



# 0.8Ω, Low-Voltage, Single-Supply SPDT Analog Switch in SC70

**MAX4714**

## General Description

The MAX4714 is a low on-resistance, low-voltage single-pole/double-throw (SPDT) analog switch that operates from a single +1.6V to +3.6V supply. The MAX4714 has break-before-make switching. This device also has fast switching speeds ( $t_{ON} = 18\text{ns}$ , max,  $t_{OFF} = 12\text{ns}$ , max).

When powered from a +3V supply, the MAX4714 features 0.8Ω (max) on-resistance ( $R_{ON}$ ), with 0.18Ω (max)  $R_{ON}$  matching and flatness. The digital logic input is 1.8V CMOS compatible when using a single +3V supply.

The MAX4714 is pin compatible with the MAX4599 and is available in a 6-pin SC70 or  $\mu$ DFN package.

## Applications

Power Routing  
Battery-Operated Equipment  
Audio and Video Signal Routing  
Low-Voltage Data-Acquisition Systems  
Communications Circuits  
PCMCIA Cards  
Cellular Phones  
Modems  
Hard Drives

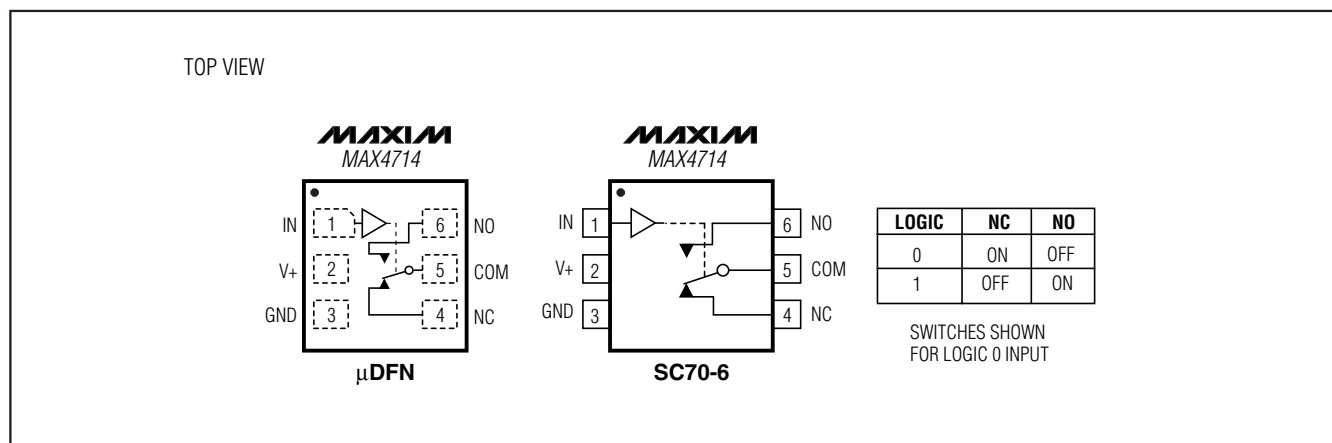
## Features

- ◆ **Low  $R_{ON}$**   
0.8Ω (max) (+3V Supply)  
2.5Ω (max) (+1.8V Supply)
- ◆ **0.18Ω max  $R_{ON}$  Flatness (+3V Supply)**
- ◆ **+1.6V to +3.6V Single-Supply Operation**
- ◆ **Available in 6-Pin  $\mu$ DFN (1.5mm x 1mm) and SC70 Packages**
- ◆ **Fast Switching:  $t_{ON} = 18\text{ns}$  (max),  $t_{OFF} = 12\text{ns}$  (max)**
- ◆ **1.8V CMOS Logic Compatible (+3V Supply)**
- ◆ **Pin Compatible with MAX4599**
- ◆ **Guaranteed Break-Before-Make**

## Ordering Information

| PART         | TEMP RANGE     | PIN-PACKAGE   | TOP MARK |
|--------------|----------------|---------------|----------|
| MAX4714EXT-T | -40°C to +85°C | 6 SC70-6      | AAY      |
| MAX4714ELT-T | -40°C to +85°C | 6 $\mu$ DFN-6 | AJ       |

## Pin Configurations/Functional Diagrams/Truth Table



# 0.8 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switch in SC70

## ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to GND

V+, IN ..... -0.3V to +4V  
 COM, NC, NO (Note 1) ..... -0.3V to (V+ + 0.3V)  
 Continuous Current NO, NC to COM .....  $\pm 150\text{mA}$   
 Peak Current NO, NC to COM  
 (pulsed at 1ms, 10% duty cycle max) .....  $\pm 300\text{mA}$   
 Continuous Power Dissipation

6-Pin SC70 (derate 3.1mW/°C above +70°C) ..... 247mW  
 6-Pin  $\mu\text{DFN-6}$  (derate 2.1mW/°C above +70°C) ..... 167mW  
 Operating Temperature Range  
 MAX4714EXT ..... -40°C to +85°C  
 Junction Temperature ..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature (soldering, 10s) ..... +300°C

