

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

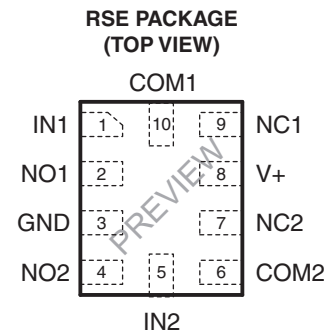
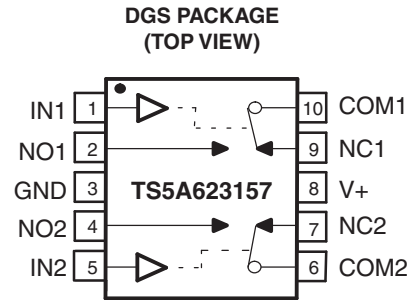
T _A	PACKAGE ⁽¹⁾⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	VSSOP (MSOP-10) – DGS	Tape and reel	TS5A623157DGSR	35R
	QFN – RSE	Tape and reel	TS5A623157RSER	PREVIEW

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

(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.

FUNCTION TABLE

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



PRODUCT PREVIEW



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

SCDS253–SEPTEMBER 2007

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 (Δr_{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⁽¹⁾⁽²⁾

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

		MIN	MAX	UNIT
V_+	Supply voltage range ⁽³⁾	−0.5	6.5	V
V_{NC} V_{NO} V_{COM}	Analog voltage range ⁽³⁾⁽⁴⁾⁽⁵⁾	−0.5	$V_+ + 0.5$	V
$I_{I/O}$	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 ⁽³⁾⁽⁴⁾	−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
θ_{JA}	Package thermal impedance ⁽¹⁾	
	DGS package	165 °C/W
	RSE package	243

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

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
Analog Switch									
Analog signal range	V _{COM} , V _{NO} , V _{NC}					0		V ₊	V
Voltage undershoot	V _{IKU}	0 ≥ (I _{NC} , I _{NO} , or I _{COM}) ≥ −50 mA			5.5 V			−2	V
Peak ON-state resistance	r _{peak}	0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −30 mA,	Switch ON, See Figure 14	25°C	4.5 V	4.6		11	Ω
				Full				13	
ON-state resistance	r _{on}	V _{NO} or V _{NC} = 0, I _{COM} = 30 mA	Switch ON, See Figure 14	25°C	4.5 V	4		6.5	Ω
				Full				8	
		V _{NO} or V _{NC} = 2.4 V, I _{COM} = −30 mA		25°C		4		8	
				Full				10	
		V _{NO} or V _{NC} = 4.5 V, I _{COM} = −30 mA		25°C		5.5		10	
				Full				12	
ON-state resistance match between channels	Δr _{on}	V _{NO} or V _{NC} = 3.15 V, I _{COM} = −30 mA,	Switch ON, See Figure 14	25°C	4.5 V	0.1		0.14	Ω
				Full				0.15	
ON-state resistance flatness	r _{on(flat)}	0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −30 mA,	Switch ON, See Figure 14	25°C	4.5 V	1.5		2	Ω
				Full				4	
NC, NO OFF leakage current	I _{NC(OFF)} , I _{NO(OFF)}	V _{NC} or V _{NO} = 0 to V ₊ , V _{COM} = V ₊ to 0	Switch OFF, See Figure 15	25°C	5.5 V	1		20	nA
				Full				150	
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 16	25°C	5.5 V	1		20	nA
				Full				150	
COM ON leakage current	I _{COM(ON)}	V _{NC} or V _{NO} = Open, V _{COM} = 0 to V ₊ ,	Switch ON, See Figure 16	25°C	5.5 V	1		20	nA
				Full				150	
Digital Control Input (IN)									
Input logic high	V _{IH}			Full		V ₊ × 0.7		5.5	V
Input logic low	V _{IL}			Full		0		V ₊ × 0.3	V
Input leakage current	I _{IH} , I _{IL}	V _I = 5.5 V or 0		25°C	5.5 V	0.1		10	nA
				Full				30	

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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
Dynamic								
Turn-on time	t_{ON}	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$, $C_L = 50\text{ pF}$, See Figure 17	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 Figure 17	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 Figure 24			2.5	$V_{OH} - 0.3$		V
Output voltage during overshoot	V_{OUTO}	See Figure 24				$V_{OL} + 0.3$	2	V
Break-before-make time	t_{BBM}	$V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, $C_L = 50\text{ pF}$, See Figure 18	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 Figure 22	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 Figure 16	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 Figure 16	25°C	5 V		14.5		pF
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON, See Figure 16	25°C	5 V		14.5		pF
Digital input capacitance	C_I	$V_I = V_+$ or GND, See Figure 16	25°C	5 V		3.5		pF
Bandwidth	BW	$R_L = 50\ \Omega$, Switch ON, See Figure 19	25°C	5 V		371		MHz
OFF isolation	O_{ISO}	$R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch OFF, See Figure 20	25°C	5 V		-61		dB
Crosstalk	X_{TALK}	$R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch ON, See Figure 21	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 Figure 23	25°C	5 V		0.06		%
Supply								
Positive supply current	I_+	$V_I = V_+$ or GND, Switch ON or OFF	25°C	5.5 V		0.01	0.15	μA
			Full				1.2	

