

## FEATURES

**Overvoltage protection up to  $-55$  V and  $+55$  V**  
**Power-off protection up to  $-55$  V and  $+55$  V**  
**Overvoltage detection on source pins**  
**Low on resistance: 10  $\Omega$**   
**On-resistance flatness: 0.5  $\Omega$**   
**5.5 kV human body model (HBM) ESD rating**  
**Latch-up immune under any circumstance**  
**Known state without digital inputs present**

## ENHANCED PRODUCT FEATURES

**Supports defense and aerospace applications (AQEC standard)**  
**Military temperature range:  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$**   
**Controlled manufacturing baseline**  
**One assembly/test site**  
**One fabrication site**  
**Enhanced product change notification**  
**Qualification data available on request**

## APPLICATIONS

**Avionics**  
**Analog input/output modules**  
**Process control/distributed control systems**  
**Data acquisition**  
**Instrumentation**  
**Automatic test equipment**  
**Communication systems**  
**Relay replacement**

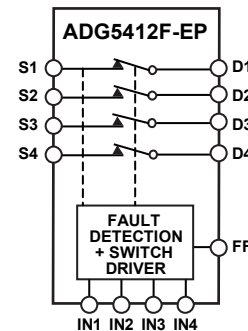
## GENERAL DESCRIPTION

The **ADG5412F-EP** contains four independently controlled single-pole/single-throw (SPST) switches. The **ADG5412F-EP** has four switches that turn on with Logic 1 inputs. Each switch conducts equally well in both directions when on, and each switch has an input signal range that extends to the supplies. The digital inputs are compatible with 3 V logic inputs over the full operating supply range.

When no power supplies are present, the switch remains in the off condition, and the switch inputs are high impedance. Under normal operating conditions, if the analog input signal levels on any  $S_x$  pin exceed  $V_{DD}$  or  $V_{SS}$  by a threshold voltage,  $V_T$ , the switch turns off. Input signal levels up to  $+55$  V or  $-55$  V relative to ground are blocked, in both the powered and unpowered condition.

The low on resistance of these switches, combined with on-resistance flatness over a significant portion of the signal range make them an ideal solution for data acquisition and gain

## FUNCTIONAL BLOCK DIAGRAM



NOTES  
 1. SWITCHES SHOWN FOR A LOGIC 1 INPUT.

Figure 1.

12705-001

switching applications where excellent linearity and low distortion are critical.

## PRODUCT HIGHLIGHTS

1. Source pins are protected against voltages greater than the supply rails, up to  $-55$  V and  $+55$  V.
2. Source pins are protected against voltages between  $-55$  V and  $+55$  V in an unpowered state.
3. Overvoltage detection with digital output indicates operating state of switches.
4. Trench isolation guards against latch-up.
5. Optimized for low on resistance and on-resistance flatness.
6. The **ADG5412F-EP** can be operated from a dual supply of  $\pm 5$  V up to  $\pm 22$  V or a single power supply of  $+8$  V up to  $+44$  V.

Additional application and technical information can be found in the **ADG5412F** data sheet.

Rev. B

**Document Feedback**

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## REVISION HISTORY

### 10/2017—Rev. A to Rev. B

|                                                                                       |   |
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| Changes to Drain Leakage Current, $I_D$ , With Overvoltage<br>Parameter, Table 1..... | 3 |
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### 8/2015—Rev. 0 to Rev. A

|                                              |   |
|----------------------------------------------|---|
| Changes to Features Section.....             | 1 |
| Added Enhanced Product Features Section..... | 1 |

### 7/2015—Revision 0: Initial Version

# SPECIFICATIONS

## ±15 V DUAL SUPPLY

$V_{DD} = 15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ ,  $C_{DECOUPLING} = 0.1\text{ }\mu\text{F}$ , unless otherwise noted.

Table 1.

| Parameter                                             | +25°C     | −40°C to +85°C | −55°C to +125°C      | Unit              | Test Conditions/Comments                                                                                                                                                    |
|-------------------------------------------------------|-----------|----------------|----------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANALOG SWITCH                                         |           |                |                      |                   | $V_{DD} = 13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$ , see Figure 30                                                                                                        |
| Analog Signal Range                                   |           |                | $V_{DD}$ to $V_{SS}$ | V                 |                                                                                                                                                                             |
| On Resistance, $R_{ON}$                               | 10        |                |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                             |
|                                                       | 11.2      | 14             | 16.5                 | $\Omega$ max      |                                                                                                                                                                             |
|                                                       | 9.5       |                |                      | $\Omega$ typ      | $V_S = \pm 9\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                              |
|                                                       | 10.7      | 13.5           | 16                   | $\Omega$ max      |                                                                                                                                                                             |
| On-Resistance Match Between Channels, $\Delta R_{ON}$ | 0.05      |                |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                             |
|                                                       | 0.5       | 0.6            | 0.7                  | $\Omega$ max      |                                                                                                                                                                             |
|                                                       | 0.05      |                |                      | $\Omega$ typ      | $V_S = \pm 9\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                              |
|                                                       | 0.35      | 0.5            | 0.5                  | $\Omega$ max      |                                                                                                                                                                             |
| On-Resistance Flatness, $R_{FLAT(ON)}$                | 0.6       |                |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                             |
|                                                       | 0.9       | 1.1            | 1.1                  | $\Omega$ max      |                                                                                                                                                                             |
|                                                       | 0.1       |                |                      | $\Omega$ typ      | $V_S = \pm 9\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                              |
|                                                       | 0.4       | 0.5            | 0.5                  | $\Omega$ max      |                                                                                                                                                                             |
| Threshold Voltage, $V_T$                              | 0.7       |                |                      | V typ             | See Figure 26                                                                                                                                                               |
| LEAKAGE CURRENTS                                      |           |                |                      |                   | $V_{DD} = 16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$                                                                                                                        |
| Source Off Leakage, $I_S$ (Off)                       | $\pm 0.1$ |                |                      | nA typ            | $V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ , see Figure 31                                                                                                           |
|                                                       | $\pm 1.5$ | $\pm 5.0$      | $\pm 21.0$           | nA max            |                                                                                                                                                                             |
| Drain Off Leakage, $I_D$ (Off)                        | $\pm 0.1$ |                |                      | nA typ            | $V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ , see Figure 31                                                                                                           |
|                                                       | $\pm 1.5$ | $\pm 5.0$      | $\pm 18.0$           | nA max            |                                                                                                                                                                             |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)            | $\pm 0.3$ |                |                      | nA typ            | $V_S = V_D = \pm 10\text{ V}$ , see Figure 32                                                                                                                               |
|                                                       | $\pm 1.5$ | $\pm 2.0$      | $\pm 4.5$            | nA max            |                                                                                                                                                                             |
| FAULT                                                 |           |                |                      |                   |                                                                                                                                                                             |
| Source Leakage Current, $I_S$<br>With Overvoltage     |           |                | $\pm 78$             | $\mu\text{A}$ typ | $V_{DD} = 16.5\text{ V}$ , $V_{SS} = 16.5\text{ V}$ , $GND = 0\text{ V}$ ,<br>$V_S = \pm 55\text{ V}$ , see Figure 35                                                       |
| Power Supplies Grounded or Floating                   |           |                | $\pm 40$             | $\mu\text{A}$ typ | $V_{DD} = 0\text{ V}$ or floating, $V_{SS} = 0\text{ V}$ or floating,<br>$GND = 0\text{ V}$ , $I_{NX} = 0\text{ V}$ or floating,<br>$V_S = \pm 55\text{ V}$ , see Figure 36 |
| Drain Leakage Current, $I_D$<br>With Overvoltage      | $\pm 2.0$ |                |                      | nA typ            | $V_{DD} = 16.5\text{ V}$ , $V_{SS} = 16.5\text{ V}$ , $GND = 0\text{ V}$ ,<br>$V_S = \pm 55\text{ V}$ , see Figure 35                                                       |
|                                                       | $\pm 20$  | $\pm 30$       | $\pm 65$             | nA max            |                                                                                                                                                                             |
| Power Supplies Grounded                               | $\pm 10$  |                |                      | nA typ            | $V_{DD} = 0\text{ V}$ , $V_{SS} = 0\text{ V}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ ,<br>$I_{NX} = 0\text{ V}$ , see Figure 36                                     |
|                                                       | $\pm 30$  | $\pm 50$       | $\pm 100$            | nA max            |                                                                                                                                                                             |
| Power Supplies Floating                               | $\pm 10$  | $\pm 10$       | $\pm 10$             | $\mu\text{A}$ typ | $V_{DD} = \text{floating}$ , $V_{SS} = \text{floating}$ , $GND = 0\text{ V}$ ,<br>$V_S = \pm 55\text{ V}$ , $I_{NX} = 0\text{ V}$ , see Figure 36                           |
| DIGITAL INPUTS/OUTPUTS                                |           |                |                      |                   |                                                                                                                                                                             |
| Input Voltage High, $V_{INH}$                         |           |                | 2.0                  | V min             | $V_{IN} = V_{GND}$ or $V_{DD}$                                                                                                                                              |
| Input Voltage Low, $V_{INL}$                          |           |                | 0.8                  | V max             |                                                                                                                                                                             |
| Input Current, $I_{INL}$ or $I_{INH}$                 | $\pm 0.7$ |                |                      | $\mu\text{A}$ typ |                                                                                                                                                                             |
|                                                       |           |                | $\pm 1.2$            | $\mu\text{A}$ max |                                                                                                                                                                             |
| Digital Input Capacitance, $C_{IN}$                   | 5.0       |                |                      | pF typ            |                                                                                                                                                                             |
| Output Voltage High, $V_{OH}$                         | 2.0       |                |                      | V min             |                                                                                                                                                                             |
| Output Voltage Low, $V_{OL}$                          | 0.8       |                |                      | V max             |                                                                                                                                                                             |