**Note 1:** Signals on NC, NO, and COM exceeding V+ or GND are clamped by internal diodes.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS—Single +3V Supply

(V+ = +2.7V to +3.6V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3.0V and T<sub>A</sub> = +25°C.) (Notes 2, 3)

| PARAMETER                                        | SYMBOL                                                  | CONDITIONS                                                                                                        | T <sub>A</sub>                                | MIN       | TYP          | MAX       | UNITS    |
|--------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------|--------------|-----------|----------|
| <b>ANALOG SWITCH</b>                             |                                                         |                                                                                                                   |                                               |           |              |           |          |
| Analog Signal Range                              | V <sub>COM</sub> ,<br>V <sub>NO</sub> , V <sub>NC</sub> |                                                                                                                   |                                               | 0         |              | V+        | V        |
| On-Resistance (Note 4)                           | R <sub>ON</sub>                                         | V+ = 2.7V, I <sub>COM</sub> = 100mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = 1.5V                                 | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> |           | 0.6<br>0.9   | 0.8       | $\Omega$ |
| On-Resistance Match<br>Between Channels (Note 5) | $\Delta R_{ON}$                                         | V+ = 2.7V, I <sub>COM</sub> = 100mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = 1.5V                                 | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> |           | 0.03<br>0.08 | 0.06      | $\Omega$ |
| On-Resistance Flatness<br>(Note 6)               | R <sub>FLAT(ON)</sub>                                   | V+ = 2.7V, I <sub>COM</sub> = 100mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = 0.6V, 1.5V, 2.1V                     | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> |           | 0.1<br>0.2   | 0.18      | $\Omega$ |
| NO or NC Off-Leakage<br>Current                  | I <sub>NO(OFF)</sub> ,<br>I <sub>NC(OFF)</sub>          | V+ = 3.3V, V <sub>COM</sub> = 0.3V, 3V,<br>V <sub>NO</sub> or V <sub>NC</sub> = 3V, 0.3V                          | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> | -1<br>-5  |              | +1<br>+5  | nA       |
| COM On-Leakage Current                           | I <sub>COM(ON)</sub>                                    | V+ = 3.3V, V <sub>COM</sub> = 0.3V, 3V,<br>V <sub>NO</sub> or V <sub>NC</sub> = 0.3V, 3V or floating              | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> | -2<br>-10 |              | +2<br>+10 | nA       |
| <b>DYNAMIC</b>                                   |                                                         |                                                                                                                   |                                               |           |              |           |          |
| Turn-On Time                                     | t <sub>ON</sub>                                         | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, R <sub>L</sub> = 50 $\Omega$ ,<br>C <sub>L</sub> = 35pF, Figure 1      | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> |           | 13<br>20     | 18        | ns       |
| Turn-Off Time                                    | t <sub>OFF</sub>                                        | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, R <sub>L</sub> = 50 $\Omega$ ,<br>C <sub>L</sub> = 35pF, Figure 1      | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> |           | 6<br>15      | 12        | ns       |
| Break-Before-Make Delay<br>(Note 7)              | t <sub>BBM</sub>                                        | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, R <sub>L</sub> = 50 $\Omega$ ,<br>C <sub>L</sub> = 35pF, Figure 2      | +25°C<br>T <sub>MIN</sub> to T <sub>MAX</sub> | 1<br>1    | 9            |           | ns       |
| Charge Injection                                 | Q                                                       | V <sub>GEN</sub> , R <sub>GEN</sub> , C <sub>L</sub> = 1.0nF, Figure 3                                            | +25°C                                         |           | 22           |           | pC       |
| Off-Isolation (Note 8)                           | V <sub>ISO</sub>                                        | f = 1MHz, V <sub>COM</sub> = 1V <sub>RMS</sub> ,<br>R <sub>L</sub> = 50 $\Omega$ , C <sub>L</sub> = 5pF, Figure 4 | +25°C                                         |           | -54          |           | dB       |
| Crosstalk (Note 9)                               |                                                         | f = 1MHz, V <sub>COM</sub> = 1V <sub>RMS</sub> ,<br>R <sub>L</sub> = 50 $\Omega$ , C <sub>L</sub> = 5pF, Figure 4 | +25°C                                         |           | -54          |           | dB       |
| Total Harmonic Distortion                        | THD                                                     | f = 20Hz to 20kHz, V <sub>COM</sub> = 2V <sub>P-P</sub> ,<br>R <sub>L</sub> = 32 $\Omega$                         | +25°C                                         |           | 0.01         |           | %        |

