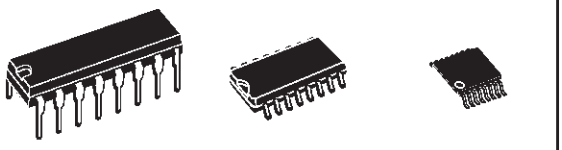
M74HC195

4 BIT PIPO SHIFT REGISTER

- HIGH SPEED :
  t_{PD} = 14 ns (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:
  $|I_{OH}| = I_{OL}$ = 4mA (MIN)
- 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 195



DIP SOP TSSOP

ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC195B1R	
SOP	M74HC195M1R	M74HC195RM13TR
TSSOP		M74HC195TTR

DESCRIPTION

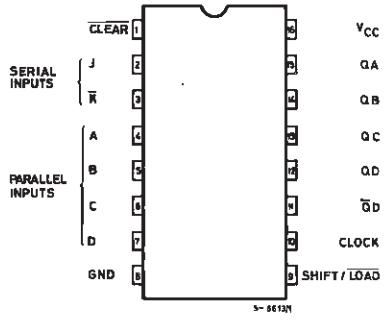
The M74HC195 is an high speed CMOS 4 BIT PIPO SHIFT REGISTER fabricated with silicon gate C^2MOS technology.

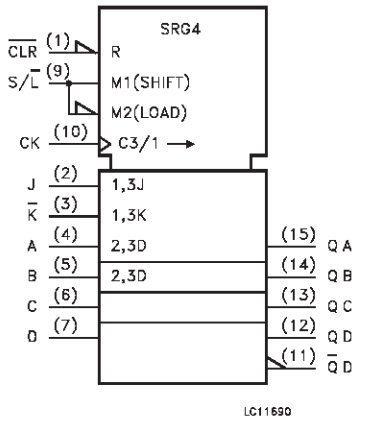
This shift register features parallel inputs, parallel outputs, J-$\overline{K}$ serial inputs, a SHIFT/$\overline{LOAD}$ control input, and direct overriding $\overline{CLEAR}$. This shift register can operate in two modes : Parallel Load; Shift from QA towards QD.

Parallel loading is accomplished by applying the four bits of data , and taking the SHIFT/$\overline{LOAD}$ (S/$\overline{L}$) control input low. The data is loaded into the associated flip-flops and appears at the outputs after the positive transition of the clock input. During parallel loading, serial data flow is inhibited. Serial shifting occurs synchronously when the SHIFT/$\overline{LOAD}$ control input is high. Serial data for this mode is entered at the J-$\overline{K}$ inputs. These inputs allow the first stage to perform as a J-$\overline{K}$ or TOGGLE flip-flop as shown in the truth table.

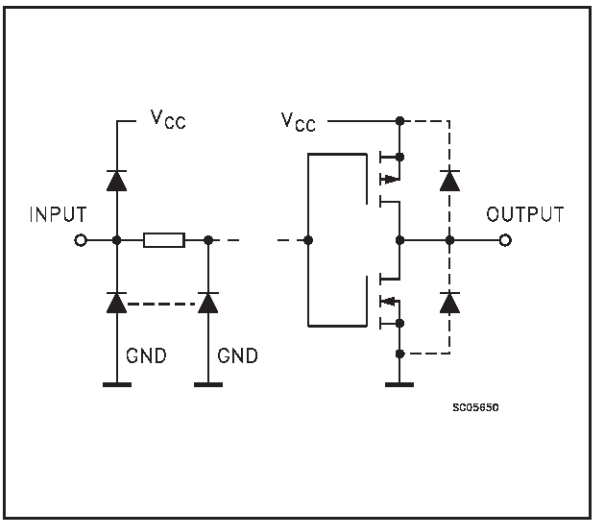
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS





INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

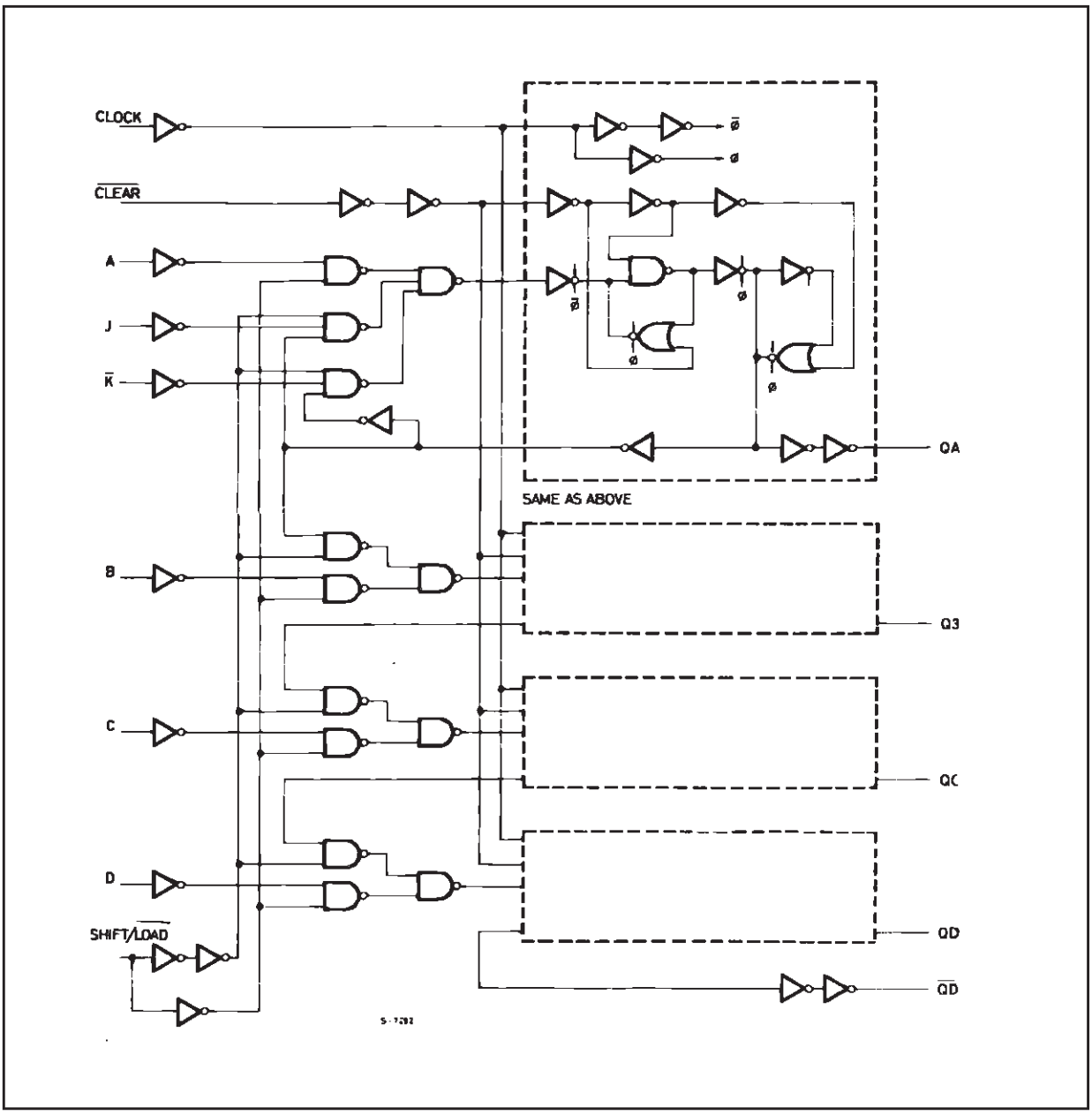
PIN No	SYMBOL	NAME AND FUNCTION
1	$\overline{\text{CLEAR}}$	Reset Input
2	J	First Stage J Input (Active LOW)
3	$\overline{K}$	First Stage $\overline{K}$ Input (Active LOW)
4, 5, 6, 7	A to D	Parallel Data Inputs
9	SHIFT/$\overline{\text{LOAD}}$	Control Input
10	CLOCK	Clock Input (LOW to HIGH Edge-triggered)
11	$\overline{Q}$D	Inverted Output From The Last Stage
15, 14, 13, 12	QA to QD	Parallel Outputs
8	GND	Ground (0V)
16	Vcc	Positive Supply Voltage

