



# M74HC4051

## SINGLE 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- **LOW POWER DISSIPATION:**  
 $I_{CC} = 4\mu\text{A}(\text{MAX.})$  at  $T_A = 25^\circ\text{C}$
- **LOGIC LEVEL TRANSLATION TO ENABLE 5V LOGIC SIGNAL TO COMMUNICATE WITH  $\pm 5\text{V}$  ANALOG SIGNAL**
- **LOW "ON" RESISTANCE:**  
 $70\Omega$  TYP. ( $V_{CC} - V_{EE} = 4.5\text{V}$ )  
 $50\Omega$  TYP. ( $V_{CC} - V_{EE} = 9\text{V}$ )
- **WIDE ANALOG INPUT VOLTAGE RANGE:**  
 $\pm 6\text{V}$
- **FAST SWITCHING:**  
 $t_{pd} = 15\text{ns}$  (TYP.) at  $T_A = 25^\circ\text{C}$
- **LOW CROSSTALK BETWEEN SWITCHES**
- **HIGH ON/OFF OUTPUT VOLTAGE RATIO**
- **WIDE OPERATING SUPPLY VOLTAGE RANGE** ( $V_{CC} - V_{EE}$ ) =  $2\text{V TO } 12\text{V}$
- **LOW SINE WAVE DISTORTION:**  
 $0.02\%$  at  $V_{CC} - V_{EE} = 9\text{V}$
- **HIGH NOISE IMMUNITY:**  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- **PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 4051**



### ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC4051B1R	
SOP	M74HC4051M1R	M74HC4051RM13TR
TSSOP		M74HC4051TTR

It contains 8 bidirectional and digitally controlled analog switches.

A built-in level shifting is included to allow an input range up to  $\pm 6\text{V}$  (peak) for an analog signal with digital control signal of 0 to 6V.

$V_{EE}$  supply pin is provided for analog input signals. It has an inhibit (INH) input terminal to disable all the switches when is at high level. For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND.

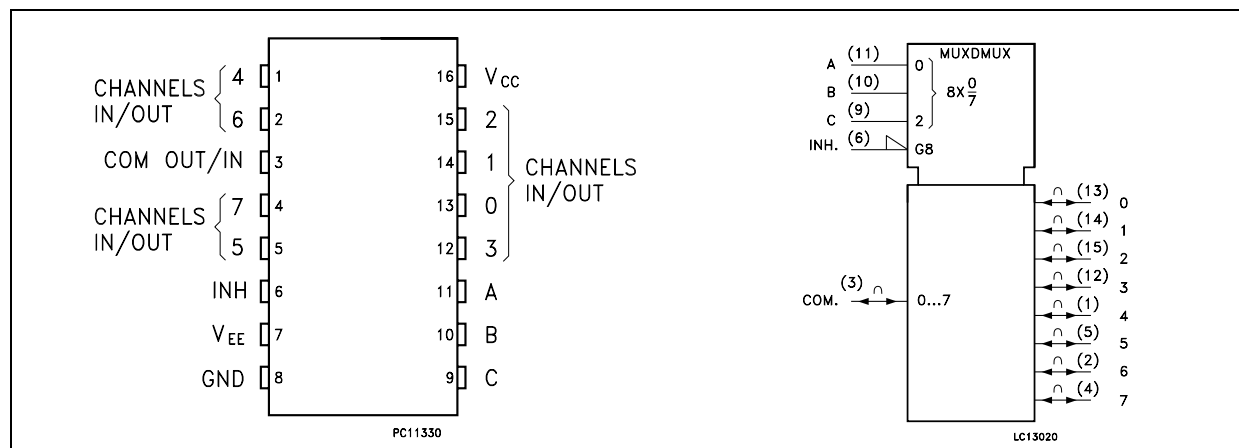
A, B and C control inputs select one channel out of eight.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

