

# MC14015B

## Dual 4-Bit Static Shift Register

The MC14015B dual 4-bit static shift register is constructed with MOS P-Channel and N-Channel enhancement mode devices in a single monolithic structure. It consists of two identical, independent 4-state serial-input/parallel-output registers. Each register has independent Clock and Reset inputs with a single serial Data input. The register states are type D master-slave flip-flops. Data is shifted from one stage to the next during the positive-going clock transition. Each register can be cleared when a high level is applied on the Reset line. These complementary MOS shift registers find primary use in buffer storage and serial-to-parallel conversion where low power dissipation and/or noise immunity is desired.

### Features

- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Logic Edge-Clocked Flip-Flop Design
- Logic State is Retained Indefinitely with Clock Level either High or Low; Information is Transferred to the Output only on the Positive-going Edge of the Clock Pulse
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range
- 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 $V_{SS}$ )

| 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 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.



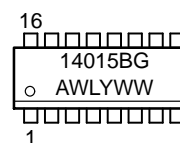
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SOIC-16  
D SUFFIX  
CASE 751B

### MARKING DIAGRAM



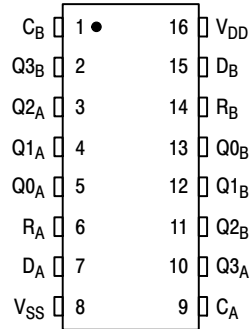
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
G = Pb-Free Indicator

### ORDERING INFORMATION

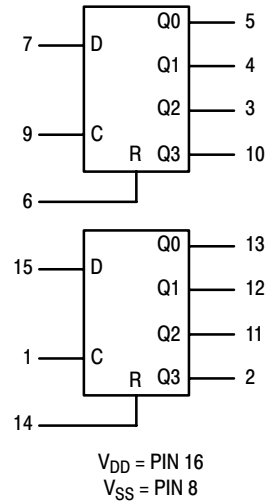
See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# MC14015B

## PIN ASSIGNMENT



## BLOCK DIAGRAM



## TRUTH TABLE

| C | D | R | Q <sub>0</sub> | Q <sub>n</sub>   |
|---|---|---|----------------|------------------|
| ↗ | 0 | 0 | 0              | Q <sub>n-1</sub> |
| ↗ | 1 | 0 | 1              | Q <sub>n-1</sub> |
| ↘ | X | 0 | No Change      | No Change        |
| X | X | 1 | 0              | 0                |

X = Don't Care

Q<sub>n</sub> = Q0, Q1, Q2, or Q3, as applicable.

Q<sub>n-1</sub> = Output of prior stage.

## ORDERING INFORMATION

| Device         | Package              | Shipping <sup>†</sup>    |
|----------------|----------------------|--------------------------|
| MC14015BDG     | SOIC-16<br>(Pb-Free) | 48 Units / Rail          |
| MC14015BDR2G   | SOIC-16<br>(Pb-Free) | 2500 Units / Tape & Reel |
| NLV14015BDR2G* | 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.

\*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

# MC14015B

## 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 .05 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> = (1.2 μA/kHz)f + I <sub>DD</sub><br>I <sub>T</sub> = (2.4 μA/kHz)f + I <sub>DD</sub><br>I <sub>T</sub> = (3.6 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 = 0.002.

# MC14015B

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

| Characteristic  | Symbol                   | $V_{DD}$                               | 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>Clock, Data to Q<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 225 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 92 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 65 \text{ ns}$<br>Reset to Q<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 375 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 147 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 95 \text{ ns}$ | $t_{PLH}$ ,<br>$t_{PHL}$ | 5.0<br>10<br>15<br><br>5.0<br>10<br>15 | –<br>–<br>–<br><br>–<br>–<br>– | 310<br>125<br>90<br><br>460<br>180<br>120 | 750<br>250<br>170<br><br>750<br>250<br>170 | ns            |
| Clock Pulse Width   | $t_{WH}$                 | 5.0<br>10<br>15                        | 400<br>175<br>135              | 185<br>85<br>55                           | –<br>–<br>–                                | ns            |
| Clock Pulse Frequency   | $f_{cl}$                 | 5.0<br>10<br>15                        | –<br>–<br>–                    | 2.0<br>6.0<br>7.5                         | 1.5<br>3.0<br>3.75                         | MHz           |
| Clock Pulse Rise and Fall Times   | $t_{TLH}$ , $t_{THL}$    | 5.0<br>10<br>15                        | –<br>–<br>–                    | –<br>–<br>–                               | 15<br>5<br>4                               | $\mu\text{s}$ |
| Reset Pulse Width   | $t_{WH}$                 | 5.0<br>10<br>15                        | 400<br>160<br>120              | 200<br>80<br>60                           | –<br>–<br>–                                | ns            |
| Setup Time  | $t_{su}$                 | 5.0<br>10<br>15                        | 350<br>100<br>75               | 100<br>50<br>40                           | –<br>–<br>–                                | ns            |

