

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:
 $V_{OLP} = 0.3\text{V (TYP.) at } V_{CC} = 3.3\text{V}$
- 75Ω 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

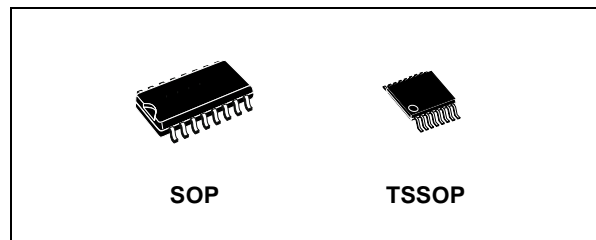


Table 1: Order Codes

PACKAGE	T & R
SOP	74LVQ174MTR
TSSOP	74LVQ174TTR

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 C²MOS

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.

Figure 1: Pin Connection And IEC Logic Symbols

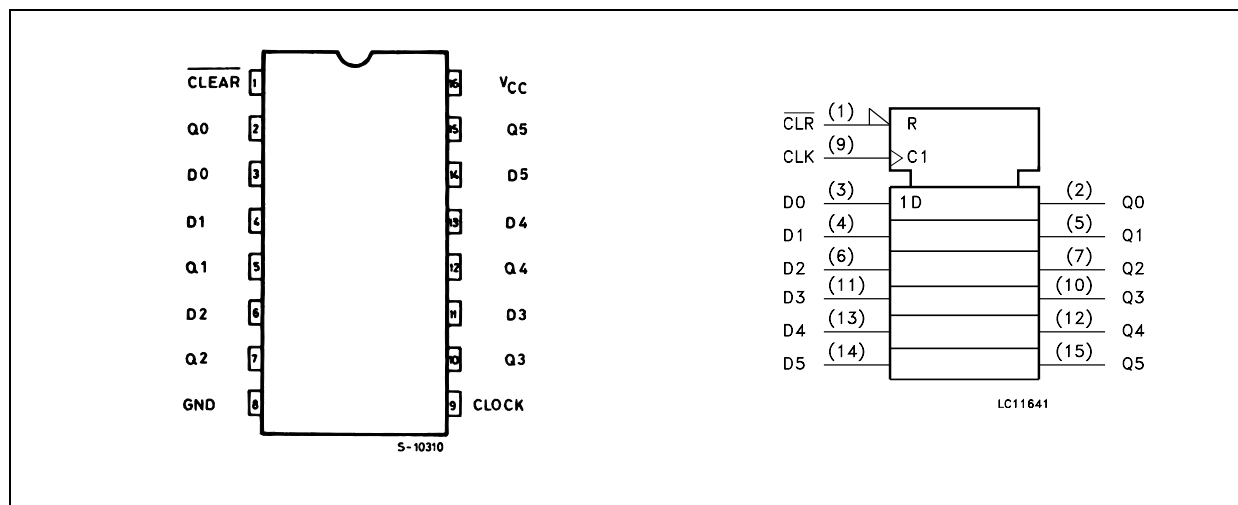


Figure 2: Input And Output Equivalent Circuit

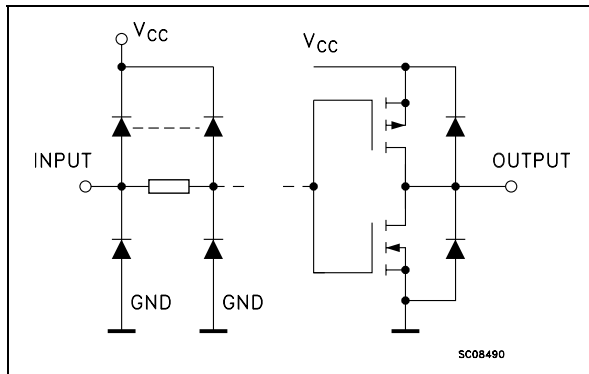


Table 2: Pin Description

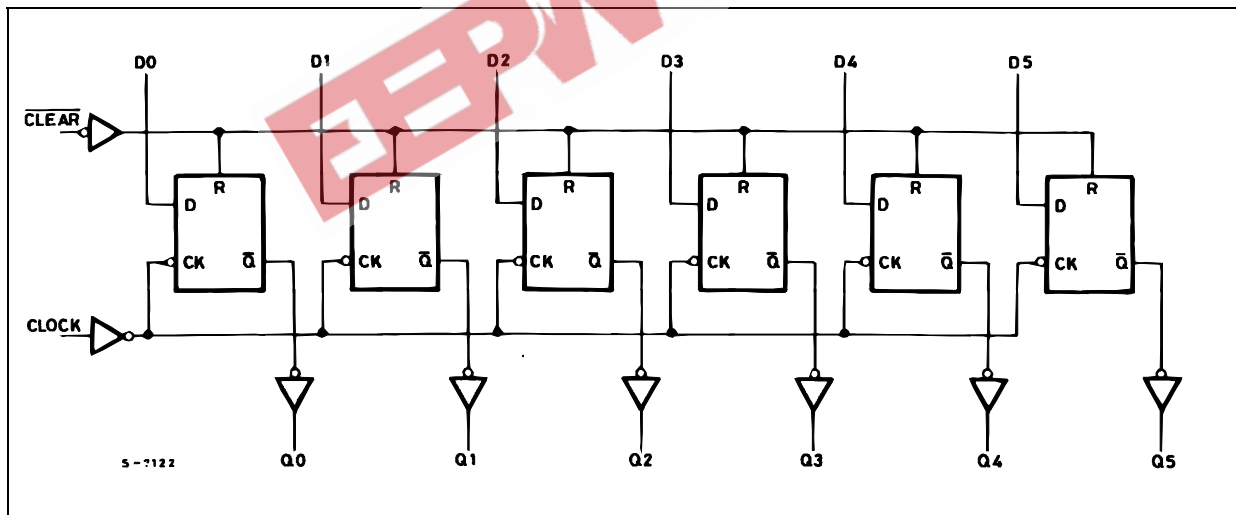
PIN N°	SYMBOL	NAME AND FUNCTION
1	CLR	Asynchronous Master Reset (Active LOW)
2, 5, 7, 10, 12, 15	Q0 to Q5	Flip-Flop Outputs
3, 4, 6, 11, 13, 14	D0 to D5	Data Inputs
9	CLK	Clock Input (Positive Edge Triggered)
8	GND	Ground (0V)
16	V _{CC}	Positive Supply Voltage

Table 3: Truth Table

INPUTS			OUTPUT	FUNCTION
CLR	D	CLK	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 to be used to estimate propagation delays

Table 4: 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	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Current	± 50	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 300	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 V_{CC}	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 $V_{CC} = 3.0V$ (note 2)	0 to 10	ns/V

1) Truth Table guaranteed: 1.2V to 3.6V

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

Table 6: DC Specifications

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

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

Table 8: AC Electrical Characteristics (C_L = 50 pF, R_L = 500 Ω, Input t_r = t_f = 3ns)

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.
t _{PLH} t _{PHL}	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 _{PHL}	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 _{W(L)}	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 _W	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 _{sL} t _{sH}	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 _{hL} t _{hH}	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 _{REM}	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 _{MAX}	Maximum Clock Frequency	2.7		60	150		50		50	MHz	
		3.3(*)		90	150		70		70		
t _{OSLH} t _{OSHL}	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_{OSLH} = |t_{PLHm} - t_{PLHn}|, t_{OSHL} = |t_{PHLm} - t_{PHLn}|)

