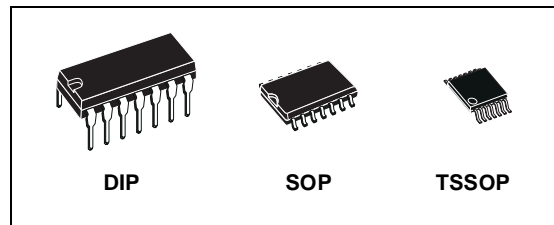




M74HC107

DUAL J-K FLIP FLOP WITH CLEAR

- HIGH SPEED :
 $f_{MAX} = 80\text{MHz}$ (TYP.) at $V_{CC} = 6\text{V}$
- LOW POWER DISSIPATION:
 $I_{CC} = 2\mu\text{A}$ (MAX.) at $T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (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} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH
 74 SERIES 107



ORDER CODES

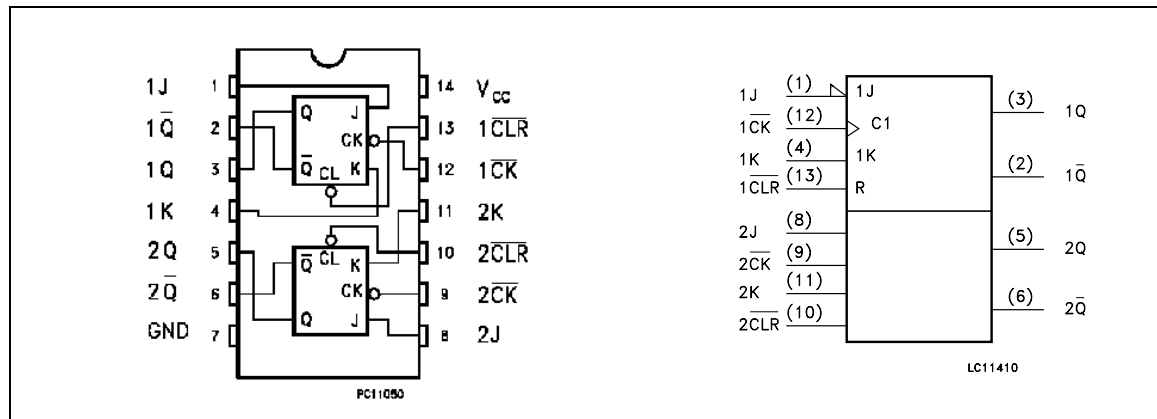
| PACKAGE | TUBE | T & R |
|---------|-------------|----------------|
| DIP | M74HC107B1R | |
| SOP | M74HC107M1R | M74HC107RM13TR |
| TSSOP | | M74HC107TTR |

DESCRIPTION

The M74HC107 is an high speed CMOS DUAL J-K FLIP FLOP fabricated with silicon gate C²MOS technology. These flip-flop are edge sensitive to the clock input and change state on the negative going transition of the clock pulse. Each one has independent J, K, CLOCK, and

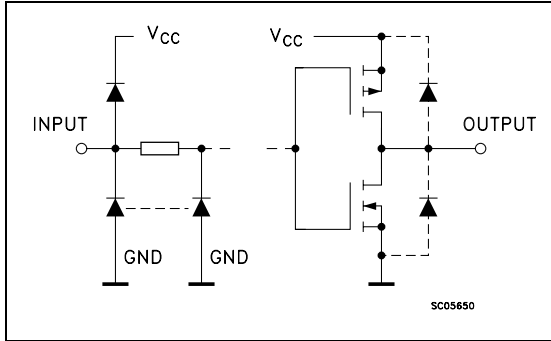
CLEAR input and Q and \bar{Q} outputs. CLEAR is independent of the clock and accomplished by a logic low on the input. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS



