

1-Ω SPDT ANALOG SWITCH

Check for Samples: [TS5A3159-Q1](#)

FEATURES

- Qualified for Automotive Applications
- AEC-Q100 Qualified with the Following Results:
 - Device Temperature Grade 1: –40°C to 125°C Ambient Operating Temperature Range
 - Device HBM ESD Classification Level H2
 - Device CDM ESD Classification Level C3B
- Specified Break-Before-Make Switching
- Low ON-State Resistance (1 Ω)
- Control Inputs are 5-V Tolerant

- Low Charge Injection
- Excellent ON-Resistance Matching
- Low Total Harmonic Distortion
- 1.65-V to 5.5-V Single-Supply Operation

APPLICATIONS

- Cell Phones
- PDAs
- Portable Instrumentation

DESCRIPTION

The TS5A3159-Q1 is a single-pole double-throw (SPDT) analog switch that is designed to operate from 1.65 V to 5.5 V. The device offers a low ON-state resistance and an excellent ON-resistance, matching with the break-before-make feature to prevent signal distortion during the transferring of a signal from one channel to another. The device has an excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications.

**SOT-23 PACKAGE
(TOP VIEW)**

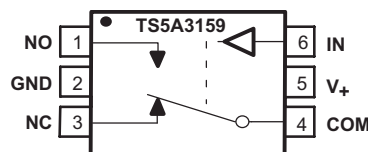


Table 1. FUNCTION TABLE

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.

Table 2. Summary of Characteristics $V_+ = 5\text{ V}$ and $T_A = 25^\circ\text{C}$

Configuration	2:1 Multiplexer / Demultiplexer (1 × SPDT)
Number of channels	1
ON-state resistance (r_{on})	1.3 Ω
ON-state resistance match (Δr_{on})	0.1 Ω
ON-state resistance flatness ($r_{\text{on(flat)}}$)	0.15 Ω
Turn on/turn off time ($t_{\text{ON}} / t_{\text{OFF}}$)	20 ns / 15 ns
Break-before-make time (t_{BBM})	12 ns
Charge injection (Q_C)	36 pC
Bandwidth (BW)	100 MHz
OFF isolation (O_{ISO})	–65 dB at 1 MHz
Crosstalk (X_{TALK})	–65 dB at 1 MHz
Total harmonic distortion (THD)	0.01%
Leakage current ($I_{\text{NO(OFF)}} / I_{\text{NC(OFF)}}$)	$\pm 6\text{ nA}$
Package option	6-pin DBV

ORDERING INFORMATION⁽¹⁾

T_A	ORDERABLE PART NUMBER ⁽²⁾	TOP-SIDE MARKING
–40°C to 125°C	TS5A3159QDBVRQ1	UAAQ

(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 web site at www.ti.com.**ABSOLUTE MAXIMUM RATINGS⁽¹⁾**

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

			MIN	MAX	UNIT
V_+	Supply voltage range ⁽²⁾		–0.5	6.5	V
$V_{\text{NO}}, V_{\text{COM}}$	Analog voltage range ⁽²⁾⁽³⁾⁽⁴⁾		–0.5	$V_+ + 0.5$	V
I_I / OK	Analog port diode current	$V_{\text{NO}}, V_{\text{COM}} < 0$ or $V_{\text{NO}}, V_{\text{COM}} > V_+$		± 50	mA
$I_{\text{NO}}, I_{\text{COM}}$	ON-state switch current	$V_{\text{NO}}, V_{\text{COM}} = 0$ to V_+		± 200	mA
	ON-state peak switch current ⁽⁵⁾			± 400	mA
V_{IN}	Digital input voltage range ⁽²⁾⁽³⁾		–0.5	6.5	V
I_{IK}	Digital input clamp current	$V_{\text{IN}} < 0$		–50	mA
	Continuous current through V_+ or GND			± 100	mA
T_{stg}	Storage temperature range		–65	150	°C
ESD Rating	Human body model (HBM) AEC-Q100 classification level H2			2	kV
	Charged device model (CDM) AEC-Q100 classification level C3B			750	V

(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) All voltages are with respect to ground, unless otherwise specified.

(3) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(4) This value is limited to 5.5 V maximum.

(5) Pulse at 1 ms duration < 10% duty cycle.

THERMAL INFORMATION

THERMAL METRIC ⁽¹⁾		TS5A3159-Q1	UNIT
		DBV (6 PINS)	
θ_{JA}	Junction-to-ambient thermal resistance	192.9	°C/W
θ_{JCTop}	Junction-to-case (top) thermal resistance	133.3	
θ_{JB}	Junction-to-board thermal resistance	37.6	
Ψ_{JT}	Junction-to-top characterization parameter	38.9	
Ψ_{JB}	Junction-to-board characterization parameter	37.1	
θ_{JBot}	Junction-to-case (bottom) thermal resistance	N/A	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

Electrical Characteristics for 5-V Supply

$V_+ = 4.5\text{ V}$ to 5.5 V and $T_A = -40^\circ\text{C}$ to 125°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A	V ₊	MIN TYP ⁽¹⁾ MAX			UNIT
Analog Switch									
V _{COM} , V _{NO} , V _{NC}	Analog signal range					0		V ₊	V
r _{peak}	Peak ON resistance	0 ≤ V _{NO} or V _{NC} ≤ V ₊ , I _{COM} = −30 mA	Switch ON, See Figure 11	25°C	4.5 V	1		1.5	Ω
				Full				1.5	
r _{on}	ON-state resistance	V _{NO} or V _{NC} = 2.5 V, I _{COM} = −30 mA	Switch ON, See Figure 11	25°C	4.5 V	0.75		1.3	Ω
				Full				1.3	
Δr _{on}	ON-state resistance match between channels	V _{NO} or V _{NC} = 2.5 V, I _{COM} = −30 mA	Switch ON, See Figure 11	25°C	4.5 V	0.1			Ω
r _{on(flat)}	ON-state resistance flatness	0 ≤ V _{NO} or V _{NC} ≤ V ₊ , I _{COM} = −30 mA	Switch ON, See Figure 11	25°C	4.5 V	0.233			Ω
		V _{NO} or V _{NC} = 1 V, 1.5 V, 2.5 V, I _{COM} = −30 mA		25°C		0.15			
I _{NC(OFF)} , I _{NO(OFF)}	NC, NO OFF leakage current	V _{NC} or V _{NO} = 4.5 V, V _{COM} = 0	Switch OFF, See Figure 12	25°C	5.5 V	−6	0.2	6	nA
				Full		−150		150	
I _{NC(ON)} , I _{NO(ON)}	NC, NO ON leakage current	V _{NC} or V _{NO} = 4.5 V, V _{COM} = Open	Switch ON, See Figure 13	25°C	5.5 V	−6	2.8	6	nA
				Full		−150		150	
I _{COM(ON)}	COM ON leakage current	V _{NC} or V _{NO} = 4.5 V or Open, V _{COM} = 4.5 V	Switch ON, See Figure 13	25°C	5.5 V	−8	0.47	8	nA
				Full		−150		150	
Digital Inputs (IN)									
V _{IH}	Input logic high			Full		2.4		5.5	V
V _{IL}	Input logic low			Full		0		0.8	V
I _{IH} , I _{IL}	Input leakage current	V _{IN} = 5.5 V or 0		Full	5.5 V	−1		1	μA
Dynamic									
t _{ON}	Turn-on time	V _{COM} = V ₊ , R _L = 50 Ω,	C _L = 35 pF, See Figure 15	25°C	4.5 V to 5.5 V	20		35	ns
				Full		40			
t _{OFF}	Turn-off time	V _{COM} = V ₊ , R _L = 50 Ω,	C _L = 35 pF, See Figure 15	25°C	4.5 V to 5.5 V	15		20	ns
				Full		35			
t _{BBM}	Break-before-make time	V _{NC} = V _{NO} = V ₊ / 2, R _L = 50 Ω,	C _L = 35 pF, See Figure 16	25°C	4.5 V to 5.5 V	1	12	14.5	ns
				Full		1			
Q _C	Charge injection	C _L = 1 nF, V _{GEN} = 0 V,		25°C	5 V	36			pC
C _{NC(OFF)} , C _{NO(OFF)}	NC, NO OFF capacitance	V _{NC} or V _{NO} = V ₊ or GND, Switch OFF,		25°C	5 V	23			pF

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 5-V Supply (continued)

