

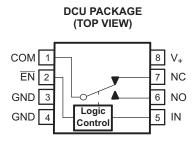
SCDS191C - MARCH 2005-REVISED FEBRUARY 2012

0.9-Ω SPDT ANALOG SWITCH 5-V/3.3-V SINGLE-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER

Check for Samples: TS5A3154

FEATURES

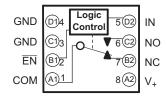
- Specified Make-Before-Break Switching
- Low ON-State Resistance (0.9 Ω)
- **Control Inputs Are 5.5-V Tolerant**
- Low Charge Injection
- **Excellent ON-State Resistance Matching**
- Low Total Harmonic Distortion (THD)
- 1.65-V to 5.5-V Single-Supply Operation
- Latch-Up Performance Exceeds 100 mA Per 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





DESCRIPTION/ORDERING INFORMATION

The TS5A3154 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 channel-to-channel ON-state resistance matching. The device has excellent total harmonic distortion (THD) performance and consumes very low power. These features make this device suitable for portable audio applications.

T _A	PACKAGE ^{(1) (2)}		ORDERABLE PART NUMBER	TOP-SIDE MARKING ⁽³⁾
–40°C to 85°C	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Reel of 3000	TS5A3154YZPR	JX_
	SSOP – DCU	Reel of 3000	TS5A3154DCUR	JCF_

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

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

DCU: The actual top-side marking has one additional character that designates the assembly/test site. (3)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).



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. NanoFree is a trademark of Texas Instruments.

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EN	IN	NO TO COM, COM TO NO								
L	L	ON	OFF							
L	н	OFF	ON							
Н	Х	OFF	OFF							

Table 2. FUNCTION TABLE

Table 3. Summary of Characteristics⁽¹⁾

Configuration	Single-Pole, Double-Throw 2:1 Multiplexer/Demultiplexer (SPDT)
Number of channels	1
ON-state resistance (r _{on})	0.9 Ω
ON-state resistance match (Δr_{on})	0.1 Ω
ON-state resistance flatness (r _{on(flat)})	0.15 Ω
Turn-on/turn-off time (t _{ON} /t _{OFF})	8 ns/12.5 ns
Make-before-break time (t _{MBB})	12 ns
Charge injection (Q _C)	10 pC
Bandwidth (BW)	100 MHz
OFF isolation (O _{ISO})	–64 dB at 1 MHz
Crosstalk (X _{TALK})	–64 dB at 1 MHz
Total harmonic distortion (THD)	0.004%
Leakage current (I _{COM(OFF)} /I _{NC(OFF)})	±20 nA
Power-supply current (I ₊)	0.1 µA
Package option	8-pin SSOP or DSBGA

(1) $V_+ = 5 V, T_A = 25^{\circ}C$



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Absolute Minimum and Maximum Ratings⁽¹⁾ ⁽²⁾

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

			MIN	MAX	UNIT
V+	Supply voltage range ⁽³⁾		-0.5	6.5	V
V _{NC} , V _{NO} , V _{COM}	Analog voltage range ^{(3) (4) (5)}		-0.5	V ₊ + 0.5	V
I _K	Analog port diode current	V_{NC} , V_{NO} , V_{COM} < 0 or V_{NO} , V_{NC} , V_{COM} > V_{+}	-50	50	mA
I _{NC} ,	On-state switch current			200	
ICOM.	On-state peak switch current ⁽⁶⁾	$V_{\rm NC}$, $V_{\rm NO}$, $V_{\rm COM}$ = 0 to V_+	-400	400	mA
VI	Digital input voltage range ⁽³⁾ ⁽⁴⁾		-0.5	6.5	V
I _{IK}	Digital input clamp current	V ₁ < 0	-50		mA
I+	Continuous current through V ₊			100	mA
I _{GND}	Continuous current through GND		-100	100	mA
0		DCU package		227	°0444
θ_{JA}	Package thermal impedance ⁽⁷⁾	YZP package		102	°C/W
T _{stg}	Storage temperature range		-65	150	°C

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(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.

NSTRUMENTS

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Electrical Characteristics for 5-V Supply⁽¹⁾