M74HC107

INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

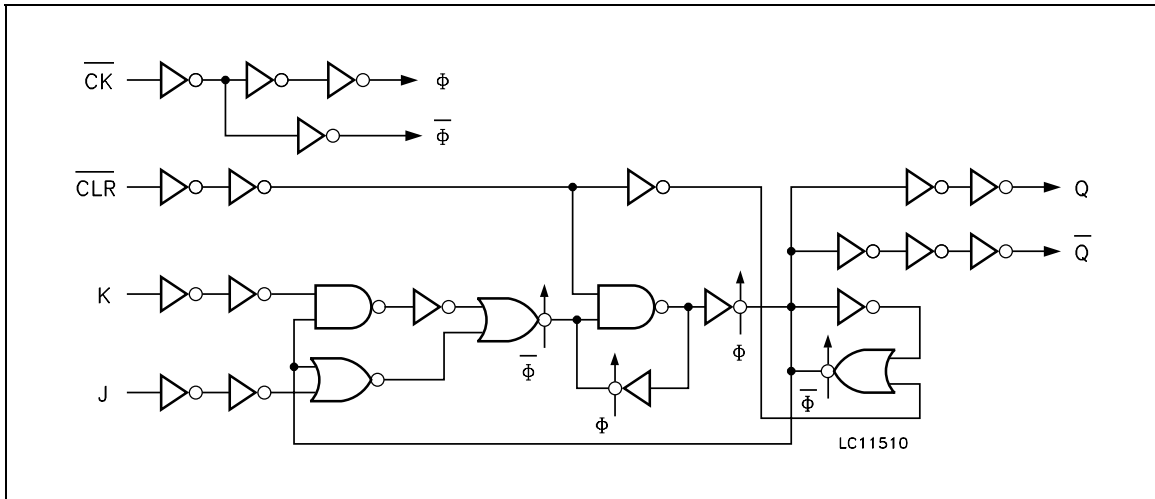
| PIN No | SYMBOL | NAME AND FUNCTION |
|-------------|----------------|---------------------------------------|
| 1, 8, 4, 11 | 1J, 2J, 1K, 2K | Synchronous Inputs; Flip-Flop 1 And 2 |
| 2, 6 | 1Q̄, 2Q̄ | Complement Flip-Flop Outputs |
| 3, 5 | 1Q, 2Q | True Flip-Flop Outputs |
| 12, 9 | 1CK, 2CK | Clock Input |
| 13, 10 | 1CLR, 2CLR | Asynchronous Reset Inputs |
| 7 | GND | Ground (0V) |
| 14 | Vcc | Positive Supply Voltage |

TRUTH TABLE

| INPUTS | | | | OUTPUTS | | FUNCTION |
|--------|---|---|-----|-----------------|-----------------|-----------|
| CLR̄ | J | K | CK̄ | Q | Q̄ | |
| L | X | X | X | L | H | CLEAR |
| H | L | L | ⌋ | Q _n | Q̄ _n | NO CHANGE |
| H | L | H | ⌋ | L | H | ---- |
| H | H | L | ⌋ | H | L | ---- |
| H | H | H | ⌋ | Q̄ _n | Q _n | TOGGLE |
| H | X | X | ⌋ | Q _n | Q̄ _n | NO CHANGE |

X : Don't Care

LOGIC DIAGRAM



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 | | | 2 | | 20 | | 40 | μA |

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

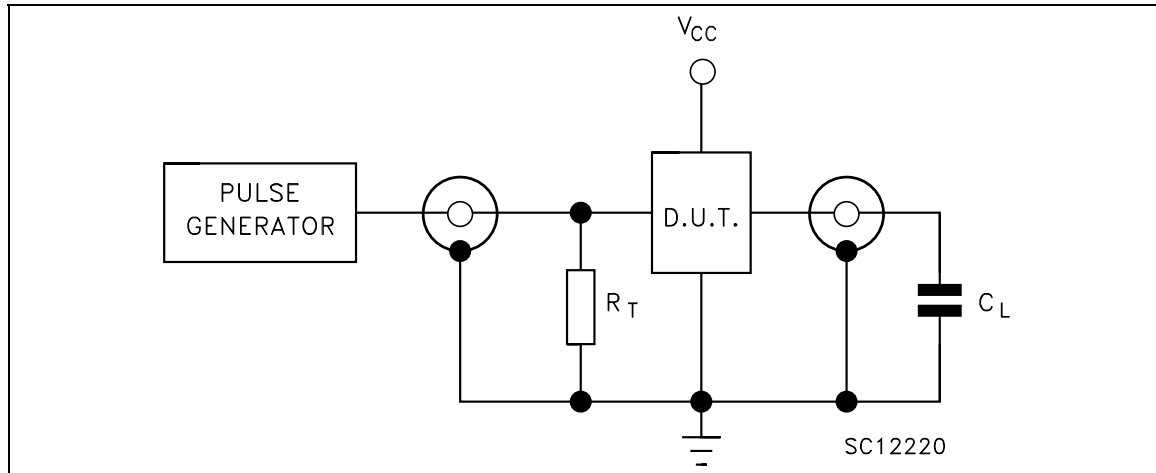
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | | |
|--------------------------|-------------------------------------|-----------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|----|
| | | 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 (CK - Q, Q) | 2.0 | | | 48 | 125 | | 155 | | 190 | ns | |
| | | 4.5 | | | 14 | 25 | | 31 | | 38 | | |
| | | 6.0 | | | 12 | 21 | | 26 | | 32 | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CLR - Q, Q) | 2.0 | | | 52 | 140 | | 175 | | 210 | ns | |
| | | 4.5 | | | 15 | 28 | | 35 | | 42 | | |
| | | 6.0 | | | 13 | 24 | | 30 | | 36 | | |
| f_{MAX} | Maximum Clock Frequency | 2.0 | | | 6.2 | 23 | | 5.0 | | 4.2 | MHz | |
| | | 4.5 | | | 31 | 70 | | 25 | | 21 | | |
| | | 6.0 | | | 37 | 80 | | 30 | | 25 | | |
| $t_{W(H)}$ $t_{W(L)}$ | Minimum Pulse Width (CLOCK) | 2.0 | | | | 20 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | | 5 | 15 | | 19 | | 22 | |
| | | 6.0 | | | | 4 | 13 | | 16 | | 19 | |
| $t_{W(L)}$ | Minimum Pulse Width (CLR) | 2.0 | | | | 20 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | | 5 | 15 | | 19 | | 22 | |
| | | 6.0 | | | | 4 | 13 | | 16 | | 19 | |
| t_s | Minimum Set-up Time | 2.0 | | | | 28 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | | 7 | 15 | | 19 | | 22 | |
| | | 6.0 | | | | 6 | 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 (CLR) | 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 | | | | 32 | | | | | | pF |

