0.9-Ω SPST ANALOG SWITCH

Check for Samples: TS5A3166

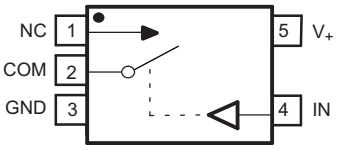
FEATURES

- **Isolation in Powered-Off Mode, V_+ = 0**
- **Low ON-State Resistance (0.9 Ω)**
- **Control Inputs Are 5.5-V Tolerant**
- **Low Charge Injection**
- **Low Total Harmonic Distortion (THD)**
- **1.65-V to 5.5-V Single-Supply Operation**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Performance Tested Per JESD 22**
  - **2000-V Human-Body Model (A114-B, Class II)**
  - **1000-V Charged-Device Model (C101)**

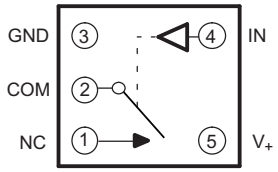
APPLICATIONS

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

SOT-23 OR SC-70 PACKAGE
(TOP VIEW)



YZP PACKAGE
(BOTTOM VIEW)



DESCRIPTION/ORDERING INFORMATION

The TS5A3166 is a single-pole single-throw (SPST) analog switch that is designed to operate from 1.65 V to 5.5 V. The device offers a low ON-state resistance. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications.

ORDERING INFORMATION

T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING(2)
–40°C to 85°C	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Tape and reel	TS5A3166YZPR	JF_
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Tape and reel	TS5A3166YZPRB(3)	JF_
	SOT (SOT-23) – DBV	Tape and reel	TS5A3166DBVR	JAT_
	SOT (SC-70) – DCK	Tape and reel	TS5A3166DCKR	JG_

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(2) DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.
(3) **YZPRB is for backside coating
YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).

Summary Of Characteristics(1)

Configuration	Single Pole Single Throw (SPST)
Number of channels	1
ON-state resistance (r_{on})	0.9 Ω
ON-state resistance flatness ($r_{on(flat)}$)	0.15 Ω
Turn-on/turn-off time (t_{ON}/t_{OFF})	7.5 ns/12.5 ns
Charge injection (Q_C)	1 pC
Bandwidth (BW)	200 MHz
OFF isolation (O_{ISO})	–64 dB at 1 MHz
Total harmonic distortion (THD)	0.005%
Leakage current ($I_{COM(OFF)}$)	±20 nA
Power-supply current (I_+)	0.5 µA
Package option	5-pin DSBGA, SOT-23, or SC-70

(1) V_+ = 5 V, T_A = 25°C

FUNCTION TABLE

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

Absolute 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_{NO} V_{COM}	Analog voltage range(3) (4) (5)		–0.5	V_+ + 0.5	V
I_K	Analog port diode current	V_{NO}, V_{COM} < 0	–50		mA
I_{NO} I_{COM}	On-state switch current	V_{NO}, V_{COM} = 0 to V_+	–200	200	mA
	On-state peak switch current(6)		–400	400	
V_I	Digital input voltage range(3) (4)		–0.5	6.5	V
I_{IK}	Digital clamp current	V_I < 0	–50		mA
I_+	Continuous current through V_+			100	mA
I_{GND}	Continuous current through GND		–100		mA
θ_{JA}	Package thermal impedance(7)	DBV package		206	°C/W
		DCK package		252	
		YZP package		132	
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum
(3) All voltages are with respect to ground, unless otherwise specified.
(4) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
(5) This value is limited to 5.5 V maximum.
(6) Pulse at 1-ms duration < 10% duty cycle.
(7) The package thermal impedance is calculated in accordance with JESD 51-7.

Electrical Characteristics for 5-V Supply(1)

V_+ = 4.5 V to 5.5 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V_+	MIN	TYP	MAX	UNIT
Analog Switch									
Analog signal range	V_{COM}, V_{NO}					0		V_+	V
Peak ON resistance	r_{peak}	$0 \le V_{NO} \le V_+$, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	4.5 V		0.8	1.1	Ω
				Full				1.2	
ON-state resistance	r_{on}	V_{NO} = 2.5 V, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	4.5 V		0.7	0.9	Ω
				Full				1	
ON-state resistance flatness	$r_{on(flat)}$	$0 \le V_{NO} \le V_+$, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	4.5 V		0.15		Ω
		V_{NO} = 1 V, 1.5 V, 2.5 V, I_{COM} = –100 mA,		25°C			0.09	0.15	
				Full				0.15	
NO OFF leakage current	$I_{NO(OFF)}$	V_{NO} = 1 V, V_{COM} = 4.5 V, or V_{NO} = 4.5 V, V_{COM} = 1 V,	Switch OFF, See Figure 14	25°C	5.5 V	–20	4	20	nA
				Full		–100		100	
	$I_{NO(PWROFF)}$	V_{NO} = 0 to 5.5 V, V_{COM} = 5.5 V to 0,		25°C	0 V	–5	0.4	5	µA
				Full		–15		15	
COM OFF leakage current	$I_{COM(OFF)}$	V_{COM} = 1 V, V_{NO} = 4.5 V, or V_{COM} = 4.5 V, V_{NO} = 1 V,	Switch OFF, See Figure 14	25°C	5.5 V	–20	4	20	nA
				Full		–100		100	
	$I_{COM(PWROFF)}$	V_{COM} = 5.5 V to 0, V_{NO} = 0 to 5.5 V,		25°C	0 V	–5	0.4	5	µA
				Full		–15		15	
NO ON leakage current	$I_{NO(ON)}$	V_{NO} = 1 V, V_{COM} = Open, or V_{NO} = 4.5 V, V_{COM} = Open,	Switch ON, See Figure 15	25°C	5.5 V	–2	0.3	2	nA
				Full		–20		20	
COM ON leakage current	$I_{COM(ON)}$	V_{COM} = 1 V, V_{NO} = Open, or V_{COM} = 4.5 V, V_{NO} = Open,	Switch ON, See Figure 15	25°C	5.5 V	–2	0.3	2	nA
				Full		–20		20	
Digital Control Inputs (IN)									
Input logic high	V_{IH}			Full		2.4		5.5	V
Input logic low	V_{IL}			Full		0		0.8	V
Input leakage current	I_{IH}, I_{IL}	V_I = 5.5 V or 0		25°C	5.5 V	–2	0.3	2	nA
				Full		–20		20	

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

Electrical Characteristics for 5-V Supply(1) (continued)

V_+ = 4.5 V to 5.5 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V+	MIN	TYP	MAX	UNIT
Dynamic									
Turn-on time	t_{ON}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	5 V	2.5	4.5	7	ns
				Full	4.5 V to 5.5 V	1.5		7.5	
Turn-off time	t_{OFF}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	5 V	6	9	11.5	ns
				Full	4.5 V to 5.5 V	4		12.5	
Charge injection	Q_C	V_{GEN} = 0, R_{GEN} = 0 ,	C_L = 1 nF, See Figure 20	25°C	5 V		1		pC
NO OFF capacitance	$C_{NO(OFF)}$	V_{NO} = V_+ or GND, Switch OFF,	See Figure 16	25°C	5 V		19		pF
COM OFF capacitance	$C_{COM(OFF)}$	V_{COM} = V_+ or GND, Switch OFF,	See Figure 16	25°C	5 V		18		pF
NO ON capacitance	$C_{NO(ON)}$	V_{NO} = V_+ or GND, Switch ON,	See Figure 16	25°C	5 V		35.5		pF
COM ON capacitance	$C_{COM(ON)}$	V_{COM} = V_+ or GND, Switch ON,	See Figure 16	25°C	5 V		35.5		pF
Digital input capacitance	C_I	V_I = V_+ or GND,	See Figure 16	25°C	5 V		2		pF
Bandwidth	BW	R_L = 50 Ω, Switch ON,	See Figure 18	25°C	5 V		200		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 1 MHz,	Switch OFF, See Figure 19	25°C	5 V		–64		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 20 Hz to 20 kHz, See Figure 21	25°C	5 V		0.005		%
Supply									
Positive supply current	I_+	V_I = V_+ or GND,	Switch ON or OFF	25°C	5.5 V		0.01	0.1	µA
				Full				0.5	

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

Electrical Characteristics for 3.3-V Supply(1)

