

# TMUX1208-Q1 1.8V ロジック搭載、5V 双方向 8:1 マルチプレクサ

## 1 特長

- 車載アプリケーション用に AEC-Q100 認定済み
  - 温度グレード 1: -40°C ~ 125°C、T<sub>A</sub>
- 低オン抵抗: 5Ω
- 広い電源電圧範囲 1.08 V ~ 5.5 V
- 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
- 低消費電流: 10nA
- 遷移時間: 14ns
- Break-Before-Make のスイッチング動作
- ESD 保護 (HBM): 2000V
- 小型の QFN パッケージ

## 2 アプリケーション

- アナログおよびデジタルの多重化/多重分離
- 車載用ヘッド・ユニット
- テレマティクス制御ユニット
- 緊急通報 (eCall)
- インフォテインメント
- ボディ・コントロール・モジュール(BCM)
- ボディ・エレクトロニクスおよびライティング
- バッテリ管理システム(BMS)
- HVAC コントローラ・モジュール
- ADAS ドメイン・コントローラ

## 3 概要

TMUX1208-Q1 は、汎用の相補型金属酸化膜半導体 (CMOS) マルチプレクサ (MUX) です。TMUX1208-Q1 は 8:1 のマルチプレクサ構成で、8 つの異なる信号バスを、共通の出力ピンにスイッチングできます。動作電圧範囲が 1.08V ~ 5.5V と広いため、各種の電源要件を持つ車載用アプリケーションで使用できます。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<sub>DD</sub> 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。

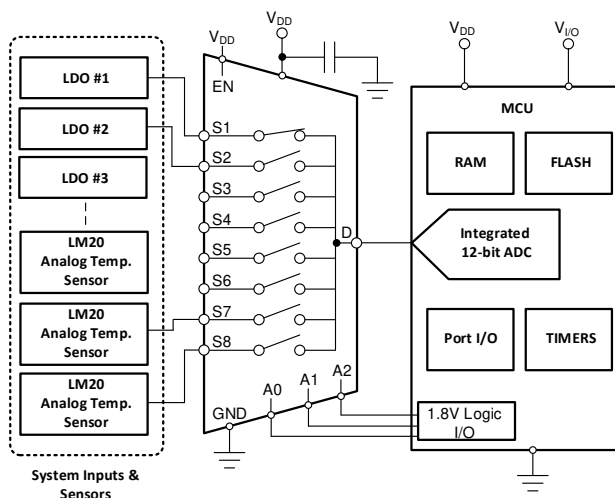
TMUX1208-Q1 は小型の QFN パッケージで供給されるため、システムのサイズ要件が緩和されます。このデバイスはオン抵抗が標準値 5Ω と小さいため、デバイスが高インピーダンスの信号パスに接続されていないとき、歪みの影響や、信号の整合性の問題が最小限に抑えられます。

すべてのロジック入力のスレッショルドは 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。フェイルセーフ回路により、電源ピンよりも前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。

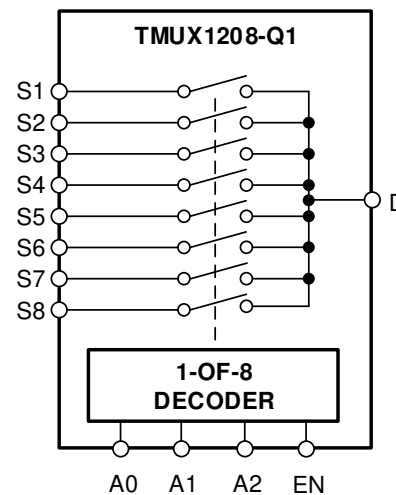
### 製品情報

| 型番 <sup>(1)</sup> (1 ページ) | パッケージ    | 本体サイズ (公称)    |
|---------------------------|----------|---------------|
| TMUX1208-Q1               | QFN (16) | 2.60mm×1.80mm |

(1) 提供されているすべての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。



アプリケーションの例



TMUX1208-Q1 のブロック図



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## 4 Revision History

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

| Changes from Revision * (August, 2019) to Revision A (July, 2020) | Page |
|---|------|
| • データシートを量産データとしてリリース.....  | 1    |

## 5 Pin Configuration and Functions

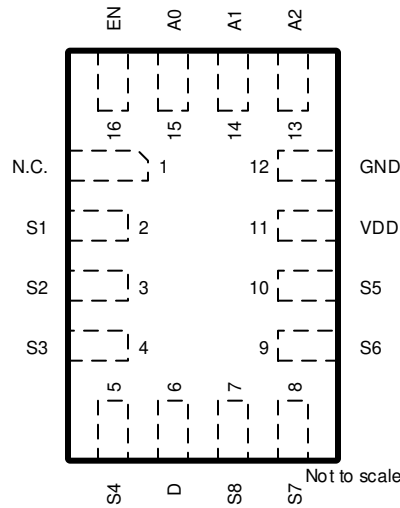


图 5-1. RSV Package 16-Pin QFN Top View

### Pin Functions

| PIN  |      | TYPE <sup>(1)</sup> | DESCRIPTION   |
|------|------|---------------------|---|
| NAME | UQFN |                     |   |
| A0   | 15   | I                   | Address line 0. Controls the switch configuration as shown in 表 8-1.  |
| EN   | 16   | I                   | Active high logic input. When this pin is low, all switches are turned off. When this pin is high, the A[2:0] address inputs determine which switch is turned on.   |
| N.C. | 1    | Not Connected       | Not Connected   |
| S1   | 2    | I/O                 | Source pin 1. Can be an input or output.  |
| S2   | 3    | I/O                 | Source pin 2. Can be an input or output.  |
| S3   | 4    | I/O                 | Source pin 3. Can be an input or output.  |
| S4   | 5    | I/O                 | Source pin 4. Can be an input or output.  |
| D    | 6    | I/O                 | Drain pin. Can be an input or output.   |
| S8   | 7    | I/O                 | Source pin 8. Can be an input or output.  |
| S7   | 8    | I/O                 | Source pin 7. Can be an input or output.  |
| S6   | 9    | I/O                 | Source pin 6. Can be an input or output.  |
| S5   | 10   | I/O                 | Source pin 5. Can be an input or output.  |
| VDD  | 11   | P                   | Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 $\mu$ F to 10 $\mu$ F between V <sub>DD</sub> and GND. |
| GND  | 12   | P                   | Ground (0 V) reference  |
| A2   | 13   | I                   | Address line 2. Controls the switch configuration as shown in 表 8-1.  |
| A1   | 14   | I                   | Address line 1. Controls the switch configuration as shown in 表 8-1.  |

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

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

|   |  | MIN  | MAX                  | UNIT |
|---|--|------|----------------------|------|
| V <sub>DD</sub>                         | Supply voltage                                   | -0.3 | 6                    | V    |
| V <sub>LOGIC</sub>                      | Logic control input pin voltage (EN, A0, A1, A2) | -0.3 | 6                    | V    |
| I <sub>LOGIC</sub>                      | Logic control input pin current (EN, A0, A1, A2) | -30  | 30                   | mA   |
| V <sub>S</sub> or V <sub>D</sub>        | Source or drain voltage (Sx, D)                  | -0.5 | V <sub>DD</sub> +0.5 | V    |
| I <sub>S</sub> or I <sub>D</sub> (CONT) | Source or drain continuous current (Sx, D)       | -30  | 30                   | mA   |
| I <sub>IK</sub>                         | Diode clamp current <sup>(4)</sup>               | -30  | 30                   | mA   |
| T <sub>stg</sub>                        | Storage temperature                              | -65  | 150                  | °C   |
| T <sub>J</sub>                          | 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) Signal path pins are diode-clamped to the power-supply rails. Over voltage signals must be voltage and current limited to maximum ratings.

### 6.2 ESD Ratings

|                    |                         |   | VALUE | UNIT |
|--------------------|-------------------------|---|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per AEC Q100-002 <sup>(1)</sup><br>HBM ESD Classification Level 2 | ±2000 | V    |
|                    |                         | Charged device model (CDM), per AEC Q100-011<br>CDM ESD Classification Level C4B          | ±750  |      |

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 6.3 Recommended Operating Conditions

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

|                                  |  | MIN  | NOM | MAX             | UNIT |
|----------------------------------|--|------|-----|-----------------|------|
| V <sub>DD</sub>                  | Supply voltage   | 1.08 |     | 5.5             | V    |
| V <sub>S</sub> or V <sub>D</sub> | Signal path input/output voltage (source or drain pin) (Sx, D) | 0    |     | V <sub>DD</sub> | V    |
| V <sub>LOGIC</sub>               | Logic control input pin voltage (EN, A0, A1, A2)               | 0    |     | 5.5             | V    |
| T <sub>A</sub>                   | Ambient temperature  | -40  |     | 125             | °C   |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | TMUX1208-Q1 | UNIT |
|-------------------------------|--|-------------|------|
|                               |  | RSV (QFN)   |      |
|                               |  | 16 PINS     |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 134.6       | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 74.3        | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 62.8        | °C/W |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 4.3         | °C/W |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 61.1        | °C/W |
| R <sub>θJC(bot)</sub>         | 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.

