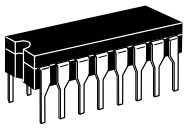
MC14547B

High Current BCD-to-Seven Segment Decoder/Driver

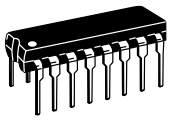
The MC14547 BCD–to–seven segment decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of an 8421 BCD–to–seven segment decoder with high output drive capability. Blanking (BI), can be used to turn off or pulse modulate the brightness of the display. The MC14547 can drive seven–segment light–emitting diodes (LED), incandescent, fluorescent or gas discharge readouts either directly or indirectly.

Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

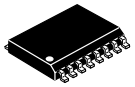
- High Current Sourcing Outputs (Up to 65 mA)
- Low Logic Circuit Power Dissipation
- Supply Voltage Range = + 3.0 V to + 18 V
- Blanking Input
- Readout Blanking on All Illegal Combinations
- Lamp Intensity Modulation Capability
- Multiplexing Capability
- Capable of Driving Two Low–Power TTL Loads, One Low–Power Schottky TTL Load or Two HTL Loads over the Rated Temperature Range
- Use MC14511B for Applications Requiring Data Latches



L SUFFIX
CERAMIC
CASE 620



P SUFFIX
PLASTIC
CASE 648

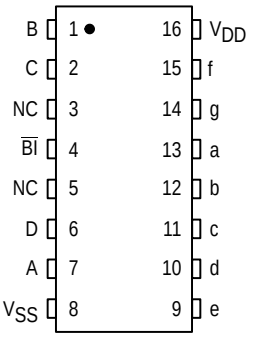


DW SUFFIX
SOIC
CASE 751G

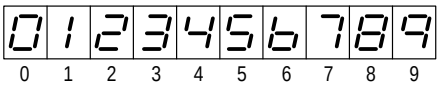
ORDERING INFORMATION

MC14XXXBCP	Plastic
MC14XXXBCL	Ceramic
MC14XXXBDW	SOIC

T_A = – 55° to 125°C for all packages.



DISPLAY



MAXIMUM RATINGS* (Voltages referenced to V_{SS}, Pin 8)

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
Operating Temperature Range	T_A	– 55 to + 125	°C
Storage Temperature Range	T_{stg}	– 65 to + 150	°C
Maximum Continuous Output Drive Current (Source) per Output	I_{OHmax}	65	mA
Maximum Continuous Power Dissipation	P_D	1200*	mW

* Maximum Ratings are those values beyond which damage to the device may occur.
* See Power Derating Curve Figure 1.

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 application of any voltage higher than maximum rated voltages to this high-impedance circuit. A destructive high current mode may occur if V_{in} and V_{out} is not constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

Due to the sourcing capability of this circuit, damage can occur to the device if V_{DD} is applied, and the outputs are shorted to V_{SS} and are at a logical 1 (See Maximum Ratings).

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

TRUTH TABLE

Inputs					Outputs							
$\overline{BI}$	D	C	B	A	a	b	c	d	e	f	g	Display
0	X	X	X	X	0	0	0	0	0	0	0	Blank
1	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	1	0	1	1	0	0	0	0	1
1	0	0	1	0	1	1	0	1	1	0	1	2
1	0	0	1	1	1	1	1	1	0	0	1	3
1	0	1	0	0	0	1	1	0	0	1	1	4
1	0	1	0	1	1	0	1	1	0	1	1	5
1	0	1	1	0	0	0	1	1	1	1	1	6
1	0	1	1	1	1	1	1	0	0	0	0	7
1	1	0	0	0	1	1	1	1	1	1	1	8
1	1	0	0	1	1	1	1	0	0	1	1	9
1	1	0	1	0	0	0	0	0	0	0	0	Blank
1	1	0	1	1	0	0	0	0	0	0	0	Blank
1	1	1	0	0	0	0	0	0	0	0	0	Blank
1	1	1	0	1	0	0	0	0	0	0	0	Blank
1	1	1	1	0	0	0	0	0	0	0	0	Blank
1	1	1	1	1	0	0	0	0	0	0	0	Blank