Electrical Characteristics for 3.3-V Supply

$V_+ = 3\text{ V}$ to 3.6 V , $T_A = -40^\circ\text{C}$ 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
Voltage undershoot	V _{IKU}	0 ≥ (I _{NC} , I _{NO} , or I _{COM}) ≥ −50 mA			3.6 V				V
Peak ON-state resistance	r _{peak}	0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −24 mA,	Switch ON, See Figure 14	25°C	3 V	8.9		14	Ω
				Full				18	
ON-state resistance	r _{on}	V _{NO} or V _{NC} = 0, I _{COM} = 24 mA	Switch ON, See Figure 14	25°C	3 V	5.4		8	Ω
				Full				10	
		V _{NO} or V _{NC} = 3 V, I _{COM} = −24 mA		25°C		7.4		12	
				Full				15	
ON-state resistance match between channels	Δr _{on}	V _{NO} or V _{NC} = 2.1 V, I _{COM} = −24 mA,	Switch ON, See Figure 14	25°C	3 V	0.1		0.2	Ω
				Full				0.2	
ON-state resistance flatness	r _{on(flat)}	0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −24 mA,	Switch ON, See Figure 14	25°C	3 V	2.8		4	Ω
				Full				7	
NC, NO OFF leakage current	I _{NC(OFF)} , I _{NO(OFF)}	V _{NC} or V _{NO} = 0 to V ₊ , V _{COM} = V ₊ to 0	Switch OFF, See Figure 15	25°C	3.6 V	0.5		10	nA
				Full				100	
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 16	25°C	3.6 V	0.5		10	nA
				Full				100	
COM ON leakage current	I _{COM(ON)}	V _{NC} or V _{NO} = Open, V _{COM} = 0 to V ₊ ,	Switch ON, See Figure 16	25°C	3.6 V	0.5		10	nA
				Full				100	
Digital Control Input (IN)									
Input logic high	V _{IH}			Full		V ₊ × 0.7		5.5	V
Input logic low	V _{IL}			Full		0		V ₊ × 0.3	V
Input leakage current	I _{IH} , I _{IL}	V _I = 5.5 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 V , $T_A = -40^\circ\text{C}$ to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	T_A	V_+	MIN	TYP	MAX	UNIT
Dynamic								
Turn-on time	t_{ON}	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$, $C_L = 50\text{ pF}$, See Figure 17	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 Figure 17	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 Figure 24			2.5	$V_{OH} - 0.3$		V
Output voltage during overshoot	V_{OUTO}	See Figure 24				$V_{OL} + 0.3$	2	V
Break-before-make time	t_{BBM}	$V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, $C_L = 50\text{ pF}$, See Figure 18	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 Figure 22	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 Figure 16	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 Figure 16	25°C	3.3 V		14.5		pF
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON, See Figure 16	25°C	3.3 V		14.5		pF
Digital input capacitance	C_I	$V_I = V_+$ or GND, See Figure 16	25°C	3.3 V		3.5		pF
Bandwidth	BW	$R_L = 50\ \Omega$, Switch ON, See Figure 19	25°C	3.3 V		370		MHz
OFF isolation	O_{ISO}	$R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch OFF, See Figure 20	25°C	3.3 V		-60		dB
Crosstalk	X_{TALK}	$R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch ON, See Figure 21	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 kHz , See Figure 23	25°C	3.3 V		0.1		%
Supply								
Positive supply current	I_+	$V_I = V_+$ or GND, Switch ON or OFF	25°C	3.6 V		0.05	0.5	μA
			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
Analog Switch									
Analog signal range	V _{COM} , V _{NO} , V _{NC}					0		V ₊	V
Voltage undershoot	V _{IKU}	0 mA ≥ (I _{NC} , I _{NO} , or I _{COM}) ≥ −50 mA			2.7 V				V
Peak ON-state resistance	r _{peak}	0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −8 mA,	Switch ON, See Figure 14	25°C Full	2.3 V	13.9 30		30 35	Ω
ON-state resistance	r _{on}	V _{NO} or V _{NC} = 0, I _{COM} = 8 mA	Switch ON, See Figure 14	25°C	2.3 V	6.6		8.5	Ω
				Full		12			
		V _{NO} or V _{NC} = 2.3 V, I _{COM} = −8 mA		25°C		8.9		18	
				Full				25	
ON-state resistance match between channels	Δr _{on}	V _{NO} or V _{NC} = 1.6 V, I _{COM} = −8 mA,	Switch ON, See Figure 14	25°C	2.3 V	0.05		0.3	Ω
				Full		0.5			
ON-state resistance flatness	r _{on(flat)}	0 ≤ (V _{NO} or V _{NC}) ≤ V ₊ , I _{COM} = −8 mA,	Switch ON, See Figure 14	25°C Full	2.3 V	5 20		15 20	Ω
NC, NO OFF leakage current	I _{NC(OFF)} , I _{NO(OFF)}	V _{NC} or V _{NO} = 0 to V ₊ , V _{COM} = V ₊ to 0,	Switch OFF, See Figure 15	25°C Full	2.7 V	0.1 100		10 100	nA
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 16	25°C Full	2.7 V	0.1 10		10 10	nA
COM ON leakage current	I _{COM(ON)}	V _{NC} or V _{NO} = Open, V _{COM} = 0 to V ₊ ,	Switch ON, See Figure 16	25°C Full	2.7 V	0.1 100		10 100	nA
Digital Control Input (IN)									
Input logic high	V _{IH}			Full		V ₊ × 0.75		5.5	V
Input logic low	V _{IL}			Full		0		V ₊ × 0.25	V
Input leakage current	I _{IH} , I _{IL}	V _I = 5.5 V or 0		25°C Full	2.7 V	5		10 20	nA

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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
Dynamic									
Turn-on time	t _{ON}	V _{COM} = V ₊ or GND, R _L = 500 Ω,	C _L = 50 pF, See Figure 17	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 Ω,	C _L = 50 pF, See Figure 17	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 Figure 24				V _{OH} – 0.3			V
Output voltage during overshoot	V _{OUTO}	See Figure 24				V _{OL} + 0.3			V
Break-before-make time	t _{BBM}	V _{NC} = V _{NO} = V ₊ /2, R _L = 50 Ω,	C _L = 50 pF, See Figure 18	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 nF, See Figure 22	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 Figure 16	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 Figure 16	25°C	2.5 V	14.5			pF
COM ON capacitance	C _{COM(ON)}	V _{COM} = V ₊ or GND, Switch ON,	See Figure 16	25°C	2.5 V	14.5			pF
Digital input capacitance	C _I	V _I = V ₊ or GND,	See Figure 16	25°C	2.5 V	3.5			pF
Bandwidth	BW	R _L = 50 Ω, Switch ON,	See Figure 19	25°C	2.5 V	367			MHz
OFF isolation	O _{ISO}	R _L = 50 Ω, f = 10 MHz,	Switch OFF, See Figure 20	25°C	2.5 V	–60			dB
Crosstalk	X _{TALK}	R _L = 50 Ω, f = 10 MHz,	Switch ON, See Figure 21	25°C	2.5 V	–60			dB
Total harmonic distortion	THD	R _L = 600 Ω, C _L = 50 pF,	f = 20 Hz to 20 kHz, See Figure 23	25°C	2.5 V	0.15			%
Supply									
Positive supply current	I ₊	V _I = V ₊ or GND, Switch ON or OFF	25°C	2.7 V	50			100	nA
			Full					550	