| Parameter                                                                                                                    | +25°C  | –40°C to +85°C | –55°C to +125°C | Unit              | Test Conditions/Comments                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------|--------|----------------|-----------------|-------------------|----------------------------------------------------------------------------------------------------------------|
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>                                                                                   |        |                |                 |                   |                                                                                                                |
| $t_{ON}$                                                                                                                     | 400    |                |                 | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$                                                                    |
|                                                                                                                              | 495    | 525            | 550             | ns max            | $V_S = 10\ \text{V}$ , see Figure 44                                                                           |
| $t_{OFF}$                                                                                                                    | 410    |                |                 | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$                                                                    |
|                                                                                                                              | 510    | 545            | 555             | ns max            | $V_S = 10\ \text{V}$ , see Figure 44                                                                           |
| Overvoltage Response Time, $t_{RESPONSE}$                                                                                    | 460    |                | 185             | ns min            | $V_{S1} = V_{S2} = 10\ \text{V}$ , see Figure 44                                                               |
|                                                                                                                              | 585    | 615            | 630             | ns typ            | $R_L = 1\ \text{k}\Omega$ , $C_L = 2\ \text{pF}$ , see Figure 39                                               |
| Overvoltage Recovery Time, $t_{RECOVERY}$                                                                                    | 720    |                |                 | ns typ            | $R_L = 1\ \text{k}\Omega$ , $C_L = 2\ \text{pF}$ , see Figure 40                                               |
|                                                                                                                              | 930    | 1050           | 1100            | ns max            |                                                                                                                |
| Interrupt Flag Response Time, $t_{DIGRESP}$                                                                                  | 85     |                | 115             | ns typ            | $C_L = 10\ \text{pF}$ , see Figure 41                                                                          |
| Interrupt Flag Recovery Time, $t_{DIGREC}$                                                                                   | 60     |                | 85              | $\mu\text{s}$ typ | $C_L = 10\ \text{pF}$ , see Figure 42                                                                          |
|                                                                                                                              | 600    |                |                 | ns typ            | $C_L = 10\ \text{pF}$ , $R_{PULLUP} = 1\ \text{k}\Omega$ , see Figure 43                                       |
| Charge Injection, $Q_{INJ}$                                                                                                  | 680    |                |                 | pC typ            | $V_S = 0\ \text{V}$ , $R_S = 0\ \Omega$ , $C_L = 1\ \text{nF}$ , see Figure 45                                 |
| Off Isolation                                                                                                                | –70    |                |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 33                                |
| Channel-to-Channel Crosstalk                                                                                                 | –90    |                |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 34                                |
| Total Harmonic Distortion Plus Noise, THD + N                                                                                | 0.0015 |                |                 | % typ             | $R_L = 10\ \text{k}\Omega$ , $V_S = 15\ \text{V p-p}$ , $f = 20\ \text{Hz to } 20\ \text{kHz}$ , see Figure 38 |
| –3 dB Bandwidth                                                                                                              | 270    |                |                 | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , see Figure 37                                                      |
| Insertion Loss                                                                                                               | –0.72  |                |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 37                                |
| $C_S$ (Off)                                                                                                                  | 13     |                |                 | pF typ            | $V_S = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                      |
| $C_D$ (Off)                                                                                                                  | 12     |                |                 | pF typ            | $V_S = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                      |
| $C_D$ (On), $C_S$ (On)                                                                                                       | 24     |                |                 | pF typ            | $V_S = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                      |
| <b>POWER REQUIREMENTS</b>                                                                                                    |        |                |                 |                   |                                                                                                                |
| $V_{DD} = 16.5\ \text{V}$ , $V_{SS} = -16.5\ \text{V}$ , $\text{GND} = 0\ \text{V}$ , digital inputs = 0 V, 5 V, or $V_{DD}$ |        |                |                 |                   |                                                                                                                |
| Normal Mode                                                                                                                  |        |                |                 |                   |                                                                                                                |
| $I_{DD}$                                                                                                                     | 0.9    |                |                 | mA typ            |                                                                                                                |
|                                                                                                                              | 1.2    |                | 1.3             | mA max            |                                                                                                                |
| $I_{GND}$                                                                                                                    | 0.4    |                |                 | mA typ            |                                                                                                                |
|                                                                                                                              | 0.55   |                | 0.6             | mA max            |                                                                                                                |
| $I_{SS}$                                                                                                                     | 0.5    |                |                 | mA typ            |                                                                                                                |
|                                                                                                                              | 0.65   |                | 0.7             | mA max            |                                                                                                                |
| Fault Mode                                                                                                                   |        |                |                 |                   | $V_S = \pm 55\ \text{V}$                                                                                       |
| $I_{DD}$                                                                                                                     | 1.2    |                |                 | mA typ            |                                                                                                                |
|                                                                                                                              | 1.6    |                | 1.8             | mA max            |                                                                                                                |
| $I_{GND}$                                                                                                                    | 0.8    |                |                 | mA typ            |                                                                                                                |
|                                                                                                                              | 1.0    |                | 1.1             | mA max            |                                                                                                                |
| $I_{SS}$                                                                                                                     | 0.5    |                |                 | mA typ            |                                                                                                                |
|                                                                                                                              | 1.0    |                | 1.8             | mA max            |                                                                                                                |
| $V_{DD}/V_{SS}$                                                                                                              |        |                | $\pm 5$         | V min             | $\text{GND} = 0\ \text{V}$                                                                                     |
|                                                                                                                              |        |                | $\pm 22$        | V max             | $\text{GND} = 0\ \text{V}$                                                                                     |

<sup>1</sup> Guaranteed by design; not subject to production test.

**±20 V DUAL SUPPLY**

$V_{DD} = 20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ ,  $C_{DECOUPLING} = 0.1\text{ }\mu\text{F}$ , unless otherwise noted.

**Table 2.**

| Parameter                                             | +25°C | −40°C to +85°C | −55°C to +125°C      | Unit              | Test Conditions/Comments                                                                                                                                           |
|-------------------------------------------------------|-------|----------------|----------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                  |       |                |                      |                   | $V_{DD} = 18\text{ V}$ , $V_{SS} = -18\text{ V}$ , see Figure 30                                                                                                   |
| Analog Signal Range                                   |       |                | $V_{DD}$ to $V_{SS}$ | V                 |                                                                                                                                                                    |
| On Resistance, $R_{ON}$                               | 10    |                |                      | $\Omega$ typ      | $V_S = \pm 15\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                    |
|                                                       | 11.5  | 14.5           | 16.5                 | $\Omega$ max      |                                                                                                                                                                    |
|                                                       | 9.5   |                |                      | $\Omega$ typ      | $V_S = \pm 13.5\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                  |
|                                                       | 11    | 14             | 16.5                 | $\Omega$ max      |                                                                                                                                                                    |
| On-Resistance Match Between Channels, $\Delta R_{ON}$ | 0.05  |                |                      | $\Omega$ typ      | $V_S = \pm 15\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                    |
|                                                       | 0.35  | 0.5            | 0.5                  | $\Omega$ max      |                                                                                                                                                                    |
|                                                       | 0.05  |                |                      | $\Omega$ typ      | $V_S = \pm 13.5\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                  |
|                                                       | 0.35  | 0.5            | 0.5                  | $\Omega$ max      |                                                                                                                                                                    |
| On-Resistance Flatness, $R_{FLAT(ON)}$                | 1.0   |                |                      | $\Omega$ typ      | $V_S = \pm 15\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                    |
|                                                       | 1.4   | 1.5            | 1.5                  | $\Omega$ max      |                                                                                                                                                                    |
|                                                       | 0.1   |                |                      | $\Omega$ typ      | $V_S = \pm 13.5\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                                  |
|                                                       | 0.4   | 0.5            | 0.5                  | $\Omega$ max      |                                                                                                                                                                    |
| Threshold Voltage, $V_T$                              | 0.7   |                |                      | V typ             | See Figure 26                                                                                                                                                      |
| <b>LEAKAGE CURRENTS</b>                               |       |                |                      |                   | $V_{DD} = 22\text{ V}$ , $V_{SS} = -22\text{ V}$                                                                                                                   |
| Source Off Leakage, $I_S$ (Off)                       | ±0.1  |                |                      | nA typ            | $V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ , see Figure 31                                                                                                  |
|                                                       | ±1.5  | ±5.0           | ±21.0                | nA max            |                                                                                                                                                                    |
| Drain Off Leakage, $I_D$ (Off)                        | ±0.1  |                |                      | nA typ            | $V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ , see Figure 31                                                                                                  |
|                                                       | ±1.5  | ±5.0           | ±18.0                | nA max            |                                                                                                                                                                    |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)            | ±0.3  |                |                      | nA typ            | $V_S = V_D = \pm 15\text{ V}$ , see Figure 32                                                                                                                      |
|                                                       | ±1.5  | ±2.0           | ±4.5                 | nA max            |                                                                                                                                                                    |
| <b>FAULT</b>                                          |       |                |                      |                   |                                                                                                                                                                    |
| Source Leakage Current, $I_S$                         |       |                |                      |                   |                                                                                                                                                                    |
| With Overvoltage                                      |       |                | ±78                  | $\mu\text{A}$ typ | $V_{DD} = 22\text{ V}$ , $V_{SS} = -22\text{ V}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , see Figure 35                                                    |
| Power Supplies Grounded or Floating                   |       |                | ±40                  | $\mu\text{A}$ typ | $V_{DD} = 0\text{ V}$ or floating, $V_{SS} = 0\text{ V}$ or floating, $GND = 0\text{ V}$ , $INx = 0\text{ V}$ or floating, $V_S = \pm 55\text{ V}$ , see Figure 36 |
| Drain Leakage Current, $I_D$                          |       |                |                      |                   |                                                                                                                                                                    |
| With Overvoltage                                      | ±5.0  |                |                      | nA typ            | $V_{DD} = +22\text{ V}$ , $V_{SS} = -22\text{ V}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , see Figure 35                                                   |
|                                                       | ±1.0  | ±1.0           | ±1.0                 | $\mu\text{A}$ max |                                                                                                                                                                    |
| Power Supplies Grounded                               | ±10   |                |                      | nA typ            | $V_{DD} = 0\text{ V}$ , $V_{SS} = 0\text{ V}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , $INx = 0\text{ V}$ , see Figure 36                                  |
|                                                       | ±30   | ±50            | ±100                 | nA max            |                                                                                                                                                                    |
| Power Supplies Floating                               | ±10   | ±10            | ±10                  | $\mu\text{A}$ typ | $V_{DD} = \text{floating}$ , $V_{SS} = \text{floating}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , $INx = 0\text{ V}$ , see Figure 36                        |
| <b>DIGITAL INPUTS</b>                                 |       |                |                      |                   |                                                                                                                                                                    |
| Input Voltage High, $V_{INH}$                         |       |                | 2.0                  | V min             |                                                                                                                                                                    |
| Input Voltage Low, $V_{INL}$                          |       |                | 0.8                  | V max             |                                                                                                                                                                    |
| Input Current, $I_{INL}$ or $I_{INH}$                 | 0.7   |                |                      | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$                                                                                                                                     |
|                                                       |       |                | 1.2                  | $\mu\text{A}$ max |                                                                                                                                                                    |
| Digital Input Capacitance, $C_{IN}$                   | 5.0   |                |                      | pF typ            |                                                                                                                                                                    |
| Output Voltage High, $V_{OH}$                         | 2.0   |                |                      | V min             |                                                                                                                                                                    |
| Output Voltage Low, $V_{OL}$                          | 0.8   |                |                      | V max             |                                                                                                                                                                    |

| Parameter                                                                                   | +25°C | −40°C to +85°C | −55°C to +125°C | Unit              | Test Conditions/Comments                                                                                       |
|---------------------------------------------------------------------------------------------|-------|----------------|-----------------|-------------------|----------------------------------------------------------------------------------------------------------------|
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>                                                  |       |                |                 |                   |                                                                                                                |
| $t_{ON}$                                                                                    | 400   |                |                 | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$                                                                    |
|                                                                                             | 500   | 530            | 555             | ns max            | $V_S = 10\ \text{V}$ , see Figure 44                                                                           |
| $t_{OFF}$                                                                                   | 415   |                |                 | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$                                                                    |
|                                                                                             | 515   | 550            | 565             | ns max            | $V_S = 10\ \text{V}$ , see Figure 44                                                                           |
| Overvoltage Response Time, $t_{RESPONSE}$                                                   | 370   |                | 200             | ns min            | $V_{S1} = V_{S2} = 10\ \text{V}$ , see Figure 44                                                               |
|                                                                                             | 480   | 500            | 515             | ns typ            | $R_L = 1\ \text{k}\Omega$ , $C_L = 2\ \text{pF}$ , see Figure 39                                               |
| Overvoltage Recovery Time, $t_{RECOVERY}$                                                   | 840   |                |                 | ns typ            | $R_L = 1\ \text{k}\Omega$ , $C_L = 2\ \text{pF}$ , see Figure 40                                               |
|                                                                                             | 1200  | 1400           | 1700            | ns max            |                                                                                                                |
| Interrupt Flag Response Time, $t_{DIGRESP}$                                                 | 85    |                | 115             | ns typ            | $C_L = 10\ \text{pF}$ , see Figure 41                                                                          |
| Interrupt Flag Recovery Time, $t_{DIGREC}$                                                  | 60    |                | 85              | $\mu\text{s}$ typ | $C_L = 10\ \text{pF}$ , see Figure 42                                                                          |
|                                                                                             | 600   |                |                 | ns typ            | $C_L = 10\ \text{pF}$ , $R_{PULLUP} = 1\ \text{k}\Omega$ , see Figure 43                                       |
| Charge Injection, $Q_{INJ}$                                                                 | 640   |                |                 | pC typ            | $V_S = 0\ \text{V}$ , $R_S = 0\ \Omega$ , $C_L = 1\ \text{nF}$ , see Figure 45                                 |
| Off Isolation                                                                               | −70   |                |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 33                                |
| Channel-to-Channel Crosstalk                                                                | −90   |                |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 34                                |
| Total Harmonic Distortion Plus Noise, THD + N                                               | 0.001 |                |                 | % typ             | $R_L = 10\ \text{k}\Omega$ , $V_S = 20\ \text{V}$ p-p, $f = 20\ \text{Hz}$ to $20\ \text{kHz}$ , see Figure 38 |
| −3 dB Bandwidth                                                                             | 270   |                |                 | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , see Figure 37                                                      |
| Insertion Loss                                                                              | −0.73 |                |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 37                                |
| $C_S$ (Off)                                                                                 | 12    |                |                 | pF typ            | $V_S = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                      |
| $C_D$ (Off)                                                                                 | 11    |                |                 | pF typ            | $V_S = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                      |
| $C_D$ (On), $C_S$ (On)                                                                      | 23    |                |                 | pF typ            | $V_S = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                      |
| <b>POWER REQUIREMENTS</b>                                                                   |       |                |                 |                   |                                                                                                                |
| $V_{DD} = 22\ \text{V}$ , $V_{SS} = -22\ \text{V}$ , digital inputs = 0 V, 5 V, or $V_{DD}$ |       |                |                 |                   |                                                                                                                |
| Normal Mode                                                                                 |       |                |                 |                   |                                                                                                                |
| $I_{DD}$                                                                                    | 0.9   |                |                 | mA typ            |                                                                                                                |
|                                                                                             | 1.2   |                | 1.3             | mA max            |                                                                                                                |
| $I_{GND}$                                                                                   | 0.4   |                |                 | mA typ            |                                                                                                                |
|                                                                                             | 0.55  |                | 0.6             | mA max            |                                                                                                                |
| $I_{SS}$                                                                                    | 0.5   |                |                 | mA typ            |                                                                                                                |
|                                                                                             | 0.65  |                | 0.7             | mA max            |                                                                                                                |
| Fault Mode                                                                                  |       |                |                 |                   | $V_S = \pm 55\ \text{V}$                                                                                       |
| $I_{DD}$                                                                                    | 1.2   |                |                 | mA typ            |                                                                                                                |
|                                                                                             | 1.6   |                | 1.8             | mA max            |                                                                                                                |
| $I_{GND}$                                                                                   | 0.8   |                |                 | mA typ            |                                                                                                                |
|                                                                                             | 1.0   |                | 1.1             | mA max            |                                                                                                                |
| $I_{SS}$                                                                                    | 0.5   |                |                 | mA typ            |                                                                                                                |
|                                                                                             | 1.0   |                | 1.8             | mA max            |                                                                                                                |
| $V_{DD}/V_{SS}$                                                                             |       |                | $\pm 5$         | V min             | GND = 0 V                                                                                                      |
|                                                                                             |       |                | $\pm 22$        | V max             | GND = 0 V                                                                                                      |

