

T-51-11



HI-381/384/ 387/390

CMOS Analog Switches

HI-381/384/387/390

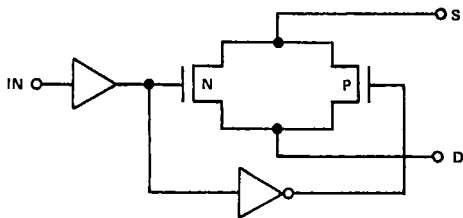
Features

- Analog Signal Range ($\pm 15V$ Supplies) $\pm 15V$
- Low Leakage (Typical @ $+25^{\circ}C$) $40pA$
- Low Leakage (Typical @ $+125^{\circ}C$) $1nA$
- Low On Resistance (Typical @ $+25^{\circ}C$) 35Ω
- Break-Before-Make Delay (Typical) $60ns$
- Charge Injection $30pC$
- TTL Compatible
- Symmetrical Switch Elements
- Low Operating Power $1.0mW$

Applications

- Sample and Hold i.e. Low Leakage Switching
- Op Amp Gain Switching i.e. Low On Resistance
- Portable Battery Operated Circuits
- Low Level Switching Circuits
- Dual or Single Supply Systems

Functional Diagram



TYPICAL SWITCH 300 SERIES

Description

The HI-381 through HI-390 series of switches are monolithic devices fabricated using CMOS technology and the Harris dielectric isolation process. These devices are TTL compatible and are available in four switching configurations. (See device pinout for particular switching function with a logic "1" input.)

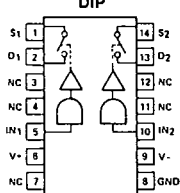
These switches feature low leakage and supply currents, low and nearly constant ON resistance over the analog signal range, break-before-make switching and low power dissipation.

The HI-381 and HI-387 switches are available in a 14 pin Epoxy or Ceramic DIP or 10 pin Metal Can. The HI-384 and HI-390 are available in a 16 pin Epoxy or Ceramic DIP. Each of the individual switch types are available in the $-55^{\circ}C$ to $+125^{\circ}C$ and $0^{\circ}C$ to $+75^{\circ}C$ operating ranges.

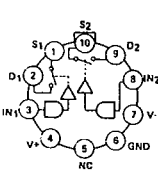
Pinouts (SWITCH STATES ARE FOR A LOGIC "1" INPUT)

DUAL SPST HI-381

TOP VIEWS



METAL CAN

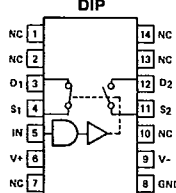


LOGIC	SW 1-2
0	OFF
1	ON

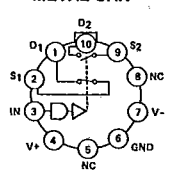
* The substrate and case are internally tied to V-. (The case should not be used as the V- connection, however.)

SPDT HI-387

TOP VIEWS



METAL CAN

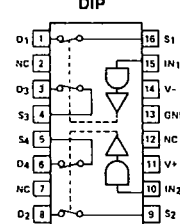


LOGIC	SW 1	SW 2
0	OFF	ON
1	ON	OFF

* The substrate and case are internally tied to V-. (The case should not be used as the V- connection, however.)

DUAL DPST HI-384

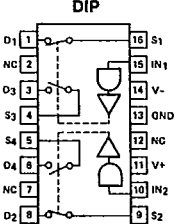
TOP VIEW



LOGIC	SW 1-4
0	OFF
1	ON

DUAL SPDT HI-390

TOP VIEW



LOGIC	SW 1 SW 2	SW 3 SW 4
0	OFF	ON
1	ON	OFF

CAUTION: These devices are sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

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Specifications HI-381/384/387/390

Absolute Maximum Ratings (Note 1)

