

# TMUX1208 5V 双向 8:1、单通道多路复用器

## TMUX1209 5V 双向 4:1、双通道多路复用器

### 1 特性

- 轨至轨运行
- 双向信号路径
- 低导通电阻: 5Ω
- 宽电源电压范围: 1.08V 至 5.5V
- -40°C 至 +125°C 运行温度
- 兼容 1.8V 逻辑
- 失效防护逻辑
- 低电源电流: 10nA
- 转换时间: 14ns
- 先断后合开关
- ESD 保护 HBM: 2000V
- 行业标准 TSSOP 和 QFN 封装

### 2 应用

- 模拟和数字多路复用/多路信号分离
- HVAC: 取暖、通风和空调
- 烟雾探测器
- 视频监控
- 电子销售终端
- 电池供电类设备
- 电器
- 消费类音频

### 3 说明

TMUX1208 和 TMUX1209 为通用互补金属氧化物半导体 (CMOS) 多路复用器 (MUX)。TMUX1208 提供 8:1 单端通道, 而 TMUX1209 提供差动 4:1 或双 4:1 单端通道。1.08V 至 5.5V 的宽电源电压工作范围可支持的各种应用中运行。该器件可在源极 (Sx) 和漏极 (D) 引脚上支持从 GND 到 V<sub>DD</sub> 范围的双向模拟和数字信号。

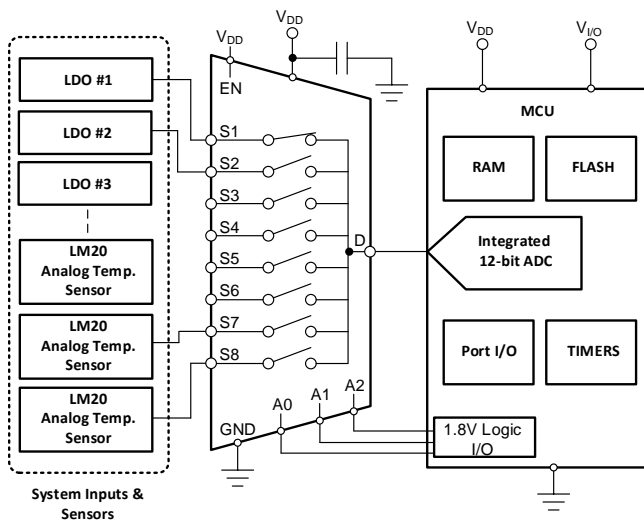
所有逻辑输入均具有兼容 1.8V 逻辑的阈值, 当器件在有效电源电压范围内运行时, 这些阈值可确保 TTL 和 CMOS 逻辑兼容性。失效防护逻辑电路允许在电源引脚之前的控制引脚上施加电压, 从而保护器件免受潜在的损害。

器件信息(1)

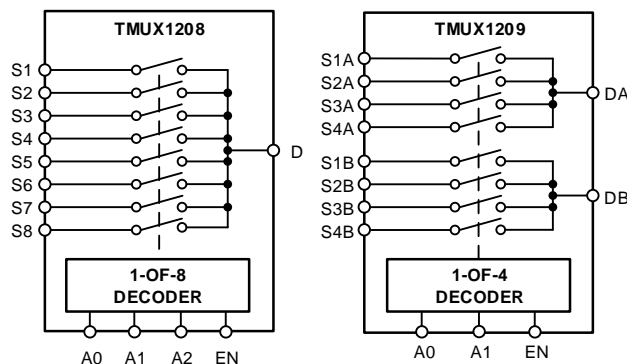
器件型号	封装	封装尺寸 (标称值)
TMUX1208	TSSOP (16)	5.00mm × 4.40mm
TMUX1209	QFN (16)	2.60mm × 1.80mm

(1) 如需了解所有可用封装, 请参阅数据表末尾的封装选项附录。

应用示例



TMUX1208、TMUX1209 方框图



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## 4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

<b>Changes from Revision B (November 2018) to Revision C</b>	<b>Page</b>
• 向数据表添加了 TMUX1209 器件 .....	1

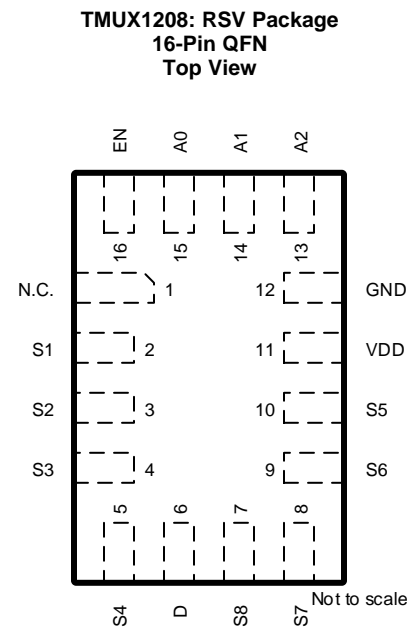
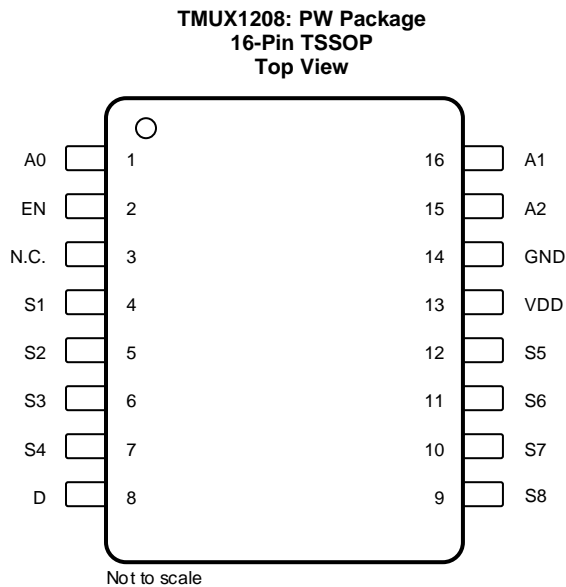
<b>Changes from Revision A (September 2018) to Revision B</b>	<b>Page</b>
• Added RSV (QFN) thermal information to <i>Thermal Information</i> : table.....	5
• Added footnote to clarify test conditions .....	8

<b>Changes from Original (August 2018) to Revision A</b>	<b>Page</b>
• 将文件状态从预告信息 更改为生产数据.....	1

## 5 Device Comparison Table

PRODUCT	DESCRIPTION
TMUX1208	8:1, 1-Channel, single-ended multiplexer
TMUX1209	4:1, 2-Channel, differential multiplexer

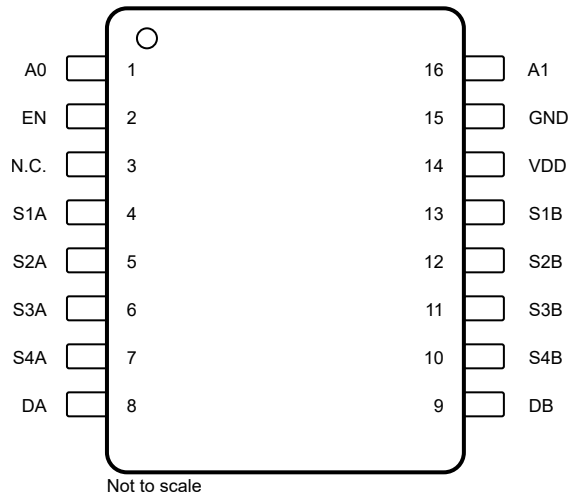
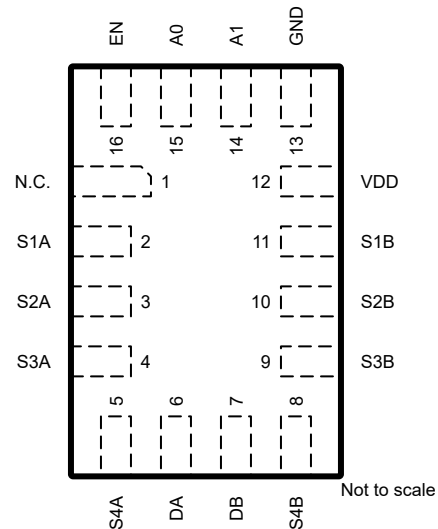
## 6 Pin Configuration and Functions



**Pin Functions TMUX1208**

NAME	PIN		TYPE <sup>(1)</sup>	DESCRIPTION
	TSSOP	QFN		
A0	1	15	I	Address line 0. Controls the switch configuration as shown in 表 1.
EN	2	16	I	Active high logic input. When this pin is low, all switches are turned off. When this pin is high, the A[2:0] address inputs determine which switch is turned on.
N.C.	3	1	Not Connected	Not Connected
S1	4	2	I/O	Source pin 1. Can be an input or output.
S2	5	3	I/O	Source pin 2. Can be an input or output.
S3	6	4	I/O	Source pin 3. Can be an input or output.
S4	7	5	I/O	Source pin 4. Can be an input or output.
D	8	6	I/O	Drain pin. Can be an input or output.
S8	9	7	I/O	Source pin 8. Can be an input or output.
S7	10	8	I/O	Source pin 7. Can be an input or output.
S6	11	9	I/O	Source pin 6. Can be an input or output.
S5	12	10	I/O	Source pin 5. Can be an input or output.
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 V <sub>DD</sub> and GND.
GND	14	12	P	Ground (0 V) reference
A2	15	13	I	Address line 2. Controls the switch configuration as shown in 表 1.
A1	16	14	I	Address line 1. Controls the switch configuration as shown in 表 1.

