

# MAXIM

## High-Speed, CMOS, Quad, SPST Analog Switch

HI-201HS

### General Description

Maxim's HI-201HS is a monolithic, CMOS, quad, single-pole-single-throw (SPST), high-speed analog switch featuring fast switching times ( $t_{OFF}$ ,  $t_{ON} \leq 50\text{ns}$ ) and low on resistance ( $50\Omega$  max). It is pin compatible with the industry-standard DG201A.

Maxim's new high-voltage silicon-gate technology increases the maximum supply-voltage rating to 44V. This improvement allows continuous operation with  $\pm 20\text{V}$  supplies, which is not permitted with the original manufacturer's devices. Maxim's HI-201HS operates from dual supplies ranging from  $\pm 5\text{V}$  to  $\pm 20\text{V}$ , or from single supplies from +12V to +20V. Logic levels are TTL-/CMOS-compatible with single or dual supplies within these ranges.

Maxim's HI-201HS is guaranteed not to latch up if power supplies are disconnected while the analog-switch inputs are present, provided the switch continuous-current ratings are not exceeded. When powered up, the HI-201HS will switch analog signals up to the power-supply rails.

### Applications

Automatic Test Equipment (ATE)  
Heads-Up Displays  
Communication Systems  
Sample-and-Hold Circuits  
Military  
Integrator Reset Circuits

### Features

- ◆ **Guaranteed Single-Supply Operation:** +12V to +20V
- ◆ **Guaranteed Dual Supplies:**  $\pm 5\text{V}$  to  $\pm 20\text{V}$
- ◆ **Fast Switching Times:**  
 $t_{ON} = 30\text{ns}$   
 $t_{OFF} = 40\text{ns}$
- ◆ **Low,  $50\Omega$  Max On Resistance**
- ◆ **TTL-/CMOS-Compatible**
- ◆ **44V Max Supply Rating**

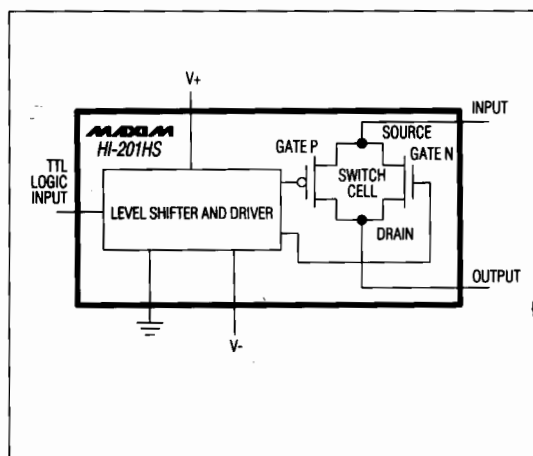
### Ordering Information

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

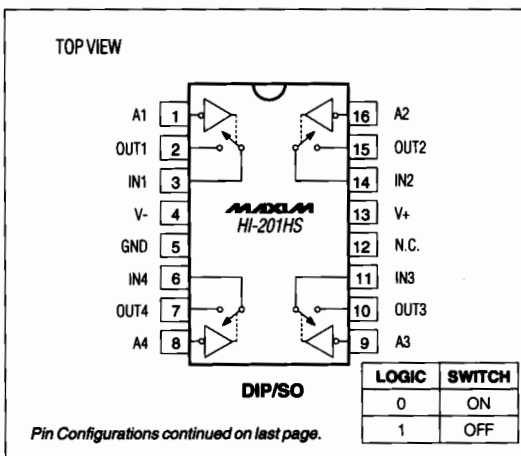
\* Contact factory for dice specifications.

\*\* Contact factory for availability.

### Functional Diagram



### Pin Configurations



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## ABSOLUTE MAXIMUM RATINGS

|                                                                                                           |      |
|-----------------------------------------------------------------------------------------------------------|------|
| Voltage Referenced to V-                                                                                  |      |
| V+ .....                                                                                                  | 44V  |
| GND .....                                                                                                 | 25V  |
| Digital Inputs Vs, V <sub>D</sub> (Note 1) ... (V- - 4V) to (V+ + 4V) or 30mA<br>(whichever occurs first) |      |
| Current (any terminal, except S or D) .....                                                               | 30mA |
| Continuous Current, S or D .....                                                                          | 20mA |
| Peak Current, S or D<br>(pulsed at 1ms, 10% duty cycle max) .....                                         | 40mA |

