MC14558B

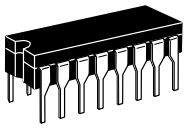
BCD-to-Seven Segment Decoder

The MC14558B decodes 4–bit binary coded decimal data dependent on the state of auxiliary inputs, Enable and $\overline{RBI}$, and provides an active–high seven–segment output for a display driver.

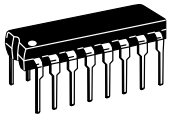
An auxiliary input truth table is shown, in addition to the BCD to seven–segment truth table, to indicate the functions available with the two auxiliary inputs.

Leading Zero blanking is easily obtained with an external flip–flop in time division multiplexed systems displaying most significant decade first.

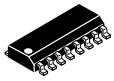
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Segment Blanking for All Illegal Input Combinations
- Lamp Test Function
- Capability for Suppression of Non–Significant Zeros
- Lamp Intensity Function
- Capable of Driving Two Low–power TTL Loads. One Low–power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range



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° to 125°C for all packages.

MAXIMUM RATINGS* (Voltages referenced to V_{SS})

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	– 0.5 to + 18	V
Input Voltage, All Inputs	V_{in}	– 0.5 to V_{DD} + 0.5	V
DC Input Voltage, per Pin	I_{in}	± 10	mAdc
Operating Temperature Range	T_A	– 55 to + 125	°C
Power Dissipation, per Package†	P_D	500	mW
Storage Temperature Range	T_{stg}	– 65 to + 150	°C

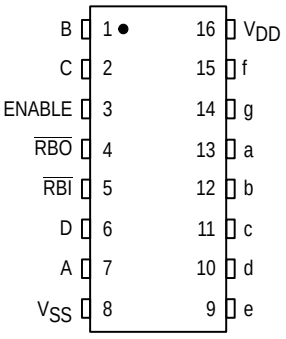
* Maximum Ratings are those values beyond which damage to the device may occur.
†Temperature Derating:
Plastic “P and D/DW” Packages: – 7.0 mW/°C From 65°C To 125°C
Ceramic “L” Packages: – 12 mW/°C From 100°C To 125°C

AUXILIARY INPUT TRUTH TABLE

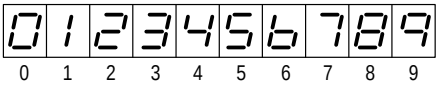
Enable Pin 3	$\overline{RBI}$ Pin 5	BCD Input Code	$\overline{RBO}$ Pin 4	Function Performed
0	0	X	0	Lamp Test
0	1	X	1	Blank Segments
1	1	0	1	Display Zero
1	0	0	0	Blank Segments
1	X	1 – 9	1	1–9 Displayed

X = Don’t Care
$\overline{RBI}$ = Ripple Blanking Input
$\overline{RBO}$ = Ripple Blanking Output

PIN ASSIGNMENT



DISPLAY



ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	– 55°C Min	– 55°C Max	25°C Min	25°C Typ #	25°C Max	125°C Min	125°C Max	Unit
Output Voltage "0" Level V_{in} = V_{DD} or 0	V_{OL}	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
"1" Level V_{in} = 0 or V_{DD}	V_{OH}	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 "0" Level (V_O = 4.5 or 0.5 Vdc) (V_O = 9.0 or 1.0 Vdc) (V_O = 13.5 or 1.5 Vdc)	V_{IL}	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
"1" Level (V_O = 0.5 or 4.5 Vdc) (V_O = 1.0 or 9.0 Vdc) (V_O = 1.5 or 13.5 Vdc)	V_{IH}	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_{OH} = 2.5 Vdc) Source (V_{OH} = 4.6 Vdc) (V_{OH} = 9.5 Vdc) (V_{OH} = 13.5 Vdc)	I_{OH}	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_{OL} = 0.4 Vdc) Sink (V_{OL} = 0.5 Vdc) (V_{OL} = 1.5 Vdc)	I_{OL}	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_{in}	15	—	±0.1	—	±0.00001	±0.1	—	±1.0	µAdc
Input Capacitance	C_{in}	—	—	—	—	5.0	7.5	—	—	pF
Quiescent Current (Per Package) V_{in} = 0 or V_{DD} I_{out} = 0 µA	I_{DD}	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_L = 50 pF on all outputs, all buffers switching)	I_T	5.0 10 15	I_T = (1.2 µA/kHz) f + I_{DD} I_T = (2.4 µA/kHz) f + I_{DD} I_T = (3.6 µA/kHz) f + I_{DD}							µAdc

#Noise immunity specified for worst–case input combination.

