

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

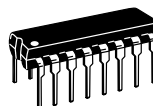
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.



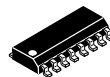
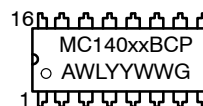
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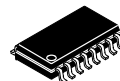
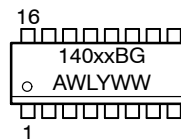
### MARKING DIAGRAMS



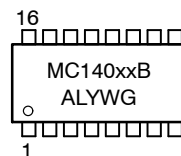
PDIP-16  
P SUFFIX  
CASE 648



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.

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## TRUTH TABLE

### SERIAL OPERATION:

t	Clock	D <sub>S</sub>	P/S	Q6 t=n+6	Q7 t=n+7	Q8 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:

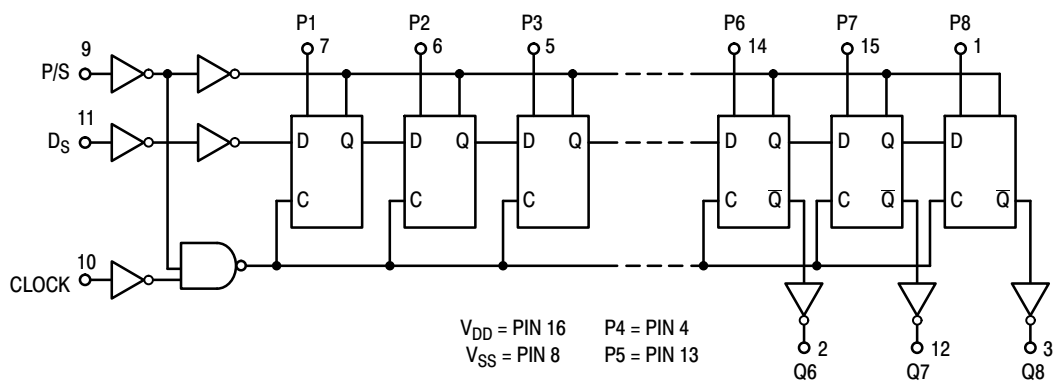
Clock		D <sub>S</sub>	P/S	P <sub>n</sub>	*Q <sub>n</sub>
MC14014B	MC14021B				
↗	X	X	1	0	0
↗	X	X	1	1	1

\*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> Vdc	- 55°C		25°C			125°C		Unit	
			Min	Max	Min	Typ (Note 2)	Max	Min	Max		
Output Voltage V <sub>in</sub> = V <sub>DD</sub> or 0  V <sub>in</sub> = 0 or V <sub>DD</sub>	"0" Level   "1" Level	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	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 (V <sub>O</sub> = 4.5 or 0.5 Vdc) (V <sub>O</sub> = 9.0 or 1.0 Vdc) (V <sub>O</sub> = 13.5 or 1.5 Vdc)  (V <sub>O</sub> = 0.5 or 4.5 Vdc) (V <sub>O</sub> = 1.0 or 9.0 Vdc) (V <sub>O</sub> = 1.5 or 13.5 Vdc)	"0" Level	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	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 (V <sub>OH</sub> = 2.5 Vdc) (V <sub>OH</sub> = 4.6 Vdc) (V <sub>OH</sub> = 9.5 Vdc) (V <sub>OH</sub> = 13.5 Vdc)  (V <sub>OL</sub> = 0.4 Vdc) (V <sub>OL</sub> = 0.5 Vdc) (V <sub>OL</sub> = 1.5 Vdc)	Source	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	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	-	15	-	0.015	15	-	600		
Total Supply Current (Notes 3 & 4) (Dynamic plus Quiescent, Per Package) (C <sub>L</sub> = 50 pF on all outputs, all buffers switching)	I <sub>T</sub>	5.0 10 15	I <sub>T</sub> = (0.75 μA/kHz) f + I <sub>DD</sub> I <sub>T</sub> = (1.50 μA/kHz) f + I <sub>DD</sub> 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

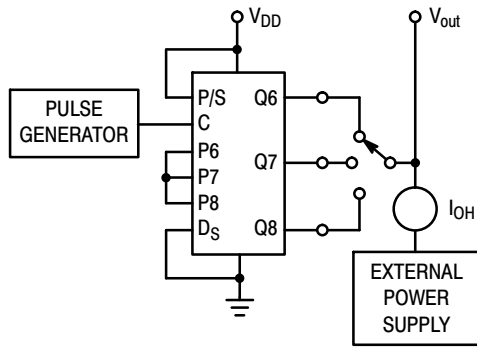
## SWITCHING CHARACTERISTICS (Note 5) ( $C_L = 50 \text{ pF}$ , $T_A = 25^\circ\text{C}$ )

