

# MC14008B

## 4-Bit Full Adder

The MC14008B 4-bit full adder is constructed with MOS P-Channel and N-Channel enhancement mode devices in a single monolithic structure. This device consists of four full adders with fast internal look-ahead carry output. It is useful in binary addition and other arithmetic applications. The fast parallel carry output bit allows high-speed operation when used with other adders in a system.

### Features

- Look-Ahead Carry Output
- Diode Protection on All Inputs
- All Outputs Buffered
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-Power TTL Loads or One Low-Power Schottky TTL Load Over the Rated Temperature Range
- Pin-for-Pin Replacement for CD4008B
- This Device is Pb-Free and is 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    |
| $V_{in}, V_{out}$ | Input or Output Voltage Range (DC or Transient)   | -0.5 to $V_{DD} + 0.5$ | V    |
| $I_{in}, I_{out}$ | 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            | °C   |
| $T_{stg}$         | Storage Temperature Range                         | -65 to +150            | °C   |
| $T_L$             | Lead Temperature (8-Second Soldering)             | 260                    | °C   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Temperature Derating: "D/DW" Package: -7.0 mW/°C From 65°C To 125°C

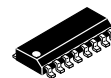
This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$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



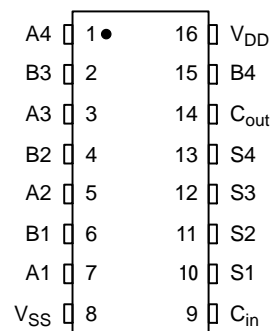
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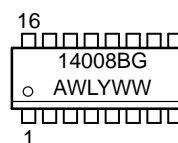


SOIC-16  
D SUFFIX  
CASE 751B

### PIN ASSIGNMENT



### MARKING DIAGRAM



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

### ORDERING INFORMATION

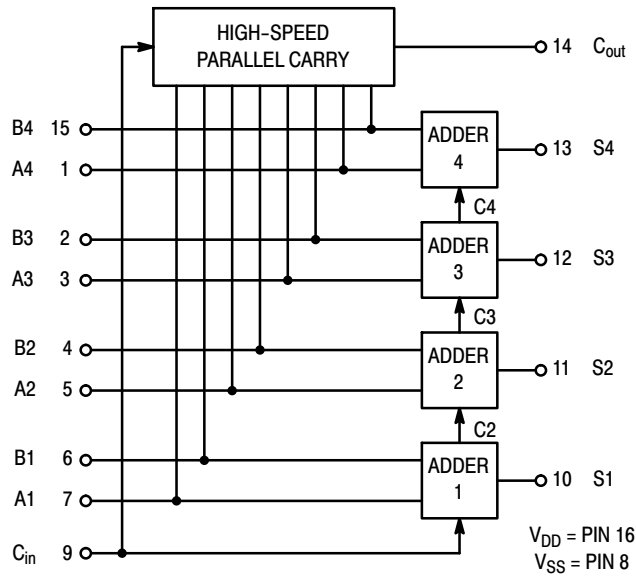
See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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## TRUTH TABLE (One Stage)

| C <sub>in</sub> | B | A | C <sub>out</sub> | S |
|-----------------|---|---|------------------|---|
| 0               | 0 | 0 | 0                | 0 |
| 0               | 0 | 1 | 0                | 1 |
| 0               | 1 | 0 | 0                | 1 |
| 0               | 1 | 1 | 1                | 0 |
| 1               | 0 | 0 | 0                | 1 |
| 1               | 0 | 1 | 1                | 0 |
| 1               | 1 | 0 | 1                | 0 |
| 1               | 1 | 1 | 1                | 1 |

## BLOCK DIAGRAM



## ORDERING INFORMATION

| Device       | Package              | Shipping <sup>†</sup>    |
|--------------|----------------------|--------------------------|
| MC14008BDR2G | SOIC-16<br>(Pb-Free) | 2500 Units / 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.

