

# MC14014B, MC14021B

## 8-Bit Static Shift Register

The MC14014B and MC14021B 8-bit static shift registers are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These shift registers find primary use in parallel-to-serial data conversion, synchronous and asynchronous parallel input, serial output data queueing; and other general purpose register applications requiring low power and/or high noise immunity.

### Features

- Synchronous Parallel Input/Serial Output (MC14014B)
- Asynchronous Parallel Input/Serial Output (MC14021B)
- Synchronous Serial Input/Serial Output
- Full Static Operation
- “Q” Outputs from Sixth, Seventh, and Eighth Stages
- Double Diode Input Protection
- 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
- MC14014B Pin-for-Pin Replacement for CD4014B
- MC14021B Pin-for-Pin Replacement for CD4021B
- These Devices are Pb-Free and are RoHS Compliant

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

| Symbol            | Parameter                                         | Value                  | Unit |
|-------------------|---------------------------------------------------|------------------------|------|
| $V_{DD}$          | DC Supply Voltage Range                           | -0.5 to +18.0          | V    |
| $V_{in}, V_{out}$ | 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   |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

#### 1. 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  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

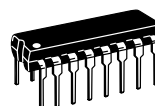
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.



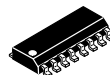
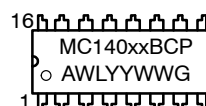
ON Semiconductor®

<http://onsemi.com>

### MARKING DIAGRAMS



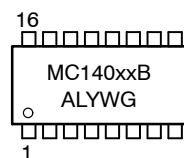
PDIP-16  
P SUFFIX  
CASE 648



SOIC-16  
D SUFFIX  
CASE 751B



SOEIAJ-16  
F SUFFIX  
CASE 966



xx = Specific Device Code  
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 6 of this data sheet.

# MC14014B, MC14021B

## TRUTH TABLE

### SERIAL OPERATION:

| t   | Clock | D <sub>S</sub> | P/S | Q6<br>t=n+6 | Q7<br>t=n+7 | Q8<br>t=n+8 |
|-----|-------|----------------|-----|-------------|-------------|-------------|
| n   |       | 0              | 0   | 0           | ?           | ?           |
| n+1 |       | 1              | 0   | 1           | 0           | ?           |
| n+2 |       | 0              | 0   | 0           | 1           | 0           |
| n+3 |       | 1              | 0   | 1           | 0           | 1           |
|     |       | X              | 0   | Q6          | Q7          | Q8          |

### PARALLEL OPERATION:

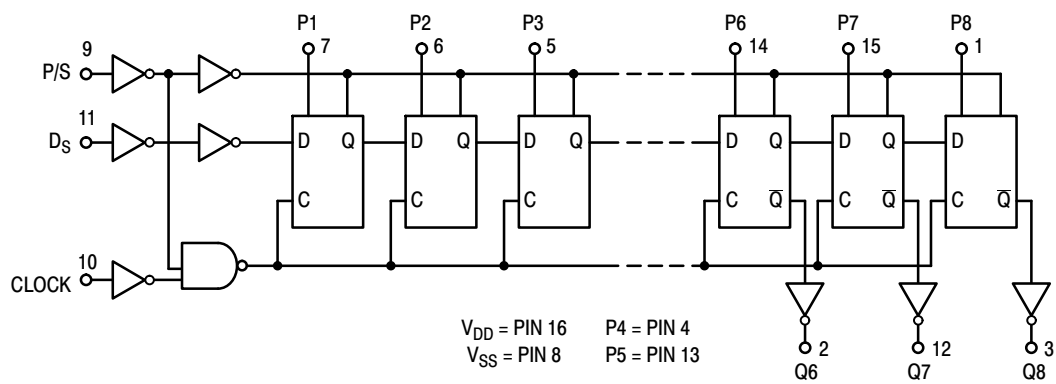
| Clock    |          | D <sub>S</sub> | P/S | P <sub>n</sub> | *Q <sub>n</sub> |
|----------|----------|----------------|-----|----------------|-----------------|
| MC14014B | MC14021B |                |     |                |                 |
|          | X        | X              | 1   | 0              | 0               |
|          | X        | X              | 1   | 1              | 1               |