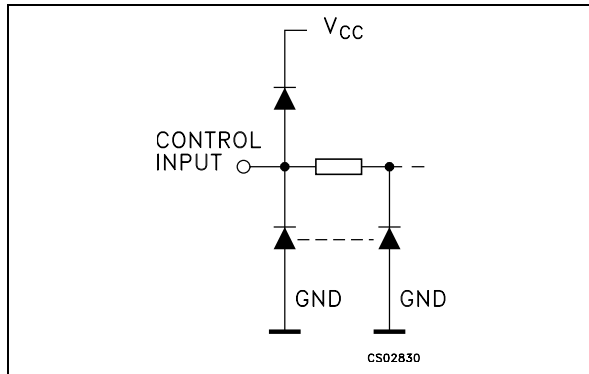
### DESCRIPTION

The M74HC4051 is a single eight-channel analog MULTIPLEXER/DEMULTIPLEXER fabricated with silicon gate  $\text{C}^2\text{MOS}$  technology and it is pin to pin compatible with the equivalent metal gate CMOS4000B series.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



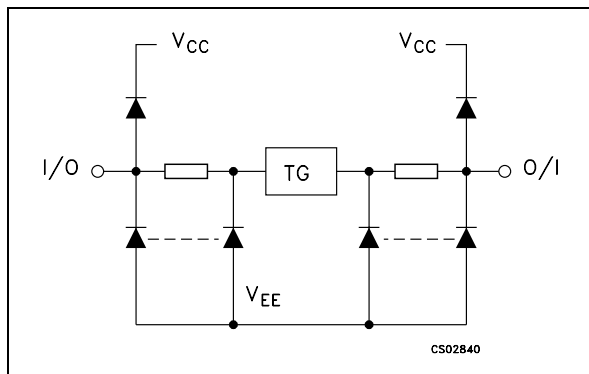
**CONTROL INPUT EQUIVALENT CIRCUIT**



**PIN DESCRIPTION**

PIN No	SYMBOL	NAME AND FUNCTION
3	COM OUT/IN	Common Output/Input
6	INH	INHIBIT Input
7	$V_{EE}$	Negative Supply Voltage
11, 10, 9	A, B, C	Select Inputs
13, 14, 15, 12, 1, 5, 2, 4	0 to 7	Independent Input/Outputs
8	GND	Ground (0V)
16	$V_{CC}$	Positive Supply Voltage

