

Description

The MAX4597 is a single-pole single-throw (SPST) analog switch that is designed to operate from 2 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 (Cellular Phones, PDAs)
- Audio and Video Signal Routing
- Communication Circuits
- PCMCIA Cards

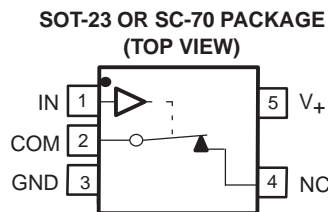
Features

- Low ON-State Resistance (10 Ω)
- ON-State Resistance Flatness (1.5 Ω)
- Control Inputs Are 5.5-V Tolerant
- Low Charge Injection (5 pC Max)
- 300-MHz –3-dB Bandwidth at 25°C
- Low Total Harmonic Distortion (THD) (0.05%)
- 2-V to 5.5-V Single-Supply Operation
- Specified at 5-V and 3.3-V Nodes
- –83-dB OFF Isolation at 1 MHz
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- 0.5-nA Max OFF Leakage
- ESD Performance Tested Per JESD 22
 - 2000-V Human-Body Model (A114-B, Class II)
 - 1000-V Charged-Device Model (C101)
- TTL/CMOS-Logic Compatible

Summary of Characteristics

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

| Configuration | Single Pole Single Throw (SPST) |
|---|---------------------------------|
| Number of channels | 1 |
| ON-state resistance (r_{ON}) | 10 Ω |
| ON-state resistance flatness ($r_{ON(FLAT)}$) | 1.5 Ω |
| Turn-on/turn-off time (t_{ON}/t_{OFF}) | 35 ns/40 ns |
| Charge injection (Q_C) | 5 pC |
| Bandwidth (BW) | 300 MHz |
| OFF isolation (O_{ISO}) | –83 dB at 1 MHz |
| Total harmonic distortion (THD) | 0.05% |
| Leakage current ($I_{COM(OFF)}/I_{NC(OFF)}$) | ±0.05 nA |
| Power-supply current (I_+) | 1 μA |
| Package option | 5-pin SOT-23 or SC-70 |



FUNCTION TABLE

| IN | NC TO COM, COM TO NC |
|----|----------------------|
| L | ON |
| H | OFF |

ORDERING INFORMATION

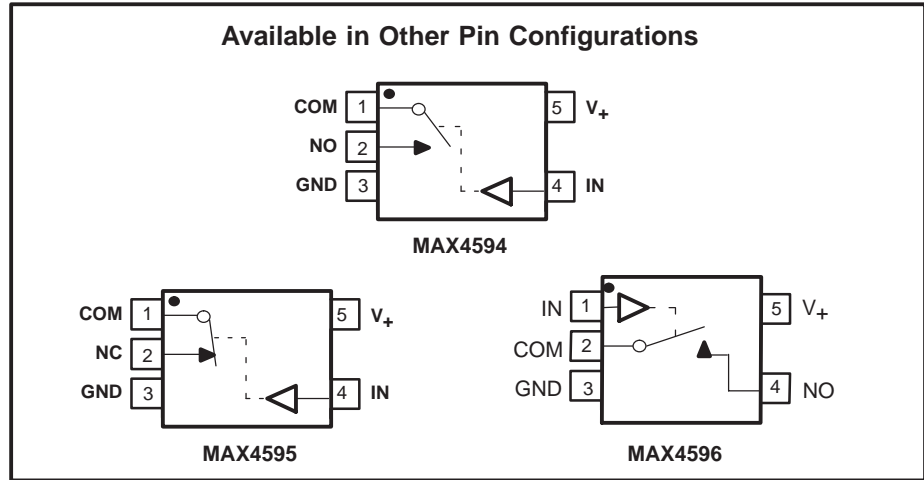
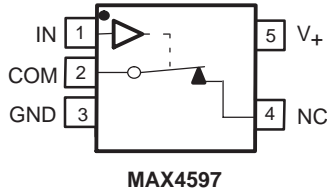
| T_A | PACKAGE(1) | | ORDERABLE PART NUMBER | TOP-SIDE MARKING(2) |
|---------------|--------------------|---------------|-----------------------|---------------------|
| –40°C to 85°C | SOT (SOT-23) – DBV | Tape and reel | MAX4597DBVR | 6SD_ |
| | SOT (SC-70) – DCK | Tape and reel | MAX4597DCKR | SD_ |

(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.



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.

Pin Configurations



Absolute Minimum and Maximum Ratings(1)(2)