|                                                               |                 |
|---------------------------------------------------------------|-----------------|
| Continuous Power Dissipation (T <sub>A</sub> = +70°C, Note 2) |                 |
| 16-Pin DIP (derate 10.53mW/°C above +70°C) .....              | 842mW           |
| 16-Pin Wide SO (derate 9.52mW/°C above +70°C) ...             | 762mW           |
| 16-Pin Cerdip (derate 10.00mW/°C above +70°C) ..              | 800mW           |
| 20-Pin LCC (derate 9.09mW/°C above +70°C) .....               | 727mW           |
| Operating Temperature Ranges:                                 |                 |
| HI-0201HS-5/-6 .....                                          | 0°C to +70°C    |
| HI-0201HS-9 .....                                             | -40°C to +85°C  |
| HI-0201HS-2/-8 .....                                          | -55°C to +125°C |
| Storage Temperature Range .....                               | -65°C to +150°C |
| Lead Temperature (soldering, 10sec) .....                     | +300°C          |

**Note 1:** Signals on S<sub>x</sub>, D<sub>x</sub>, or I<sub>Nx</sub> exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.

**Note 2:** All leads soldered or welded to PC board.

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

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

| PARAMETER                             | SYMBOL   | CONDITIONS                      | HI-201HS-2/-8       |                 |       | HI-201HS-5/-6/-9 |                 |       | UNITS |    |
|---------------------------------------|----------|---------------------------------|---------------------|-----------------|-------|------------------|-----------------|-------|-------|----|
|                                       |          |                                 | MIN<br>(Note 3)     | TYP<br>(Note 4) | MAX   | MIN<br>(Note 3)  | TYP<br>(Note 4) | MAX   |       |    |
| SWITCH                                |          |                                 |                     |                 |       |                  |                 |       |       |    |
| Analog-Signal Range                   | VANALOG  |                                 | -15                 |                 | 15    | -15              |                 | 15    | V     |    |
| Drain-Source On Resistance (Note 5)   | rDS (on) | VD = ±10V, VIN = 0.8V, IS = 1mA |                     | 30              | 50    |                  | 30              | 50    | Ω     |    |
| Source-Off Leakage Current            | IS (off) | VIN = 3.0V                      | VS = 14V, VD = -14V | -1              | ±0.01 | 1                | -1              | ±0.01 | 1     | nA |
|                                       |          |                                 | VS = -14V, VD = 14V | -1              | ±0.02 | 1                | -1              | ±0.02 | 1     |    |
| Drain-Off Leakage Current             | ID (off) | VIN = 3.0V                      | VD = 14V, VS = -14V | -1              | ±0.01 | 1                | -1              | ±0.01 | 1     | nA |
|                                       |          |                                 | VD = -14V, VS = 14V | -1              | ±0.02 | 1                | -1              | ±0.02 | 1     |    |
| Drain-On Leakage Current (Note 6)     | ID (on)  | VD = -14V, VIN = 0.8V           | -1                  | ±0.10           | 1     | -1               | ±0.10           | 1     | nA    |    |
|                                       |          | VD = 14V, VIN = 0.8V            | -1                  | ±0.15           | 1     | -1               | ±0.15           | 1     |       |    |
| LOGIC INPUT                           |          |                                 |                     |                 |       |                  |                 |       |       |    |
| Input Current with Input Voltage High | IINH     | VIN = 3.0V                      | -1                  | 0               | 1     | -1               | 0               | 1     | μA    |    |
|                                       |          | VIN = 15V                       | -1                  | 0               | 1     | -1               | 0               | 1     |       |    |
| Input Current with Input Voltage Low  | IINL     | VIN = 0.8V                      | -1                  | 0               | 1     | -1               | 0               | 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                                                                 | HI-201HS-2/-8   |                 |     | HI-201HS-5/-6/-9 |                 |     | UNITS |
|---------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------|-----------------|-----------------|-----|------------------|-----------------|-----|-------|
|                                             |                                                         |                                                                            | MIN<br>(Note 3) | TYP<br>(Note 4) | MAX | MIN<br>(Note 3)  | TYP<br>(Note 4) | MAX |       |
| DYNAMIC                                     |                                                         |                                                                            |                 |                 |     |                  |                 |     |       |
| Turn-On Time                                | t <sub>on</sub>                                         | Figure 6                                                                   | 30              | 50              |     | 30               | 50              |     | ns    |
| Turn-Off Time                               | t <sub>off</sub>                                        | Figure 6                                                                   | 40              | 50              |     | 40               | 50              |     | ns    |
|                                             | t <sub>off2</sub>                                       |                                                                            | 150             |                 | 150 |                  |                 |     |       |
| Output Settling Time                        |                                                         |                                                                            | 180             |                 |     | 180              |                 |     | ns    |
| Charge Injection                            | Q                                                       | C <sub>L</sub> = 1000pF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω      | 10              |                 |     | 10               |                 |     | pC    |
| Source-Off Capacitance                      | C <sub>S (off)</sub>                                    | V <sub>S</sub> = 0V, V <sub>IN</sub> = 5V      f = 140kHz                  | 10              |                 |     | 10               |                 |     | pF    |
| Drain-Off Capacitance                       | C <sub>D (off)</sub>                                    | V <sub>S</sub> = 0V, V <sub>IN</sub> = 5V      f = 140kHz                  | 10              |                 |     | 10               |                 |     | 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 | 30              |                 |     | 30               |                 |     | pF    |
| Off Isolation                               |                                                         | V <sub>IN</sub> = 3V <sub>RMS</sub> , Z <sub>L</sub> = 1kΩ, f = 100kHz     | 72              |                 |     | 72               |                 |     | dB    |
| Crosstalk<br>(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                                                     | -3.0            | 3.8             | 6.5 | -3.0             | 3.8             | 6.5 | mA    |
| Negative Supply Current                     | I <sub>-</sub>                                          |                                                                            | 1.0             |                 |     | 1.0              |                 |     | mA    |
| Power-Supply Range for Continuous Operation | V <sub>OP</sub>                                         | (Note 5)                                                                   | ±4.5            |                 | ±20 | ±4.5             |                 | ±20 | V     |

