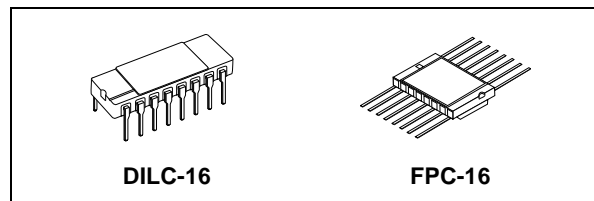




M54HC123

RAD-HARD DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

- HIGH SPEED: $t_{PD} = 23 \text{ ns}$ (TYP.) at $V_{CC} = 6V$
- LOW POWER DISSIPATION:
STAND BY STATE:
 $I_{CC} = 4\mu\text{A}$ (MAX.) at $T_A = 25^\circ\text{C}$
ACTIVE STATE:
 $I_{CC} = 200\mu\text{A}$ (MAX.) at $V_{CC} = 5V$
- 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
- 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 SERIES 123
- SPACE GRADE-1: ESA SCC QUALIFIED
- 50 krad QUALIFIED, 100 krad AVAILABLE ON REQUEST
- NO SEL UNDER HIGH LET HEAVY IONS IRRADIATION
- DEVICE FULLY COMPLIANT WITH SCC-9207-006



ORDER CODES

| PACKAGE | FM | EM |
|---------|-----------|------------|
| DILC | M54HC123D | M54HC123D1 |
| FPC | M54HC123K | M54HC123K1 |

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 approximately given by the formula: $t_{W(OUT)} = K \cdot C_x \cdot R_x$. ($K \approx 0.45$).

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

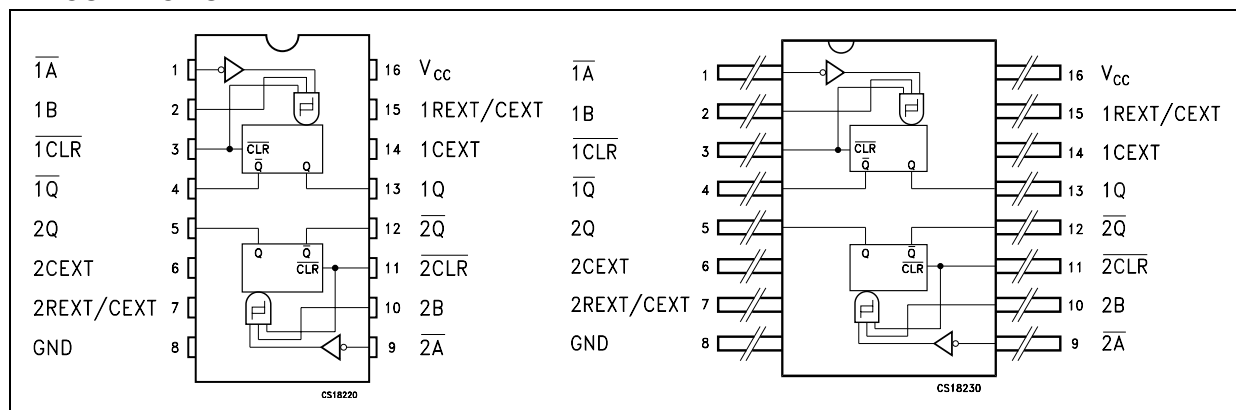
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

