

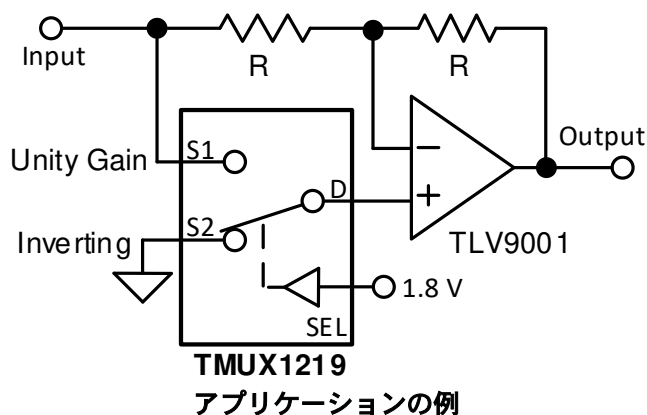
TMUX1219-Q1 5V、双方向、2:1 汎用スイッチ

1 特長

- 車載アプリケーション用に AEC-Q100 認定済み
 - デバイス温度グレード 1: -40°C ~ 125°C の動作時周囲温度範囲
 - デバイス HBM 分類レベル H1C
 - デバイス CDM 分類レベル C3
- レール ツー レールの動作
- 双方向の信号パス
- 1.8V ロジック互換
- フェイルセーフ ロジック
- 低いオン抵抗: 3Ω
- 幅広い電源電圧範囲: 1.08V ~ 5.5V
- 40°C ~ +125°C の動作温度
- 低い消費電流: 4nA
- 遷移時間: 14ns
- ブレイク ビフォー メイクのスイッチング動作
- ESD 保護 (HBM): 2000V

2 アプリケーション

- アナログおよびデジタル スwitchング
- I2C および SPI バスの多重化
- 先進運転支援システム (ADAS)
- ボディ エレクトロニクスとライティング
- インフォテインメントおよびクラスタ
- ゾーン アーキテクチャ
- 車体制御モジュール
- バッテリー管理システム
- テレマティクス
- 車載ヘッド ユニット



3 概要

TMUX1219-Q1 は、汎用の CMOS (相補型金属酸化膜半導体) 単極双投 (SPDT) スwitch です。TMUX1219-Q1 は、SEL ピンの状態に基づいて、2 つのソース入力間のスswitchングを行います。1.08V ~ 5.5V の広い動作電源電圧範囲で、幅広い車載用アプリケーションに使用可能です。このデバイスは、ソース (Sx) およびドレイン (D) ピンで、GND 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。消費電流が 4nA と低いため、携帯型アプリケーションで使用できます。

すべてのロジック入力のスレッシュホールドは **1.8V ロジック互換** で、有効な電源電圧範囲で動作していれば、TTL と CMOS の両方のロジックと互換性が保証されます。**フェイルセーフ ロジック** 回路により、電源ピンよりも先に制御ピンに電圧が印加されるため、デバイスへの損傷の可能性が避けられます。

製品情報

部品番号	パッケージ (1)	本体サイズ (公称)
TMUX1219-Q1	SOT-23 (6)	2.90 mm × 1.60mm

(1) 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。

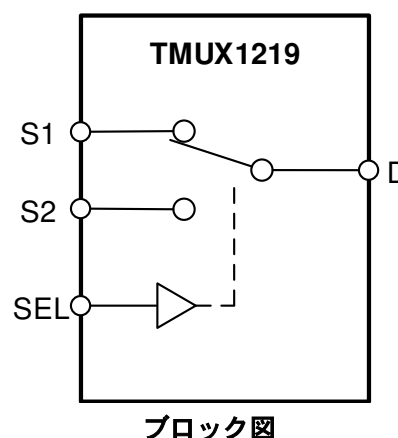
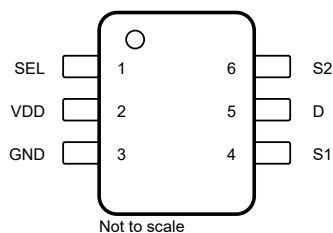


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4 Pin Configuration and Functions



Product Preview

図 4-1. DBV Package 6-Pin SOT-23 Top View

表 4-1. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
SEL	1	I	Select pin: controls state of the switch according to 表 7-1. (Logic Low = S1 to D, Logic High = S2 to D)
VDD	2	P	Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 μ F to 10 μ F between V _{DD} and GND.
GND	3	P	Ground (0 V) reference
S1	4	I/O	Source pin 1. Can be an input or output.
D	5	I/O	Drain pin. Can be an input or output.
S2	6	I/O	Source pin 2. Can be an input or output.

(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)^{(1) (2)}

		MIN	MAX	UNIT
V_{DD}	Supply voltage	−0.5	6	V
V_{SEL}	Logic control input pin voltage (SEL)	−0.5	6	V
I_{SEL}	Logic control input pin current (SEL)	−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.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101 or ANSI/ESDA/JEDEC JS-002, all pins ⁽²⁾	±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.

5.3 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}	Logic control input pin voltage (SEL)	0		5.5	V
T_A	Ambient temperature	−40		125	°C

5.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TMUX1219-Q1	UNIT
		DBV (SOT-23)	
		6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	212.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	156.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	96.5	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	80.7	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	96.2	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

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

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R _{ON}	On-resistance	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		3		Ω
			−40°C to +85°C			5	Ω
			−40°C to +125°C			6	Ω
ΔR _{ON}	On-resistance matching between channels	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		0.15		Ω
			−40°C to +85°C			0.4	Ω
			−40°C to +125°C			1	Ω
R _{ON} FLAT	On-resistance flatness	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		1.5		Ω
			−40°C to +85°C			2	Ω
			−40°C to +125°C			3	Ω
I _{S(OFF)}	Source off leakage current ⁽¹⁾	V _{DD} = 5 V Switch Off V _D = 4.5 V / 1.5 V V _S = 1.5 V / 4.5 V Refer to (1)	25°C		±5		nA
			−40°C to +85°C	−25		25	nA
			−40°C to +125°C	−40		40	nA
I _{D(ON)} I _{S(ON)}	Channel on leakage current	V _{DD} = 5 V Switch On V _D = V _S = 4.5 V / 1.5 V Refer to (1)	25°C		±15		nA
			−40°C to +85°C	−50		50	nA
			−40°C to +125°C	−80		80	nA
LOGIC INPUTS (SEL)							
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		±0.005		μA
I _{IH} I _{IL}	Input leakage current		−40°C to +125°C			±0.05	μA
C _{IN}	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		−40°C to +125°C			2	pF
POWER SUPPLY							
I _{DD}	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	25°C		0.003		μA
			−40°C to +125°C			1.5	μA

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS							
t_{TRAN}	Switching time between channels	$V_S = 3\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		12		ns
			-40°C to $+85^\circ\text{C}$			18	ns
			-40°C to $+125^\circ\text{C}$			19	ns
t_{OPEN} (BBM)	Break before make time	$V_S = 3\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		8		ns
			-40°C to $+85^\circ\text{C}$	1			ns
			-40°C to $+125^\circ\text{C}$	1			ns
Q_C	Charge Injection	$V_D = 1\text{ V}$ $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$ Refer to (1)	25°C		-10		pC
O_{ISO}	Off Isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		-65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		-45		dB
X_{TALK}	Crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		-65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		-45		dB
BW	Bandwidth	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ Refer to (1)	25°C		250		MHz
C_{SOFF}	Source off capacitance	$f = 1\text{ MHz}$	25°C		7		pF
C_{SON} C_{DON}	On capacitance	$f = 1\text{ MHz}$	25°C		23		pF

(1) When V_S is 4.5V, V_D is 1.5V or when V_S is 1.5V, V_D is 4.5V.

