

DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

- HIGH SPEED
 $t_{PD} = 25 \text{ ns (TYP) at } V_{CC} = 5\text{V}$
- LOW POWER DISSIPATION
 STANDBY STATE $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25^\circ\text{C}$
 ACTIVE STATE $I_{CC} = 200 \mu\text{A (TYP.) AT } V_{CC} = 5\text{V}$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- OUTPUT DRIVE CAPABILITY
 10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
 $I_{OH} = I_{OL} = 4 \text{ mA (MIN.)}$
- BALANCED PROPAGATION DELAYS
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 6 \text{ V}$
- WIDE OUTPUT PULSE WIDTH RANGE
 $t_{WOUT} = 120 \text{ ns} \sim 60 \text{ s OVER AT } V_{CC} = 4.5 \text{ V}$
- PIN AND FUNCTION COMPATIBLE WITH
 54/74LS123

DESCRIPTION

The M54/74HC123 is a high speed CMOS MONOSTABLE multivibrator fabricated with silicon gate C²MOS technology. It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation. There are two trigger inputs, \bar{A} INPUT (negative edge) and \bar{B} INPUT (positive edge). These inputs are valid for slow rising/falling signals, ($t_r = t_f = 1 \text{ sec}$). The device may also be triggered by using the CLR input (positive-edge) because of the Schmitt-trigger input ; after triggering the output maintains the MONOSTABLE state for the time period determined by the external resistor R_x and capacitor C_x . When $C_x \geq 10\text{nF}$ and $R_x \geq 10\text{K}\Omega$, the output pulse width value is approssimatively given by the formula: $t_{w(out)} = K \bullet C_x \bullet R_x$.

Two different pulse width constant are available:

$K \cong 0.45$ for HC123 $K \cong 1$ for HC123A.

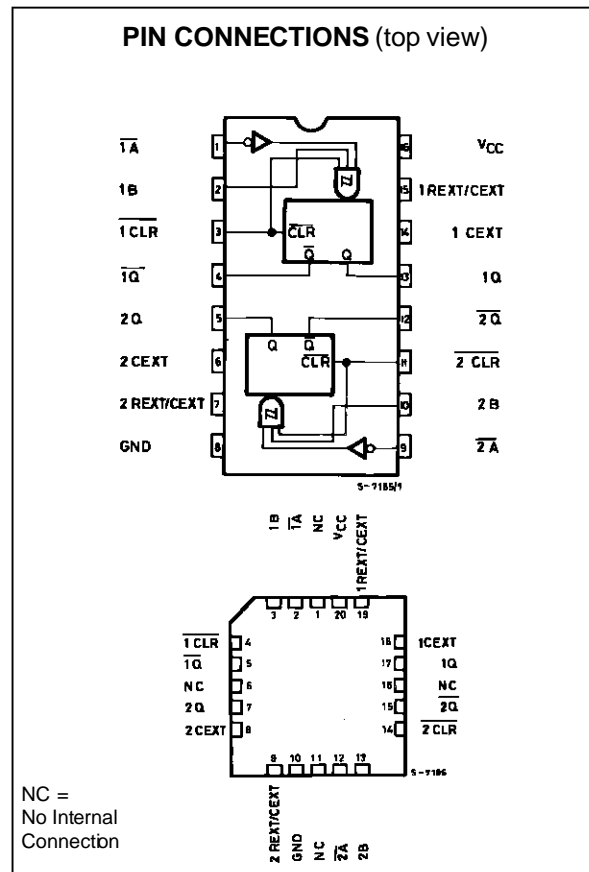
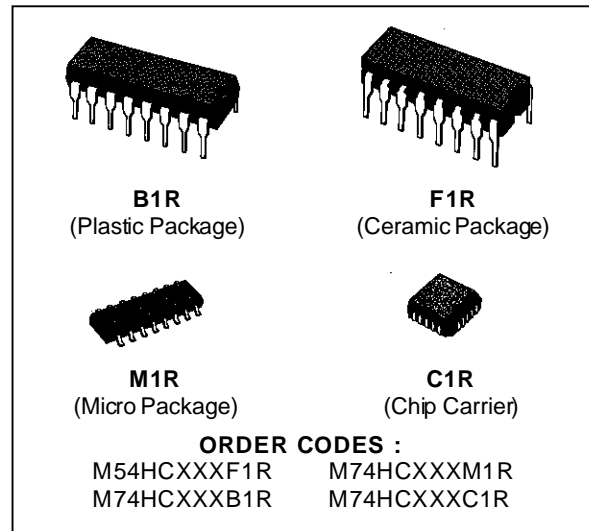
Taking CLR low breaks this MONOSTABLE STATE. If the next trigger pulse occurs during the MONOSTABLE period it makes the MONOSTABLE period longer. Limit for values of C_x and R_x :

C_x : NO LIMIT

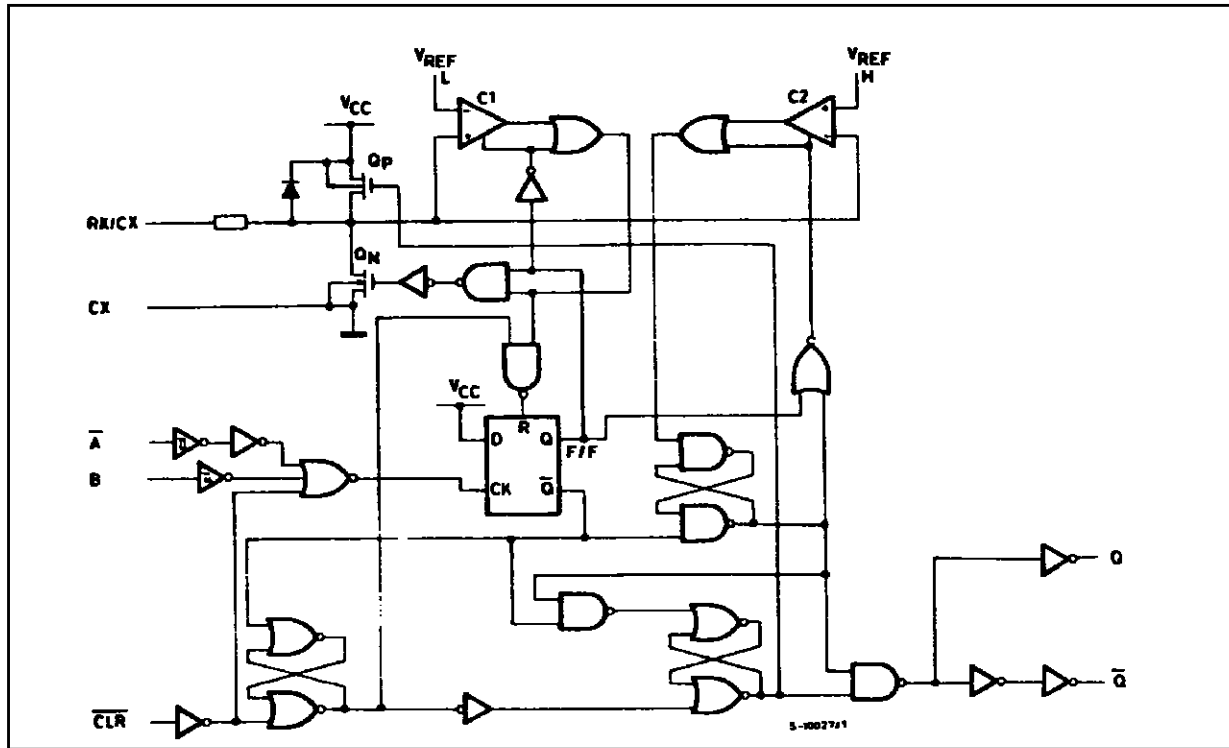
R_x : $V_{CC} < 3.0 \text{ V}$ 5 K Ω to 1 M Ω

