatness | r _{on(flat)} | 0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −24 mA, | Switch ON, See Figure 13 | 25°C | 3 V | 9 | | 11 | Ω |
| | | | | Full | | | | 12 | |
| NO, NC OFF leakage current | I _{NO(OFF)} , I _{NC(OFF)} | V _{NO} or V _{NC} = 1 V, V _{COM} = 3 V, or V _{NO} or V _{NC} = 3 V, V _{COM} = 1 V, | Switch OFF, See Figure 14 | 25°C | 3.6 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −0.2 | 0.1 | 0.2 | |
| NO, NC ON leakage current | I _{NO(ON)} , I _{NC(ON)} | V _{NO} or V _{NC} = 1 V, V _{COM} = Open, or V _{NO} or V _{NC} = 3 V, V _{COM} = Open, | Switch ON, See Figure 15 | 25°C | 3.6 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −0.2 | 0.1 | 0.2 | |
| COM ON leakage current | I _{COM(ON)} | V _{COM} = 1 V, V _{NO} or V _{NC} = Open, or V _{COM} = 3 V, V _{NO} or V _{NC} = Open, | Switch ON, See Figure 15 | 25°C | 3.6 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −0.2 | 0.1 | 0.2 | |
| Digital Control Input (IN) | | | | | | | | | |
| Input logic high | V _{IH} | | | Full | | V ₊ × 0.7 | | 5.5 | V |
| Input logic low | V _{IL} | | | Full | | 0 | | V ₊ × 0.3 | V |
| Input leakage current | I _{IH} , I _{IL} | V _I = 5.5 V or 0 | | 25°C | 3.6 V | −0.1 | 0.05 | 0.1 | μA |
| | | | | Full | | −1 | | 1 | |

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

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Electrical Characteristics for 3.3-V Supply⁽¹⁾ (Continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|---------------------------|---------------|---|-------|--------------|-----|-------|------|---------------|
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = 2\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, See Figure 17 | 25°C | 3.3 V | 3.5 | 7 | 9.5 | ns |
| | | | Full | 3 V to 3.6 V | 1.5 | | 10.5 | |
| Turn-off time | t_{OFF} | $V_{COM} = 2\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, See Figure 17 | 25°C | 3.3 V | 1 | 3.5 | 6.5 | ns |
| | | | Full | 3 V to 3.6 V | 1 | | 7.5 | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, See Figure 18 | 25°C | 3.3 V | 2.5 | 3 | 5 | ns |
| | | | Full | 3 V to 3.6 V | 2 | | 5 | |
| Charge injection | Q_C | $V_{GEN} = 0$, $R_{GEN} = 0$, $C_L = 0.1\text{ nF}$, See Figure 22 | 25°C | 3.3 V | | 3 | | pC |
| NO, NC OFF capacitance | $C_{NO(OFF)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch OFF, See Figure 16 | 25°C | 3.3 V | | 5.5 | | pF |
| NO, NC ON capacitance | $C_{NO(ON)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 3.3 V | | 17.5 | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 3.3 V | | 17.5 | | pF |
| Digital input capacitance | C_I | $V_I = V_+$ or GND, See Figure 16 | 25°C | 3.3 V | | 2.8 | | pF |
| Bandwidth | BW | $R_L = 50\ \Omega$, Switch ON, See Figure 19 | 25°C | 3.3 V | | 300 | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch OFF, See Figure 20 | 25°C | 3.3 V | | –65 | | dB |
| Crosstalk | X_{TALK} | $R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch ON, See Figure 21 | 25°C | 3.3 V | | –66 | | dB |
| Total harmonic distortion | THD | $R_L = 600\ \Omega$, $C_L = 50\text{ pF}$, $f = 20\text{ Hz to }20\text{ kHz}$, See Figure 23 | 25°C | 3.3 V | | 0.015 | | % |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_I = V_+$ or GND, Switch ON or OFF | 25°C | 3.6 V | | 2.5 | 5 | μA |
| | | | Full | | | | 10 | |

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

Electrical Characteristics for 2.5-V Supply⁽¹⁾

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|--|----------------------------|--|--------------|-------|------------------|-------------|------------------|---------------|
| Analog Switch | | | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | | | 0 | | V_+ | V |
| ON-state resistance | r_{on} | $0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$, $I_{COM} = -8 \text{ mA}$, Switch ON, See Figure 13 | 25°C Full | 2.3 V | | 35 | 45 50 | Ω |
| ON-state resistance match between channels | Δr_{on} | $V_{NO} \text{ or } V_{NC} = 1.6 \text{ V}$, $I_{COM} = -8 \text{ mA}$, Switch ON, See Figure 13 | 25°C Full | 2.3 V | | 0.3 | 0.5 0.7 | Ω |
| ON-state resistance flatness | $r_{on(flat)}$ | $0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$, $I_{COM} = -8 \text{ mA}$, Switch ON, See Figure 13 | 25°C Full | 2.3 V | | 30 | 40 40 | Ω |
| NO, NC OFF leakage current | $I_{NO(OFF)}, I_{NC(OFF)}$ | $V_{NO} \text{ or } V_{NC} = 0.5 \text{ V}$, $V_{COM} = 2.2 \text{ V}$, or $V_{NO} \text{ or } V_{NC} = 2.2 \text{ V}$, $V_{COM} = 0.5 \text{ V}$, Switch OFF, See Figure 14 | 25°C Full | 2.7 V | -0.1 -0.2 | 0.05 0.1 | 0.1 0.2 | μA |
| NO, NC ON leakage current | $I_{NO(ON)}, I_{NC(ON)}$ | $V_{NO} \text{ or } V_{NC} = 0.5 \text{ V}$, $V_{COM} = \text{Open}$, or $V_{NO} \text{ or } V_{NC} = 2.2 \text{ V}$, $V_{COM} = \text{Open}$, Switch ON, See Figure 15 | 25°C Full | 2.7 V | -0.1 -0.2 | 0.05 0.1 | 0.1 0.2 | μA |
| COM ON leakage current | $I_{COM(ON)}$ | $V_{COM} = 0.5 \text{ V}$, $V_{NO} \text{ or } V_{NC} = \text{Open}$, or $V_{COM} = 2.2 \text{ V}$, $V_{NO} \text{ or } V_{NC} = \text{Open}$, Switch ON, See Figure 15 | 25°C Full | 2.7 V | -0.1 -0.2 | 0.05 0.1 | 0.1 0.2 | μA |
| Digital Control Input (IN) | | | | | | | | |
| Input logic high | V_{IH} | | Full | | $V_+ \times 0.7$ | | 5.5 | V |
| Input logic low | V_{IL} | | Full | | 0 | | $V_+ \times 0.3$ | V |
| Input leakage current | I_{IH}, I_{IL} | $V_I = 5.5 \text{ V or } 0$ | 25°C Full | 2.7 V | -0.1 -1 | 0.05 | 0.1 1 | μA |

