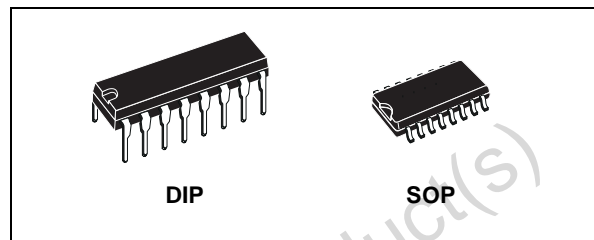




# HCF4053B

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- LOW "ON" RESISTANCE : 125Ω (Typ.) OVER 15V p.p SIGNAL-INPUT RANGE FOR  $V_{DD} - V_{EE} = 15V$
- HIGH "OFF" RESISTANCE : CHANNEL LEAKAGE  $\pm 100pA$  (Typ.) at  $V_{DD} - V_{EE} = 18V$
- BINARY ADDRESS DECODING ON CHIP
- HIGH DEGREE OF LINEARITY :  $< 0.5\%$  DISTORTION TYP. at  $f_{IS} = 1KHz$ ,  $V_{IS} = 5 V_{pp}$ ,  $V_{DD} - V_{SS} \geq 10V$ ,  $R_L = 10K\Omega$
- VERY LOW QUIESCENT POWER DISSIPATION UNDER ALL DIGITAL CONTROL INPUT AND SUPPLY CONDITIONS : 0.2  $\mu W$  (Typ.) at  $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10V$
- MATCHED SWITCH CHARACTERISTICS :  $R_{ON} = 5\Omega$  (Typ.) FOR  $V_{DD} - V_{EE} = 15V$
- WIDE RANGE OF DIGITAL AND ANALOG SIGNAL LEVELS : DIGITAL 3 to 20, ANALOG TO 20V p.p.
- QUIESCENT CURRENT SPECIF. UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  $I_I = 100nA$  (MAX) AT  $V_{DD} = 18V$   $T_A = 25^\circ C$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



### ORDER CODES

PACKAGE	TUBE	T & R
DIP	HCF4053BEY	
SOP	HCF4053BM1	HCF4053M013TR

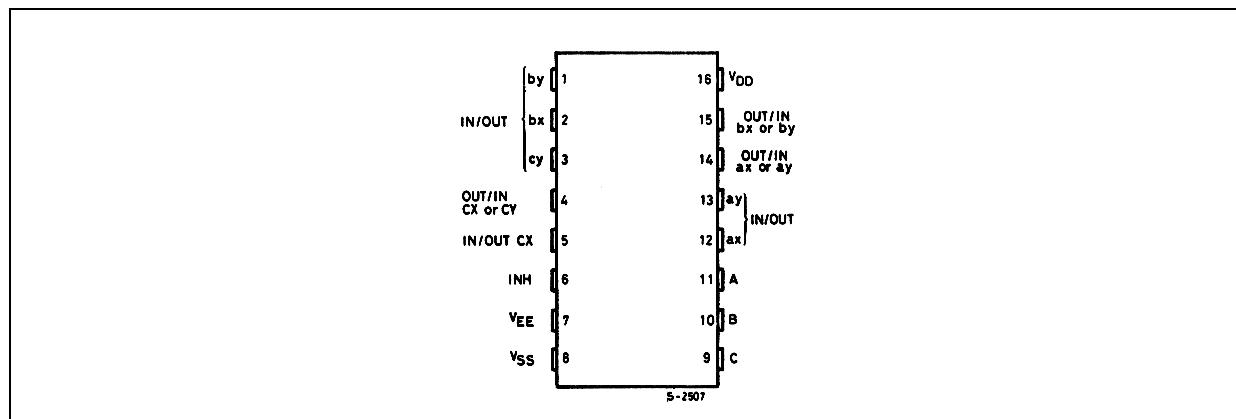
technology available in DIP and SOP packages. The HCF4053B analog multiplexer/demultiplexer is a digitally controlled analog switch having low ON impedance and very low OFF leakage current. This multiplexer circuit dissipate extremely low quiescent power over the full  $V_{DD} - V_{SS}$  and  $V_{DD} - V_{EE}$  supply voltage range, independent of the logic state of the control signals.