Voltage Between Supplies	44V (± 22)
Digital Input Voltage	+V _{SUPPLY} +4V -V _{SUPPLY} -4V
Analog Input Voltage	+V _{SUPPLY} +1.5V -V _{SUPPLY} -1.5V
Total Power Dissipation*	14 Pin Epoxy DIP 526mW 14 Pin Ceramic DIP 588mW 16 Pin Epoxy DIP 625mW 16 Pin Ceramic DIP 685mW 10 Pin Metal Can* 435mW

Operating Temperature Range

HI-3XX-2	-55°C to +125°C
HI-3XX-5	0°C to +75°C
Storage Temperature	-65°C to +150°C

*Derate 6.9mW/°C Above T_A = +70°C

Electrical Specifications

Unless Otherwise Specified:

Supplies = +15V, -15V; V_{IN} = Logic Input.V_{IN} for Logic "1" = 4V, for Logic "0" = 0.8V

PARAMETER	TEMP	-55°C to +125°C			0°C to +75°C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
ANALOG SWITCH CHARACTERISTICS								
Analog Signal Range	Full	-15	-	+15	-15	-	+15	V
R _{ON} , On Resistance (Note 2)	+25°C	-	35	50	-	35	50	Ω
I _S (OFF), Off Input Leakage Current (Note 3)	Full	-	40	75	-	40	75	Ω
	+25°C	-	0.04	1	-	0.04	5	nA
I _D (OFF), Off Output Leakage Current (Note 3)	Full	-	1	100	-	0.2	100	nA
	+25°C	-	0.04	1	-	0.04	5	nA
I _D (ON), On Leakage Current (Note 4)	Full	-	1	100	-	0.2	100	nA
	+25°C	-	0.03	1	-	0.03	5	nA
	Full	-	0.5	100	-	0.2	100	nA
DIGITAL INPUT CHARACTERISTICS								
V _{INL} , Input Low Level	Full	-	-	0.8	-	-	0.8	V
V _{INH} , Input High Level	Full	4	-	-	4	-	-	V
I _{INL} , Input Leakage Current (Low) (Note 5)	Full	-	-	1	-	-	1	μA
I _{INH} , Input Leakage Current (High) (Note 5)	Full	-	-	1	-	-	1	μA
SWITCHING CHARACTERISTICS								
t _{OPEN} , Break-Before Make Delay (HI-387/390 Only)	+25°C	-	60	-	-	60	-	ns
t _{ON} , Switch On Time	+25°C	-	210	300	-	210	300	ns
t _{OFF} , Switch Off Time	+25°C	-	160	250	-	160	250	ns
"Off Isolation" (Note 6)	+25°C	-	60	-	-	60	-	dB
Charge Injection (Note 7)	+25°C	-	3	-	-	3	-	mV
C _S (OFF), Input Switch Capacitance	+25°C	-	16	-	-	16	-	pF
C _D (OFF), Output Switch Capacitance	+25°C	-	14	-	-	14	-	pF
C _D (ON), Output Switch Capacitance	+25°C	-	35	-	-	35	-	pF
C _{IN} , (High) Digital Input Capacitance	+25°C	-	5	-	-	5	-	pF
C _{IN} , (Low) Digital Input Capacitance	+25°C	-	5	-	-	5	-	pF
POWER REQUIREMENTS								
I ⁺ , Current (Note 8)	+25°C	-	0.09	0.5	-	0.09	0.5	mA
	Full	-	-	1	-	-	1	mA
I ⁻ , Current (Note 8)	+25°C	-	0.01	10	-	0.01	100	μA
	Full	-	-	100	-	-	-	μA
I ⁺ , Current (Note 9)	+25°C	-	0.01	10	-	0.01	100	μA
	Full	-	-	100	-	-	-	μA
I ⁻ , Current (Note 9)	+25°C	-	0.01	10	-	0.01	100	μA
	Full	-	-	100	-	-	-	μA