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## ELECTRICAL CHARACTERISTICS

(V+ = 15V, V- = -15V, GND = 0V, TA = TMIN to TMAX, unless otherwise noted.)

| PARAMETER                             | SYMBOL   | CONDITIONS                      | HI-201HS-2/-8       |                 |     | HI-201HS-5/-6/-9 |                 |     | UNITS |    |
|---------------------------------------|----------|---------------------------------|---------------------|-----------------|-----|------------------|-----------------|-----|-------|----|
|                                       |          |                                 | MIN<br>(Note 3)     | TYP<br>(Note 4) | MAX | MIN<br>(Note 3)  | TYP<br>(Note 4) | MAX |       |    |
| SWITCH                                |          |                                 |                     |                 |     |                  |                 |     |       |    |
| Analog-Signal Range                   | VANALOG  |                                 |                     | -15             |     | 15               | -15             |     | 15    | V  |
| Drain-Source On Resistance (Note 5)   | rDS (on) | VD = ±10V, VIN = 0.8V, IS = 1mA |                     |                 |     | 75               |                 |     | 75    | Ω  |
| Source-Off Leakage Current            | IS (off) | VIN = 3.0V                      | VS = 14V, VD = -14V | -100            |     | 100              | -50             |     | 50    | nA |
|                                       |          |                                 | VS = -14V, VD = 14V | -100            |     | 100              | -50             |     | 50    |    |
| Drain-Off Leakage Current             | ID (off) | VIN = 3.0V                      | VD = 14V, VS = -14V | -100            |     | 100              | -50             |     | 50    | nA |
|                                       |          |                                 | VD = -14V, VS = 14V | -100            |     | 100              | -50             |     | 50    |    |
| Drain-On Leakage Current (Note 6)     | ID (on)  | VD = -14V, VIN = 0.8V           |                     | -100            |     | 100              | -50             |     | 50    | nA |
|                                       |          | VD = 14V, VIN = 0.8V            |                     | -100            |     | 100              | -50             |     | 50    |    |
| LOGIC INPUT                           |          |                                 |                     |                 |     |                  |                 |     |       |    |
| Input Current with Input Voltage High | IINH     | VIN = 3.0V                      |                     | -1.0            |     | 1.0              | -1.0            |     | 1.0   | μA |
|                                       |          | VIN = 15V                       |                     | -1.0            |     | 1.0              | -1.0            |     | 1.0   |    |
| Input Current with Input Voltage Low  | IINL     | VIN = 0.8V                      |                     | -1.0            |     | 1.0              | -1.0            |     | 1.0   | μA |
| DYNAMIC                               |          |                                 |                     |                 |     |                  |                 |     |       |    |
| Turn-On Time                          | ton      | See Figure 6                    |                     |                 |     | 75               |                 |     | 75    | ns |
| Turn-Off Time                         | toff     | See Figure 6                    |                     |                 |     | 75               |                 |     | 75    | ns |
| SUPPLY                                |          |                                 |                     |                 |     |                  |                 |     |       |    |
| Positive Supply Current               | I+       | All channels on or off          |                     |                 |     | 10               |                 |     | 10    | mA |
| Negative Supply Current               | I-       | All channels on or off          |                     | 6               |     |                  | 6               |     |       | mA |