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

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Electrical Characteristics for 2.5-V Supply⁽¹⁾ (Continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|---------------------------|----------------------------------|--|-------|----------------|-----|-------|------|---------------|
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = 1.5 \text{ V}$, $R_L = 300 \Omega$, $C_L = 35 \text{ pF}$, See Figure 17 | 25°C | 2.5 V | 5 | 8 | 13.5 | ns |
| | | | Full | 2.3 V to 2.7 V | 3.5 | | 14 | |
| Turn-off time | t_{OFF} | $V_{COM} = 1.5 \text{ V}$, $R_L = 300 \Omega$, $C_L = 35 \text{ pF}$, See Figure 17 | 25°C | 2.5 V | 1 | 3.5 | 6.5 | ns |
| | | | Full | 2.3 V to 2.7 V | 1 | | 7.5 | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50 \Omega$, $C_L = 35 \text{ pF}$, See Figure 18 | 25°C | 2.5 V | 3.5 | 5 | 7 | ns |
| | | | Full | 2.3 V to 2.7 V | 3 | | 7.5 | |
| Charge injection | Q_C | $V_{GEN} = 0$, $R_{GEN} = 0$, $C_L = 0.1 \text{ nF}$, See Figure 22 | 25°C | 2.5 V | | 2 | | pC |
| NO, NC OFF capacitance | $C_{NO(OFF)}$, $C_{NC(OFF)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch OFF, See Figure 16 | 25°C | 2.5 V | | 5.5 | | pF |
| NO, NC ON capacitance | $C_{NO(ON)}$, $C_{NC(ON)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 2.5 V | | 17.5 | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 2.5 V | | 17.5 | | pF |
| Digital input capacitance | C_I | $V_I = V_+$ or GND, See Figure 16 | 25°C | 2.5 V | | 2.8 | | pF |
| Bandwidth | BW | $R_L = 50 \Omega$, Switch ON, See Figure 19 | 25°C | 2.5 V | | 300 | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50 \Omega$, $f = 10 \text{ MHz}$, Switch OFF, See Figure 20 | 25°C | 2.5 V | | –65 | | dB |
| Crosstalk | X_{TALK} | $R_L = 50 \Omega$, $f = 10 \text{ MHz}$, Switch ON, See Figure 21 | 25°C | 2.5 V | | –66 | | dB |
| Total harmonic distortion | THD | $R_L = 600 \Omega$, $C_L = 50 \text{ pF}$, $f = 20 \text{ Hz to } 20 \text{ kHz}$, See Figure 23 | 25°C | 2.5 V | | 0.025 | | % |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_I = V_+$ or GND, Switch ON or OFF | 25°C | 2.7 V | | 2.5 | 5 | μA |
| | | | Full | | | | 10 | |

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

Electrical Characteristics for 1.8-V Supply⁽¹⁾

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|--|--|--|--------------|--------|-------------------|-------------------|------------|------|
| Analog Switch | | | | | | | | |
| Analog signal range | $V_{\text{COM}}, V_{\text{NO}}, V_{\text{NC}}$ | | | | 0 | | V_+ | V |
| ON-state resistance | r_{on} | $0 \leq (V_{\text{NO}} \text{ or } V_{\text{NC}}) \leq V_+$, $I_{\text{COM}} = -4 \text{ mA}$, Switch ON, See Figure 13 | 25°C Full | 1.65 V | | 140 160 | 160 | Ω |
| ON-state resistance match between channels | Δr_{on} | $V_{\text{NO}} \text{ or } V_{\text{NC}} = 1.16 \text{ V}$, $I_{\text{COM}} = -4 \text{ mA}$, Switch ON, See Figure 13 | 25°C Full | 1.65 V | | 0.5 0.75 | 0.6 | Ω |
| ON-state resistance flatness | $r_{\text{on(flat)}}$ | $0 \leq (V_{\text{NO}} \text{ or } V_{\text{NC}}) \leq V_+$, $I_{\text{COM}} = -4 \text{ mA}$, Switch ON, See Figure 13 | 25°C Full | 1.65 V | | 125 140 | 130 | Ω |
| NO, NC OFF leakage current | $I_{\text{NO(OFF)}}, I_{\text{NC(OFF)}}$ | $V_{\text{NO}} \text{ or } V_{\text{NC}} = 0.3 \text{ V}$, $V_{\text{COM}} = 1.65 \text{ V}$, or $V_{\text{NO}} \text{ or } V_{\text{NC}} = 1.65 \text{ V}$, $V_{\text{COM}} = 0.3 \text{ V}$, Switch OFF, See Figure 14 | 25°C Full | 1.95 V | -0.1 -0.2 | 0.05 0.1 | 0.1 0.2 | μA |
| NO, NC ON leakage current | $I_{\text{NO(ON)}}, I_{\text{NC(ON)}}$ | $V_{\text{NO}} \text{ or } V_{\text{NC}} = 0.3 \text{ V}$, $V_{\text{COM}} = \text{Open}$, or $V_{\text{NO}} \text{ or } V_{\text{NC}} = 1.65 \text{ V}$, $V_{\text{COM}} = \text{Open}$, Switch ON, See Figure 15 | 25°C Full | 1.95 V | -0.1 -0.2 | 0.05 0.1 | 0.1 0.2 | μA |
| COM ON leakage current | $I_{\text{COM(ON)}}$ | $V_{\text{COM}} = 0.3 \text{ V}$, $V_{\text{NO}} \text{ or } V_{\text{NC}} = \text{Open}$, or $V_{\text{COM}} = 1.65 \text{ V}$, $V_{\text{NO}} \text{ or } V_{\text{NC}} = \text{Open}$, Switch ON, See Figure 15 | 25°C Full | 1.95 V | -0.1 -0.2 | 0.05 0.1 | 0.1 0.2 | μA |
| Digital Control Input (IN) | | | | | | | | |
| Input logic high | V_{IH} | | Full | | $V_+ \times 0.65$ | | 5.5 | V |
| Input logic low | V_{IL} | | Full | | 0 | $V_+ \times 0.35$ | | V |
| Input leakage current | $I_{\text{IH}}, I_{\text{IL}}$ | $V_{\text{I}} = 5.5 \text{ V}$ or 0 | 25°C Full | 1.95 V | -0.1 -1 | 0.05 | 0.1 1 | μA |

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

TS5A3157
10-Ω SPDT ANALOG SWITCH

SCDS219–NOVEMBER 2005

Electrical Characteristics for 1.8-V Supply⁽¹⁾(Continued)

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

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|---------------------------|----------------------------|--|-------|------------------|-----|-------|-----|---------------|
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = 1.3\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, See Figure 17 | 25°C | 1.8 V | 5 | 15 | 23 | ns |
| | | | Full | 1.65 V to 1.95 V | 7 | | 24 | |
| Turn-off time | t_{OFF} | $V_{COM} = 1.3\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, See Figure 17 | 25°C | 1.8 V | 1 | 3.5 | 6.5 | ns |
| | | | Full | 1.65 V to 1.95 V | 1 | | 7.5 | |
| Break-before-make time | t_{BBM} | $V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, See Figure 18 | 25°C | 1.8 V | 5.5 | 7.5 | 9 | ns |
| | | | Full | 1.65 V to 1.95 V | 5.2 | | 12 | |
| Charge injection | Q_C | $V_{GEN} = 0$, $R_{GEN} = 0$, $C_L = 0.1\text{ nF}$, See Figure 22 | 25°C | 1.8 V | | 1 | | pC |
| NO, NC OFF capacitance | $C_{NO(OFF)}, C_{NC(OFF)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch OFF, See Figure 16 | 25°C | 1.8 V | | 5.5 | | pF |
| NO, NC ON capacitance | $C_{NO(ON)}, C_{NC(ON)}$ | V_{NO} or $V_{NC} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 1.8 V | | 17.5 | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM} = V_+$ or GND, Switch ON, See Figure 16 | 25°C | 1.8 V | | 17.5 | | pF |
| Digital input capacitance | C_I | $V_I = V_+$ or GND, See Figure 16 | 25°C | 1.8 V | | 2.8 | | pF |
| Bandwidth | BW | $R_L = 50\ \Omega$, Switch ON, See Figure 19 | 25°C | 1.8 V | | 300 | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch OFF, See Figure 20 | 25°C | 1.8 V | | –65 | | dB |
| Crosstalk | X_{TALK} | $R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch ON, See Figure 21 | 25°C | 1.8 V | | –66 | | dB |
| Total harmonic distortion | THD | $R_L = 10\text{ k}\Omega$, $C_L = 50\text{ pF}$, $f = 20\text{ Hz to }20\text{ kHz}$, See Figure 23 | 25°C | 1.8 V | | 0.015 | | % |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_I = V_+$ or GND, Switch ON or OFF | 25°C | 1.95 V | | 2.5 | 5 | μA |
| | | | Full | | | | 10 | |

