

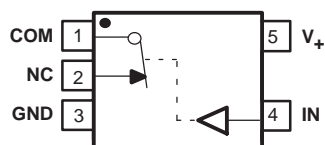
## Description

The TS5A4595 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 Circuit
- Battery-Powered Equipment (Cellular Phones, PDAs)
- Audio and Video Signal Routing
- Communication Circuits
- PCMCIA Cards

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



FUNCTION TABLE

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

## Features

- Low ON-State Resistance (8 Ω)
- ON-State Resistance Flatness (1.5 Ω)
- Control Inputs Are 5.5-V Tolerant
- Low Charge Injection (5 pC Max)
- 450-MHz –3-dB Bandwidth at 25°C
- Low Total Harmonic Distortion (THD) (0.04%)
- 2-V to 5.5-V Single-Supply Operation
- –82-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 ( $r_{ON}$ )	8 Ω
ON-state resistance flatness ( $r_{ON(flat)}$ )	1.5 Ω
Turn-on/turn-off time ( $t_{ON}/t_{OFF}$ )	17 ns/14 ns
Charge injection ( $Q_C$ )	5 pC
Bandwidth (BW)	450 MHz
OFF isolation ( $O_{ISO}$ )	–82 dB at 1 MHz
Total harmonic distortion (THD)	0.04%
Leakage current ( $I_{COM(OFF)}/I_{NC(OFF)}$ )	±0.5 nA
Power-supply current ( $I_+$ )	0.25 μA
Package option	5-pin SOT-23 or SC-70

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(2)</sup>
–40°C to 85°C	SOT (SOT-23) – DBV	Tape and reel	TS5A4595DBVR	JSB_
	SOT (SC-70) – DCK	Tape and reel	TS5A4595DCKR	JT_

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

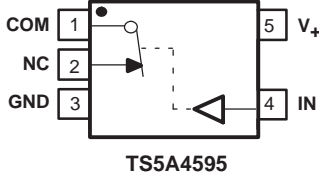
# TS5A4595

## 8-Ω SPST ANALOG SWITCH

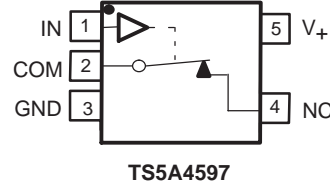
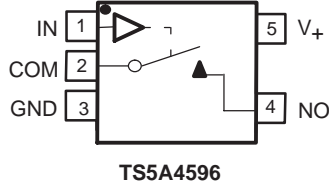
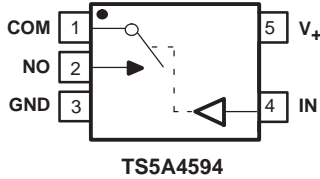
### 5-V/3.3-V SINGLE-CHANNEL ANALOG SWITCH

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#### Pin Configurations



#### Available in Other Pin Configurations



#### Absolute Minimum and Maximum Ratings<sup>(1)(2)</sup>

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

			MIN	MAX	UNIT
V <sub>+</sub>	Supply voltage range <sup>(3)</sup>		-0.3	6	V
V <sub>NC</sub> V <sub>COM</sub>	Analog voltage range <sup>(3)(4)</sup>		-0.3	V <sub>+</sub> + 0.3	V
I <sub>K</sub>	Analog port diode current	V <sub>NC</sub> , V <sub>COM</sub> < 0	-50		mA
I <sub>NC</sub> I <sub>COM</sub>	On-state switch current	V <sub>NC</sub> , V <sub>COM</sub> = 0 to V <sub>+</sub>	-20	20	mA
V <sub>I</sub>	Digital input voltage range <sup>(3)(4)</sup>		-0.3	6	V
I <sub>IK</sub>	Digital input clamp current	V <sub>I</sub> < 0	-50		mA
I <sub>+</sub>	Continuous current through V <sub>+</sub>		100		mA
I <sub>GND</sub>	Continuous current through GND		-100		mA
θ <sub>JA</sub>	Package thermal impedance <sup>(5)</sup>	DBV package	206		°C/W
		DCK package	252		
T <sub>stg</sub>	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<sup>(1)</sup>

$V_+ = 4.5\text{ V}$  to  $5.5\text{ V}$ ,  $V_{IH} = 2.4\text{ V}$ ,  $V_{IL} = 0.8\text{ V}$   $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT
<b>Analog Switch</b>								
Analog signal range	$V_{COM}, V_{NC}$				0		$V_+$	V
ON-state resistance	$r_{on}$	$V_+ = 4.5\text{ V}$ , $V_{NC} = 3.5\text{ V}$ , $I_{COM} = 10\text{ mA}$ , Switch ON, See Figure 13	25°C Full	4.5 V		5	8 10	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 -5	0.01	0.5 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 -5	0.01	0.5 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 -10	0.01	1 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 -10	0.01	1 10	nA
<b>Digital Control Input (IN)</b>								
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 Full	5.5 V	-0.5 -5	0.01	0.5 5	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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**8-Ω SPST ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL ANALOG SWITCH**

