

# 14-Bit Binary Counter and Oscillator

## MC14060B

The MC14060B is a 14-stage binary ripple counter with an on-chip oscillator buffer. The oscillator configuration allows design of either RC or crystal oscillator circuits. Also included on the chip is a reset function which places all outputs into the zero state and disables the oscillator. A negative transition on Clock will advance the counter to the next state. Schmitt trigger action on the input line permits very slow input rise and fall times. Applications include time delay circuits, counter controls, and frequency dividing circuits.

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.

### Features

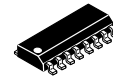
- Fully Static Operation
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 V to 18 V
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range
- Buffered Outputs Available from Stages 4 Through 10 and 12 Through 14
- Common Reset Line
- Pin-for-Pin Replacement for CD4060B
- These Devices are Pb-Free and are RoHS Compliant

### MAXIMUM RATINGS (Voltages Referenced to $V_{SS}$ )

| Symbol                  | Parameter   | Value                    | Unit               |
|-------------------------|---|--------------------------|--------------------|
| $V_{DD}$                | DC Supply Voltage Range                           | -0.5 to +18.0            | V                  |
| $V_{in}$ ,<br>$V_{out}$ | Input or Output Voltage Range (DC or Transient)   | -0.5 to $V_{DD}$<br>+0.5 | V                  |
| $I_{in}$ ,<br>$I_{out}$ | Input or Output Current (DC or Transient) per Pin | $\pm 10$                 | mA                 |
| $P_D$                   | Power Dissipation, per Package (Note 1)           | 500                      | mW                 |
| $T_A$                   | Ambient Temperature Range                         | -55 to +125              | $^{\circ}\text{C}$ |
| $T_{stg}$               | Storage Temperature Range                         | -65 to +150              | $^{\circ}\text{C}$ |
| $T_L$                   | Lead Temperature (8 Second Soldering)             | 260                      | $^{\circ}\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Temperature Derating: "D/DW" Packages: -7.0 mW/ $^{\circ}\text{C}$  from 65 $^{\circ}\text{C}$  To 125 $^{\circ}\text{C}$ .

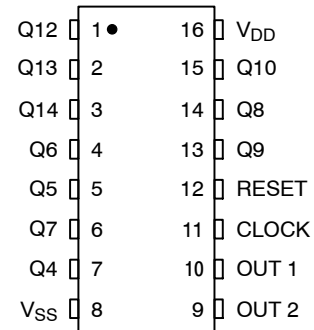


SOIC-16  
D SUFFIX  
CASE 751B

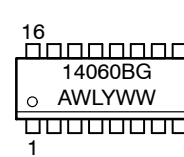


TSSOP-16  
DT SUFFIX  
CASE 948F

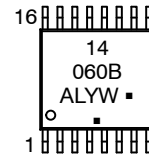
### PIN ASSIGNMENT



### MARKING DIAGRAMS



SOIC-16



TSSOP-16

- A = Assembly Location
- WL, L = Wafer Lot
- YY, Y = Year
- WW, W = Work Week
- G or ■ = Pb-Free Package



(Note: Microdot may be in either location)

### ORDERING INFORMATION

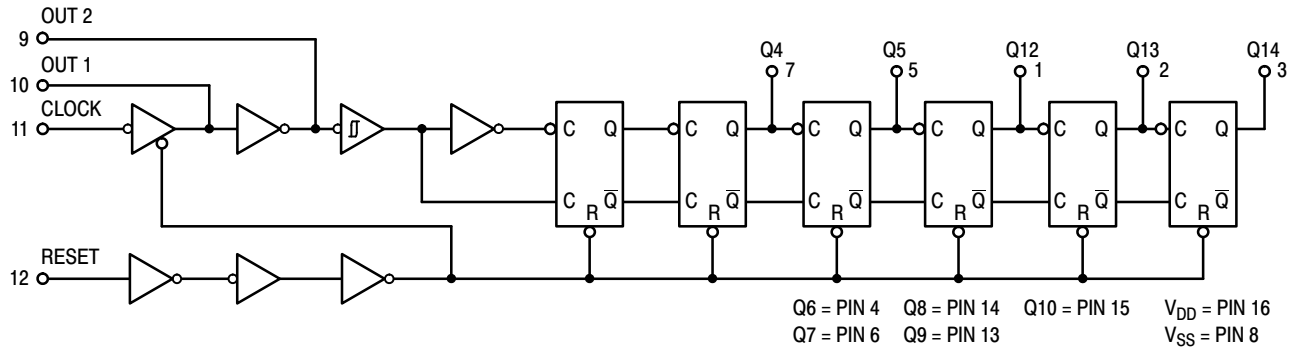
See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# MC14060B