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

TYPICAL PERFORMANCE

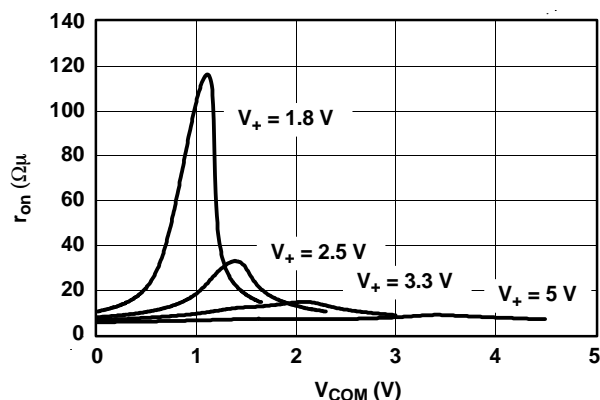


Figure 1. r_{on} vs V_{COM}

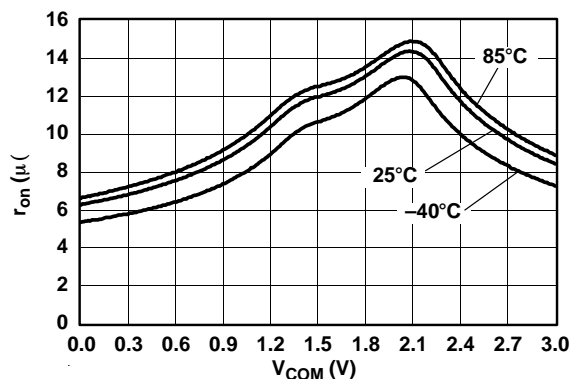


Figure 2. r_{on} vs V_{COM} ($V_+ = 3$ V)

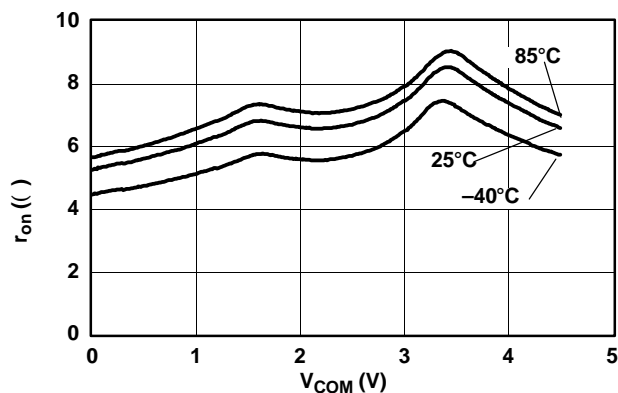


Figure 3. r_{on} vs V_{COM} ($V_+ = 4.5$ V)

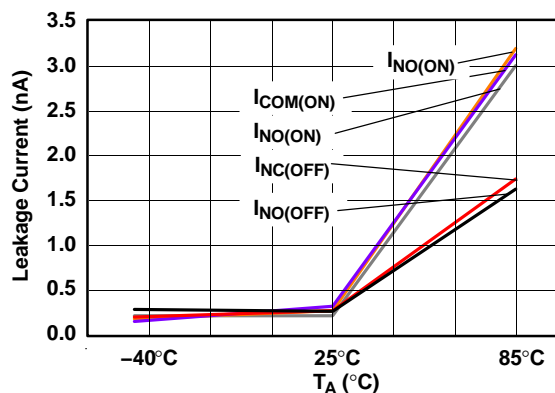


Figure 4. Leakage Current vs Temperature ($V_+ = 5.5$ V)

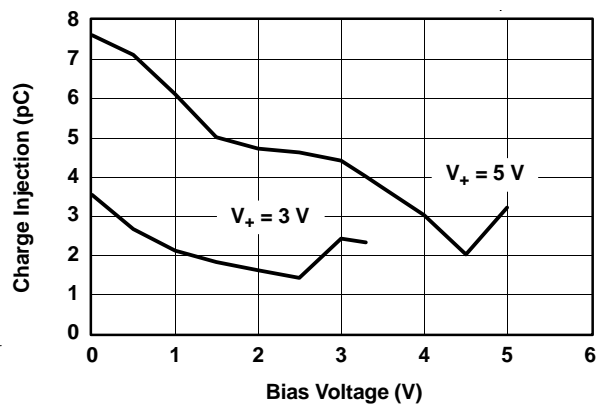


Figure 5. Charge Injection (Q_C) vs V_{COM}

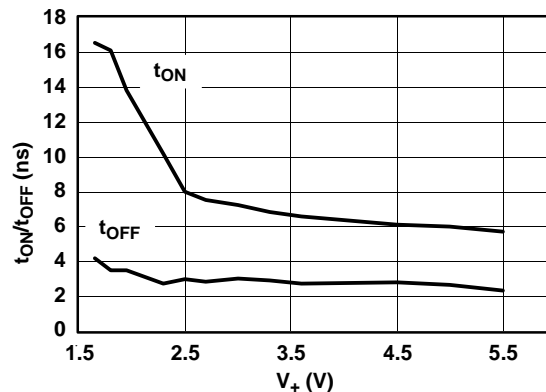


Figure 6. t_{ON} and t_{OFF} vs Supply Voltage

TYPICAL PERFORMANCE

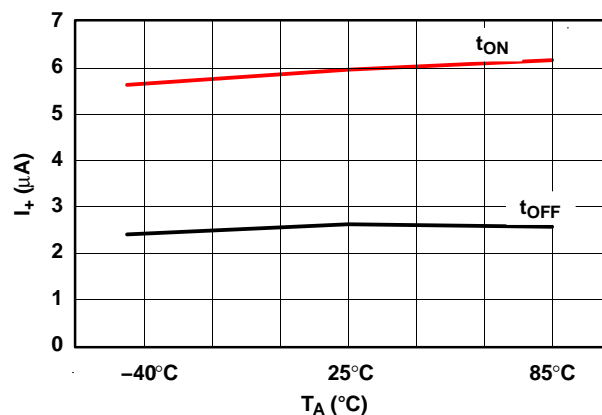


Figure 7. t_{ON} and t_{OFF} vs Temperature ($V_+ = 5\text{ V}$)