V_+ = 3 V to 3.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V_+	MIN	TYP	MAX	UNIT
Analog Switch									
Analog signal range	V_{COM}, V_{NO}					0		V_+	V
Peak ON resistance	r_{peak}	0 ≤ V_{NO} ≤ V_+, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	3 V		1.1	1.5	Ω
				Full				1.7	
ON-state resistance	r_{on}	V_{NO} = 2 V, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	3 V		1	1.4	Ω
				Full				1.5	
ON-state resistance flatness	$r_{on(flat)}$	0 ≤ V_{NO} ≤ V_+, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	3 V		0.3		Ω
		V_{NO} = 2 V, 0.8 V, I_{COM} = –100 mA,		25°C			0.09	0.15	
				Full				0.15	
NO OFF leakage current	$I_{NO(OFF)}$	V_{NO} = 1 V, V_{COM} = 3 V, or V_{NO} = 3 V, V_{COM} = 1 V,	Switch OFF, See Figure 14	25°C	3.6 V	–2	0.5	2	nA
				Full		–20		20	
	$I_{NO(PWROFF)}$	V_{NO} = 0 to 3.6 V, V_{COM} = 3.6 V to 0,		25°C	0 V	–1	0.1	1	µA
				Full		–5		5	
COM OFF leakage current	$I_{COM(OFF)}$	V_{COM} = 1 V, V_{NO} = 3 V, or V_{COM} = 3 V, V_{NO} = 1 V,	Switch OFF, See Figure 14	25°C	3.6 V	–2	0.5	2	nA
				Full		–20		20	
	$I_{COM(PWROFF)}$	V_{COM} = 3.6 V to 0, V_{NO} = 0 to 3.6 V,		25°C	0 V	–1	0.1	1	µA
				Full		–5		5	
NO ON leakage current	$I_{NO(ON)}$	V_{NO} = 1 V, V_{COM} = Open, or V_{NO} = 3 V, V_{COM} = Open,	Switch ON, See Figure 15	25°C	3.6 V	–2	0.2	2	nA
				Full		–20		20	
COM ON leakage current	$I_{COM(ON)}$	V_{COM} = 1 V, V_{NO} = Open, or V_{COM} = 3 V, V_{NO} = Open,	Switch ON, See Figure 15	25°C	3.6 V	–2	0.2	2	nA
				Full		–20		20	
Digital Control Inputs (IN)									
Input logic high	V_{IH}			Full		2		5.5	V
Input logic low	V_{IL}			Full		0		0.8	V
Input leakage current	I_{IH}, I_{IL}	V_I = 5.5 V or 0		25°C	3.6 V	–2	0.3	2	nA
				Full		–20		20	

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

Electrical Characteristics for 3.3-V Supply(1) (continued)

V_+ = 3 V to 3.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V+	MIN	TYP	MAX	UNIT
Dynamic									
Turn-on time	t_{ON}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	3.3 V	2	5	10	ns
				Full	3 V to 3.6 V	1.5		11	
Turn-off time	t_{OFF}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	3.3 V	6.5	9	12	ns
				Full	3 V to 3.6 V	4		13	
Charge injection	Q_C	V_{GEN} = 0, R_{GEN} = 0,	C_L = 1 nF, See Figure 21	25°C	3.3 V		1		pC
NO OFF capacitance	$C_{NO(OFF)}$	V_{NO} = V_+ or GND, Switch OFF,	See Figure 16	25°C	3.3 V		19		pF
COM OFF capacitance	$C_{COM(OFF)}$	V_{COM} = V_+ or GND, Switch OFF,	See Figure 16	25°C	3.3 V		18		pF
NO ON capacitance	$C_{NO(ON)}$	V_{NO} = V_+ or GND, Switch ON,	See Figure 16	25°C	3.3 V		36		pF
COM ON capacitance	$C_{COM(ON)}$	V_{COM} = V_+ or GND, Switch ON,	See Figure 16	25°C	3.3 V		36		pF
Digital input capacitance	C_I	V_I = V_+ or GND,	See Figure 16	25°C	3.3 V		2		pF
Bandwidth	BW	R_L = 50 Ω, Switch ON,	See Figure 18	25°C	3.3 V		200		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 1 MHz,	Switch OFF, See Figure 19	25°C	3.3 V		–64		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 20 Hz to 20 kHz, See Figure 21	25°C	3.3 V		0.01		%
Supply									
Positive supply current	I_+	V_I = V_+ or GND,	Switch ON or OFF	25°C	3.6 V		0.01	0.1	µA
				Full				0.25	

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

Electrical Characteristics for 2.5-V Supply(1)

V_+ = 2.3 V to 2.7 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V_+	MIN	TYP	MAX	UNIT
Analog Switch									
Analog signal range	V_{COM}, V_{NO}				2.3 V	0		V_+	V
Peak ON resistance	r_{peak}	0 ≤ V_{NO} ≤ V_+, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	2.3 V		1.8	2.4	Ω
				Full				2.6	
ON-state resistance	r_{on}	V_{NO} = 2 V, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	2.3 V		1.2	2.1	Ω
				Full				2.4	
ON-state resistance flatness	$r_{on(flat)}$	0 ≤ V_{NO} ≤ V_+, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	2.3 V		0.7		Ω
		V_{NO} = 2 V, 0.8 V, I_{COM} = –100 mA,		25°C			0.4	0.6	
				Full				0.6	
NO OFF leakage current	$I_{NO(OFF)}$	V_{NO} = 1 V, V_{COM} = 3 V, or V_{NO} = 3 V, V_{COM} = 1 V,	Switch OFF, See Figure 14	25°C	2.7 V	–5	0.3	5	nA
				Full		–50		50	
	$I_{NO(PWROFF)}$	V_{NO} = 0 to 3.6 V, V_{COM} = 3.6 V to 0,		25°C	0 V	–2	0.05	2	µA
				Full		–15		15	
COM OFF leakage current	$I_{COM(OFF)}$	V_{COM} = 1 V, V_{NO} = 3 V, or V_{COM} = 3 V, V_{NO} = 1 V,	Switch OFF, See Figure 14	25°C	2.7 V	–5	0.3	5	nA
				Full		–50		50	
	$I_{COM(PWROFF)}$	V_{COM} = 3.6 V to 0, V_{NO} = 0 to 3.6 V,		25°C	0 V	–2	0.05	2	µA
				Full		–15		15	
NO ON leakage current	$I_{NO(ON)}$	V_{NO} = 1 V, V_{COM} = Open, or V_{NO} = 3 V, V_{COM} = Open,	Switch ON, See Figure 15	25°C	2.7 V	–2	0.3	2	nA
				Full		–20		20	
COM ON leakage current	$I_{COM(ON)}$	V_{COM} = 1 V, V_{NO} = Open, or V_{COM} = 3 V, V_{NO} = Open,	Switch ON, See Figure 15	25°C	2.7 V	–2	0.3	2	nA
				Full		–20		20	
Digital Control Inputs (IN1, IN2)									
Input logic high	V_{IH}			Full		1.8		5.5	V
Input logic low	V_{IL}			Full		0		0.6	V
Input leakage current	I_{IH}, I_{IL}	V_I = 5.5 V or 0		25°C	2.7 V	–2	0.3	2	nA
				Full		–20		20	

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

Electrical Characteristics for 2.5-V Supply(1) (continued)

V_+ = 2.3 V to 2.7 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V+	MIN	TYP	MAX	UNIT
Dynamic									
Turn-on time	t_{ON}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	2.5 V	2	6	10	ns
				Full	2.3 V to 2.7 V	1		12	
Turn-off time	t_{OFF}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	2.5 V	4.5	8	10.5	ns
				Full	2.3 V to 2.7 V	3		15	
Charge injection	Q_C	V_{GEN} = 0, R_{GEN} = 0,	C_L = 1 nF, See Figure 21	25°C	2.5 V		4		pC
NO OFF capacitance	$C_{NO(OFF)}$	V_{NO} = V_+ or GND, Switch OFF,	See Figure 16	25°C	2.5 V		19.5		pF
COM OFF capacitance	$C_{COM(OFF)}$	V_{COM} = V_+ or GND, Switch OFF,	See Figure 16	25°C	2.5 V		18.5		pF
NO ON capacitance	$C_{NO(ON)}$	V_{NO} = V_+ or GND, Switch ON,	See Figure 16	25°C	2.5 V		36.5		pF
COM ON capacitance	$C_{COM(ON)}$	V_{COM} = V_+ or GND, Switch ON,	See Figure 16	25°C	2.5 V		36.5		pF
Digital input capacitance	C_I	V_I = V_+ or GND,	See Figure 16	25°C	2.5 V		2		pF
Bandwidth	BW	R_L = 50 Ω, Switch ON,	See Figure 18	25°C	2.5 V		150		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 1 MHz,	Switch OFF, See Figure 19	25°C	2.5 V		–62		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 20 Hz to 20 kHz, See Figure 21	25°C	2.5 V		0.02		%
Supply									
Positive supply current	I_+	V_I = V_+ or GND,	Switch ON or OFF	25°C	2.7 V		0.001	0.02	μA
				Full				0.25	

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

Electrical Characteristics for 1.8-V Supply(1)

V_+ = 1.65 V to 1.95 V, T_A = –40°C to 85°C (unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V_+	MIN	TYP	MAX	UNIT
Analog Switch									
Analog signal range	V_{COM}, V_{NO}					0		V_+	V
Peak ON resistance	r_{peak}	$0 \le V_{NO} \le V_+$, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	1.65 V		4.2	25	Ω
				Full				30	
ON-state resistance	r_{on}	V_{NO} = 2 V, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	1.65 V		1.6	3.9	Ω
				Full				4.0	
ON-state resistance flatness	$r_{on(flat)}$	$0 \le V_{NO} \le V_+$, I_{COM} = –100 mA,	Switch ON, See Figure 13	25°C	1.65 V		2.8		Ω
		V_{NO} = 2 V, 0.8 V, I_{COM} = –100 mA,		25°C			4.1	22	
				Full				27	
NO OFF leakage current	$I_{NO(OFF)}$	V_{NO} = 1 V, V_{COM} = 3 V, or V_{NO} = 3 V, V_{COM} = 1 V,	Switch OFF, See Figure 14	25°C	1.95 V	–5		5	nA
				Full		–50		50	
	$I_{NO(PWROFF)}$	V_{NO} = 0 to 3.6 V, V_{COM} = 3.6 V to 0,		25°C	0 V	–2		2	µA
				Full		–10		10	
COM OFF leakage current	$I_{COM(OFF)}$	V_{COM} = 1 V, V_{NO} = 3 V, or V_{COM} = 3 V, V_{NO} = 1 V,	Switch OFF, See Figure 14	25°C	1.95 V	–5		5	nA
				Full		–50		50	
	$I_{COM(PWROFF)}$	V_{COM} = 0 to 3.6 V, V_{NO} = 3.6 V to 0,		25°C	0 V	–2		2	µA
				Full		–10		10	
NO ON leakage current	$I_{NO(ON)}$	V_{NO} = 1 V, V_{COM} = Open, or V_{NO} = 3 V, V_{COM} = Open,	Switch ON, See Figure 15	25°C	1.95 V	–2		2	nA
				Full		–20		20	
COM ON leakage current	$I_{COM(ON)}$	V_{COM} = 1 V, V_{NO} = Open, or V_{COM} = 3 V, V_{NO} = Open,	Switch ON, See Figure 15	25°C	1.95 V	–2		2	nA
				Full		–20		20	
Digital Control Inputs (IN1, IN2)									
Input logic high	V_{IH}			Full		1.5		5.5	V
Input logic low	V_{IL}			Full		0		0.6	V
Input leakage current	I_{IH}, I_{IL}	V_I = 5.5 V or 0		25°C	1.95 V	–2	0.3	2	nA
				Full		–20		20	

