



**THE DATASHEET OF
ADG821BRMZ**



ADG821/ADG822/ADG823

FEATURES

- 0.8 Ω maximum on resistance @ 125°C**
- 0.3 Ω maximum on resistance flatness @ 125°C**
- 1.8 V to 5.5 V single supply**
- 200 mA current carrying capability**
- Automotive temperature range: -40°C to +125°C**
- Rail-to-rail operation**
- 8-lead MSOP**
- 33 ns switching times**
- Typical power consumption: <0.01 μ W**
- TTL-/CMOS-compatible inputs**
- Pin-compatible with the ADG721/ADG722/ADG723**

APPLICATIONS

- Power routing**
- Battery-powered systems**
- Communication systems**
- Data acquisition systems**
- Audio and video signal routing**
- Cellular phones**
- Modems**
- PCMCIA cards**
- Hard drives**
- Relay replacement**

GENERAL DESCRIPTION

The ADG821/ADG822/ADG823 are monolithic CMOS single-pole, single-throw (SPST) switches. These switches are designed on an advanced submicron process that provides low power dissipation, yet gives high switching speed, low on resistance, and low leakage currents.

The ADG821/ADG822/ADG823 are designed to operate from a single 1.8 V to 5.5 V supply, making them ideal for use in battery-powered instruments.

Each switch of the ADG821/ADG822/ADG823 conducts equally well in both directions when on. The ADG821/ADG822/ADG823 contain two independent SPST switches. The ADG821 and ADG822 differ only in that both switches are normally open and normally closed, respectively. In the ADG823, Switch 1 is normally open and Switch 2 is normally closed. The ADG823 exhibits break-before-make switching action.

The ADG821/ADG822/ADG823 are available in an 8-lead MSOP.

Rev. A

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FUNCTIONAL BLOCK DIAGRAMS

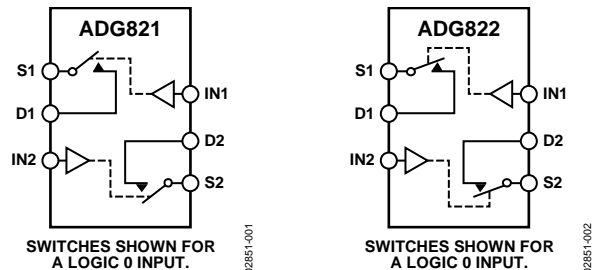


Figure 1.

Figure 2.

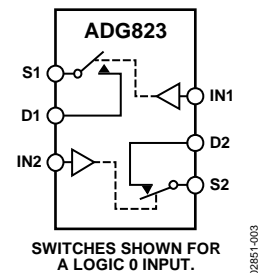


Figure 3.

PRODUCT HIGHLIGHTS

1. Very Low On Resistance: 0.5 Ω typ.
2. On Resistance Flatness ($R_{FLAT(ON)}$): 0.15 Ω typ.
3. Automotive Temperature Range: -40°C to +125°C.
4. Current Carrying Capability: 200 mA.
5. Low Power Dissipation. CMOS construction ensures low power dissipation.
6. 8-Lead MSOP.

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REVISION HISTORY

4/08—Rev. 0 to Rev. A

| | |
|----------------------------------|-----------|
| Updated Format..... | Universal |
| Added Table 6..... | 6 |
| Updated Outline Dimensions | 12 |
| Changes to Ordering Guide | 12 |

8/02—Revision 0: Initial Version

SPECIFICATIONS

$V_{DD} = 5\text{ V} \pm 10\%$, $GND = 0\text{ V}$; $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted.

Table 1.