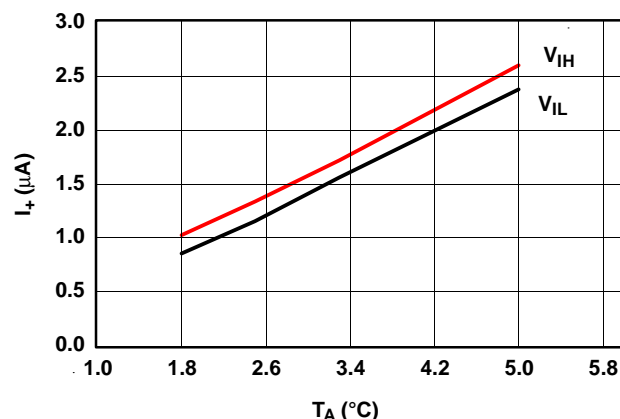


Figure 8. Logic-Level Threshold vs V_+

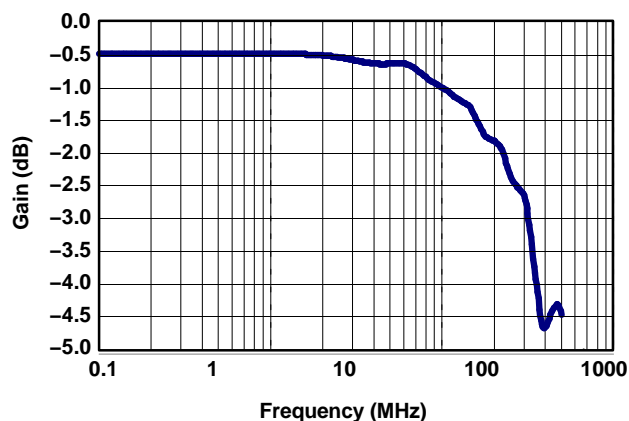


Figure 9. Bandwidth (Gain vs Frequency) ($V_+ = 5\text{ V}$)

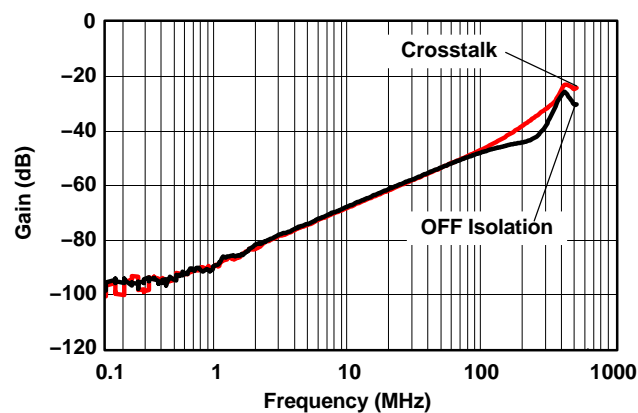


Figure 10. OFF Isolation ($V_+ = 5\text{ V}$)

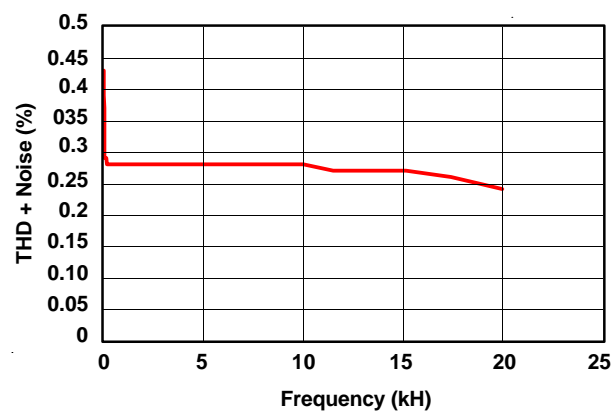


Figure 11. Total Harmonic Distortion vs Frequency

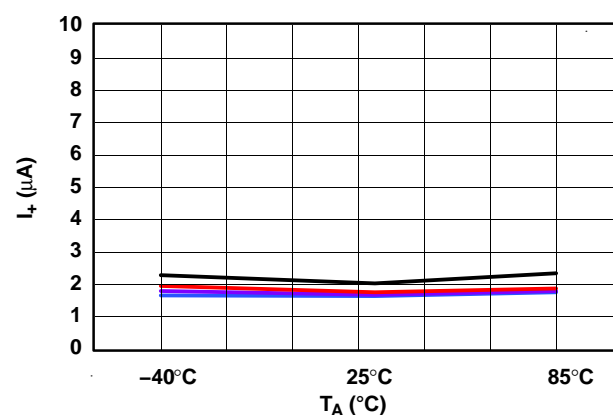


Figure 12. Power-Supply Current vs Temperature ($V_+ = 5\text{ V}$)

PIN DESCRIPTION

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

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 |
| Δr _{on} | Difference of r _{on} between channels in a specific device |
| 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 |
| I _{NO(OFF)} | Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state |
| 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) 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) 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) open |
| V _{IH} | Minimum input voltage for logic high for the control input (IN) |
| V _{IL} | Maximum input voltage for logic low for the control input (IN) |
| V _I | Voltage at the control input (IN) |
| I _{IH} , I _{IL} | Leakage current measured at the control input (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 output (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 output (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 _{COM} , C _L is the load capacitance and ΔV _{COM} is the change in analog output voltage. |
| 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 _I | Capacitance of control input (IN) |
| O _{ISO} | OFF isolation of the switch is a measurement of 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 where the gain of an ON channel is –3 dB below the DC gain. |
| THD | Total harmonic distortion describes the signal distortion caused by the analog switch. This is defined as the ratio of root mean square (RMS) value of the second, third, and higher harmonic to the absolute magnitude of fundamental harmonic. |
| I ₊ | Static power-supply current with the control (IN) pin at V ₊ or GND |

PARAMETER MEASUREMENT INFORMATION

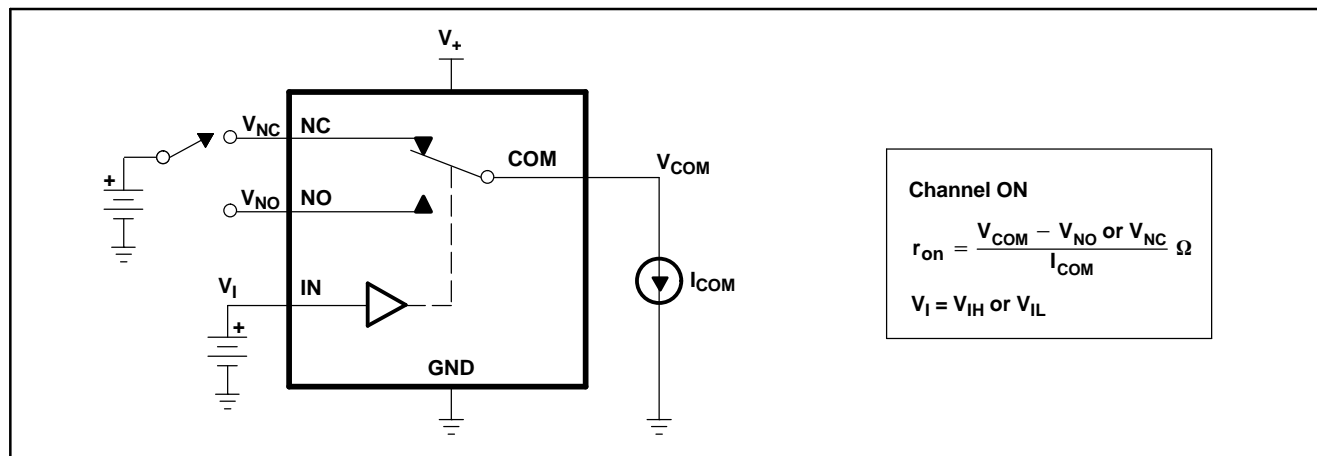


Figure 13. ON-State Resistance (r_{on})

