

COS/MOS INTEGRATED CIRCUIT

40110B



PRELIMINARY DATA

DECADE UP-DOWN COUNTER/DECODER/LATCH/DRIVER

- SEPARATE CLOCK-UP AND CLOCK-DOWN LINES
- CAPABLE OF DRIVING COMMON CATHODE LEDS AND OTHER DISPLAYS DIRECTLY
- ALLOWS CASCADING WITHOUT ANY EXTERNAL CIRCUITRY
- MAXIMUM INPUT CURRENT OF $1 \mu\text{A}$ AT 18V (FULL PACKAGE-TEMPERATURE RANGE)
- QUIESCENT CURRENT AT 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 40110B** (extended temperature range) and **HCF 40110B** (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 40110B** is a dual-clocked up/down counter with a special preconditioning circuit that allows the counter to be clocked, via positive going inputs, up or down regardless of that state or timing (within 100 ns typ.) of the other clock line. The clock signal is fed into the control logic and Johnson counter after is preconditioned. The outputs of the Johnson counter (which include anti-lock gating to avoid being locked at an illegal state) are fed into a latch. This data can be fed directly to the decoder through the latch or can be strobed to hold a particular count while the Johnson counter continues to be clocked. The decoder feeds a seven-segment bipolar output driver which can source up to 25 mA to drive LEDs and other displays such as low-voltage fluorescent and incandescent lamps. A short duration negative-going pulse appears on the BORROW output when the count changes from 0 to 9 or the CARRY output when the count changes from 9 to 0. At the other times the BORROW and CARRY output are a logic 1. The CARRY and BORROW outputs can be tied directly to the clock-up and clock-down lines respectively of another HCC/HCF 40110B for easy cascading of several counters.

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) Dissipation per output transistor for T_{op} = full package-temperature range	200 100	mW 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

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

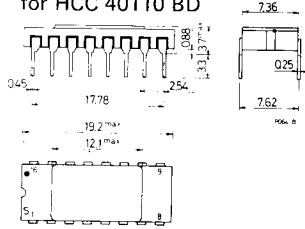
* All voltages are with respect to V_{SS} (GND).

ORDERING NUMBERS:

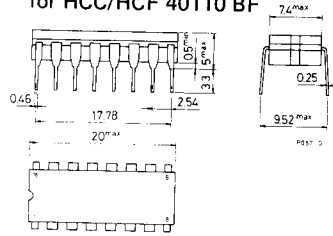
- HCC 40110 BD for dual in-line ceramic package
- HCC 40110 BF for dual in-line ceramic package, frit seal
- HCC 40110 BK for ceramic flat package
- HCF 40110 BE for dual in-line plastic package
- HCF 40110 BF for dual in-line ceramic package, frit seal

MECHANICAL DATA (dimensions in mm)

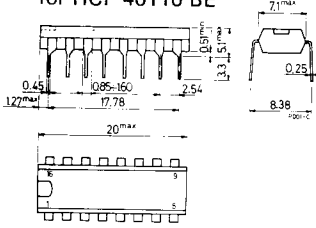
Dual in-line ceramic package for HCC 40110 BD



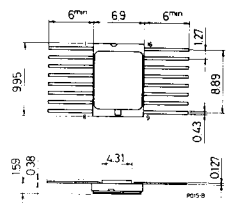
Dual in-line ceramic package for HCC/HCF 40110 BF



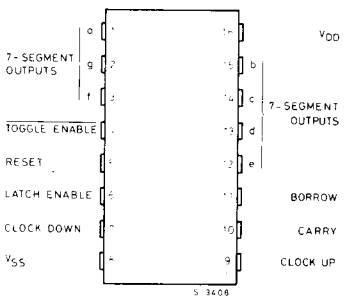
Dual in-line plastic package for HCF 40110 BE



