TS5A23157
DUAL 10-Ω SPDT ANALOG SWITCH

SCDS165 A − MAY 2004 − REVISED MARCH 2005

DESCRIPTION

The TS5A23157 is a dual, single-pole, double-throw (SPDT) analog switch designed to operate from 1.65 V to 5.5 V. This device can handle both digital and analog signals. Signals up to 5.5 V (peak) can be transmitted in either direction.

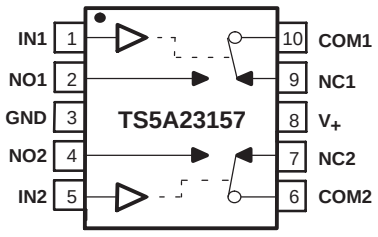
APPLICATIONS

- **Sample-and-Hold Circuit**
- **Battery-Powered Equipments**
- **Audio and Video Signal Routing**
- **Communication Circuits**

FEATURES

- **Specified Break-Before-Make Switching**
- **Low ON-State Resistance (10 Ω)**
- **Control Inputs Are 5-V Tolerant**
- **Low Charge Injection**
- **Excellent ON-Resistance Matching**
- **Low Total Harmonic Distortion**
- **1.8-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)**

DGS PACKAGE
(TOP VIEW)



FUNCTION TABLE

INPUT IN	NC TO COM COM TO NC	NO TO COM COM TO NO
L	ON	OFF
H	OFF	ON

SUMMARY OF CHARACTERISTICS

(V_+ = 5 V; T_A = 25°C)

CONFIGURATION	2:1 MULTIPLEXER/ DEMULTIPLEXER (2 × SPDT)
Number of channels	2
r_{on}	10 Ω
Δr_{on}	0.15 Ω
$r_{on(flat)}$	4 Ω
t_{ON}/t_{OFF}	5.7 ns/3.8 ns
t_{BBM}	0.5 ns
Charge injection	7 pC
Bandwidth	220 MHz
OFF isolation	−65 dB at 10 MHz
Crosstalk	−66 dB at 10 MHz
Total harmonic distortion	0.01%
$I_{COM(OFF)}/I_{NC(OFF)}$	±1 μA
Package option	10-pin DGS

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	VSSOP (MSOP-10) − DGS	Tape and reel	TS5A23157DGSR	JBR

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

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.

ABSOLUTE MAXIMUM RATINGS

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

Supply voltage range, V_+ (see Note 1) . . . . . −0.5 V to 6.5 V
Analog voltage range, V_{NC}, V_{NO}, V_{COM} (see Notes 1, 2, and 3) . . . . . −0.5 V to V_+ + 0.5 V
Analog port diode current, $I_{I/OK}$ (V_{NC}, V_{NO}, V_{COM} < 0 or V_{NC}, V_{NO}, V_{COM} > V_+) . . . . . ±50 mA
On-state switch current, I_{NC}, I_{NO}, I_{COM} (V_{NC}, V_{NO}, V_{COM} = 0 to V_+) . . . . . ±50 mA
Digital input voltage range, V_{IN} (see Notes 1 and 2) . . . . . −0.5 V to 6.5 V
Digital input clamp current, I_{IK} (V_{IN} < 0) . . . . . −50 mA
Continuous current through V_+ or GND . . . . . ±100 mA
Package thermal impedance, θ_{JA} (see Note 4) . . . . . 165°C/W
Storage temperature range, T_{stg} . . . . . −65°C to 150°C

† 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.

(1) All voltages are with respect to ground, unless otherwise specified.
(2) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
(3) This value is limited to 5.5 V maximum.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

ELECTRICAL CHARACTERISTICS FOR 5-V SUPPLY

(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
ANALOG SWITCH									
Analog signal range	V_{COM}, V_{NO}, V_{NC}					0		V_+	V
ON resistance	r_{on}	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −30 mA,	Switch ON, see Figure 10	Full	4.5 V			10	Ω
ON resistance match between channels	Δr_{on}	V_{NO} or V_{NC} = 3.15 V, I_{COM} = −30 mA,	Switch ON, see Figure 10	25°C	4.5 V		0.15		Ω
ON resistance flatness	$r_{on(flat)}$	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −30 mA,	Switch ON, see Figure 10	25°C	4.5 V		4		Ω
NC, NO, OFF leakage current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = 0 to V_+,	Switch OFF, see Figure 11	25°C	5.5 V	−1	0.05	1	µA
				Full		−1		1	
NC, NO, ON leakage current	$I_{NC(ON)}$, $I_{NO(ON)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = Open,	Switch ON, see Figure 11	25°C	5.5 V	−0.1		0.1	µA
				Full		−1		1	
COM ON leakage current	$I_{COM(ON)}$	V_{NC} or V_{NO} = Open, V_{COM} = 0 to V_+,	Switch ON, see Figure 11	25°C	5.5 V	−0.1		0.1	µA
				Full		−1		1	
DIGITAL INPUTS (IN1, IN2) (see Note 1)									
Input logic high	V_{IH}			Full		$V_+ \times 0.7$			V
Input logic low	V_{IL}			Full				$V_+ \times 0.3$	V
Input leakage current	I_{IH}, I_{IL}	V_{IN} = 5.5 V or 0		25°C	5.5 V	−1	0.05	1	µA
				Full		−1		1	

† T_A = 25°C

(1) 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 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									
Turnon time	t_{ON}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	4.5 V to 5.5 V	1.7		5.7	ns
Turnoff time	t_{OFF}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	4.5 V to 5.5 V	0.8		3.8	ns
Break-before-make time	t_{BBM}	V_{NC} = V_{NO} = V_+/2, R_L = 50 Ω,	C_L = 35 pF, see Figure 14	Full	4.5 V to 5.5 V	0.5			ns
Charge injection	Q_C	R_L = 1 MΩ, C_L = 0.1 nF,	see Figure 18	25°C	5 V		7		pC
NC, NO OFF capacitance	$C_{NC(OFF)}$, $C_{NO(OFF)}$	V_{NC} or V_{NO} = V_+ or GND,	Switch OFF, see Figure 12	25°C	5 V		5.5		pF
NC, NO ON capacitance	$C_{NC(ON)}$, $C_{NO(ON)}$	V_{NC} or V_{NO} = V_+ or GND,	Switch ON, see Figure 12	25°C	5 V		17.5		pF
COM ON capacitance	$C_{COM(ON)}$	V_{COM} = V_+ or GND,	Switch ON, see Figure 12	25°C	5 V		17.5		pF
Digital input capacitance	C_{IN}	V_{IN} = V_+ or GND,	see Figure 12	25°C	5 V		2.8		pF
Bandwidth	BW	R_L = 50 Ω,	Switch ON, see Figure 15	25°C	4.5 V		220		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 10 MHz,	Switch OFF, see Figure 16	25°C	4.5 V		−65		dB
Crosstalk	X_{TALK}	R_L = 50 Ω, f = 10 MHz,	Switch ON, see Figure 17	25°C	4.5 V		−66		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 600 Hz to 20 kHz, see Figure 19	25°C	4.5 V		0.01		%
SUPPLY									
Positive supply current	I_+	V_{IN} = V_+ or GND,	Switch ON or OFF	25°C	5.5 V			1	µA
				Full				10	
Change in supply current	ΔI_+	V_{IN} = V_+ − 0.6 V		Full	5.5 V			500	µA

