PRELIMINARY DATA

QUAD 2-INPUT NAND SCHMITT TRIGGERS

- SCHMITT-TRIGGER ACTION ON EACH INPUT WITH NO EXTERNAL COMPONENTS
- HYSTERESIS VOLTAGE TYPICALLY 0.9V AT V_{DD}= 5V AND 2.3V AT V_{DD}= 10V
- NOISE IMMUNITY GREATER THAN 50% OF V_{DD} (TYP.)
- NO LIMIT ON INPUT RISE AND FALL TIMES
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED TO 20V
- MAXIMUM INPUT CURRENT OF 1 μA AT 18V (FULL PACKAGE-TEMPERATURE RANGE)
- 5V, 10V, AND 15V PARAMETRIC RATINGS

The **HCC 4093B** (extended temperature range) and **HCF 4093B** (intermediate temperature range) are available in 14-lead dual in-line plastic or ceramic package, and ceramic flat package.
The **HCC/HCF 4093B** consists of four Schmitt-trigger circuits. Each circuit functions as a two-input NAND gate with Schmitt-trigger action on both inputs. The gate switches at different points for positive and negative-going signals.
The difference between the positive voltage (V_P) and the negative voltage (V_N) is defined as hysteresis voltage (V_H) (See Fig. 1).

ABSOLUTE MAXIMUM RATINGS

V_{DD}*	Supply voltage	-0.5 to 20	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)	200	mW
	Dissipation per output transistor for T_{op}= full package-temperature range	100	mW
T_{op}	Operating temperature: for **HCC** types	-55 to 125	°C
	for **HCF** types	-40 to 85	°C
T_{stg}	Storage temperature	-65 to 150	°C

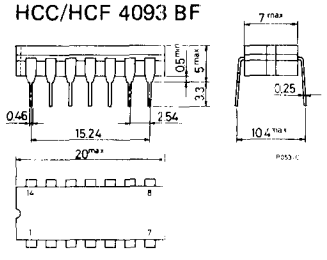
* All voltage values are referred to V_{SS} pin voltage

ORDERING NUMBERS:

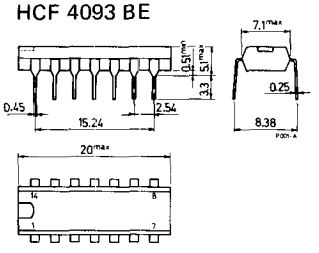
HCC 4093 BD for dual in-line ceramic package
HCC 4093 BF for dual in-line ceramic package, frit seal
HCC 4093 BK for ceramic flat package
HCF 4093 BE for dual in-line plastic package
HCF 4093 BF for dual in-line ceramic package, frit seal

MECHANICAL DATA (dimensions in mm)

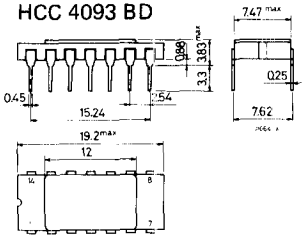
Dual in-line ceramic package for HCC/HCF 4093 BF



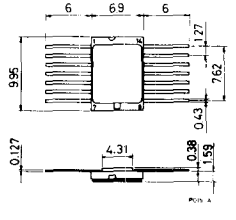
Dual in-line plastic package for HCF 4093 BE



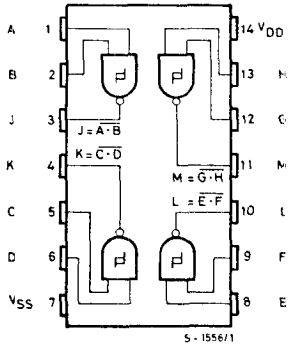
Dual in-line ceramic package for HCC 4093 BD



Ceramic flat package for HCC 4093 BK

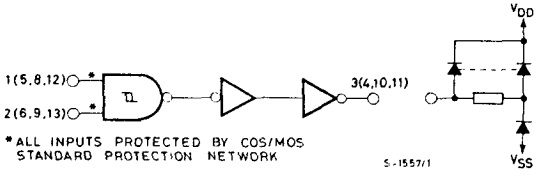


CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM

1 of 4 Schmitt triggers



RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage	3 to 18	V
V_I	Input voltage	0 to V_{DD}	V
T_{op}	Operating temperature: for **HCC** types	-55 to 125	°C
	for **HCF** types	-40 to 85	°C

STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Parameter		Test conditions				Values							Unit
		V_I (V)	V_O (V)	$\|I_O\|$ (μA)	V_{DD} (V)	T_{Low}*		25°C			T_{High}*		
						Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
I_L	Quiescent supply current	0/ 5			5		1		0.02	1		30	μA
		0/10			10		2		0.02	2		60	
		0/15			15		4		0.02	4		120	
		0/20			20		20		0.04	20		600	
V_P	Positive trigger threshold voltage	a			5	2.2	3.6	2.2	2.9	3.6	2.2	3.6	V
		a			10	4.6	7.1	4.6	5.9	7.1	4.6	7.1	
		a			15	6.8	10.8	6.8	8.8	10.8	6.8	10.8	
		b			5	2.6	4	2.6	3.3	4	2.6	4	
		b			10	5.6	8.2	5.6	7	8.2	5.6	8.2	
		b			15	6.3	12.7	6.3	9.4	12.7	6.3	12.7	
V_N	Negative trigger threshold voltage	a			5	0.9	2.8	0.9	1.9	2.8	0.9	2.8	V
		a			10	2.5	5.2	2.5	3.9	5.2	2.5	5.2	
		a			15	4	7.4	4	5.8	7.4	4	7.4	
		b			5	1.4	3.2	1.4	2.3	3.2	1.4	3.2	
		b			10	3.4	6.6	3.4	5.1	6.6	3.4	6.6	
		b			15	4.8	9.6	4.8	7.3	9.6	4.8	9.6	
V_H	Hysteresis voltage	a			5	0.3	1.6	0.3	0.9	1.6	0.3	1.6	V
		a			10	1.2	3.4	1.2	2.3	3.4	1.2	3.4	
		a			15	1.6	5	1.6	3.5	5	1.6	5	
		b			5	0.3	1.6	0.3	0.9	1.6	0.3	1.6	
		b			10	1.2	3.4	1.2	2.3	3.4	1.2	3.4	
		b			15	1.6	5	1.6	3.5	5	1.6	5	
V_{OH}	Output high voltage	0/ 5		< 1	5	4.95		4.95			4.95		V
		0/10		< 1	10	9.95		9.95			9.95		
		0/15		< 1	15	14.95		14.95			14.95		
V_{OL}	Output low voltage	5/0		< 1	5		0.05			0.05		0.05	V
		10/0		< 1	10		0.05			0.05		0.05	
		15/0		< 1	15		0.05			0.05		0.05	
I_{OH}	Output drive drive current HCC types	0/ 5	2.5		5	-2		-1.6	-3.2		-1.15		mA
		0/ 5	4.6		5	-0.64		-0.51	-1		-0.36		
		0/10	9.5		10	-1.6		-1.3	-2.6		-0.9		
		0/15	13.5		15	-4.2		-3.4	-6.8		-2.4		
	HCF types	0/ 5	2.5		5	-1.8		-1.6	-3.2		-1.3		
		0/ 5	4.6		5	-0.61		-0.51	-1		-0.42		
		0/10	9.5		10	-1.5		-1.3	-2.6		-1.1		
		0/15	13.5		15	-4		-3.4	-6.8		-2.8		

a : input on terminals 1, 5, 8, 12 or 2, 6, 9, 13; other inputs to V_{DD}.
b : input on terminals 1 and 2, 5 and 6, 8 and 9, or 12 and 13; other inputs to V_{DD}.

STATIC ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions				Values							Unit
		V_I (V)	V_O (V)	$\|I_O\|$ (μA)	V_{DD} (V)	T_{Low}* Min.	T_{Low}* Max.	25°C Min.	25°C Typ.	25°C Max.	T_{High}* Min.	T_{High}* Max.	
I_{OL} Output sink current	HCC types	0/ 5	0.4		5	0.64		0.51	1		0.36		mA
		0/10	0.5		10	1.6		1.3	2.6		0.9		
		0/15	1.5		15	4.2		3.4	6.8		2.4		
	HCF types	0/ 5	0.4		5	0.61		0.51	1		0.42		
		0/10	0.5		10	1.5		1.3	2.6		1.1		
		0/15	1.5		15	4		3.4	6.8		2.8		
I_{IH},I_L Input leakage current		0/18	Any input		18		± 0.1		± 10^{-5}	± 0.1		± 1	μA
C_I Input capacitance			Any input						5	7.5			pF

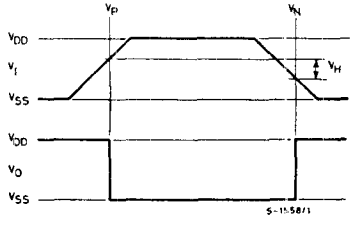
* T_{Low} = − 55°C for **HCC** device; − 40°C for **HCF** device.
* T_{High} = +125°C for **HCC** device; + 85°C for **HCF** device.

DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 50 pF, R_L = 200 kΩ, typical temperature coefficient for all V_{DD} values is 0.3%/°C, all input rise and fall times = 20 ns)

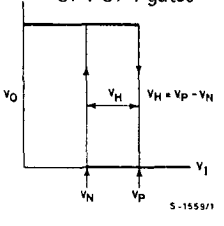
Parameter	Test conditions	Values				Unit
		V_{DD} (V)	Min.	Typ.	Max.	
t_{PLH}, t_{PHL} Propagation delay time		5		300	600	ns
		10		150	300	
		15		120	240	
t_{TLH}, t_{THL} Transition time		5		100	200	ns
		10		50	100	
		15		40	80	

Fig. 1 - Hysteresis definition, characteristic and test setup

(a) Definition of V_P, V_N and V_H



(b) Transfer characteristic of 1 of 4 gates



(c) Test setup

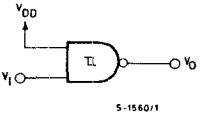


Fig. 2 - Input and output characteristics

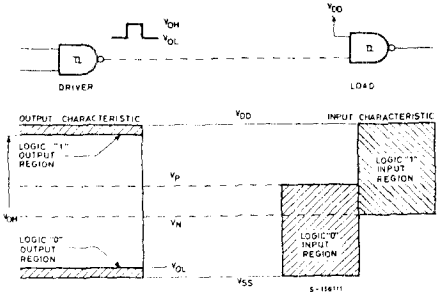


Fig. 3 - Typical current and voltage transfer characteristics

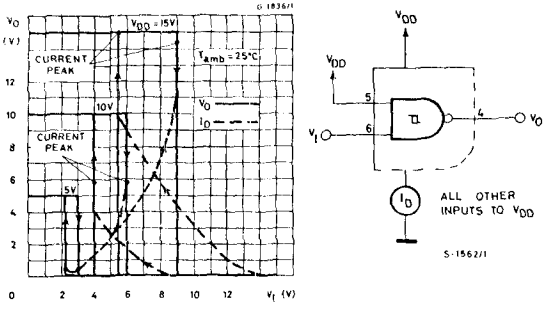


Fig. 4 - Typical voltage transfer characteristics as a function of temperature, and test circuit