# 0.8 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switch in SC70

## ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V+ = +2.7V to +3.6V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3.0V and T<sub>A</sub> = +25°C.) (Notes 2, 3)

| PARAMETER                | SYMBOL                                         | CONDITIONS                             | T <sub>A</sub>                       | MIN | TYP  | MAX | UNITS |
|--------------------------|------------------------------------------------|----------------------------------------|--------------------------------------|-----|------|-----|-------|
| NC or NO Off-Capacitance | C <sub>NO(OFF)</sub> ,<br>C <sub>NC(OFF)</sub> | f = 1MHz, Figure 5                     | +25°C                                |     | 30   |     | pF    |
| COM On-Capacitance       | C <sub>COM(ON)</sub>                           | f = 1MHz, Figure 5                     | +25°C                                |     | 65   |     | pF    |
| <b>LOGIC INPUT</b>       |                                                |                                        |                                      |     |      |     |       |
| Input Voltage Low        | V <sub>IL</sub>                                |                                        |                                      |     |      | 0.5 | V     |
| Input Voltage High       | V <sub>IH</sub>                                |                                        |                                      | 1.4 |      |     | V     |
| Input Leakage Current    | I <sub>IN</sub>                                | V <sub>IN</sub> = 0V or V+             |                                      | -1  |      | +1  | μA    |
| <b>SUPPLY</b>            |                                                |                                        |                                      |     |      |     |       |
| Power-Supply Range       | V+                                             |                                        |                                      | 1.6 |      | 3.6 | V     |
| Positive Supply Current  | I+                                             | V+ = +3.6V, V <sub>IN</sub> = 0V or V+ | +25°C                                |     | 0.04 | 0.2 | μA    |
|                          |                                                |                                        | T <sub>MIN</sub> to T <sub>MAX</sub> |     |      | 2   |       |

## ELECTRICAL CHARACTERISTICS—Single +1.8V Supply

(V+ = +1.8V, V<sub>IH</sub> = +1V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Notes 2, 3)

| PARAMETER                           | SYMBOL                                                  | CONDITIONS                                                                                          | T <sub>A</sub>                       | MIN | TYP  | MAX | UNITS |
|-------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------|-----|------|-----|-------|
| ANALOG SWITCH                       |                                                         |                                                                                                     |                                      |     |      |     |       |
| Analog Signal Range                 | V <sub>COM</sub> ,<br>V <sub>NO</sub> , V <sub>NC</sub> |                                                                                                     |                                      | 0   |      | V+  | V     |
| On-Resistance                       | R <sub>ON</sub>                                         | I <sub>COM</sub> = 10mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = +0.9V                              | +25°C                                |     | 1.2  | 2.5 | Ω     |
|                                     |                                                         |                                                                                                     | T <sub>MIN</sub> to T <sub>MAX</sub> |     |      | 5   |       |
| NO or NC Off-Leakage Current        | I <sub>NO(OFF)</sub> ,<br>I <sub>NC(OFF)</sub>          | V <sub>COM</sub> = 0.3V, 1.5V,<br>V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, 0.3V                   | +25°C                                | -1  | 0.01 | +1  | nA    |
|                                     |                                                         |                                                                                                     | T <sub>MIN</sub> to T <sub>MAX</sub> | -5  |      | +5  |       |
| COM On-Leakage Current              | I <sub>COM(ON)</sub>                                    | V <sub>COM</sub> = 0.3V, 1.5V, V <sub>NO</sub> or<br>V <sub>NC</sub> = 0.3V, 1.5V or floating       | +25°C                                | -2  |      | +2  | nA    |
|                                     |                                                         |                                                                                                     | T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |      | +10 |       |
| DYNAMIC                             |                                                         |                                                                                                     |                                      |     |      |     |       |
| Turn-On Time                        | t <sub>ON</sub>                                         | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, R <sub>L</sub> = 50Ω,<br>C <sub>L</sub> = 35pF, Figure 1 | +25°C                                |     | 18   | 25  | ns    |
|                                     |                                                         |                                                                                                     | T <sub>MIN</sub> to T <sub>MAX</sub> |     |      | 30  |       |
| Turn-Off Time                       | t <sub>OFF</sub>                                        | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, R <sub>L</sub> = 50Ω,<br>C <sub>L</sub> = 35pF, Figure 1 | +25°C                                |     | 9    | 15  | ns    |
|                                     |                                                         |                                                                                                     | T <sub>MIN</sub> to T <sub>MAX</sub> |     |      | 18  |       |
| Break-Before-Make Delay<br>(Note 7) | t <sub>BBM</sub>                                        | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, R <sub>L</sub> = 50Ω,<br>C <sub>L</sub> = 35pF, Figure 2 | +25°C                                |     | 2    |     | ns    |
|                                     |                                                         |                                                                                                     | T <sub>MIN</sub> to T <sub>MAX</sub> |     | 2    |     |       |
| Charge Injection                    | Q                                                       | V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1nF,<br>Figure 3                      | +25°C                                |     | 12   |     | pC    |

