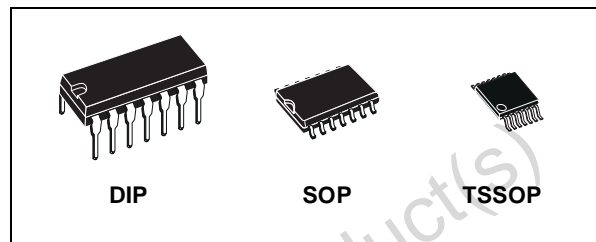




M74HC4024

7 STAGE BINARY COUNTER

- HIGH SPEED :
 $f_{MAX} = 79 \text{ MHz (TYP.) at } V_{CC} = 6V$
- 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
 74 SERIES 4024



ORDER CODES

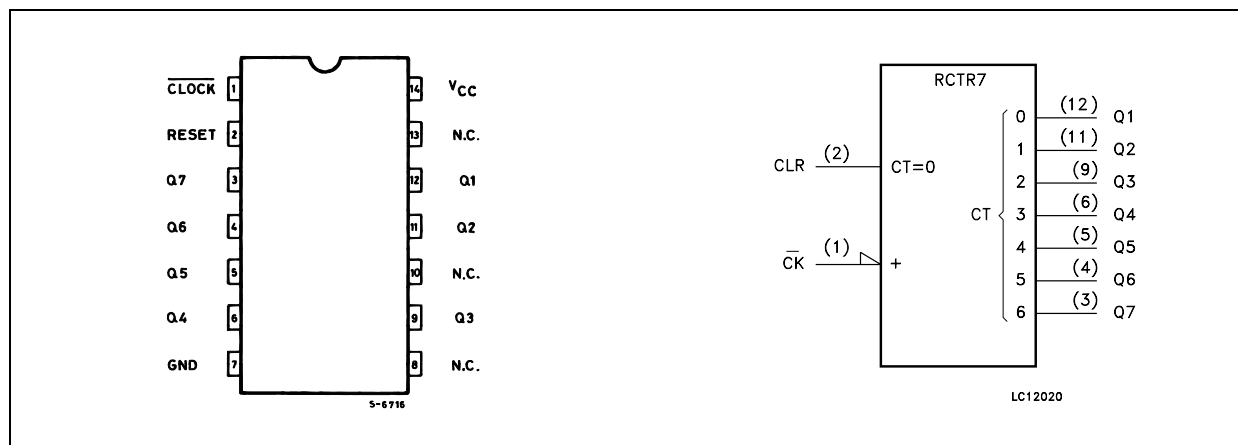
| PACKAGE | TUBE | T & R |
|---------|--------------|-----------------|
| DIP | M74HC4024B1R | |
| SOP | M74HC4024M1R | M74HC4024RM13TR |
| TSSOP | | M74HC4024TTR |

DESCRIPTION

The M74HC4024 is an high speed CMOS 7 STAGE BINARY COUNTER fabricated with silicon gate C²MOS technology. This devices is incremented on the falling edge (negative transition) of the input clock, and all its

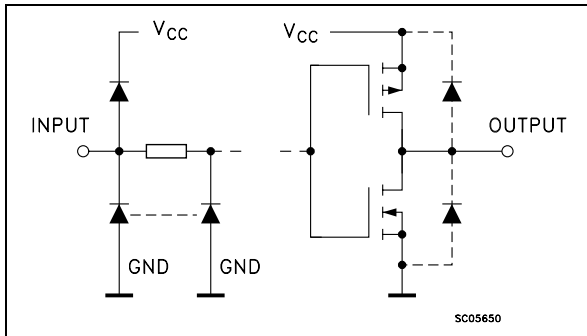
outputs are reset to a low level by applying a logical high level on their reset input (CLEAR). All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS



M74HC4024

INPUT AND OUTPUT EQUIVALENT CIRCUIT



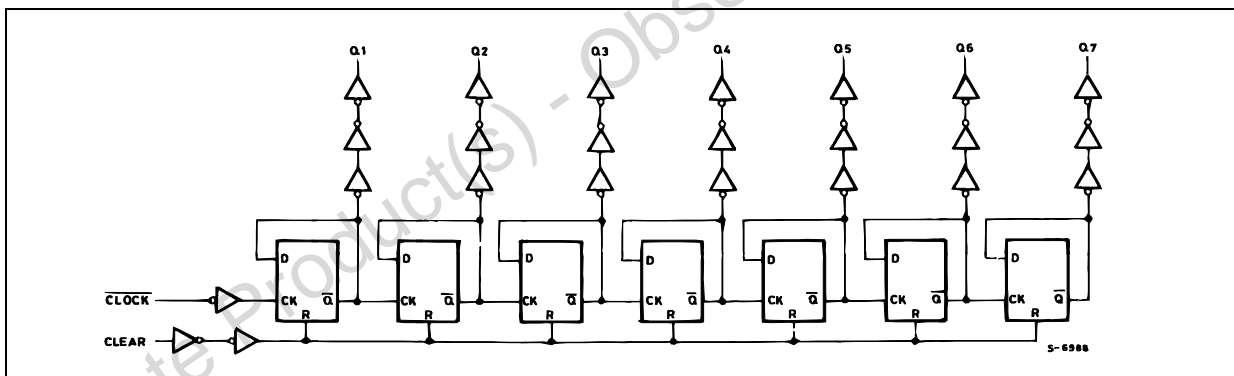
PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|-----------------------|---------------------------|---|
| 1 | $\overline{\text{CLOCK}}$ | Clock Input (HIGH to LOW, Edge-triggered) |
| 2 | CLEAR | Reser Input (Active High) |
| 12, 11, 9, 6, 5, 4, 3 | Q1 to Q7 | Parallel Inputs |
| 8, 10, 13 | NC | Not Connected |
| 7 | GND | Ground (0V) |
| 14 | Vcc | Positive Supply Voltage |

TRUTH TABLE

| $\overline{\text{CLOCK}}$ | CLEAR | OUTPUT STATE |
|---------------------------|-------|-----------------------|
| X | H | ALL OUTPUTS = "L" |
| | L | NO CHANGE |
| | L | ADVANCE TO NEXT STATE |

LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

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) | | $T_A = 25^\circ C$ | | | -40 to $85^\circ C$ | | -55 to $125^\circ C$ | | |
| | | | | 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 |