## 6.5 Electrical Characteristics (V<sub>DD</sub> = 5 V ±10 %)

 at T<sub>A</sub> = 25°C, V<sub>DD</sub> = 5 V (unless otherwise noted)

| PARAMETER                                |   | TEST CONDITIONS   | TA              | MIN  | TYP    | MAX   | UNIT |    |
|--|---|---|-----------------|------|--------|-------|------|----|
| <b>ANALOG SWITCH</b>                     |   |   |                 |      |        |       |      |    |
| R <sub>ON</sub>                          | On-resistance                             | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                  | 25°C            |      | 5      |       | Ω    |    |
|  |   |   | -40°C to +85°C  |      |        | 7     | Ω    |    |
|  |   |   | -40°C to +125°C |      |        | 9     | Ω    |    |
| ΔR <sub>ON</sub>                         | On-resistance matching between channels   | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                  | 25°C            |      | 0.15   |       | Ω    |    |
|  |   |   | -40°C to +85°C  |      |        | 1     | Ω    |    |
|  |   |   | -40°C to +125°C |      |        | 1     | Ω    |    |
| R <sub>ON</sub><br>FLAT                  | On-resistance flatness                    | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                  | 25°C            |      | 1.5    |       | Ω    |    |
|  |   |   | -40°C to +85°C  |      |        | 2     | Ω    |    |
|  |   |   | -40°C to +125°C |      |        | 3     | Ω    |    |
| I <sub>S(OFF)</sub>                      | Source off leakage current <sup>(1)</sup> | V <sub>DD</sub> = 5 V<br>Switch Off<br>V <sub>D</sub> = 4.5 V / 1 V<br>V <sub>S</sub> = 1 V / 4.5 V<br>Refer to <a href="#">7-2</a> | 25°C            |      | ±75    |       | nA   |    |
|  |   |   | -40°C to +85°C  |      |        | -150  | 150  | nA |
|  |   |   | -40°C to +125°C |      |        | -175  | 175  | nA |
| I <sub>D(OFF)</sub>                      | Drain off leakage current <sup>(1)</sup>  | V <sub>DD</sub> = 5 V<br>Switch Off<br>V <sub>D</sub> = 4.5 V / 1 V<br>V <sub>S</sub> = 1 V / 4.5 V<br>Refer to <a href="#">7-2</a> | 25°C            |      | ±200   |       | nA   |    |
|  |   |   | -40°C to +85°C  |      |        | -500  | 500  | nA |
|  |   |   | -40°C to +125°C |      |        | -750  | 750  | nA |
| I <sub>D(ON)</sub><br>I <sub>S(ON)</sub> | Channel on leakage current                | V <sub>DD</sub> = 5 V<br>Switch On<br>V <sub>D</sub> = V <sub>S</sub> = 4.5 V / 1 V<br>Refer to <a href="#">7-3</a>                 | 25°C            |      | ±200   |       | nA   |    |
|  |   |   | -40°C to +85°C  |      |        | -500  | 500  | nA |
|  |   |   | -40°C to +125°C |      |        | -750  | 750  | nA |
| <b>LOGIC INPUTS (EN, A0, A1, A2)</b>     |   |   |                 |      |        |       |      |    |
| V <sub>IH</sub>                          | Input logic high                          |   | -40°C to 125°C  | 1.49 |        | 5.5   | V    |    |
| V <sub>IL</sub>                          | Input logic low                           |   | -40°C to 125°C  | 0    |        | 0.87  | V    |    |
| I <sub>IH</sub><br>I <sub>IL</sub>       | Input leakage current                     |   | 25°C            |      | ±0.005 |       | μA   |    |
|  |   |   | -40°C to +125°C |      |        | ±0.10 | μA   |    |
| C <sub>IN</sub>                          | Logic input capacitance                   |   | 25°C            |      | 1      |       | pF   |    |
| C <sub>IN</sub>                          | Logic input capacitance                   |   | -40°C to +125°C |      |        | 2     | pF   |    |
| <b>POWER SUPPLY</b>                      |   |   |                 |      |        |       |      |    |
| I <sub>DD</sub>                          | V <sub>DD</sub> supply current            | Logic inputs = 0 V or 5.5 V   | 25°C            |      | 0.02   |       | μA   |    |
|  |   |   | -40°C to +125°C |      |        | 2.7   | μA   |    |

**TMUX1208-Q1**

JAJSHU2A – AUGUST 2019 – REVISED JULY 2020

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

| PARAMETER                            |                                  | TEST CONDITIONS  | TA  | MIN  | TYP | MAX | UNIT |
|--------------------------------------|----------------------------------|--|---|------|-----|-----|------|
| <b>DYNAMIC CHARACTERISTICS</b>       |                                  |  |   |      |     |     |      |
| $t_{\text{TRAN}}$                    | Transition time between channels | $V_S = 3\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-4</a> | 25°C  |      | 14  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      |     | 33  | ns   |
|                                      |                                  |  | -40°C to +125°C   |      |     | 33  | ns   |
| $t_{\text{OPEN}}$<br>(BBM)           | Break before make time           | $V_S = 3\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-5</a> | 25°C  |      | 8   |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      | 1   |     | ns   |
|                                      |                                  |  | -40°C to +125°C   |      | 1   |     | ns   |
| $t_{\text{ON(EN)}}$                  | Enable turn-on time              | $V_S = 3\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C  |      | 14  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      |     | 20  | ns   |
|                                      |                                  |  | -40°C to +125°C   |      |     | 20  | ns   |
| $t_{\text{OFF(EN)}}$                 | Enable turn-off time             | $V_S = 3\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C  |      | 11  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      |     | 20  | ns   |
|                                      |                                  |  | -40°C to +125°C   |      |     | 20  | ns   |
| $Q_C$                                | Charge Injection                 | $V_S = V_{DD}/2$<br>$R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$<br>Refer to <a href="#">7-7</a>      | 25°C  |      | -8  |     | pC   |
| $O_{\text{ISO}}$                     | Off Isolation                    | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-8</a>   | 25°C  |      | -62 |     | dB   |
|                                      |                                  |  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-8</a> | 25°C |     | -42 |      |
| $X_{\text{TALK}}$                    | Crosstalk                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-9</a>   | 25°C  |      | -62 |     | dB   |
|                                      |                                  |  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-9</a> | 25°C |     | -42 |      |
| BW                                   | Bandwidth                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>Refer to <a href="#">7-10</a>                        | 25°C  |      | 65  |     | MHz  |
| $C_{\text{SOFF}}$                    | Source off capacitance           | $f = 1\text{ MHz}$   | 25°C  |      | 13  |     | pF   |
| $C_{\text{DOFF}}$                    | Drain off capacitance            | $f = 1\text{ MHz}$   | 25°C  |      | 76  |     | pF   |
| $C_{\text{SON}}$<br>$C_{\text{DON}}$ | On capacitance                   | $f = 1\text{ MHz}$   | 25°C  |      | 85  |     | pF   |

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

## 6.6 Electrical Characteristics (V<sub>DD</sub> = 3.3 V ±10 %)

at T<sub>A</sub> = 25°C, V<sub>DD</sub> = 3.3 V (unless otherwise noted)

| PARAMETER                                |   | TEST CONDITIONS   | TA              | MIN    | TYP | MAX   | UNIT |
|--|---|---|-----------------|--------|-----|-------|------|
| <b>ANALOG SWITCH</b>                     |   |   |                 |        |     |       |      |
| R <sub>ON</sub>                          | On-resistance                             | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                | 25°C            | 9      |     |       | Ω    |
|  |   |   | -40°C to +85°C  |        |     | 15    | Ω    |
|  |   |   | -40°C to +125°C |        |     | 17    | Ω    |
| ΔR <sub>ON</sub>                         | On-resistance matching between channels   | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                | 25°C            | 0.15   |     |       | Ω    |
|  |   |   | -40°C to +85°C  |        |     | 1     | Ω    |
|  |   |   | -40°C to +125°C |        |     | 1     | Ω    |
| R <sub>ON</sub><br>FLAT                  | On-resistance flatness                    | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                | 25°C            | 3      |     |       | Ω    |
|  |   |   | -40°C to +85°C  |        |     | 5     | Ω    |
|  |   |   | -40°C to +125°C |        |     | 6     | Ω    |
| I <sub>S(OFF)</sub>                      | Source off leakage current <sup>(1)</sup> | V <sub>DD</sub> = 3.3 V<br>Switch Off<br>V <sub>D</sub> = 3 V / 1 V<br>V <sub>S</sub> = 1 V / 3 V<br>Refer to <a href="#">7-2</a> | 25°C            | ±75    |     |       | nA   |
|  |   |   | -40°C to +85°C  | -150   |     | 150   | nA   |
|  |   |   | -40°C to +125°C | -175   |     | 175   | nA   |
| I <sub>D(OFF)</sub>                      | Drain off leakage current <sup>(1)</sup>  | V <sub>DD</sub> = 3.3 V<br>Switch Off<br>V <sub>D</sub> = 3 V / 1 V<br>V <sub>S</sub> = 1 V / 3 V<br>Refer to <a href="#">7-2</a> | 25°C            | ±200   |     |       | nA   |
|  |   |   | -40°C to +85°C  | -500   |     | 500   | nA   |
|  |   |   | -40°C to +125°C | -750   |     | 750   | nA   |
| I <sub>D(ON)</sub><br>I <sub>S(ON)</sub> | Channel on leakage current                | V <sub>DD</sub> = 3.3 V<br>Switch On<br>V <sub>D</sub> = V <sub>S</sub> = 3 V / 1 V<br>Refer to <a href="#">7-3</a>               | 25°C            | ±200   |     |       | nA   |
|  |   |   | -40°C to +85°C  | -500   |     | 500   | nA   |
|  |   |   | -40°C to +125°C | -750   |     | 750   | nA   |
| <b>LOGIC INPUTS (EN, A0, A1, A2)</b>     |   |   |                 |        |     |       |      |
| V <sub>IH</sub>                          | Input logic high                          |   | -40°C to 125°C  | 1.35   |     | 5.5   | V    |
| V <sub>IL</sub>                          | Input logic low                           |   | -40°C to 125°C  | 0      |     | 0.8   | V    |
| I <sub>IH</sub><br>I <sub>IL</sub>       | Input leakage current                     |   | 25°C            | ±0.005 |     |       | μA   |
|  |   |   | -40°C to +125°C |        |     | ±0.10 | μA   |
| C <sub>IN</sub>                          | Logic input capacitance                   |   | 25°C            | 1      |     |       | pF   |
| C <sub>IN</sub>                          | Logic input capacitance                   |   | -40°C to +125°C |        |     | 2     | pF   |
| <b>POWER SUPPLY</b>                      |   |   |                 |        |     |       |      |
| I <sub>DD</sub>                          | V <sub>DD</sub> supply current            | Logic inputs = 0 V or 5.5 V   | 25°C            | 0.01   |     |       | μA   |
|  |   |   | -40°C to +125°C |        |     | 1.5   | μA   |

