

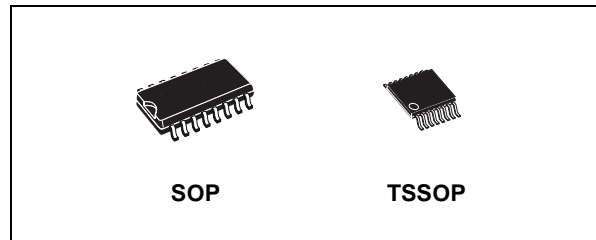


## HEX D-TYPE FLIP FLOP WITH CLEAR

- HIGH SPEED:  
 $f_{MAX} = 150 \text{ MHz (TYP.) at } V_{CC} = 3.3 \text{ V}$
- COMPATIBLE WITH TTL OUTPUTS
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- LOW NOISE:  
 $V_{OLP} = 0.3\text{V (TYP.) at } V_{CC} = 3.3\text{V}$
- $75\Omega$  TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 12\text{mA (MIN) at } V_{CC} = 3.0 \text{ V}$
- PCI BUS LEVELS GUARANTEED AT 24 mA
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2\text{V to } 3.6\text{V (1.2V Data Retention)}$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 174
- IMPROVED LATCH-UP IMMUNITY

### DESCRIPTION

The 74LVQ174 is a low voltage CMOS HEX D-TYPE FLIP FLOP WITH CLEAR NON INVERTING fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS



### ORDER CODES

PACKAGE	TUBE	T & R
SOP	74LVQ174M	74LVQ174MTR
TSSOP		74LVQ174TTR

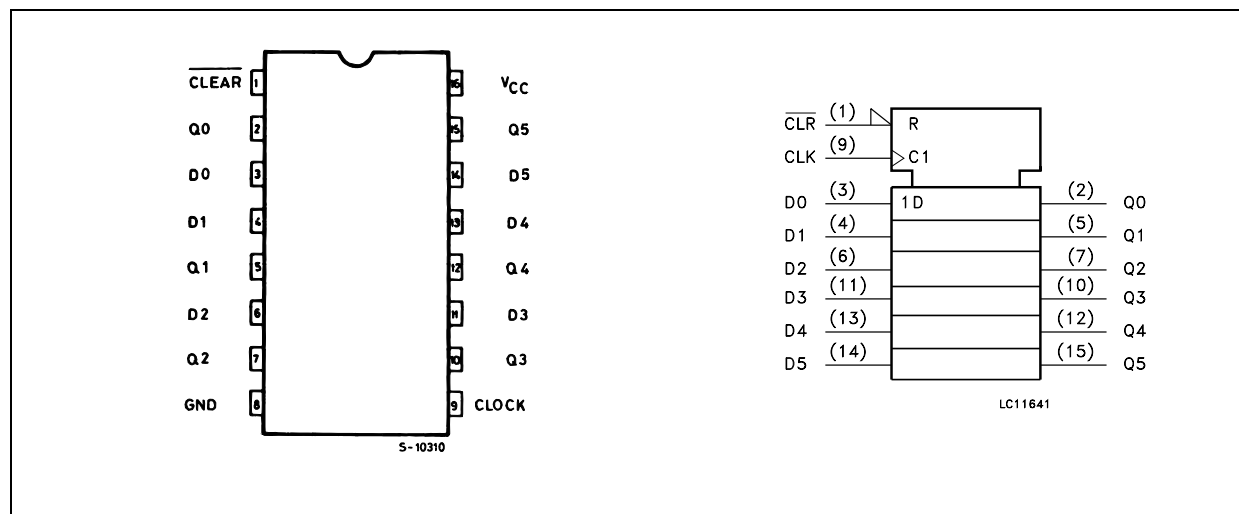
technology. It is ideal for low power and low noise 3.3V applications.

Information signals applied to D inputs are transferred to the Q outputs on the positive going edge of the CLK pulse.

When the CLR input is held low, the Q outputs are held low independently of the other inputs.