$V_+ = 4.5 \text{ V}$ to 5.5 V and $T_A = -40^\circ\text{C}$ to 125°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_A	V_+	MIN	TYP ⁽¹⁾	MAX	UNIT
$C_{NC(ON)}, C_{NO(ON)}$	NC, NO ON capacitance V_{NC} or $V_{NO} = V_+$ or GND, Switch ON,	See Figure 14	25°C	5 V	84		pF
$C_{COM(ON)}$	COM ON capacitance $V_{COM} = V_+$ or GND, Switch ON,	See Figure 14	25°C	5 V	84		pF
C_{IN}	Digital input capacitance $V_{IN} = V_+$ or GND,	See Figure 14	25°C	5 V	2.1		pF
BW	Bandwidth $R_L = 50 \Omega$, Switch ON,	See Figure 17	25°C	5 V	100		MHz
O_{ISO}	OFF isolation $R_L = 50 \Omega$, $f = 1 \text{ MHz}$,	Switch OFF, See Figure 18	25°C	5 V	-65		dB
X_{TALK}	Crosstalk $R_L = 50 \Omega$, $f = 1 \text{ MHz}$,	Switch ON, See Figure 19	25°C	5 V	-65		dB
THD	Total harmonic distortion $R_L = 600 \Omega$, $C_L = 50 \text{ pF}$,	$f = 600 \text{ Hz}$ to 20 kHz , See Figure 21	25°C	5 V	0.01		%
Supply							
I_+	Positive supply current $V_{IN} = V_+$ or GND,	Switch ON or OFF	25°C Full	5.5 V	0.1 0.5		μA

Electrical Characteristics for 3.3-V Supply

$V_+ = 3 \text{ V}$ to 3.6 V and $T_A = -40^\circ\text{C}$ to 125°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_A	V_+	MIN	TYP ⁽¹⁾	MAX	UNIT
Analog Switch							
V_{COM}, V_{NO}, V_{NC}	Analog signal range			0		V_+	V
r_{peak}	Peak ON-state resistance $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -24 \text{ mA}$,	Switch ON, See Figure 11	25°C Full	3 V	1.35 2.2	2.2	Ω
r_{on}	ON-state resistance V_{NO} or $V_{NC} = 2 \text{ V}$, $I_{COM} = -24 \text{ mA}$,	Switch ON, See Figure 11	25°C Full	3 V	1.15 1.8	1.8	Ω
Δr_{on}	ON-state resistance match between channels V_{NO} or $V_{NC} = 2 \text{ V}$, 0.8 V , $I_{COM} = -24 \text{ mA}$,	Switch ON, See Figure 11	25°C	3 V	0.11		Ω
$r_{on(Flat)}$	ON-state resistance flatness $0 \leq V_{NO}$ or $V_{NC} \leq V_+$, $I_{COM} = -24 \text{ mA}$, V_{NO} or $V_{NC} = 2 \text{ V}$, 0.8 V , $I_{COM} = -24 \text{ mA}$,	Switch ON, See Figure 11	25°C 25°C	3 V	0.225 0.25		Ω
$I_{NC(OFF)}, I_{NO(OFF)}$	NC, NO OFF leakage current V_{NC} or $V_{NO} = 3 \text{ V}$, $V_{COM} = 0$,	Switch OFF, See Figure 12	25°C	3.6 V	0.2		nA
$I_{NC(ON)}, I_{NO(ON)}$	NC, NO ON leakage current V_{NC} or $V_{NO} = 3 \text{ V}$, $V_{COM} = \text{Open}$,	Switch ON, See Figure 13	25°C	3.6 V	2.8		nA
$I_{COM(ON)}$	COM ON leakage current V_{NC} or $V_{NO} = 3 \text{ V}$ or Open, $V_{COM} = 3 \text{ V}$,	Switch ON, See Figure 13	25°C	3.6 V	0.47		nA
Digital Inputs (IN)							
V_{IH}	Input logic high		Full		2	5.5	V
V_{IL}	Input logic low		Full		0	0.6	V
I_{IH}, I_{IL}	Input leakage current $V_{IN} = 5.5 \text{ V}$ or 0		Full	3.6 V	-1	1	μA
Dynamic							
t_{ON}	Turn-on time $V_{COM} = V_+$, $R_L = 50 \Omega$	$C_L = 35 \text{ pF}$, See Figure 15	25°C Full	3 V to 3.6 V	30 55	40	ns
t_{OFF}	Turn-off time $V_{COM} = V_+$, $R_L = 50 \Omega$	$C_L = 35 \text{ pF}$, See Figure 15	25°C Full	3 V to 3.6 V	20 40	25	ns

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 3.3-V Supply (continued)

 $V_+ = 3\text{ V}$ to 3.6 V and $T_A = -40^\circ\text{C}$ to 125°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A	V ₊	MIN	TYP ⁽¹⁾	MAX	UNIT
t _{BBM}	Break-before-make time	V _{NC} = V _{NO} = V ₊ / 2, R _L = 50 Ω	C _L = 35 pF, See Figure 16	25°C	3 V to 3.6 V	1	21	29	ns
				Full		1			
Q _C	Charge injection	C _L = 1 nF, V _{GEN} = 0 V	See Figure 20	25°C	3.3 V	20			pC
C _{NC(OFF)} , C _{NO(OFF)}	NC, NO OFF capacitance	V _{NC} or V _{NO} = V ₊ or GND, Switch OFF	See Figure 14	25°C	3.3 V	23			pF
C _{NC(ON)} , C _{NO(ON)}	NC, NO ON capacitance	V _{NC} or V _{NO} = V ₊ or GND, Switch ON	See Figure 14	25°C	3.3 V	84			pF
C _{COM(ON)}	COM ON capacitance	V _{COM} = V ₊ or GND, Switch ON	See Figure 14	25°C	3.3 V	84			pF
C _{IN}	Digital input capacitance	V _{IN} = V ₊ or GND	See Figure 14	25°C	3.3 V	2.1			pF
BW	Bandwidth	R _L = 50 Ω, Switch ON	See Figure 17	25°C	3.3 V	100			MHz
O _{ISO}	OFF isolation	R _L = 50 Ω, f = 1 MHz	Switch OFF, See Figure 18	25°C	3.3 V	−65			dB
X _{TALK}	Crosstalk	R _L = 50 Ω, f = 1 MHz	Switch ON, See Figure 19	25°C	3.3 V	−65			dB
THD	Total harmonic distortion	R _L = 600 Ω, C _L = 50 pF	f = 600 Hz to 20 kHz, See Figure 21	25°C	3.3 V	0.015			%
Supply									
I ₊	Positive supply current	V _{IN} = V ₊ or GND	Switch ON or OFF	25°C	3.6 V	0.1			μA
				Full		0.5			

Electrical Characteristics for 2.5-V Supply

 $V_+ = 2.3\text{ V}$ to 2.7 V and $T_A = -40^\circ\text{C}$ to 125°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_A	V_+	MIN	TYP ⁽¹⁾	MAX	UNIT
Analog Switch							
V_{COM} , V_{NO} , V_{NC} Analog signal range				0		V_+	V
r_{peak} Peak ON-state resistance	$0 \leq V_{\text{NO}}$ or $V_{\text{NC}} \leq V_+$, $I_{\text{COM}} = -8\text{ mA}$	Switch ON, See Figure 11	25°C	2.5 V	1.7	2.9	Ω
			Full			2.9	
r_{on} ON-state resistance	V_{NO} or $V_{\text{NC}} = 1.8\text{ V}$, $I_{\text{COM}} = -8\text{ mA}$	Switch ON, See Figure 11	25°C	2.5 V	1.45	2.3	Ω
			Full			2.3	
Δr_{on} ON-state resistance match between channels	V_{NO} or $V_{\text{NC}} = 0.8\text{ V}$, 1.8 V , $I_{\text{COM}} = -8\text{ mA}$	Switch ON, See Figure 11	25°C	2.5 V	0.7		Ω
$r_{\text{on(flat)}}$ ON-state resistance flatness	$0 \leq V_{\text{NO}}$ or $V_{\text{NC}} \leq V_+$, $I_{\text{COM}} = -8\text{ mA}$	Switch ON, See Figure 11	25°C	2.5 V	0.5		Ω
	V_{NO} or $V_{\text{NC}} = 0.8\text{ V}$, 1.8 V , $I_{\text{COM}} = -8\text{ mA}$		25°C		0.45		
$I_{\text{NC(OFF)}}$, $I_{\text{NO(OFF)}}$ NC, NO Off leakage current	V_{NC} or $V_{\text{NO}} = 2.3\text{ V}$, $V_{\text{COM}} = 0$	Switch OFF, See Figure 12	25°C	2.7 V	0.2		nA
$I_{\text{NC(ON)}}$, $I_{\text{NO(ON)}}$ NC, NO On leakage current	V_{NC} or $V_{\text{NO}} = 2.3\text{ V}$, $V_{\text{COM}} = \text{Open}$	Switch ON, See Figure 13	25°C	2.7 V	2.8		nA
$I_{\text{COM(ON)}}$ COM On leakage current	V_{NC} or $V_{\text{NO}} = 2.3\text{ V}$ or Open, $V_{\text{COM}} = 2.3\text{ V}$	Switch ON, See Figure 13	25°C	2.7 V	0.47		nA
Digital Inputs (IN)							
V_{IH} Input logic high		Full		1.8		5.5	V
V_{IL} Input logic low		Full		0	0.6		V
I_{IH} , I_{IL} Input leakage current	$V_{\text{IN}} = 5.5\text{ V}$ or 0	Full	2.7 V	–1		1	μA

