

August 1996

Dual/Quad SPST CMOS Analog Switches

Features

- Analog Voltage Range $\pm 15V$
- Analog Current Range..... **80mA**
- Turn-On Time **240ns**
- Low R_{ON} **55\Omega**
- Low Power Dissipation **15mW**
- TTL/CMOS Compatible

Applications

- High Frequency Analog Switching
- Sample and Hold Circuits
- Digital Filters
- Operational Amplifier Gain Switching Networks

Description

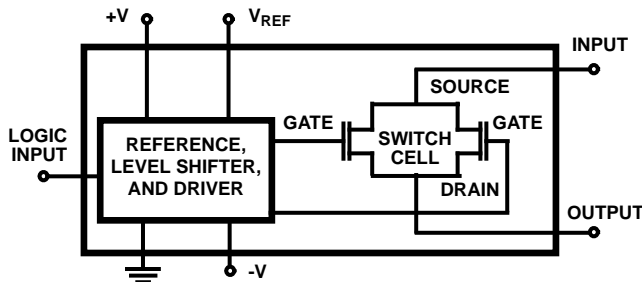
HI-200/HI-201 are monolithic devices comprising independently selectable SPST switches which feature fast switching speeds (HI-200 240ns, and HI-201 185ns) combined with low power dissipation (15mW at +25°C). Each switch provides low "ON" resistance operation for input signal voltage up to the supply rails and for signal current up to 80mA. Rugged DI construction eliminates latch-up and substrate SCR failure modes.

All devices provide break-before-make switching and are TTL and CMOS compatible for maximum application versatility. HI-200/HI-201 are ideal components for use in high frequency analog switching. Typical applications include signal path switching, sample and hold circuit, digital filters, and operational amplifier gain switching networks.

HI-200 is a dual SPST CMOS analog switch available in DIP and (TO-99) metal cans and is pin compatible with other available "200 series" switches. For MIL-STD-883 compliant parts, request the HI-200/883 data sheet.

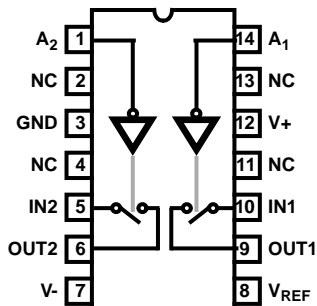
HI-201 is a quad SPST CMOS analog switch available in DIP and SOIC package and pin compatible with other available "200 series" switches. For MIL-STD-883 compliant parts, request the HI-201/883 datasheet.

