

January 1989

Dual DPST CMOS Analog Switch

Features

- This Circuit is Processed in Accordance to MIL-Std-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Analog Signal Range ($\pm 15V$ Supplies) $\pm 15V$
- Low Leakage ($+25^{\circ}C$) $1nA$ (Max)
- Low Leakage ($+125^{\circ}C$) $100nA$ (Max)
- Low ON Resistance 50Ω (Max)
- Charge Injection $30pC$ (Typ)
- CMOS Compatible
- Symmetrical Switch Elements
- Low Operating Power
- Compatible with DG306

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

Description

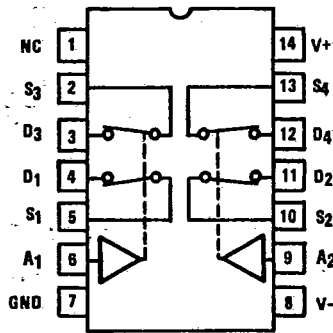
The HI-306/883 switch is a monolithic device fabricated using CMOS technology and the Harris Dielectric Isolation process. This switch features low and nearly constant ON resistance over the full analog signal range, and low power dissipation.

The HI-306/883 is CMOS compatible and has a logic "0" condition with an input less than 3.5V and a logic "1" condition with an input greater than 11.0V.

The HI-306/883 is pin-for-pin compatible with the industry standard Siliconix DG306. The device is available in a 14 pin Ceramic DIP. The HI-306/883 operates over the $-55^{\circ}C$ to $+125^{\circ}C$ temperature range.

Pinout

HI1-306/883 (CERAMIC DIP)
 TOP VIEW



LOGIC	SWITCH
0	OFF
1	ON

Absolute Maximum Ratings

Voltage Between V+ and V- Terminals	44V
±VSUPPLY to Ground (V+, V-)	±22V
Analog Input Voltage +VS	+VSUPPLY +1.5V
-VS	-VSUPPLY -1.5V
Digital Input Voltage +VA	+VSUPPLY +4V
-VA	-VSUPPLY -4V
Peak Current (S or D) (Pulse at 1ms, 10% Duty Cycle Max)	40mA
Continuous Current	30mA
Junction Temperature	+175°C
Storage Temperature Range	-85°C to +150°C
Lead Temperature (Soldering 10 sec)	≤275°C

Thermal Information

Thermal Resistance	θ_{ja}	θ_{jc}
Ceramic DIP Package	88°C/W	24°C/W
Package Power Dissipation at +75°C		
Ceramic DIP Package	0.85W	
Package Power Dissipation Derating Factor Above +75°C		
Ceramic DIP Package	11.36mW/°C	

CAUTION: Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operability under any of these conditions is not necessarily implied.

Recommended Operating Conditions

Operating Temperature Range	-55°C to +125°C	Logic Low Level (VAL)	0V to 3.5V
Operating Supply Voltage (±VSUPPLY)	±15V	Logic High Level (VAH)	11V to +VSUPPLY
Analog Input Voltage (VS)	±VSUPPLY		

TABLE 1. D.C. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: +VSUPPLY = +15V, -VSUPPLY = -15V, GND = 0V, Unless Otherwise Specified

