







#### **TS5A3166**

SCDS186E - FEBRUARY 2005 - REVISED FEBRUARY 2018

# TS5A3166 0.9- $\Omega$ SPST Analog Switch

#### Features 1

**EXAS** 

Instruments

- Low ON-State Resistance (0.9  $\Omega$ )
- 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 2

- **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

### 3 Description

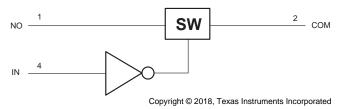
The TS5A3166 device is a single-pole single-throw (SPST) analog switch that is designed to operate from 1.65 V to 5.5 V. The device offers a low ONstate resistance. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable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

#### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
	SOT-23 (5)	2.90 mm × 1.60 mm
TS5A3166	SC70 (5)	2.00 mm × 1.25 mm
10040100	DSBGA (5)	1.388 mm × 0.888 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

#### Simplified Schematic





Product Folder Links: TS5A3166

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### **4** Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

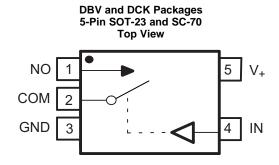
C	nanges from Revision D (February 2016) to Revision E Page
•	Changed the YZP package pin numbers
C	nanges from Revision C (May 2015) to Revision D Page
•	Added "port" to COM description in <i>Pin Functions</i> table
•	Deleted "digitial" from GND description in <i>Pin Functions</i> table
C	nanges from Revision B (September 2013) to Revision C Page
•	Added Applications, Device Information table, Pin Functions table, ESD Ratings table, Thermal Information table, Typical Characteristics, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section. 1
•	Deleted Ordering Information table
C	nanges from Revision A (October 2012) to Revision B Page
•	Removed 'Isolation in Powered-Off Mode, $V_{+} = 0$ ' bullet from <i>Features</i>

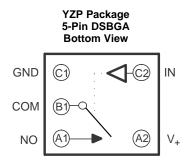
Changed pin name from NC to NO throughout the datasheet. ..... 1

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### 5 Pin Configuration and Functions





#### **Pin Functions**

	PIN						
DBC, DCK NO.	YZP NO.	NAME	TYPE	DESCRIPTION			
1	A1	NO	I/O	Normally opened port			
2	B1	COM	I/O	Common port			
3	C1	GND	GND	Ground			
4	C2	IN	I	Digital control pin to connect COM to NO			
5	A2	V+	Power	Power Supply			

### 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)(2)</sup>

			MIN	MAX	UNIT
V <sub>+</sub>	Supply voltage <sup>(3)</sup>		-0.5	6.5	V
V <sub>NO</sub> V <sub>COM</sub>	Analog voltage <sup>(3)(4)(5)</sup>		-0.5	V <sub>+</sub> + 0.5	V
Ι <sub>Κ</sub>	Analog port diode current	$V_{NO}, V_{COM} < 0$	-50		mA
I <sub>NO</sub>	ON-state switch current		-200	200	~ ^
ICOM	ON-state peak switch current <sup>(6)</sup>	$V_{NO,} V_{COM} = 0$ to $V_{+}$	-400	400	mA
VI	Digital input voltage <sup>(3)(4)</sup>		-0.5	6.5	V
I <sub>IK</sub>	Digital clamp current	V <sub>1</sub> < 0	-50		mA
I+	Continuous current through V <sub>+</sub>			100	mA
I <sub>GND</sub>	Continuous current through GND		-100		mA
T <sub>stg</sub>	Storage temperature		-65	150	°C
Tj	Junction temperature			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.

STRUMENTS

EXAS

### 6.2 ESD Ratings

			VALUE	UNIT
		Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±2000	
V <sub>(ESD)</sub>	Electrostatic discharge	Charged-device model (CDM), per JEDEC specification JESD22-C101 $^{\rm (2)}$	±1000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
V <sub>I/O</sub>	Input/output voltage	0	V <sub>+</sub>	V
V+	Supply voltage	1.65	5.5	V
VI	Control Input Voltage	0	5.5	V
T <sub>A</sub>	Operating free-air temperature	-40	85	°C

### 6.4 Thermal Information

			TS5A3166		
	THERMAL METRIC <sup>(1)</sup>	DBV (SOT)	DCK (SC-70)	YZP (DSBGA)	UNIT
		5 PINS	5 PINS	5 PINS	
$R_{\thetaJA}$	Junction-to-ambient thermal resistance	206	252	132	°C/W

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

### 6.5 Electrical Characteristics for 5-V Supply

 $V_{+} = 4.5 \text{ V}$  to 5.5 V,  $T_{A} = -40^{\circ}\text{C}$  to 85°C (unless otherwise noted)<sup>(1)</sup>

PAR	RAMETER	TEST CO	NDITIONS	TA	V.	MIN	TYP	MAX	UNIT
Analog Switc	h	1				·			
V <sub>COM</sub> , V <sub>NO</sub>	Analog signal range					0		V+	V
-	Peak ON	$0 \le V_{NO} \le V_+,$	Switch ON,	25°C	4.5 V		0.8	1.1	Ω
r <sub>peak</sub>	resistance	$I_{COM} = -100 \text{ mA},$	see Figure 13	Full	4.5 V			1.2	22
r.	ON-state	V <sub>NO</sub> = 2.5 V,	Switch ON,	25°C	4.5 V		0.7 0.9	Ω	
r <sub>on</sub>	resistance	$I_{COM} = -100 \text{ mA},$	see Figure 13	Full	4.5 V			1	22
	ON-state	$0 \le V_{NO} \le V_+,$ $I_{COM} = -100 \text{ mA},$	Switch ON.	25°C			0.15		
r <sub>on(flat)</sub>	resistance flatness	V <sub>NO</sub> = 1 V, 1.5 V, 2.5 V,	see Figure 13	25°C	4.5 V		0.09	0.15	Ω
	hallooo	$I_{COM} = -100 \text{ mA},$		Full				0.15	
		V <sub>NO</sub> = 1 V,		25°C		-20	4	20	
I <sub>NO(OFF)</sub>	NO OFF leakage – current	$V_{COM} = 4.5 \text{ V},$ or $V_{NO} = 4.5 \text{ V},$ $V_{COM} = 1 \text{ V},$	Switch OFF, see Figure 14	Full	5.5 V	-100		100	nA
		V <sub>NO</sub> = 0 to 5.5 V,		Full 25°C	οv	-5	0.4	5	μA
NO(PWROFF)		$V_{COM} = 5.5 V \text{ to } 0,$		Full	0.0	-15		15	μA
		$V_{COM} = 1 V,$		25°C		-20	4	20	
I <sub>COM(OFF)</sub>	COM OFF leakage	$V_{NO} = 4.5 \text{ V},$ or $V_{COM} = 4.5 \text{ V},$ $V_{NO} = 1 \text{ V},$	Switch OFF, see Figure 14	Full	5.5 V	-100		100	nA
	Gunon	V <sub>COM</sub> = 5.5 V to 0,		25°C	0.)/	-5	0.4	5	•
COM(PWROFF)		$V_{NO} = 0$ to 5.5 V,		Full	0 V	-15		20 100 5 15 20 100	μA

