

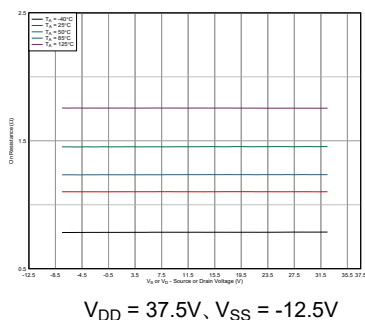
# TMUX7612 1.8V ロジック対応、50V、低 RON、1:1 (SPST)、4 チャンネルの高精度スイッチ

## 1 特長

- 両電源電圧範囲:  $\pm 4.5\text{V} \sim \pm 25\text{V}$
- 単電源電圧範囲:  $4.5\text{V} \sim 50\text{V}$
- 非対称のデュアル電源のサポート (例:  $V_{DD} = 37.5\text{V}$ 、 $V_{SS} = -12.5\text{V}$ )
- 1.8V ロジック互換
- 精度性能:
  - 低いオン抵抗:  $1.1\Omega$  (代表値)
  - 低い静電容量:  $27\text{pF}$  (標準値)
  - 超低オン抵抗平坦性:  $0.0003\Omega$  (代表値)
  - 大電流のサポート:  $470\text{mA}$  (最大値)
  - 低オンリーク電流:  $3.7\text{pA}$  (標準値)、 $0.3\text{nA}$  (最大値)
  - 低オフリーク電流:  $30\text{pA}$  (標準値)、 $0.15\text{nA}$  (最大値)
  - 超低電荷注入:  $2\text{pC}$  (標準値)
- $-40^\circ\text{C} \sim +125^\circ\text{C}$  の動作温度範囲
- レールツーレール動作
- 双方向動作
- ブレイクビフォーメイクのスイッチング動作

## 2 アプリケーション

- 半導体試験装置
- SSR とフォトリレーの交換
- 自動試験装置
- LCD 試験装置
- メモリ試験装置
- プログラマブル・ロジック・コントローラ (PLC)
- ファクトリ・オートメーション / 制御
- 計測機器: ラボ、分析、ポータブル
- データ・アキュイジション・システム (DAQ)
- 光学試験装置



オン抵抗とソースまたはドレイン電圧との関係

## 3 概要

TMUX7612 は、独立して選択できる 4 つの 1:1 単極単投 (SPST) スイッチ チャンネルを備えた相補型金属酸化膜半導体 (CMOS) スイッチ デバイスです。このデバイスは、単一電源 ( $4.5\text{V} \sim 50\text{V}$ )、デュアル電源 ( $\pm 4.5\text{V} \sim \pm 25\text{V}$ )、または非対称電源 ( $V_{DD} = 37.5\text{V}$ 、 $V_{SS} = -12.5\text{V}$  など) で動作します。TMUX7612 は、ソース (Sx) およびドレイン (Dx) ピンで、 $V_{SS}$  から  $V_{DD}$  までの範囲の双方向アナログおよびデジタル信号をサポートします。

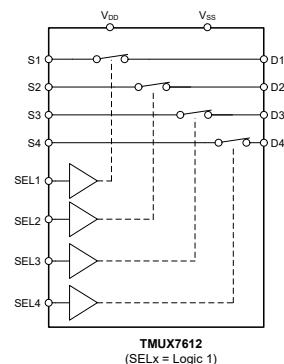
TMUX7612 のスイッチは、SELx ピンの適切なロジック制御入力で制御されます。TMUX7612 は、超低電荷注入を可能にする特殊なアーキテクチャを採用しています。この機能は、制御入力からデバイスのアナログ出力への望ましくないカップリングを防止し、AC ノイズとオフセット誤差を低減するのに役立ちます。

TMUX7612 は高精度スイッチおよびマルチプレクサ デバイス ファミリの製品であり、オンおよびオフ時のリーク電流が非常に小さいため、高精度の測定用途に使用できます。

### パッケージ情報

部品番号	パッケージ (1)	パッケージ サイズ (2)
TMUX7612	PW (TSSOP, 16)	5mm × 6.4mm
	RUM (WQFN, 16)	4mm × 4mm

- 利用可能なパッケージについては、データシートの末尾にあるパッケージ オプションについての付録を参照してください。
- パッケージ サイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。



TMUX7612 ブロック図



## Table of Contents

<b>1 特長</b> .....	<b>1</b>	6.7 Off Isolation.....	<b>24</b>
<b>2 アプリケーション</b> .....	<b>1</b>	6.8 Channel-to-Channel Crosstalk.....	<b>25</b>
<b>3 概要</b> .....	<b>1</b>	6.9 Bandwidth.....	<b>25</b>
<b>4 Pin Configuration and Functions</b> .....	<b>3</b>	6.10 THD + Noise.....	<b>26</b>
<b>5 Specifications</b> .....	<b>4</b>	6.11 Power Supply Rejection Ratio (PSRR).....	<b>26</b>
5.1 Absolute Maximum Ratings.....	4	<b>7 Detailed Description</b> .....	<b>27</b>
5.2 ESD Ratings.....	4	7.1 Overview.....	27
5.3 Thermal Information.....	5	7.2 Functional Block Diagram.....	27
5.4 Source or Drain Current through Switch.....	5	7.3 Feature Description.....	27
5.5 Recommended Operating Conditions.....	5	7.4 Device Functional Modes.....	28
5.6 Electrical Characteristics (Global).....	6	<b>8 Application and Implementation</b> .....	<b>30</b>
5.7 Electrical Characteristics (±15 V Dual Supply).....	7	8.1 Application Information.....	30
5.8 Switching Characteristics (±15 V Dual Supply).....	9	8.2 Typical Application.....	30
5.9 Electrical Characteristics (±20 V Dual Supply).....	10	8.3 Thermal Considerations.....	32
5.10 Switching Characteristics (±20 V Dual Supply).....	11	8.4 Power Supply Recommendations.....	33
5.11 Electrical Characteristics (+37.5 V/–12.5 V Dual Supply).....	12	8.5 Layout.....	33
5.12 Switching Characteristics (+37.5 V/–12.5 V Dual Supply).....	14	<b>9 Device and Documentation Support</b> .....	<b>36</b>
5.13 Electrical Characteristics (12 V Single Supply).....	15	9.1 Documentation Support.....	36
5.14 Switching Characteristics (12 V Single Supply).....	16	9.2 ドキュメントの更新通知を受け取る方法.....	36
5.15 Typical Characteristics.....	17	9.3 サポート・リソース.....	36
<b>6 Parameter Measurement Information</b> .....	<b>21</b>	9.4 Trademarks.....	36
6.1 On-Resistance.....	21	9.5 静電気放電に関する注意事項.....	36
6.2 Off-Leakage Current.....	21	9.6 用語集.....	36
6.3 On-Leakage Current.....	22	<b>10 Revision History</b> .....	<b>36</b>
6.4 $t_{ON}$ and $t_{OFF}$ Time.....	22	<b>11 Mechanical, Packaging, and Orderable Information</b> .....	<b>36</b>
6.5 Propagation Delay.....	23	11.1 Tape and Reel Information.....	37
6.6 Charge Injection.....	24	11.2 Mechanical Data.....	39

## 4 Pin Configuration and Functions

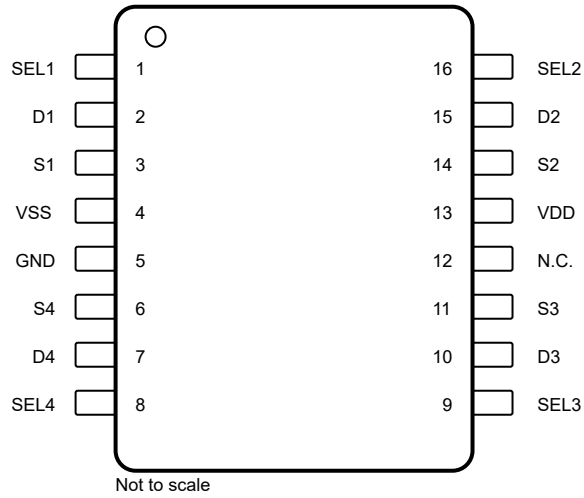


図 4-1. PW Package, 16-Pin TSSOP (Top View)

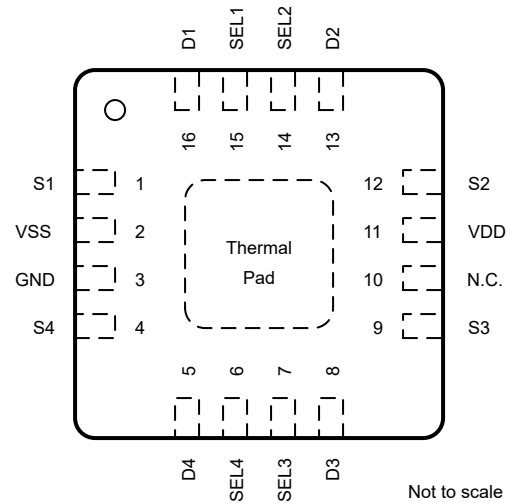


図 4-2. RUM Package, 16-Pin WQFN (Top View)

表 4-1. Pin Functions

PIN			TYPE <sup>(1)</sup>	DESCRIPTION
NAME	TSSOP	WQFN		
D1	2	16	I/O	Drain pin 1. Can be an input or output.
D2	15	13	I/O	Drain pin 2. Can be an input or output.
D3	10	8	I/O	Drain pin 3. Can be an input or output.
D4	7	5	I/O	Drain pin 4. Can be an input or output.
GND	5	3	P	Ground (0 V) reference.
N.C.	12	10	—	No internal connection. Can be shorted to GND or left floating
S1	3	1	I/O	Source pin 1. Can be an input or output.
S2	14	12	I/O	Source pin 2. Can be an input or output.
S3	11	9	I/O	Source pin 3. Can be an input or output.
S4	6	4	I/O	Source pin 4. Can be an input or output.
SEL1	1	15	I	Logic control input 1, has internal pull-down resistor. Controls channel 1 state as provided in 表 7-1.
SEL2	16	14	I	Logic control input 2, has internal pull-down resistor. Controls channel 2 state as provided in 表 7-1.
SEL3	9	7	I	Logic control input 3, has internal pull-down resistor. Controls channel 3 state as provided in 表 7-1.
SEL4	8	6	I	Logic control input 4, has internal pull-down resistor. Controls channel 4 state as provided in 表 7-1.
VDD	13	11	P	Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 $\mu$ F to 10 $\mu$ F between VDD and GND
VSS	4	2	P	Negative power supply. This pin is the most negative power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 $\mu$ F to 10 $\mu$ F between VSS and GND. In single-supply applications, this pin should be connected to ground.
Thermal Pad			—	The thermal exposed pad is connected internally. It is recommended that the pad be tied to VSS for best performance.

(1) I = input, O = output, I/O = input and output, P = power.

## 5 Specifications

### 5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
$V_{DD} - V_{SS}$	Supply voltage		53	V
$V_{DD}$		–0.5	53	V
$V_{SS}$		–32	0.5	V
$V_{SEL}$	Logic Supply Voltage	–0.5	53	V
$I_{SEL}$	Logic control input pin current (SEL pins)	–30	30	mA
$V_S$ or $V_D$	Source or drain voltage (Sx, Dx)	$V_{SS}-0.5$	$V_{DD}+0.5$	V
$I_{IK}$	Diode clamp current <sup>(3)</sup>	–30	30	mA
$I_S$ or $I_D$ (CONT)	Source or drain current (Sx, Dx)		$I_{DC} + 10\%$ <sup>(4)</sup>	mA
$T_A$	Ambient temperature	–55	150	°C
$T_{stg}$	Storage temperature	–65	150	°C
$T_J$	Junction temperature		150	°C

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) All voltages are with respect to ground, unless otherwise specified.
- (3) Pins are diode-clamped to the power-supply rails. Over voltage signals must be voltage and current limited to maximum ratings.
- (4) Refer to *Source or Drain Current* table for  $I_{DC}$  specifications.

### 5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins <sup>(1)</sup>	±3000	V
		Charged device model (CDM), per ANSI/ESDA/ JEDEC JS-002, all pins <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.

## 5.3 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TMUX7612		UNIT
		RUM (QFN)	PW (TSSOP)	
		16 PINS	16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	42.8	99.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	27.9	27.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	17.9	46.5	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	0.3	1.3	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	17.9	45.7	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	3.8	N/A	°C/W

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

## 5.4 Source or Drain Current through Switch

Current through the Switch	Test Conditions	$T_J = 25^\circ\text{C}$	$T_J = 50^\circ\text{C}$	$T_J = 85^\circ\text{C}$	$T_J = 105^\circ\text{C}$	$T_J = 125^\circ\text{C}$	$T_J = 135^\circ\text{C}$	$T_J = 150^\circ\text{C}$	UNIT
$I_{DC}$ <sup>(1)</sup>	$V_{SS}$ to $V_{DD} - 2.5\text{V}$	470	470	470	309	143	100	60	mA
$I_{peak}$ <sup>(2)</sup>	$V_{SS}$ to $V_{DD} - 2.5\text{V}$	470	470	470	470	470	470	470	mA

(1) See **Thermal Considerations** section for more details

(2) Pulse current of 1ms with 10% Duty Cycle

## 5.5 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
$V_{DD} - V_{SS}$ <sup>(1)</sup>	Power supply voltage differential	4.5		50	V
$V_{DD}$	Positive power supply voltage	4.5		50	V
$V_S$ or $V_D$	Signal path input/output voltage (source or drain pin) (Sx, D)	$V_{SS}$		$V_{DD}$	V
$V_{SEL}$	Logic Supply Voltage	0		44	V
	Logic supply voltage				
$I_S$ or $I_D (CONT)$	Source or drain continuous current (Sx, D)			$I_{DC}$ <sup>(2)</sup>	mA
$T_A$	Ambient temperature	–40		125	°C

(1)  $V_{DD}$  and  $V_{SS}$  can be any value as long as  $4.5\text{ V} \leq (V_{DD} - V_{SS}) \leq 50\text{ V}$ , and the minimum  $V_{DD}$  is met.

(2) Refer to *Source or Drain Current through Switch* table for  $I_{DC}$  specifications.

## 5.6 Electrical Characteristics (Global)

Typical at  $V_{DD} = +15\text{ V}$ ,  $V_{SS} = -15\text{ V}$ ,  $V_L = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
<b>LOGIC INPUTS</b>							
$V_{IH}$	Logic voltage high		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	1.3		44	V
$V_{IL}$	Logic voltage low		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	0		0.8	V
$I_{IH}$	Input leakage current		$-40^\circ\text{C}$ to $+125^\circ\text{C}$		0.005	2	$\mu\text{A}$
$I_{IL}$	Input leakage current		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	-2	-0.005		$\mu\text{A}$
$T_{SD}$	Thermal shutdown				165		$^\circ\text{C}$
$T_{SD\_HYST}$	Thermal shutdown hysteresis				15		$^\circ\text{C}$
$C_{IN}$	Logic input capacitance		$-40^\circ\text{C}$ to $+125^\circ\text{C}$		4		pF

## 5.7 Electrical Characteristics (±15 V Dual Supply)

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$  GND = 0 V (unless otherwise noted)

Typical at  $V_{DD} = +15\text{ V}$ ,  $V_{SS} = -15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R <sub>ON</sub>	On-resistance	V <sub>S</sub> = −10 V to +10 V I <sub>D</sub> = −10 mA	25°C		1.1	1.4	Ω
			−40°C to +50°C			1.6	
			−40°C to +85°C			1.8	
			−40°C to +125°C			2.2	
ΔR <sub>ON</sub>	On-resistance mismatch between channels	V <sub>S</sub> = −10 V to +10 V I <sub>D</sub> = −10 mA	25°C		0.005		Ω
			−40°C to +50°C			0.045	
			−40°C to +85°C			0.055	
			−40°C to +125°C			0.060	
R <sub>ON FLAT</sub>	On-resistance flatness	V <sub>S</sub> = −10 V to +10 V I <sub>D</sub> = −10 mA	25°C		0.0003		Ω
			−40°C to +50°C			0.045	
			−40°C to +85°C			0.055	
			−40°C to +125°C			0.060	
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 0 V, I <sub>S</sub> = −10 mA	−40°C to +125°C		0.006		Ω/°C
I <sub>S(OFF)</sub>	Source off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V Switch state is off V <sub>S</sub> = +10 V / −10 V V <sub>D</sub> = −10 V / +10 V	25°C	−0.15	0.03	0.15	nA
			−40°C to +50°C	−0.3		0.3	
			−40°C to +85°C	−0.65		0.65	
			−40°C to +125°C	−4		4	
I <sub>D(OFF)</sub>	Drain off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V Switch state is off V <sub>S</sub> = +10 V / −10 V V <sub>D</sub> = −10 V / +10 V	25°C	−0.15	0.03	0.15	nA
			−40°C to +50°C	−0.3		0.3	
			−40°C to +85°C	−0.65		0.65	
			−40°C to +125°C	−4		4	
I <sub>S(ON)</sub> I <sub>D(ON)</sub>	Channel on leakage current <sup>(2)</sup>	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V Switch state is on V <sub>S</sub> = V <sub>D</sub> = ±10 V	25°C	−0.3	0.0037	0.3	nA
			−40°C to +50°C	−0.4		0.4	
			−40°C to +85°C	−0.55		0.55	
			−40°C to +125°C	−4		4	
ΔI <sub>S(ON)</sub> ΔI <sub>D(ON)</sub>	Leakage current mismatch between channels <sup>(2)</sup>	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V Switch state is on V <sub>S</sub> = V <sub>D</sub> = ±10 V	25°C		10		pA
			−40°C to +50°C		13		
			−40°C to +85°C		22		
			−40°C to +125°C		32		
POWER SUPPLY							
I <sub>DDQ</sub>	V <sub>DD</sub> quiescent supply current	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V All switches OFF	25°C		35	45	μA
			−40°C to +85°C			55	
			−40°C to +125°C			65	
I <sub>DD</sub>	V <sub>DD</sub> supply current	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V All switches ON	25°C		435	480	μA
			−40°C to +85°C			520	
			−40°C to +125°C			545	
I <sub>SSQ</sub>	V <sub>SS</sub> quiescent supply current	V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V All switches OFF	25°C		15	20	μA
			−40°C to +85°C			25	
			−40°C to +125°C			40	

## 5.7 Electrical Characteristics ( $\pm 15$ V Dual Supply) (続き)

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$  GND = 0 V (unless otherwise noted)

Typical at  $V_{DD} = +15\text{ V}$ ,  $V_{SS} = -15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$I_{SS}$	$V_{SS}$ supply current	$V_{DD} = 16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$ All switches ON	25°C		340	380	$\mu\text{A}$
			-40°C to +85°C			410	
			-40°C to +125°C			425	

(1) When  $V_S$  is positive,  $V_D$  is negative, or when  $V_S$  is negative,  $V_D$  is positive.

