

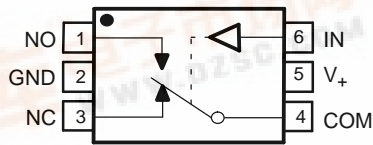
## FEATURES

- Isolation in the Powered-Off Mode,  $V_+ = 0$
- Specified Make-Before-Break Switching
- Low ON-State Resistance (1 Ω)
- Control Inputs Are 5.5-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)

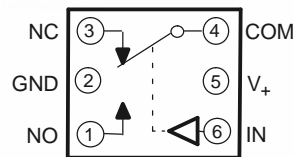
## APPLICATIONS

- Cell Phones
- PDAs
- Portable Instrumentation
- Audio and Video Signal Routing
- Low-Voltage Data Acquisition Systems
- Communication Circuits
- Modems
- Hard Drives
- Computer Peripherals
- Wireless Terminals and Peripherals

DBV OR DCK PACKAGE  
(TOP VIEW)



YEP OR YZP PACKAGE  
(BOTTOM VIEW)



## DESCRIPTION/ORDERING INFORMATION

The TS5A3160 is a single-pole double-throw (SPDT) analog switch that is designed to operate from 1.65 V to 5.5 V. The device offers a low ON-state resistance and an excellent channel-to-channel ON-state resistance matching. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications.

### ORDERING INFORMATION

T <sub>A</sub>	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(2)</sup>
–40°C to 85°C	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump – YEP	Tape and reel	TS5A3160YEPR	PREVIEW
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)		TS5A3160YZPR	
	SOT (SOT-23) – DBV	Tape and reel	TS5A3160DBVR	JA8_
	SOT (SC-70) – DCK <sup>(2)</sup>	Tape and reel	TS5A3160DCKR	JA_

(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.  
YEP/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).

**TS5A3160**  
**1-Ω SPDT ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER**

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**Summary of Characteristics<sup>(1)</sup>**

Configuration	2:1 Multiplexer/ Demultiplexer (1 × SPDT)
Number of channels	1
ON-state resistance ( $r_{on}$ )	1.1 Ω
ON-state resistance match ( $\Delta r_{on}$ )	0.1 Ω
ON-state resistance flatness ( $r_{on(flat)}$ )	0.15 Ω
Turn-on/turn-off time ( $t_{ON}/t_{OFF}$ )	20 ns/15 ns
Make-before-break time ( $t_{MKB}$ )	12 ns
Charge injection ( $Q_C$ )	36 pC
Bandwidth (BW)	100 MHz
OFF isolation ( $O_{ISO}$ )	−65 dB at 1 MHz
Crosstalk ( $X_{TALK}$ )	−66 dB at 1 MHz
Total harmonic distortion (THD)	0.01%
Leakage current ( $I_{COM(OFF)}/I_{NC(OFF)}$ )	±20 nA
Power-supply current ( $I_+$ )	0.1 μA
Package options	6-pin DBV, DCK, YEP, or YZP

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

**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<sup>(1)(2)</sup>

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

			MIN	MAX	UNIT
$V_+$	Supply voltage range <sup>(3)</sup>		-0.5	6.5	V
$V_{NC}$ $V_{NO}$ $V_{COM}$	Analog voltage range <sup>(3)(4)(5)</sup>		-0.5	$V_+ + 0.5$	V
$I_K$	Analog port diode current	$V_{NC}, V_{NO}, V_{COM} < 0$	-50		mA
$I_{NC}$ $I_{NO}$ $I_{COM}$	On-state switch current On-state peak switch current <sup>(6)</sup>	$V_{NC}, V_{NO}, V_{COM} = 0$ to $V_+$	-200 -400	200 400	mA
$V_I$	Digital input voltage range <sup>(3)(4)</sup>		-0.5	6.5	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 <sup>(7)</sup>	DBV package		165	°C/W
		DCK package		259	
		YEP/YZP package		123	
$T_{stg}$	Storage temperature range		-65	150	°C

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) 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) Pulse at 1-ms duration < 10% duty cycle
- (7) The package thermal impedance is calculated in accordance with JESD 51-7.

**TS5A3160**  
**1-Ω SPDT ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER**



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**Electrical Characteristics for 5-V Supply<sup>(1)</sup>**

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT	
<b>Analog Switch</b>									
Analog signal range	$V_{COM}, V_{NC}, V_{NO}$				0		$V_+$	V	
Peak ON resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -100 \text{ mA}$ ,	Switch ON, See Figure 13	25°C	4.5 V	0.8	1.1	$\Omega$	
				Full			1.5		
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 2.5 \text{ V}$ , $I_{COM} = -100 \text{ mA}$ ,	Switch ON, See Figure 13	25°C	4.5 V	0.7	0.9	$\Omega$	
				Full			1.1		
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 2.5 \text{ V}$ , $I_{COM} = -100 \text{ mA}$ ,	Switch ON, See Figure 13	25°C	4.5 V	0.05	0.1	$\Omega$	
				Full			0.1		
ON-state resistance flatness	$r_{on(Flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -100 \text{ mA}$ ,	Switch ON, See Figure 13	25°C	4.5 V	0.15		$\Omega$	
				25°C		0.1	0.25		
				Full		0.25			
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 1 \text{ V}$ , $V_{COM} = 4.5 \text{ V}$ , or $V_{NO} = 4.5 \text{ V}, V_{COM} = 1 \text{ V}$ ,	Switch OFF, See Figure 14	25°C	5.5 V	-20	2	20	nA
				Full			-100	100	
	$I_{NC(PWROFF)}, I_{NO(PWROFF)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } 5.5 \text{ V}$ , $V_{COM} = 5.5 \text{ V to } 0$ ,	Switch OFF, See Figure 14	25°C	0 V	-1	0.2	1	$\mu\text{A}$
				Full			-20	20	
NC, NO ON leakage current	$I_{NC(ON)}, I_{NO(ON)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } V_+$ , $V_{COM} = \text{Open}$ ,	Switch ON, See Figure 15	25°C	5.5 V	-20	2	20	nA
				Full			-100	100	
COM OFF leakage current	$I_{COM(PWROFF)}$	$V_{COM} = 0 \text{ to } 5.5 \text{ V}$ , $V_{NC} \text{ or } V_{NO} = 5.5 \text{ V to } 0$ ,	Switch OFF, See Figure 14	25°C	0 V	-1	0.1	1	$\mu\text{A}$
				Full			-20	20	
COM ON leakage current	$I_{COM(ON)}$	$V_{COM} = 1 \text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ , or $V_{COM} = 4.5 \text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ ,	Switch ON, See Figure 15	25°C	5.5 V	-20	2	20	nA
				Full			-100	100	
<b>Digital Control Input (IN)<sup>(2)</sup></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	$I_{IH}, I_{IL}$	$V_I = 5.5 \text{ V or } 0$	25°C	5.5 V	-2		0.2	$\mu\text{A}$	
			Full			100	100		

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

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

### Electrical Characteristics for 5-V Supply (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	
<b>Dynamic</b>									
Turn-on time	$t_{ON}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ ,	$C_L = 35\text{ pF}$ , See Figure 17	25°C	5 V	2	3.5	6	ns
				Full	4.5 V to 5.5 V	1		8	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ ,	$C_L = 35\text{ pF}$ , See Figure 17	25°C	5 V	3	8.5	13	ns
				Full	4.5 V to 5.5 V	2		15	
Make-before-break time	$t_{MBB}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ ,	$C_L = 35\text{ pF}$ , See Figure 18	25°C	5 V	2	7	12	ns
				Full	5 V to 5.5 V	2		15	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ ,	$C_L = 1\text{ nF}$ , See Figure 22	25°C	5 V		36.5	pC	
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF,	See Figure 16	25°C	5 V		18	pF	
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON,	See Figure 16	25°C	5 V		55	pF	
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON,	See Figure 16	25°C	5 V		55	pF	
Digital input capacitance	$C_I$	$V_I = V_+$ or GND,	See Figure 16	25°C	5 V		2	pF	
Bandwidth	BW	$R_L = 50\ \Omega$ , Switch ON,	See Figure 19	25°C	5 V		100	MHz	
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ ,	See Figure 20	25°C	5 V		-64	dB	
Crosstalk	$X_{TALK}$	$R_L = 50\ \Omega$ , $f = 1\text{ MHz}$ ,	See Figure 20	25°C	5 V		-64	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		0.004	%	
<b>Supply</b>									
Positive supply current	$I_+$	$V_I = V_+$ or GND	25°C	5.5 V		10	50	nA	
			Full				500		

**TS5A3160**  
**1-Ω SPDT ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER**



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**Electrical Characteristics for 3.3-V Supply<sup>(1)</sup>**