$V_{+} = 4.5 \text{ V to } 5.5 \text{ V}$, $T_A = -40^{\circ}C$ to $85^{\circ}C$	(unless otherwise noted)
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PARAMETER	SYMBOL	TEST CON	DITIONS	TA	V.	MIN	TYP	MAX	UNIT	
Analog Switch										
Analog signal range	V _{COM} , V _{NO} , V _{NC}					0		V+	V	
Peak ON resistance	r _{peak}	$\begin{array}{l} 0 \leq (V_{\rm NO} \mbox{ or } V_{\rm NC}) \leq V_{+}, \\ I_{\rm COM} = -100 \mbox{ mA}, \end{array}$	Switch ON, See Figure 13	25°C Full	4.5 V		0.9	1.1 1.3	Ω	
ON-state resistance	r _{on}	V_{NO} or V_{NC} = 2.5 V, I_{COM} = -100 mA,	Switch ON, See Figure 13	25°C Full	4.5 V		0.8	0.9 1.1	Ω	
ON-state resistance				25°C			0.05	0.1		
matching between channels	Δr _{on}	V_{NO} or $V_{NC} = 2.5 V$, $I_{COM} = -100 \text{ mA}$,	Switch ON, See Figure 13	Full	4.5 V			0.1	Ω	
ON-state		$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$ $I_{COM} = -100 \text{ mA},$	Switch ON, See Figure 13	25°C Full			0.15			
resistance flatness	r _{on(flat)}	V _{NO} or V _{NC} = 1 V, 1.5 V, 2.5 V.	Switch ON,	25°C	4.5 V		0.09	0.15	Ω	
		$I_{COM} = -100 \text{ mA},$	See Figure 13	Full				0.15		
	I _{NC(OFF)} , V _{COI} Or V _{NC}		V_{NC} or $V_{NO} = 1 V$,		25°C		-20	2	20	ļ
NC, NO OFF leakage current		$V_{\text{NC}} \text{ or } V_{\text{NO}} = 4.5 \text{ V},$ $V_{\text{COM}} = 1 \text{ V},$	Switch OFF, See Figure 14	Full	5.5 V	-150		150	nA	
ourroint	$I_{NC(PWROFF)}, V_{NC} \text{ or } V_{NO} = 0 \text{ to } 5.5 \text{ V}, Switch OFF, \\ V_{COM} = 5.5 \text{ V to } 0, See Figure 14 Full 0 V -25$	0.7	5	μA						
	I _{NO} (PWROFF)		See Figure 14	Full		-25	-	25		
NC, NO ON leakage current	I _{NC(ON)} , I _{NO(ON)}	$ \begin{array}{l} V_{NC} \mbox{ or } V_{NO} = 1 \mbox{ V}, \\ V_{COM} = \mbox{ Open}, \\ \mbox{ or } \\ V_{NC} \mbox{ or } V_{NO} = 4.5 \mbox{ V}, \\ V_{COM} = \mbox{ Open}, \end{array} $	Switch ON, See Figure 15	25°C Full	5.5 V	-20 -150	2	20 150	nA	
		$V_{COM} = 1 V, V_{NC} or$		25°C		-20	2	20		
COM OFF leakage current	I _{COM(OFF)}		Switch OFF, See Figure 14	Full	5.5 V	-150		150	nA	
ourion	1	V_{NC} or V_{NO} = 0 to 5.5 V,	Switch OFF,	25°C	0 V	-5	0.7	5	μA	
	ICOM(PWROFF)	$V_{COM} = 5.5 V \text{ to } 0,$	See Figure 14	Full	0 0	-25		25	μΛ	
COM		$V_{COM} = 1 V$,		25°C		-20	2	20		
COM ON leakage current	$I_{COM(ON)} \begin{array}{c} V_{NC} \text{ or } V_{NO} = \text{Open}, \\ \text{or} \\ V_{COM} = 4.5 \text{ V}, \\ V_{NC} \text{ or } V_{NO} = \text{Open}, \end{array} \begin{array}{c} \text{Switch ON}, \\ \text{See Figure 15} \\ \text{See Figure 15} \end{array}$	Full	5.5 V	-150		150	nA			
Digital Control I	nputs (IN, EN) ⁽²⁾									
Input logic high	V _{IH}			Full		2.4		5.5	V	
Input logic low	VIL			Full		0		0.8	V	
Input leakage current	I _{IH} , I _{IL}	$V_{I} = 5.5 V \text{ or } 0 V$		25°C Full	5.5 V	-100 -100	25	100 100	nA	

(1)

The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum. All unused digital inputs of the device must be held at V_{+} or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004. (2)



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

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

PARAMETER	SYMBOL	TEST CON	DITIONS	TA	V.	MIN	TYP	MAX	UNIT
Dynamic									
Turne and times			0 05 -5	25°C	5 V	1	5.2	8	
Turn-on time, IN or OE	t _{ON}		C _L = 35 pF, See Figure 17	Full	4.5 V to 5.5 V	1		9	ns
Turn-off time.			0 25 pF	25°C	5 V	5	9.5	12.5	
IN or OE	t _{OFF}		C _L = 35 pF, See Figure 17	Full	4.5 V to 5.5 V	4		13.5	ns
Make-before-			$C_{1} = 35 \text{ pF},$	25°C	5 V	4	6.3	12	
break time	t _{MBB}		See Figure 18	Full	4.5 V to 5.5 V	4		13	ns
Charge injection	Q _C		C _L = 1 nF, See Figure 22	25°C	5 V		10		рС
NC, NO OFF capacitance	C _{NC(OFF)} , C _{NO(OFF)}	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch OFF, See Figure 16	25°C	5 V		19		pF
NC, NO ON capacitance	C _{NC(ON)} , C _{NO(ON)}	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch ON, See Figure 16	25°C	5 V		57		pF
COM OFF capacitance	C _{COM(OFF)}	$V_{COM} = V_{+} \text{ or GND},$	Switch ON, See Figure 16	25°C	5 V		36		pF
COM ON capacitance	C _{COM(ON)}	$V_{COM} = V_{+} \text{ or GND},$	Switch ON, See Figure 16	25°C	5 V		57		pF
Digital input capacitance	Cl	$V_1 = V_+ \text{ or GND},$	See Figure 16	25°C	5 V		2		pF
Bandwidth	BW	$R_L = 50 \Omega,$	Switch ON, See Figure 19	25°C	5 V		100		MHz
OFF isolation	O _{ISO}	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch OFF, See Figure 20	25°C	5 V		-64		dB
Crosstalk	X _{TALK}	$ \begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array} $	Switch ON, See Figure 21	25°C	5 V		-64		dB
Total harmonic distortion	THD	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz, See Figure 23	25°C	5 V		0.004		%
Supply		·			· I			I	
Positive supply current	I+	$V_{I} = V_{+}$ or GND,	Switch ON or OFF	25°C Full	5.5 V		0.02	0.1 0.5	μA

TEXAS INSTRUMENTS

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Electrical Characteristics for 3.3-V Supply⁽¹⁾