(2) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.



## 5.8 Switching Characteristics (±15 V Dual Supply)

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ , GND = 0 V (unless otherwise noted)

Typical at  $V_{DD} = +15\text{ V}$ ,  $V_{SS} = -15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-on time from control input	$V_S = 10\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		2.0	2.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			2.75	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			3	$\mu\text{s}$
$t_{OFF}$	Turn-off time from control input	$V_S = 10\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		1.7	2.2	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			2.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			3	$\mu\text{s}$
$t_{BBM}$	Break-before-make time delay	$V_S = 10\text{ V}$ , $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		310		ns
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$	125			ns
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$	125			ns
$Q_{INJ}$	Charge injection	$V_S = 0\text{ V}$ , $C_L = 100\text{ pF}$	$25^\circ\text{C}$		-2		pC
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		-105		dB
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-74		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		-114		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-105		dB
BW	-3dB Bandwidth	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$	$25^\circ\text{C}$		180		MHz
$I_L$	Insertion loss	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-0.095		dB
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP} = 0.62\text{ V}$ on $V_{DD}$ and $V_{SS}$ $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-80		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 15\text{ V}$ , $V_{BIAS} = 0\text{ V}$ $R_L = 110\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$	$25^\circ\text{C}$		0.0006		%
$C_{S(OFF)}$	Source off capacitance to ground	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		27		pF
$C_{D(OFF)}$	Drain off capacitance to ground	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		27		pF
$C_{S(ON)}$ , $C_{D(ON)}$	On capacitance to ground	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		22		pF

## 5.9 Electrical Characteristics (±20 V Dual Supply)

$V_{DD} = +20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ , GND = 0 V (unless otherwise noted)

Typical at  $V_{DD} = +20\text{ V}$ ,  $V_{SS} = -20\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R <sub>ON</sub>	On-resistance	V <sub>S</sub> = −15 V to +15 V I <sub>D</sub> = −10 mA	25°C		1.1	1.4	Ω
			−40°C to +50°C			1.6	
			−40°C to +85°C			1.9	
			−40°C to +125°C			2.2	
ΔR <sub>ON</sub>	On-resistance mismatch between channels	V <sub>S</sub> = −15 V to +15 V I <sub>D</sub> = −10 mA	25°C		0.007		Ω
			−40°C to +50°C			0.04	
			−40°C to +85°C			0.05	
			−40°C to +125°C			0.06	
R <sub>ON FLAT</sub>	On-resistance flatness	V <sub>S</sub> = −15 V to +15 V I <sub>D</sub> = −10 mA	25°C		0.006		Ω
			−40°C to +50°C			0.065	
			−40°C to +85°C			0.070	
			−40°C to +125°C			0.075	
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 0 V, I <sub>S</sub> = −10 mA	−40°C to +125°C		0.005		Ω/°C
I <sub>S(OFF)</sub>	Source off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V Switch state is off V <sub>S</sub> = +15 V / −15 V V <sub>D</sub> = −15 V / +15 V	25°C	−0.16	0.012	0.16	nA
			−40°C to +50°C	−0.6	0.05	0.6	
			−40°C to +85°C	−5	0.3	5	
			−40°C to +125°C	−40	1.8	40	
I <sub>D(OFF)</sub>	Drain off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V Switch state is off V <sub>S</sub> = +15 V / −15 V V <sub>D</sub> = −15 V / +15 V	25°C	−0.16	0.012	0.16	nA
			−40°C to +50°C	−0.6	0.05	0.6	
			−40°C to +85°C	−5	0.3	5	
			−40°C to +125°C	−40	1.8	40	
I <sub>S(ON)</sub> I <sub>D(ON)</sub>	Channel on leakage current <sup>(2)</sup>	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V Switch state is on V <sub>S</sub> = V <sub>D</sub> = ±15 V	25°C	−0.35	0.0045	0.35	nA
			−40°C to +50°C	−0.45		0.45	
			−40°C to +85°C	−0.6		0.6	
			−40°C to +125°C	−6.5		6.5	
POWER SUPPLY							
I <sub>DDQ</sub>	V <sub>DD</sub> quiescent supply current	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V All switches OFF	25°C		35	45	μA
			−40°C to +85°C			55	
			−40°C to +125°C			75	
I <sub>DD</sub>	V <sub>DD</sub> supply current	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V All switches ON	25°C		435	480	μA
			−40°C to +85°C			520	
			−40°C to +125°C			545	
I <sub>SSQ</sub>	V <sub>SS</sub> quiescent supply current	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V All switches OFF	25°C		15	20	μA
			−40°C to +85°C			30	
			−40°C to +125°C			40	
I <sub>SS</sub>	V <sub>SS</sub> supply current	V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V All switches ON	25°C		340	400	μA
			−40°C to +85°C			425	
			−40°C to +125°C			450	

(1) When  $V_S$  is positive,  $V_D$  is negative, or when  $V_S$  is negative,  $V_D$  is positive.

(2) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

## 5.10 Switching Characteristics (±20 V Dual Supply)

$V_{DD} = +20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

Typical at  $V_{DD} = +20\text{ V}$ ,  $V_{SS} = -20\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-on time from control input	$V_S = 10\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		2	2.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			2.9	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			3	$\mu\text{s}$
$t_{OFF}$	Turn-off time from control input	$V_S = 10\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		1.8	2.2	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			2.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			2.8	$\mu\text{s}$
$t_{BBM}$	Break-before-make time delay	$V_S = 10\text{ V}$ , $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		320		ns
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$	150			ns
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$	150			ns
$Q_{INJ}$	Charge injection	$V_S = 0\text{ V}$ , $C_L = 100\text{ pF}$	$25^\circ\text{C}$		-3		pC
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		-105		dB
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-76		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		-114		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-105		dB
BW	-3dB Bandwidth	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$	$25^\circ\text{C}$		200		MHz
$I_L$	Insertion loss	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-0.093		dB
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP} = 0.62\text{ V}$ on $V_{DD}$ and $V_{SS}$ $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-76		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 20\text{ V}$ , $V_{BIAS} = 0\text{ V}$ $R_L = 110\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$	$25^\circ\text{C}$		0.0003		%
$C_{S(OFF)}$	Source off capacitance to ground	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		24		pF
$C_{D(OFF)}$	Drain off capacitance to ground	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		24		pF
$C_{S(ON)}$ , $C_{D(ON)}$	On capacitance to ground	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		21		pF

## 5.11 Electrical Characteristics (+37.5 V/–12.5 V Dual Supply)

$V_{DD} = +37.5\text{ V} - 10\%$ ,  $V_{SS} = -12.5\text{ V} - 10\%$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

Typical at  $V_{DD} = +37.5\text{ V} - 10\%$ ,  $V_{SS} = -12.5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R <sub>ON</sub>	On-resistance	V <sub>S</sub> = −7.5 V to 32.5 V I <sub>D</sub> = −10 mA	25°C		1.1	1.35	Ω
			−40°C to +50°C			1.6	
			−40°C to +85°C			1.8	
			−40°C to +125°C			2.1	
ΔR <sub>ON</sub>	On-resistance mismatch between channels	V <sub>S</sub> = −7.5 V to 32.5 V I <sub>D</sub> = −10 mA	25°C		0.005		Ω
			−40°C to +50°C			0.055	
			−40°C to +85°C			0.065	
			−40°C to +125°C			0.07	
R <sub>ON FLAT</sub>	On-resistance flatness	V <sub>S</sub> = −7.5 V to 32.5 V I <sub>D</sub> = −10 mA	25°C		0.006		Ω
			−40°C to +50°C			0.075	
			−40°C to +85°C			0.080	
			−40°C to +125°C			0.085	
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 0 V, I <sub>S</sub> = −10 mA	−40°C to +125°C		0.006		Ω/°C
I <sub>S(OFF)</sub>	Source off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V Switch state is off V <sub>S</sub> = 32.5 V / −7.5 V V <sub>D</sub> = −7.5 V / 32.5 V	25°C	−0.3	0.021	0.3	nA
			−40°C to +50°C	−0.8	0.07	0.8	
			−40°C to +85°C	−6	0.4	6	
			−40°C to +125°C	−50	2.9	50	
I <sub>D(OFF)</sub>	Drain off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V Switch state is off V <sub>S</sub> = 32.5 V / −7.5 V V <sub>D</sub> = −7.5 V / 32.5 V	25°C	−0.3	0.021	0.3	nA
			−40°C to +50°C	−0.8	0.07	0.8	
			−40°C to +85°C	−6	0.4	6	
			−40°C to +125°C	−50	2.9	50	
I <sub>S(ON)</sub> I <sub>D(ON)</sub>	Channel on leakage current <sup>(2)</sup>	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V Switch state is on V <sub>S</sub> = V <sub>D</sub> = 32.5 V or −7.5 V	25°C	−0.35	0.02	0.35	nA
			−40°C to +50°C	−0.45		0.45	
			−40°C to +85°C	−1.1		1.1	
			−40°C to +125°C	−8		8	
ΔI <sub>S(ON)</sub> ΔI <sub>D(ON)</sub>	Leakage current mismatch between channels <sup>(2)</sup>	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V Switch state is on V <sub>S</sub> = V <sub>D</sub> = 32.5 V or −7.5 V	25°C		1.1		pA
			−40°C to +50°C		2.1		
			−40°C to +85°C		4		
			−40°C to +125°C		12.1		
POWER SUPPLY							
I <sub>DDQ</sub>	V <sub>DD</sub> quiescent supply current	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V All switches OFF	25°C		38	50	μA
			−40°C to +85°C			60	
			−40°C to +125°C			75	
I <sub>DD</sub>	V <sub>DD</sub> supply current	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V All switches ON	25°C		435	480	μA
			−40°C to +85°C			520	
			−40°C to +125°C			545	
I <sub>SSQ</sub>	V <sub>SS</sub> quiescent supply current	V <sub>DD</sub> = 37.5 V, V <sub>SS</sub> = -12.5 V All switches OFF	25°C		17	25	μA
			−40°C to +85°C			30	
			−40°C to +125°C			45	

## 5.11 Electrical Characteristics (+37.5 V/–12.5 V Dual Supply) (続き)

$V_{DD} = +37.5\text{ V} - 10\%$ ,  $V_{SS} = -12.5\text{ V} - 10\%$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

Typical at  $V_{DD} = +37.5\text{ V} - 10\%$ ,  $V_{SS} = -12.5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$I_{SS}$	$V_{SS}$ supply current	$V_{DD} = 37.5\text{ V}$ , $V_{SS} = -12.5\text{ V}$ All switches ON	25°C		340	380	$\mu\text{A}$
			–40°C to +85°C			400	
			–40°C to +125°C			430	

- (1) When  $V_S$  is positive,  $V_D$  is negative, or when  $V_S$  is negative,  $V_D$  is positive.
- (2) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

## 5.12 Switching Characteristics (+37.5 V/–12.5 V Dual Supply)

$V_{DD} = +37.5\text{ V} \pm 10\%$ ,  $V_{SS} = -12.5\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

Typical at  $V_{DD} = +37.5\text{ V} \pm 10\%$ ,  $V_{SS} = -12.5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-on time from control input	$V_S = 10\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		2.1	3	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			3.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			4	$\mu\text{s}$
$t_{OFF}$	Turn-off time from control input	$V_S = 10\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		1.74	2	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			2.1	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			2.5	$\mu\text{s}$
$t_{BBM}$	Break-before-make time delay	$V_S = 10\text{ V}$ , $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		350		ns
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$	310			ns
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$	300			ns
$Q_{INJ}$	Charge injection	$V_S = 12.5\text{ V}$ , $C_L = 100\text{ pF}$	$25^\circ\text{C}$		6.5		pC
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 12.5\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		–105		dB
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 12.5\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		–75		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 12.5\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		–110		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 12.5\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		–100		dB
BW	–3dB Bandwidth	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 12.5\text{ V}$	$25^\circ\text{C}$		200		MHz
$I_L$	Insertion loss	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 12.5\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		–0.093		dB
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP} = 0.62\text{ V}$ on $V_{DD}$ and $V_{SS}$ $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		–80		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 15\text{ V}$ , $V_{BIAS} = 0\text{ V}$ $R_L = 110\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$	$25^\circ\text{C}$		0.0005		%
$C_{S(OFF)}$	Source off capacitance to ground	$V_S = 12.5\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		24		pF
$C_{D(OFF)}$	Drain off capacitance to ground	$V_S = 12.5\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		24		pF
$C_{S(ON)}$ , $C_{D(ON)}$	On capacitance to ground	$V_S = 12.5\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		21		pF

### 5.13 Electrical Characteristics (12 V Single Supply)

$V_{DD} = +12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$  (unless otherwise noted)  
Typical at  $V_{DD} = +12\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R <sub>ON</sub>	On-resistance	V <sub>S</sub> = 3 V to 9 V I <sub>D</sub> = −10 mA	25°C		1.15	1.6	Ω
			−40°C to +50°C			1.75	
			−40°C to +85°C			2	
			−40°C to +125°C			2.3	
ΔR <sub>ON</sub>	On-resistance mismatch between channels	V <sub>S</sub> = 3 V to 9 V I <sub>D</sub> = −10 mA	25°C		0.005		Ω
			−40°C to +50°C			0.05	
			−40°C to +85°C			0.05	
			−40°C to +125°C			0.05	
R <sub>ON FLAT</sub>	On-resistance flatness	V <sub>S</sub> = 3 V to 9 V I <sub>D</sub> = −10 mA	25°C		0.084		Ω
			−40°C to +50°C			0.13	
			−40°C to +85°C			0.15	
			−40°C to +125°C			0.16	
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 0 V, I <sub>S</sub> = −10 mA	−40°C to +125°C		0.006		Ω/°C
I <sub>S(OFF)</sub>	Source off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 12 V, V <sub>SS</sub> = 0 V Switch state is off V <sub>S</sub> = 1 V / 10 V V <sub>D</sub> = 10 V / 1 V	25°C	−0.07	0.0035	0.07	nA
			−40°C to +50°C	−0.16		0.16	
			−40°C to +85°C	−0.6		0.6	
			−40°C to +125°C	−12		12	
I <sub>D(OFF)</sub>	Drain off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 12 V, V <sub>SS</sub> = 0 V Switch state is off V <sub>S</sub> = 1 V / 10 V V <sub>D</sub> = 10 V / 1 V	25°C	−0.07	0.0027	0.07	nA
			−40°C to +50°C	−0.16		0.16	
			−40°C to +85°C	−0.6		0.6	
			−40°C to +125°C	−12		12	
I <sub>S(ON)</sub> I <sub>D(ON)</sub>	Channel on leakage current <sup>(2)</sup>	V <sub>DD</sub> = 12 V, V <sub>SS</sub> = 0 V Switch state is on V <sub>S</sub> = V <sub>D</sub> = 1 V or 10 V	25°C	−0.3	0.003	0.3	nA
			−40°C to +50°C	−0.4		0.4	
			−40°C to +85°C	−0.5		0.5	
			−40°C to +125°C	−6		6	
POWER SUPPLY							
I <sub>DDQ</sub>	V <sub>DD</sub> quiescent supply current	V <sub>DD</sub> = 12 V, V <sub>SS</sub> = 0 V All switches OFF	25°C		30	40	μA
			−40°C to +85°C			45	
			−40°C to +125°C			55	
I <sub>DD</sub>	V <sub>DD</sub> supply current	V <sub>DD</sub> = 12 V, V <sub>SS</sub> = 0 V All switches ON	25°C		385	440	μA
			−40°C to +85°C			470	
			−40°C to +125°C			480	

(1) When  $V_S$  is positive,  $V_D$  is negative, or when  $V_S$  is negative,  $V_D$  is positive.