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**Electrical Characteristics for 5-V Supply<sup>(1)</sup> (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 <sub>A</sub>	V <sub>+</sub>	MIN	TYP	MAX	UNIT
Dynamic									
Turn-on time	t <sub>ON</sub>	V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω,	C <sub>L</sub> = 35 pF, See Figure 17	25°C	5 V	12	17	ns	
				Full	4.5 V to 5.5 V		19		
Turn-off time	t <sub>OFF</sub>	V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω,	C <sub>L</sub> = 35 pF, See Figure 17	25°C	5 V	9	14	ns	
				Full	4.5 V to 5.5 V		17		
Charge injection	Q <sub>C</sub>	V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1 nF,	See Figure 20	25°C	4.5 V to 5.5 V	2	5	pC	
NC OFF capacitance	C <sub>NC(OFF)</sub>	V <sub>NC</sub> = 0, f = 1 MHz, Switch OFF,	See Figure 16	25°C	5 V	6.5		pF	
COM OFF capacitance	C <sub>COM(OFF)</sub>	V <sub>COM</sub> = 0, f = 1 MHz, Switch OFF,	See Figure 16	25°C	5 V	6.5		pF	
NC ON capacitance	C <sub>NC(ON))</sub>	V <sub>NC</sub> = 0, f = 1 MHz, Switch ON,	See Figure 16	25°C	5 V	13		pF	
COM ON capacitance	C <sub>COM(ON)</sub>	V <sub>COM</sub> = GND, f = 1 MHz, Switch ON,	See Figure 16	25°C	5 V	13		pF	
Digital input capacitance	C <sub>I</sub>	V <sub>I</sub> = V <sub>+</sub> or GND,	See Figure 16	25°C	5 V	3		pF	
Bandwidth	BW	R <sub>L</sub> = 50 Ω, Switch ON, Signal = 0 dBm	See Figure 18	25°C	5 V	450		MHz	
OFF isolation	O <sub>ISO</sub>	R <sub>L</sub> = 50 Ω, V <sub>NC</sub> = 1 V <sub>RMS</sub> f = 1 MHz, C <sub>L</sub> = 5 pF	Switch OFF, See Figure 19	25°C	5 V	−82		dB	
Total harmonic distortion	THD	R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF, V <sub>SOURCE</sub> = 5 V <sub>p-p</sub> ,	f = 20 Hz to 20 kHz, See Figure 21	25°C	5 V	0.04		%	
Supply									
Positive supply current	I <sub>+</sub>	V <sub>I</sub> = V <sub>+</sub> or GND,	Switch ON or OFF	25°C	5.5 V	0.01	0.25	μA	
				Full			0.5		

(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<sup>(1)</sup>

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT
<b>Analog Switch</b>								
Analog signal range	$V_{COM}, V_{NC}$				0		$V_+$	V
ON-state resistance	$r_{on}$	$V_+ = 3 \text{ V}$ , $V_{NC} = 1.5 \text{ V}$ , $I_{COM} = 10 \text{ mA}$ , Switch ON, See Figure 13	25°C Full	2.7 V	9.5	16	20	Ω
ON-state resistance flatness	$r_{on(flat)}$	$V_{NC} = 1.5 \text{ V}$ , $2.5 \text{ V}$ , $I_{COM} = 10 \text{ mA}$ , Switch ON, See Figure 13	25°C Full	2.7 V	1.8	6	7	Ω
NC OFF leakage current	$I_{NC(OFF)}$	$V_{NC} = 1 \text{ V}$ , $V_{COM} = 3 \text{ V}$ , or $V_{NC} = 3 \text{ V}$ , $V_{COM} = 1 \text{ V}$ , Switch OFF, See Figure 14	25°C Full	3.6 V	-0.5	0.01	0.5	nA
COM OFF leakage current	$I_{COM(OFF)}$	$V_{COM} = 1 \text{ V}$ , $V_{NC} = 3 \text{ V}$ , or $V_{COM} = 1 \text{ V}$ , $V_{NC} = 3 \text{ V}$ , Switch OFF, See Figure 14	25°C Full	3.6 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 $V_{NC} = 3 \text{ V}$ , $V_{COM} = 3 \text{ V}$ , or $V_{NC} = 1 \text{ V}$ , $3 \text{ V}$ , $V_{COM} = \text{Open}$ , Switch ON, See Figure 15	25°C Full	3.6 V	-1	0.01	1	nA
COM ON leakage current	$I_{COM(ON)}$	$V_{COM} = 1 \text{ V}$ , $V_{NC} = 1 \text{ V}$ , or $V_{COM} = 3 \text{ V}$ , $V_{NC} = 3 \text{ V}$ , or $V_{COM} = 1 \text{ V}$ , $3 \text{ V}$ , $V_{NC} = \text{Open}$ , Switch ON, See Figure 15	25°C Full	3.6 V	-1	0.01	1	nA
<b>Digital Control Input (IN)</b>								
Input logic high	$V_{IH}$		Full		2		5.5	V
Input logic low	$V_{IL}$		Full		0		0.8	V
Input leakage current	$I_{IH}, I_{IL}$	$V_I = V_+ \text{ or } 0$	25°C Full	3.6 V	-0.5	0.01	0.5	nA

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

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**8-Ω SPST ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL ANALOG SWITCH**

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**Electrical Characteristics for 3-V Supply<sup>(1)</sup> (continued)**