2) Parameter guaranteed by design

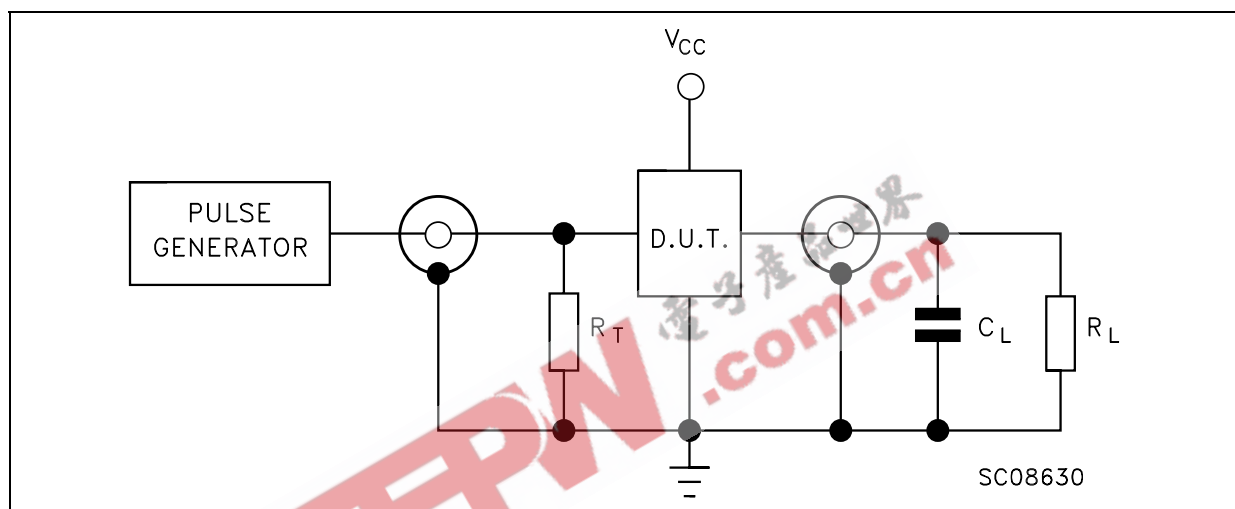
(*) Voltage range is 3.3V ± 0.3V

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			4						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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6$ (per flip flop)

Figure 4: Test Circuit



C_L = 50pF or equivalent (includes jig and probe capacitance)
 R_L = R₁ = 500Ω or equivalent
 R_T = Z_{OUT} of pulse generator (typically 50Ω)

Figure 5: Waveform - Propagation Delays, Setup And Hold Times, Clock Pulse Width ($f=1\text{MHz}$; 50% duty cycle)

