



# HCF40193B

## PRESETTABLE UP/DOWN COUNTERS (DUAL CLOCK WITH RESET) BINARY TYPE

- INDIVIDUAL CLOCK LINES FOR COUNTING UP OR COUNTING DOWN
- SYNCHRONOUS HIGH-SPEED CARRY AND BORROW PROPAGATION DELAYS FOR CASCADING
- ASYNCHRONOUS RESET AND PRESET CAPABILITY
- MEDIUM-SPEED OPERATION -  $f_{CL} = 8\text{MHz}$  (typ.) AT 10 V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIF. UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  
 $I_l = 100\text{nA}$  (MAX) AT  $V_{DD} = 18\text{V}$   $T_A = 25^\circ\text{C}$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



### ORDER CODES

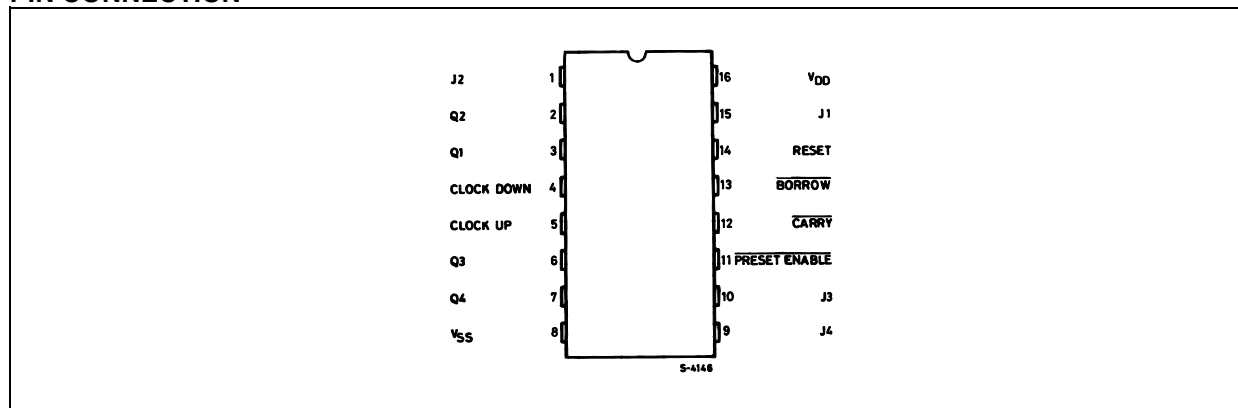
PACKAGE	TUBE	T & R
DIP	HCF40193BEY	
SOP	HCF40193BM1	HCF40193M013TR

and  $\overline{\text{BORROW}}$  outputs for multiple-stage counting schemes are provided. The counter is cleared so that all outputs are in a low state by a high on the  $\overline{\text{RESET}}$  line. A  $\overline{\text{RESET}}$  is accomplished asynchronously with the clock. Each output is individually programmable asynchronously with the clock to the level on the corresponding jam input when the  $\overline{\text{PRESET ENABLE}}$  control is low. The counter counts up one count on the positive clock edge of the  $\overline{\text{CLOCK UP}}$  signal provided the  $\overline{\text{CLOCK DOWN}}$  line is high. The counter counts down one count on the positive clock edge of the  $\overline{\text{CLOCK DOWN}}$  signal provided the  $\overline{\text{CLOCK UP}}$  line is high. The  $\overline{\text{CARRY}}$  and  $\overline{\text{BORROW}}$  signals are high when the counter counts up or down. The  $\overline{\text{CARRY}}$  signal goes low one-half clock cycle after the counter reaches its maximum count in the count-up mode. The  $\overline{\text{BORROW}}$  signal goes low

### DESCRIPTION

HCF40193B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF40193B Presettable Binary Up/Down Counter consists of 4 synchronously clocked, GATED "D" type flip-flops connected as a counter. The inputs consist of four individual jam lines, a  $\overline{\text{PRESET ENABLE}}$  control, individual  $\overline{\text{CLOCK UP}}$  and  $\overline{\text{CLOCK DOWN}}$  signals and a master  $\overline{\text{RESET}}$ . Four buffered Q signal outputs as well as  $\overline{\text{CARRY}}$

### PIN CONNECTION

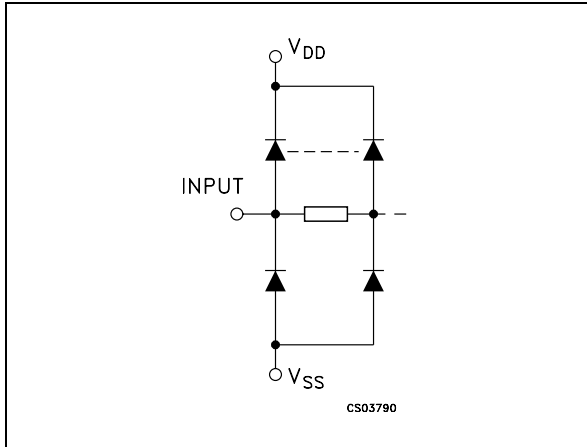


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one-half clock cycle after the counter reaches its minimum count in the count-down mode. The cascading of multiple packages is easily accomplished without the need for additional

external circuitry by tying the  $\overline{\text{BORROW}}$  and  $\overline{\text{CARRY}}$  outputs to the  $\text{CLOCK DOWN}$  and  $\text{CLOCK UP}$  inputs, respectively, of the following package.

