

# MAXIM

## Quad SPST CMOS Analog Switch

HI-201

### General Description

The Maxim HI-201 monolithic CMOS quad single-pole-single-throw (SPST) analog switch is a plug-in upgrade for the Harris HI-201. Maxim has eliminated the need for a VREF supply, which is normally required for operation with power supplies other than  $\pm 15V$ . And Maxim's part consumes 1/4 the power (4mW typ), making it better suited for portable applications.

Maxim's switch can be continuously operated with power supplies ranging from  $\pm 4.5V$  to  $\pm 18V$ , or single supplies over a range of +5V to +30V. Each switch can be independently selected and features fast switching ( $t_{on} = 260ns$ ,  $t_{off} = 100ns$  typ) and low on resistance ( $45\Omega$  typ). Maxim guarantees these switches will not latchup if the power supplies are disconnected with switch input signals still present. Logic inputs are both CMOS and TTL compatible without the need for pull-up resistors.

### Applications

Disk Drives  
Test Equipment  
Communication Systems  
PBX, PABX  
Guidance and Control Systems  
Heads-Up Displays

### Features

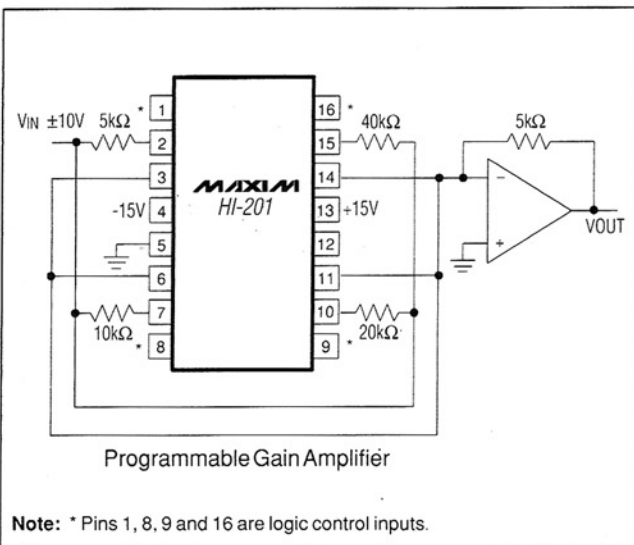
- ◆ No VREF Supply Required
- ◆ Monolithic, Low-Power CMOS Design
- ◆ Guaranteed Single-Supply Operation from +5V to +30V
- ◆ Guaranteed  $\pm 4.5V$  to  $\pm 18V$  Operation
- ◆ Fast Switching Times:  $t_{on} = 260ns$  (typ)  
 $t_{off} = 100ns$  (typ)
- ◆  $45\Omega$  (typ) On Resistance
- ◆ Non-Latching with Supplies Turned Off and Input Signals Present
- ◆ CMOS and TTL Logic Compatible (0.8V/2.4V)

### Ordering Information

| PART        | TEMP. RANGE     | PIN-PACKAGE    |
|-------------|-----------------|----------------|
| HI3-0201-5  | 0°C to +70°C    | 16 Plastic DIP |
| HI6-0201-5  | 0°C to +70°C    | 16 Wide SO     |
| HI1-0201-5  | 0°C to +70°C    | 16 Cerdip      |
| HI0-0201-6  | 0°C to +70°C    | Dice           |
| HI3-0201-9  | -40°C to +85°C  | 16 Plastic DIP |
| HI6-0201-9  | -40°C to +85°C  | 16 Wide SO     |
| HI1-0201-9  | -40°C to +85°C  | 16 Cerdip      |
| HI1-0201-2  | -55°C to +125°C | 16 Cerdip      |
| HI4-0201-8* | -55°C to +125°C | 20 LCC         |

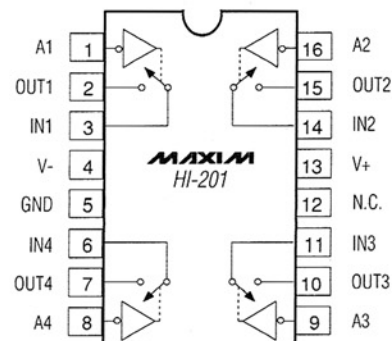
\* Contact Factory for Availability

### Typical Operating Circuit



### Pin Configurations

TOP VIEW



DIP/SO

Pin configurations continued on page 7.

