

LOW VOLTAGE CMOS HEX D-TYPE FLIP-FLOP WITH CLEAR WITH 5V TOLERANT INPUTS

- HIGH SPEED:
 $f_{MAX} = 180\text{MHz (TYP.) at } V_{CC} = 3.3\text{V}$
- 5V TOLERANT INPUTS
- INPUT VOLTAGE LEVEL:
 $V_{IL}=0.8\text{V, } V_{IH}=2\text{V at } V_{CC}=3\text{V}$
- LOW POWER DISSIPATION:
 $I_{CC} = 4 \mu\text{A (MAX.) at } T_A=25^\circ\text{C}$
- LOW NOISE:
 $V_{OLP} = 0.3\text{V (TYP.) at } V_{CC} = 3.3\text{V}$
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 4\text{mA (MIN)}$
- 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
- POWER DOWN PROTECTION ON INPUTS

DESCRIPTION

The 74LVX174 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 C²MOS technology. It is ideal for low power, battery operated and low noise 3.3V applications.

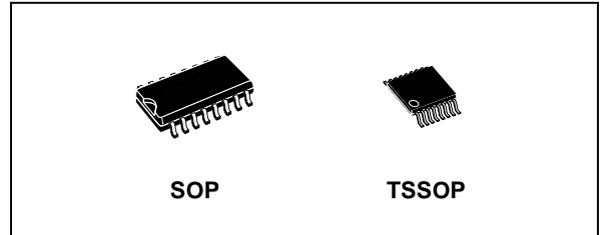


Table 1: Order Codes

PACKAGE	T & R
SOP	74LVX174MTR
TSSOP	74LVX174TTR

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

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

Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage.

This device can be used to interface 5V to 3V system. It combines high speed performance with the true CMOS low power consumption.