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT
<b>Analog Switch</b>								
Analog signal range	$V_{COM}, V_{NC}, V_{NO}$				0		$V_+$	V
Peak ON resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -100\text{ mA}$ , Switch ON, See Figure 13	25°C Full	3 V		1.3	1.6 2	Ω
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 2\text{ V}$ , $I_{COM} = -100\text{ mA}$ , Switch ON, See Figure 13	25°C Full	3 V		1.2	1.5 1.7	Ω
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 2\text{ V}, 0.8\text{ V}$ , $I_{COM} = -100\text{ mA}$ , Switch ON, See Figure 13	25°C Full	3 V		0.1	0.15 0.15	Ω
ON-state resistance flatness	$r_{on(flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -100\text{ mA}$ , $V_{NO} \text{ or } V_{NC} = 2\text{ V}, 0.8\text{ V}$ , $I_{COM} = -100\text{ mA}$ , Switch ON, See Figure 13	25°C Full	3 V		0.2 0.15	0.3 0.3	Ω
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 1\text{ V}$ , $V_{COM} = 3\text{ V}$ , or $V_{NC} \text{ or } V_{NO} = 3\text{ V}$ , $V_{COM} = 1\text{ V}$ , Switch OFF, See Figure 14	25°C	3.6 V	-20	2	20	nA
			Full		-50		50	
NC, NO ON leakage current	$I_{NC(ON)}, I_{NO(ON)}$	$V_{NC} \text{ or } V_{NO} = 1\text{ V}$ , $V_{COM} = \text{Open}$ , or $V_{NC} \text{ or } V_{NO} = 3\text{ V}$ , $V_{COM} = \text{Open}$ , Switch ON, See Figure 15	25°C	3.6 V	-1	0.2	1	μA
			Full		-15		15	
COM OFF leakage current	$I_{COM(PWROFF)}$	$V_{COM} = 0 \text{ to } 3.6\text{ V}$ , $V_{NC} \text{ or } V_{NO} = 3.6\text{ V to } 0$ , Switch OFF, See Figure 14	25°C	0 V	-10	2	10	nA
			Full		-20		20	
COM ON leakage current	$I_{COM(ON)}$	$V_{COM} = 1\text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ , or $V_{COM} = 3\text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ , Switch ON, See Figure 15	25°C	3.6 V	-1	0.2	1	μA
			Full		-15		15	
Digital Control Input (IN) <sup>(2)</sup>			25°C	3.6 V	-10	2	10	nA
			Full		-20		20	
Input logic high	$V_{IH}$		Full		2		5.5	V
Input logic low	$V_{IL}$		Full		0		0.8	V
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5\text{ V or } 0$	25°C	3.6 V	-2		2	nA
			Full		-100		100	

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

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

### Electrical Characteristics for 3.3-V Supply (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
<b>Dynamic</b>								
Turn-on time	$t_{ON}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ , See Figure 17	25°C	3.3 V	2	4.5	13	ns
			Full	3 V to 3.6 V	1		15	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ , See Figure 17	25°C	3.3 V	3	9	15	ns
			Full	3 V to 3.6 V	2		20	
Make-before-break time	$t_{MKB}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ , See Figure 18	25°C	3.3 V	1	7	12	ns
			Full	3 V to 3.6 V	1		15	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ , $C_L = 1\text{ nF}$ , See Figure 22	25°C	3.3 V		20		pC
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF, See Figure 16	25°C	3.3 V		18		pF
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON, See Figure 16	25°C	3.3 V		55		pF
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON, See Figure 16	25°C	3.3 V		55		pF
Digital input capacitance	$C_I$	$V_I = V_+$ or GND, See Figure 16	25°C	3.3 V		2		pF
Bandwidth	BW	$R_L = 50\ \Omega$ , Switch ON, See Figure 19	25°C	3.3 V		100		MHz
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ , See Figure 20	25°C	3.3 V		-64		dB
Crosstalk	$X_{TALK}$	$R_L = 50\ \Omega$ , $f = 1\text{ MHz}$ , See Figure 20	25°C	3.3 V		-64		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		0.010		%
<b>Supply</b>								
Positive supply current	$I_+$	$V_I = V_+$ or GND	25°C	3.6 V		10	30	nA
			Full				100	

**TS5A3160**  
**1-Ω SPDT ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER**



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**Electrical Characteristics for 2.5-V Supply<sup>(1)</sup>**

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT	
<b>Analog Switch</b>									
Analog signal range	$V_{COM}, V_{NC}, V_{NO}$				0		$V_+$	V	
Peak ON resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -8 \text{ mA}$ , Switch ON, See Figure 13	25°C Full	2.3 V		1.8	2.5 2.7	Ω	
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 1.8 \text{ V}$ , $I_{COM} = -8 \text{ mA}$ , Switch ON, See Figure 13	25°C Full	2.3 V		1.5	2 2.4	Ω	
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 1.8 \text{ V}$ , $I_{COM} = -8 \text{ mA}$ , Switch ON, See Figure 13	25°C Full	2.3 V		0.15	0.2 0.2	Ω	
ON-state resistance flatness	$r_{on(Flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -8 \text{ mA}$ , $V_{NO} \text{ or } V_{NC} = 0.8 \text{ V}, 1.8 \text{ V}$ , $I_{COM} = -8 \text{ mA}$ , Switch ON, See Figure 13	25°C Full	2.3 V		2.6	0.6 1 1	Ω	
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 0.5 \text{ V}$ , $V_{COM} = 2.2 \text{ V}$ , or $V_{NC} \text{ or } V_{NO} = 2.2 \text{ V}$ , $V_{COM} = 0.5 \text{ V}$ , Switch OFF, See Figure 14	25°C	2.3 V		-20	2	20	nA
			Full			-50		50	
NC, NO ON leakage current	$I_{NC(ON)}, I_{NO(ON)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } 2.7 \text{ V}$ , $V_{COM} = 2.7 \text{ V to } 0$ , Switch OFF, See Figure 14	25°C	0 V		-1	0.1	1	μA
			Full			-10		10	
COM OFF leakage current	$I_{COM(PWROFF)}$	$V_{COM} = 0 \text{ to } 2.7 \text{ V}$ , $V_{NC} \text{ or } V_{NO} = 2.7 \text{ V to } 0$ , Switch OFF, See Figure 14	25°C	0 V		-10	2	10	nA
			Full			-20		20	
COM ON leakage current	$I_{COM(ON)}$	$V_{COM} = 0.5 \text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ , or $V_{COM} = 2.2 \text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ , Switch ON, See Figure 15	25°C	2.7 V		-10	2	10	nA
			Full			-20		20	
<b>Digital Control Input (IN)<sup>(2)</sup></b>									
Input logic high	$V_{IH}$		Full			1.8		5.5	V
Input logic low	$V_{IL}$		Full			0		0.6	V
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5 \text{ V or } 0$	25°C	2.7 V		-2		2	nA
			Full			-20		20	

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

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



### Electrical Characteristics for 2.5-V Supply (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
<b>Dynamic</b>								
Turn-on time	$t_{ON}$	$V_{COM} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , See Figure 17	25°C	2.5 V	2	6.5	15	ns
			Full	2.3 V to 2.7 V	1		17	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , See Figure 17	25°C	2.5 V	3	11	18	ns
			Full	2.3 V to 2.7 V	2		20	
Make-before-break time	$t_{MBO}$	$V_{COM} = V_+$ , $R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ , See Figure 18	25°C	2.5 V	1	8	12	ns
			Full	2.3 V to 2.7 V	1		15	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ , $C_L = 1 \text{ nF}$ , See Figure 22	25°C	2.5 V		12		pC
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF, See Figure 16	25°C	2.5 V		18		pF
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON, See Figure 16	25°C	2.5 V		55		pF
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON, See Figure 16	25°C	2.5 V		55		pF
Digital input capacitance	$C_I$	$V_I = V_+$ or GND, See Figure 16	25°C	2.5 V		2		pF
Bandwidth	BW	$R_L = 50 \Omega$ , Switch ON, See Figure 19	25°C	2.5 V		100		MHz
OFF isolation	$O_{ISO}$	$R_L = 50 \Omega$ , $f = 10 \text{ MHz}$ , See Figure 20	25°C	2.5 V		-64		dB
Crosstalk	$X_{TALK}$	$R_L = 50 \Omega$ , $f = 1 \text{ MHz}$ , See Figure 20	25°C	2.5 V		-64		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		0.02		%
<b>Supply</b>								
Positive supply current	$I_+$	$V_I = V_+$ or GND	25°C	2.7 V		10	30	nA
			Full				50	

**TS5A3160**  
**1-Ω SPDT ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER**



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**Electrical Characteristics for 1.8-V Supply<sup>(1)</sup>**

