

**FEATURES**

**0.58  $\Omega$  typical on resistance**  
**0.82  $\Omega$  maximum on resistance at 85°C**  
**2.3 V to 5.5 V single supply**  
**High current carrying capability: 250 mA continuous**  
**Rail-to-rail switching operation**  
**Fast-switching times: <20 ns**  
**Typical power consumption: <0.1  $\mu$ W**  
**2.1 mm  $\times$  2.1 mm mini LFCSP**

**APPLICATIONS**

**Cellular phones**  
**PDA's**  
**MP3 players**  
**Power routing**  
**Battery-powered systems**  
**PCMCIA cards**  
**Modems**  
**Audio and video signal routing**  
**Communication systems**

**GENERAL DESCRIPTION**

The ADG858 is a low voltage CMOS device containing four single-pole, double-throw (SPDT) switches. This device offers ultralow on resistance of less than 0.82  $\Omega$  over the full temperature range. The ADG858 is fully specified for 4.2 V to 5.5 V and 2.7 V to 3.6 V supply operation.

Each switch conducts equally well in both directions when on and has an input signal range that extends to the supplies. The ADG858 exhibits break-before-make switching action.

The ADG858 is available in a 2.1 mm  $\times$  2.1 mm, 16-lead mini LFCSP. This tiny package makes the part ideal for space-constrained applications, such as handsets, PDA's, and MP3's.

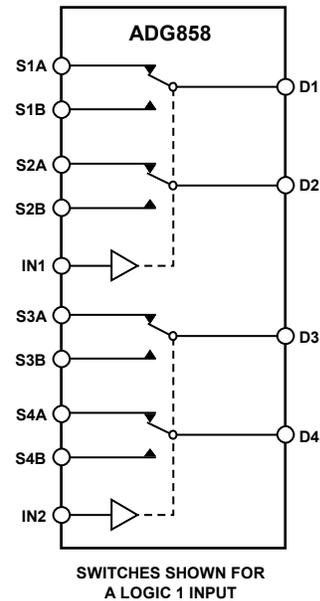
**FUNCTIONAL BLOCK DIAGRAM**


Figure 1.

**PRODUCT HIGHLIGHTS**

1. <0.82  $\Omega$  over the full temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .
2. Single 2.3 V to 5.5 V operation.
3. Compatible with 1.8 V CMOS logic.
4. High current handling capability (250 mA continuous current per channel).
5. Low THD + N: 0.06% typical.
6. 2.1 mm  $\times$  2.1 mm, 16-lead mini LFCSP.

**Rev. 0**

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

**TABLE OF CONTENTS**

|                                |   |  |    |
|--------------------------------|---|--|----|
| Features .....                 | 1 | ESD Caution.....                                 | 5  |
| Applications.....              | 1 | Pin Configuration and Function Descriptions..... | 6  |
| Functional Block Diagram ..... | 1 | Typical Performance Characteristics .....        | 7  |
| General Description .....      | 1 | Test Circuits.....                               | 10 |
| Product Highlights .....       | 1 | Terminology .....                                | 12 |
| Revision History .....         | 2 | Outline Dimensions .....                         | 13 |
| Specifications.....            | 3 | Ordering Guide .....                             | 13 |
| Absolute Maximum Ratings.....  | 5 |  |    |

**REVISION HISTORY**

**8/08—Revision 0: Initial Version**

## SPECIFICATIONS

$V_{DD} = 4.2\text{ V to }5.5\text{ V}$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 1.**