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 2.5-V Supply (continued)

$V_+ = 2.3 \text{ V to } 2.7 \text{ V}$ and $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A	V ₊	MIN	TYP ⁽¹⁾	MAX	UNIT
Dynamic									
t _{ON}	Turn-on time	V _{COM} = V ₊ , R _L = 50 Ω,	C _L = 35 pF, See Figure 15	25°C	2.3 V to 2.7 V	40	55	70	ns
				Full					
t _{OFF}	Turn-off time	V _{COM} = V ₊ , R _L = 50 Ω,	C _L = 35 pF, See Figure 15	25°C	2.3 V to 2.7 V	30	40	55	ns
				Full					
t _{BBM}	Break-before-make time	V _{NC} = V _{NO} = V ₊ / 2, R _L = 50 Ω,	C _L = 35 pF, See Figure 16	25°C	2.3 V to 2.7 V	1	33	39	ns
				Full		1			
Q _C	Charge injection	C _L = 1 nF, V _{GEN} = 0 V,	See Figure 20	25°C	2.5 V	13			pC
C _{NC(OFF)} , C _{NO(OFF)}	NC, NO OFF capacitance	V _{NC} or V _{NO} = V ₊ or GND, Switch OFF,	See Figure 14	25°C	2.5 V	23			pF
C _{NC(ON)} , C _{NO(ON)}	NC, NO ON capacitance	V _{NC} or V _{NO} = V ₊ or GND, Switch ON,	See Figure 14	25°C	2.5 V	84			pF
C _{COM(ON)}	COM ON capacitance	V _{COM} = V ₊ or GND, Switch ON,	See Figure 14	25°C	2.5 V	84			pF
C _{IN}	Digital input capacitance	V _{IN} = V ₊ or GND,	See Figure 14	25°C	2.5 V	2.1			pF
BW	Bandwidth	R _L = 50 Ω, Switch ON,	See Figure 17	25°C	2.5 V	100			MHz
O _{ISO}	OFF isolation	R _L = 50 Ω, f = 1 MHz,	Switch OFF, See Figure 18	25°C	2.5 V	−64			dB
X _{TALK}	Crosstalk	R _L = 50 Ω, f = 1 MHz,	Switch ON, See Figure 19	25°C	2.5 V	−64			dB
THD	Total harmonic distortion	R _L = 600 Ω, C _L = 50 pF,	f = 600 Hz to 20 kHz, See Figure 21	25°C	2.5 V	0.025			%
Supply									
I ₊	Positive supply current	V _{IN} = V ₊ or GND,	Switch ON or OFF	25°C	2.7 V	0.1			μA
				Full		0.5			

Electrical Characteristics for 1.8-V Supply

$V_+ = 1.65 \text{ V to } 1.95 \text{ V}$ and $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A	V ₊	MIN	TYP ⁽¹⁾	MAX	UNIT
Analog Switch									
V _{COM} , V _{NO} , V _{NC}	Analog signal range					0		V ₊	V
r _{peak}	Peak ON-state resistance	0 ≤ V _{NO} or V _{NC} ≤ V ₊ , I _{COM} = −2 mA	Switch ON, See Figure 11	25°C	1.8 V	4	5.2	5.2	Ω
				Full					
r _{on}	ON-state resistance	V _{NO} or V _{NC} = 1.5 V, I _{COM} = −2 mA	Switch ON, See Figure 11	25°C	1.8 V	1.7	3.5	3.5	Ω
				Full					
Δr _{on}	ON-state resistance match between channels	V _{NO} or V _{NC} = 0.6 V, 1.5 V, I _{COM} = −2 mA	Switch ON, See Figure 11	25°C	1.8 V	0.7			Ω
				Full		0.7			
r _{on(flat)}	ON-state resistance flatness	0 ≤ V _{NO} or V _{NC} ≤ V ₊ , I _{COM} = −2 mA	Switch ON, See Figure 11	25°C	1.8 V	1.85			Ω
				Full		1.85			
		V _{NO} or V _{NC} = 0.6 V, 1.5 V, I _{COM} = −2 mA		25°C		0.9			
				Full		0.9			
I _{NC(OFF)} , I _{NO(OFF)}	NC, NO Off leakage current	V _{NC} or V _{NO} = 1.65 V, V _{COM} = 0	Switch OFF, See Figure 12	25°C	1.95 V	0.2			nA

(1) $T_A = 25^\circ\text{C}$

Electrical Characteristics for 1.8-V Supply (continued)

 $V_+ = 1.65 \text{ V to } 1.95 \text{ V}$ and $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	V_+	MIN	TYP ⁽¹⁾	MAX	UNIT
$I_{NC(ON)}, I_{NO(ON)}$	NC, NO On leakage current	V_{NC} or $V_{NO} = 1.65 \text{ V}$, $V_{COM} = \text{Open}$	Switch ON, See Figure 13	25°C	1.95 V		2.8		nA
$I_{COM(ON)}$	COM On leakage current	V_{NC} or $V_{NO} = 1.65 \text{ V}$ or Open, $V_{COM} = 1.65 \text{ V}$	Switch ON, See Figure 13	25°C	1.95 V		0.47		nA
Digital Inputs (IN)									
V_{IH}	Input logic high			Full		1.5		5.5	V
V_{IL}	Input logic low			Full		0		0.6	V
I_{IH}, I_{IL}	Input leakage current	$V_{IN} = 5.5 \text{ V}$ or 0		Full	1.95 V	-1		1	μA
Dynamic									
t_{ON}	Turn-on time	$V_{COM} = V_+$, $R_L = 50 \Omega$,	$C_L = 35 \text{ pF}$, See Figure 15	25°C	1.65 V to		65	70	ns
				Full	1.95 V			95	
t_{OFF}	Turn-off time	$V_{COM} = V_+$, $R_L = 50 \Omega$,	$C_L = 35 \text{ pF}$, See Figure 15	25°C	1.65 V to		40	55	ns
				Full	1.95 V			70	
t_{BBM}	Break-before-make time	$V_{NC} = V_{NO} = V_+ / 2$, $R_L = 50 \Omega$,	$C_L = 35 \text{ pF}$, See Figure 16	25°C	1.65 V to	1	60	72	ns
				Full	1.95 V	0.5			
Q_C	Charge injection	$C_L = 1 \text{ nF}$, $V_{GEN} = 0 \text{ V}$,	See Figure 20	25°C	1.8 V		13		pC
$C_{NC(OFF)}, C_{NO(OFF)}$	NC, NO OFF capacitance	V_{NC} or $V_{NO} = V_+$ or GND, Switch OFF,	See Figure 14	25°C	1.8 V		23		pF
$C_{NC(ON)}, C_{NO(ON)}$	NC, NO ON capacitance	V_{NC} or $V_{NO} = V_+$ or GND, Switch ON,	See Figure 14	25°C	1.8 V		84		pF
$C_{COM(ON)}$	COM ON capacitance	$V_{COM} = V_+$ or GND, Switch ON,	See Figure 14	25°C	1.8 V		84		pF
C_{IN}	Digital input capacitance	$V_{IN} = V_+$ or GND,	See Figure 14	25°C	1.8 V		2.1		pF
BW	Bandwidth	$R_L = 50 \Omega$, Switch ON,	See Figure 17	25°C	1.8 V		100		MHz
O_{ISO}	OFF isolation	$R_L = 50 \Omega$, $f = 1 \text{ MHz}$,	Switch OFF, See Figure 18	25°C	1.8 V		-63		dB
X_{TALK}	Crosstalk	$R_L = 50 \Omega$, $f = 1 \text{ MHz}$,	Switch ON, See Figure 19	25°C	1.8 V		-63		dB
Supply									
I_+	Positive supply current	$V_{IN} = V_+$ or GND,	Switch ON or OFF	25°C	1.95 V		0.1		μA
				Full			0.5		

TYPICAL CHARACTERISTICS

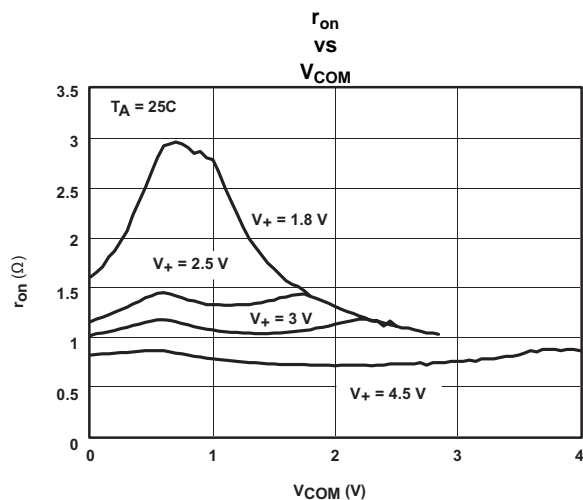


Figure 1.

