



M74HC195

4 BIT PIPO SHIFT REGISTER

- HIGH SPEED :
 $t_{PD} = 14 \text{ ns (TYP.) at } V_{CC} = 6V$
- 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
 74 SERIES 195



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 C²MOS technology.

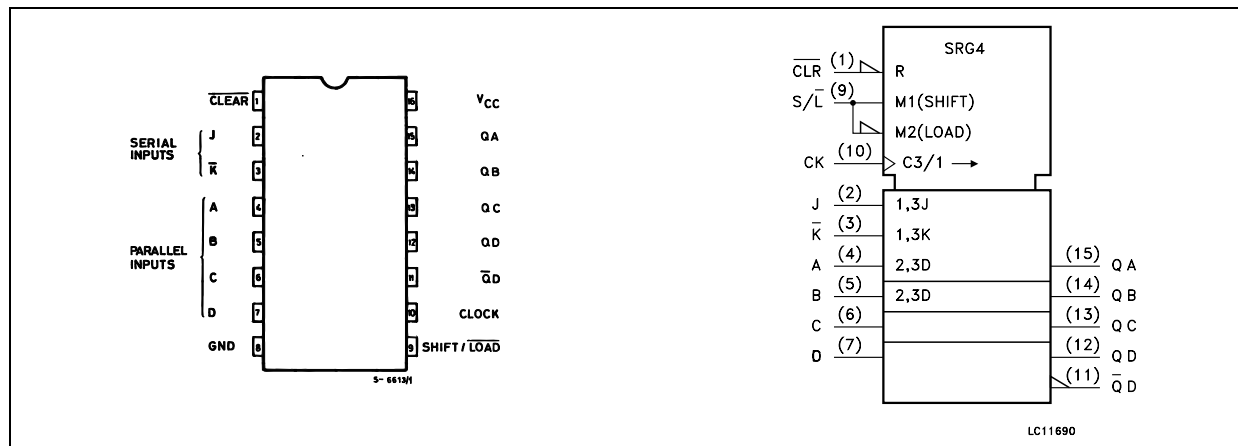
This shift register features parallel inputs, parallel outputs, J-K serial inputs, a SHIFT/LOAD control input, and direct overriding CLEAR. This shift register can operate in two modes : Parallel Load; Shift from QA towards QD.

Parallel loading is accomplished by applying the four bits of data, and taking the SHIFT/LOAD (S/L) control input low. The data is loaded into the associated flip-flops and appears at the outputs

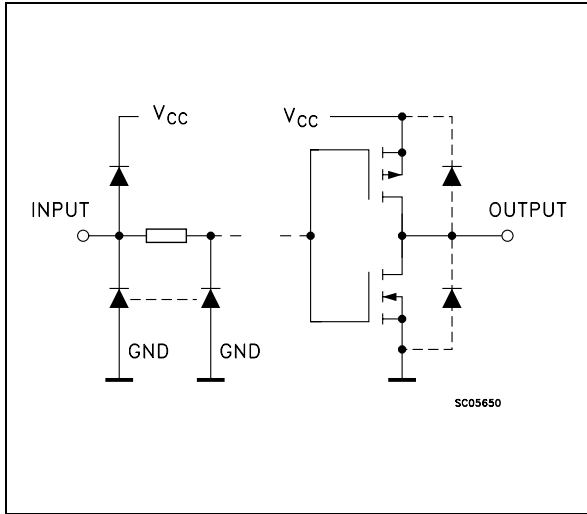
after the positive transition of the clock input. During parallel loading, serial data flow is inhibited. Serial shifting occurs synchronously when the SHIFT/LOAD control input is high. Serial data for this mode is entered at the J-K inputs. These inputs allow the first stage to perform as a J-K or TOGGLE 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 | CLEAR | Reset Input |
| 2 | J | First Stage J Input (Active LOW) |
| 3 | \bar{K} | First Stage K Input (Active LOW) |
| 4, 5, 6, 7 | A to D | Parallel Data Inputs |
| 9 | SHIFT/LOAD | Control Input |
| 10 | CLOCK | Clock Input (LOW to HIGH Edge-triggered) |
| 11 | \bar{QD} | Inverted Output From The Last Stage |
| 15, 14, 13, 12 | QA to QD | Parallel Outputs |
| 8 | GND | Ground (0V) |
| 16 | Vcc | Positive Supply Voltage |