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT
<b>Dynamic</b>								
Turn-on time	$t_{ON}$	$V_{NC} = 2\text{ V}$ , $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , See Figure 17	25°C	3 V		20	30	ns
			Full	2.7 V to 3.6 V			35	
Turn-off time	$t_{OFF}$	$V_{NC} = 2\text{ V}$ , $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , See Figure 17	25°C	3 V		15	25	ns
			Full	2.7 V to 3.6 V			30	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ , $C_L = 1\text{ nF}$ , See Figure 20	25°C	3 V		1	4	pC
NC OFF capacitance	$C_{NC(OFF)}$	$V_{NC} = 0$ , $f = 1\text{ MHz}$ , Switch OFF, See Figure 16	25°C	3 V		6.5		pF
COM OFF capacitance	$C_{COM(OFF)}$	$V_{COM} = 0$ , $f = 1\text{ MHz}$ , Switch OFF, See Figure 16	25°C	3 V		6.5		pF
NC ON capacitance	$C_{NC(ON)}$	$V_{NC} = 0$ , $f = 1\text{ MHz}$ , Switch ON, See Figure 16	25°C	3 V		13		pF
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = 0$ , $f = 1\text{ MHz}$ , Switch ON, See Figure 16	25°C	3 V		13		pF
Digital input capacitance	$C_I$	$V_I = V_+$ or GND, See Figure 16	25°C	3 V		3		pF
Bandwidth	BW	$R_L = 50\ \Omega$ , Signal = 0 dBm, Switch ON, See Figure 18	25°C	3 V		450		MHz
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , $V_{NC} = 1\text{ V}_{RMS}$ , Switch OFF, See Figure 19	25°C	3 V		-82		dB
Total harmonic distortion	THD	$R_L = 600\ \Omega$ , $C_L = 50\text{ pF}$ , $V_{SOURCE} = 3\text{ V}_{p-p}$ , $f = 20\text{ Hz to }20\text{ kHz}$ , See Figure 21	25°C	3 V		0.09		%
<b>Supply</b>								
Positive supply current	$I_+$	$V_I = V_+$ or GND, Switch ON or OFF	25°C	3.6 V		0.01	0.25	$\mu\text{A}$
			Full				0.5	

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

## TYPICAL PERFORMANCE

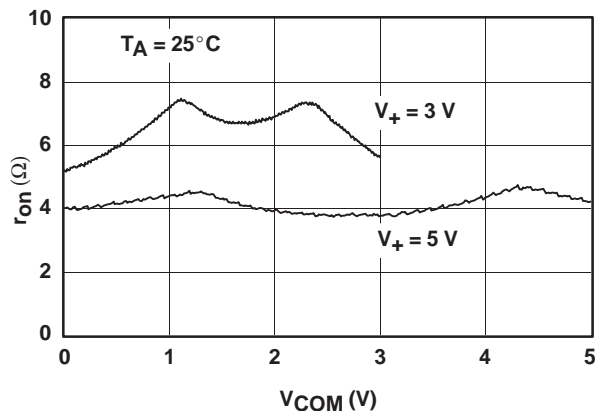


Figure 1.  $r_{on}$  vs  $V_{COM}$

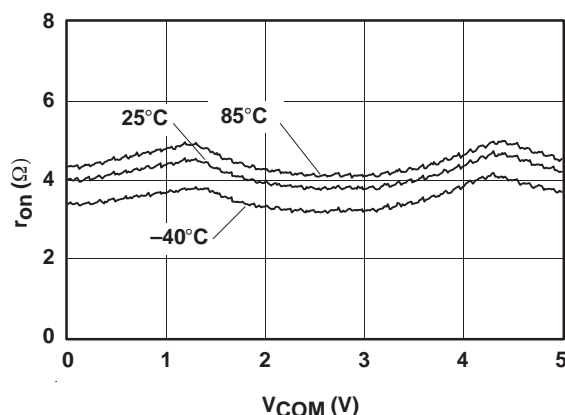


Figure 2.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 5\text{ V}$ )

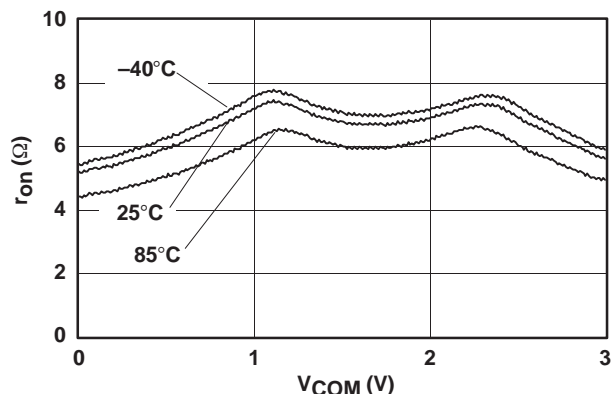


Figure 3.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 3\text{ V}$ )

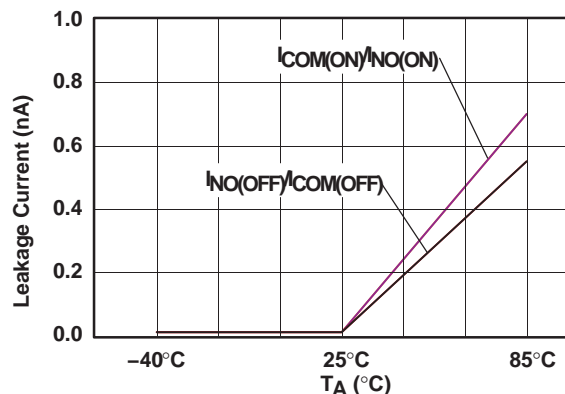


Figure 4. Leakage Current vs Temperature ( $V_+ = 5\text{ V}$ )