Functional Diagram

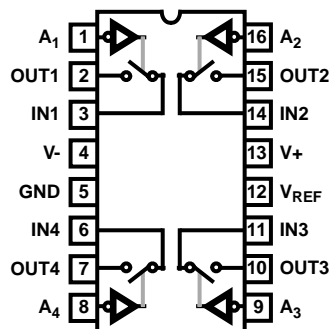


Pinouts

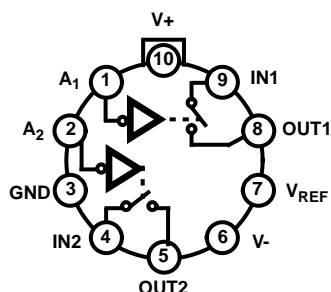
HI-200 (CERDIP, PDIP, SOIC)
TOP VIEW



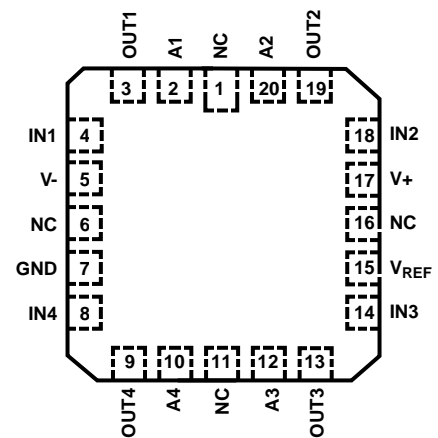
HI-201 (CERDIP, PDIP, SOIC)
TOP VIEW



HI-200 (METAL CAN)
TOP VIEW



HI-201 (PLCC, CLCC)
TOP VIEW



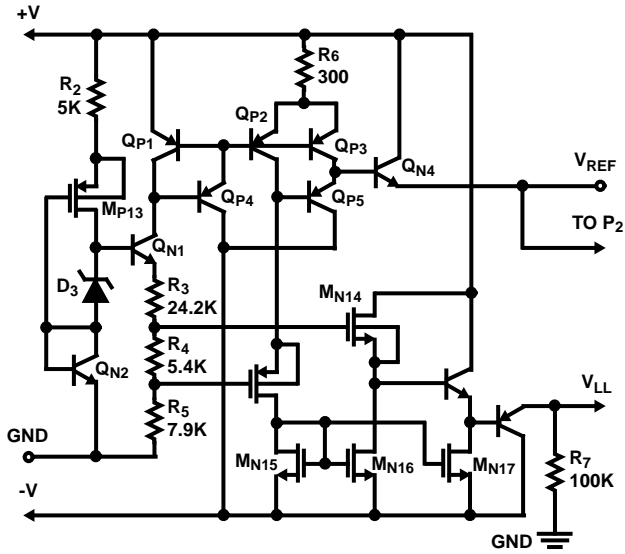
HI-200, HI-201

Ordering Information

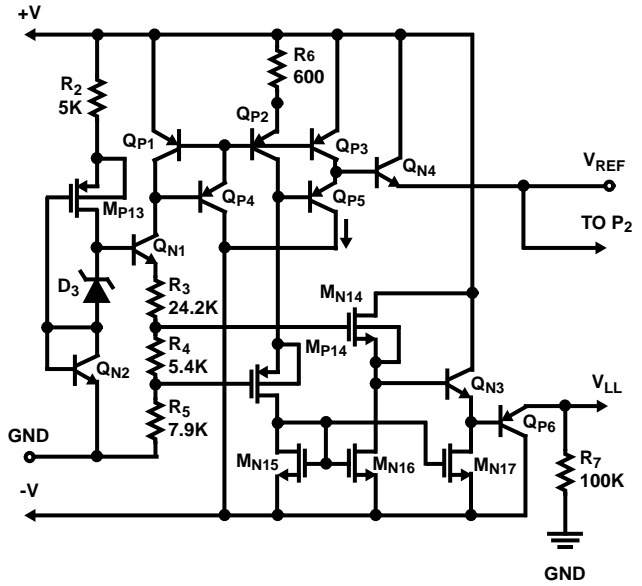
| PART NUMBER | TEMPERATURE RANGE | PACKAGE | PKG. NO. |
|--------------|------------------------------|--------------------------|----------|
| HI2-0200-5 | 0°C to +75°C | 10 Pin Metal Can | T10.B |
| HI1-0200-5 | 0°C to +75°C | 14 Lead CERDIP | F14.3 |
| HI2-0200-4 | -25°C to +85°C | 10 Pin Metal Can | T10.B |
| HI3-0200-5 | 0°C to +75°C | 14 Lead PDIP | E14.3 |
| HI2-0200-7 | 0°C to +75°C +96 Hr. Burn-In | 10 Pin Metal Can | T10.B |
| HI1-0200-7 | 0°C to +75°C +96 Hr. Burn-In | 14 Lead CERDIP | F14.3 |
| HI1-0200-2 | -55°C to +125°C | 14 Lead CERDIP | F14.3 |
| HI1-0200-4 | -25°C to +85°C | 14 Lead CERDIP | F14.3 |
| HI2-0200-2 | -55°C to +125°C | 10 Pin Metal Can | T10.B |
| HI9P0200-5 | 0°C to +75°C | 14 Lead Plastic SOIC | M14.15 |
| HI9P0200-9 | -40°C to +85°C | 14 Lead Plastic SOIC | M14.15 |
| HI1-0200/883 | -55°C to +125°C | 14 Lead CERDIP | F14.3 |
| HI2-0200/883 | -55°C to +125°C | 10 Pin Metal Can | T10.B |
| HI1-0201-7 | 0°C to +75°C +96 Hr. Burn-In | 16 Lead CERDIP | F16.3 |
| HI1-0201-5 | 0°C to +75°C | 16 Lead CERDIP | F16.3 |
| HI1-0201-4 | -25°C to +85°C | 16 Lead CERDIP | F16.3 |
| HI4P0201-5 | 0°C to +75°C | 20 Lead PLCC | N20.35 |
| HI9P0201-5 | 0°C to +75°C | 16 Lead Plastic SOIC (N) | M16.15 |
| HI9P0201-9 | -40°C to +85°C | 16 Lead Plastic SOIC (N) | M16.15 |
| HI1-0201-2 | -55°C to +125°C | 16 Lead CERDIP | F16.3 |
| HI3-0201-5 | 0°C to +75°C | 16 Lead PDIP | E16.3 |
| HI1-0201/883 | -55°C to +125°C | 16 Lead CERDIP | F16.3 |
| HI4-0201/883 | -55°C to +125°C | 20 Lead CLCC | J20.A |

