

# M74HC74

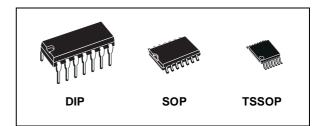
# DUAL D TYPE FLIP FLOP WITH PRESET AND CLEAR

- HIGH SPEED :
- f<sub>MAX</sub> = 67MHz (TYP.) at V<sub>CC</sub> = 6V ■ LOW POWER DISSIPATION:
- $I_{CC} = 2\mu A(MAX.)$  at  $T_A = 25^{\circ}C$
- HIGH NOISE IMMUNITY:
  V<sub>NIH</sub> = V<sub>NIL</sub> = 28 % V<sub>CC</sub> (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:  $|I_{OH}| = I_{OL} = 4mA (MIN)$
- 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 74

#### DESCRIPTION

The M74HC74 is an high speed CMOS DUAL D TYPE FLIP FLOP WITH CLEAR fabricated with silicon gate C<sup>2</sup>MOS technology.

A signal on the D INPUT is transferred on the Q OUTPUT during the positive going transition of the clock pulse. CLEAR and PRESET are



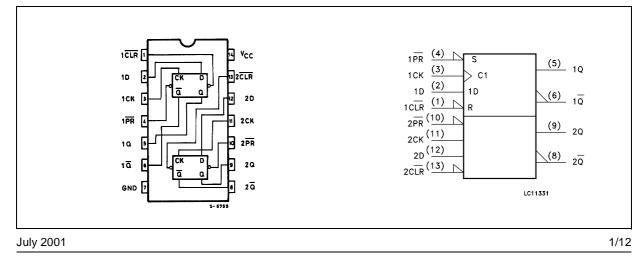
#### **ORDER CODES**

PACKAGE	TUBE	T & R
DIP	M74HC74B1R	
SOP	M74HC74M1R	M74HC74RM13TR
TSSOP		M74HC74TTR

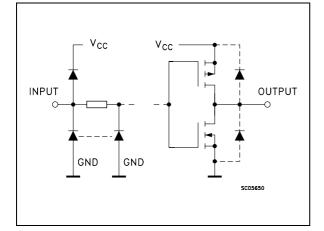
independent of the clock and accomplished by a low on the appropriate input.

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

#### PIN CONNECTION AND IEC LOGIC SYMBOLS



### INPUT AND OUTPUT EQUIVALENT CIRCUIT



#### **PIN DESCRIPTION**

PIN No	SYMBOL	NAME AND FUNCTION
1,13	$1\overline{\text{CLR}}, 2\overline{\text{CLR}}$	Asynchronous Reset - Direct Input
2, 12	1D, 2D	Data Inputs
3, 11	1CK, 2CK	Clock Input (LOW-to-HIGH, Edge-Triggered)
4, 10	1PR, 2PR	Asynchronous Set - Direct Input
5, 9	1Q, 2Q	True Flip-Flop Outputs
6, 8	1 <u>Q</u> , 2 <u>Q</u>	Complement Flip-Flop Outputs
7	GND	Ground (0V)
14	Vcc	Positive Supply Voltage

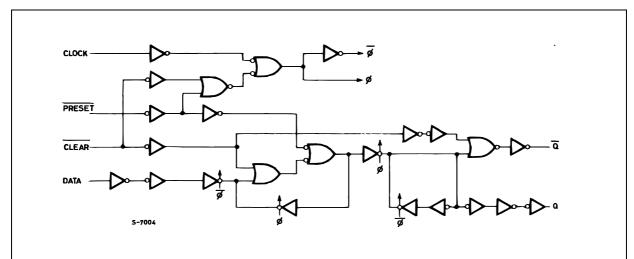
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#### **TRUTH TABLE**

