

## **DUAL 4 BIT BINARY COUNTER**

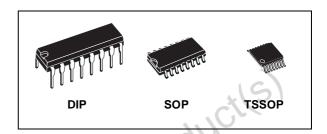
- HIGH SPEED : f<sub>MAX</sub> = 60 MHz (TYP.) at V<sub>CC</sub> = 6V
- LOW POWER DISSIPATION:  $I_{CC} = 4\mu A(MAX.)$  at  $T_A = 25$ °C
- HIGH NOISE IMMUNITY: V<sub>NIH</sub> = V<sub>NIL</sub> = 28 % V<sub>CC</sub> (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE: |I<sub>OH</sub>| = I<sub>OL</sub> = 4mA (MIN)
- BALANCED PROPAGATION DELAYS: t<sub>PLH</sub> ≅ t<sub>PHL</sub>
- WIDE OPERATING VOLTAGE RANGE: V<sub>CC</sub> (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 4520



The M74HC4520 is an high speed CMOS DUAL BINARY COUNTER fabricated with silicon gate  $\mbox{C}^2\mbox{MOS}$  technology.

It consists of two identical internally synchronous 4-stage counters. The counter stages are D-TYPE flip-flops having interchangeable CLOCK and ENABLE inputs for incrementing on either the positive-going or negative-going transition.

For single-unit operation the ENABLE input is maintained "high" and the counter advances on



#### **ORDER CODES**

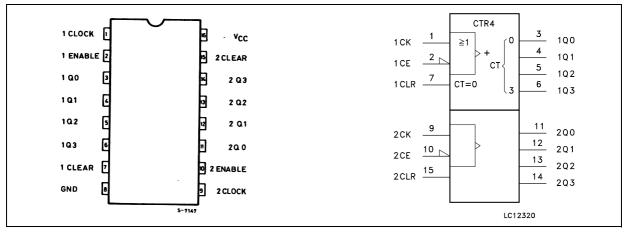
PACKAGE	TUBE	T & R
DIP	M74HC4520B1R	
SOP	M74HC4520M1R	M74HC4520RM13TR
TSSOP		M74HC4520TTR

each positive-going transition of the CLOCK. The counters are cleared by high levels on their clear lines.

The counter can be cascaded in the ripple mode by connecting Q4 to the enable input of the subsequent counter while the clock input of the latter is held permanently low.

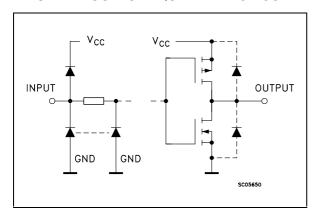
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

#### PIN CONNECTION AND IEC LOGIC SYMBOLS



July 2001 1/12

### INPUT AND OUTPUT EQUIVALENT CIRCUIT



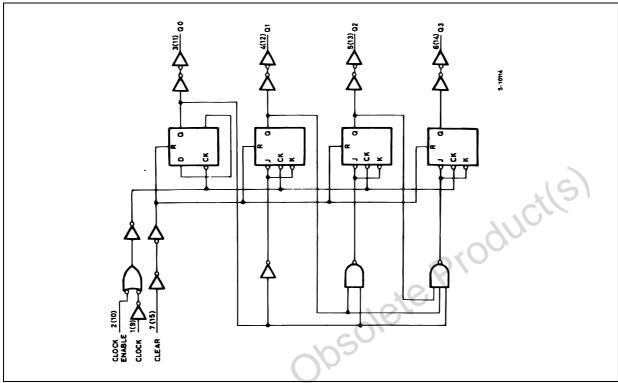
#### **PIN DESCRIPTION**

PIN No	SYMBOL	NAME AND FUNCTION				
1, 9	1CLOCK, 2CLOCK	Clock Inputs (LOW to HIGH, Edge-Triggered)				
2, 10	1CE, 2CE	Clock Enable Inputs				
3, 4, 5, 6	1Q0 to 1Q3	Data Outputs				
7, 15	1CLEAR, 2CLEAR	Asynchronous Reset Inputs (Active LOW)				
11, 12, 13, 14	2Q0 tO 2Q3	Data Outputs				
8	GND	Ground (0V)				
16	Vcc	Positive Supply Voltage				