\*Q6, Q7, & Q8 are available externally  
X = Don't Care

## PIN ASSIGNMENT

|                 |   |    |                 |
|-----------------|---|----|-----------------|
| P8              | 1 | 16 | V <sub>DD</sub> |
| Q6              | 2 | 15 | P7              |
| Q8              | 3 | 14 | P6              |
| P4              | 4 | 13 | P5              |
| P3              | 5 | 12 | Q7              |
| P2              | 6 | 11 | D <sub>S</sub>  |
| P1              | 7 | 10 | C               |
| V <sub>SS</sub> | 8 | 9  | P/S             |

## LOGIC DIAGRAM



# MC14014B, MC14021B

## 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<br><br>V <sub>in</sub> = 0 or V <sub>DD</sub>                                                                                                                                             | “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  |      |
|                                                                                                                                                                                                                                                    | “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)<br><br>(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)  | “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   |      |
|                                                                                                                                                                                                                                                    | “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)<br><br>(V <sub>OL</sub> = 0.4 Vdc)<br>(V <sub>OL</sub> = 0.5 Vdc)<br>(V <sub>OL</sub> = 1.5 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  | –     |      |
|                                                                                                                                                                                                                                                    | 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                     | –                                                                                                                                                              | 15    | –      | 0.015           | 15    | –      | 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> = (0.75 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (1.50 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (2.25 μA/kHz) f + I <sub>DD</sub> |       |        |                 |       |        |       | μAdc |

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 = 0.0015.

# MC14014B, MC14021B

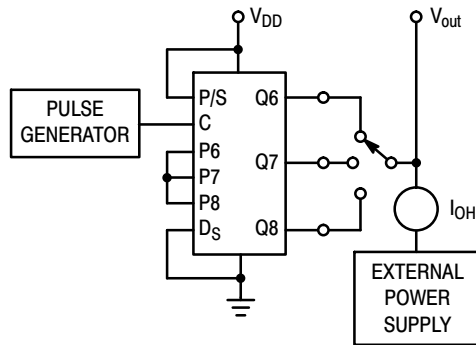
## SWITCHING CHARACTERISTICS (Note 5) ( $C_L = 50 \text{ pF}$ , $T_A = 25^\circ\text{C}$ )

| 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 (Clock to Q, P/S to Q)<br>$t_{PHL}, t_{PLH} = (1.7 \text{ ns/pF}) C_L + 315 \text{ ns}$<br>$t_{PHL}, t_{PLH} = (0.66 \text{ ns/pF}) C_L + 137 \text{ ns}$<br>$t_{PHL}, t_{PLH} = (0.5 \text{ ns/pF}) C_L + 90 \text{ ns}$ | $t_{PLH},$<br>$t_{PHL}$ | 5.0<br>10<br>15 | –<br>–<br>–       | 400<br>170<br>115 | 800<br>340<br>230 | ns            |
| Clock Pulse Width                                                                                                                                                                                                                                | $t_{WH}$                | 5.0<br>10<br>15 | 400<br>175<br>135 | 150<br>75<br>40   | –<br>–<br>–       | ns            |
| Clock Frequency                                                                                                                                                                                                                                  | $f_{cl}$                | 5.0<br>10<br>15 | –<br>–<br>–       | 3.0<br>6.0<br>8.0 | 1.5<br>3.0<br>4.0 | MHz           |
| Parallel/Serial Control Pulse Width                                                                                                                                                                                                              | $t_{WH}$                | 5.0<br>10<br>15 | 400<br>175<br>135 | 150<br>75<br>40   | –<br>–<br>–       | ns            |
| Setup Time<br>P/S to Clock                                                                                                                                                                                                                       | $t_{su}$                | 5.0<br>10<br>15 | 200<br>100<br>80  | 100<br>50<br>40   | –<br>–<br>–       | ns            |
| Hold Time<br>Clock to P/S                                                                                                                                                                                                                        | $t_h$                   | 5.0<br>10<br>15 | 20<br>20<br>25    | –2.5<br>–10<br>0  | –<br>–<br>–       | ns            |
| Setup Time<br>Data (Parallel or Serial) to<br>Clock or P/S                                                                                                                                                                                       | $t_{su}$                | 5.0<br>10<br>15 | 350<br>80<br>60   | 150<br>50<br>30   | –<br>–<br>–       | ns            |
| Hold Time<br>Clock to $D_s$                                                                                                                                                                                                                      | $t_h$                   | 5.0<br>10<br>15 | 45<br>35<br>35    | 0<br>0<br>5       | –<br>–<br>–       | ns            |
| Hold Time<br>Clock to $P_n$                                                                                                                                                                                                                      | $t_h$                   | 5.0<br>10<br>15 | 50<br>45<br>45    | 25<br>20<br>20    | –<br>–<br>–       | ns            |
| Input Clock Rise Time                                                                                                                                                                                                                            | $t_{r(cl)}$             | 5.0<br>10<br>15 | –<br>–<br>–       | –<br>–<br>–       | 15<br>5<br>4      | $\mu\text{s}$ |