TRUTH TABLE

INPUTS									OUTPUTS				
$\overline{\text{CLEAR}}$	SHIFT/$\overline{\text{LOAD}}$	CLOCK	SERIAL		PARALLEL				QA	QB	QC	QD	$\overline{Q}$D
			J	$\overline{K}$	A	B	C	D					
L	X	X	X	X	X	X	X	X	L	L	L	L	L
H	L	⌐	X	X	a	b	c	d	a	b	c	d	d
H	H	¬	X	X	X	X	X	X	QA0	QB0	QC0	QD0	$\overline{Q}$D0
H	H	⌐	L	H	X	X	X	X	QA0	QA0	QBn	QCn	$\overline{Q}$Cn
H	H	⌐	L	L	X	X	X	X	L	QAn	QBn	QCn	$\overline{Q}$Cn
H	H	⌐	H	H	X	X	X	X	H	QAn	QBn	QCn	$\overline{Q}$Cn
H	H	⌐	H	L	X	X	X	X	$\overline{Q}$An	QAn	QBn	QCn	$\overline{Q}$Cn

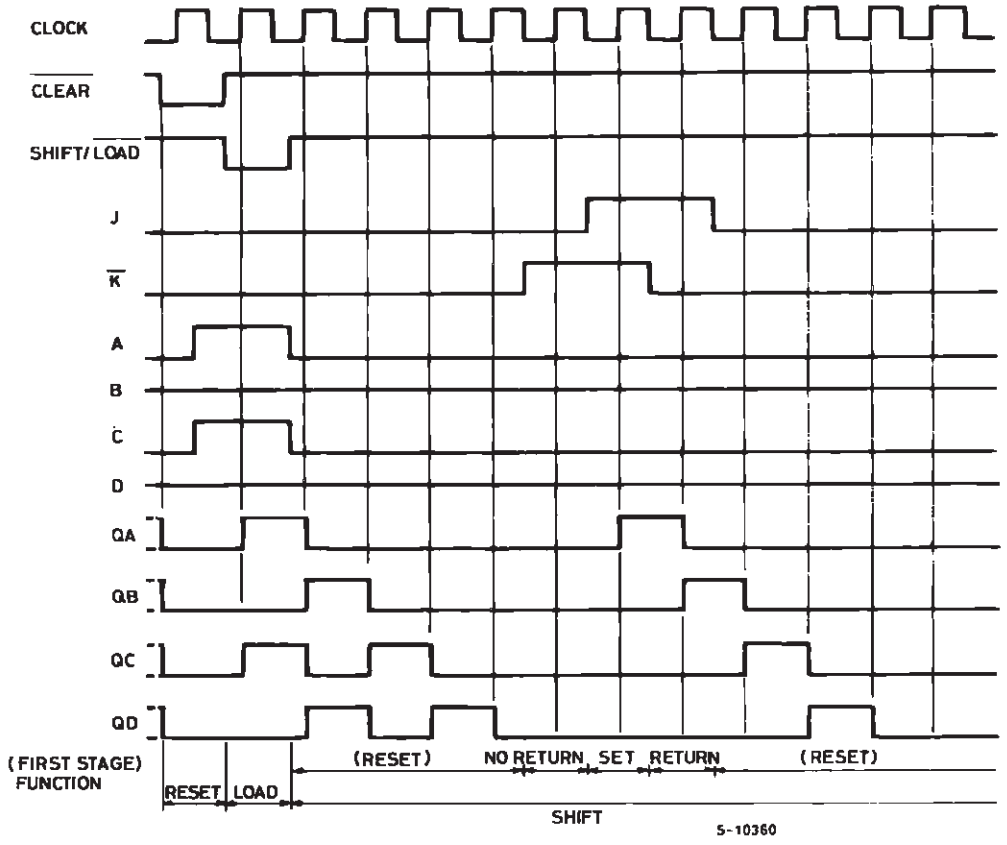
X : Don't Care
QAn ~ QCn : The level of QA, QB, QC, respectively, before the most recent positive transition of the clock.

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	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	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