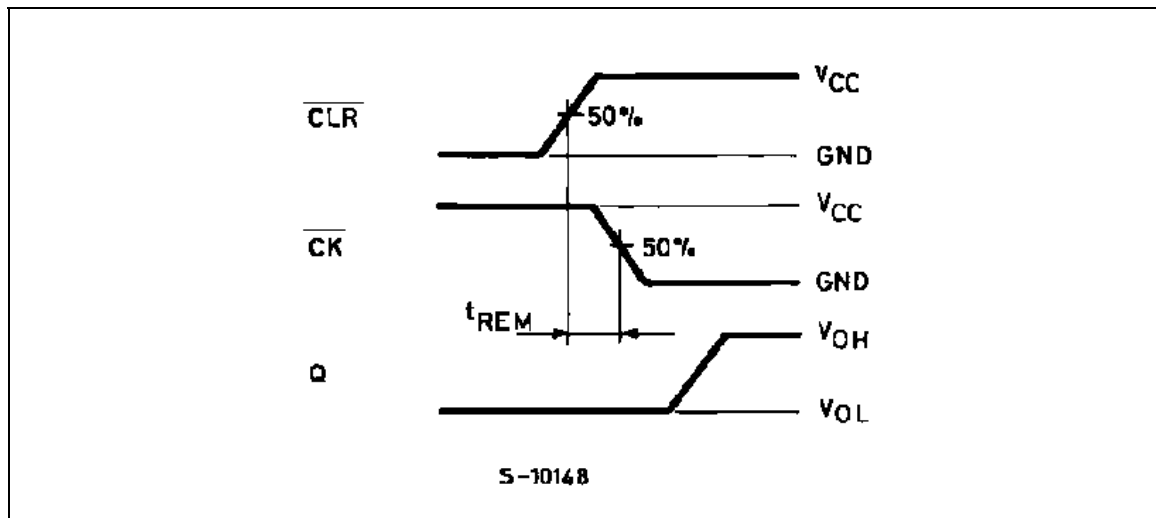
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opp)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per FLIP/FLOP)