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

| PARAMETER                            |                                  | TEST CONDITIONS  | TA              | MIN | TYP     | MAX | UNIT |
|--------------------------------------|----------------------------------|--|-----------------|-----|---------|-----|------|
| <b>DYNAMIC CHARACTERISTICS</b>       |                                  |  |                 |     |         |     |      |
| $t_{\text{TRAN}}$                    | Transition time between channels | $V_S = 2\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-4</a> | 25°C            |     | 14      |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |     |         | 25  | ns   |
|                                      |                                  |  | -40°C to +125°C |     |         | 25  | ns   |
| $t_{\text{OPEN}}$<br>(BBM)           | Break before make time           | $V_S = 2\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-5</a> | 25°C            |     | 8       |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |     | 1       |     | ns   |
|                                      |                                  |  | -40°C to +125°C |     | 1       |     | ns   |
| $t_{\text{ON(EN)}}$                  | Enable turn-on time              | $V_S = 2\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C            |     | 17      |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |     |         | 25  | ns   |
|                                      |                                  |  | -40°C to +125°C |     |         | 25  | ns   |
| $t_{\text{OFF(EN)}}$                 | Enable turn-off time             | $V_S = 2\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C            |     | 7       |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |     |         | 13  | ns   |
|                                      |                                  |  | -40°C to +125°C |     |         | 13  | ns   |
| $Q_C$                                | Charge Injection                 | $V_S = V_{DD}/2$<br>$R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$<br>Refer to <a href="#">7-7</a>      | 25°C            |     | $\pm 7$ |     | pC   |
| $O_{\text{ISO}}$                     | Off Isolation                    | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-8</a>   | 25°C            |     | -62     |     | dB   |
|                                      |                                  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-8</a>  | 25°C            |     | -42     |     | dB   |
| $X_{\text{TALK}}$                    | Crosstalk                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-9</a>   | 25°C            |     | -62     |     | dB   |
|                                      |                                  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-9</a>  | 25°C            |     | -42     |     | dB   |
| BW                                   | Bandwidth                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>Refer to <a href="#">7-10</a>                        | 25°C            |     | 65      |     | MHz  |
| $C_{\text{SOFF}}$                    | Source off capacitance           | $f = 1\text{ MHz}$   | 25°C            |     | 13      |     | pF   |
| $C_{\text{DOFF}}$                    | Drain off capacitance            | $f = 1\text{ MHz}$   | 25°C            |     | 76      |     | pF   |
| $C_{\text{SON}}$<br>$C_{\text{DON}}$ | On capacitance                   | $f = 1\text{ MHz}$   | 25°C            |     | 85      |     | pF   |

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



## 6.7 Electrical Characteristics (V<sub>DD</sub> = 1.8 V ±10 %)

at T<sub>A</sub> = 25°C, V<sub>DD</sub> = 1.8 V (unless otherwise noted)

| PARAMETER                                |   | TEST CONDITIONS  | TA              | MIN    | TYP | MAX   | UNIT |
|--|---|--|-----------------|--------|-----|-------|------|
| <b>ANALOG SWITCH</b>                     |   |  |                 |        |     |       |      |
| R <sub>ON</sub>                          | On-resistance                             | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                     | 25°C            | 40     |     |       | Ω    |
|  |   |  | -40°C to +85°C  |        |     | 80    | Ω    |
|  |   |  | -40°C to +125°C |        |     | 80    | Ω    |
| ΔR <sub>ON</sub>                         | On-resistance matching between channels   | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                     | 25°C            | 0.15   |     |       | Ω    |
|  |   |  | -40°C to +85°C  |        |     | 1.5   | Ω    |
|  |   |  | -40°C to +125°C |        |     | 1.5   | Ω    |
| I <sub>S(OFF)</sub>                      | Source off leakage current <sup>(1)</sup> | V <sub>DD</sub> = 1.98 V<br>Switch Off<br>V <sub>D</sub> = 1.8 V / 1 V<br>V <sub>S</sub> = 1 V / 1.8 V<br>Refer to <a href="#">7-2</a> | 25°C            | ±75    |     |       | nA   |
|  |   |  | -40°C to +85°C  | -150   |     | 150   | nA   |
|  |   |  | -40°C to +125°C | -175   |     | 175   | nA   |
| I <sub>D(OFF)</sub>                      | Drain off leakage current <sup>(1)</sup>  | V <sub>DD</sub> = 1.98 V<br>Switch Off<br>V <sub>D</sub> = 1.8 V / 1 V<br>V <sub>S</sub> = 1 V / 1.8 V<br>Refer to <a href="#">7-2</a> | 25°C            | ±200   |     |       | nA   |
|  |   |  | -40°C to +85°C  | -500   |     | 500   | nA   |
|  |   |  | -40°C to +125°C | -750   |     | 750   | nA   |
| I <sub>D(ON)</sub><br>I <sub>S(ON)</sub> | Channel on leakage current                | V <sub>DD</sub> = 1.98 V<br>Switch On<br>V <sub>D</sub> = V <sub>S</sub> = 1.8 V / 1 V<br>Refer to <a href="#">7-3</a>                 | 25°C            | ±200   |     |       | nA   |
|  |   |  | -40°C to +85°C  | -500   |     | 500   | nA   |
|  |   |  | -40°C to +125°C | -750   |     | 750   | nA   |
| <b>LOGIC INPUTS (EN, A0, A1, A2)</b>     |   |  |                 |        |     |       |      |
| V <sub>IH</sub>                          | Input logic high                          |  | -40°C to +125°C | 1.07   |     | 5.5   | V    |
| V <sub>IL</sub>                          | Input logic low                           |  | -40°C to +125°C | 0      |     | 0.68  | V    |
| I <sub>IH</sub><br>I <sub>IL</sub>       | Input leakage current                     |  | 25°C            | ±0.005 |     |       | μA   |
|  |   |  | -40°C to +125°C |        |     | ±0.10 | μA   |
| C <sub>IN</sub>                          | Logic input capacitance                   |  | 25°C            | 1      |     |       | pF   |
|  |   |  | -40°C to +125°C |        |     | 2     | pF   |
| <b>POWER SUPPLY</b>                      |   |  |                 |        |     |       |      |
| I <sub>DD</sub>                          | V <sub>DD</sub> supply current            | Logic inputs = 0 V or 5.5 V  | 25°C            | 0.006  |     |       | μA   |
|  |   |  | -40°C to +125°C |        |     | 0.95  | μA   |

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

| PARAMETER                            |                                  | TEST CONDITIONS  | TA  | MIN  | TYP | MAX | UNIT |
|--------------------------------------|----------------------------------|--|---|------|-----|-----|------|
| <b>DYNAMIC CHARACTERISTICS</b>       |                                  |  |   |      |     |     |      |
| $t_{\text{TRAN}}$                    | Transition time between channels | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-4</a> | 25°C  |      | 28  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      |     | 48  | ns   |
|                                      |                                  |  | -40°C to +125°C   |      |     | 48  | ns   |
| $t_{\text{OPEN}}$<br>(BBM)           | Break before make time           | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-5</a> | 25°C  |      | 16  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      | 1   |     | ns   |
|                                      |                                  |  | -40°C to +125°C   |      | 1   |     | ns   |
| $t_{\text{ON(EN)}}$                  | Enable turn-on time              | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C  |      | 28  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      |     | 48  | ns   |
|                                      |                                  |  | -40°C to +125°C   |      |     | 48  | ns   |
| $t_{\text{OFF(EN)}}$                 | Enable turn-off time             | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C  |      | 16  |     | ns   |
|                                      |                                  |  | -40°C to +85°C  |      |     | 27  | ns   |
|                                      |                                  |  | -40°C to +125°C   |      |     | 27  | ns   |
| $Q_C$                                | Charge Injection                 | $V_S = V_{DD}/2$<br>$R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$<br>Refer to <a href="#">7-7</a>      | 25°C  |      | -2  |     | pC   |
| $O_{\text{ISO}}$                     | Off Isolation                    | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-8</a>   | 25°C  |      | -62 |     | dB   |
|                                      |                                  |  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-8</a> | 25°C |     | -42 |      |
| $X_{\text{TALK}}$                    | Crosstalk                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-9</a>   | 25°C  |      | -62 |     | dB   |
|                                      |                                  |  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-9</a> | 25°C |     | -42 |      |
| BW                                   | Bandwidth                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>Refer to <a href="#">7-10</a>                        | 25°C  |      | 65  |     | MHz  |
| $C_{\text{SOFF}}$                    | Source off capacitance           | $f = 1\text{ MHz}$   | 25°C  |      | 13  |     | pF   |
| $C_{\text{DOFF}}$                    | Drain off capacitance            | $f = 1\text{ MHz}$   | 25°C  |      | 76  |     | pF   |
| $C_{\text{SON}}$<br>$C_{\text{DON}}$ | On capacitance                   | $f = 1\text{ MHz}$   | 25°C  |      | 85  |     | pF   |

 (1) When  $V_S$  is 1.8 V,  $V_D$  is 1 V or when  $V_S$  is 1 V,  $V_D$  is 1.8 V.