# 0.8 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switch in SC70

## ELECTRICAL CHARACTERISTICS—Single +1.8V Supply (continued)

( $V_+ = +1.8\text{V}$ ,  $V_{IH} = +1\text{V}$ ,  $V_{IL} = +0.4\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3)

| PARAMETER               | SYMBOL   | CONDITIONS                    | $T_A$                  | MIN | TYP  | MAX | UNITS         |
|-------------------------|----------|-------------------------------|------------------------|-----|------|-----|---------------|
| <b>LOGIC INPUT</b>      |          |                               |                        |     |      |     |               |
| Input Voltage Low       | $V_{IL}$ |                               |                        |     |      | 0.4 | V             |
| Input Voltage High      | $V_{IH}$ |                               |                        | 1   |      |     | V             |
| Input Leakage Current   | $I_{IN}$ | $V_{IN} = 0\text{V}$ or $V_+$ |                        |     |      | 1   | $\mu\text{A}$ |
| <b>SUPPLY</b>           |          |                               |                        |     |      |     |               |
| Positive Supply Current | $I_+$    | $V_{IN} = 0\text{V}$ or $V_+$ | $+25^\circ\text{C}$    |     | 0.04 | 0.2 | $\mu\text{A}$ |
|                         |          |                               | $T_{MIN}$ to $T_{MAX}$ |     |      | 2   |               |

**Note 2:** The algebraic convention, where the most negative value is a minimum and the most positive value is a maximum, is used in this data sheet.

**Note 3:** Parts are 100% tested at  $+25^\circ\text{C}$ . Limits across the full temperature range are guaranteed by design and correlation.

**Note 4:** Guaranteed by design for  $\mu\text{DFN}$  package.

**Note 5:**  $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ .

**Note 6:** Flatness is defined as the difference between the maximum and minimum values of on-resistance as measured over the specified analog signal range.

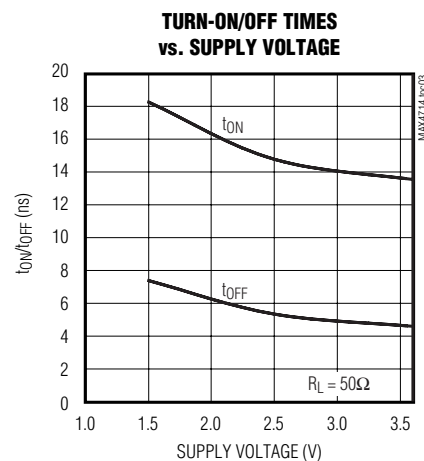
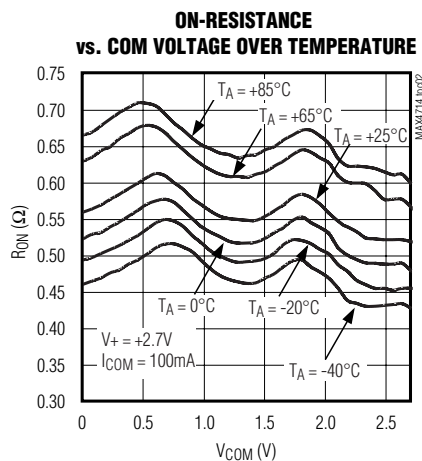
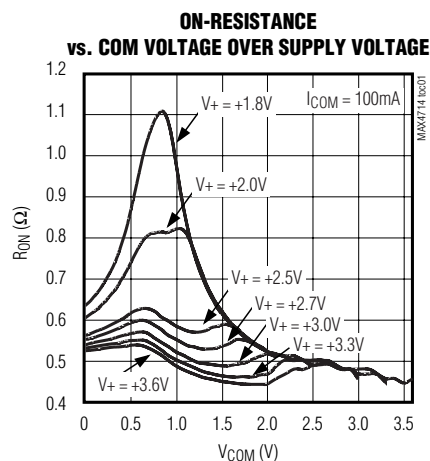
**Note 7:** Guaranteed by design.

**Note 8:** Off-Isolation =  $20\log_{10} [V_{COM} / (V_{NC} \text{ or } V_{NO})]$ ,  $V_{COM}$  = output,  $V_{NC}$  or  $V_{NO}$  = input to off switch.

**Note 9:** Between the two switches.

## Typical Operating Characteristics

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

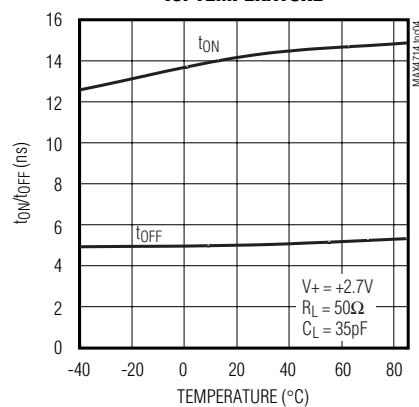


# 0.8 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switch in SC70

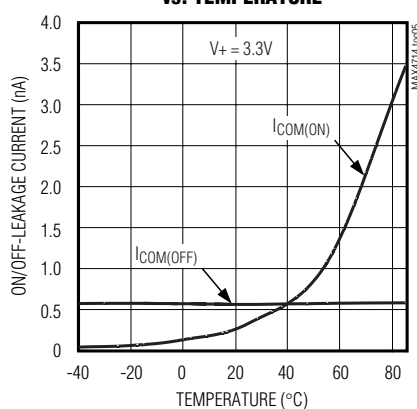
## Typical Operating Characteristics (continued)

