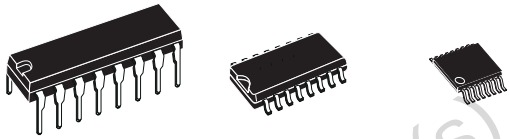
M74HC590

8 BINARY COUNTER REGISTER WITH 3 STATE OUTPUT

- HIGH SPEED:
  f_{MAX} = 61 MHz (TYP.) at V_{CC} = 6V
- LOW POWER DISSIPATION:
  I_{CC} = 4µA(MAX.) at T_A=25°C
- HIGH NOISE IMMUNITY:
  $V_{NIH} = V_{NIL}$ = 28 % V_{CC} (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 6mA (MIN) for QA ~ QH OUTPUT
  $|I_{OH}| = I_{OL}$ = 4mA (MIN) for RCO OUTPUT
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 590



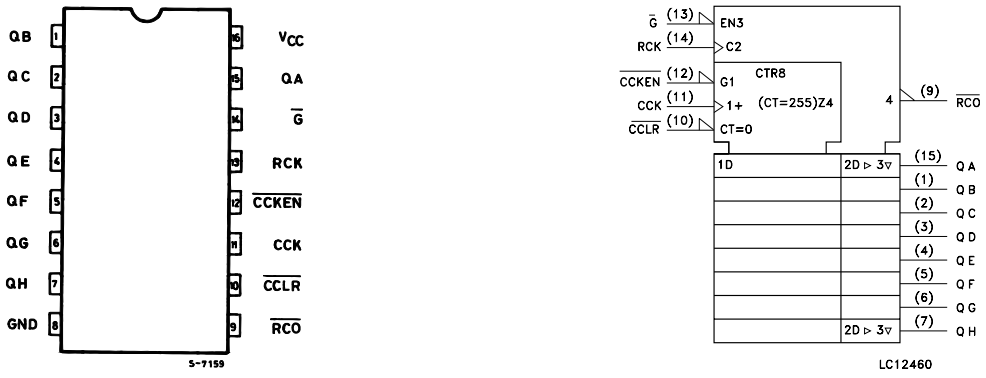
ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC590B1R	
SOP	M74HC590M1R	M74HC590RM13TR
TSSOP		M74HC590TTR

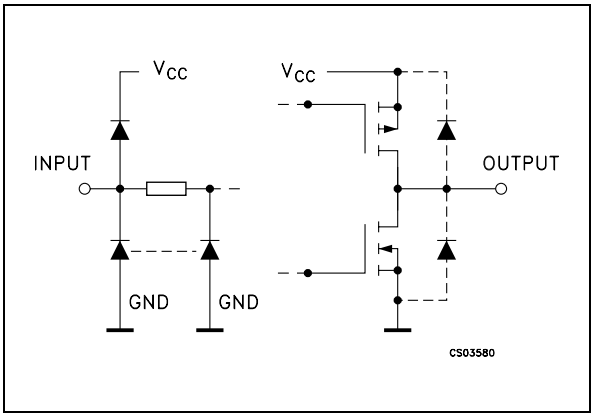
DESCRIPTION

The M74HC590 is an high speed CMOS 8-BIT BINARY COUNTER REGISTER (3 STATE) fabricated with silicon gate C^2MOS technology.
This device contains an 8-bit binary counter that feeds an 8-bit storage register. The storage register has parallel outputs. Separate clocks are provided for both the binary counter and storage register. The binary counter features a direct clear input $\overline{CCLR}$ and a count enable input $\overline{CCKEN}$. For cascading, a ripple carry output $\overline{RCO}$ is provided. Expansion is easily accomplished by tying $\overline{RCO}$ of the first stage to $\overline{CCKEN}$ of the second stage, etc. Both the counter and register clocks are positive edge triggered. If the user wishes to connect both clocks together, the counter state will always be one count ahead of the register. Internal circuitry prevents clocking from the clock enable. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

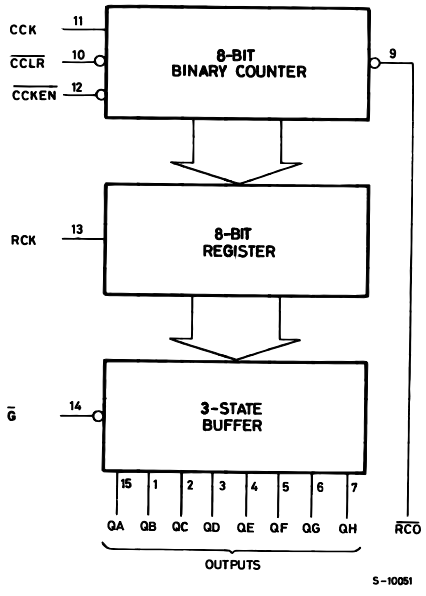
PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 15	QA to QH	Outputs
11	CCK	Counter Clock Input
12	$\overline{\text{CCKEN}}$	Counter Clock Enable Input
13	RCK	Register Clock Input
9	$\overline{\text{RCO}}$	Ripple Carry Output
14	$\overline{\text{G}}$	Output Enable Input
10	$\overline{\text{CCLR}}$	Counter Clear Input
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