Schematic Diagrams

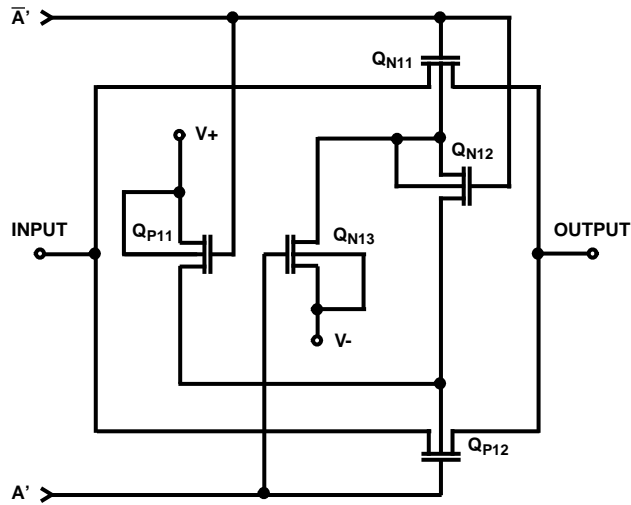
TTL/CMOS REFERENCE CIRCUIT V_{REF} CELL
HI-200



TTL/CMOS REFERENCE CIRCUIT V_{REF} CELL
HI-201

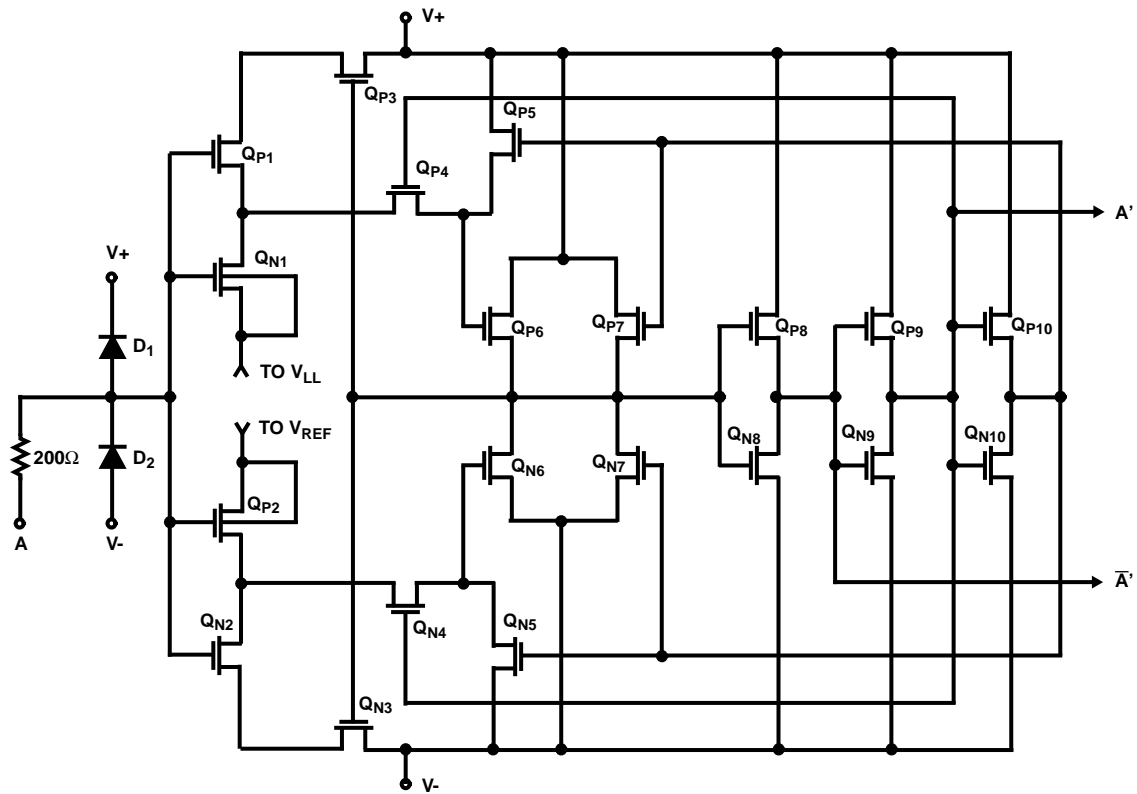


SWITCH CELL



Schematic Diagrams (Continued)

DIGITAL INPUT BUFFER AND LEVEL SHIFTER



HI-200, HI-201

Absolute Maximum Ratings

| | |
|-----------------------------------|---|
| Supply Voltage | 44V (±22) |
| V _{REF} to Ground | 20V, -5V |
| Digital Input Voltage | +V _{SUPPLY} 4V -V _{SUPPLY} -4V |
| Analog Input Voltage (One Switch) | +V _{SUPPLY} 2.0V -V _{SUPPLY} -2.0V |

