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STMicroelectronics
74VHC174MTR

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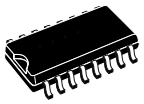
74VHC174

HEX D-TYPE FLIP FLOP WITH CLEAR

- HIGH SPEED:
  f_{MAX} = 175MHz (TYP.) at V_{CC} = 5V
- LOW POWER DISSIPATION:
  I_{CC} = 4 µA (MAX.) at T_A=25°C
- HIGH NOISE IMMUNITY:
  $V_{NIH} = V_{NIL}$ = 28% V_{CC} (MIN.)
- POWER DOWN PROTECTION ON INPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 8 mA (MIN)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:
  V_{CC}(OPR) = 2V to 5.5V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 174
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE: V_{OLP} = 0.8V (MAX.)



SOP

TSSOP

Table 1: Order Codes

PACKAGE	T & R
SOP	74VHC174MTR
TSSOP	74VHC174TTR

DESCRIPTION

The 74VHC174 is an advanced high-speed CMOS HEX D-TYPE FLIP FLOP WITH CLEAR fabricated with sub-micron silicon gate and double-layer metal wiring C^2MOS technology.
Information signals applied to D inputs are transferred to the Q outputs on the positive going edge of the clock pulse.

When the $\overline{CLEAR}$ 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.
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

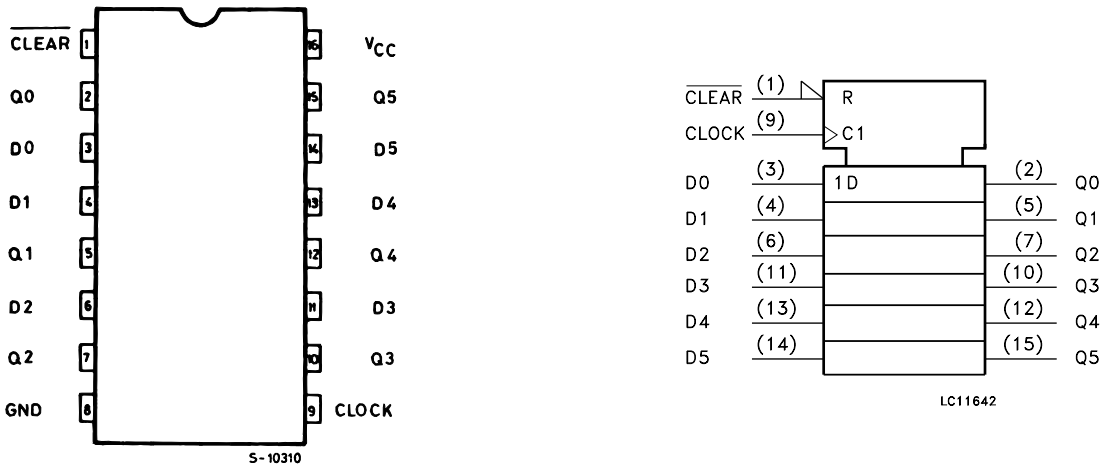


Figure 2: Input Equivalent Circuit

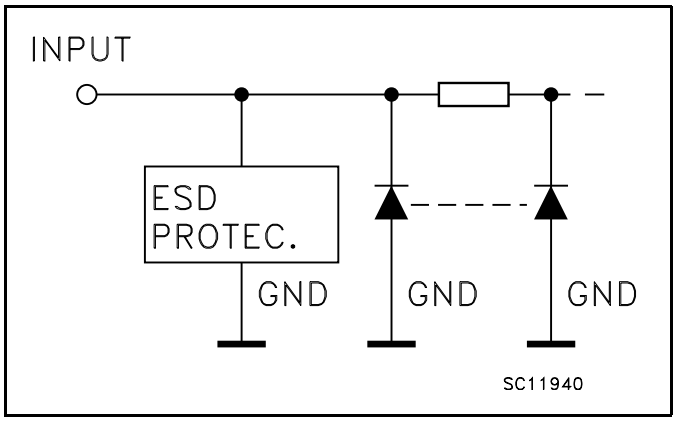


Table 2: Pin Description

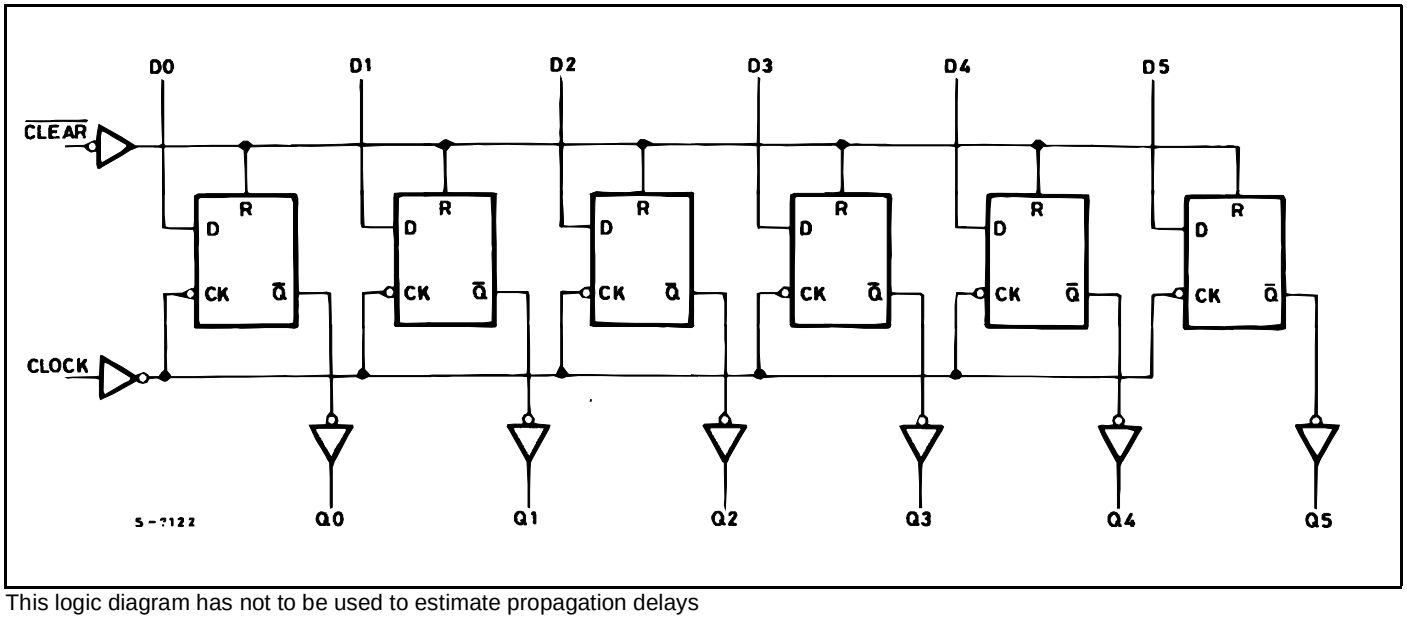
PIN N°	SYMBOL	NAME AND FUNCTION