$V_{CC} \geq 3.0 \text{ V}$ 1 K Ω to 1 M Ω

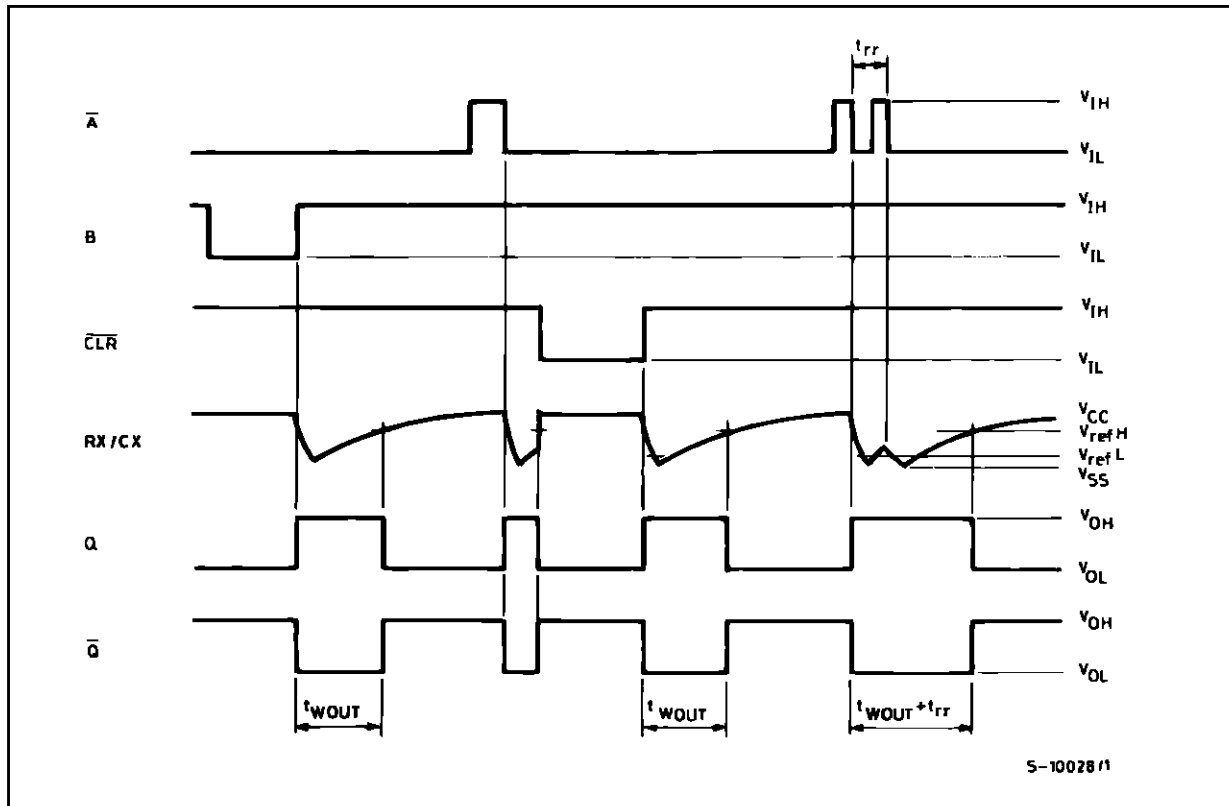
All inputs are equipped with protection circuits



