HARRIS

HI-300 thru HI-307

CMOS Analog Switches

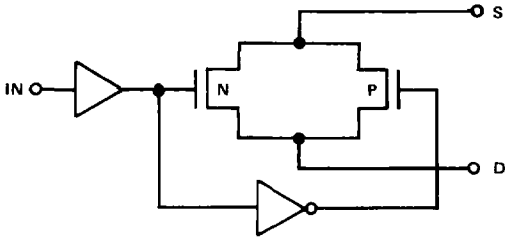
Features

- Analog Signal Range (±15V Supplies) ..... ±15V
- Low Leakage (Typical @ +25°C) 40pA
- Low Leakage (Typical @ +125°C) 1nA
- Low On Resistance (Typical @ +25°C) 35Ω
- Break-Before-Make Delay (Typical) 60ns
- Charge Injection 30pC
- TTL, CMOS Compatible
- Symetrical Switch Elements
- Low Operating Power ..... 1.0mW (Typical for HI-300 - 303)

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-300 through HI-307 series of switches are monolithic devices fabricated using CMOS technology and the Harris dielectric isolation process. These switches feature break-before-make switching, (HI-301, 303, 305 & 307 only), low and nearly constant ON resistance over the full analog signal range, and low power dissipation, (a few milliwatts for the HI-300 - 303, a few hundred microwatts for the HI-304 - 307).

The HI-300 - 303 are TTL compatible and have a logic "0" condition with an input less than 0.8V and a logic "1" condition with an input greater than 4.0V. The HI-304 - 307 switches are CMOS compatible and have a low state with an input less than 3.5V and a high state with an input greater than 11V. (See pinouts for switch conditions with a logic "1" input.)

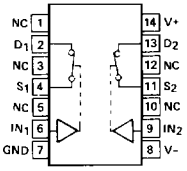
All the devices are available in a 14 pin Epoxy or Ceramic DIP. The HI-300, 301, 304 and 305 are also available in a 10 pin Metal Can. Each of the switch types are available in either the -55°C to +125°C or 0°C to +75°C operating ranges.

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

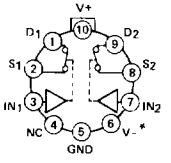
DUAL SPST HI-300 & HI-304

TOP VIEWS

DIP



METAL CAN



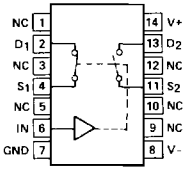
LOGIC	SWITCH
0	OFF
1	ON

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

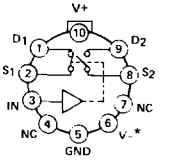
SPDT HI-301 & HI-305

TOP VIEWS

DIP



METAL CAN



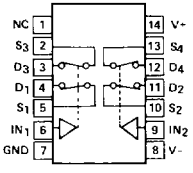
LOGIC	SW 1	SW 2
0	OFF	ON
1	ON	OFF

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

DUAL DPST HI-302 & HI-306

TOP VIEW

DIP

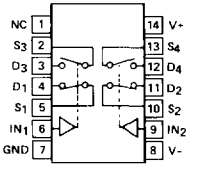


LOGIC	SWITCH
0	OFF
1	ON

DUAL SPDT HI-303 & HI-307

TOP VIEW

DIP



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.

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
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/0°C Above T_A = +70°C

Electrical Specifications

Unless Otherwise Specified: Supplies = +15V, -15V; V_{IN} = Logic Input.
HI-300-303: V_{IN} - for Logic "1" = 4V, for Logic "0" = 0.8V
HI-304-307: V_{IN} - for Logic "1" = 11V, for Logic "0" = 3.5V

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
	Full	-	40	75	-	40	75	Ω
$I_{S(OFF)}$, Off Input Leakage Current (Note 3)	+25°C	-	0.04	1	-	0.04	5	nA
	Full	-	1	100	-	0.2	100	nA
$I_{D(OFF)}$, Off Output Leakage Current (Note 3)	+25°C	-	0.04	1	-	0.04	5	nA
	Full	-	1	100	-	0.2	100	nA
$I_{D(ON)}$, On Leakage Current (Note 4)	+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
V_{INL}, Input Low Level**	Full	-	-	3.5	-	-	3.5	V
V_{INH}, Input High Level**	Full	11	-	-	11	-	-	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***	+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
t_{ON}, Switch Off Time**	+25°C	-	160	250	-	160	250	ns
t_{OFF}, Switch Off Time**	+25°C	-	100	150	-	100	150	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
I^+, Current** (Note 10)	+25°C	-	0.01	10	-	0.01	100	µA
	Full	-	-	100	-	-	-	µA
I^-, Current** (Note 10)	+25°C	-	0.01	10	-	0.01	100	µA
	Full	-	-	100	-	-	-	µA
I^+, Current** (Note 11)	+25°C	-	0.01	10	-	0.01	100	µA
	Full	-	-	100	-	-	-	µA
I^-, Current** (Note 11)	+25°C	-	0.01	10	-	0.01	100	µA
	Full	-	-	100	-	-	-	µA

