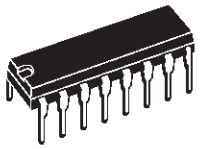
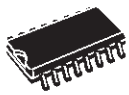
74AC161

SYNCHRONOUS PRESETTABLE 4-BIT COUNTER

- HIGH SPEED:
  f_{MAX} =125 MHz (TYP.) at V_{CC} = 5V
- LOW POWER DISSIPATION:
  I_{CC} = 8 µA (MAX.) at T_A = 25 °C
- HIGH NOISE IMMUNITY:
  $V_{NIH} = V_{NIL}$ = 28% V_{CC} (MIN.)
- 50Ω TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 24 mA (MIN)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 161
- IMPROVED LATCH-UP IMMUNITY



B
(Plastic Package)



M
(Micro Package)

ORDER CODES :

74AC161B 74AC161M

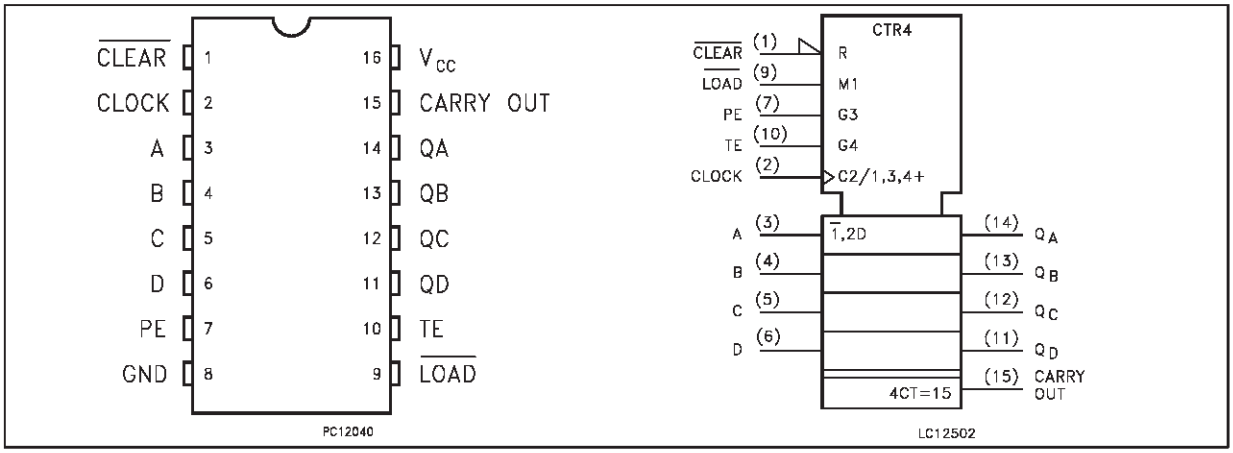
DESCRIPTION

The AC161 is a high-speed CMOS SYNCRONOUS PRESETTABLE COUNTER fabricated with sub-micron silicon gate and double-layer metal wiring C^2MOS technology. It is ideal for low power applications mantaining high speed operation similar to eqivalent Bipolar Schottky TTL. It is a 4 bit binary counter with Asynchronous Clear.

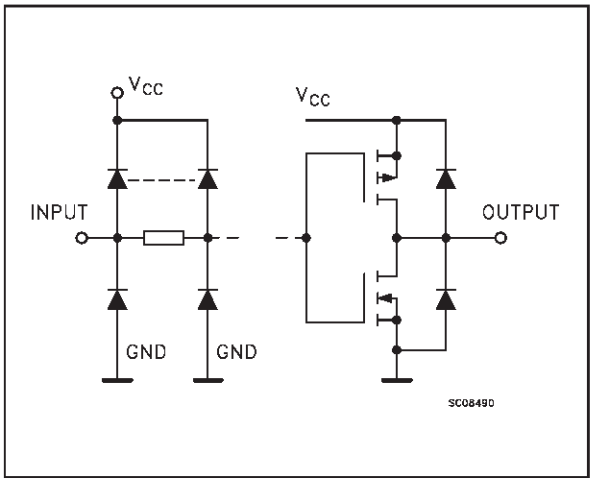
The circuit have four fundamental modes of operation, in order of preference: synchronous reset, parallel load, count-up and hold. Four control inputs, Master Reset ($\overline{CLEAR}$), Parallel Enable Input ($\overline{LOAD}$), Count Enable Input (PE) and Count Enable Carry Input (TE), determine the mode of operation as shown in the Truth Table. A LOW signal on $\overline{CLEAR}$ overrides counting and parallel loading and sets all outputs on LOW state. A LOW signal on $\overline{LOAD}$ overrides counting and allows information on Parallel Data Qn inputs to be loaded into the flip-flops on the next rising edge of CLOCK. With $\overline{LOAD}$ and $\overline{CLEAR}$, PE and TE permit counting when both are HIGH. Conversely, a LOW signal on either PE and TE inhibits counting.