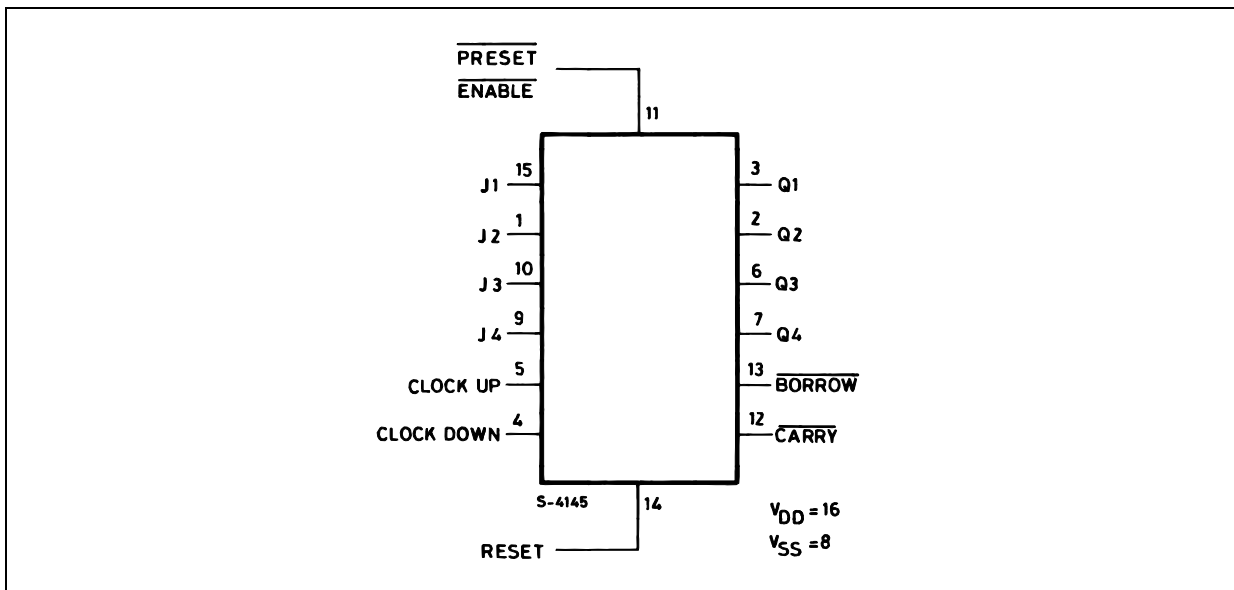
## INPUT EQUIVALENT CIRCUIT



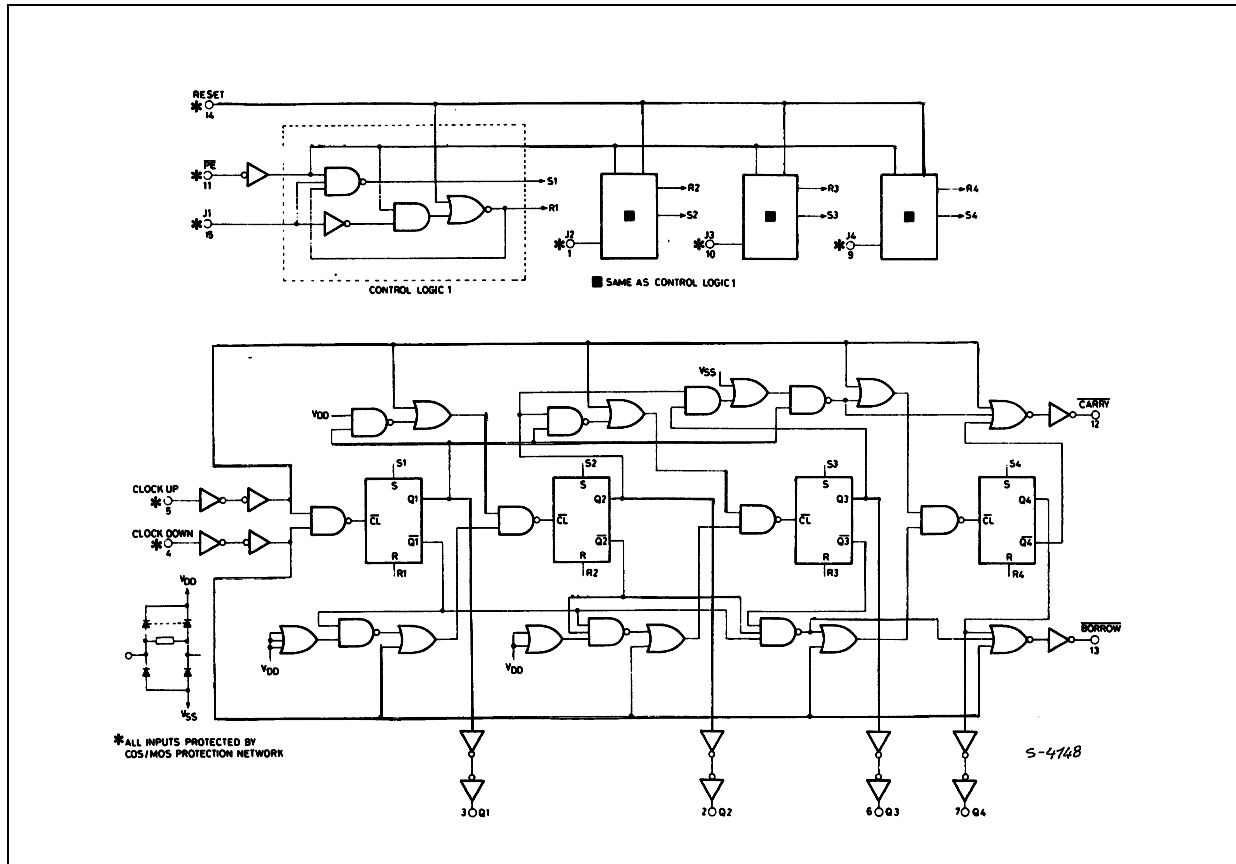
## PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
3, 2, 6, 7	Q1 to Q4	Flip-Flop Outputs
4	CLOCK DOWN	Clock Down Input
5	CLOCK UP	Clock Up Input
11	$\overline{\text{PRESET ENABLE}}$	Preset Enable Input
12	$\overline{\text{CARRY}}$	Count Up (Carry)
13	$\overline{\text{BORROW}}$	Count Down (Borrow)
14	RESET	Reset Input
15, 1, 10, 9	J1 to J4	Data Input
8	$V_{SS}$	Negative Supply Voltage
16	$V_{DD}$	Positive Supply Voltage

