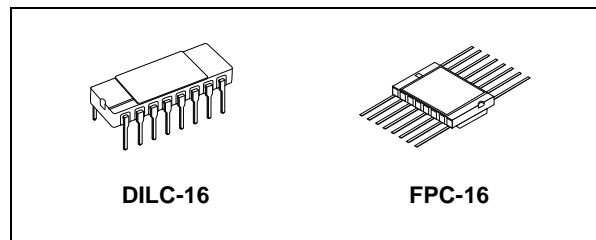




## RAD-HARD 8 BIT PISO SHIFT REGISTER

- HIGH SPEED:  
 $f_{MAX} = 63 \text{ MHz (TYP.) at } V_{CC} = 6V$
- 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:  
 $t_{PLH} \approx t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:  
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- PIN AND FUNCTION COMPATIBLE WITH 54 SERIES 166
- 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-9306-043



### ORDER CODES

PACKAGE	FM	EM
DILC	M54HC166D	M54HC166D1
FPC	M54HC166K	M54HC166K1

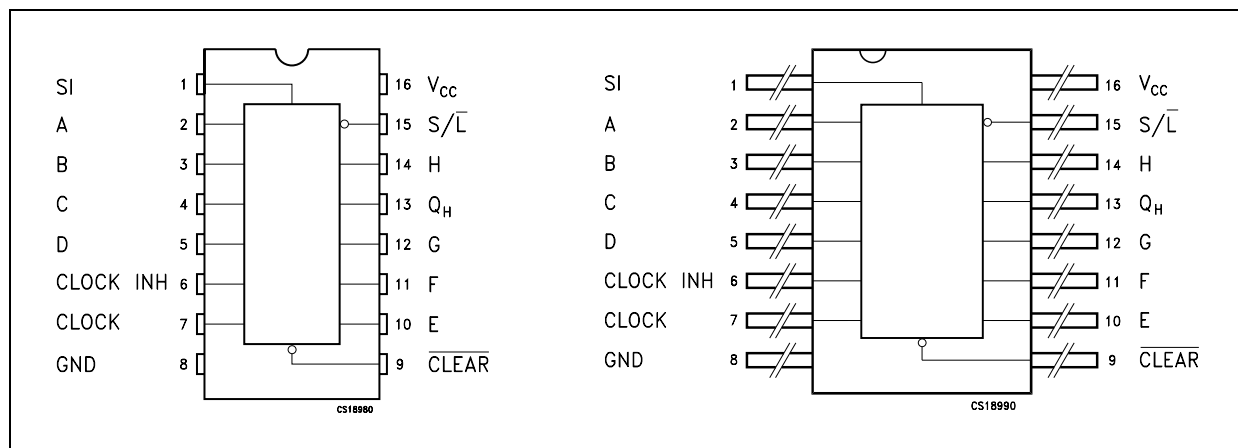
### DESCRIPTION

The M54HC166 is an high speed CMOS 8 BIT PISO SHIFT REGISTER fabricated with silicon gate C<sup>2</sup>MOS technology.

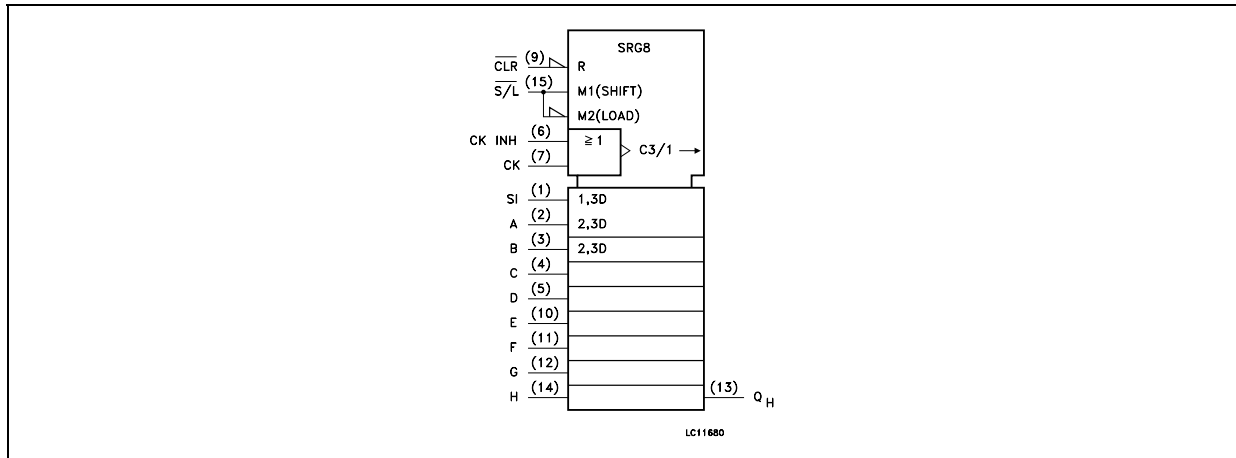
It consists of parallel or serial inputs and a serial-out 8 bit shift register with gated clock inputs and an overriding clear input. The parallel-in or serial-in modes are controlled by the SHIFT/LOAD

