

## MM74HC4538 Dual Retriggerable Monostable Multivibrator

### General Description

The MM74HC4538 high speed monostable multivibrator (one shots) is implemented in advanced silicon-gate CMOS technology. They feature speeds comparable to low power Schottky TTL circuitry while retaining the low power and high noise immunity characteristic of CMOS circuits.

Each multivibrator features both a negative, A, and a positive, B, transition triggered input, either of which can be used as an inhibit input. Also included is a clear input that when taken low resets the one shot. The MM74HC4538 is retriggerable. That is, it may be triggered repeatedly while their outputs are generating a pulse and the pulse will be extended.

Pulse width stability over a wide range of temperature and supply is achieved using linear CMOS techniques. The output pulse equation is simply:  $PW = 0.7(R)(C)$  where PW is in seconds, R is in ohms, and C is in farads. This device is pin compatible with the CD4528, and the CD4538 one shots. All inputs are protected from damage due to static discharge by diodes to  $V_{CC}$  and ground.

### Features

- Schmitt trigger on A and B inputs
- Wide power supply range: 2–6V
- Typical trigger propagation delay: 32 ns
- Fanout of 10 LS-TTL loads
- Low input current: 1  $\mu$ A max

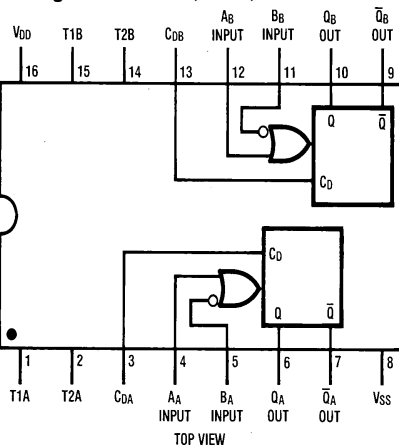
### Ordering Code:

| Order Number  | Package Number | Package Description   |
|---------------|----------------|---|
| MM74HC4538M   | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body |
| MM74HC4538SJ  | M16D           | 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                     |
| MM74HC4538MTC | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide       |
| MM74HC4538N   | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide            |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

### Connection Diagram

Pin Assignments for DIP, SOIC, SOP and TSSOP

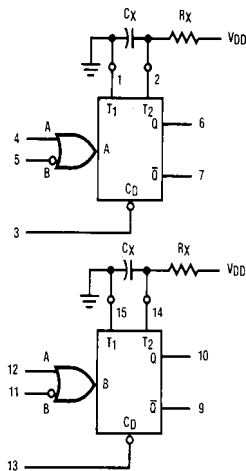


### Truth Table

| Clear | Inputs |   | Outputs |           |
|-------|--------|---|---------|-----------|
|       | A      | B | Q       | $\bar{Q}$ |
| L     | X      | X | L       | H         |
| X     | H      | X | L       | H         |
| X     | X      | L | L       | H         |
| H     | L      | ↓ | ┌       | └         |
| H     | ↑      | H | └       | ┌         |

H = HIGH Level  
L = LOW Level  
↑ = Transition from LOW-to-HIGH  
↓ = Transition from HIGH-to-LOW  
┌ = One HIGH Level Pulse  
└ = One LOW Level Pulse  
X = Irrelevant

