

MUX36xxx 36V、低容量、低リーク電流、高精度のアナログ・マルチプレクサ

1 特長

- 低いオン容量
 - MUX36S08: 9.4pF
 - MUX36D04: 6.7pF
- 低入力リーク電流: 1pA
- 低電荷注入: 0.3pC
- レール・ツー・レール動作
- 幅広い電源電圧範囲: $\pm 5V \sim \pm 18V$ 、 $10V \sim 36V$
- 低オン抵抗: 125 Ω
- 遷移時間: 92ns
- Break-Before-Makeの切り替え動作
- V_{DD} に接続可能なENピン
- ロジック・レベル: $2V \sim V_{DD}$
- 低い消費電流: 45 μA
- ESD保護(HBM): 2000V
- 業界標準のTSSOPパッケージと小型のWQFNパッケージ
- 他の構成については、次の資料を参照
 - [TMUX6111/12/13](#) (4 チャンネル SPST)
 - [TMUX6121/22/23](#) (2 チャンネル SPST)
 - [TMUX6119](#) (1 チャンネル SPDT)
 - [TMUX6136](#) (2 チャンネル SPDT)
 - [TMUX6104](#) (1 チャンネル 4:1)

2 アプリケーション

- ファクトリ・オートメーションと産業プロセス制御
- 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
- ATE試験装置
- バッテリー・モニタリング・システム

3 概要

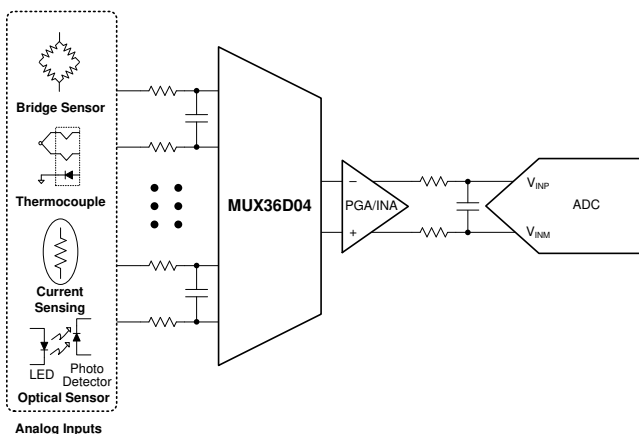
MUX36S08およびMUX36D04 (MUX36xxx)は、最新のCMOS (相補型金属酸化膜半導体)アナログ・マルチプレクサ(MUX)です。MUX36S08は8:1シングルエンド・チャンネル、MUX36D04は差動4:1またはデュアル4:1シングルエンド・チャンネルを提供します。MUX36S08およびMUX36D04は、デュアル電源($\pm 5V \sim \pm 18V$)でも単電源($10V \sim 36V$)でも正常に動作します。また、対称電源($V_{DD} = 12V$ 、 $V_{SS} = -12V$ など)でも、非対称電源($V_{DD} = 12V$ 、 $V_{SS} = -5V$ など)でも正常に動作します。すべてのデジタル入力にはTTLロジック互換のスレッシュホールドがあり、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確保されます。

製品情報⁽¹⁾

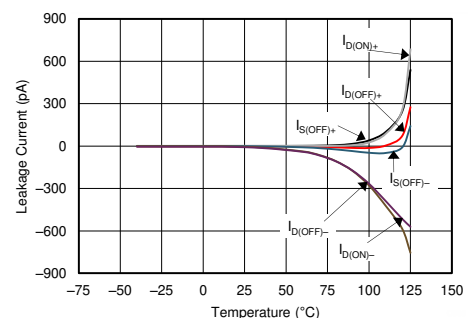
| 型番 | パッケージ | 本体サイズ(公称) |
|----------|------------|---------------|
| MUX36S08 | TSSOP (16) | 5.00mm×4.40mm |
| MUX36D04 | WQFN (16) | 4.00mm×4.00mm |

(1) 利用可能なすべてのパッケージについては、この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。

概略回路図



リーク電流と温度



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4 改訂履歴

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。

| Revision C (April 2018) から Revision D に変更 | Page |
|---|------|
| 「特長」:「他の構成については、次の資料を参照」を追加 | 1 |
| Added RRJ (WQFN) package option to the MUX36D08 | 5 |
| Changed the WQFN S6 pin number From: 19 To: 9 | 5 |
| Added the RRJ package option to the MUX36D04 | 6 |
| Added WQFN (RRJ) data to <i>Thermal Information</i> | 8 |
| Changed On-resistance drift unit value From: Ω To: $\%/^{\circ}\text{C}$ | 8 |
| Changed $I_{DL(ON)}$ unit value From: nA To: pA | 8 |

| Revision B (July 2016) から Revision C に変更 | Page |
|---|------|
| 「特長」にWQFNパッケージ・オプションを追加 | 1 |
| 「製品情報」にWQFNパッケージ・オプションを追加 | 1 |
| Changed Description column of MUX36D04 row in <i>Device Comparison Table</i> | 5 |
| Added WQFN (RUM) data to <i>Thermal Information</i> | 8 |
| Changed On-resistance drift TYP value From: 0.52 To: 0.64 in <i>Electrical Characteristics: Dual Supply</i> | 8 |
| Changed Analog Switch, I_D parameter in <i>Electrical Characteristics: Dual Supply</i> table: split parameter into $I_{D(OFF)}$ and $I_{D(ON)}$ parameters, changed symbols, parameter names, and test conditions | 8 |
| Changed Analog Switch, $I_{DL(ON)}$ parameter test conditions in <i>Electrical Characteristics: Dual Supply</i> table | 8 |
| Changed On-resistance drift TYP value From: 0.47 To: 1.13 in <i>Electrical Characteristics: Single Supply</i> | 10 |
| Changed Analog Switch, I_D parameter in <i>Electrical Characteristics: Single Supply</i> table: split parameter into $I_{D(OFF)}$ | |

| | |
|---|----|
| and $I_{D(ON)}$ parameters, changed symbols, parameter names, and $I_{D(ON)}$ test conditions | 10 |
| • Changed and swapped data between 25°C and 85°C to fix the typo | 11 |
| • Changed ☒ 30 : changed low-voltage level to 0 V | 19 |
| • Changed ☒ 33 : added 0 V line, flipped V_S supply symbol | 21 |
| • Changed ☒ 37 : changed 5 V_{RMS} marking in <i>Audio Precision</i> box | 23 |
| • Changed description of MUX36D04 in <i>Overview</i> section..... | 24 |
| • Changed ☒ 43 : changed OPA140 amplifier and charge kickback filter box | 28 |

Revision A (January 2016) から Revision B に変更
Page

| | |
|--|----|
| • Added differential on-leakage current parameter to <i>Electrical Characteristics</i> table | 8 |
| • Added <i>Differential On-Leakage Current</i> section..... | 18 |

2016年1月発行のものから更新
Page

| | |
|---------------------------|---|
| • 製品プレビューから量産データに変更 | 1 |
|---------------------------|---|

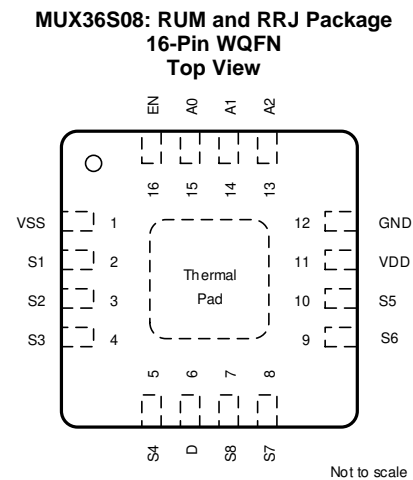
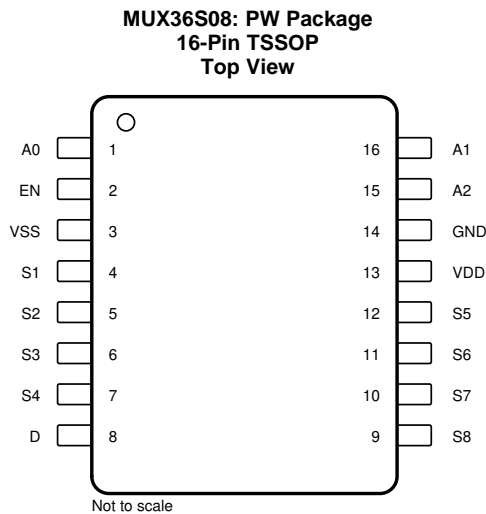
5 概要 (続き)

MUX36S08およびMUX36D04のオン/オフ・リーク電流は非常に低いため、これらのマルチプレクサは入力インピーダンスの高い信号源からの信号を、最小限の誤差でスイッチング可能です。消費電流が $45\mu\text{A}$ と低いため、携帯用アプリケーションで使用できます。

6 Device Comparison Table

| PRODUCT | DESCRIPTION |
|----------|--|
| MUX36S08 | 8-channel, single-ended analog multiplexer (8:1 mux) |
| MUX36D04 | 4-channel differential or dual 4:1 single-ended analog multiplexer (8:2 mux) |

7 Pin Configuration and Functions

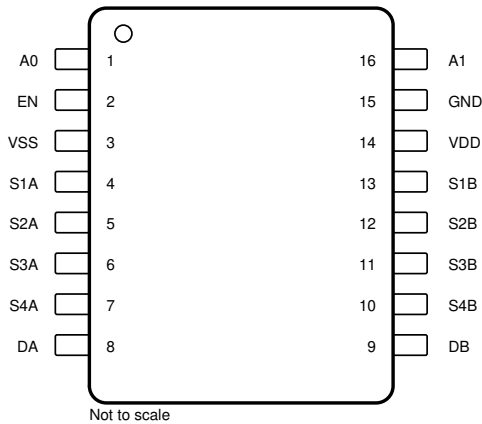
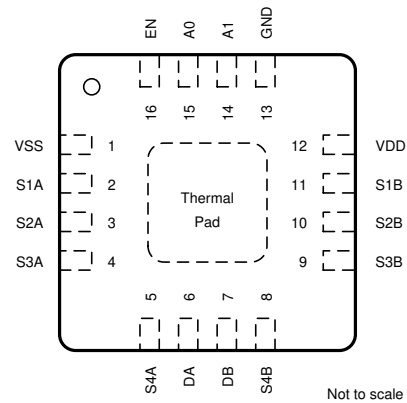


RUM and RRJ have the same package dimension, but different thermal pad dimension and lead finger length.

Pin Functions: MUX36S08

| NAME | PIN | | FUNCTION | DESCRIPTION |
|----------------------------|-------|------|------------------------|---|
| | TSSOP | WQFN | | |
| A0 | 1 | 15 | Digital input | Address line 0 |
| A1 | 16 | 14 | Digital input | Address line 1 |
| A2 | 15 | 13 | Digital input | Address line 2 |
| D | 8 | 6 | Analog input or output | Drain pin. Can be an input or output. |
| EN | 2 | 16 | Digital input | Active high digital input. When this pin is low, all switches are turned off. When this pin is high, the A[2:0] logic inputs determine which switch is turned on. |
| GND | 14 | 12 | Power supply | Ground (0 V) reference |
| S1 | 4 | 2 | Analog input or output | Source pin 1. Can be an input or output. |
| S2 | 5 | 3 | Analog input or output | Source pin 2. Can be an input or output. |
| S3 | 6 | 4 | Analog input or output | Source pin 3. Can be an input or output. |
| S4 | 7 | 5 | Analog input or output | Source pin 4. Can be an input or output. |
| S5 | 12 | 10 | Analog input or output | Source pin 5. Can be an input or output. |
| S6 | 11 | 9 | Analog input or output | Source pin 6. Can be an input or output. |
| S7 | 10 | 8 | Analog input or output | Source pin 7. Can be an input or output. |
| S8 | 9 | 7 | Analog input or output | Source pin 8. Can be an input or output. |
| VDD | 13 | 11 | Power supply | Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 μ F to 10 μ F between V _{DD} and GND. |
| VSS | 3 | 1 | Power supply | Negative power supply. This pin is the most negative power-supply potential. In single-supply applications, this pin can be connected to ground. For reliable operation, connect a decoupling capacitor ranging from 0.1 μ F to 10 μ F between V _{SS} and GND. |
| Thermal Pad ⁽¹⁾ | - | - | Power supply | Exposed Pad. The exposed pad is electrically connected to V _{SS} internally. Connect EP to V _{SS} to achieve rated thermal and ESD performance. |

(1) RUM and RRJ have the same package dimension, but different thermal pad dimension and lead finger length.

**MUX36D04: PW Package
16-Pin TSSOP
Top View**

**MUX36D04: RUM and RRJ Package
16-Pin WQFN
Top View**


RUM and RRJ have the same package dimension, but different thermal pad dimension and lead finger length.

Pin Functions: MUX36D04

| PIN | | | FUNCTION | DESCRIPTION |
|----------------------------|-------|------|------------------------|---|
| NAME | TSSOP | WQFN | | |
| A0 | 1 | 15 | Digital input | Address line 0 |
| A1 | 16 | 14 | Digital input | Address line 1 |
| DA | 8 | 6 | Analog input or output | Drain pin A. Can be an input or output. |
| DB | 9 | 7 | Analog input or output | Drain pin B. Can be an input or output. |
| EN | 2 | 16 | Digital input | Active high digital input. When this pin is low, all switches are turned off. When this pin is high, the A[1:0] logic inputs determine which pair of switches is turned on. |
| GND | 15 | 13 | Power supply | Ground (0 V) reference |
| S1A | 4 | 2 | Analog input or output | Source pin 1A. Can be an input or output. |
| S2A | 5 | 3 | Analog input or output | Source pin 2A. Can be an input or output. |
| S3A | 6 | 4 | Analog input or output | Source pin 3A. Can be an input or output. |
| S4A | 7 | 5 | Analog input or output | Source pin 4A. Can be an input or output. |
| S1B | 13 | 11 | Analog input or output | Source pin 1B. Can be an input or output. |
| S2B | 12 | 10 | Analog input or output | Source pin 2B. Can be an input or output. |
| S3B | 11 | 9 | Analog input or output | Source pin 3B. Can be an input or output. |
| S4B | 10 | 8 | Analog input or output | Source pin 4B. Can be an input or output. |
| V _{DD} | 14 | 12 | Power supply | Positive power supply. This pin is the most positive power supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 μ F to 10 μ F between V _{DD} and GND. |
| V _{SS} | 3 | 1 | Power supply | Negative power supply. This pin is the most negative power supply potential. In single-supply applications, this pin can be connected to ground. For reliable operation, connect a decoupling capacitor ranging from 0.1 μ F to 10 μ F between V _{SS} and GND. |
| Thermal Pad ⁽¹⁾ | - | - | Power supply | Exposed Pad. The exposed pad is electrically connected to V _{SS} internally. Connect EP to V _{SS} to achieve rated thermal and ESD performance. |

(1) RUM and RRJ have the same package dimension, but different thermal pad dimension and lead finger length.

8 Specifications

8.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT | |
|------------------------|---|-------------------|----------------|----------------|---|
| Voltage | Supply | V_{DD} | -0.3 | 40 | V |
| | | V_{SS} | -40 | 0.3 | |
| | | $V_{DD} - V_{SS}$ | | 40 | |
| | Digital input pins: ⁽²⁾ EN, A0, A1, A2 | | $V_{SS} - 0.3$ | $V_{DD} + 0.3$ | V |
| | Analog input pins: ⁽²⁾ Sx, SxA, SxB, D, DA, DB | | $V_{SS} - 2$ | $V_{DD} + 2$ | V |
| Current ⁽³⁾ | | -30 | 30 | mA | |
| Temperature | Operating, T_A | -55 | 150 | °C | |
| | Junction, T_J | | 150 | | |
| | Storage, T_{stg} | -65 | 150 | | |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* 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 Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) Only one pin at a time

(3) Voltage limits are valid if current is limited to ± 30 mA.

8.2 ESD Ratings

| | | VALUE | UNIT | |
|-------------|-------------------------|--|------------|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ± 2000 | V |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ± 500 | |

(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.

