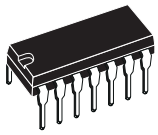
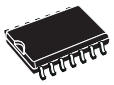
# M74HCT164

## 8 BIT SIPO SHIFT REGISTER

- HIGH SPEED:
  $t_{PD}$ = 24 ns (TYP.) at $V_{CC}$ = 4.5V
- LOW POWER DISSIPATION:
  $I_{CC}$ = 4µA(MAX.) at $T_A$=25°C
- COMPATIBLE WITH TTL OUTPUTS :
  $V_{IH}$ = 2V (MIN.) $V_{IL}$ = 0.8V (MAX)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 4mA (MIN)
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 164



DIP



SOP

TSSOP

**ORDER CODES**

| PACKAGE | TUBE | T & R |
|---|---|---|
| DIP | M74HCT164B1R | |
| SOP | M74HCT164M1R | M74HCT164RM13TR |
| TSSOP | | M74HCT164TTR |

### DESCRIPTION

The M74HCT164 is an high speed CMOS 8 BIT SIPO SHIFT REGISTER fabricated with silicon gate $C^2MOS$ technology.

The 74HCT164 is an 8 bit shift register with serial data entry and an output from each of the eight stages. Data is entered serially through one of two inputs (A or B), either of these inputs can be used as an active high enable for data entry through the other input. An unused input must be high, or both inputs connected together. Each low-to-high transition on the clock inputs shifts data one place to the right and enters into QA, the logic NAND of the two data inputs (A x B), the data that existed before the rising clock edge. A low level on the clear input overrides all other inputs and clears the register asynchronously, forcing all Q outputs low.

The M74HCT164 is designed to directly interface HSC$^2$MOS systems with TTL and NMOS components.

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

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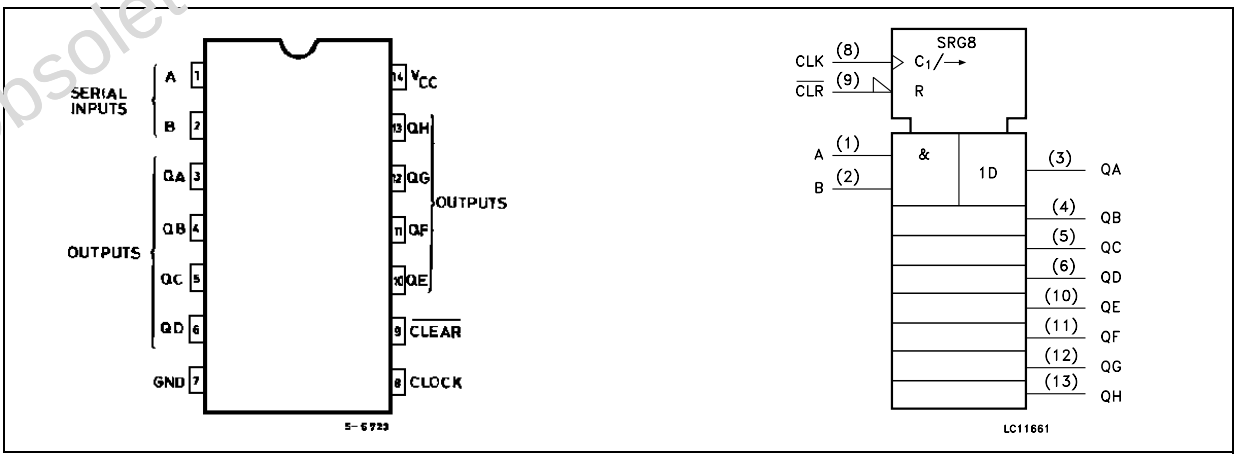
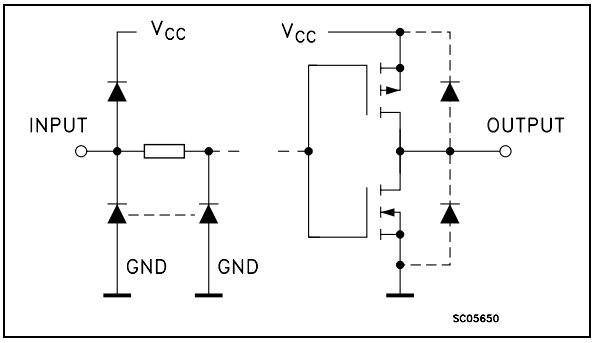
### PIN CONNECTION AND IEC LOGIC SYMBOLS



