



CMOS 1.8 V to 5.5 V, 2.5 Ω SPDT Switch/2:1 Mux in Tiny SC70 Package

ADG779

FEATURES

- 1.8 V to 5.5 V single supply
- 2.5 Ω on resistance
- 0.75 Ω on-resistance flatness
- 3 dB bandwidth >200 MHz
- Rail-to-rail operation
- 6-lead SC70 package
- Fast switching times
 - t_{ON} 20 ns
 - t_{OFF} 6 ns
- Typical power consumption (<0.01 μ W)
- TTL/CMOS compatible

APPLICATIONS

- Battery-powered systems
- Communication systems
- Sample hold systems
- Audio signal routing
- Video switching
- Mechanical reed relay replacements

GENERAL DESCRIPTION

The ADG779 is a monolithic CMOS SPDT (single-pole, double-throw) switch. This switch is designed on a submicron process that provides low power dissipation yet gives high switching speed, low on resistance, and low leakage currents.

The ADG779 operates from a single supply range of 1.8 V to 5.5 V, making it ideal for use in battery-powered instruments and with the new generation of DACs and ADCs from Analog Devices, Inc.

Each switch of the ADG779 conducts equally well in both directions when on. The ADG779 exhibits break-before-make switching action.

Because of the advanced submicron process, -3 dB bandwidth of greater than 200 MHz can be achieved.

The ADG779 is available in a 6-lead SC70 package.

FUNCTIONAL BLOCK DIAGRAM

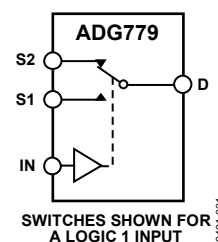


Figure 1.

PRODUCT HIGHLIGHTS

1. Tiny 6-Lead SC70 Package.
2. 1.8 V to 5.5 V Single-Supply Operation. The ADG779 offers high performance, including low on resistance and fast switching times, and is fully specified and guaranteed with 3 V and 5 V supply rails.
3. Very Low R_{ON} (5 Ω max at 5 V, 10 Ω max at 3 V). At 1.8 V operation, R_{ON} is typically 40 Ω over the temperature range.
4. On-Resistance Flatness ($R_{FLAT(ON)}$) (0.75 Ω typ).
5. -3 dB Bandwidth > 200 MHz.
6. Low Power Dissipation. CMOS construction ensures low power dissipation.
7. 14 ns Switching Times.

Rev. A

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REVISION HISTORY

10/05—Rev. 0 to Rev. A

| | |
|-------------------------------------|-----------|
| Updated Format..... | Universal |
| Changes to Table 1..... | 3 |
| Changes to Table 2..... | 4 |
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7/01—Revision 0: Initial Version

SPECIFICATIONS

$V_{DD} = 5\text{ V} \pm 10\%$, $GND = 0\text{ V}$ ¹

Table 1.

