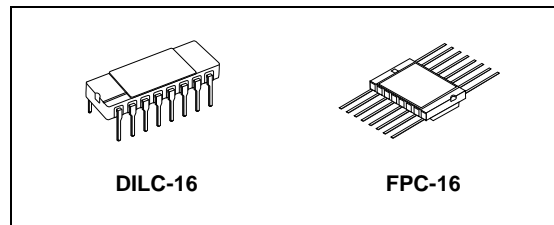




M54HC160

RAD-HARD SYNCHRONOUS PRESETTABLE 4-BIT COUNTER

- HIGH SPEED:
 $f_{MAX} = 62 \text{ MHz (TYP.) at } V_{CC} = 6V$
- LOW POWER DISSIPATION:
 $I_{CC} = 4\mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 4\text{mA (MIN)}$
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \cong t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- PIN AND FUNCTION COMPATIBLE WITH 54 SERIES 160
- SPACE GRADE-1: ESA SCC QUALIFIED
- 50 krad QUALIFIED, 100 krad AVAILABLE ON REQUEST
- NO SEL UNDER HIGH LET HEAVY IONS IRRADIATION
- DEVICE FULLY COMPLIANT WITH SCC-9204-062



ORDER CODES

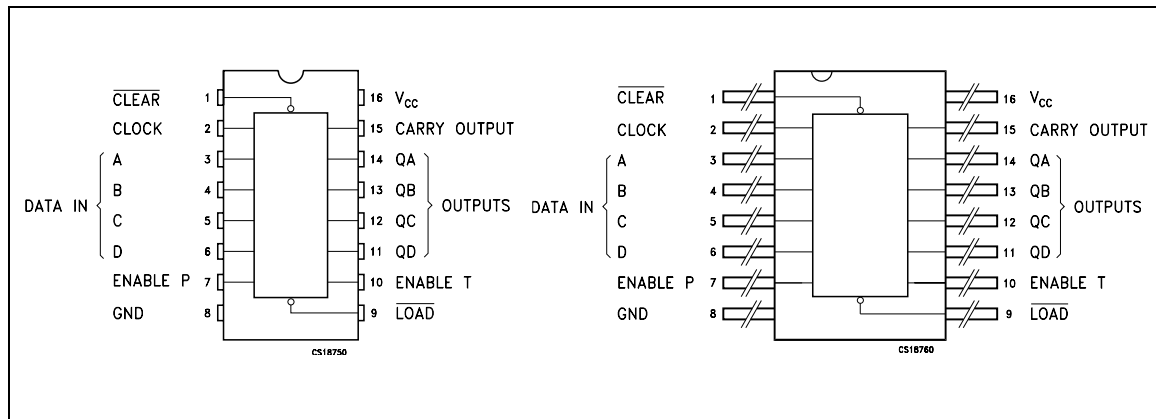
PACKAGE	FM	EM
DILC	M54HC160D	M54HC160D1
FPC	M54HC160K	M54HC160K1

The **CLOCK** input is active on the rising edge. Both **LOAD** and **CLEAR** inputs are active LOW. Presetting is synchronous on the rising edge of the clock, the function is cleared asynchronously. Two enable inputs (**TE** and **PE**) and **CARRY** output are provided to enable easy cascading of counters, which facilitates easy implementation of N-bit counters without using external gates. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

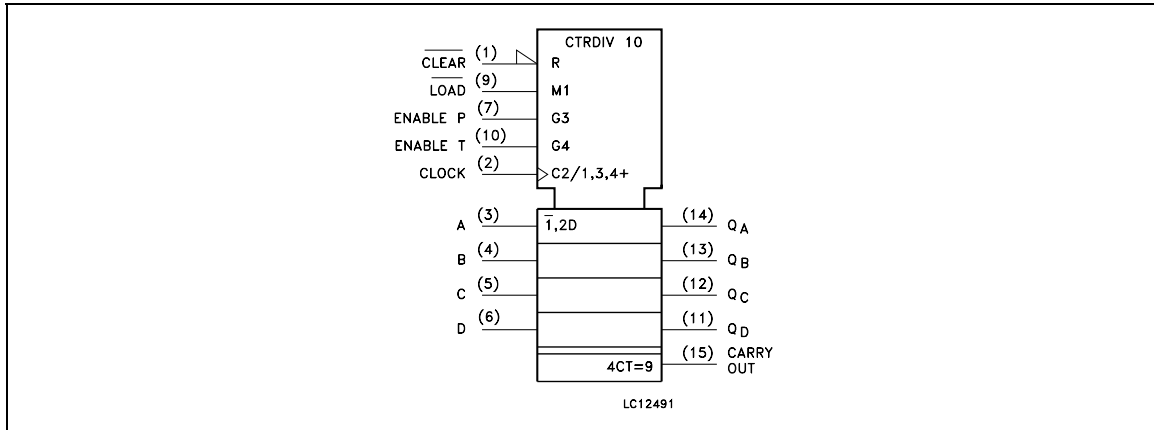
DESCRIPTION

The M54HC160 is an high speed CMOS SYNCHRONOUS BCD DECADE PRESETTABLE COUNTER fabricated with silicon gate C²MOS technology.