## INPUT AND OUTPUT EQUIVALENT CIRCUIT




## PIN DESCRIPTION

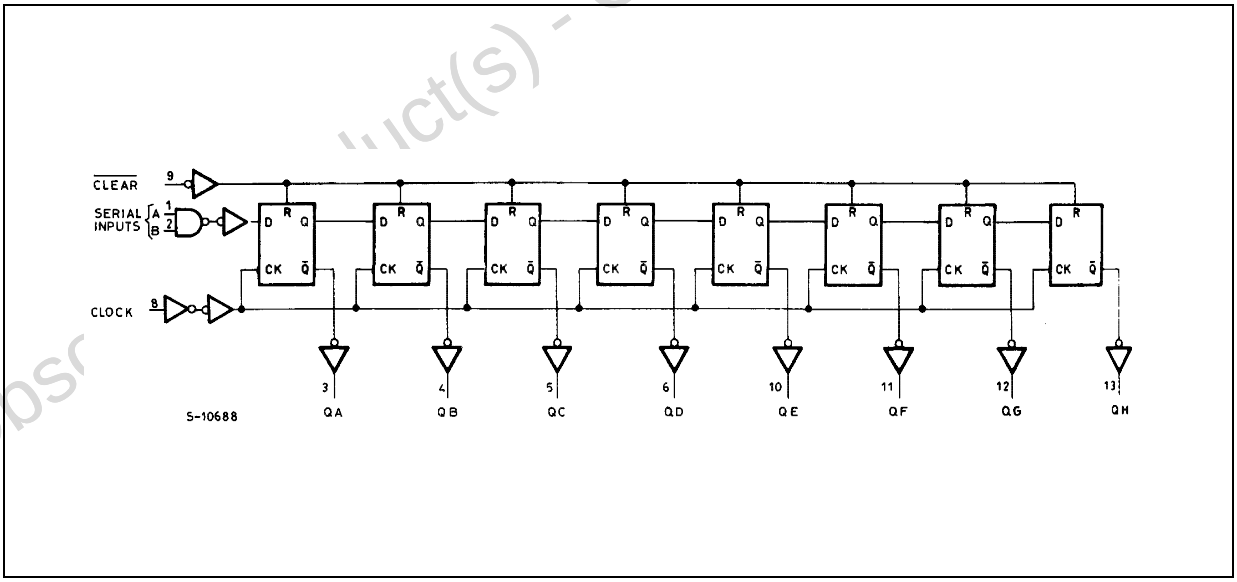
| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1,2 | A, B | Data Inputs |
| 3, 4, 5, 6, 10, 11, 12, 13 | QA to QH | Outputs |
| 8 | CLOCK | Clock Input (LOW to HIGH, Edge Triggered |
| 9 | $\overline{\text{CLEAR}}$ | Master Reset Input |
| 7 | GND | Ground (0V) |
| 14 | Vcc | Positive Supply Voltage |

## TRUTH TABLE

| INPUTS | | | | OUTPUTS | | | |
|---|---|---|---|---|---|---|---|
| $\overline{\text{CLEAR}}$ | CLOCK | SERIAL IN | | QA | QB | ..... | QH |
| | | A | B | | | | |
| L | X | X | X | L | L | ..... | L |
| H | ⎍ | X | X | NO CHANGE | | | |
| H | ⎍⎍ | L | X | L | QAn | ..... | QGn |
| H | ⎍⎍ | X | L | L | QAn | ..... | QGn |
| H | ⎍⎍ | H | H | H | QAn | ..... | QGn |

X : Don't Care
QAn - QGn : The level of QA - QG, respectively. before the most-recent transition of the clock