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

Figure 1: Pin Connection And IEC Logic Symbols

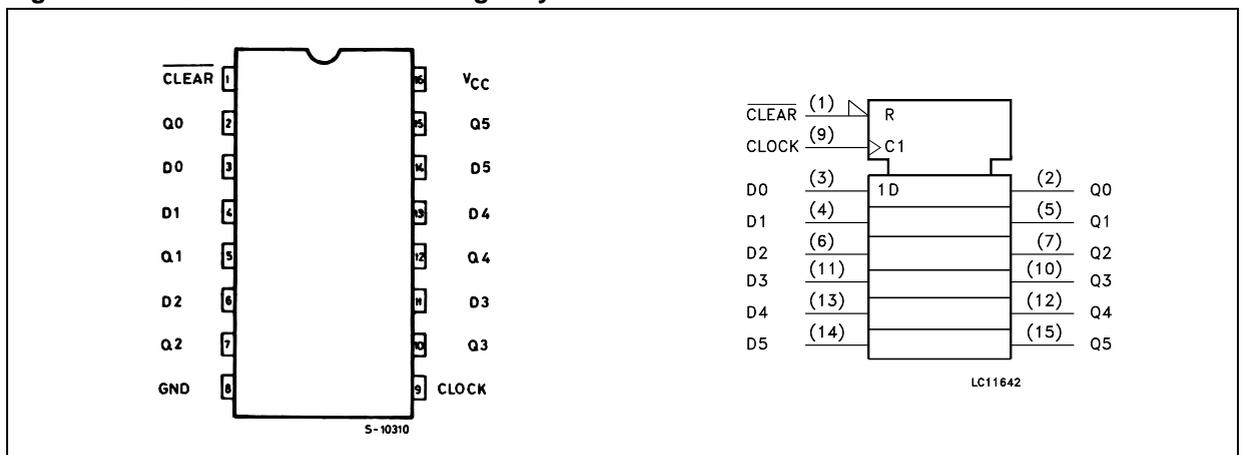


Figure 2: Input Equivalent Circuit

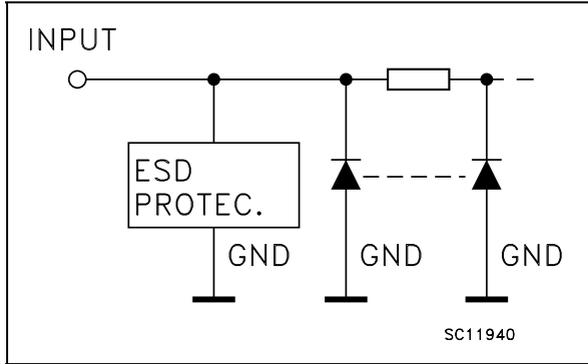


Table 2: Pin Description

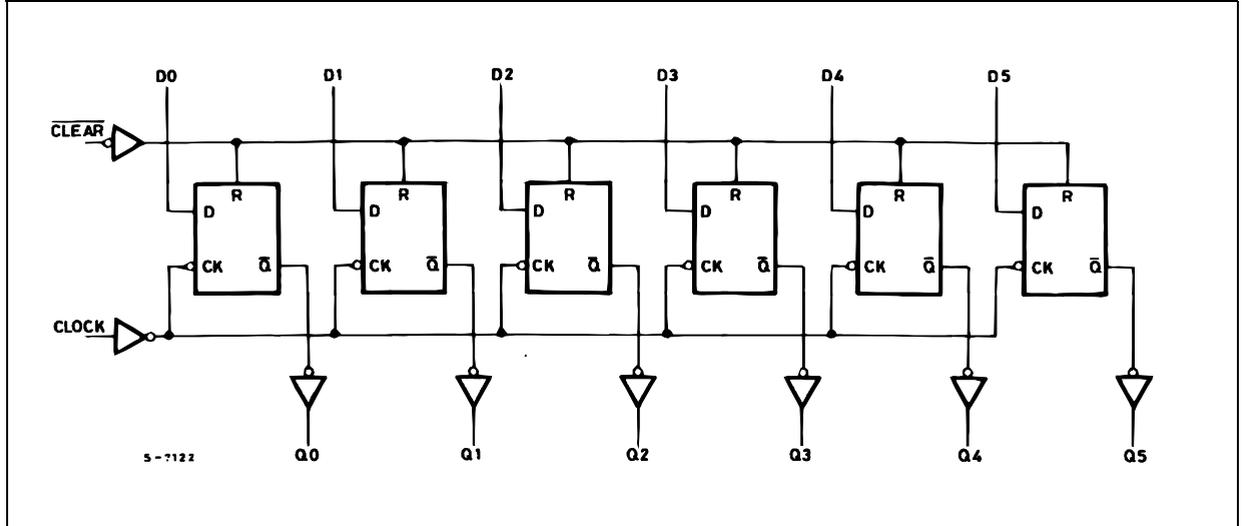
PIN N°	SYMBOL	NAME AND FUNCTION
1	CLEAR	Asynchronous Master Reset (Active LOW)
2, 5, 7, 10, 12, 15	Q0 to Q5	Flip-Flop Outputs
3, 4, 6, 11, 13, 14	D0 to D5	Data Inputs
9	CLOCK	Clock Input (LOW-to-HIGH, Edge Triggered)
8	GND	Ground (0V)
16	V _{CC}	Positive Supply Voltage

Table 3: Truth Table

INPUTS			OUTPUTS	FUNCTION
$\overline{\text{CLEAR}}$	D	CLOCK	Q	
L	X	X	L	CLEAR
H	L		L	
H	H		H	
H	X		Q _n	NO CHANGE

X : Don't Care

Figure 3: Logic Diagram



This logic diagram has not be used to estimate propagation delays

Table 4: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7.0	V
V_I	DC Input Voltage	-0.5 to +7.0	V
V_O	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
I_{IK}	DC Input Diode Current	- 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Current	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
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.