M74HC4024

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

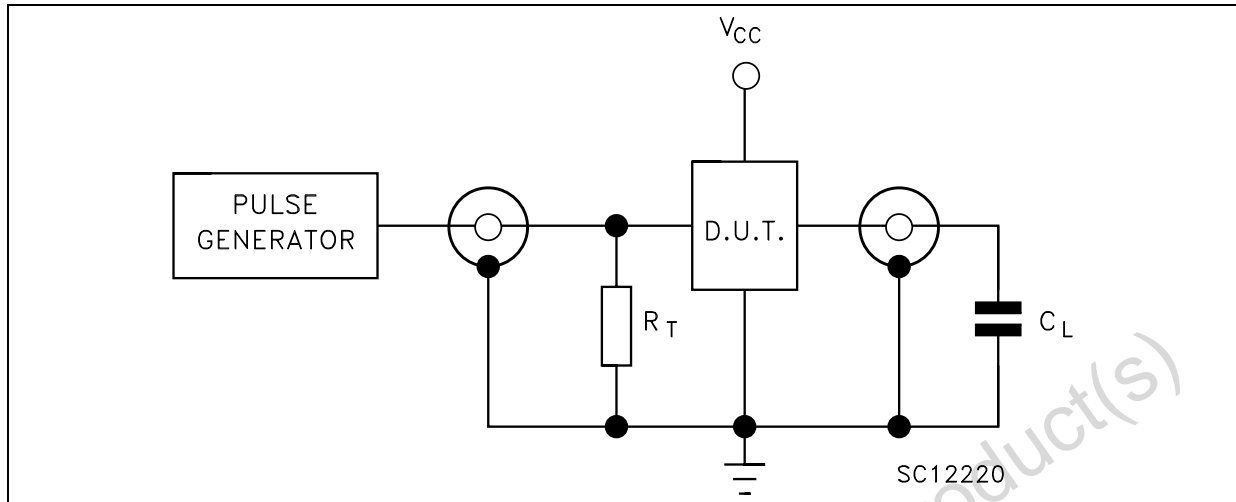
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|--------------------------|---|-----------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | V_{CC} (V) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | 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 ($Q_n - Q_{n+1}$) | 2.0 | | | 24 | 60 | | 75 | | 90 | ns |
| | | 4.5 | | | 6 | 12 | | 15 | | 18 | |
| | | 6.0 | | | 5 | 10 | | 13 | | 15 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CLOCK - Q_1) | 2.0 | | | 60 | 120 | | 150 | | 180 | ns |
| | | 4.5 | | | 15 | 24 | | 30 | | 36 | |
| | | 6.0 | | | 13 | 20 | | 26 | | 31 | |
| t_{PHL} | Propagation Delay Time (CLEAR - Q_n) | 2.0 | | | 60 | 120 | | 150 | | 180 | ns |
| | | 4.5 | | | 15 | 24 | | 30 | | 36 | |
| | | 6.0 | | | 13 | 20 | | 26 | | 31 | |
| f_{MAX} | Maximum Clock Frequency | 2.0 | | | 8 | 17 | | 7 | | 5.6 | MHz |
| | | 4.5 | | | 42 | 67 | | 34 | | 28 | |
