

# 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.

- 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.

### MAXIMUM RATINGS (Voltages Referenced to $V_{SS}$ ) (Note 2.)

| 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 3.)          | 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   |

2. Maximum Ratings are those values beyond which damage to the device may occur.

3. Temperature Derating:  
Plastic "P and D/DW" Packages: - 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  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

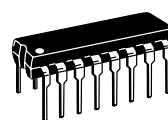
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.



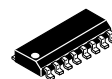
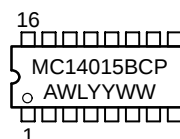
ON Semiconductor

<http://onsemi.com>

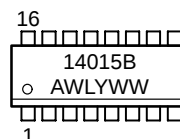
### MARKING DIAGRAMS



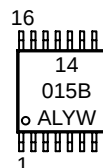
PDIP-16  
P SUFFIX  
CASE 648



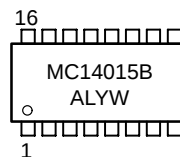
SOIC-16  
D SUFFIX  
CASE 751B



TSSOP-16  
DT SUFFIX  
CASE 948F



SOEIAJ-16  
F SUFFIX  
CASE 966



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

### ORDERING INFORMATION

| Device      | Package   | Shipping         |
|-------------|-----------|------------------|
| MC14015BCP  | PDIP-16   | 2000/Box         |
| MC14015BD   | SOIC-16   | 48/Rail          |
| MC14015BDR2 | SOIC-16   | 2500/Tape & Reel |
| MC14015BDT  | TSSOP-16  | 2000/Tape & Reel |
| MC14015BF   | SOEIAJ-16 | See Note 1.      |
| MC14015BFEL | SOEIAJ-16 | See Note 1.      |

1. For ordering information on the EIAJ version of the SOIC packages, please contact your local ON Semiconductor representative.

# MC14015B

## TRUTH TABLE

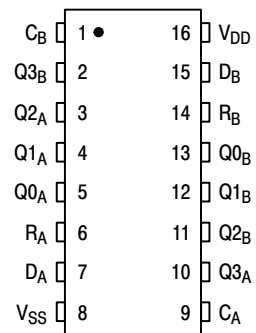
| C                                                                                 | D | R | Q0        | Q <sub>n</sub>   |
|-----------------------------------------------------------------------------------|---|---|-----------|------------------|
|  | 0 | 0 | 0         | Q <sub>n-1</sub> |
|  | 1 | 0 | 1         | Q <sub>n-1</sub> |
|  | X | 0 | No Change | No Change        |
| X                                                                                 | X | 1 | 0         | 0                |

X = Don't Care

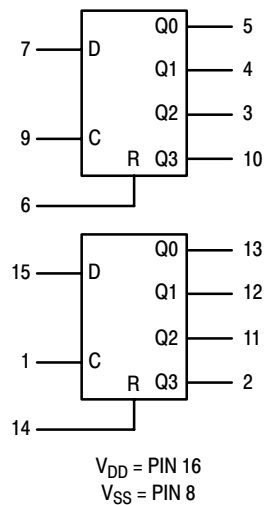
Q<sub>n</sub> = Q0, Q1, Q2, or Q3, as applicable.

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

## PIN ASSIGNMENT



## BLOCK DIAGRAM



# 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 (4.) | 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 .05 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<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 (5.) (6.)<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> = (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 |

4. Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.

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

6. 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 <sup>(7.)</sup> ( $C_L = 50 \text{ pF}$ , $T_A = 25^\circ\text{C}$ )

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                                                                                | Symbol             | $V_{DD}$                               | Min                            | Typ <sup>(8.)</sup>                       | 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>$t_{TLH}, t_{THL} = (0.55 \text{ ns/pF}) C_L + 9.5 \text{ ns}$                                                                                                                                                                                                                                | $t_{TLH}, t_{THL}$ | 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>$t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 95 \text{ ns}$ | $t_{PLH}, t_{PHL}$ | 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            |