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

| | | MIN | MAX | UNIT |
|-----------------------|-----------------------------------|--------------------------------|-------------|---------|
| V_+ | Supply voltage range(3) | -0.3 | 6 | V |
| V_{NC} V_{COM} | Analog voltage range(3)(4) | -0.3 | $V_+ + 0.3$ | V |
| I_K | Analog port diode current | $V_{NC}, V_{COM} < 0$ | | mA |
| I_{NC} I_{COM} | On-state switch current | $V_{NC}, V_{COM} = 0$ to V_+ | | mA |
| V_I | Digital input voltage range(3)(4) | -0.3 | 6 | V |
| I_{IK} | Digital input clamp current | $V_I < 0$ | | mA |
| I_+ | Continuous current through V_+ | | | 100 mA |
| I_{GND} | Continuous current through GND | | | -100 mA |
| θ_{JA} | Package thermal impedance(5) | DBV package | | 206 |
| | | DCK package | | 252 |
| 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) 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_{NC} | | | | 0 | | V_+ | V |
| ON-state resistance | r_{on} | $V_{NC} = 3.5\text{ V}$, $I_{COM} = 10\text{ mA}$, | Switch ON, See Figure 13 | 25°C Full | 4.5 V | 6.5 | 10 12 | Ω |
| ON-state resistance flatness | $r_{on(Flat)}$ | $V_{NC} = 1.5\text{ V}, 2.5\text{ V}, 3.5\text{ V}$, $I_{COM} = 10\text{ mA}$, | Switch ON, See Figure 13 | 25°C Full | 4.5 V | 0.5 | 1.5 2 | Ω |
| NC OFF leakage current | $I_{NC(OFF)}$ | $V_{NC} = 1\text{ V}, V_{COM} = 4.5\text{ V}$, or $V_{NC} = 4.5\text{ V}, V_{COM} = 1\text{ V}$, | Switch OFF, See Figure 14 | 25°C Full | 5.5 V | -0.5 | 0.01 0.5 | nA |
| COM OFF leakage current | $I_{COM(OFF)}$ | $V_{COM} = 1\text{ V}, V_{NC} = 4.5\text{ V}$, or $V_{COM} = 4.5\text{ V}, V_{NC} = 1\text{ V}$, | Switch OFF, See Figure 14 | 25°C Full | 5.5 V | -0.5 | 0.01 0.5 | nA |
| NC ON leakage current | $I_{NC(ON)}$ | $V_{NC} = 1\text{ V}, V_{COM} = 1\text{ V}$, or $V_{NC} = 4.5\text{ V}, V_{COM} = 4.5\text{ V}$, or $V_{NC} = 1\text{ V}, 4.5\text{ V}, V_{COM} = \text{Open}$, | Switch ON, See Figure 15 | 25°C Full | 5.5 V | -1 | 0.01 10 | nA |
| COM ON leakage current | $I_{COM(ON)}$ | $V_{COM} = 1\text{ V}, V_{NC} = 1\text{ V}$, or $V_{COM} = 4.5\text{ V}, V_{NC} = 4.5\text{ V}$, or $V_{COM} = 1\text{ V}, 4.5\text{ V}, V_{NC} = \text{Open}$, | Switch ON, See Figure 15 | 25°C Full | 5.5 V | -1 | 0.01 10 | nA |
| Digital Control Input (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} | $V_I = 5.5\text{ V or }0$ | | 25°C Full | 5.5 V | -1 | 0.03 1 | μA |

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

MAX4597

SINGLE-CHANNEL 10-Ω SPST ANALOG SWITCH

SLLS642 – JANUARY 2005

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

V_+ = 4.5 V to 5.5 V, T_A = -40°C to 85°C (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|---------------------------|--------------|---|--|-------|----------------|------|-----|---------------|
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{NC} = 3\text{ V}$, $R_L = 300\ \Omega$, | $C_L = 35\text{ pF}$, See Figure 17 | 25°C | 5 V | 20 | 35 | ns |
| | | | | Full | 4.5 V to 5.5 V | | 45 | |
| Turn-off time | t_{OFF} | $V_{NC} = 3\text{ V}$, $R_L = 300\ \Omega$, | $C_L = 35\text{ pF}$, See Figure 17 | 25°C | 5 V | 25 | 40 | ns |
| | | | | Full | 4.5 V to 5.5 V | | 50 | |
| Charge injection | Q_C | $V_{GEN} = 0$, $R_{GEN} = 0$, | $C_L = 1\text{ nF}$, See Figure 20 | 25°C | 5 V | 2 | 5 | pC |
| NC OFF capacitance | C_{NCOFF} | $V_{NC} = 0$, $f = 1\text{ MHz}$, | Switch OFF, See Figure 16 | 25°C | 5 V | 8 | | pF |
| COM OFF capacitance | C_{COMOFF} | $V_{COM} = 0$, $f = 1\text{ MHz}$, | Switch OFF, See Figure 16 | 25°C | 5 V | 8 | | pF |
| NC ON capacitance | C_{NCON} | $V_{NC} = 0$, $f = 1\text{ MHz}$, | Switch ON, See Figure 16 | 25°C | 5 V | 20 | | pF |
| COM ON capacitance | C_{COMON} | $V_{COM} = 0$, $f = 1\text{ MHz}$, | Switch ON, See Figure 16 | 25°C | 5 V | 20 | | pF |
| Digital input capacitance | C_I | $V_I = V_+$ or GND, | See Figure 16 | 25°C | 5 V | 3 | | pF |
| Bandwidth | BW | $R_L = 50\ \Omega$, Signal = 0 dBm, | Switch ON, See Figure 18 | 25°C | 5 V | 300 | | MHz |
| OFF isolation | O_{ISO} | $R_L = 50\ \Omega$, $f = 10\text{ MHz}$, $V_{NC} = 1\text{ V}_{RMS}$, | Switch OFF, See Figure 19 | 25°C | 5 V | -83 | | dB |
| Total harmonic distortion | THD | $R_L = 600\ \Omega$, $C_L = 50\text{ pF}$, $V_{SOURCE} = 5\text{ V}_{p-p}$, | $f = 20\text{ Hz}$ to 20 kHz, See Figure 21 | 25°C | 5 V | 0.05 | | % |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_I = V_+$ or GND, | Switch ON or OFF | Full | 5.5 V | | 1 | μA |