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

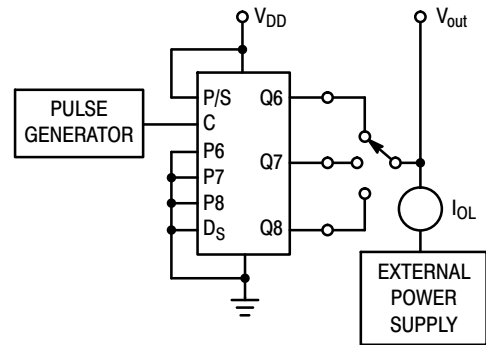
6. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

## MC14014B, MC14021B

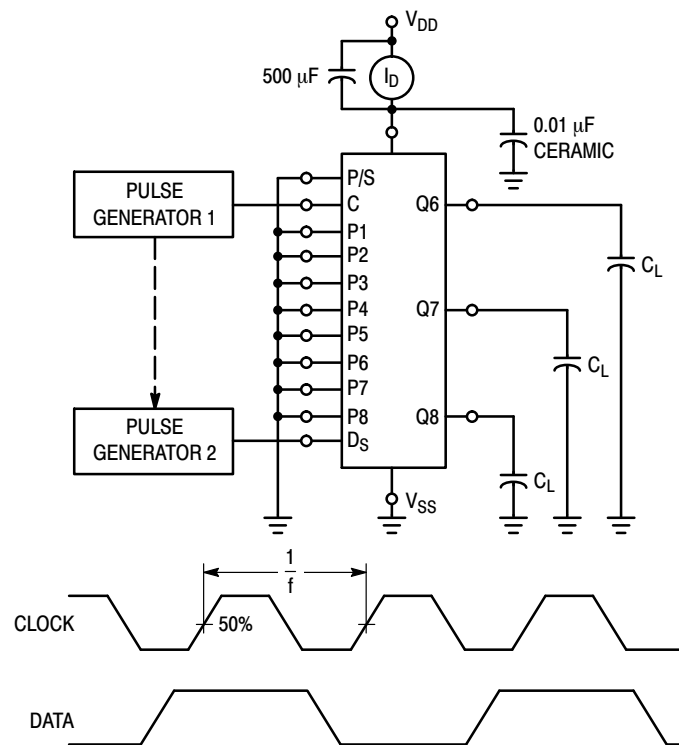


Preset output under test to a logic "1" level.