1	$\overline{CLEAR}$	Asynchronous Master Reset (Active LOW)
2, 5, 7, 10, 12, 15	Q0 to Q5	Flip-Flop Outputs
3, 4, 6, 11, 13, 14	D0 to D5	Data Inputs
9	CLOCK	Clock Input (LOW-to-HIGH, Edge Triggered)
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

Table 3: Truth Table

INPUTS			OUTPUTS	FUNCTION
$\overline{CLEAR}$	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 to 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	2 to 5.5	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 1) (V_{CC} = 3.3 ± 0.3V) (V_{CC} = 5.0 ± 0.5V)	0 to 100 0 to 20	ns/V

1) V_{IN} from 30% to 70% of V_{CC}

Table 6: DC Specifications

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_{IH}	High Level Input Voltage	2.0		1.5			1.5		1.5		V
		3.0 to 5.5		$0.7V_{CC}$			$0.7V_{CC}$		$0.7V_{CC}$		
V_{IL}	Low Level Input Voltage	2.0				0.5		0.5		0.5	V
		3.0 to 5.5				$0.3V_{CC}$		$0.3V_{CC}$		$0.3V_{CC}$	
V_{OH}	High Level Output Voltage	2.0	I_O=-50 µA	1.9	2.0		1.9		1.9		V
		3.0	I_O=-50 µA	2.9	3.0		2.9		2.9		
		4.5	I_O=-50 µA	4.4	4.5		4.4		4.4		
		3.0	I_O=-4 mA	2.58			2.48		2.4		
		4.5	I_O=-8 mA	3.94			3.8		3.7		
V_{OL}	Low Level Output Voltage	2.0	I_O=50 µA		0.0	0.1		0.1		0.1	V
		3.0	I_O=50 µA		0.0	0.1		0.1		0.1	
		4.5	I_O=50 µA		0.0	0.1		0.1		0.1	
		3.0	I_O=4 mA			0.36		0.44		0.55	
		4.5	I_O=8 mA			0.36		0.44		0.55	
I_I	Input Leakage Current	0 to 5.5	V_I = 5.5V or GND			± 0.1		± 1		± 1	µA
I_{CC}	Quiescent Supply Current	5.5	V_I = V_{CC} or GND			4		40		40	µA

