

TS12A12511 5-Ω Single-Channel SPDT Analog Switch With Negative Signaling Capability

1 Features

- $\pm 2.7\text{-V}$ to $\pm 6\text{-V}$ dual supply
- 2.7-V to 12-V single supply
- $5\text{-}\Omega$ (typical) ON-state resistance
- $1.6\text{-}\Omega$ (typical) ON-state resistance flatness
- 3.3-V , 5-V compatible digital control inputs
- Rail-to-rail analog signal handling
- Fast t_{ON} , t_{OFF} times
- Supports both digital and analog signal applications
- Tiny 8-lead SOT-23, 8-lead MSOP, and QFN-8 packages
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- ESD performance tested per JESD 22
 - $\pm 2000\text{-V}$ Human Body Model (A114-B, Class II)
 - $\pm 1000\text{-V}$ Charged-Device Model (C101)

2 Applications

- [Automatic test equipment](#)
- [Power routing](#)
- [Communication systems](#)
- [Data acquisition systems](#)
- Sample-and-hold systems
- Relay replacement
- [Grid Infrastructure](#)

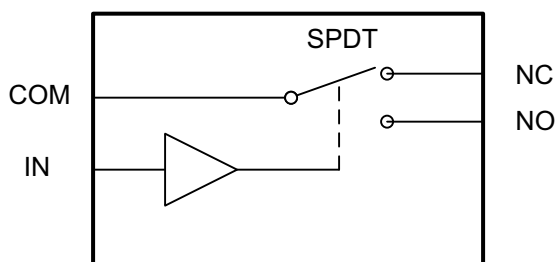
3 Description

The TS12A12511 is a bidirectional, single-channel, single-pole double-throw (SPDT) analog switch that can pass signals with swings of 0 to 12 V or -6 V to 6 V . This switch conducts equally well in both directions when it is on. The device also offers a low ON-state resistance of $5\text{ }\Omega$ (typical), which is matched to within $1\text{ }\Omega$ between channels. The maximum current consumption is $<1\text{ }\mu\text{A}$ and -3 dB bandwidth is $>93\text{ MHz}$. The TS12A12511 exhibits break-before-make switching action, preventing momentary shorting when switching channels. This device is available packaged in an 8-lead VSSOP, 8-lead SOT-23, and a 8-pin WSON.

Package Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TS12A12511	DCN (SOT-23, 8)	2.90 mm × 1.63 mm
	DGK (VSSOP, 8)	3.00 mm × 3.00 mm
	DRJ (WSON, 8)	4.00 mm × 4.00 mm

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



Simplified Schematic



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4 Revision History

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

Changes from Revision D (January 2019) to Revision E (September 2022)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document.....	1
• Updated the <i>Applications</i> section.....	1
• Updated the <i>Leakage Current vs I/O Voltage (Switch ON)</i> and <i>Leakage Current vs I/O Voltage (Switch OFF)</i> figures.....	8
Changes from Revision C (January 2015) to Revision D (January 2019)	Page
• Added Junction temperature to the <i>Absolute Maximum Ratings</i> table.....	4
Changes from Revision B (April 2011) to Revision C (January 2015)	Page
• Added <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section	1
Changes from Revision A (May 2010) to Revision B (April 2011)	Page
• Deleted preview status from DGK and DCN packages.....	3

5 Pin Configuration and Functions

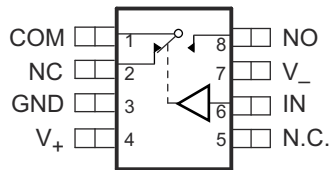


Figure 5-1. DGK Package, 8-Pin VSSOP (Top View)

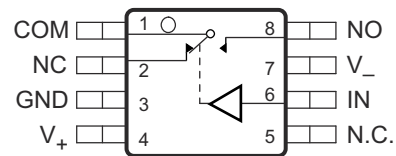
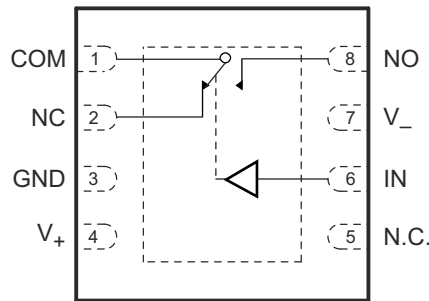


Figure 5-2. DCN Package, 8-Pin SOT-23 (Top View)



N.C. – Not internally connected NC – Normally closed NO – Normally open
 The Exposed Thermal Pad must be electrically connected to V₋ or left floating.

Figure 5-3. DRJ Package, 8-Pin WSON (Top View)

Table 5-1. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
COM	1	I/O	Common. Can be an input or output.
GND	3	—	Ground (0 V) reference
IN	6	I	Logic control input
NC	2	I/O	Normally closed. Can be an input or output.
N.C.	5	—	No connect. Not internally connected.
NO	8	I/O	Normally open. Can be an input or output.
V _{CC}	4	I	Most positive power supply
-V _{CC}	7	I	Most negative power supply. This pin is only used in dual-supply applications and should be tied to ground in single-supply applications.
Thermal pad		—	The Exposed Thermal Pad must be electrically connected to V ₋ or left floating.

(1) I = input, O = output

6 Specifications

6.1 Absolute Maximum Ratings

 $T_A = 25^\circ\text{C}$ (unless otherwise noted).⁽¹⁾

			MIN	MAX	UNIT
V_{CC} to $-V_{CC}$			0	13	V
V_{CC} to GND			-0.3	13	V
$-V_{CC}$ to GND			-6.5	0.3	V
$V_{I/O}$	Analog inputs	NC, NO, or COM	$-V_{CC} - 0.5$	$V_{CC} + 0.5$	V
I_{IN}	Digital inputs			± 30	mA
$I_{I/O}$	Peak current	NC, NO, or COM		± 100	mA
	Continuous current	NC, NO, or COM		± 50	mA
T_A	Operating temperature		-40	85	$^\circ\text{C}$
T_J	Junction temperature			150	$^\circ\text{C}$
T_{stg}	Storage temperature		-65	150	$^\circ\text{C}$

- (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 [Section 6.3](#) is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

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

- (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_{CC}		0	12	V
$-V_{CC}$		-6	0	V
$V_{I/O}$		$-V_{CC}$	V_{CC}	V
V_{IN}		0	V_{CC}	V

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TS12A12511			UNIT
		DCN	DGK	DRJ	
		8 PINS			
$R_{\theta JA}$	Junction-to-ambient thermal resistance	218.4	184.5	47.8	$^\circ\text{C}/\text{W}$
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	89.9	71.0	48.6	
$R_{\theta JB}$	Junction-to-board thermal resistance	144.4	104.5	24.2	
Ψ_{JT}	Junction-to-top characterization parameter	7.8	11.3	1.2	
Ψ_{JB}	Junction-to-board characterization parameter	141.7	103.3	24.4	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	9.0	

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

6.5 Electrical Characteristics: ±5-V Dual Supply

$V_{CC} = 5\text{ V} \pm 10\%$, $-V_{CC} = -5\text{ V} \pm 10\%$, $T_A = -40^\circ\text{C}$ to 85°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ to 85°C			UNIT		
		MIN	TYP	MAX	MIN	TYP	MAX			
ANALOG SWITCH										
	Analog signal range				$-V_{CC}$	V_{CC}		V		
R_{ON}	ON-state resistance	$V_{NC} = -4.5\text{ V}$ to $+4.5\text{ V}$ or $V_{NO} = -4.5\text{ V}$ to $+4.5\text{ V}$, $I_{COM} = -10\text{ mA}$; see Figure 7-1			5		5	8	Ω	
ΔR_{ON}	ON-state resistance match between channels	$V_{NC} = -4.5\text{ V}$ to $+4.5\text{ V}$ or $V_{NO} = -4.5\text{ V}$ to $+4.5\text{ V}$, $I_{COM} = -10\text{ mA}$			1	1.2		1.6	Ω	
$R_{ON(\text{flat})}$	ON-state resistance flatness	$V_{NC} = -3.3\text{ V}$ to $+3.3\text{ V}$ or $V_{NO} = -3.3\text{ V}$ to $+3.3\text{ V}$, $I_{COM} = -10\text{ mA}$			1.6	2.2		2.2	Ω	
LEAKAGE CURRENTS										
$I_{NC(\text{OFF})}$, $I_{NO(\text{OFF})}$	OFF leakage current	$V_{NC} = -4.5\text{ V}$ to $+4.5\text{ V}$ or $V_{NO} = -4.5\text{ V}$ to $+4.5\text{ V}$ $V_{COM} = -4.5\text{ V}$ to $+4.5\text{ V}$; see Figure 7-2			-1	± 0.5	1	-50	50	nA
$I_{NC(\text{ON})}$, $I_{NO(\text{ON})}$	ON leakage current	$V_{NC} = -4.5\text{ V}$ to $+4.5\text{ V}$ or $V_{NO} = -4.5\text{ V}$ to $+4.5\text{ V}$ $V_{COM} = \text{open}$; see Figure 7-3			-1	± 0.5	1	-50	50	nA
DIGITAL INPUTS										
V_{INH}	High-level input voltage				2.4		V_{CC}		V	
V_{INL}	Low-level input voltage				0		0.8		V	
I_{INL} , I_{INH}	Input current	$V_{IN} = V_{INL}$ or V_{INH}			0.005			-1	1	μA
C_{IN}	Control input capacitance				2.5					pF
DYNAMIC⁽¹⁾										
t_{ON}	Turn-ON time	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{COM} = 3.3\text{ V}$; see Figure 7-5			80	95		115		ns
t_{OFF}	Turn-OFF time	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{COM} = 3.3\text{ V}$			41	50		56		ns
t_{BBM}	Break-before-make time delay	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{NC} = V_{NO} = 3.3\text{ V}$; see Figure 7-6			36			18		ns
Q_C	Charge injection	$V_{NC} = V_{NO} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 7-7			26					pC
O_{ISO}	OFF isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 7-8			-70					dB
X_{TALK}	Channel-to-channel crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 7-9			-70					dB
BW	Bandwidth -3 dB	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 7-10			93					MHz
THD	Total harmonic distortion	$R_L = 600\ \Omega$, $C_L = 15\text{ pF}$, $V_{NO} = 1V_{RMS}$, $f = 20\text{ kHz}$; see Figure 7-11			0.004%					
$C_{NC(\text{OFF})}$, $C_{NO(\text{OFF})}$	NC, NO OFF capacitance	$f = 1\text{ MHz}$; see Figure 7-4			14					pF
$C_{COM(\text{ON})}$, $C_{NC(\text{ON})}$, $C_{NO(\text{ON})}$	COM, NC, NO ON capacitance	$f = 1\text{ MHz}$; see Figure 7-4			60					pF
SUPPLY										
I_{CC}	Positive supply current				0.03			1		μA

(1) Specified by design, not subject to production test.

