CMOS INTEGRATED CIRCUITS

HCC/HCF 4518B
HCC/HCF 4520B

DUAL UP-COUNTERS: HCC/HCF 4518B DUAL BCD UP-COUNTER HCC/HCF 4520B DUAL BINARY UP-COUNTER

- MEDIUM-SPEED OPERATION - 6 MHz TYP. CLOCK FREQUENCY AT 10V
- POSITIVE - OR NEGATIVE - EDGE TRIGGERING
- SYNCHRONOUS INTERNAL CARRY PROPAGATION
- 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 4518B/4520B** (extended temperature range) and **HCF 4518B/4520B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and ceramic flat package. The **HCC/HCF 4518B** Dual BCD Up Counter and **HCC/HCF 4520B** Dual Binary Up Counter each consist of two identical, internally synchronous 4-stage counters. The counter stages are D-type flip-flops having interchangeable Clock and Enable lines for incrementing on either the positive-going or negative-going transition. For single-unit operation the Enable input is maintained "high" and the counter advances on each positive-going transition of the Clock. The counters are cleared by high levels on their Reset lines. The counter can be cascaded in the ripple mode by connecting Q4 to the enable input of the subsequent counter while the clock input of the latter is held low.

ABSOLUTE MAXIMUM RATINGS

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 45XX BD for dual in-line ceramic package
HCC 45XX BF for dual in-line ceramic package, frit seal
HCC 45XX BK for ceramic flat package
HCF 45XX BE for dual in-line plastic package
HCF 45XX BF for dual in-line ceramic package, frit seal

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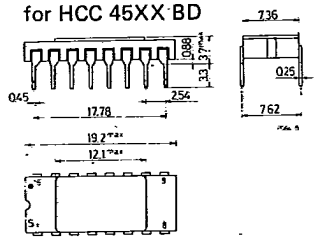
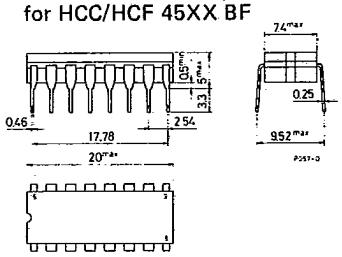
HCC/HCF 4518B
HCC/HCF 4520B

MECHANICAL DATA (dimensions in mm)

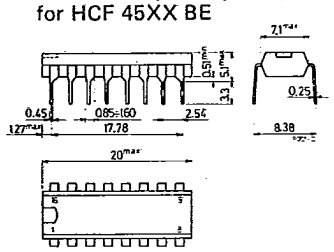
Dual in-line ceramic package for HCC 45XX BD



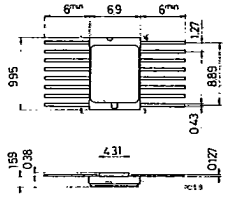
Dual in-line ceramic package for HCC/HCF 45XX BF



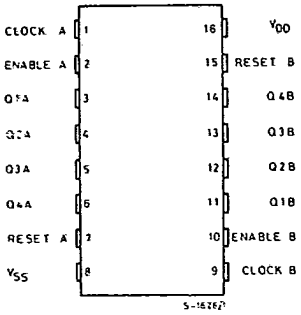
Dual in-line plastic package for HCF 45XX BE



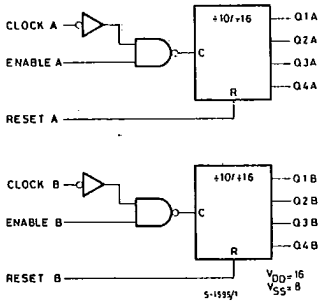
Ceramic flat package for HCC 45XX BK



CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM



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

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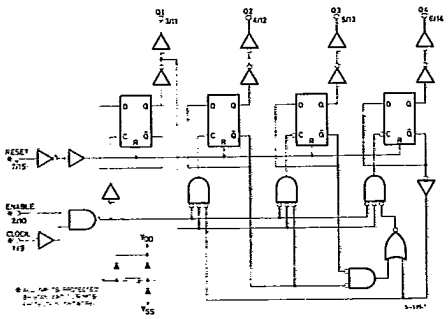
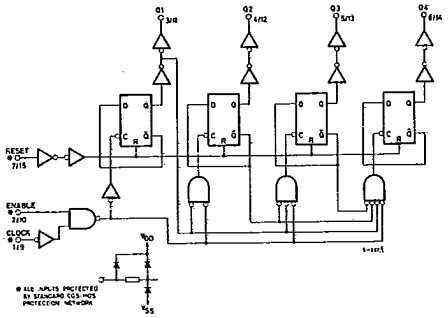
LOGIC DIAGRAMS (for one of two identical counter)

