



**THE DATASHEET OF  
M74HC73RM13TR**





# M74HC73

## DUAL J-K FLIP FLOP WITH PRESET AND CLEAR

- HIGH SPEED :  
 $f_{MAX} = 80\text{MHz}$  (TYP.) at  $V_{CC} = 6\text{V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 2\mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 4\text{mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH  
 74 SERIES 73



### ORDER CODES

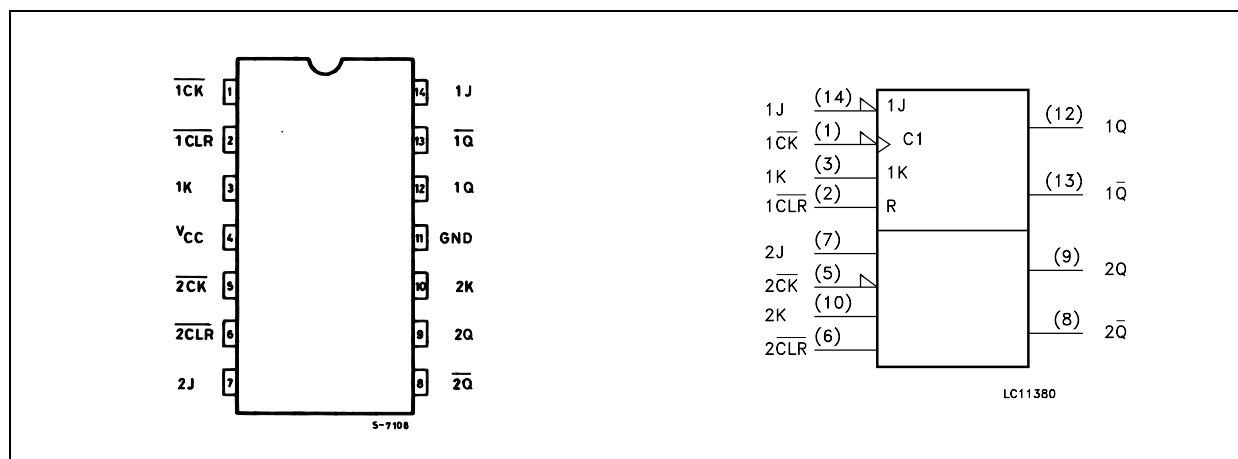
PACKAGE	TUBE	T & R
DIP	M74HC73B1R	
SOP	M74HC73M1R	M74HC73RM13TR
TSSOP		M74HC73TTR

### DESCRIPTION

The M74HC73 is an high speed CMOS DUAL J-K FLIP FLOP WITH CLEAR fabricated with silicon gate C<sup>2</sup>MOS technology. Depending on the logic level applied to J and K inputs, this device changes state on the negative going transition of clock input pulse ( $\overline{CK}$ ). The

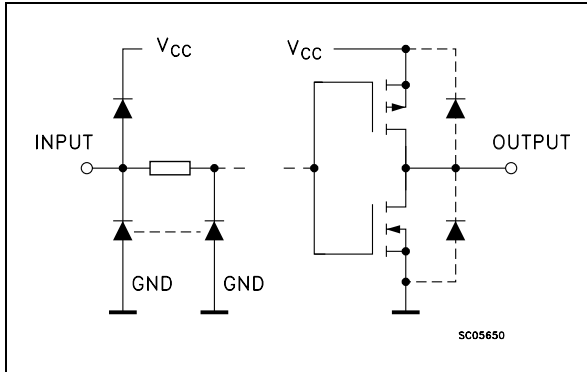
clear function is accomplished independently of the clock condition when the clear input ( $\overline{CLR}$ ) is taken low. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