When a logic "1" is present at the inhibit input terminal all channel are off. This device is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a single pole double-throw configuration.

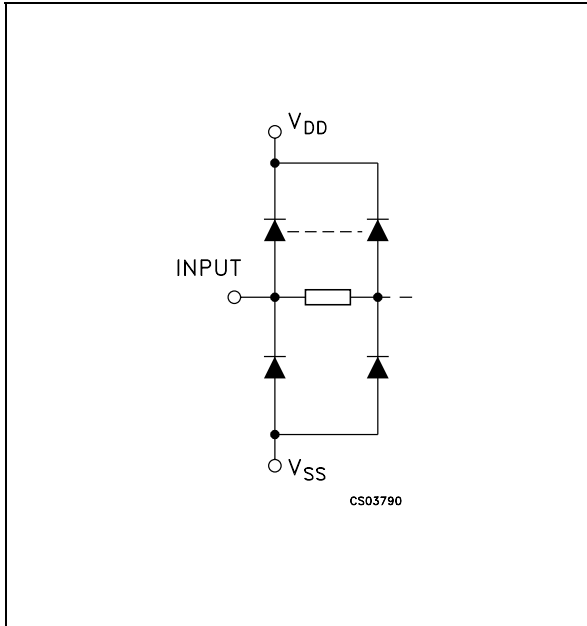
### DESCRIPTION

The HCF4053B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor

### PIN CONNECTION



INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

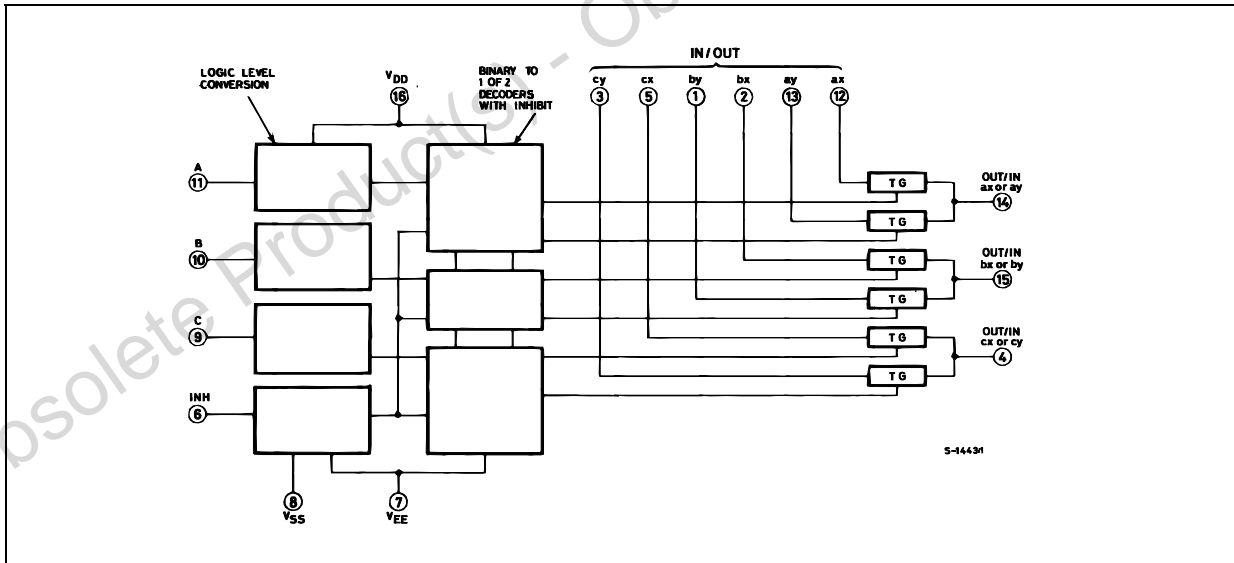
PIN No	SYMBOL	NAME AND FUNCTION
11, 10, 9	A, B, C	Binary Control Inputs
6	INH	Inhibit Inputs
12, 13, 2, 1, 5, 3	IN/OUT	ax,ay,bx,by,cx,cy Input/Output
14	OUT/IN	ax or ay
15	OUT/IN	bx or by
4	OUT/IN	cx or cy
7	V <sub>EE</sub>	Supply Voltage
8	V <sub>SS</sub>	Negative Supply Voltage
16	V <sub>DD</sub>	Positive Supply Voltage

