

FEATURES

33 V supply range
Fully specified at +12 V, ±15 V
130 Ω on resistance
No V_L supply required
3 V logic-compatible inputs
Rail-to-rail operation
16-lead TSSOP and 16-lead SOIC
Typical power consumption: <0.03 μW

APPLICATIONS

Signal switching
Battery-powered systems
Communication systems
Audio/video signal routing

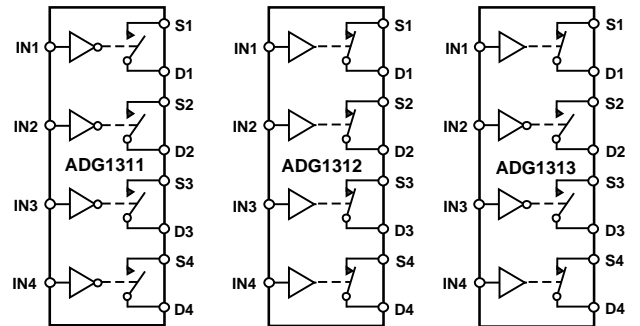
GENERAL DESCRIPTION

The ADG1311/ADG1312/ADG1313 are monolithic CMOS devices containing four independently selectable switches designed on a CMOS process.

The ADG1311/ADG1312/ADG1313 contain four independent single-pole/single-throw (SPST) switches. The ADG1311 and ADG1312 differ only in that the digital control logic is inverted. The ADG1311 switches are turned on with Logic 0 on the appropriate control input, while Logic 1 is required for the ADG1312. The ADG1313 has two switches with digital control logic similar to the ADG1311; the logic is inverted on the other two switches. The ADG1313 exhibits break-before-make switching action for use in multiplexer applications.

Each switch conducts equally well in both directions when on and has an input signal range that extends to the supplies. In the off condition, signal levels up to the supplies are blocked.

FUNCTIONAL BLOCK DIAGRAM



SWITCHES SHOWN FOR A LOGIC 1 INPUT

Figure 1.

05676-001

PRODUCT HIGHLIGHTS

- 3 V logic-compatible digital inputs: $V_{IH} = 2.0$ V, $V_{IL} = 0.8$ V.
- No V_L logic power supply required.
- 16-lead TSSOP and SOIC packages.

Rev. A

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REVISION HISTORY

2/09—Rev. 0 to Rev. A

| | |
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| Changes to Power Requirements, I_{DD} , Digital Inputs = 5 V Parameter, Table 1..... | 3 |
| Changes to Power Requirements, I_{DD} , Digital Inputs = 5 V Parameter, Table 2..... | 4 |

10/05—Revision 0: Initial Version

SPECIFICATIONS

DUAL SUPPLY

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

Table 1.

