

## CMOS Analog Switches

### General Description

Maxim's IH5048-IH5051 analog switches are designed for applications requiring low leakage. They feature extremely low on resistance ( $30\Omega$  typical) as well as quiescent power-supply current below  $1\mu\text{A}$ . Switch control inputs are fully compatible with both CMOS and TTL logic.

These switches are plug-in upgrades for the original manufacturer's devices, with improved specifications for analog-signal range and switch on and off times. They are also pin-compatible with the IH5040 family of analog switches. The IH5048 series is supplied in 16-pin DIP and SO packages.

### Applications

Precision Sample-and-Hold Circuits  
Transducer and Sensor Switching  
Low-Level Signal Conditioning  
Battery-Powered Instrumentation  
Programmable-Gain Amplifiers

### Features

- ◆ Low Charge Injection (10pC Typ)
- ◆ Quiescent Current Below 1mA
- ◆ TTL and CMOS Compatible
- ◆ Low On Resistance ( $25\Omega$  Max for IH5048A)
- ◆ Latchup-Proof Construction

### Ordering Information

| PART       | TEMP. RANGE     | PIN-PACKAGE    |
|------------|-----------------|----------------|
| IH5048CPE  | 0°C to +70°C    | 16 Plastic DIP |
| IH5048CWE  | 0°C to +70°C    | 16 Wide SO     |
| IH5048CJE  | 0°C to +70°C    | 16 CERDIP      |
| IH5048C/D  | 0°C to +70°C    | Dice*          |
| IH5048MJE  | -55°C to +125°C | 16 CERDIP**    |
| IH5048ACPE | 0°C to +70°C    | 16 Plastic DIP |
| IH5048ACWE | 0°C to +70°C    | 16 Wide SO     |
| IH5048ACJE | 0°C to +70°C    | 16 CERDIP      |
| IH5048AC/D | 0°C to +70°C    | Dice*          |
| IH5048AMJE | -55°C to +125°C | 16 CERDIP**    |

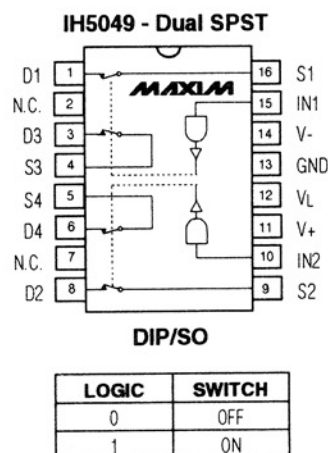
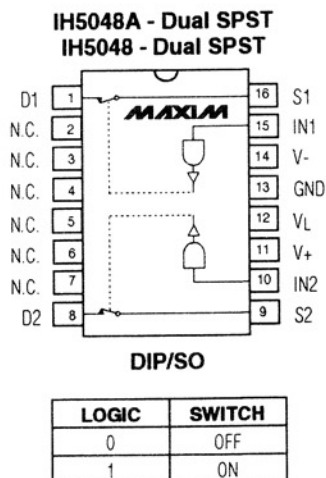
Ordering Information continued on last page.

\* Contact factory for dice specifications.

\*\* Contact factory for availability and processing to MIL-STD-883.

### Pin Configurations & Switching-State Diagrams

TOP VIEW



SWITCH STATES ARE FOR  
LOGIC "1" INPUTS (POSITIVE LOGIC)

Pin Configurations & Switching-State Diagrams are continued on last page.

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## ABSOLUTE MAXIMUM RATINGS

|                                           |                                                   |
|-------------------------------------------|---------------------------------------------------|
| V <sub>+</sub> to V <sub>-</sub>          | 36V                                               |
| V <sub>+</sub> to V <sub>D</sub>          | 30V                                               |
| V <sub>D</sub> to V <sub>-</sub>          | 30V                                               |
| V <sub>D</sub> to V <sub>S</sub>          | ±28V                                              |
| V <sub>L</sub> to V <sub>-</sub>          | 33V                                               |
| V <sub>L</sub> to V <sub>IN</sub>         | 30V                                               |
| V <sub>L</sub> to GND                     | 20V                                               |
| V <sub>IN</sub> to GND                    | 20V                                               |
| Current (any terminal)                    | 30mA                                              |
| Digital Inputs                            | (V <sub>+</sub> + 0.3V) to (V <sub>+</sub> - 38V) |
| V <sub>S</sub> or V <sub>D</sub> (Note 1) | -0.3V to (V <sub>+</sub> + 0.3V)                  |

Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 Plastic DIP (derate 10.53mW/°C above +70°C) . . . . . 842mW  
 Wide SO (derate 20.00mW/°C above +70°C) . . . . . 1600mW  
 CERDIP (derate 10.00mW/°C above +70°C) . . . . . 800mW  
 Operating Temperature Ranges:  
 IH50\_C\_/IH50\_AC\_ . . . . . 0°C to +70°C  
 IH50\_M\_/IH50\_AM\_ . . . . . -55°C to +125°C  
 Storage Temperature Range . . . . . -65°C to +150°C  
 Lead Temperature (soldering, 10sec) . . . . . +300°C

**Note 1:** Signals on S, D, and digital inputs that exceed V<sub>-</sub> or V<sub>+</sub> will be clamped by internal diodes. Limit forward diode current to 30mA maximum.

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<sub>+</sub> = 15V, V<sub>-</sub> = -15V, V<sub>L</sub> = 5V, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                                       | SYMBOL                                        | CONDITIONS                                      |              | IH50_M<br>IH50_AM |       |        | IH50_C<br>IH50_AC |      |      | UNITS |
|-------------------------------------------------|-----------------------------------------------|-------------------------------------------------|--------------|-------------------|-------|--------|-------------------|------|------|-------|
|                                                 |                                               |                                                 |              | -55°C             | +25°C | +125°C | 0°C               | +25C | +70C |       |
| Input Logic Current                             | I <sub>IN(ON)</sub>                           | V <sub>IN</sub> = 2.4V                          |              | ±1                | ±1    | ±10    | ±1                | ±1   | ±10  | μA    |
|                                                 | I <sub>IN(OFF)</sub>                          | V <sub>IN</sub> = 0.8V                          |              | ±1                | ±1    | ±10    | ±1                | ±1   | ±10  |       |
| Input Logic Low                                 | V <sub>IL</sub>                               |                                                 |              | 0.8               | 0.8   | 0.8    | 0.8               | 0.8  | 0.8  | V     |
| Input Logic High                                | V <sub>IH</sub>                               |                                                 |              | 2.4               | 2.4   | 2.4    | 2.4               | 2.4  | 2.4  | V     |
| Drain-Source On Resistance                      | r <sub>DS(ON)</sub>                           | I <sub>S</sub> = 10mA,<br>V <sub>D</sub> = ±10V | IH5048A only | 25                | 25    | 35     | 30                | 30   | 45   | Ω     |
|                                                 |                                               |                                                 | All others   | 40                | 40    | 60     | 45                | 45   | 75   |       |
| Channel-to-Channel<br>r <sub>DS(ON)</sub> Match | Δr <sub>DS(ON)</sub>                          |                                                 |              | 8 (typ)           |       |        | 8 (typ)           |      |      | Ω     |
| Minimum Analog Signal<br>Handling Capability    | V <sub>ANALOG</sub>                           |                                                 |              | ±14               | ±14   | ±14    | ±14               | ±14  | ±14  | V     |
| Switch-Off Leakage Current                      | I <sub>D</sub> /I <sub>S(OFF)</sub>           | V <sub>ANALOG</sub> = -10V to 10V               |              | ±1                |       | ±100   | ±5                |      | ±100 | nA    |
| Switch-On Leakage Current                       | I <sub>D(ON)</sub><br>+<br>I <sub>S(ON)</sub> | V <sub>D</sub> = V <sub>S</sub> = -10V to 10V   |              | ±2                |       | ±200   | ±10               |      | ±200 | nA    |
| Switch-On Time                                  | t <sub>ON</sub>                               | Figure 1                                        |              | 400               |       |        | 600               |      |      | ns    |
| Switch-Off Time                                 | t <sub>OFF</sub>                              | Figure 1                                        |              | 200               |       |        | 300               |      |      | ns    |
| Charge Injection                                | Q <sub>INJ</sub>                              | Figure 2 (Note 2)                               |              | 10<br>(typ)       |       |        | 10<br>(typ)       |      |      | pC    |
| Minimum Off-Isolation<br>Rejection Ratio        | O <sub>IRR</sub>                              | Figure 3, C <sub>L</sub> < 5pF                  |              | 54<br>(typ)       |       |        | 50<br>(typ)       |      |      | dB    |