† T_A = 25°C

ELECTRICAL CHARACTERISTICS FOR 3.3-V SUPPLY

(V_+ = 3 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_{NO}, V_{NC}					0		V_+	V
ON resistance	r_{on}	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −24 mA,	Switch ON, see Figure 10	Full	3 V			18	Ω
ON-resistance match between channels	Δr_{on}	V_{NO} or V_{NC} = 2.1 V, I_{COM} = −24 mA,	Switch ON, see Figure 10	25°C	3 V		0.2		Ω
ON-resistance flatness	$r_{on(flat)}$	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −24 mA,	Switch ON, see Figure 12	25°C	3 V		9		Ω
NC, NO OFF leakage current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = 0 to V_+,	Switch OFF, see Figure 11	25°C	3.6 V	−1	0.05	1	µA
				Full		−1		1	
NC, NO ON leakage current	$I_{NC(ON)}$, $I_{NO(ON)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = Open,	Switch ON, see Figure 11	25°C	3.6 V	−0.1		0.1	µA
				Full		−1		1	
COM ON leakage current	$I_{COM(ON)}$	V_{NC} or V_{NO} = Open, V_{COM} = 0 to V_+,	Switch ON, see Figure 11	25°C	3.6 V	−0.1		0.1	µA
				Full		−1		1	
DIGITAL INPUTS (IN1, IN2) (see Note 1)									
Input logic high	V_{IH}			Full		$V_+ \times 0.7$			V
Input logic low	V_{IL}			Full				$V_+ \times 0.3$	V
Input leakage current	I_{IH}, I_{IL}	V_{IN} = 5.5 V or 0		25°C	3.6 V	−1	0.05	1	µA
				Full		−1		1	
DYNAMIC									
Turnon time	t_{ON}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	3 V to 3.6 V	2.5		7.6	ns
Turnoff time	t_{OFF}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	3 V to 3.6 V	1.5		5.3	ns
Break-before-make time	t_{BBM}	V_{NC} = V_{NO} = V_+/2, R_L = 50 Ω,	C_L = 35 pF, see Figure 14	Full	3 V to 3.6 V	0.5			ns
Charge injection	Q_C	R_L = 1 MΩ, C_L = 0.1 nF,	see Figure 18	25°C	3.3 V		3		pC
Bandwidth	BW	R_L = 50 Ω, Switch ON,	see Figure 15	25°C	3 V		220		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 10 MHz,	Switch OFF, see Figure 16	25°C	3 V		−65		dB
Crosstalk	X_{TALK}	R_L = 50 Ω, f = 10 MHz,	Switch ON, see Figure 17	25°C	3 V		−66		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 600 Hz to 20 kHz, see Figure 19	25°C	3 V		0.015		%
SUPPLY									
Positive supply current	I_+	V_{IN} = V_+ or GND,	Switch ON or OFF	25°C	3.6 V			1	µA
				Full				10	
Change in supply current	ΔI_+	V_{IN} = V_+ − 0.6 V		Full	3.6 V			500	µA

† T_A = 25°C

(1) 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

(V_+ = 2.3 V to 2.7 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_{NO}, V_{NC}					0		V_+	V
ON resistance	r_{on}	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −8 mA,	Switch ON, see Figure 10	Full	2.3 V			45	Ω
ON-resistance match between channels	Δr_{on}	V_{NO} or V_{NC} = 1.6 V, I_{COM} = −8 mA,	Switch ON, see Figure 10	25°C	2.3 V		0.5		Ω
ON-resistance flatness	$r_{on(flat)}$	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −8 mA,	Switch ON, see Figure 10	25°C	2.3 V		27		Ω
NC, NO OFF leakage current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = 0 to V_+,	Switch OFF, see Figure 11	25°C	2.7 V	−1	0.05	1	µA
				Full		−1		1	
NC, NO ON leakage current	$I_{NC(ON)}$, $I_{NO(ON)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = Open,	Switch ON, see Figure 11	25°C	2.7 V	−0.1		0.1	µA
				Full		−1		1	
COM ON leakage current	$I_{COM(ON)}$	V_{NC} or V_{NO} = Open, V_{COM} = 0 to V_+,	Switch ON, see Figure 11	25°C	2.7 V	−0.1		0.1	µA
				Full		−1		1	
DIGITAL INPUTS (IN1, IN2) (see Note 1)									
Input logic high	V_{IH}			Full		$V_+ \times 0.7$			V
Input logic low	V_{IL}			Full				$V_+ \times 0.3$	V
Input leakage current	I_{IH}, I_{IL}	V_{IN} = 5.5 V or 0		25°C	2.7 V	−1	0.05	1	µA
				Full		−1		1	
DYNAMIC									
Turnon time	t_{ON}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	2.3 V to 2.7 V	3.5		14	ns
Turnoff time	t_{OFF}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	2.3 V to 2.7 V	2		7.5	ns
Break-before-make time	t_{BBM}	V_{NC} = V_{NO} = V_+/2, R_L = 50 Ω,	C_L = 35 pF, see Figure 14	Full	2.3 V to 2.7 V	0.5			ns
Bandwidth	BW	R_L = 50 Ω,	Switch ON, see Figure 15	25°C	2.3 V		220		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 10 MHz,	Switch OFF, see Figure 16	25°C	2.3 V		−65		dB
Crosstalk	X_{TALK}	R_L = 50 Ω, f = 10 MHz,	Switch ON, see Figure 17	25°C	2.3 V		−66		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 600 Hz to 20 kHz, see Figure 19	25°C	2.3 V		0.025		%
SUPPLY									
Positive supply current	I_+	V_{IN} = V_+ or GND,	Switch ON or OFF	25°C	2.7 V			1	µA
				Full				10	
Change in supply current	ΔI_+	V_{IN} = V_+ − 0.6 V		Full	2.7 V			500	µA

