



74VHC16374

16-BIT D-TYPE FLIP FLOP WITH 3-STATE OUTPUTS NON INVERTING

- HIGH SPEED:
 $f_{MAX} = 185 \text{ MHz (TYP.) at } V_{CC} = 5V$
- LOW POWER DISSIPATION:
 $I_{CC} = 4 \mu A \text{ (MAX.) at } T_A = 25^\circ C$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- POWER DOWN PROTECTION ON INPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 8 \text{ mA (MIN.)}$
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \approx t_{PHL}$
- OPERATING VOLTAGE RANGE:
 $V_{CC(OPR)} = 2V \text{ to } 5.5V$
- PIN AND FUNCTION COMPATIBLE WITH
74 SERIES 16374
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE: $V_{OLP} = 0.9V \text{ (MAX.)}$

DESCRIPTION

The 74VHC16374 is an advanced high-speed FLIP FLOP with 3 STATE OUTPUTS NON INVERTING fabricated with sub-micron silicon gate and double-layer metal wiring C²MOS technology.

These 16 bit D-TYPE flip-flop is controlled by two clock inputs (CK) and two output enable inputs ($\overline{noE}$). The device can be used as two 8-bit flip-flops or one 16-bit flip-flop.

On the positive transition of the clock, the Q outputs will be set to the logic state that were setup at the D inputs.

While the ($\overline{OE}$) input is low, the outputs will be in a normal logic state (high or low logic level); while OE is high, the outputs will be in a high impedance state.

The output control does not affect the internal operation of flip-flops; that is, the old data can be retained or the new data can be entered even while the outputs are off.

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.

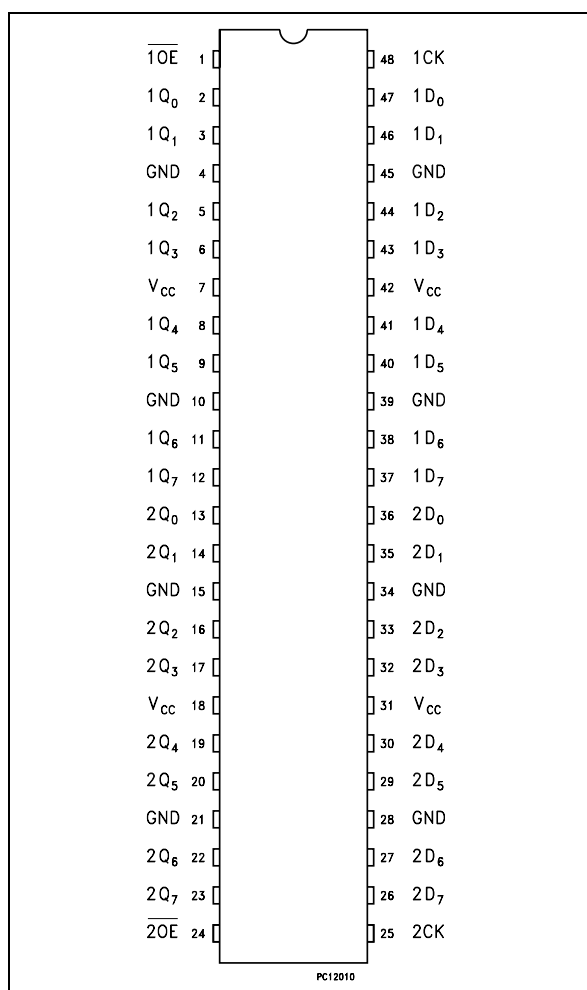
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.



