



**THE DATASHEET OF
ADG1406BCPZ-REEL7**





FEATURES

- 9.5 Ω on resistance at 25°C
- Up to 300 mA of continuous current
- Fully specified at ±15 V/+12 V/±5 V
- 3 V logic-compatible inputs
- Rail-to-rail operation
- Break-before-make switching action
- 28-lead TSSOP and 32-lead, 5 mm × 5 mm LFCSP

APPLICATIONS

- Medical equipment
- Audio and video routing
- Automatic test equipment
- Data acquisition systems
- Battery-powered systems
- Sample-and-hold systems
- Communication systems

GENERAL DESCRIPTION

The **ADG1406** and **ADG1407** are monolithic iCMOS® analog multiplexers comprising 16 single channels and eight differential channels, respectively. The **ADG1406** switches one of 16 inputs to a common output, as determined by the 4-bit binary address lines (A0, A1, A2, and A3). The **ADG1407** switches one of eight differential inputs to a common differential output, as determined by the 3-bit binary address lines (A0, A1, and A2). An EN input on both devices enables or disables the device. When disabled, all channels switch off. When on, each channel conducts equally well in both directions and has an input signal range that extends to the supplies.

The industrial CMOS (iCMOS) modular manufacturing process combines high voltage complementary metal-oxide semiconductor (CMOS) and bipolar technologies. It enables the development of a wide range of high performance analog ICs capable of 33 V operation in a footprint that no other generation

Rev. C

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FUNCTIONAL BLOCK DIAGRAMS

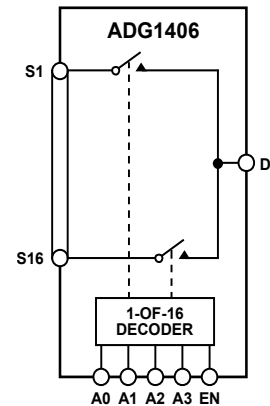


Figure 1.

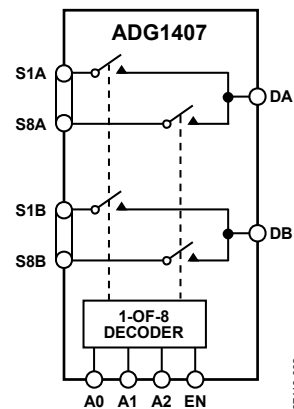


Figure 2.

of high voltage devices has been able to achieve. Unlike analog ICs using conventional CMOS processes, iCMOS components can tolerate high supply voltages while providing increased performance, dramatically lower power consumption, and reduced package size.

The ultralow on resistance and on-resistance flatness of these switches make them ideal solutions for data acquisition and gain switching applications where low distortion is critical. iCMOS construction ensures ultralow power dissipation, making the devices ideally suited for portable and battery-powered instruments.

Table 1. Related Devices

| Device No. | Description |
|---------------------------------|---|
| ADG1206/ADG1207 | Low capacitance, low charge injection, and low leakage 8-/16-channel ±15 V multiplexers |

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REVISION HISTORY

6/2016—Rev. B to Rev. C

| | |
|---|---|
| Changes to Analog Inputs Parameter, Table 7 | 8 |
| Added Digital Inputs Parameter, Table 7 | 8 |

4/2016—Rev. A to Rev. B

| | |
|---------------------------------------|------------|
| Changed CP-32-2 to CP-32-7 | Throughout |
| Changed LFCSP_VQ to LFCSP | Throughout |
| Changes to Figure 4 and Table 9..... | 9 |
| Changes to Figure 6 and Table 10..... | 11 |
| Updated Outline Dimensions | 20 |
| Changes to Ordering Guide | 20 |

3/2009—Rev. 0 to Rev. A

| | |
|--|----|
| Change to I _{DD} Parameter, Table 2 | 4 |
| Change to I _{DD} Parameter, Table 3 | 5 |
| Changes to Figure 16..... | 14 |

8/2008—Revision 0: Initial Version

SPECIFICATIONS

±15 V DUAL SUPPLY

$V_{DD} = +15\text{ V} \pm 10\%$, $V_{SS} = -15\text{ V} \pm 10\%$, $GND = 0\text{ V}$, unless otherwise noted.¹

Table 2.

| Parameter | +25°C | -40°C to +85°C | -40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|--|--------------------------------------|----------------|------------------------------|--|--|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | V_{SS} to V_{DD} | V | |
| On Resistance (R_{ON}) | 9.5 11.5 | 14 | 16 | Ω typ Ω max | $V_{DD} = +13.5\text{ V}$, $V_{SS} = -13.5\text{ V}$, $V_S = \pm 10\text{ V}$, $I_S = -10\text{ mA}$; see Figure 27 |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.55 | | | Ω typ | $V_{DD} = +13.5\text{ V}$, $V_{SS} = -13.5\text{ V}$, $V_S = \pm 10\text{ V}$, $I_S = -10\text{ mA}$ |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 1 1.6 | 1.5 | 1.7 | Ω max Ω typ | $V_{DD} = +13.5\text{ V}$, $V_{SS} = -13.5\text{ V}$, $V_S = \pm 10\text{ V}$, $I_S = -10\text{ mA}$ |
| | 1.9 | 2.15 | 2.3 | Ω max | |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 ± 0.25 | ± 1 | ± 4 | nA typ nA max | $V_{DD} = +16.5\text{ V}$, $V_{SS} = -16.5\text{ V}$ $V_S = \pm 10\text{ V}$, $V_D = \mp 10\text{ V}$; see Figure 28 |
| Drain Off Leakage, I_D (Off) | ± 0.01 | | | nA typ | $V_S = \pm 10\text{ V}$, $V_D = \mp 10\text{ V}$; see Figure 28 |
| Channel On Leakage, I_D , I_S (On) | ± 0.5 ± 0.05 ± 0.5 | ± 3 | ± 20 | nA max nA typ nA max | $V_S = V_D = \pm 10\text{ V}$; see Figure 29 |
| DIGITAL INPUTS | | | | | |
| Input High Voltage, V_{INH} | | | 2.0 | V min | |
| Input Low Voltage, V_{INL} | | | 0.8 | V max | |
| Input Current | ± 0.002 | | | μA typ μA max | $V_{IN} = V_{GND}$ or V_{DD} |
| Digital Input Capacitance, C_{IN} | 3 | | | pF typ | |
| DYNAMIC CHARACTERISTICS ² | | | | | |
| Transition Time, $t_{TRANSITION}$ | 105 160 | 200 | 225 | ns typ ns max | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ $V_S = 10\text{ V}$, see Figure 30 |
| Break-Before-Make Time Delay, t_{BBM} | 40 | | 10 | ns typ ns min | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ $V_{S1} = V_{S2} = 10\text{ V}$; see Figure 31 |
| t_{ON} (EN) | 83 110 | 140 | 155 | ns typ ns max | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ $V_S = 10\text{ V}$; see Figure 32 |
| t_{OFF} (EN) | 98 120 | 145 | 165 | ns typ ns max | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ $V_S = 10\text{ V}$; see Figure 32 |
| Charge Injection | 10 | | | pC typ | $V_S = 0\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 33 |
| Off Isolation | -73 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 34 |
| Channel-to-Channel Crosstalk | -70 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 35 |
| Total Harmonic Distortion Plus Noise (THD + N) | 0.07 | | | % typ | $R_L = 110\ \Omega$, 15 V p-p , $f = 20\text{ Hz to } 20\text{ kHz}$; see Figure 37 |
| -3 dB Bandwidth | | | | | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 36 |
| ADG1406 | 60 | | | MHz typ | |
| ADG1407 | 110 | | | MHz typ | |
| Insertion Loss | 0.6 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 36 |
| C_S (Off) | 8 | | | pF typ | $f = 1\text{ MHz}$ |
| C_D (Off) | | | | | $f = 1\text{ MHz}$ |
| ADG1406 | 90 | | | pF typ | |
| ADG1407 | 45 | | | pF typ | |

| Parameter | +25°C | −40°C to +85°C | −40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|---------------------------------------|-----------|----------------|------------------------------|--|--|
| C_D, C_S (On) ADG1406 ADG1407 | 115 70 | | | pF typ pF typ | $f = 1 \text{ MHz}$ |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.002 | | 1 | μA typ μA max | $V_{DD} = +16.5 \text{ V}, V_{SS} = -16.5 \text{ V}$ Digital inputs = 0 V or V_{DD} |
| I_{DD} | 280 | | 475 | μA typ μA max | Digital inputs = 5 V |
| I_{SS} | 0.002 | | 1 | μA typ μA max | Digital inputs = 0 V, 5 V or V_{DD} |
| V_{DD}/V_{SS} | | | $\pm 4.5/\pm 16.5$ | V min/max | |

¹ Temperature range for B version is -40°C to $+125^\circ\text{C}$.