(2) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

## 5.14 Switching Characteristics (12 V Single Supply)

$V_{DD} = +12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

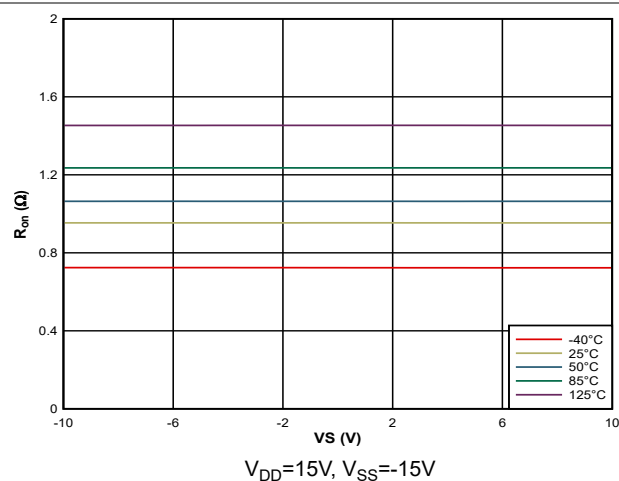
Typical at  $V_{DD} = +12\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-on time from control input	$V_S = 8\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		2	2.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			3	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			3.5	$\mu\text{s}$
$t_{OFF}$	Turn-off time from control input	$V_S = 8\text{ V}$ $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		1.7	2.2	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$			2.5	$\mu\text{s}$
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$			3	$\mu\text{s}$
$t_{BBM}$	Break-before-make time delay	$V_S = 8\text{ V}$ , $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$	$25^\circ\text{C}$		320		ns
			$-40^\circ\text{C}$ to $+85^\circ\text{C}$	160			ns
			$-40^\circ\text{C}$ to $+125^\circ\text{C}$	160			ns
$Q_{INJ}$	Charge injection	$V_S = 6\text{ V}$ , $C_L = 100\text{ pF}$	$25^\circ\text{C}$		4		pC
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 6\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		-100		dB
$O_{ISO}$	Off-isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 6\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-70		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 6\text{ V}$ , $f = 100\text{ kHz}$	$25^\circ\text{C}$		-114		dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 6\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-105		dB
BW	-3dB Bandwidth	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 6\text{ V}$	$25^\circ\text{C}$		165		MHz
$I_L$	Insertion loss	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $V_S = 200\text{ mV}_{RMS}$ , $V_{BIAS} = 6\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-0.095		dB
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP} = 0.62\text{ V}$ on $V_{DD}$ and $V_{SS}$ $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		-78		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 6\text{ V}$ , $V_{BIAS} = 6\text{ V}$ $R_L = 110\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$	$25^\circ\text{C}$		0.0095		%
$C_{S(OFF)}$	Source off capacitance to ground	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		37		pF
$C_{D(OFF)}$	Drain off capacitance to ground	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		37		pF
$C_{S(ON)}$ , $C_{D(ON)}$	On capacitance to ground	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$	$25^\circ\text{C}$		27		pF

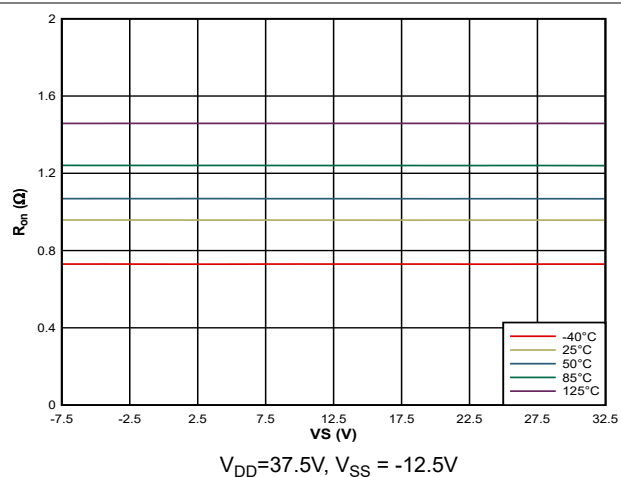


## 5.15 Typical Characteristics

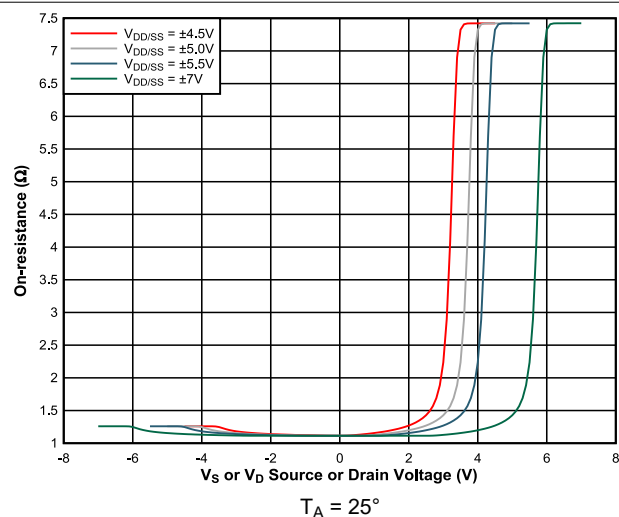
at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)



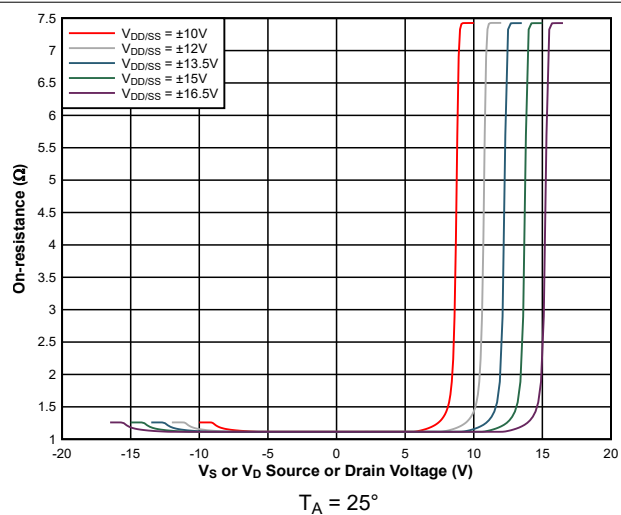
5-1. On-Resistance vs Source or Drain Operational Voltage



5-2. On-Resistance vs Source or Drain Operational Voltage



5-3. On-Resistance vs Source or Drain Voltage for dual supply



5-4. On-Resistance vs Source or Drain Voltage for dual supply

## 5.15 Typical Characteristics (continued)

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

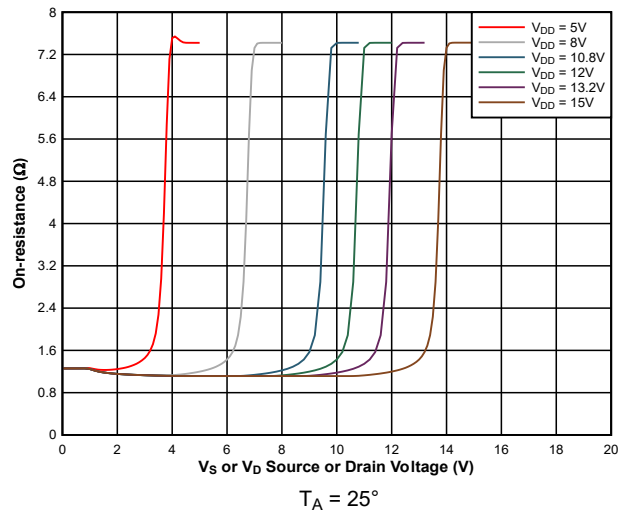


Figure 5-5. On-Resistance vs Source or Drain Voltage for single supply

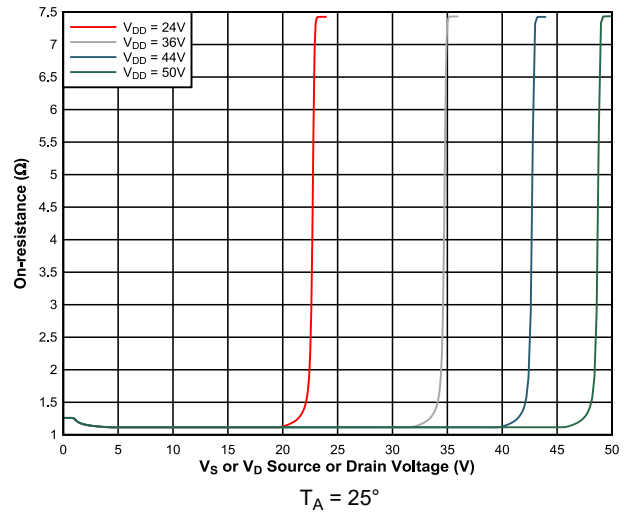


Figure 5-6. On-Resistance vs Source or Drain Voltage

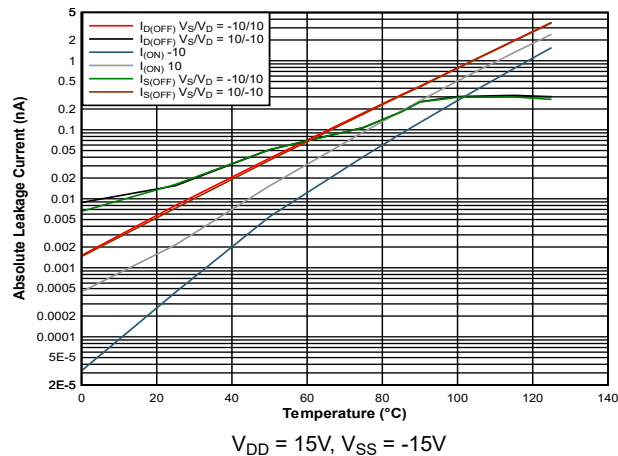


Figure 5-7. Leakage Current vs Temperature

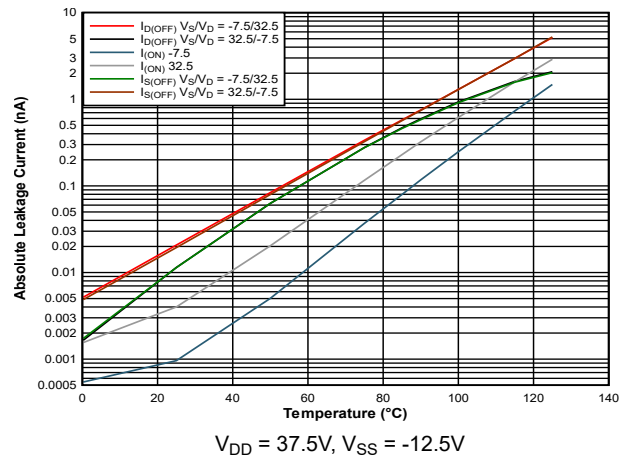


Figure 5-8. Leakage Current vs Temperature

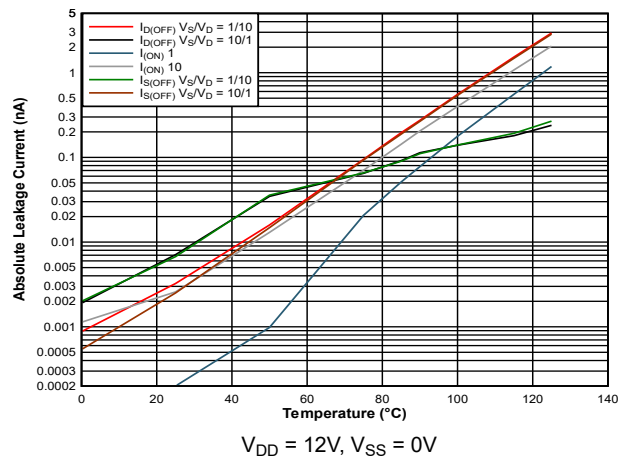


Figure 5-9. Leakage Current vs Temperature

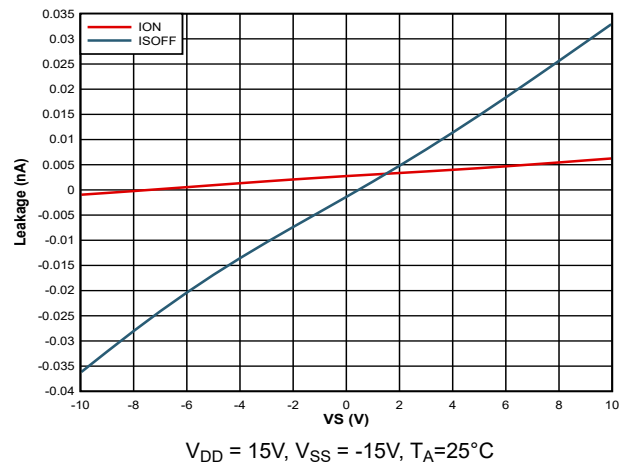
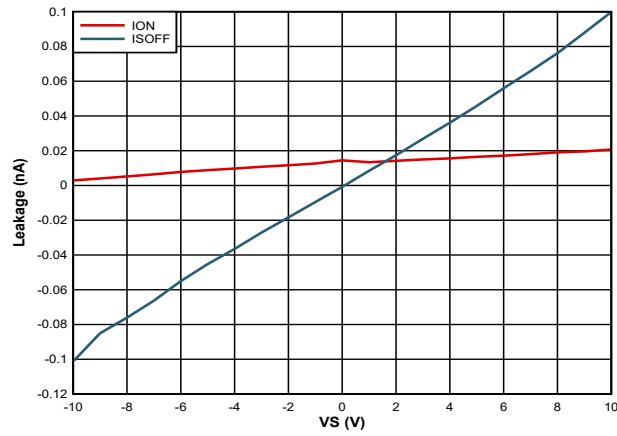


Figure 5-10. Leakage Current vs  $V_S$

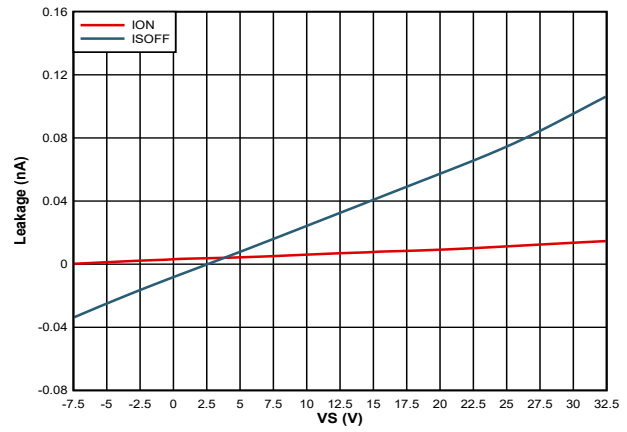
## 5.15 Typical Characteristics (continued)

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



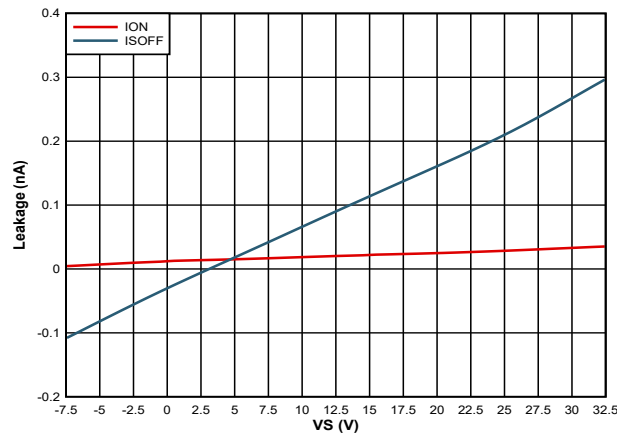
$V_{DD} = 15\text{V}$ ,  $V_{SS} = -15\text{V}$ ,  $T_A = 50^\circ\text{C}$

図 5-11. Leakage Current vs  $V_S$



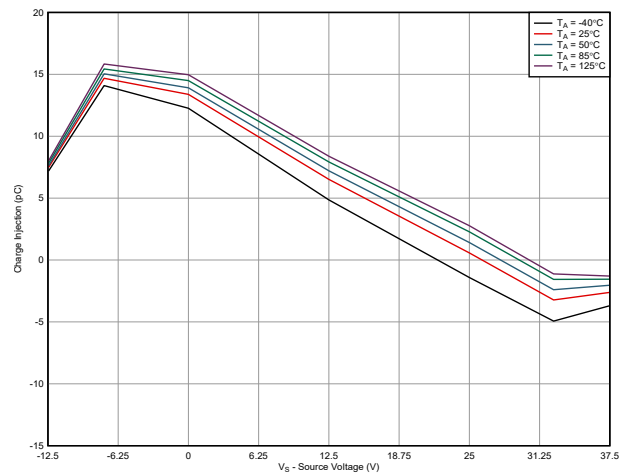
$V_{DD} = 37.5\text{V}$ ,  $V_{SS} = -12.5\text{V}$ ,  $T_A = 25^\circ\text{C}$