DESCRIPTION

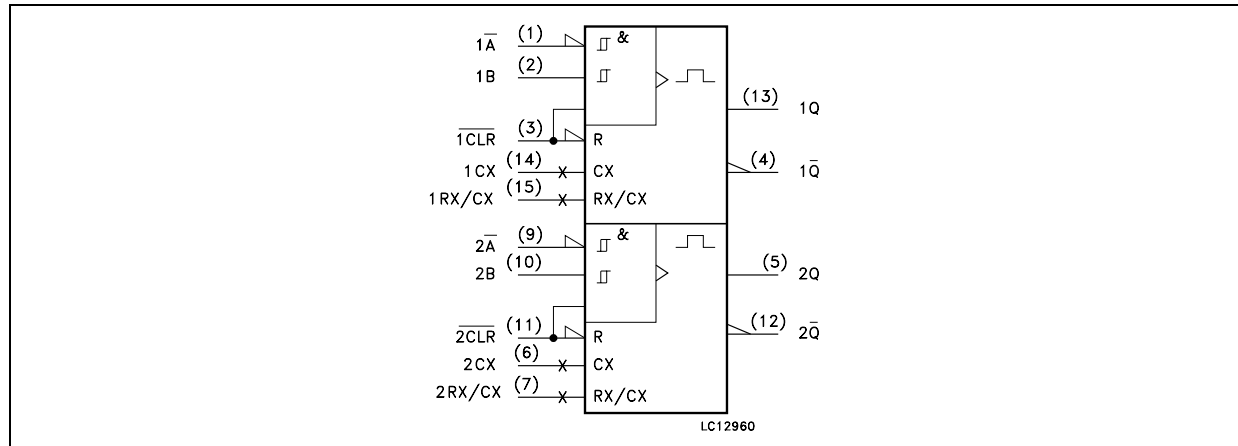
The M54HC123 is an high speed CMOS MONOSTABLE MULTIVIBRATOR fabricated with silicon gate C²MOS technology.

There are two trigger inputs, A INPUT (negative edge) and B INPUT (positive edge). These inputs