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

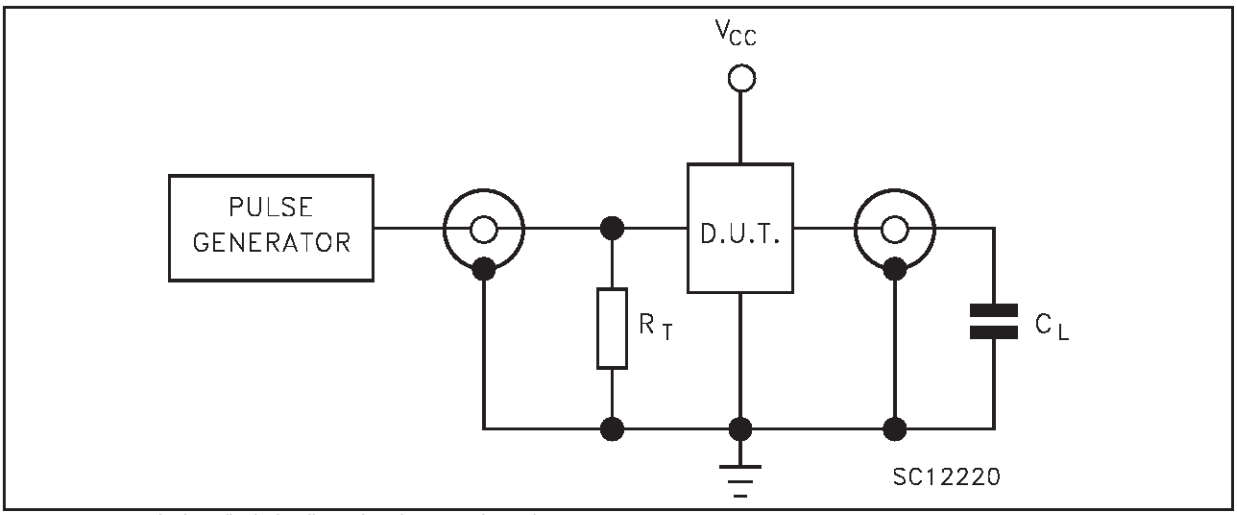
Symbol	Parameter	Test Condition		Value							Unit
		V_{CC} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0			30	75		95		115	ns
		4.5			8	15		19		23	
		6.0			7	13		16		20	
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - Qn, $\overline{Q}$D)	2.0			48	125		155		190	ns
		4.5			16	25		31		38	
		6.0			14	21		26		32	
t_{PHL}	Propagation Delay Time ($\overline{CLEAR}$ - Qn, $\overline{Q}$D)	2.0			45	120		150		180	ns
		4.5			15	24		30		36	
		6.0			13	20		26		31	
f_{MAX}	Maximum Clock Frequency	2.0		7.6	15		6		5		MHz
		4.5		38	60		30		25		
		6.0		45	71		35		30		
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0			20	75		95		115	ns
		4.5			5	15		19		23	
		6.0			4	13		16		20	
$t_{W(L)}$	Minimum Pulse Width ($\overline{CLEAR}$)	2.0			20	75		95		115	ns
		4.5			5	15		19		23	
		6.0			4	13		16		20	
t_s	Minimum Set-up Time (PI)	2.0			28	75		95		115	ns
		4.5			7	15		19		23	
		6.0			6	13		16		20	
t_s	Minimum Set-up Time (J, K, S/L)	2.0			28	75		95		115	ns
		4.5			7	15		19		23	
		6.0			6	13		16		20	
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				5		5		5	ns
		4.5				5		5		5	
		6.0				5		5		5	

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	5.0			5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0			72						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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

