

## FEATURES

- Overshoot and Undershoot Voltage Protection
- 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 (THD)
- 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)
  - 300-V Machine Model (A115-A)

## APPLICATIONS

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

## DESCRIPTION/ORDERING INFORMATION

The TS5A623157 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 V+ (peak) can be transmitted in either direction.

The TS5A623157 senses overshoot and undershoot events at the I/Os and responds by preventing voltage differentials from developing and turning the switch on.

### ORDERING INFORMATION

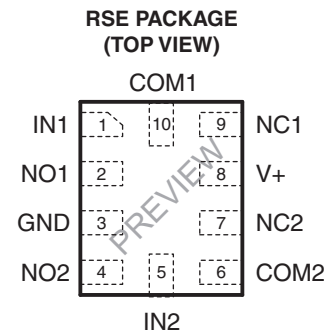
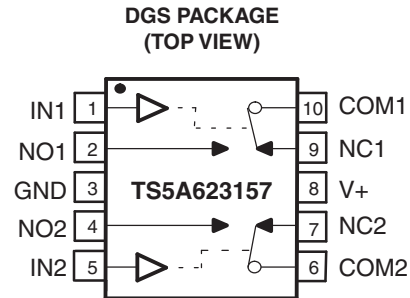
T <sub>A</sub>	PACKAGE <sup>(1)(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	VSSOP (MSOP-10) – DGS	Tape and reel	TS5A623157DGSR	35R
	QFN – RSE	Tape and reel	TS5A623157RSER	PREVIEW

(1) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).

### FUNCTION TABLE

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



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.

**TS5A623157**  
**DUAL 10-Ω SPDT ANALOG SWITCH**  
**WITH UNDERSHOOT/OVERSHOOT VOLTAGE PROTECTION**

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

Configuration	2:1 multiplexer/demultiplexer (1 × SPDT)
Number of channels	2
ON-state resistance ( $r_{on}$ )	10 Ω
ON-state resistance match ( $\Delta r_{on}$ )	0.15 Ω
ON-state resistance flatness ( $r_{on(flat)}$ )	2 Ω
Turn-on/turn-off time ( $t_{ON}/t_{OFF}$ )	5 ns / 3.4 ns
Break-before-make time ( $t_{BBM}$ )	0.5 ns
Charge injection ( $Q_C$ )	5 pC
Bandwidth (BW)	371 MHz
OFF isolation ( $O_{ISO}$ )	-61 dB at 10 MHz
Crosstalk ( $X_{TALK}$ )	-61 dB at 10 MHz
Total harmonic distortion (THD)	0.06%
Leakage current ( $I_{NO(OFF)}/I_{NC(OFF)}$ )	±1 μA
Power-supply current ( $I_+$ )	1.2 μA
Undershoot protection	-2 V
Overshoot protection	$V_+ + 2\text{ V}$
Package options	10-pin VSSOP (DGS), 10-pin QFN (RSE)

**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
$I_{I/OK}$	Analog port diode current	$V_+ < V_{NC}, V_{NO}, V_{COM} < 0$		±50 mA
$I_{NC}$ $I_{NO}$ $I_{COM}$	On-state switch current	$V_{NC}, V_{NO}, V_{COM} = 0 \text{ to } V_+$		±50 mA
$V_{IN}$	Digital input voltage range <sup>(3)(4)</sup>	-0.5	6.5	V
$I_{IK}$	Digital input clamp current	$V_I < 0$		-50 mA
$I_+$ $I_{GND}$	Continuous current through $V_+$ or GND			±100 mA
$T_{stg}$	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.

**Package Thermal Impedance**

			UNIT
$\theta_{JA}$	Package thermal impedance <sup>(1)</sup>	DGS package	165
		RSE package	243

- (1) The package thermal impedance is calculated in accordance with JESD 51-7.

PRODUCT PREVIEW

### Electrical Characteristics for 5-V Supply

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT
<b>Analog Switch</b>								
Analog signal range	$V_{COM}, V_{NO}, V_{NC}$				0		$V_+$	V
Voltage undershoot	$V_{IKU}$	$0 \geq (I_{NC}, I_{NO}, \text{ or } I_{COM}) \geq -50 \text{ mA}$		5.5 V			-2	V
Peak ON-state resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -30 \text{ mA}$ , Switch ON, See Figure 14	25°C	4.5 V		4.6	11	$\Omega$
			Full					
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 0$ , $I_{COM} = 30 \text{ mA}$	25°C	4.5 V		4	6.5	$\Omega$
			Full					
			25°C					
			Full					
			25°C					
			Full					
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 3.15 \text{ V}$ , $I_{COM} = -30 \text{ mA}$ , Switch ON, See Figure 14	25°C	4.5 V		0.1	0.14	$\Omega$
			Full					
ON-state resistance flatness	$r_{on(Flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -30 \text{ mA}$ , Switch ON, See Figure 14	25°C	4.5 V		1.5	2	$\Omega$
			Full					
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } V_+$ , $V_{COM} = V_+ \text{ to } 0$ , Switch OFF, See Figure 15	25°C	5.5 V		1	20	nA
			Full					
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 16	25°C	5.5 V		1	20	nA
			Full					
COM ON leakage current	$I_{COM(ON)}$	$V_{NC} \text{ or } V_{NO} = \text{Open}$ , $V_{COM} = 0 \text{ to } V_+$ , Switch ON, See Figure 16	25°C	5.5 V		1	20	nA
			Full					
<b>Digital Control Input (IN)</b>								
Input logic high	$V_{IH}$		Full		$V_+ \times 0.7$		5.5	V
Input logic low	$V_{IL}$		Full		0		$V_+ \times 0.3$	V
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5 \text{ V or } 0$	25°C	5.5 V		0.1	10	nA
			Full					

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**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	$t_{ON}$	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$ ,	$C_L = 50\text{ pF}$ , See <a href="#">Figure 17</a>	25°C	5 V	1	3.5	5	ns
				Full	4.5 V to 5.5 V	1		6	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$ ,	$C_L = 50\text{ pF}$ , See <a href="#">Figure 17</a>	25°C	5 V	1	2.8	3.4	ns
				Full	4.5 V to 5.5 V	1		3.8	
Output voltage during undershoot	$V_{OUTU}$	See <a href="#">Figure 24</a>			2.5	$V_{OH} - 0.3$		V	
Output voltage during overshoot	$V_{OUTO}$	See <a href="#">Figure 24</a>				$V_{OL} + 0.3$	2	V	
Break-before-make time	$t_{BBM}$	$V_{NC} = V_{NO} = V_+/2$ , $R_L = 50\ \Omega$ ,	$C_L = 50\text{ pF}$ , See <a href="#">Figure 18</a>	25°C	5 V	0.5	5	12	ns
				Full	4.5 V to 5.5 V	0.5		14	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ ,	$C_L = 0.1\text{ nF}$ , See <a href="#">Figure 22</a>	25°C	5 V		110	pC	
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF,	See <a href="#">Figure 16</a>	25°C	5 V		5	pF	
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON,	See <a href="#">Figure 16</a>	25°C	5 V		14.5	pF	
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON,	See <a href="#">Figure 16</a>	25°C	5 V		14.5	pF	
Digital input capacitance	$C_I$	$V_I = V_+$ or GND,	See <a href="#">Figure 16</a>	25°C	5 V		3.5	pF	
Bandwidth	BW	$R_L = 50\ \Omega$ , Switch ON,	See <a href="#">Figure 19</a>	25°C	5 V		371	MHz	
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ ,	Switch OFF, See <a href="#">Figure 20</a>	25°C	5 V		-61	dB	
Crosstalk	$X_{TALK}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ ,	Switch ON, See <a href="#">Figure 21</a>	25°C	5 V		-61	dB	
Total harmonic distortion	THD	$R_L = 600\ \Omega$ , $C_L = 50\text{ pF}$ ,	$f = 20\text{ Hz to }20\text{ kHz}$ , See <a href="#">Figure 23</a>	25°C	5 V		0.06	%	
<b>Supply</b>									
Positive supply current	$I_+$	$V_I = V_+$ or GND,	Switch ON or OFF	25°C	5.5 V	0.01	0.15	$\mu\text{A}$	
				Full			1.2		