## 6.8 Electrical Characteristics (V<sub>DD</sub> = 1.2 V ±10 %)

at T<sub>A</sub> = 25°C, V<sub>DD</sub> = 1.2 V (unless otherwise noted)

| PARAMETER                                |   | TEST CONDITIONS  | TA              | MIN    | TYP | MAX   | UNIT |
|--|---|--|-----------------|--------|-----|-------|------|
| <b>ANALOG SWITCH</b>                     |   |  |                 |        |     |       |      |
| R <sub>ON</sub>                          | On-resistance                             | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                     | 25°C            | 70     |     |       | Ω    |
|  |   |  | -40°C to +85°C  |        |     | 105   | Ω    |
|  |   |  | -40°C to +125°C |        |     | 105   | Ω    |
| ΔR <sub>ON</sub>                         | On-resistance matching between channels   | V <sub>S</sub> = 0 V to V <sub>DD</sub><br>I <sub>SD</sub> = 10 mA<br>Refer to <a href="#">7-1</a>                                     | 25°C            | 0.15   |     |       | Ω    |
|  |   |  | -40°C to +85°C  |        |     | 1.5   | Ω    |
|  |   |  | -40°C to +125°C |        |     | 1.5   | Ω    |
| I <sub>S(OFF)</sub>                      | Source off leakage current <sup>(1)</sup> | V <sub>DD</sub> = 1.32 V<br>Switch Off<br>V <sub>D</sub> = 1.2 V / 1 V<br>V <sub>S</sub> = 1 V / 1.2 V<br>Refer to <a href="#">7-2</a> | 25°C            | ±75    |     |       | nA   |
|  |   |  | -40°C to +85°C  | -150   |     | 150   | nA   |
|  |   |  | -40°C to +125°C | -175   |     | 175   | nA   |
| I <sub>D(OFF)</sub>                      | Drain off leakage current <sup>(1)</sup>  | V <sub>DD</sub> = 1.32 V<br>Switch Off<br>V <sub>D</sub> = 1.2 V / 1 V<br>V <sub>S</sub> = 1 V / 1.2 V<br>Refer to <a href="#">7-2</a> | 25°C            | ±200   |     |       | nA   |
|  |   |  | -40°C to +85°C  | -500   |     | 500   | nA   |
|  |   |  | -40°C to +125°C | -750   |     | 750   | nA   |
| I <sub>D(ON)</sub><br>I <sub>S(ON)</sub> | Channel on leakage current                | V <sub>DD</sub> = 1.32 V<br>Switch On<br>V <sub>D</sub> = V <sub>S</sub> = 1.2 V / 1 V<br>Refer to <a href="#">7-3</a>                 | 25°C            | ±200   |     |       | nA   |
|  |   |  | -40°C to +85°C  | -500   |     | 500   | nA   |
|  |   |  | -40°C to +125°C | -750   |     | 750   | nA   |
| <b>LOGIC INPUTS (EN, A0, A1, A2)</b>     |   |  |                 |        |     |       |      |
| V <sub>IH</sub>                          | Input logic high                          |  | -40°C to +125°C | 0.96   |     | 5.5   | V    |
| V <sub>IL</sub>                          | Input logic low                           |  | -40°C to +125°C | 0      |     | 0.36  | V    |
| I <sub>IH</sub><br>I <sub>IL</sub>       | Input leakage current                     |  | 25°C            | ±0.005 |     |       | μA   |
|  |   |  | -40°C to +125°C |        |     | ±0.10 | μA   |
| C <sub>IN</sub>                          | Logic input capacitance                   |  | 25°C            | 1      |     |       | pF   |
|  |   |  | -40°C to +125°C |        |     | 2     | pF   |
| <b>POWER SUPPLY</b>                      |   |  |                 |        |     |       |      |
| I <sub>DD</sub>                          | V <sub>DD</sub> supply current            | Logic inputs = 0 V or 5.5 V  | 25°C            | 0.005  |     |       | μA   |
|  |   |  | -40°C to +125°C |        |     | 0.8   | μA   |

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

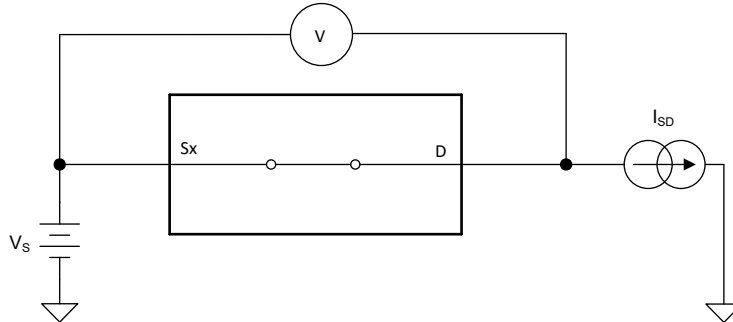
| PARAMETER                            |                                  | TEST CONDITIONS  | TA              | MIN | TYP | MAX | UNIT |    |
|--------------------------------------|----------------------------------|--|-----------------|-----|-----|-----|------|----|
| <b>DYNAMIC CHARACTERISTICS</b>       |                                  |  |                 |     |     |     |      |    |
| $t_{\text{TRAN}}$                    | Transition time between channels | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-4</a> | 25°C            |     | 60  |     | ns   |    |
|                                      |                                  |  | -40°C to +85°C  |     |     | 210 |      | ns |
|                                      |                                  |  | -40°C to +125°C |     |     | 210 |      | ns |
| $t_{\text{OPEN}}$<br>(BBM)           | Break before make time           | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-5</a> | 25°C            |     | 32  |     | ns   |    |
|                                      |                                  |  | -40°C to +85°C  |     | 1   |     | ns   |    |
|                                      |                                  |  | -40°C to +125°C |     | 1   |     | ns   |    |
| $t_{\text{ON(EN)}}$                  | Enable turn-on time              | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C            |     | 60  |     | ns   |    |
|                                      |                                  |  | -40°C to +85°C  |     |     | 190 |      | ns |
|                                      |                                  |  | -40°C to +125°C |     |     | 190 |      | ns |
| $t_{\text{OFF(EN)}}$                 | Enable turn-off time             | $V_S = 1\text{ V}$<br>$R_L = 200\ \Omega$ , $C_L = 15\text{ pF}$<br>Refer to <a href="#">7-6</a> | 25°C            |     | 45  |     | ns   |    |
|                                      |                                  |  | -40°C to +85°C  |     |     | 150 |      | ns |
|                                      |                                  |  | -40°C to +125°C |     |     | 150 |      | ns |
| $Q_C$                                | Charge Injection                 | $V_S = V_{DD}/2$<br>$R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$<br>Refer to <a href="#">7-7</a>      | 25°C            |     | -2  |     | pC   |    |
| $O_{\text{ISO}}$                     | Off Isolation                    | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-8</a>   | 25°C            |     | -62 |     | dB   |    |
|                                      |                                  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-8</a>  | 25°C            |     | -42 |     | dB   |    |
| $X_{\text{TALK}}$                    | Crosstalk                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 1\text{ MHz}$<br>Refer to <a href="#">7-9</a>   | 25°C            |     | -62 |     | dB   |    |
|                                      |                                  | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>$f = 10\text{ MHz}$<br>Refer to <a href="#">7-9</a>  | 25°C            |     | -42 |     | dB   |    |
| BW                                   | Bandwidth                        | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$<br>Refer to <a href="#">7-10</a>                        | 25°C            |     | 65  |     | MHz  |    |
| $C_{\text{SOFF}}$                    | Source off capacitance           | $f = 1\text{ MHz}$   | 25°C            |     | 13  |     | pF   |    |
| $C_{\text{DOFF}}$                    | Drain off capacitance            | $f = 1\text{ MHz}$   | 25°C            |     | 76  |     | pF   |    |
| $C_{\text{SON}}$<br>$C_{\text{DON}}$ | On capacitance                   | $f = 1\text{ MHz}$   | 25°C            |     | 85  |     | pF   |    |

 (1) When  $V_S$  is 1.2 V,  $V_D$  is 1 V or when  $V_S$  is 1 V,  $V_D$  is 1.2 V.

