

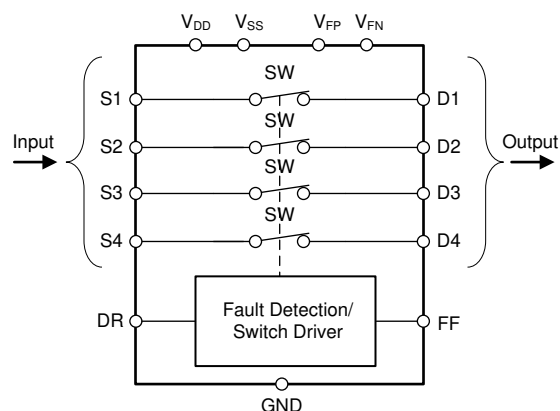
# TMUX7462F $\pm 60$ V Fault-Protected, Latch-Up Immune, Quad Channel Protector with Adjustable Fault Threshold and 1.8-V Logic

## 1 Features

- Wide supply range: 8 V to 44 V single supply  
 $\pm 5$  V to  $\pm 22$  V dual supply
- Channel protector without need for dedicated select pin per channel
  - Reduces number of control logic signals to route across PCB
- Integrated fault protection:
  - Overvoltage protection, source to supplies or source to drain:  $\pm 85$  V
  - Overvoltage protection:  $\pm 60$  V
  - Powered-off protection:  $\pm 60$  V
  - Interrupt flags to indicate fault status
  - Adjustable overvoltage triggering thresholds
    - $V_{FP}$ : 3 V to  $V_{DD}$ ,  $V_{FN}$ : 0 V to  $V_{SS}$
  - Adjustable output behavior (clamped or open) during fault
- Latch-up immunity by device construction
- 6 kV human body model (HBM) ESD rating
- Low On-Resistance:  $8.3\ \Omega$  typical
- Flat On-Resistance: 5 m $\Omega$  typical
- Industry-standard TSSOP and smaller WQFN package

## 2 Applications

- [Factory automation and control](#)
- [Programmable logic controllers \(PLC\)](#)
- [Analog input modules](#)
- [Semiconductor test equipment](#)
- [Battery test equipment](#)
- [Servo drive control module](#)
- [Data acquisition systems \(DAQ\)](#)



**Block Diagram**

## 3 Description

The TMUX7462F is a four-channel protector that can be placed on the front end of a signal path to protect sensitive components downstream from damage caused by overvoltage faults. Each of the 4 channels has an internal switch that is turned-off automatically upon occurrence of an overvoltage fault without the need of external controls. This simplifies robust system level protection designs by removing the need for control signals for each channel of the device. The overvoltage protection is available in powered and powered-off conditions, making the TMUX7462F suitable for applications where power supply sequencing cannot be precisely controlled.

The switch channels remain in the high impedance state (regardless of switch input conditions) when the devices power supplies are floating, grounded, or at a level that is below the undervoltage (UV) threshold. If the signal level on any  $S_x$  pin exceeds the fault supply ( $V_{FP}$  or  $V_{FN}$ ) by a threshold voltage ( $V_T$ ), then the  $S_x$  pin becomes high impedance and an output fault flag is asserted low to indicate a fault condition under normal operation. The drain pin ( $D_x$ ) is either pulled to the fault supply voltage that was exceeded or left floating depending on the DR control logic.

The device operates with dual supplies ( $\pm 5$  V to  $\pm 22$  V), a single supply (8 V to 44 V), or asymmetric supplies. The low and flat on-resistance of the device makes the TMUX7462F an excellent solution for data acquisition applications where excellent linearity and low distortion is critical.

### Package Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | PACKAGE SIZE <sup>(2)</sup> |
|-------------|------------------------|-----------------------------|
| TMUX7462F   | PW (TSSOP, 16)         | 5 mm $\times$ 6.4 mm        |
|             | RRP (WQFN, 16)         | 4 mm $\times$ 4 mm          |

- (1) See the orderable addendum at the end of the data sheet for all available packages.
- (2) The package size (length  $\times$  width) is a nominal value and includes pins, where applicable.



## Table of Contents

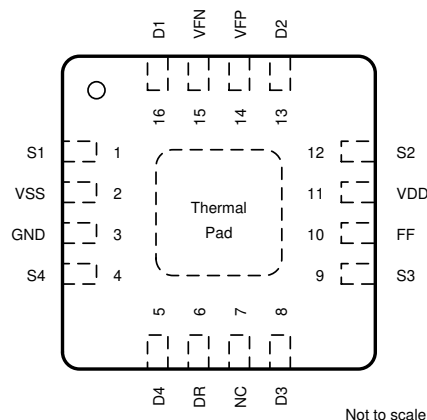
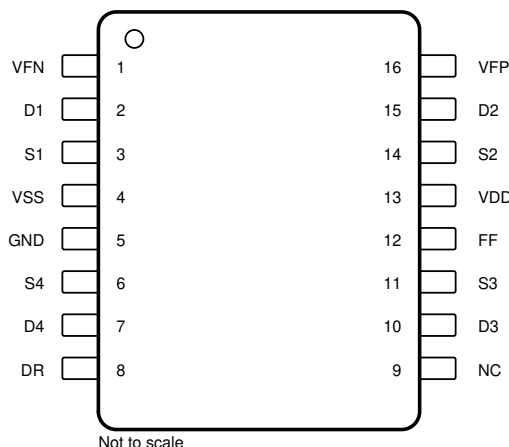
|                                                                      |           |                                                                      |           |
|----------------------------------------------------------------------|-----------|----------------------------------------------------------------------|-----------|
| <b>1 Features</b> .....                                              | <b>1</b>  | 7.7 Fault Flag Recovery Time.....                                    | <b>22</b> |
| <b>2 Applications</b> .....                                          | <b>1</b>  | 7.8 Fault Drain Enable Time.....                                     | <b>23</b> |
| <b>3 Description</b> .....                                           | <b>1</b>  | 7.9 Inter-Channel Crosstalk.....                                     | <b>23</b> |
| <b>4 Revision History</b> .....                                      | <b>2</b>  | 7.10 Bandwidth.....                                                  | <b>24</b> |
| <b>5 Pin Configuration and Functions</b> .....                       | <b>3</b>  | 7.11 THD + Noise.....                                                | <b>24</b> |
| <b>6 Specifications</b> .....                                        | <b>4</b>  | <b>8 Detailed Description</b> .....                                  | <b>25</b> |
| 6.1 Absolute Maximum Ratings.....                                    | <b>4</b>  | 8.1 Overview.....                                                    | <b>25</b> |
| 6.2 ESD Ratings.....                                                 | <b>4</b>  | 8.2 Functional Block Diagram.....                                    | <b>25</b> |
| 6.3 Thermal Information.....                                         | <b>5</b>  | 8.3 Feature Description.....                                         | <b>25</b> |
| 6.4 Recommended Operating Conditions.....                            | <b>5</b>  | 8.4 Device Functional Modes.....                                     | <b>28</b> |
| 6.5 Electrical Characteristics (Global).....                         | <b>5</b>  | <b>9 Application and Implementation</b> .....                        | <b>29</b> |
| 6.6 $\pm 15$ V Dual Supply: Electrical Characteristics.....          | <b>6</b>  | 9.1 Application Information.....                                     | <b>29</b> |
| 6.7 $\pm 20$ V Dual Supply: Electrical Characteristics.....          | <b>8</b>  | 9.2 Typical Application.....                                         | <b>29</b> |
| 6.8 12 V Single Supply: Electrical Characteristics.....              | <b>10</b> | 9.3 Power Supply Recommendations.....                                | <b>31</b> |
| 6.9 36 V Single Supply: Electrical Characteristics.....              | <b>12</b> | 9.4 Layout.....                                                      | <b>31</b> |
| 6.10 Typical Characteristics.....                                    | <b>14</b> | <b>10 Device and Documentation Support</b> .....                     | <b>33</b> |
| <b>7 Parameter Measurement Information</b> .....                     | <b>19</b> | 10.1 Documentation Support.....                                      | <b>33</b> |
| 7.1 On-Resistance.....                                               | <b>19</b> | 10.2 Receiving Notification of Documentation Updates.....            | <b>33</b> |
| 7.2 On-Leakage Current.....                                          | <b>19</b> | 10.3 Support Resources.....                                          | <b>33</b> |
| 7.3 Input and Output Leakage Current under<br>Overvoltage Fault..... | <b>20</b> | 10.4 Trademarks.....                                                 | <b>33</b> |
| 7.4 Fault Response Time.....                                         | <b>21</b> | 10.5 Electrostatic Discharge Caution.....                            | <b>33</b> |
| 7.5 Fault Recovery Time.....                                         | <b>21</b> | 10.6 Glossary.....                                                   | <b>33</b> |
| 7.6 Fault Flag Response Time.....                                    | <b>22</b> | <b>11 Mechanical, Packaging, and Orderable<br/>Information</b> ..... | <b>33</b> |

## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

|                                                                                                           |             |
|-----------------------------------------------------------------------------------------------------------|-------------|
| <b>Changes from Revision A (October 2021) to Revision B (November 2022)</b>                               | <b>Page</b> |
| • Changed the status of the PW package from: <i>preview</i> to: <i>active</i> .....                       | <b>1</b>    |
| • Updated the format of the <i>Package Information</i> table to include package leads.....                | <b>1</b>    |
| <b>Changes from Revision * (March 2021) to Revision A (October 2021)</b>                                  | <b>Page</b> |
| • Changed the status of the data sheet from: <i>Advanced Information</i> to: <i>Production Data</i> ..... | <b>1</b>    |

## 5 Pin Configuration and Functions



**Figure 5-1. PW Package, 16-Pin TSSOP (Top View)** **Figure 5-2. RRP Package, 16-Pin WQFN (Top View)**

**Table 5-1. Pin Functions**

| PIN             |       |      | TYPE <sup>(1)</sup> | DESCRIPTION                                                                                                                                                                                                                                                                                                                                 |
|-----------------|-------|------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NAME            | TSSOP | WQFN |                     |                                                                                                                                                                                                                                                                                                                                             |
| D1              | 2     | 16   | I/O                 | Drain pin 1 can be an input or output. The drain pin is not overvoltage protected and shall remain within the recommended operating range.                                                                                                                                                                                                  |
| D2              | 15    | 13   | I/O                 | Drain pin 2 can be an input or output. The drain pin is not overvoltage protected and shall remain within the recommended operating range.                                                                                                                                                                                                  |
| D3              | 10    | 8    | I/O                 | Drain pin 3 can be an input or output. The drain pin is not overvoltage protected and shall remain within the recommended operating range.                                                                                                                                                                                                  |
| D4              | 7     | 5    | I/O                 | Drain pin 4 can be an input or output. The drain pin is not overvoltage protected and shall remain within the recommended operating range.                                                                                                                                                                                                  |
| DR              | 8     | 6    | I                   | Drain Response (DR) input. Tying the DR pin to GND enables the drain to be pulled to V <sub>FP</sub> or V <sub>FN</sub> through a 40 kΩ resistor during an overvoltage fault event. The drain pin becomes open circuit when the DR pin is a logic high or left floating.                                                                    |
| FF              | 12    | 10   | O                   | General fault flag. This pin is an open drain output and is asserted low when overvoltage condition is detected on any of the source (Sx) pins. Connect this pin to an external supply (1.8 V to 5.5 V) through a 1 kΩ pull-up resistor.                                                                                                    |
| GND             | 5     | 3    | P                   | Ground (0 V) reference.                                                                                                                                                                                                                                                                                                                     |
| N.C.            | 9     | 7    | —                   | No internal connection                                                                                                                                                                                                                                                                                                                      |
| S1              | 3     | 1    | I/O                 | Overvoltage protected source pin 1 can be an input or output.                                                                                                                                                                                                                                                                               |
| S2              | 14    | 12   | I/O                 | Overvoltage protected source pin 2 can be an input or output.                                                                                                                                                                                                                                                                               |
| S3              | 11    | 9    | I/O                 | Overvoltage protected source pin 3 can be an input or output.                                                                                                                                                                                                                                                                               |
| S4              | 6     | 4    | I/O                 | Overvoltage protected source pin 4 can be an input or output.                                                                                                                                                                                                                                                                               |
| V <sub>DD</sub> | 13    | 11   | P                   | Positive power supply. This pin is the most positive power-supply potential. Connect a decoupling capacitor ranging from 0.1 μF to 10 μF between V <sub>DD</sub> and GND for reliable operation.                                                                                                                                            |
| V <sub>FP</sub> | 16    | 14   | P                   | Positive fault voltage supply that determines the overvoltage protection triggering threshold on the positive side. Connect to V <sub>DD</sub> if the triggering threshold is the same as the device's positive supply. Connect a decoupling capacitor ranging from 0.1 μF to 10 μF between V <sub>FP</sub> and GND for reliable operation. |
| V <sub>FN</sub> | 1     | 15   | P                   | Negative fault voltage supply that determines the overvoltage protection triggering threshold on the negative side. Connect to V <sub>SS</sub> if the triggering threshold is the same as the device's negative supply. Connect a decoupling capacitor ranging from 0.1 μF to 10 μF between V <sub>FN</sub> and GND for reliable operation. |
| V <sub>SS</sub> | 4     | 2    | P                   | Negative power supply. This pin is the most negative power-supply potential. This pin can be connected to ground in single-supply applications. Connect a decoupling capacitor ranging from 0.1 μF to 10 μF between V <sub>SS</sub> and GND for reliable operation.                                                                         |
| Thermal Pad     |       |      | —                   | The thermal pad is not connected internally. No requirement to solder this pad. For best performance it is recommended that the pad be tied to GND or VSS.                                                                                                                                                                                  |

(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>

|                          |                                                    | MIN                              | MAX                              | UNIT |
|--------------------------|----------------------------------------------------|----------------------------------|----------------------------------|------|
| $V_{DD}$ to $V_{SS}$     | Supply voltage                                     |                                  | 48                               | V    |
| $V_{DD}$ to GND          |                                                    | –0.3                             | 48                               | V    |
| $V_{SS}$ to GND          |                                                    | –48                              | 0.3                              | V    |
| $V_{FP}$ to GND          | Fault clamping voltage                             | –0.3                             | $V_{DD} + 0.3$                   | V    |
| $V_{FN}$ to GND          |                                                    | $V_{SS} - 0.3$                   | 0.3                              | V    |
| $V_S$ to GND             | Source input pin (Sx) voltage to GND               | –65                              | 65                               | V    |
| $V_S$ to $V_{DD}$        | Source input pin (Sx) voltage to $V_{DD}$ or $V_D$ | –90                              |                                  | V    |
| $V_S$ to $V_{SS}$        | Source input pin (Sx) voltage to $V_{SS}$ or $V_D$ |                                  | 90                               | V    |
| $V_D$                    | Drain pin (Dx) voltage                             | $V_{FN} - 0.7$                   | $V_{FP} + 0.7$                   | V    |
| $V_{DR}$                 | Logic input pin (DR) voltage <sup>(2)</sup>        | GND – 0.7                        | 48                               | V    |
| $V_{FF}$                 | Logic output pin (FF) voltage <sup>(2)</sup>       | GND – 0.7                        | 6                                | V    |
| $I_{DR}$                 | Logic input pin (DR) current <sup>(2)</sup>        | –30                              | 30                               | mA   |
| $I_{FF}$                 | Logic output pin (FF) current <sup>(2)</sup>       | –10                              | 10                               | mA   |
| $I_S$ or $I_D$ (CONT)    | Source or drain continuous current (Sx or Dx)      | $I_{DC} \pm 10\%$ <sup>(3)</sup> | $I_{DC} \pm 10\%$ <sup>(3)</sup> | mA   |
| $T_{stg}$                | Storage temperature                                | –65                              | 150                              | °C   |
| $T_A$                    | Ambient temperature                                | –55                              | 150                              | °C   |
| $T_J$                    | Junction temperature                               |                                  | 150                              | °C   |
| $P_{tot}$ <sup>(4)</sup> | Total power dissipation (QFN)                      |                                  | 1600                             | mW   |

- (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) Stresses have to be kept at or below both voltage and current ratings at all time.
- (3) Refer to Recommended Operating Conditions for  $I_{DC}$  ratings.
- (4) For QFN package:  $P_{tot}$  derates linearly above  $T_A = 70^\circ\text{C}$  by 23.5 mW/°C

### 6.2 ESD Ratings

|             |                         |                                                                                 | VALUE | UNIT |
|-------------|-------------------------|---------------------------------------------------------------------------------|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>     | ±6000 | V    |
|             |                         | Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002, all pins <sup>(2)</sup> | ±750  | V    |

- (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.

## 6.3 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | TMUX7462F  |            | UNIT |
|-------------------------------|----------------------------------------------|------------|------------|------|
|                               |                                              | PW (TSSOP) | RRP (WQFN) |      |
|                               |                                              | 16 PINS    | 16 PINS    |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 100.4      | 42.8       | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 31.3       | 28.5       | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 46.4       | 17.9       | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 1.7        | 0.3        | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 45.8       | 17.9       | °C/W |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | N/A        | 4.0        | °C/W |

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

## 6.4 Recommended Operating Conditions

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

|                                  |                                                                | MIN                       | NOM | MAX      | UNIT |
|----------------------------------|----------------------------------------------------------------|---------------------------|-----|----------|------|
| $V_{DD} - V_{SS}$ <sup>(1)</sup> | Power supply voltage differential                              | 8                         |     | 44       | V    |
| $V_{DD}$                         | Positive power supply voltage                                  | 5                         |     | 44       |      |
| $V_{FP}$                         | Positive fault clamping voltage                                | 3                         |     | $V_{DD}$ |      |
| $V_{FN}$                         | Negative fault clamping voltage                                | $V_{SS}$                  |     | 0        |      |
| $V_S$                            | Source pin (Sx) voltage (non-fault condition)                  | $V_{FN}$                  |     | $V_{FP}$ | V    |
| $V_S$ to GND                     | Source pin (Sx) voltage to GND (fault condition)               | –60                       |     | 60       |      |
| $V_S$ to $V_{DD}$ <sup>(2)</sup> | Source pin (Sx) voltage to $V_{DD}$ or $V_D$ (fault condition) | –85                       |     |          |      |
| $V_S$ to $V_{SS}$ <sup>(2)</sup> | Source pin (Sx) voltage to $V_{SS}$ or $V_D$ (fault condition) |                           |     | 85       |      |
| $V_D$                            | Drain pin (Dx) voltage                                         | $V_{FN}$                  |     | $V_{FP}$ | V    |
| $V_{DR}$                         | Logic input pin (DR) voltage                                   | GND                       |     | 44       |      |
| $V_{FF}$ <sup>(3)</sup>          | Logic output pin (FF) voltage                                  | GND                       |     | 5.5      |      |
| $T_A$                            | Ambient temperature                                            | –40                       |     | 125      | °C   |
| $I_{DC}$                         | Continuous current through switch, WQFN package                | $T_A = 25^\circ\text{C}$  |     | 150      | mA   |
|                                  |                                                                | $T_A = 85^\circ\text{C}$  |     | 100      |      |
|                                  |                                                                | $T_A = 125^\circ\text{C}$ |     | 60       |      |

- (1)  $V_{DD}$  and  $V_{SS}$  can be any value as long as  $8\text{ V} \leq (V_{DD} - V_{SS}) \leq 44\text{ V}$ , and the minimum  $V_{DD}$  is met.  
(2) Source pin voltage (Sx) under a fault condition may not exceed 85 V from supply pins ( $V_{DD}$  and  $V_{SS}$ ) or drain pins (D, Dx).  
(3) Logic output pin (FF) is an open drain output and should be pulled up to a voltage within the max ratings