| Parameter   | +25°C    | -40°C to +85°C | Unit              | Test Conditions/Comments  |
|---|----------|----------------|-------------------|---|
| <b>ANALOG SWITCH</b>                                  |          |                |                   |   |
| Analog Signal Range                                   |          | 0 to $V_{DD}$  | V                 |   |
| On Resistance, $R_{ON}$                               | 0.58     |                | $\Omega$ typ      | $V_{DD} = 4.2\text{ V}$ , $V_S = 0\text{ V to }V_{DD}$ , $I_S = 100\text{ mA}$ , see Figure 16                                  |
|   | 0.72     | 0.82           | $\Omega$ max      |   |
| On-Resistance Match Between Channels, $\Delta R_{ON}$ | 0.04     |                | $\Omega$ typ      | $V_{DD} = 4.2\text{ V}$ , $V_S = 2\text{ V}$ , $I_S = 100\text{ mA}$  |
|   |          | 0.14           | $\Omega$ max      |   |
| On-Resistance Flatness, $R_{FLAT(ON)}$                | 0.12     |                | $\Omega$ typ      | $V_{DD} = 4.2\text{ V}$ , $V_S = 0\text{ V to }V_{DD}$  |
|   |          | 0.26           | $\Omega$ max      | $I_S = 100\text{ mA}$   |
| <b>LEAKAGE CURRENTS</b>                               |          |                |                   |   |
| Source Off Leakage, $I_S$ (Off)                       | $\pm 10$ |                | pA typ            | $V_{DD} = 5.5\text{ V}$<br>$V_S = 0.6\text{ V}/4.2\text{ V}$ , $V_D = 4.2\text{ V}/0.6\text{ V}$ , see Figure 17                |
| Channel On Leakage, $I_D$ , $I_S$ (On)                | $\pm 10$ |                | pA typ            | $V_S = V_D = 0.6\text{ V}$ or $4.2\text{ V}$ , see Figure 18  |
| <b>DIGITAL INPUTS</b>                                 |          |                |                   |   |
| Input High Voltage, $V_{INH}$                         |          | 2.0            | V min             |   |
| Input Low Voltage, $V_{INL}$                          |          | 0.8            | V max             |   |
| Input Current   |          |                |                   |   |
| $I_{INL}$ or $I_{INH}$                                | 0.004    |                | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$  |
|   |          | 0.05           | $\mu\text{A}$ max |   |
| Digital Input Capacitance, $C_{IN}$                   | 2        |                | pF typ            |   |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>            |          |                |                   |   |
| $t_{ON}$  | 20       |                | ns typ            | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$   |
|   | 27       | 36             | ns max            | $V_S = 3\text{ V}/0\text{ V}$ , see Figure 19   |
| $t_{OFF}$   | 8        |                | ns typ            | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$   |
|   | 12       | 13             | ns max            | $V_S = 3\text{ V}$ , see Figure 19  |
| Break-Before-Make Time Delay, $t_{BBM}$               | 14       |                | ns typ            | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$   |
|   |          | 9              | ns min            | $V_{S1} = V_{S2} = 1.5\text{ V}$ , see Figure 20  |
| Charge Injection                                      | 45       |                | pC typ            | $V_S = 1.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 21  |
| Off Isolation   | -67      |                | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ , see Figure 22   |
| Channel-to-Channel Crosstalk                          | -85      |                | dB typ            | S1A to S2A/S1B to S2B/S3A to S4A/S3B to S4B,<br>$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ , see Figure 25 |
|   | -67      |                | dB typ            | S1A to S1B/S2A to S2B/S3A to S3B/S4A to S4B,<br>$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ , see Figure 24 |
| Total Harmonic Distortion, THD + N                    | 0.06     |                | %                 | $R_L = 32\ \Omega$ , $f = 20\text{ Hz to }20\text{ kHz}$ , $V_S = 2\text{ V p-p}$   |
| Insertion Loss  | -0.05    |                | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 23  |
| -3 dB Bandwidth                                       | 70       |                | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 23  |
| $C_S$ (Off)   | 25       |                | pF typ            |   |
| $C_D$ , $C_S$ (On)                                    | 75       |                | pF typ            |   |
| <b>POWER REQUIREMENTS</b>                             |          |                |                   |   |
| $I_{DD}$  | 0.003    |                | $\mu\text{A}$ typ | $V_{DD} = 5.5\text{ V}$<br>Digital inputs = 0 V or 5.5 V  |
|   |          | 1              | $\mu\text{A}$ max |   |

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

# ADG858

$V_{DD} = 2.7\text{ V}$  to  $3.6\text{ V}$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 2.**