8.3 Recommended Operating Conditions

| | | MIN | NOM | MAX | UNIT |
|-------------------------|--|---------------|-----|----------|------|
| V_{DD} ⁽¹⁾ | Positive power-supply voltage | Dual supply | 5 | 18 | V |
| | | Single supply | 10 | 36 | |
| V_{SS} ⁽²⁾ | Negative power-supply voltage (dual supply) | -5 | | -18 | V |
| $V_{DD} - V_{SS}$ | Supply voltage | 10 | | 36 | V |
| V_S | Source pins voltage ⁽³⁾ | V_{SS} | | V_{DD} | V |
| V_D | Drain pins voltage | V_{SS} | | V_{DD} | V |
| V_{EN} | Enable pin voltage | V_{SS} | | V_{DD} | V |
| V_A | Address pins voltage | V_{SS} | | V_{DD} | V |
| I_{CH} | Channel current ($T_A = 25^\circ\text{C}$) | -25 | | 25 | mA |
| T_A | Operating temperature | -40 | | 125 | °C |

(1) When $V_{SS} = 0$ V, V_{DD} can range from 10 V to 36 V.

(2) V_{DD} and V_{SS} can be any value as long as $10 \text{ V} \leq (V_{DD} - V_{SS}) \leq 36 \text{ V}$.

(3) V_S is the voltage on all S pins.

8.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | MUX36S08 and MUX36D04 | | | UNIT |
|--|-----------------------|------------|------------|------|
| | PW (TSSOP) | RUM (WQFN) | RRJ (WQFN) | |
| | 16 PINS | 16 PINS | 16 PINS | |
| R _{θJA} Junction-to-ambient thermal resistance | 103.8 | 37.3 | 46.2 | °C/W |
| R _{θJC(top)} Junction-to-case (top) thermal resistance | 36.8 | 31.6 | 37.7 | °C/W |
| R _{θJB} Junction-to-board thermal resistance | 49.8 | 16.2 | 21.7 | °C/W |
| ψ _{JT} Junction-to-top characterization parameter | 2.7 | 0.5 | 0.7 | °C/W |
| ψ _{JB} Junction-to-board characterization parameter | 49.1 | 16.2 | 21.7 | °C/W |
| R _{θJC(bot)} Junction-to-case (bottom) thermal resistance | N/A | 6.1 | 6.2 | °C/W |

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

8.5 Electrical Characteristics: Dual Supply

at T_A = 25°C, V_{DD} = 15 V, and V_{SS} = -15 V (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT | |
|--|--|----------------------------------|-------|-----------------|------|----|
| ANALOG SWITCH | | | | | | |
| Analogue signal range | T _A = -40°C to +125°C | V _{SS} | | V _{DD} | V | |
| R _{ON} On-resistance | V _S = 0 V, I _{CH} = 1 mA | | 125 | 170 | Ω | |
| | V _S = ±10 V, I _{CH} = 1 mA | T _A = -40°C to +85°C | 145 | 200 | Ω | |
| | | T _A = -40°C to +125°C | | 250 | | |
| ΔR _{ON} On-resistance mismatch between channels | V _S = ±10 V, I _{CH} = 1 mA | | 2.4 | 6 | Ω | |
| | | T _A = -40°C to +85°C | | 9 | | |
| | | T _A = -40°C to +125°C | | 11 | | |
| R _{FLAT} On-resistance flatness | V _S = 10 V, 0 V, -10 V | | 2.4 | 6 | Ω | |
| | | T _A = -40°C to +85°C | | 53 | | |
| | | T _A = -40°C to +125°C | | 58 | | |
| On-resistance drift | V _S = 0 V | | 0.64 | | %/°C | |
| I _{S(OFF)} Input leakage current | Switch state is off, V _S = ±10 V, V _D = ±10 V ⁽¹⁾ | | -0.04 | 0.001 | 0.04 | nA |
| | | T _A = -40°C to +85°C | -0.15 | | 0.15 | |
| | | T _A = -40°C to +125°C | -1.9 | | 1.9 | |
| I _{D(OFF)} Output off leakage current | Switch state is off, V _S = ±10 V, V _D = ±10 V ⁽¹⁾ | | -0.1 | 0.005 | 0.1 | nA |
| | | T _A = -40°C to +85°C | -0.5 | | 0.5 | |
| | | T _A = -40°C to +125°C | -2 | | 2 | |
| I _{D(ON)} Output on leakage current | Switch state is on, V _D = ±10 V, V _S = floating | | -0.1 | 0.008 | 0.1 | nA |
| | | T _A = -40°C to +85°C | -0.5 | | 0.5 | |
| | | T _A = -40°C to +125°C | -3.3 | | 3.3 | |
| I _{DL(ON)} Differential on-leakage current | Switch state is on, V _{DA} = V _{DB} = ±10 V, V _S = floating | | -15 | 3 | 15 | pA |
| | | T _A = -40°C to +85°C | -100 | | 100 | |
| | | T _A = -40°C to +125°C | -500 | | 500 | |
| LOGIC INPUT | | | | | | |
| V _{IH} Logic voltage high | | 2 | | | V | |
| V _{IL} Logic voltage low | | | | 0.8 | V | |

(1) When V_S is positive, V_D is negative, and vice versa.

Electrical Characteristics: Dual Supply (continued)

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

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|---|--|-----------|------|---------------|
| I_D Input current | | | | 0.15 | μA |
| SWITCH DYNAMICS⁽²⁾ | | | | | |
| t_{ON} Enable turn-on time | $V_S = \pm 10\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | | 88 | 136 | ns |
| | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | 144 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | 151 | |
| t_{OFF} Enable turn-off time | $V_S = \pm 10\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | | 63 | 75 | ns |
| | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | 83 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | 90 | |
| t_t Transition time | $V_S = 10\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | | 92 | 143 | ns |
| | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | 151 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | 157 | |
| t_{BBM} Break-before-make time delay | $V_S = 10\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | 30 | 54 | | ns |
| Q_J Charge injection | $C_L = 1\text{ nF}$, $R_S = 0\ \Omega$ | $V_S = 0\text{ V}$ | 0.3 | | pC |
| | | $V_S = -15\text{ V to } +15\text{ V}$ | ± 0.6 | | |
| Off-isolation | $R_L = 50\ \Omega$, $V_S = 1\text{ V}_{RMS}$, $f = 1\text{ MHz}$ | Nonadjacent channel to D, DA, DB | -96 | | dB |
| | | Adjacent channel to D, DA, DB | -85 | | |
| Channel-to-channel crosstalk | $R_L = 50\ \Omega$, $V_S = 1\text{ V}_{RMS}$, $f = 1\text{ MHz}$ | Nonadjacent channels | -96 | | dB |
| | | Adjacent channels | -88 | | |
| $C_{S(OFF)}$ Input off-capacitance | $f = 1\text{ MHz}$, $V_S = 0\text{ V}$ | | 2.4 | 2.9 | pF |
| $C_{D(OFF)}$ Output off-capacitance | $f = 1\text{ MHz}$, $V_S = 0\text{ V}$ | MUX36S08 | 7.5 | 8.4 | pF |
| | | MUX36D04 | 4.3 | 5 | |
| $C_{S(ON)}$, $C_{D(ON)}$ Output on-capacitance | $f = 1\text{ MHz}$, $V_S = 0\text{ V}$ | MUX36S08 | 9.4 | 10.6 | pF |
| | | MUX36D04 | 6.7 | 7.7 | |
| POWER SUPPLY | | | | | |
| V_{DD} supply current | All $V_A = 0\text{ V}$ or 3.3 V , $V_S = 0\text{ V}$, $V_{EN} = 3.3\text{ V}$ | | 45 | 59 | μA |
| | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | 62 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | 83 | |
| V_{SS} supply current | All $V_A = 0\text{ V}$ or 3.3 V , $V_S = 0\text{ V}$, $V_{EN} = 3.3\text{ V}$ | | 25 | 34 | μA |
| | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | 37 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | 57 | |

(2) Specified by design, not subject to production testing.

8.6 Electrical Characteristics: Single Supply

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

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|------------------------------|--|---|----------|-------|-----------|---------------------|
| ANALOG SWITCH | | | | | | | |
| Analog signal range | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | V_{SS} | | V_{DD} | V |
| R_{ON} | On-resistance | $V_S = 10\text{ V}$, $I_{CH} = 1\text{ mA}$ | | 235 | 340 | | Ω |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | | 390 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 430 | |
| ΔR_{ON} | On-resistance match | $V_S = 10\text{ V}$, $I_{CH} = 1\text{ mA}$ | | 3.1 | 12 | | Ω |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | | 19 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 23 | |
| On-resistance drift | | $V_S = 10\text{ V}$ | | | 1.13 | | %/ $^\circ\text{C}$ |
| $I_{S(OFF)}$ | Input leakage current | Switch state is off, $V_S = 1\text{ V}$ and $V_D = 10\text{ V}$, or $V_S = 10\text{ V}$ and $V_D = 1\text{ V}$ ⁽¹⁾ | | -0.04 | 0.001 | 0.04 | nA |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | -0.15 | | 0.15 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | -1.9 | | 1.9 | |
| $I_{D(OFF)}$ | Output off leakage current | Switch state is off, $V_S = 1\text{ V}$ and $V_D = 10\text{ V}$, or $V_S = 10\text{ V}$ and $V_D = 1\text{ V}$ ⁽¹⁾ | | -0.1 | 0.005 | 0.1 | nA |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | -0.5 | | 0.5 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | -2 | | 2 | |
| $I_{D(ON)}$ | Output on leakage current | Switch state is on, $V_D = 1\text{ V}$ and 10 V , $V_S = \text{floating}$ | | -0.1 | 0.008 | 0.1 | nA |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | -0.5 | | 0.5 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | -3.3 | | 3.3 | |
| LOGIC INPUT | | | | | | | |
| V_{IH} | Logic voltage high | | | 2.0 | | | V |
| V_{IL} | Logic voltage low | | | | | 0.8 | V |
| I_D | Input current | | | | | 0.15 | μA |
| SWITCH DYNAMIC CHARACTERISTICS⁽²⁾ | | | | | | | |
| t_{ON} | Enable turn-on time | $V_S = 8\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | | | 85 | 140 | ns |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | | 145 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 149 | |
| t_{OFF} | Enable turn-off time | $V_S = 8\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | | | 48 | 83 | ns |
| | | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | | 94 | |
| | | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 102 | |
| t_t | Transition time | $V_S = 8\text{ V}$, $C_L = 35\text{ pF}$ | | | 87 | 147 | ns |
| | | $V_S = 8\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | | 153 | |
| | | $V_S = 8\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | | 155 | |
| t_{BBM} | Break-before-make time delay | $V_S = 8\text{ V}$, $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | 30 | 54 | | ns |
| Q_J | Charge injection | $C_L = 1\text{ nF}$, $R_S = 0\ \Omega$ | $V_S = 6\text{ V}$ | | 0.15 | | pC |
| | | | $V_S = 0\text{ V}$ to 12 V , | | | ± 0.4 | |
| | Off-isolation | $R_L = 50\ \Omega$, $V_S = 1\text{ V}_{RMS}$, $f = 1\text{ MHz}$ | Nonadjacent channel to D, DA, DB | | -96 | | dB |
| | | | Adjacent channel to D, DA, DB | | | -85 | |
| | Channel-to-channel crosstalk | $R_L = 50\ \Omega$, $V_S = 1\text{ V}_{RMS}$, $f = 1\text{ MHz}$ | Nonadjacent channels | | -96 | | dB |
| | | | Adjacent channels | | | -88 | |
| $C_{S(OFF)}$ | Input off-capacitance | $f = 1\text{ MHz}$, $V_S = 6\text{ V}$ | | | 2.7 | 3.2 | pF |
| $C_{D(OFF)}$ | Output off-capacitance | $f = 1\text{ MHz}$, $V_S = 6\text{ V}$ | | MUX36S08 | 9.1 | 10 | pF |
| | | | | MUX36D04 | 5 | 5.7 | |
| $C_{S(ON)}$, $C_{D(ON)}$ | Output on-capacitance | $f = 1\text{ MHz}$, $V_S = 6\text{ V}$ | | MUX36S08 | 10.8 | 12 | pF |
| | | | | MUX36D04 | 6.9 | 8 | |

 (1) When V_S is 1 V , V_D is 10 V , and vice versa.

(2) Specified by design; not subject to production testing.

Electrical Characteristics: Single Supply (continued)

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

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------------|--|---|-----|-----|---------------|
| POWER SUPPLY | | | | | |
| V_{DD} supply current | All $V_A = 0\text{ V}$ or 3.3 V , $V_S = 0\text{ V}$, $V_{EN} = 3.3\text{ V}$ | | 42 | 53 | μA |
| | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | 56 | |
| | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | 77 | |
| V_{SS} supply current | All $V_A = 0\text{ V}$ or 3.3 V , $V_S = 0\text{ V}$, $V_{EN} = 3.3\text{ V}$ | | 23 | 31 | μA |
| | | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | 38 | |
| | | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | | 51 | |

8.7 Typical Characteristics

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

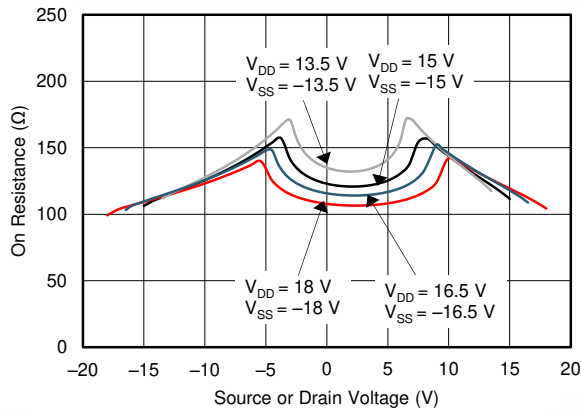


Fig 1. On-Resistance vs Source or Drain Voltage

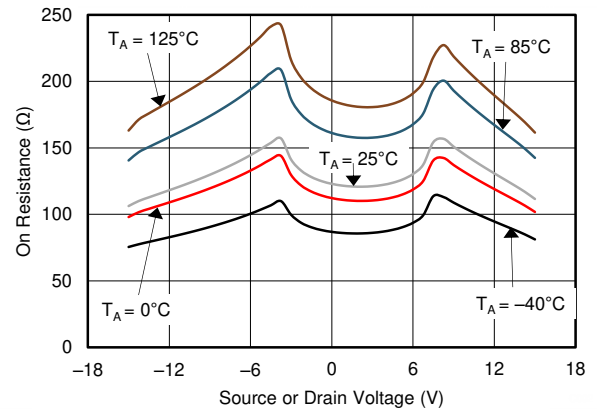


Fig 2. On-Resistance vs Source or Drain Voltage

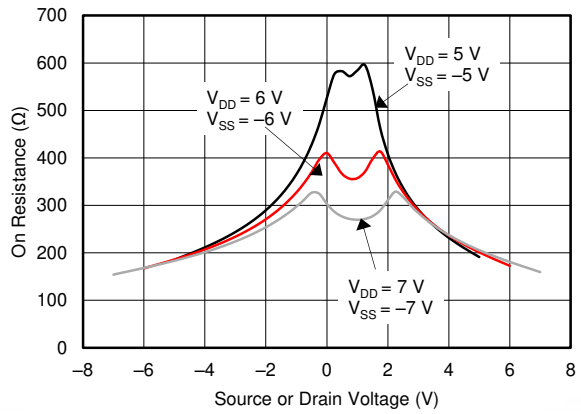


Fig 3. On-Resistance vs Source or Drain Voltage

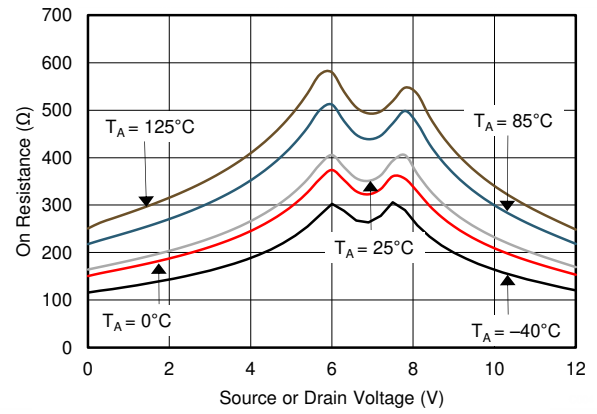


Fig 4. On-Resistance vs Source or Drain Voltage

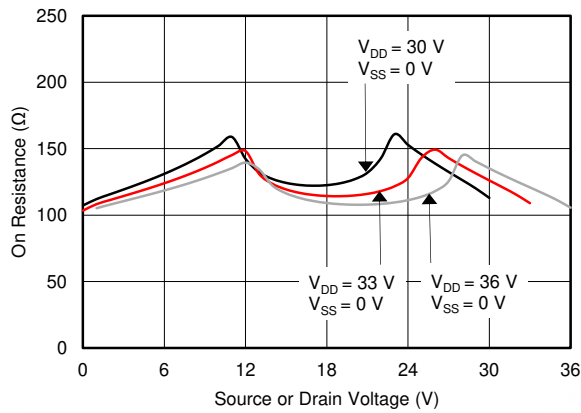


Fig 5. On-Resistance vs Source or Drain Voltage

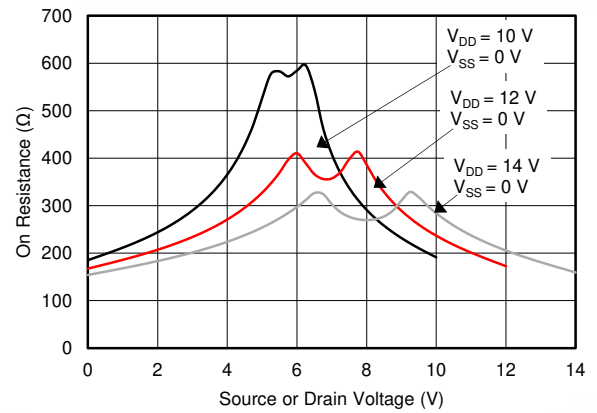
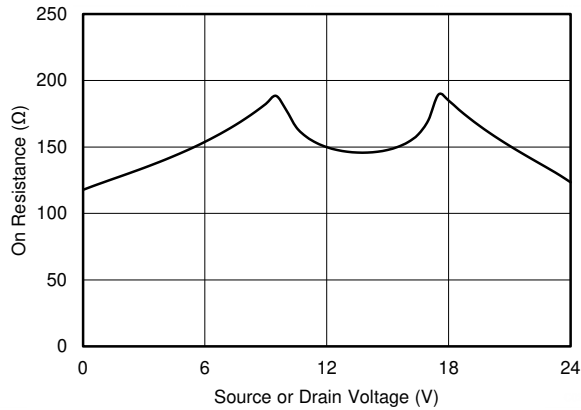