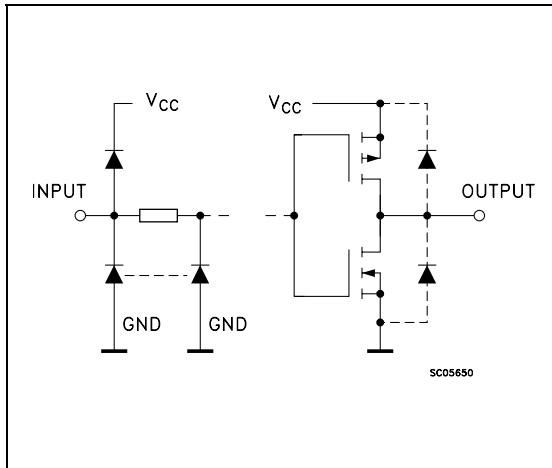
PIN CONNECTION



IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

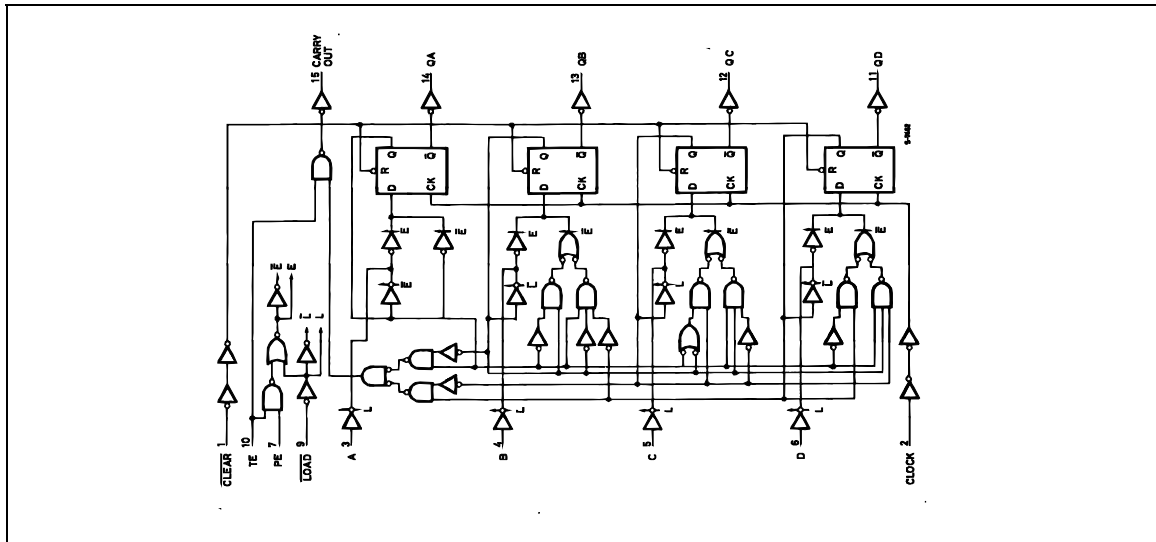
PIN N°	SYMBOL	NAME AND FUNCTION
1	$\overline{\text{CLEAR}}$	Asynchronous Master Reset
2	CLOCK	Clock Input (LOW to HIGH, Edge-triggered)
3, 4, 5, 6	A, B, C, D	Data Inputs
7	PE	Count Enable Input
10	TE	Count Enable Carry Input
9	LOAD	Parallel Enable Input
14, 13, 12, 11	QA to QD	Flip Flop Outputs
15	CARRY	Terminal Count Output
8	GND	Ground (0V)
16	V _{CC}	Positive Supply Voltage

TRUTH TABLE

INPUTS					OUTPUTS				FUNCTION
$\overline{\text{CLEAR}}$	$\overline{\text{LOAD}}$	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