| Parameter   | +25°C    | -40°C to +85°C | Unit              | Test Conditions/Comments  |
|---|----------|----------------|-------------------|---|
| <b>ANALOG SWITCH</b>                                  |          |                |                   |   |
| Analog Signal Range                                   |          | 0 to $V_{DD}$  | V                 |   |
| On Resistance, $R_{ON}$                               | 1        |                | $\Omega$ typ      | $V_{DD} = 2.7\text{ V}$ , $V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = 100\text{ mA}$ , see Figure 16                                |
|   | 1.35     | 1.5            | $\Omega$ max      |   |
| On-Resistance Match Between Channels, $\Delta R_{ON}$ | 0.05     |                | $\Omega$ typ      | $V_{DD} = 2.7\text{ V}$ , $V_S = 0.7\text{ V}$ , $I_S = 100\text{ mA}$  |
|   |          | 0.15           | $\Omega$ max      |   |
| On-Resistance Flatness, $R_{FLAT(ON)}$                | 0.35     |                | $\Omega$ typ      | $V_{DD} = 2.7\text{ V}$ , $V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = 100\text{ mA}$  |
|   |          | 0.79           | $\Omega$ max      |   |
| <b>LEAKAGE CURRENTS</b>                               |          |                |                   |   |
| Source Off Leakage $I_S$ (Off)                        | $\pm 10$ |                | $\mu\text{A}$ typ | $V_{DD} = 3.6\text{ V}$<br>$V_S = 0.6\text{ V}/3.3\text{ V}$ , $V_D = 3.3\text{ V}/0.6\text{ V}$ , see Figure 17                |
| Channel On Leakage $I_D$ , $I_S$ (On)                 | $\pm 10$ |                | $\mu\text{A}$ typ | $V_S = V_D = 0.6\text{ V}$ or $3.3\text{ V}$ , see Figure 18  |
| <b>DIGITAL INPUTS</b>                                 |          |                |                   |   |
| Input High Voltage, $V_{INH}$                         |          | 1.35           | V min             |   |
| Input Low Voltage, $V_{INL}$                          |          | 0.8            | V max             |   |
| Input Current   |          |                |                   |   |
| $I_{INL}$ or $I_{INH}$                                | 0.004    |                | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$  |
|   |          | 0.05           | $\mu\text{A}$ max |   |
| Digital Input Capacitance, $C_{IN}$                   | 2        |                | pF typ            |   |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>            |          |                |                   |   |
| $t_{ON}$  | 30       |                | ns typ            | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$   |
|   | 50       | 59             | ns max            | $V_S = 1.5\text{ V}/0\text{ V}$ , see Figure 19   |
| $t_{OFF}$   | 9        |                | ns typ            | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$   |
|   | 14       | 15             | ns max            | $V_S = 1.5\text{ V}$ , see Figure 19  |
| Break-Before-Make Time Delay, $t_{BBM}$               | 25       |                | ns typ            | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$   |
|   |          | 11             | ns min            | $V_{S1} = V_{S2} = 1.5\text{ V}$ , see Figure 20  |
| Charge Injection                                      | 35       |                | pC typ            | $V_S = 1.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 21  |
| Off Isolation   | -67      |                | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ , see Figure 22   |
| Channel-to-Channel Crosstalk                          | -85      |                | dB typ            | S1A to S2A/S1B to S2B/S3A to S4A/S3B to S4B,<br>$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ , see Figure 25 |
|   | -67      |                | dB typ            | S1A to S1B/S2A to S2B/S3A to S3B/S4A to S4B,<br>$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ , see Figure 24 |
| Total Harmonic Distortion, THD + N                    | 0.1      |                | %                 | $R_L = 32\ \Omega$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ , $V_S = 1.5\text{ V}$ p-p   |
| Insertion Loss  | -0.06    |                | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 23  |
| -3 dB Bandwidth                                       | 70       |                | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 23  |
| $C_S$ (Off)   | 25       |                | pF typ            |   |
| $C_D$ , $C_S$ (On)                                    | 75       |                | pF typ            |   |
| <b>POWER REQUIREMENTS</b>                             |          |                |                   |   |
| $I_{DD}$  | 0.003    |                | $\mu\text{A}$ typ | $V_{DD} = 3.6\text{ V}$<br>Digital inputs = $0\text{ V}$ or $3.6\text{ V}$  |
|   |          | 1              | $\mu\text{A}$ max |   |

<sup>1</sup> 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 +6 V                                      |
| Analog Inputs <sup>1</sup>                     | -0.3 V to $V_{DD} + 0.3$ V                          |
| Digital Inputs <sup>1</sup>                    | -0.3 V to $V_{DD}$ or 10 mA, whichever occurs first |
| Peak Current, S or D                           | 500 mA (pulsed at 1 ms, 10% duty cycle max)         |
| Continuous Current, S or D                     | 250 mA  |
| Operating Temperature Range                    | -40°C to +85°C                                      |
| Storage Temperature Range                      | -65°C to +150°C                                     |
| Junction Temperature                           | 150°C   |
| 16-Lead Mini LFCSP                             |   |
| $\theta_{JA}$ Thermal Impedance, 3-Layer Board | 84.9°C/W  |
| Reflow Soldering, Pb-Free                      |   |
| Peak Temperature                               | 260(+0/-5)°C  |
| Time at Peak Temperature                       | 10 sec to 40 sec                                    |

<sup>1</sup> 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.