Table 5: Recommended Operating Conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage (note 1)	2 to 3.6	V
V_I	Input Voltage	0 to 5.5	V
V_O	Output Voltage	0 to V_{CC}	V
T_{op}	Operating Temperature	-55 to 125	°C
dt/dv	Input Rise and Fall Time (note 2) ($V_{CC} = 3.3V$)	0 to 100	ns/V

1) Truth Table guaranteed: 1.2V to 3.6V

2) V_{IN} from 0.8V to 2.0V

Table 6: DC Specifications

Symbol	Parameter	Test Condition		Value						Unit	
				$T_A = 25^\circ\text{C}$			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V_{IH}	High Level Input Voltage	V_{CC} (V)		1.5			1.5		1.5		V
				2.0			2.0		2.0		
				2.4			2.4		2.4		
V_{IL}	Low Level Input Voltage	V_{CC} (V)				0.5		0.5		0.5	V
						0.8		0.8		0.8	
						0.8		0.8		0.8	
V_{OH}	High Level Output Voltage	V_{CC} (V)	$I_O = -50 \mu\text{A}$	1.9	2.0		1.9		1.9		V
			$I_O = -50 \mu\text{A}$	2.9	3.0		2.9		2.9		
			$I_O = -4 \text{ mA}$	2.58			2.48		2.4		
V_{OL}	Low Level Output Voltage	V_{CC} (V)	$I_O = 50 \mu\text{A}$		0.0	0.1		0.1		0.1	V
			$I_O = 50 \mu\text{A}$		0.0	0.1		0.1		0.1	
			$I_O = 4 \text{ mA}$			0.36		0.44		0.55	
I_I	Input Leakage Current	3.6	$V_I = 5V$ or GND			± 0.1		± 1		± 1	μA
I_{CC}	Quiescent Supply Current	3.6	$V_I = V_{CC}$ or GND			4		40		40	μA