MAXIM

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For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).

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## ABSOLUTE MAXIMUM RATINGS

|                                      |                                  |
|--------------------------------------|----------------------------------|
| Supply Voltage Between Pins 4 and 13 | 44V (±22)                        |
| VREF to Ground                       | +20V, -5V                        |
| Digital Input Voltage                | +VSUPPLY +4V<br>-VSUPPLY -4V     |
| Analog Input Voltage (One Switch)    | +VSUPPLY +2.0V<br>-VSUPPLY -2.0V |
| Analog Current - Continuous, Peak    | 30mA, 80mA                       |
| Power Dissipation (any package)      | 750mW                            |
| Derate Above +75°C                   | 8mW/°C                           |

|                             |                 |
|-----------------------------|-----------------|
| Operating Temperature       |                 |
| HI_-0201-5,6                | 0°C to +70°C    |
| HI_-0201-9                  | -40°C to +85°C  |
| HI_-0201-2,8                | -55°C to +125°C |
| Storage Temperature         | -65°C to +150°C |
| Power Dissipation (Note 1)  |                 |
| 16-Pin CERDIP (Note 2)      | 900mW           |
| 16-Pin Plastic DIP (Note 3) | 470mW           |
| 16-Pin Wide SO (Note 4)     | 400mW           |

**Note 1:** Device mounted with all pins soldered to PC board.

**Note 2:** Derate 12mW/°C above +75°C.

**Note 3:** Derate 6.5mW/°C above +25°C.

**Note 4:** Derate 7mW/°C above +25°C.

Stresses listed under "Absolute Maximum Ratings" may be applied (one at a time) to devices without resulting in permanent damage. These are stress ratings only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V+ = +15V, V- = -15V, GND = 0V, TA = +25°C, unless otherwise noted.)

| PARAMETER                             | SYMBOL   | CONDITIONS                      |                     | LIMITS          |                 |     |                 |                 |     | UNITS |
|---------------------------------------|----------|---------------------------------|---------------------|-----------------|-----------------|-----|-----------------|-----------------|-----|-------|
|                                       |          |                                 |                     | HI_-0201-2/8    |                 |     | HI_-0201-5/6/9  |                 |     |       |
|                                       |          |                                 |                     | MIN<br>(Note 5) | TYP<br>(Note 6) | MAX | MIN<br>(Note 5) | TYP<br>(Note 6) | MAX |       |
| SWITCH                                |          |                                 |                     |                 |                 |     |                 |                 |     |       |
| Analog-Signal Range                   | VANALOG  |                                 |                     | -15             |                 | 15  | -15             |                 | 15  | V     |
| Drain-Source On Resistance (Note 7)   | rDS (on) | VD = ±10V, VIN = 0.8V, IS = 1mA |                     |                 | 45              | 70  |                 | 45              | 80  | Ω     |
| Source-Off Leakage Current            | IS (off) | VIN = 2.4V                      | VS = 14V, VD = -14V | -5              | ±0.01           | 5   | -10             | ±0.01           | 10  | nA    |
|                                       |          |                                 | VS = -14V, VD = 14V | -5              | ±0.02           | 5   | -10             | ±0.02           | 10  |       |
| Drain-Off Leakage Current             | ID (off) | VIN = 2.4V                      | VD = 14V, VS = -14V | -5              | ±0.01           | 5   | -10             | ±0.01           | 10  | nA    |
|                                       |          |                                 | VD = -14V, VS = 14V | -5              | ±0.02           | 5   | -10             | ±0.02           | 10  |       |
| Drain-On Leakage Current (Note 8)     | ID (on)  | VS = -14V, VIN = 0.8V           |                     | -5              | ±0.1            | 5   | -10             | ±0.1            | 10  | nA    |
|                                       |          | VD = 14V, VIN = 0.8V            |                     | -5              | ±0.15           | 5   | -10             | ±0.15           | 10  |       |
| LOGIC INPUT                           |          |                                 |                     |                 |                 |     |                 |                 |     |       |
| Input Current with Input Voltage High | IINH     | VIN = 2.4V                      |                     | -1              | ±0.0004         | 1   | -1              | ±0.0004         | 1   | μA    |
|                                       |          | VIN = 15V                       |                     | -1              | 0.003           | 1   | -1              | 0.003           | 1   |       |
| Input Current with Input Voltage Low  | IINL     | VIN = 0V                        |                     | -1              | ±0.0004         | 1   | -1              | ±0.0004         | 1   | μA    |