TRUTH TABLE

INHIBIT	C or B or A	
0	0	ax or bx or cx
0	1	ay or by or cy
1	X	NONE

X : Don't Care

FUNCTIONAL DIAGRAM



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	-0.5 to +22	V
$V_I$	DC Input Voltage	-0.5 to $V_{DD} + 0.5$	V
$I_I$	DC Input Current	$\pm 10$	mA
$P_D$	Power Dissipation per Package	500 (*)	mW
	Power Dissipation per Output Transistor	100	mW
$T_{op}$	Operating Temperature	-55 to +125	°C
$T_{stg}$	Storage Temperature	-65 to +150	°C

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

All voltage values are referred to  $V_{SS}$  pin voltage.

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

**RECOMMENDED OPERATING CONDITIONS**


Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	3 to 20	V
$V_I$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature	-55 to 125	°C

DC SPECIFICATIONS

Symbol	Parameter	Test Condition				Value						Unit		
		V <sub>IS</sub> (V)	V <sub>EE</sub> (V)	V <sub>SS</sub> (V)	V <sub>DD</sub> (V)	T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C			
						Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
I <sub>L</sub>	Quiescent Device Current (all switches ON or all switches OFF)				5		0.04	5		150		150	μA	
					10		0.04	10		300		300		
					15		0.04	20		600		600		
					20		0.08	100		3000		3000		
<b>SWITCH</b>														
R <sub>ON</sub>	Resistance	0 ≤ V <sub>I</sub> ≤ V <sub>DD</sub>	0	0	5		470	1050		1200		1200	Ω	
					10		180	400		520		520		
					15		125	280		360		360		
Δ <sub>ON</sub>	Resistance Δ <sub>RON</sub> (between any 2 of 4 switches)	0 ≤ V <sub>I</sub> ≤ V <sub>DD</sub>	0	0	5		10						Ω	
					10		10							
					15		5							
OFF*	Channel Leakage Current (All Channel OFF) (COMMON O/I)		0	0	18		±0.1	100		1000		1000	nA	
OFF*	Channel Leakage Current (Any Channel OFF)		0	0	18		±0.1	100		1000		1000	nA	
C <sub>I</sub>	Input Capacitance						5						pF	
C <sub>O</sub>	Output Capacitance		-5	-5	5		9							
C <sub>IO</sub>	Feed through						0.2							
<b>CONTROL (Address or Inhibit)</b>														
V <sub>IL</sub>	Input Low Voltage	= V <sub>DD</sub> thru 1KΩ	V <sub>EE</sub> = V <sub>SS</sub>	R <sub>L</sub> = 1KΩ to V <sub>SS</sub>	I <sub>IS</sub> < 2μA (on all OFF channels)	5			1.5		1.5		1.5	V
						10			3		3		3	
						15			4		4		4	
V <sub>IH</sub>	Input High Voltage	= V <sub>DD</sub> thru 1KΩ	V <sub>EE</sub> = V <sub>SS</sub>	R <sub>L</sub> = 1KΩ to V <sub>SS</sub>	I <sub>IS</sub> < 2μA (on all OFF channels)	5	3.5			3.5		3.5	V	
						10	7			7		7		
						15	11			11		11		
I <sub>IH</sub> , I <sub>IL</sub>	Input Leakage Current		V <sub>I</sub> = 0/18V		18		±10 <sup>-3</sup>	±0.1		±1		±1	μA	
C <sub>I</sub>	Input Capacitance						5	7.5					pF	

\* Determined by minimum feasible leakage measurement for automating testing.