 $V_{+} = 3 V$ to 3.6 V, $T_{A} = -40^{\circ}C$ to $85^{\circ}C$ (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIO	NS	T _A	V+	MIN	TYP	MAX	UNIT
Analog Switch									
Analog signal range	V _{COM} , V _{NO} , V _{NC}					0		V+	V
Peak ON resistance	r _{peak}	$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$ $I_{COM} = -100 \text{ mA},$	Switch ON, See Figure 13	25°C Full	3 V		1.3	1.6 1.9	Ω
ON-state	r _{on}	$V_{NO} \text{ or } V_{NC} = 2 \text{ V},$	Switch ON,	25°C	3 V		1.2	1.5	Ω
resistance	on	$I_{COM} = -100 \text{ mA},$	See Figure 13	Full	5.			1.7	32
ON-state resistance match between channels	Δr_{on}	$V_{\rm NO}$ or $V_{\rm NC}$ = 2 V, 0.8 V $I_{\rm COM}$ = –100 mA,	Switch ON, See Figure 13	25°C Full	3 V		0.08	0.15 0.15	Ω
		$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$	Switch ON,	25°C			0.3		Ω
ON-state resistance ro flatness	-	$I_{COM} = -100 \text{ mA},$	See Figure 13	Full	3 V				
	r _{on(flat)}	V_{NO} or V_{NC} = 2 V, 0.8 V,	Switch ON,	25°C	3 V		0.09	0.15	
		$I_{COM} = -100 \text{ mA},$	See Figure 13	Full				0.15	
NC, NO	I _{NC(OFF)} , I _{NO(OFF)}	V_{NC} or $V_{NO} = 1 V$, $V_{COM} = 3 V$, or	See Figure 14 Full	25°C	3.6 V	-20 -50	2	20 50	nA
OFF leakage		V_{NC} or V_{NO} = 3 V, V_{COM} = 1 V,							
current	I _{NC(PWROFF)} , I _{NO(PWROFF)}	V_{NC} or $V_{NO} = 0$ to 3.6 V, $V_{COM} = 3.6$ V to 0 V,	Switch OFF, See Figure 14	25°C Full	0 V	_1 _15	0.2	1 15	μA
NC, NO		V_{NC} or V_{NO} = 1 V, V_{COM} = Open,	-	25°C		-20	2	20	
ON leakage current	I _{NC(ON)} , I _{NO(ON)}	or V_{NC} or $V_{NO} = 3 V$, $V_{COM} = Open$,	Switch ON, See Figure 15	Full	3.6 V	-50		50	nA
		$V_{COM} = 1 \text{ V}, \text{ V}_{NC} \text{ or } \text{ V}_{NO} = 3 \text{ V},$	Switch OFF,	25°C		-20	2	20	
COM OFF leakage	I _{COM(OFF)}	or $V_{COM} = 3 \text{ V}, \text{ V}_{NC} \text{ or } \text{ V}_{NO} = 1 \text{ V},$	See Figure 14	Full	3.6 V	-50		50	nA
current		$V_{\rm NC}$ or $V_{\rm NO}$ = 0 to 3.6 V,	Switch OFF,	25°C	0 V	-1	0.2	1	μA
	ICOM(PWROFF)	$V_{COM} = 3.6 V \text{ to } 0,$	See Figure 14	Full	0.	-15		15	μ
COM ON leakage	I	$V_{COM} = 1 V, V_{NC} \text{ or } V_{NO} = Open,$	Switch ON,	25°C	3.6 V	-20	2	20	n۸
current	I _{COM(ON)}	$V_{COM} = 3 V, V_{NC} \text{ or } V_{NO} = Open$	See Figure 15	Full	5.0 V	-50		50	nA
Digital Control	Inputs (IN, EN) ⁽²⁾								
Input logic high	V _{IH}			Full		2		5.5	V
Input logic low	V _{IL}			Full		0		0.8	V
Input leakage	hu bi	V ₁ = 5.5 V or 0		25°C	3.6 V	-100	25	100	nA
current	I _{IH} , I _{IL}			Full	5.0 V	-100		100	ПA

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

 (2) All unused digital inputs of the device must be held at V₊ or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004.



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

 $V_{+} = 3 V$ to 3.6 V, $T_{A} = -40^{\circ}$ C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST COND	TIONS	TA	V+	MIN	TYP	MAX	UNIT
Dynamic				•					
Turn on time			0 25 25	25°C	3.3 V	3	6	10	
Turn-on time, IN or OE	t _{ON}		C _L = 35 pF, See Figure 17	Full	3 V to 3.6 V	2		10.5	ns
Turn off time			0 25 25	25°C	3.3 V	5	10	15	
Turn- <u>off</u> time, IN or OE	t _{OFF}		C _L = 35 pF, See Figure 17	Full	3 V to 3.6 V	4		17	ns
Make-before-		$\mathcal{M} = \mathcal{M}$	C _I = 35 pF,	25°C	3.3 V	4	5.7	12	
break time	t _{MBB}		See Figure 18	Full	3 V to 3.6 V	4		13	ns
Charge injection	Q _C	$V_{GEN} = 0,$ $R_{GEN} = 0,$	C _L = 1 nF, See Figure 22	25°C	3.3 V		9		рС
NC, NO OFF capacitance	$\begin{array}{c} C_{NC(OFF)},\\ C_{NO(OFF)} \end{array}$	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch OFF, See Figure 16	25°C	3.3 V		19		pF
NC, NO ON capacitance	C _{NC(ON)} , C _{NO(ON)}	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch ON, See Figure 16	25°C	3.3 V		57		pF
COM OFF capacitance	C _{COM(OFF)}	$V_{COM} = V_{+} \text{ or GND},$	Switch ON, See	25°C	3.3 V		36		pF
COM ON capacitance	C _{COM(ON)}	$V_{COM} = V_+ \text{ or GND},$	Switch ON, See Figure 16	25°C	3.3 V		57		pF
Digital input capacitance	CI	$V_{I} = V_{+}$ or GND,	See Figure 16	25°C	3.3 V		2		pF
Bandwidth	BW	R _L = 50 Ω,	Switch ON, See Figure 19	25°C	3.3 V		100		MHz
OFF isolation	O _{ISO}	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch OFF, See Figure 20	25°C	3.3 V		-64		dB
Crosstalk	X _{TALK}	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch ON, See Figure 21	25°C	3.3 V		-64		dB
Total harmonic distortion	THD	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz, See Figure 23	25°C	3.3 V		0.01 0		%
Supply									
Positive supply current	I+	$V_1 = V_+ \text{ or GND},$	Switch ON or OFF	25°C Full	3.6 V		0.01	0.1 0.25	μA

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Electrical Characteristics for 2.5-V Supply⁽¹⁾

