

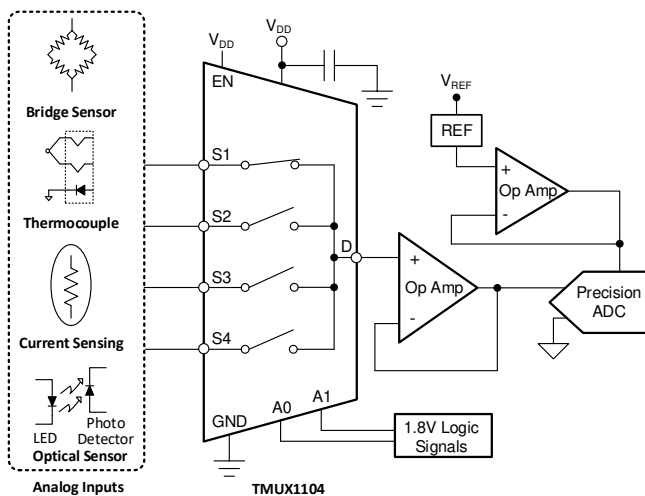
TMUX1104 5V、低リーク電流、4:1 高精度マルチプレクサ

1 特長

- 幅広い電源電圧範囲: 1.08V~5.5V
- 小さいリーク電流: 3pA
- 少ない電荷注入: 1.5pC
- 低いオン抵抗: 2Ω
- -40°C~+125°Cの動作温度範囲
- **1.8V ロジック互換**
- **フェイルセーフ ロジック**
- **レール ツー レールの動作**
- **双方向の信号パス**
- 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

- **超音波スキャナ**
- **メディカル モニタと診断**
- **血糖値モニタ**
- **光学ネットワーク機器**
- **光学テスト機器**
- **リモート無線ユニット**
- **有線ネットワーク**
- **データアキュイジションシステム**
- **ATE 試験装置**
- **ファクトリオートメーションと産業用制御**
- **プログラマブルロジックコントローラ (PLC)**
- **アナログ入力モジュール**
- **ソナー受信機**
- **バッテリーモニタリングシステム**



概略回路図

3 概要

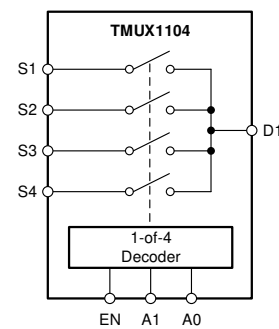
TMUX1104 は、高精度の CMOS (相補型金属酸化膜半導体) マルチプレクサ (MUX) です。TMUX1104 はシングルチャネル、4:1 構成です。このデバイスは 1.08V~5.5V の広い電源電圧範囲で動作するため、医療機器から産業システムまで、幅広い用途に適しています。このデバイスは、ソース (Sx) およびドレイン (D) ピンで、GND から V_{DD} までの範囲の双方向アナログおよびデジタル信号をサポートします。すべてのロジック入力のスレッシュホールドは **1.8V ロジック互換** で、有効な電源電圧範囲で動作していれば、TTL と CMOS の両方のロジックと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。

TMUX1104 は、高精度スイッチおよびマルチプレクサのデバイスファミリの製品です。これらのデバイスは、オンおよびオフ時のリーク電流が非常に小さく、電荷注入も少ないため、高精度の測定用途に使用できます。消費電流が 5nA と低く、小さいパッケージオプションが存在するため、携帯型アプリケーションでも使用できます。

パッケージ情報

部品番号	パッケージ ⁽¹⁾	パッケージサイズ ⁽²⁾
TMUX1104	DGS (VSSOP, 10)	3mm × 4.9mm
	DQA (USON, 10)	2.5mm × 1mm

- (1) 詳細については、**セクション 11** を参照してください。
- (2) パッケージサイズ (長さ×幅) は公称値であり、該当する場合はピンも含まれます。



ブロック図



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4 Pin Configuration and Functions

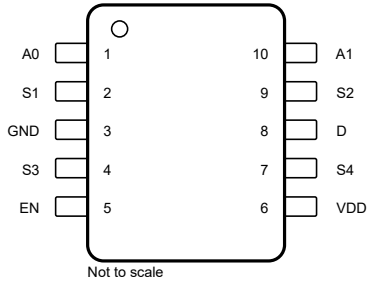


図 4-1. DGS Package,
10-Pin VSSOP (Top View)

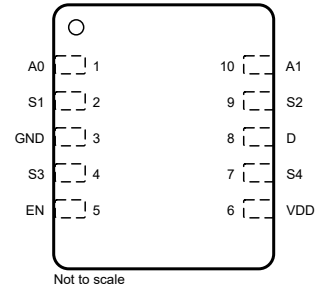


図 4-2. DQA Package,
10-Pin USON (Top View)

表 4-1. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
A0	1	I	Address line 0. Controls the switch configuration as shown in 表 7-1.
S1	2	I/O	Source pin 1. Can be an input or output.
GND	3	P	Ground (0V) reference
S3	4	I/O	Source pin 3. Can be an input or output.
EN	5	I	Active high logic enable. When this pin is low, all switches are turned off. When this pin is high, the A[1:0] logic inputs determine which switch is turned on.
VDD	6	P	Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1μF to 10μF between V _{DD} and GND.
S4	7	I/O	Source pin 4. Can be an input or output.
D	8	I/O	Drain pin. Can be an input or output.
S2	9	I/O	Source pin 2. Can be an input or output.
A1	10	I	Address line 1. Controls the switch configuration as shown in 表 7-1.

(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⁾ ⁽³⁾

		MIN	MAX	UNIT
V _{DD}	Supply voltage	-0.5	6	V
V _{SEL} or V _{EN}	Logic control input pin voltage (EN, A0, A1)	-0.5	6	V
I _{SEL} or I _{EN}	Logic control input pin current (EN, A0, A1)	-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)	I _{DC} ± 10 % ⁽⁴⁾	I _{DC} ± 10 % ⁽⁴⁾	mA
I _S or I _D (PEAK)	Source and drain peak current: (1 ms period max, 10% duty cycle maximum) (Sx, D)	I _{peak} ± 10 % ⁽⁴⁾	I _{peak} ± 10 % ⁽⁴⁾	mA
T _{stg}	Storage temperature	-65	150	°C
P _{tot}	Total power dissipation ⁽⁵⁾ ⁽⁶⁾		500	mW
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.
- (4) Refer to Recommended Operating Conditions for I_{DC} and I_{Peak} ratings
- (5) For DGS(VSSOP) package: P_{tot} derates linearly above TA=53°C by 5.16mW/°C
- (6) For DQA(USON) package: P_{tot} derates linearly above TA=63°C by 5.78mW/°C

5.2 ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins ⁽¹⁾	±2000
		Charged device model (CDM), per JEDEC specification JESD22-C101, 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}	Positive power 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	0		5.5	V
T _A	Ambient temperature	-40		125	°C
I _{DC}	Continuous current through switch	T _J = 25°C		150	mA
		T _J = 85°C		120	mA
		T _J = 125°C		60	mA
		T _J = 130°C		50	mA

5.3 Recommended Operating Conditions (続き)

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

			MIN	NOM	MAX	UNIT
I_{peak}	Peak current through switch(1 ms period max, 10% duty cycle maximum)	$T_j = 25^\circ\text{C}$		300		mA
		$T_j = 85^\circ\text{C}$		300		mA
		$T_j = 125^\circ\text{C}$		180		mA
		$T_j = 130^\circ\text{C}$		160		mA

5.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TMUX1104		UNIT
		DGS (VSSOP)	DQA (USON)	
		10 PINS	10 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	193.9	173.0	$^\circ\text{C}/\text{W}$
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	83.1	99.7	$^\circ\text{C}/\text{W}$
$R_{\theta JB}$	Junction-to-board thermal resistance	116.5	73.5	$^\circ\text{C}/\text{W}$
Ψ_{JT}	Junction-to-top characterization parameter	22.0	8.9	$^\circ\text{C}/\text{W}$
Ψ_{JB}	Junction-to-board characterization parameter	114.6	73.0	$^\circ\text{C}/\text{W}$
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	$^\circ\text{C}/\text{W}$

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

PARAMETER	TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT		
ANALOG SWITCH								
R_{ON}	On-resistance	$V_S = 0V$ to V_{DD} $I_{SD} = 10\text{ mA}$ Refer to On-Resistance	25 $^\circ\text{C}$	2	4	Ω		
			-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$			4.5	Ω	
			-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$			4.9	Ω	
ΔR_{ON}	On-resistance matching between channels	$V_S = 0V$ to V_{DD} $I_{SD} = 10\text{ mA}$ Refer to On-Resistance	25 $^\circ\text{C}$	0.13		Ω		
			-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$			0.4	Ω	
			-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$			0.5	Ω	
$R_{ON\ FLAT}$	On-resistance flatness	$V_S = 0V$ to V_{DD} $I_{SD} = 10\text{ mA}$ Refer to On-Resistance	25 $^\circ\text{C}$	0.85		Ω		
			-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$			1.6	Ω	
			-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$			1.6	Ω	
$I_{S(OFF)}$	Source off leakage current ⁽¹⁾	$V_{DD} = 5V$ Switch Off $V_D = 4.5V / 1.5V$ $V_S = 1.5V / 4.5V$ Refer to Off-Leakage Current	25 $^\circ\text{C}$	-0.08	± 0.005	0.08	nA	
			-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$			-0.3	0.3	nA
			-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$			-0.9	0.9	nA
$I_{D(OFF)}$	Drain off leakage current ⁽¹⁾	$V_{DD} = 5V$ Switch Off $V_D = 4.5V / 1.5V$ $V_S = 1.5V / 4.5V$ Refer to Off-Leakage Current	25 $^\circ\text{C}$	-0.1	± 0.01	0.1	nA	
			-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$			-0.75	0.75	nA
			-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$			-3.5	3.5	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 5V$ Switch On $V_D = V_S = 2.5V$ Refer to On-Leakage Current	25 $^\circ\text{C}$	-0.025	± 0.003	0.025	nA	
			-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$			-0.3	0.3	nA
			-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$			-0.95	0.95	nA

5.5 Electrical Characteristics (V_{DD} = 5V ±10 %) (続き)

at T_A = 25°C, V_{DD} = 5V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
I _{D(ON)} I _{S(ON)}	Channel on leakage current	V _{DD} = 5V Switch On V _D = V _S = 4.5V / 1.5V Refer to On-Leakage Current	25°C	-0.1	±0.01	0.1	nA
			-40°C to +85°C	-0.75		0.75	nA
			-40°C to +125°C	-3.5		3.5	nA
LOGIC INPUTS (EN, A0, A1)							
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
			-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 = 0V or 5.5V	25°C	0.005			µA
			-40°C to +125°C			1	µA
DYNAMIC CHARACTERISTICS							
t _{TRAN}	Transition time between channels	V _S = 3V R _L = 200Ω, C _L = 15 pF Refer to Transition Time	25°C	14			ns
			-40°C to +85°C			18	ns
			-40°C to +125°C			19	ns
t _{OPEN} (BBM)	Break before make time	V _S = 3V R _L = 200Ω, C _L = 15 pF Refer to Break-Before-Make	25°C	8			ns
			-40°C to +85°C	1			ns
			-40°C to +125°C	1			ns
t _{ON(EN)}	Enable turn-on time	V _S = 3V R _L = 200Ω, C _L = 15 pF Refer to tON(EN) and tOFF(EN)	25°C	12			ns
			-40°C to +85°C			17	ns
			-40°C to +125°C			18	ns
t _{OFF(EN)}	Enable turn-off time	V _S = 3V R _L = 200Ω, C _L = 15 pF Refer to tON(EN) and tOFF(EN)	25°C	5			ns
			-40°C to +85°C			8	ns
			-40°C to +125°C			9	ns
Q _C	Charge Injection	V _S = 1V R _S = 0Ω, C _L = 1 nF Refer to Charge Injection	25°C	1.5			pC
O _{ISO}	Off Isolation	R _L = 50 Ω, C _L = 5 pF f = 1 MHz Refer to Off Isolation	25°C	-65			dB
		R _L = 50 Ω, C _L = 5 pF f = 10 MHz Refer to Off Isolation	25°C	-45			dB
X _{TALK}	Crosstalk	R _L = 50 Ω, C _L = 5 pF f = 1 MHz Refer to Crosstalk	25°C	-65			dB
		R _L = 50 Ω, C _L = 5 pF f = 10 MHz Refer to Crosstalk	25°C	-45			dB
BW	Bandwidth	R _L = 50 Ω, C _L = 5 pF Refer to Bandwidth	25°C	155			MHz
C _{SOFF}	Source off capacitance	f = 1 MHz	25°C	6			pF
C _{DOFF}	Drain off capacitance	f = 1 MHz	25°C	28			pF

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
C_{SON} C_{DON}	On capacitance	f = 1 MHz	25°C		35		pF

(1) When V_S is 4.5V, V_D is 1.5V, and vice versa.