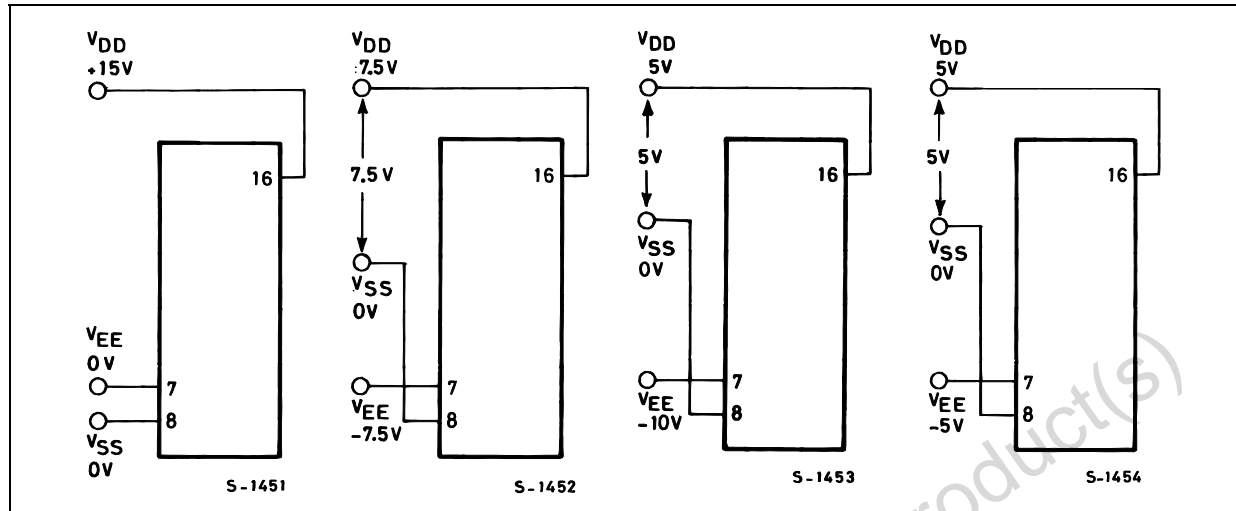
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ , all input square wave rise and fall time = 20 ns )

Parameter	Test Condition						Value			Unit	
	$V_{EE}$ (V)	$R_L$ (K $\Omega$ )	$f_I$ (KHz)	$V_I$ (V)	$V_{SS}$ (V)	$V_{DD}$ (V)	Min.	Typ.	Max.		
Propagation Delay Time (signal input to output)		200		$V_{DD}$ 		5		30	60	ns	
						10		15	30		
						15		11	20		
Frequency Response Channel "ON" (sine wave input) at $20 \log V_O/V_I = -3\text{dB}$	$= V_{SS}$	1		5(*)		10	$V_O$ at Common OUT/IN	25		MHz	
							$V_O$ at any channel	60			
Feed through (all channels OFF) at $20 \log V_O/V_I = -40\text{dB}$	$= V_{SS}$	1		5(*)		10	$V_O$ at Common OUT/IN	10		MHz	
							$V_O$ at any channel	8			
Frequency Signal Crosstalk at $20 \log V_O/V_I = -40\text{dB}$	$= V_{SS}$	1		5(*)		10	Between any 2 Sections (IN pin 2, OUT pin 14)	2.5		MHz	
							Between any 2 Sections (IN pin 15, OUT pin 14)	6			
Sine Wave Distortion $f_{IS} = 1\text{KHz}$ Sine Wave	$= V_{SS}$	10	1	2(*)		5		0.3		%	
				3(*)		10		0.2			
				5(*)		15		0.12			
<b>CONTROL (Address or Inhibit)</b>											
Propagation Delay: Address to Signal OUT (Channels ON or OFF)	0					0	5		360	720	ns
	0					0	10		160	320	
	0					0	15		120	240	
	-5					0	5		225	450	
Propagation Delay: Inhibit to Signal OUT (Channel turning ON)	0	1				0	5		360	720	ns
	0					0	10		160	320	
	0					0	15		120	240	
	-10					0	5		200	400	
Propagation Delay: Inhibit to Signal OUT (Channel turning OFF)	0	10					5		200	450	ns
	0						10		90	210	
	0						15		70	160	
	-10						5		130	300	
Address or Inhibit to Signal Crosstalk	0	10 <sup>(1)</sup>			0	10	$V_C = V_{DD} - V_{SS}$ (square wave)	65		mV peak	

(1) Both ends of channel.

