

# MC14585B

## 4-Bit Magnitude Comparator

The MC14585B 4-Bit Magnitude Comparator is constructed with complementary MOS (CMOS) enhancement mode devices. The circuit has eight comparing inputs (A3, B3, A2, B2, A1, B1, A0, B0), three cascading inputs ( $A < B$ ,  $A = B$ , and  $A > B$ ), and three outputs ( $A < B$ ,  $A = B$ , and  $A > B$ ). This device compares two 4-bit words (A and B) and determines whether they are “less than”, “equal to”, or “greater than” by a high level on the appropriate output. For words greater than 4-bits, units can be cascaded by connecting outputs ( $A > B$ ), ( $A < B$ ), and ( $A = B$ ) to the corresponding inputs of the next significant comparator. Inputs ( $A < B$ ), ( $A = B$ ), and ( $A > B$ ) on the least significant (first) comparator are connected to a low, a high, and a low, respectively.

Applications include logic in CPU's, correction and/or detection of instrumentation conditions, comparator in testers, converters, and controls.

### Features

- Diode Protection on All Inputs
- Expandable
- Applicable to Binary or 8421-BCD Code
- 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
- Can be Cascaded – See Figure 3
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable\*
- This Device is Pb-Free and is RoHS Compliant

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

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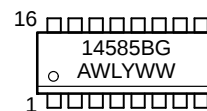


1  
SOIC-16  
D SUFFIX  
CASE 751B

### PIN ASSIGNMENT

|                            |   |    |                             |
|----------------------------|---|----|-----------------------------|
| B2                         | 1 | 16 | $V_{DD}$                    |
| A2                         | 2 | 15 | A3                          |
| (A = B) <sub>out</sub>     | 3 | 14 | B3                          |
| (A $\cup$ B) <sub>in</sub> | 4 | 13 | (A $\cup$ B) <sub>out</sub> |
| (A $\cap$ B) <sub>in</sub> | 5 | 12 | (A $\cap$ B) <sub>out</sub> |
| (A = B) <sub>in</sub>      | 6 | 11 | B0                          |
| A1                         | 7 | 10 | A0                          |
| $V_{SS}$                   | 8 | 9  | B1                          |

### MARKING DIAGRAM



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

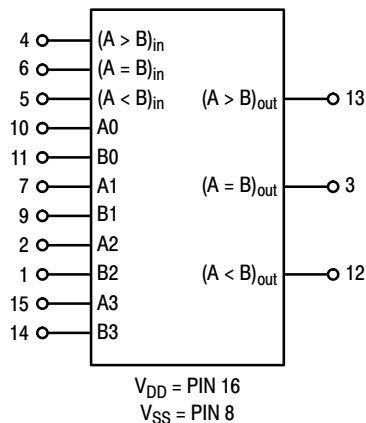
### ORDERING INFORMATION

| Device         | Package           | Shipping†        |
|----------------|-------------------|------------------|
| MC14585BDG     | SOIC-16 (Pb-Free) | 48 Units / Rail  |
| MC14585BDR2G   | SOIC-16 (Pb-Free) | 2500/Tape & Reel |
| NLV14585BDR2G* | SOIC-16 (Pb-Free) | 2500/Tape & Reel |

†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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## BLOCK DIAGRAM



**TRUTH TABLE** (x = Don't Care)

| Inputs    |         |         |         |           |       |       | Outputs |       |       |
|-----------|---------|---------|---------|-----------|-------|-------|---------|-------|-------|
| Comparing |         |         |         | Cascading |       |       |         |       |       |
| A3, B3    | A2, B2  | A1, B1  | A0, B0  | A < B     | A = B | A > B | A < B   | A = B | A > B |
| A3 > B3   | x       | x       | x       | x         | x     | x     | 0       | 0     | 1     |
| A3 = B3   | A2 > B2 | x       | x       | x         | x     | x     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 > B1 | x       | x         | x     | x     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 > B0 | x         | x     | x     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 0         | 0     | x     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 0         | 1     | x     | 0       | 1     | 0     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 1         | 0     | x     | 1       | 0     | 0     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 1         | 1     | x     | 1       | 1     | 0     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 < B0 | x         | x     | x     | 1       | 0     | 0     |
| A3 = B3   | A2 = B2 | A1 < B1 | x       | x         | x     | x     | 1       | 0     | 0     |
| A3 = B3   | A2 < B2 | x       | x       | x         | x     | x     | 1       | 0     | 0     |
| A3 < B3   | x       | x       | x       | x         | x     | x     | 1       | 0     | 0     |

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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                                                                                           | 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>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)                      | 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>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)  | 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  | –    |      |
|                                                                                                                                                    | 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 (V <sub>in</sub> = 0)                                                                                                            | C <sub>in</sub> | –                      | –                                                                                                                                                           | –    | –     | 5.0             | 7.5  | –     | –    | pF   |
| Quiescent Current (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<br>10<br>15        | I <sub>T</sub> = (0.6 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (1.2 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (1.8 μA/kHz) f + I <sub>DD</sub> |      |       |                 |      |       |      | μAdc |

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<sub>T</sub>(C<sub>L</sub>) = I<sub>T</sub>(50 pF) + (C<sub>L</sub> – 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 = 0.001.