PRODUCT PREVIEW

**Electrical Characteristics for 3.3-V Supply**
 $V_+ = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT
<b>Analog Switch</b>								
Analog signal range	$V_{COM}, V_{NO}, V_{NC}$				0		$V_+$	V
Voltage undershoot	$V_{IKU}$	$0 \geq (I_{NC}, I_{NO}, \text{ or } I_{COM}) \geq -50\text{ mA}$		3.6 V				V
Peak ON-state resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -24\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	3 V		8.9	14	$\Omega$
			Full				18	
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 0$ , $I_{COM} = 24\text{ mA}$	25°C	3 V		5.4	8	$\Omega$
			Full				10	
		25°C				7.4	12	
		Full				15		
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 2.1\text{ V}$ , $I_{COM} = -24\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	3 V		0.1	0.2	$\Omega$
			Full				0.2	
ON-state resistance flatness	$r_{on(flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -24\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	3 V		2.8	4	$\Omega$
			Full				7	
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } V_+$ , $V_{COM} = V_+ \text{ to } 0$ , Switch OFF, See <a href="#">Figure 15</a>	25°C	3.6 V		0.5	10	nA
			Full				100	
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 <a href="#">Figure 16</a>	25°C	3.6 V		0.5	10	nA
			Full				100	
COM ON leakage current	$I_{COM(ON)}$	$V_{NC} \text{ or } V_{NO} = \text{Open}$ , $V_{COM} = 0 \text{ to } V_+$ , Switch ON, See <a href="#">Figure 16</a>	25°C	3.6 V		0.5	10	nA
			Full				100	
<b>Digital Control Input (IN)</b>								
Input logic high	$V_{IH}$		Full		$V_+ \times 0.7$		5.5	V
Input logic low	$V_{IL}$		Full		0		$V_+ \times 0.3$	V
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5\text{ V or }0$	25°C	3.6 V		0.1	10	nA
			Full				20	

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**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	$t_{ON}$	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$ ,	$C_L = 50\text{ pF}$ , See <a href="#">Figure 17</a>	25°C	3.3 V	1	4.7	9.0	ns
				Full	3 V to 3.6 V	1		10.0	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$ ,	$C_L = 50\text{ pF}$ , See <a href="#">Figure 17</a>	25°C	3.3 V	1	3.2	6.3	ns
				Full	3 V to 3.6 V	1		7.0	
Output voltage during undershoot	$V_{OUTU}$	See <a href="#">Figure 24</a>			2.5	$V_{OH} - 0.3$		V	
Output voltage during overshoot	$V_{OUTO}$	See <a href="#">Figure 24</a>				$V_{OL} + 0.3$	2	V	
Break-before-make time	$t_{BBM}$	$V_{NC} = V_{NO} = V_+/2$ , $R_L = 50\ \Omega$ ,	$C_L = 50\text{ pF}$ , See <a href="#">Figure 18</a>	25°C	3.3 V	0.5	7	17	ns
				Full	3 V to 3.6 V	0.5		19.5	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ ,	$C_L = 0.1\text{ nF}$ , See <a href="#">Figure 22</a>	25°C	3.3 V		75	pC	
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF,	See <a href="#">Figure 16</a>	25°C	3.3 V		5	pF	
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON,	See <a href="#">Figure 16</a>	25°C	3.3 V		14.5	pF	
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON,	See <a href="#">Figure 16</a>	25°C	3.3 V		14.5	pF	
Digital input capacitance	$C_I$	$V_I = V_+$ or GND,	See <a href="#">Figure 16</a>	25°C	3.3 V		3.5	pF	
Bandwidth	BW	$R_L = 50\ \Omega$ , Switch ON,	See <a href="#">Figure 19</a>	25°C	3.3 V		370	MHz	
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ ,	Switch OFF, See <a href="#">Figure 20</a>	25°C	3.3 V		-60	dB	
Crosstalk	$X_{TALK}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ ,	Switch ON, See <a href="#">Figure 21</a>	25°C	3.3 V		-60	dB	
Total harmonic distortion	THD	$R_L = 600\ \Omega$ , $C_L = 50\text{ pF}$ ,	$f = 20\text{ Hz to }20\text{ kHz}$ , See <a href="#">Figure 23</a>	25°C	3.3 V		0.1	%	
<b>Supply</b>									
Positive supply current	$I_+$	$V_I = V_+$ or GND,	Switch ON or OFF	25°C	3.6 V		0.05	0.5	$\mu\text{A}$
				Full				0.75	

**Electrical Characteristics for 2.5-V Supply**
 $V_+ = 2.3 \text{ V to } 2.7 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		$T_A$	$V_+$	MIN	TYP	MAX	UNIT	
<b>Analog Switch</b>										
Analog signal range	$V_{COM}, V_{NO}, V_{NC}$					0		$V_+$	V	
Voltage undershoot	$V_{IKU}$	$0 \text{ mA} \geq (I_{NC}, I_{NO}, \text{ or } I_{COM}) \geq -50 \text{ mA}$			2.7 V				V	
Peak ON-state resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -8 \text{ mA}$ ,	Switch ON, See <a href="#">Figure 14</a>	25°C	2.3 V		13.9	30	$\Omega$	
				Full						35
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 0$ , $I_{COM} = 8 \text{ mA}$	Switch ON, See <a href="#">Figure 14</a>	25°C	2.3 V		6.6	8.5	$\Omega$	
				Full						12
		$V_{NO} \text{ or } V_{NC} = 2.3 \text{ V}$ , $I_{COM} = -8 \text{ mA}$		25°C				8.9		18
				Full						
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 1.6 \text{ V}$ , $I_{COM} = -8 \text{ mA}$ ,	Switch ON, See <a href="#">Figure 14</a>	25°C	2.3 V		0.05	0.3	$\Omega$	
Full	0.5									
ON-state resistance flatness	$r_{on(Flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -8 \text{ mA}$ ,	Switch ON, See <a href="#">Figure 14</a>	25°C	2.3 V		5	15	$\Omega$	
Full	20									
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } V_+$ , $V_{COM} = V_+ \text{ to } 0$ ,	Switch OFF, See <a href="#">Figure 15</a>	25°C	2.7 V		0.1	10	nA	
				Full						100
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 <a href="#">Figure 16</a>	25°C	2.7 V		0.1	10	nA	
				Full						10
COM ON leakage current	$I_{COM(ON)}$	$V_{NC} \text{ or } V_{NO} = \text{Open}$ , $V_{COM} = 0 \text{ to } V_+$ ,	Switch ON, See <a href="#">Figure 16</a>	25°C	2.7 V		0.1	10	nA	
				Full						100
<b>Digital Control Input (IN)</b>										
Input logic high	$V_{IH}$			Full		$V_+ \times 0.75$		5.5	V	
Input logic low	$V_{IL}$			Full		0		$V_+ \times 0.25$	V	
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5 \text{ V or } 0$		25°C	2.7 V		5	10	nA	
				Full						20

