

## 8-Stage Shift/Store Register with Three-State Outputs

The MC14094B combines an 8-stage shift register with a data latch for each stage and a three-state output from each latch.

Data is shifted on the positive clock transition and is shifted from the seventh stage to two serial outputs. The  $Q_S$  output data is for use in high-speed cascaded systems. The  $Q'_S$  output data is shifted on the following negative clock transition for use in low-speed cascaded systems.

Data from each stage of the shift register is latched on the negative transition of the strobe input. Data propagates through the latch while strobe is high.

Outputs of the eight data latches are controlled by three-state buffers which are placed in the high-impedance state by a logic Low on Output Enable.

- Three-State Outputs
- Capable of Driving Two Low-Power TTL Loads or One Low-Power Schottky TTL Load Over the Rated Temperature Range
- Input Diode Protection
- Data Latch
- Dual Outputs for Data Out on Both Positive and Negative Clock Transitions
- Useful for Serial-to-Parallel Data Conversion
- Pin-for-Pin Compatible with CD4094B

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







Symbol	Parameter	Value	Unit
$V_{DD}$	DC Supply Voltage	- 0.5 to + 18.0	V
$V_{in}, V_{out}$	Input or Output Voltage (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†	500	mW
$T_{stg}$	Storage Temperature	- 65 to + 150	°C
$T_L$	Lead Temperature (8-Second Soldering)	260	°C

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

† Temperature Derating:

Plastic "P and D/DW" Packages: - 7.0 mW/°C From 65°C To 125°C

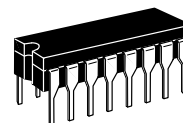
Ceramic "L" Packages: - 12 mW/°C From 100°C To 125°C

Clock	Output Enable	Strobe	Data	Parallel Outputs		Serial Outputs	
				$Q_1$	$Q_N$	$Q_S^*$	$Q'_S$
	0	X	X	Z	Z	$Q_7$	No Chg.
	0	X	X	Z	Z	No Chg.	$Q_7$
	1	0	X	No Chg.	No Chg.	$Q_7$	No Chg.
	1	1	0	0	$Q_{N-1}$	$Q_7$	No Chg.
	1	1	1	1	$Q_{N-1}$	$Q_7$	No Chg.
	1	1	1	No Chg.	No Chg.	No Chg.	$Q_7$

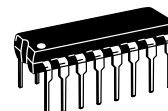
Z = High Impedance    X = Don't Care

\* At the positive clock edge, information in the 7th shift register stage is transferred to  $Q_8$  and  $Q_S$ .

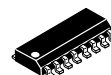
## MC14094B



**L SUFFIX**  
CERAMIC  
CASE 620



**P SUFFIX**  
PLASTIC  
CASE 648



**D SUFFIX**  
SOIC  
CASE 751B

### ORDERING INFORMATION

MC14XXXBCP	Plastic
MC14XXXBCL	Ceramic
MC14XXXBD	SOIC

$T_A = -55^\circ$  to  $125^\circ\text{C}$  for all packages.

### PIN ASSIGNMENT

STROBE	1	16	$V_{DD}$
DATA	2	15	OUTPUT ENABLE
CLOCK	3	14	$Q_5$
$Q_1$	4	13	$Q_6$
$Q_2$	5	12	$Q_7$
$Q_3$	6	11	$Q_8$
$Q_4$	7	10	$Q'_S$
$V_{SS}$	8	9	$Q_S$

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.