<sup>1</sup> Guaranteed by design; not subject to production test.

**12 V SINGLE SUPPLY**

$V_{DD} = 12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ ,  $C_{DECOUPLING} = 0.1\text{ }\mu\text{F}$ , unless otherwise noted.

**Table 3.**

| Parameter                                             | +25°C     | −40°C to +85°C | −55°C to +125°C | Unit              | Test Conditions/Comments                                                                                                                                              |
|-------------------------------------------------------|-----------|----------------|-----------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                  |           |                |                 |                   | $V_{DD} = 10.8\text{ V}$ , $V_{SS} = 0\text{ V}$ , see Figure 30                                                                                                      |
| Analog Signal Range                                   |           |                | 0 V to $V_{DD}$ | V                 |                                                                                                                                                                       |
| On Resistance, $R_{ON}$                               | 22        |                |                 | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                           |
|                                                       | 24.5      | 31             | 37              | $\Omega$ max      |                                                                                                                                                                       |
|                                                       | 10        |                |                 | $\Omega$ typ      | $V_S = 3.5\text{ V}$ to $8.5\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                        |
|                                                       | 11.2      | 14             | 16.5            | $\Omega$ max      |                                                                                                                                                                       |
| On-Resistance Match Between Channels, $\Delta R_{ON}$ | 0.05      |                |                 | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                           |
|                                                       | 0.5       | 0.6            | 0.7             | $\Omega$ max      |                                                                                                                                                                       |
|                                                       | 0.05      |                |                 | $\Omega$ typ      | $V_S = 3.5\text{ V}$ to $8.5\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                        |
|                                                       | 0.5       | 0.6            | 0.7             | $\Omega$ max      |                                                                                                                                                                       |
| On-Resistance Flatness, $R_{FLAT(ON)}$                | 12.5      |                |                 | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                           |
|                                                       | 14.5      | 19             | 23              | $\Omega$ max      |                                                                                                                                                                       |
|                                                       | 0.6       |                |                 | $\Omega$ typ      | $V_S = 3.5\text{ V}$ to $8.5\text{ V}$ , $I_S = -10\text{ mA}$                                                                                                        |
|                                                       | 0.9       | 1.1            | 1.3             | $\Omega$ max      |                                                                                                                                                                       |
| Threshold Voltage, $V_T$                              | 0.7       |                |                 | V typ             | See Figure 26                                                                                                                                                         |
| <b>LEAKAGE CURRENTS</b>                               |           |                |                 |                   | $V_{DD} = 13.2\text{ V}$ , $V_{SS} = 0\text{ V}$                                                                                                                      |
| Source Off Leakage, $I_S$ (Off)                       | $\pm 0.1$ |                |                 | nA typ            | $V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ , see Figure 31                                                                                       |
|                                                       | $\pm 1.5$ | $\pm 5.0$      | $\pm 21.0$      | nA max            |                                                                                                                                                                       |
| Drain Off Leakage, $I_D$ (Off)                        | $\pm 0.1$ |                |                 | nA typ            | $V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ , see Figure 31                                                                                       |
|                                                       | $\pm 1.5$ | $\pm 5.0$      | $\pm 18.0$      | nA max            |                                                                                                                                                                       |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)            | $\pm 0.3$ |                |                 | nA typ            | $V_S = V_D = 1\text{ V}/10\text{ V}$ , see Figure 32                                                                                                                  |
|                                                       | $\pm 1.5$ | $\pm 2.0$      | $\pm 4.5$       | nA max            |                                                                                                                                                                       |
| <b>FAULT</b>                                          |           |                |                 |                   |                                                                                                                                                                       |
| Source Leakage Current, $I_S$                         |           |                |                 |                   |                                                                                                                                                                       |
| With Overvoltage                                      |           |                | $\pm 78$        | $\mu\text{A}$ typ | $V_{DD} = 13.2\text{ V}$ , $V_{SS} = 0\text{ V}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , see Figure 35                                                       |
| Power Supplies Grounded or Floating                   |           |                | $\pm 40$        | $\mu\text{A}$ typ | $V_{DD} = 0\text{ V}$ or floating, $V_{SS} = 0\text{ V}$ or floating, $GND = 0\text{ V}$ , $I_{NX} = 0\text{ V}$ or floating, $V_S = \pm 55\text{ V}$ , see Figure 36 |
| Drain Leakage Current, $I_D$                          |           |                |                 |                   |                                                                                                                                                                       |
| With Overvoltage                                      | $\pm 2.0$ |                |                 | nA typ            | $V_{DD} = 13.2\text{ V}$ , $V_{SS} = 0\text{ V}$ or floating, $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , see Figure 35                                            |
|                                                       | $\pm 20$  | $\pm 30$       | $\pm 65$        | nA max            |                                                                                                                                                                       |
| Power Supplies Grounded                               | $\pm 10$  |                |                 | nA typ            | $V_{DD} = 0\text{ V}$ , $V_{SS} = 0\text{ V}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , $I_{NX} = 0\text{ V}$ , see Figure 36                                  |
|                                                       | $\pm 30$  | $\pm 50$       | $\pm 100$       | nA max            |                                                                                                                                                                       |
| Power Supplies Floating                               | $\pm 10$  | $\pm 10$       | $\pm 10$        | $\mu\text{A}$ typ | $V_{DD} = \text{floating}$ , $V_{SS} = \text{floating}$ , $GND = 0\text{ V}$ , $V_S = \pm 55\text{ V}$ , $I_{NX} = 0\text{ V}$ , see Figure 36                        |
| <b>DIGITAL INPUTS</b>                                 |           |                |                 |                   |                                                                                                                                                                       |
| Input Voltage High, $V_{INH}$                         |           |                | 2.0             | V min             |                                                                                                                                                                       |
| Input Voltage Low, $V_{INL}$                          |           |                | 0.8             | V max             |                                                                                                                                                                       |
| Input Current, $I_{INL}$ or $I_{INH}$                 | 0.7       |                |                 | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$                                                                                                                                        |
|                                                       |           |                | 1.2             | $\mu\text{A}$ max |                                                                                                                                                                       |
| Digital Input Capacitance, $C_{IN}$                   | 5.0       |                |                 | pF typ            |                                                                                                                                                                       |
| Output Voltage High, $V_{OH}$                         | 2.0       |                |                 | V min             |                                                                                                                                                                       |
| Output Voltage Low, $V_{OL}$                          | 0.8       |                |                 | V max             |                                                                                                                                                                       |

| Parameter                                          | +25°C | –40°C to +85°C | –55°C to +125°C | Unit                                         | Test Conditions/Comments                                                                       |
|----------------------------------------------------|-------|----------------|-----------------|----------------------------------------------|------------------------------------------------------------------------------------------------|
| DYNAMIC CHARACTERISTICS <sup>1</sup>               |       |                |                 |                                              |                                                                                                |
| t <sub>ON</sub>                                    | 400   | 515            | 540             | ns typ                                       | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                 |
|                                                    | 485   |                |                 | ns max                                       | V <sub>S</sub> = 8 V, see Figure 44                                                            |
| t <sub>OFF</sub>                                   | 375   | 495            | 520             | ns typ                                       | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                 |
|                                                    | 460   |                |                 | ns max                                       | V <sub>S</sub> = 8 V, see Figure 44                                                            |
| Overvoltage Response Time, t <sub>RESPONSE</sub>   | 560   | 700            | 720             | ns min                                       | V <sub>S1</sub> = V <sub>S2</sub> = 8 V, see Figure 44                                         |
|                                                    | 660   |                |                 | ns typ                                       | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 2 pF, see Figure 39                                    |
| Overvoltage Recovery Time, t <sub>RECOVERY</sub>   | 640   | 865            | 960             | ns max                                       | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 2 pF, see Figure 40                                    |
|                                                    | 800   |                |                 | ns typ                                       |                                                                                                |
| Interrupt Flag Response Time, t <sub>DIGRESP</sub> | 85    |                | 115             | ns typ                                       | C <sub>L</sub> = 10 pF, see Figure 41                                                          |
| Interrupt Flag Recovery Time, t <sub>DIGREC</sub>  | 60    |                | 85              | μs typ                                       | C <sub>L</sub> = 10 pF, see Figure 42                                                          |
|                                                    | 600   |                |                 | ns typ                                       | C <sub>L</sub> = 10 pF, R <sub>PULLUP</sub> = 1 kΩ, see Figure 43                              |
| Charge Injection, Q <sub>INJ</sub>                 | 340   |                |                 | pC typ                                       | V <sub>S</sub> = 6 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF, see Figure 45               |
| Off Isolation                                      | –65   |                |                 | dB typ                                       | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz, see Figure 33                         |
| Channel-to-Channel Crosstalk                       | –90   |                |                 | dB typ                                       | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz, see Figure 34                         |
| Total Harmonic Distortion Plus Noise, THD + N      | 0.007 |                |                 | % typ                                        | R <sub>L</sub> = 10 kΩ, V <sub>S</sub> = 6 V p-p, f = 20 Hz to 20 kHz, see Figure 38           |
| –3 dB Bandwidth                                    | 270   |                |                 | MHz typ                                      | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, see Figure 37                                    |
| Insertion Loss                                     | –0.74 |                |                 | dB typ                                       | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz, see Figure 37                         |
| C <sub>S</sub> (Off)                               | 16    |                |                 | pF typ                                       | V <sub>S</sub> = 6 V, f = 1 MHz                                                                |
| C <sub>D</sub> (Off)                               | 15    |                |                 | pF typ                                       | V <sub>S</sub> = 6 V, f = 1 MHz                                                                |
| C <sub>D</sub> (On), C <sub>S</sub> (On)           | 25    |                |                 | pF typ                                       | V <sub>S</sub> = 6 V, f = 1 MHz                                                                |
| POWER REQUIREMENTS                                 |       |                |                 |                                              |                                                                                                |
| Normal Mode                                        |       |                |                 |                                              | V <sub>DD</sub> = 13.2 V, V <sub>SS</sub> = 0 V, digital inputs = 0 V, 5 V, or V <sub>DD</sub> |
| I <sub>DD</sub>                                    | 0.9   |                | 1.3             | mA typ                                       | V <sub>S</sub> = ±55 V                                                                         |
|                                                    | 1.2   |                |                 | mA max                                       |                                                                                                |
| I <sub>GND</sub>                                   | 0.4   | 0.6            | mA typ          |                                              |                                                                                                |
|                                                    | 0.55  |                | mA max          |                                              |                                                                                                |
| I <sub>SS</sub>                                    | 0.5   | 0.7            | mA typ          |                                              |                                                                                                |
|                                                    | 0.65  |                | mA max          |                                              |                                                                                                |
| Fault Mode                                         |       |                |                 |                                              |                                                                                                |
| I <sub>DD</sub>                                    | 1.2   |                | 1.8             | mA typ                                       |                                                                                                |
|                                                    | 1.6   |                |                 | mA max                                       |                                                                                                |
| I <sub>GND</sub>                                   | 0.8   | 1.1            | mA typ          |                                              |                                                                                                |
|                                                    | 1.0   |                | mA max          |                                              |                                                                                                |
| I <sub>SS</sub>                                    | 0.5   | 1.8            | mA typ          | Digital inputs = 5 V                         |                                                                                                |
|                                                    | 1.0   |                | mA max          | V <sub>S</sub> = ±55 V, V <sub>D</sub> = 0 V |                                                                                                |
| V <sub>DD</sub>                                    |       |                | 8               | V min                                        | GND = 0 V                                                                                      |
|                                                    |       |                | 44              | V max                                        | GND = 0 V                                                                                      |