## FUNCTIONAL DIAGRAM



LOGIC DIAGRAM

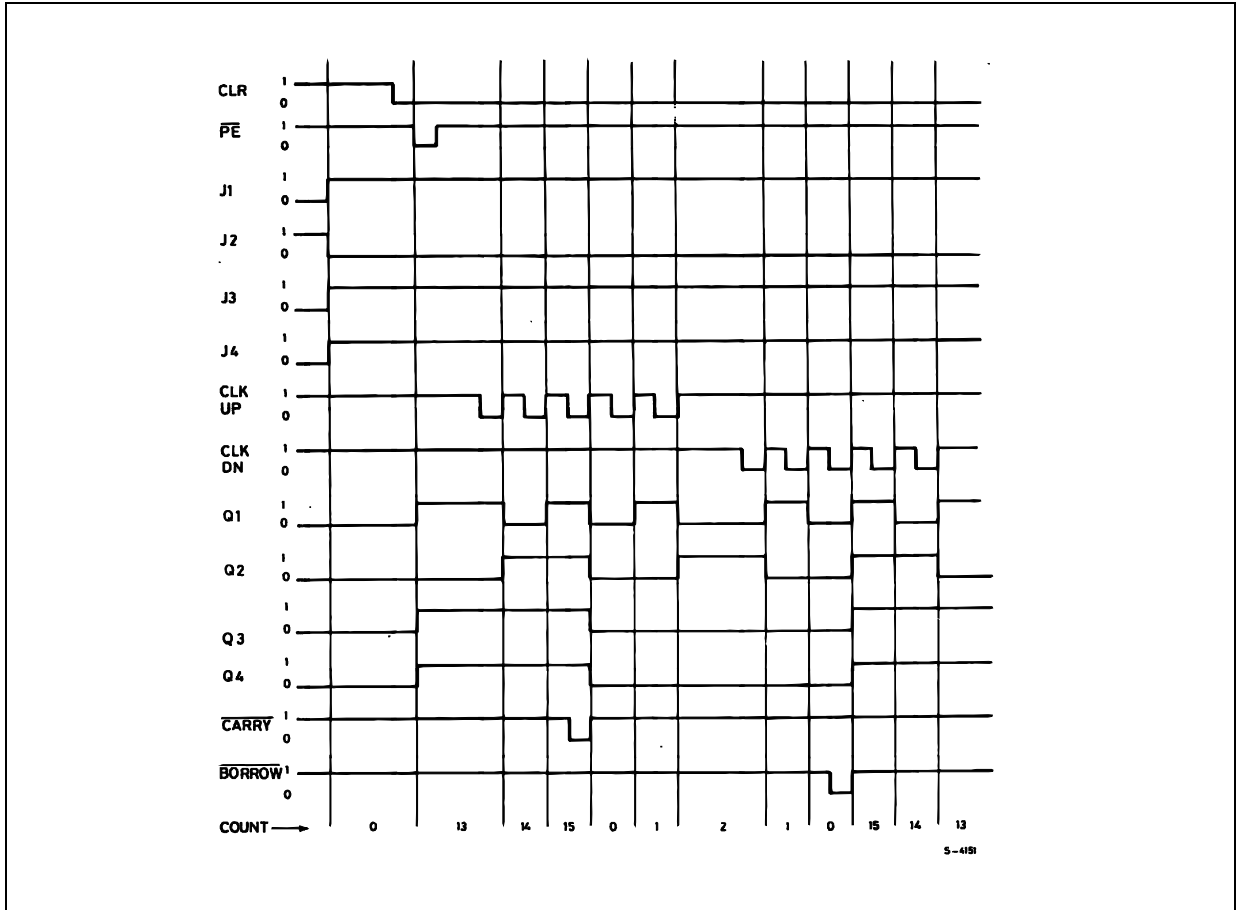


TRUTH TABLE

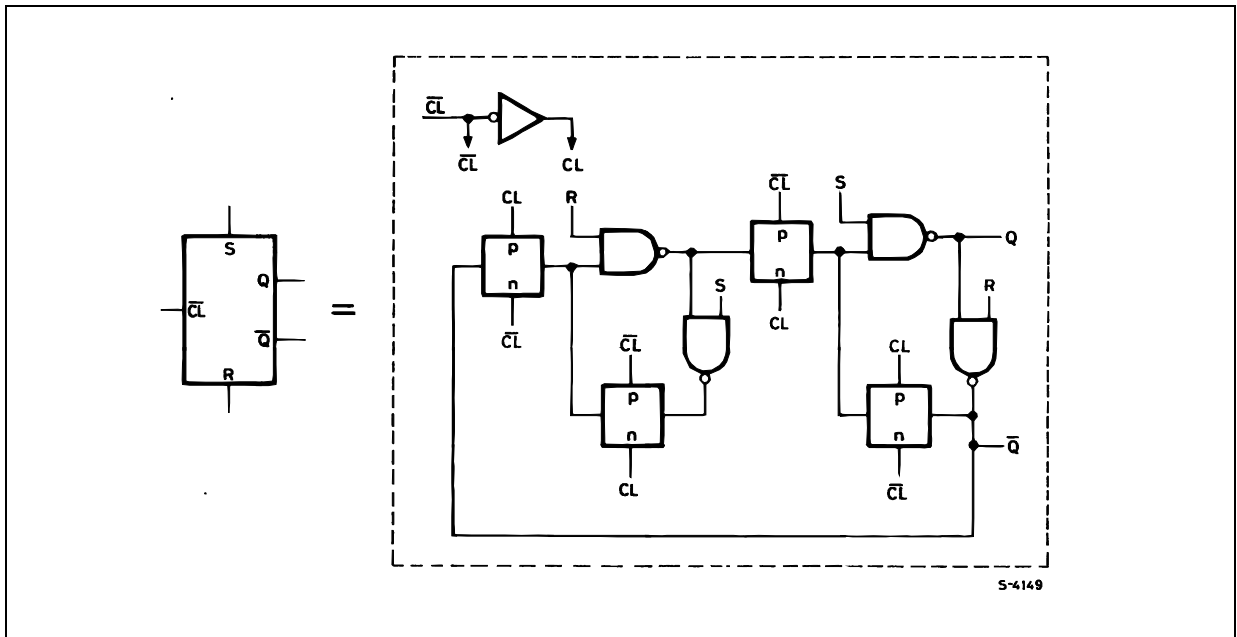
CLOCK UP	CLOCK DOWN	PRESET ENABLE	RESET	ACTION
	H	H	L	COUNT UP
	H	H	L	NO COUNT
H		H	L	COUNT DOWN
H		H	L	NO COUNT
X	X	L	L	PRESET
X	X	X	H	RESET

(X) : Don't Care

TIMING DIAGRAM



INTERNAL LOGIC OF FLIP-FLOP



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	-0.5 to +22	V
$V_I$	DC Input Voltage	-0.5 to $V_{DD} + 0.5$	V
$I_I$	DC Input Current	$\pm 10$	mA
$P_D$	Power Dissipation per Package	200	mW
	Power Dissipation per Output Transistor	100	mW
$T_{op}$	Operating Temperature	-55 to +125	°C
$T_{stg}$	Storage Temperature	-65 to +150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to  $V_{SS}$  pin voltage.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	3 to 20	V
$V_I$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature	-55 to 125	°C