# CMOS Analog Switches

## ELECTRICAL CHARACTERISTICS (continued)

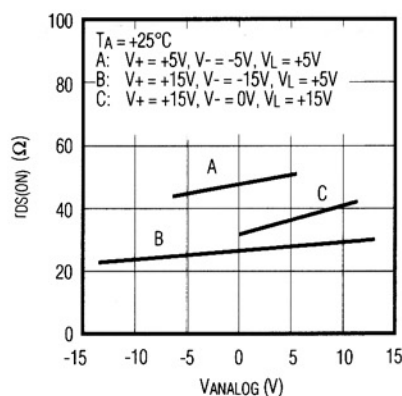
( $V_+ = 15V$ ,  $V_- = -15V$ ,  $V_L = 5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

| PARAMETER                                                 | SYMBOL           | CONDITIONS               | IH50_M<br>IH50_AM |       |        | IH50_C<br>IH50_AC |       |       | UNITS   |
|-----------------------------------------------------------|------------------|--------------------------|-------------------|-------|--------|-------------------|-------|-------|---------|
|                                                           |                  |                          | -55°C             | +25°C | +125°C | 0°C               | +25°C | +70°C |         |
| V+ Quiescent Current                                      | I+Q              | $V_{IN} = 0V$ or $5V$    | 1                 | 1     | 10     | 10                | 10    | 100   | $\mu A$ |
| V- Quiescent Current                                      | I-Q              | $V_{IN} = 0V$ or $5V$    | -1                | -1    | -10    | -10               | -10   | -100  | $\mu A$ |
| +5V Quiescent Current                                     | I <sub>LQ</sub>  | $V_{IN} = 0V$ or $5V$    | 1                 | 1     | 10     | 10                | 10    | 100   | $\mu A$ |
| Ground Quiescent Current                                  | I <sub>GND</sub> | $V_{IN} = 0V$ or $5V$    | 1                 | 1     | 10     | 10                | 10    | 100   | $\mu A$ |
| Minimum Channel-to-Channel Cross-Coupling Rejection Ratio | CCRR             | One channel off (Note 2) | 54<br>(typ)       |       |        | 50<br>(typ)       |       |       | dB      |

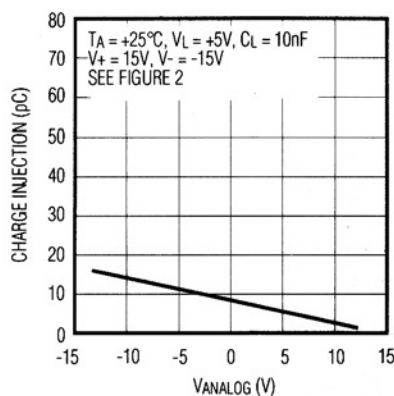
**Note 2:** Not production tested.

## Typical Operating Characteristics

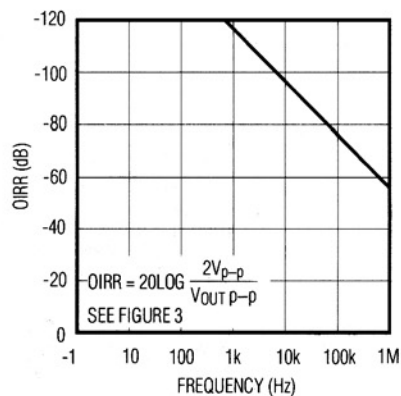
**DRAIN-SOURCE ON RESISTANCE vs. ANALOG SIGNAL**



