

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

- 5V TOLERANT INPUTS
- HIGH SPEED:
 $f_{MAX} = 150$ MHz (MAX.) at $V_{CC} = 3V$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OHL}| = I_{OL} = 24$ mA (MIN) at $V_{CC} = 3V$
- PCI BUS LEVELS GUARANTEED AT 24 mA
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \equiv t_{PHL}$
- OPERATING VOLTAGE RANGE:
 $V_{CC}(OPR) = 2.0V$ to $3.6V$ (1.5V Data Retention)
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 74
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:
HBM > 2000V (MIL STD 883 method 3015); MM > 200V

DESCRIPTION

The 74LCX74 is a low voltage CMOS DUAL D-TYPE FLIP FLOP WITH PRESET AND CLEAR NON INVERTING fabricated with sub-micron silicon gate and double-layer metal wiring C²MOS technology. It is ideal for low power and high speed 3.3V applications; it can be interfaced to 5V signal environment for inputs.

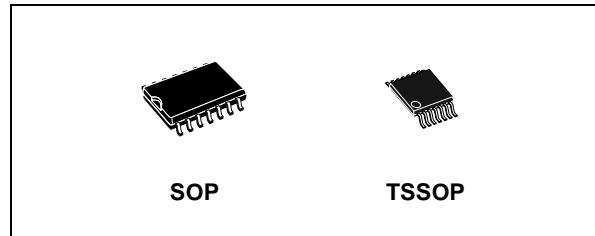


Table 1: Order Codes

PACKAGE	T & R
SOP	74LCX74MTR
TSSOP	74LCX74TTR

A signal on the D INPUT is transferred to the Q OUTPUT during the positive going transition of the clock pulse.

CLR and PR are independent of the clock and accomplished by a low setting on the appropriate input.

It has same speed performance at 3.3V than 5V AC/ACT family, combined with a lower 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