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

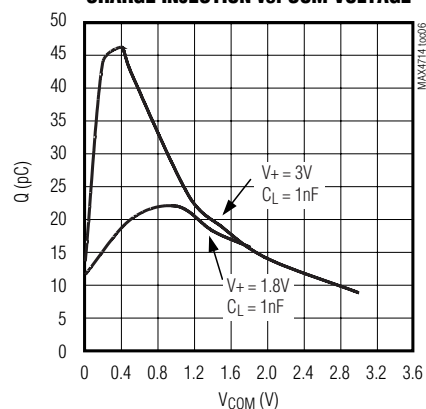
**TURN-ON/OFF TIMES  
vs. TEMPERATURE**



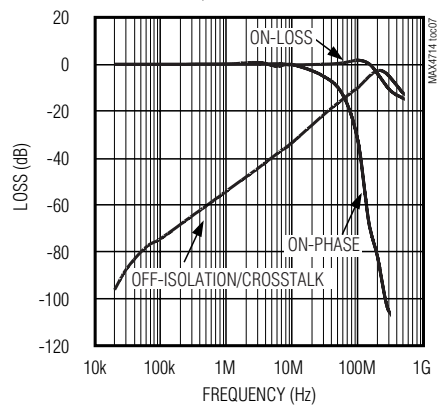
**ON/OFF-LEAKAGE CURRENT  
vs. TEMPERATURE**



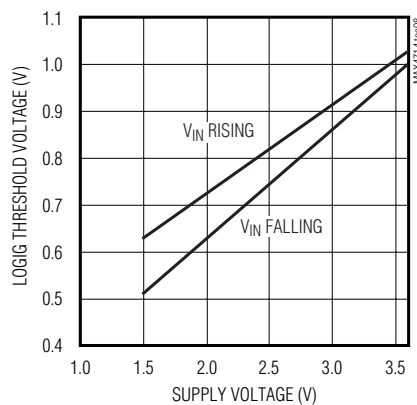
**CHARGE INJECTION vs. COM VOLTAGE**



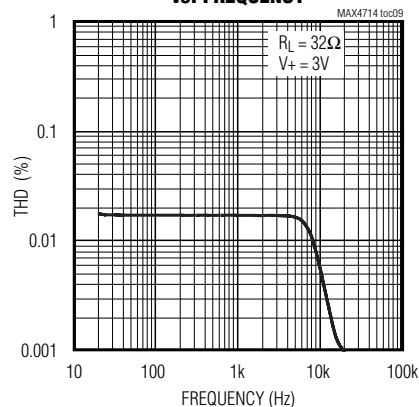
**FREQUENCY RESPONSE**



**LOGIC THRESHOLD VOLTAGE  
vs. SUPPLY VOLTAGE**



**TOTAL HARMONIC DISTORTION  
vs. FREQUENCY**



## Pin Description

| PIN | NAME | FUNCTION                      |
|-----|------|-------------------------------|
| 1   | IN   | Digital Control Input         |
| 2   | V+   | Positive Supply Voltage Input |
| 3   | GND  | Ground                        |
| 4   | NC   | Analog Switch—Normally Closed |
| 5   | COM  | Analog Switch—Common          |
| 6   | NO   | Analog Switch—Normally Open   |

# 0.8Ω, Low-Voltage, Single-Supply SPDT Analog Switch in SC70

## Detailed Description

The MAX4714 is a low-on-resistance ( $R_{ON}$ ), low-voltage, single-pole/double-throw (SPDT) analog switch that operates from a +1.6V to +3.6V supply. The MAX4714 has break-before-make switching. This device also has fast switching speeds ( $t_{ON} = 18\text{ns}$ , max,  $t_{OFF} = 12\text{ns}$ , max).

When powered from a +3V supply, the 0.8Ω (max)  $R_{ON}$  allows high continuous currents to be switched in a variety of applications.

## Applications Information

### Logic Inputs

The MAX4714 logic input can be driven up to +3.6V regardless of the supply voltage. For example, with a

+3.3V supply, IN may be driven low to GND and high to +3.6V. Driving IN rail-to-rail minimizes power consumption.

### Analog Signal Levels

Analog signals that range over the entire supply voltage ( $V_+$  to GND) can be passed with very little change in on-resistance (see *Typical Operating Characteristics*). The switches are bidirectional, so the NO, NC, and COM pins can be used as either inputs or outputs.