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

### ESD CAUTION



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

# ADG858

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

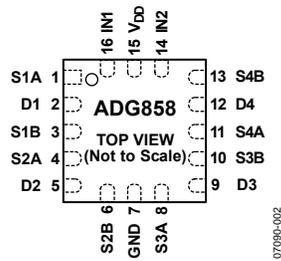


Figure 2. Pin Configuration

Table 4. Pin Function Descriptions

| Pin No.                   | Mnemonic                               | Description                                 |
|---------------------------|--|---|
| 1, 3, 4, 6, 8, 10, 11, 13 | S1A, S1B, S2A, S2B, S3A, S3B, S4A, S4B | Source Terminal. Can be an input or output. |
| 2, 5, 9, 12               | D1, D2, D3, D4                         | Drain Terminal. Can be an input or output.  |
| 7                         | GND                                    | Ground (0 V) Reference.                     |
| 14, 16                    | IN1, IN2                               | Logic Control Input.                        |
| 15                        | V <sub>DD</sub>                        | Most Positive Power Supply Potential.       |

Table 5. ADG858 Truth Table

| Logic (IN1/IN2) | Switch A (S1A/S2A/S3A/S4A) | Switch B (S1B/S2B/S3B/S4B) |
|-----------------|----------------------------|----------------------------|
| 0               | Off                        | On                         |
| 1               | On                         | Off                        |

# TYPICAL PERFORMANCE CHARACTERISTICS

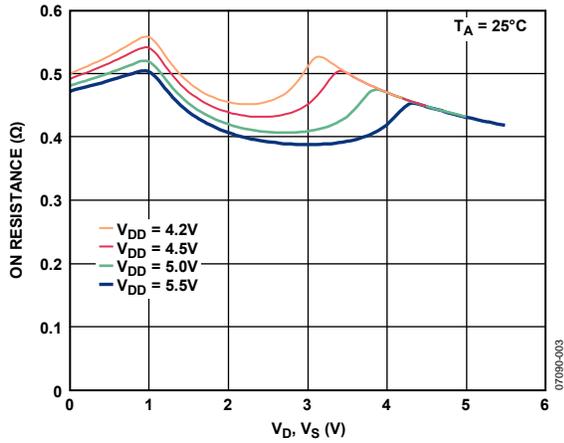


Figure 3. On Resistance vs.  $V_D$  ( $V_S$ ),  $V_{DD} = 4.2$  V to 5.5 V

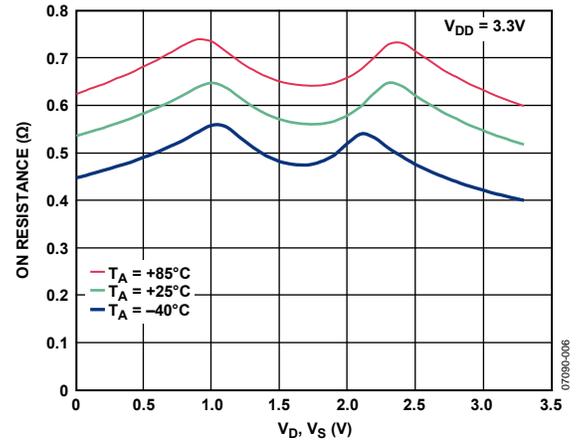


Figure 6. On Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures,  $V_{DD} = 3.3$  V