Table 7: Dynamic Switching Characteristics

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V _{OLP}	Dynamic Low Voltage Quiet Output (note 1, 2)	3.3	C _L = 50 pF		0.3	0.8					V
V _{OLV}				-0.8	-0.3						
V _{IHD}	Dynamic High Voltage Input (note 1, 3)	3.3		2							
V _{ILD}	Dynamic Low Voltage Input (note 1, 3)	3.3				0.8					

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_{ILD}), 0V to threshold (V_{IHD}), f=1MHz.

Table 8: AC Electrical Characteristics (Input t_r = t_f = 3ns)

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)	C _L (pF)	T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t _{PLH} t _{PHL}	Propagation Delay Time CLOCK to Q	2.7	15		7.6	14.5	1.0	17.5	1.0	18.5	ns
		2.7	50		10.1	18.0	1.0	21.0	1.0	22.0	
		3.3(*)	15		5.9	9.3	1.0	11.0	1.0	12.0	
		3.3(*)	50		8.4	12.8	1.0	14.5	1.0	15.5	
t _{PLH} t _{PHL}	Propagation Delay Time CLEAR to Q	2.7	15		7.9	15.0	1.0	18.5	1.0	19.5	ns
		2.7	50		10.4	18.5	1.0	22.0	1.0	23.0	
		3.3(*)	15		6.2	9.7	1.0	11.5	1.0	12.5	
		3.3(*)	50		8.7	13.2	1.0	15.0	1.0	16.0	
t _{WL}	CLEAR pulse Width, HIGH	2.7			6.5			7.5		7.5	ns
		3.3(*)			5.0			5.0		5.0	
t _W	CLOCK pulse Width	2.7			6.5			7.5		7.5	ns
		3.3(*)			5.0			5.0		5.0	
t _S	Setup Time Q to CLOCK HIGH or LOW	2.7			7.5			8.5		8.5	ns
		3.3(*)			5.0			6.0		6.0	
t _h	Hold Time Q to CLOCK HIGH or LOW	2.7			0.0			0.0		0.0	ns
		3.3(*)			0.0			0.0		0.0	
t _{REM}	Recovery Time CLEAR to Q	2.7			4.5			4.5			ns
		3.3(*)			3.0			3.0			
f _{MAX}	Maximum Clock Frequency	2.7	15		65	130		55			MHz
		2.7	50		45	60		40			
		3.3(*)	15		115	180		95			
		3.3(*)	50		65	95		55			
t _{OSLH} t _{OSHL}	Output To Output Skew Time (note 1, 2)	2.7	50		0.5	1.0		1.5		1.5	ns
		3.3(*)	50		0.5	1.0		1.5		1.5	

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

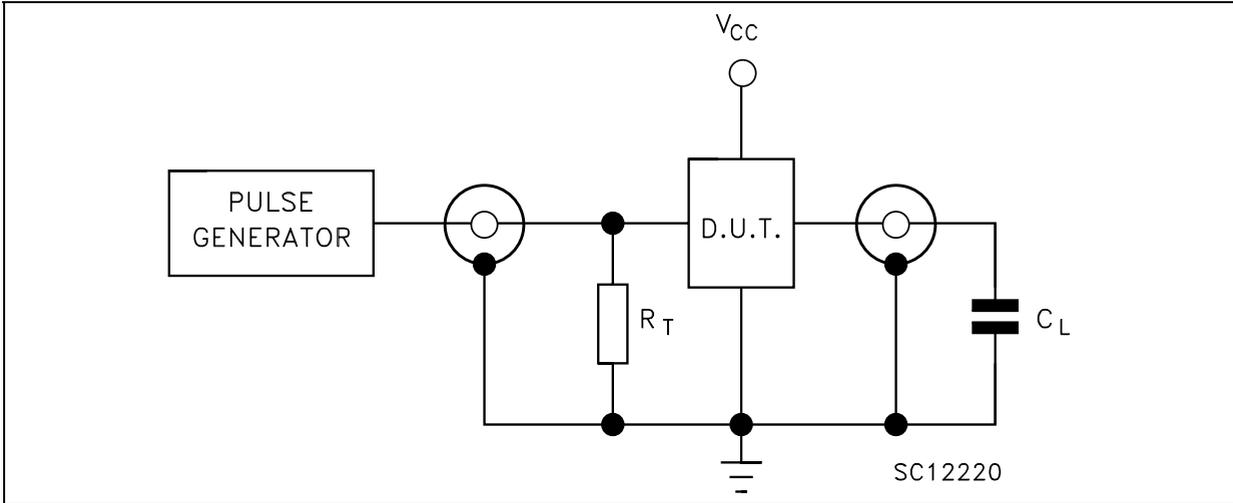
2) Parameter guaranteed by design (*) Voltage range is 3.3V ± 0.3V