(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 (continued)

PA	ARAMETER	TEST C	CONDITIONS	TA	V.	MIN	TYP	MAX	UNIT
	NO	$V_{NO} = 1 V,$ $V_{COM} = Open,$		25°C		-2	0.3	2	
I <sub>NO(ON)</sub>	ON leakage current	$v_{COM} = Open,$ or $V_{NO} = 4.5 V,$ $V_{COM} = Open,$	Switch ON, see Figure 15	Full	5.5 V	-20		20	nA
	0.014	$V_{COM} = 1 V.$		25°C		-2	0.3	2	
I <sub>COM(ON)</sub>	COM ON leakage current	$V_{NO} = Open,$ or $V_{COM} = 4.5 V,$ $V_{NO} = Open,$	Switch ON, see Figure 15	Full	5.5 V	-20		20	nA
Digital Cont	rol Inputs (IN)			1	1 1	· · ·			
V <sub>IH</sub>	Input logic high			Full		2.4		5.5	V
V <sub>IL</sub>	Input logic low			Full		0		0.8	V
lus lu	Input leakage	V <sub>1</sub> = 5.5 V or 0		25°C	5.5 V	-2	0.3	2	nA
I <sub>IH</sub> , I <sub>IL</sub>	current	v] = 5.5 v 0i 0		Full	5.5 V	-20		20	ΠA
Dynamic		T			TT				
		$V_{COM} = V_+,$	C <sub>L</sub> = 35 pF,	25°C	5 V	2.5	4.5	7	
t <sub>ON</sub>	Turnon time	$R_L = 50 \Omega,$	see Figure 17	Full	4.5 V to 5.5 V	1.5		7.5	ns
		$V_{COM} = V_+,$	C <sub>L</sub> = 35 pF,	25°C	5 V	6	9	11.5	
t <sub>OFF</sub>	Turnoff time	$R_{L} = 50 \Omega,$	see Figure 17	Full	4.5 V to 5.5 V	4		12.5	ns
Q <sub>C</sub>	Charge injection		C <sub>L</sub> = 1 nF, see Figure 20	25°C	5 V		1		рС
C <sub>NO(OFF)</sub>	NO OFF capacitance	$V_{NO} = V_{+}$ or GND, Switch OFF,	See Figure 16	25°C	5 V		19		pF
C <sub>COM(OFF)</sub>	COM OFF capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch OFF,	See Figure 16	25°C	5 V		18		pF
C <sub>NO(ON)</sub>	NO ON capacitance	$V_{NO} = V_{+}$ or GND, Switch ON,	See Figure 16	25°C	5 V		35.5		pF
C <sub>COM(ON)</sub>	COM ON capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch ON,	See Figure 16	25°C	5 V		35.5		pF
CI	Digital input capacitance	$V_1 = V_+$ or GND,	See Figure 16	25°C	5 V		2		pF
BW	Bandwidth	$R_L = 50 \Omega$ , Switch ON,	See Figure 18	25°C	5 V		200		MHz
O <sub>ISO</sub>	OFF isolation	$ \begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array} $	Switch OFF, see Figure 19	25°C	5 V		-64		dB
THD	Total harmonic distortion	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz, see Figure 21	25°C	5 V		0.005%		
Supply		·		•	· · ·				
	Positive supply	V = V or CND	Switch ON or OFF	25°C	551		0.01	0.1	
l <sub>+</sub>	current	$V_1 = V_+ \text{ or GND},$	Switch UN of UFF	Full	5.5 V			0.5	μA

### 6.6 Electrical Characteristics for 3.3-V Supply

 $V_{\star}$  = 3 V to 3.6 V,  $T_{A}$  = –40°C to 85°C (unless otherwise noted)  $^{(1)}$ 