| Parameter | 25°C | -40°C to +85°C | -40°C to +125°C ¹ | Unit | Test Conditions/Comments |
|--|------------|----------------|------------------------------|-------------------|--|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | 0 V to V_{DD} | V | |
| On Resistance (R_{ON}) | 0.5 | | | Ω typ | $V_S = 0\text{ V}$ to V_{DD} , $I_S = 100\text{ mA}$, see Figure 17 |
| | 0.6 | 0.7 | 0.8 | Ω max | |
| On Resistance Match Between Channels (ΔR_{ON}) | 0.16 | | | Ω typ | $V_S = 0\text{ V}$ to V_{DD} , $I_S = 100\text{ mA}$ |
| | 0.2 | 0.25 | 0.28 | Ω max | |
| On Resistance Flatness ($R_{FLAT(ON)}$) | 0.15 | | | Ω typ | $V_S = 0\text{ V}$ to V_{DD} , $I_S = 100\text{ mA}$ |
| | 0.23 | 0.26 | 0.3 | Ω max | |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 | | | nA typ | $V_{DD} = 5.5\text{ V}$ $V_S = 4.5\text{ V}/1\text{ V}$, $V_D = 1\text{ V}/4.5\text{ V}$, see Figure 18 |
| | ± 0.25 | ± 3 | ± 25 | nA max | |
| Drain Off Leakage, I_D (Off) | ± 0.01 | | | nA typ | $V_S = 4.5\text{ V}/1\text{ V}$, $V_D = 1\text{ V}/4.5\text{ V}$, see Figure 18 |
| | ± 0.25 | ± 3 | ± 25 | nA max | |
| Channel On Leakage, I_D , I_S (On) | ± 0.01 | | | nA typ | $V_S = V_D = 1\text{ V}$, or $V_S = V_D = 4.5\text{ V}$, see Figure 19 |
| | ± 0.25 | ± 3 | ± 25 | nA max | |
| 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} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS² | | | | | |
| t_{ON} | 33 | | | ns typ | $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, $V_S = 3\text{ V}$, see Figure 20 |
| | 45 | 48 | 52 | ns max | |
| t_{OFF} | 11 | | | ns typ | $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, $V_S = 3\text{ V}$, see Figure 20 |
| | 16 | 19 | 21 | ns max | |
| Break-Before-Make Time Delay, t_{BBM} (ADG823 Only) | 32 | | 1 | ns typ ns min | $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, $V_{S1} = V_{S2} = 3\text{ V}$, see Figure 21 |
| Charge Injection | 15 | | | pC typ | $V_S = 2.5\text{ V}$; $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$, see Figure 22 |
| Off Isolation | -52 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 23 |
| Channel-to-Channel Crosstalk | -82 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 24 |
| Bandwidth -3 dB | 24 | | | MHz typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, see Figure 25 |
| C_S (Off) | 85 | | | pF typ | $f = 1\text{ MHz}$ |
| C_D (Off) | 98 | | | pF typ | $f = 1\text{ MHz}$ |
| C_D , C_S (On) | 230 | | | pF typ | $f = 1\text{ MHz}$ |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.001 | | | μA typ | $V_{DD} = 5.5\text{ V}$, digital inputs = 0 V or 5.5 V |
| | | 1.0 | 2.0 | μA max | |

¹ On resistance parameters tested with $I_S = 10\text{ mA}$.

² Guaranteed by design, not subject to production test.

ADG821/ADG822/ADG823

$V_{DD} = 2.7\text{ V to }3.6\text{ V}$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C to }+125^\circ\text{C}$, unless otherwise noted.