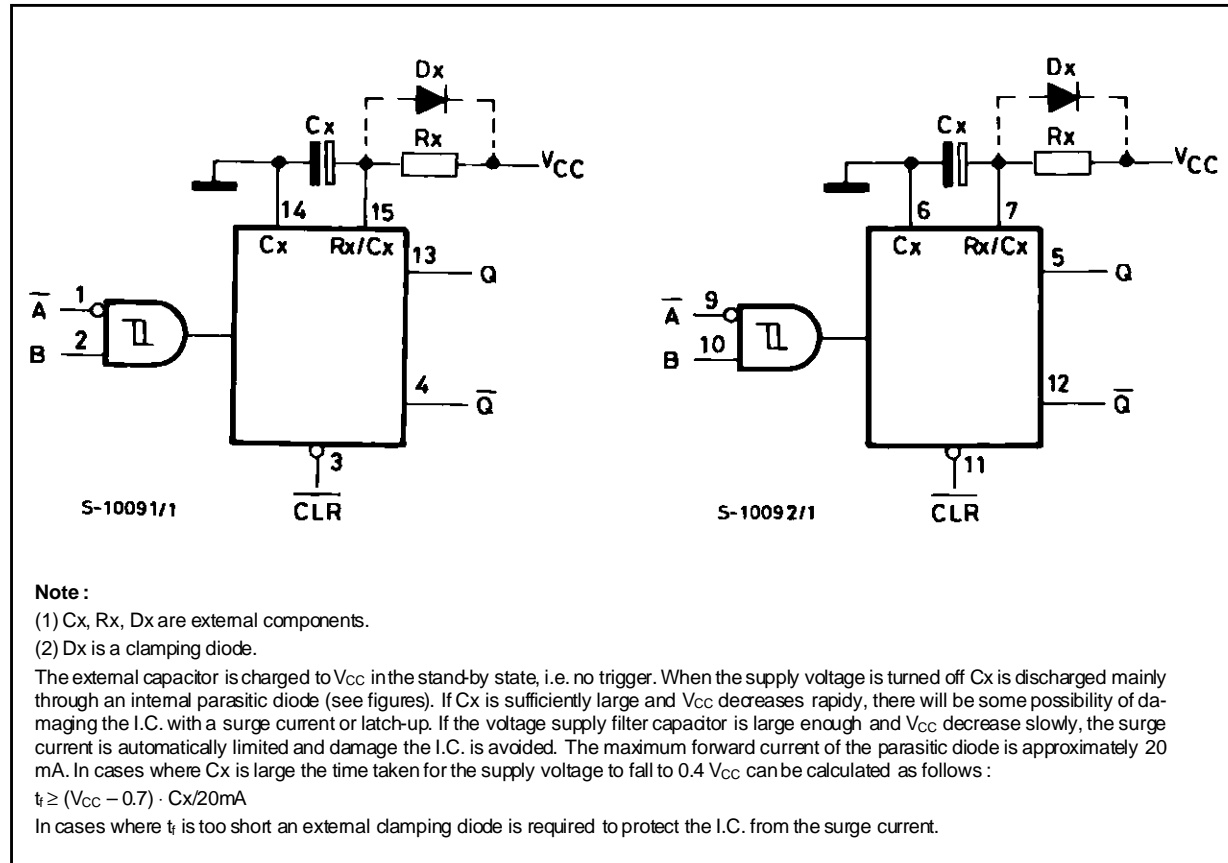
SYSTEM DIAGRAM



TIMING CHART



BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

STAND-BY STATE

The external capacitor, Cx, is fully charged to V_{CC} in the stand-by state. Hence, before triggering, transistor Qp and Qn (connected to the Rx/Cx node) are both turned-off. The two comparators that control the timing and the two reference voltage sources stop operating. The total supply current is therefore only leakage current.

TRIGGER OPERATION

Triggering occurs when :

- 1 st) A is "low" and B has a falling edge ;
- 2 nd) B is "high" and A has a rising edge ;
- 3 rd) A is low and B is high and C1 has a rising edge.

After the multivibrator has been retriggered comparator C1 and C2 start operating and Qn is turned on. Cx then discharges through Qn. The voltage at the node R/C external falls.

When it reaches V_{REFL} the output of comparator C1 becomes low. This in turn resets the flip-flop and Qn is turned off.

At this point C1 stops functioning but C2 continues to operate.

The voltage at R/C external begins to rise with a time constant set by the external components Rx, Cx.

Triggering the multivibrator causes Q to go high after internal delay due to the flip-flop and the gate. Q remains high until the voltage at R/C external rises again to V_{REFH}. At this point C2 output goes low and O goes low. C2 stop operating. That means that after triggering when the voltage R/C external returns to V_{REFH} the multivibrator has returned to its MONOSTABLE STATE. In the case where Rx · Cx are large enough and the discharge time of the capacitor and the delay time in the I.C. can be ignored, the width of the output pulse t_w (out) is as follows :

$$t_{w(OUT)} = 0.46 Cx \cdot Rx \text{ (HC123)}$$

$$t_{w(OUT)} = Cx \cdot Rx \text{ (HC123A)}$$

FUNCTIONAL DESCRIPTION (continued)

RE-TRIGGERED OPERATION

When a second trigger pulse follows the first its effect will depend on the state of the multivibrator. If the capacitor Cx is being charged the voltage level of R/C external falls to Vrefl again and Q remains high i.e. the retrigger pulse arrives in a time shorter than the period $R_x \cdot C_x$ seconds, the capacitor charging time constant. If the second trigger pulse is very close to the initial trigger pulse it is ineffective ; i.e. the second trigger must arrive in the capacitor discharge cycle to be ineffective; Hence the mini-

imum time for a second trigger to be effective depends on Vcc and Cx.

RESET OPERATION

CL is normally high. If CL is low, the trigger is not effective because Q output goes low and trigger control flip-flop is reset.

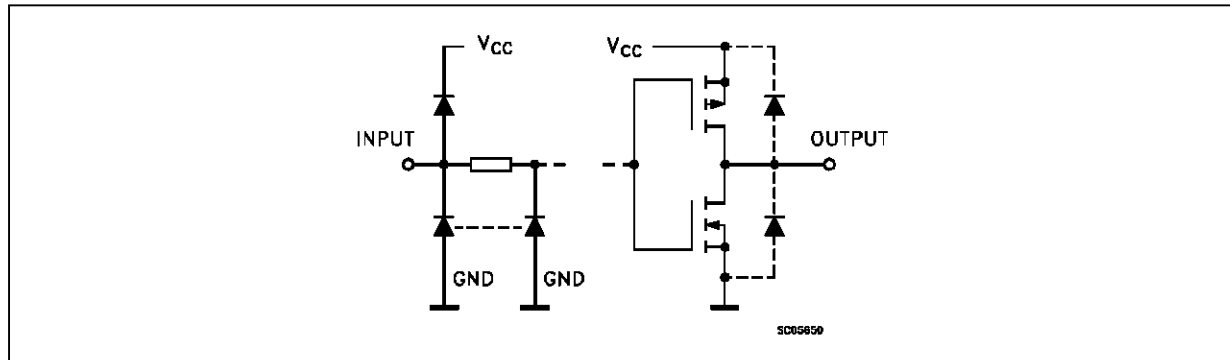
Also transistor Op is turned on and Cx is charged quickly to Vcc. This means if CL input goes low, the IC becomes waiting state both in operating and non operating state.