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R _{ON}	On-resistance	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		5		Ω
			–40°C to +85°C			10	Ω
			–40°C to +125°C			12	Ω
ΔR _{ON}	On-resistance matching between channels	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		0.15		Ω
			–40°C to +85°C			1	Ω
			–40°C to +125°C			1	Ω
R _{ON} FLAT	On-resistance flatness	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		3.5		Ω
			–40°C to +85°C			4	Ω
			–40°C to +125°C			5	Ω
I _{S(OFF)}	Source off leakage current ⁽¹⁾	V _{DD} = 3.3 V Switch Off V _D = 3 V / 1 V V _S = 1 V / 3 V Refer to (1)	25°C		±5		nA
			–40°C to +85°C	–25		25	nA
			–40°C to +125°C	–40		40	nA
I _{D(ON)} I _{S(ON)}	Channel on leakage current	V _{DD} = 3.3 V Switch On V _D = V _S = 3 V / 1 V Refer to (1)	25°C		±15		nA
			–40°C to +85°C	–50		50	nA
			–40°C to +125°C	–80		80	nA
LOGIC INPUTS (SEL)							
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		±0.005		μA
I _{IH} I _{IL}	Input leakage current		–40°C to 125°C			±0.05	μA
C _{IN}	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		–40°C to +125°C			2	pF
POWER SUPPLY							
I _{DD}	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	25°C		0.003		μA
			–40°C to +125°C			0.8	μA

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS							
t_{TRAN}	Switching time between channels	$V_S = 2\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		14		ns
			-40°C to $+85^\circ\text{C}$			20	ns
			-40°C to $+125^\circ\text{C}$			21	ns
t_{OPEN} (BBM)	Break before make time	$V_S = 2\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		9		ns
			-40°C to $+85^\circ\text{C}$	1			ns
			-40°C to $+125^\circ\text{C}$	1			ns
Q_C	Charge Injection	$V_D = 1\text{ V}$ $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$ Refer to (1)	25°C		–6		pC
O_{ISO}	Off Isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		–65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		–45		dB
X_{TALK}	Crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		–65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		–45		dB
BW	Bandwidth	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ Refer to (1)	25°C		250		MHz
C_{SOFF}	Source off capacitance	$f = 1\text{ MHz}$	25°C		7		pF
C_{SON} C_{DON}	On capacitance	$f = 1\text{ MHz}$	25°C		23		pF

(1) When V_S is 3V, V_D is 1V or when V_S is 1V, V_D is 3V.

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R _{ON}	On-resistance	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		40		Ω
			–40°C to +85°C			80	Ω
			–40°C to +125°C			80	Ω
ΔR _{ON}	On-resistance matching between channels	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		0.4		Ω
			–40°C to +85°C			1.5	Ω
			–40°C to +125°C			1.5	Ω
I _{S(OFF)}	Source off leakage current(1)	V _{DD} = 1.98 V Switch Off V _D = 1.62 V / 1 V V _S = 1 V / 1.62 V Refer to (1)	25°C		±5		nA
			–40°C to +85°C	–25		25	nA
			–40°C to +125°C	–40		40	nA
I _{D(ON)} I _{S(ON)}	Channel on leakage current	V _{DD} = 1.98 V Switch On V _D = V _S = 1.62 V / 1 V Refer to (1)	25°C		±15		nA
			–40°C to +85°C	–50		50	nA
			–40°C to +125°C	–80		80	nA
LOGIC INPUTS (SEL)							
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		±0.005		μA
I _{IH} I _{IL}	Input leakage current		–40°C to +125°C			±0.05	μA
C _{IN}	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		–40°C to +125°C			2	pF
POWER SUPPLY							
I _{DD}	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	25°C		0.001		μA
			–40°C to +125°C			0.6	μA

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS							
t_{TRAN}	Transition time between channels	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		28		ns
			-40°C to $+85^\circ\text{C}$			44	ns
			-40°C to $+125^\circ\text{C}$			44	ns
t_{OPEN} (BBM)	Break before make time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		16		ns
			-40°C to $+85^\circ\text{C}$	1			ns
			-40°C to $+125^\circ\text{C}$	1			ns
Q_C	Charge Injection	$V_D = 1\text{ V}$ $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$ Refer to (1)	25°C		–3		pC
O_{ISO}	Off Isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		–65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		–45		dB
X_{TALK}	Crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		–65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		–45		dB
BW	Bandwidth	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$	25°C		250		MHz
C_{SOFF}	Source off capacitance	$f = 1\text{ MHz}$	25°C		7		pF
C_{SON} C_{DON}	On capacitance	$f = 1\text{ MHz}$	25°C		23		pF

(1) When V_S is 1.62V, V_D is 1V or when V_S is 1V, V_D is 1.62V.

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R _{ON}	On-resistance	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		70		Ω
			–40°C to +85°C			105	Ω
			–40°C to +125°C			105	Ω
ΔR _{ON}	On-resistance matching between channels	V _S = 0 V to V _{DD} I _{SD} = 10 mA Refer to (1)	25°C		0.4		Ω
			–40°C to +85°C			1.5	Ω
			–40°C to +125°C			1.5	Ω
I _{S(OFF)}	Source off leakage current(1)	V _{DD} = 1.32 V Switch Off V _D = 1 V / 0.8 V V _S = 0.8 V / 1 V Refer to (1)	25°C		±5		nA
			–40°C to +85°C	–25		25	nA
			–40°C to +125°C	–40		40	nA
I _{D(ON)} I _{S(ON)}	Channel on leakage current	V _{DD} = 1.32 V Switch On V _D = V _S = 1 V / 0.8 V Refer to (1)	25°C		±15		nA
			–40°C to +85°C	–50		50	nA
			–40°C to +125°C	–80		80	nA
LOGIC INPUTS (SEL)							
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		±0.005		μA
I _{IH} I _{IL}	Input leakage current		–40°C to +125°C			±0.05	μA
C _{IN}	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		–40°C to +125°C			2	pF
POWER SUPPLY							
I _{DD}	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	25°C		0.003		μA
			–40°C to +125°C			0.5	μA

