![Texas Instruments]
**TEXAS INSTRUMENTS**
www.ti.com

**MAX4595**
**SINGLE-CHANNEL 10-Ω SPST ANALOG SWITCH**
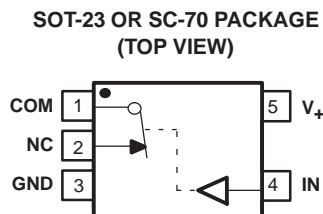
SLLS640 – JANUARY 2005

## Description

The MAX4595 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**
- **–80-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

$V_+ = 5$ V, $T_A = 25°C$

| 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 ($O_{ISO}$) | –80 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 |

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



**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 | MAX4595DBVR | 6SB_ |
| | SOT (SC–70) – DCK | Tape and reel | MAX4595DCKR | SB_ |

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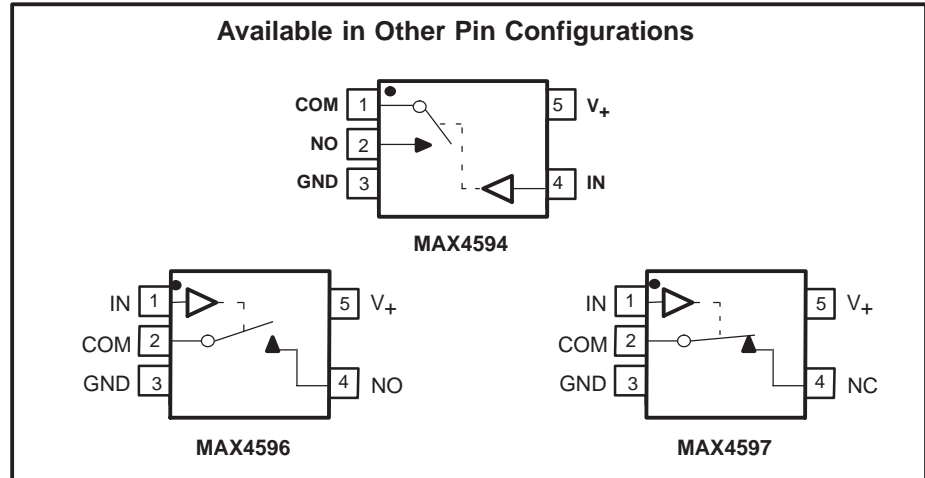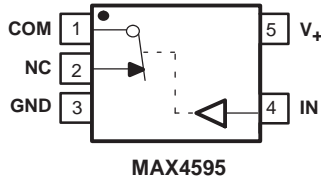
⚠ Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

**TEXAS INSTRUMENTS**
www.ti.com

## Pin Configurations



**Available in Other Pin Configurations**

MAX4595

MAX4594

MAX4596

MAX4597

## 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 | $V_{NC}$, $V_{COM} < 0$ | –50 |  | mA |
| $I_{NC}$ $I_{COM}$ | On-state switch current | $V_{NC}$, $V_{COM} = 0$ to $V_+$ | –20 | 20 | mA |
| $V_I$ | Digital input voltage range[3][4] |  | –0.3 | 6 | V |
| $I_{IK}$ | Digital input clamp current | $V_I < 0$ | –50 |  | mA |
| $I_+$ | Continuous current through $V_+$ |  |  | 100 | mA |
| $I_{GND}$ | Continuous current through GND |  | –100 |  | mA |
| $\theta_{JA}$ | Package thermal impedance[5] | DBV package |  | 206 | °C/W |
|  |  | 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 V to 5.5 V, $V_{IH}$ = 2.4 V, $V_{IL}$ = 0.8 V $T_A$ = –40°C to 85°C (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | $T_A$ | $V_+$ | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | | | |
| Analog signal range | $V_{COM}$, $V_{NC}$ | | | | | 0 | | $V_+$ | V |
| ON-state resistance | $r_{on}$ | $V_+$ = 4.5 V, $V_{NC}$ = 3.5 V, $I_{COM}$ = 10 mA, | Switch ON, See Figure 13 | 25°C | 4.5 V | | 6.5 | 10 | Ω |
| | | | | Full | | | | 12 | |
| ON-state resistance flatness | $r_{on(flat)}$ | $V_{NC}$ = 1.5 V, 2.5 V, 3.5 V, $I_{COM}$ = 10 mA, | Switch ON, See Figure 13 | 25°C | 4.5 V | | 0.5 | 1.5 | Ω |
| | | | | Full | | | | 2 | |
| NC OFF leakage current | $I_{NC(OFF)}$ | $V_{NC}$ = 1 V, $V_{COM}$ = 4.5 V, or $V_{NC}$ = 4.5 V, $V_{COM}$ = 1 V, | Switch OFF, See Figure 14 | 25°C | 5.5 V | –0.5 | 0.01 | 0.5 | nA |
| | | | | Full | | –5 | | 5 | |
| COM OFF leakage current | $I_{COM(OFF)}$ | $V_{COM}$ = 1 V, $V_{NC}$ = 4.5 V, or $V_{COM}$ = 4.5 V, $V_{NC}$ = 1 V, | Switch OFF, See Figure 14 | 25°C | 5.5 V | –0.5 | 0.01 | 0.5 | nA |
| | | | | Full | | –5 | | 5 | |
| NC ON leakage current | $I_{NC(ON)}$ | $V_{NC}$ = 1 V, $V_{COM}$ = 1 V, or $V_{NC}$ = 4.5 V, $V_{COM}$ = 4.5 V, or $V_{NC}$ = 1 V, 4.5 V, $V_{COM}$ = Open, | Switch ON, See Figure 15 | 25°C | 5.5 V | –1 | 0.01 | 1 | nA |
| | | | | Full | | –10 | | 10 | |
| COM ON leakage current | $I_{COM(ON)}$ | $V_{COM}$ = 1 V, $V_{NC}$ = 1 V, or $V_{COM}$ = 4.5 V, $V_{NC}$ = 4.5 V, or $V_{COM}$ = 1 V, 4.5 V, $V_{NC}$ = Open, | Switch ON, See Figure 15 | 25°C | 5.5 V | –1 | 0.01 | 1 | nA |
| | | | | Full | | –10 | | 10 | |
| **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 | $I_{IH}$, $I_{IL}$ | $V_I$ = $V_+$ or 0 | | 25°C | 5.5 V | –1 | 0.03 | 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