| Parameter | Y Version ¹ | | Unit | Test Conditions/Comments |
|----------------------------------------------------------|------------------------|----------------------|-------------------|-------------------------------------------------------------------------------|
| | 25°C | -40°C to +105°C | | |
| ANALOG SWITCH | | | | |
| Analogue Signal Range | | V_{DD} to V_{SS} | V | |
| On Resistance (R_{ON}) | 130 | 230 | Ω typ | $V_S = \pm 10\text{ V}$, $I_S = -1\text{ mA}$; see Figure 10 |
| | 200 | | Ω max | $V_{DD} = +13.5\text{ V}$, $V_{SS} = -13.5\text{ V}$ |
| On Resistance Match Between Channels (ΔR_{ON}) | 5 | | Ω typ | $V_S = \pm 10\text{ V}$, $I_S = -1\text{ mA}$ |
| | 10 | | Ω max | |
| On Resistance Flatness ($R_{FLAT(ON)}$) | 25 | | Ω typ | $V_S = -5\text{ V}/0\text{ V}/+5\text{ V}$; $I_S = -1\text{ mA}$ |
| | 65 | | Ω max | |
| LEAKAGE CURRENTS | | | | |
| Source Off Leakage, I_S (Off) | ± 10 | | nA typ | $V_{DD} = +16.5\text{ V}$, $V_{SS} = -16.5\text{ V}$ |
| Drain Off Leakage, I_D (Off) | ± 10 | | nA typ | $V_S = \pm 10\text{ V}$, $V_D = \mp 10\text{ V}$; see Figure 11 |
| Channel On Leakage, I_D , I_S (On) | ± 10 | | nA typ | $V_S = \pm 10\text{ V}$, $V_D = \mp 10\text{ V}$; see Figure 11 |
| | | | | $V_S = V_D = \pm 10\text{ V}$; see Figure 12 |
| DIGITAL INPUTS | | | | |
| Input High Voltage, V_{INH} | | 2.0 | V min | |
| Input Low Voltage, V_{INL} | | 0.8 | V max | |
| Input Current, I_{INL} or I_{INH} | 0.005 | | μA typ | $V_{IN} = V_{INL}$ or V_{INH} |
| | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 2.5 | | pF typ | |
| DYNAMIC CHARACTERISTICS² | | | | |
| t_{ON} | 105 | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 125 | 180 | ns max | $V_S = 10\text{ V}$; see Figure 13 |
| t_{OFF} | 40 | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 50 | 60 | ns max | $V_S = 10\text{ V}$; see Figure 13 |
| Break-Before-Make Time Delay, t_D (ADG1313 Only) | 25 | 10 | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | ns min | $V_{S1} = V_{S2} = 10\text{ V}$; see Figure 14 |
| Charge Injection | 2 | | pC typ | $V_S = 0\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 15 |
| Off Isolation | 80 | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 16 |
| Channel-to-Channel Crosstalk | 90 | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 17 |
| -3 dB Bandwidth | 600 | | MHz typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 18 |
| C_S (Off) | 5 | | pF typ | |
| C_D (Off) | 5 | | pF typ | |
| C_D , C_S (On) | 10 | | pF typ | |
| POWER REQUIREMENTS | | | | |
| I_{DD} | 0.001 | | μA typ | $V_{DD} = +16.5\text{ V}$, $V_{SS} = -16.5\text{ V}$ |
| | | 1.0 | μA max | Digital inputs = 0 V or V_{DD} |
| I_{DD} | 220 | | μA typ | Digital inputs = 5 V |
| | | 380 | μA max | |
| I_{SS} | 0.001 | | μA typ | Digital inputs = 0 V or V_{DD} |
| | | 1.0 | μA max | |
| I_{SS} | 0.001 | | μA typ | Digital inputs = 5 V |
| | | 1.0 | μA max | |

¹ Temperature range for Y Version is -40°C to +105°C.

² Guaranteed by design, not subject to production test.

ADG1311/ADG1312/ADG1313

SINGLE SUPPLY

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

Table 2.