**I/O EQUIVALENT CIRCUIT**

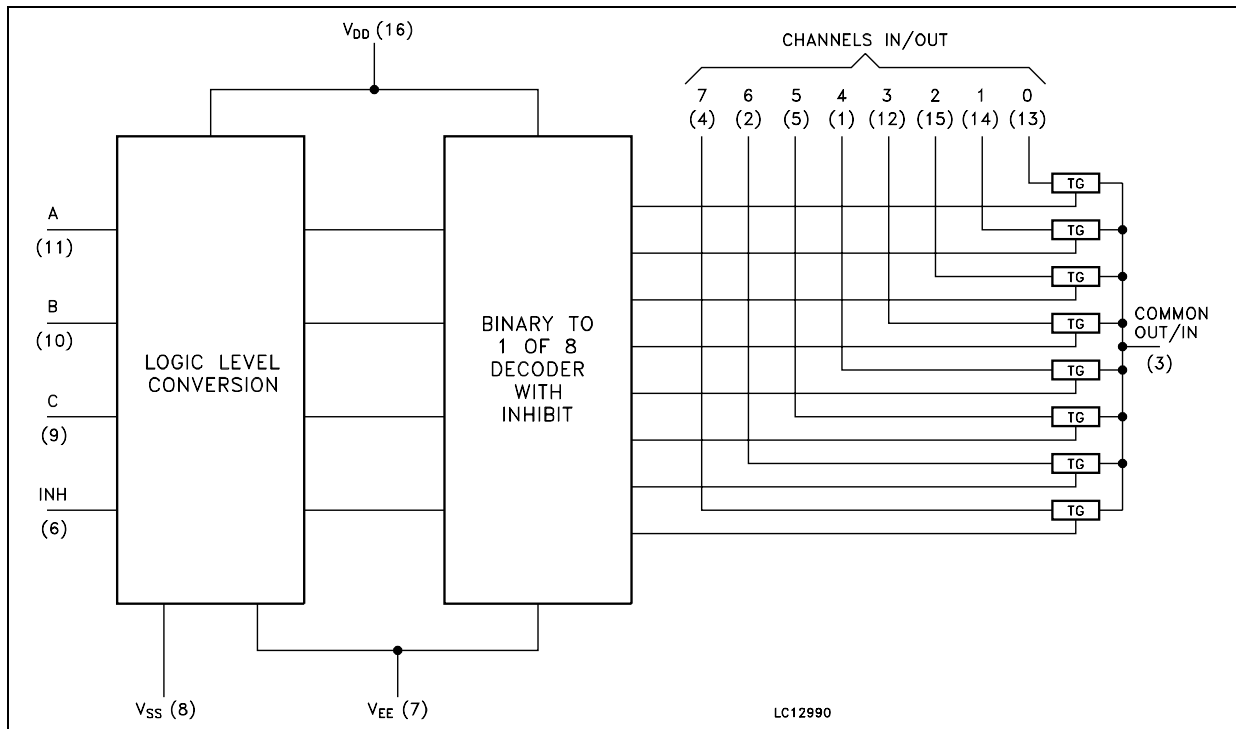


**TRUTH TABLE**

INPUT STATE				ON CHANNEL
INH	C	B	A	
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	X	X	X	NONE

X: Don't care

**FUNCTIONAL DIAGRAM**



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to +7	V
$V_{CC} - V_{EE}$	Supply Voltage	-0.5 to +13	V
$V_I$	Control Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{I/O}$	Switch I/O Voltage	$V_{EE} - 0.5$ to $V_{CC} + 0.5$	V
$I_{CK}$	Control Input Diode Current	$\pm 20$	mA
$I_{I/O}$	I/O Diode Current	$\pm 20$	mA
$I_T$	Switch Through Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	500(*)	mW
$T_{stg}$	Storage Temperature	-65 to +150	°C
$T_L$	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

(\*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply Voltage	2 to 6	V	
$V_{EE}$	Supply Voltage	-6 to 0	V	
$V_{CC} - V_{EE}$	Supply Voltage	2 to 12	V	
$V_I$	Input Voltage	0 to $V_{CC}$	V	
$V_{I/O}$	I/O Voltage	$V_{EE}$ to $V_{CC}$	V	
$T_{op}$	Operating Temperature	-55 to 125	°C	
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2.0V$	0 to 1000	ns
		$V_{CC} = 4.5V$	0 to 500	
		$V_{CC} = 6.0V$	0 to 400	

DC SPECIFICATIONS

Symbol	Parameter	Test Condition			Value						Unit	
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IHC</sub>	High Level Input Voltage	2.0			1.5			1.5		1.5		V
		4.5			3.15			3.15		3.15		
		6.0			4.2			4.2		4.2		
V <sub>ILC</sub>	Low Level Input Voltage	2.0					0.5		0.5		0.5	V
		4.5					1.35		1.35		1.35	
		6.0					1.8		1.8		1.8	
R <sub>ON</sub>	ON Resistance	4.5	GND	V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub> I <sub>I/O</sub> ≤ 2mA		85	180		225		270	Ω
		4.5	-4.5			55	120		150		180	
		6.0	-6.0			50	100		125		150	
		2.0	GND	V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or V <sub>EE</sub> I <sub>I/O</sub> ≤ 2mA		150						
		4.5	GND			70	150		190		230	
		4.5	-4.5			50	100		125		150	
6.0	-6.0		45	80		100		120				
ΔR <sub>ON</sub>	Difference of ON Resistance between switches	4.5	GND	V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or V <sub>EE</sub> I <sub>I/O</sub> ≤ 2mA		10	30		35		45	Ω
		4.5	-4.5			5	12		15		18	
		6.0	-6.0			5	10		12		15	
I <sub>OFF</sub>	Input/Output Leakage Current (SWITCH OFF)	6.0	GND	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IS</sub> = GND or V <sub>CC</sub> V <sub>I</sub> = V <sub>ILC</sub> or V <sub>IHC</sub>			±0.06		± 0.6		± 1.2	μA
		6.0	-6.0				± 0.1		± 1		± 2	
I <sub>Iz</sub>	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub>			±0.06		± 0.6		± 1.2	μA
		6.0	-6.0				± 0.1		± 1		± 2	
I <sub>I</sub>	Input Leakage Current	6.0	GND	V <sub>I</sub> = V <sub>CC</sub> or GND			± 0.1		± 0.1		± 1	μA
I <sub>CC</sub>	Quiescent Supply Current	6.0	GND	V <sub>I</sub> = V <sub>CC</sub> or GND			4		40		80	μA
		6.0	-6.0				8		80		160	