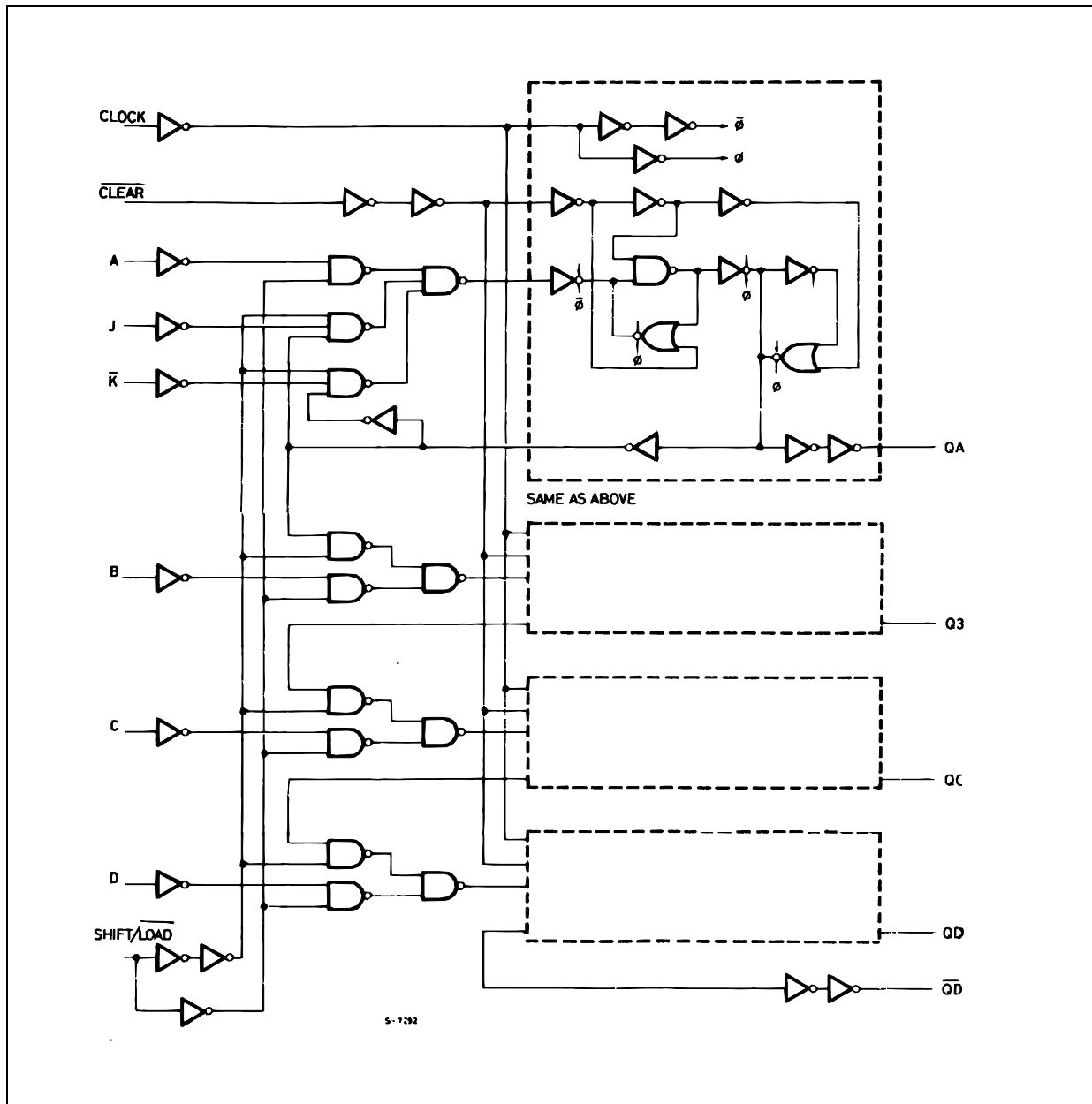
TRUTH TABLE

| INPUTS | | | | | | | | | OUTPUTS | | | | |
|---------------------------|------------|-------|--------|-----------|----------|---|---|---|-------------|-----|-----|-----|-------------|
| $\overline{\text{CLEAR}}$ | SHIFT/LOAD | CLOCK | SERIAL | | PARALLEL | | | | QA | QB | QC | QD | \bar{QD} |
| | | | J | \bar{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 | $\bar{QD0}$ |
| H | H | | L | H | X | X | X | X | QA0 | QA0 | QBn | QCn | \bar{QCn} |
| H | H | | L | L | X | X | X | X | L | QAn | QBn | QCn | \bar{QCn} |
| H | H | | H | H | X | X | X | X | H | QAn | QBn | QCn | \bar{QCn} |
| H | H | | H | L | X | X | X | X | \bar{QAn} | QAn | QBn | QCn | \bar{QCn} |