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

Electrical Characteristics for 1.8-V Supply(1) (continued)

V_+ = 1.65 V to 1.95 V, T_A = –40°C to 85°C (unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITIONS		T_A	V+	MIN	TYP	MAX	UNIT
Dynamic									
Turn-on time	t_{ON}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	1.8 V	3	9	18	ns
				Full	1.65 V to 1.95 V	1		20	
Turn-off time	t_{OFF}	V_{COM} = V_+, R_L = 50 Ω,	C_L = 35 pF, See Figure 17	25°C	1.8 V	5	10	15.5	ns
				Full	1.65 V to 1.95 V	4		18.5	
Charge injection	Q_C	V_{GEN} = 0, R_{GEN} = 0,	C_L = 1 nF, See Figure 21	25°C	1.8 V		2		pC
NO OFF capacitance	$C_{NO(OFF)}$	V_{NO} = V_+ or GND, Switch OFF,	See Figure 16	25°C	1.8 V		19.5		pF
COM OFF capacitance	$C_{COM(OFF)}$	V_{COM} = V_+ or GND, Switch OFF,	See Figure 16	25°C	1.8 V		18.5		pF
NO ON capacitance	$C_{NO(ON)}$	V_{NO} = V_+ or GND, Switch ON,	See Figure 16	25°C	1.8 V		36.5		pF
COM ON capacitance	$C_{COM(ON)}$	V_{COM} = V_+ or GND, Switch ON,	See Figure 16	25°C	1.8 V		36.5		pF
Digital input capacitance	C_I	V_I = V_+ or GND,	See Figure 16	25°C	1.8 V		2		pF
Bandwidth	BW	R_L = 50 Ω, Switch ON,	See Figure 18	25°C	1.8 V		150		MHz
OFF isolation	O_{ISO}	R_L = 50 Ω, f = 1 MHz,	Switch OFF, See Figure 19	25°C	1.8 V		–62		dB
Total harmonic distortion	THD	R_L = 600 Ω, C_L = 50 pF,	f = 20 Hz to 20 kHz See Figure 21	25°C	1.8 V		0.055		%
Supply									
Positive supply current	I_+	V_I = V_+ or GND,	Switch ON or OFF	25°C	1.95 V		0.001	0.01	µA
				Full				0.15	

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

TYPICAL PERFORMANCE

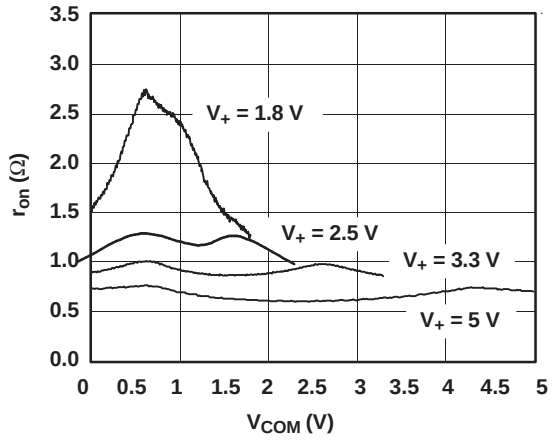


Figure 1. r_{on} vs V_{COM}

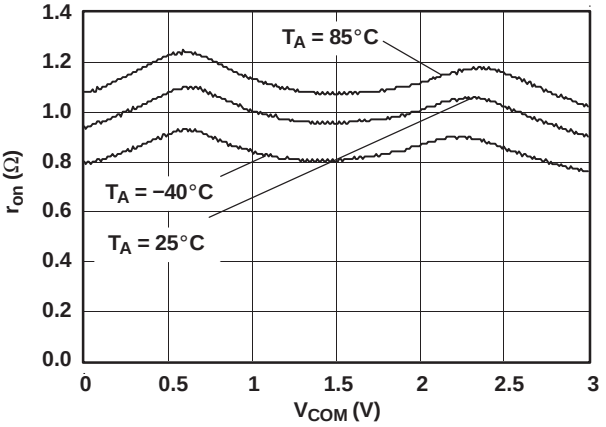


Figure 2. r_{on} vs V_{COM} (V_+ = 3 V)

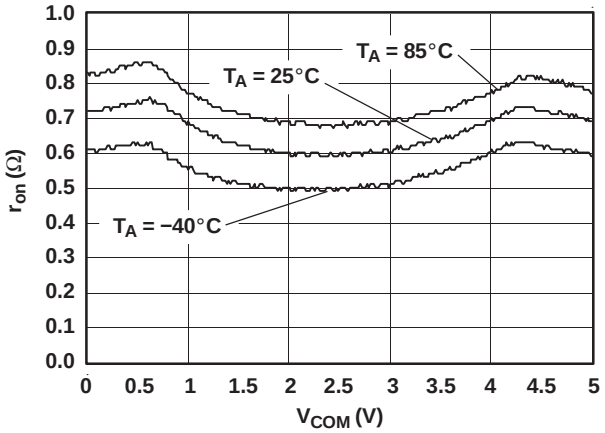


Figure 3. r_{on} vs V_{COM} (V_+ = 5 V)

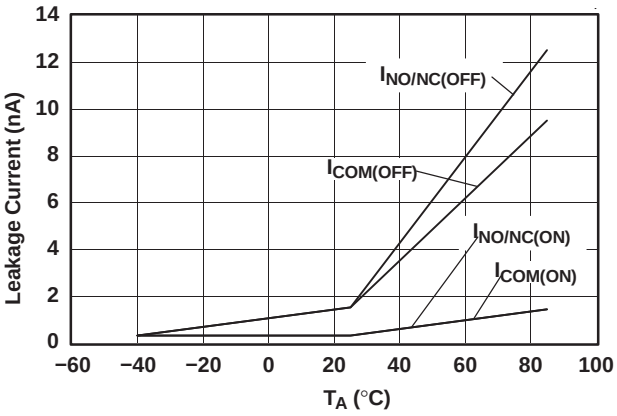


Figure 4. Leakage Current vs Temperature (V_+ = 5.5 V)

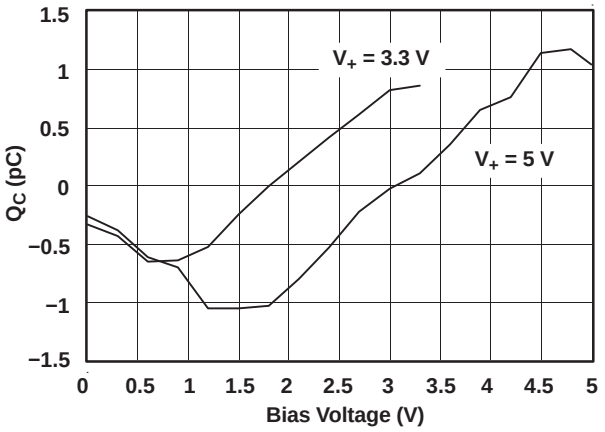


Figure 5. Charge Injection (Q_C) vs V_{COM}

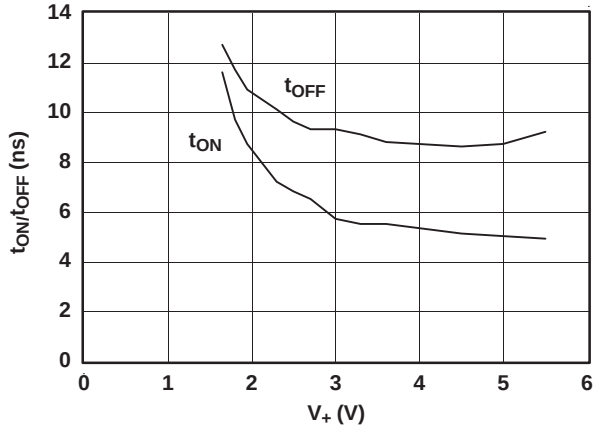


Figure 6. t_{ON} and t_{OFF} vs Supply Voltage

TYPICAL PERFORMANCE (continued)