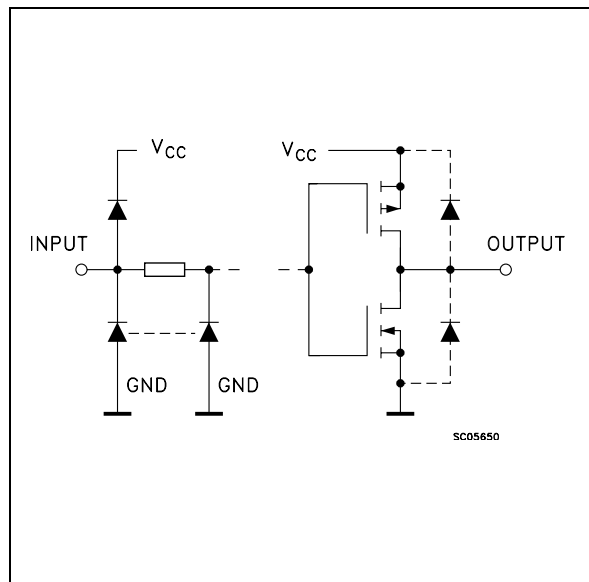
PIN CONNECTION



IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

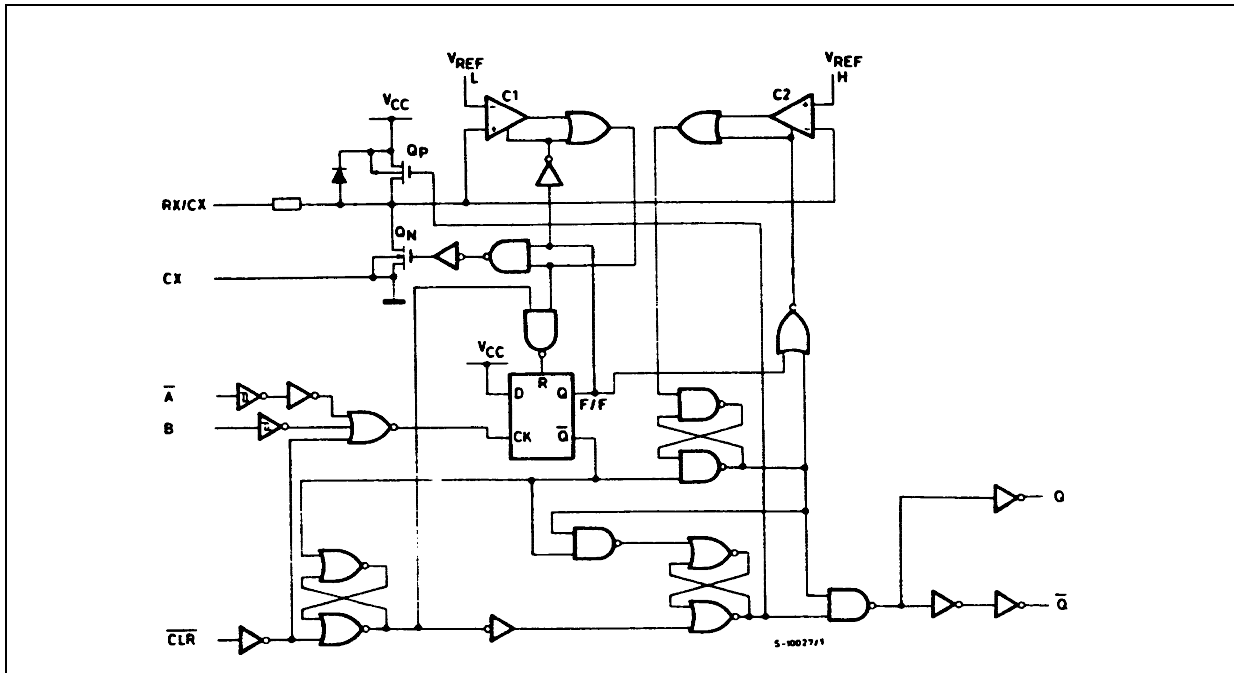
| PIN N° | SYMBOL | NAME AND FUNCTION |
|--------|----------------|--|
| 1,9 | 1A, 2A | Trigger Inputs (Negative Edge Triggered) |
| 2, 10 | 1B, 2B | Trigger Inputs (Positive Edge Triggered) |
| 3, 11 | 1 CLR 2 CLR | Direct Reset LOW and trigger Action at Positive Edge |
| 4, 12 | 1Q, 2Q | Outputs (Active Low) |
| 7 | 2RX/CX | External Resistor Capacitor Connection |
| 13, 5 | 1Q, 2Q | Outputs (Active High) |
| 14, 6 | 1CX 2CX | External Capacitor Connection |
| 15 | 1RX/CX | External Resistor Capacitor Connection |
| 8 | GND | Ground (0V) |
| 16 | VCC | Positive Supply Voltage |

TRUTH TABLE

| INPUTS | | | OUTPUTS | | NOTE |
|--------|---|-----|---------|---|---------------|
| A | B | CLR | Q | 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 |