**Note 3:** The algebraic convention where the most negative value is a minimum and the most positive a maximum is used in this data sheet.

**Note 4:** Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.

**Note 5:** Electrical characteristics, such as on resistance, will change when power supplies other than ±15V are used.

**Note 6:** ID(on) is leakage from driver into on switch.

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## Protecting Against Fault Conditions

Fault conditions occur when power supplies are turned off and input signals are still present, or when 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 must be kept at low ( $\mu\text{A}$ ) levels, we recommend adding external protection diodes (Figure 1).

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

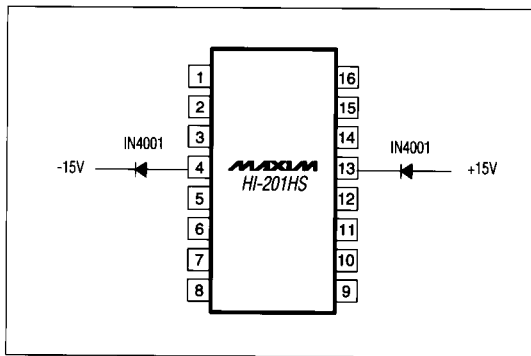


Figure 1. Protection Against Fault Conditions

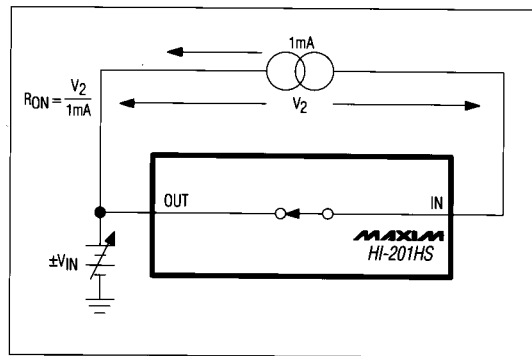


Figure 2. On Resistance

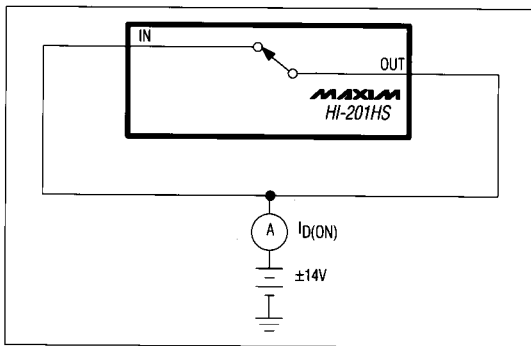


Figure 3. On Leakage Current

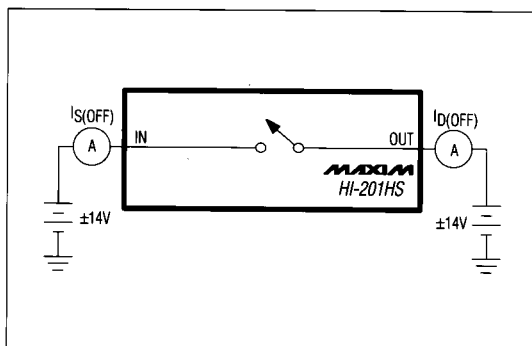


Figure 4. Off Leakage Current

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## Pin Configurations (continued)