Table 7: 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	3.3(*)	15			5.8	11.0	1.0	13.0	1.0	13.0	ns
		3.3(*)	50			7.5	14.5	1.0	16.5	1.0	16.5	
		5.0(**)	15			4.1	7.2	1.0	8.5	1.0	8.5	
		5.0(**)	50			5.5	9.2	1.0	10.5	1.0	10.5	
t_{PHL}	Propagation Delay Time $\overline{\text{CLEAR}}$ to Q	3.3(*)	15			7.4	11.4	1.0	13.5	1.0	13.5	ns
		3.3(*)	50			9.9	14.9	1.0	17.0	1.0	17.0	
		5.0(**)	15			5.1	7.6	1.0	9.0	1.0	9.0	
		5.0(**)	50			6.6	9.6	1.0	11.0	1.0	11.0	
t_W	$\overline{\text{CLEAR}}$ Pulse Width LOW	3.3(*)					5.0		5.0		5.0	ns
		5.0(**)					5.0		5.0		5.0	
t_W	$\overline{\text{CLEAR}}$ Pulse Width HIGH or LOW	3.3(*)					5.0		5.0		5.0	ns
		5.0(**)					5.0		5.0		5.0	
t_s	Setup Time D to CLOCK, HIGH or LOW	3.3(*)					5.0		6.0		6.0	ns
		5.0(**)					4.5		4.5		4.5	
t_h	Hold Time D to CLOCK, HIGH or LOW	3.3(*)					0.0		0.0		0.0	ns
		5.0(**)					0.5		0.5		0.5	
t_{REM}	Recovery Time $\overline{\text{CLEAR}}$ to CLOCK	3.3(*)					3.0		3.0		3.0	ns
		5.0(**)					2.5		2.5		2.5	
f_{MAX}	Maximum Clock Frequency	3.3(*)	15		95	150		80		80		MHz
		3.3(*)	50		55	85		50		50		
		5.0(**)	15		130	175		110		110		
		5.0(**)	50		90	120		80		80		

(*) Voltage range is 3.3V ± 0.3V
(**) Voltage range is 5.0V ± 0.5V

Table 8: Capacitive Characteristics

Symbol	Parameter	Test Condition	Value							Unit
			T_A = 25°C			-40 to 85°C		-55 to 125°C		
			Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
C_{IN}	Input Capacitance			6	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)			15						pF

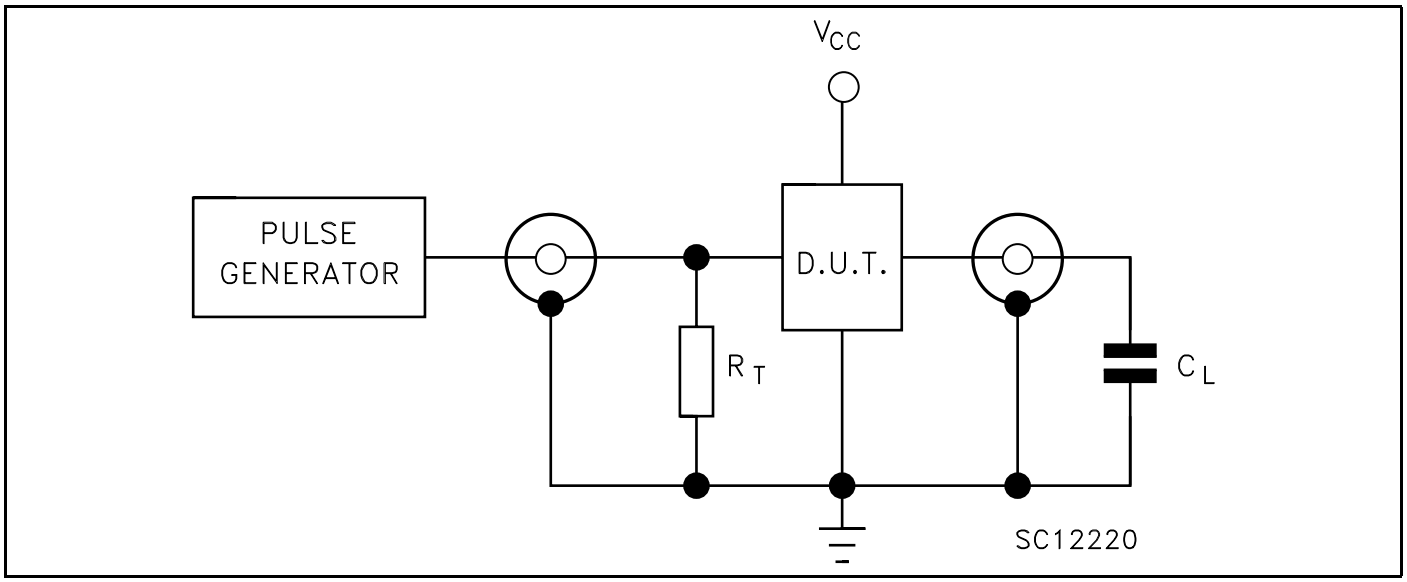
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6$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

Table 9: 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)	5.0	C_L = 50 pF		0.3	0.8					V
V_{OLV}				-0.8	-0.3						
V_{IHD}	Dynamic High Voltage Input (note 1, 3)	5.0		3.5							V
V_{ILD}	Dynamic Low Voltage Input (note 1, 3)	5.0				1.5					V

1) Worst case package.
2) Max number of outputs defined as (n). Data inputs are driven 0V to 5.0V, (n-1) outputs switching and one output at GND.
3) Max number of data inputs (n) switching. (n-1) switching 0V to 5.0V. Inputs under test switching: 5.0V to threshold (V_{ILD}), 0V to threshold (V_{IHD}), f=1MHz.