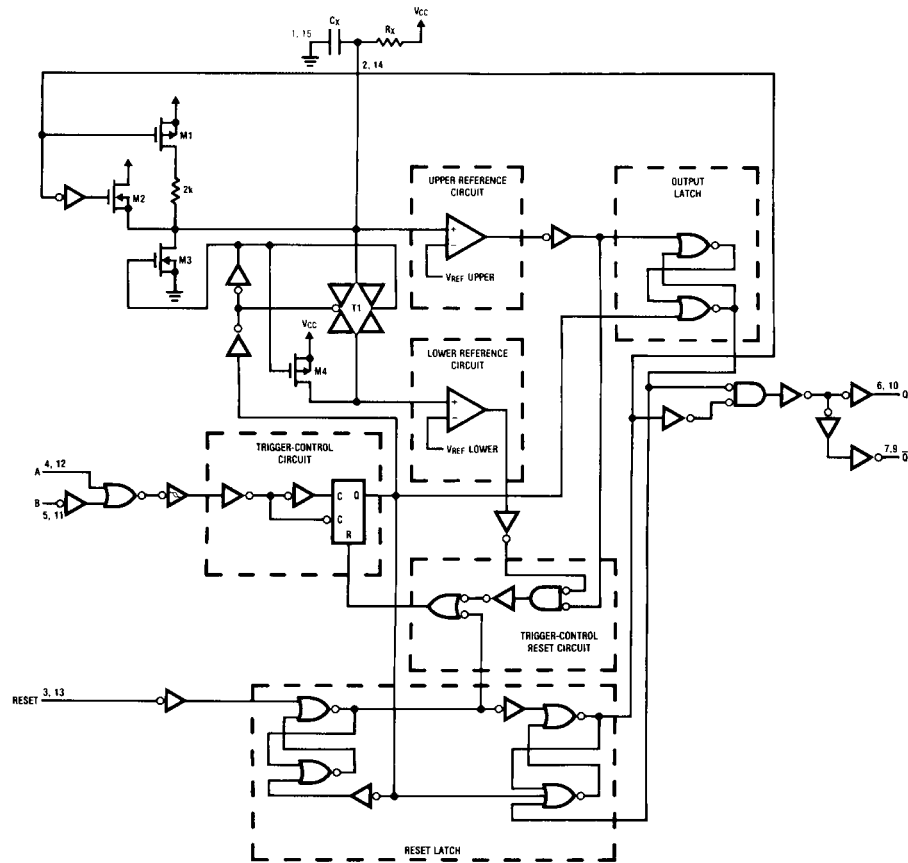
### Block Diagrams



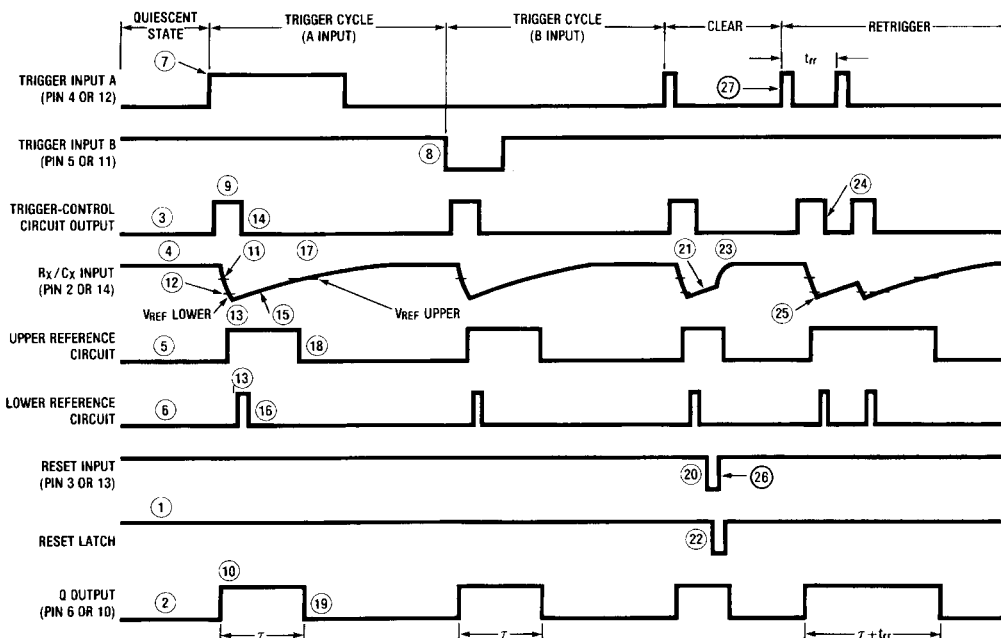
R<sub>X</sub> AND C<sub>X</sub> ARE EXTERNAL COMPONENTS

Note: Pin 1 and Pin 15 must be hard-wired to GND.

### Logic Diagram



## Timing Diagram



## Circuit Operation

The MM74HC4538 operates as follows (refer to logic diagram). In the quiescent state, the external timing capacitor,  $C_X$ , is charged to  $V_{CC}$ . When a trigger occurs, the Q output goes HIGH and  $C_X$  discharges quickly to the lower reference voltage ( $V_{REF\ Lower} = \frac{1}{3} V_{CC}$ ).  $C_X$  then charges, through  $R_X$ , back up to the upper reference voltage ( $V_{REF\ Upper} = \frac{2}{3} V_{CC}$ ), at which point the one-shot has timed out and the Q output goes LOW.

The following, more detailed description of the circuit operation refers to both the logic diagram and the timing diagram.

### QUIESCENT STATE

In the quiescent state, before an input trigger appears, the output latch is HIGH and the reset latch is HIGH (#1 in logic diagram).

Thus the Q output (pin 6 or 10) of the monostable multivibrator is LOW (#2, timing diagram).