## 7 Parameter Measurement Information

### 7.1 On-Resistance

The on-resistance of a device is the ohmic resistance between the source (Sx) and drain (D) pins of the device. The on-resistance varies with input voltage and supply voltage. The symbol  $R_{ON}$  is used to denote on-resistance. The measurement setup used to measure  $R_{ON}$  is shown below. Voltage (V) and current ( $I_{SD}$ ) are measured using this setup, and  $R_{ON}$  is computed as shown in [Figure 7-1](#) with  $R_{ON} = V / I_{SD}$ :



**Figure 7-1. On-Resistance Measurement Setup**

### 7.2 Off-Leakage Current

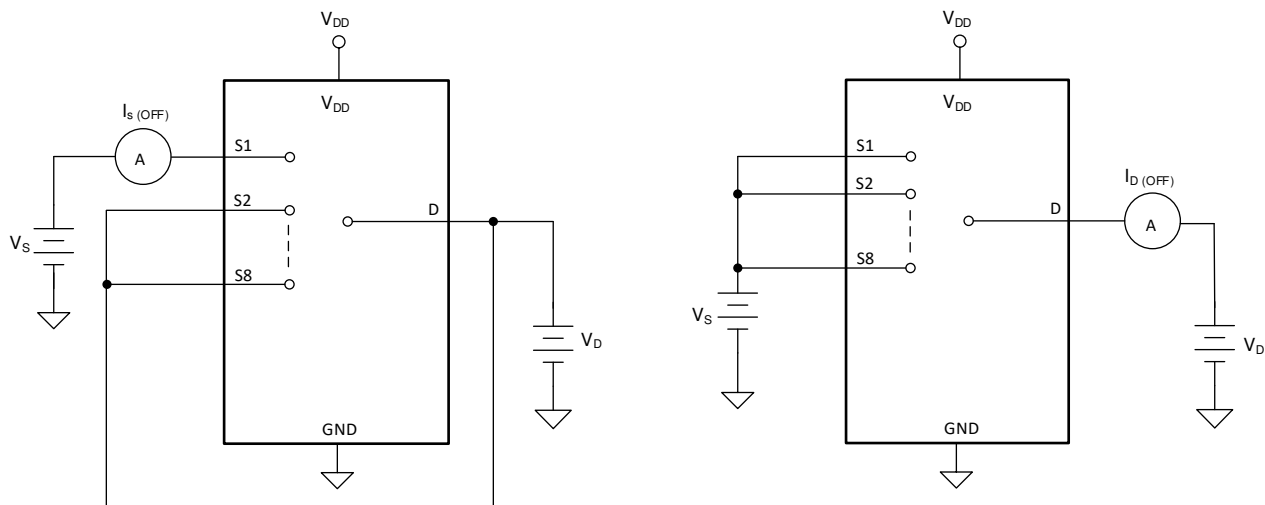
There are two types of leakage currents associated with a switch during the off state:

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 7-2](#).




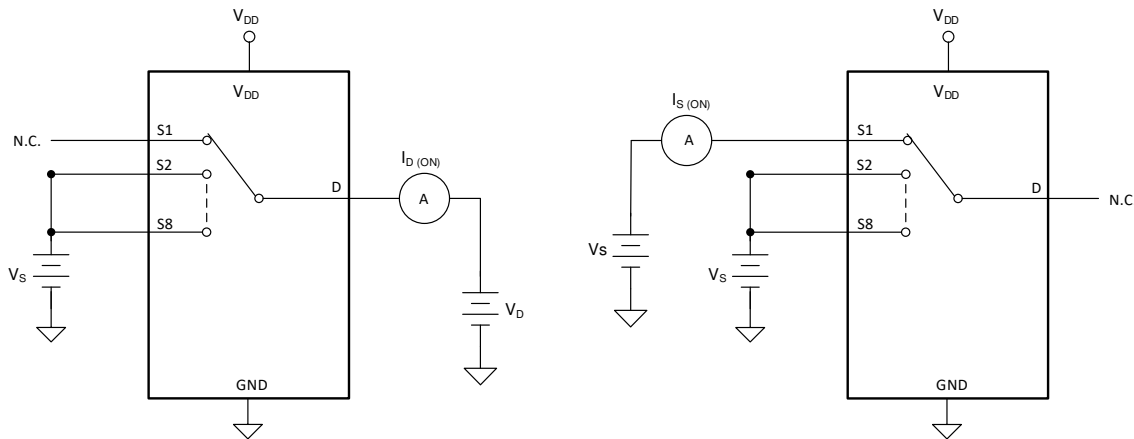
**Figure 7-2. Off-Leakage Measurement Setup**

### 7.3 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  $I_{D(ON)}$ .

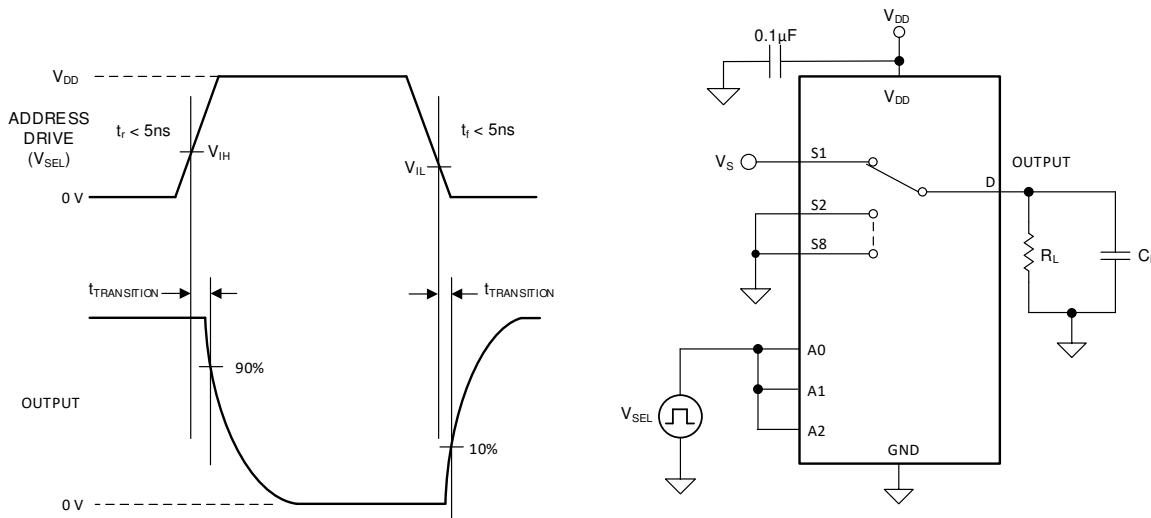
Either the source pin or drain pin is left floating during the measurement.  7-3 shows the circuit used for measuring the on-leakage current, denoted by  $I_{S(ON)}$  or  $I_{D(ON)}$ .



 7-3. On-Leakage Measurement Setup

### 7.4 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.  7-4 shows the setup used to measure transition time, denoted by the symbol  $t_{TRANSITION}$ .



 7-4. Transition-Time Measurement Setup

## 7.5 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 7-5 shows the setup used to measure break-before-make delay, denoted by the symbol  $t_{\text{OPEN(BBM)}}$ .

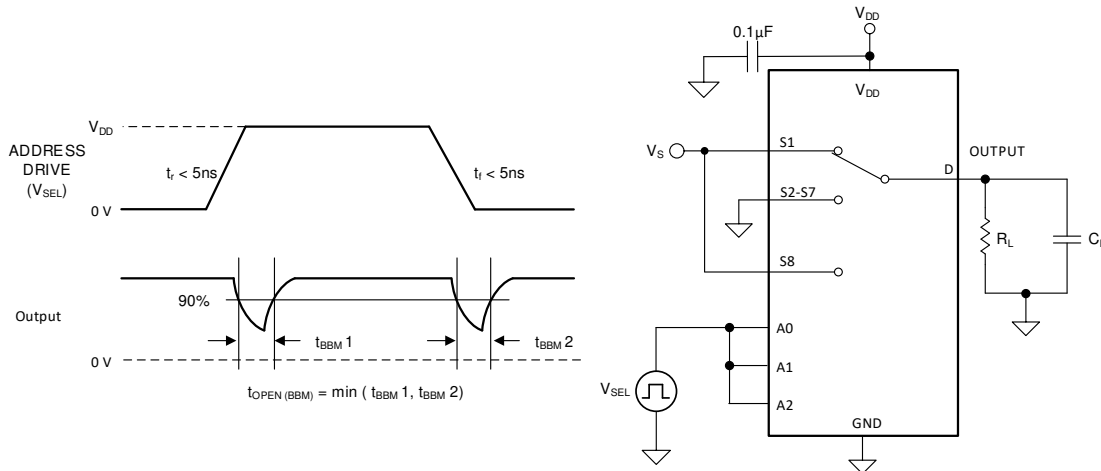


Figure 7-5. Break-Before-Make Delay Measurement Setup

## 7.6 $t_{\text{ON(EN)}}$ and $t_{\text{OFF(EN)}}$

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. Figure 7-6 shows the setup used to measure transition time, denoted by the symbol  $t_{\text{ON(EN)}}$ .

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. Figure 7-6 shows the setup used to measure transition time, denoted by the symbol  $t_{\text{OFF(EN)}}$ .