6.6 Electrical Characteristics: 12-V Single Supply

 $V_{CC} = 12\text{ V} \pm 10\%$, $-V_{CC} = 0\text{ V}$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C}$ to 85°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ to 85°C			UNIT		
		MIN	TYP	MAX	MIN	TYP	MAX			
ANALOG SWITCH										
	Analog signal range				0		V_{CC}	V		
R_{on}	ON-state resistance	$V_{NC} = 0\text{ V}$ to 10.8 V or $V_{NO} = 0\text{ V}$ to 10.8 V , $I_{COM} = -10\text{ mA}$, see Figure 7-1			5	5	8	Ω		
ΔR_{on}	ON-state resistance match between channels	$V_{NC} = 0\text{ V}$ to 10.8 V or $V_{NO} = 0\text{ V}$ to 10.8 V , $I_{COM} = -10\text{ mA}$			1.6	2.4	2.6	Ω		
$R_{on(flat)}$	ON-state resistance flatness	$V_{NC} = 3.3\text{ V}$ to 7 V or $V_{NO} = 3.3\text{ V}$ to 7 V , $I_{COM} = -10\text{ mA}$			1.7	1.8	3.2	Ω		
LEAKAGE CURRENTS										
$I_{NC(OFF)}$, $I_{NO(OFF)}$	OFF leakage current	$V_{NC} = 0\text{ V}$ to 10.8 V or $V_{NO} = 0\text{ V}$ to 10.8 V , $V_{COM} = 0\text{ V}$ to 10.8 V ; see Figure 7-2			-10	± 0.5	10	-50	50	nA
$I_{NC(ON)}$, $I_{NO(ON)}$	ON leakage current	$V_{NC} = 0\text{ V}$ to 10.8 V or $V_{NO} = 0\text{ V}$ to 10.8 V , $V_{COM} = \text{open}$; see Figure 7-3			-10	± 0.5	10	-50	50	nA
DIGITAL INPUTS										
V_{INH}	High-level input voltage				5		V_{CC}	V		
V_{INL}	Low-level input voltage				0		0.8	V		
I_{INL} , I_{INH}	Input current	$V_{IN} = V_{INL}$ or V_{INH}			± 0.005			-0.1	0.1	μA
C_{IN}	Digital input capacitance				2.7				pF	
DYNAMIC ⁽¹⁾										
t_{ON}	Turn-ON time	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{COM} = 3.3\text{ V}$; see Figure 7-5			56	85		110	ns	
t_{OFF}	Turn-OFF time	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{COM} = 3.3\text{ V}$; see Figure 7-5			25	30		31	ns	
t_{BBM}	Break-before-make time delay	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{NC} = V_{NO} = 3.3\text{ V}$; see Figure 7-6			30		19		ns	
Q_C	Charge injection	$R_{GEN} = V_{NC} = V_{NO} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 7-7			491				pC	
O_{ISO}	OFF isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 7-8			-70				dB	
X_{TALK}	Channel-to-channel crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 7-9			-70				dB	
BW	Bandwidth -3 dB	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, see Figure 7-10			200				MHz	
THD	Total harmonic distortion	$R_L = 600\ \Omega$, $C_L = 15\text{ pF}$, $V_{NO} = 1\text{ V}$, V_{RMS} , $f = 20\text{ kHz}$; see Figure 7-11			0.04%					
$C_{NC(OFF)}$, $C_{NO(OFF)}$	NC, NO OFF capacitance	$f = 1\text{ MHz}$, see Figure 7-4			14				pF	
$C_{COM(ON)}$, $C_{NC(ON)}$, $C_{NO(ON)}$	COM, NC, NO ON capacitance	$f = 1\text{ MHz}$, see Figure 7-4			55				pF	
SUPPLY										
I_{CC}	Positive supply current				0.07			1	μA	

(1) Specified by design, not subject to production test.

6.7 Electrical Characteristics: 5-V Single Supply

 $V_{CC} = 5\text{ V} \pm 10\%$, $-V_{CC} = 0\text{ V}$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C}$ to 85°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ to 85°C			UNIT		
		MIN	TYP	MAX	MIN	TYP	MAX			
ANALOG SWITCH										
	Analog signal range				0		V_{CC}	V		
R_{on}	ON-state resistance	$V_{NC} = 0\text{ V}$ to 4.5 V or $V_{NO} = 0\text{ V}$ to 4.5 V , $I_{COM} = -10\text{ mA}$; see Figure 7-1			8	10		12.5	Ω	
ΔR_{on}	ON-state resistance match between channels	$V_{NC} = 0\text{ V}$ to 4.5 V or $V_{NO} = 0\text{ V}$ to 4.5 V , $I_{COM} = -10\text{ mA}$			1	1.1		1.5	Ω	
$R_{on(Flat)}$	ON-state resistance flatness	$V_{NC} = 0\text{ V}$ to 4.5 V or $V_{NO} = 0\text{ V}$ to 4.5 V , $I_{COM} = -10\text{ mA}$			1.3		1.3	2	Ω	
LEAKAGE CURRENTS										
$I_{NC(OFF)}$, $I_{NO(OFF)}$	OFF leakage current	$V_{NC} = 0\text{ V}$ to 4.5 V or $V_{NO} = 0\text{ V}$ to 4.5 V , $V_{COM} = 0\text{ V}$ to 4.5 V ; see Figure 7-2			-1	± 0.5	1	-50	50	nA
$I_{NC(ON)}$, $I_{NO(ON)}$	ON leakage current	$V_{NC} = 0\text{ V}$ to 4.5 V or $V_{NO} = 0\text{ V}$ to 4.5 V , $V_{COM} = \text{open}$; see Figure 7-3			-1	± 0.5	1	-50	50	nA
DIGITAL INPUTS										
V_{INH}	High-level input voltage				2.4		V_{CC}		V	
V_{INL}	Low-level input voltage				0		0.8		V	
I_{INL} , I_{INH}	Input current	$V_{IN} = V_{INL}$ or V_{INH}			0.01			-0.1	0.1	μA
C_{IN}	Digital input capacitance				2.8				pF	
DYNAMIC⁽¹⁾										
t_{ON}	Turn-ON time	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{COM} = 3.3\text{ V}$; see Figure 7-5			119	145		178	ns	
t_{OFF}	Turn-OFF time	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{COM} = 3.3\text{ V}$; see Figure 7-5			38	47		95.2	ns	
t_{BBM}	Break-before-make time delay	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $V_{NC} = V_{NO} = 3.3\text{ V}$; see Figure 7-6			79		44		ns	
Q_C	Charge injection	$V_{GEN} = V_{NC} = V_{NO} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 7-7			65				pC	
O_{ISO}	OFF isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 7-8			-70				dB	
X_{TALK}	Channel-to-channel crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 7-9			-70				dB	
BW	Bandwidth -3 dB	$R_L = 50\ \Omega$, see Figure 7-10			152				MHz	
THD	Total harmonic distortion	$R_L = 600\ \Omega$, $C_L = 15\text{ pF}$, $V_{NO} = 1\text{ V}_{RMS}$, $f = 20\text{ kHz}$; see Figure 7-11			0.04%					
$C_{NC(OFF)}$, $C_{NO(OFF)}$	NC, NO OFF capacitance	$f = 1\text{ MHz}$, see Figure 7-4			15				pF	
$C_{COM(ON)}$, $C_{NC(ON)}$, $I_{NO(ON)}$	COM, NC, NO ON capacitance	$f = 1\text{ MHz}$, see Figure 7-4			55				pF	
POWER REQUIREMENTS										
I_{CC}	Positive supply current	$V_{IN} = 0\text{ V}$ or V_{CC}			0.02			1	μA	

(1) Specified by design, not subject to production test.

6.8 Typical Characteristics

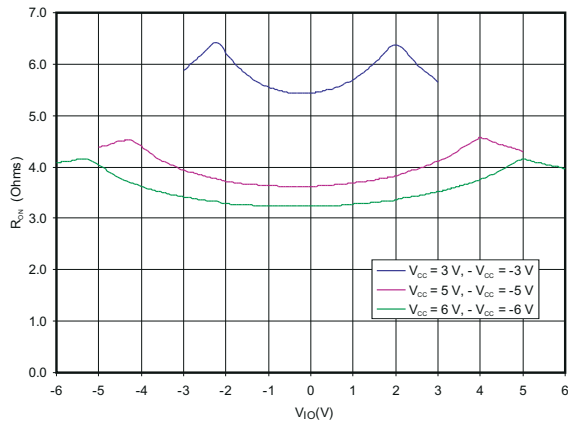


Figure 6-1. R_{ON} vs V_{IO}

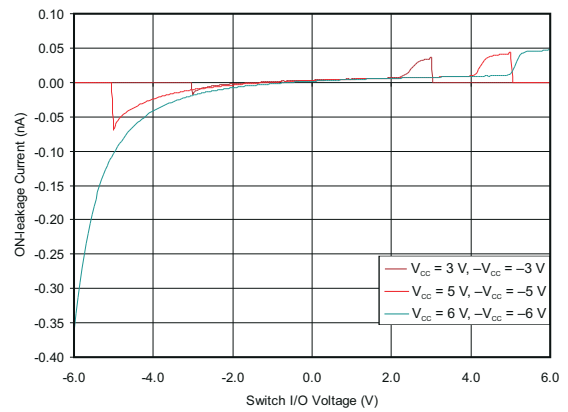


Figure 6-2. Leakage Current vs I/O Voltage (Switch ON)