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

PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

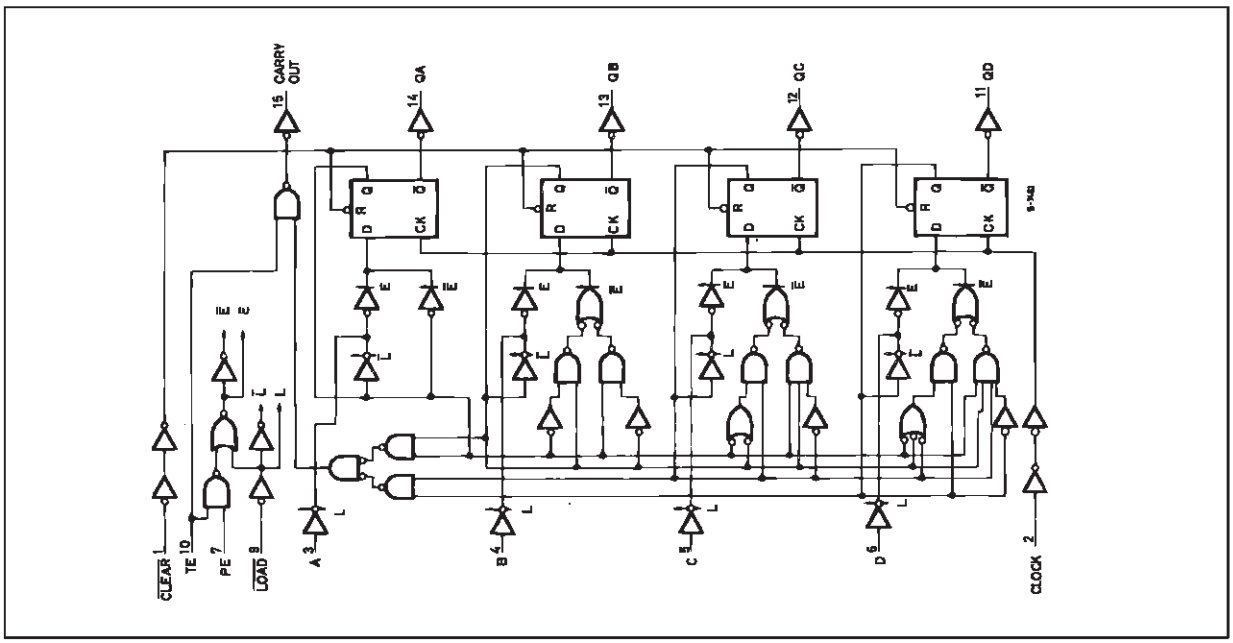
PIN No	SYMBOL	NAME AND FUNCTION
1	$\overline{CLEAR}$	Master Reset
2	CLOCK	Clock Input (LOW-to-HIGH, Edge- Triggered)
3, 4, 5, 6	A, B, C, D	Data Inputs
7	PE	Count Enable Input
10	TE	Count Enable Carry Input
9	$\overline{LOAD}$	Parallel Enable Input
14, 13, 12, 11	QA to QD	Flip-Flop Outpus
15	CARRY OUT	Terminal Count Output
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

TRUTH TABLE

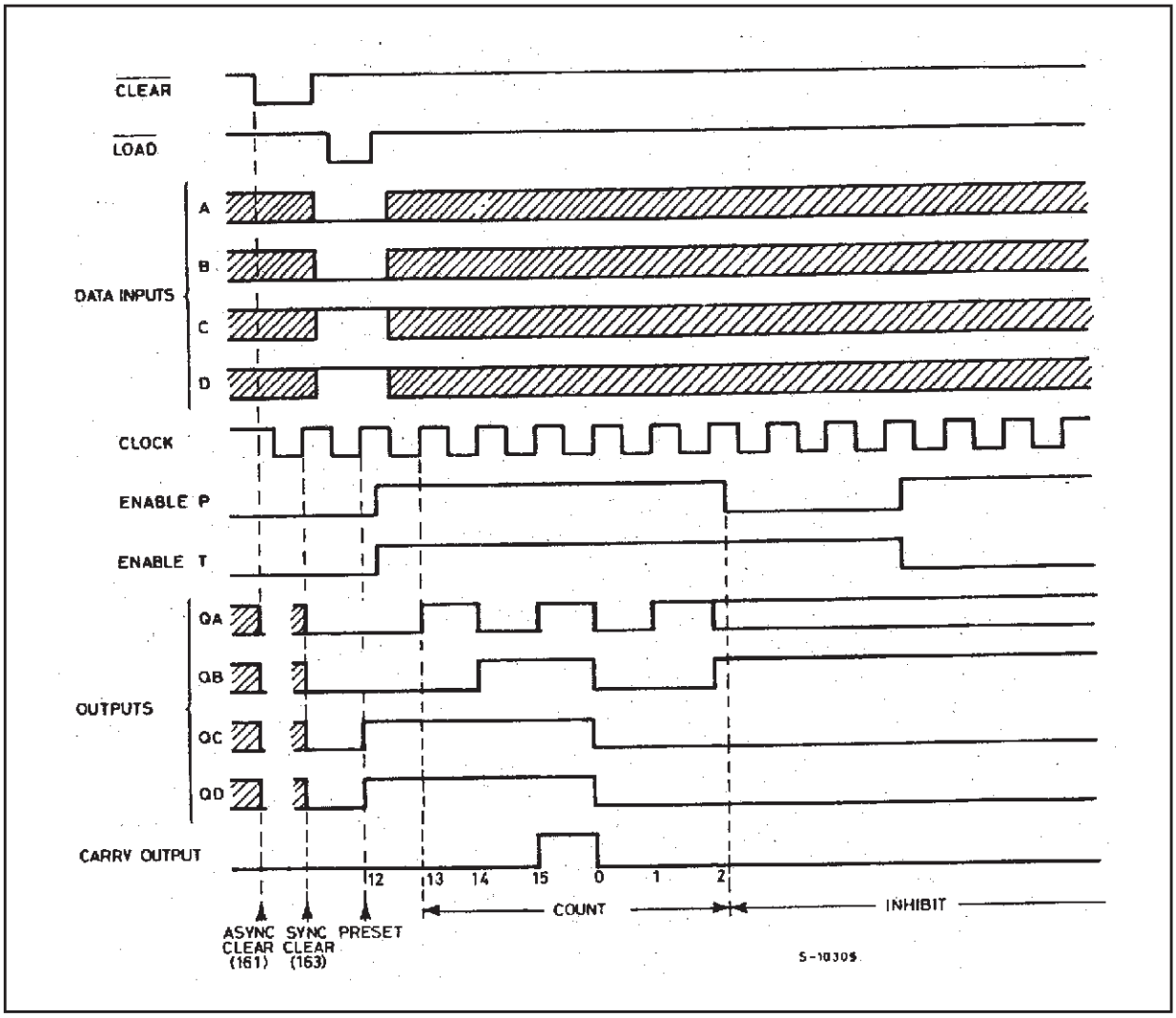
INPUTS					OUTPUTS				FUNCTION
$\overline{CLEAR}$	$\overline{LOAD}$	PE	TE	CLOCK	QA	QB	QC	QD	
L	X	X	X	X	L	L	L	L	RESET TO "0"
H	L	X	X	↑	A	B	C	D	PRESET DATA
H	H	X	L	↑	NO CHANGE				NO COUNT
H	H	L	X	↑	NO CHANGE				NO COUNT
H	H	H	H	↑	COUNT UP				COUNT
H	X	X	X	↑	NO CHANGE				NO COUNT