Operating Temperature Range

| | |
|--------------------|----------------|
| HI-200-2, HI-201-2 | -55°C to 125°C |
| HI-200-4, HI-201-4 | -25°C to 85°C |
| HI-200-5, HI-201-5 | 0°C to 75°C |
| HI200-9, HI201-9 | -40°C to 85°C |

Thermal Information

| | | |
|---|----------------------|----------------------|
| Thermal Resistance (Typical, Note 1) | θ_{JA} (°C/W) | θ_{JC} (°C/W) |
| CERDIP Package (/883 Versions) | 80 | 24 |
| CERDIP Package (Non /883 Versions) | 95 | 40 |
| Plastic LCC Package | 80 | - |
| Plastic DIP Package | 100 | - |
| Plastic SOP Package (14 Lead) | 120 | - |
| Plastic SOP Package (16 Lead) | 100 | - |
| Metal Can Package | 160 | 75 |
| Ceramic LCC Package | 65 | 13 |
| Maximum Storage Temperature | -65°C to 150°C | |
| Maximum Junction Temperature (Hermetic) | +175°C | |
| Maximum Junction Temperature (Plastic) | +150°C | |
| Maximum Lead Temperature (Soldering, 10s) | 300°C | |
| (For Surface Mount Packages - Lead Tips Only) | | |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Characteristics Supplies = +15V, -15V; V_{REF} = Open; V_{AH} (Logic Level High) = 2.4V, V_{AL} (Logic Level Low) = +0.8V

| PARAMETER | TEST CONDITIONS | TEMP | HI-200, HI-201-2 | | | HI-200, HI201 -4, -5, -7, -9 | | | UNITS |
|---|-----------------|-------|------------------|------|-----|------------------------------|------|-----|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| SWITCHING CHARACTERISTICS | | | | | | | | | |
| Switch On Time, t _{ON} | | | | | | | | | |
| HI-200 | | +25°C | - | 240 | 500 | - | 240 | - | ns |
| HI-201 | | +25°C | - | 185 | 500 | - | 185 | - | ns |
| | | Full | - | 1000 | - | - | 1000 | - | ns |
| Switch Off Time, t _{OFF} | | | | | | | | | |
| HI-200 | | +25°C | - | 330 | 500 | - | 500 | - | ns |
| HI-201 | | +25°C | - | 220 | 500 | - | 220 | - | ns |
| | | Full | - | 1000 | - | - | 1000 | - | ns |
| "Off Isolation" | (Note 4) | | | | | | | | |
| HI-200 | | +25°C | - | 70 | - | - | 70 | - | dB |
| HI-201 | | +25°C | - | 80 | - | - | 80 | - | dB |
| Input Switch Capacitance, C _{S(OFF)} | | +25°C | - | 5.5 | - | - | 5.5 | - | pF |
| Output Switch Capacitance, C _{D(OFF)} | | +25°C | - | 5.5 | - | - | 5.5 | - | pF |
| Output Switch Capacitance, C _{D(ON)} | | +25°C | - | 11 | - | - | 11 | - | pF |
| Digital Input Capacitance, C _A | | +25°C | - | 5 | - | - | 5 | - | pF |
| Drain-to-Source Capacitance, C _{DS(OFF)} | | +25°C | - | 0.5 | - | - | 0.5 | - | pF |
| DIGITAL INPUT CHARACTERISTICS | | | | | | | | | |
| Input Low Threshold, V _{AL} | | Full | - | - | 0.8 | - | - | 0.8 | V |
| Input High Threshold, V _{AH} | | Full | 2.4 | - | - | 2.4 | - | - | V |
| Input Leakage Current (High or Low), I _A | (Note 2) | Full | - | - | 1.0 | - | - | 1.0 | μA |
| ANALOG SWITCH CHARACTERISTICS | | | | | | | | | |
| Analog Signal Range, V _S | | Full | -15 | - | +15 | -15 | - | +15 | V |

HI-200, HI-201

Electrical Characteristics Supplies = +15V, -15V; V_{REF} = Open; V_{AH} (Logic Level High) = 2.4V,
V_{AL} (Logic Level Low) = +0.8V (Continued)