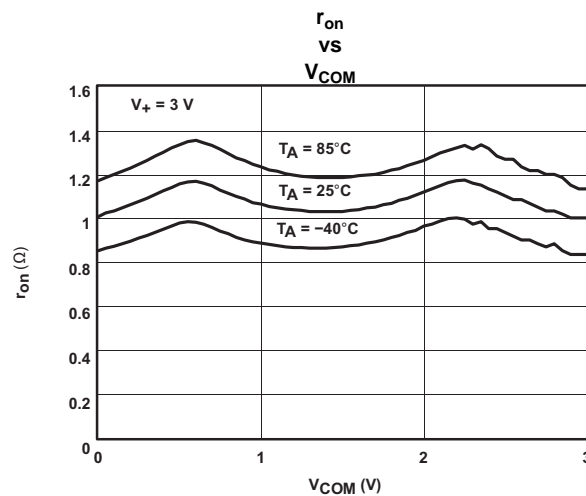


Figure 2.

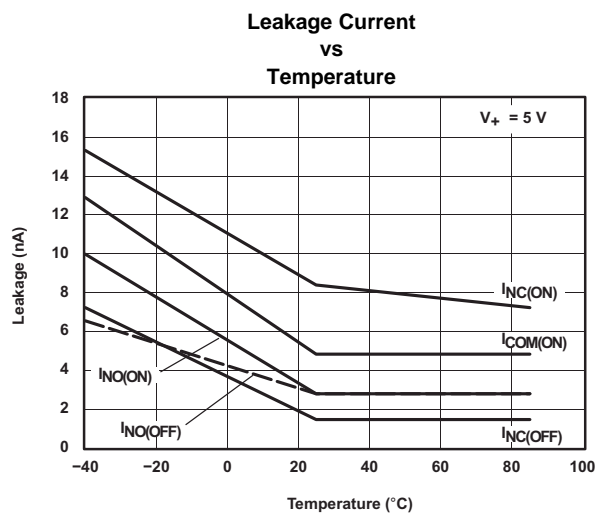


Figure 3.

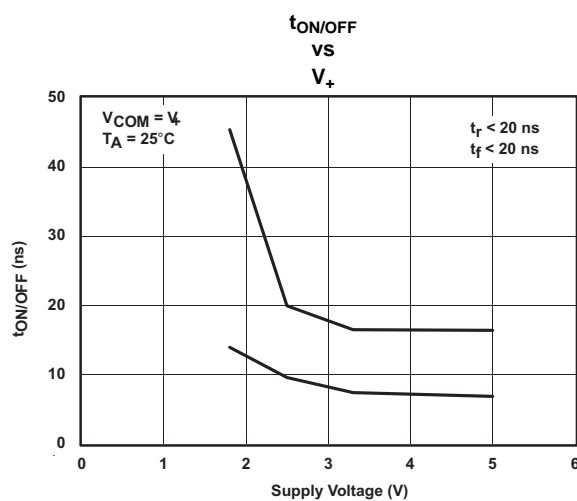


Figure 4.

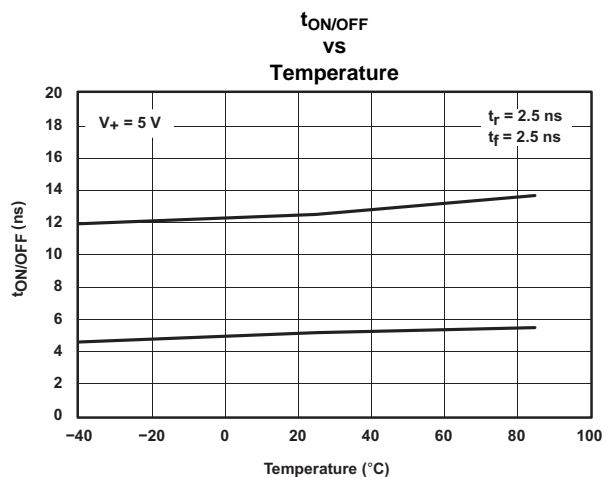


Figure 5.

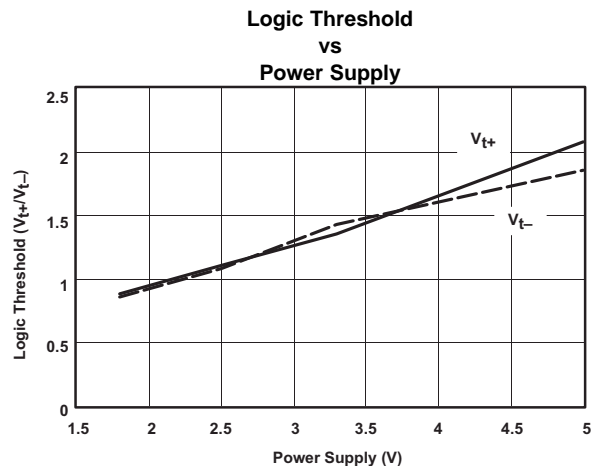


Figure 6.

TYPICAL CHARACTERISTICS (continued)

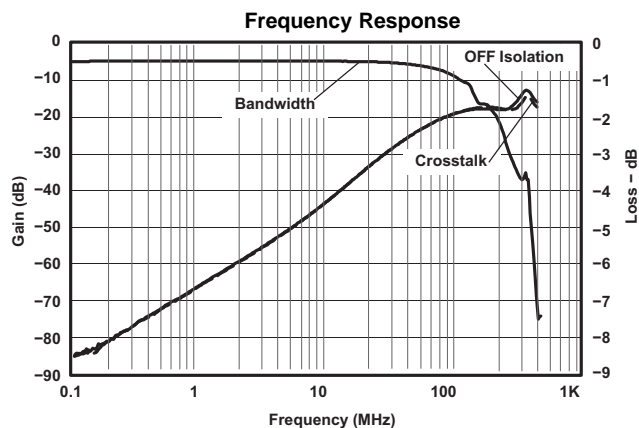


Figure 7.

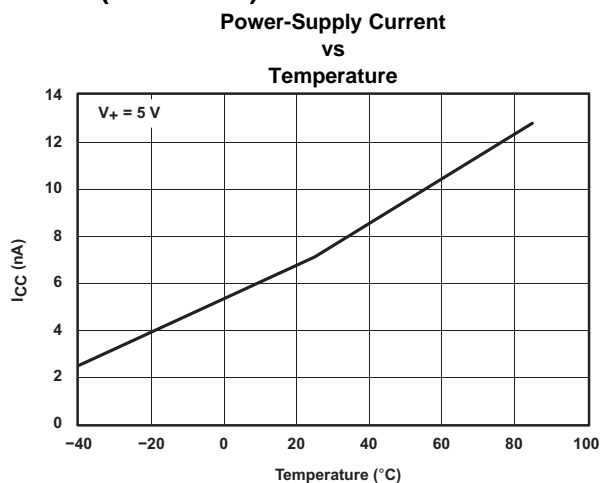


Figure 8.

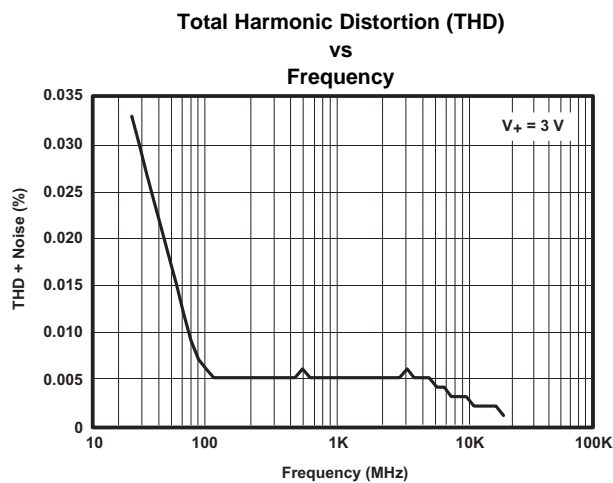


Figure 9.