PA	RAMETER	TEST	CONDITIONS	T <sub>A</sub>	V.	MIN	ТҮР	MAX	UNIT
Analog Swite	ch								
V <sub>COM</sub> , V <sub>NO</sub>	Analog signal range					0		V+	V
r <sub>peak</sub>	Peak ON resistance	$\begin{array}{l} 0 \leq V_{\rm NO} \leq V_{+}, \\ I_{\rm COM} = -100 \ {\rm mA}, \end{array}$	Switch ON, see Figure 13	25°C Full	3 V		1.1	1.5 1.7	Ω
r <sub>on</sub>	ON-state resistance	$V_{NO} = 2 V,$ $I_{COM} = -100 \text{ mA},$	Switch ON, see Figure 13	25°C Full	3 V		1	1.4 1.5	Ω
	ON-state	$0 \le V_{NO} \le V_+,$ $I_{COM} = -100 \text{ mA},$		25°C			0.3	1.0	
r <sub>on(flat)</sub>	resistance flatness	$V_{NO} = 2 V, 0.8 V,$ $I_{COM} = -100 mA,$	Switch ON, see Figure 13	25°C Full	3 V		0.09	0.15 0.15	Ω
		$V_{NO} = 1 V,$ $V_{COM} = 3 V,$		25°C		-2	0.5	0.15	
I <sub>NO(OFF)</sub>	NO OFF leakage current	$v_{COM} = 3 V,$ or $V_{NO} = 3 V,$ $V_{COM} = 1 V,$	Switch OFF, see Figure 14	Full	3.6 V	-20		20	nA
I <sub>NO(PWROFF)</sub>		$V_{NO} = 0 \text{ to } 3.6 \text{ V},$ $V_{COM} = 3.6 \text{ V to } 0,$		25°C Full	0 V	-1 -5	0.1	1 5	μΑ
		V <sub>COM</sub> = 1 V,		25°C		-2	0.5	2	
I <sub>COM(OFF)</sub>	COM OFF leakage	$V_{NO} = 3 V,$ or $V_{COM} = 3 V,$ $V_{NO} = 1 V,$	Switch OFF, see Figure 14	Full	3.6 V	-20		20	nA
I <sub>COM(PWROFF)</sub>	_ current	$V_{COM} = 3.6 V \text{ to } 0,$ $V_{NO} = 0 \text{ to } 3.6 V,$		25°C Full	0 V	-1 -5	0.1	1 5	μΑ
		V <sub>NO</sub> = 1 V,		25°C		-2	0.2	2	
I <sub>NO(ON)</sub>	NO ON leakage current	$V_{COM} = Open,$ or $V_{NO} = 3 V,$ $V_{COM} = Open,$	Switch ON, see Figure 15	Full	3.6 V	-20		20	nA
		V <sub>COM</sub> = 1 V,		25°C		-2	0.2	2	
I <sub>COM(ON)</sub>	COM ON leakage current	$V_{NO} = Open,$ or $V_{COM} = 3 V,$ $V_{NO} = Open,$	Switch ON, see Figure 15	Full	3.6 V	-20		20	nA
Digital Contr	rol Inputs (IN)			4					
V <sub>IH</sub>	Input logic high			Full		2		5.5	V
V <sub>IL</sub>	Input logic low			Full		0		0.8	V
	Input leakage	V <sub>I</sub> = 5.5 V or 0		25°C	3.6 V	-2	0.3	2	۳Å
I <sub>IH</sub> , I <sub>IL</sub>	current	v <sub>1</sub> = 5.5 v 01 0		Full	3.0 V	-20		20	nA
Dynamic		1			1				
	<b>-</b> ·	$V_{COM} = V_+,$	C <sub>L</sub> = 35 pF,	25°C	3.3 V	2	5	10	
t <sub>ON</sub>	Turnon time	$R_L = 50 \Omega,$	see Figure 17	Full	3 V to 3.6 V	1.5		11	ns
t	Turnoff time	$V_{COM} = V_+,$	C <sub>L</sub> = 35 pF,	25°C	3.3 V	6.5	9	12	ns
t <sub>OFF</sub>		$R_L = 50 \Omega,$	see Figure 17	Full	3 V to 3.6 V	4		13	115
Q <sub>C</sub>	Charge injection	$V_{GEN} = 0,$ $R_{GEN} = 0,$	C <sub>L</sub> = 1 nF, see Figure 21	25°C	3.3 V		1		рС
C <sub>NO(OFF)</sub>	NO OFF capacitance	$V_{NO} = V_+ \text{ or GND},$ Switch OFF,	See Figure 16	25°C	3.3 V		19		pF
C <sub>COM(OFF)</sub>	COM OFF capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch OFF,	See Figure 16	25°C	3.3 V		18		pF
C <sub>NO(ON)</sub>	NO ON capacitance	$V_{NO} = V_+ \text{ or GND},$ Switch ON,	See Figure 16	25°C	3.3 V		36		pF
C <sub>COM(ON)</sub>	COM ON capacitance	$V_{COM} = V_+$ or GND, Switch ON,	See Figure 16	25°C	3.3 V		36		pF

(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 (continued)

	PARAMETER	TEST	CONDITIONS	TA	V.	MIN TYP	MAX	UNIT
Cı	Digital input capacitance	$V_I = V_+ \text{ or } GND,$	See Figure 16	25°C	3.3 V	2		pF
BW	Bandwidth	$R_L = 50 \Omega$ , Switch ON,	See Figure 18	25°C	3.3 V	200		MHz
O <sub>ISO</sub>	OFF isolation	$R_L = 50 \Omega,$ f = 1 MHz,	Switch OFF, see Figure 19	25°C	3.3 V	-64		dB
THD	Total harmonic distortion	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz, see Figure 21	25°C	3.3 V	0.01%		
Supply								
	Positive supply	$V_1 = V_+$ or GND,	Switch ON or OFF	25°C	3.6 V	0.01	0.1	
	current	$v_{\parallel} = v_{+}$ or GND,	Switch ON OF OFF	Full	3.0 V		0.25	μΑ

### 6.7 Electrical Characteristics for 2.5-V Supply

 $V_{\star}$  = 2.3 V to 2.7 V,  $T_{A}$  = –40°C to 85°C (unless otherwise noted)  $^{(1)}$ 

P	ARAMETER	TEST CO	ONDITIONS	T <sub>A</sub>	۷,	MIN	TYP	MAX	UNIT	
Analog Sw	itch									
V <sub>COM</sub> , V <sub>NO</sub>	Analog signal range				2.3 V	0		V+	V	
<b>r</b> .	Peak ON resistance	$0 \le V_{NO} \le V_+,$	Switch ON,	25°C	2.3 V		1.8	2.4	Ω	
r <sub>peak</sub>	T eak ON resistance	$I_{COM} = -100 \text{ mA},$	see Figure 13	Full	2.5 V			2.6	32	
r	ON-state resistance	V <sub>NO</sub> = 2 V,	Switch ON,	25°C	2.3 V		1.2	2.1	Ω	
r <sub>on</sub>		$I_{COM} = -100 \text{ mA},$	see Figure 13	Full	2.5 V			2.4	32	
r <sub>on(flat)</sub>	ON-state resistance	$\begin{array}{l} 0 \leq V_{\rm NO} \leq V_{+}, \\ I_{\rm COM} = -100 \mbox{ mA}, \end{array}$	Switch ON,	25°C	0.014		0.7	$     \begin{array}{c}       2.4 \\       2.6 \\       2.1 \\       2.4 \\       2.6 \\       2.1 \\       2.6 \\       2.6 \\       2.6 \\       2.6 \\       2.1 \\       2.4 \\       $	0	
	flatness V <sub>NO</sub> = 2	V <sub>NO</sub> = 2 V, 0.8 V,	see Figure 13	25°C	2.3 V		0.4	0.6	Ω	
		$I_{COM} = -100 \text{ mA},$		Full				0.6		
		$V_{NO} = 1 V,$		25°C	-	-5	0.3	5		
I <sub>NO(OFF)</sub>	NO	$V_{COM} = 3 V,$ or $V_{NO} = 3 V,$ OFF leakage current $V_{COM} = 1 V,$		Switch OFF, see Figure 14	Full	2.7 V	-50		50	nA
INO(PWROFF	-	$V_{NO} = 0$ to 3.6 V,		25°C	0.14	-2	0.05	2	•	
)		$V_{COM} = 3.6 V \text{ to } 0,$		Full	0 V	-15		15	μA	
		$V_{COM} = 1 V,$		25°C		-5	0.3	5		
I <sub>COM(OFF)</sub>	COM OFF leakage current	$V_{NO} = 3 V,$ or $V_{COM} = 3 V,$ $V_{NO} = 1 V,$	Switch OFF, see Figure 14	Full	2.7 V	-50	-50		nA	
I <sub>COM(PWRO</sub>	-	$V_{COM} = 3.6 V \text{ to } 0,$		25°C	0 V -	-2	0.05	2	μA	
FF)		$V_{NO} = 0$ to 3.6 V,		Full		-15		15		
		$V_{NO} = 1 V,$		25°C		-2	0.3	2		
I <sub>NO(ON)</sub>	NO ON leakage current	$V_{COM} = Open,$ or $V_{NO} = 3 V,$ $V_{COM} = Open,$	Switch ON, see Figure 15	Full	2.7 V	-20		20	nA	
		$V_{COM} = 1 V,$		25°C		-2	0.3	2		
I <sub>COM(ON)</sub>	COM ON leakage current	$V_{NO} = Open,$ or $V_{COM} = 3 V,$ $V_{NO} = Open,$	Switch ON, see Figure 15	Full	2.7 V	-20		20	nA	
Digital Con	trol Inputs (IN1, IN2)									
V <sub>IH</sub>	Input logic high			Full		1.8		5.5	V	
V <sub>IL</sub>	Input logic low			Full		0		0.6	V	