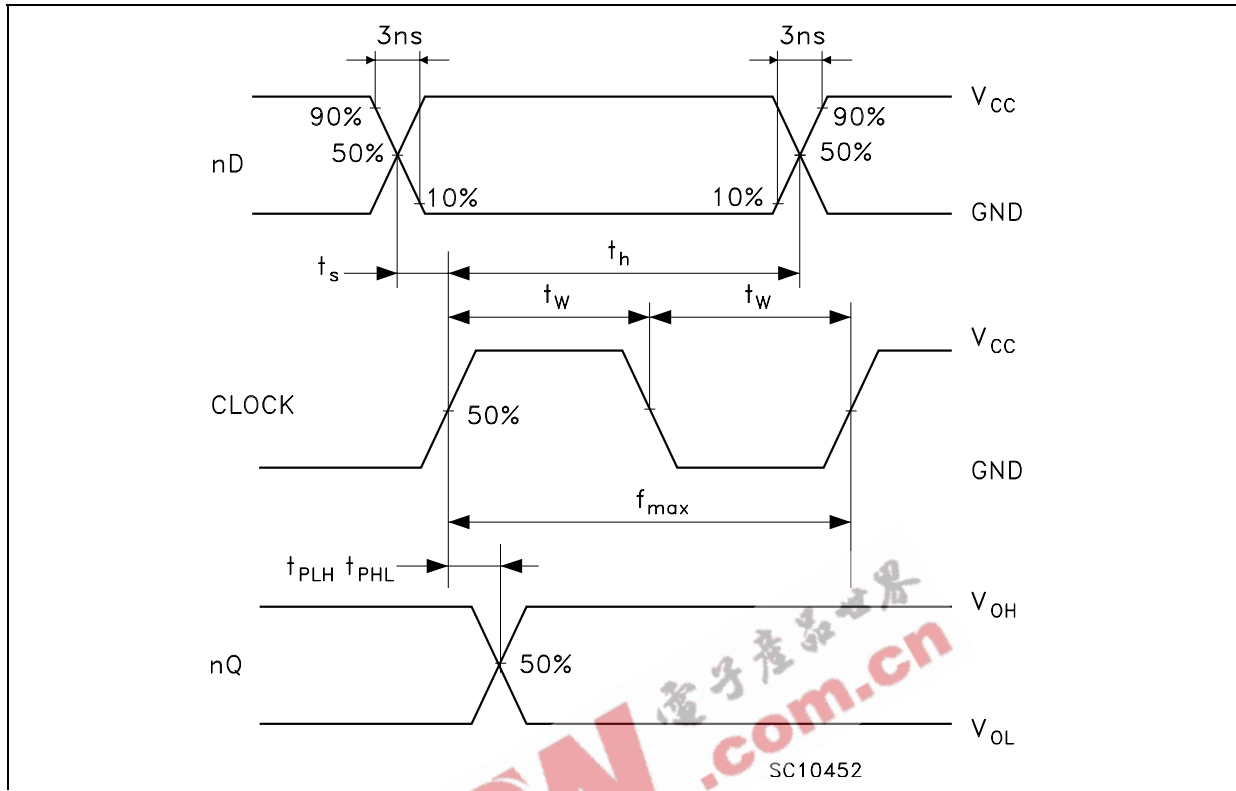


Figure 6: Waveform - Propagation Delays ($f=1\text{MHz}$; 50% duty cycle)