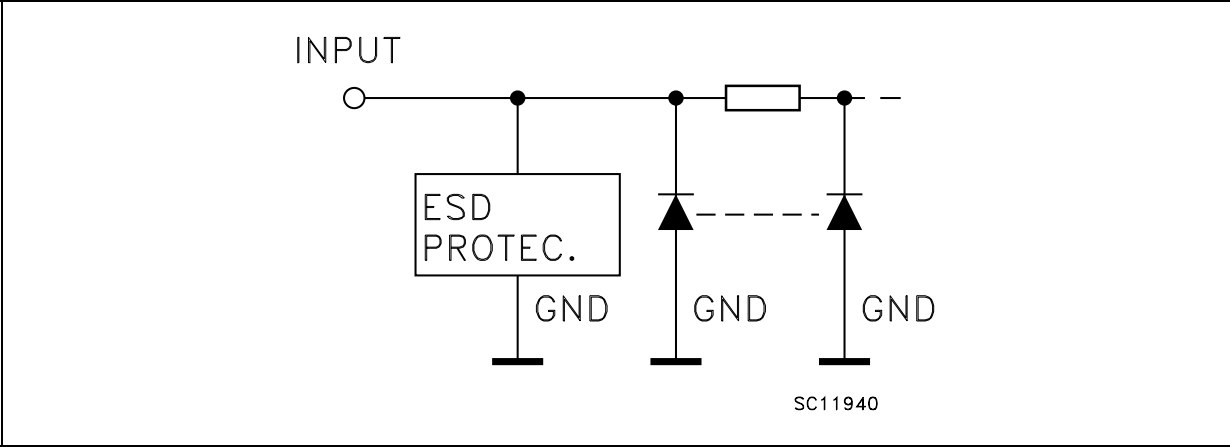
ORDER CODES

PACKAGE	TUBE	T & R
TSSOP		74VHC16374TTR

PIN CONNECTION



INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

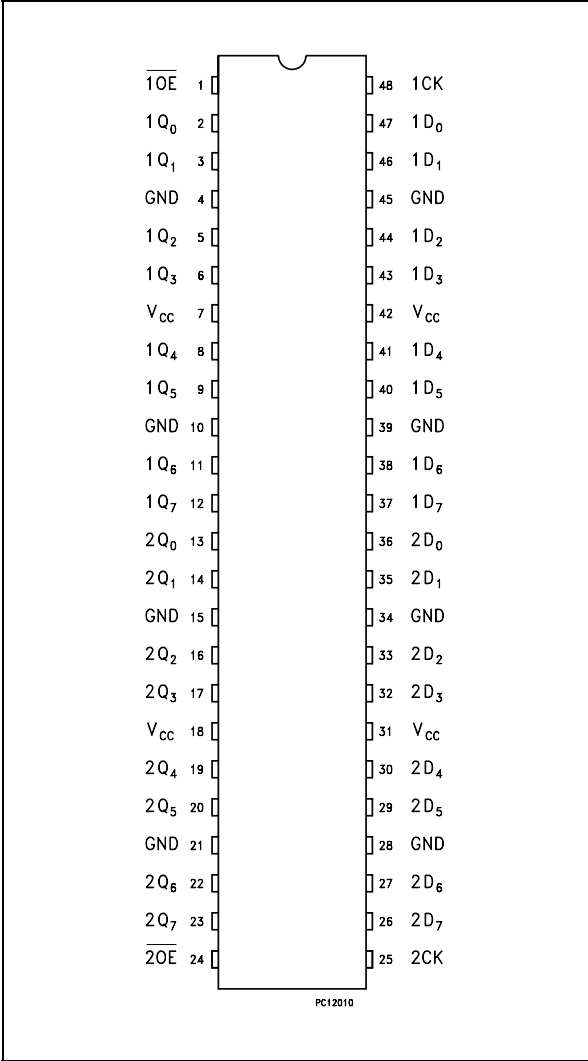
PIN No	SYMBOL	NAME AND FUNCTION
1	1OE	3 State Output Enable Input (Active LOW)
2, 3, 5, 6, 8, 9, 11, 12	1Q0 to 1Q7	3-State Outputs
13, 14, 16, 17, 19, 20, 22, 23	2Q0 to 2Q7	3-State Outputs
24	2OE	3 State Output Enable Input (Active LOW)
25	2CK	Clock Input (LOW-to-HIGH Edge Trigger)
36, 35, 33, 32, 30, 29, 27, 26	2D0 to 2D7	Data Inputs
47, 46, 44, 43, 41, 40, 38, 37	1D0 to 1D7	Data Inputs
48	1CK	Clock Input (LOW-to-HIGH Edge Trigger)
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V _{CC}	Positive Supply Voltage