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## ELECTRICAL CHARACTERISTICS (Voltages Referenced to V<sub>SS</sub>)

| Characteristic  | Symbol                       | V <sub>DD</sub><br>Vdc | -55°C   |      | 25°C  |                 |      | 125°C |      | Unit |
|---|------------------------------|------------------------|---|------|-------|-----------------|------|-------|------|------|
|   |                              |                        | Min   | Max  | Min   | Typ<br>(Note 2) | Max  | Min   | Max  |      |
| Output Voltage<br>V <sub>in</sub> = V <sub>DD</sub> or 0  | “0” Level<br>V <sub>OL</sub> | 5.0                    | -   | 0.05 | -     | 0               | 0.05 | -     | 0.05 | Vdc  |
|   |                              | 10                     | -   | 0.05 | -     | 0               | 0.05 | -     | 0.05 |      |
| 15  |                              | -                      | 0.05  | -    | 0     | 0.05            | -    | 0.05  |      |      |
| V <sub>in</sub> = 0 or V <sub>DD</sub>  | “1” Level<br>V <sub>OH</sub> | 5.0                    | 4.95  | -    | 4.95  | 5.0             | -    | 4.95  | -    | Vdc  |
|   |                              | 10                     | 9.95  | -    | 9.95  | 10              | -    | 9.95  | -    |      |
|   |                              | 15                     | 14.95   | -    | 14.95 | 15              | -    | 14.95 | -    |      |
| Input Voltage<br>(V <sub>O</sub> = 4.5 or 0.5 Vdc)<br>(V <sub>O</sub> = 9.0 or 1.0 Vdc)<br>(V <sub>O</sub> = 13.5 or 1.5 Vdc)                       | “0” Level<br>V <sub>IL</sub> | 5.0                    | -   | 1.5  | -     | 2.25            | 1.5  | -     | 1.5  | Vdc  |
|   |                              | 10                     | -   | 3.0  | -     | 4.50            | 3.0  | -     | 3.0  |      |
| 15  |                              | -                      | 4.0   | -    | 6.75  | 4.0             | -    | 4.0   |      |      |
| (V <sub>O</sub> = 0.5 or 4.5 Vdc)<br>(V <sub>O</sub> = 1.0 or 9.0 Vdc)<br>(V <sub>O</sub> = 1.5 or 13.5 Vdc)  | “1” Level<br>V <sub>IH</sub> | 5.0                    | 3.5   | -    | 3.5   | 2.75            | -    | 3.5   | -    | Vdc  |
|   |                              | 10                     | 7.0   | -    | 7.0   | 5.50            | -    | 7.0   | -    |      |
|   |                              | 15                     | 11  | -    | 11    | 8.25            | -    | 11    | -    |      |
| Output Drive Current<br>(V <sub>OH</sub> = 2.5 Vdc)<br>(V <sub>OH</sub> = 4.6 Vdc)<br>(V <sub>OH</sub> = 9.5 Vdc)<br>(V <sub>OH</sub> = 13.5 Vdc)   | Source<br>I <sub>OH</sub>    | 5.0                    | -3.0  | -    | -2.4  | -4.2            | -    | -1.7  | -    | mAdc |
|   |                              | 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 | -     |      |      |
| (V <sub>OL</sub> = 0.4 Vdc)<br>(V <sub>OL</sub> = 0.5 Vdc)<br>(V <sub>OL</sub> = 1.5 Vdc)   | Sink<br>I <sub>OL</sub>      | 5.0                    | 0.64  | -    | 0.51  | 0.88            | -    | 0.36  | -    | mAdc |
|   |                              | 10                     | 1.6   | -    | 1.3   | 2.25            | -    | 0.9   | -    |      |
|   |                              | 15                     | 4.2   | -    | 3.4   | 8.8             | -    | 2.4   | -    |      |
| Input Current   | I <sub>in</sub>              | 15                     | -   | ±0.1 | -     | ±0.00001        | ±0.1 | -     | ±1.0 | μAdc |
| Input Capacitance<br>(V <sub>in</sub> = 0)  | C <sub>in</sub>              | -                      | -   | -    | -     | 5.0             | 7.5  | -     | -    | pF   |
| Quiescent Current<br>(Per Package)  | I <sub>DD</sub>              | 5.0                    | -   | 5.0  | -     | 0.005           | 5.0  | -     | 150  | μAdc |
|   |                              | 10                     | -   | 10   | -     | 0.010           | 10   | -     | 300  |      |
|   |                              | 15                     | -   | 20   | -     | 0.015           | 20   | -     | 600  |      |
| Total Supply Current (Notes 3 & 4)<br>(Dynamic plus Quiescent,<br>Per Package)<br>(C <sub>L</sub> = 50 pF on all outputs, all<br>buffers switching) | I <sub>T</sub>               | 5.0                    | I <sub>T</sub> = (1.7 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (3.4 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (5.0 μA/kHz) f + I <sub>DD</sub> |      |       |                 |      |       |      | μAdc |
|   |                              | 10                     |   |      |       |                 |      |       |      |      |
|   |                              | 15                     |   |      |       |                 |      |       |      |      |

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:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) Vfk$$

where: I<sub>T</sub> is in μA (per package), C<sub>L</sub> in pF, V = (V<sub>DD</sub> - V<sub>SS</sub>) in volts, f in kHz is input frequency, and k = 0.005.