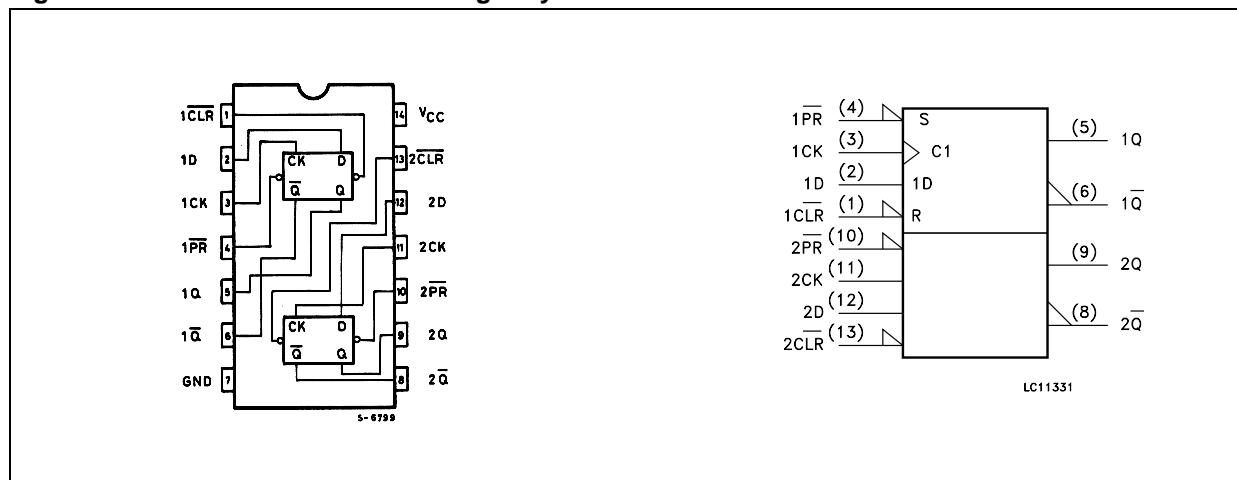


Figure 2: Input And Output Equivalent Circuit

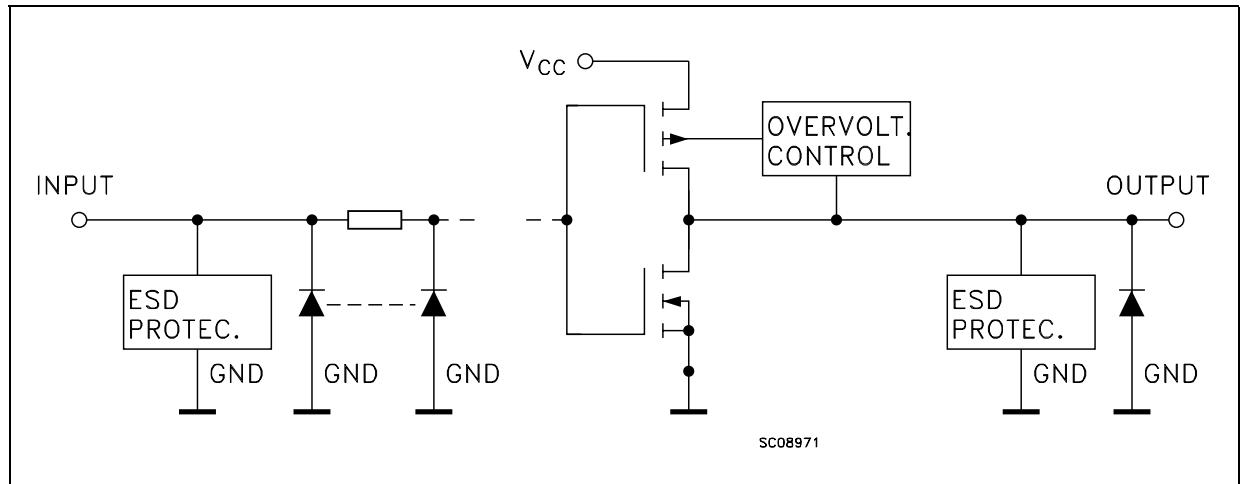


Table 2: Pin Description

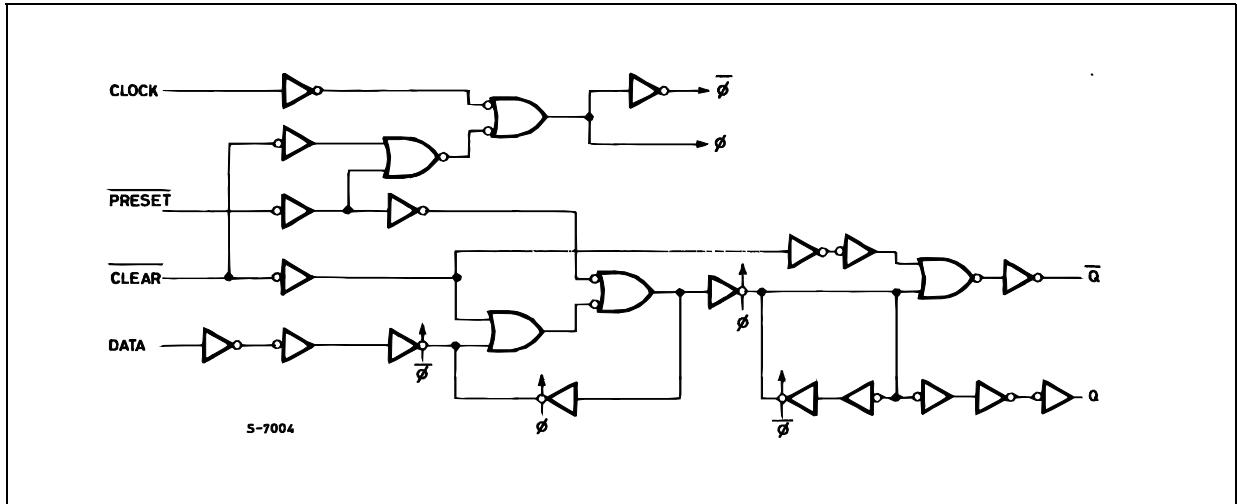
PIN N°	SYMBOL	NAME AND FUNCTION
1, 13	1CLR, 2CLR	Asynchronous Reset - Direct Input
2, 12	1D, 2D	Data Inputs
3, 11	1CK, 2CK	Clock Input (LOW to HIGH, Edge Triggered)
4, 10	1PR, 2PR	Asynchronous Set - Direct Input
5, 9	1Q, 2Q	True Flip-Flop Outputs
6, 8	1Q, 2Q	Complement Flip-Flop Outputs
7	GND	Ground (0V)
14	V _{CC}	Positive Supply Voltage

Table 3: Truth Table

INPUTS				OUTPUTS		FUNCTION
CLR	PR	D	CK	Q	Q̄	
L	H	X	X	L	H	CLEAR
H	L	X	X	H	L	PRESET
L	L	X	X	H	H	
H	H	L	◻	L	H	
H	H	H	◻	H	L	
H	H	X	◻	Q _n	Q̄ _n	NO CHANGE

X : Don't Care

Figure 3: Logic Diagram



This logic diagram has not been 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 ($V_{CC} = 0V$)	-0.5 to +7.0	V
V_O	DC Output Voltage (High or Low State) (note 1)	-0.5 to $V_{CC} + 0.5$	V
I_{IK}	DC Input Diode Current	- 50	mA
I_{OK}	DC Output Diode Current (note 2)	- 50	mA
I_O	DC Output Current	± 50	mA
I_{CC}	DC Supply Current per Supply Pin	± 100	mA
I_{GND}	DC Ground Current per Supply Pin	± 100	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.

- not implied

 - 1) I_O absolute maximum rating must be observed
 - 2) $V_O < GND$

Table 5: Recommended Operating Conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage (note 1)	2.0 to 3.6	V
V_I	Input Voltage	0 to 5.5	V
V_O	Output Voltage ($V_{CC} = 0V$)	0 to 5.5	V
V_O	Output Voltage (High or Low State)	0 to V_{CC}	V
I_{OH}, I_{OL}	High or Low Level Output Current ($V_{CC} = 3.0$ to $3.6V$)	± 24	mA
I_{OH}, I_{OL}	High or Low Level Output Current ($V_{CC} = 2.7V$)	± 12	mA
T_{op}	Operating Temperature	-55 to 125	°C
dt/dv	Input Rise and Fall Time (note 2)	0 to 10	ns/V

- 1) Truth Table guaranteed: 1.5V to 3.6V
 - 2) V_{IN} from 0.8V to 2V at $V_{CC} = 3.0V$