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, Setup And Hold Times (f=1MHz; 50% duty cycle)

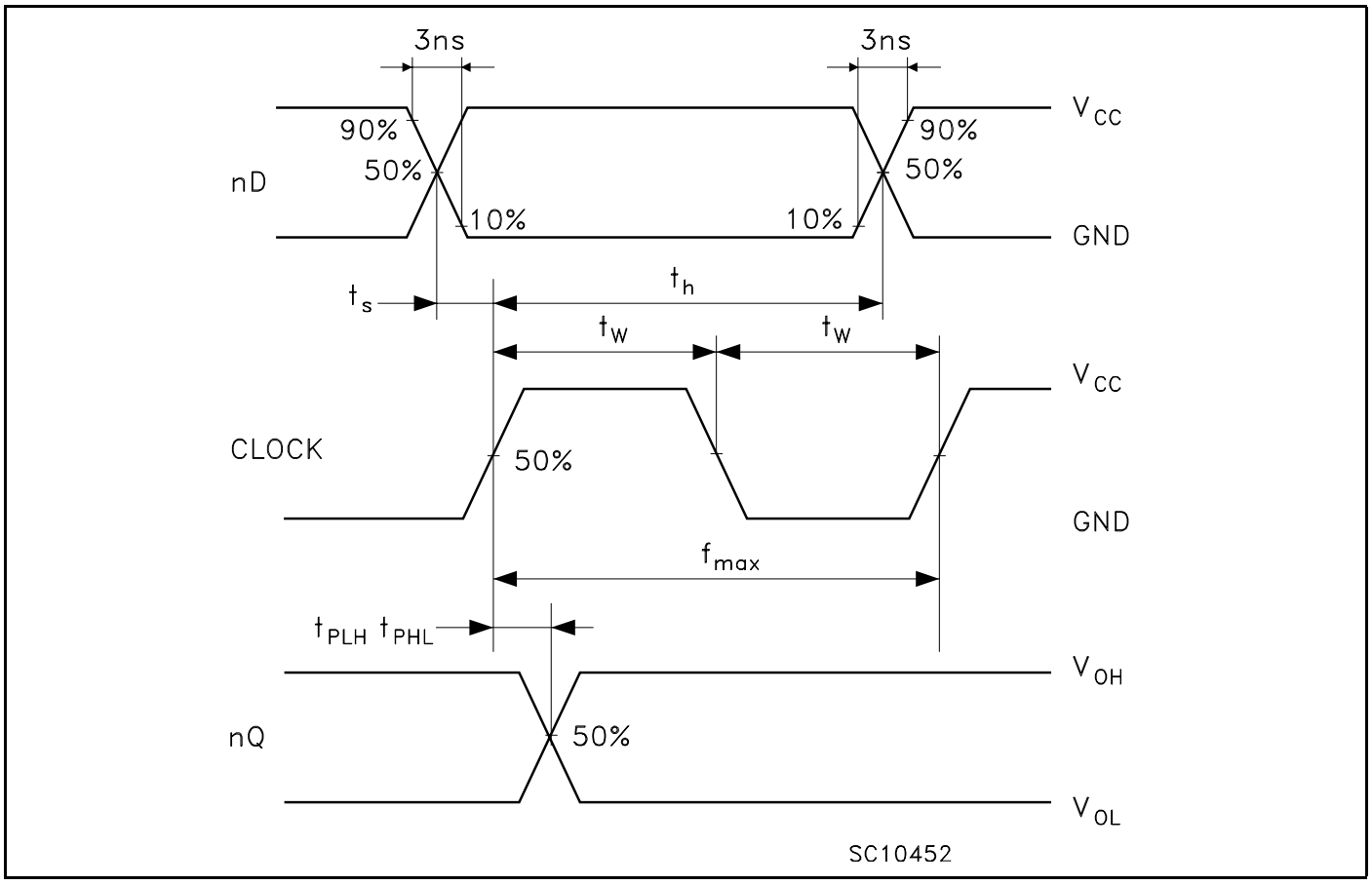


Figure 6: Waveform - Propagation Delays (f=1MHz; 50% duty cycle)