TRUTH TABLE

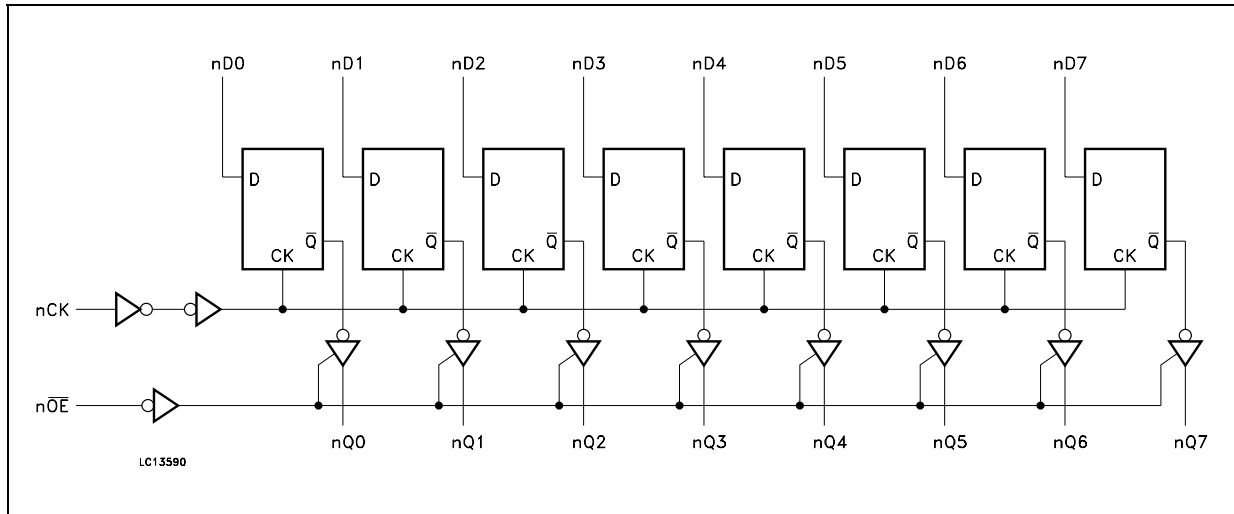
INPUTS			OUTPUTS
OE	CK	D	Q
H	X	X	Z
L		X	NO CHANGE
L		L	L
L		H	H

X : Don't Care
Z : High Impedance

IEC LOGIC SYMBOLS



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 +7.0	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	± 75	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

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) ($V_{CC} = 3.3 \pm 0.3V$) ($V_{CC} = 5.0 \pm 0.5V$)	0 to 100 0 to 20	ns/V

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

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 _{OZ}	High Impedance Output Leakage Current	5.5	V _I = V _{IH} or V _{IL} V _O = V _{CC} or GND			±0.25		± 2.5		± 5	μA
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

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3\text{ns}$)

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 CK to Q	3.3 ^(*)	15			9	15	1	17	1	17	ns
		3.3 ^(*)	50			10.6	16.2	1	18.5	1	18.5	
		5.0 ^(**)	15			5.4	9.1	1	10.1	1	10.1	
		5.0 ^(**)	50			6.9	10.1	1	11.5	1	11.5	
t _{PZL} t _{PZH}	Output Enable Time	3.3 ^(*)	15			8	13	1	15	1	15	ns
		3.3 ^(*)	50			9.6	14.9	1	16	1	16	
		5.0 ^(**)	15			5.1	9.1	1	10	1	10	ns
		5.0 ^(**)	50			6.6	10.1	1	11.5	1	11.5	
t _{PLZ} t _{PHZ}	Output Disable Time	3.3 ^(*)	50			11.8	15.5	1	17	1	17	ns
		5.0 ^(**)	50			6.1	10.5	1	11.5	1	11.5	
t _w	Pulse Width (CK) HIGH or LOW	3.3 ^(*)			5			5		5		ns
		5.0 ^(**)			5			5		5		
t _s	Setup Time Dn to CK HIGH or LOW	3.3 ^(*)			4.5			4		4		ns
		5.0 ^(**)			3			3		3		
t _h	Hold Time Dn to LE HIGH or LOW	3.3 ^(*)			2			2		2		ns
		5.0 ^(**)			2			2		2		
f _{MAX}	Maximum Clock Frequency	3.3 ^(*)			80	130		70		70		MHz
		5.0 ^(**)			130	185		110		110		
t _{OSLH} t _{OSHL}	Output to Output Skew time (note 1)	3.3 ^(*)	50				1.5		1.5		1.5	ns
		5.0 ^(**)	50				1		1		1	