# M74HC73

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

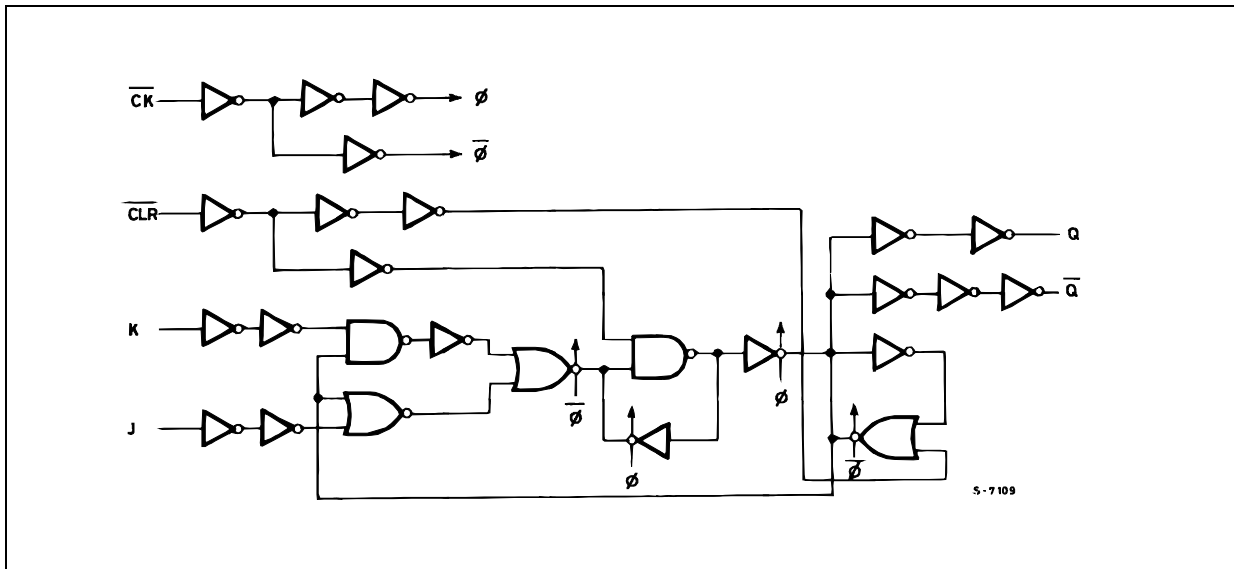
PIN No	SYMBOL	NAME AND FUNCTION
1, 5	$\overline{1CK}, \overline{2CK}$	Clock Input
2, 6	$\overline{1CLR}, \overline{2CLR}$	Asynchronous Reset Inputs
12, 9	$1Q, 2Q$	True Flip-Flop Outputs
13, 8	$\overline{1Q}, \overline{2Q}$	Complement Flip-Flop Outputs
14, 7, 3, 10	$1J, 2J, 1K, 2K$	Synchronous Inputs Flip-Flop 1 and 2
11	GND	Ground (0V)
4	Vcc	Positive Supply Voltage

## TRUTH TABLE

INPUTS				OUTPUTS		FUNCTION
$\overline{CLR}$	J	K	$\overline{CK}$	Q	$\overline{Q}$	
L	X	X	X	L	H	CLEAR
H	L	L	$\square$	$Q_n$	$\overline{Q}_n$	NO CHANGE
H	L	H	$\square$	L	H	----
H	H	L	$\square$	H	L	----
H	H	H	$\square$	$\overline{Q}_n$	$Q_n$	TOGGLE
H	X	X	$\square$	$Q_n$	$\overline{Q}_n$	NO CHANGE

X : Don't Care

## LOGIC DIAGRAM



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to +7	V
$V_I$	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_O$	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{IK}$	DC Input Diode Current	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	500(*)	mW
$T_{stg}$	Storage Temperature	-65 to +150	°C
$T_L$	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	
$V_{CC}$	Supply Voltage	2 to 6	V	
$V_I$	Input Voltage	0 to $V_{CC}$	V	
$V_O$	Output Voltage	0 to $V_{CC}$	V	
$T_{op}$	Operating Temperature	-55 to 125	°C	
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2.0V$	0 to 1000	ns
		$V_{CC} = 4.5V$	0 to 500	ns
		$V_{CC} = 6.0V$	0 to 400	ns

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IH</sub>	High Level Input Voltage	2.0		1.5			1.5		1.5		V
		4.5		3.15			3.15		3.15		
		6.0		4.2			4.2		4.2		
V <sub>IL</sub>	Low Level Input Voltage	2.0				0.5		0.5		0.5	V
		4.5				1.35		1.35		1.35	
		6.0				1.8		1.8		1.8	
V <sub>OH</sub>	High Level Output Voltage	2.0	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9		V
		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		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 Voltage	2.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	V
		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	
		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	
I <sub>I</sub>	Input Leakage Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			± 0.1		± 1		± 1	μA
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			2		20		40	μA