† T_A = 25°C

(1) 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

(V_+ = 1.65 V to 1.95 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_{NO}, V_{NC}					0		V_+	V
ON resistance	r_{on}	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −4 mA,	Switch ON, see Figure 10	Full	1.65 V			140	Ω
ON-resistance match between channels	Δr_{on}	V_{NO} or V_{NC} = 1.15 V, I_{COM} = −4 mA,	Switch ON, see Figure 10	25°C	1.65 V		1		Ω
ON-resistance flatness	$r_{on(flat)}$	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = −4 mA,	Switch ON, see Figure 10	25°C	1.65 V		110		Ω
NC, NO OFF leakage current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = 0 to V_+,	Switch OFF, see Figure 11	25°C	1.95 V	−1	0.05	1	µA
				Full		−1		1	
NC, NO ON leakage current	$I_{NC(ON)}$, $I_{NO(ON)}$	V_{NC} or V_{NO} = 0 to V_+, V_{COM} = Open,	Switch ON, see Figure 11	25°C	1.95 V	−0.1		0.1	µA
				Full		−1		1	
COM ON leakage current	$I_{COM(ON)}$	V_{NC} or V_{NO} = Open, V_{COM} = 0 to V_+,	Switch ON, see Figure 11	25°C	1.95 V	−0.1		0.1	µA
				Full		−1		1	
DIGITAL INPUTS (IN1, IN2) (see Note 1)									
Input logic high	V_{IH}			Full		$V_+ \times 0.75$			V
Input logic low	V_{IL}			Full				$V_+ \times 0.25$	V
Input leakage current	I_{IH}, I_{IL}	V_{IN} = 5.5 V or 0		25°C	1.95 V	−1	0.05	1	µA
				Full		−1		1	
DYNAMIC									
Turnon time	t_{ON}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	1.65 V to 1.95 V	7		24	ns
Turnoff time	t_{OFF}	V_{NC} = GND and V_{NO} = V_+ or V_{NC} = V_+ and V_{NO} = GND,	R_L = 500 Ω, C_L = 50 pF, see Figure 13	Full	1.65 V to 1.95 V	3		13	ns
Break-before-make time	t_{BBM}	V_{NC} = V_{NO} = V_+/2, R_L = 50 Ω,	C_L = 35 pF, see Figure 14	Full	1.65 V to 1.95 V	0.5			ns
Bandwidth	BW	R_L = 50 Ω,	Switch ON, see Figure 15	25°C	1.8 V		220		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 10 MHz,	Switch OFF, see Figure 16	25°C	1.8 V		−60		dB
Crosstalk	X_{TALK}	R_L = 50 Ω, f = 10 MHz,	Switch ON, see Figure 17	25°C	1.8 V		−66		dB
Total harmonic distortion	THD	R_L = 600 kΩ, C_L = 50 pF,	f = 600 Hz to 20 kHz, see Figure 19	25°C	1.8 V		0.015		%
SUPPLY									
Positive supply current	I_+	V_{IN} = V_+ or GND,	Switch ON or OFF	25°C	1.95 V			1	µA
				Full				10	
Change in supply current	ΔI_+	V_{IN} = V_+ − 0.6 V		Full	1.95 V			500	µA

† T_A = 25°C

(1) 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.

TYPICAL PERFORMANCE

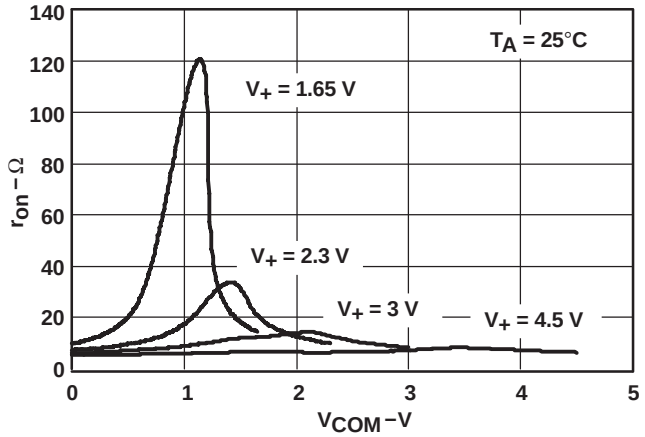


Figure 1. r_{on} vs V_{COM}

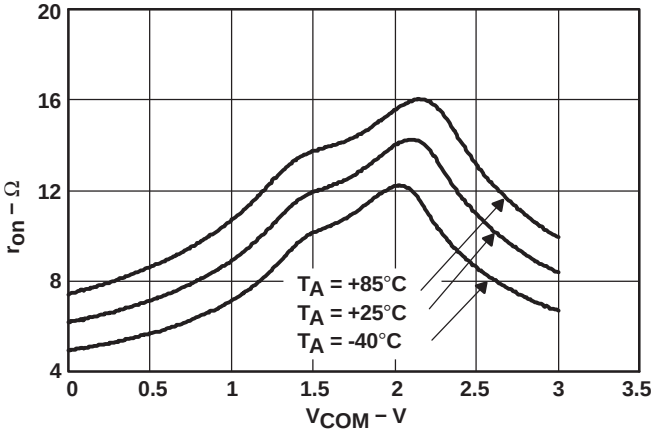


Figure 2. r_{on} vs V_{COM} (V_+ = 3 V)

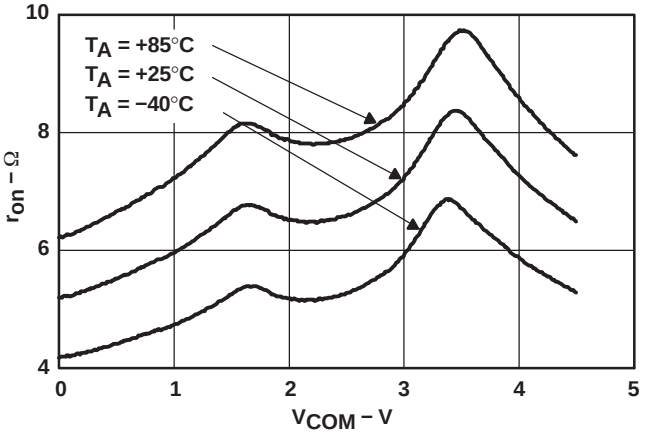


Figure 3. r_{on} vs V_{COM} (V_+ = 5 V)