## 6.5 Electrical Characteristics (Global)

at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

Typical at  $V_{DD} = 15\text{ V}$ ,  $V_{SS} = -15\text{ V}$ , GND = 0 V (unless otherwise noted)

| PARAMETER                  |                                      | TEST CONDITIONS              | $T_A$           | MIN | TYP   | MAX  | UNIT |
|----------------------------|--------------------------------------|------------------------------|-----------------|-----|-------|------|------|
| <b>ANALOG SWITCH</b>       |                                      |                              |                 |     |       |      |      |
| $V_T$                      | Threshold voltage for fault detector |                              | 25°C            |     | 0.7   |      | V    |
| <b>LOGIC INPUT/ OUTPUT</b> |                                      |                              |                 |     |       |      |      |
| $V_{IH}$                   | High-level input voltage             | DR pin                       | –40°C to +125°C | 1.3 |       |      | V    |
| $V_{IL}$                   | Low-level input voltage              | DR pin                       | –40°C to +125°C |     |       | 0.8  | V    |
| $I_{IH}$                   | High-level input current             | $V_{DR} = \text{logic high}$ | –40°C to +125°C |     | 0.4   | 3    | μA   |
| $I_{IL}$                   | Low-level input current              | $V_{DR} = \text{logic low}$  | –40°C to +125°C | –1  | –0.65 |      | μA   |
| $V_{OL(FLAG)}$             | Low-level output voltage             | FF pin, $I_O = 5\text{ mA}$  | –40°C to +125°C |     |       | 0.35 | V    |

## 6.5 Electrical Characteristics (Global) (continued)

at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

Typical at  $V_{DD} = 15\text{ V}$ ,  $V_{SS} = -15\text{ V}$ ,  $\text{GND} = 0\text{ V}$  (unless otherwise noted)

| PARAMETER           |                                                                                       | TEST CONDITIONS             | T <sub>A</sub>  | MIN | TYP | MAX | UNIT |
|---------------------|---------------------------------------------------------------------------------------|-----------------------------|-----------------|-----|-----|-----|------|
| POWER SUPPLY        |                                                                                       |                             |                 |     |     |     |      |
| V <sub>UVLO</sub>   | Undervoltage lockout (UVLO) threshold voltage (V <sub>DD</sub> – V <sub>SS</sub> )    | Rising edge, single supply  | –40°C to +125°C | 5.1 | 5.8 | 6.4 | V    |
|                     |                                                                                       | Falling edge, single supply | –40°C to +125°C | 5   | 5.7 | 6.3 | V    |
| V <sub>HYS</sub>    | V <sub>DD</sub> Undervoltage lockout (UVLO) hysteresis                                | Single supply               | –40°C to +125°C |     | 0.2 |     | V    |
| R <sub>D(OVP)</sub> | Drain resistance to fault supply during overvoltage protection when enabled by DR pin |                             | 25°C            |     | 40  |     | kΩ   |

## 6.6 ±15 V Dual Supply: Electrical Characteristics

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ ,  $\text{GND} = 0\text{ V}$  (unless otherwise noted)

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

| PARAMETER                                  |                                                                         | TEST CONDITIONS                                                                                                                                                      | T <sub>A</sub>  | MIN   | TYP   | MAX  | UNIT |
|--------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------|-------|------|------|
| ANALOG SWITCH                              |                                                                         |                                                                                                                                                                      |                 |       |       |      |      |
| R <sub>ON</sub>                            | On-resistance                                                           | V <sub>S</sub> = −10 V to +10 V<br>I <sub>D</sub> = −10 mA                                                                                                           | 25°C            | 8.3   | 10.7  | Ω    |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  |       | 13.5  |      |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C |       | 16    |      |      |
| ΔR <sub>ON</sub>                           | On-resistance mismatch between channels                                 | V <sub>S</sub> = −10 V to +10 V<br>I <sub>D</sub> = −10 mA                                                                                                           | 25°C            | 0.05  | 0.45  | Ω    |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  |       | 0.5   |      |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C |       | 0.6   |      |      |
| R <sub>FLAT</sub>                          | On-resistance flatness                                                  | V <sub>S</sub> = −10 V to +10 V<br>I <sub>D</sub> = −10 mA                                                                                                           | 25°C            | 0.005 | 0.4   | Ω    |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  |       | 0.4   |      |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C |       | 0.4   |      |      |
| R <sub>ON_DRIFT</sub>                      | On-resistance drift                                                     | V <sub>S</sub> = 0 V, I <sub>S</sub> = −10 mA                                                                                                                        | −40°C to +125°C | 0.04  |       | Ω/°C |      |
| I <sub>S(ON)</sub> ,<br>I <sub>D(ON)</sub> | Channel on leakage current <sup>(1)</sup>                               | Switch state is on,<br>V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = −16.5 V,<br>V <sub>S</sub> = V <sub>D</sub> = ±10 V                                               | 25°C            | −0.7  | 0.1   | 0.7  | nA   |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  | −2    |       | 2    |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C | −15   |       | 15   |      |
| FAULT CONDITION                            |                                                                         |                                                                                                                                                                      |                 |       |       |      |      |
| I <sub>S(FA)</sub>                         | Input leakage current during overvoltage                                | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V                                       | −40°C to +125°C | ±110  |       |      | μA   |
| I <sub>S(FA)</sub> Grounded                | Input leakage current during overvoltage with grounded supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                                   | −40°C to +125°C | ±135  |       |      | μA   |
| I <sub>S(FA)</sub> Floating                | Input leakage current during overvoltage with floating supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating,                                             | −40°C to +125°C | ±140  |       |      | μA   |
| I <sub>D(FA)</sub>                         | Output leakage current during overvoltage                               | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 5 V or floating | 25°C            | −20   | ±0.1  | 20   | nA   |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  | −30   |       | 30   |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C | −60   |       | 60   |      |
| I <sub>D(FA)</sub> Grounded                | Output leakage current during overvoltage with grounded supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                                   | 25°C            | −30   | ±0.01 | 30   | nA   |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  | −50   |       | 50   |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C | −90   |       | 90   |      |
| I <sub>D(FA)</sub> Floating                | Output leakage current during overvoltage with floating supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                              | 25°C            | ±0.6  |       |      | μA   |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +85°C  | ±1.2  |       |      |      |
|                                            |                                                                         |                                                                                                                                                                      | −40°C to +125°C | ±2.2  |       |      |      |

## 6.6 ±15 V Dual Supply: Electrical Characteristics (continued)

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

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

| PARAMETER                                  |                                            | TEST CONDITIONS                                                                                                                                                        | T <sub>A</sub>  | MIN    | TYP  | MAX | UNIT |
|--------------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|------|-----|------|
| SWITCHING CHARACTERISTICS                  |                                            |                                                                                                                                                                        |                 |        |      |     |      |
| t <sub>RESPONSE</sub>                      | Fault response time                        | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 12 pF                                                                     | 25°C            | 100    | 350  | ns  |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 380  |     |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 400  |     |      |
| t <sub>RECOVERY</sub>                      | Fault recovery time                        | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 12 pF                                                                     | 25°C            | 1600   | 4500 | ns  |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 4800 |     |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 4800 |     |      |
| t <sub>RESPONSE(FLAG)</sub>                | Fault flag response time                   | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>V <sub>PU</sub> = 5 V, R <sub>PU</sub> = 1 kΩ, C <sub>L</sub> = 12 pF                                              | 25°C            | 250    |      | ns  |      |
| t <sub>RECOVERY(FLAG)</sub>                | Fault flag recovery time                   | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>V <sub>PU</sub> = 5 V, R <sub>PU</sub> = 1 kΩ, C <sub>L</sub> = 15 pF                                              | 25°C            | 1.2    |      | μs  |      |
| t <sub>RESPONSE(DR)</sub>                  | Fault output response time                 | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>V <sub>PU</sub> = 5 V, C <sub>L</sub> = 12 pF                                                                      | 25°C            | 2.7    |      | μs  |      |
| X <sub>TALK</sub>                          | Intra-channel crosstalk                    | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V, f = 1 MHz                    | 25°C            | −100   |      | dB  |      |
| BW                                         | −3 dB bandwidth (WQFN Package)             | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V                               | 25°C            | 650    |      | MHz |      |
| BW                                         | −3 dB bandwidth (TSSOP Package)            | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V                               | 25°C            | 580    |      | MHz |      |
| I <sub>LOSS</sub>                          | Insertion loss                             | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V, f = 1 MHz                    | 25°C            | −0.7   |      | dB  |      |
| THD+N                                      | Total harmonic distortion plus noise       | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 10 kΩ,<br>V <sub>S</sub> = 15 V <sub>PP</sub> , V <sub>BIAS</sub> = 0 V,<br>f = 20 Hz to 20 kHz                                | 25°C            | 0.0006 |      | %   |      |
| C <sub>S(ON)</sub> ,<br>C <sub>D(ON)</sub> | Input/Output on-capacitance                | f = 1 MHz, V <sub>S</sub> = 0 V                                                                                                                                        | 25°C            | 14     |      | pF  |      |
| POWER SUPPLY                               |                                            |                                                                                                                                                                        |                 |        |      |     |      |
| I <sub>DD</sub>                            | V <sub>DD</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V,<br>V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                          | 25°C            | 0.32   | 0.5  | mA  |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 0.5  |     |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 0.6  |     |      |
| I <sub>SS</sub>                            | V <sub>SS</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V,<br>V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                          | 25°C            | 0.26   | 0.4  | mA  |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 0.4  |     |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 0.5  |     |      |
| I <sub>GND</sub>                           | GND current                                | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            | 0.06   |      | mA  |      |
| I <sub>FP</sub>                            | V <sub>FP</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            | 10     |      | μA  |      |
| I <sub>FN</sub>                            | V <sub>FN</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            | 10     |      | μA  |      |
| I <sub>DD(FA)</sub>                        | V <sub>DD</sub> supply current under fault | V <sub>S</sub> = ± 60 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 0.27   | 0.5  | mA  |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 0.5  |     |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 0.6  |     |      |
| I <sub>SS(FA)</sub>                        | V <sub>SS</sub> supply current under fault | V <sub>S</sub> = ± 60 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 0.2    | 0.3  | mA  |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 0.3  |     |      |
|                                            |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 0.4  |     |      |
| I <sub>GND(FA)</sub>                       | GND current under fault                    | V <sub>S</sub> = ± 60 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 0.15   |      | mA  |      |
| I <sub>FP(FA)</sub>                        | V <sub>FP</sub> supply current under fault | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            | 10     |      | μA  |      |
| I <sub>FN(FA)</sub>                        | V <sub>FN</sub> supply current under fault | V <sub>DD</sub> = V <sub>FP</sub> = 16.5 V, V <sub>SS</sub> = V <sub>FN</sub> = −16.5 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            | 10     |      | μA  |      |

(1) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

## 6.7 $\pm 20$ V Dual Supply: Electrical Characteristics

$V_{DD} = +20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ , GND = 0 V (unless otherwise noted)

Typical at  $V_{DD} = +20\text{ V}$ ,  $V_{SS} = -20\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                  |                                                                         | TEST CONDITIONS                                                                                                                                                  | T <sub>A</sub>  | MIN   | TYP  | MAX  | UNIT |
|--------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------|------|------|------|
| ANALOG SWITCH                              |                                                                         |                                                                                                                                                                  |                 |       |      |      |      |
| R <sub>ON</sub>                            | On-resistance                                                           | V <sub>S</sub> = −15 V to +15 V<br>I <sub>D</sub> = −10 mA                                                                                                       | 25°C            | 8.3   | 10.5 | Ω    |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  |       | 14   |      |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C |       | 17   |      |      |
| ΔR <sub>ON</sub>                           | On-resistance mismatch between channels                                 | V <sub>S</sub> = −15 V to +15 V<br>I <sub>D</sub> = −10 mA                                                                                                       | 25°C            | 0.05  | 0.35 | Ω    |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  |       | 0.5  |      |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C |       | 0.5  |      |      |
| R <sub>FLAT</sub>                          | On-resistance flatness                                                  | V <sub>S</sub> = −15 V to +15 V<br>I <sub>D</sub> = −10 mA                                                                                                       | 25°C            | 0.006 | 0.4  | Ω    |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  |       | 0.5  |      |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C |       | 0.5  |      |      |
| R <sub>ON_DRIFT</sub>                      | On-resistance drift                                                     | V <sub>S</sub> = 0 V, I <sub>S</sub> = −10 mA                                                                                                                    | −40°C to +125°C | 0.04  |      | Ω/°C |      |
| I <sub>S(ON)</sub> ,<br>I <sub>D(ON)</sub> | Channel on leakage current <sup>(1)</sup>                               | Switch state is on,<br>V <sub>DD</sub> = 22 V, V <sub>SS</sub> = −22 V<br>V <sub>S</sub> = V <sub>D</sub> = ±15 V                                                | 25°C            | −0.7  | 0.1  | 0.7  | nA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  | −2    |      | 2    |      |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C | −15   |      | 15   |      |
| FAULT CONDITION                            |                                                                         |                                                                                                                                                                  |                 |       |      |      |      |
| I <sub>S(FA)</sub>                         | Input leakage current during overvoltage                                | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V                                       | −40°C to +125°C |       | ±95  |      | μA   |
| I <sub>S(FA)</sub> Grounded                | Input leakage current during overvoltage with grounded supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                                | −40°C to +125°C |       | ±135 |      | μA   |
| I <sub>S(FA)</sub> Floating                | Input leakage current during overvoltage with floating supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                           | −40°C to +125°C |       | ±140 |      | μA   |
| I <sub>D(FA)</sub>                         | Output leakage current during overvoltage                               | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 5 V or floating | 25°C            | −50   | ±10  | 50   | nA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  | −70   |      | 70   | nA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C | −90   |      | 90   | nA   |
| I <sub>D(FA)</sub> Grounded                | Output leakage current during overvoltage with grounded supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                               | 25°C            | −700  | ±500 | 700  | nA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  | −700  |      | 700  | nA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C | −700  |      | 700  | nA   |
| I <sub>D(FA)</sub> Floating                | Output leakage current during overvoltage with floating supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                          | 25°C            |       | ±0.6 |      | μA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +85°C  |       | ±1.3 |      | μA   |
|                                            |                                                                         |                                                                                                                                                                  | −40°C to +125°C |       | ±2.3 |      | μA   |

## 6.7 ±20 V Dual Supply: Electrical Characteristics (continued)

$V_{DD} = +20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

Typical at  $V_{DD} = +20\text{ V}$ ,  $V_{SS} = -20\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                  |                                            | TEST CONDITIONS                                                                                                                                                    | T <sub>A</sub>  | MIN | TYP    | MAX  | UNIT |
|--------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|--------|------|------|
| SWITCHING CHARACTERISTICS                  |                                            |                                                                                                                                                                    |                 |     |        |      |      |
| t <sub>RESPONSE</sub>                      | Fault response time                        | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 12 pF                                                                 | 25°C            |     | 150    | 400  | ns   |
|                                            |                                            |                                                                                                                                                                    | −40°C to +85°C  |     |        | 430  |      |
|                                            |                                            |                                                                                                                                                                    | −40°C to +125°C |     |        | 450  |      |
| t <sub>RECOVERY</sub>                      | Fault recovery time                        | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 12 pF                                                                 | 25°C            |     | 1100   | 4500 | ns   |
|                                            |                                            |                                                                                                                                                                    | −40°C to +85°C  |     |        | 4900 |      |
|                                            |                                            |                                                                                                                                                                    | −40°C to +125°C |     |        | 4900 |      |
| t <sub>RESPONSE(FLAG)</sub>                | Fault flag response time                   | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>V <sub>PU</sub> = 5 V, R <sub>PU</sub> = 1 kΩ, C <sub>L</sub> = 12 pF                                          | −40°C to +125°C |     | 220    |      | ns   |
| t <sub>RECOVERY(FLAG)</sub>                | Fault flag recovery time                   | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V,<br>V <sub>PU</sub> = 5 V, R <sub>PU</sub> = 1 kΩ, C <sub>L</sub> = 12 pF                                          | −40°C to +125°C |     | 1.1    |      | μs   |
| t <sub>RESPONSE(DR)</sub>                  | Fault output response time                 | V <sub>FP</sub> = 10 V, V <sub>FN</sub> = −10 V, V <sub>PU</sub> = 5 V, C <sub>L</sub> = 12 pF                                                                     | −40°C to +125°C |     | 2.7    |      | μs   |
| X <sub>TALK</sub>                          | Intra-channel crosstalk                    | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V, f = 1 MHz                | 25°C            |     | −100   |      | dB   |
| BW                                         | −3 dB bandwidth (WQFN Package)             | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V                           | 25°C            |     | 650    |      | MHz  |
| BW                                         | −3 dB bandwidth (TSSOP Package)            | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V                           | 25°C            |     | 590    |      | MHz  |
| I <sub>LOSS</sub>                          | Insertion loss                             | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 0 V, f = 1 MHz                | 25°C            |     | −0.7   |      | dB   |
| THD+N                                      | Total harmonic distortion plus noise       | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 10 kΩ,<br>V <sub>S</sub> = 20 V <sub>PP</sub> , V <sub>BIAS</sub> = 0 V,<br>f = 20 Hz to 20 kHz                            | 25°C            |     | 0.0006 |      | %    |
| C <sub>S(ON)</sub> ,<br>C <sub>D(ON)</sub> | Input/Output on-capacitance                | f = 1 MHz, V <sub>S</sub> = 0 V                                                                                                                                    | 25°C            |     | 14     |      | pF   |
| POWER SUPPLY                               |                                            |                                                                                                                                                                    |                 |     |        |      |      |
| I <sub>DD</sub>                            | V <sub>DD</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 22 V,<br>V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                          | 25°C            |     | 0.32   | 0.5  | mA   |
|                                            |                                            |                                                                                                                                                                    | −40°C to +85°C  |     |        | 0.5  |      |
|                                            |                                            |                                                                                                                                                                    | −40°C to +125°C |     |        | 0.6  |      |
| I <sub>SS</sub>                            | V <sub>SS</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 22 V,<br>V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                          | 25°C            |     | 0.26   | 0.4  | mA   |
|                                            |                                            |                                                                                                                                                                    | −40°C to +85°C  |     |        | 0.4  |      |
|                                            |                                            |                                                                                                                                                                    | −40°C to +125°C |     |        | 0.5  |      |
| I <sub>GND</sub>                           | GND current                                | V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            |     | 0.07   |      | mA   |
| I <sub>FP</sub>                            | V <sub>FP</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            |     | 10     |      | μA   |
| I <sub>FN</sub>                            | V <sub>FN</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            |     | 10     |      | μA   |
| I <sub>DD(FA)</sub>                        | V <sub>DD</sub> supply current under fault | V <sub>S</sub> = ± 60 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            |     | 0.27   | 0.5  | mA   |
|                                            |                                            |                                                                                                                                                                    | −40°C to +85°C  |     |        | 0.5  |      |
|                                            |                                            |                                                                                                                                                                    | −40°C to +125°C |     |        | 0.6  |      |
| I <sub>SS(FA)</sub>                        | V <sub>SS</sub> supply current under fault | V <sub>S</sub> = ± 60 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            |     | 0.2    | 0.3  | mA   |
|                                            |                                            |                                                                                                                                                                    | −40°C to +85°C  |     |        | 0.3  |      |
|                                            |                                            |                                                                                                                                                                    | −40°C to +125°C |     |        | 0.4  |      |
| I <sub>GND(FA)</sub>                       | GND current under fault                    | V <sub>S</sub> = ± 60 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            |     | 0.15   |      | mA   |
| I <sub>FP(FA)</sub>                        | V <sub>FP</sub> supply current under fault | V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            |     | 10     |      | μA   |
| I <sub>FN(FA)</sub>                        | V <sub>FN</sub> supply current under fault | V <sub>DD</sub> = V <sub>FP</sub> = 22 V, V <sub>SS</sub> = V <sub>FN</sub> = −22 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                             | 25°C            |     | 10     |      | μA   |