 $V_{+} = 3 \text{ V}$ to 3.6 V, $T_{A} = -40^{\circ}\text{C}$ to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST COND	ITIONS	TA	٧.	MIN	TYP	MAX	UNIT
Analog Switch	I								
Analog signal range	V _{COM} , V _{NO} , V _{NC}					0		V+	V
Peak ON resistance	r _{peak}	$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$ $I_{COM} = -8 \text{ mA},$	Switch ON, See Figure 13	25°C Full	2.3 V		1.9	2.5 2.7	Ω
ON-state resistance	r _{on}	V_{NO} or V_{NC} = 1.8 V, I_{COM} = -8 mA,	Switch ON, See Figure 13	25°C	2.3 V		1.6	2.1	Ω
ON-state			occ rigare ro	Full 25°C			0.12	2.5 0.2	
resistance matching between channels	Δr _{on}	V_{NO} or V_{NC} = 1.8 V, I_{COM} = -8 mA,	Switch ON, See Figure 13	Full	2.3 V		0.12	0.2	Ω
		$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$	Switch ON,	25°C			0.65		
ON-state resistance	r _{on(flat)}	$I_{COM} = -8 \text{ mA},$	See Figure 13	Full	2.3 V				Ω
flatness	·on(nat)	$V_{NO} \text{ or } V_{NC} = 0.8 \text{ V}, 1.8 \text{ V},$	Switch ON,	25°C	2.0 .		0.5	1	
		$I_{COM} = -8 \text{ mA},$	See Figure 13	Full				1	
NC, NO OFF leakage current		V_{NC} or $V_{NO} = 0.5 V$, $V_{COM} = 2.3 V$,		25°C		-20	2	20	nA
	I _{NC(OFF)} , I _{NO(OFF)}	$\begin{array}{c} \text{INC(OFF),} & \text{or} & \text{Sv} \\ \text{INO(OFF)} & \text{V}_{\text{NC}} \text{ or } \text{V}_{\text{NO}} = 2.3 \text{ V}, \\ \text{V}_{\text{COM}} = 0.5 \text{ V}, \end{array}$	Switch OFF, See Figure 14	Full	2.7 V	-50		50	
canon	I _{NC(PWROFF)} ,	V_{NC} or $V_{NO} = 0$ to 2.7 V,	Switch OFF,	25°C	0 V	-1	<u> </u>		
	INO(PWROFF)	$V_{COM} = 2.7 V \text{ to } 0,$	See Figure 14	Full	0 v	-10		10	10 ^{µA}
		V_{NC} or $V_{NO} = 0.5 V$,		25°C		-20		20	
NC, NO ON leakage current	I _{NC(ON)} , I _{NO(ON)}		Switch ON, See Figure 15	Full	2.7 V	-50		50	nA
		$V_{COM} = 0.5 V, V_{NC} or$		25°C		-20		20	
COM OFF leakage current	I _{COM(OFF)}	$\label{eq:VNO} \begin{array}{l} V_{NO} = 2.3 \ \text{V}, \\ \text{or} \\ V_{COM} = 2.3 \ \text{V}, \ \text{V}_{NC} \ \text{or} \\ V_{NO} = 0.5 \ \text{V}, \end{array}$	Switch OFF, See Figure 14	Full	2.7 V	-50		50	nA
	1	V_{NC} or V_{NO} = 0 to 2.7 V,	Switch OFF,	25°C	0 V	-1		1	μA
	ICOM(PWROFF)	$V_{COM} = 2.7 V \text{ to } 0,$	See Figure 14	Full	0 v	-10		10	μΑ
0014		$V_{COM} = 0.5 \text{ V}, V_{NC} \text{ or}$		25°C		-20		20	
COM ON leakage current	I _{COM(ON)}	$\label{eq:VNO} \begin{array}{l} V_{NO} = Open, \\ or \\ V_{COM} = 2.3 \ V, \ V_{NC} \ or \\ V_{NO} = Open, \end{array}$	Switch ON, See Figure 15	Full	2.7 V	-50		50	nA
Digital Control In	nputs (IN, EN) ⁽²⁾			· ·					
Input logic high	VIH			Full		1.8		5.5	V
Input logic low	VIL			Full		0		0.6	V
Input leakage current	I _{IH} , I _{IL}	V ₁ = 5.5 V or 0		25°C Full	2.7 V	-100 -100	25	100 100	nA

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

 (2) All unused digital inputs of the device must be held at V₊ or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004.



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

 $V_{+} = 3 V$ to 3.6 V, $T_{A} = -40^{\circ}C$ to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST CON	DITIONS	TA	٧.	MIN	TYP	MAX	UNIT
Dynamic									
Turn on time			0 25 25	25°C	2.5 V	4	7.0	11.5	
Turn- <u>on</u> time, IN or OE	t _{ON}	$V_{COM} = V_+, \\ R_L = 50 \ \Omega,$	C _L = 35 pF, See Figure 17	Full	2.3 V to 2.7 V	3.5		12	ns
Turn off time			0 25 25	25°C	2.5 V	5	11.5	18.5	
Turn- <u>off</u> time, IN or OE	t _{OFF}		C _L = 35 pF, See Figure 17	Full	2.3 V to 2.7 V	4		21	ns
Make-before-		$V_{COM} = V_+,$	C _L = 35 pF,	25°C	2.5 V	4	6.3	15	
break time	t _{MBB}	$R_{L} = 50 \Omega,$	See Figure 18	Full	2.3 V to 2.7 V	4		16	ns
Charge injection	Q _C	$V_{\text{GEN}} = 0,$ $R_{\text{GEN}} = 0,$	C _L = 1 nF, See Figure 22	25°C	2.5 V		7		рС
NC, NO OFF capacitance	C _{NC(OFF)} , C _{NO(OFF)}	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch OFF, See Figure 16	25°C	2.5 V		19		pF
NC, NO ON capacitance	C _{NC(ON)} , C _{NO(ON)}	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch ON, See Figure 16	25°C	2.5 V		57		pF
COM OFF capacitance	C _{COM(OFF)}	$V_{COM} = V_+ \text{ or GND},$	Switch ON, See Figure 16	25°C	2.5 V		36		pF
COM ON capacitance	C _{COM(ON)}	$V_{COM} = V_+ \text{ or GND},$	Switch ON, See Figure 16	25°C	2.5 V		57		pF
Digital input capacitance	Cl	$V_I = V_+ \text{ or } GND,$	See Figure 16	25°C	2.5 V		2		pF
Bandwidth	BW	$R_L = 50 \Omega$,	Switch ON, See Figure 19	25°C	2.5 V		100		MHz
OFF isolation	O _{ISO}	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch OFF, See Figure 20	25°C	2.5 V		-64		dB
Crosstalk	X _{TALK}	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch ON, See Figure 21	25°C	2.5 V		-64		dB
Total harmonic distortion	THD	$R_L = 600 \Omega,$ $C_L = 50 pF,$	f = 20 Hz to 20 kHz, See Figure 23	25°C	2.5 V		0.020		%
Supply									
Positive supply	I+	$V_1 = V_+ \text{ or GND},$	Switch ON or OFF	25°C	2.7 V		0.001	0.05	μA
current	'+	$v_1 = v_+$ or Give,	Switch ON OFF	Full	2.1 V			0.15	μΑ