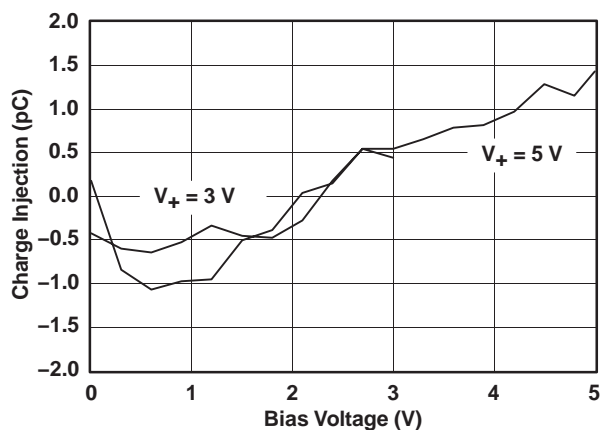


Figure 5. Charge-Injection ( $Q_C$ ) vs  $V_{COM}$

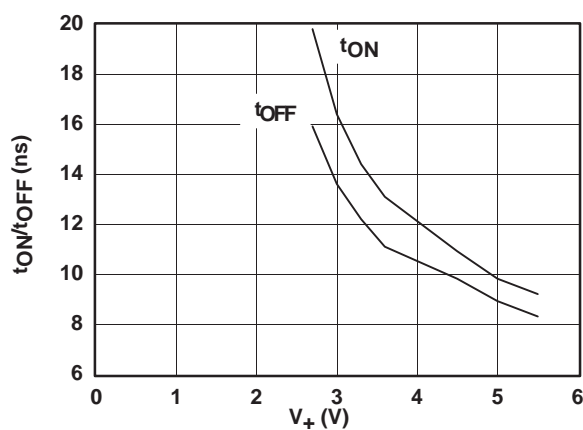
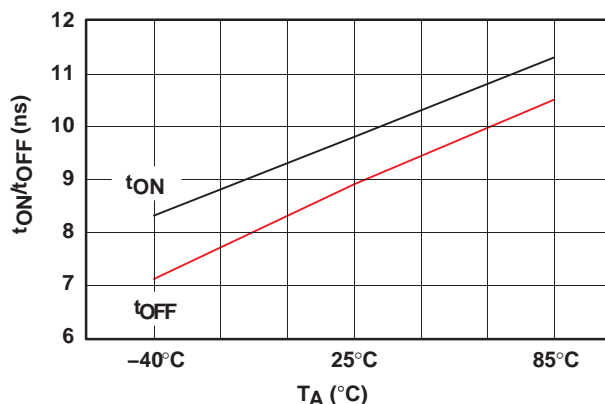
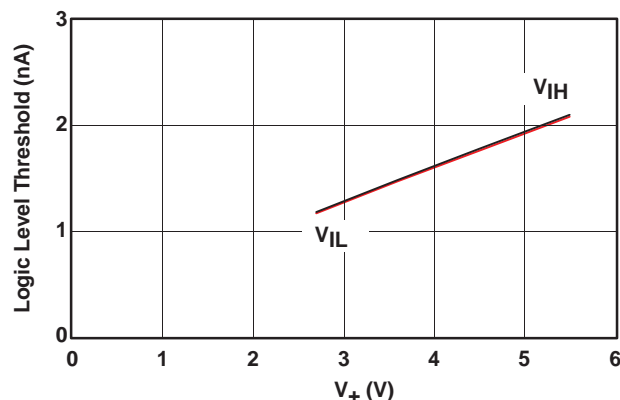


Figure 6.  $t_{ON}$  and  $t_{OFF}$  vs Supply Voltage

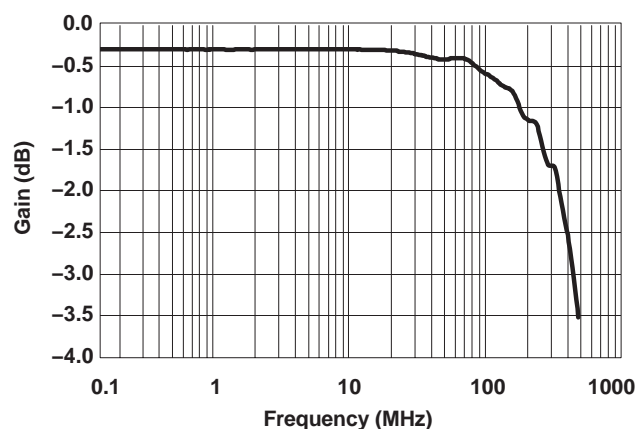
**TYPICAL PERFORMANCE (continued)**



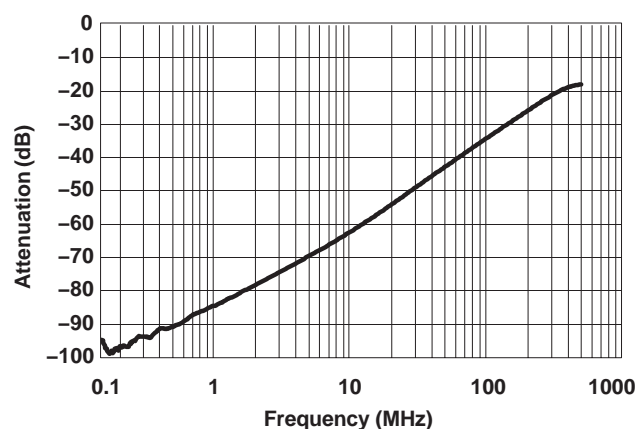
**Figure 7.  $t_{ON}$  and  $t_{OFF}$  vs Temperature ( $V_+ = 5\text{ V}$ )**



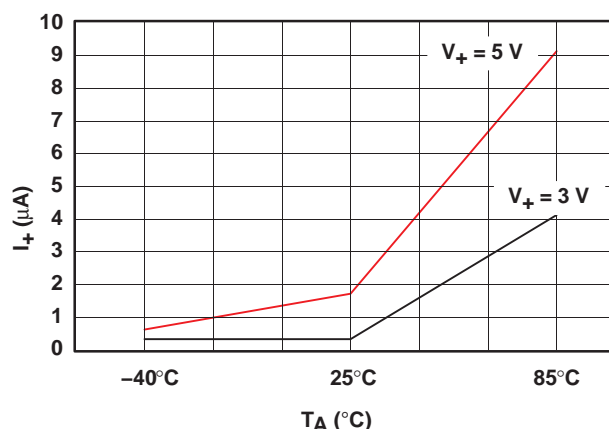
**Figure 8. Logic-Level Threshold vs  $V_+$**