\* Peak to Peak voltage symmetrical about  $(V_{DD} - V_{EE}) / 2$

TYPICAL BIAS VOLTAGES



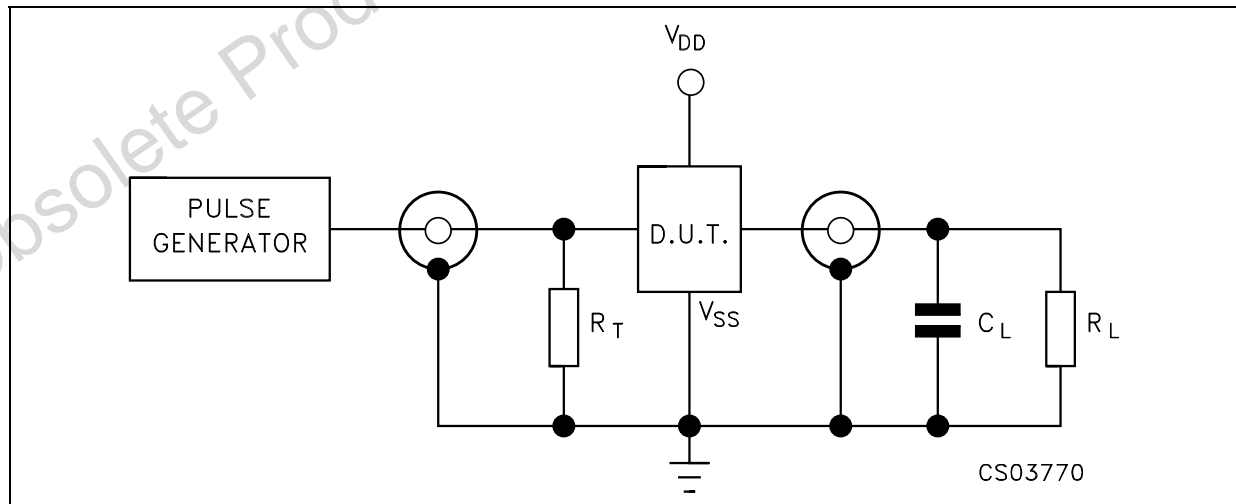
The ADDRESS (digital-control inputs) and INHIBIT logic levels are : "0"= $V_{SS}$  and "1"= $V_{DD}$ . The analog signal (through the TG) may swing from  $V_{EE}$  to  $V_{DD}$