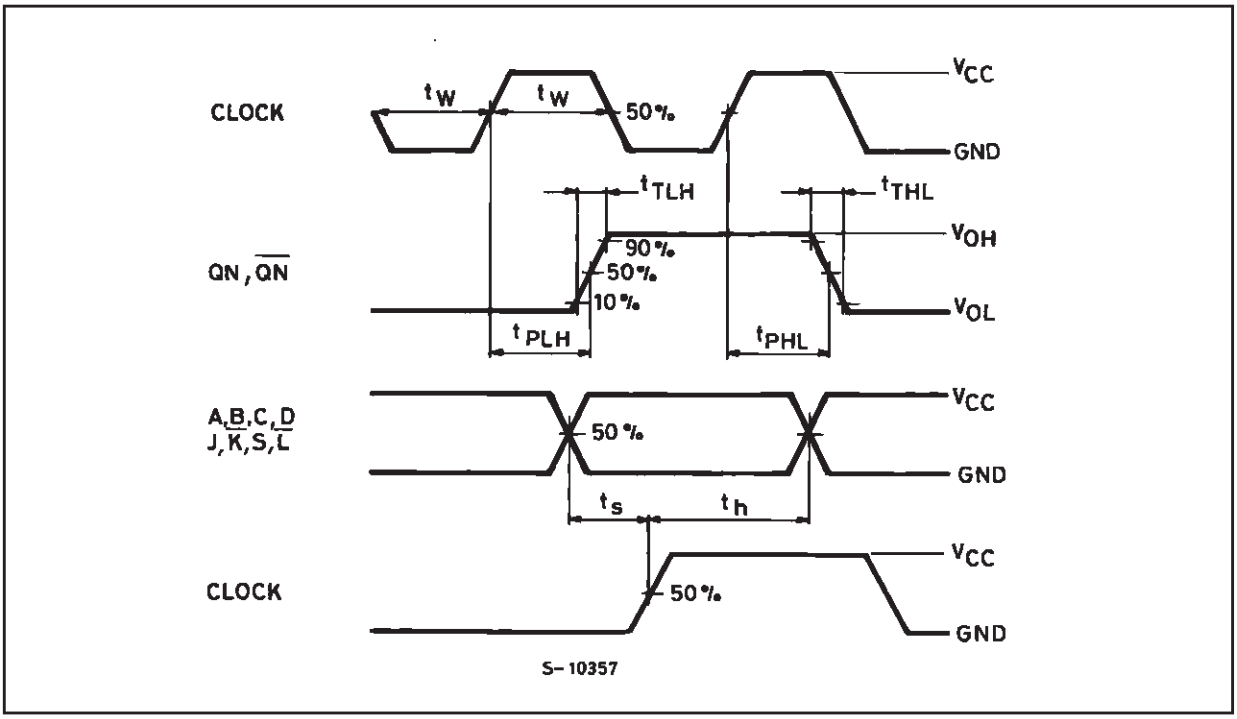
TEST CIRCUIT



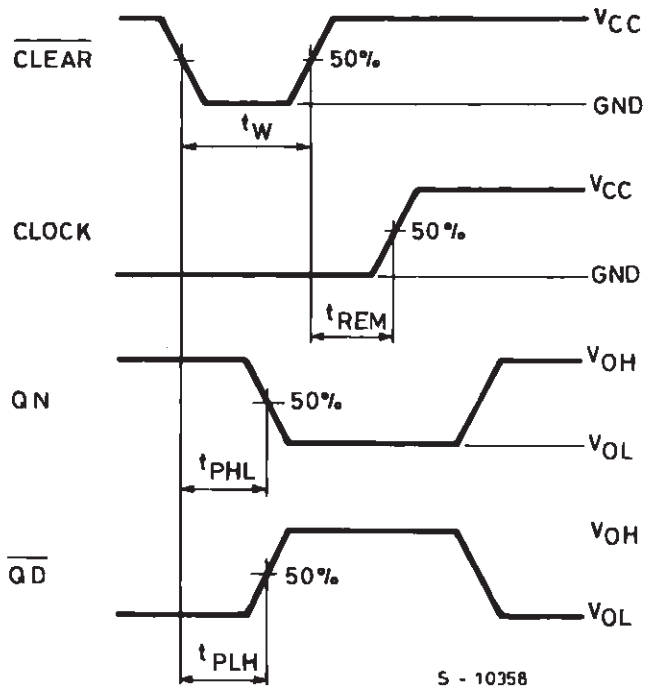
C_L = 50pF or equivalent (includes jig and probe capacitance)
R_T = Z_{OUT} of pulse generator (typically 50Ω)

WAVEFORM 1 : PROPAGATION DELAYS, MINIMUM PULSE WIDTH, SETUP AND HOLD TIME

(f=1MHz; 50% duty cycle)