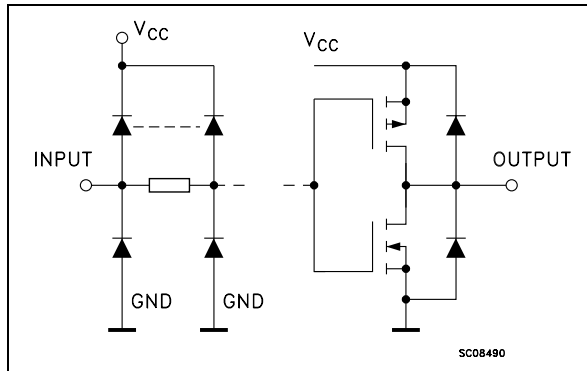
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



# 74LVQ174

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

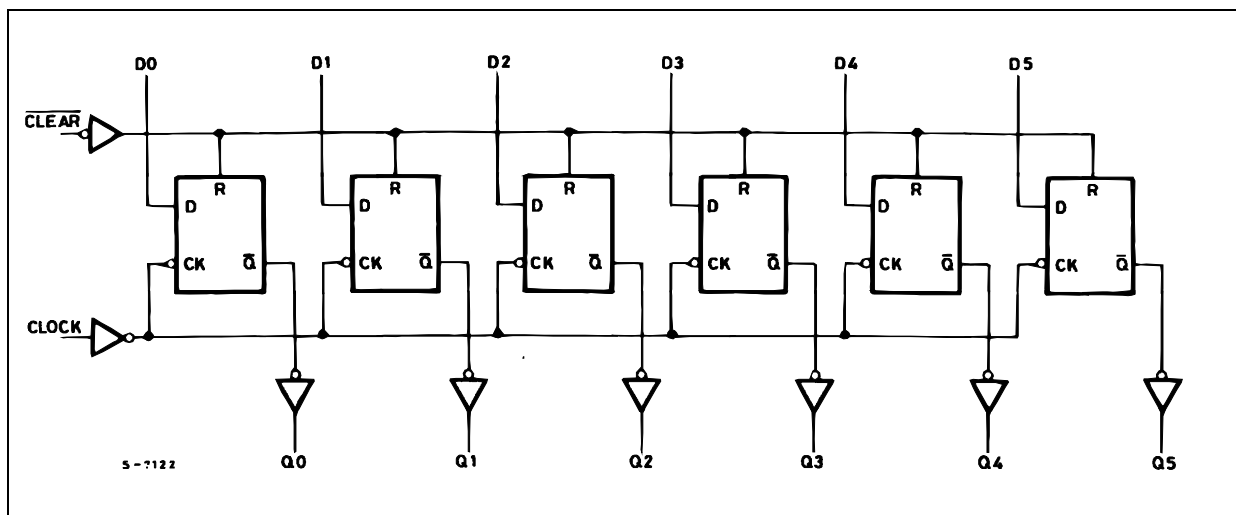
PIN No	SYMBOL	NAME AND FUNCTION
1	$\overline{\text{CLR}}$	Asynchronous Master Reset (Active LOW)
2, 5, 7, 10, 12, 15	Q0 to Q5	Flip-Flop Outputs
3, 4, 6, 11, 13, 14	D0 to D5	Data Inputs
9	CLK	Clock Input (Positive Edge Triggered)
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

## TRUTH TABLE

INPUTS			OUTPUT	FUNCTION
$\overline{\text{CLR}}$	D	CLK	Q	
L	X	X	L	CLEAR
H	L		L	
H	H		H	
H	X		Q <sub>n</sub>	NO CHANGE

X : Don't Care

## LOGIC DIAGRAM



This logic diagram has not to be used to estimate propagation delays

## 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	$\pm 50$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 300$	mA
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}\text{C}$
$T_L$	Lead Temperature (10 sec)	300	$^{\circ}\text{C}$

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

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage (note 1)	2 to 3.6	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	$^{\circ}\text{C}$
dt/dv	Input Rise and Fall Time $V_{CC} = 3.0\text{V}$ (note 2)	0 to 10	ns/V