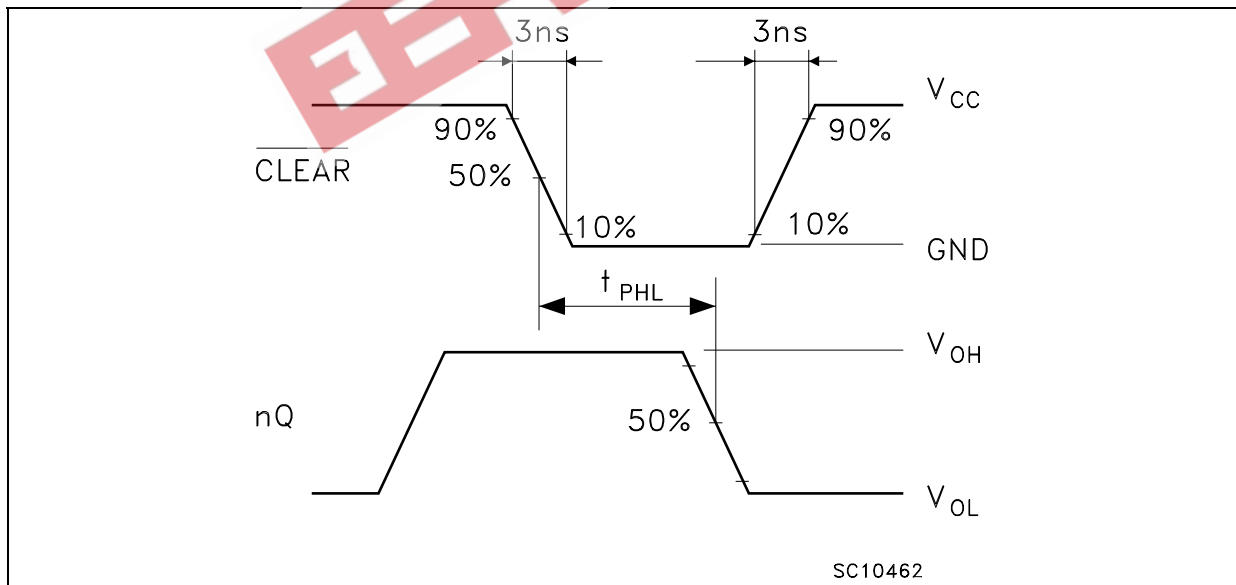
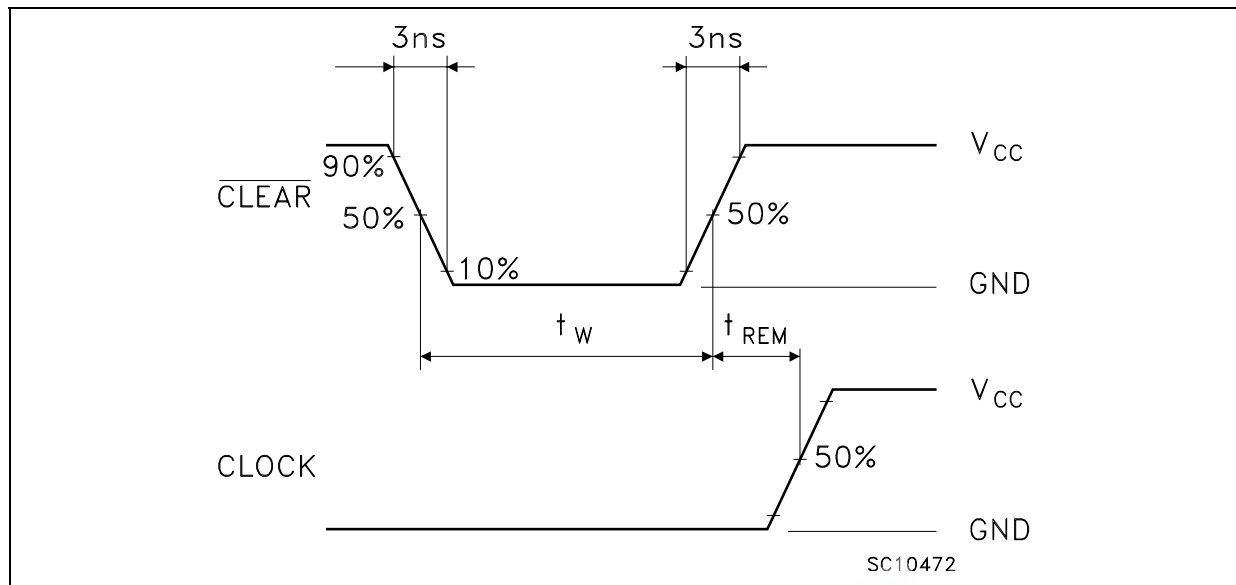