NSTRUMENTS www.ti.com

EXAS

Electrical Characteristics for 1.8-V Supply⁽¹⁾

PARAMETER	SYMBOL	TEST COND	T _A	V.	MIN	TYP	MAX	UNIT					
Analog Switch													
Analog signal range	V _{COM} , V _{NO} , V _{NC}					0		V+	V				
Peak ON resistance	r _{peak}	$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$ $I_{COM} = -2 \text{ mA},$	Switch ON, See Figure 13	25°C Full	1.65 V		5.5	25 30	Ω				
ON-state resistance	r _{on}	V_{NO} or V_{NC} = 1.5 V, I_{COM} = -2 mA,	Switch ON, See Figure 13	25°C Full	1.65 V		2	2.7 3.1	Ω				
ON-state				25°C			0.16	0.3					
resistance matching between channels	Δr _{on}	V_{NO} or V_{NC} = 1.5 V, I_{COM} = -2 mA,	Switch ON, See Figure 13	Full	1.65 V		0.10	0.3	Ω				
ON-state		$0 \le (V_{NO} \text{ or } V_{NC}) \le V_+,$ $I_{COM} = -2 \text{ mA},$	Switch ON, See Figure 13	25°C			3		Ω				
resistance flatness	r _{on(flat)}	V_{NO} or $V_{NC} = 0.6 V$, 1.5 V,	Switch ON,	25°C	1.65 V		3	20					
namess		$I_{COM} = -2 \text{ mA},$	See Figure 13	Full				25					
	Inc(off), Ino(off)	V_{NC} or $V_{NO} = 0.3 V$,		25°C		-20	1.5	20					
NC, NO OFF leakage current		$\label{eq:VCOM} \begin{array}{l} V_{COM} = 1.65 \ \text{V}, \\ \text{or} \\ V_{NC} \ \text{or} \ V_{NO} = 1.65 \ \text{V}, \\ V_{COM} = 0.3 \ \text{V}, \end{array}$	Switch OFF, See Figure 14	Full	1.95 V	-50		50	nA				
current	I _{NC(PWROFF)} , I _{NO(PWROFF)}	$\label{eq:VNC} \begin{array}{l} V_{NC} \text{ or } V_{NO} = 0 \text{ to } 1.95 \text{ V}, \\ V_{COM} = 1.95 \text{ V to } 0, \end{array}$	Switch OFF,	25°C	0 V	-1	0.1	1					
			See Figure 14	Full		-10		10	μA				
						V_{NC} or $V_{NO} = 0.3 V$,		25°C		-20	1.5	20	
NC, NO ON leakage current	I _{NC(ON)} , I _{NO(ON)}		Switch ON, See Figure 15	Full	1.95 V	-50		50	nA				
	I _{COM(OFF)}	I _{COM(OFF)}		V_{NC} or V_{NO} = 1.65 V,		25°C		-20	1.5	20			
COM OFF leakage current				Switch OFF, See Figure 14	Full	1.95 V	-50		50	nA			
		V_{NC} or $V_{NO} = 1.95$ V to 0,	Switch OFF,	25°C	0 V	-1	0.06	1	μA				
	COM(PWROFF)	$V_{COM} = 0$ to 1.95 V,	See Figure 14	Full	0 0	-10		10					
		V_{NC} or V_{NO} = Open,		25°C		-20	1.5	20	nA				
COM ON leakage current	I _{COM(ON)}	$\label{eq:VCOM} \begin{array}{l} V_{COM} = 0.3 \ V, \\ \text{or} \\ V_{NC} \ \text{or} \ V_{NO} = Open, \\ V_{COM} = 1.65 \ V, \end{array}$	Switch ON, See Figure 15	Full	1.95 V	-50		50					
Digital Control	Inputs (IN, EN) ⁽²⁾												
Input logic high	V _{IH}			Full		1.5		5.6	V				
Innut Ingia Iour	V _{IL}			Full		0		0.6	V				
Input logic low								nA					

40°C to 95°C (unless othe **١** o notod)

(1)

The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum All unused digital inputs of the device must be held at V_{+} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004. (2)