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 | | | 0 V to V_{DD} | V | |
| On Resistance (R_{ON}) | 0.7 | | | Ω typ | $V_S = 0\text{ V to }V_{DD}$, $I_S = 100\text{ mA}$, see Figure 17 |
| | 1.4 | 1.5 | 1.6 | Ω max | |
| On Resistance Match Between Channels (ΔR_{ON}) | 0.16 | | | Ω typ | $V_S = 0\text{ V to }V_{DD}$, $I_S = 100\text{ mA}$ |
| | 0.2 | 0.25 | 0.28 | Ω max | |
| On Resistance Flatness ($R_{FLAT(ON)}$) | 0.3 | | 0.33 | Ω typ | $V_S = 0\text{ V to }V_{DD}$, $I_S = 100\text{ mA}$ |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 | | | nA typ | $V_{DD} = 3.6\text{ V}$ $V_S = 3.3\text{ V}/1\text{ V}$, $V_D = 1\text{ V}/3.3\text{ V}$, see Figure 18 |
| | ± 0.25 | ± 3 | ± 15 | nA max | |
| Drain Off Leakage, I_D (Off) | ± 0.01 | | | nA typ | $V_S = 3.3\text{ V}/1\text{ V}$, $V_D = 1\text{ V}/3.3\text{ V}$, see Figure 18 |
| | ± 0.25 | ± 3 | ± 25 | nA max | |
| Channel On Leakage, I_D , I_S (On) | ± 0.01 | | | nA typ | $V_S = V_D = 1\text{ V}$, or 3.3 V , see Figure 19 |
| | ± 0.25 | ± 3 | ± 25 | nA max | |
| 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} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS² | | | | | |
| t_{ON} | 48 | | | ns typ | $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, $V_S = 1.5\text{ V}$, see Figure 20 |
| | 67 | 74 | 78 | ns max | |
| t_{OFF} | 12 | | | ns typ | $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, $V_S = 1.5\text{ V}$, see Figure 20 |
| | 18 | 20 | 23 | ns max | |
| Break-Before-Make Time Delay, t_{BBM} (ADG823 Only) | 40 | | 1 | ns typ ns min | $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, $V_{S1} = V_{S2} = 1.5\text{ V}$, see Figure 21 |
| Charge Injection | ± 2 | | | pC typ | $V_S = 1.5\text{ V}$; $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$, see Figure 22 |
| Off Isolation | -52 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 23 |
| Channel-to-Channel Crosstalk | -82 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$, see Figure 24 |
| Bandwidth -3 dB | 24 | | | MHz typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, see Figure 25 |
| C_S (Off) | 85 | | | pF typ | $f = 1\text{ MHz}$ |
| C_D (Off) | 98 | | | pF typ | $f = 1\text{ MHz}$ |
| C_D , C_S (On) | 230 | | | pF typ | $f = 1\text{ MHz}$ |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.001 | | | μA typ | $V_{DD} = 3.6\text{ V}$, digital inputs = 0 V or 3.6 V |
| | | 1.0 | 2.0 | μA max | |

¹ On resistance parameters tested with $I_S = 10\text{ mA}$.

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 GND | −0.3 V to +7 V |
| Analog Inputs ¹ | −0.3 V to V _{DD} + 0.3 V or 30 mA, whichever occurs first |
| Digital Inputs ¹ | −0.3 V to V _{DD} + 0.3 V or 30 mA, whichever occurs first |
| Peak Current, S or D | 400 mA (pulsed at 1 ms, 10% duty cycle maximum) |
| Continuous Current, S or D | 200 mA |
| Operating Temperature Range | |
| Automotive | −40°C to +125°C |
| Storage Temperature Range | −65°C to +150°C |
| Junction Temperature (T _J max) | 150°C |
| Package Power Dissipation | (T _J max − T _A)/θ _{JA} |
| 8-Lead MSOP Thermal Impedance | |
| θ _{JA} | 206°C/W |
| θ _{JC} | 44°C/W |
| Lead Temperature, Soldering (10 sec) | 300°C |
| IR Reflow, Peak Temperature (<20 sec) | 235°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. Truth Table for the ADG821/ADG822

| ADG821 INx | ADG822 INx | Switch x Condition |
|------------|------------|--------------------|
| 0 | 1 | Off |
| 1 | 0 | On |

Table 5. Truth Table for the ADG823

| IN1 | IN2 | Switch S1 | Switch S2 |
|-----|-----|-----------|-----------|
| 0 | 0 | Off | On |
| 0 | 1 | Off | Off |
| 1 | 0 | On | On |
| 1 | 1 | On | Off |

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.

ADG821/ADG822/ADG823

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

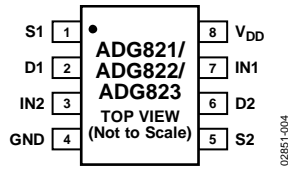


Figure 4. Pin Configuration

Table 6. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|---------|-----------------|--|
| 1 | S1 | Source Terminal. This pin can be an input or output. |
| 2 | D1 | Drain Terminal. This pin can be an input or output. |
| 3 | IN2 | Logic Control Input. |
| 4 | GND | Ground (0 V) Reference. |
| 5 | S2 | Source Terminal. This pin can be an input or output. |
| 6 | D2 | Drain Terminal. This pin can be an input or output. |
| 7 | IN1 | Logic Control Input. |
| 8 | V _{DD} | Most Positive Power Supply Potential. |