**Table 1. Truth Table**

| Clock   | Reset | Output State          |
|---|-------|-----------------------|
|  | L     | No Change             |
|  | L     | Advance to Next State |
| H   | H     | All Outputs are Low   |

X = Don't Care



**Figure 1. Logic Diagram**

## ORDERING INFORMATION

| Device        | Package               | Shipping <sup>†</sup> |
|---------------|-----------------------|-----------------------|
| MC14060BDG    | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       |
| MC14060BDR2G  | SOIC-16<br>(Pb-Free)  | 2500 / Tape & Reel    |
| MC14060BDTR2G | TSSOP-16<br>(Pb-Free) | 2500 / Tape & Reel    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MC14060B

## ELECTRICAL CHARACTERISTICS (Voltages Referenced to $V_{SS}$ )

| Symbol   | Characteristic   | $V_{DD}$<br>Vdc | -55°C   |           | 25°C  |                 |           | 125°C |           | Unit    |
|----------|--|-----------------|---|-----------|-------|-----------------|-----------|-------|-----------|---------|
|          |  |                 | Min   | Max       | Min   | Typ<br>(Note 2) | Max       | Min   | Max       |         |
| $V_{OL}$ | Output Voltage "0" Level<br>$V_{in} = V_{DD}$ or 0   | 5.0             | -   | 0.05      | -     | 0               | 0.05      | -     | 0.05      | V       |
|          |  | 10              | -   | 0.05      | -     | 0               | 0.05      | -     | 0.05      |         |
|          |  | 15              | -   | 0.05      | -     | 0               | 0.05      | -     | 0.05      |         |
| $V_{OH}$ | $V_{in} = 0$ or $V_{DD}$ "1" Level   | 5.0             | 4.95  | -         | 4.95  | 5.0             | -         | 4.95  | -         | V       |
|          |  | 10              | 9.95  | -         | 9.95  | 10              | -         | 9.95  | -         |         |
|          |  | 15              | 14.95   | -         | 14.95 | 15              | -         | 14.95 | -         |         |
| $V_{IL}$ | Input Voltage "0" Level<br>( $V_O = 4.5$ or $0.5$ V)<br>( $V_O = 9.0$ or $1.0$ V)<br>( $V_O = 13.5$ or $1.5$ V)                                    | 5.0             | -   | 1.5       | -     | 2.25            | 1.5       | -     | 1.5       | V       |
|          |  | 10              | -   | 3.0       | -     | 4.50            | 3.0       | -     | 3.0       |         |
|          |  | 15              | -   | 4.0       | -     | 6.75            | 4.0       | -     | 4.0       |         |
| $V_{IH}$ | Input Voltage "1" Level<br>( $V_O = 0.5$ or $4.5$ V)<br>( $V_O = 1.0$ or $9.0$ V)<br>( $V_O = 1.5$ or $13.5$ V)                                    | 5.0             | 3.5   | -         | 3.5   | 2.75            | -         | 3.5   | -         | V       |
|          |  | 10              | 7.0   | -         | 7.0   | 5.50            | -         | 7.0   | -         |         |
|          |  | 15              | 11.0  | -         | 11.0  | 8.25            | -         | 11.0  | -         |         |
