



PRESETTABLE UP/DOWN COUNTERS

- MEDIUM SPEED OPERATION $f_{CL} = 8 \text{ MHz TYP. AT } 10\text{V}$
- SYNCHRONOUS INTERNAL CARRY PROPAGATION
- RESET AND PRESET CAPABILITY
- 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 4510B**, **HCC 4516B** (extended temperature range) and the **HCF 4510B**, **HCF 4516B** (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 4510B** Presettable BCD Up/Down Counter and the **HCC/HCF 4516B** Presettable Binary Up/Down Counter consist of four synchronously clocked D-type flip-flops (with a gating structure to provide T-type flip-flop capability) connected as counters. These counters can be cleared by a high level on the RESET line, and can be preset to any binary number present on the jam inputs by a high level on the PRESET ENABLE line. The **HCC/HCF 4510B** will count out of non-BCD counter states in a maximum of two clock pulses in the up mode, and a maximum of four clock pulses in the down mode. If the CARRY-IN input is held low, the counter advances up or down on each positive-going clock transition. Synchronous cascading is accomplished by connecting all clock inputs in parallel and connecting the CARRY-OUT of a less significant stage to the CARRY-IN of a more significant stage. The **HCC/HCF 4510B** and **HCC/HCF 4516B** can be cascaded in the ripple mode by connecting the CARRY-OUT to the clock of the next stage. If the UP/DOWN input changes during a terminal count, the CARRY-OUT must be gated with the clock, and the UP/DOWN input must change while the clock is high. This method provides a clean clock signal to the subsequent counting stage.

ABSOLUTE MAXIMUM RATINGS

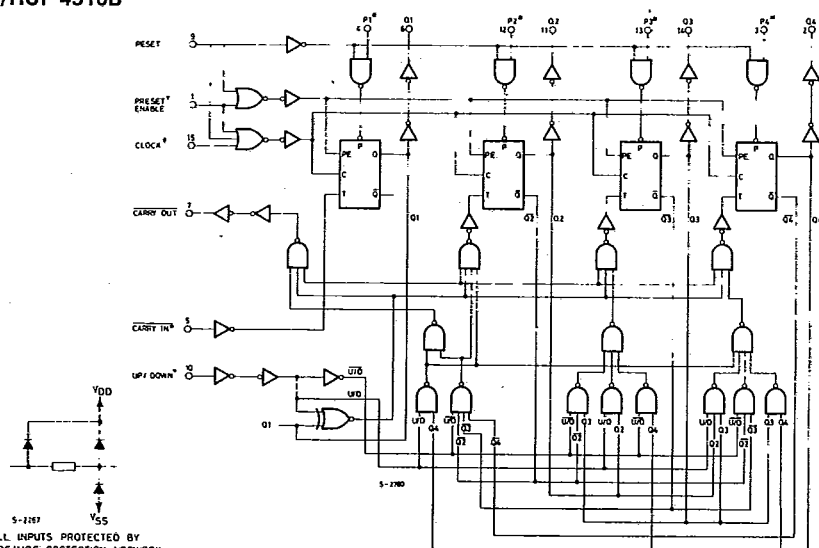
V_{DD}^*	Supply voltage: HCC types HCF types	-0.5 to 20 -0.5 to 18	V V
V_I	Input voltage	-0.5 to $V_{DD} + 0.5$	V
I_I	DC input current (any one input)	± 10	mA
P_{tot}	Total power dissipation (per package)	200	mW
	Dissipation per output transistor for $T_{op} =$ full package-temperature range	100	mW
T_{op}	Operating temperature: HCC types HCF types	-55 to 125 -40 to 85	°C °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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LOGIC DIAGRAMS
for HCC/HCF 4510B



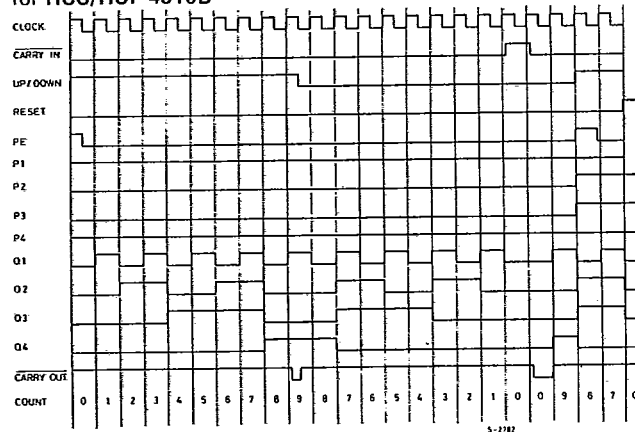
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HCC/HCF 4510B
HCC/HCF 4516B