5. The formulas given are for 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.

# MC14015B

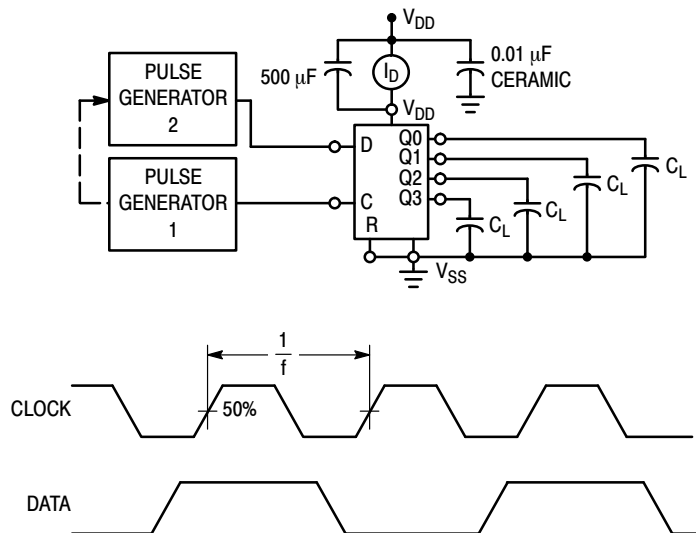


Figure 1. Power Dissipation Test Circuit and Waveform

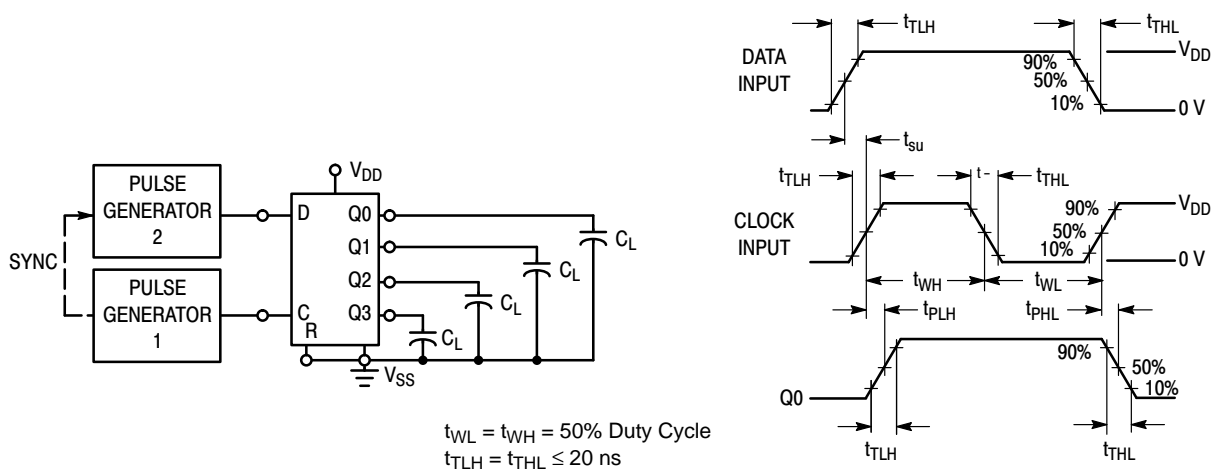