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## SWITCHING CHARACTERISTICS (Note 5) ( $C_L = 50 \text{ pF}$ , $T_A = 25^\circ\text{C}$ )

| Characteristic   | Symbol                   | $V_{DD}$<br>Vdc | Min         | Typ<br>(Note 6)  | Max  | Unit |
|--|--------------------------|-----------------|-------------|--|--|------|
| Output Rise and Fall Time<br>$t_{TLH}$ , $t_{THL} = (1.5 \text{ ns/pF}) C_L + 25 \text{ ns}$<br>$t_{TLH}$ , $t_{THL} = (0.75 \text{ ns/pF}) C_L + 12.5 \text{ ns}$<br>$t_{TLH}$ , $t_{THL} = (0.55 \text{ ns/pF}) C_L + 9.5 \text{ ns}$  | $t_{TLH}$ ,<br>$t_{THL}$ | 5.0<br>10<br>15 | –<br>–<br>– | 100<br>50<br>40  | 200<br>100<br>80   | ns   |
| Propagation Delay Time<br>Sum in to Sum Out<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 315 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 127 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 90 \text{ ns}$<br>Sum In to Carry Out<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 220 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 112 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 85 \text{ ns}$<br>Carry In to Sum Out<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 290 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 122 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 90 \text{ ns}$<br>Carry In to Carry Out<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 85 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 42 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 30 \text{ ns}$ | $t_{PLH}$ , $t_{PHL}$    | 5.0<br>10<br>15 | –<br>–<br>– | 400<br>160<br>115<br>305<br>145<br>110<br>375<br>155<br>115<br>170<br>75<br>55 | 800<br>320<br>230<br>610<br>290<br>220<br>750<br>310<br>230<br>340<br>150<br>110 | ns   |