図 5-12. Leakage Current vs Temperature



$V_{DD} = 37.5\text{V}$ ,  $V_{SS} = -12.5\text{V}$ ,  $T_A = 50^\circ\text{C}$

図 5-13. Leakage Current vs Temperature



$V_{DD} = 37.5\text{V}$ ,  $V_{SS} = -12.5\text{V}$

図 5-14. Charge Injection vs Source Voltage

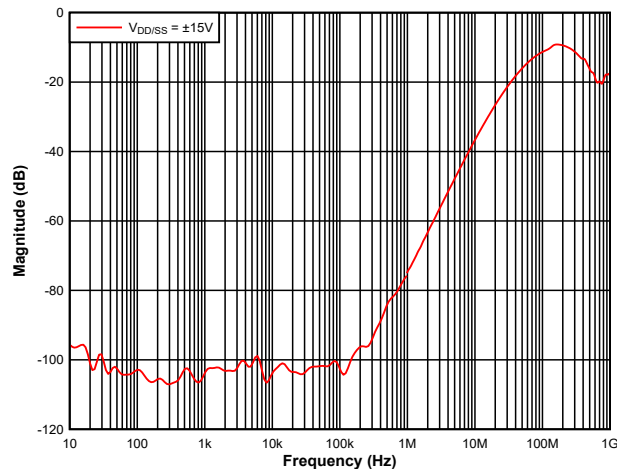


図 5-15. Off-Isolation vs Frequency

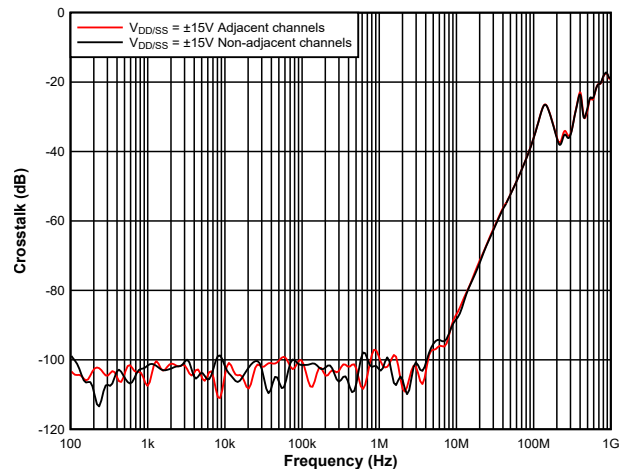


図 5-16. Crosstalk vs Frequency

## 5.15 Typical Characteristics (continued)

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

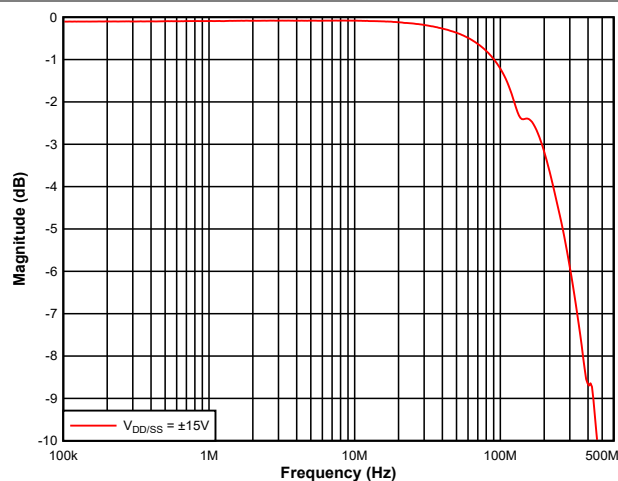


图 5-17. Bandwidth vs Frequency

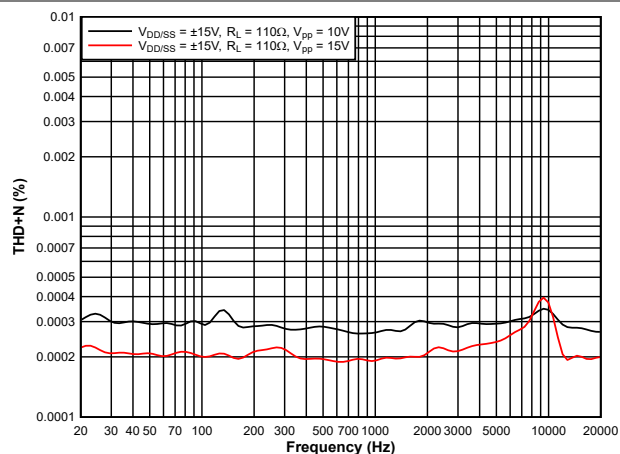


图 5-18. THD+N vs Frequency

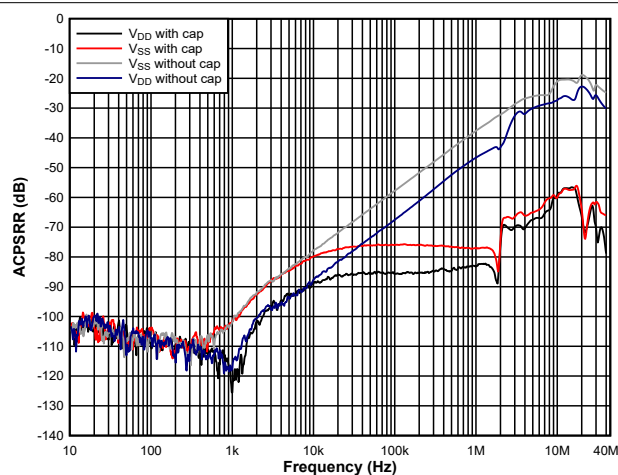
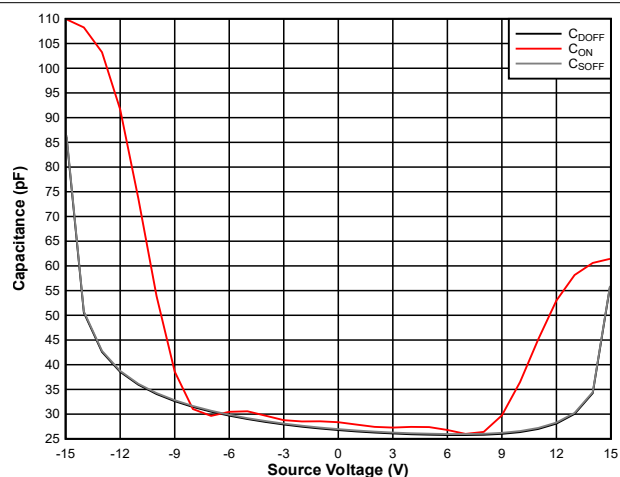


图 5-19. ACPSRR vs Frequency



$V_{DD} = 15\text{V}$ ,  $V_{SS} = -15\text{V}$

图 5-20. Capacitance vs Source or Drain Voltage

## 6 Parameter Measurement Information

### 6.1 On-Resistance

The on-resistance of a device is the ohmic resistance between the source (Sx) and drain (Dx) pins of the device. The on-resistance varies with input voltage and supply voltage. The symbol  $R_{ON}$  is used to denote on-resistance. Figure 6-1 shows the measurement setup used to measure  $R_{ON}$ . Voltage (V) and current ( $I_{SD}$ ) are measured using this setup, and  $R_{ON}$  is computed with  $R_{ON} = V / I_{SD}$ :

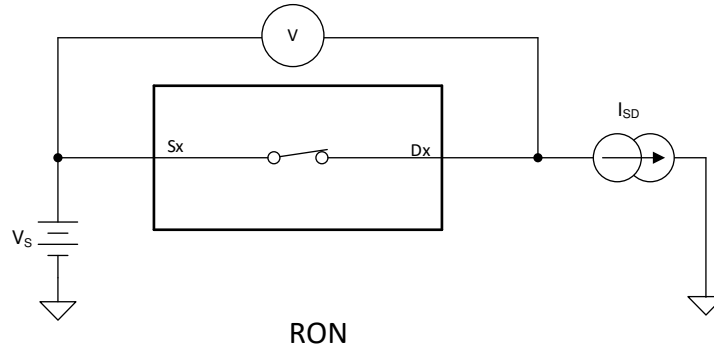


Figure 6-1. On-Resistance Measurement Setup

### 6.2 Off-Leakage Current

There are two types of leakage currents associated with a switch during the off state:

1. Source off-leakage current.
2. Drain off-leakage current.

Source leakage current is defined as the leakage current flowing into or out of the source pin when the switch is off. This current is denoted by the symbol  $I_{S(OFF)}$ .

Drain leakage current is defined as the leakage current flowing into or out of the drain pin when the switch is off. This current is denoted by the symbol  $I_{D(OFF)}$ .

Figure 6-2 shows the setup used to measure both off-leakage currents.

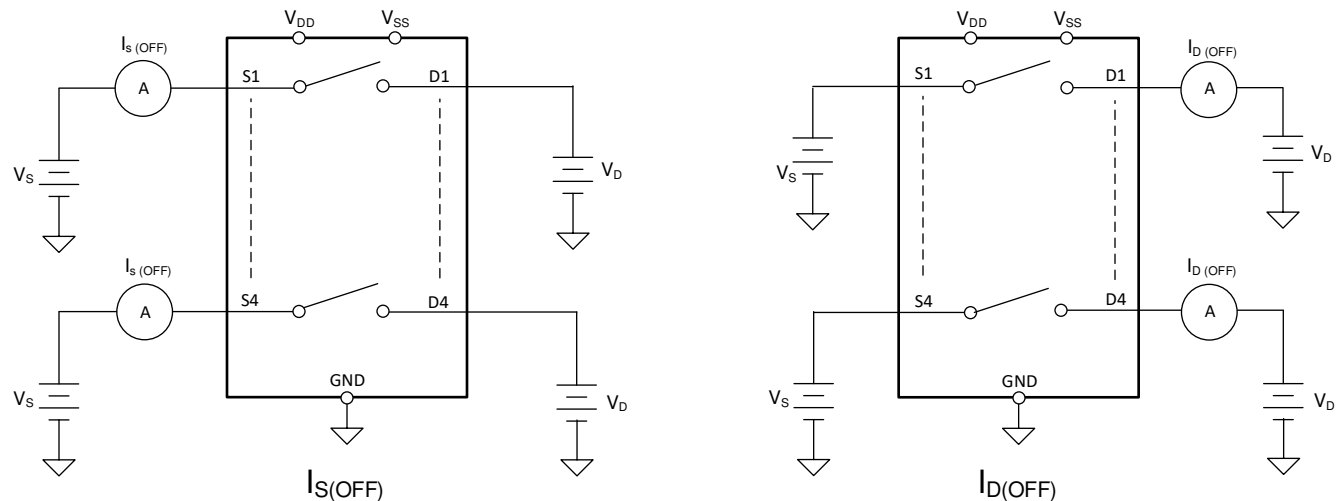



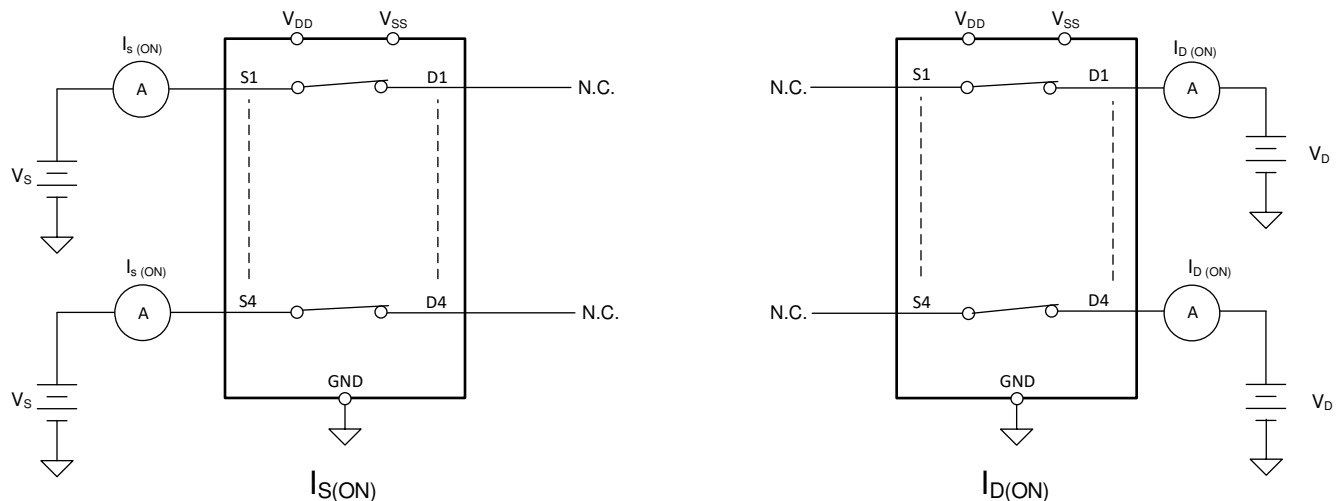
Figure 6-2. Off-Leakage Measurement Setup

### 6.3 On-Leakage Current

Source on-leakage current is defined as the leakage current flowing into or out of the source pin when the switch is on. This current is denoted by the symbol  $I_{S(ON)}$ .


Drain on-leakage current is defined as the leakage current flowing into or out of the drain pin when the switch is on. This current is denoted by the symbol  $I_{D(ON)}$ .


Either the source pin or drain pin is left floating during the measurement.  6-3 shows the circuit used for measuring the on-leakage current, denoted by  $I_{S(ON)}$  or  $I_{D(ON)}$ .

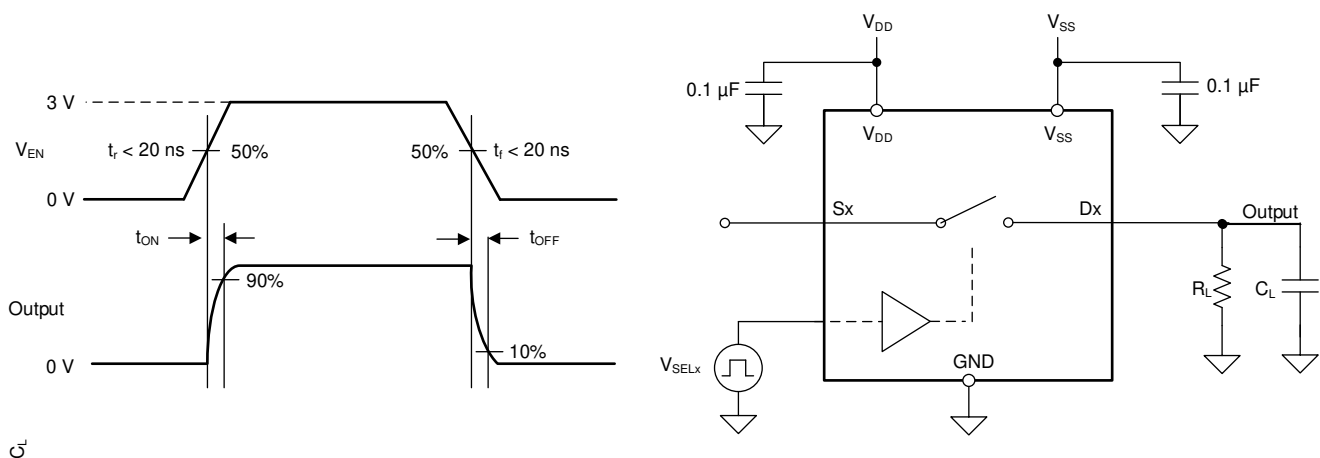


 6-3. On-Leakage Measurement Setup

### 6.4 $t_{ON}$ and $t_{OFF}$ Time

Turn-on time is defined as the time taken by the output of the device to rise to 90% after the enable has risen past the logic threshold. The 90% measurement is utilized to provide the timing of the device. System level timing can then account for the time constant added from the load resistance and load capacitance.  6-4 shows the setup used to measure turn-on time, denoted by the symbol  $t_{ON}$ .

Turn-off time is defined as the time taken by the output of the device to fall to 10% after the enable has fallen past the logic threshold. The 10% measurement is utilized to provide the timing of the device. System level timing can then account for the time constant added from the load resistance and load capacitance.  6-4 shows the setup used to measure turn-off time, denoted by the symbol  $t_{OFF}$ .



 6-4. Turn-On and Turn-Off Time Measurement Setup

## 6.5 Propagation Delay

Propagation delay is defined as the time taken by the output of the device to rise or fall 50% after the input signal has risen or fallen past the 50% threshold. 図 6-5 shows the setup used to measure propagation delay, denoted by the symbol  $t_{PD}$ .

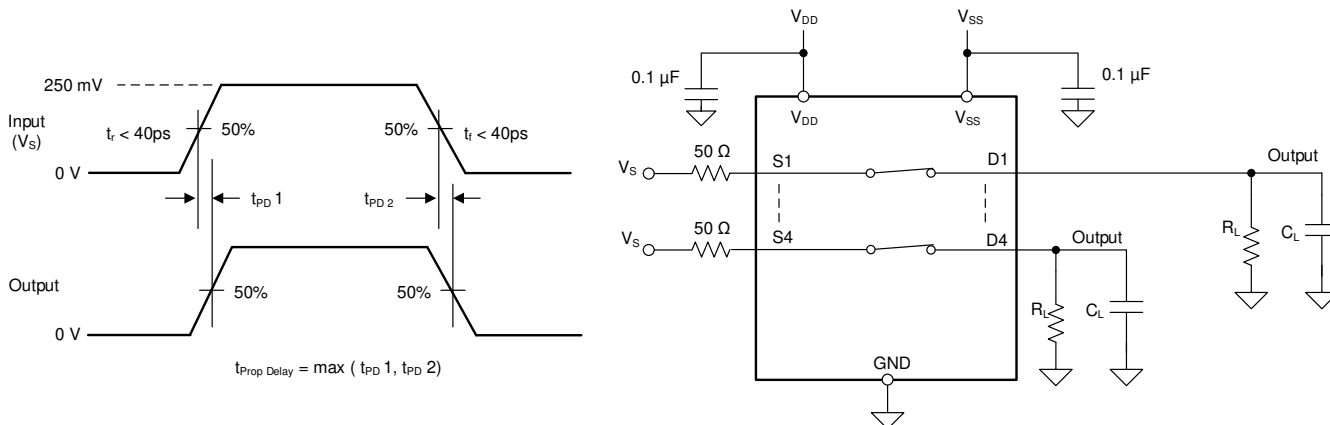
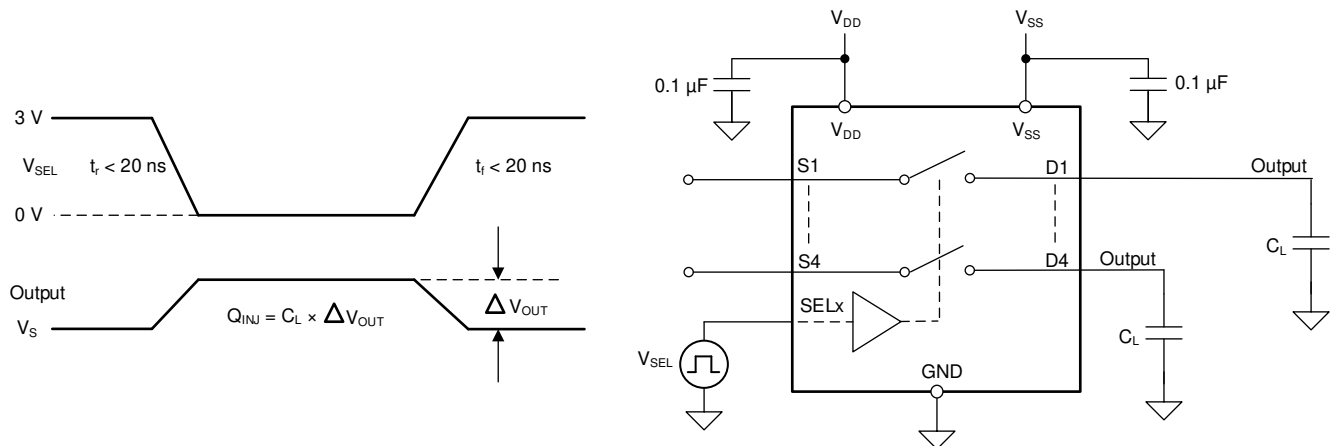


図 6-5. Propagation Delay Measurement Setup

## 6.6 Charge Injection

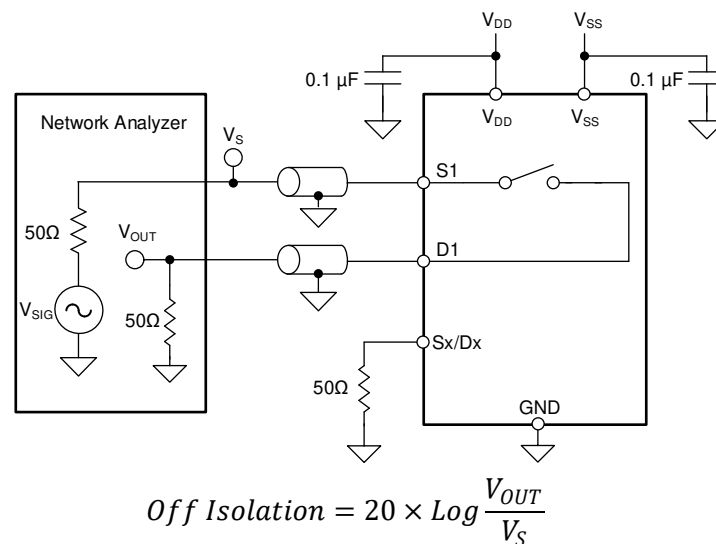
This device has a transmission-gate topology. Any mismatch in capacitance between the NMOS and PMOS transistors results in a charge injected into the drain or source during the falling or rising edge of the gate signal. The amount of charge injected into the source or drain of the device is known as charge injection, and is denoted by the symbol  $Q_C$ . 6-6 shows the setup used to measure charge injection from source ( $S_x$ ) to drain ( $D_x$ ).