<sup>1</sup> Guaranteed by design; not subject to production test.



**36 V SINGLE SUPPLY**

$V_{DD} = 36 \text{ V} \pm 10\%$ ,  $V_{SS} = 0 \text{ V}$ ,  $GND = 0 \text{ V}$ ,  $C_{DECOUPLING} = 0.1 \mu\text{F}$ , unless otherwise noted.

**Table 4.**

| Parameter                                             | +25°C     | −40°C to<br>+85°C | −55°C to<br>+125°C | Unit              | Test Conditions/Comments                                                                                                                                                                     |
|-------------------------------------------------------|-----------|-------------------|--------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                  |           |                   |                    |                   | $V_{DD} = 32.4 \text{ V}$ , $V_{SS} = 0 \text{ V}$ , see Figure 30                                                                                                                           |
| Analog Signal Range                                   |           |                   | 0 V to $V_{DD}$    | V                 |                                                                                                                                                                                              |
| On Resistance, $R_{ON}$                               | 22        |                   |                    | $\Omega$ typ      | $V_S = 0 \text{ V}$ to 30 V, $I_S = -10 \text{ mA}$                                                                                                                                          |
|                                                       | 24.5      | 31                | 37                 | $\Omega$ max      |                                                                                                                                                                                              |
|                                                       | 10        |                   |                    | $\Omega$ typ      | $V_S = 4.5 \text{ V}$ to 28 V, $I_S = -10 \text{ mA}$                                                                                                                                        |
|                                                       | 11        | 14                | 16.5               | $\Omega$ max      |                                                                                                                                                                                              |
| On-Resistance Match Between Channels, $\Delta R_{ON}$ | 0.05      |                   |                    | $\Omega$ typ      | $V_S = 0 \text{ V}$ to 30 V, $I_S = -10 \text{ mA}$                                                                                                                                          |
|                                                       | 0.5       | 0.6               | 0.7                | $\Omega$ max      |                                                                                                                                                                                              |
|                                                       | 0.05      |                   |                    | $\Omega$ typ      | $V_S = 4.5 \text{ V}$ to 28 V, $I_S = -10 \text{ mA}$                                                                                                                                        |
|                                                       | 0.35      | 0.5               | 0.5                | $\Omega$ max      |                                                                                                                                                                                              |
| On-Resistance Flatness, $R_{FLAT(ON)}$                | 12.5      |                   |                    | $\Omega$ typ      | $V_S = 0 \text{ V}$ to 30 V, $I_S = -10 \text{ mA}$                                                                                                                                          |
|                                                       | 14.5      | 19                | 23                 | $\Omega$ max      |                                                                                                                                                                                              |
|                                                       | 0.1       |                   |                    | $\Omega$ typ      | $V_S = 4.5 \text{ V}$ to 28 V, $I_S = -10 \text{ mA}$                                                                                                                                        |
|                                                       | 0.4       | 0.5               | 0.5                | $\Omega$ max      |                                                                                                                                                                                              |
| Threshold Voltage, $V_T$                              | 0.7       |                   |                    | V typ             | See Figure 26                                                                                                                                                                                |
| <b>LEAKAGE CURRENTS</b>                               |           |                   |                    |                   | $V_{DD} = 39.6 \text{ V}$ , $V_{SS} = 0 \text{ V}$                                                                                                                                           |
| Source Off Leakage, $I_S$ (Off)                       | $\pm 0.1$ |                   |                    | nA typ            | $V_S = 1 \text{ V}/30 \text{ V}$ , $V_D = 30 \text{ V}/1 \text{ V}$ , see Figure 31                                                                                                          |
|                                                       | $\pm 1.5$ | $\pm 5.0$         | $\pm 21.0$         | nA max            |                                                                                                                                                                                              |
| Drain Off Leakage, $I_D$ (Off)                        | $\pm 0.1$ |                   |                    | nA typ            | $V_S = 1 \text{ V}/30 \text{ V}$ , $V_D = 30 \text{ V}/1 \text{ V}$ , see Figure 31                                                                                                          |
|                                                       | $\pm 1.5$ | $\pm 5.0$         | $\pm 18.0$         | nA max            |                                                                                                                                                                                              |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)            | $\pm 0.3$ |                   |                    | nA typ            | $V_S = V_D = 1 \text{ V}/30 \text{ V}$ , see Figure 32                                                                                                                                       |
|                                                       | $\pm 1.5$ | $\pm 2.0$         | $\pm 4.5$          | nA max            |                                                                                                                                                                                              |
| <b>FAULT</b>                                          |           |                   |                    |                   |                                                                                                                                                                                              |
| Source Leakage Current, $I_S$<br>With Overvoltage     |           |                   | $\pm 78$           | $\mu\text{A}$ typ | $V_{DD} = 39.6 \text{ V}$ , $V_{SS} = 0 \text{ V}$ , $GND = 0 \text{ V}$ ,<br>$V_S = +55 \text{ V}$ , $-40 \text{ V}$ , see Figure 35                                                        |
| Power Supplies Grounded or Floating                   |           |                   | $\pm 40$           | $\mu\text{A}$ typ | $V_{DD} = 0 \text{ V}$ or floating, $V_{SS} = 0 \text{ V}$ or<br>floating, $GND = 0 \text{ V}$ , $INx = 0 \text{ V}$ or<br>floating, $V_S = +55 \text{ V}$ , $-40 \text{ V}$ , see Figure 36 |
| Drain Leakage Current, $I_D$<br>With Overvoltage      | $\pm 2.0$ |                   |                    | nA typ            | $V_{DD} = 39.6 \text{ V}$ , $V_{SS} = 0 \text{ V}$ or floating,<br>$GND = 0 \text{ V}$ , $V_S = +55 \text{ V}$ , $-40 \text{ V}$ ,<br>see Figure 35                                          |
|                                                       | $\pm 20$  | $\pm 30$          | $\pm 65$           | nA max            |                                                                                                                                                                                              |
| Power Supplies Grounded                               | $\pm 10$  |                   |                    | nA typ            | $V_{DD} = 0 \text{ V}$ , $V_{SS} = 0 \text{ V}$ , $GND = 0 \text{ V}$ ,<br>$V_S = +55 \text{ V}$ , $-40 \text{ V}$ , $INx = 0 \text{ V}$ ,<br>see Figure 36                                  |
|                                                       | $\pm 30$  | $\pm 50$          | $\pm 100$          | nA max            |                                                                                                                                                                                              |
| Power Supplies Floating                               | $\pm 10$  | $\pm 10$          | $\pm 10$           | $\mu\text{A}$ typ | $V_{DD} = \text{floating}$ , $V_{SS} = \text{floating}$ ,<br>$GND = 0 \text{ V}$ , $V_S = +55 \text{ V}$ , $-40 \text{ V}$ ,<br>$INx = 0 \text{ V}$ , see Figure 36                          |
| <b>DIGITAL INPUTS</b>                                 |           |                   |                    |                   |                                                                                                                                                                                              |
| Input Voltage High, $V_{INH}$                         |           |                   | 2.0                | V min             | $V_{IN} = V_{GND}$ or $V_{DD}$                                                                                                                                                               |
| Input Voltage Low, $V_{INL}$                          |           |                   | 0.8                | V max             |                                                                                                                                                                                              |
| Input Current, $I_{INL}$ or $I_{INH}$                 | 0.7       |                   |                    | $\mu\text{A}$ typ |                                                                                                                                                                                              |
|                                                       |           |                   | 1.2                | $\mu\text{A}$ max |                                                                                                                                                                                              |
| Digital Input Capacitance, $C_{IN}$                   | 5.0       |                   |                    | pF typ            |                                                                                                                                                                                              |
| Output Voltage High, $V_{OH}$                         | 2.0       |                   |                    | V min             |                                                                                                                                                                                              |
| Output Voltage Low, $V_{OL}$                          | 0.8       |                   |                    | V max             |                                                                                                                                                                                              |