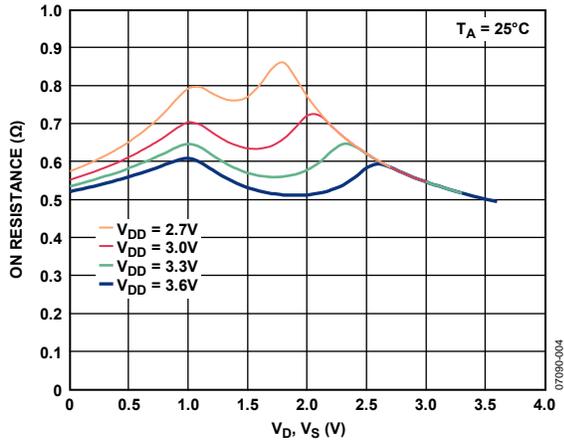


Figure 4. On Resistance vs.  $V_D$  ( $V_S$ ),  $V_{DD} = 2.7$  V to 3.6 V

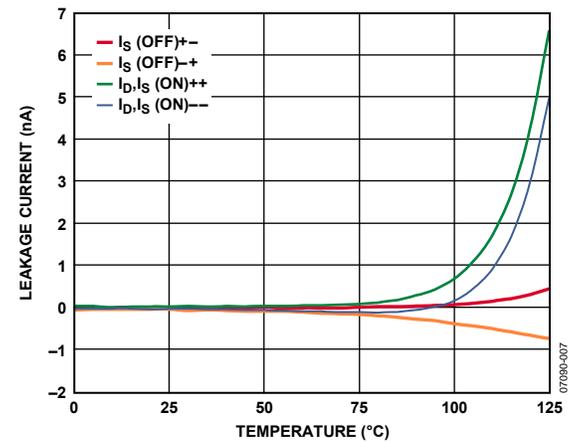


Figure 7. Leakage Current vs. Temperature,  $V_{DD} = 5$  V

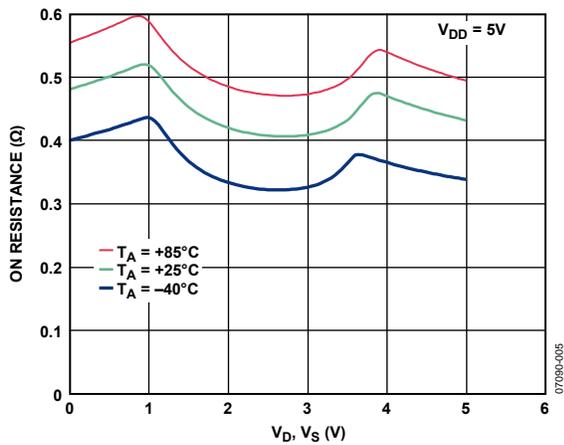


Figure 5. On Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures,  $V_{DD} = 5$  V