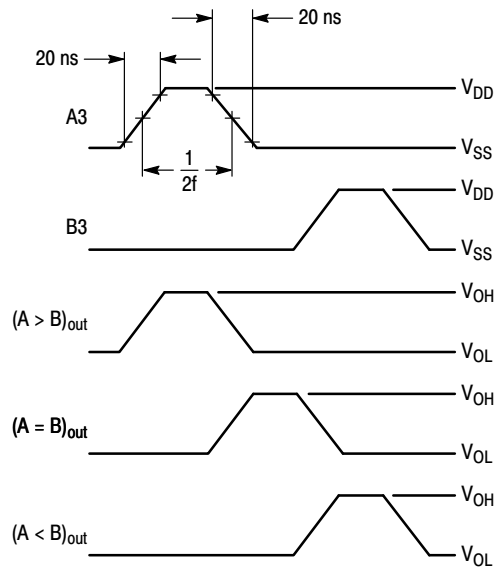
## SWITCHING CHARACTERISTICS (Note 5) (C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C)

| Characteristic                                                                                                                                                                                                                                                       | Symbol                                 | V <sub>DD</sub> | Min | Typ<br>(Note 6) | Max | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------|-----|-----------------|-----|------|
| Output Rise and Fall Time<br>t <sub>TLH</sub> , t <sub>THL</sub> = (1.5 ns/pF) C <sub>L</sub> + 25 ns<br>t <sub>TLH</sub> , t <sub>THL</sub> = (0.75 ns/pF) C <sub>L</sub> + 12.5 ns<br>t <sub>TLH</sub> , t <sub>THL</sub> = (0.55 ns/pF) C <sub>L</sub> + 9.5 ns   | t <sub>TLH</sub> ,<br>t <sub>THL</sub> | 5.0             | –   | 100             | 200 | ns   |
|                                                                                                                                                                                                                                                                      |                                        | 10              | –   | 50              | 100 |      |
|                                                                                                                                                                                                                                                                      |                                        | 15              | –   | 40              | 80  |      |
|                                                                                                                                                                                                                                                                      |                                        | 15              | –   | 40              | 80  |      |
| Turn-On, Turn-Off Delay Time<br>t <sub>PLH</sub> , t <sub>PHL</sub> = (1.7 ns/pF) C <sub>L</sub> + 345 ns<br>t <sub>PLH</sub> , t <sub>PHL</sub> = (0.66 ns/pF) C <sub>L</sub> + 147 ns<br>t <sub>PLH</sub> , t <sub>PHL</sub> = (0.5 ns/pF) C <sub>L</sub> + 105 ns | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | 5.0             | –   | 430             | 860 | ns   |
|                                                                                                                                                                                                                                                                      |                                        | 10              | –   | 180             | 360 |      |
|                                                                                                                                                                                                                                                                      |                                        | 15              | –   | 130             | 260 |      |
|                                                                                                                                                                                                                                                                      |                                        | 15              | –   | 130             | 260 |      |

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

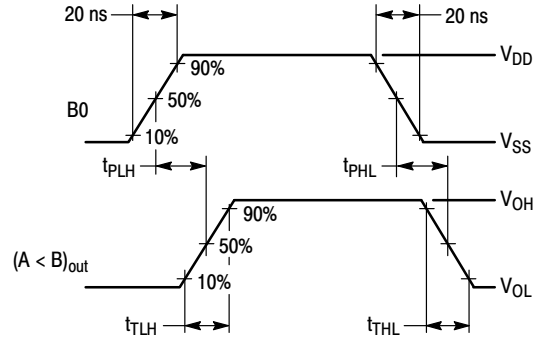
6. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