NOTE: X: Don't Care
A, B, C, D: Logic level of data input
CARRY OUT=TE • QA • QB • QC • QD

LOGIC DIAGRAMS



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 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 condition is not implied.

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:	-40 to +85	°C
dt/dv	Input Rise and Fall Time V_{CC} = 3.0, 4.5 or 5.5 V(note 1)	8	ns/V

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

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions			Value					Unit
		V_{CC} (V)			T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	3.0	V_O = 0.1 V or V_{CC} - 0.1 V		2.1	1.5		2.1		V
		4.5			3.15	2.25		3.15		
		5.5			3.85	2.75		3.85		
V_{IL}	Low Level Input Voltage	3.0	V_O = 0.1 V or V_{CC} - 0.1 V			1.5	0.9		0.9	V
		4.5				2.25	1.35		1.35	
		5.5				2.75	1.65		1.65	
V_{OH}	High Level Output Voltage	3.0	V_I(*) = V_{IH} or V_{IL}	I_O=-50 µA	2.9	2.99		2.9		V
		4.5		I_O=-50 µA	4.4	4.49		4.4		
		5.5		I_O=-50 µA	5.4	5.49		5.4		
		3.0		I_O=-12 mA	2.56			2.46		
		4.5		I_O=-24 mA	3.86			3.76		
		5.5		I_O=-24 mA	4.86			4.76		
V_{OL}	Low Level Output Voltage	3.0	V_I(*) = V_{IH} or V_{IL}	I_O=50 µA		0.002	0.1		0.1	V
		4.5		I_O=50 µA		0.001	0.1		0.1	
		5.5		I_O=50 µA		0.001	0.1		0.1	
		3.0		I_O=12 mA			0.36		0.44	
		4.5		I_O=24 mA			0.36		0.44	
		5.5		I_O=24 mA			0.36		0.44	
I_I	Input Leakage Current	5.5	V_I = V_{CC} or GND				±0.1		±1	µA
I_{CC}	Quiescent Supply Current	5.5	V_I = V_{CC} or GND				8		80	µA
I_{OLD}	Dynamic Output Current (note 1, 2)	5.5	V_{OLD} = 1.65 V max						75	mA
I_{OHD}			V_{OHD} = 3.85 V min						-75	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 50 Ω.
(*) All outputs loaded.