² Guaranteed by design, not subject to production test.

12 V SINGLE SUPPLY

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

Table 3.

| Parameter | +25°C | −40°C to +85°C | −40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|--|-------------|----------------|------------------------------|-------------------|---|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | 0 to V_{DD} | V | |
| On Resistance (R_{ON}) | 18 | | | Ω typ | $V_{DD} = 10.8 \text{ V}, V_{SS} = 0 \text{ V}; V_S = 0 \text{ V to } 10 \text{ V}, I_S = -10 \text{ mA}$; see Figure 27 |
| | 21.5 | 26 | 28.5 | Ω max | |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.55 | | | Ω typ | $V_{DD} = 10.8 \text{ V}, V_{SS} = 0 \text{ V}; V_S = 0 \text{ V to } 10 \text{ V}, I_S = -10 \text{ mA}$ |
| | 1.2 | 1.6 | 1.8 | Ω max | |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 5 | | | Ω typ | $V_{DD} = 10.8 \text{ V}, V_{SS} = 0 \text{ V}; V_S = 0 \text{ V to } 10 \text{ V}, I_S = -10 \text{ mA}$ |
| | 6 | 6.9 | 7.3 | Ω max | |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 | | | nA typ | $V_{DD} = 10.8 \text{ V}$ $V_S = 1 \text{ V}/10 \text{ V}, V_D = 10 \text{ V}/1 \text{ V}$; see Figure 28 |
| | ± 0.25 | ± 1 | ± 4 | nA max | |
| Drain Off Leakage, I_D (Off) | ± 0.01 | | | nA typ | $V_S = 1 \text{ V}/10 \text{ V}, V_D = 10 \text{ V}/1 \text{ V}$; see Figure 28 |
| | ± 0.5 | ± 3 | ± 20 | nA max | |
| Channel On Leakage, I_D, I_S (On) | ± 0.01 | | | nA typ | $V_S = V_D = 1 \text{ V or } 10 \text{ V}$; see Figure 29 |
| | ± 0.5 | ± 3 | ± 20 | nA max | |
| DIGITAL INPUTS | | | | | |
| Input High Voltage, V_{INH} | | | 2.0 | V min | |
| Input Low Voltage, V_{INL} | | | 0.8 | V max | |
| Input Current | ± 0.002 | | | μA typ | $V_{IN} = V_{GND}$ or V_{DD} |
| | | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS² | | | | | |
| Transition Time, $t_{TRANSITION}$ | 170 | | | ns typ | $R_L = 100 \Omega, C_L = 35 \text{ pF}$ |
| | 250 | 310 | 350 | ns max | $V_S = 8 \text{ V}$; see Figure 29 |
| Break-Before-Make Time Delay, t_{BBM} | 75 | | | ns typ | $R_L = 100 \Omega, C_L = 35 \text{ pF}$ |
| | | | 30 | ns min | $V_{S1} = V_{S2} = 8 \text{ V}$; see Figure 31 |

| Parameter | +25°C | −40°C to +85°C | −40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|--------------------------------------|------------|----------------|------------------------------|------------------|---|
| t _{ON} (EN) | 145 205 | 250 | 285 | ns typ ns max | R _L = 100 Ω, C _L = 35 pF V _S = 8 V; see Figure 31 |
| t _{OFF} (EN) | 112 150 | 175 | 200 | ns typ ns max | R _L = 100 Ω, C _L = 35 pF V _S = 8 V; see Figure 31 |
| Charge Injection | 10 | | | pC typ | V _S = 6 V, R _S = 0 Ω, C _L = 1 nF; see Figure 33 |
| Off Isolation | −73 | | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz; see Figure 34 |
| Channel-to-Channel Crosstalk | −70 | | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz; see Figure 35 |
| −3 dB Bandwidth | | | | | R _L = 50 Ω, C _L = 5 pF; see Figure 36 |
| ADG1406 | 35 | | | MHz typ | |
| ADG1407 | 70 | | | MHz typ | |
| Insertion Loss | 0.6 | | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz; see Figure 36 |
| C _S (Off) | 12 | | | pF typ | f = 1 MHz |
| C _D (Off) | | | | | f = 1 MHz |
| ADG1406 | 145 | | | pF typ | |
| ADG1407 | 72 | | | pF typ | |
| C _D , C _S (On) | | | | | f = 1 MHz |
| ADG1406 | 166 | | | pF typ | |
| ADG1407 | 93 | | | pF typ | |
| POWER REQUIREMENTS | | | | | |
| I _{DD} | 0.002 | | 1 | μA typ μA max | V _{DD} = 13.2 V Digital inputs = 0 V or V _{DD} |
| I _{DD} | 150 | | 475 | μA typ μA max | Digital inputs = 5 V |
| V _{DD} | | | 5/16.5 | V min/max | V _{SS} = 0 V, GND = 0 V |

¹ Temperature range for B version: −40°C to +125°C.

² Guaranteed by design, not subject to production test.

±5 V DUAL SUPPLY

$V_{DD} = +5\text{ V} \pm 10\%$, $V_{SS} = -5\text{ V} \pm 10\%$, $GND = 0\text{ V}$, unless otherwise noted.

Table 4.

| Parameter | +25°C | -40°C to +85°C | -40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|--|-------------|----------------|------------------------------|-------------------|--|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | V_{SS} to V_{DD} | V | |
| On Resistance (R_{ON}) | 21 | | | Ω typ | $V_{DD} = +4.5\text{ V}$, $V_{SS} = -4.5\text{ V}$, $V_S = \pm 4.5\text{ V}$, $I_S = -10\text{ mA}$; see Figure 27 |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.6 | 29 | 32 | Ω max | |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 1.3 | 1.7 | 1.9 | Ω max | $V_{DD} = +4.5\text{ V}$, $V_{SS} = -4.5\text{ V}$, $V_S = \pm 4.5\text{ V}$, $I_S = -10\text{ mA}$ |
| | 5.2 | | | Ω typ | |
| | 6.4 | 7.3 | 7.6 | Ω max | $V_{DD} = +4.5\text{ V}$, $V_{SS} = -4.5\text{ V}$, $V_S = \pm 4.5\text{ V}$, $I_S = -10\text{ mA}$ |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 | | | nA typ | $V_{DD} = +5.5\text{ V}$, $V_{SS} = -5.5\text{ V}$ |
| | ± 0.25 | ± 1 | ± 4 | nA max | $V_S = \pm 4.5\text{ V}$, $V_D = \mp 4.5\text{ V}$; see Figure 28 |
| Drain Off Leakage, I_D (Off) | ± 0.01 | | | nA typ | |
| | ± 0.5 | ± 3 | ± 20 | nA max | $V_S = \pm 4.5\text{ V}$, $V_D = \mp 4.5\text{ V}$; see Figure 28 |
| Channel On Leakage, I_D , I_S (On) | ± 0.01 | ± 3 | ± 20 | nA typ | $V_S = V_D = \pm 4.5\text{ V}$; see Figure 29 |
| | ± 0.5 | ± 3 | ± 20 | nA max | |
| DIGITAL INPUTS | | | | | |
| Input High Voltage, V_{INH} | | | 2.0 | V min | |
| Input Low Voltage, V_{INL} | | | 0.8 | V max | |
| Input Current | ± 0.002 | | | μA typ | $V_{IN} = V_{GND}$ or V_{DD} |
| | | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 3.5 | | | pF typ | |
| DYNAMIC CHARACTERISTICS² | | | | | |
| Transition Time, $t_{TRANSITION}$ | 260 | | | ns typ | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ |
| | 435 | 510 | 565 | ns max | $V_S = 5\text{ V}$; see Figure 30 |
| Break-Before-Make Time Delay, t_{BBM} | 90 | | | ns typ | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | 30 | ns min | $V_{S1} = V_{S2} = 5\text{ V}$; see Figure 31 |
| t_{ON} (EN) | 230 | | | ns typ | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ |
| | 335 | 400 | 445 | ns max | $V_S = 5\text{ V}$; see Figure 32 |
| t_{OFF} (EN) | 205 | | | ns typ | $R_L = 100\ \Omega$, $C_L = 35\text{ pF}$ |
| | 290 | 340 | 370 | ns max | $V_S = 5\text{ V}$; see Figure 32 |
| Charge Injection | 10 | | | pC typ | $V_S = 0\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 33 |
| Off Isolation | -73 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 34 |
| Channel-to-Channel Crosstalk | -70 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 35 |
| Total Harmonic Distortion, THD + N | 0.18 | | | % typ | $R_L = 110\ \Omega$, 5 V p-p , $f = 20\text{ Hz to } 20\text{ kHz}$; see Figure 37 |
| -3 dB Bandwidth | | | | | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 36 |
| ADG1406 | 40 | | | MHz typ | |
| ADG1407 | 80 | | | MHz typ | |
| Insertion Loss | 1.15 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 36 |
| C_S (Off) | 10 | | | pF typ | $f = 1\text{ MHz}$ |
| C_D (Off) | | | | | $f = 1\text{ MHz}$ |
| ADG1406 | 123 | | | pF typ | |
| ADG1407 | 62 | | | pF typ | |
| C_D , C_S (On) | | | | | $f = 1\text{ MHz}$ |
| ADG1406 | 148 | | | pF typ | |
| ADG1407 | 88 | | | pF typ | |