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

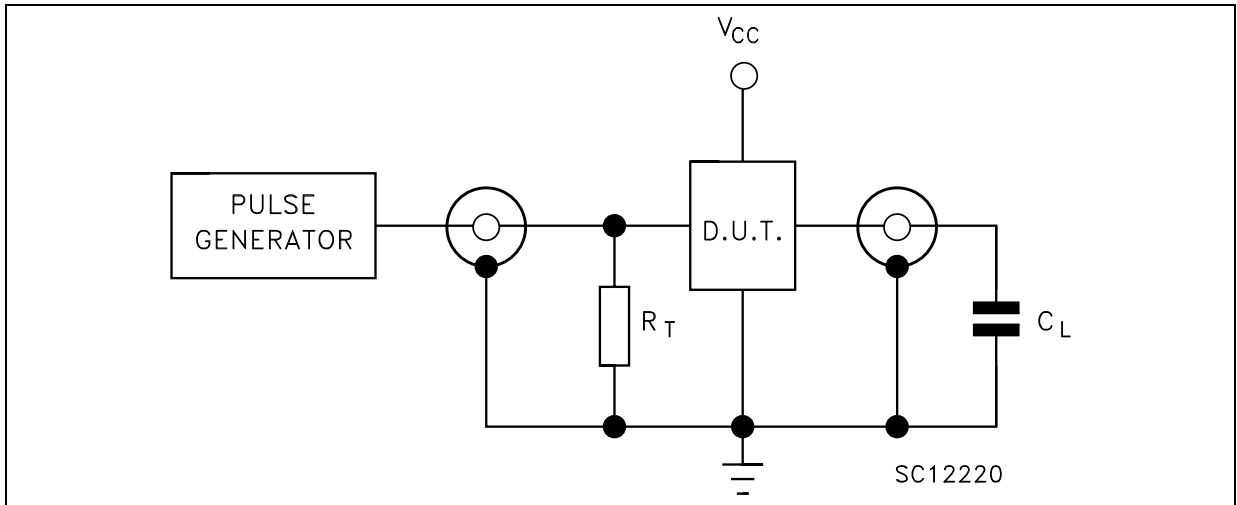
Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$t_{TLH}$ $t_{THL}$	Output Transition Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time (CK - Q)	2.0			42	125		155		190	ns
		4.5			14	25		31		38	
		6.0			12	21		26		32	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time (CLR - Q)	2.0			54	145		180		220	ns
		4.5			18	29		36		44	
		6.0			15	25		31		37	
$f_{MAX}$	Maximum Clock Frequency	2.0		6	15		4.8		4		MHz
		4.5		30	60		24		20		
		6.0		35	80		28		24		
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CK)	2.0			18	75		95		110	ns
		4.5			6	15		19		22	
		6.0			6	13		16		19	
$t_{W(L)}$	Minimum Pulse Width (CLR)	2.0			21	75		95		110	ns
		4.5			7	15		19		22	
		6.0			6	13		16		19	
$t_s$	Minimum Set-up Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			6	13		16		19	
$t_h$	Minimum Hold Time	2.0				0		0		0	ns
		4.5				0		0		0	
		6.0					0		0	0	
$t_{REM}$	Minimum Removal Time	2.0			25	75		95		110	ns
		4.5			7	15		19		22	
		6.0			6	13		16		19	

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$C_{IN}$	Input Capacitance	5.0			5	10		10		10	pF
$C_{PD}$	Power Dissipation Capacitance (note 1)	5.0			35						pF