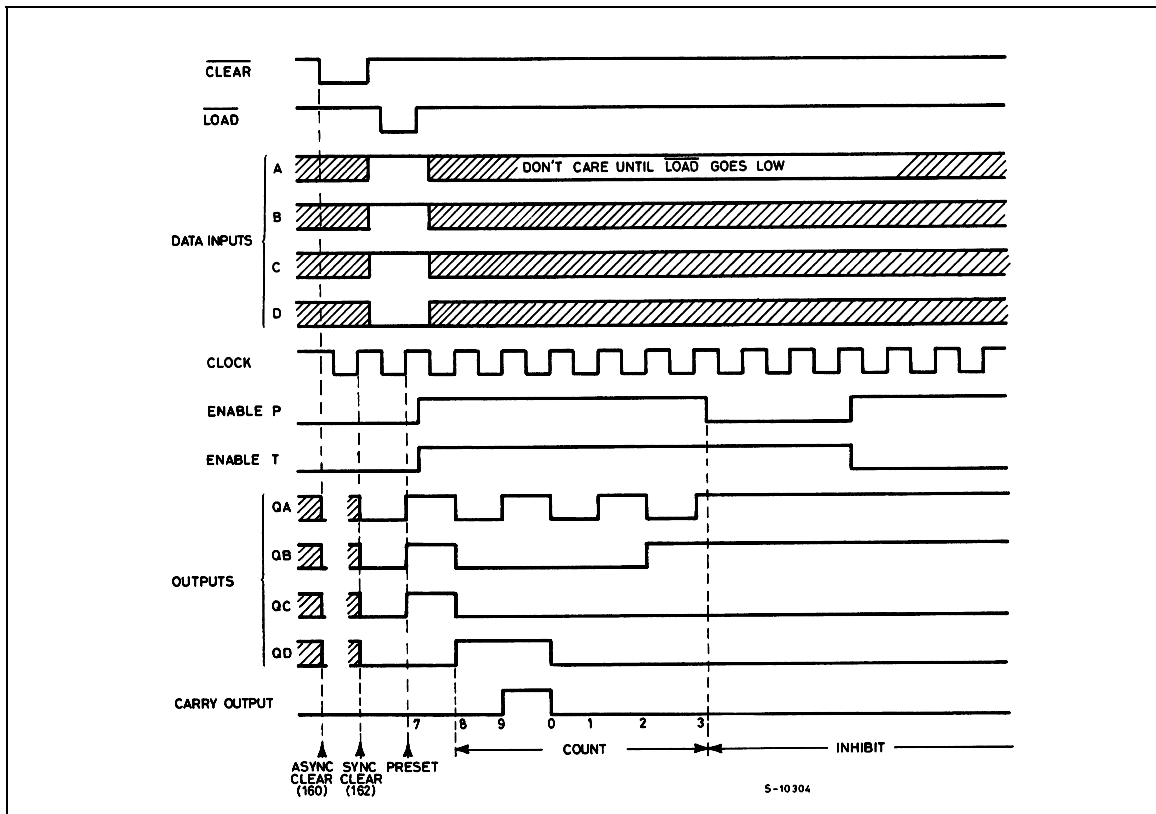
X : Don't Care
 A, B, C, D: Logic level of data inputs
 Carry: CARRY = TE·QA·QB·QC·QD

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 Current	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	300	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	265	°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 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	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 _{OL}	Low Level Output Voltage	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	
I _I	Input Leakage Current	6.0	V _I = V _{CC} or GND			± 0.1		± 1		± 1	μA
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND			4		40		80	μA