6-6. Charge-Injection Measurement Setup

## 6.7 Off Isolation

Off isolation is defined as the ratio of the signal at the drain pin ( $D_x$ ) of the device when a signal is applied to the source pin ( $S_x$ ) of an off-channel. The characteristic impedance,  $Z_0$ , for the measurement is 50  $\Omega$ . 6-7 shows the setup used to measure off isolation. Use off isolation equation to compute off isolation.

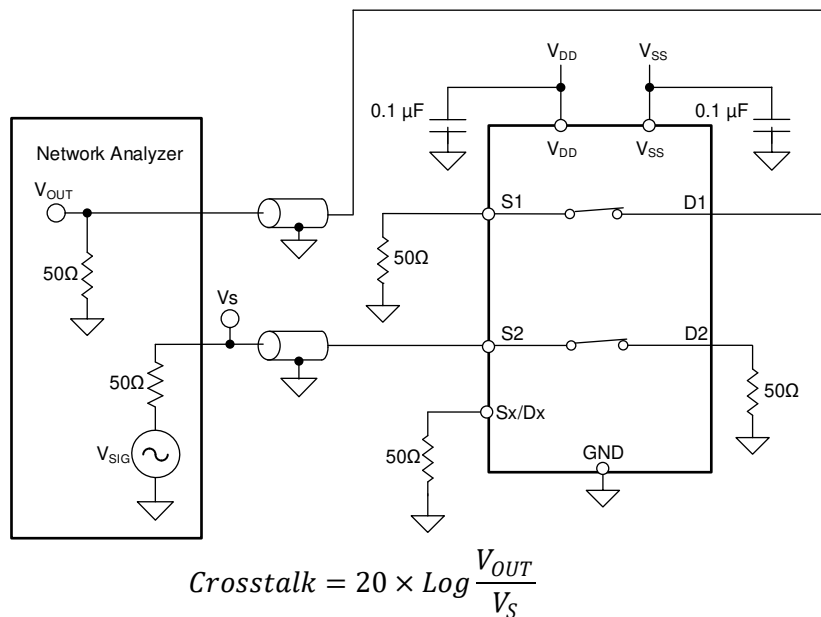


6-7. Off Isolation Measurement Setup



## 6.8 Channel-to-Channel Crosstalk

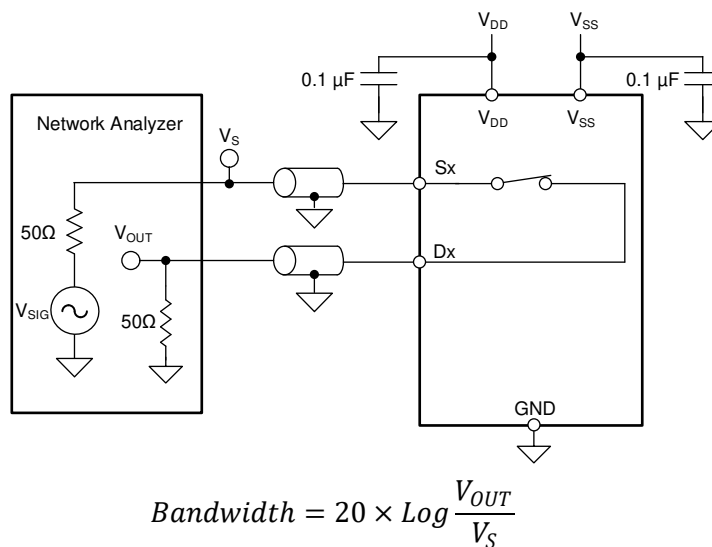
Crosstalk is defined as the ratio of the signal at the drain pin (Dx) of a different channel, when a signal is applied at the source pin (Sx) of an on-channel. The characteristic impedance,  $Z_0$ , for the measurement is 50  $\Omega$ . 6-8 shows the setup used to measure, and the equation used to compute crosstalk.



6-8. Channel-to-Channel Crosstalk Measurement Setup

## 6.9 Bandwidth

Bandwidth is defined as the range of frequencies that are attenuated by less than 3 dB when the input is applied to the source pin (Sx) of an on-channel, and the output is measured at the drain pin (Dx) of the device. The characteristic impedance,  $Z_0$ , for the measurement is 50  $\Omega$ . 6-9 shows the setup used to measure bandwidth.



6-9. Bandwidth Measurement Setup

## 6.10 THD + Noise

The total harmonic distortion (THD) of a signal is a measurement of the harmonic distortion, and is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency at the mux output. The on-resistance of the device varies with the amplitude of the input signal and results in distortion when the drain pin is connected to a low-impedance load. Total harmonic distortion plus noise is denoted as THD + N.

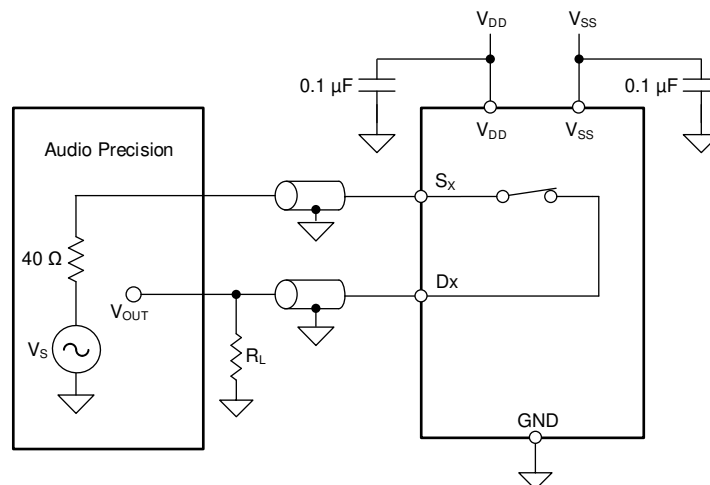


Figure 6-10. THD + N Measurement Setup

## 6.11 Power Supply Rejection Ratio (PSRR)

PSRR measures the ability of a device to prevent noise and spurious signals that appear on the supply voltage pin from coupling to the output of the switch. The DC voltage on the device supply is modulated by a sine wave of 100 mV<sub>PP</sub>. The ratio of the amplitude of signal on the output to the amplitude of the modulated signal is the AC PSRR.

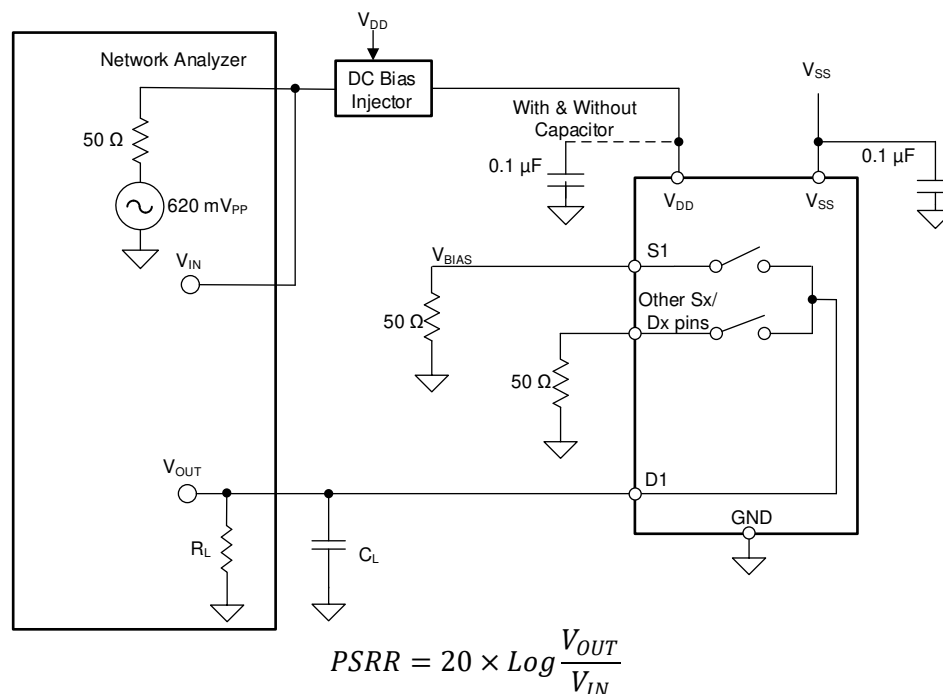


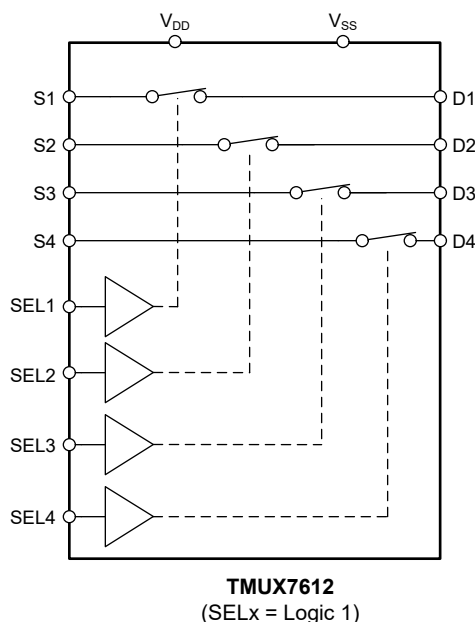
Figure 6-11. AC PSRR Measurement Setup

## 7 Detailed Description

### 7.1 Overview

TMUX7612 is a 1:1 (SPST), 4-channel switch. This device has four independently selectable single-pole, single-throw switches that are turned-on or turned-off based on the state of the corresponding select pin. This device works well with dual supplies, a single supply, or asymmetric supplies such as  $V_{DD} = 37.5V$ ,  $V_{SS} = -12.5V$ .

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Bidirectional Operation

The TMUX7612 conducts equally well from source (Sx) to drain (Dx) or from drain (Dx) to source (Sx). Each channel has similar characteristics in both directions and supports both analog and digital signals.

#### 7.3.2 Rail-to-Rail Operation

The valid signal path input and output voltage for TMUX7612 ranges from  $V_{SS}$  to  $V_{DD}$ .

#### 7.3.3 1.8 V Logic Compatible Inputs

The TMUX7612 has 1.8-V logic compatible control for all logic control inputs. 1.8-V logic level inputs allows the TMUX7612 to interface with processors that have lower logic I/O rails and eliminates the need for an external translator, which saves both space and BOM cost. For more information on 1.8 V logic implementations, refer to [Simplifying Design with 1.8 V logic Muxes and Switches](#).

#### 7.3.4 Flat On-Resistance

The TMUX7612 is designed with a special switch architecture to produce ultra-flat on-resistance (RON) across most of the switch input operating region. The flat RON response allows the device to be used in precision applications since the RON is controlled regardless of the signals sampled. The architecture is implemented without a charge pump so unwanted noise is not produced from the device to affect sampling accuracy.

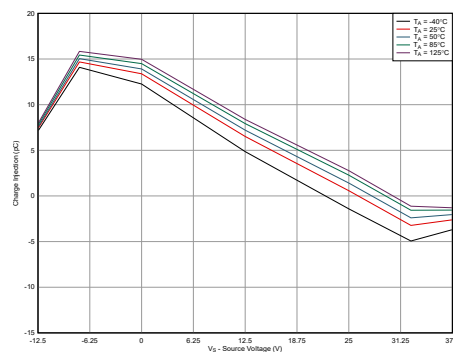
This architecture also keeps RON the same regardless of the supply voltage. The flattest on-resistance region extends roughly from 5 V above  $V_{SS}$  to 5 V below  $V_{DD}$ . As long as this headroom is maintained, the TMUX7612 exhibits an extremely linear response.

### 7.3.5 Power-Up Sequence Free

The TMUX7612 supports any power up sequencing. With the supply rails (VDD and VSS), any rail can be powered on first. Similarly, when powering down the supply rails can be powered down in any order.

### 7.3.6 Ultra-Low Charge Injection

The TMUX7612 contains specialized architecture to significantly reduce charge injection, which is consistent across supply and bias conditions. The result is a dramatic drop in AC noise when switching compared to other low on-resistance multiplexers or switches.

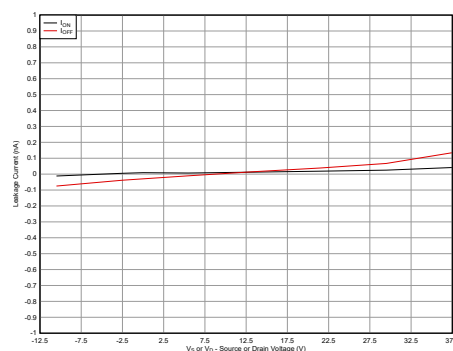


$V_{DD} = 37.5\text{ V}$ ,  $V_{SS} = -12.5\text{ V}$

Figure 7-1. Charge Injection vs Source Voltage

### 7.3.7 Ultra-Low Leakage Current

The TMUX7612 provides extremely low on-leakage and off-leakage currents. This device is capable of switching signals from high source-impedance inputs into a high input-impedance op amp with minimal offset error because of the ultra-low leakage currents. Figure 7-2 shows typical leakage currents of the TMUX7612 devices versus source or drain voltage at  $V_{DD} = 32.5\text{ V}$ ,  $V_{SS} = -12.5\text{ V}$  and  $50^\circ\text{C}$ . The typical performance seen here is less than 0.2 nA at  $50^\circ\text{C}$ , which enables the TMUX7612 to be used in a wide array of precision applications.



$V_{DD} = 37.5\text{ V}$ ,  $V_{SS} = -12.5\text{ V}$

Figure 7-2. Leakage Current at  $50^\circ\text{C}$  vs Bias Voltage

## 7.4 Device Functional Modes

The TMUX7612 has four independently selectable single-pole, single-throw switches that are turned-on or turned-off based on the state of the corresponding select pin. The control pins operate down to 1.8 V logic and can be as high as 44 V.

The TMUX7612 devices can be operated without any external components except for the supply decoupling capacitors. The SELx pins have internal pull-down resistors.

#### 7.4.1 Truth Tables

表 7-1 provides the truth table for TMUX7612.

**表 7-1. TMUX7612 Truth Table**

SEL x <sup>(1)</sup>	CHANNEL x
0	Channel x OFF
1	Channel x ON

(1) x denotes 1, 2, 3, or 4 for the corresponding channel.

## 8 Application and Implementation

### 注


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.

### 8.1 Application Information

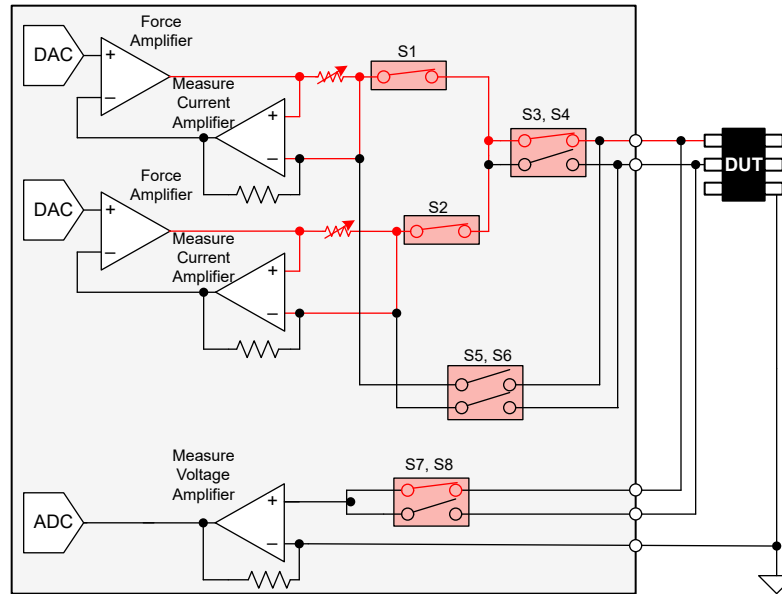
The TMUX7612 is a part of the precision switches and multiplexers family of devices. The device operates with dual supplies ( $\pm 4.5$  V to  $\pm 25$  V), a single supply (4.5 V to 50 V), or asymmetric supplies (such as  $V_{DD} = 37.5$  V,  $V_{SS} = -12.5$  V), and offers a true rail-to-rail input and output signal range. The TMUX7612 offers a low  $R_{ON}$ , low on and off leakage currents and ultra-low charge injection performance. These features make the TMUX7612 a great option for high-performance and high-voltage industrial applications.

### 8.2 Typical Application

New generation LCD test equipment often requires simultaneous high-precision, high-voltage, multi-channel measurement capabilities and minimum channel-to-channel variation during measurement.