*HI-300 Thru HI-303 Only; **HI-304 Thru HI-307 Only; ***HI-301, HI-303, HI-305, HI-307 Only

Electrical Specifications Notes:

1. 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.
2. V_S = ±10V, I_{OUT} = -10mA. On resistance derived from the voltage measured across the switch under the above conditions.
3. V_S = ±14V, V_D = ±14V.
4. $V_S = V_D$ = ±14V.
5. The digital inputs are diode protected MOS gates and typical leakages of 1nA or less can be expected.
6. $V_S = 1V_{RMS}$, f = 500kHz, C_L = 15pF, R_L = 1k.
7. V_S = 0V, C_L = 10,000pF, Logic Drive = 5V pulse. (HI-300 - 303) Switches are symmetrical; S and D may be interchanged. Logic Drive = 15V (HI-304 - 307).
8. V_{IN} = 4V (One Input) (All Other Inputs = 0V).
9. V_{IN} = 0.8V (All Inputs).
10. V_{IN} = 15V (All Inputs).
11. V_{IN} = 0V (All Inputs).
12. To drive from DTL/TTL circuits, pull-up resistors to +5V supply are recommended.

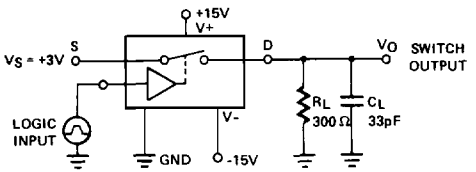
Test Circuits

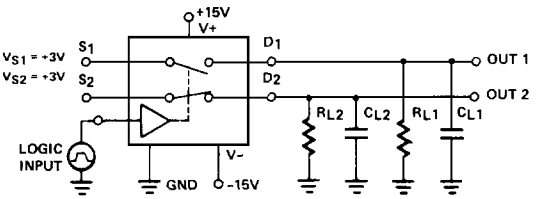
SWITCHING TEST CIRCUIT (t_{ON}, t_{OFF})

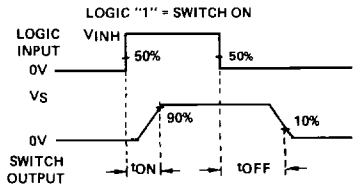
SWITCH TYPE	V_{INH}
HI-300 thru HI-303	4V
HI-304 thru HI-307	15V

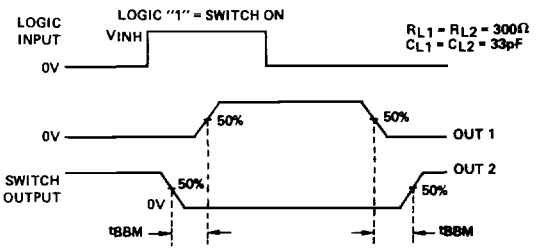
BREAK-BEFORE-MAKE TEST CIRCUIT (t_{BBM})

SWITCH TYPE	V_{INH}
HI-301, HI-303	5V
HI-305, HI-307	15V



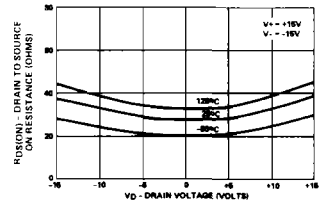




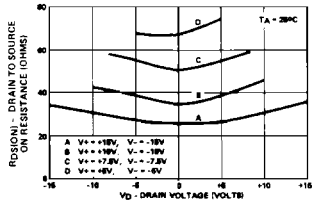


Typical Performance Curves

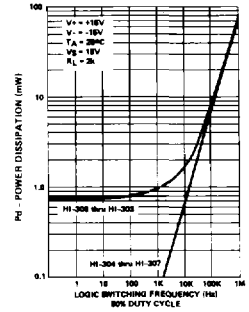
$R_{DS(ON)}$ vs. V_D and Temperature



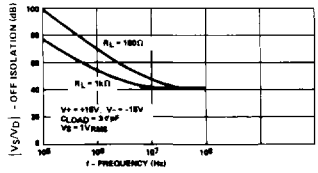
$R_{DS(ON)}$ vs. V_D and Power Supply Voltage



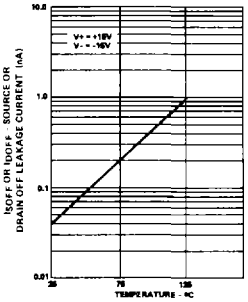
Device Power Dissipation vs. Switching Frequency Single Logic Input



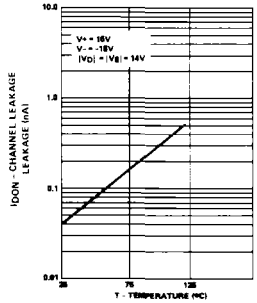
Off Isolation vs. Frequency



$I_{S(OFF)}$ or $I_{D(OFF)}$ vs. Temperature *

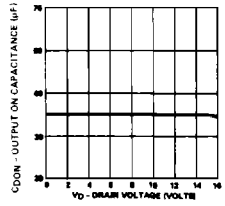


$I_{D(ON)}$ vs. Temperature *

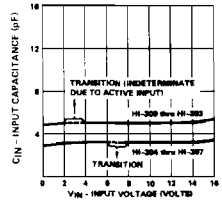


* The net leakage into the source or drain is the n-channel leakage minus the p-channel leakage. This difference can be positive, negative, or zero depending on the analog voltage and temperature, and will vary greatly from unit to unit.