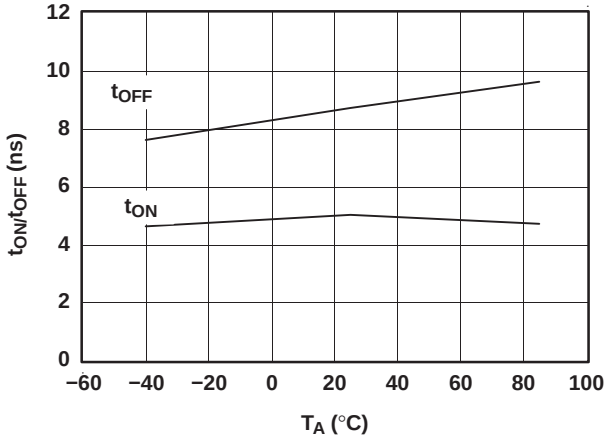


Figure 7. t_{ON} and t_{OFF} vs Temperature (V_+ = 5 V)

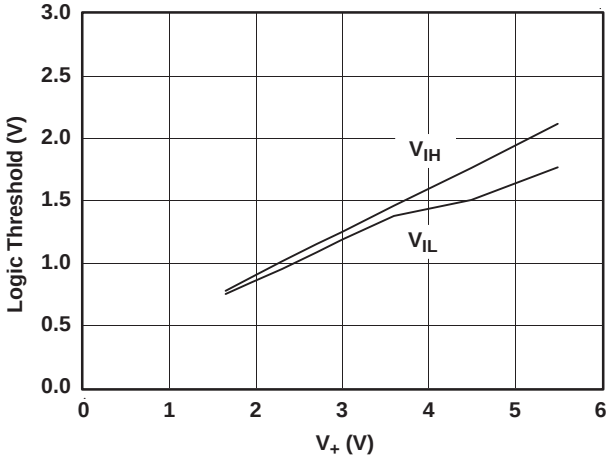


Figure 8. Logic Threshold vs V_+

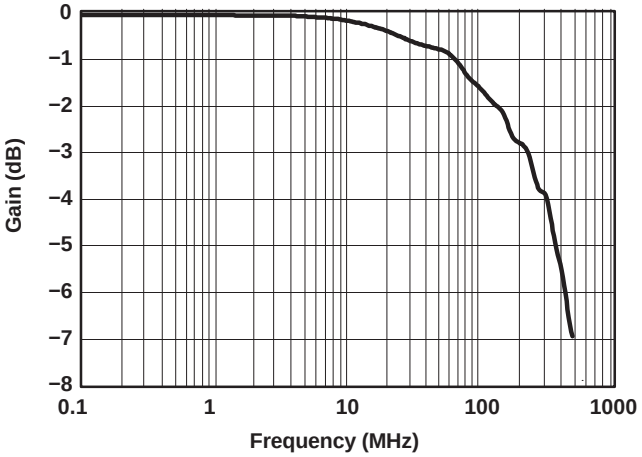


Figure 9. Gain vs Frequency (V_+ = 5 V)

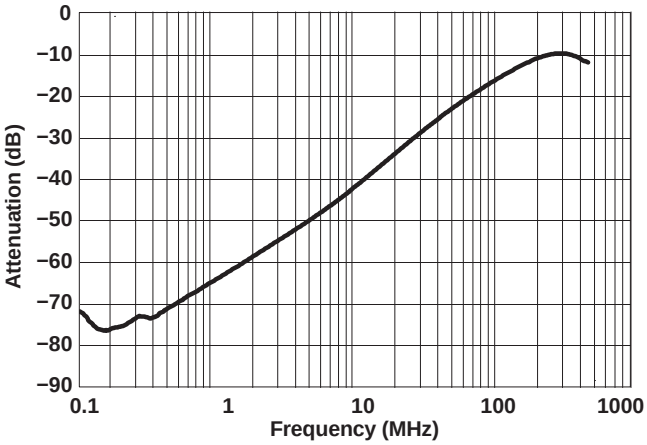


Figure 10. OFF Isolation vs Frequency (V_+ = 5 V)

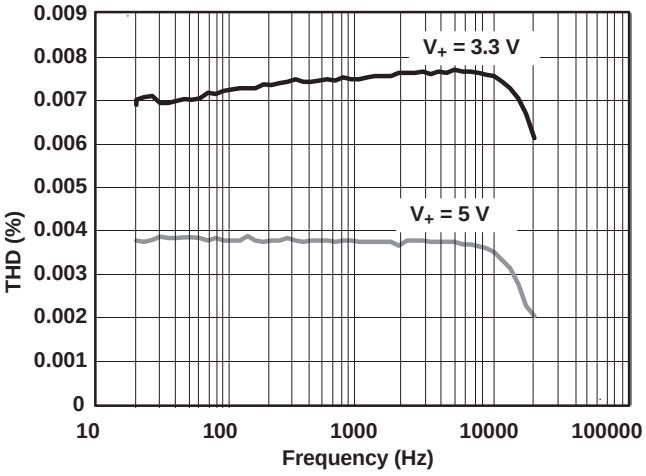


Figure 11. Total Harmonic Distortion vs Frequency (V_+ = 5 V)

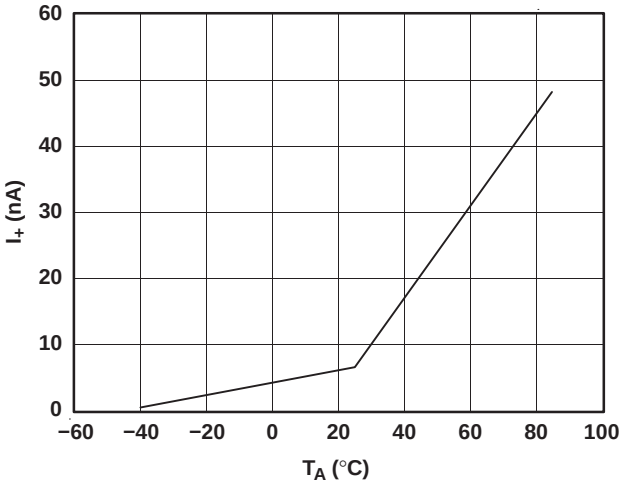


Figure 12. Power-Supply Current vs Temperature (V_+ = 5 V)

Table 1. PIN DESCRIPTION

PIN NUMBER	NAME	DESCRIPTION
1	NO	Normally closed
2	COM	Common

TYPICAL PERFORMANCE (continued)

Table 1. PIN DESCRIPTION (continued)

PIN NUMBER	NAME	DESCRIPTION
3	GND	Digital ground
4	IN	Digital control pin to connect COM to NO
5	V_+	Power Supply

PARAMETER DESCRIPTION

SYMBOL	DESCRIPTION
V_{COM}	Voltage at COM
V_{NO}	Voltage at NO
r_{on}	Resistance between COM and NO ports when the channel is ON
r_{peak}	Peak on-state resistance over a specified voltage range
$r_{on(flat)}$	Difference between the maximum and minimum value of r_{on} in a channel over the specified range of 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
$I_{NO(PWROFF)}$	Leakage current measured at the NO port during the power-down condition, $V_+ = 0$
$I_{COM(OFF)}$	Leakage current measured at the COM port, with the corresponding channel (COM to NO) in the OFF state under worst-case input and output conditions
$I_{COM(PWROFF)}$	Leakage current measured at the COM port during the power-down condition, $V_+ = 0$
$I_{NO(ON)}$	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the ON state and the output (COM) open
$I_{COM(ON)}$	Leakage current measured at the COM port, with the corresponding channel (COM to NO) in the ON state and the output (NO) open
V_{IH}	Minimum input voltage for logic high for the control input (IN)
V_{IL}	Maximum input voltage for logic low for the control input (IN)
V_I	Voltage at the control input (IN)
I_{IH}, I_{IL}	Leakage current measured at the 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 output (COM 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 output (COM or NO) signal when the switch is turning OFF.
Q_C	Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (NO or COM) output. This is measured in coulomb (C) and measured by the total charge induced due to switching of the control input. Charge injection, $Q_C = C_L \times \Delta V_{COM}$. C_L is the load capacitance, and ΔV_{COM} is the change in analog output voltage.
$C_{NO(OFF)}$	Capacitance at the NO port when the corresponding channel (NO to COM) is OFF
$C_{COM(OFF)}$	Capacitance at the COM port when the corresponding channel (COM to NO) is OFF
$C_{NO(ON)}$	Capacitance at the NO port when the corresponding channel (NO to COM) is ON
$C_{COM(ON)}$	Capacitance at the COM port when the corresponding channel (COM to NO) is ON
C_I	Capacitance of 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 (NO to COM) in the OFF state.
BW	Bandwidth of the switch. This is the frequency in which the gain of an ON channel is –3 dB below the DC gain.
THD	Total harmonic distortion describes the signal distortion caused by the analog switch. This is defined as the ratio of root mean square (RMS) value of the second, third, and higher harmonic to the absolute magnitude of the fundamental harmonic.
I_+	Static power-supply current with the control (IN) pin at V_+ or GND