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS							
t_{TRAN}	Transition time between channels	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		55		ns
			-40°C to $+85^\circ\text{C}$			190	ns
			-40°C to $+125^\circ\text{C}$			190	ns
t_{OPEN} (BBM)	Break before make time	$V_S = 1\text{ V}$ $R_L = 200\ \Omega$, $C_L = 15\text{ pF}$ Refer to (1)	25°C		28		ns
			-40°C to $+85^\circ\text{C}$	1			ns
			-40°C to $+125^\circ\text{C}$	1			ns
Q_C	Charge Injection	$V_D = 1\text{ V}$ $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$ Refer to (1)	25°C		–2		pC
O_{ISO}	Off Isolation	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		–65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		–45		dB
X_{TALK}	Crosstalk	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ Refer to (1)	25°C		–65		dB
		$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 10\text{ MHz}$ Refer to (1)	25°C		–45		dB
BW	Bandwidth	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$	25°C		250		MHz
C_{SOFF}	Source off capacitance	$f = 1\text{ MHz}$	25°C		7		pF
C_{SON} C_{DON}	On capacitance	$f = 1\text{ MHz}$	25°C		23		pF

(1) When V_S is 1V, V_D is 0.8V or when V_S is 0.8V, V_D is 1V.

5.9 Typical Characteristics

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

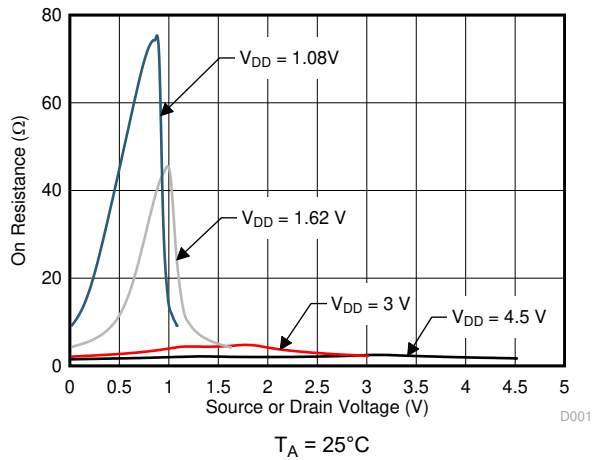


Figure 5-1. On-Resistance vs Source or Drain Voltage

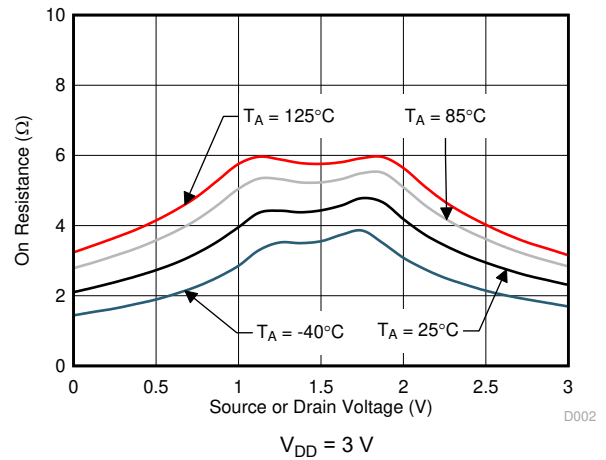


Figure 5-2. On-Resistance vs Source or Drain Voltage

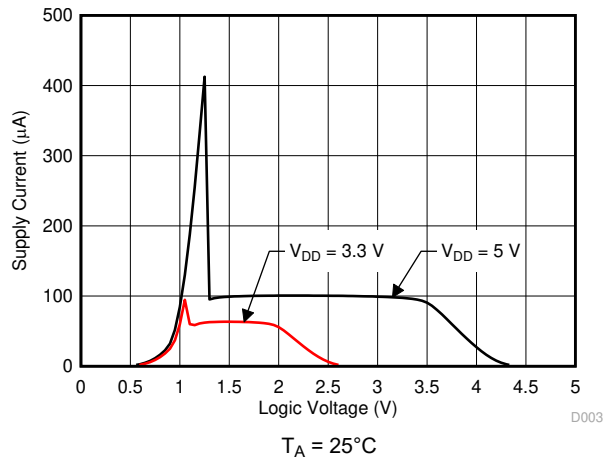


Figure 5-3. Supply Current vs Logic Voltage