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Switch "ON" Resistance	RDS	VA = 11V, VD = 10V, IS = -10mA S1/S2/S3/S4	1	+25°C	-	50	Ω
			2,3	-55°C to +125°C	-	75	Ω
		VA = 11V, VD = -10V, IS = 10mA S1/S2/S3/S4	1	+25°C	-	50	Ω
			2,3	-55°C to +125°C	-	75	Ω
Source "OFF" Leakage Current	IS(OFF)	VS = +14V, VD = -14V, VA = 3.5V S1/S2/S3/S4	1	+25°C	-1	1	nA
			2,3	-55°C to +125°C	-100	100	nA
		VS = -14V, VD = +14V, VA = 3.5V S1/S2/S3/S4	1	+25°C	-1	1	nA
			2,3	-55°C to +125°C	-100	100	nA
Drain "OFF" Leakage Current	ID(OFF)	VS = +14V, VD = -14V, VA = 3.5V S1/S2/S3/S4	1	+25°C	-1	1	nA
			2,3	-55°C to +125°C	-100	100	nA
		VS = -14V, VD = +14V, VA = 3.5V S1/S2/S3/S4	1	+25°C	-1	1	nA
			2,3	-55°C to +125°C	-100	100	nA
Channel "ON" Leakage Current	ID(ON)	VD = VS = +14V, VA = 11V S1/S2/S3/S4	1	+25°C	-1	1	nA
			2,3	-55°C to +125°C	-100	100	nA
		VD = VS = -14V, VA = 11V S1/S2/S3/S4	1	+25°C	-1	1	nA
			2,3	-55°C to +125°C	-100	100	nA
Low Level Input Current	IAL	All Channels VA = 3.5V	1	+25°C	-1.0	1.0	μA
			2,3	-55°C to +125°C	-1.0	1.0	μA
High Level Input Current	IAH	All Channels VA = 11V	1	+25°C	-1.0	1.0	μA
			2,3	-55°C to +125°C	-1.0	1.0	μA
Supply Current	+ICC	All Channels VA = 0V	1	+25°C	-	10	μA
			2,3	-55°C to +125°C	-	100	μA
		All Channels VA = 15V	1	+25°C	-	10	μA
			2,3	-55°C to +125°C	-	100	μA
Supply Current	-ICC	All Channels VA = 0V	1	+25°C	-10	-	μA
			2,3	-55°C to +125°C	-100	-	μA
		All Channels VA = 15V	1	+25°C	-10	-	μA
			2,3	-55°C to +125°C	-100	-	μA

4
CMOS ANALOG SWITCHES

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

TABLE 2. A.C. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: +VSUPPLY = +15V, -VSUPPLY = -15V, GND = 0V, Unless Otherwise Specified

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Turn "ON" Time	t _(ON)	C _L = 33pF R _L = 300Ω	9	+25°C	-	250	ns
			10, 11	-55°C, +125°C	-	500	ns
Turn "OFF" Time	t _(OFF)	C _L = 33pF R _L = 300Ω	9	+25°C	-	150	ns
			10, 11	-55°C, +125°C	-	450	ns

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (NOTE 1)

Device Characterized at: +VSUPPLY = +15V, -VSUPPLY = -15V, GND = 0V, Unless Otherwise Specified

PARAMETERS	SYMBOL	CONDITIONS	NOTE	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Switch Input Capacitance	C _{IS(OFF)}	Measured Source to GND	1	+25°C	-	28	pF
Driver Input Capacitance	CC1	V _A = 0V	1	+25°C	-	10	pF
	CC2	V _A = 15V	1	+25°C	-	10	pF
Switch Output Capacitance	C _{OS}	Measured Drain to GND	1	+25°C	-	28	pF
Off Isolation	V _{ISO}	f = 1MHz, V _{GEN} = 1V _{p-p}	1	+25°C	40	-	dB
Crosstalk	V _{CT}	f = 1MHz, V _{GEN} = 1V _{p-p}	1	+25°C	40	-	dB
Charge Transfer	V _{CTE}	V _S = GND, C _L = 0.01μF	1	+25°C	-	15	mV

NOTE 1. Parameters listed in Table 3 are controlled via design or process parameters and are not directly tested at final production. These parameters are lab characterized upon initial design release, or upon design changes. These parameters are guaranteed by characterization based upon data from multiple production runs which reflect lot to lot and within lot variation.

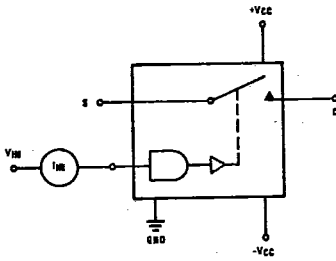
TABLE 4. ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLES 1 & 2)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1*, 2, 3, 9, 10, 11
Group A Test Requirements	1, 2, 3, 9, 10, 11
Groups C & D Endpoints	1

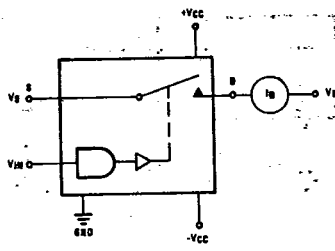
* PDA applies to Subgroup 1 only.