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

Electrical Characteristics for 3-V Supply⁽¹⁾
 $V_+ = 2.7\text{ V to }3.6\text{ V}$, $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | T_A | V_+ | MIN | TYP | MAX | UNIT |
|-----------------------------------|-------------------------|---|---|--------------|-----------------------|-----|-----------|------|
| Analog Switch | | | | | | | | |
| Analog signal range | V_{COM} , V_{NC} | | | | 0 | | V_+ | V |
| ON-state resistance | r_{on} | $V_{NC} = 1.5\text{ V}$, $I_{COM} = 10\text{ mA}$, | Switch ON, See Figure 13 | 25°C Full | 2.7 V | 10 | 20 25 | Ω |
| Digital Control Input (IN) | | | | | | | | |
| Input logic high | V_{IH} | | | Full | | 2 | 5.5 | V |
| Input logic low | V_{IL} | | | Full | | 0 | 0.8 | V |
| Input leakage current | I_{IH} , I_{IL} | $V_I = V_+$ or 0 | | 25°C Full | 3.6 V | -1 | 0.03 1 | μA |
| Dynamic | | | | | | | | |
| Turn-on time | t_{ON} | $V_{COM} = 2\text{ V}$, $R_L = 300\text{ Ω}$, | $C_L = 35\text{ pF}$, See Figure 17 | 25°C Full | 3 V 2.7 V to 3.6 V | 25 | 45 55 | ns |
| Turn-off time | t_{OFF} | $V_{COM} = 2\text{ V}$, $R_L = 300\text{ Ω}$, | $C_L = 35\text{ pF}$, See Figure 17 | 25°C Full | 3 V 2.7 V to 3.6 V | 30 | 50 60 | ns |
| Charge injection | Q_C | $V_{NC} = 0$, $C_L = 1\text{ nF}$, | See Figure 20 | 25°C | 3 V | 2 | 4 | pC |
| Supply | | | | | | | | |
| Positive supply current | I_+ | $V_I = V_+$ or GND, | Switch ON or OFF | Full | 3.6 V | | 1 | μA |

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

TYPICAL PERFORMANCE

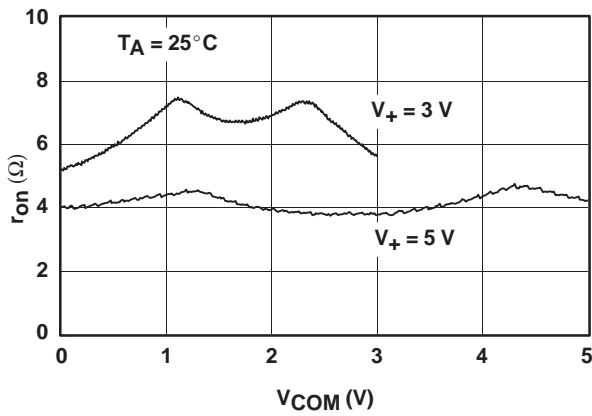


Figure 1. r_{on} vs V_{COM}

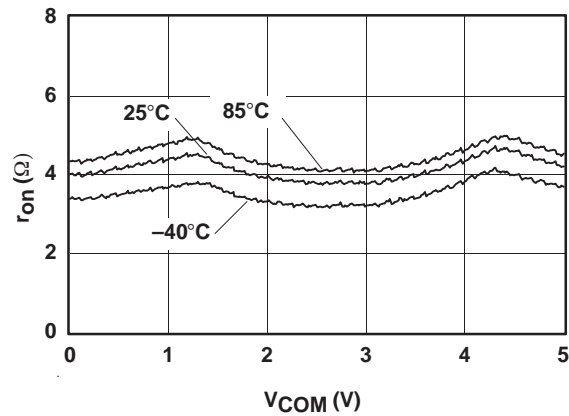


Figure 2. r_{on} vs V_{COM} ($V_+ = 5$ V)

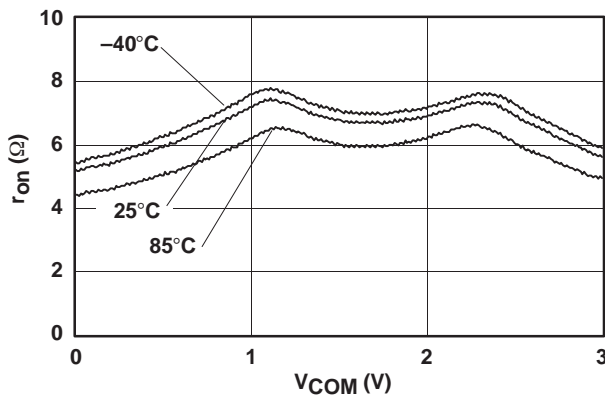


Figure 3. r_{on} vs V_{COM} ($V_+ = 3$ V)

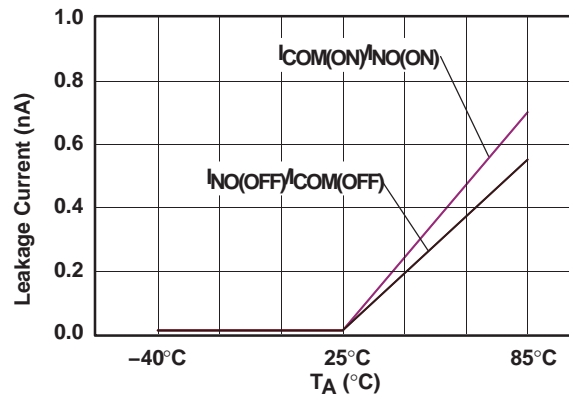


Figure 4. Leakage Current vs Temperature ($V_+ = 5$ V)