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT	
<b>Analog Switch</b>									
Analog signal range	$V_{COM}, V_{NC}, V_{NO}$				0		$V_+$	V	
Peak ON resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -2\text{ mA}$ ,	Switch ON, See Figure 13	25°C	1.65 V	5		Ω	
				Full		15			
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 1.5\text{ V}$ , $I_{COM} = -2\text{ mA}$ ,	Switch ON, See Figure 13	25°C	1.65 V	2	2.5	Ω	
				Full		3.5			
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 1.5\text{ V}$ , $I_{COM} = -2\text{ mA}$ ,	Switch ON, See Figure 13	25°C	1.65 V	0.15 0.4		Ω	
				Full		0.4			
ON-state resistance flatness	$r_{on(Flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -2\text{ mA}$ ,	Switch ON, See Figure 13	25°C	1.65 V	5		Ω	
				25°C		4.5			
				Full					
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 0.3\text{ V}$ , $V_{COM} = 1.65\text{ V}$ , or $V_{NC} \text{ or } V_{NO} = 1.65\text{ V}$ , $V_{COM} = 0.3\text{ V}$ ,	Switch OFF, See Figure 14	25°C	1.95 V	-5	2	5	nA
				Full		-20		20	
	$I_{NC(PWROFF)}, I_{NO(PWROFF)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } 1.95\text{ V}$ , $V_{COM} = 1.95\text{ V to } 0$ ,	Switch OFF, See Figure 14	25°C	0 V	-1	0.1	1	μA
				Full		-5		5	
NC, NO ON leakage current	$I_{NC(ON)}, I_{NO(ON)}$	$V_{NC} \text{ or } V_{NO} = 0.3\text{ V}$ , $V_{COM} = \text{Open}$ , or $V_{NC} \text{ or } V_{NO} = 1.65\text{ V}$ , $V_{COM} = \text{Open}$ ,	Switch ON, See Figure 15	25°C	1.95 V	-5	2	5	nA
				Full		-20		20	
COM OFF leakage current	$I_{COM(PWROFF)}$	$V_{COM} = 0 \text{ to } 1.95\text{ V}$ , $V_{NC} \text{ or } V_{NO} = 1.95\text{ V to } 0$ ,	Switch OFF, See Figure 14	25°C	0 V	-1	0.1	1	μA
				Full		-5		5	
COM ON leakage current	$I_{COM(ON)}$	$V_{COM} = 0.3\text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ , or $V_{COM} = 1.65\text{ V}$ , $V_{NC} \text{ or } V_{NO} = \text{Open}$ ,	Switch ON, See Figure 15	25°C	1.95 V	-5	2	5	nA
				Full		-20		20	
<b>Digital Control Input (IN)<sup>(2)</sup></b>									
Input logic high	$V_{IH}$			Full		1.5	5.5	V	
Input logic low	$V_{IL}$			Full		0	0.6	V	
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5\text{ V or } 0$		25°C	1.95 V	-2	2	nA	
				Full		-20	20		

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

(2) All unused digital inputs of the device must be held at  $V_+$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

**Electrical Characteristics for 1.8-V Supply (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	
<b>Dynamic</b>									
Turn-on time	$t_{ON}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ ,	$C_L = 35\text{ pF}$ , See Figure 17	25°C	1.8 V	6	13	24	ns
				Full	2.3 V to 2.7 V	5		27	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ ,	$C_L = 35\text{ pF}$ , See Figure 17	25°C	1.8 V	6	15	27	ns
				Full	2.3 V to 2.7 V	5		30	
Make-before-break time	$t_{MKB}$	$V_{COM} = V_+$ , $R_L = 50\ \Omega$ ,	$C_L = 35\text{ pF}$ , See Figure 18	25°C	1.8 V	2	7	12	ns
				Full	2.3 V to 2.7 V	2		15	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ ,	$C_L = 1\text{ nF}$ , See Figure 22	25°C	1.8 V		5.5	pC	
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF,	See Figure 16	25°C	1.8 V		18	pF	
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON,	See Figure 16	25°C	1.8 V		55	pF	
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON,	See Figure 16	25°C	1.8 V		55	pF	
Digital input capacitance	$C_I$	$V_I = V_+$ or GND,	See Figure 16	25°C	1.8 V		2	pF	
Bandwidth	BW	$R_L = 50\ \Omega$ , Switch ON,	See Figure 19	25°C	1.8 V		105	MHz	
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ ,	See Figure 20	25°C	1.8 V		-64	dB	
Crosstalk	$X_{TALK}$	$R_L = 50\ \Omega$ , $f = 1\text{ MHz}$ ,	See Figure 20	25°C	1.8 V		-64	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	1.8 V		0.06	%	
<b>Supply</b>									
Positive supply current	$I_+$	$V_I = V_+$ or GND	25°C	1.95 V		5	15	nA	
			Full				50		

**TYPICAL PERFORMANCE**

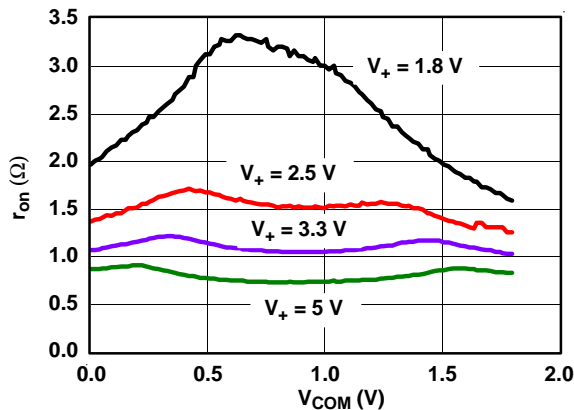


Figure 1.  $r_{on}$  vs  $V_{COM}$

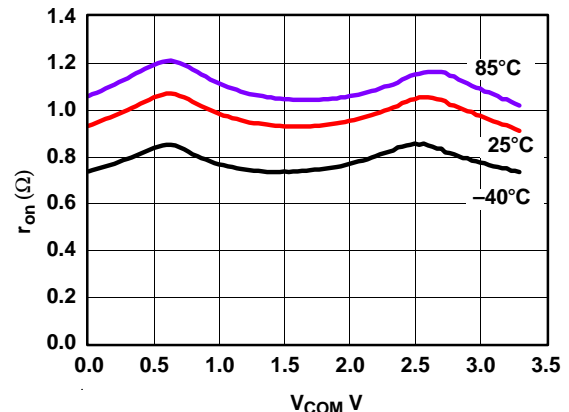


Figure 2.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 3.3\text{ V}$ )

TYPICAL PERFORMANCE (continued)

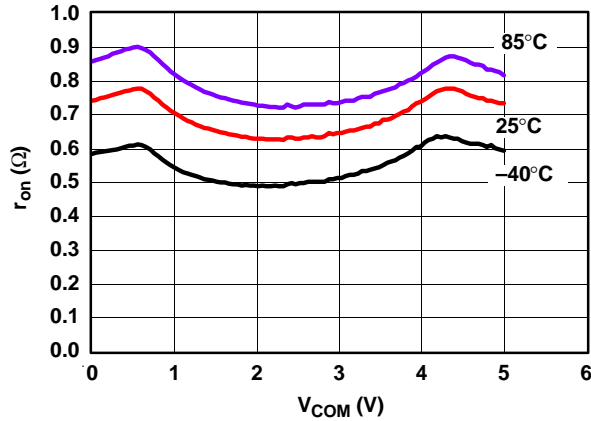


Figure 3.  $r_{on}$  vs  $V_{COM}$  ( $V_+ = 5$  V)

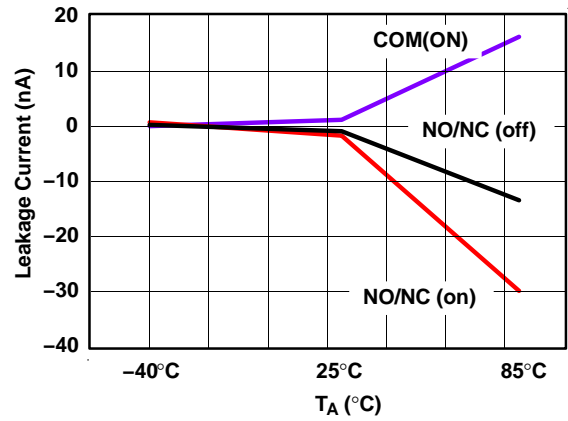


Figure 4. Leakage Current vs Temperature ( $V_+ = 5.5$  V)