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition				Value						Unit	
		V <sub>I</sub> (V)	V <sub>O</sub> (V)	I <sub>OL</sub>   ( $\mu$ A)	V <sub>DD</sub> (V)	T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
						Min.	Typ.	Max.	Min.	Max.	Min.		Max.
I <sub>L</sub>	Quiescent Current	0/5			5		0.04	5		150		150	$\mu$ A
		0/10			10		0.04	10		300		300	
		0/15			15		0.04	20		600		600	
		0/20			20		0.08	100		3000		3000	
V <sub>OH</sub>	High Level Output 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 <sub>OL</sub>	Low Level Output 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 <sub>IH</sub>	High Level Input 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 <sub>IL</sub>	Low Level Input 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 <sub>OH</sub>	Output Drive Current	0/5	2.5	<1	5	-1.36	-3.2		-1.1		-1.1		mA
		0/5	4.6	<1	5	-0.44	-1		-0.36		-0.36		
		0/10	9.5	<1	10	-1.1	-2.6		-0.9		-0.9		
		0/15	13.5	<1	15	-3.0	-6.8		-2.4		-2.4		
I <sub>OL</sub>	Output Sink Current	0/5	0.4	<1	5	0.44	1		0.36		0.36		mA
		0/10	0.5	<1	10	1.1	2.6		0.9		0.9		
		0/15	1.5	<1	15	3.0	6.8		2.4		2.4		
I <sub>I</sub>	Input Leakage Current	0/18	Any Input		18		$\pm 10^{-5}$	$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu$ A
C <sub>I</sub>	Input Capacitance		Any Input				5	7.5					pF

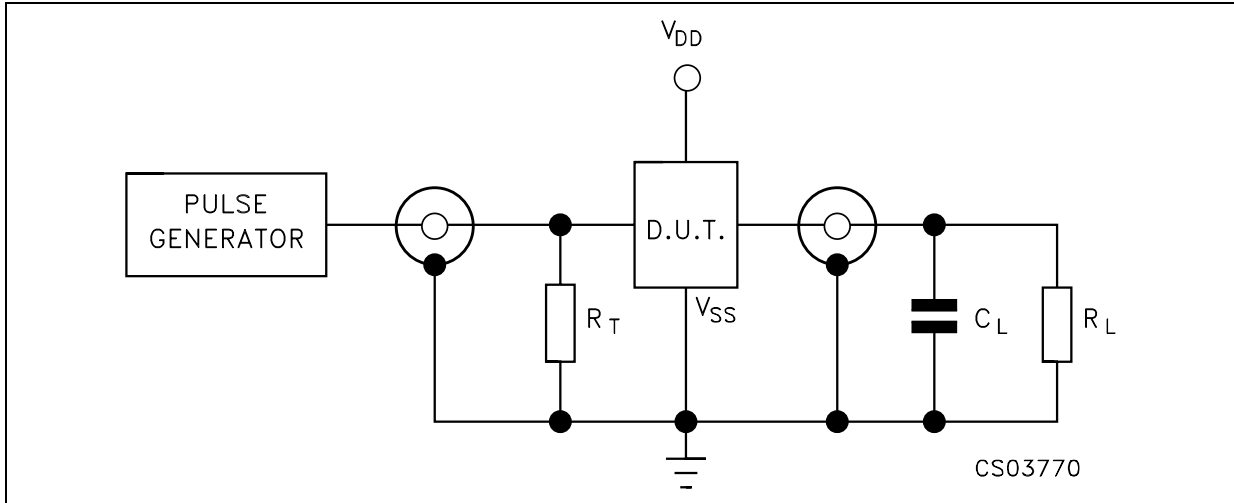
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{K}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

Symbol	Parameter	Test Condition		Value (*)			Unit
		$V_{DD}$ (V)		Min.	Typ.	Max.	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time Clock Up or Clock Down to Q Reset to Q	5			250	500	ns
		10			120	240	
		15			90	180	
	PE to Q	5			200	400	ns
		10			100	200	
		15			70	140	
	Clock Up to $\overline{\text{Carry}}$ Clock Down to $\overline{\text{Borrow}}$	5			160	320	ns
		10			80	160	
		15			60	120	
	$\overline{\text{Reset}}$ or PR to $\overline{\text{Borrow}}$ or $\overline{\text{Carry}}$	5			300	600	ns
		10			150	300	
		15			110	220	
$t_{THL}$ $t_{TLH}$	Transition Time	5			100	200	ns
		10			50	100	
		15			40	80	
$t_{rem}^*$	Removal Time $\overline{\text{Reset}}$ or $\overline{\text{PE}}$	5		80	40		ns
		10		40	20		
		15		30	15		
$t_W$	Clock Input Pulse Width Reset	5		480	240		ns
		10		300	150		
		15		260	130		
	PE	5			120	240	ns
		10			85	170	
		15			70	140	
	Clock	5			90	180	ns
		10			45	90	
		15			30	60	
$t_r$ $t_f$	Clock Input Rise or Fall Time	5				15	$\mu\text{s}$
		10				15	
		15				5	
$f_{CL}$	Maximum Clock Input Frequency	5		2	4		MHz
		10		5	8		
		15		5.5	11		