Test Circuits

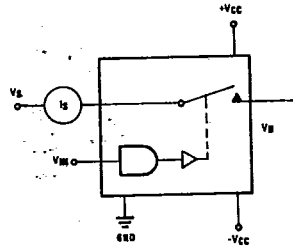
INPUT LEAKAGE CURRENT



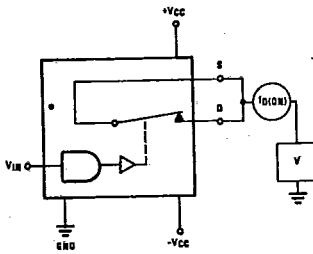
I_D(OFF)



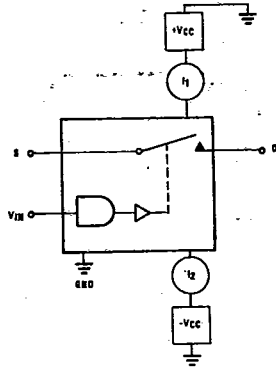
I_S(OFF)



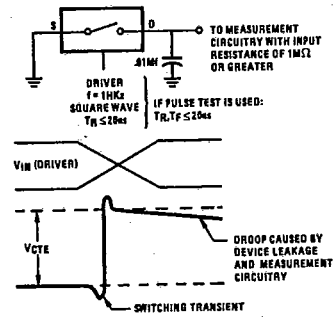
I_D(ON)



SUPPLY CURRENTS

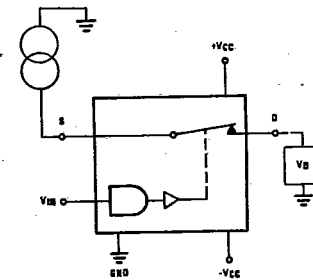


CHARGE TRANSFER ERROR

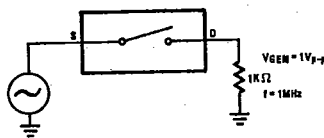


NOTE: V_{CTE} may be a positive or negative value

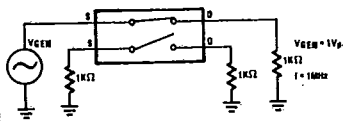
R_{DS}



OFF CHANNEL ISOLATION



CROSSTALK BETWEEN CHANNELS

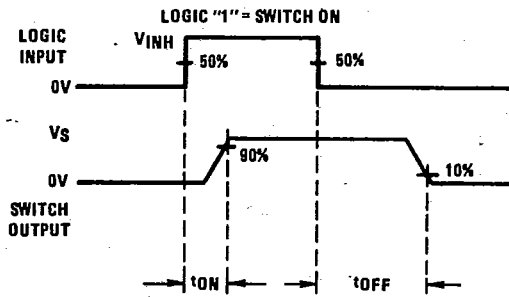
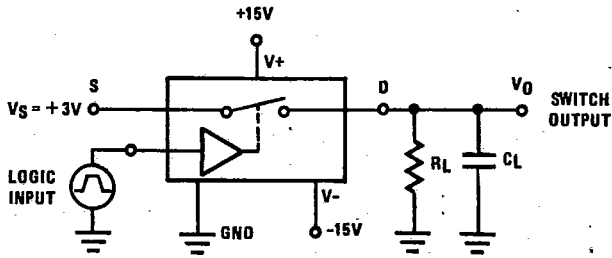


