

## QUAD BILATERAL SWITCH

- 20V DIGITAL OR  $\pm 10V$  PEAK TO PEAK SWITCHING
- 280 $\Omega$  TYPICAL ON RESISTANCE FOR 15V OPERATION
- SWITCH ON RESISTANCE MATCHED TO WITHIN 10 $\Omega$  TYP. OVER 15V SIGNAL INPUT RANGE
- HIGH ON/OFF OUTPUT VOLTAGE RATIO : 65dB TYP. at  $f_{IS} = 10KHz$ ,  $R_L = 10K\Omega$
- HIGH DEGREE OF LINEARITY : < 0.5% DISTORTION TYP. at  $f_{IS} = 1KHz$ ,  $V_{IS} = 5 V_{pp}$ ,  $V_{DD} - V_{SS} \geq 10V$ ,  $R_L = 10K\Omega$
- EXTREMELY LOW OFF SWITCH LEAKAGE RESULTING IN VERY LOW OFFSET CURRENT AND HIGH EFFECTIVE OFF RESISTANCE : 100pA TYP. at  $V_{DD} - V_{SS} = 18V$ ,  $T_{amb} = 25^\circ C$
- EXTREMELY HIGH CONTROL INPUT IMPEDANCE (control circuit isolated from signal circuit 10<sup>12</sup> $\Omega$  typ.)
- LOW CROSSTALK BETWEEN SWITCHES : 50dB Typ. at  $f_{IS} = 0.9MHz$ ,  $R_L = 1K\Omega$
- MATCHED CONTROL - INPUT TO SIGNAL OUTPUT CAPACITANCE : REDUCES OUTPUT SIGNAL TRANSIENTS
- FREQUENCY RESPONSE SWITCH ON : 40MHz (Typ.)
- QUIESCENT CURRENT SPECIF. UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  
 $I_l = 100nA$  (MAX) AT  $V_{DD} = 18V$   $T_A = 25^\circ C$



### ORDER CODES

PACKAGE	TUBE	T & R
DIP	HCF4016BEY	
SOP	HCF4016BM1	HCF4016M013TR

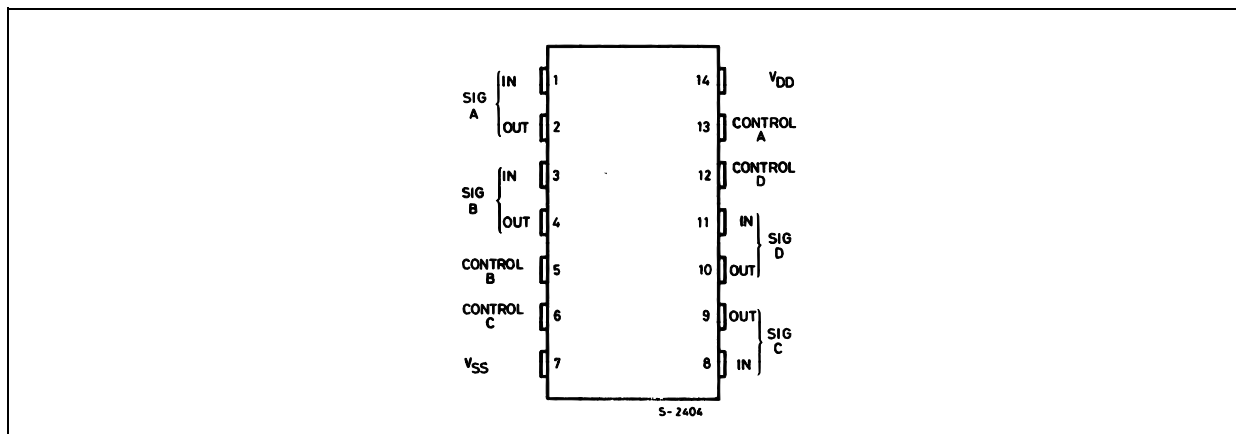
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"