Decade counter for 4518B



Binary counter for 4520B

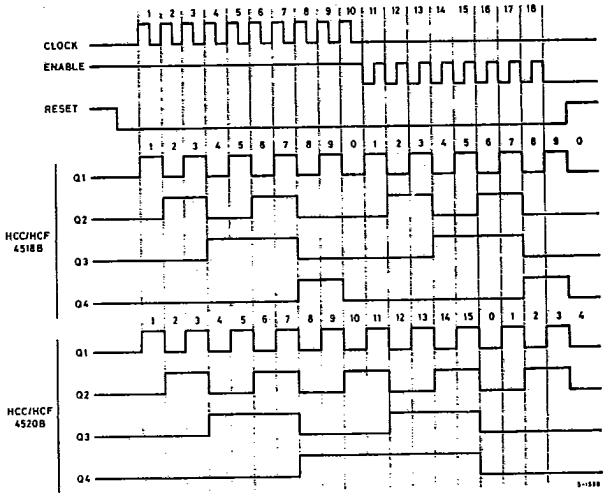


TRUTH TABLE

CLOCK	ENABLE	RESET	ACTION
↑	1	0	Increment Counter
0	↓	0	Increment Counter
↓	X	0	No Change
X	↑	0	No Change
↑	0	0	No Change
1	↓	0	No Change
X	X	1	Q1 thru Q4 = 0

X= Don't Care 1= High State 0= Low State

TIMING DIAGRAM



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HCC/HCF 4518B
HCC/HCF 4520B

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

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HCC/HCF 4518B
HCC/HCF 4520B

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

Parameter		Test conditions	Values			Unit
		V_{DD} (V)	Min.	Typ.	Max.	
t_{PLH}, t_{PHL}	Propagation delay time (Reset to output)	5		280	560	ns
		10		115	230	
		15		80	160	
t_{PLH}, t_{PHL}	Propagation delay time (Clock or Enable to output)	5		330	650	ns
		10		130	225	
		15		90	170	
t_{TLH}, t_{THL}	Transition time	5		100	200	ns
		10		50	100	
		15		40	80	
t_W	Clock pulse width	5	200	100		ns
		10	100	50		
		15	70	35		
t_W	Reset pulse width	5	250	125		ns
		10	110	55		
		15	80	40		
t_W	Enable pulse width	5	400	200		ns
		10	200	100		
		15	140	70		
t_r, t_f	Clock or enable rise and fall time	5			15	μs
		10			15	
		15			5	
f_{max}	Maximum clock frequency	5	1,5	3		MHz
		10	3	6		
		15	4	8		
t_r, t_f	Clock input rise of fall time	5			15	μs
		10			5	
		15			5	

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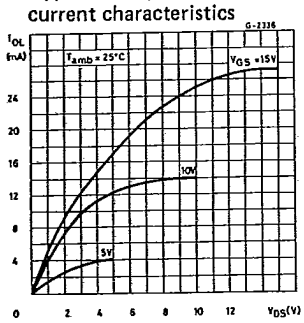
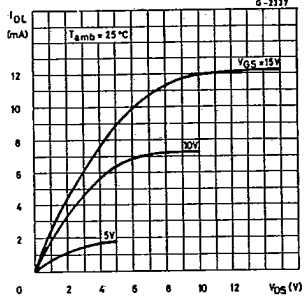
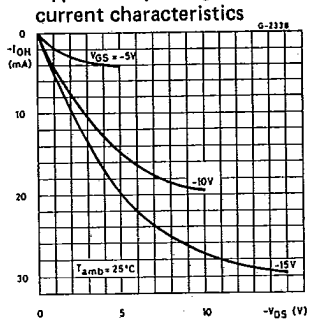
Typical output low (sink) current characteristics



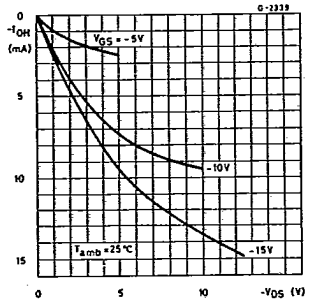
Minimum output low (sink) current characteristics