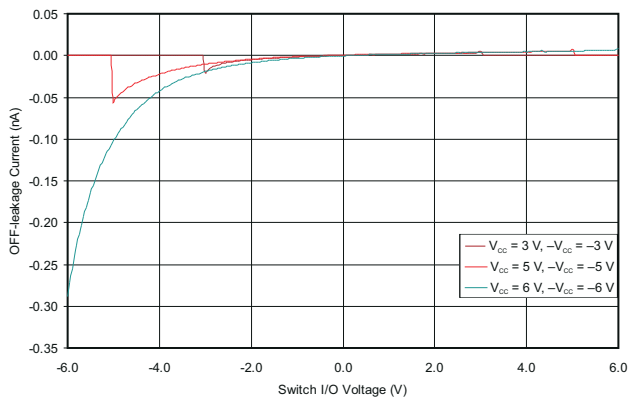


Figure 6-3. Leakage Current vs I/O Voltage (Switch OFF)

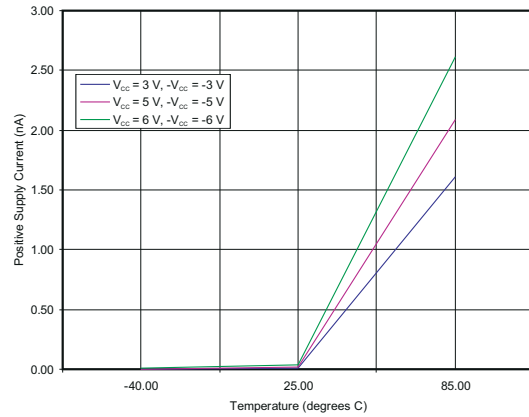


Figure 6-4. Positive Supply Current vs Temperature

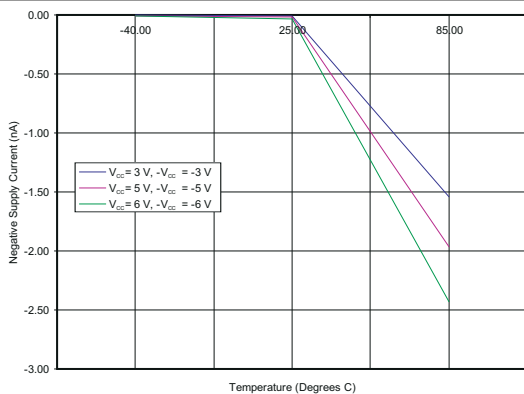


Figure 6-5. Negative Supply Current vs Temperature

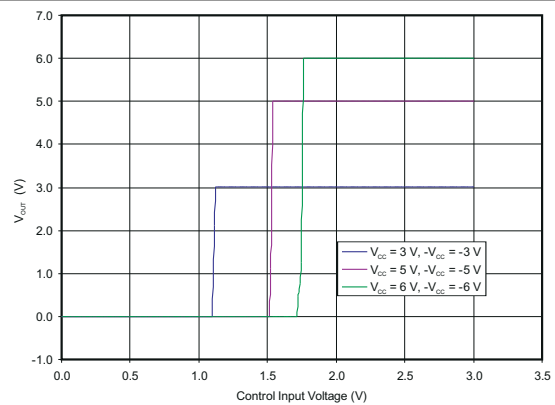


Figure 6-6. Control Input (IN) Threshold Voltage

6.8 Typical Characteristics (continued)

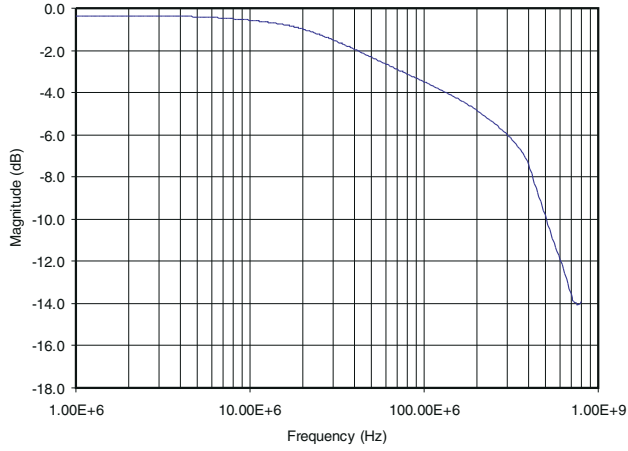


Figure 6-7. Bandwidth Dual Supply (±5 V)

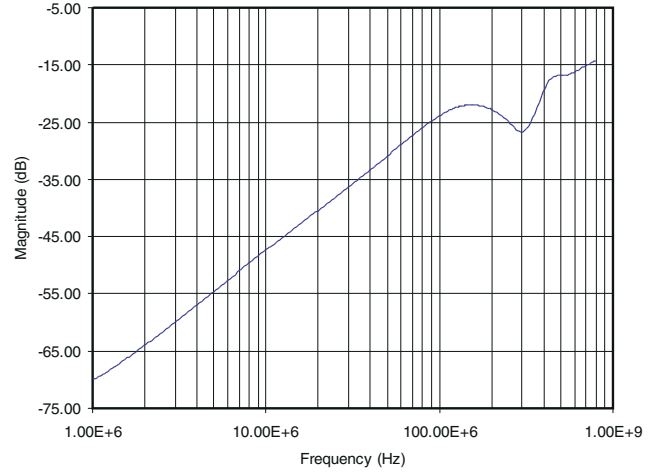


Figure 6-8. Off Isolation vs Frequency Dual Supply (±5 V)

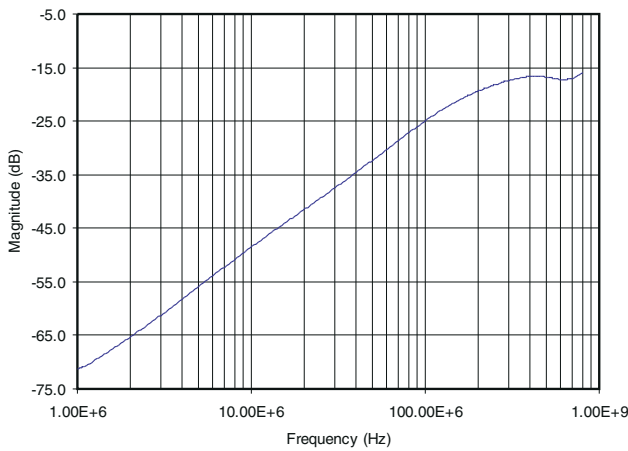


Figure 6-9. Crosstalk vs Frequency Dual Supply (±5 V)

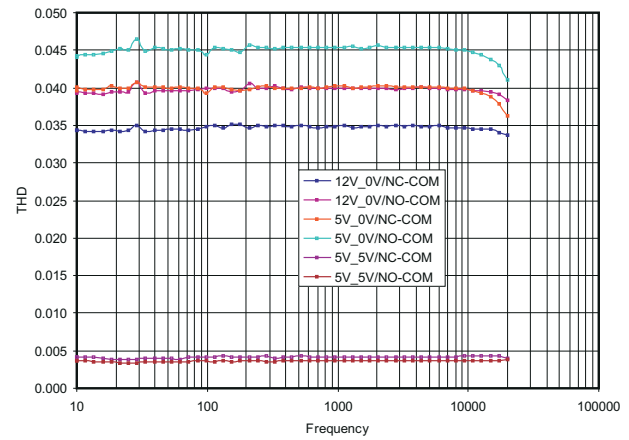


Figure 6-10. THD+N (%) vs Frequency

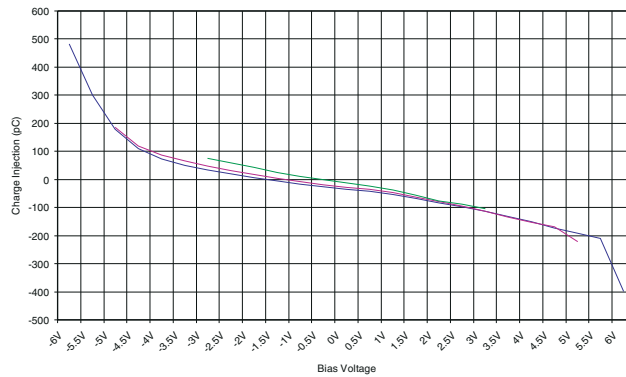


Figure 6-11. Charge Injection vs Bias Voltage

7 Parameter Measurement Information

7.1 Test Circuits

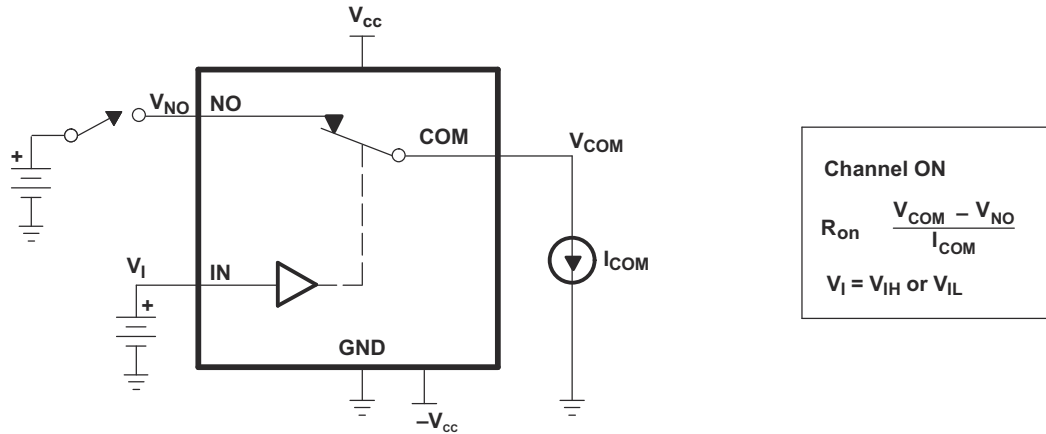


Figure 7-1. ON-State Resistance

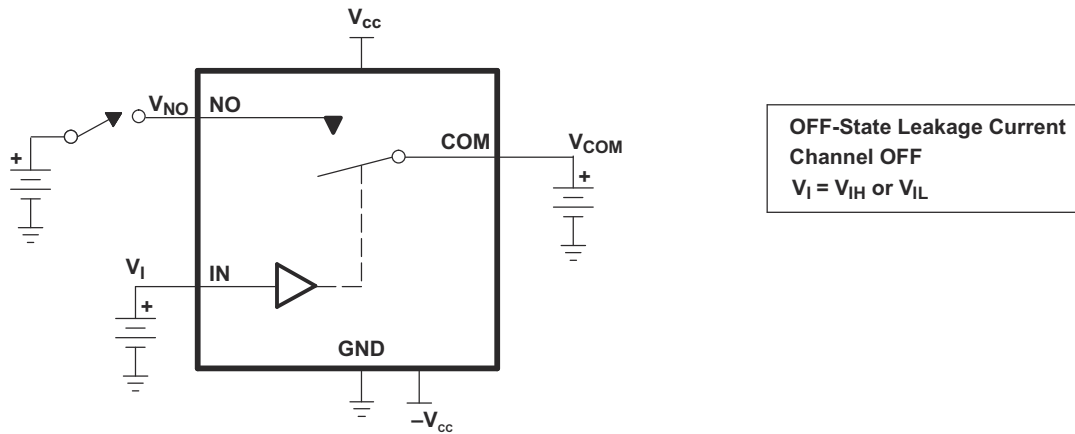


Figure 7-2. OFF-State Leakage Current ($I_{COM(OFF)}$, $I_{NC(OFF)}$)