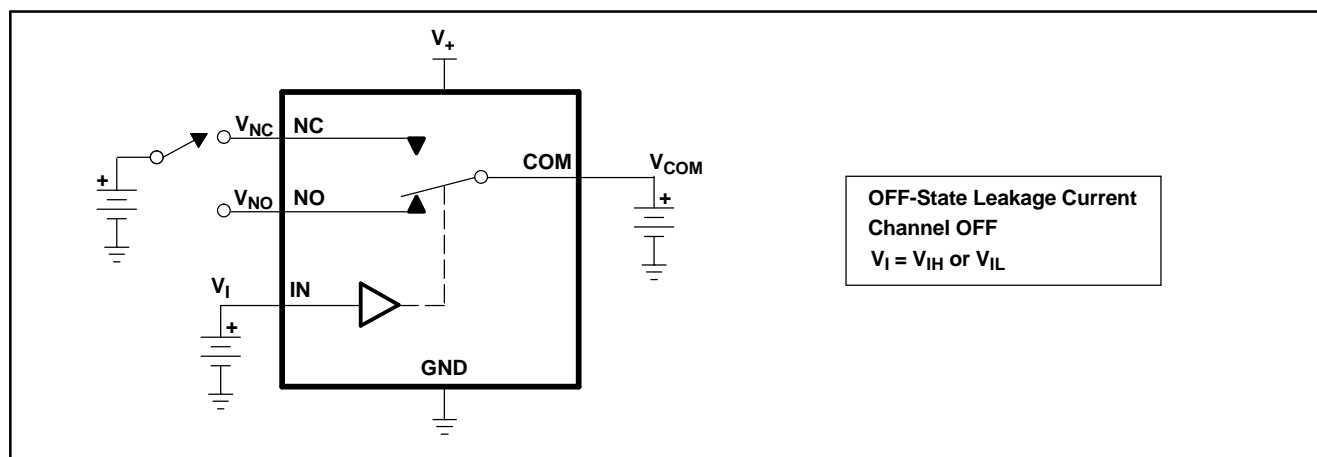


Figure 14. OFF-State Leakage Current ($I_{NC(OFF)}$, $I_{NO(OFF)}$)

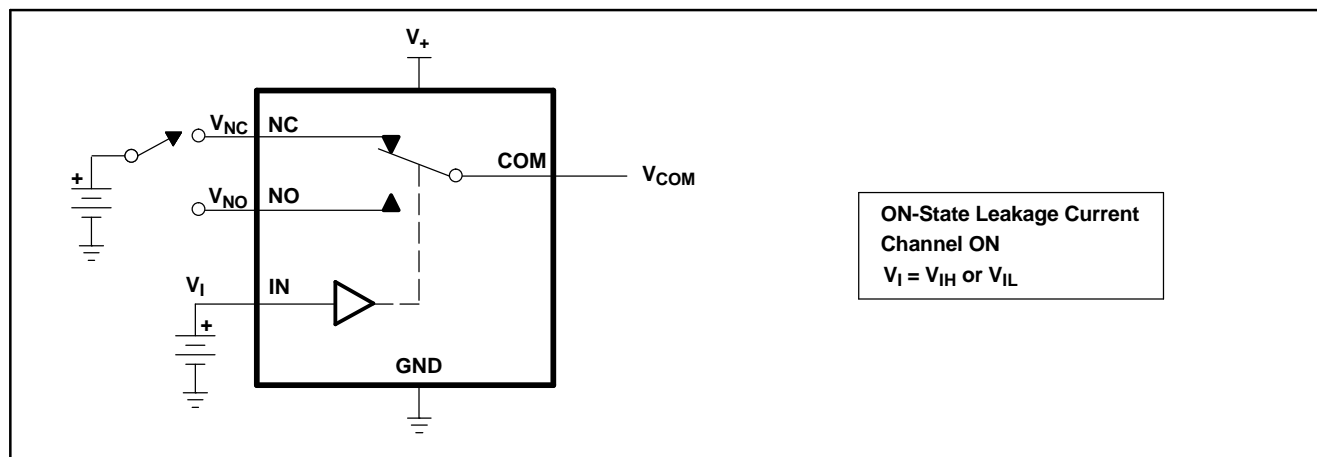


Figure 15. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$, $I_{NO(ON)}$)

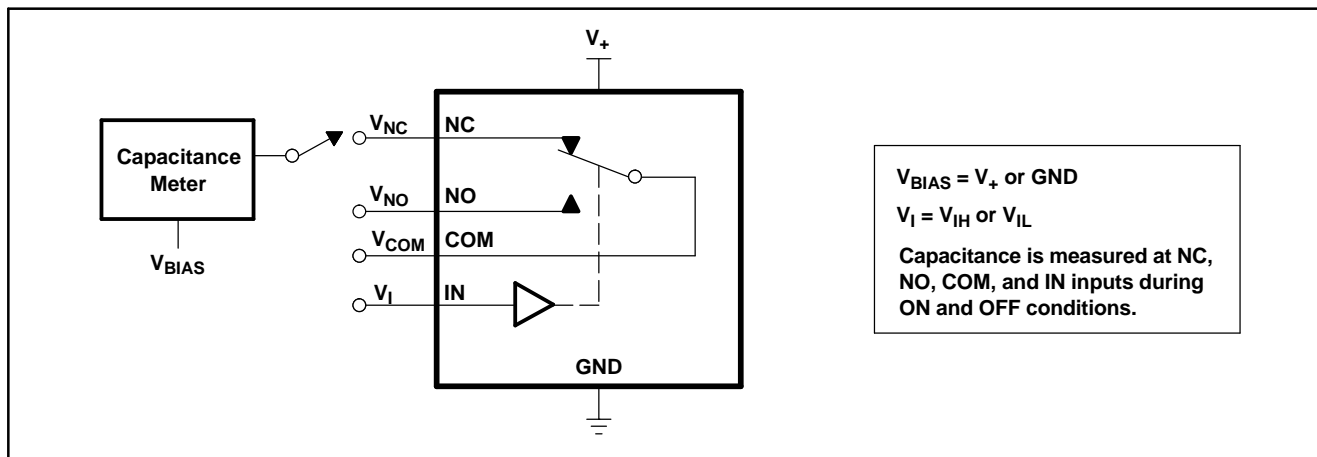
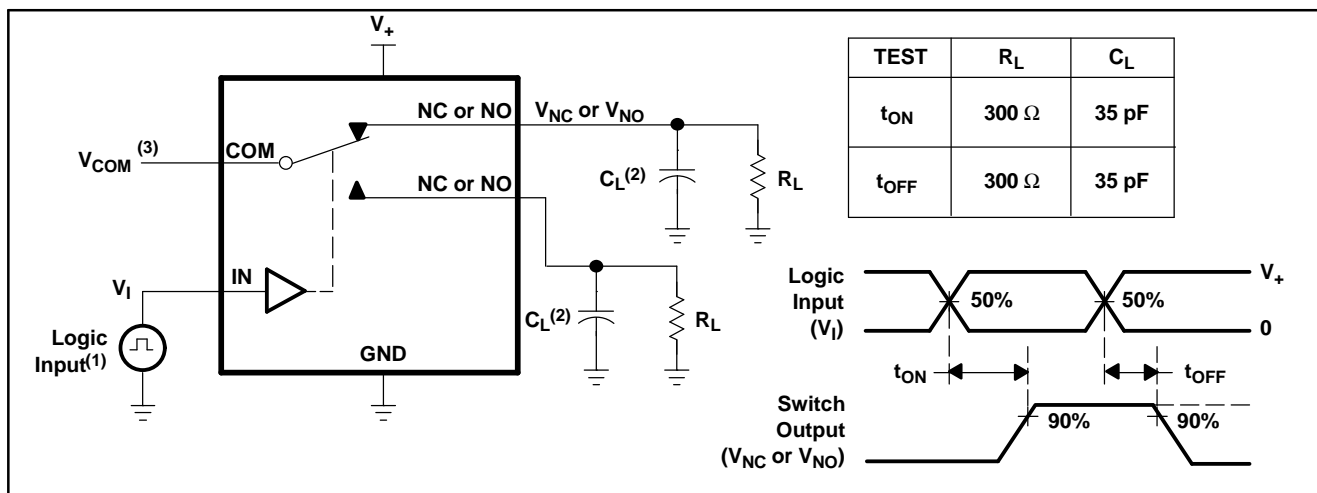