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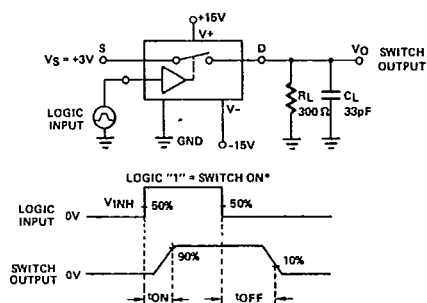
Electrical Specifications Notes:

- As with all semiconductors, stresses listed under "Absolute Maximum Ratings" may be applied to devices (one at a time) without resulting in permanent damage. This is a stress rating only. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. The conditions listed under "Electrical Specifications" are the only conditions recommended for satisfactory operation.
- $V_S = \pm 10V$, $I_{OUT} = -10mA$. On resistance derived from the voltage measured across the switch under the above conditions.
- $V_S = \pm 14V$, $V_D = \pm 14V$.
- $V_S = V_D = \pm 14V$.
- The digital inputs are diode protected MOS gates and typical leakages of 1nA or less can be expected.
- $V_S = 1V_{RMS}$, $f = 500kHz$, $C_L = 15pF$, $R_L = 1k$, $C_L = C_{FIXTURE} + C_{PROBE}$, "off isolation" = $20 \log V_S/V_D$.
- $V_S = 0V$, $C_L = 10,000pF$, Logic Drive = 5V pulse. Switches are symmetrical; S and D may be interchanged.
- $V_{IN} = 4V$ (One Input) (All Other Inputs = 0V).
- $V_{IN} = 0.8V$ (All Inputs).
- To drive from DTL/TTL circuits, pull-up resistors to +5V supply are recommended.

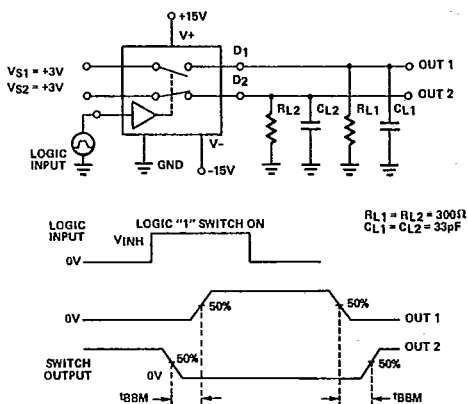
Test Circuits

SWITCHING TEST CIRCUIT (t_{ON} , t_{OFF})

SWITCH TYPE	V_{INH}
HI-381 thru HI-390	5V

BREAK-BEFORE-MAKE TEST CIRCUIT (t_{BBM})