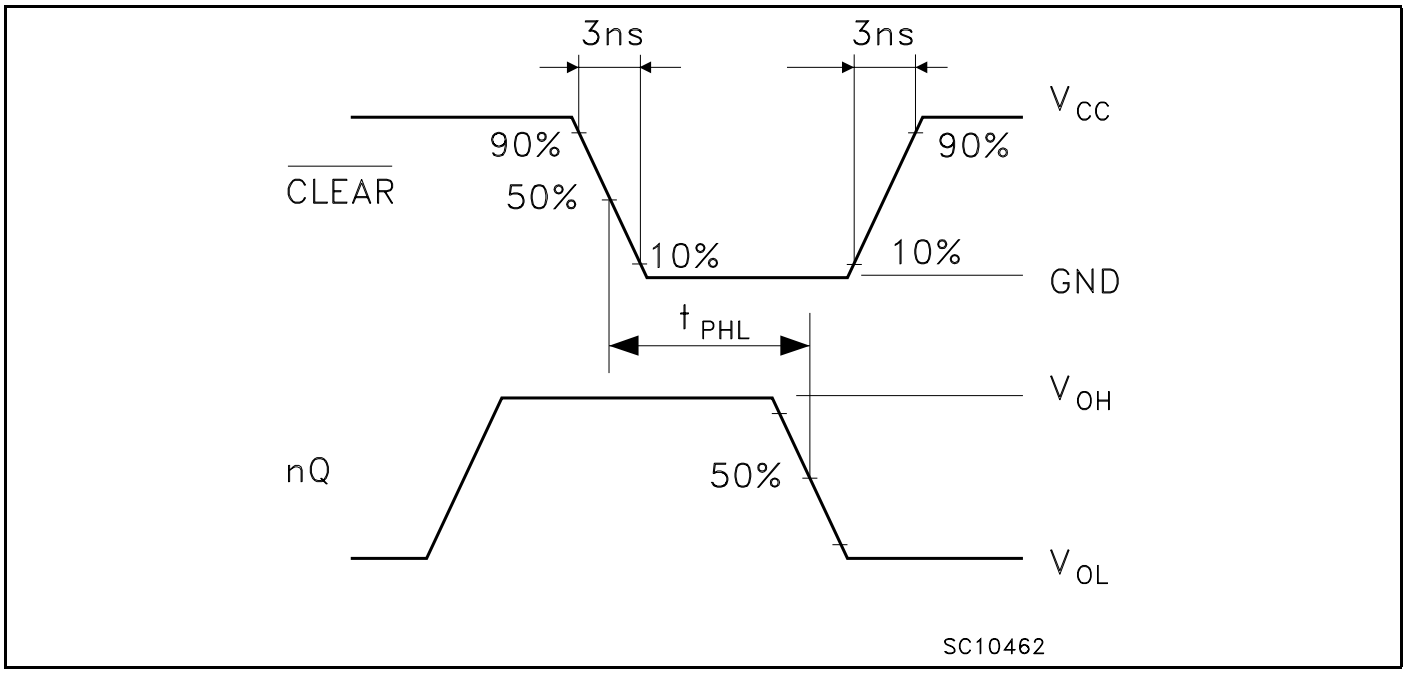
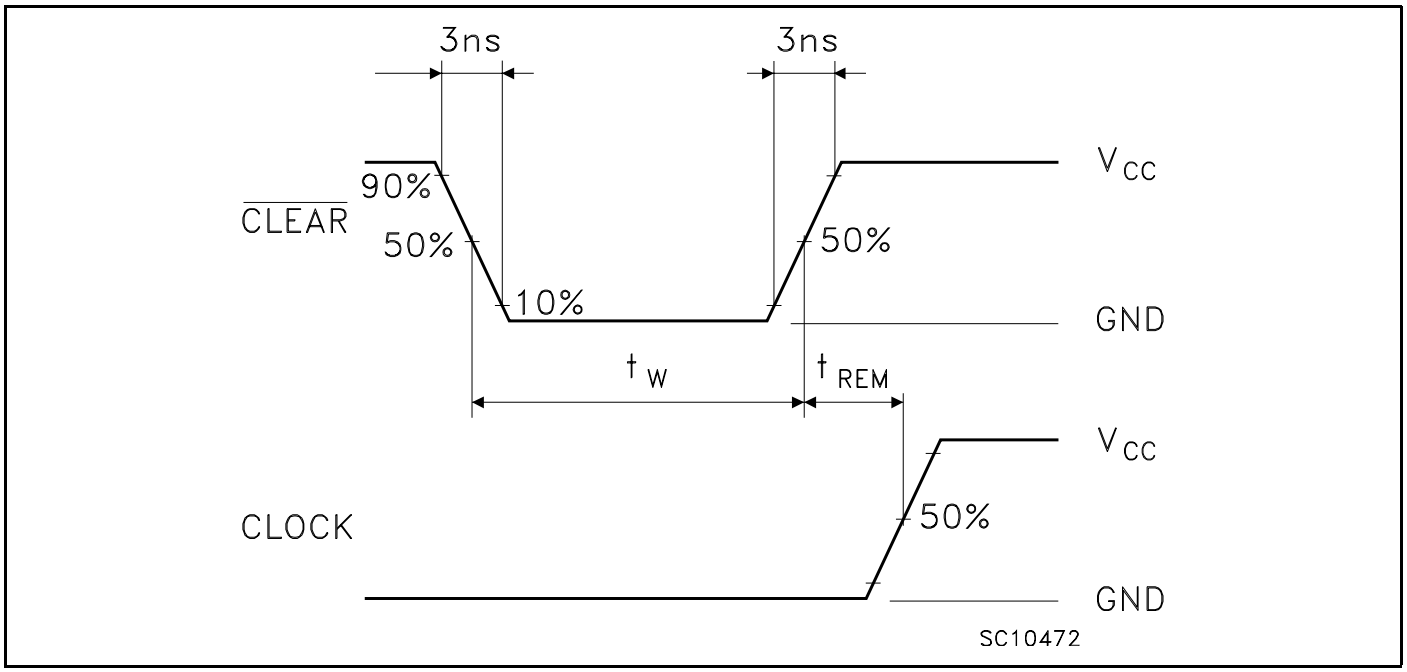