| Parameter | +25°C | -40°C to +85°C | -40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|---------------------------|-------|----------------|------------------------------|--|--|
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.002 | | 1 | $\mu\text{A typ}$ $\mu\text{A max}$ | $V_{DD} = +5.5\text{ V}, V_{SS} = -5.5\text{ V}$ Digital inputs = 0 V or V_{DD} |
| I_{SS} | 0.002 | | 1 | $\mu\text{A typ}$ $\mu\text{A max}$ | Digital inputs = 0 V, 5 V, or V_{DD} |
| V_{DD}/V_{SS} | | | $\pm 4.5/\pm 16.5$ | V min/max | |

¹ Temperature range for B version: -40°C to +125°C.

² Guaranteed by design, not subject to production test.

CONTINUOUS CURRENT PER CHANNEL

Table 5. Continuous Current per Channel (ADG1406)

| Parameter | 25°C | 85°C | 125°C | Unit | Test Conditions/Comments |
|---|------|------|-------|--------|--|
| CONTINUOUS CURRENT PER CHANNEL¹ | | | | | |
| 15 V Dual Supply | | | | | $V_{DD} = +13.5\text{ V}, V_{SS} = -13.5\text{ V}$ |
| 28-Lead TSSOP | 180 | 100 | 50 | mA max | |
| 32-Lead LFCSP | 300 | 150 | 60 | mA max | |
| 12 V Single Supply | | | | | $V_{DD} = 10.8\text{ V}, V_{SS} = 0\text{ V}$ |
| 28-Lead TSSOP | 150 | 90 | 50 | mA max | |
| 32-Lead LFCSP | 260 | 130 | 55 | mA max | |
| 5 V Dual Supply | | | | | $V_{DD} = +4.5\text{ V}, V_{SS} = -4.5\text{ V}$ |
| 28-Lead TSSOP | 140 | 85 | 45 | mA max | |
| 32-Lead LFCSP | 245 | 130 | 55 | mA max | |

¹ Guaranteed by design, not subject to production test.

Table 6. Continuous Current per Channel (ADG1407)

| Parameter | 25°C | 85°C | 125°C | Unit | Test Conditions/Comments |
|---|------|------|-------|--------|--|
| CONTINUOUS CURRENT PER CHANNEL¹ | | | | | |
| 15 V Dual Supply | | | | | $V_{DD} = +13.5\text{ V}, V_{SS} = -13.5\text{ V}$ |
| 28-Lead TSSOP | 135 | 85 | 45 | mA max | |
| 32-Lead LFCSP | 235 | 125 | 55 | mA max | |
| 12 V Single Supply | | | | | $V_{DD} = 10.8\text{ V}, V_{SS} = 0\text{ V}$ |
| 28-Lead TSSOP | 110 | 70 | 40 | mA max | |
| 32-Lead LFCSP | 190 | 110 | 50 | mA max | |
| 5 V Dual Supply | | | | | $V_{DD} = +4.5\text{ V}, V_{SS} = -4.5\text{ V}$ |
| 28-Lead TSSOP | 105 | 65 | 40 | mA max | |
| 32-Lead LFCSP | 180 | 100 | 50 | mA max | |

¹ Guaranteed by design, not subject to production test.

ABSOLUTE MAXIMUM RATINGS

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

Table 7.

| Parameter | Rating |
|---|---|
| V_{DD} to V_{SS} | 35 V |
| V_{DD} to GND | -0.3 V to +25 V |
| V_{SS} to GND | +0.3 V to -25 V |
| Analog Inputs ¹ | $V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first |
| Digital Inputs ¹ | GND - 0.3 V to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first |
| Continuous Current, Sx or Dx Pins | Table 5 and Table 6 specifications + 15% |
| Peak Current, Sx or Dx Pins (Pulsed at 1 ms, 10% Duty Cycle Maximum) | |
| 28-Lead TSSOP | 300 mA |
| 32-Lead LFCSP | 550 mA |
| Operating Temperature Range | |
| Industrial (B Version) | -40°C to +125°C |
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature | 150°C |
| Reflow Soldering, Pb-Free | |
| Peak Temperature | 260 (+0/-5)°C |
| Time at Peak Temperature | 10 sec to 40 sec |

¹ Overvoltages at the Ax, EN, Sx, or Dx pins are clamped by internal diodes. Limit current to the maximum ratings given.

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 may be applied at any one time.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 8. Thermal Resistance

| Package Type | θ_{JA} | θ_{JC} | Unit |
|---------------|---------------|---------------|------|
| 28-Lead TSSOP | 97.9 | 14 | °C/W |
| 32-Lead LFCSP | 27.27 | | °C/W |