1) Truth Table guaranteed: 1.2V to 3.6V

2)  $V_{IN}$  from 0.8V to 2V

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value						Unit		
				$V_{CC}$ (V)	$T_A = 25^{\circ}\text{C}$			$-40$ to $85^{\circ}\text{C}$			$-55$ to $125^{\circ}\text{C}$	
					Min.	Typ.	Max.	Min.	Max.		Min.	Max.
$V_{IH}$	High Level Input Voltage	3.0 to 3.6		2.0			2.0		2.0		V	
$V_{IL}$	Low Level Input Voltage				0.8		0.8		0.8		V	
$V_{OH}$	High Level Output Voltage	3.0	$I_O = -50 \mu\text{A}$	2.9	2.99		2.9		2.9		V	
			$I_O = -12 \text{ mA}$	2.58			2.48		2.48			
			$I_O = -24 \text{ mA}$				2.2		2.2			
$V_{OL}$	Low Level Output Voltage	3.0	$I_O = 50 \mu\text{A}$		0.002	0.1		0.1		0.1	V	
			$I_O = 12 \text{ mA}$		0	0.36		0.44		0.44		
			$I_O = 24 \text{ mA}$					0.55		0.55		
$I_I$	Input Leakage Current	3.6	$V_I = V_{CC}$ or GND			$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu\text{A}$	
$I_{CC}$	Quiescent Supply Current	3.6	$V_I = V_{CC}$ or GND			4		40		40	$\mu\text{A}$	
$I_{OLD}$	Dynamic Output Current (note 1, 2)	3.6	$V_{OLD} = 0.8 \text{ V max}$				36		25		mA	
$I_{OHD}$			$V_{OHD} = 2 \text{ V min}$				-25		-25		mA	

1) Maximum test duration 2ms, one output loaded at time

2) Incident wave switching is guaranteed on transmission lines with impedances as low as  $75\Omega$

## DYNAMIC SWITCHING CHARACTERISTICS

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>OLP</sub>	Dynamic Low Voltage Quiet Output (note 1, 2)	3.3	C <sub>L</sub> = 50 pF		0.3	0.8					V
V <sub>OLV</sub>				-0.8	-0.3						
V <sub>IHD</sub>	Dynamic High Voltage Input (note 1, 3)	3.3		2							V
V <sub>ILD</sub>	Dynamic Low Voltage Input (note 1, 3)	3.3				0.8					V

1) Worst case package.

2) Max number of outputs defined as (n). Data inputs are driven 0V to 3.3V, (n-1) outputs switching and one output at GND.

3) Max number of data inputs (n) switching. (n-1) switching 0V to 3.3V. Inputs under test switching: 3.3V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f=1MHz.

AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω, Input t<sub>r</sub> = t<sub>f</sub> = 3ns)

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.
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time CK to Q	2.7			6.7	11.0		12.5		14.5	ns
		3.3(*)			5.5	8.0		9.5		11.0	
t <sub>PHL</sub>	Propagation Delay Time CLR to Q	2.7			8.3	13.5		15.5		18.0	ns
		3.3(*)			7.0	10.0		11.5		13.0	
t <sub>W(L)</sub>	CLR Pulse Width, LOW	2.7		4.0	1.0		4.0		5.0		ns
		3.3(*)		3.0	1.0		3.0		4.0		
t <sub>W</sub>	CLOCK Pulse Width, HIGH or LOW	2.7		4.0	1.0		4.0		5.0		ns
		3.3(*)		3.0	1.0		3.0		4.0		
t <sub>sL</sub> t <sub>sH</sub>	Setup Time D to CK, HIGH or LOW	2.7		4.0	-0.5		4.0		4.0		ns
		3.3(*)		3.0	-0.4		3.0		3.0		
t <sub>hL</sub> t <sub>hH</sub>	Hold Time D to CK, HIGH or LOW	2.7		3.0	0.5		3.0		3.0		ns
		3.3(*)		2.0	0.4		2.0		2.0		
t <sub>REM</sub>	Recovery Time CLR to CK	2.7		3.0	-0.3		3.0		3.0		ns
		3.3(*)		2.0	-0.3		2.0		2.0		
f <sub>MAX</sub>	Maximum Clock Frequency	2.7		60	150		50		50		MHz
		3.3(*)		90	150		70		70		
t <sub>OSLH</sub> t <sub>OSHL</sub>	Output To Output Skew Time (note1, 2)	2.7			0.5	1.0		1.0		1.0	ns
		3.3(*)			0.5	1.0		1.0		1.0	

1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW (t<sub>OSLH</sub> = |t<sub>PLHm</sub> - t<sub>PLHn</sub>|, t<sub>OSHL</sub> = |t<sub>PHLm</sub> - t<sub>PHLn</sub>|)

