COS/MOS INTEGRATED CIRCUIT

T-45-23-17

HCC/HCF 4060B

41C 08835 D

14-STAGE RIPPLE-CARRY BINARY COUNTER/DIVIDER AND OSCILLATOR

- MEDIUM-SPEED OPERATION
- COMMON RESET
- FULLY STATIC OPERATION
- BUFFERED INPUTS AND OUTPUTS
- 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 4060B** (extended temperature range) and **HCF 4060B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and ceramic flat package. The **HCC/HCF 4060B** consists of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC or crystal oscillator circuits. A RESET input is provided which resets the counter to the all-0's state and disables the oscillator. A high level on the RESET line accomplishes the reset function. All counter stages are master-slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of ϕ_1 (and ϕ_0). All inputs and outputs are fully buffered. Schmitt trigger action on the clock line permits unlimited clock rise and fall times.

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 4060 BD for dual in-line ceramic package
HCC 4060 BF for dual in-line ceramic package, frit seal
HCC 4060 BK for ceramic flat package
HCF 4060 BE for dual in-line plastic package
HCF 4060 BF for dual in-line ceramic package, frit seal

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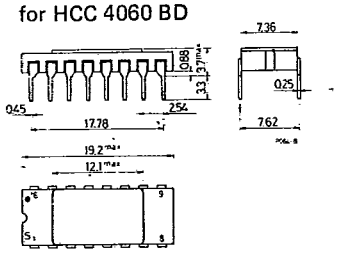
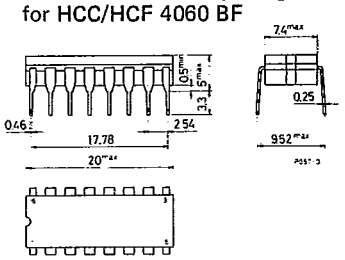
MECHANICAL DATA (dimensions in mm)

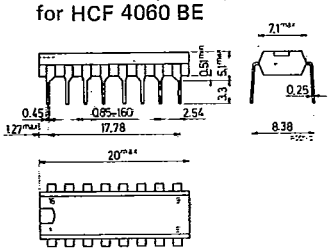
Dual in-line ceramic package for HCC 4060 BD



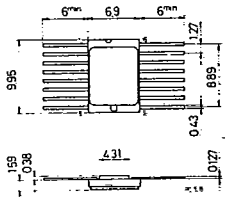
Dual in-line ceramic package for HCC/HCF 4060 BF



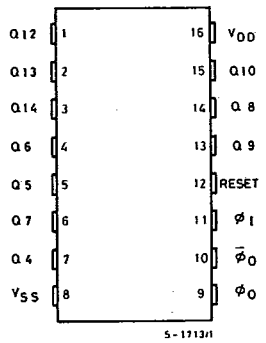
Dual in-line plastic package for HCF 4060 BE



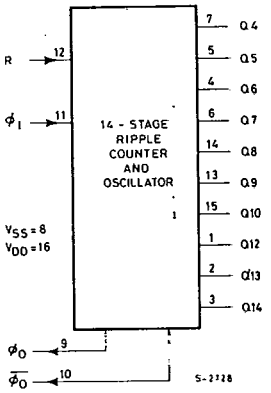
Ceramic flat package for HCC 4060 BK



CONNECTION DIAGRAM



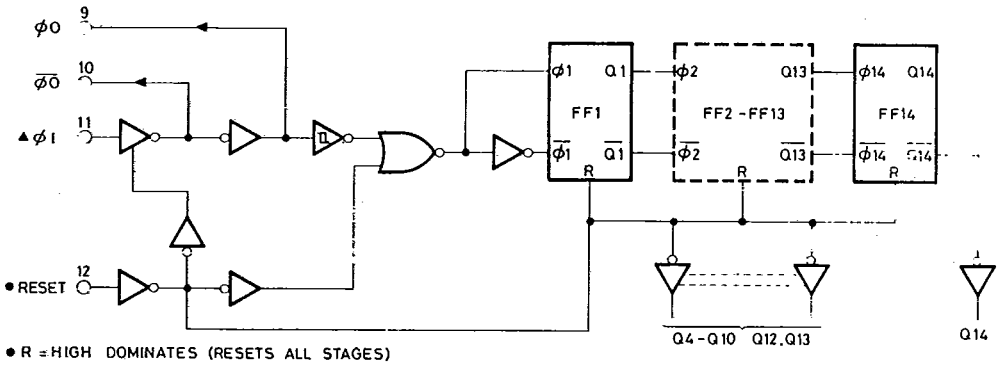
FUNCTIONAL DIAGRAM



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

LOGIC DIAGRAM



● R = HIGH DOMINATES (RESETS ALL STAGES)