### DESCRIPTION

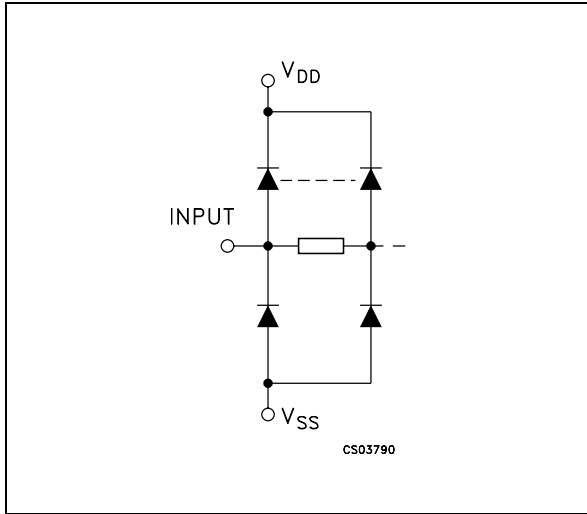
The HCF4016B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. The HCF4016B is a QUAD BILATERAL SWITCH intended for the transmission or multiplexing of analog or digital signals.

Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch ON or OFF.

### PIN CONNECTION



INPUT EQUIVALENT CIRCUIT



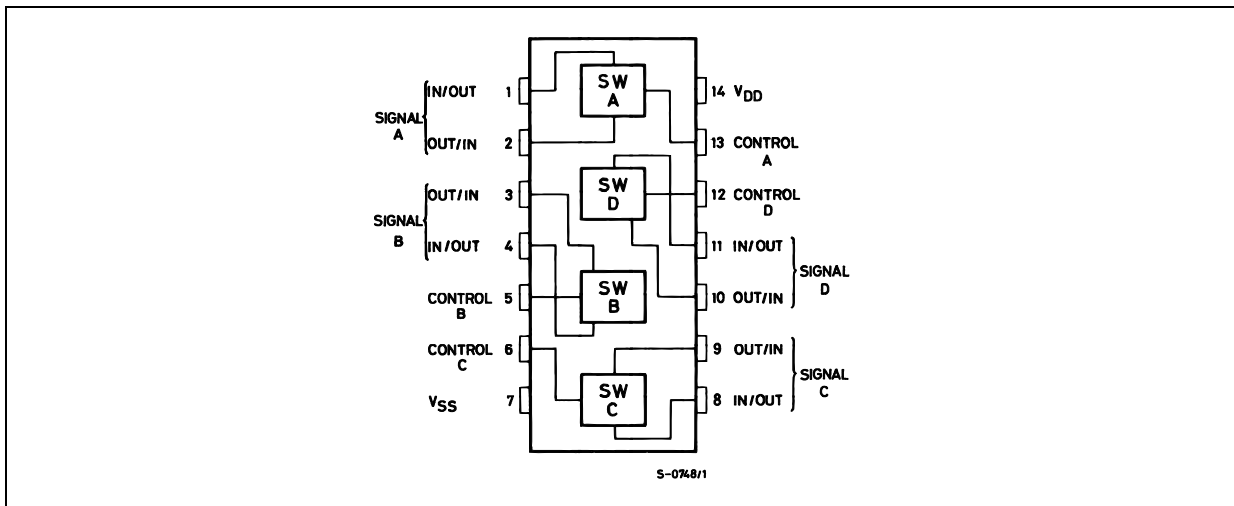
PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 4, 8, 11	A to D I/O	Independent Inputs/Outputs
2, 3, 9, 10	A to D O/I	Independent Outputs/Inputs
13, 5, 6, 12	CONTROL A to D	Enable Inputs
7	V <sub>SS</sub>	Negative Supply Voltage
14	V <sub>DD</sub>	Positive Supply Voltage

TRUTH TABLE

CONTROL	SWITCH FUNCTION
H	ON
L	OFF

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>DD</sub>	Supply Voltage	-0.5 to +22	V
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>DD</sub> + 0.5	V
I <sub>I</sub>	DC Input Current	± 10	mA
P <sub>D</sub>	Power Dissipation per Package	200	mW
	Power Dissipation per Output Transistor	100	mW
T <sub>op</sub>	Operating Temperature	-55 to +125	°C
T <sub>stg</sub>	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<sub>SS</sub> pin voltage.