(1) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

## 6.8 12 V Single Supply: Electrical Characteristics

$V_{DD} = +12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

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

| PARAMETER                                  |                                                                         | TEST CONDITIONS                                                                                                                                                 | T <sub>A</sub>  | MIN  | TYP | MAX | UNIT |  |
|--------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|-----|-----|------|--|
| ANALOG SWITCH                              |                                                                         |                                                                                                                                                                 |                 |      |     |     |      |  |
| R <sub>ON</sub>                            | On-resistance                                                           | V <sub>S</sub> = 0 V to 7.8 V,<br>I <sub>S</sub> = −10 mA                                                                                                       | 25°C            | 8.3  | 11  |     | Ω    |  |
|                                            |                                                                         | V <sub>S</sub> = 0 V to 7.8 V, I <sub>S</sub> = −10 mA                                                                                                          | −40°C to +85°C  |      |     | 15  | Ω    |  |
|                                            |                                                                         | V <sub>S</sub> = 0 V to 7.8 V, I <sub>S</sub> = −10 mA                                                                                                          | −40°C to +125°C |      |     | 18  | Ω    |  |
| ΔR <sub>ON</sub>                           | On-resistance mismatch between channels                                 | V <sub>S</sub> = 0 V to 7.8 V,<br>I <sub>S</sub> = −10 mA                                                                                                       | 25°C            | 0.05 | 0.5 |     | Ω    |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +85°C  |      |     | 0.6 |      |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +125°C |      |     | 0.7 |      |  |
| R <sub>FLAT</sub>                          | On-resistance flatness                                                  | V <sub>S</sub> = 0 V to 7.8 V,<br>I <sub>S</sub> = −10 mA                                                                                                       | 25°C            | 0.05 | 0.4 |     | Ω    |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +85°C  |      |     | 0.5 |      |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +125°C |      |     | 0.5 |      |  |
| R <sub>ON_DRIFT</sub>                      | On-resistance drift                                                     | V <sub>S</sub> = 6 V, I <sub>S</sub> = −10 mA                                                                                                                   | −40°C to +125°C | 0.04 |     |     | Ω/°C |  |
| I <sub>S(ON)</sub> ,<br>I <sub>D(ON)</sub> | Output on leakage current <sup>(1)</sup>                                | Switch state is on,<br>V <sub>DD</sub> = 13.2 V, V <sub>SS</sub> = 0 V,<br>V <sub>S</sub> = V <sub>D</sub> = 1 V/ 10 V,                                         | 25°C            | −0.7 | 0.1 | 0.7 | nA   |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +85°C  | −2   |     | 2   |      |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +125°C | −14  |     | 14  |      |  |
| FAULT CONDITION                            |                                                                         |                                                                                                                                                                 |                 |      |     |     |      |  |
| I <sub>S(FA)</sub>                         | Input leakage current during overvoltage                                | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 13.2 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,                                     | −40°C to +125°C | ±145 |     |     | μA   |  |
| I <sub>S(FA)</sub> Grounded                | Input leakage current during overvoltage with grounded supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                              | −40°C to +125°C | ±135 |     |     | μA   |  |
| I <sub>S(FA)</sub> Floating                | Input leakage current during overvoltage with floating supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                         | −40°C to +125°C | ±140 |     |     | μA   |  |
| I <sub>D(FA)</sub>                         | Output leakage current during overvoltage                               | V <sub>S</sub> = ± 60 V, GND = 0V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 13.2 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 5 V or floating | 25°C            | −20  | ±2  | 20  | nA   |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +85°C  | −30  |     | 30  |      |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +125°C | −50  |     | 50  |      |  |
| I <sub>D(FA)</sub> Grounded                | Output leakage current during overvoltage with grounded supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                              | 25°C            | −30  | ±10 | 30  | nA   |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +85°C  | −50  |     | 50  |      |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +125°C | −90  |     | 90  |      |  |
| I <sub>D(FA)</sub> Floating                | Output leakage current during overvoltage with floating supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                         | 25°C            | ±0.6 |     |     | μA   |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +85°C  | ±1.3 |     |     |      |  |
|                                            |                                                                         |                                                                                                                                                                 | −40°C to +125°C | ±2.3 |     |     |      |  |

## 6.8 12 V Single Supply: Electrical Characteristics (continued)

$V_{DD} = +12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

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

| PARAMETER                               |                                            | TEST CONDITIONS                                                                                                                                                                         | $T_A$           | MIN    | TYP  | MAX | UNIT          |
|-----------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|------|-----|---------------|
| <b>SWITCHING CHARACTERISTICS</b>        |                                            |                                                                                                                                                                                         |                 |        |      |     |               |
| $t_{\text{RESPONSE}}$                   | Fault response time                        | $V_{FP} = 8\text{ V}$ , $V_{FN} = 0\text{ V}$ ,<br>$R_L = 300\ \Omega$ , $C_L = 12\text{ pF}$                                                                                           | 25°C            | 500    | 600  |     | ns            |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +85°C  |        | 650  |     |               |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +125°C |        | 700  |     |               |
| $t_{\text{RECOVERY}}$                   | Fault recovery time                        | $V_{FP} = 8\text{ V}$ , $V_{FN} = 0\text{ V}$ ,<br>$R_L = 300\ \Omega$ , $C_L = 12\text{ pF}$                                                                                           | 25°C            | 850    | 2400 |     | ns            |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +85°C  |        | 2900 |     |               |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +125°C |        | 2900 |     |               |
| $t_{\text{RESPONSE(FLAG)}}$             | Fault flag response time                   | $V_{FP} = 8\text{ V}$ , $V_{FN} = 0\text{ V}$ ,<br>$V_{PU} = 5\text{ V}$ , $R_{PU} = 1\text{ k}\Omega$ , $C_L = 12\text{ pF}$                                                           | –40°C to +125°C | 110    |      |     | ns            |
| $t_{\text{RECOVERY(FLAG)}}$             | Fault flag recovery time                   | $V_{FP} = 8\text{ V}$ , $V_{FN} = 0\text{ V}$ ,<br>$V_{PU} = 5\text{ V}$ , $R_{PU} = 1\text{ k}\Omega$ , $C_L = 12\text{ pF}$                                                           | –40°C to +125°C | 0.8    |      |     | $\mu\text{s}$ |
| $t_{\text{RESPONSE(DR)}}$               | Fault output response time                 | $V_{FP} = 8\text{ V}$ , $V_{FN} = 0\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $C_L = 12\text{ pF}$                                                                                         | –40°C to +125°C | 3      |      |     | $\mu\text{s}$ |
| $X_{\text{TALK}}$                       | Inter-channel crosstalk                    | $R_S = 50\ \Omega$ , $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ,<br>$V_S = 200\text{ mV}_{\text{RMS}}$ , $V_{\text{BIAS}} = 2\text{ V}$ , $f = 1\text{ MHz}$                             | 25°C            | –100   |      |     | dB            |
| BW                                      | –3 dB bandwidth (WQFN Package)             | $R_S = 50\ \Omega$ , $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ,<br>$V_S = 200\text{ mV}_{\text{RMS}}$ , $V_{\text{BIAS}} = 2\text{ V}$                                                  | 25°C            | 620    |      |     | MHz           |
| BW                                      | –3 dB bandwidth (TSSOP Package)            | $R_S = 50\ \Omega$ , $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ,<br>$V_S = 200\text{ mV}_{\text{RMS}}$ , $V_{\text{BIAS}} = 2\text{ V}$                                                  | 25°C            | 560    |      |     | MHz           |
| $I_{\text{LOSS}}$                       | Insertion loss                             | $R_S = 50\ \Omega$ , $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ,<br>$V_S = 200\text{ mV}_{\text{RMS}}$ , $V_{\text{BIAS}} = 2\text{ V}$ , $f = 1\text{ MHz}$                             | 25°C            | –0.7   |      |     | dB            |
| THD+N                                   | Total harmonic distortion plus noise       | $R_S = 50\ \Omega$ , $R_L = 10\text{ k}\Omega$ ,<br>$V_S = 6\text{ V}_{\text{PP}}$ , $V_{\text{BIAS}} = 6\text{ V}$ ,<br>$f = 20\text{ Hz to } 20\text{ kHz}$                           | 25°C            | 0.0007 |      |     | %             |
| $C_{\text{S(ON)}}$ , $C_{\text{D(ON)}}$ | Input/Output on-capacitance                | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                                                                                                                                 | 25°C            | 16     |      |     | pF            |
| <b>POWER SUPPLY</b>                     |                                            |                                                                                                                                                                                         |                 |        |      |     |               |
| $I_{\text{DD}}$                         | $V_{\text{DD}}$ supply current             | $V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ ,<br>$V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$                           | 25°C            | 0.3    | 0.5  |     | mA            |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +85°C  |        | 0.5  |     | mA            |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +125°C |        | 0.6  |     | mA            |
| $I_{\text{GND}}$                        | GND current                                | $V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ ,<br>$V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$                           | 25°C            | 0.06   |      |     | mA            |
| $I_{\text{FP}}$                         | $V_{\text{FP}}$ supply current             | $V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ ,<br>$V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$                           | 25°C            | 10     |      |     | $\mu\text{A}$ |
| $I_{\text{FN}}$                         | $V_{\text{FN}}$ supply current             | $V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ ,<br>$V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$                           | 25°C            | 10     |      |     | $\mu\text{A}$ |
| $I_{\text{DD(FA)}}$                     | $V_{\text{DD}}$ supply current under fault | $V_S = \pm 60\text{ V}$ ,<br>$V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ , $V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$ | 25°C            | 0.32   | 0.5  |     | mA            |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +85°C  |        | 0.5  |     | mA            |
|                                         |                                            |                                                                                                                                                                                         | –40°C to +125°C |        | 0.6  |     | mA            |
| $I_{\text{GND(FA)}}$                    | GND current under fault                    | $V_S = \pm 60\text{ V}$ ,<br>$V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ , $V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$ | 25°C            | 0.16   |      |     | mA            |
| $I_{\text{FP(FA)}}$                     | $V_{\text{FP}}$ supply current under fault | $V_S = \pm 60\text{ V}$ ,<br>$V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ , $V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$ | 25°C            | 10     |      |     | $\mu\text{A}$ |
| $I_{\text{FN(FA)}}$                     | $V_{\text{FN}}$ supply current under fault | $V_S = \pm 60\text{ V}$ ,<br>$V_{\text{DD}} = V_{\text{FP}} = 13.2\text{ V}$ , $V_{\text{SS}} = V_{\text{FN}} = 0\text{ V}$ ,<br>$V_{\text{DR}} = 0\text{ V}$ , 5 V, or $V_{\text{DD}}$ | 25°C            | 10     |      |     | $\mu\text{A}$ |

(1) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

## 6.9 36 V Single Supply: Electrical Characteristics

$V_{DD} = +36 \text{ V} \pm 10\%$ ,  $V_{SS} = 0 \text{ V}$ ,  $GND = 0 \text{ V}$  (unless otherwise noted)

Typical at  $V_{DD} = +36 \text{ V}$ ,  $V_{SS} = 0 \text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                  |                                                                         | TEST CONDITIONS                                                                                                                                                        | T <sub>A</sub>  | MIN  | TYP  | MAX | UNIT |
|--------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------|-----|------|
| ANALOG SWITCH                              |                                                                         |                                                                                                                                                                        |                 |      |      |     |      |
| R <sub>ON</sub>                            | On-resistance                                                           | V <sub>S</sub> = 0 V to 30 V,<br>I <sub>S</sub> = −10 mA                                                                                                               | 25°C            |      | 8.3  | 11  | Ω    |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  |      |      | 14  |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C |      |      | 17  |      |
| ΔR <sub>ON</sub>                           | On-resistance mismatch between channels                                 | V <sub>S</sub> = 0 V to 30 V,<br>I <sub>S</sub> = −10 mA                                                                                                               | 25°C            |      | 0.05 | 0.5 | Ω    |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  |      |      | 0.6 |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C |      |      | 0.7 |      |
| R <sub>FLAT</sub>                          | On-resistance flatness                                                  | V <sub>S</sub> = 0 V to 30 V,<br>I <sub>S</sub> = −10 mA                                                                                                               | 25°C            |      | 0.06 | 0.9 | Ω    |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  |      |      | 1.1 |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C |      |      | 1.3 |      |
| R <sub>ON_DRIFT</sub>                      | On-resistance drift                                                     | V <sub>S</sub> = 18 V, I <sub>S</sub> = −10 mA                                                                                                                         | −40°C to +125°C |      | 0.04 |     | Ω/°C |
| I <sub>S(ON)</sub> ,<br>I <sub>D(ON)</sub> | Output on leakage current <sup>(1)</sup>                                | Switch state is on,<br>V <sub>DD</sub> = 39.6 V, V <sub>SS</sub> = 0 V,<br>V <sub>S</sub> = V <sub>D</sub> = 1 V/ 30 V                                                 | 25°C            | −0.7 | 0.2  | 0.7 | nA   |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  | −2   |      | 2   |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C | −15  |      | 15  |      |
| FAULT CONDITION                            |                                                                         |                                                                                                                                                                        |                 |      |      |     |      |
| I <sub>S(FA)</sub>                         | Input leakage current during overvoltage                                | V <sub>S</sub> = 60 V / −40 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V                                       | −40°C to +125°C |      | ±98  |     | μA   |
| I <sub>S(FA)</sub> Grounded                | Input leakage current during overvoltage with grounded supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                                     | −40°C to +125°C |      | ±135 |     | μA   |
| I <sub>S(FA)</sub> Floating                | Input leakage current during overvoltage with floating supply voltages  | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                                | −40°C to +125°C |      | ±140 |     | μA   |
| I <sub>D(FA)</sub>                         | Output leakage current during overvoltage                               | V <sub>S</sub> = 60 V / −40 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.2 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 5 V or floating | 25°C            | −20  | ±2   | 20  | nA   |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  | −30  |      | 30  |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C | −50  |      | 50  |      |
| I <sub>D(FA)</sub> Grounded                | Output leakage current during overvoltage with grounded supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = 0 V                                                     | 25°C            | −30  | ±10  | 30  | nA   |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  | −50  |      | 50  |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C | −90  |      | 90  |      |
| I <sub>D(FA)</sub> Floating                | Output leakage current during overvoltage with floating supply voltages | V <sub>S</sub> = ± 60 V, GND = 0 V,<br>V <sub>DD</sub> = V <sub>SS</sub> = V <sub>FP</sub> = V <sub>FN</sub> = floating                                                | 25°C            |      | ±0.6 |     | μA   |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +85°C  |      | ±1.3 |     |      |
|                                            |                                                                         |                                                                                                                                                                        | −40°C to +125°C |      | ±2.3 |     |      |

## 6.9 36 V Single Supply: Electrical Characteristics (continued)

$V_{DD} = +36\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

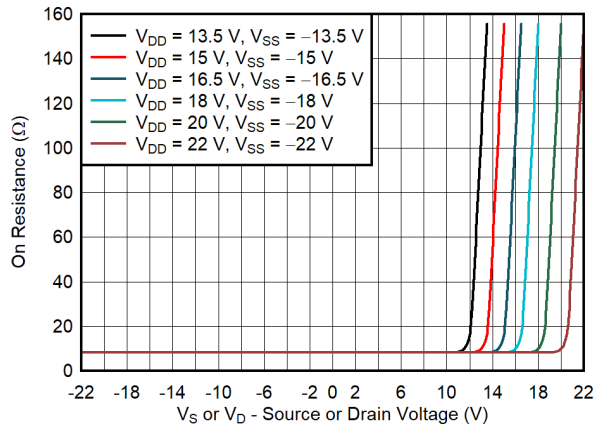
Typical at  $V_{DD} = +36\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                               |                                            | TEST CONDITIONS                                                                                                                                                        | T <sub>A</sub>  | MIN    | TYP  | MAX | UNIT |
|-----------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|------|-----|------|
| SWITCHING CHARACTERISTICS               |                                            |                                                                                                                                                                        |                 |        |      |     |      |
| t <sub>RESPONSE</sub>                   | Fault response time                        | V <sub>FP</sub> = 18 V, V <sub>FN</sub> = 0 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 12 pF                                                                       | 25°C            | 150    | 310  | ns  |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 330  |     |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 350  |     |      |
| t <sub>RECOVERY</sub>                   | Fault recovery time                        | V <sub>FP</sub> = 18 V, V <sub>FN</sub> = 0 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 12 pF                                                                       | 25°C            | 1100   | 2200 | ns  |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 2700 |     |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 2700 |     |      |
| t <sub>RESPONSE(FLAG)</sub>             | Fault flag response time                   | V <sub>FP</sub> = 18 V, V <sub>FN</sub> = 0 V,<br>V <sub>PU</sub> = 5 V, R <sub>PU</sub> = 1 kΩ, C <sub>L</sub> = 12 pF                                                | −40°C to +125°C | 110    |      | ns  |      |
| t <sub>RECOVERY(FLAG)</sub>             | Fault flag recovery time                   | V <sub>FP</sub> = 18 V, V <sub>FN</sub> = 0 V,<br>V <sub>PU</sub> = 5 V, R <sub>PU</sub> = 1 kΩ, C <sub>L</sub> = 12 pF                                                | −40°C to +125°C | 0.8    |      | μs  |      |
| t <sub>RESPONSE(DR)</sub>               | Fault output response time                 | V <sub>FP</sub> = 8 V, V <sub>FN</sub> = 0 V,<br>R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 12 pF                                                                         | −40°C to +125°C | 2.7    |      | μs  |      |
| X <sub>TALK</sub>                       | Inter-channel crosstalk                    | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200m V <sub>RMS</sub> , V <sub>BIAS</sub> = 2 V, f = 1 MHz                    | 25°C            | −100   |      | dB  |      |
| BW                                      | −3 dB bandwidth (WQFN Package)             | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 2 V                               | 25°C            | 600    |      | MHz |      |
| BW                                      | −3 dB bandwidth (TSSOP Package)            | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 2 V                               | 25°C            | 580    |      | MHz |      |
| I <sub>LOSS</sub>                       | Insertion loss                             | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>V <sub>S</sub> = 200 mV <sub>RMS</sub> , V <sub>BIAS</sub> = 2 V, f = 1 MHz                    | 25°C            | −0.7   |      | dB  |      |
| THD+N                                   | Total harmonic distortion plus noise       | R <sub>S</sub> = 50 Ω, R <sub>L</sub> = 10 kΩ,<br>V <sub>S</sub> = 18 V <sub>PP</sub> , V <sub>BIAS</sub> = 18 V,<br>f = 20 Hz to 20 kHz                               | 25°C            | 0.0006 |      | %   |      |
| C <sub>S(ON)</sub> , C <sub>D(ON)</sub> | Input/Output on-capacitance                | f = 1 MHz, V <sub>S</sub> = 18 V                                                                                                                                       | 25°C            | 17     |      | pF  |      |
| POWER SUPPLY                            |                                            |                                                                                                                                                                        |                 |        |      |     |      |
| I <sub>DD</sub>                         | V <sub>DD</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                                 | 25°C            | 0.3    | 0.5  | mA  |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 0.5  |     |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 0.6  |     |      |
| I <sub>SS</sub>                         | V <sub>SS</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub>                                  | 25°C            | 0.25   |      | mA  |      |
| I <sub>GND</sub>                        | GND current                                | V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 5 V, or V <sub>DD</sub>                                      | 25°C            | 0.07   |      | mA  |      |
| I <sub>FP</sub>                         | V <sub>FP</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 5 V, or V <sub>DD</sub>                                      | 25°C            | 10     |      | μA  |      |
| I <sub>FN</sub>                         | V <sub>FN</sub> supply current             | V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 5 V, or V <sub>DD</sub>                                      | 25°C            | 10     |      | μA  |      |
| I <sub>DD(FA)</sub>                     | V <sub>DD</sub> supply current under fault | V <sub>S</sub> = 60 / −40 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 0.32   | 0.5  | mA  |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +85°C  |        | 0.5  |     |      |
|                                         |                                            |                                                                                                                                                                        | −40°C to +125°C |        | 0.6  |     |      |
| I <sub>SS(FA)</sub>                     | V <sub>SS</sub> supply current under fault | V <sub>S</sub> = 60 / −40 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 0.18   |      | mA  |      |
| I <sub>GND(FA)</sub>                    | GND current under fault                    | V <sub>S</sub> = 60 / −40 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 0.12   |      | mA  |      |
| I <sub>FP(FA)</sub>                     | V <sub>FP</sub> supply current under fault | V <sub>S</sub> = 60 / −40 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 10     |      | μA  |      |
| I <sub>FN(FA)</sub>                     | V <sub>FN</sub> supply current under fault | V <sub>S</sub> = 60 / −40 V,<br>V <sub>DD</sub> = V <sub>FP</sub> = 39.6 V, V <sub>SS</sub> = V <sub>FN</sub> = 0 V,<br>V <sub>DR</sub> = 0 V, 5 V, or V <sub>DD</sub> | 25°C            | 10     |      | μA  |      |

(1) When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.