| | | 6.0 | | | 49 | 79 | | 40 | | 34 | |
| $t_{W(H)}$ $t_{W(L)}$ | Minimum Pulse Width (CLOCK) | 2.0 | | | 24 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 6 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 5 | 13 | | 16 | | 19 | |
| $t_{W(H)}$ | Minimum Pulse Width (CLEAR) | 2.0 | | | 32 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 8 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 7 | 13 | | 16 | | 19 | |
| t_{REM} | Minimum Removal Time | 2.0 | | | | 25 | | 30 | | 40 | ns |
| | | 4.5 | | | | 5 | | 6 | | 8 | |
| | | 6.0 | | | | 5 | | 5 | | 7 | |

CAPACITIVE CHARACTERISTICS

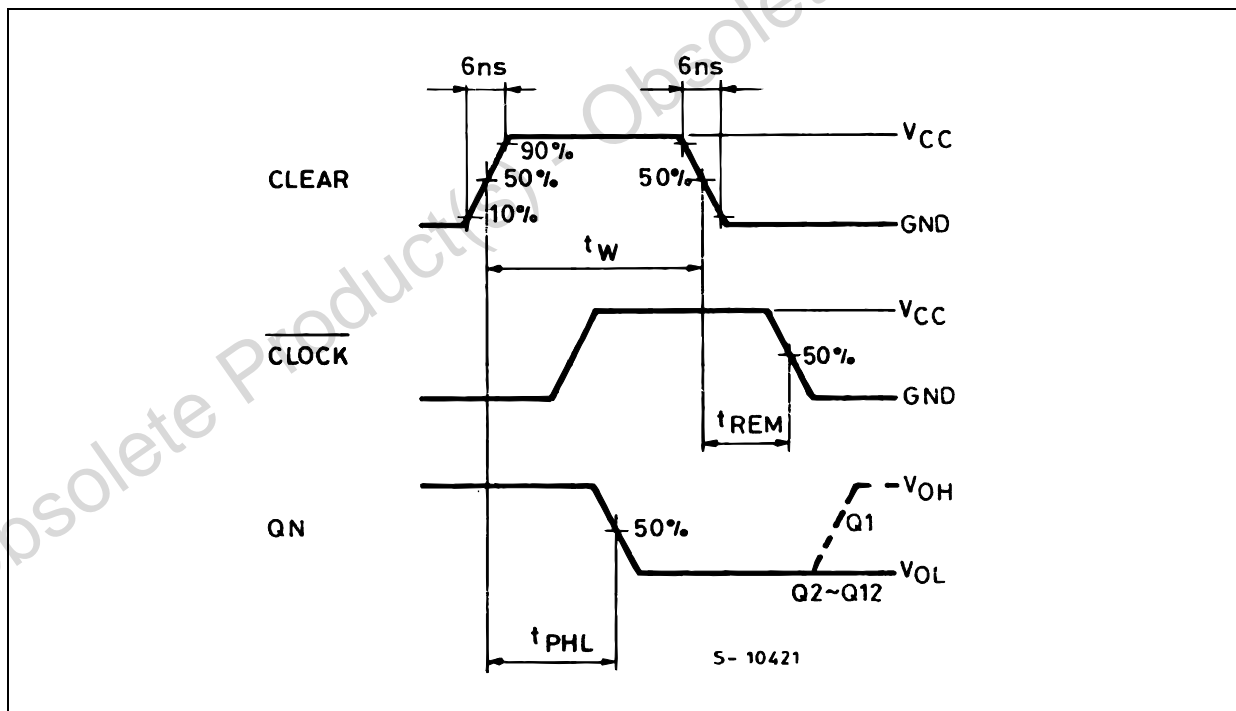
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|----------|--|-----------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | V_{CC} (V) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | 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 | | | 34 | | | | | | 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. $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