(*) Voltage range is $3.3\text{V} \pm 0.3\text{V}$ (**) Voltage range is $5.0\text{V} \pm 0.5\text{V}$ Note 1 : Parameter guaranteed by design. $t_{soLH} = |t_{pLHm} - t_{pLHn}|$, $t_{soHL} = |t_{pHLm} - t_{pHLn}|$ **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				2.5	10		10		10	pF
C _{OUT}	Output Capacitance				4						pF
C _{PD}	Power Dissipation Capacitance (note 1)	5.0	f _{IN} = 10MHz		21						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. $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/16$ (per Latch)

DYNAMIC SWITCHING CHARACTERISTICS

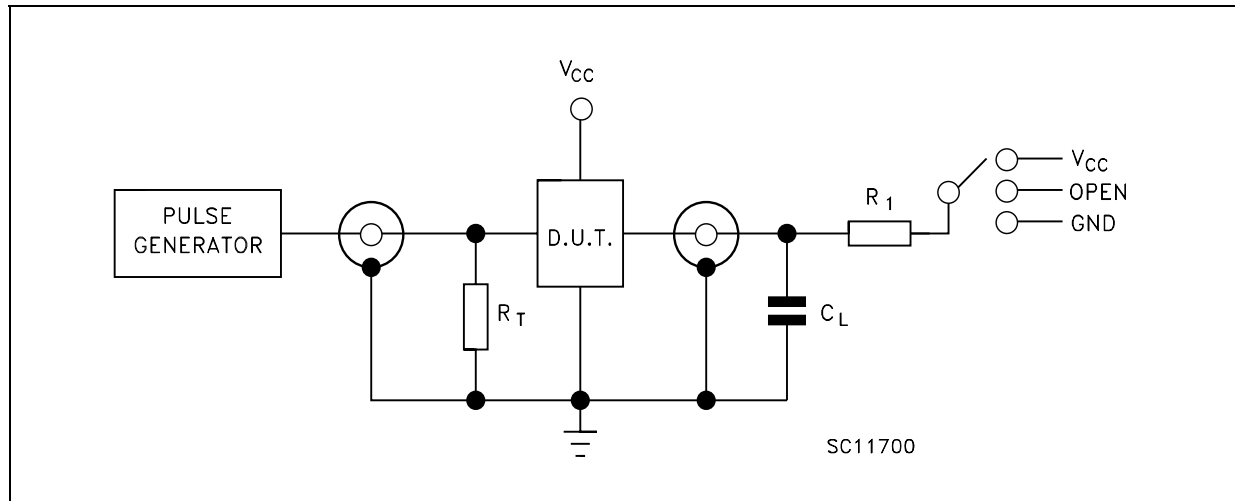
Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V _{OLP}	Dynamic Low Voltage Quiet Output (note 1, 2)	5.0	C _L = 50 pF		0.6	0.9					V
V _{OLV}				-0.9	-0.6						
V _{IHD}	Dynamic High Voltage Input (note 1, 3)	5.0		3.5							V
V _{ILD}	Dynamic Low Voltage Input (note 1, 3)	5.0					1.5				

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.