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

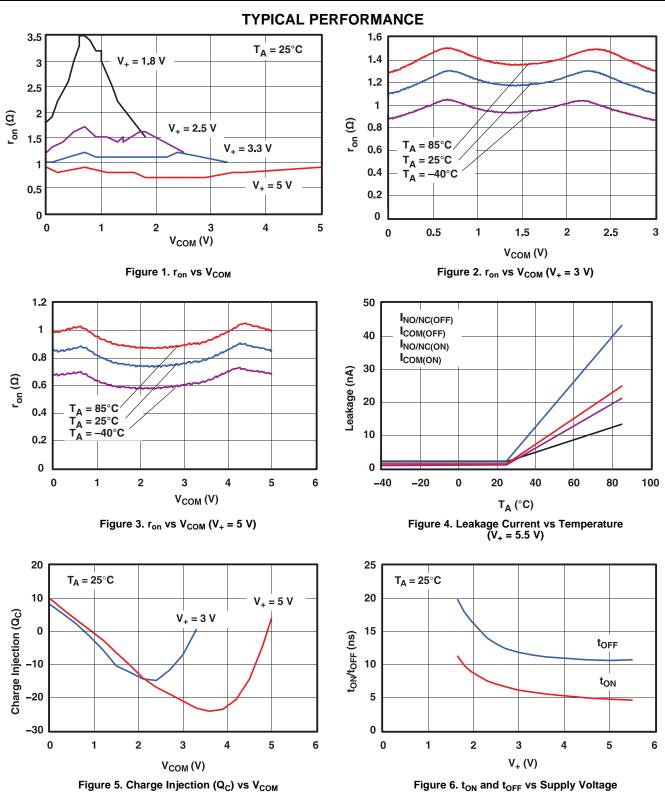
 $V_{+} = 1.65$ V to 1.95 V, $T_{A} = -40^{\circ}$ C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	TEST COND	DITIONS	TA	٧.	MIN	TYP	MAX	UNIT
Dynamic		1			н Ц			ļ	
Turn-on time,			0 25 55	25°C	5 V	5		20.5	
IN or OE	t _{ON}	$V_{COM} = V_+, \\ R_L = 50 \ \Omega,$	C _L = 35 pF, See Figure 17	Full	1.65 V to 1.95 V	4.5		21	ns
Turn-off time,			0 25 55	25°C	5 V	7	16.5	27.5	
IN or OE	t _{OFF}	$V_{COM} = V_+, \\ R_L = 50 \ \Omega,$	C _L = 35 pF, See Figure 17	Full	1.65 V to 1.95 V	5		30	ns
Make-before-			C _L = 35 pF,	25°C	5 V	4	8.3	15	
break time	t _{MBB}		See Figure 18	Full	1.65 V to 1.95 V	4		16	ns
Charge injection	Q _C		C _L = 1 nF, See <mark>Figure 22</mark>	25°C	1.8 V		5		рС
NC, NO OFF capacitance	$\begin{array}{c} C_{NC(OFF)},\\ C_{NO(OFF)} \end{array}$	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch OFF, See Figure 16	25°C	1.8 V		19		pF
NC, NO ON capacitance	C _{NC(ON)} , C _{NO(ON)}	V_{NC} or $V_{NO} = V_{+}$ or GND,	Switch ON, See Figure 16	25°C	1.8 V		57		pF
COM OFF capacitance	C _{COM(OFF)}	$V_{COM} = V_+ \text{ or GND},$	Switch ON, See Figure 16	25°C	1.8 V		36		pF
COM ON capacitance	C _{COM(ON)}	$V_{COM} = V_+ \text{ or } GND,$	Switch ON, See Figure 16	25°C	1.8 V		57		pF
Digital input capacitance	CI	$V_I = V_+ \text{ or } GND,$	See Figure 16	25°C	1.8 V		2.0		pF
Bandwidth	BW	$R_L = 50 \Omega$,	Switch ON, See Figure 19	25°C	1.8 V		100		MHz
OFF isolation	O _{ISO}	$\begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array}$	Switch OFF, See Figure 20	25°C	1.8 V		-64		dB
Crosstalk	X _{TALK}	$ \begin{array}{l} R_{L} = 50 \ \Omega, \\ f = 1 \ MHz, \end{array} $	Switch ON, See Figure 21	25°C	1.8 V		-64		dB
Total harmonic distortion	THD	$ \begin{aligned} R_L &= 600 \ \Omega, \\ C_L &= 50 \ pF, \end{aligned} $	f = 20 Hz to 20 kHz, See Figure 23	25°C	1.8 V		0.060		%
Supply									
Positive supply current	I+	$V_I = V_+ \text{ or } GND,$	Switch ON or OFF	25°C Full	1.95 V		0.001	0.05 0.1	μA

TEXAS INSTRUMENTS

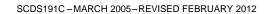
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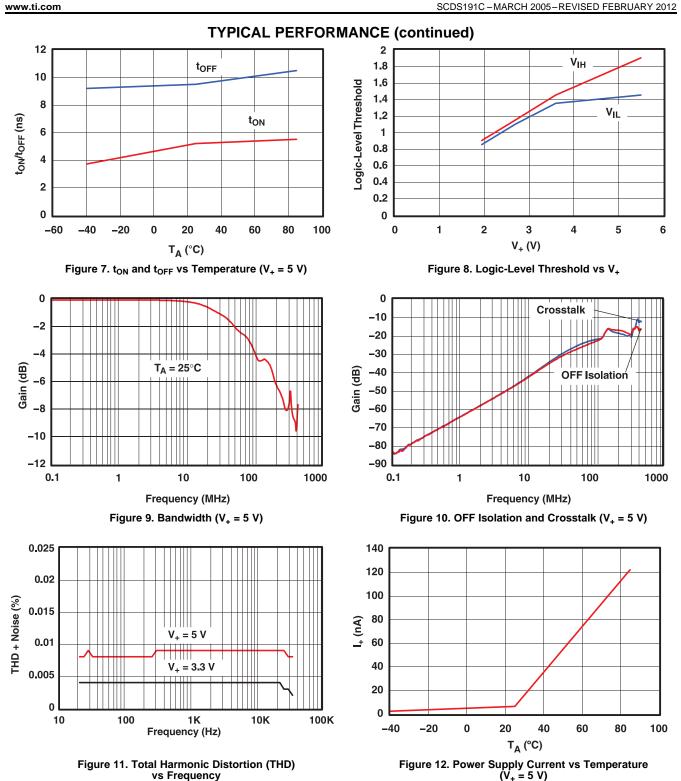
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NSTRUMENTS

Texas

PIN DESCRIPTION

PIN NO.	NAME	DESCRIPTION
1	COM	Common
2	EN	Enable control input
3	GND	Digital ground
4	GND	Digital ground
5	IN	Digital control to connect the COM to NO or NC
6	NO	Normally open
7	NC	Normally closed
8	V ₊	Power supply

PARAMETER DESCRIPTION

SYMBOL	DESCRIPTION
V _{COM}	Voltage at COM
V _{NC}	Voltage at NC
V _{NO}	Voltage at NO
r _{on}	Resistance between COM and NC or COM and NO ports when the channel is ON
Δr_{on}	Difference of ron between channels in a specific device
r _{on(flat)}	Difference between the maximum and minimum value of ron 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
I _{NO(OFF)}	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state
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) 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) 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) open
V _{IH}	Minimum input voltage for logic high for the control input (IN)
VIL	Maximum input voltage for logic low for the control input (IN)
VI	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, 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 output (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, $Q_C = C_L \times \Delta V_{COM}$, C_L is the load capacitance and ΔV_{COM} 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
Cl	Capacitance of control input (IN)
O _{ISO}	OFF isolation of the switch is a measurement of OFF-state switch impedance. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM or NO to COM) in the OFF state.
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 where 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 fundamental harmonic.