## LOGIC DIAGRAM




This logic diagram has not be used to estimate propagation delays

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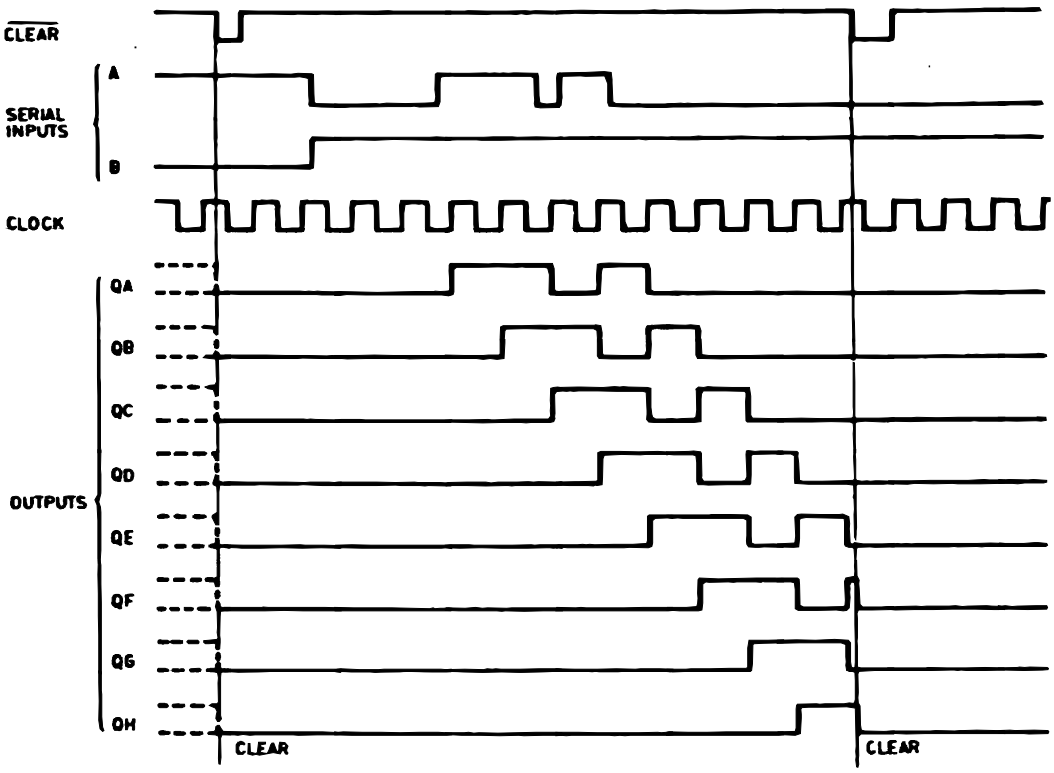
## TIMING CHART




## 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

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## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 4.5 to 5.5 | 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 ($V_{CC}$ = 4.5 to 5.5V) | 0 to 500 | 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 | 4.5 to 5.5 | | 2.0 | | | 2.0 | | 2.0 | | V |
| $V_{IL}$ | Low Level Input Voltage | 4.5 to 5.5 | | | | 0.8 | | 0.8 | | 0.8 | V |
| $V_{OH}$ | High Level Output Voltage | 4.5 | $I_O$=-20 µA | 4.4 | 4.5 | | 4.4 | | 4.4 | | V |
| | | | $I_O$=-4.0 mA | 4.18 | 4.31 | | 4.13 | | 4.10 | | |
| $V_{OL}$ | Low Level Output Voltage | 4.5 | $I_O$=20 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | | $I_O$=4.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.40 | |
| $I_I$ | Input Leakage Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | ± 0.1 | | ± 1 | | ± 1 | µA |
| $I_{CC}$ | Quiescent Supply Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | 4 | | 40 | | 80 | µA |
| $\Delta I_{CC}$ | Additional Worst Case Supply Current | 5.5 | Per Input pin $V_I$ = 0.5V or $V_I$ = 2.4V Other Inputs at $V_{CC}$ or GND $I_O$ = 0 | | | 2.0 | | 2.9 | | 3.0 | mA |

Obsolete Product(s)
Obsolete Product(s)

**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 | 4.5 | | | 8 | 15 | | 19 | | 22 | ns |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (CLOCK - Q) | 4.5 | | | 23 | 36 | | 45 | | 54 | ns |
| $t_{PHL}$ | Propagation Delay Time (CLEAR - Q) | 4.5 | | | 24 | 37 | | 46 | | 56 | ns |
| $f_{MAX}$ | Maximum Clock Frequency | 4.5 | | 30 | 50 | | 24 | | 20 | | MHz |
| $t_{W(H)}$ $t_{W(L)}$ | Minimum Pulse Width (CLOCK) | 4.5 | | | 8 | 15 | | 19 | | 22 | ns |
| $t_{W(L)}$ | Minimum Pulse Width (CLEAR) | 4.5 | | | 8 | 15 | | 19 | | 22 | ns |
| $t_s$ | Minimum Set-Up Time (A, B - CK) | 4.5 | | | 4 | 10 | | 13 | | 15 | ns |
| $t_h$ | Minimum Hold Time (A, B - CK) | 4.5 | | | | 0 | | 0 | | 0 | ns |
| $t_{REM}$ | Minimum Removal Time | 4.5 | | | | 5 | | 6 | | 8 | ns |