M54HC160

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

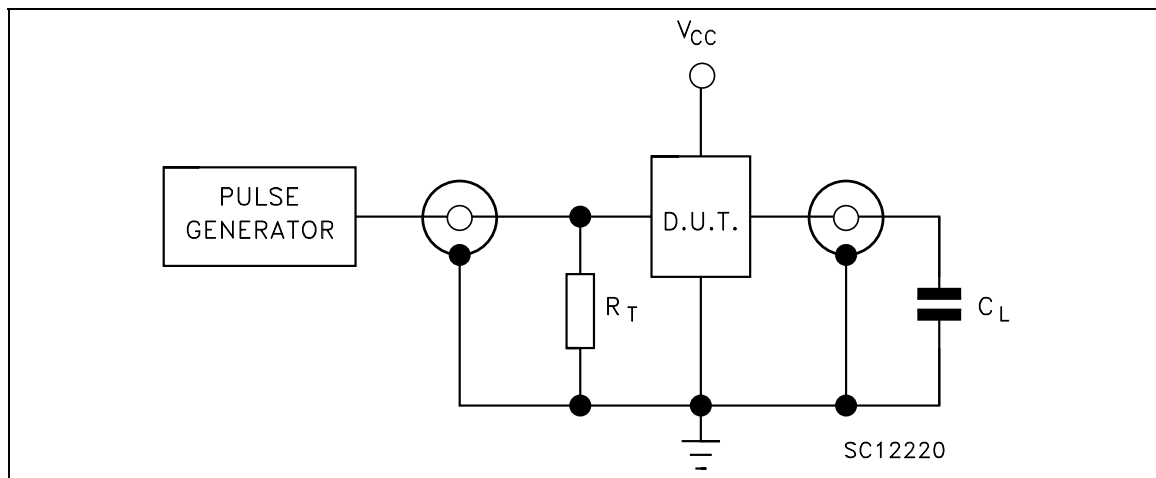
Symbol	Parameter	Test Condition V_{CC} (V)	Value						Unit	
			$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
			Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t_{TLH} t_{THL}	Output Transition Time	2.0		25	75		95		110	ns
		4.5		7	15		19		22	
		6.0		6	13		16		19	
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - Q)	2.0		48	125		155		190	ns
		4.5		16	25		31		38	
		6.0		14	21		26		32	
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - CARRY)	2.0		57	150		190		225	ns
		4.5		19	30		38		45	
		6.0		16	26		32		38	
t_{PLH} t_{PHL}	Propagation Delay Time (TE - CARRY)	2.0		39	100		125		150	ns
		4.5		13	20		25		30	
		6.0		11	17		21		26	
t_{PHL}	Propagation Delay Time ($\overline{\text{CLEAR}}$ - Q)	2.0		60	150		190		225	ns
		4.5		20	30		38		45	
		6.0		17	26		32		38	
t_{PHL}	Propagation Delay Time ($\overline{\text{CLEAR}}$ - CARRY)	2.0		72	200		250		300	ns
		4.5		24	40		50		60	
		6.0		20	34		43		51	
f_{MAX}	Maximum Clock Frequency	2.0		6.2	18		5		4.2	MHz
		4.5		31	53		25		21	
		6.0		37	62		30		25	
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0		18	75		95		110	ns
		4.5		6	15		19		22	
		6.0		6	13		16		19	
$t_{W(L)}$	Minimum Pulse Width (CLEAR)	2.0		24	75		95		110	ns
		4.5		7	15		19		22	
		6.0		6	13		16		19	
t_s	Minimum Set-up Time (LOAD, PE, TE)	2.0		40	100		125		150	ns
		4.5		10	20		25		30	
		6.0		8	17		21		26	
t_s	Minimum Set-up Time (A, B, C, D)	2.0		20	75		95		110	ns
		4.5		5	15		19		22	
		6.0		3	13		16		19	
t_h	Minimum Hold Time (A, B - CK)	2.0			0		0		0	ns
		4.5			0		0		0	
		6.0			0		0		0	
t_{REM}	Minimum Removal Time	2.0		18	50		65		75	ns
		4.5		4	10		13		15	
		6.0		3	9		11		13	

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition V_{CC} (V)	Value						Unit	
			$T_A = 25^\circ\text{C}$			-40 to 85°C		-55 to 125°C		
			Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C_{IN}	Input Capacitance	5.0		5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0		50						pF

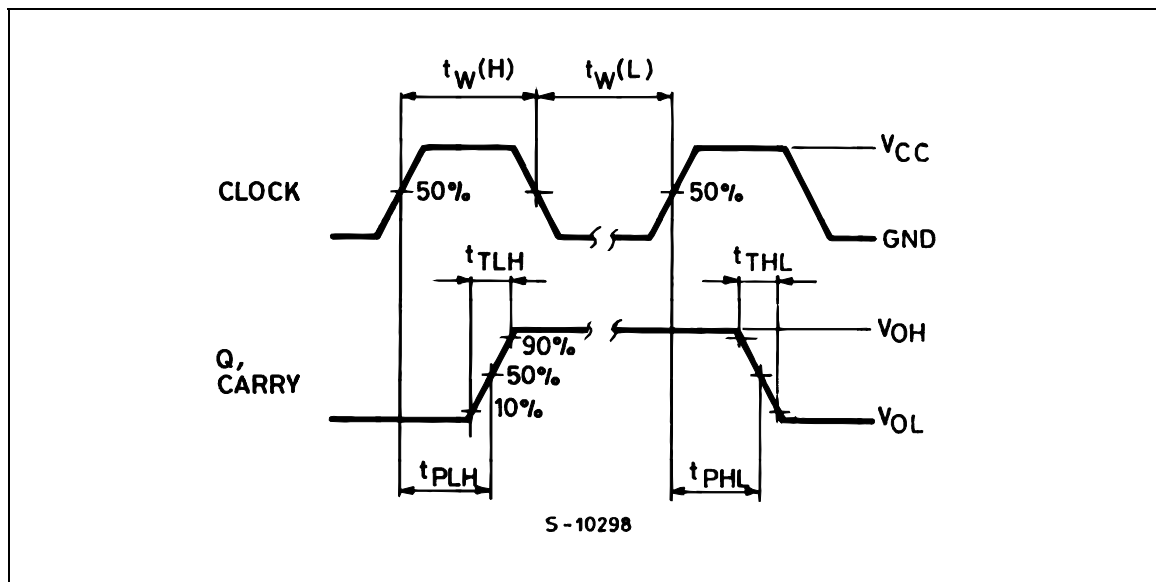
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