(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 (continued)

	$V_{1} = 2.3 V \text{ to } 2.7 V.$	$T_{A} = -40^{\circ}C$ to 85°C (	unless otherwise noted) <sup>(1)</sup>
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P	ARAMETER	TEST CC	NDITIONS	TA	۷.	MIN	TYP	MAX	UNIT
	Input leakage	V <sub>1</sub> = 5.5 V or 0		25°C	2.7 V	-2	0.3	2	n۸
I <sub>IH</sub> , I <sub>IL</sub>	current	$v_1 = 5.5 \ v \ 01 \ 0$		Full	2.7 V	-20		20	nA
Dynamic									
		$\mathcal{M} = \mathcal{M}$	C <sub>L</sub> = 35 pF,	25°C	2.5 V	2	6	10	
t <sub>ON</sub>	Turnon time	$V_{\text{COM}} = V_+,$ $R_{\text{L}} = 50 \ \Omega,$	see Figure 17	Full	2.3 V to 2.7 V	1		12	ns
			0 05 - 5	25°C	2.5 V	4.5	8	10.5	
t <sub>OFF</sub>	Turnoff time	$V_{\text{COM}} = V_+,$ $R_{\text{L}} = 50 \ \Omega,$	C <sub>L</sub> = 35 pF, see Figure 17	Full	2.3 V to 2.7 V	3		15	ns
Q <sub>C</sub>	Charge injection	$V_{GEN} = 0,$ $R_{GEN} = 0,$	C <sub>L</sub> = 1 nF, see Figure 21	25°C	2.5 V		4		рС
C <sub>NO(OFF)</sub>	NO OFF capacitance	$V_{NO} = V_+ \text{ or GND},$ Switch OFF,	See Figure 16	25°C	2.5 V		19.5		pF
C <sub>COM(OFF)</sub>	COM OFF capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch OFF,	See Figure 16	25°C	2.5 V		18.5		pF
C <sub>NO(ON)</sub>	NO ON capacitance	$V_{NO} = V_{+} \text{ or GND},$ Switch ON,	See Figure 16	25°C	2.5 V		36.5		pF
C <sub>COM(ON)</sub>	COM ON capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch ON,	See Figure 16	25°C	2.5 V		36.5		pF
CI	Digital input capacitance	$V_I = V_+ \text{ or } GND,$	See Figure 16	25°C	2.5 V		2		pF
BW	Bandwidth	$R_L = 50 \Omega$ , Switch ON,	See Figure 18	25°C	2.5 V		150		MHz
O <sub>ISO</sub>	OFF isolation	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch OFF, see Figure 19	25°C	2.5 V		-62		dB
THD	Total harmonic distortion	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz, see Figure 21	25°C	2.5 V		0.02%		
Supply									
1	Positive supply	V V at CND		25°C	271		0.001	0.02	
I <sub>+</sub>	current	$v_1 = v_+$ or GND,	$V_1 = V_+ \text{ or GND},$ Switch ON or OFF		2.7 V			0.25	μA



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# 6.8 Electrical Characteristics for 1.8-V Supply<sup>(1)</sup>

 $V_{\star}$  = 1.65 V to 1.95 V,  $T_{A}$  = –40°C to 85°C (unless otherwise noted))