Figure 16. Capacitance (C_I , $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NO(OFF)}$, $C_{NC(ON)}$, $C_{NO(ON)}$)

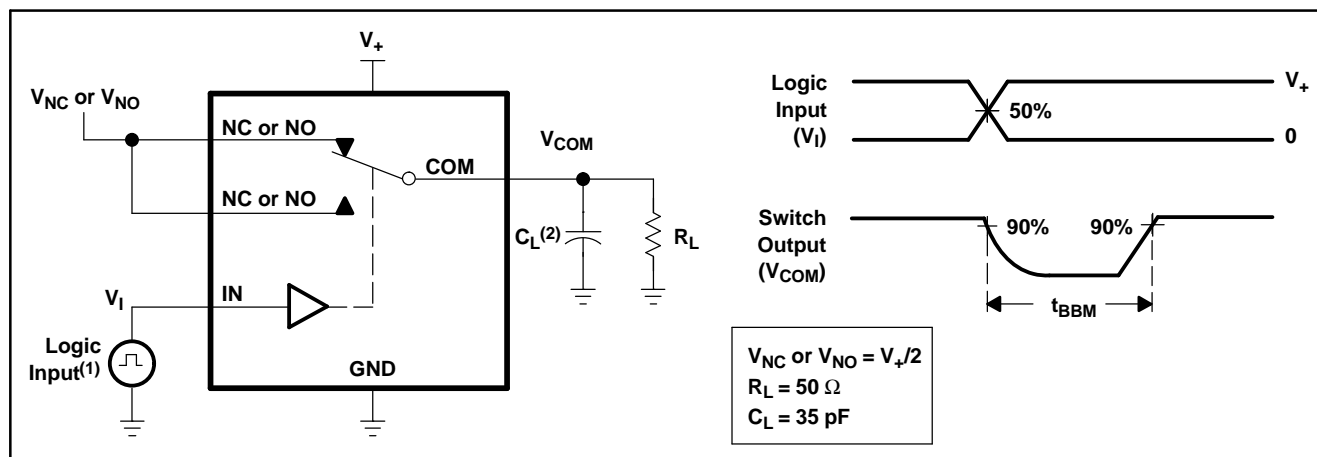


(1) All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r < 5 \text{ ns}$, $t_f < 5 \text{ ns}$.

(2) C_L includes probe and jig capacitance.

(3) See Electrical Characteristic for V_{COM} .

Figure 17. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})



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

(2) C_L includes probe and jig capacitance.

Figure 18. Break-Before-Make Time (t_{BBM})

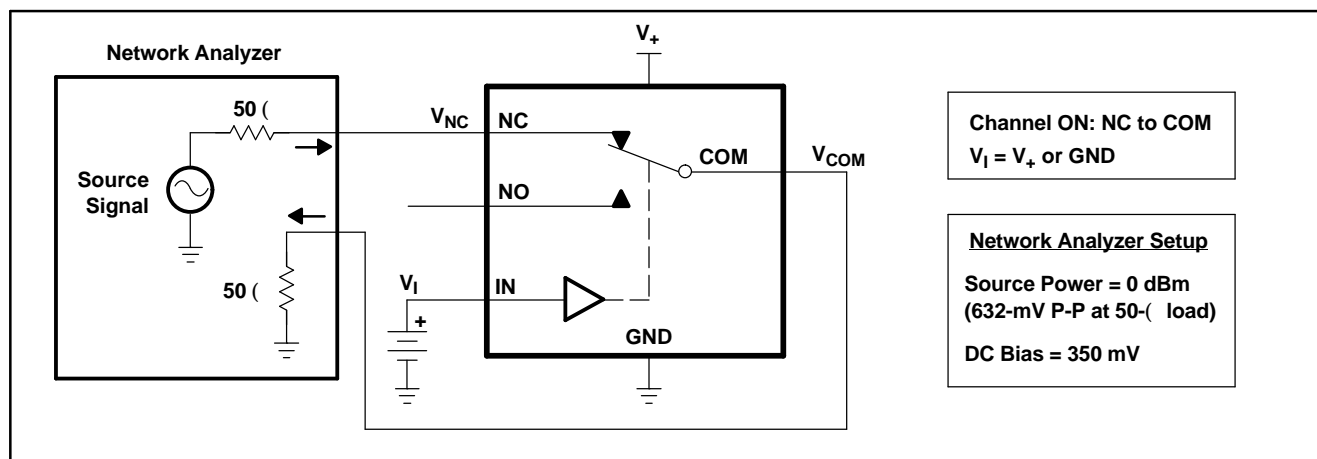


Figure 19. Bandwidth (BW)

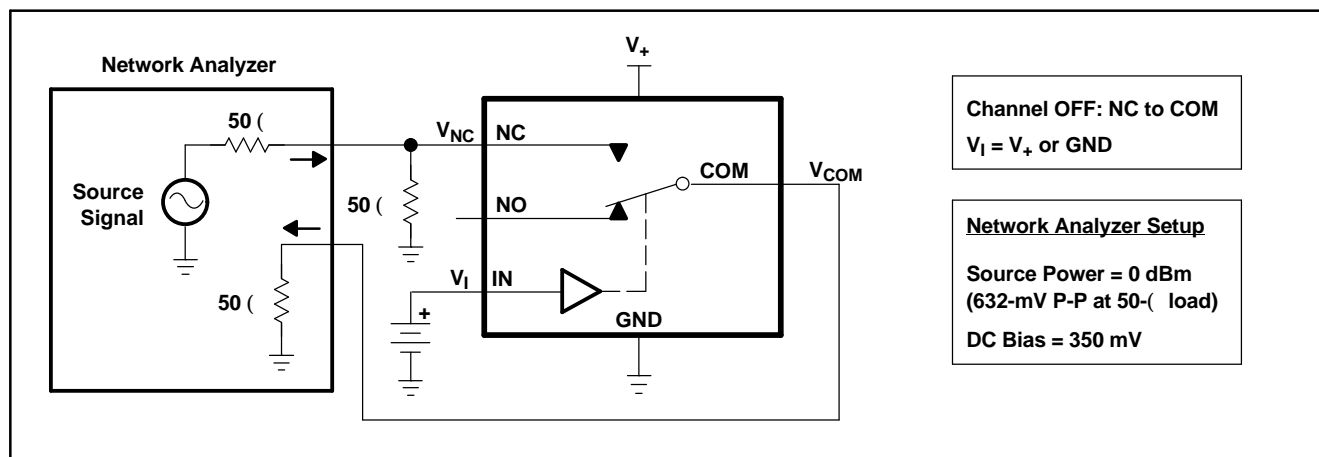


Figure 20. OFF Isolation (O_{ISO})