In LCD test systems, the parametric measurement unit (PMU) is tasked to measure device (DUT) LCD driver parametric information in terms of voltage and current. To measure current, voltage is applied at the DUT pin. To measure voltage, current is applied at the DUT pin. A 4-channel SPST switch can be used to select appropriate signals in the feedback path and measurement path in the two measurement modes. The PMU typically supports a voltage range of -12 V to 35 V and can be any combination of high or low current. An appropriate switch like the TMUX7612 with low on-resistance works well in these applications to increase the capability of higher current and even PMU ganging where multiple PMU channels are connected in parallel, allowing for a higher current output.  8-1 shows a simplified diagram of such an implementation. The extremely flat on-resistance profile reduced the IR drop variation across the switch, enabling a much more streamlined calibration.

For calibration and diagnostics, the LCD test equipment also includes signals routed to the input path to confirm the system is calibrated across the life of a product or after installation. The multiplexer connects the selected signal to the appropriate pin. The TMUX7612 devices with very low  $R_{ON}$  (1.35  $\Omega$  typical) and on-leakage current (1 nA maximum) allows these devices to be used in precision measurement applications providing rail-to-rail operation suitable for high voltage testing.



**図 8-1. PMU Ganging Multiple Channels in Parallel**

### 8.2.1 Detailed Design Procedure

Figure 9-1 shows one example of how two TMUX7612 can be used to gang two PMU channels together for higher current serial measurements while keeping the option for lower current parallel measurements. Here, switches S1 and S2 are used to gang the output current of the two force amplifiers in parallel to achieve a higher current output. The measure current amplifiers sense the current over the shunt resistors as a feedback to the force amplifier. S3 and S4 are used to select the DUT (device under test) channel. S7 and S8 are switched so that the correct DUT channel voltage can be measured by the measure voltage amplifier. Finally, S5 and S6 can be used when S1, S2, S3, and S4 are open to force current on both DUT channels in parallel if the higher current is not needed. This is only a two PMU channel solution but the amount of channels can be increased to any number by adding more switches.

The TMUX7612 can support 1.8-V logic signals on the control input, allowing the device to interface with low logic controls of an FPGA or MCU. All inputs to the switch must fall within the recommend operating conditions of the TMUX7612 including signal range and continuous current. For this design with a positive supply of 37.5 V on  $V_{DD}$ , and a negative supply of -12.5 V on  $V_{SS}$ , the signal range can be 37.5 V to -12.5 V. For the best linear performance, the signal range should be held within a 5 V headroom below the positive and above the negative supplies. The maximum continuous current ( $I_{DC}$ ) can be up to 470 mA as shown in the *Recommended Operating Conditions* table for wide-range current measurement.

### 8.2.2 Design Requirements

For this design example, use the parameters listed in 表 8-1.

**表 8-1. Design Parameters**

PARAMETERS	VALUES
Supply ( $V_{DD}$ )	37.5 V
Supply ( $V_{SS}$ )	-12.5 V
Input / Output signal range	-12.5 V to 37.5 V (Rail-to-Rail operation)
	-10 V to 32.5 V (Best performance with headroom)
Max current through each channel	470 mA
Control logic thresholds	1.8 V compatible

### 8.2.3 Application Curve

TMUX7612 has excellent linearity, leakage, and charge injection performance making them an excellent choice to minimize noise and offset errors for precision applications and very low current range measurements.

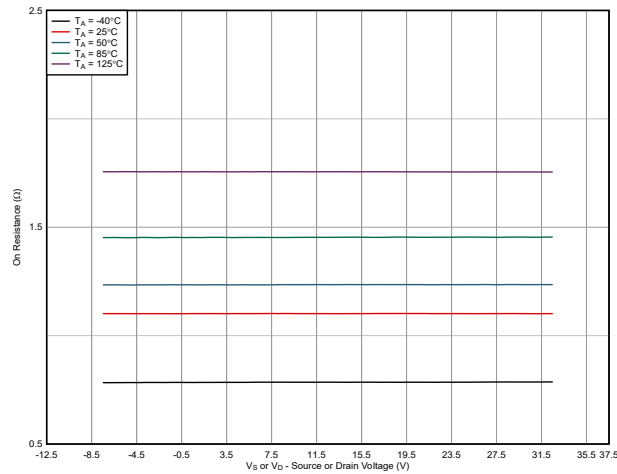


Figure 8-2. On-Resistance vs Source or Drain Voltage

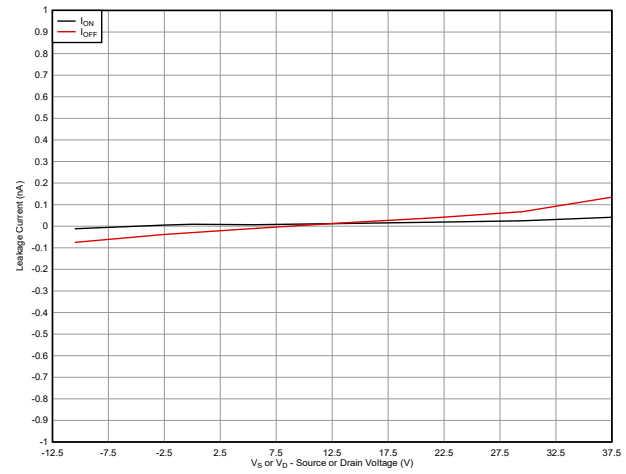


Figure 8-3. Leakage Current vs Bias Voltage

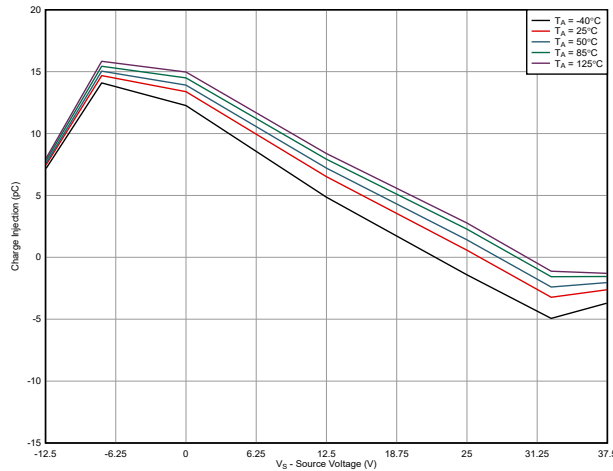


Figure 8-4. Charge Injection vs Source Voltage

### 8.3 Thermal Considerations

For analog switches in many applications, several 100s of mA of current needs to be supported through the switch (from source to drain, or NO/NC to COM). Many devices already have a maximum current specified based on ambient temperature, but if a device specifies with junction temperature or you want to calculate for your specific use case (temperature, supply voltage, channels in parallel) you can use the following equations and scheme.

There are mainly 2 limitations to this maximum current:

1. Inherent metal limitations of the device
2. Thermal self-heating limitations

To calculate maximum current for your specific setup you need the following information:



- $T_A$  = maximum ambient temperature
- $R_{\theta JA}$  = package thermal coefficients
- $R_{ON}$  = on resistance
- $n$  = number of channels in parallel
- Limitations on maximum current based on junction temperature from the datasheet

**Below is an example using TMUX7612 specifications:**

Device maximum  $T_J = 150^\circ\text{C}$

For this example we assume  $20^\circ\text{C}$  of self-heating at a maximum  $T_A = 105^\circ\text{C}$  and operating with 4 channels at once at  $\pm 15\text{V}$ . We can assume worst case  $R_{ON} = 2.2\Omega$ . This number is taken from the maximum specified value at  $T_A = 125^\circ\text{C}$  where  $T_J = 125^\circ\text{C}$  since the specification assumes no self-heating. Using the following equation we can calculate the maximum thermal limitation.

Similarly, you can calculate the  $T_J$  and total power dissipated in these examples with the following equations. Note there will be some small power dissipated from the supply current consumption of the device, which is ignored here.

$$T_J = R_{\theta JA} \times I^2 \times R_{ON} \times n + T_A \quad (1)$$

$$P_{total} = \frac{T_J - T_A}{R_{\theta JA}} \quad (2)$$

Pulse current can be calculated the same way, but using the duty cycle,  $d$ . Typically, pulse current is specified at a 10% duty cycle; however, do not exceed the maximum current provided in the pulse current table even with a shorter duty cycle.

$$I = \frac{1}{d} \sqrt{\frac{T_J - T_A}{R_{\theta JA} \times R_{ON} \times n}} \quad (3)$$

$$T_J = R_{\theta JA} \times (d \times I)^2 \times R_{ON} \times n + T_A \quad (4)$$

## 8.4 Power Supply Recommendations

The TMUX7612 device operates across a wide supply range of  $\pm 4.5\text{ V}$  to  $\pm 25\text{V}$  ( $4.5\text{ V}$  to  $50\text{V}$  in single-supply mode). The device also performs well with asymmetrical supplies such as  $V_{DD} = 37.5\text{ V}$  and  $V_{SS} = -12.5\text{ V}$ .

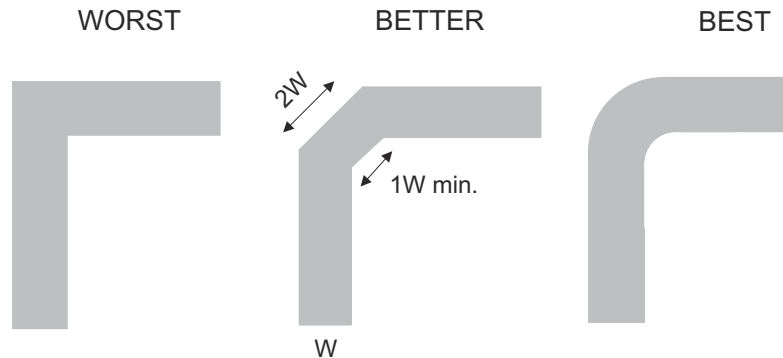
Power-supply bypassing improves noise margin and prevents switching noise propagation from the supply rails to other components. Good power-supply decoupling is important to achieve optimum performance. For improved supply noise immunity, use a supply decoupling capacitor ranging from  $0.1\text{ }\mu\text{F}$  to  $10\text{ }\mu\text{F}$  at both the  $V_{DD}$  and  $V_{SS}$  pins to ground. Place the bypass capacitors as close to the power supply pins of the device as possible using low-impedance connections. TI recommends using multi-layer ceramic chip capacitors (MLCCs) that offer low equivalent series resistance (ESR) and inductance (ESL) characteristics for power-supply decoupling purposes. For very sensitive systems, or for systems in harsh noise environments, avoiding the use of vias for connecting the capacitors to the device pins may offer superior noise immunity. The use of multiple vias in parallel lowers the overall inductance and is beneficial for connections to ground and power planes. Always make sure a solid ground (GND) connection is established before supplies are ramped.

## 8.5 Layout

### 8.5.1 Layout Guidelines

When a PCB trace turns a corner at a  $90^\circ$  angle, a reflection can occur. A reflection occurs primarily because of the change of width of the trace. At the apex of the turn, the trace width increases to 1.414 times the width. This increase upsets the transmission-line characteristics, especially the distributed capacitance and self-inductance of the trace which results in the reflection. Not all PCB traces can be straight and therefore some traces must

turn corners. 8-5 shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.



8-5. Trace Example

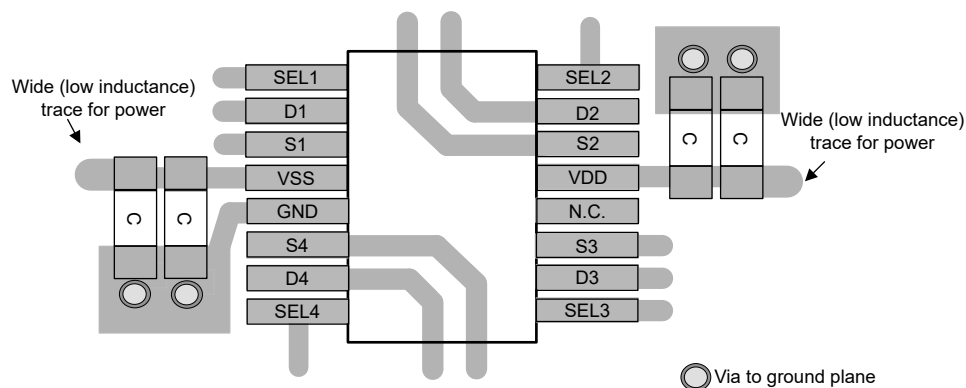
Route high-speed signals using a minimum of vias and corners which reduces signal reflections and impedance changes. When a via must be used, increase the clearance size around it to minimize its capacitance. Each via introduces discontinuities in the signal's transmission line and increases the chance of picking up interference from the other layers of the board. Be careful when designing test points, through-hole pins are not recommended at high frequencies.

8-6 shows an example of a PCB layout with the TMUX7612.

Some key considerations are:

- For reliable operation, connect a decoupling capacitor ranging from 0.1  $\mu\text{F}$  to 10  $\mu\text{F}$  between VDD/VSS and GND. We recommend a 0.1  $\mu\text{F}$  and 1  $\mu\text{F}$  capacitor, placing the lowest value capacitor as close to the pin as possible. Make sure that the capacitor voltage rating is sufficient for the supply voltage.
- Keep the input lines as short as possible.
- Use a solid ground plane to help reduce electromagnetic interference (EMI) noise pickup.
- Do not run sensitive analog traces in parallel with digital traces. Avoid crossing digital and analog traces if possible, and only make perpendicular crossings when necessary.
- Using multiple vias in parallel will lower the overall inductance and is beneficial for connection to ground planes.

### 8.5.2 Layout Example



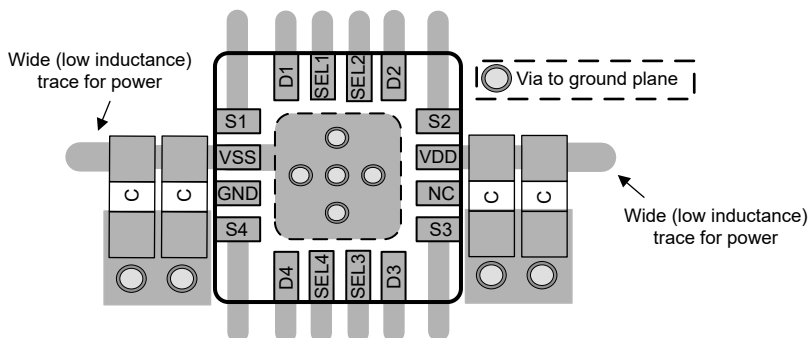


図 8-6. TMUX7612 Layout Example

## 9 Device and Documentation Support

### 9.1 Documentation Support

#### 9.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [When to Replace a Relay with a Multiplexer](#) application brief
- Texas Instruments, [Improving Signal Measurement Accuracy in Automated Test Equipment](#) application brief
- Texas Instruments, [Sample & Hold Glitch Reduction for Precision Outputs Reference Design](#) reference guide
- Texas Instruments, [Simplifying Design with 1.8 V logic Muxes and Switches](#) application brief
- Texas Instruments, [System-Level Protection for High-Voltage Analog Multiplexers](#) application note
- Texas Instruments, [QFN/SON PCB Attachment](#) application note

### 9.2 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、[www.tij.co.jp](http://www.tij.co.jp) のデバイス製品フォルダを開いてください。[通知] をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取ることができます。変更の詳細については、改訂されたドキュメントに含まれている改訂履歴をご覧ください。

### 9.3 サポート・リソース

テキサス・インスツルメンツ E2E™ サポート・フォーラムは、エンジニアが検証済みの回答と設計に関するヒントをエキスパートから迅速かつ直接得ることができる場所です。既存の回答を検索したり、独自の質問をしたりすることで、設計に必要な支援を迅速に得ることができます。

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### 9.4 Trademarks

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すべての商標は、それぞれの所有者に帰属します。

### 9.5 静電気放電に関する注意事項



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ESD による破損は、わずかな性能低下からデバイスの完全な故障まで多岐にわたります。精密な IC の場合、パラメータがわずかに変化するだけで公表されている仕様から外れる可能性があるため、破損が発生しやすくなっています。

### 9.6 用語集

[テキサス・インスツルメンツ用語集](#) この用語集には、用語や略語の一覧および定義が記載されています。

## 10 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

### Changes from Revision \* (August 2023) to Revision A (December 2024)

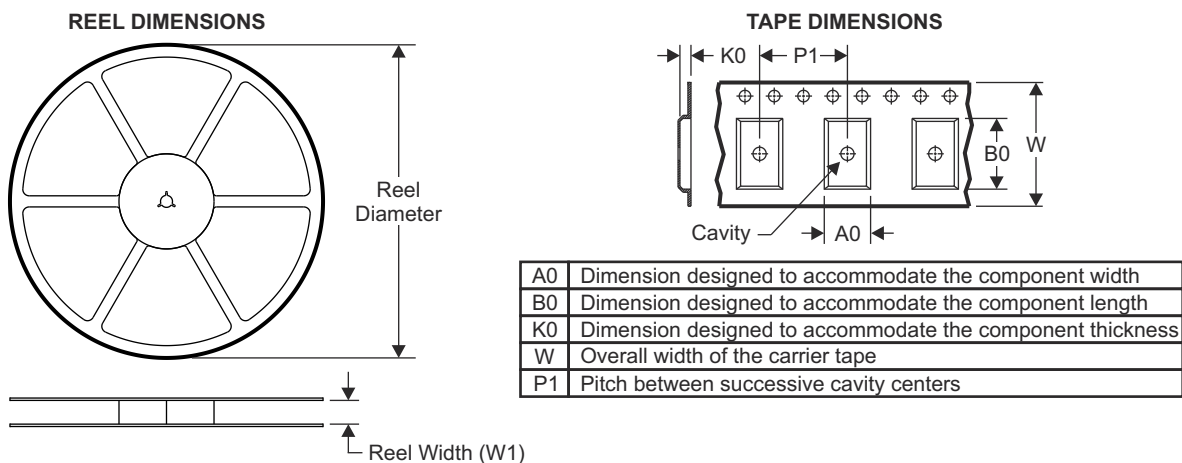
Page

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| • ステータスを「事前情報」から「量産データ」に変更..... | 1 |
|---------------------------------|---|

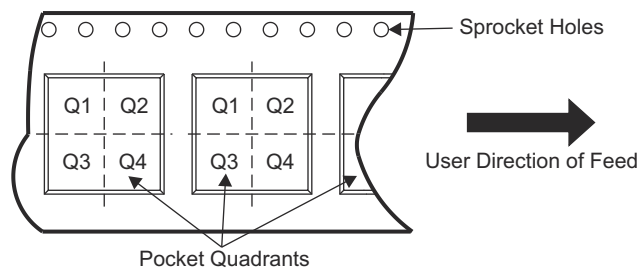
## 11 Mechanical, Packaging, and Orderable Information

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.