TEST CIRCUIT

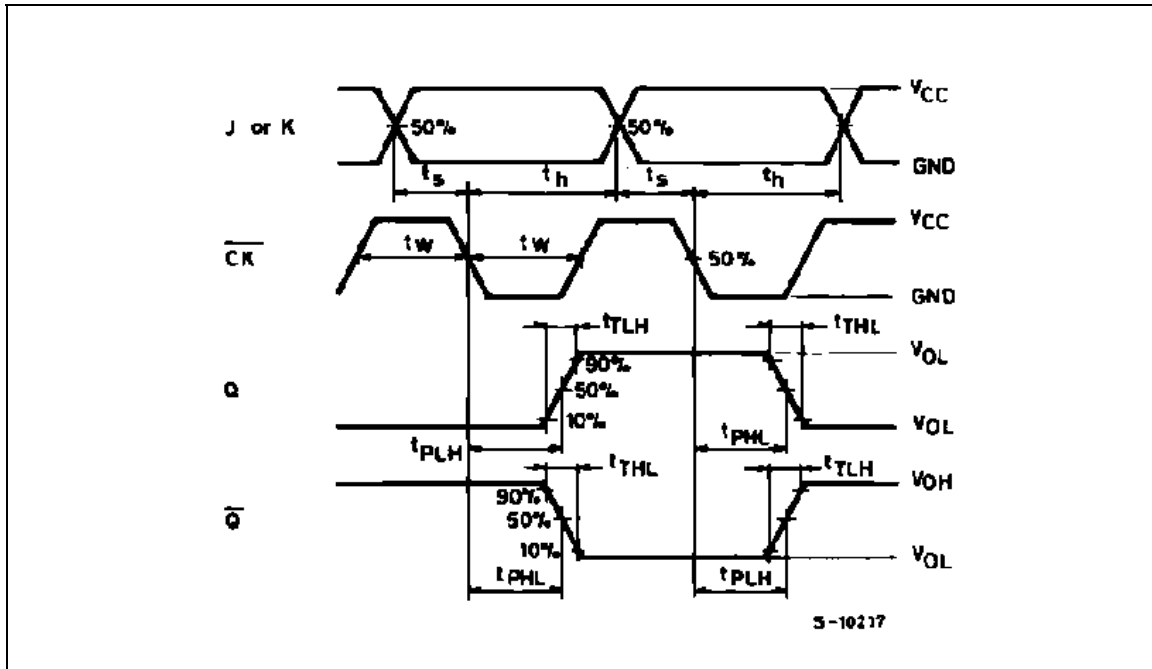


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

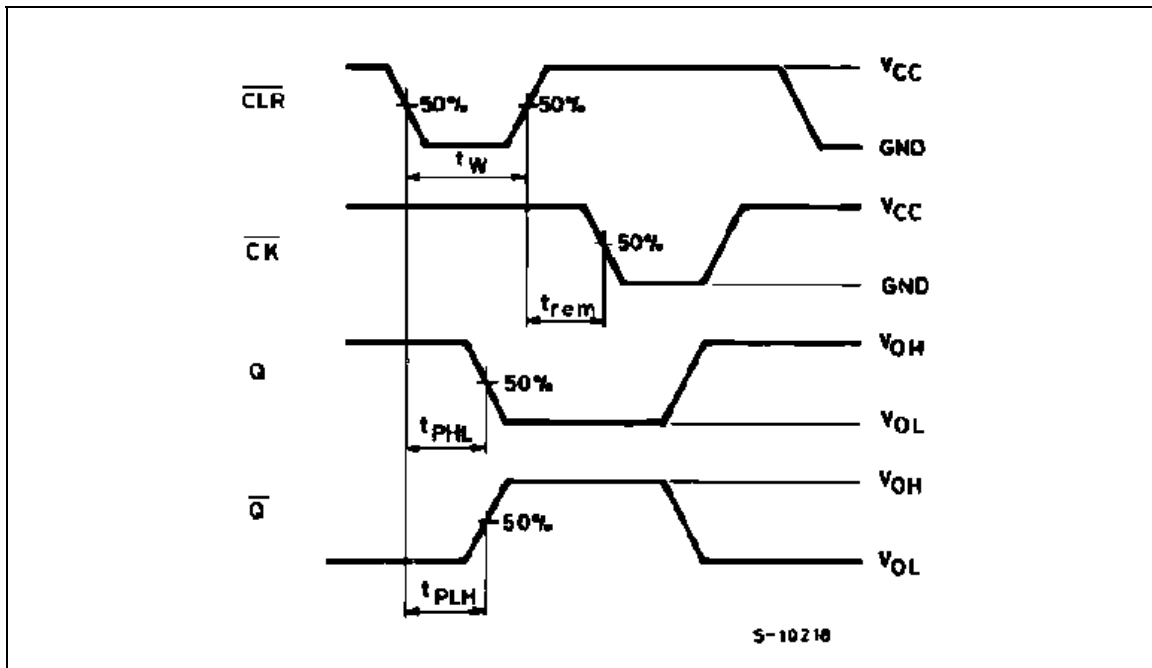
WAVEFORM 1: MINIMUM REMOVAL TIME ($f=1\text{MHz}$; 50% duty cycle)