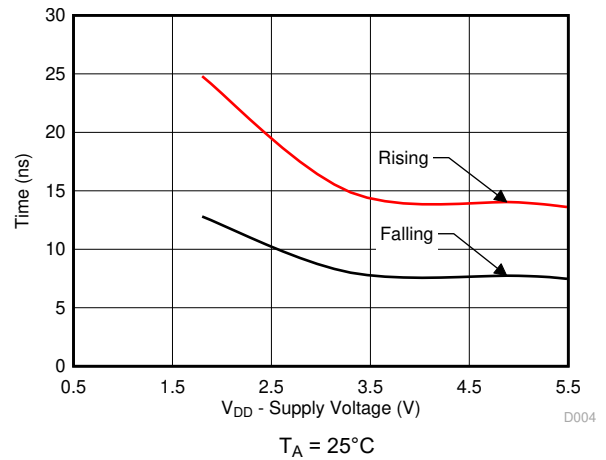


Figure 5-4. $T_{\text{transition}}$ vs Supply Voltage

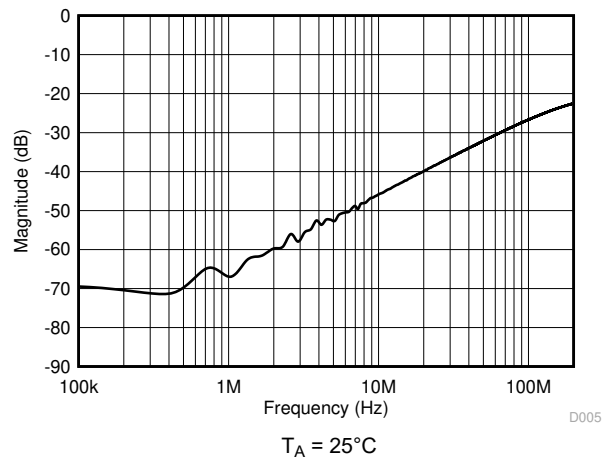


Figure 5-5. Crosstalk and Off-Isolation vs Frequency

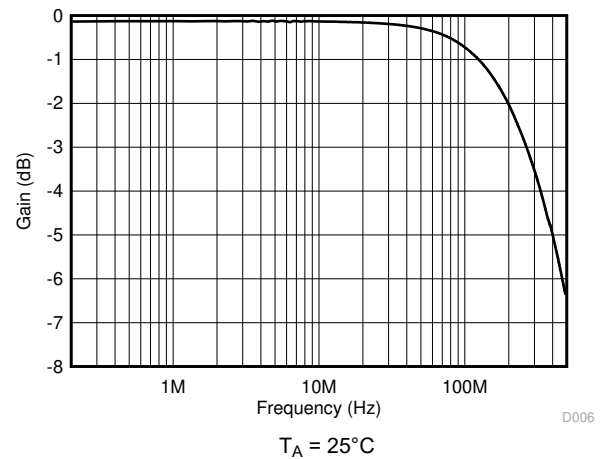
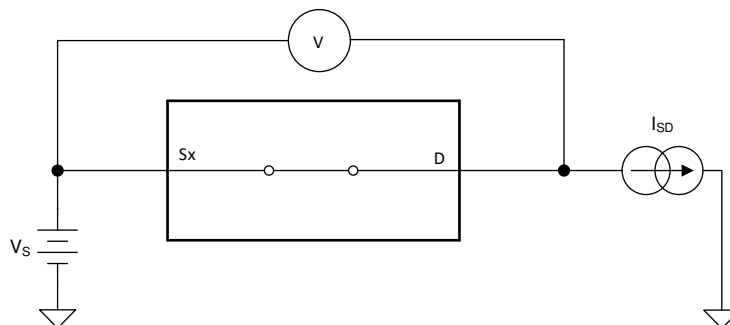


Figure 5-6. Frequency Response

6 Parameter Measurement Information

6.1 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 in 6-1. Voltage (V) and current (I_{SD}) are measured using this setup, and R_{ON} is computed with $R_{ON} = V / I_{SD}$:

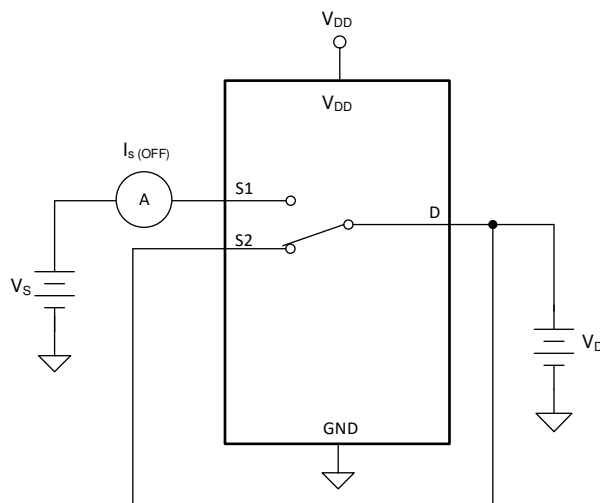


6-1. On-Resistance Measurement Setup

6.2 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 $I_{S(OFF)}$.

The setup used to measure off-leakage current is shown in 6-2.



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. Figure 6-3 shows the circuit used for measuring the on-leakage current, denoted by $I_{S(ON)}$ or $I_{D(ON)}$.

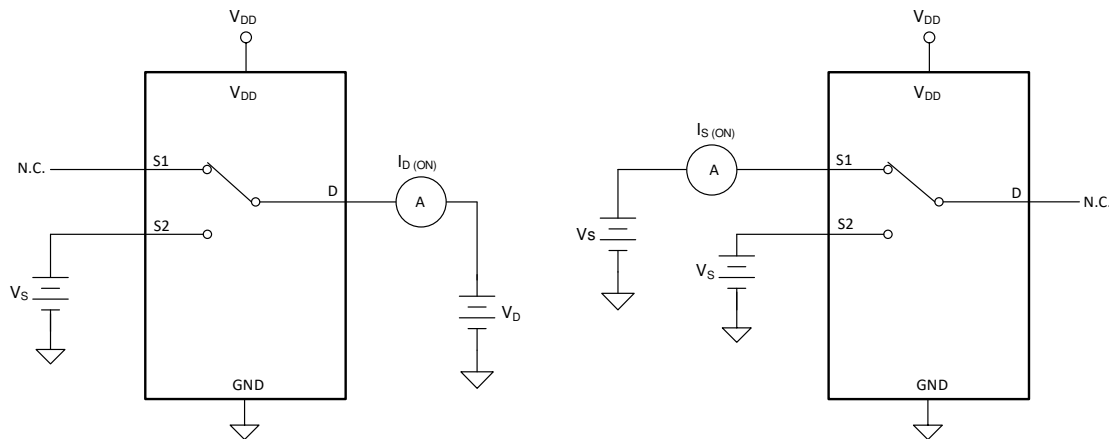


Figure 6-3. On-Leakage Measurement Setup

6.4 Transition Time

Transition time is defined as the time taken by the output of the device to rise or fall 10% after the logic control 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. Figure 6-4 shows the setup used to measure transition time, denoted by the symbol $t_{\text{TRANSITION}}$.

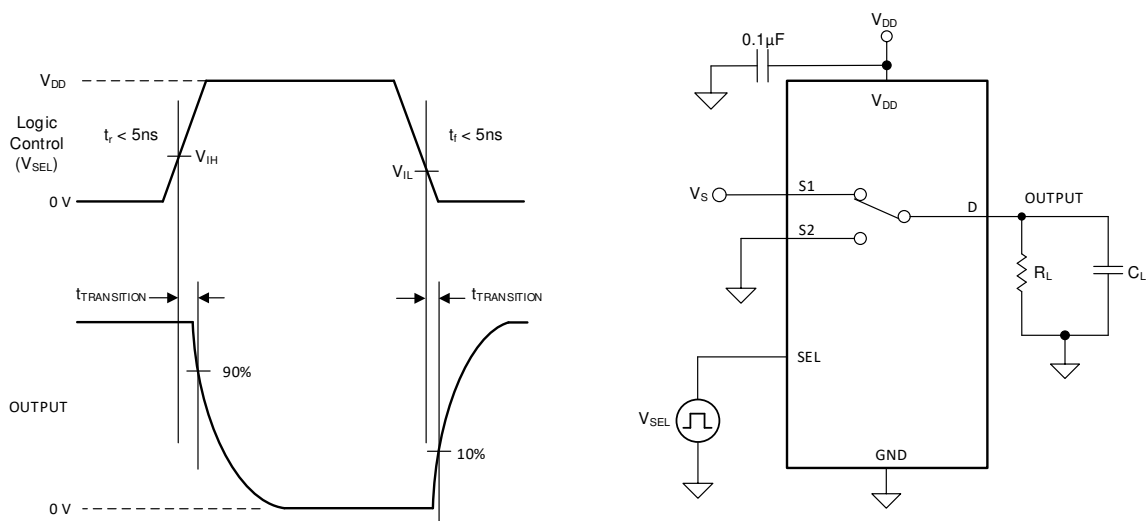


Figure 6-4. Transition-Time Measurement Setup

6.5 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. Figure 6-5 shows the setup used to measure break-before-make delay, denoted by the symbol $t_{\text{OPEN(BBM)}}$.