PIN DESCRIPTION

PIN		DESCRIPTION
NO.	NAME	
1	NO	Normally-open terminal
2	GND	Digital ground
3	NC	Normally-closed terminal
4	COM	Common terminal
5	V ₊	Power supply
6	IN	Digital control pin to connect COM terminal to NO or NC terminals

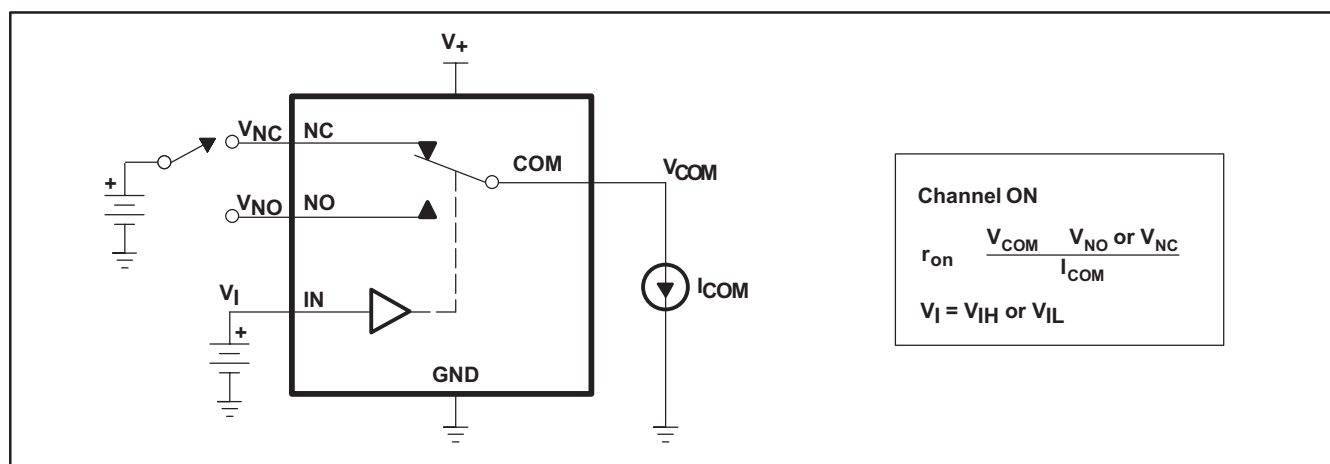
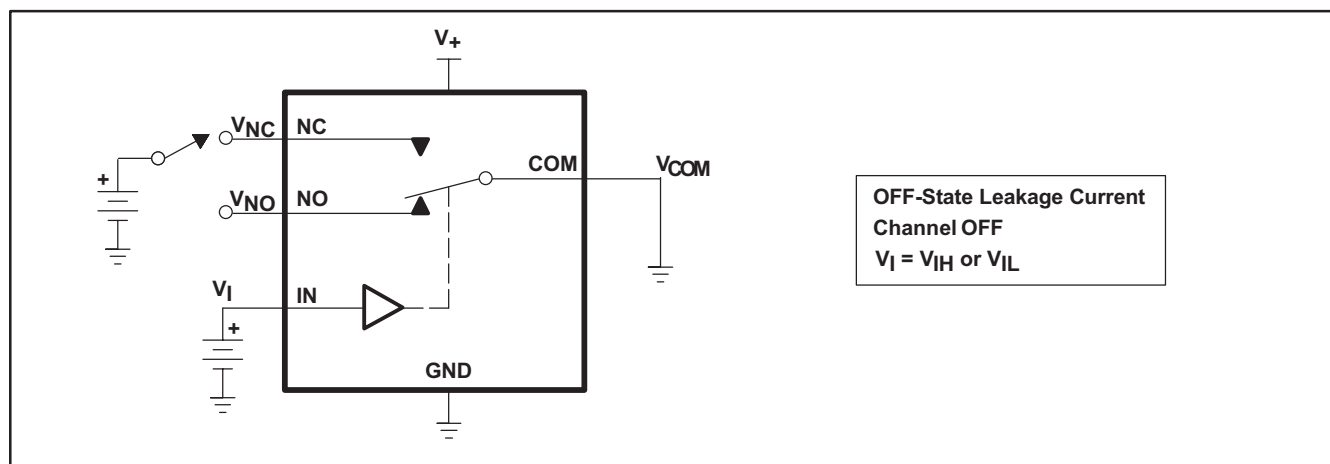
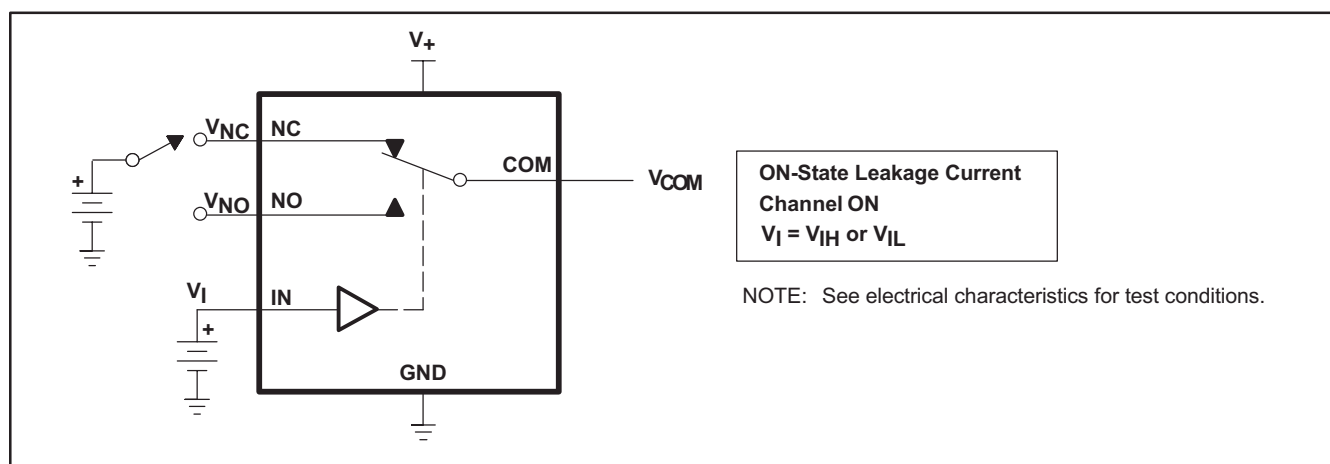
PARAMETER DESCRIPTION

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
r _{peak}	Peak ON-state resistance over a specified voltage range
Δr _{on}	Difference of r _{on} between channels
ron(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 (COM to NO or COM to NC) 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 IN
I _{IH} , I _{IL}	Leakage current measured at 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, or 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, or 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 coulomb (C) and measured by the total charge induced due to switching of the control input. Charge injection, Q _C = C _L × ΔV _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 (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 IN
O _{ISO}	OFF isolation of the switch is a measurement 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.
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 in a specific frequency and in dB.
BW	Bandwidth of the switch. This is the frequency in which the gain of an ON channel is –3 dB below the DC gain.

PARAMETER DESCRIPTION (continued)

SYMBOL	DESCRIPTION
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. OFF-State Leakage Current ($I_{NC(OFF)}$, $I_{NO(OFF)}$)Figure 12. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$, $I_{NO(ON)}$)

PARAMETER MEASUREMENT INFORMATION (continued)

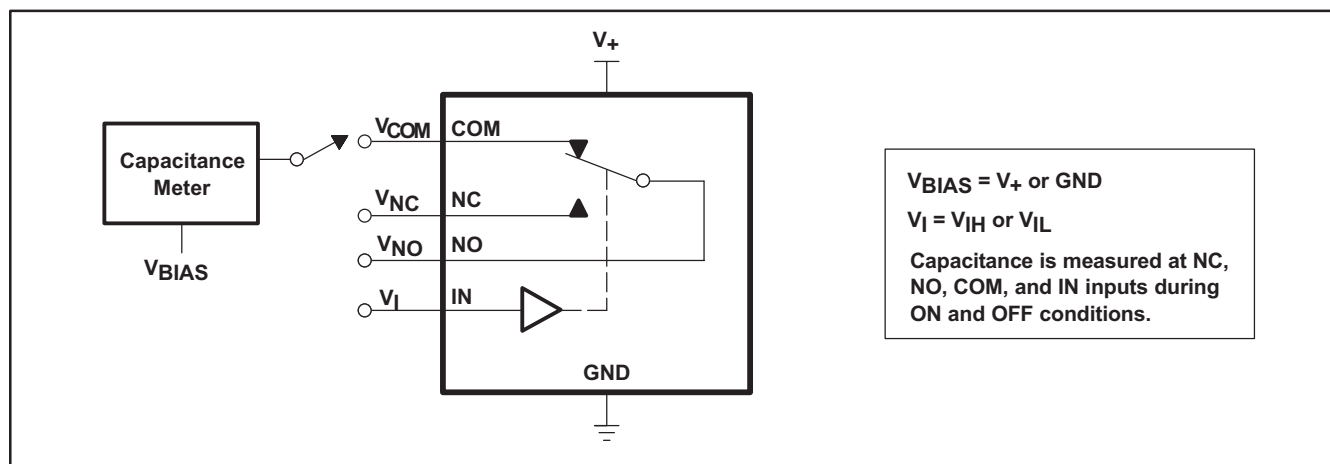
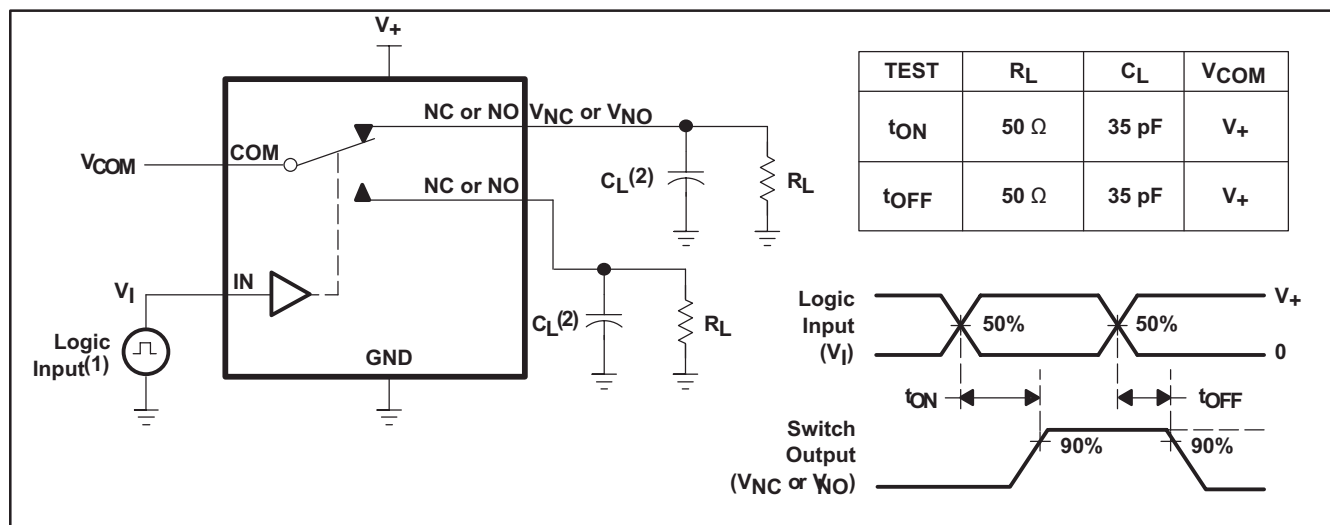