## 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		
		$V_C = V_{DD}$	$V_{SS}$ (V)	$V_{DD}$ (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.	
$I_L$	Quiescent Device Current (all switches ON or all switches OFF)			5		0.01	0.25		7.5		7.5	$\mu\text{A}$	
				10		0.01	0.5		15		15		
				15		0.01	1		30		30		
				20		0.02	5		150		150		
<b>SWITCH</b>													
$R_{ON}$	Resistance	$R_L = 10\text{K}\Omega$	+7.5	-7.5	+7.5		200	400		600		600	$\Omega$
					-7.5		200	400		600		600	
					$\pm 0.25$		280	850		1230		1230	
			+5	-5	+5		250	660		840		840	
					-5		250	660		840		840	
					$\pm 0.25$		580	2000		2380		2380	
			+15	0	+15		200	400		520		520	
					+0.25		200	400		520		520	
					+9.3		300	800		1080		1080	
			+10	0	+10		250	660		840		840	
					+0.25		250	660		840		840	
					+5.6		560	2000		2380		2380	
$\Delta_{ON}$	Resistance $\Delta_{RON}$ (between any 2 of 4 switches)	$R_L = 10\text{K}\Omega$	+7.5	-7.5	$\pm 7.5$		10					$\Omega$	
			+5	-5	$\pm 5$		15						
	Input or Output Leakage Current Switch OFF (effective off resistance)		$V_{DD} +15$	$V_C = V_{SS} 0$			$10^{-5}$	$\pm 0.3$		$\pm 1$		$\mu\text{A}$	
$C_I$	Input Capacitance	$V_{CC} = V_{SS} = -5$					4					pF	
$C_O$	Output Capacitance						4						
$C_{IO}$	Feedthrough						0.2						
<b>CONTROL (<math>V_C</math>)</b>													
$V_{TH}$	Switch Threshold Voltage	$I_{IS} = 10 \mu\text{A}$			5		2.25		1		1		V
					10		4.5		2		2		
					15		6.75		2		2		
$I_I$	Input Current	$V_{IS} \leq V_{DD}$			18		$\pm 10^{-5}$	$\pm 0.1$		$\pm 1$		$\mu\text{A}$	
$C_I$	Input Capacitance						5	7.5				pF	

## HCF4016B

**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	
	$V_C$ (V)	$R_L$ (K $\Omega$ )	$f_1$ (KHz)	$V_I$ (V)	$V_{SS}$ (V)	$V_{DD}$ (V)	Min.	Typ.	Max.		
Propagation Delay Time (signal input to output)	$= V_{DD}$	10		10sq. Wave	GND	5		40	100	ns	
						10		20	50		
						15		15	40		
Crosstalk Between any 2 of 4 Switches (f at -50dB) $20 \log_{10} V_{O(B)}/V_{I(A)} = -50\text{dB}$	$V_{C(A)} = V_{DD} = +5$ $V_{C(B)} = V_{SS} = -5$	1		$V_{I(A)} \Delta = 5\text{p-p}$				0.9		MHz	
Feedthrough(switch OFF) at $20 \log_{10} V_O/V_I = -50\text{dB}$	$= V_{DD} = +5$	1		5p-p		5		1.25		MHz	
Frequency Response Switch"ON" (sine wave input) at $20 \log_{10} V_O/V_I = -3\text{dB}$	$= V_{SS} = -5$	1		-5p-p	-5			40		MHz	
Sine Wave Distortion	$= V_{DD} = 5$	10	1	5p-p	-5			0.4		%	
<b>CONTROL (<math>V_C</math>)</b>											
Propagation Delay Time (turn on control to output)	$V_{DD} - V_{SS}$ (sq. wave)	1		$V_{DD}$ or $V_{SS}$		5	$V_{DD} - V_{SS} = 10\text{V}$		35	70	ns
						10			20	40	
						15			15	30	
Max. Allowable Control Input Repetition Rate	10 (sq. wave)	1		$V_{DD}$	GND	10		10		MHz	
Crosstalk (control Input to signal output)	10 (sq. wave)	10			GND	10		50		mV	