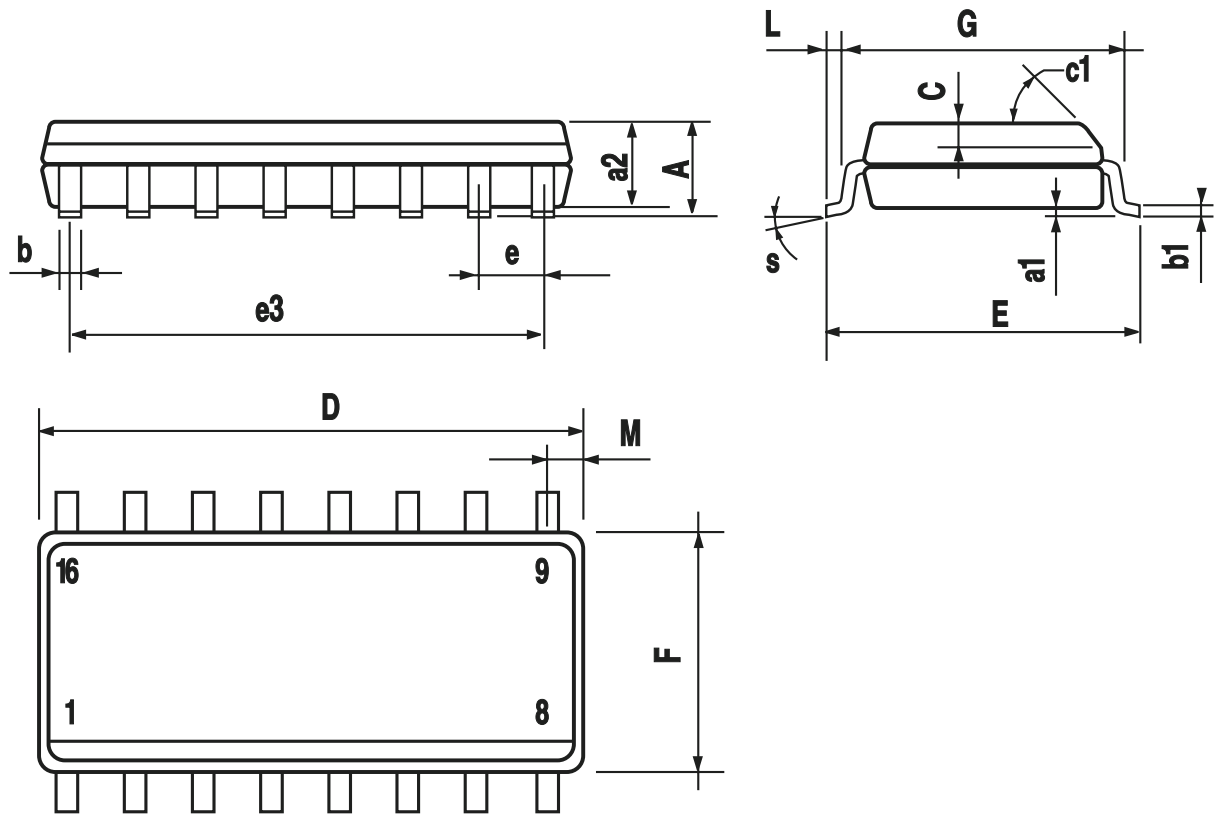