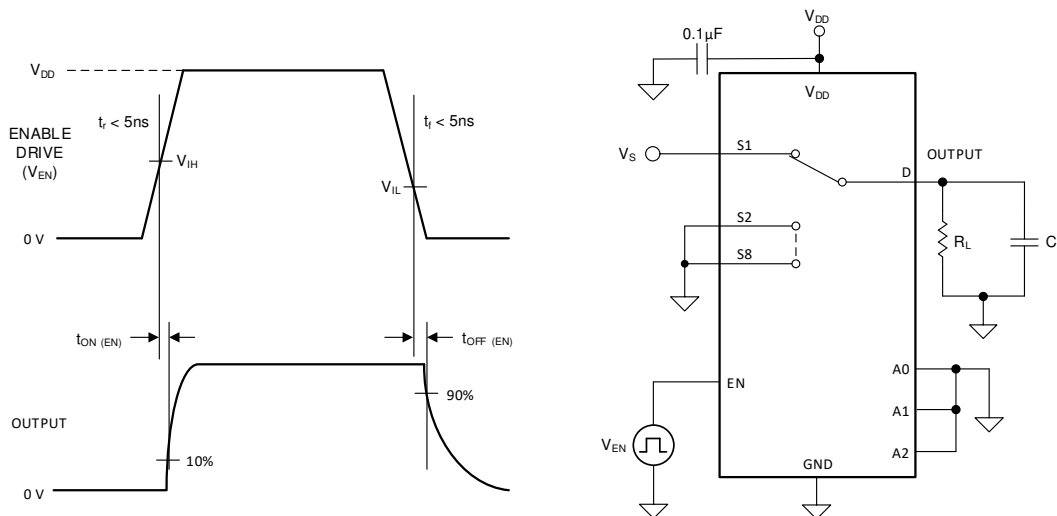
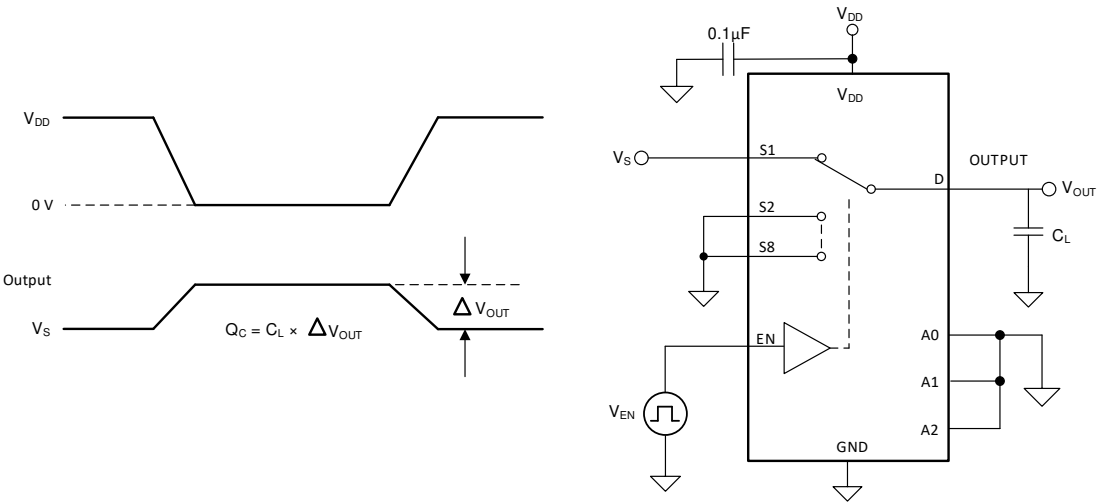
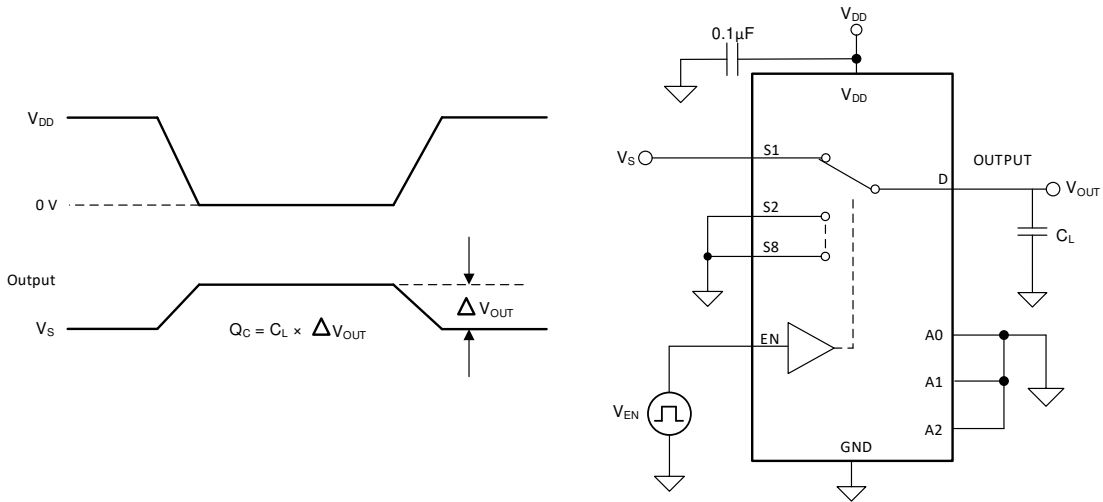


Figure 7-6. Turn-On and Turn-Off Time Measurement Setup

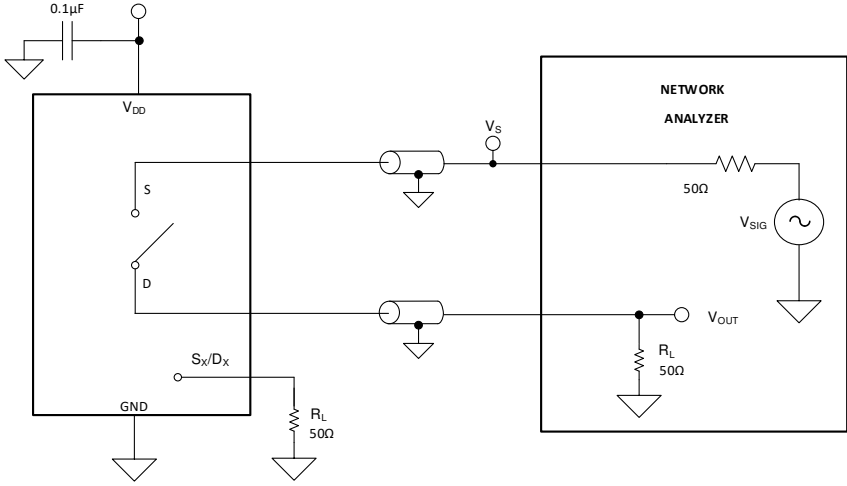
## 7.7 Charge Injection

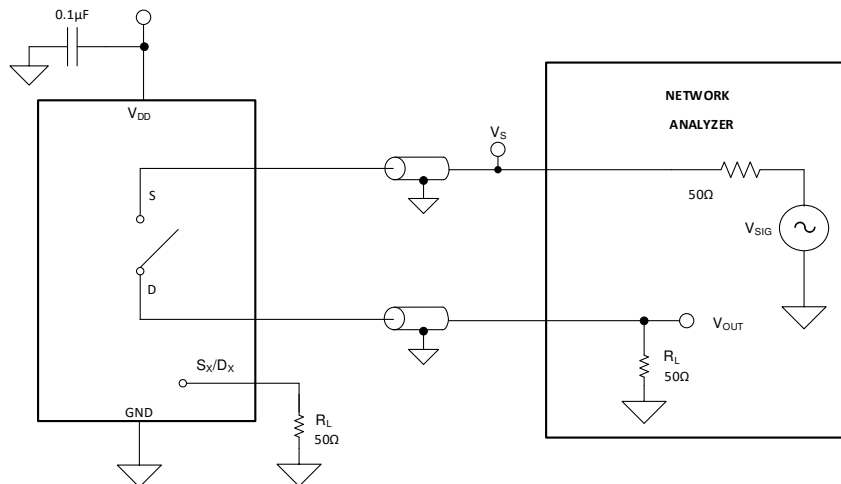
The TMUX1208-Q1 has a transmission-gate topology. Any mismatch in capacitance between the NMOS and PMOS transistors results in a charge injected into the drain or source during the falling or rising edge of the gate signal. The amount of charge injected into the source or drain of the device is known as charge injection, and is denoted by the symbol  $Q_C$ .  shows the setup used to measure charge injection from source ( $S_x$ ) to drain (D).



 **7-7. Charge-Injection Measurement Setup**

## 7.8 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 ( $S_x$ ) of an off-channel.  shows the setup used to measure, and the equation to compute off isolation.