Electrical Characteristics for 1.8-V Supply

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

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

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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
Dynamic								
Turn-on time	t_{ON}	$V_{COM} = V_+$ or GND, $R_L = 500\ \Omega$, $C_L = 50\text{ pF}$, See Figure 17	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 Figure 17	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 Figure 24				$V_{OH} - 0.3$		V
Output voltage during overshoot	V_{OUTO}	See Figure 24				$V_{OL} + 0.3$		V
Break-before-make time	t_{BBM}	$V_{NC} = V_{NO} = V_+/2$, $R_L = 50\ \Omega$, $C_L = 50\text{ pF}$, See Figure 18	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 Figure 22	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 Figure 16	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 Figure 16	25°C	1.8 V		14.5		pF
COM ON capacitance	$C_{COM(ON)}$	$V_{COM} = V_+$ or GND, Switch ON, See Figure 16	25°C	1.8 V		14.5		pF
Digital input capacitance	C_I	$V_I = V_+$ or GND, See Figure 16	25°C	1.8 V		3.5		pF
Bandwidth	BW	$R_L = 50\ \Omega$, Switch ON, See Figure 19	25°C	1.8 V		369		MHz
OFF isolation	O_{ISO}	$R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch OFF, See Figure 20	25°C	1.8 V		-60		dB
Crosstalk	X_{TALK}	$R_L = 50\ \Omega$, $f = 10\text{ MHz}$, Switch ON, See Figure 21	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 Figure 23	25°C	1.8 V		0.4		%
Supply								
Positive supply current	I_+	$V_I = V_+$ or GND, Switch ON or OFF	25°C	1.95 V		0.1	50	nA
			Full				400	

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
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 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 ΔV_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_I	Capacitance of control input (IN)
O_{ISO}	OFF isolation of the switch is a measurement of OFF-state switch impedance. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM or NO to COM) in the OFF state.

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PARAMETER DESCRIPTION (continued)

SYMBOL	DESCRIPTION
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.
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 _{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 _{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.

PRODUCT PREVIEW

TYPICAL CHARACTERISTICS

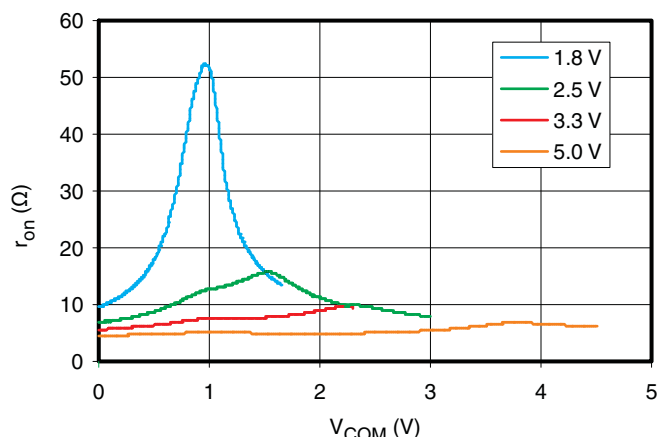


Figure 1. r_{ON} vs V_{COM}

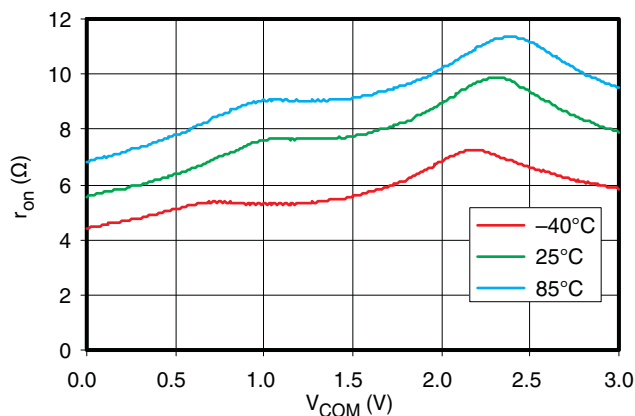


Figure 2. r_{ON} vs V_{COM} ($V_+ = 3.3$ V)

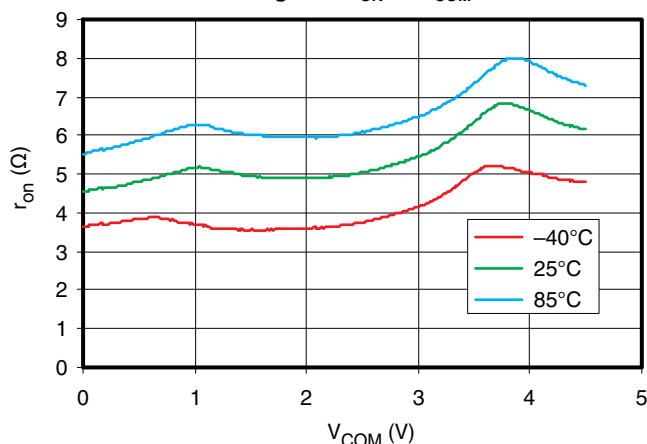


Figure 3. r_{ON} vs V_{COM} ($V_+ = 5$ V)

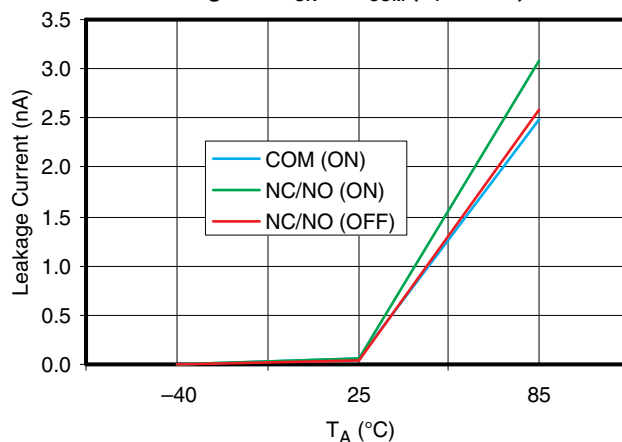


Figure 4. Leakage Current vs Temperature

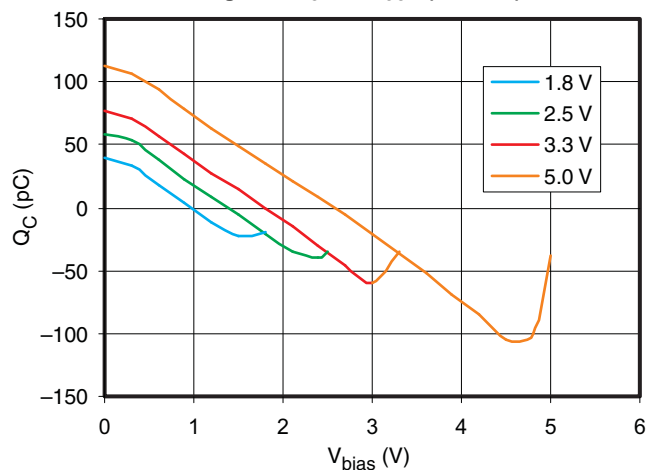


Figure 5. Charge Injection vs V_{COM}

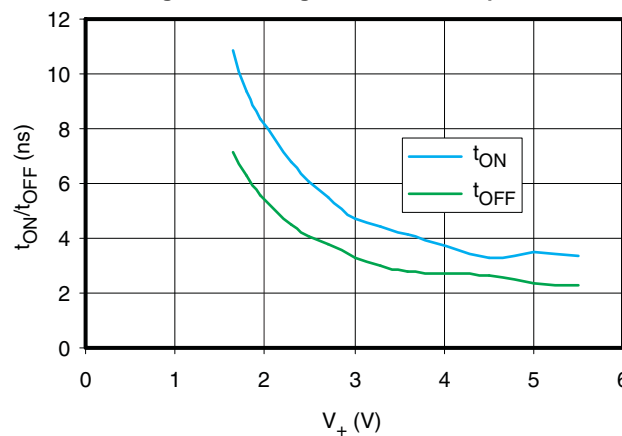


Figure 6. t_{ON} and t_{OFF} vs Supply Voltage

PRODUCT PREVIEW

TYPICAL CHARACTERISTICS (continued)