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

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

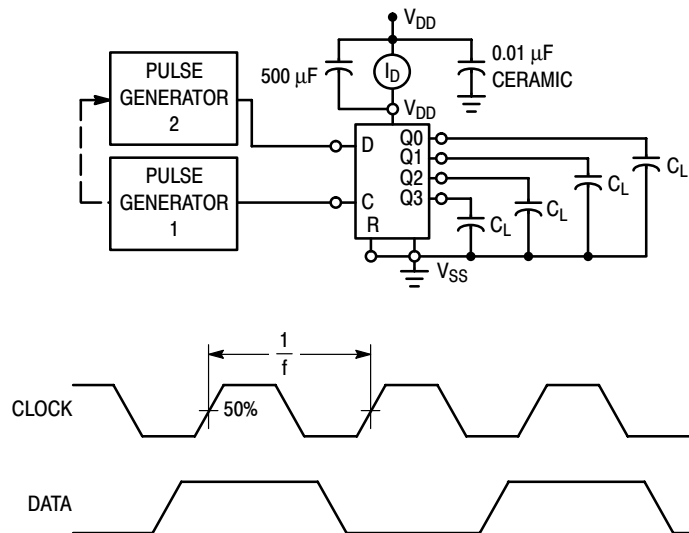


Figure 1. Power Dissipation Test Circuit and Waveform