input. When the SHIFT/LOAD input is held high, the serial data input is enabled and the eight flip-flops perform serial shifting with each clock pulse; when held low, the parallel data inputs are enabled and synchronous loading occurs on the next clock pulse. Clocking is accomplished on the low-to-high level edge of the clock pulse. The CLOCK-INHIBIT input should be changed to the high only while the clock input is held high. A direct clear input overrides all other inputs, including the clock, and sets all flip-flops to zero. Functional details are shown in the truth table and the timing chart. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

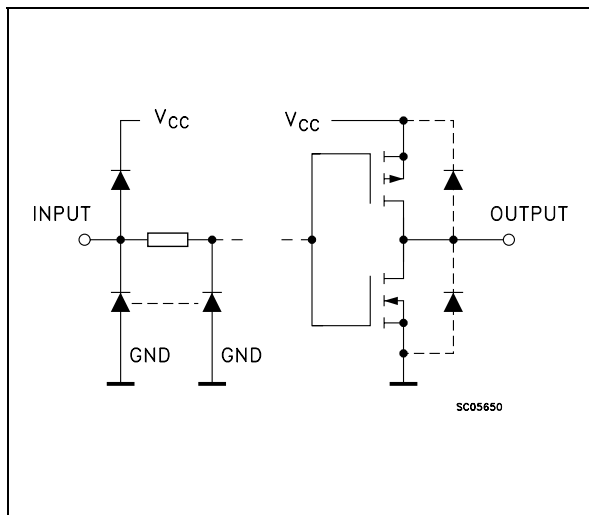
### PIN CONNECTION



IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

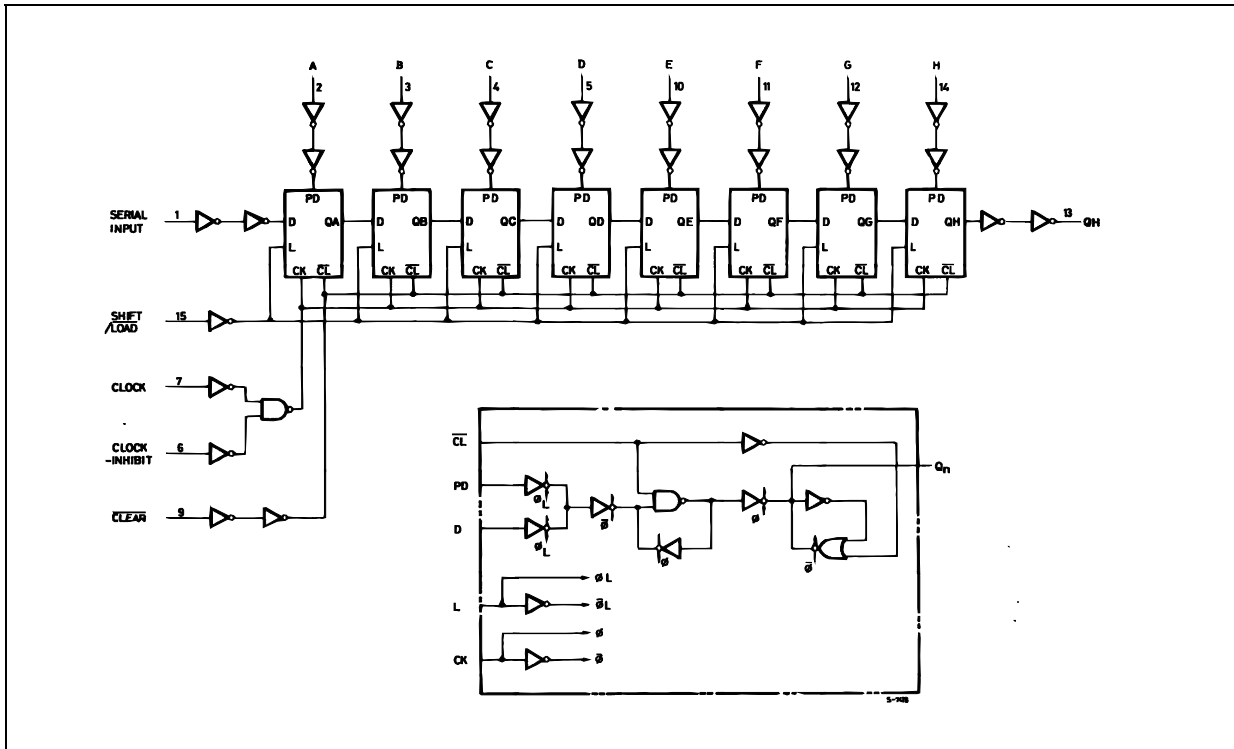
PIN N°	SYMBOL	NAME AND FUNCTION
1	SI	Serial Data Inputs
2, 3, 4, 5, 10, 11, 12, 14	A to H	Parallel Data Inputs
6	CLOCK INH	Clock Enable Input (Active Low)
7	CLOCK	Clock Input (LOW to HIGH, Edge Triggered)
9	$\overline{\text{CLEAR}}$	Asynchronous Master Reset Input (Active Low)
13	QH	Serial Output from the Last Stage
15	SHIFT/LOAD	Parallel Enable Input (Active Low)
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

TRUTH TABLE

INPUTS						INTERNAL OUTPUTS		OUTPUTS
$\overline{\text{CLEAR}}$	SHIFT/LOAD	CLOCK INH	CLOCK	SERIAL IN	PARALLEL A.....H	QA	QB	QH
L	X	X	X	X	X	L	L	L
L	X	X		X	X	NO CHANGE		
H	L	L		X	a.....h	a	b	h
H	H	L		H	X	H	QAn	QGn
H	H	L		L	X	L	QAn	QGn
H	X	H	X	X	X	NO CHANGE		