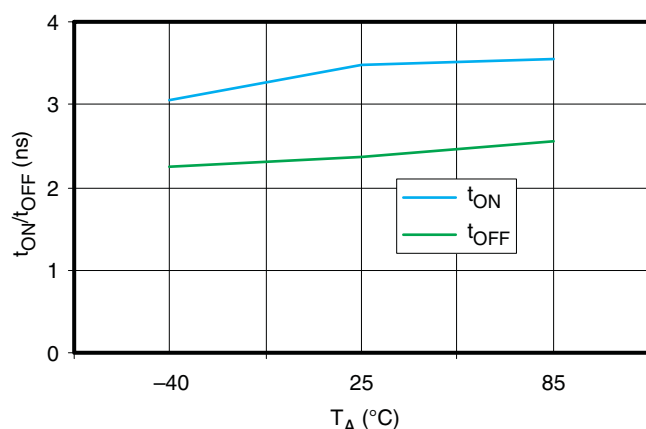


Figure 7. t_{ON} and t_{OFF} vs Temperature

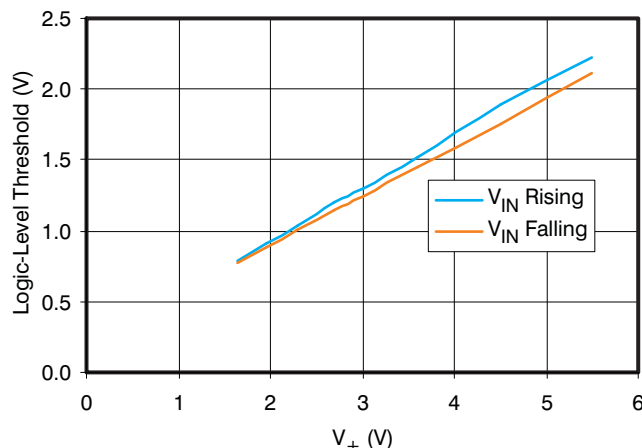


Figure 8. Logic-Level Threshold

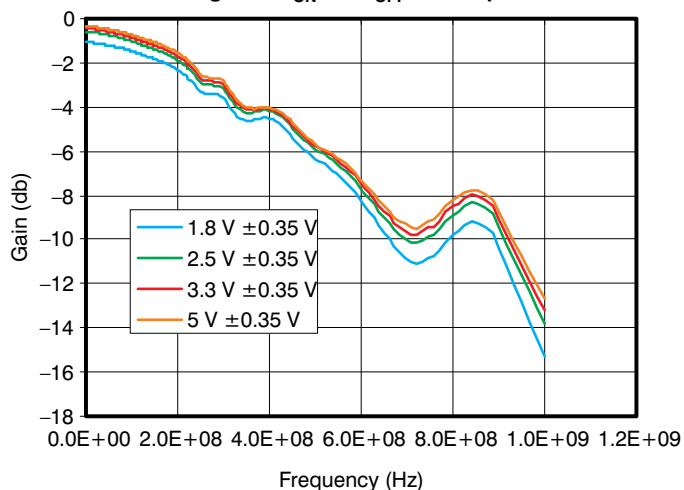


Figure 9. Bandwidth (BW)

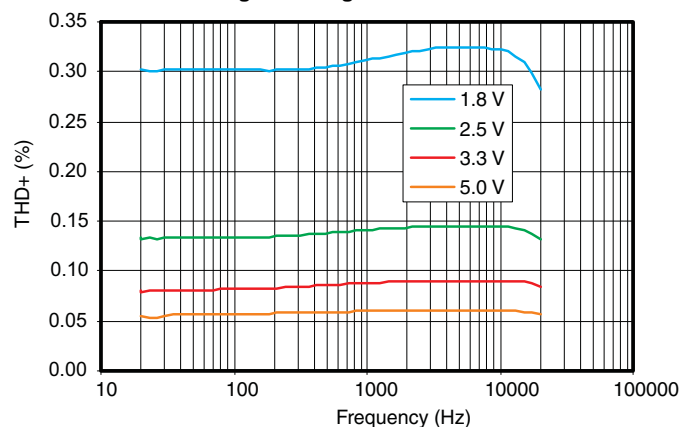


Figure 10. Total Harmonic Distortion (THD) vs Frequency

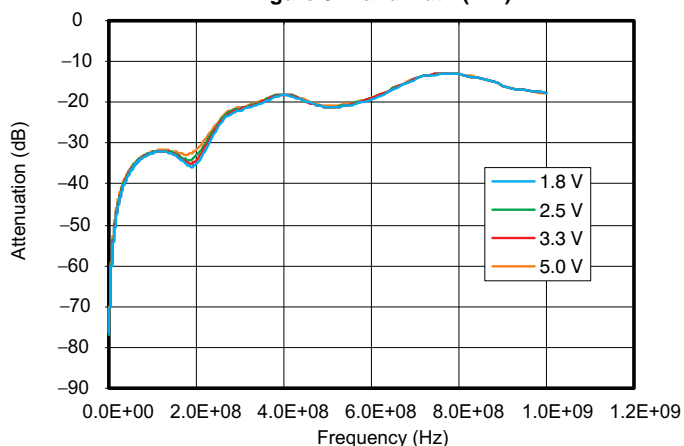


Figure 11. Off Isolation

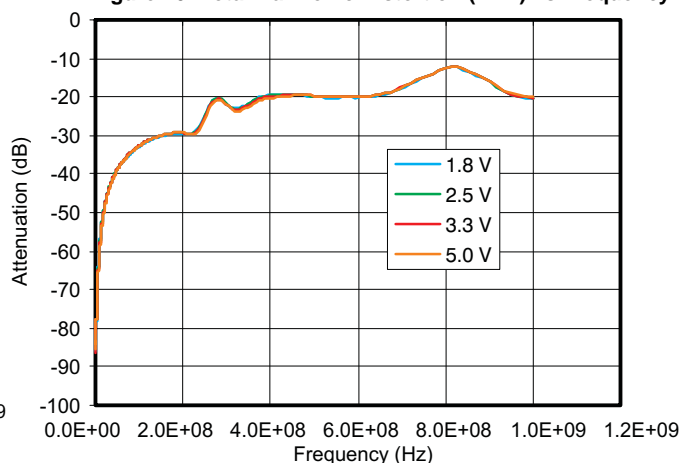


Figure 12. Crosstalk

TYPICAL CHARACTERISTICS (continued)