**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$\Phi_{I/O}$	Phase Difference Between Input and Output	2.0	GND			25	60		75		90	ns
		4.5	GND			6	12		15		18	
		6.0	GND			5	10		13		15	
		4.5	-4.5			4						
$t_{PZL}$ $t_{PZH}$	Output Enable Time	2.0	GND	$R_L = 1\text{K}\Omega$		64	225		280		340	ns
		4.5	GND			18	45		56		68	
		6.0	GND			15	38		48		58	
		4.5	-4.5			18						
$t_{PLZ}$ $t_{PHZ}$	Output Disable Time	2.0	GND	$R_L = 1\text{K}\Omega$		100	250		315		375	ns
		4.5	GND			33	50		63		70	
		6.0	GND			28	43		54		64	
		4.5	-4.5			29						

**CAPACITIVE CHARACTERISTICS**

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$C_{IN}$	Input Capacitance	5.0				5	10		10		10	pF
$C_{I/O}$	Common Terminal Capacitance	5.0	-5.0			36	70		70		70	pF
$C_{I/O}$	Switch Terminal Capacitance	5.0	-5.0			7	15		15		15	pF
$C_{IOS}$	Feed Through Capacitance	5.0	-5.0			0.95	2		2		2	pF
$C_{PD}$	Power Dissipation Capacitance (note 1)	5.0	GND			70						pF