X : Don't Care

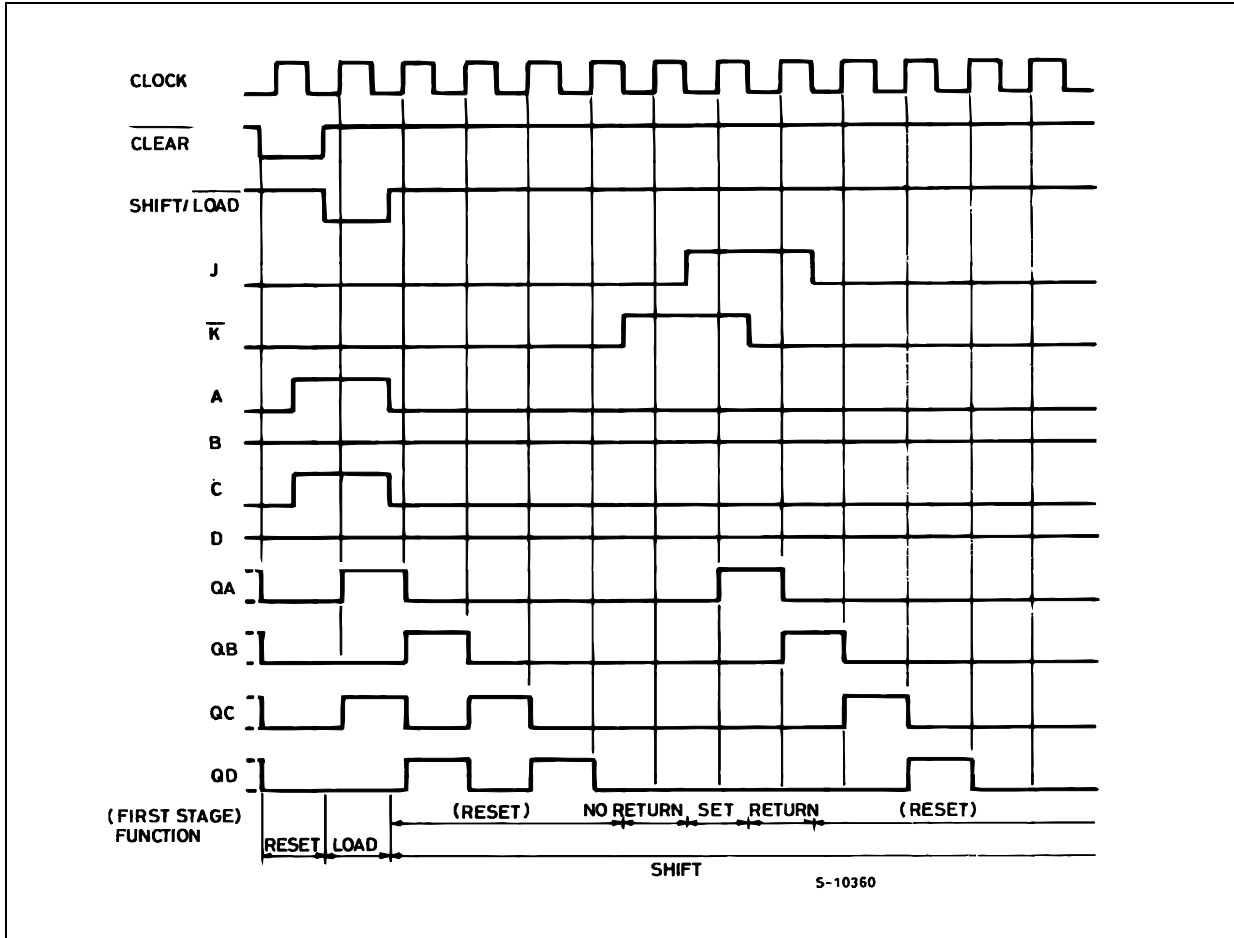
QAn ~ QCn : The level of QA, QB, QC, respectively, before the most recent positive transition of the clock.

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 | $^{\circ}C$ |
| T_L | Lead Temperature (10 sec) | 300 | $^{\circ}C$ |

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 $^{\circ}C$; derate to 300mW by 10mW/ $^{\circ}C$ from 65 $^{\circ}C$ to 85 $^{\circ}C$

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) | | $T_A = 25^\circ C$ | | | -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 | $I_O = -20 \mu A$ | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | 4.5 | $I_O = -20 \mu A$ | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | 6.0 | $I_O = -20 \mu A$ | 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 | $I_O = 20 \mu A$ | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | $I_O = 20 \mu A$ | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | $I_O = 20 \mu A$ | | 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 |