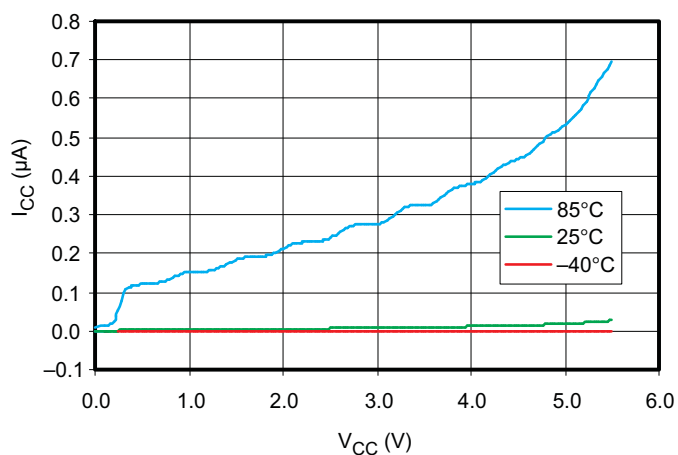


Figure 13. Supply Current vs Supply Voltage

PARAMETER MEASUREMENT INFORMATION

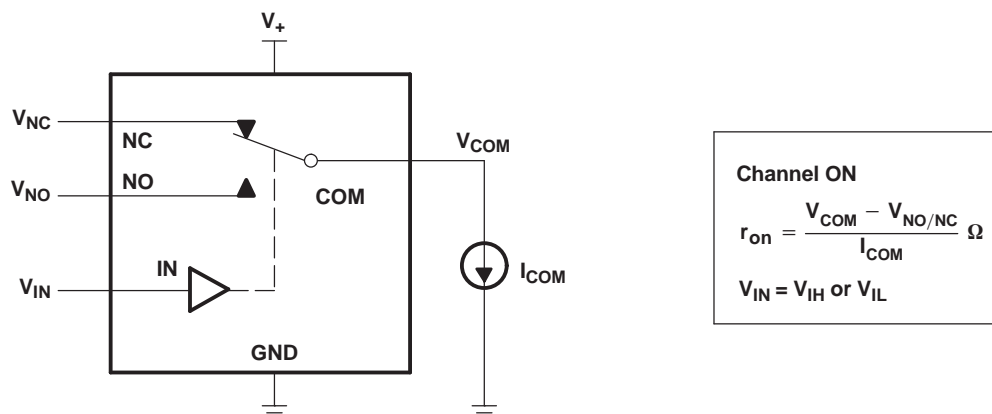


Figure 14. ON-State Resistance (r_{on})

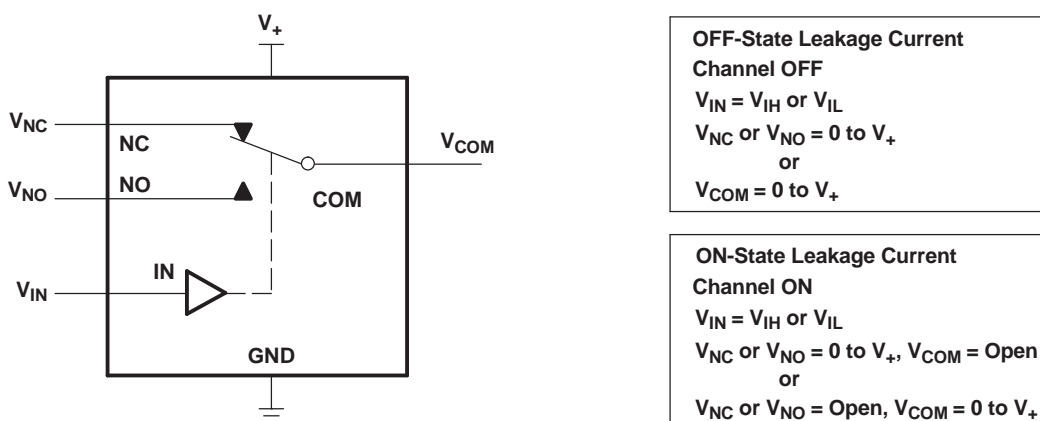


Figure 15. ON- and OFF-State Leakage Current ($I_{COM(ON)}$, $I_{NC(OFF)}$, $I_{NO(OFF)}$, $I_{NC(ON)}$, $I_{NO(ON)}$)

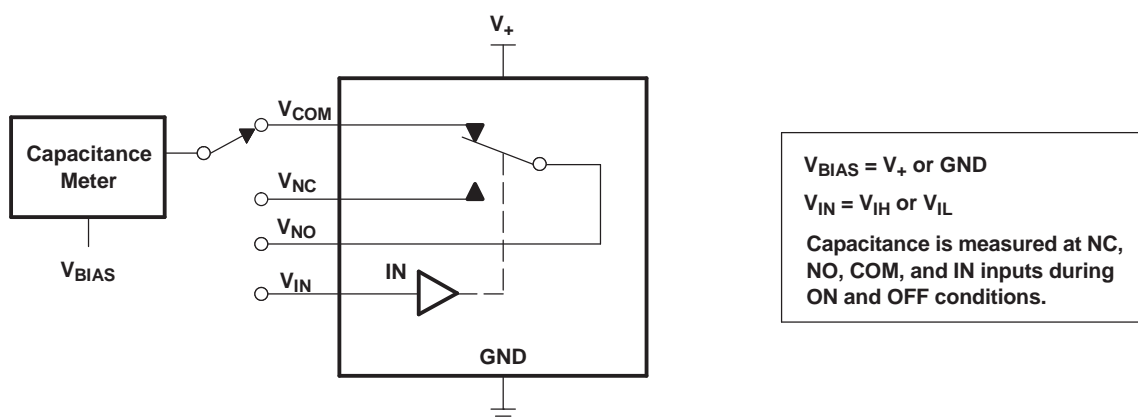
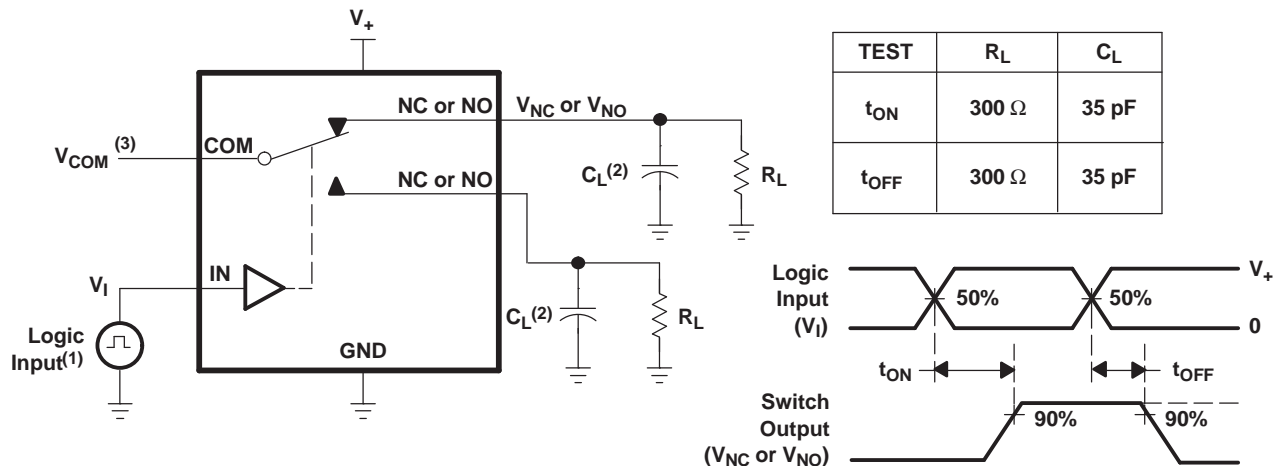