5.6 Electrical Characteristics (V_{DD} = 3.3V ±10 %)

at T_A = 25°C, V_{DD} = 3.3V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT	
ANALOG SWITCH								
R _{ON}	On-resistance	V _S = 0V to V _{DD} I _{SD} = 10mA Refer to On-Resistance	25°C		3.7	8.8	Ω	
			-40°C to +85°C			9.5	Ω	
			-40°C to +125°C			9.8	Ω	
ΔR _{ON}	On-resistance matching between channels	V _S = 0V to V _{DD} I _{SD} = 10mA Refer to On-Resistance	25°C		0.13		Ω	
			-40°C to +85°C			0.4	Ω	
			-40°C to +125°C			0.5	Ω	
R _{ON} FLAT	On-resistance flatness	V _S = 0V to V _{DD} I _{SD} = 10mA Refer to On-Resistance	25°C		1.9		Ω	
			-40°C to +85°C			2	Ω	
			-40°C to +125°C			2.2	Ω	
I _{S(OFF)}	Source off leakage current ⁽¹⁾	V _{DD} = 3.3V Switch Off V _D = 3V / 1V V _S = 1V / 3V Refer to Off-Leakage Current	25°C	-0.05	±0.001	0.05	nA	
			-40°C to +85°C			-0.1	0.1	nA
			-40°C to +125°C			-0.5	0.5	nA
I _{D(OFF)}	Drain off leakage current ⁽¹⁾	V _{DD} = 3.3V Switch Off V _D = 3V / 1V V _S = 1V / 3V Refer to Off-Leakage Current	25°C	-0.1	±0.005	0.1	nA	
			-40°C to +85°C			-0.5	0.5	nA
			-40°C to +125°C			-2	2	nA
I _{D(ON)} I _{S(ON)}	Channel on leakage current	V _{DD} = 3.3V Switch On V _D = V _S = 3V / 1V Refer to On-Leakage Current	25°C	-0.1	±0.005	0.1	nA	
			-40°C to +85°C			-0.5	0.5	nA
			-40°C to +125°C			-2	2	nA
LOGIC INPUTS (EN, A0, A1)								
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 = 0V or 5.5V	25°C		0.005		μA	
			-40°C to +125°C			1	μA	
DYNAMIC CHARACTERISTICS								
t _{TRAN}	Transition time between channels	V _S = 2V R _L = 200Ω, C _L = 15pF Refer to Transition Time	25°C		15		ns	
			-40°C to +85°C			21	ns	
			-40°C to +125°C			22	ns	
t _{OPEN} (BBM)	Break before make time	V _S = 2V R _L = 200Ω, C _L = 15pF Refer to Break-Before-Make	25°C		9		ns	
			-40°C to +85°C			1	ns	
			-40°C to +125°C			1	ns	
t _{ON(EN)}	Enable turn-on time	V _S = 2V R _L = 200Ω, C _L = 15pF Refer to t_{ON(EN)} and t_{OFF(EN)}	25°C		14		ns	
			-40°C to +85°C			21	ns	
			-40°C to +125°C			21	ns	

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
$t_{OFF(EN)}$	Enable turn-off time	$V_S = 2V$ $R_L = 200\Omega$, $C_L = 15pF$ Refer to tON(EN) and tOFF(EN)	25°C		7		ns
			-40°C to +85°C			9	ns
			-40°C to +125°C			10	ns
Q_C	Charge Injection	$V_S = 1V$ $R_S = 0\Omega$, $C_L = 1nF$ Refer to Charge Injection	25°C		-1.5		pC
O_{ISO}	Off Isolation	$R_L = 50\Omega$, $C_L = 5pF$ $f = 1MHz$ Refer to Off Isolation	25°C		-65		dB
			25°C			-45	dB
X_{TALK}	Crosstalk	$R_L = 50\Omega$, $C_L = 5pF$ $f = 1MHz$ Refer to Crosstalk	25°C		-65		dB
			25°C			-45	dB
BW	Bandwidth	$R_L = 50\Omega$, $C_L = 5pF$ Refer to Bandwidth	25°C		155		MHz
C_{SOFF}	Source off capacitance	$f = 1MHz$	25°C		6		pF
C_{DOFF}	Drain off capacitance	$f = 1MHz$	25°C		28		pF
C_{SON} C_{DON}	On capacitance	$f = 1MHz$	25°C		35		pF

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

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

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R_{ON}	On-resistance	$V_S = 0V$ to V_{DD} $I_{SD} = 10mA$ Refer to On-Resistance	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	$V_S = 0V$ to V_{DD} $I_{SD} = 10mA$ Refer to On-Resistance	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⁾	$V_{DD} = 1.98V$ Switch Off $V_D = 1.62V / 1V$ $V_S = 1V / 1.62V$ Refer to Off-Leakage Current	25°C	-0.05	± 0.003	0.05	nA
			-40°C to +85°C			0.1	nA
			-40°C to +125°C			0.5	nA
$I_{D(OFF)}$	Drain off leakage current ⁽¹⁾	$V_{DD} = 1.98V$ Switch Off $V_D = 1.62V / 1V$ $V_S = 1V / 1.62V$ Refer to Off-Leakage Current	25°C	-0.1	± 0.005	0.1	nA
			-40°C to +85°C			0.5	nA
			-40°C to +125°C			2	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 1.98V$ Switch On $V_D = V_S = 1.62V / 1V$ Refer to On-Leakage Current	25°C	-0.1	± 0.005	0.1	nA
			-40°C to +85°C			0.5	nA
			-40°C to +125°C			2	nA

5.7 Electrical Characteristics (V_{DD} = 1.8V ±10 %) (続き)

at T_A = 25°C, V_{DD} = 1.8V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
LOGIC INPUTS (EN, A0, A1)							
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 = 0V or 5.5V	25°C		0.001		µA
			–40°C to +125°C			0.85	µA
DYNAMIC CHARACTERISTICS							
t _{TRAN}	Transition time between channels	V _S = 1V R _L = 200Ω, C _L = 15pF Refer to Transition Time	25°C		28		ns
			–40°C to +85°C			44	ns
			–40°C to +125°C			44	ns
t _{OPEN} (BBM)	Break before make time	V _S = 1V R _L = 200Ω, C _L = 15pF Refer to Break-Before-Make	25°C		16		ns
			–40°C to +85°C	1			ns
			–40°C to +125°C	1			ns
t _{ON(EN)}	Enable turn-on time	V _S = 1V R _L = 200Ω, C _L = 15pF Refer to tON(EN) and tOFF(EN)	25°C		25		ns
			–40°C to +85°C			41	ns
			–40°C to +125°C			41	ns
t _{OFF(EN)}	Enable turn-off time	V _S = 1V R _L = 200Ω, C _L = 15pF Refer to tON(EN) and tOFF(EN)	25°C		13		ns
			–40°C to +85°C			23	ns
			–40°C to +125°C			23	ns
Q _C	Charge Injection	V _S = 1V R _S = 0Ω, C _L = 1nF Refer to Charge Injection	25°C		–0.5		pC
O _{ISO}	Off Isolation	R _L = 50 Ω, C _L = 5pF f = 1MHz Refer to Off Isolation	25°C		–65		dB
		R _L = 50 Ω, C _L = 5pF f = 10MHz Refer to Off Isolation	25°C		–45		dB
X _{TALK}	Crosstalk	R _L = 50 Ω, C _L = 5pF f = 1MHz Refer to Crosstalk	25°C		–65		dB
		R _L = 50 Ω, C _L = 5pF f = 10MHz Refer to Crosstalk	25°C		–45		dB
BW	Bandwidth	R _L = 50 Ω, C _L = 5pF Refer to Bandwidth	25°C		140		MHz
C _{SOFF}	Source off capacitance	f = 1MHz	25°C		6		pF
C _{DOFF}	Drain off capacitance	f = 1MHz	25°C		28		pF
C _{SON} C _{DON}	On capacitance	f = 1MHz	25°C		35		pF

(1) When V_S is 1.62V, V_D is 1V, and vice versa.

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

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
R_{ON}	On-resistance	$V_S = 0V$ to V_{DD} $I_{SD} = 10mA$ Refer to On-Resistance	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	$V_S = 0V$ to V_{DD} $I_{SD} = 10mA$ Refer to On-Resistance	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⁾	$V_{DD} = 1.32V$ Switch Off $V_D = 1V / 0.8V$ $V_S = 0.8V / 1V$ Refer to Off-Leakage Current	25°C	-0.05	± 0.003	0.05	nA
			-40°C to +85°C	-0.1		0.1	nA
			-40°C to +125°C	-0.5		0.5	nA
$I_{D(OFF)}$	Drain off leakage current ⁽¹⁾	$V_{DD} = 1.32V$ Switch Off $V_D = 1V / 0.8V$ $V_S = 0.8V / 1V$ Refer to Off-Leakage Current	25°C	-0.1	± 0.005	0.1	nA
			-40°C to +85°C	-0.5		0.5	nA
			-40°C to +125°C	-2		2	nA
$I_{D(ON)}$ $I_{S(ON)}$	Channel on leakage current	$V_{DD} = 1.32V$ Switch On $V_D = V_S = 1V / 0.8V$ Refer to On-Leakage Current	25°C	-0.1	± 0.005	0.1	nA
			-40°C to +85°C	-0.5		0.5	nA
			-40°C to +125°C	-2		2	nA
LOGIC INPUTS (EN, A0, A1)							
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
			-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 = 0V or 5.5V	25°C		0.001		μA
			-40°C to +125°C			0.7	μA
DYNAMIC CHARACTERISTICS							
t_{TRAN}	Transition time between channels	$V_S = 1V$ $R_L = 200\Omega$, $C_L = 15pF$ Refer to Transition Time	25°C		55		ns
			-40°C to +85°C			190	ns
			-40°C to +125°C			190	ns
t_{OPEN} (BBM)	Break before make time	$V_S = 1V$ $R_L = 200\Omega$, $C_L = 15pF$ Refer to Break-Before-Make	25°C		28		ns
			-40°C to +85°C	1			ns
			-40°C to +125°C	1			ns
$t_{ON(EN)}$	Enable turn-on time	$V_S = 1V$ $R_L = 200\Omega$, $C_L = 15pF$ Refer to tON(EN) and tOFF(EN)	25°C		50		ns
			-40°C to +85°C			175	ns
			-40°C to +125°C			175	ns
$t_{OFF(EN)}$	Enable turn-off time	$V_S = 1V$ $R_L = 200\Omega$, $C_L = 15pF$ Refer to tON(EN) and tOFF(EN)	25°C		35		ns
			-40°C to +85°C			135	ns
			-40°C to +125°C			135	ns
Q_C	Charge Injection	$V_S = 1V$ $R_S = 0\Omega$, $C_L = 1nF$ Refer to Charge Injection	25°C		-0.5		pC