Fig 6. On-Resistance vs Source or Drain Voltage

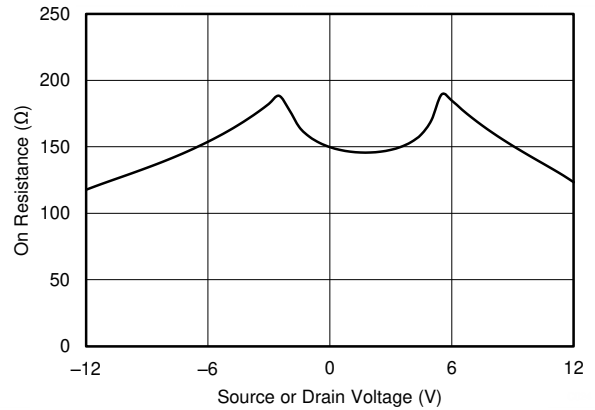
Typical Characteristics (continued)

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



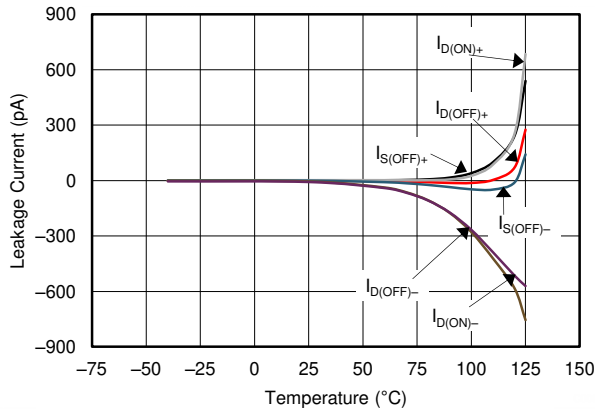
$V_{DD} = 24\text{ V}$, $V_{SS} = 0\text{ V}$

Fig. 7. On-Resistance vs Source or Drain Voltage



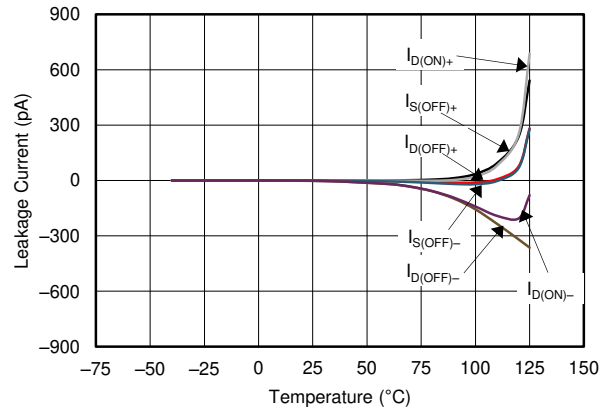
$V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$

Fig. 8. On-Resistance vs Source or Drain Voltage



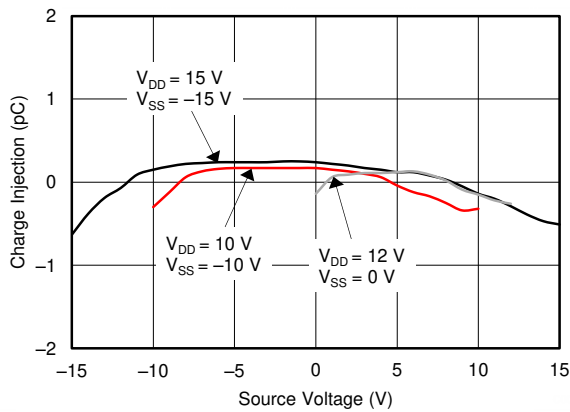
$V_{DD} = 15\text{ V}$, $V_{SS} = -15\text{ V}$

Fig. 9. Leakage Current vs Temperature



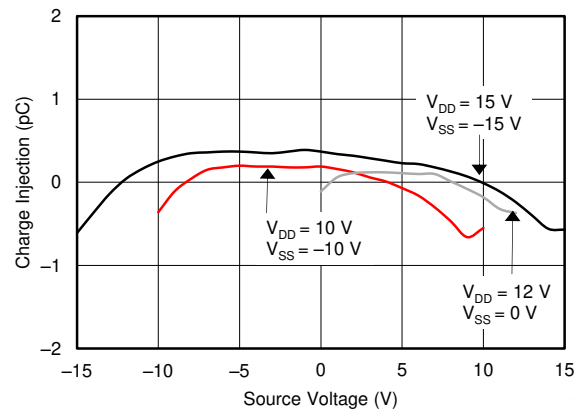
$V_{DD} = 12\text{ V}$, $V_{SS} = 0\text{ V}$

Fig. 10. Leakage Current vs Temperature



MUX36S08, source-to-drain

Fig. 11. Charge Injection vs Source Voltage

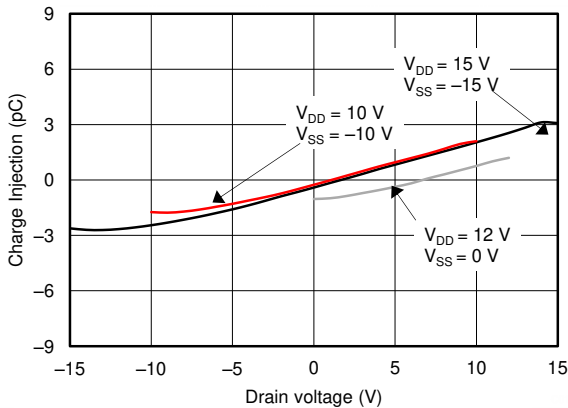


MUX36D04, source-to-drain

Fig. 12. Charge Injection vs Source Voltage

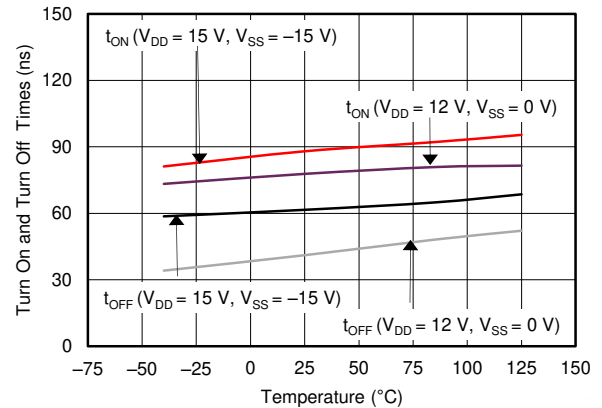
Typical Characteristics (continued)

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

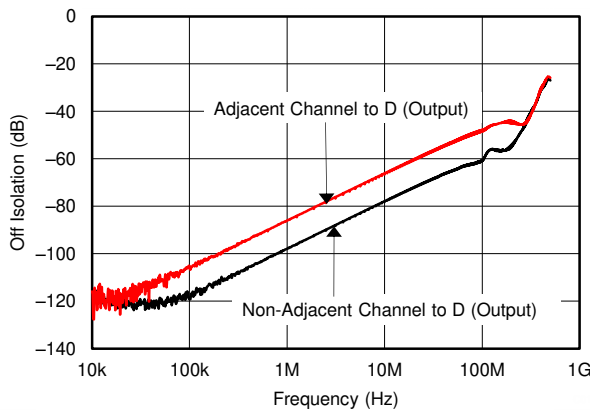


Drain-to-source

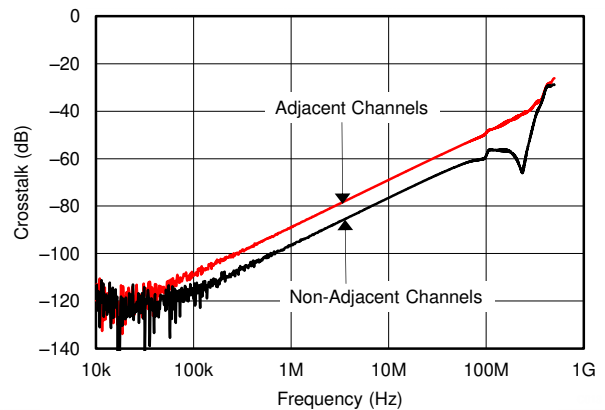
13. Charge Injection vs Source or Drain Voltage



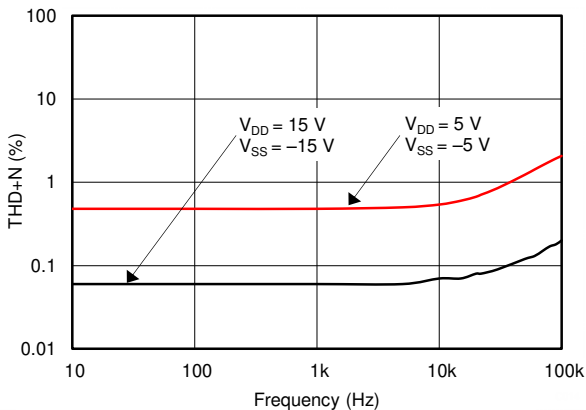
14. Turn-On and Turn-Off Times vs Temperature



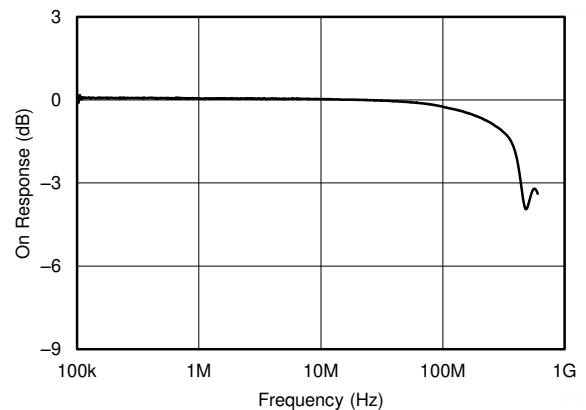
15. Off Isolation vs Frequency



16. Crosstalk vs Frequency



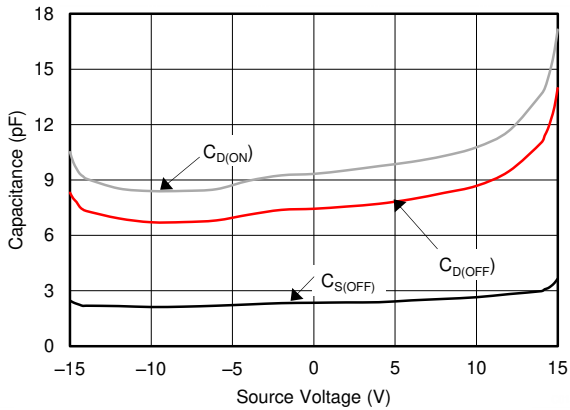
17. THD+N vs Frequency



18. On Response vs Frequency

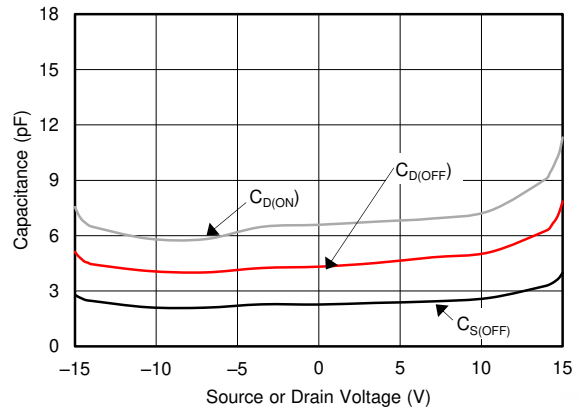
Typical Characteristics (continued)

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



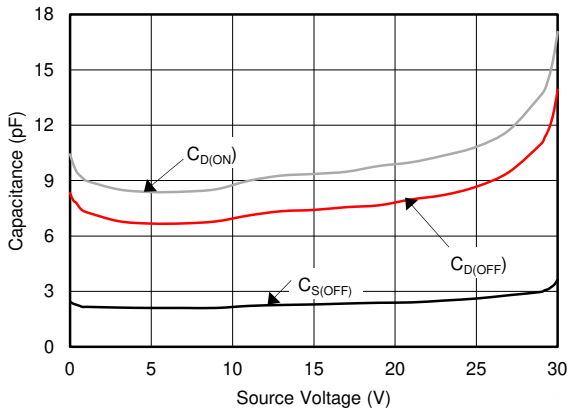
MUX36S08, $V_{DD} = 15\text{ V}$, $V_{SS} = -15\text{ V}$

19. Capacitance vs Source Voltage



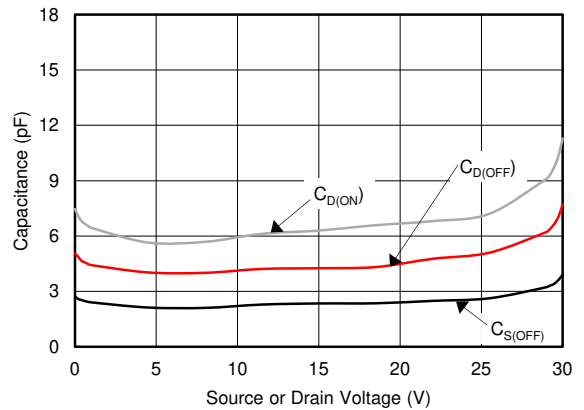
MUX36D04, $V_{DD} = 15\text{ V}$, $V_{SS} = -15\text{ V}$

20. Capacitance vs Source Voltage



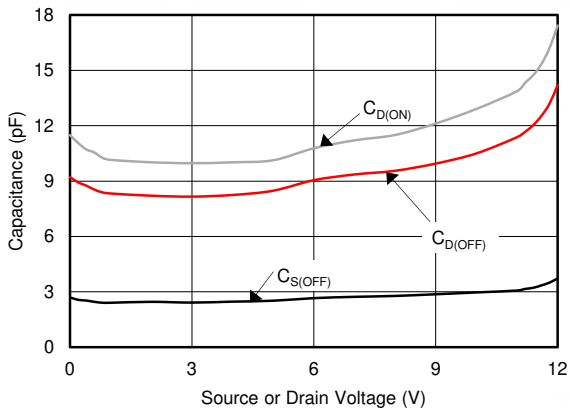
MUX36S08, $V_{DD} = 30\text{ V}$, $V_{SS} = 0\text{ V}$

21. Capacitance vs Source Voltage



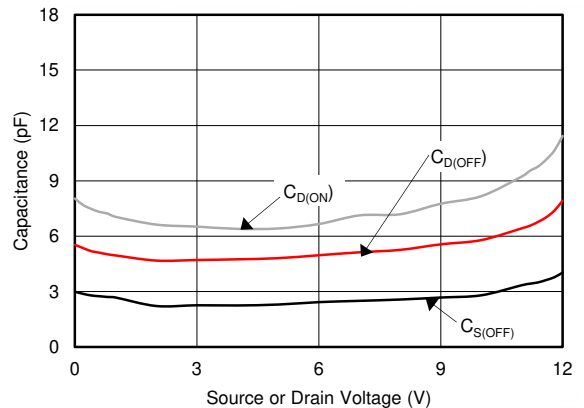
MUX36D04, $V_{DD} = 30\text{ V}$, $V_{SS} = 0\text{ V}$

22. Capacitance vs Source Voltage



MUX36S08, $V_{DD} = 12\text{ V}$, $V_{SS} = 0\text{ V}$

23. Capacitance vs Source Voltage



MUX36D04, $V_{DD} = 12\text{ V}$, $V_{SS} = 0\text{ V}$

24. Capacitance vs Source Voltage

Typical Characteristics (continued)

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

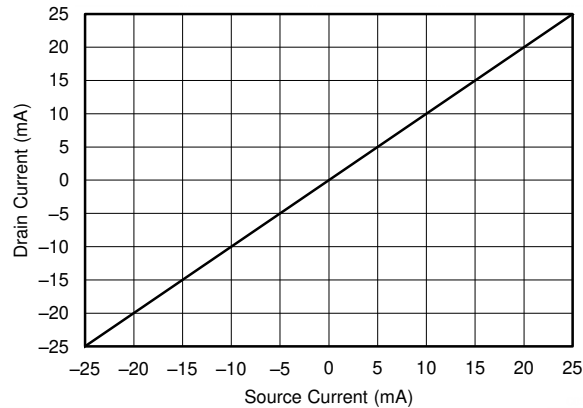


图 25. Source Current vs Drain Current

9 Parameter Measurement Information

9.1 Truth Tables

表 1 and 表 2 show the truth tables for the MUX36S08 and MUX36D04, respectively.