TEST CIRCUIT



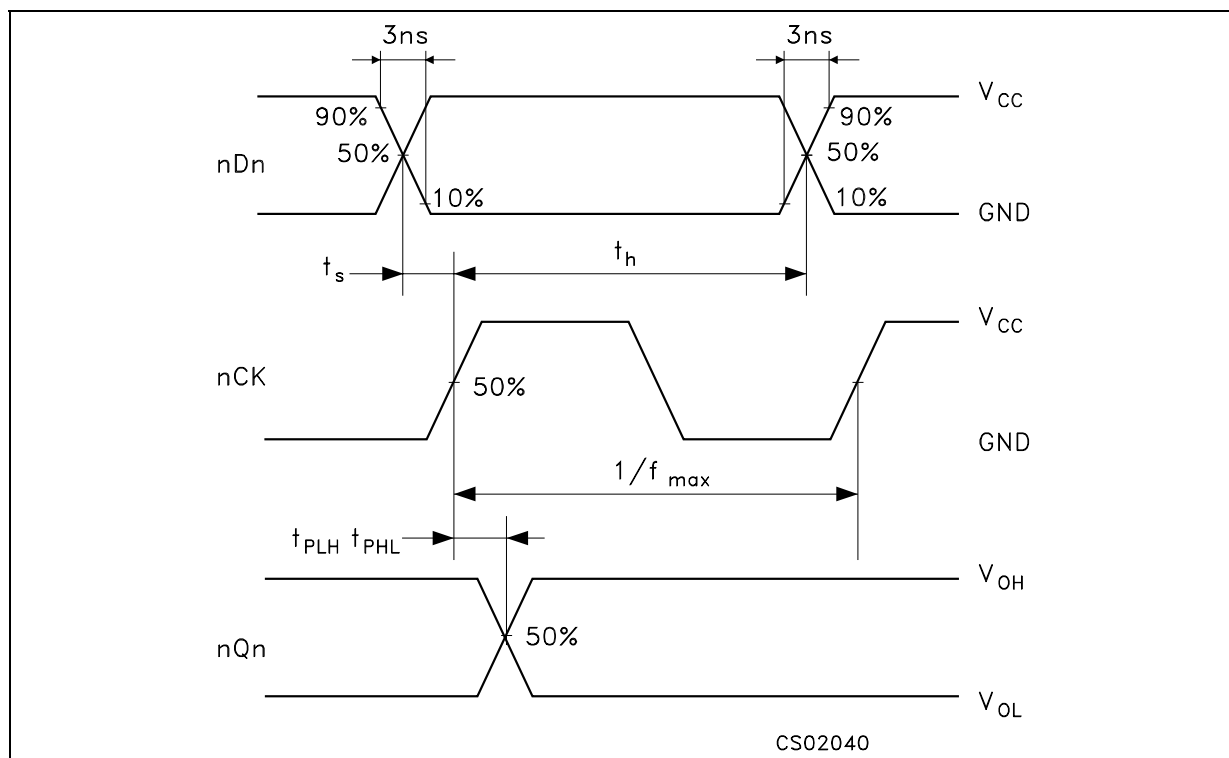
TEST	SWITCH
t _{PLH} , t _{PHL}	Open
t _{PZL} , t _{PLZ}	V _{CC}
t _{PZH} , t _{PHZ}	GND

C_L = 15/50 pF or equivalent (includes jig and probe capacitance)