 **7-8. Off Isolation Measurement Setup**

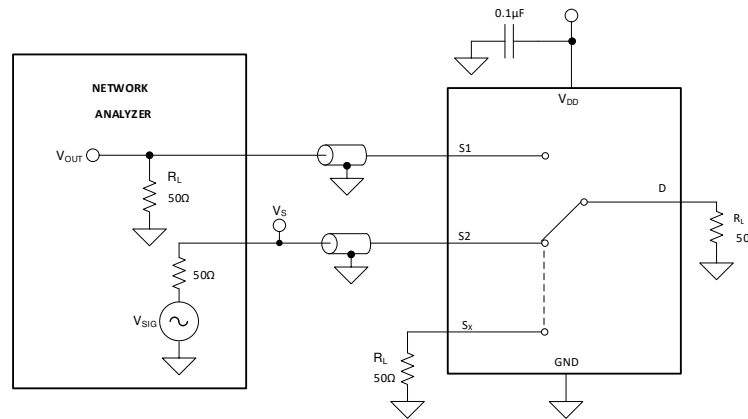
$$\text{Off Isolation} = 20 \cdot \text{Log} \left( \frac{V_{\text{OUT}}}{V_S} \right)$$

(1)



## 7.9 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. [Figure 7-9](#) shows the setup used to measure, and the equation used to compute crosstalk.

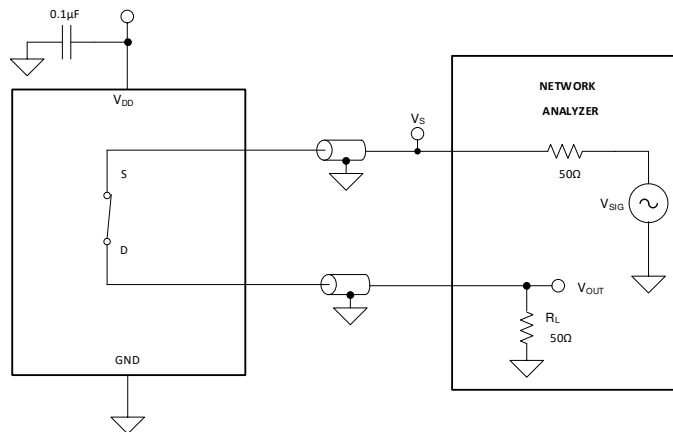


**Figure 7-9. Channel-to-Channel Crosstalk Measurement Setup**

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

## 7.10 Bandwidth

Bandwidth is defined as the range of frequencies that are attenuated by less than 3 dB when the input is applied to the source pin (Sx) of an on-channel, and the output is measured at the drain pin (D) of the device. [Figure 7-10](#) shows the setup used to measure bandwidth.



**Figure 7-10. Bandwidth Measurement Setup**

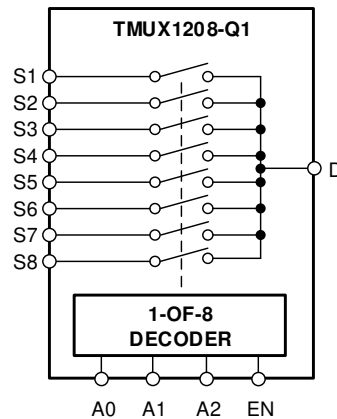
$$\text{Attenuation} = 20 \cdot \text{Log} \left( \frac{V_2}{V_1} \right) \quad (3)$$

## 8 Detailed Description

### 8.1 Overview

The TMUX1208-Q1 is an 8:1, single-ended (1-channel), mux. Each channel is turned on or off based on the state of the address lines and enable pin.

### 8.2 Functional Block Diagram



### 8.3 Feature Description

#### 8.3.1 Bidirectional Operation

The TMUX1208-Q1 conducts equally well from source (Sx) to drain (D) or from drain (D) to source (Sx). Each channel has very similar characteristics in both directions and supports both analog and digital signals.

#### 8.3.2 Rail to Rail Operation

The valid signal path input/output voltage for TMUX1208-Q1 ranges from GND to  $V_{DD}$ .

#### 8.3.3 1.8 V Logic Compatible Inputs

The TMUX1208-Q1 has 1.8-V logic compatible control for all logic control inputs. The logic input thresholds scale with supply but still provide 1.8-V logic control when operating at 5.5 V supply voltage. 1.8-V logic level inputs allows the multiplexers to interface with processors that have lower logic I/O rails and eliminates the need for an external translator, which saves both space and BOM cost. For more information on 1.8 V logic implementations refer to [Simplifying Design with 1.8 V logic Muxes and Switches](#)

#### 8.3.4 Fail-Safe Logic

The TMUX1208-Q1 has Fail-Safe Logic on the control input pins (EN, A0, A1, A2) allowing for operation up to 5.5 V, regardless of the state of the supply pin. This feature allows voltages on the control pins to be applied before the supply pin, protecting the device from potential damage. Fail-Safe Logic minimizes system complexity by removing the need for power supply sequencing on the logic control pins. For example, the Fail-Safe Logic feature allows the select pins of the TMUX1208-Q1 to be ramped to 5.5 V while  $V_{DD} = 0$  V. Additionally, the feature enables operation of the multiplexers with  $V_{DD} = 1.2$  V while allowing the select pins to interface with a logic level of another device up to 5.5 V.

### 8.3.5 Device Functional Modes

When the EN pin of the TMUX1208-Q1 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 TMUX1208-Q1 can be operated without any external components except for the supply decoupling capacitors. Unused logic control pins should be tied to GND or  $V_{DD}$  in order to ensure the device does not consume additional current as highlighted in *Implications of Slow or Floating CMOS Inputs*. Unused signal path inputs (Sx or D) should be connected to GND.

### 8.3.6 Truth Tables

表 8-1 shows the truth tables for the TMUX1208-Q1.

**表 8-1. TMUX1208-Q1 Truth Table**

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

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

## Application and Implementation

### Note

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

### 9.1 Application Information

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

### 9.2 Typical Application

One useful application to take advantage of the TMUX1208-Q1 features is multiplexing various signals into an ADC that is integrated into a MCU. Using an integrated ADC in a MCU allows a system to minimize cost with a potential tradeoff of system performance when compared to an external ADC. The multiplexer allows for multiple inputs/sensors to be monitored with a single ADC pin of the device, which is critical in systems with limited I/O.

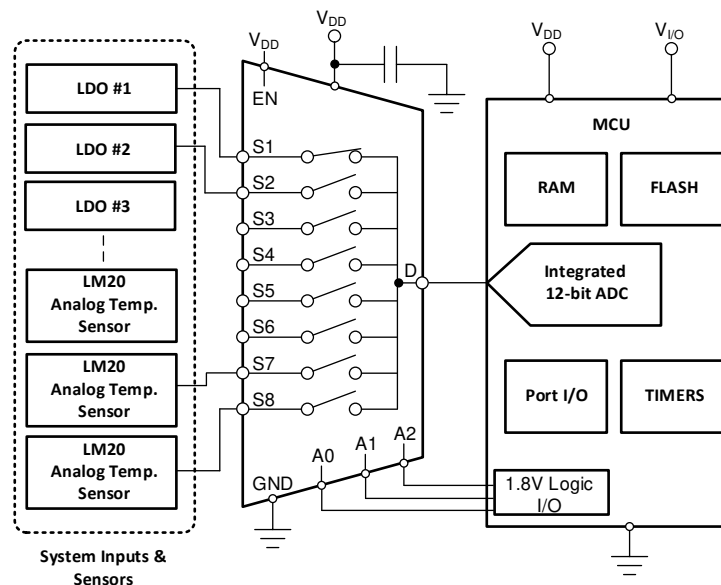


图 9-1. Multiplexing Signals to Integrated ADC

### 9.3 Design Requirements

For this design example, use the parameters listed in 表 9-1.

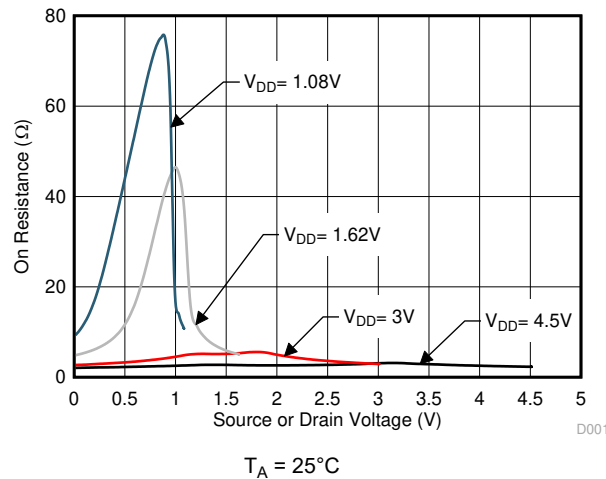
表 9-1. Design Parameters

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

## 9.4 Detailed Design Procedure

The TMUX1208-Q1 can be operated without any external components except for the supply decoupling capacitors. If the parts desired power-up state is disabled, the enable pin should have a weak pull-down resistor and be controlled by the MCU via GPIO. All inputs being muxed to the ADC of the MCU must fall within the recommend operating conditions of the TMUX1208-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.

## 9.5 Application Curve



☒ 9-2. On-Resistance vs Source or Drain Voltage

## 9 Power Supply Recommendations

The TMUX1208-Q1 operate across a wide supply range of 1.08 V to 5.5 V. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices.