| Parameter | B Version | | Unit | Test Conditions/Comments |
|--|-----------|------------------------|---------|--|
| | 25°C | –40°C to +85°C | | |
| ANALOG SWITCH | | | | |
| Analog Signal Range | | 0 V to V _{DD} | V | |
| On Resistance (R _{ON}) | 2.5 | | Ω typ | V _S = 0 V to V _{DD} , I _S = –10 mA, see Figure 12 |
| | 5 | 6 | Ω max | |
| On-Resistance Match Between Channels (ΔR _{ON}) | 0.1 | | Ω typ | V _S = 0 V to V _{DD} , I _S = –10 mA |
| | | 0.8 | Ω max | |
| On-Resistance Flatness (R _{FLAT (ON)}) | 0.75 | | Ω typ | V _S = 0 V to V _{DD} , I _S = –10 mA |
| | | 1.2 | Ω max | |
| LEAKAGE CURRENTS ² | | | | |
| Source Off Leakage I _S (Off) | ±0.01 | ±0.05 | nA typ | V _{DD} = 5.5 V V _S = 4.5 V/1 V, V _D = 1 V/4.5 V, see Figure 13 |
| Channel On Leakage I _D , I _S (On) | ±0.01 | ±0.05 | nA typ | V _S = V _D = 1 V, or V _S = V _D = 4.5 V, see Figure 14 |
| DIGITAL INPUTS | | | | |
| Input High Voltage, V _{INH} | | 2.4 | 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 | |
| DYNAMIC CHARACTERISTICS ² | | | | |
| t _{ON} | 14 | | ns typ | R _L = 300 Ω, C _L = 35 pF |
| | | 20 | ns max | V _S = 3 V, see Figure 15 |
| t _{OFF} | 3 | | ns typ | R _L = 300 Ω, C _L = 35 pF |
| | | 6 | ns max | V _S = 3 V, see Figure 15 |
| Break-Before-Make Time Delay, t _D | 8 | | ns typ | R _L = 300 Ω, C _L = 35 pF |
| | | 1 | ns min | V _{S1} = V _{S2} = 3 V, see Figure 16 |
| Off Isolation | –67 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 10 MHz |
| | –87 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz, see Figure 17 |
| Channel-to-Channel Crosstalk | –62 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 10 MHz |
| | –82 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz, see Figure 18 |
| Bandwidth –3 dB | 200 | | MHz typ | R _L = 50 Ω, C _L = 5 pF, see Figure 19 |
| C _S (Off) | 7 | | pF typ | f = 1 MHz |
| C _D , C _S (On) | 27 | | pF typ | f = 1 MHz |
| POWER REQUIREMENTS | | | | |
| I _{DD} | 0.001 | | μA typ | V _{DD} = 5.5 V Digital Inputs = 0 V or 5 V |
| | | 1.0 | μA max | |

¹ Temperature range is B Version, –40°C to +85°C.

² Guaranteed by design, not subject to production test.

ADG779

$V_{DD} = 3\text{ V} \pm 10\%$, $GND = 0\text{ V}$ ¹

Table 2.

| Parameter | B Version | | Unit | Test Conditions/Comments |
|--|-----------|------------------------|---------|--|
| | 25°C | –40°C to +85°C | | |
| ANALOG SWITCH | | | | |
| Analog Signal Range | | 0 V to V _{DD} | V | V _S = 0 V to V _{DD} , I _S = –10 mA, see Figure 12 |
| On Resistance (R _{ON}) | 6 | 7 | Ω typ | |
| | | 10 | Ω max | |
| On-Resistance Match Between Channels (ΔR _{ON}) | 0.1 | | Ω typ | V _S = 0 V to V _{DD} , I _S = –10 mA |
| | | 0.8 | Ω max | |
| On-Resistance Flatness (R _{FLAT (ON)}) | 2.5 | | Ω typ | V _S = 0 V to V _{DD} , I _S = –10 mA |
| LEAKAGE CURRENTS ² | | | | |
| Source Off Leakage I _S (Off) | ±0.01 | ±0.05 | nA typ | V _{DD} = 3.3 V V _S = 3 V/1 V, V _D = 1 V/3 V, see Figure 13 |
| Channel On Leakage I _D , I _S (On) | ±0.01 | ±0.05 | nA typ | V _S = V _D = 1 V, or V _S = V _D = 3 V, see Figure 14 |
| DIGITAL INPUTS | | | | |
| Input High Voltage, V _{INH} | | 2.0 | V min | V _{IN} = V _{INL} or V _{INH} |
| Input Low Voltage, V _{INL} | | 0.8 | V max | |
| Input Current | | | | |
| I _{INL} or I _{INH} | 0.005 | | μA typ | |
| | | ±0.1 | μA max | |
| DYNAMIC CHARACTERISTICS ² | | | | |
| t _{ON} | 16 | | ns typ | R _L = 300 Ω, C _L = 35 pF |
| | | 24 | ns max | V _S = 2 V, see Figure 15 |
| t _{OFF} | 4 | | ns typ | R _L = 300 Ω, C _L = 35 pF |
| | | 7 | ns max | V _S = 2 V, see Figure 15 |
| Break-Before-Make Time Delay, t _D | 8 | | ns typ | R _L = 300 Ω, C _L = 35 pF |
| | | 1 | ns min | V _{S1} = V _{S2} = 2 V, see Figure 16 |
| Off Isolation | –67 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 10 MHz |
| | –87 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz, see Figure 17 |
| Channel-to-Channel Crosstalk | –62 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 10 MHz |
| | –82 | | dB typ | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz, see Figure 18 |
| Bandwidth –3 dB | 200 | | MHz typ | R _L = 50 Ω, C _L = 5 pF, see Figure 19 |
| C _S (Off) | 7 | | pF typ | f = 1 MHz |
| C _D , C _S (On) | 27 | | pF typ | f = 1 MHz |
| POWER REQUIREMENTS | | | | |
| I _{DD} | 0.001 | | μA typ | V _{DD} = 3.3 V Digital Inputs = 0 V or 3 V |
| | | 1.0 | μA max | |