TEST CIRCUIT

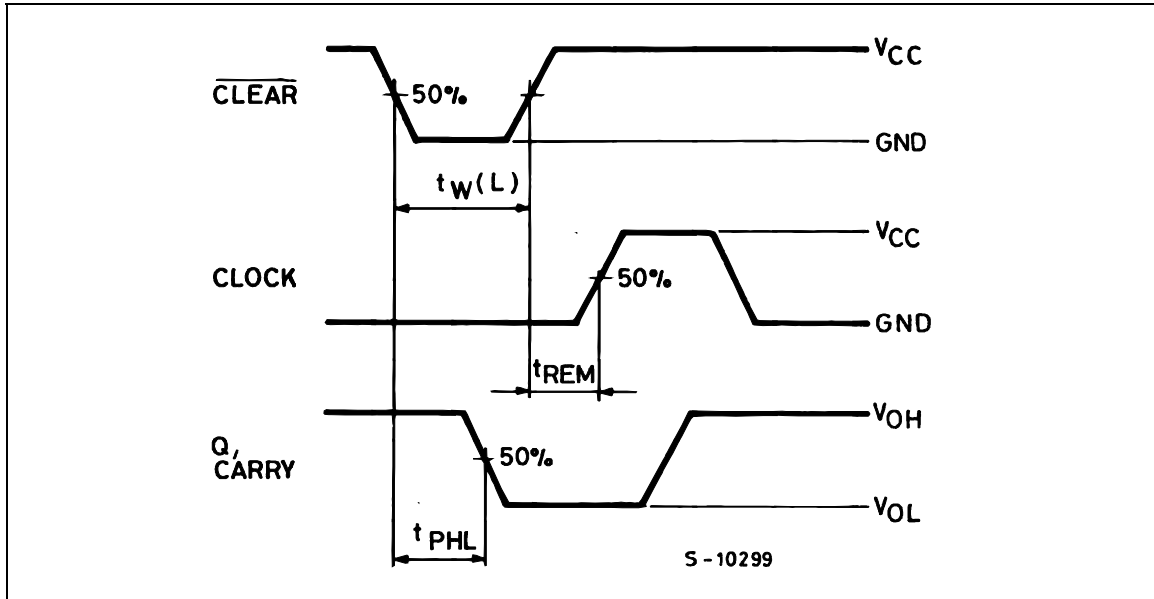


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

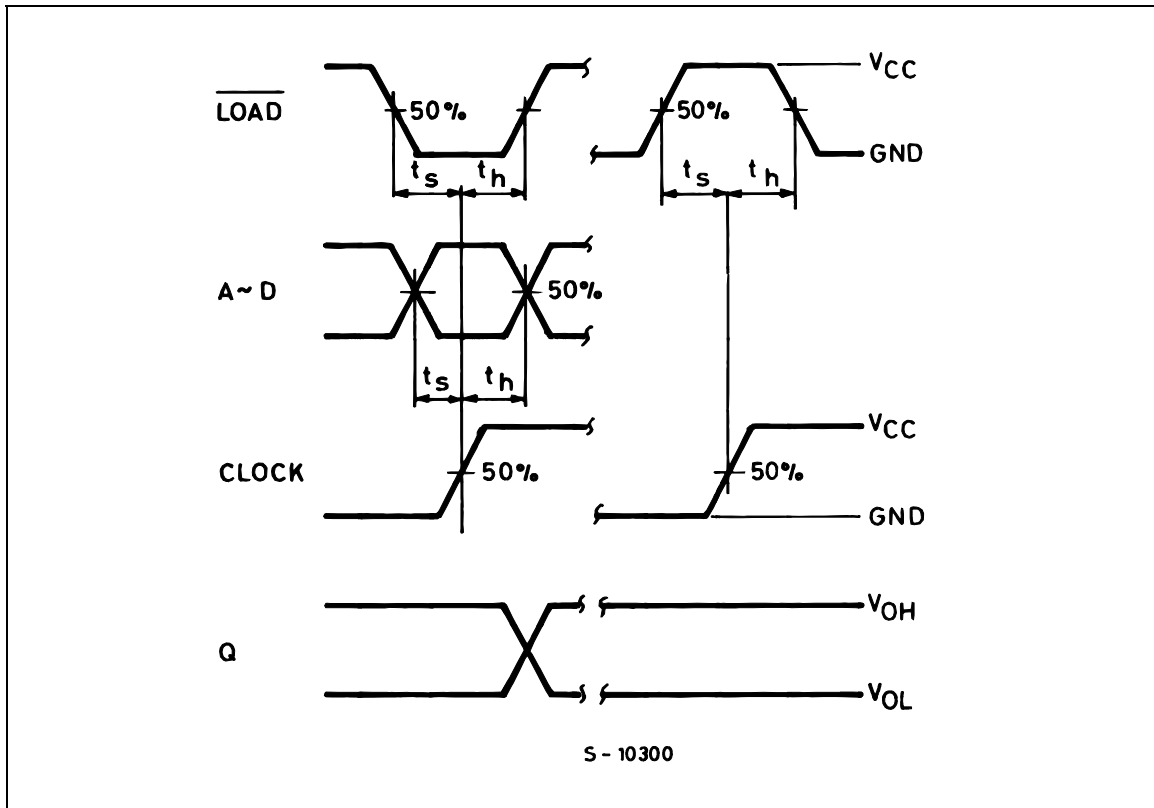
WAVEFORM 1: PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH (CLOCK), (COUNT MODE)
 (f=1MHz; 50% duty cycle)