**MAX4595**
**SINGLE-CHANNEL 10-Ω SPST ANALOG SWITCH**

**TEXAS
INSTRUMENTS**
www.ti.com

SLLS640 – 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 V, $R_L$ = 300 Ω, | $C_L$ = 35 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 V, $R_L$ = 300 Ω, | $C_L$ = 35 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 nF, See Figure 20 | 25°C | 4.5 V to 5.5 V | | 2 | 5 | pC |
| NC OFF capacitance | $C_{NC(OFF)}$ | $V_{NC}$ = 0, f = 1 MHz, | Switch OFF, See Figure 16 | 25°C | 5 V | | 8 | | pF |
| COM OFF capacitance | $C_{COM(OFF)}$ | $V_{COM}$ = 0, f = 1 MHz, | Switch OFF, See Figure 16 | 25°C | 5 V | | 8 | | pF |
| NC ON capacitance | $C_{NC(ON)}$ | $V_{NC}$ = 0, f = 1 MHz, | Switch ON, See Figure 16 | 25°C | 5 V | | 20 | | pF |
| COM ON capacitance | $C_{COM(ON)}$ | $V_{COM}$ = GND, f = 1 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 Ω, Switch ON, | Signal = 0 dBm, See Figure 18 | 25°C | 5 V | | 300 | | MHz |
| OFF isolation | $O_{ISO}$ | $R_L$ = 50 Ω, $V_{NC}$ = 1 $V_{RMS}$, f = 1 MHz, $C_L$ = 5 pF | Switch OFF, See Figure 19 | 25°C | 5 V | | –80 | | dB |
| Total harmonic distortion | THD | $R_L$ = 600 Ω, $C_L$ = 50 pF, $V_{SOURCE}$ = 5 $V_{p-p}$, | f = 20 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 V to 3.6 V, $T_A$ = –40°C to 85°C (unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | $T_A$ | $V_+$ | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | | | |
| Analog signal range | $V_{COM}$, $V_{NC}$ | | | | | 0 | | $V_+$ | V |
| ON-state resistance | $r_{on}$ | $V_+$ = 3 V, $V_{NC}$ = 1.5 V, $I_{COM}$ = 10 mA, | Switch ON, See Figure 13 | 25°C | 2.7 V | | 10 | 20 | Ω |
| | | | | Full | | | | 25 | |
| **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 | 3.6 V | −1 | 0.03 | 1 | μA |
| | | | | Full | | −1 | | 1 | |
| **Dynamic** | | | | | | | | | |
| Turn-on time | $t_{ON}$ | $V_{NC}$ = 2 V, $R_L$ = 300 Ω, | $C_L$ = 35 pF, See Figure 17 | 25°C | 3 V | | 25 | 45 | ns |
| | | | | Full | 2.7 V to 3.6 V | | | 55 | |
| Turn-off time | $t_{OFF}$ | $V_{NC}$ = 2 V, $R_L$ = 300 Ω, | $C_L$ = 35 pF, See Figure 17 | 25°C | 3 V | | 30 | 50 | ns |
| | | | | Full | 2.7 V to 3.6 V | | | 60 | |
| Charge injection | $Q_C$ | $V_{GEN}$ = 0, $R_{GEN}$ = 0, | $C_L$ = 1 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