¹ Temperature range is B Version, –40°C to +85°C.

² Guaranteed by design, not subject to production test.

ABSOLUTE MAXIMUM RATINGS

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

Table 3.

| Parameter | Rating |
|-------------------------------------|---|
| V_{DD} to GND | –0.3 V to +7 V |
| Analog, Digital Inputs ¹ | –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, S or D | 30 mA |
| Operating Temperature Range | |
| Industrial (B Version) | –40°C to +85°C |
| Storage Temperature Range | –65°C to +150°C |
| Junction Temperature | 150°C |
| SC70 Package, Power Dissipation | 315 mW |
| θ_{JA} Thermal Impedance | 332°C/W |
| θ_{JC} Thermal Impedance | 120°C/W |
| Lead Temperature, Soldering | |
| Vapor Phase (60 sec) | 215°C |
| Infrared (15 sec) | 220°C |
| Reflow Soldering (Pb-free) | |
| Peak Temperature | 260 (+0/–5)°C |
| Time at Peak Temperature | 10 sec to 40 sec |

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

| ADG779 IN | Switch S1 | Switch S2 |
|-----------|-----------|-----------|
| 0 | On | Off |
| 1 | Off | On |

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V 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.



ADG779

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

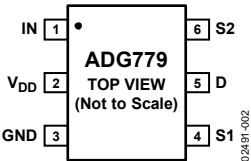


Figure 2. Pin Configuration

Table 5. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|---------|-----------------|--|
| 1 | IN | Logic Control Input. |
| 2 | V _{DD} | Most Positive Power Supply Potential. |
| 3 | GND | Ground (0 V) Reference. |
| 4 | S1 | Source Terminal. Can be an input or an output. |
| 5 | D | Drain Terminal. Can be an input or an output. |
| 6 | S2 | Source Terminal. Can be an input or an output. |

TERMINOLOGY

V_{DD}

Most positive power supply potential.

I_{DD}

Positive supply current.

GND

Ground (0 V) reference.

S

Source terminal. Can be an input or an output.

D

Drain terminal. Can be an input or an output.

IN

Logic control input.

V_D (V_S)

Analog voltage on drain (D) and source (S) terminals.

R_{ON}

Ohmic resistance between the D and S.

R_{FLAT} (ON)

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

ΔR_{ON}

On-resistance mismatch between any two channels.

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_{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. Measured with reference to ground.

C_D (Off)

Off switch drain capacitance. Measured with reference to ground.

C_D , C_S (On)

On switch capacitance. Measured with reference to ground.

C_{IN}

Digital input capacitance.

t_{ON}

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

t_{OFF}

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

t_{BBM}

On or off time measured between the 80% points of both switches when switching from one to another.

Charge Injection

A measure of the glitch impulse transferred from the digital input to the analog output during on/off 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 because of parasitic capacitance.