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

**TMUX1209: PW Package  
16-Pin TSSOP  
Top View**

**TMUX1209: RSV Package  
16-Pin QFN  
Top View**

**Pin Functions TMUX1209**

PIN			TYPE <sup>(1)</sup>	DESCRIPTION
NAME	TSSOP	UQFN		
A0	1	15	I	Address line 0. Controls the switch configuration as shown in 表 2.
EN	2	16	I	Active high logic input. When this pin is low, all switches are turned off. When this pin is high, the A[1:0] address inputs determine which switch is turned on.
N.C.	3	1	Not Connected	Not Connected
S1A	4	2	I/O	Source pin 1A. Can be an input or output.
S2A	5	3	I/O	Source pin 2A. Can be an input or output.
S3A	6	4	I/O	Source pin 3A. Can be an input or output.
S4A	7	5	I/O	Source pin 4A. Can be an input or output.
DA	8	6	I/O	Drain pin A. Can be an input or output.
DB	9	7	I/O	Drain pin B. Can be an input or output.
S4B	10	8	I/O	Source pin 4B. Can be an input or output.
S3B	11	9	I/O	Source pin 3B. Can be an input or output.
S2B	12	10	I/O	Source pin 2B. Can be an input or output.
S1B	13	11	I/O	Source pin 1B. Can be an input or output.
VDD	14	12	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 V <sub>DD</sub> and GND.
GND	15	13	P	Ground (0 V) reference
A1	16	14	I	Address line 1. Controls the switch configuration as shown in 表 2.

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

## 7 Specifications

### 7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1) (2) (3)</sup>

		MIN	MAX	UNIT
$V_{DD}$	Supply voltage	-0.3	6	V
$V_{SEL}$ or $V_{EN}$	Logic control input pin voltage (EN, A0, A1, A2)	-0.3	6	V
$I_{SEL}$ or $I_{EN}$	Logic control input pin current (EN, A0, A1, A2)	-30	30	mA
$V_S$ or $V_D$	Source or drain voltage (Sx, D)	-0.5	$V_{DD}+0.5$	V
$I_S$ or $I_D$ (CONT)	Source or drain continuous current (Sx, D)	-30	30	mA
$T_{stg}$	Storage temperature	-65	150	°C
$T_J$	Junction temperature		150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Rating* 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 Condition*. 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.

### 7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup>	±750	

- (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.

### 7.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
$V_{DD}$	Supply voltage	1.08		5.5	V
$V_S$ or $V_D$	Signal path input/output voltage (source or drain pin) (Sx, D)	0		$V_{DD}$	V
$V_{SEL}$ or $V_{EN}$	Logic control input pin voltage (EN, A0, A1, A2)	0		5.5	V
$T_A$	Ambient temperature	-40		125	°C

### 7.4 Thermal Information

THERMAL METRIC		TMUX1208 / TMUX1209		UNIT
		PW (TSSOP)	RSV (QFN)	
		16 PINS	16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	118.9	134.6	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	49.3	74.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	65.2	62.8	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	7.6	4.3	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	64.6	61.1	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W

**7.5 Electrical Characteristics ( $V_{DD} = 5\text{ V} \pm 10\%$ )**

 at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>ANALOG SWITCH</b>							
$R_{ON}$	On-resistance	$V_S = 0\text{ V to }V_{DD}$ $I_{SD} = 10\text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	5			$\Omega$
			-40°C to +85°C			7	$\Omega$
			-40°C to +125°C			9	$\Omega$
$\Delta R_{ON}$	On-resistance matching between channels	$V_S = 0\text{ V to }V_{DD}$ $I_{SD} = 10\text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	0.15			$\Omega$
			-40°C to +85°C			1	$\Omega$
			-40°C to +125°C			1	$\Omega$
$R_{ON\text{ FLAT}}$	On-resistance flatness	$V_S = 0\text{ V to }V_{DD}$ $I_{SD} = 10\text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	1.5			$\Omega$
			-40°C to +85°C			2	$\Omega$
			-40°C to +125°C			3	$\Omega$
$I_{S(OFF)}$	Source off leakage current <sup>(1)</sup>	$V_{DD} = 5\text{ V}$ Switch Off $V_D = 4.5\text{ V} / 1\text{ V}$ $V_S = 1\text{ V} / 4.5\text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 75$			nA
			-40°C to +85°C	-150		150	nA
			-40°C to +125°C	-175		175	nA
$I_{D(OFF)}$	Drain off leakage current <sup>(1)</sup>	$V_{DD} = 5\text{ V}$ Switch Off $V_D = 4.5\text{ V} / 1\text{ V}$ $V_S = 1\text{ V} / 4.5\text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 200$			nA
			-40°C to +85°C	-500		500	nA
			-40°C to +125°C	-750		750	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 5\text{ V}$ Switch On $V_D = V_S = 4.5\text{ V} / 1\text{ V}$ Refer to <a href="#">On-Leakage Current</a>	25°C	$\pm 200$			nA
			-40°C to +85°C	-500		500	nA
			-40°C to +125°C	-750		750	nA
<b>LOGIC INPUTS (EN, A0, A1, A2)</b>							
$V_{IH}$	Input logic high		-40°C to 125°C	1.49		5.5	V
$V_{IL}$	Input logic low		-40°C to 125°C	0		0.87	V
$I_{IH}$ $I_{IL}$	Input leakage current		25°C	$\pm 0.005$			$\mu\text{A}$
$I_{IH}$ $I_{IL}$	Input leakage current		-40°C to +125°C			$\pm 0.10$	$\mu\text{A}$
$C_{IN}$	Logic input capacitance		25°C	1			pF
$C_{IN}$	Logic input capacitance		-40°C to +125°C			2	pF
<b>POWER SUPPLY</b>							
$I_{DD}$	$V_{DD}$ supply current	Logic inputs = 0 V or 5.5 V	25°C	0.02			$\mu\text{A}$
			-40°C to +125°C			2.7	$\mu\text{A}$

 (1) When  $V_S$  is 4.5 V,  $V_D$  is 1 V, and vice versa.

**Electrical Characteristics ( $V_{DD} = 5\text{ V} \pm 10\%$ ) (continued)**

at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>DYNAMIC CHARACTERISTICS</b>							
$t_{\text{TRAN}}$	Transition time between channels	$V_S = 3\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Transition Time</a>	25°C	14			ns
			-40°C to +85°C			33	ns
			-40°C to +125°C			33	ns
$t_{\text{OPEN}}$ (BBM)	Break before make time	$V_S = 3\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Break-Before-Make</a>	25°C	8			ns
			-40°C to +85°C	1			ns
			-40°C to +125°C	1			ns
$t_{\text{ON(EN)}}$	Enable turn-on time	$V_S = 3\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C	14			ns
			-40°C to +85°C			20	ns
			-40°C to +125°C			20	ns
$t_{\text{OFF(EN)}}$	Enable turn-off time	$V_S = 3\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C	5			ns
			-40°C to +85°C			20	ns
			-40°C to +125°C			20	ns
$Q_C$	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ Refer to <a href="#">Charge Injection</a>	25°C		±9		pC
$O_{\text{ISO}}$	Off Isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C		-62		dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C		-42		dB
$X_{\text{TALK}}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C		-62		dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C		-42		dB
BW	Bandwidth - TMUX1208	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C		65		MHz
	Bandwidth - TMUX1209	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C		125		MHz
$C_{\text{SOFF}}$	Source off capacitance	$f = 1\text{ MHz}$	25°C		13		pF
$C_{\text{DOFF}}$	Drain off capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C		76		pF
	Drain off capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C		38		pF
$C_{\text{SON}}$	On capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C		85		pF
$C_{\text{DON}}$	On capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C		42		pF

## 7.6 Electrical Characteristics ( $V_{DD} = 3.3\text{ V} \pm 10\%$ )

 at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.3\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>ANALOG SWITCH</b>							
$R_{ON}$	On-resistance	$V_S = 0\text{ V to }V_{DD}$ $I_{SD} = 10\text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	9			$\Omega$
			-40°C to +85°C			15	$\Omega$
			-40°C to +125°C			17	$\Omega$
$\Delta R_{ON}$	On-resistance matching between channels	$V_S = 0\text{ V to }V_{DD}$ $I_{SD} = 10\text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	0.15			$\Omega$
			-40°C to +85°C			1	$\Omega$
			-40°C to +125°C			1	$\Omega$
$R_{ON\text{ FLAT}}$	On-resistance flatness	$V_S = 0\text{ V to }V_{DD}$ $I_{SD} = 10\text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	3			$\Omega$
			-40°C to +85°C			5	$\Omega$
			-40°C to +125°C			6	$\Omega$
$I_{S(OFF)}$	Source off leakage current <sup>(1)</sup>	$V_{DD} = 3.3\text{ V}$ Switch Off $V_D = 3\text{ V} / 1\text{ V}$ $V_S = 1\text{ V} / 3\text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 75$			nA
			-40°C to +85°C	-150		150	nA
			-40°C to +125°C	-175		175	nA
$I_{D(OFF)}$	Drain off leakage current <sup>(1)</sup>	$V_{DD} = 3.3\text{ V}$ Switch Off $V_D = 3\text{ V} / 1\text{ V}$ $V_S = 1\text{ V} / 3\text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 200$			nA
			-40°C to +85°C	-500		500	nA
			-40°C to +125°C	-750		750	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 3.3\text{ V}$ Switch On $V_D = V_S = 3\text{ V} / 1\text{ V}$ Refer to <a href="#">On-Leakage Current</a>	25°C	$\pm 200$			nA
			-40°C to +85°C	-500		500	nA
			-40°C to +125°C	-750		750	nA
<b>LOGIC INPUTS (EN, A0, A1, A2)</b>							
$V_{IH}$	Input logic high		-40°C to 125°C	1.35		5.5	V
$V_{IL}$	Input logic low		-40°C to 125°C	0		0.8	V
$I_{IH}$ $I_{IL}$	Input leakage current		25°C	$\pm 0.005$			$\mu\text{A}$
$I_{IH}$ $I_{IL}$	Input leakage current		-40°C to +125°C			$\pm 0.10$	$\mu\text{A}$
$C_{IN}$	Logic input capacitance		25°C	1			pF
$C_{IN}$	Logic input capacitance		-40°C to +125°C			2	pF
<b>POWER SUPPLY</b>							
$I_{DD}$	$V_{DD}$ supply current	Logic inputs = 0 V or 5.5 V	25°C	0.01			$\mu\text{A}$
			-40°C to +125°C			1.5	$\mu\text{A}$

 (1) When  $V_S$  is 3 V,  $V_D$  is 1 V, and vice versa.