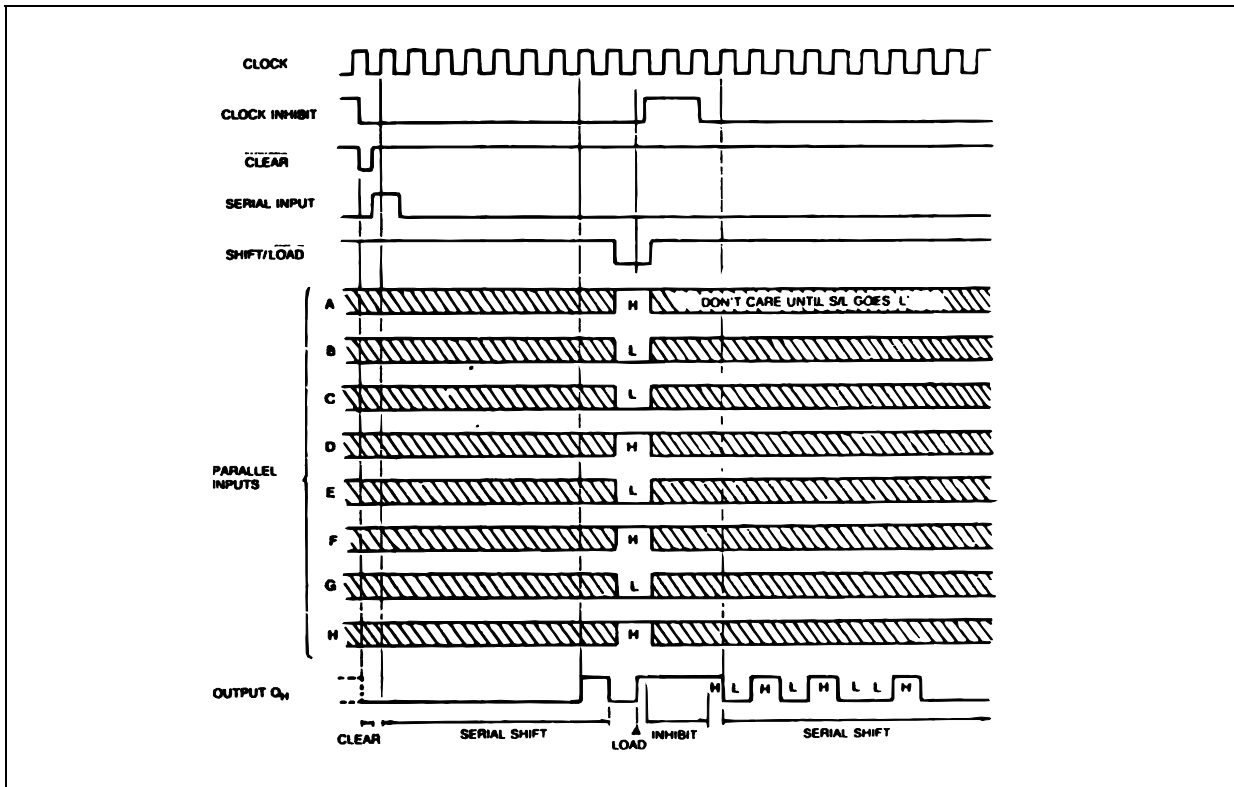
X : Don't Care  
 a.....h : The level of steady input voltage at inputs a through H respectively

LOGIC DIAGRAM



This logic diagram has not been 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	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	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 <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IH</sub>	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 <sub>IL</sub>	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 <sub>OH</sub>	High Level Output Voltage	2.0	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9		V
		4.5	I <sub>O</sub> =-20 μA	4.4	4.5		4.4		4.4		
		6.0	I <sub>O</sub> =-20 μA	5.9	6.0		5.9		5.9		
		4.5	I <sub>O</sub> =-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I <sub>O</sub> =-5.2 mA	5.68	5.8		5.63		5.60		
V <sub>OL</sub>	Low Level Output Voltage	2.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	V
		4.5	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	
		6.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	
		4.5	I <sub>O</sub> =4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I <sub>O</sub> =5.2 mA		0.18	0.26		0.33		0.40	
I <sub>I</sub>	Input Leakage Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			± 0.1		± 1		± 1	μA
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			4		40		80	μA