TRUTH TABLE

| INPUTS | | | OUTPUTS | | NOTE |
|-----------|---|------------|---------|-----------|---------------|
| \bar{A} | B | \bar{CL} | Q | \bar{Q} | |
| | H | H | | | OUTPUT ENABLE |
| X | L | H | L | H | INHIBIT |
| H | X | H | L | H | INHIBIT |
| L | | H | | | OUTPUT ENABLE |
| L | H | | | | OUTPUT ENABLE |
| X | X | L | L | H | INHIBIT |

X: Don't Care Z: High Impedance

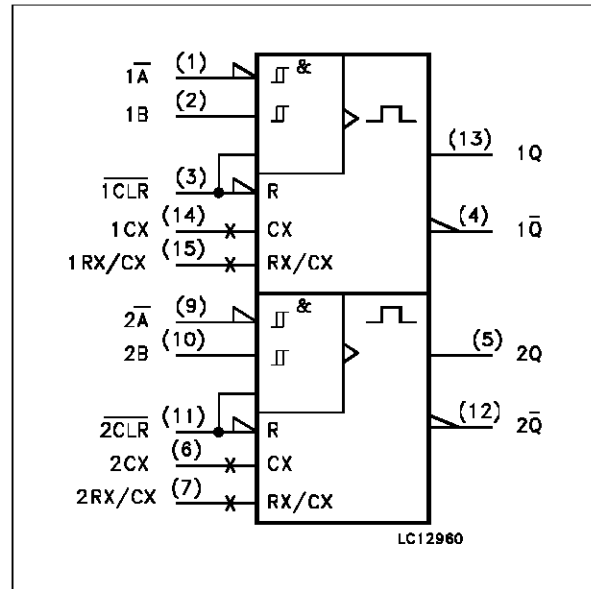
INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|--------|--------------|--|
| 1, 9 | 1A, 2A | Trigger Inputs (Negative Edge Triggered) |
| 2, 10 | 1B, 2B | Trigger Inputs (Positive Edge Triggered) |
| 3, 11 | 1CLR, 2CLR | Direct Reset LOW and Trigger Action at Positive Edge |
| 4, 12 | 1Q, 2Q | Outputs (Active LOW) |
| 7 | 2REXT/CEXT | External Resistor Capacitor Connection |
| 13, 5 | 1Q, 2Q | Outputs (Active HIGH) |
| 14, 6 | 1CEXT, 2CEXT | External Capacitor Connection |
| 15 | 1REXT/CEXT | External Resistor Capacitor Connection |
| 8 | GND | Ground (0V) |
| 16 | VCC | Positive Supply Voltage |

IEC LOGIC SYMBOL



ABSOLUTE MAXIMUM RATING

| 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 Source Sink Current Per Output Pin | ± 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 condition is not implied.
 (*) 500 mW: ± 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

M54/M74HC123/123A

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: M54HC Series M74HC Series | -55 to +125 -40 to +85 | °C °C | |
| t _r , t _f | Input Rise and Fall Time | 0 to 1000 0 to 500 0 to 400 | ns | |
| C _X | External Capacitor | NO LIMITATION | pF | |
| R _X | External Resistor | V _{CC} < 3 V | 5K to 1M | Ω |
| | | V _{CC} ≥ 3 V | 1K to 1M | |

(*) The maximum allowable values of C_x and R_x are a function of leakage of capacitor C_x, the leakage of device and leakage due to the board layout and surface resistance. Susceptibility to externally induced noise may occur for R_x > 1MΩ

DC SPECIFICATIONS

| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | | |
|-------------------|---------------------------------|------------------------|--|---|-------------------------|------|----------------------|------|-----------------------|------|------|------|
| | | V _{CC} (V) | | T _A = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | | |
| | | | | 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 | V _I = V _{IH} or V _{IL} I _O = -20 μA | 1.9 | 2.0 | | 1.9 | | 1.9 | | V | |
| | | 4.5 | | 4.4 | 4.5 | | 4.4 | | 4.4 | | | |
| | | 6.0 | | 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 | V _I = V _{IH} or V _{IL} I _O = 20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V | |
| | | 4.5 | | | 0.0 | 0.1 | | 0.1 | | 0.1 | | |
| | | 6.0 | | | 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 | | |
| I _I | Input Leakage Current | 6.0 | V _I = V _{CC} or GND | | | ±0.1 | | ±1 | | ±1 | μA | |
| I _I | R/C Terminal Off State 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 | |
| I _{CC} ' | Active State Supply Current (1) | 2.0 | V _I = V _{CC} or GND Pin 7 or 15 V _{IN} = V _{CC} /2 | | 45 | 200 | | 260 | | 320 | μA | |
| | | 4.5 | | | 500 | 600 | | 780 | | 960 | μA | |
| | | 6.0 | | | 0.7 | 1 | | 1.3 | | 1.6 | mA | |

(1): Per Circuit

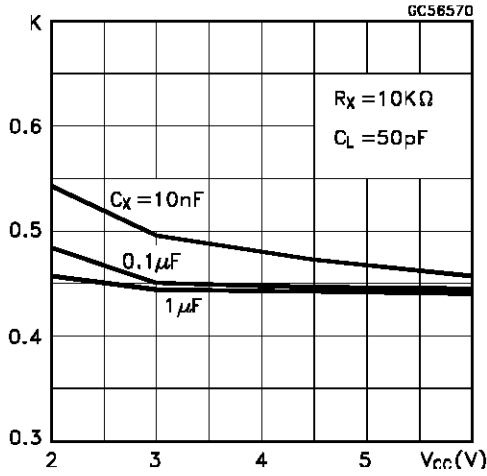
AC ELECTRICAL CHARACTERISTICS ($C_L = 50$ pF, Input $t_r = t_f = 6$ ns)

| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | | |
|--|---|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|----|
| | | V _{CC} (V) | | T _A = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | | |
| | | | | 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 (A, B - Q, Q̄) | 2.0 | | | 102 | 210 | | 265 | | 315 | ns | |
| | | 4.5 | | | 29 | 42 | | 53 | | 63 | | |
| | | 6.0 | | | 22 | 36 | | 45 | | 54 | | |
| t _{PLH} t _{PHL} | Propagation Delay Time (CLR TRIGGER - Q, Q̄) | 2.0 | | | 102 | 235 | | 295 | | 355 | ns | |
| | | 4.5 | | | 31 | 47 | | 59 | | 71 | | |
| | | 6.0 | | | 23 | 40 | | 50 | | 60 | | |
| t _{PLH} t _{PHL} | Propagation Delay Time (CLR - Q, Q̄) | 2.0 | | | 68 | 160 | | 200 | | 240 | ns | |
| | | 4.5 | | | 20 | 32 | | 40 | | 48 | | |
| | | 6.0 | | | 16 | 27 | | 34 | | 41 | | |
| t _{WOUT} | Output Pulse Width (for HC123) | 2.0 | C _X = 100 pF R _X = 10 KΩ | | 1.4 | | | | | | μs | |
| | | 4.5 | | | 1.2 | | | | | | | |
| | | 6.0 | | | 1.1 | | | | | | | |
| | | 2.0 | C _X = 0.1 μF R _X = 100 KΩ | | 4.6 | | | | | | | ms |
| | | 4.5 | | | 4.4 | | | | | | | |
| | | 6.0 | | | 4.3 | | | | | | | |
| t _{WOUT} | Output Pulse Width (for HC123A) | 2.0 | C _X = 100 pF R _X = 10 KΩ | | 1.9 | | | | | | μs | |
| | | 4.5 | | | 1.6 | | | | | | | |
| | | 6.0 | | | 1.5 | | | | | | | |
| | | 2.0 | C _X = 0.1 μF R _X = 100 KΩ | | 9.8 | | | | | | | ms |
| | | 4.5 | | | 9.5 | | | | | | | |
| | | 6.0 | | | 9.4 | | | | | | | |
| Δt _{WOUT} | Output Pulse Width Error Between Circuits in Same Package | | | | ±1 | | | | | | % | |
| t _{W(H)} t _{W(L)} | Minimum Pulse Width | 2.0 | | | | 75 | | 95 | | 110 | ns | |
| | | 4.5 | | | | 15 | | 19 | | 22 | | |
| | | 6.0 | | | | 13 | | 16 | | 19 | | |
| t _{W(L)} | Minimum Pulse Width (CLR) | 2.0 | | | | 75 | | 95 | | 110 | ns | |
| | | 4.5 | | | | 15 | | 19 | | 22 | | |
| | | 6.0 | | | | 13 | | 16 | | 19 | | |
| t _{rr} | Minimum Retrigger Time | 2.0 | C _X = 100 pF R _X = 1 KΩ | | 325 | | | | | | ns | |
| | | 4.5 | | | 108 | | | | | | | |
| | | 6.0 | | | 78 | | | | | | | |
| | | 2.0 | C _X = 0.1 μF R _X = 100 KΩ | | 5 | | | | | | | μs |
| | | 4.5 | | | 1.4 | | | | | | | |
| | | 6.0 | | | 1.2 | | | | | | | |
| C _{IN} | Input Capacitance | | | | 5 | 10 | | 10 | | 10 | pF | |
| C _{PD} (*) | Power Dissipation Capacitance | | | | 162 | | | | | | pF | |

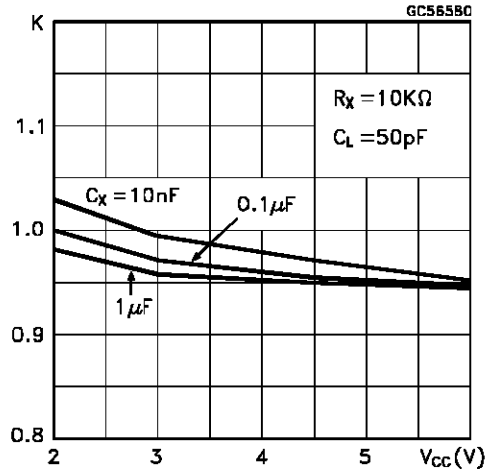
(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$ Duty/100 + I_C/2 (per monostable) (I_{CC}: Active Supply Current) (Duty:%)

M54/M74HC123/123A

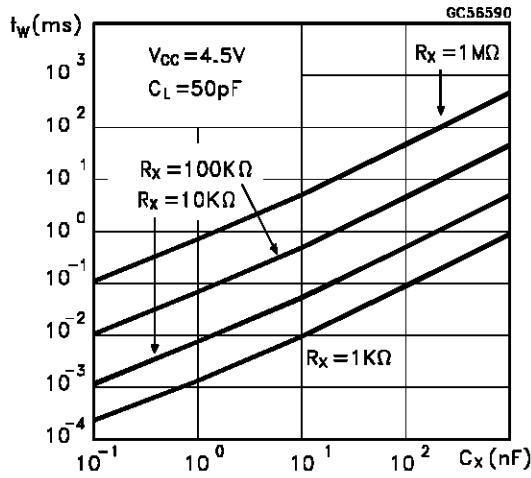
Output Pulse Width Constant Characteristics (for HC123)



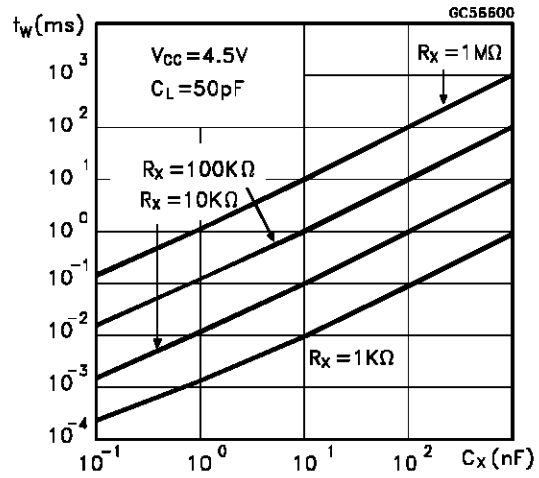
Output Pulse Width Constant Characteristics (for HC123A)



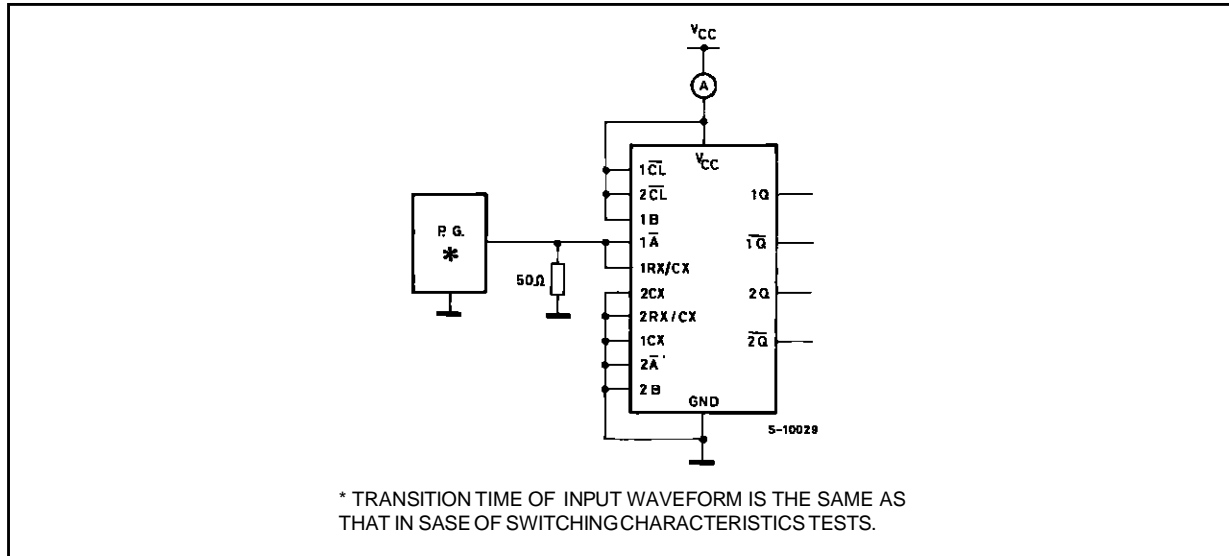
Output Pulse Width Characteristics (for HC123)