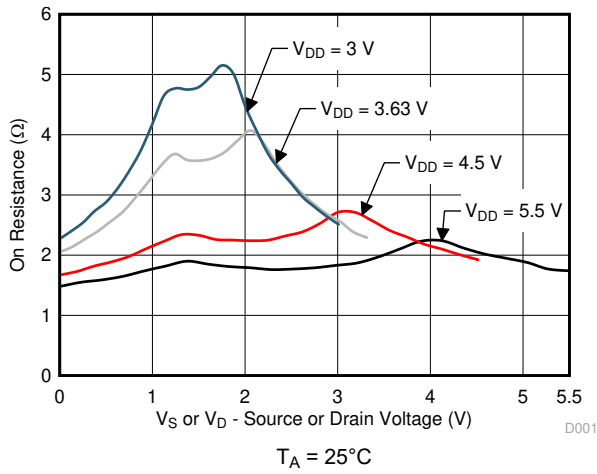
5.8 Electrical Characteristics ($V_{DD} = 1.2V \pm 10\%$) (続き)

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
O _{ISO}	Off Isolation	R _L = 50 Ω, C _L = 5pF f = 1MHz Refer to Off Isolation	25°C		-65		dB
		R _L = 50 Ω, C _L = 5pF f = 10MHz Refer to Off Isolation	25°C		-45		dB
X _{TALK}	Crosstalk	R _L = 50 Ω, C _L = 5pF f = 1MHz Refer to Crosstalk	25°C		-65		dB
		R _L = 50 Ω, C _L = 5pF f = 10MHz Refer to Crosstalk	25°C		-45		dB
BW	Bandwidth	R _L = 50 Ω, C _L = 5pF Refer to Bandwidth	25°C		125		MHz
C _{SOFF}	Source off capacitance	f = 1MHz	25°C		7		pF
C _{DOFF}	Drain off capacitance	f = 1MHz	25°C		32		pF
C _{SON} C _{DON}	On capacitance	f = 1MHz	25°C		40		pF

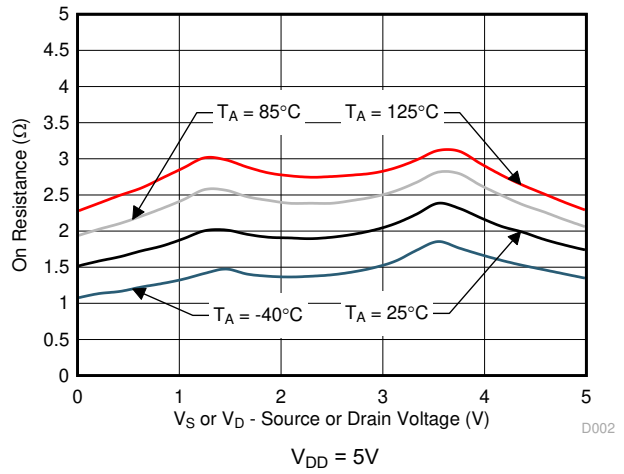
(1) When V_S is 1V, V_D is 0.8V, and vice versa.

5.9 Typical Characteristics

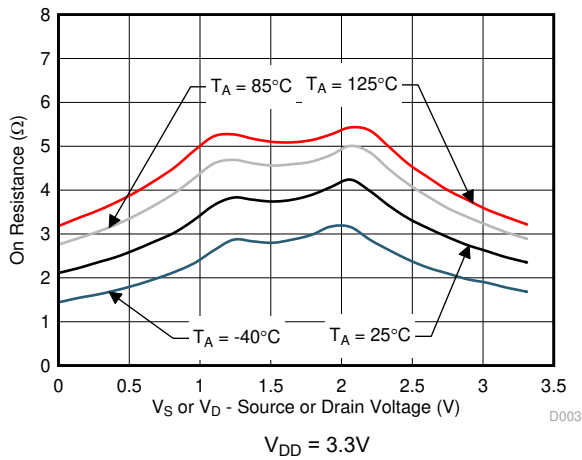
at $T_A = 25^\circ\text{C}$, $V_{DD} = 5\text{V}$ (unless otherwise noted)



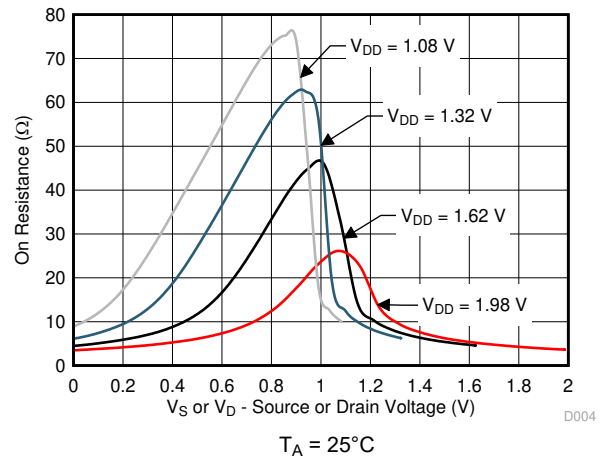
5-1. On-Resistance vs Source or Drain Voltage



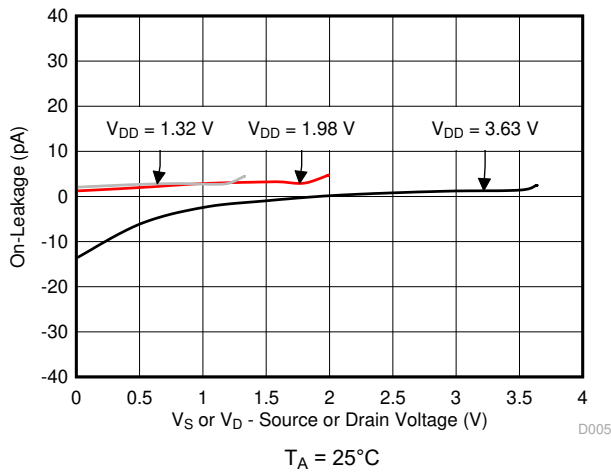
5-2. On-Resistance vs Temperature



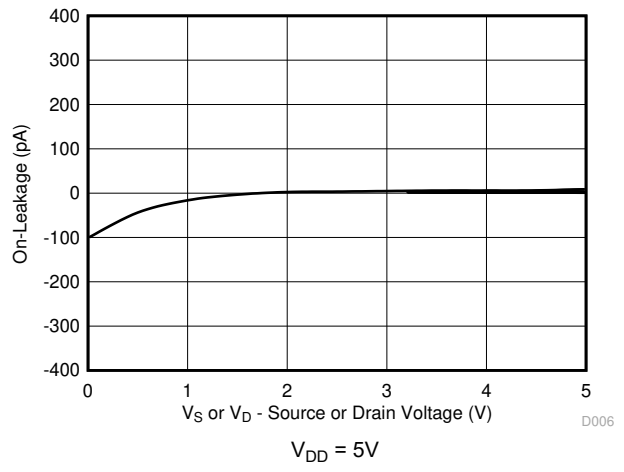
5-3. On-Resistance vs Temperature



5-4. On-Resistance vs Source or Drain Voltage



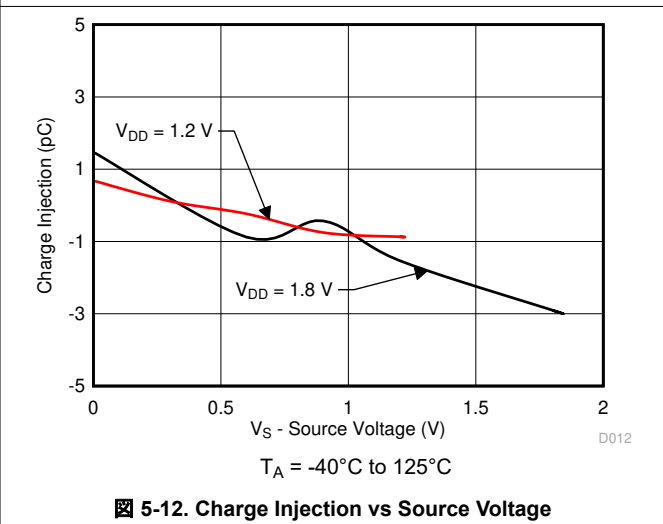
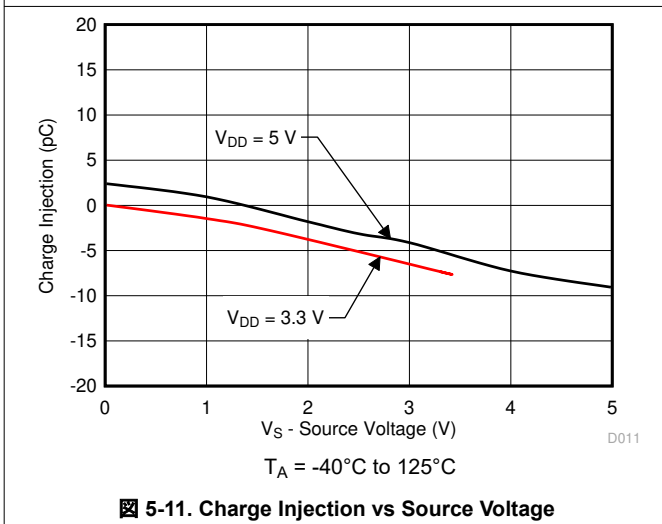
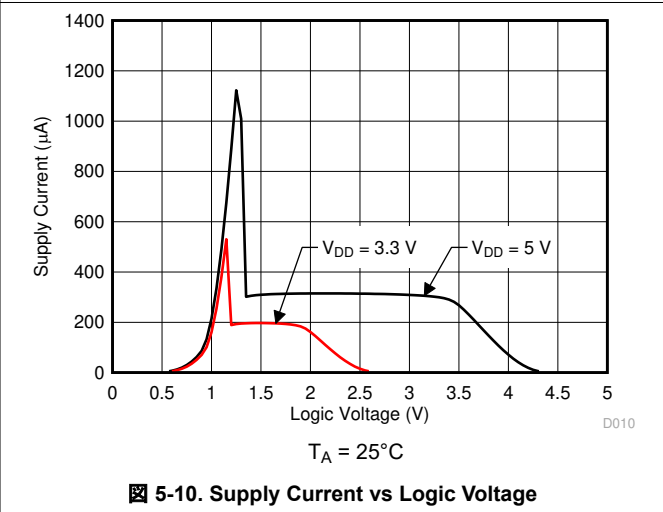
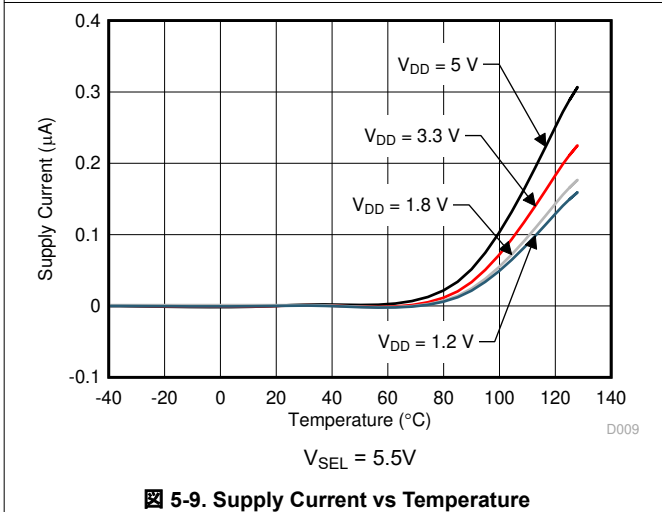
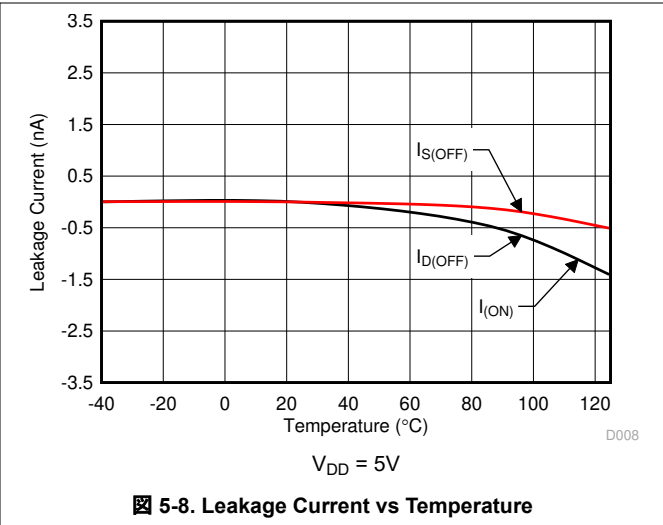
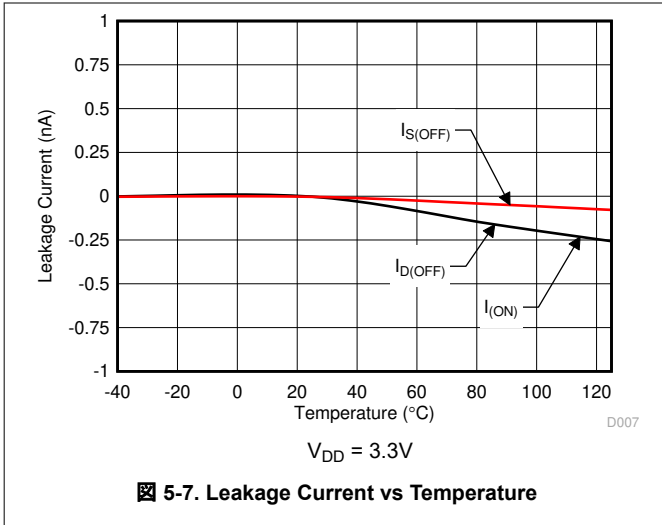
5-5. On-Leakage vs Source or Drain Voltage