**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 #	Max	Min	Max	
Output Voltage V <sub>in</sub> = V <sub>DD</sub> or 0	V <sub>OL</sub>	5.0 10 15	— — —	0.05 0.05 0.05	— — —	0 0 0	0.05 0.05 0.05	— — —	0.05 0.05 0.05	Vdc
V <sub>in</sub> = 0 or V <sub>DD</sub>	V <sub>OH</sub>	5.0 10 15	4.95 9.95 14.95	— — —	4.95 9.95 14.95	5.0 10 15	— — —	4.95 9.95 14.95	— — —	Vdc
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>IL</sub>	5.0 10 15	— — —	1.5 3.0 4.0	— — —	2.25 4.50 6.75	1.5 3.0 4.0	— — —	1.5 3.0 4.0	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)	V <sub>IH</sub>	5.0 10 15	3.5 7.0 11	— — —	3.5 7.0 11	2.75 5.50 8.25	— — —	3.5 7.0 11	— — —	Vdc
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)	I <sub>OH</sub>	5.0 5.0 10 15	– 3.0 – 0.64 – 1.6 – 4.2	— — — —	– 2.4 – 0.51 – 1.3 – 3.4	– 4.2 – 0.88 – 2.25 – 8.8	— — — —	– 1.7 – 0.36 – 0.9 – 2.4	— — — —	mAdc
(V <sub>OL</sub> = 0.4 Vdc) (V <sub>OL</sub> = 0.5 Vdc) (V <sub>OL</sub> = 1.5 Vdc)	I <sub>OL</sub>	5.0 10 15	0.64 1.6 4.2	— — —	0.51 1.3 3.4	0.88 2.25 8.8	— — —	0.36 0.9 2.4	— — —	mAdc
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 10 15	— — —	5.0 10 20	— — —	0.005 0.010 0.015	5.0 10 20	— — —	150 300 600	μAdc
Total Supply Current**† (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> = (4.1 μA/kHz) f + I <sub>DD</sub> I <sub>T</sub> = (14 μA/kHz) f + I <sub>DD</sub> I <sub>T</sub> = (140 μA/kHz) f + I <sub>DD</sub>							μAdc
3–State Output Leakage Current	I <sub>TL</sub>	15	—	± 0.1	—	± 0.0001	± 0.1	—	± 3.0	μA

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

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

†To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) V_{fk}$$

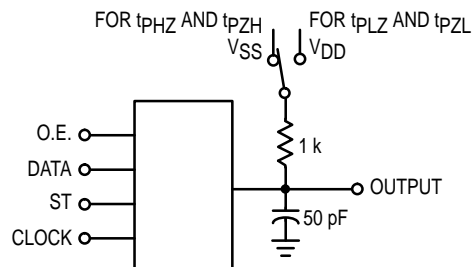
where: I<sub>T</sub> is in μA (per package), C<sub>L</sub> in pF, V = (V<sub>DD</sub> – V<sub>SS</sub>) in volts, f in kHz is input frequency, and k = 0.001.

