



QUAD BILATERAL SWITCH

- 20V DIGITAL OR $\pm 10V$ PEAK-TO-PEAK SWITCHING
- 280 Ω TYPICAL ON RESISTANCE FOR 15V OPERATION
- SWITCH ON RESISTANCE MATCHED TO WITHIN 10 Ω TYP. OVER 15V SIGNAL INPUT RANGE
- HIGH ON/OFF OUTPUT-VOLTAGE RATIO: 65 dB TYP. @ $f_{is} = 10$ kHz, $R_L = 10$ k Ω
- HIGH DEGREE OF LINEARITY: < 0.5% DISTORTION TYP. @ $f_{is} = 1$ KHz, $V_{is} = 5$ V_{pp}, $V_{DD} - V_{SS} \geq 10V$, $R_L = 10$ k Ω
- EXTREMELY LOW OFF SWITCH LEAKAGE RESULTING IN VERY LOW OFFSET CURRENT AND HIGH EFFECTIVE OFF RESISTANCE: 100 pA TYP. @ $V_{DD} - V_{SS} = 18V$, $T_{amb} = 25^\circ C$
- EXTREMELY HIGH CONTROL INPUT IMPEDANCE (CONTROL CIRCUIT ISOLATED FROM SIGNAL CIRCUIT 10¹² Ω TYP.)
- LOW CROSSTALK BETWEEN SWITCHES: -50 dB TYP. @ $f_{is} = 0.9$ MHz, $R_L = 1$ k Ω
- MATCHED CONTROL-INPUT TO SIGNAL-OUTPUT CAPACITANCE: REDUCES OUTPUT SIGNAL TRANSIENTS
- FREQUENCY RESPONSE* SWITCH ON = 40 MHz (TYP.)
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100 nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD NO. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

The **HCC 4016B** (extended temperature range) and **HCF 4016B** (intermediate temperature range) are monolithic integrated circuit, available in 14-lead dual in-line plastic or ceramic package, ceramic flat package and plastic micropackage.

The **HCC/HCF 4016B** Series types are quad bilateral switches 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.

ABSOLUTE MAXIMUM RATINGS

V_{DD}^*	Supply voltage: HCC types HCF types	-0.5 to 20 -0.5 to 18	V V
V_i	Input voltage	-0.5 to $V_{DD} + 0.5$	V
I_i	DC input current (any one input)	± 10	mA
P_{tot}	Total power dissipation (per package) Dissipation per output transistor for T_{op} = full package-temperature range	200 100	mW mW
T_{op}	Operating temperature: HCC types HCF types	-55 to 125 -40 to 85	$^\circ C$ $^\circ C$
T_{stg}	Storage temperature	-65 to 150	$^\circ C$

* All voltage values are referred to V_{SS} pin voltage

ORDERING NUMBERS:

HCC 4016 BD for dual in-line ceramic package
 HCC 4016 BF for dual in-line ceramic package, frit seal
 HCC 4016 BK for ceramic flat package
 HCF 4016 BE for dual in-line plastic package
 HCF 4016 BF for dual in-line ceramic package, frit seal
 HCF 4016 BM for plastic micropackage