TYPICAL PERFORMANCE CHARACTERISTICS

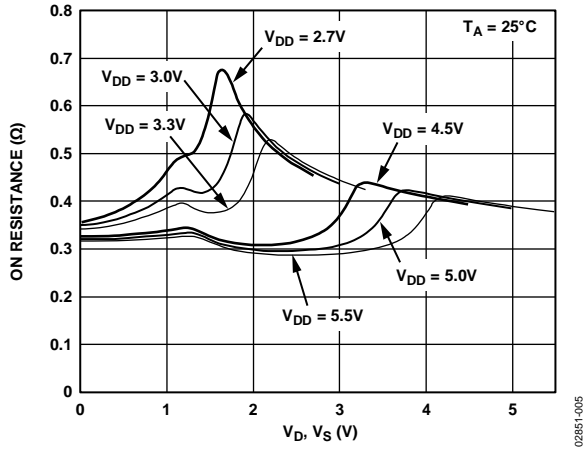


Figure 5. On Resistance vs. V_D , V_S

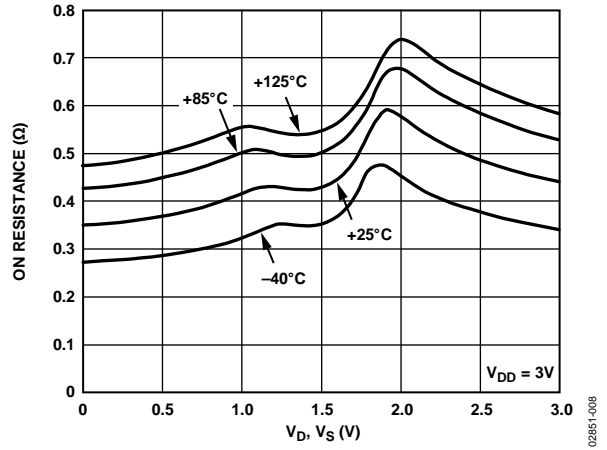


Figure 8. On Resistance vs. V_D , V_S for Different Temperatures, $V_{DD} = 3V$

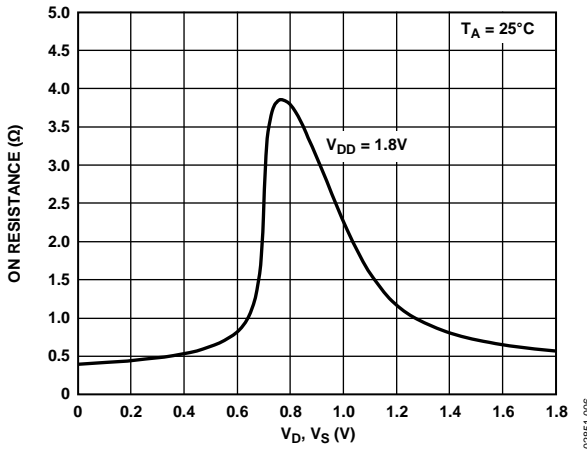


Figure 6. On Resistance vs. V_D , V_S ; $V_{DD} = 1.8V$

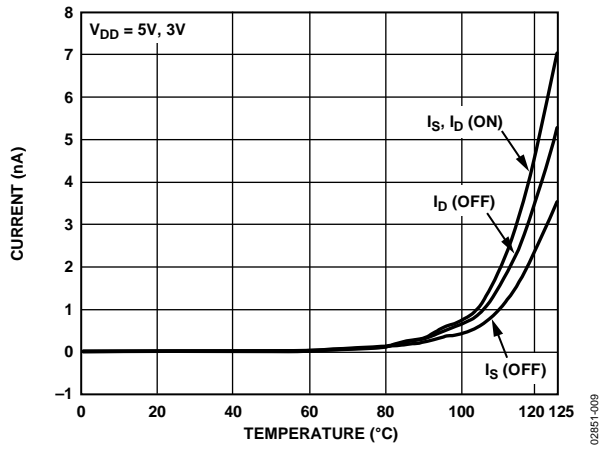


Figure 9. Leakage Current vs. Temperature

