

COS/MOS
INTEGRATED
CIRCUITS



7929225 S G S SEMICONDUCTOR CORP

T-45-23-17

RIPPLE-CARRY BINARY COUNTER/DIVIDERS: 4020B - 14 STAGE
 4024B - 7 STAGE
 4040B - 12 STAGE

- MEDIUM-SPEED OPERATION
- FULLY STATIC OPERATION
- COMMON RESET
- BUFFERED INPUTS AND OUTPUTS
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 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 4XXXB** (extended temperature range) and **HCF 4XXXB** (intermediate temperature range) are monolithic integrated circuits, available in 14-lead dual in-line for **4024B** and 16-lead dual in-line for **4020B**, **4040B**. The series types are supplied in plastic or ceramic dual in-line package and ceramic flat package. The **4024B** is also available in 14 pin plastic micropackage.

The **HCC/HCF 4020B**, **4024B**, and **4040B** are ripple-carry binary counters. All counter stages are master-slave flip-flops. The state of a counter advances one count on the negative transition of each input pulse; a high level on the **RESET** line resets the counter to its all zeros stage. Schmitt trigger action on the input-pulse line permits unlimited block rise and fall times. All inputs and outputs are buffered.

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 4XXX BD for dual in-line ceramic package
 HCC 4XXX BF for dual in-line ceramic package, frit seal
 HCC 4XXX BK for ceramic flat package
 HCF 4XXX BE for dual in-line plastic package
 HCF 4XXX BF for dual in-line ceramic package, frit seal
 HCF 4XXX BM for plastic micropackage

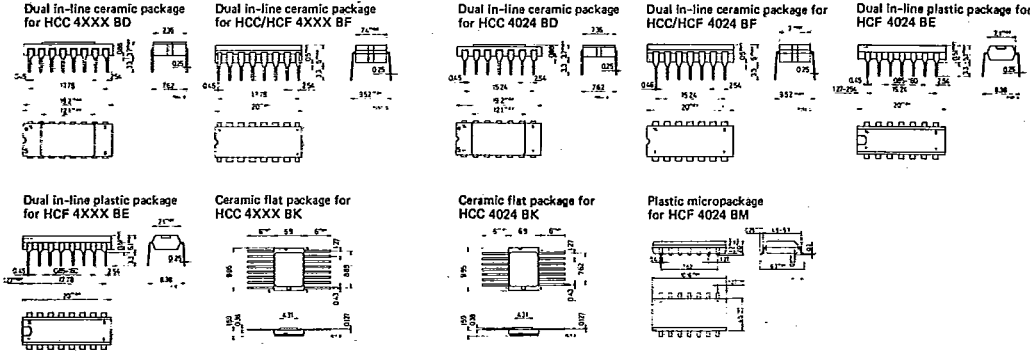


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MECHANICAL DATA (dimensions in mm)

For 4020B and 4040B

For 4024B

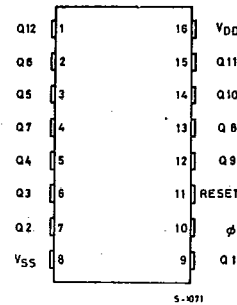
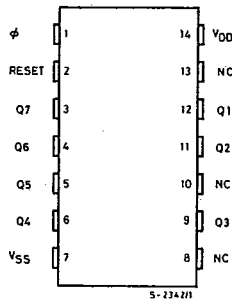
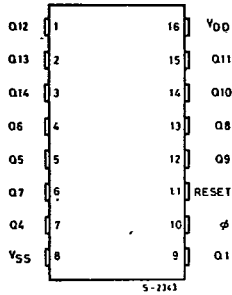


CONNECTION DIAGRAMS

For 4020B

For 4024B

For 4040B



RECOMMENDED OPERATING CONDITIONS

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

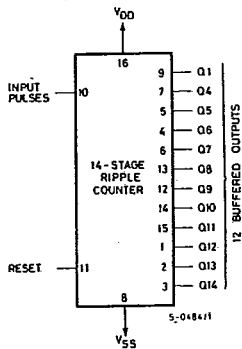


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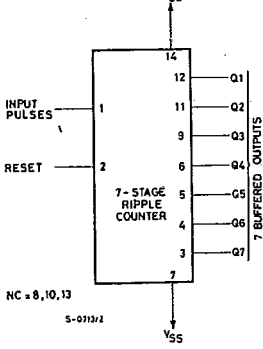
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FUNCTIONAL DIAGRAMS