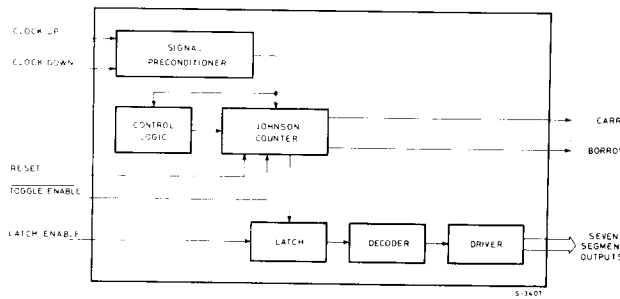
Ceramic flat package for HCC 40110 BK



PIN CONNECTIONS



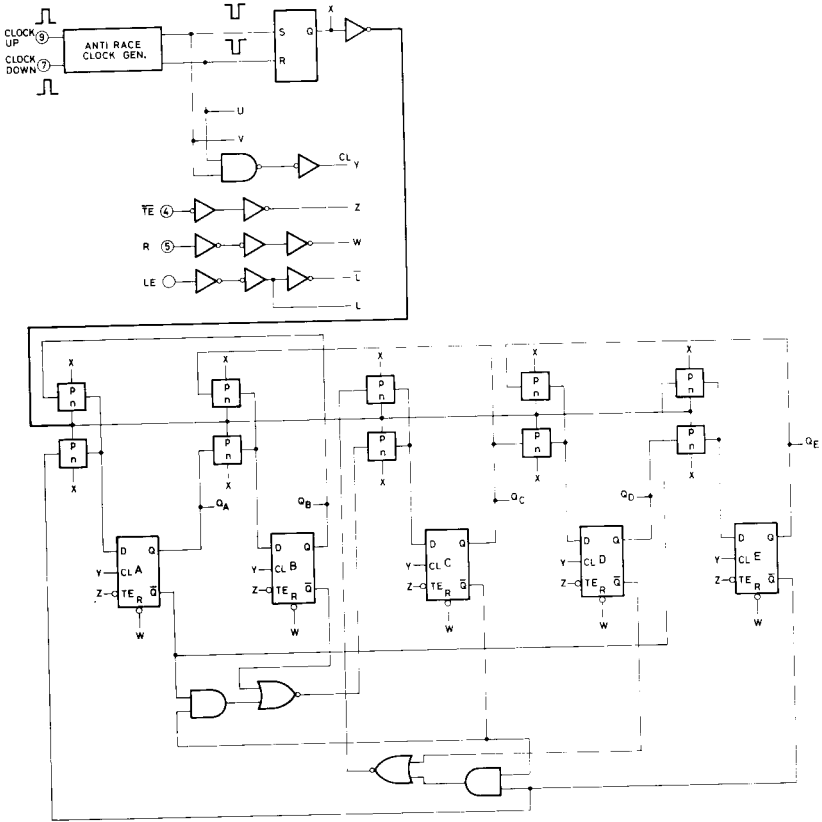
FUNCTIONAL DIAGRAM



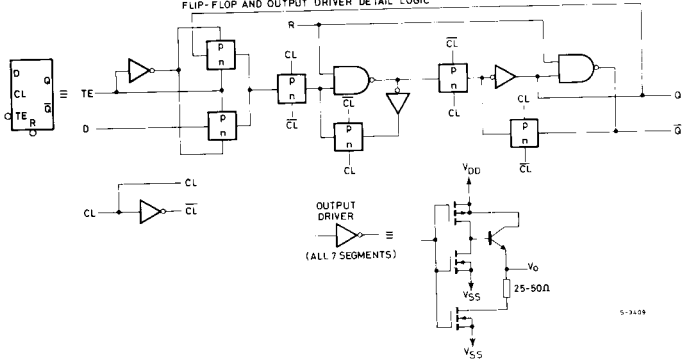
RECOMMENDED OPERATING CONDITIONS

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

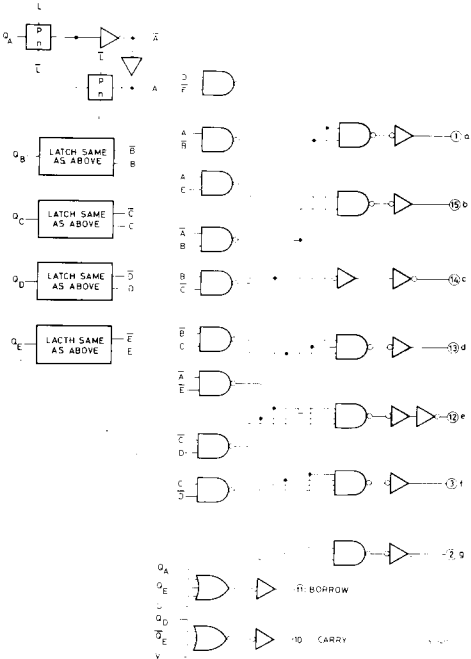
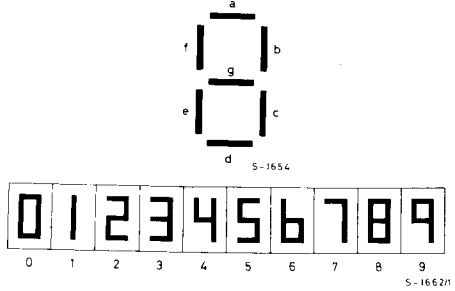
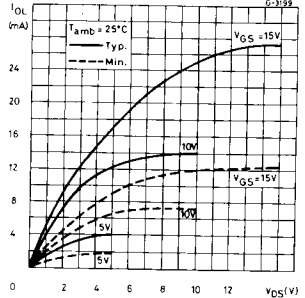
LOGIC DIAGRAM