# MC14585B



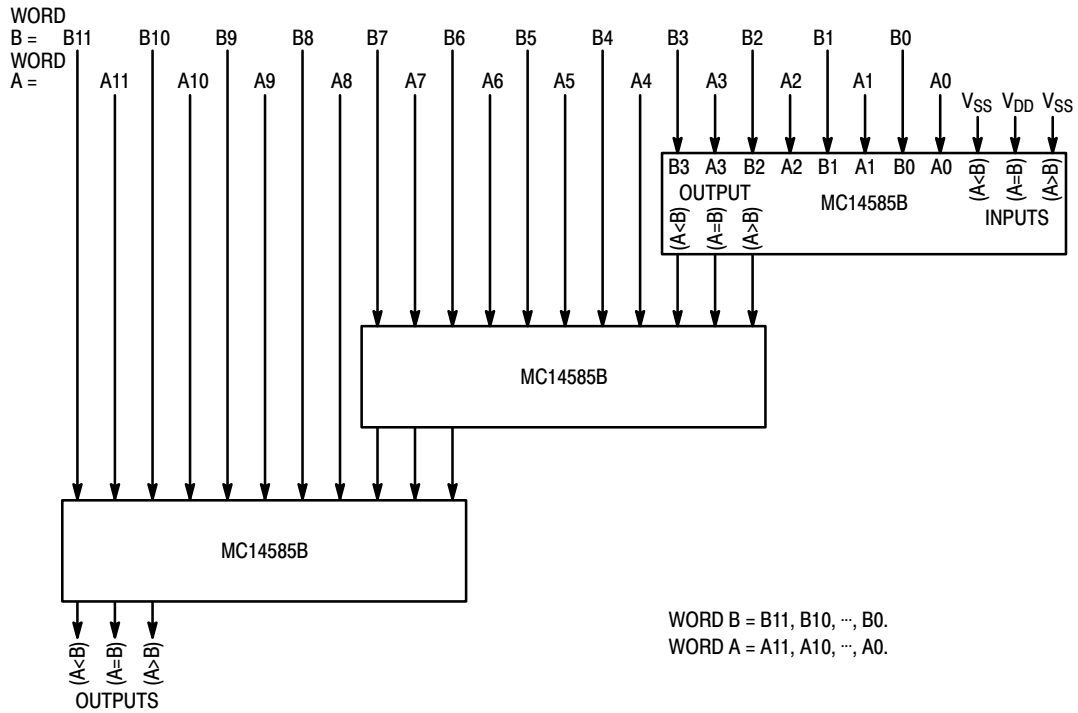
Inputs (A>B) and (A=B) high, and inputs B2, A2, B1, A1, B0, A0 and (A<B) low.  
f in respect to a system clock.

**Figure 1. Dynamic Power Dissipation Signal Waveforms**



Inputs (A>B) and (A=B) high, and inputs B3, A3, B2, A2, B1, A1, A0, and (A<B) low.