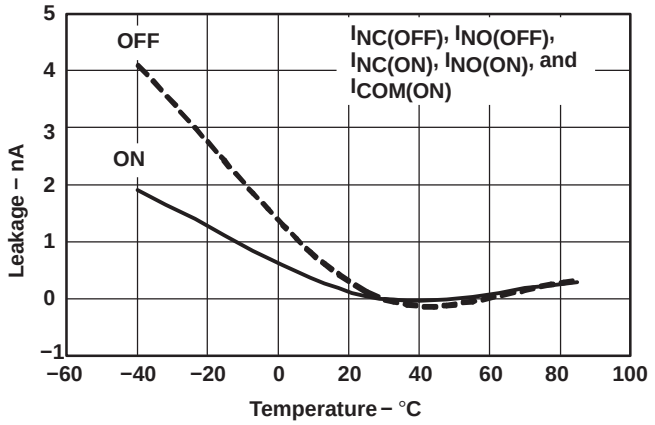


Figure 4. Leakage Current vs Temperature (V_+ = 5.5 V)

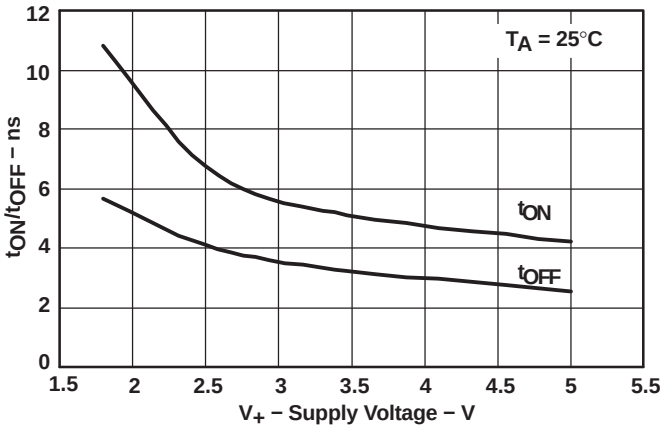


Figure 5. t_{ON} and t_{OFF} vs V_+

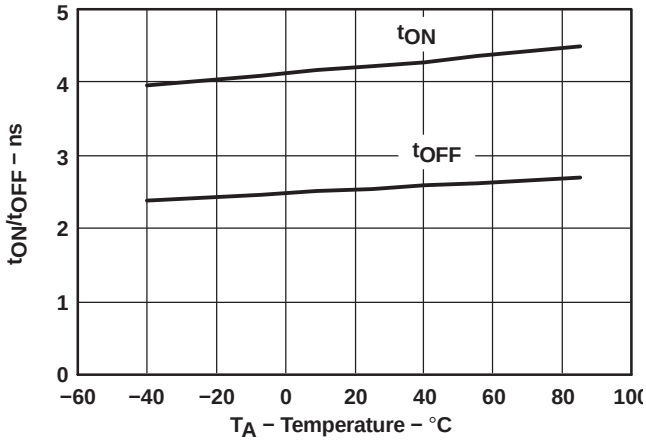


Figure 6. t_{ON} and t_{OFF} vs Temperature (V_+ = 5 V)

TYPICAL PERFORMANCE (continued)

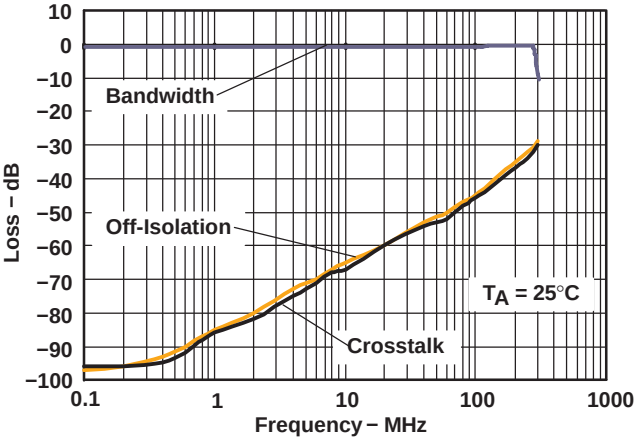


Figure 7. Frequency Response (V_+ = 3 V)

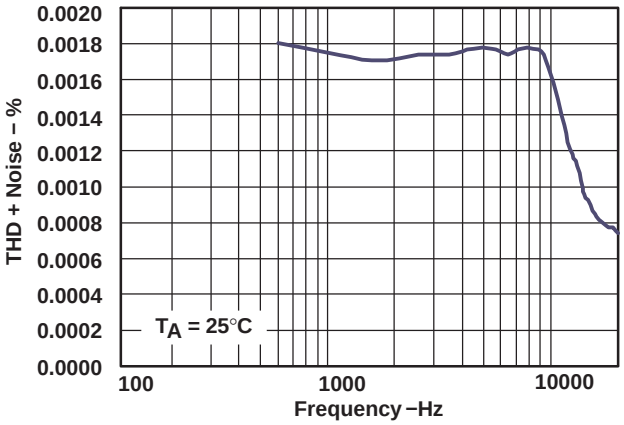


Figure 8. Total Harmonic Distortion (THD) vs Frequency (V_+ = 3 V)

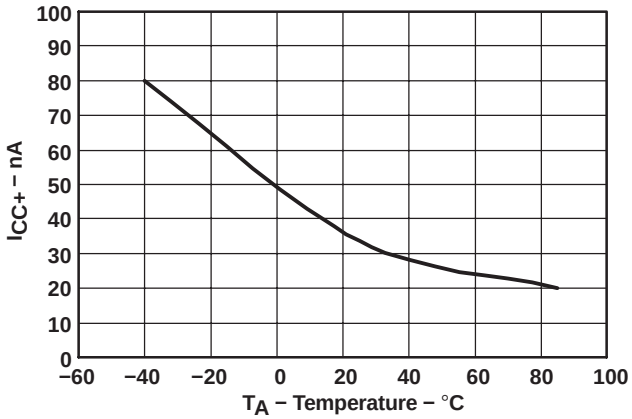


Figure 9. Power-Supply Current vs Temperature (V_+ = 5 V)