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, R_L = 500 Ω, Input $t_r = t_f$ =3 ns)

Symbol	Parameter	Test Condition		Value					Unit
		V_{CC} (V)		T_A = 25 °C			-40 to 85 °C		
				Min.	Typ.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time CK to Q	3.3(*)			7.0	12.0		13.0	ns
		5.0(**)			5.0	9.0		10.0	
t_{PLH} t_{PHL}	Propagation Delay Time CK to CARRY OUT	3.3(*)			8.5	14.0		15.0	ns
		5.0(**)			6.0	10.0		11.0	
t_{PLH} t_{PHL}	Propagation Delay Time TE to CARRY OUT	3.3(*)			5.5	9.5		11.0	ns
		5.0(**)			3.5	6.5		7.5	
t_{PHL}	Propagation Delay Time $\overline{CLR}$ to Q	3.3(*)			6.5	12.0		13.0	ns
		5.0(**)			5.5	9.0		10.0	
t_{PHL}	Propagation Delay Time $\overline{CLR}$ to CARRY OUT	3.3(*)			7.0	12.0		13.0	ns
		5.0(**)			5.5	9.5		10.0	
t_{wL}	$\overline{CLR}$ pulse Width, LOW (LOAD)	3.3(*)			3.0	5.5		7.5	ns
		5.0(**)			2.5	4.5		6.0	
t_w	CK pulse Width HIGH or LOW	3.3(*)			2.0	3.5		4.0	ns
		5.0(**)			2.0	3.0		3.5	
t_s	Setup Time HIGH or LOW (INPUT to CLOCK)	3.3(*)			4.0	13.5		16.0	ns
		5.0(**)			1.5	8.5		10.5	
t_h	Hold Time HIGH or LOW (INPUT to CLOCK)	3.3(*)			-1.0	-1.0		0.5	ns
		5.0(**)			-0.5	0.5		1.0	
t_s	Setup Time HIGH or LOW (CLEAR to CLOCK)	3.3(*)			3.0	11.5		14.0	ns
		5.0(**)			2.0	7.5		8.5	
t_h	Hold Time HIGH or LOW (CLEAR to CLOCK)	3.3(*)			-2.5	0		0	ns
		5.0(**)			-2.0	0.5		1.0	
t_s	Setup Time HIGH or LOW (PE or TE to CLOCK)	3.3(*)			3.0	6.0		7.0	ns
		5.0(**)			2.0	4.5		5.0	
t_h	Hold Time HIGH or LOW (PE or TE to CLOCK)	3.3(*)			-3.5	0		0	ns
		5.0(**)			-2.0	0		0.5	
t_{REM}	Recovery Time $\overline{CLR}$ to CLOCK	3.3(*)			-1.0	0		0.5	ns
		5.0(**)			-0.5	0.5		1.0	
f_{MAX}	Maximum Clock Frequency	3.3(*)		70	110		60		MHz
		5.0(**)		110	165		95		

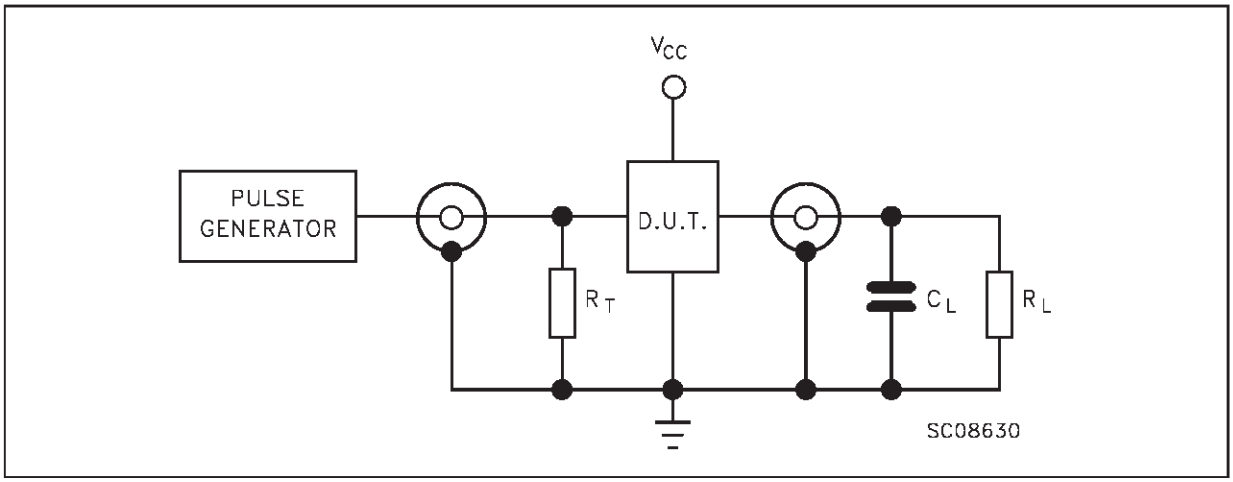
(*) Voltage range is 3.3V ± 0.3V
(**) Voltage range is 5V ± 0.5V

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions		Value					Unit
		V_{CC} (V)		T_A = 25 °C			-40 to 85 °C		
				Min.	Typ.	Max.	Min.	Max.	
C_{IN}	Input Capacitance	5.0			4.5				pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0	f_{IN} = 10 MHz		45				pF