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STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Parameter		Test conditions			Values						Unit		
		$V_C = V_{DD}$	V_{SS} (V)	V_{DD} (V)	T_{Low}^*		25°C			T_{High}^*			
					Min.	Max.	Min.	Typ.	Max.	Min.		Max.	
I_L Quiescent device current (all switches ON or all switches OFF)	HCC types			5		0.25		0.01	0.25		7.5	μA	
				10		0.5		0.01	0.5		15		
				15		1		0.01	1		30		
				20		5		0.02	5		150		
	HCF types			5		1		0.01	1		7.5		
				10		2		0.01	2		15		
			15		4		0.01	4		30			
SWITCH													
R_{ON} Resistance	HCC	$R_L = 10k\Omega$	+7.5	-7.5	V_{IS}								
					+7.5		360		200	400		600	
					-7.5		360		200	400		600	
					± 0.25		775		280	850		1230	
					+7.5		370		200	400		520	
					-7.5		370		200	400		520	
	HCF	$R_L = 10k\Omega$	+7.5	-7.5	V_{IS}								
					+7.5		370		200	400		520	
					-7.5		370		200	400		520	
					± 0.25		790		280	850		1080	
					+5		600		250	660		960	
					-5		600		250	660		960	
	HCC	$R_L = 10k\Omega$	+5	-5	V_{IS}								
					+5		1870		580	2000		2600	
					-5		610		250	660		840	
					± 0.25		1900		580	2000		2380	
					+15		360		200	400		600	
					± 0.25		360		200	400		600	
	HCF	$R_L = 10k\Omega$	+15	0	V_{IS}								
					+15		370		200	400		520	
					± 0.25		370		200	400		520	
					+9.3		790		300	800		1080	
					+10		600		250	660		960	
					± 0.25		600		250	660		960	
HCC	$R_L = 10k\Omega$	+10	0	V_{IS}									
				+10		1870		560	2000		2600		
				+5.6		1870		560	2000		2600		
				+10		610		250	660		840		
				± 0.25		610		250	660		840		
				+5.6		1900		560	2000		2380		
ΔR_{ON} Resistance ΔR_{ON} (between any 2 of 4 switches)	$R_L = 10k\Omega$	+7.5	-7.5	± 7.5					10			Ω	
					+5	-5	± 5				15		
Input or output leakage current switch OFF (effective OFF resistance)	HCC	V_{DD}	$V_C = V_{SS}$	0		± 0.1		10^{-5}	± 0.1		1	μA	
	HCF	V_{DD}	$V_C = V_{SS}$	0		± 0.3		10^{-5}	± 0.3		1		



HCC/HCF 4016B

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STATIC ELECTRICAL CHARACTERISTICS (continued)

Parameter		Tested conditions	Values								Unit	
			V _{DD} (V)	T _{Low} (*)		25°C			T _{High} (*)			
				Min.	Max.	Min.	Typ.	Max.	Min.	Max.		
C _I	Input capacitance	V _{CC} = V _{SS} = -5	+ 5				4				pF	
C _O	Output capacitance						4					
C _{IO}	Feedthrough						0.2					
CONTROL (V _C)												
V _{TH}		Switch threshold voltage	I _{IS} = 10 μA	5	1		1	2.25		1		V
				10	2		2	4.5		2		
				15	2		2	6.75		2		
I _I	Input current	HCC types HCF types	V _{IS} ≤ V _{DD}	18		±0.1		±10 ⁻⁵	±0.1		± 1	μA
				15		±0.3		±10 ⁻⁵	±0.3		± 1	
C _I	Input capacitance							5	7.5			pF

* T_{Low} = - 55°C for HCC device; -40°C for HCF device.* T_{High} = +125°C for HCC device; +85°C for HCF device.DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 50 pF all input square wave rise and fall time = 20 ns)

Parameter	V _C (V)	Test conditions						Values		Unit
		R _L (kΩ)	f _i (KHz)	V _I (V)	V _{SS} (V)	V _{DD} (V)		Typ.	Max.	
SWITCH										
t _{pd} Propagation delay time (Signal input to output)	= V _{DD}	10		10sq. Wave	GND	5 10 15		40 20 15	100 50 40	ns
Crosstalk between any 2 of 4 switches (f @ -50 dB) 20 log 10 $\frac{V_{O(B)}}{V_{I(A)}} = -50$ dB	V _{C(A)} =V _{DD} = +5 V _{C(B)} =V _{SS} = -5	1		V _{I(A)} =5p-p				0.9		MHz
Frequency response switch "ON"(Sine wave input) at 20 log 10 $\frac{V_O}{V_I} = -3$ dB	= V _{DD} = + 5	1		5p-p	- 5			40		MHz
Feedthrough (Switch OFF) at 20 log 10 $\frac{V_O}{V_I} = -50$ dB	= V _{SS} = - 5	1		-5p-p		5		1.25		MHz
Sine wave distortion	= V _{DD} = 5	10	1	5p-p	- 5			0.4		%



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DYNAMIC ELECTRICAL CHARACTERISTICS (continued)