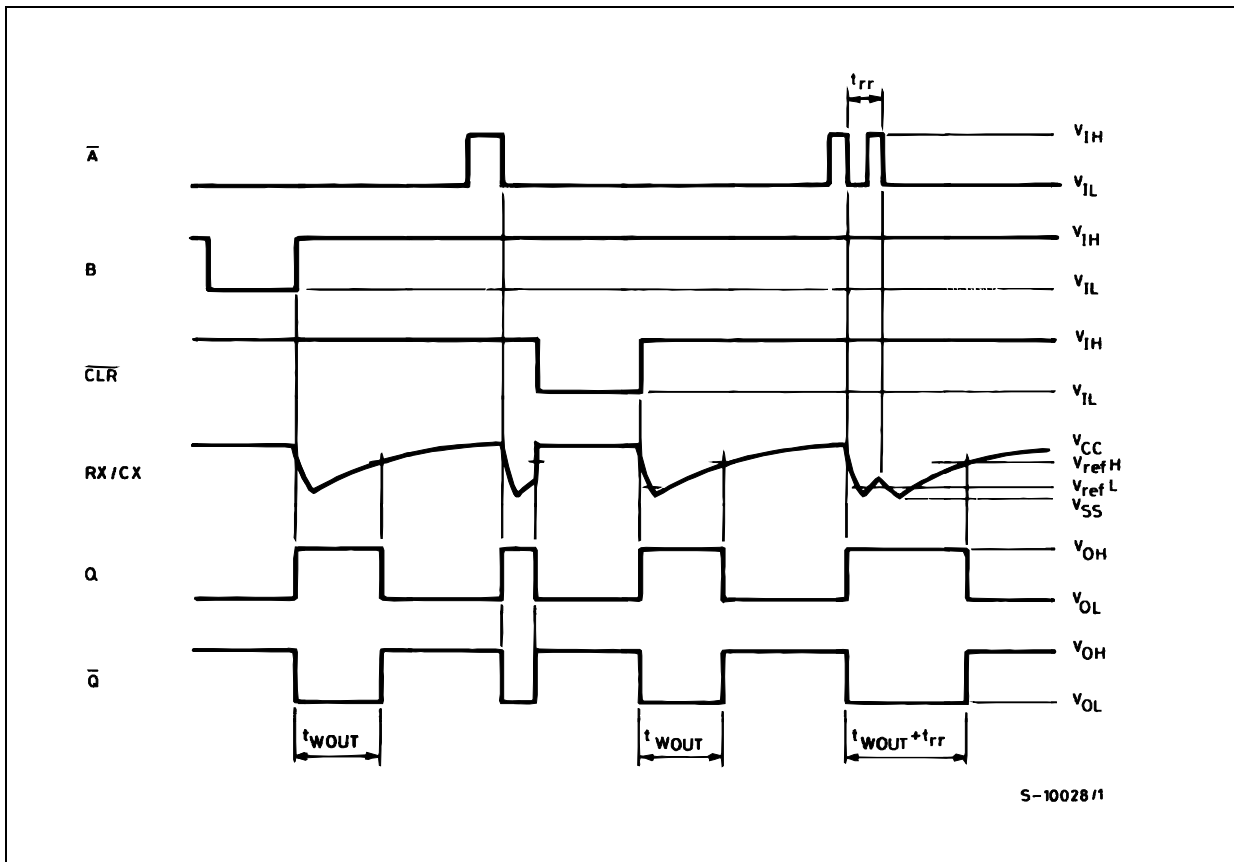
X : Don't Care

SYSTEM DIAGRAM

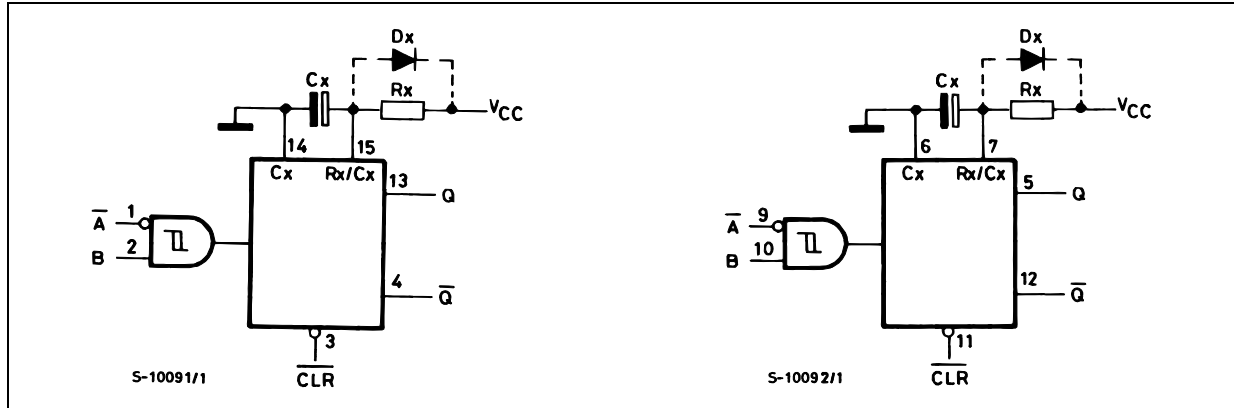


This logic diagram has not been used to estimate propagation delays

TIMING CHART



BLOCK DIAGRAM



(1) Cx, Rx, Dx are external components.
 (2) Dx is a clamping diode.

The external capacitor is charged to V_{CC} in the stand-by-state, i.e. no trigger. When the supply voltage is turned off Cx is discharged mainly through an internal parasitic diode (see figures). If Cx is sufficiently large and V_{CC} decreases rapidly, there will be some possibility of damaging the I.C. with a surge current or latch-up. If the voltage supply filter capacitor is large enough and V_{CC} decrease slowly, the surge current is automatically limited and damage to the I.C. is avoided. The maximum forward current of the parasitic diode is approximately 20 mA. In cases where Cx is large the time taken for the supply voltage to fall to 0.4 V_{CC} can be calculated as follows:

$$t_f \geq (V_{CC} - 0.7) \times Cx / 20mA$$

In cases where t_f is too short an external clamping diode is required to protect the I.C. from the surge current.