## Chip Information

TRANSISTOR COUNT: 135

PROCESS: CMOS

## Test Circuits/Timing Diagrams

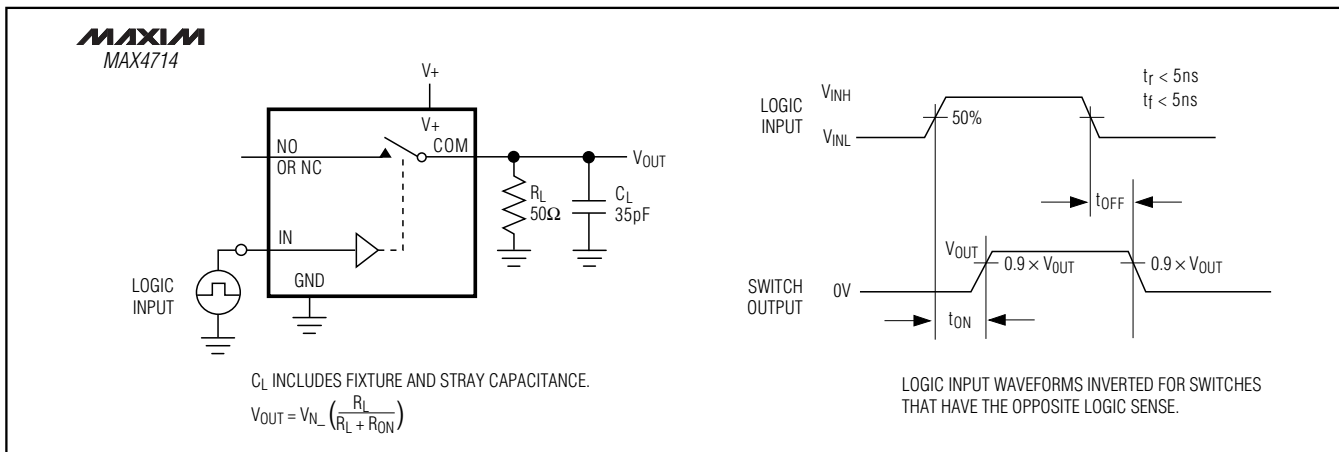


Figure 1. Switching Time

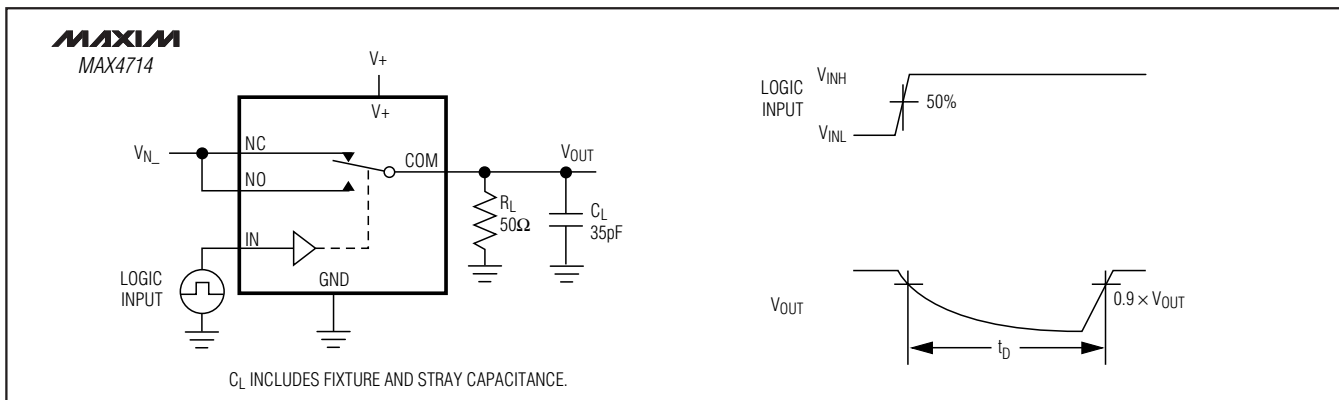


Figure 2. Break-Before-Make Interval

# 0.8Ω, Low-Voltage, Single-Supply SPDT Analog Switch in SC70

## Test Circuits/Timing Diagrams (continued)

MAX4714

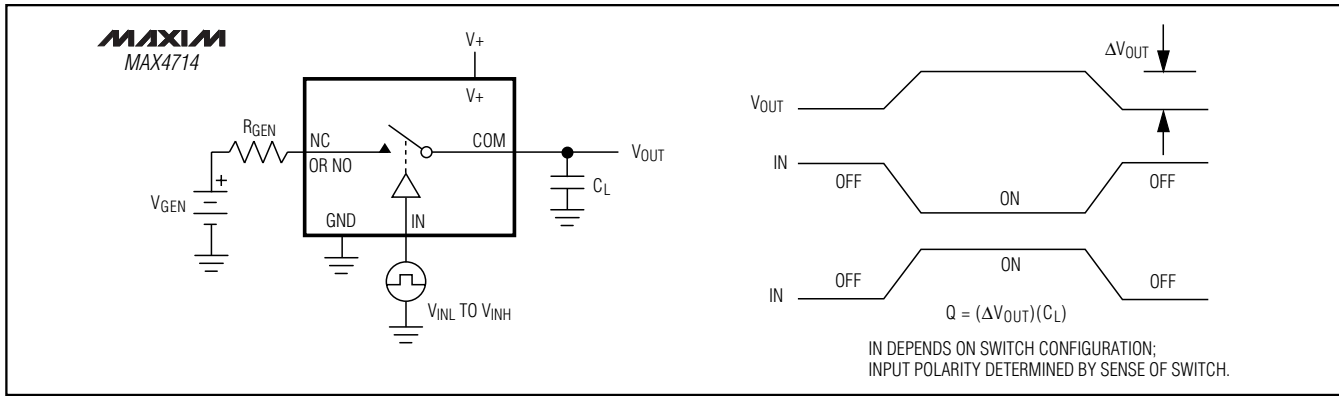


Figure 3. Charge Injection