SPECIAL CONSIDERATIONS

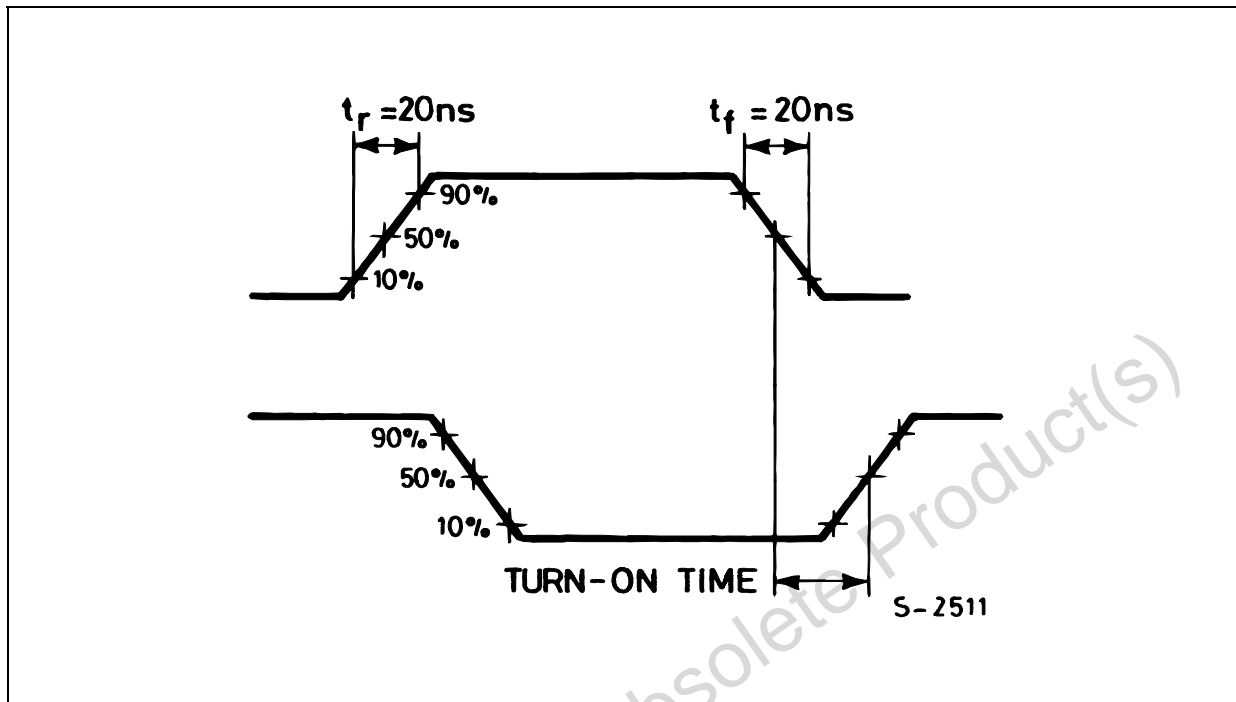
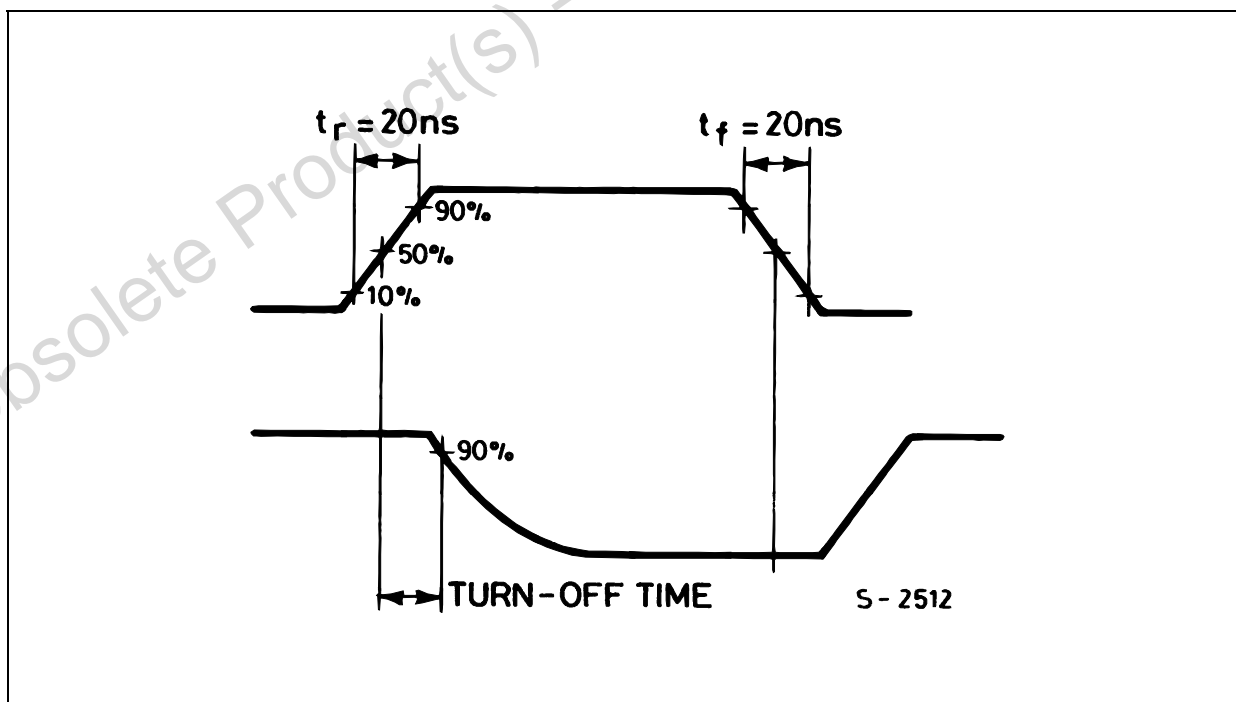
Control of analog signals up to 20V peak to peak can be achieved by digital signal amplitudes of 4.5 to 20V (if  $V_{DD} - V_{SS} = 3V$ , a  $V_{DD} - V_{EE}$  of up to 13V can be controlled; for  $V_{DD} - V_{EE}$  level differences above 13V, a  $V_{DD} - V_{SS}$  of at least 4.5V is required. For example, if  $V_{DD} = +5V$ ,  $V_{SS} = 0V$ , and  $V_{EE} = -13.5V$ , analog signals from -13.5V to 4.5V can be controlled by digital inputs of 0 to 4.5V. In