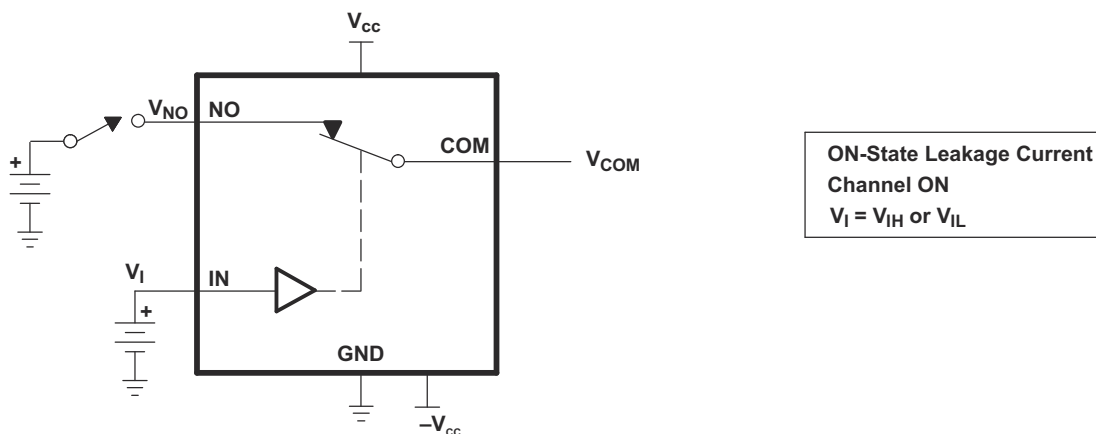


Figure 7-3. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$)

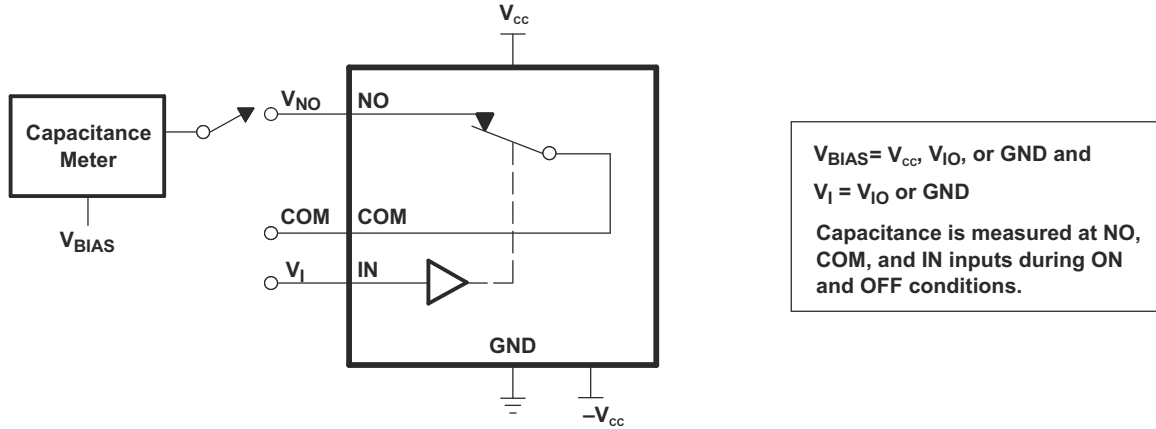
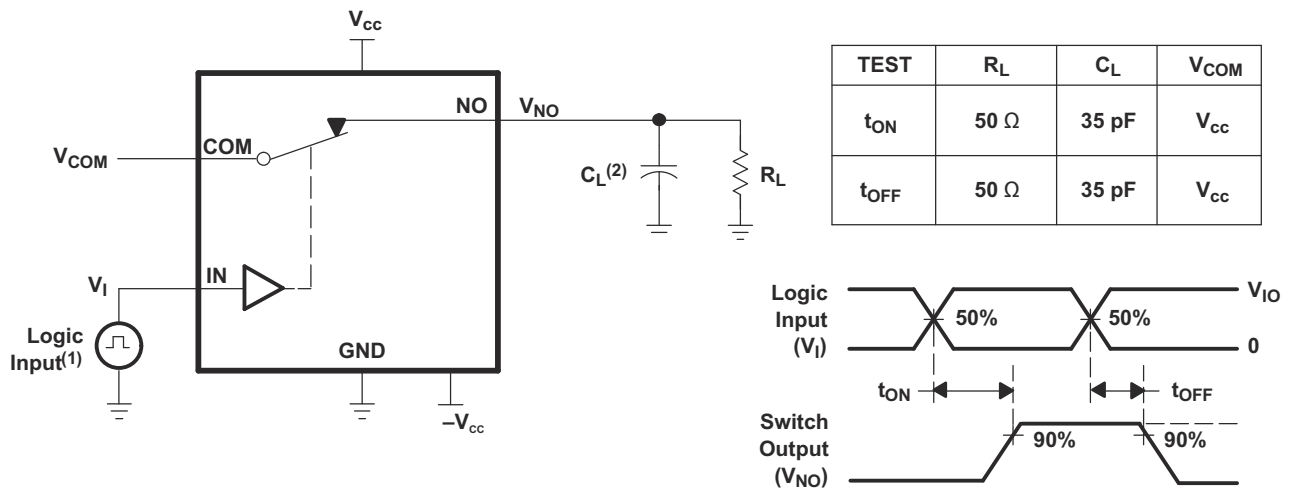
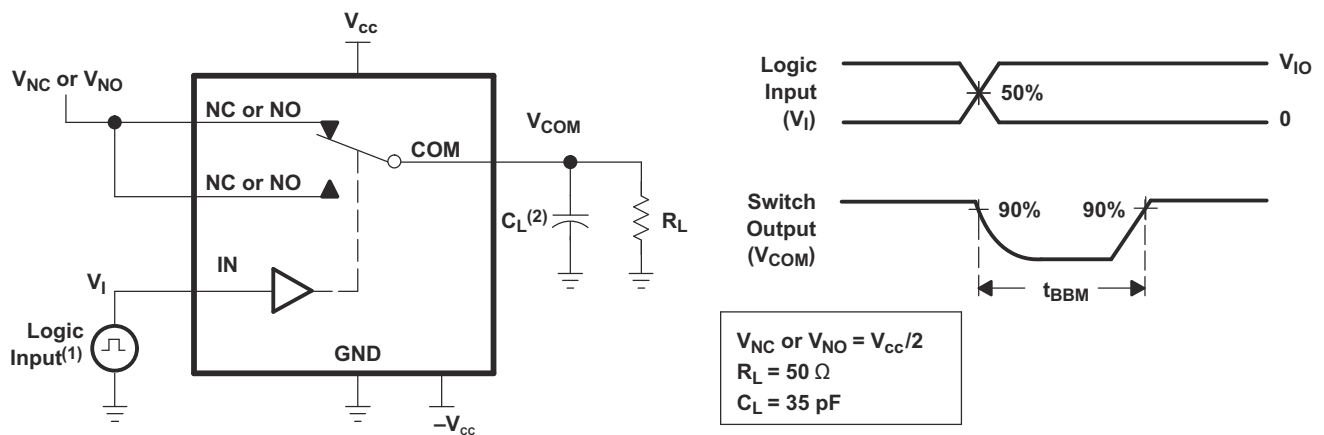


Figure 7-4. Capacitance ($C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NC(ON)}$)



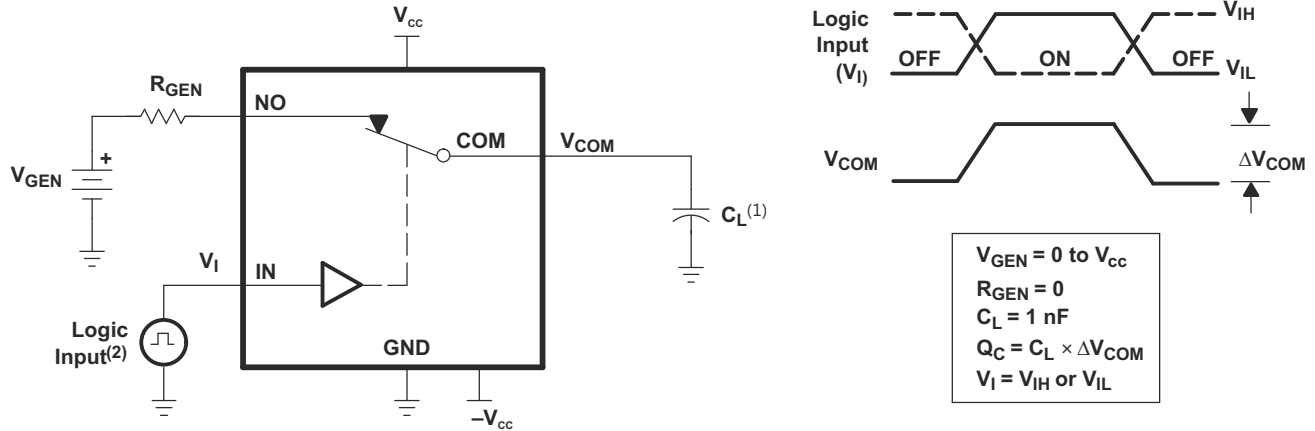
- (1) All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r < 5 \text{ ns}$, $t_f < 5 \text{ ns}$.
 (2) C_L includes probe and jig capacitance.