| $V_{IL}$ | Input Voltage "0" Level<br>( $V_O = 4.5$ Vdc)<br>( $V_O = 9.0$ Vdc)<br>( $V_O = 13.5$ Vdc)<br>(For Input 11 and Output 10)                         | 5.0             | -   | 1.0       | -     | 2.25            | 1.0       | -     | 1.0       | Vdc     |
|          |  | 10              | -   | 2.0       | -     | 4.50            | 2.0       | -     | 2.0       |         |
|          |  | 15              | -   | 2.5       | -     | 6.75            | 2.5       | -     | 2.5       |         |
| $V_{IH}$ | Input Voltage "1" Level<br>( $V_O = 0.5$ Vdc)<br>( $V_O = 1.0$ Vdc)<br>( $V_O = 1.5$ Vdc)  | 5.0             | 4.0   | -         | 4.0   | 2.75            | -         | 4.0   | -         | Vdc     |
|          |  | 10              | 8.0   | -         | 8.0   | 5.50            | -         | 8.0   | -         |         |
|          |  | 15              | 12.5  | -         | 12.5  | 8.25            | -         | 12.5  | -         |         |
| $I_{OH}$ | Output Drive Current<br>( $V_{OH} = 2.5$ V)<br>( $V_{OH} = 4.6$ V)<br>( $V_{OH} = 9.5$ V)<br>( $V_{OH} = 13.5$ V)<br>(Except Source Pins 9 and 10) | 5.0             | -3.0  | -         | -2.4  | -4.2            | -         | -1.7  | -         | mA      |
|          |  | 5.0             | -0.64   | -         | -0.51 | -0.88           | -         | -0.36 | -         |         |
|          |  | 10              | -1.6  | -         | -1.3  | -2.25           | -         | -0.9  | -         |         |
|          |  | 15              | -4.2  | -         | -3.4  | -8.8            | -         | -2.4  | -         |         |
| $I_{OL}$ | Output Drive Current Sink<br>( $V_{OL} = 0.4$ V)<br>( $V_{OL} = 0.5$ V)<br>( $V_{OL} = 1.5$ V)   | 5.0             | 0.64  | -         | 0.51  | 0.88            | -         | 0.36  | -         | mA      |
|          |  | 10              | 1.6   | -         | 1.3   | 2.25            | -         | 0.9   | -         |         |
|          |  | 15              | 4.2   | -         | 3.4   | 8.8             | -         | 2.4   | -         |         |
| $I_{in}$ | Input Current  | 15              | -   | $\pm 0.1$ | -     | $\pm 0.00001$   | $\pm 0.1$ | -     | $\pm 1.0$ | $\mu A$ |
| $C_{in}$ | Input Capacitance ( $V_{in} = 0$ )   | -               | -   | -         | -     | 5.0             | 7.5       | -     | -         | pF      |
| $I_{DD}$ | Quiescent Current<br>(Per Package)   | 5.0             | -   | 5.0       | -     | 0.005           | 5.0       | -     | 150       | $\mu A$ |
|          |  | 10              | -   | 10        | -     | 0.010           | 10        | -     | 300       |         |
|          |  | 15              | -   | 20        | -     | 0.015           | 20        | -     | 600       |         |
| $I_T$    | Total Supply Current (Notes 3, 4)<br>(Dynamic plus Quiescent,<br>Per Package)<br>( $C_L = 50$ pF on all outputs,<br>all buffers switching)         | 5.0<br>10<br>15 | $I_T = (0.25 \mu A/kHz) f + I_{DD}$<br>$I_T = (0.54 \mu A/kHz) f + I_{DD}$<br>$I_T = (0.85 \mu A/kHz) f + I_{DD}$ |           |       |                 |           |       |           | $\mu A$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