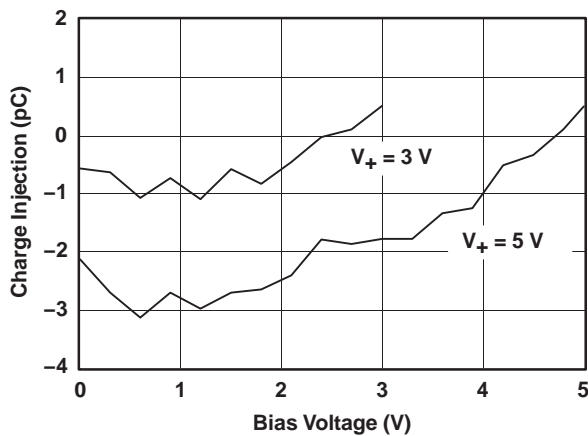


Figure 5. Charge-Injection (Q_C) vs V_{COM}

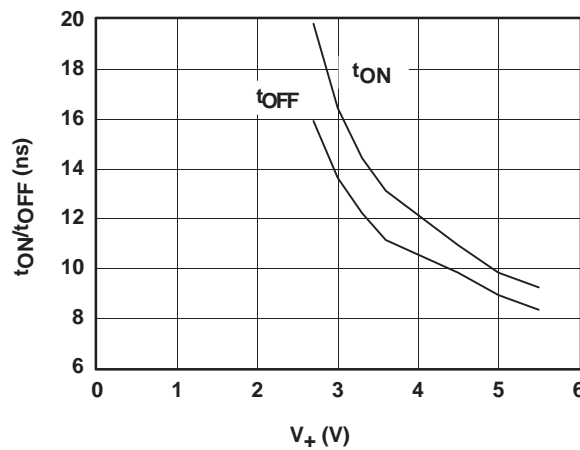


Figure 6. t_{ON} and t_{OFF} vs Supply Voltage

TYPICAL PERFORMANCE

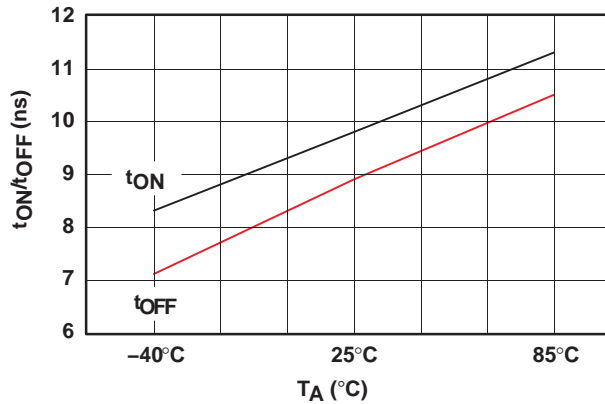


Figure 7. t_{ON} and t_{OFF} vs Temperature (V₊ = 5 V)

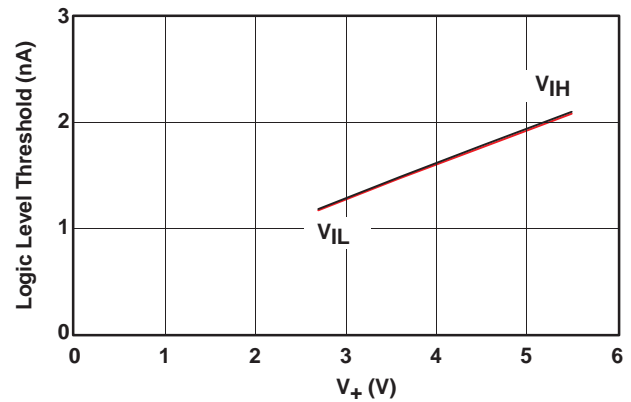


Figure 8. Logic-Level Threshold vs V₊

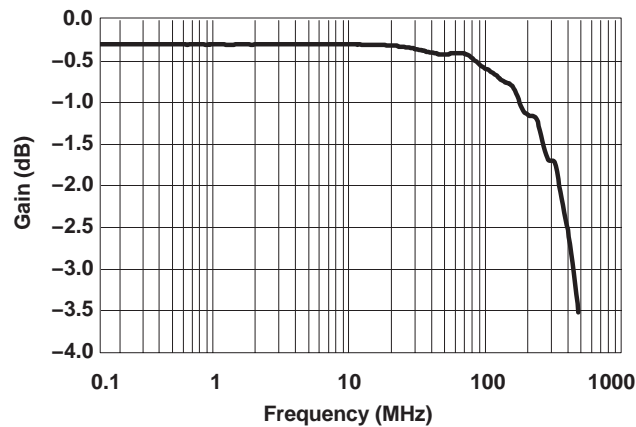


Figure 9. Bandwidth (Gain vs Frequency) (V₊ = 5 V)