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

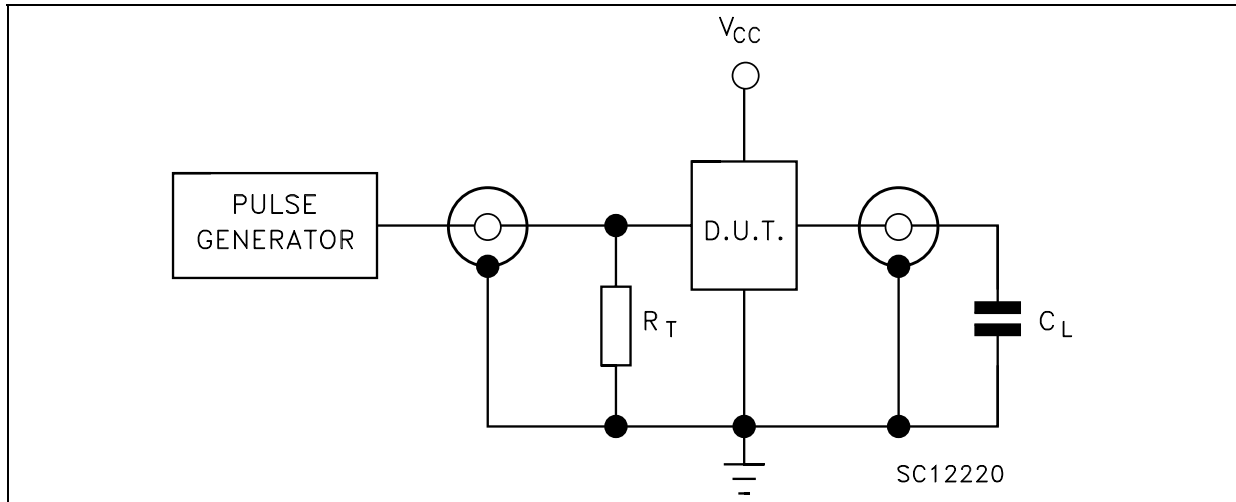
Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$t_{TLH}$ $t_{THL}$	Output Transition Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time (CLOCK - QH)	2.0			70	150		190		225	ns
		4.5			20	30		38		45	
		6.0			16	26		32		38	
$t_{PHL}$	Propagation Delay Time (CLEAR - QH)	2.0			60	135		170		205	ns
		4.5			18	27		34		41	
		6.0			14	23		29		35	
$f_{MAX}$	Maximum Clock Frequency	2.0		6.2	14		5.0		4.2		MHz
		4.5		31	50		25		21		
		6.0		37	63		30		25		
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0			28	75		95		110	ns
		4.5			6	15		19		22	
		6.0			5	13		16		19	
$t_{W(L)}$	Minimum Pulse Width (CLEAR)	2.0			28	75		95		110	ns