The output of the trigger-control circuit is LOW (#3), and transistors M1, M2, and M3 are turned off. The external timing capacitor,  $C_X$ , is charged to  $V_{CC}$  (#4), and the upper reference circuit has a LOW output (#5). Transistor M4 is turned ON and transmission gate T1 is turned OFF. Thus the lower reference circuit has  $V_{CC}$  at the noninverting input and a resulting LOW output (#6).

In addition, the output of the trigger-control reset circuit is LOW.

### TRIGGER OPERATION

The MM74HC4538 is triggered by either a rising-edge signal at input A (#7) or a falling-edge signal at input B (#8), with the unused trigger input and the Reset input held at the voltage levels shown in the Truth Table. Either trigger signal will cause the output of the trigger-control circuit to go HIGH (#9).

The trigger-control circuit going HIGH simultaneously initiates three events. First, the output latch goes LOW, thus taking the Q output of the HC4538 to a HIGH State (#10). Second, transistor M3 is turned on, which allows the external timing capacitor,  $C_X$ , to rapidly discharge toward ground (#11). (Note that the voltage across  $C_X$  appears at the input of the upper reference circuit comparator.) Third, transistor M4 is turned off and transmission gate T1 is turned ON, thus allowing the voltage across  $C_X$  to also appear at the input of the lower reference circuit comparator.

When  $C_X$  discharges to the reference voltage of the lower reference circuit (#12), the outputs of both reference circuits will be HIGH (#13). The trigger-control reset circuit goes HIGH, resetting the trigger-control circuit flip-flop to a LOW State (#14). This turns transistor M3 OFF again, allowing  $C_X$  to begin to charge back up toward  $V_{CC}$ , with a time constant  $t = R_X C_X$  (#15). In addition, transistor M4 is turned ON and transmission gate T1 is turned OFF. Thus a high voltage level is applied to the input of the lower reference circuit comparator, causing its output to go LOW (#16). The monostable multivibrator may be retriggered at any time after the trigger-control circuit goes LOW.

When  $C_X$  charges up to the reference voltage of the upper reference circuit (#17), the output of the upper reference

circuit goes LOW (#18). This causes the output latch to toggle, taking the Q output of the HC4538 to a LOW State (#19), and completing the time-out cycle.

#### RESET OPERATION

A low voltage applied to the Reset pin always forces the Q output of the HC4538 to a LOW State.

The timing diagram illustrates the case in which reset occurs (#20) while  $C_X$  is charging up toward the reference voltage of the upper reference circuit (#21). When a reset occurs, the output of the reset latch goes LOW (#22), turning ON transistor M1. Thus  $C_X$  is allowed to quickly charge up to  $V_{CC}$  (#23) to await the next trigger signal.

Recovery time is the required delay after reset goes inactive to a new trigger rising edge. On the diagram it is shown as (#26) to (#27).

#### RETRIGGER OPERATION

In the retriggerable mode, the HC4538 may be retriggered during timing out of the output pulse at any time after the trigger-control circuit flip-flop has been reset (#24). Because the trigger-control circuit flip-flop resets shortly after  $C_X$  has discharged to the reference voltage of the lower reference circuit (#25), the minimum retrigger time,  $t_{rr}$  is a function of internal propagation delays and the discharge time of  $C_X$ :

$$t_{rr}(\text{ns}) \approx 72 + \frac{V_{CC}(\text{volts}) \cdot C_X(\text{pF})}{30.5}$$

at room temperature

#### POWER-DOWN CONSIDERATIONS

Large values of  $C_X$  may cause problems when powering down the MM74HC4538 because of the amount of energy

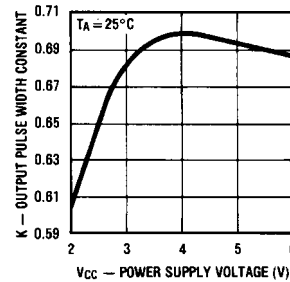
stored in the capacitor. When a system containing this device is powered down, the capacitor may discharge from  $V_{CC}$  through the input protection diodes at pin 2 or pin 14. Current through the protection diodes must be limited to 30 mA; therefore, the turn-off time of the  $V_{CC}$  power supply must not be faster than  $t = V_{CC} \cdot C_X / (30 \text{ mA})$ . For example, if  $V_{CC} = 5\text{V}$  and  $C_X = 15 \mu\text{F}$ , the  $V_{CC}$  supply must turn OFF no faster than  $t = (15\text{V}) \cdot (15 \mu\text{F}) / 30 \text{ mA} = 2.5 \text{ ms}$ . This is usually not a problem because power supplies are heavily filtered and cannot discharge at this rate.