	INP	JTS		OUTI	PUTS	FUNCTION
CLR	PR	D	СК	Q	Q	FUNCTION
L	Н	Х	Х	L	Н	CLEAR
Н	L	Х	Х	Н	L	PRESET
L	L	Х	Х	Н	Н	
Н	Н	L		L	Н	
н	Н	Н		Н	L	
Н	Н	Х	7	Q <sub>n</sub>	Q <sub>n</sub>	NO CHANGE

X : Don't Care

#### LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

#### **ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7	V
VI	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
۱ <sub>0</sub>	DC Output Current	± 25	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	± 50	mA
PD	Power Dissipation	500(*)	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
ΤL	Lead Temperature (10 sec)	300	°C

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		Value	Unit
V <sub>CC</sub>	Supply Voltage		2 to 6	V
VI	Input Voltage		0 to V <sub>CC</sub>	V
Vo	Output Voltage		0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature		-55 to 125	°C
	Input Rise and Fall Time	$V_{CC} = 2.0V$	0 to 1000	ns
t <sub>r</sub> , t <sub>f</sub>		$V_{CC} = 4.5V$	0 to 500	ns
		$V_{CC} = 6.0V$	0 to 400	ns



#### DC SPECIFICATIONS

		1	Test Condition				Value				
Symbol	Parameter	v <sub>cc</sub>		т	A = 25°	C	-40 to	85°C	-55 to	125°C	Unit
		(V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
V <sub>IH</sub>	High Level Input	2.0		1.5			1.5		1.5		
	Voltage	4.5		3.15			3.15		3.15		V
		6.0		4.2			4.2		4.2		
V <sub>IL</sub>	Low Level Input	2.0				0.5		0.5		0.5	
	Voltage	4.5				1.35		1.35		1.35	V
		6.0				1.8		1.8		1.8	
V <sub>OH</sub>	High Level Output	2.0	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9		
	Voltage	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		V
		4.5	I <sub>O</sub> =-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I <sub>O</sub> =-5.2 mA	5.68	5.8		5.63		5.60		
V <sub>OL</sub>	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	
		6.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	V
		4.5	I <sub>O</sub> =4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I <sub>O</sub> =5.2 mA		0.18	0.26		0.33		0.40	
Ι <sub>Ι</sub>	Input Leakage Current	6.0	$V_{I} = V_{CC}$ or GND			± 0.1		± 1		± 1	μΑ
I <sub>CC</sub>	Quiescent Supply Current	6.0	$V_{I} = V_{CC}$ or GND			2		20		40	μΑ

		т	est Condition	Value							
Symbol	Parameter	Parameter V <sub>CC</sub>		T <sub>A</sub> = 25°C			-40 to	85°C	-55 to	125°C	Unit
		(Ŭ)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
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			48	150		190		225	
	Time (CK - Q, Q)	4.5			16	30		38		45	ns
		6.0			13	26		32		38	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay	2.0			51	150		190		225	
	Tim <u>e</u> (CLR, PR -	4.5			17	30		38		45	ns
	Q, Q)	6.0			15	26		32		38	
f <sub>MAX</sub>	Maximum Clock	2.0		6.2	21		5		4.2		
	Frequency	4.5		31	63		25		21		MHz
		6.0		37	67		30		25		
t <sub>W(H)</sub>	Minimum Pulse	2.0			18	75		95		110	
t <sub>W(L)</sub>	Width (CK)	4.5			6	15		19		22	ns
.,		6.0			6	13		16		19	
t <sub>W(L)</sub>	Minimum Pulse	2.0			21	75		95		110	
(_)	Width (CLR, PR)	4.5			7	15		19		22	ns
		6.0			6	13		16		19	
t <sub>s</sub>	Minimum Set-up	2.0			15	75		95		110	
	Time	4.5			4	15		19		22	ns
		6.0			3	13		16		19	
t <sub>h</sub>	Minimum Hold	2.0				0		0		0	
	Time	4.5				0		0		0	ns
		6.0				0		0		0	
t <sub>REM</sub>	Minim <u>um Rem</u> oval	2.0			0	25		30		35	
	Time (CLR, PR to	4.5			0	5		6		7	ns
	CK)	6.0			0	4		5		6	115