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**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	$t_{ON}$	$V_{COM} = V_+$ or GND, $R_L = 500 \Omega$ ,	$C_L = 50 \text{ pF}$ , See <a href="#">Figure 17</a>	25°C	2.5 V	2	6.2	9.6	ns
				Full	2.3 V to 2.7 V	2		12	
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ or GND, $R_L = 500 \Omega$ ,	$C_L = 50 \text{ pF}$ , See <a href="#">Figure 17</a>	25°C	2.5 V	1.5	4.5	7.0	ns
				Full	2.3 V to 2.7 V	1.5		7.5	
Output voltage during undershoot	$V_{OUTU}$	See <a href="#">Figure 24</a>			$V_{OH} - 0.3$			V	
Output voltage during overshoot	$V_{OUTO}$	See <a href="#">Figure 24</a>			$V_{OL} + 0.3$			2 V	
Break-before-make time	$t_{BBM}$	$V_{NC} = V_{NO} = V_+/2$ , $R_L = 50 \Omega$ ,	$C_L = 50 \text{ pF}$ , See <a href="#">Figure 18</a>	25°C	2.5 V	0.5	10	25	ns
				Full	2.3 V to 2.7 V	0.5		28.5	
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ ,	$C_L = 0.1 \text{ nF}$ , See <a href="#">Figure 22</a>	25°C	2.5 V	58		pC	
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF,	See <a href="#">Figure 16</a>	25°C	2.5 V	5		pF	
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON,	See <a href="#">Figure 16</a>	25°C	2.5 V	14.5		pF	
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON,	See <a href="#">Figure 16</a>	25°C	2.5 V	14.5		pF	
Digital input capacitance	$C_I$	$V_I = V_+$ or GND,	See <a href="#">Figure 16</a>	25°C	2.5 V	3.5		pF	
Bandwidth	BW	$R_L = 50 \Omega$ , Switch ON,	See <a href="#">Figure 19</a>	25°C	2.5 V	367		MHz	
OFF isolation	$O_{ISO}$	$R_L = 50 \Omega$ , $f = 10 \text{ MHz}$ ,	Switch OFF, See <a href="#">Figure 20</a>	25°C	2.5 V	-60		dB	
Crosstalk	$X_{TALK}$	$R_L = 50 \Omega$ , $f = 10 \text{ MHz}$ ,	Switch ON, See <a href="#">Figure 21</a>	25°C	2.5 V	-60		dB	
Total harmonic distortion	THD	$R_L = 600 \Omega$ , $C_L = 50 \text{ pF}$ ,	$f = 20 \text{ Hz to } 20 \text{ kHz}$ , See <a href="#">Figure 23</a>	25°C	2.5 V	0.15		%	
<b>Supply</b>									
Positive supply current	$I_+$	$V_I = V_+$ or GND,	Switch ON or OFF	25°C	2.7 V	50		100	nA
				Full		550			

PRODUCT PREVIEW



### Electrical Characteristics for 1.8-V Supply

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

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A$	$V_+$	MIN	TYP	MAX	UNIT	
<b>Analog Switch</b>									
Analog signal range	$V_{COM}, V_{NO}, V_{NC}$				0		$V_+$	V	
Voltage undershoot	$V_{IKU}$	$0 \geq (I_{NC}, I_{NO}, \text{ or } I_{COM}) \geq -50\text{ mA}$		1.95 V				V	
Peak ON-state resistance	$r_{peak}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -4\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	1.65 V		41.1	60	Ω	
			Full				120		
ON-state resistance	$r_{on}$	$V_{NO} \text{ or } V_{NC} = 0$ , $I_{COM} = 4\text{ mA}$ ,  $V_{NO} \text{ or } V_{NC} = 1.65\text{ V}$ , $I_{COM} = -4\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	1.65 V		9.2	15	Ω	
			Full				15		
			25°C				1.8		40
			Full				45		
ON-state resistance match between channels	$\Delta r_{on}$	$V_{NO} \text{ or } V_{NC} = 1.15\text{ V}$ , $I_{COM} = -4\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	1.65 V		0.1	0.6	Ω	
			Full				0.8		
ON-state resistance flatness	$r_{on(Flat)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -4\text{ mA}$ , Switch ON, See <a href="#">Figure 14</a>	25°C	1.65 V		26.5	80	Ω	
			Full				100		
NC, NO OFF leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NC} \text{ or } V_{NO} = 0 \text{ to } V_+$ , $V_{COM} = V_+ \text{ to } 0$ , Switch OFF, See <a href="#">Figure 15</a>	25°C	1.95 V		0.05	10	nA	
			Full				100		
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 <a href="#">Figure 16</a>	25°C	1.95 V		0.1	10	μA	
			Full				100		
COM ON leakage current	$I_{COM(ON)}$	$V_{NC} \text{ or } V_{NO} = \text{Open}$ , $V_{COM} = 0 \text{ to } V_+$ , Switch ON, See <a href="#">Figure 16</a>	25°C	1.95 V		0.1	10	nA	
			Full				100		
<b>Digital Control Input (IN)</b>									
Input logic high	$V_{IH}$		Full		$V_+ \times 0.75$		5.5	V	
Input logic low	$V_{IL}$		Full		0		$V_+ \times 0.25$	V	
Input leakage current	$I_{IH}, I_{IL}$	$V_I = 5.5\text{ V or }0$	25°C	1.95 V		0.05	1	nA	
			Full				20		

PRODUCT PREVIEW

**TS5A623157**  
**DUAL 10-Ω SPDT ANALOG SWITCH**  
**WITH UNDERSHOOT/OVERSHOOT VOLTAGE PROTECTION**

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**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	$t_{ON}$	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$ , $C_L = 50\text{ pF}$ , See <a href="#">Figure 17</a>	25°C	1.8 V	9.6	23	ns	
			Full	1.65 V to 1.95 V		24		
Turn-off time	$t_{OFF}$	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$ , $C_L = 50\text{ pF}$ , See <a href="#">Figure 17</a>	25°C	1.8 V	6.3	10	ns	
			Full	1.65 V to 1.95 V		12		
Output voltage during undershoot	$V_{OUTU}$	See <a href="#">Figure 24</a>			$V_{OH} - 0.3$		V	
Output voltage during overshoot	$V_{OUTO}$	See <a href="#">Figure 24</a>			$V_{OL} + 0.3$		V	
Break-before-make time	$t_{BBM}$	$V_{NC} = V_{NO} = V_+/2$ , $R_L = 50\ \Omega$ , $C_L = 50\text{ pF}$ , See <a href="#">Figure 18</a>	25°C	1.8 V	0.5	18	50	ns
			Full	1.65 V to 1.95 V	0.5	55		
Charge injection	$Q_C$	$V_{GEN} = 0$ , $R_{GEN} = 0$ , $C_L = 0.1\text{ nF}$ , See <a href="#">Figure 22</a>	25°C	1.8 V	40		pC	
NC, NO OFF capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch OFF, See <a href="#">Figure 16</a>	25°C	1.8 V	5.0		pF	
NC, NO ON capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$	$V_{NC}$ or $V_{NO} = V_+$ or GND, Switch ON, See <a href="#">Figure 16</a>	25°C	1.8 V	14.5		pF	
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON, See <a href="#">Figure 16</a>	25°C	1.8 V	14.5		pF	
Digital input capacitance	$C_I$	$V_I = V_+$ or GND, See <a href="#">Figure 16</a>	25°C	1.8 V	3.5		pF	
Bandwidth	BW	$R_L = 50\ \Omega$ , Switch ON, See <a href="#">Figure 19</a>	25°C	1.8 V	369		MHz	
OFF isolation	$O_{ISO}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ , Switch OFF, See <a href="#">Figure 20</a>	25°C	1.8 V	-60		dB	
Crosstalk	$X_{TALK}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$ , Switch ON, See <a href="#">Figure 21</a>	25°C	1.8 V	-60		dB	
Total harmonic distortion	THD	$R_L = 600\ \Omega$ , $C_L = 50\text{ pF}$ , $f = 20\text{ Hz to }20\text{ kHz}$ , See <a href="#">Figure 23</a>	25°C	1.8 V	0.4		%	
<b>Supply</b>								
Positive supply current	$I_+$	$V_I = V_+$ or GND, Switch ON or OFF	25°C	1.95 V	0.1	50	nA	
			Full		400			

