

# TS3A27518E 6-channel (qSPI), 1:2 multiplexer/demultiplexer with integrated IEC L-4 ESD and 1.8-V logic compatible control inputs

## 1 Features

- 1.65-V to 3.6-V Single-Supply Operation
- Isolation in Power-Down Mode,  $V_{CC} = 0$
- Low-Capacitance Switches, 21.5 pF (Typical)
- Bandwidth Up to 240 MHz for High-Speed Rail-to-Rail Signal Handling
- Crosstalk and OFF Isolation of  $-62$  dB
- 1.8-V Logic Compatible Control Inputs
- 3.6-V Tolerant Control Inputs
- Latch-Up Performance Exceeds 100-mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
  - 2500-V Human-Body Model (A114-B, Class II)
  - 1500-V Charged-Device Model (C101)
- ESD Performance: NC/NO Ports
  - $\pm 6$ -kV Contact Discharge (IEC 61000-4-2)
- 24-WQFN (4.00 mm  $\times$  4.00 mm), 24-BGA (3.00 mm  $\times$  3.00 mm) and 24-TSSOP (7.90 mm  $\times$  6.60 mm) Packages

## 2 Applications

- SD-SDIO and MMC Two-Port MUX
- PC VGA Video MUX-Video Systems
- Audio and Video Signal Routing

## 3 Description

The TS3A27518E is a bidirectional, 6-channel, 1:2 multiplexer-demultiplexer designed to operate from 1.65 V to 3.6 V. This device can handle both digital and analog signals, and can transmit signals up to  $V_{CC}$  in either direction. The TS3A27518E has two control pins, each controlling three 1:2 muxes at the same time, and an enable pin that put all outputs in high-impedance mode. The control pins are compatible with 1.8-V logic thresholds and are backward compatible with 2.5-V and 3.3-V logic thresholds.

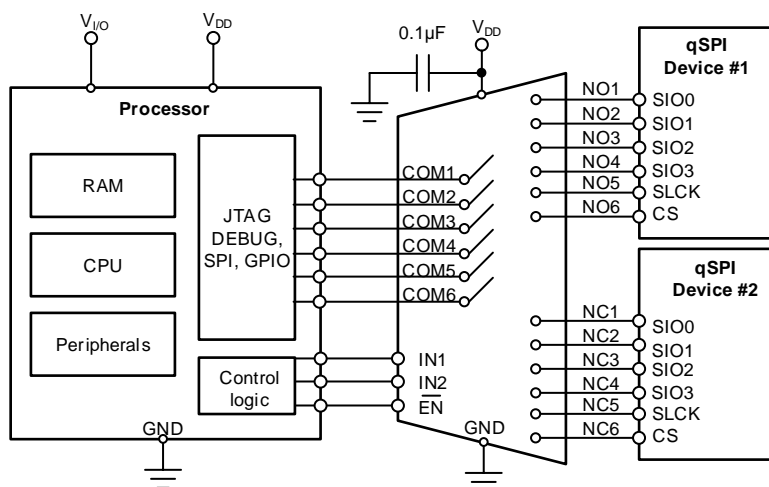
The TS3A27518E allows any SD, SDIO, and multimedia card host controllers to expand out to multiple cards or peripherals because the SDIO interface consists of 6-bits: CMD, CLK, and Data[0:3] signals. This device will support other 6-bit interfaces such a qSPI. The TS3A27518E has two control pins that give additional flexibility to the user. For example, the ability to mux two different audio-video signals in equipment such as an LCD television, an LCD monitor, or a notebook docking station.

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

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TS3A27518E	WQFN (24)	4.00 mm $\times$ 4.00 mm
	TSSOP (24)	7.90 mm $\times$ 6.60 mm
	BGA MICROSTAR JUNIOR (24)	3.00 mm $\times$ 3.00 mm

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

### Typical Application



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## 4 Revision History

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

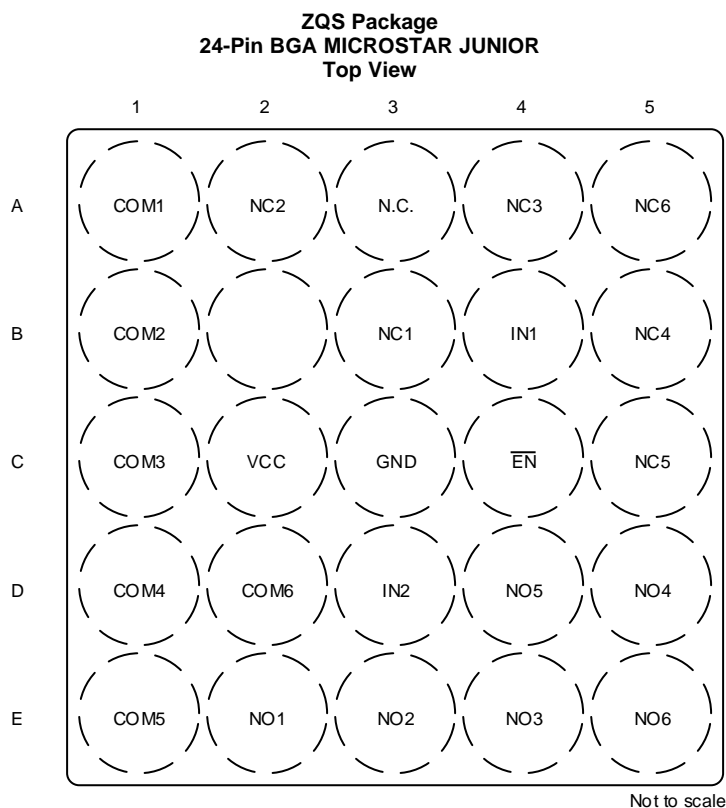
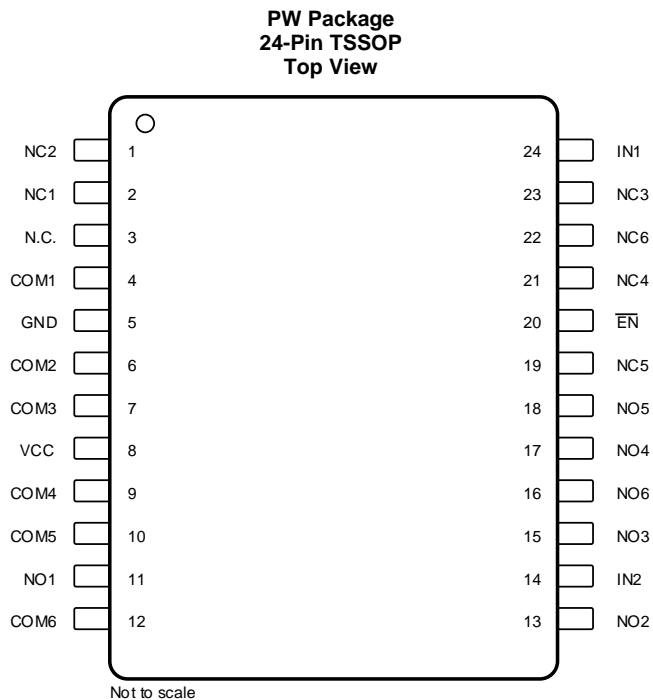
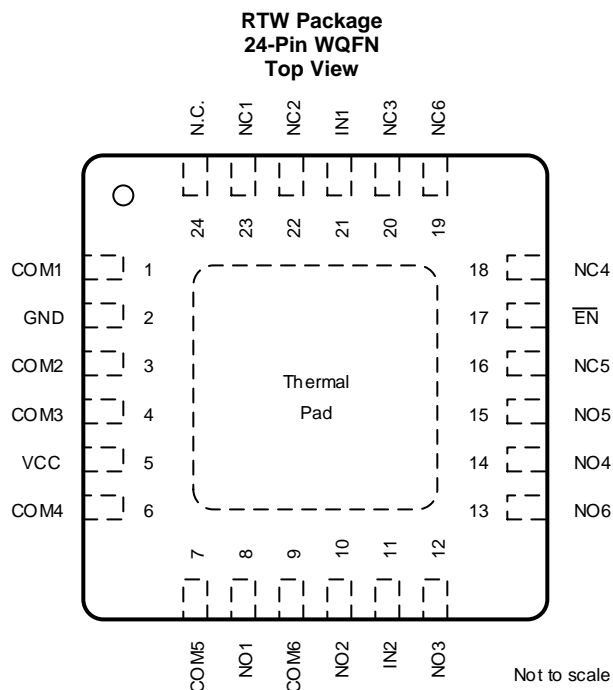
<b>Changes from Revision D (May 2016) to Revision E</b>	<b>Page</b>
• Changed the <i>Typical Application</i> .....	<b>1</b>
• Changed the <i>Pin Configuration</i> images .....	<b>3</b>
• Removed Note: "The input and output voltage ratings..." from the <i>Absolute Maximum Ratings</i> table .....	<b>5</b>
• Removed Note: "This value is limited to 5.5-V maximum" from the <i>Absolute Maximum Ratings</i> table .....	<b>5</b>
• Changed the <i>Application Information</i> section .....	<b>21</b>
• Added <a href="#">Figure 27</a> .....	<b>22</b>

<b>Changes from Revision C (December 2015) to Revision D</b>	<b>Page</b>
• Updated <i>Pin Functions</i> table .....	<b>1</b>

<b>Changes from Revision B (May 2009) to Revision C</b>	<b>Page</b>
• Added <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 .....	<b>1</b>

<b>Changes from Revision A (March 2009) to Revision B</b>	<b>Page</b>
• Changed the data sheet From: <i>Product Preview</i> To: <i>Production</i> data .....	<b>1</b>

## 5 Pin Configuration and Functions



**Pin Functions**

NAME	PIN			I/O	DESCRIPTION
	RTW	ZQS	PW		
COM1	1	A1	4	I/O	Common-signal path
COM2	3	B1	6	I/O	Common-signal path
COM3	4	C1	7	I/O	Common-signal path
COM4	6	D1	9	I/O	Common-signal path
COM5	7	E1	10	I/O	Common-signal path
COM6	9	D2	12	I/O	Common-signal path
$\overline{\text{EN}}$	17	C4	20	I	Digital control to enable or disable all signal paths
GND	2	C3	5	—	Ground.
IN1	21	B4	24	I	Digital control to connect COM to NC or NO
IN2	11	D3	14	I	Digital control to connect COM to NC or NO
N.C.	24	A3	3	—	Not connected
NC1	23	B3	2	I/O	Normally closed-signal path
NC2	22	A2	1	I/O	Normally closed-signal path
NC3	20	A4	23	I/O	Normally closed-signal path
NC4	18	B5	21	I/O	Normally closed-signal path
NC5	16	C5	19	I/O	Normally closed-signal path
NC6	19	A5	22	I/O	Normally closed-signal path
NO1	8	E2	11	I/O	Normally open-signal path
NO2	10	E3	13	I/O	Normally open-signal path
NO3	12	E4	15	I/O	Normally open-signal path
NO4	14	D5	17	I/O	Normally open-signal path
NO5	15	D4	18	I/O	Normally open-signal path
NO6	13	E5	16	I/O	Normally open-signal path
V <sub>CC</sub>	5	C2	8	—	Voltage supply

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage <sup>(3)</sup>	-0.5	4.6	V
$V_{NC}$ $V_{NO}$ $V_{COM}$	Analog signal voltage <sup>(3)</sup>	-0.5	4.6	V
$I_K$	Analog port diode current <sup>(4)</sup>	$V_{CC} < V_{NC}, V_{NO}, V_{COM} < 0$		mA
$I_{IN}$ $I_{INO}$ $I_{COM}$	ON-state switch current <sup>(5)</sup>	$V_{NC}, V_{NO}, V_{COM} = 0 \text{ to } V_{CC}$		mA
$V_I$	Digital input voltage <sup>(3)</sup>	-0.5	4.6	V
$I_{IK}$	Digital input clamp current <sup>(3)</sup>	$V_{IO} < V_I < 0$		mA
$I_{CC}$	Continuous current through $V_{CC}$		100	mA
$I_{GND}$	Continuous current through GND	-100		mA
$T_{stg}$	Storage temperature	-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. 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) Requires clamp diodes on analog port to  $V_{CC}$ .
- (5) Pulse at 1-ms duration < 10% duty cycle.

