COS/MOS INTEGRATED CIRCUIT

4063 B

HCC/HCF 4063B

4-BIT MAGNITUDE COMPARATOR

- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- STANDARD B-SERIES OUTPUT DRIVE
- EXPANSION TO 8-16V .... 4N BITS BY CASCADING UNITS
- MEDIUM SPEED OPERATION: COMPARES TWO 4-BIT WORDS IN 250 ns (TYP.) AT 10V
- 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 4063B** (extended temperature range) and **HCF 4063B** (intermediate temperature range) are available in 16-lead dual in-line plastic or ceramic package, ceramic flat package and plastic micropackage.
The **HCC/HCF 4063B** is a low-power 4-bit magnitude comparator designed for use in computer and logic applications that require the comparison of two 4-bit words. This logic circuit determines whether one 4-bit word (Binary or BCD) is "less than", "equal to" or "greater than" a second 4-bit word.
The **HCC/HCF 4063B** has eight comparing inputs (A3, B3, through A0, B0), three outputs ($A < B$, $A = B$, $A > B$) and three cascading inputs ($A < B$, $A = B$, $A > B$) that permit systems designers to expand the comparator function to 8, 12, 16 . . . . 4N bits. When a single **HCC/HCF 4063B** is used, the cascading inputs are connected as follows: $(A < B)$ = low, $(A = B)$ = high, $(A > B)$ = low.
For words longer than 4 bits, **HCC/HCF 4063B** devices may be cascaded by connecting the outputs of the less-significant comparator to the corresponding cascading inputs of the more-significant comparator. Cascading inputs ($A < B$, $A = B$, and $A > B$) on the least significant comparator are connected to a low, a high, and a low level, respectively.

ABSOLUTE MAXIMUM RATINGS

7R

V_{DD}*	Supply voltage: **HCC** types	-0.5 to 20	V
	HCF types	-0.5 to 18	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: **HCC** types	-55 to 125	°C
	HCF types	-40 to 85	°C
T_{stg}	Storage temperature	-65 to 150	°C

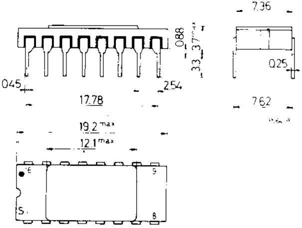
* All voltage values are referred to V_{SS} pin voltage

ORDERING NUMBERS:

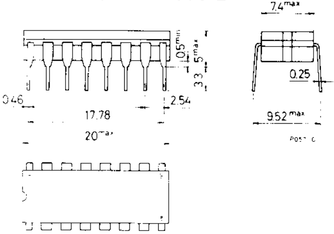
HCC 4063	BD	for dual in-line ceramic package
HCC 4063	BF	for dual in-line ceramic package, frit seal
HCC 4063	BK	for ceramic flat package
HCF 4063	BE	for dual in-line plastic package
HCF 4063	BF	for dual in-line ceramic package, frit seal
HCF 4063	BM	for plastic micropackage

MECHANICAL DATA (dimensions in mm)

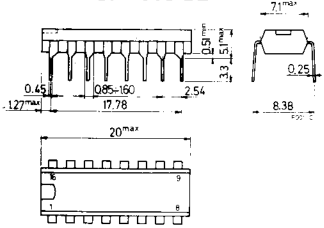
Dual in-line ceramic package
for HCC 4063 BD



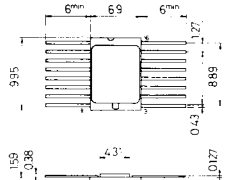
Dual in-line ceramic package
for HCC/HCF 4063 BF



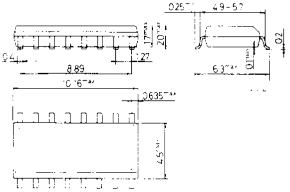
Dual in-line plastic package
for HCF 4063 BE