For Detail Information Refer to HI-306/883 Test Tech Brief

4
 CMOS ANALOG SWITCHES

Test Waveforms

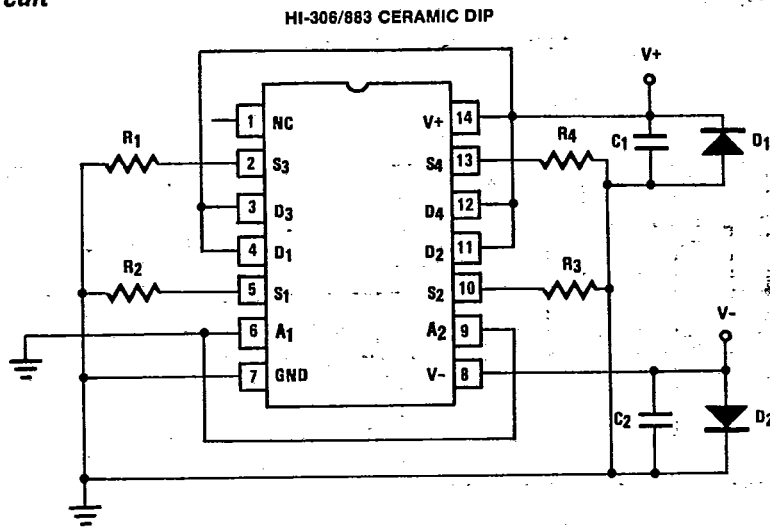
T-51-11



NOTES:

1. $R_L = 300\Omega$; $C_L = 33pF$
 2. $V_{INH} = 15V$
- RISETIME (1.5V to 13.5V) $\leq 20ns$
 FALLTIME (13.5V to 1.5V) $\leq 20ns$

Burn-In Circuit



NOTES:

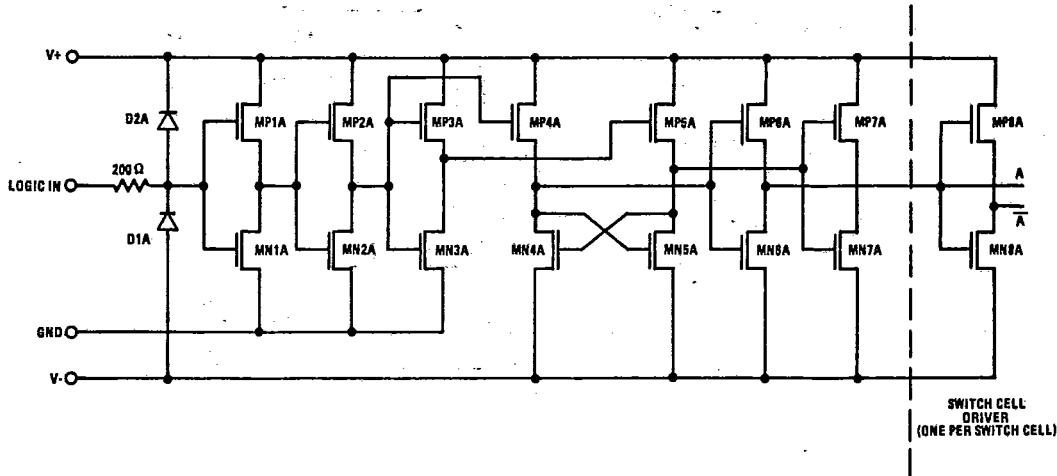
- R₁ = R₂ = R₃ = R₄ = 10KΩ, 5%, 1/4 or 1/2 watt
- C₁ = C₂ = 0.01μF (per socket) or 0.1μF (per row)
- D₁ = D₂ = 1N4002 (per board)
- | (V₊ - V₋) | = 30V

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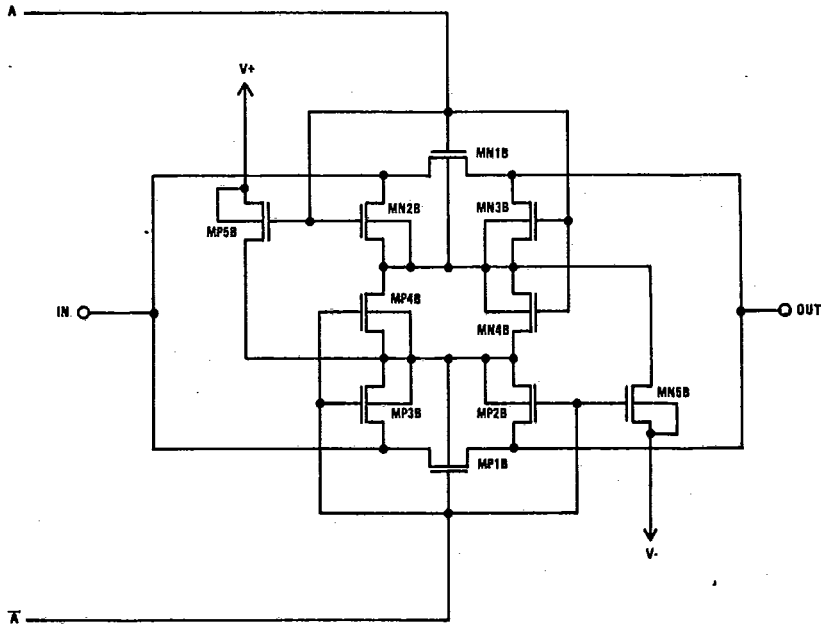
CMOS ANALOG SWITCHES