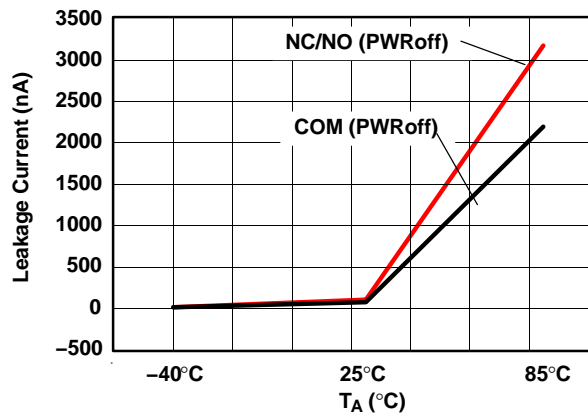


Figure 5. Leakage Current vs Temperature ( $V_+ = 5$  V)

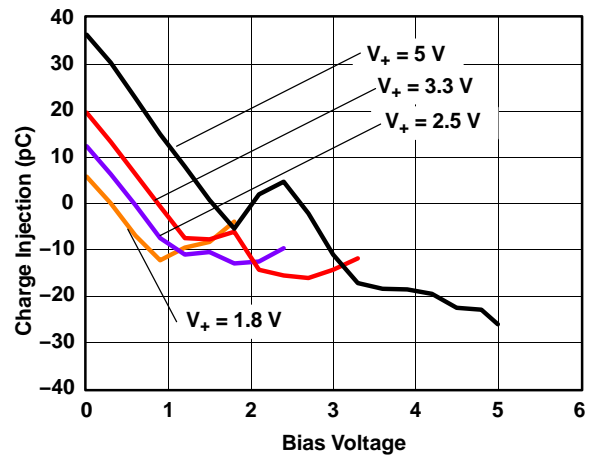


Figure 6. Charge Injection ( $Q_C$ ) vs  $V_{COM}$

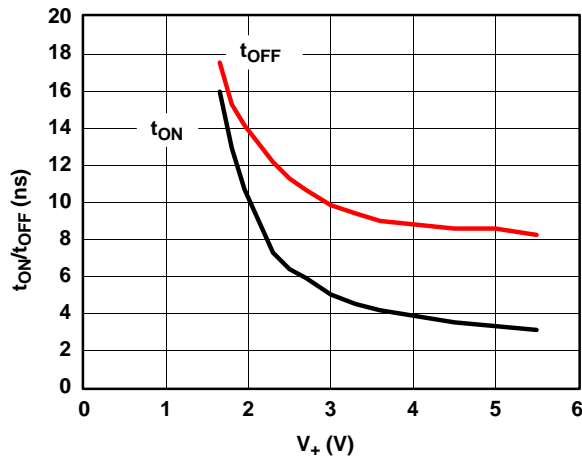


Figure 7.  $t_{ON}$  and  $t_{OFF}$  vs Supply Voltage

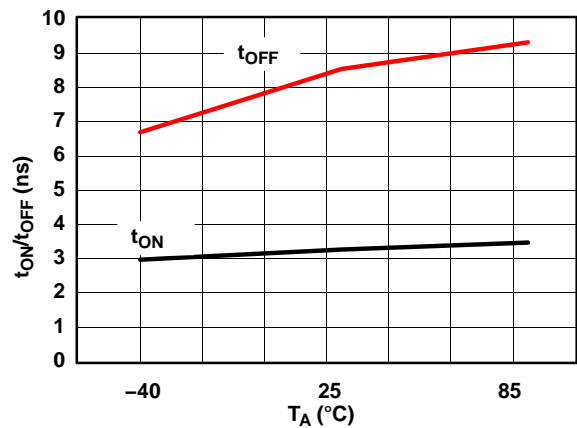


Figure 8.  $t_{ON}$  and  $t_{OFF}$  vs Temperature ( $V_+ = 5$  V)

**TYPICAL PERFORMANCE (continued)**

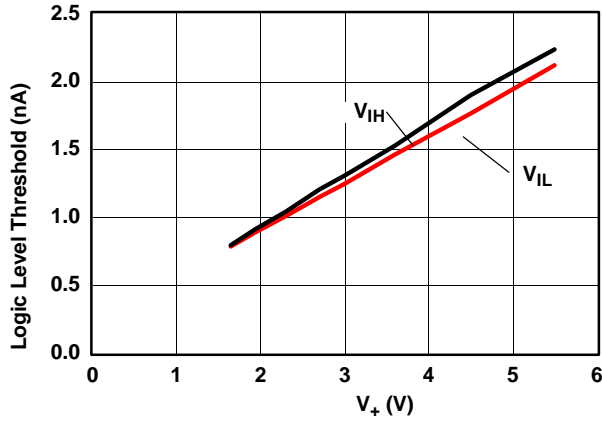


Figure 9. Logic-Level Threshold vs V<sub>+</sub>

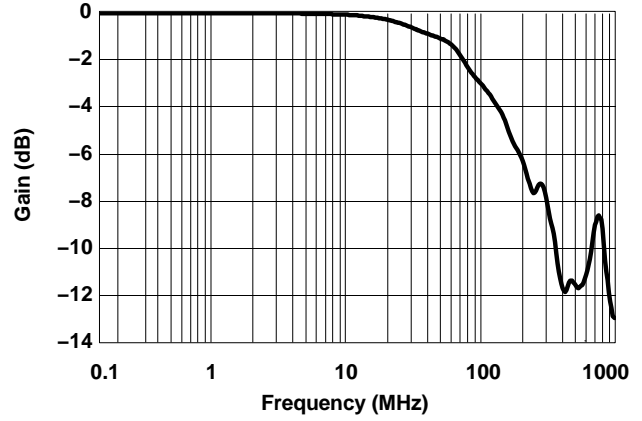


Figure 10. Bandwidth (Gain vs Frequency) (V<sub>+</sub> = 5 V)

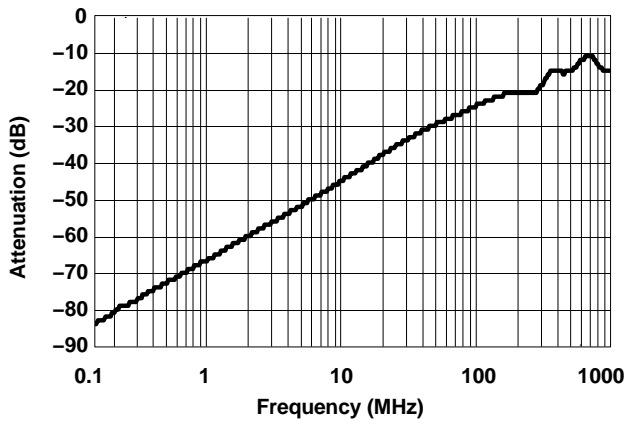


Figure 11. OFF Isolation vs Crosstalk (V<sub>+</sub> = 5 V)

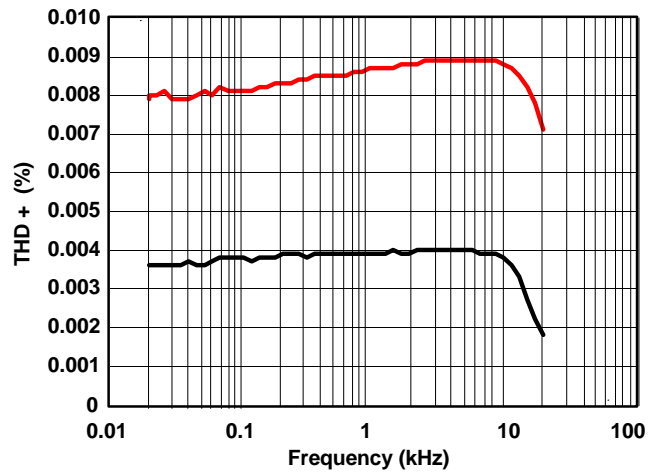


Figure 12. Total Harmonic Distortion vs Frequency

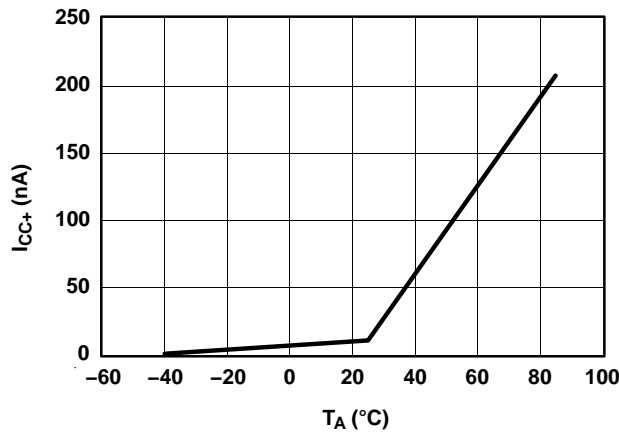


Figure 13. Power-Supply Current vs Temperature (V<sub>+</sub> = 5 V)