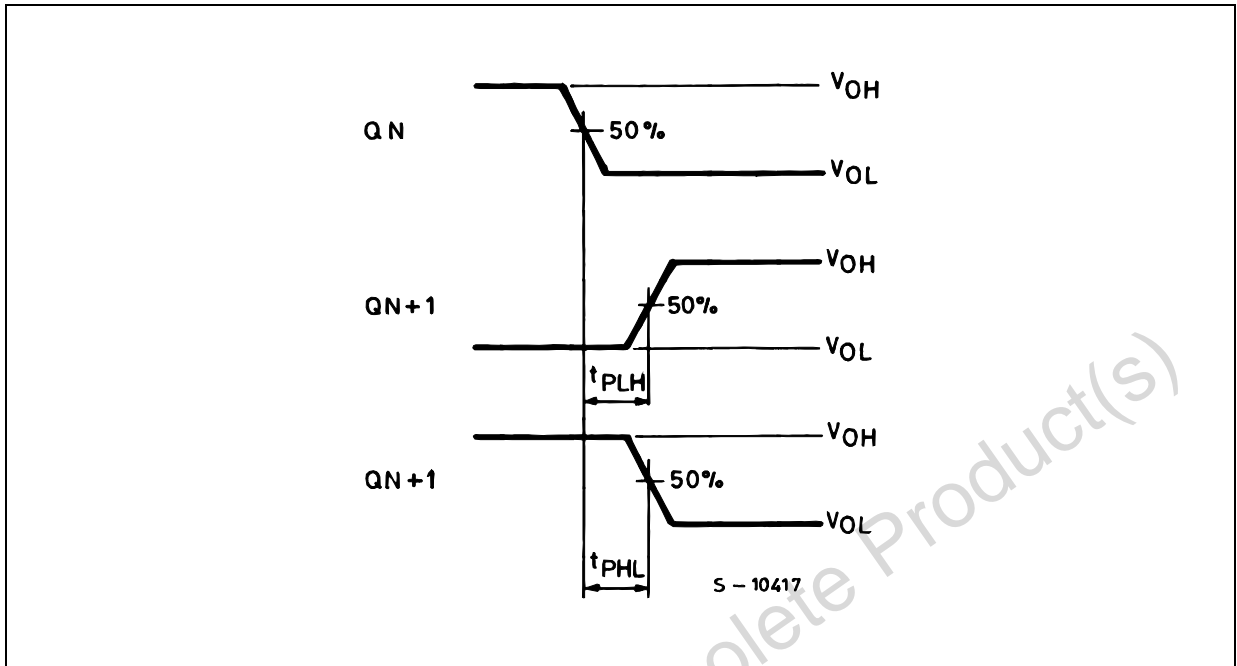
TEST CIRCUIT



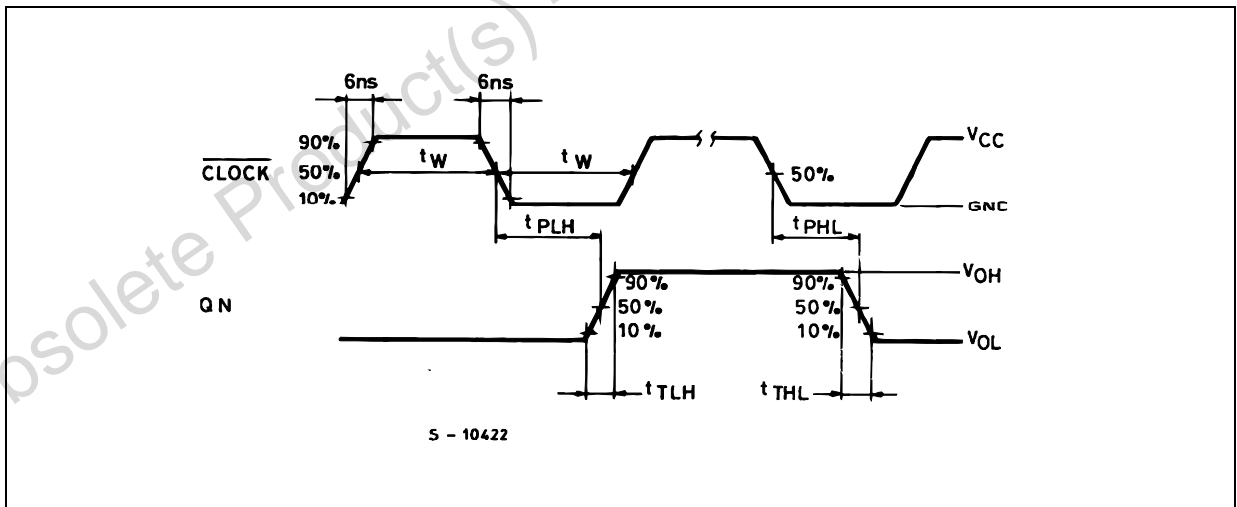
$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

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

WAVEFORM 2 : PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)