表 1. MUX36S08 Truth Table

| EN | A2 | A1 | A0 | STATE |
|----|------------------|------------------|------------------|----------------------|
| 0 | X ⁽¹⁾ | X ⁽¹⁾ | X ⁽¹⁾ | All channels are off |
| 1 | 0 | 0 | 0 | Channel 1 |
| 1 | 0 | 0 | 1 | Channel 2 |
| 1 | 0 | 1 | 0 | Channel 3 |
| 1 | 0 | 1 | 1 | Channel 4 |
| 1 | 1 | 0 | 0 | Channel 5 |
| 1 | 1 | 0 | 1 | Channel 6 |
| 1 | 1 | 1 | 0 | Channel 7 |
| 1 | 1 | 1 | 1 | Channel 8 |

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

表 2. MUX36D04 Truth Table

| EN | A1 | A0 | STATE |
|----|------------------|------------------|----------------------|
| 0 | X ⁽¹⁾ | X ⁽¹⁾ | All channels are off |
| 1 | 0 | 0 | Channels 1A and 1B |
| 1 | 0 | 1 | Channels 2A and 2B |
| 1 | 1 | 0 | Channels 3A and 3B |
| 1 | 1 | 1 | Channels 4A and 4B |

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

9.2 On-Resistance

The on-resistance of the MUX36xxx is the ohmic resistance across the source (Sx, SxA, or SxB) and drain (D, DA, or DB) 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 26](#). Voltage (V) and current (I_{CH}) are measured using this setup, and R_{ON} is computed as shown in [Equation 1](#):

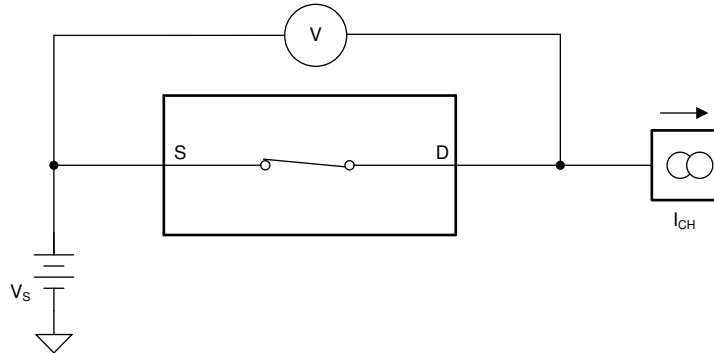


Figure 26. On-Resistance Measurement Setup

$$R_{ON} = V / I_{CH} \quad (1)$$

9.3 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 27](#)

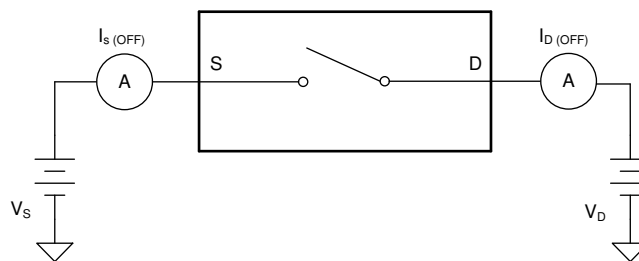
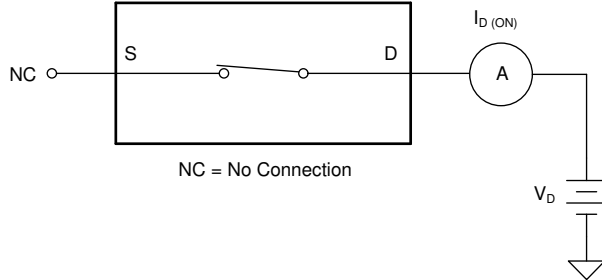
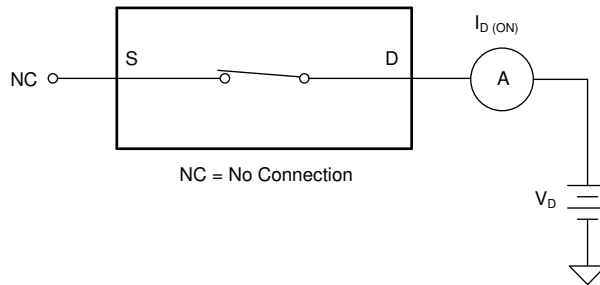


Figure 27. Off-Leakage Measurement Setup

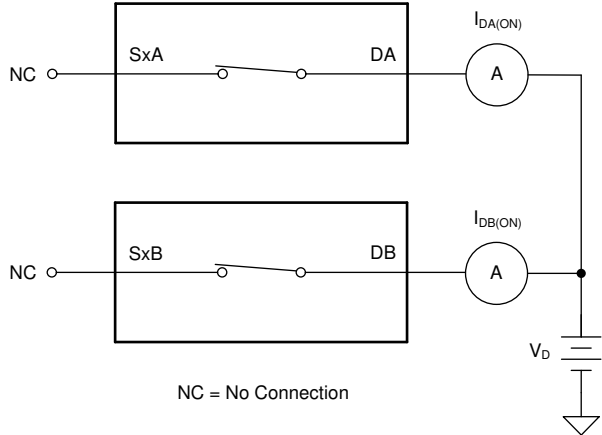
9.4 On-Leakage Current

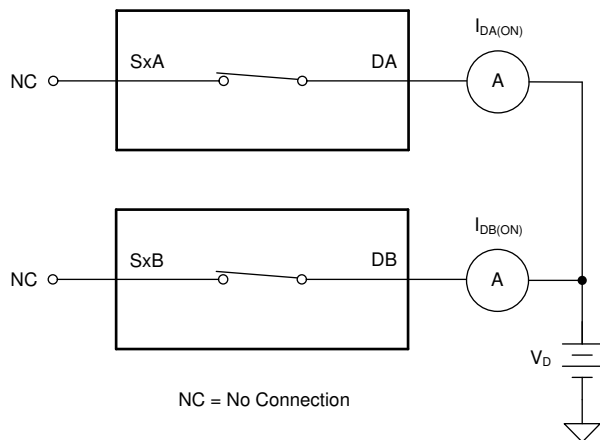
On-leakage current is defined as the leakage current that flows into or out of the drain pin when the switch is in the on state. The source pin is left floating during the measurement.  shows the circuit used for measuring the on-leakage current, denoted by $I_{D(ON)}$.



 **28. On-Leakage Measurement Setup**

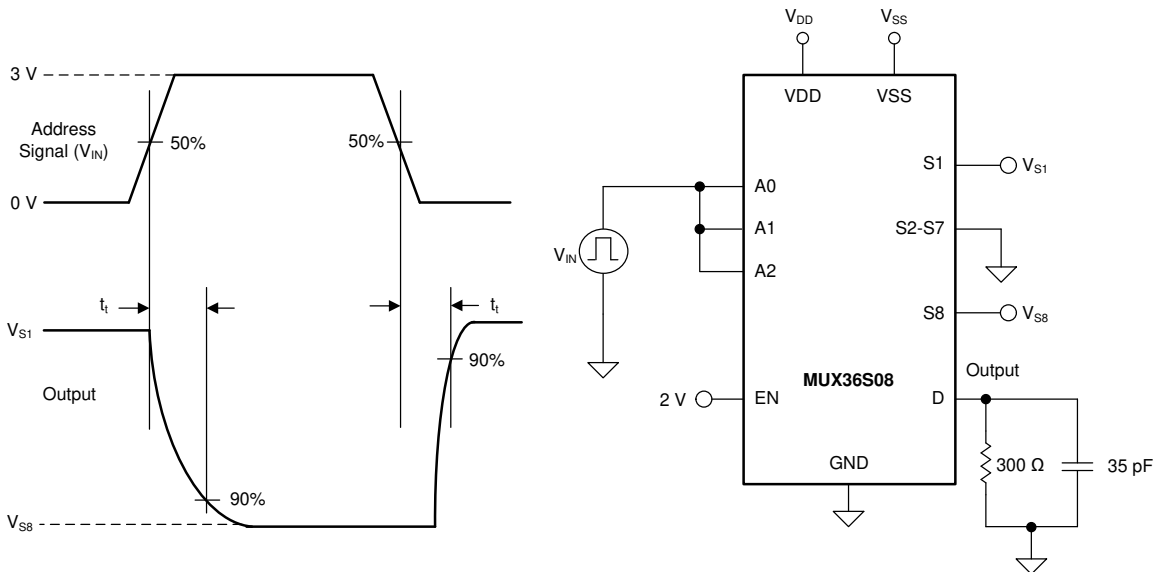
9.5 Differential On-Leakage Current

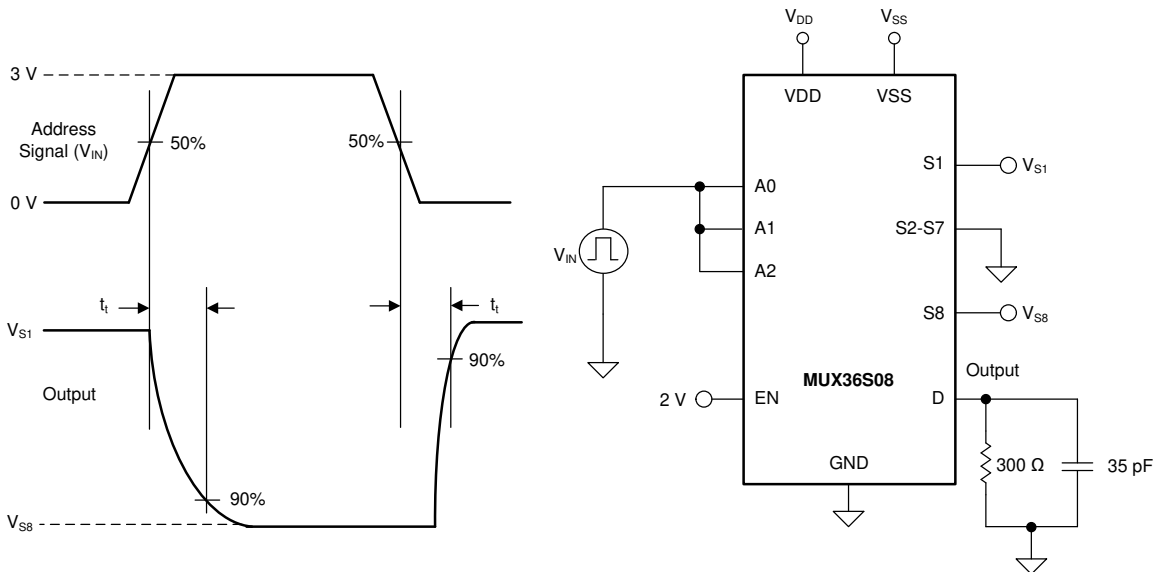
In case of a differential signal, the on-leakage current is defined as the differential leakage current that flows into or out of the drain pins when the switches is in the on state. The source pins are left floating during the measurement.  shows the circuit used for measuring the on-leakage current on each signal path, denoted by $I_{DA(ON)}$ and $I_{DB(ON)}$. The absolute difference between these two current is defined as the differential on-leakage current $I_{DL(ON)}$.



 **29. Differential On-Leakage Measurement Setup**

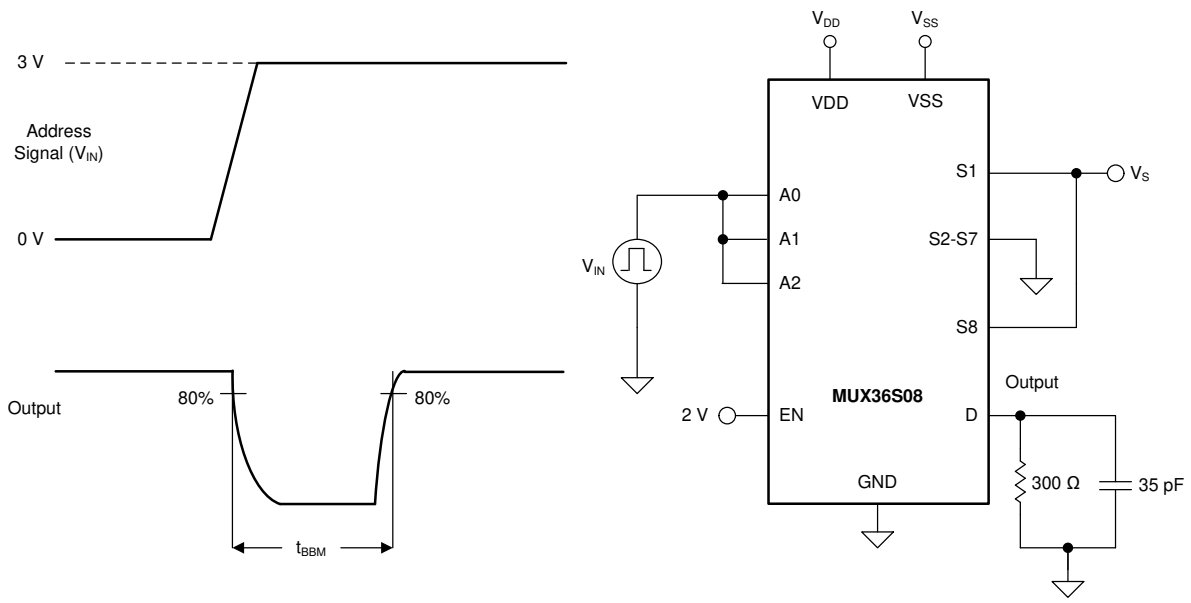
9.6 Transition Time

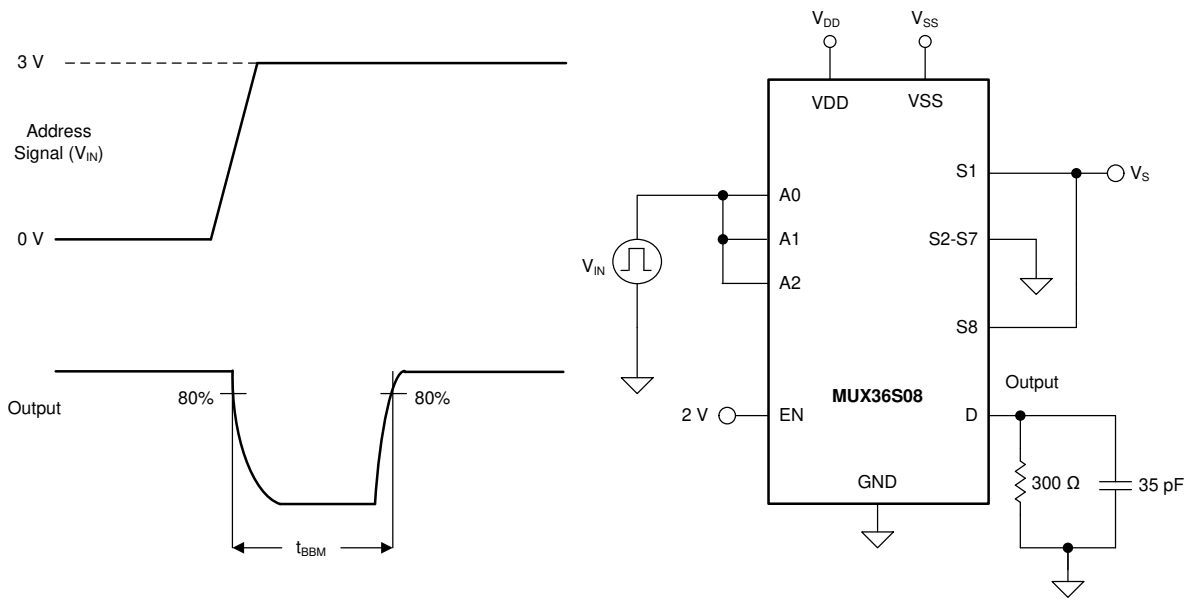
Transition time is defined as the time taken by the output of the MUX36xxx to rise or fall to 90% of the transition after the digital address signal has fallen or risen to 50% of the transition.  shows the setup used to measure transition time, denoted by the symbol t_t .