**TS5A3160**  
**1-Ω SPDT ANALOG SWITCH**  
**5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER**



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**PIN DESCRIPTION**

PIN NUMBER	NAME	DESCRIPTION
1	NO	Normally open
2	GND	Digital ground
3	NC	Normally closed
4	COM	Common
5	V <sub>+</sub>	Power supply
6	IN	Digital control to connect COM to NO

**PARAMETER DESCRIPTION**

SYMBOL	DESCRIPTION
V <sub>COM</sub>	Voltage at COM
V <sub>NC</sub>	Voltage at NC
V <sub>NO</sub>	Voltage at NO
r <sub>on</sub>	Resistance between COM and NO ports when the channel is ON
r <sub>peak</sub>	Peak on-state resistance over a specified voltage range
Δr <sub>on</sub>	Difference of r <sub>on</sub> between channels in a specific device
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 under worst-case input and output conditions
I <sub>NC(PWROFF)</sub>	Leakage current measured at the NC port during the power-off condition, V <sub>+</sub> = 0
I <sub>NO(OFF)</sub>	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state
I <sub>NO(PWROFF)</sub>	Leakage current measured at the NO port during the power-off condition, V <sub>+</sub> = 0
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>NO(ON)</sub>	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the ON state and the output (COM) open
I <sub>NO(OFF)</sub>	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state and the output (COM) open
I <sub>NO(ON)</sub>	Leakage current measured at the NO port, with the corresponding channel (NO 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 NO) in the OFF state
I <sub>COM(PWROFF)</sub>	Leakage current measured at the COM port during the power-off condition, V <sub>+</sub> = 0
I <sub>COM(ON)</sub>	Leakage current measured at the COM port, with the corresponding channel (COM to NO) in the ON state and the output (NO) 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 NO) 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 NO) signal when the switch is turning OFF.
t <sub>MBB</sub>	Make-before-break 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 <sub>C</sub>	Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (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 <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>NO(OFF)</sub>	Capacitance at the NO port when the corresponding channel (NO to COM) is OFF

**PARAMETER DESCRIPTION (continued)**

SYMBOL	DESCRIPTION
$C_{NC(ON)}$	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 NO) is ON
$C_I$	Capacitance of 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 (NO to COM) in the OFF state.
$X_{TALK}$	Crosstalk is a measurement of unwanted signal coupling from an ON channel to an adjacent ON channel (NC1 to NC2). This is measured in a specific frequency and in dB.
BW	Bandwidth of the switch. This is the frequency in which the gain of an ON channel is -3 dB below the DC gain.
THD	Total harmonic distortion is defined as the ratio of the root mean square (RMS) value of the second, third, and higher harmonics to the magnitude of fundamental harmonic.
$I_+$	Static power-supply current with the control (IN) pin at $V_+$ or GND

PARAMETER MEASUREMENT INFORMATION

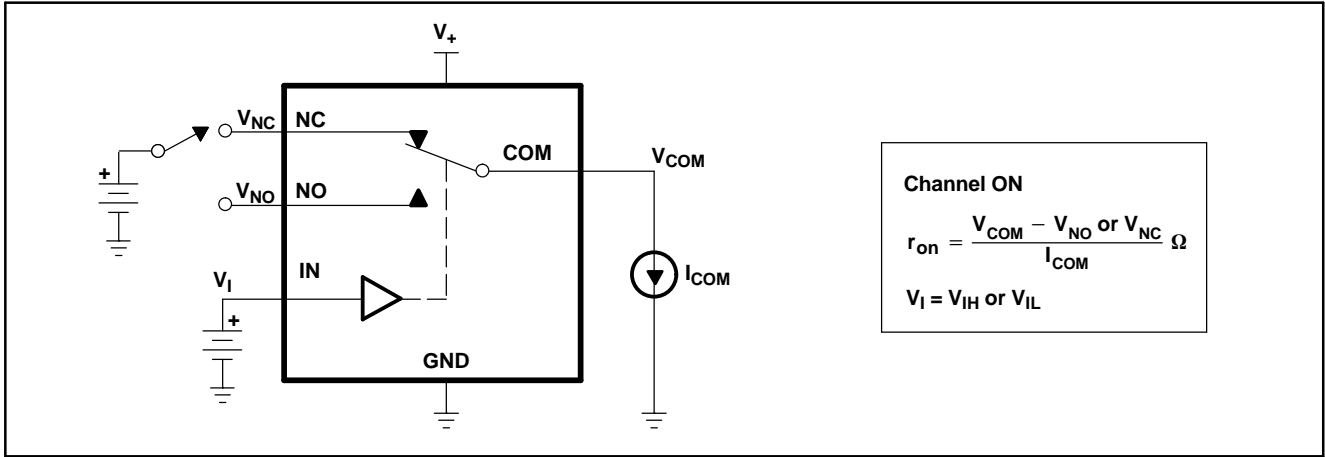


Figure 14. ON-State Resistance ( $r_{on}$ )

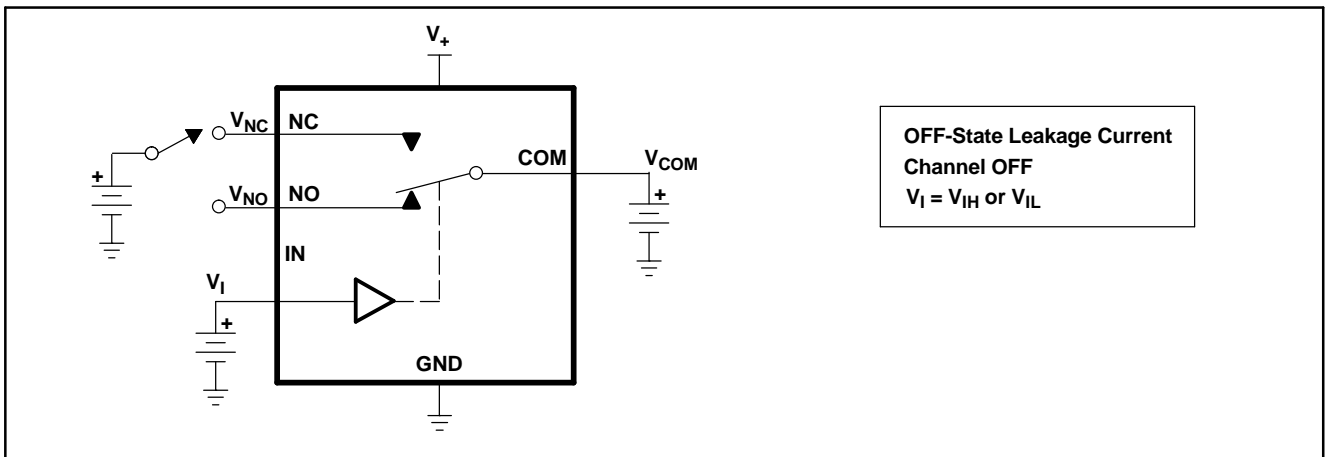


Figure 15. OFF-State Leakage Current ( $I_{NC(OFF)}$ ,  $I_{NO(OFF)}$ ,  $I_{COM(OFF)}$ ,  $I_{NC(PWROFF)}$ ,  $I_{NO(PWROFF)}$ ,  $I_{COM(PWROFF)}$ )