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 CONFIGURATIONS AND FUNCTION DESCRIPTIONS

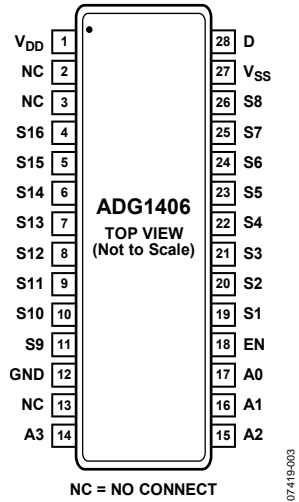


Figure 3. ADG1406 TSSOP Pin Configuration

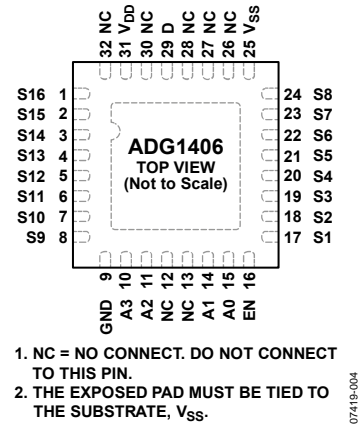


Figure 4. ADG1406 LFCSP Pin Configuration

Table 9. ADG1406 Pin Function Descriptions

| Pin No. | | Mnemonic | Description |
|----------------|----------------------------|-----------------|--|
| TSSOP | LFCSP | | |
| 1 | 31 | V _{DD} | Most Positive Power Supply Potential. |
| 2, 3, 13 | 12, 13, 26, 27, 28, 30, 32 | NC | No Connect. |
| 4 | 1 | S16 | Source Terminal 16. This pin can be an input or an output. |
| 5 | 2 | S15 | Source Terminal 15. This pin can be an input or an output. |
| 6 | 3 | S14 | Source Terminal 14. This pin can be an input or an output. |
| 7 | 4 | S13 | Source Terminal 13. This pin can be an input or an output. |
| 8 | 5 | S12 | Source Terminal 12. This pin can be an input or an output. |
| 9 | 6 | S11 | Source Terminal 11. This pin can be an input or an output. |
| 10 | 7 | S10 | Source Terminal 10. This pin can be an input or an output. |
| 11 | 8 | S9 | Source Terminal 9. This pin can be an input or an output. |
| 12 | 9 | GND | Ground (0 V) Reference. |
| 14 | 10 | A3 | Logic Control Input. |
| 15 | 11 | A2 | Logic Control Input. |
| 16 | 14 | A1 | Logic Control Input. |
| 17 | 15 | A0 | Logic Control Input. |
| 18 | 16 | EN | Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the Ax logic inputs determine which switch is turned on. |
| 19 | 17 | S1 | Source Terminal 1. This pin can be an input or an output. |
| 20 | 18 | S2 | Source Terminal 2. This pin can be an input or an output. |
| 21 | 19 | S3 | Source Terminal 3. This pin can be an input or an output. |
| 22 | 20 | S4 | Source Terminal 4. This pin can be an input or an output. |
| 23 | 21 | S5 | Source Terminal 5. This pin can be an input or an output. |
| 24 | 22 | S6 | Source Terminal 6. This pin can be an input or an output. |
| 25 | 23 | S7 | Source Terminal 7. This pin can be an input or an output. |
| 26 | 24 | S8 | Source Terminal 8. This pin can be an input or an output. |
| 27 | 25 | V _{SS} | Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground. |
| 28 | 29 | D | Drain Terminal. This pin can be an input or an output. |
| Not applicable | 0 | EPAD | Exposed Pad. The exposed pad must be tied to the substrate, V _{SS} . |

Table 10. **ADG1406** Truth Table

| A3 | A2 | A1 | A0 | EN | On Switch |
|-----------|-----------|-----------|-----------|-----------|------------------|
| X | X | X | X | 0 | None |
| 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 2 |
| 0 | 0 | 1 | 0 | 1 | 3 |
| 0 | 0 | 1 | 1 | 1 | 4 |
| 0 | 1 | 0 | 0 | 1 | 5 |
| 0 | 1 | 0 | 1 | 1 | 6 |
| 0 | 1 | 1 | 0 | 1 | 7 |
| 0 | 1 | 1 | 1 | 1 | 8 |
| 1 | 0 | 0 | 0 | 1 | 9 |
| 1 | 0 | 0 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 1 | 11 |
| 1 | 0 | 1 | 1 | 1 | 12 |
| 1 | 1 | 0 | 0 | 1 | 13 |
| 1 | 1 | 0 | 1 | 1 | 14 |
| 1 | 1 | 1 | 0 | 1 | 15 |
| 1 | 1 | 1 | 1 | 1 | 16 |

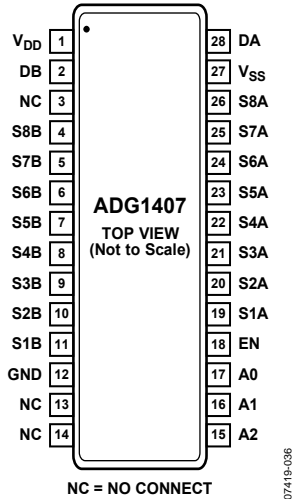


Figure 5. ADG1407 TSSOP Pin Configuration

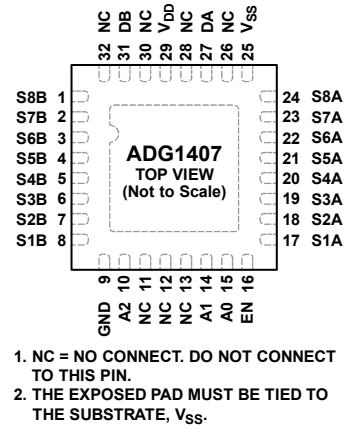


Figure 6. ADG1407 LFCSP Pin Configuration

Table 11. ADG1407 Pin Function Descriptions

| Pin No. | | Mnemonic | Description |
|----------------|----------------------------|-----------------|--|
| TSSOP | LFCSP | | |
| 1 | 29 | V _{DD} | Most Positive Power Supply Potential. |
| 2 | 31 | DB | Drain Terminal B. This pin can be an input or an output. |
| 3, 13, 14 | 11, 12, 13, 26, 28, 30, 32 | NC | No Connect. |
| 4 | 1 | S8B | Source Terminal 8B. This pin can be an input or an output. |
| 5 | 2 | S7B | Source Terminal 7B. This pin can be an input or an output. |
| 6 | 3 | S6B | Source Terminal 6B. This pin can be an input or an output. |
| 7 | 4 | S5B | Source Terminal 5B. This pin can be an input or an output. |
| 8 | 5 | S4B | Source Terminal 4B. This pin can be an input or an output. |
| 9 | 6 | S3B | Source Terminal 3B. This pin can be an input or an output. |
| 10 | 7 | S2B | Source Terminal 2B. This pin can be an input or an output. |
| 11 | 8 | S1B | Source Terminal 1B. This pin can be an input or an output. |
| 12 | 9 | GND | Ground (0 V) Reference. |
| 15 | 10 | A2 | Logic Control Input. |
| 16 | 14 | A1 | Logic Control Input. |
| 17 | 15 | A0 | Logic Control Input. |
| 18 | 16 | EN | Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the Ax logic inputs determine which switch is turned on. |
| 19 | 17 | S1A | Source Terminal 1A. This pin can be an input or an output. |
| 20 | 18 | S2A | Source Terminal 2A. This pin can be an input or an output. |
| 21 | 19 | S3A | Source Terminal 3A. This pin can be an input or an output. |
| 22 | 20 | S4A | Source Terminal 4A. This pin can be an input or an output. |
| 23 | 21 | S5A | Source Terminal 5A. This pin can be an input or an output. |
| 24 | 22 | S6A | Source Terminal 6A. This pin can be an input or an output. |
| 25 | 23 | S7A | Source Terminal 7A. This pin can be an input or an output. |
| 26 | 24 | S8A | Source Terminal 8A. This pin can be an input or an output. |
| 27 | 25 | V _{SS} | Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground. |
| 28 | 27 | DA | Drain Terminal A. This pin can be an input or an output. |
| Not applicable | 0 | EPAD | Exposed Pad. The exposed pad must be tied to the substrate, V _{SS} . |

Table 12. **ADG1407** Truth Table

| A2 | A1 | A0 | EN | On Switch Pair |
|-----------|-----------|-----------|-----------|-----------------------|
| X | X | X | 0 | None |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 2 |
| 0 | 1 | 0 | 1 | 3 |
| 0 | 1 | 1 | 1 | 4 |
| 1 | 0 | 0 | 1 | 5 |
| 1 | 0 | 1 | 1 | 6 |
| 1 | 1 | 0 | 1 | 7 |
| 1 | 1 | 1 | 1 | 8 |

TYPICAL PERFORMANCE CHARACTERISTICS

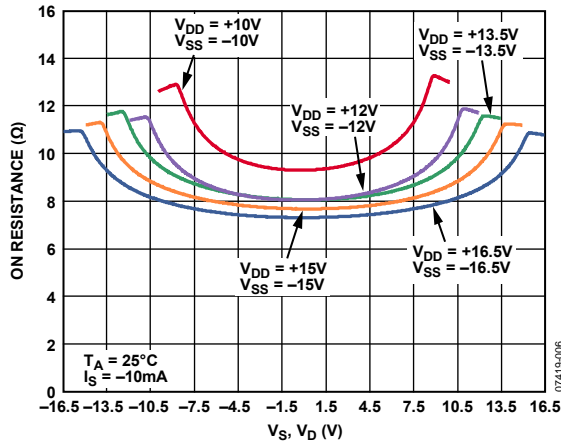


Figure 7. On Resistance as a Function of $V_D (V_S)$, Dual Supply

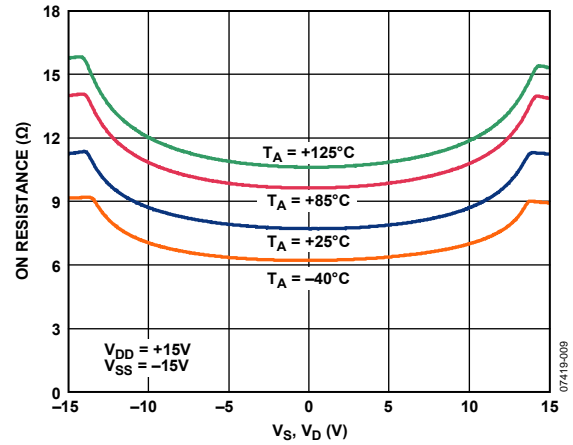


Figure 10. On Resistance as a Function of $V_D (V_S)$ for Different Temperatures, 15 V Dual Supply