2) Parameter guaranteed by design

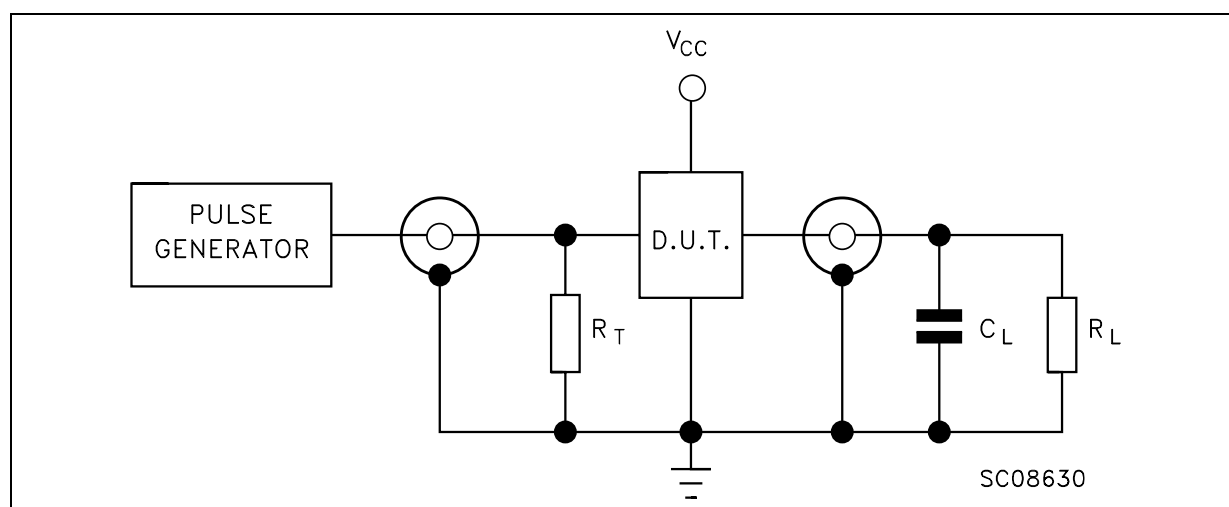
(\*) Voltage range is 3.3V ± 0.3V

## CAPACITIVE CHARACTERISTICS

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.
C <sub>IN</sub>	Input Capacitance	3.3			4						pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	3.3	f <sub>IN</sub> = 10MHz		23						pF

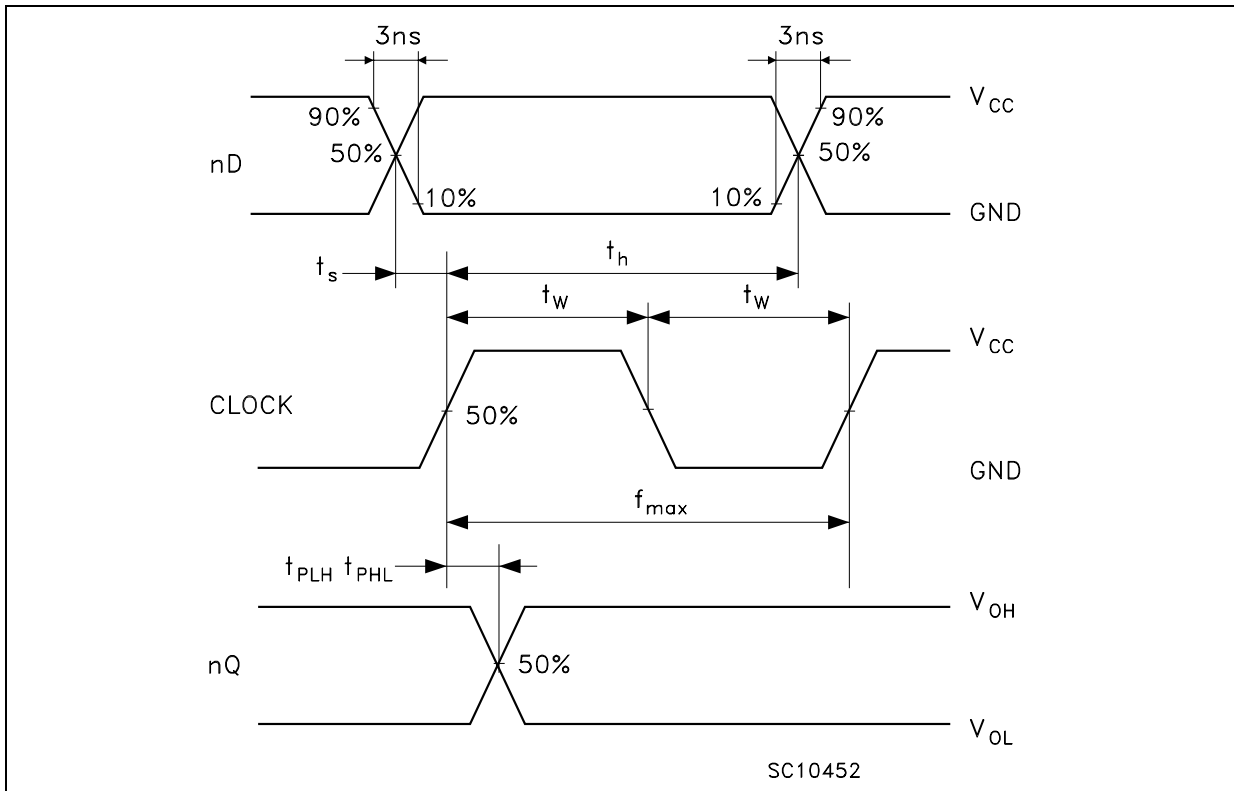
1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6$  (per flip flop)