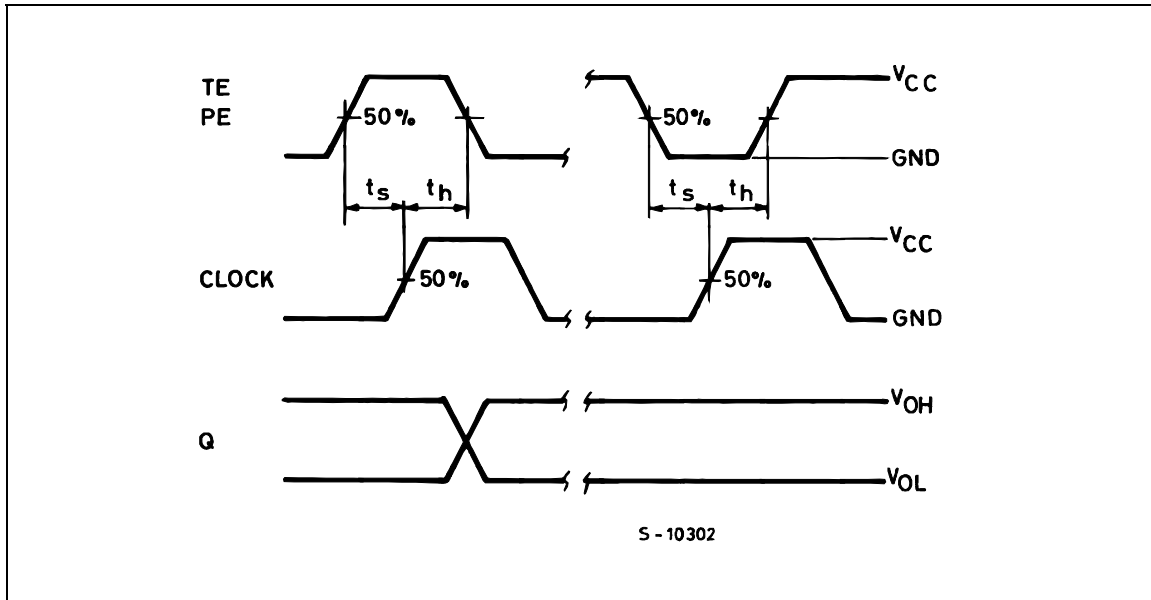
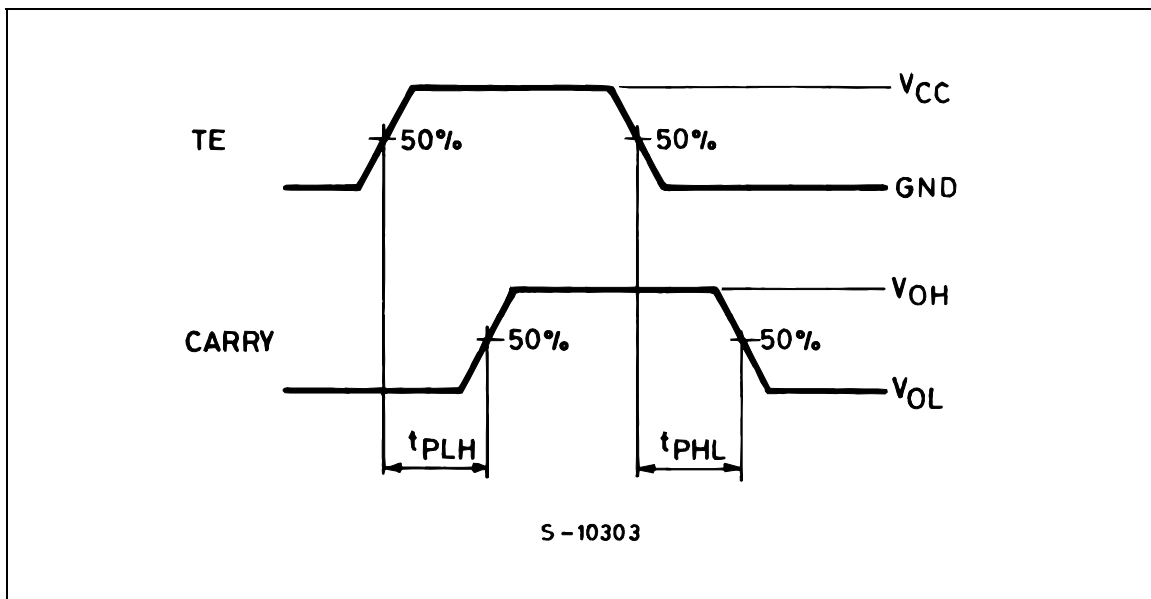