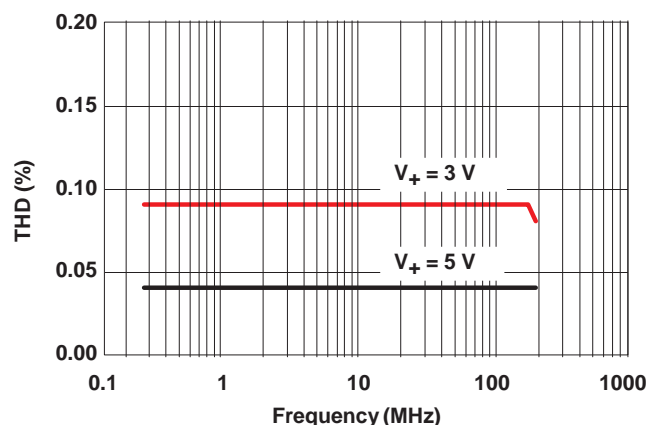
**Figure 9. Bandwidth (Gain vs Frequency) ( $V_+ = 5\text{ V}$ )**



**Figure 10. OFF Isolation vs Frequency**



**Figure 11. Power-Supply Current vs Temperature**



**Figure 12. Total Harmonic Distortion vs Frequency**



**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 <sub>+</sub>	Power supply

**PARAMETER DESCRIPTION**

SYMBOL	DESCRIPTION
V <sub>COM</sub>	Voltage at COM
V <sub>NC</sub>	Voltage at NC
r <sub>on</sub>	Resistance between COM and NC ports when the channel is ON
r <sub>on(flat)</sub>	Difference between the maximum and minimum value of r <sub>on</sub> in a channel over the specified range of conditions
I <sub>NC(OFF)</sub>	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the OFF state
I <sub>NC(ON)</sub>	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the ON state and the output (COM) open
I <sub>COM(OFF)</sub>	Leakage current measured at the COM port, with the corresponding channel (COM to NC) in the OFF state
I <sub>COM(ON)</sub>	Leakage current measured at the COM port, with the corresponding channel (COM to NC) in the ON state and the output (NC) open
V <sub>IH</sub>	Minimum input voltage for logic high for the control input (IN)
V <sub>IL</sub>	Maximum input voltage for logic low for the control input (IN)
V <sub>I</sub>	Voltage at the control input (IN)
I <sub>IH</sub> , I <sub>IL</sub>	Leakage current measured at the control input (IN)
t <sub>ON</sub>	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 <sub>OFF</sub>	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 <sub>C</sub>	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 <sub>C</sub> = C <sub>L</sub> × ΔV <sub>COM</sub> , C <sub>L</sub> is the load capacitance, and ΔV <sub>COM</sub> is the change in analog output voltage.
C <sub>NC(OFF)</sub>	Capacitance at the NC port when the corresponding channel (NC to COM) is OFF
C <sub>NC(ON)</sub>	Capacitance at the NC port when the corresponding channel (NC to COM) is ON
C <sub>COM(OFF)</sub>	Capacitance at the COM port when the corresponding channel (COM to NC) is OFF
C <sub>COM(ON)</sub>	Capacitance at the COM port when the corresponding channel (COM to NC) is ON
C <sub>I</sub>	Capacitance of control input (IN)
O <sub>ISO</sub>	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 <sub>+</sub>	Static power-supply current with the control (IN) pin at V <sub>+</sub> or GND

## PARAMETER MEASUREMENT INFORMATION

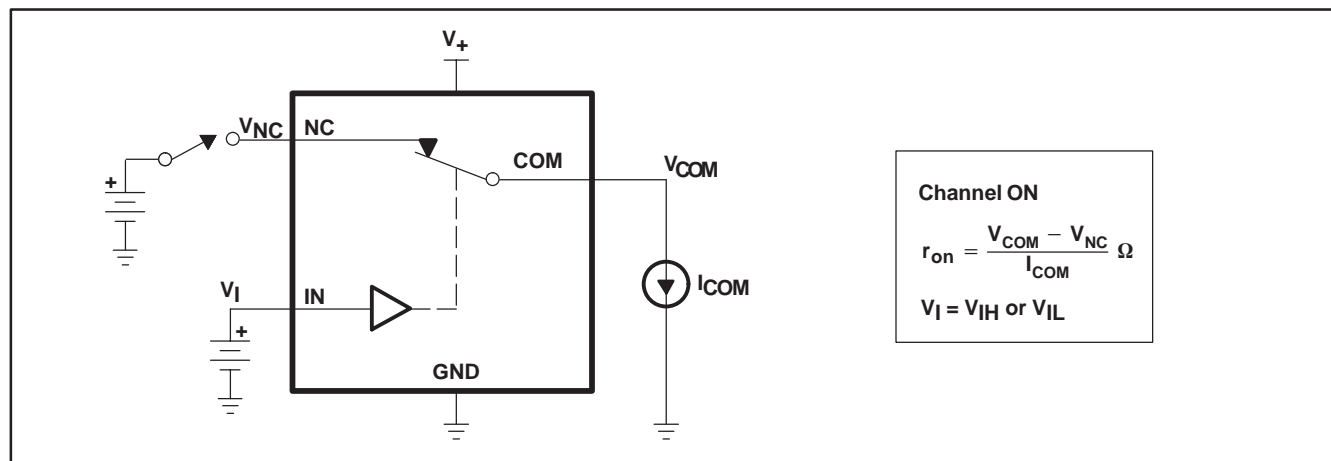


Figure 13. ON-State Resistance ( $r_{on}$ )