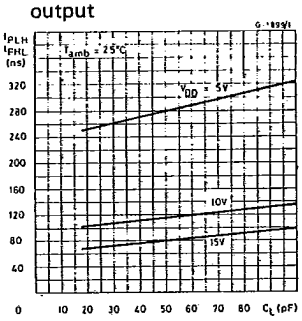
Typical output high (source) current characteristics



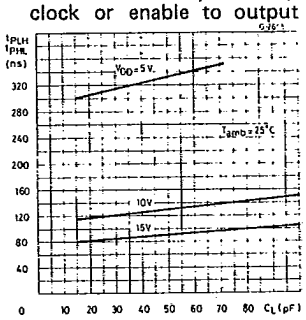
Minimum output high (source) current characteristics



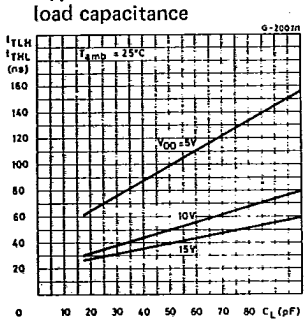
Typical propagation delay vs. load capacitance, reset to output



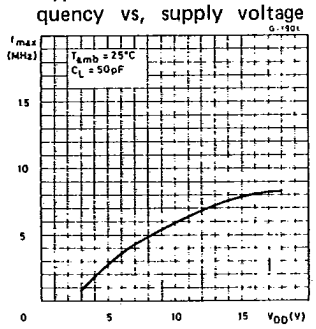
Typical propagation delay time vs. load capacitance, clock or enable to output



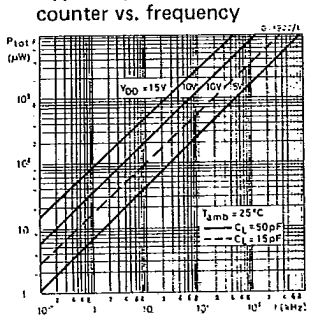
Typical transition time vs. load capacitance



Typical maximum-clock frequency vs, supply voltage



Typical power dissipation/ counter vs. frequency



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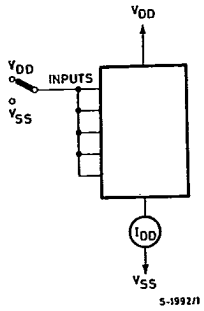
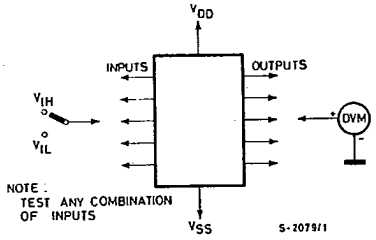
TEST CIRCUITS