Schematic Diagram

DIGITAL INPUT BUFFER AND LEVEL SHIFTER



SWITCH CELL



Die Characteristics

DIE DIMENSIONS:
76 x 83.9 x 19 mils

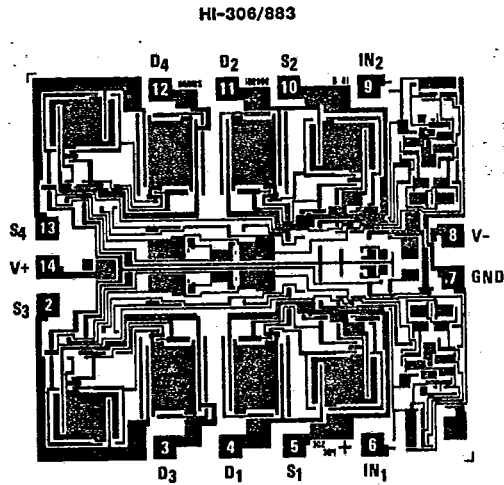
METALLIZATION:
Type: Aluminum
Thickness: 16kÅ ± 2kÅ

GLASSIVATION:
Type: Nitride
Thickness: 7kÅ ± 0.7kÅ

DIE ATTACH:
Material: Gold/Silicon Eutectic Alloy
Temperature: Ceramic DIP — 460°C (Max)

WORST CASE CURRENT DENSITY:
3.9 x 10⁵A/cm² at 30mA
This device meets Glassivation Integrity Test
requirement per Mil-Std-883 Method 2021 and
Mil-M-38510 paragraph 3.5.5.4.

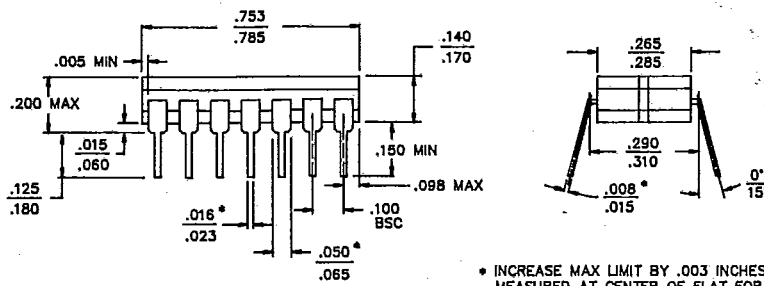
Metallization Mask Layout



4
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SWITCHES

Packaging†

14 PIN CERAMIC DIP



• INCREASE MAX LIMIT BY .003 INCHES MEASURED AT CENTER OF FLAT FOR SOLDER FINISH

LEAD MATERIAL: Type B
LEAD FINISH: Type A
PACKAGE MATERIAL: Ceramic, 90% Alumina
PACKAGE SEAL:
 Material: Glass Frit
 Temperature: 450°C ± 10°C
 Method: Furnace Seal

INTERNAL LEAD WIRE:
 Material: Aluminum
 Diameter: 1.25 Mil
 Bonding Method: Ultrasonic
COMPLIANT OUTLINE: 38510 D-1

NOTE: All Dimensions are $\frac{\text{Min}}{\text{Max}}$, Dimensions are in inches.

†Mil-M-38510 Compliant Materials, Finishes, and Dimensions.



DESIGN INFORMATION

HI-306

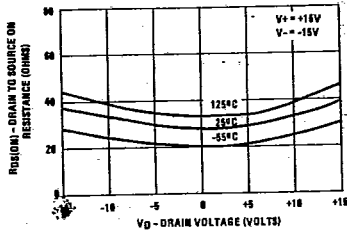
T-51-11

Dual DPST CMOS Analog Switch

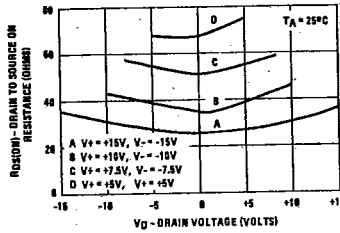
The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design data only. No guarantee is implied.