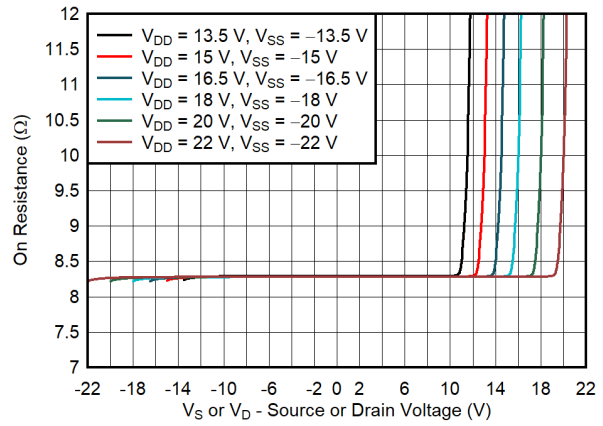
## 6.10 Typical Characteristics

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



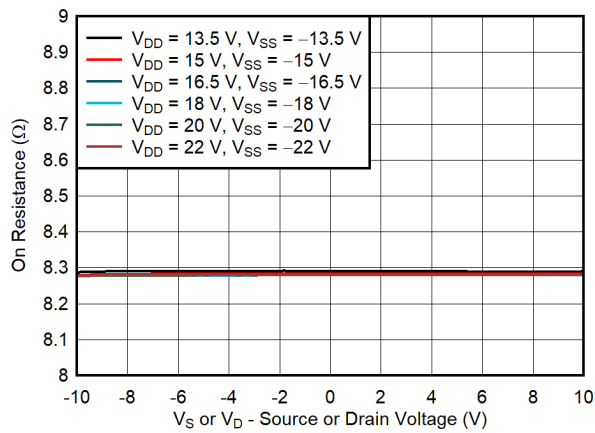
Dual Supply Voltages

Figure 6-1. On-Resistance vs Source or Drain Voltage



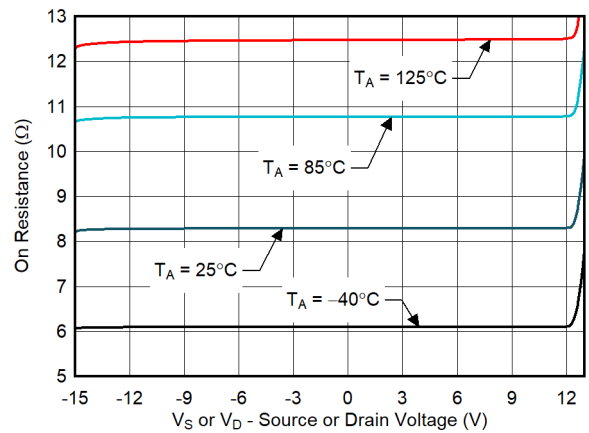
Dual Supply Flat Ron Region

Figure 6-2. On-Resistance vs Source or Drain Voltage



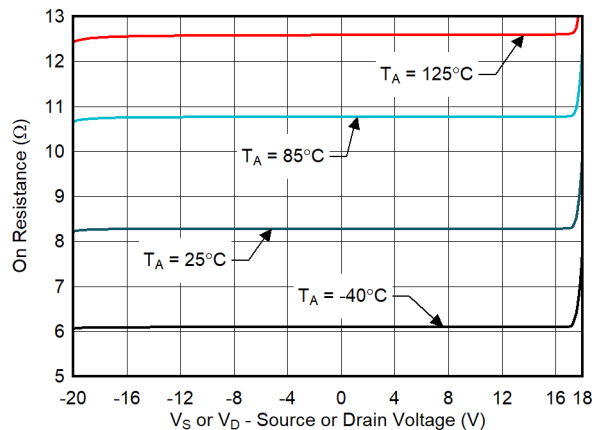
Flattest  $R_{ON}$  region for all supply voltages shown

Figure 6-3. On-Resistance vs Source or Drain Voltage



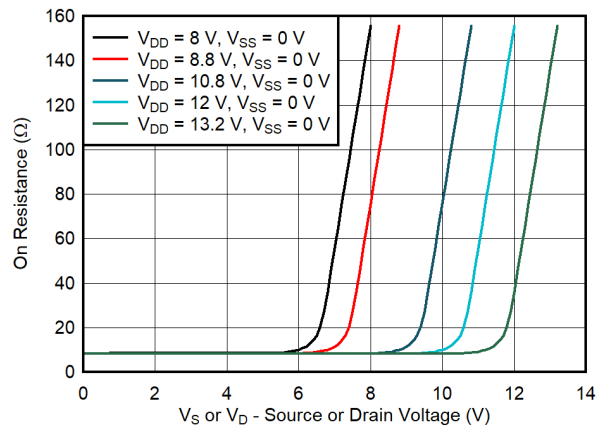
$\pm 15\text{ V}$  Supply Flattest Ron Region

Figure 6-4. On-Resistance vs Source or Drain Voltage



$\pm 20\text{ V}$  Supply Flattest Ron Region

Figure 6-5. On-Resistance vs Source or Drain Voltage

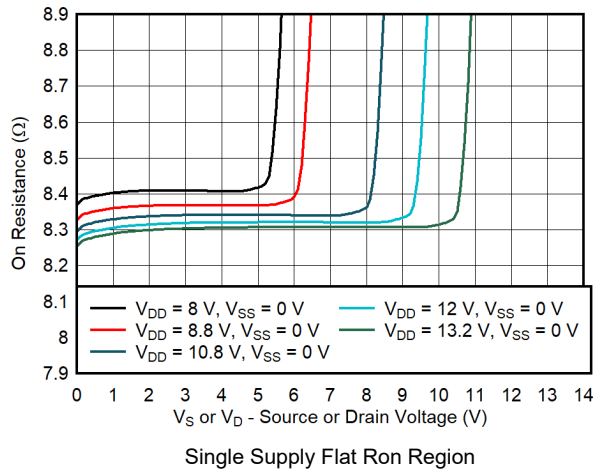


Single Supply Voltages

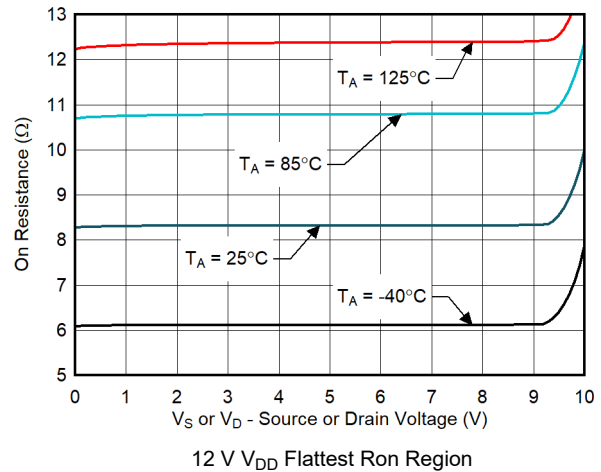
Figure 6-6. On-Resistance vs Source or Drain Voltage

## 6.10 Typical Characteristics (continued)

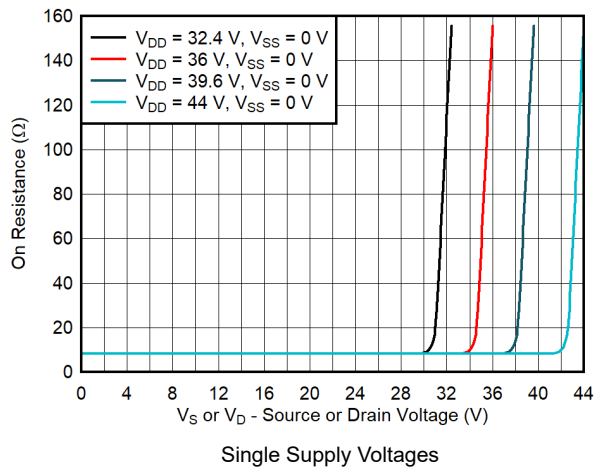
at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 15\text{ V}$ , and  $V_{SS} = -15\text{ V}$  (unless otherwise noted)



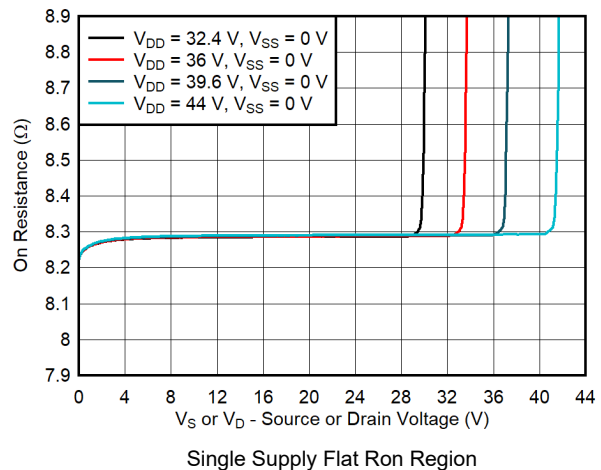
**Figure 6-7. On-Resistance vs Source or Drain Voltage**



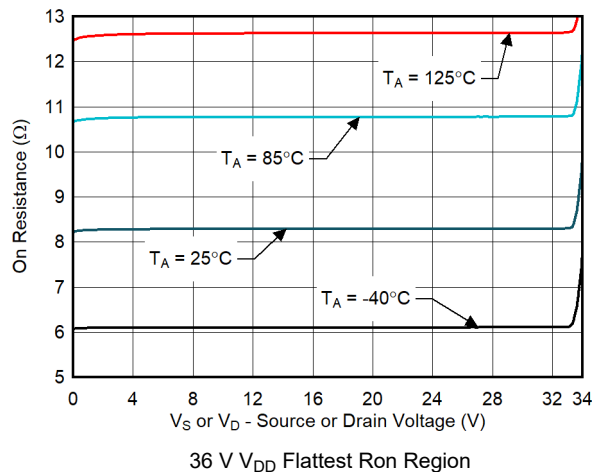
**Figure 6-8. On-Resistance vs Source or Drain Voltage**



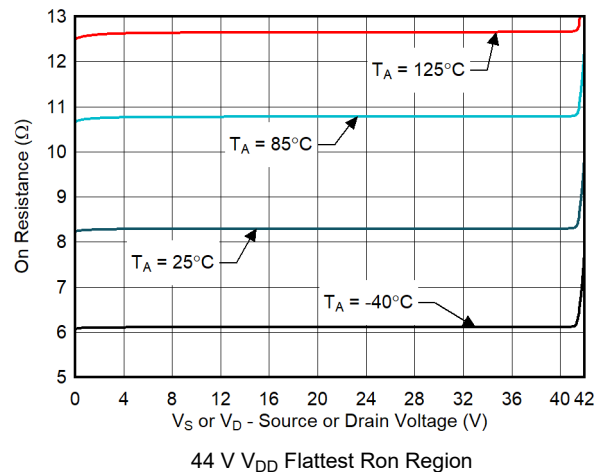
**Figure 6-9. On-Resistance vs Source or Drain Voltage**



**Figure 6-10. On-Resistance vs Source or Drain Voltage**



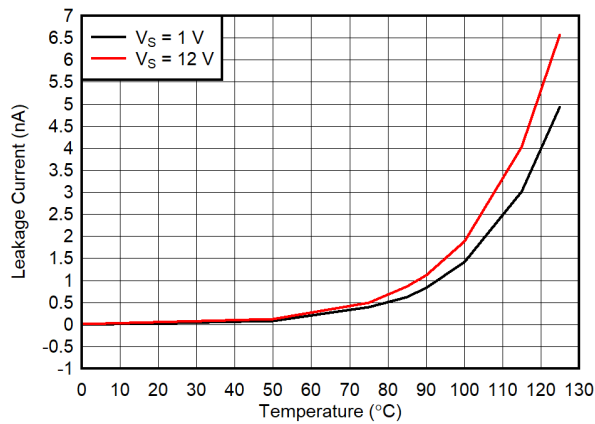
**Figure 6-11. On-Resistance vs Source or Drain Voltage**



**Figure 6-12. On-Resistance vs Source or Drain Voltage**

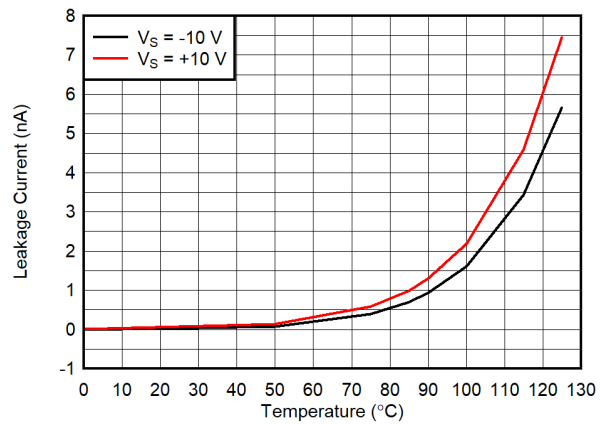
## 6.10 Typical Characteristics (continued)

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



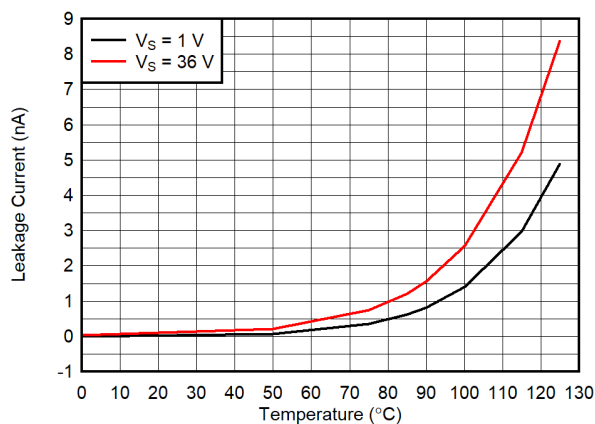
$V_{DD} = 12\text{ V}$ ,  $V_{SS} = 0\text{ V}$

Figure 6-13.  $I_{ON}$  Leakage Current vs Temperature



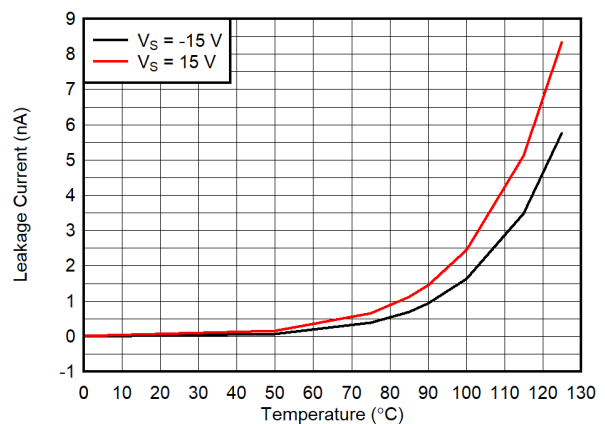
$V_{DD} = 15\text{ V}$ ,  $V_{SS} = -15\text{ V}$

Figure 6-14.  $I_{ON}$  Leakage Current vs Temperature



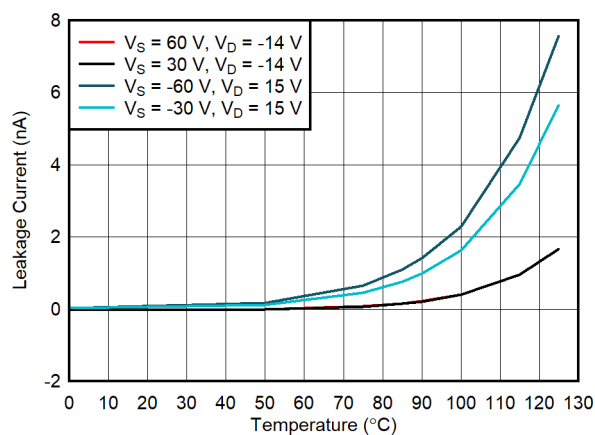
$V_{DD} = 36\text{ V}$ ,  $V_{SS} = 0\text{ V}$

Figure 6-15.  $I_{ON}$  Leakage Current vs Temperature



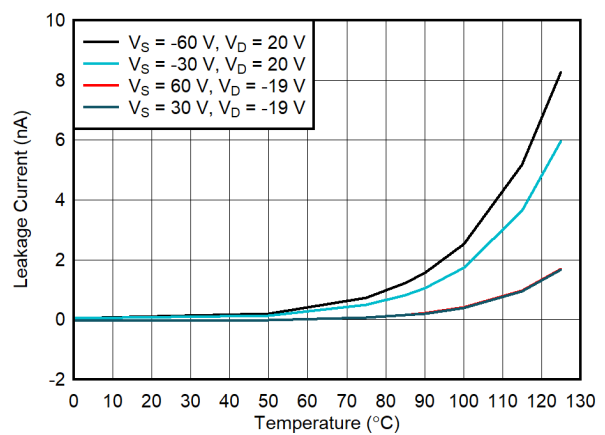
$V_{DD} = +20\text{ V}$ ,  $V_{SS} = -20\text{ V}$