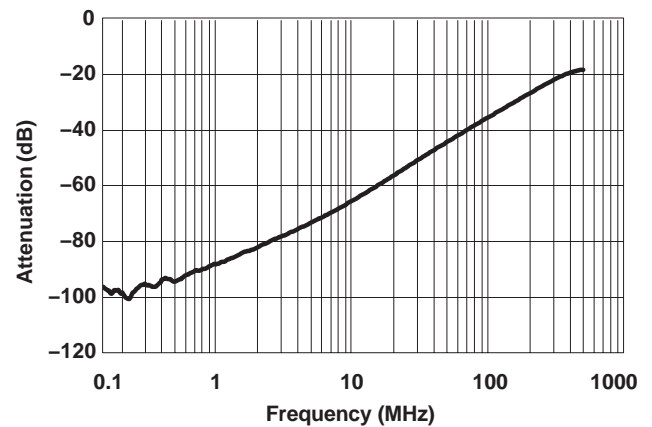


Figure 10. Off Isolation vs Frequency

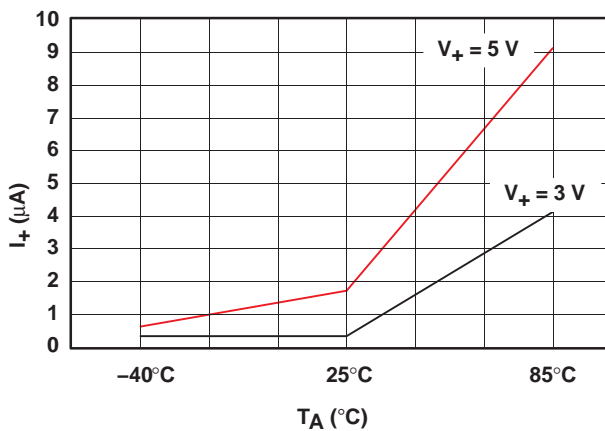


Figure 11. Power-Supply Current vs Temperature

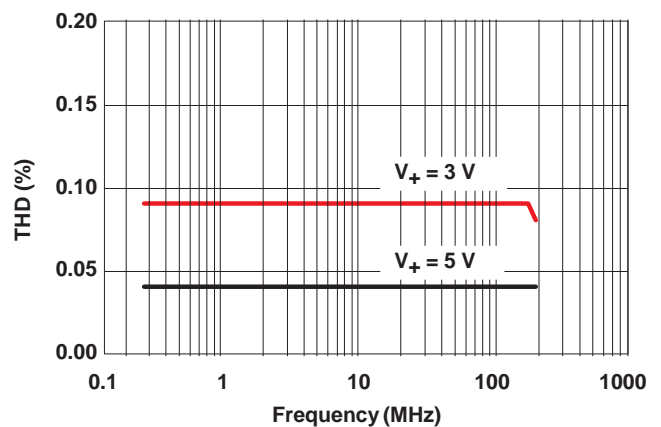


Figure 12. Total Harmonic Distortion vs Frequency

PIN DESCRIPTION

| PIN NUMBER | NAME | DESCRIPTION |
|------------|----------------|--|
| 1 | IN | Digital control pin to connect COM to NC |
| 2 | COM | Common |
| 3 | GND | Digital ground |
| 4 | NC | Normally closed |
| 5 | V ₊ | Power supply |

PARAMETER DESCRIPTION

| SYMBOL | DESCRIPTION |
|-----------------------------------|---|
| V _{COM} | Voltage at COM |
| V _{NC} | Voltage at NC |
| r _{on} | Resistance between COM and NC ports when the channel is ON |
| 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 _{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 _{COM(OFF)} | Leakage current measured at the COM port, with the corresponding channel (COM to NC) in the OFF state |
| I _{COM(ON)} | Leakage current measured at the COM port, with the corresponding channel (COM to NC) in the ON state and the output (NC) 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 or NC) 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 or NC) signal when the switch is turning OFF. |
| Q _C | Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (NC 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 _{NC(ON)} | Capacitance at the NC port when the corresponding channel (NC to COM) is ON |
| C _{COM(OFF)} | Capacitance at the COM port when the corresponding channel (COM to NC) is OFF |
| C _{COM(ON)} | Capacitance at the COM port when the corresponding channel (COM to NC) 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) in the OFF state. |
| BW | Bandwidth of the switch. This is the frequency in which 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 the fundamental harmonic. |
| I ₊ | Static power-supply current with the control (IN) pin at V ₊ or GND |

PARAMETER MEASUREMENT INFORMATION

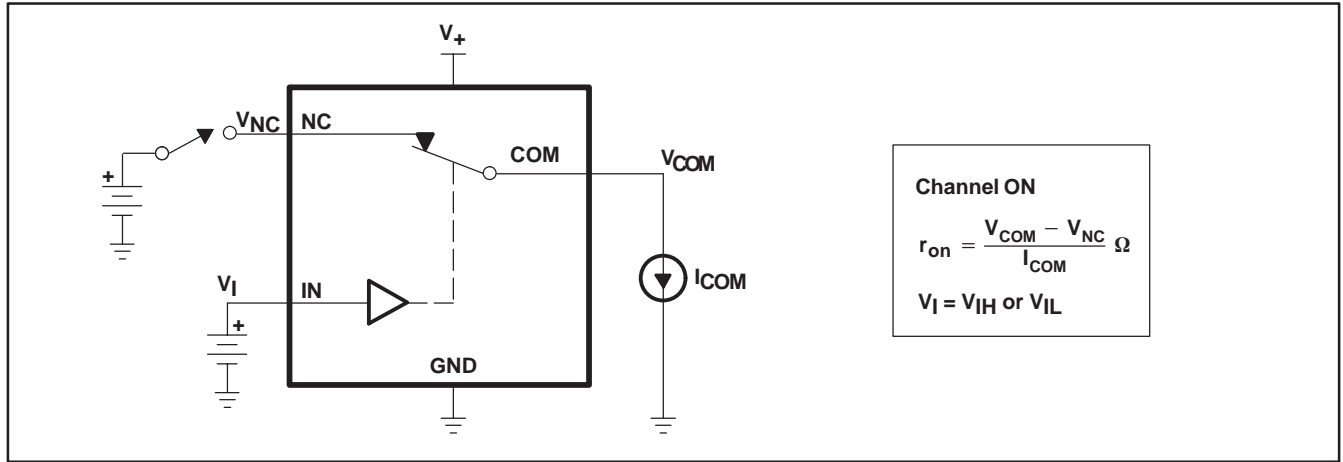


Figure 13. ON-State Resistance (r_{on})