**TEXAS INSTRUMENTS**
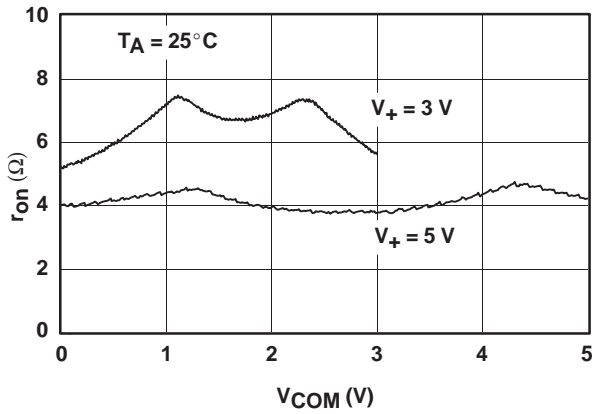www.ti.com

## TYPICAL PERFORMANCE
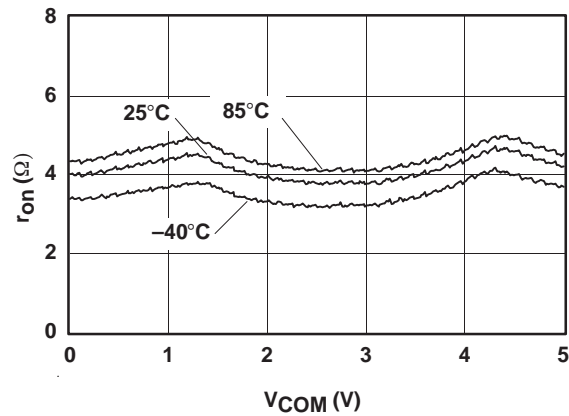


Figure 1. $r_{on}$ vs $V_{COM}$



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

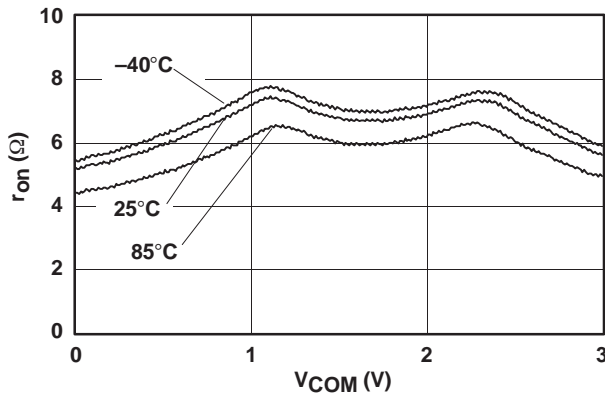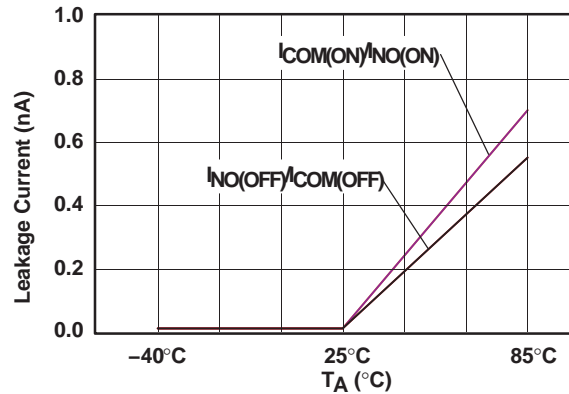

Figure 3. $r_{on}$ vs $V_{COM}$ ($V_+ = 3$ V)
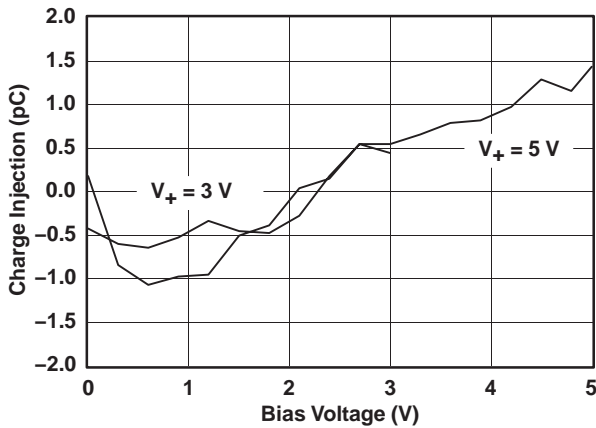


Figure 4. Leakage Current vs Temperature
($V_+ = 5$ V)



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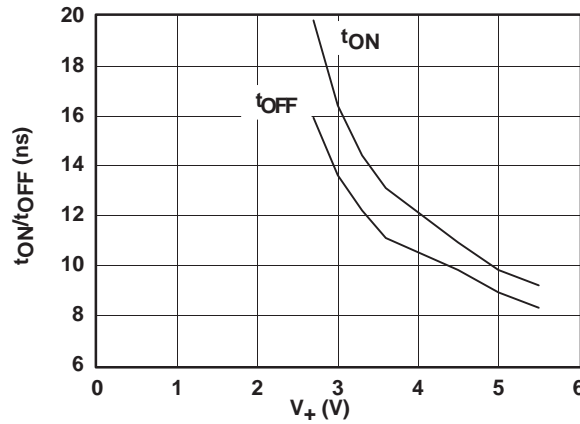


Figure 6. $t_{ON}$ and $t_{OFF}$ vs Supply Voltage

**TEXAS INSTRUMENTS**
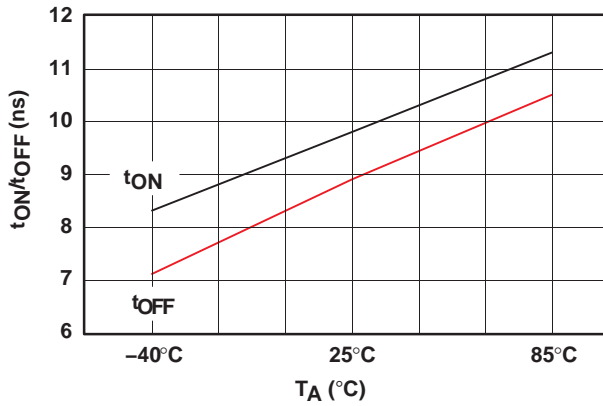www.ti.com

## TYPICAL PERFORMANCE



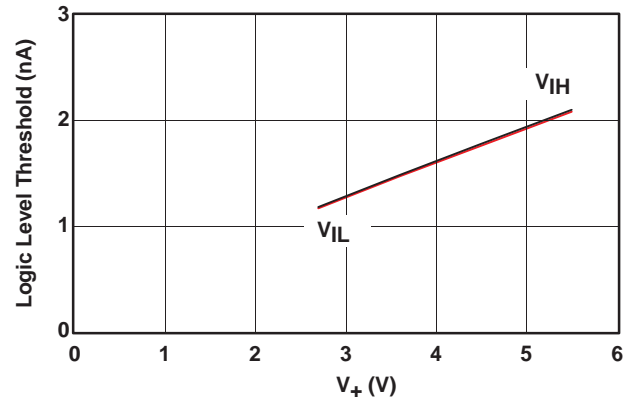Figure 7. $t_{ON}$ and $t_{OFF}$ vs Temperature ($V_+ = 5$ V)