Figure 6-16.  $I_{ON}$  Leakage Current vs Temperature



$\pm 15\text{ V}$  Dual Supply

Figure 6-17.  $I_{D(FA)}$  Overvoltage Leakage Current vs Temperature



$\pm 20\text{ V}$  Dual Supply

Figure 6-18.  $I_{D(FA)}$  Overvoltage Leakage Current vs Temperature

## 6.10 Typical Characteristics (continued)

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

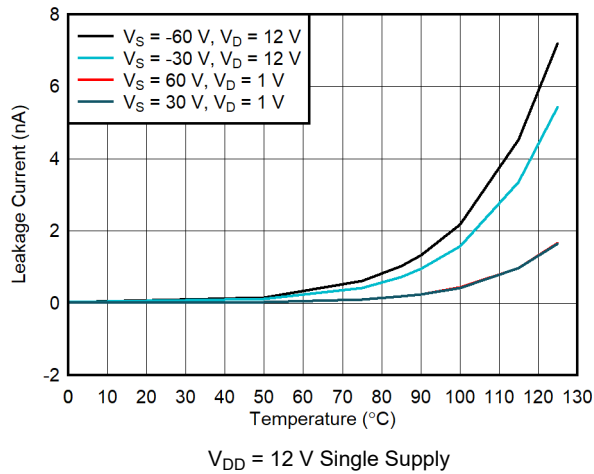


Figure 6-19.  $I_{D(FA)}$  Overvoltage Leakage Current vs Temperature

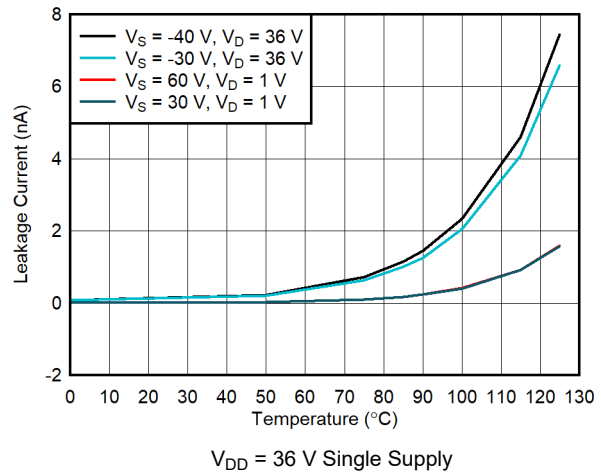


Figure 6-20.  $I_{D(FA)}$  Overvoltage Leakage Current vs Temperature

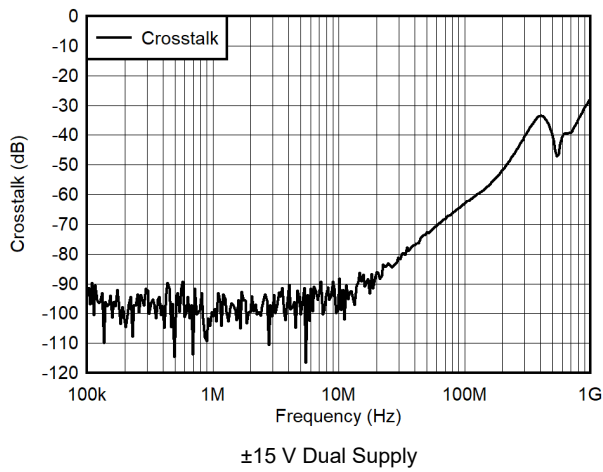


Figure 6-21. Crosstalk vs Frequency

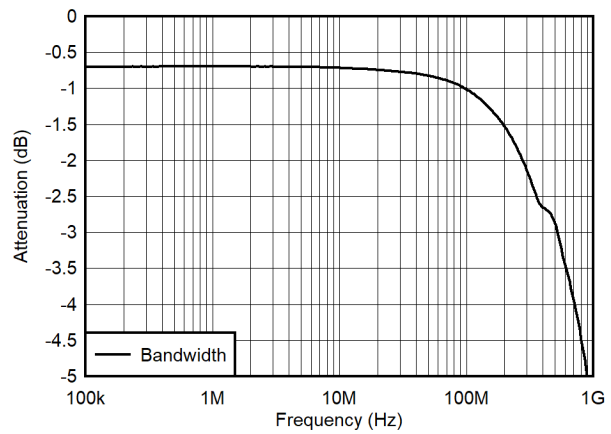


Figure 6-22. Insertion Loss vs Frequency

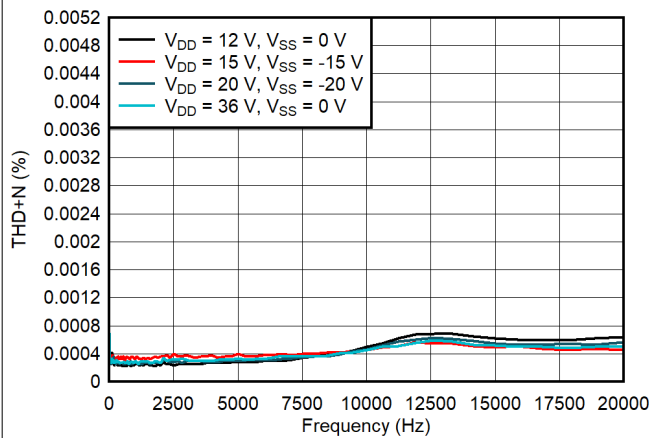


Figure 6-23. THD+N vs Frequency

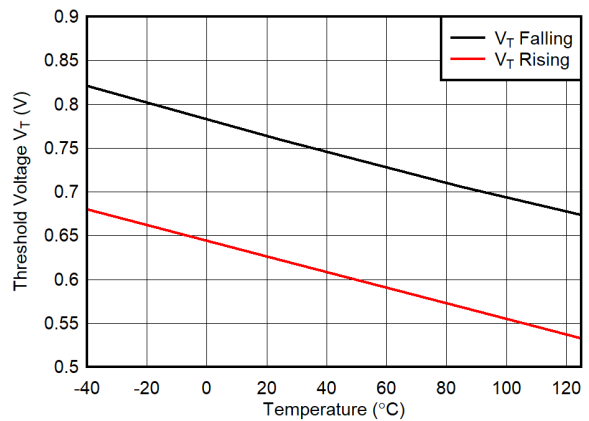
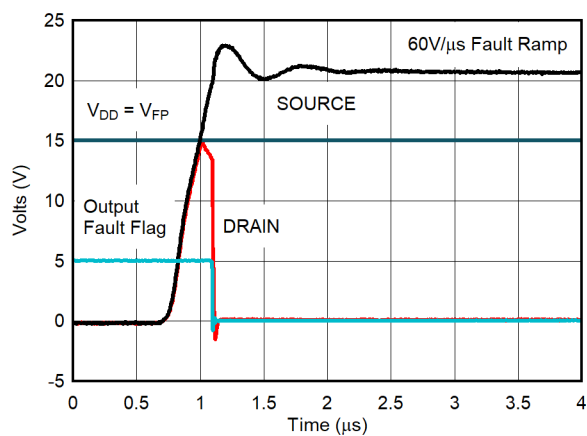


Figure 6-24. Threshold Voltage vs Temperature

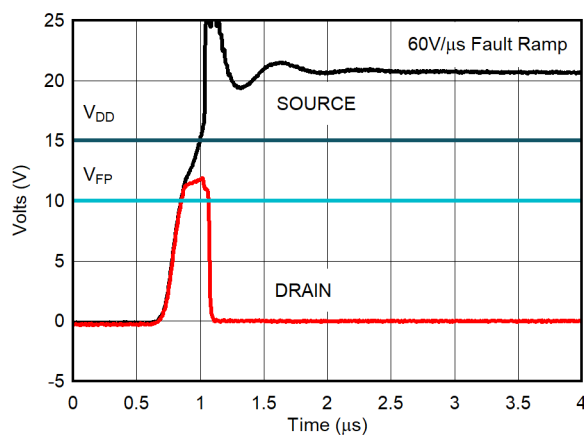
## 6.10 Typical Characteristics (continued)

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



$V_{DD} = V_{FP} = 15\text{ V}$

Figure 6-25. Drain Output Response - Positive Overvoltage



$V_{DD} = 15\text{ V}$ ,  $V_{FP} = 10\text{ V}$

Figure 6-26. Drain Output Response - Positive Overvoltage

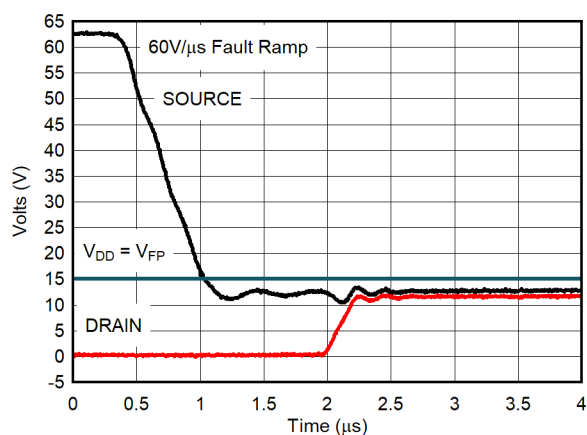


Figure 6-27. Drain Output Recovery - Positive Overvoltage

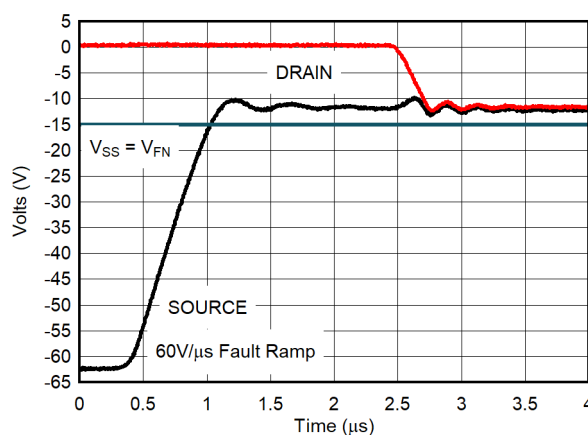


Figure 6-28. Drain Output Recovery - Negative Overvoltage

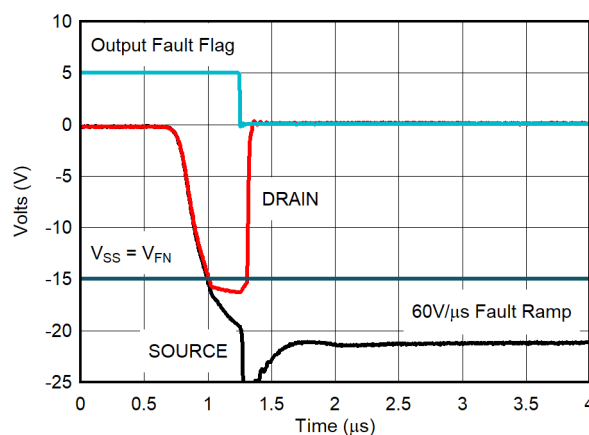
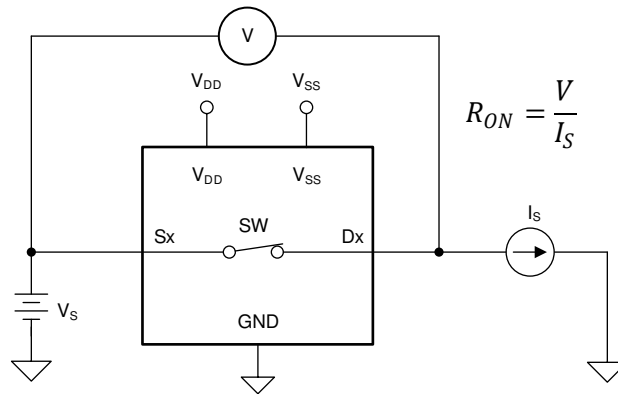


Figure 6-29. Drain Output Response - Negative Overvoltage

## 7 Parameter Measurement Information

### 7.1 On-Resistance

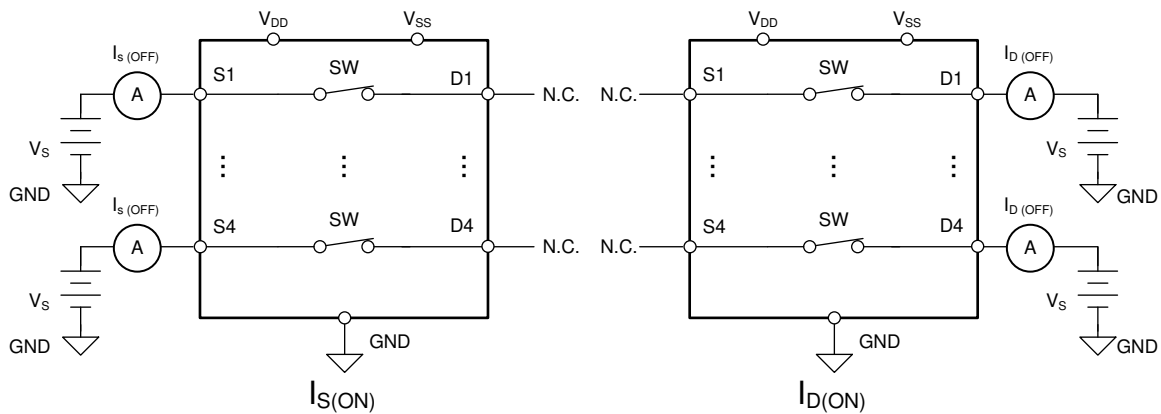
The TMUX7462F's on-resistance is the ohmic resistance across the source (Sx) and drain (Dx) pins of the device. The on-resistance varies with input voltage and supply voltage. The symbol  $R_{ON}$  is used to denote on-resistance. The measurement setup used to measure  $R_{ON}$  is shown in Figure 7-1.  $\Delta R_{ON}$  represents the difference between the  $R_{ON}$  of any two channels, while  $R_{ON\_FLAT}$  denotes the flatness that is defined as the difference between the maximum and minimum value of on-resistance measured over the specified analog signal range.



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

### 7.2 On-Leakage Current

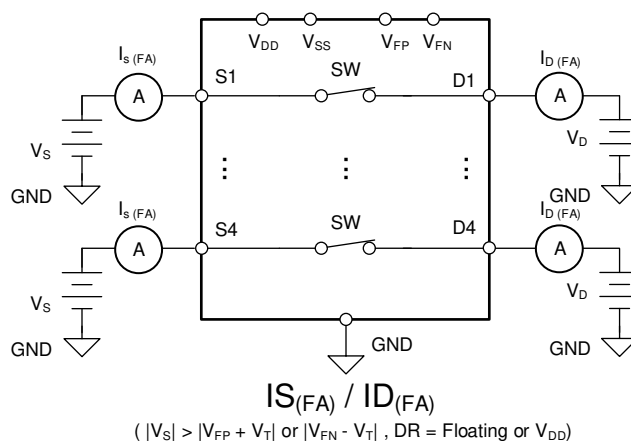
Source on-leakage current ( $I_{S(ON)}$ ) and drain on-leakage current ( $I_{D(ON)}$ ) denotes the channel leakage currents when the switch is in the on state.  $I_{S(ON)}$  is measured with the drain floating, while  $I_{D(ON)}$  is measured with the source floating. Figure 7-2 shows the circuit used for measuring the on-leakage currents.



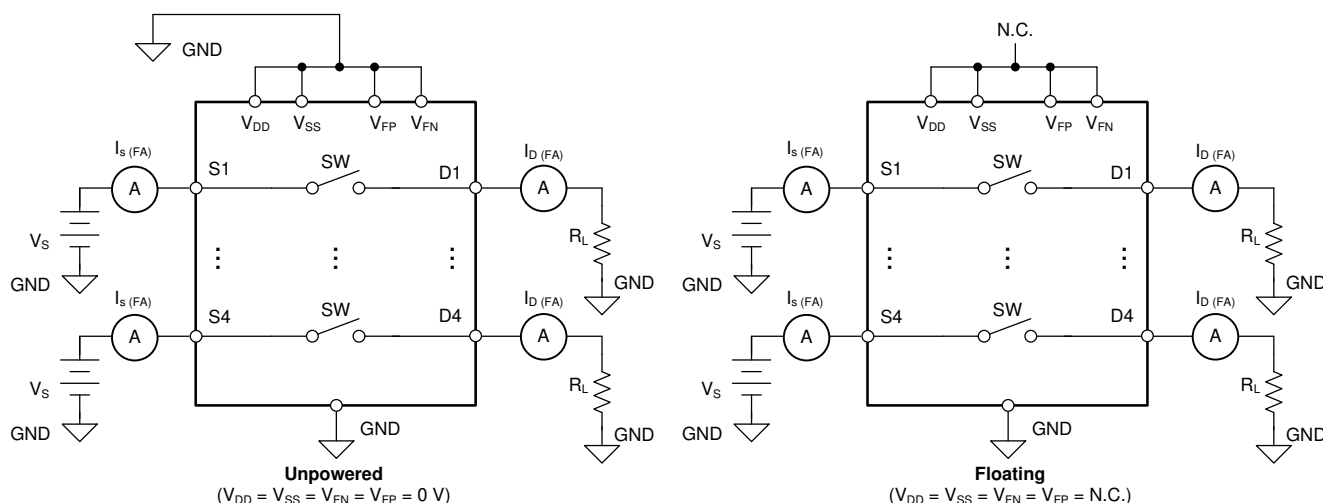
**Figure 7-2. On-Leakage Measurement Setup**

### 7.3 Input and Output Leakage Current under Overvoltage Fault

If any of the source pin voltage goes above the fault supplies ( $V_{FP}$  or  $V_{FN}$ ) by one threshold voltage ( $V_T$ ), the TMUX7462F's overvoltage protection feature is triggered to turn off the switch under fault, keeping the fault channel in the high-impedance state.  $I_{S(FA)}$  and  $I_{D(FA)}$  denotes the input and output leakage current under overvoltage fault conditions, respectively. The supply (or supplies) can either be in normal operating condition (Figure 7-3) or abnormal operating condition (Figure 7-4) when the overvoltage fault occurs. The supply (or supplies) can either be unpowered ( $V_{DD} = V_{SS} = V_{FN} = V_{FP} = 0$  V), floating ( $V_{DD} = V_{SS} = V_{FN} = V_{FP} = \text{No Connection}$ ), or at any level that is below the undervoltage (UV) threshold during abnormal operating conditions.



**Figure 7-3. Measurement Setup for Input and Output Leakage Current Under Overvoltage Fault with Normal Supplies**



**Figure 7-4. Measurement Setup for Input and Output Leakage Current Under Overvoltage Fault with Unpowered or Floating Supplies**

## 7.4 Fault Response Time

Fault response time ( $t_{\text{RESPONSE}}$ ) measures the delay between the source voltage exceeding the fault supply voltage ( $V_{\text{FP}}$  or  $V_{\text{FN}}$ ) by 0.5V and the drain voltage failing to 90% of the fault supply voltage exceeded. Figure 7-5 shows the setup used to measure  $t_{\text{RESPONSE}}$ .

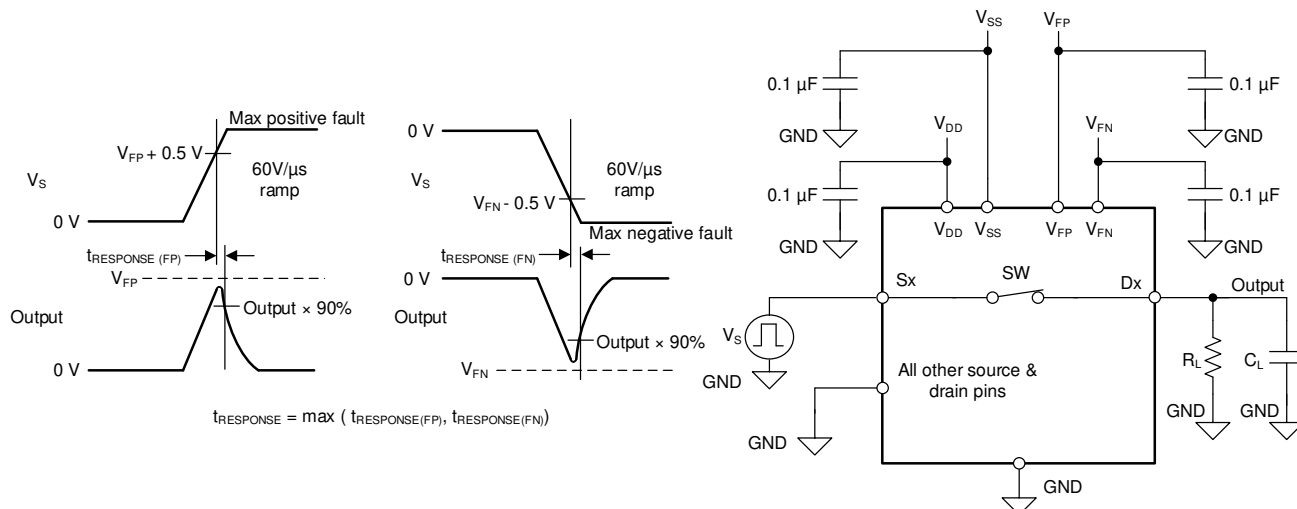


Figure 7-5. Fault Response Time Measurement Setup

## 7.5 Fault Recovery Time

Fault recovery time ( $t_{\text{RECOVERY}}$ ) measures the delay between the source voltage falling from overvoltage condition to below fault supply voltage ( $V_{\text{FP}}$  or  $V_{\text{FN}}$ ) plus 0.5 V and the drain voltage rising from 0V to 50% of the fault supply voltage exceeded. Figure 7-6 shows the setup used to measure  $t_{\text{RECOVERY}}$ .