TRUTH TABLE

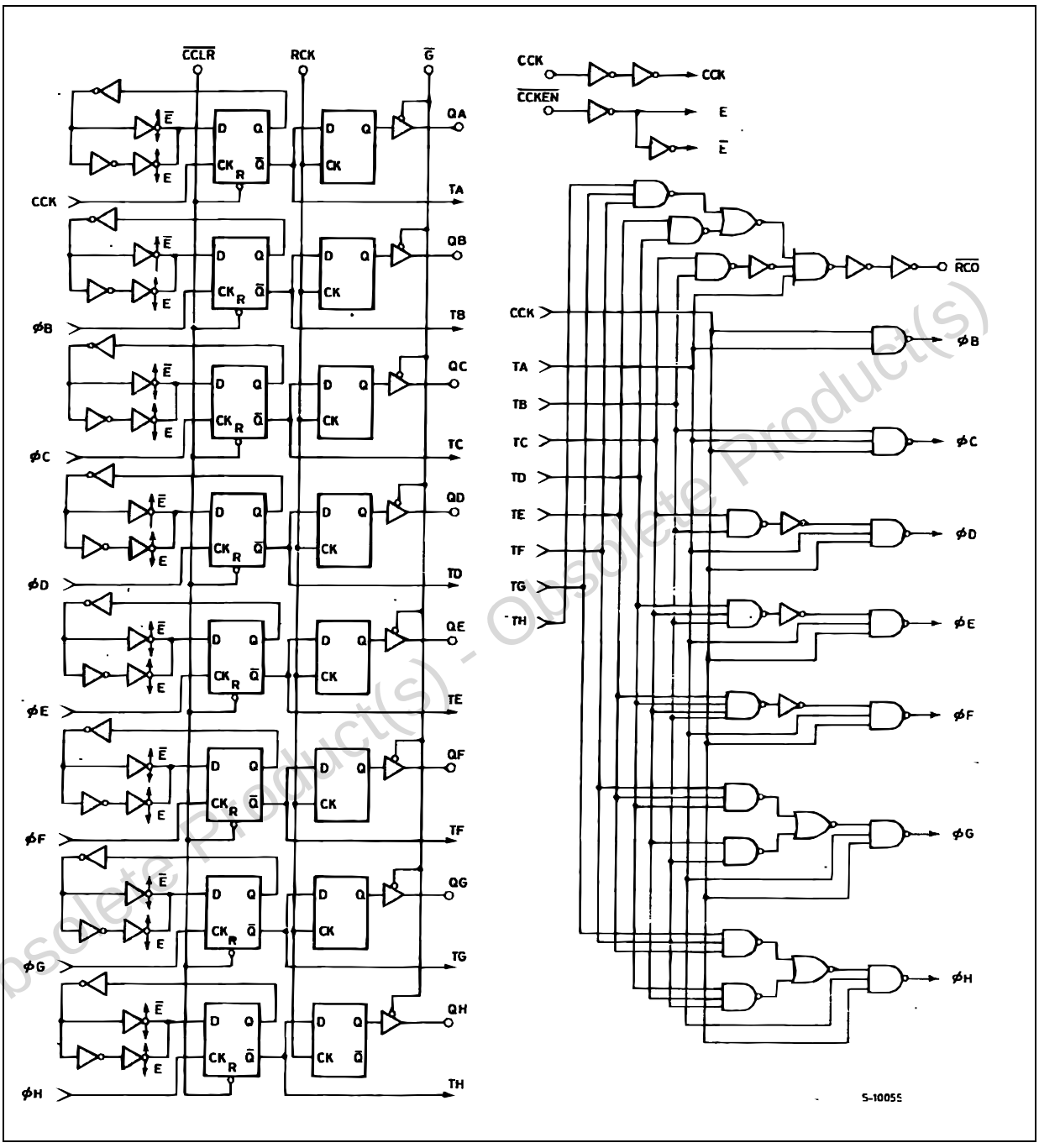
INPUTS					OUTPUT
$\overline{\text{G}}$	RCK	$\overline{\text{CCLR}}$	$\overline{\text{CCKEN}}$	CCK	
H	X	X	X	X	Q OUTPUTS DISABLE
L	X	X	X	X	Q OUTPUTS ENABLE
X	⌐	X	X	X	COUNTER DATA IS STORED INTO REGISTER
X	¬	X	X	X	REGISTER STAGE IS NOT CHANGED
X	X	L	X	X	COUNTER CLEAR
X	X	H	L	⌐	ADVANCE ONE COUNT
X	X	H	L	¬	NO COUNT
X	X	H	H	X	NO COUNT

X: Don't Care
$\overline{\text{RCO}}$ = QA'·QB'·QC'·QD'·QE'·QF'·QG'·QH(QA' to QH' : INTERNAL OUTPUTS OF THE COUNTER)