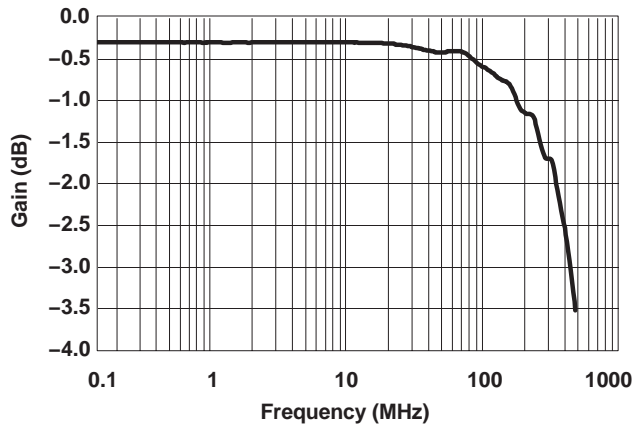Figure 8. Logic-Level Threshold vs $V_+$
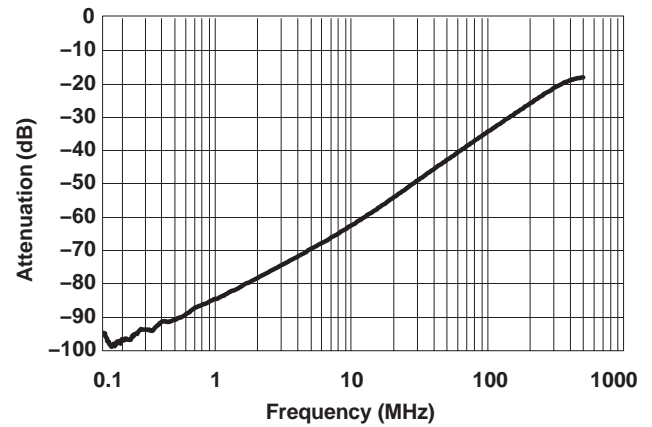


Figure 9. Bandwidth (Gain vs Frequency)
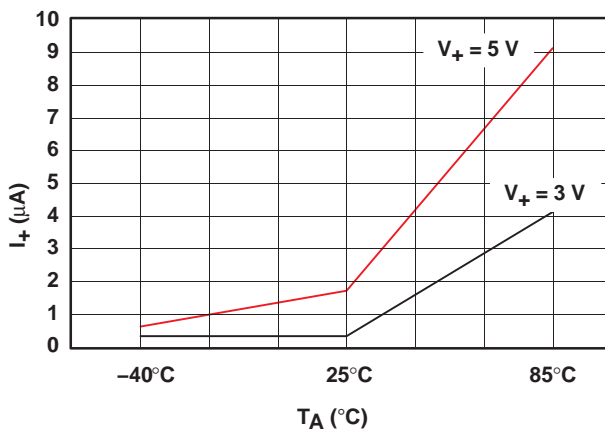($V_+ = 5$ V)



Figure 10. Off Isolation vs Frequency
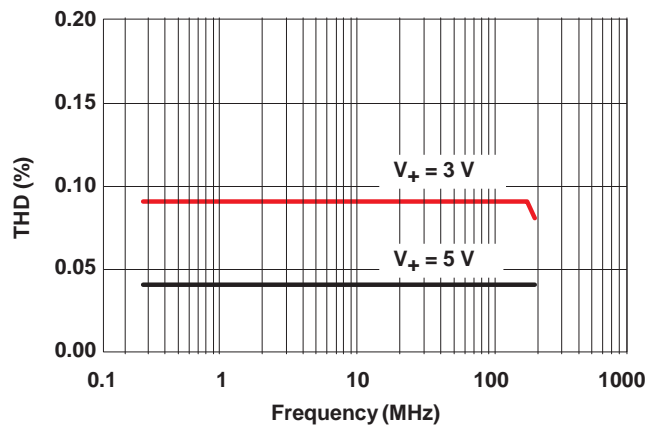


Figure 11. Power-Supply Current vs
Temperature



Figure 12. Total Harmonic Distortion vs
Frequency

SLLS640 – JANUARY 2005

## PIN DESCRIPTION

| PIN NUMBER | NAME | DESCRIPTION |
|---|---|---|
| 1 | COM | Common |
| 2 | NC | Normally closed |
| 3 | GND | Digital ground |
| 4 | IN | Digital control pin to connect COM to NC |
| 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$_L$ × $\Delta$V$_{COM}$, C$_L$ is the load capacitance, and $\Delta$V$_{COM}$ 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 |