### 6.2 ESD Ratings

		VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±2500
		Charged-device model (CDM), per JEDEC specification JESD22-C101 or ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup>	±1500

- (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
Supply voltage	$V_{CC}$	1.65	3.6	V
Analog signal voltage	$V_{NC}$	0	$V_{CC}$	V
	$V_{NO}$			
	$V_{COM}$			
Digital input voltage	$V_I$	0	$V_{CC}$	V

## 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TS3A27518E			UNIT
		PW (TSSOP)	RTW (WQFN)	ZQS (BGA MICROSTAR JUNIOR)	
		24 PINS	24 PINS	24 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	104	40.7	155.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	51.6	42.9	69.9	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	57.5	19.2	94.6	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	9.9	1	9	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	57.1	19.3	92.2	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	8	—	°C/W

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

## 6.5 Electrical Characteristics for 3.3-V Supply<sup>(1)</sup>

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

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
<b>ANALOG SWITCH</b>								
$V_{COM}, V_{NO}, V_{NC}$	Analog signal voltage				0		$V_{CC}$	V
$r_{on}$	ON-state resistance	$V_{CC} = 3\text{ V}$	$0 \leq (V_{NC} \text{ or } V_{NO}) \leq V_{CC}$ , $I_{COM} = -32\text{ mA}$	Switch ON, see <a href="#">Figure 15</a>	$T_A = 25^\circ\text{C}$	4.4	6.2	V
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		7.6	
$\Delta r_{on}$	ON-state resistance match between channels	$V_{CC} = 3\text{ V}$	$V_{NC} \text{ or } V_{NO} = 2.1\text{ V}$ , $I_{COM} = -32\text{ mA}$	Switch ON, see <a href="#">Figure 15</a>	$T_A = 25^\circ\text{C}$	0.3	0.7	$\Omega$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		0.8	
$r_{on(Flat)}$	ON-state resistance flatness	$V_{CC} = 3\text{ V}$	$0 \leq (V_{NC} \text{ or } V_{NO}) \leq V_{CC}$ , $I_{COM} = -32\text{ mA}$	Switch ON, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	0.95	2.1	$\Omega$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		2.3	
$I_{NC(OFF)}, I_{NO(OFF)}$	NC, NO OFF leakage current	$V_{CC} = 3.6\text{ V}$	$V_{NC} \text{ or } V_{NO} = 1\text{ V}$ , $V_{COM} = 3\text{ V}$ , or $V_{NC} \text{ or } V_{NO} = 3\text{ V}$ , $V_{COM} = 1\text{ V}$	Switch OFF, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	-0.5	0.05	0.5
						$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-7	
$I_{NC(PWROFF)}, I_{NO(PWROFF)}$		$V_{CC} = 0\text{ V}$	$V_{NC} \text{ or } V_{NO} = 0\text{ to }3.6\text{ V}$ , $V_{COM} = 3.6\text{ V to }0$ , or $V_{NC} \text{ or } V_{NO} = 3.6\text{ V to }0$ , $V_{COM} = 0\text{ to }3.6\text{ V}$		$T_A = 25^\circ\text{C}$	-1	0.05	1
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-12		12
$I_{COM(OFF)}$	COM OFF leakage current	$V_{CC} = 3.6\text{ V}$	$V_{NC} \text{ or } V_{NO} = 3\text{ V}$ , $V_{COM} = 1\text{ V}$ , or $V_{NC} \text{ or } V_{NO} = 1\text{ V}$ , $V_{COM} = 3\text{ V}$	Switch OFF, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	-1	0.01	1
						$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-2	
$I_{COM(PWROFF)}$		$V_{CC} = 0\text{ V}$	$V_{NC} \text{ or } V_{NO} = 3.6\text{ V to }0$ , $V_{COM} = 0\text{ to }3.6\text{ V}$ , or $V_{NC} \text{ or } V_{NO} = 0\text{ to }3.6\text{ V}$ , $V_{COM} = 3.6\text{ V to }0$		$T_A = 25^\circ\text{C}$	-1	0.02	1
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-12		1

(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<sup>(1)</sup> (continued)**
 $V_{CC} = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT	
$I_{NO(ON)}$ , $I_{NC(ON)}$	NC, NO ON leakage current	$V_{CC} = 3.6\text{ V}$	$V_{NC}$ or $V_{NO} = 1\text{ V}$ , $V_{COM} = \text{open}$ , or $V_{NC}$ or $V_{NO} = 3\text{ V}$ , $V_{COM} = \text{open}$	Switch ON, see <a href="#">Figure 17</a>	$T_A = 25^\circ\text{C}$	-2.5	0.04	2.2	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-7		7	
$I_{COM(ON)}$	COM ON leakage current	$V_{CC} = 3.6\text{ V}$	$V_{NC}$ or $V_{NO} = \text{open}$ , $V_{COM} = 1\text{ V}$ , or $V_{NC}$ or $V_{NO} = \text{open}$ , $V_{COM} = 3\text{ V}$	Switch ON, see <a href="#">Figure 17</a>	$T_A = 25^\circ\text{C}$	-2	0.03	2	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-7		7	
<b>DIGITAL CONTROL INPUTS (IN1, IN2, <math>\overline{\text{EN}}</math>)<sup>(2)</sup></b>									
$V_{IH}$	Input logic high	$V_{CC} = 3.6\text{ V}$			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	1.2		3.6	V
$V_{IL}$	Input logic low	$V_{CC} = 3.6\text{ V}$			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	0		0.65	V
$I_{IH}$ , $I_{IL}$	Input leakage current	$V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$ or 0		$T_A = 25^\circ\text{C}$	-0.1	0.05	0.1	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-2.5		2.5	
<b>DYNAMIC</b>									
$t_{ON}$	Turnon time	$V_{CC} = 3.3\text{ V}$	$V_{COM} = V_{CC}$ , $R_L = 50\ \Omega$	$C_L = 35\text{ pF}$ , see <a href="#">Figure 19</a>	$T_A = 25^\circ\text{C}$		18.1	59	ns
		$V_{CC} = 3\text{ V to }3.6\text{ V}$			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$			60	
$t_{OFF}$	Turnoff time	$V_{CC} = 3.3\text{ V}$	$V_{COM} = V_{CC}$ , $R_L = 50\ \Omega$	$C_L = 35\text{ pF}$ , see <a href="#">Figure 19</a>	$T_A = 25^\circ\text{C}$		25.4	60.6	ns
		$V_{CC} = 3\text{ V to }3.6\text{ V}$			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$			61	
$t_{BBM}$	Break-before- make time	$V_{CC} = 3.3\text{ V}$	$V_{NC} = V_{NO} = V_{CC}/2$ , $R_L = 50\ \Omega$	$C_L = 35\text{ pF}$ , see <a href="#">Figure 20</a>	$T_A = 25^\circ\text{C}$	4	11.1	22.7	ns
		$V_{CC} = 3\text{ V to }3.6\text{ V}$			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$			28	
$Q_C$	Charge injection	$V_{CC} = 3.3\text{ V}$	$V_{GEN} = 0$ , $R_{GEN} = 0$	$C_L = 0.1\text{ nF}$ , see <a href="#">Figure 24</a>	$T_A = 25^\circ\text{C}$		0.81		pC
$C_{NC(OFF)}$ , $C_{NO(OFF)}$	NC, NO OFF capacitance	$V_{CC} = 3.3\text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, Switch OFF	See <a href="#">Figure 18</a>	$T_A = 25^\circ\text{C}$		13		pF
$C_{COM(OFF)}$	COM OFF capacitance	$V_{CC} = 3.3\text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, Switch OFF	See <a href="#">Figure 18</a>	$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		8.5		pF
$C_{NC(ON)}$ , $C_{NO(ON)}$	NC, NO ON capacitance	$V_{CC} = 3.3\text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, Switch OFF	See <a href="#">Figure 18</a>			21.5		pF
$C_{COM(ON)}$	COM ON capacitance	$V_{CC} = 3.3\text{ V}$	$V_{COM} = V_{CC}$ or GND, Switch ON	See <a href="#">Figure 18</a>			21.5		pF
$C_I$	Digital input capacitance	$V_{CC} = 3.3\text{ V}$	$V_I = V_{CC}$ or GND	See <a href="#">Figure 18</a>			2		pF
BW	Bandwidth	$V_{CC} = 3.3\text{ V}$	$R_L = 50\ \Omega$ ,	Switch ON, see <a href="#">Figure 20</a>			240		MHz
$O_{ISO}$	OFF isolation	$V_{CC} = 3.3\text{ V}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$	Switch OFF, see <a href="#">Figure 22</a>			-62		dB
$X_{TALK}$	Crosstalk	$V_{CC} = 3.3\text{ V}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$	Switch ON, see <a href="#">Figure 23</a>			-62		dB
$X_{TALK(ADJ)}$	Crosstalk adjacent	$V_{CC} = 3.3\text{ V}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$	Switch ON, see <a href="#">Figure 23</a>			-71		dB
THD	Total harmonic distortion	$V_{CC} = 3.3\text{ V}$	$R_L = 600\ \Omega$ , $C_L = 50\text{ pF}$	$f = 20\text{ Hz to }20\text{ kHz}$ , see <a href="#">Figure 25</a>			0.05%		

(2) All unused digital inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. See the TI application report, *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).

**Electrical Characteristics for 3.3-V Supply<sup>(1)</sup> (continued)**
 $V_{CC} = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
<b>SUPPLY</b>								
$I_{CC}$	Positive supply current	$V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$ or GND	Switch ON or OFF	$T_A = 25^\circ\text{C}$	0.04	0.3	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		3	

**6.6 Electrical Characteristics for 2.5-V Supply<sup>(1)</sup>**
 $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT	
<b>ANALOG SWITCH</b>									
$V_{COM}, V_{NO}, V_{NC}$	Analog signal voltage				0		$V_{CC}$	V	
$r_{on}$	ON-state resistance	$V_{CC} = 2.3\text{ V}$	$0 \leq (V_{NC} \text{ or } V_{NO}) \leq V_{CC}$ , $I_{COM} = -32\text{ mA}$	Switch ON, see Figure 15	$T_A = 25^\circ\text{C}$	5.5	9.6	$\Omega$	
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		11.5		
$\Delta r_{on}$	ON-state resistance match between channels	$V_{CC} = 2.3\text{ V}$	$V_{NC}$ or $V_{NO} = 1.6\text{ V}$ , $I_{COM} = -32\text{ mA}$	Switch ON, see Figure 15	$T_A = 25^\circ\text{C}$	0.3	0.8	$\Omega$	
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		0.9		
$r_{on(Flat)}$	ON-state resistance flatness	$V_{CC} = 2.3\text{ V}$	$0 \leq (V_{NC} \text{ or } V_{NO}) \leq V_{CC}$ , $I_{COM} = -32\text{ mA}$	Switch ON, see Figure 16	$T_A = 25^\circ\text{C}$	0.91	2.2	$\Omega$	
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		2.3		
$I_{NC(OFF)}, I_{NO(OFF)}$	NC, NO OFF leakage current	$V_{CC} = 2.7\text{ V}$	$V_{NC}$ or $V_{NO} = 0.5\text{ V}$ , $V_{COM} = 2.3\text{ V}$ , or $V_{NC}$ or $V_{NO} = 2.3\text{ V}$ , $V_{COM} = 0.5\text{ V}$	Switch OFF, see Figure 16	$T_A = 25^\circ\text{C}$	-0.3	0.04	0.3	$\mu\text{A}$
$I_{NC(PWROFF)}, I_{NO(PWROFF)}$		$V_{CC} = 0\text{ V}$	$V_{NC}$ or $V_{NO} = 0$ to $2.7\text{ V}$ , $V_{COM} = 2.7\text{ V to }0$ , or $V_{NC}$ or $V_{NO} = 2.7\text{ V to }0$ , $V_{COM} = 0$ to $2.7\text{ V}$		$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-6		6	
$I_{COM(OFF)}$	COM OFF leakage current	$V_{CC} = 2.7\text{ V}$	$V_{NC}$ or $V_{NO} = 0.5\text{ V}$ , $V_{COM} = 2.3\text{ V}$ , or $V_{NC}$ or $V_{NO} = 2.3\text{ V}$ , $V_{COM} = 0.5\text{ V}$	Switch OFF, see Figure 16	$T_A = 25^\circ\text{C}$	-0.7	0.02	0.7	$\mu\text{A}$
$I_{COM(PWROFF)}$		$V_{CC} = 0\text{ V}$	$V_{NC}$ or $V_{NO} = 2.7\text{ V to }0$ , $V_{COM} = 0$ to $2.7\text{ V}$ , or $V_{NC}$ or $V_{NO} = 0$ to $2.7\text{ V}$ , $V_{COM} = 2.7\text{ V to }0$		$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-1		1	
$I_{NO(ON)}, I_{NC(ON)}$	NC, NO ON leakage current	$V_{CC} = 2.7\text{ V}$	$V_{NC}$ or $V_{NO} = 0.5\text{ V or }2.3\text{ V}$ , $V_{COM} = \text{open}$	Switch ON, see Figure 17	$T_A = 25^\circ\text{C}$	-2.1	0.03	2.1	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-6		6	
$I_{COM(ON)}$	COM ON leakage current	$V_{CC} = 2.7\text{ V}$	$V_{NC}$ or $V_{NO} = \text{open}$ , $V_{COM} = 0.5\text{ V}$ , or $V_{NC}$ or $V_{NO} = \text{open}$ , $V_{COM} = 2.3\text{ V}$	Switch ON, see Figure 17	$T_A = 25^\circ\text{C}$	-2	0.02	2	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-5.7		5.7	
<b>DIGITAL CONTROL INPUTS (IN1, IN2, EN)<sup>(2)</sup></b>									
$V_{IH}$	Input logic high	$V_{CC} = 2.7\text{ V}$	$V_I = V_{CC}$ or GND		$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	1.15		3.6	V
$V_{IL}$	Input logic low	$V_{CC} = 2.7\text{ V}$				0		0.55	V
$I_{IH}, I_{IL}$	Input leakage current	$V_{CC} = 2.7\text{ V}$	$V_I = V_{CC}$ or 0		$T_A = 25^\circ\text{C}$	-0.1	0.01	0.1	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-2.1		2.1	

(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  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, SCBA004.