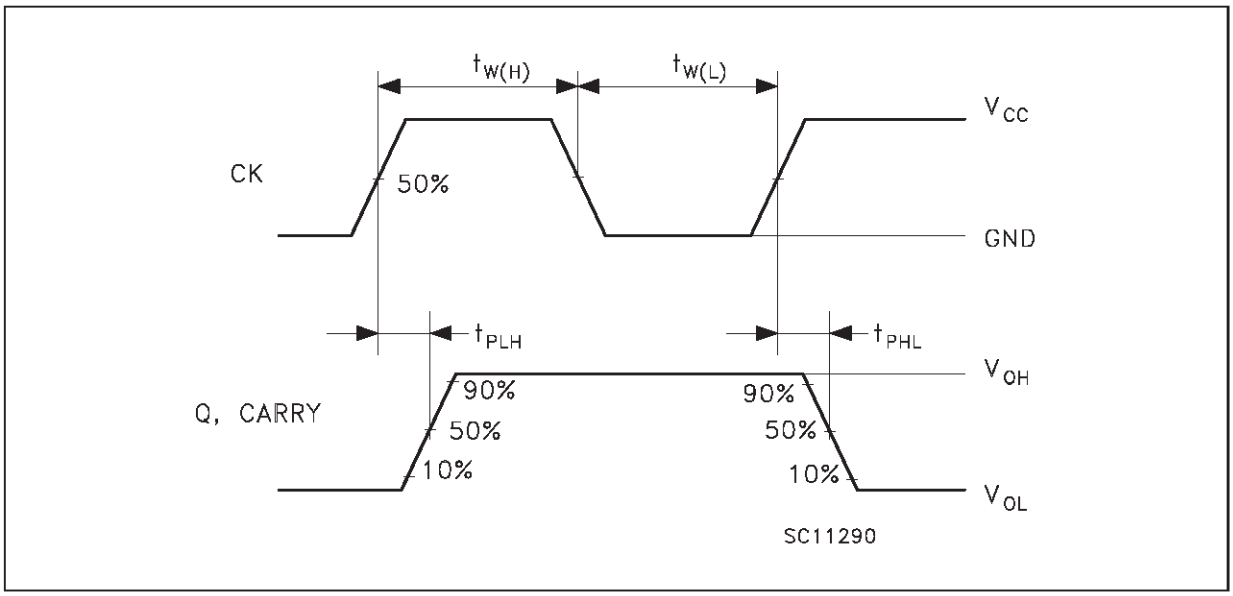
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/n$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

TEST CIRCUIT

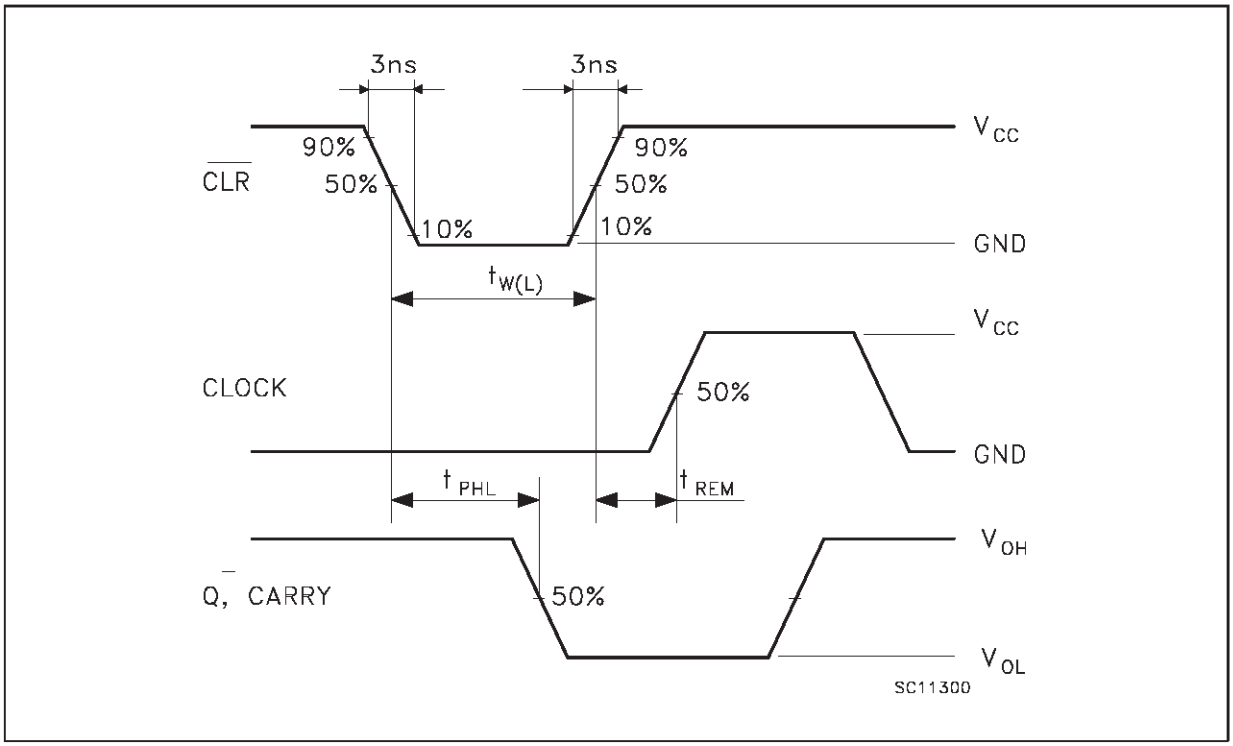


C_L = 50 pF or equivalent (includes jig and probe capacitance)
$R_L = R_1$ = 500Ω or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