Figure 16. Capacitance (C_{IN} , $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NO(OFF)}$, $C_{NC(ON)}$, $C_{NO(ON)}$)

PARAMETER MEASUREMENT INFORMATION (continued)



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

Figure 17. Turn-On (t_{ON}) and Turn-Off (t_{OFF}) Time

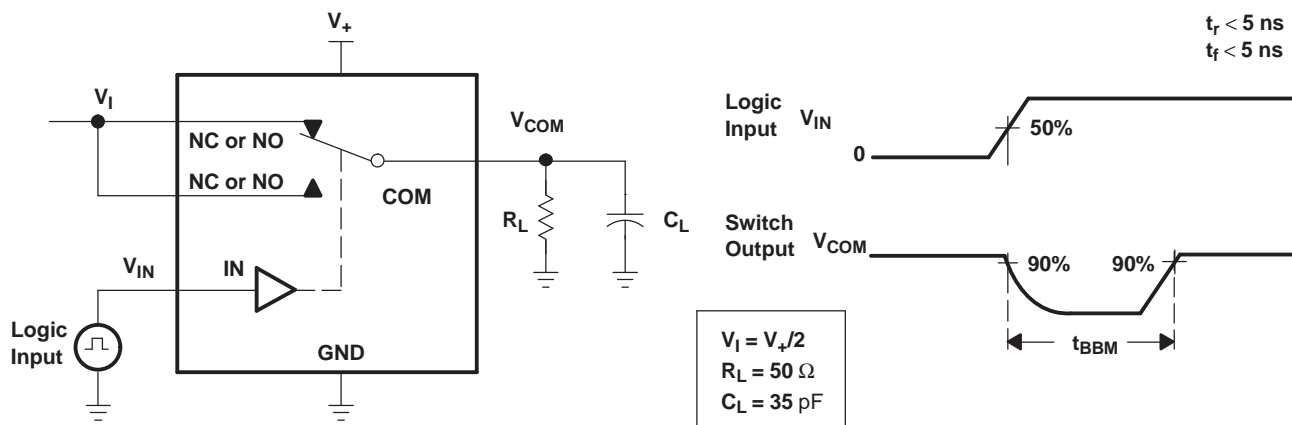


Figure 18. Break-Before-Make (t_{BBM}) Time

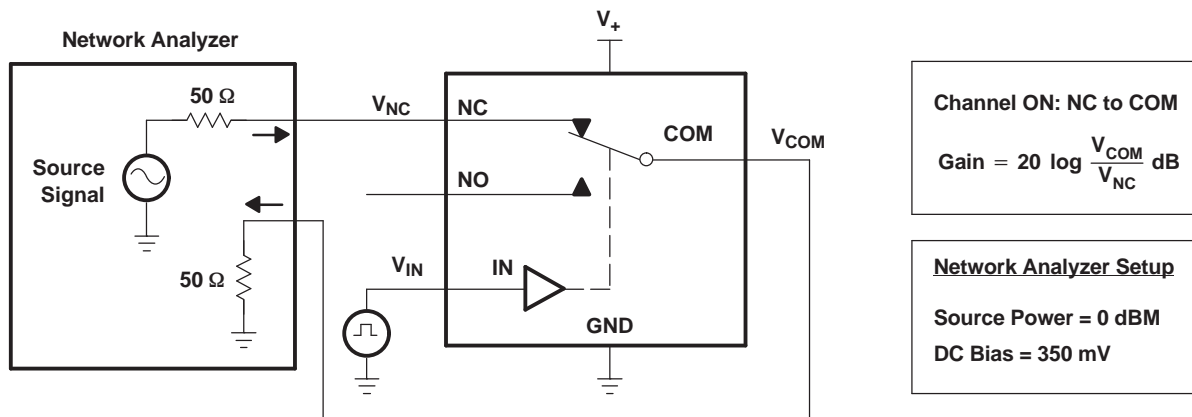


Figure 19. Frequency Response (BW)

PARAMETER MEASUREMENT INFORMATION (continued)

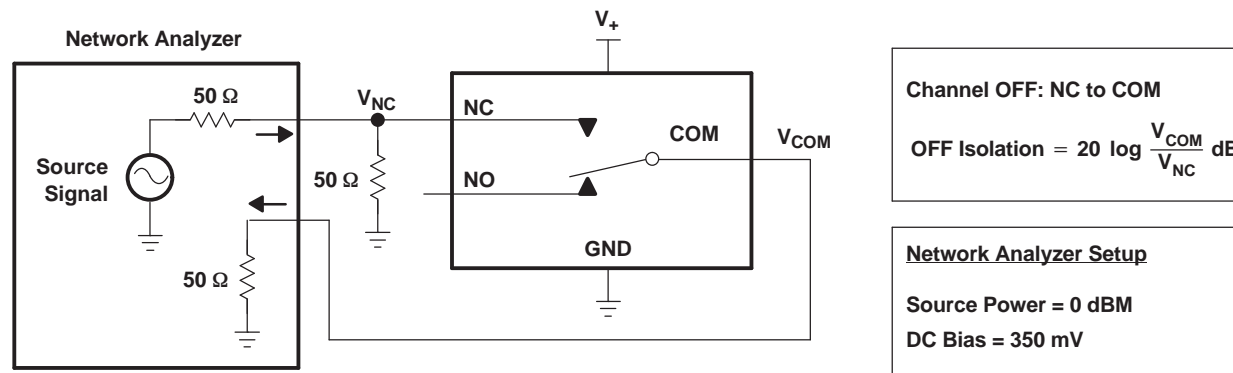


Figure 20. OFF Isolation (O_{ISO})