		4.5			6	15		19		22	
		6.0			5	13		16		19	
$t_s$	Minimum Set-up Time (SI, PI)	2.0			20	75		95		110	ns
		4.5			4	15		19		22	
		6.0			3	13		16		19	
$t_s$	Minimum Set-up Time (SHIFT/LOAD)	2.0			25	75		95		110	ns
		4.5			5	15		19		22	
		6.0			3	13		16		19	
$t_h$	Minimum Hold Time	2.0				0		0		0	ns
		4.5				0		0		0	
		6.0				0		0		0	
$t_{REM}$	Minimum Removal Time	2.0			12	50		65		75	ns
		4.5			3	10		13		15	
		6.0			3	9		11		13	

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$C_{IN}$	Input Capacitance	5.0			5	10		10		10	pF
$C_{PD}$	Power Dissipation Capacitance (note 1)	5.0			60						pF

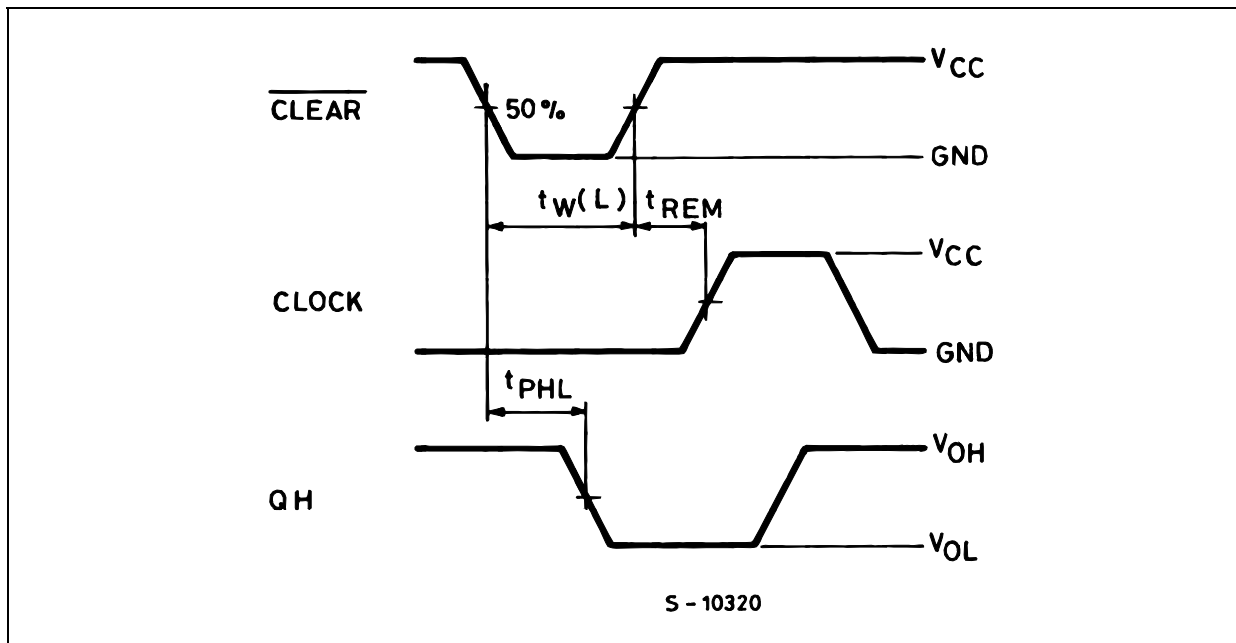
1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN}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