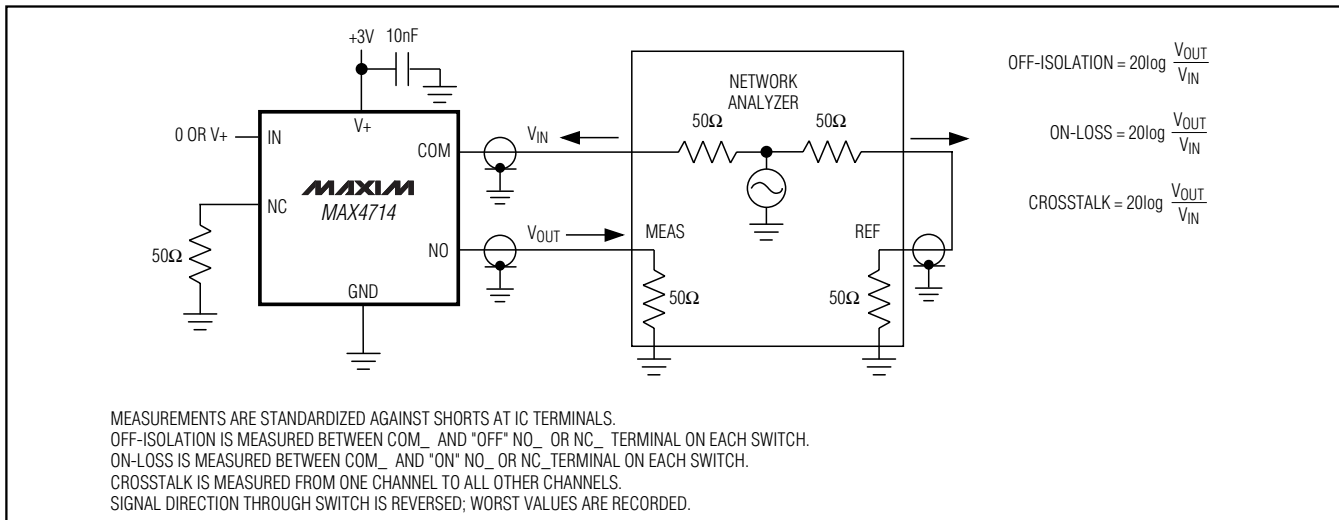


Figure 4. On-Loss, Off-Isolation, and Crosstalk

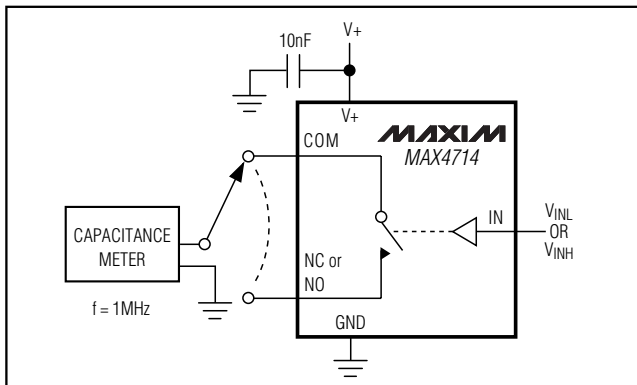


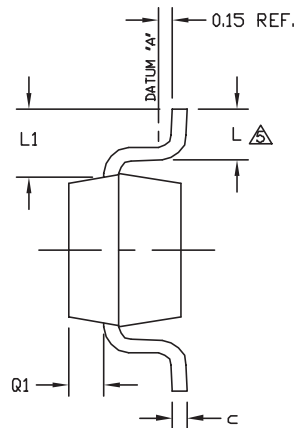
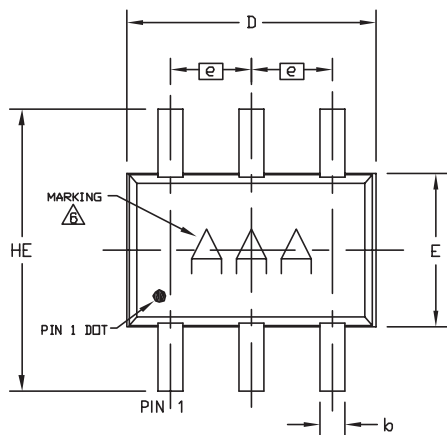
Figure 5. Channel Off/On-Capacitance

# 0.8Ω, Low-Voltage, Single-Supply SPDT Analog Switch in SC70

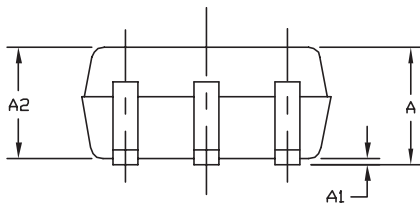
## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