# MC14015B

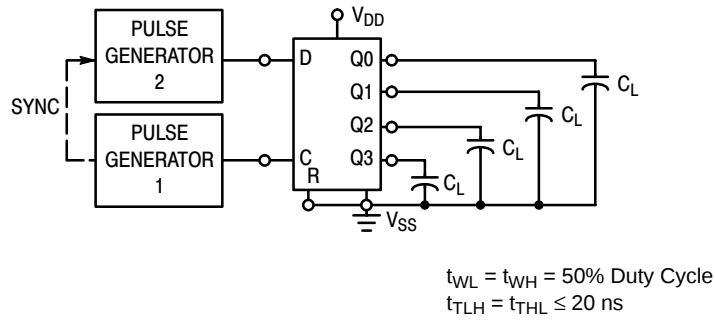


Figure 2. Switching Test Circuit and Waveforms

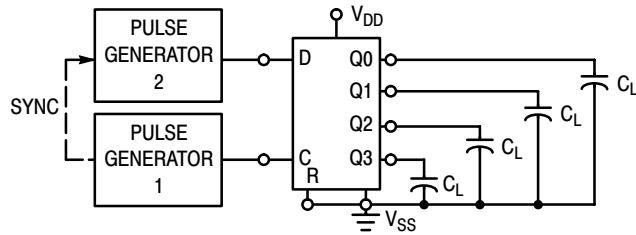
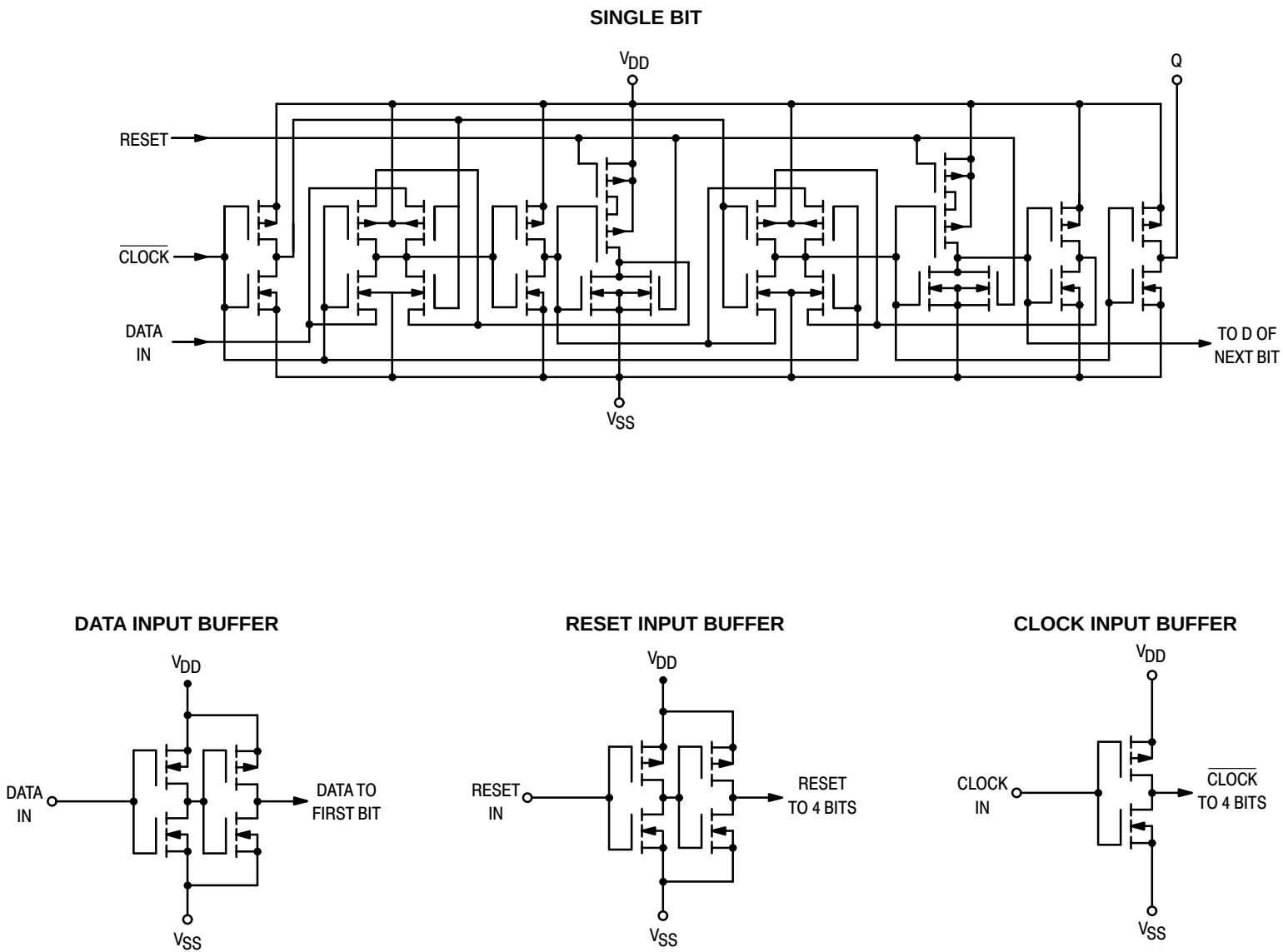