| Parameter | Y Version ¹ | | Unit | Test Conditions/Comments |
|----------------------------------------------------------|------------------------|-----------------|-------------------|---------------------------------------------------------------------------------|
| | 25°C | –40°C to +105°C | | |
| ANALOG SWITCH | | | | |
| Analogue Signal Range | | 0 V to V_{DD} | V | |
| On Resistance (R_{ON}) | 325 | 520 | Ω typ | $V_S = 0\text{ V} - 10\text{ V}$, $I_S = -1\text{ mA}$; see Figure 10 |
| | 500 | | Ω max | $V_{DD} = 10.8\text{ V}$, $V_{SS} = 0\text{ V}$ |
| On Resistance Match Between Channels (ΔR_{ON}) | 10 | | Ω typ | $V_S = 0\text{ V} - 10\text{ V}$, $I_S = -1\text{ mA}$ |
| | 15 | | Ω max | |
| On Resistance Flatness ($R_{FLAT(ON)}$) | 65 | | Ω typ | $V_S = 3\text{ V}/6\text{ V}/9\text{ V}$, $I_S = -1\text{ mA}$ |
| LEAKAGE CURRENTS | | | | |
| Source Off Leakage, I_S (Off) | ± 10 | | nA typ | $V_{DD} = 13.2\text{ V}$, $V_{SS} = 0\text{ V}$ |
| Drain Off Leakage, I_D (Off) | ± 10 | | nA typ | $V_S = 1\text{ V}/10\text{ V}$, $V_D = 10\text{ V}/1\text{ V}$; see Figure 11 |
| Channel On Leakage, I_D , I_S (On) | ± 10 | | nA typ | $V_S = 1\text{ V}/10\text{ V}$, $V_D = 10\text{ V}/1\text{ V}$ see Figure 11 |
| | | | | $V_S = V_D = 1\text{ V}$ or 10 V ; see Figure 12 |
| DIGITAL INPUTS | | | | |
| Input High Voltage, V_{INH} | | 2.0 | V min | |
| Input Low Voltage, V_{INL} | | 0.8 | V max | |
| Input Current, I_{INL} or I_{INH} | 0.001 | | μA typ | $V_{IN} = V_{INL}$ or V_{INH} |
| | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 3 | | pF typ | |
| DYNAMIC CHARACTERISTICS² | | | | |
| t_{ON} | 120 | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 155 | 210 | ns max | $V_S = 8\text{ V}$; see Figure 13 |
| t_{OFF} | 45 | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 65 | 80 | ns max | $V_S = 8\text{ V}$; see Figure 13 |
| Break-Before-Make Time Delay, t_D (ADG1313 Only) | 50 | 10 | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | ns min | $V_{S1} = V_{S2} = 8\text{ V}$; see Figure 14 |
| Charge Injection | 2 | | pC typ | $V_S = 6\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 15 |
| Off Isolation | 80 | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 16 |
| Channel-to-Channel Crosstalk | 90 | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 17 |
| –3 dB Bandwidth | 500 | | MHz typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 18 |
| C_S (Off) | 5 | | pF typ | |
| C_D (Off) | 5 | | pF typ | |
| C_D , C_S (On) | 10 | | pF typ | |
| POWER REQUIREMENTS | | | | |
| I_{DD} | 0.001 | | μA typ | $V_{DD} = 13.2\text{ V}$ |
| | | 1.0 | μA max | Digital inputs = 0 V or V_{DD} |
| I_{DD} | 220 | | μA typ | Digital inputs = 5 V |
| | | 380 | μA max | |

¹ Temperature range for Y Version is –40°C to +105°C.

² Guaranteed by design, not subject to production test.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 3.

| 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 V to V _{DD} + 0.3 V or 30 mA, whichever occurs first |
| Digital Inputs ¹ | GND − 0.3 V to V _{DD} + 0.3 V or 30 mA, whichever occurs first |
| Peak Current, S or D | 100 mA (pulsed at 1 ms, 10% duty cycle max) |
| Continuous Current per Channel, S or D | 25 mA |
| Operating Temperature Range Automotive | −40°C to +105°C |
| Storage Temperature Range | −65°C to +150°C |
| Junction Temperature | 150°C |
| 16-Lead TSSOP, θ _{JA} Thermal Impedance (4-layer board) | 112°C/W |
| 16-Lead SOIC, θ _{JA} Thermal Impedance | 77°C/W |
| Reflow Soldering Peak Temperature, Pb free | 260°C |

¹ Overvoltages at IN, S, or D are clamped by internal diodes. Current should be limited to the maximum ratings given.