5-6. On-Leakage vs Source or Drain Voltage

5.9 Typical Characteristics (continued)

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



5.9 Typical Characteristics (continued)

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

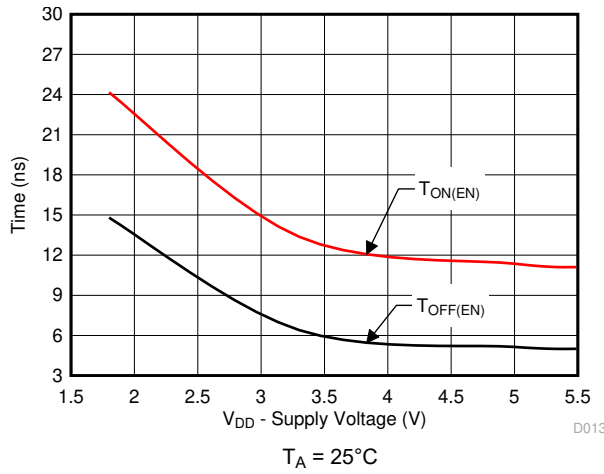


Figure 5-13. $T_{ON(EN)}$ and $T_{OFF(EN)}$ vs Supply Voltage

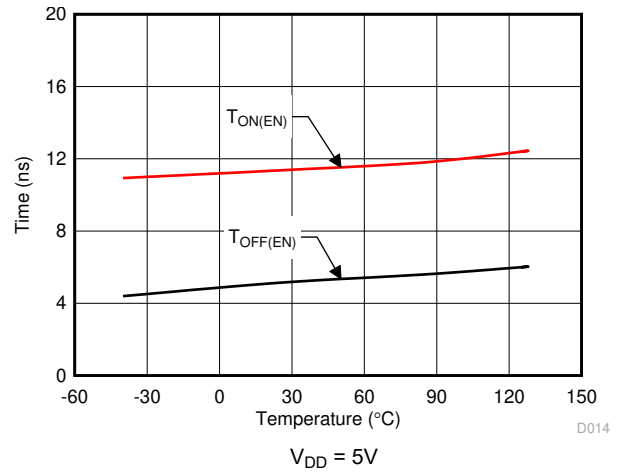


Figure 5-14. $T_{ON(EN)}$ and $T_{OFF(EN)}$ vs Temperature

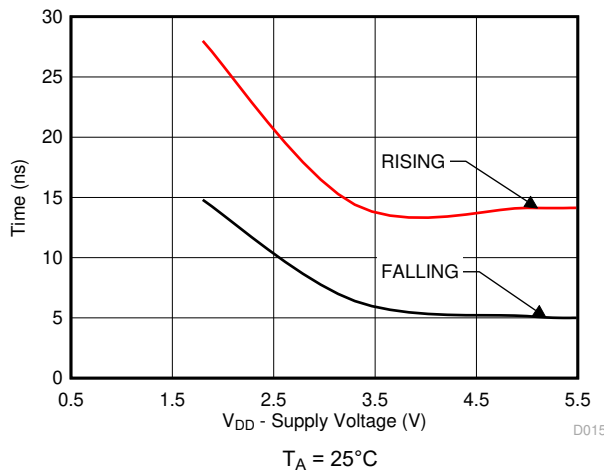


Figure 5-15. Output $T_{TRANSITION}$ vs Supply Voltage

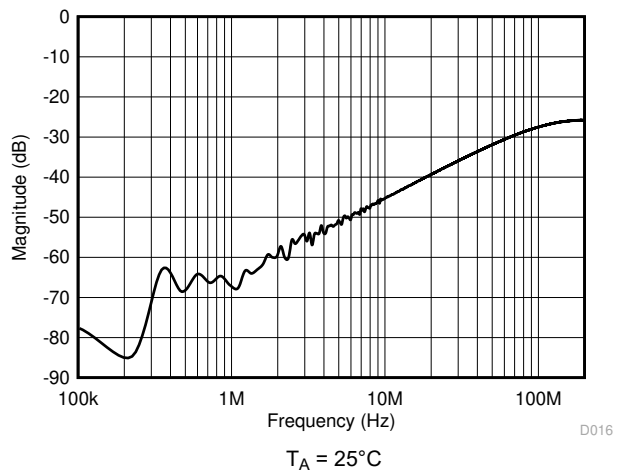


Figure 5-16. Xtalk and Off-Isolation vs Frequency

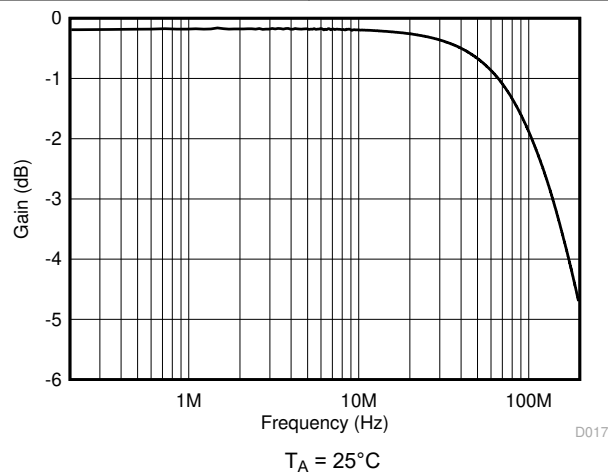


Figure 5-17. On Response vs Frequency

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

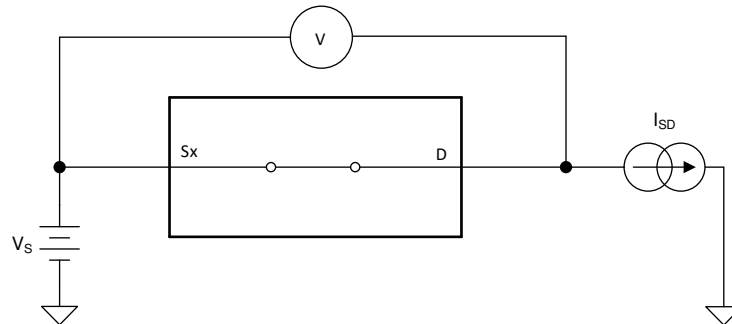


Figure 6-1. On-Resistance Measurement Setup

6.2 Off-Leakage Current

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

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

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

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

The setup used to measure both off-leakage currents is shown in [Figure 6-2](#).