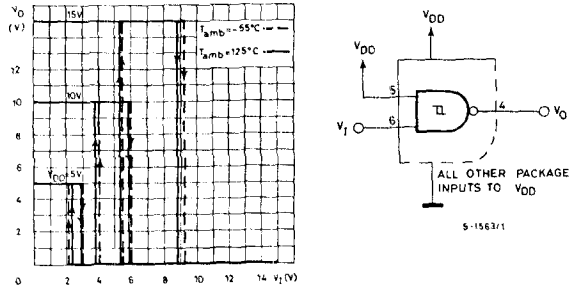


Fig. 5 - Typical output low (sink) current characteristics

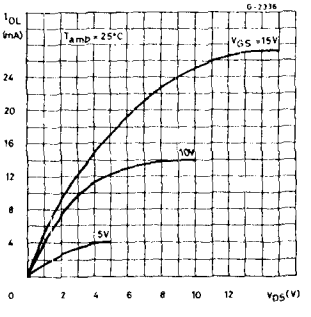


Fig. 6 - Minimum output low (sink) current characteristics

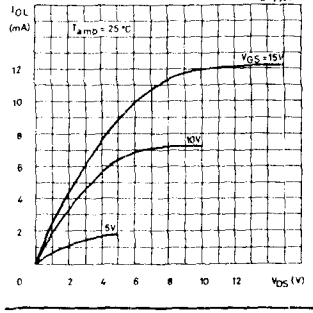


Fig. 7 - Typical output high (source) current characteristics

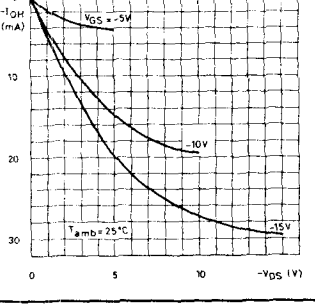


Fig. 8 - Minimum output high(source) current characteristics

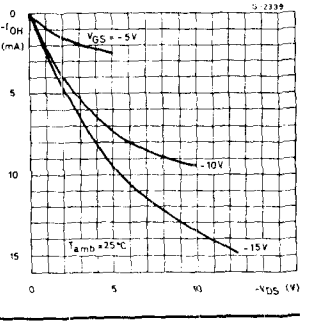


Fig. 9 - Typical propagation delay time vs. supply voltage

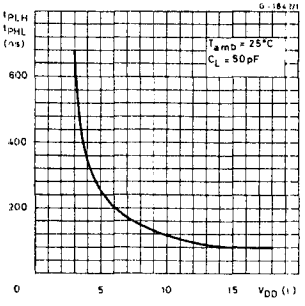


Fig. 10 - Typical transition time vs. load capacitance

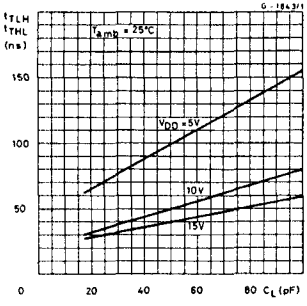


Fig. 11 - Typical trigger threshold voltage vs. V_{DD}

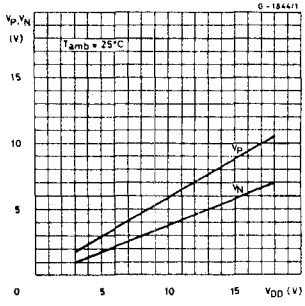


Fig. 12 - Typical per cent hysteresis vs. supply voltage

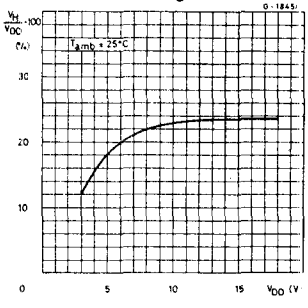


Fig. 13 - Typical dissipation characteristics

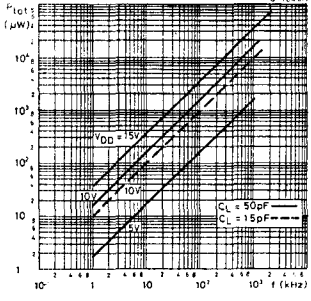
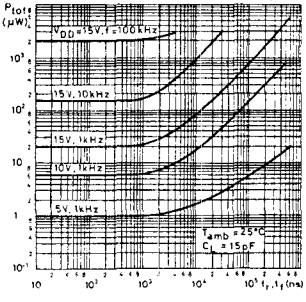
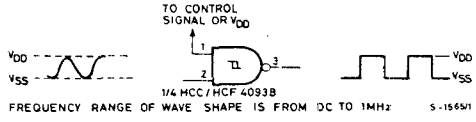


Fig. 14 - Power dissipation vs. rise and fall times



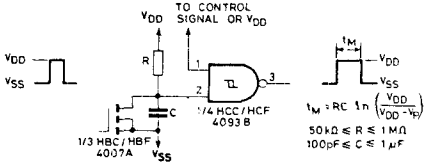
APPLICATIONS

Fig. 15 - Wave shaper



FREQUENCY RANGE OF WAVE SHAPE IS FROM DC TO 1MHz

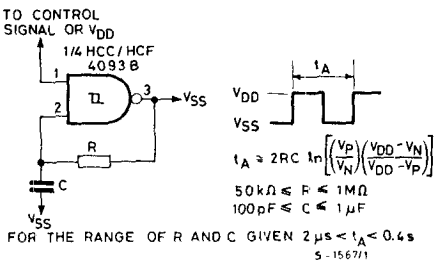
Fig. 16 - Monostable multivibrator



FOR THE RANGE OF R AND C GIVEN 5 μs < t_M < 1s

APPLICATIONS (continued)

Fig. 17 - Astable multivibrator



TEST CIRCUITS

Fig. 18 - Quiescent device current

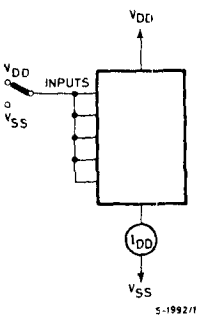


Fig. 19 - Input leakage current