Noise Margin for both "1" and "0" level = 1.0 V min @ V_{DD} = 5.0 V
2.0 V min @ V_{DD} = 10 V
2.5 V min @ V_{DD} = 15 V

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

$$I_T(C_L) = I_T(50\ pF) + 3.5 \times 10^{-3} (C_L - 50) V_{DD} f$$

where: I_T is in µA (per package), C_L in pF, V_{DD} in V, and f in kHz is input frequency.

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

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation it is recommended that V_{in} and V_{out} be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

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

SWITCHING CHARACTERISTICS* (C_L = 50 pF, T_A = 25°C; see Figure 1)

Characteristic	Symbol	V_{DD}	Min	Typ	Max	Unit
Output Rise Time	t_{TLH}					ns
t_{TLH} = (3.0 ns/pF) C_L + 30 ns		5.0	—	100	200	
t_{TLH} = (1.5 ns/pF) C_L + 15 ns		10	—	50	100	
t_{TLH} = (1.1 ns/pF) C_L + 10 ns		15	—	40	80	
Output Fall Time	t_{THL}					ns
t_{THL} = (1.5 ns/pF) C_L + 25 ns		5.0	—	100	200	
t_{THL} = (0.75 ns/pF) C_L + 12.5 ns		10	—	50	100	
t_{THL} = (0.55 ns/pF) C_L + 9.5 ns		15	—	40	80	
Propagation Delay Time	t_{PLH}					ns
t_{PLH} = (1.7 ns/pF) C_L + 495 ns		5.0	—	580	1160	
t_{PLH} = (0.66 ns/pF) C_L + 187 ns		10	—	220	440	
t_{PLH} = (0.5 ns/pF) C_L + 120 ns		15	—	145	230	
Propagation Delay Time	t_{PHL}					ns
t_{PHL} = (1.7 ns/pF) C_L + 695 ns		5.0	—	780	1560	
t_{PHL} = (0.66 ns/pF) C_L + 242 ns		10	—	275	550	
t_{PHL} = (0.5 ns/pF) C_L + 160 ns		15	—	185	370	

* The formulae given are for the typical characteristics only.

TRUTH TABLE

Inputs						Outputs*								
Enable Pin 3	$\overline{RBI}$ Pin 5	D Pin 6	C Pin 2	B Pin 1	A Pin 7	a Pin 13	b Pin 12	c Pin 11	d Pin 10	e Pin 9	f Pin 15	g Pin 14	$\overline{RBO}$ Pin 4	Display
1	1	0	0	0	0	1	1	1	1	1	1	0	1	0
1	X	0	0	0	1	0	0	0	0	1	1	0	1	1
1	X	0	0	1	0	1	1	0	1	1	0	1	1	2
1	X	0	0	1	1	1	1	1	1	0	0	1	1	3
1	X	0	1	0	0	0	1	1	0	0	1	1	1	4
1	X	0	1	0	1	1	0	1	1	0	1	1	1	5
1	X	0	1	1	0	0	0	1	1	1	1	1	1	6
1	X	0	1	1	1	1	1	1	0	0	0	0	1	7
1	X	1	0	0	0	1	1	1	1	1	1	1	1	8
1	X	1	0	0	1	1	1	1	0	0	1	1	1	9
1	0	0	0	0	0	0	0	0	0	0	0	0	0	Blank
0	0	X	X	X	X	1	1	1	1	1	1	1	0	8
0	1	X	X	X	X	0	0	0	0	0	0	0	1	Blank