Figure 7-5. Turn-ON (t_{ON}) and Turn-OFF Time (t_{OFF})



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

Figure 7-6. Break-Before-Make Time Delay (t_{BBM})



(1) C_L includes probe and jig capacitance.

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

Figure 7-7. Charge Injection (Q_C)

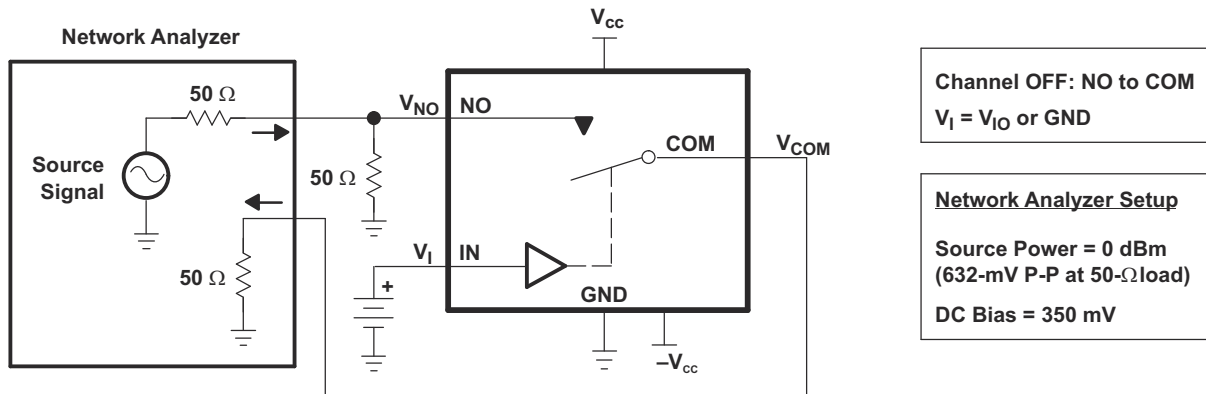


Figure 7-8. OFF Isolation (O_{ISO})

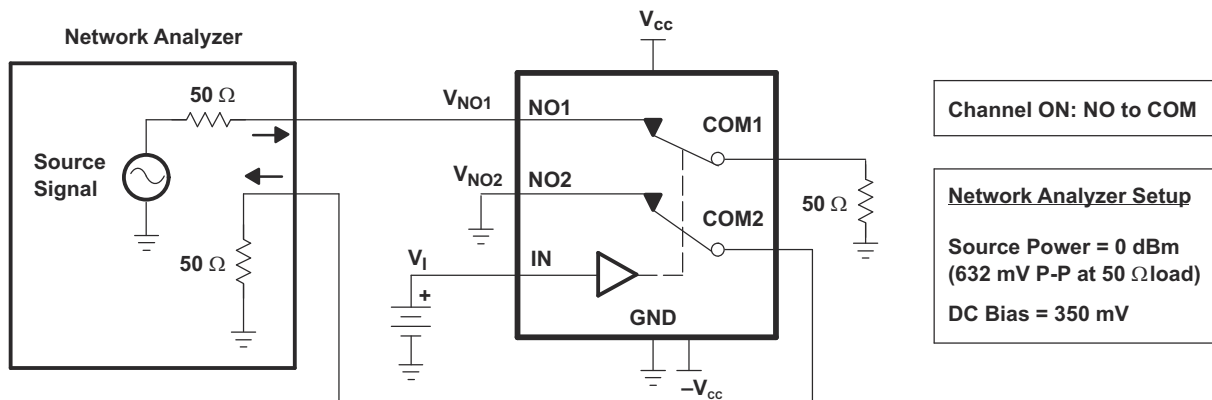


Figure 7-9. Channel-to-Channel Crosstalk (X_{TALK})

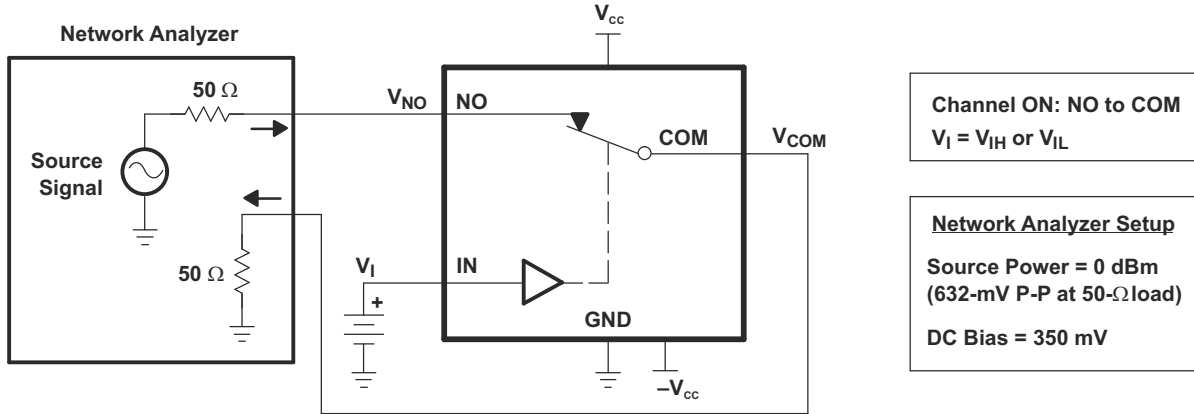
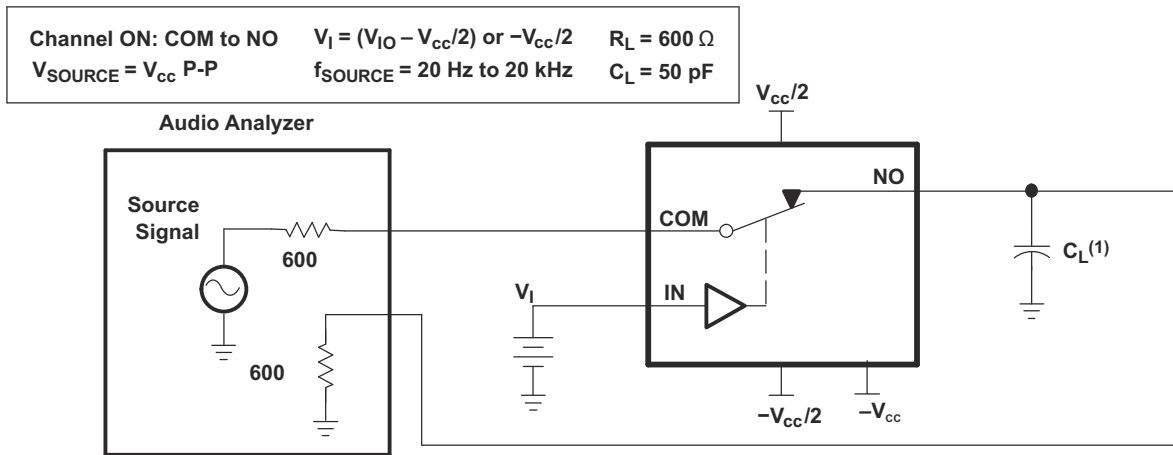


Figure 7-10. Bandwidth (BW)



(1) C_L includes probe and jig capacitance.

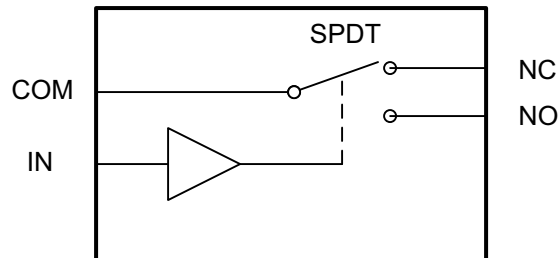
Figure 7-11. Total Harmonic Distortion

8 Detailed Description

8.1 Overview

The TS12A12511 is a bidirectional, single channel, single-pole double-throw (SPDT) analog switch that can pass signals with swings of 0 to 12 V or –6 V to 6 V. This switch conducts equally well in both directions when it is on. It also offers a low ON-state resistance of 5 Ω (typical), which is matched to within 1 Ω between channels. The maximum current consumption is < 1 μA and –3 dB bandwidth is > 93 MHz. The TS12A12511 exhibits break-before-make switching action, preventing momentary shorting when switching channels. This device is available in an 8-lead MSOP, 8-lead SOT-23, and 8-pin QFN package.

8.2 Functional Block Diagram



8.3 Feature Description

The TS12A12511 can pass signals with swings of 0 to 12 V or –6 V to 6. The device is great for applications where the AC signals do not have a common mode voltage since both the positive and negative swing of the signal can be passed through the device with little distortion.

8.4 Device Functional Modes

Table 8-1. Truth Table

IN	NC TO COM, COM TO NC	NO TO COM, COM TO NO
L	On	Off
H	Off	On

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, as well as validating and testing their design implementation to confirm system functionality.

9.1 Application Information

Analog signals that range over the entire supply voltage (V_{CC} to GND) or (V_{CC} to $-V_{CC}$) can be passed with very little change in ON-state resistance. The switches are bidirectional, so the NO, NC, and COM pins can be used as either inputs or outputs.