When a more rapid decrease of  $V_{CC}$  to zero volts occurs, the MM74HC4538 may sustain damage. To avoid this possibility, use an external clamping diode,  $D_X$ , connected from  $V_{CC}$  to the  $C_X$  pin.

#### SET UP RECOMMENDATIONS

Minimum  $R_X = 1 \text{ k}\Omega$

Minimum  $C_X = 0 \text{ pF}$ .



**Absolute Maximum Ratings** (Note 1)

(Note 2)

|  |                         |
|--|-------------------------|
| Supply Voltage ( $V_{CC}$ )                      | -0.5 to +7.0V           |
| DC Input Voltage ( $V_{IN}$ )                    | -1.5 to $V_{CC} + 1.5V$ |
| DC Output Voltage ( $V_{OUT}$ )                  | -0.5 to $V_{CC} + 0.5V$ |
| Clamp Diode Current ( $I_{IK}, I_{OK}$ )         | $\pm 20$ mA             |
| DC Output Current, per pin ( $I_{OUT}$ )         | $\pm 25$ mA             |
| DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ ) | $\pm 50$ mA             |
| Storage Temperature Range ( $T_{STG}$ )          | -65°C to +150°C         |
| Power Dissipation ( $P_D$ )                      |                         |
| (Note 3)   | 600 mW                  |
| S.O. Package only                                | 500 mW                  |
| Lead Temperature ( $T_L$ )                       |                         |
| (Soldering 10 seconds)                           | 260°C                   |

**Recommended Operating Conditions**

|  | Min | Max      | Units |
|--|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                      | 2   | 6        | V     |
| DC Input or Output Voltage ( $V_{IN}, V_{OUT}$ ) | 0   | $V_{CC}$ | V     |
| Operating Temperature Range ( $T_A$ )            | -40 | +85      | °C    |
| Input Rise or Fall Times (Reset only)            |     |          |       |
| ( $t_r, t_f$ ) $V_{CC} = 2.0V$                   |     | 1000     | ns    |
| $V_{CC} = 4.5V$                                  |     | 500      | ns    |
| $V_{CC} = 6.0V$                                  |     | 400      | ns    |

**Note 1:** Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation Temperature Derating: Plastic "N" Package: -12mW/°C from 65°C to 85°C.

**DC Electrical Characteristics** (Note 4)

| Symbol             | Parameter                                   | Conditions  | $V_{CC}$ | $T_A = 25^\circ C$ |                   | $T_A = -40$ to $85^\circ C$ |           | $T_A = -55$ to $125^\circ C$ |   | Units |
|--------------------|---|---|----------|--------------------|-------------------|-----------------------------|-----------|------------------------------|---|-------|
|                    |   |   |          | Typ                | Guaranteed Limits |                             |           |                              |   |       |
| $V_{IH}$           | Minimum HIGH Level Input Voltage            |   | 2.0V     |                    | 1.5               | 1.5                         | 1.5       |                              | V |       |
|                    |   |   | 4.5V     |                    | 3.15              | 3.15                        | 3.15      | V                            |   |       |
|                    |   |   | 6.0V     |                    | 4.2               | 4.2                         | 4.2       | V                            |   |       |
| $V_{IL}$           | Maximum LOW Level Input Voltage             |   | 2.0V     |                    | 0.5               | 0.5                         | 0.5       |                              | V |       |
|                    |   |   | 4.5V     |                    | 1.35              | 1.35                        | 1.35      | V                            |   |       |
|                    |   |   | 6.0V     |                    | 1.8               | 1.8                         | 1.8       | V                            |   |       |
| $V_{OH}$           | Minimum HIGH Level Output Voltage           | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 20 \mu A$                          | 2.0V     | 2.0                | 1.9               | 1.9                         | 1.9       | V                            |   |       |
|                    |   |   | 4.5V     | 4.5                | 4.4               | 4.4                         | 4.4       | V                            |   |       |
|                    |   |   | 6.0V     | 6.0                | 5.9               | 5.9                         | 5.9       | V                            |   |       |
|                    |   | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 4.0$ mA<br>$ I_{OUT}  \leq 5.2$ mA | 4.5V     |                    | 3.98              | 3.84                        | 3.7       | V                            |   |       |
|                    |   |   | 6.0V     |                    | 5.48              | 5.34                        | 5.2       | V                            |   |       |
|                    |   |   |          |                    |                   |                             |           |                              |   |       |
| $V_{OL}$           | Maximum LOW Level Output Voltage            | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 20 \mu A$                          | 2.0V     | 0                  | 0.1               | 0.1                         | 0.1       | V                            |   |       |
|                    |   |   | 4.5V     | 0                  | 0.1               | 0.1                         | 0.1       | V                            |   |       |
|                    |   |   | 6.0V     | 0                  | 0.1               | 0.1                         | 0.1       | V                            |   |       |
|                    |   | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 4.0$ mA<br>$ I_{OUT}  \leq 5.2$ mA | 4.5V     |                    | 0.26              | 0.33                        | 0.4       | V                            |   |       |
|                    |   |   | 6.0V     |                    | 0.26              | 0.33                        | 0.4       | V                            |   |       |
|                    |   |   |          |                    |                   |                             |           |                              |   |       |
| $I_{IN}$           | Maximum Input Current (Pins 2, 14) (Note 5) | $V_{IN} = V_{CC}$ or GND  | 6.0V     |                    | $\pm 0.1$         | $\pm 1.0$                   | $\pm 1.0$ | $\mu A$                      |   |       |
| $I_{IN}$           | Maximum Input Current (all other pins)      | $V_{IN} = V_{CC}$ or GND  | 6.0V     |                    | $\pm 0.1$         | $\pm 1.0$                   | $\pm 1.0$ | $\mu A$                      |   |       |
| $I_{CC}$ Active    | Maximum Active Supply Current               | Pins 2, 14 = 0.5 $V_{CC}$<br>Q1, Q2 = HIGH<br>$V_{IN} = V_{CC}$ or GND              | 6.0V     |                    | 150               | 250                         | 400       | $\mu A$                      |   |       |
| $I_{CC}$ Quiescent | Maximum Quiescent Supply Current            | Pins 2, 14 = OPEN<br>Q1, Q2 = LOW<br>$V_{IN} = V_{CC}$ or GND                       | 6.0V     |                    | 130               | 220                         | 350       | $\mu A$                      |   |       |