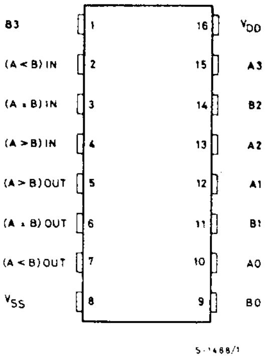
Ceramic flat package for
HCC 4063 BK



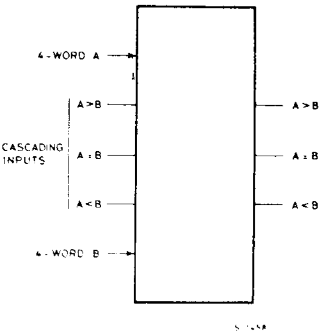
Plastic micropackage for
HCF 4063 BM



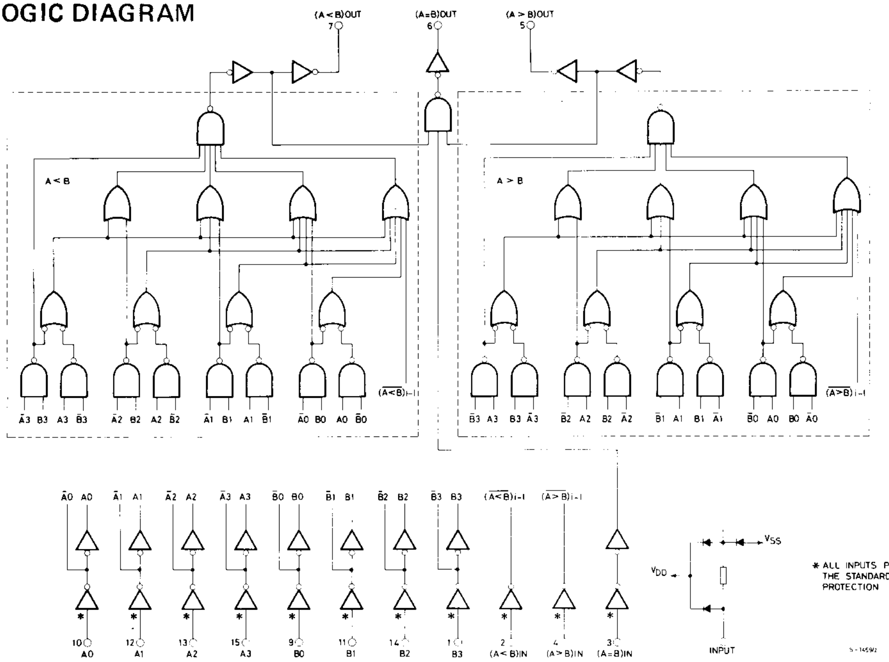
CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM



LOGIC DIAGRAM



TRUTH TABLE

INPUTS							OUTPUTS		
COMPARING				CASCADING					
A3, B3	A2, B2	A1, B1	A0, B0	A < B	A = B	A > B	A < B	A = B	A > B
A3 > B3	X	X	X	X	X	X	0	0	1
A3 = B3	A2 > B2	X	X	X	X	X	0	0	1
A3 = B3	A2 = B2	A1 > B1	X	X	X	X	0	0	1
A3 = B3	A2 = B2	A1 = B1	A0 > B0	X	X	X	0	0	1
A3 = B3	A2 = B2	A1 = B1	A0 = B0	0	0	1	0	0	1
A3 = B3	A2 = B2	A1 = B1	A0 = B0	0	1	0	0	1	0
A3 = B3	A2 = B2	A1 = B1	A0 = B0	1	0	0	1	0	0
A3 = B3	A2 = B2	A1 = B1	A0 < B0	X	X	X	1	0	0
A3 = B3	A2 = B2	A1 < B1	X	X	X	X	1	0	0
A3 = B3	A2 < B2	X	X	X	X	X	1	0	0
A3 < B3	X	X	X	X	X	X	1	0	0

X = Don't care
1 ≡ High state
0 ≡ Low state

RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage: **HCC** types	3 to 18	V
	HCF types	3 to 15	V
V_I	Input voltage	0 to V_{DD}	V
T_{op}	Operating temperature: **HCC** types	-55 to 125	°C
	HCF types	-40 to 85	°C