M74HC195

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

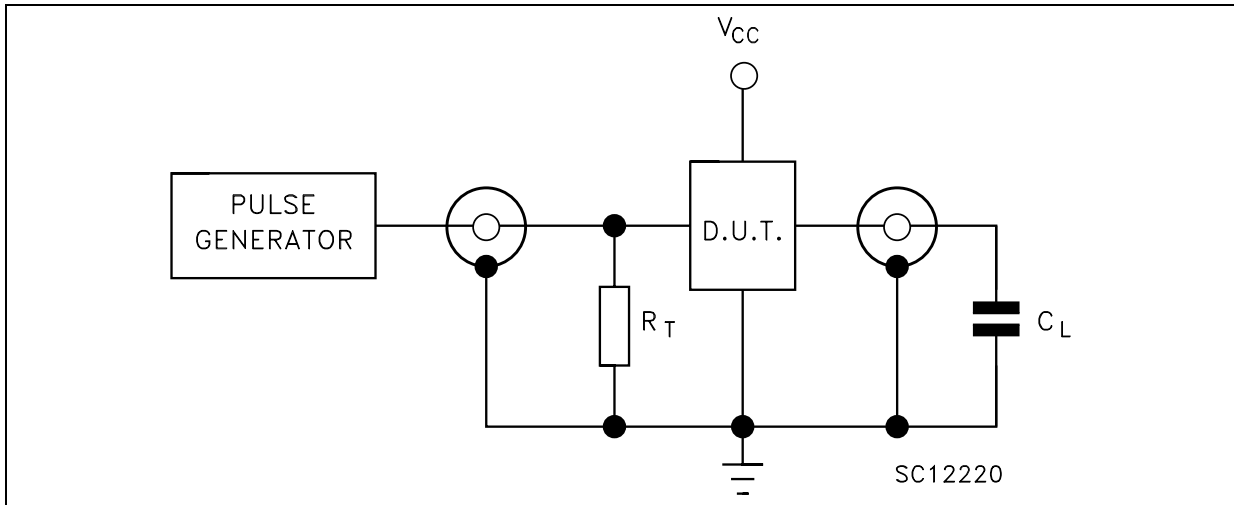
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|--------------------------|--|-----------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | V_{CC} (V) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t_{TLH} t_{THL} | Output Transition Time | 2.0 | | | 30 | 75 | | 95 | | 115 | ns |
| | | 4.5 | | | 8 | 15 | | 19 | | 23 | |
| | | 6.0 | | | 7 | 13 | | 16 | | 20 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CLOCK - Q_n , \overline{QD}) | 2.0 | | | 48 | 125 | | 155 | | 190 | ns |
| | | 4.5 | | | 16 | 25 | | 31 | | 38 | |
| | | 6.0 | | | 14 | 21 | | 26 | | 32 | |
| t_{PHL} | Propagation Delay Time (CLEAR - Q_n , \overline{QD}) | 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 (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) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | 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 | | | 72 | | | | | | pF |

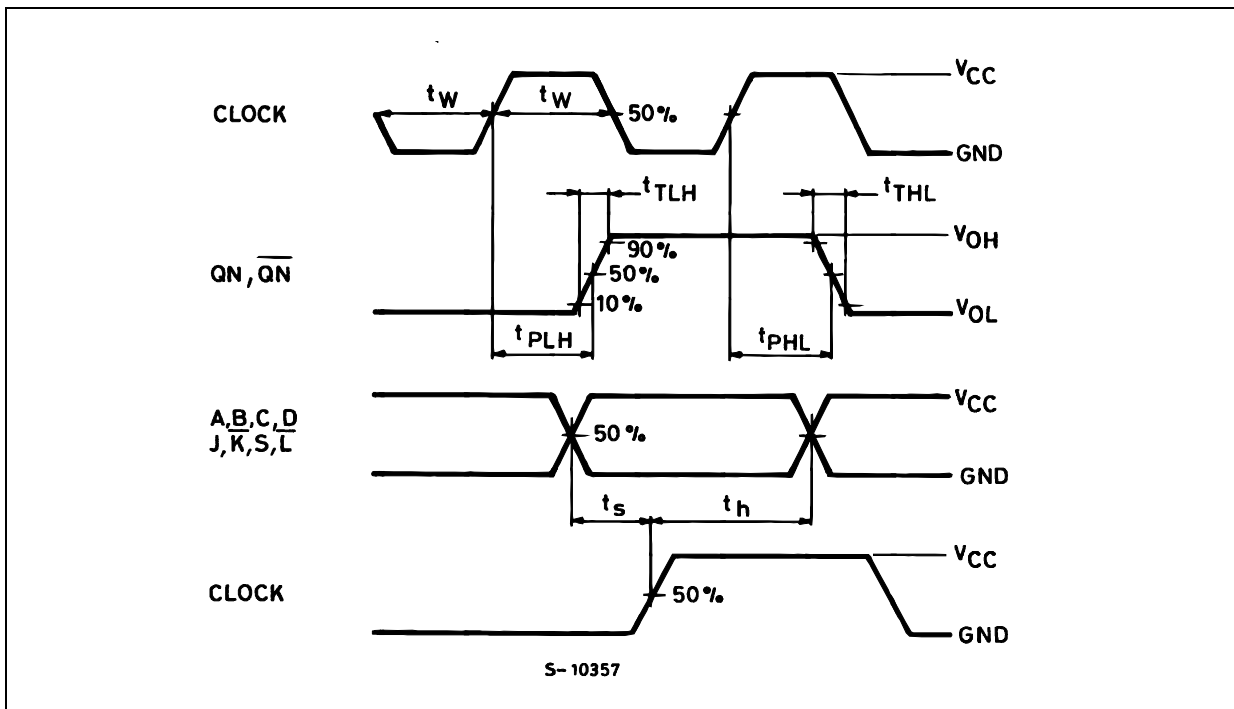
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