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

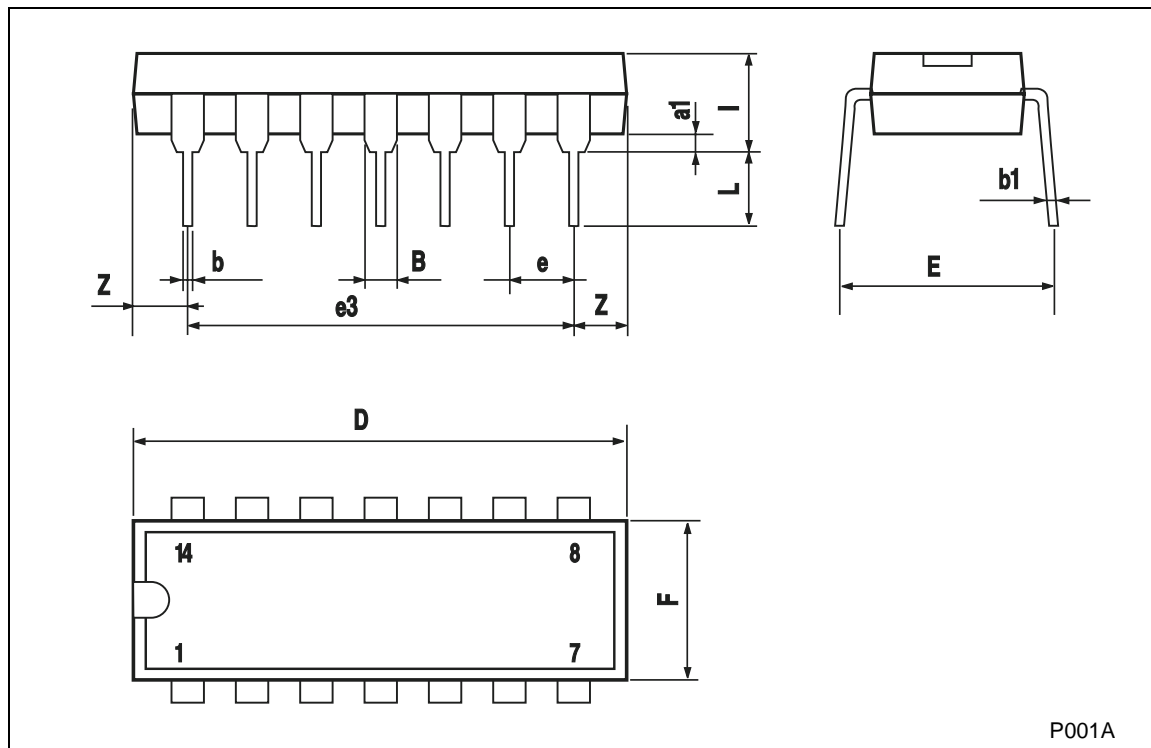


WAVEFORM 3 : MINIMUM PULSE WIDTH AND REMOVAL TIME (f=1MHz; 50% duty cycle)