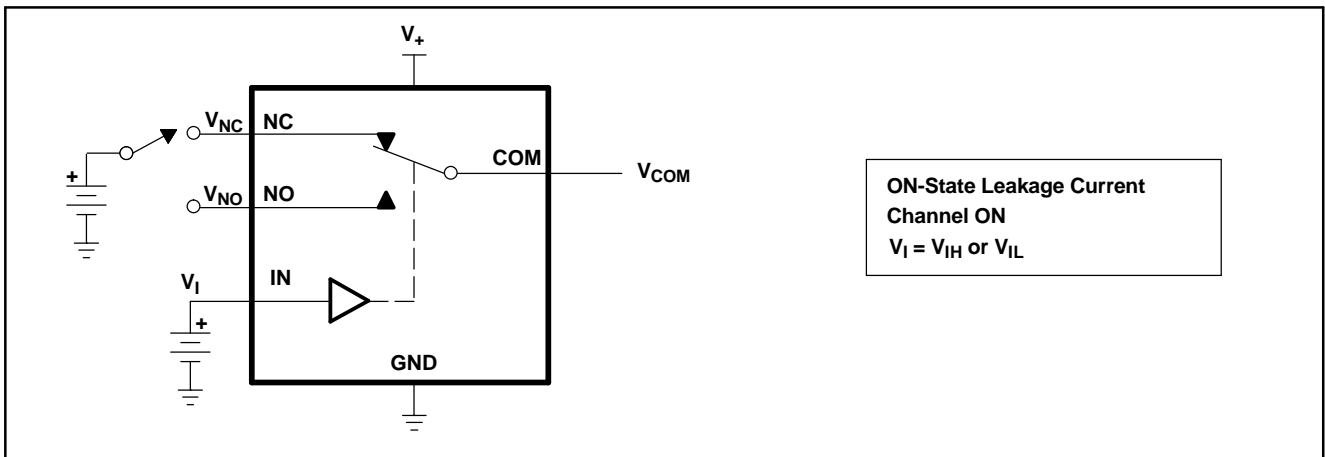
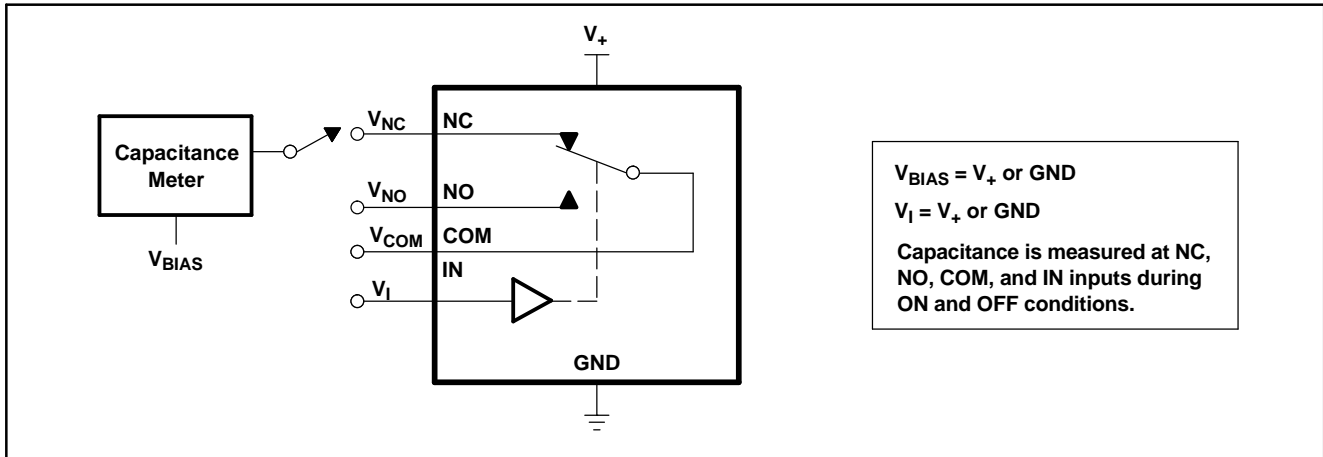


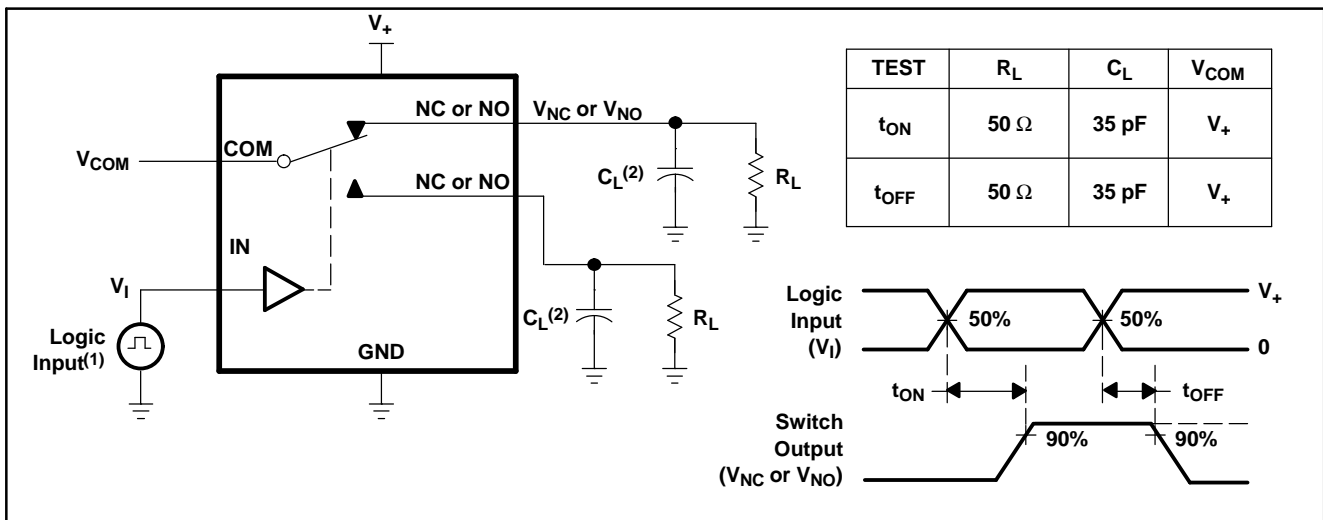
Figure 16. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ ,  $I_{NO(ON)}$ )



**PARAMETER MEASUREMENT INFORMATION (continued)**



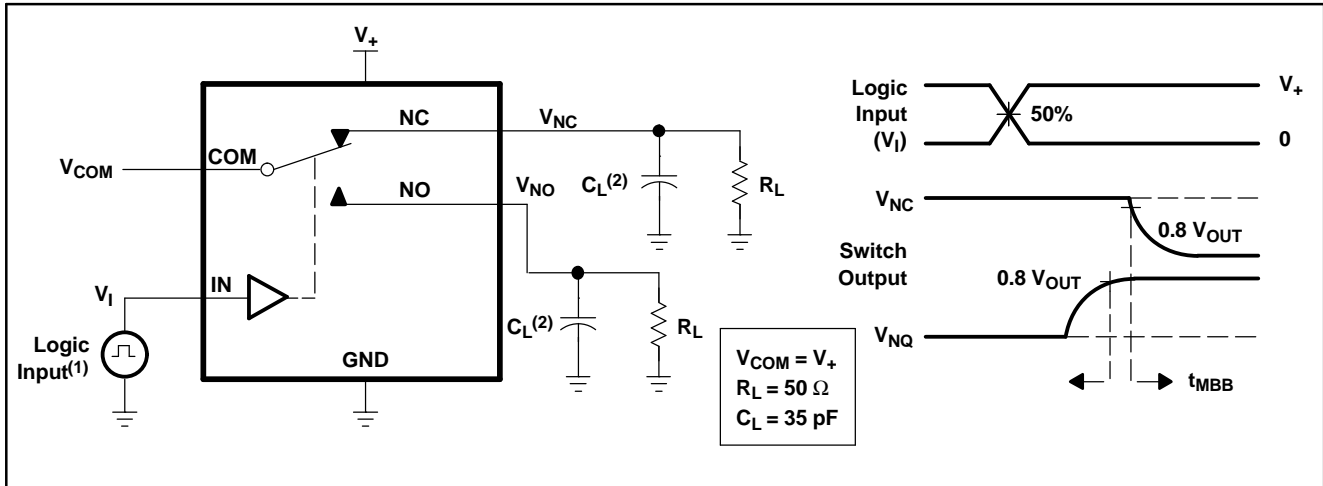
**Figure 17. Capacitance ( $C_I$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NO(OFF)}$ ,  $C_{NC(ON)}$ ,  $C_{NO(ON)}$ )**



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

**Figure 18. Turn-On ( $t_{ON}$ ) and Turn-Off Time ( $t_{OFF}$ )**

PARAMETER MEASUREMENT INFORMATION (continued)



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

Figure 19. Make-Before-Break Time ( $t_{\text{M BB}}$ )