Parameter	Test conditions							Values		Unit
	V _C (V)	R _L (kΩ)	f _i (KHz)	V _I (V)	V _{SS} (V)	V _{DD} (V)		Typ.	Max.	
CONTROL (V _C)										
Propagation delay: (Turn ON Control to Output)	V _{DD} -V _{SS} (Sq. Wawe)	1		V _{DD} or V _{SS}		5	V _{DD} -V _{SS} =10V	35	70	ns
						10		20	40	
						15		15	30	
Max. Allowable control input repetition rate	10 (Sq. Wawe)	1		V _{DD}	GND	10		10		MHz
Crosstalk (Control input to signal output)	10 (sq. Wave)	10			GND	10		50		mV

(▲) Symmetrical about 0V (●) For all test conditions.

TYPICAL "ON" RESISTANCE CHARACTERISTICS, T_{amb} = 25°C

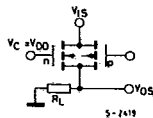
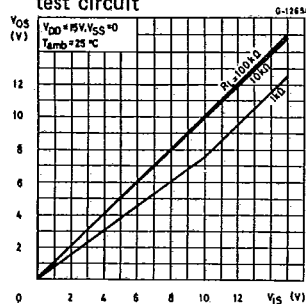
CHARAC- TERISTIC*	SUPPLY CONDITIONS		LOAD CONDITIONS					
			R _L = 1 kΩ		R _L = 10 kΩ		R _L = 100 kΩ	
	V _{DD} (V)	V _{SS} (V)	VALUE (Ω)	V _{IS} (V)	VALUE (Ω)	V _{IS} (V)	VALUE (Ω)	V _{IS} (V)
R _{ON}	+15	0	200	+15	200	+15	180	+15
			200	0	200	0	200	0
R _{ON} (max.)	+15	0	300	+11	300	+9.3	320	+9.2
R _{ON}	+10	0	290	+10	250	+10	240	+10
			290	0	250	0	300	0
R _{ON} (max.)	+10	0	500	+7.4	560	+5.6	610	+5.5
R _{ON}	+5	0	860	+5	470	+5	450	+5
			600	0	580	0	800	0
R _{ON} (max.)	+5	0	1.7k	+4.2	7k	+2.9	33k	+2.7
R _{ON}	+2.5	-2.5	590	+2.5	450	+2.5	490	+2.5
			720	-2.5	520	-2.5	520	-2.5
R _{ON} (max.)	+2.5	-2.5	232k	± 0.25	300k	± 0.25	870k	± 0.25

* Variation from a perfect switch, R_{ON} = 0Ω.

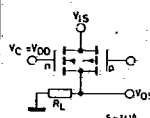
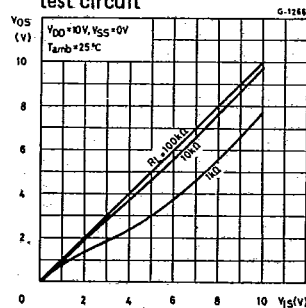
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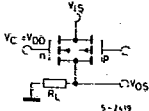
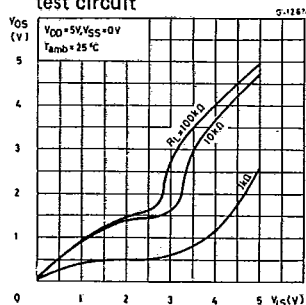
Typical "ON" characteristics for 1 of 4 switches with $V_{DD} = +15V$, $V_{SS} = 0V$, and test circuit



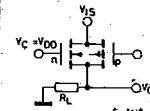
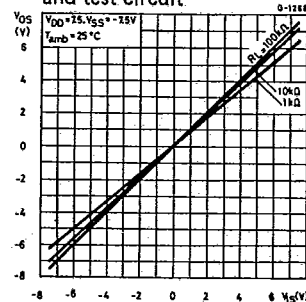
Typical "ON" characteristics for 1 of 4 switches with $V_{DD} = +10V$, $V_{SS} = 0V$, and test circuit