1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

**ANALOG SWITCH CHARACTERISTICS (GND = 0V; T<sub>A</sub> = 25°C)**

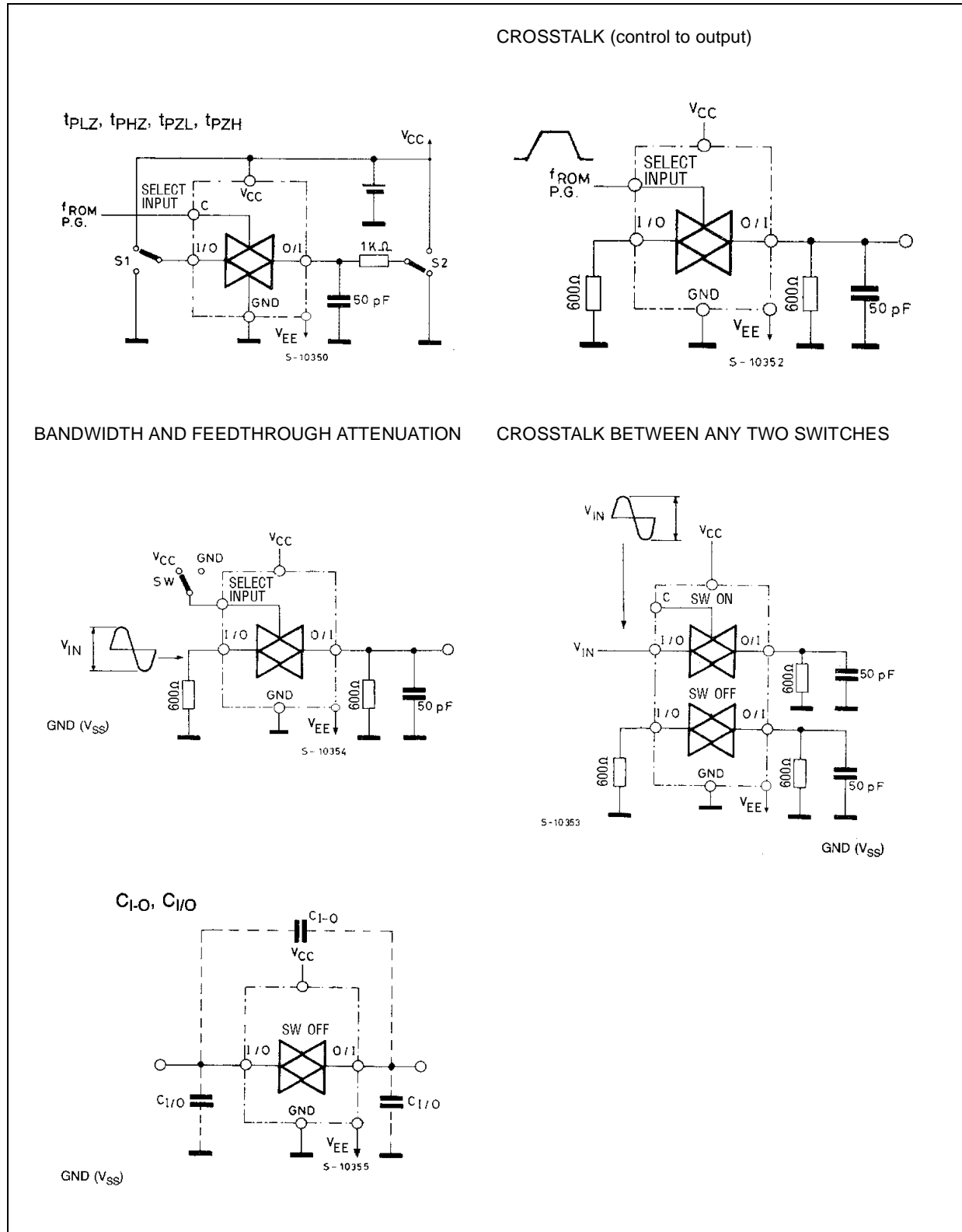
Symbol	Parameter	Test Condition			Value	Unit
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	V <sub>IN</sub> (V <sub>p-p</sub> )		
	Sine Wave Distortion	2.25	-2.25	4	0.025	%
		4.5	-4.5	8	0.020	
		6.0	-6.0	11	0.018	
f <sub>MAX</sub>	Frequency Response (Switch ON) (*)	2.25	-2.25	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> . Increase f <sub>IN</sub> Frequency until dB meter reads -3dB R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10 pF, f <sub>IN</sub> = 1KHz sine wave	120	MHz
		4.5	-4.5		190	
		6.0	-6.0		200	
f <sub>MAX</sub>	Frequency Response (Switch ON) (**)	2.25	-2.25	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> . Increase f <sub>IN</sub> Frequency until dB meter reads -3dB R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10 pF, f <sub>IN</sub> = 1KHz sine wave	45	MHz
		4.5	-4.5		70	
		6.0	-6.0		85	
	Feed through Attenuation (Switch OFF)	2.25	-2.25	V <sub>IN</sub> is centered at (V <sub>CC</sub> - V <sub>EE</sub> )/2 Adjust input for 0 dBm R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz sine wave	-50	dB
		4.5	-4.5		-50	
		6.0	-6.0		-50	
	Crosstalk (Control Input to Signal Output)	2.25	-2.25	Adjust R <sub>L</sub> at set up so that I <sub>S</sub> = 0A. R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz square wave	60	mV
		4.5	-4.5		140	
		6.0	-6.0		200	
	Crosstalk (between any two Switches)	2.25	-2.25	Adjust V <sub>IN</sub> to obtain 0dBm at input R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz sine wave	-50	dB
		4.5	-4.5		-50	
		6.0	-6.0		-50	