SWITCH TYPE	V_{INH}
HI-387, HI-390	5V



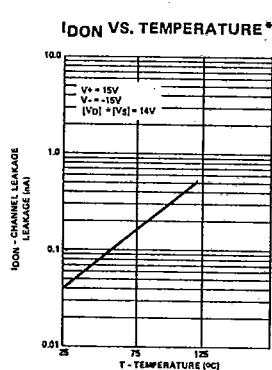
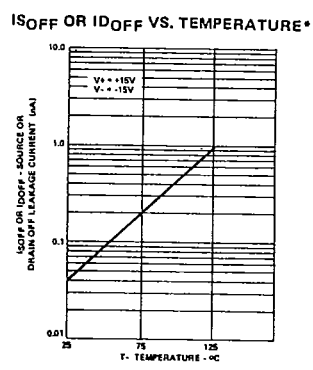
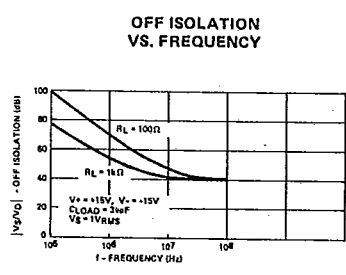
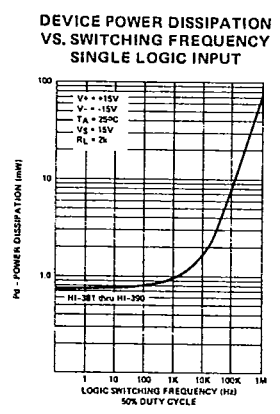
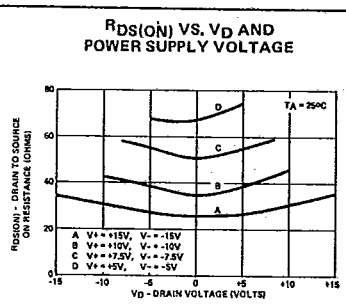
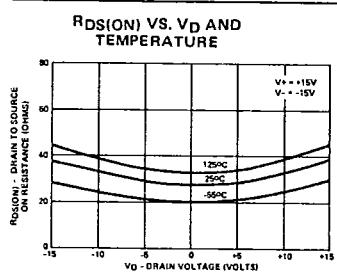
Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HI1-0381-5	0°C to +75°C	14-Pin Cerdip
HI1-0381-2	-55°C to +125°C	14-Pin Cerdip
HI2-0381-2	-55°C to +125°C	10-Pin Metal Can
HI2-0381-5	0°C to +75°C	10-Pin Metal Can
HI1-0384-5	0°C to +75°C	16-Pin Cerdip
HI1-0384-2	-55°C to +125°C	16-Pin Cerdip
HI2-0387-2	-55°C to +125°C	10-Pin Metal Can
HI1-0387-2	-55°C to +125°C	16-Pin Cerdip
HI1-0387-5	0°C to +75°C	16-Pin Cerdip
HI2-0387-5	0°C to +75°C	10-Pin Metal Can
HI1-0390-5	0°C to +75°C	16-Pin Cerdip
HI1-0390-2	-55°C to +125°C	16-Pin Cerdip

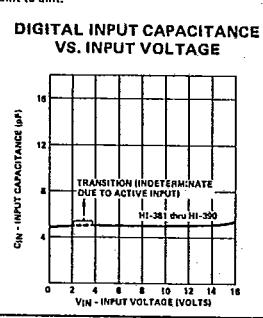
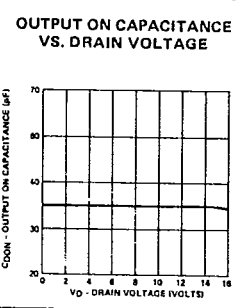
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HI-381/384/387/390 Typical Performance Curves

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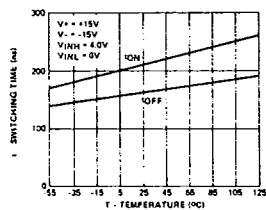
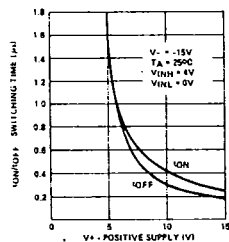
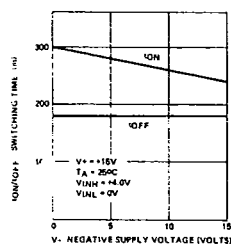
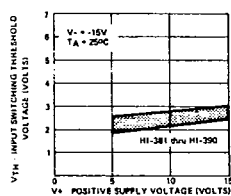
* The net leakage into the source or drain is the n-channel leakage minus the p-channel leakage. This difference can be positive, negative, or zero depending on the analog voltage and temperature, and will vary greatly from unit to unit.