* All non–valid BCD input codes produce a blank display.
X = Don't Care

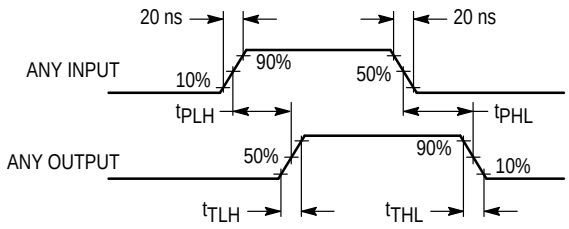
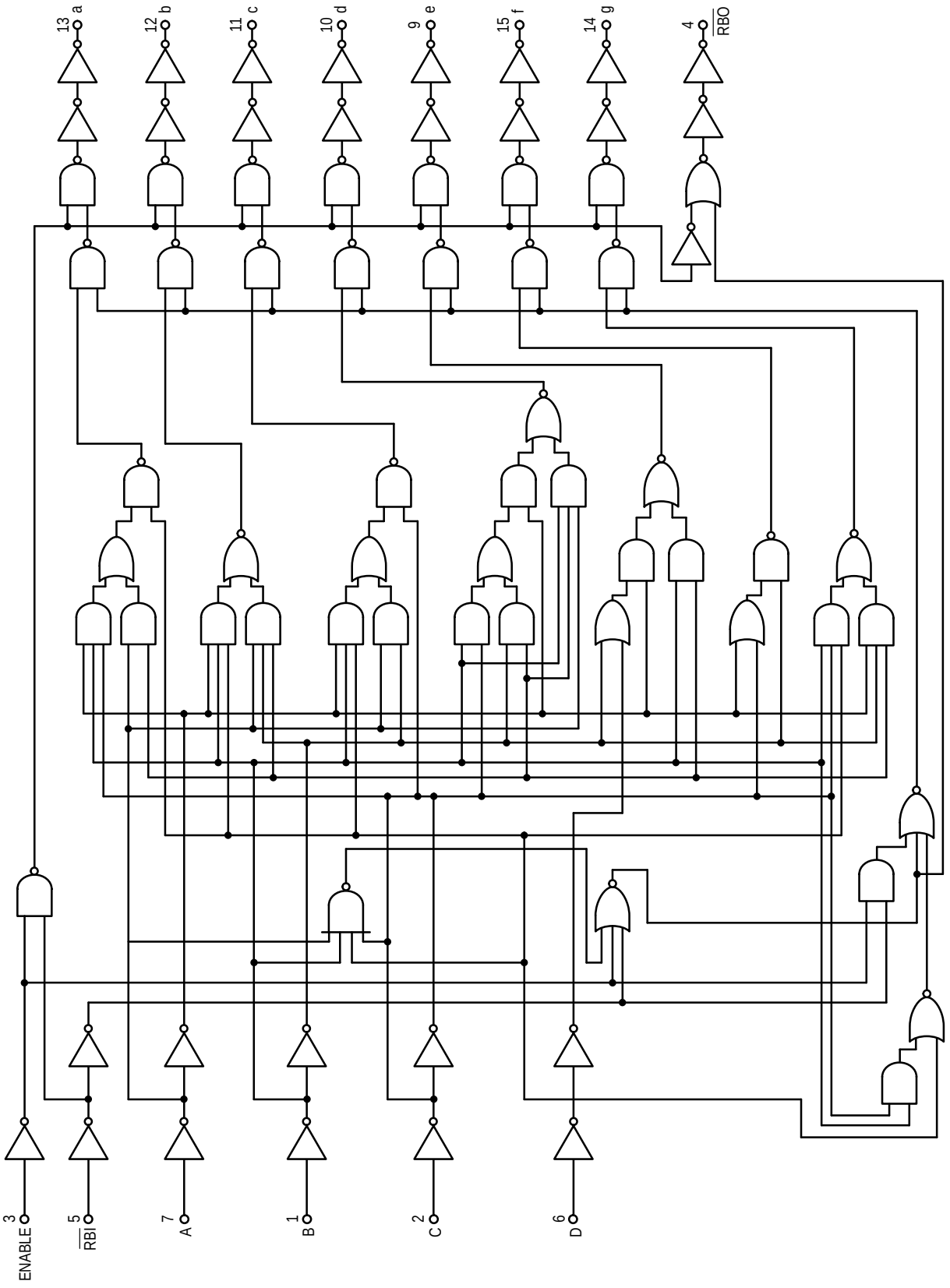