PIN DESCRIPTION

PIN NUMBER	NAME	DESCRIPTION
1	IN1	Digital control pin to connect the COM terminal to the NO or NC terminals
2	NO1	Normally-open terminal
3	GND	Digital ground
4	NO2	Normally-open terminal
5	IN2	Digital control pin to connect the COM terminal to the NO or NC terminals
6	COM2	Common terminal
7	NC2	Normally-closed terminal
8	V_+	Power supply
9	NC1	Normally-closed terminal
10	COM1	Common terminal

PARAMETER DESCRIPTION

SYMBOL	DESCRIPTION
V_{COM}	Voltage at the COM pin
V_{NC}	Voltage at the NC pin
V_{NO}	Voltage at the NO pin
r_{on}	Resistance between COM and NC or COM and NO ports when the channel is ON
Δr_{on}	Difference of r_{on} between channels
$r_{on(flat)}$	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 under worst-case input and output conditions.
$I_{NO(OFF)}$	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state under worst-case input and output conditions
$I_{NC(ON)}$	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the ON state and the output (COM) being open
$I_{NO(ON)}$	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the ON state and the output (COM) being open
$I_{COM(ON)}$	Leakage current measured at the COM port, with the corresponding channel (NO to COM or NC to COM) in the ON state and the output (NC or NO) being open
V_{IH}	Minimum input voltage for logic high for the control input (IN)
V_{IL}	Minimum input voltage for logic low for the control input (IN)
V_{IN}	Voltage at the IN pin
I_{IH}, I_{IL}	Leakage current measured at the IN pin
t_{ON}	Turnon 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 outputs (COM/NC/NO) signal when the switch is turning ON.
t_{OFF}	Turnoff 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 outputs (COM/NC/NO) signal when the switch is turning OFF.
t_{BBM}	Break-before-make time. This parameter is measured under the specified range of conditions and by the propagation delay between the output of two adjacent analog channels (NC and NO) when the control signal changes state.
Q_C	Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (NC, NO, or COM) output. This is measured in coulombs (C) and measured by the total charge induced due to switching of the control input. Charge injection, $Q_C = C_L \times \Delta V_O$, C_L is the load capacitance and ΔV_O is the change in analog output voltage.

PARAMETER DESCRIPTION (continued)

SYMBOL	DESCRIPTION
$C_{NC(OFF)}$	Capacitance at the NC port when the corresponding channel (NC to COM) is OFF
$C_{NO(OFF)}$	Capacitance at the NO port when the corresponding channel (NO to COM) is OFF
$C_{NC(ON)}$	Capacitance at the NC port when the corresponding channel (NC to COM) is ON
$C_{NO(ON)}$	Capacitance at the NO port when the corresponding channel (NO to COM) is ON
$C_{COM(ON)}$	Capacitance at the COM port when the corresponding channel (COM to NC or COM to NO) is ON
C_{IN}	Capacitance of the IN input
O_{ISO}	OFF isolation of the switch is a measurement of off-state switch impedance. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM or NO to COM) in the OFF state. OFF isolation, O_{ISO} = 20 LOG (V_{NC}/V_{COM}) dB, V_{COM} is the input and V_{NC} is the output.
X_{TALK}	Crosstalk is a measurement of unwanted signal coupling from an ON channel to an OFF channel (NC to NO or NO to NC). This is measured at a specific frequency and in dB. Crosstalk, X_{TALK} = 20 log (V_{NC1}/V_{NO1}), V_{NO1} is the input and V_{NC1} is the output.
BW	Bandwidth of the switch. This is the frequency where the gain of an ON channel is −3 dB below the dc gain. Gain is measured from the equation, 20 log (V_{NC}/V_{COM}) dB, where V_{NC} is the output and V_{COM} is the input.
I_+	Static power-supply current with the control (IN) pin at V_+ or GND
ΔI_+	This is the increase in I_+ for each control (IN) input that is at the specified voltage rather than at V_+ or GND.

PARAMETER MEASUREMENT INFORMATION

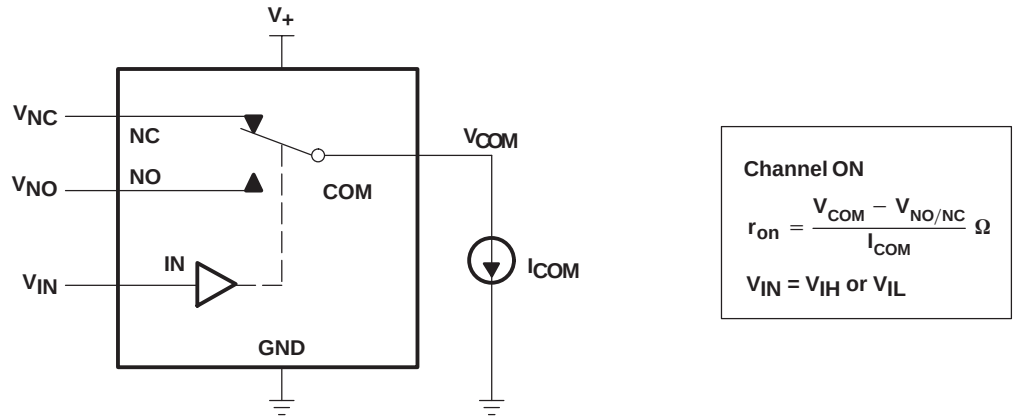


Figure 10. ON-State Resistance (r_{on})