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

Table 4. ADG1311/ADG1312 Truth Table

| ADG1311 INx | ADG1312 INx | Switch Condition |
|-------------|-------------|------------------|
| 0 | 1 | On |
| 1 | 0 | Off |

Table 5. ADG1313 Truth Table

| ADG1313 INx | Switch 1, 4 | Switch 2, 3 |
|-------------|-------------|-------------|
| 0 | Off | On |
| 1 | On | Off |

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



ADG1311/ADG1312/ADG1313

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

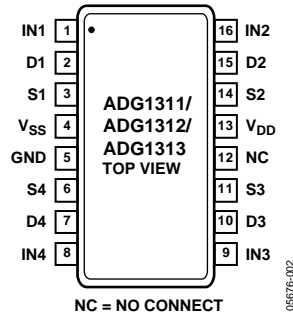


Figure 2. SOIC/TSSOP Pin Configuration

Table 6. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|---------|-----------------|---------------------------------------------|
| 1 | IN1 | Logic Control Input. |
| 2 | D1 | Drain Terminal. Can be an input or output. |
| 3 | S1 | Source Terminal. Can be an input or output. |
| 4 | V _{SS} | Most Negative Power Supply Potential. |
| 5 | GND | Ground (0 V) Reference. |
| 6 | S4 | Source Terminal. Can be an input or output. |
| 7 | D4 | Drain Terminal. Can be an input or output. |
| 8 | IN4 | Logic Control Input. |
| 9 | IN3 | Logic Control Input. |
| 10 | D3 | Drain Terminal. Can be an input or output. |
| 11 | S3 | Source Terminal. Can be an input or output. |
| 12 | NC | No Connection. |
| 13 | V _{DD} | Most Positive Power Supply Potential. |
| 14 | S2 | Source Terminal. Can be an input or output. |
| 15 | D2 | Drain Terminal. Can be an input or output. |
| 16 | IN2 | Logic Control Input. |

TERMINOLOGY

I_{DD}

The positive supply current.

I_{SS}

The negative supply current.

$V_D (V_S)$

The analog voltage on Terminal D and Terminal S.

R_{ON}

The ohmic resistance between D and S.

$R_{FLAT(ON)}$

Flatness is defined as the difference between the maximum and minimum value of on resistance, as measured over the specified analog signal range.

$I_S (Off)$

The source leakage current with the switch off.

$I_D (Off)$

The drain leakage current with the switch off.

$I_D, I_S (On)$

The channel leakage current with the switch on.

V_{INL}

The maximum input voltage for Logic 0.

V_{INH}

The minimum input voltage for Logic 1.

$I_{INL} (I_{INH})$

The input current of the digital input.

$C_S (Off)$

The off switch source capacitance, measured with reference to ground.

$C_D (Off)$

The off switch drain capacitance, measured with reference to ground.

$C_D, C_S (On)$

The on switch capacitance, measured with reference to ground.

C_{IN}

The digital input capacitance.

t_{ON}

The delay between applying the digital control input and the output switching on. See Figure 13.

t_{OFF}

The delay between applying the digital control input and the output switching off. See Figure 13.

Charge Injection

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

Off Isolation

A measure of unwanted signal coupling through an off switch.

Crosstalk

A measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance.

Bandwidth

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

On Response

The frequency response of the on switch.

Insertion Loss

The loss due to the on resistance of the switch.