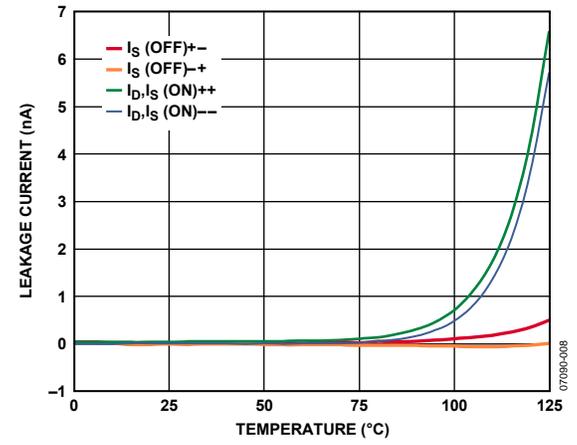


Figure 8. Leakage Current vs. Temperature,  $V_{DD} = 3.3$  V

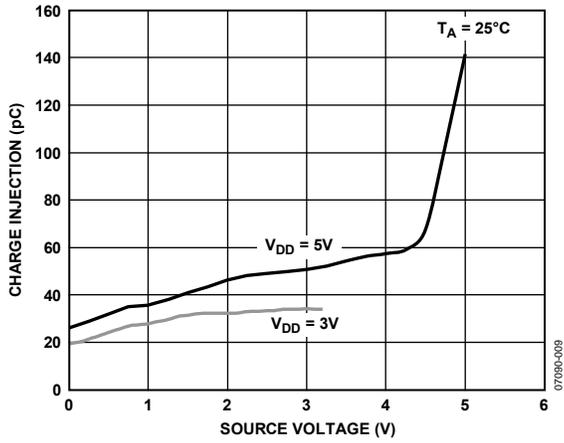


Figure 9. Charge Injection vs. Source Voltage

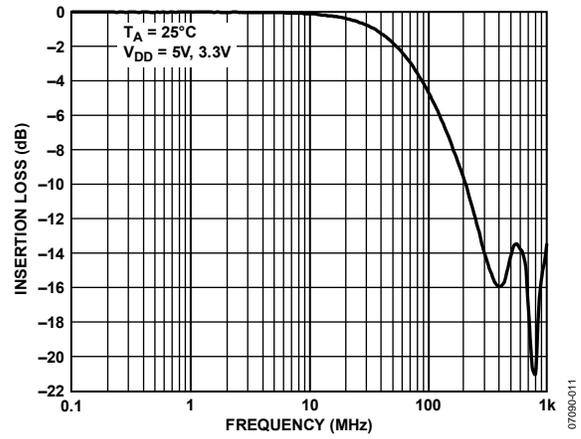


Figure 11. Bandwidth

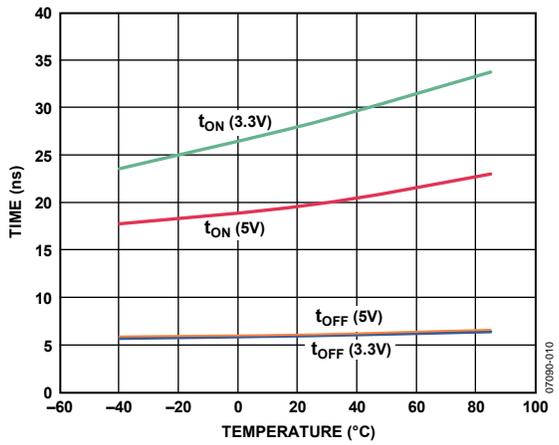


Figure 10. t<sub>ON</sub>/t<sub>OFF</sub> Times vs. Temperature

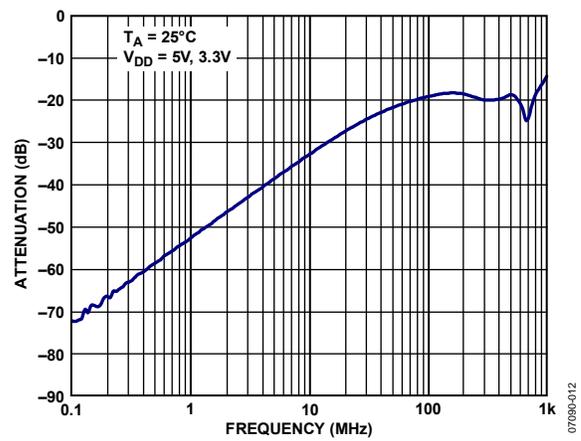


Figure 12. Off Isolation vs. Frequency

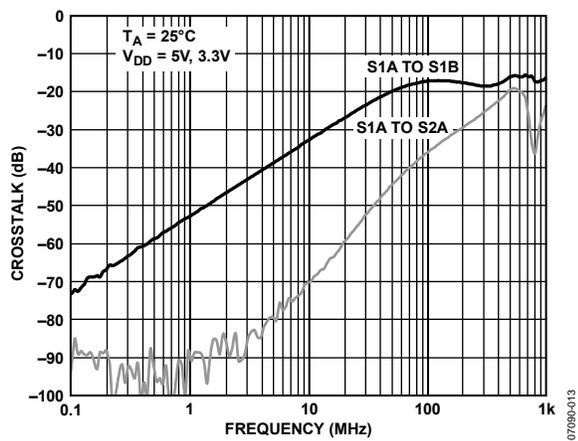


Figure 13. Crosstalk vs. Frequency

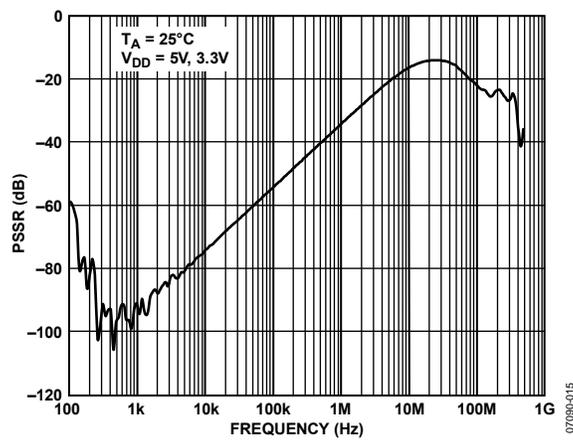


Figure 15. PSSR vs. Frequency

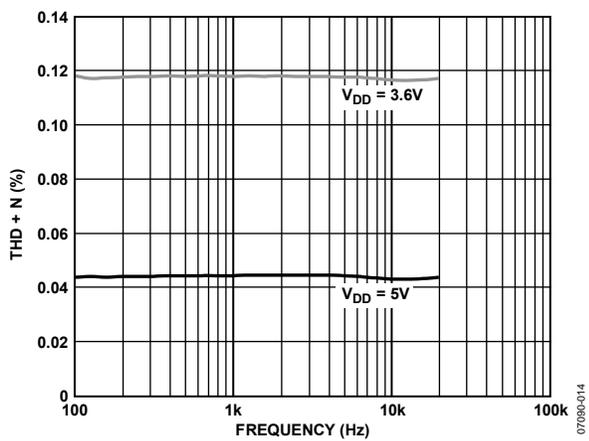


Figure 14. Total Harmonic Distortion + Noise (THD + N) vs. Frequency

TEST CIRCUITS