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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	—	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_{in} = 0 or V_{DD}	V_{OH}	5.0	4.1	—	4.4	4.6	—	4.3	—	Vdc
		10	9.1	—	9.4	9.6	—	9.3	—	
		15	14.1	—	14.4	14.6	—	14.4	—	
Input Voltage # “0” Level	V_{IL}									Vdc
(V_O = 3.8 or 0.5 Vdc)		5.0	—	1.5	—	2.25	1.5	—	1.5	
(V_O = 8.8 or 1.0 Vdc)		10	—	3.0	—	4.50	3.0	—	3.0	
(V_O = 13.8 or 1.5 Vdc)		15	—	4.0	—	6.75	4.0	—	4.0	
(V_O = 0.5 or 3.8 Vdc)	V_{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
(V_O = 1.0 or 8.8 Vdc)		10	7.0	—	7.0	5.50	—	7.0	—	
(V_O = 1.5 or 13.8 Vdc)		15	11	—	11	8.25	—	11	—	
Output Drive Voltage	V_{OH}									Vdc
(I_{OH} = 5.0 mA) Source		5.0	4.0	—	4.2	4.3	—	4.3	—	
(I_{OH} = 10 mA)			—	—	4.1	4.3	—	—	—	
(I_{OH} = 20 mA)			3.8		3.9	4.2	—	4.0	—	
(I_{OH} = 40 mA)			—	—	3.7	4.0	—	—	—	
(I_{OH} = 65 mA)			3.1	—	3.2	3.7	—	3.0	—	
(I_{OH} = 5.0 mA)		10	9.1	—	9.2	9.3	—	9.3	—	Vdc
(I_{OH} = 10 mA)			—	—	9.1	9.3	—	—	—	
(I_{OH} = 20 mA)			8.8	—	9.0	9.2	—	9.2	—	
(I_{OH} = 40 mA)			—	—	8.9	9.0	—	—	—	
(I_{OH} = 65 mA)			8.4	—	8.5	8.8	—	8.1	—	
(I_{OH} = 5.0 mA)		15	14	—	14.2	14.3	—	14.4	—	Vdc
(I_{OH} = 10 mA)			—	—	14.1	14.3	—	—	—	
(I_{OH} = 20 mA)			13.8	—	14.0	14.2	—	14.2	—	
(I_{OH} = 40 mA)			—	—	13.8	14.0	—	—	—	
(I_{OH} = 65 mA)			13.5	—	13.5	13.7	—	13.3	—	
Output Drive Current	I_{OL}									mAdc
(V_{OL} = 0.4 Vdc) Sink		5.0	0.32	—	0.26	0.44	—	0.18	—	
(V_{OL} = 0.5 Vdc)		10	0.80	—	0.65	1.13	—	0.45	—	
(V_{OL} = 1.5 Vdc)		15	2.10	—	1.7	4.4	—	1.2	—	
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	I_{DD}	5.0	—	5.0	—	0.005	5.0	—	150	µAdc
(Per Package) V_{in} = 0 or V_{DD},		10	—	10	—	0.010	10	—	300	
I_{out} = 0 µA		15	—	20	—	0.015	20	—	600	
Total Supply Current**† (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0	I_T = (1.9 µA/kHz) f + I_{DD}							µAdc
		10	I_T = (3.8 µA/kHz) f + I_{DD}							
		15	I_T = (5.7 µA/kHz) f + I_{DD}							

#Noise immunity specified for worst 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:

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

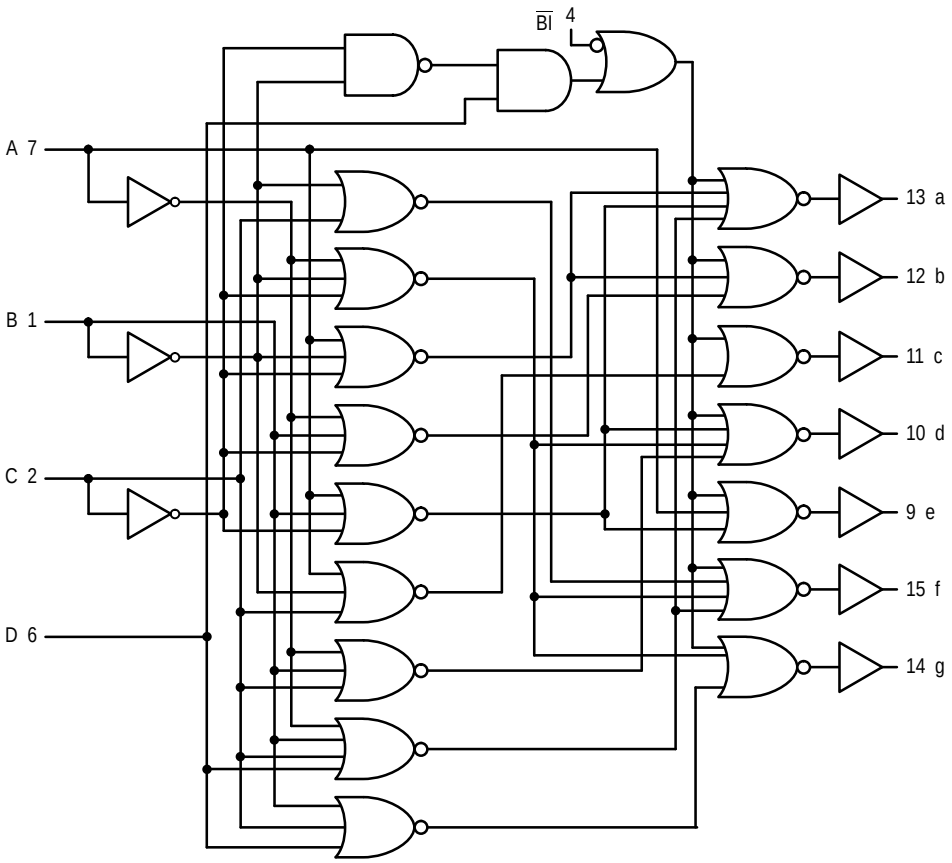
where: I_T is in µA (per package), C_L in pF, V_{DD} in V, and f in kHz is input frequency.

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

SWITCHING CHARACTERISTICS (C_L = 50 pF, T_A = 25°C)

Characteristic	Symbol	V_{DD} Vdc	Min	Typ	Max	Unit
Output Rise Time	t_{TLH}	5.0 10 15	— — —	40 40 40	80 80 80	ns
Output Fall Time	t_{THL}	5.0 10 15	— — —	125 75 70	250 150 140	ns
Data Propagation Delay Time	t_{PLH}	5.0 10 15	— — —	750 300 200	1500 600 400	ns
	t_{PHL}	5.0 10 15	— — —	750 300 200	1500 600 400	
Blank Propagation Delay Time	t_{PLH}	5.0 10 15	— — —	750 300 200	1500 600 400	ns
	t_{PHL}	5.0 10 15	— — —	500 250 170	1000 500 340	

LOGIC DIAGRAM



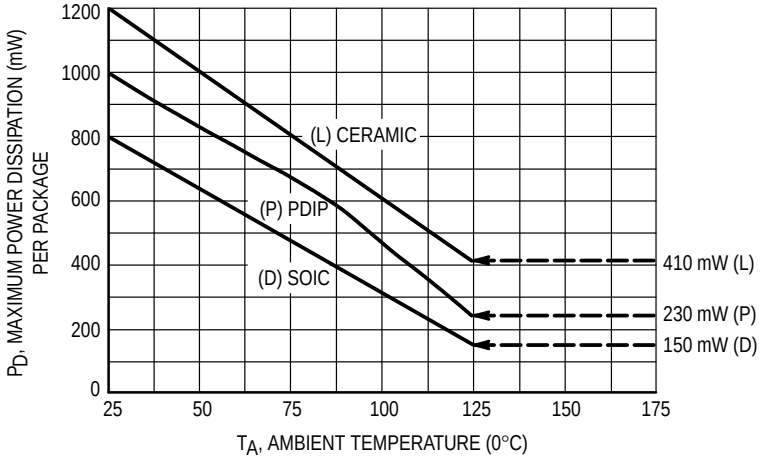
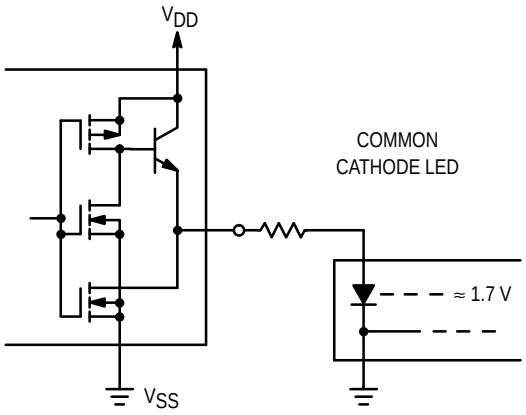
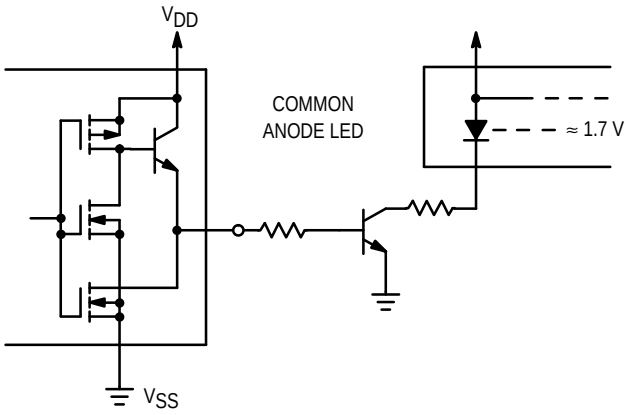