## TEST CIRCUIT

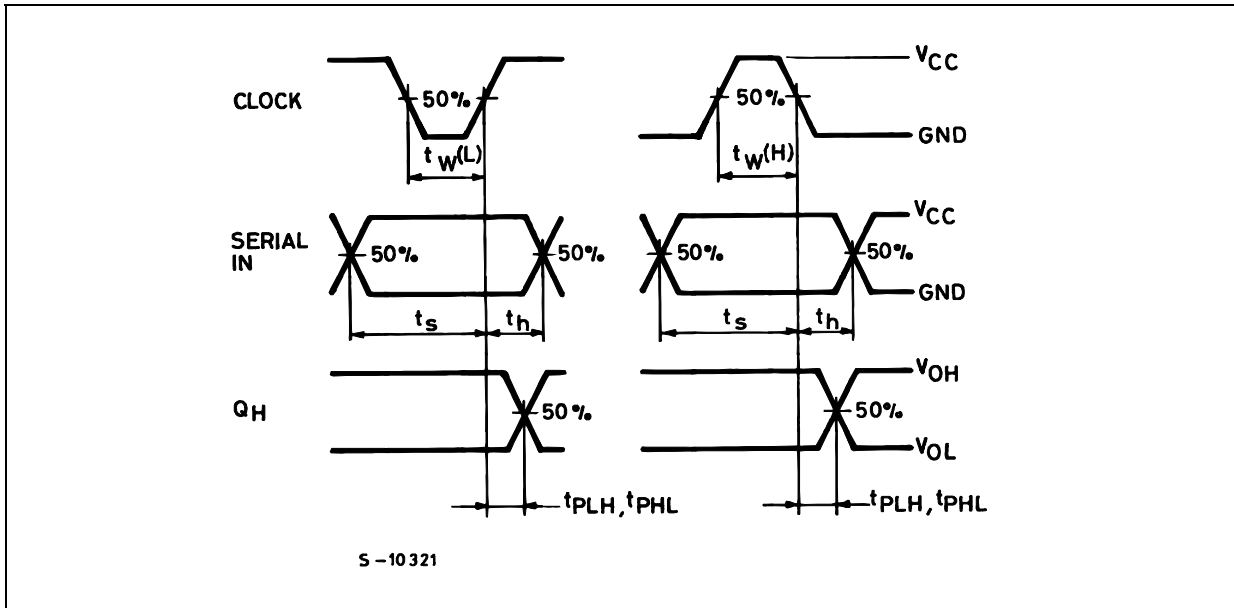


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

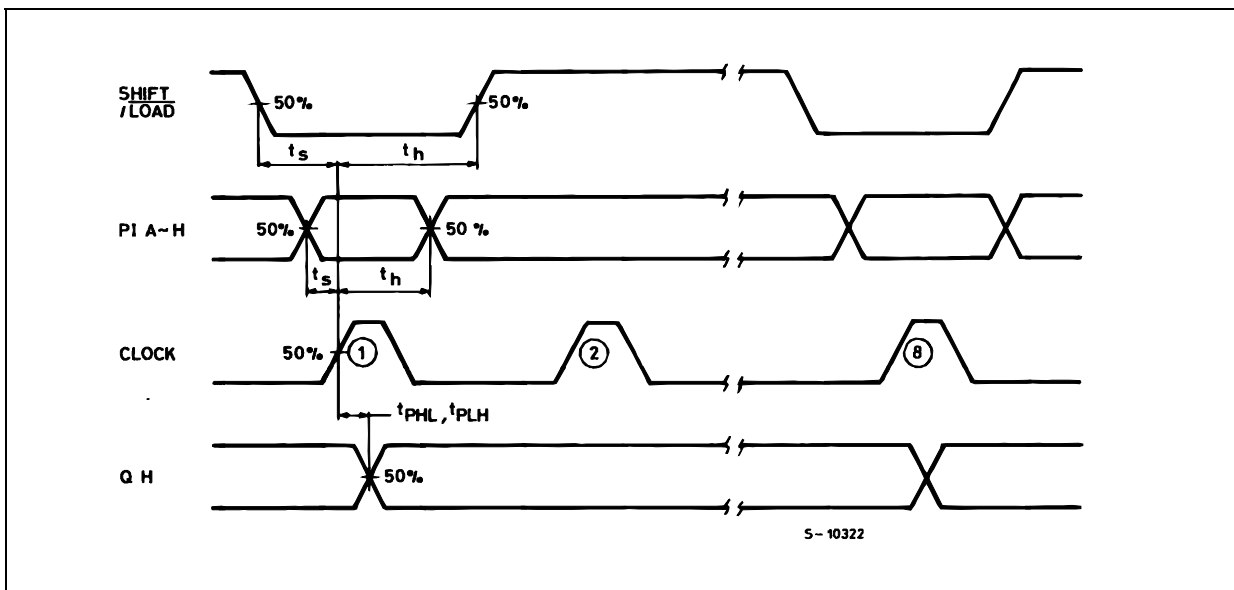
**WAVEFORM 1: MINIMUM PULSE WIDTH (CLEAR), REMOVAL TIME (CLEAR TO CLOCK)**  
 ( $f=1\text{MHz}$ ; 50% duty cycle)