SC70, 6LEPS



| COMMON DIMENSIONS |            |      |
|-------------------|------------|------|
| SYMBOL            | MIN        | MAX  |
| A                 | 0.80       | 1.10 |
| A1                | 0.00       | 0.10 |
| A2                | 0.80       | 1.00 |
| b                 | 0.15       | 0.30 |
| c                 | 0.10       | 0.18 |
| D                 | 1.80       | 2.20 |
| e                 | 0.65 BSC.  |      |
| E                 | 1.15       | 1.35 |
| HE                | 1.80       | 2.40 |
| L                 | 0.10       | 0.41 |
| L1                | 0.425 TYP. |      |
| Q1                | 0.10       | 0.40 |



### NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. COPLANARITY 4 MILS. MAX.
5. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM "A" AND LEAD SURFACE.
6. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
7. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.

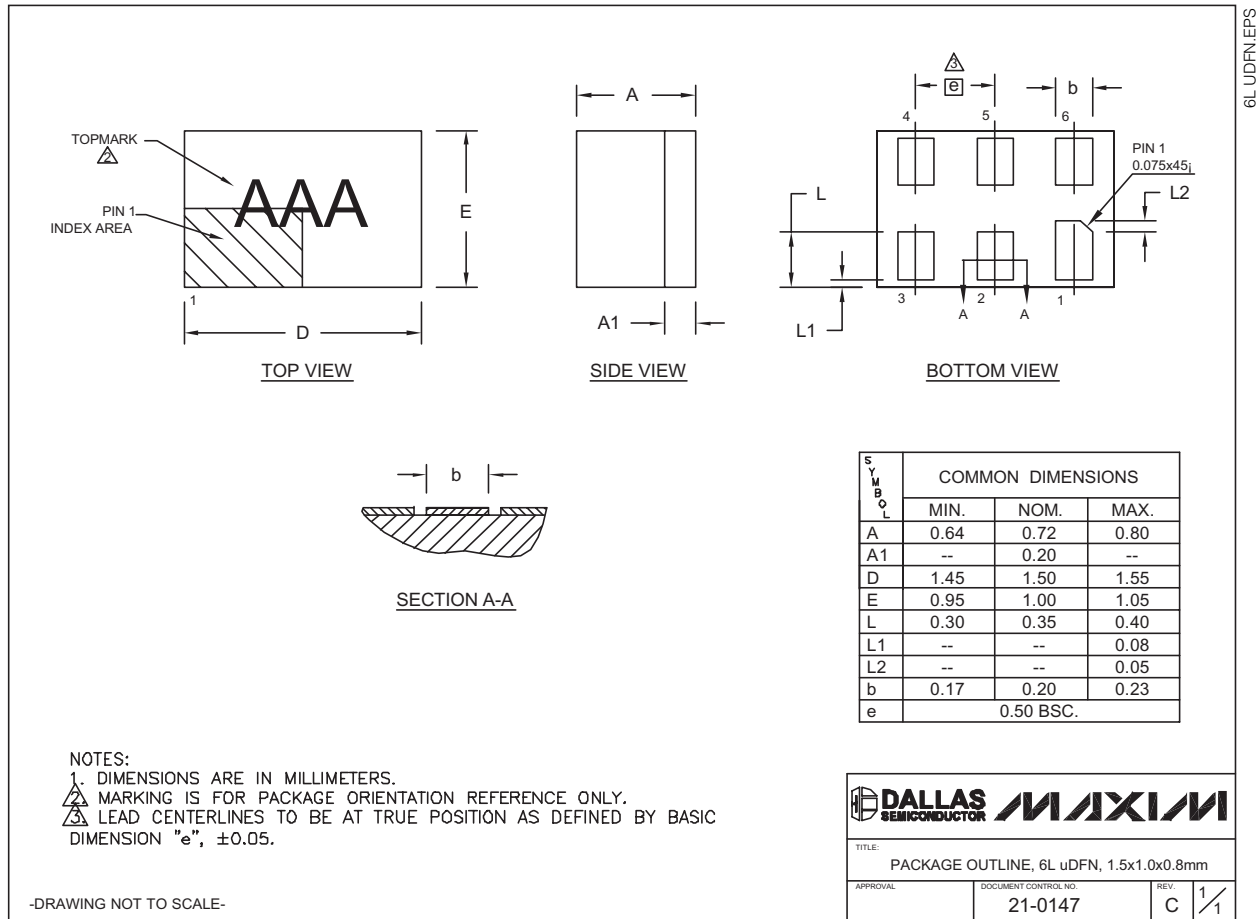
-DRAWING NOT TO SCALE-

|                          |                      |       |
|--------------------------|----------------------|-------|
|                          |                      |       |
| TITLE                    |                      |       |
| PACKAGE OUTLINE, 6L SC70 |                      |       |
| APPROVAL                 | DOCUMENT CONTROL NO. | REV.  |
|                          | 21-0077              | C 1/1 |

# 0.8Ω, Low-Voltage, Single-Supply SPDT Analog Switch in SC70

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



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