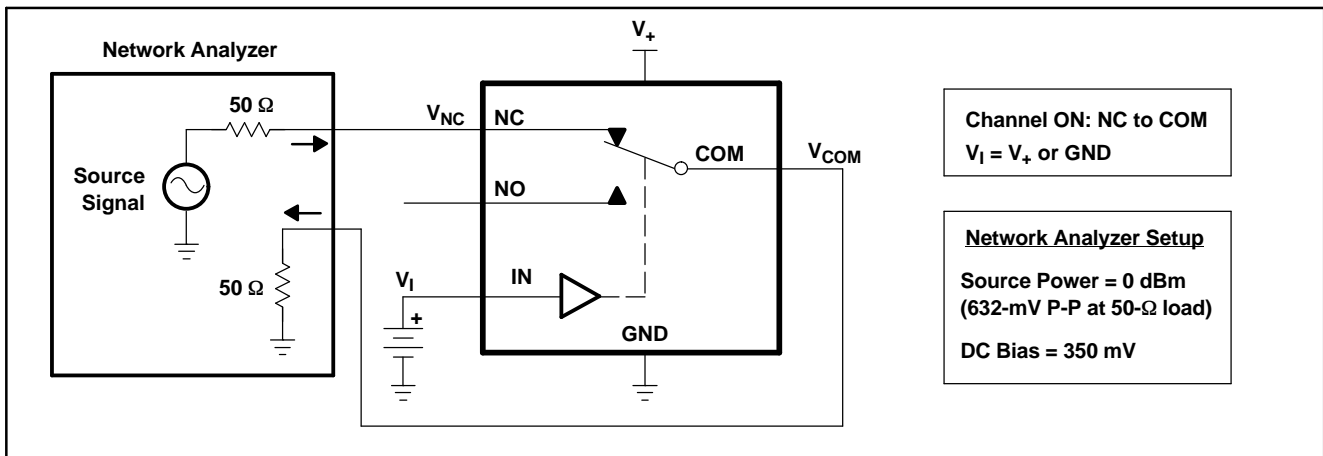
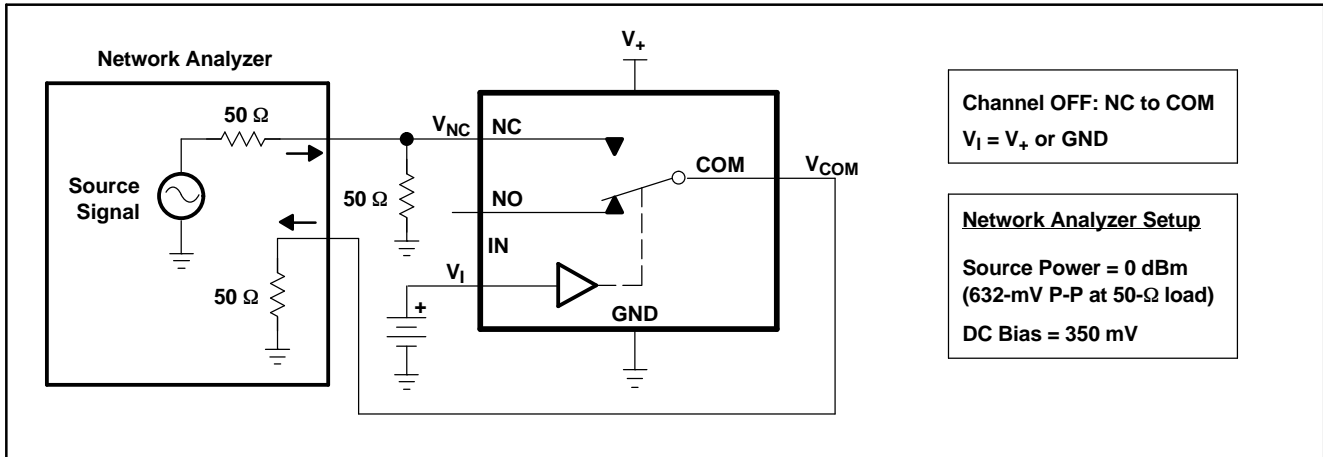
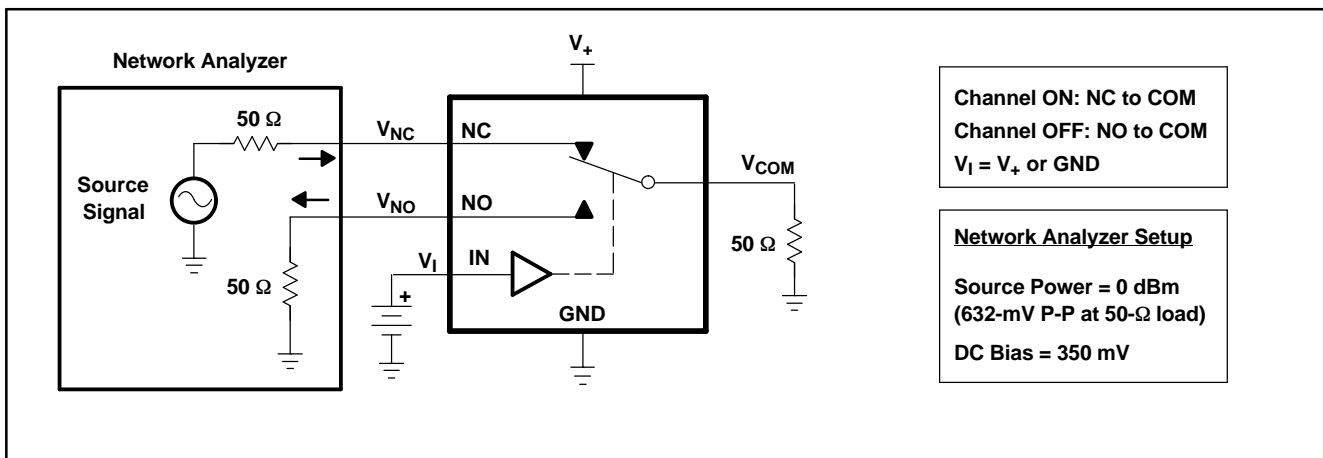


Figure 20. Bandwidth (BW)

**PARAMETER MEASUREMENT INFORMATION (continued)**

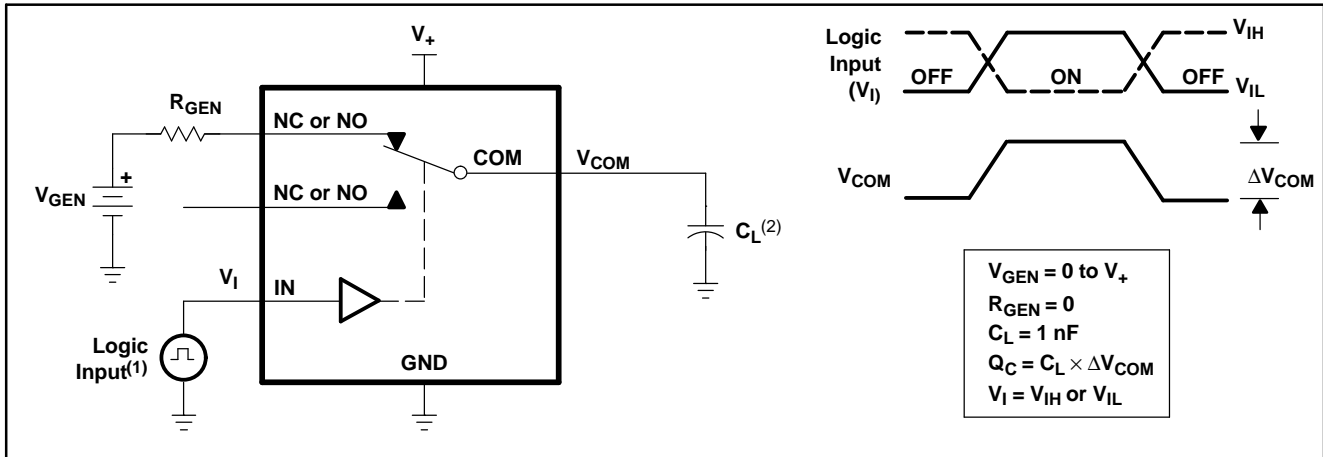


**Figure 21. OFF Isolation (OISO)**



**Figure 22. Crosstalk ( $X_{TALK}$ )**

PARAMETER MEASUREMENT INFORMATION (continued)



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

Figure 23. Charge Injection ( $Q_C$ )

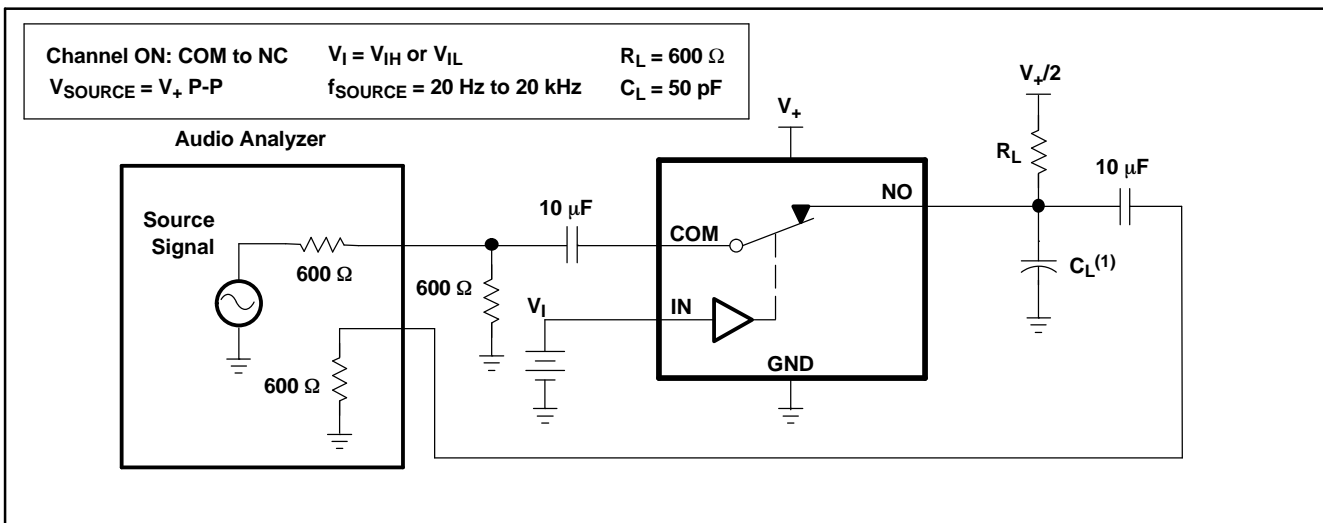


Figure 24. Total Harmonic Distortion (THD)