Characteristic	Symbol	$V_{DD}$ Vdc	Min	Typ (Note 6)	Max	Unit
Output Rise and Fall Time $t_{TLH}$ , $t_{THL} = (1.5 \text{ ns/pF}) C_L + 25 \text{ ns}$ $t_{TLH}$ , $t_{THL} = (0.75 \text{ ns/pF}) C_L + 12.5 \text{ ns}$ $t_{TLH}$ , $t_{THL} = (0.55 \text{ ns/pF}) C_L + 9.5 \text{ ns}$	$t_{TLH}$ , $t_{THL}$	5.0 10 15	– – –	100 50 40	200 100 80	ns
Propagation Delay Time (Clock to Q, P/S to Q) $t_{PHL}$ , $t_{PLH} = (1.7 \text{ ns/pF}) C_L + 315 \text{ ns}$ $t_{PHL}$ , $t_{PLH} = (0.66 \text{ ns/pF}) C_L + 137 \text{ ns}$ $t_{PHL}$ , $t_{PLH} = (0.5 \text{ ns/pF}) C_L + 90 \text{ ns}$	$t_{PLH}$ , $t_{PHL}$	5.0 10 15	– – –	400 170 115	800 340 230	ns
Clock Pulse Width	$t_{WH}$	5.0 10 15	400 175 135	150 75 40	– – –	ns
Clock Frequency	$f_{cl}$	5.0 10 15	– – –	3.0 6.0 8.0	1.5 3.0 4.0	MHz
Parallel/Serial Control Pulse Width	$t_{WH}$	5.0 10 15	400 175 135	150 75 40	– – –	ns
Setup Time P/S to Clock	$t_{su}$	5.0 10 15	200 100 80	100 50 40	– – –	ns
Hold Time Clock to P/S	$t_h$	5.0 10 15	20 20 25	–2.5 –10 0	– – –	ns
Setup Time Data (Parallel or Serial) to Clock or P/S	$t_{su}$	5.0 10 15	350 80 60	150 50 30	– – –	ns
Hold Time Clock to $D_s$	$t_h$	5.0 10 15	45 35 35	0 0 5	– – –	ns
Hold Time Clock to $P_n$	$t_h$	5.0 10 15	50 45 45	25 20 20	– – –	ns
Input Clock Rise Time	$t_{r(cl)}$	5.0 10 15	– – –	– – –	15 5 4	$\mu\text{s}$

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

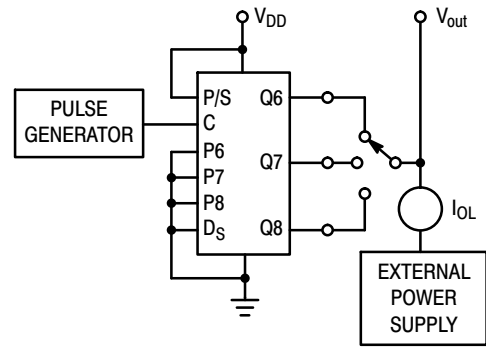
6. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

# MC14014B, MC14021B

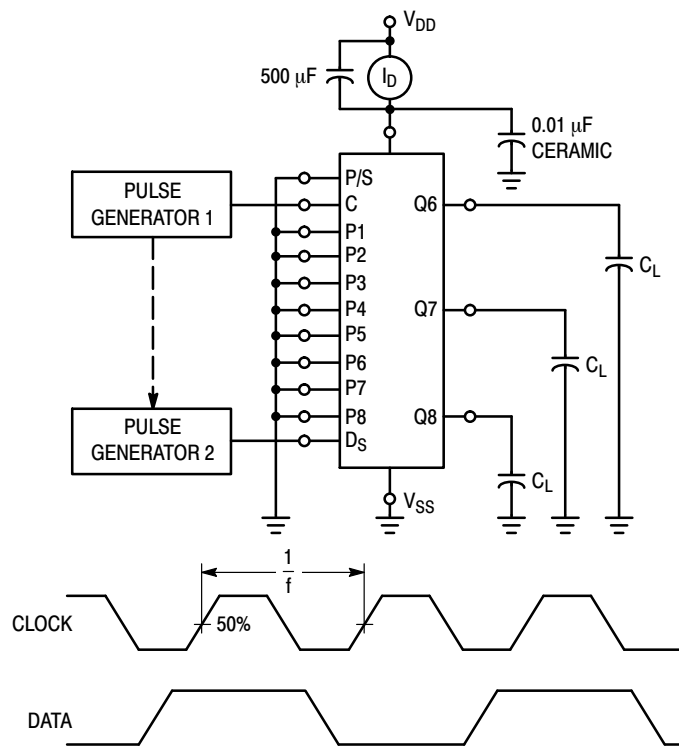


Preset output under test to a logic "1" level.