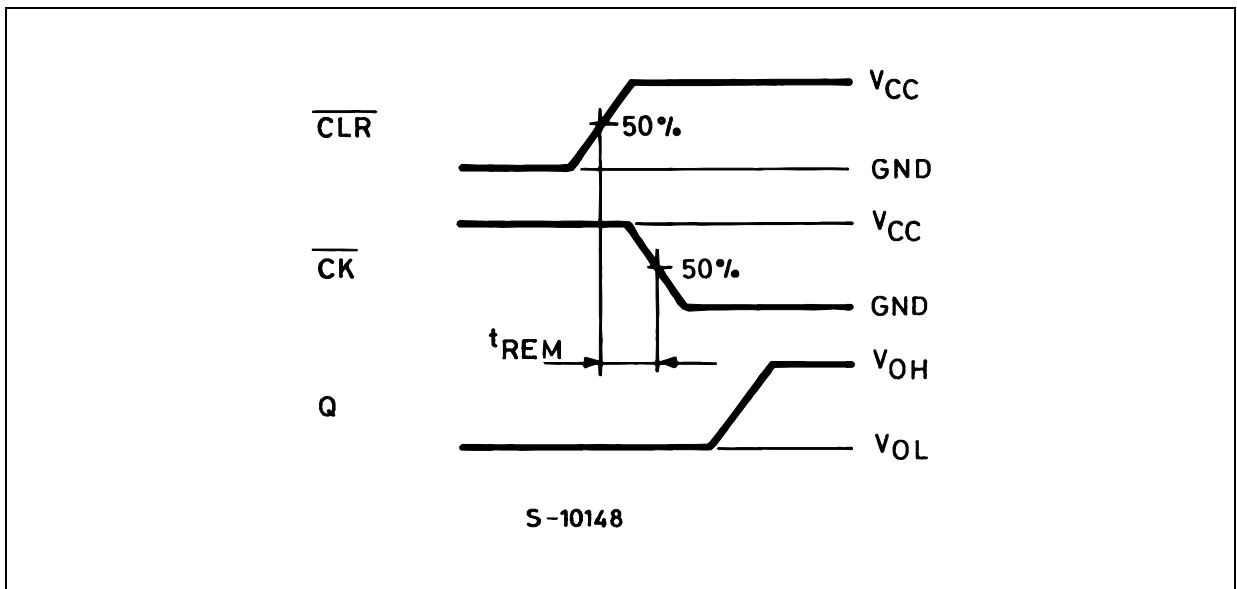
1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} +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