| Parameter                                                                                   | +25°C | –40°C to<br>+85°C | –55°C to<br>+125°C | Unit              | Test Conditions/Comments                                                                                       |
|---------------------------------------------------------------------------------------------|-------|-------------------|--------------------|-------------------|----------------------------------------------------------------------------------------------------------------|
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>                                                  |       |                   |                    |                   |                                                                                                                |
| $t_{ON}$                                                                                    | 400   |                   |                    | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$                                                                    |
|                                                                                             | 490   | 520               | 545                | ns max            | $V_S = 18\ \text{V}$ , see Figure 44                                                                           |
| $t_{OFF}$                                                                                   | 375   |                   |                    | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$                                                                    |
|                                                                                             | 460   | 485               | 510                | ns max            | $V_S = 18\ \text{V}$ , see Figure 44                                                                           |
|                                                                                             |       |                   | 195                | ns min            | $V_{S1} = V_{S2} = 18\ \text{V}$ , see Figure 44                                                               |
| Overvoltage Response Time, $t_{RESPONSE}$                                                   | 250   |                   |                    | ns typ            | $R_L = 1\ \text{k}\Omega$ , $C_L = 2\ \text{pF}$ , see Figure 39                                               |
|                                                                                             | 350   | 360               | 375                | ns max            |                                                                                                                |
| Overvoltage Recovery Time, $t_{RECOVERY}$                                                   | 1500  |                   |                    | ns typ            | $R_L = 1\ \text{k}\Omega$ , $C_L = 2\ \text{pF}$ , see Figure 40                                               |
|                                                                                             | 2000  | 2300              | 2700               | ns max            |                                                                                                                |
| Interrupt Flag Response Time, $t_{DIGRESP}$                                                 | 85    |                   | 115                | ns typ            | $C_L = 10\ \text{pF}$ , see Figure 41                                                                          |
| Interrupt Flag Recovery Time, $t_{DIGREC}$                                                  | 60    |                   | 85                 | $\mu\text{s}$ typ | $C_L = 10\ \text{pF}$ , see Figure 42                                                                          |
|                                                                                             | 600   |                   |                    | ns typ            | $C_L = 10\ \text{pF}$ , $R_{PULLUP} = 1\ \text{k}\Omega$ , see Figure 43                                       |
| Charge Injection, $Q_{INJ}$                                                                 | 610   |                   |                    | pC typ            | $V_S = 18\ \text{V}$ , $R_S = 0\ \Omega$ , $C_L = 1\ \text{nF}$ , see Figure 45                                |
| Off Isolation                                                                               | –70   |                   |                    | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 33                                |
| Channel-to-Channel Crosstalk                                                                | –90   |                   |                    | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 34                                |
| Total Harmonic Distortion Plus Noise, THD + N                                               | 0.001 |                   |                    | % typ             | $R_L = 10\ \text{k}\Omega$ , $V_S = 18\ \text{V}$ p-p, $f = 20\ \text{Hz}$ to $20\ \text{kHz}$ , see Figure 38 |
| –3 dB Bandwidth                                                                             | 270   |                   |                    | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , see Figure 37                                                      |
| Insertion Loss                                                                              | –0.75 |                   |                    | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 37                                |
| $C_S$ (Off)                                                                                 | 12    |                   |                    | pF typ            | $V_S = 18\ \text{V}$ , $f = 1\ \text{MHz}$                                                                     |
| $C_D$ (Off)                                                                                 | 11    |                   |                    | pF typ            | $V_S = 18\ \text{V}$ , $f = 1\ \text{MHz}$                                                                     |
| $C_D$ (On), $C_S$ (On)                                                                      | 23    |                   |                    | pF typ            | $V_S = 18\ \text{V}$ , $f = 1\ \text{MHz}$                                                                     |
| <b>POWER REQUIREMENTS</b>                                                                   |       |                   |                    |                   |                                                                                                                |
| $V_{DD} = 39.6\ \text{V}$ , $V_{SS} = 0\ \text{V}$ , digital inputs = 0 V, 5 V, or $V_{DD}$ |       |                   |                    |                   |                                                                                                                |
| Normal Mode                                                                                 |       |                   |                    |                   |                                                                                                                |
| $I_{DD}$                                                                                    | 0.9   |                   |                    | mA typ            |                                                                                                                |
|                                                                                             | 1.2   |                   | 1.3                | mA max            |                                                                                                                |
| $I_{GND}$                                                                                   | 0.4   |                   |                    | mA typ            |                                                                                                                |
|                                                                                             | 0.55  |                   | 0.6                | mA max            |                                                                                                                |
| $I_{SS}$                                                                                    | 0.5   |                   |                    | mA typ            |                                                                                                                |
|                                                                                             | 0.65  |                   | 0.7                | mA max            |                                                                                                                |
| Fault Mode                                                                                  |       |                   |                    |                   | $V_S = +55\ \text{V}$ , $-40\ \text{V}$                                                                        |
| $I_{DD}$                                                                                    | 1.2   |                   |                    | mA typ            |                                                                                                                |
|                                                                                             | 1.6   |                   | 1.8                | mA max            |                                                                                                                |
| $I_{GND}$                                                                                   | 0.8   |                   |                    | mA typ            |                                                                                                                |
|                                                                                             | 1.0   |                   | 1.1                | mA max            |                                                                                                                |
| $I_{SS}$                                                                                    | 0.5   |                   |                    | mA typ            |                                                                                                                |
|                                                                                             | 1.0   |                   | 1.8                | mA max            |                                                                                                                |
| $V_{DD}$                                                                                    |       |                   | 8                  | V min             | GND = 0 V                                                                                                      |
|                                                                                             |       |                   | 44                 | V max             | GND = 0 V                                                                                                      |

<sup>1</sup> Guaranteed by design; not subject to production test.

**CONTINUOUS CURRENT PER CHANNEL, Sx OR Dx**

Table 5.

| Parameter                               | 25°C | 85°C | 125°C | Unit   | Test Conditions/Comments                                 |
|-----------------------------------------|------|------|-------|--------|----------------------------------------------------------|
| 16-LEAD TSSOP                           |      |      |       |        |                                                          |
| $\theta_{JA} = 112.6^{\circ}\text{C/W}$ | 83   | 59   | 39    | mA max | $V_S = V_{SS} + 4.5\text{ V}$ to $V_{DD} - 4.5\text{ V}$ |
|                                         | 64   | 48   | 29    | mA max | $V_S = V_{SS}$ to $V_{DD}$                               |

## ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ , unless otherwise noted.

**Table 6.**

| Parameter                                                      | Rating                                                                              |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------|
| $V_{DD}$ to $V_{SS}$                                           | 48 V                                                                                |
| $V_{DD}$ to GND                                                | −0.3 V to +48 V                                                                     |
| $V_{SS}$ to GND                                                | −48 V to +0.3 V                                                                     |
| Sx Pins to GND                                                 | −55 V to +55 V                                                                      |
| Sx to $V_{DD}$ or $V_{SS}$                                     | 80 V                                                                                |
| $V_S$ to $V_D$                                                 | 80 V                                                                                |
| Dx Pins <sup>1</sup>                                           | $V_{SS} - 0.7\text{ V}$ to $V_{DD} + 0.7\text{ V}$ or 30 mA, whichever occurs first |
| Digital Inputs                                                 | GND − 0.3 V to +48 V                                                                |
| Peak Current, Sx or Dx Pins                                    | 288 mA (pulsed at 1 ms, 10% duty cycle maximum)                                     |
| Continuous Current, Sx or Dx Pins                              | Data <sup>2</sup> + 15%                                                             |
| Digital Output                                                 | GND − 0.3 V to 6 V or 30 mA, whichever occurs first                                 |
| Operating Temperature Range                                    | −55°C to +125°C                                                                     |
| Storage Temperature Range                                      | −65°C to +150°C                                                                     |
| Junction Temperature                                           | 150°C                                                                               |
| Thermal Impedance, $\theta_{JA}$                               |                                                                                     |
| 16-Lead TSSOP, $\theta_{JA}$ Thermal Impedance (4-Layer Board) | 112.6°C/W                                                                           |
| Reflow Soldering Peak Temperature, Pb Free                     | As per JEDEC J-STD-020                                                              |
| ESD (HBM: ANSI/ESD STM5.1-2007)                                |                                                                                     |
| Input/Output Port to Supplies                                  | 5.5 kV                                                                              |
| Input/Output Port to Input/Output Port                         | 5.5 kV                                                                              |
| All Other Pins                                                 | 5.5 kV                                                                              |

<sup>1</sup> Overvoltages at the Dx pins are clamped by internal diodes. Limit current to the maximum ratings given.

<sup>2</sup> See Table 5.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

Only one absolute maximum rating can be applied at any one time.

### ESD CAUTION



#### ESD (electrostatic discharge) sensitive device.

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

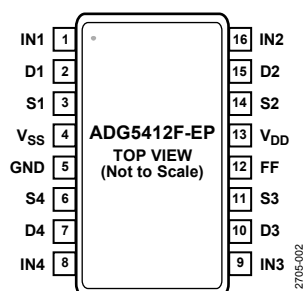


Figure 2. Pin Configuration

Table 7. Pin Function Descriptions

| Pin No. | Mnemonic        | Description                                                                                                                                                         |
|---------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | IN1             | Logic Control Input.                                                                                                                                                |
| 2       | D1              | Drain Terminal. This pin can be an input or an output.                                                                                                              |
| 3       | S1              | Overvoltage Protected Source Terminal. This pin can be an input or an output.                                                                                       |
| 4       | V <sub>SS</sub> | Most Negative Power Supply Potential.                                                                                                                               |
| 5       | GND             | Ground (0 V) Reference.                                                                                                                                             |
| 6       | S4              | Overvoltage Protected Source Terminal. This pin can be an input or an output.                                                                                       |
| 7       | D4              | Drain Terminal. This pin can be an input or an output.                                                                                                              |
| 8       | IN4             | Logic Control Input.                                                                                                                                                |
| 9       | IN3             | Logic Control Input.                                                                                                                                                |
| 10      | D3              | Drain Terminal. This pin can be an input or an output.                                                                                                              |
| 11      | S3              | Overvoltage Protected Source Terminal. This pin can be an input or an output.                                                                                       |
| 12      | FF              | Fault Flag Digital Output. This pin has a high output when the device is in normal operation or a low output when a fault condition occurs on any of the Sx inputs. |
| 13      | V <sub>DD</sub> | Most Positive Power Supply Potential.                                                                                                                               |
| 14      | S2              | Overvoltage Protected Source Terminal. This pin can be an input or an output.                                                                                       |
| 15      | D2              | Drain Terminal. This pin can be an input or an output.                                                                                                              |
| 16      | IN2             | Logic Control Input.                                                                                                                                                |

Table 8. ADG5412F-EP Truth Table

| INx | Switch Condition (S1 to S4) |
|-----|-----------------------------|
| 1   | On                          |
| 0   | Off                         |

# TYPICAL PERFORMANCE CHARACTERISTICS

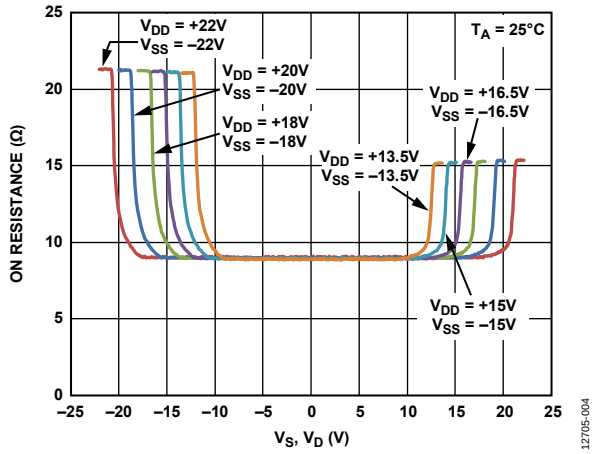


Figure 3.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  (Dual Supply)

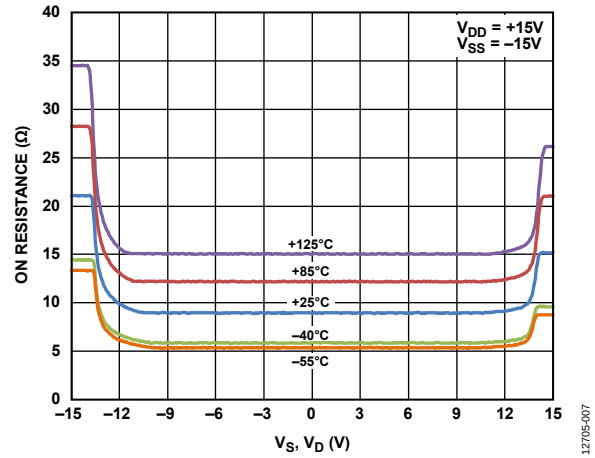


Figure 6.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  for Different Temperatures,  $\pm 15$  V Dual Supply

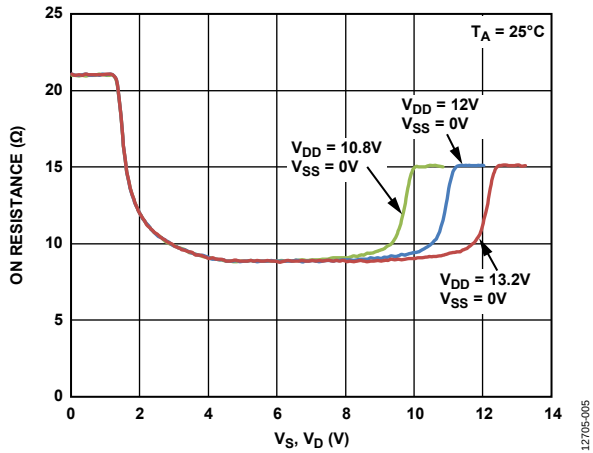


Figure 4.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  (12 V Single Supply)

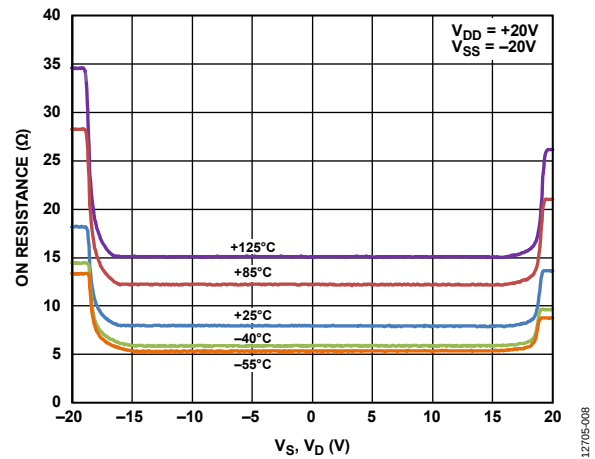


Figure 7.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  for Different Temperatures,  $\pm 20$  V Dual Supply