PARAMETER MEASUREMENT INFORMATION

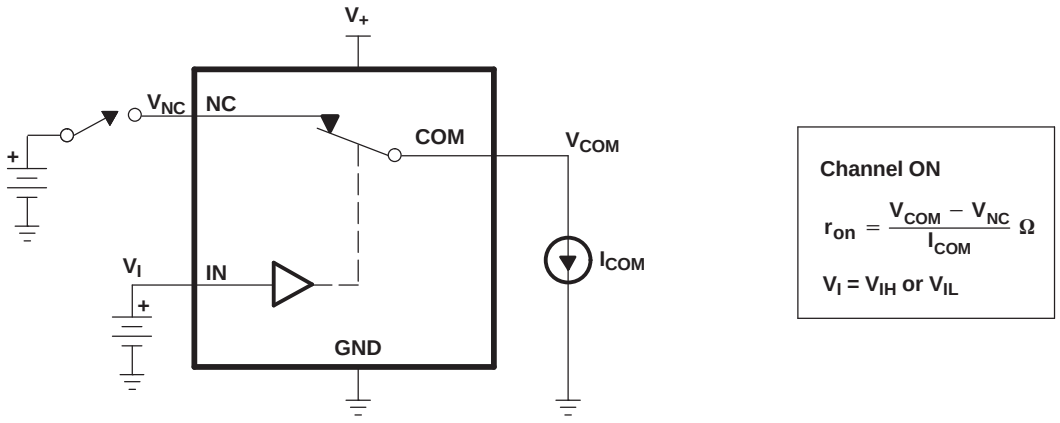


Figure 13. ON-State Resistance (r_{on})

PARAMETER MEASUREMENT INFORMATION (continued)

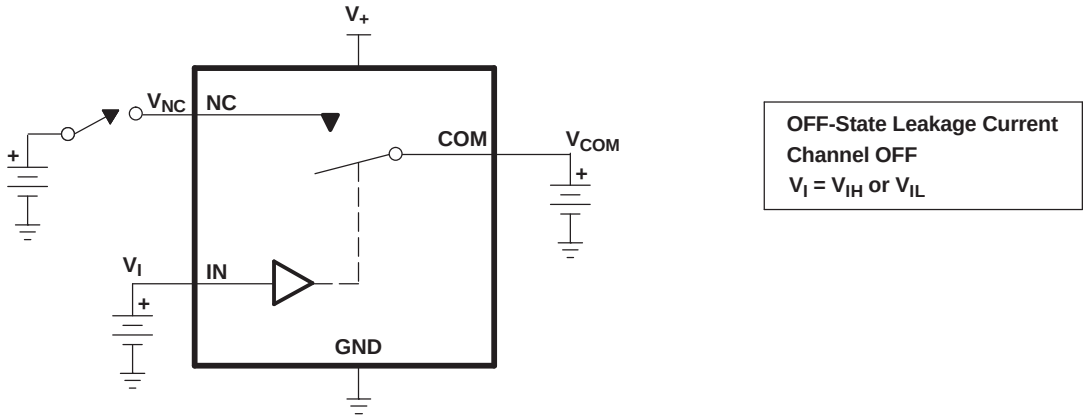


Figure 14. OFF-State Leakage Current ($I_{COM(OFF)}$, $I_{NO(OFF)}$, $I_{COM(PWROFF)}$, $I_{NO(PWR(FF)}$)

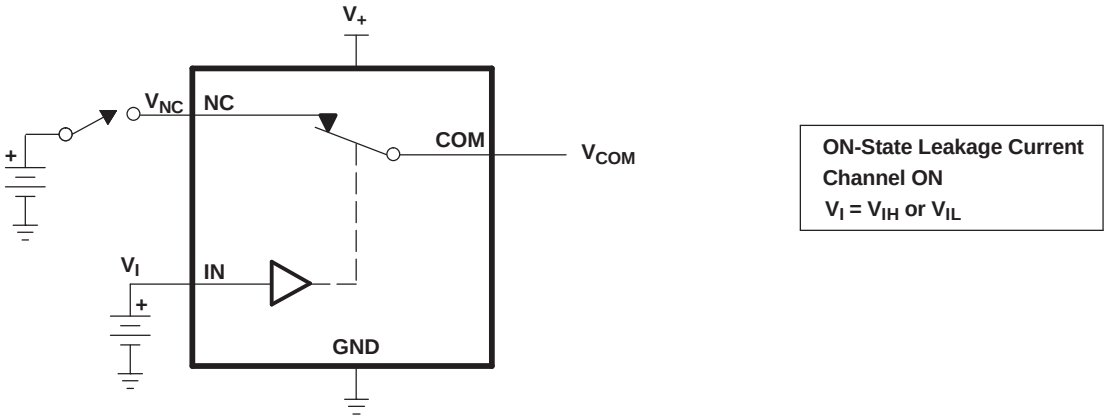


Figure 15. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NO(ON)}$)

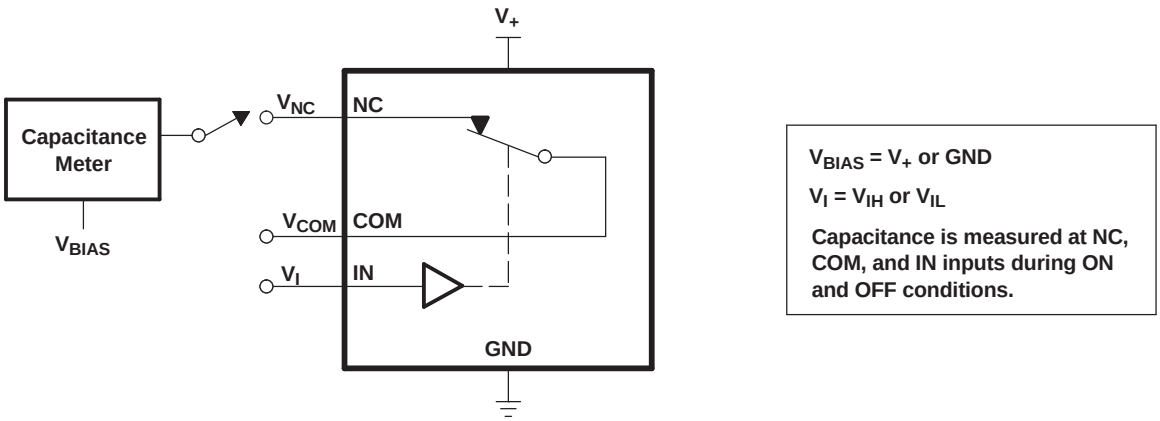
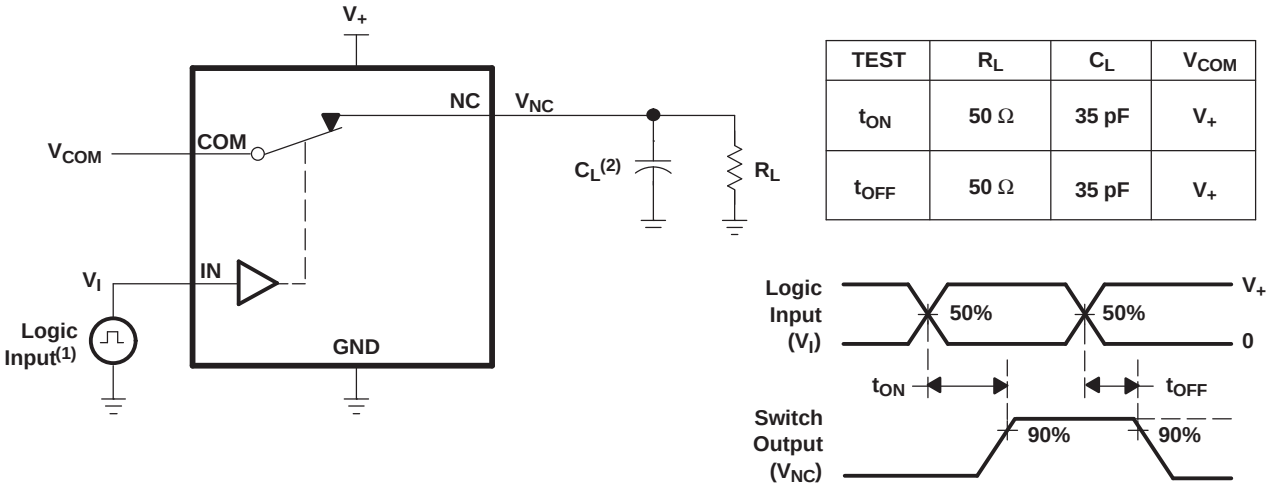


Figure 16. Capacitance (C_I, $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NO(OFF)}$, $C_{NO(ON)}$)

PARAMETER MEASUREMENT INFORMATION (continued)

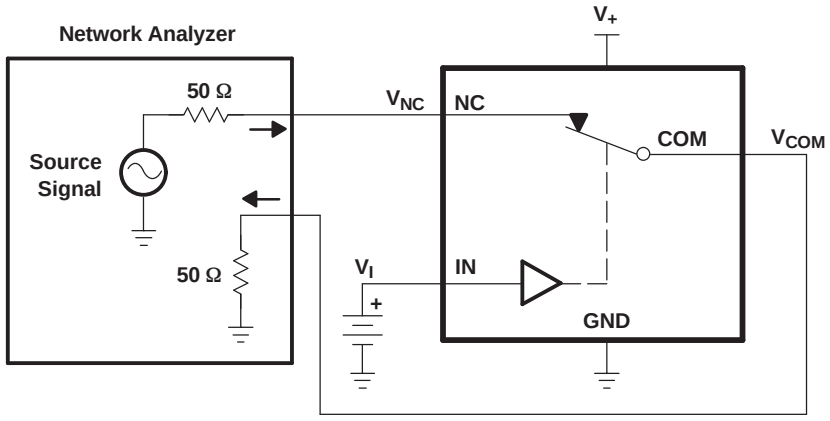


TEST	R_L	C_L	V_{COM}
t_{ON}	50 Ω	35 pF	V_+
t_{OFF}	50 Ω	35 pF	V_+

(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.