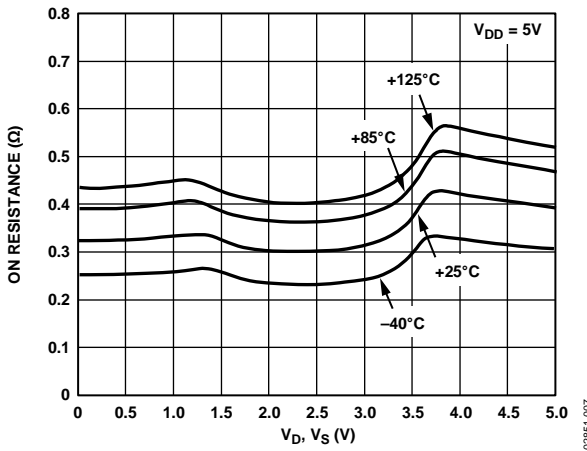


Figure 7. On Resistance vs. V_D , V_S for Different Temperatures, $V_{DD} = 5V$

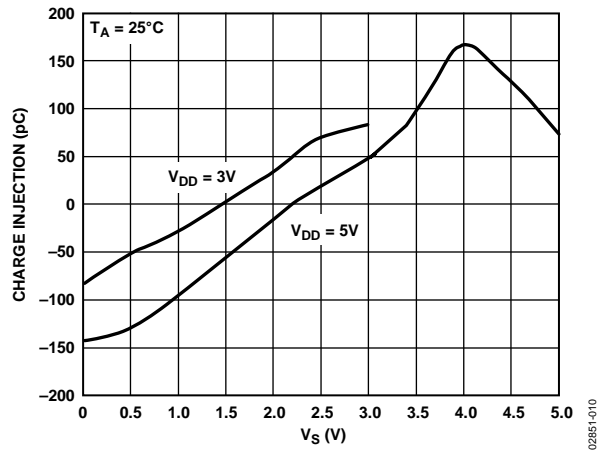


Figure 10. Charge Injection vs. Source Voltage

ADG821/ADG822/ADG823

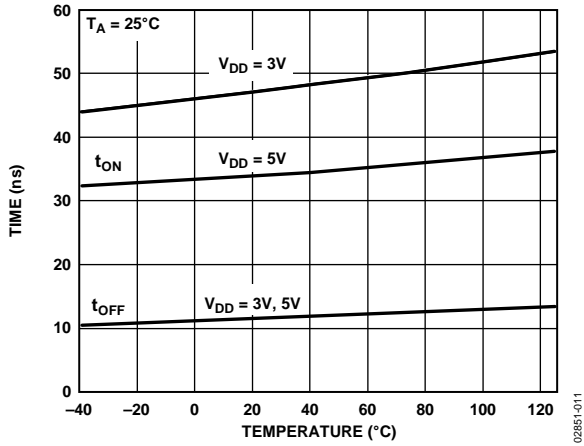


Figure 11. t_{ON}/t_{OFF} vs. Temperature

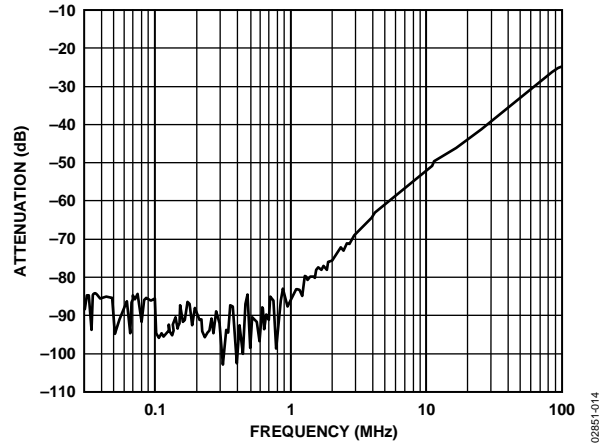


Figure 14. Crosstalk vs. Frequency

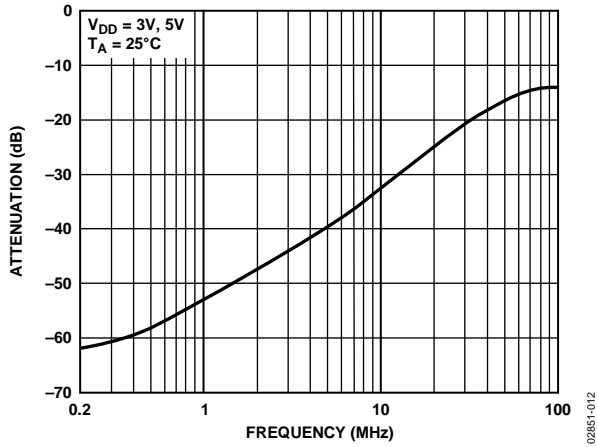