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TS5A3160DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A3160DCKR	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A3160DCKRE4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

**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)

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

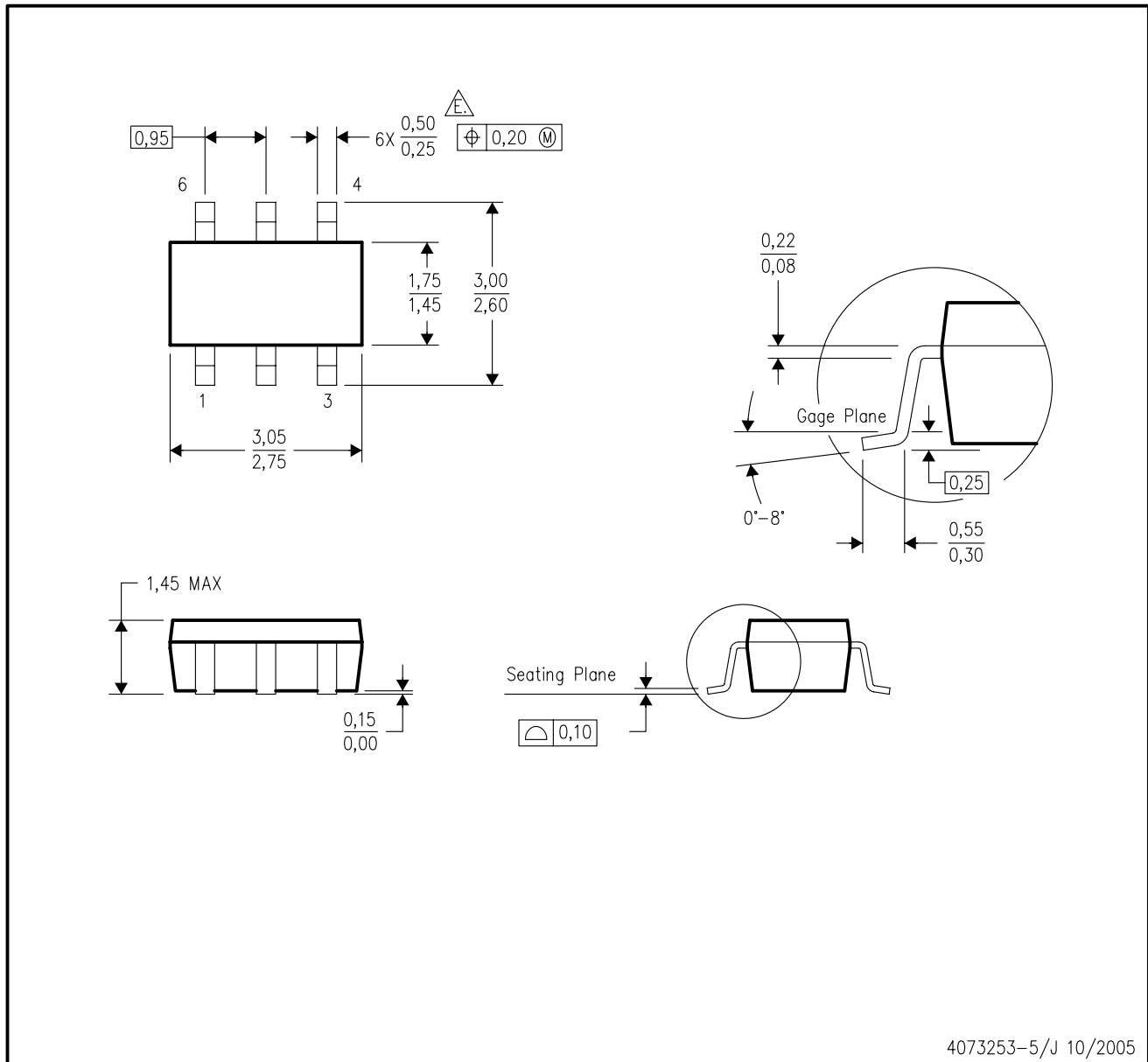
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# MECHANICAL DATA

DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE

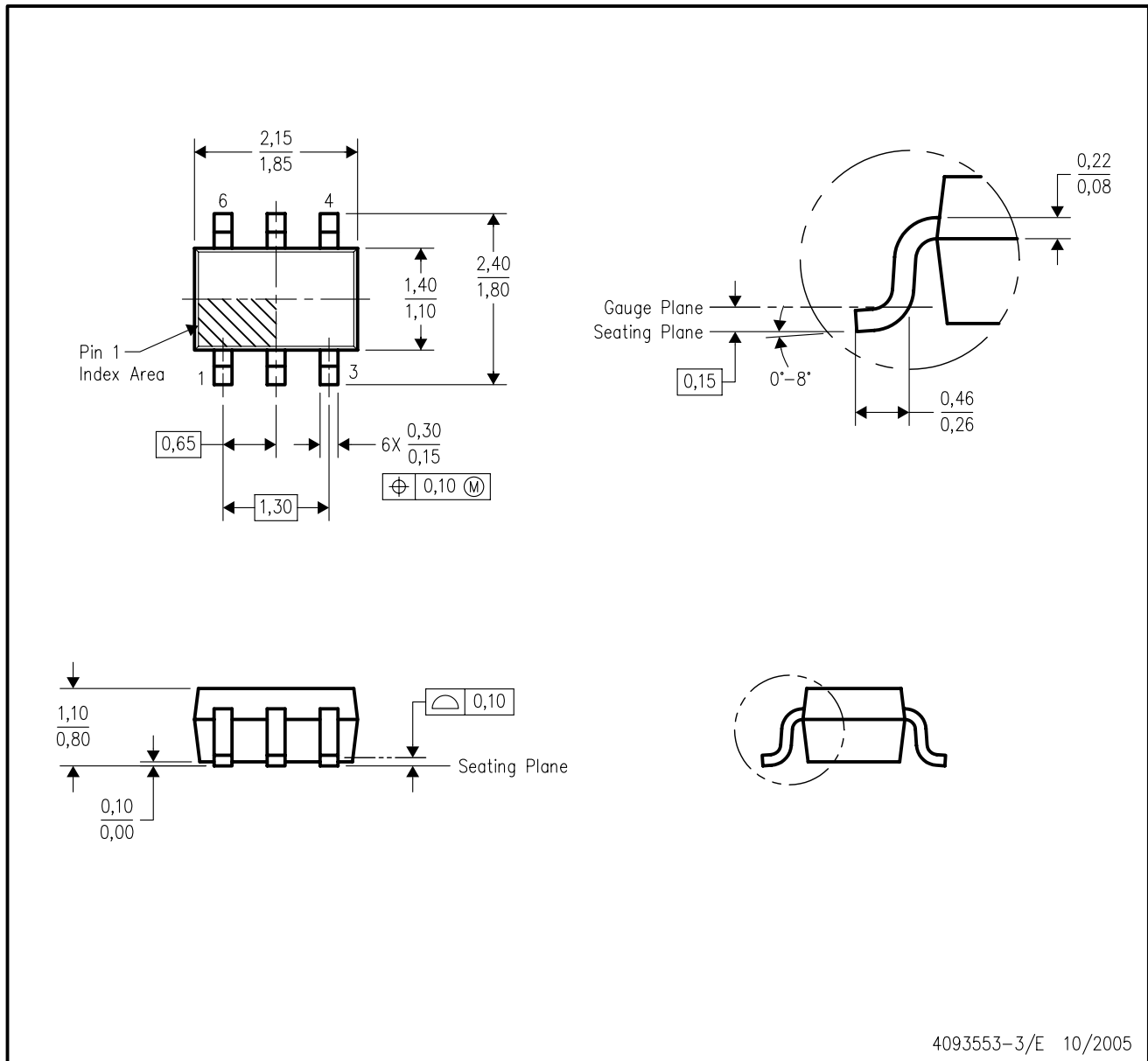


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.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

# MECHANICAL DATA

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



4093553-3/E 10/2005

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

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