**Electrical Characteristics ( $V_{DD} = 3.3\text{ V} \pm 10\%$ ) (continued)**

at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.3\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>DYNAMIC CHARACTERISTICS</b>							
$t_{\text{TRAN}}$	Transition time between channels	$V_S = 2\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Transition Time</a>	25°C	14			ns
			-40°C to +85°C			25	ns
			-40°C to +125°C			25	ns
$t_{\text{OPEN}}$ (BBM)	Break before make time	$V_S = 2\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Break-Before-Make</a>	25°C	8			ns
			-40°C to +85°C	1			ns
			-40°C to +125°C	1			ns
$t_{\text{ON(EN)}}$	Enable turn-on time	$V_S = 2\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C	14			ns
			-40°C to +85°C			25	ns
			-40°C to +125°C			25	ns
$t_{\text{OFF(EN)}}$	Enable turn-off time	$V_S = 2\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C	7			ns
			-40°C to +85°C			13	ns
			-40°C to +125°C			13	ns
$Q_C$	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ Refer to <a href="#">Charge Injection</a>	25°C		$\pm 7$		pC
$O_{\text{ISO}}$	Off Isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C		-62		dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C		-42		dB
$X_{\text{TALK}}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C		-62		dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C		-42		dB
BW	Bandwidth - TMUX1208	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C		65		MHz
	Bandwidth - TMUX1209	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C		125		MHz
$C_{\text{SOFF}}$	Source off capacitance	$f = 1\text{ MHz}$	25°C		13		pF
$C_{\text{DOFF}}$	Drain off capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C		76		pF
	Drain off capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C		38		pF
$C_{\text{SON}}$	On capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C		85		pF
$C_{\text{DON}}$	On capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C		42		pF

## 7.7 Electrical Characteristics ( $V_{DD} = 1.8 \text{ V} \pm 10 \%$ )

 at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 1.8 \text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>ANALOG SWITCH</b>							
$R_{ON}$	On-resistance	$V_S = 0 \text{ V to } V_{DD}$ $I_{SD} = 10 \text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	40			$\Omega$
			-40°C to +85°C			80	$\Omega$
			-40°C to +125°C			80	$\Omega$
$\Delta R_{ON}$	On-resistance matching between channels	$V_S = 0 \text{ V to } V_{DD}$ $I_{SD} = 10 \text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	0.15			$\Omega$
			-40°C to +85°C			1.5	$\Omega$
			-40°C to +125°C			1.5	$\Omega$
$I_{S(OFF)}$	Source off leakage current <sup>(1)</sup>	$V_{DD} = 1.98 \text{ V}$ Switch Off $V_D = 1.8 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.8 \text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 75$			nA
			-40°C to +85°C	-150		150	nA
			-40°C to +125°C	-175		175	nA
$I_{D(OFF)}$	Drain off leakage current <sup>(1)</sup>	$V_{DD} = 1.98 \text{ V}$ Switch Off $V_D = 1.8 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.8 \text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 200$			nA
			-40°C to +85°C	-500		500	nA
			-40°C to +125°C	-750		750	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 1.98 \text{ V}$ Switch On $V_D = V_S = 1.8 \text{ V} / 1 \text{ V}$ Refer to <a href="#">On-Leakage Current</a>	25°C	$\pm 200$			nA
			-40°C to +85°C	-500		500	nA
			-40°C to +125°C	-750		750	nA
<b>LOGIC INPUTS (EN, A0, A1, A2)</b>							
$V_{IH}$	Input logic high		-40°C to +125°C	1.07		5.5	V
$V_{IL}$	Input logic low		-40°C to +125°C	0		0.68	V
$I_{IH}$ $I_{IL}$	Input leakage current		25°C	$\pm 0.005$			$\mu\text{A}$
			-40°C to +125°C			$\pm 0.10$	$\mu\text{A}$
$C_{IN}$	Logic input capacitance		25°C	1			pF
			-40°C to +125°C			2	pF
<b>POWER SUPPLY</b>							
$I_{DD}$	$V_{DD}$ supply current	Logic inputs = 0 V or 5.5 V	25°C	0.006			$\mu\text{A}$
			-40°C to +125°C			0.95	$\mu\text{A}$

 (1) When  $V_S$  is 1.8 V,  $V_D$  is 1 V, and vice versa.

**Electrical Characteristics ( $V_{DD} = 1.8\text{ V} \pm 10\%$ ) (continued)**

at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 1.8\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>DYNAMIC CHARACTERISTICS</b>							
$t_{\text{TRAN}}$	Transition time between channels	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Transition Time</a>	25°C		28		ns
			-40°C to +85°C			48	ns
			-40°C to +125°C			48	ns
$t_{\text{OPEN}}$ (BBM)	Break before make time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Break-Before-Make</a>	25°C		16		ns
			-40°C to +85°C		1		ns
			-40°C to +125°C		1		ns
$t_{\text{ON(EN)}}$	Enable turn-on time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C		28		ns
			-40°C to +85°C			48	ns
			-40°C to +125°C			48	ns
$t_{\text{OFF(EN)}}$	Enable turn-off time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C		16		ns
			-40°C to +85°C			27	ns
			-40°C to +125°C			27	ns
$Q_C$	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ Refer to <a href="#">Charge Injection</a>	25°C		-2		pC
$O_{\text{ISO}}$	Off Isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C		-62		dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C		-42		dB
$X_{\text{TALK}}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C		-62		dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C		-42		dB
BW	Bandwidth - TMUX1208	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C		65		MHz
	Bandwidth - TMUX1209	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C		125		MHz
$C_{\text{SOFF}}$	Source off capacitance	$f = 1\text{ MHz}$	25°C		13		pF
$C_{\text{DOFF}}$	Drain off capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C		76		pF
	Drain off capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C		38		pF
$C_{\text{SON}}$	On capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C		85		pF
$C_{\text{DON}}$	On capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C		42		pF

## 7.8 Electrical Characteristics ( $V_{DD} = 1.2 \text{ V} \pm 10 \%$ )

 at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 1.2 \text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>ANALOG SWITCH</b>							
$R_{ON}$	On-resistance	$V_S = 0 \text{ V to } V_{DD}$ $I_{SD} = 10 \text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	70			$\Omega$
			–40°C to +85°C			105	$\Omega$
			–40°C to +125°C			105	$\Omega$
$\Delta R_{ON}$	On-resistance matching between channels	$V_S = 0 \text{ V to } V_{DD}$ $I_{SD} = 10 \text{ mA}$ Refer to <a href="#">On-Resistance</a>	25°C	0.15			$\Omega$
			–40°C to +85°C			1.5	$\Omega$
			–40°C to +125°C			1.5	$\Omega$
$I_{S(OFF)}$	Source off leakage current <sup>(1)</sup>	$V_{DD} = 1.32 \text{ V}$ Switch Off $V_D = 1.2 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.2 \text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 75$			nA
			–40°C to +85°C		–150	150	nA
			–40°C to +125°C		–175	175	nA
$I_{D(OFF)}$	Drain off leakage current <sup>(1)</sup>	$V_{DD} = 1.32 \text{ V}$ Switch Off $V_D = 1.2 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.2 \text{ V}$ Refer to <a href="#">Off-Leakage Current</a>	25°C	$\pm 200$			nA
			–40°C to +85°C		–500	500	nA
			–40°C to +125°C		–750	750	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 1.32 \text{ V}$ Switch On $V_D = V_S = 1.2 \text{ V} / 1 \text{ V}$ Refer to <a href="#">On-Leakage Current</a>	25°C	$\pm 200$			nA
			–40°C to +85°C		–500	500	nA
			–40°C to +125°C		–750	750	nA
<b>LOGIC INPUTS (EN, A0, A1, A2)</b>							
$V_{IH}$	Input logic high		–40°C to +125°C	0.96		5.5	V
$V_{IL}$	Input logic low		–40°C to +125°C	0		0.36	V
$I_{IH}$ $I_{IL}$	Input leakage current		25°C	$\pm 0.005$			$\mu\text{A}$
			–40°C to +125°C			$\pm 0.10$	$\mu\text{A}$
$C_{IN}$	Logic input capacitance		25°C	1			pF
			–40°C to +125°C			2	pF
<b>POWER SUPPLY</b>							
$I_{DD}$	$V_{DD}$ supply current	Logic inputs = 0 V or 5.5 V	25°C	0.005			$\mu\text{A}$
			–40°C to +125°C			0.8	$\mu\text{A}$

 (1) When  $V_S$  is 1.2 V,  $V_D$  is 1 V, and vice versa.