Table 6: DC Specifications

Symbol	Parameter	Test Condition		Value				Unit	
		V _{CC} (V)		-40 to 85 °C		-55 to 125 °C			
				Min.	Max.	Min.	Max.		
V _{IH}	High Level Input Voltage	2.7 to 3.6		2.0		2.0		V	
V _{IL}	Low Level Input Voltage				0.8		0.8	V	
V _{OH}	High Level Output Voltage	2.7 to 3.6	I _O =-100 µA	V _{CC} -0.2		V _{CC} -0.2		V	
		2.7	I _O =-12 mA	2.2		2.2			
		3.0	I _O =-18 mA	2.4		2.4			
			I _O =-24 mA	2.2		2.2			
V _{OL}	Low Level Output Voltage	2.7 to 3.6	I _O =100 µA		0.2		0.2	V	
		2.7	I _O =12 mA		0.4		0.4		
		3.0	I _O =16 mA		0.4		0.4		
			I _O =24 mA		0.55		0.55		
I _I	Input Leakage Current	2.7 to 3.6	V _I = 0 to 5.5V		± 5		± 5	µA	
I _{off}	Power Off Leakage Current	0	V _I or V _O = 5.5V		10		10	µA	
I _{CC}	Quiescent Supply Current	2.7 to 3.6	V _I = V _{CC} or GND		10		10	µA	
			V _I or V _O = 3.6 to 5.5V		± 10		± 10		
ΔI _{CC}	I _{CC} incr. per Input	2.7 to 3.6	V _{IH} = V _{CC} - 0.6V		500		500	µA	

Table 7: Dynamic Switching Characteristics

Symbol	Parameter	Test Condition		Value			Unit	
		V _{CC} (V)		T _A = 25 °C				
				Min.	Typ.	Max.		
V _{OLP}	Dynamic Low Level Quiet Output (note 1)	3.3	C _L = 50pF		0.8		V	
			V _{IL} = 0V, V _{IH} = 3.3V		-0.8			

1) Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the LOW state.

Table 8: AC Electrical Characteristics

Symbol	Parameter	Test Condition				Value				Unit	
		V _{CC} (V)	C _L (pF)	R _L (Ω)	t _s = t _r (ns)	-40 to 85 °C		-55 to 125 °C			
						Min.	Max.	Min.	Max.		
t _{PLH} t _{PHL}	Propagation Delay Time (CK to Q or Q)	2.7	50	500	2.5	1.5	8.0	1.5	9.2	ns	
		3.0 to 3.6				1.5	7.0	1.5	8.0		
t _{PLH} t _{PHL}	Propagation Delay Time (PR or CLR to Q or Q)	2.7	50	500	2.5	1.5	8.0	1.5	9.2	ns	
		3.0 to 3.6				1.5	7.0	1.5	8.0		
t _S	Setup Time, HIGH or LOW level D to CK	2.7	50	500	2.5	2.5		3.5		ns	
		3.0 to 3.6				2.5		3.5			
t _H	Hold Time, HIGH or LOW level D to CK	2.7	50	500	2.5	1.5		1.5		ns	
		3.0 to 3.6				1.5		1.5			
t _W	CK Pulse Width, HIGH or LOW PR or CLR Pulse Width, LOW	2.7	50	500	2.5	3.0		4.0		ns	
		3.0 to 3.6				3.0		4.0			
t _{rec}	Recovery Time PR or CLR to CK	2.7	50	500	2.5	0		0		ns	
		3.0 to 3.6				0		0			
f _{MAX}	Clock Pulse Frequency	2.7	50	500	2.5	150		150		MHz	
t _{OSLH} t _{OSSH}	Output To Output Skew Time (note1, 2)	3.0 to 3.6	50	500	2.5		1.0		1.0	ns	

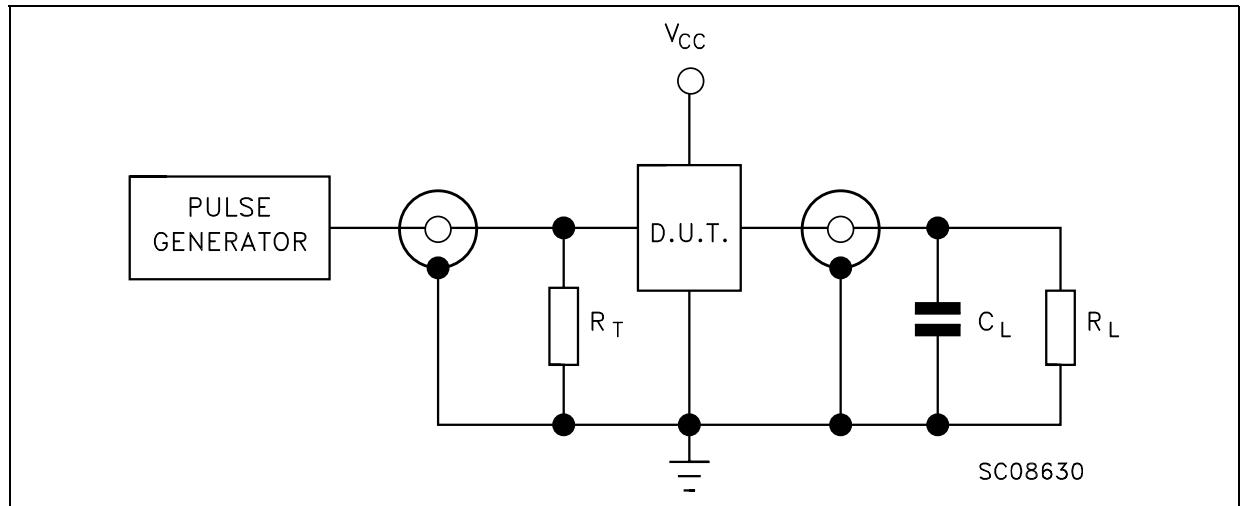
1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW ($t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSSH} = |t_{PHLm} - t_{PHLn}|$)