**Electrical Characteristics for 2.5-V Supply<sup>(1)</sup> (continued)**
 $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$ ,  $T_A = -40^\circ\text{C to } +85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
<b>DYNAMIC</b>								
$t_{ON}$	Turnon time	$V_{CC} = 2.5 \text{ V}$	$V_{COM} = V_{CC}$ , $R_L = 50 \Omega$	$C_L = 35 \text{ pF}$ , see Figure 19	$T_A = 25^\circ\text{C}$	17.2	36.8	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		42.5	
$t_{OFF}$	Turnoff time	$V_{CC} = 2.5 \text{ V}$	$V_{COM} = V_{CC}$ , $R_L = 50 \Omega$	$C_L = 35 \text{ pF}$ , see Figure 19	$T_A = 25^\circ\text{C}$	17.1	29.8	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		34.4	
$t_{BBM}$	Break-before-make time	$V_{CC} = 2.5 \text{ V}$	$V_{NC} = V_{NO} = V_{CC}/2$ , $R_L = 50 \Omega$	$C_L = 35 \text{ pF}$ , see Figure 20	$T_A = 25^\circ\text{C}$	4.5	13	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		33.3	
$Q_C$	Charge injection	$V_{CC} = 2.5 \text{ V}$	$V_{GEN} = 0$ , $R_{GEN} = 0$	$C_L = 0.1 \text{ nF}$ , see Figure 24		0.47		pC
$C_{NC(OFF)}$ , $C_{NO(OFF)}$	NC, NO OFF capacitance	$V_{CC} = 2.5 \text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, switch OFF	See Figure 18		13.5		pF
$C_{COM(OFF)}$	COM OFF capacitance	$V_{CC} = 2.5 \text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, switch OFF	See Figure 18	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$	9		pF
$C_{NC(ON)}$ , $C_{NO(ON)}$	NC, NO ON capacitance	$V_{CC} = 2.5 \text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, switch OFF	See Figure 18		22		pF
$C_{COM(ON)}$	COM ON capacitance	$V_{CC} = 2.5 \text{ V}$	$V_{COM} = V_{CC}$ or GND, switch ON	See Figure 18		22		pF
$C_I$	Digital input capacitance	$V_{CC} = 2.5 \text{ V}$	$V_I = V_{CC}$ or GND	See Figure 18		2		pF
BW	Bandwidth	$V_{CC} = 2.5 \text{ V}$	$R_L = 50 \Omega$	Switch ON, see Figure 20		240		MHz
$O_{ISO}$	OFF isolation	$V_{CC} = 2.5 \text{ V}$	$R_L = 50 \Omega$ , $f = 10 \text{ MHz}$	Switch OFF, see Figure 22		-62		dB
$X_{TALK}$	Crosstalk	$V_{CC} = 2.5 \text{ V}$	$R_L = 50 \Omega$ , $f = 10 \text{ MHz}$	Switch ON, see Figure 23		-62		dB
$X_{TALK(ADJ)}$	Crosstalk adjacent	$V_{CC} = 2.5 \text{ V}$	$R_L = 50 \Omega$ , $f = 10 \text{ MHz}$	Switch ON, see Figure 23		-71		dB
THD	Total harmonic distortion	$V_{CC} = 2.5 \text{ V}$	$R_L = 600 \Omega$ , $C_L = 50 \text{ pF}$	$f = 20 \text{ Hz to } 20 \text{ kHz}$ , see Figure 25		0.06%		
<b>SUPPLY</b>								
$I_{CC}$	Positive supply current	$V_{CC} = 2.7 \text{ V}$	$V_I = V_{CC}$ or GND	Switch ON or OFF	$T_A = 25^\circ\text{C}$	0.01	0.1	$\mu\text{A}$
					$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		2	

**6.7 Electrical Characteristics for 1.8-V Supply<sup>(1)</sup>**
 $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ ,  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
<b>ANALOG SWITCH</b>								
$V_{COM}$ , $V_{NO}$ , $V_{NC}$	Analogue signal voltage				0		$V_{CC}$	V
$r_{on}$	ON-state resistance	$V_{CC} = 1.65 \text{ V}$	$0 \leq (V_{NC} \text{ or } V_{NO}) \leq V_{CC}$ , $I_{COM} = -32 \text{ mA}$	Switch ON, see Figure 15	$T_A = 25^\circ\text{C}$	7.1	14.4	$\Omega$
					$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		16.3	
$\Delta r_{on}$	ON-state resistance match between channels	$V_{CC} = 1.65 \text{ V}$	$V_{NC}$ or $V_{NO} = 1.5 \text{ V}$ , $I_{COM} = -32 \text{ mA}$	Switch ON, see Figure 15	$T_A = 25^\circ\text{C}$	0.3	1	$\Omega$
					$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		1.2	
$r_{on(Flat)}$	ON-state resistance flatness	$V_{CC} = 1.65 \text{ V}$	$0 \leq (V_{NC} \text{ or } V_{NO}) \leq V_{CC}$ , $I_{COM} = -32 \text{ mA}$	Switch ON, see Figure 16	$T_A = 25^\circ\text{C}$	2.7	5.5	$\Omega$
					$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		7.3	

(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)**
 $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT	
$I_{NC(OFF)}$ , $I_{NO(OFF)}$	NC, NO OFF leakage current	$V_{CC} = 1.95\text{ V}$	$V_{NC}$ or $V_{NO} = 0.3\text{ V}$ , $V_{COM} = 1.65\text{ V}$ , or $V_{NC}$ or $V_{NO} = 1.65\text{ V}$ , $V_{COM} = 0.3\text{ V}$	Switch OFF, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	-0.25	0.03	0.25	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-5		5	
$I_{NC(PWROFF)}$ , $I_{NO(PWROFF)}$		$V_{CC} = 0\text{ V}$	$V_{NC}$ or $V_{NO} = 1.95\text{ V}$ to 0, $V_{COM} = 0$ to 1.95 V, or $V_{NC}$ or $V_{NO} = 0$ to 1.95 V, $V_{COM} = 1.95\text{ V}$ to 0	Switch OFF, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	-0.4	0.01	0.4	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-7.2		7.2	
$I_{COM(OFF)}$	COM OFF leakage current	$V_{CC} = 1.95\text{ V}$	$V_{NC}$ or $V_{NO} = 0.3\text{ V}$ , $V_{COM} = 1.65\text{ V}$ , or $V_{NC}$ or $V_{NO} = 1.65\text{ V}$ , $V_{COM} = 0.3\text{ V}$	Switch OFF, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	-0.4	0.02	0.4	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-0.9		0.9	
$I_{COM(PWROFF)}$		$V_{CC} = 0\text{ V}$	$V_{NC}$ or $V_{NO} = 1.95\text{ V}$ to 0, $V_{COM} = 0$ to 1.95 V, or $V_{NC}$ or $V_{NO} = 0$ to 1.95 V, $V_{COM} = 1.95\text{ V}$ to 0	Switch OFF, see <a href="#">Figure 16</a>	$T_A = 25^\circ\text{C}$	-0.4	0.02	0.4	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-5		5	
$I_{NO(ON)}$ , $I_{NC(ON)}$	NC, NO ON leakage current	$V_{CC} = 1.95\text{ V}$	$V_{NC}$ or $V_{NO} = 0.3\text{ V}$ , $V_{COM} = \text{open}$ , or $V_{NC}$ or $V_{NO} = 1.65\text{ V}$ , $V_{COM} = \text{open}$	Switch ON, see <a href="#">Figure 17</a>	$T_A = 25^\circ\text{C}$	-2	0.02	2	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-5.2		5.2	
$I_{COM(ON)}$	COM ON leakage current	$V_{CC} = 1.95\text{ V}$	$V_{NC}$ or $V_{NO} = \text{open}$ , $V_{COM} = 0.3\text{ V}$ , or $V_{NC}$ or $V_{NO} = \text{open}$ , $V_{COM} = 1.65\text{ V}$	Switch ON, see <a href="#">Figure 17</a>	$T_A = 25^\circ\text{C}$	-2	0.02	2	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-5.2		5.2	
<b>DIGITAL CONTROL INPUTS (IN1, IN2, EN)<sup>(2)</sup></b>									
$V_{IH}$	Input logic high	$V_{CC} = 1.95\text{ V}$	$V_I = V_{CC}$ or GND		$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	1		3.6	V
$V_{IL}$	Input logic low	$V_{CC} = 1.95\text{ V}$			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	0		0.4	V
$I_{IH}$ , $I_{IL}$	Input leakage current	$V_{CC} = 1.95\text{ V}$	$V_I = V_{CC}$ or 0		$T_A = 25^\circ\text{C}$	-0.1	0.01	0.1	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$	-2.1		2.1	
<b>DYNAMIC</b>									
$t_{ON}$	Turnon time	$V_{CC} = 1.8\text{ V}$	$V_{COM} = V_{CC}$ , $R_L = 50\ \Omega$	$C_L = 35\text{ pF}$ , see <a href="#">Figure 19</a>	$T_A = 25^\circ\text{C}$	14.1		49.3	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$			56.7	
$t_{OFF}$	Turnoff time	$V_{CC} = 1.8\text{ V}$	$V_{COM} = V_{CC}$ , $R_L = 50\ \Omega$	$C_L = 35\text{ pF}$ , see <a href="#">Figure 19</a>	$T_A = 25^\circ\text{C}$	16.1		26.5	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$			31.2	
$t_{BBM}$	Break- before- make time	$V_{CC} = 1.8\text{ V}$	$V_{NC} = V_{NO} = V_{CC}/2$ , $R_L = 50\ \Omega$	$C_L = 35\text{ pF}$ , see <a href="#">Figure 20</a>	$T_A = 25^\circ\text{C}$	5.3	18.4	58	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V			$T_A = -40^\circ\text{C to }+85^\circ\text{C}$			58	
$Q_C$	Charge injection	$V_{CC} = 1.8\text{ V}$	$V_{GEN} = 0$ , $R_{GEN} = 0$	$C_L = 1\text{ nF}$ , see <a href="#">Figure 24</a>			0.21		pC
$C_{NC(OFF)}$ , $C_{NO(OFF)}$	NC, NO OFF capacitance	$V_{CC} = 1.8\text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, switch OFF	See <a href="#">Figure 18</a>			9		pF
$C_{NC(ON)}$ , $C_{NO(ON)}$	NC, NO ON capacitance	$V_{CC} = 1.8\text{ V}$	$V_{NC}$ or $V_{NO} = V_{CC}$ or GND, switch OFF	See <a href="#">Figure 18</a>			22		pF
$C_{COM(ON)}$	COM ON capacitance	$V_{CC} = 1.8\text{ V}$	$V_{COM} = V_{CC}$ or GND, switch ON	See <a href="#">Figure 18</a>			22		pF

(2) All unused digital inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).