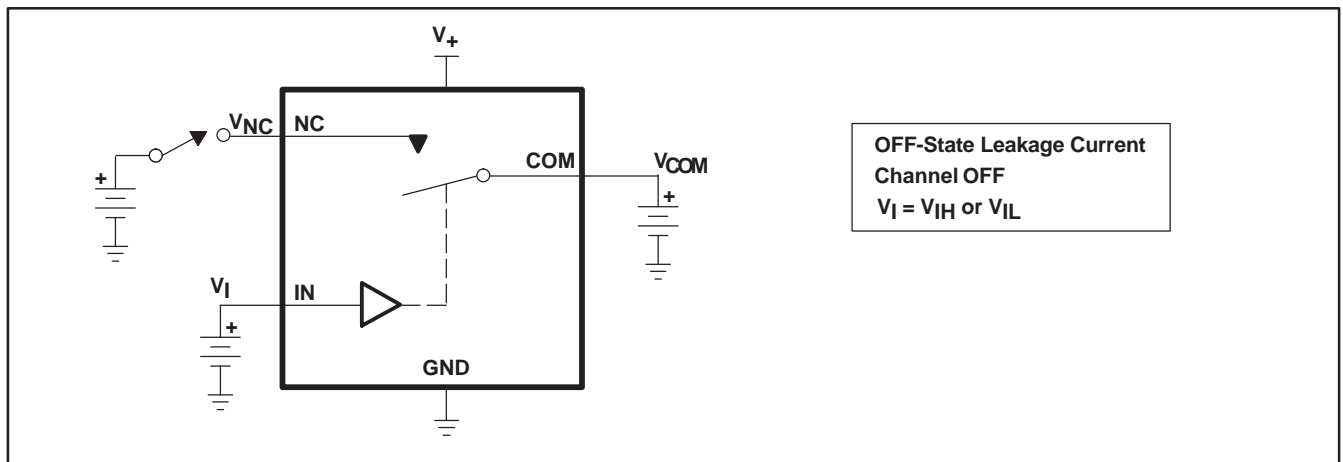


Figure 14. OFF-State Leakage Current ($I_{COM(OFF)}$, $I_{NC(OFF)}$)

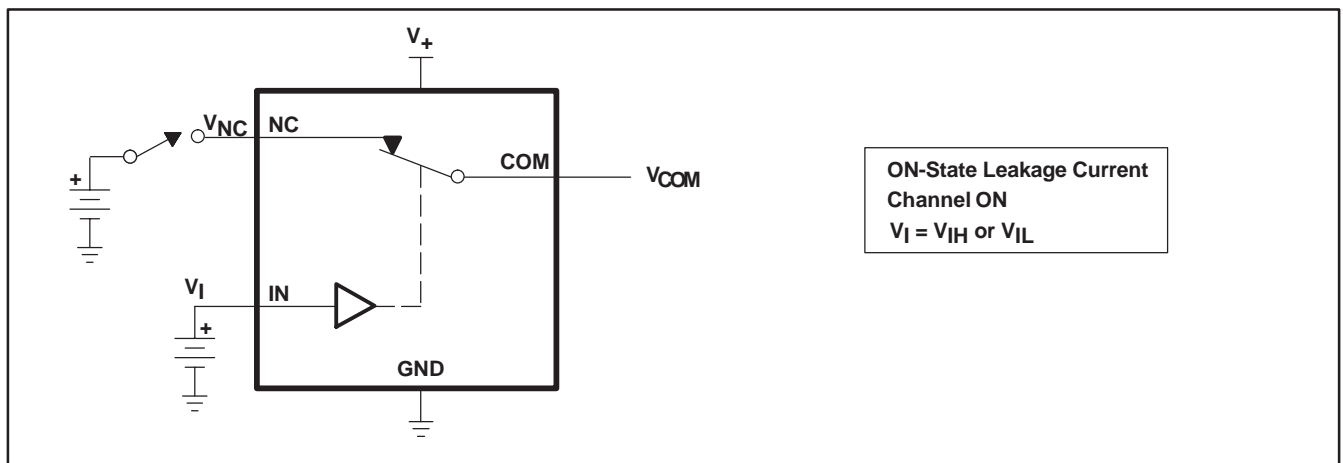


Figure 15. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$)

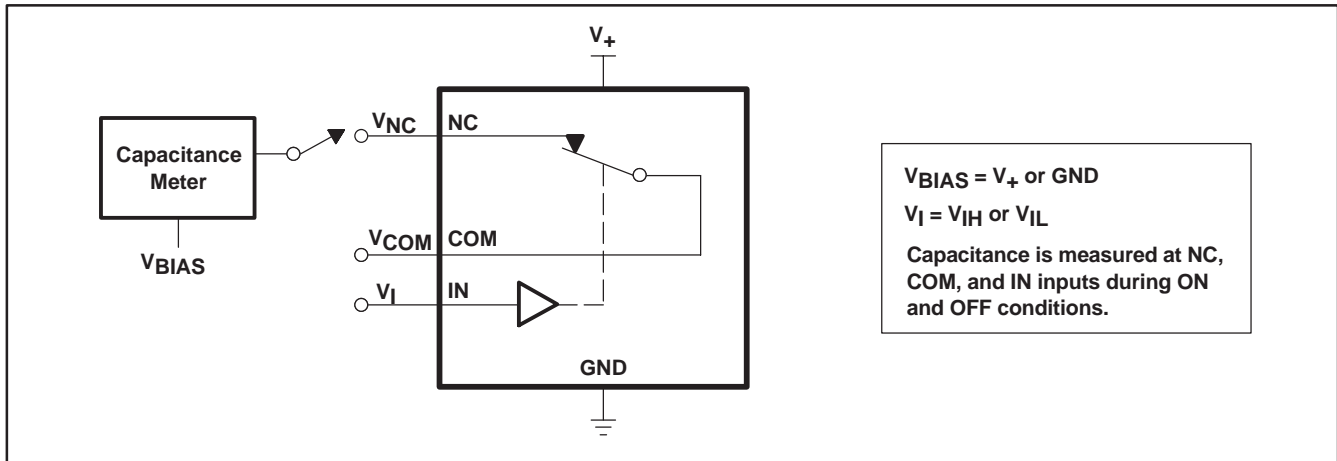
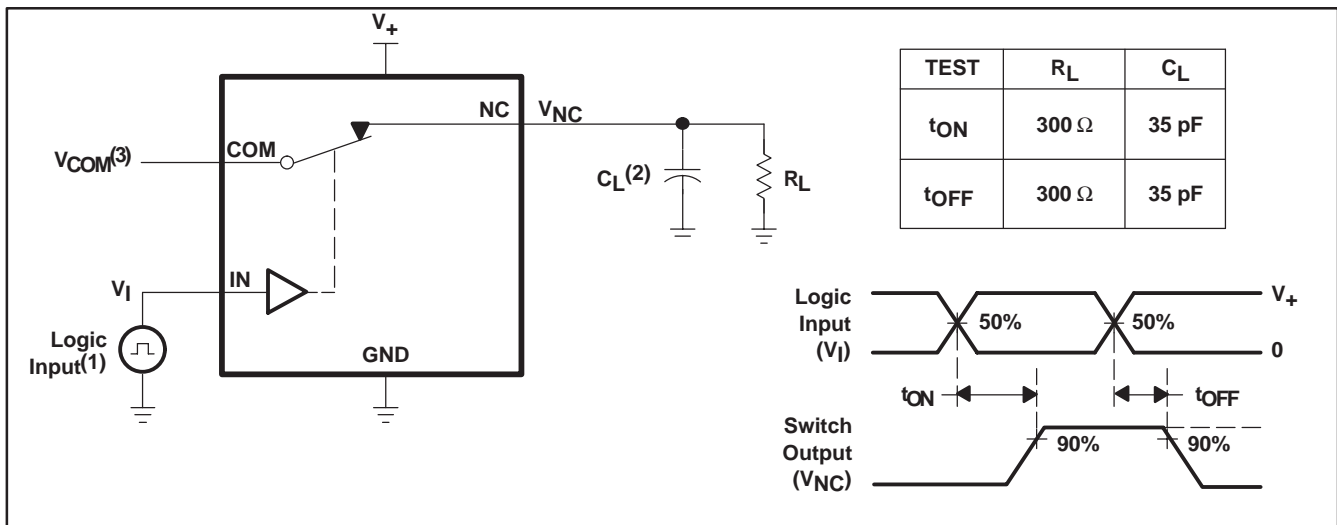