TYPICAL PERFORMANCE CHARACTERISTICS

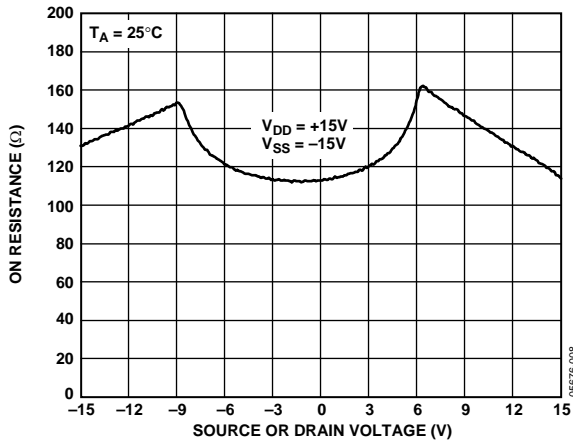


Figure 3. On Resistance as a Function of V_D (V_S) for Dual Supply

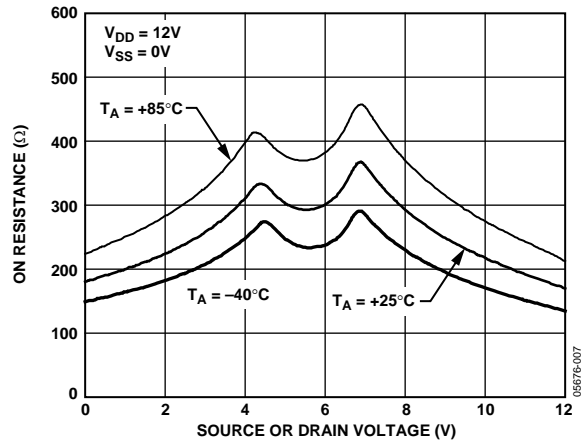


Figure 6. On Resistance as a Function of V_D (V_S) for Different Temperatures, Single Supply

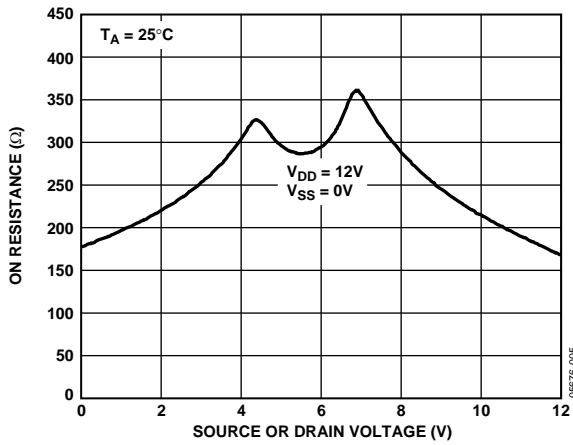


Figure 4. On Resistance as a Function of V_D (V_S) for Single Supply

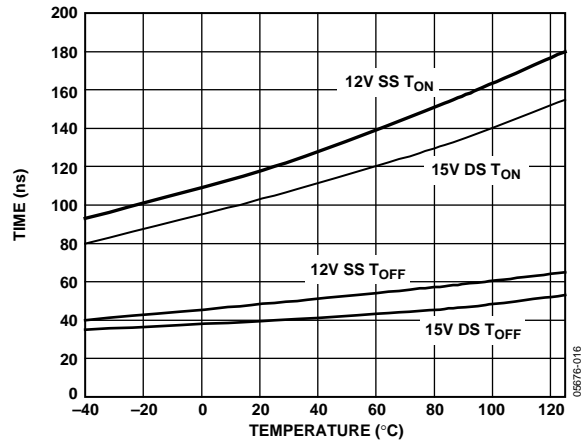


Figure 7. T_{ON}/T_{OFF} Times vs. Temperature

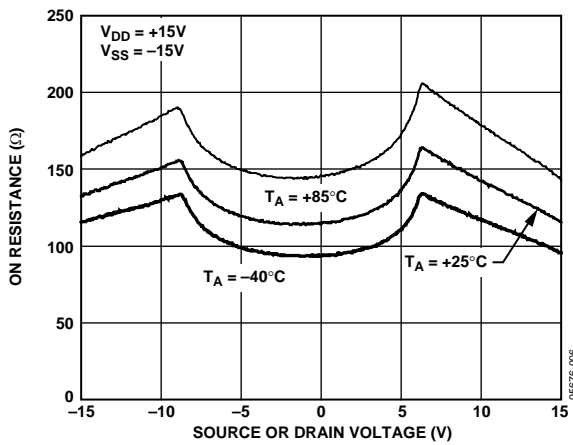


Figure 5. On Resistance as a Function of V_D (V_S) for Different Temperatures, Dual Supply