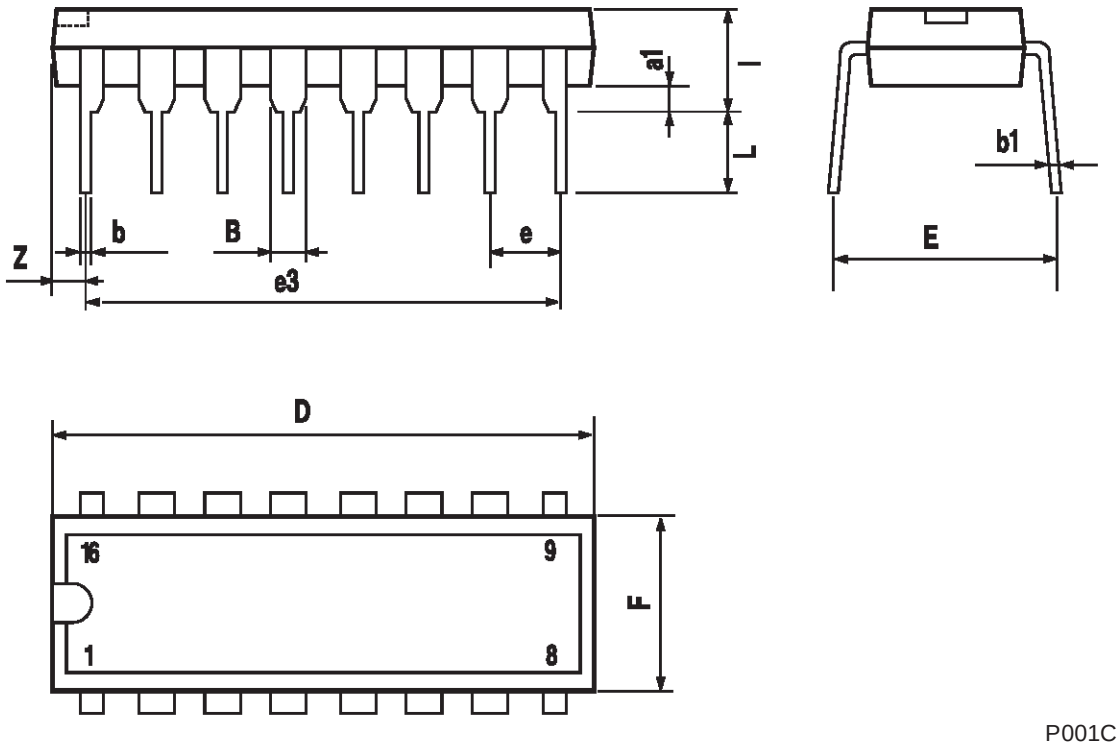


WAVEFORM 2 : MINIMUM PULSE WIDTH AND REMOVAL TIME (f=1MHz; 50% duty cycle)



Plastic DIP-16 (0.25) MECHANICAL DATA

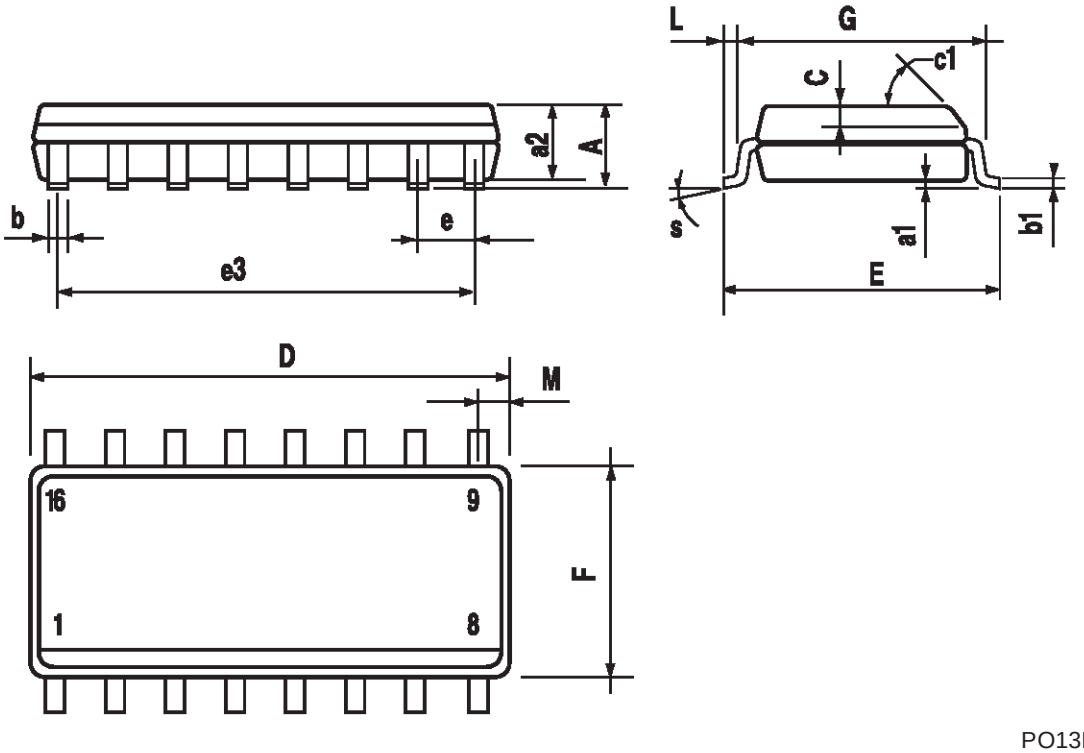
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



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