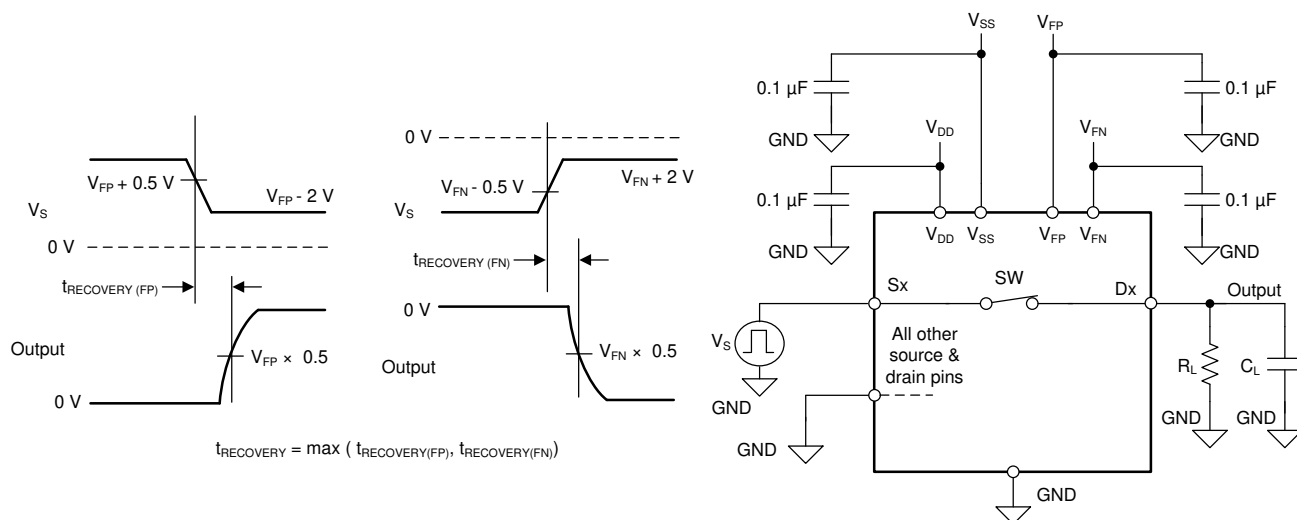


Figure 7-6. Fault Recovery Time Measurement Setup

## 7.6 Fault Flag Response Time

Fault flag response time ( $t_{\text{RESPONSE(FLAG)}}$ ) measures the delay between the source voltage exceeding the fault supply voltage ( $V_{\text{FP}}$  or  $V_{\text{FN}}$ ) by 0.5 V and the general fault flag (FF) pin to go below 10% of its original value.

Figure 7-7 shows the setup used to measure  $t_{\text{RESPONSE(FLAG)}}$ .

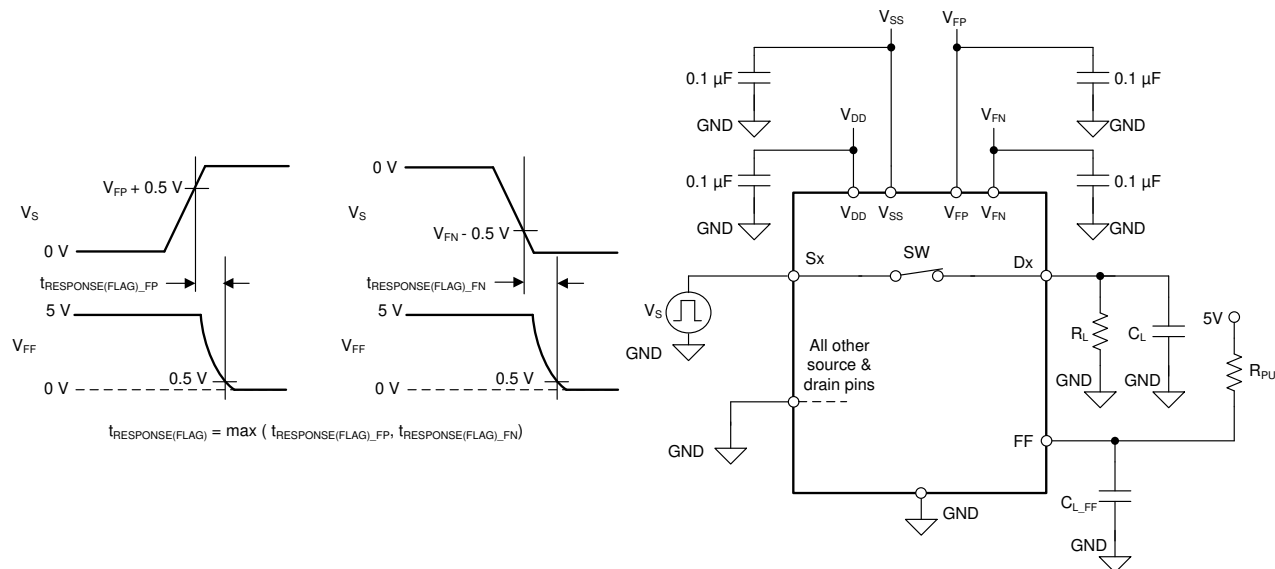


Figure 7-7. Fault Flag Response Time Measurement Setup

## 7.7 Fault Flag Recovery Time

Fault flag recovery time ( $t_{\text{RECOVERY(FLAG)}}$ ) measures the delay between the source voltage falling from the overvoltage condition to below the fault supply voltage ( $V_{\text{FP}}$  or  $V_{\text{FN}}$ ) plus 0.5 V and the general fault flag (FF) pin to rise above 3 V with 5 V external pull-up. Figure 7-8 shows the setup used to measure  $t_{\text{RECOVERY(FLAG)}}$ .

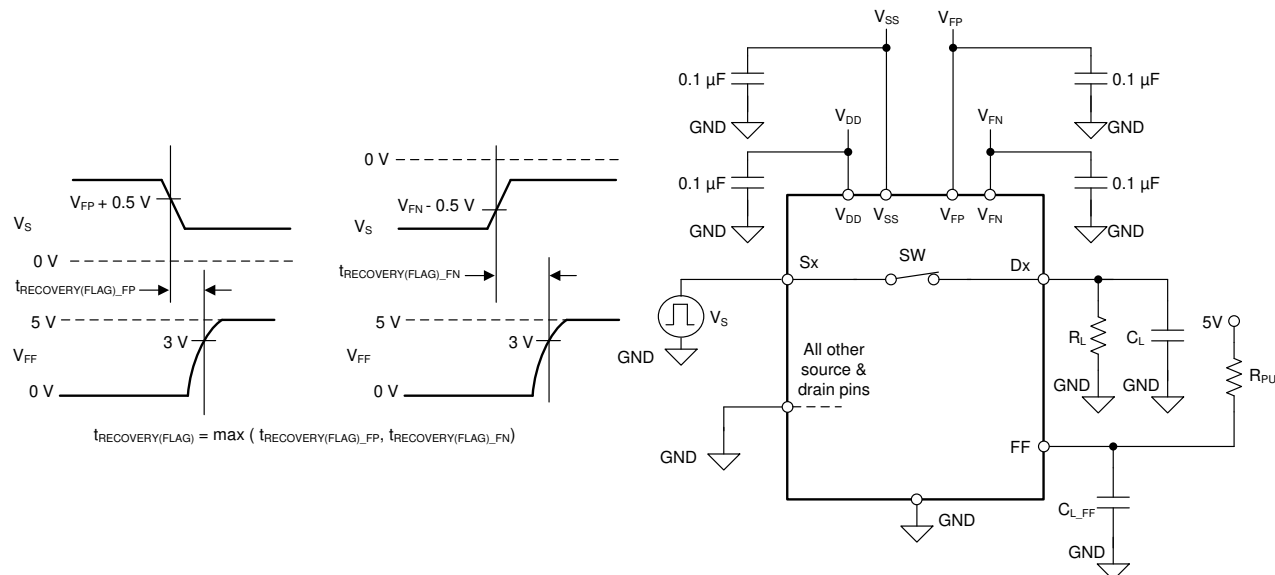


Figure 7-8. Fault Flag Recovery Time Measurement Setup

## 7.8 Fault Drain Enable Time

$t_{\text{RESPONSE(DR)}}$  represents the delay between the voltage at the DR pin falling from a high to low signal and the output of the drain pin reaching 90% of the fault supplies ( $V_{FP}$  or  $V_{FN}$ ).  $t_{\text{RESPONSE(DR)}}$  is a measure of how quickly the internal pull-up engages in response to the DR pin. Figure 7-9 shows the setup used to measure  $t_{\text{RESPONSE(DR)}}$ .

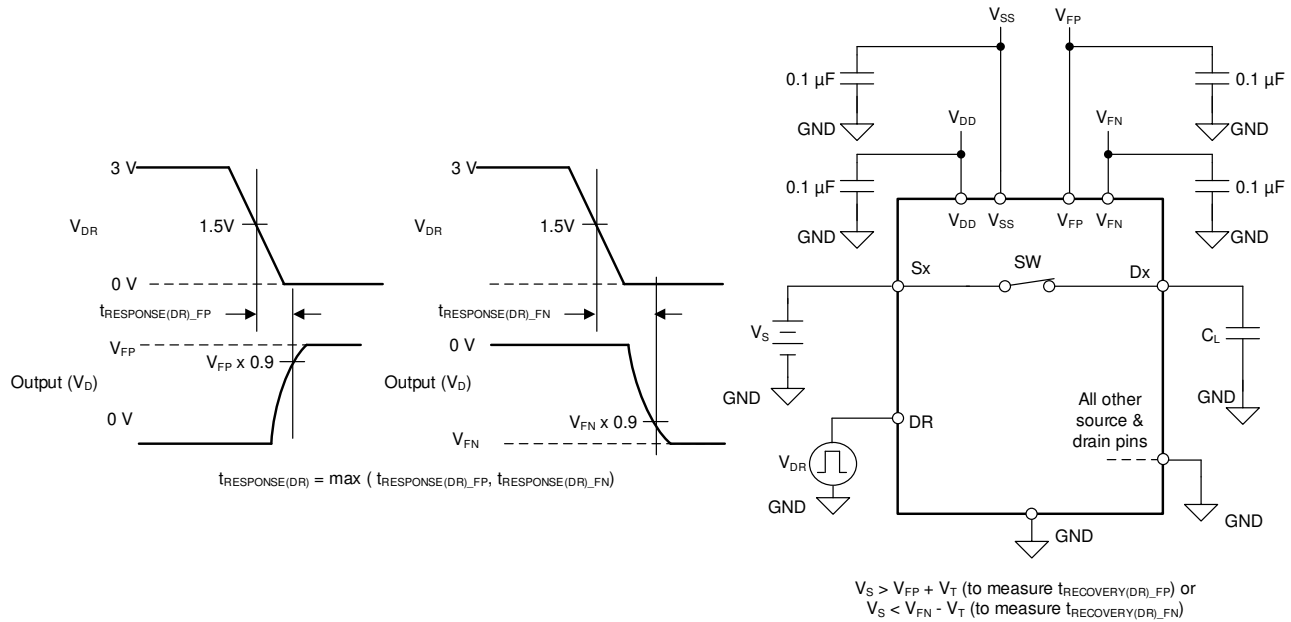


Figure 7-9. Fault Drain Enable Time Measurement Setup

## 7.9 Inter-Channel Crosstalk

Figure 7-10 and Equation 1 shows how the inter-channel crosstalk ( $X_{\text{TALK(INTER)}}$ ) is measured as the voltage at the source pin ( $S_x$ ) of an on-switch input, when a  $1-V_{\text{RMS}}$  signal is applied at the source pin of an on-switch input in a different channel.

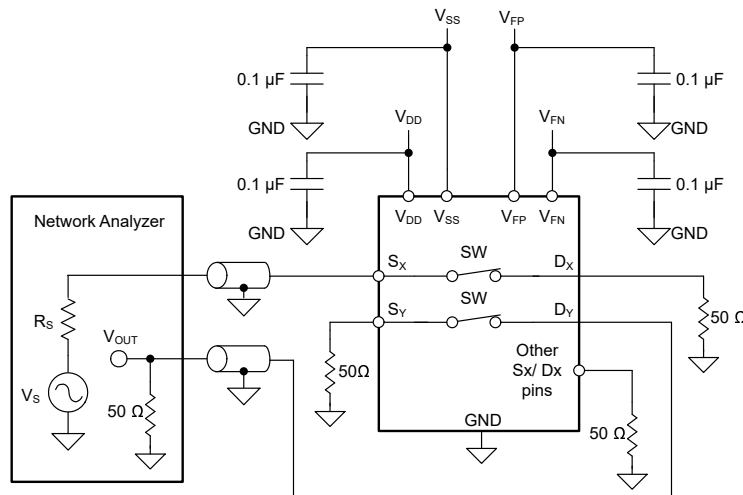
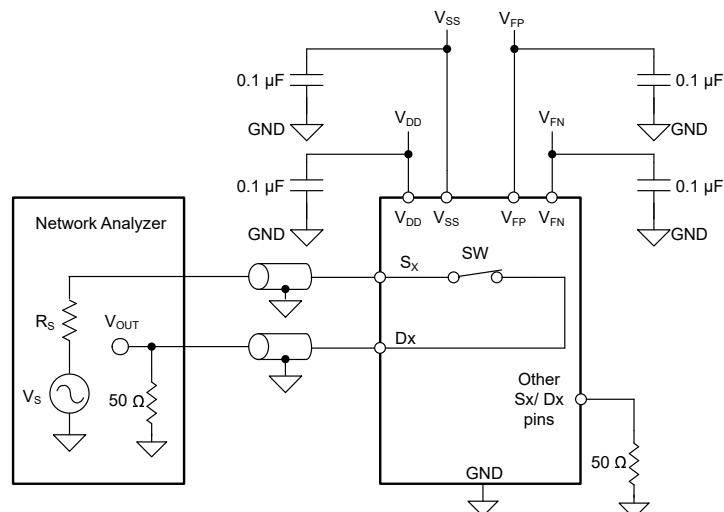


Figure 7-10. Inter-Channel Crosstalk Measurement Setup

$$\text{Inter-channel Crosstalk} = 20 \times \log \frac{V_{\text{OUT}}}{V_S} \quad (1)$$

## 7.10 Bandwidth

Bandwidth (BW) is defined as the range of frequencies that are attenuated by < 3 dB when the input is applied to the source pin (Sx) of an on-channel, and the output is measured at the TMUX7462F's drain pin (D or Dx). [Figure 7-11](#) and [Equation 2](#) shows the setup used to measure bandwidth of the switch.

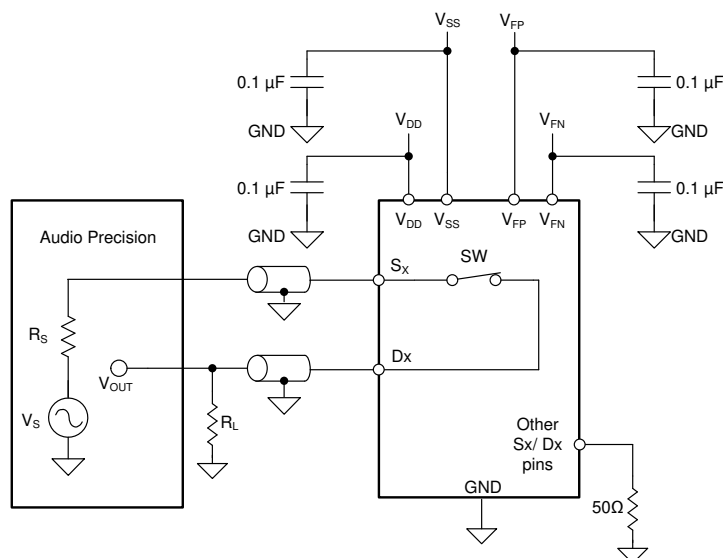


**Figure 7-11. Bandwidth Measurement Setup**

$$\text{Bandwidth} = 20 \times \log \frac{V_{OUT}}{V_S} \quad (2)$$

## 7.11 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 multiplexer output. The on-resistance of the TMUX7462F 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 7-12](#) shows the setup used to measure THD+N of the devices.



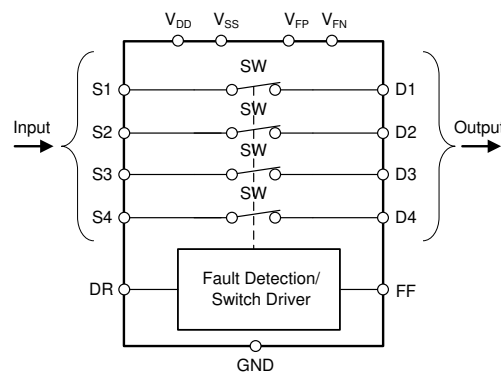
**Figure 7-12. THD+N Measurement Setup**

## 8 Detailed Description

### 8.1 Overview

The TMUX7462F is a four-channel protector that can be placed in series with the signal path to protect sensitive components downstream from overvoltage faults. The channel protector prevents overvoltages in both powered and powered-off conditions, making it suitable for applications where correct power supply sequencing cannot be precisely controlled. The powered-off condition includes floating power supplies, grounded power supplies, or power supplies at any level that are below the undervoltage (UV) threshold. The internal switch is turned-on and turned-off autonomously based on the fault situation without the need of external controls, making the device extremely easy to implement in the system. The primary supply voltages define the on-resistance profile, while the secondary supply voltages define the voltage level at which the overvoltage protection engages. The device works well with dual supplies ( $\pm 5\text{ V}$  to  $\pm 22\text{ V}$ ), a single supply (8 V to 44 V), or asymmetric supplies (such as  $V_{DD} = 12\text{ V}$ ,  $V_{SS} = -5\text{ V}$ ).

### 8.2 Functional Block Diagram



### 8.3 Feature Description

#### 8.3.1 Flat ON-Resistance

The TMUX7462F are designed with a special switch architecture to produce ultra-flat on-resistance ( $R_{ON}$ ) across most of the switch input operation region. The flat  $R_{ON}$  response allows the device to be used in precision sensor applications since the  $R_{ON}$  is controlled regardless of the signals sampled. The architecture is implemented without a charge pump so no unwanted noise is produced from the device to affect sampling accuracy.

#### 8.3.2 Protection Features

The TMUX7462F offers a number of protection features to enable robust system implementations.

##### 8.3.2.1 Input Voltage Tolerance

The maximum voltage that can be applied to any source input pin is +60 V or -60 V, allowing the device to handle typical voltage fault conditions in industrial applications. Take caution: the device has different maximum stress ratings across different pin combinations and are defined as the following:

##### 1. Between source pins and supply rails: 85 V

For example, if the device is powered by  $V_{DD}$  supply of 25 V, then the maximum negative signal level on any source pin is -60 V. If the device is powered by  $V_{DD}$  supply of 40 V, then the maximum negative signal level on any source pin is reduced to -45 V to maintain the 85 V maximum rating across the source pin and the supply.

##### 2. Between source pins and drain pin of the same channel: 85 V

For example, if the DR pin is left floating and an overvoltage voltage fault of -60 V occurs on the source pin S1, then the maximum positive voltage signal level driven on the drain pin channel D1 is 25 V to maintain the 85 V maximum rating across the source pin and the drain pin.

### 8.3.2.2 Powered-Off Protection

The source (Sx) pins of the device remain in the high impedance (Hi-Z) state, and the device performance remains within the leakage performance specifications when the supplies of TMUX7462F are removed ( $V_{DD}/V_{SS} = 0\text{ V}$  or floating) or at a level that is below the undervoltage (UV) threshold. Powered-off protection minimizes system design complexity by removing the need to control the system's power supply sequencing. The feature prevents errant voltages on the input source pins from reaching the rest of the system and maintains isolation when the system is powering up. Without powered-off protection, signal on the input source pins can back-power the supply rails through internal ESD diodes and cause potential damage to the system.

A GND reference must always be present to for proper operation. Source and drain voltage levels of up to  $\pm 60\text{ V}$  are blocked in the powered-off condition.

### 8.3.2.3 Fail-Safe Logic

Fail-Safe logic circuitry allows voltages on the control input pin (DR) to be applied before the supply pins. This eliminates the need for power sequencing of the logic signals and protects the device from potential damage. The control inputs are protected against positive faults of up to  $+44\text{ V}$  in the powered-off condition, but do not offer protection against a negative overvoltage condition.

### 8.3.2.4 Overvoltage Protection and Detection

The TMUX7462F detects overvoltage inputs by comparing the voltage on a source pin (Sx) with the fault supplies ( $V_{FP}$  and  $V_{FN}$ ). A signal is considered overvoltage if it exceeds the fault supply voltages by the threshold voltage ( $V_T$ ).

The switch automatically turns OFF and the source pin becomes high impedance so that only small leakage currents flow through the switch when an overvoltage is detected. The drain pin (Dx) behavior can be adjusted by controlling the drain response (DR) pin in the following ways:

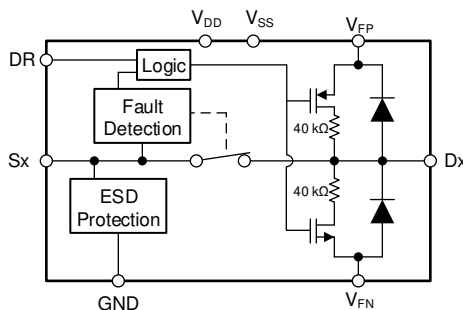
1. **DR pin floating or driven above  $V_{IH}$ :**

If the DR pin is driven about  $V_{IH}$  level of the pin, then the drain pin becomes high impedance (Hi-Z) upon overvoltage fault.