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## ELECTRICAL CHARACTERISTICS (continued)

(V<sub>+</sub> = +15V, V<sub>-</sub> = -15V, GND = 0V, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                                   | SYMBOL                                                  | CONDITIONS                                                            |            | LIMITS          |                 |     |                 |                 |     | UNITS |
|---------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------|------------|-----------------|-----------------|-----|-----------------|-----------------|-----|-------|
|                                             |                                                         |                                                                       |            | HI_-0201-2/8    |                 |     | HI_-0201-5/6/9  |                 |     |       |
|                                             |                                                         |                                                                       |            | MIN<br>(Note 5) | TYP<br>(Note 6) | MAX | MIN<br>(Note 5) | TYP<br>(Note 6) | MAX |       |
| DYNAMIC                                     |                                                         |                                                                       |            |                 |                 |     |                 |                 |     |       |
| Turn-On Time                                | t <sub>on</sub>                                         | See Switching-Time Test Circuit                                       |            | 260             | 400             |     | 260             | 500             |     | ns    |
| Turn-Off Time                               | t <sub>off</sub>                                        | See Switching-Time Test Circuit                                       |            | 100             | 300             |     | 100             | 350             |     | ns    |
| Charge Injection                            | Q                                                       | C <sub>L</sub> = 1000pF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω |            | 20              |                 |     | 20              |                 |     | pC    |
| Source-Off Capacitance                      | C <sub>S (off)</sub>                                    | V <sub>S</sub> = 0V, V <sub>IN</sub> = 5V                             | f = 140kHz | 5               |                 |     | 5               |                 |     | pF    |
| Drain-Off Capacitance                       | C <sub>D (off)</sub>                                    | V <sub>S</sub> = 0V, V <sub>IN</sub> = 5V                             | f = 140kHz | 5               |                 |     | 5               |                 |     | pF    |
| Channel-On Capacitance                      | C <sub>D (on)</sub> <sup>+</sup><br>C <sub>S (on)</sub> | V <sub>D</sub> = V <sub>S</sub> = 0V, V <sub>IN</sub> = 0V            | f = 140kHz | 16              |                 |     | 16              |                 |     | pF    |
| Off Isolation                               |                                                         | V <sub>IN</sub> = 5V, Z <sub>L</sub> = 75Ω                            |            | 70              |                 |     | 70              |                 |     | dB    |
| Crosstalk (Channel-to-Channel)              |                                                         | V <sub>S</sub> = 2.0V, f = 100kHz                                     |            | 90              |                 |     | 90              |                 |     | dB    |
| SUPPLY                                      |                                                         |                                                                       |            |                 |                 |     |                 |                 |     |       |
| Positive Supply Current                     | I <sub>+</sub>                                          | All Channels On or Off                                                |            | 0.2             | 0.3             |     | 0.2             | 0.3             |     | mA    |
| Negative Supply Current                     | I <sub>-</sub>                                          |                                                                       |            | -0.1            | -0.01           |     | -0.1            | -0.01           |     | mA    |
| Power-Supply Range for Continuous Operation | V <sub>OP</sub>                                         | (Note 7)                                                              |            | ±4.5            |                 | ±18 | ±4.5            |                 | ±18 | V     |

**Note 5:** The algebraic convention where the most negative value is a minimum and the most positive a maximum is used in this data sheet.