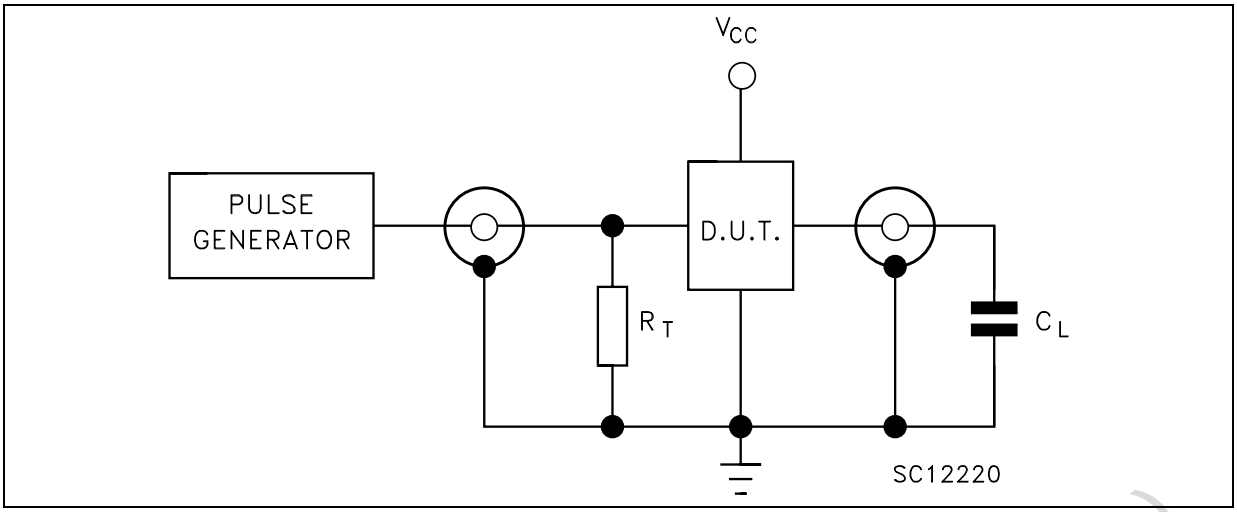
**CAPACITIVE CHARACTERISTICS**

| 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 | 10 | | 10 | | 10 | pF |
| $C_{PD}$ | Power Dissipation Capacitance (note 1) | | | | 137 | | | | | | 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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