Figure 1. Signal Waveforms

LOGIC DIAGRAM



TYPICAL APPLICATIONS

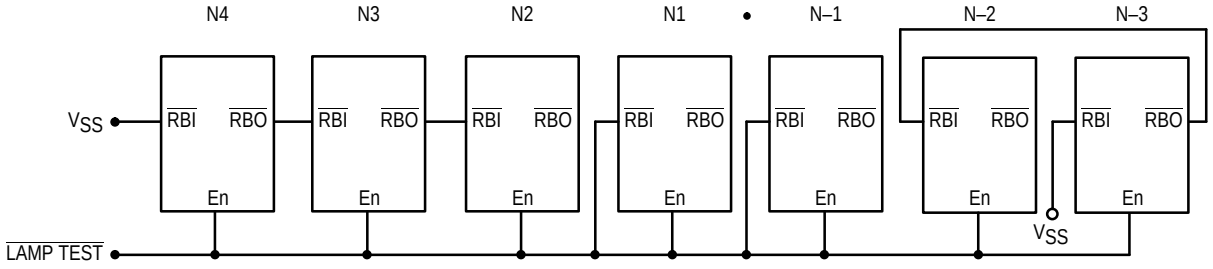


Figure 2. Leading and Trailing Zero Suppression with Lamp Test

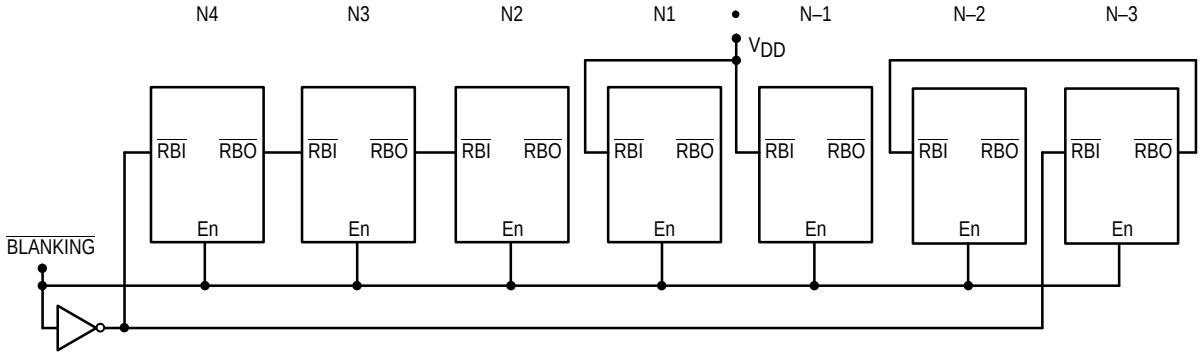


Figure 3. Leading and Trailing Zero Suppression with PWM Intensity Blanking and No Lamp Test

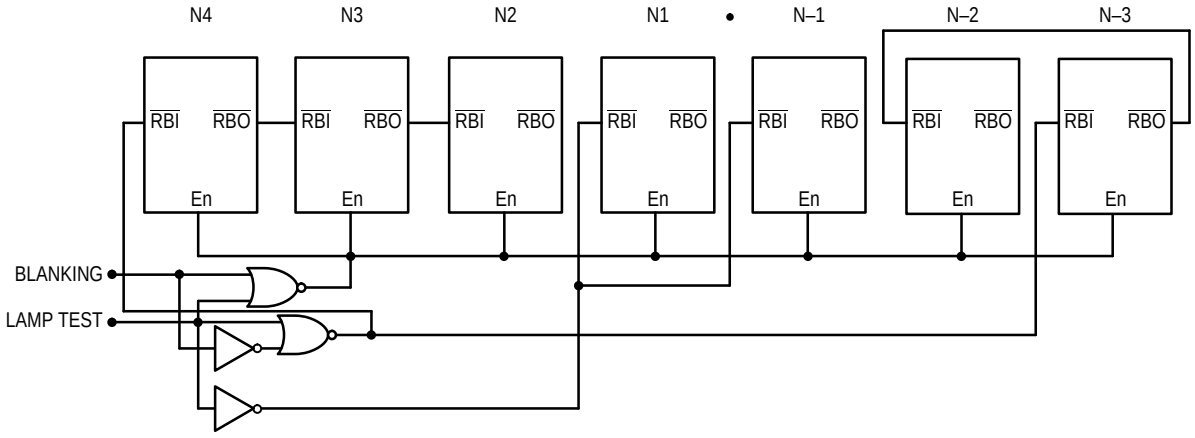
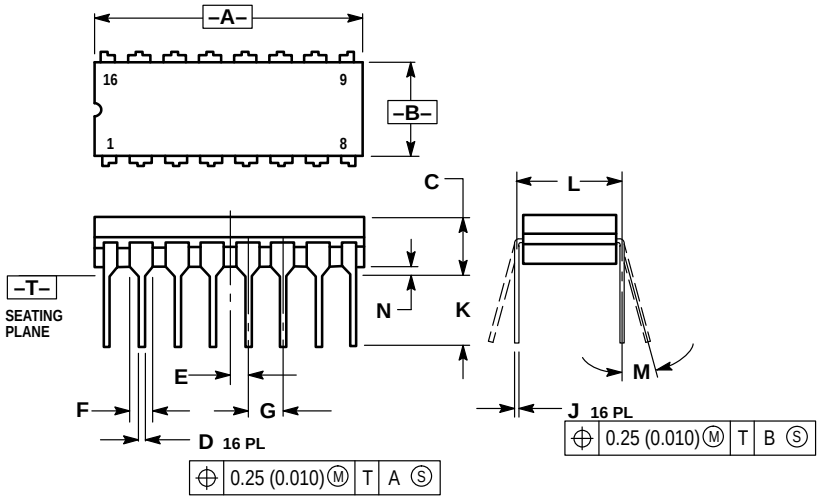