Figure 7: Waveform - Recovery Time (f=1MHz; 50% duty cycle)



SO-16 MECHANICAL DATA

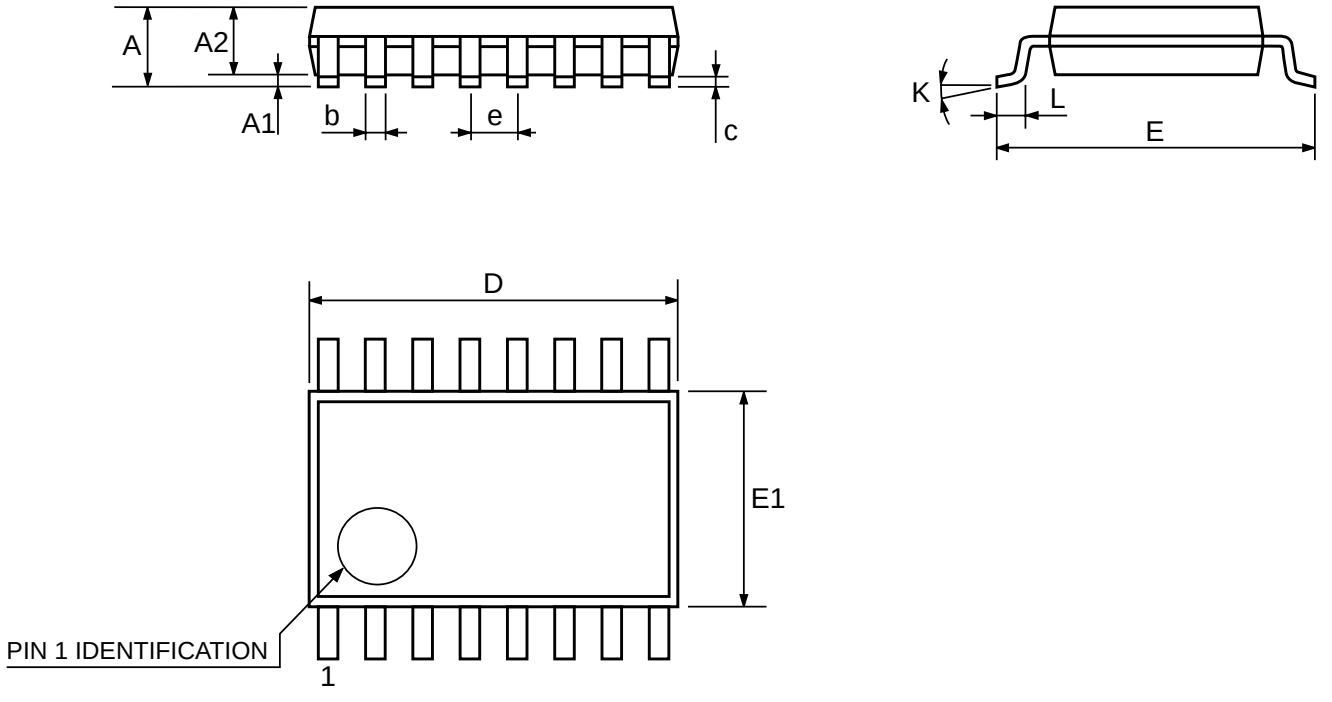
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.25	0.004		0.010
a2			1.64			0.063
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157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