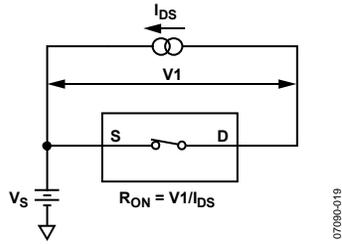


Figure 16. On Resistance

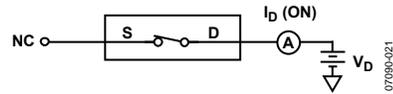


Figure 18. On Leakage

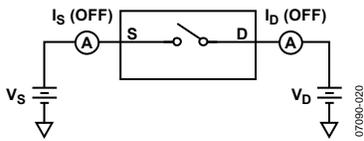


Figure 17. Off Leakage

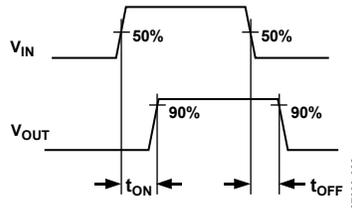
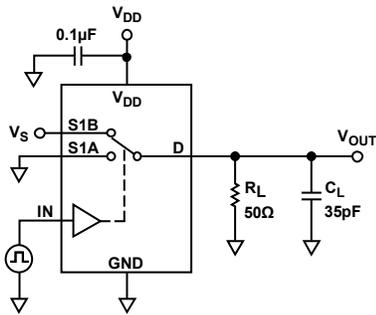


Figure 19. Switching Times,  $t_{ON}$ ,  $t_{OFF}$

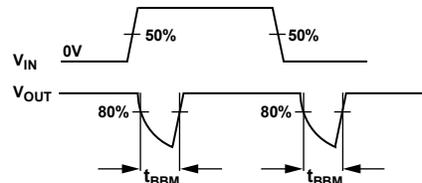
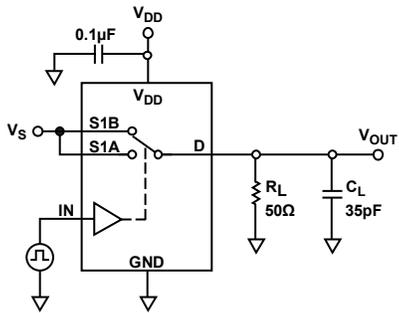


Figure 20. Break-Before-Make Time Delay,  $t_{BBM}$

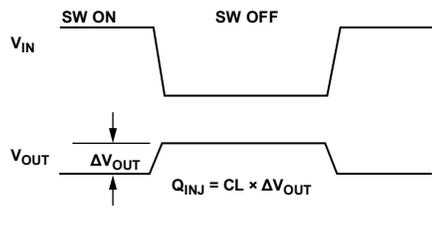
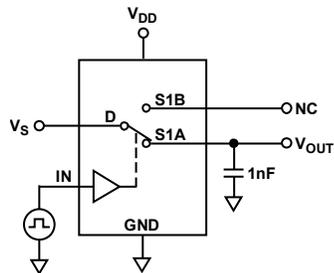


Figure 21. Charge Injection

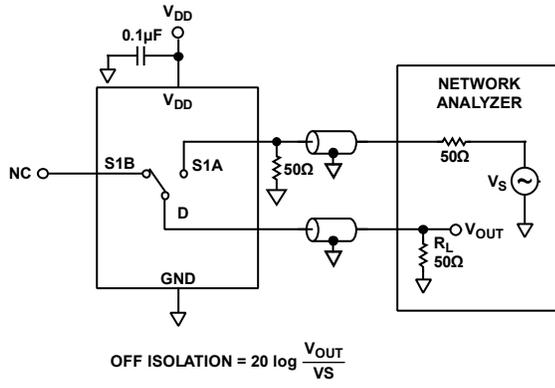


Figure 22. Off Isolation

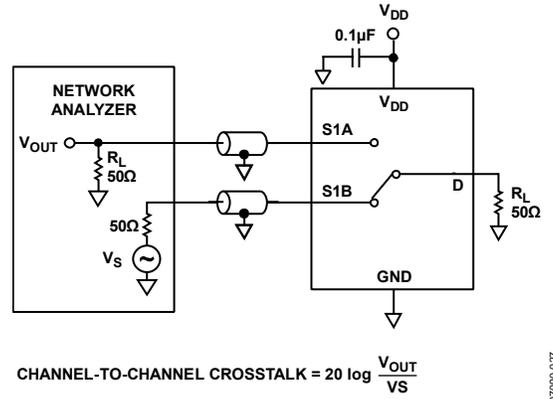


Figure 24. Channel-to-Channel Crosstalk (S1A to S1B)