3. The formulas given are for the typical characteristics only at 25°C.

4. To calculate total supply current at loads other than 50 pF:  $I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) \text{ Vfk}$

where:  $I_T$  is in  $\mu A$  (per package),  $C_L$  in pF,  $V = (V_{DD} - V_{SS})$  in volts,  $f$  in kHz is input frequency, and  $k = 0.002$ .

# MC14060B

## SWITCHING CHARACTERISTICS (C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C)

| Symbol                               | Characteristic  | V <sub>DD</sub><br>Vdc | Min      | Typ<br>(Note 5) | Max | Unit |
|--------------------------------------|---|------------------------|----------|-----------------|-----|------|
| t <sub>TLH</sub>                     | Output Rise Time (Counter Outputs)                        | 5.0                    | -        | 40              | 200 | ns   |
|                                      |   | 10                     | -        | 25              | 100 |      |
|                                      |   | 15                     | -        | 20              | 80  |      |
| t <sub>THL</sub>                     | Output Fall Time (Counter Outputs)                        | 5.0                    | -        | 50              | 200 | ns   |
|                                      |   | 10                     | -        | 30              | 100 |      |
|                                      |   | 15                     | -        | 20              | 80  |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time<br>Clock to Q4<br><br>Clock to Q14 | 5.0                    | -        | 415             | 740 | ns   |
|                                      |   | 10                     | -        | 175             | 300 |      |
|                                      |   | 15                     | -        | 125             | 200 |      |
|                                      |   | 5.0                    | -        | 1.5             | 2.7 | μs   |
|                                      |   | 10                     | -        | 0.7             | 1.3 |      |
|                                      |   | 15                     | -        | 0.4             | 1.0 |      |
| t <sub>WH</sub>                      | Clock Pulse Width   | 5.0                    | 100      | 65              | -   | ns   |
|                                      |   | 10                     | 40       | 30              | -   |      |
|                                      |   | 15                     | 30       | 20              | -   |      |
| f <sub>φ</sub>                       | Clock Pulse Frequency                                     | 5.0                    | -        | 5               | 3.5 | MHz  |
|                                      |   | 10                     | -        | 14              | 8   |      |
|                                      |   | 15                     | -        | 17              | 12  |      |
| t <sub>TLH</sub><br>t <sub>THL</sub> | Clock Rise and Fall Time                                  | 5.0                    | No Limit |                 |     | ns   |
|                                      |   | 10                     |          |                 |     |      |
|                                      |   | 15                     |          |                 |     |      |
| t <sub>w</sub>                       | Reset Pulse Width   | 5.0                    | 120      | 40              | -   | ns   |
|                                      |   | 10                     | 60       | 15              | -   |      |
|                                      |   | 15                     | 40       | 10              | -   |      |
| t <sub>PHL</sub>                     | Propagation Delay Time<br>Reset to On                     | 5.0                    | -        | 170             | 350 | ns   |
|                                      |   | 10                     | -        | 80              | 160 |      |
|                                      |   | 15                     | -        | 60              | 100 |      |

5. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

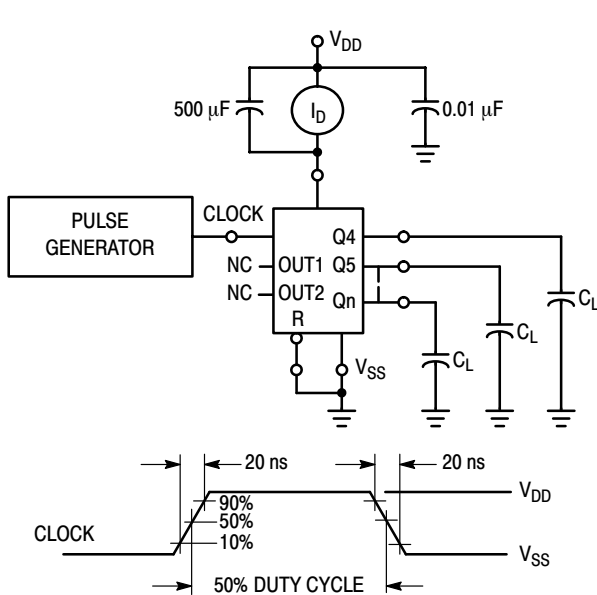


Figure 1. Power Dissipation Test Circuit and Waveform

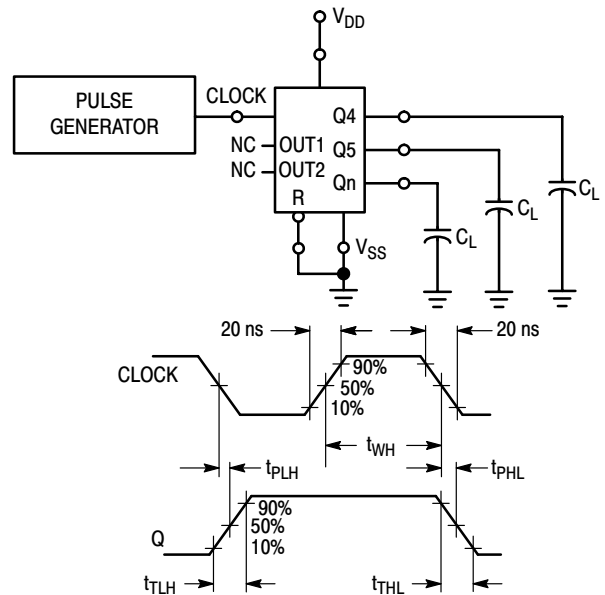
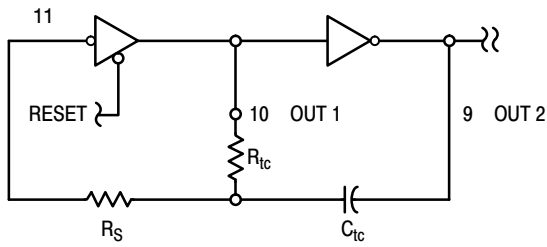