FLIP-FLOP AND OUTPUT DRIVER DETAIL LOGIC



5-3419

LOGIC DIAGRAM (continued)

DISPLAY SEGMENTS

Output low (sink) current characteristics

TRUTH TABLE

CLOCK UP*	CLOCK DOWN*	LATCH ENABLE	TOGGLE ENABLE	RESET	COUNTER	DISPLAY
	X	0	0	0	Increments by 1	Follows Counter
X		0	0	0	Decrements by 1	Follows Counter
		X	X	0	No Change	No Change
X	X	X	X	1	Goes to 00000	Follows Counter (Display = 00000)
X	X	X	1	0	Inhibited	Remains Fixed
	X	1	0	0	Increments by 1	Remains Fixed
X		1	0	0	Decrements by 1	Remains Fixed

X = Don't care 1 = High State 0 = Low State.
 * Typically 100 ns between clock-up and clock-down positive transitions are required to ensure proper counting.

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			5			495				V	
		0/10			10			955					
		0/15			15			1455					
V _{OL}	Output low voltage	5/0			5		0.05	0	0.05		0.05	V	
		10/0			10		0.05	0	0.05		0.05		
		15/0			15		0.05	0	0.05		0.05		
V _{IH}	Input high voltage	0.5/3.8			5	3.5		3.5			3.5	V	
		1/8.8			10	7		7			7		
		1.5/3.8			15	11		11			11		
V _{IL}	Input low voltage	0.5/3.8			5		1.5			1.5	1.5	V	
		1/8.8			10		3			3	3		
		1.5/13.8			15		4			4	4		
V _{OH}	Output drive voltage (for HCC/HCF)			0	5			455				V	
				10	5			4.13					
				25	5			364					
				0	10			9.55					
				10	10			9.25					
				25	10			8.85					
				0	15			14.55					
				10	15			14.21					
				25	15			13.9					
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		\pm 0.1	\pm 10 ⁻⁵	\pm 0.1		\pm 1	μ A	
		HCF types	0/15		15		\pm 0.3	\pm 10 ⁻⁵	\pm 0.3		\pm 1		
C _T	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 ($T_{amb} = 25^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}\Omega$, typical temperature coefficient for all V_{DD} values is $0.3\%/^{\circ}\text{C}$, all input rise and fall time = 20 ns)

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

CLOCK UP/CLOCK DOWN

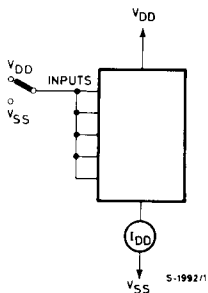
t_w Pulse width		5		85	ns
		10		35	
		15		15	
f_{CL} Maximum frequency		5		2.5	MHz
		10		5	
		15		8	
t_{WC} Carry pulse width		5		225	ns
		10		100	
		15		70	
t_{WB} Borrow pulse width		5		260	ns
		10		110	
		15		80	

RESET

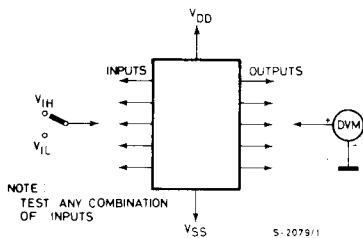
t_{PHL} , t_{PLH} Propagation Delay time Reset to Clock		5		750	ns
		10		285	
		15		200	
Delay from Reset to first allowable Clock		5		300	ns
		10		125	
		15		75	
t_w Pulse width		5		150	ns
		10		60	
		15		40	

TEST CIRCUITS

Quiescent device current



Input voltage



Input leakage current