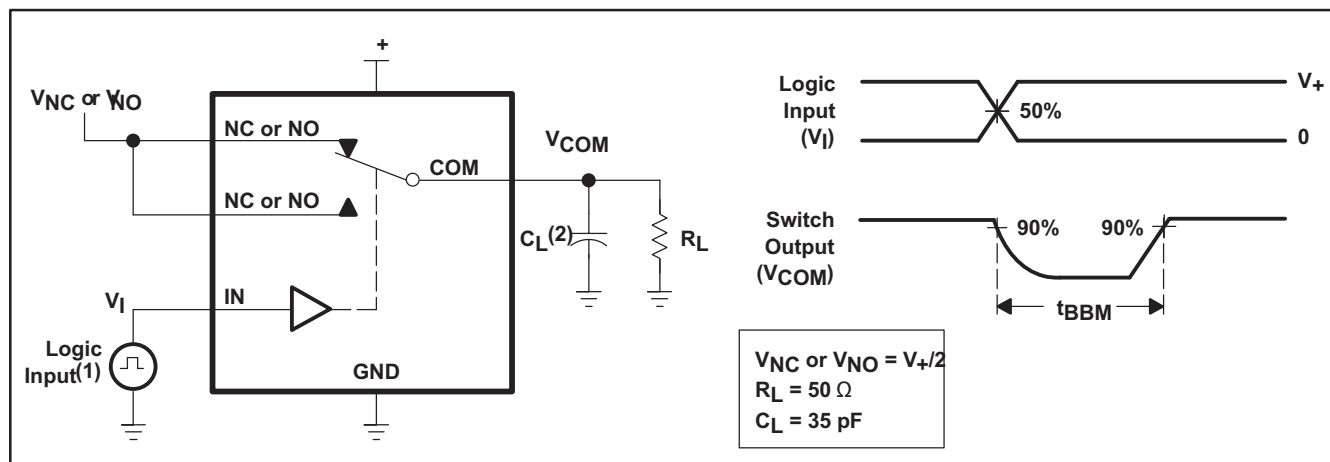
Figure 13. Capacitance (C_I , $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NO(OFF)}$, $C_{NC(ON)}$, $C_{NO(ON)}$)



(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.

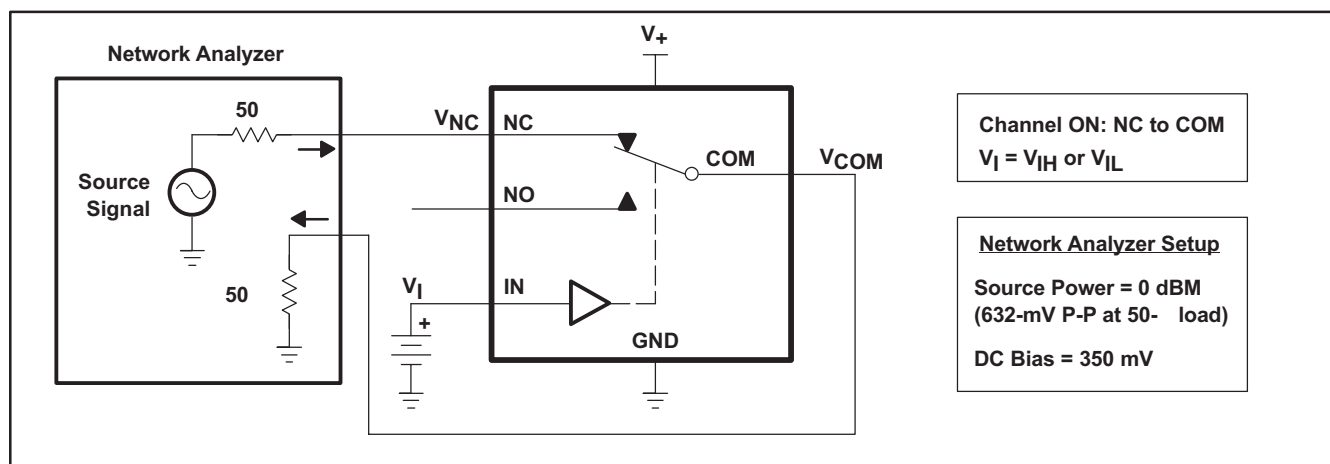
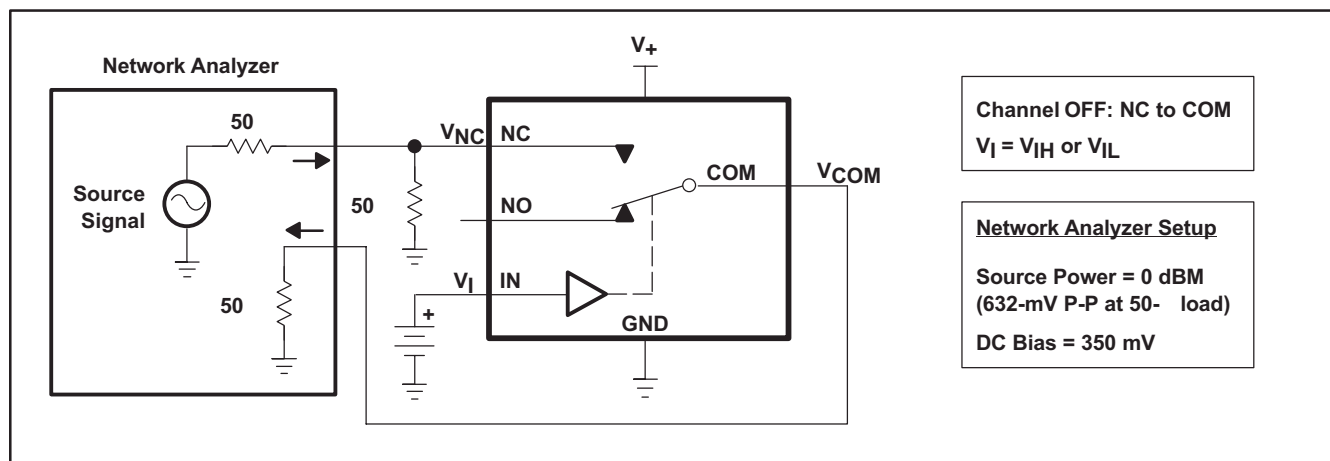
(2) C_L includes probe and jig capacitance.

Figure 14. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

PARAMETER MEASUREMENT INFORMATION (continued)

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

(2) C_L includes probe and jig capacitance.

