# Low Power Fast CMOS Analog Switches

## ABSOLUTE MAXIMUM RATINGS

Current (Any Terminal) ..... < 30mA
Storage Temperature ..... -65°C to +150°C
Operating Temperature ..... -55°C to +125°C
Power Dissipation ..... 450mW
(All Leads Soldered to a P.C. Board)
Derate 6mW/°C Above +70°C
Lead Temperature (Soldering, 10 sec) ..... 300°C
Voltages
$V^+ - V^-$ ..... < 38V
$V^+ - V_D$ ..... < 30V
$V_D - V^-$ ..... <30V
$V_D - V_S$ ..... < ±22V
$V_L - V^-$ ..... < 33V
$V_L - V_{IN}$ ..... < 30V
$V_L$ - GND ..... < 20V
$V_{IN}$ - GND ..... < 20V
Digital Inputs ..... $(V^+ + 0.3V)$ to $(V^+ - 38V)$
$V_S$ or $V_D$ ..... -0.3V to $(V^+ + 0.3V)$ (Note 1)

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

*Stresses above 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 above 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

(All Parameters with $V^+ = +15V$, $V^- = -15V$, $V_L = +5V$, unless otherwise indicated)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN./MAX. LIMITS | | | | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MILITARY | | | COMMERCIAL | | | |
| | | | -55°C | +25°C | +125°C | 0°C | +25°C | +70°C | |
| Input Logic Current | $I_{INH}$ | $V_{IN} = 2.4V$ (Note 2) | ±1 | ±1 | 10 | ±1 | ±1 | 10 | µA |
| Input Logic Current | $I_{INL}$ | $V_{IN} = 0.8V$ (Note 2) | ±1 | ±1 | 10 | ±1 | ±1 | 10 | µA |
| Drain-Source On Resistance | $r_{DS(ON)}$ | $I_S = -10mA$<br>$V_{ANALOG} = -10V$ to $+10V$ | 50 | 50 | 75 | 75 | 75 | 100 | Ω |
| Channel to Channel $r_{DS(ON)}$ Match | $\Delta r_{DS(ON)}$ | | | 3 (typ) | | | 5 (typ) | | Ω |
| Minimum Analog Signal Handling Capability | $V_{ANALOG}$ | | | ±15 | | | ±15 | | V |
| Switch OFF Leakage Current | $I_{D(OFF)}$<br>$+ I_{S(OFF)}$ | $V_D = +10V$, $V_S = -10V$<br>$V_D = -10V$, $V_S = +10V$ | | ±0.5<br>±0.5 | 100<br>100 | | ±5<br>±5 | 100<br>100 | nA |
| Switch ON Leakage Current | $I_{D(ON)}$<br>$+ I_{S(ON)}$ | $V_D = V_S = -10V$ to $+10V$ | | ±1 | 200 | | ±2 | 200 | nA |
| Switch "ON" Time<br>Switch "OFF" Time | $t_{ON}$<br>$t_{OFF}$ | | See switching time specifications and timing diagrams. | | | | | | |
| Charge Injection | $Q_{(INJ.)}$ | (Note 3) | | 10 (typ) | | | 15 (typ) | | pC |
| Minimum Off Isolation Rejection Ratio | OIRR | f = 1MHz, $R_L = 100\Omega$,<br>$C_L \leq 5pF$ (Note 3) | | 54 (typ) | | | 50 (typ) | | dB |
| + Power Supply Quiescent Current | $I^+$ | $V^+ = +15V$, $V^- = -15V$,<br>$V_L = +5V$ | 1.0 | 1.0 | 10.0 | 10 | 10 | 100 | µA |
| - Power Supply Quiescent Current | $I^-$ | | -1.0 | -1.0 | -10.0 | -10 | -10 | -100 | µA |
| +5V Supply Quiescent Current | $I_L$ | | 1.0 | 1.0 | 10.0 | 10 | 10 | 100 | µA |
| Ground Supply Quiescent Current | $I_{GND}$ | | 1.0 | 1.0 | 10.0 | 10 | 10 | 100 | µA |
| Minimum Channel to Channel Cross Coupling Rejection Ratio | CCRR | One Channel Off (Note 3) | | 54 (typ) | | | 50 (typ) | | dB |
| Power Supply Range for Continuous Operation | $V_{OP}$ | (Note 4) | | ±4.5 (min)<br>±18V (max) | | | ±4.5 (min)<br>±18V (max) | | V |

**Note:**
2. Some channels are turned on by high (1) logic inputs and other channels are turned on by low (0) inputs; however, 0.8V to 2.4V describes the minimum range for switching properly. Refer to logic diagrams to find logical value of logic input required to produce ON or OFF state.
3. Typical values are for design aid only, not guaranteed and not subject to production testing.
4. Electrical characteristics, such as ON Resistance, will change when power supplies, other than ±15V, are used.