▲ COUNTER ADVANCES ONE BINARY COUNT ON EACH NEGATIVE-GOING TRANSITION OF φI (AND φO)

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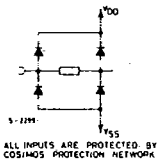
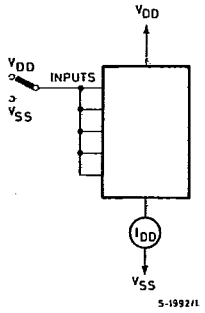


ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK

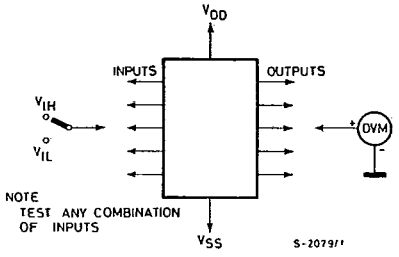
TEST CIRCUITS

Quiescent device current



5-1992/1

Input voltage



NOTE
TEST ANY COMBINATION OF INPUTS

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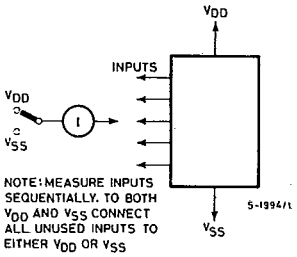
Input leakage current



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

5-1994/1

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

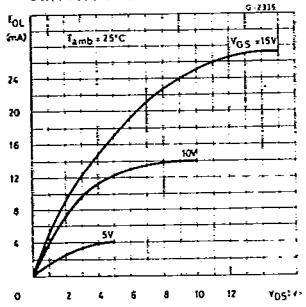
* T_{Low} = − 55°C for **HCC** device: −40°C for **HCF** device.
* T_{High} = +125°C for **HCC** device: +85°C for **HCF** device.
The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD}= 5V
2V min. with V_{DD}= 10V
2.5V min. with V_{DD}= 15V

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

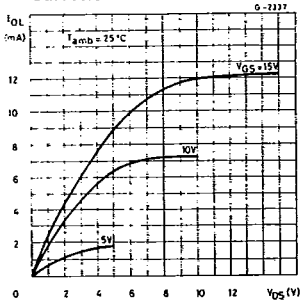
Parameter	Test conditions	V_{DD} (V)	Values Min.	Values Typ.	Values Max.	Unit
INPUT-PULSE OPERATION						
t_{PLH}, t_{PHL} Propagation delay time (ϕ to Q4 Out)		5		370	740	ns
		10		150	300	
		15		100	200	
t_{PLH}, t_{PHL} Propagation delay time (Qn to Q_{n+1})		5		100	200	ns
		10		50	100	
		15		40	80	
t_{TLH}, t_{THL} Transition time		5		100	200	ns
		10		50	100	
		15		40	80	
t_W Input pulse width	f = 100 kHz	5		50	100	ns
		10		20	40	
		15		15	30	
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		180	360	ns
		10		80	160	
		15		50	100	
t_W Reset pulse width		5		60	120	ns
		10		30	60	
		15		20	40	
RC OPERATION						
Variation of Frequency (Unit-to-Unit)	C_X = 200 KΩ, R_S = 560 KΩ, R_X = 50 KΩ	5	18	21.5	25	KHz
		10	20	23	26	
		15	21.1	24	27	
Variation of Frequency with voltage change (Same Unit)	C_X = 200 pF, R_S = 560 KΩ, R_X = 50 KΩ	5V to 10V	–	–	2	
		10V to 15V	–	–	1	
R_X max	C_X = 10 μF	5	–	–	20	MΩ
	= 50 μF	10	–	–	20	
	= 10 μF	15	–	–	10	
C_X max	R_X = 500 KΩ	5	–	–	1000	μF
	= 300 KΩ	10	–	–	50	
	= 300 KΩ	15	–	–	50	
Maximum Oscillator Frequency *	R_X = 5 KΩ, C_X = 15 pF	10	530	650	810	KHz
		15	690	800	940	

* RC oscillator applications are not recommended at supply voltages below 7 V for R_X = 50 KΩ

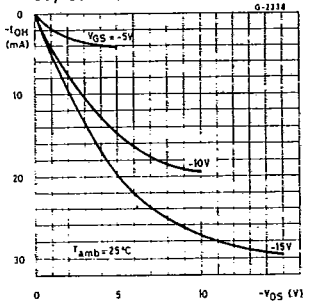
Minimum output low (sink) current characteristics