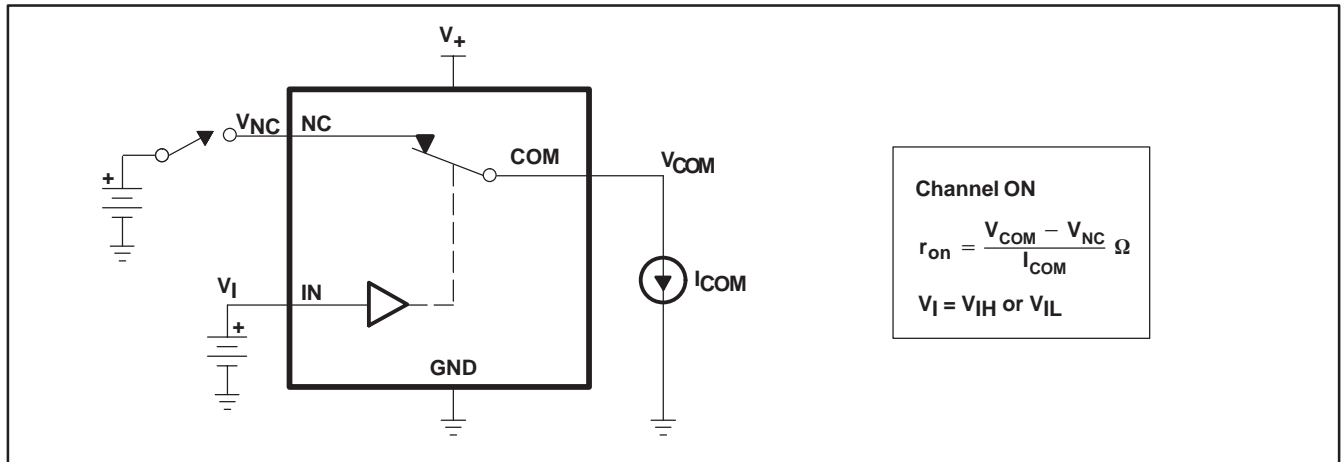**PARAMETER MEASUREMENT INFORMATION**



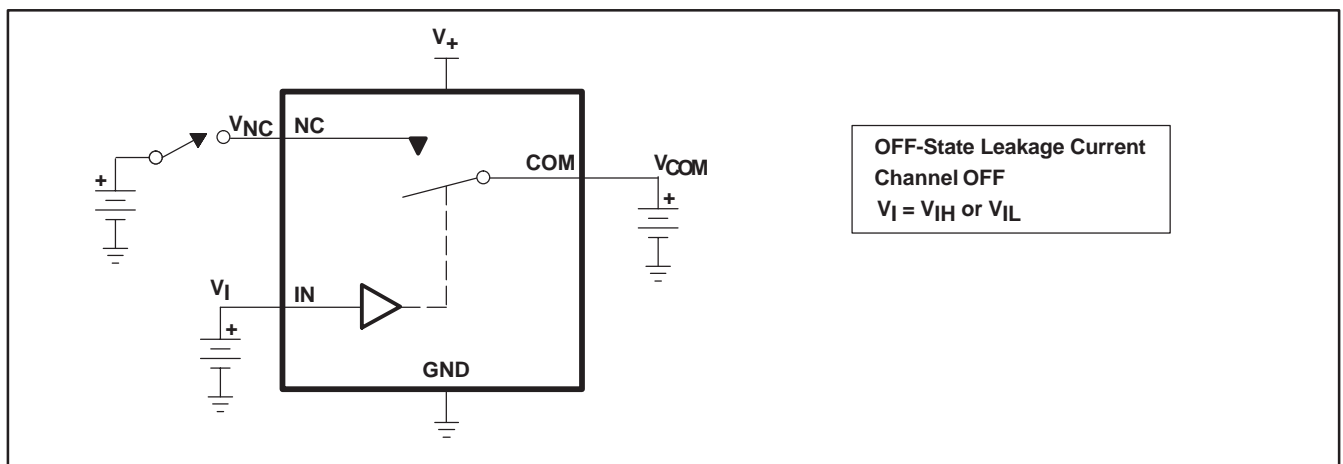**Figure 13. ON-State Resistance (r$_{on}$)**



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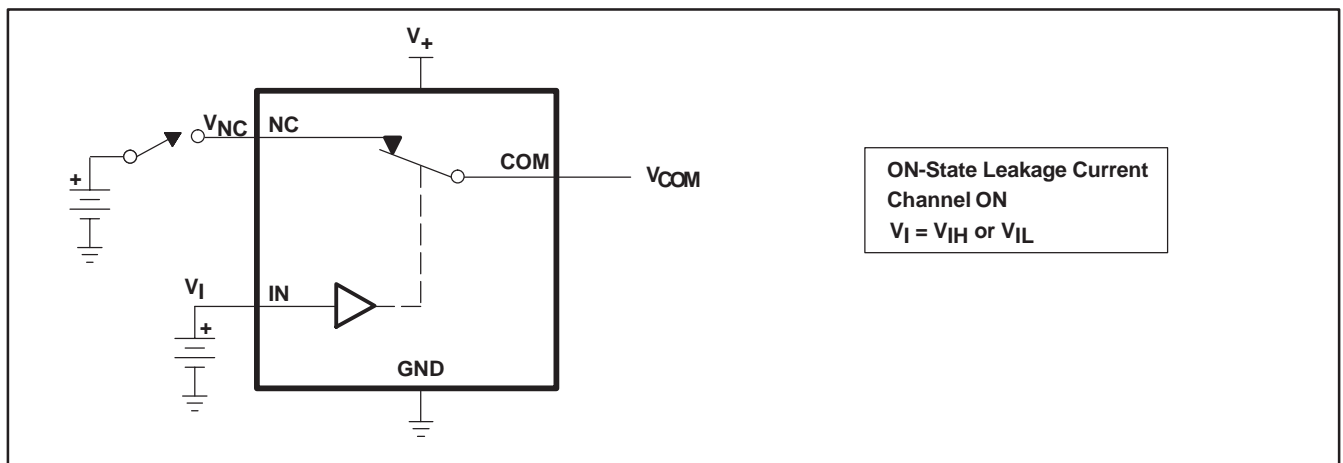