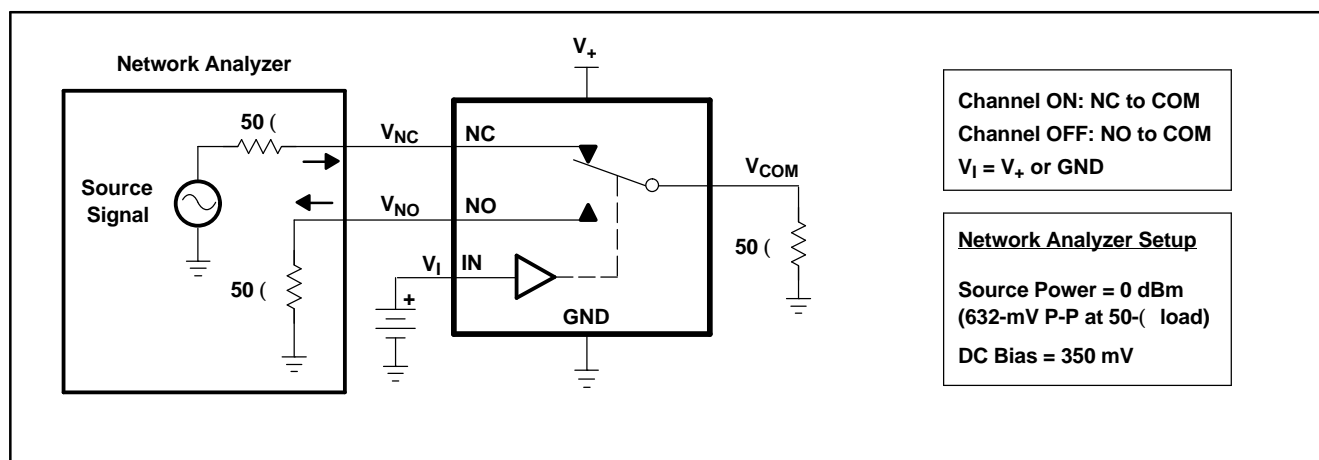
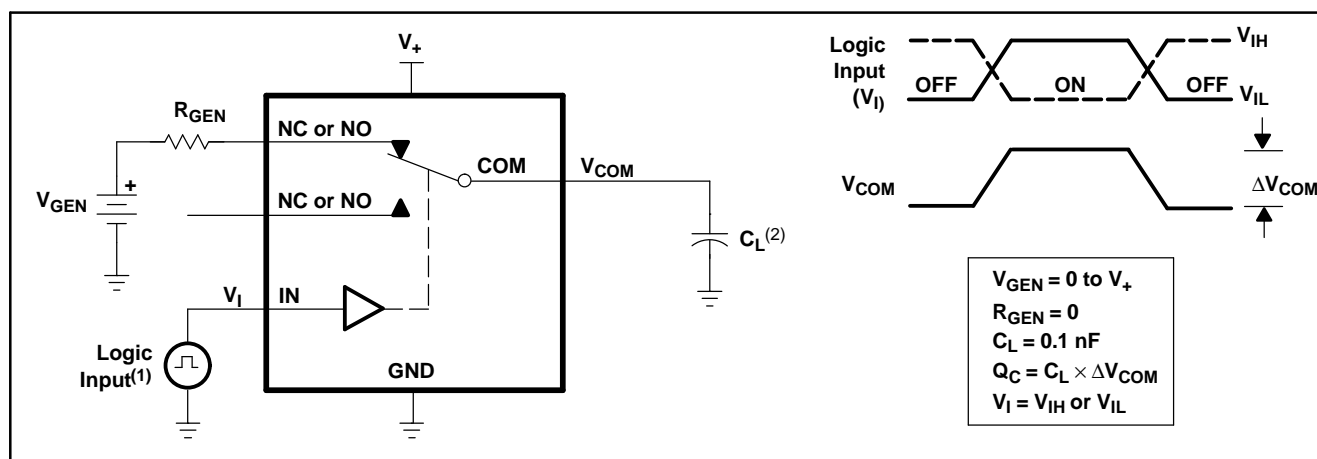


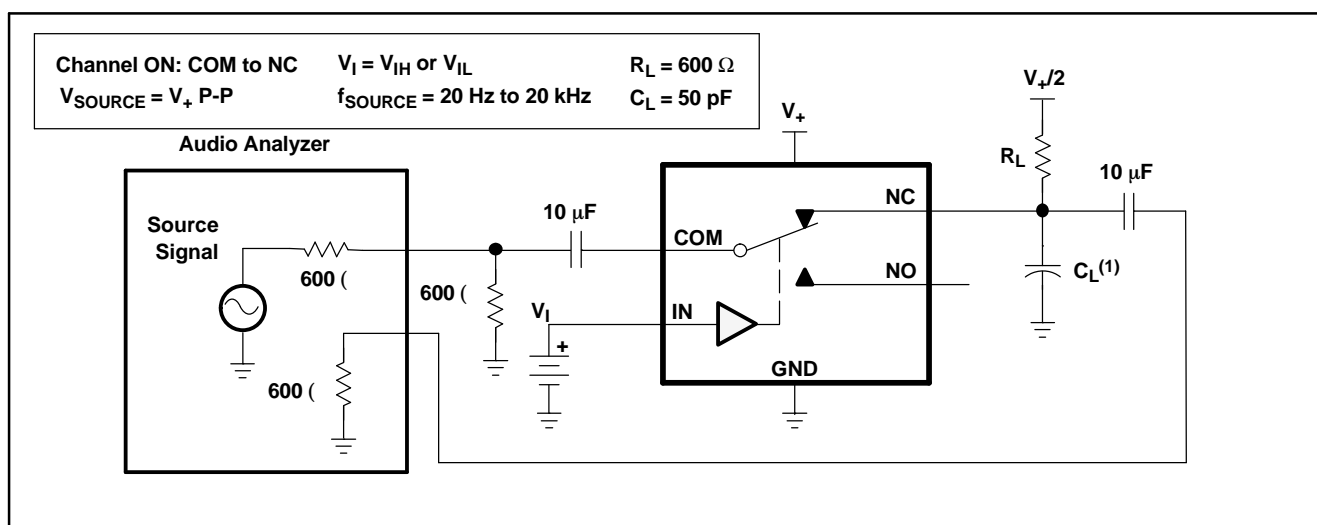
Figure 21. Crosstalk (X_{TALK})



(1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, $Z_O = 50 \Omega$, $t_r < 5$ ns, $t_f < 5$ ns.