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**PIN DESCRIPTION**

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

**PARAMETER DESCRIPTION**

SYMBOL	DESCRIPTION
$V_{COM}$	Voltage at COM
$V_{NC}$	Voltage at NC
$V_{NO}$	Voltage at NO
$r_{on}$	Resistance between COM and NC or COM and NO ports when the channel is ON
$\Delta r_{on}$	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 control input (IN)
$I_{IH}, I_{IL}$	Leakage current measured at control input (IN)
$t_{ON}$	Turn-on time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog outputs (COM/NC/NO) signal when the switch is turning ON.
$t_{OFF}$	Turn-off time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog 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 (=) 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 $\Delta V_O$ is the change in analog output voltage.
$C_{NC(OFF)}$	Capacitance at the NC port when the corresponding channel (NC to COM) is OFF
$C_{NO(OFF)}$	Capacitance at the NO port when the corresponding channel (NC to COM) is OFF
$C_{NC(ON)}$	Capacitance at the NC port when the corresponding channel (NC to COM) is ON
$C_{NO(ON)}$	Capacitance at the NO port when the corresponding channel (NC 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
$C_1$	Capacitance of control input (IN)
$O_{ISO}$	OFF isolation of the switch is a measurement of OFF-state switch impedance. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM or NO to COM) in the OFF state.

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**PARAMETER DESCRIPTION (continued)**

<b>SYMBOL</b>	<b>DESCRIPTION</b>
$X_{\text{TALK}}$	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.
BW	Bandwidth of the switch. This is the frequency where 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
$V_{\text{OUTU}}$	Output voltage during an undershoot event. This is measured by turning off a specific channel and applying an undershoot voltage at the input of the switch.
$V_{\text{OUTO}}$	Output voltage during an overshoot event. This is measured by turning off a specific channel and applying an overshoot voltage at the input of the switch.

TYPICAL CHARACTERISTICS

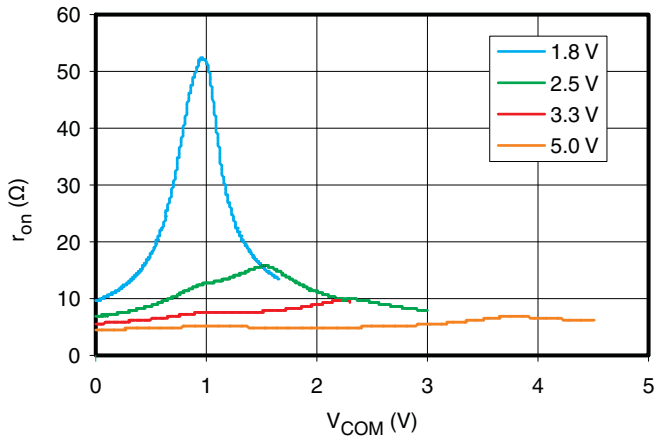


Figure 1.  $r_{ON}$  vs  $V_{COM}$

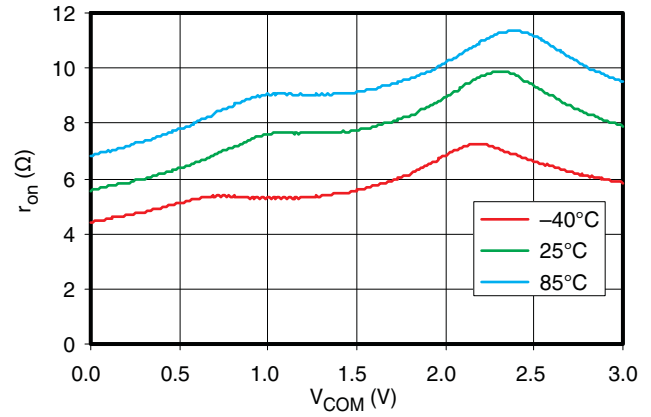


Figure 2.  $r_{ON}$  vs  $V_{COM}$  ( $V_+ = 3.3$  V)

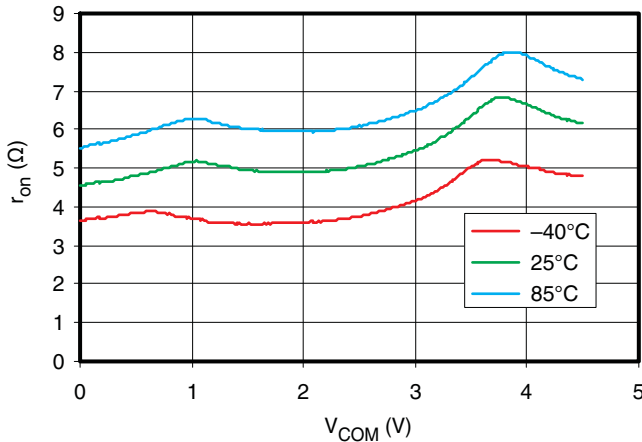


Figure 3.  $r_{ON}$  vs  $V_{COM}$  ( $V_+ = 5$  V)