| PARAMETER | TEST CONDITIONS | TEMP | HI-200, HI-201-2 | | | HI-200, HI201 -4, -5, -7, -9 | | | UNITS |
|---|-----------------|-------|------------------|-----|-----|------------------------------|-----|-----|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| On Resistance, R _{ON} | (Note 1) | +25°C | - | 55 | 70 | - | 55 | 80 | Ω |
| | | Full | - | 80 | 100 | - | 72 | 100 | Ω |
| Off Input Leakage Current, I _{S(OFF)} | (Note 6) | +25°C | - | 1 | 5 | - | 1 | 50 | nA |
| | | Full | - | 100 | 500 | - | 10 | 500 | nA |
| Off Output Leakage Current, I _{D(OFF)} | (Note 6) | +25°C | - | 1 | 5 | - | 1 | 50 | nA |
| | | Full | - | 100 | 500 | - | 10 | 500 | nA |
| On Leakage Current, I _{D(ON)} | (Note 6) | +25°C | - | 1 | 5 | - | 1 | 50 | nA |
| | | Full | - | 100 | 500 | - | 10 | 500 | nA |
| I _{S(OFF)} | | +25°C | - | 2 | 5 | - | 2 | 50 | nA |
| HI-201 | | Full | - | - | 500 | - | - | 250 | nA |
| I _{D(OFF)} | | +25°C | - | 2 | 5 | - | 2 | 50 | nA |
| HI-201 | | Full | - | 35 | 500 | - | 35 | 250 | nA |
| I _{D(ON)} | | +25°C | - | 2 | 5 | - | 2 | 50 | nA |
| HI-201 | | Full | - | - | 500 | - | - | 250 | nA |
| POWER REQUIREMENTS (Note 5) | | | | | | | | | |
| Power Dissipation, P _D | | +25°C | - | 15 | - | - | 15 | - | mW |
| | | Full | - | - | 60 | - | - | 60 | mW |
| Current, I ₊ | | +25°C | - | 0.5 | - | - | 0.5 | - | mA |
| | | Full | - | - | 2.0 | - | - | 2.0 | mA |
| Current, I ₋ | | +25°C | - | 0.5 | - | - | 0.5 | - | mA |
| | | Full | - | - | 2.0 | - | - | 2.0 | mA |

NOTES:

2. V_{OUT} = ±10V, I_{OUT} = 1mA.
3. Digital Inputs are MOS gates: typical leakage is < 1nA.
4. V_{AH} = 4.0V.
5. V_A = 5V, R_L = 1kΩ, C_L = 10pF, V_S = 3V_{RMS}, f = 100kHz.
6. V_A = +3V or V_A = 0V for Both Switches.
7. Refer to Leakage Current Measurements (Figure 4).

Performance Curves and Test Circuits T_A = +25°C, V_{SUPPLY} = 15V, V_{AH} = 2.4V, V_{AL} = 0.8V and V_{REF} = Open

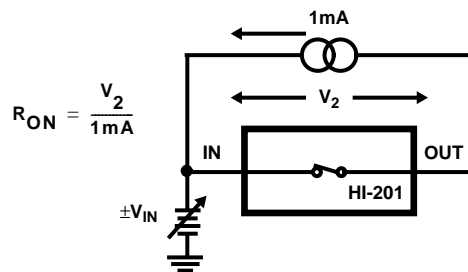


FIGURE 1. ON RESISTANCE vs ANALOG SIGNAL LEVEL, SUPPLY VOLTAGE AND TEMPERATURE

Performance Curves and Test Circuits $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = 15\text{V}$, $V_{\text{AH}} = 2.4\text{V}$, $V_{\text{AL}} = 0.8\text{V}$ and $V_{\text{REF}} = \text{Open}$
(Continued)