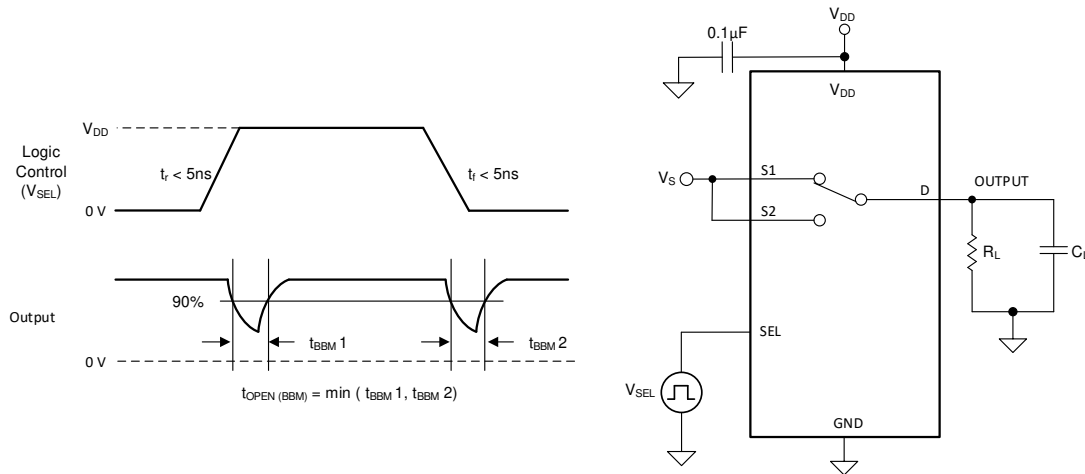


Figure 6-5. Break-Before-Make Delay Measurement Setup

6.6 Charge Injection

The TMUX1219-Q1 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 . Figure 6-6 shows the setup used to measure charge injection from Drain (D) to Source (Sx).

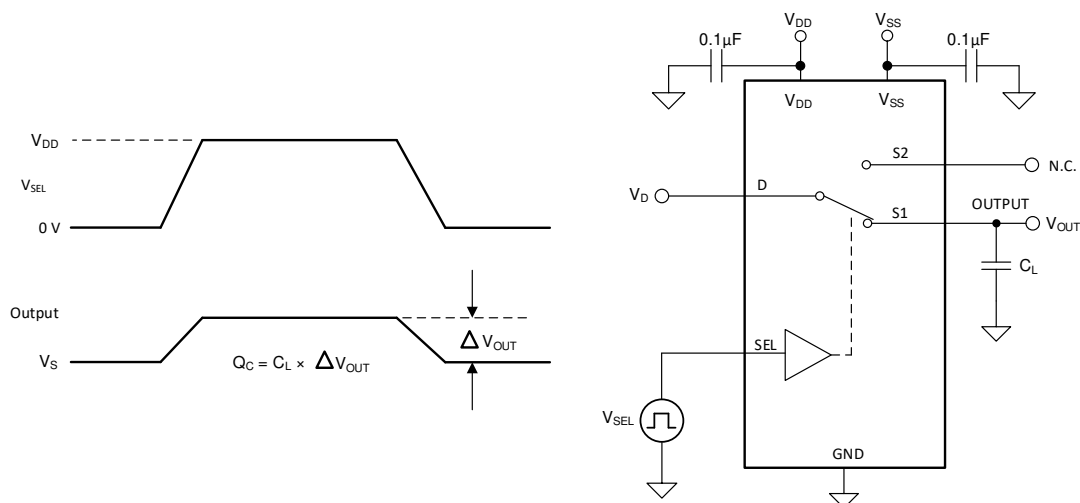


Figure 6-6. Charge-Injection Measurement Setup

6.7 Off Isolation

Off isolation is defined as the ratio of the signal at the drain pin (D) of the device when a signal is applied to the source pin (Sx) of an off-channel. [Figure 6-7](#) shows the setup used to measure, and the equation used to calculate off isolation.

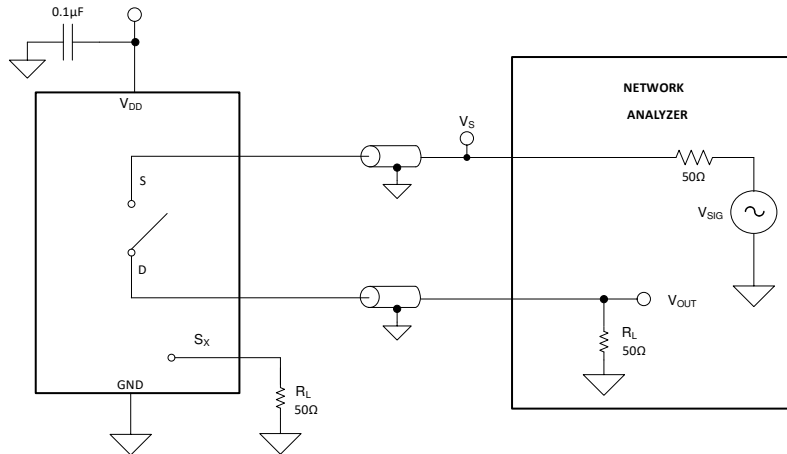


Figure 6-7. Off Isolation Measurement Setup

$$\text{Off Isolation} = 20 \cdot \log \left(\frac{V_{\text{OUT}}}{V_S} \right) \quad (1)$$

6.8 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. [Figure 6-8](#) shows the setup used to measure, and the equation used to calculate crosstalk.

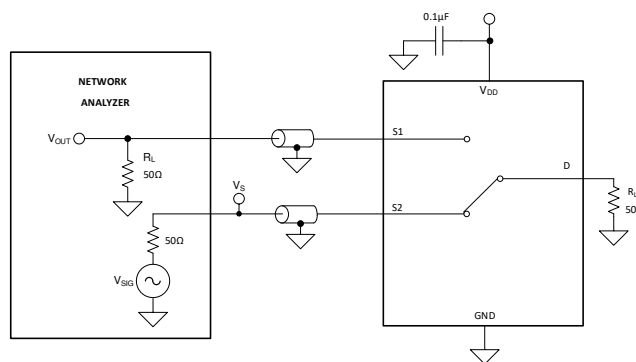
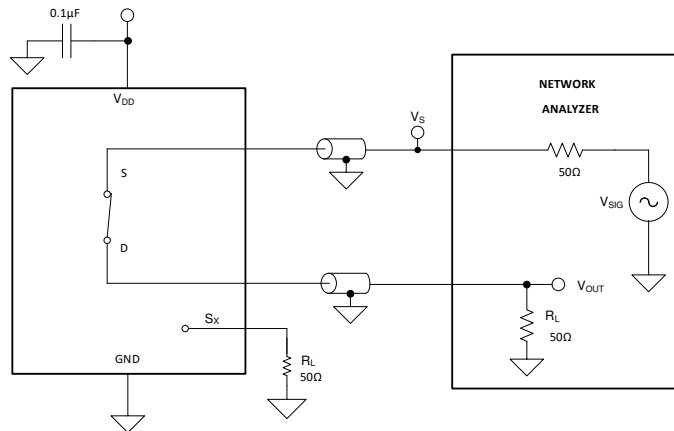


Figure 6-8. Crosstalk Measurement Setup

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

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 (D) of the device.  6-9 shows the setup used to measure bandwidth.