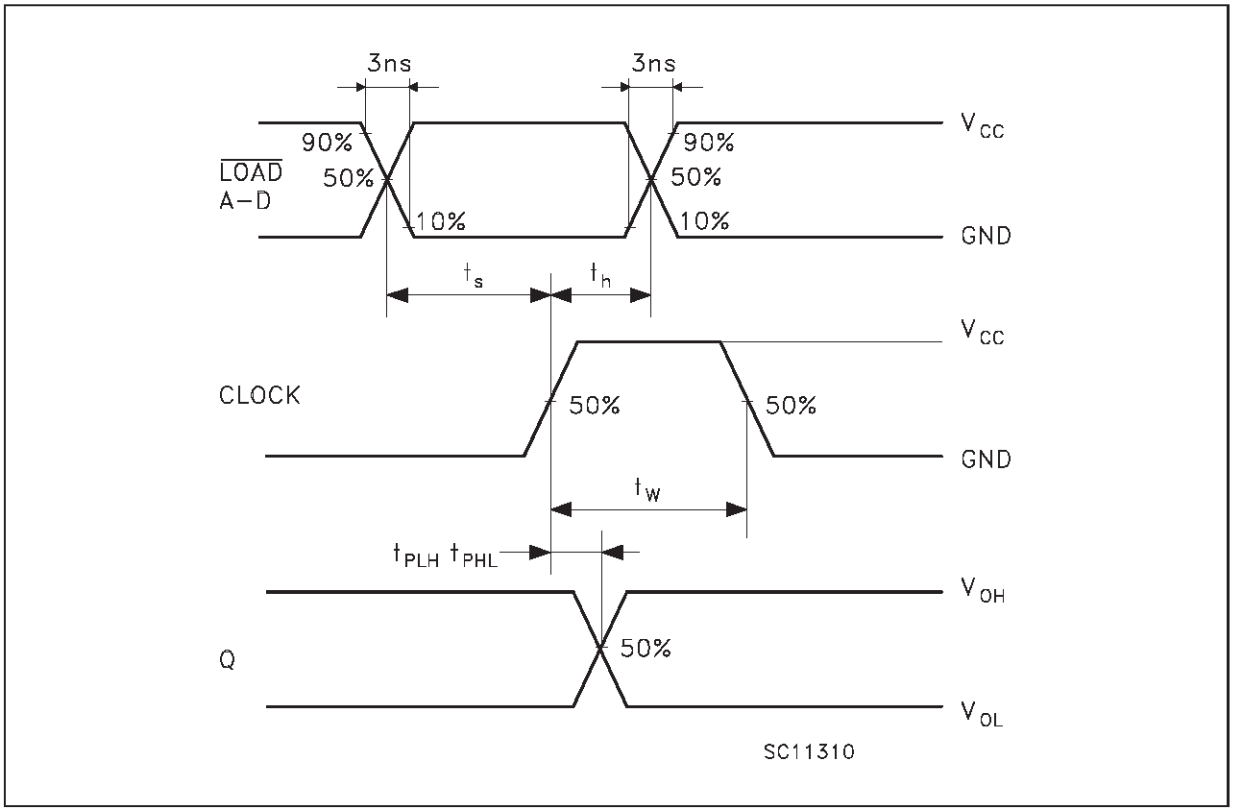
WAVEFORM 1: PROPAGATION DELAYS, COUNT MODE (f=1MHz; 50% duty cycle)



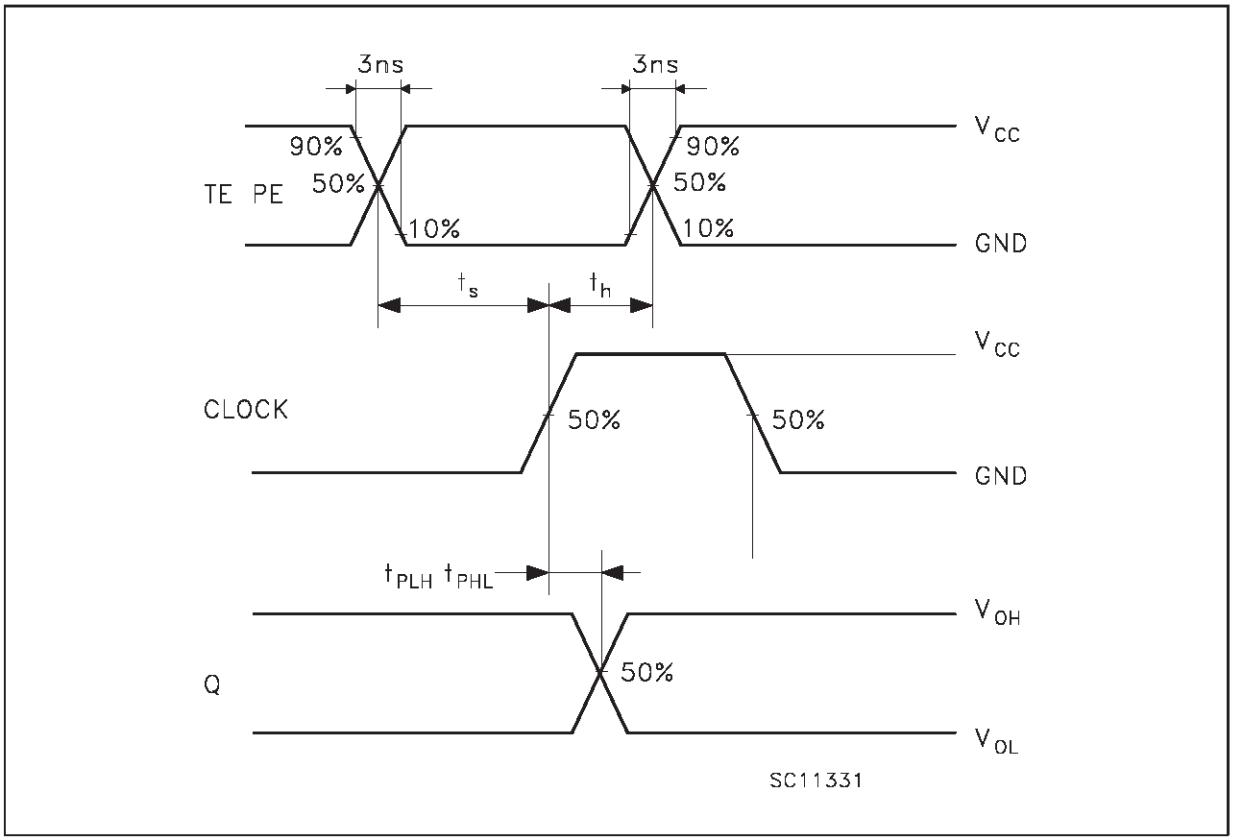
WAVEFORM 2: PROPAGATION DELAYS CLEAR MODE (f=1MHz; 50% duty cycle)