## 11.1 Tape and Reel Information

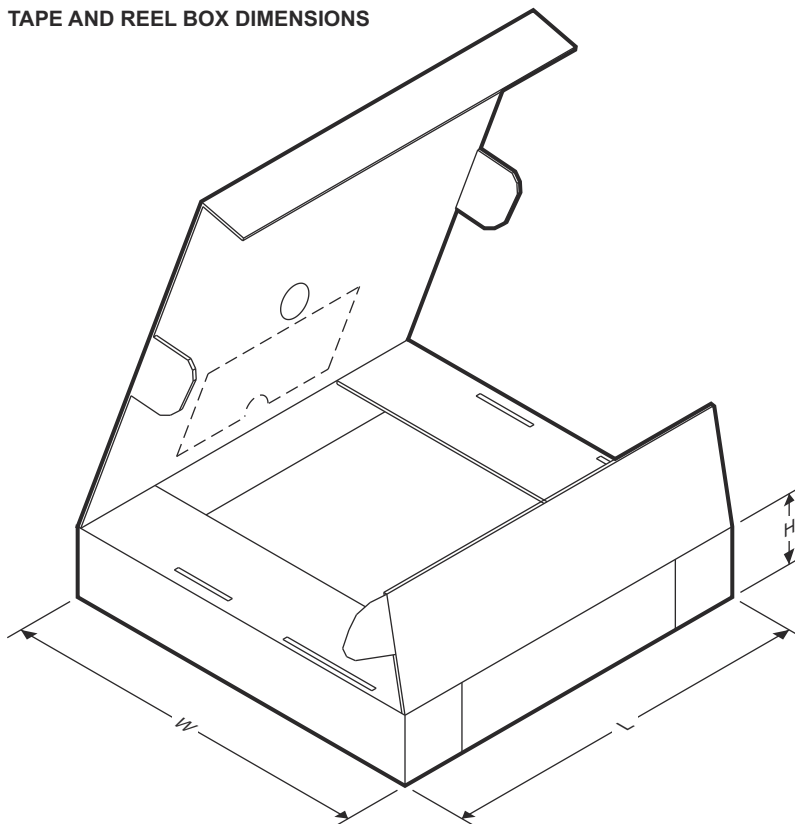


### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



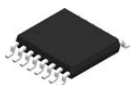
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
PTMUX7612PWR	TSSOP	PW	16	3000	330	12.4	6.90	5.60	1.60	8	12	Q1
PTMUX7612RUMR	WQFN	RUM	16	3000	330	12.4	4.25	4.25	1.15	8	12	Q2

## TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
PTMUX7612PWR	TSSOP	PW	16	3000	367	367	35
PTMUX7612RUMR	WQFN	RUM	16	3000	360	360	36

## 11.2 Mechanical Data

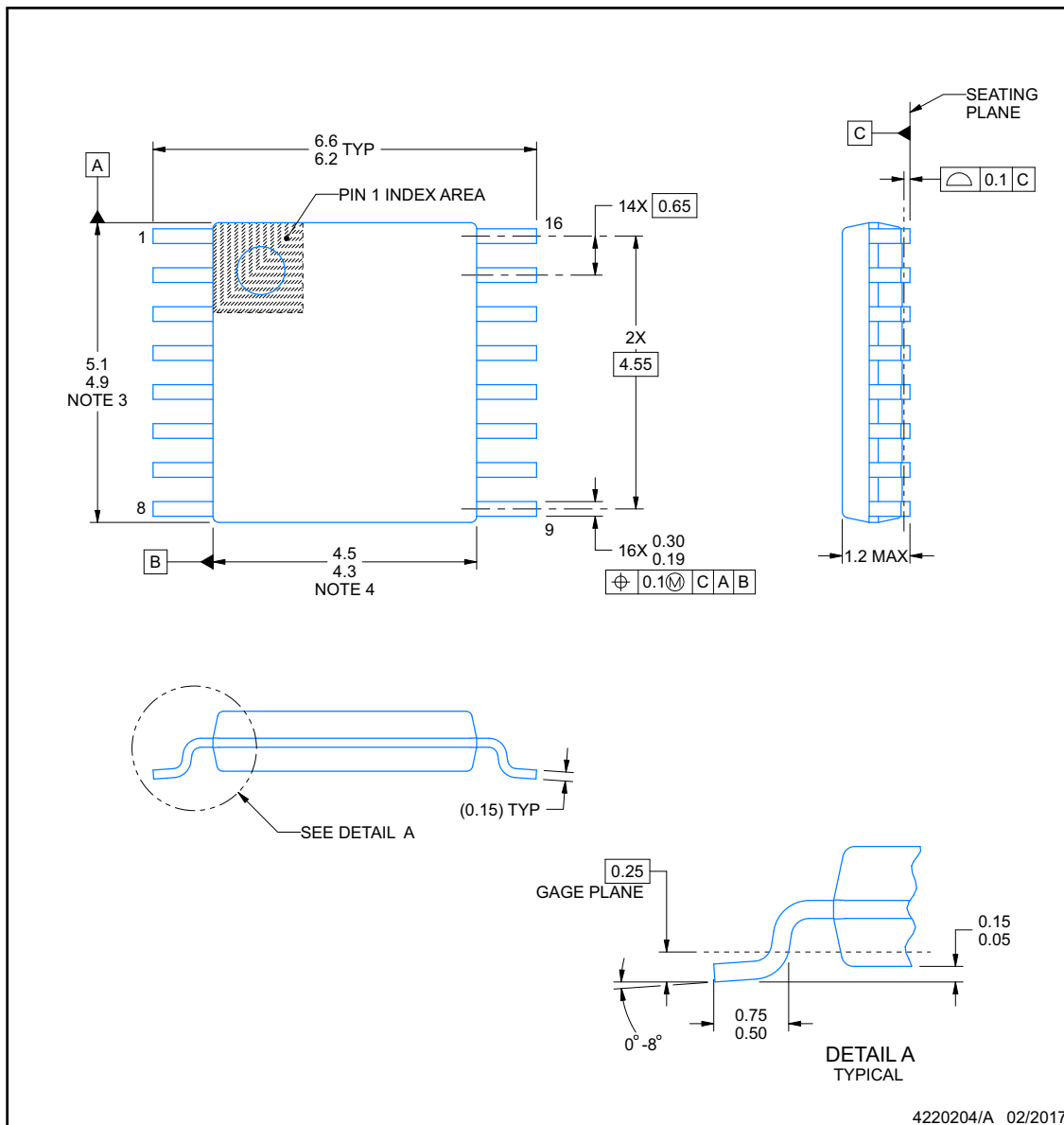


**PW0016A**

### PACKAGE OUTLINE

**TSSOP - 1.2 mm max height**

SMALL OUTLINE PACKAGE

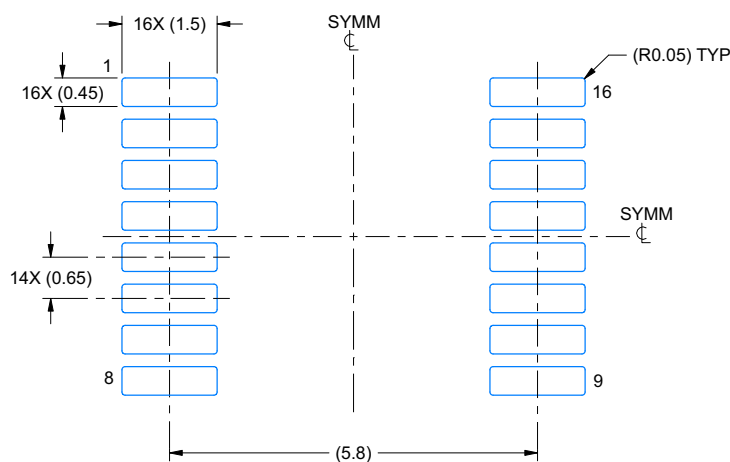


#### NOTES:

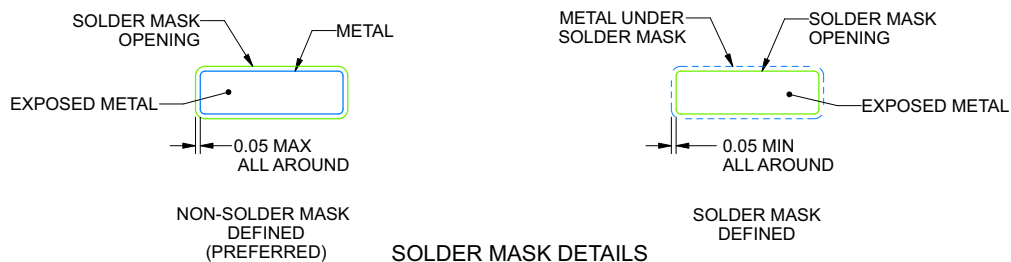
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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-153.

**EXAMPLE BOARD LAYOUT****PW0016A****TSSOP - 1.2 mm max height**

SMALL OUTLINE PACKAGE



**LAND PATTERN EXAMPLE**  
 EXPOSED METAL SHOWN  
 SCALE: 10X



4220204/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.

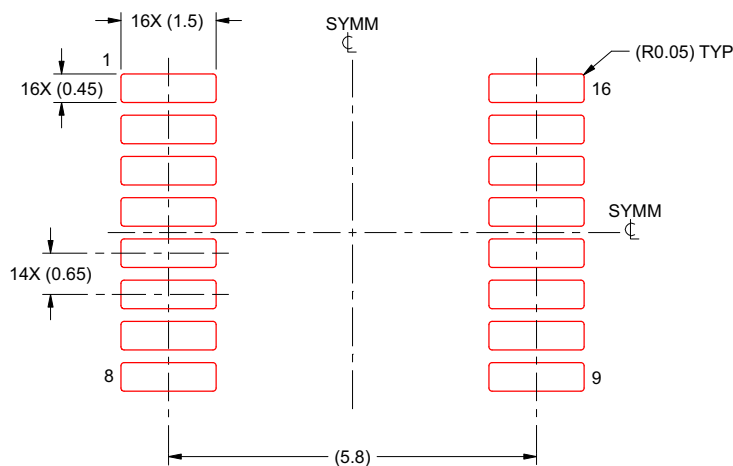


## EXAMPLE STENCIL DESIGN

**PW0016A**

**TSSOP - 1.2 mm max height**

SMALL OUTLINE PACKAGE

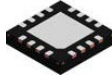


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

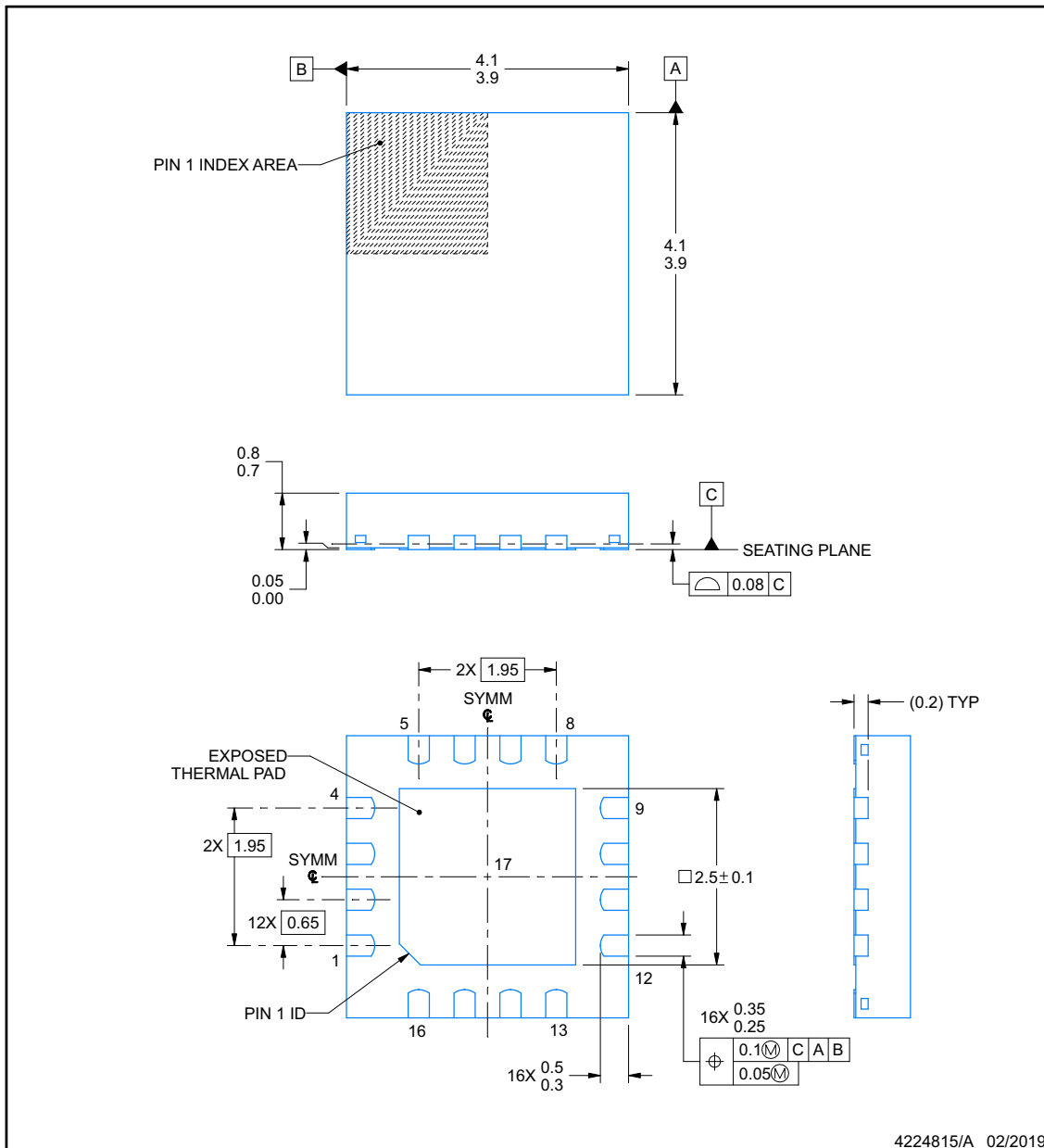
4220204/A 02/2017

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.

**RUM0016E****PACKAGE OUTLINE****WQFN - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD

**NOTES:**

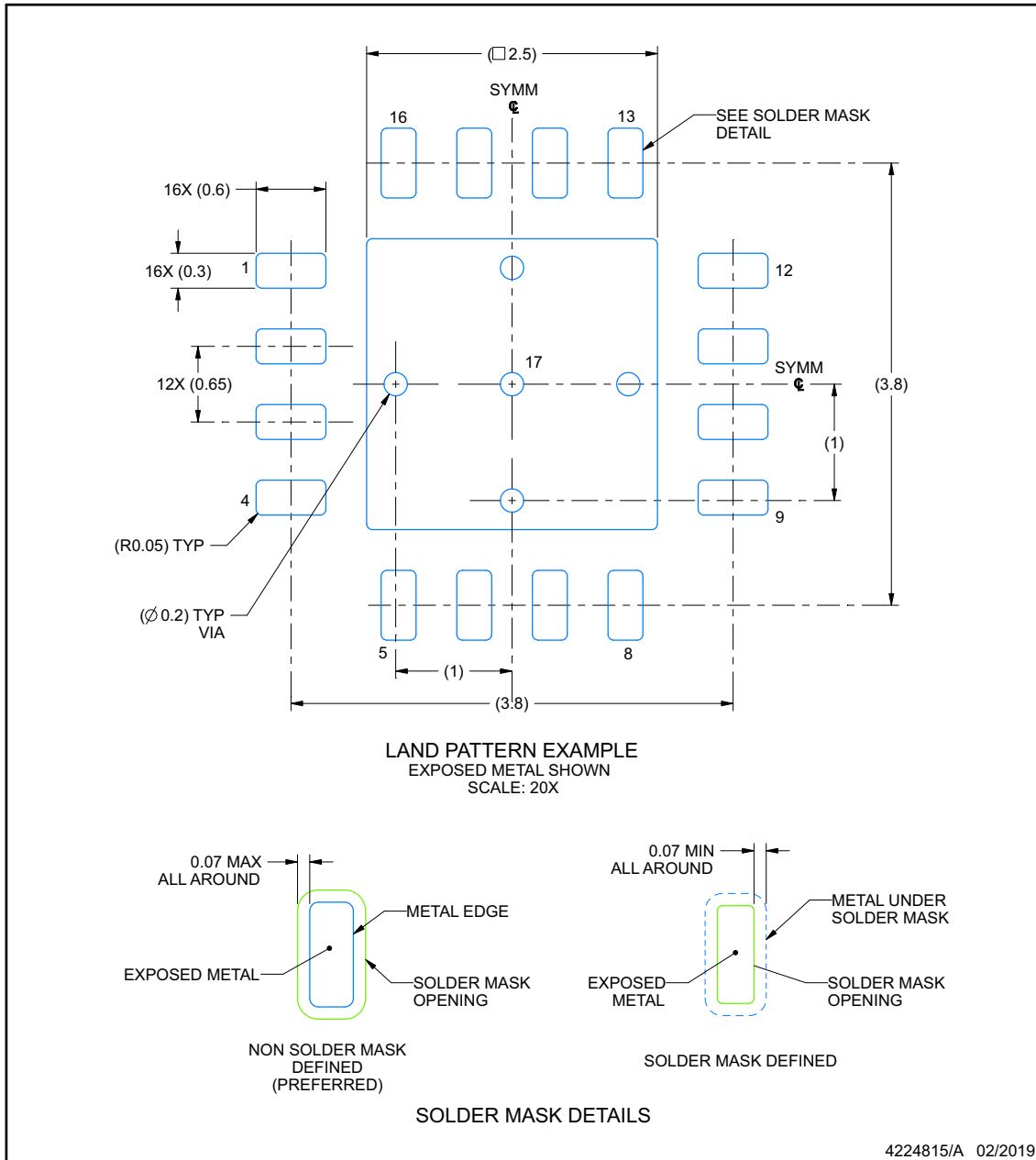
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