❏ 6-9. Bandwidth Measurement Setup

7 Detailed Description

7.1 Functional Block Diagram

The TMUX1219-Q1 is an 2:1 (SPDT), 1-channel switch where the input is controlled with a single select (SEL) control pin.

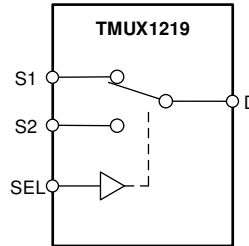


図 7-1. TMUX1219-Q1 Functional Block Diagram

7.2 Feature Description

7.2.1 Bidirectional Operation

The TMUX1219-Q1 conducts equally well from source (Sx) to drain (D) or from drain (D) to source (Sx). The device has very similar characteristics in both directions and supports both analog and digital signals.

7.2.2 Rail to Rail Operation

The valid signal path input/output voltage for TMUX1219-Q1 ranges from GND to V_{DD} .

7.2.3 1.8 V Logic Compatible Inputs

The TMUX1219-Q1 has 1.8-V logic compatible control for the logic control input (SEL). The logic input threshold scales with supply but still provides 1.8-V logic control when operating at 5.5 V supply voltage. 1.8-V logic level inputs allow the TMUX1219-Q1 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](#)

7.2.4 Fail-Safe Logic

The TMUX1219-Q1 supports Fail-Safe Logic on the control input pin (SEL) allowing for operation up to 5.5 V, regardless of the state of the supply pin. This feature allows voltages on the control pin 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 pin of the TMUX1219-Q1 to be ramped to 5.5 V while $V_{DD} = 0$ V. Additionally, the feature enables operation of the TMUX1219-Q1 with $V_{DD} = 1.2$ V while allowing the select pin to interface with a logic level of another device up to 5.5 V.

7.3 Device Functional Modes

The select (SEL) pin of the TMUX1219-Q1 controls which source channel is connected to the drain of the device. When a signal path is not selected, that source pin is in high impedance mode (HI-Z). The control pin can be as high as 5.5 V.

7.4 Truth Tables

表 7-1. TMUX1219-Q1 Truth Table

CONTROL LOGIC (SEL)	Selected Source (Sx) Connected To Drain (D) Pin
0	S1
1	S2

8 Application and Implementation

注

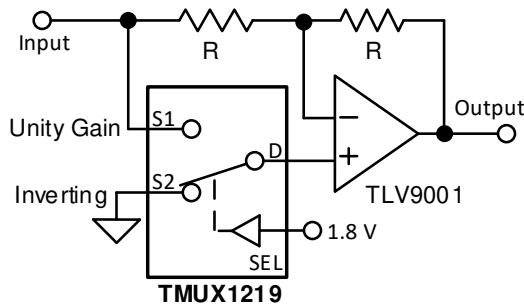
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

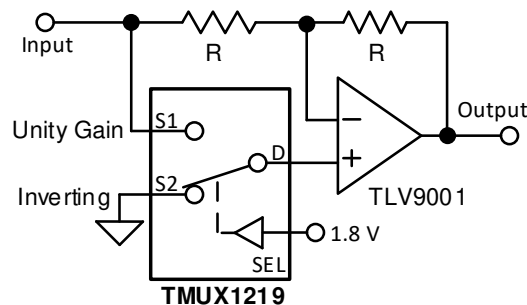
8.1 Application Information

The 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 pin supports 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 of the TMUX12xx, a family of general purpose multiplexers and switches, reduce system complexity, board size, and overall system cost.

8.2 Typical Application

8.2.1 Switchable Operational Amplifier Gain Setting

One example application of the TMUX1219-Q1 is to change an Op Amp from unity gain setting to an inverting amplifier configuration. Utilizing a switch allows a system to have a configurable gain and allows the same architecture to be utilized across the board for various inputs to the system.  8-1 shows the TMUX1219-Q1 configured for gain setting application.



 8-1. Switchable Op Amp Gain Setting

8.2.1.1 Design Requirements

This design example uses the parameters listed in  8-1.

表 8-1. Design Parameters

PARAMETERS	VALUES
Input Signal	0 V to 2.75 V
Mux Supply (V_{DD})	2.75 V
Op Amp Supply (V_{+}/V_{-})	± 2.75 V
Mux I/O signal range	0 V to V_{DD} (Rail to Rail)
Control logic thresholds	1.8 V compatible (up to 5.5V)

8.2.1.2 Detailed Design Procedure

The application shown in [Figure 8-1](#) demonstrates how to use a single control input and toggle between gain settings of -1 and +1. If switching between inverting and unity gain is not required, the TMUX1219-Q1 can be utilized in the feedback path to select different feedback resistors and provide scalable gain settings for configurable signal conditioning.

The TMUX1219-Q1 can be operated without any external components except for the supply decoupling capacitors. The select pin is recommended to have a weak pull-down or pull-up resistor to ensure the input is in a known state. All inputs to the switch must fall within the recommend operating conditions of the TMUX1219-Q1 including signal range and continuous current. For this design with a supply of 2.75 V the signal range can be 0 V to 2.75 V and the max continuous current can be 30 mA.

8.2.1.3 Application Curve

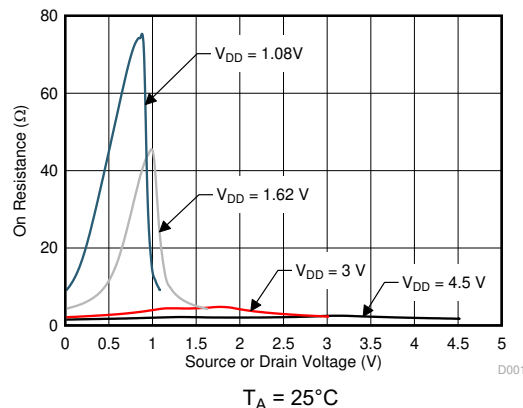


Figure 8-2. On-Resistance vs Source or Drain Voltage

8.2.2 Input Control for Power Amplifier

Another application of the TMUX1219-Q1 is for input control of a power amplifier. Utilizing a switch allows a system to control when the DAC is connected to the power amplifier, and can stop biasing the power amplifier by switching the gate to GND. [Figure 8-3](#) shows the TMUX1219-Q1 configured for control of the power amplifier.