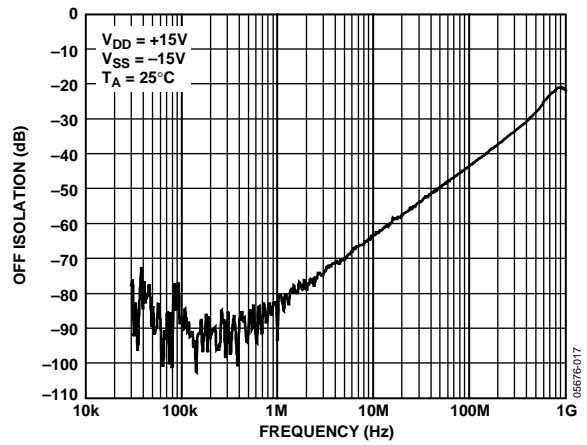


Figure 8. Off Isolation vs. Frequency

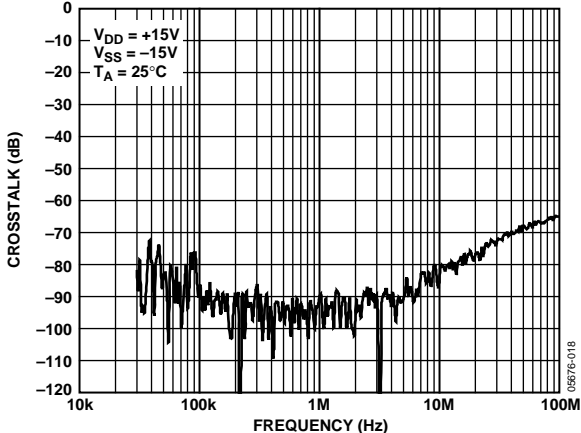


Figure 9. Crosstalk vs. Frequency

TEST CIRCUITS

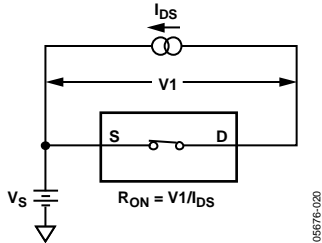


Figure 10. On Resistance

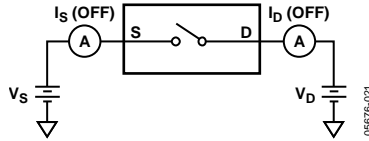


Figure 11. Off Leakage

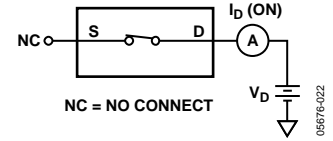


Figure 12. On Leakage

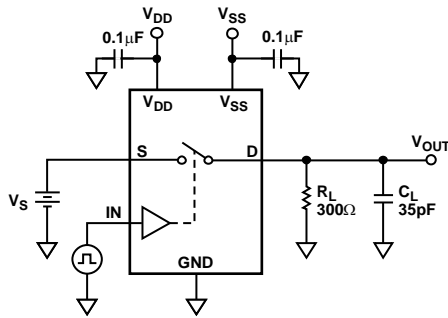


Figure 13. Switching Times

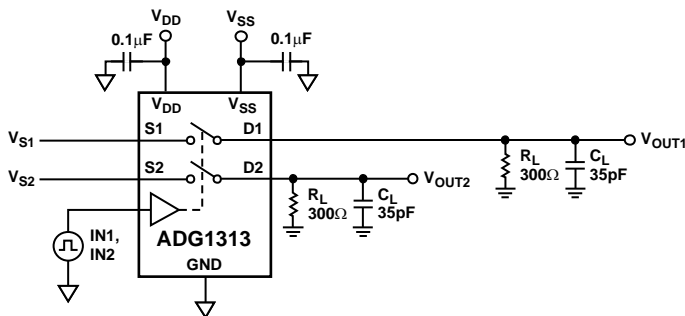
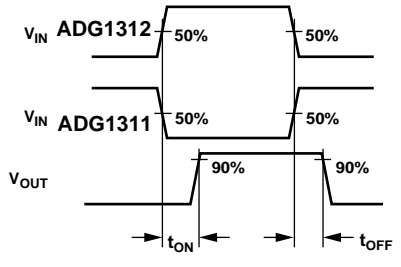


