COS/MOS INTEGRATED CIRCUITS

4020B
4024B
4040B

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

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 clock rise and fall times. All inputs and outputs are buffered.

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

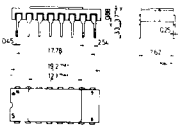
ORDERING NUMBERS:

HCC 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

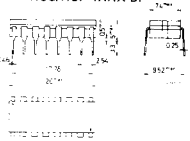
MECHANICAL DATA (dimensions in mm)

For **4020B** and 4040B

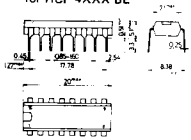
Dual in-line ceramic package for HCC 4XXX BD



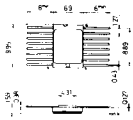
Dual in-line ceramic package for HCC/HCF 4XXX BF



Dual in-line plastic package for HCF 4XXX BE

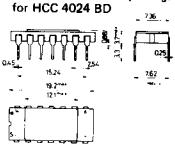


Ceramic flat package for HCC 4XXX BK

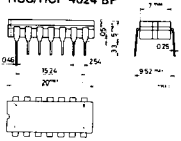


For **4024B**

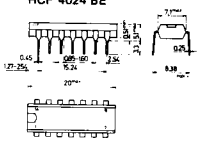
Dual in-line ceramic package for HCC 4024 BD



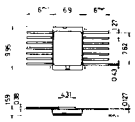
Dual in-line ceramic package for HCC/HCF 4024 BF



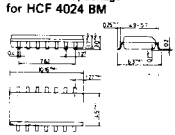
Dual in-line plastic package for HCF 4024 BE



Ceramic flat package for HCC 4024 BK

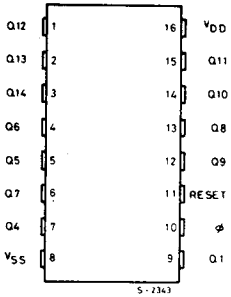


Plastic micropackage for HCF 4024 BM

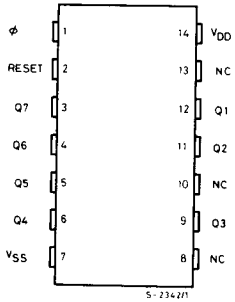


CONNECTION DIAGRAMS

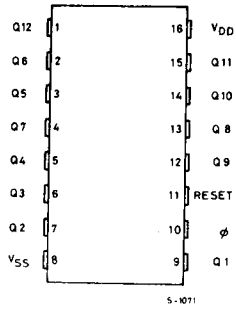
For **4020B**



For **4024B**



For **4040B**

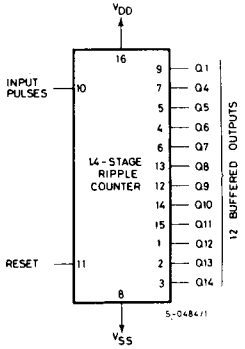


RECOMMENDED OPERATING CONDITIONS

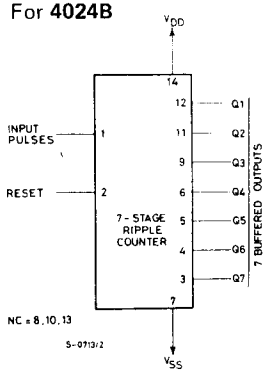
V_{DD}	Supply voltage: **HCC** types	3 to 18	V
	HCF types	3 to 15	V
V_I	Input voltage	0 to V_{DD}	V
T_{op}	Operating temperature: **HCC** types	-55 to 125	°C
	HCF types	-40 to 85	°C