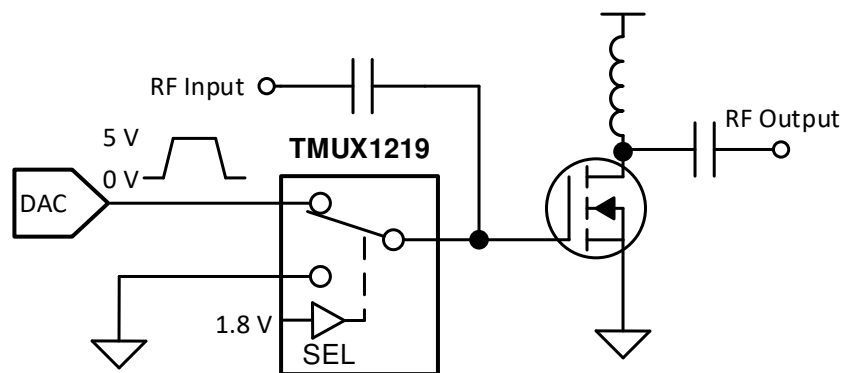


Figure 8-3. Input Control of Power Amplifier

8.2.2.1 Design Requirements

This design example uses the parameters listed in 表 8-1.

表 8-2. Design Parameters

PARAMETERS	VALUES
Supply (V_{DD})	5 V
Mux I/O signal range	0 V to V_{DD} (Rail to Rail)
Control logic thresholds	1.8 V compatible (up to 5.5V)

8.2.2.2 Detailed Design Procedure

The application shown in 図 8-3 demonstrates how to toggle between the DAC output and GND for control of a power amplifier using a single control input. The DAC output is utilized to bias the gate of the power amplifier and can be disconnected from the circuit using the select pin of the switch. The TMUX1219-Q1 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. The TMUX1219-Q1 can be operated without any external components except for the supply decoupling capacitors. The select pin is recommended to have a weak pull-down or pull-up resistor to ensure the input is in a known state. All inputs to the switch must fall within the recommend operating conditions of the TMUX1219-Q1 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.

8.2.2.3 Application Curve

A key parameter for this application is the transition time of the device. Faster transition time allows the system to toggle between input sources at a faster rate and allows the output to settle to the final value. The TMUX1219-Q1 has a transition time that varies with supply voltage and is shown in 図 8-4

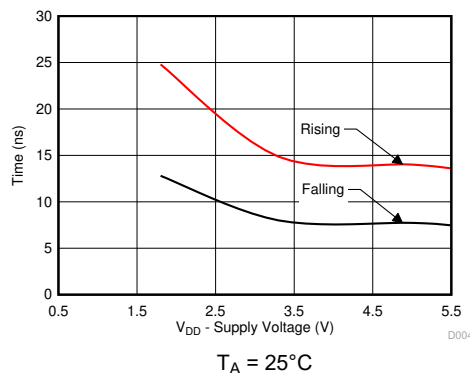


図 8-4. $T_{\text{transition}}$ vs Supply Voltage

9 Power Supply Recommendations

The TMUX1219-Q1 operates 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 μF to 10 μF 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.

10 Layout

10.1 Layout Guidelines

10.1.1 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. [Figure 10-1](#) shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

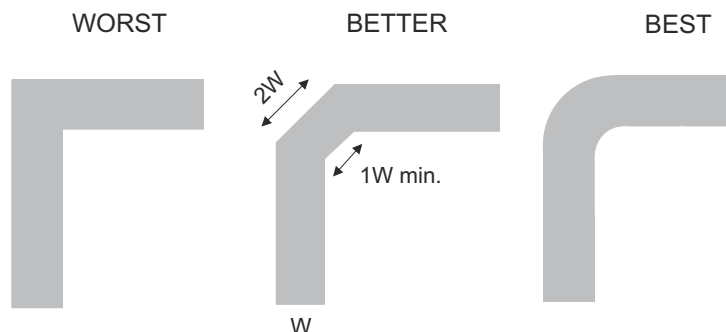


Figure 10-1. Trace Example

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.

[Figure 10-2](#) illustrates an example of a PCB layout with the TMUX1219-Q1. Some key considerations are:

- Decouple the V_{DD} pin with a 0.1- μ 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.

10.2 Layout Example

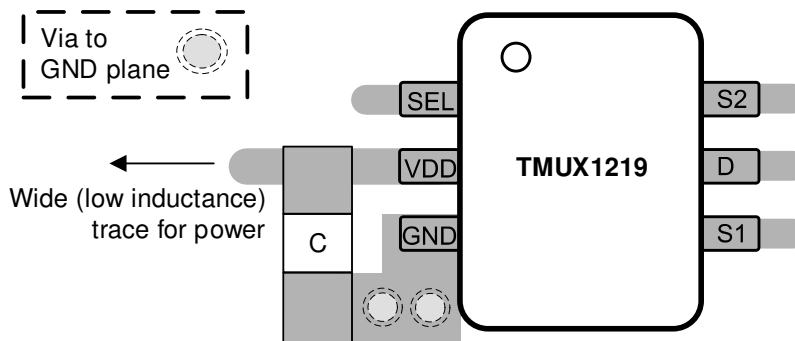


Figure 10-2. TMUX1219-Q1 Layout Example

11 Device and Documentation Support

11.1 Documentation Support

11.1.1 Related Documentation

Texas Instruments, [Improve Stability Issues with Low CON Multiplexers](#).

Texas Instruments, [Simplifying Design with 1.8 V logic Muxes and Switches](#).

Texas Instruments, [Eliminate Power Sequencing with Powered-off Protection Signal Switches](#).

Texas Instruments, [System-Level Protection for High-Voltage Analog Multiplexers](#).

11.2 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 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。

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11.6 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。

12 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。

DATE	REVISION	NOTES
September 2024	*	Initial Release

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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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)
TMUX1219DBVRQ1	Active	Production	SOT-23 (DBV) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	3GUT
TMUX1219DBVRQ1.A	Active	Production	SOT-23 (DBV) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	3GUT

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

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

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

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

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

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

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

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OTHER QUALIFIED VERSIONS OF TMUX1219-Q1 :