 30. Transition-Time Measurement Setup


9.7 Break-Before-Make Delay


Break-before-make delay is a safety feature that prevents two inputs from connecting when the MUX36xxx is switching. The MUX36xxx 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.  shows the setup used to measure break-before-make delay, denoted by the symbol t_{BBM} .

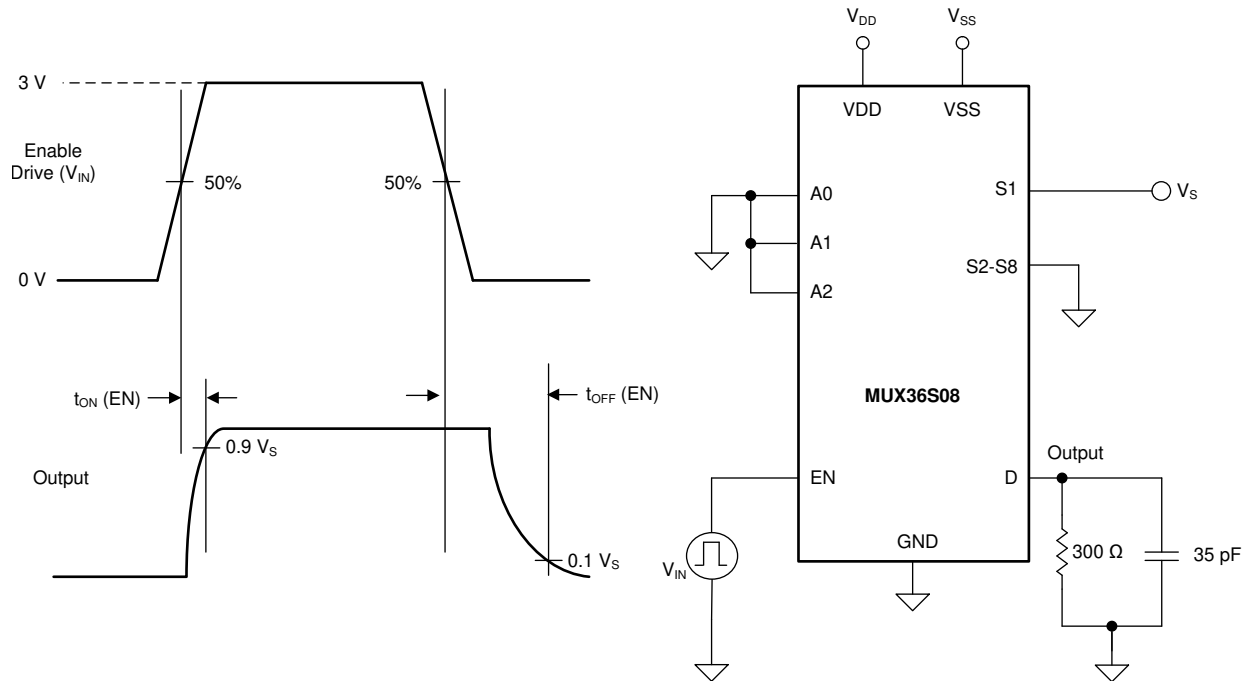


 31. Break-Before-Make Delay Measurement Setup

9.8 Turn-On and Turn-Off Time

Turn-on time is defined as the time taken by the output of the MUX36xxx to rise to a 90% final value after the enable signal has risen to a 50% final value.  32 shows the setup used to measure turn-on time. Turn-on time is denoted by the symbol t_{ON} .

Turn off time is defined as the time taken by the output of the MUX36xxx to fall to a 10% initial value after the enable signal has fallen to a 50% initial value.  32 shows the setup used to measure turn-off time. Turn-off time is denoted by the symbol t_{OFF} .



 32. Turn-On and Turn-Off Time Measurement Setup

9.9 Charge Injection

The MUX36xxx have a simple 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_{INJ} . [Figure 33](#) shows the setup used to measure charge injection.

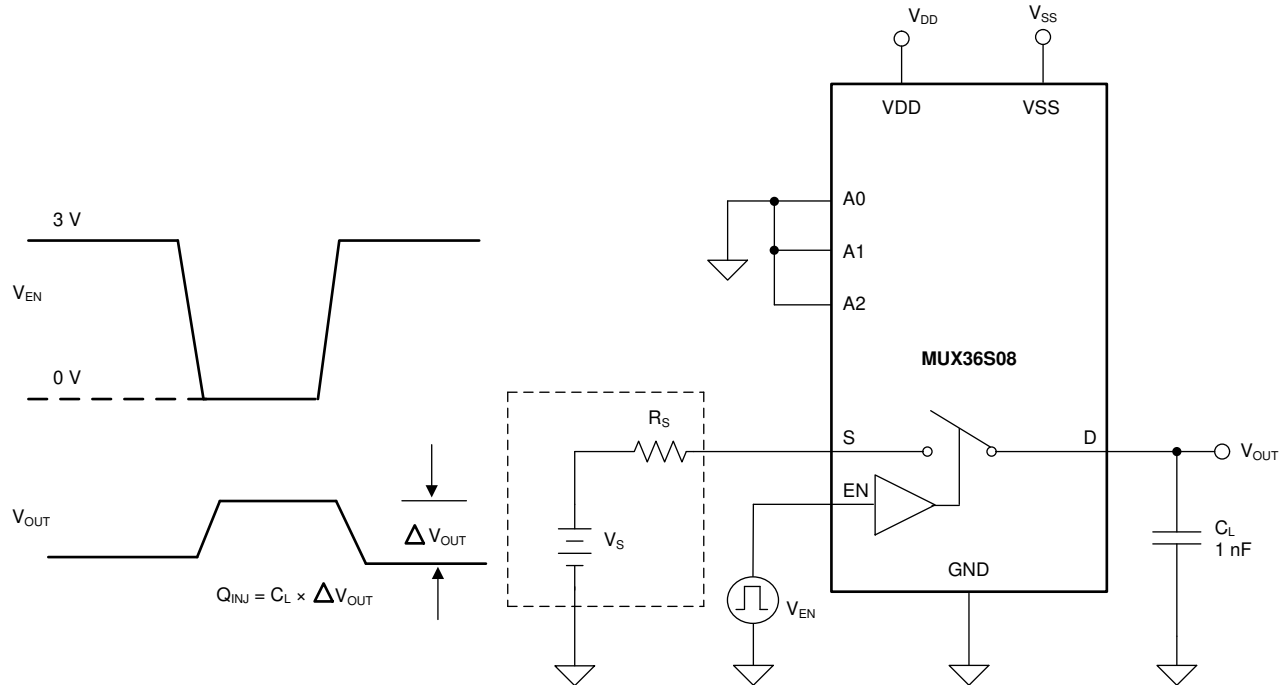
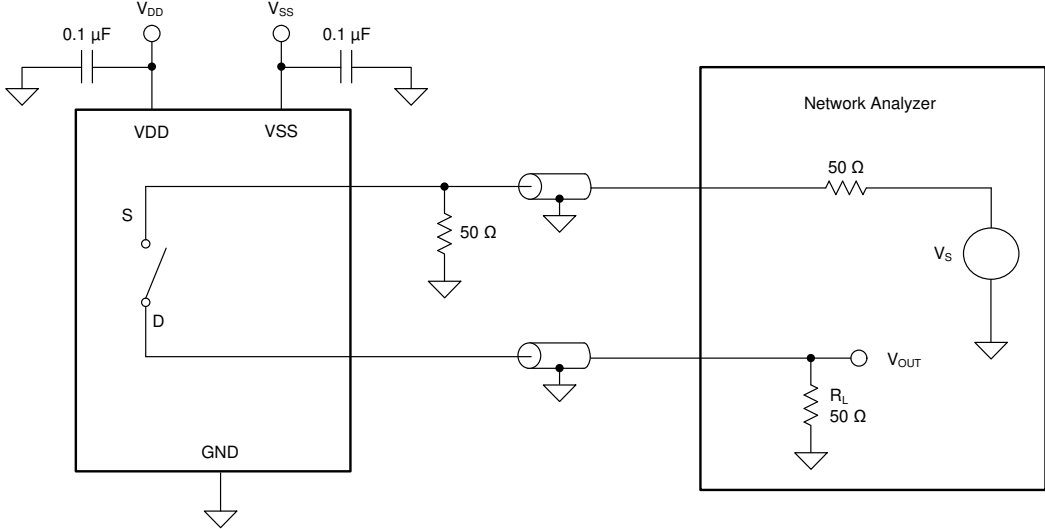
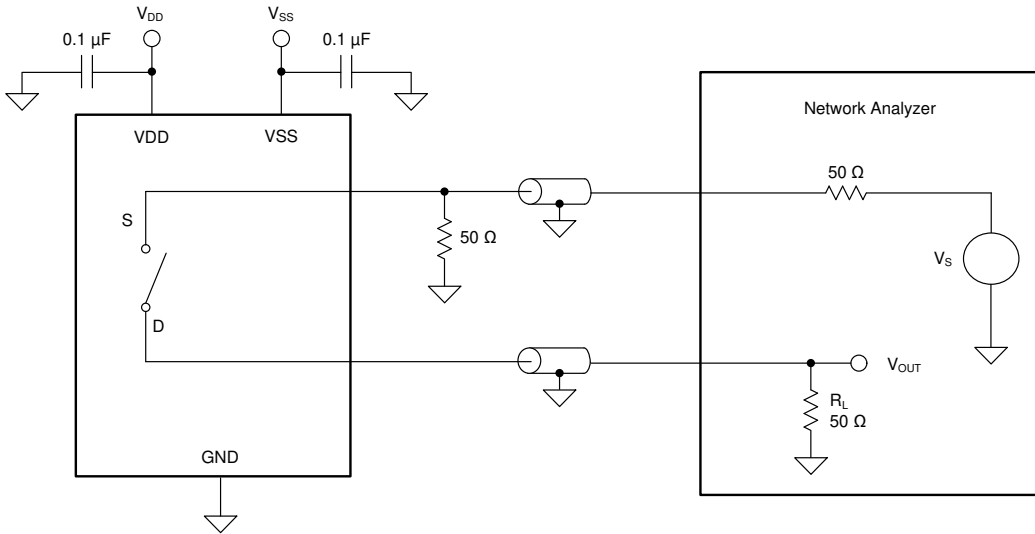


Figure 33. Charge-Injection Measurement Setup

9.10 Off Isolation

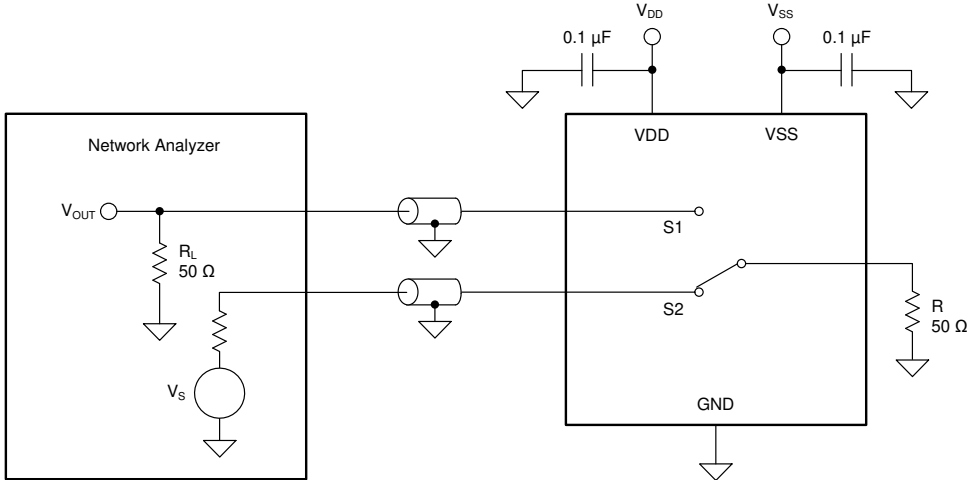
Off isolation is defined as the voltage at the drain pin (D, DA, or DB) of the MUX36xxx when a 1- V_{RMS} signal is applied to the source pin (Sx, SxA, or SxB) of an off-channel.  shows the setup used to measure off isolation. Use [Equation 2](#) to compute off isolation.

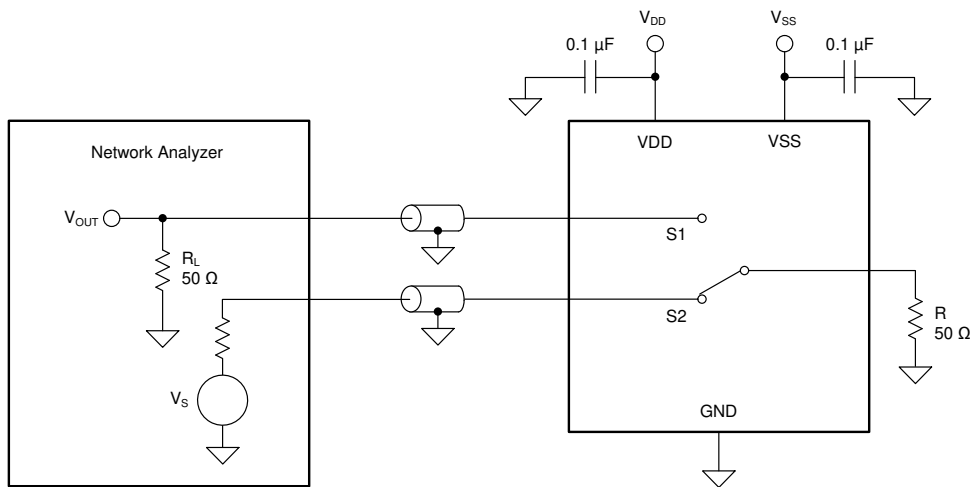


 **34. Off Isolation Measurement Setup**

$$\text{Off Isolation} = 20 \cdot \text{Log} \left(\frac{V_{\text{OUT}}}{V_{\text{S}}} \right) \tag{2}$$

9.11 Channel-to-Channel Crosstalk

Channel-to-channel crosstalk is defined as the voltage at the source pin (Sx, SxA, or SxB) of an off-channel, when a 1- V_{RMS} signal is applied at the source pin of an on-channel.  shows the setup used to measure, and [Equation 3](#) is the equation used to compute, channel-to-channel crosstalk.



 **35. Channel-to-Channel Crosstalk Measurement Setup**

$$\text{Channel-to-Channel Crosstalk} = 20 \cdot \text{Log} \left(\frac{V_{\text{OUT}}}{V_{\text{S}}} \right) \tag{3}$$

9.12 Bandwidth

Bandwidth is defined as the range of frequencies that are attenuated by < 3 dB when the input is applied to the source pin of an on-channel, and the output is measured at the drain pin of the MUX36xxx. [Figure 36](#) shows the setup used to measure bandwidth of the mux. Use [Equation 4](#) to compute the attenuation.