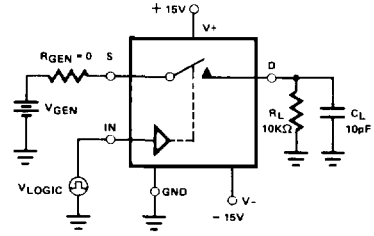
Output On Capacitance vs. Drain Voltage



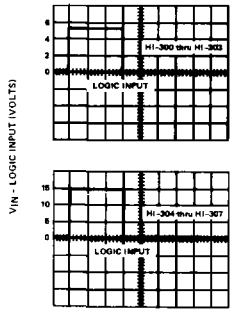
Digital Input Capacitance vs. Input Voltage

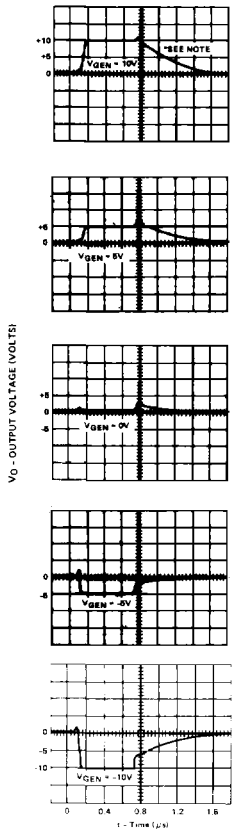


Typical delay, rise, fall, settling times, and switching transients in this circuit.



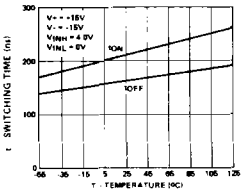
If R_{GEN}, R_L or C_L is increased, there will be proportional increases in rise and/or fall RC times.



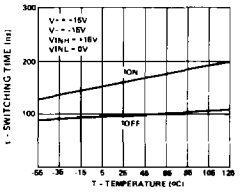


Typical Performance Curves (Continued)

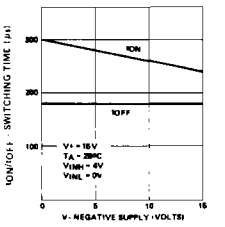
SWITCHING TIME VS. TEMPERATURE HI-300 thru HI-303



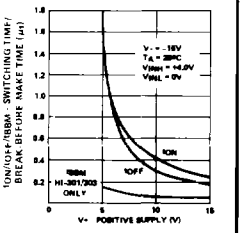
SWITCHING TIME VS. TEMPERATURE HI-304 thru HI-307



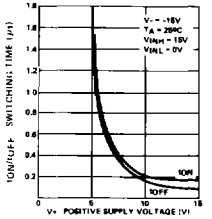
SWITCHING TIME VS. NEGATIVE SUPPLY VOLTAGE HI-300 thru HI-303



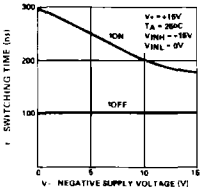
SWITCHING TIME AND BREAK BEFORE MAKE TIME VS. POSITIVE SUPPLY VOLTAGE HI-300 thru HI-303



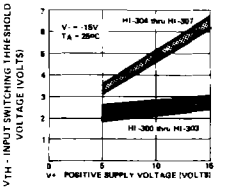
SWITCHING TIME VS. POSITIVE SUPPLY VOLTAGE HI-304 thru HI-307



SWITCHING TIME VS. NEGATIVE SUPPLY VOLTAGE HI-304 thru HI-307

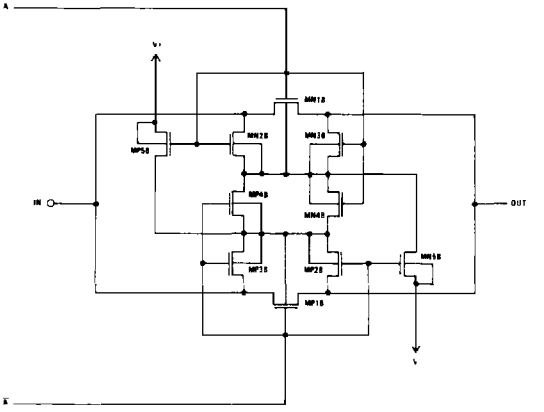


INPUT SWITCHING THRESHOLD VS. POSITIVE SUPPLY VOLTAGE HI-300 thru HI-307



Schematic Diagrams

SWITCH CELL



DIGITAL INPUT BUFFER AND LEVEL SHIFTER