#### **TRUTH TABLE**

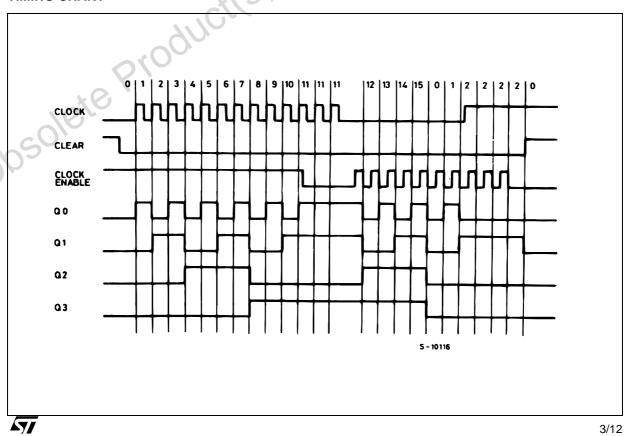
OI OOK	INPUTS	01.545	01	FUNCTION
CLOCK	CLOCK ENABLE	CLEAR	8,	INCREMENT COUNTE
L				INCREMENT COUNTE
	X	VS L		NO CHANGE
X		) L		NO CHANGE
	L /	L		NO CHANGE
Н	[5]	L		NO CHANGE
X : Don't Care	X	Н		Q0 THRU Q3=L
: High Impedance	2000			

#### **LOGIC DIAGRAM**



This logic diagram has not be used to estimate propagation delays

### **TIMING CHART**



#### **ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7	V
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
V <sub>O</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	± 20	mA
I <sub>OK</sub>	DC Output Diode Current	± 20	mA
Ιο	DC Output Current	± 25	mA
$I_{CC}$ or $I_{GND}$	DC V <sub>CC</sub> or Ground Current	± 50	mA
$P_{D}$	Power Dissipation	500(*)	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
TL	Lead Temperature (10 sec)	300	ç

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied
(\*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

#### **RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	1018	Value	Unit
V <sub>CC</sub>	Supply Voltage		2 to 6	V
VI	Input Voltage	50	0 to V <sub>CC</sub>	V
Vo	Output Voltage	9	0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature		-55 to 125	°C
	Input Rise and Fall Time	V <sub>CC</sub> = 2.0V	0 to 1000	ns
$t_r$ , $t_f$	.(5)	$V_{CC} = 4.5V$	0 to 500	ns
		$V_{CC} = 6.0V$	0 to 400	ns
5019	ite Pros			

#### **DC SPECIFICATIONS**

Parameter	Test Condition			Value						
	v <sub>cc</sub>		Т	<sub>A</sub> = 25°	С	-40 to	85°C	-55 to	125°C	Un
	(V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
High Level Input	2.0		1.5			1.5		1.5		
Voltage	4.5		3.15			3.15		3.15		٧
	6.0		4.2			4.2		4.2		
Low Level Input	2.0				0.5		0.5		0.5	
Voltage	4.5				1.35		1.35		1.35	١
	6.0				1.8		1.8		1.8	
	2.0	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9	16	
voitage	4.5	I <sub>O</sub> =-20 μA	4.4	4.5		4.4		4.4		"
	6.0	I <sub>O</sub> =-20 μA	5.9	6.0		5.9		5.9		\
	4.5	I <sub>O</sub> =-4.0 mA	4.18	4.31		4.13	$\triangle \hat{O}$	4.10		
	6.0	I <sub>O</sub> =-5.2 mA	5.68	5.8		5.63	O	5.60		
Low Level Output	2.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	
Voltage	4.5	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	
		<u> </u>							0.1	١
	4.5	I <sub>O</sub> =4.0 mA		0.17	0.26		0.37		0.40	
	6.0	I <sub>O</sub> =5.2 mA	5	0.18	0.26		0.37		0.40	
Input Leakage Current	6.0	$V_I = V_{CC}$ or GND			± 0.1		± 1		± 1	μ
Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND			4		40		80	μ
	Low Level Input Voltage  High Level Output Voltage  Low Level Output Voltage  Input Leakage Current Ouiescent Supply	Company   Comp	Cov Level Input Voltage   2.0   4.5   6.0     High Level Output Voltage   2.0   I <sub>O</sub> =-20 μA   4.5   I <sub>O</sub> =-20 μA   4.5   I <sub>O</sub> =-20 μA   4.5   I <sub>O</sub> =-4.0 mA   6.0   I <sub>O</sub> =-5.2 mA     Low Level Output Voltage   2.0   I <sub>O</sub> =20 μA   4.5   I <sub>O</sub> =4.0 mA   6.0   I <sub>O</sub> =5.2 mA     Input Leakage Current   6.0   V <sub>I</sub> = V <sub>CC</sub> or GND   Ouiescent Supply   0.0	Company   Com	Company   Com	Company   Com	Color   Col	Company   Com	Low Level Input Voltage  2.0  4.5  6.0  High Level Output Voltage  4.5  I 0=-20 μA  4.6  I 0=-20 μA  4.7  4.8  4.9  4.9  4.9  4.9  4.9  4.9  4.9	Low Level Input Voltage   2.0   4.5   6.0   6.0   1.35