**Electrical Characteristics for 1.8-V Supply<sup>(1)</sup> (continued)**
 $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
$C_I$	Digital input capacitance	$V_{CC} = 1.8\text{ V}$	$V_I = V_{CC}$ or GND	See <a href="#">Figure 18</a>		2		pF
BW	Bandwidth	$V_{CC} = 1.8\text{ V}$	$R_L = 50\ \Omega$	Switch ON, see <a href="#">Figure 20</a>		240		MHz
$O_{ISO}$	OFF isolation	$V_{CC} = 1.8\text{ V}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$	Switch OFF, see <a href="#">Figure 22</a>		-60		dB
$X_{TALK}$	Crosstalk	$V_{CC} = 1.8\text{ V}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$	Switch ON, see <a href="#">Figure 23</a>		-60		dB
$X_{TALK(ADJ)}$	Crosstalk adjacent	$V_{CC} = 1.8\text{ V}$	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$	Switch ON, see <a href="#">Figure 23</a>		-71		dB
THD	Total harmonic distortion	$V_{CC} = 1.8\text{ V}$	$R_L = 600\ \Omega$ , $C_L = 50\text{ pF}$	$f = 20\text{ Hz to }20\text{ kHz}$ , see <a href="#">Figure 25</a>		0.1%		
<b>SUPPLY</b>								
$I_{CC}$	Positive supply current	$V_{CC} = 1.95\text{ V}$	$V_I = V_{CC}$ or GND	Switch ON or OFF	$T_A = 25^\circ\text{C}$	0.01	0.1	$\mu\text{A}$
					$T_A = -40^\circ\text{C to }+85^\circ\text{C}$		1.5	

## 6.8 Typical Characteristics

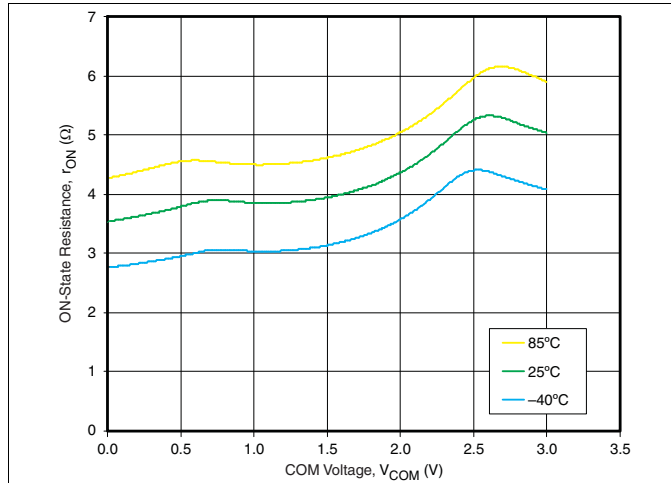


Figure 1. ON-State Resistance vs COM Voltage ( $V_{CC} = 3\text{ V}$ )

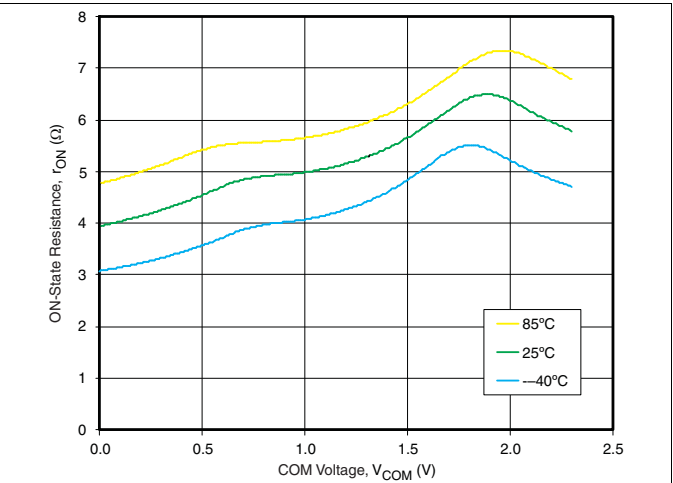


Figure 2. ON-State Resistance vs COM Voltage ( $V_{CC} = 2.3\text{ V}$ )

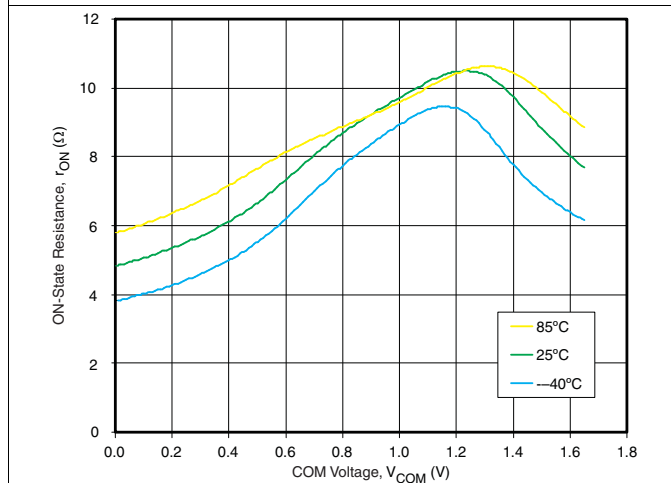


Figure 3. ON-State Resistance vs COM Voltage ( $V_{CC} = 1.65\text{ V}$ )

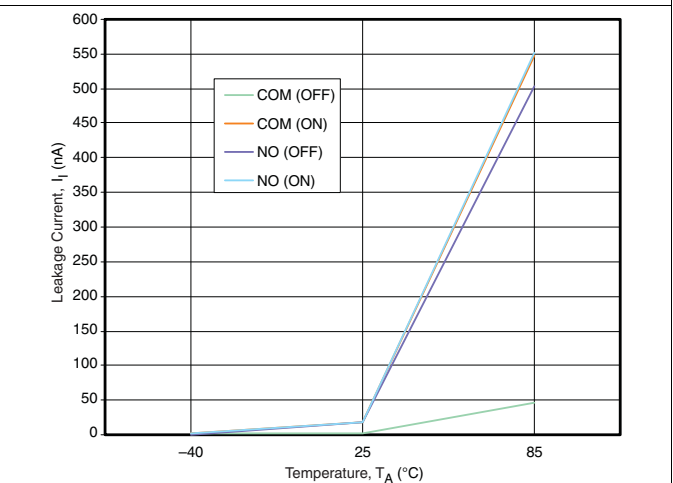


Figure 4. Leakage Current vs Temperature ( $V_{CC} = 3.3\text{ V}$ )

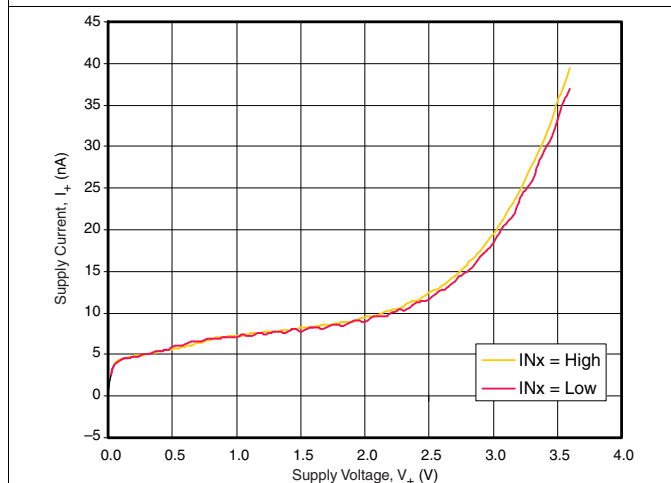


Figure 5. Supply Current vs Supply Voltage

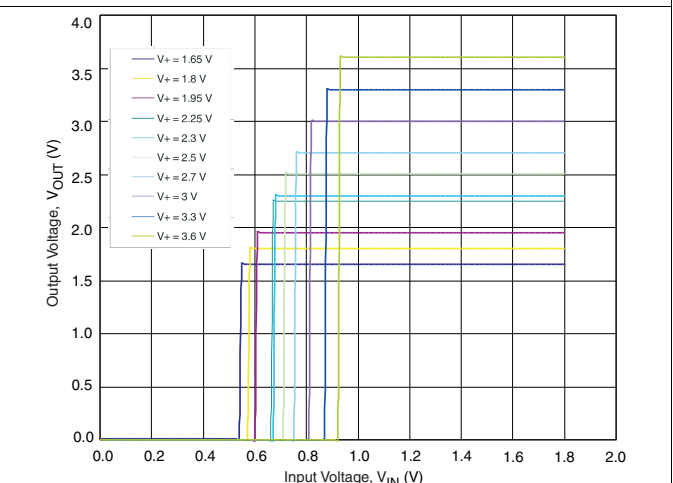


Figure 6. Control Input Thresholds ( $IN1, T_A = 25^\circ\text{C}$ )

Typical Characteristics (continued)