2. **DR driven below  $V_{IL}$ :**

If the DR pin is driven below  $V_{IL}$  level of the pin, then the drain pin (Dx) is pulled to the supply that was exceeded. For example, if the source voltage exceeds  $V_{FP}$ , then the drain output is pulled to  $V_{FP}$ . If the source voltage exceeds  $V_{FN}$ , then the drain output is pulled to  $V_{FN}$ . The pull-up impedance is approximately  $40\text{ k}\Omega$ , and as a result, the drain current is limited to roughly  $1\text{ mA}$  during a shorted load (to GND) condition.

Figure 8-1 shows a detailed view of the how the DR pin controls the output state of the drain pin under a fault scenario.



**Figure 8-1. Detailed Functional Diagram**

$V_{FP}$  and  $V_{FN}$  are required fault supplies that set the level at which the overvoltage protection is engaged.  $V_{FP}$  can be supplied from  $3\text{ V}$  to  $V_{DD}$ , while the  $V_{FN}$  can be supplied from  $V_{SS}$  to  $0\text{ V}$ . If the fault supplies are not available in the system, then the  $V_{FP}$  pin must be connected to  $V_{DD}$ , while the  $V_{FN}$  pin must be connected to  $V_{SS}$ . In this case, the overvoltage protection then engages at the primary supply voltages  $V_{DD}$  and  $V_{SS}$ .

### 8.3.2.5 Latch-Up Immunity

Latch-up is a condition where a low impedance path is created between a supply pin and ground. This condition is caused by a trigger (current injection or overvoltage), but once activated, the low impedance path remains even after the trigger is no longer present. This low impedance path may cause system upset or catastrophic damage due to excessive current levels. The Latch-up condition typically requires a power cycle to eliminate the low impedance path.

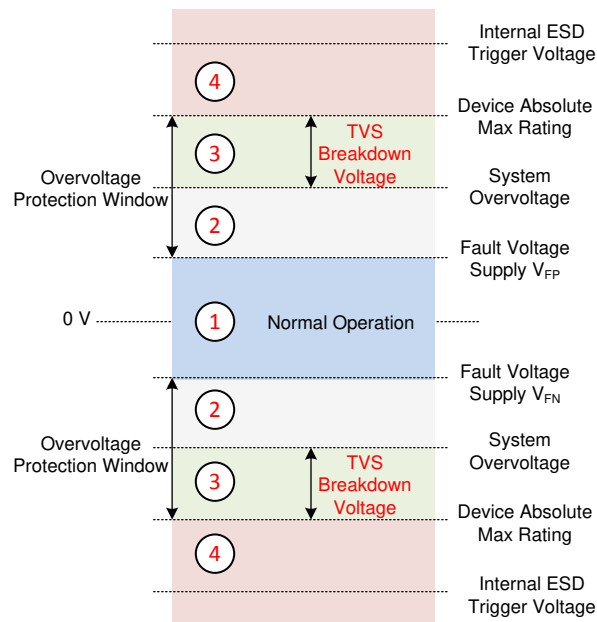
An insulating oxide layer is placed on top of the silicon substrate to prevent any parasitic junctions from forming in the TMUX7462F devices. As a result, the devices are latch-up immune under all circumstances by device construction.

### 8.3.2.6 EMC Protection

The TMUX7462F is not intended for standalone electromagnetic compatibility (EMC) protection in industrial applications. There are three common high voltage transient specifications that govern industrial high voltage transient specifications: IEC61000-4-2 (ESD), IEC61000-4-4 (EFT), and IEC61000-4-5 (surge immunity). A transient voltage suppressor (TVS), along with some low-value series current limiting resistor, are required to prevent source input voltages from going above the rated  $\pm 60$  V limits.

It is critical to ensure that the maximum working voltage is greater than the normal operating range of the input source pins protected and any known system common-mode overvoltage that may be present due to incorrect wiring, loss of power, or short circuit when selecting a TVS protection device. Figure 8-2 shows an example of the proper design window when selecting a TVS device.

Region 1 denotes the normal operation region of TMUX7462F, where the input source voltages stay below the fault supplies  $V_{FP}$  and  $V_{FN}$ . Region 2 represents the range of possible persistent DC (or long duration AC overvoltage fault) presented on the source input pins. Region 3 represents the margin between any known DC overvoltage level and the absolute maximum rating of the TMUX7462F. The TVS breakdown voltage must be selected to be less than the absolute maximum rating of the TMUX7462F, but greater than any known possible persistent DC or long duration AC overvoltage fault to avoid triggering the TVS inadvertently. Region 4 represents the margin the system designers must impose when selecting the TVS protection device to prevent accidental triggering the ESD cells of the TMUX7462F.



**Figure 8-2. System Operation Regions and Proper Region of Selecting a TVS Protection Device**

### 8.3.3 Overvoltage Fault Flags

The voltages on TMUX7462F's source input pins are continuously monitored, and the status of whether an overvoltage condition occurs is indicated by an active low general fault flag (FF). The voltage on the FF pin indicates if any of the source input pins are experiencing an overvoltage condition. If any source pin voltage exceeds the fault supply voltages by a  $V_T$ , the FF output is pulled-down to below  $V_{OL}$ . The FF pin is an open-drain output, and external pull-up resistors of 1 k $\Omega$  are recommended. The pull-up voltage can be in the range of 1.8 V to 5.5 V, depending on the controller voltage the device interfaces with.

### 8.3.4 Bidirectional Operation

The TMUX7462F conducts equally well from source (Sx) to drain (Dx) or from drain (Dx) to source (Sx). Each signal path has very similar characteristics in both directions; however, it is noted that the overvoltage protection is implemented only on the source (Sx) side. The voltage on the drain is only allowed to swing between  $V_{FP}$  and  $V_{FN}$  and no overvoltage protection is available on the drain side.

The primary supplies ( $V_{DD}$  and  $V_{SS}$ ) define the on-resistance profile of the switch channel, whereas the fault voltage supplies ( $V_{FP}$  and  $V_{FN}$ ) define the signal range that can be passed through from source to drain of the device. It is good practice to use voltages on  $V_{FP}$  and  $V_{FN}$  that are lower than  $V_{DD}$  and  $V_{SS}$  to take advantage of the flat on-resistance region of the device for better input-to-output linearity. The flattest on-resistance region extends from  $V_{SS}$  to roughly 3 V below  $V_{DD}$ . Once the signal is within 3 V of  $V_{DD}$  the on-resistance will exponentially increase and may impact desired signal transmission.

## 8.4 Device Functional Modes

The TMUX7462F offers two modes of operation (Normal mode and Fault mode) depending on whether any of the input pins experience an overvoltage condition.

### 8.4.1 Normal Mode

In Normal mode operation, signals of up to  $V_{FP}$  and  $V_{FN}$  can be passed through the switch from source (Sx) to drain (Dx) or from drain (Dx) to source (Sx). The following conditions must be satisfied for the switch to stay in the ON condition:

- The difference between the primary supplies ( $V_{DD} - V_{SS}$ ) must be higher or equal to 8 V.
- $V_{FP}$  must be between 3 V and  $V_{DD}$ , and  $V_{FN}$  must be between  $V_{SS}$  and 0 V.
- The input signals on the source (Sx) or the drain (Dx) must be between  $V_{FP} + V_T$  and  $V_{FN} - V_T$ .

### 8.4.2 Fault Mode

The TMUX7462F enters into the Fault mode when any of the input signals on the source (Sx) pins exceed  $V_{FP}$  or  $V_{FN}$  by a threshold voltage  $V_T$ . The switch input experiencing the fault automatically turns off, and the source pin becomes high impedance with negligible amount of leakage current flowing through the switch under the overvoltage condition. For how the drain pin (Dx) behavior under the Fault mode can be programmed, refer to [Section 8.3.2.4](#). The general fault flag (FF) is asserted low in the Fault mode.

The overvoltage protection is provided only for the source (Sx) input pins. The drain (Dx) pin, if used as signal input, must stay in between  $V_{FP}$  and  $V_{FN}$  at all time since no overvoltage protection is implemented on the drain pin.

### 8.4.3 Truth Table

[Table 8-1](#) provides the truth tables for the TMUX7462F. Each switch is independently controlled by its own select pin.

**Table 8-1. TMUX7462F Truth Table**

| DR PIN STATE | Dx State During Fault Condition   |
|--------------|-----------------------------------|
| 0            | Pulled up to $V_{FP}$ or $V_{FN}$ |
| 1            | Open (HI-Z)                       |

## 9 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, as well as validating and testing their design implementation to confirm system functionality.

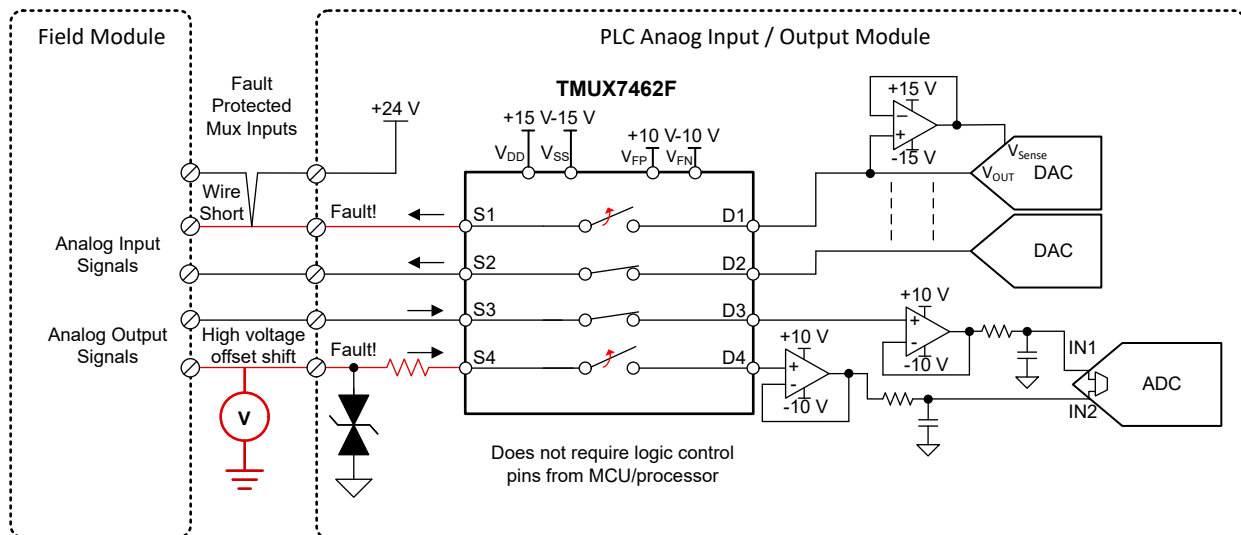
### 9.1 Application Information

The TMUX7462F is part of the fault protected switches and multiplexers family of devices. The ability to protect downstream components from overvoltage events up to  $\pm 60$  V and latch-up immunity features makes these switches and multiplexers suitable for harsh environments.

### 9.2 Typical Application

The need to monitor remote sensors is common among factory automation control systems. For example, an analog input module or mixed module (AI, AO, DI, and DO) of a programmable logic controller (PLC) will interface to a field transmitter to monitor various process sensors at remote locations around the factory. A switch or multiplexer is often used to connect multiple inputs from the system and reduce the number of downstream channels.

There are a number of fault cases that may occur that can be damaging to many of the integrated circuits. Such fault conditions may include, but are not limited to, human error due to miswiring, component failure, wire shorts, electromagnetic interference (EMI), transient disturbances, and more.



**Figure 9-1. Typical Application**

## 9.2.1 Design Requirements

**Table 9-1. Design Parameters**

| PARAMETER                                | VALUE                        |
|------------------------------------------|------------------------------|
| Positive supply ( $V_{DD}$ ) mux         | +15 V                        |
| Negative supply ( $V_{SS}$ ) mux         | -15 V                        |
| Power board supply voltage               | 24 V                         |
| Input or output signal range non-faulted | -10 V to 10 V                |
| Overvoltage protection levels            | -60 V to 60 V                |
| Control logic thresholds                 | 1.8 V compatible, up to 44 V |
| Temperature range                        | -40°C to +125°C              |

## 9.2.2 Detailed Design Procedure

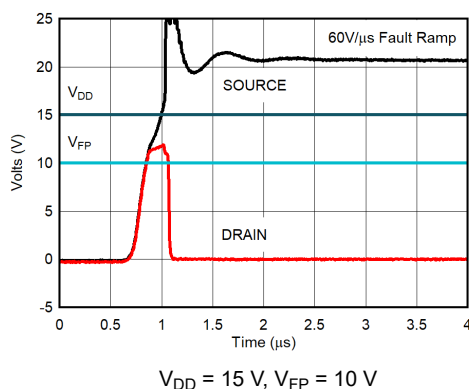
The TMUX7462F device's normal operation is to provide fault protection for the system while minimizing the control logic signals required to route across the PCB. The device works as a channel protector by allowing the signals to pass when in the valid voltage range, and opening the switch if there is a fault case. A fault protected switch can add extra robustness to the system against fault conditions while also reducing the number of components required to interface with the physical input channels.

The application shows two channels of the TMUX7462F connected as analog outputs and two channels connected as analog inputs to the PLC system. The analog input channels utilize the TMUX7462F to protect downstream operational amplifiers that are operating at a lower supply voltage than the multiplexer. The TMUX7462F only has overvoltage protection on the source pins, therefore these pins are connected to the external system connector on the analog output channels. If there is a miswiring or wire short issue on the connectors, the channel protector will open the switch channel to help prevent long term fault conditions from damaging the DAC.

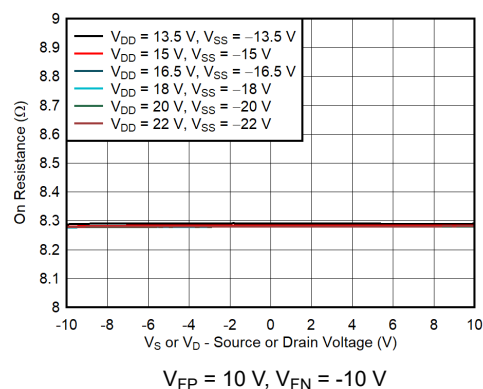
If there is a fault condition, the drain pin of the channels can either be pulled up to the fault supply voltage ( $V_{FP}$  and  $V_{FN}$ ) through a 40 k $\Omega$  resistor or be left floating depending on the state of the DR pin. This can be configured to match the system requirements on how to handle a fault condition.

## 9.2.3 Application Curves

The example application utilizes adjustable fault threshold voltages of the TMUX7462F to allow for protection of downstream components operating on lower supply voltages. Figure 9-2 shows an example of positive overvoltage fault response with a fast fault ramp rate of 60 V/ $\mu$ s. Figure 9-3 shows the extremely flat on-resistance across source voltage while operating within the fault threshold voltage levels for many supply voltage scenarios. These features make the TMUX7462F an excellent solution for data acquisition applications that may face various fault conditions but also require excellent linearity and low distortion.



**Figure 9-2. Positive Overvoltage Response**



**Figure 9-3.  $R_{ON}$  Flatness in Non-Fault Region**

## 9.3 Power Supply Recommendations

The TMUX7462F operates across a wide supply range of  $\pm 5\text{ V}$  to  $\pm 22\text{ V}$  (8 V to 44 V in single-supply mode). The device also performs well with asymmetrical supplies such as  $V_{DD} = 12\text{ V}$  and  $V_{SS} = -5\text{ V}$ . For improved supply noise immunity, use a supply decoupling capacitor ranging from 1  $\mu\text{F}$  to 10  $\mu\text{F}$  at the  $V_{DD}$  and  $V_{SS}$  pins to ground. Always ensure the ground (GND) connection is established before supplies are ramped.

The fault supplies ( $V_{FP}$  and  $V_{FN}$ ) provide the current required to operate the fault protection, and thus, must be low impedance supplies. They can be derived from the primary supplies by using a resistor divider and buffer or be an independent supply rail. The fault supplies must not exceed the primary supplies as it might cause unexpected behavior of the switch. Use a supply decoupling capacitor ranging from 1  $\mu\text{F}$  to 10  $\mu\text{F}$  at the  $V_{FP}$  and  $V_{FN}$  pins to ground for improved supply noise immunity.

The positive supply,  $V_{DD}$ , must be ramped before the positive fault rail,  $V_{FP}$ , for proper power sequencing of the TMUX7462F. Similarly, the negative supply,  $V_{SS}$ , must be ramped before the negative fault voltage rail,  $V_{FN}$ .

## 9.4 Layout

### 9.4.1 Layout Guidelines

The following images shows an example of a PCB layout with the TMUX7462F. Some key considerations are as follows:

- Decouple the  $V_{DD}$  and  $V_{SS}$  pins with a 1- $\mu\text{F}$  capacitor, placed as close to the pin as possible. Make sure that the capacitor voltage rating is sufficient for the supplies.
- Multiple decoupling capacitors can be used if there is a lot of noise in the system. For example, a 0.1- $\mu\text{F}$  and 1- $\mu\text{F}$  can be placed on the supply pins. If multiple capacitors are used, then it is recommended to place the lowest value capacitor closest to the supply pin.
- Keep the input lines as short as possible.
- Use a solid ground plane to help distribute heat and 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.

## 9.4.2 Layout Example

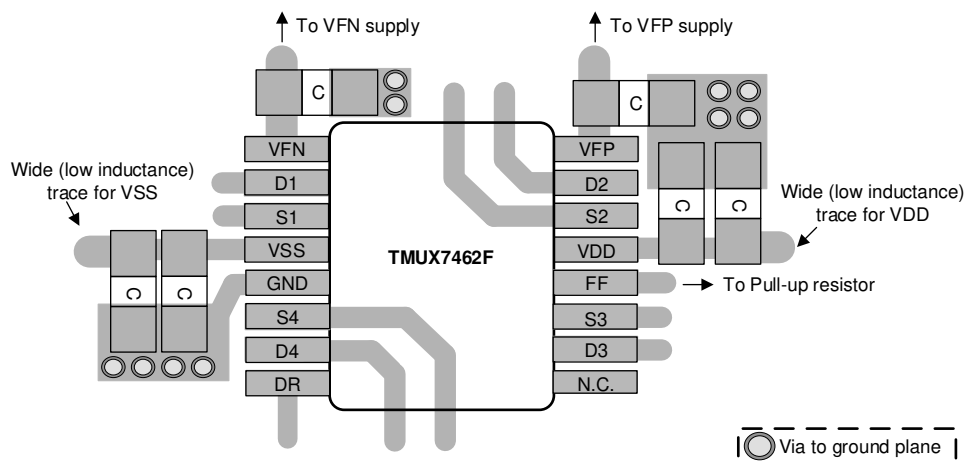


Figure 9-4. TSSOP Layout Example

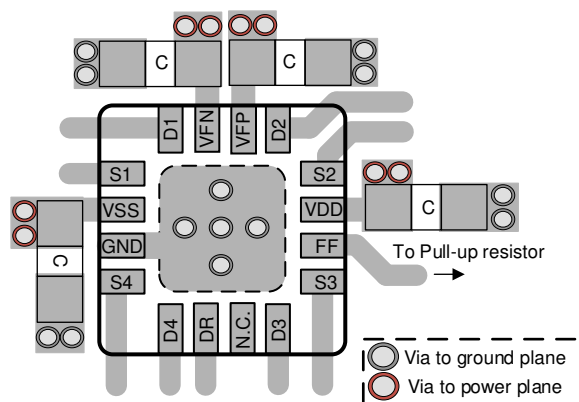


Figure 9-5. WQFN Layout Example

## 10 Device and Documentation Support

### 10.1 Documentation Support

#### 10.1.1 Related Documentation

- Texas Instruments, [Multiplexers and Signal Switches Glossary](#)
- Texas Instruments, [Protection Against Overvoltage Events, Miswiring, and Common Mode Voltages](#)
- Texas Instruments, [Improving Analog Input Modules Reliability Using Fault Protected Multiplexers](#)
- Texas Instruments, [Using Latch-Up Immune Multiplexers to Help Improve System Reliability](#)

### 10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on *Subscribe to updates* 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.