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PARAMETER DESCRIPTION (continued)

-	
SYMBOL	DESCRIPTION
I+	Static power-supply current with the control (IN) pin at V_+ or GND

PARAMETER MEASUREMENT INFORMATION

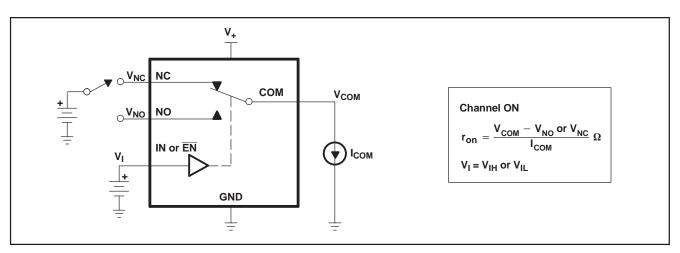


Figure 13. ON-State Resistance (ron)

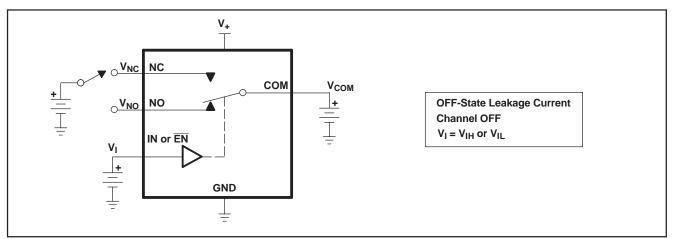
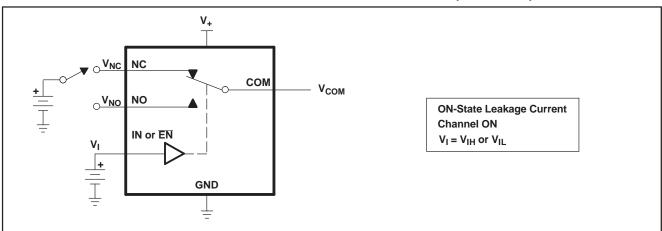
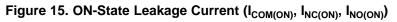


Figure 14. OFF-State Leakage Current (I_{NC(OFF)}, I_{NO(OFF)}, I_{NO(PWROFF)}, I_{COM(PWROFF)})

PARAMETER MEASUREMENT INFORMATION (continued)





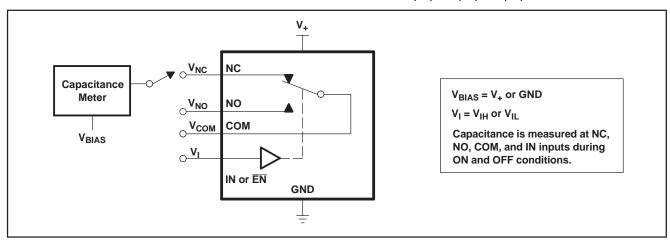
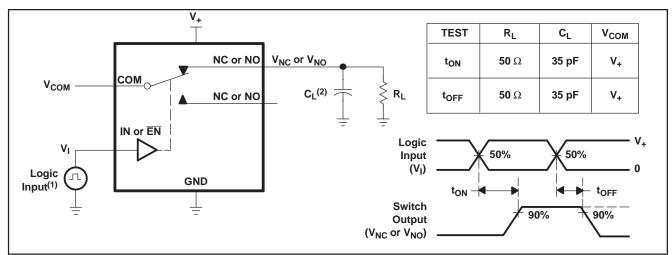


Figure 16. Capacitance (CI, C_{COM(OFF)}, C_{COM(ON)}, C_{NC(OFF)}, C_{NO(OFF)}, C_{NC(ON)}, C_{NO(ON)})



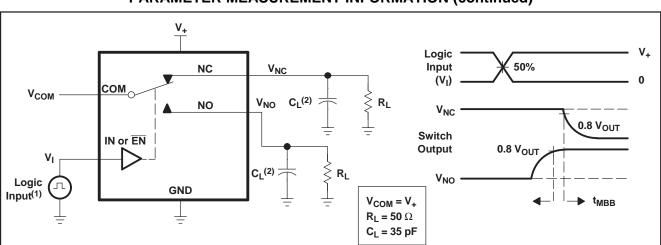
⁽¹⁾ All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz, Z_Q = 50 Ω , t_f < 5 ns, t_f < 5 ns.

 $^{(2)}$ C_L includes probe and jig capacitance.

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

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PARAMETER MEASUREMENT INFORMATION (continued)

⁽¹⁾ All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz, Z₀ = 50 Ω , t_r < 5 ns, t_f < 5 ns.

⁽²⁾ C_L includes probe and jig capacitance.