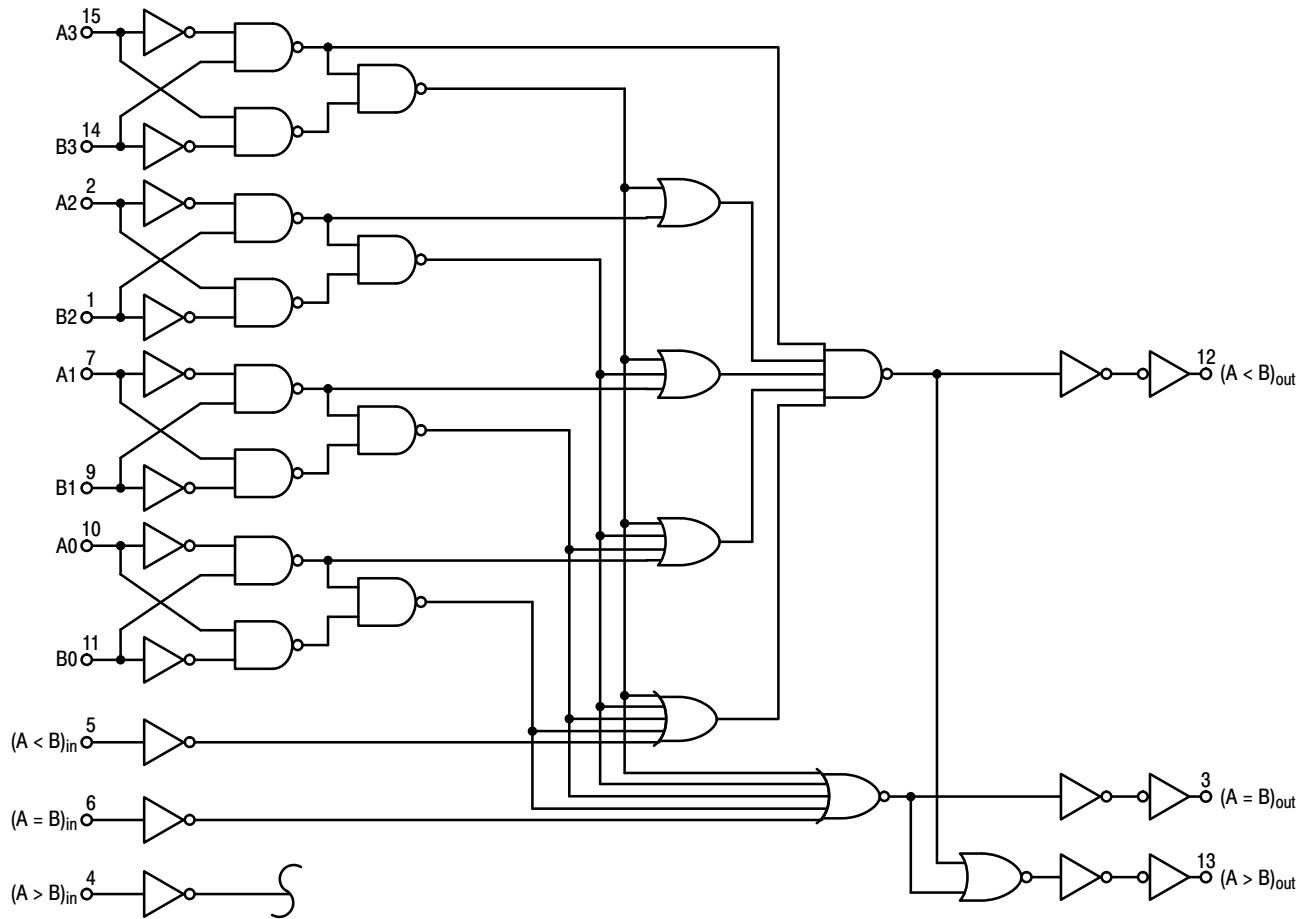
**Figure 2. Dynamic Signal Waveforms**



**Figure 3. Cascading Comparators**

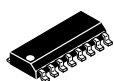
# MC14585B

## LOGIC DIAGRAM



# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



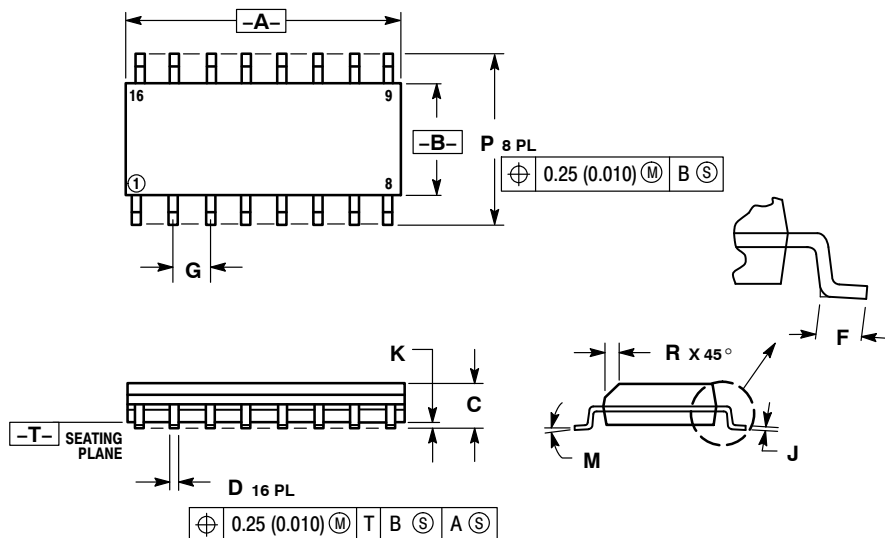
SCALE 1:1

### SOIC-16

#### CASE 751B-05

#### ISSUE K

DATE 29 DEC 2006



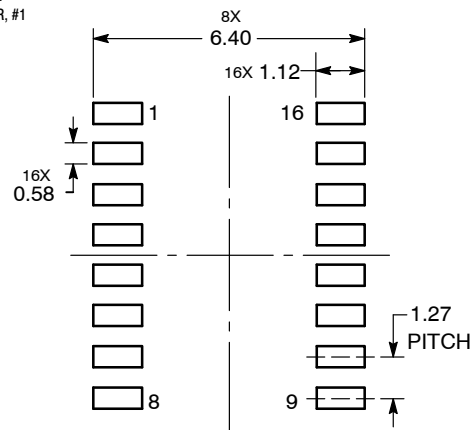
#### NOTES:

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 |

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

#### 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.

|                  |             |                                                                                                                                                                                     |
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