**Note 6:** Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.

**Note 7:** Electrical characteristics, such as on resistance, will change when power supplies other than ±15V are used.

**Note 8:** I<sub>D(on)</sub> is leakage from driver into on switch.

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## ELECTRICAL CHARACTERISTICS

(V<sub>+</sub> = +15V, V<sub>-</sub> = -15V, GND = 0V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>)

| PARAMETER                             | SYMBOL   | CONDITIONS                      |                     | LIMITS          |                 |      |                 |                 |     | UNITS |
|---------------------------------------|----------|---------------------------------|---------------------|-----------------|-----------------|------|-----------------|-----------------|-----|-------|
|                                       |          |                                 |                     | HI_-201-2/7/8   |                 |      | HI_-201-5/6/9   |                 |     |       |
|                                       |          |                                 |                     | MIN<br>(Note 5) | TYP<br>(Note 6) | MAX  | MIN<br>(Note 5) | TYP<br>(Note 6) | MAX |       |
| SWITCH                                |          |                                 |                     |                 |                 |      |                 |                 |     |       |
| Analog-Signal Range                   | VANALOG  |                                 |                     | -15             |                 | 15   | -15             |                 | 15  | V     |
| Drain-Source On Resistance (Note 9)   | rDS (on) | VD = ±10V, VIN = 0.8V, IS = 1mA |                     |                 |                 | 100  |                 |                 | 100 | Ω     |
| Source-Off Leakage Current            | IS (off) | VIN = 2.4V                      | VS = 14V, VD = -14V |                 |                 | 500  |                 |                 | 250 | nA    |
|                                       |          |                                 | VS = -14V, VD = 14V | -500            |                 | -250 |                 |                 |     |       |
| Drain-Off Leakage Current             | ID (off) | VIN = 2.4V                      | VD = 14V, VS = -14V |                 |                 | 500  |                 |                 | 250 | nA    |
|                                       |          |                                 | VD = -14V, VS = 14V | -500            |                 | -250 |                 |                 |     |       |
| Drain-On Leakage Current (Note 10)    | ID (on)  | VS = -14V, VIN = 0.8V           |                     |                 |                 | 500  |                 |                 | 250 | nA    |
|                                       |          | VD = 14V, VIN = 0.8V            |                     | -500            |                 | -250 |                 |                 |     |       |
| LOGIC INPUT                           |          |                                 |                     |                 |                 |      |                 |                 |     |       |
| Input Current with Input Voltage High | IINH     | VIN = 2.4V                      |                     | -1.0            |                 |      | -1.0            |                 |     | μA    |
|                                       |          | VIN = 15V                       |                     | 1.0             |                 |      | 1.0             |                 |     |       |
| Input Current with Input Voltage Low  | IINL     | VIN = 0V                        |                     | -1.0            |                 |      | -1.0            |                 |     | μA    |
| DYNAMIC                               |          |                                 |                     |                 |                 |      |                 |                 |     |       |
| Turn-On Time                          | ton      | See Switching-Time Test Circuit |                     | 500             |                 |      | 600             |                 |     | ns    |
| Turn-Off Time                         | toff     | See Switching-Time Test Circuit |                     | 400             |                 |      | 450             |                 |     | ns    |
| SUPPLY                                |          |                                 |                     |                 |                 |      |                 |                 |     |       |
| Positive Supply Current               | I+       | All Channels On or Off          |                     | 0.4             |                 |      | 0.4             |                 |     | mA    |
| Negative Supply Current               | I-       | All Channels On or Off          |                     | -0.1            |                 |      | -0.1            |                 |     | mA    |