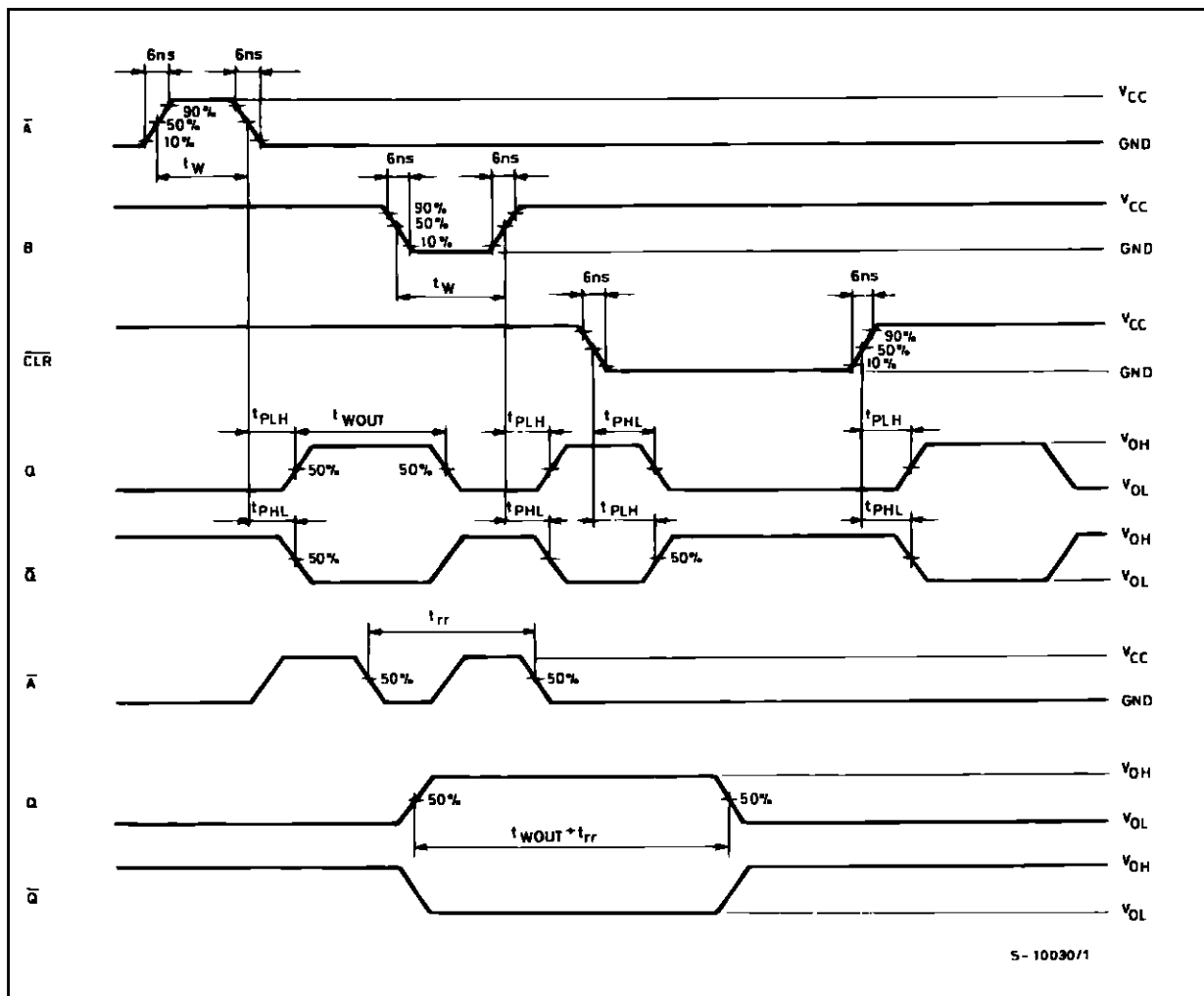
Output Pulse Width Characteristics (for HC123A)



TEST CIRCUIT I_{CC} (Opr)