Figure 12. Off Isolation vs. Frequency

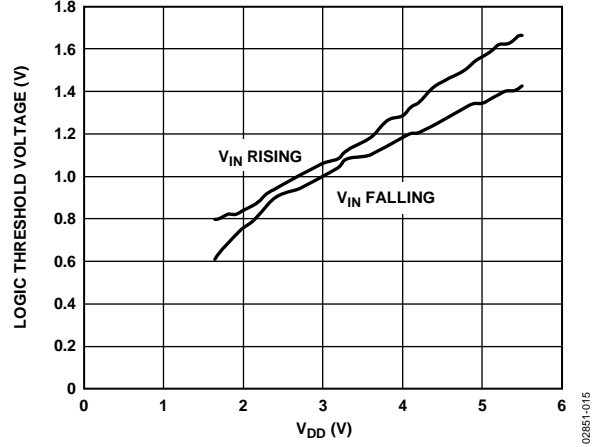


Figure 15. Logic Threshold Voltage vs. Supply Voltage

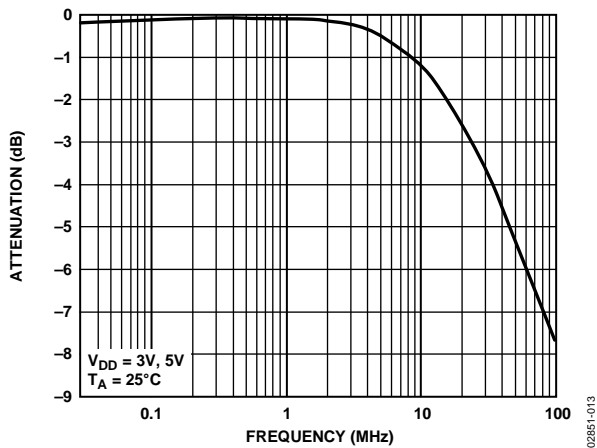


Figure 13. On Response vs. Frequency

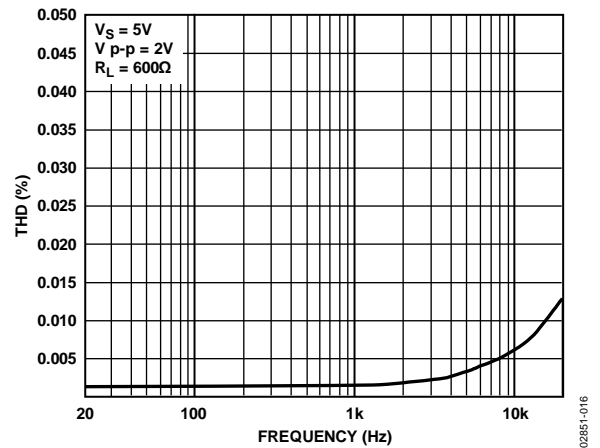


Figure 16. THD vs. Frequency

TEST CIRCUITS

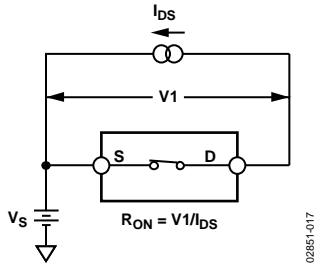


Figure 17. On Resistance

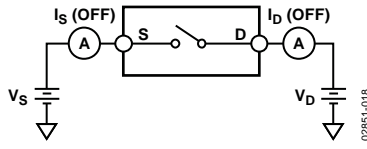