-3 dB 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.

THD + N

The ratio of harmonic amplitudes plus noise of a signal to the fundamental.

TYPICAL PERFORMANCE CHARACTERISTICS

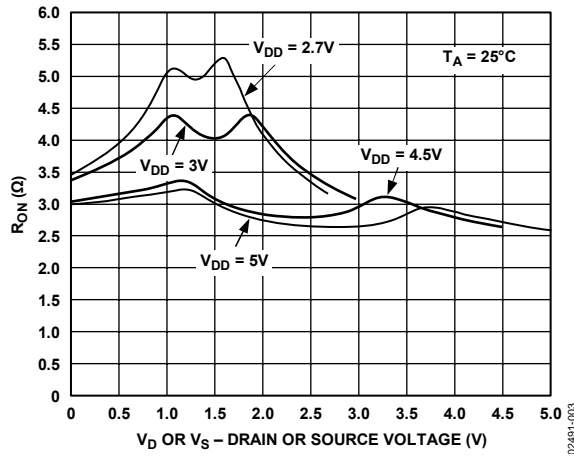


Figure 3. On Resistance as a Function of V_D (V_S) Single Supplies

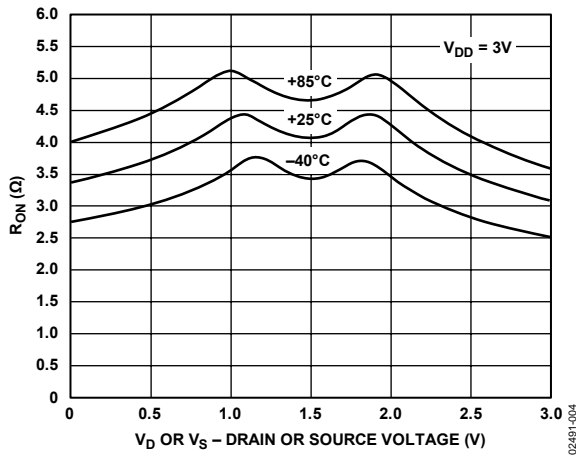


Figure 4. On Resistance as a Function of V_D (V_S) for Different Temperatures $V_{DD} = 3\text{V}$

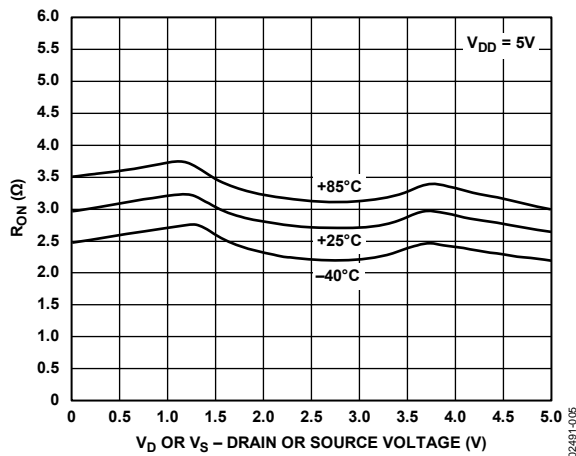


Figure 5. On Resistance as a Function of V_D (V_S) for Different Temperatures $V_{DD} = 5\text{V}$