2) Parameter guaranteed by design

Table 9: Capacitive Characteristics

Symbol	Parameter	Test Condition			Value			Unit	
		V _{CC} (V)			T _A = 25 °C				
			Min.	Typ.	Max.				
C _{IN}	Input Capacitance	3.3	V _{IN} = 0 to V _{CC}		6			pF	
C _{PD}	Power Dissipation Capacitance (note 1)	3.3	f _{IN} = 10MHz V _{IN} = 0 or V _{CC}		40			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. $I_{CC(\text{opr})} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per Flip-Flop)

Figure 4: Test Circuit

$C_L = 50 \text{ pF}$ or equivalent (includes jig and probe capacitance)

$R_L = 500\Omega$ or equivalent

$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

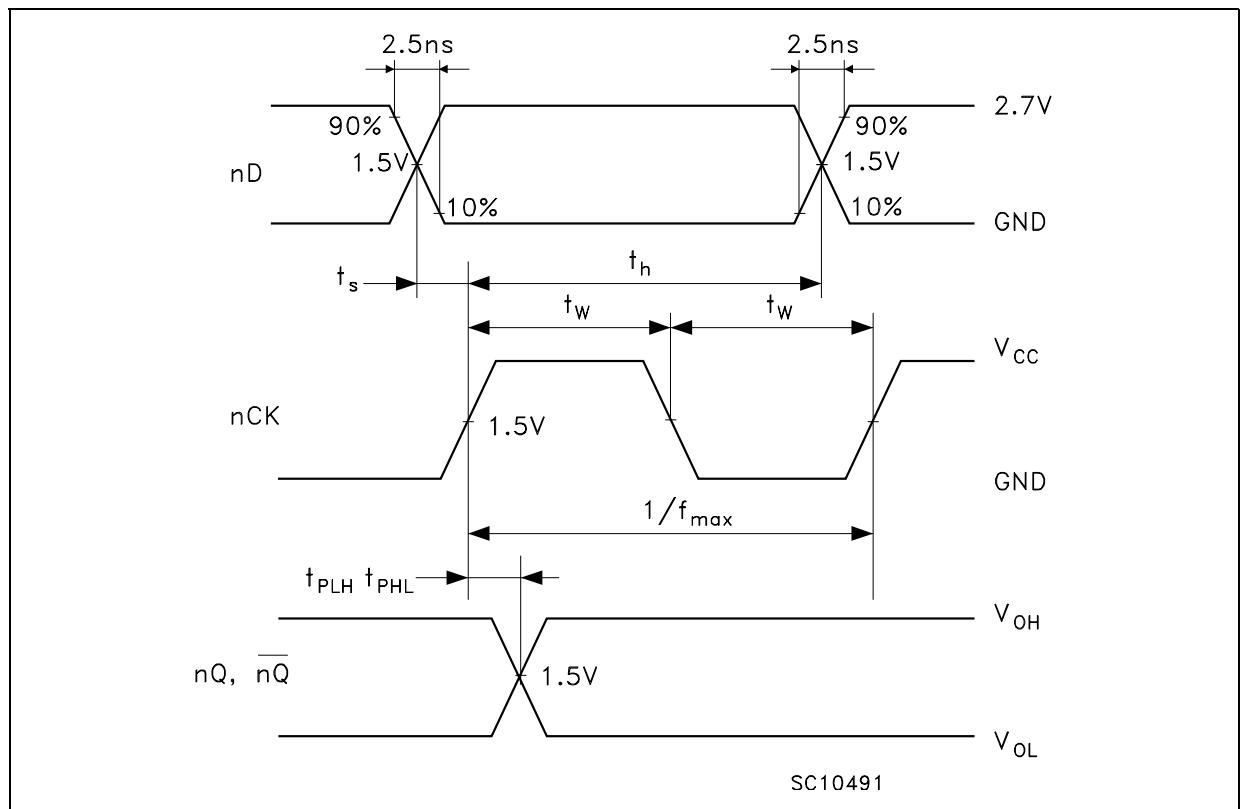
Figure 5: Waveform - Propagation Delays, Setup And Hold Times (f=1MHz; 50% duty cycle)