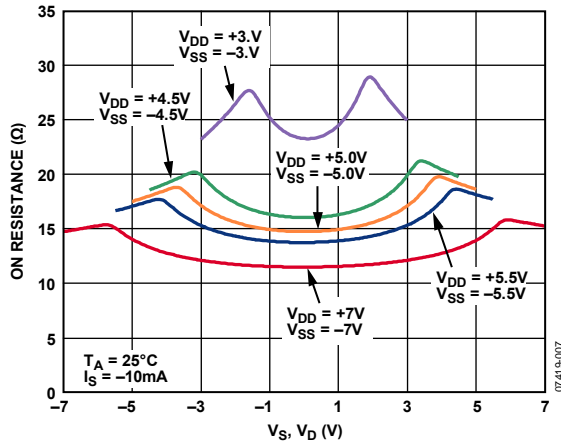


Figure 8. On Resistance as a Function of $V_D (V_S)$, Dual Supply

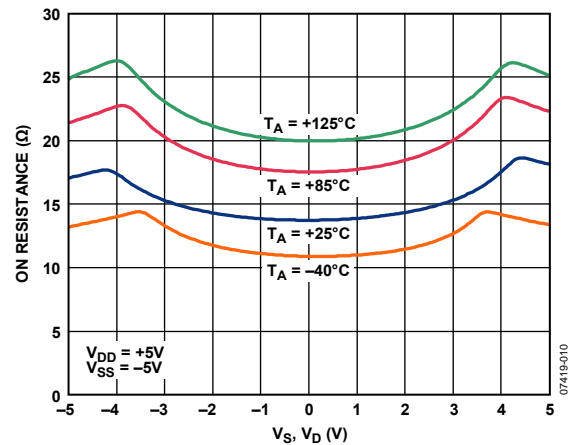


Figure 11. On Resistance as a Function of $V_D (V_S)$ for Different Temperatures, 5 V Dual Supply

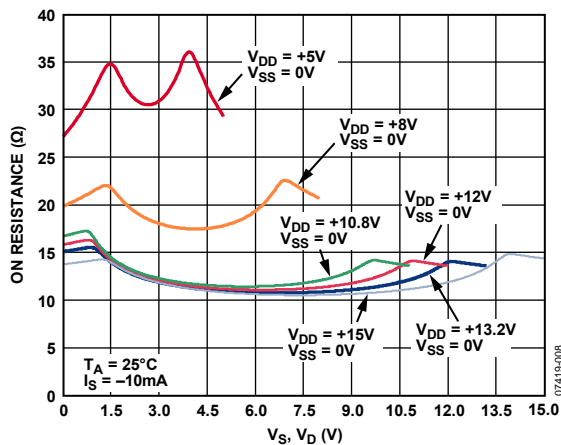


Figure 9. On Resistance as a Function of $V_D (V_S)$, Single Supply

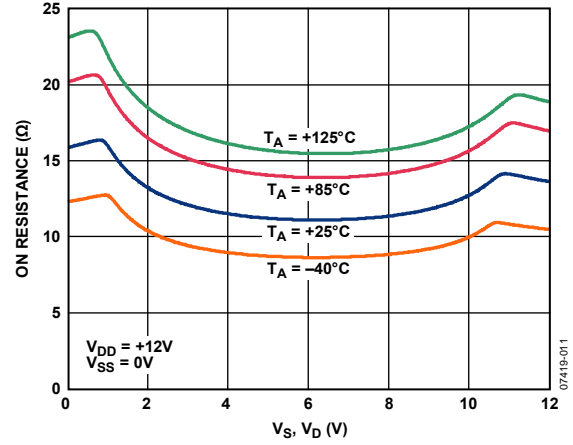


Figure 12. On Resistance as a Function of $V_D (V_S)$ for Different Temperatures, 12 V Single Supply

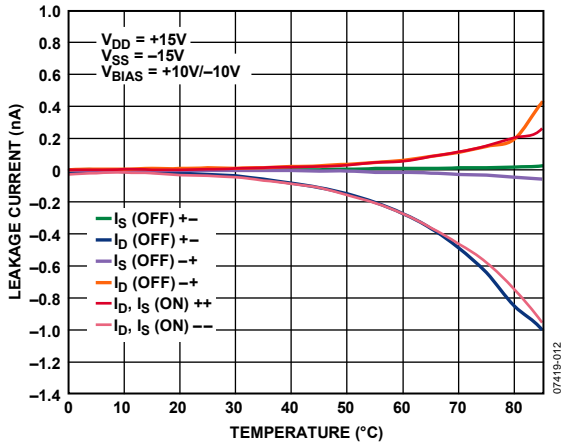


Figure 13. Leakage Current as a Function of Temperature (up to 85°C), 15 V Dual Supply