Compl

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}* Min.	T_{Low}* Max.	25°C Min.	25°C Typ.	25°C Max.	T_{High}* Min.	T_{High}* Max.	
I_L	Quiescent current	HCC types	0/ 5			5		5		0.04	5		150	µA
			0/10			10		10		0.04	10		300	
			0/15			15		20		0.04	20		600	
			0/20			20		100		0.08	100		3000	
		HCF types	0/ 5			5		20		0.04	20		150	
			0/10			10		40		0.04	40		300	
			0/15			15		80		0.04	80		600	
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	
V_{IH}	Input high voltage			0.5/4.5	< 1	5	3.5		3.5			3.5		V
				1/9	< 1	10	7		7			7		
				1.5/13.5	< 1	15	11		11			11		
V_{IL}	Input low voltage			4.5/0.5	< 1	5		1.5			1.5		1.5	V
				9/1	< 1	10		3			3		3	
				13.5/1.5	< 1	15		4			4		4	
I_{OH}	Output 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	-1.53		-1.36	-3.2		-1.1		
			0/ 5	4.6		5	-0.52		-0.44	-1		-0.36		
			0/10	9.5		10	-1.3		-1.1	-2.6		-0.9		
			0/15	13.5		15	-3.6		-3.0	-6.8		-2.4		
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	0.52		0.44	1		0.36		
			0/10	0.5		10	1.3		1.1	2.6		0.9		
			0/15	1.5		15	3.6		3.0	6.8		2.4		
I_{IH}, I_{IL}	Input leakage current	HCC types	0/18	Any input		18		±0.1		$\pm 10^{-5}$	±0.1		± 1	µA
		HCF types	0/15			15		±0.3		$\pm 10^{-5}$	±0.3		± 1	
C_I	Input capacitance			Any input						5	7.5			pF

* T_{Low} = - 55°C for **HCC** device: -40°C for **HCF** device.

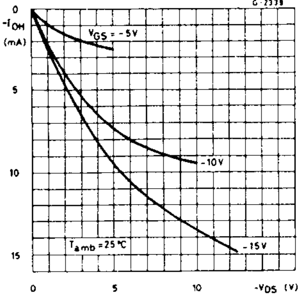
* T_{High} = +125°C for **HCC** device: +85°C for **HCF** device.

The Noise Margin for both "1" and "0" level is:
1V min. with V_{DD}= 5V
2V min. with V_{DD}= 10V
2.5V min. with V_{DD}= 15V

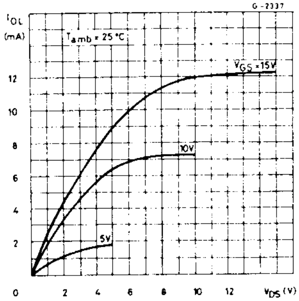
DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 50 pF, R_L = 200 kΩ, typical temperature coefficient for all V_{DD} values is 0,3%/°C, all input rise and fall times = 20 ns)

Parameter		Test conditions		Values			Unit
			V_{DD} (V)	Min.	Typ.	Max.	
t_{PLH}, t_{PHL}	Propagation delay time	Comparing inputs to outputs	5		625	1250	ns
			10		250	500	
			15		175	350	
		Cascading inputs to outputs	5		500	1000	
			10		200	400	
			15		140	280	
t_{TLH} t_{THL}	Transition time		5		100	200	ns
			10		50	100	
			15		40	80	

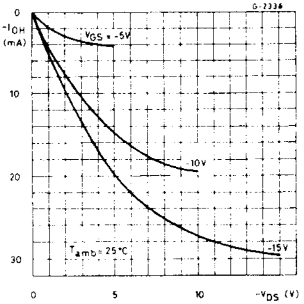
Minimum output high (source) current characteristics



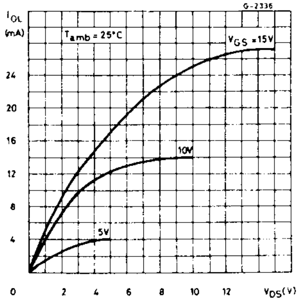
Minimum output low (sink) current characteristics