**Note 4:** For a power supply of 5V  $\pm 10\%$  the worst case output voltages ( $V_{OH}$ , and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

**DC Electrical Characteristics** (Continued)Note 5: The device must be set up with 3 steps before measuring  $I_{IN}$ :

|    | Clear | A | B |
|----|-------|---|---|
| 1. | H     | L | H |
| 2. | H     | H | H |
| 3. | H     | L | H |

**AC Electrical Characteristics** $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ ,  $C_L = 15 pF$ ,  $t_r = t_f = 6 ns$ 

| Symbol    | Parameter                                      | Conditions | Typ | Limit | Units |
|-----------|--|------------|-----|-------|-------|
| $t_{PLH}$ | Maximum Propagation Delay A, or B to Q         |            | 23  | 45    | ns    |
| $t_{PHL}$ | Maximum Propagation Delay A, or B to $\bar{Q}$ |            | 26  | 50    | ns    |
| $t_{PHL}$ | Maximum Propagation Delay Clear to Q           |            | 23  | 45    | ns    |
| $t_{PLH}$ | Maximum Propagation Delay Clear to $\bar{Q}$   |            | 26  | 50    | ns    |
| $t_W$     | Minimum Pulse Width A, B or Clear              |            | 10  | 16    | ns    |

**AC Electrical Characteristics** $C_L = 50 pF$ ,  $t_r = t_f = 6 ns$  (unless otherwise specified)

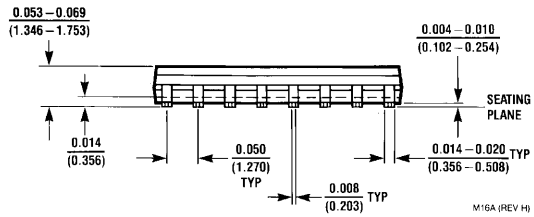
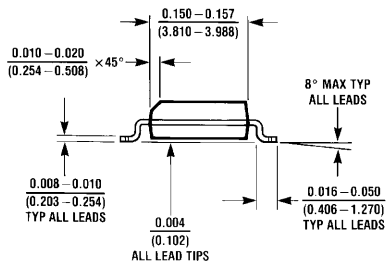
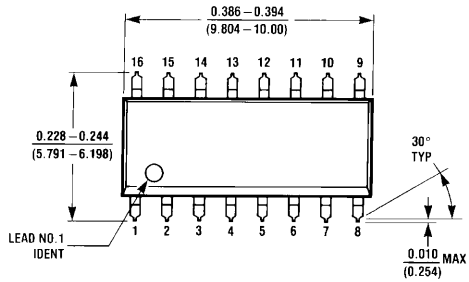
| Symbol             | Parameter                                       | Conditions                           | $V_{CC}$ | $T_A = 25^\circ C$ |                   | $T_A = -40 \text{ to } 85^\circ C$ |                   | $T_A = -55 \text{ to } 125^\circ C$ |                   | Units |
|--------------------|---|--------------------------------------|----------|--------------------|-------------------|------------------------------------|-------------------|-------------------------------------|-------------------|-------|
|                    |   |                                      |          | Typ                | Guaranteed Limits | Typ                                | Guaranteed Limits | Typ                                 | Guaranteed Limits |       |
| $t_{PLH}$          | Maximum Propagation Delay A, or B to Q          |                                      | 2.0V     | 100                | 250               | 315                                |                   | 373                                 | ns                |       |
|                    |   |                                      | 4.5V     | 25                 | 50                | 63                                 |                   | 75                                  | ns                |       |
|                    |   |                                      | 6.0V     | 21                 | 43                | 54                                 |                   | 63                                  | ns                |       |
| $t_{PHL}$          | Maximum Propagation Delay A, or B to $\bar{Q}$  |                                      | 2.0V     | 110                | 275               | 347                                |                   | 410                                 | ns                |       |
|                    |   |                                      | 4.5V     | 28                 | 55                | 69                                 |                   | 82                                  | ns                |       |
|                    |   |                                      | 6.0V     | 23                 | 47                | 59                                 |                   | 70                                  | ns                |       |
| $t_{PHL}$          | Maximum Propagation Delay Clear to Q            |                                      | 2.0V     | 100                | 250               | 315                                |                   | 373                                 | ns                |       |
|                    |   |                                      | 4.5V     | 25                 | 50                | 63                                 |                   | 75                                  | ns                |       |
|                    |   |                                      | 6.0V     | 21                 | 43                | 54                                 |                   | 63                                  | ns                |       |
| $t_{PLH}$          | Maximum Propagation Delay Clear to $\bar{Q}$    |                                      | 2.0V     | 110                | 275               | 347                                |                   | 410                                 | ns                |       |
|                    |   |                                      | 4.5V     | 28                 | 55                | 69                                 |                   | 82                                  | ns                |       |
|                    |   |                                      | 6.0V     | 23                 | 47                | 59                                 |                   | 70                                  | ns                |       |