Figure 15. Break-Before-Make Time (t_{BBM})**Figure 16. Bandwidth (BW)****Figure 17. OFF Isolation (O_{ISO})**

PARAMETER MEASUREMENT INFORMATION (continued)

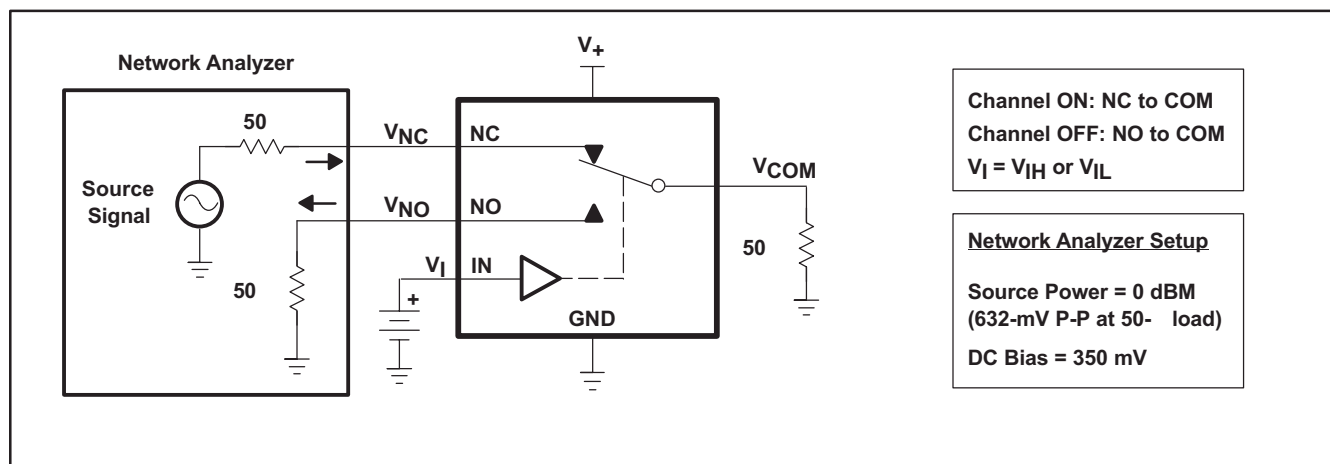
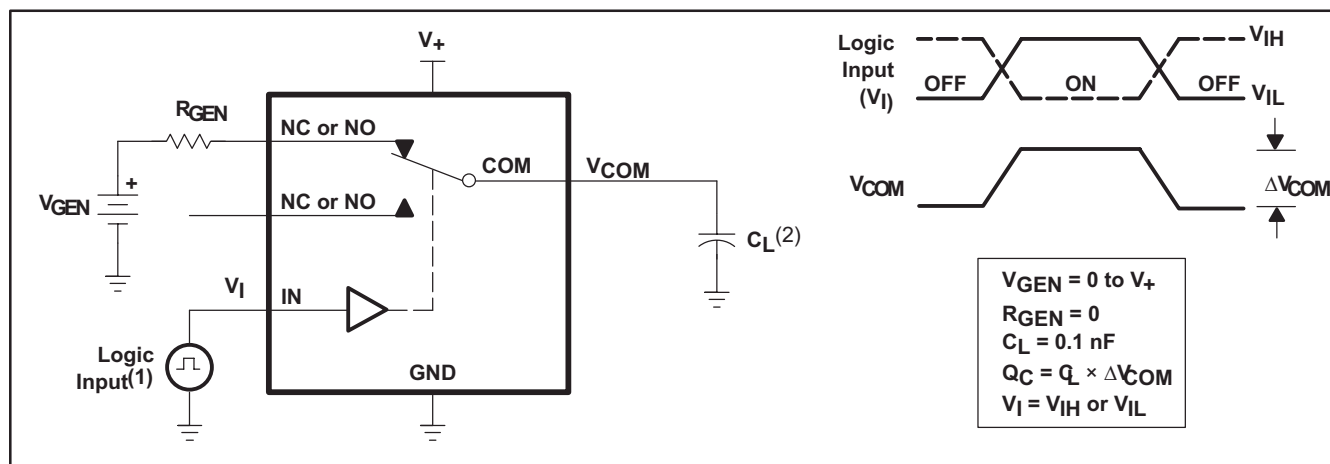


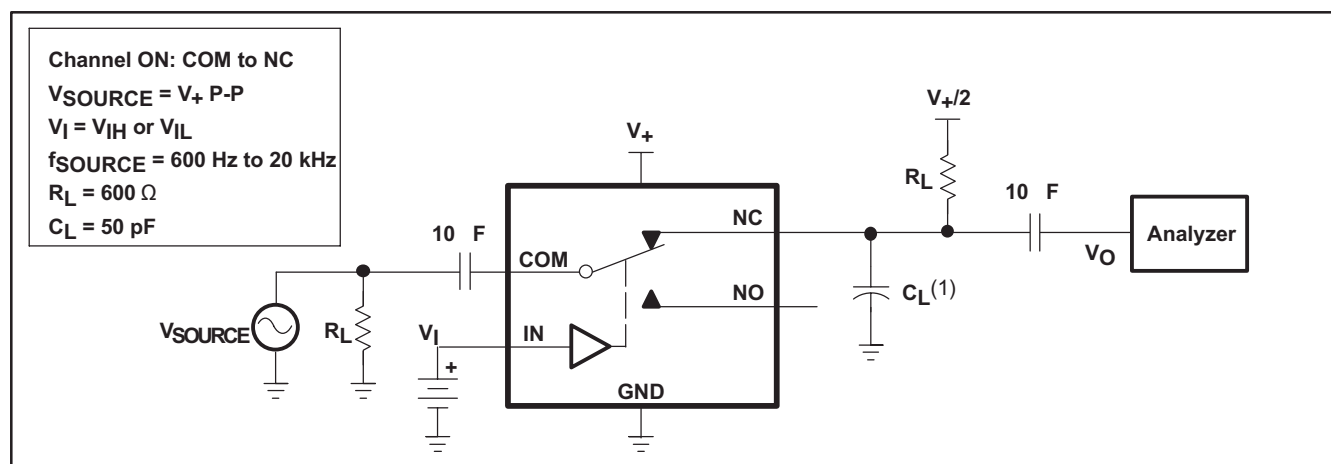
Figure 18. Crosstalk (X_{TALK})



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

(2) C_L includes probe and jig capacitance.

Figure 19. Charge Injection (Q_C)

PARAMETER MEASUREMENT INFORMATION (continued)

(1) C_L includes probe and jig capacitance.

Figure 20. Total Harmonic Distortion (THD)

REVISION HISTORY

Changes from Original (November, 2012) to Revision A	Page
• Device going from Preview to Production	1
• Changed ON-state resistance from 1.1 to 1.3 Ω	2
• Changed leakage current from ± 20 nA to ± 6 nA.	2
• Changed r_{on} max values from 1.1 to 1.3	3
• Changed $I_{NC(OFF)}$, $I_{NO(OFF)}$ min and max values for 25°C from –2 and 2 to –6 and 6, respectively. Changed min and max values for Full from –20 and 20 to –150 and 150, respectively.	3
• Changed $I_{NC(ON)}$, $I_{NO(ON)}$ min and max values for 25°C from –4 and 4 to –6 and 6, respectively. Changed min and max values for Full from –40 and 40 to –150 and 150, respectively.	3
• Changed $I_{COM(ON)}$ min and max values for 25°C from –4 and 4 to –8 and 8, respectively. Changed min and max values for Full from –40 and 40 to –150 and 150, respectively.	3
• Inserted 25°C above Full in T_A column and inserted 0.5 μ A max value for I_+	4
• Changed max values for r_{peak} from 2.1 to 2.2.	4
• Changed max values for r_{on} from 1.5 to 1.8.	4
• Added 25°C to T_A column and added 0.5 max value to I_+	5
• Changed r_{peak} max values from 2.7 to 2.9.	5
• Changed r_{on} max values from 2 to 2.3.	5
• Added 25°C to T_A column and added 0.5 max value to I_+	6
• Changed r_{peak} max values from 4.9 to 5.2.	6
• Changed r_{on} max values from 3.2 to 3.5.	6
• Added 25°C to T_A column and added 0.5 max value to I_+	7

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
TS5A3159QDBVRQ1	ACTIVE	SOT-23	DBV	6	3000	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.

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OTHER QUALIFIED VERSIONS OF TS5A3159-Q1 :

• Catalog: [TS5A3159](#)

• Enhanced Product: [TS5A3159-EP](#)

NOTE: Qualified Version Definitions:

-
- Catalog - TI's standard catalog product
 - Enhanced Product - Supports Defense, Aerospace and Medical Applications

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
TS5A3159QDBVRQ1	SOT-23	DBV	6	3000	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