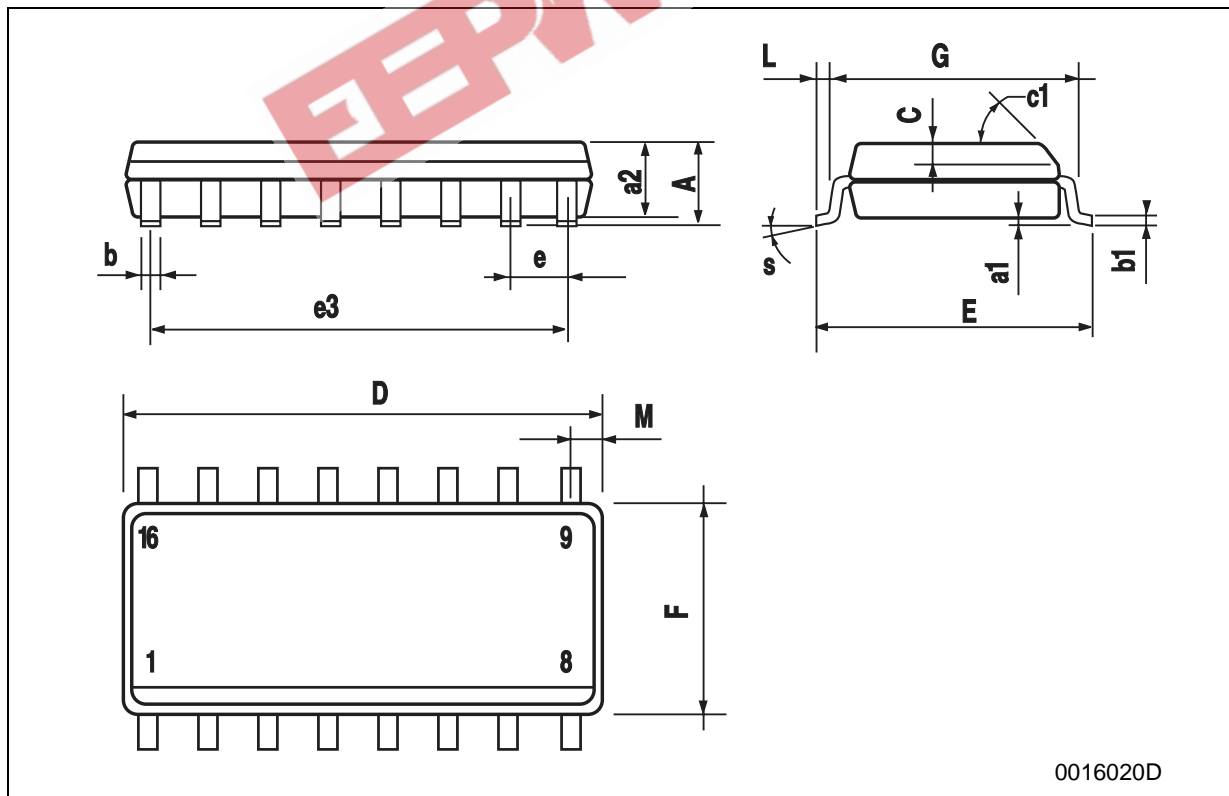