TEST CIRCUIT

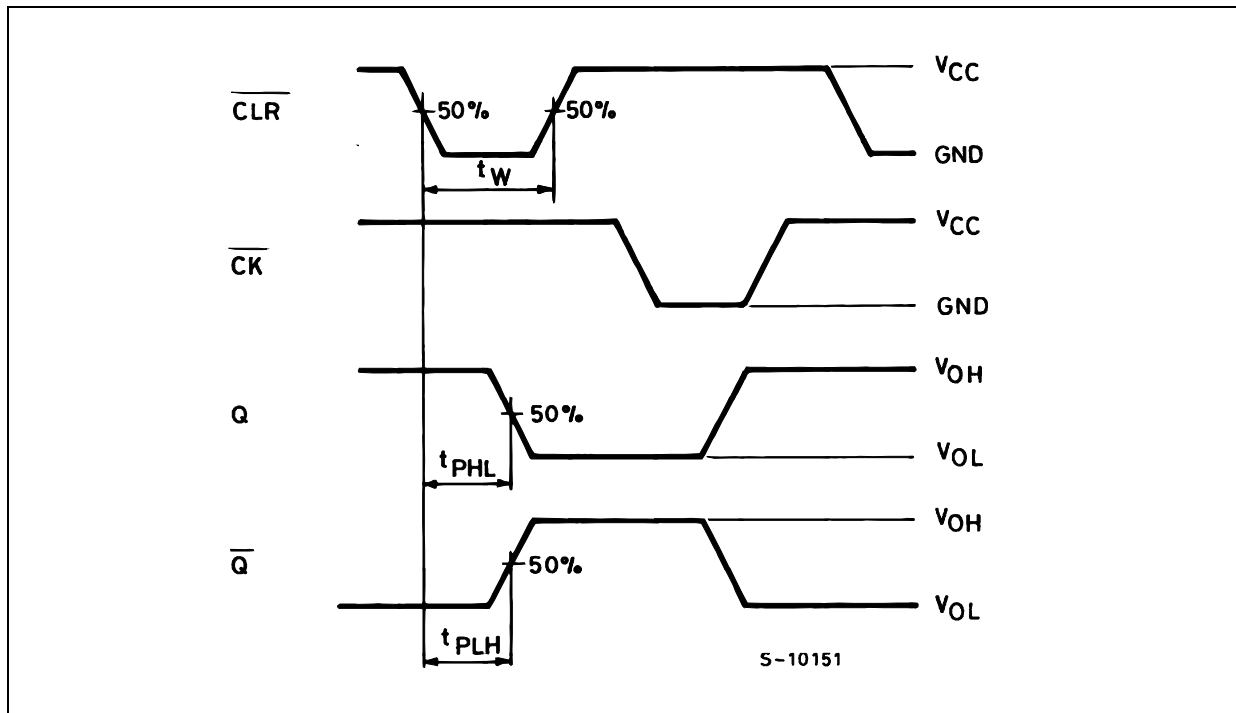


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

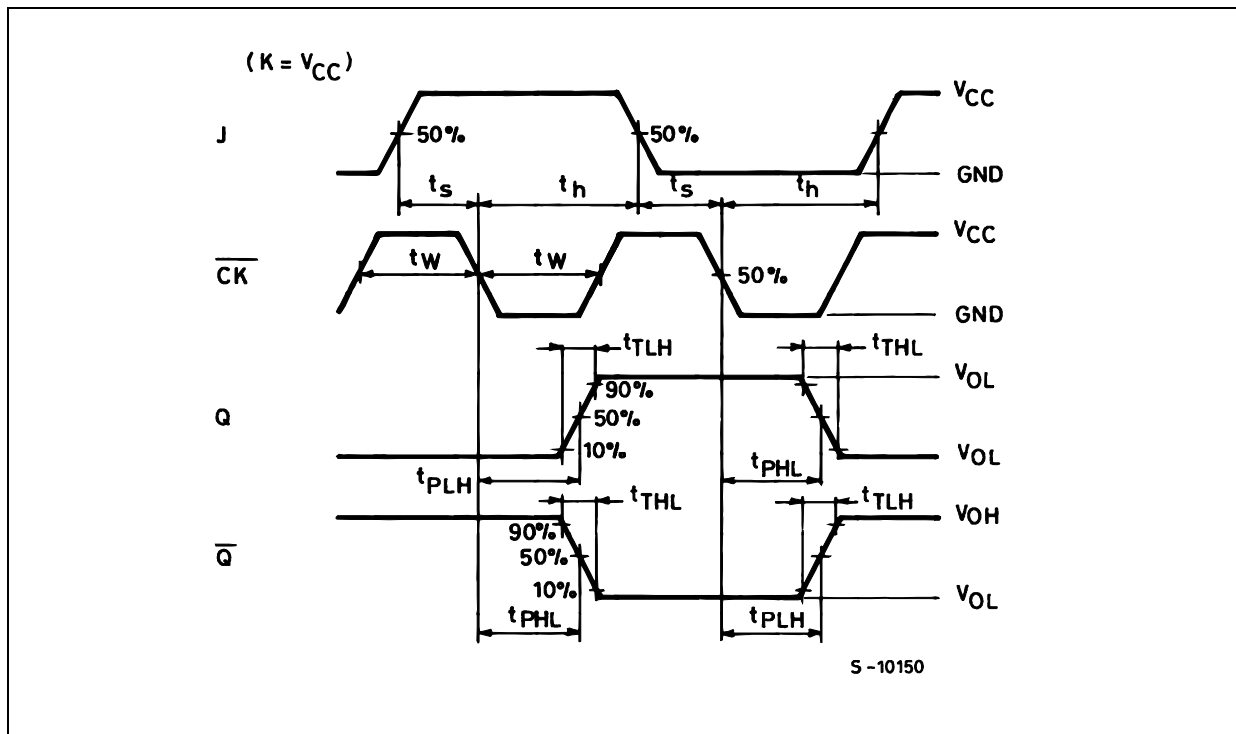
WAVEFORM 1: MINIMUM REMOVAL TIME ( $f=1\text{MHz}$ ; 50% duty cycle)



WAVEFORM 2 : MINIMUM PULSE WIDTH, PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)