## AC ELECTRICAL CHARACTERISTICS (CL = 50 pF, Input $t_r = t_f = 6ns$ )

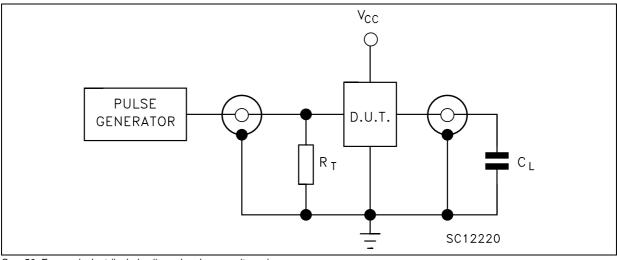
### **CAPACITIVE CHARACTERISTICS**

		٦	Test Condition				Value				
Symbol	Parameter	V <sub>CC</sub>		т	<sub>A</sub> = 25°	С	-40 to	85°C	-55 to	125°C	Unit
		V <sub>CC</sub> (V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
C <sub>IN</sub>	Input Capacitance	5.0			5	10		10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	5.0			34						pF

1)  $C_{PD}$  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 FLIP/ FLOP)

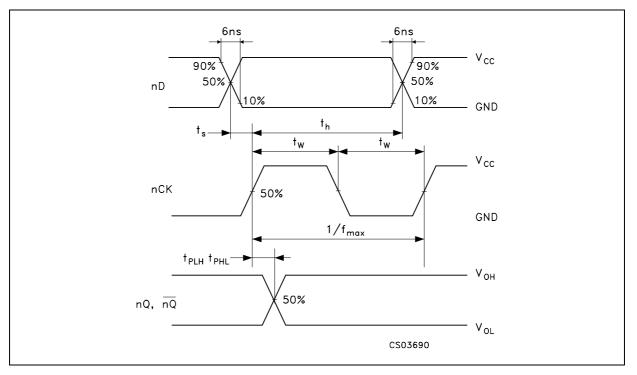


#### **TEST CIRCUIT**

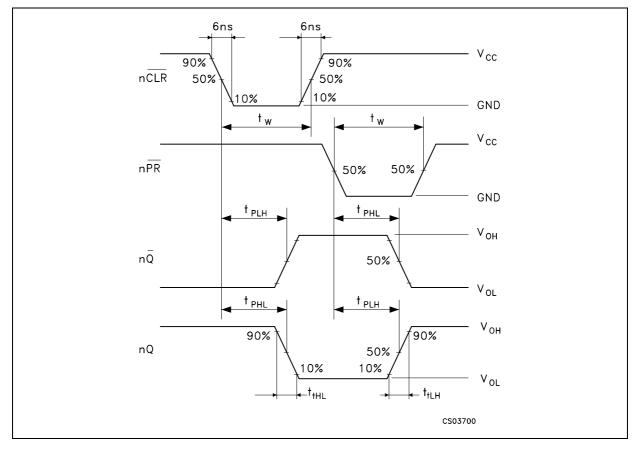


 $C_L$  = 50pF or equivalent (includes jig and probe capacitance)  $R_T$  =  $Z_{OUT}$  of pulse generator (typically 50 $\Omega$ )

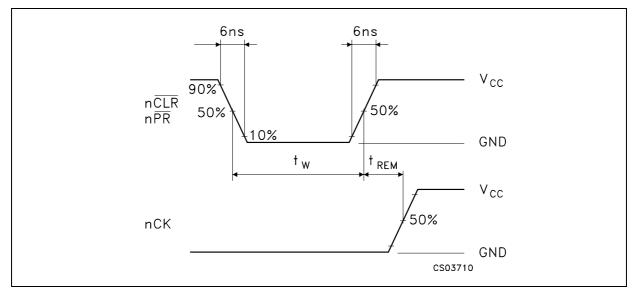
#### WAVEFORM 1: nCK TO nQ, nQ PROPAGATION DELAY TIMES, nD TO nCK SETUP AND HOLD TIMES, nCK MINIMUM PULSE WIDTH, MAXIMUM nCK FREQUENCY (f=1MHz; 50% duty cycle)