# AC ELECTRICAL CHARACTERISTICS ( $C_L = 50 \text{ pF}$ , Input $t_r = t_f = 6 \text{ns}$ )

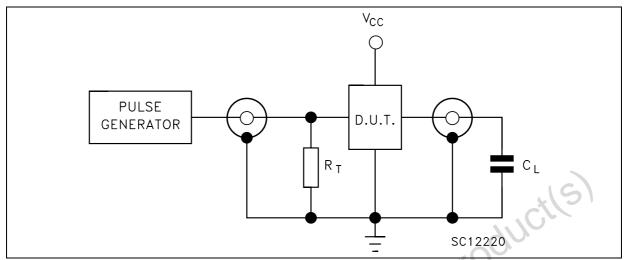
		٦	Test Condition				Value				
Symbol	Parameter V <sub>CC</sub>			T <sub>A</sub> = 25°C			-40 to	85°C	-55 to	125°C	Unit
		(V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	İ
t <sub>TLH</sub> t <sub>THL</sub>	Output Transition	2.0			30	75		95		110	
	Time	4.5			8	15		19		22	ns
		6.0			7	13		16		19	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay	2.0			72	160		200		240	
	Time	4.5			22	32		40		48	ns
	(CLOCK, CE - Qn)	6.0			18	27		34		41	
t <sub>PHL</sub>	Propagation Delay	2.0			65	150		190		225	
	Time	4.5			20	30		38	- 1	45	ns
	(CLEAR - Qn)	6.0			16	26		33	10	38	
f <sub>MAX</sub>	Maximum Clock	2.0		6	23		4.8	8	4		
	Frequency	4.5		30	51		24		20		MHz
		6.0		35	60		28		24		
t <sub>W(H)</sub>	Minimum Pulse	2.0			25	75		95		110	
t <sub>W(L)</sub>	Width	4.5			6	15		19		22	ns
	(CLOCK ,CE)	6.0			5	13		16		19	
$t_{W(L)}$	Minimum Pulse	2.0			20	75		95		110	
	Width	4.5			5	15		19		22	ns
	(CLEAR)	6.0			4	13		16		19	
t <sub>REM</sub>	Minimum Removal	2.0		,	21	50		60		75	
	Time	4.5			3	10		12		15	ns
	(CLEAR)	6.0	1191		3	9		11		13	

## **CAPACITIVE CHARACTERISTICS**

	240		Test Condition		Value						
Symbol	Parameter	v <sub>cc</sub>		T,	<sub>A</sub> = 25°	С	-40 to	85°C	-55 to	125°C	Unit
	18,16	(V)	Min.	Тур.	Max.	Min.	Max.	Min.	Max.		
C <sub>IN</sub>	Input Capacitance				5	10		10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)				32						pF

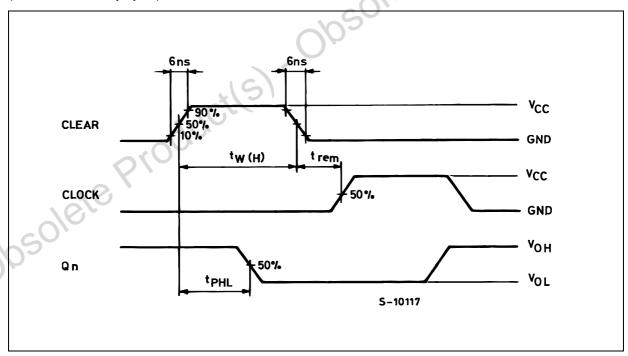
<sup>1)</sup>  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$  (per COUNTER)

#### **TEST CIRCUIT**

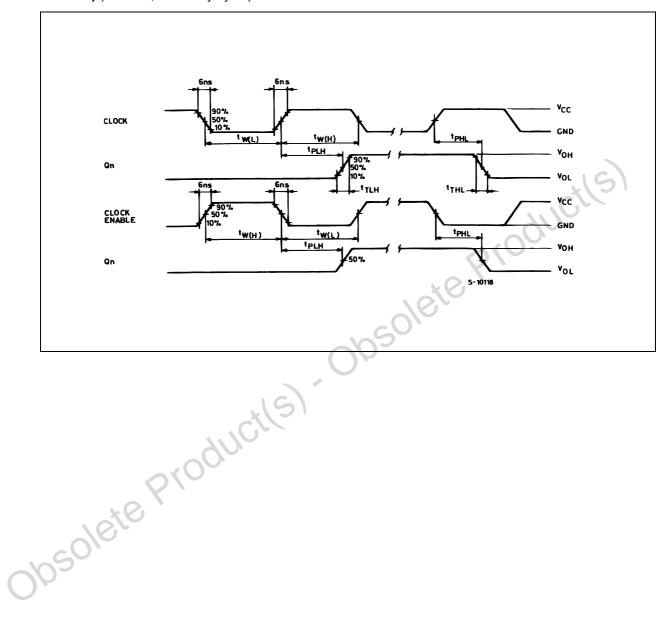


 $C_L$  = 50pF or equivalent (includes jig and probe capacitance)  $R_T$  =  $Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