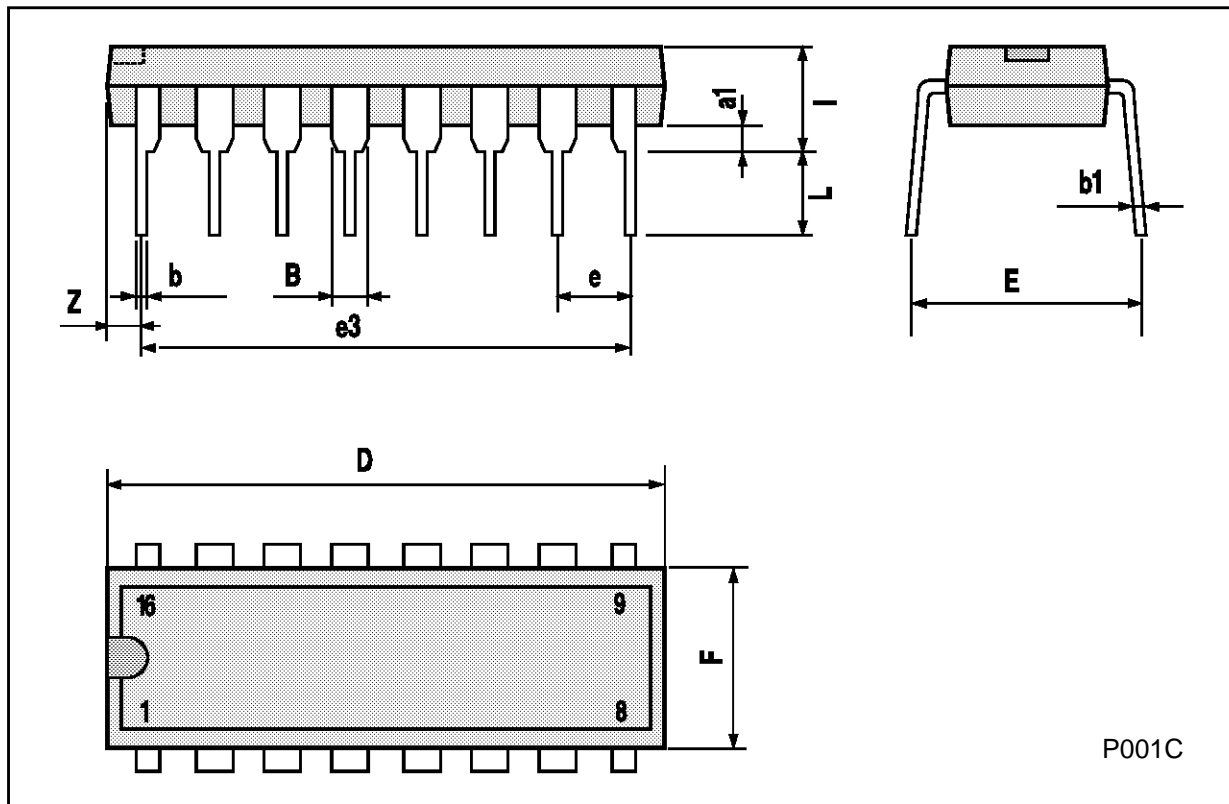
SWITCHING CHARACTERISTICS TEST WAVEFORM



S-10030/1

Plastic DIP16 (0.25) MECHANICAL DATA

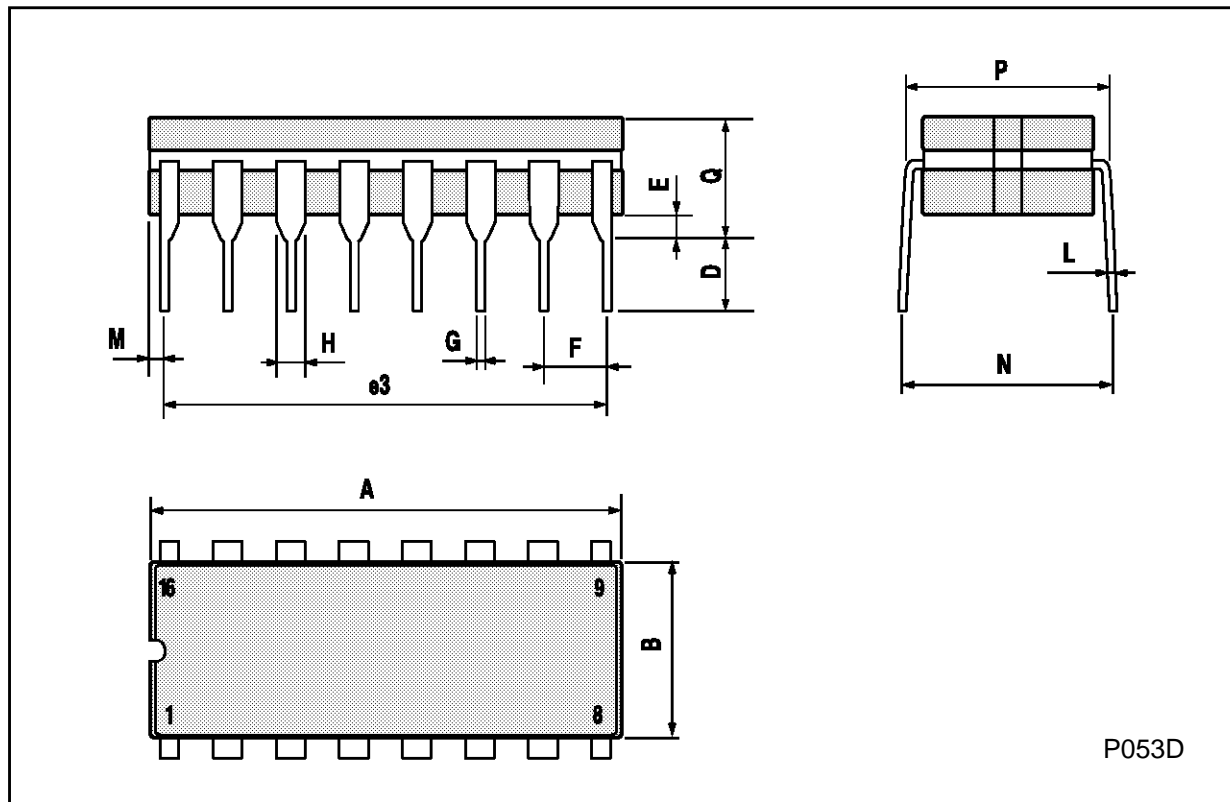
| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 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