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 reset 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:

$$t_{w(OUT)} = 0.45 Cx \cdot Rx$$

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 V_{REFL} again and Q remains High i.e. the retrigger pulse arrives in a time shorter than the period Rx · Cx 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 minimum time for a second trigger to be effective depends on V_{CC} 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 V_{CC}. This means if C_L input goes low the IC becomes waiting state both in operating and non operating state.

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 | 300 | mW |
| T_{stg} | Storage Temperature | -65 to +150 | $^{\circ}C$ |
| T_L | Lead Temperature (10 sec) | 265 | $^{\circ}C$ |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

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 | $^{\circ}C$ | |
| 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 |
| C_x | External Capacitor | NO LIMITATION | pF | |
| R_x | External Resistor | $V_{CC} < 3V$ | 5K to 1M | Ω |
| | | $V_{CC} \geq 3V$ | 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 $R_x > 1M\Omega$.

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 | |

| 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 _{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 | | | 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 ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ ns}$)

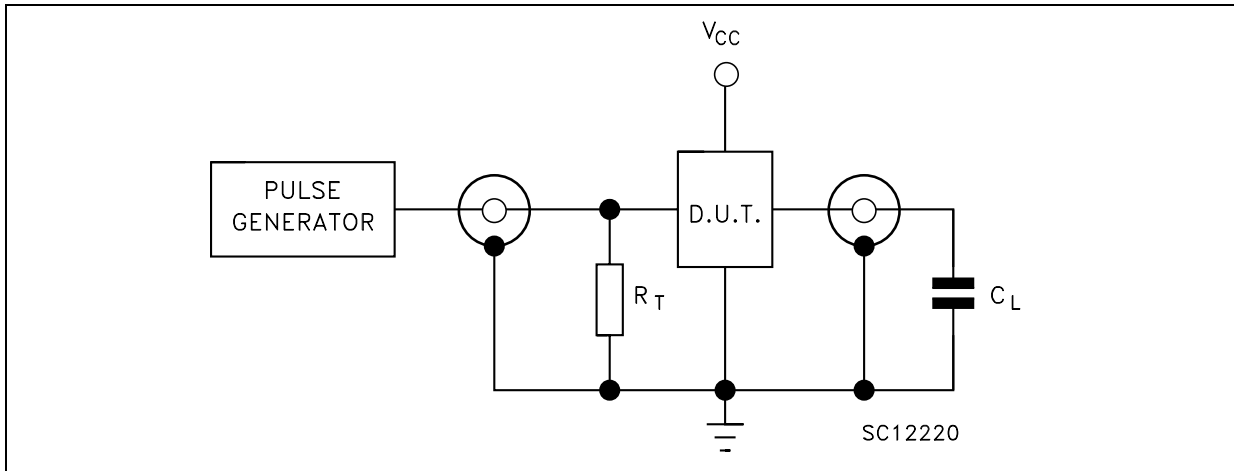
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|--------------------------|---|-----------------|---|--------------------------|---------|------|------------------------------------|------|-------------------------------------|------|---------------|
| | | V_{CC} (V) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | 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 (A, B - Q, \bar{Q}) | 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, \bar{Q}) | 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, \bar{Q}) | 2.0 | | | 68 | 160 | | 200 | | 240 | ns |
| | | 4.5 | | | 20 | 32 | | 40 | | 48 | |
| | | 6.0 | | | 16 | 27 | | 34 | | 41 | |
| t_{WOUT} | Output Pulse Width | 2.0 | $C_x = 100 \text{ pF}$ $R_x = 10\text{K}\Omega$ | | 1.4 | | | | | | μs |
| | | 4.5 | | | 1.2 | | | | | | |
| | | 6.0 | | | 1.1 | | | | | | |
| | | 2.0 | $C_x = 0.1\mu\text{F}$ $R_x = 100\text{K}\Omega$ | | 4.6 | | | | | | ms |
| | | 4.5 | | | 4.4 | | | | | | |
| | | 6.0 | | | 4.3 | | | | | | |
| 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 | $C_x = 100 \text{ pF}$ $R_x = 10\text{K}\Omega$ | | 325 | | | | | | ns |
| | | 4.5 | | | 108 | | | | | | |
| | | 6.0 | | | 78 | | | | | | |
| | | 2.0 | $C_x = 0.1\mu\text{F}$ $R_x = 100\text{K}\Omega$ | | 5 | | | | | | μs |
| | | 4.5 | | | 1.4 | | | | | | |
| | | 6.0 | | | 1.2 | | | | | | |