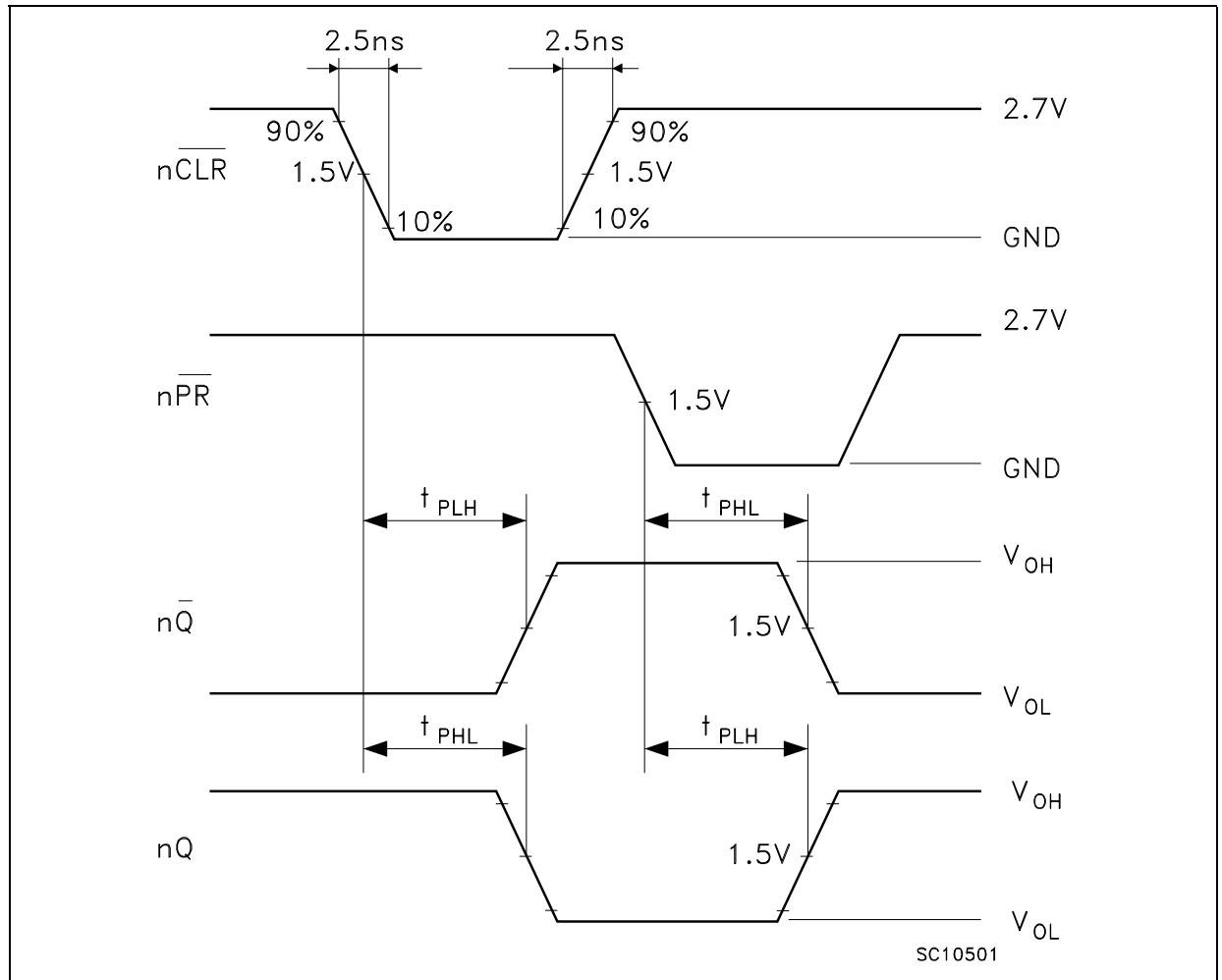
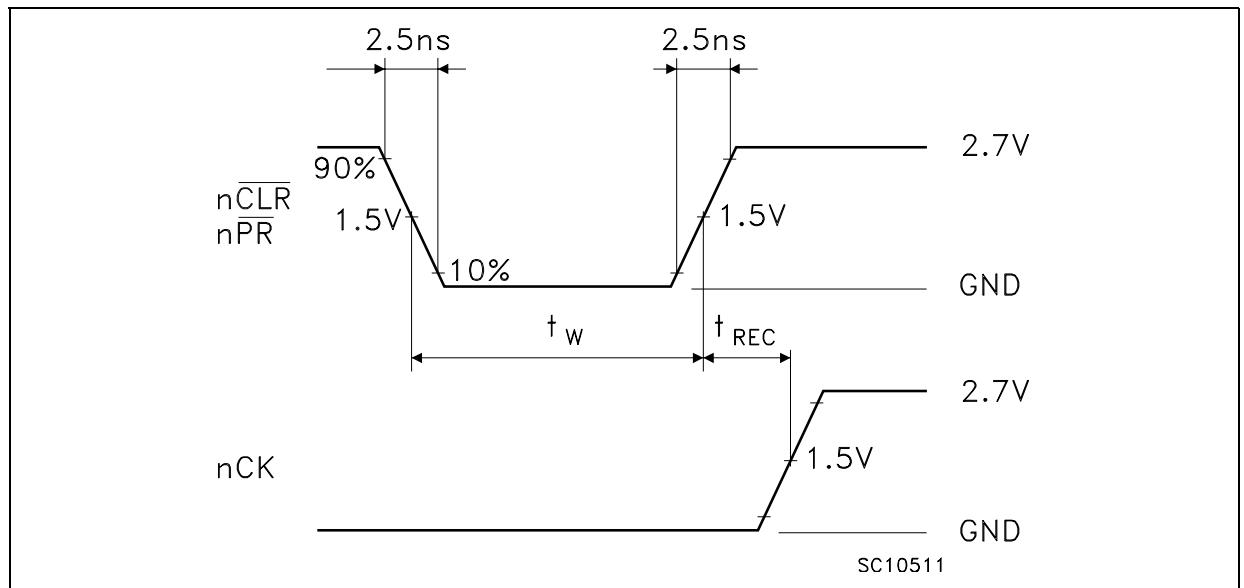
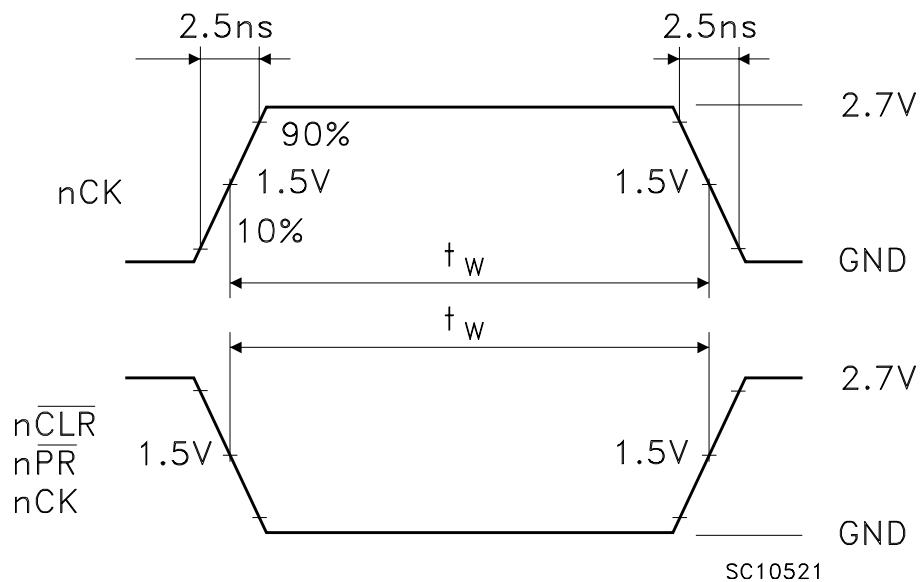
Figure 6: Waveform - Propagation Delays (f=1MHz; 50% duty cycle)**Figure 7: Waveform - Recovery Times (f=1MHz; 50% duty cycle)**