TEST CIRCUIT

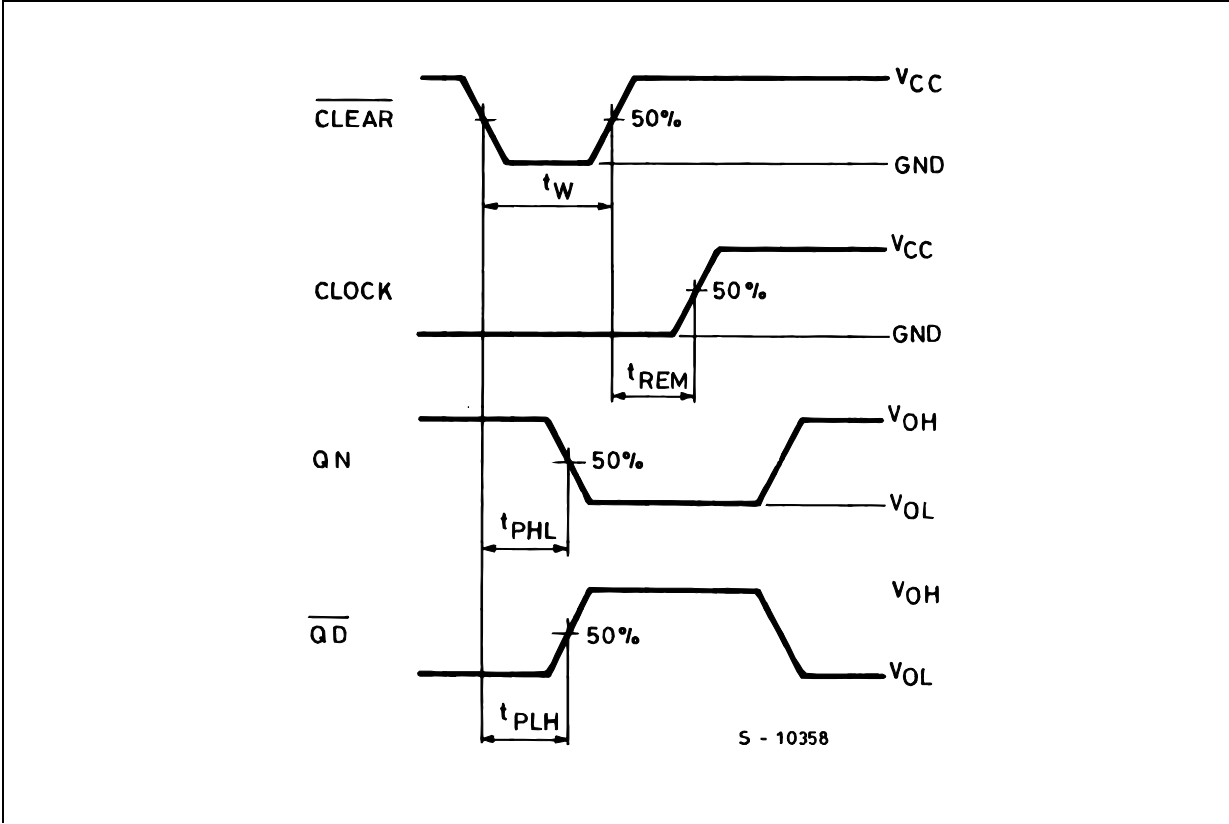


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

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 |



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 |



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