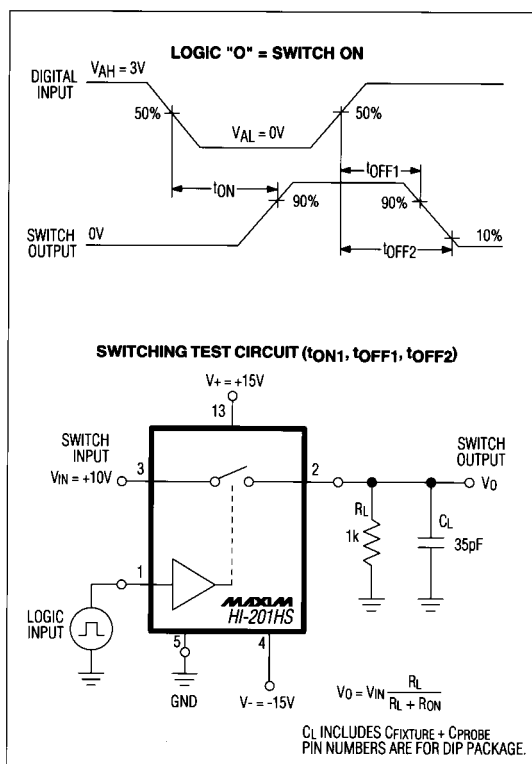
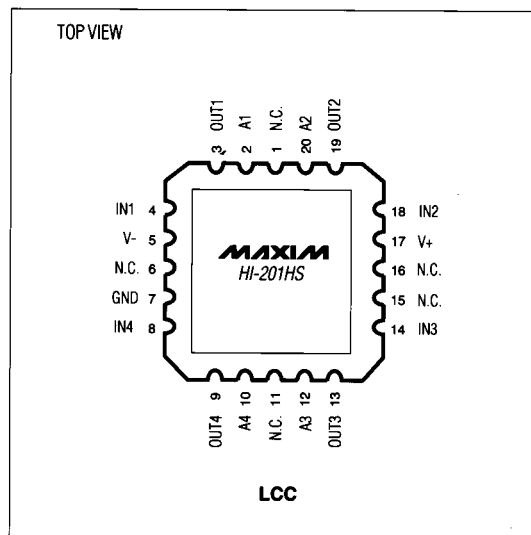


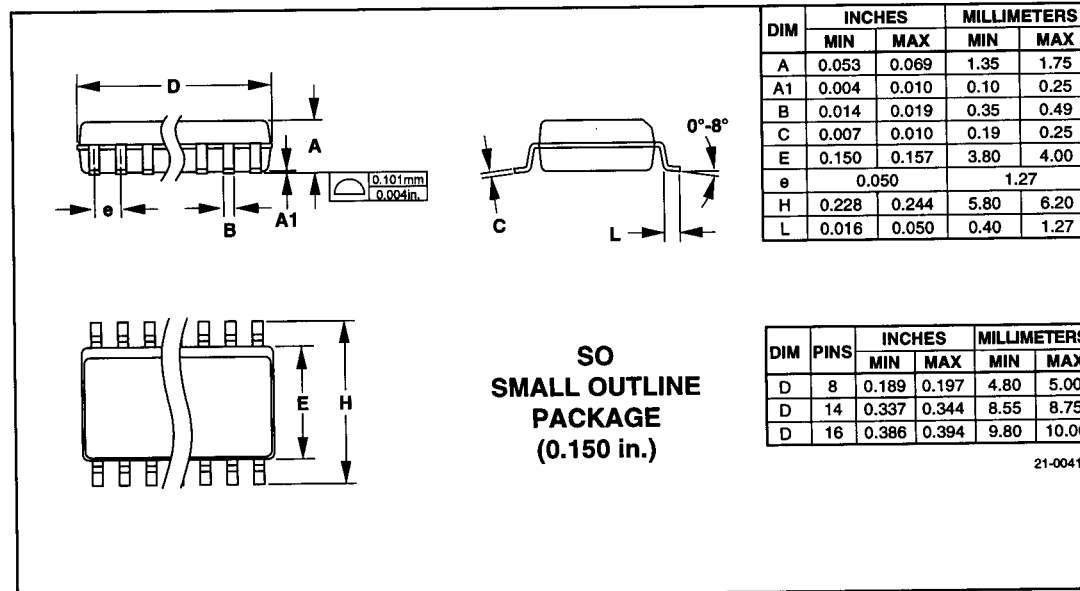
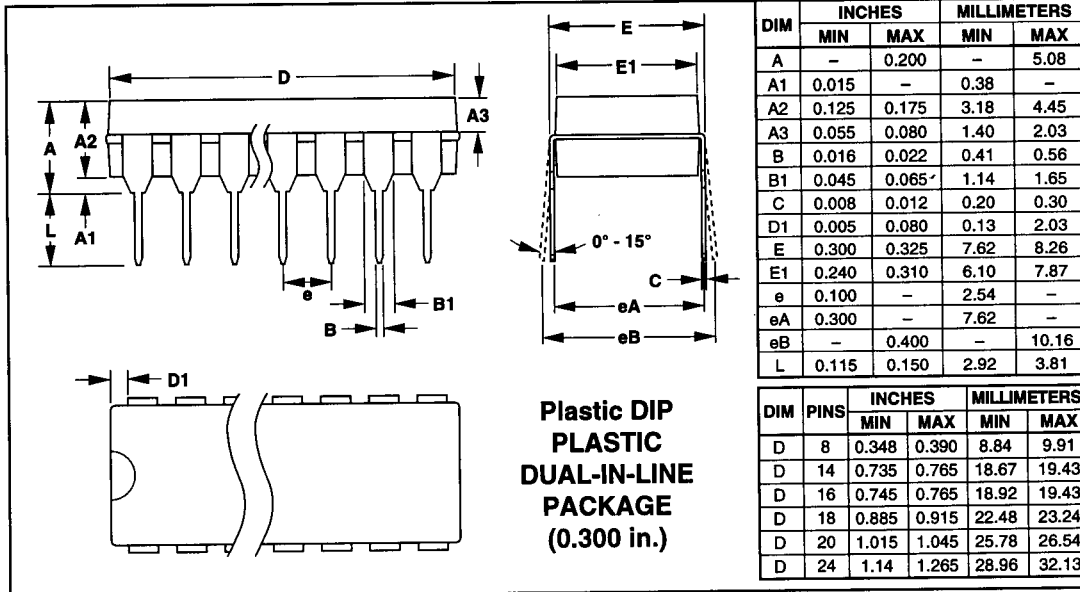
Figure 6. Switching-Time Test Circuit