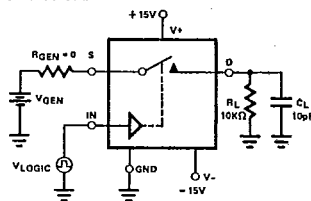
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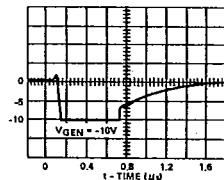
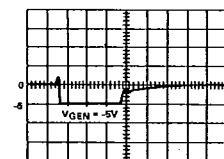
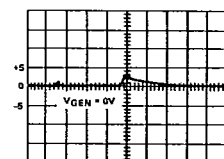
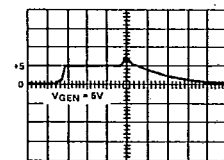
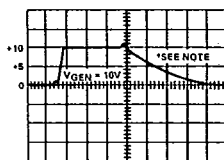
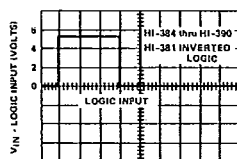
HI-381/384/387/390 Typical Performance Curves (Continued)

SWITCHING TIME vs. TEMPERATURE
HI-381 THRU HI-390SWITCHING TIME vs. POSITIVE SUPPLY VOLTAGE
HI-381 THRU HI-390SWITCHING TIME vs. NEGATIVE SUPPLY VOLTAGE
HI-381 THRU HI-390INPUT SWITCHING THRESHOLD vs.
POSITIVE SUPPLY VOLTAGE
HI-381 THRU HI-390

Typical delay, rise, fall, settling times, and switching transients in this circuit.



If RGEN, RL or CL is increased, there will be proportional increases in rise and/or fall RC times.



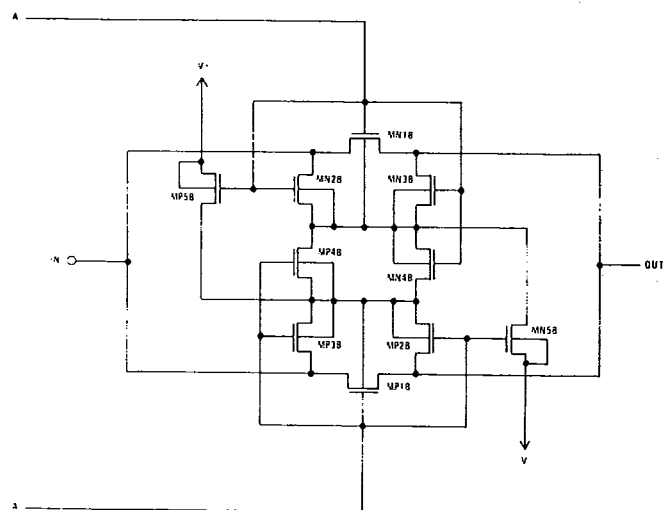
* NOTE: The turn-off time is primarily limited here by the RC time constant (100ns) of the load.

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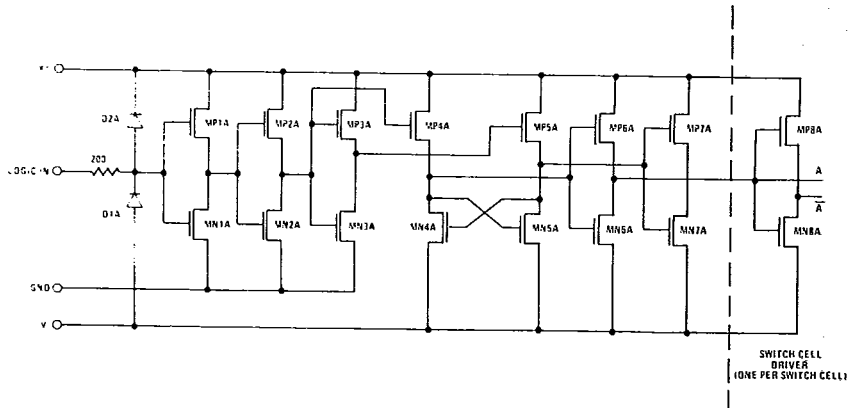
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Schematic Diagrams



DIGITAL INPUT BUFFER
AND LEVEL SHIFTER



HI-381/384/387/390

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