Figure 14. Break-Before-Make Time Delay

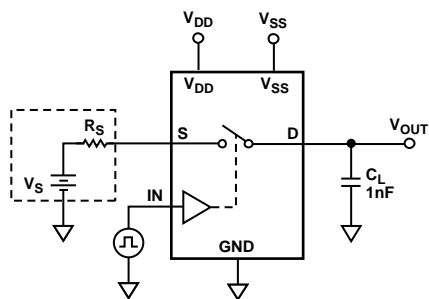
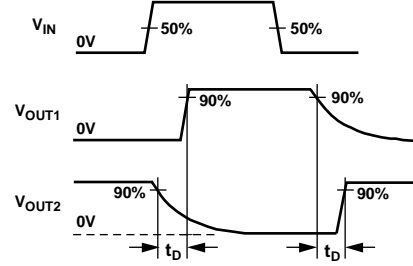
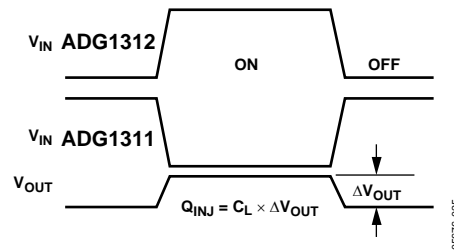


Figure 15. Charge Injection



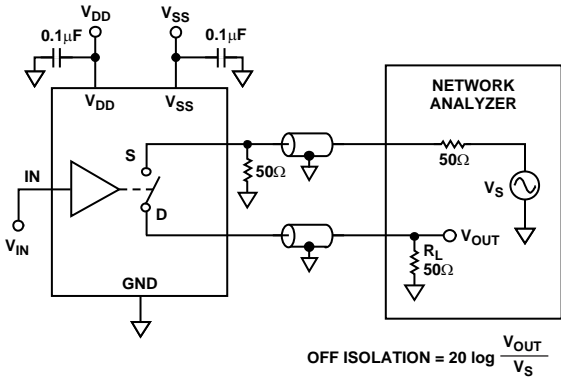


Figure 16. Off Isolation

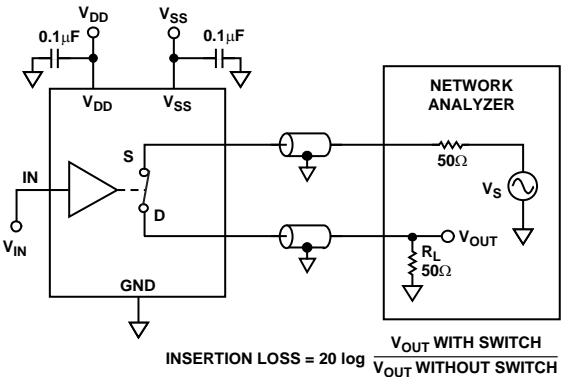


Figure 18. Bandwidth

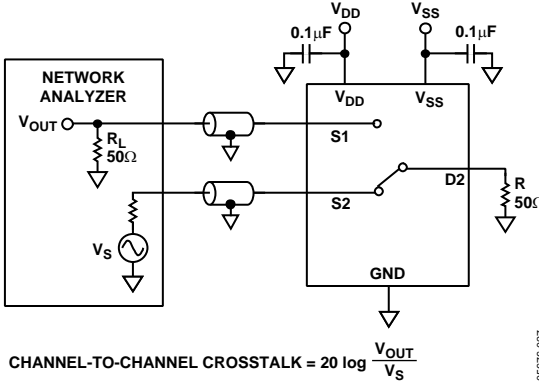


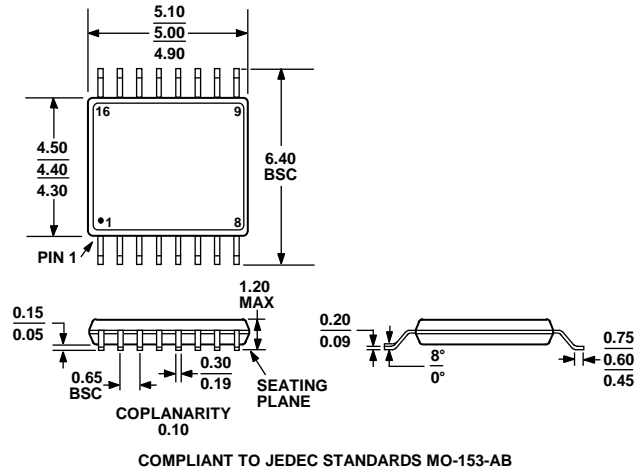
Figure 17. Channel-to-Channel Crosstalk

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05676-028

05676-027

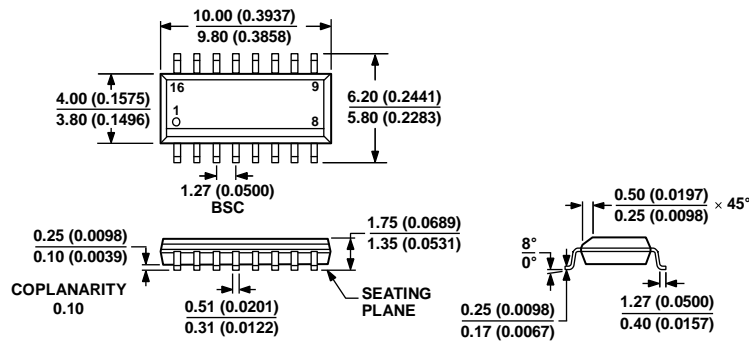
OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 19. 16-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-16)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MS-012-AC

CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 20. 16-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-16)

Dimensions shown in millimeters and (inches)

060606-A

ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option |
|--------------------------------|-------------------|----------------------------------------------------|----------------|
| ADG1311YRUZ ¹ | -40°C to +105°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 |
| ADG1311YRUZ-REEL7 ¹ | -40°C to +105°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 |