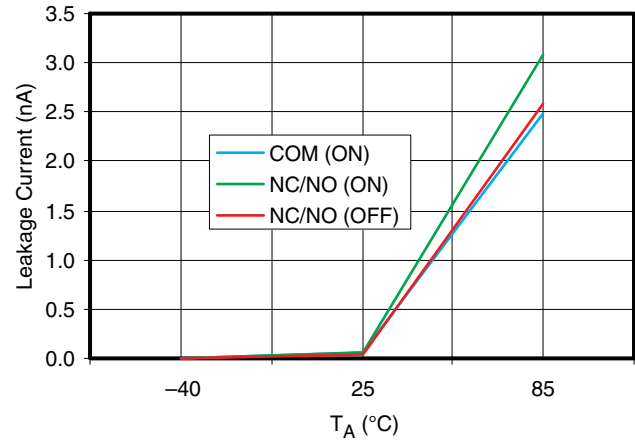


Figure 4. Leakage Current vs Temperature

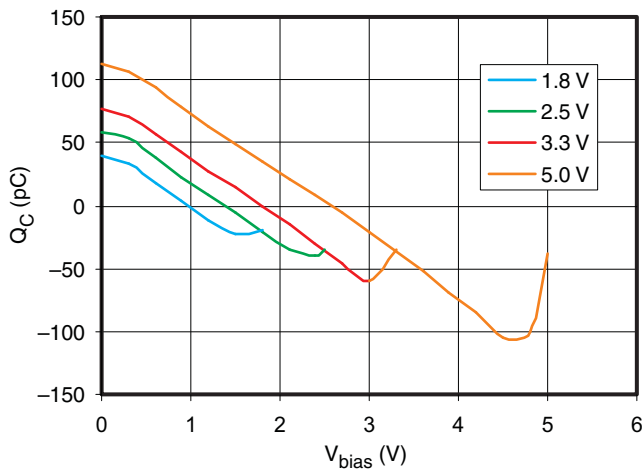


Figure 5. Charge Injection vs  $V_{COM}$

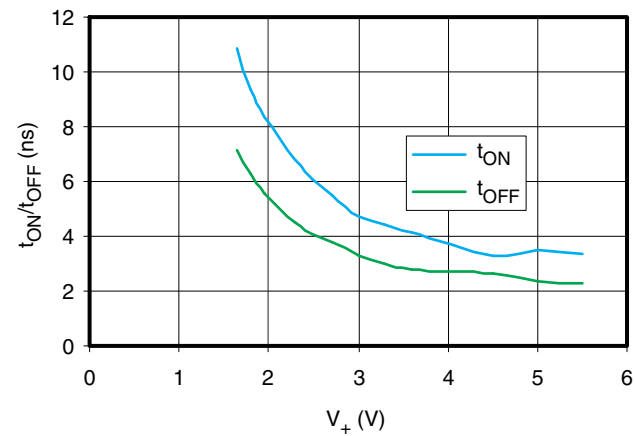
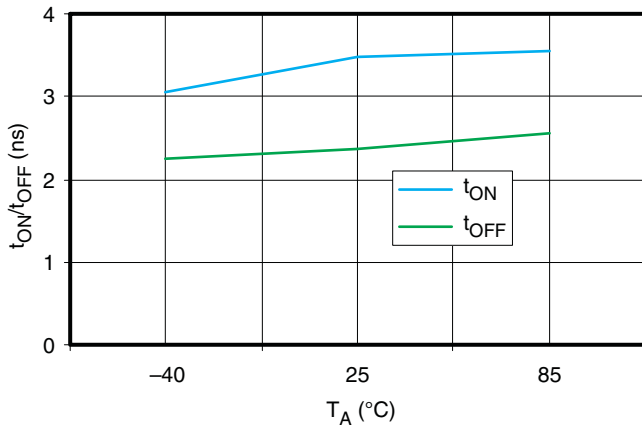


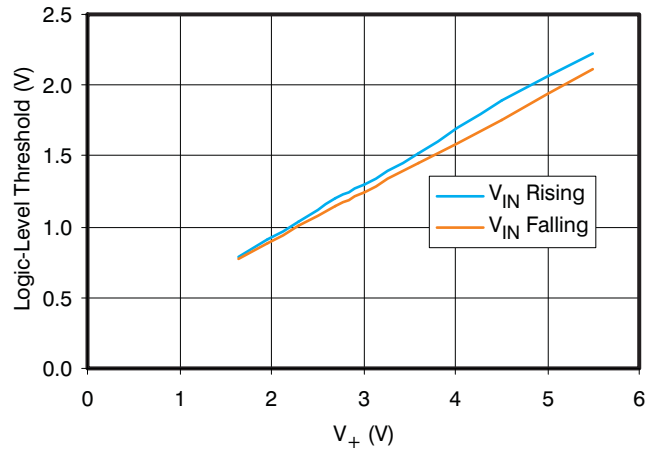
Figure 6.  $t_{ON}$  and  $t_{OFF}$  vs Supply Voltage

PRODUCT PREVIEW

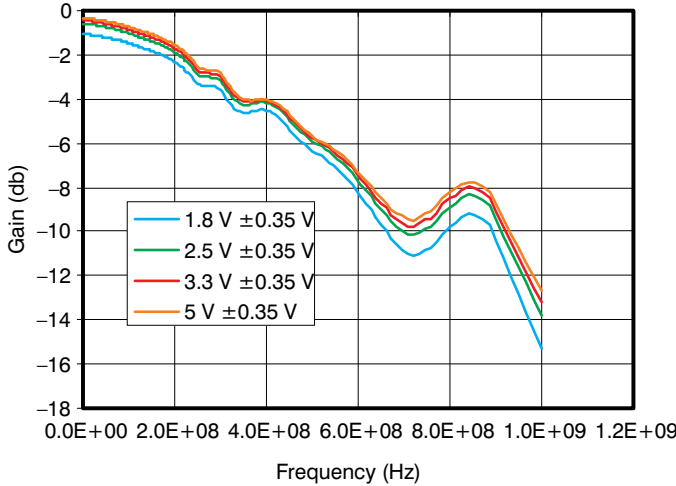
**TYPICAL CHARACTERISTICS (continued)**



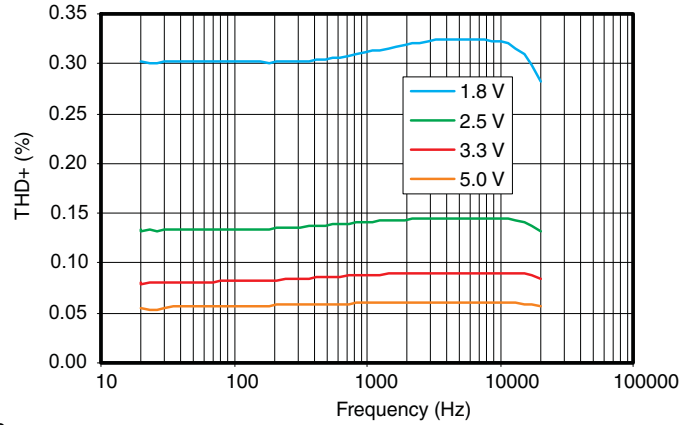
**Figure 7.  $t_{ON}$  and  $t_{OFF}$  vs Temperature**



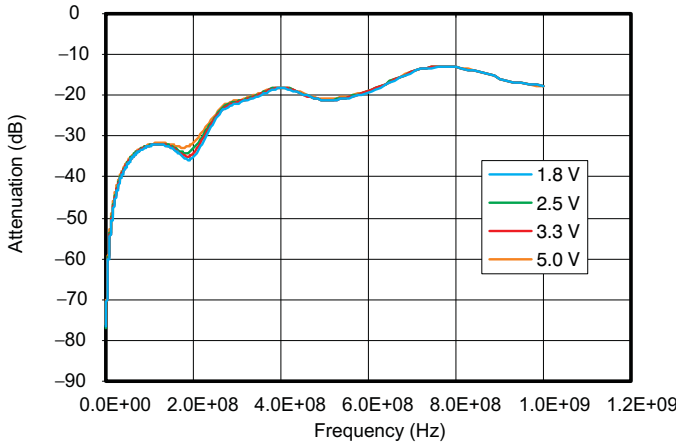
**Figure 8. Logic-Level Threshold**



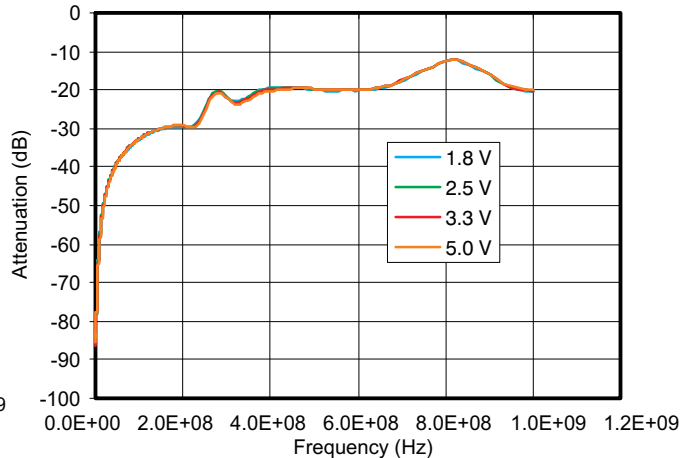
**Figure 9. Bandwidth (BW)**



**Figure 10. Total Harmonic Distortion (THD) vs Frequency**



**Figure 11. Off Isolation**



**Figure 12. Crosstalk**

**PRODUCT PREVIEW**

TYPICAL CHARACTERISTICS (continued)