Figure 16. Capacitance (C_I , $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NC(ON)}$)



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

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

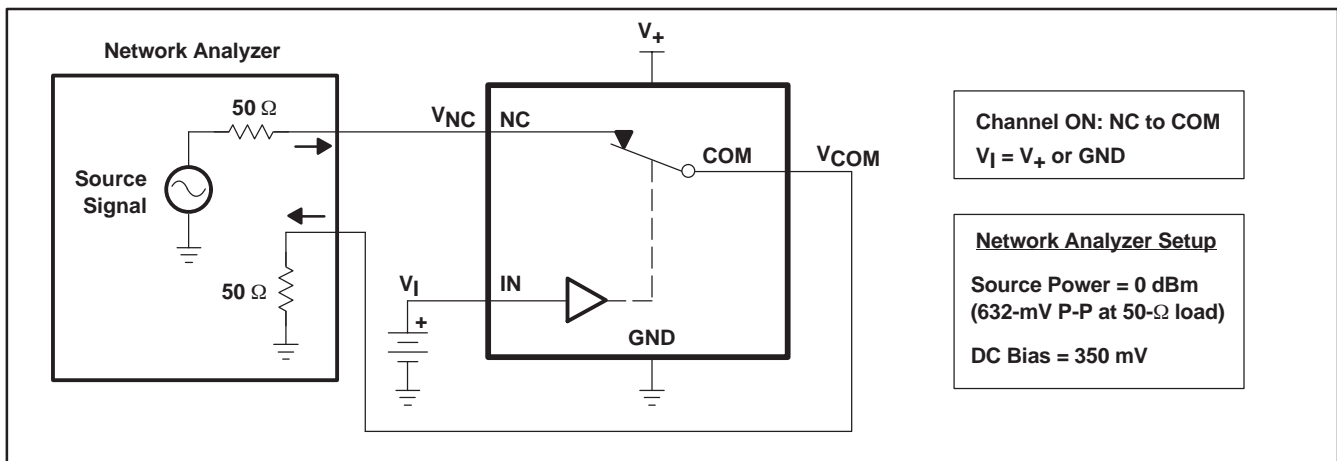


Figure 18. Bandwidth (BW)