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TIMING DIAGRAMS AND TRUTH TABLE

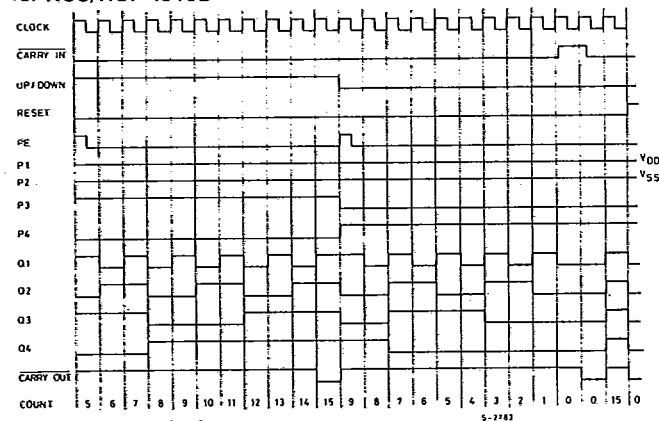
for HCC/HCF 4510B



CL	CT	U/D	PE	R	ACTION
X	1	X	0	0	NO COUNT
	0	1	0	0	COUNT UP
	0	0	0	0	COUNT DOWN
X	X	X	1	0	PRESET
X	X	X	X	1	RESET

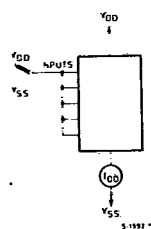
X = Don't care

for HCC/HCF 4516B

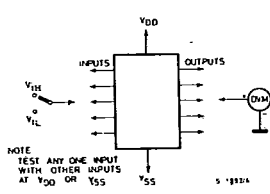


TEST CIRCUITS

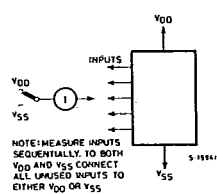
Quiescent device current



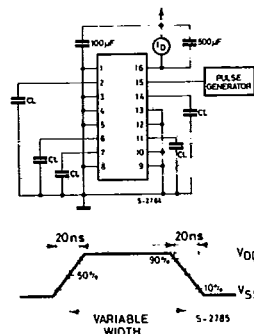
Noise immunity



Input leakage current



Power dissipation and input waveform





HCC/HCF 4510B
HCC/HCF 4516B

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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 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		±10 ⁻⁵	±0.1		± 1	μA	
		HCF types	0/15		15		±0.3		±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} = 5V2V min. with V_{DD} = 10V2.5V min. with V_{DD} = 15V