| $t_{TLH}, t_{THL}$ | Maximum Output Rise and Fall Time               |                                      | 2.0V     | 30                 | 75                | 95                                 |                   | 110                                 | ns                |       |
|                    |   |                                      | 4.5V     | 10                 | 15                | 19                                 |                   | 22                                  | ns                |       |
|                    |   |                                      | 6.0V     | 8                  | 13                | 16                                 |                   | 19                                  | ns                |       |
| $t_r, t_f$         | Maximum Input Rise and Fall Time (Reset only)   |                                      | 2.0V     |                    | 1000              | 1000                               |                   | 1000                                | ns                |       |
|                    |   |                                      | 4.5V     |                    | 500               | 500                                |                   | 500                                 | ns                |       |
|                    |   |                                      | 6.0V     |                    | 400               | 400                                |                   | 400                                 | ns                |       |
| $t_W$              | Minimum Pulse Width A, B, Clear                 |                                      | 2.0V     |                    | 80                | 101                                |                   | 119                                 | ns                |       |
|                    |   |                                      | 4.5V     |                    | 16                | 20                                 |                   | 24                                  | ns                |       |
|                    |   |                                      | 6.0V     |                    | 14                | 17                                 |                   | 20                                  | ns                |       |
| $t_{REC}$          | Minimum Recovery Time, Clear Inactive to A or B |                                      | 2.0V     | -5                 | 0                 | 0                                  |                   | 0                                   | ns                |       |
|                    |   |                                      | 4.5V     |                    | 0                 | 0                                  |                   | 0                                   | ns                |       |
|                    |   |                                      | 6.0V     |                    | 0                 | 0                                  |                   | 0                                   | ns                |       |
| $t_{WQ}$           | Output Pulse Width                              | $C_X = 12 pF$<br>$R_X = 1 k\Omega$   | Min      | 3.0V               | 283               | 190                                |                   |                                     | ns                |       |
|                    |   |                                      |          | 5.0V               | 147               | 120                                |                   |                                     | ns                |       |
|                    |   | Max                                  | 3.0V     | 283                | 400               |                                    |                   | ns                                  |                   |       |
|                    |   |                                      | 5.0V     | 147                | 185               |                                    |                   | ns                                  |                   |       |
| $t_{WQ}$           | Output Pulse Width                              | $C_X = 100 pF$<br>$R_X = 10 k\Omega$ | Min      | 3.0V               | 1.2               |                                    |                   |                                     | $\mu s$           |       |
|                    |   |                                      |          | 5.0V               | 1.0               |                                    |                   |                                     | $\mu s$           |       |
|                    |   | Max                                  | 3.0V     | 1.2                |                   |                                    |                   | $\mu s$                             |                   |       |
|                    |   |                                      | 5.0V     | 1.0                |                   |                                    |                   | $\mu s$                             |                   |       |