- Catalog : [TMUX1219](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

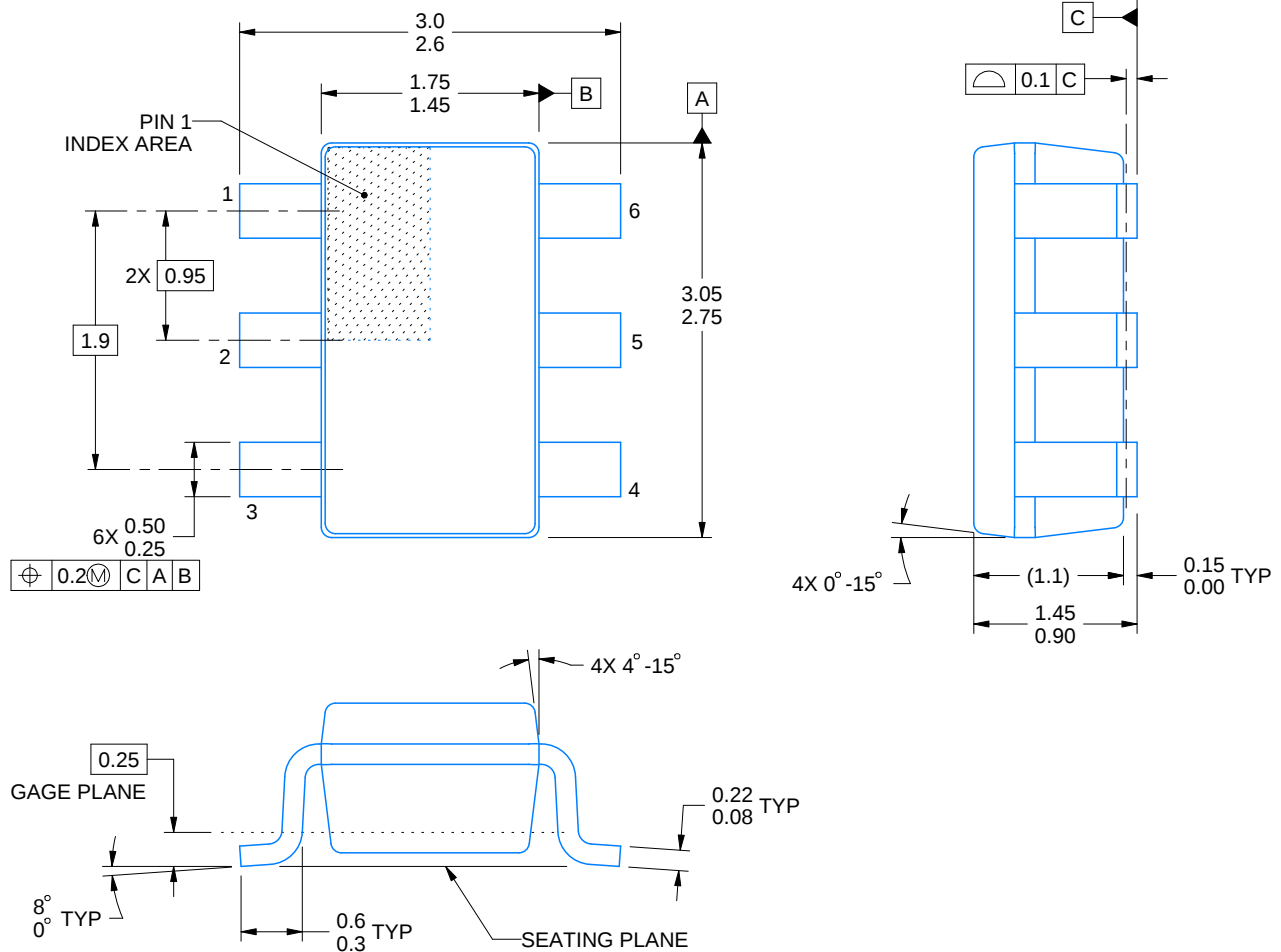
DBV0006A



PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



4214840/G 08/2024

NOTES:

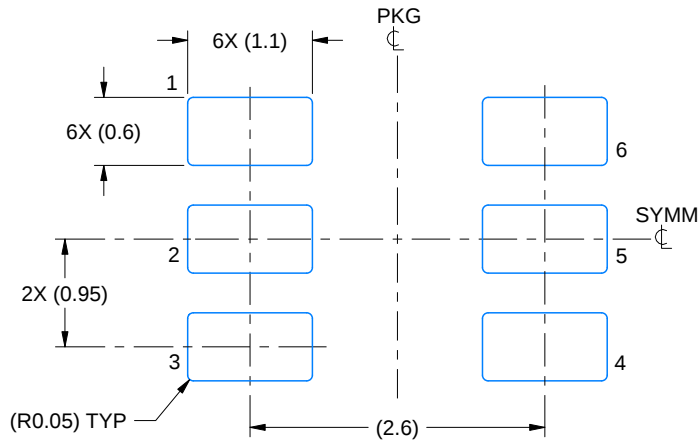
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.25 per side.
4. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
5. Reference JEDEC MO-178.

EXAMPLE BOARD LAYOUT

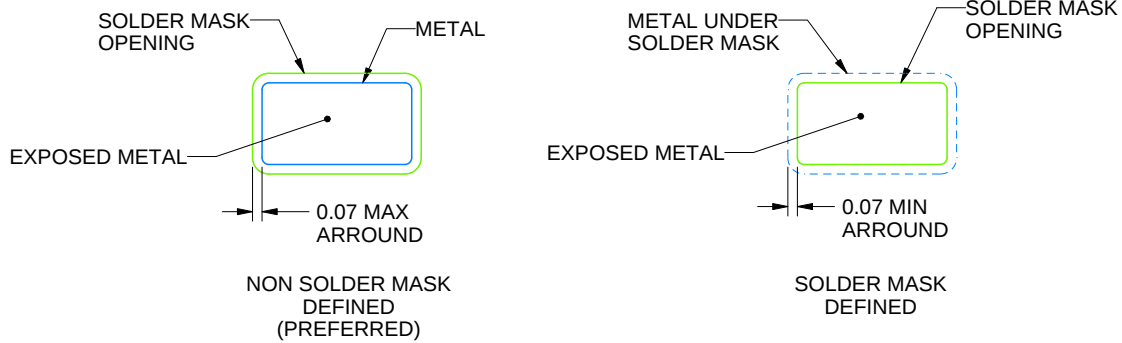
DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

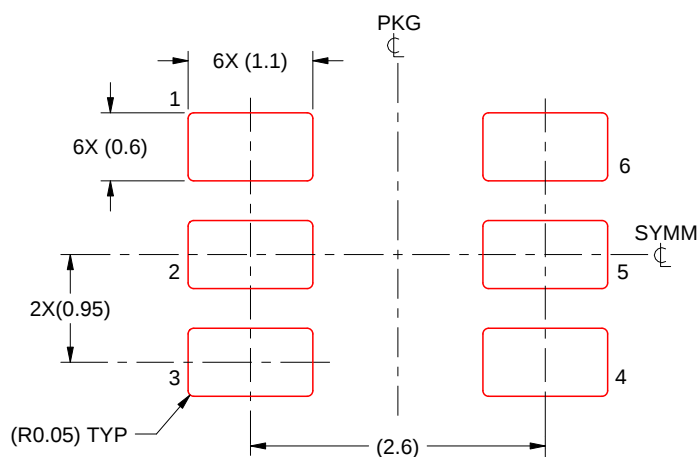
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

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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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