**Electrical Characteristics ( $V_{DD} = 1.2\text{ V} \pm 10\%$ ) (continued)**

at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 1.2\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
<b>DYNAMIC CHARACTERISTICS</b>							
$t_{\text{TRAN}}$	Transition time between channels	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Transition Time</a>	25°C	60			ns
			-40°C to +85°C			210	ns
			-40°C to +125°C			210	ns
$t_{\text{OPEN}}$ (BBM)	Break before make time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#">Break-Before-Make</a>	25°C	28			ns
			-40°C to +85°C	1			ns
			-40°C to +125°C	1			ns
$t_{\text{ON(EN)}}$	Enable turn-on time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C	60			ns
			-40°C to +85°C			190	ns
			-40°C to +125°C			190	ns
$t_{\text{OFF(EN)}}$	Enable turn-off time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$ Refer to <a href="#"><math>t_{\text{ON(EN)}}</math></a> and <a href="#"><math>t_{\text{OFF(EN)}}</math></a>	25°C	45			ns
			-40°C to +85°C			150	ns
			-40°C to +125°C			150	ns
$Q_C$	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ Refer to <a href="#">Charge Injection</a>	25°C	$\pm 2$			pC
$O_{\text{ISO}}$	Off Isolation	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C	-62			dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Off Isolation</a>	25°C	-42			dB
$X_{\text{TALK}}$	Crosstalk	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C	-62			dB
		$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to <a href="#">Crosstalk</a>	25°C	-42			dB
BW	Bandwidth - TMUX1208	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C	65			MHz
	Bandwidth - TMUX1209	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ Refer to <a href="#">Bandwidth</a>	25°C	125			MHz
$C_{\text{SOFF}}$	Source off capacitance	$f = 1\text{ MHz}$	25°C	13			pF
$C_{\text{DOFF}}$	Drain off capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C	76			pF
	Drain off capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C	38			pF
$C_{\text{SON}}$	On capacitance - TMUX1208	$f = 1\text{ MHz}$	25°C	85			pF
$C_{\text{DON}}$	On capacitance - TMUX1209	$f = 1\text{ MHz}$	25°C	42			pF

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## 7.9 Typical Characteristics

at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)

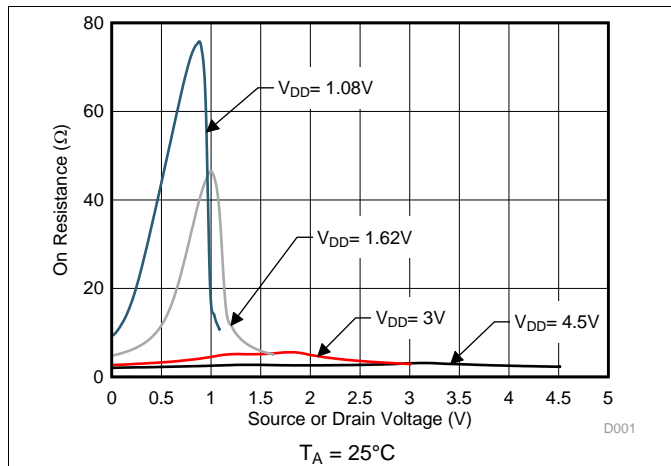


图 1. On-Resistance vs Source or Drain Voltage

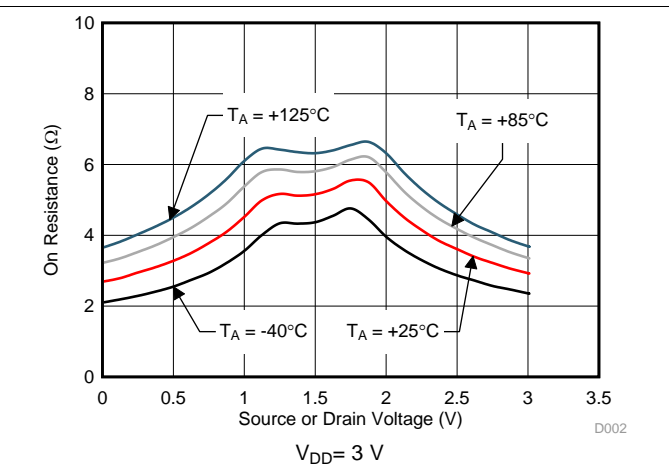


图 2. On-Resistance vs Source or Drain Voltage

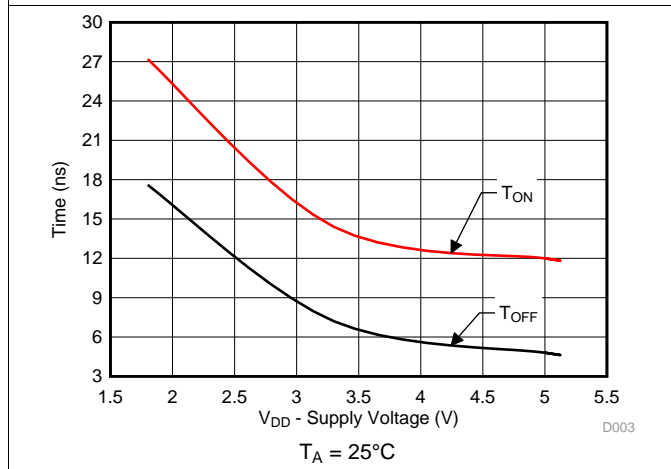


图 3.  $T_{ON}$  (EN) and  $T_{OFF}$  (EN) vs Supply Voltage

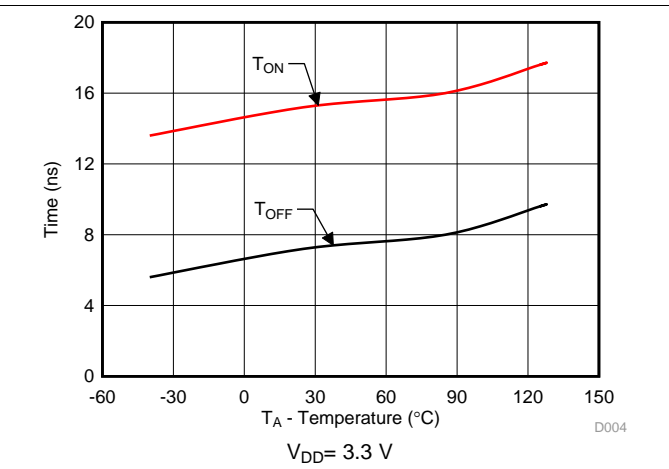


图 4.  $T_{ON}$  (EN) and  $T_{OFF}$  (EN) vs Temperature

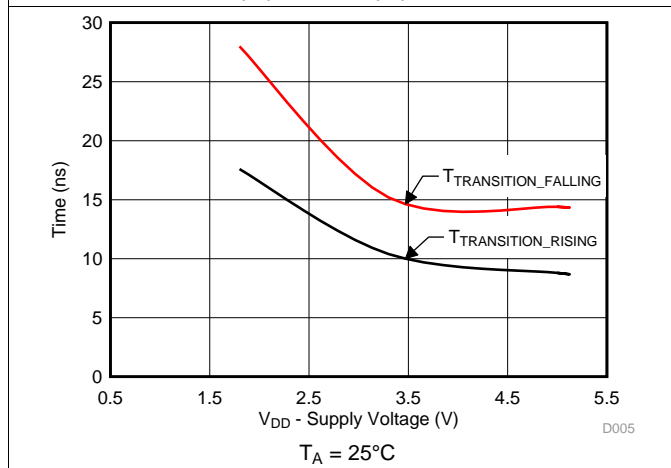


图 5.  $T_{TRANSITION}$  vs Supply Voltage

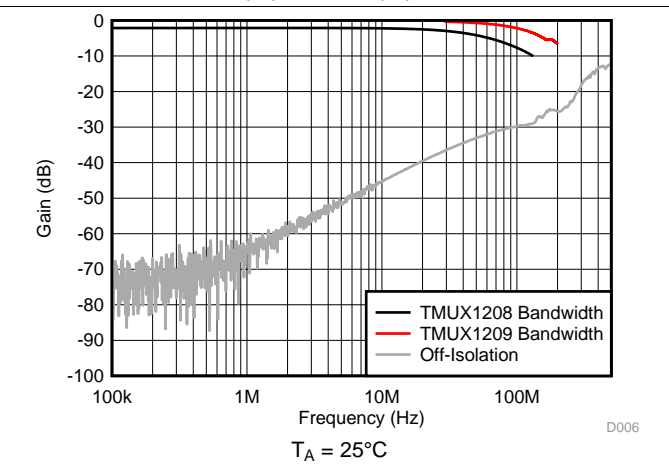


图 6. Frequency Response

## 8 Detailed Description

### 8.1 Overview

#### 8.1.1 On-Resistance

The on-resistance of a device is the ohmic resistance between the source (Sx) and drain (D) pins of the device. The on-resistance varies with input voltage and supply voltage. The symbol  $R_{ON}$  is used to denote on-resistance. The measurement setup used to measure  $R_{ON}$  is shown below. Voltage (V) and current ( $I_{SD}$ ) are measured using this setup, and  $R_{ON}$  is computed as shown in 图 7 with  $R_{ON} = V / I_{SD}$ :

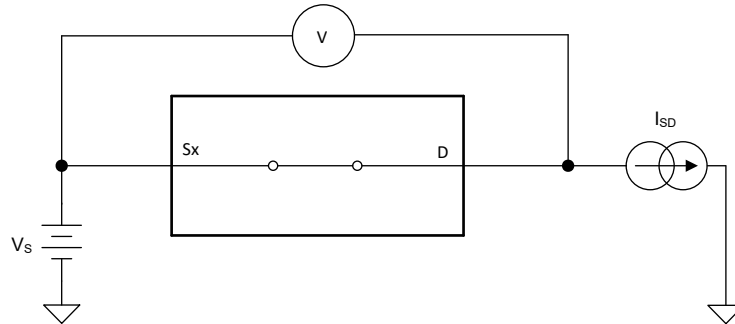


图 7. On-Resistance Measurement Setup

#### 8.1.2 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  $I_{D(OFF)}$ .

The setup used to measure both off-leakage currents is shown in 图 8.