certain applications, the external load resistor current may include both  $V_{DD}$  and signal-line components. To avoid drawing  $V_{DD}$  current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0.8V (calculated from  $R_{ON}$  values shown in DC SPECIFICATIONS). No  $V_{DD}$  current will flow through  $R_L$  if the switch current flows into leads 4, 14 and 15.

TEST CIRCUIT

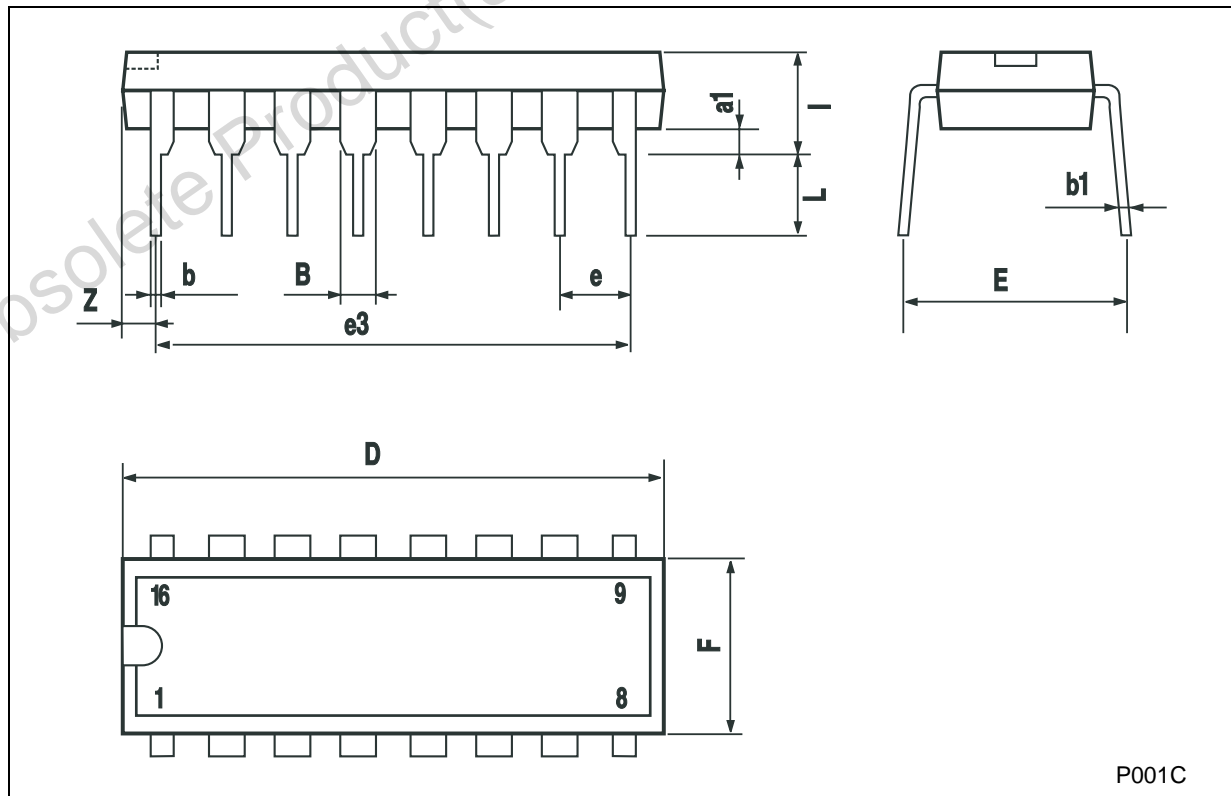


$C_L = 50pF$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200K\Omega$   
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