## SWITCHING TIME SPECIFICATIONS

($t_{on}$, $t_{off}$ are maximum specifications and $t_{on}$-$t_{off}$ is minimum specifications)

| PART NUMBER | CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MILITARY | | | COMMERCIAL | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | -55°C | +25°C | +125°C | 0°C | +25°C | +70°C | |
| IH5140-5141 | Switch "ON" time | $t_{on}$ | Figure 1 | | 100* | | | 150 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 75* | | | 125 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| | Switch "ON" time | $t_{on}$ | Figure 2 | | 150 | | | 175 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125 | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| IH5142-5143 | Switch "ON" time | $t_{on}$ | Figure 1 | | 175* | | | 250 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125* | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| | Switch "ON" time | $t_{on}$ | Figure 2 | | 200 | | | 300 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125 | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| | Switch "ON" time | $t_{on}$ | Figure 3 | | 175* | | | 250 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125* | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| | Switch "ON" time | $t_{on}$ | Figure 4 | | 200 | | | 300 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125 | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| IH5144-5145 | Switch "ON" time | $t_{on}$ | Figure 1 | | 175* | | | 250 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125* | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |
| | Switch "ON" time | $t_{on}$ | Figure 2 | | 200 | | | 300 | | ns |
| | Switch "OFF" time | $t_{off}$ | | | 125 | | | 150 | | |
| | Break-before-make | $t_{on}$-$t_{off}$ | | | 10* TYP | | | 5 | | |

Note: Switching times are measured at 90% points.

* Guaranteed but not subjected to production testing.

## Switching Time Test Circuits

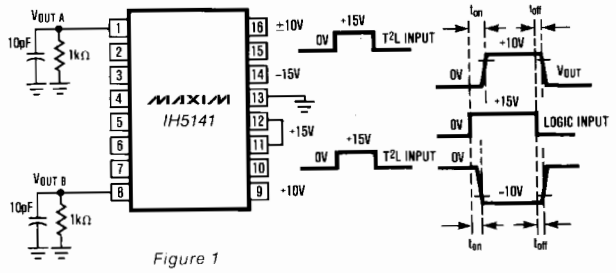



Figure 1

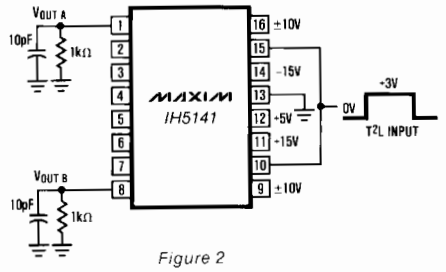



Figure 2

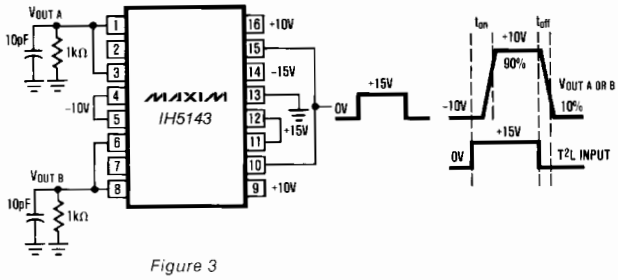



Figure 3

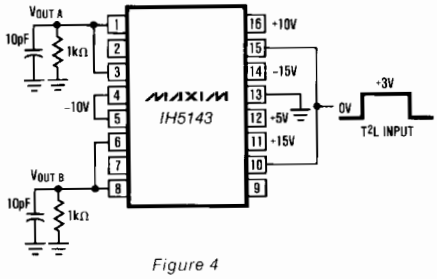
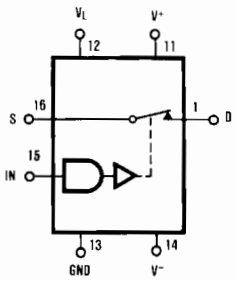