**WAVEFORM 2: PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH (CLOCK), SETUP AND HOLD TIME (SI to CLOCK) (f=1MHz; 50% duty cycle)**



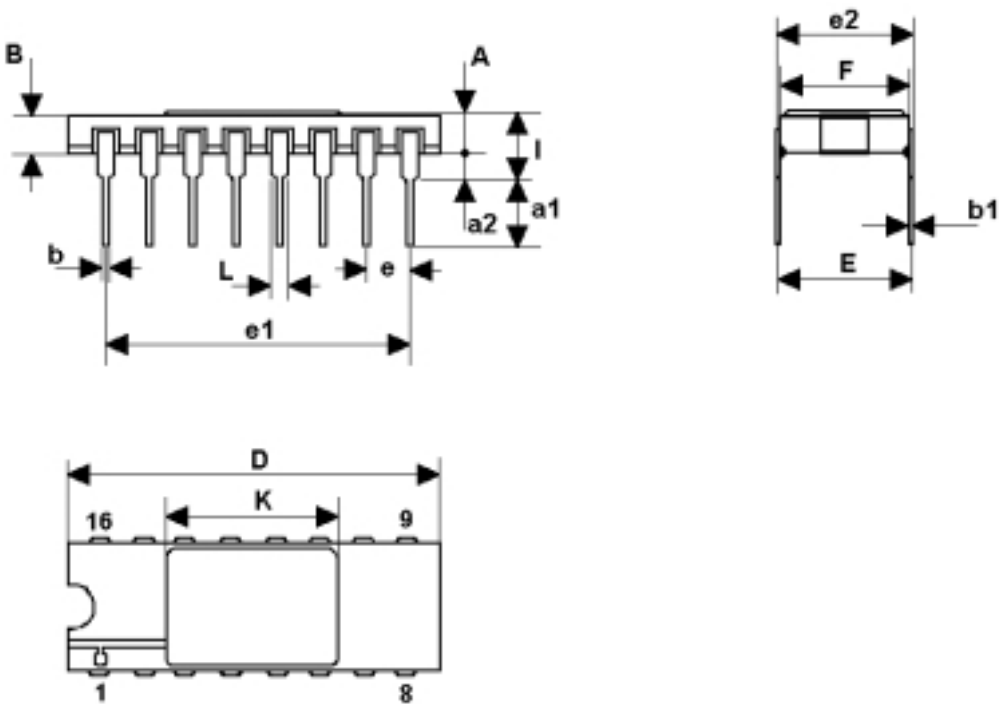
**WAVEFORM 3: PROPAGATION DELAY TIME, SETUP AND HOLD TIME (PI,  $\overline{S/L}$  to CLOCK) (f=1MHz; 50% duty cycle)**