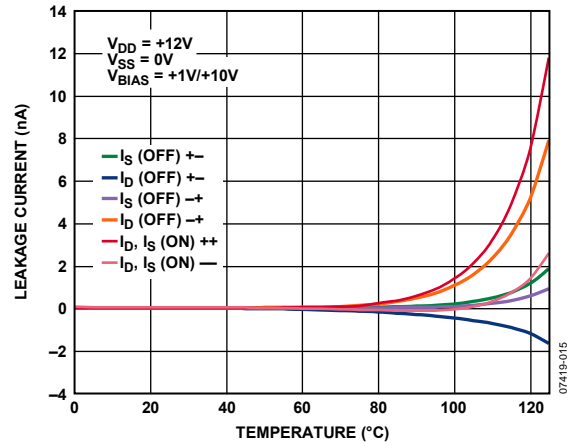


Figure 16. Leakage Current as a Function of Temperature, 12 V Single Supply

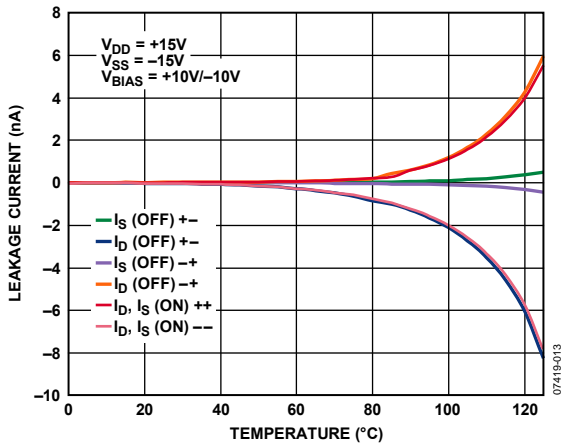


Figure 14. Leakage Current as a Function of Temperature, 15 V Dual Supply

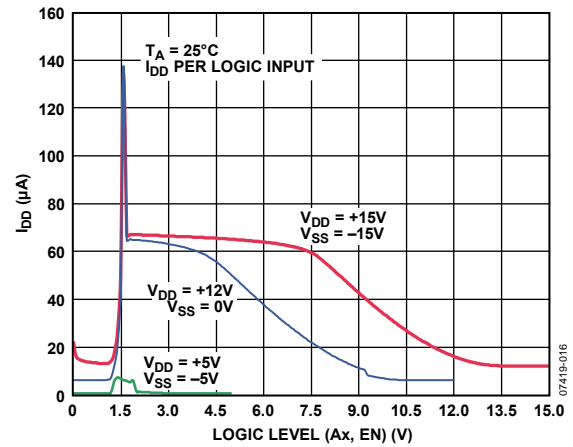


Figure 17. I_{DD} vs. Logic Level

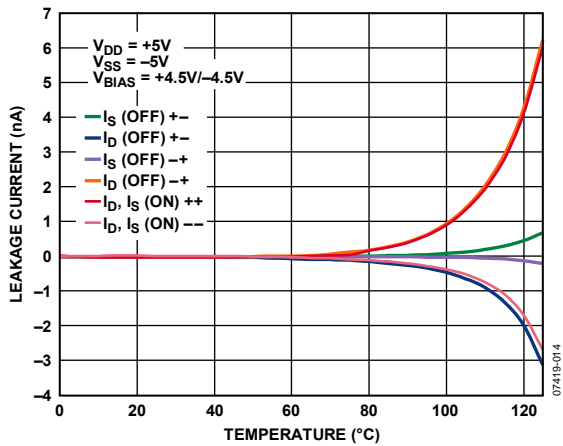


Figure 15. Leakage Current as a Function of Temperature, 5 V Dual Supply

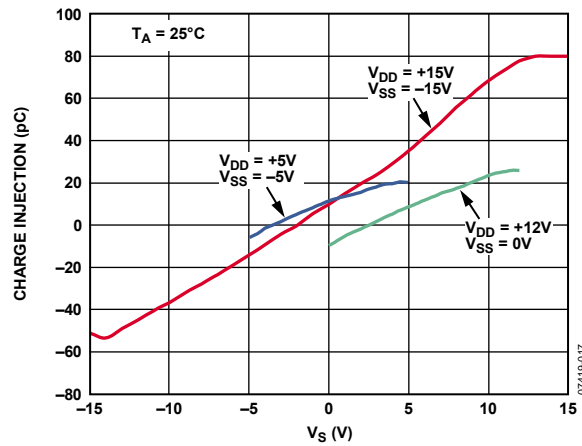


Figure 18. Charge Injection vs. Source Voltage

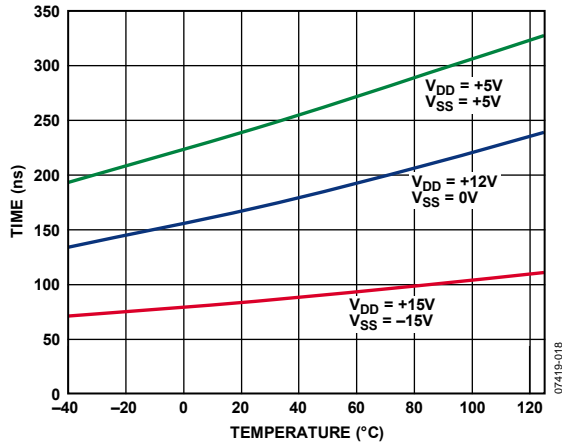


Figure 19. Transition Time vs. Temperature

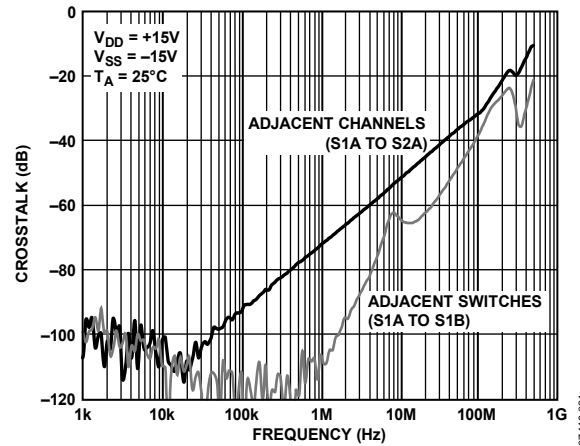


Figure 22. ADG1407 Crosstalk vs. Frequency

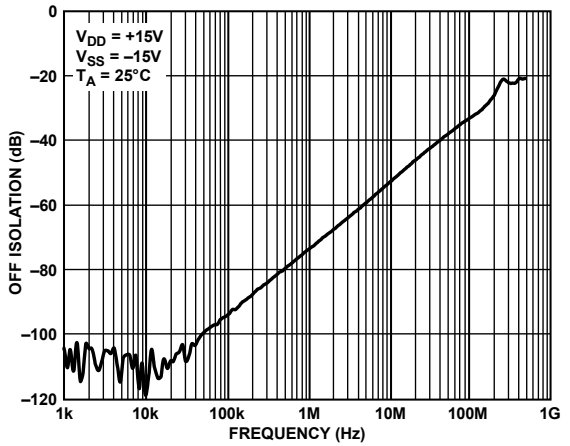


Figure 20. Off Isolation vs. Frequency

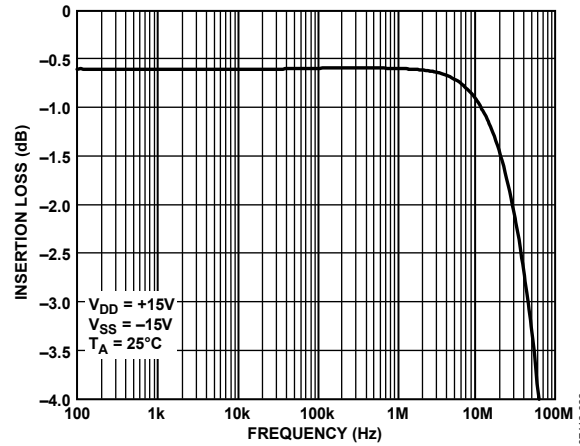


Figure 23. ADG1406 On Response vs. Frequency

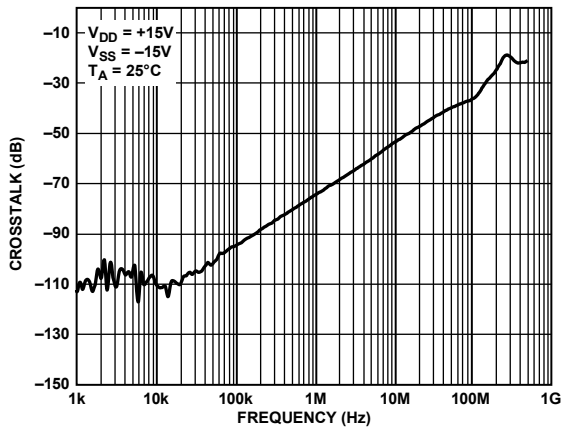


Figure 21. ADG1406 Crosstalk vs. Frequency

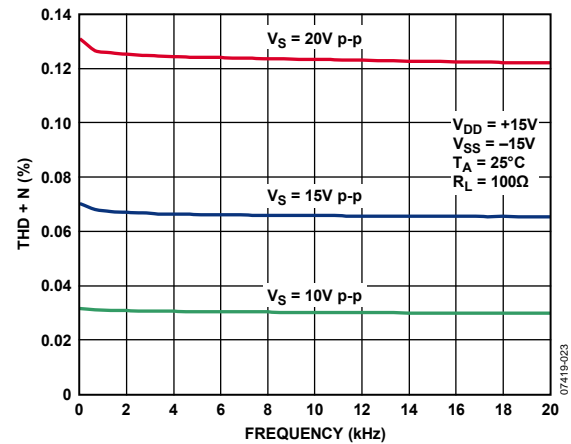


Figure 24. THD + N vs. Frequency, 15 V Dual Supply

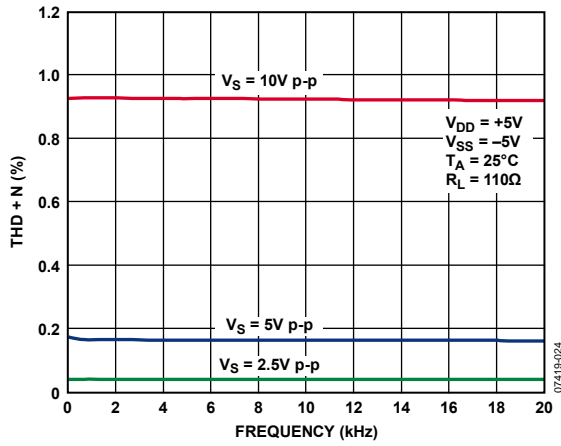


Figure 25. THD + N vs. Frequency, 5 V Dual Supply

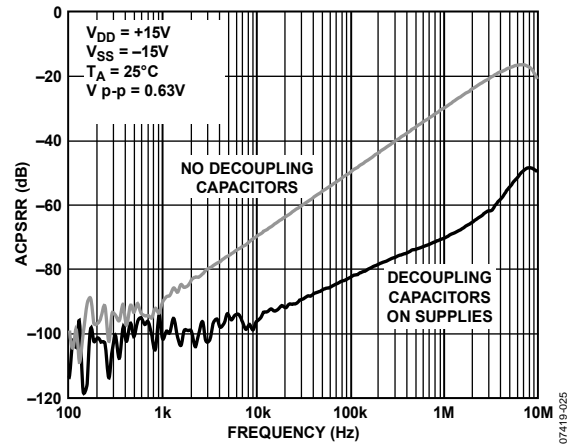


Figure 26. ACPSRR vs. Frequency

TERMINOLOGY

R_{ON}

Ohmic resistance between the D and S terminals.