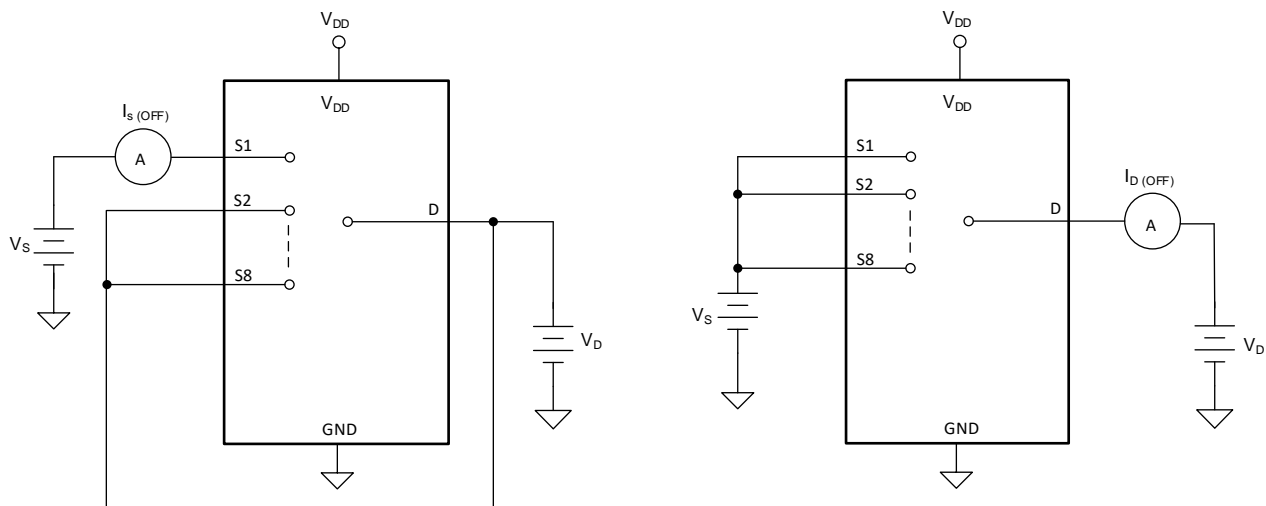


图 8. Off-Leakage Measurement Setup

## Overview (接下页)

### 8.1.3 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. 图 9 shows the circuit used for measuring the on-leakage current, denoted by  $I_{S(ON)}$  or  $I_{D(ON)}$ .

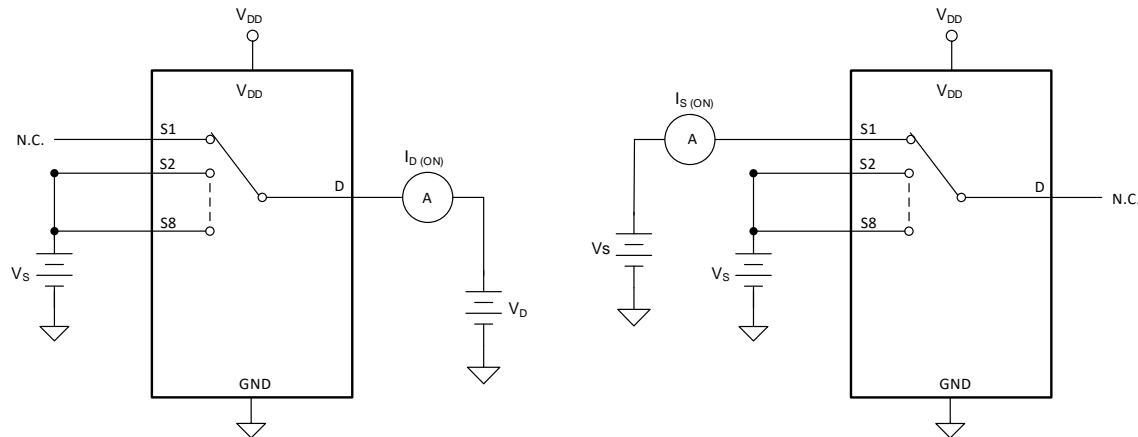


图 9. On-Leakage Measurement Setup

### 8.1.4 Transition Time

Transition time is defined as the time taken by the output of the device to rise or fall 10% after the address signal has risen or fallen past the logic threshold. The 10% transition 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. 图 10 shows the setup used to measure transition time, denoted by the symbol  $t_{TRANSITION}$ .

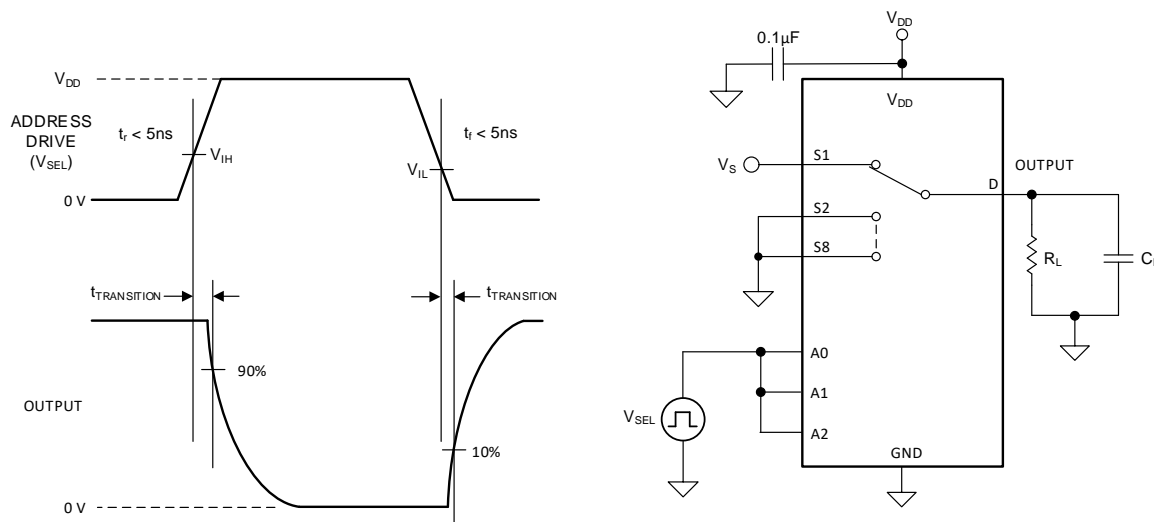


图 10. Transition-Time Measurement Setup



## Overview (接下页)

### 8.1.5 Break-Before-Make

Break-before-make delay is a safety feature that prevents two inputs from connecting when the device is switching. The output first breaks from the on-state switch before making the connection with the next on-state switch. The time delay between the *break* and the *make* is known as break-before-make delay. 图 11 shows the setup used to measure break-before-make delay, denoted by the symbol  $t_{OPEN(BBM)}$ .

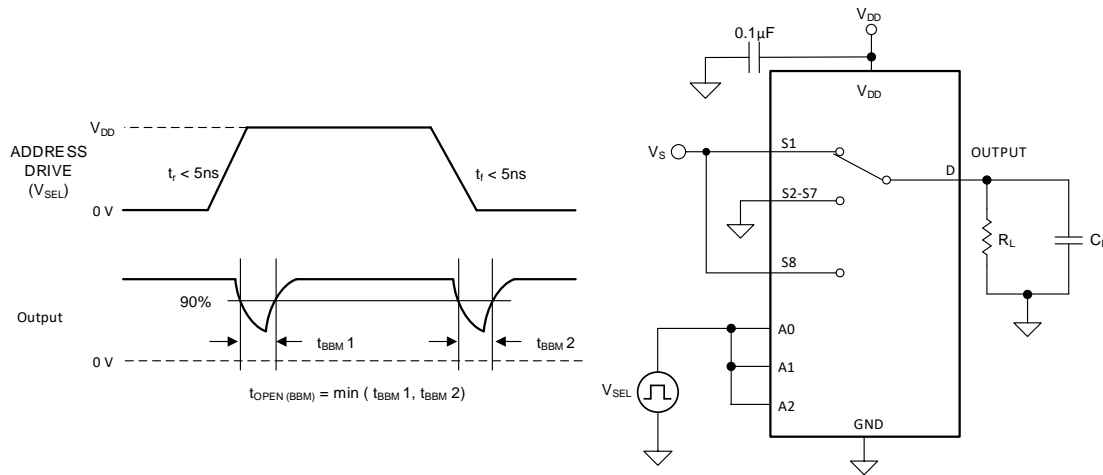


图 11. Break-Before-Make Delay Measurement Setup

### 8.1.6 $t_{ON(EN)}$ and $t_{OFF(EN)}$

Turn-on time is defined as the time taken by the output of the device to rise to 10% after the enable has risen 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. 图 12 shows the setup used to measure transition time, denoted by the symbol  $t_{ON(EN)}$ .