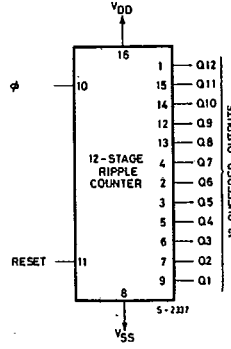
For 4020B



For 4024B

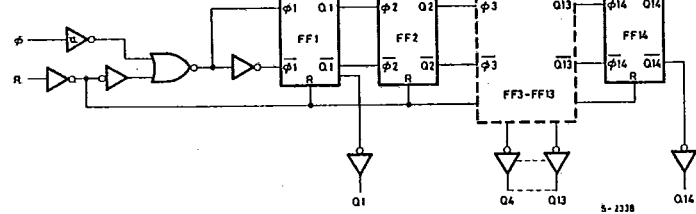


For 4040B

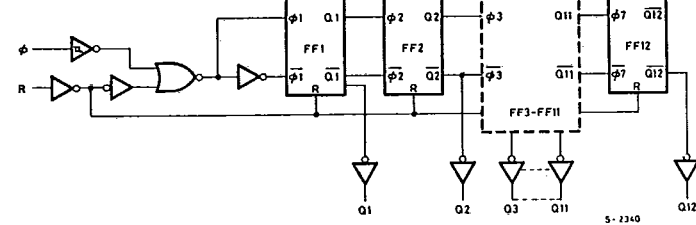


LOGIC DIAGRAMS

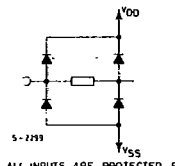
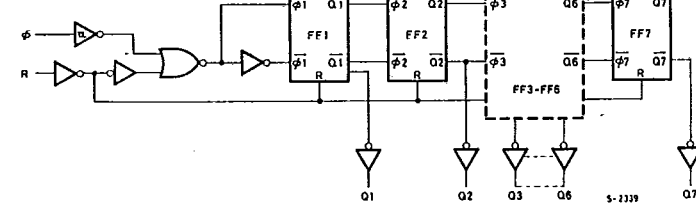
For 4020B



For 4040B



For 4024B



ALL INPUTS ARE PROTECTED BY COSMOS PROTECTION NETWORK



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STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Parameter		Test conditions				Values						Unit		
		V _I (V)	V _O (V)	I _O (μ A)	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	μ A
			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	μ A	
		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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DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}C$, $C_L = 50$ pF, $R_L = 200$ K Ω , typical temperature coefficient for all $V_{DD} = 0.3\%/^{\circ}C$ values, all input rise and fall time = 20 ns)

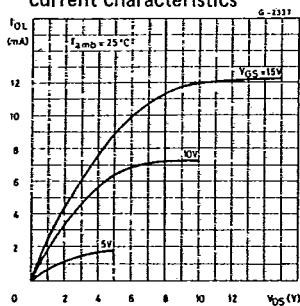
Parameter	Test conditions	Values			Unit	
		V_{DD} (V)	Min.	Typ.		Max.
INPUT-PULSE OPERATION						
t_{PLH} , t_{PHL} Propagation delay time (ϕ to Q1 Out)		5		180	360	ns
		10		80	160	
		15		65	130	
t_{PLH} , t_{PHL} Propagation delay time Qn to Qn + 1		5		100	200	ns
		10		40	80	
		15		30	60	
t_{TLH} , t_{THL} Transition time		5		100	200	ns
		10		50	100	
		15		40	80	
t_W Minimum input pulse width		5		70	140	ns
		10		30	60	
		15		20	40	
t_r , t_f Input pulse rise and fall time		5	Unlimited			μs
		10				
		15				
f_{max} Maximum clock input frequency		5	3.5	7		MHz
		10	8	16		
		15	12	24		
RESET OPERATION						
t_{PHL} Propagation delay time		5		140	280	ns
		10		60	120	
		15		50	100	
t_W Minimum reset pulse width		5		100	200	ns
		10		40	80	
		15		30	60	
t_{rem} Reset removal time		5		175	350	ns
		10		75	150	
		15		50	100	