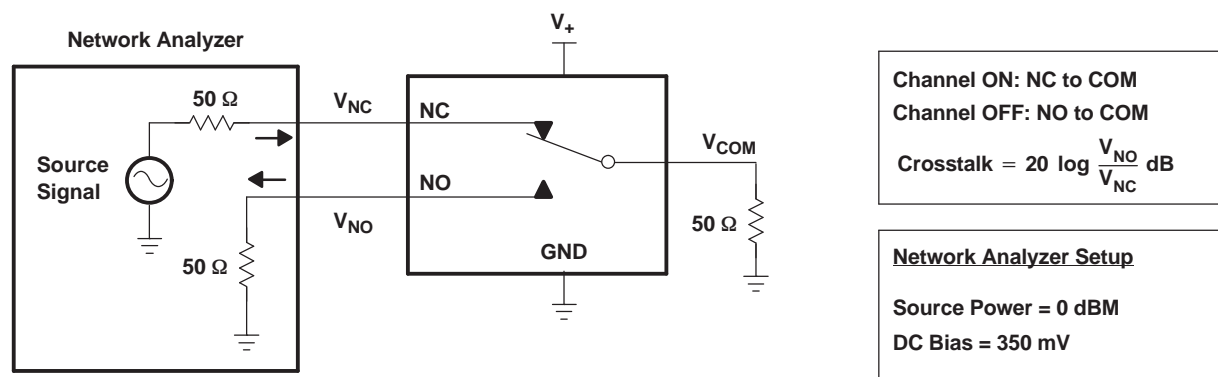


Figure 21. Crosstalk (X_{TALK})

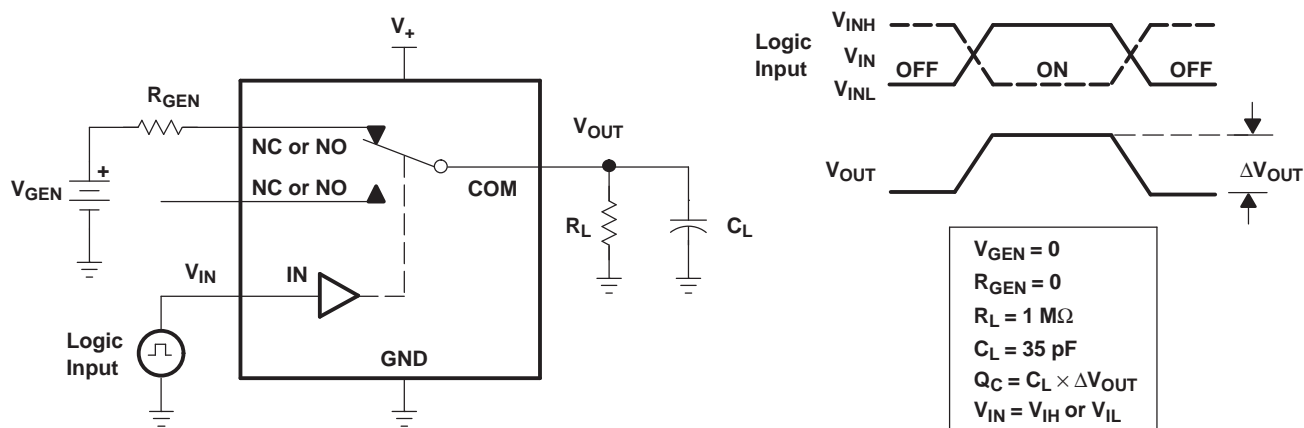


Figure 22. Charge Injection (Q_C)

PARAMETER MEASUREMENT INFORMATION (continued)

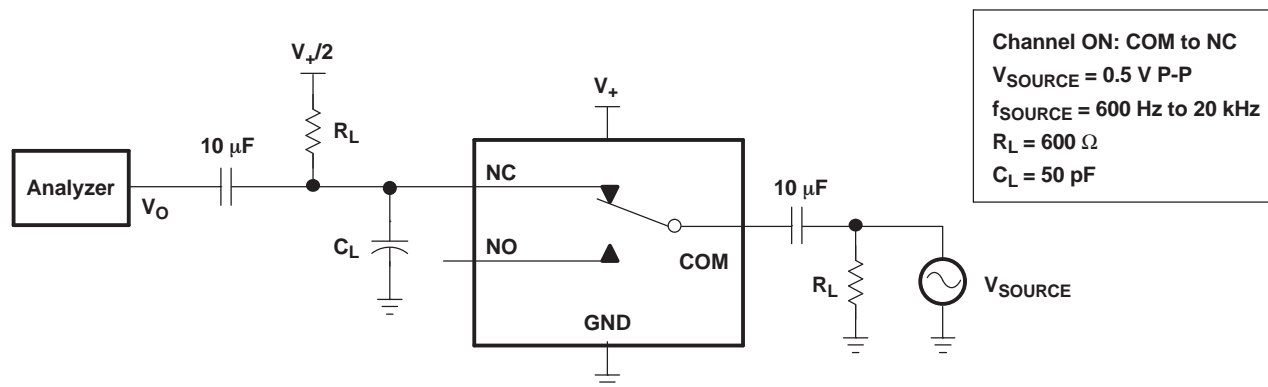


Figure 23. Total Harmonic Distortion (THD)