LOGIC DIAGRAM

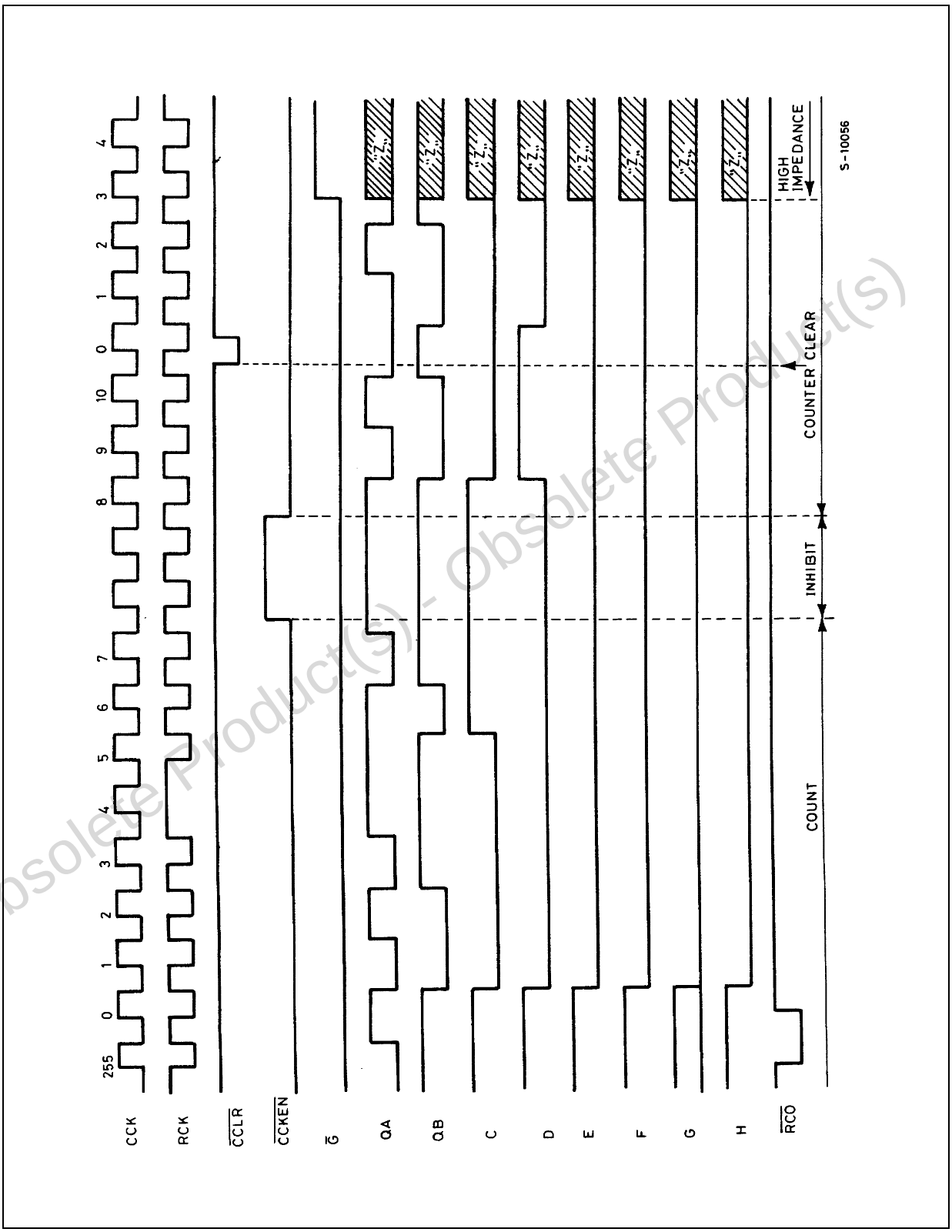


LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

TIMING CHART



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 Source Sink Current per Output PIN (RCO) (QA - QH)	± 25 ± 35	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 70	mA
P_D	Power Dissipation	500(*)	mW
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
(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		2 to 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
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2.0V	0 to 1000	ns
		V_{CC} = 4.5V	0 to 500	ns
		V_{CC} = 6.0V	0 to 400	ns

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
		4.5		3.15			3.15		3.15		
		6.0		4.2			4.2		4.2		
V_{IL}	Low Level Input Voltage	2.0				0.5		0.5		0.5	V
		4.5				1.35		1.35		1.35	
		6.0				1.8		1.8		1.8	
V_{OH}	High Level Output Voltage (for $\overline{RCO}$ Output)	2.0	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5	I_O=-20 µA	4.4	4.5		4.4		4.4		
		6.0	I_O=-20 µA	5.9	6.0		5.9		5.9		
		4.5	I_O=-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I_O=-5.2 mA	5.68	5.8		5.63		5.60		
V_{OH}	High Level Output Voltage (for QA to QH Outputs)	2.0	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5	I_O=-20 µA	4.4	4.5		4.4		4.4		
		6.0	I_O=-20 µA	5.9	6.0		5.9		5.9		
		4.5	I_O=-6.0 mA	4.18	4.31		4.13		4.10		
		6.0	I_O=-7.8 mA	5.68	5.8		5.63		5.60		
V_{OL}	Low Level Output Voltage (for $\overline{RCO}$ Output)	2.0	I_O=20 µA		0.0	0.1		0.1		0.1	V
		4.5	I_O=20 µA		0.0	0.1		0.1		0.1	
		6.0	I_O=20 µA		0.0	0.1		0.1		0.1	
		4.5	I_O=4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I_O=5.2 mA		0.18	0.26		0.33		0.40	
V_{OL}	Low Level Output Voltage (for QA to QH Outputs)	2.0	I_O=20 µA		0.0	0.1		0.1		0.1	V
		4.5	I_O=20 µA		0.0	0.1		0.1		0.1	
		6.0	I_O=20 µA		0.0	0.1		0.1		0.1	
		4.5	I_O=6.0 mA		0.17	0.26		0.33		0.40	
		6.0	I_O=7.8 mA		0.18	0.26		0.33		0.40	
I_I	Input Leakage Current	6.0	V_I = V_{CC} or GND			± 0.1		± 1		± 1	µA
I_{OZ}	High Impedance Output Leakage Current	6.0	V_I = V_{IH} or V_{IL} V_O = V_{CC} or GND			± 0.5		± 5		± 10	µA
I_{CC}	Quiescent Supply Current	6.0	V_I = V_{CC} or GND			4		40		80	µA

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6ns)