Turn-off time is defined as the time taken by the output of the device to fall to 90% after the enable has fallen 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. 图 12 shows the setup used to measure transition time, denoted by the symbol  $t_{OFF(EN)}$ .

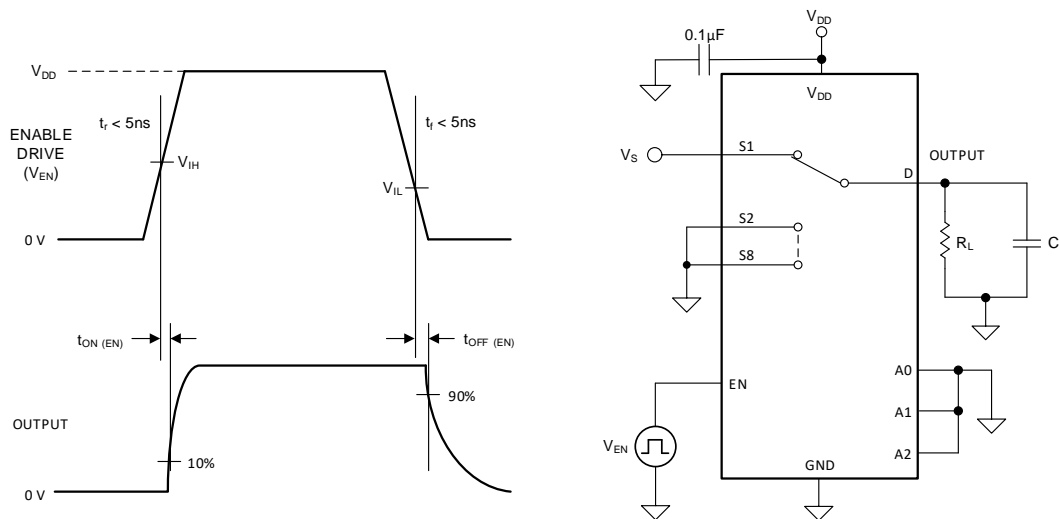


图 12. Turn-On and Turn-Off Time Measurement Setup

Overview (接下页)

8.1.7 Charge Injection

The TMUX1208 and TMUX1209 have 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  $Q_C$ . 图 13 shows the setup used to measure charge injection from source (Sx) to drain (D).

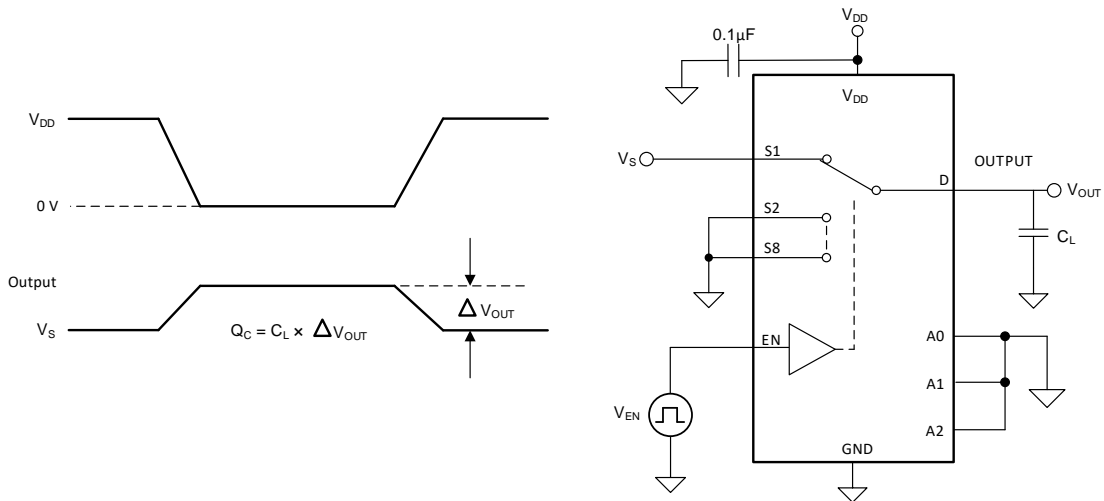


图 13. Charge-Injection Measurement Setup

8.1.8 Off Isolation

Off isolation is defined as the ratio of the signal at the drain pin (D) of the device when a signal is applied to the source pin (Sx) of an off-channel. 图 14 shows the setup used to measure, and the equation to compute off isolation.

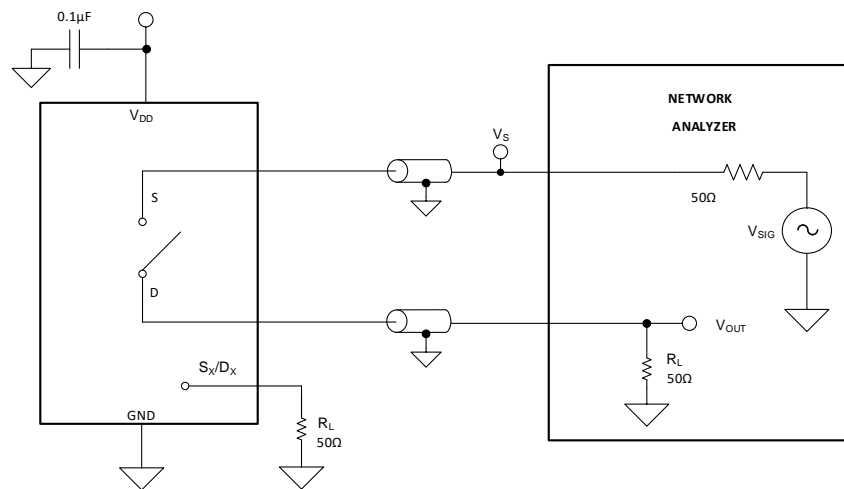


图 14. Off Isolation Measurement Setup

$$\text{Off Isolation} = 20 \cdot \text{Log} \left( \frac{V_{\text{OUT}}}{V_S} \right)$$

(1)

## Overview (接下页)

### 8.1.9 Crosstalk

Crosstalk is defined as the ratio of the signal at the drain pin (D) of a different channel, when a signal is applied at the source pin (Sx) of an on-channel. 图 15 shows the setup used to measure, and the equation used to compute crosstalk.

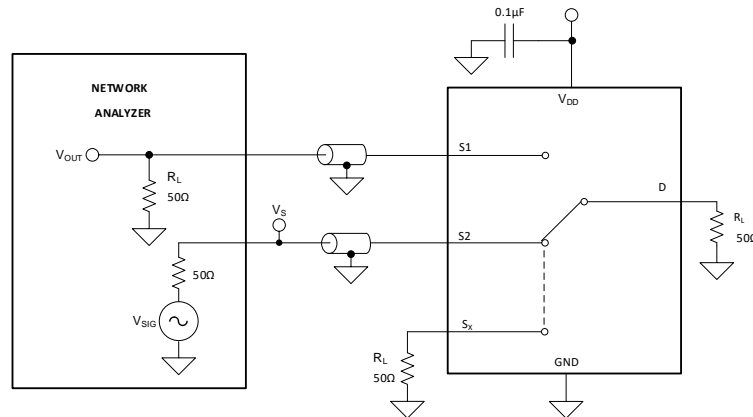


图 15. Channel-to-Channel Crosstalk Measurement Setup

$$\text{Channel-to-Channel Crosstalk} = 20 \cdot \text{Log} \left( \frac{V_{\text{OUT}}}{V_{\text{S}}} \right) \quad (2)$$

### 8.1.10 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 (D) of the device. 图 16 shows the setup used to measure bandwidth.

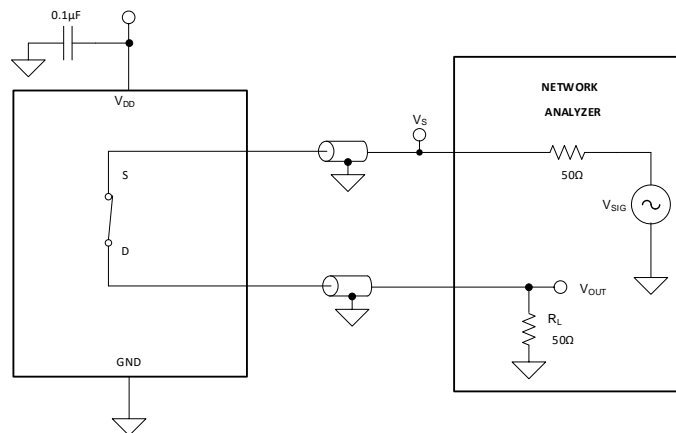


图 16. Bandwidth Measurement Setup

$$\text{Attenuation} = 20 \cdot \text{Log} \left( \frac{V_2}{V_1} \right) \quad (3)$$

## 8.2 Functional Block Diagram

The TMUX1208 is an 8:1, single-ended (1-ch.), mux. The TMUX1209 is an 4:1, differential (2-ch.), mux. Each channel is turned on or turned off based on the state of the address lines and enable pin.