| ADG1311YRZ ¹ | -40°C to +105°C | 16-Lead Narrow Body Small Outline Package [SOIC_N] | R-16 |
| ADG1311YRZ-REEL7 ¹ | -40°C to +105°C | 16-Lead Narrow Body Small Outline Package [SOIC_N] | R-16 |
| ADG1312YRUZ ¹ | -40°C to +105°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 |
| ADG1312YRUZ-REEL7 ¹ | -40°C to +105°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 |
| ADG1312YRZ ¹ | -40°C to +105°C | 16-Lead Narrow Body Small Outline Package [SOIC_N] | R-16 |
| ADG1312YRZ-REEL7 ¹ | -40°C to +105°C | 16-Lead Narrow Body Small Outline Package [SOIC_N] | R-16 |
| ADG1313YRUZ ¹ | -40°C to +105°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 |
| ADG1313YRUZ-REEL7 ¹ | -40°C to +105°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 |
| ADG1313YRZ ¹ | -40°C to +105°C | 16-Lead Narrow Body Small Outline Package [SOIC_N] | R-16 |
| ADG1313YRZ-REEL7 ¹ | -40°C to +105°C | 16-Lead Narrow Body Small Outline Package [SOIC_N] | R-16 |

¹ Z = RoHS Compliant Part.

Mouser Electronics

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[ADG1312YRUZ-REEL7](#) [ADG1313YRUZ-REEL7](#) [ADG1313YRZ](#) [ADG1311YRZ-REEL7](#) [ADG1311YRUZ](#)
[ADG1313YRZ-REEL7](#) [ADG1311YRUZ-REEL7](#) [ADG1313YRUZ](#) [ADG1312YRUZ](#) [ADG1312YRZ](#) [ADG1311YRZ](#)
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