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



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



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

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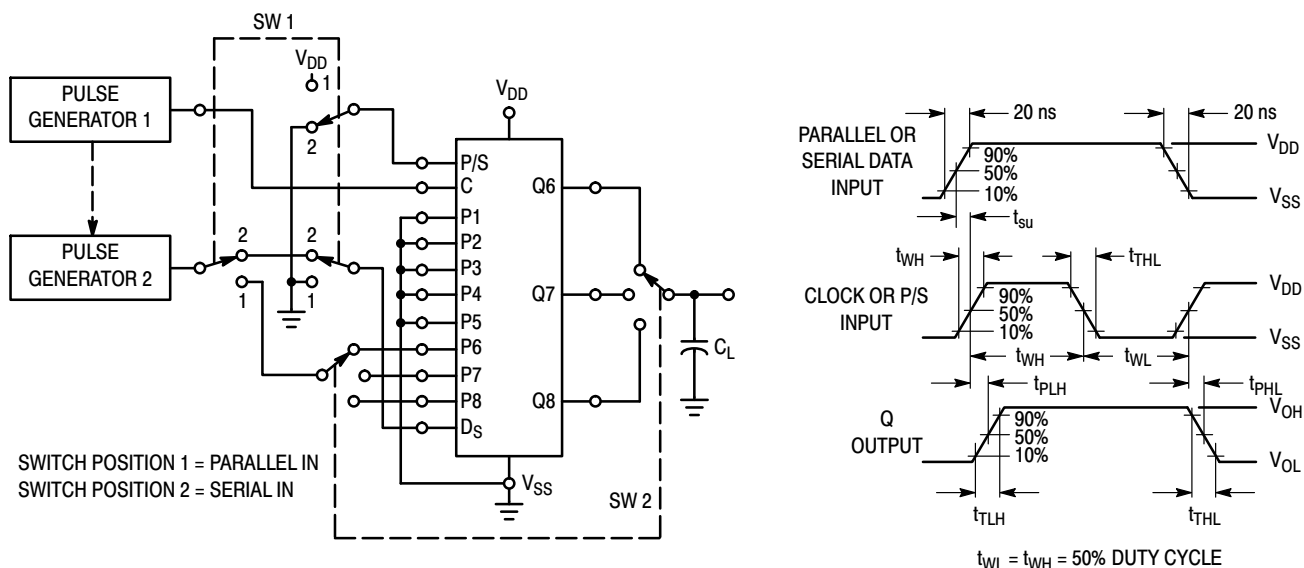


Figure 4. Switching Time Test Circuit and Waveforms

## ORDERING INFORMATION

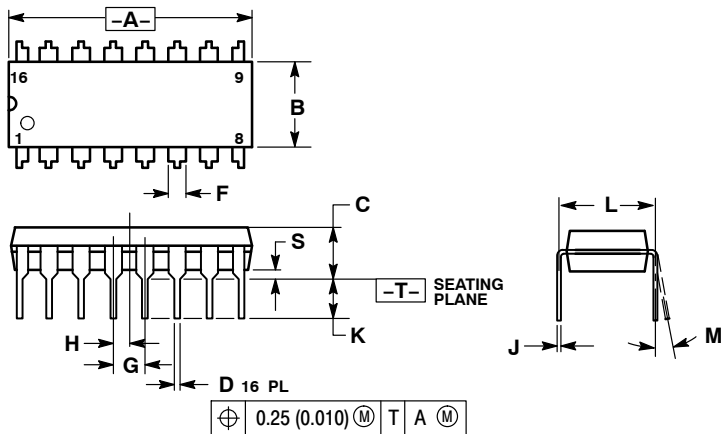
Device	Package	Shipping†
MC14014BCPG	PDIP-16 (Pb-Free)	500 Units / Rail
MC14014BDG	SOIC-16 (Pb-Free)	48 Units / Rail
MC14014BDR2G	SOIC-16 (Pb-Free)	2500 Units / Tape & Reel
MC14014BFELG	SOEIAJ-16	2000 Units / Tape & Reel
MC14021BCPG	PDIP-16 (Pb-Free)	500 Units / Rail
MC14021BDG	SOIC-16 (Pb-Free)	48 Units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