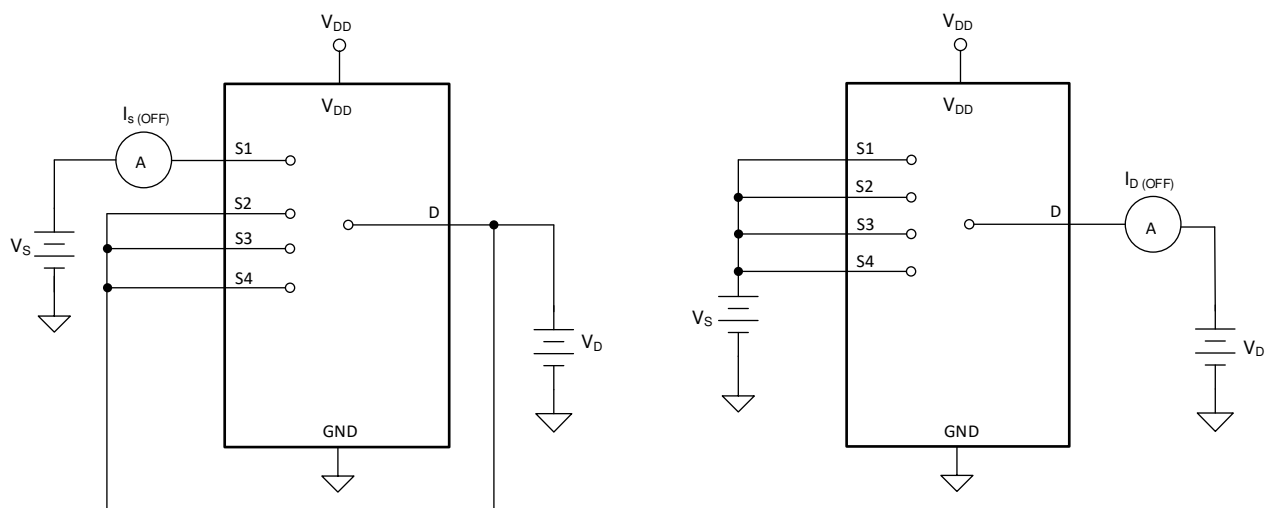


Figure 6-2. Off-Leakage Measurement Setup

6.3 On-Leakage Current

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

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

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

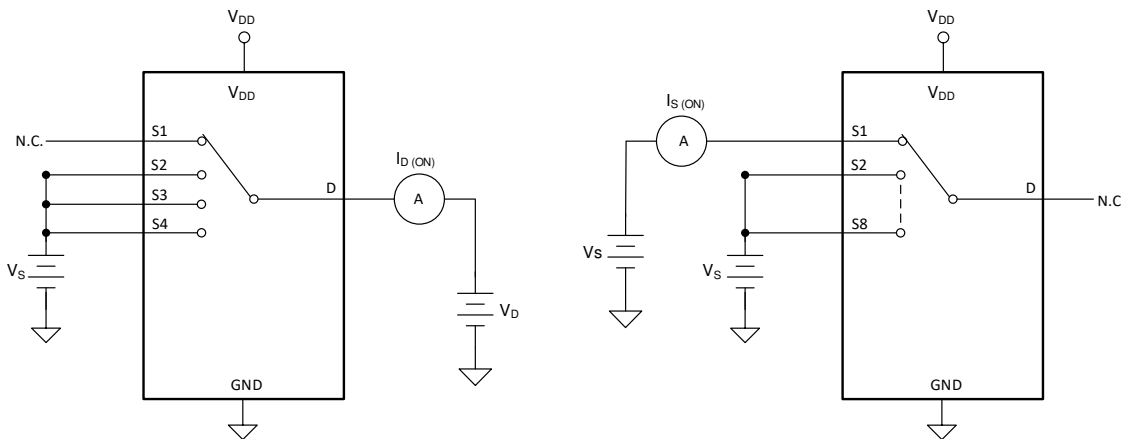


Figure 6-3. On-Leakage Measurement Setup

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 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. Figure 6-4 shows the setup used to measure transition time, denoted by the symbol $t_{TRANSITION}$.

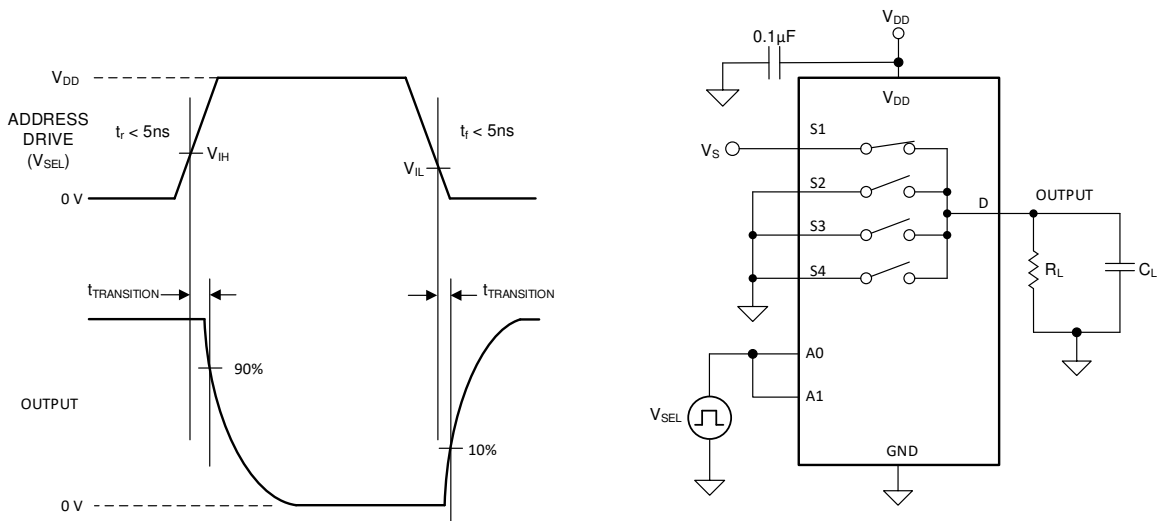
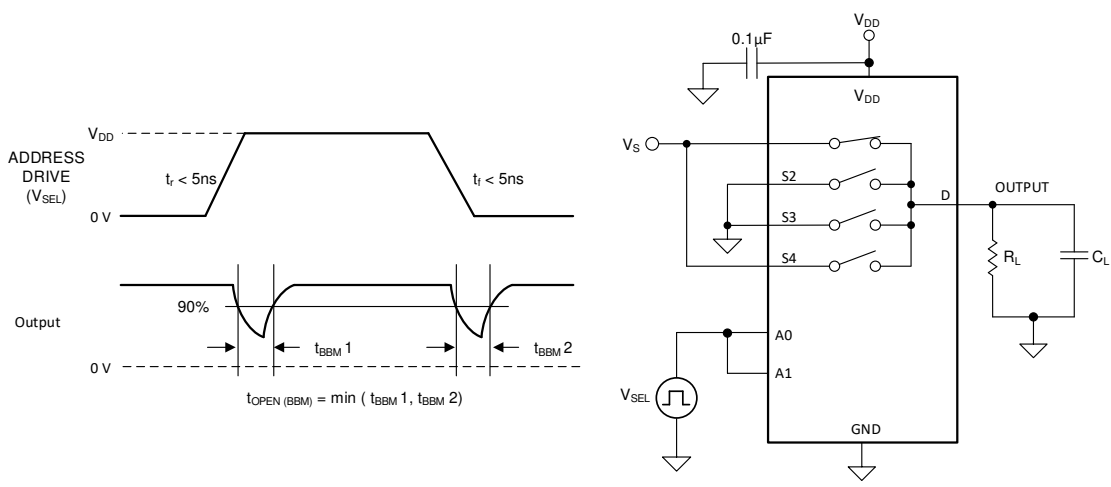
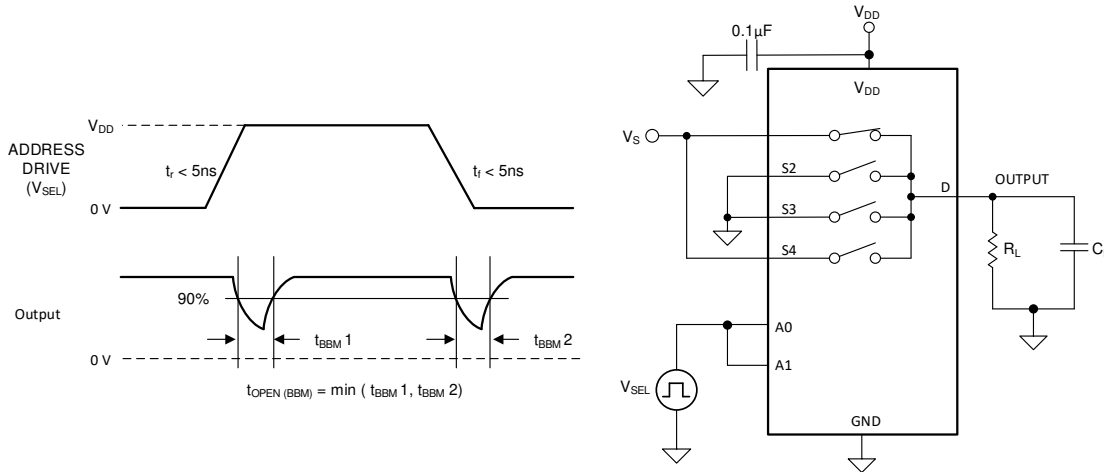


Figure 6-4. Transition-Time Measurement Setup

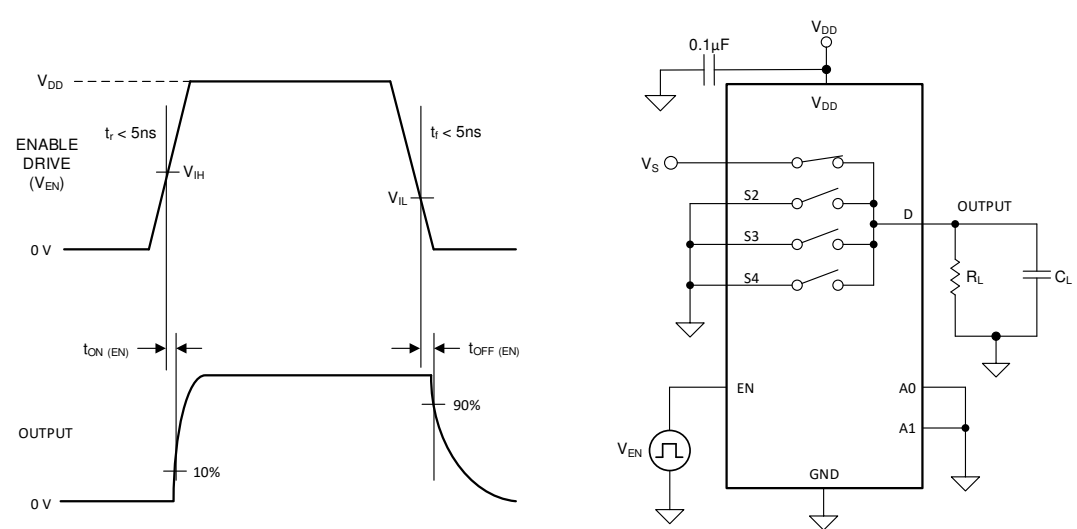
6.5 Break-Before-Make

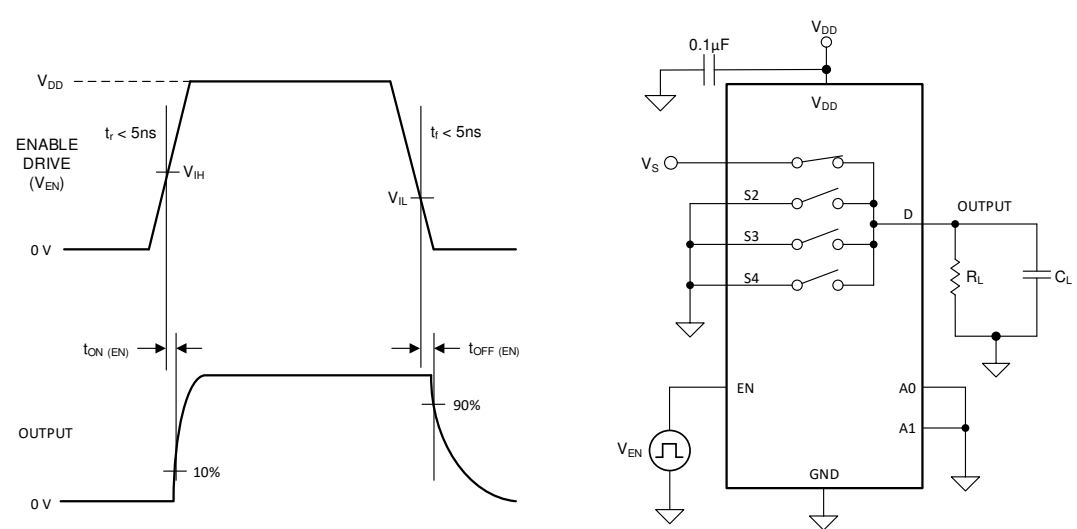
Break-before-make delay is a safety feature that prevents two inputs from connecting when the device is switching. The output first breaks from the on-state switch before making the connection with the next on-state switch. The time delay between the *break* and the *make* is known as break-before-make delay.  6-5 shows the setup used to measure break-before-make delay, denoted by the symbol $t_{OPEN(BBM)}$.