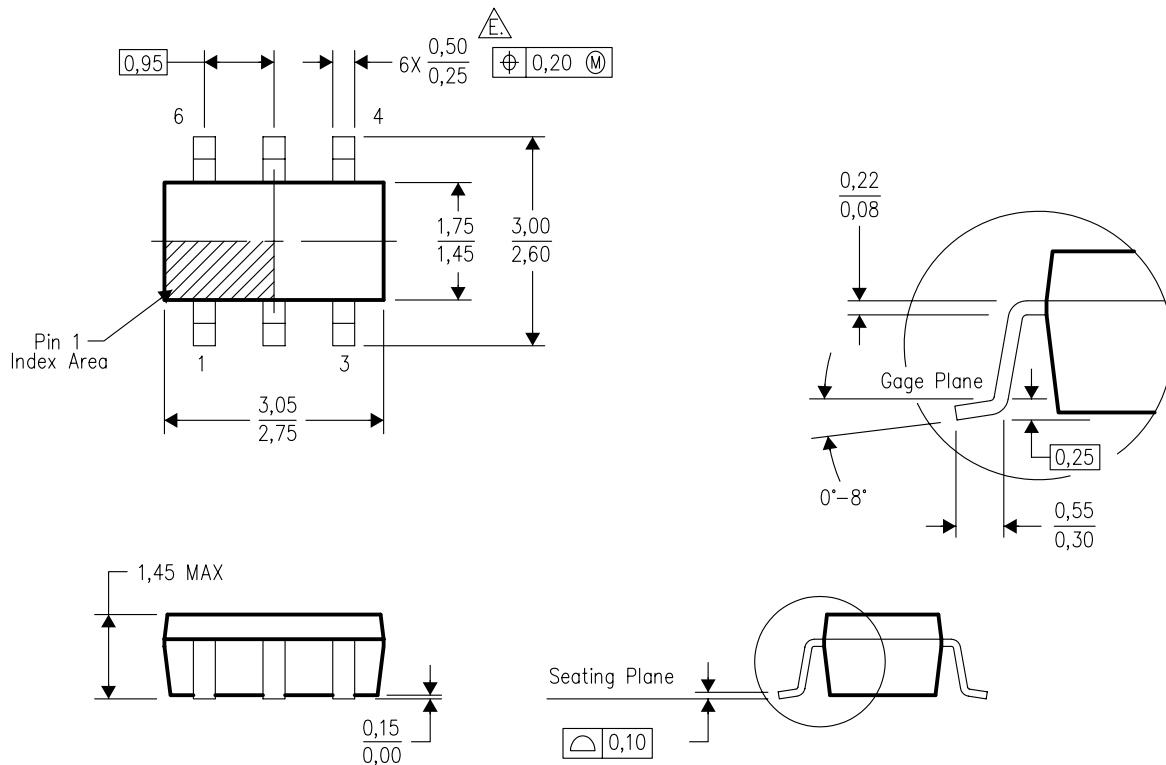


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS5A3159QDBVRQ1	SOT-23	DBV	6	3000	202.0	201.0	28.0

DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE

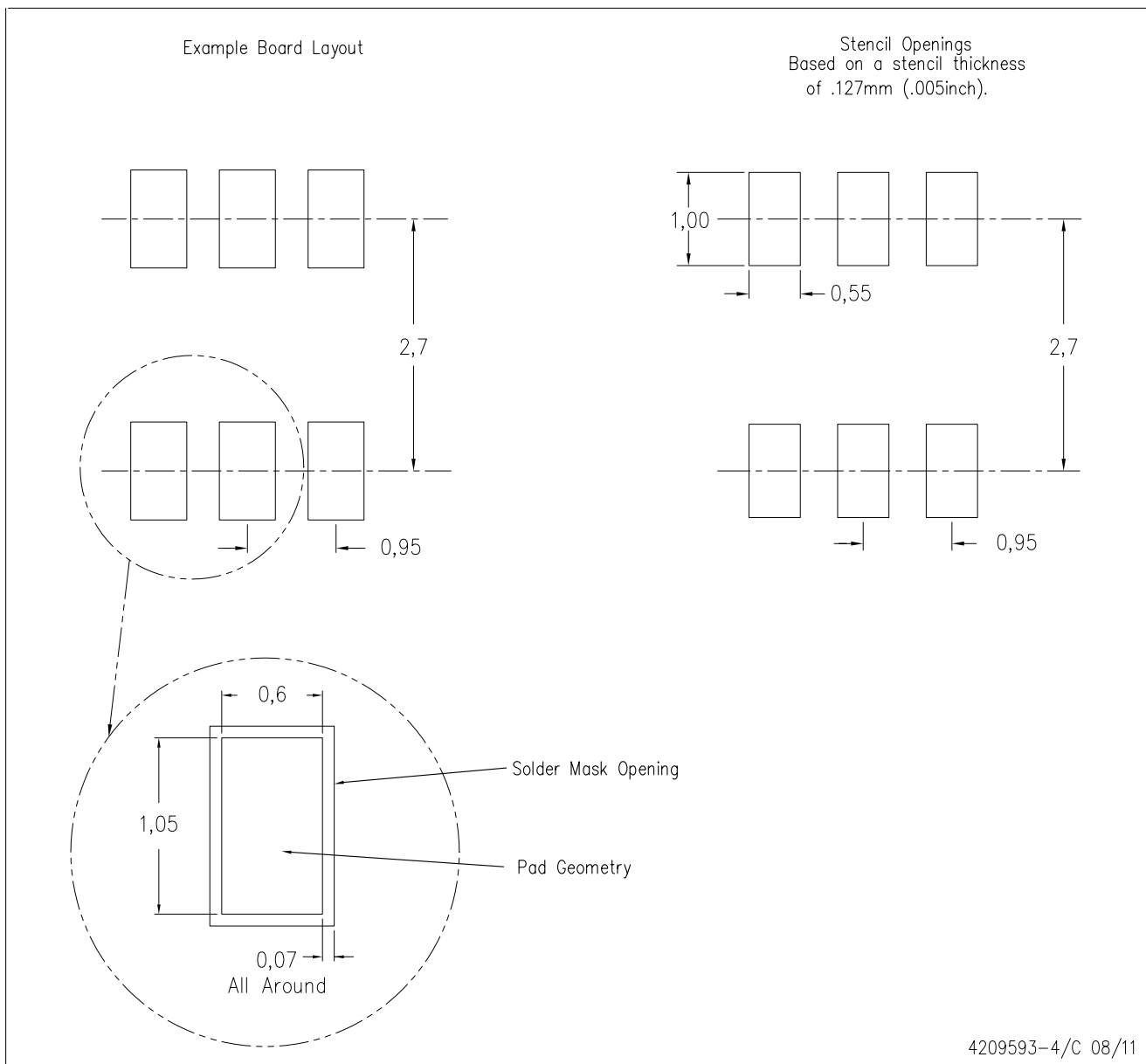


4073253-5/K 03/2006

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

DBV (R-PDSO-G6)

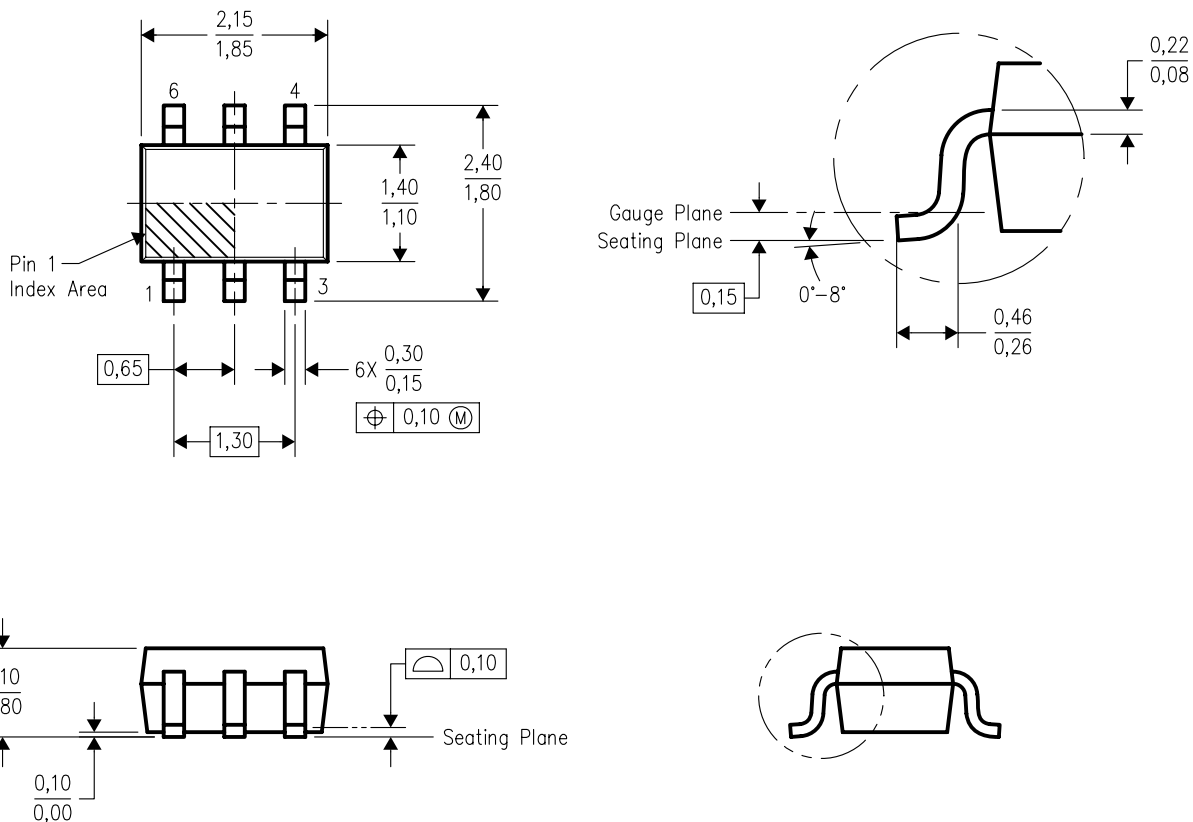
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



4093553-4/G 01/2007

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 - Falls within JEDEC MO-203 variation AB.

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