Figure 4

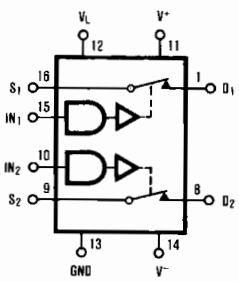
# Low Power Fast CMOS Analog Switches

## Pin Configuration and Switching State Diagrams

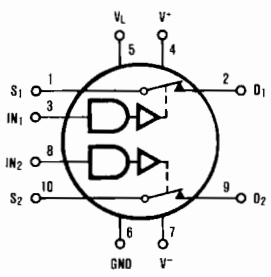
IH5140 SPST
DIP (JE, PE, WE)



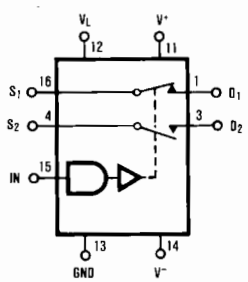

IH5141 Dual SPST
DIP (JE, PE, WE)



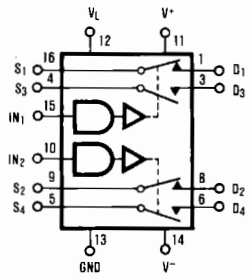

IH5141 Dual SPST
TO-100 Metal Can



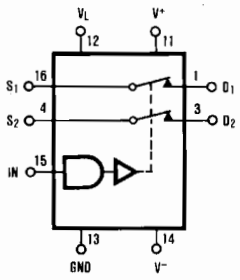

IH5142 SPDT
DIP (JE, PE, WE)




IH5143 Dual SPDT
DIP (JE, PE, WE)




IH5144 DPST
DIP (JE, PE, WE)




IH5145 Dual DPST
DIP (JE, PE, WE)

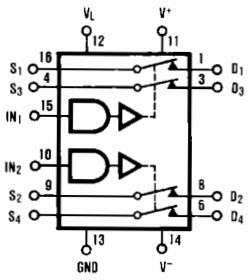



**Table 1. USING THE 5140 FAMILY WITH ONLY 2 SUPPLIES**

($V_L$ tied to $V^+$)

| SUPPLY VOLTAGES | MIN. LOGIC I/P FOR "1" STATE |
|---|---|
| ±15V | +12.6V |
| +12V | +9.6V |
| ±10V | +7.6V |
| ±5V | +2.6V |

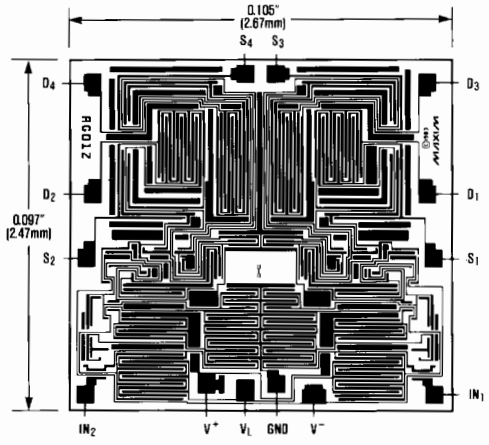
**Note:** Switch states are for logic "1" input.

## Ordering Information (continued)

| PART | TEMP. RANGE | PACKAGE |
|---|---|---|
| **DOUBLE POLE SINGLE THROW (DPST)** | | |
| IH5144C/D | 0°C to +70°C | DICE |
| IH5144CJE | 0°C to +70°C | 16 Lead CERDIP |
| IH5144CPE | 0°C to +70°C | 16 Lead Plastic DIP |
| IH5144CWE | 0°C to +70°C | 16 Lead Wide SO |
| IH5144M/D | -55°C to +125°C | DICE |
| IH5144MJE | -55°C to +125°C | 16 Lead CERDIP |
| **DUAL DOUBLE POLE SINGLE THROW (DUAL DPST)** | | |
| IH5145C/D | 0°C to +70°C | DICE |
| IH5145CJE | 0°C to +70°C | 16 Lead CERDIP |
| IH5145CPE | 0°C to +70°C | 16 Lead Plastic DIP |
| IH5145CWE | 0°C to +70°C | 16 Lead Wide SO |
| IH5145M/D | -55°C to +125°C | DICE |
| IH5145MJE | -55°C to +125°C | 16 Lead CERDIP |

*For the IH5142 and IH5144 in 10 Lead Metal Can package contact factory. For all devices in Ceramic Flat Package contact factory.*

## Chip Topography



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