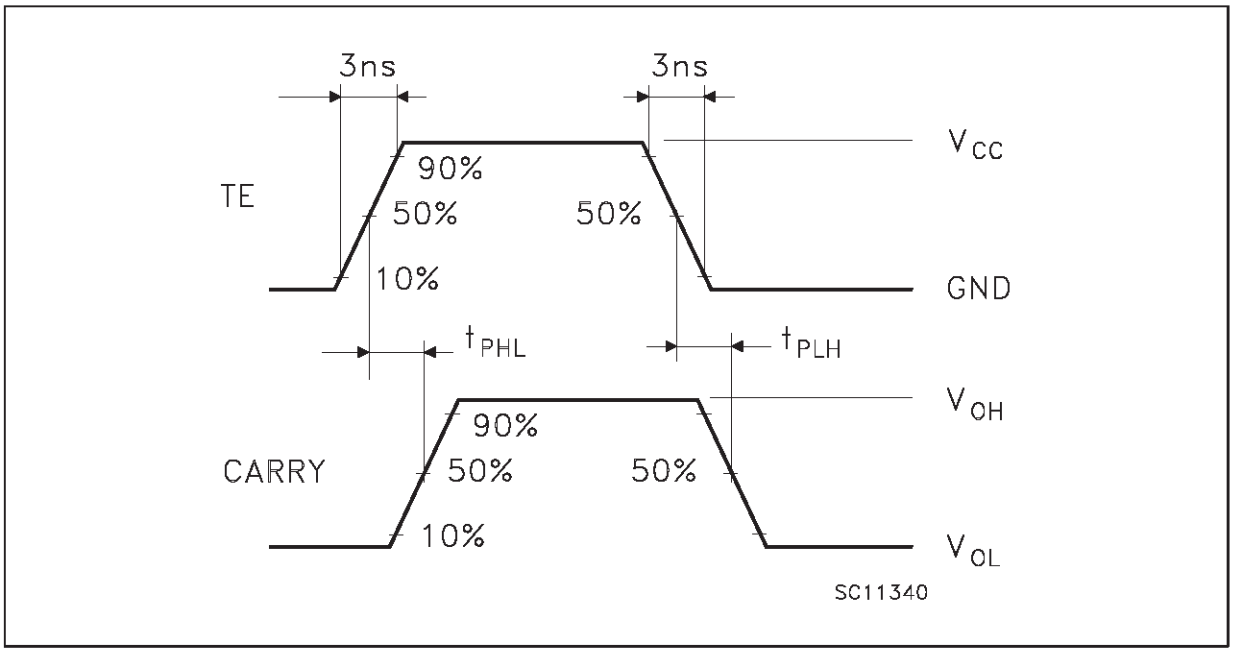
WAVEFORM 3: PROPAGATION DELAYS PRESET MODE (f=1MHz; 50% duty cycle)



WAVEFORM 4: PROPAGATION DELAYS COUNTEABLE MODE (f=1MHz; 50% duty cycle)