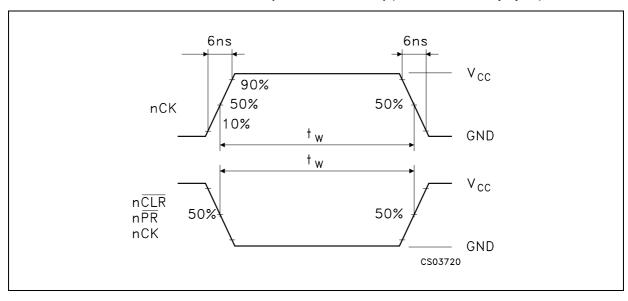


 $\label{eq:WaveForm_2:nQ,nQ} WAVeForm \underline{2:nQ,nQ} TO \ \overline{CLR,PR} \ PROPAGATION \ DELAY \ TIMES, \ MINIMUM \ PULSE \ WIDTH \ (nCLR \ and \ nPR) \ (f=1MHz; 50\% \ duty \ cycle)$ 



WAVEFORM 3 : MINIMUM PULSE WIDTH (nCLR and nPR),MINIMUM REMOVAL TIME (nCLR and nPR TO nCK)(f=1MHz; 50% duty cycle)



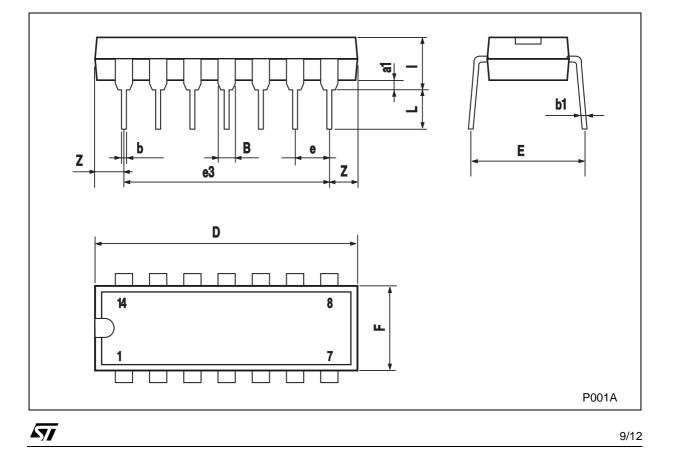


## WAVEFORM 4 : MINIMUM PULSE WIDTH (nCLR, nPR , nCK) (f=1MHz; 50% duty cycle)

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DIM.		mm.			inch	
DIW.	MIN.	ТҮР	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
В	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
е		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	