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

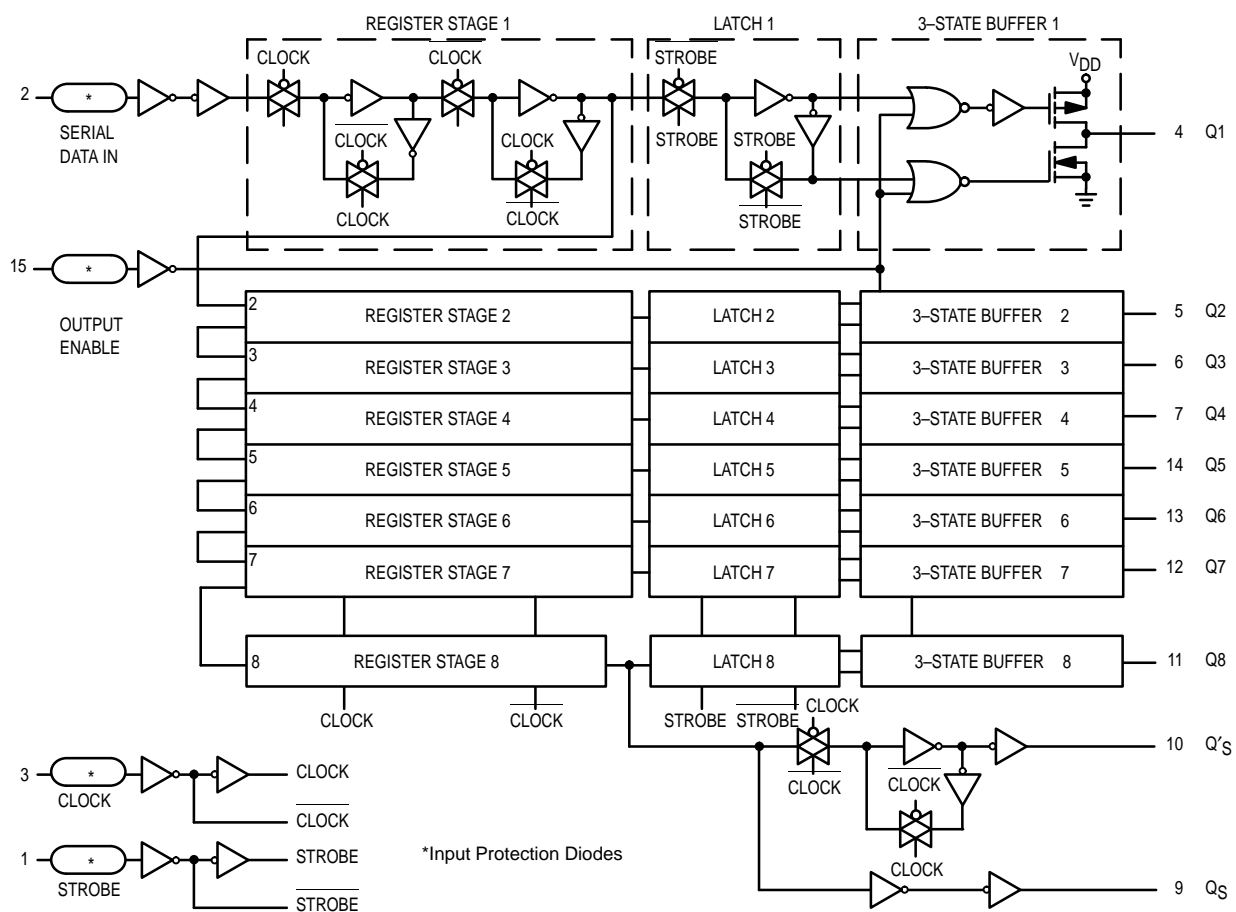
Characteristic	Symbol	V <sub>DD</sub> Vdc	Min	Typ #	Max	Unit
Output Rise and Fall Time $t_{TLH}, t_{THL} = (1.35 \text{ ns/pF}) C_L + 33 \text{ ns}$ $t_{TLH}, t_{THL} = (0.6 \text{ ns/pF}) C_L + 20 \text{ ns}$ $t_{TLH}, t_{THL} = (0.4 \text{ ns/pF}) C_L + 20 \text{ ns}$	$t_{TLH},$ $t_{THL}$	5.0 10 15	— — —	100 50 40	200 100 80	ns
Propagation Delay Time Clock to Serial out QS $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 305 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 107 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 82 \text{ ns}$  Clock to Serial out Q'S $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 350 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 149 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 62 \text{ ns}$  Clock to Parallel out $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 375 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.35 \text{ ns/pF}) C_L + 177 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 122 \text{ ns}$  Strobe to Parallel out $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 245 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 127 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 87 \text{ ns}$	$t_{PLH},$ $t_{PHL}$	5.0 10 15  5.0 10 15  5.0 10 15  5.0 10 15	— — —  — — —  — — —  — — —	350 125 95  230 110 75  420 195 135  290 145 100	600 250 190  460 220 150  840 390 270  580 290 200	ns
Output Enable to Output $t_{PHZ}, t_{PZL} = (0.90 \text{ ns/pF}) C_L + 95 \text{ ns}$ $t_{PHZ}, t_{PZL} = (0.36 \text{ ns/pF}) C_L + 57 \text{ ns}$ $t_{PHZ}, t_{PZL} = (0.26 \text{ ns/pF}) C_L + 42 \text{ ns}$	$t_{PHZ},$ $t_{PZL}$	5.0 10 15	— — —	140 75 55	280 150 110	
$t_{PLZ}, t_{PZH} = (0.90 \text{ ns/pF}) C_L + 180 \text{ ns}$ $t_{PLZ}, t_{PZH} = (0.36 \text{ ns/pF}) C_L + 77 \text{ ns}$ $t_{PLZ}, t_{PZH} = (0.26 \text{ ns/pF}) C_L + 57 \text{ ns}$	$t_{PLZ},$ $t_{PZH}$	5.0 10 15	— — —	225 95 70	450 190 140	
Setup Time Data in to Clock	$t_{su}$	5.0 10 15	125 55 35	60 30 20	— — —	ns
Hold Time Clock to Data	$t_h$	5.0 10 15	0 20 20	– 40 – 10 0	— — —	ns
Clock Pulse Width, High	$t_{WH}$	5.0 10 15	200 100 83	100 50 40	— — —	ns
Clock Rise and Fall Time	$t_{r(cl)}$ $t_{f(cl)}$	5 10 15	— — —	— — —	15 5.0 4.0	$\mu\text{s}$
Clock Pulse Frequency	$f_{cl}$	5.0 10 15	— — —	2.5 5.0 6.0	1.25 2.5 3.0	MHz
Strobe Pulse Width	$t_{WL}$	5.0 10 15	200 80 70	100 40 35	— — —	ns