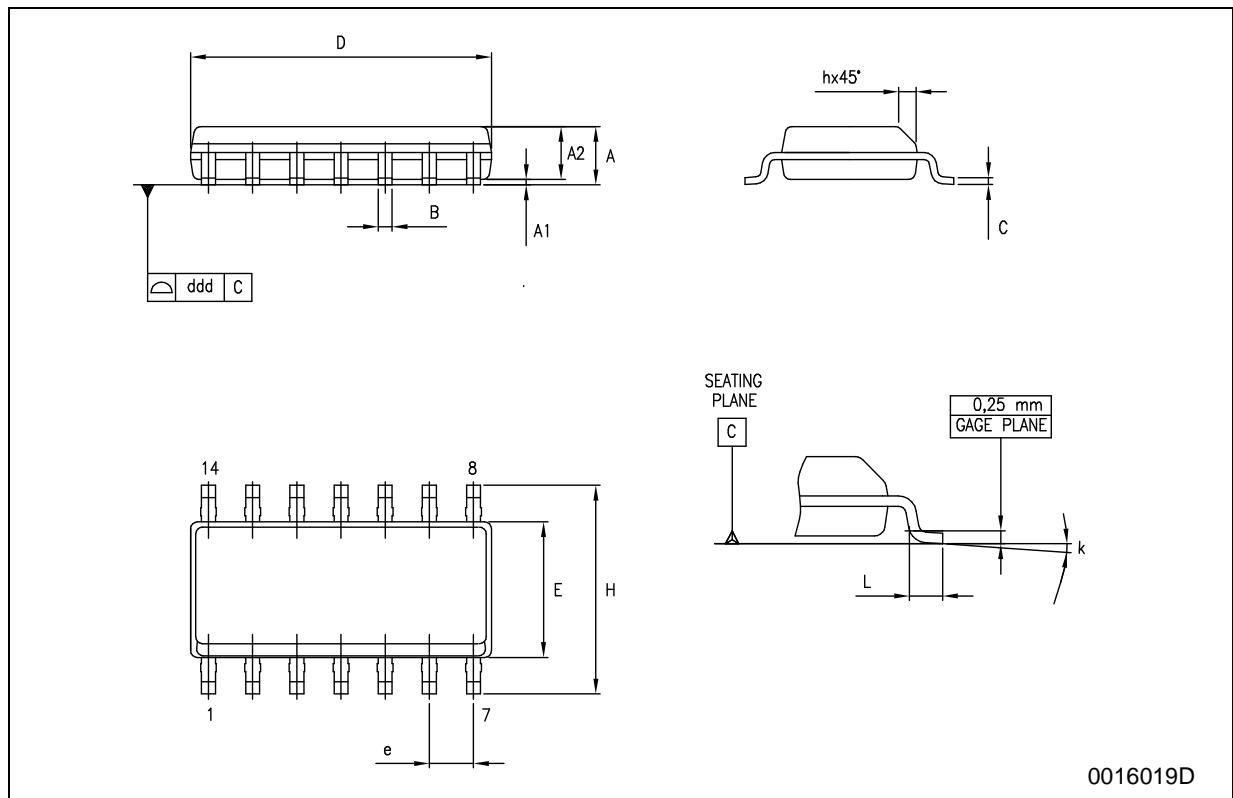
Figure 8: Waveform - Pulse Width (f=1MHz; 50% duty cycle)