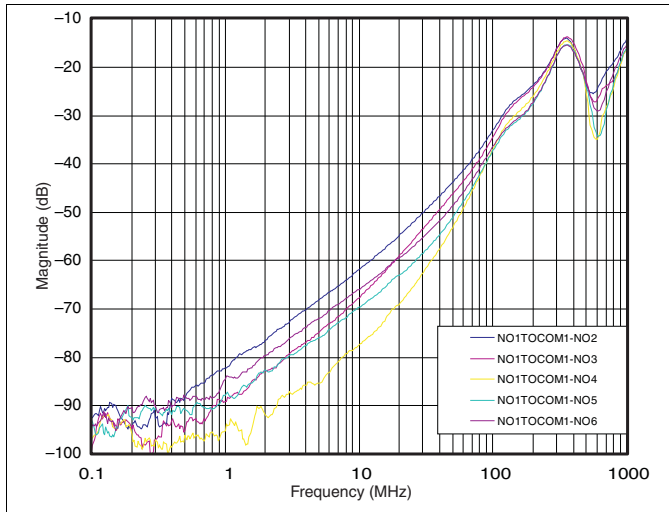


Figure 7. Crosstalk Adjacent

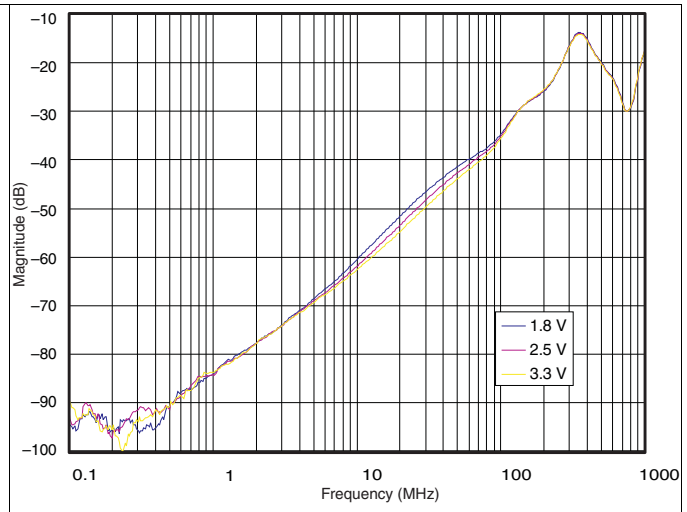


Figure 8. Crosstalk

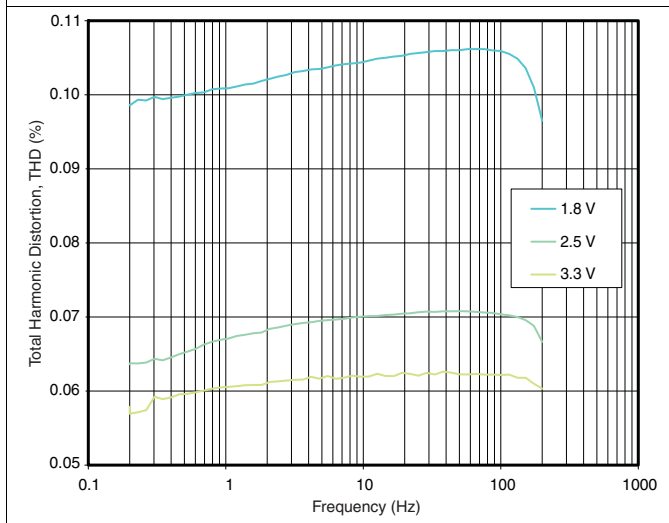


Figure 9. Total Harmonic Distortion vs Frequency

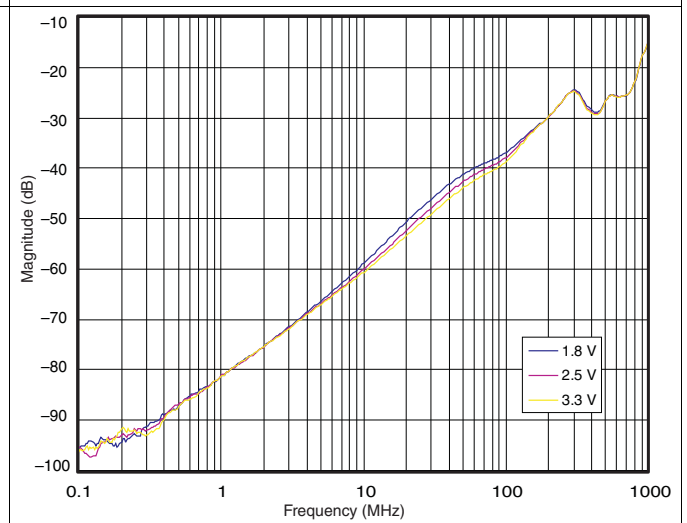


Figure 10. OFF Isolation

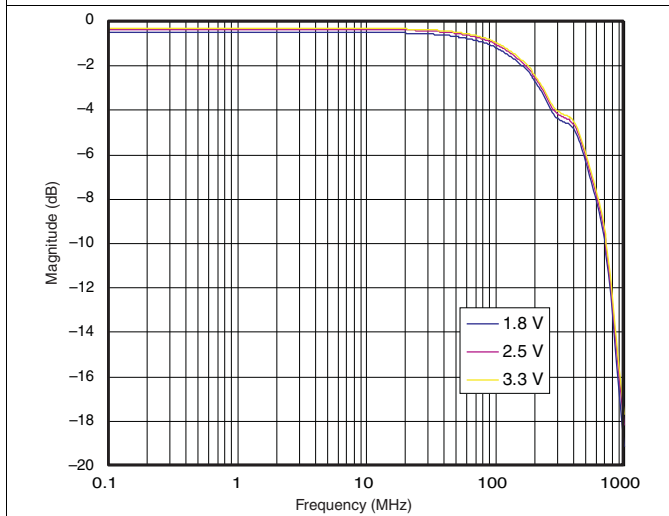


Figure 11. Insertion Loss

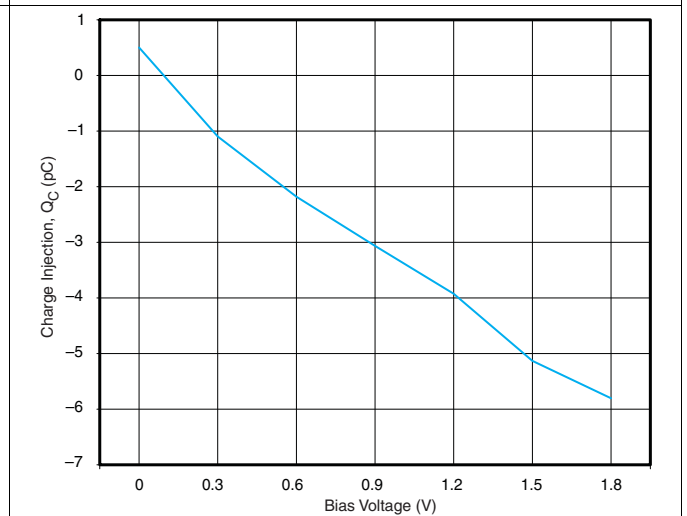
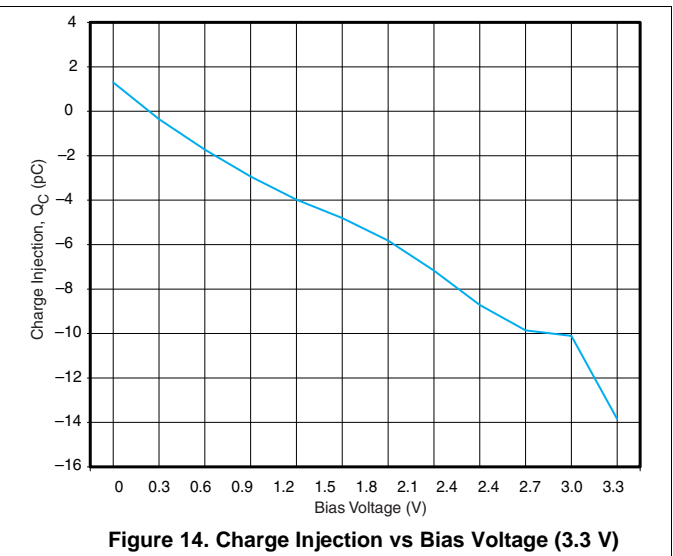
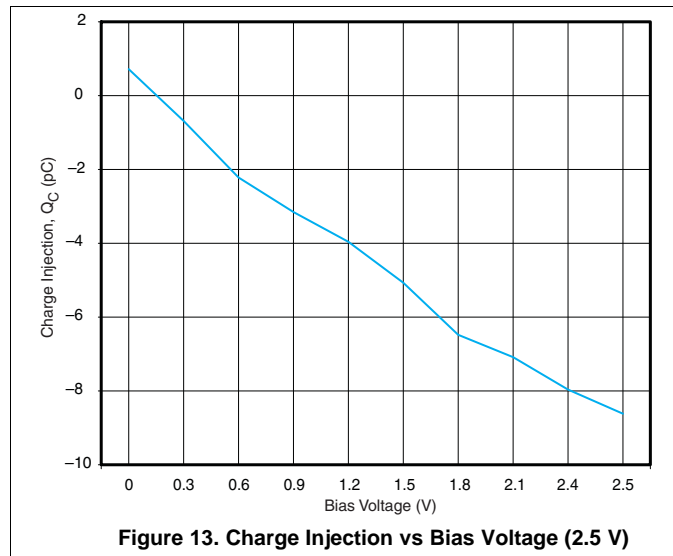


Figure 12. Charge Injection vs Bias Voltage (1.8 V)

**Typical Characteristics (continued)**



## 7 Parameter Measurement Information

**Table 1. Parameter Description**

DESCRIPTION	
$V_{COM}$	Voltage at COM.
$V_{NC}$	Voltage at NC.
$V_{NO}$	Voltage at NO.
$r_{on}$	Resistance between COM and NC or NO ports when the channel is ON.
$\Delta r_{on}$	Difference of $r_{on}$ between channels in a specific device.
$r_{on(Flat)}$	Difference between the maximum and minimum value of $r_{on}$ in a channel over the specified range of conditions.
$I_{NC(OFF)}$	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the OFF state.
$I_{NC(ON)}$	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the ON state and the output (COM) open.
$I_{NO(OFF)}$	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the OFF state.
$I_{NO(ON)}$	Leakage current measured at the NO port, with the corresponding channel (NO to COM) in the ON state and the output (COM) open.
$I_{COM(OFF)}$	Leakage current measured at the COM port, with the corresponding channel (COM to NC or NO) in the OFF state.
$I_{COM(ON)}$	Leakage current measured at the COM port, with the corresponding channel (COM to NC or NO) in the ON state and the output (NC or NO) open.
$V_{IH}$	Minimum input voltage for logic high for the control input (IN, $\overline{EN}$ ).
$V_{IL}$	Maximum input voltage for logic low for the control input (IN, $\overline{EN}$ ).
$V_I$	Voltage at the control input (IN, $\overline{EN}$ ).
$I_{IH}, I_{IL}$	Leakage current measured at the control input (IN, $\overline{EN}$ ).
$t_{ON}$	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 (NC or NO) signal when the switch is turning ON.
$t_{OFF}$	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 (NC or NO) signal when the switch is turning OFF.
$Q_C$	Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (NC or NO) 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.
$C_{NC(OFF)}$	Capacitance at the NC port when the corresponding channel (NC to COM) is OFF.
$C_{NC(ON)}$	Capacitance at the NC port when the corresponding channel (NC to COM) is ON.
$C_{NO(OFF)}$	Capacitance at the NC port when the corresponding channel (NO to COM) is OFF.
$C_{NO(ON)}$	Capacitance at the NC port when the corresponding channel (NO to COM) is ON.
$C_{COM(OFF)}$	Capacitance at the COM port when the corresponding channel (COM to NC) is OFF.
$C_{COM(ON)}$	Capacitance at the COM port when the corresponding channel (COM to NC) is ON.
$C_I$	Capacitance of control input (IN, $\overline{EN}$ ).
$O_{ISO}$	OFF isolation of the switch is a measurement of OFF-state switch impedence. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM) in the OFF state.
$X_{TALK}$	Crosstalk is a measurement of unwanted signal coupling from an ON channel to an OFF channel (NC1 to NO1). Adjacent crosstalk is a measure of unwanted signal coupling from an ON channel to an adjacent ON channel (NC1 to NC2). This is measured in a specific frequency and in dB.
BW	Bandwidth of the switch. This is the frequency in which the gain of an ON channel is –3 dB below the DC gain.
THD	Total harmonic distortion describes the signal distortion caused by the analog switch. This is defined as the ratio of root mean square (RMS) value of the second, third, and higher harmonic to the absolute magnitude of the fundamental harmonic.
$I_{CC}$	Static power-supply current with the control (IN) pin at $V_{CC}$ or GND.

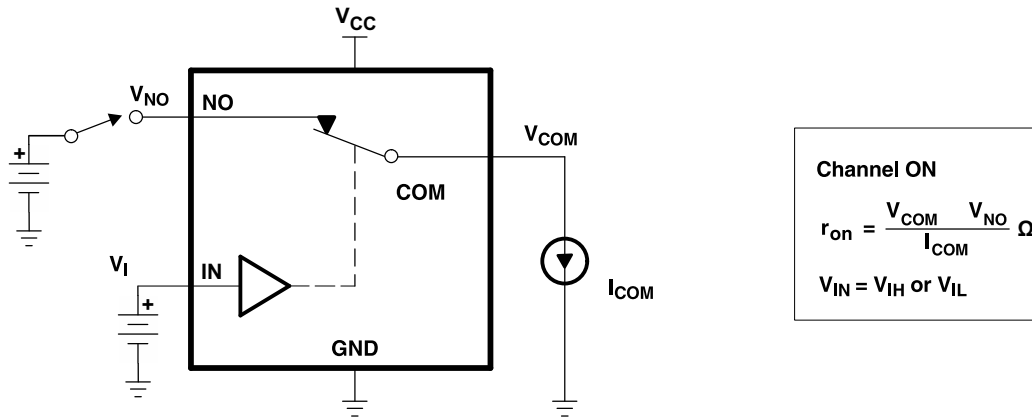


Figure 15. ON-State Resistance ( $r_{ON}$ )

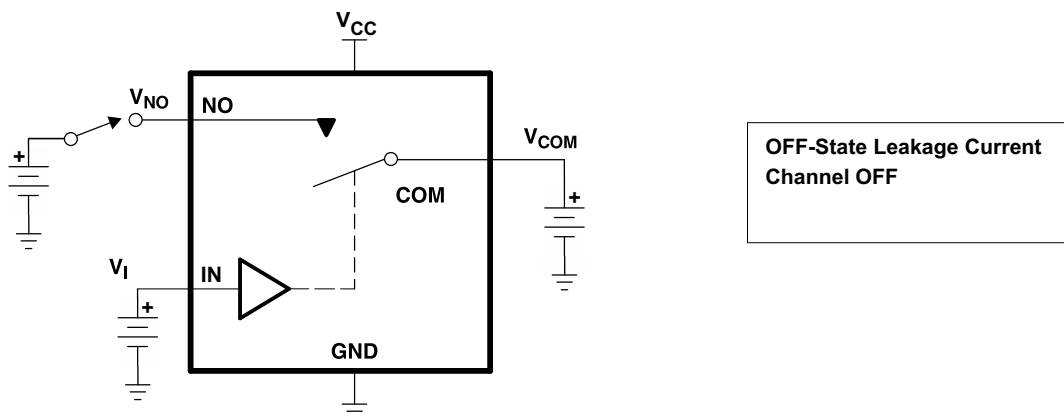


Figure 16. OFF-State Leakage Current  
( $I_{COM(OFF)}$ ,  $I_{NC(OFF)}$ ,  $I_{COM(PWROFF)}$ ,  $I_{NC(PWROFF)}$ )

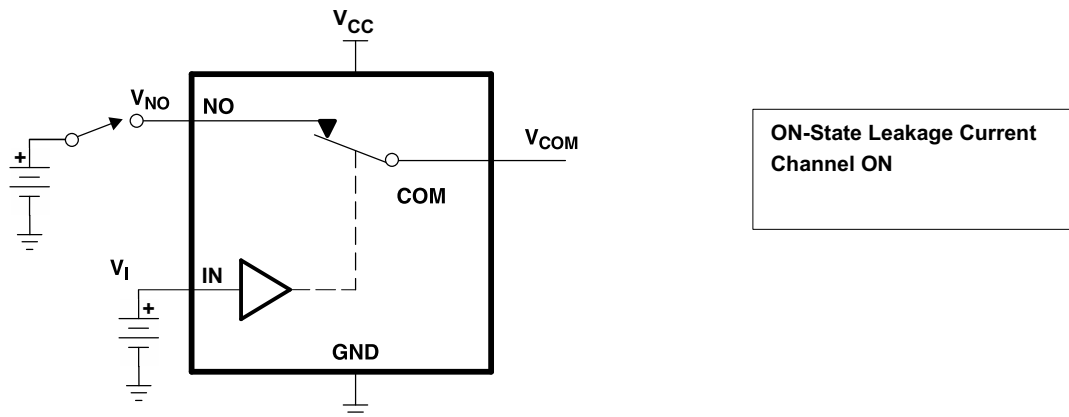
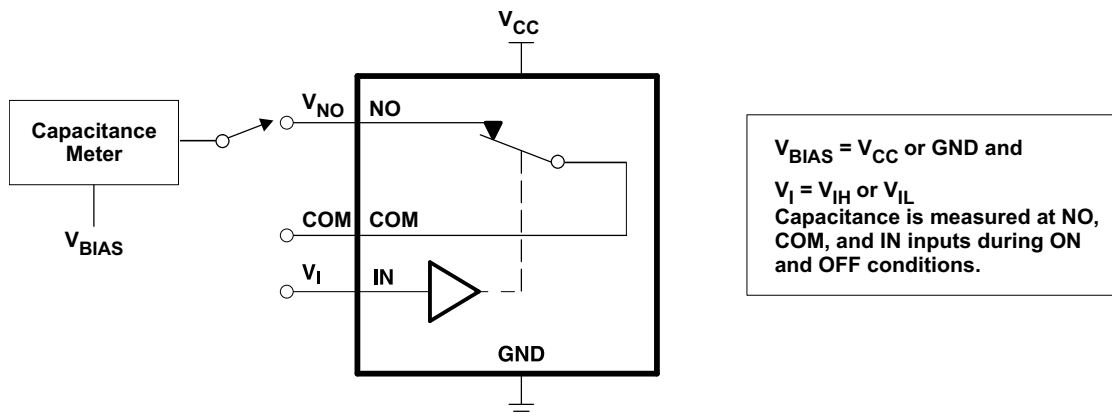