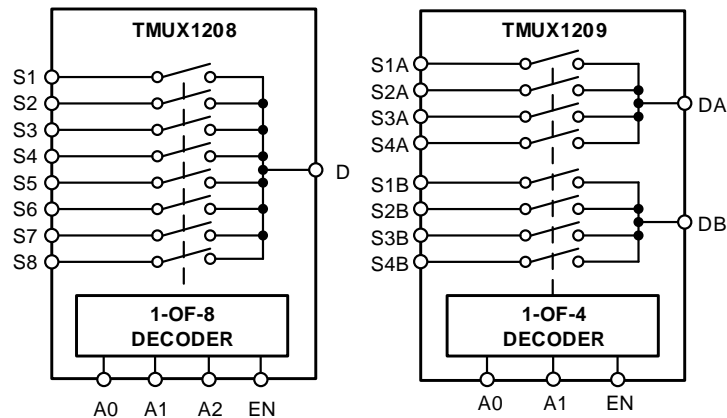


图 17. TMUX1208, TMUX1209 Functional Block Diagrams

## 8.3 Feature Description

### 8.3.1 Bidirectional Operation

The TMUX1208 and TMUX1209 conduct equally well from source ( $S_x$ ) to drain (D) or from drain (D) to source ( $S_x$ ). Each channel has very similar characteristics in both directions and supports both analog and digital signals.

### 8.3.2 Rail to Rail Operation

The valid signal path input/output voltage for TMUX1208 and TMUX1209 ranges from GND to  $V_{DD}$ .

### 8.3.3 1.8 V Logic Compatible Inputs

The TMUX1208 and TMUX1209 has 1.8-V logic compatible control for all logic control inputs. The logic input thresholds scale with supply but still provide 1.8-V logic control when operating at 5.5 V supply voltage. 1.8-V logic level inputs allows the multiplexers 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](#)

### 8.3.4 Fail-Safe Logic

The TMUX1208 and TMUX1209 have Fail-Safe Logic on the control input pins (EN, A0, A1, A2) allowing for operation up to 5.5 V, regardless of the state of the supply pin. This feature allows voltages on the control pins to be applied before the supply pin, protecting the device from potential damage. Fail-Safe Logic minimizes system complexity by removing the need for power supply sequencing on the logic control pins. For example, the Fail-Safe Logic feature allows the select pins of the TMUX1208 or TMUX1209 to be ramped to 5.5 V while  $V_{DD} = 0$  V. Additionally, the feature enables operation of the multiplexers with  $V_{DD} = 1.2$  V while allowing the select pins to interface with a logic level of another device up to 5.5 V.

## Feature Description (接下页)

### 8.3.5 Device Functional Modes

When the EN pin of the TMUX1208 is pulled high, one of the switches is closed based on the state of the address lines. Similarly, when the EN pin of the TMUX1209 is pulled high, two of the switches are closed based on the state of the address lines. When the EN pin is pulled low, all the switches are in an open state regardless of the state of the address lines.

### 8.3.6 Truth Tables

表 1 和 表 2 show the truth tables for the TMUX1208 and TMUX1209, respectively.

**表 1. TMUX1208 Truth Table**

EN	A2	A1	A0	Selected Inputs Connected To Drain (D) Pin
0	X <sup>(1)</sup>	X <sup>(1)</sup>	X <sup>(1)</sup>	All channels are off
1	0	0	0	S1
1	0	0	1	S2
1	0	1	0	S3
1	0	1	1	S4
1	1	0	0	S5
1	1	0	1	S6
1	1	1	0	S7
1	1	1	1	S8

(1) X denotes *don't care*.

**表 2. TMUX1209 Truth Table**

EN	A1	A0	Selected Input Connected To Drain (DA, DB) Pins
0	X <sup>(1)</sup>	X <sup>(1)</sup>	All channels are off
1	0	0	S1A and S1B
1	0	1	S2A and S2B
1	1	0	S3A and S3B
1	1	1	S4A and S4B

(1) X denotes *don't care*.

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

### 9.1 Application Information

The TMUX12xx family offers good system performance across a wide operating supply (1.08V to 5.5V). These devices include 1.8V logic compatible control input pins that enable operation in systems with 1.8V I/O rails. Additionally, the control input pins support Fail-Safe Logic which allows for operation up to 5.5V, regardless of the state of the supply pin. This protection stops the logic pins from back-powering the supply rail. These features make the TMUX12xx a family of general purpose multiplexers and switches that can reduce system complexity, board size, and overall system cost.

### 9.2 Typical Application

One useful application to take advantage of the TMUX1208 features is multiplexing various signals into an ADC that is integrated into a MCU. Utilizing an integrated ADC in a MCU allows a system to minimize cost with a potential tradeoff of system performance when compared to an external ADC. The multiplexer allows for multiple inputs/sensors to be monitored with a single ADC pin of the device, which is critical in systems with limited I/O. The TMUX1209 is suitable for similar design example using differential signals, or as two 4:1 multiplexers.

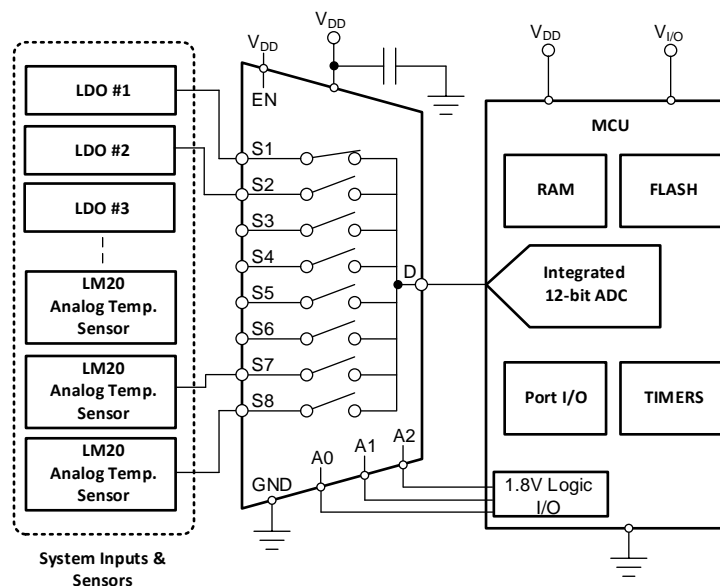


图 18. Multiplexing Signals to Integrated ADC

### 9.3 Design Requirements

For this design example, use the parameters listed in 表 3.

表 3. Design Parameters

PARAMETERS	VALUES
Supply ( $V_{DD}$ )	5.0 V
I/O signal range	0 V to $V_{DD}$ (Rail to Rail)
Control logic thresholds	1.8 V compatible

## 9.4 Detailed Design Procedure

The TMUX1208 and TMUX1209 can be operated without any external components except for the supply decoupling capacitors. If the parts desired power-up state is disabled, the enable pin should have a weak pull-down resistor and be controlled by the MCU via GPIO. All inputs being muxed to the ADC of the MCU must fall within the recommend operating conditions of the TMUX1208 and TMUX1209 including signal range and continuous current. For this design with a supply of 5 V the signal range can be 0 V to 5 V and the max continuous current can be 30 mA.

## 9.5 Application Curve

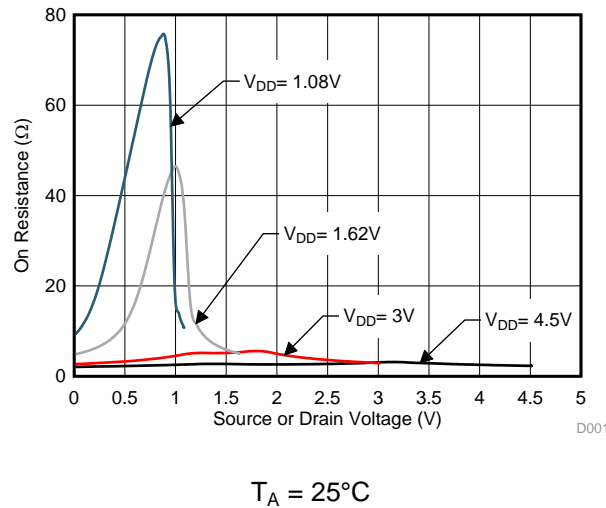


图 19. On-Resistance vs Source or Drain Voltage

## 10 Power Supply Recommendations

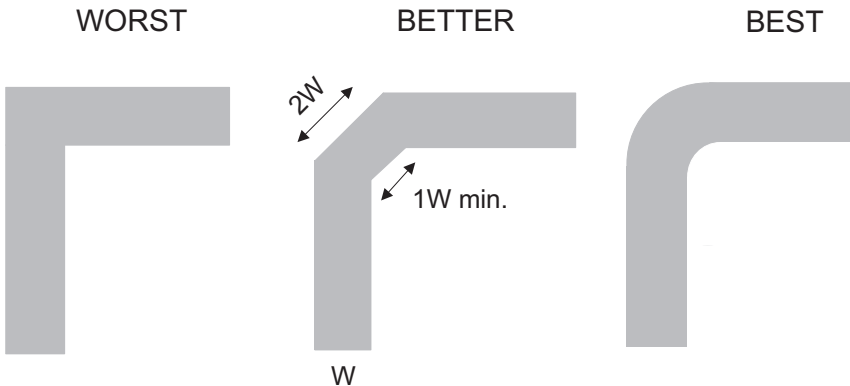
The TMUX1208 and TMUX1209 operate across a wide supply range of 1.08 V to 5.5 V. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices.

Power-supply bypassing improves noise margin and prevents switching noise propagation from the  $V_{DD}$  supply 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  $\mu\text{F}$  to 10  $\mu\text{F}$  from  $V_{DD}$  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 planes.