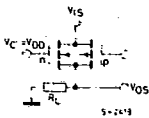
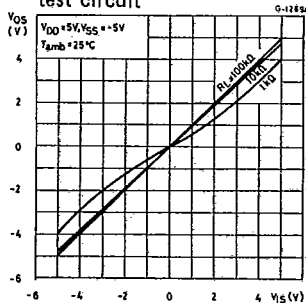
Typical "ON" characteristics for 1 of 4 switches with $V_{DD} = +5V$, $V_{SS} = 0V$, and test circuit



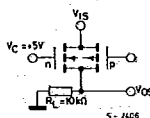
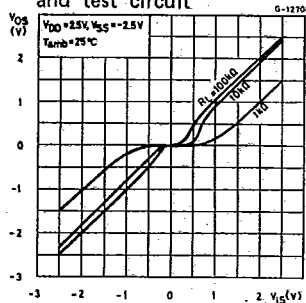
Typical "ON" characteristics for 1 of 4 switches with $V_{DD} = +7.5V$, $V_{SS} = -7.5V$, and test circuit



Typical "ON" characteristics for 1 of 4 switches with $V_{DD} = +5V$, $V_{SS} = -5V$, and test circuit



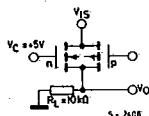
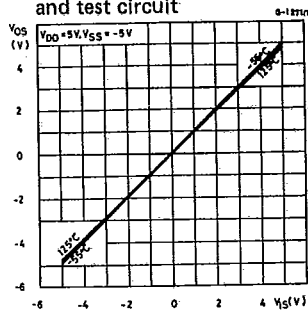
Typical "ON" characteristics for 1 of 4 switches with $V_{DD} = +2.5V$, $V_{SS} = -2.5V$, and test circuit



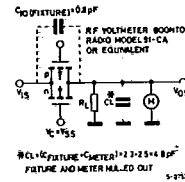
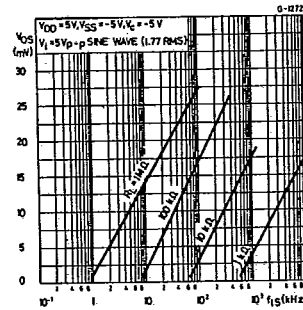


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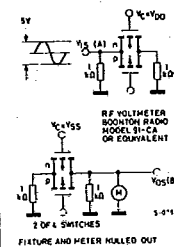
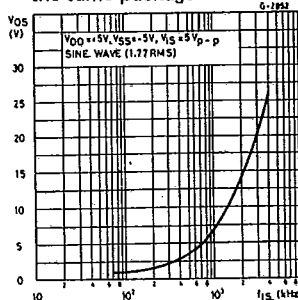
Typical "ON" characteristics as function of temp. for 1 of 4 switches with $V_{DD} = +5V$ and test circuit



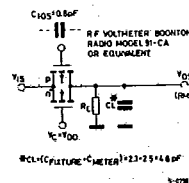
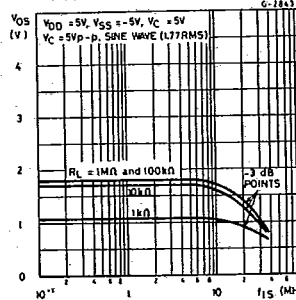
Typical feedthru vs. frequency-switch "OFF" and test circuit



Typical crosstalk between switch circuits in the same package

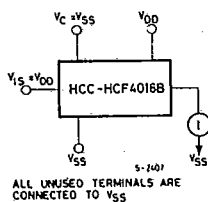


Typical switch frequency response-switch "ON" and test circuit

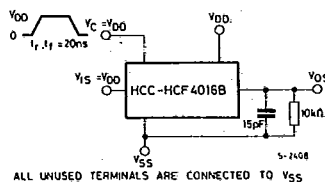


TEST CIRCUITS

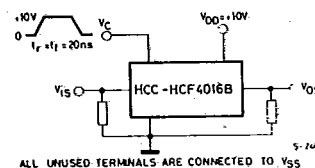
"OFF" switch input or put leakage current



Square-wave response



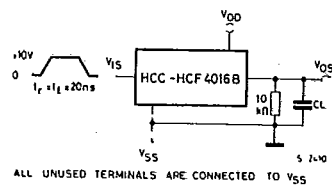
Crosstalk-control input to signal output