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 | | | 162 | | | | | | pF |

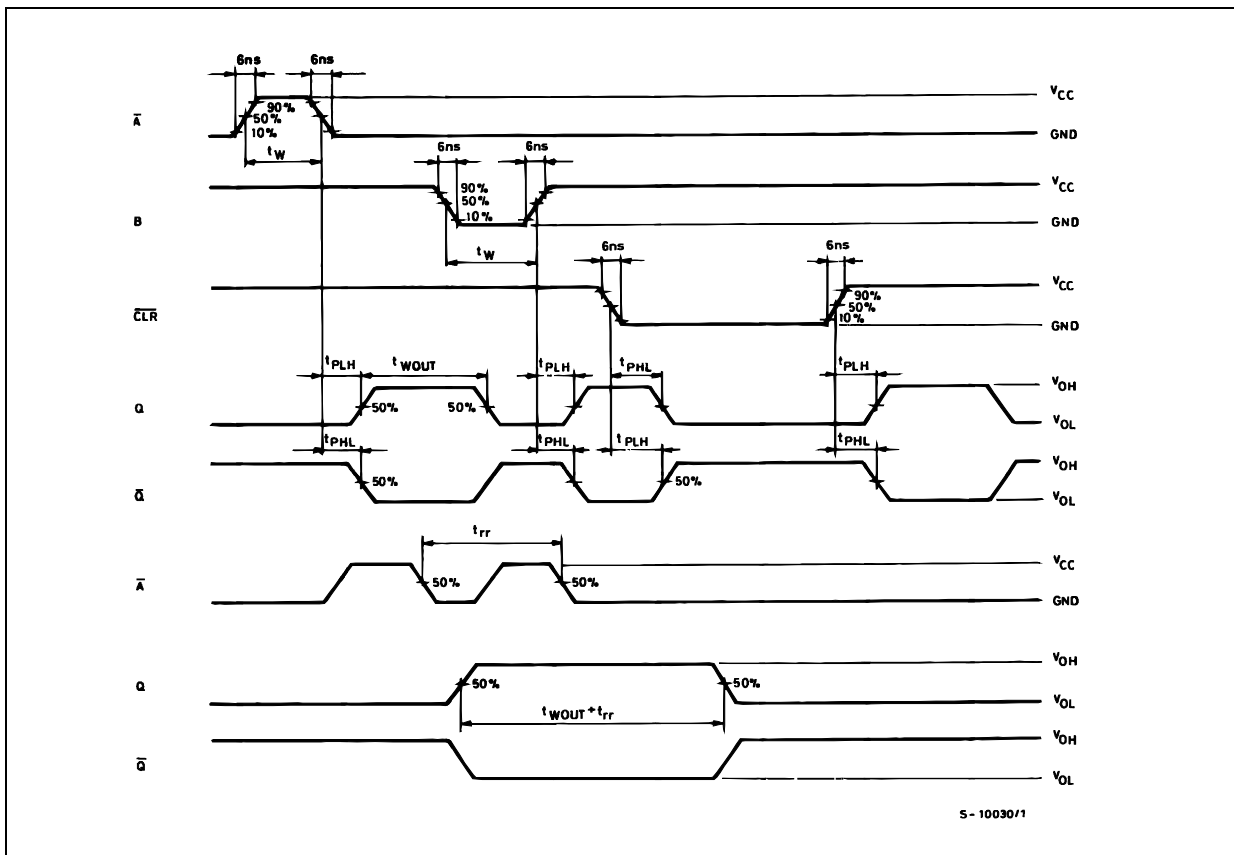
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}'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