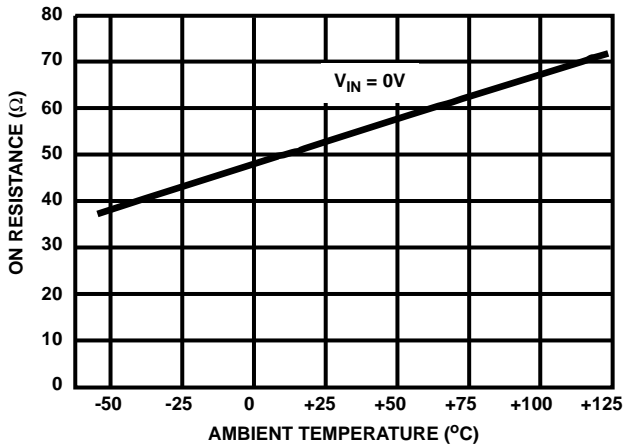


FIGURE 2. ON RESISTANCE vs TEMPERATURE

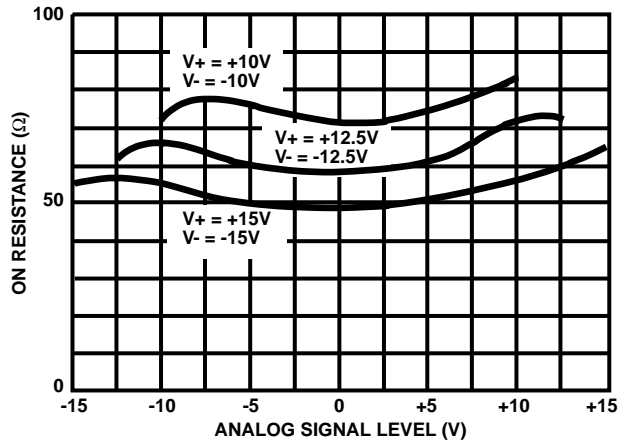


FIGURE 3. HI-201 ON RESISTANCE vs ANALOG SIGNAL LEVEL AND POWER SUPPLY VOLTAGE

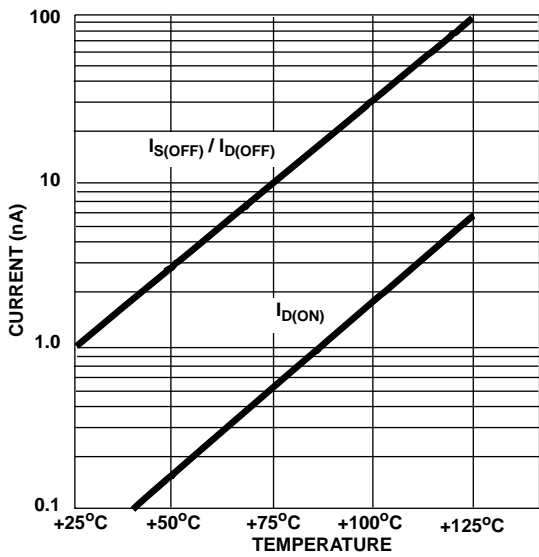


FIGURE 4A. HI-201 SWITCH LEAKAGE CURRENT vs TEMPERATURE

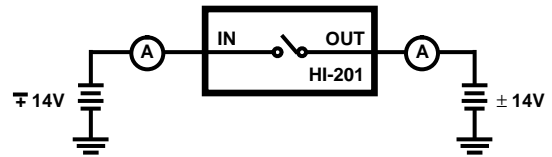


FIGURE 4B. OFF LEAKAGE CURRENT vs TEMPERATURE

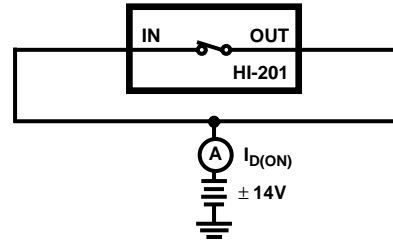


FIGURE 4C. ON LEAKAGE CURRENT vs TEMPERATURE

FIGURE 4.

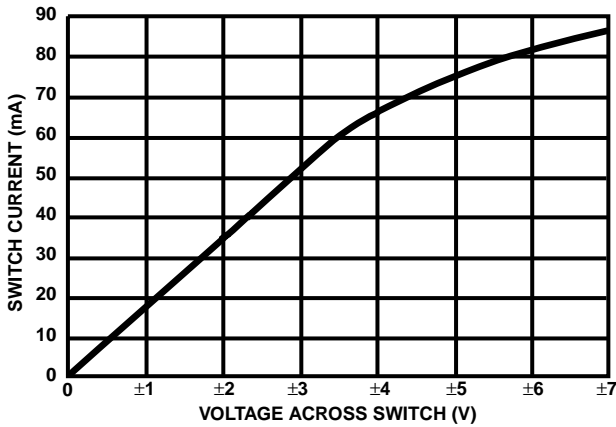


FIGURE 5A.

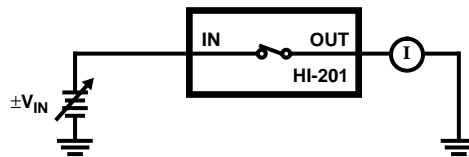


FIGURE 5B.

FIGURE 5. SWITCH CURRENT vs VOLTAGE

Switching Waveforms

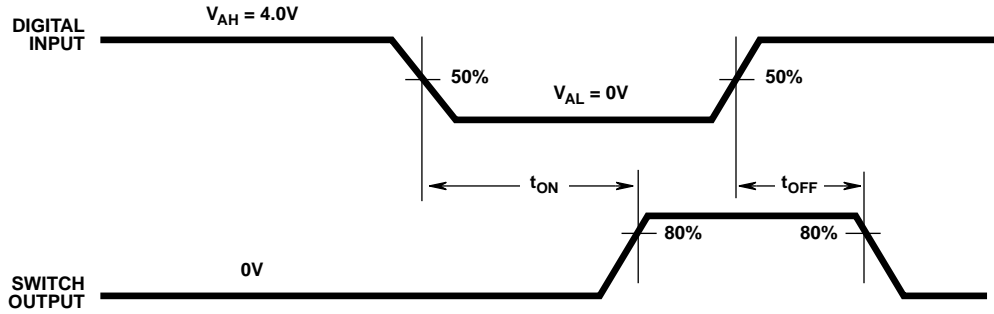


FIGURE 6. LOGIC "0" = SWITCH ON

t_{ON}, t_{OFF} (TTL INPUT), $V_{IN} = +4.0V$
 Vertical: 2V/Div.
 Horizontal: 100ns/Div.

t_{ON}, t_{OFF} (TTL INPUT), $V_{IN} = +15.0V$
 Vertical: 5V/Div.
 Horizontal: 100ns/Div.