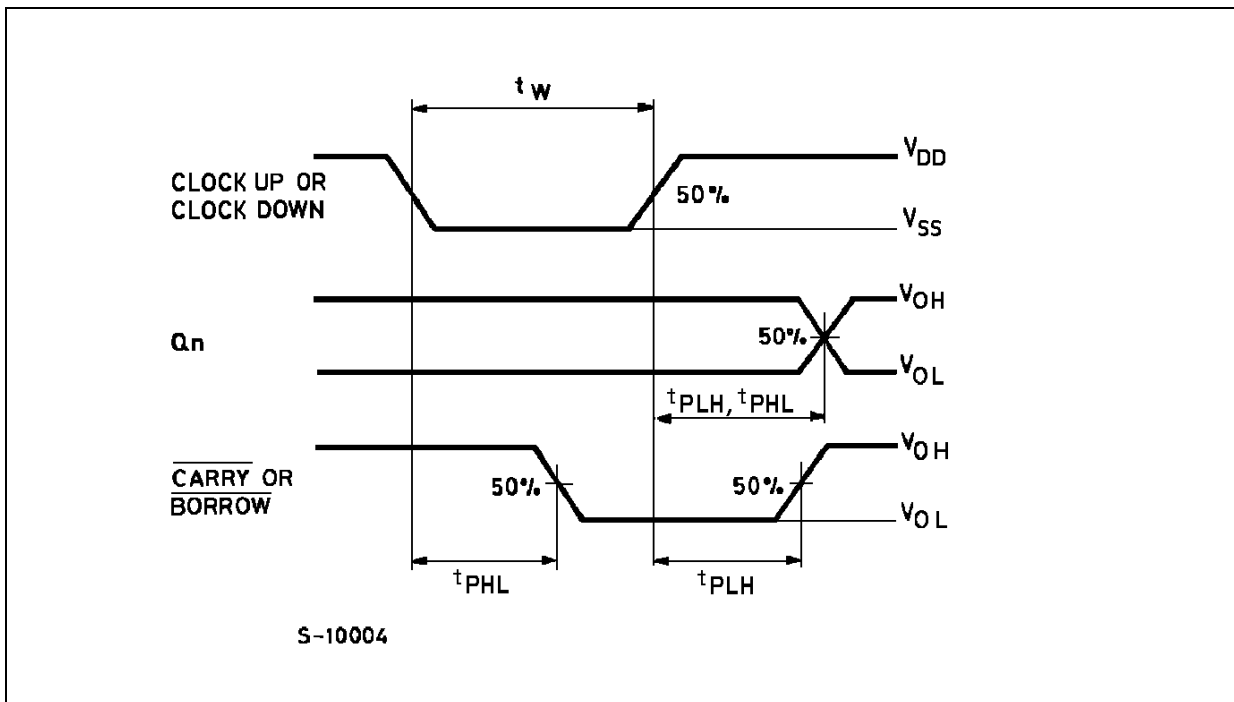
(\*) The time required for Reset or Preset Enable control to be removed before clocking (see timing diagram).

TEST CIRCUIT



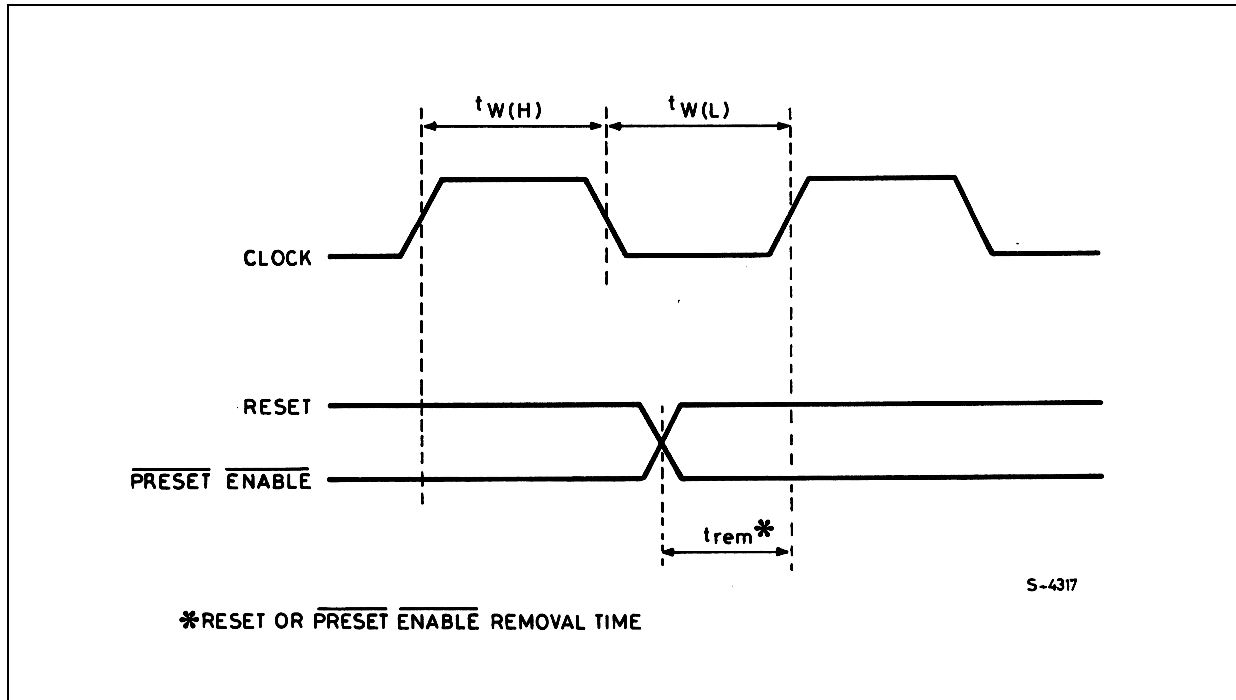
$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{K}\Omega$   
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