Figure 3. Setup and Hold Time Test Circuit and Waveforms

## CIRCUIT SCHEMATICS



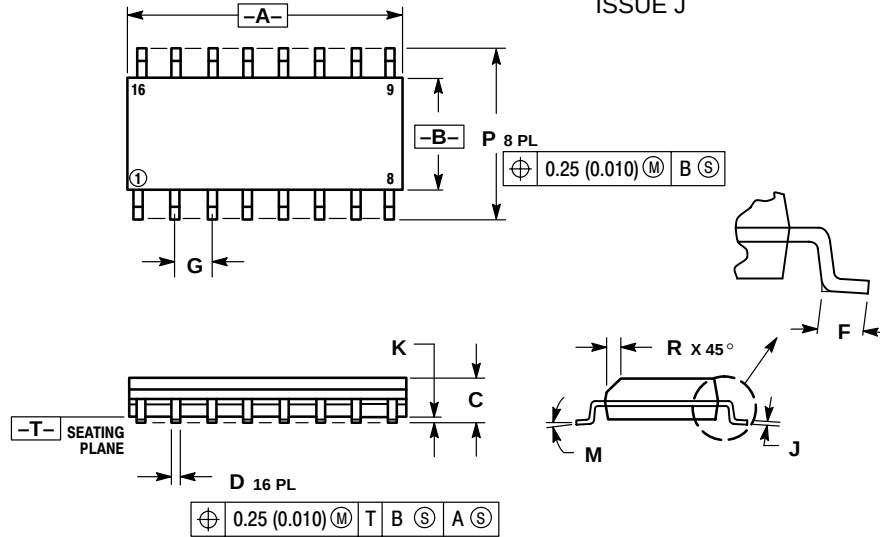




# MC14015B

## PACKAGE DIMENSIONS

SOIC-16  
D SUFFIX  
PLASTIC SOIC PACKAGE  
CASE 751B-05  
ISSUE J



### NOTES:

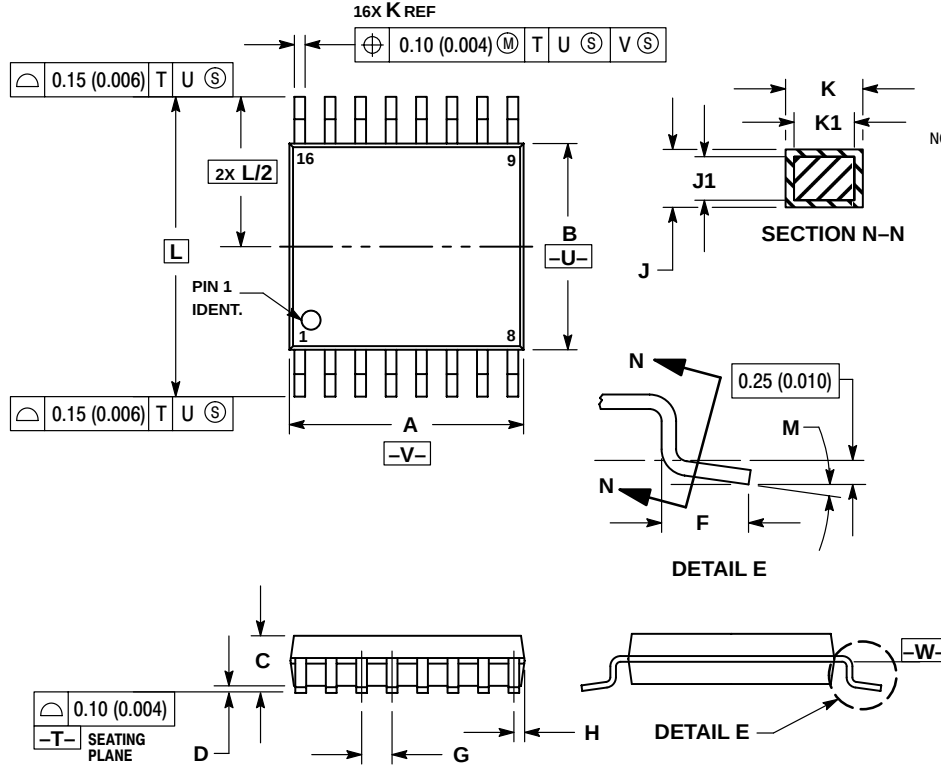
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL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

# MC14015B

## PACKAGE DIMENSIONS

TSSOP-16  
DT SUFFIX  
PLASTIC TSSOP PACKAGE  
CASE 948F-01  
ISSUE O



### NOTES:

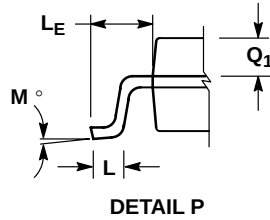
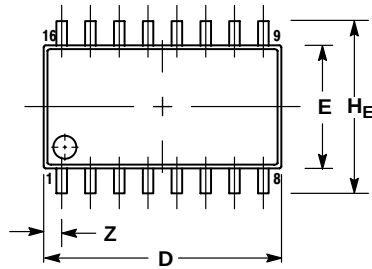
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 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.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. 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°    |

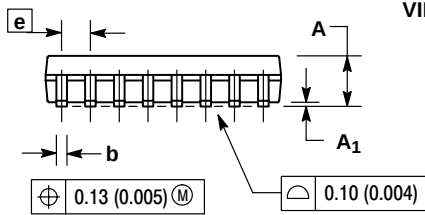
# MC14015B

## PACKAGE DIMENSIONS

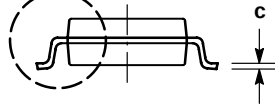
### SOEIAJ-16 F SUFFIX PLASTIC EIAJ SOIC PACKAGE CASE 966-01 ISSUE O



DETAIL P



VIEW P



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | MIN         | MAX   | MIN       | MAX   |
| A              | ---         | 2.05  | ---       | 0.081 |
| A <sub>1</sub> | 0.05        | 0.20  | 0.002     | 0.008 |
| b              | 0.35        | 0.50  | 0.014     | 0.020 |
| c              | 0.18        | 0.27  | 0.007     | 0.011 |
| D              | 9.90        | 10.50 | 0.390     | 0.413 |
| E              | 5.10        | 5.45  | 0.201     | 0.215 |
| e              | 1.27 BSC    |       | 0.050 BSC |       |
| H <sub>E</sub> | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| L <sub>E</sub> | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0 °         | 10 °  | 0 °       | 10 °  |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 0.78  | ---       | 0.031 |

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