### 10.3 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.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 10.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 10.5 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.

### 10.6 Glossary

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

## 11 Mechanical, Packaging, and Orderable Information

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

## PACKAGING INFORMATION

| Orderable part number         | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TMUX7462FPWR</a>  | Active        | Production           | TSSOP (PW)   16 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | TM7462F             |
| TMUX7462FPWR.B                | Active        | Production           | TSSOP (PW)   16 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | TM7462F             |
| <a href="#">TMUX7462FRRPR</a> | Active        | Production           | WQFN (RRP)   16 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | TMUX<br>7462F       |
| TMUX7462FRRPR.B               | Active        | Production           | WQFN (RRP)   16 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | TMUX<br>7462F       |

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

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

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

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

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

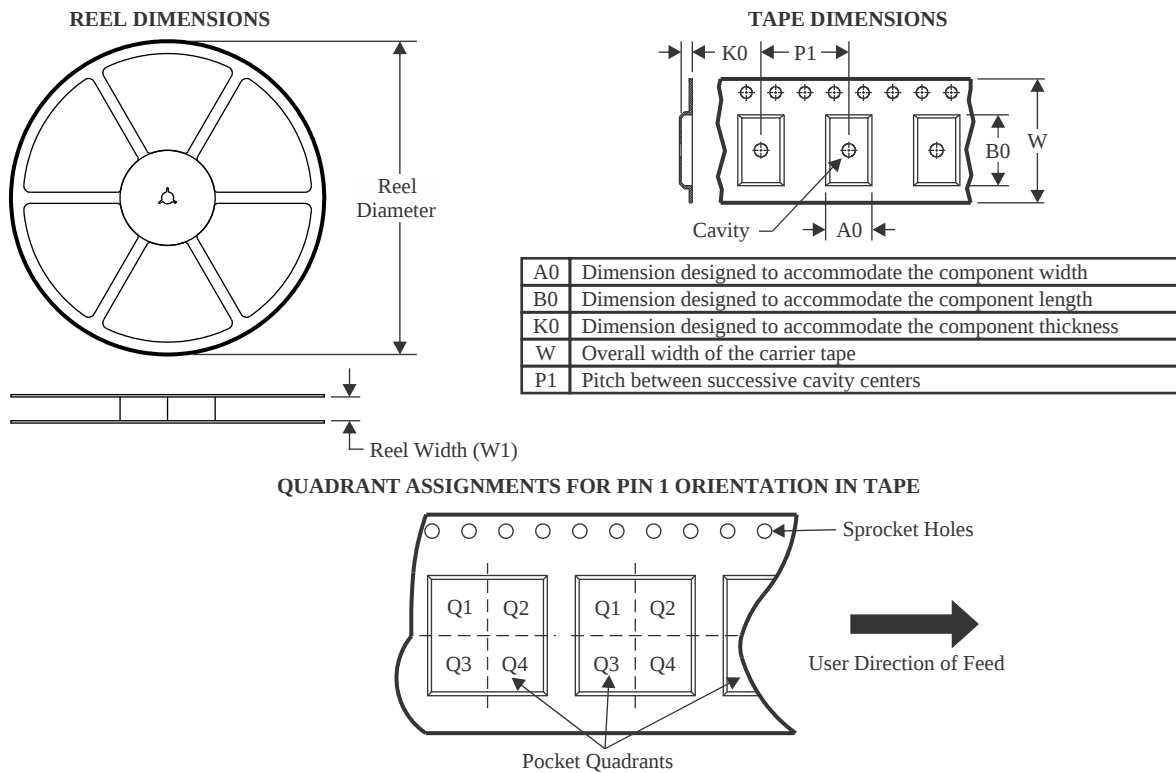
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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

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## TAPE AND REEL INFORMATION



\*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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TMUX7462FPWR  | TSSOP        | PW              | 16   | 3000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TMUX7462FRRPR | WQFN         | RRP             | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TMUX7462FPWR  | TSSOP        | PW              | 16   | 3000 | 353.0       | 353.0      | 32.0        |
| TMUX7462FRRPR | WQFN         | RRP             | 16   | 3000 | 360.0       | 360.0      | 36.0        |



## TSSOP - 1.2 mm max height

## SMALL OUTLINE PACKAGE



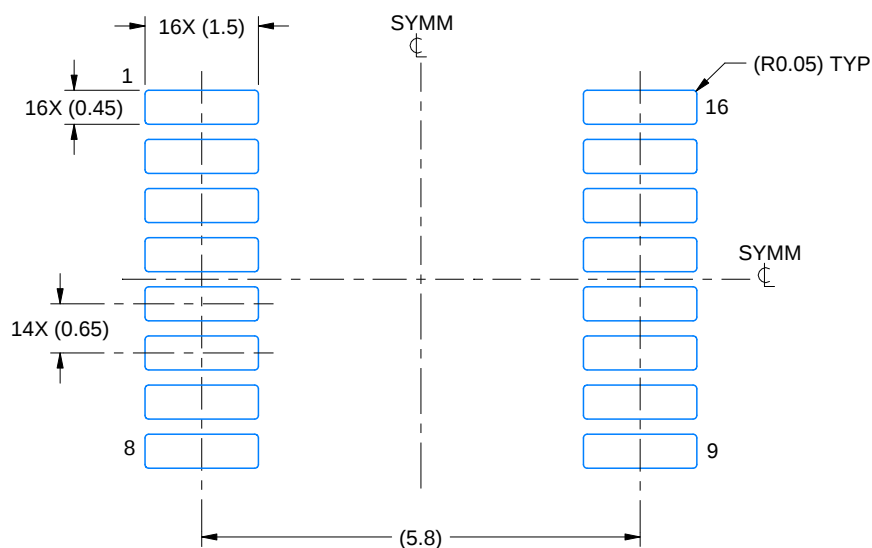
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

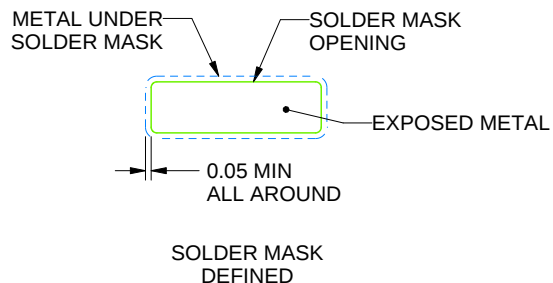
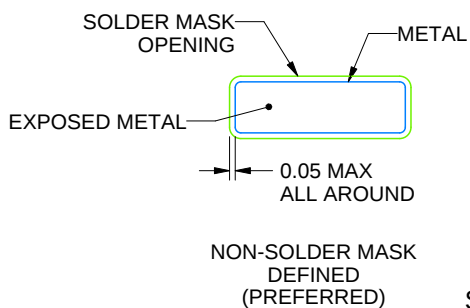
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

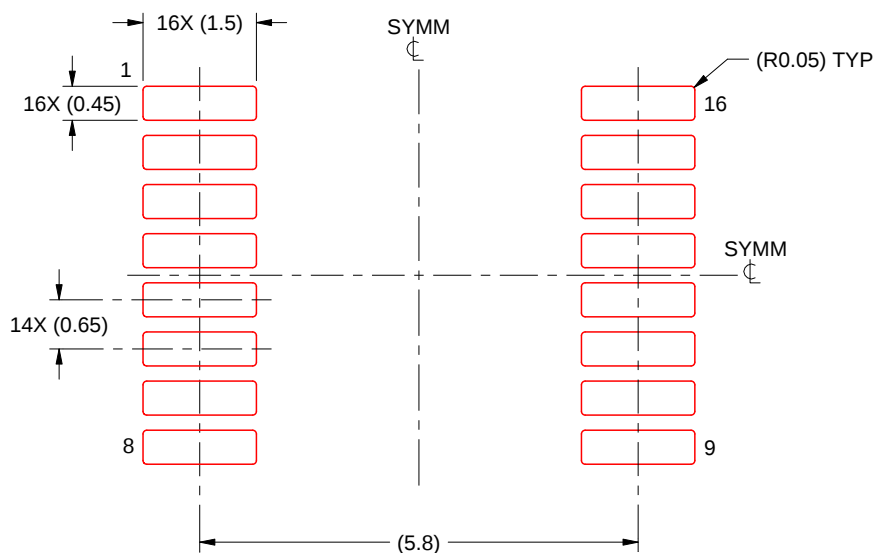
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

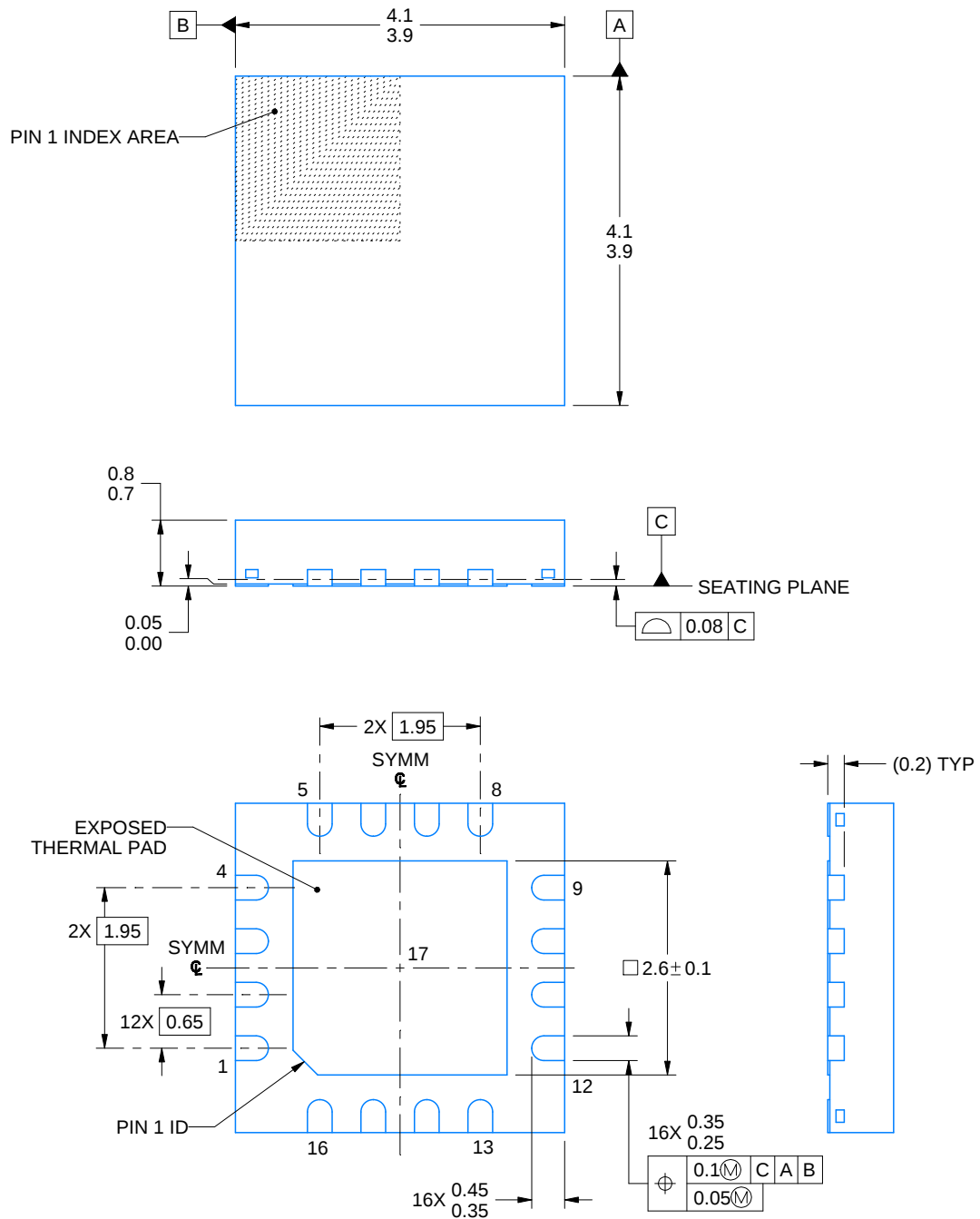
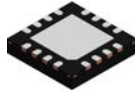


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/B 12/2023

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.



4224816/A 02/2019

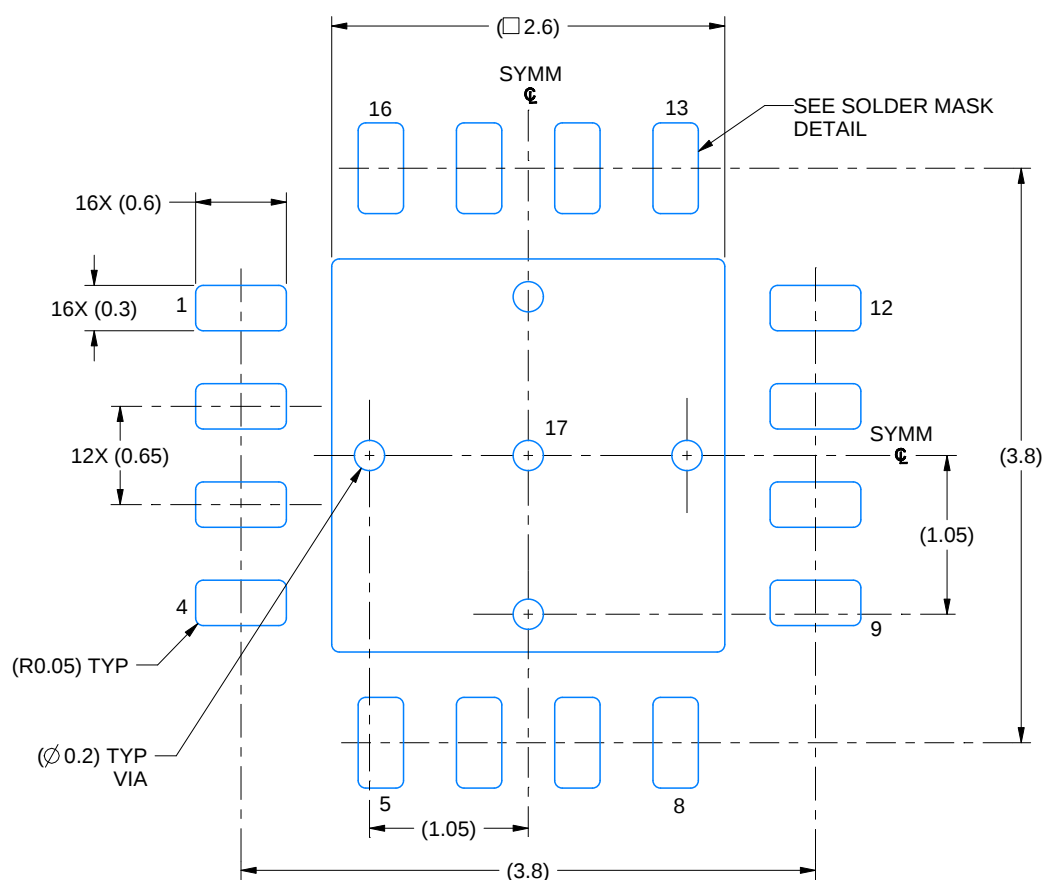
## NOTES:

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.

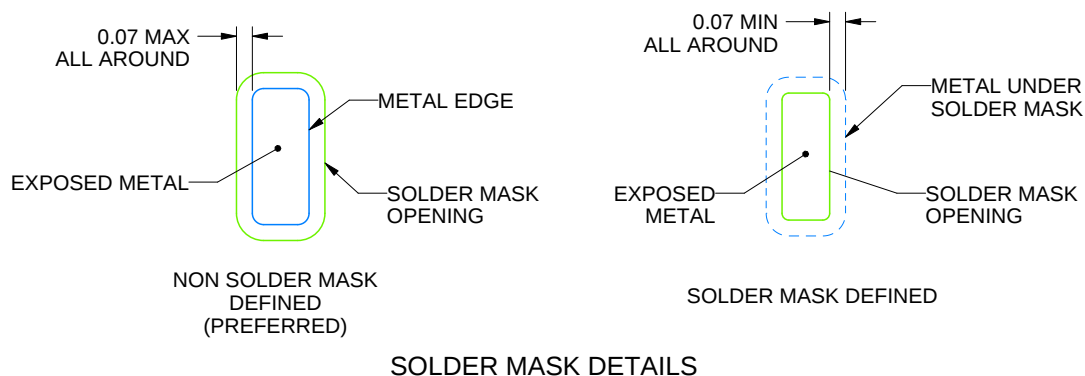
**RRP0016A**

**WQFN - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 20X



4224816/A 02/2019

NOTES: (continued)

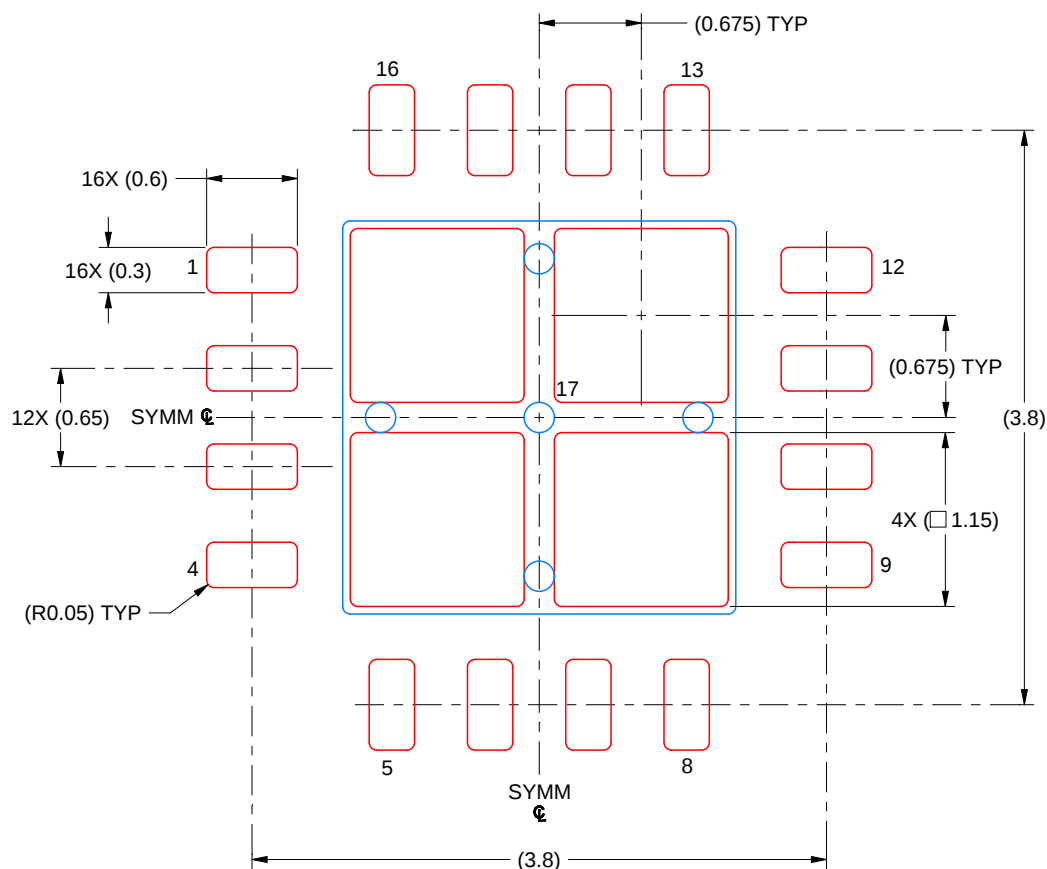
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented,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

# EXAMPLE STENCIL DESIGN

RRP0016A

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  
 78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4224816/A 02/2019

NOTES: (continued)

6. 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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