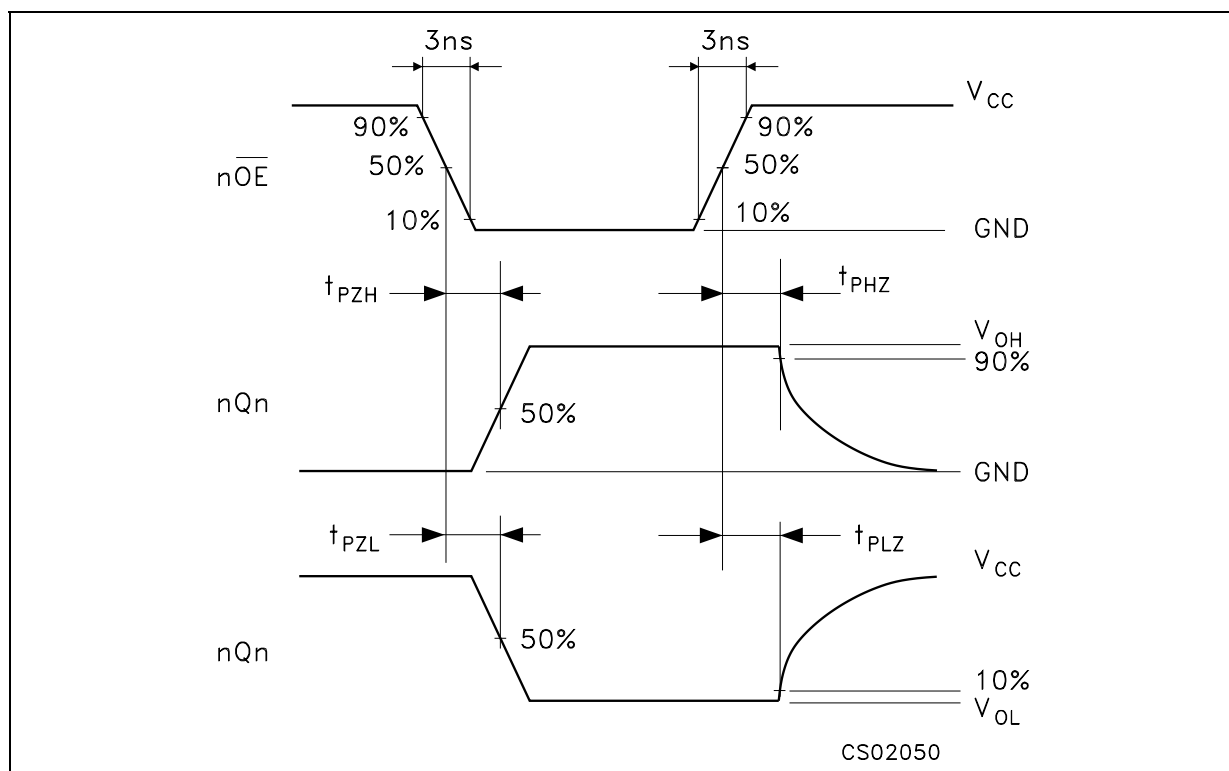
R_L = R₁ = 1KΩ or equivalent

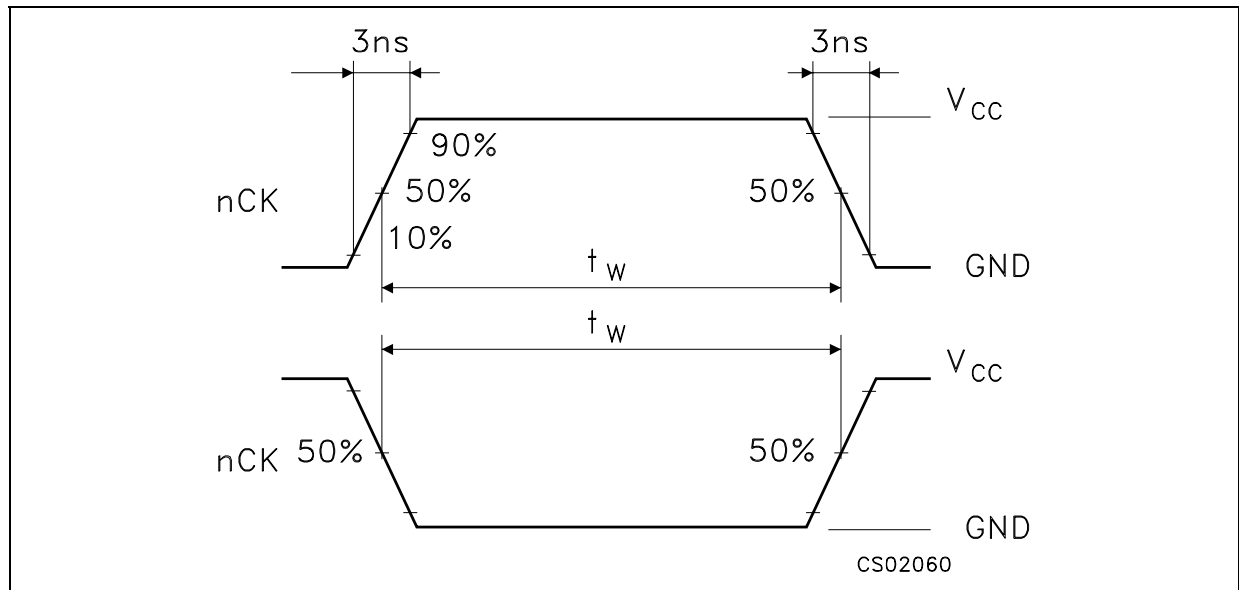
R_T = Z_{OUT} of pulse generator (typically 50Ω)