PA	RAMETER	TEST COI	NDITIONS	T <sub>A</sub>	V.	MIN	TYP	MAX	UNIT	
Analog Swit	ch									
V <sub>COM</sub> , V <sub>NO</sub>	Analog signal range					0		V+	V	
r <sub>peak</sub>	Peak ON resistance	$0 \le V_{NO} \le V_+,$ $I_{COM} = -100 \text{ mA},$	Switch ON, see Figure 13	25°C Full	1.65 V		4.2	25 30	Ω	
r <sub>on</sub>	ON-state resistance	$V_{NO} = 2 V,$ $I_{COM} = -100 \text{ mA},$	Switch ON, see Figure 13	25°C Full	1.65 V		1.6	3.9 4.0	Ω	
ON-state		$0 \le V_{NO} \le V_+,$ $I_{COM} = -100 \text{ mA},$	Switch ON,	25°C			2.8			
r <sub>on(flat)</sub>	resistance flatness	$V_{NO} = 2 V, 0.8 V,$ $I_{COM} = -100 mA,$	see Figure 13	25°C Full	1.65 V		4.1	22 27	Ω	
		V <sub>NO</sub> = 1 V,		25°C		-5		5		
I <sub>NO(OFF)</sub>	NO OFF leakage current	$V_{COM} = 3 V,$ or $V_{NO} = 3 V,$ $V_{COM} = 1 V,$	Switch OFF, see Figure 14	Full	1.95 V	-50		50	nA	
	ourion	$V_{NO} = 0$ to 3.6 V,		25°C	- 0 V	-2		2	ıμΔ	
I <sub>NO(PWROFF)</sub>		$V_{COM} = 3.6 V \text{ to } 0,$		Full	0 0	-10		10	μΛ	
		$V_{COM} = 1 V,$		25°C		-5		5		
I <sub>COM(OFF)</sub>	COM OFF leakage		Switch OFF, see Figure 14	Full	1.95 V	-50		50	nA	
ICOM(PWROFF	ounon	$V_{COM} = 0$ to 3.6 V,		25°C	0.)/	-2		2	٨	
)		$V_{\rm NO} = 3.6 \ V \ {\rm to} \ 0,$		Full	0 V	-10		10	μA	
		$V_{NO} = 1 V,$		25°C		-2		2	-	
NO I <sub>NO(ON)</sub> ON leakage current		$V_{COM} = Open,$ or $V_{NO} = 3 V,$ $V_{COM} = Open,$	Switch ON, see Figure 15	Full	Full 1.95 V			20	nA	
		$V_{COM} = 1 V,$		25°C		-2		2	2	
I <sub>COM(ON)</sub>	COM ON leakage current	$\label{eq:VNO} \begin{array}{l} V_{NO} = Open, \\ or \\ V_{COM} = 3 \ V, \\ V_{NO} = Open, \end{array}$	Switch ON, see Figure 15	Full	1.95 V	-20		20	nA	
-	rol Inputs (IN1, IN2)	) 			1					
V <sub>IH</sub>	Input logic high			Full		1.5		5.5	V	
V <sub>IL</sub>	Input logic low			Full		0		0.6	V	
I <sub>IH</sub> , I <sub>IL</sub>	Input leakage	$V_1 = 5.5 V \text{ or } 0$		25°C	1.95 V	-2	0.3	2	nA	
	current			Full		-20		20		
Dynamic		1								
	<b>T</b>	$V_{COM} = V_+,$	C <sub>L</sub> = 35 pF,	25°C	1.8 V	3	9	18		
t <sub>ON</sub>	Turnon time	$R_L = 50 \Omega,$	see Figure 17	Full	1.65 V to 1.95 V	1		$\begin{array}{c c} & \Omega \\ \hline 30 \\ \hline 30 \\ \hline 3.9 \\ 4.0 \\ \hline 0 \\ \hline 10 \\ 2 \\ 75 \\ 50 \\ \hline 10 \\ 2 \\ 10 \\ - \\ 75 \\ 50 \\ - \\ 10 \\ - $		
	T	$V_{COM} = V_+,$	C <sub>L</sub> = 35 pF,	25°C	1.8 V	5	10	15.5		
t <sub>OFF</sub>	Turnoff time	$R_{L} = 50 \Omega,$	see Figure 17	Full	1.65 V to 1.95 V	4		18.5	ns	
Q <sub>C</sub>	Charge injection	$V_{GEN} = 0,$ $R_{GEN} = 0,$	C <sub>L</sub> = 1 nF, see Figure 21	25°C	1.8 V		2		рС	
C <sub>NO(OFF)</sub>	NO OFF capacitance	$V_{NO} = V_{+}$ or GND, Switch OFF,	See Figure 16	25°C	1.8 V		19.5		pF	
C <sub>COM(OFF)</sub>	COM OFF capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch OFF,	See Figure 16	25°C	1.8 V		18.5		pF	

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

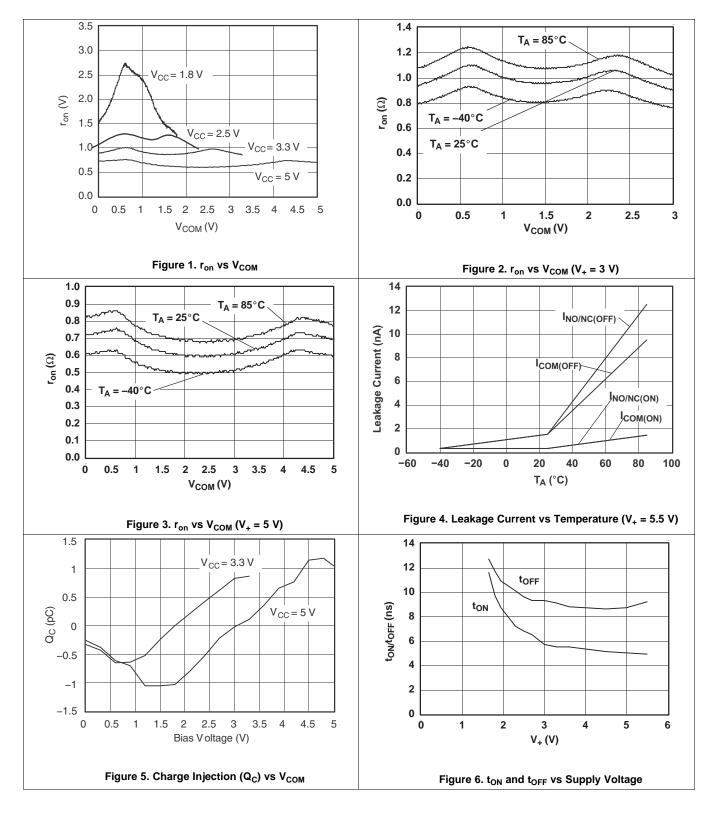
### Electrical Characteristics for 1.8-V Supply<sup>(1)</sup> (continued)

#### $V_{\star}$ = 1.65 V to 1.95 V, $T_{A}$ = –40°C to 85°C (unless otherwise noted))

P.	ARAMETER	TEST CO	NDITIONS	TA	۷.	MIN TYP	TYP MAX	
C <sub>NO(ON)</sub>	NO ON capacitance	$V_{NO} = V_{+}$ or GND, Switch ON,	See Figure 16	25°C	1.8 V	36.5		pF
C <sub>COM(ON)</sub>	COM ON capacitance	$V_{COM} = V_+ \text{ or GND},$ Switch ON,	See Figure 16	25°C	1.8 V	36.5		pF
CI	Digital input capacitance	$V_I = V_+ \text{ or } GND,$	See Figure 16	25°C	1.8 V	2		pF
BW	Bandwidth	$R_L = 50 \Omega$ , Switch ON,	See Figure 18	25°C	1.8 V	150		MHz
O <sub>ISO</sub>	OFF isolation	$\begin{array}{l} R_L = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch OFF, see Figure 19	25°C	1.8 V	-62		dB
THD	Total harmonic distortion	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz see Figure 21	25°C	1.8 V	0.055 %		
Supply								
	Positive supply	V = V or CND	Switch ON or	25°C	1.95 V	0.001	0.01	
I+	current	$V_I = V_+ \text{ or GND},$	OFF	Full	I.90 V		0.15	μA