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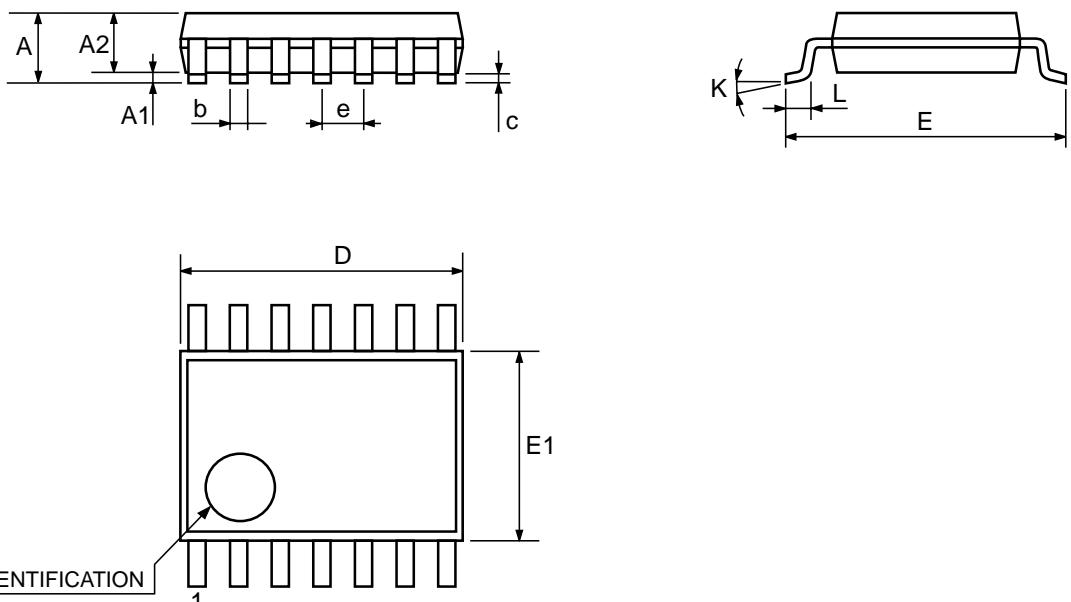
SO-14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.1		0.25	0.004		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	8.55		8.75	0.337		0.344
E	3.8		4.0	0.150		0.157
e		1.27			0.050	
H	5.8		6.2	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.4		1.27	0.016		0.050
k	0°		8°	0°		8°
ddd			0.100			0.004



TSSOP14 MECHANICAL DATA

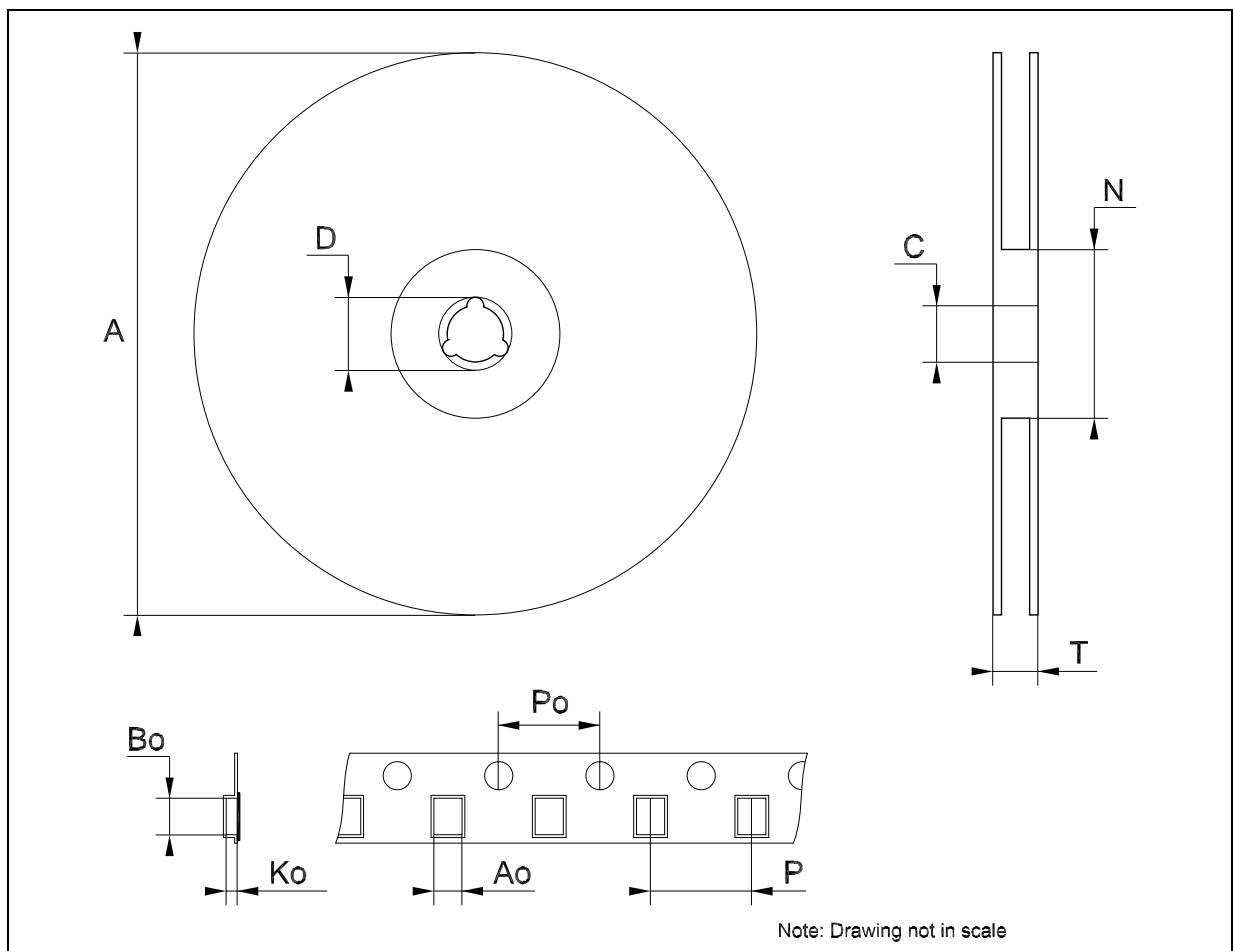
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