**AC Electrical Characteristics** (Continued)

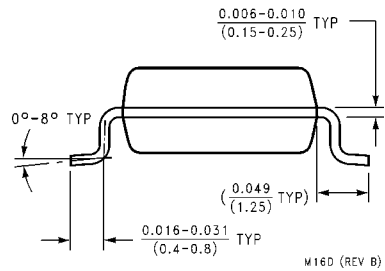
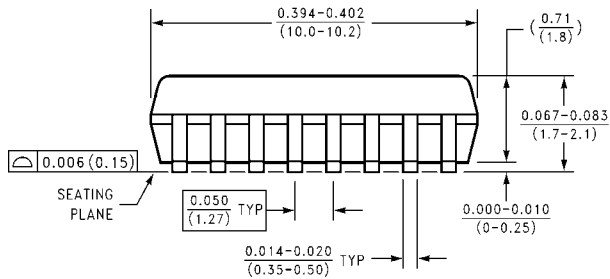
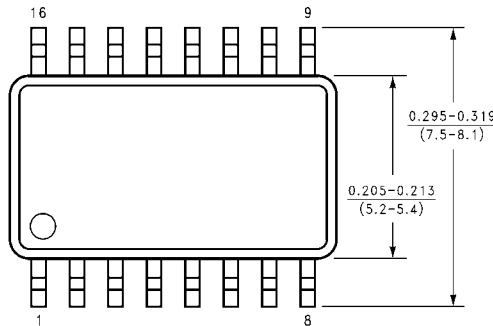
| Symbol           | Parameter  | Conditions   | V <sub>CC</sub> | T <sub>A</sub> = -25°C |                   | T <sub>A</sub> = -40 to 85°C | T <sub>A</sub> = -55 to 125°C | Units |    |
|------------------|--|--|-----------------|------------------------|-------------------|------------------------------|-------------------------------|-------|----|
|                  |  |  |                 | Typ                    | Guaranteed Limits |                              |                               |       |    |
| t <sub>WQ</sub>  | Output Pulse Width                                 | C <sub>X</sub> = 1000 pF<br>R <sub>X</sub> = 10 kΩ | Min             | 3.0V                   | 10.5              | 9.4                          |                               | μs    |    |
|                  |  |  |                 | 5.0V                   | 10.0              | 9.3                          |                               | μs    |    |
|                  |  |  | Max             | 3.0V                   | 10.5              | 11.6                         |                               | μs    |    |
|                  |  |  | 5.0V            | 10.0                   | 10.7              |                              | μs                            |       |    |
| t <sub>WQ</sub>  | Output Pulse Width                                 | C <sub>X</sub> = 0.1μF<br>R <sub>X</sub> = 10k     | Min             | 5.0V                   |                   | 0.63                         | 0.602                         | 0.595 | ms |
|                  |  |  | Max             | 5.0V                   |                   | 0.77                         | 0.798                         | 0.805 | ms |
| C <sub>IN</sub>  | Maximum Input Capacitance (Pins 2 & 14)            |  |                 | 25                     |                   |                              |                               | pF    |    |
| C <sub>IN</sub>  | Maximum Input Capacitance (other inputs)           |  |                 | 5                      | 10                | 10                           | 10                            | pF    |    |
| C <sub>PD</sub>  | Power Dissipation Capacitance (Note 6)             | (per one shot)                                     |                 | 150                    |                   |                              |                               | pF    |    |
| Δt <sub>WQ</sub> | Pulse Width Match Between Circuits in Same Package |  |                 | ±1                     |                   |                              |                               | %     |    |

**Note 6:** C<sub>PD</sub> determines the no load dynamic consumption, P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>, and the no load dynamic current consumption, I<sub>S</sub> = V<sub>CC</sub> f + I<sub>CC</sub>.