### 6.9 Typical Characteristics

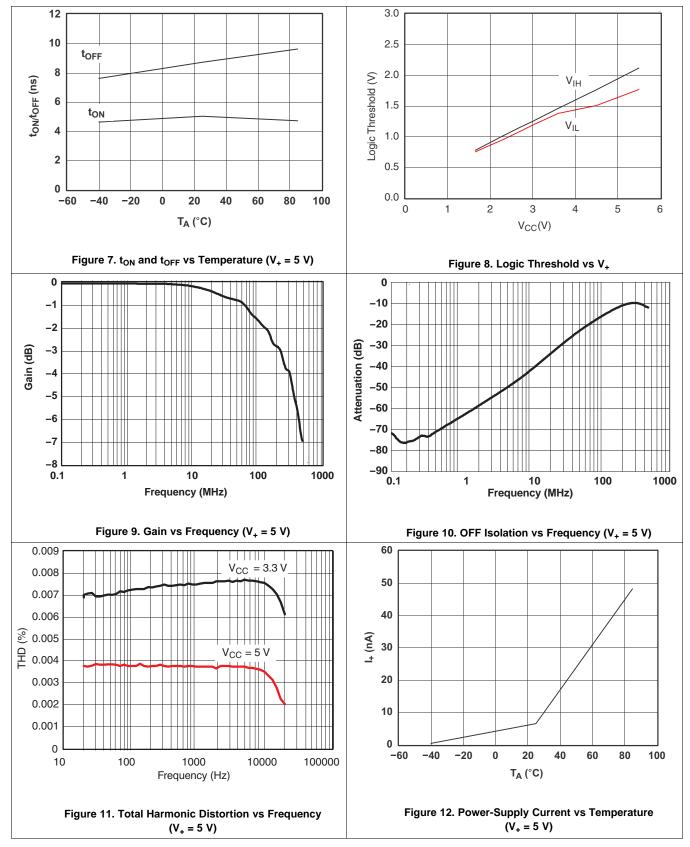


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### **Typical Characteristics (continued)**





### 7 Parameter Measurement Information

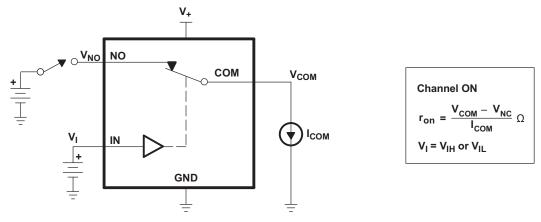


Figure 13. ON-State Resistance (ron)

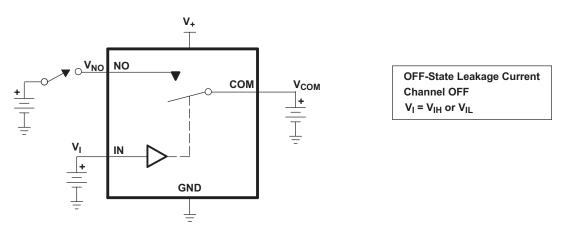


Figure 14. OFF-State Leakage Current (I<sub>COM(OFF)</sub>, I<sub>NO(OFF)</sub>, I<sub>COM(PWROFF)</sub>, I<sub>NO(PWR(FF)</sub>)

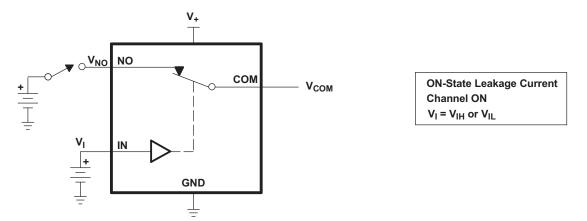
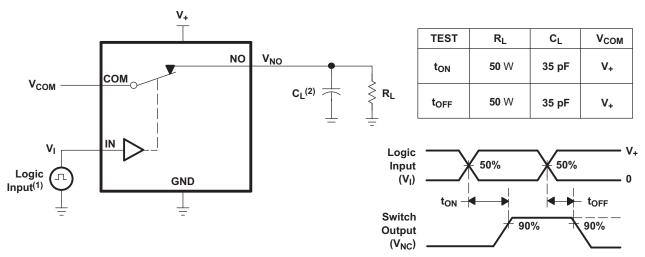


Figure 15. ON-State Leakage Current (I<sub>COM(ON)</sub>, I<sub>NO(ON)</sub>)

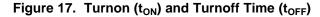
V+ V<sub>NO</sub> NO Capacitance V<sub>BIAS</sub> = V<sub>+</sub> or GND Meter  $V_I = V_{IH} \text{ or } V_{IL}$ ⊖ V<sub>COM</sub> СОМ Capacitance is measured at NO, V<sub>BIAS</sub> COM, and IN inputs during ON  $\mathbf{v}_{\mathbf{l}}$ IN and OFF conditions. GND

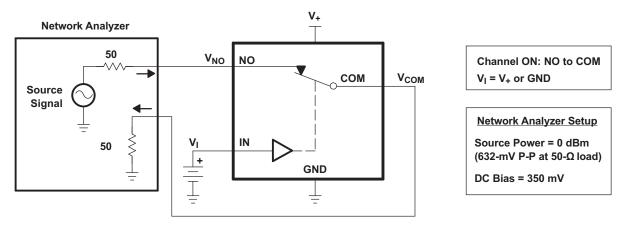
### Parameter Measurement Information (continued)





- (1) All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz, Z<sub>0</sub> = 50  $\Omega$ , t<sub>r</sub> < 5 ns, t<sub>f</sub> < 5 ns.
- (2)  $C_L$  includes probe and jig capacitance.