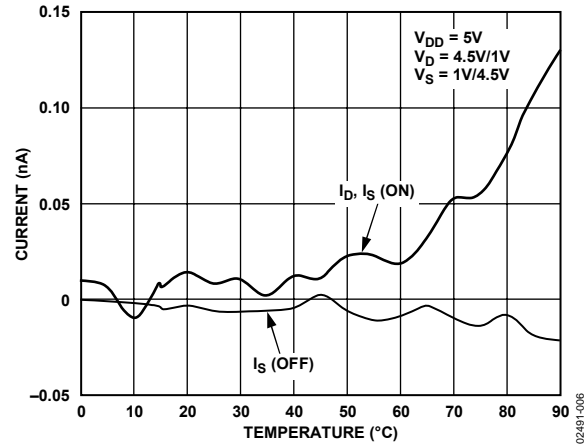


Figure 6. Leakage Currents as a Function of Temperature

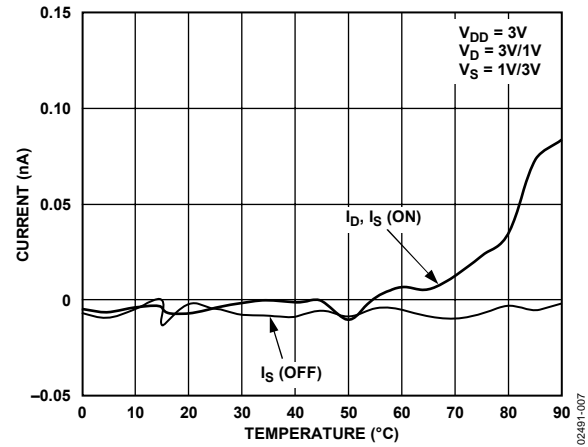


Figure 7. Leakage Currents as a Function of Temperature

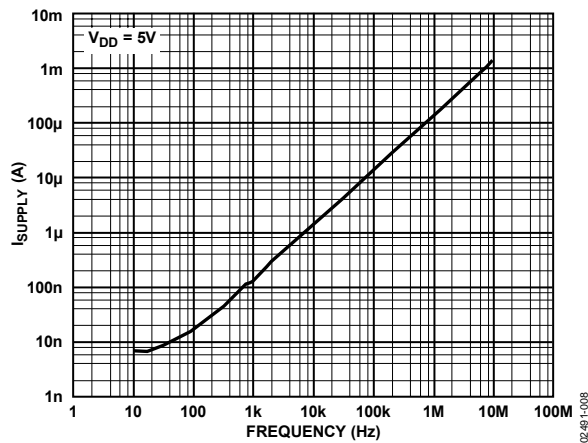


Figure 8. Supply Current vs. Input Switching Frequency

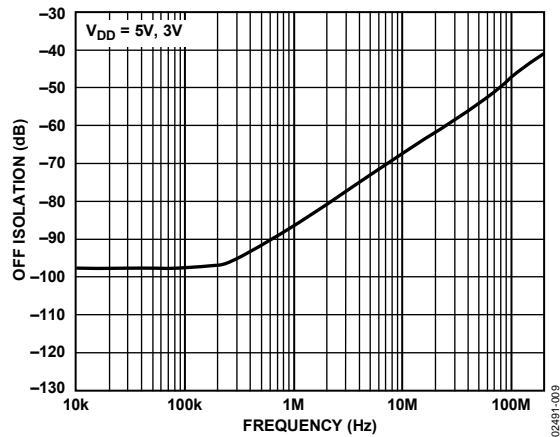


Figure 9. Off Isolation vs. Frequency

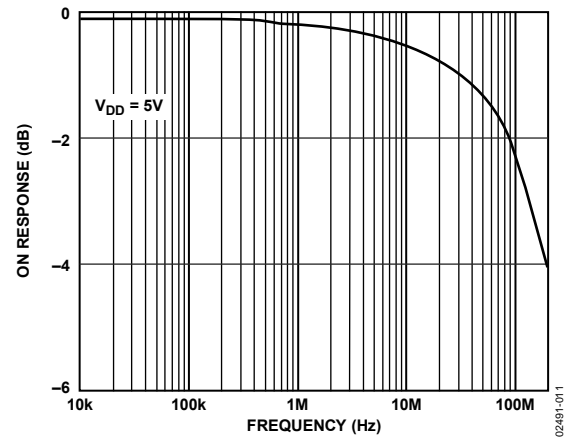


Figure 11. On Response vs. Frequency

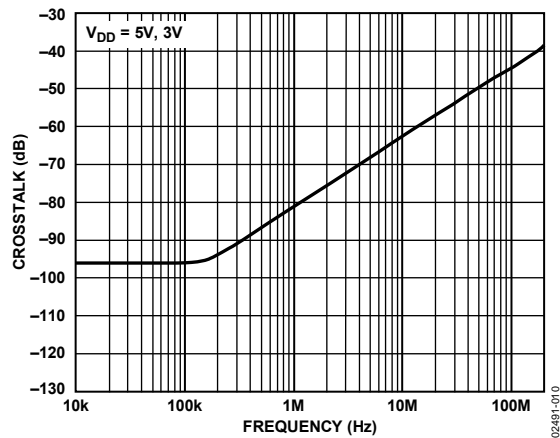


Figure 10. Crosstalk vs. Frequency

TEST CIRCUITS

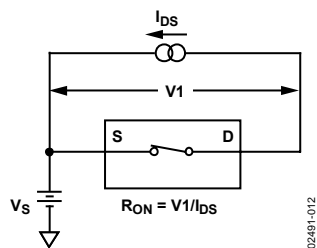


Figure 12. On Resistance

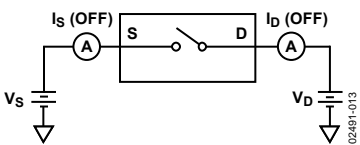


Figure 13. Off Leakage

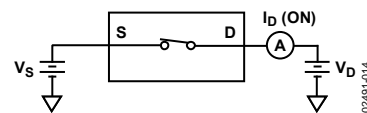


Figure 14. On Leakage