WAVEFORM 1 PROPAGATION DELAYS, SETUP AND HOLD TIMES, MAXIMUM CLOCK FREQUENCY ($f=1\text{MHz}$; 50% duty cycle)



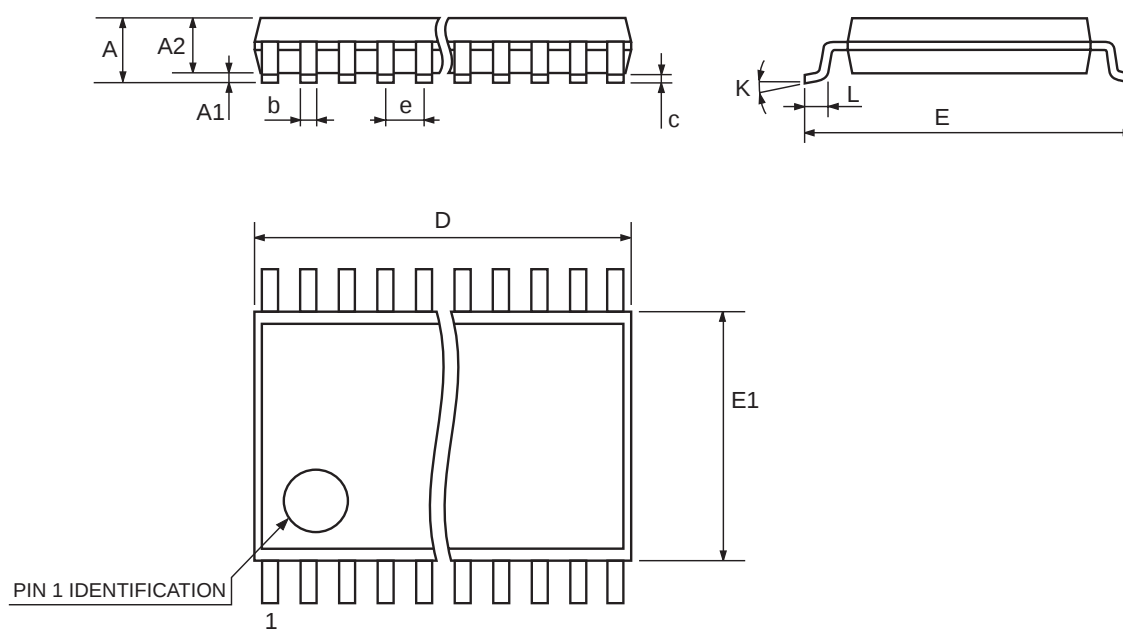
WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME ($f=1\text{MHz}$; 50% duty cycle)



WAVEFORM 3 : CLOCK PULSE WIDTHS ($f=1\text{MHz}$; 50% duty cycle)