**Figure 1. Output Source Current Test Circuit**



**Figure 2. Output Sink Current Test Circuit**



**Figure 3. Power Dissipation Test Circuit and Waveform**

## MC14014B, MC14021B

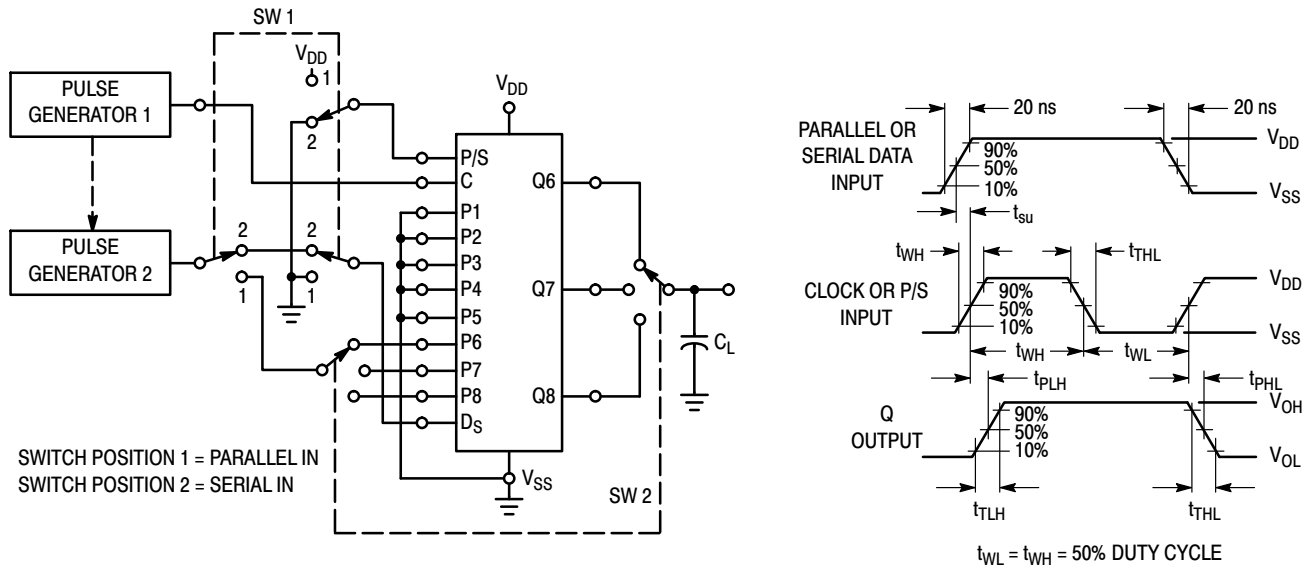


Figure 4. Switching Time Test Circuit and Waveforms

### ORDERING INFORMATION

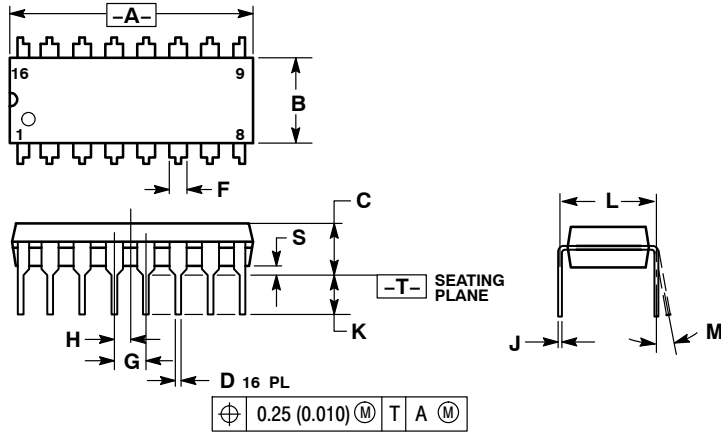
| Device       | Package              | Shipping†                |
|--------------|----------------------|--------------------------|
| MC14014BCPG  | PDIP-16<br>(Pb-Free) | 500 Units / Rail         |
| MC14014BDG   | SOIC-16<br>(Pb-Free) | 48 Units / Rail          |
| MC14014BDR2G | SOIC-16<br>(Pb-Free) | 2500 Units / Tape & Reel |
| MC14014BFELG | SOEIAJ-16            | 2000 Units / Tape & Reel |
| MC14021BCPG  | PDIP-16<br>(Pb-Free) | 500 Units / Rail         |
| MC14021BDG   | SOIC-16<br>(Pb-Free) | 48 Units / Rail          |
| MC14021BDR2G | SOIC-16<br>(Pb-Free) | 2500 Units / Tape & Reel |
| MC14021BFELG | SOEIAJ-16            | 2000 Units / 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.