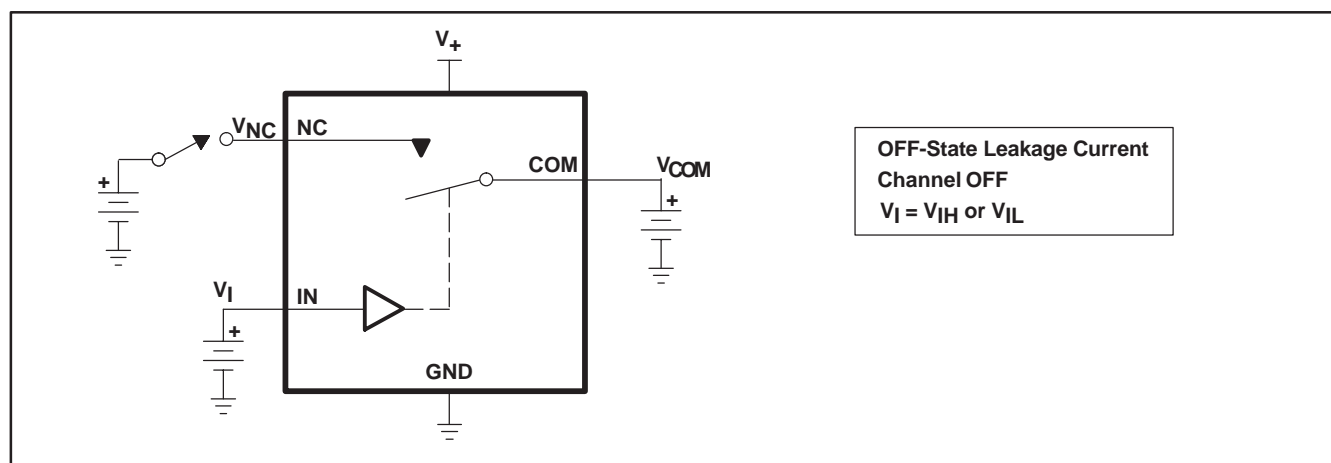


Figure 14. OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NC(OFF)}$ )

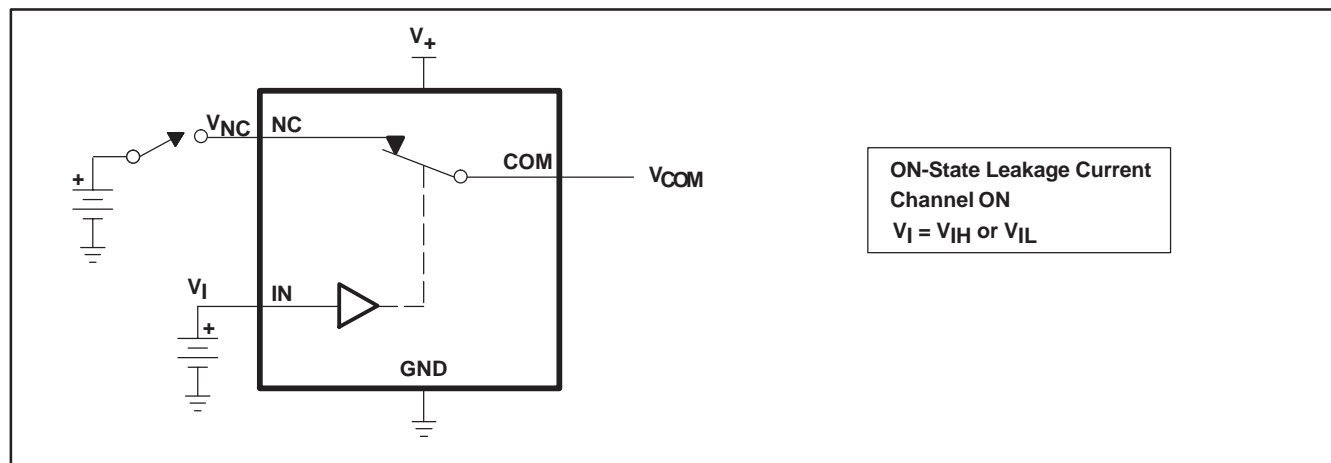


Figure 15. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ )

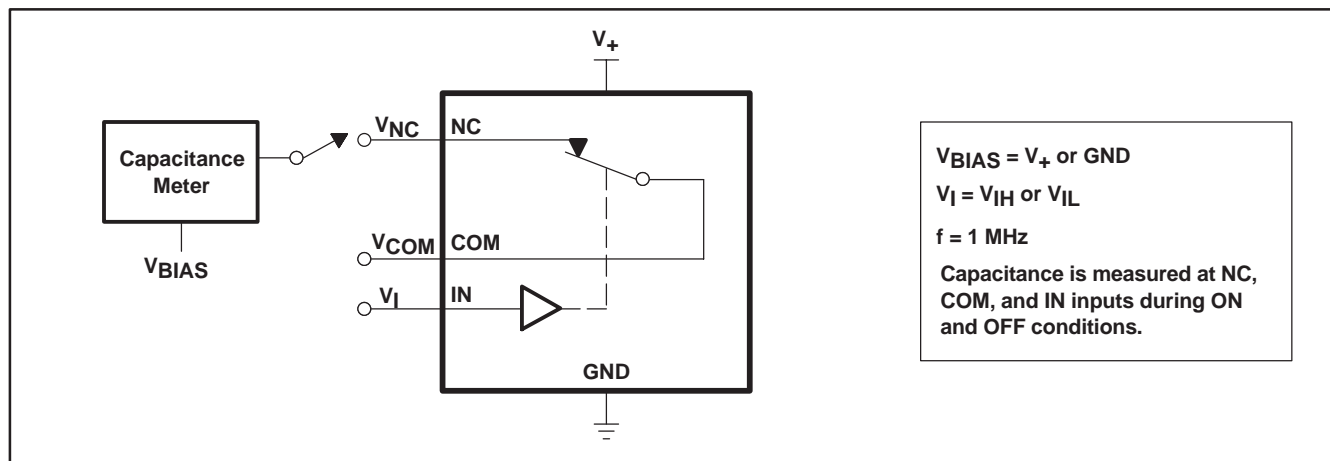
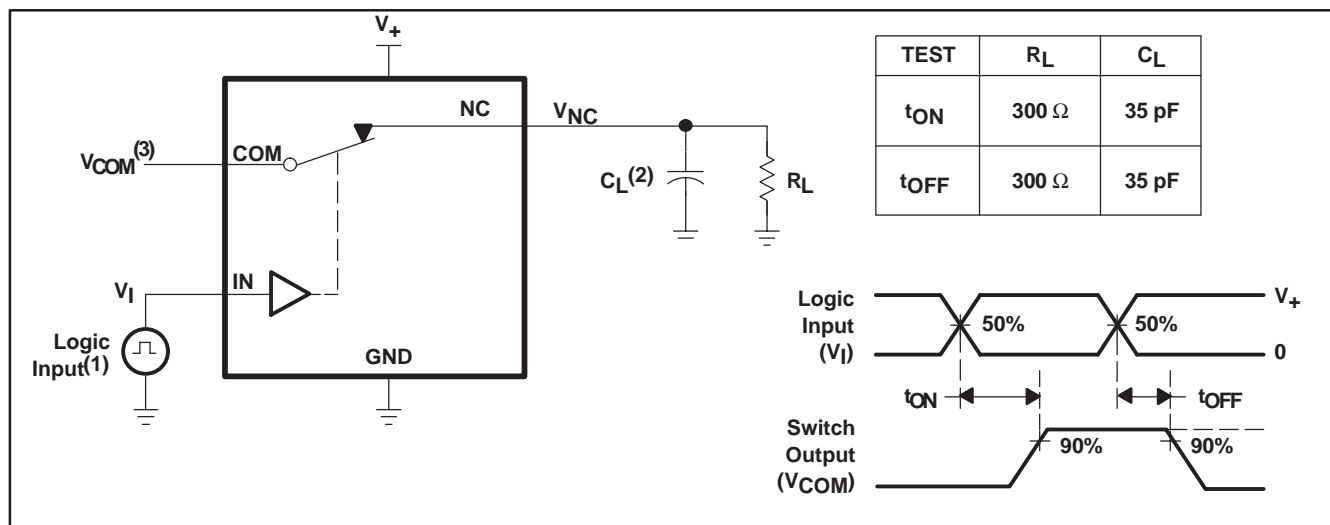


Figure 16. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NC(ON)}$ )



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

Figure 17. Turn-On (t<sub>ON</sub>) and Turn-Off Time (t<sub>OFF</sub>)

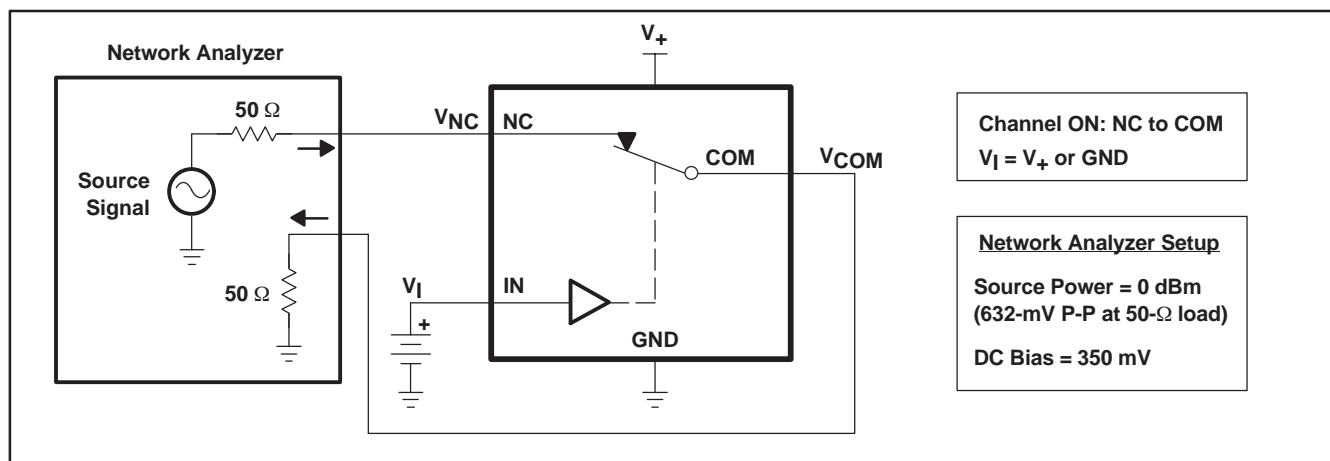
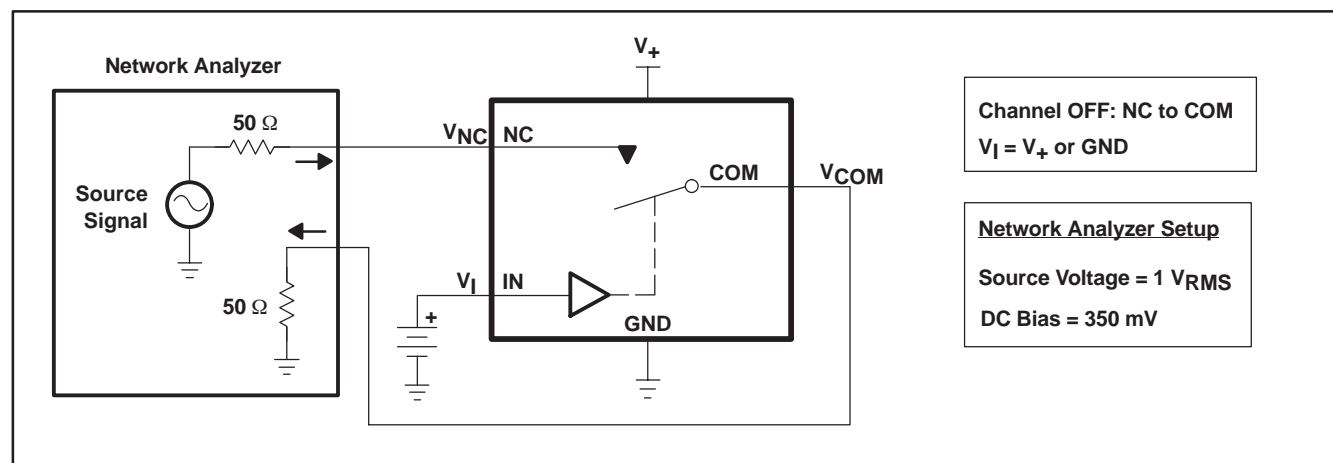