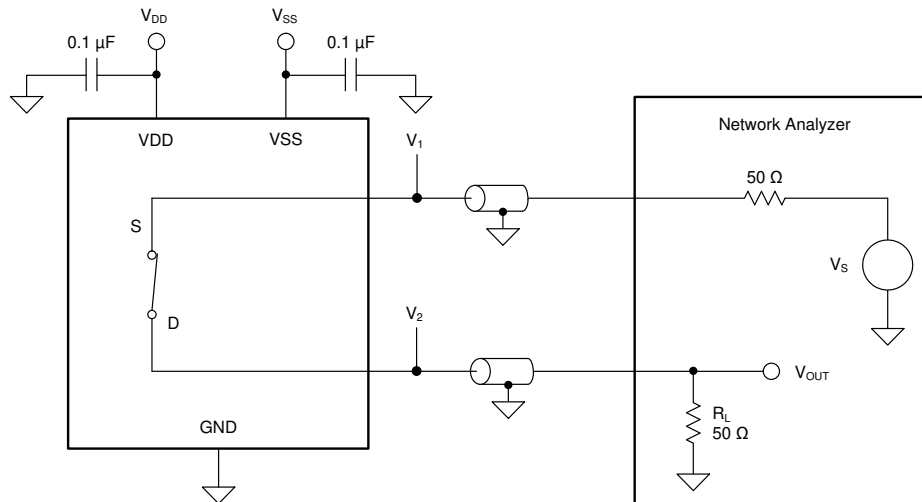


Figure 36. Bandwidth Measurement Setup

$$\text{Attenuation} = 20 \cdot \text{Log} \left(\frac{V_2}{V_1} \right) \tag{4}$$

9.13 THD + Noise

The total harmonic distortion (THD) of a signal is a measurement of the harmonic distortion, and is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency at the mux output. The on-resistance of the MUX36xxx varies with the amplitude of the input signal and results in distortion when the drain pin is connected to a low-impedance load. Total harmonic distortion plus noise is denoted as THD+N. [Figure 37](#) shows the setup used to measure THD+N of the MUX36xxx.

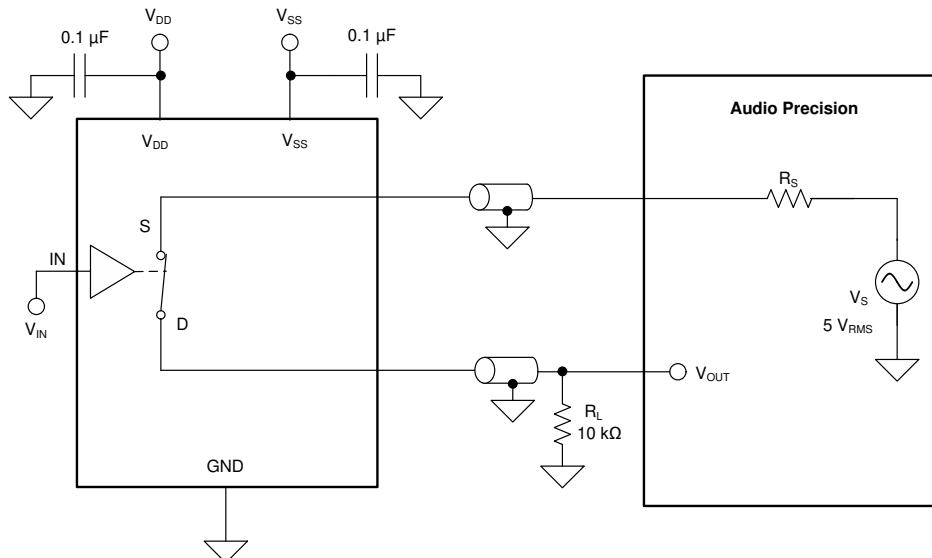


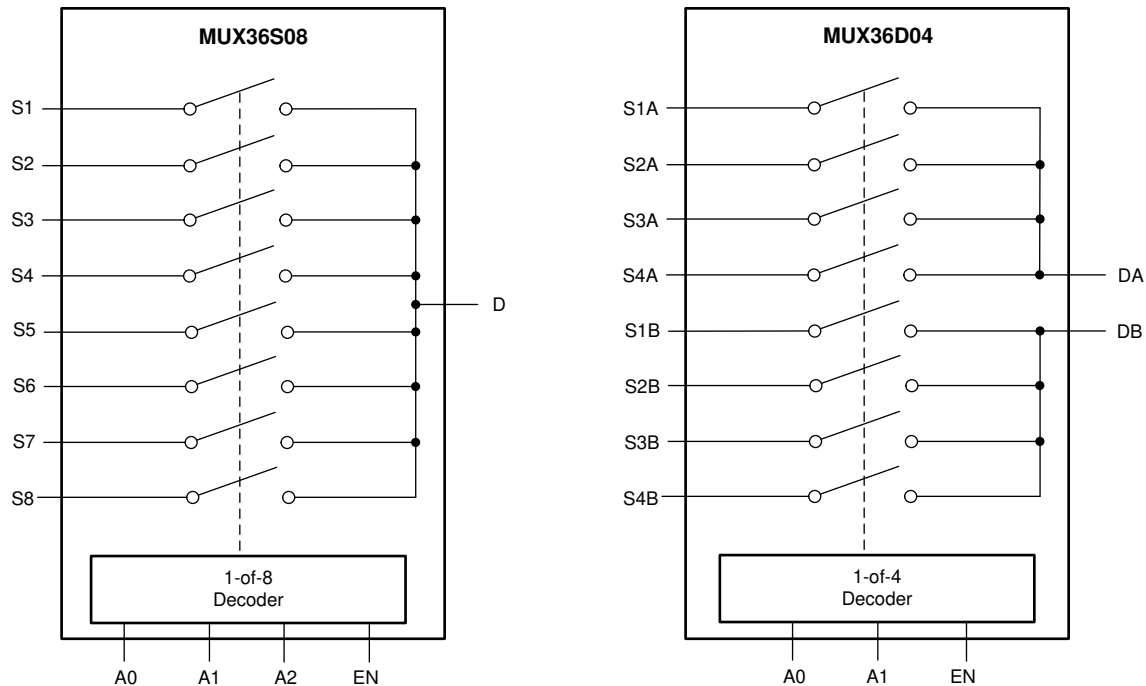
Figure 37. THD+N Measurement Setup

10 Detailed Description

10.1 Overview

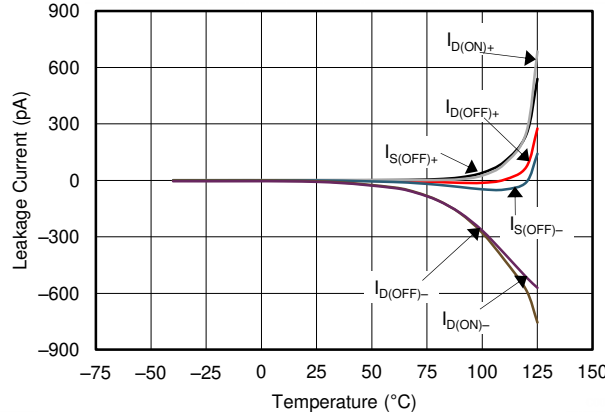
The MUX36xxx are a family of analog multiplexers. The *Functional Block Diagram* section provides a top-level block diagram of both the MUX36S08 and MUX36D04. The MUX36S08 is an 8-channel, single-ended, analog mux. The MUX36D04 is a 4-channel, differential or dual 4:1, single-ended, analog mux. Each channel is turned on or turned off based on the state of the address lines and enable pin.

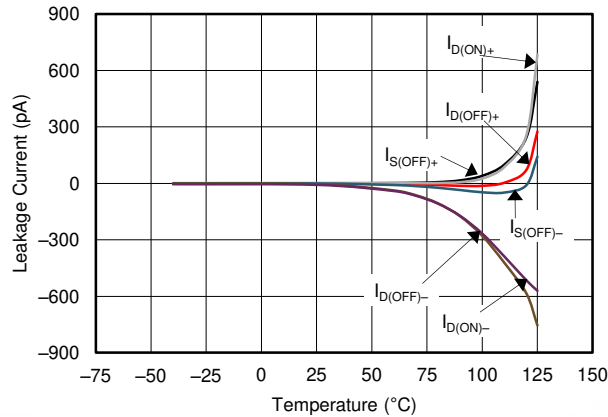
10.2 Functional Block Diagram



10.3 Feature Description

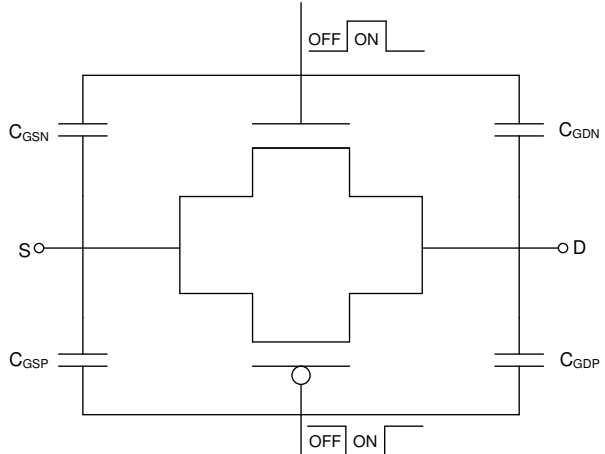
10.3.1 Ultralow Leakage Current

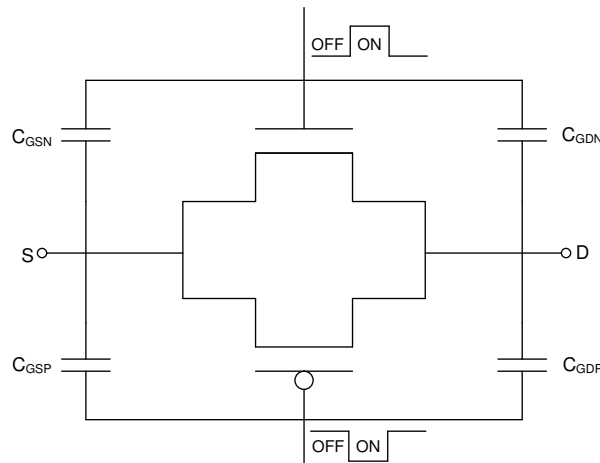
The MUX36xxx provide extremely low on- and off-leakage currents. The MUX36xxx are capable of switching signals from high source-impedance inputs into a high input-impedance op amp with minimal offset error because of the ultralow leakage currents.  38 shows typical leakage currents of the MUX36xxx versus temperature.



 38. Leakage Current vs Temperature

10.3.2 Ultralow Charge Injection

The MUX36xxx have a simple transmission gate topology, as shown in  39. Any mismatch in the stray capacitance associated with the NMOS and PMOS causes an output level change whenever the switch is opened or closed.



 39. Transmission Gate Topology

Feature Description (continued)

The MUX36xxx have special charge-injection cancellation circuitry that reduces the source-to-drain charge injection to as low as 0.3 pC at $V_S = 0$ V, and ± 0.6 pC in the full signal range, as shown in [Figure 40](#).

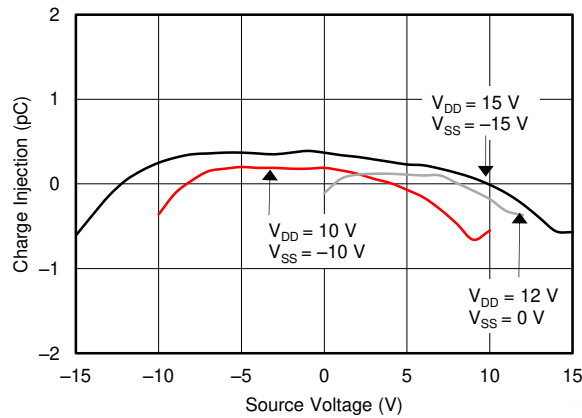


Figure 40. Source-to-Drain Charge Injection vs Source or Drain Voltage

The drain-to-source charge injection becomes important when the device is used as a demultiplexer (demux), where D becomes the input and Sx becomes the output. [Figure 41](#) shows the drain-to-source charge injection across the full signal range.

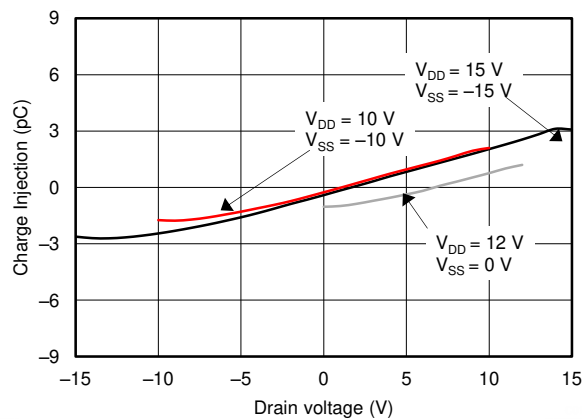


Figure 41. Drain-to-Source Charge Injection vs Source or Drain Voltage

10.3.3 Bidirectional Operation

The MUX36xxx are operable as both a mux and demux. The source (Sx, SxA, SxB) and drain (D, DA, DB) pins of the MUX36xxx are used either as input or output. Each MUX36xxx channel has very similar characteristics in both directions.

Feature Description (continued)

10.3.4 Rail-to-Rail Operation

The valid analog signal for the MUX36xxx ranges from V_{SS} to V_{DD} . The input signal to the MUX36xxx swings from V_{SS} to V_{DD} without any significant degradation in performance. The on-resistance of the MUX36xxx varies with input signal, as shown in [Figure 42](#)

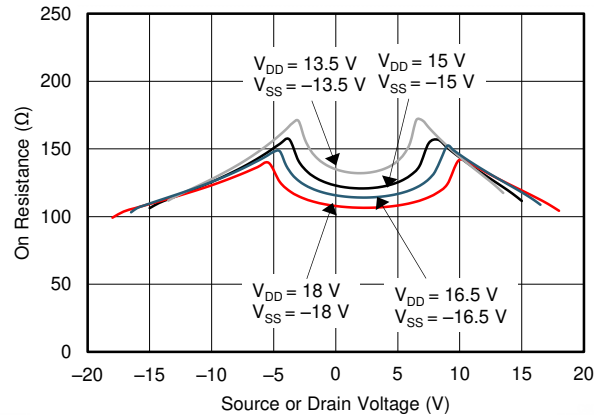


Figure 42. On-Resistance vs Source or Drain Voltage

10.4 Device Functional Modes

When the EN pin of the MUX36xxx 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 irrespective of the state of the address lines. The EN pin can be connected to V_{DD} (as high as 36 V).

11 Application and Implementation

注

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

11.1 Application Information

The MUX36xxx family offers outstanding input/output leakage currents and ultralow charge injection. These devices operate up to 36 V, and offer true rail-to-rail input and output. The on-capacitance of the MUX36xxx is very low. These features makes the MUX36xxx a family of precision, robust, high-performance analog multiplexer for high-voltage, industrial applications.

11.2 Typical Application

Figure 43 shows a 16-bit, differential, 4-channel, multiplexed, data-acquisition system. This example is typical in industrial applications that require low distortion and a high-voltage differential input. The circuit uses the ADS8864, a 16-bit, 400-kSPS successive-approximation-resistor (SAR) analog-to-digital converter (ADC), along with a precision, high-voltage, signal-conditioning front end, and a 4-channel differential mux. This TI Precision Design details the process for optimizing the precision, high-voltage, front-end drive circuit using the MUX36D04, OPA192 and OPA140 to achieve excellent dynamic performance and linearity with the ADS8864.