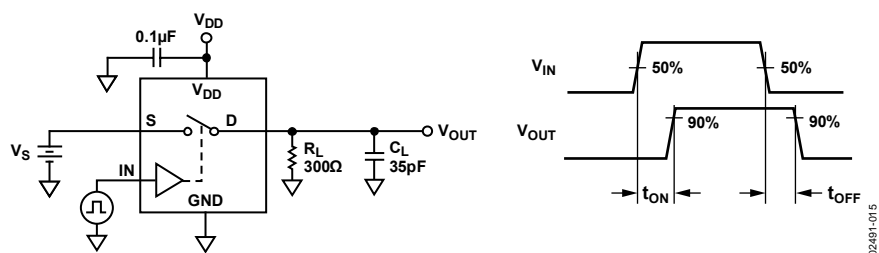


Figure 15. Switching Times

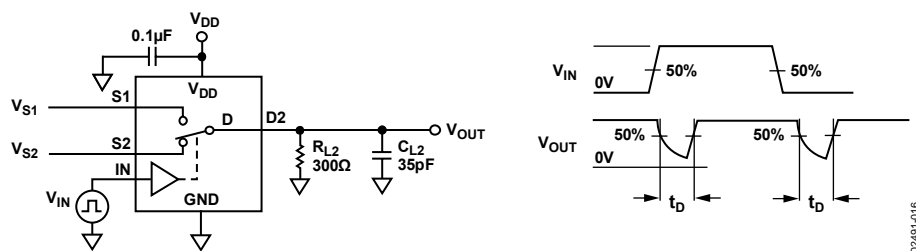


Figure 16. Break-Before-Make Time Delay, t_D

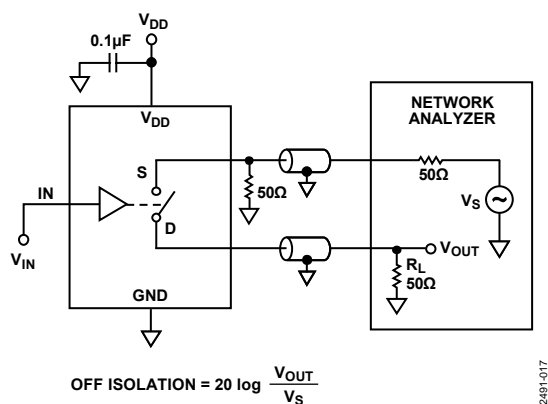


Figure 17. Off Isolation

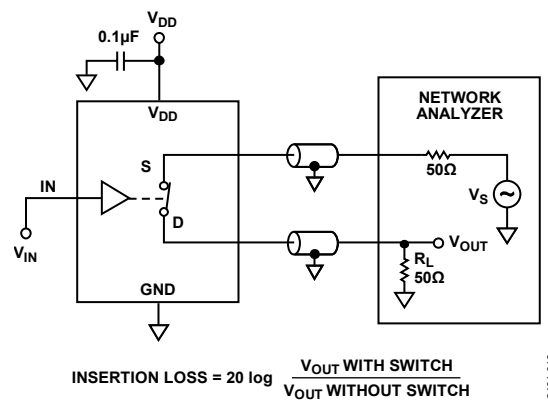


Figure 19. Bandwidth

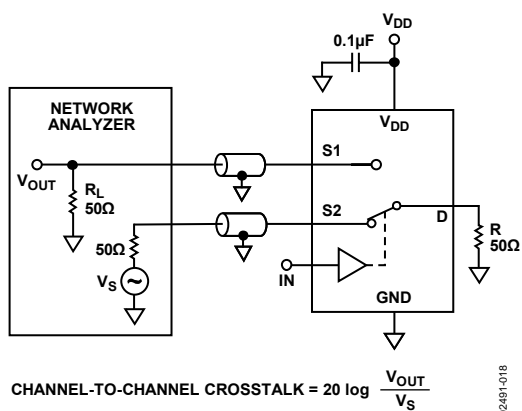


Figure 18. Channel-to-Channel Crosstalk

OUTLINE DIMENSIONS

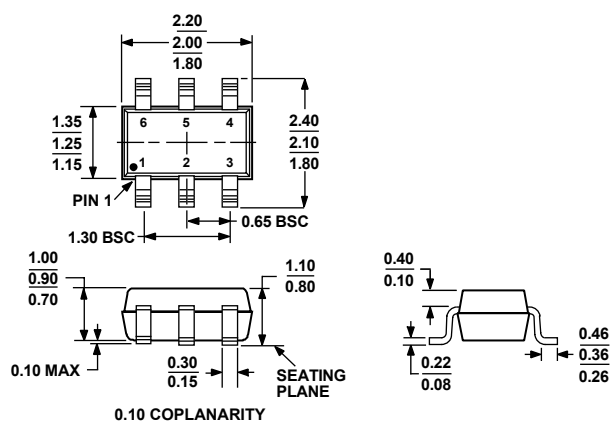


Figure 20. 6-Lead Thin Shrink Small Outline Transistor Package [SC70]
(KS-6)
Dimensions shown in millimeters

ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option | Branding ¹ |
|-------------------------------|-------------------|--|----------------|-----------------------|
| ADG779BKS-R2 | -40°C to +85°C | 6-Lead Thin Shrink Small Outline Transistor Package (SC70) | KS-6 | SKB |
| ADG779BKS-REEL | -40°C to +85°C | 6-Lead Thin Shrink Small Outline Transistor Package (SC70) | KS-6 | SKB |
| ADG779BKS-REEL7 | -40°C to +85°C | 6-Lead Thin Shrink Small Outline Transistor Package (SC70) | KS-6 | SKB |
| ADG779BKSZ-R2 ² | -40°C to +85°C | 6-Lead Thin Shrink Small Outline Transistor Package (SC70) | KS-6 | S0M |
| ADG779BKSZ-REEL ² | -40°C to +85°C | 6-Lead Thin Shrink Small Outline Transistor Package (SC70) | KS-6 | S0M |
| ADG779BKSZ-REEL7 ² | -40°C to +85°C | 6-Lead Thin Shrink Small Outline Transistor Package (SC70) | KS-6 | S0M |

¹ Brand on these packages is limited to three characters due to space constraints.

² Z = Pb-free part.