**Note 9:** Electrical characteristics, such as on resistance, will change when power supplies other than ±15V are used.

**Note 10:** I<sub>D(on)</sub> is leakage from driver into on switch.

# Quad SPST CMOS Analog Switch

## Protecting Against Fault Conditions

Fault conditions occur when power supplies are turned off and input signals are still present, or overvoltages occur at the inputs during normal operation. In either case, source-to-body diodes can be forward biased and conduct current from the signal source. If this current is required to be kept to low ( $\mu\text{A}$ ) levels, the addition of external protection diodes is recommended (Figure 1).

To provide protection for overvoltages up to 20V above the supplies, a 1N4001 or 1N914 type diode should be placed in series with the positive and negative supplies, as shown in Figure 1. The addition of these diodes will reduce the analog-signal range to 1V below the positive supply and 1V above the negative supply.

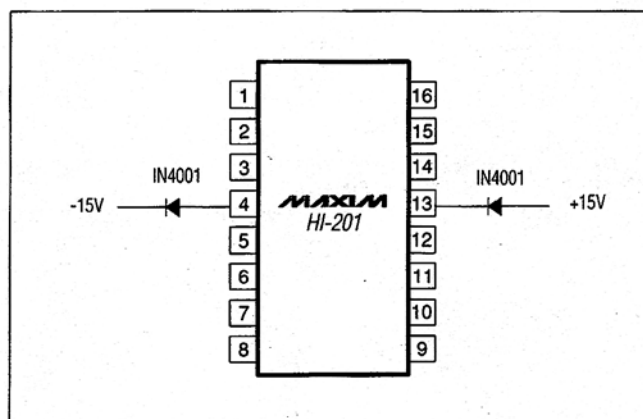


Figure 1. Protection Against Fault Conditions

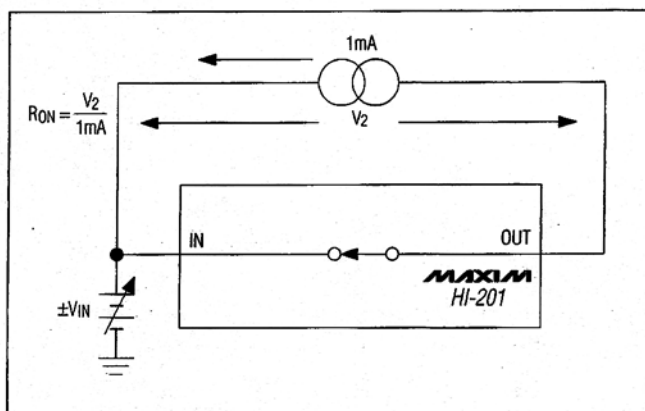


Figure 2. On Resistance vs. Analog-Signal Level Supply Voltage

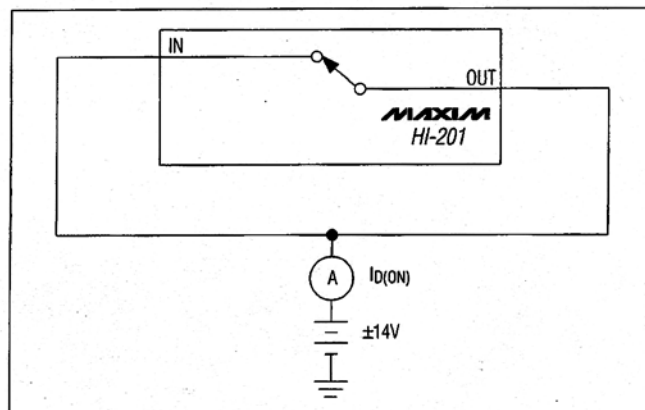


Figure 3. On Leakage Current

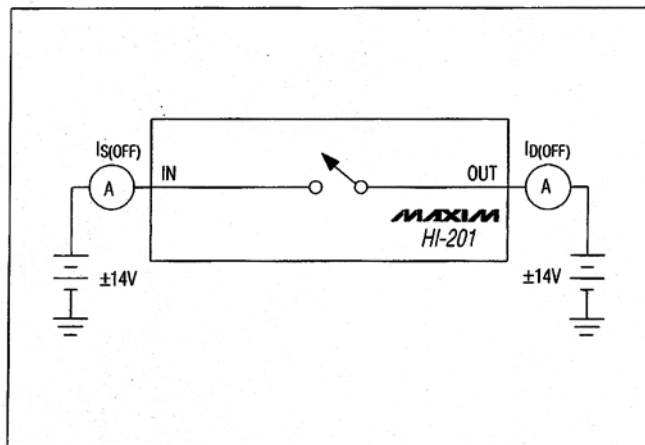


Figure 4. Off Leakage Current

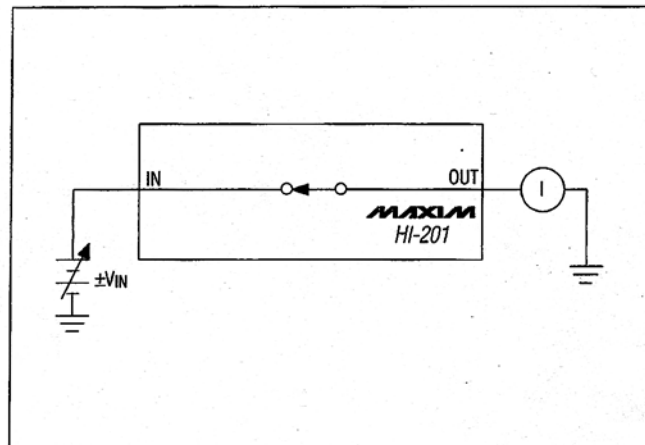
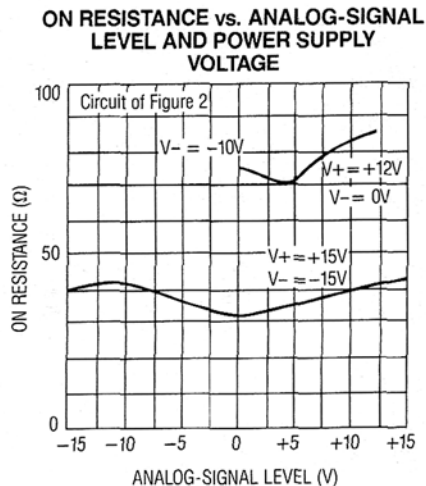
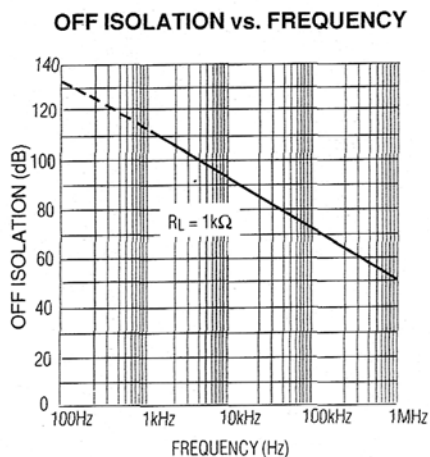
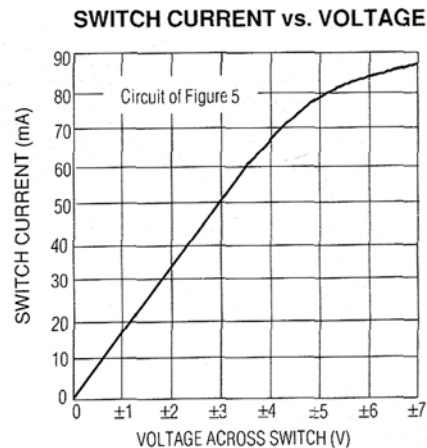
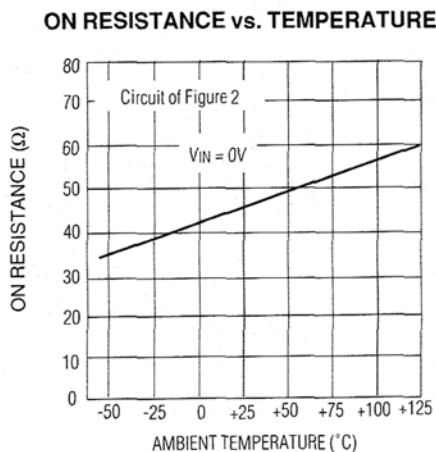
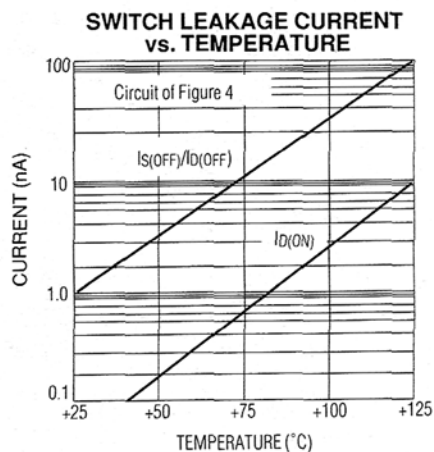