Figure 1. Ambient Temperature Power Derating

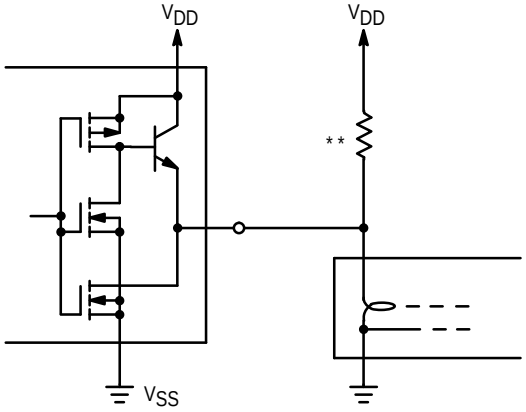
CONNECTIONS TO VARIOUS DISPLAY READOUTS

LIGHT EMITTING DIODE (LED) READOUT

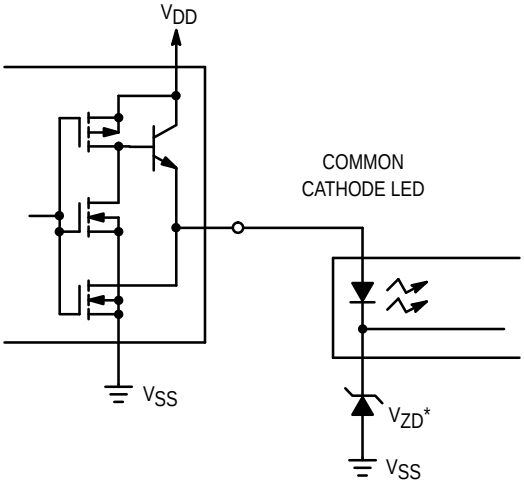




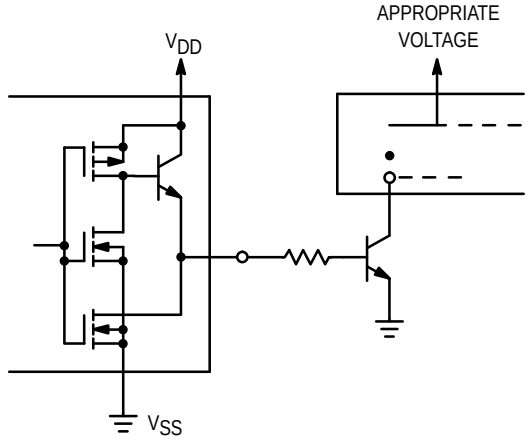
INCANDESCENT READOUT



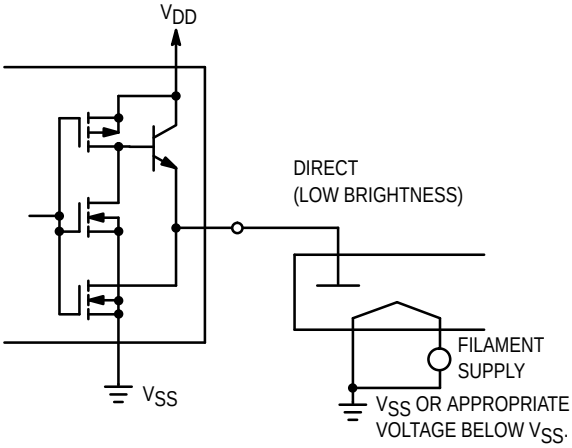
LIGHT–EMITTING DIODE (LED) READOUT USING A ZENER DIODE TO REPLACE DROPPING RESISTORS