WAVEFORM 1 : PROPAGATION DELAY TIMES ( $f=1\text{MHz}$ ; 50% duty cycle)

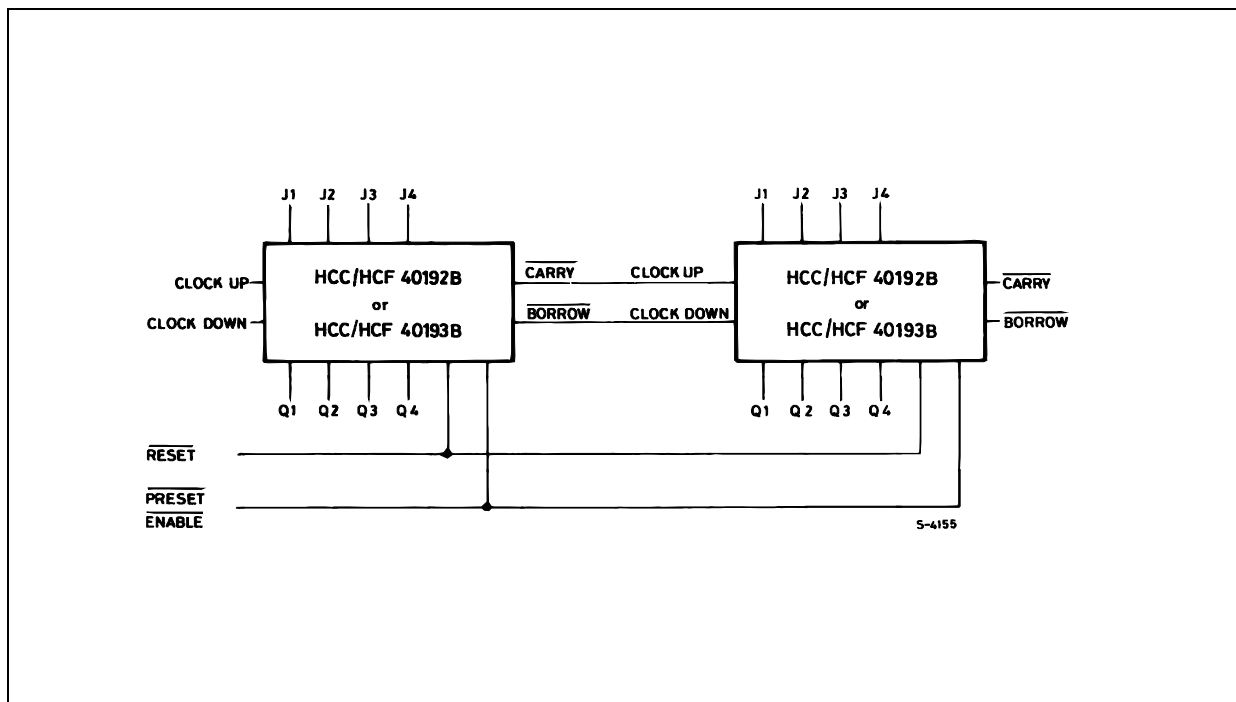




WAVEFORM 2 : MINIMUM PULSE WIDTH AND REMOVAL TIME (f=1MHz; 50% duty cycle)