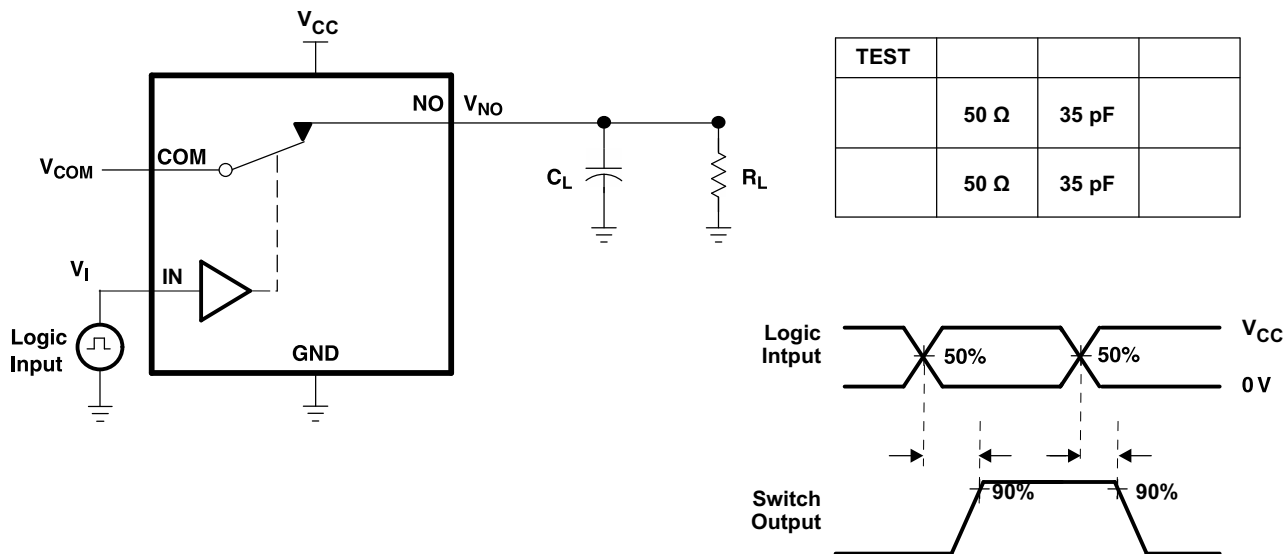
Figure 17. ON-State Leakage Current  
( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ )





**Figure 18. Capacitance**  
 ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NC(ON)}$ )

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



**Figure 19. Turnon ( $t_{ON}$ ) and Turnoff Time ( $t_{OFF}$ )**

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

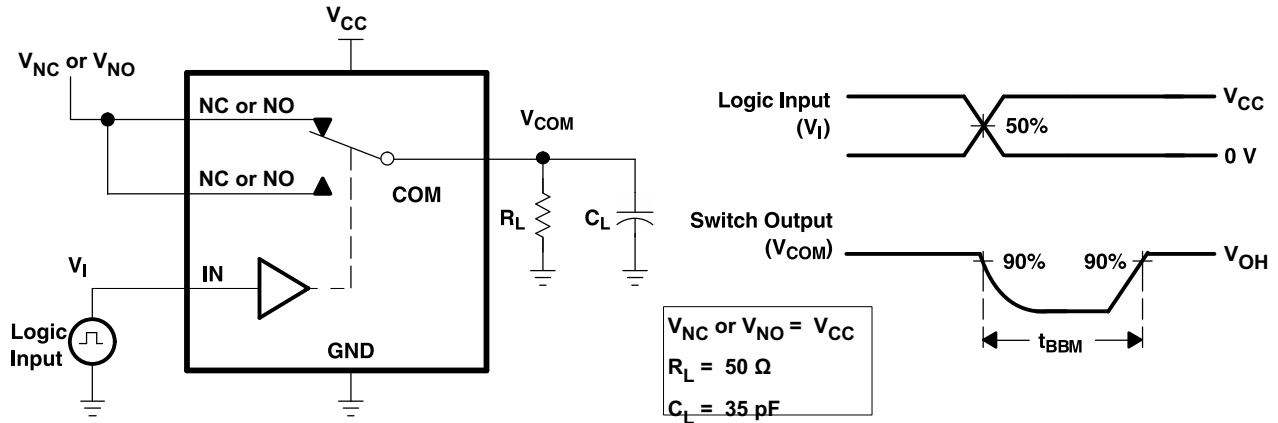


Figure 20. Break-Before-Make Time ( $t_{BBM}$ )

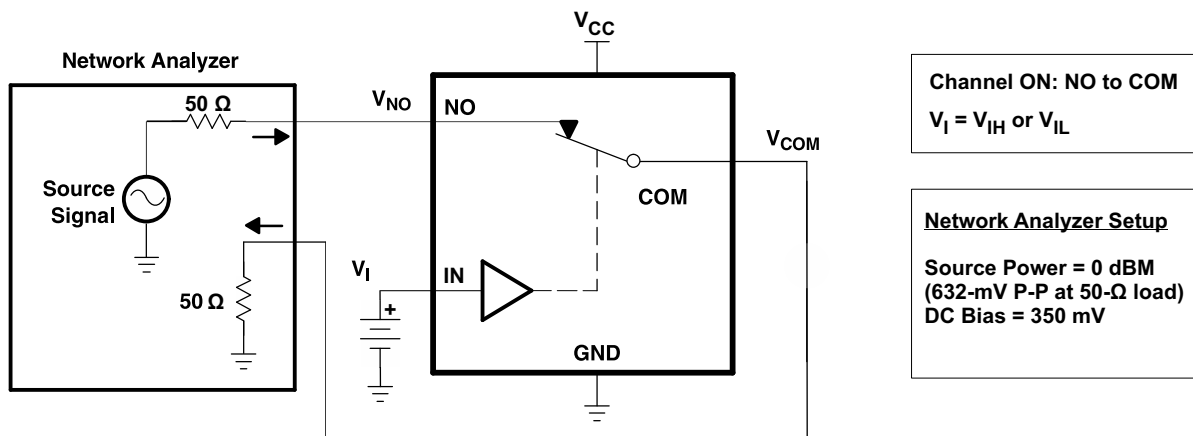


Figure 21. Bandwidth (BW)

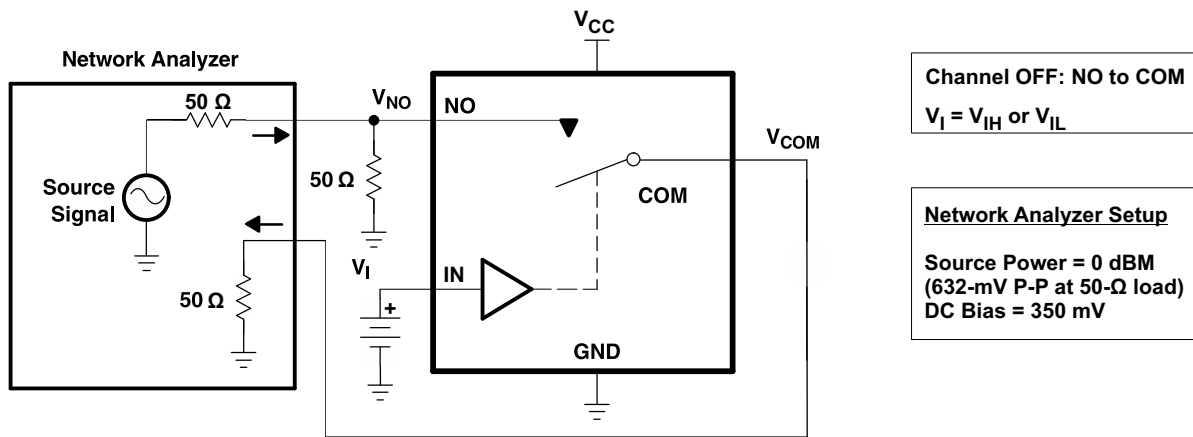


Figure 22. OFF Isolation ( $O_{ISO}$ )

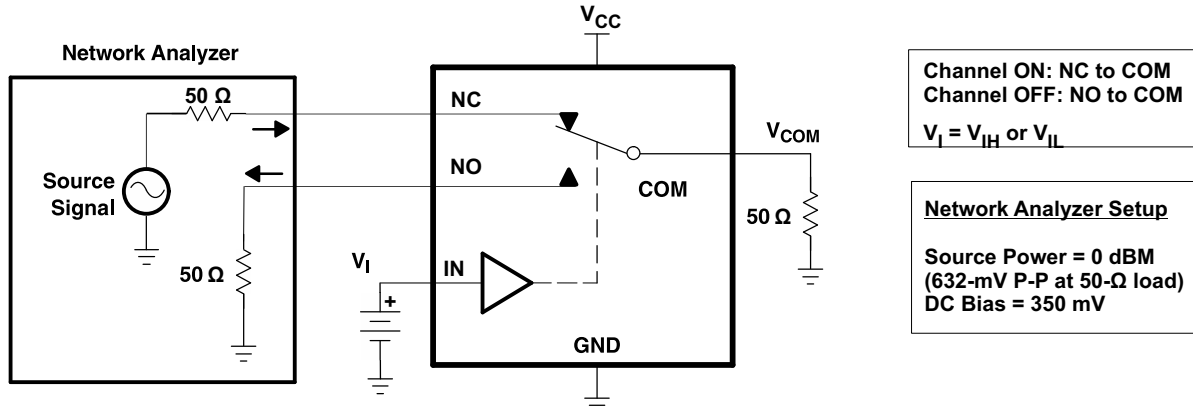


Figure 23. Crosstalk ( $X_{TALK}$ )

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

$C_L$  includes probe and jig capacitance.

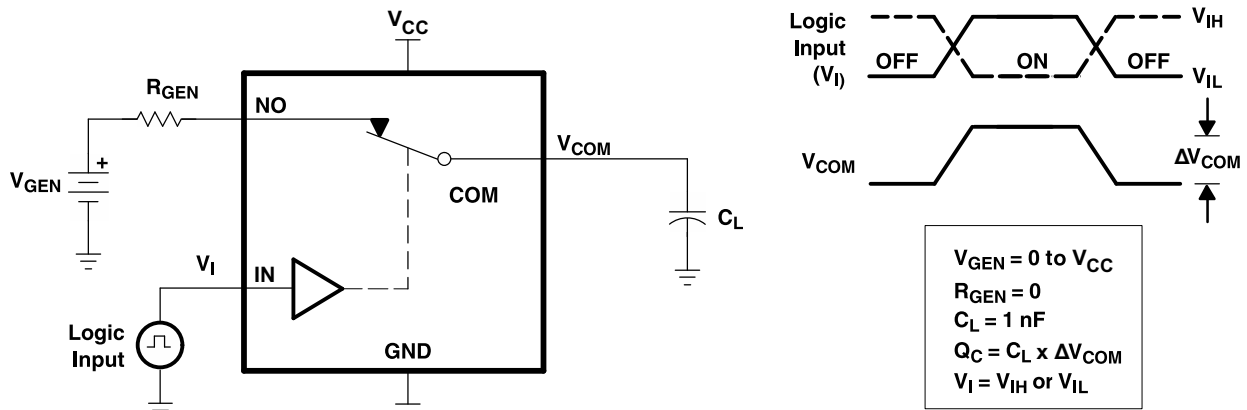


Figure 24. Charge Injection ( $Q_C$ )

$C_L$  includes probe and jig capacitance.