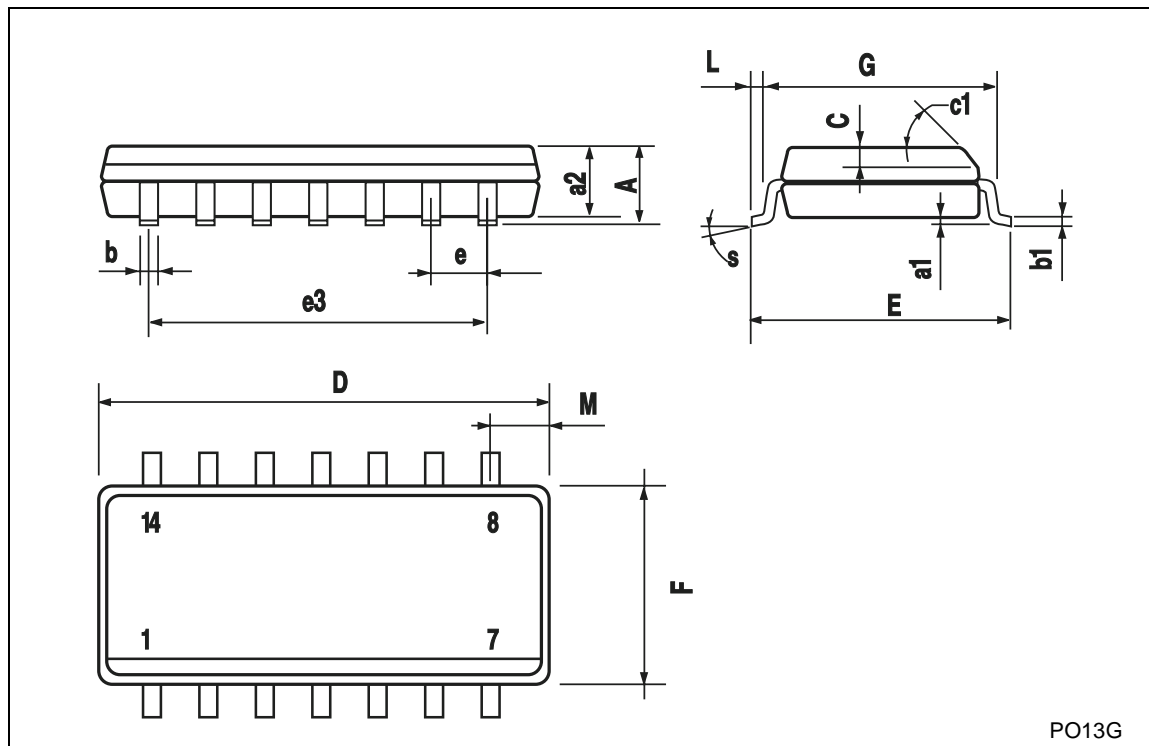
Plastic DIP-14 MECHANICAL DATA

| 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 |



SO-14 MECHANICAL DATA

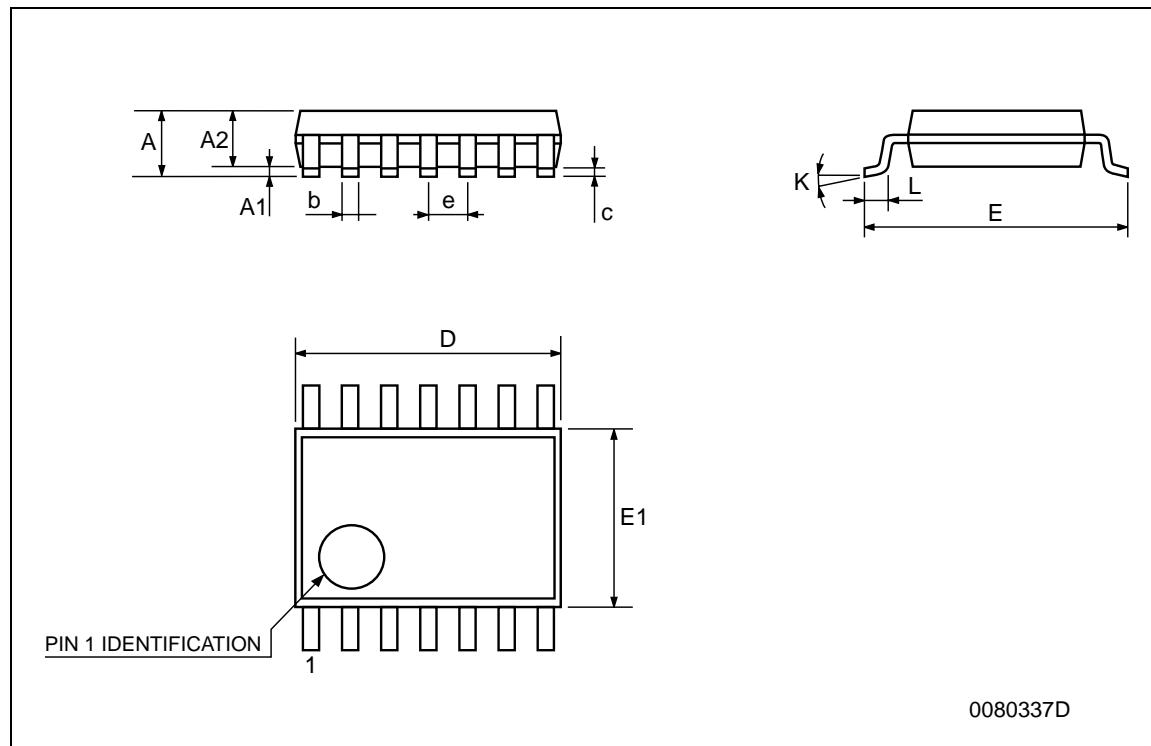
| DIM. | mm. | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007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