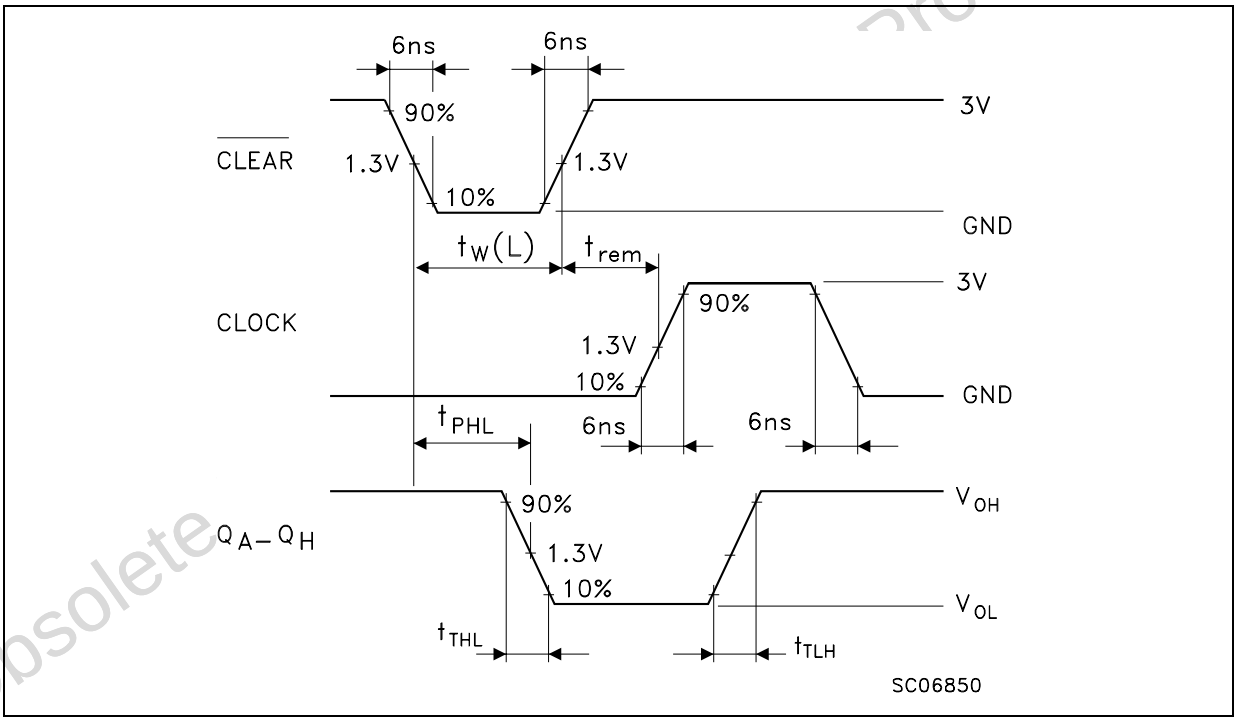
Obsolete Product(s) - Obsolete Product(s)

## TEST CIRCUIT



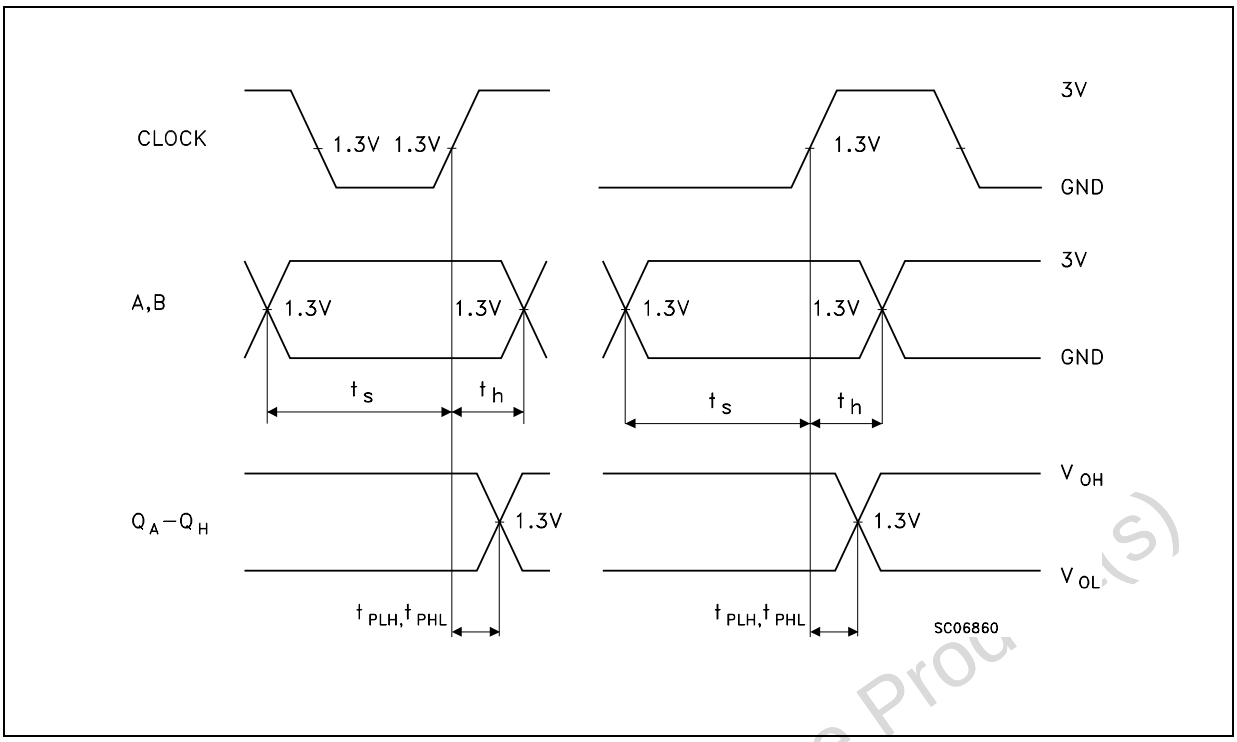

$C_L$ = 50pF or equivalent (includes jig and probe capacitance)
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