Channel ON: COM to NO	$V_I = V_{IH}$ or $V_{IL}$	$R_L = 600 \Omega$
$V_{SOURCE} = V_{CC}$ P-P	$f_{SOURCE} = 20$ Hz to 20 kHz	$C_L = 50$ pF

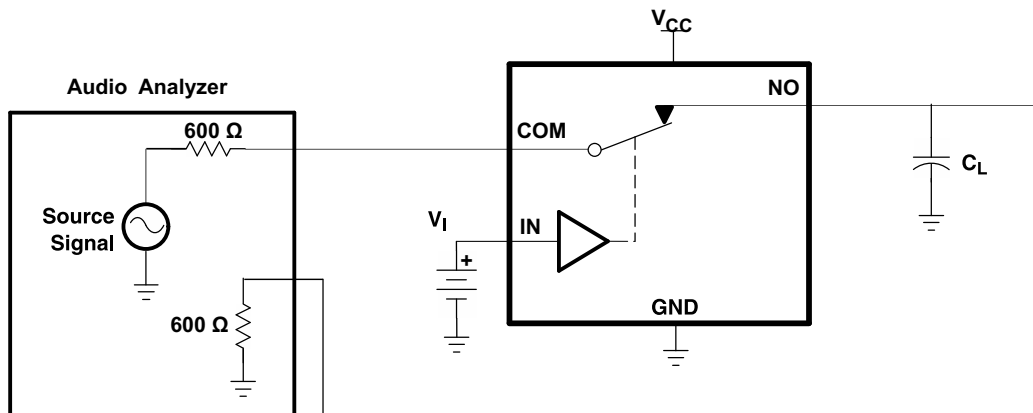


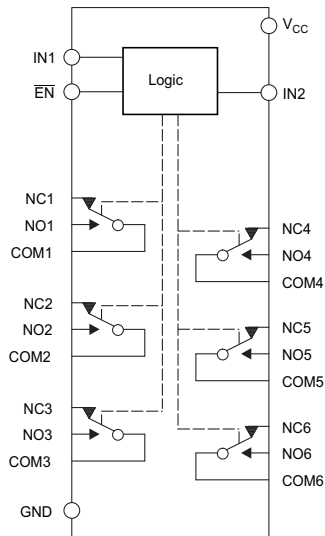
Figure 25. Total Harmonic Distortion (THD)

## 8 Detailed Description

### 8.1 Overview

The TS3A27518E is a bidirectional, 6-channel, 1:2 multiplexer-demultiplexer designed to operate from 1.65 V to 3.6 V. This device can handle both digital and analog signals, and can transmit signals up to  $V_{CC}$  in either direction. The TS3A27518E has two control pins, each controlling three 1:2 muxes at the same time, and an enable pin that puts all outputs in high-impedance mode. The control pins are compatible with 1.8-V logic thresholds and are backward compatible with 2.5-V and 3.3-V logic thresholds.

### 8.2 Functional Block Diagram



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### 8.3 Feature Description

The isolation in power-down mode,  $V_{CC} = 0$  feature places all switch paths in high-impedance state (High-Z) when the supply voltage equals 0 V.

### 8.4 Device Functional Modes

The TS3A27518E is a bidirectional device that has two sets of three single-pole double-throw switches. Two digital signals control the 6 channels of the switch; one digital control for each set of three single-pole, double-throw switches. Digital input pin IN1 controls switches 1, 2, and 3, while pin IN2 controls switches 4, 5, and 6.

The TS3A27518 has an  $\overline{EN}$  pin that when set to logic high, it places all channels into a high-impedance or HIGH-Z state. [Table 2](#) lists the functions of TS3A27518E

Table 2. Function Table

$\overline{EN}$	IN1	IN2	NC1/2/3 TO COM1/2/3, COM1/2/3 TO NC1/2/3	NC4/5/6 TO COM4/5/6, COM4/5/6 TO NC4/5/6	NO1/2/3 TO COM1/2/3, COM1/2/3 TO NO1/2/3	NO4/5/6 TO COM4/5/6, COM4/5/6 TO NO4/5/6
H	X	X	OFF	OFF	OFF	OFF
L	L	L	ON	ON	OFF	OFF
L	H	L	OFF	ON	ON	OFF
L	L	H	ON	OFF	OFF	ON
L	H	H	OFF	OFF	ON	ON

## 9 Application and Implementation

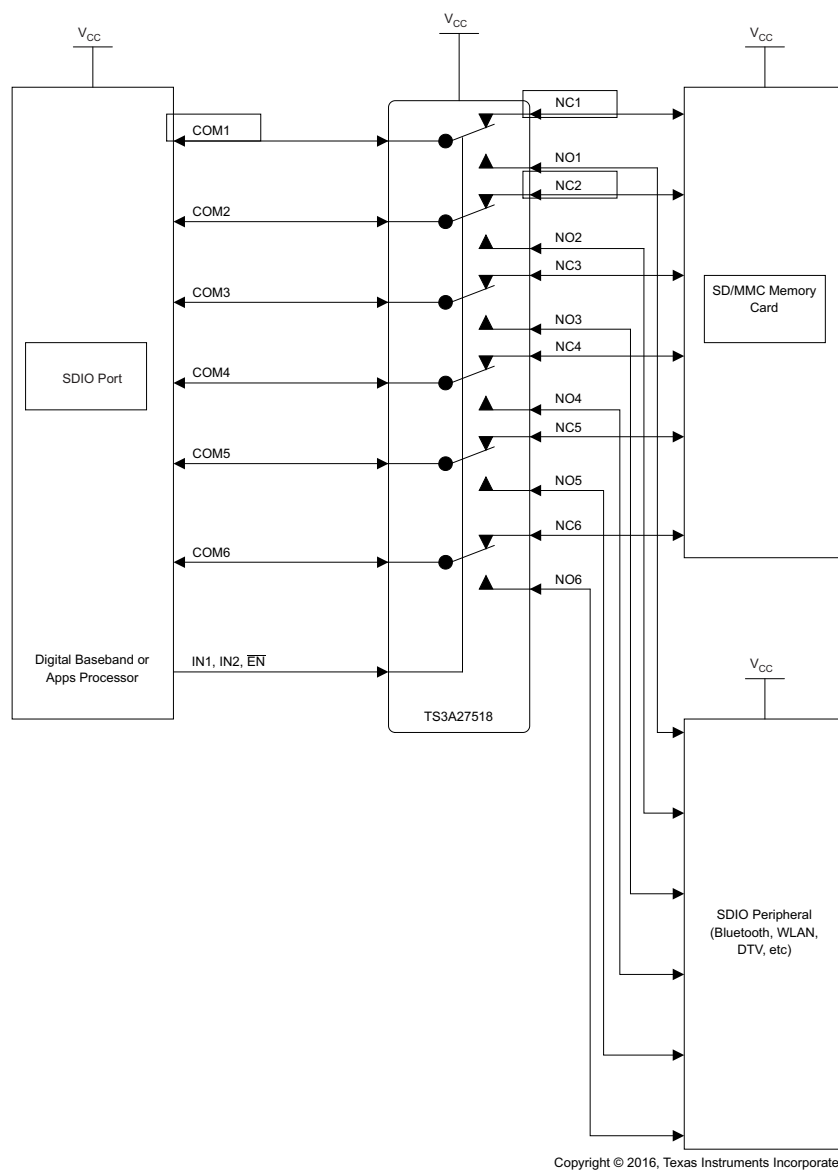
### NOTE

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. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

The switches are bidirectional, so the NO, NC, and COM pins can be used as either inputs or outputs. This functionality allows port expansion to support many different types of bidirectional signal interfaces such as SD, SDIO, GPIO, MMC and qSPI.

### 9.2 Typical Application



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Figure 26. SDIO Expander Application Block Diagram

Typical Application (continued)

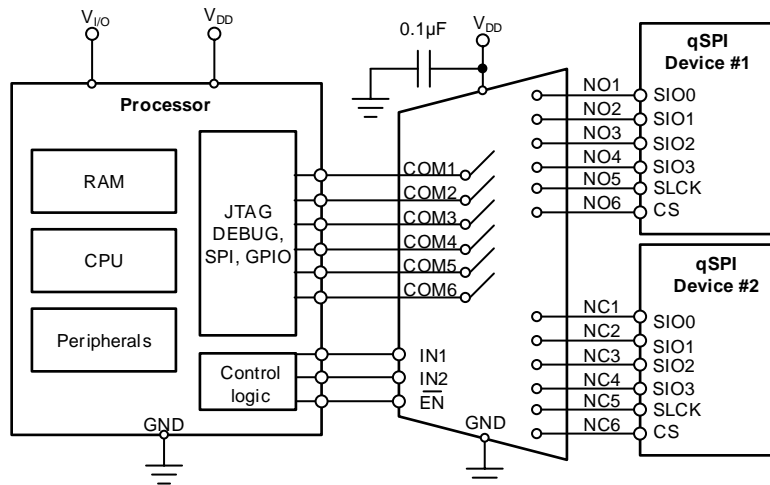


Figure 27. qSPI Expander Application Block Diagram

9.2.1 Design Requirement

Ensure that all of the signals passing through the switch are within the recommended operating ranges to ensure proper performance, see [Recommended Operating Conditions](#).

9.2.2 Detailed Design Procedure

The TS3A27518E can be properly operated without any external components. However, TI recommends connecting unused pins to the ground through a 50-Ω resistor to prevent signal reflections back into the device. TI also recommends that the digital control pins (INX) be pulled up to V<sub>CC</sub> or down to GND to avoid undesired switch positions that could result from the floating pin.

For the RTW package connect the thermal pad to ground.

9.2.3 Application Curve

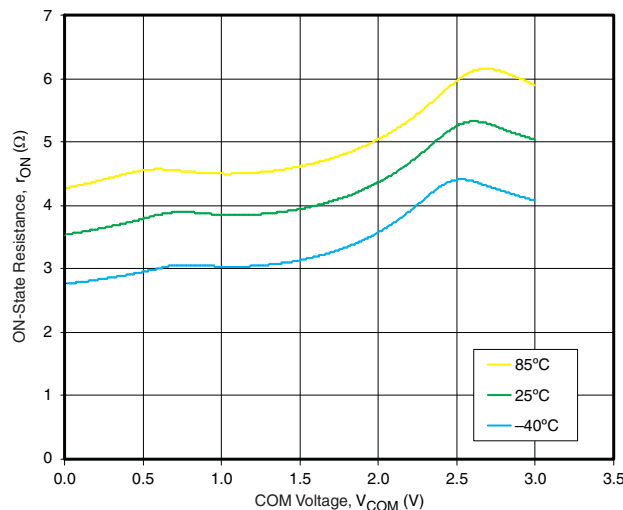


Figure 28. ON-State Resistance vs COM Voltage (V<sub>CC</sub> = 3 V)

## 10 Power Supply Recommendations

TI recommends proper power-supply sequencing 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  $V_{CC}$  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  $V_{CC}$  supply to other components. A 0.1- $\mu$ F capacitor is adequate for most applications, if connected from  $V_{CC}$  to GND.

## 11 Layout

### 11.1 Layout Guidelines

To ensure reliability of the device, TI recommends following these common printed-circuit board layout guidelines:

- Bypass capacitors should be used on power supplies, and should be placed as close as possible to the  $V_{CC}$  pin
- Short trace-lengths should be used to avoid excessive loading
- For the RTW package, connect the thermal pad to ground

### 11.2 Layout Example

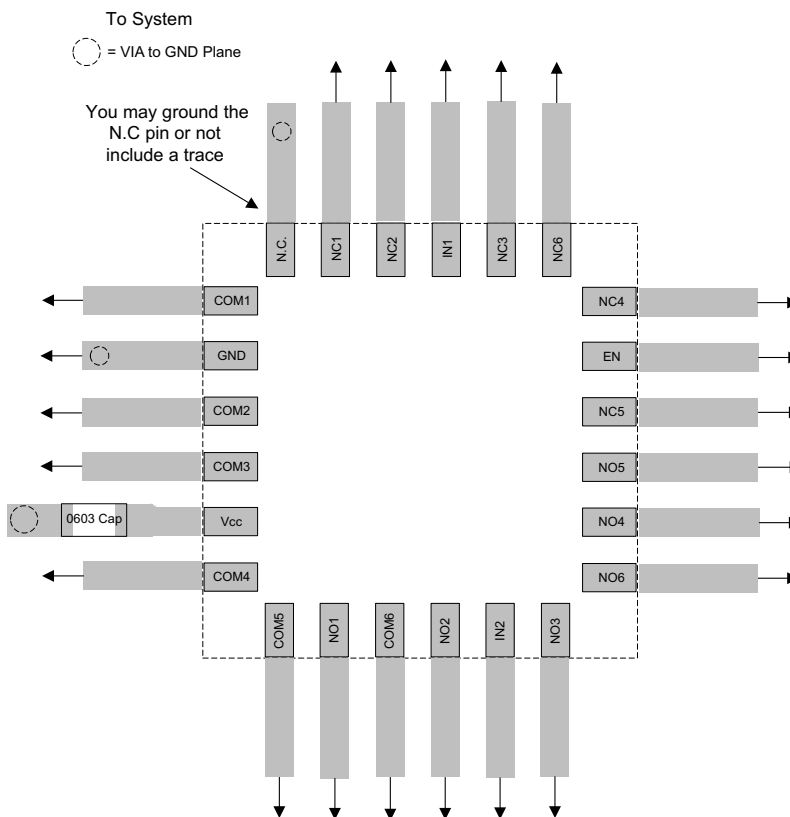


Figure 29. WQFN Layout Recommendation

## 12 Device and Documentation Support

### 12.1 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™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://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.

### 12.2 Trademarks

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

### 12.3 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.

### 12.4 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.



**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TS3A27518EPWR	ACTIVE	TSSOP	PW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	YL518E	<a href="#">Samples</a>
TS3A27518ERTWR	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	YL518E	<a href="#">Samples</a>

(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) **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 (Cl) 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.

(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.