(2) C_L includes probe and jig capacitance.

Figure 22. Charge Injection (Q_C)



(1) C_L includes probe and jig capacitance.

Figure 23. 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⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TS5A3157DBVR | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3157DBVRE4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3157DCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3157DCKRE4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TS5A3157YZPR | ACTIVE | WCSP | YZP | 6 | 3000 | Pb-Free (RoHS) | SNAGCU | Level-1-260C-UNLIM |

⁽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.

OBsolete: 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)

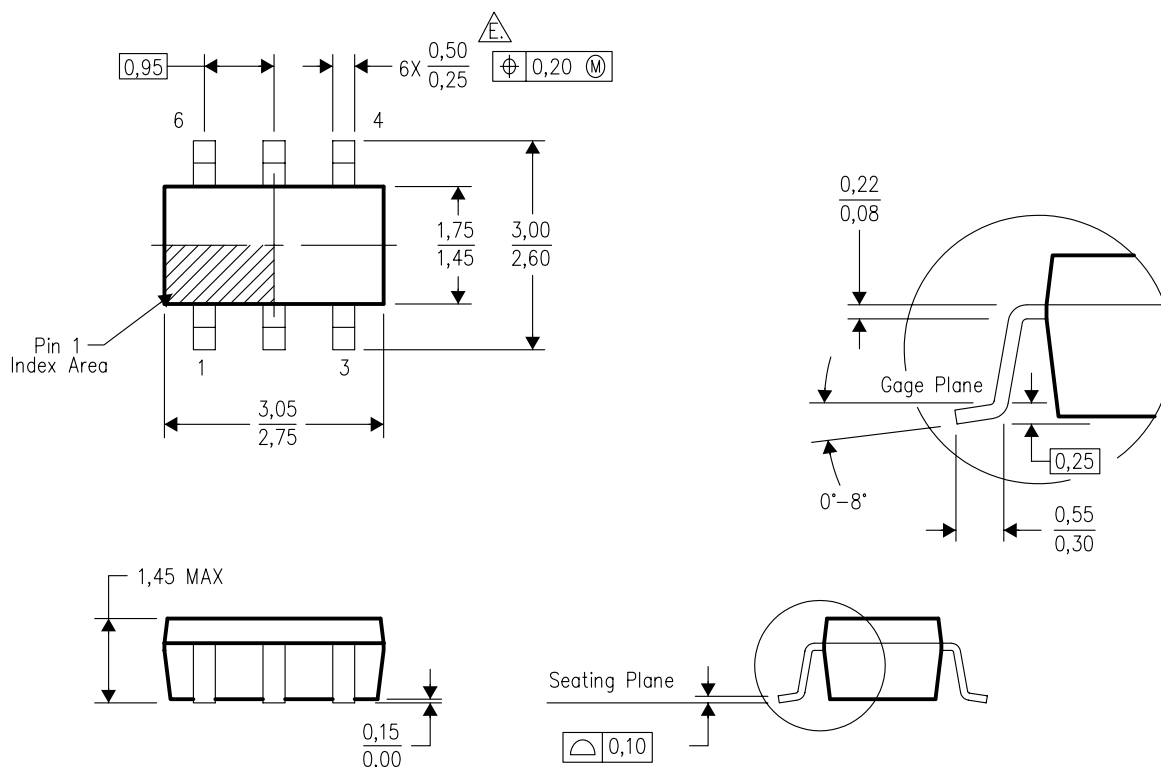
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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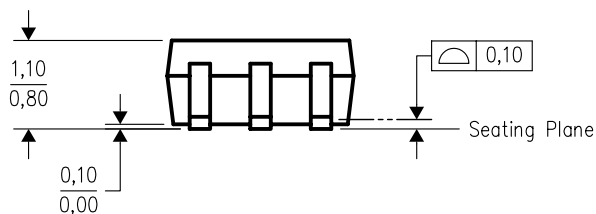
DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



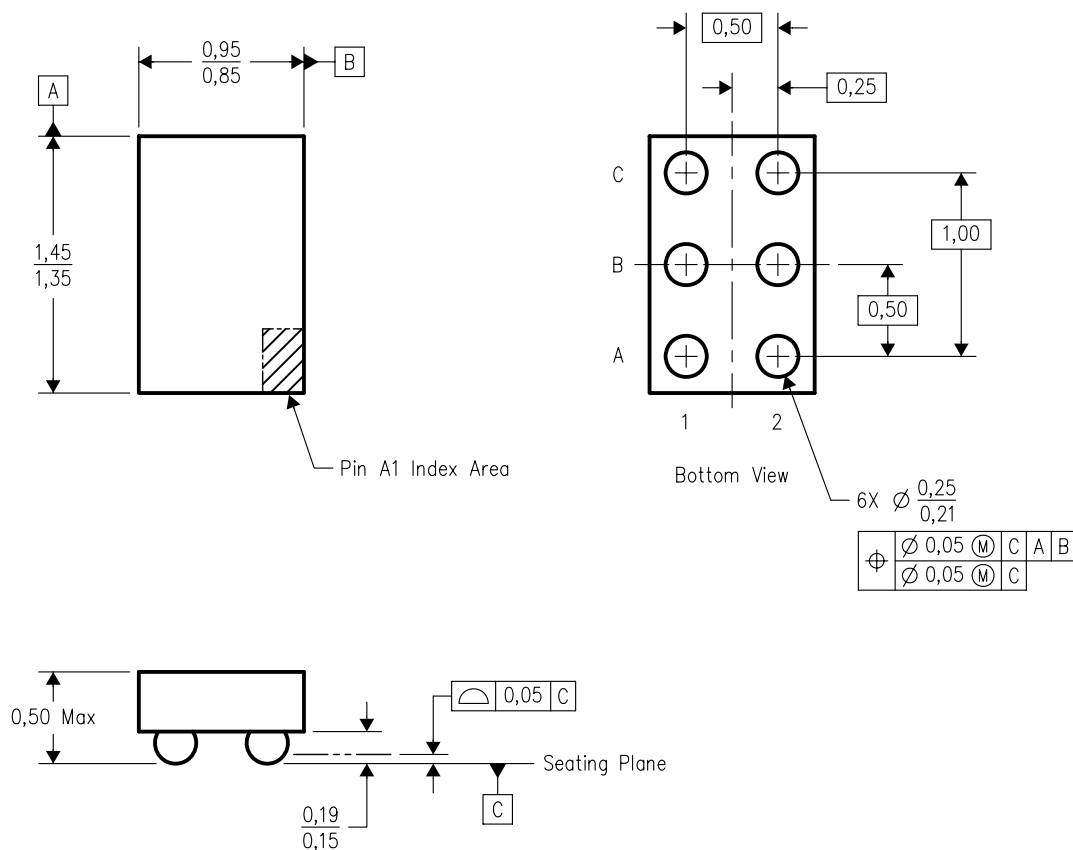
4073253-5/K 03/2006

- 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. 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.



YZP (R-XBGA-N6)

DIE-SIZE BALL GRID ARRAY



4204741-3/B 04/2006

- 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.
 - D. This package is lead-free. Refer to the 6 YEP package (drawing 4204725) for tin-lead (SnPb).

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