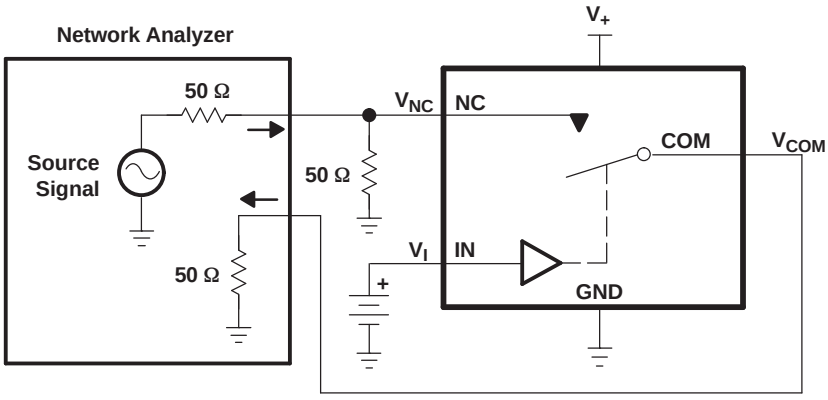
Figure 17. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})



Channel ON: NC to COM
V_I = V_+ or GND

Network Analyzer Setup
Source Power = 0 dBm (632-mV P-P at 50-Ω load)
DC Bias = 350 mV

Figure 18. Bandwidth (BW)

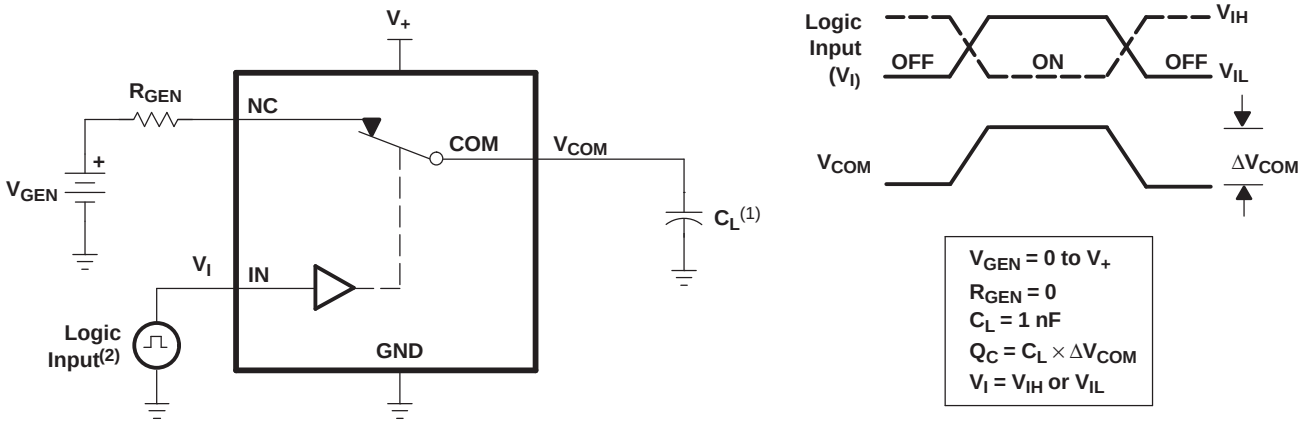


Channel OFF: NC to COM
V_I = V_+ or GND

Network Analyzer Setup
Source Power = 0 dBm (632-mV P-P at 50-Ω load)
DC Bias = 350 mV

Figure 19. OFF Isolation (O_{ISO})

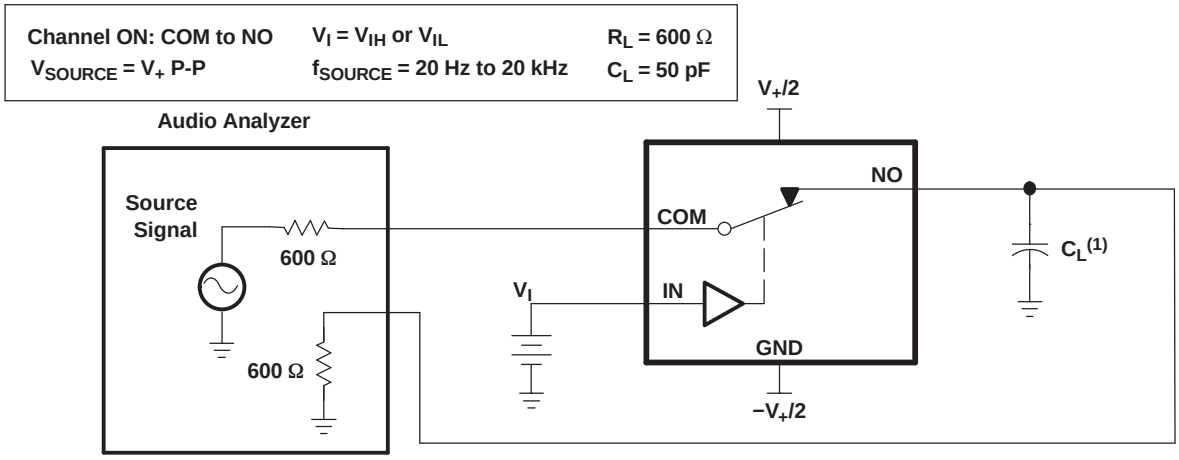
PARAMETER MEASUREMENT INFORMATION (continued)



(1) C_L includes probe and jig capacitance.

(2) 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.

Figure 20. Charge Injection (Q_C)



(1) C_L includes probe and jig capacitance.

Figure 21. Total Harmonic Distortion (THD)

REVISION HISTORY

Changes from Original (February 2005) to Revision A	Page
• Updated ORDERING INFORMATION table.	1

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)
TS5A3166DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TS5A3166DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TS5A3166DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TS5A3166DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TS5A3166DCKRE4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TS5A3166DCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TS5A3166YZPR	ACTIVE	DSBGA	YZP	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	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.

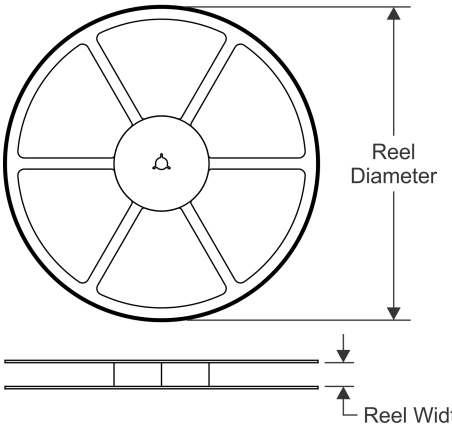
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and

continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

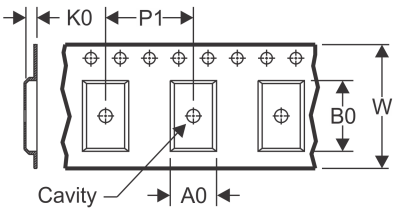
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

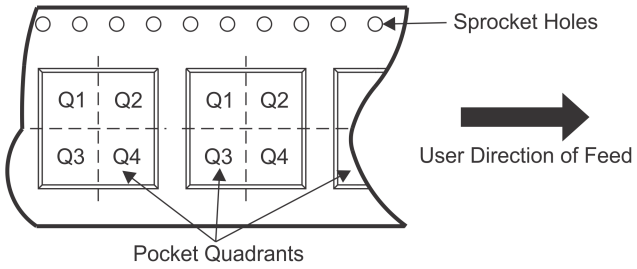


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

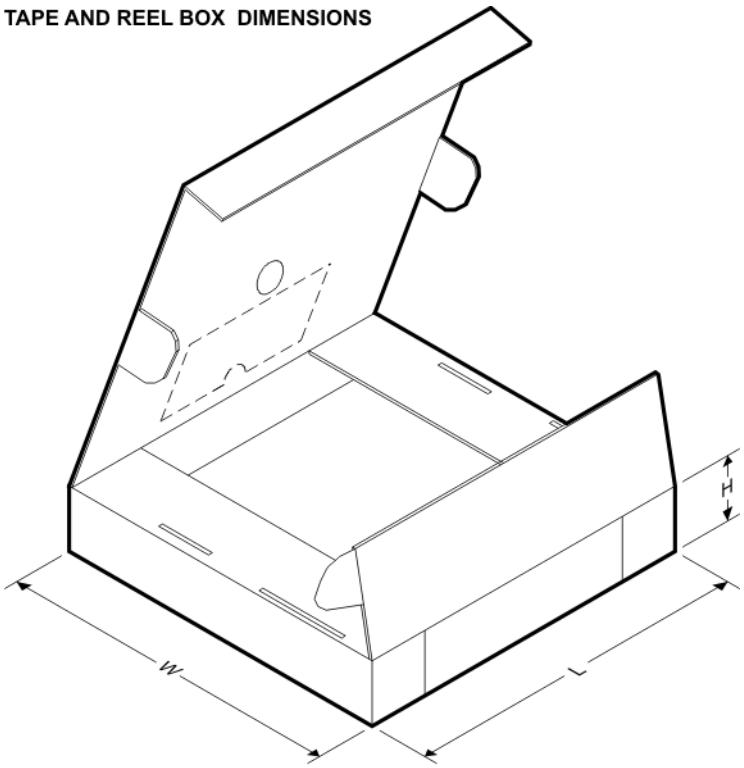
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TS5A3166DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TS5A3166DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TS5A3166YZPR	DSBGA	YZP	5	3000	178.0	9.2	1.02	1.52	0.63	4.0	8.0	Q1