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_{TLH} t_{THL}	Output Transition Time	2.0	50			25	60		75		90	ns
		4.5				7	12		15		18	
		6.0				6	10		13		15	
t_{TLH} t_{THL}	Output Transition Time ($\overline{RCO}$)	2.0	50			30	75		95		115	ns
		4.5				8	15		19		23	
		6.0				7	13		16		20	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CCK}$ - $\overline{RCO}$)	2.0	50			56	165		205		250	ns
		4.5				19	33		41		50	
		6.0				16	28		35		43	
t_{PLH}	Propagation Delay Time ($\overline{CCLR}$ - $\overline{RCO}$)	2.0	50			53	175		220		265	ns
		4.5				21	35		44		53	
		6.0				18	30		37		45	
t_{PLH} t_{PHL}	Propagation Delay Time (RCK - Q)	2.0	50			48	145		180		220	ns
		4.5				17	29		36		44	
		6.0				14	25		31		37	
		2.0	150			60	185		230		280	ns
		4.5				21	37		46		56	
		6.0				18	31		39		48	
t_{PZL} t_{PZH}	High Impedance Output Enable Time	2.0	50	R_L = 1 KΩ		39	105		130		160	ns
		4.5				13	21		26		32	
		6.0				11	18		22		27	
		2.0	150	R_L = 1 KΩ		51	135		170		205	ns
		4.5				17	27		34		41	
		6.0				14	23		29		35	
t_{PLZ} t_{PHZ}	High Impedance Output Disable Time	2.0	50	R_L = 1 KΩ		28	105		130		160	ns
		4.5				14	21		26		32	
		6.0				12	18		22		27	
f_{MAX}	Maximum Clock Frequency	2.0	50		6.6	13		5.2		4.4		MHz
		4.5			33	52		26		22		
		6.0			39	61		31		26		
$t_{W(L)}$ $t_{W(H)}$	Minimum Pulse Width (CCK, RCK)	2.0	50			36	100		125		145	ns
		4.5				9	20		25		29	
		6.0				8	17		21		25	
$t_{W(L)}$	Minimum Pulse Width ($\overline{CCLR}$)	2.0	50			32	75		95		110	ns
		4.5				8	15		19		22	
		6.0				7	13		16		19	
t_s	Minimum Set-up Time ($\overline{CCKEN}$ - CCK)	2.0	50			44	100		125		150	ns
		4.5				11	20		25		30	
		6.0				9	17		21		26	
$t_{s(H)}$	Minimum Set-up Time (CCK - RCK)	2.0	50			76	175		220		255	ns
		4.5				19	35		44		51	
		6.0				16	30		37		43	
t_h	Minimum Hold Time	2.0	50				0		0		0	ns
		4.5					0		0		0	
		6.0					0		0		0	

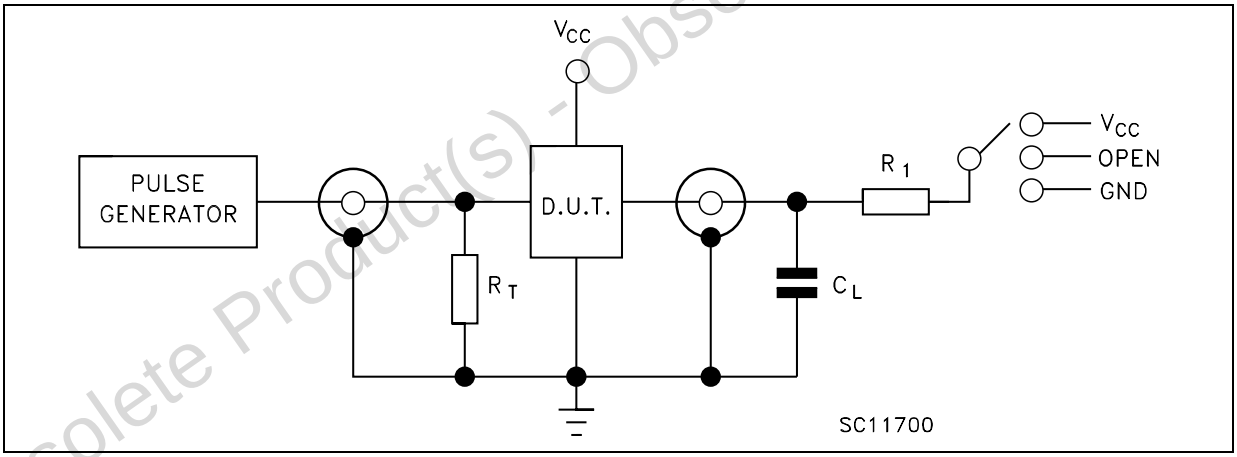
Symbol	Parameter	Test Condition			Value							Unit
		V_{CC} (V)	C_L (pF)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{REM}	Minimum Removal Time ($\overline{CCLR}$)	2.0	50			28	75		95		110	ns
		4.5				7	15		19		22	
		6.0				6	13		16		19	

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					5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)					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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