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## Package Information

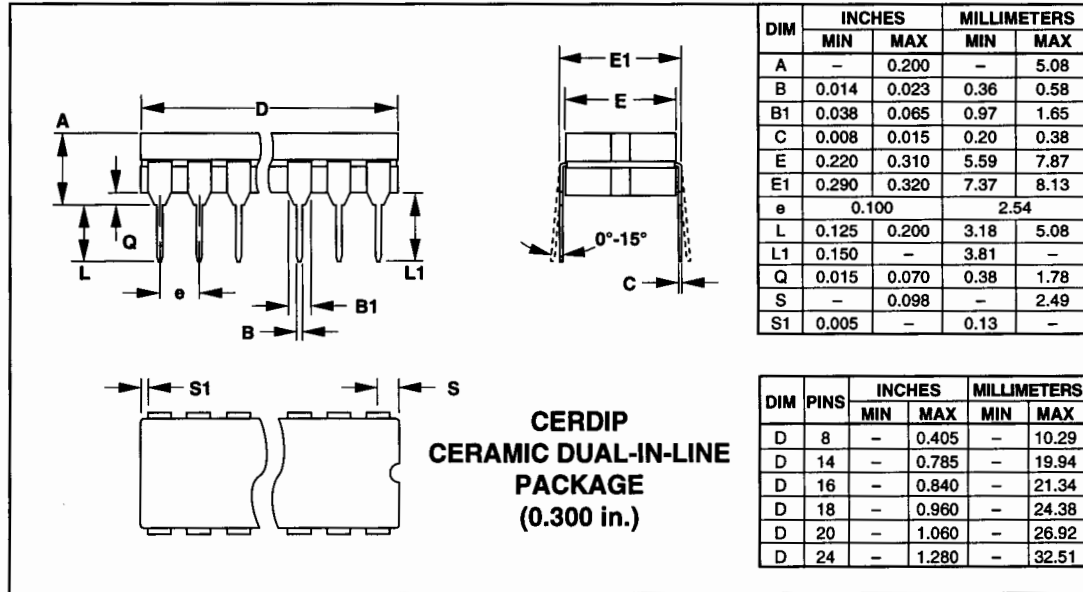
HI-201HS



**HI-201HS**

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### Package Information (continued)



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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