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

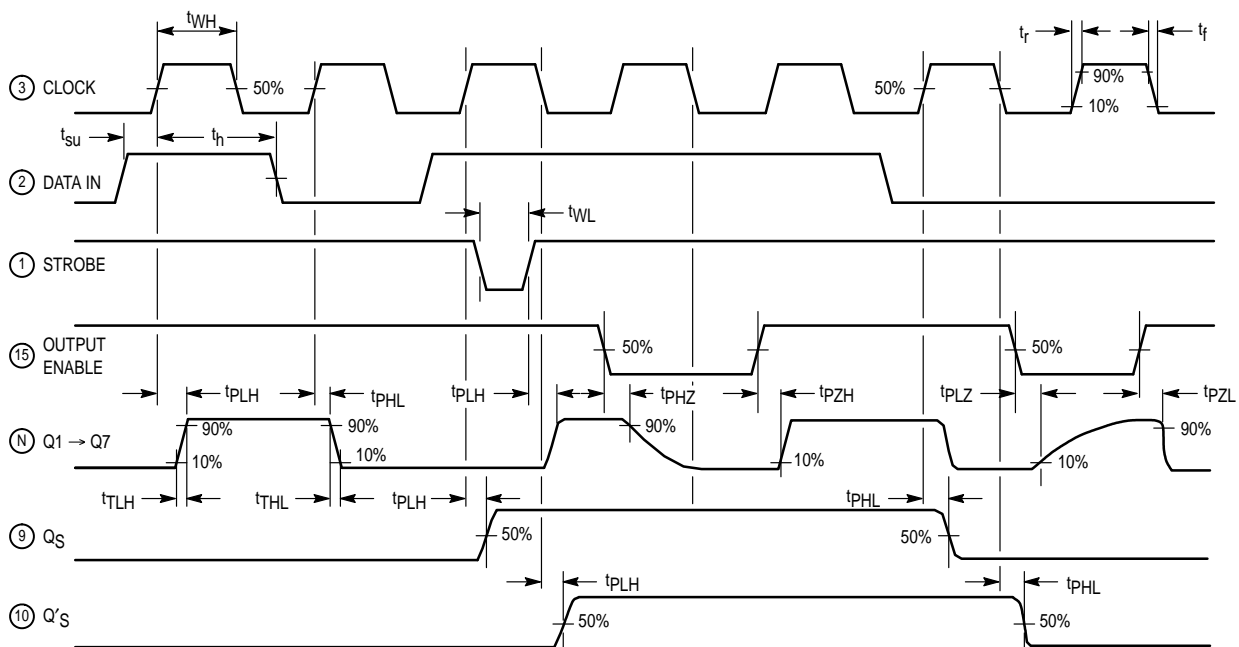
#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