## DILC-16 MECHANICAL DATA

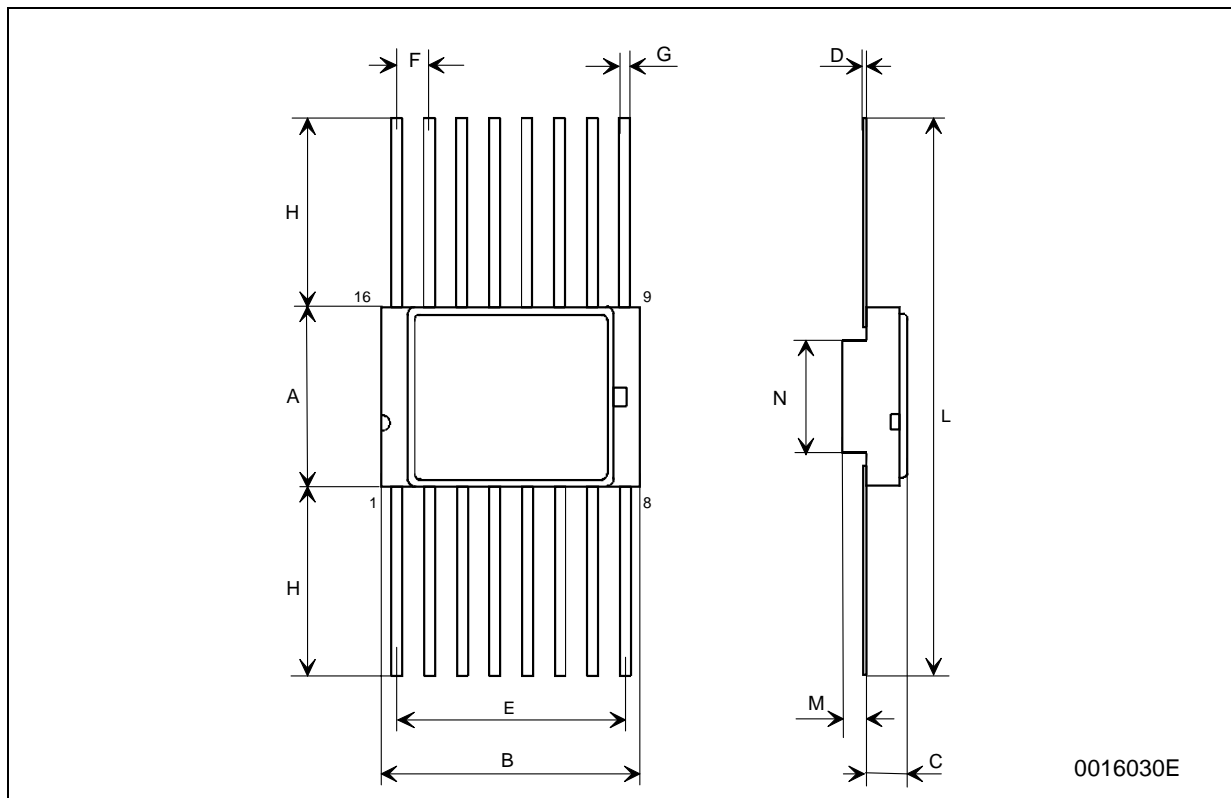
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.1		2.71	0.083		0.107
a1	3.00		3.70	0.118		0.146
a2	0.63	0.88	1.14	0.025	0.035	0.045
B	1.82		2.39	0.072		0.094
b	0.40	0.45	0.50	0.016	0.018	0.020
b1	0.20	0.254	0.30	0.008	0.010	0.012
D	20.06	20.32	20.58	0.790	0.800	0.810
e	7.36	7.62	7.87	0.290	0.300	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



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**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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