**Figure 15. ON-State Leakage Current (I$_{COM(ON)}$, I$_{NC(ON)}$)**

**MAX4595**
**SINGLE-CHANNEL 10-$\Omega$ SPST ANALOG SWITCH**

**TEXAS**
**INSTRUMENTS**
**www.ti.com**

SLLS640 – JANUARY 2005
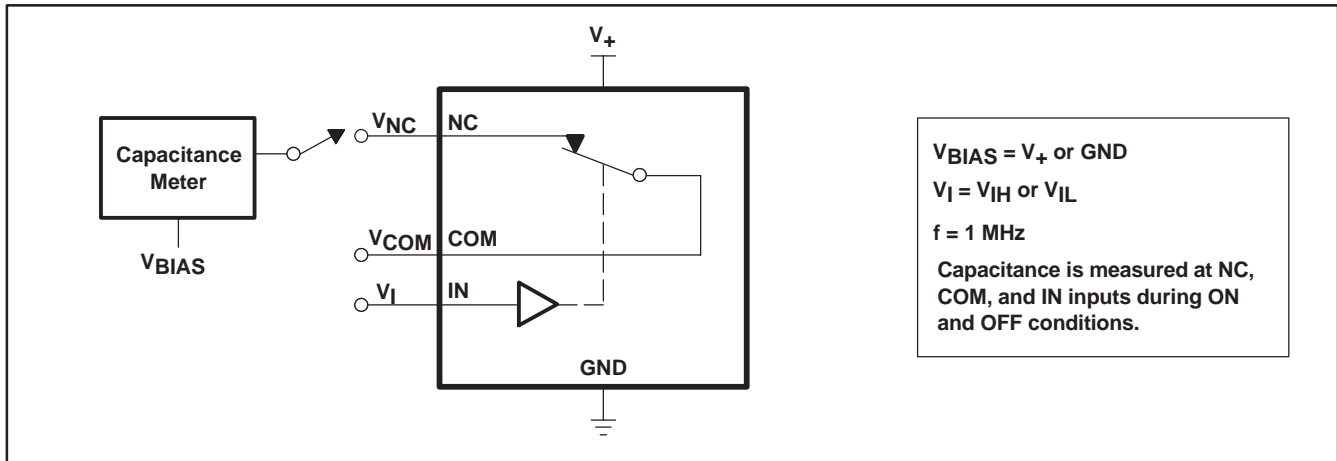
**Figure 16. Capacitance ($C_I$, $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NC(ON)}$)**
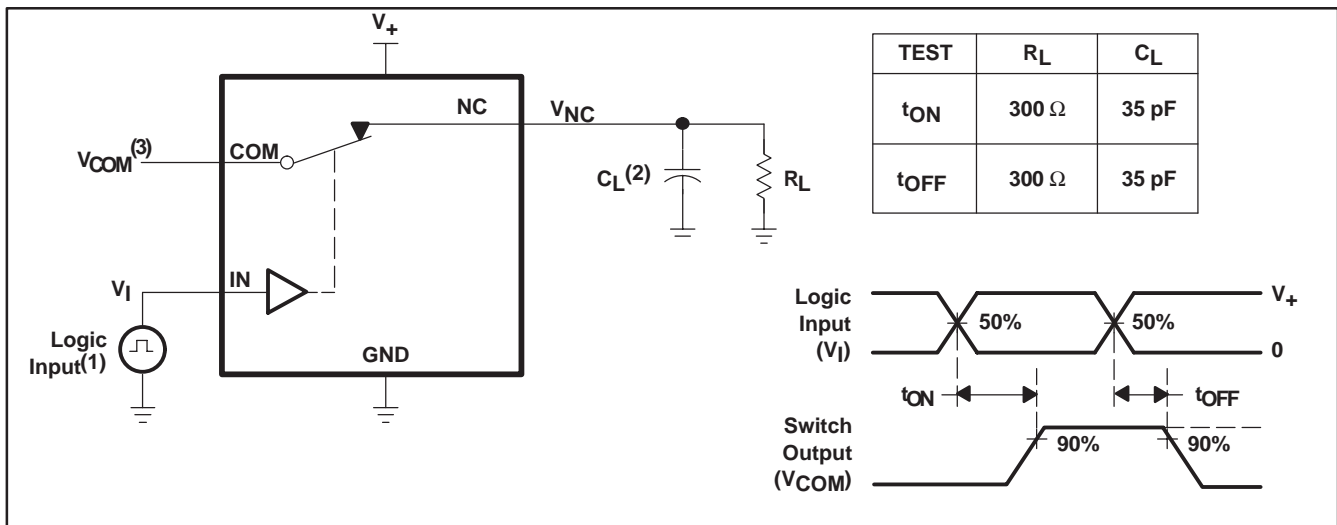


(1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, $Z_O$ = 50 $\Omega$, $t_r$ < 5 ns, $t_f$ < 5 ns.
(2) $C_L$ includes probe and jig capacitance.
(3) See Electrical Characteristics for $V_{COM}$.