## 11 Layout

### 11.1 Layout Guidelines

#### 11.1.1 Layout Information

When a PCB trace turns a corner at a 90° 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.  shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

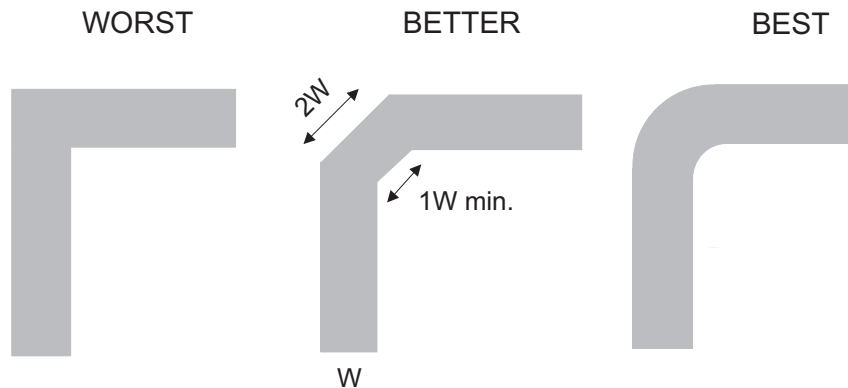


图 20. Trace Example

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.

 illustrates an example of a PCB layout with the TMUX1208. Some key considerations are:

- Decouple the  $V_{DD}$  pin with a 0.1- $\mu\text{F}$  capacitor, placed as close to the pin as possible. Make sure that the capacitor voltage rating is sufficient for the  $V_{DD}$  supply.
- 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.

### 11.2 Layout Example

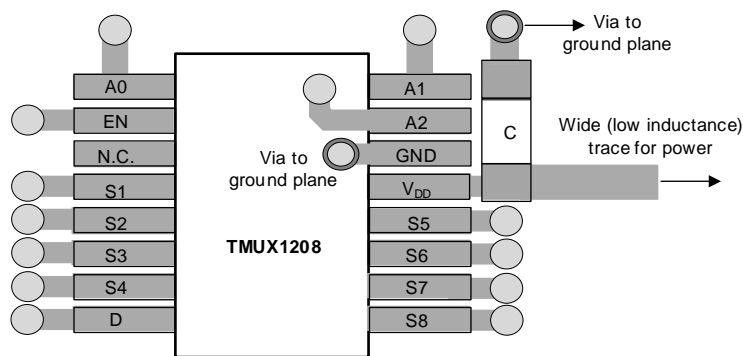


图 21. TMUX1208 Layout Example



## 12 器件和文档支持

### 12.1 文档支持

#### 12.1.1 相关文档

德州仪器 (TI), 《[使用 1.8V 逻辑多路复用器和开关简化设计](#)》。

德州仪器 (TI), 《[QFN/SON PCB 连接](#)》。

Texas Instruments, 《[四方扁平封装无引线逻辑封装](#)》。

### 12.2 相关链接

下表列出了快速访问链接。类别包括技术文档、支持和社区资源、工具和软件, 以及立即订购快速访问。

表 4. 相关链接

器件	产品文件夹	立即订购	技术文档	工具与软件	支持和社区
TMUX1208	<a href="#">单击此处</a>	<a href="#">单击此处</a>	<a href="#">单击此处</a>	<a href="#">单击此处</a>	<a href="#">单击此处</a>
TMUX1209	<a href="#">单击此处</a>	<a href="#">单击此处</a>	<a href="#">单击此处</a>	<a href="#">单击此处</a>	<a href="#">单击此处</a>

### 12.3 接收文档更新通知

要接收文档更新通知, 请导航至 [TI.com.cn](http://TI.com.cn) 上的器件产品文件夹。单击右上角的[通知我进行注册](#), 即可每周接收产品信息更改摘要。有关更改的详细信息, 请查看任何已修订文档中包含的修订历史记录。

### 12.4 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范, 并且不一定反映 TI 的观点; 请参阅 TI 的《[使用条款](#)》。

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**设计支持** **TI 参考设计支持** 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

### 12.5 商标

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ESD 的损坏小至导致微小的性能降级, 大至整个器件故障。精密的集成电路可能更容易受到损坏, 这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 12.7 术语表

**SLYZ022** — *TI 术语表*。

这份术语表列出并解释术语、缩写和定义。

## 13 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更, 恕不另行通知, 且不会对此文档进行修订。如需获取此数据表的浏览器版本, 请查阅左侧的导航栏。

**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
TMUX1208PWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TM1208	<a href="#">Samples</a>
TMUX1208RSVR	ACTIVE	UQFN	RSV	16	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	1B4	<a href="#">Samples</a>
TMUX1209PWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TM1209	<a href="#">Samples</a>
TMUX1209RSVR	ACTIVE	UQFN	RSV	16	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	1D2	<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.

**OBSELETE:** 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.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

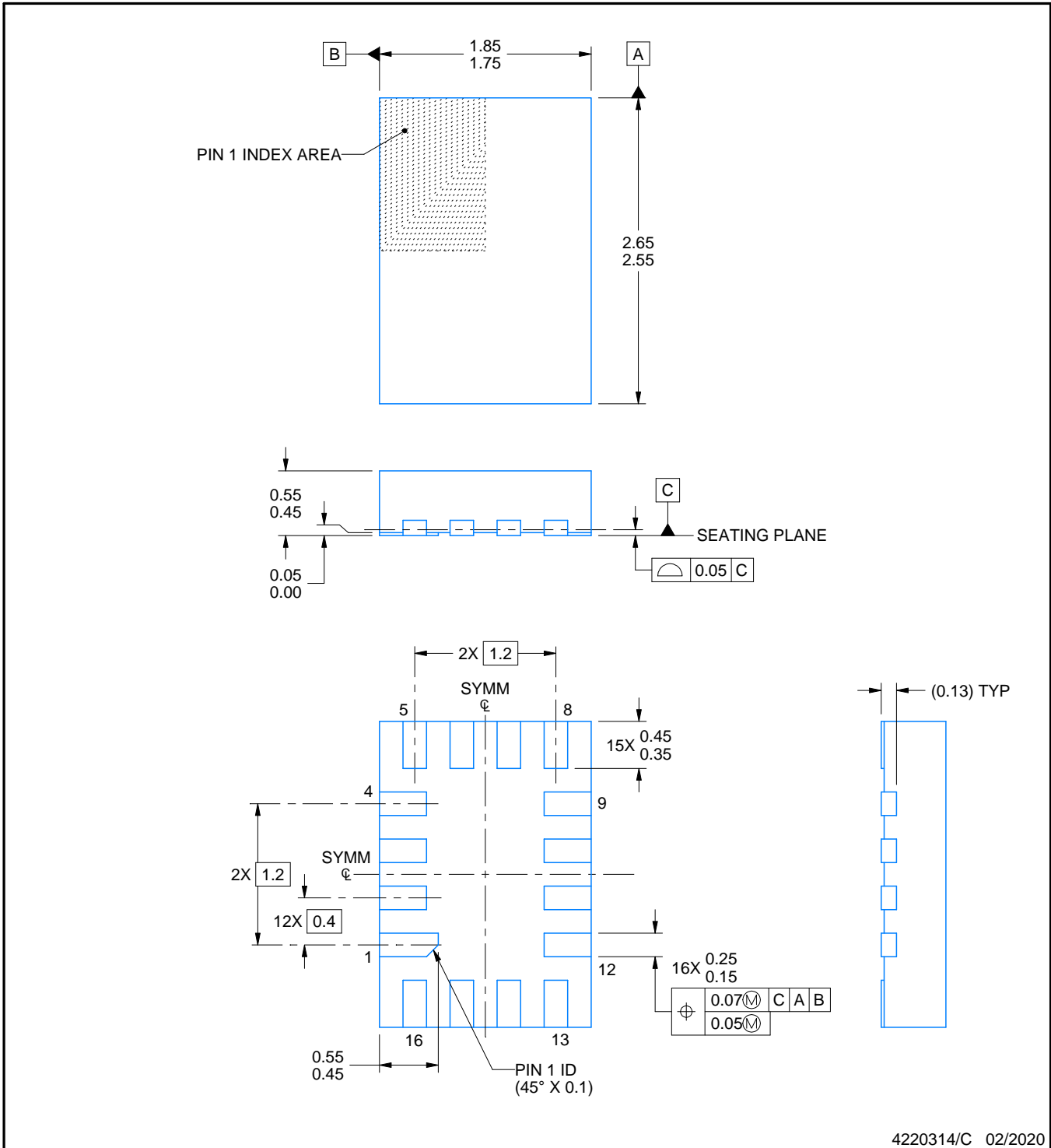
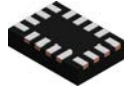
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TMUX1208PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TMUX1208RSVR	UQFN	RSV	16	3000	178.0	13.5	2.1	2.9	0.75	4.0	12.0	Q1
TMUX1209PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TMUX1209RSVR	UQFN	RSV	16	3000	178.0	13.5	2.1	2.9	0.75	4.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TMUX1208PWR	TSSOP	PW	16	2000	356.0	356.0	35.0
TMUX1208RSVR	UQFN	RSV	16	3000	189.0	185.0	36.0
TMUX1209PWR	TSSOP	PW	16	2000	356.0	356.0	35.0
TMUX1209RSVR	UQFN	RSV	16	3000	189.0	185.0	36.0



4220314/C 02/2020

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.

# EXAMPLE BOARD LAYOUT

RSV0016A

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 25X



4220314/C 02/2020

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

RSV0016A

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.125 MM THICK STENCIL  
SCALE: 25X

4220314/C 02/2020

NOTES: (continued)

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





4220204/A 02/2017

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



SOLDER MASK DETAILS

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.

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