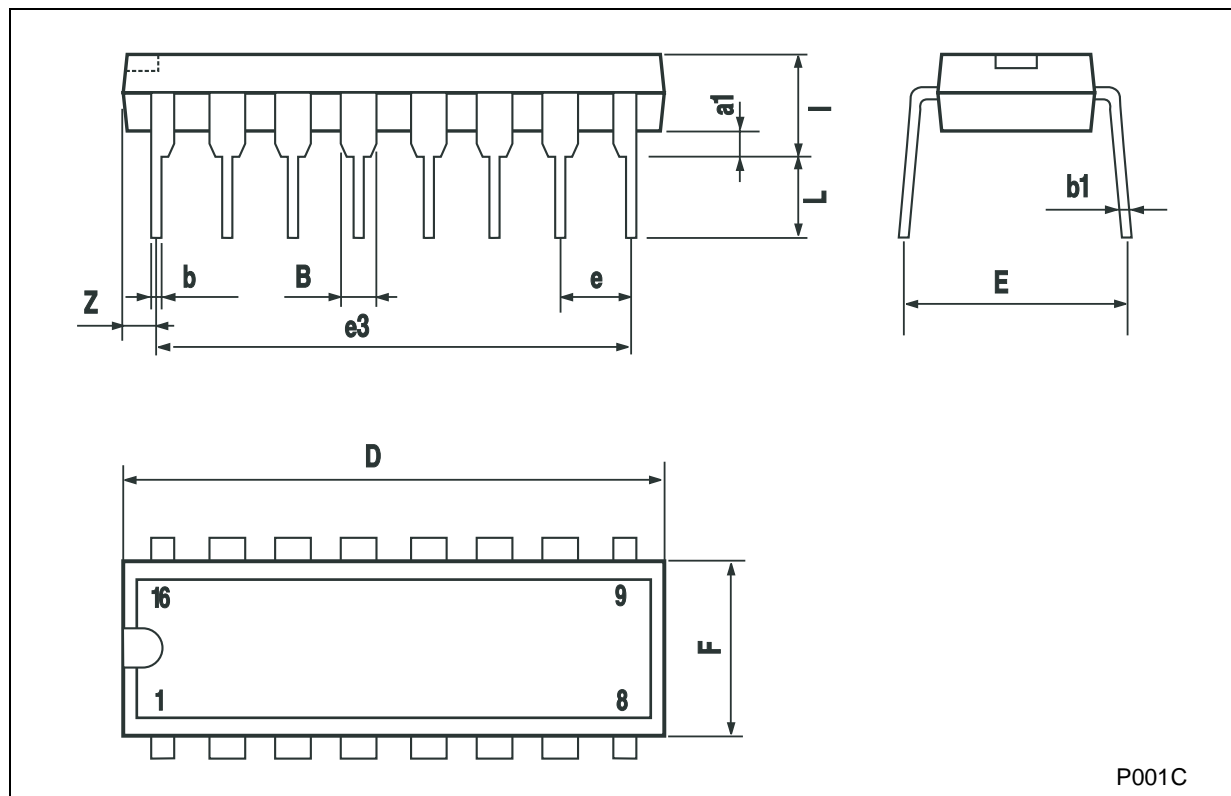


TYPICAL APPLICATION: CASCADED COUNTER PACKAGES



**Plastic DIP-16 (0.25) MECHANICAL DATA**

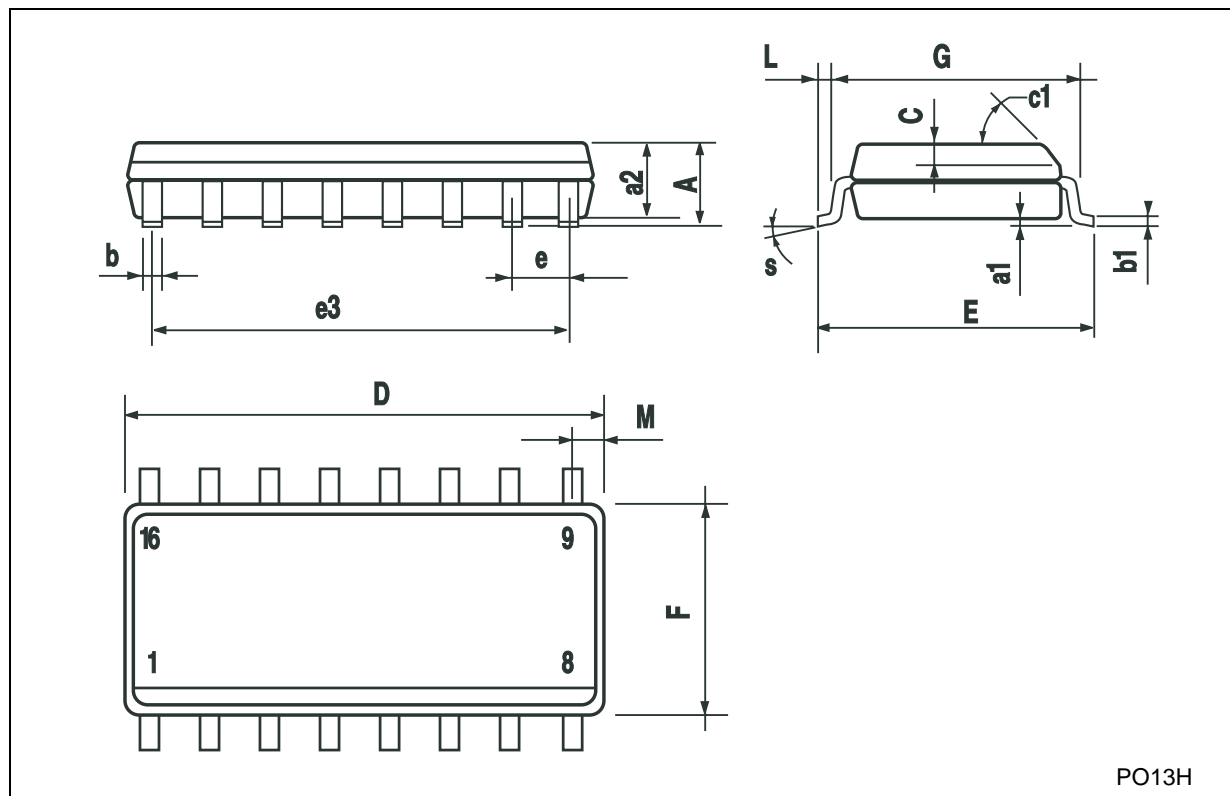
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

## SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



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