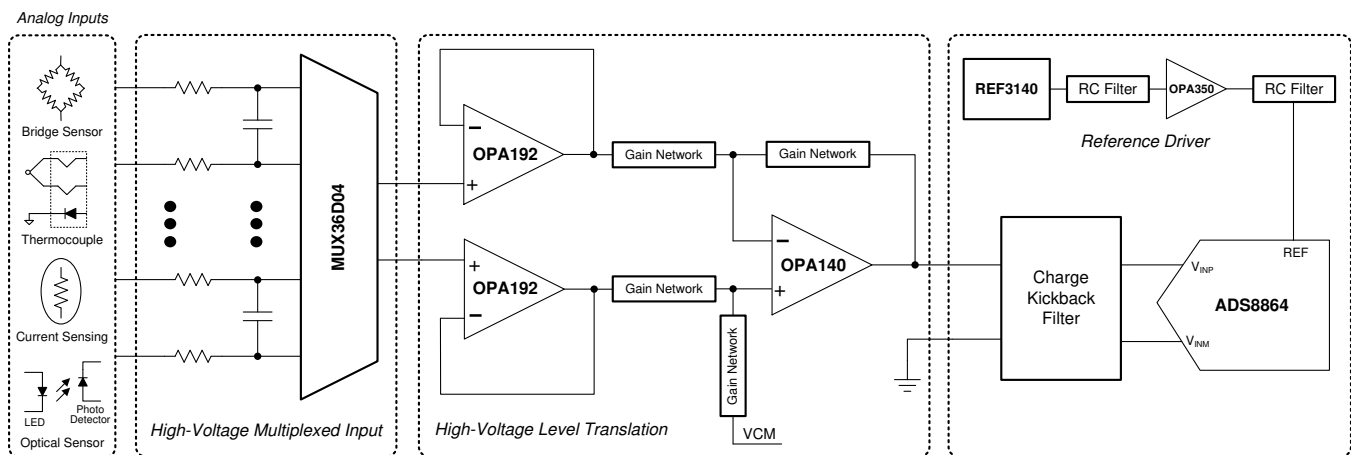


Figure 43. 16-Bit Precision Multiplexed Data-Acquisition System for High-Voltage Inputs With Lowest Distortion

Typical Application (continued)

11.2.1 Design Requirements

The primary objective is to design a ± 20 V, differential, 4-channel, multiplexed, data-acquisition system with lowest distortion using the 16-bit ADS8864 at a throughput of 400 kSPS for a 10-kHz, full-scale, pure, sine-wave input. The design requirements for this block design are:

- System supply voltage: ± 15 V
- ADC supply voltage: 3.3 V
- ADC sampling rate: 400 kSPS
- ADC reference voltage (REFP): 4.096 V
- System input signal: A high-voltage differential input signal with a peak amplitude of 20 V and frequency (f_{IN}) of 10 kHz are applied to each differential input of the mux.

11.2.2 Detailed Design Procedure

The purpose of this precision design is to design an optimal, high-voltage, multiplexed, data-acquisition system for highest system linearity and fast settling. The overall system block diagram is illustrated in [Figure 43](#). The circuit is a multichannel, data-acquisition signal chain consisting of an input low-pass filter, mux, mux output buffer, attenuating SAR ADC driver, and the reference driver. The architecture allows fast sampling of multiple channels using a single ADC, providing a low-cost solution. This design systematically approaches each analog circuit block to achieve a 16-bit settling for a full-scale input stage voltage and linearity for a 10-kHz sinusoidal input signal at each input channel.



For step-by-step design procedure, circuit schematics, bill of materials, PCB files, simulation results, and test results, refer to [TI Precision Design TIPD151, 16-Bit, 400-kSPS, 4-Channel Multiplexed Data-Acquisition System for High-Voltage Inputs with Lowest Distortion](#).

11.2.3 Application Curve

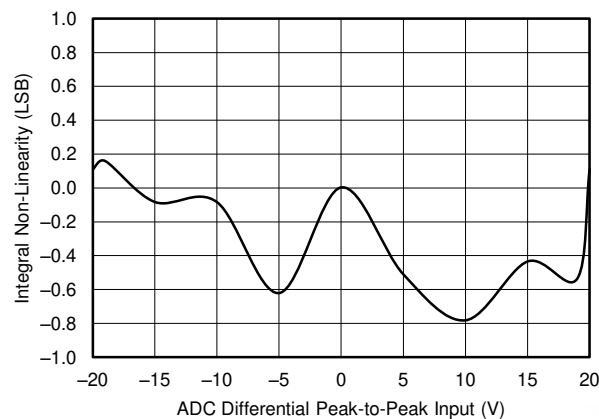


Figure 44. ADC 16-Bit Linearity Error for the Multiplexed Data-Acquisition Block

12 Power Supply Recommendations

The MUX36xxx operates across a wide supply range of ± 5 V to ± 18 V (10 V to 36 V in single-supply mode). They also perform well with unsymmetric supplies such as $V_{DD} = 12$ V and $V_{SS} = -5$ V. For reliable operation, use a supply decoupling capacitor ranging between 0.1 μ F to 10 μ F at both the VDD and VSS pins to ground.

The on-resistance of the MUX36xxx varies with supply voltage, as illustrated in [Figure 45](#)

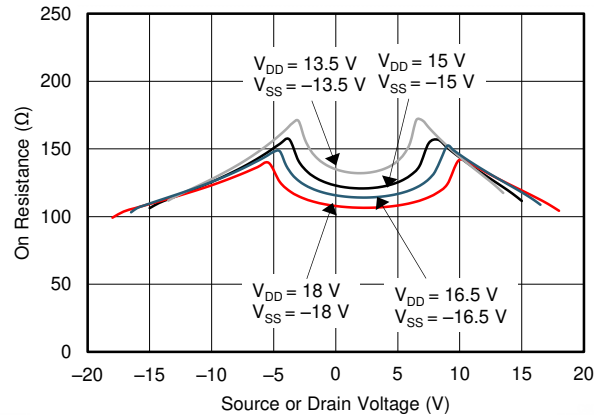


Figure 45. On-Resistance Variation With Supply and Input Voltage

13 Layout

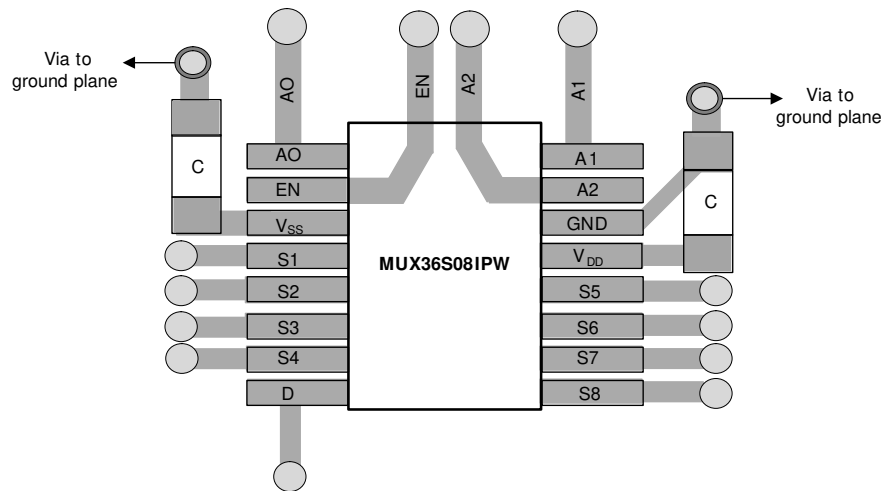
13.1 Layout Guidelines

☒ 46 illustrates an example of a PCB layout with the MUX36S08IPW, and ☒ 47 illustrates an example of a PCB layout with MUX36D04IPW.

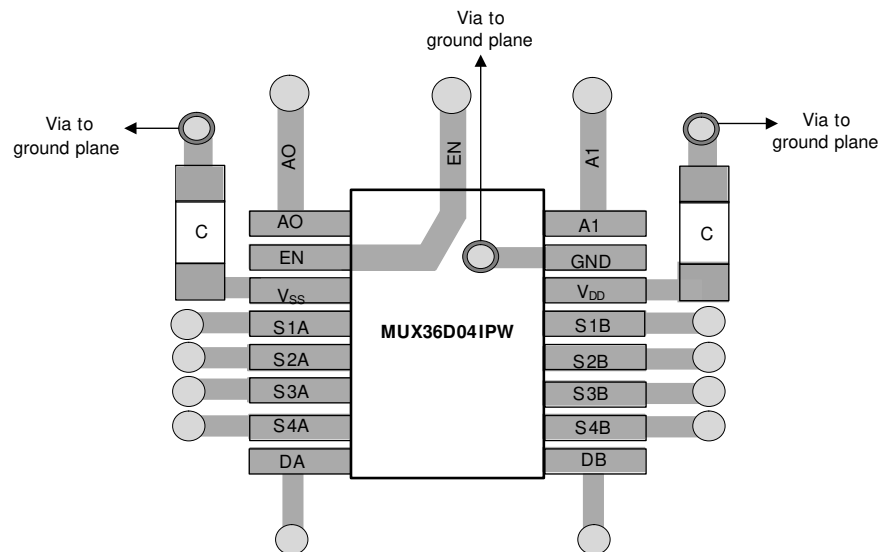
Some key considerations are:

1. Decouple the VDD and VSS pins with a 0.1- μ F capacitor, placed as close to the pin as possible. Make sure that the capacitor voltage rating is sufficient for the V_{DD} and V_{SS} supplies.
2. Keep the input lines as short as possible. In case of the differential signal, make sure the A inputs and B inputs are as symmetric as possible.
3. Use a solid ground plane to help distribute heat and reduce electromagnetic interference (EMI) noise pickup.
4. 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.

13.2 Layout Example



☒ 46. MUX36S08IPW Layout Example



☒ 47. MUX36D04IPW Layout Example

14 デバイスおよびドキュメントのサポート

14.1 ドキュメントのサポート

14.1.1 関連資料

- 『ADS8664 12ビット、500kSPS、4および8チャンネル、シングル電源、バイポーラ入力範囲のSAR ADC』(SBAS492)
- 『OPA140 高精度、低ノイズ、レール・ツー・レール出力、11MHz JFETオペアンプ』(SBOS498)
- 『OPA192 36V、高精度、レール・ツー・レール入力/出力、低オフセット電圧、低入力バイアス電流、e-trim™搭載のオペアンプ』(SBOS620)

14.2 関連リンク

表 3 に、クイック・アクセス・リンクの一覧を示します。カテゴリには、技術資料、サポートおよびコミュニティ・リソース、ツールとソフトウェア、およびサンプル注文またはご購入へのクイック・アクセスが含まれます。

表 3. 関連リンク

| 製品 | プロダクト・フォルダ | ご注文はこちら | 技術資料 | ツールとソフトウェア | サポートとコミュニティ |
|----------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| MUX36S08 | ここをクリック | ここをクリック | ここをクリック | ここをクリック | ここをクリック |
| MUX36D04 | ここをクリック | ここをクリック | ここをクリック | ここをクリック | ここをクリック |

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14.4 コミュニティ・リソース

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Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

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静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

14.7 Glossary

SLYZ022 — TI Glossary.

This glossary lists and explains terms, acronyms, and definitions.

15 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。これらの情報は、指定のデバイスに対して提供されている最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| MUX36D04IPW | ACTIVE | TSSOP | PW | 16 | 90 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | MUXD04C | Samples |
| MUX36D04IPWR | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | MUXD04C | Samples |
| MUX36D04IRRJR | ACTIVE | WQFN | RRJ | 16 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | MUX 36D04 | Samples |
| MUX36D04IRUMR | ACTIVE | WQFN | RUM | 16 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | MUX 36D04 | Samples |
| MUX36S08IPW | ACTIVE | TSSOP | PW | 16 | 90 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | MUXS08B | Samples |
| MUX36S08IPWR | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | MUXS08B | Samples |
| MUX36S08IRRJR | ACTIVE | WQFN | RRJ | 16 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | MUX 36S08 | Samples |
| MUX36S08IRUMR | ACTIVE | WQFN | RUM | 16 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | MUX 36S08 | 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.

OBSOLETE: TI has discontinued the production of the device.

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

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

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

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

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

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

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

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MUX36D04IPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| MUX36D04IPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| MUX36D04IRRJR | WQFN | RRJ | 16 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| MUX36D04IRUMR | WQFN | RUM | 16 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| MUX36S08IPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| MUX36S08IRRJR | WQFN | RRJ | 16 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| MUX36S08IRUMR | WQFN | RUM | 16 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| MUX36D04IPWR | TSSOP | PW | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| MUX36D04IPWR | TSSOP | PW | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| MUX36D04IRRJR | WQFN | RRJ | 16 | 3000 | 367.0 | 367.0 | 35.0 |
| MUX36D04IRUMR | WQFN | RUM | 16 | 3000 | 367.0 | 367.0 | 35.0 |
| MUX36S08IPWR | TSSOP | PW | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| MUX36S08IRRJR | WQFN | RRJ | 16 | 3000 | 367.0 | 367.0 | 35.0 |
| MUX36S08IRUMR | WQFN | RUM | 16 | 3000 | 367.0 | 367.0 | 35.0 |

TUBE


*All dimensions are nominal

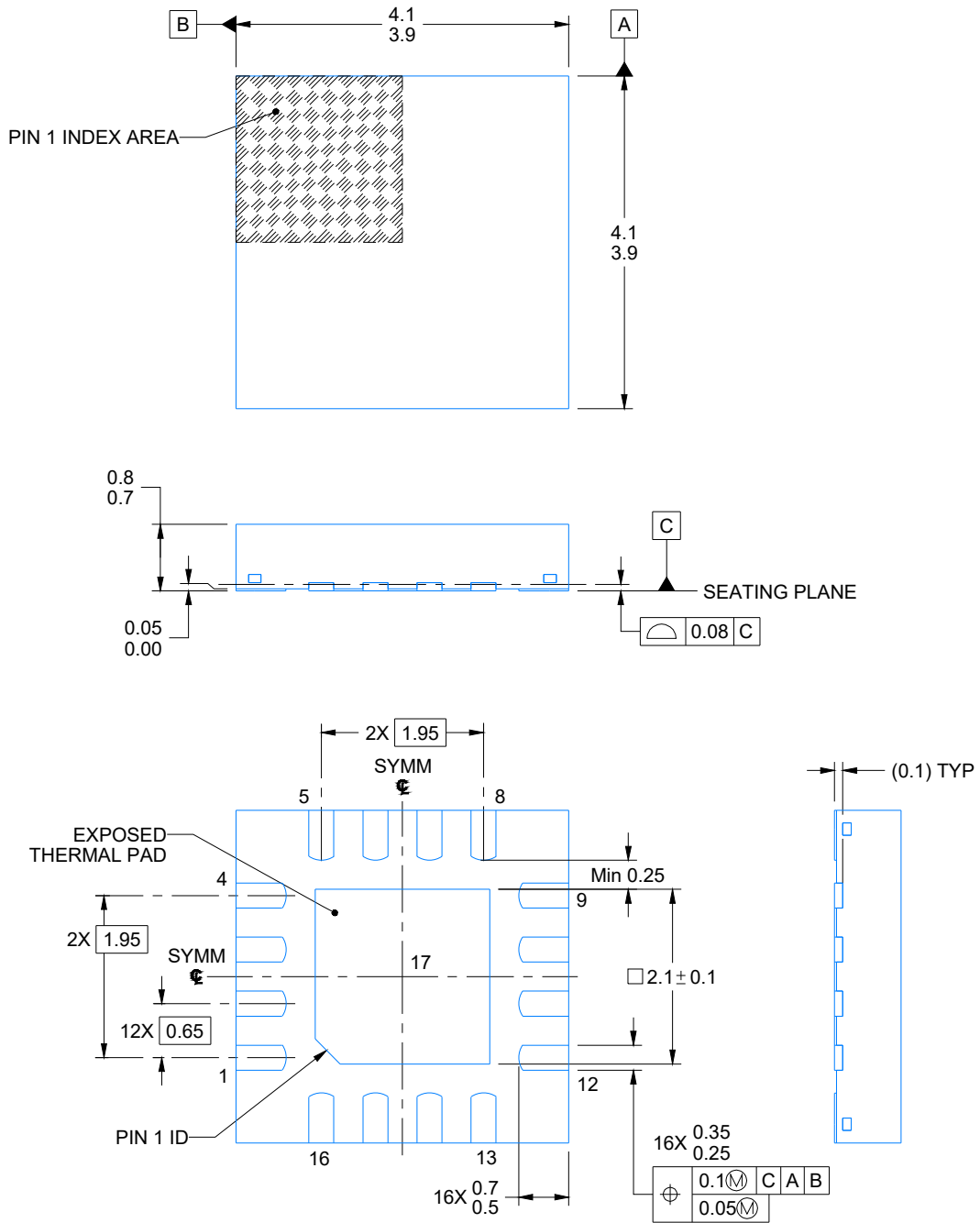
| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| MUX36D04IPW | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |
| MUX36S08IPW | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |