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




Obsolete Product(s)

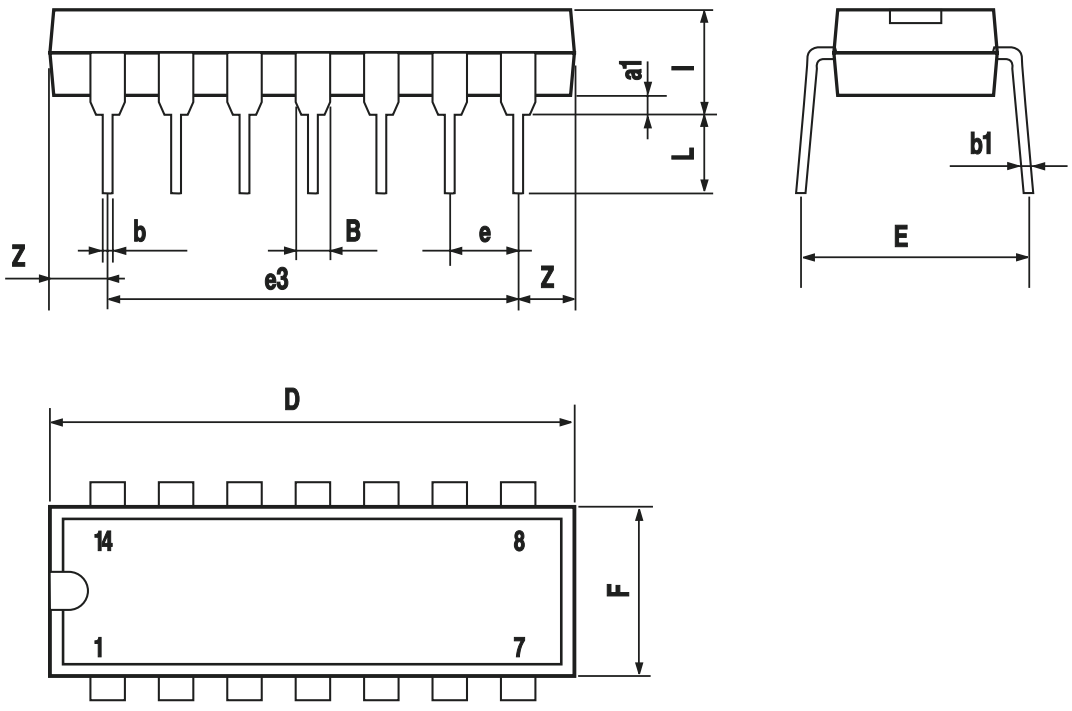
**WAVEFORM 2 : PROPAGATION DELAY TIMES, SETUP AND HOLD TIME** (f=1MHz; 50% duty cycle)




Obsolete Product(s) - Obsolete Prod(s)