WAVEFORM 2: MINIMUM PULSE WIDTH ($\overline{\text{CLEAR}}$), REMOVAL TIME ($\overline{\text{CLEAR}}$ to CLOCK) (PRESET MODE) ($f=1\text{MHz}$; 50% duty cycle)



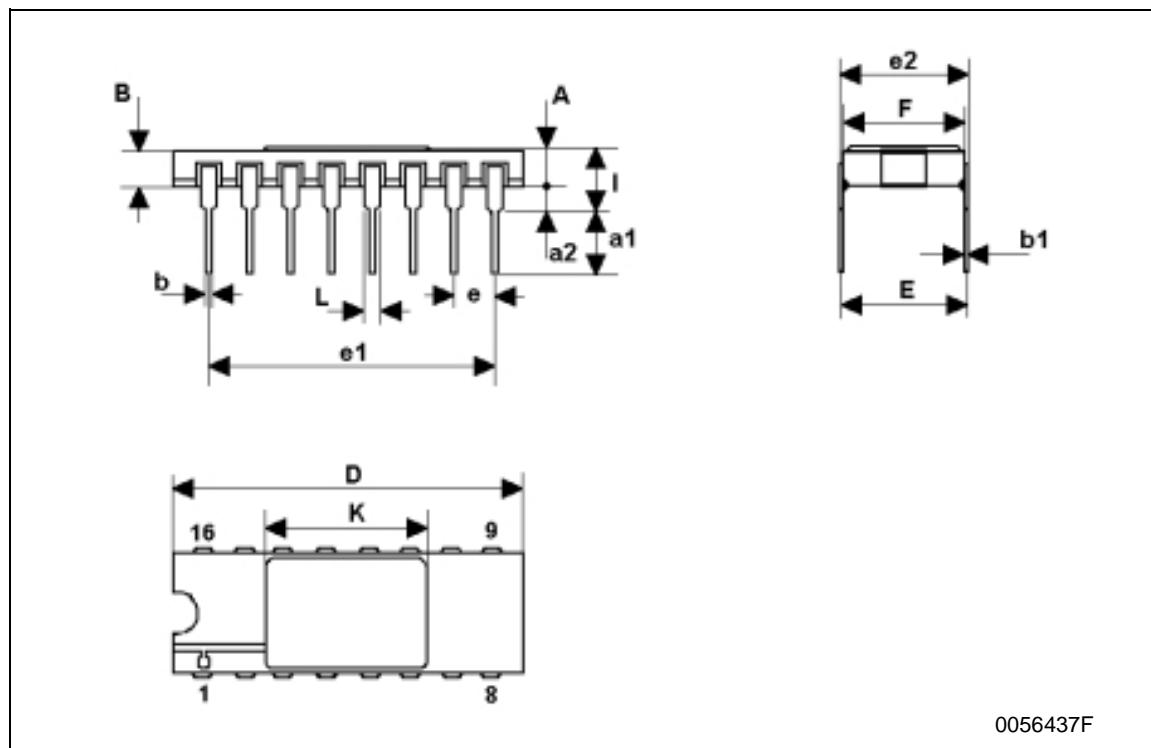
WAVEFORM 3: SETUP AND HOLD TIMES (CLEAR MODE) ($f=1\text{MHz}$; 50% duty cycle)