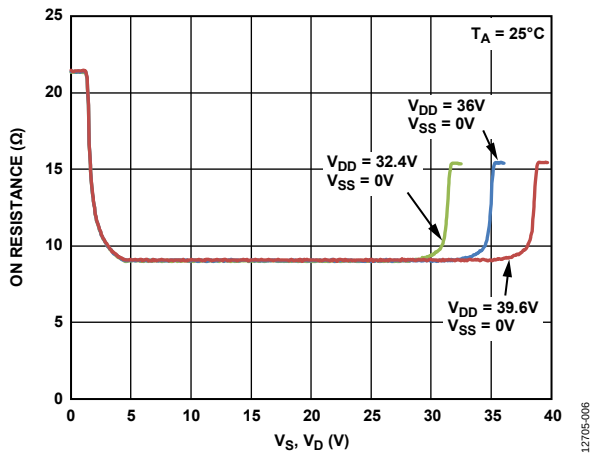


Figure 5.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  (36 V Single Supply)

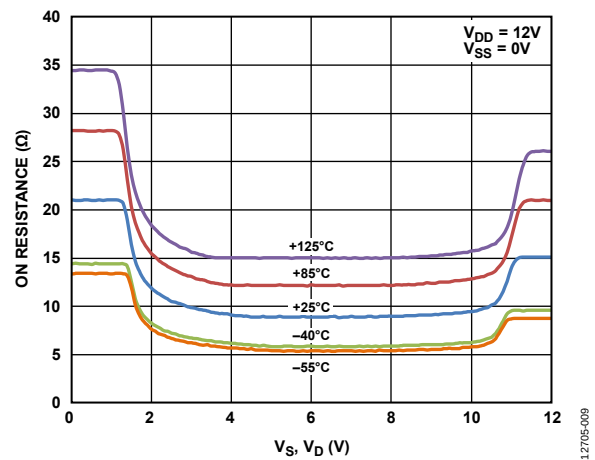


Figure 8.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  for Different Temperatures, 12 V Single Supply

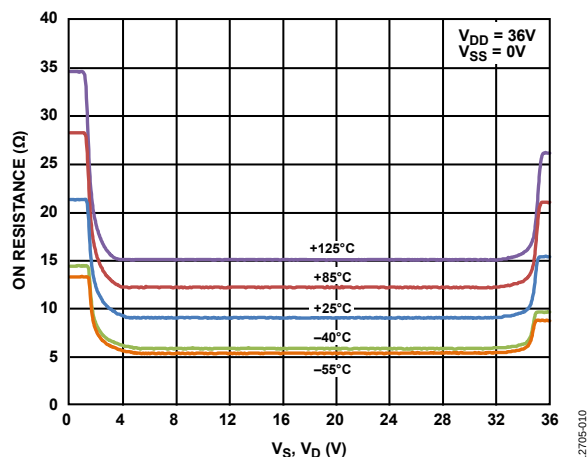


Figure 9.  $R_{ON}$  as a Function of  $V_S$ ,  $V_D$  for Different Temperatures, 36 V Single Supply