Figure 18. Off Leakage

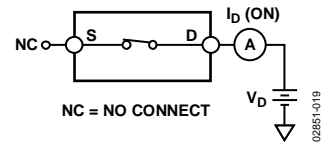


Figure 19. On Leakage

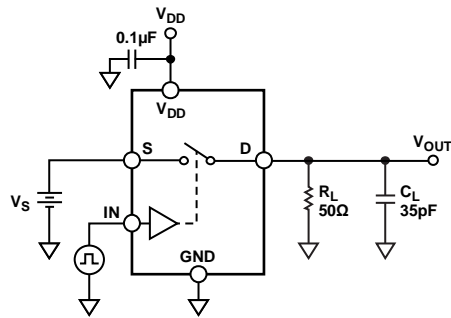


Figure 20. Switching Times

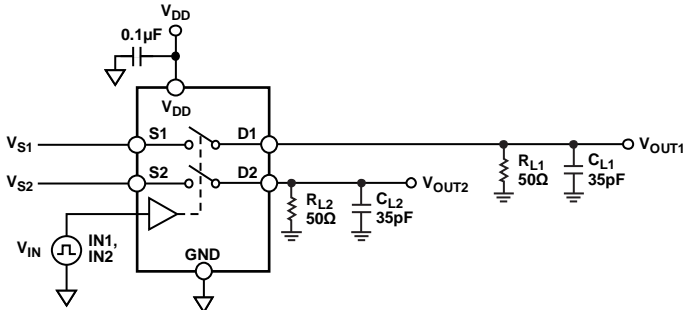
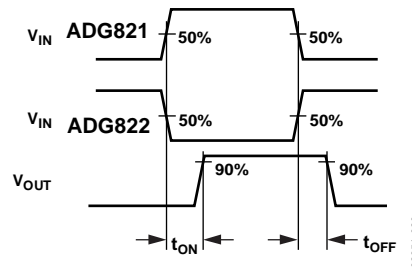


Figure 21. Break-Before-Make Time Delay, t_{BBM} (ADG823 only)

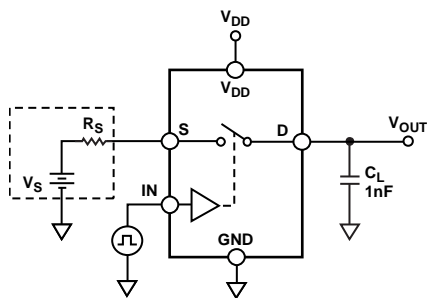
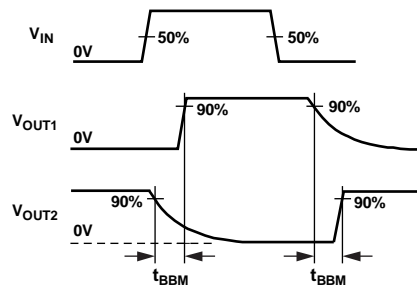
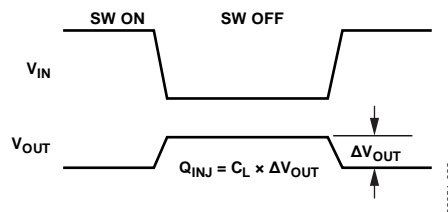