0080337D

Tape & Reel SO-14 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	6.4		6.6	0.252		0.260
Bo	9		9.2	0.354		0.362
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 TSSOP14 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

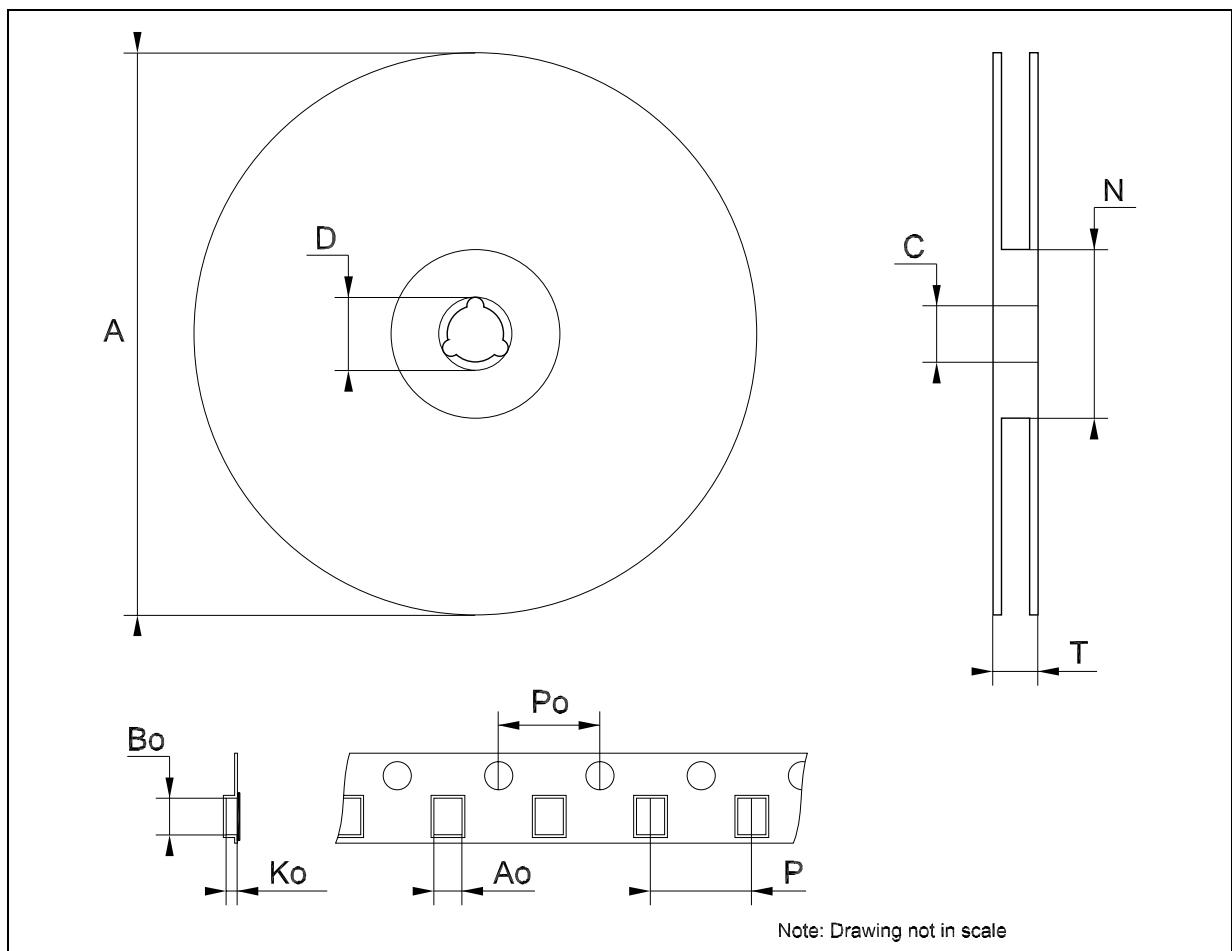


Table 10: Revision History

Date	Revision	Description of Changes
15-Sep-2004	7	Ordering Codes Revision - pag. 1.

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