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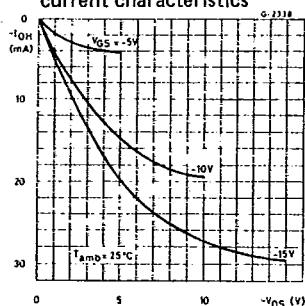
HCC/HCF 4020B
HCC/HCF 4024B
HCC/HCF 4040B

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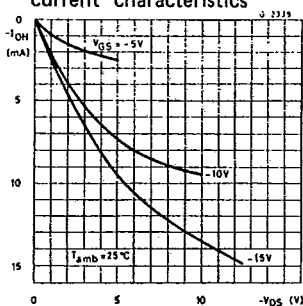
Minimum output low (sink) current characteristics



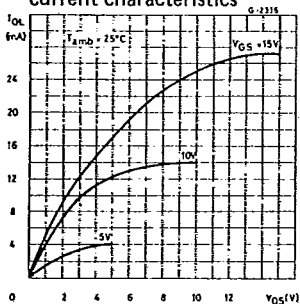
Typical output high (source) current characteristics



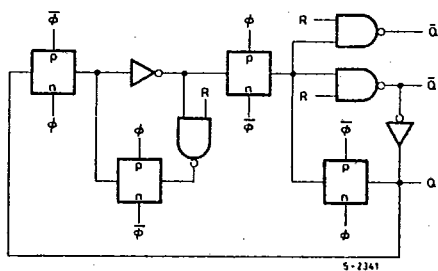
Minimum output high (source) current characteristics

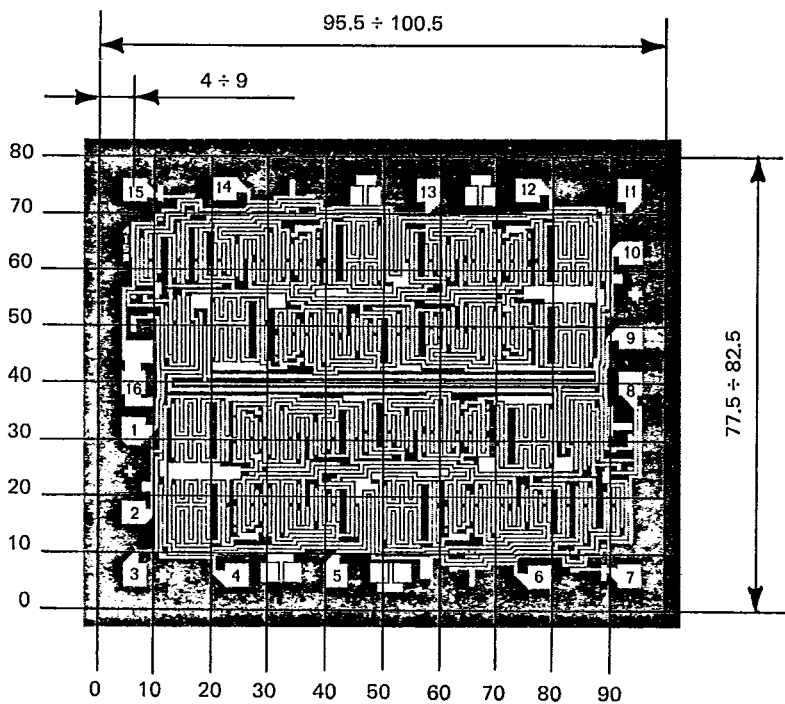


Typical output low (sink) current characteristics

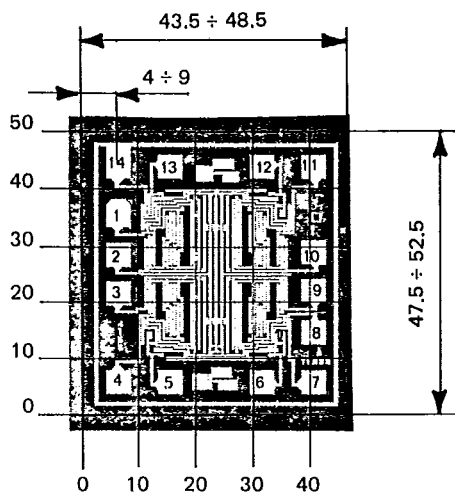


Detail of typical flip-flop stage





4015B



4016B