**WAVEFORM 1 : CHANNEL BEING TURNED ON** ( $R_L = 1K\Omega$ ,  $f=1MHz$ ; 50% duty cycle)**WAVEFORM 2 : CHANNEL BEING TURNED OFF** ( $R_L = 1K\Omega$ ,  $f=1MHz$ ; 50% duty cycle)

**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

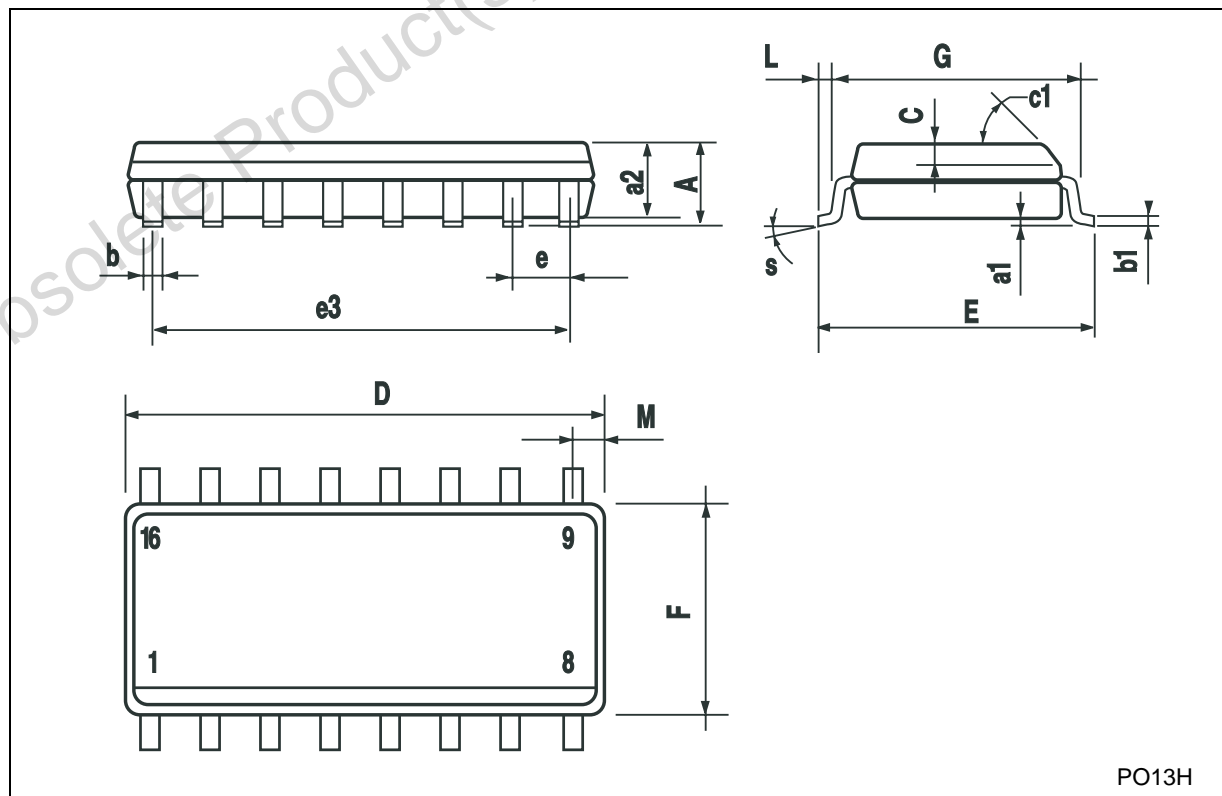


P001C



## 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.)					



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