GAS DISCHARGE READOUT



FLUORESCENT READOUT



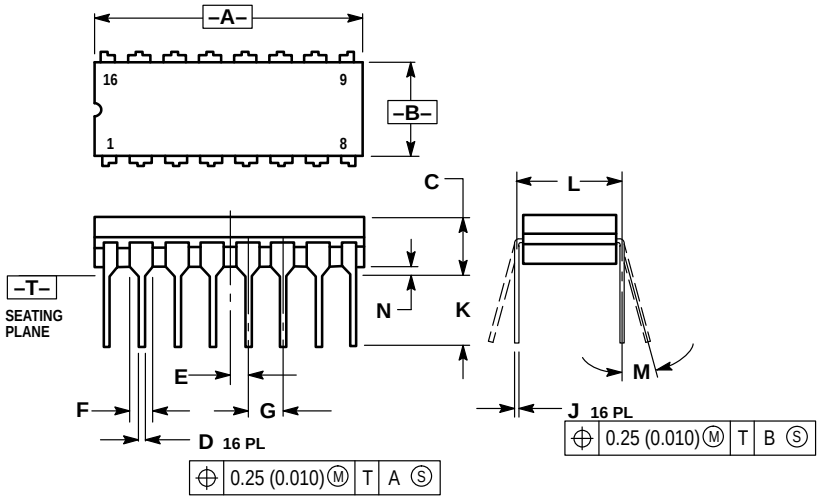
(Caution: Absolute maximum working voltage = 18.0 V)

* V_{ZD} should be set at $V_{DD} - 1.3\,V - V_{LED}$. Wattage of zener diode must be calculated for number of segments and worst–case conditions.

** A filament pre–warm resistor is recommended to reduce filament thermal shock and increase the effective cold resistance of the filament.

OUTLINE DIMENSIONS

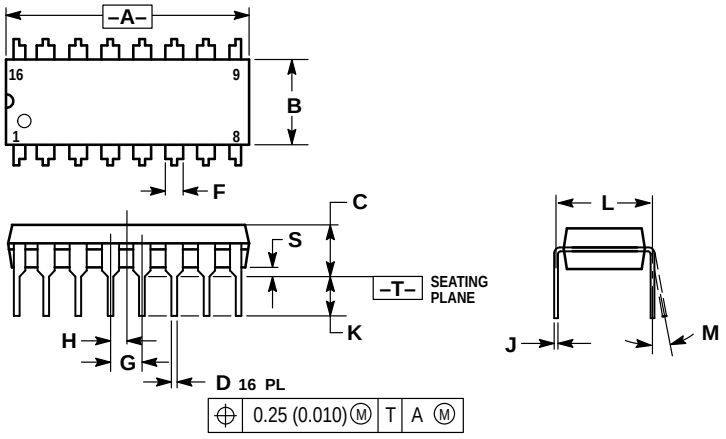
L SUFFIX
CERAMIC DIP PACKAGE
CASE 620–10
ISSUE V



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

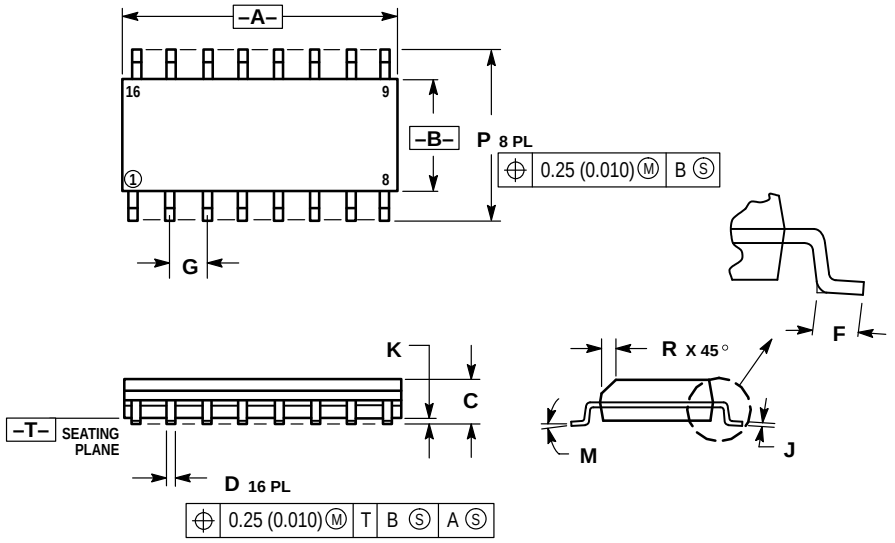


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	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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ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298