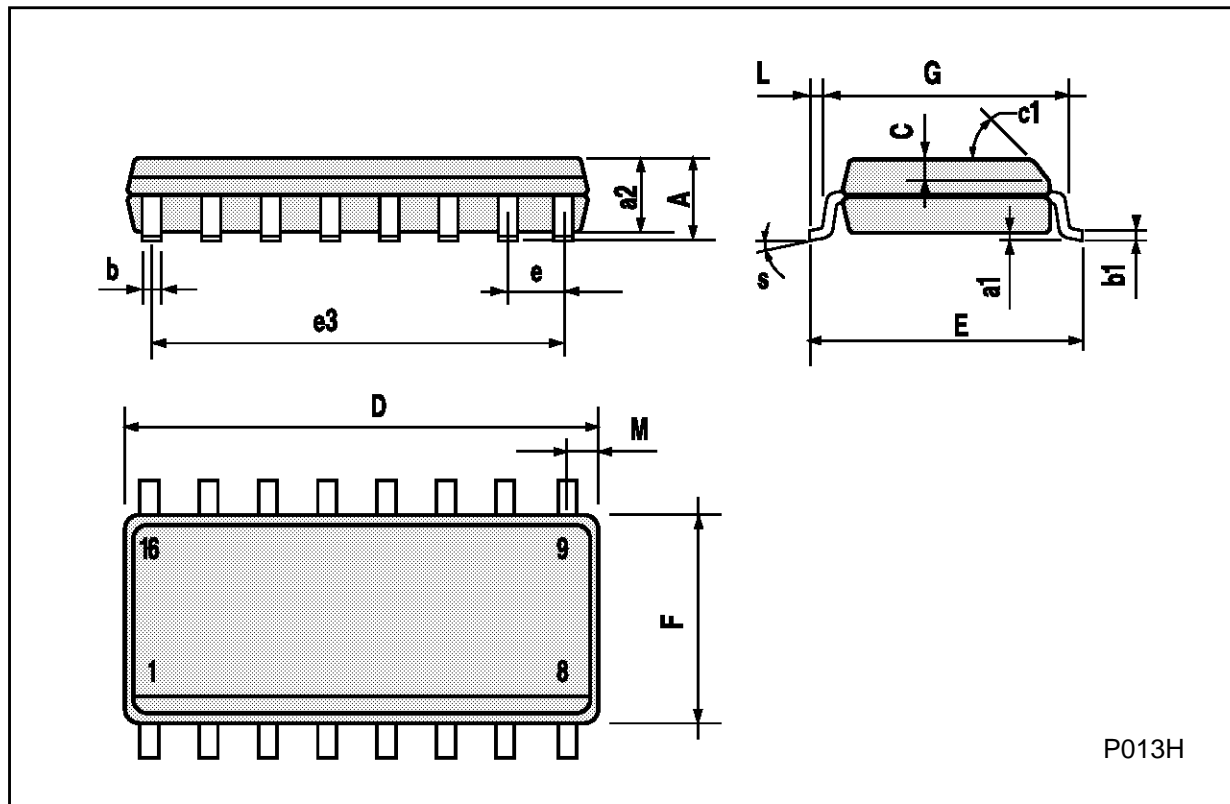
Ceramic DIP16/1 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 20 | | | 0.787 |
| B | | | 7 | | | 0.276 |
| D | | 3.3 | | | 0.130 | |
| E | 0.38 | | | 0.015 | | |
| e3 | | 17.78 | | | 0.700 | |
| F | 2.29 | | 2.79 | 0.090 | | 0.110 |
| G | 0.4 | | 0.55 | 0.016 | | 0.022 |
| H | 1.17 | | 1.52 | 0.046 | | 0.060 |
| L | 0.22 | | 0.31 | 0.009 | | 0.012 |
| M | 0.51 | | 1.27 | 0.020 | | 0.050 |
| N | | | 10.3 | | | 0.406 |
| P | 7.8 | | 8.05 | 0.307 | | 0.317 |
| Q | | | 5.08 | | | 0.200 |



SO16 (Narrow) MECHANICAL DATA

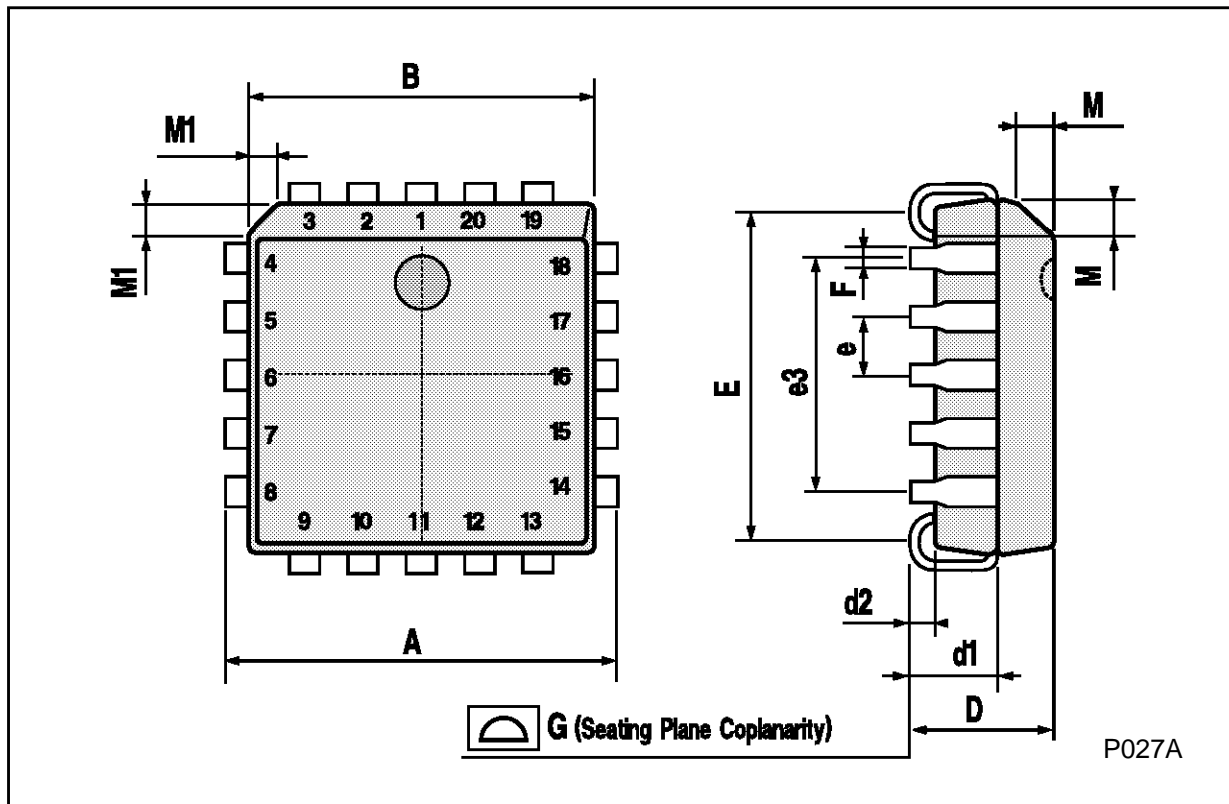
| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 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.) | | | | | |



P013H

PLCC20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 9.78 | | 10.03 | 0.385 | | 0.395 |
| B | 8.89 | | 9.04 | 0.350 | | 0.356 |
| D | 4.2 | | 4.57 | 0.165 | | 0.180 |
| d1 | | 2.54 | | | 0.100 | |
| d2 | | 0.56 | | | 0.022 | |
| E | 7.37 | | 8.38 | 0.290 | | 0.330 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 5.08 | | | 0.200 | |
| F | | 0.38 | | | 0.015 | |
| G | | | 0.101 | | | 0.004 |
| M | | 1.27 | | | 0.050 | |
| M1 | | 1.14 | | | 0.045 | |



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