TSSOP48 MECHANICAL DATA

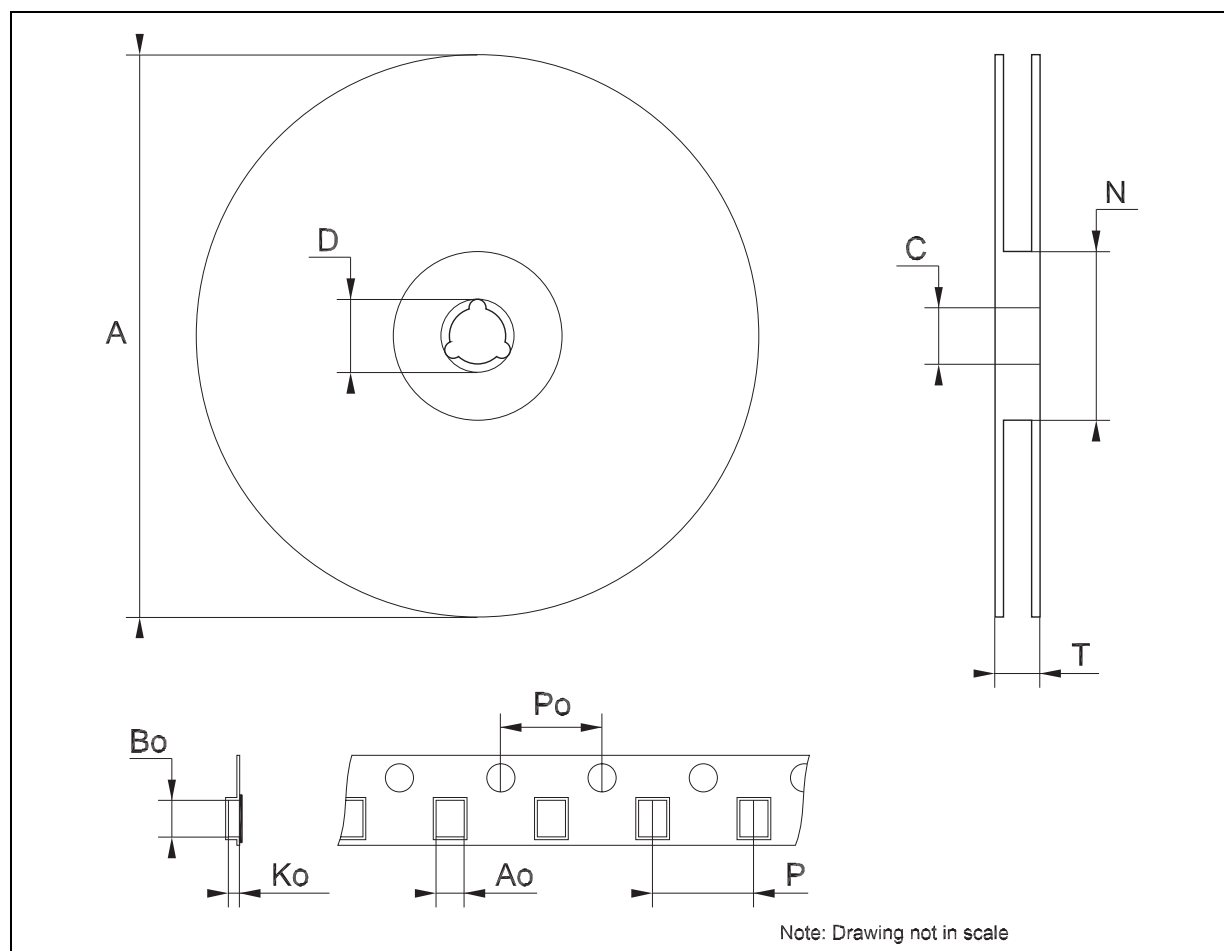
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2		0.9			0.035	
b	0.17		0.27	0.0067		0.011
c	0.09		0.20	0.0035		0.0079
D	12.4		12.6	0.488		0.496
E		8.1 BSC			0.318 BSC	
E1	6.0		6.2	0.236		0.244
e		0.5 BSC			0.0197 BSC	
K	0°		8°	0°		8°
L	0.50		0.75	0.020		0.030



7065588C

Tape & Reel TSSOP48 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			30.4			1.197
Ao	8.7		8.9	0.343		0.350
Bo	13.1		13.3	0.516		0.524
Ko	1.5		1.7	0.059		0.067
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476



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