**CHARGE INJECTION vs. ANALOG SIGNAL**



**OFF-ISOLATION REJECTION RATIO (OIRR)**



## Test Circuits

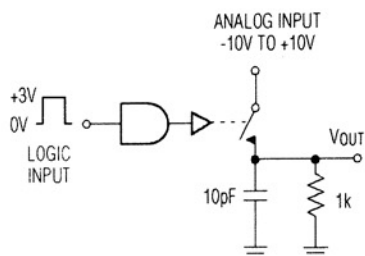


Figure 1. Switching Time

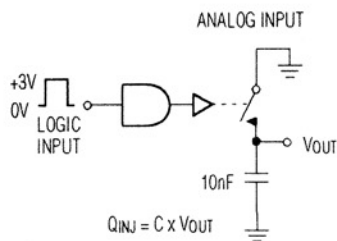


Figure 2. Charge Injection

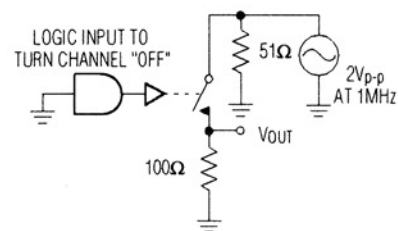
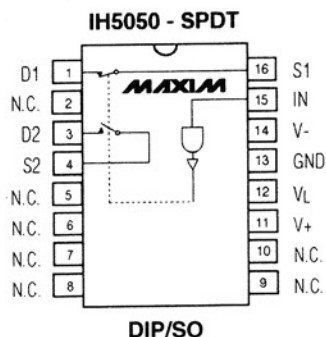


Figure 3. Off-Isolation Rejection Ratio

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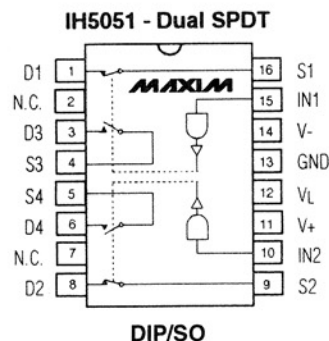
## Pin Configurations & Switching-State Diagrams (continued)

TOP VIEW



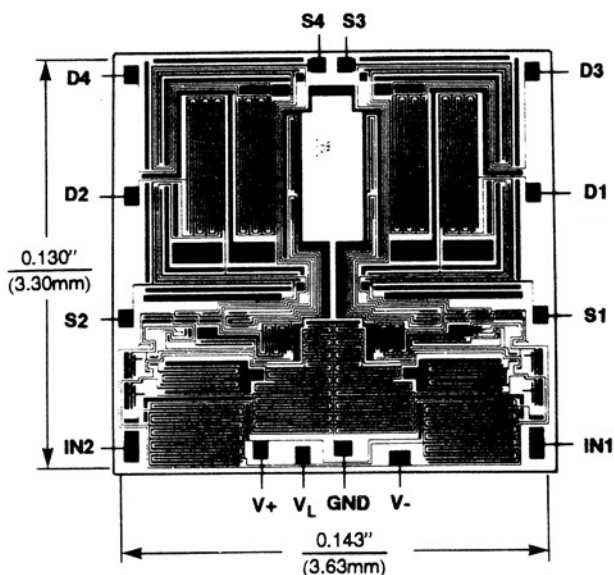
SWITCH STATES ARE FOR LOGIC "1" INPUTS (POSITIVE LOGIC)

| LOGIC | SWITCH 1 | SWITCH 2 |
|-------|----------|----------|
| 0     | OFF      | ON       |
| 1     | ON       | OFF      |



| LOGIC | SWITCH 1, SWITCH 2 | SWITCH 3, SWITCH 4 |
|-------|--------------------|--------------------|
| 0     | OFF                | ON                 |
| 1     | ON                 | OFF                |

## Chip Topography



## Ordering Information (continued)

| PART             | TEMP. RANGE     | PIN-PACKAGE    |
|------------------|-----------------|----------------|
| IH5049CPE        | 0°C to +70°C    | 16 Plastic DIP |
| IH5049CWE        | 0°C to +70°C    | 16 Wide SO     |
| IH5049CJE        | 0°C to +70°C    | 16 CERDIP      |
| IH5049C/D        | 0°C to +70°C    | Dice*          |
| IH5049MJE        | -55°C to +125°C | 16 CERDIP**    |
| <b>IH5050CPE</b> | 0°C to +70°C    | 16 Plastic DIP |
| IH5050CWE        | 0°C to +70°C    | 16 Wide SO     |
| IH5050CJE        | 0°C to +70°C    | 16 CERDIP      |
| IH5050C/D        | 0°C to +70°C    | Dice*          |
| IH5050MJE        | -55°C to +125°C | 16 CERDIP**    |
| <b>IH5051CPE</b> | 0°C to +70°C    | 16 Plastic DIP |
| IH5051CWE        | 0°C to +70°C    | 16 Wide SO     |
| IH5051ACJE       | 0°C to +70°C    | 16 CERDIP      |
| IH5051AC/D       | 0°C to +70°C    | Dice*          |
| IH5051MJE        | -55°C to +125°C | 16 CERDIP**    |

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