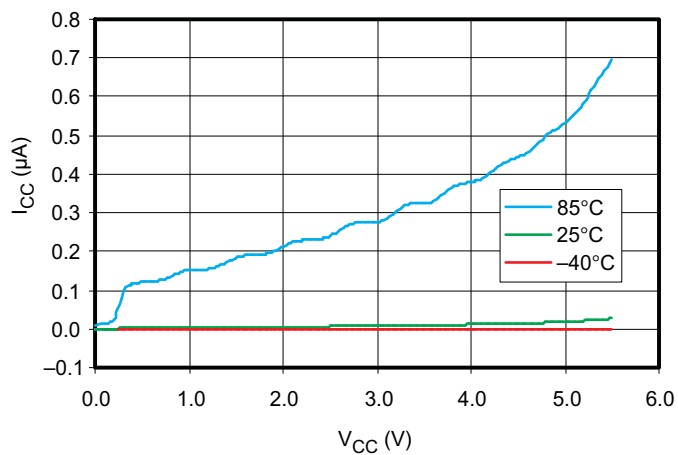


Figure 13. Supply Current vs Supply Voltage

PARAMETER MEASUREMENT INFORMATION

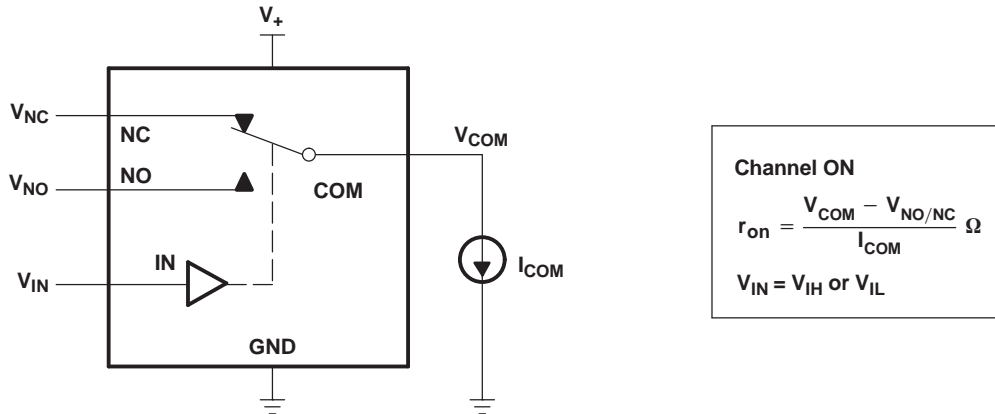


Figure 14. ON-State Resistance ( $r_{on}$ )

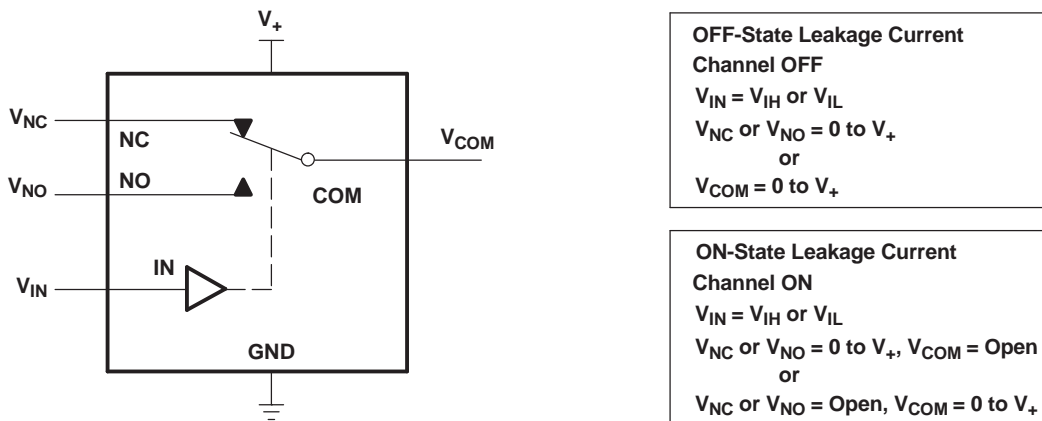


Figure 15. ON- and OFF-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(OFF)}$ ,  $I_{NO(OFF)}$ ,  $I_{NC(ON)}$ ,  $I_{NO(ON)}$ )

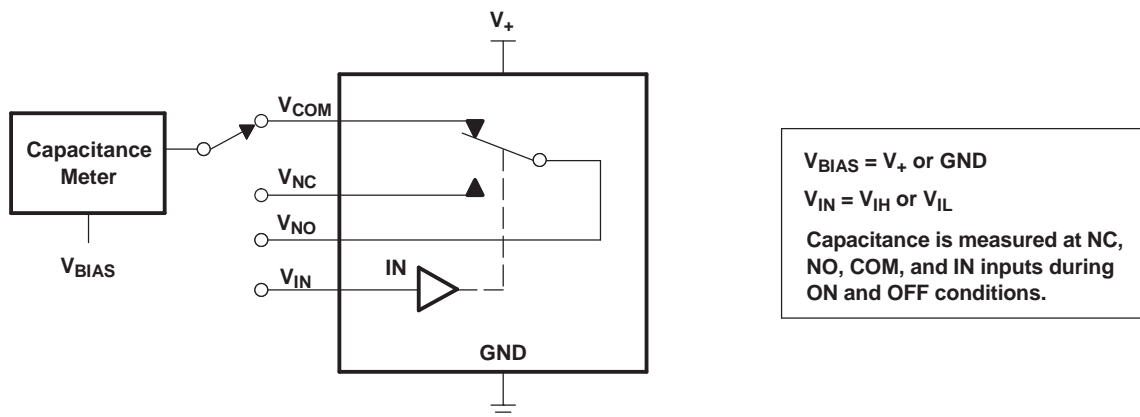
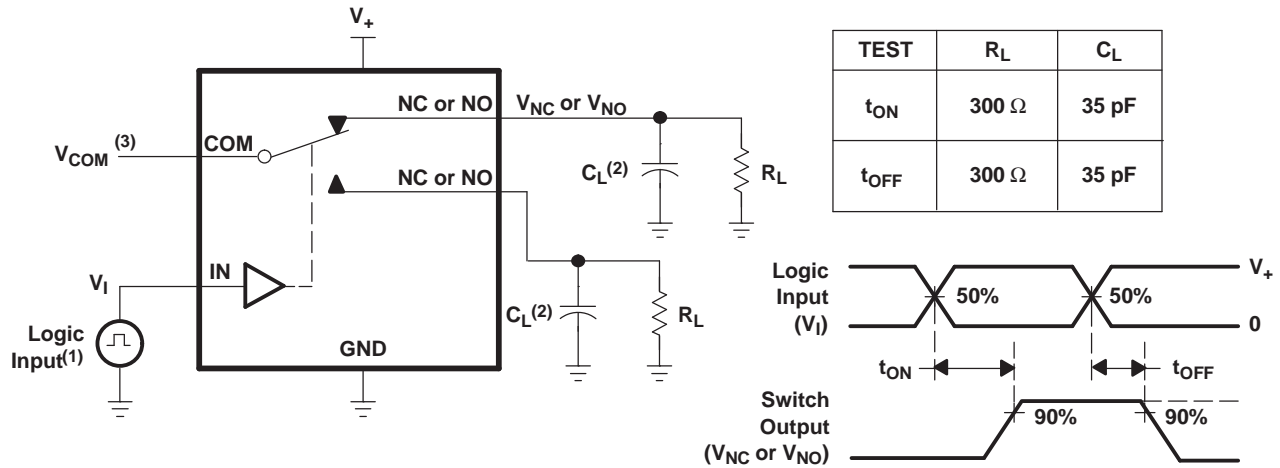