9.2 Typical Application

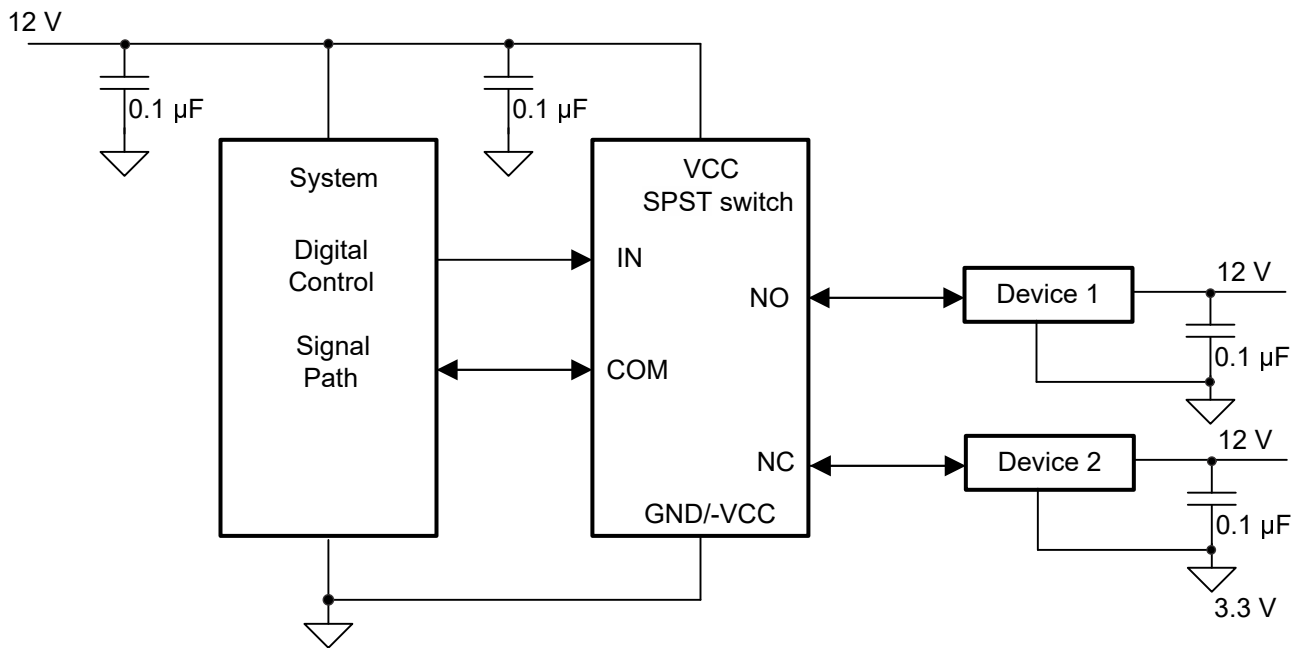


Figure 9-1. Typical Application Schematic

9.2.1 Design Requirements

Pull the digitally controlled input select pin IN to VCC or GND to avoid unwanted switch states that could result if the logic control pin is left floating.

9.2.2 Detailed Design Procedure

Select the appropriate supply voltage to cover the entire voltage swing of the signal passing through the switch since the TS12A12511 input or output signal swing of the device is dependant of the supply voltage V_{CC} and $-V_{CC}$.

9.2.3 Application Curve

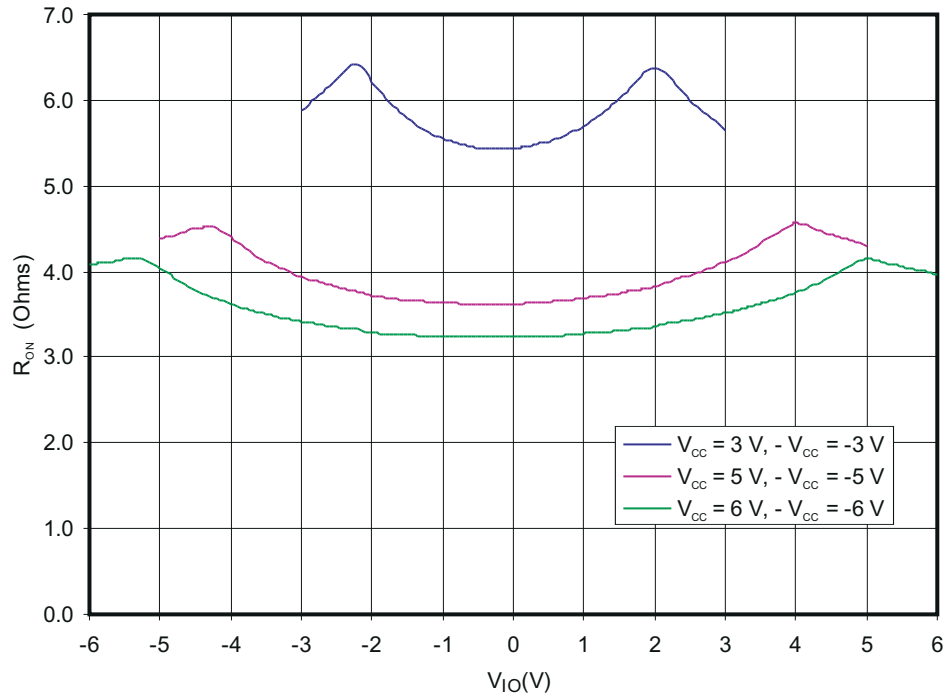


Figure 9-2. R_{ON} vs V_{IO}

10 Power Supply Recommendations

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings can cause permanent damage to the device. Always sequence VCC and -VCC on first, followed by NO, NC, or COM.

Although it is not required, power-supply bypassing improves noise margin and prevents switching noise propagation from the VCC supply to other components. A 0.1- μ F capacitor, connected from VCC to GND, is adequate for most applications.

11 Layout

11.1 Layout Guidelines

It is recommended to place a bypass capacitor as close to the supply pins, VCC and -VCC, as possible to help smooth out lower frequency noise and provide better load regulation across the frequency spectrum. Minimize trace lengths and vias on the signal paths to preserve signal integrity.

11.2 Layout Example

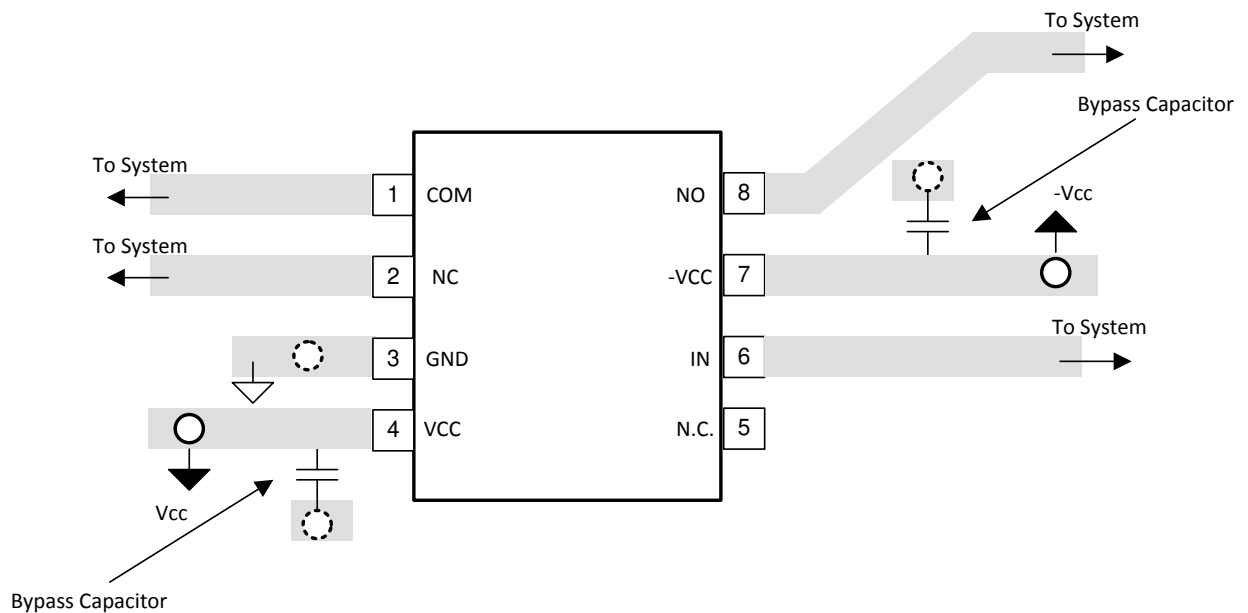
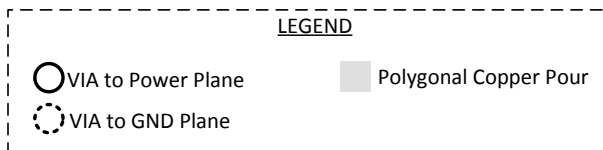


Figure 11-1. Layout Schematic

12 Device and Documentation Support

12.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

12.2 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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12.3 Trademarks

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12.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

12.5 Glossary

[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.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TS12A12511DCNR	Active	Production	SOT-23 (DCN) 8	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	NFHS NFHA
TS12A12511DCNR.A	Active	Production	SOT-23 (DCN) 8	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	NFHS NFHA
TS12A12511DCNR.B	Active	Production	SOT-23 (DCN) 8	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	NFHS NFHA
TS12A12511DGKR	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2US 2UA
TS12A12511DGKR.A	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2US 2UA
TS12A12511DGKR.B	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2US 2UA
TS12A12511DRJR	Active	Production	SON (DRJ) 8	1000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ZVE
TS12A12511DRJR.A	Active	Production	SON (DRJ) 8	1000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ZVE
TS12A12511DRJR.B	Active	Production	SON (DRJ) 8	1000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ZVE

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

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

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

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

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

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

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

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TAPE AND REEL INFORMATION

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
TS12A12511DCNR	SOT-23	DCN	8	3000	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
TS12A12511DGKR	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TS12A12511DRJR	SON	DRJ	8	1000	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS

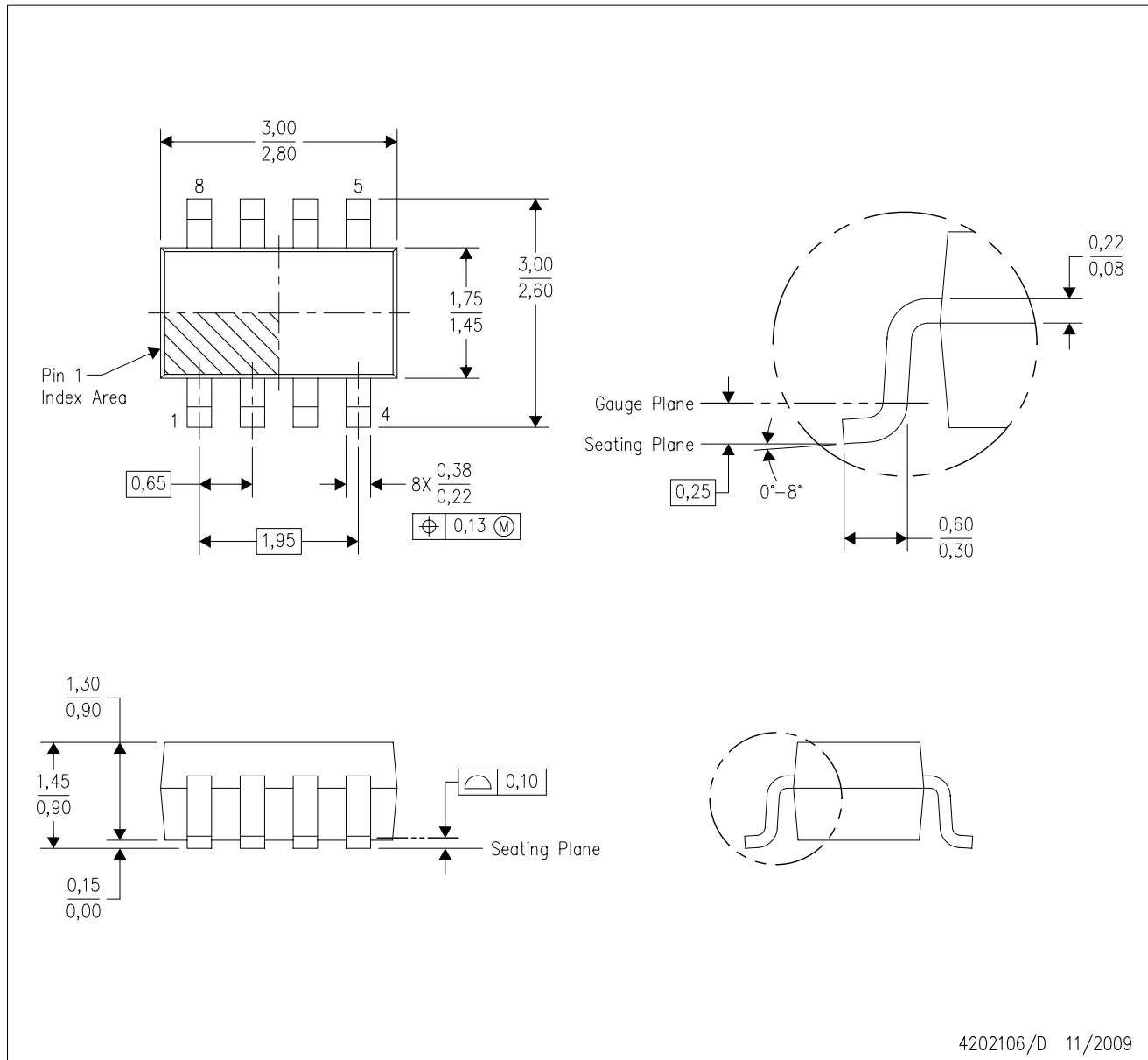


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS12A12511DCNR	SOT-23	DCN	8	3000	202.0	201.0	28.0
TS12A12511DGKR	VSSOP	DGK	8	2500	358.0	335.0	35.0
TS12A12511DRJR	SON	DRJ	8	1000	213.0	191.0	35.0

DCN (R-PDSO-G8)

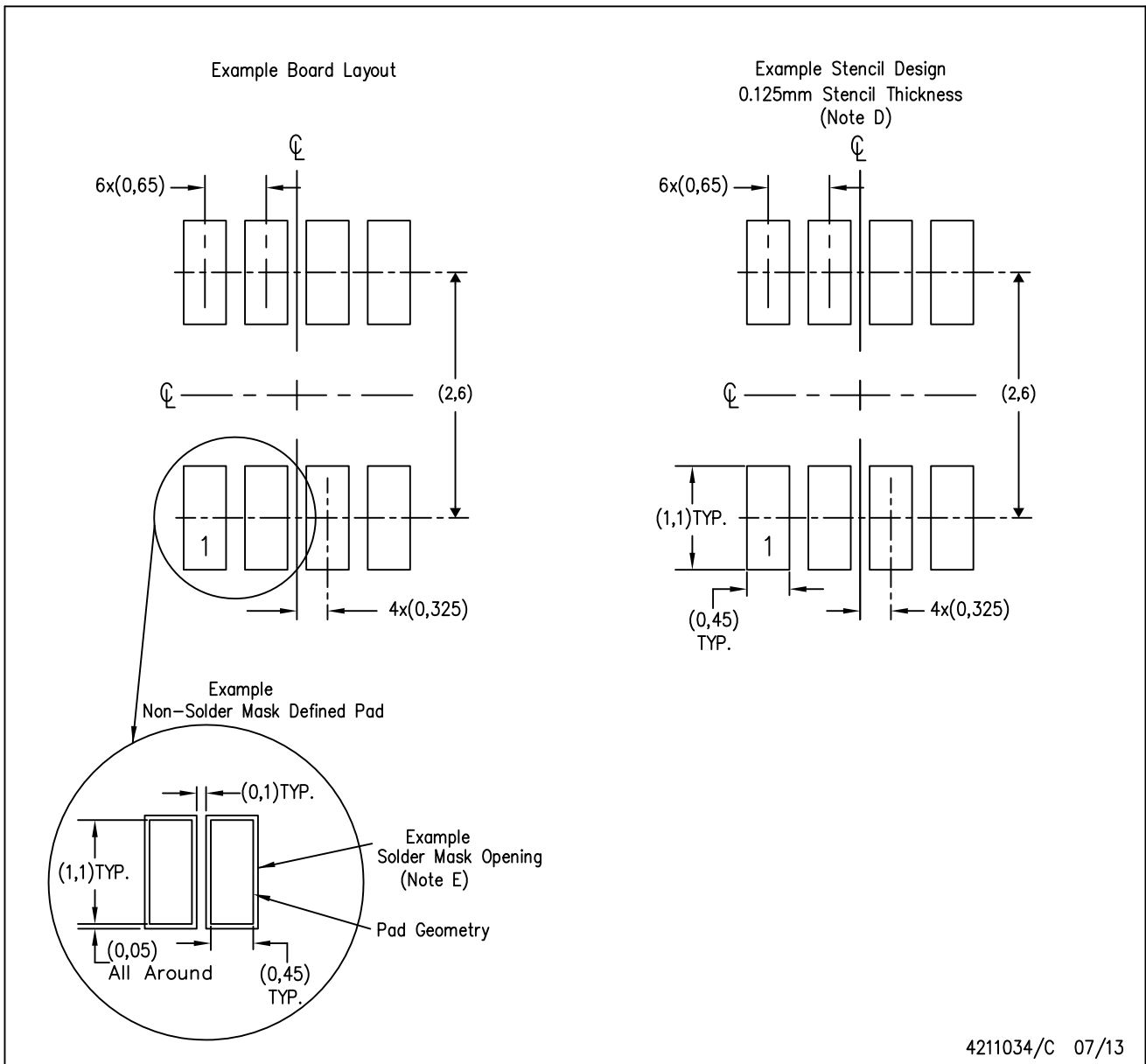
PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Package outline exclusive of metal burr & dambar protrusion/intrusion.
 - D. Package outline inclusive of solder plating.
 - E. A visual index feature must be located within the Pin 1 index area.
 - F. Falls within JEDEC MO-178 Variation BA.
 - G. Body dimensions do not include flash or protrusion. Mold flash and protrusion shall not exceed 0.25 per side.

DCN (R-PDSO-G8)

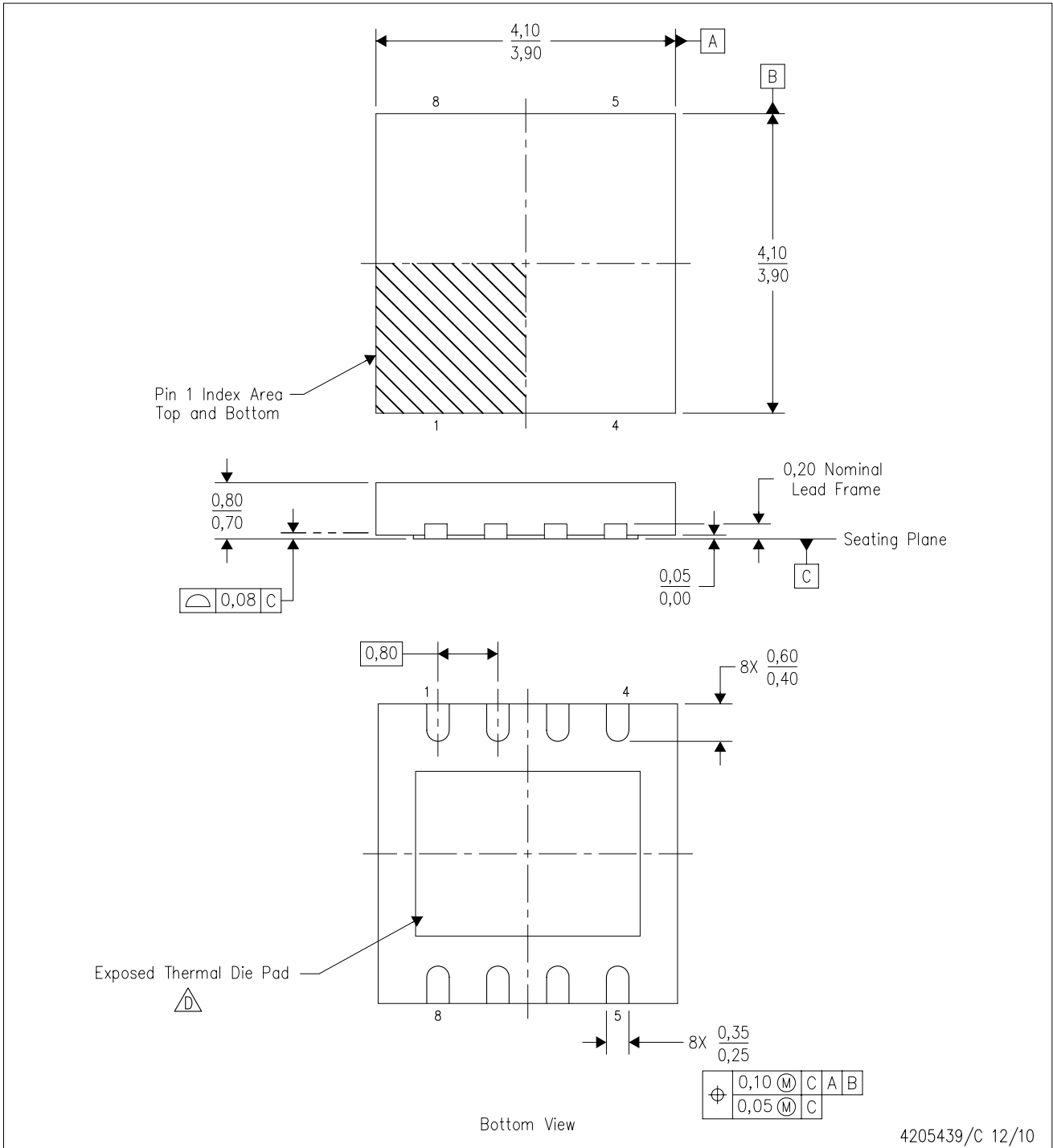
PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. 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.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DRJ (S-PWSON-N8)

PLASTIC SMALL OUTLINE NO-LEAD



4205439/C 12/10

- 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. SON (Small Outline No-Lead) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
 - E. Package complies to JEDEC MO-229 variation WGGB.