ΔR_{ON}

Difference between the R_{ON} of any two channels.

$R_{FLAT(ON)}$

Flatness is defined as the difference between the maximum and minimum value of on resistance as measured.

I_S (Off)

Source leakage current when the switch is off.

I_D (Off)

Drain leakage current when the switch is off.

I_D, I_S (On)

Channel leakage current when the switch is on.

V_D, V_S

Analog voltage on Terminal D and Terminal S.

C_S (Off)

Channel input capacitance for the off condition.

C_D (Off)

Channel output capacitance for the off condition.

C_D, C_S (On)

On switch capacitance.

C_{IN}

Digital input capacitance.

t_{ON} (EN)

Delay time between the 50% and 90% points of the digital input and the switch on condition.

t_{OFF} (EN)

Delay time between the 50% and 90% points of the digital input and the switch off condition.

$t_{TRANSITION}$

Delay time between the 50% and 90% points of the digital inputs and the switch on condition when switching from one address state to another.

t_{BMM}

Off time measured between the 80% points of the switches when switching from one address state to another.

V_{INL}

Maximum input voltage for Logic 0.

V_{INH}

Minimum input voltage for Logic 1.

I_{INL}, I_{INH}

Input current of the digital input.

I_{DD}

Positive supply current.

I_{SS}

Negative supply current.

Off Isolation

A measure of unwanted signal coupling through an off channel.

Charge Injection

A measure of the glitch impulse transferred from the digital input to the analog output during switching.

Bandwidth

The frequency at which the output is attenuated by 3 dB.

On Response

The frequency response of the on switch.

Total Harmonic Distortion Plus Noise (THD + N)

The ratio of the harmonic amplitude plus noise of the signal to the fundamental.

AC Power Supply Rejection Ratio (ACPSRR)

Measures the ability of a device to avoid coupling noise and spurious signals that appear on the supply voltage pin to the output of the switch. The dc voltage on the device is modulated by a sine wave of 0.62 V p-p. The ratio of the amplitude of signal on the output to the amplitude of the modulation is the ACPSRR.

TEST CIRCUITS

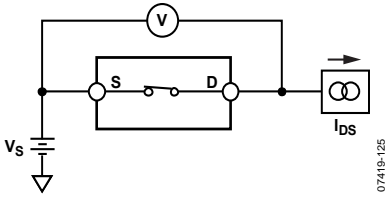


Figure 27. On Resistance

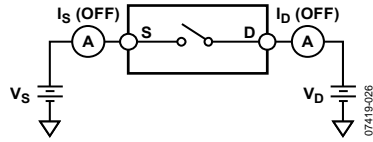


Figure 28. Off Leakage

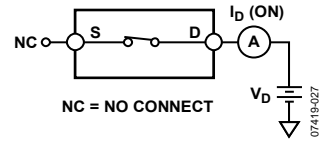


Figure 29. On Leakage

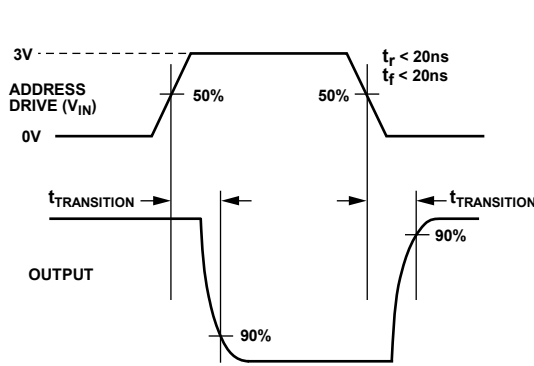
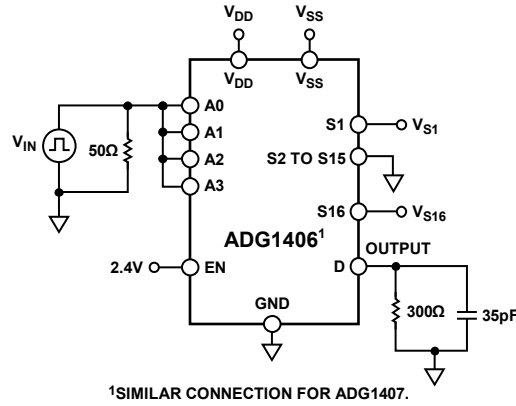


Figure 30. Address to Output Switching Times, $t_{\text{TRANSITION}}$



¹SIMILAR CONNECTION FOR ADG1407.

07419-028

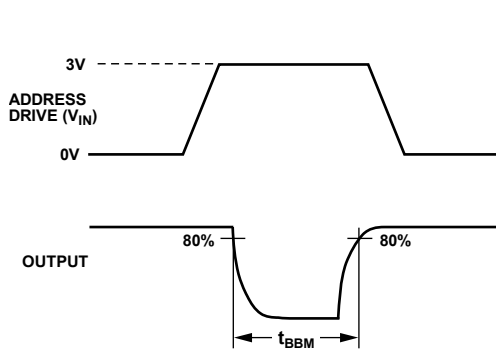
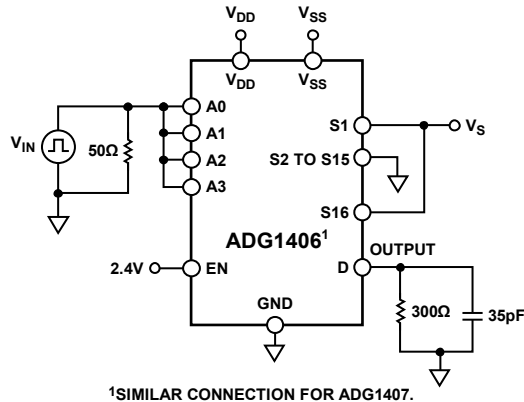


Figure 31. Break-Before-Make Delay, t_{BBM}



¹SIMILAR CONNECTION FOR ADG1407.

07419-029

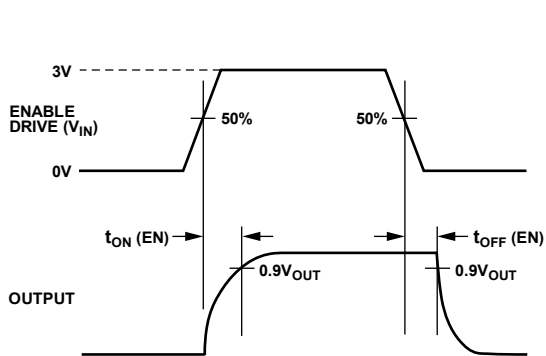
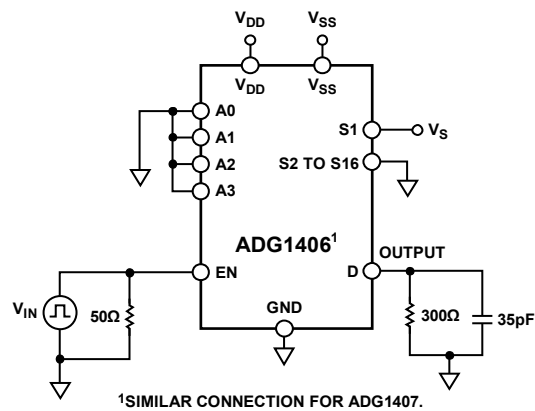
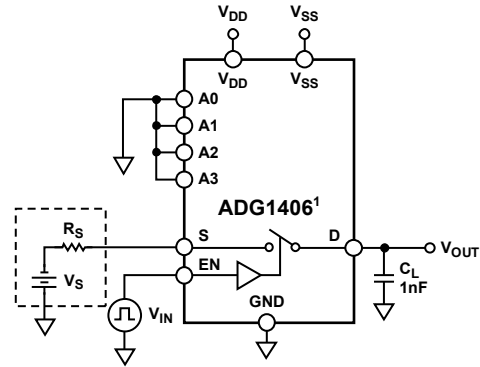
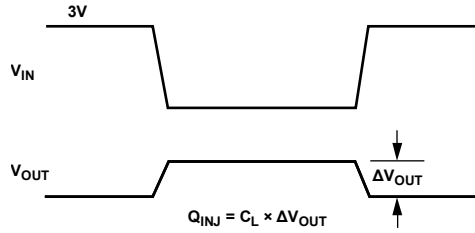


Figure 32. Enable Delay, $t_{\text{ON}}(\text{EN})$, $t_{\text{OFF}}(\text{EN})$



¹SIMILAR CONNECTION FOR ADG1407.