PACKAGE OUTLINE

RRJ0016A

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4224485/A 08/2018

NOTES:

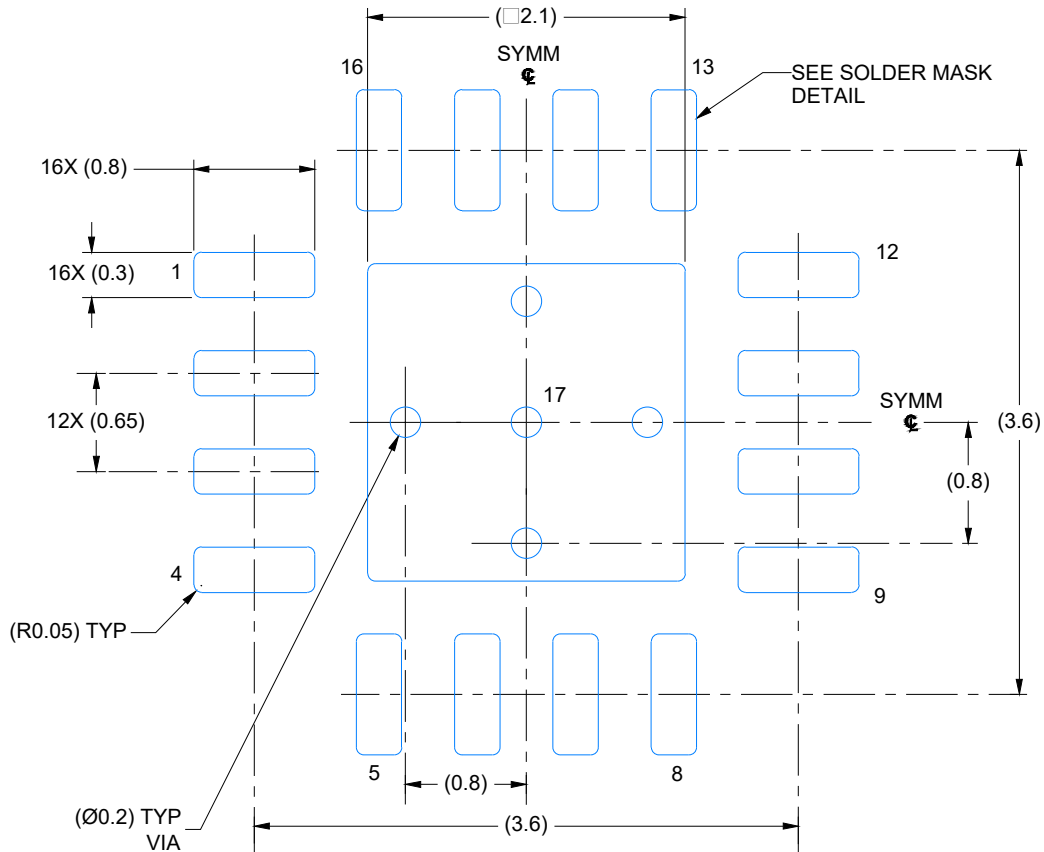
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

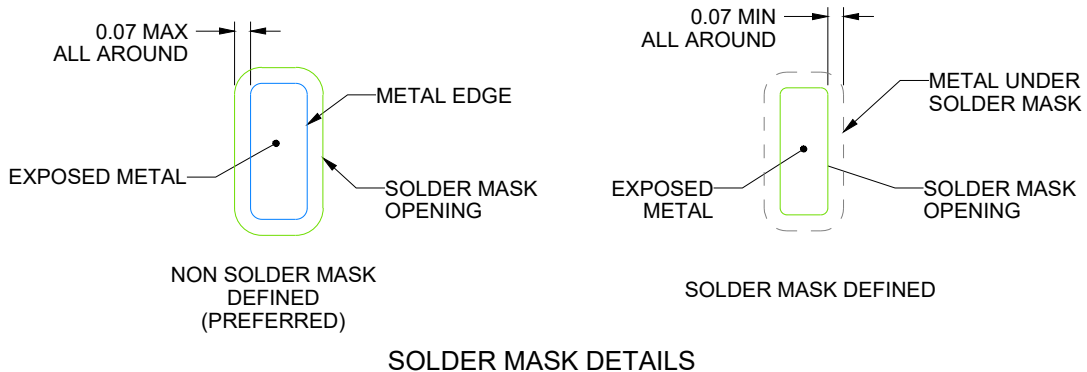
RRJ0016A

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



4224485/A 08/2018

NOTES: (continued)

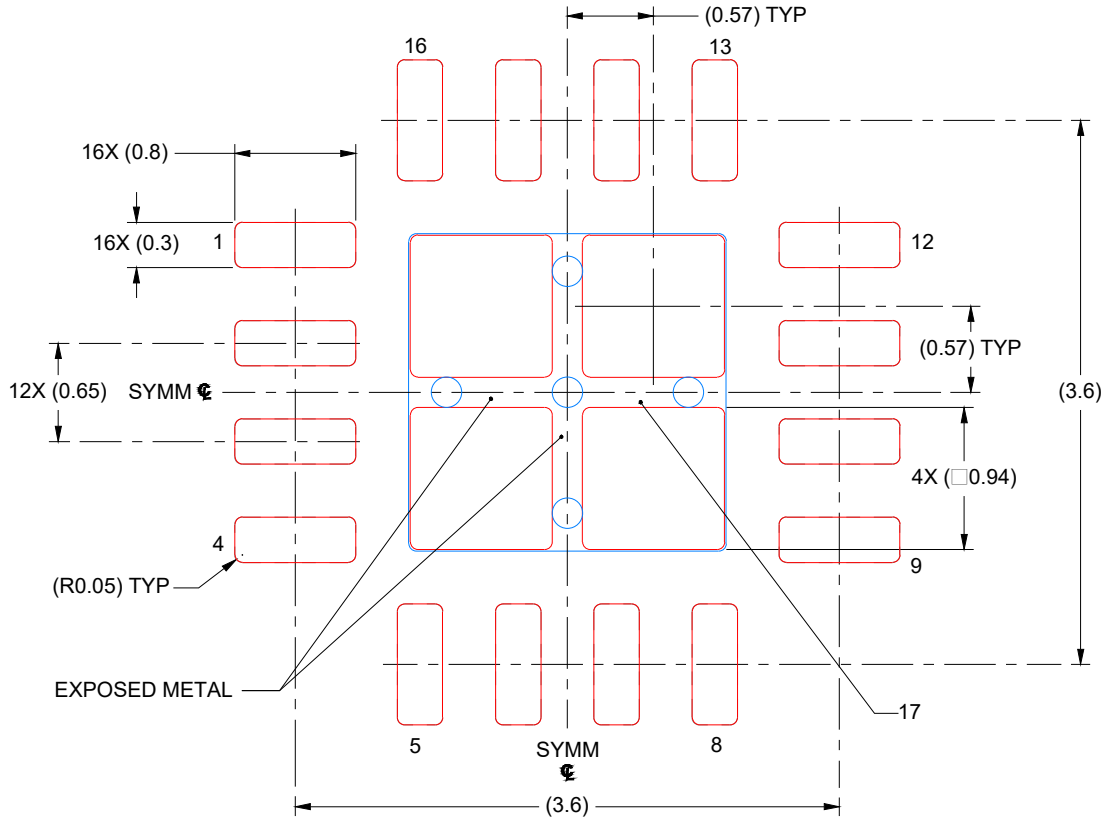
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown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

EXAMPLE STENCIL DESIGN

RRJ0016A

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



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

EXPOSED PAD 17
80% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4224485/A 08/2018

NOTES: (continued)

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

PW0016A



PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220204/A 02/2017

NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- 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.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220204/A 02/2017

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

GENERIC PACKAGE VIEW

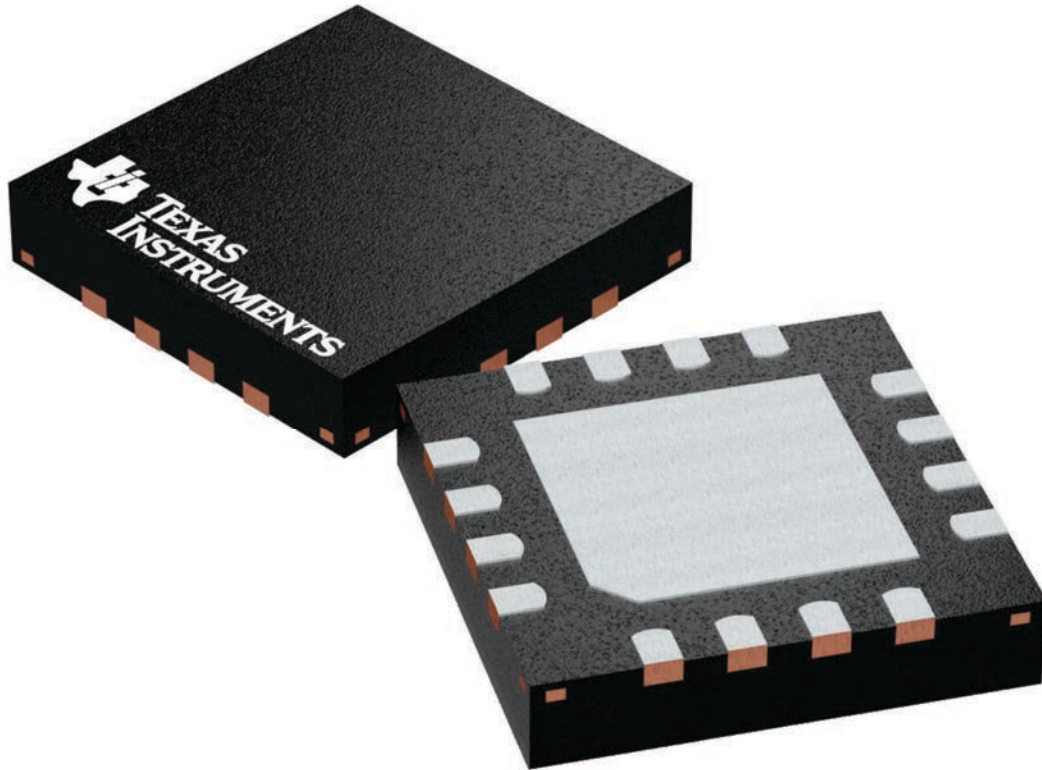
RUM 16

WQFN - 0.8 mm max height

4 x 4, 0.65 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

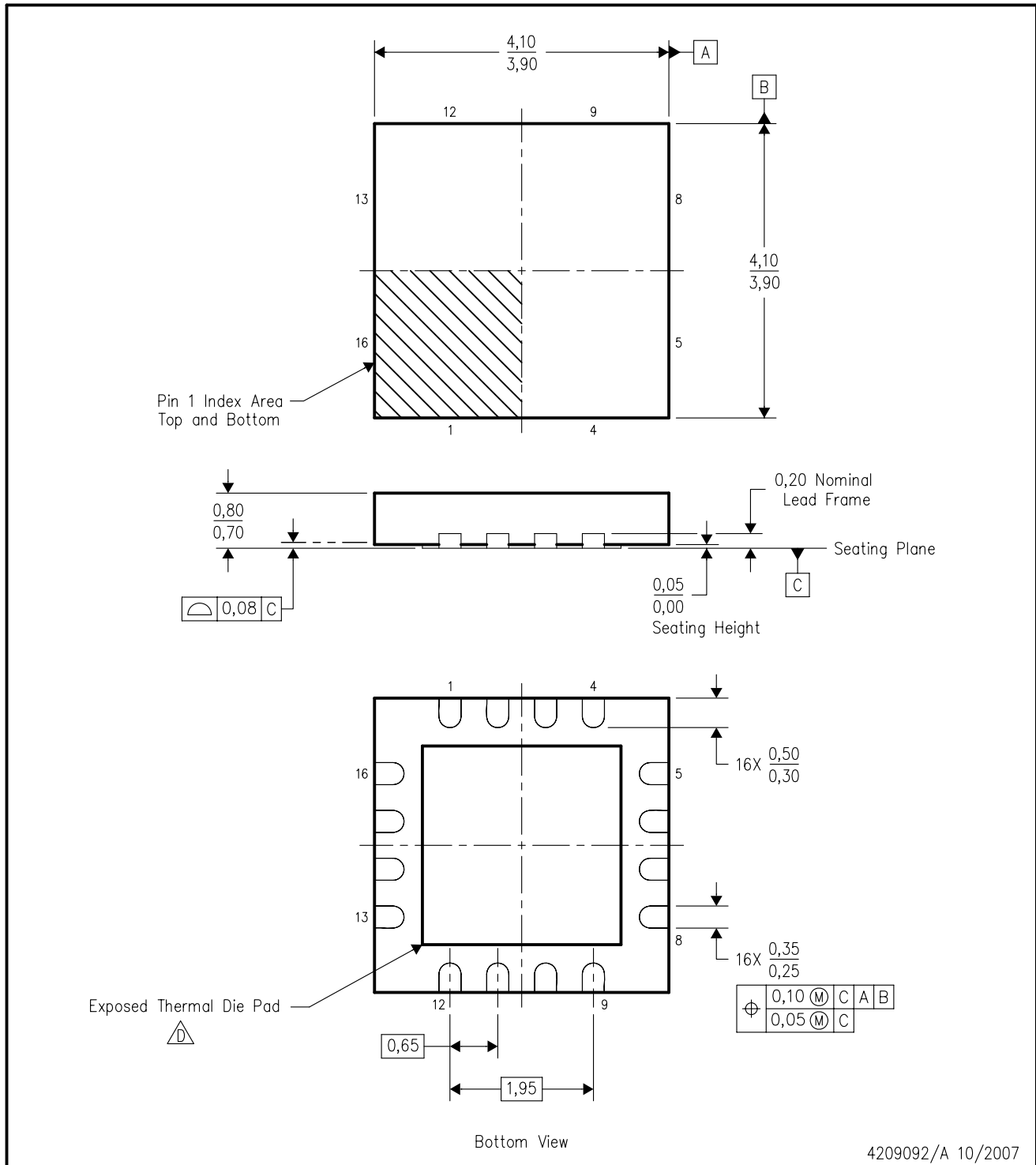
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.




4224843/A

RUM (S-PQFP-N16)

PLASTIC QUAD FLATPACK



4209092/A 10/2007

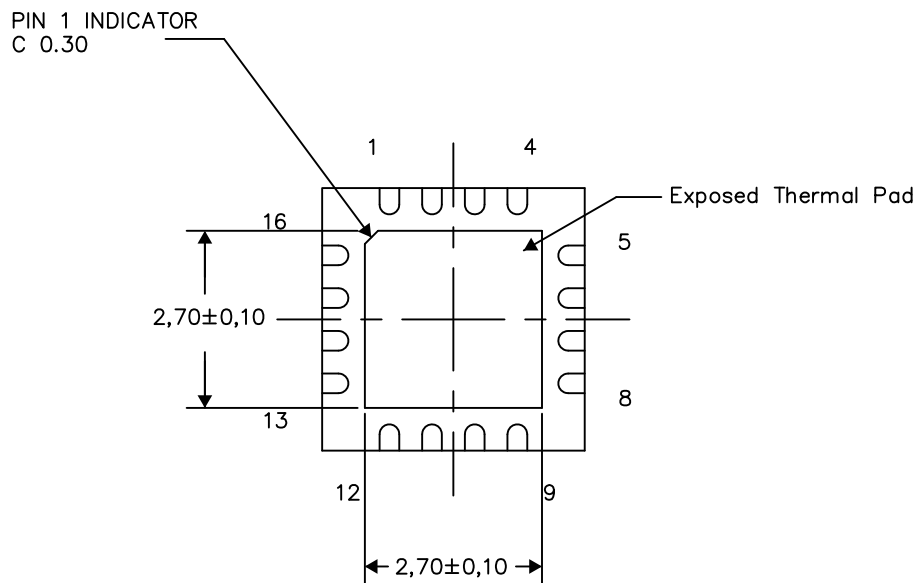
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 -  The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
 - E. Package complies to JEDEC MO-220 variation WGGC-3.

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

Exposed Thermal Pad Dimensions

4209093-2/F 09/15

NOTES: All linear dimensions are in millimeters

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