(\*) Input COMMON Terminal, and measured at SWITCH Terminal

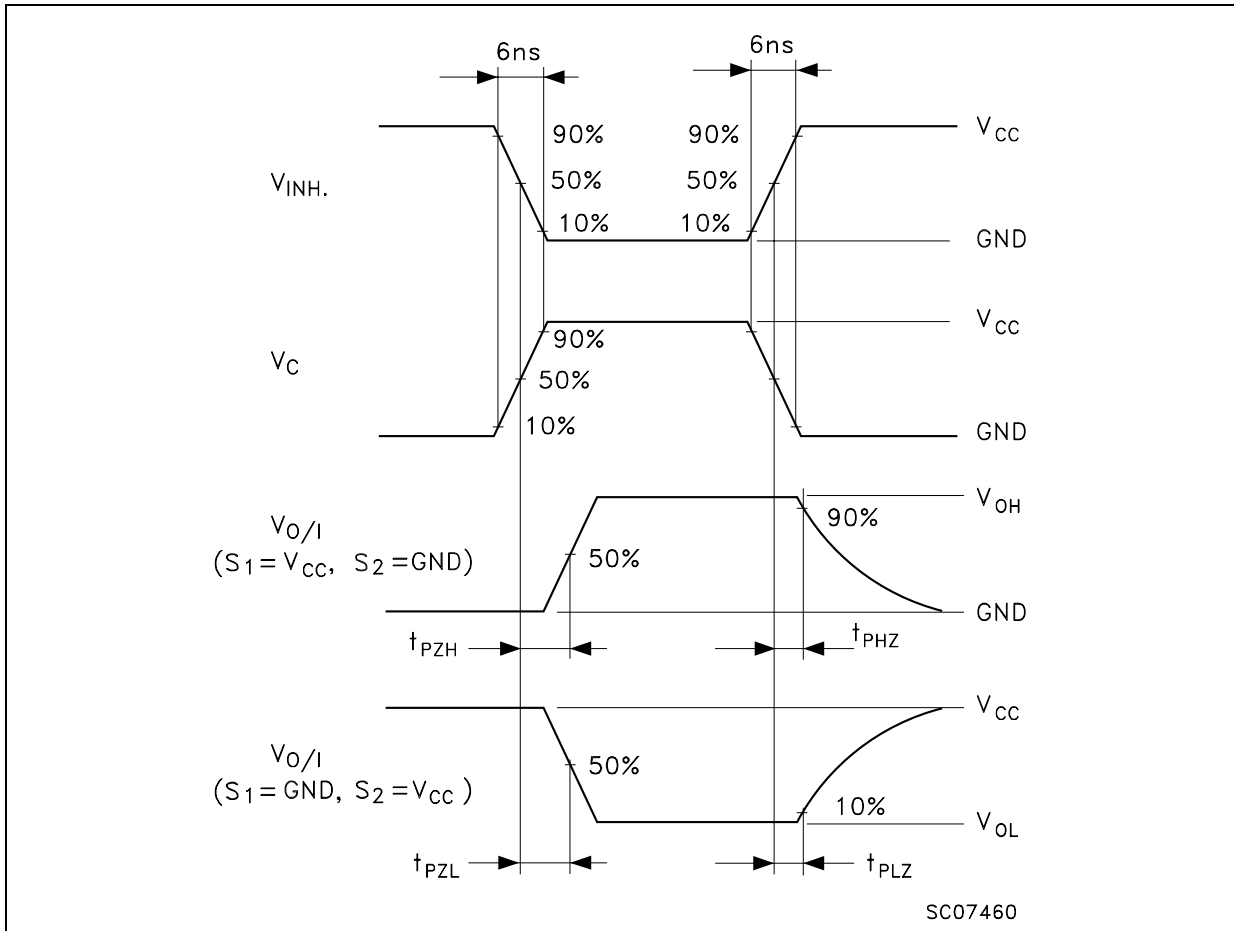
(\*\*) Input SWITCH Terminal, and measured at common Terminal

NOTE: These characteristics are determined by the design of the device.