## EXAMPLE BOARD LAYOUT

**RUM0016E**

**WQFN - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD

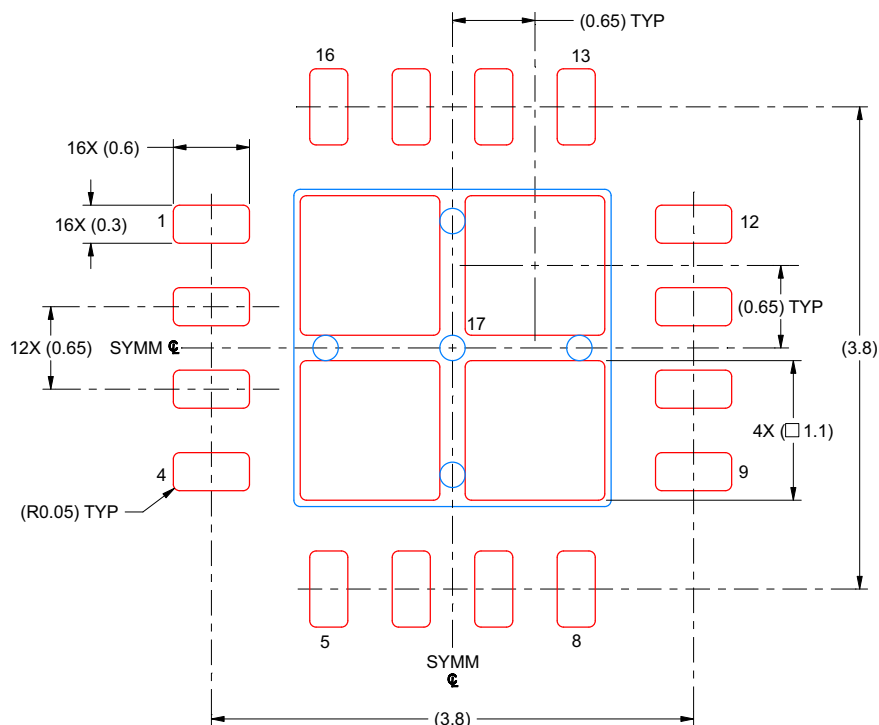


NOTES: (continued)

- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
- 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.

**EXAMPLE STENCIL DESIGN****RUM0016E****WQFN - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



**SOLDER PASTE EXAMPLE**  
 BASED ON 0.125 MM THICK STENCIL  
 SCALE: 20X

EXPOSED PAD 17  
 77% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4224815/A 02/2019

NOTES: (continued)

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

## 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)
<a href="#">TMUX7612PWR</a>	Active	Production	TSSOP (PW)   16	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	7612
TMUX7612PWR.A	Active	Production	TSSOP (PW)   16	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	7612
<a href="#">TMUX7612RUMR</a>	Active	Production	WQFN (RUM)   16	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TMUX 7612
TMUX7612RUMR.A	Active	Production	WQFN (RUM)   16	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TMUX 7612

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

<sup>(2)</sup> **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.

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

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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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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.

## GENERIC PACKAGE VIEW

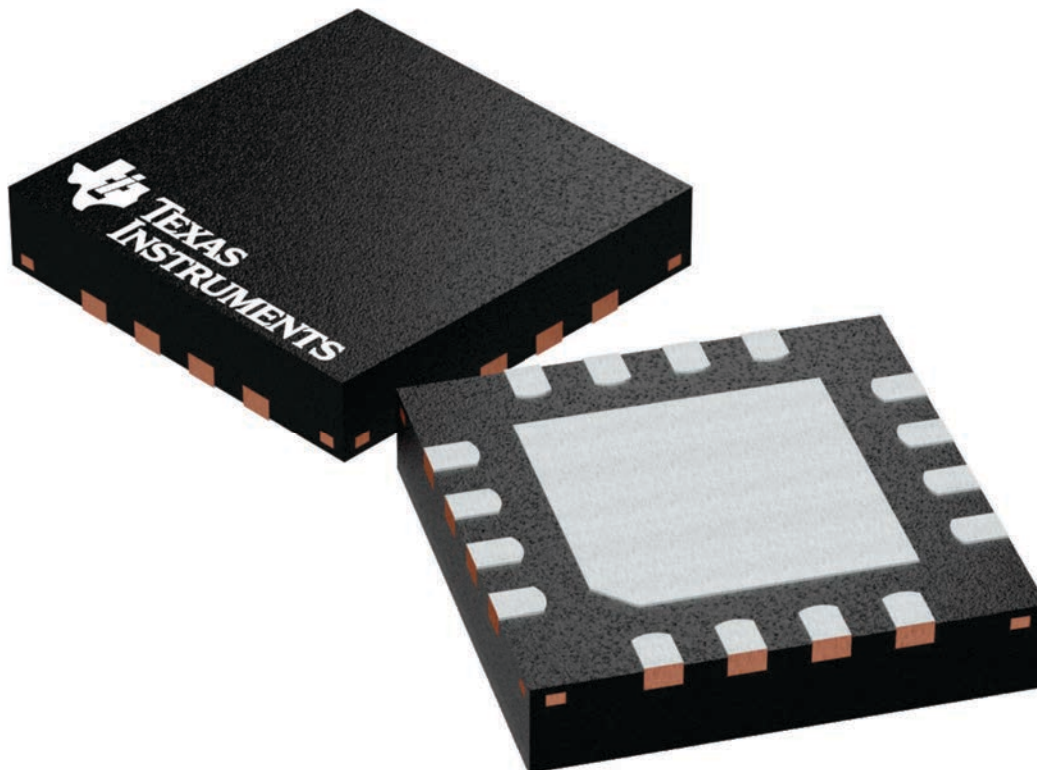
**RUM 16**

**WQFN - 0.8 mm max height**

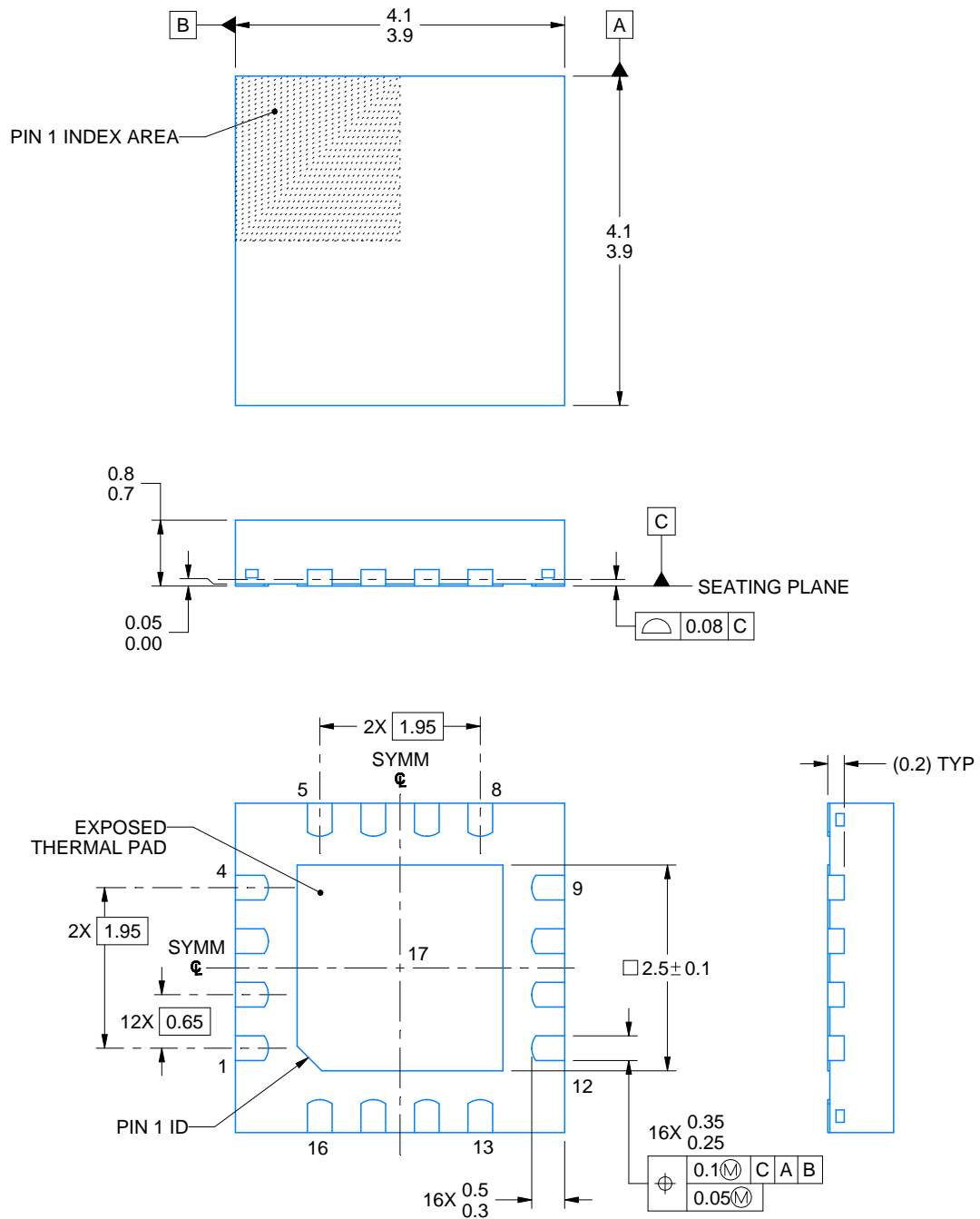
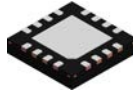
4 x 4, 0.65 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4224843/A



4224815/A 02/2019

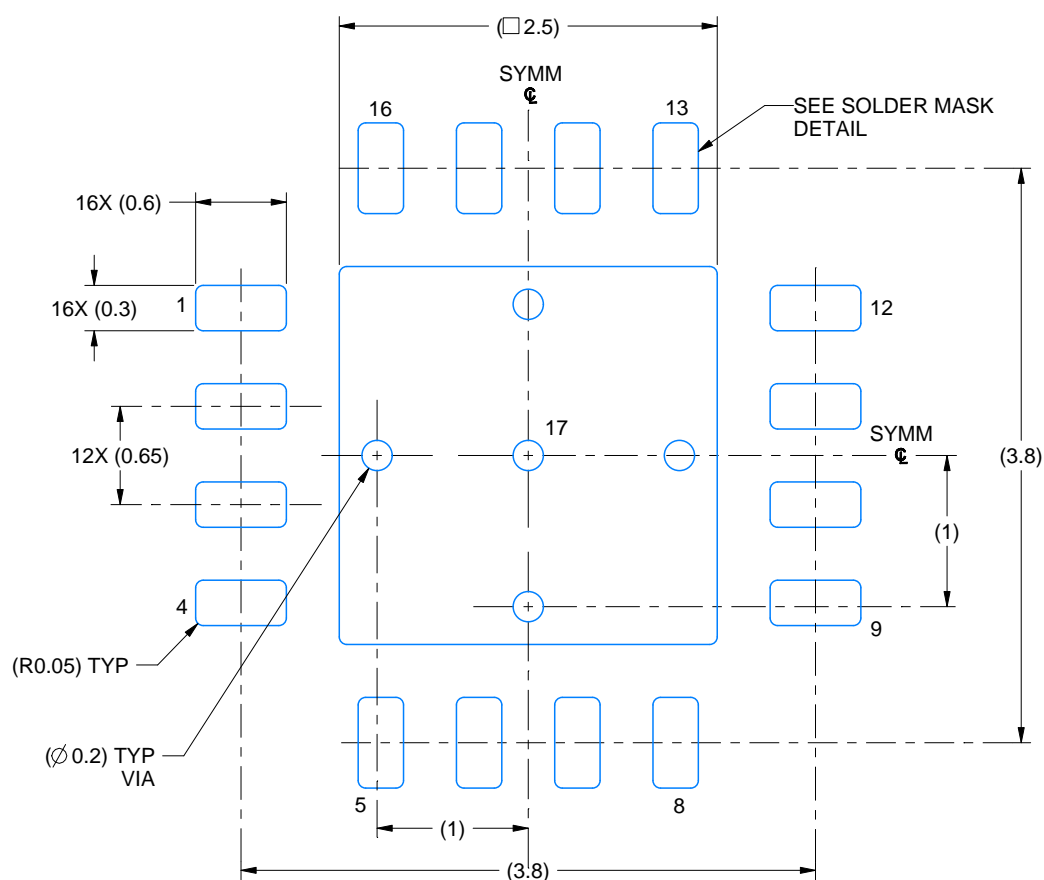
## NOTES:

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.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

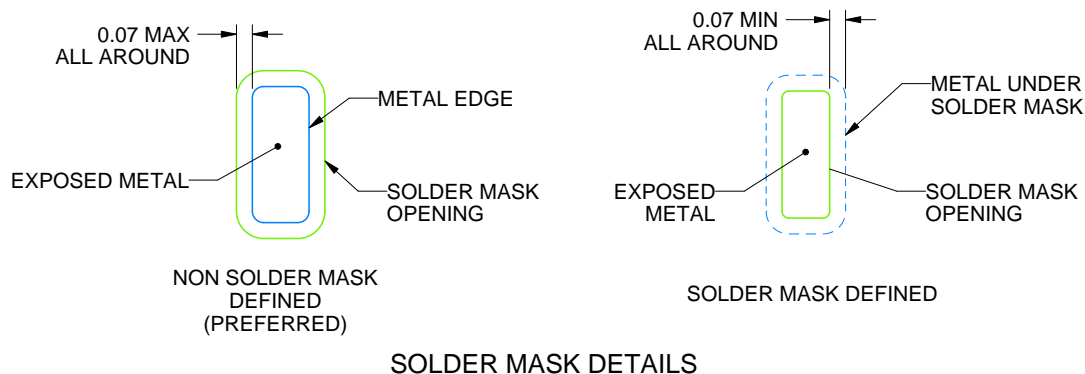
**RUM0016E**

**WQFN - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 20X



4224815/A 02/2019

NOTES: (continued)

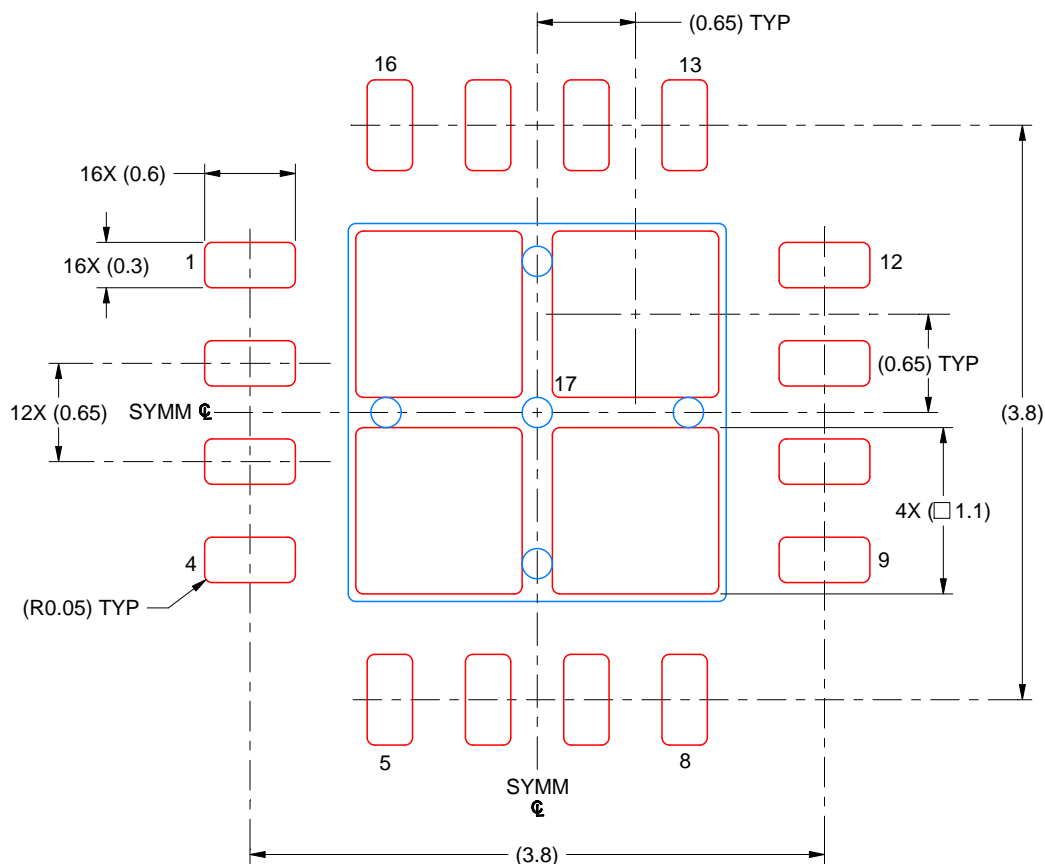
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



**RUM0016E**

### WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.125 MM THICK STENCIL  
SCALE: 20X

EXPOSED PAD 17  
77% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4224815/A 02/2019

NOTES: (continued)

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



## PACKAGE OUTLINE

## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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-153.

# EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220204/B 12/2023

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.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/B 12/2023

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.

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