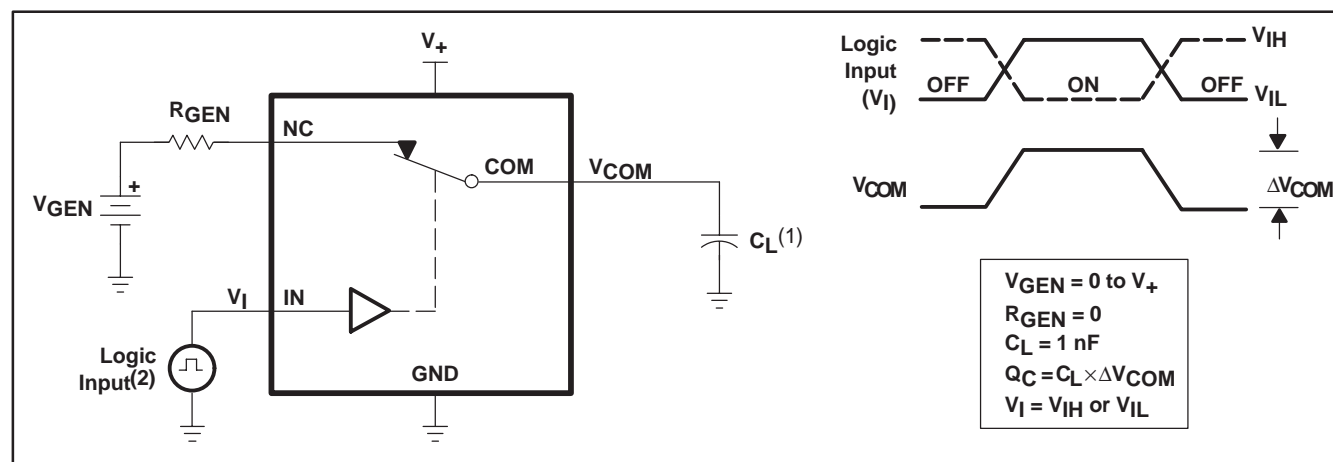
Figure 18. Bandwidth (BW)

**TS5A4595**  
**8-Ω SPST ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL ANALOG SWITCH**

SCDS180 – FEBRUARY 2005



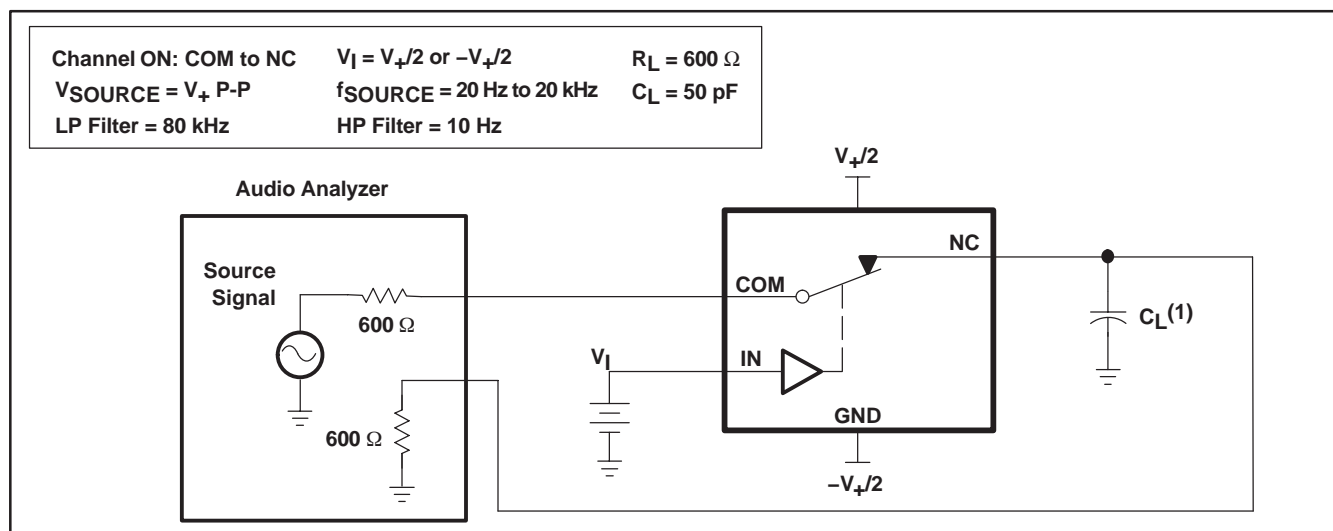
**Figure 19. OFF Isolation ( $O_{ISO}$ )**



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

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

**Figure 20. Charge Injection ( $Q_C$ )**



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

**Figure 21. Total Harmonic Distortion (THD)**

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