Figure 5. Switch Current vs. Voltage

# Quad SPST CMOS Analog Switch

## Typical Operating Characteristics

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# Quad SPST CMOS Analog Switch

## Pin Configurations (continued)

**HI-201**

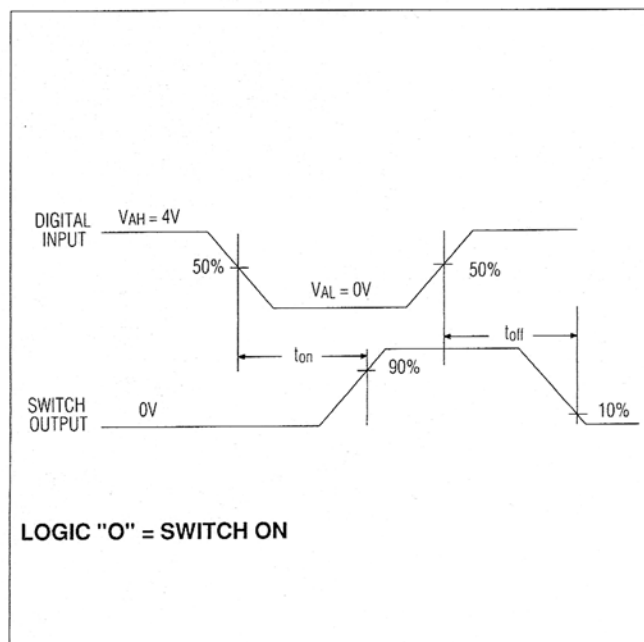
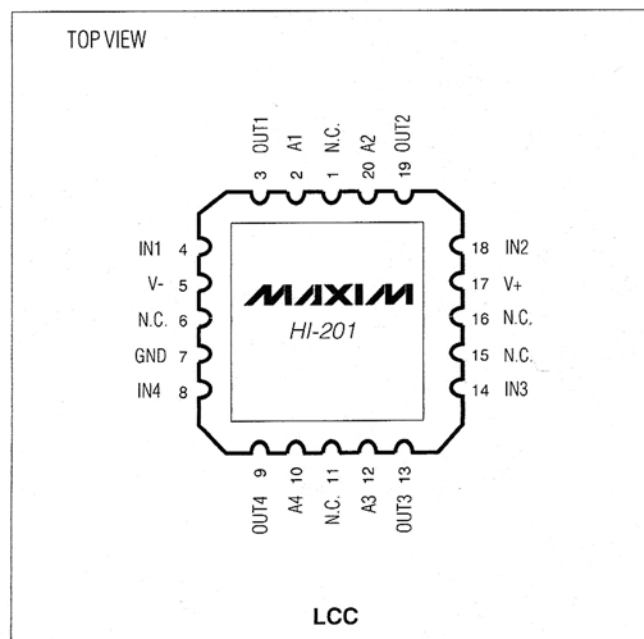