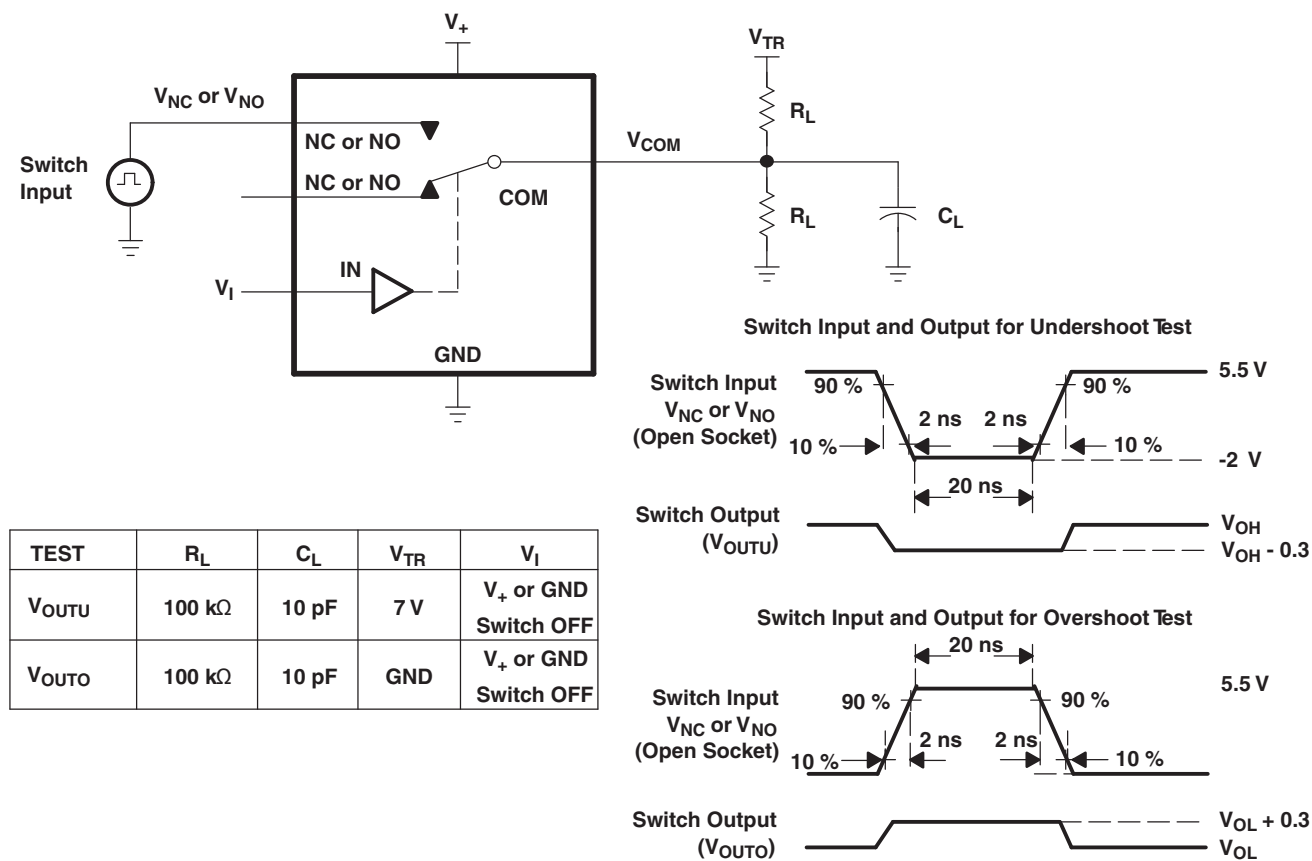


Figure 24. Undershoot and Overshoot Test

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TS5A623157DGSR	Active	Production	VSSOP (DGS) 10	2500 LARGE T&R	Yes	NIPDAU SN	Level-1-260C-UNLIM	-40 to 85	35R
TS5A623157DGSR.B	Active	Production	VSSOP (DGS) 10	2500 LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	35R

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

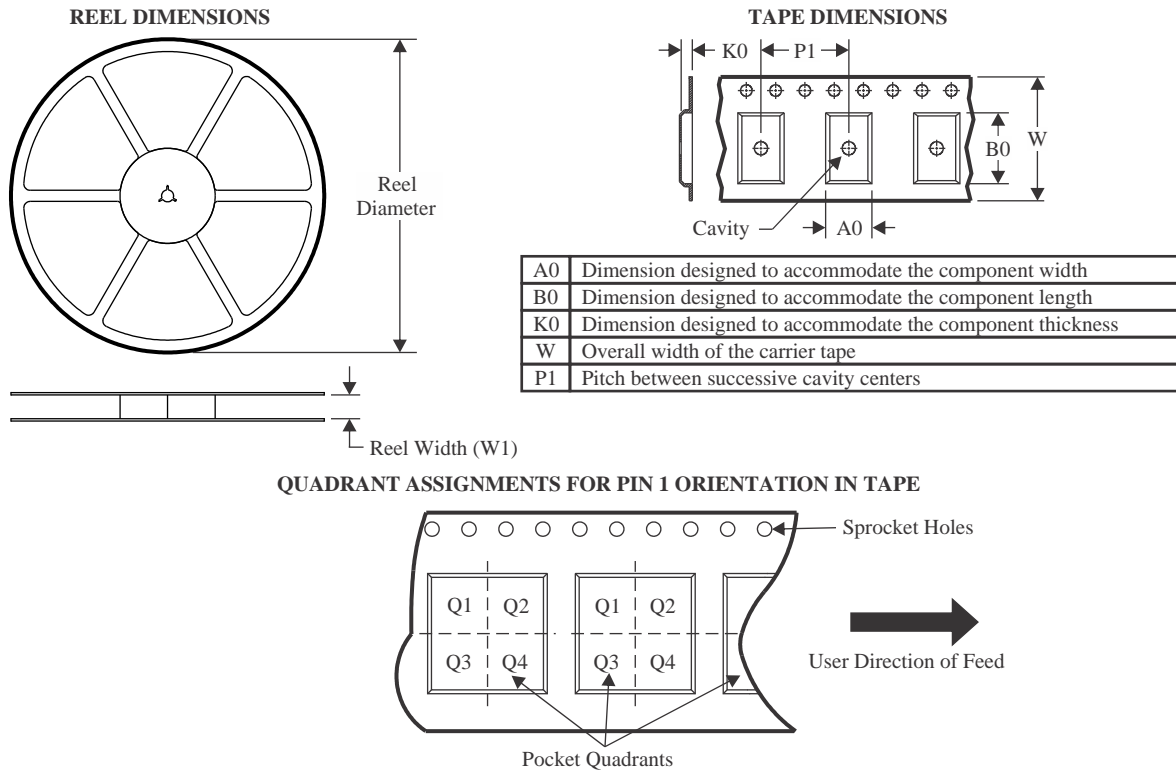
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TAPE AND REEL INFORMATION



*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	5.25	3.35	1.25	8.0	12.0	Q1
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	366.0	364.0	50.0
TS5A623157DGSR	VSSOP	DGS	10	2500	358.0	335.0	35.0



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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. 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.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187, variation BA.

EXAMPLE BOARD LAYOUT

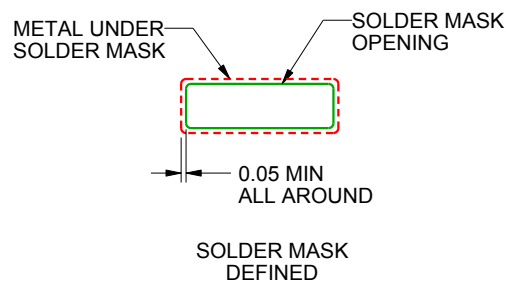
DGS0010A

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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