Figure 7: Waveform - Recovery Time, $\overline{\text{CLEAR}}$ Pulse Width ($f=1\text{MHz}$; 50% duty cycle)

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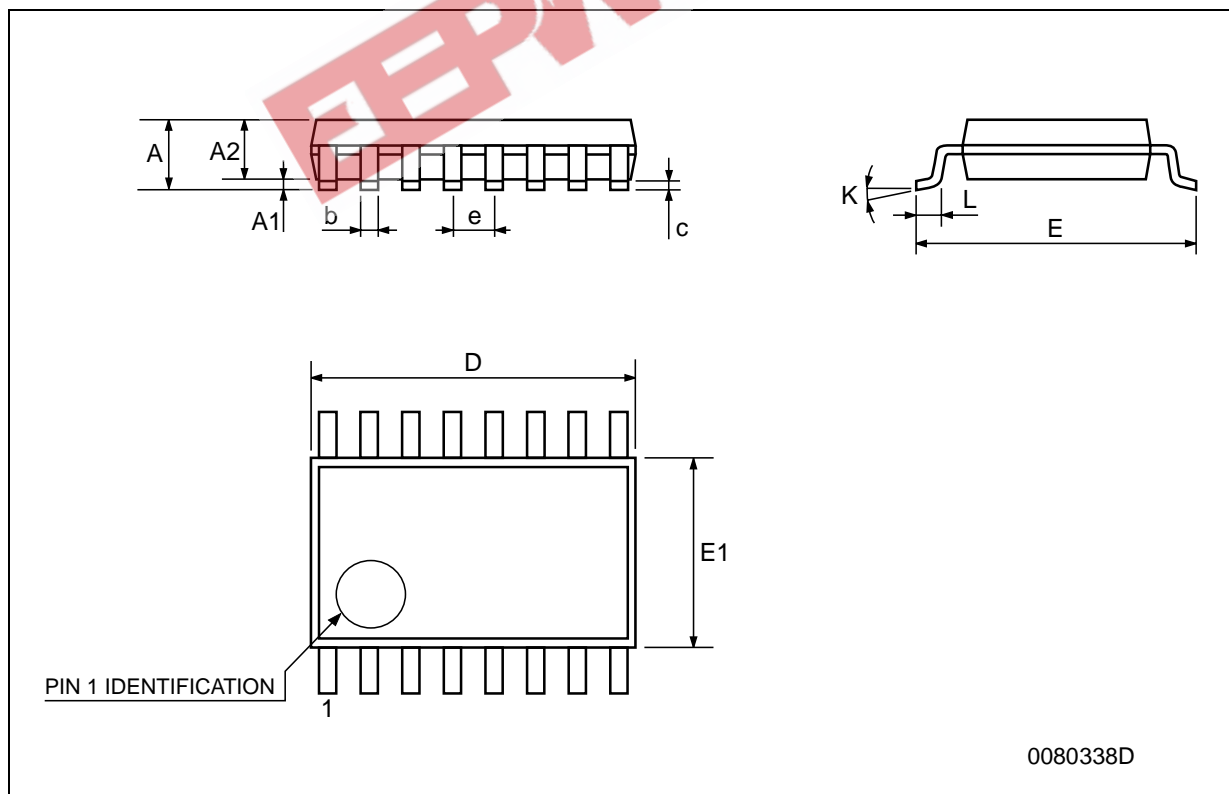
SO-16 MECHANICAL DATA

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.)					