Figure 6. HI-201 Switch Timing



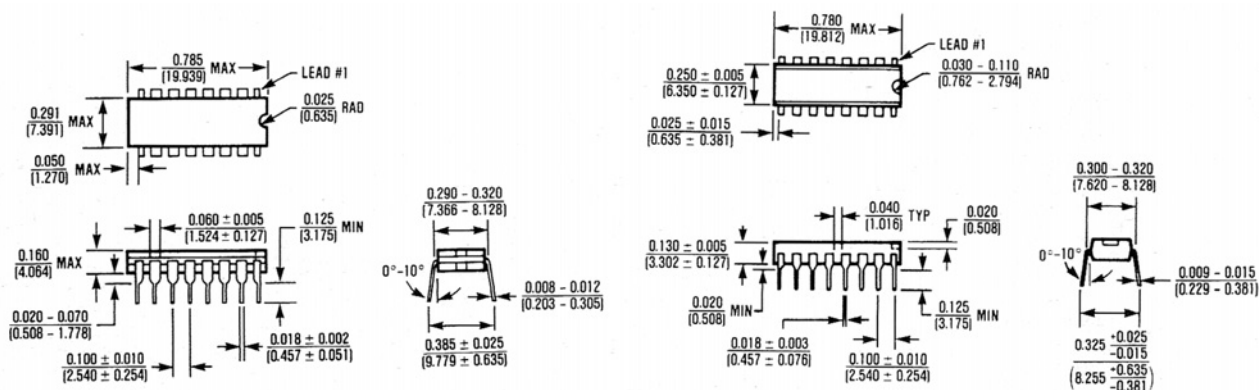


# Quad SPST CMOS Analog Switch

## 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).)

HI-201



### 16 Lead Cerdip (HI1)

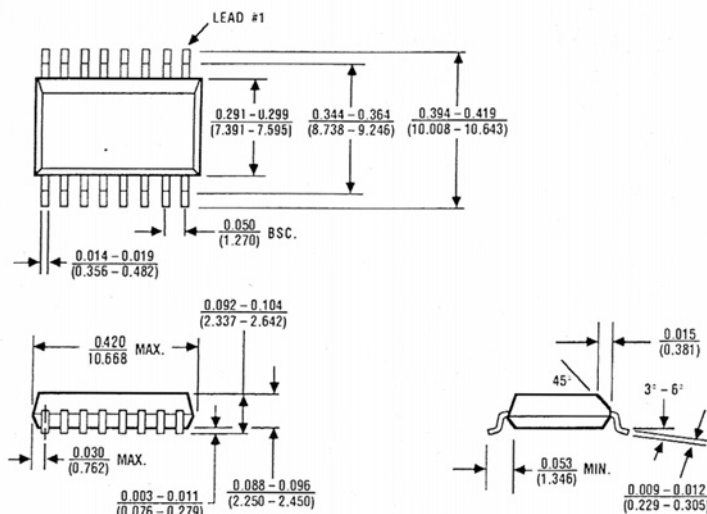
$\theta_{JA} = 100^{\circ}\text{C/W}$

$\theta_{JC} = 50^{\circ}\text{C/W}$

### 16 Lead Plastic DIP (HI3)

$\theta_{JA} = 135^{\circ}\text{C/W}$

$\theta_{JC} = 65^{\circ}\text{C/W}$



### 16 Lead Small Outline, Wide (W16)

$\theta_{JA} = 105^{\circ}\text{C/W}$

$\theta_{JC} = 60^{\circ}\text{C/W}$

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