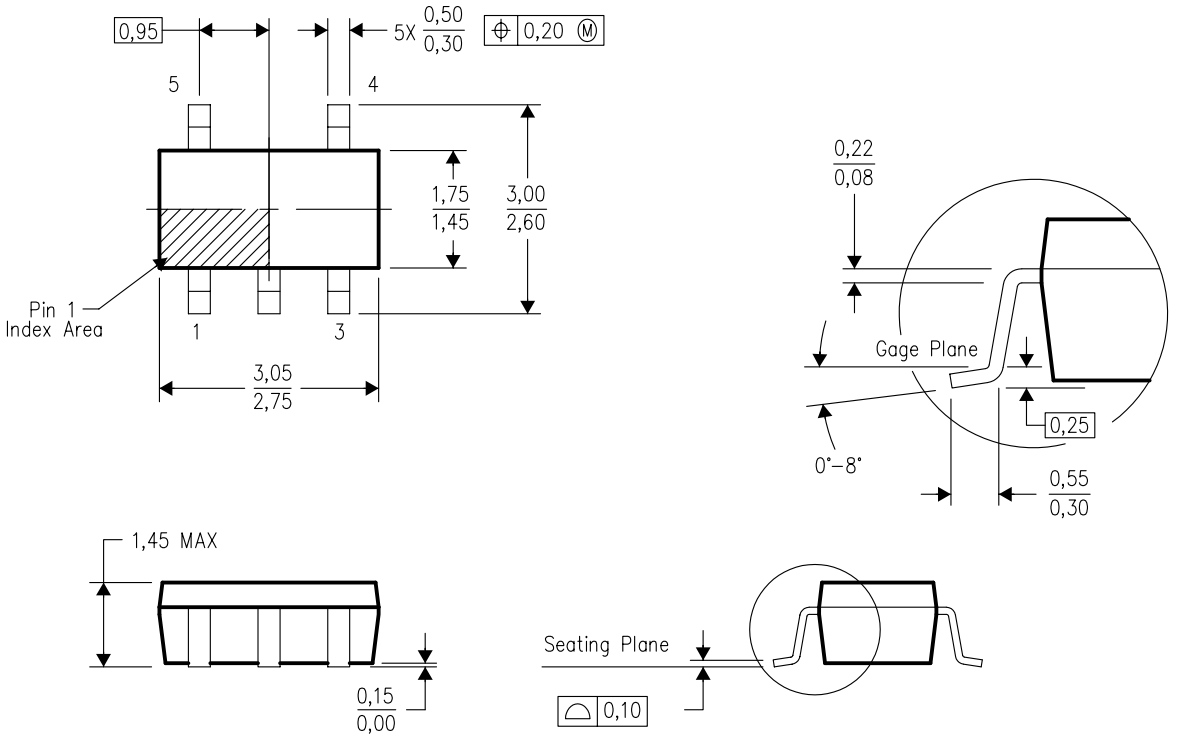
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS5A3166DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TS5A3166DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TS5A3166YZPR	DSBGA	YZP	5	3000	220.0	220.0	35.0

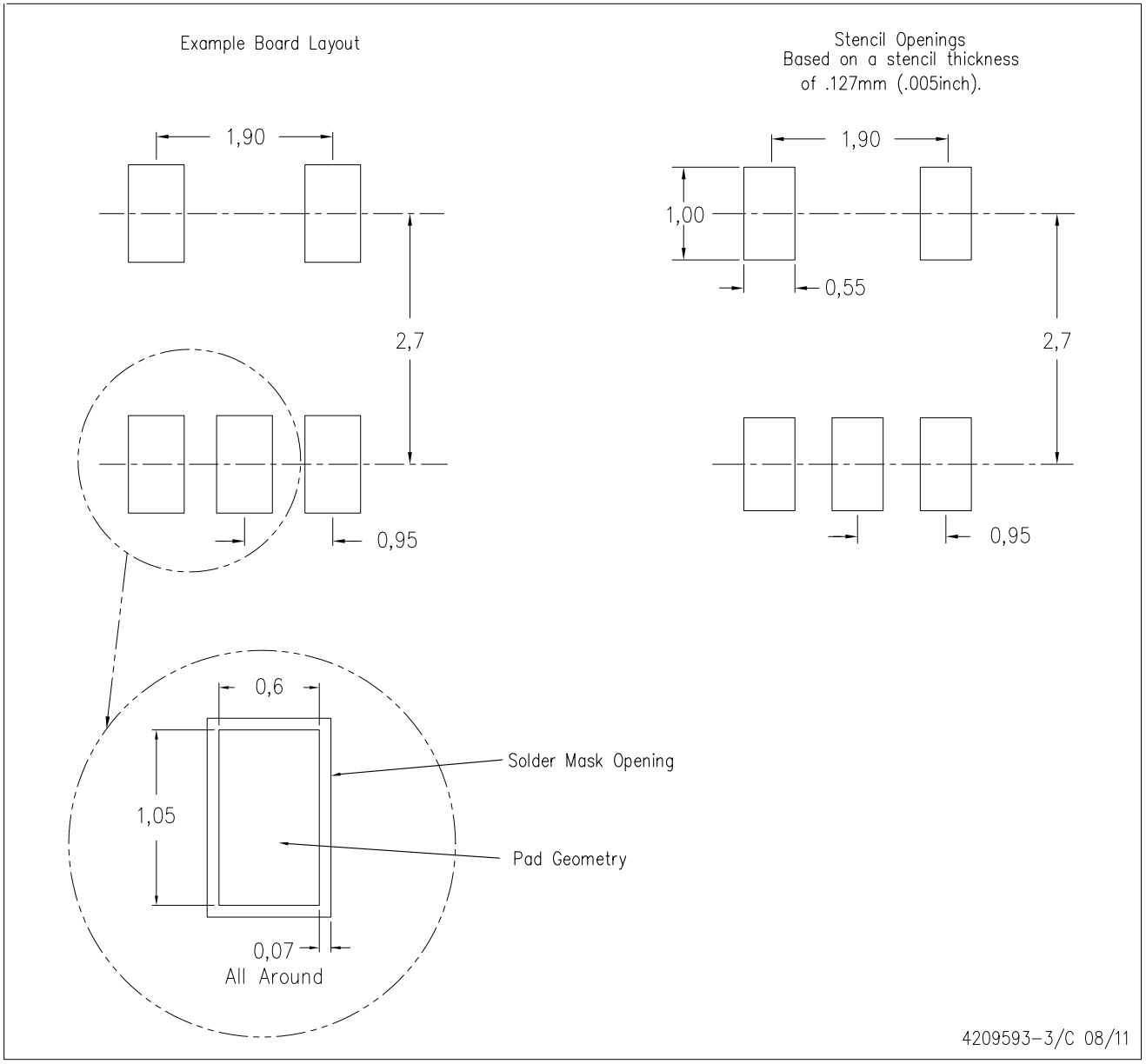
DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



4073253–4/K 03/2006

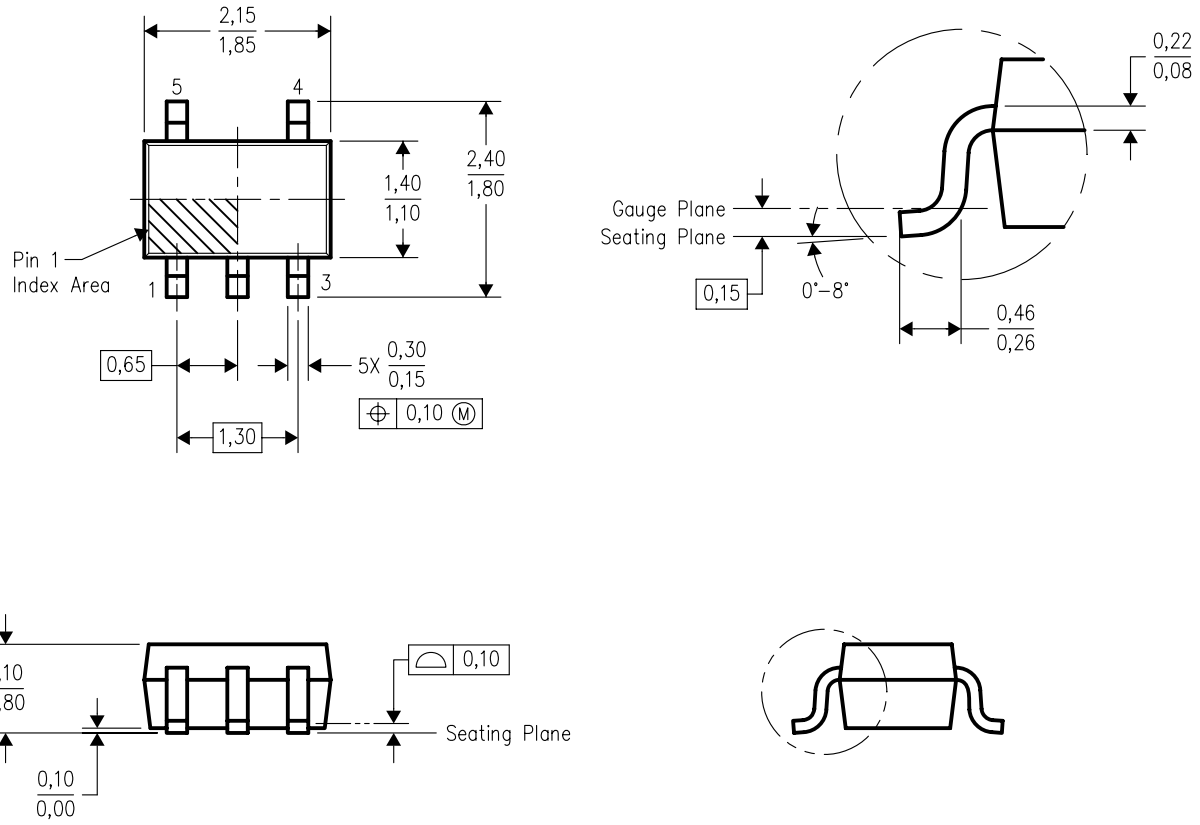
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

DBV (R–PDSO–G5) 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.