5. The formulas given are for the typical characteristics only at  $25^\circ\text{C}$ .

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

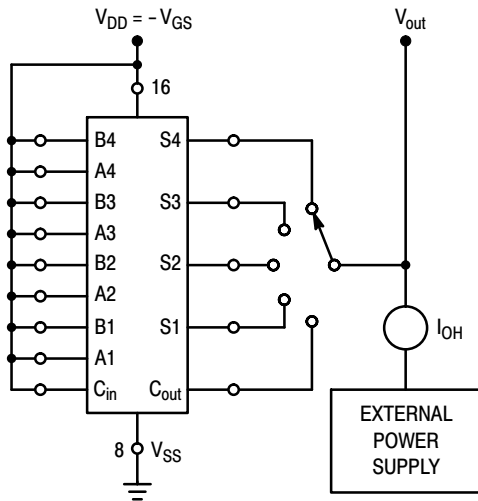


Figure 1. Typical Source Current Characteristics Test Circuit

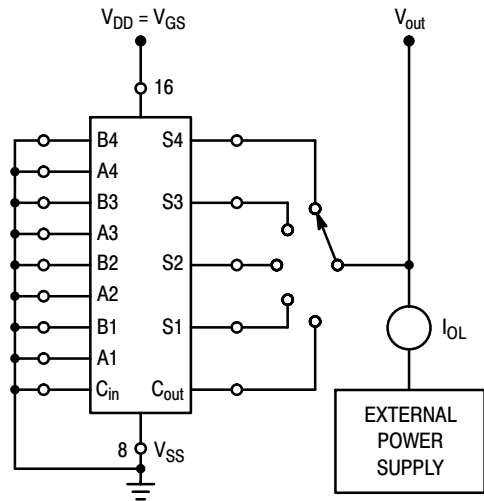


Figure 2. Typical Sink Current Characteristics Test Circuit

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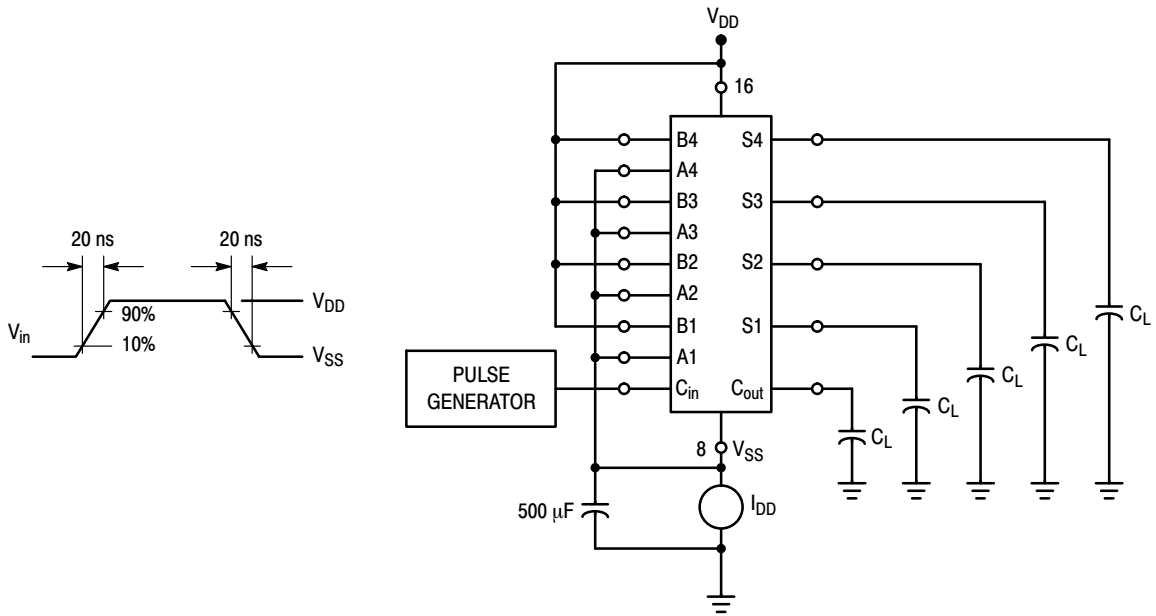