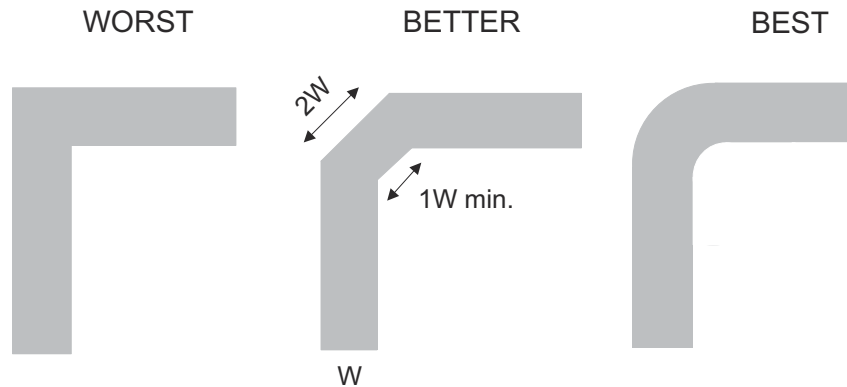
Power-supply bypassing improves noise margin and prevents switching noise propagation from the V<sub>DD</sub> supply to other components. Good power-supply decoupling is important to achieve optimum performance. For improved supply noise immunity, use a supply decoupling capacitor ranging from 0.1 μF to 10 μF from V<sub>DD</sub> 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**

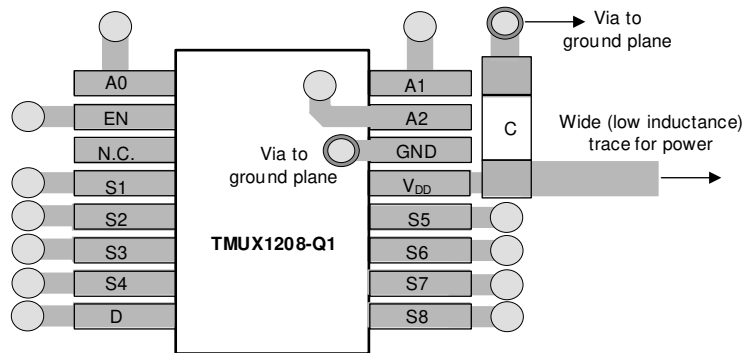
Route high-speed signals using a minimum of vias and corners which reduces signal reflections and impedance changes. When a via must be used, increase the clearance size around it to minimize its capacitance. Each via introduces discontinuities in the signal's transmission line and increases the chance 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.

#### 10.1.2

[Figure 10-2](#) illustrates an example of a PCB layout with the TMUX1208-Q1. Some key considerations are:

- Decouple the  $V_{DD}$  pin with a 0.1- $\mu$ 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



☒ 10-2. TMUX1208-Q1 Layout Example

## 11 Device and Documentation Support

### 11.1 Third-Party Products Disclaimer

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### 11.2 Documentation Support

#### 11.2.1 Related Documentation

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

Texas Instruments, [QFN/SON PCB Attachment](#).

Texas Instruments, [Quad Flatpack No-Lead Logic Packages](#).

### 11.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 11.4 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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### 11.5 Trademarks

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## 12 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## 13 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## Mechanical, Packaging, and Orderable Information

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



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| TMUX1208QRSVRQ1  | ACTIVE        | UQFN         | RSV             | 16   | 3000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 208Q                    | Samples |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

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

**OTHER QUALIFIED VERSIONS OF TMUX1208-Q1 :**

- Catalog : [TMUX1208](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

**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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TMUX1208QRSVRQ1 | UQFN         | RSV             | 16   | 3000 | 178.0              | 13.5               | 2.1     | 2.9     | 0.75    | 4.0     | 12.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TMUX1208QRSVRQ1 | UQFN         | RSV             | 16   | 3000 | 189.0       | 185.0      | 36.0        |

## GENERIC PACKAGE VIEW

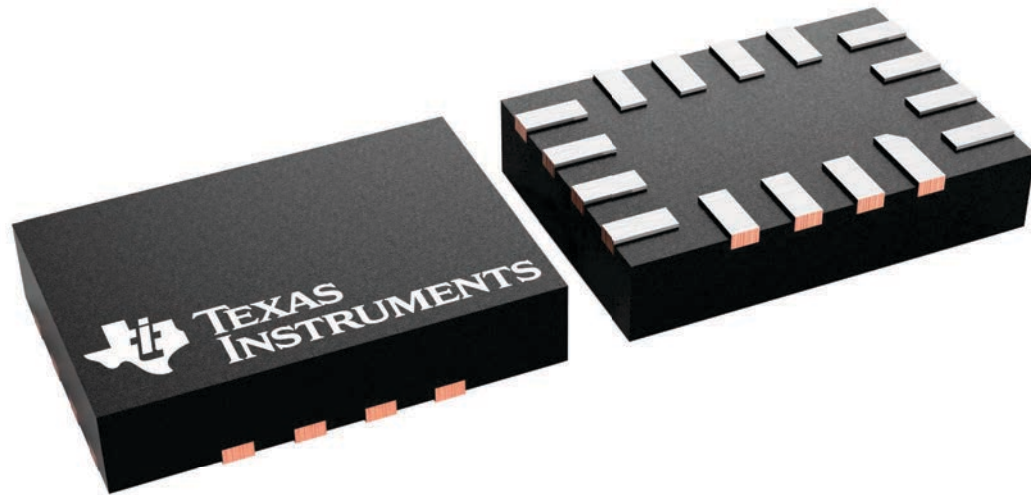
**RSV 16**

**UQFN - 0.55 mm max height**

1.8 x 2.6, 0.4 mm pitch

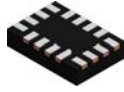
ULTRA THIN QUAD FLATPACK - NO LEAD

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



4231225/A

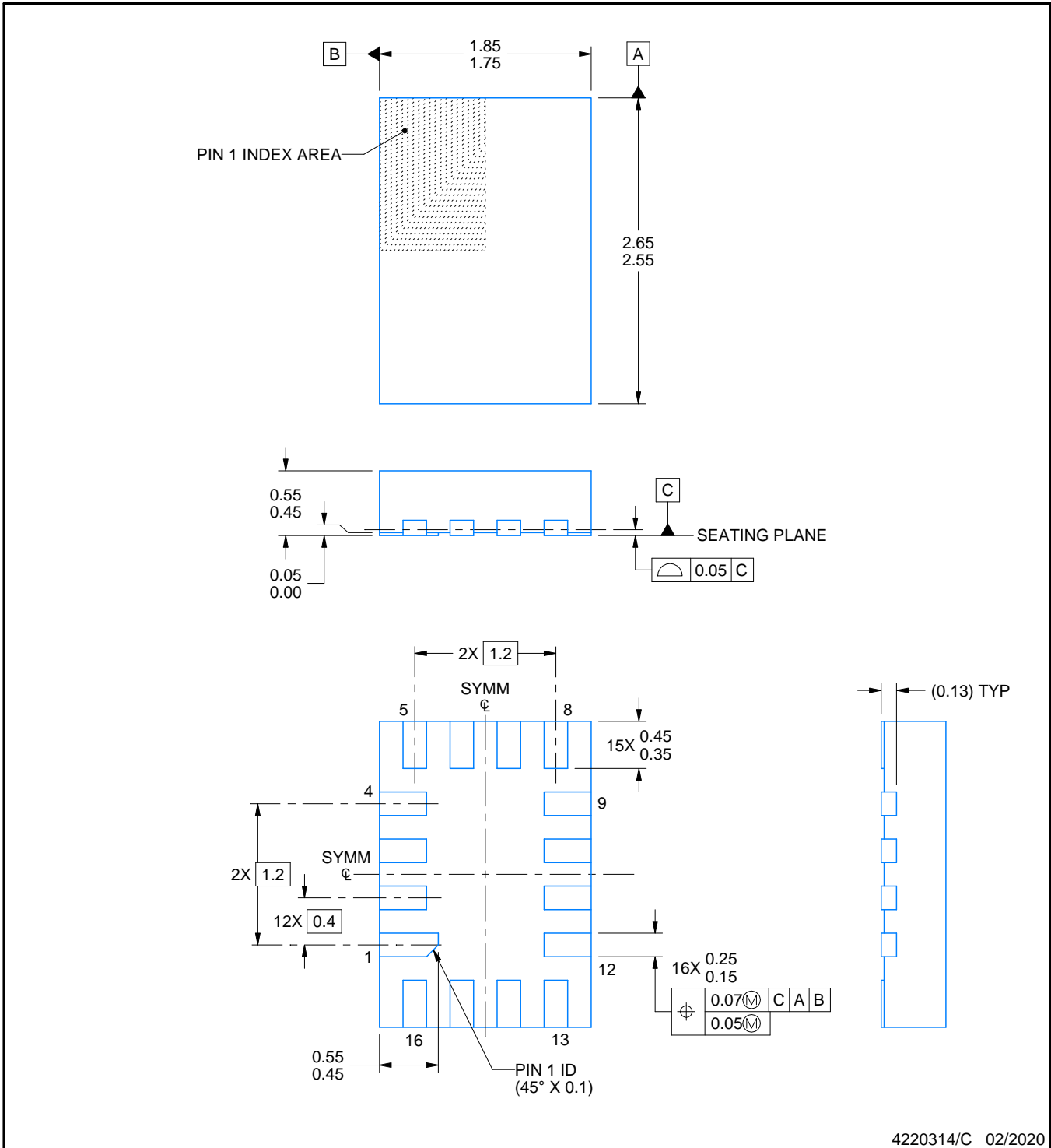
RSV0016A



PACKAGE OUTLINE

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



NOTES:

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

# EXAMPLE BOARD LAYOUT

RSV0016A

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 25X



4220314/C 02/2020

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

RSV0016A

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



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

4220314/C 02/2020

NOTES: (continued)

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



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