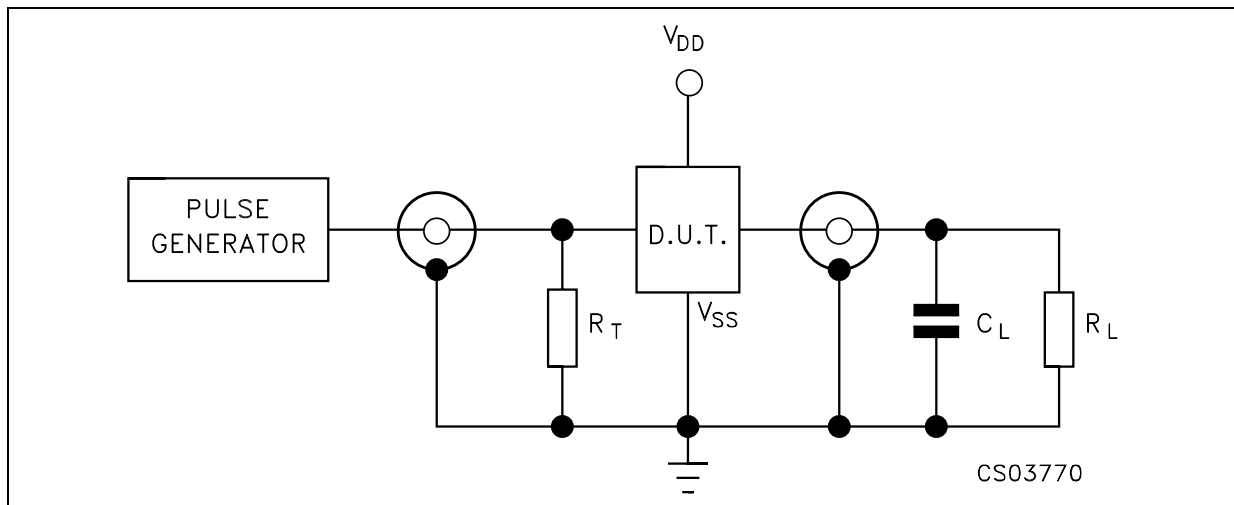
( $\Delta$ ) Symmetrical about OV

TYPICAL "ON" RESISTANCE CHARACTERISTICS,  $T_{amb} = 25^{\circ}\text{C}$

Characteristics*	Supply Conditions		Load Conditions					
			RL = 1KΩ		RL = 10KΩ		RL = 100KΩ	
	V <sub>DD</sub> (V)	V <sub>SS</sub> (V)	Value (Ω)	V <sub>is</sub> (V)	Value (Ω)	V <sub>is</sub> (V)	Value (Ω)	V <sub>is</sub> (V)
R <sub>ON</sub>	+ 15	0	200	+ 15	200	+ 15	180	+ 15
			200	0	200	0	200	0
R <sub>ON</sub> (max.)	+ 15	0	300	+ 11	300	+ 9.3	300	+ 9.2
R <sub>ON</sub>	+ 10	0	290	+ 10	250	+ 10	240	+ 10
			290	0	250	0	300	0
R <sub>ON</sub> (max.)	+ 10	0	500	+ 7.4	560	+ 5.6	610	+ 5.5
R <sub>ON</sub>	+ 5	0	860	+ 5	470	+ 5	450	+ 5
			600	0	580	0	800	0
R <sub>ON</sub> (max.)	+ 5	0	1.7K	+ 4.2	7K	+ 2.9	33K	+ 2.7
R <sub>ON</sub>	+ 2.5	- 2.5	590	+ 2.5	450	+ 2.5	490	+ 2.5
			720	- 2.5	520	- 2.5	520	- 2.5
R <sub>ON</sub> (max.)	+ 2.5	- 2.5	232K	± 0.25	300K	± 0.25	870K	± 0.25

\* Variation from a perfect switch, R<sub>ON</sub> = 0Ω

TEST CIRCUIT



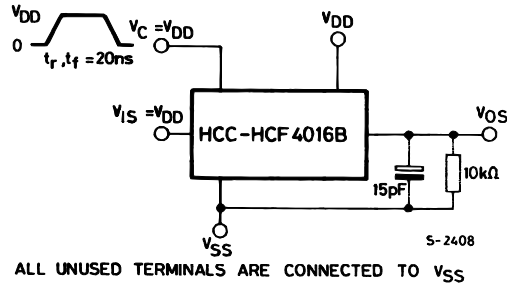
C<sub>L</sub> = 50pF or equivalent (includes jig and probe capacitance)