Figure 2. Switching Time Test Circuit and Waveforms

# MC14060B



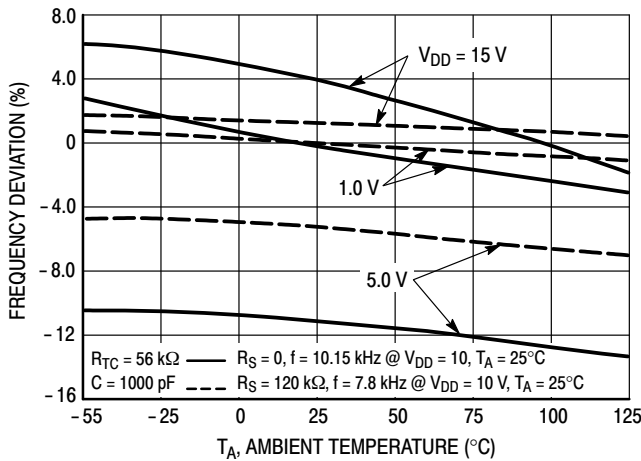
$$f \approx \frac{1}{2.3 R_{tc} C_{tc}}$$

if  $1 \text{ kHz} \leq f \leq 100 \text{ kHz}$   
and  $2R_{tc} < R_S < 10R_{tc}$   
(f in Hz, R in ohms, C in farads)

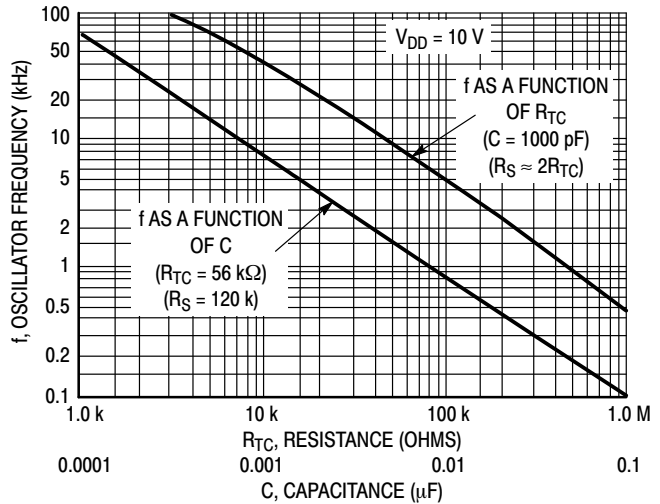
The formula may vary for other frequencies. Recommended maximum value for the resistors in  $1 \text{ M}\Omega$ .

**Figure 3. Oscillator Circuit Using RC Configuration**

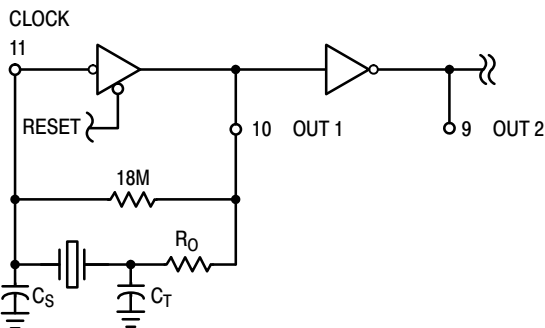
## TYPICAL RC OSCILLATOR CHARACTERISTICS



**Figure 4. RC Oscillator Stability**



**Figure 5. RC Oscillator Frequency as a Function of  $R_{TC}$  and C**



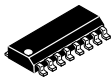
**Figure 6. Typical Crystal Oscillator Circuit**