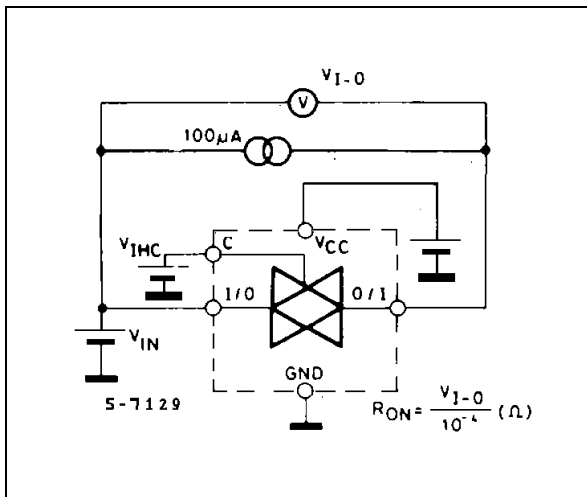
SWITCHING CHARACTERISTICS TEST CIRCUIT



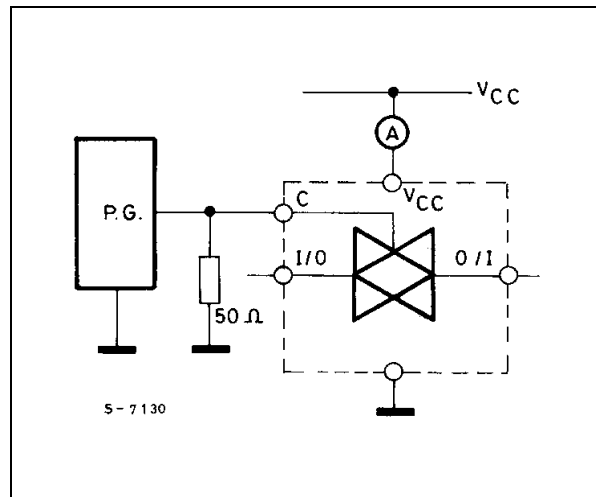
SWITCHING CHARACTERISTICS WAVEFORM



CHANNEL RESISTANCE ( $R_{ON}$ )



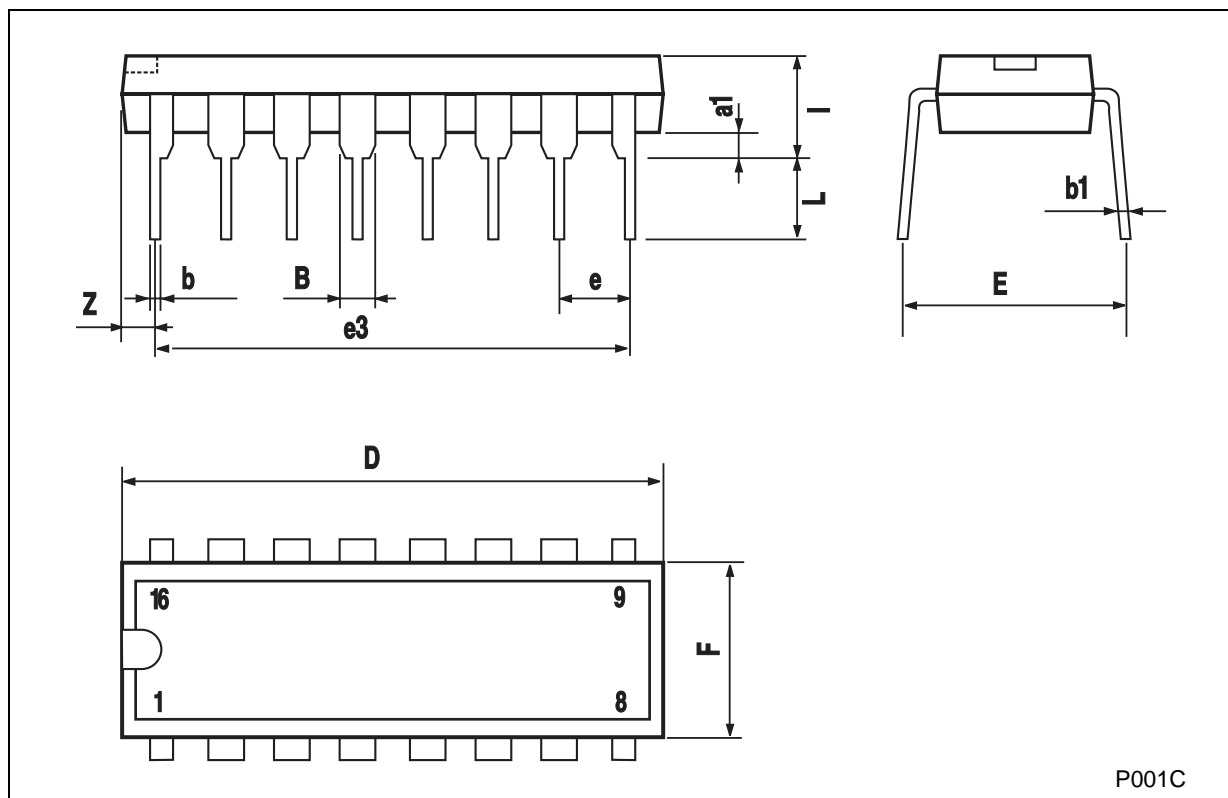
$I_{CC}$  (Opr.)





**Plastic DIP-16 (0.25) MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



**SO-16 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



PO13H

## TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



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