Figure 16. Capacitance ( $C_{IN}$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NO(OFF)}$ ,  $C_{NC(ON)}$ ,  $C_{NO(ON)}$ )



PARAMETER MEASUREMENT INFORMATION (continued)



- (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 Characteristic for V<sub>COM</sub>.

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

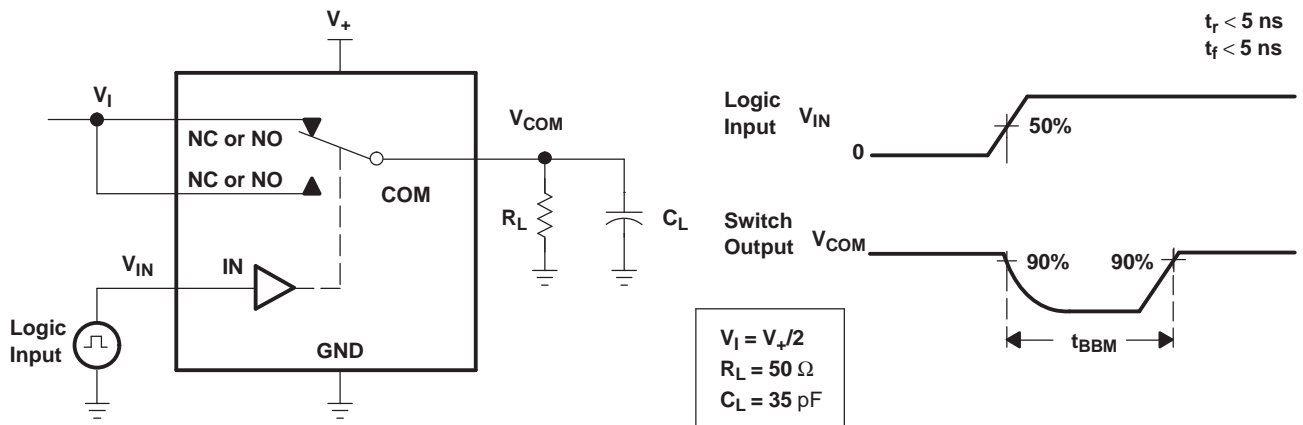


Figure 18. Break-Before-Make (t<sub>BBM</sub>) Time

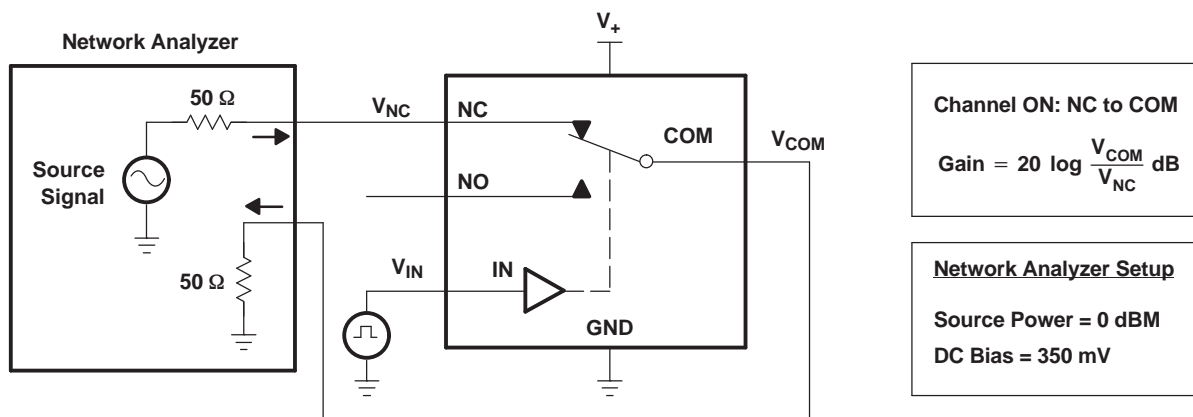
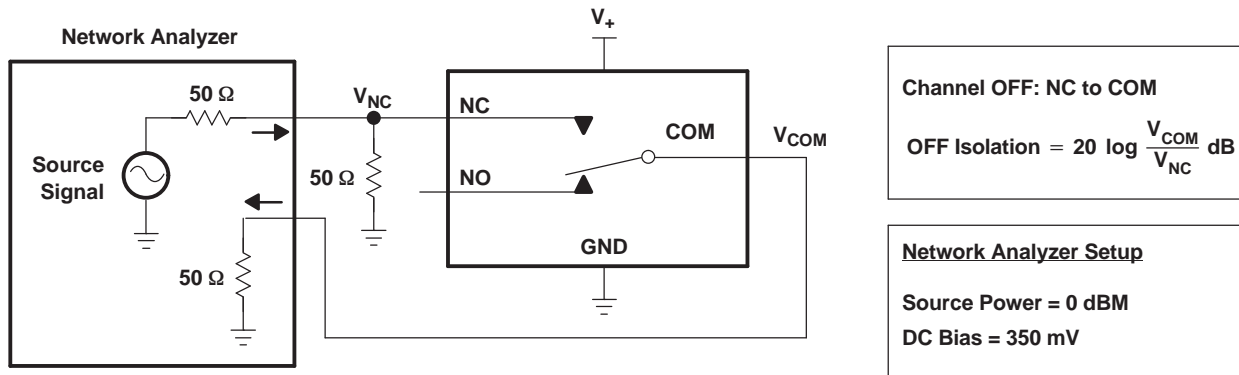
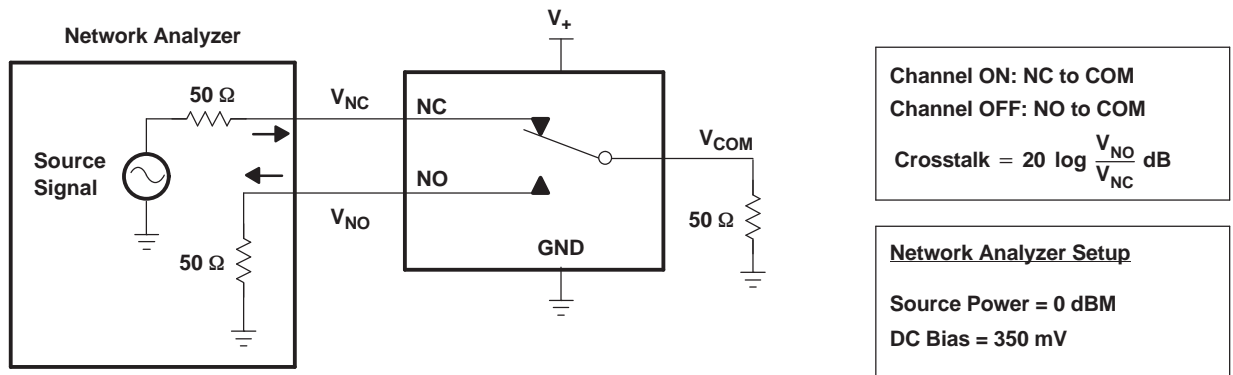