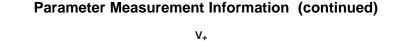




**ISTRUMENTS** 

ÈXAS





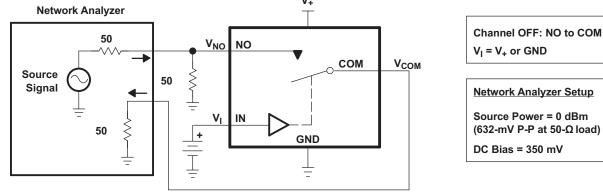
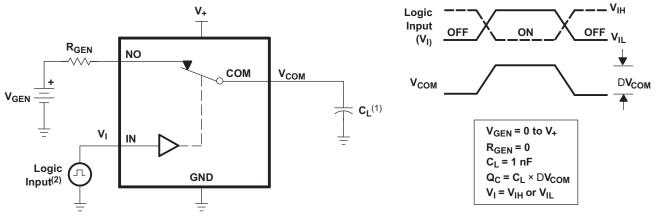
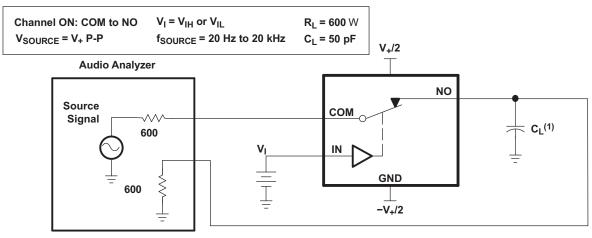


Figure 19. OFF Isolation (O<sub>ISO</sub>)

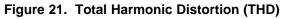


- (1) C<sub>L</sub> includes probe and jig capacitance.
- (2) All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz, Z<sub>0</sub> = 50  $\Omega$ , t<sub>r</sub> < 5 ns, t<sub>f</sub> < 5 ns.

### Figure 20. Charge Injection (Q<sub>c</sub>)



(1) C<sub>L</sub> includes probe and jig capacitance.



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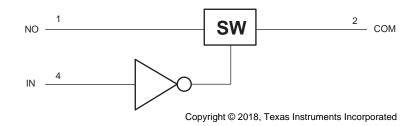


### 8 Detailed Description

#### 8.1 Overview

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.

#### 8.2 Functional Block Diagram



#### 8.3 Feature Description

The low ON-state resistance, ON-state resistance matching, and charge injection in the TS5A3166 make this switch an excellent choice for analog signals that require minimal distortion. In addition, the low THD allows audio signals to be preserved more clearly as they pass through the device.

The 1.65-V to 5.5-V operation allows compatibility with more logic levels, and the bidirectional I/Os can pass analog signals from 0 V to  $V_{+}$  with low distortion.

#### 8.4 Device Functional Modes

IN	NO TO COM, COM TO NO
L	OFF
Н	ON

#### Table 1. Function Table



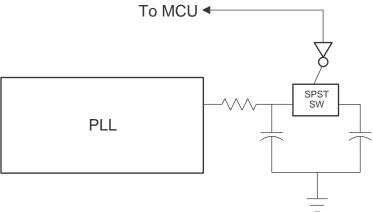
### 9 Application and Implementation

#### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

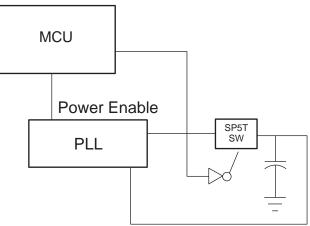
#### 9.1 Application Information

SPST analog switch is a basic component that could be used in any electrical system design. Figure 22 and Figure 23 are some basic applications that utilize the TS5A3166.



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### Figure 22. Improved Lock Time Circuit Simplified Block Diagram



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Figure 23. PLL Improved Power Consumption Simplified Block Diagram

### 9.2 Typical Application

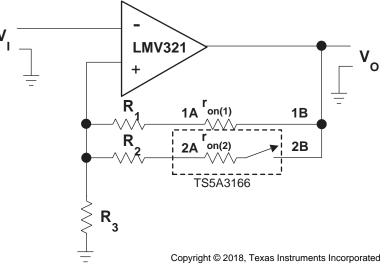


Figure 24. Gain-Control Circuit for Operational Amplifier

#### 9.2.1 Design Requirements

By choosing values of R1 and R2, such that  $Rx >> r_{on(x)}$ ,  $r_{on}$  of TS5A3166 can be ignored. The gain of operational amplifier can be calculated as follow:

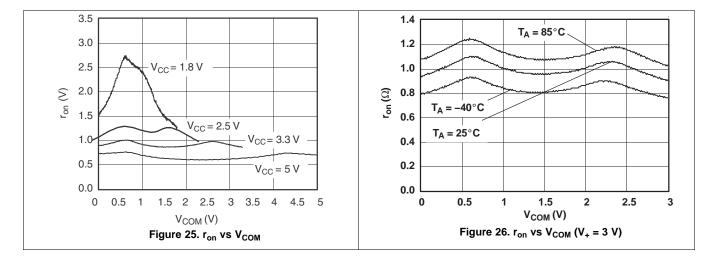
$$Vo / VI = 1 + R|| / R3$$
(1)  

$$R|| = (R1 + r_{on(1)}) || (R2 + r_{on(2)})$$
(2)

#### 9.2.2 Detailed Design Procedure

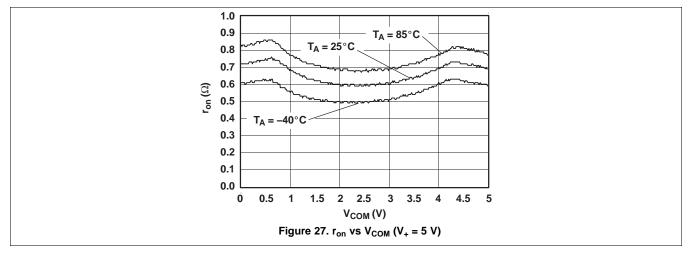
Place a switch in series with the input of the operational amplifier. Since the operational amplifier input impedance is very large, a switch on  $r_{on(1)}$  is irrelevant.

### 9.2.3 Application Curves





### **Typical Application (continued)**



### **10** Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions*.

Each V<sub>CC</sub> terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1- $\mu$ F bypass capacitor is recommended. If there are multiple pins labeled V<sub>CC</sub>, then a 0.01- $\mu$ F or 0.022- $\mu$ F capacitor is recommended for each V<sub>CC</sub> because the V<sub>CC</sub> pins will be tied together internally. For devices with dual supply pins operating at different voltages, for example V<sub>CC</sub> and V<sub>DD</sub>, a 0.1- $\mu$ F bypass capacitor is recommended for each supply pin. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1- $\mu$ F and 1- $\mu$ F capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.