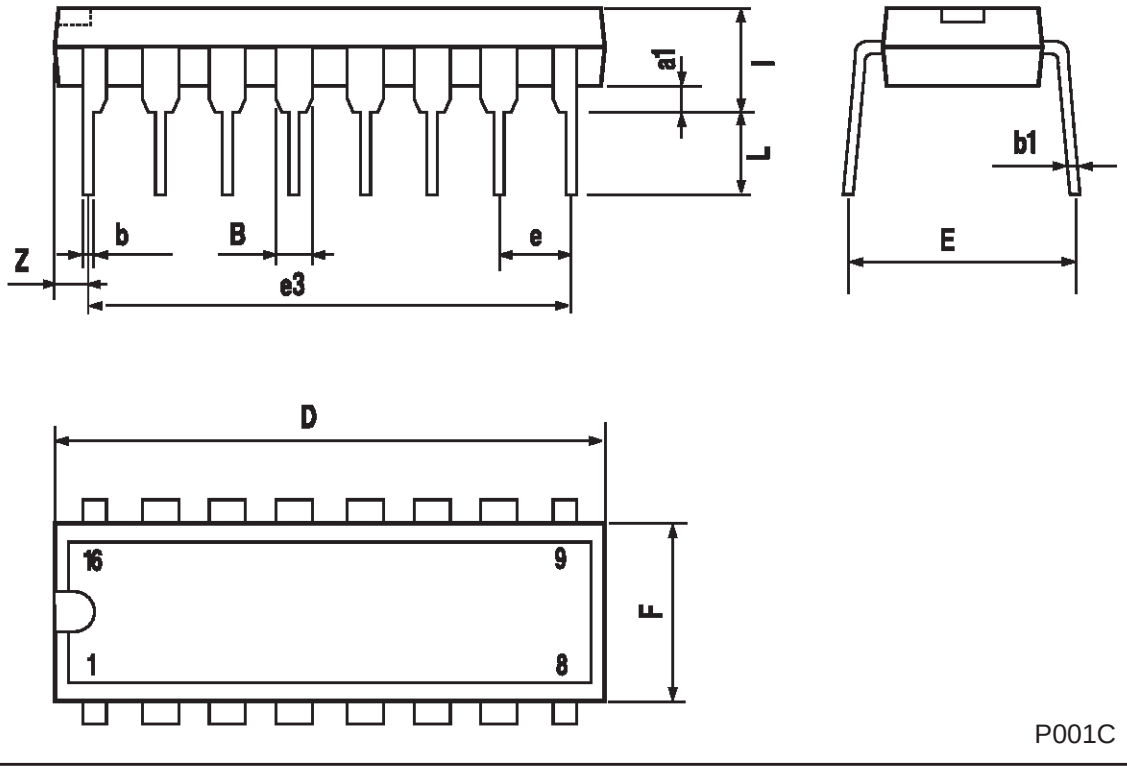


WAVEFORM 5: PROPAGATION DELAYS CASCADE MODE (f=1MHz; 50% duty cycle)



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



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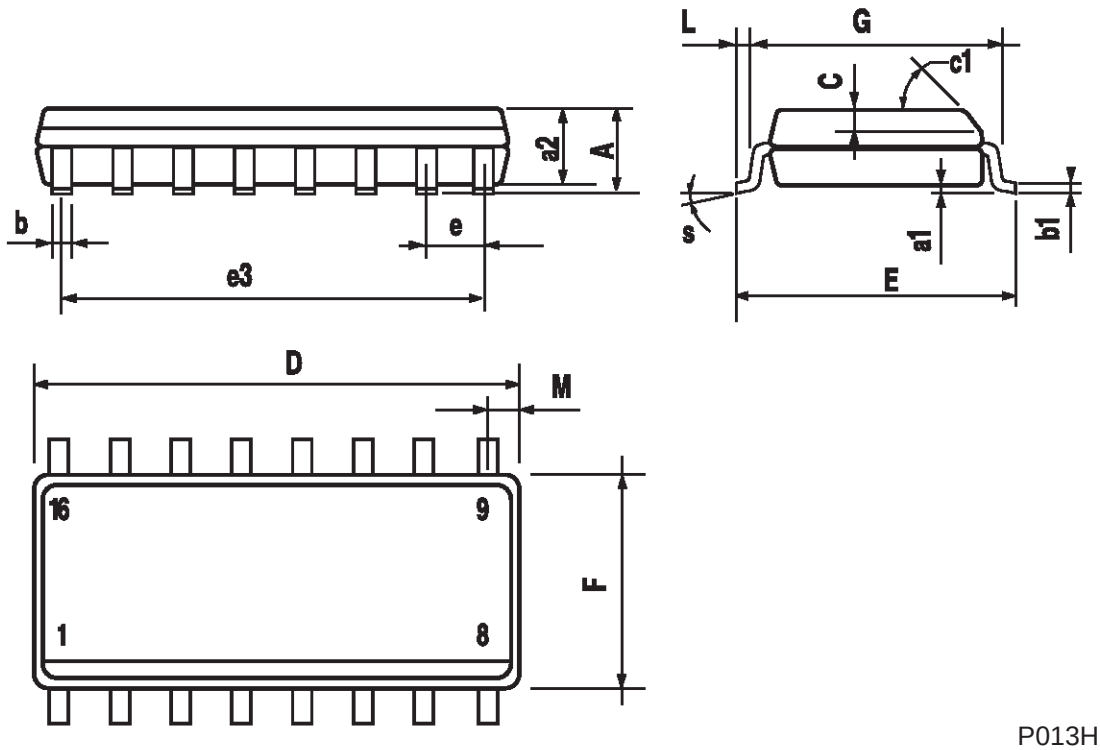
SO-16 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		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.)					



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