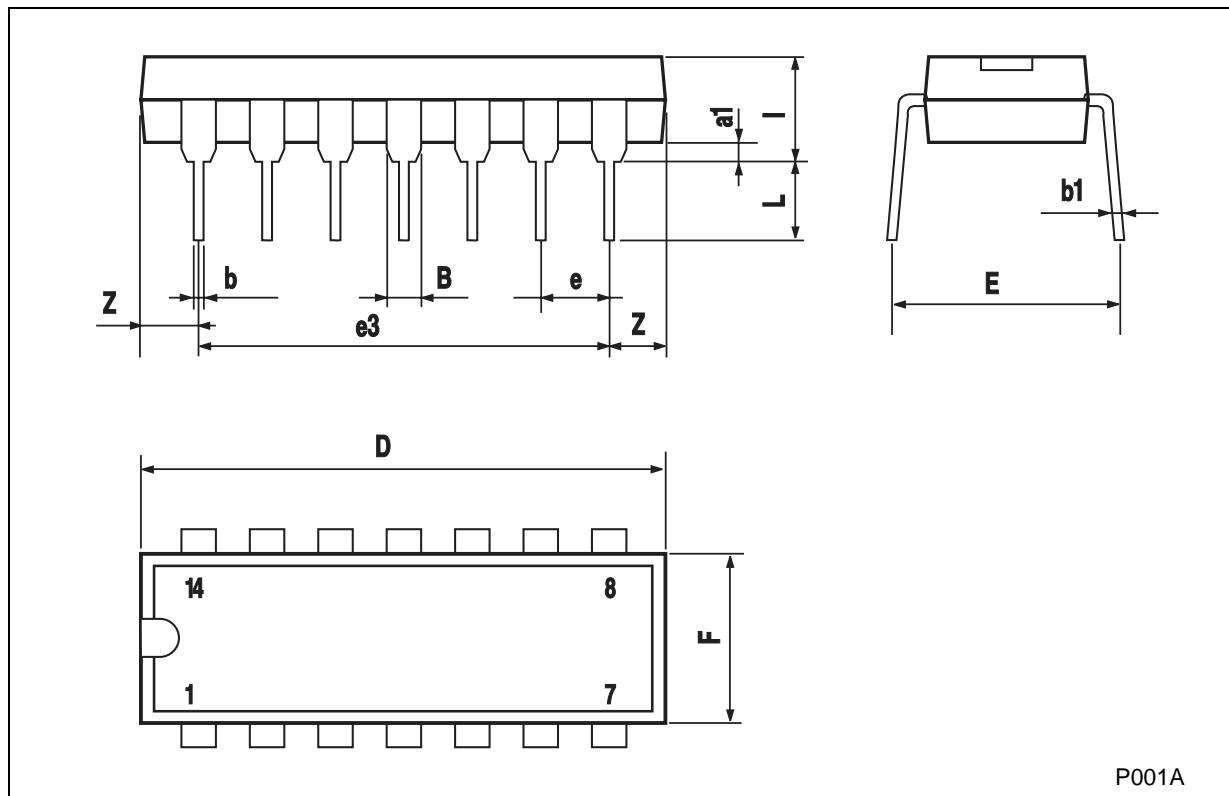


WAVEFORM 3 : PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH, SETUP AND HOLD TIME (f=1MHz; 50% duty cycle)



**Plastic DIP-14 MECHANICAL DATA**

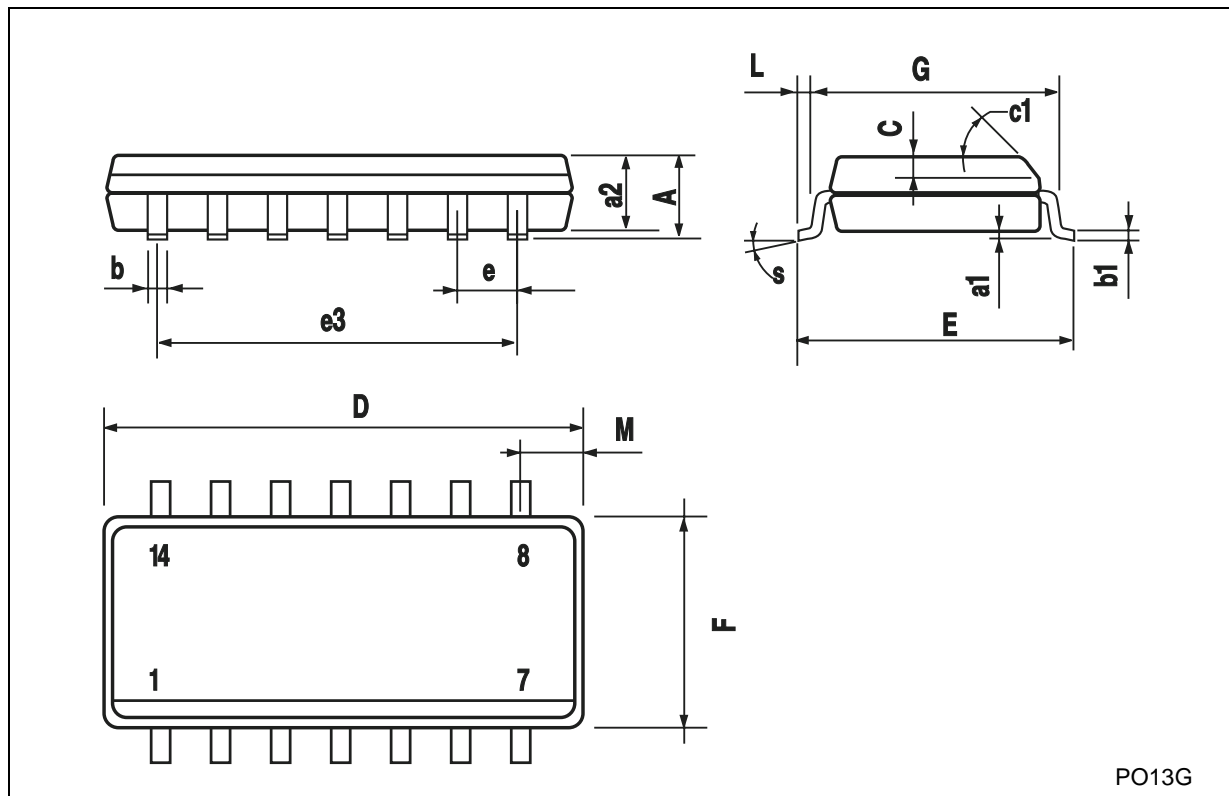
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