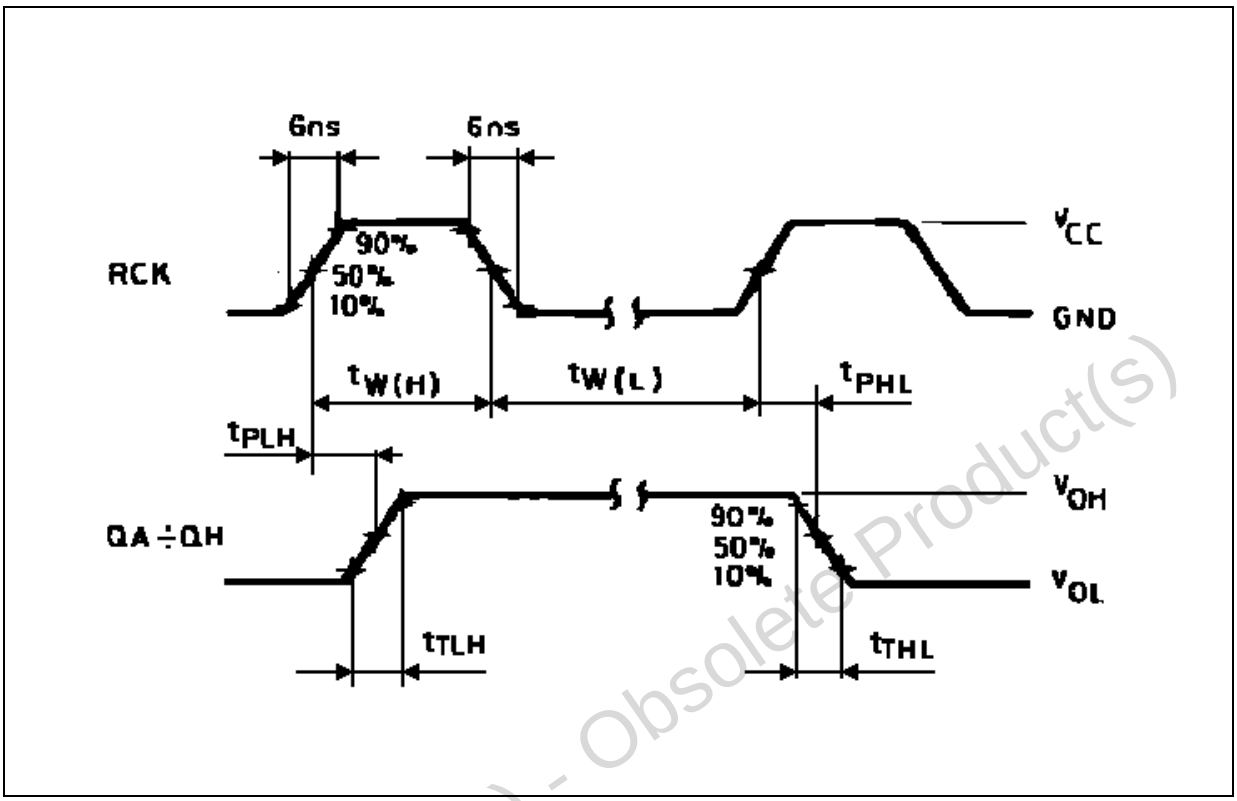
TEST CIRCUIT



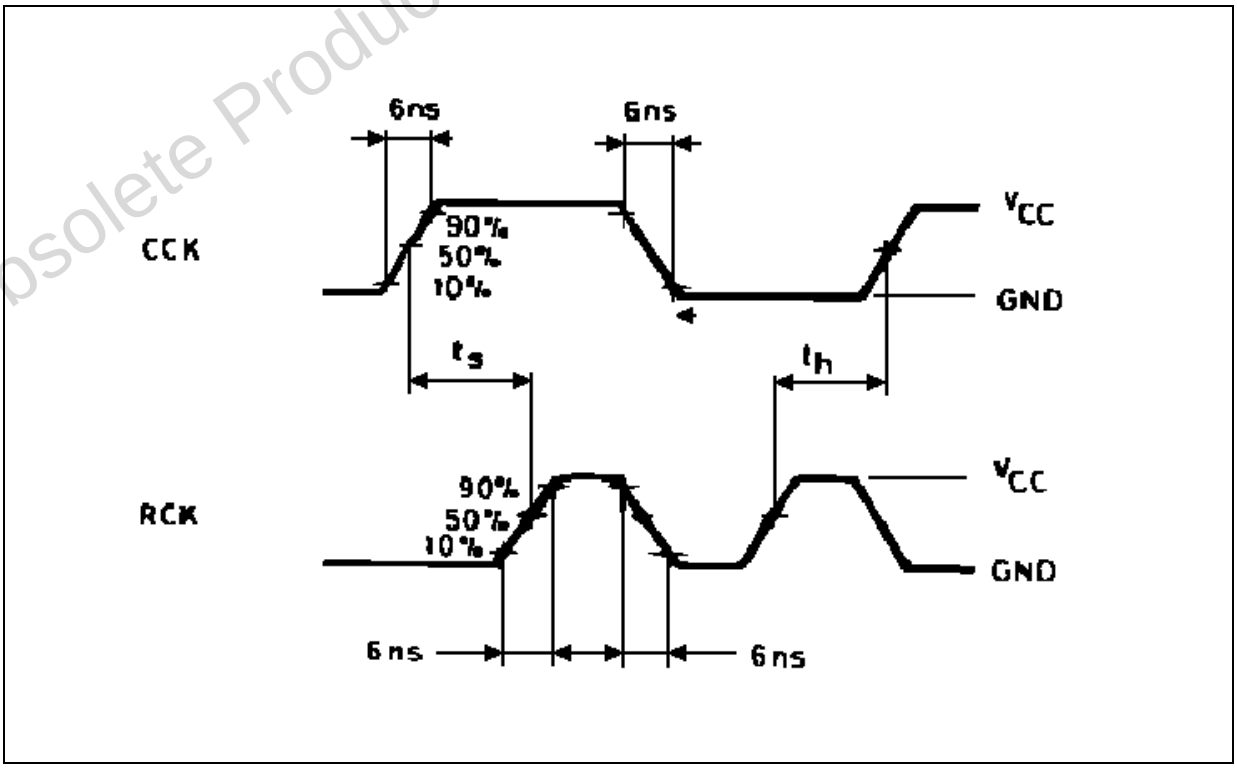
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	V_{CC}
t_{PZH}, t_{PHZ}	GND

C_L = 50pF/150pF or equivalent (includes jig and probe capacitance)
R_1 = 1KΩ or equivalent
R_T = Z_{OUT} of pulse generator (typically 50Ω)