## TEST CIRCUIT

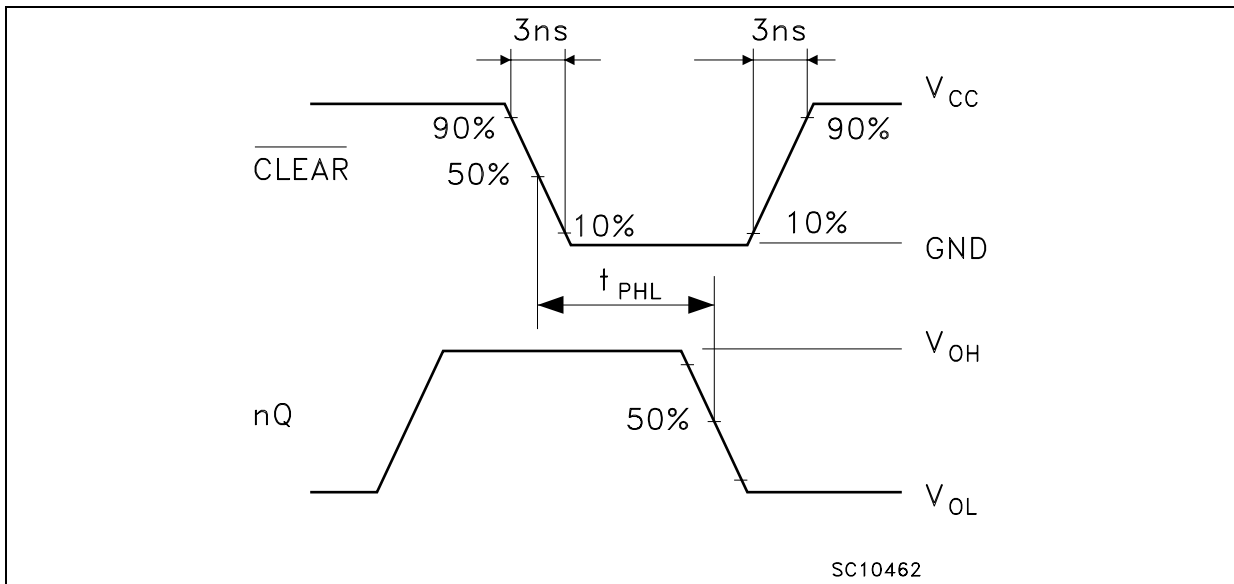


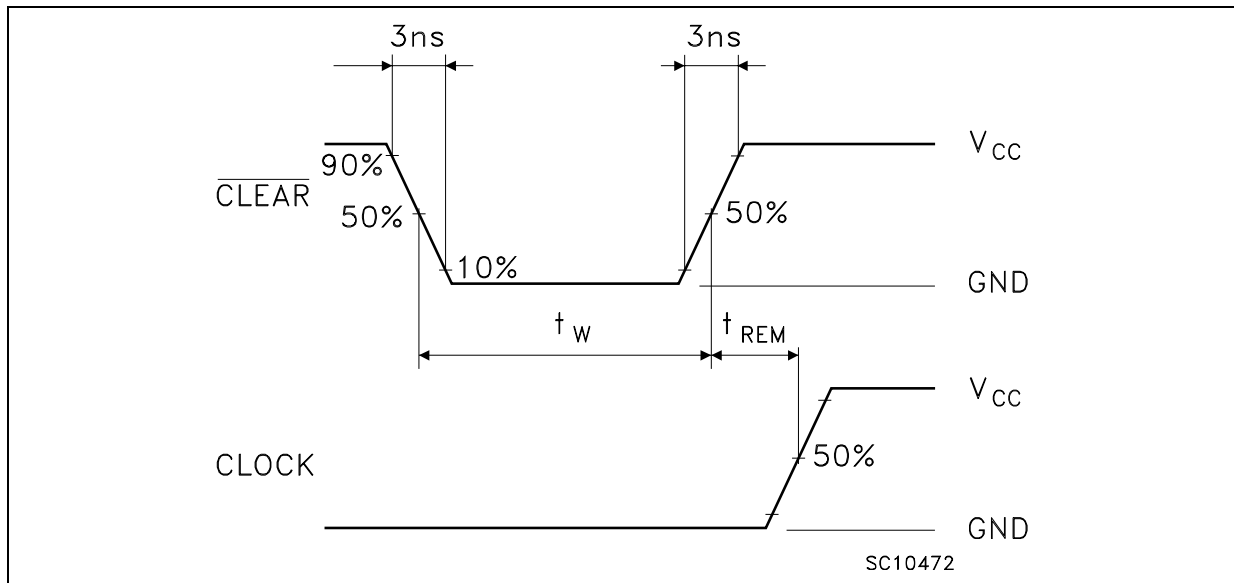
C<sub>L</sub> = 50pF or equivalent (includes jig and probe capacitance)  
R<sub>L</sub> = R<sub>1</sub> = 500Ω or equivalent  