**3-STATE TEST CIRCUIT**


## BLOCK DIAGRAM

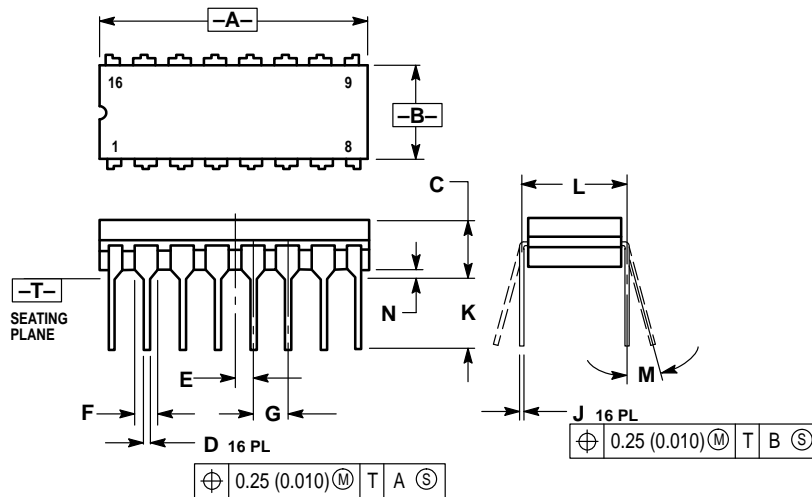


## DYNAMIC TIMING DIAGRAM



## OUTLINE DIMENSIONS

### L SUFFIX CERAMIC DIP PACKAGE CASE 620-10 ISSUE V

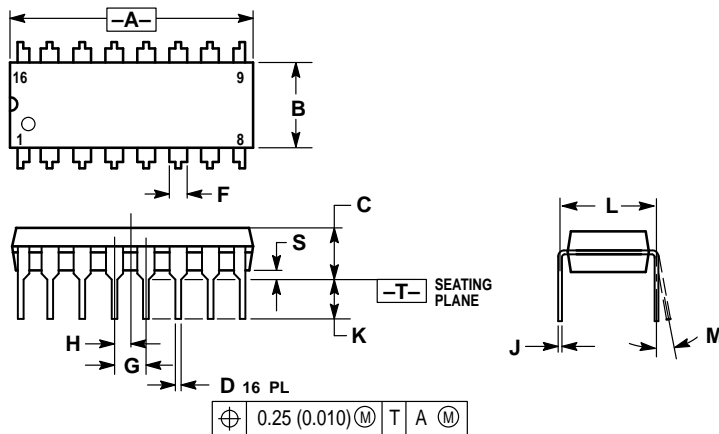


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.750	0.785	19.05	19.93
B	0.240	0.295	6.10	7.49
C	—	0.200	—	5.08
D	0.015	0.020	0.39	0.50
E	0.050	BSC	1.27	BSC
F	0.055	0.065	1.40	1.65
G	0.100	BSC	2.54	BSC
H	0.008	0.015	0.21	0.38
K	0.125	0.170	3.18	4.31
L	0.300	BSC	7.62	BSC
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

### P SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R



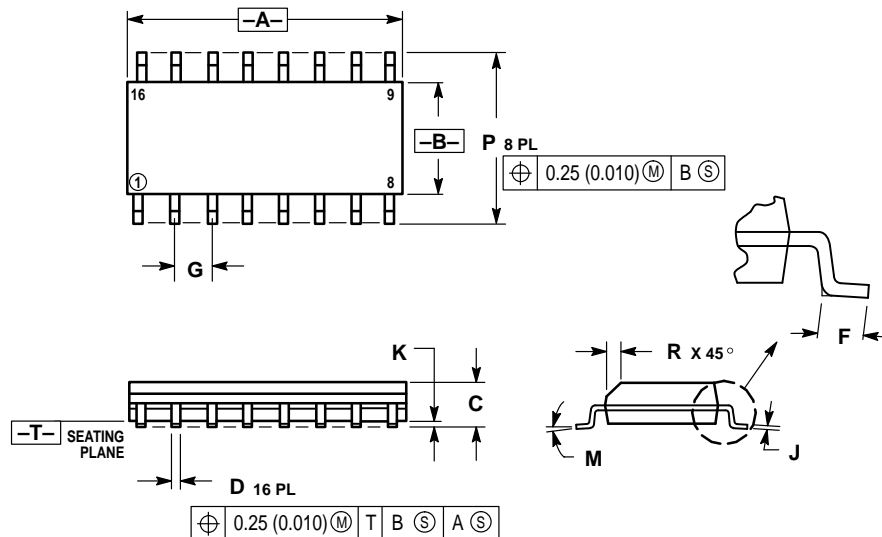
#### NOTES:

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

## OUTLINE DIMENSIONS


### 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
E	0.40	1.25	0.016	0.049
F	1.27 BSC		0.050 BSC	
G	0.19	0.25	0.008	0.009
H	0.10	0.25	0.004	0.009
I	0°	7°	0°	7°
J	5.80	6.20	0.229	0.244
K	0.25	0.50	0.010	0.019

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