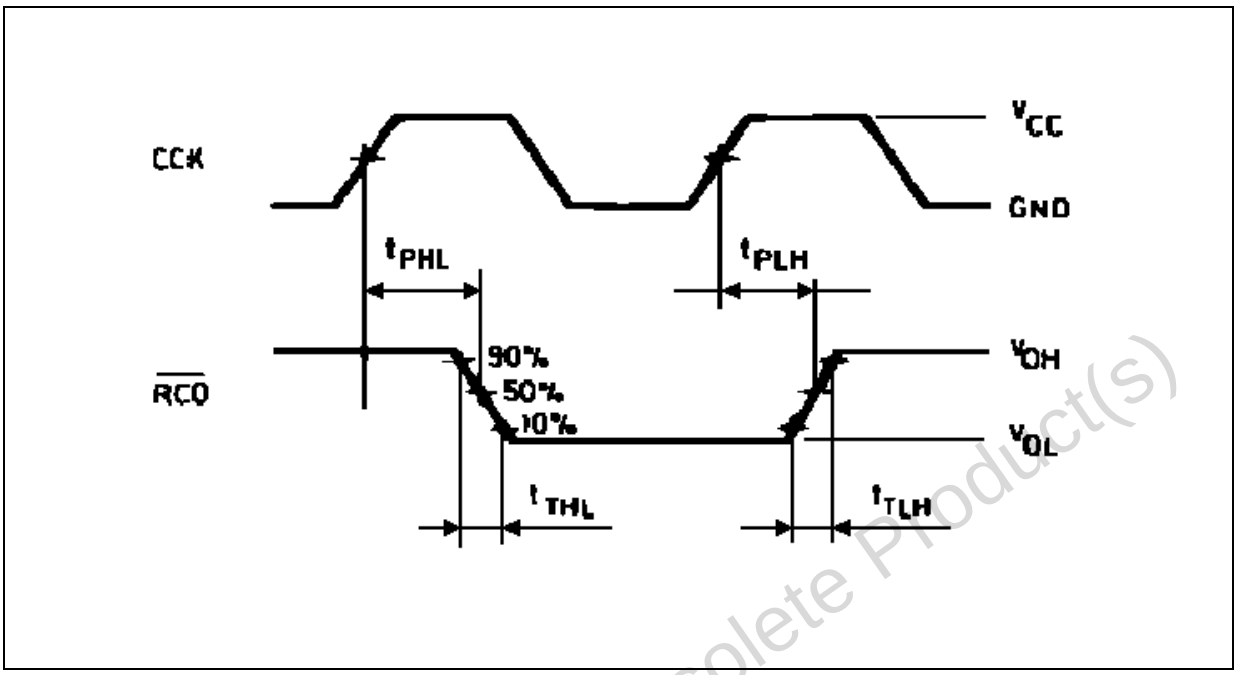
WAVEFORM 1 : PROPAGATION DELAY, MINIMUM PULSE WIDTH (f=1MHz; 50% duty cycle)



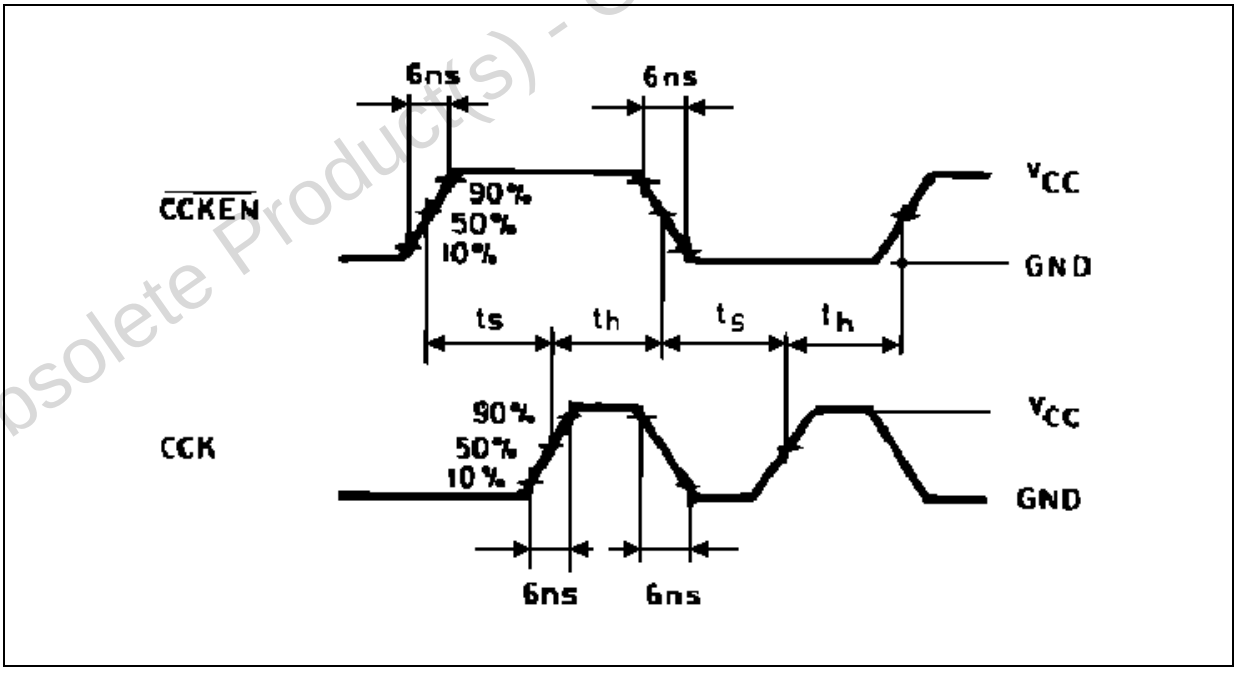
WAVEFORM 2 : MINIMUM SETUP AND HOLD TIME (f=1MHz; 50% duty cycle)