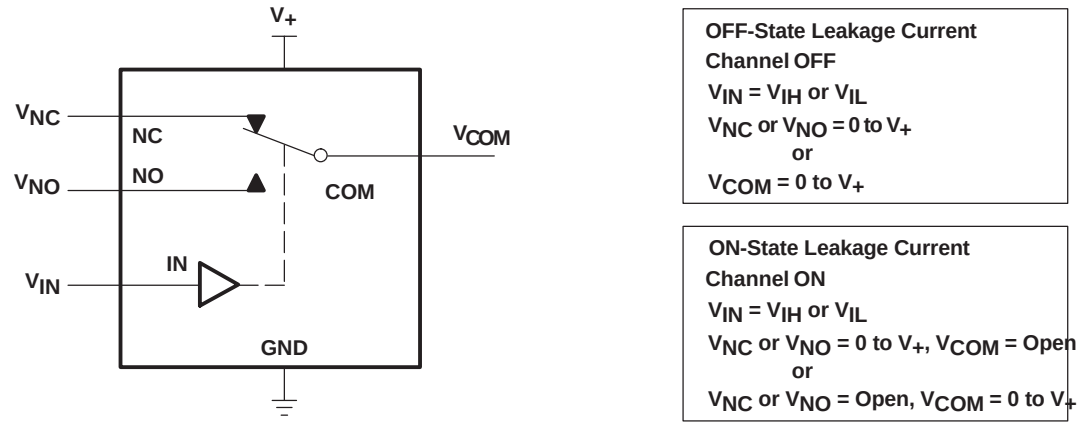


Figure 11. ON- and OFF-State Leakage Current ($I_{COM(ON)}$, $I_{NC(OFF)}$, $I_{NO(OFF)}$, $I_{NC(ON)}$, $I_{NO(ON)}$)

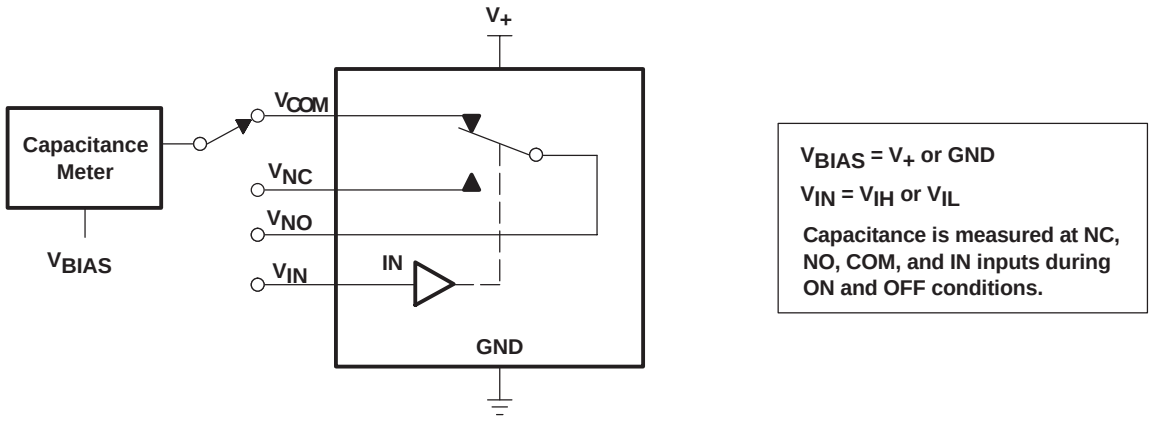
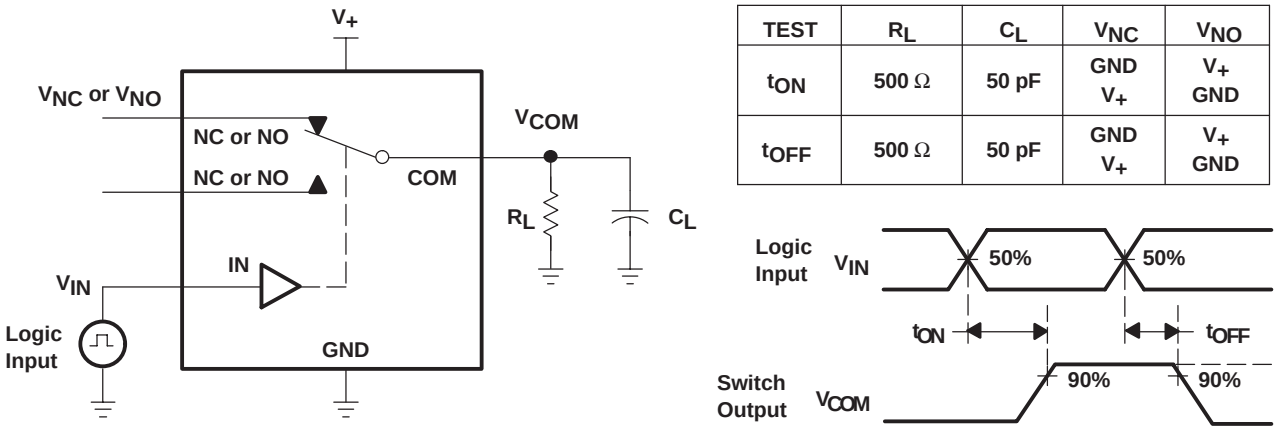


Figure 12. Capacitance (C_{IN}, $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NO(OFF)}$, $C_{NC(ON)}$, $C_{NO(ON)}$)