(6) Lead finish/Ball material - Orderable Devices 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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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

**OTHER QUALIFIED VERSIONS OF TS3A27518E :**

- Automotive: [TS3A27518E-Q1](#)

## NOTE: Qualified Version Definitions:

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

## 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
TS3A27518EPWR	TSSOP	PW	24	2000	330.0	16.4	6.95	8.3	1.6	8.0	16.0	Q1
TS3A27518ERTWR	WQFN	RTW	24	3000	330.0	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)
TS3A27518EPWR	TSSOP	PW	24	2000	853.0	449.0	35.0
TS3A27518ERTWR	WQFN	RTW	24	3000	853.0	449.0	35.0

PW0024A



# PACKAGE OUTLINE

## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220208/A 02/2017

# EXAMPLE BOARD LAYOUT

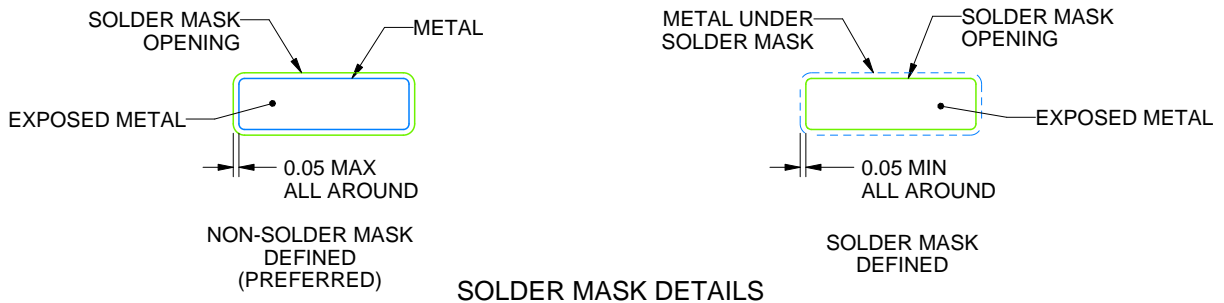
PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220208/A 02/2017

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.

# EXAMPLE STENCIL DESIGN

PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

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

RTW (S-PWQFN-N24)

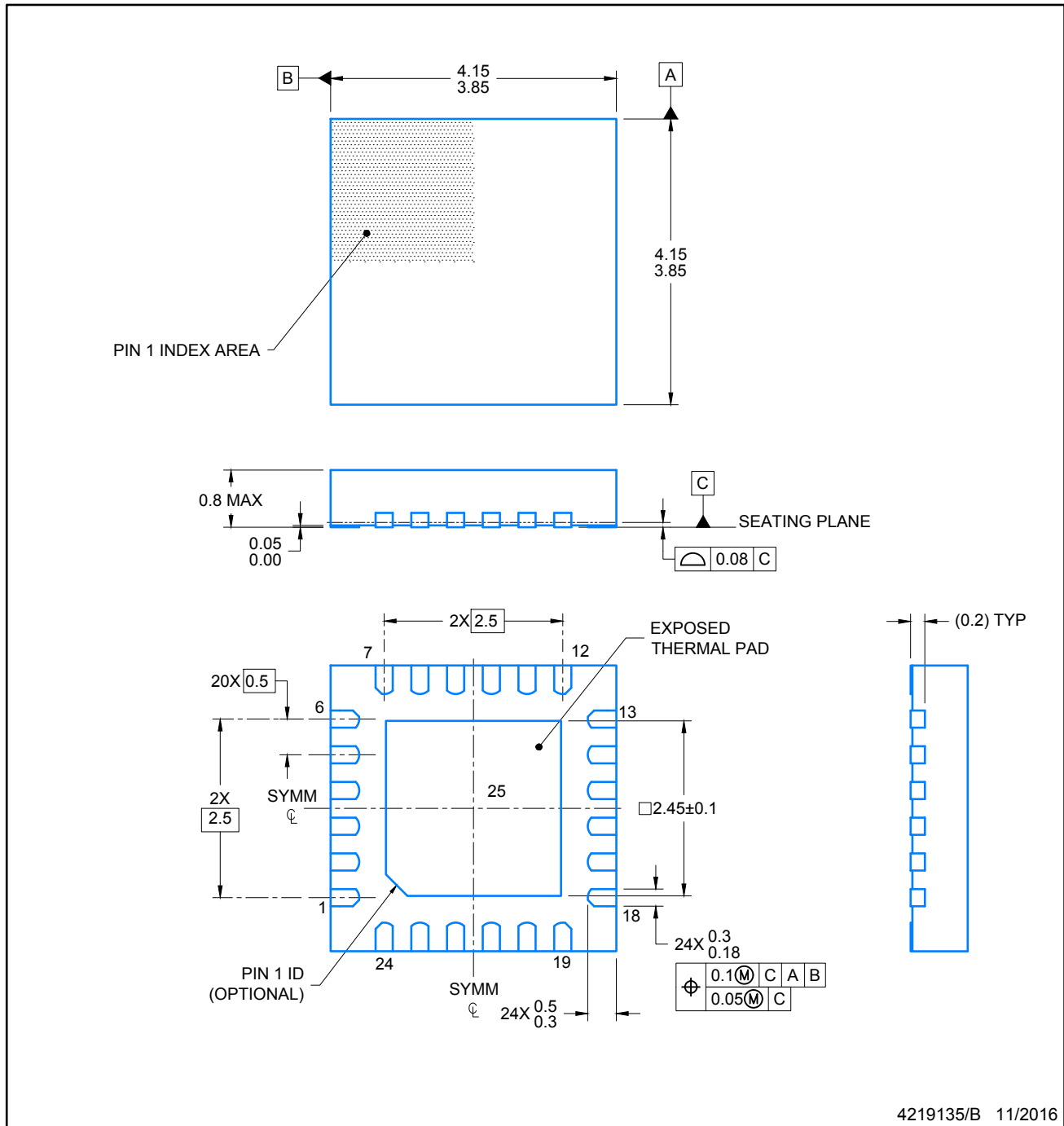
PLASTIC QUAD FLATPACK NO-LEAD



4206244/C 07/11

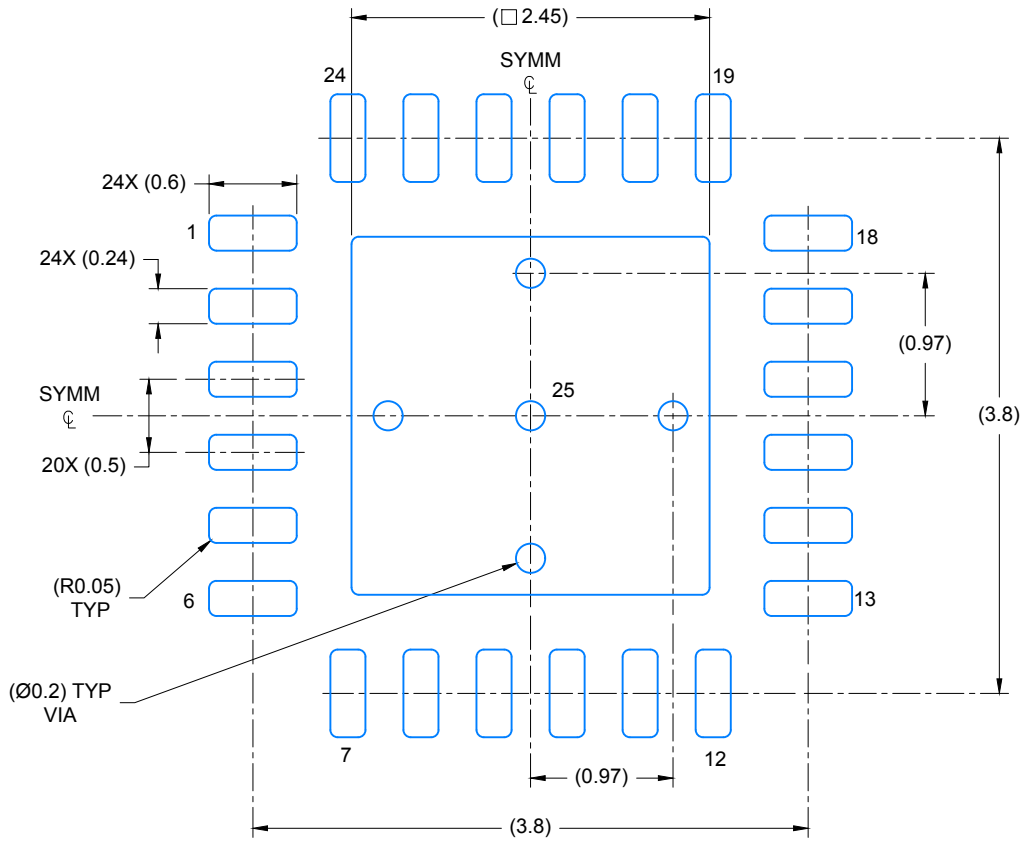
- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - Quad Flatpack, No-Leads (QFN) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - Falls within JEDEC MO-220.



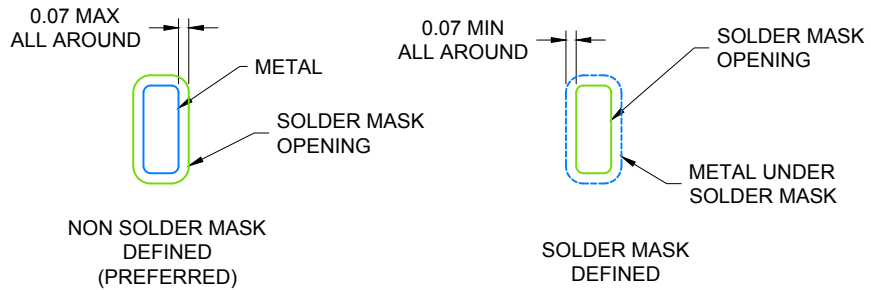


**NOTES:**

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.



LAND PATTERN EXAMPLE  
SCALE: 20X

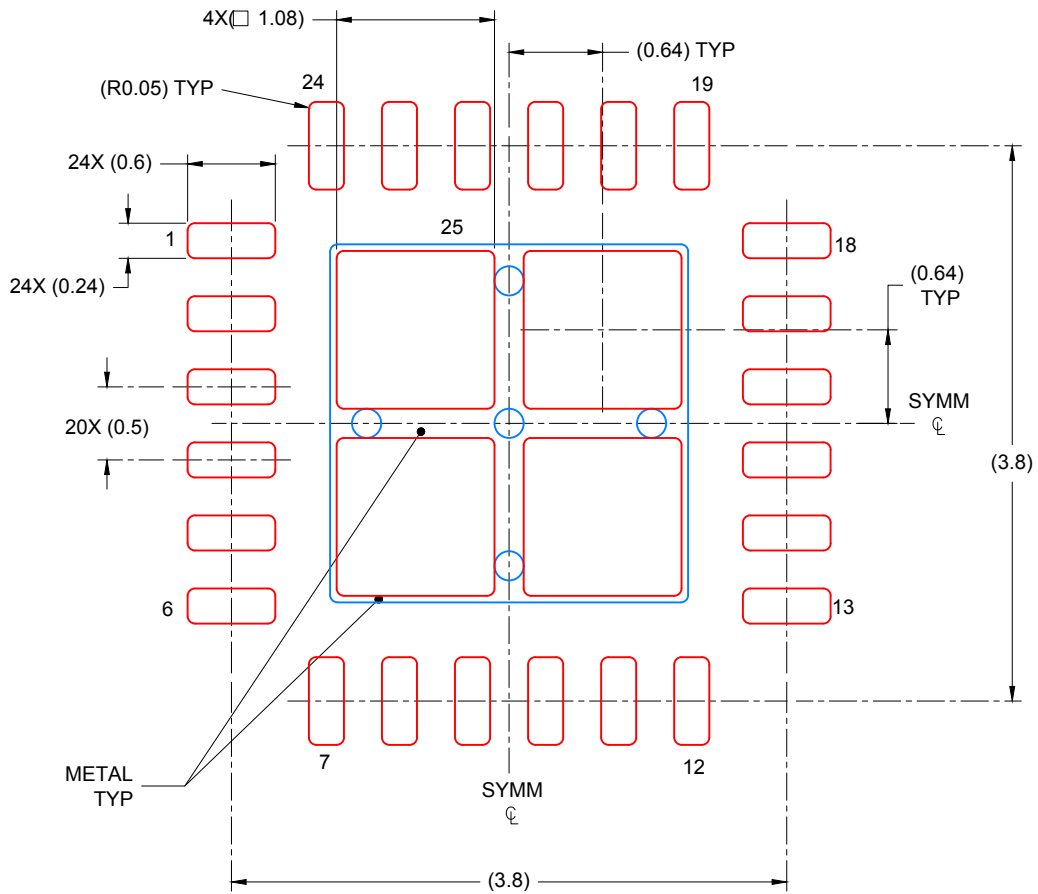


SOLDER MASK DETAILS

4219135/B 11/2016

NOTES: (continued)

- For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).



SOLDER PASTE EXAMPLE  
 BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 25:  
 78% PRINTED COVERAGE BY AREA UNDER PACKAGE  
 SCALE: 20X

4219135/B 11/2016

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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