FUNCTIONAL DIAGRAMS

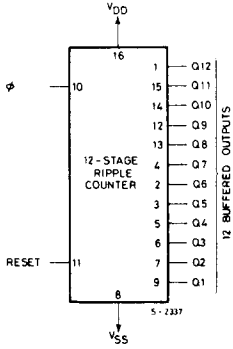
For **4020B**



For **4024B**

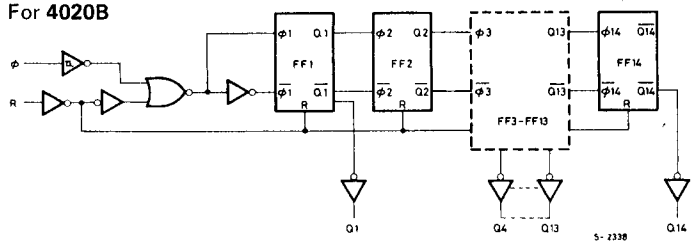


For **4040B**

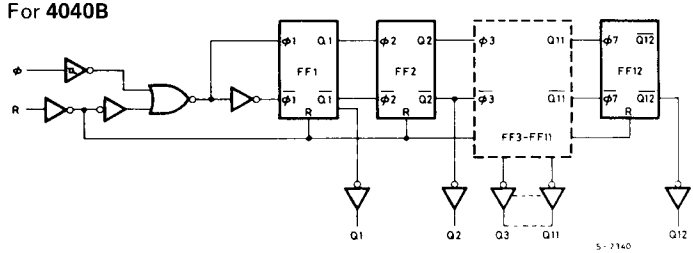


LOGIC DIAGRAMS

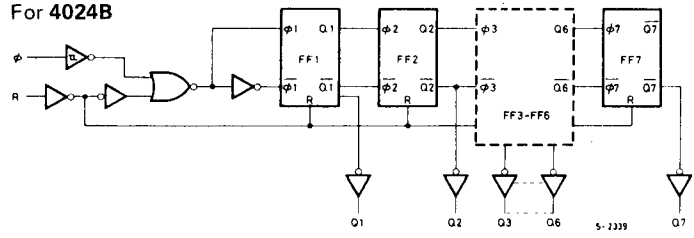
For **4020B**

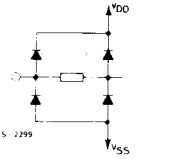


For **4040B**



For **4024B**





STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

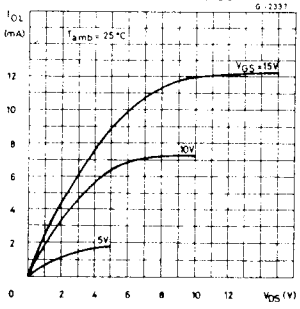
Parameter			Test conditions				Values							Unit
			V_I (V)	V_O (V)	$\|I_O\|$ (μA)	V_{DD} (V)	T_{Low}* Min.	T_{Low}* Max.	25°C Min.	25°C Typ.	25°C Max.	T_{High}* Min.	T_{High}* Max.	
I_L	Quiescent current	HCC types	0/ 5			5		5		0.04	5		150	μA
			0/10			10		10		0.04	10		300	
			0/15			15		20		0.04	20		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		$±10^{-5}$	±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}= 5V
2V min. with V_{DD}= 10V
2.5V min. with V_{DD}= 15V

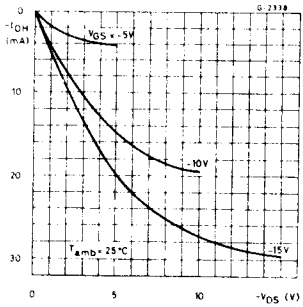
DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb}= 25°C, C_L= 50 pF, R_L= 200 KΩ, typical temperatura coefficient for all V_{DD}= 0.3%/°C values, all input rise and fall time = 20 ns)

Parameter		Test conditions	Values			Unit
		V_{DD} (V)	Min.	Typ.	Max.	
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	

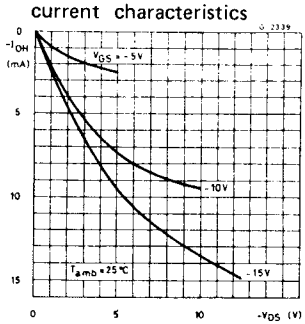
Minimum output low (sink) current characteristics



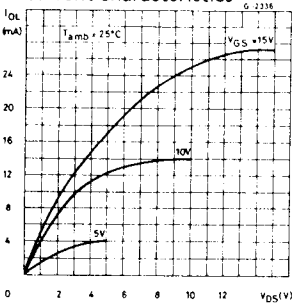
Typical output high (source) current characteristics



Minimum output high (source) current characteristics



Typical output low (sink) current characteristics



Detail of typical flip-flop stage