Figure 3. Dynamic Power Dissipation Test Circuit and Waveform

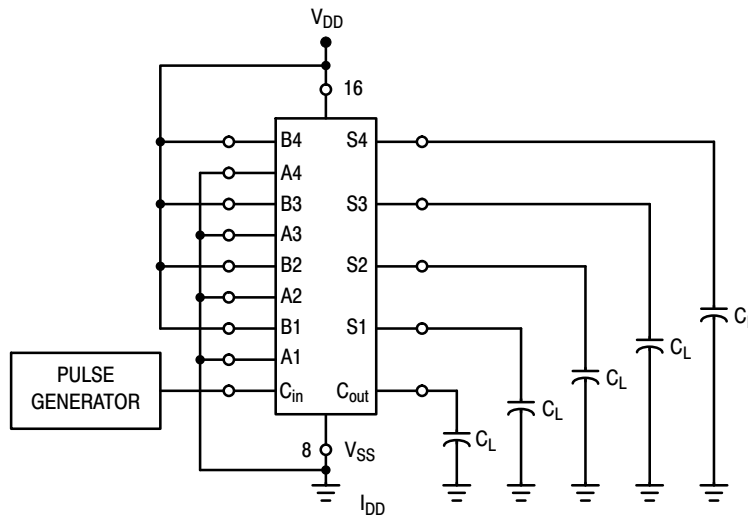


Figure 4. Switching Time Test Circuit and Waveforms

# MC14008B

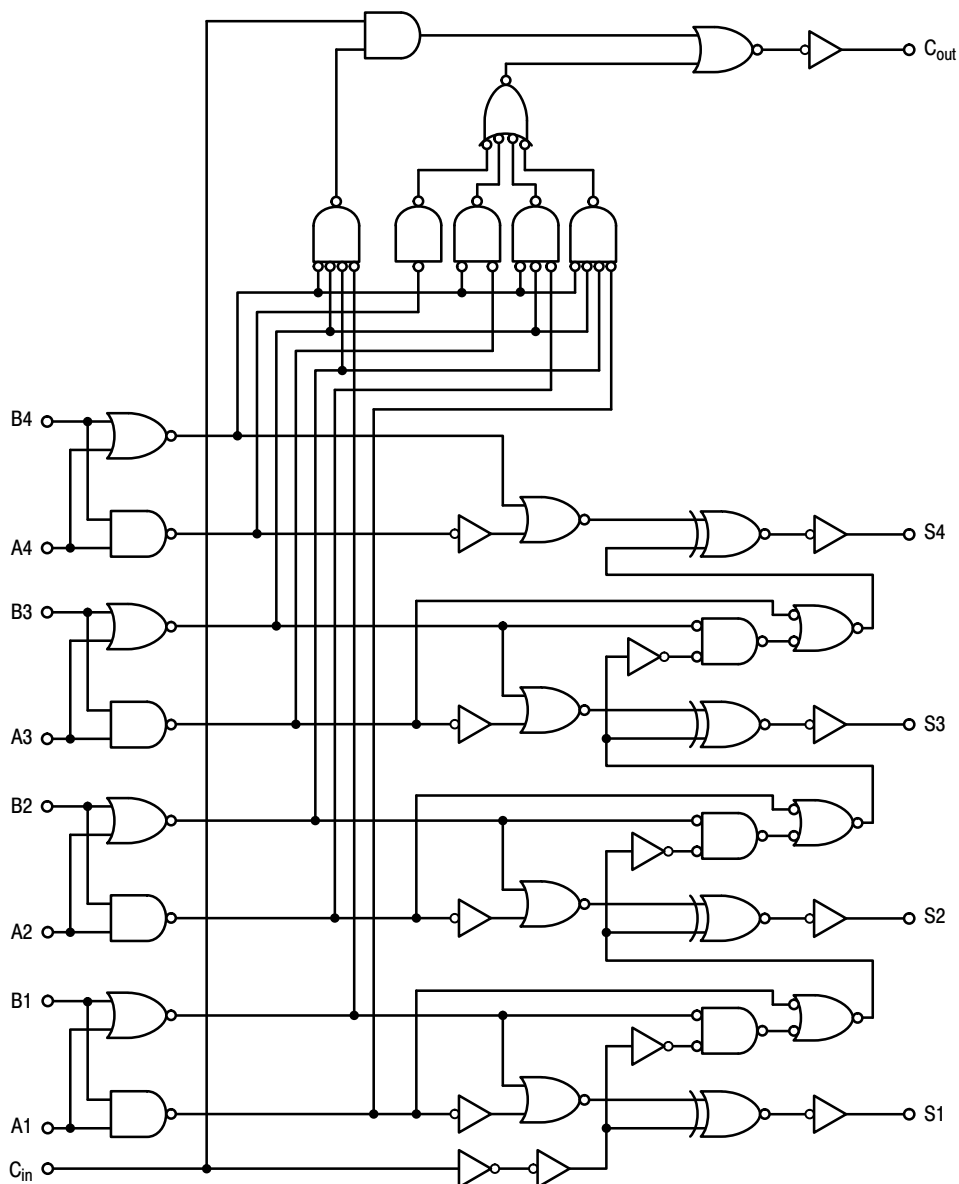
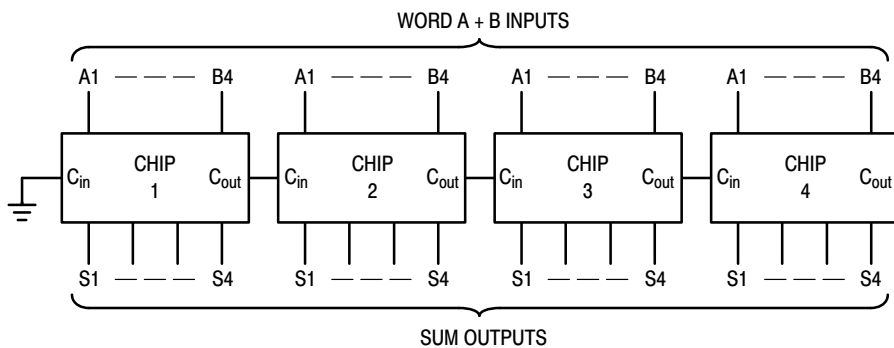


Figure 5. Logic Diagram

## TYPICAL APPLICATION



Calculation of 16-bit adder speed:

$$t_p \text{ total} = t_p (\text{Sum to Carry}) + t_p (\text{Carry to Sum}) + 2 t_p (\text{Carry to Carry})$$

The guaranteed 16-bit adder speed at 10 V, 25°C,  $C_L = 50 \text{ pF}$  is:

$$t_p \text{ total} = 290 + 310 + 300 = 900 \text{ ns}$$

Figure 6. Using the MC14008B in a 16-Bit Adder Configuration

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



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> |  |

### SOLDERING FOOTPRINT



|                  |             |  |
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