HCC/HCF 4510B
HCC/HCF 4516B

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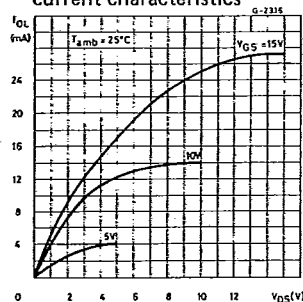
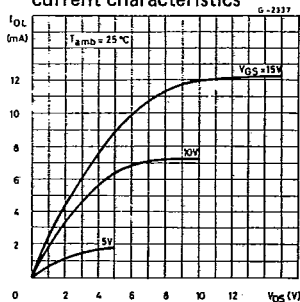
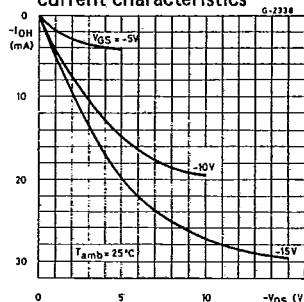
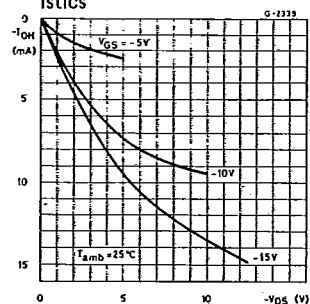
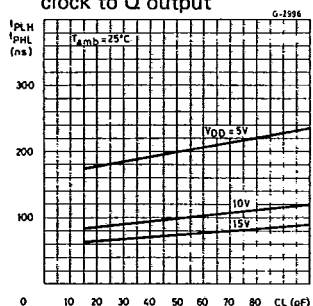
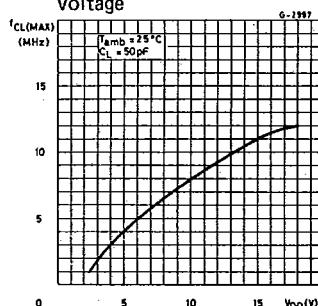
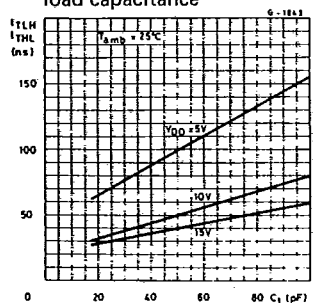
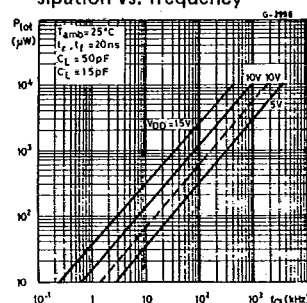
DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$, $C_L = 50 \text{ pF}$, $R_L = 200 \text{ k}\Omega$, typical temperature coefficient for all V_{DD} values is $0.3\%/^{\circ}\text{C}$, all input rise and fall times = 20 ns)

Parameter	Test conditions	Values			Unit
		V_{DD} (V)	Min.	Typ.	Max.
t_{PHL} , t_{PLH} Propagation delay time clock to Q output		5		200	400
		10		100	200
		15		75	150
t_{PHL} , t_{PLH} Propagation delay time preset or reset to Q output		5		210	420
		10		105	210
		15		80	160
t_{PHL} , t_{PLH} Propagation delay time clock to carry out		5		240	480
		10		120	240
		15		90	180
t_{PHL} , t_{PLH} Propagation delay time carry in to carry out		5		125	250
		10		60	120
		15		50	100
t_{PHL} , t_{PLH} Propagation delay time preset or reset to carry out		5		320	640
		10		160	320
		15		125	250
t_{THL} , t_{TLH} Transition time		5		100	200
		10		50	100
		15		40	80
f_{max} Max. clock frequency		5	2	4	
		10	4	8	
		15	5.5	11	
t_W Clock pulse width		5	150		
		10	75		
		15	60		
* Preset enable or reset removal time		5	150		
		10	80		
		15	60		
t_r , t_f * Clock rise and fall time		5			15
		10			5
		15			5
t_{setup} Carry in setup time		5	130		
		10	60		
		15	45		
t_{setup} Up-down setup time		5	360		
		10	160		
		15	110		
t_W Preset enable or reset pulse width		5	220		
		10	100		
		15	75		

* Time required after the falling edge of the reset or preset enable inputs before the rising edge of the clock will trigger the counter (similar to setup time).

* If more than unit is cascaded in the parallel clocked application, t_{rCL} should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage for the estimated capacitive load.

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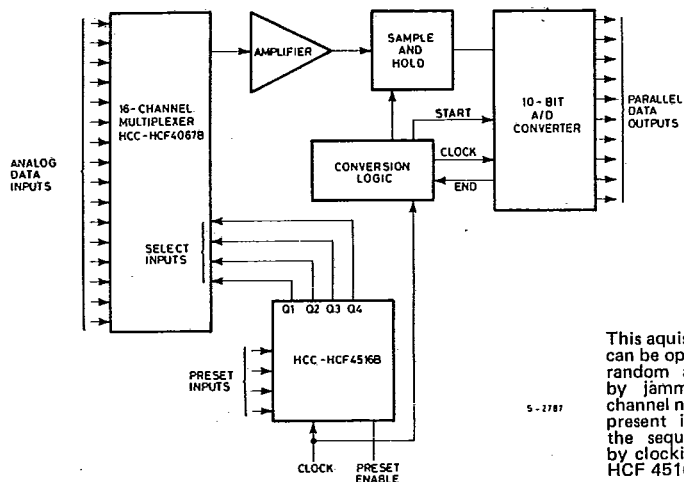
Typical output low (sink)
current characteristicsMinimum output low (sink)
current characteristicsTypical output high (source)
current characteristicsMinimum output high
(source) current characteristicsTypical propagation delay
time vs. load capacitance for
clock to Q outputTypical maximum clock
input frequency vs. supply
voltageTypical transition time vs.
load capacitanceTypical dynamic power dis-
sipation vs. frequency