WAVEFORM 4: SETUP AND HOLD TIMES (COUNTENABLE MODE) ($f=1\text{MHz}$; 50% duty cycle)

WAVEFORM 5: PROPAGATION DELAY TIMES (CASCADE MODE) ($f=1\text{MHz}$; 50% duty cycle)


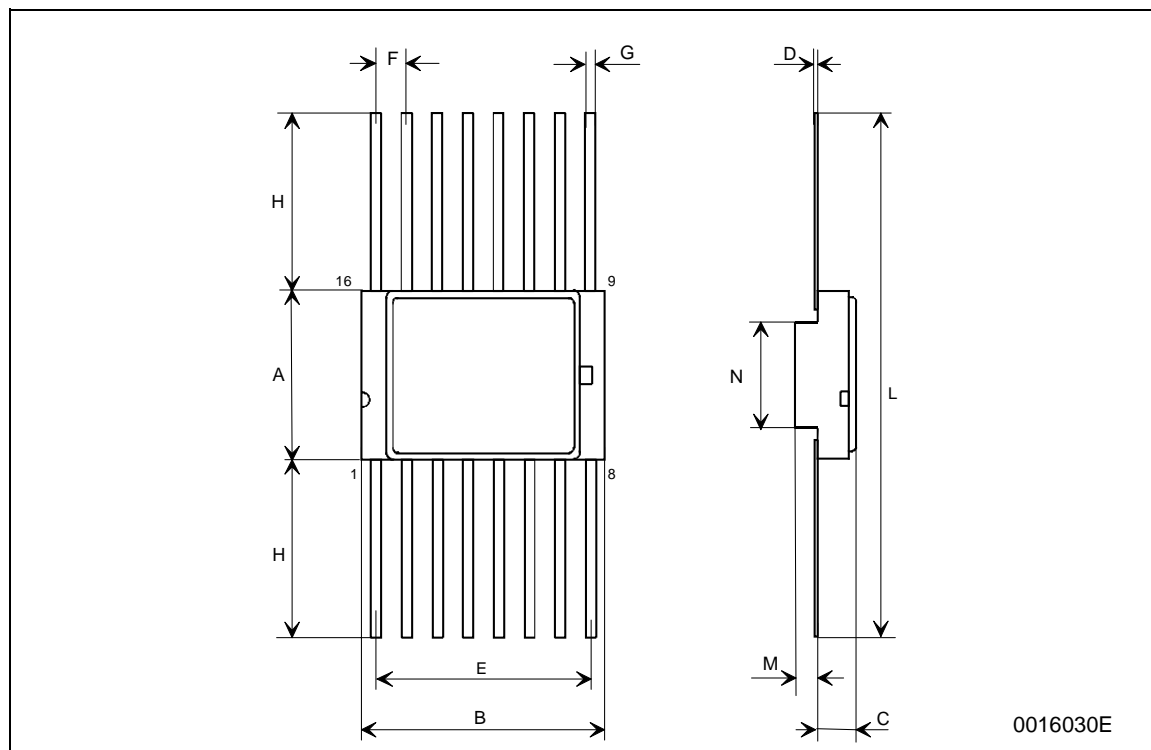
DILC-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.1		2.71	0.083		0.107
a1	3.00		3.70	0.118		0.146
a2	0.63	0.88	1.14	0.025	0.035	0.045
B	1.82		2.39	0.072		0.094
b	0.40	0.45	0.50	0.016	0.018	0.020
b1	0.20	0.254	0.30	0.008	0.010	0.012
D	20.06	20.32	20.58	0.790	0.800	0.810
e	7.36	7.62	7.87	0.290	0.300	0.310
e1		2.54			0.100	
e2	17.65	17.78	17.90	0.695	0.700	0.705
e3	7.62	7.87	8.12	0.300	0.310	0.320
F	7.29	7.49	7.70	0.287	0.295	0.303
I			3.83			0.151
K	10.90		12.1	0.429		0.476
L	1.14		1.5	0.045		0.059



FPC-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	6.75	6.91	7.06	0.266	0.272	0.278
B	9.76	9.94	10.14	0.384	0.392	0.399
C	1.49		1.95	0.059		0.077
D	0.102	0.127	0.152	0.004	0.005	0.006
E	8.76	8.89	9.01	0.345	0.350	0.355
F		1.27			0.050	
G	0.38	0.43	0.48	0.015	0.017	0.019
H	6.0			0.237		
L	18.75		22.0	0.738		0.867
M	0.33	0.38	0.43	0.013	0.015	0.017
N		4.31			0.170	



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