TEST CIRCUIT



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

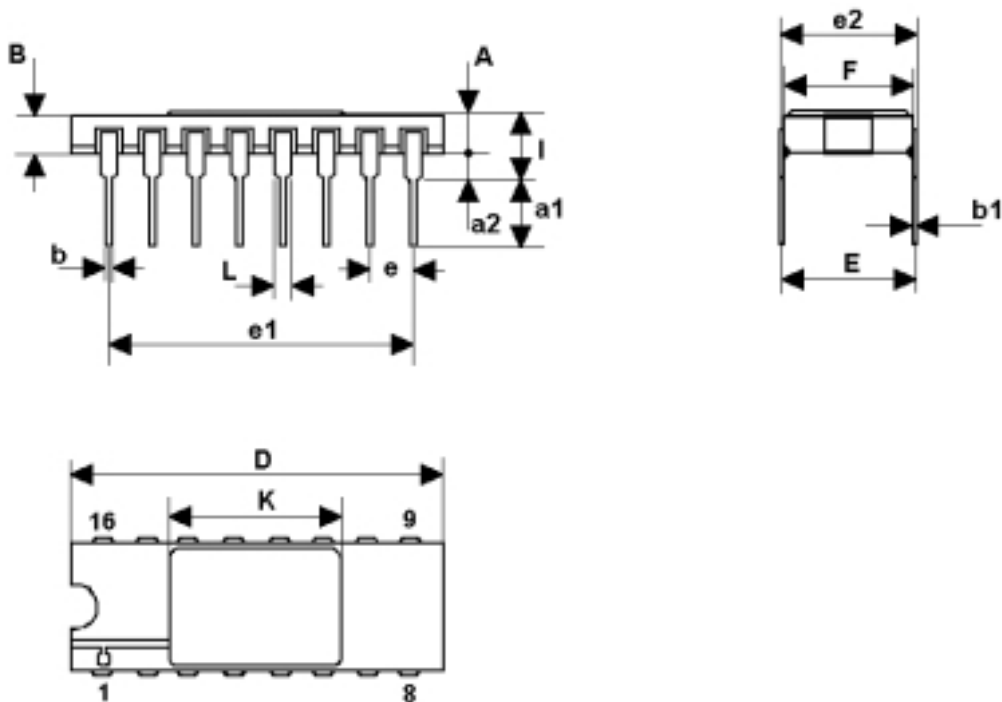
WAVEFORM: SWITCHING CHARACTERISTICS TEST WAVEFORM ($f=1\text{MHz}$; 50% duty cycle)