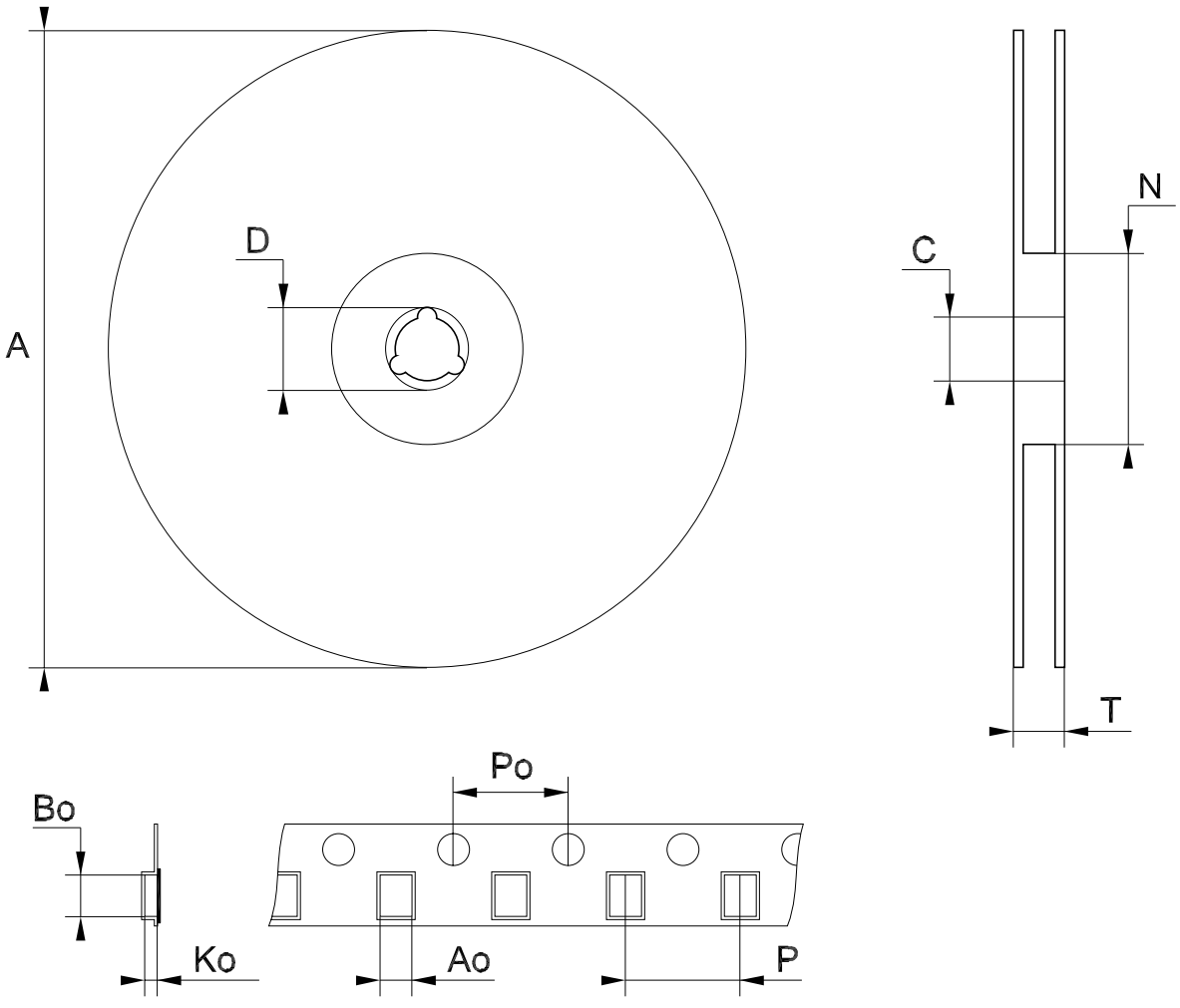
TSSOP16 MECHANICAL DATA

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



Tape & Reel SO-16 MECHANICAL DATA

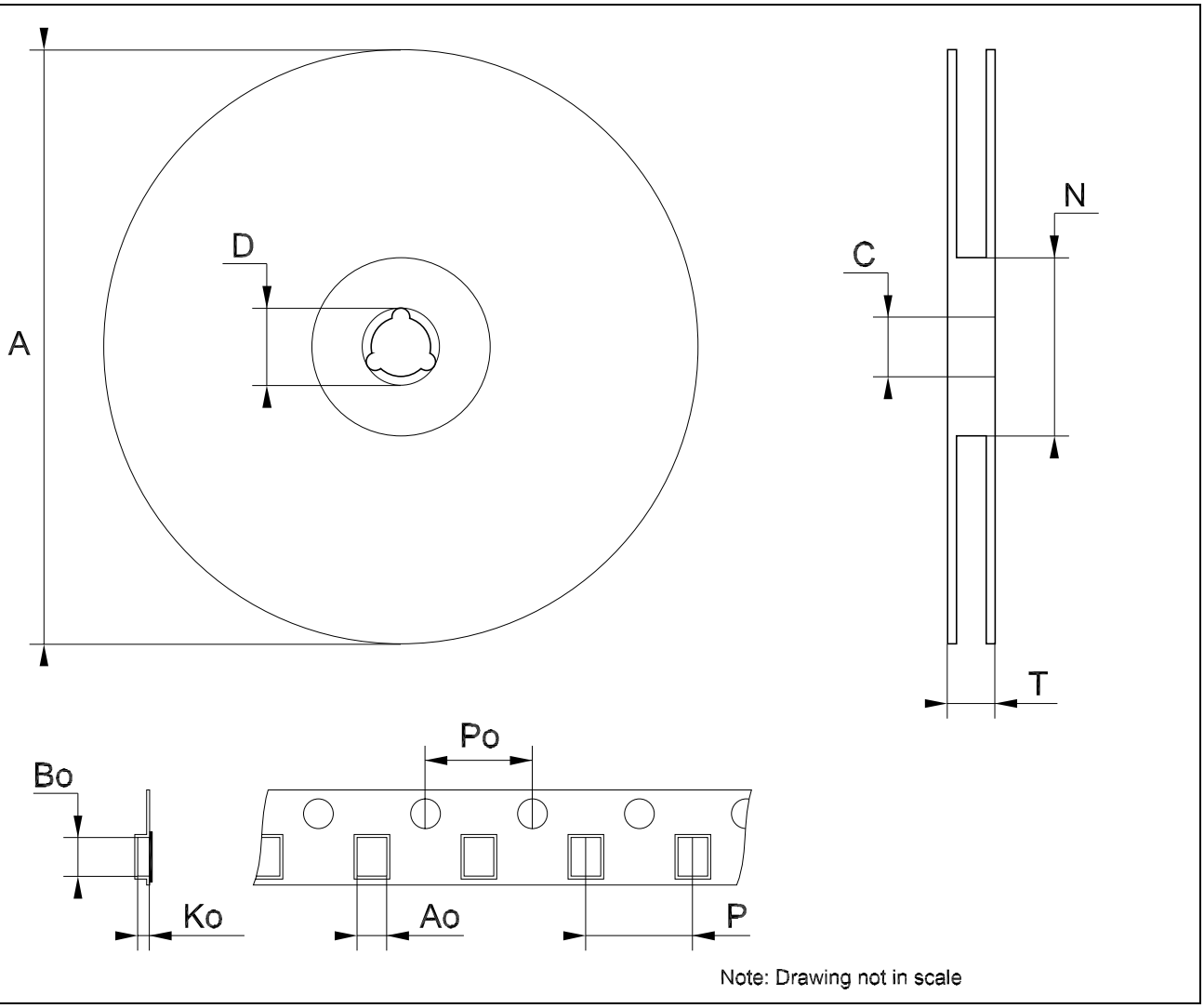
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

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



Note: Drawing not in scale

Table 10: Revision History

Date	Revision	Description of Changes
12-Nov-2004	4	Order Codes Revision - pag. 1.