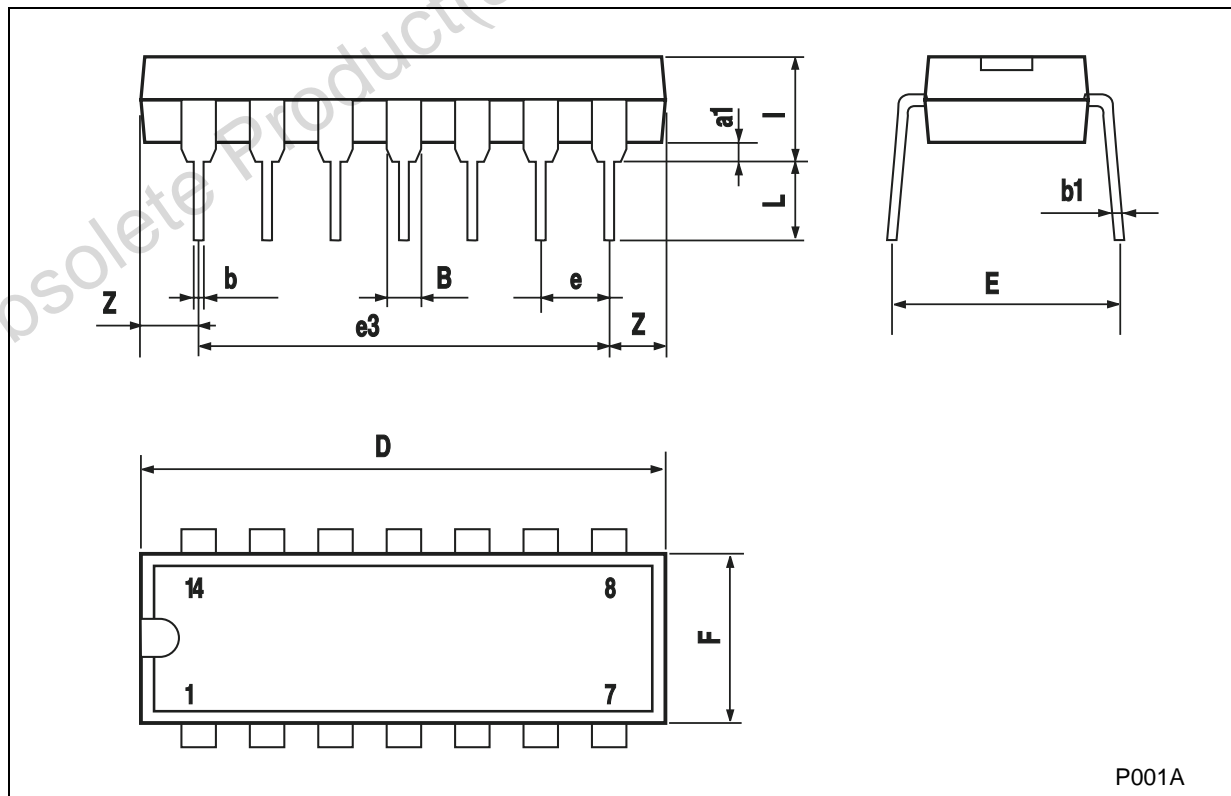


WAVEFORM 3 : MINIMUM PULSE WIDTH (CLOCK), PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)



| | | | | | | |
|---------------------------------------|--|--|--|--|--|--|
| Plastic DIP-14 MECHANICAL DATA | | | | | | |
|---------------------------------------|--|--|--|--|--|--|

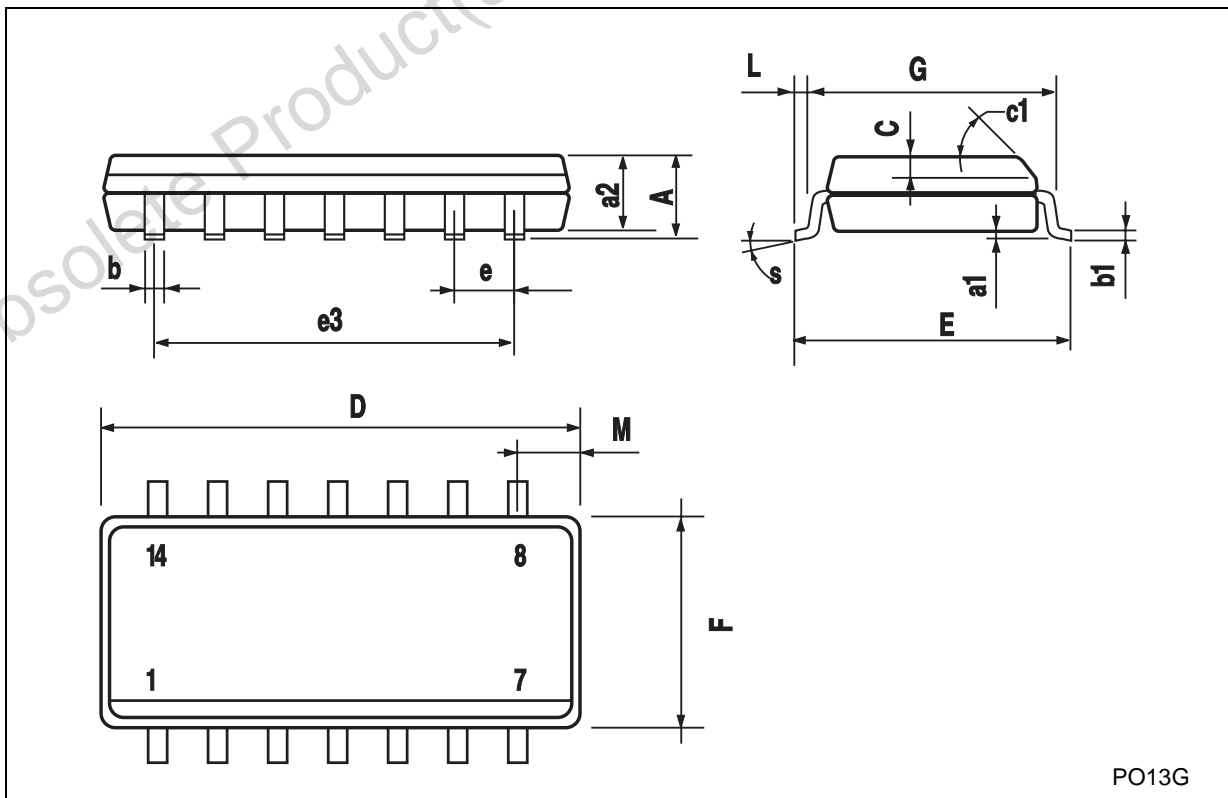
| DIM. | mm. | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 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