S-10030/1

DILC-16 MECHANICAL DATA

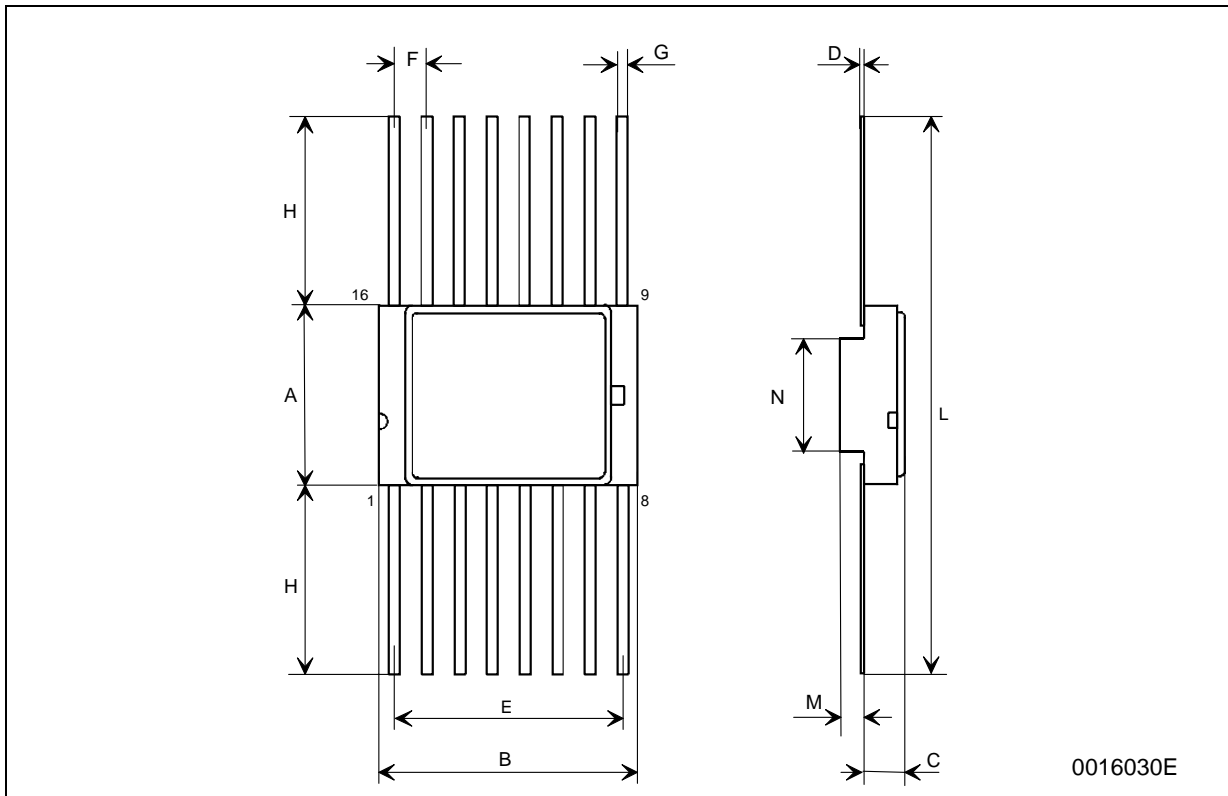
| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 2.1 | | 2.71 | 0.083 | | 0.107 |
| a1 | 3.00 | | 3.70 | 0.118 | | 0.146 |
| a2 | 0.63 | 0.88 | 1.14 | 0.025 | 0.035 | 0.045 |
| B | 1.82 | | 2.39 | 0.072 | | 0.094 |
| b | 0.40 | 0.45 | 0.50 | 0.016 | 0.018 | 0.020 |
| b1 | 0.20 | 0.254 | 0.30 | 0.008 | 0.010 | 0.012 |
| D | 20.06 | 20.32 | 20.58 | 0.790 | 0.800 | 0.810 |
| e | 7.36 | 7.62 | 7.87 | 0.290 | 0.300 | 0.310 |
| e1 | | 2.54 | | | 0.100 | |
| e2 | 17.65 | 17.78 | 17.90 | 0.695 | 0.700 | 0.705 |
| e3 | 7.62 | 7.87 | 8.12 | 0.300 | 0.310 | 0.320 |
| F | 7.29 | 7.49 | 7.70 | 0.287 | 0.295 | 0.303 |
| I | | | 3.83 | | | 0.151 |
| K | 10.90 | | 12.1 | 0.429 | | 0.476 |
| L | 1.14 | | 1.5 | 0.045 | | 0.059 |



0056437F

FPC-16 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 6.75 | 6.91 | 7.06 | 0.266 | 0.272 | 0.278 |
| B | 9.76 | 9.94 | 10.14 | 0.384 | 0.392 | 0.399 |
| C | 1.49 | | 1.95 | 0.059 | | 0.077 |
| D | 0.102 | 0.127 | 0.152 | 0.004 | 0.005 | 0.006 |
| E | 8.76 | 8.89 | 9.01 | 0.345 | 0.350 | 0.355 |
| F | | 1.27 | | | 0.050 | |
| G | 0.38 | 0.43 | 0.48 | 0.015 | 0.017 | 0.019 |
| H | 6.0 | | | 0.237 | | |
| L | 18.75 | | 22.0 | 0.738 | | 0.867 |
| M | 0.33 | 0.38 | 0.43 | 0.013 | 0.015 | 0.017 |
| N | | 4.31 | | | 0.170 | |



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