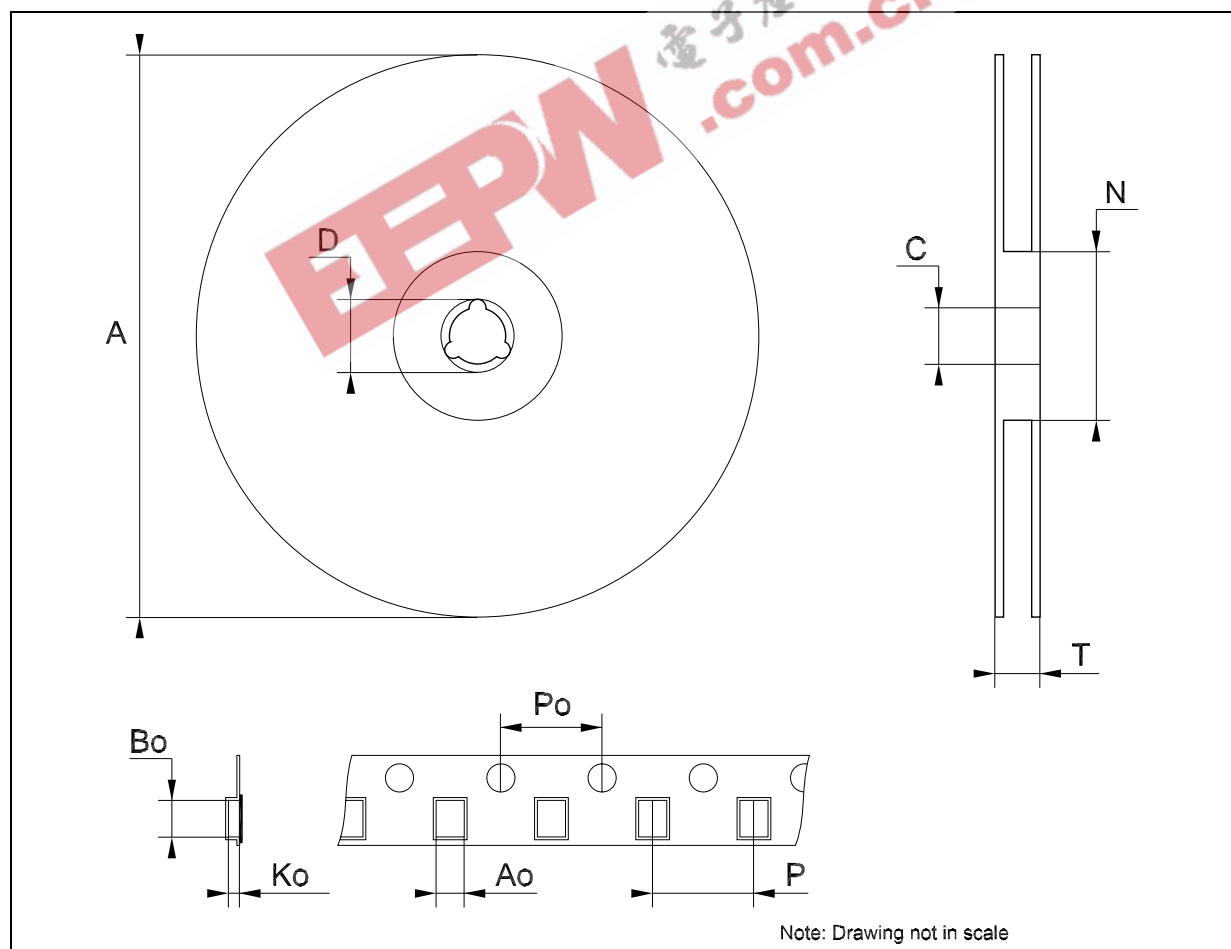
TSSOP16 MECHANICAL DATA

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



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