**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 ≤ 10 MHz, $Z_O$ = 50 Ω, $t_r$ < 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

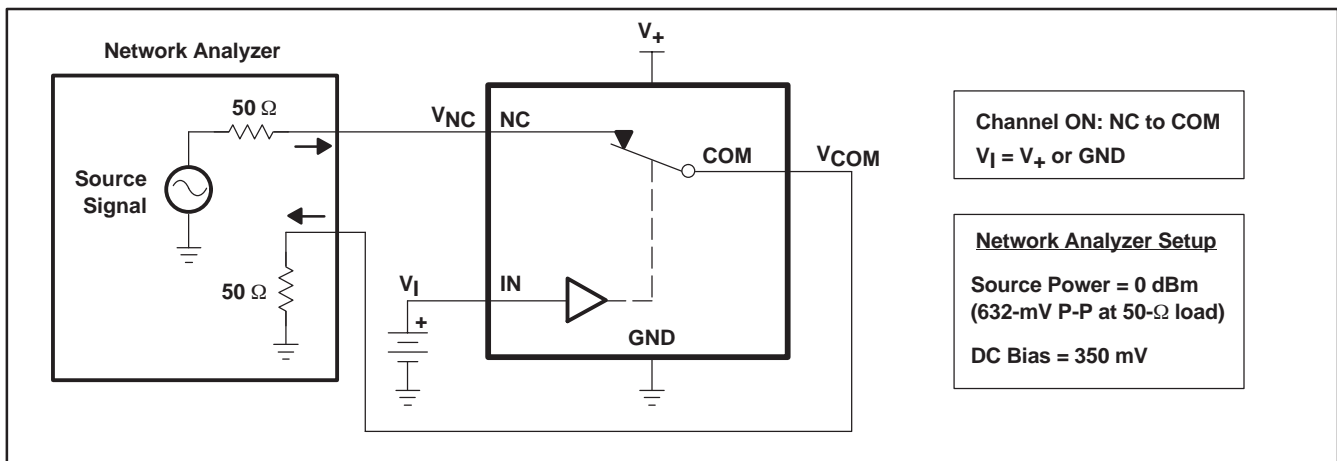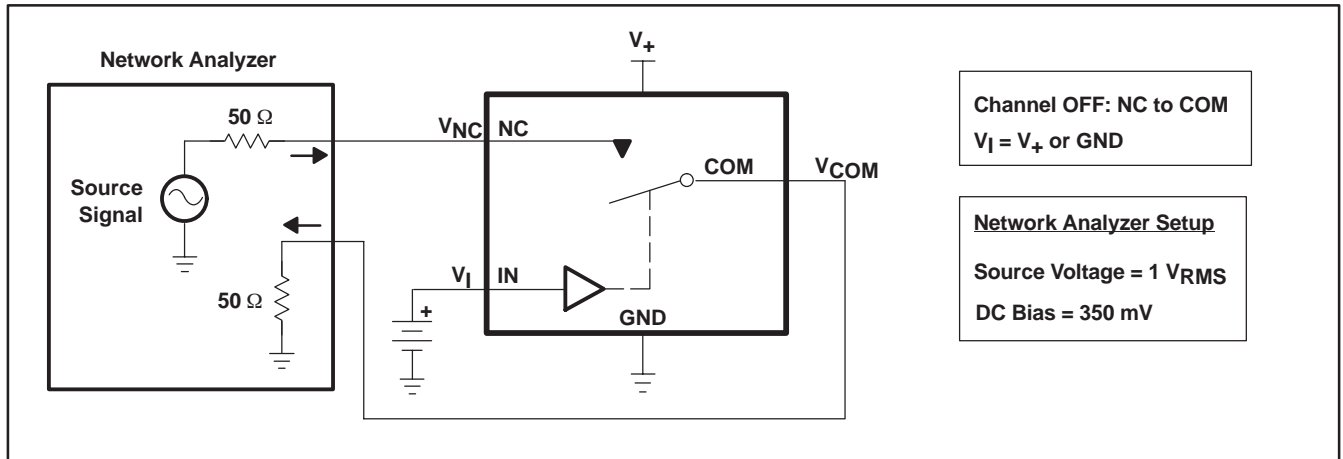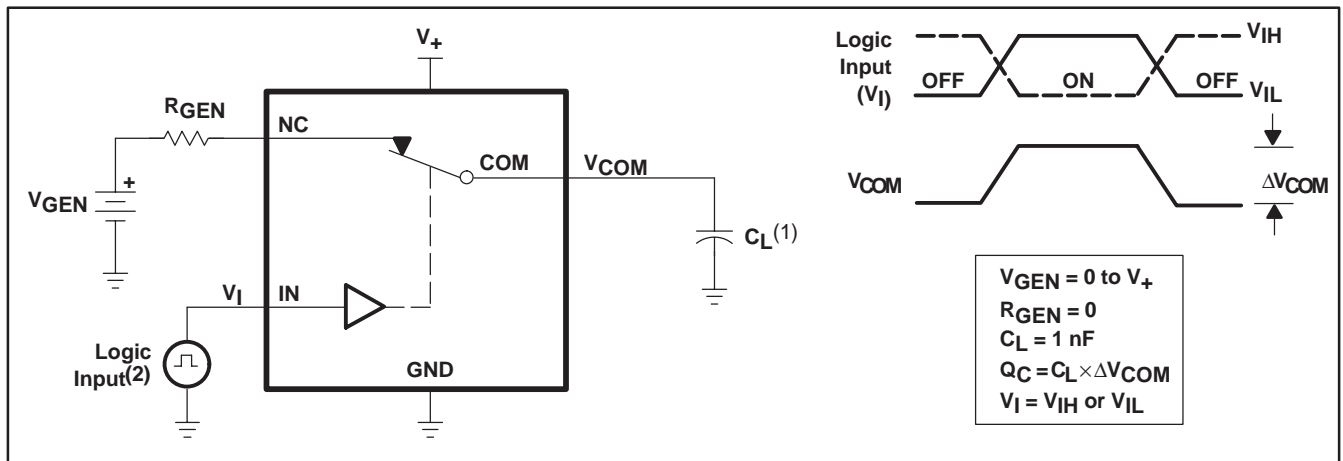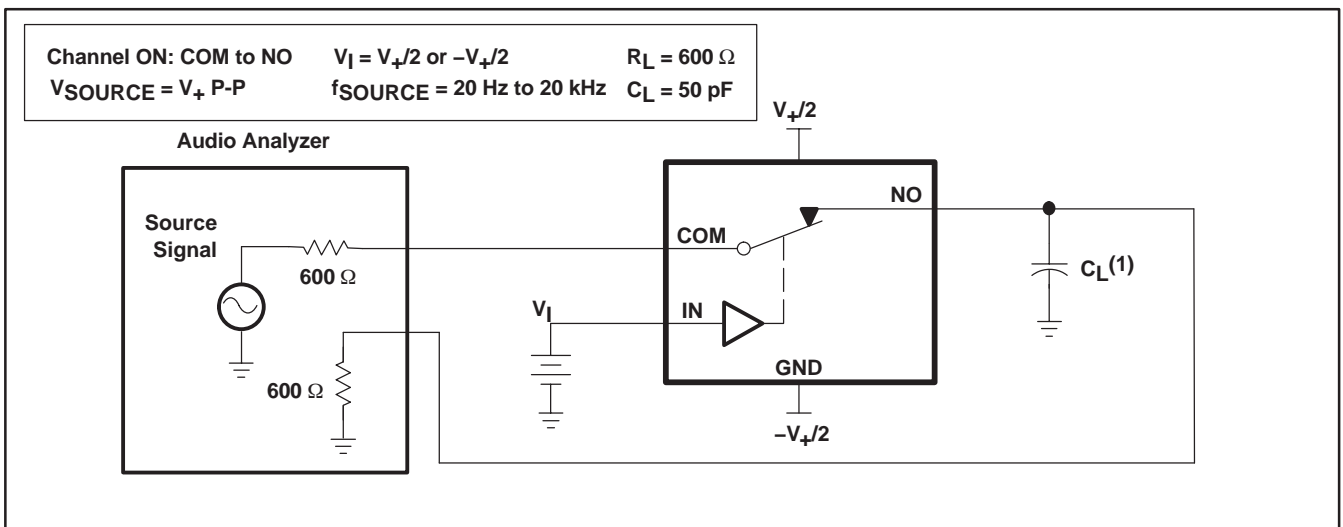| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MAX4595DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 6SBR | Samples |
| MAX4595DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 6SBR | Samples |
| MAX4595DCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | SBR | Samples |
| MAX4595DCKRG4 | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | SBR | Samples |