Table 9: Capacitive Characteristics

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C _{IN}	Input Capacitance	3.3			5			10		10	pF
C _{PD}	Power Dissipation Capacitance (note 1)	3.3	f _{IN} = 10MHz		23						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} × V_{CC} × f_{IN} + I_{CC}/n (per circuit)

Figure 4: Test Circuit



C_L = 15/50pF or equivalent (includes jig and probe capacitance)
 R_T = Z_{OUT} of pulse generator (typically 50Ω)

Figure 5: Waveform - Propagation Delays (f=1MHz; 50% duty cycle)

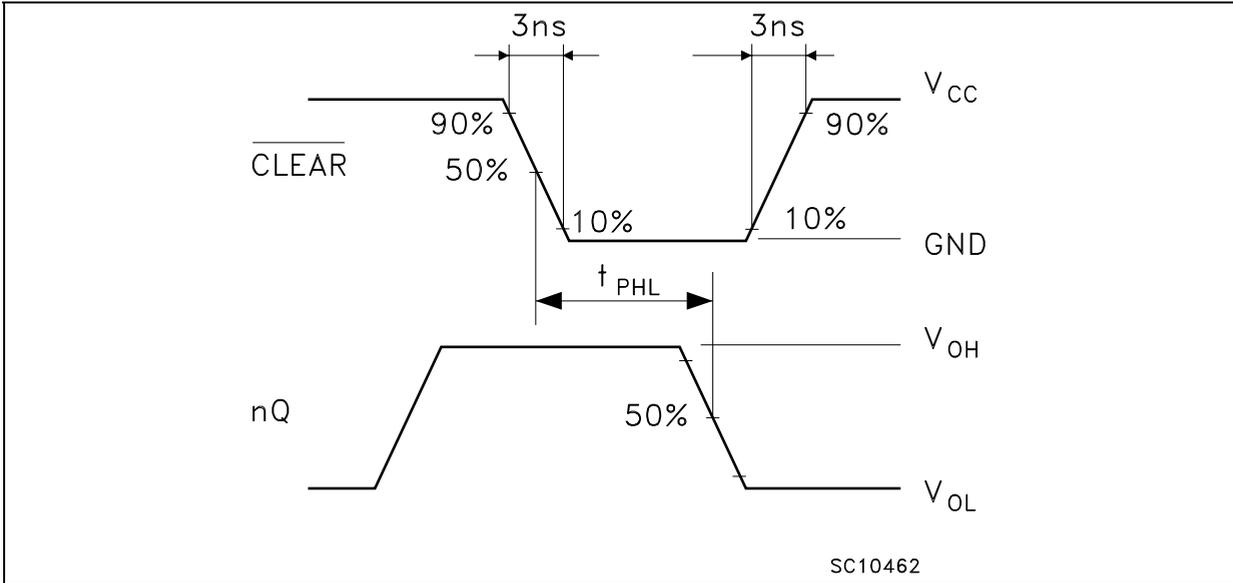
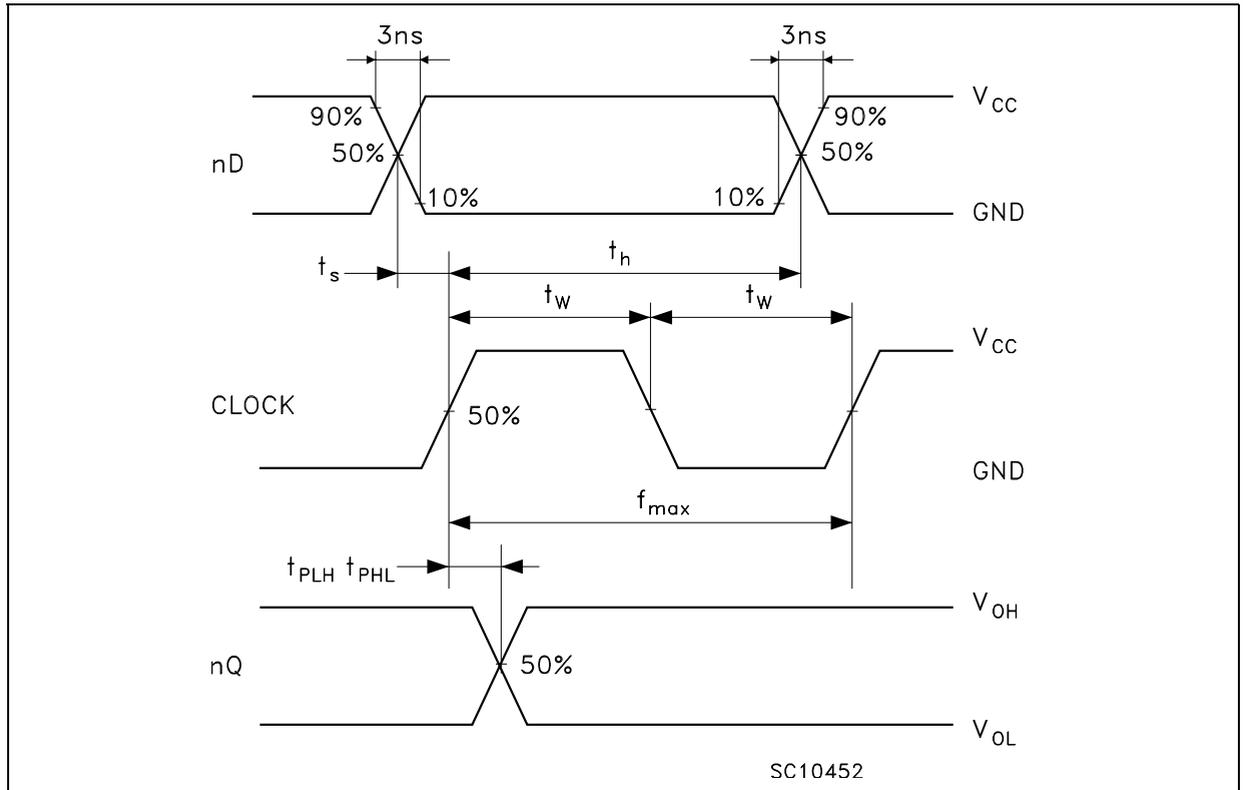
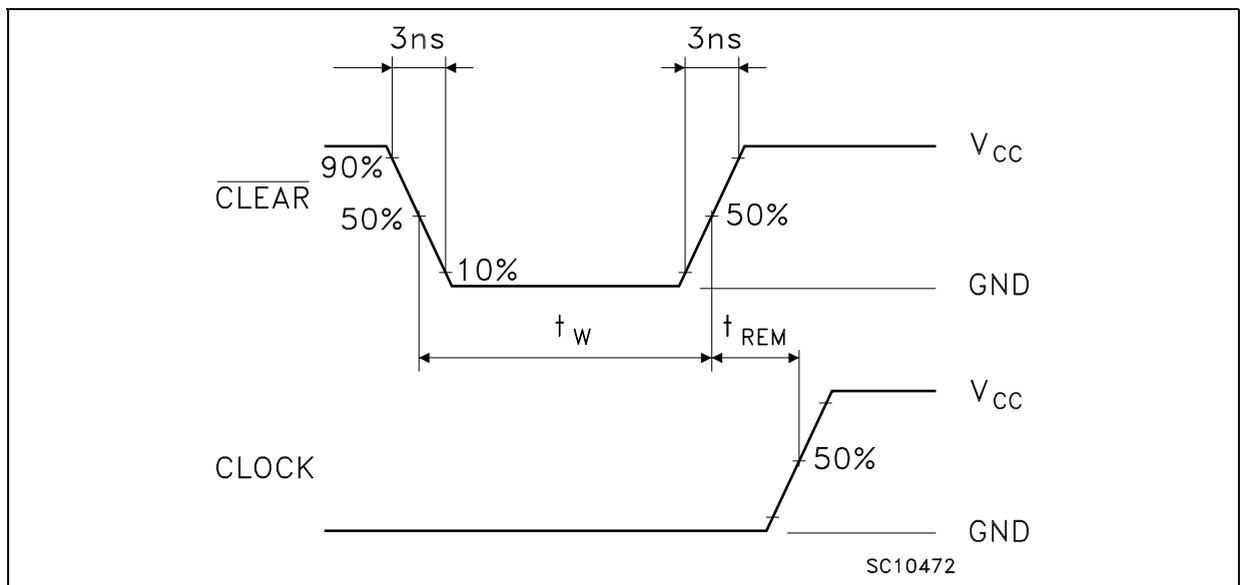
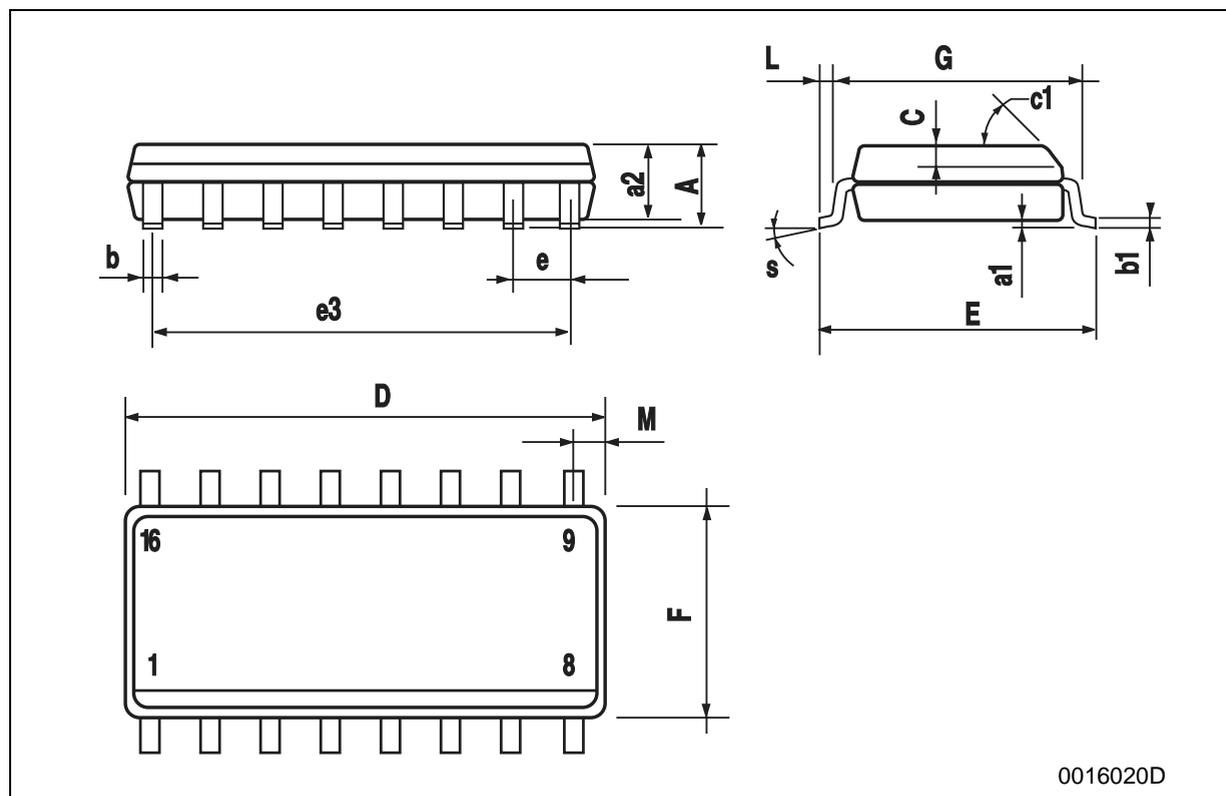