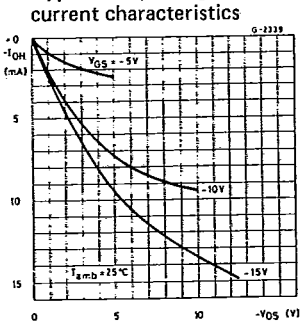
Typical output low (sink) current



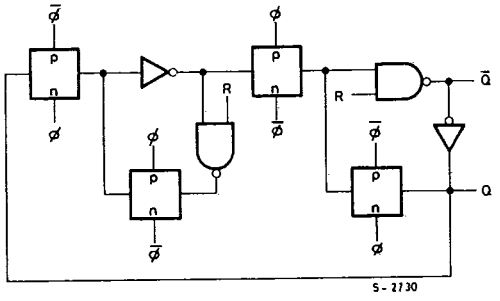
Minimum output high (source) current characteristics



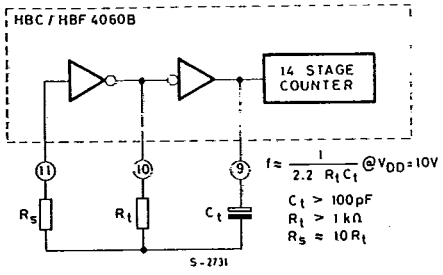
Typical output high (source) current characteristics



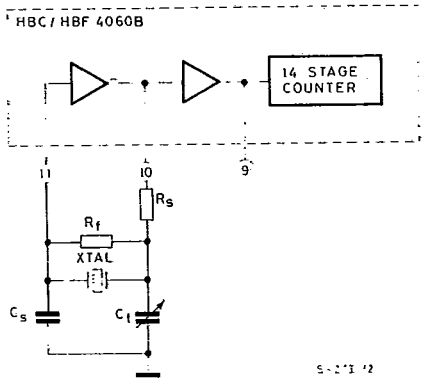
Detail of tipical flip-flop stage

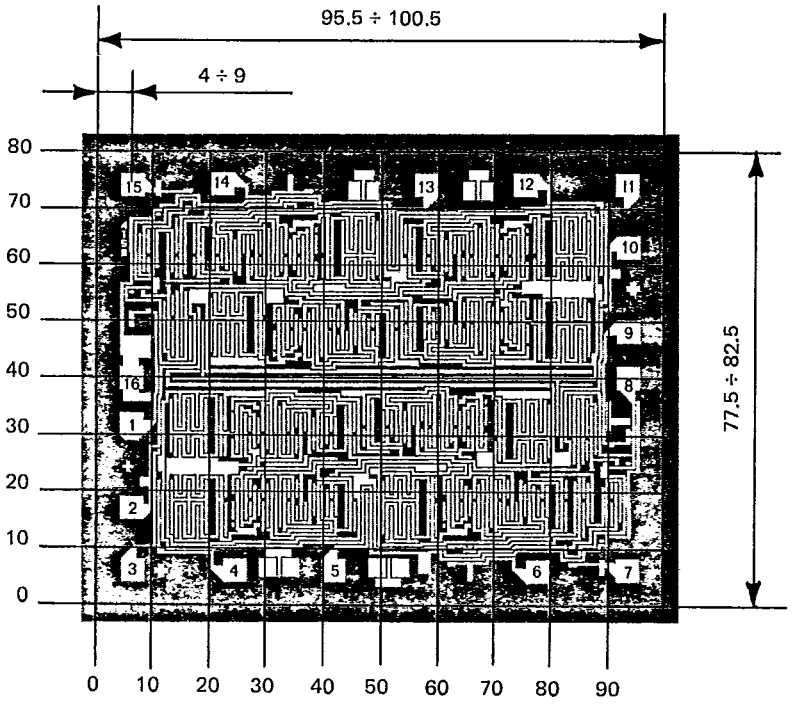


Typical RC oscillator circuit



Typical crystal oscillator circuit




95.5 ÷ 100.5
4 ÷ 9
77.5 ÷ 82.5
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90
15 14 13 12 11 10 9 8 16 1 2 3 4 5 6 7

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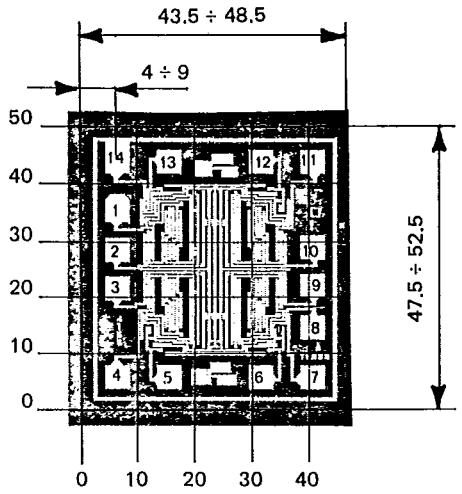
43.5 ÷ 48.5
4 ÷ 9
47.5 ÷ 52.5
50
40
30
20
10
0
0 10 20 30 40
14 13 12 11 1 2 3 10 9 8 4 5 6 7

4016B