**Table 2. Typical Data for Crystal Oscillator Circuit**

| Characteristic   | 500 kHz Circuit | 32 kHz Circuit | Unit       |
|--|-----------------|----------------|------------|
| Crystal Characteristics  |                 |                |            |
| Resonant Frequency   | 500             | 32             | kHz        |
| Equivalent Resistance, $R_S$   | 1.0             | 6.2            | k $\Omega$ |
| External Resistor/Capacitor Values   |                 |                |            |
| $R_0$  | 47              | 750            | k $\Omega$ |
| $C_T$  | 82              | 82             | pF         |
| $C_S$  | 20              | 20             | pF         |
| Frequency Stability  |                 |                |            |
| Frequency Changes as a Function of $V_{DD}$ ( $T_A = 25^\circ\text{C}$ )                   |                 |                |            |
| $V_{DD}$ Change from 5.0 V to 10 V   | +6.0            | +2.0           | ppm        |
| $V_{DD}$ Change from 10 V to 15 V  | +2.0            | +2.0           | ppm        |
| Frequency Change as a Function of Temperature ( $V_{DD} = 10 \text{ V}$ )                  |                 |                |            |
| $T_A$ Change from $-55^\circ\text{C}$ to $+25^\circ\text{C}$ Complete Oscillator (Note 6)  | +100            | +120           | ppm        |
| $T_A$ Change from $+25^\circ\text{C}$ to $+125^\circ\text{C}$ Complete Oscillator (Note 6) | -160            | -560           | ppm        |

6. Complete oscillator includes crystal, capacitors, and resistors.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-16  
CASE 751B-05  
ISSUE K

DATE 29 DEC 2006



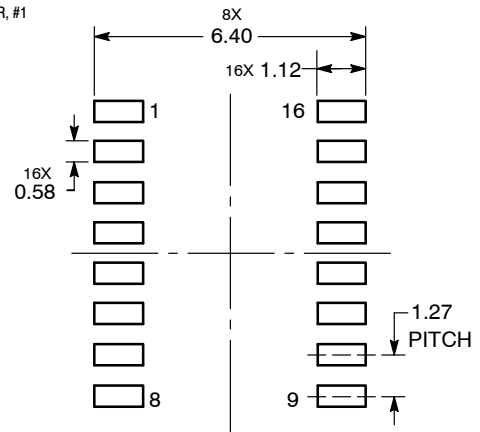
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.80        | 10.00 | 0.386     | 0.393 |
| B   | 3.80        | 4.00  | 0.150     | 0.157 |
| C   | 1.35        | 1.75  | 0.054     | 0.068 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.40        | 1.25  | 0.016     | 0.049 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.19        | 0.25  | 0.008     | 0.009 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0° 7°       |       | 0° 7°     |       |
| P   | 5.80        | 6.20  | 0.229     | 0.244 |
| R   | 0.25        | 0.50  | 0.010     | 0.019 |