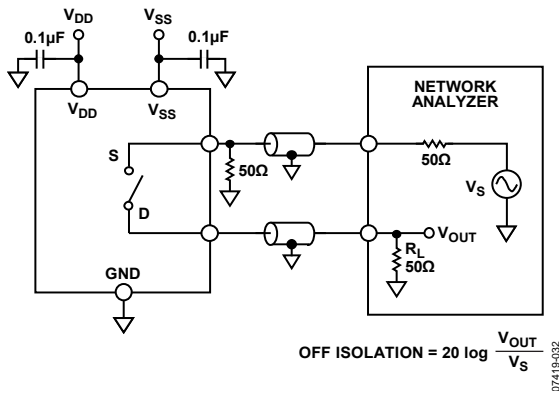
07419-030



¹SIMILAR CONNECTION FOR ADG1407.

07419-031

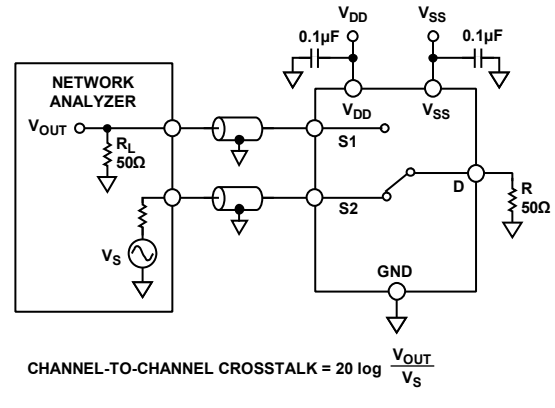
Figure 33. Charge Injection



$$\text{OFF ISOLATION} = 20 \log \frac{V_{\text{OUT}}}{V_S}$$

07419-032

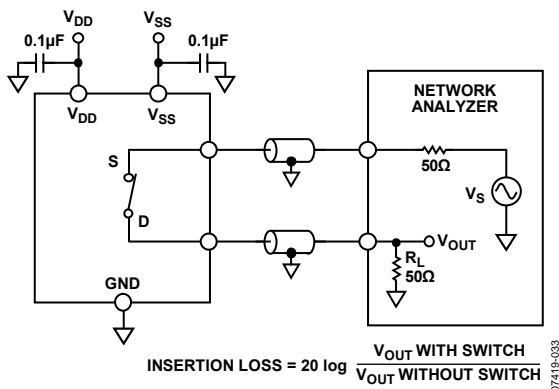
Figure 34. Off Isolation



$$\text{CHANNEL-TO-CHANNEL CROSSTALK} = 20 \log \frac{V_{\text{OUT}}}{V_S}$$

07419-034

Figure 36. Channel-to-Channel Crosstalk



$$\text{INSERTION LOSS} = 20 \log \frac{V_{\text{OUT WITH SWITCH}}}{V_{\text{OUT WITHOUT SWITCH}}}$$

07419-033

Figure 35. Bandwidth

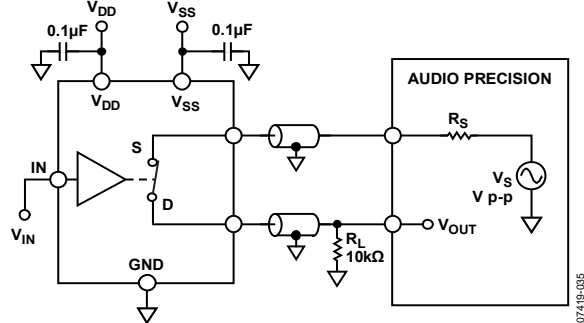
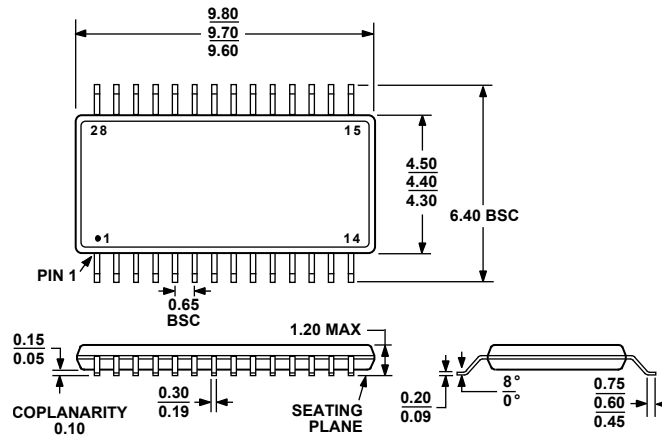


Figure 37. THD + N

07419-035

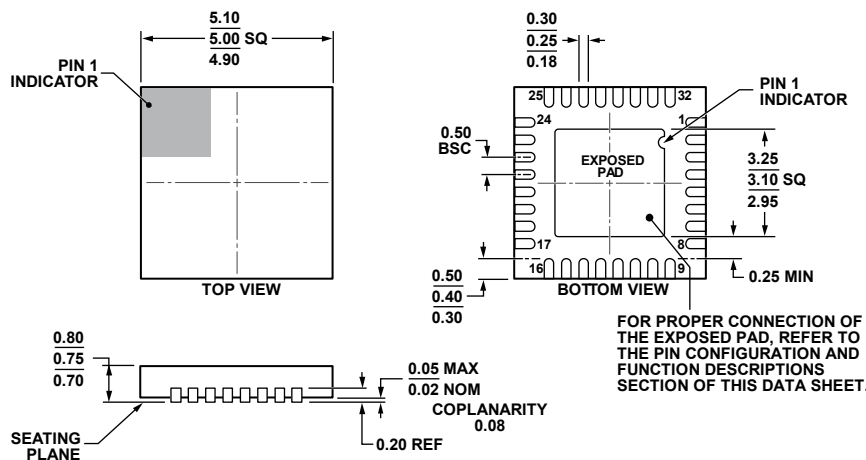
OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AE

Figure 38. 28-Lead Thin Shrink Small Outline Package [TSSOP] (RU-28)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-WHHD.

Figure 39. 32-Lead Lead Frame Chip Scale Package [LFCSP] 5 mm x 5 mm Body and 0.75 mm Package Height (CP-32-7)

Dimensions shown in millimeters

ORDERING GUIDE

| Model ¹ | Temperature Range | Description | Package Option |
|--------------------|-------------------|---|----------------|
| ADG1406BRUZ | -40°C to +125°C | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28 |
| ADG1406BRUZ-REEL7 | -40°C to +125°C | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28 |
| ADG1406BCPZ-REEL7 | -40°C to +125°C | 32-Lead Lead Frame Chip Scale Package [LFCSP] | CP-32-7 |
| ADG1407BRUZ | -40°C to +125°C | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28 |
| ADG1407BRUZ-REEL7 | -40°C to +125°C | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28 |
| ADG1407BCPZ-REEL7 | -40°C to +125°C | 32-Lead Lead Frame Chip Scale Package [LFCSP] | CP-32-7 |

¹ Z = RoHS Compliant Part.

Looking for pricing, stock, or lifecycle information?

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 [View ADG1406BCPZ-REEL7 on WIN SOURCE](#)

 [Analog Devices Inc. Information](#)

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