Typical Performance Characteristics Unless Otherwise Specified: $V_+ = +15V$, $V_- = -15V$, $T_A = +25^\circ C$

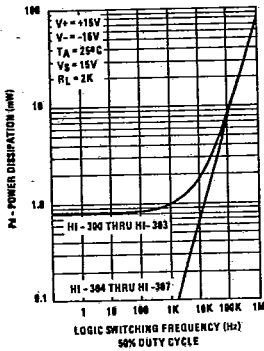
R_{DS(ON)} vs. V_D AND TEMPERATURE



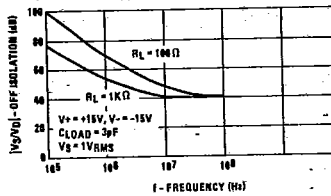
R_{DS(ON)} vs. V_D AND POWER SUPPLY VOLTAGE



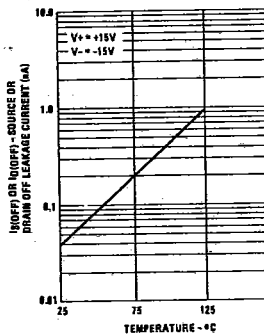
DEVICE POWER DISSIPATION vs. SWITCHING FREQUENCY SIGNAL LOGIC INPUT



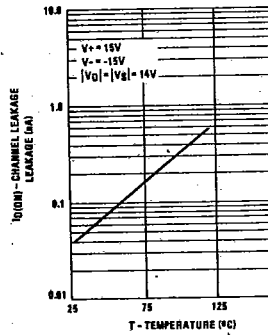
OFF ISOLATION vs. FREQUENCY



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.

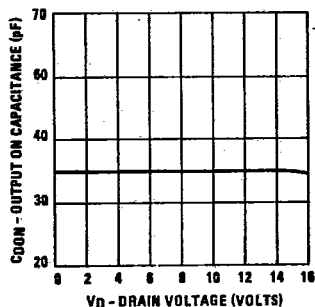
4 CMOS ANALOG SWITCHES

DESIGN INFORMATION (Continued)

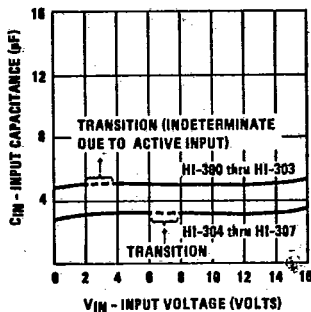
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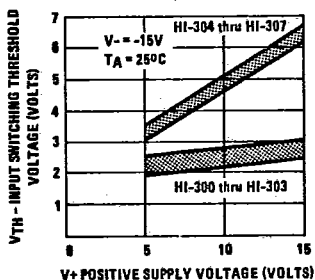
OUTPUT ON CAPACITANCE vs. DRAIN VOLTAGE



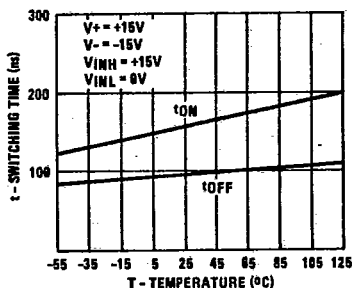
DIGITAL INPUT CAPACITANCE vs. INPUT VOLTAGE



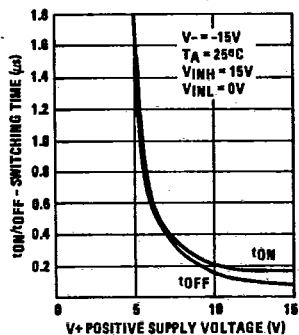
INPUT SWITCHING THRESHOLD vs. POSITIVE SUPPLY VOLTAGE



SWITCHING TIME vs. TEMPERATURE



SWITCHING TIME vs. POSITIVE SUPPLY VOLTAGE



SWITCHING TIME vs. NEGATIVE SUPPLY VOLTAGE