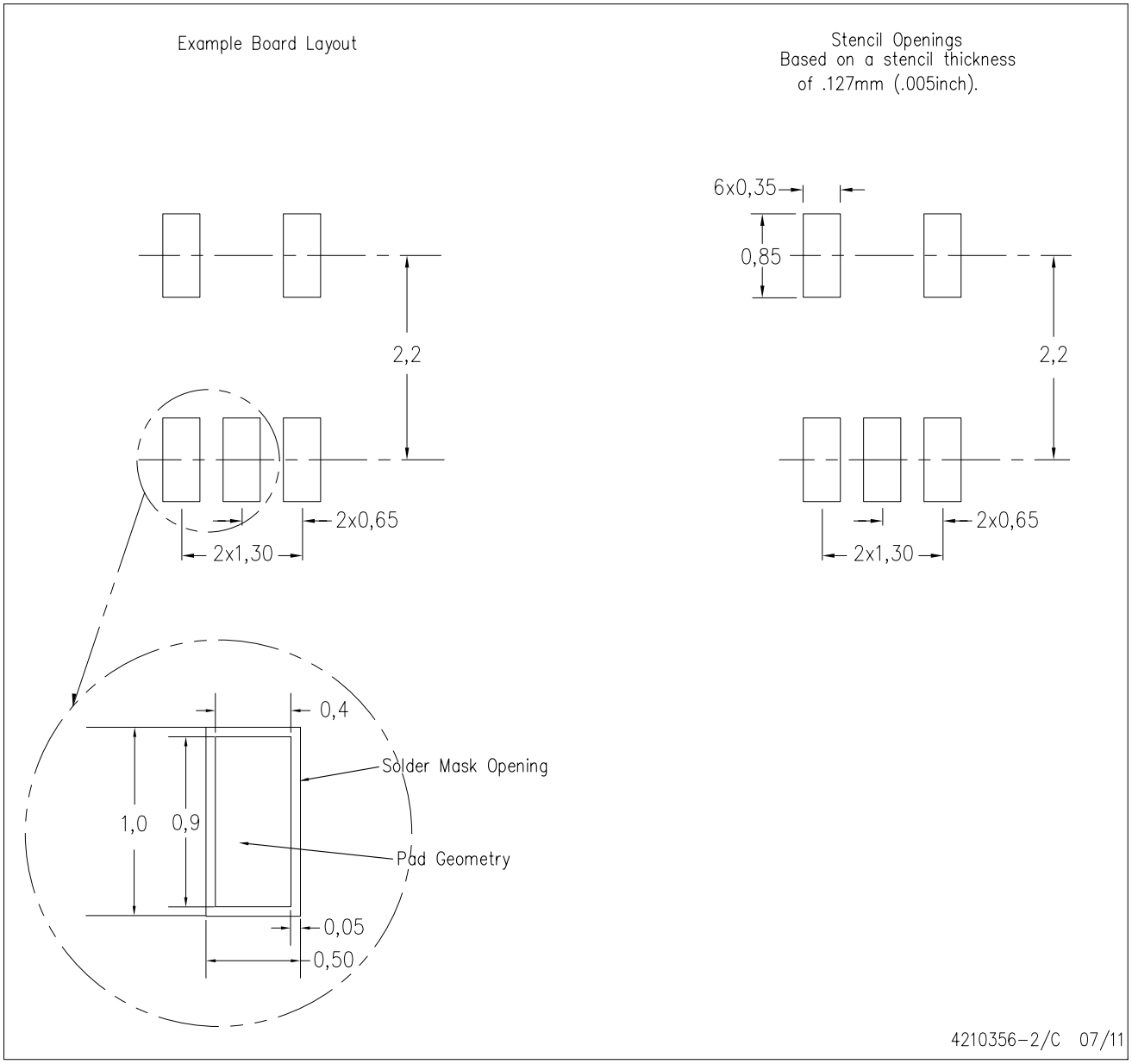
DCK (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



4093553–3/G 01/2007

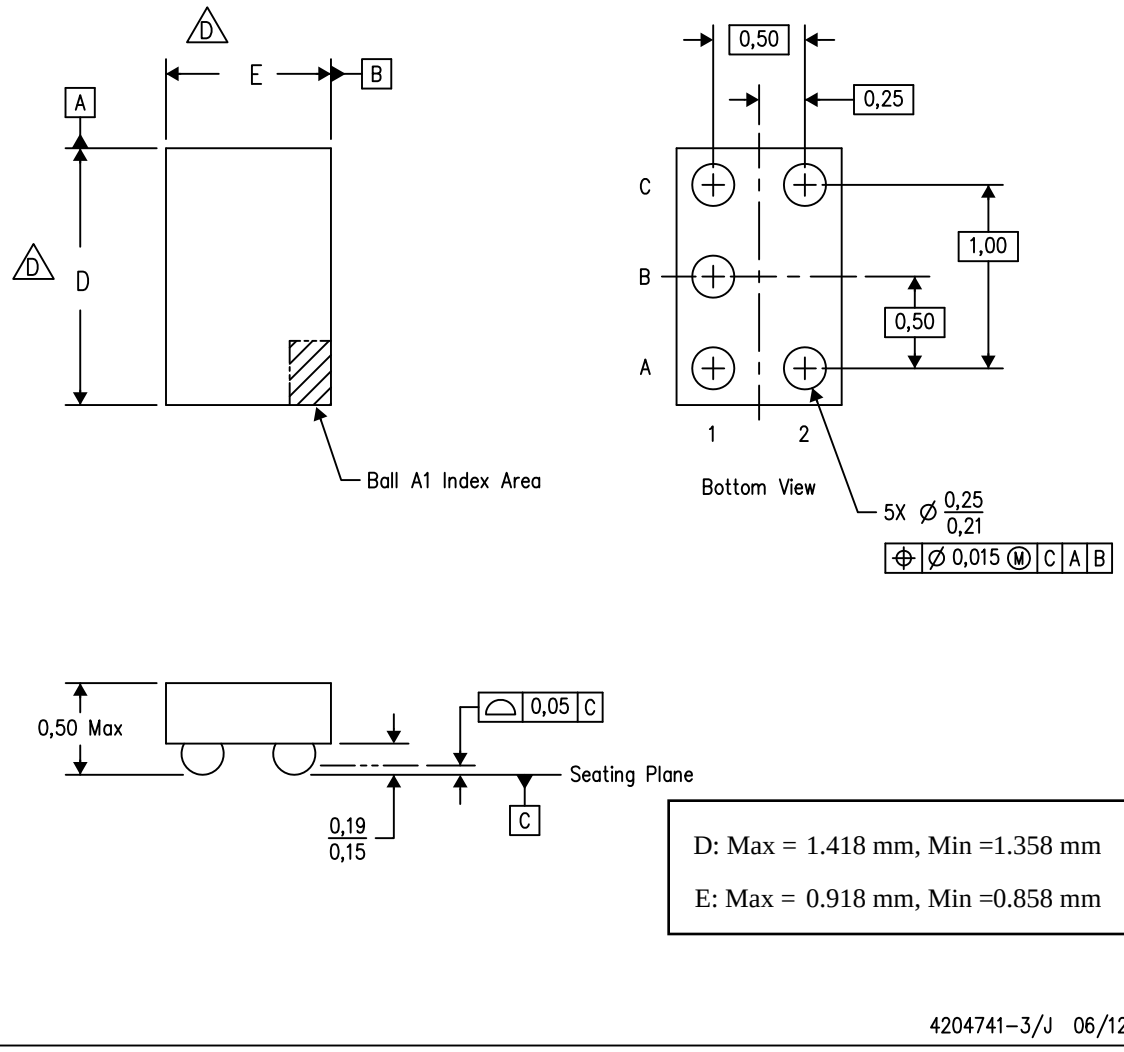
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–203 variation AA.

DCK (R–PDSO–G5) 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.

YZP (R–XBGA–N5) DIE–SIZE BALL GRID ARRAY



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.
D. The package size (Dimension D and E) of a particular device is specified in the device Product Data Sheet version of this drawing, in case it cannot be found in the product data sheet please contact a local TI representative.
E. This package is a Pb–free solder ball design. Refer to the 5 YEP package (drawing 4204725) for tin–lead (SnPb).

NanoFree is a trademark of Texas Instruments.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

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

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

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