**Physical Dimensions** inches (millimeters) unless otherwise noted

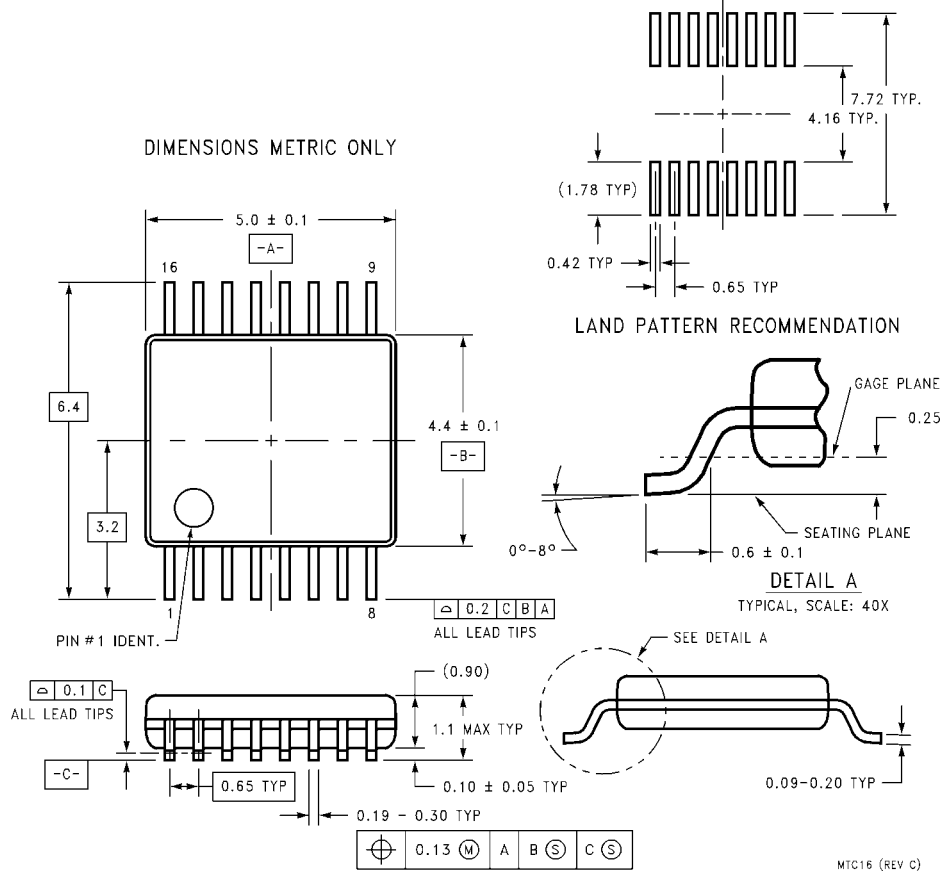


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body**  
**Package Number M16A**



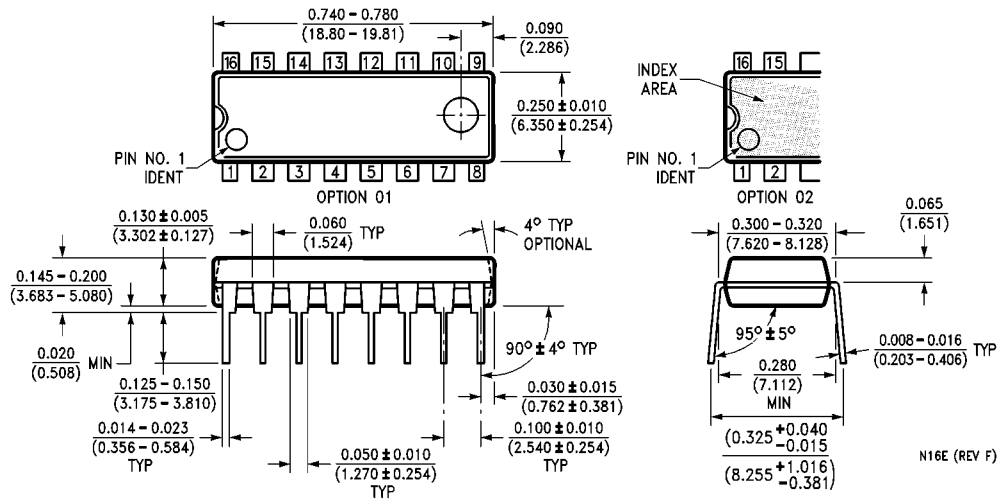
**16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide**  
**Package Number M16D**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC16**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E

N16E (REV F)

**LIFE SUPPORT POLICY**

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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