Figure 22. Charge Injection



ADG821/ADG822/ADG823

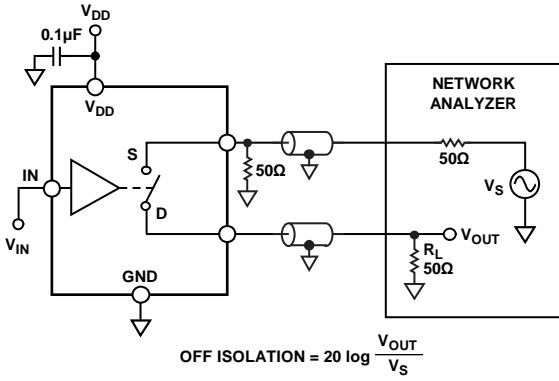


Figure 23. Off Isolation

02851-023

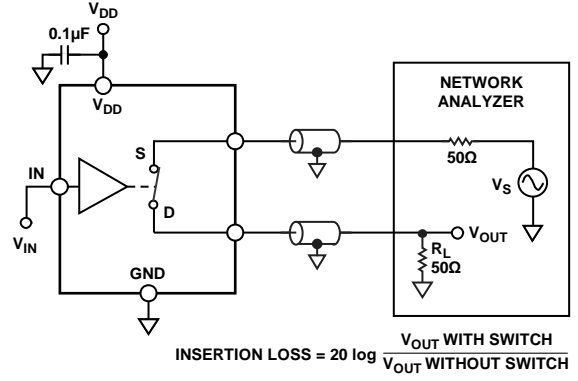


Figure 25. Bandwidth

02851-025

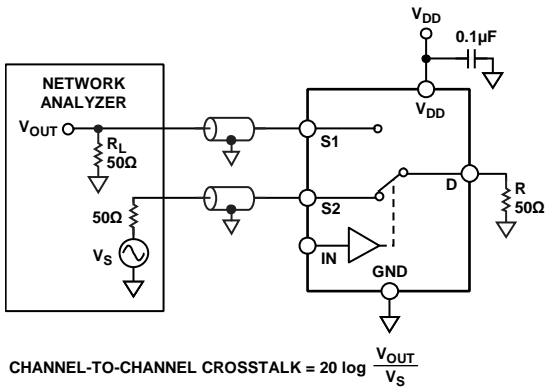


Figure 24. Channel-to-Channel Crosstalk

02851-024

TERMINOLOGY

V_{DD}

Most positive power supply potential.

GND

Ground (0 V) reference.

I_{DD}

Positive supply current.

S

Source terminal. May be an input or output.

D

Drain terminal. May be an input or output.

IN

Logic control input.

R_{ON}

Ohmic resistance between Terminal D and Terminal S.

ΔR_{ON}

On resistance match between any two channels (that is, $R_{ON\ max} - R_{ON\ min}$).

$R_{FLAT(ON)}$

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)

Source leakage current with the switch off.

I_D (Off)

Drain leakage current with the switch off.

I_D, I_S (On)

Channel leakage current with the switch on.

V_D, V_S

Analog voltage on Terminal D and Terminal S.

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.

C_S (Off)

Off switch source capacitance.

C_D (Off)

Off switch drain capacitance.

C_D, C_S (On)

On switch capacitance.

t_{ON}

Delay between applying the digital control input and the output switching on.

t_{OFF}

Delay between applying the digital control input and the output switching off.

t_{BBM}

Off time or on time measured between the 90% points of both switches, when switching from one address state to another.

Charge Injection

Charge injection is a measure of the glitch impulse transferred from the digital input to the analog output during switching.

Crosstalk

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

Off Isolation

A measure of unwanted signal coupling through an off switch.

Bandwidth

The frequency at which the output is attenuated by -3 dBs.

On Response

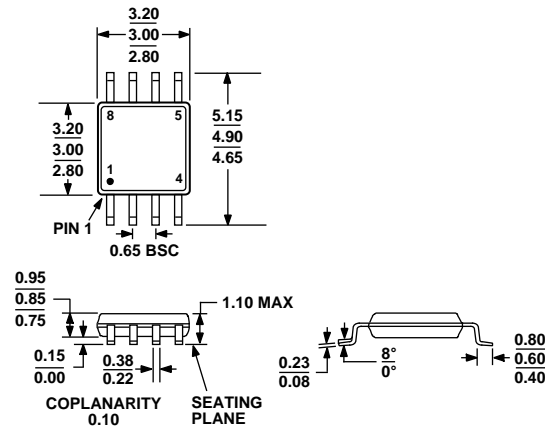
The frequency response of the on switch.

Insertion Loss

The loss due to the on resistance of the switch.

ADG821/ADG822/ADG823

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-187-AA

Figure 26. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)

Dimensions shown in millimeters

ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option | Branding |
|------------------------------|-------------------|--|----------------|----------|
| ADG821BRM | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SQB |
| ADG821BRM-REEL | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SQB |
| ADG821BRMZ ¹ | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SOP |
| ADG821BRMZ-REEL ⁷ | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SOP |
| ADG822BRM | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SRB |
| ADG822BRM-REEL | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SRB |
| ADG822BRM-REEL7 | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SRB |
| ADG822BRMZ ¹ | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | S1J |
| ADG822BRMZ-REEL ⁷ | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | S1J |
| ADG823BRM | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SSB |
| ADG823BRM-REEL | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SSB |
| ADG823BRMZ ¹ | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SSB# |
| ADG823BRMZ-REEL ⁷ | -40°C to +125°C | 8-Lead Mini Small Outline Package [MSOP] | RM-8 | SSB# |

¹ Z = RoHS Compliant Part, # denotes RoHS compliant product may be top or bottom marked.

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