Figure 4. Zero Suppression with Lamp Test and Intensity Blanking

OUTLINE DIMENSIONS

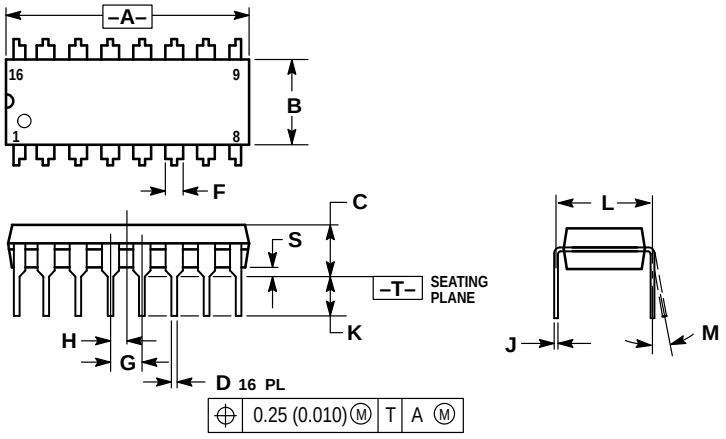
L SUFFIX
CERAMIC DIP PACKAGE
CASE 620–10
ISSUE V



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.

	INCHES		MILLIMETERS	
DIM	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

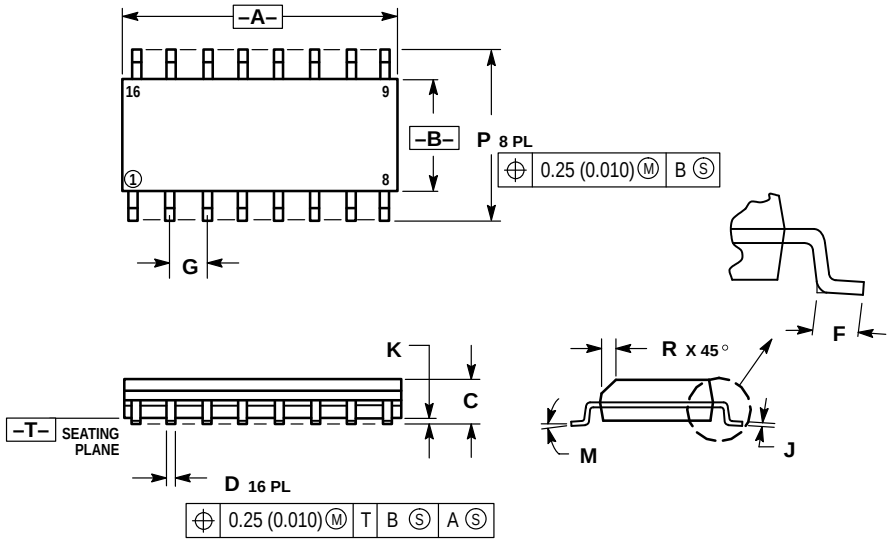


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	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.

	MILLIMETERS		INCHES	
DIM	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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