Figure 19. Frequency Response (BW)

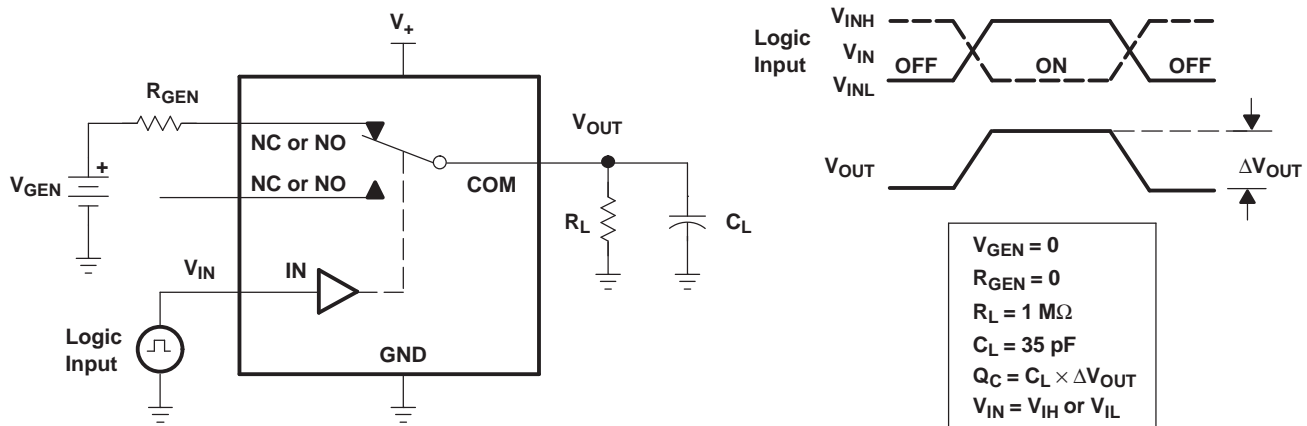
**PARAMETER MEASUREMENT INFORMATION (continued)**



**Figure 20. OFF Isolation ( $O_{ISO}$ )**



**Figure 21. Crosstalk ( $X_{TALK}$ )**



**Figure 22. Charge Injection ( $Q_C$ )**

**PRODUCT PREVIEW**

PARAMETER MEASUREMENT INFORMATION (continued)

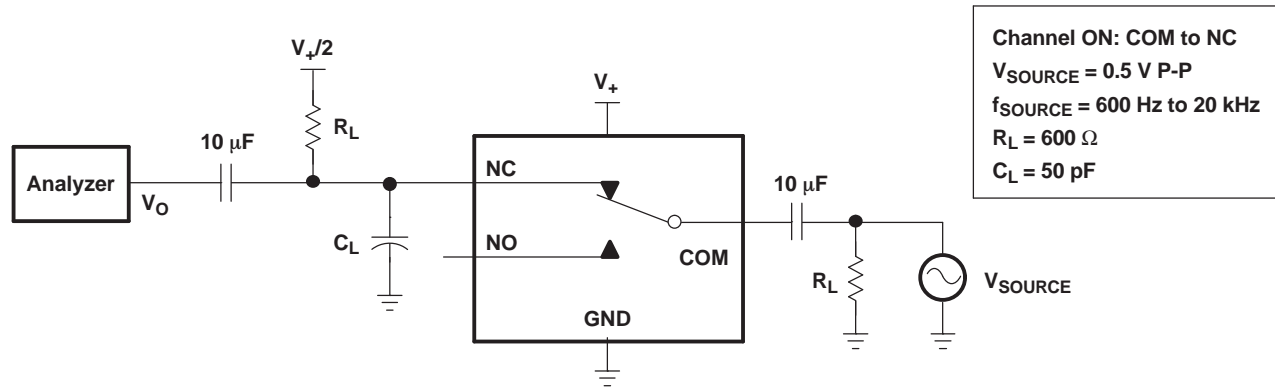
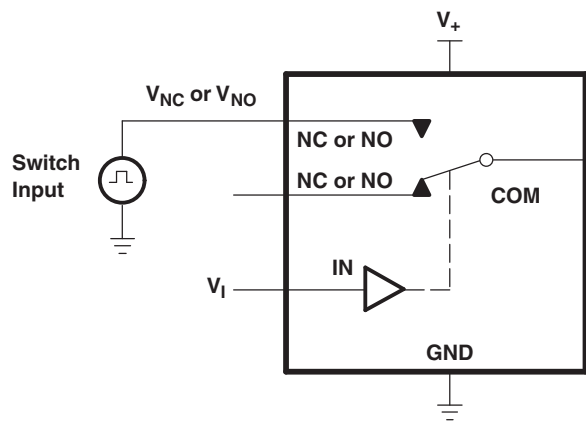


Figure 23. Total Harmonic Distortion (THD)



TEST	$R_L$	$C_L$	$V_{TR}$	$V_I$
$V_{OUTU}$	100 kΩ	10 pF	7 V	$V_+$ or GND Switch OFF
$V_{OUTO}$	100 kΩ	10 pF	GND	$V_+$ or GND Switch OFF

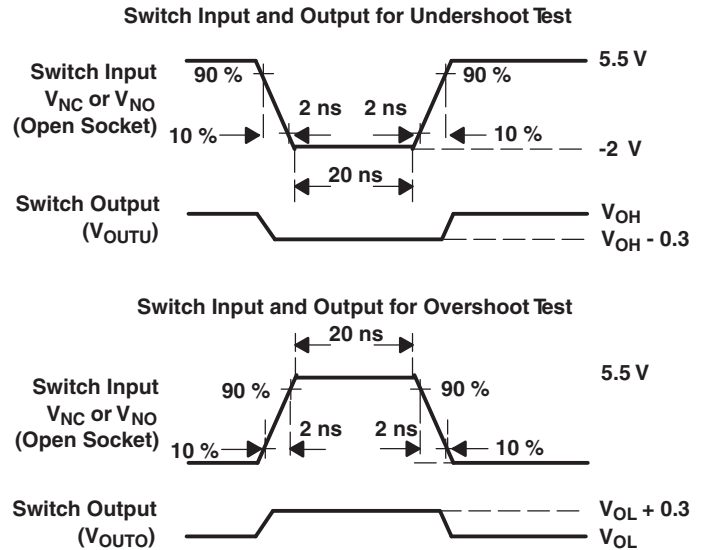


Figure 24. Undershoot and Overshoot Test

PRODUCT PREVIEW

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TS5A623157DGSR	ACTIVE	VSSOP	DGS	10	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	35R	Samples

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

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

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

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TS5A623157DGSR	VSSOP	DGS	10	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS5A623157DGSR	VSSOP	DGS	10	2500	358.0	335.0	35.0

# DGS0010A



# PACKAGE OUTLINE

## VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



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### NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- Reference JEDEC registration MO-187, variation BA.



# EXAMPLE BOARD LAYOUT

DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:10X

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NOTES: (continued)

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

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