HCC/HCF 4510B
HCC/HCF 4516B

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HCC/HCF 41C 08985 D

TYPICAL APPLICATIONS

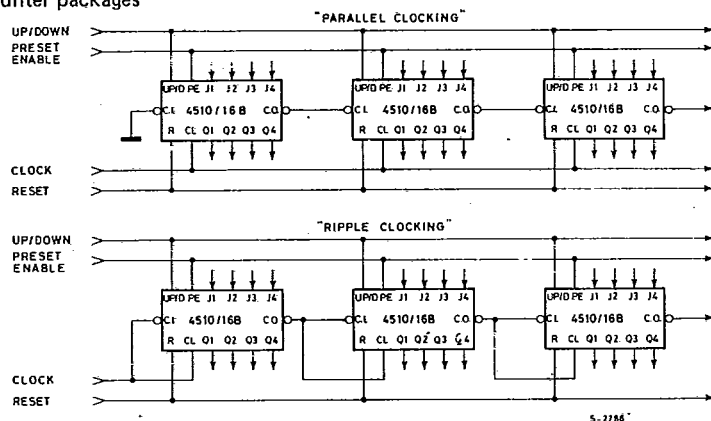
Typical 16-channel, 10 bit data acquisition system



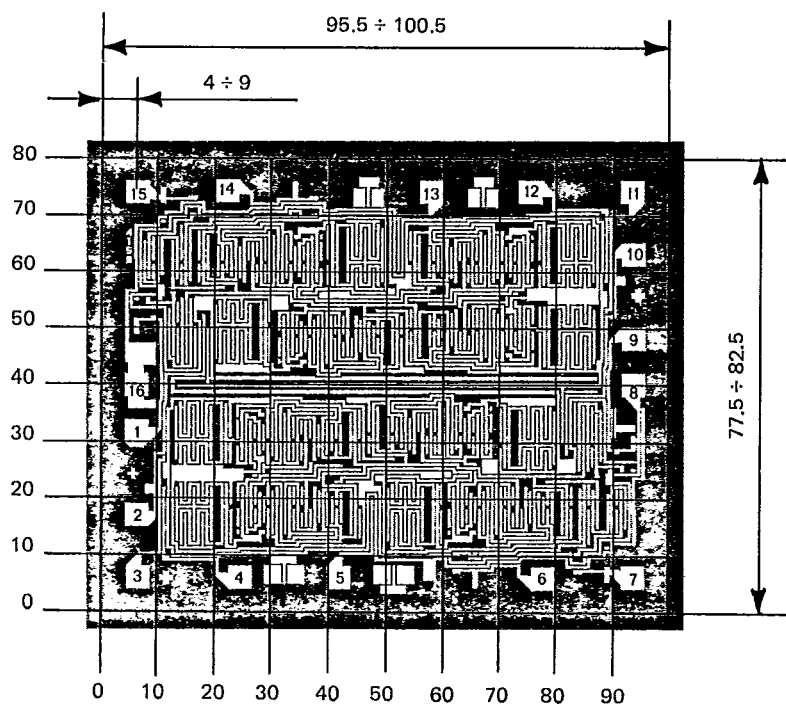
This acquisition system can be operated in the random access mode by jamming in the channel number at the preset inputs, or in the sequential mode by clocking the HCC/HCF 4516B.

S-2787

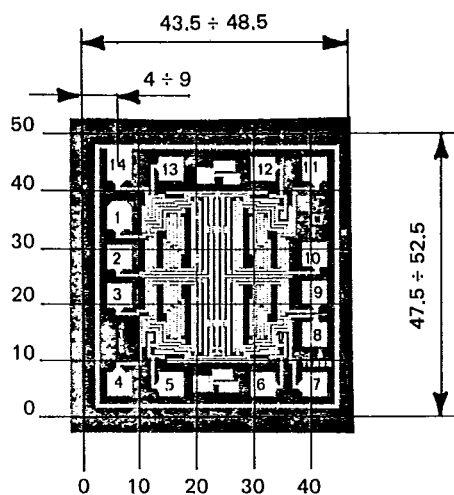
Cascading counter packages



S-2786



4015B



4016B