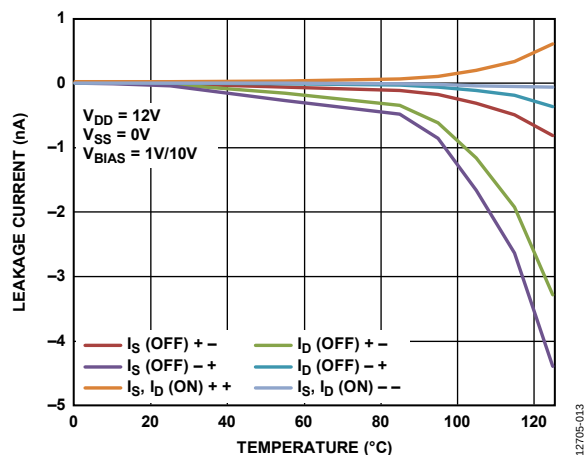


Figure 12. Leakage Current vs. Temperature, 12 V Single Supply

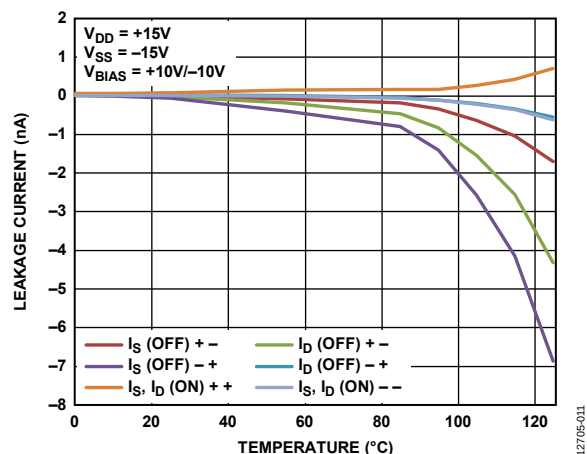


Figure 10. Leakage Current vs. Temperature,  $\pm 15 V$  Dual Supply

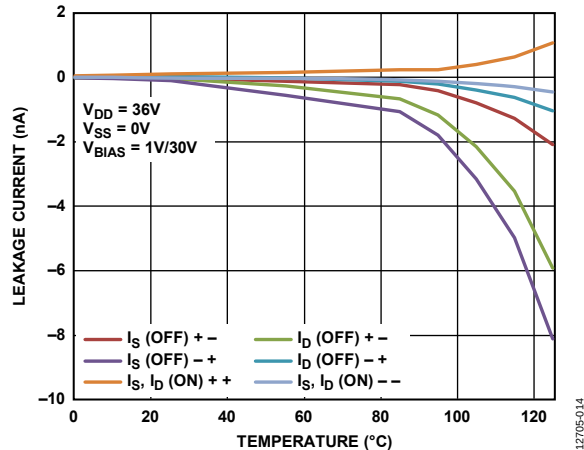


Figure 13. Leakage Current vs. Temperature, 36 V Single Supply

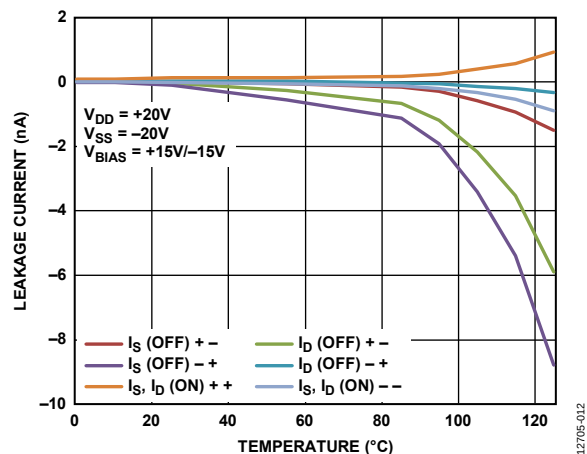


Figure 11. Leakage Current vs. Temperature,  $\pm 20 V$  Dual Supply

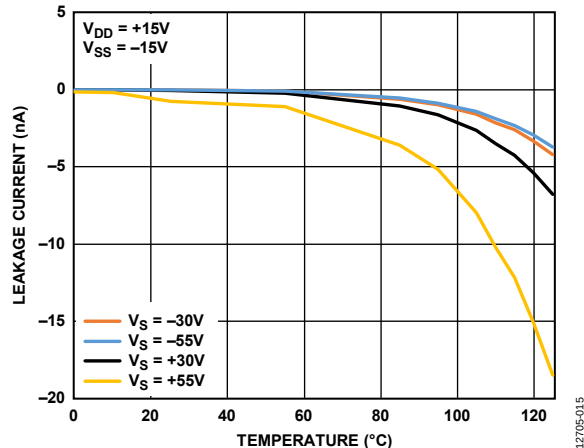


Figure 14. Overvoltage Leakage Current vs. Temperature,  $\pm 15 V$  Dual Supply

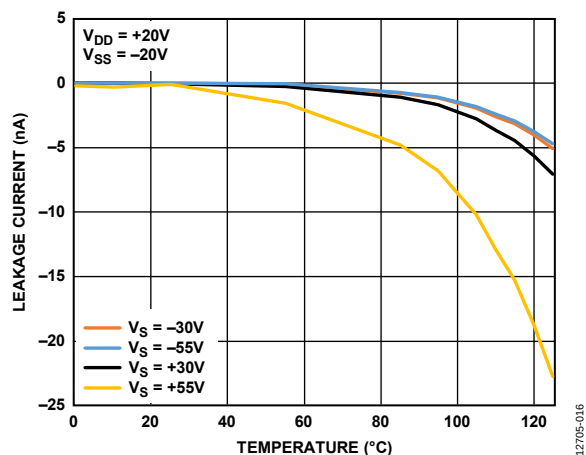


Figure 15. Overvoltage Leakage Current vs. Temperature,  $\pm 20$  V Dual Supply

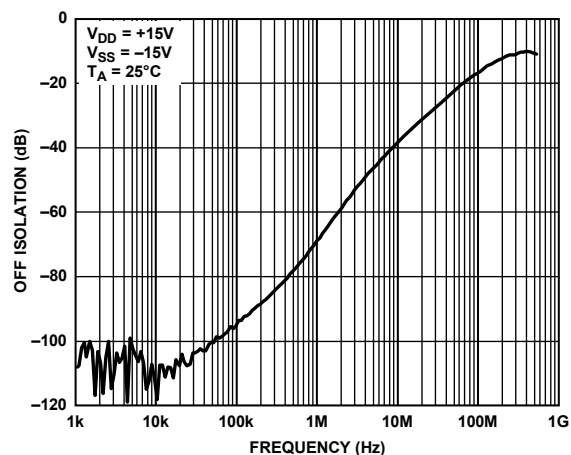


Figure 18. Off Isolation vs. Frequency,  $\pm 15$  V Dual Supply

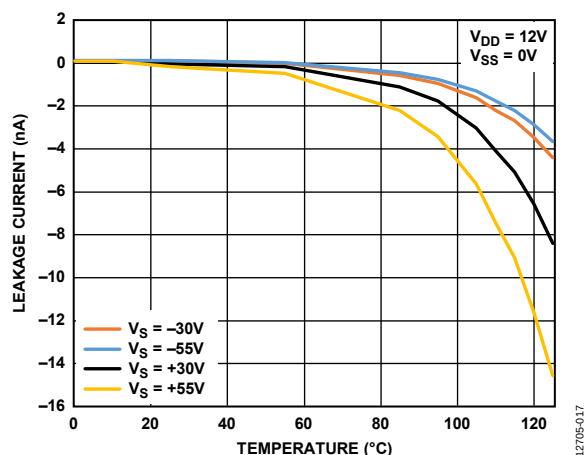


Figure 16. Overvoltage Leakage Current vs. Temperature, 12 V Single Supply

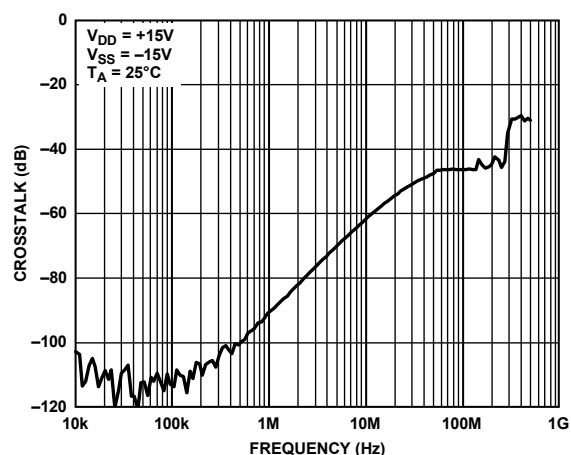


Figure 19. Crosstalk vs. Frequency,  $\pm 15$  V Dual Supply

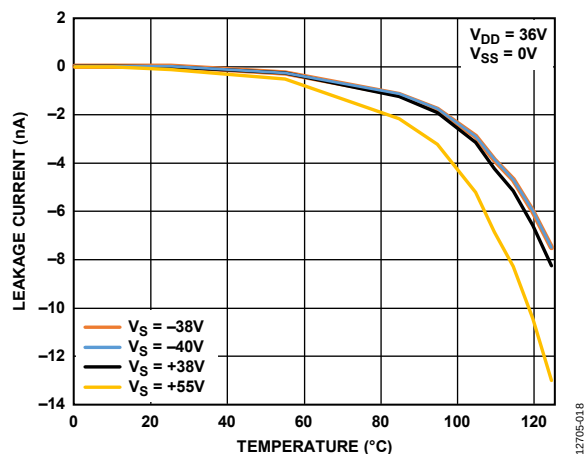


Figure 17. Overvoltage Leakage Current vs. Temperature, 36 V Single Supply

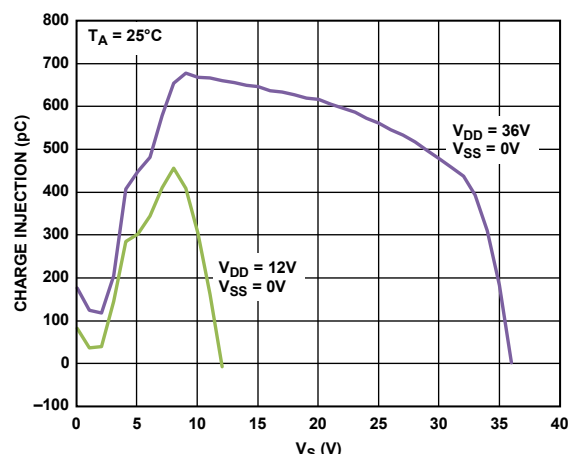


Figure 20. Charge Injection vs. Source Voltage ( $V_S$ ), Single Supply



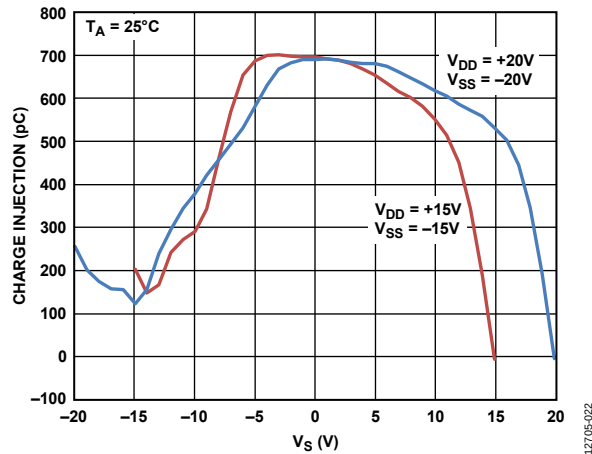
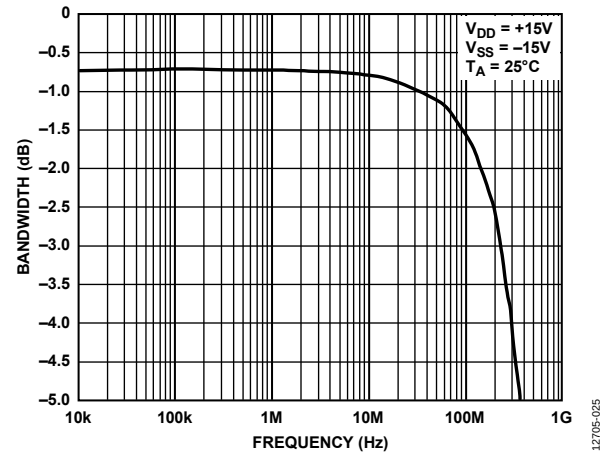
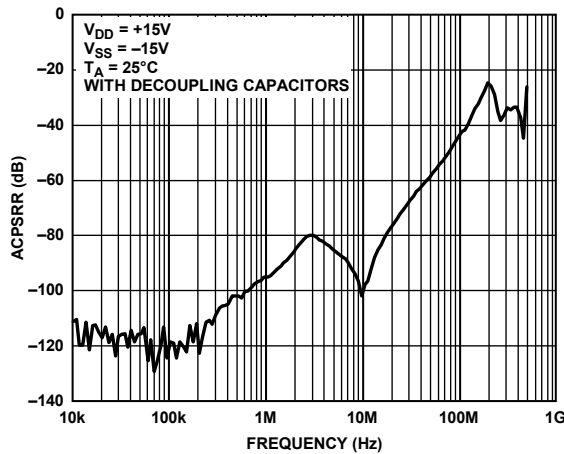
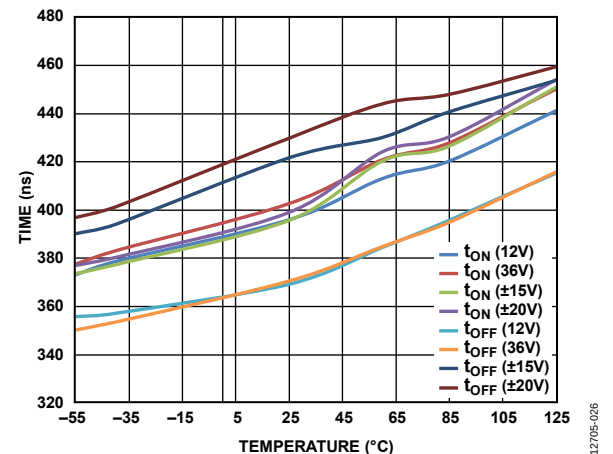
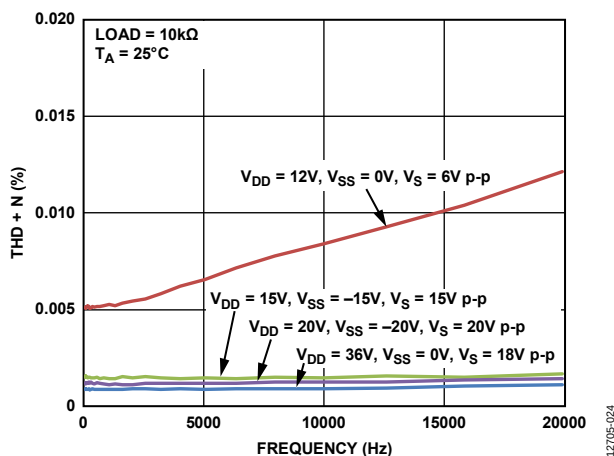
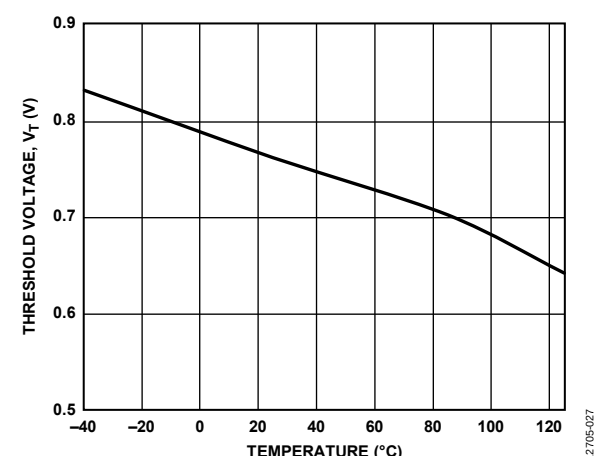
Figure 21. Charge Injection vs. Source Voltage ( $V_S$ ), Dual SupplyFigure 24. Bandwidth vs. Frequency,  $\pm 15$  V Dual SupplyFigure 22. ACPSRR vs. Frequency,  $\pm 15$  V Dual SupplyFigure 25.  $t_{ON}$ ,  $t_{OFF}$  Times vs. Temperature