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

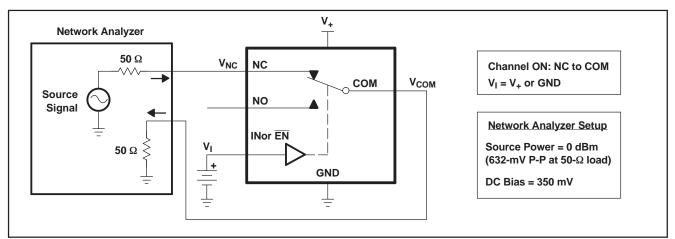


Figure 19. Bandwidth (BW)

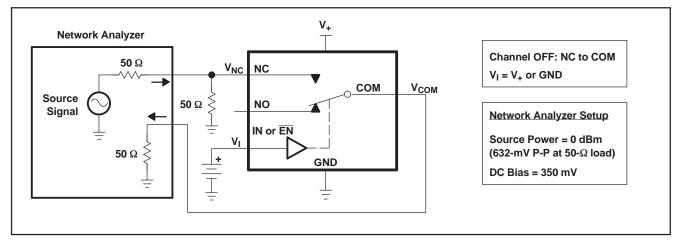


Figure 20. OFF Isolation (O_{ISO})

PARAMETER MEASUREMENT INFORMATION (continued)

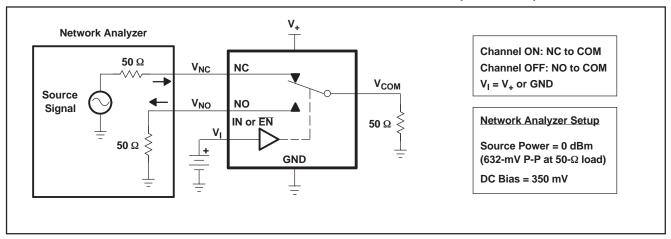
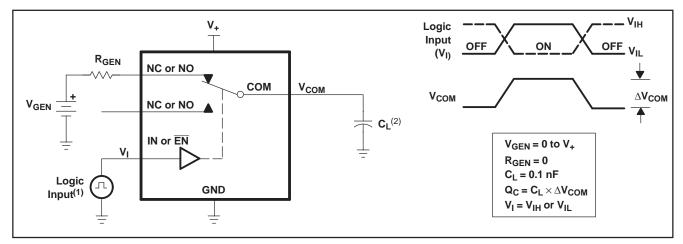


Figure 21. Crosstalk (X_{TALK})



⁽¹⁾ All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz, Z_O = 50 Ω , t_f < 5 ns, t_f < 5 ns. ⁽²⁾ C_L includes probe and jig capacitance.

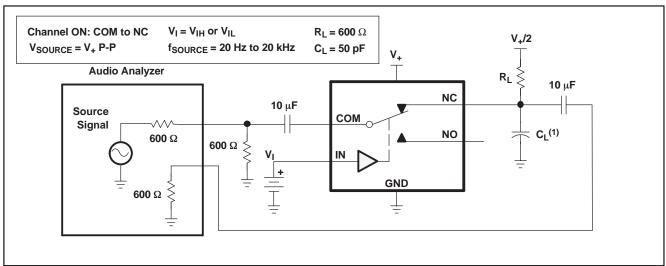
Figure 22. Charge Injection (Q_c)



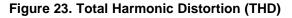
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PARAMETER MEASUREMENT INFORMATION (continued)



 $^{(1)}\,$ CL includes probe and jig capacitance.



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REVISION HISTORY

С	hanges from Revision B (May 2009) to Revision C	Page
•	Changed ORDERING INFORMATION Table.	1

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23-Jun-2013

PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty		Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
TS5A3154DCUR	(1) ACTIVE	US8	DCU	8	3000	(2) Green (RoHS & no Sb/Br)	CU NIPDAU	(3) Level-1-260C-UNLIM	-40 to 85	(CF ~ JCFR) JZ	Samples
TS5A3154DCURE4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(CF ~ JCFR) JZ	Samples
TS5A3154DCURE6	PREVIEW	US8	DCU	8	3000	TBD	Call TI	Call TI	-40 to 85	CF JZ	
TS5A3154DCURG4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(CF ~ JCFR) JZ	Samples
TS5A3154YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	(JX7 ~ JXN)	Samples

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

ACTIVE: Product device recommended for new designs.

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

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

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

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.

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

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



23-Jun-2013

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PACKAGE MATERIALS INFORMATION

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Texas Instruments

TAPE AND REEL INFORMATION





QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal												
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
TS5A3154DCUR	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
TS5A3154YZPR	DSBGA	YZP	8	3000	178.0	9.2	1.02	2.02	0.63	4.0	8.0	Q1

TEXAS INSTRUMENTS

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PACKAGE MATERIALS INFORMATION

3-Jul-2013



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS5A3154DCUR	US8	DCU	8	3000	202.0	201.0	28.0
TS5A3154YZPR	DSBGA	YZP	8	3000	220.0	220.0	35.0

DCU (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



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-187 variation CA.



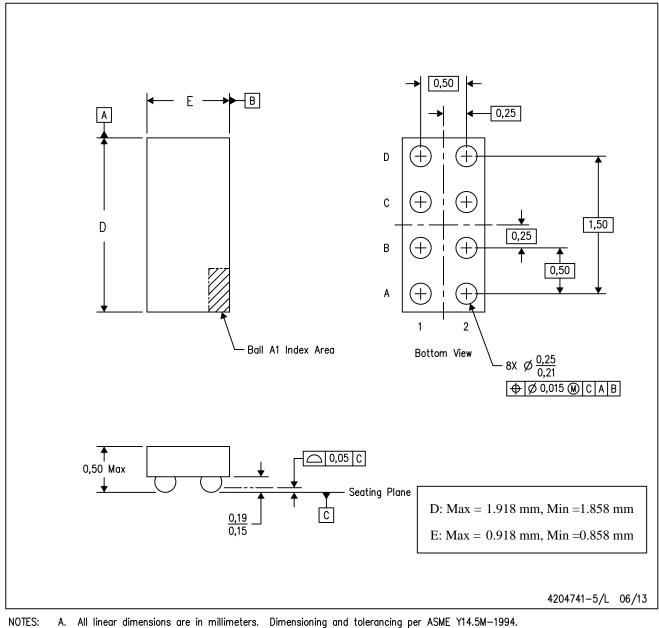


- NOTES: A. All linear dimensions are in millimeters. В. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



YZP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



- Α.
- This drawing is subject to change without notice. Β.
- C. NanoFree™ package configuration.

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