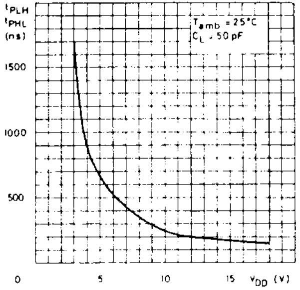
Typical output high (source) current characteristics



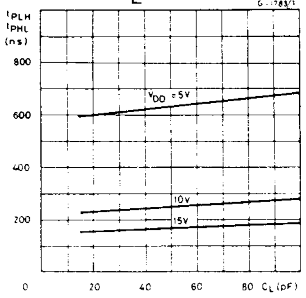
Typical output low (sink) current characteristics



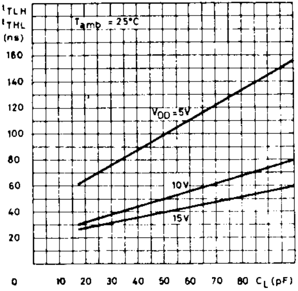
Typical propagation delay time vs. V_{DD}



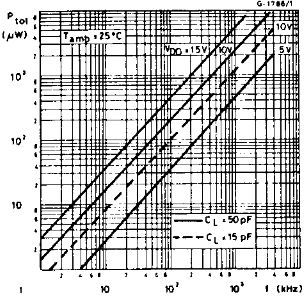
Typical propagation delay time vs. C_L



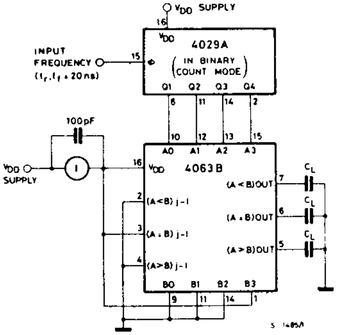
Typical transition time vs. load capacitance



Typical power dissipation characteristics

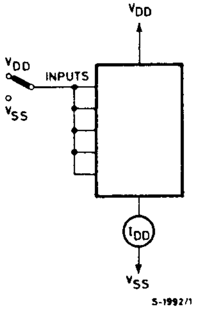


Dynamic power dissipation

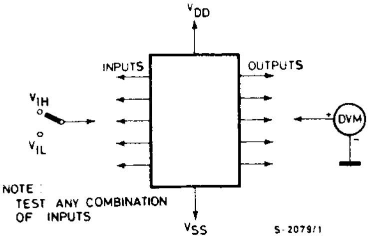


TEST CIRCUITS

Quiescent device current

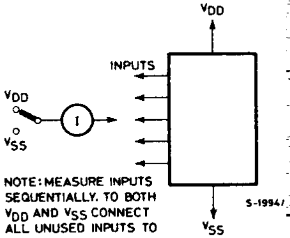


Noise immunity



NOTE :
TEST ANY COMBINATION
OF INPUTS

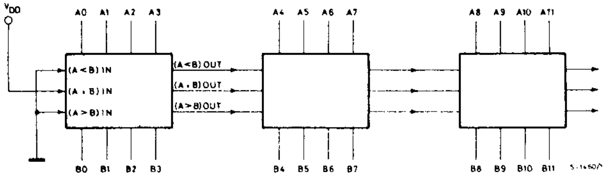
Input leakage current



NOTE: MEASURE INPUTS SEQUENTIALLY. TO BOTH V_{DD} AND V_{SS} CONNECT ALL UNUSED INPUTS TO EITHER V_{DD} OR V_{SS}

TYPICAL APPLICATION

Typical speed characteristics of a 12-bit comparator



$t_{p\,(TOT.)} = t_p\left(\substack{\text{COMPARE}\\ \text{INPUTS}}\right) + 2 \times t_p\left(\substack{\text{CASCADE}\\ \text{INPUTS}}\right)$ at $C_L = 50$ pF (each output), $V_{DD} = 10$V (3 stages)

$= 250 + 2 \times (200) = 650$ ns (typ.)