TEST	R_L	C_L	V_{NC}	V_{NO}
t_{ON}	500 Ω	50 pF	GND V_+	V_+ GND
t_{OFF}	500 Ω	50 pF	GND V_+	V_+ GND

Figure 13. Turnon (t_{ON}) and Turnoff(t_{OFF}) Time

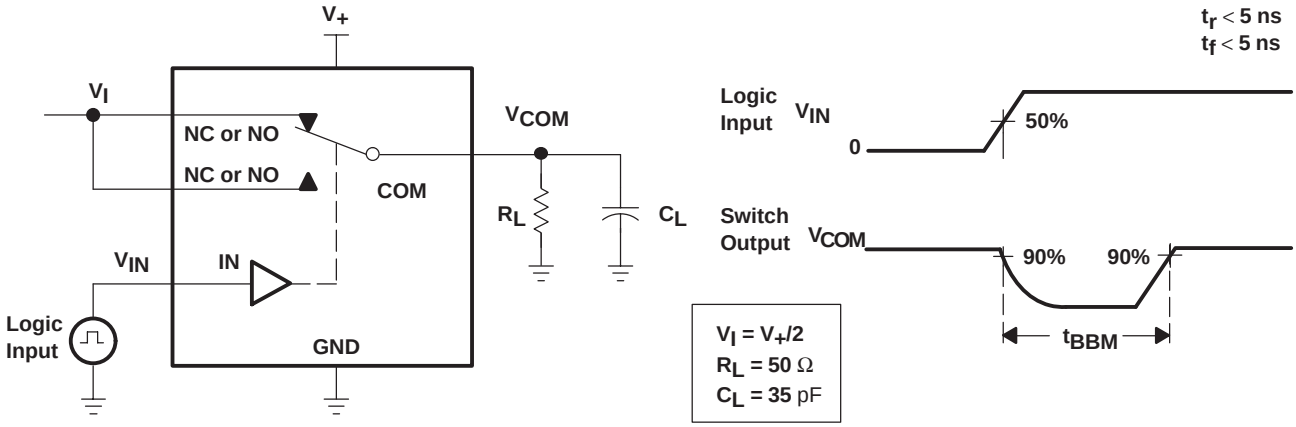


Figure 14. Break-Before-Make (t_{BBM}) Time

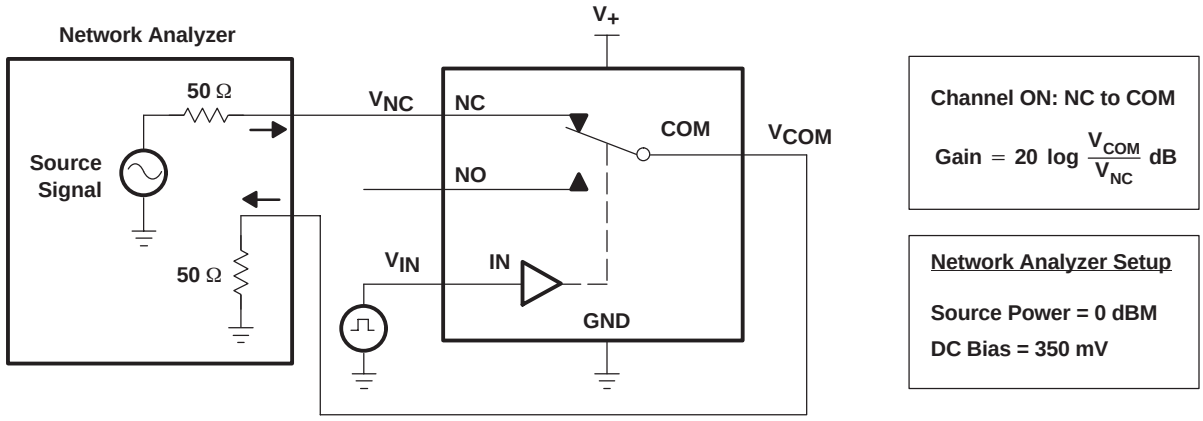


Figure 15. Frequency Response (BW)

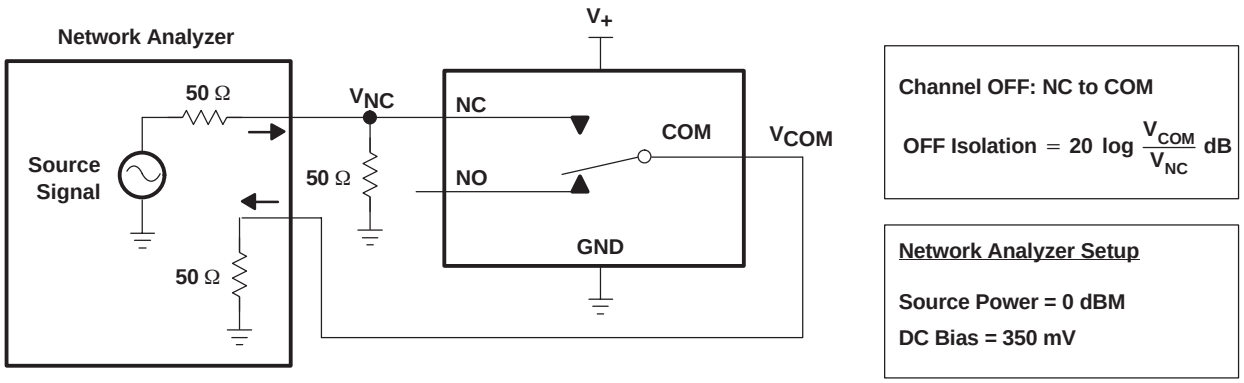


Figure 16. OFF Isolation (O_{ISO})

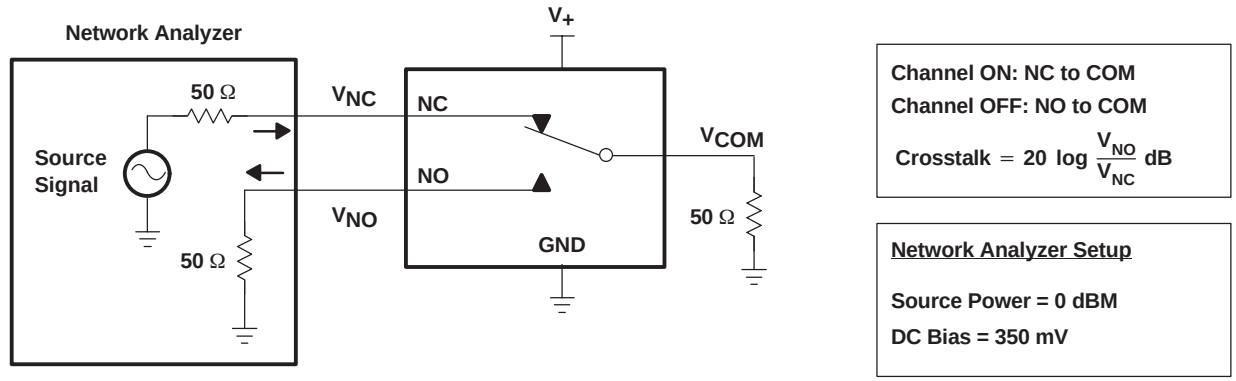


Figure 17. Crosstalk (X_{TALK})