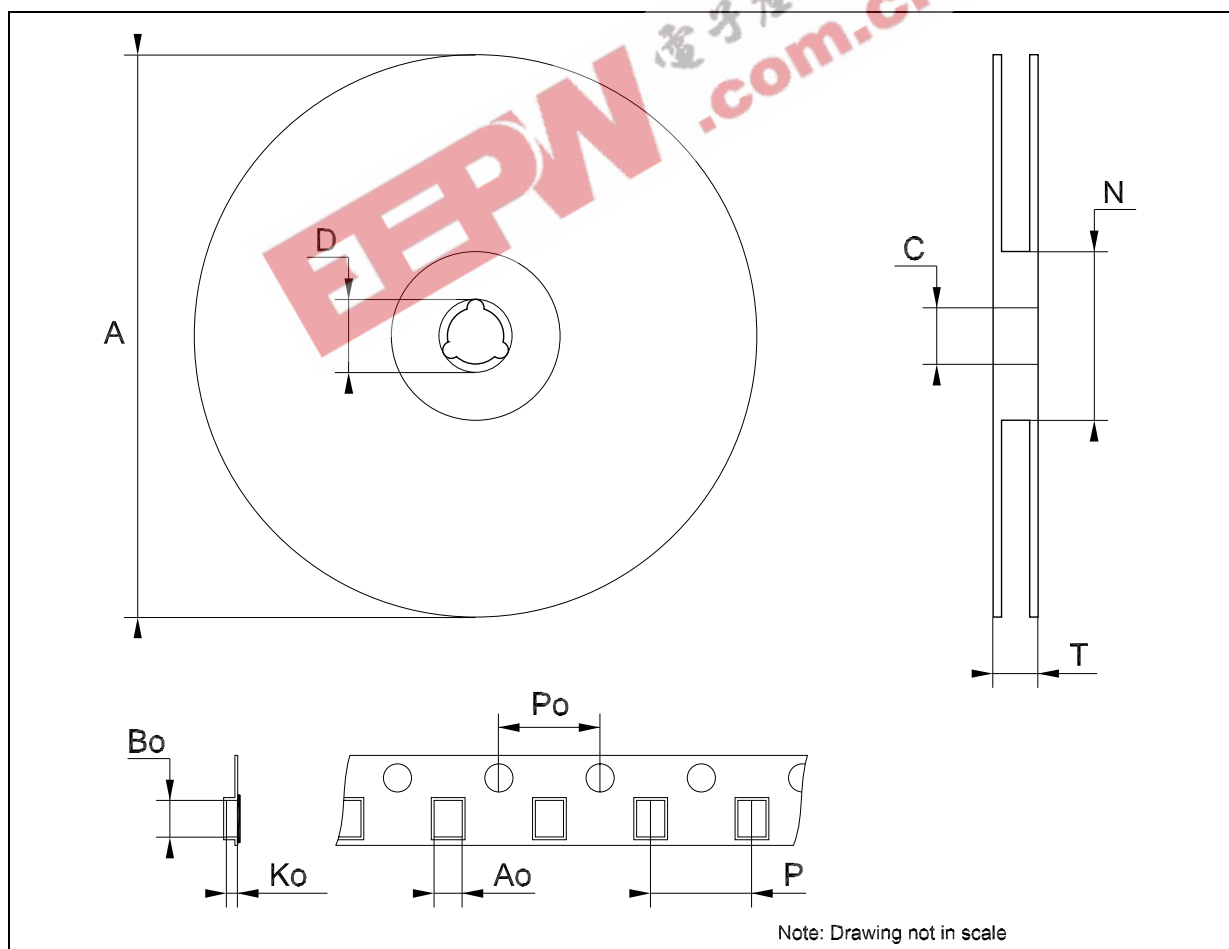


Table 10: Revision History

Date	Revision	Description of Changes
29-Jul-2004	5	Ordering Codes Revision - pag. 1.

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