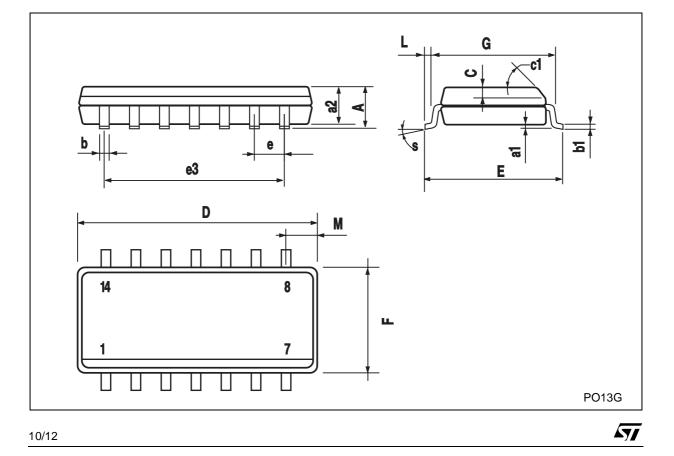




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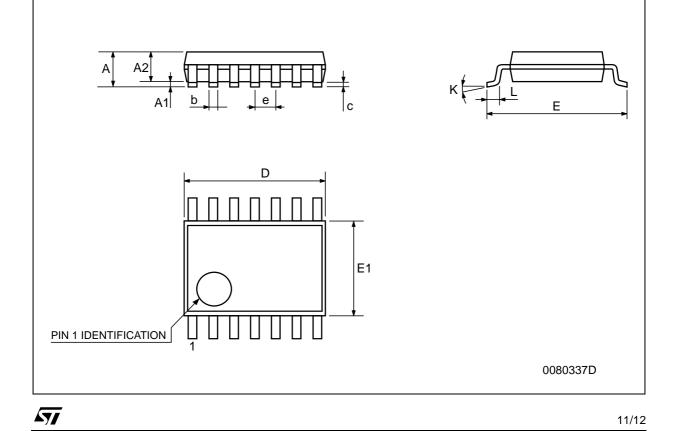
DIM.      MIN.      TYP      MAX.      MIN.      TYP.        A      1.75      1.75      1.75      1.75        a1      0.1      0.2      0.003      1.75        a2      1.65      1.75      1.75      1.75        b      0.1      0.2      0.003      1.75        b1      0.1      0.2      0.003      1.75        b1      0.35      0.46      0.013      1.75        b1      0.19      0.25      0.007      1.75        C      0.5      1.75      0.019      1.75        C      0.5      1.75      0.019      1.75        C      0.5      1.75      0.019      1.75        C      0.5      8.75      0.336      1.75        D      8.55      8.75      0.336      1.75        E      5.8      6.2      0.228      1.75        e      1.27      1.76      0.300      1.76        F      3.8      4.0      0.149      1.75	mm			inch	
a1      0.1      0.2      0.003         a2      1.65      1.65          b      0.35      0.46      0.013          b1      0.19      0.25      0.007          C      0.5      1      0.019          c1	I. TYI	MIN.	)	TYP.	MAX.
a2    1.65    1.65      b    0.35    0.46    0.013      b1    0.19    0.25    0.007      C    0.5    0.007    0.019      c1					0.068
b      0.35      0.46      0.013        b1      0.19      0.25      0.007         C      0.5      0.007      0.019         c1      0.5      0.007      0.019         D      8.55      8.75      0.336          E      5.8      6.2      0.228          e      1.27      0.300           F      3.8      4.0      0.149		0.003			0.007
b1    0.19    0.25    0.007      C    0.5    0.019      c1    45° (typ.)      D    8.55    0.336    1      E    5.8    6.2    0.228    0.050      e    1.27    0.300    0.300    0.300      F    3.8    4.0    0.149    0.149					0.064
C      0.5      0.019        c1      45° (typ.)        D      8.55      8.75      0.336        E      5.8      6.2      0.228        e      1.27      0.050      0.300        e3      7.62      0.300      0.300        F      3.8      4.0      0.149	5	0.013			0.018
c1    45° (typ.)      D    8.55    8.75    0.336    1      E    5.8    6.2    0.228    1      e    1.27    0.050    0.300    1      e3    7.62    0.149    0.300    1	9	0.007			0.010
D      8.55      8.75      0.336         E      5.8      6.2      0.228         e      1.27      0.050         e3      7.62      0.300         F      3.8      4.0      0.149	0.5			0.019	
E    5.8    6.2    0.228      e    1.27    0.050      e3    7.62    0.300      F    3.8    4.0    0.149	ł				-
e    1.27    0.050      e3    7.62    0.300      F    3.8    4.0    0.149	5	0.336			0.344
e3      7.62      0.300        F      3.8      4.0      0.149	3	0.228			0.244
F      3.8      4.0      0.149	1.2		,	0.050	
	7.6		2	0.300	
	3	0.149			0.157
G 4.6 5.3 0.181	3	0.181			0.208
L 0.5 1.27 0.019	5	0.019			0.050





		mm.				
DIM.	MIN.	ТҮР	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		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			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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