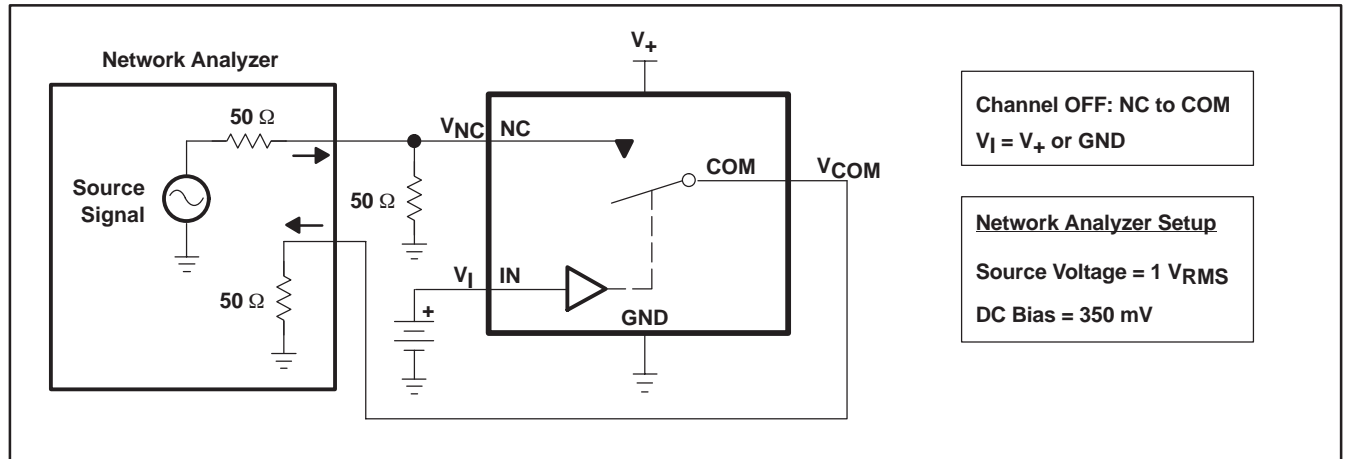
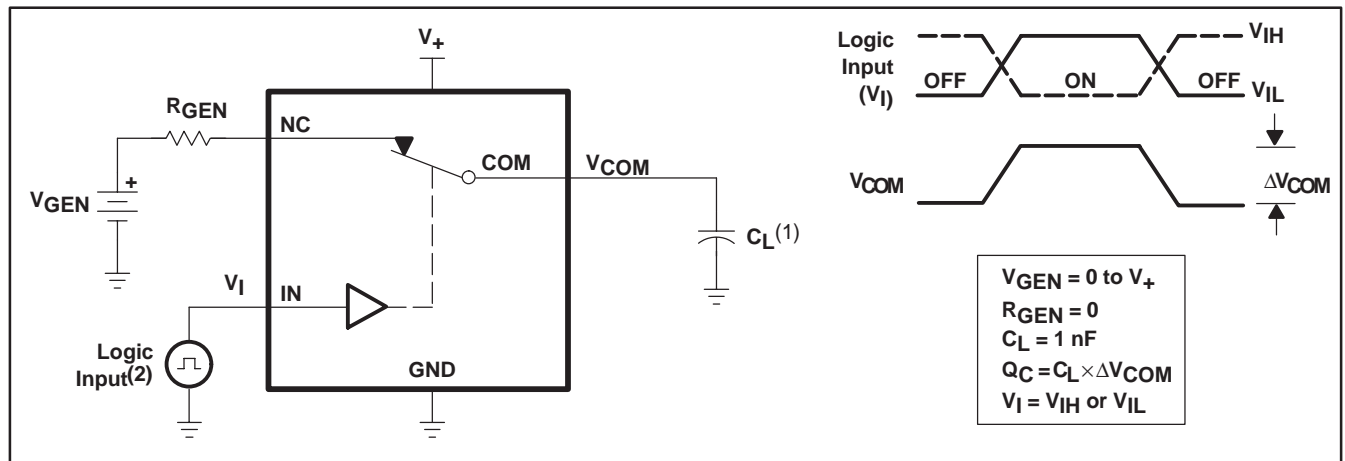


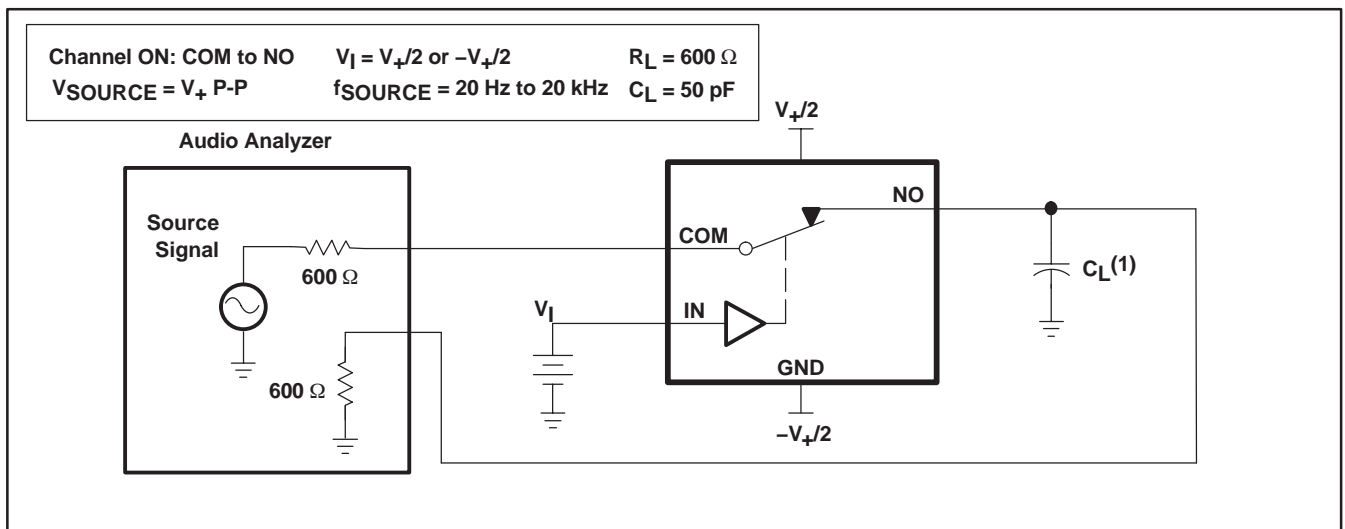
Figure 19. OFF Isolation (O_{ISO})



(1) C_L includes probe and jig capacitance.

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

Figure 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⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| MAX4597DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| MAX4597DBVRE4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| MAX4597DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| MAX4597DCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| MAX4597DCKRE4 | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| MAX4597DCKRG4 | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | 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.

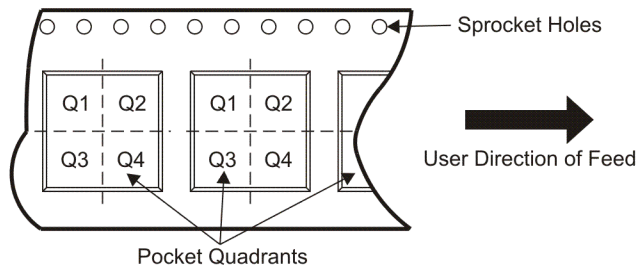
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TAPE AND REEL INFORMATION



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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MAX4597DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 9.2 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| MAX4597DCKR | SC70 | DCK | 5 | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| MAX4597DBVR | SOT-23 | DBV | 5 | 3000 | 202.0 | 201.0 | 28.0 |
| MAX4597DCKR | SC70 | DCK | 5 | 3000 | 202.0 | 201.0 | 28.0 |

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