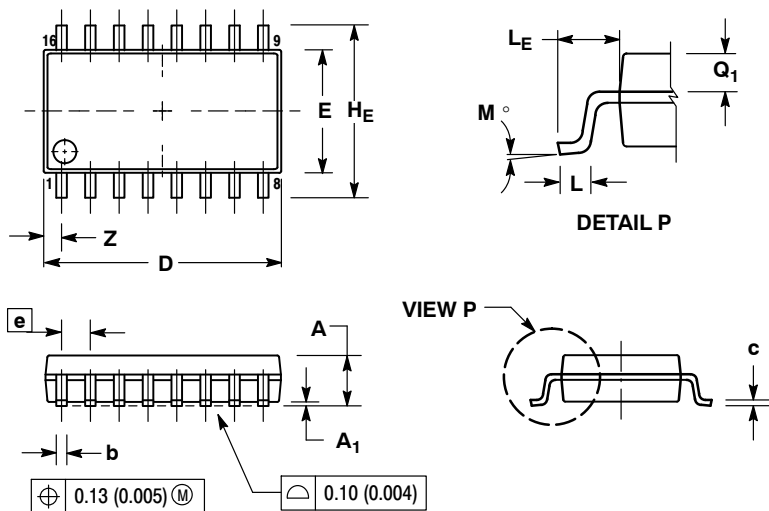
PDIP-16  
P SUFFIX  
PLASTIC DIP PACKAGE  
CASE 648-08  
ISSUE T



- 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

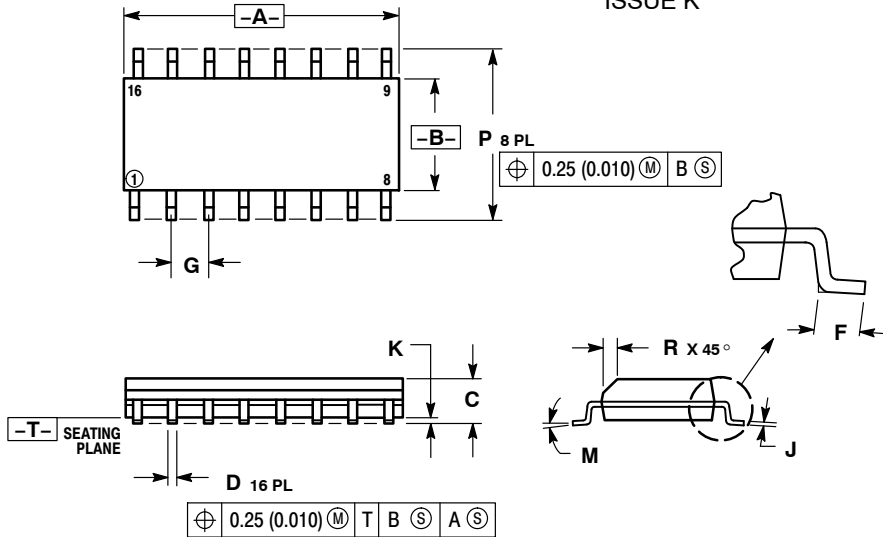


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. TERMINAL NUMBERS ARE SHOWN 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
A <sub>1</sub>	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 <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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## SOIC-16 D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE K

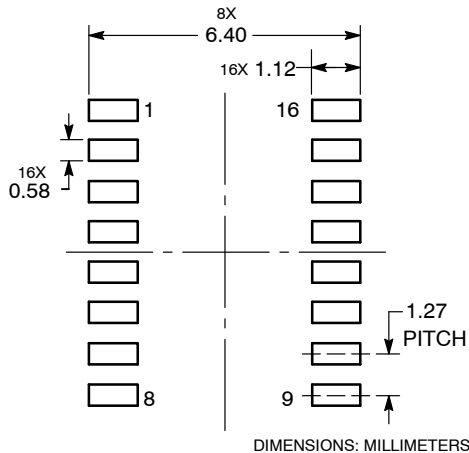


### NOTES:

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

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