Figure 6: Waveform - Propagation Delays, Setup And Hold Times ($f=1\text{MHz}$; 50% duty cycle)Figure 7: Waveform - Recovery Time, Minimum Pulse Width ($f=1\text{MHz}$; 50% duty cycle)

SO-16 MECHANICAL DATA

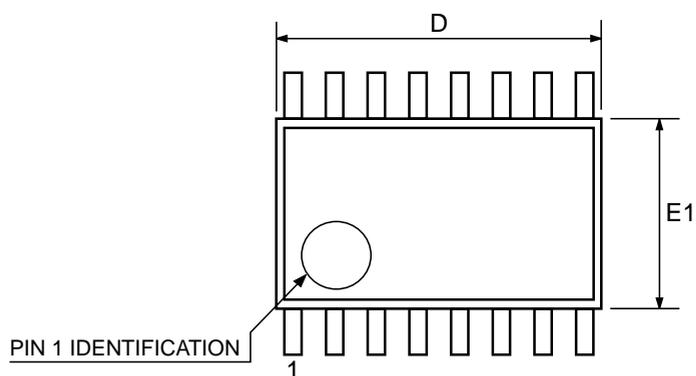
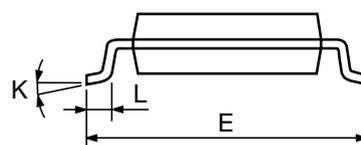
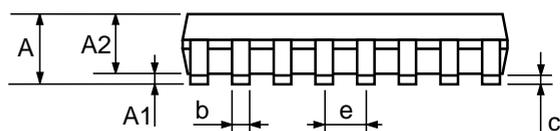
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.25	0.004		0.010
a2			1.64			0.063
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
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.)					



0016020D

TSSOP16 MECHANICAL DATA

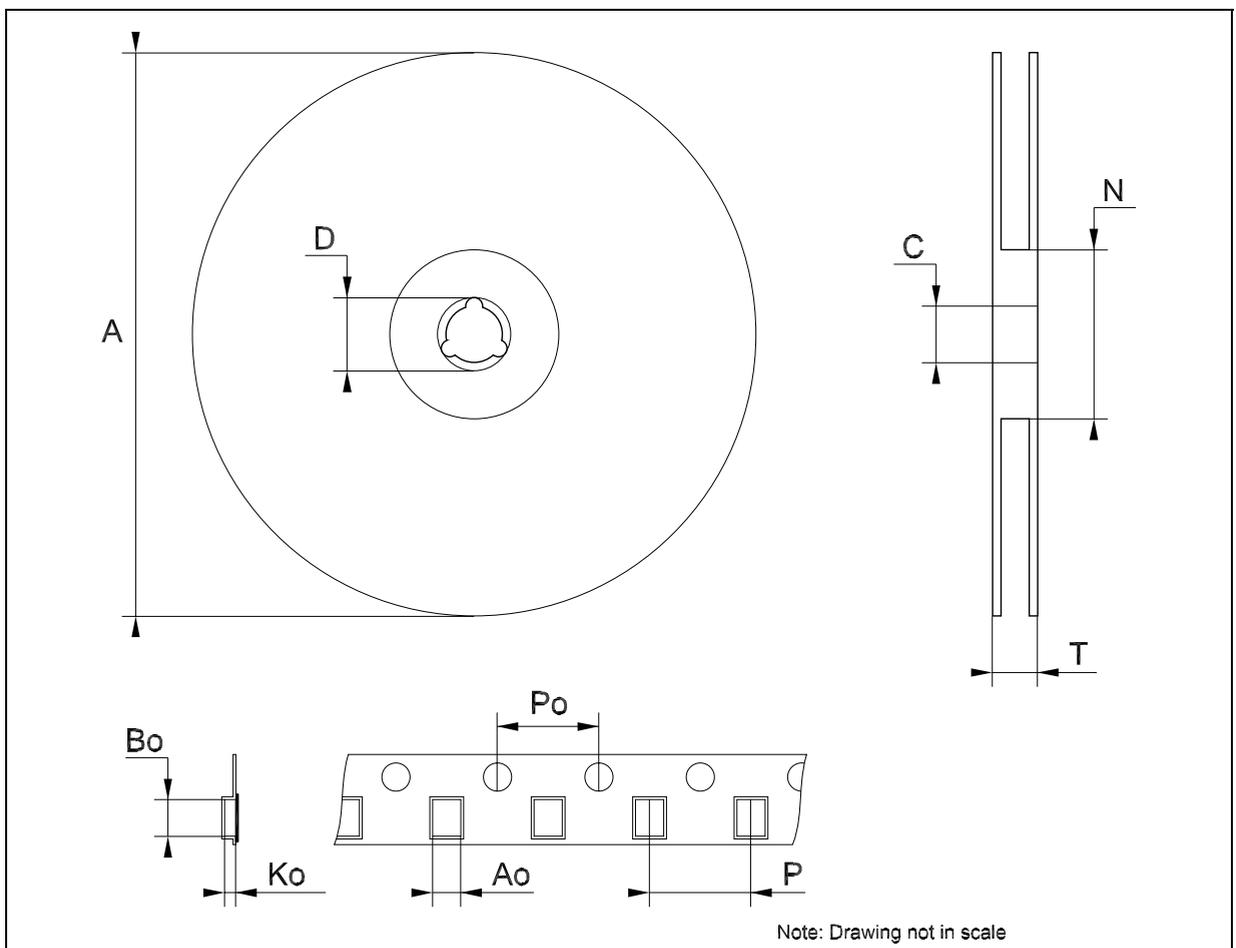
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