Figure 2. Switching Test Circuit and Waveforms

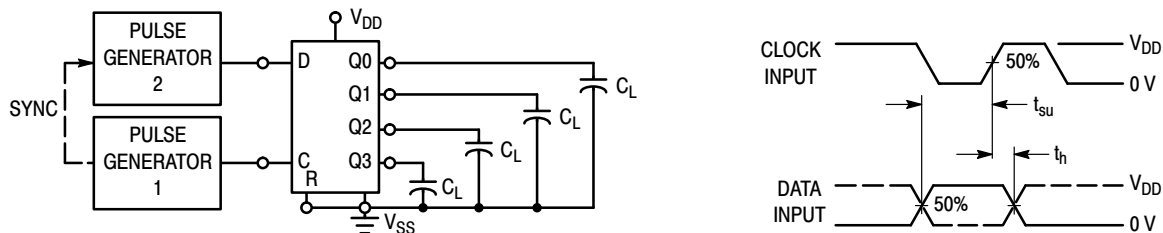
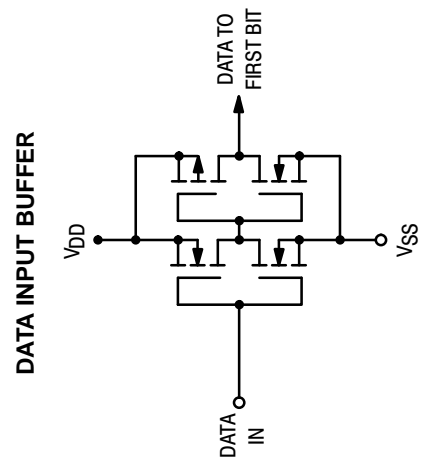
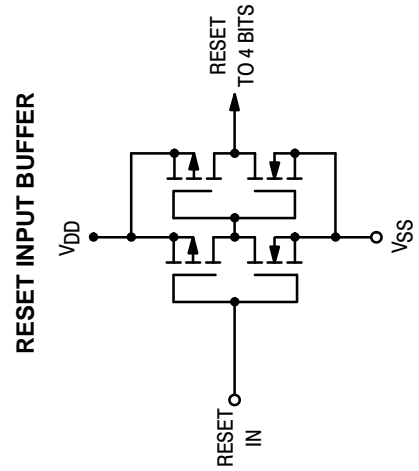
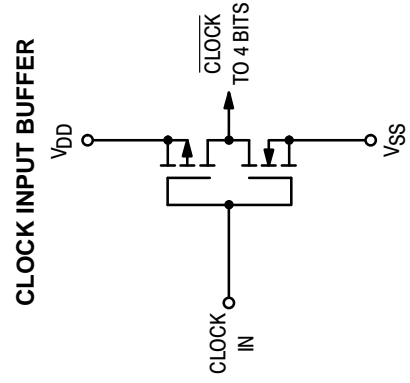
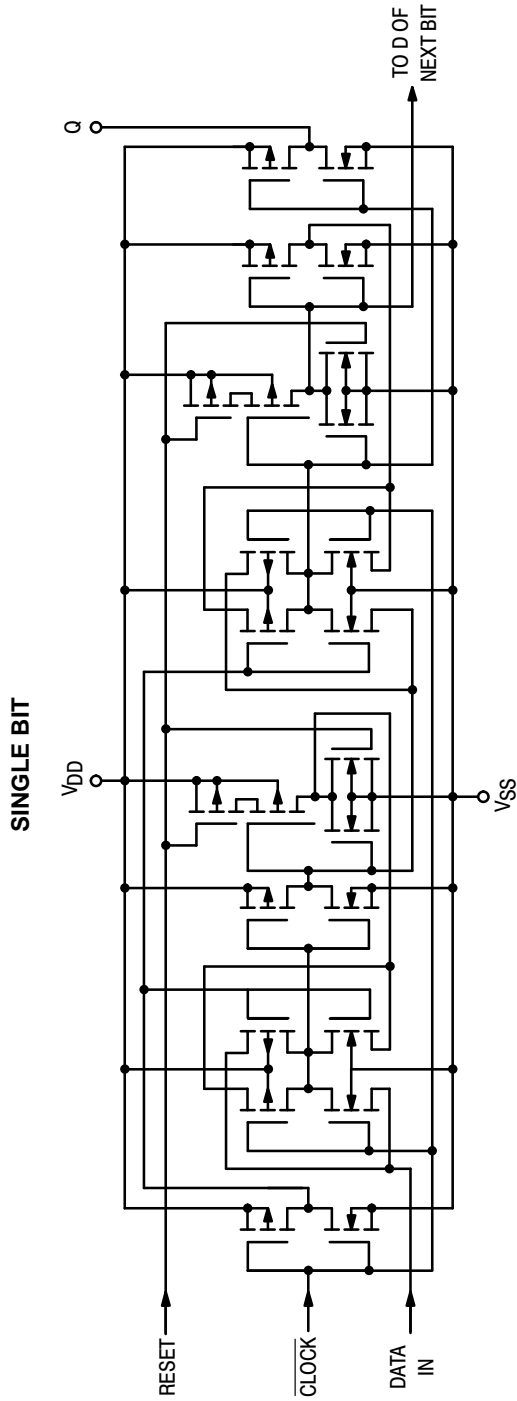