THERMAL PAD MECHANICAL DATA

DRJ (S-PWSON-N8)

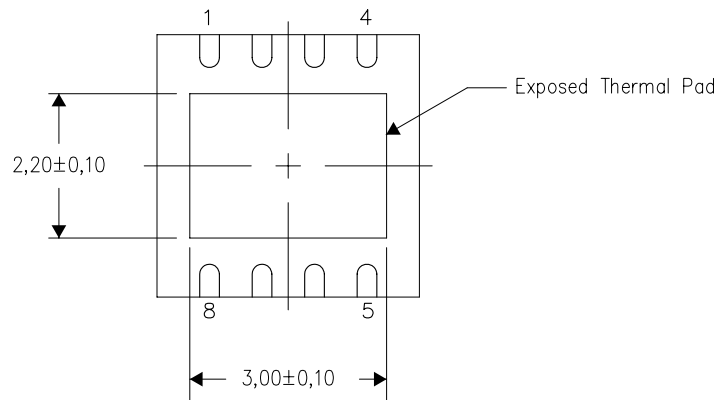
PLASTIC SMALL OUTLINE NO-LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

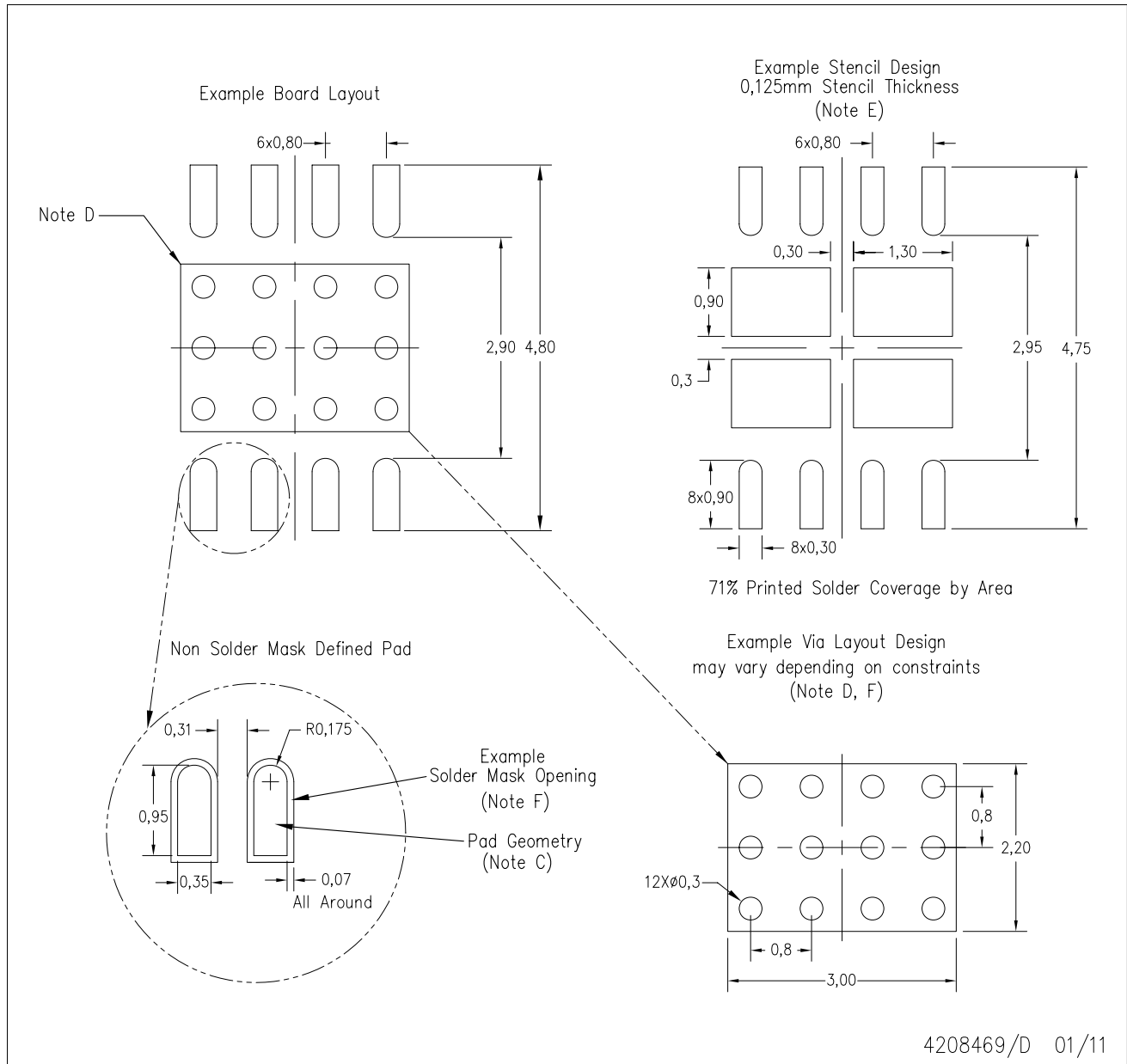
Exposed Thermal Pad Dimensions

4206882/F 01/11

NOTE: All linear dimensions are in millimeters

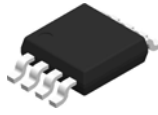
DRJ (S-PWSON-N8)

SMALL PACKAGE OUTLINE NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>.
 - E. Laser cutting apertures with electropolish 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 stencil design considerations.
 - F. Customers should contact their board fabrication site for solder mask tolerances and vias tenting recommendations for vias placed in the thermal pad.

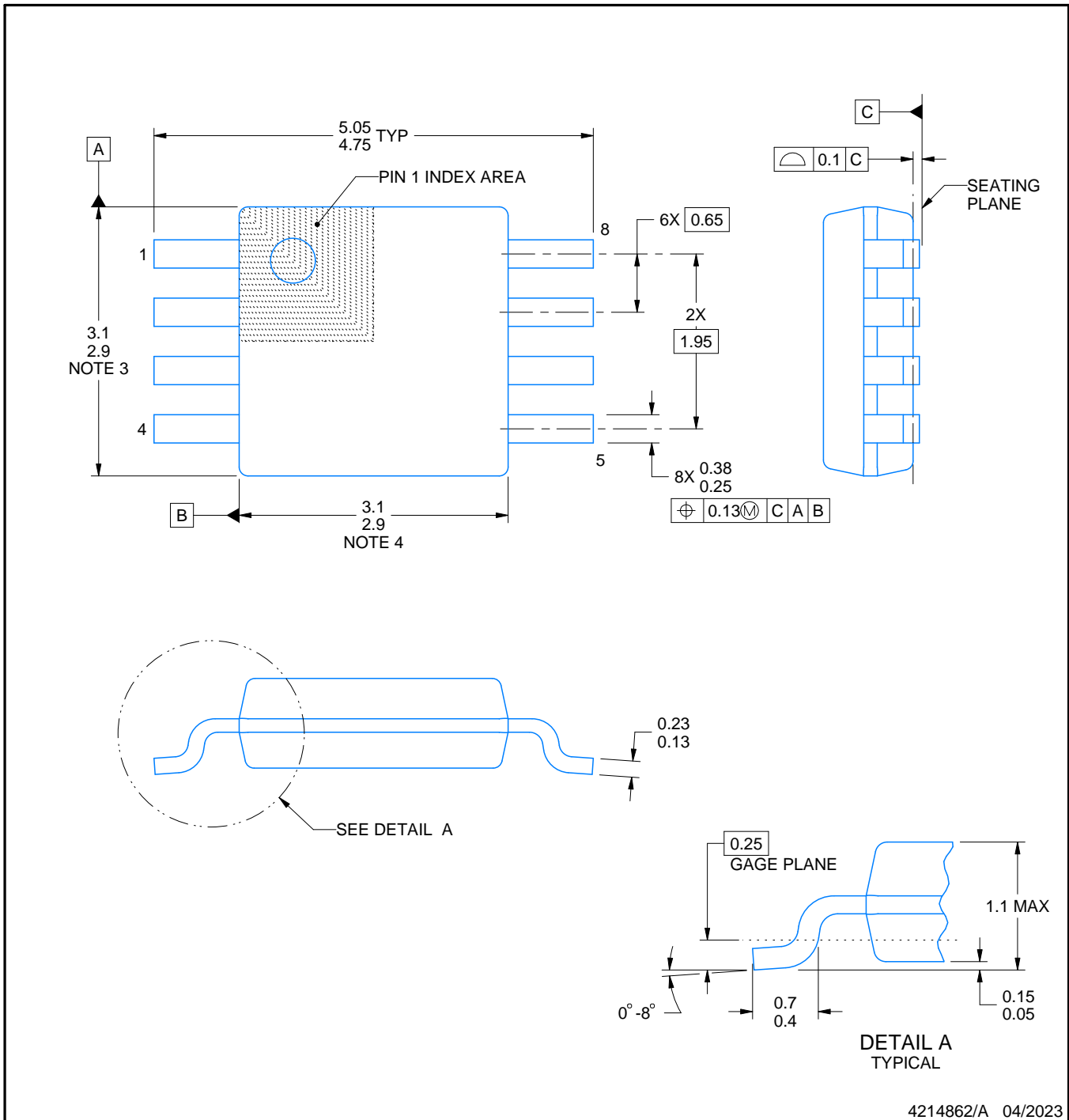
DGK0008A



PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4214862/A 04/2023

NOTES:

PowerPAD is a trademark of Texas Instruments.

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

EXAMPLE BOARD LAYOUT

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

DGK0008A

TM VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

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