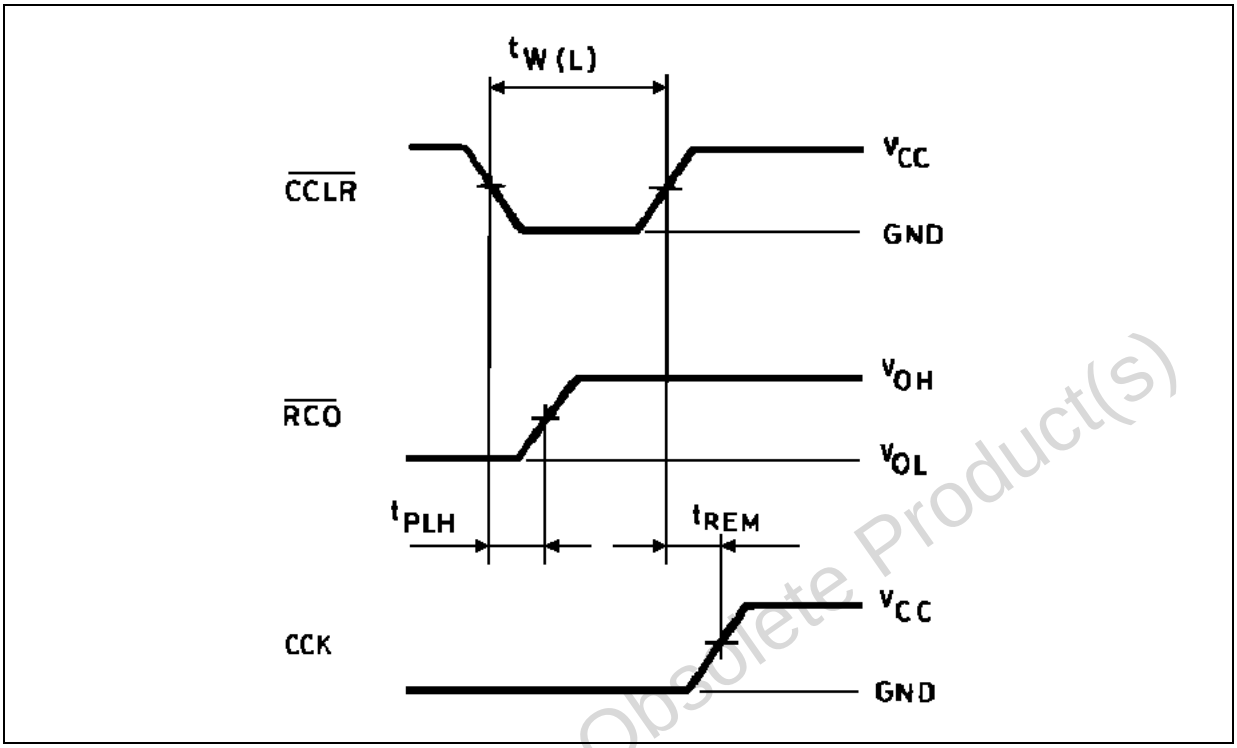
WAVEFORM 3 : PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)



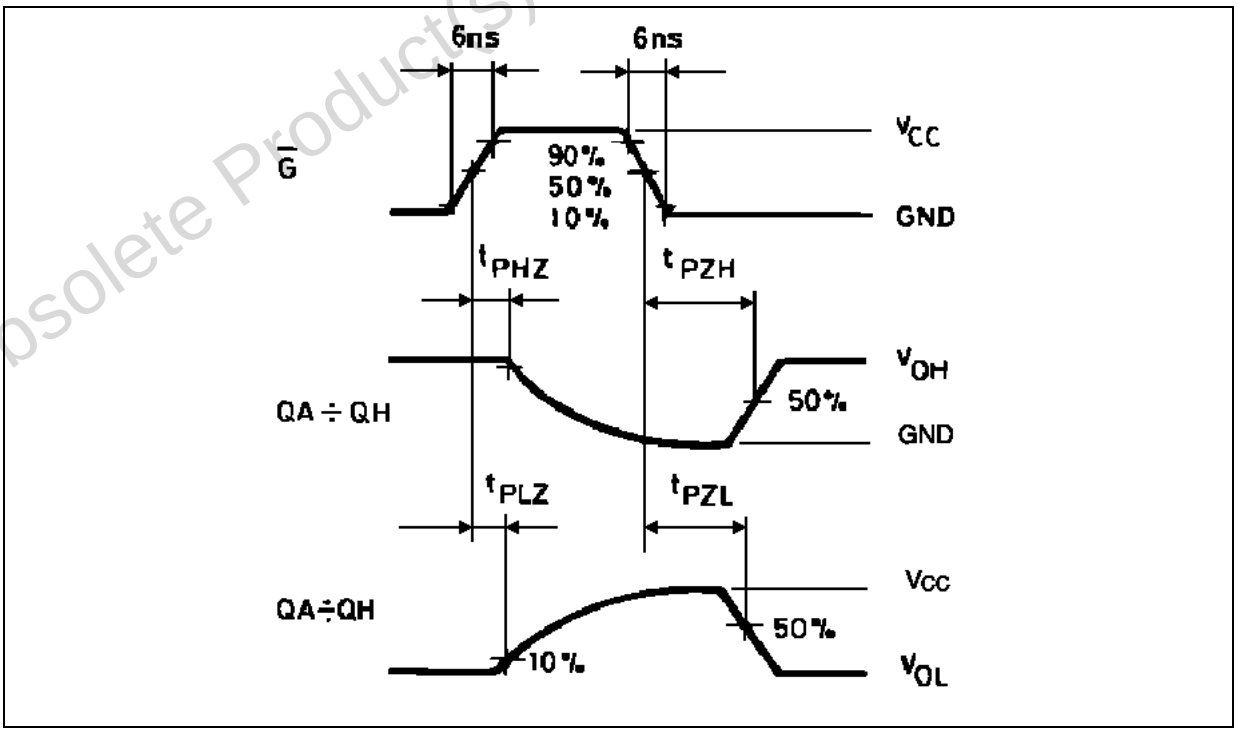
WAVEFORM 4 : MINIMUM SETUP AND HOLD TIME (f=1MHz; 50% duty cycle)