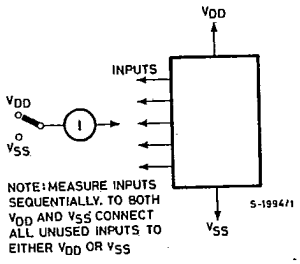
Quiescent device current



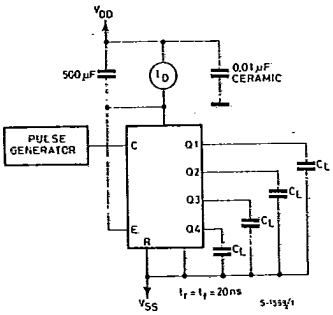
Noise immunity



Input leakage current

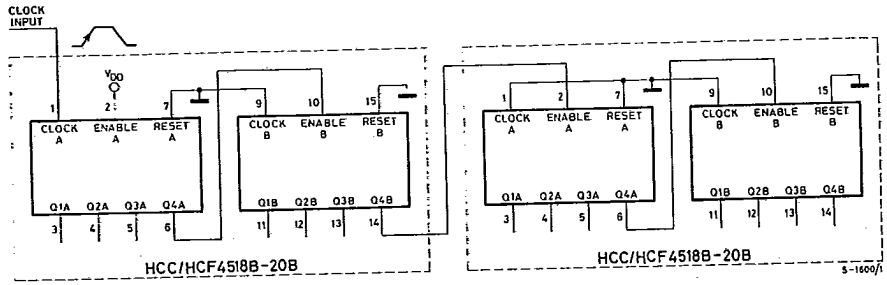


Dynamic power dissipation



TYPICAL APPLICATIONS

Ripple cascading of four counters with positive-edge triggering



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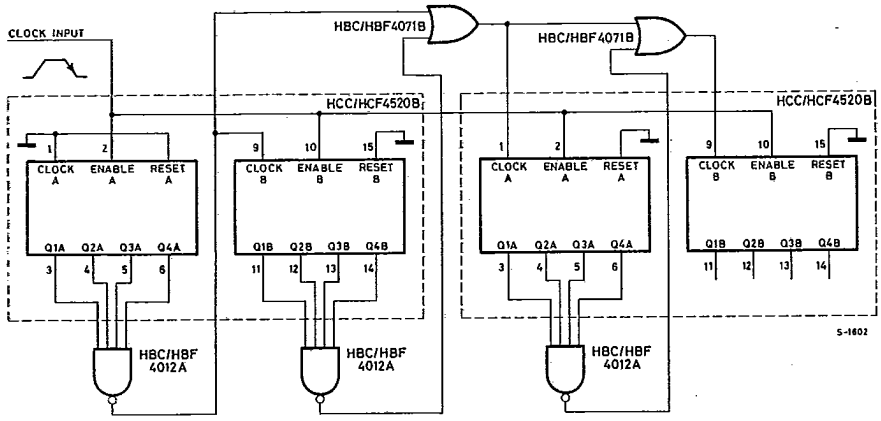
TYPICAL APPLICATIONS (continued)

Synchronous cascading of four binary counters with negative-edge triggering



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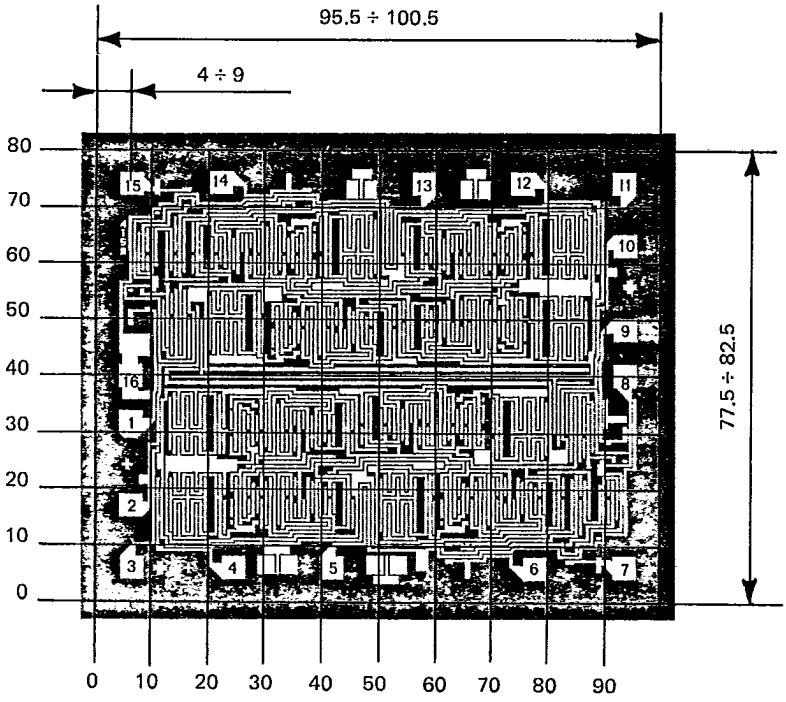

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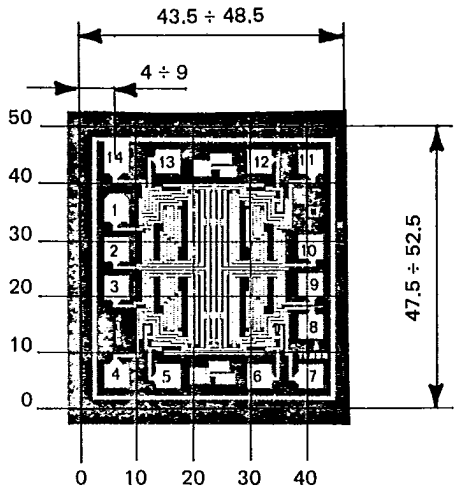

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