## Plastic DIP-14 MECHANICAL DATA

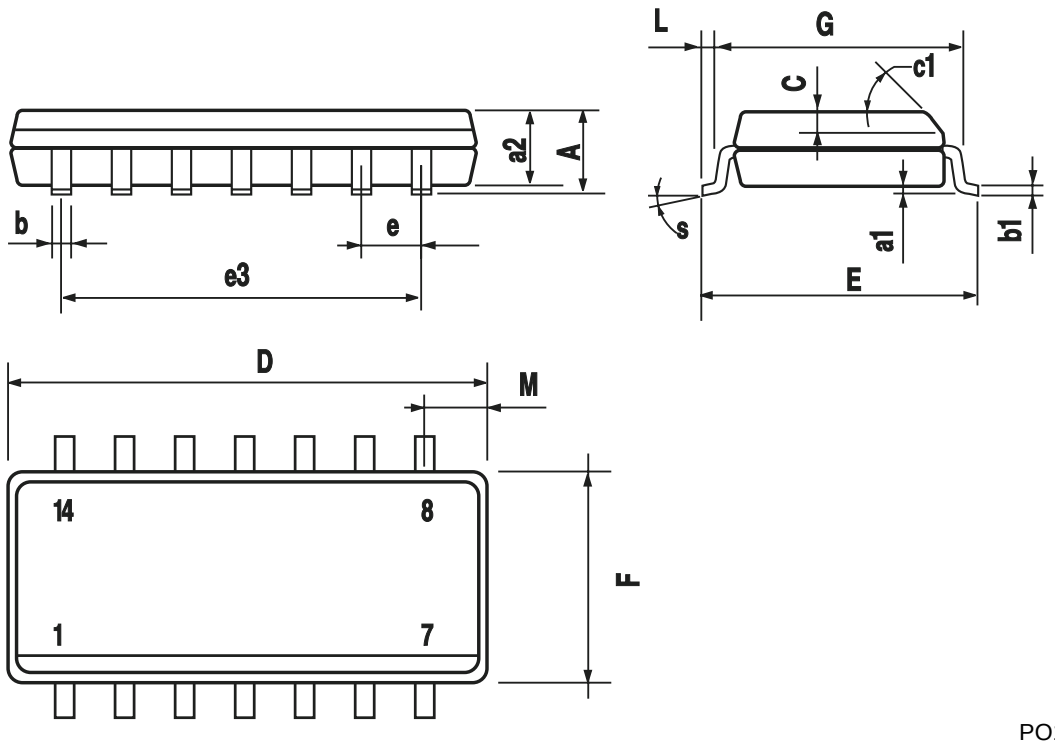
| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 15.24 | | | 0.600 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | 1.27 | | 2.54 | 0.050 | | 0.100 |




P001A

## SO-14 MECHANICAL DATA

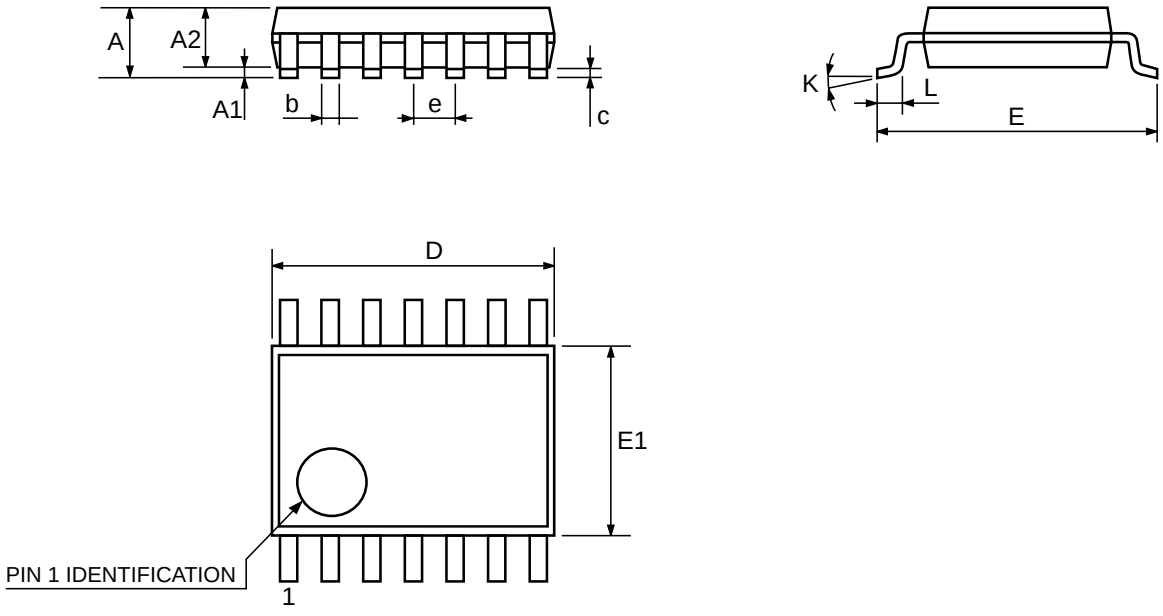
| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45° (typ.) | | | | | |
| D | 8.55 | | 8.75 | 0.336 | | 0.344 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 7.62 | | | 0.300 | |
| 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 | | | 0.68 | | | 0.026 |
| S | 8° (max.) | | | | | |




PO13G

## TSSOP14 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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