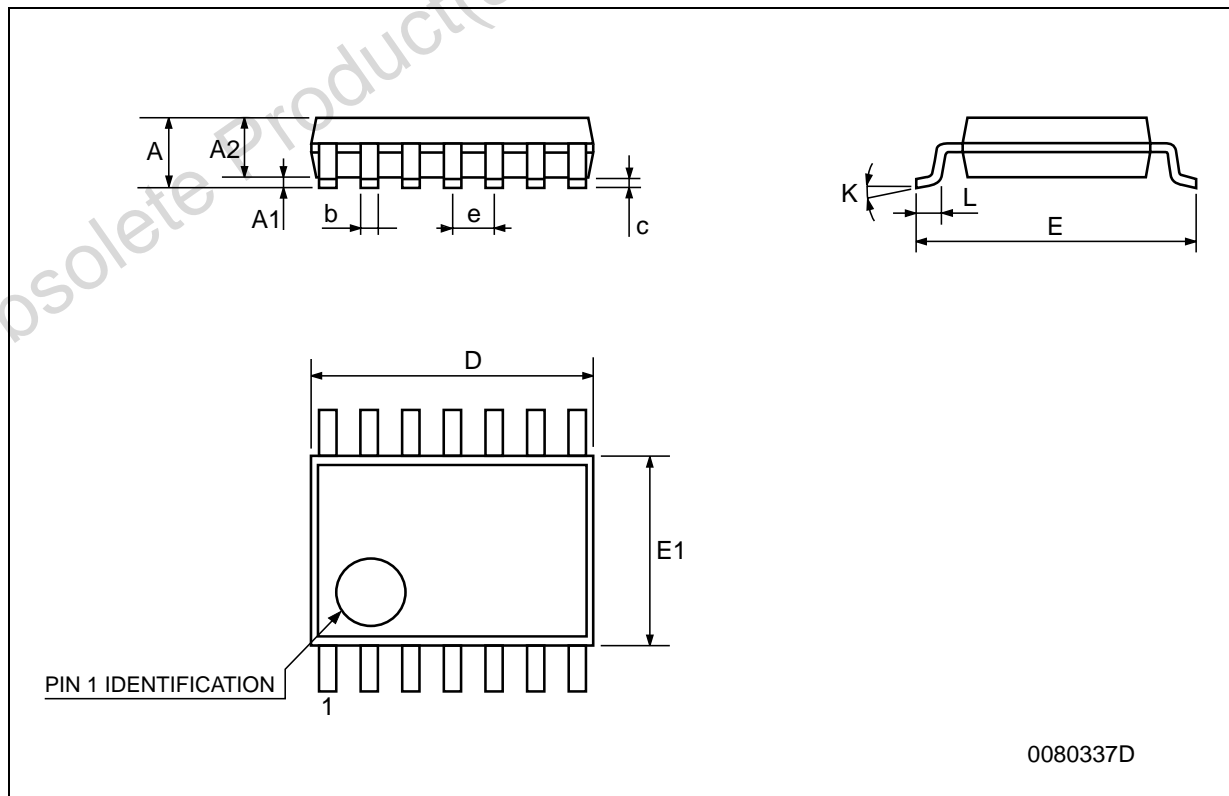
| DIM. | mm. | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 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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