# MC14014B, MC14021B

## PACKAGE DIMENSIONS

**PDIP-16**  
**P SUFFIX**  
 PLASTIC DIP PACKAGE  
 CASE 648-08  
 ISSUE T

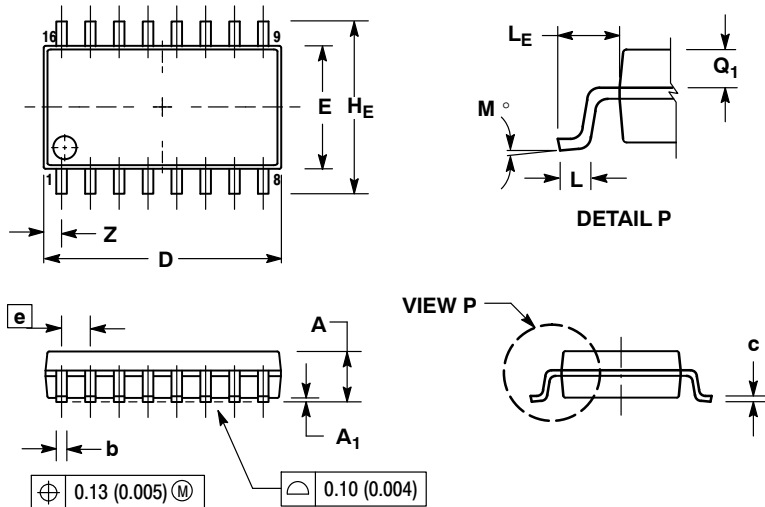


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.70  | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        | 10°   | 0°          | 10°   |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |

**SOEIAJ-16**  
**F SUFFIX**  
 PLASTIC EIAJ SOIC PACKAGE  
 CASE 966-01  
 ISSUE A



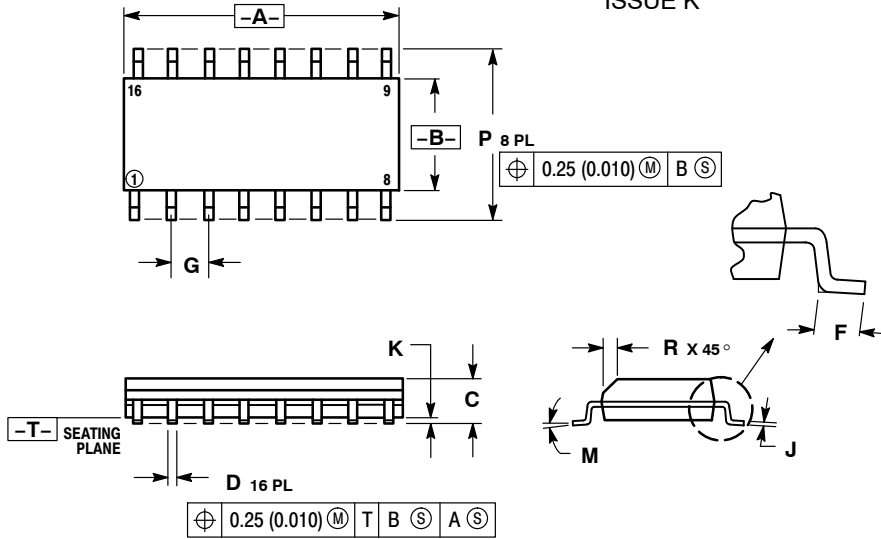
### NOTES:

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 |
| A1  | 0.05        | 0.20  | 0.002     | 0.008 |
| b   | 0.35        | 0.50  | 0.014     | 0.020 |
| c   | 0.10        | 0.20  | 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   | 7.40        | 8.20  | 0.291     | 0.323 |
| L   | 0.50        | 0.85  | 0.020     | 0.033 |
| L1  | 1.10        | 1.50  | 0.043     | 0.059 |
| M   | 0°          | 10°   | 0°        | 10°   |
| Q1  | 0.70        | 0.90  | 0.028     | 0.035 |
| Z   | ---         | 0.78  | ---       | 0.031 |

# MC14014B, MC14021B

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

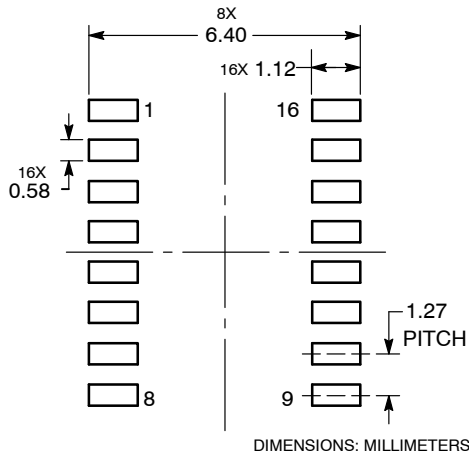


### NOTES:

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 |

### SOLDERING FOOTPRINT



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