0080338D

Tape & Reel SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Tape & Reel TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.7		6.9	0.264		0.272
Bo	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319

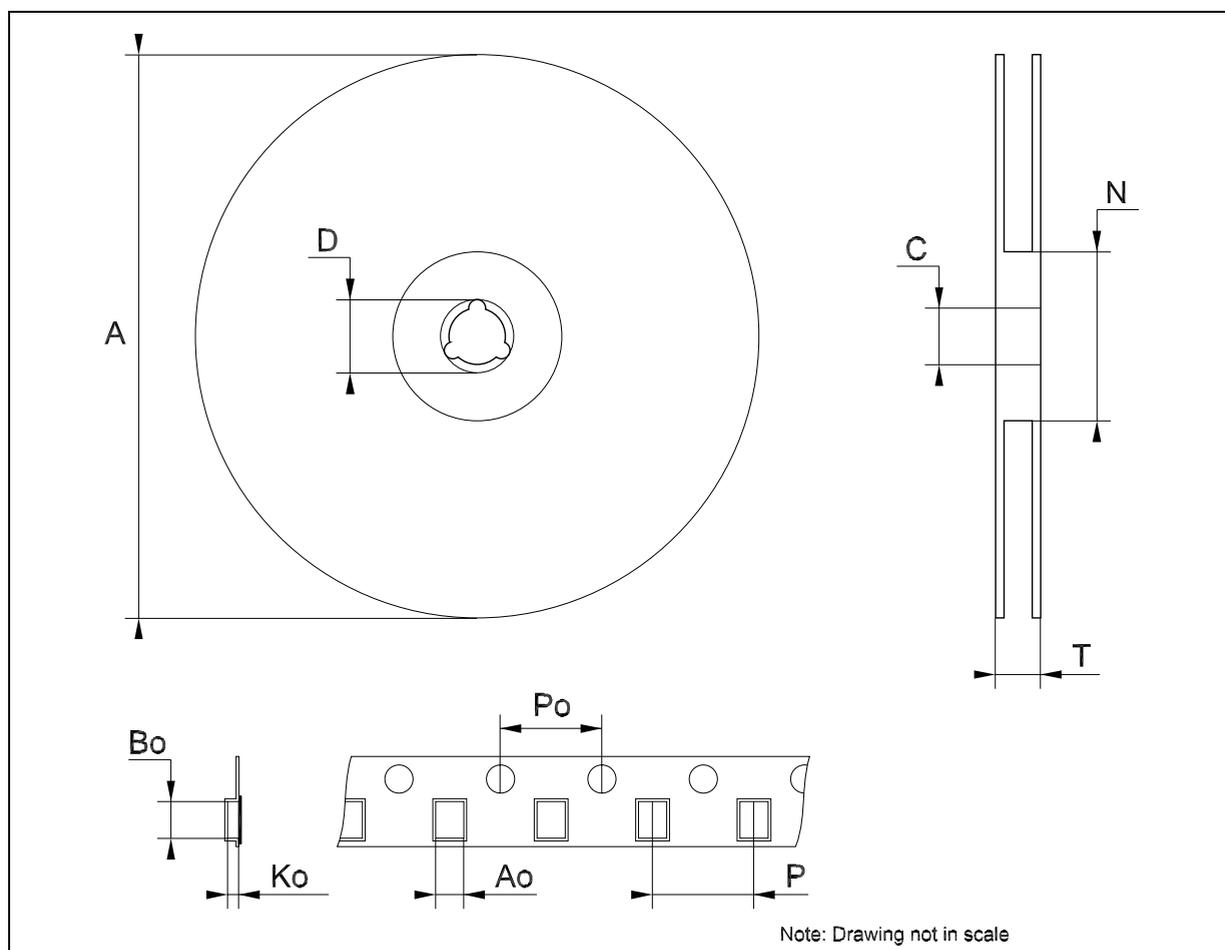


Table 10: Revision History

Date	Revision	Description of Changes
27-Aug-2004	3	Ordering Codes Revision - pag. 1.

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