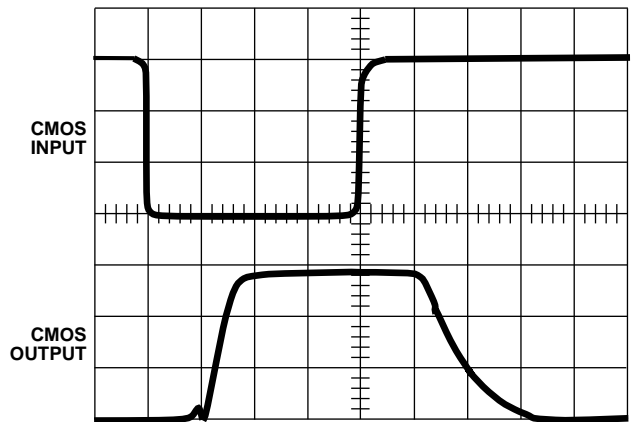
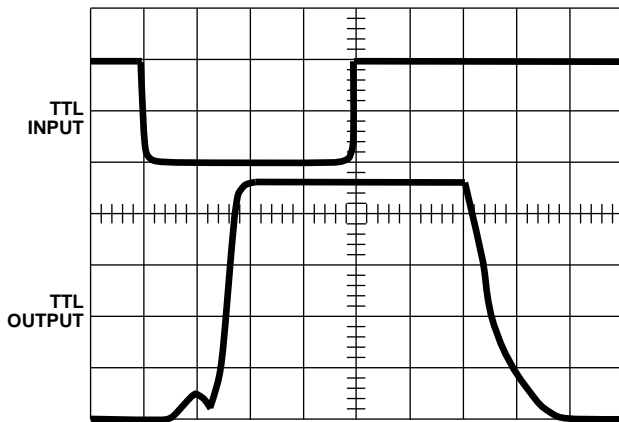


FIGURE 7. TTL INPUT

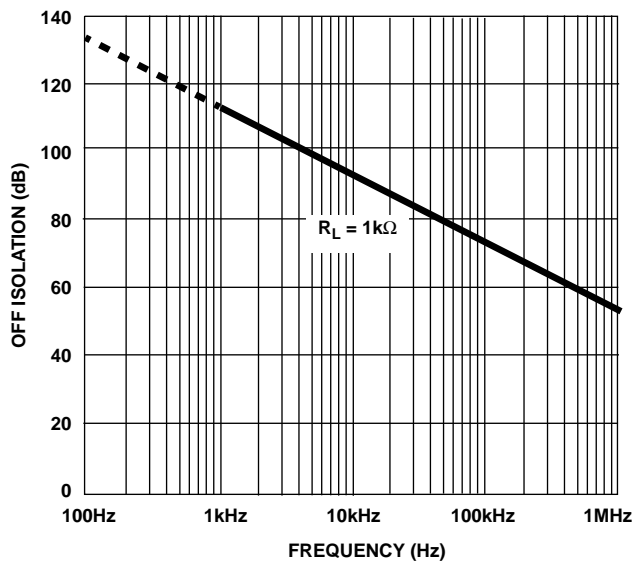


FIGURE 8. OFF ISOLATION vs FREQUENCY

For more information see Application Notes 520, 521, 531, 532 and 557.

HI-200

Die Characteristics

DIE DIMENSIONS:

54 mils x 79 mils x 19 mils

METALLIZATION:

Type: CuAL

Thickness: $16\text{k}\text{\AA} \pm 2\text{k}\text{\AA}$

GLASSIVATION:

Type: Nitride over Silox

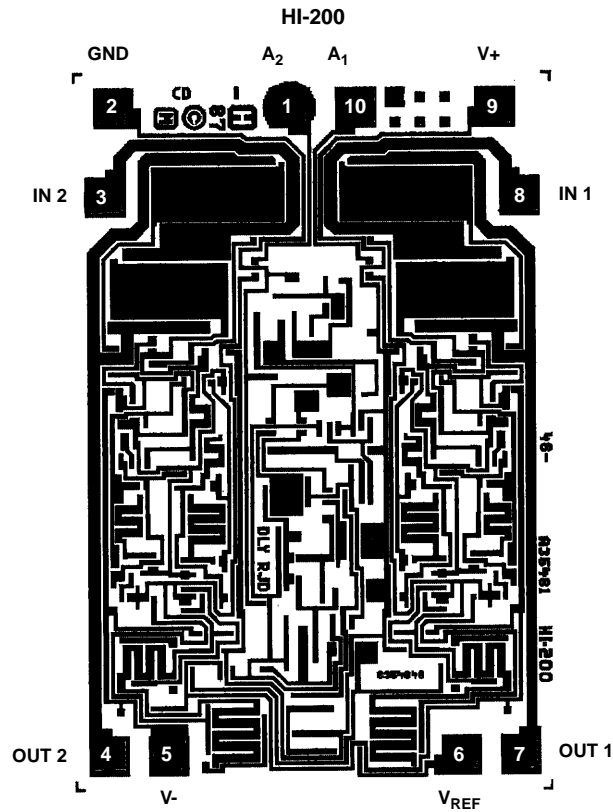
Nitride Thickness: $3.5\text{k}\text{\AA} \pm 1\text{k}\text{\AA}$

Silox Thickness: $12\text{k}\text{\AA} \pm 2\text{k}\text{\AA}$

WORST CASE CURRENT DENSITY:

$2 \times 10^5 \text{ A/cm}^2$ at 25mA

Metallization Mask Layout



Die Characteristics

DIE DIMENSIONS:

81 mils x 85 mils x 19 mils

METALLIZATION:

Type: CuAl

Thickness: 16kÅ ±2kÅ

GLASSIVATION:

Type: Nitride over Silox

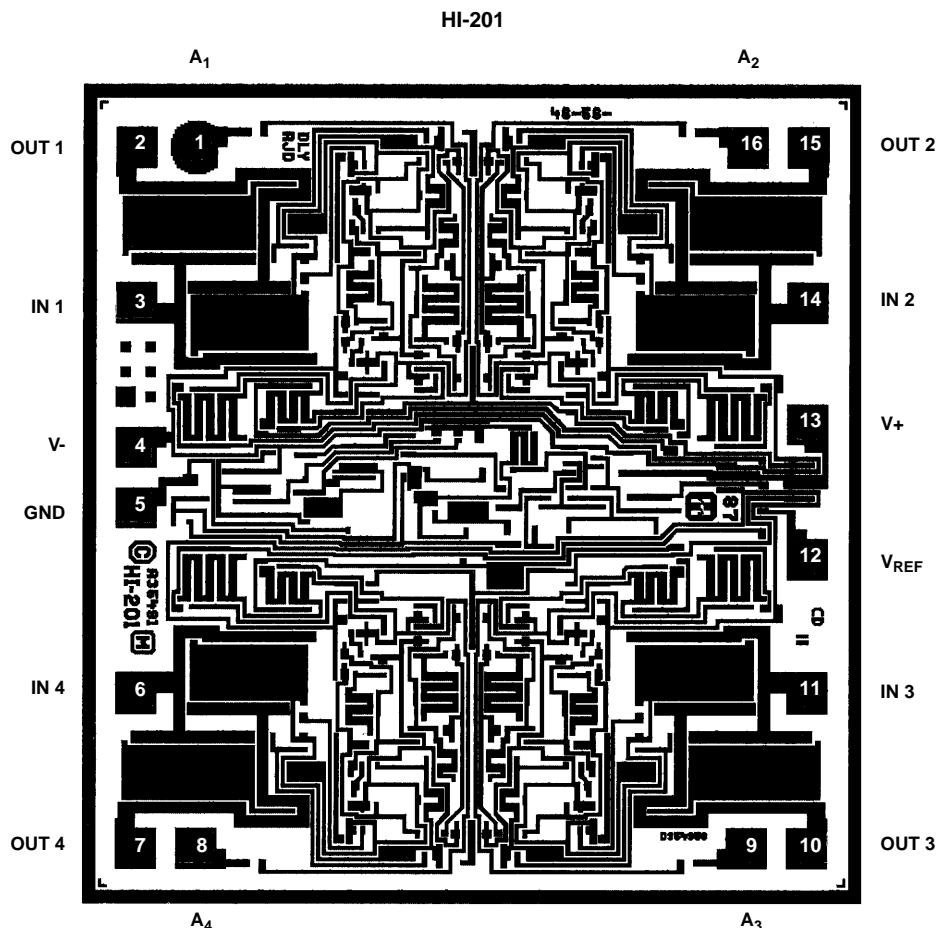
Nitride Thickness: 3.5kÅ ±1kÅ

Silox Thickness: 12kÅ ±2kÅ

WORST CASE CURRENT DENSITY:

2 x 10⁵ A/cm² at 25mA

Metallization Mask Layout



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