## WAVEFORM 1: PROPAGATION DELAY, MINIMUM PULSE WIDTH AND REMOVAL TIMES (CLEAR) (f=1MHz; 50% duty cycle)

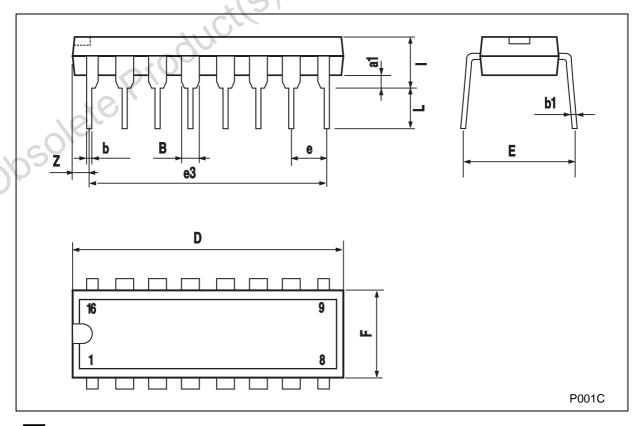


WAVEFORM 2 :PROPAGATION DELAY, MINIMUM PULSE WIDTH AND REMOVAL TIMES (CLOCK AND CE) (f=1MHz; 50% duty cycle)



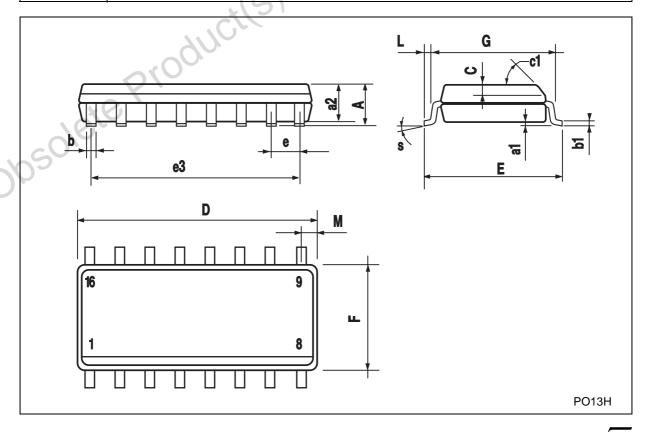
# Plastic DIP-16 (0.25) MECHANICAL DATA

DIM		mm.			inch	
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
В	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	16
D			20		.(	0.787
E		8.5			0.335	
е		2.54			0.100	
e3		17.78		×61	0.700	
F			7.1	7/6/		0.280
I			5.1	0.		0.201
L		3.3	OA		0.130	
Z			1.27			0.050



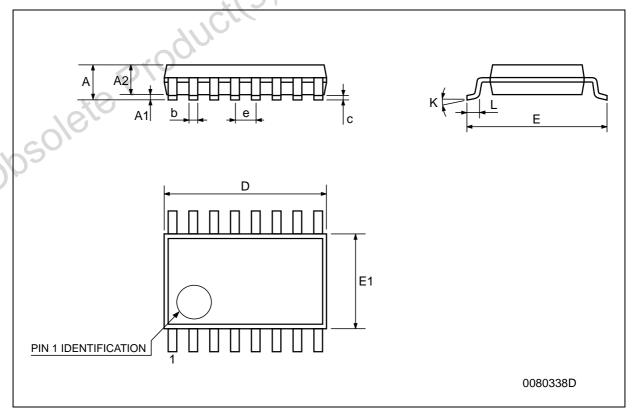
## **SO-16 MECHANICAL DATA**

DIM		mm.			inch	
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
А			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
С		0.5			0.019	.(5)
c1			45° (	typ.)	(	
D	9.8		10	0.385	40,	0.393
Е	5.8		6.2	0.228	100	0.244
е		1.27			0.050	
e3		8.89		94	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
М			0.62			0.024
S			8° (n	nax.)		



## **TSSOP16 MECHANICAL DATA**

DIM		mm.			inch	
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
А			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
С	0.09		0.20	0.004	401	0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
е		0.65 BSC	-100	0,	0.0256 BSC	
К	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030





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