R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAYS , SETUP AND HOLD TIMES , CLOCK PULSE WIDTH**  
 (f=1MHz; 50% duty cycle)



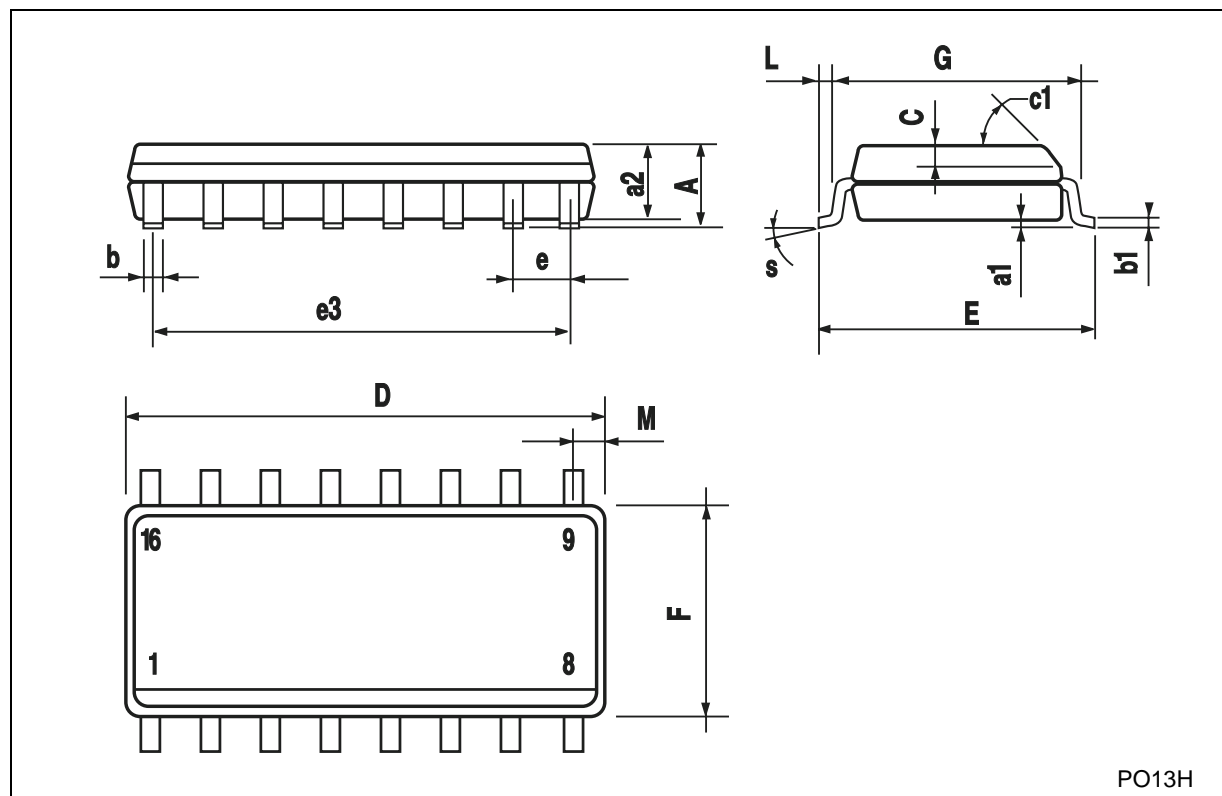
**WAVEFORM 2: PROPAGATION DELAYS** (f=1MHz; 50% duty cycle)