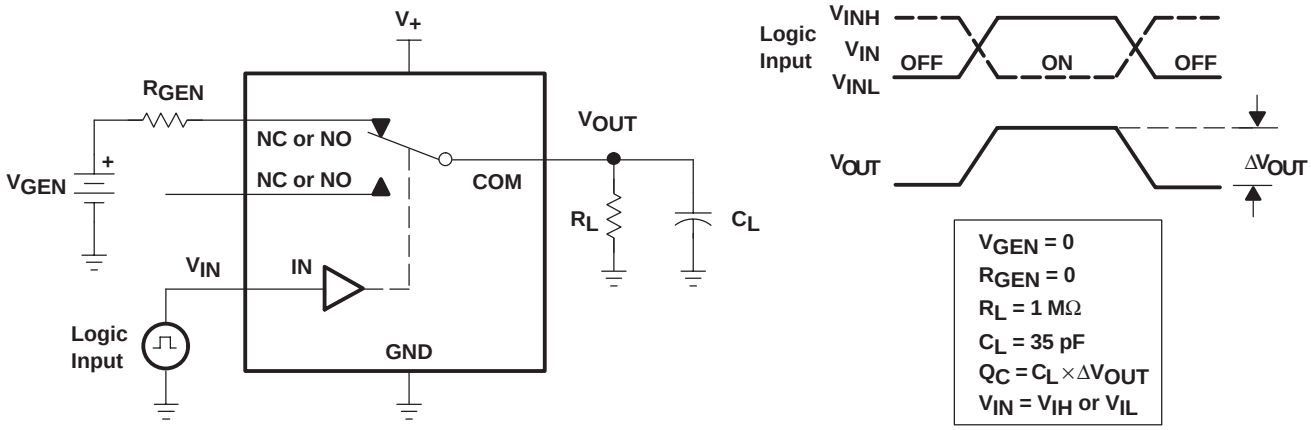


Figure 18. Charge Injection (Q_C)

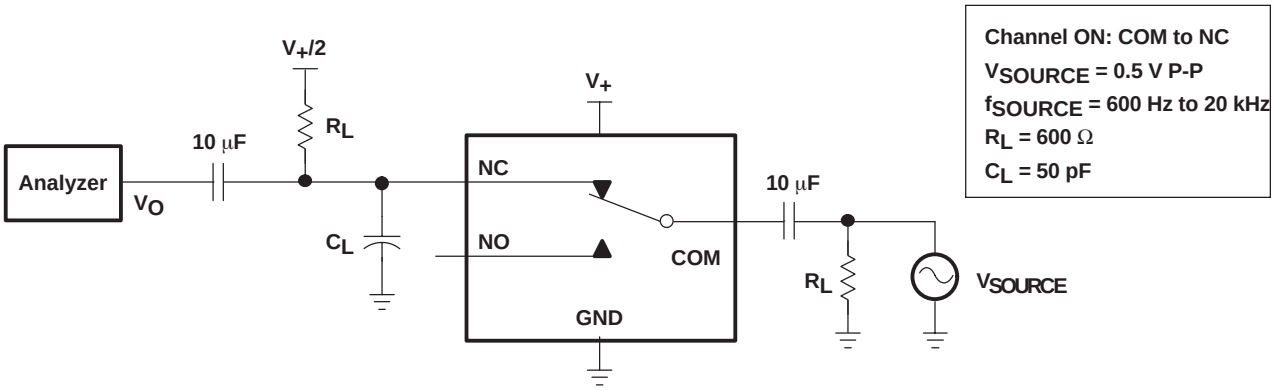


Figure 19. Total Harmonic Distortion (THD)

PACKAGING INFORMATION

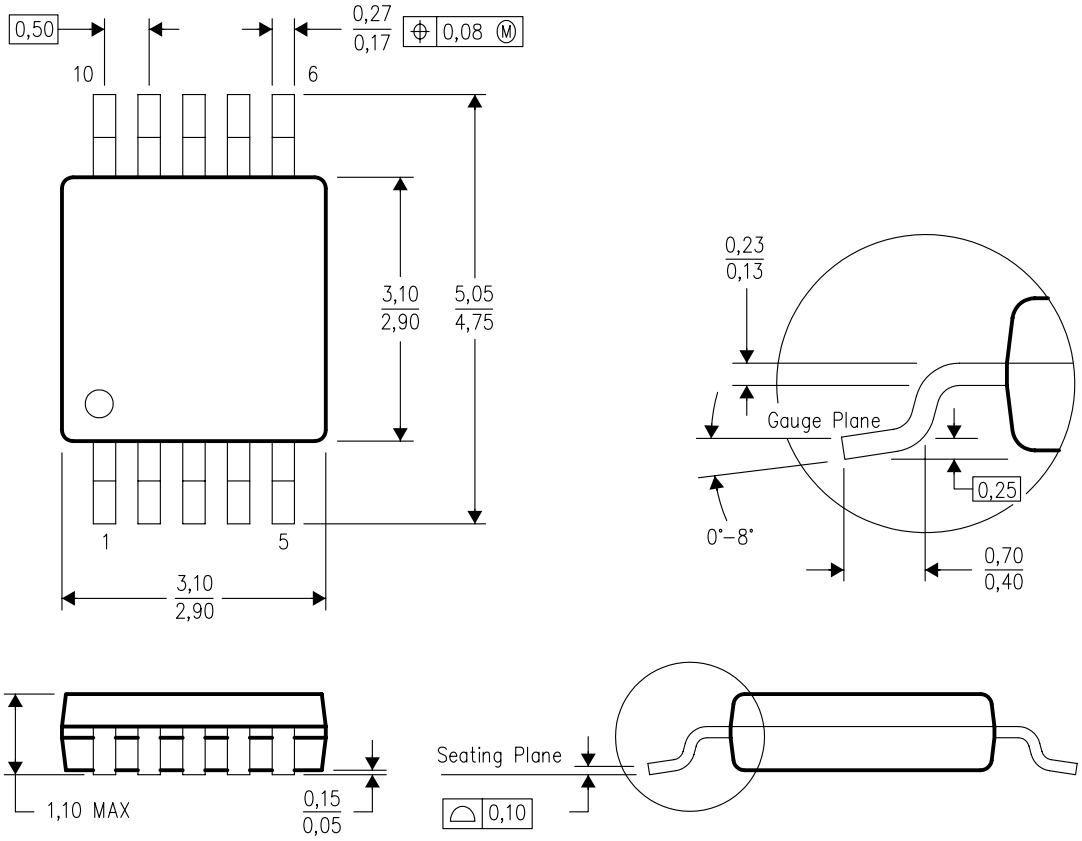
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TS5A23157DGSR	ACTIVE	MSOP	DGS	10	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A23157DGSRE4	ACTIVE	MSOP	DGS	10	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A23157DGSRG4	ACTIVE	MSOP	DGS	10	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A23157DGST	ACTIVE	MSOP	DGS	10	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A23157DGSTE4	ACTIVE	MSOP	DGS	10	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TS5A23157DGSTG4	ACTIVE	MSOP	DGS	10	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

DGS (S–PDSO–G10) PLASTIC SMALL–OUTLINE PACKAGE



4073272/C 02/04

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.
D. Falls within JEDEC MO–187 variation BA.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information 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.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265