**(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.

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

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

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

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**



Reel Diameter

Reel Width (W1)

**TAPE DIMENSIONS**



Cavity

| A0 | Dimension designed to accommodate the component width |
|----|----|
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



Sprocket Holes

Q1 | Q2
Q3 | Q4

Q1 | Q2
Q3 | Q4

User Direction of Feed

Pocket Quadrants

*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 |
|--------|--------------|-----------------|------|-----|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MAX4595DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| MAX4595DCKR | SC70 | DCK | 5 | 3000 | 180.0 | 8.4 | 2.47 | 2.3 | 1.25 | 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) |
|---|---|---|---|---|---|---|---|
| MAX4595DBVR | SOT-23 | DBV | 5 | 3000 | 202.0 | 201.0 | 28.0 |
| MAX4595DCKR | SC70 | DCK | 5 | 3000 | 202.0 | 201.0 | 28.0 |

DCK (R−PDSO−G5)                    PLASTIC SMALL−OUTLINE PACKAGE

2,15
1,85

5      4

1,40
1,10

2,40
1,80

Pin 1
Index Area          1    2    3

0,65

5X  0,30
     0,15

1,30

⊕ 0,10 Ⓜ

0,22
0,08

Gauge Plane
Seating Plane

0,15      0°−8°

0,46
0,26

1,10
0,80

0,10

Seating Plane

0,10
0,00

4093553−3/G   01/2007

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 AA.

DCK (R−PDSO−G5)                              PLASTIC SMALL OUTLINE

Example Board Layout

Stencil Openings
Based on a stencil thickness
of .127mm (.005inch).

6x0,35

0,85

2,2

2x0,65

2x1,30

2,2

2x0,65

2x1,30

0,4

Solder Mask Opening

1,0   0,9

Pad Geometry

0,05

0,50

4210356−2/C  07/11

NOTES:   A.  All linear dimensions are in millimeters.
         B.  This drawing is subject to change without notice.
         C.  Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
         D.  Publication IPC−7351 is recommended for alternate designs.
         E.  Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release.  Customers should
             contact their board assembly site for stencil design recommendations.  Example stencil design based on a 50% volumetric
             metal load solder paste.  Refer to IPC−7525 for other stencil recommendations.

Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4073253/P

TEXAS
INSTRUMENTS

**DBV0005A**

SMALL OUTLINE TRANSISTOR



4214839/C   04/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-178.

PKG

5X (1.1)

1

5X (0.6)

5

SYMM

2

(1.9)

2X (0.95)

3

4

(R0.05) TYP

(2.6)

LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

SOLDER MASK
OPENING

METAL

EXPOSED METAL

0.07 MAX
ARROUND

NON SOLDER MASK
DEFINED
(PREFERRED)

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

EXPOSED METAL

0.07 MIN
ARROUND

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4214839/C   04/2017

NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

5X (1.1)

PKG
℄

1

5X (0.6)

2

2X(0.95)

3

(R0.05) TYP

5

SYMM
℄

(1.9)

4

(2.6)

SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/C   04/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate
   design recommendations.
7. Board assembly site may have different recommendations for stencil design.

# IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

TI's published terms of sale for semiconductor products (http://www.ti.com/sc/docs/stdterms.htm) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.