WAVEFORM 5 : MINIMUM PULSE WIDTH, REMOVAL TIME (f=1MHz; 50% duty cycle)

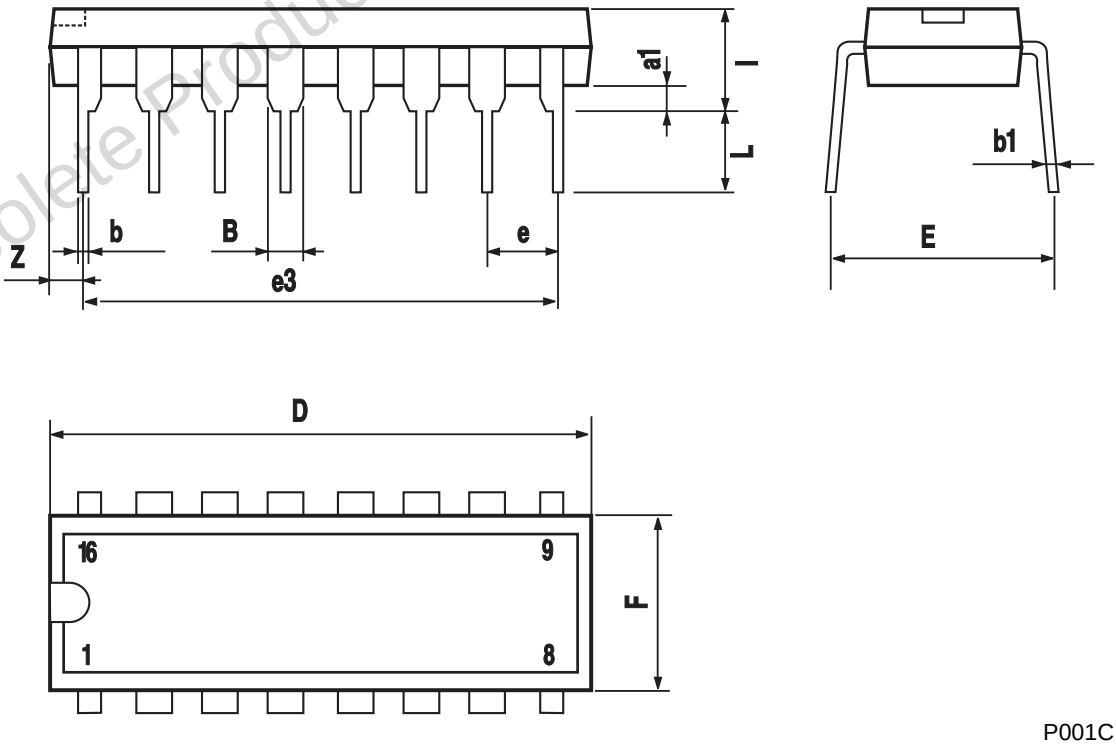


WAVEFORM 6 : OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cycle)



Plastic DIP-16 (0.25) MECHANICAL DATA

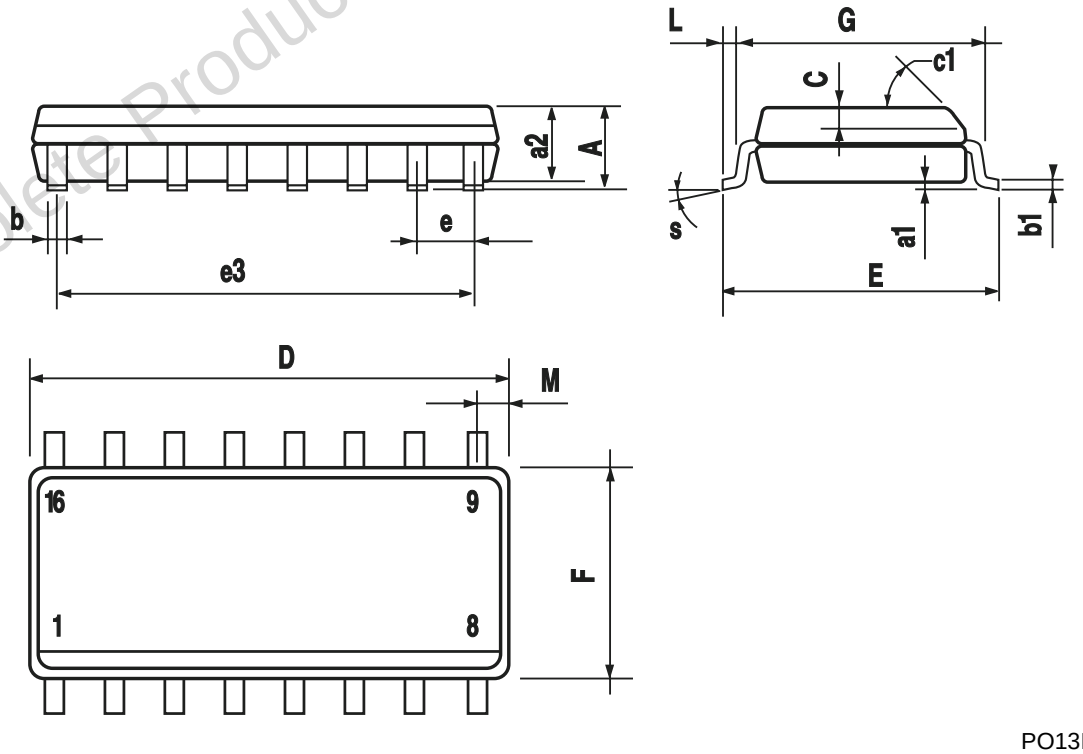
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
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.)					



PO13H

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		0.0089
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