Figure 3. Setup and Hold Time Test Circuit and Waveforms

# MC14015B

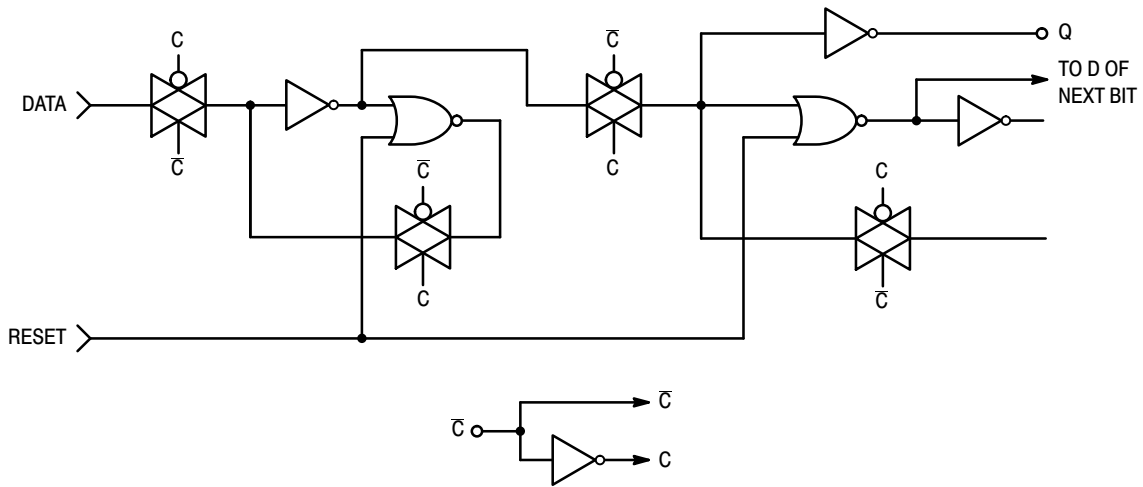
## CIRCUIT SCHEMATICS



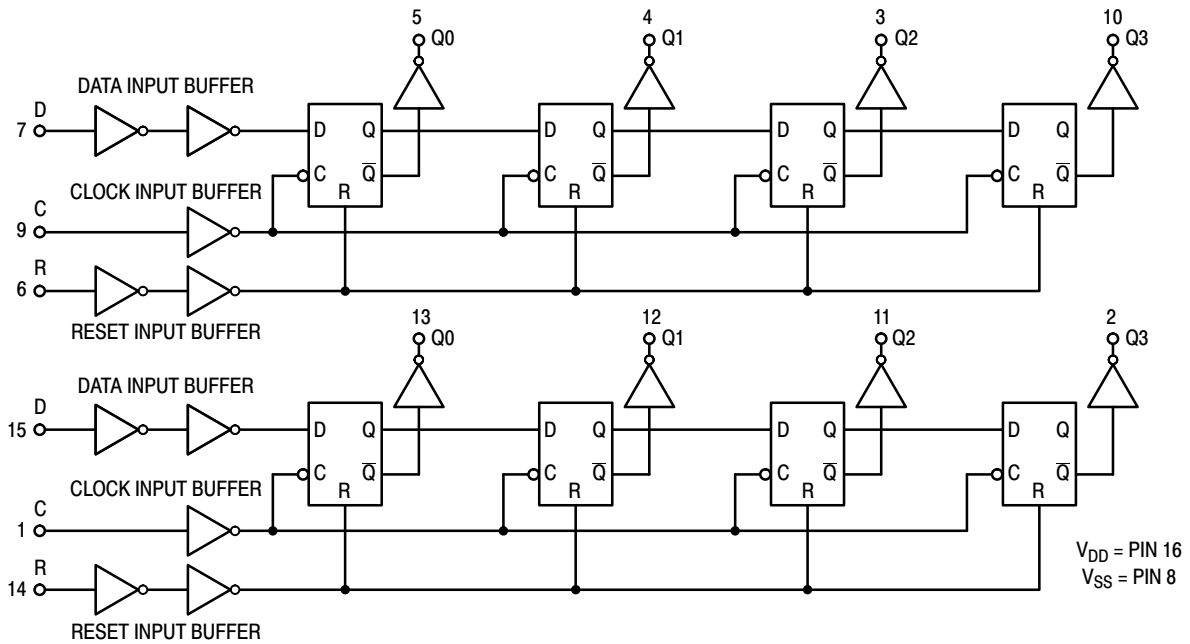
# MC14015B

## LOGIC DIAGRAMS

### SINGLE BIT

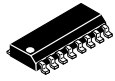


### COMPLETE DEVICE



# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

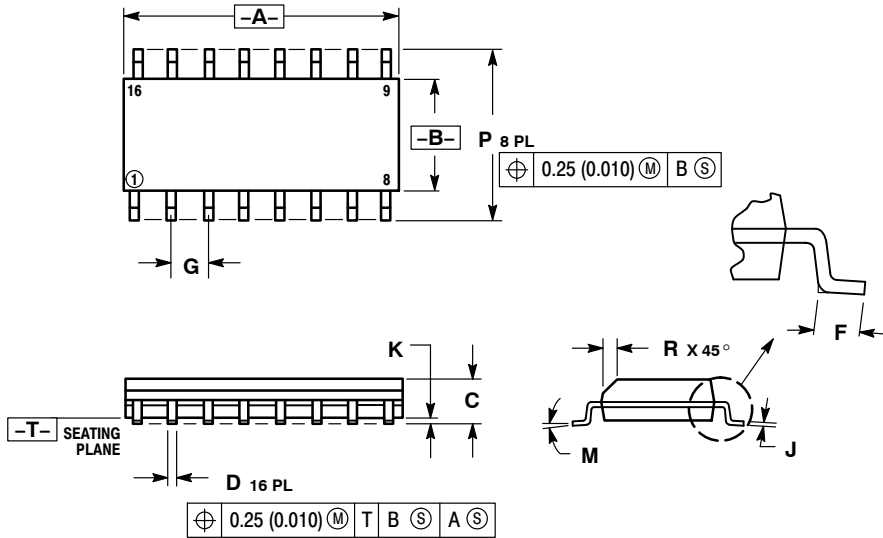
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SCALE 1:1

SOIC-16  
CASE 751B-05  
ISSUE K

DATE 29 DEC 2006

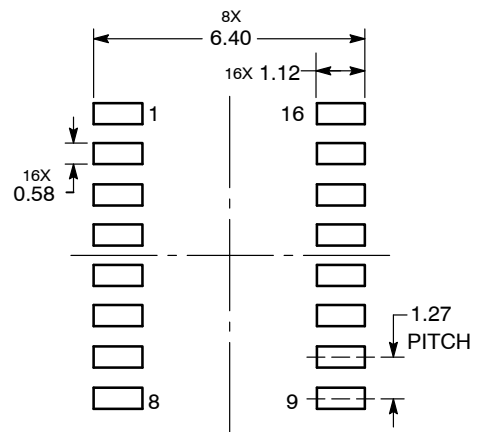


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 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



DIMENSIONS: MILLIMETERS

|                  |             |  |
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