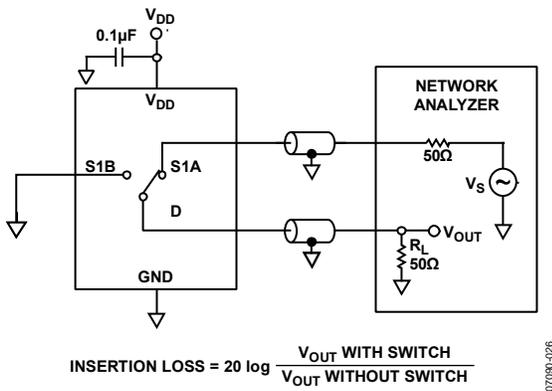


Figure 23. Bandwidth

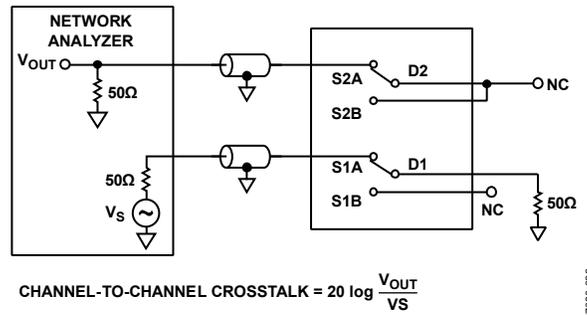


Figure 25. Channel-to-Channel Crosstalk (S1A to S2A)

07090-025

07090-027

07090-026

07090-028

**TERMINOLOGY****I<sub>DD</sub>**

Positive supply current.

**V<sub>D</sub> (V<sub>S</sub>)**

Analog voltage on Terminal D and Terminal S.

**R<sub>ON</sub>**

Ohmic resistance between Terminal D and Terminal S.

**R<sub>FLAT (ON)</sub>**

The difference between the maximum and minimum values of on resistance as measured on the switch.

**ΔR<sub>ON</sub>**

On resistance match between any two channels.

**I<sub>S</sub> (Off)**

Source leakage current with the switch off.

**I<sub>D</sub> (Off)**

Drain leakage current with the switch off.

**I<sub>D</sub>, I<sub>S</sub> (On)**

Channel leakage current with the switch on.

**V<sub>INL</sub>**

Maximum input voltage for Logic 0.

**V<sub>INH</sub>**

Minimum input voltage for Logic 1.

**I<sub>INL</sub> (I<sub>INH</sub>)**

Input current of the digital input.

**C<sub>S</sub> (Off)**

Off switch source capacitance. Measured with reference to ground.

**C<sub>D</sub> (Off)**

Off switch drain capacitance. Measured with reference to ground.

**C<sub>D</sub>, C<sub>S</sub> (On)**

On switch capacitance. Measured with reference to ground.

**C<sub>IN</sub>**

Digital input capacitance.

**t<sub>ON</sub>**

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

**t<sub>OFF</sub>**

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

**t<sub>BEM</sub>**

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

**Charge Injection**

Measure of the glitch impulse transferred from the digital input to the analog output during on/off switching.

**Off Isolation**

Measure of unwanted signal coupling through an off switch.

**Crosstalk**

Measure of unwanted signal that is coupled from one channel to another because of parasitic capacitance.

**-3 dB Bandwidth**

Frequency at which the output is attenuated by 3 dB.

**On Response**

Frequency response of the on switch.

**Insertion Loss**

The loss due to the on resistance of the switch.

**THD + N**

Ratio of the harmonics amplitude plus noise of a signal to the fundamental.

# OUTLINE DIMENSIONS

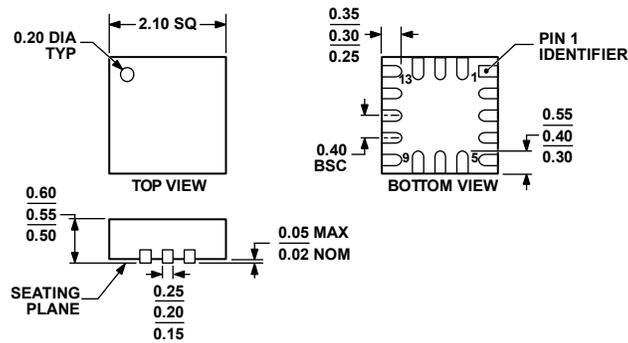


Figure 26. 16-Lead Lead Frame Chip Scale Package [LFCSP\_UQ]  
 2.10 mm × 2.10 mm Body, Ultra Thin Quad  
 (CP-16-15)  
 Dimensions shown in millimeters

022807-A

## ORDERING GUIDE

| Model                         | Temperature Range | Package Description                              | Package Option | Branding |
|-------------------------------|-------------------|--|----------------|----------|
| ADG858BCPZ-REEL <sup>1</sup>  | -40°C to +85°C    | 16-Lead Lead Frame Chip Scale Package [LFCSP_UQ] | CP-16-15       | 11       |
| ADG858BCPZ-REEL7 <sup>1</sup> | -40°C to +85°C    | 16-Lead Lead Frame Chip Scale Package [LFCSP_UQ] | CP-16-15       | 11       |

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

**ADG858**

**NOTES**

**NOTES**

**ADG858**

**NOTES**