### 11 Layout

### 11.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. Figure 28 shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

### 11.2 Layout Example

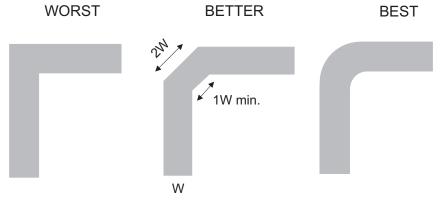


Figure 28. Trace Example



### **12** Device and Documentation Support

### 12.1 Device Support

### 12.1.1 Device Nomenclature

Table	2.	Parameter	Description	
-------	----	-----------	-------------	--

SYMBOL	DESCRIPTION
V <sub>COM</sub>	Voltage at COM
V <sub>NO</sub>	Voltage at NO
r <sub>on</sub>	Resistance between COM and NO ports when the channel is ON
r <sub>peak</sub>	Peak ON-state resistance over a specified voltage range
r <sub>on(flat)</sub>	Difference between the maximum and minimum value of ron in a channel over the specified range of conditions
I <sub>NO(OFF)</sub>	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 <sub>NO(PWROFF)</sub>	Leakage current measured at the NO port during the power-down condition, $V_{+} = 0$
I <sub>COM(OFF)</sub>	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
ICOM(PWROFF)	Leakage current measured at the COM port during the power-down condition, $V_{+} = 0$
I <sub>NO(ON)</sub>	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the ON state and the output (COM) open
I <sub>COM(ON)</sub>	Leakage current measured at the COM port, with the corresponding channel (COM to NO) in the ON state and the output (NO) open
V <sub>IH</sub>	Minimum input voltage for logic high for the control input (IN)
V <sub>IL</sub>	Maximum input voltage for logic low for the control input (IN)
VI	Voltage at the control input (IN)
I <sub>IH</sub> , I <sub>IL</sub>	Leakage current measured at the control input (IN)
t <sub>ON</sub>	Turnon time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog output (COM or NO) signal when the switch is turning ON.
t <sub>OFF</sub>	Turnoff time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog output (COM or NO) signal when the switch is turning OFF.
Q <sub>C</sub>	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 $\Delta V_{COM}$ is the change in analog output voltage.
C <sub>NO(OFF)</sub>	Capacitance at the NO port when the corresponding channel (NO to COM) is OFF
C <sub>COM(OFF)</sub>	Capacitance at the COM port when the corresponding channel (COM to NO) is OFF
C <sub>NO(ON)</sub>	Capacitance at the NO port when the corresponding channel (NO to COM) is ON
C <sub>COM(ON)</sub>	Capacitance at the COM port when the corresponding channel (COM to NO) is ON
Cl	Capacitance of control input (IN)
O <sub>ISO</sub>	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.
l+	Static power-supply current with the control (IN) pin at V <sub>+</sub> or GND



### 12.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E<sup>™</sup> Online Community *TI's Engineer-to-Engineer (E2E) Community.* Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.3 Trademarks

E2E is a trademark of Texas Instruments. All other trademarks are the property of their respective owners.

#### 12.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.5 Glossary

#### SLYZ022 — TI Glossary.

This glossary lists and explains terms, acronyms, and definitions.

### 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.



31-Jan-2018

### PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package	Pins	Package	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
	(1)		Drawing		Qty	(2)	(6)	(3)		(4/5)	
TS5A3166DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	-40 to 85	(JASF, JASR)	Samples
TS5A3166DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	JASF	Samples
TS5A3166DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	JASF	Samples
TS5A3166DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(JF5, JFF, JFR)	Samples
TS5A3166DCKRE4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(JF5, JFF, JFR)	Samples
TS5A3166DCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(JF5, JFF, JFR)	Samples
TS5A3166YZPR	ACTIVE	DSBGA	YZP	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	JFN	Samples

<sup>(1)</sup> 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.

<sup>(2)</sup> RoHS: TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (CI) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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



# PACKAGE OPTION ADDENDUM

31-Jan-2018

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

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#### **OTHER QUALIFIED VERSIONS OF TS5A3166 :**

Automotive: TS5A3166-Q1

NOTE: Qualified Version Definitions:

• Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

# PACKAGE MATERIALS INFORMATION

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### TAPE AND REEL INFORMATION





### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	Package Drawing		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	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
TS5A3166DBVRG4	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	180.0	8.4	2.47	2.3	1.25	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

TEXAS INSTRUMENTS

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# PACKAGE MATERIALS INFORMATION

31-Jan-2018



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS5A3166DBVR	SOT-23	DBV	5	3000	202.0	201.0	28.0
TS5A3166DBVRG4	SOT-23	DBV	5	3000	180.0	180.0	18.0
TS5A3166DCKR	SC70	DCK	5	3000	202.0	201.0	28.0
TS5A3166DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TS5A3166YZPR	DSBGA	YZP	5	3000	220.0	220.0	35.0

# YZP0005



# **PACKAGE OUTLINE**

### DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



- 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.



# YZP0005

# **EXAMPLE BOARD LAYOUT**

### DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



# YZP0005

# **EXAMPLE STENCIL DESIGN**

### DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.



# DBV 5

# **GENERIC PACKAGE VIEW**

# SOT-23 - 1.45 mm max height SMALL OUTLINE TRANSISTOR



Images above are just a representation of the package family, actual package may vary. Refer to the product data sheet for package details.





# **PACKAGE OUTLINE**

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
   This drawing is subject to change without notice.
   Reference JEDEC MO-178.



# **EXAMPLE BOARD LAYOUT**

### SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.

5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# **EXAMPLE STENCIL DESIGN**

### SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



NOTES: (continued)

7. Board assembly site may have different recommendations for stencil design.



<sup>6.</sup> Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



# **PACKAGE OUTLINE**

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
   This drawing is subject to change without notice.
   Reference JEDEC MO-178.



# **EXAMPLE BOARD LAYOUT**

### SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.

5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# **EXAMPLE STENCIL DESIGN**

### SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



NOTES: (continued)

7. Board assembly site may have different recommendations for stencil design.



<sup>6.</sup> Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- 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.



# LAND PATTERN DATA



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.



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