Figure 23. THD + N vs. Frequency

Figure 26. Threshold Voltage ( $V_T$ ) vs. Temperature

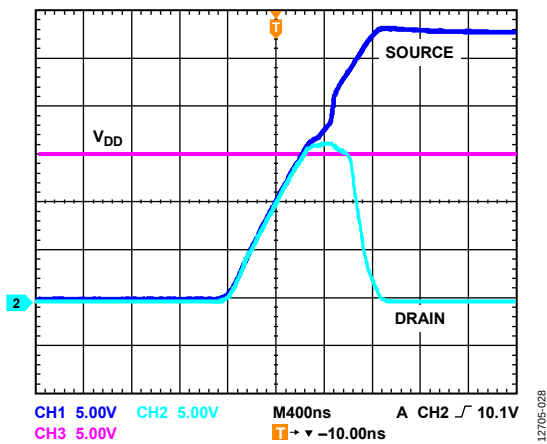


Figure 27. Drain Output Response to Positive Overvoltage

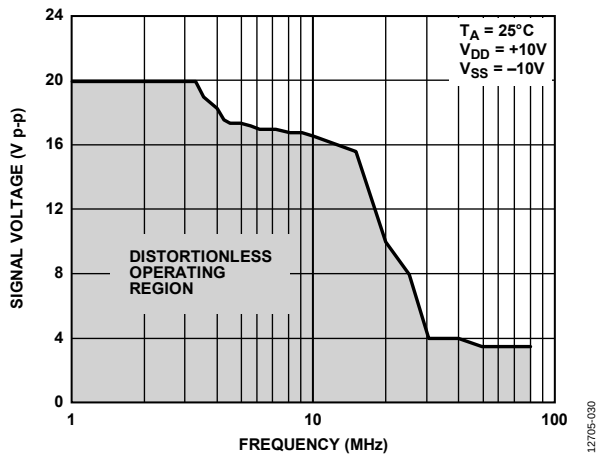


Figure 29. Large Signal Voltage Tracking vs. Frequency

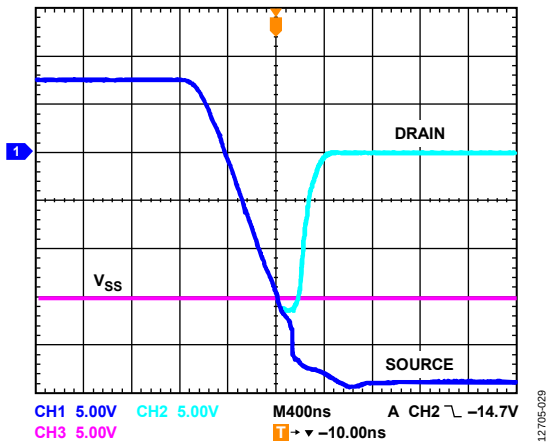


Figure 28. Drain Output Response to Negative Overvoltage

## TEST CIRCUITS

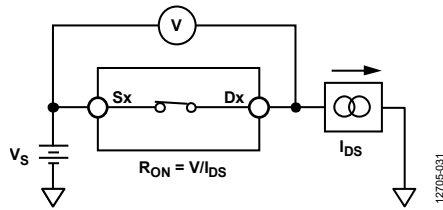


Figure 30. On Resistance

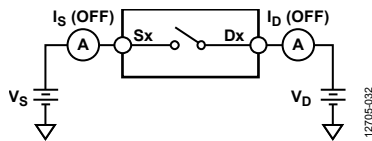


Figure 31. Off Leakage

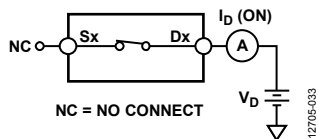


Figure 32. On Leakage

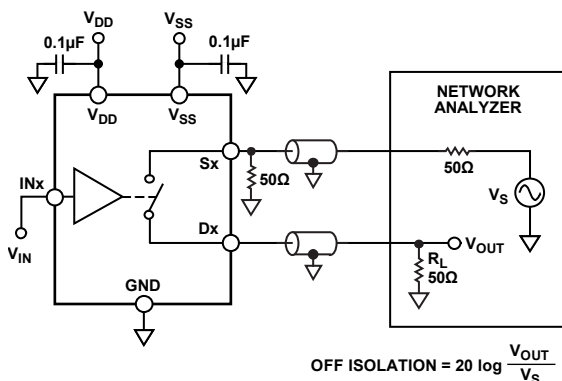


Figure 33. Off Isolation

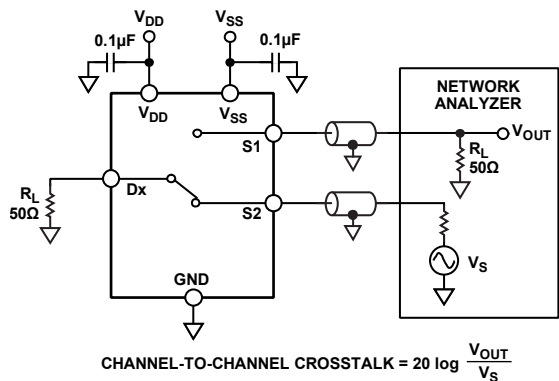


Figure 34. Channel-to-Channel Crosstalk

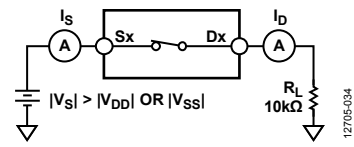


Figure 35. Switch Overvoltage Leakage

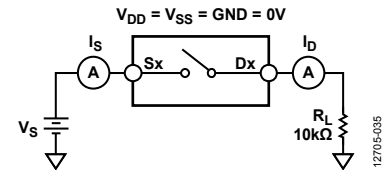


Figure 36. Switch Unpowered Leakage

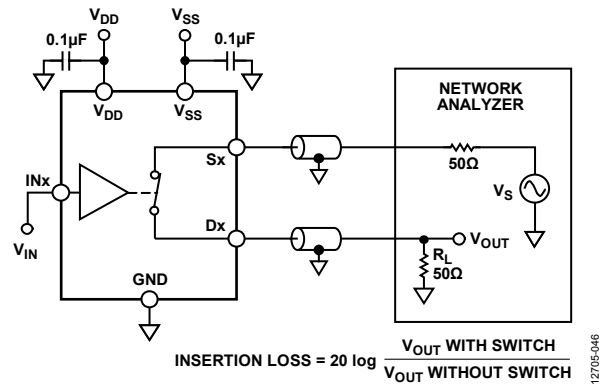


Figure 37. Bandwidth

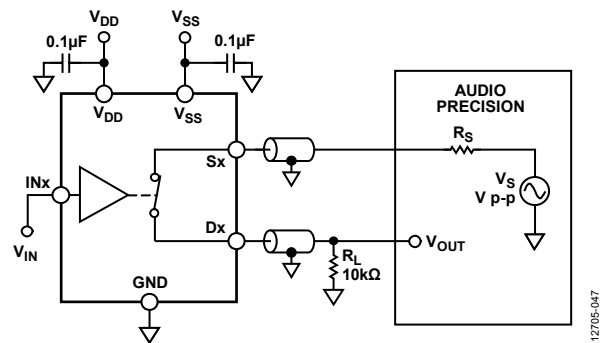
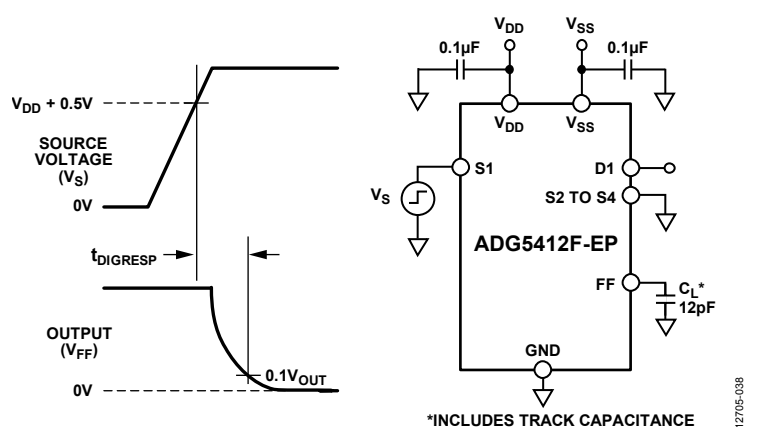
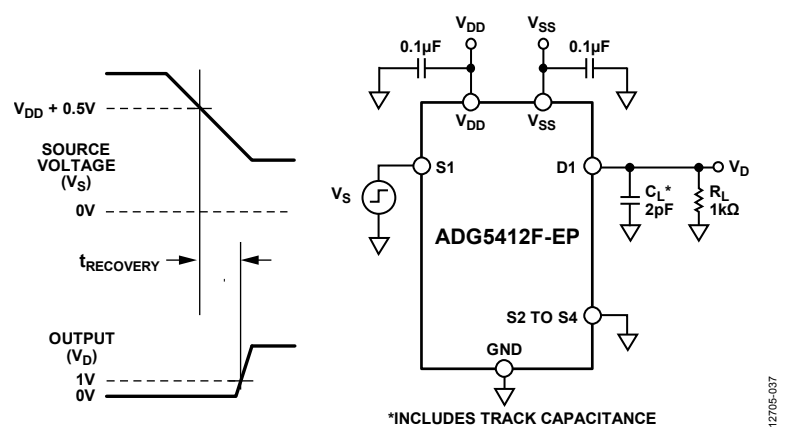
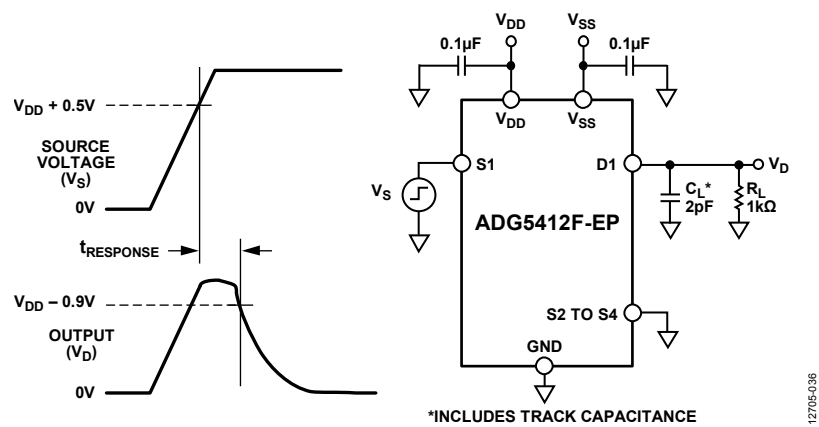
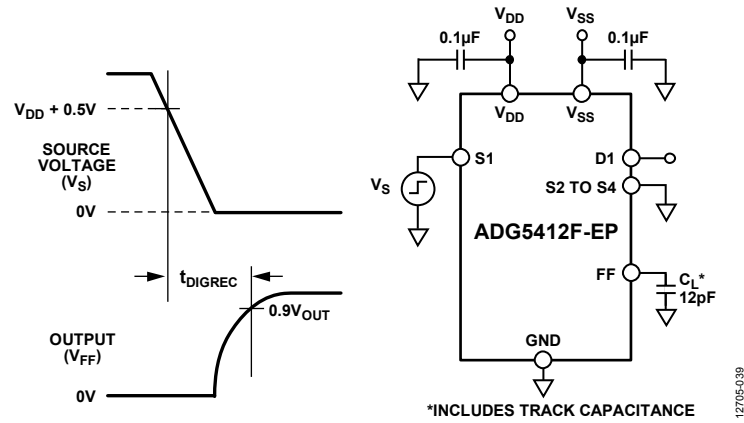
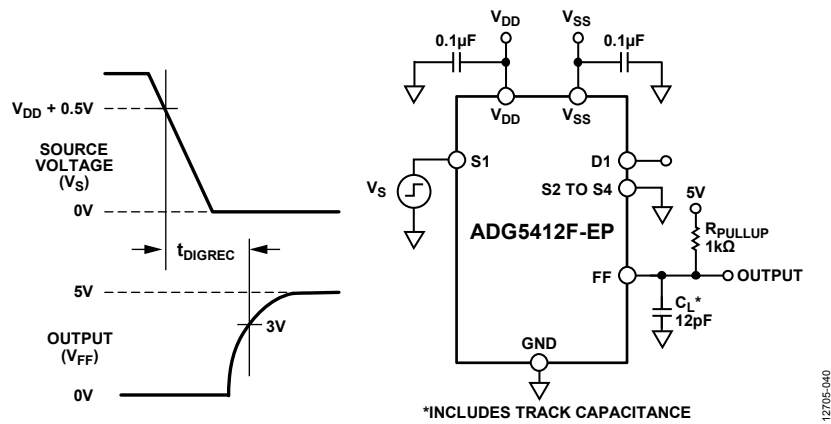
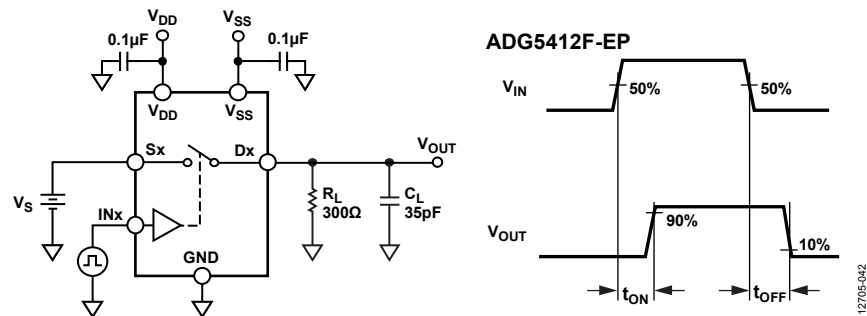
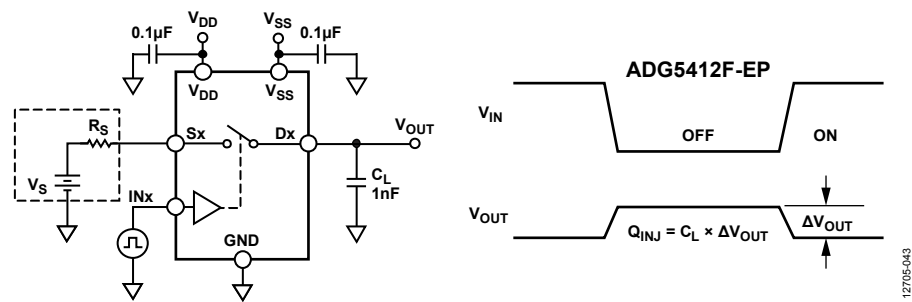
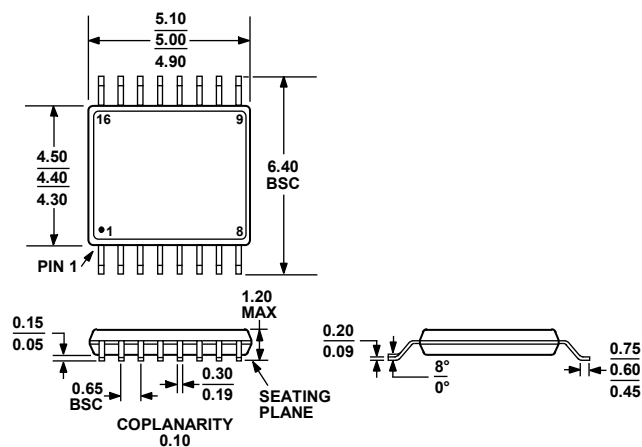


Figure 38. THD + N



Figure 42. Interrupt Flag Recovery Time,  $t_{DIGREC}$ Figure 43. Interrupt Flag Recovery Time,  $t_{DIGREC}$ , with a 1 kΩ Pull-Up ResistorFigure 44. Switching Times,  $t_{ON}$  and  $t_{OFF}$ Figure 45. Charge Injection,  $Q_{INJ}$

## OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 46. 16-Lead Thin Shrink Small Outline Package [TSSOP]  
(RU-16)

Dimensions shown in millimeters

## ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                               | Package Option |
|--------------------|-------------------|---------------------------------------------------|----------------|
| ADG5412FTRUZ-EP    | –55°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG5412FTRUZ-EP-R7 | –55°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |

<sup>1</sup> Z = RoHS Compliant Part.