- |  |  |  |  |
|--|--|--|--|
| <p>STYLE 1:</p> <p>PIN 1. COLLECTOR</p> <p>2. BASE</p> <p>3. EMITTER</p> <p>4. NO CONNECTION</p> <p>5. EMITTER</p> <p>6. BASE</p> <p>7. COLLECTOR</p> <p>8. COLLECTOR</p> <p>9. BASE</p> <p>10. EMITTER</p> <p>11. NO CONNECTION</p> <p>12. EMITTER</p> <p>13. BASE</p> <p>14. COLLECTOR</p> <p>15. EMITTER</p> <p>16. COLLECTOR</p>                           | <p>STYLE 2:</p> <p>PIN 1. CATHODE</p> <p>2. ANODE</p> <p>3. NO CONNECTION</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. NO CONNECTION</p> <p>7. ANODE</p> <p>8. CATHODE</p> <p>9. CATHODE</p> <p>10. ANODE</p> <p>11. NO CONNECTION</p> <p>12. CATHODE</p> <p>13. CATHODE</p> <p>14. NO CONNECTION</p> <p>15. ANODE</p> <p>16. CATHODE</p> | <p>STYLE 3:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. BASE, #1</p> <p>3. EMITTER, #1</p> <p>4. COLLECTOR, #1</p> <p>5. COLLECTOR, #2</p> <p>6. BASE, #2</p> <p>7. EMITTER, #2</p> <p>8. COLLECTOR, #2</p> <p>9. COLLECTOR, #3</p> <p>10. BASE, #3</p> <p>11. EMITTER, #3</p> <p>12. COLLECTOR, #3</p> <p>13. COLLECTOR, #4</p> <p>14. BASE, #4</p> <p>15. EMITTER, #4</p> <p>16. COLLECTOR, #4</p>   | <p>STYLE 4:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. COLLECTOR, #1</p> <p>3. COLLECTOR, #2</p> <p>4. COLLECTOR, #2</p> <p>5. COLLECTOR, #3</p> <p>6. COLLECTOR, #3</p> <p>7. COLLECTOR, #4</p> <p>8. COLLECTOR, #4</p> <p>9. BASE, #4</p> <p>10. EMITTER, #4</p> <p>11. BASE, #3</p> <p>12. EMITTER, #3</p> <p>13. BASE, #2</p> <p>14. EMITTER, #2</p> <p>15. BASE, #1</p> <p>16. EMITTER, #1</p> |
| <p>STYLE 5:</p> <p>PIN 1. DRAIN, DYE #1</p> <p>2. DRAIN, #1</p> <p>3. DRAIN, #2</p> <p>4. DRAIN, #2</p> <p>5. DRAIN, #3</p> <p>6. DRAIN, #3</p> <p>7. DRAIN, #4</p> <p>8. DRAIN, #4</p> <p>9. GATE, #4</p> <p>10. SOURCE, #4</p> <p>11. GATE, #3</p> <p>12. SOURCE, #3</p> <p>13. GATE, #2</p> <p>14. SOURCE, #2</p> <p>15. GATE, #1</p> <p>16. SOURCE, #1</p> | <p>STYLE 6:</p> <p>PIN 1. CATHODE</p> <p>2. CATHODE</p> <p>3. CATHODE</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. CATHODE</p> <p>7. CATHODE</p> <p>8. CATHODE</p> <p>9. ANODE</p> <p>10. ANODE</p> <p>11. ANODE</p> <p>12. ANODE</p> <p>13. ANODE</p> <p>14. ANODE</p> <p>15. ANODE</p> <p>16. ANODE</p>                                 | <p>STYLE 7:</p> <p>PIN 1. SOURCE N-CH</p> <p>2. COMMON DRAIN (OUTPUT)</p> <p>3. COMMON DRAIN (OUTPUT)</p> <p>4. GATE P-CH</p> <p>5. COMMON DRAIN (OUTPUT)</p> <p>6. COMMON DRAIN (OUTPUT)</p> <p>7. COMMON DRAIN (OUTPUT)</p> <p>8. SOURCE P-CH</p> <p>9. SOURCE P-CH</p> <p>10. COMMON DRAIN (OUTPUT)</p> <p>11. COMMON DRAIN (OUTPUT)</p> <p>12. COMMON DRAIN (OUTPUT)</p> <p>13. GATE N-CH</p> <p>14. COMMON DRAIN (OUTPUT)</p> <p>15. COMMON DRAIN (OUTPUT)</p> <p>16. SOURCE N-CH</p> |  |

RECOMMENDED  
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

|                  |             |  |
|------------------|-------------|--|
| DOCUMENT NUMBER: | 98ASB42566B | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | SOIC-16     | PAGE 1 OF 1  |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**TSSOP-16 WB**  
CASE 948F  
ISSUE B

DATE 19 OCT 2006



**NOTES:**

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
- TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.90        | 5.10 | 0.193     | 0.200 |
| B   | 4.30        | 4.50 | 0.169     | 0.177 |
| C   | ---         | 1.20 | ---       | 0.047 |
| D   | 0.05        | 0.15 | 0.002     | 0.006 |
| F   | 0.50        | 0.75 | 0.020     | 0.030 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.18        | 0.28 | 0.007     | 0.011 |
| J   | 0.09        | 0.20 | 0.004     | 0.008 |
| J1  | 0.09        | 0.16 | 0.004     | 0.006 |
| K   | 0.19        | 0.30 | 0.007     | 0.012 |
| K1  | 0.19        | 0.25 | 0.007     | 0.010 |
| L   | 6.40 BSC    |      | 0.252 BSC |       |
| M   | 0°          | 8°   | 0°        | 8°    |

**RECOMMENDED  
SOLDERING FOOTPRINT\***



**GENERIC  
MARKING DIAGRAM\***



- XXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- G or ■ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

|                         |                    |  |
|-------------------------|--------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98ASH70247A</b> | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>TSSOP-16</b>    | <b>PAGE 1 OF 1</b>   |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)