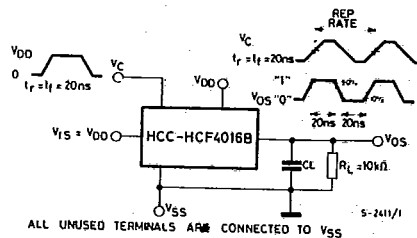
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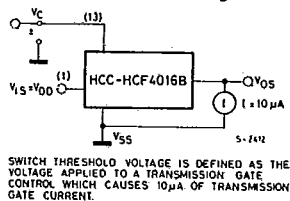
Propagation delay time signal input (V_{IS}) to signal output (V_{OS})



Max. allowable control-input repetition rate

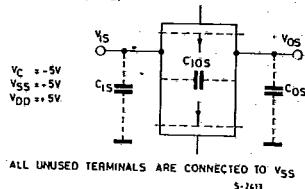


Switch threshold voltage

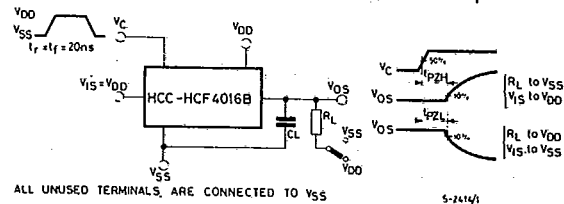


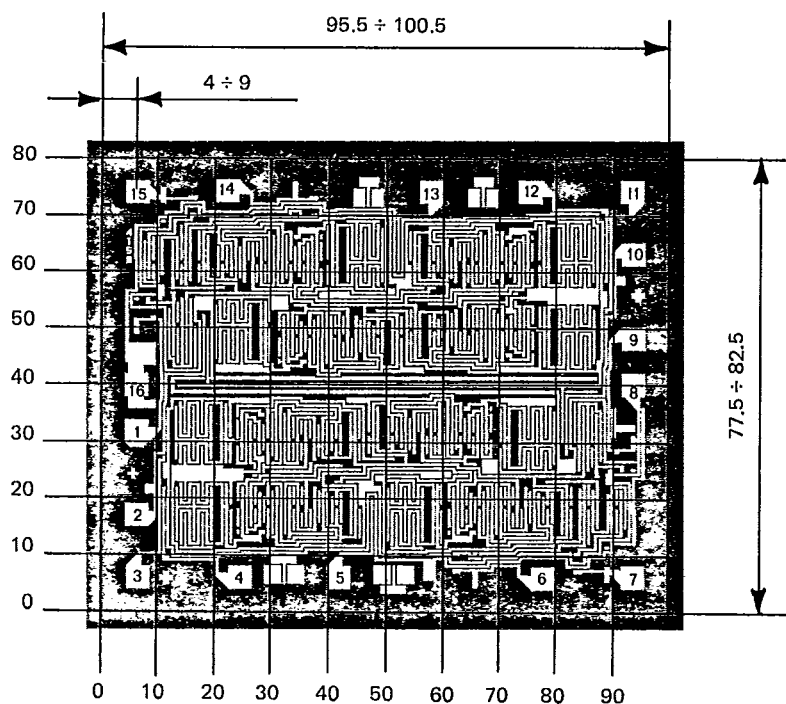
Capacitance C_{IOS} and C_{OS}

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

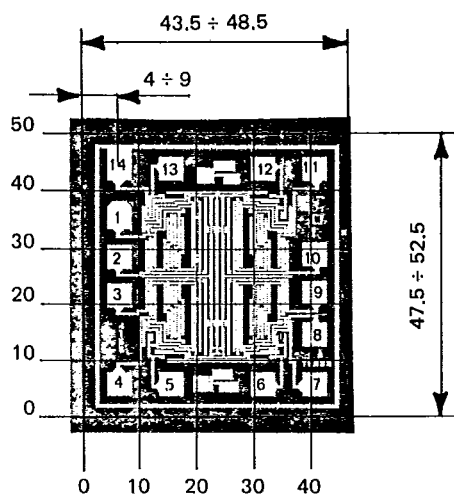


Turn-On propagation delay-control input to output





4015B



4016B