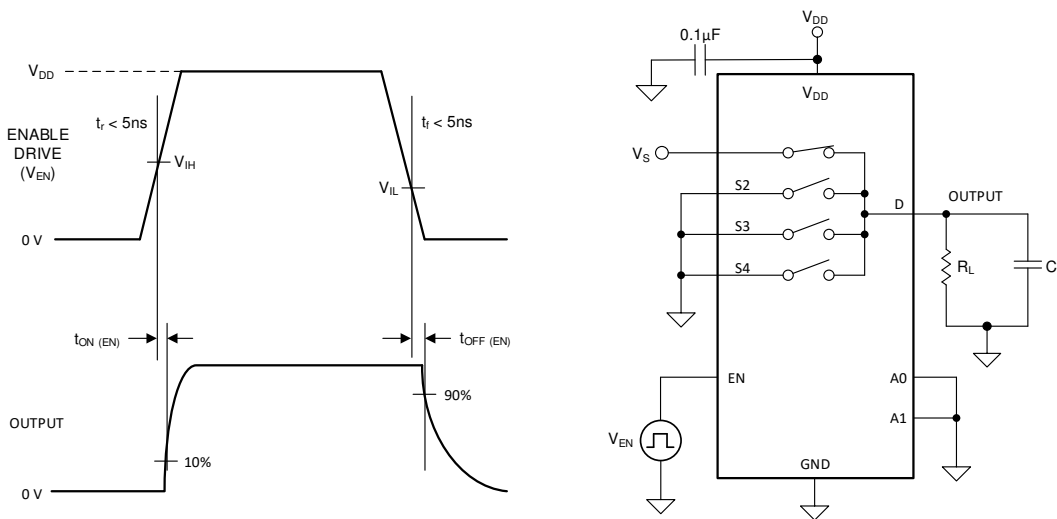


 **6-5. Break-Before-Make Delay Measurement Setup**

6.6 $t_{ON(EN)}$ 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.  6-6 shows the setup used to measure turn-on 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.  6-6 shows the setup used to measure turn-off time, denoted by the symbol $t_{OFF(EN)}$.



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

6.7 Charge Injection

The TMUX1104 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 6-7 shows the setup used to measure charge injection from source (Sx) to drain (D).

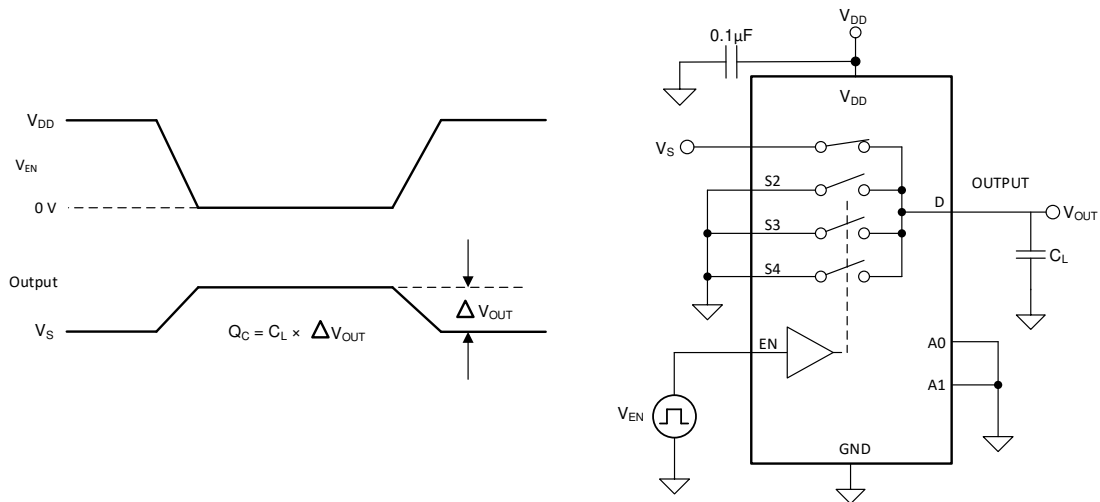


Figure 6-7. Charge-Injection Measurement Setup

6.8 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. Figure 6-8 shows the setup used to measure, and the equation used to calculate off isolation.

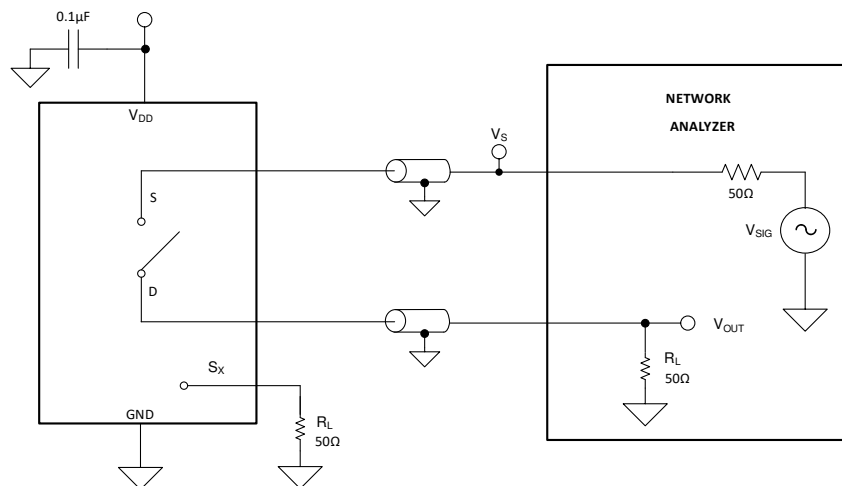

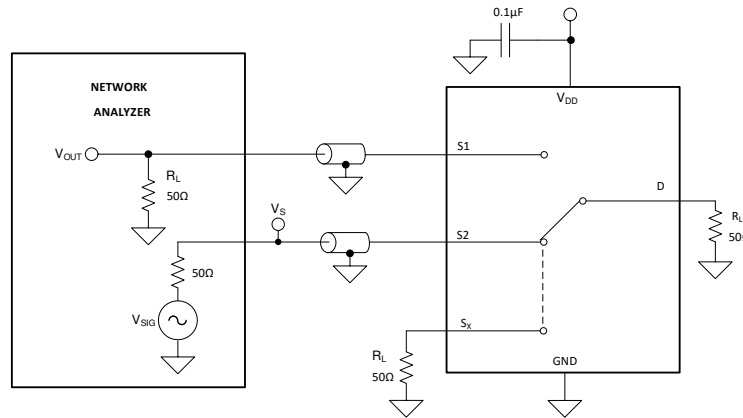


Figure 6-8. Off Isolation Measurement Setup

$$\text{Off Isolation} = 20 \cdot \text{Log} \left(\frac{V_{\text{OUT}}}{V_{\text{S}}} \right) \tag{1}$$

6.9 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.  6-9 shows the setup used to measure, and the equation used to calculate crosstalk.

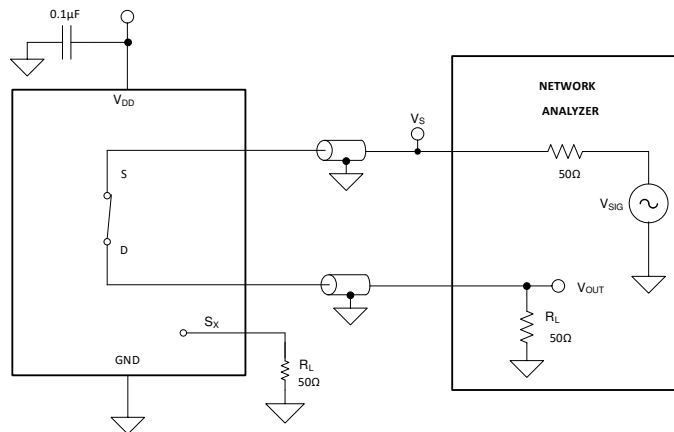


 **6-9. Crosstalk Measurement Setup**

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

6.10 Bandwidth

Bandwidth is defined as the range of frequencies that are attenuated by less than 3dB 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.  6-10 shows the setup used to measure bandwidth.



 **6-10. Bandwidth Measurement Setup**

7 Detailed Description

7.1 Functional Block Diagram

The TMUX1104 is an 4:1, 1-channel (single-ended) multiplexer or demultiplexer. Each input is turned on or turned off based on the state of the address lines and enable pin.

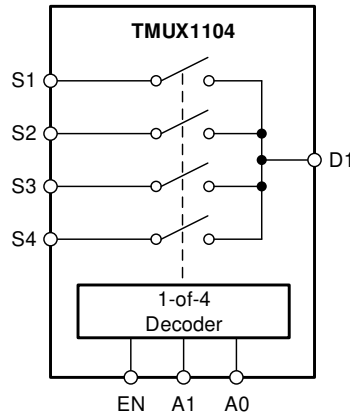


図 7-1. TMUX1104 Functional Block Diagram

7.2 Feature Description

7.2.1 Bidirectional Operation

The TMUX1104 conducts equally well from source (S_x) to drain (D_x) or from drain (D_x) to source (S_x). Each channel 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 TMUX1104 ranges from GND to V_{DD} .


7.2.3 1.8V Logic Compatible Inputs

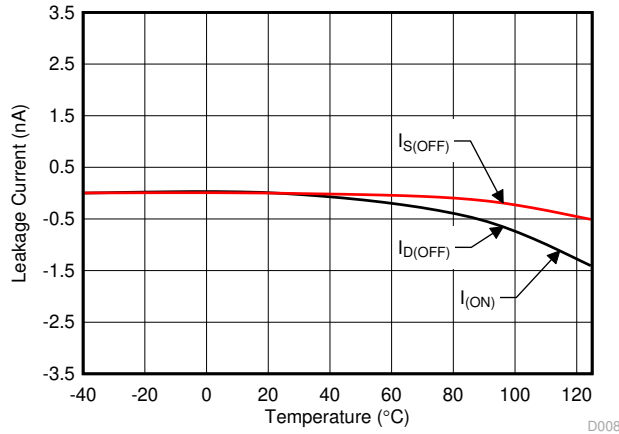
The TMUX1104 has 1.8V logic compatible control for all logic control inputs. The logic input thresholds scale with supply but still provide 1.8V logic control when operating at 5.5V supply voltage. 1.8V logic level inputs allows the TMUX1104 to interface with processors that have lower logic I/O rails and eliminates the need for an external translator, which saves both space and BOM cost. For more information on 1.8V logic implementations, refer to [Simplifying Design with 1.8V logic Muxes and Switches](#)

7.2.4 Fail-Safe Logic

The TMUX1104 supports Fail-Safe Logic on the control input pins (EN, A0, A1) allowing for operation up to 5.5V, 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 TMUX1104 to be ramped to 5.5V while $V_{DD} = 0V$. Additionally, the feature enables operation of the TMUX1104 with $V_{DD} = 1.2V$ while allowing the select pins to interface with a logic level of another device up to 5.5V.


7.2.5 Ultra-low Leakage Current

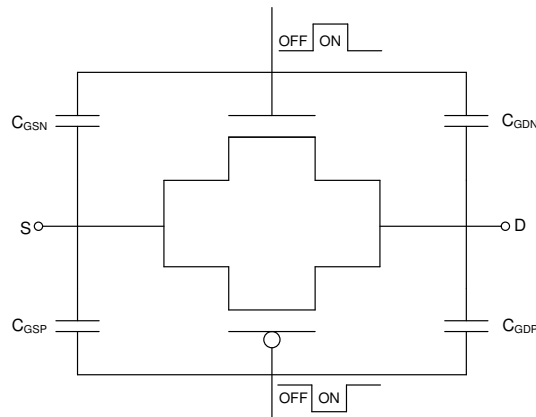
The TMUX1104 provides extremely low on-leakage and off-leakage currents. The TMUX1104 is capable of switching signals from high source-impedance inputs into a high input-impedance op amp with minimal offset error because of the ultra-low leakage currents.  7-2 shows typical leakage currents of the TMUX1104 versus temperature.