R<sub>L</sub> = 200KΩ

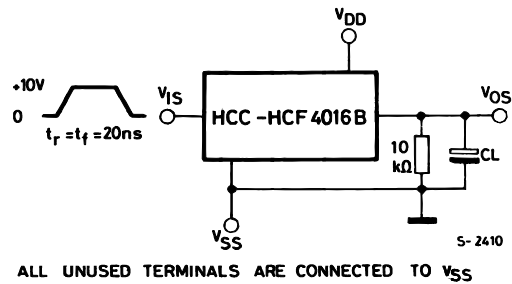
R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50Ω)

SWITCHING CHARACTERISTICS TEST CIRCUIT

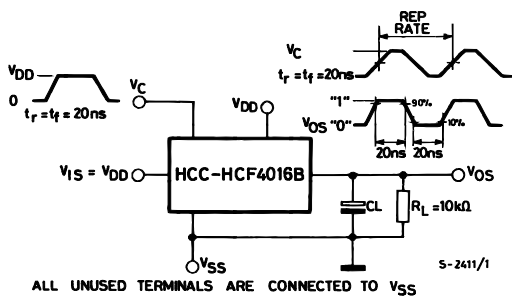
SQUARE-WAVE RESPONSE



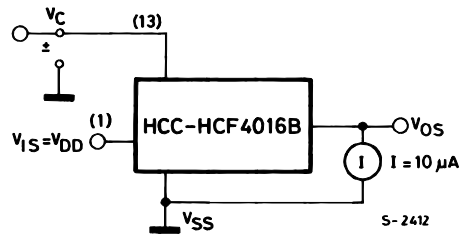
PROPAGATION DELAY TIME SIGNAL INPUT (V<sub>I</sub>) TO SIGNAL OUTPUT (V<sub>O</sub>)



MAX ALLOWABLE CONTROL-INPUT REPETITION RATE

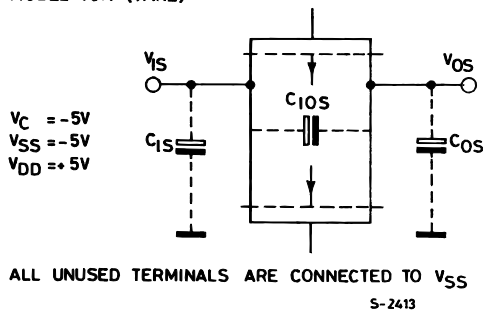


SWITCH TRESHOLD VOLTAGE

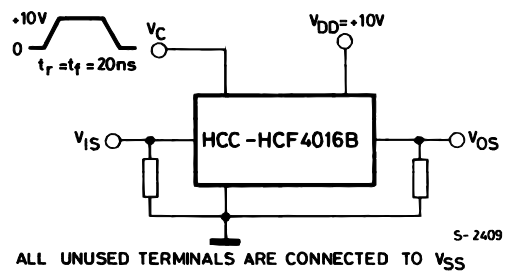


CAPACITANCE C<sub>I0S</sub> AND C<sub>O0S</sub>

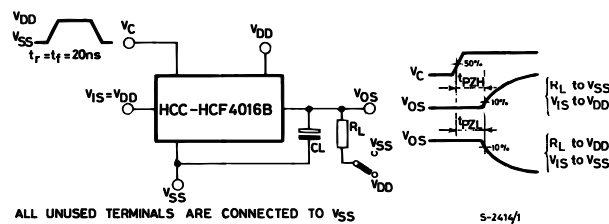
MEASURED ON BOONTON CAPACITANCE BRIDGE MODEL 75A (1MHz)



CROSSTALK CONTROL INPUT TO SIGNAL OUTPUT



TURN-ON PROPAGATION DELAY-CONTROL INPUT TO OUTPUT



### Plastic DIP-14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		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		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



**SO-14 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	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
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			0.68			0.026
S	8° (max.)					



PO13G



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