P001A

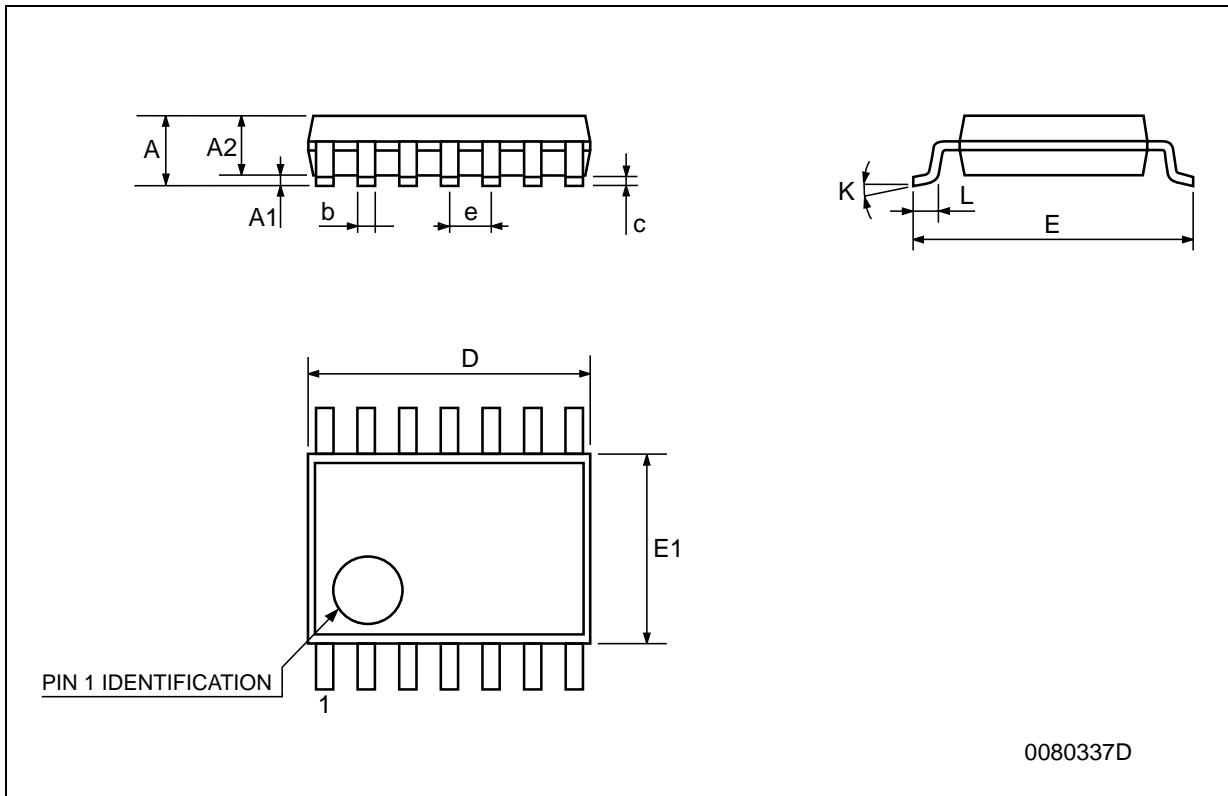
## SO-14 MECHANICAL DATA

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	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
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			0.68			0.026
S	8° (max.)					



**TSSOP14 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			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
c	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
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



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