 7-2. Leakage Current vs Temperature

7.2.6 Ultra-low Charge Injection

The TMUX1104 has a transmission gate topology, as shown in  7-3. Any mismatch in the stray capacitance associated with the NMOS and PMOS causes an output level change whenever the switch is opened or closed.



 7-3. Transmission Gate Topology

The TMUX1104 has special charge-injection cancellation circuitry that reduces the source-to-drain charge injection to 1.5pC at $V_S = 1V$ as shown in [Figure 7-4](#).

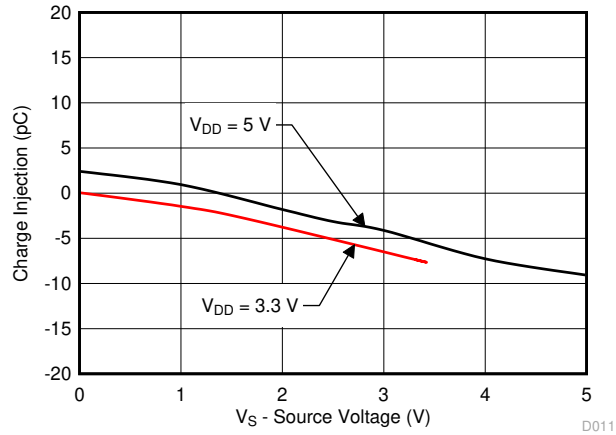


Figure 7-4. Charge Injection vs Source Voltage

7.3 Device Functional Modes

When the EN pin of the TMUX1104 is pulled high, one of the switches is 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. The control pins can be as high as 5.5V.

7.4 Truth Tables

[Table 7-1](#) provides the truth tables for the TMUX1104.

Table 7-1. TMUX1104 Truth Table

EN	A1	A0	Selected Input Connected To Drain (D) Pin
0	X ⁽¹⁾	X ⁽¹⁾	All channels are off
1	0	0	S1
1	0	1	S2
1	1	0	S3
1	1	1	S4

(1) X denotes *do not care*.

8 Application and Implementation

注

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8.1 Application Information

The TMUX11xx family offers ultra-low input/output leakage currents and low charge injection. These devices operate up to 5.5V, and offer true rail-to-rail input and output of both analog and digital signals. The TMUX1104 has a low on-capacitance which allows faster settling time when multiplexing inputs in the time domain. These features make the TMUX11xx devices a family of precision, high-performance switches and multiplexers for low-voltage applications.

8.2 Typical Application

図 8-1 shows a 16-bit, 4 input, multiplexed, data-acquisition system. This example is typical in industrial applications that require low distortion for precision measurements. The circuit uses the ADS8864, a 16-bit, 400kSPS successive-approximation-resistor (SAR) analog-to-digital converter (ADC), along with a precision amplifier, and a 4 input mux.

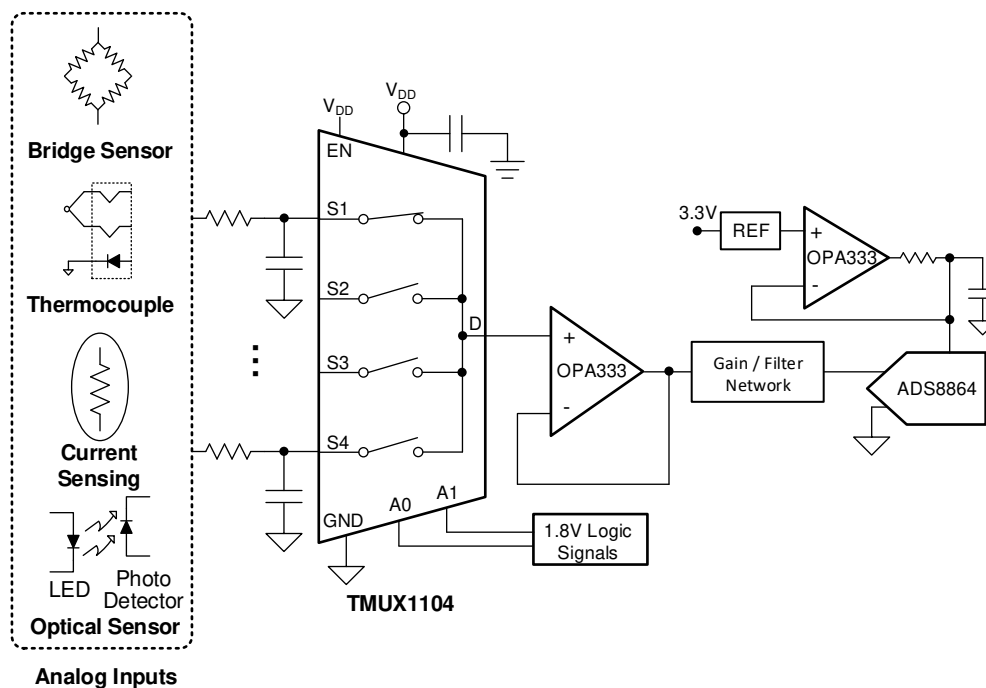


図 8-1. Multiplexing Signals to External ADC

8.2.1 Design Requirements

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

表 8-1. Design Parameters

PARAMETERS	VALUES
Supply (V_{DD})	3.3V
I/O signal range	0V to V_{DD} (Rail to Rail)
Control logic thresholds	1.8V compatible

8.2.2 Detailed Design Procedure

The TMUX1104 can be operated without any external components except for the supply decoupling capacitors. If the desired power-up state is disabled, the enable pin should have a weak pull-down resistor and be controlled by the MCU through the GPIO. All inputs being muxed to the ADC must fall within the recommend operating conditions of the TMUX1104, including signal range and continuous current. For this design with a supply of 3.3V the signal range can be 0V to 3.3V, and the max continuous current can be 30mA.

The design example highlights a multiplexed data-acquisition system for highest system linearity and fast settling. The overall system block diagram is shown in 図 8-1. The circuit is a multichannel data-acquisition signal chain consisting of an input low-pass filter, mux, mux output buffer, SAR ADC driver, and a reference buffer. The architecture provides a cost-effective solution for fast sampling of multiple channels using a single ADC.

8.2.3 Application Curve

The TMUX1104 is capable of switching signals from high source-impedance inputs into a high input-impedance op amp with minimal offset error because of the ultra-low leakage currents.

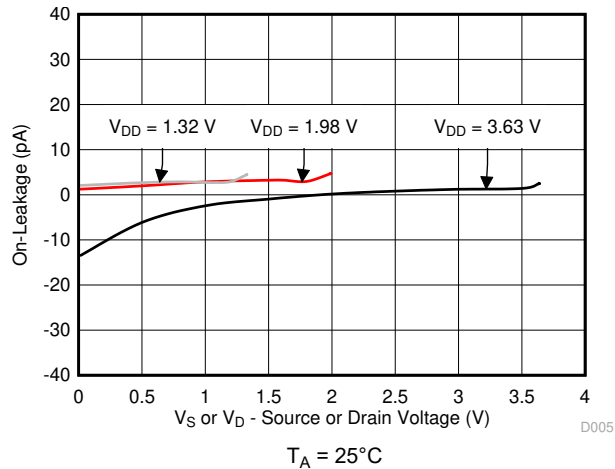


図 8-2. On-Leakage vs Source or Drain Voltage

8.3 Power Supply Recommendations

The TMUX1104 operates across a wide supply range of 1.08V to 5.5V. 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.

8.4 Layout

8.4.1 Layout Guidelines

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 8-3](#) shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

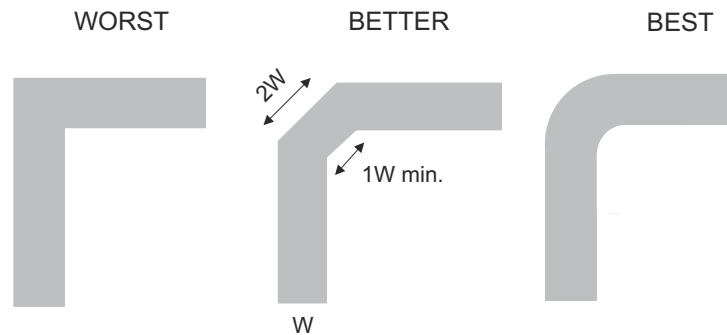


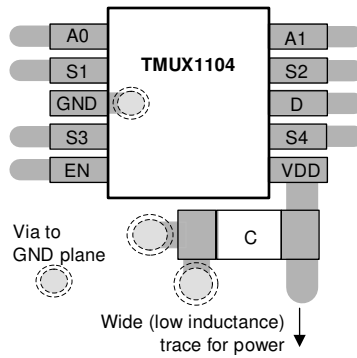
Figure 8-3. Trace Example

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 8-4](#) shows an example of a PCB layout with the TMUX1104. Some key considerations are as follows:

- Decouple the V_{DD} pin with a 0.1 μF capacitor, placed as close to the pin as possible. Ensure 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.

8.4.2 Layout Example



8-4. TMUX1104 Layout Example

9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [True Differential, 4 x 2 MUX, Analog Front End, Simultaneous-Sampling ADC Circuit](#).
- Texas Instruments, [Improve Stability Issues with Low CON Multiplexers](#).
- Texas Instruments, [Simplifying Design with 1.8V 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](#).
- Texas Instruments, [QFN/SON PCB Attachment](#).
- Texas Instruments, [Quad Flatpack No-Lead Logic Packages](#).

9.2 ドキュメントの更新通知を受け取る方法

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9.6 用語集

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

10 Revision History

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

Changes from Revision B (July 2019) to Revision C (February 2024)	Page
• Updated Is or Id (Continuous Current) values.....	4
• Added Ipeak values to <i>Recommended Operating Conditions</i> table.....	4

Changes from Revision A (December 2018) to Revision B (July 2019)	Page
• 「製品情報」表で DQA パッケージから「製品プレビュー」の注記を削除	1
• Deleted the <i>Product Preview</i> note from the DQA package in the <i>Pin Configuration and Functions</i> section.....	3

- Added DQA (USON) thermal values to *Thermal Information* 5
-

Changes from Revision * (November 2018) to Revision A (December 2018) **Page**

- ドキュメントのステータスを「事前情報」から「量産混合」データに変更 1
-

11 Mechanical, Packaging, and Orderable Information

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

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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)
TMUX1104DGSR	Active	Production	VSSOP (DGS) 10	2500 LARGE T&R	Yes	NIPDAUAG SN	Level-1-260C-UNLIM	-40 to 125	1D7
TMUX1104DGSR.A	Active	Production	VSSOP (DGS) 10	2500 LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	1D7
TMUX1104DQAR	Active	Production	USON (DQA) 10	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	104
TMUX1104DQAR.A	Active	Production	USON (DQA) 10	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	104
TMUX1104DQARG4.A	Active	Production	USON (DQA) 10	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	104

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

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

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

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

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

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

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

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TMUX1104DGSR	VSSOP	DGS	10	2500	330.0	12.4	5.25	3.35	1.25	8.0	12.0	Q1
TMUX1104DQAR	USON	DQA	10	3000	180.0	9.5	1.18	2.68	0.72	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TMUX1104DGSR	VSSOP	DGS	10	2500	366.0	364.0	50.0
TMUX1104DQAR	USON	DQA	10	3000	189.0	185.0	36.0

DGS0010A



PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4221984/A 05/2015

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-187, variation BA.