**WAVEFORM 3: RECOVERY TIME,  $\overline{\text{CLEAR}}$  PULSE WIDTH** (f=1MHz; 50% duty cycle)

## 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.)					

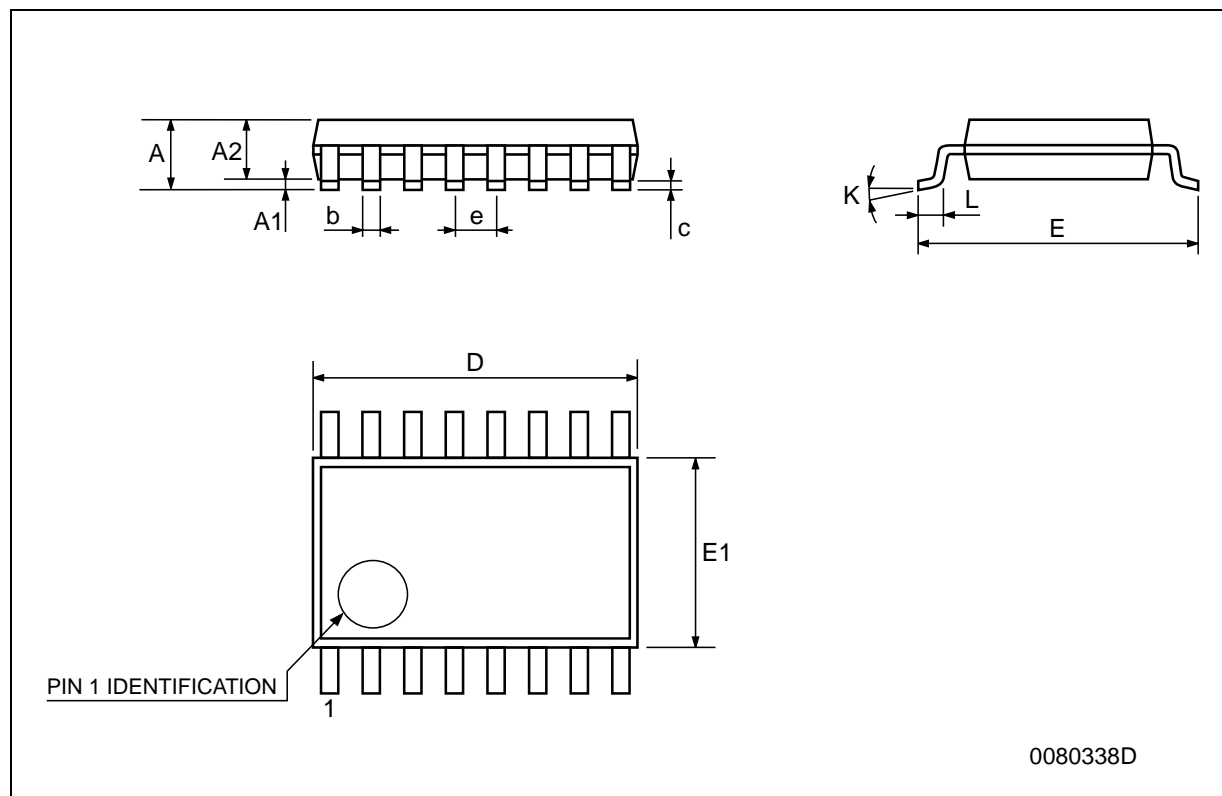


PO13H



## TSSOP16 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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