EXAMPLE BOARD LAYOUT

DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:10X



SOLDER MASK DETAILS
NOT TO SCALE

4221984/A 05/2015

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

DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



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

4221984/A 05/2015

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.

GENERIC PACKAGE VIEW

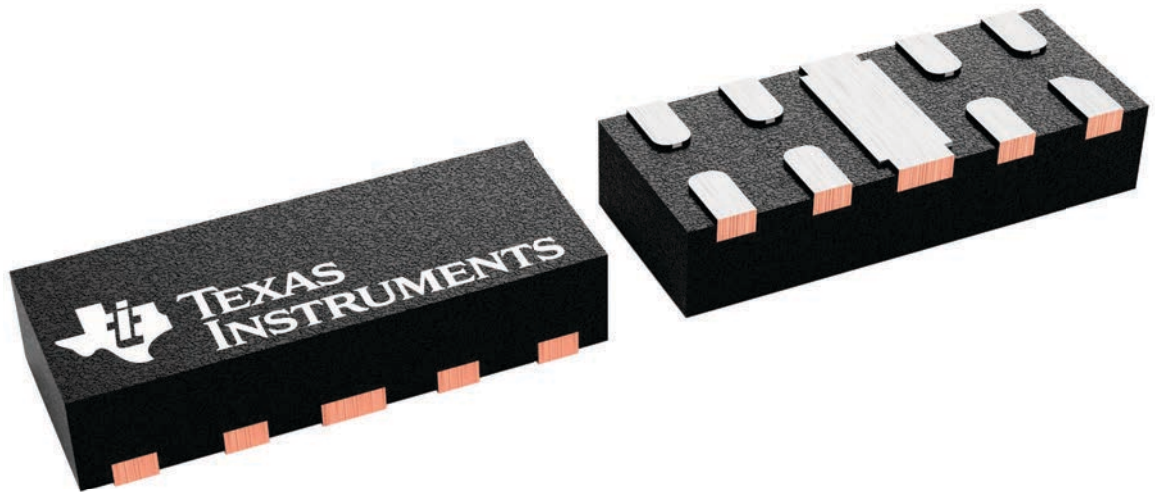
DQA 10

USON - 0.55 mm max height

1 x 2.5, 0.5 mm pitch

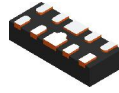
PLASTIC SMALL OUTLINE - NO LEAD

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



4230320/A

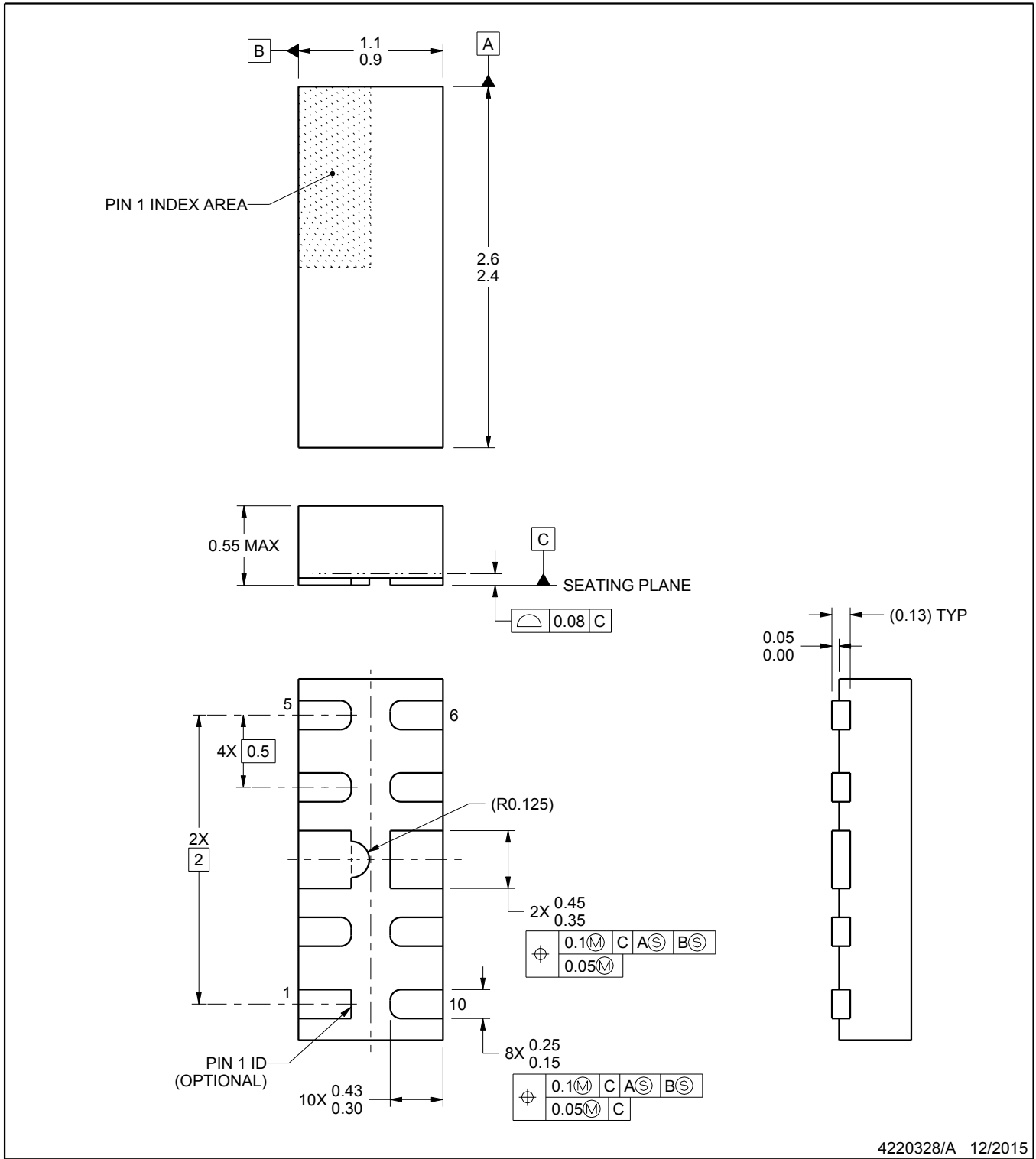
DQA0010A



PACKAGE OUTLINE

USON - 0.55 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



4220328/A 12/2015

NOTES:

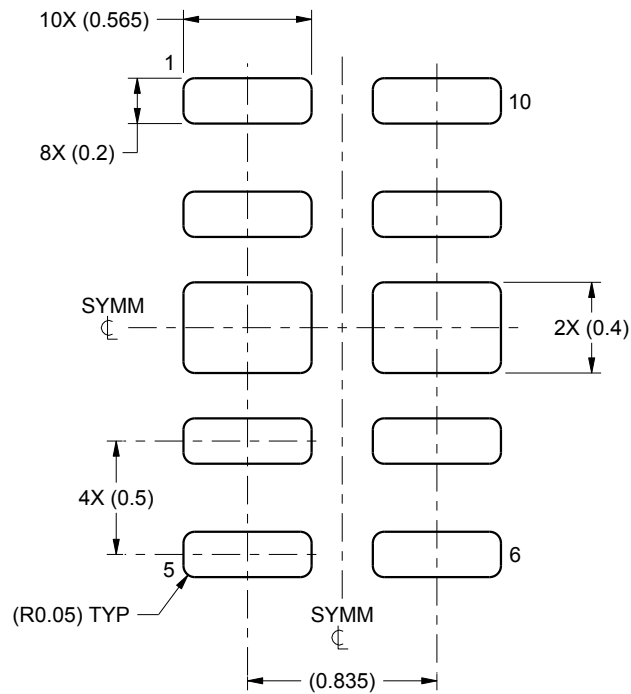
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

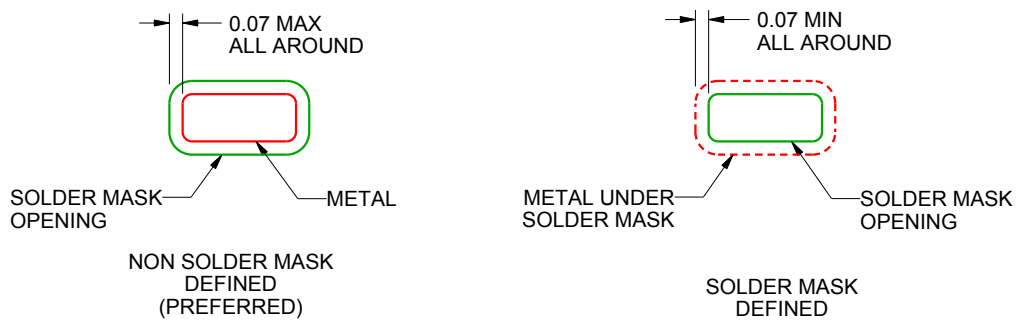
DQA0010A

USON - 0.55 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
SCALE:30X



SOLDER MASK DETAILS

4220328/A 12/2015

NOTES: (continued)

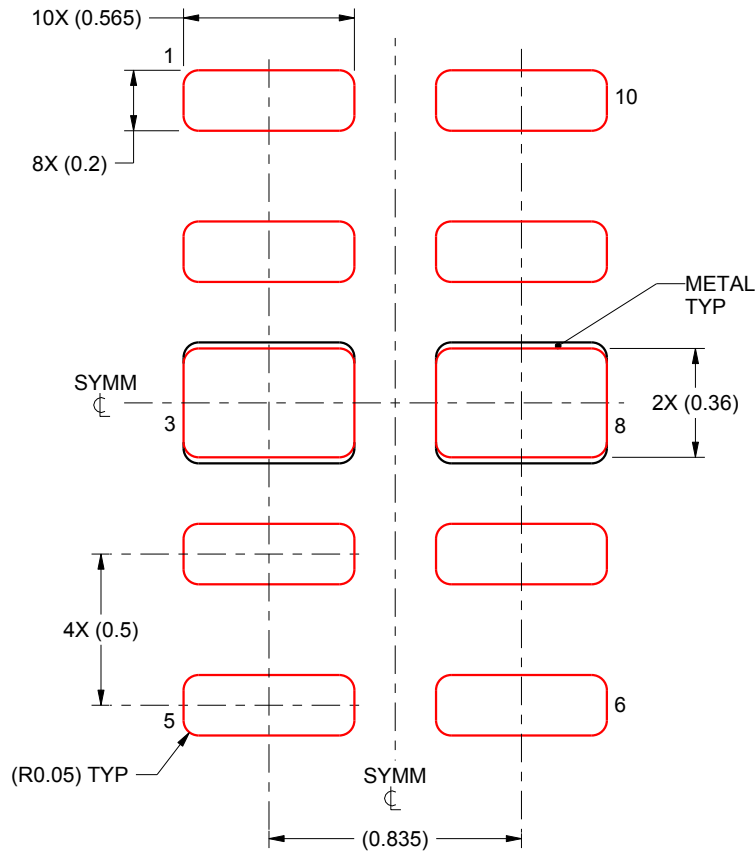
3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

DQA0010A

USON - 0.55 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL

EXPOSED PADS 3 & 8:
90% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:40X

4220328/A 12/2015

NOTES: (continued)

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

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