

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 (\overline{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

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

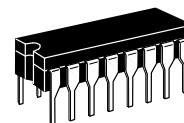
* Maximum Ratings are those values beyond which damage to the device may occur.

* See Power Derating Curve Figure 1.

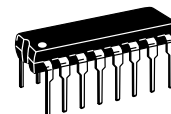
This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit. A destructive high current mode may occur if V_{in} and V_{out} is not constrained to the range $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

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).

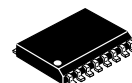
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}).



L SUFFIX
CERAMIC
CASE 620



P SUFFIX
PLASTIC
CASE 648

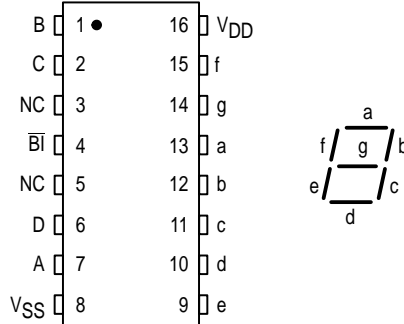


DW SUFFIX
SOIC
CASE 751G

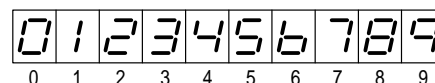
ORDERING INFORMATION

MC14XXXBCP	Plastic
MC14XXXBCL	Ceramic
MC14XXXBDW	SOIC

$T_A = -55^\circ$ to 125°C for all packages.



DISPLAY



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	0	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

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	- 55°C		25°C			125°C		Unit	
			Min	Max	Min	Typ #	Max	Min	Max		
Output Voltage $V_{in} = V_{DD}$ or 0 $V_{in} = 0$ or V_{DD}	"0" Level 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_{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 # ($V_O = 3.8$ or 0.5 Vdc) ($V_O = 8.8$ or 1.0 Vdc) ($V_O = 13.8$ or 1.5 Vdc) ($V_O = 0.5$ or 3.8 Vdc) ($V_O = 1.0$ or 8.8 Vdc) ($V_O = 1.5$ or 13.8 Vdc)	"0" Level V_{IL}	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		
	V_{IH}	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 Voltage Source ($I_{OH} = 5.0$ mA) ($I_{OH} = 10$ mA) ($I_{OH} = 20$ mA) ($I_{OH} = 40$ mA) ($I_{OH} = 65$ mA) ($I_{OH} = 5.0$ mA) ($I_{OH} = 10$ mA) ($I_{OH} = 20$ mA) ($I_{OH} = 40$ mA) ($I_{OH} = 65$ mA) ($I_{OH} = 5.0$ mA) ($I_{OH} = 10$ mA) ($I_{OH} = 20$ mA) ($I_{OH} = 40$ mA) ($I_{OH} = 65$ mA)	V_{OH}	5.0	4.0	—	4.2	4.3	—	4.3	—	Vdc	
		10	—	—	4.1	4.3	—	—	—		
		10	3.8	—	3.9	4.2	—	4.0	—		
		10	—	—	3.7	4.0	—	—	—		
	10	5.0	—	—	3.7	4.0	—	—	—	Vdc	
		10	9.1	—	9.2	9.3	—	9.3	—		
		10	—	—	9.1	9.3	—	—	—		
		10	8.8	—	9.0	9.2	—	9.2	—		
	15	5.0	—	—	8.9	9.0	—	—	—	Vdc	
		15	8.4	—	8.5	8.8	—	8.1	—		
		15	14	—	14.2	14.3	—	14.4	—		
		15	—	—	14.1	14.3	—	—	—		
Output Drive Current Sink ($V_{OL} = 0.4$ Vdc) ($V_{OL} = 0.5$ Vdc) ($V_{OL} = 1.5$ Vdc)	I_{OL}	5.0	0.32	—	0.26	0.44	—	0.18	—	mAdc	
		10	0.80	—	0.65	1.13	—	0.45	—		
		15	2.10	—	1.7	4.4	—	1.2	—		
		15	—	—	—	—	—	—	—		
Input Current	I_{in}	15	—	± 0.1	—	± 0.00001	± 0.1	—	± 1.0	μ Adc	
Input Capacitance	C_{in}	—	—	—	—	5.0	7.5	—	—	pF	
Quiescent Current (Per Package) $V_{in} = 0$ or V_{DD} . $I_{out} = 0 \mu$ A	I_{DD}	5.0	—	5.0	—	0.005	5.0	—	150	μ Adc	
		10	—	10	—	0.010	10	—	300		
		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	$I_T = (1.9 \mu\text{A/kHz}) f + I_{DD}$							μ Adc	
		10	$I_T = (3.8 \mu\text{A/kHz}) f + I_{DD}$								
		15	$I_T = (5.7 \mu\text{A/kHz}) f + I_{DD}$								

#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:

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

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

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

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

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

LOGIC DIAGRAM

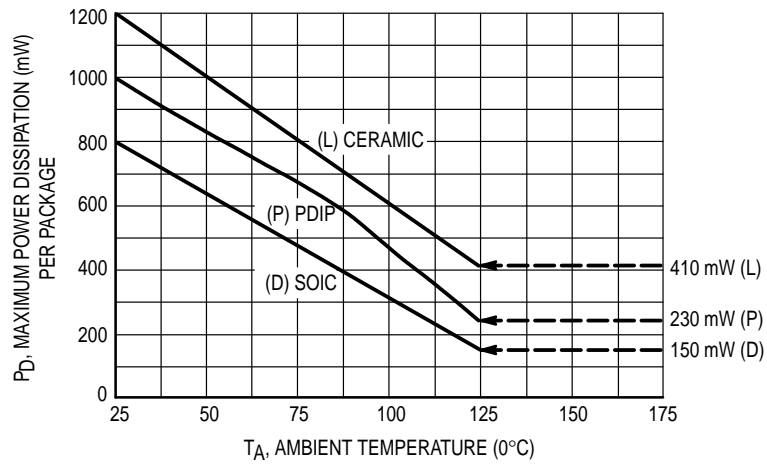
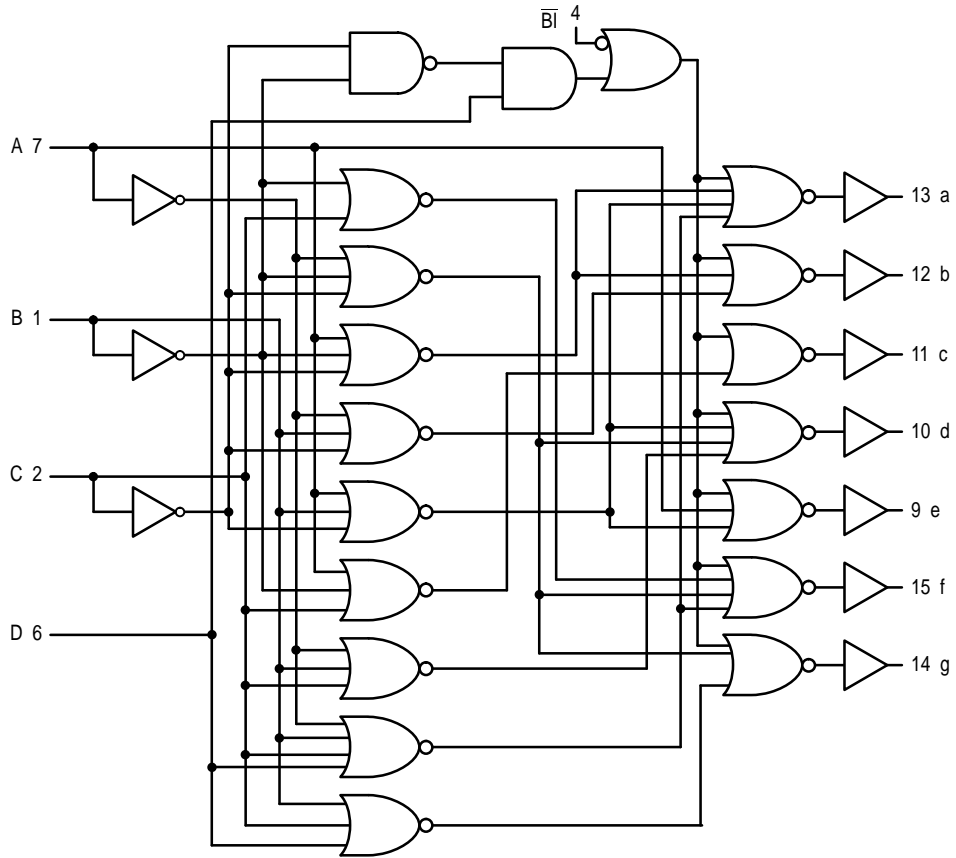
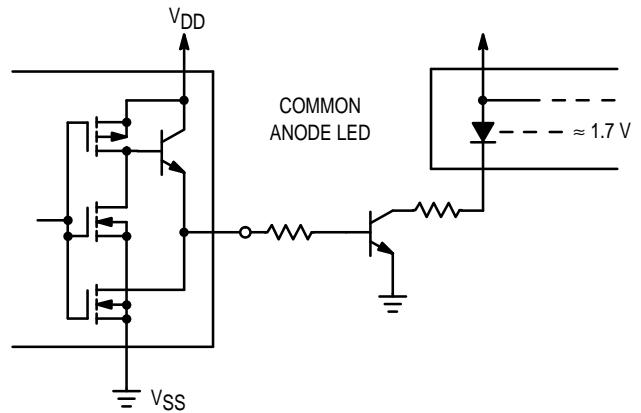
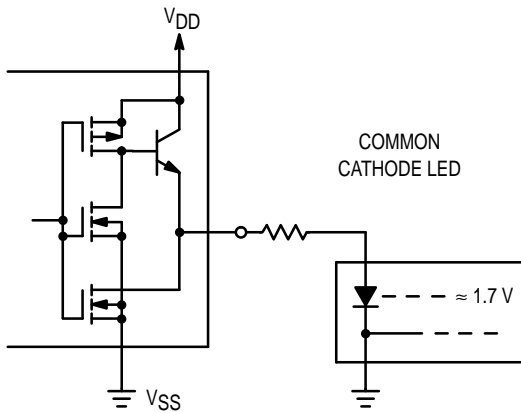


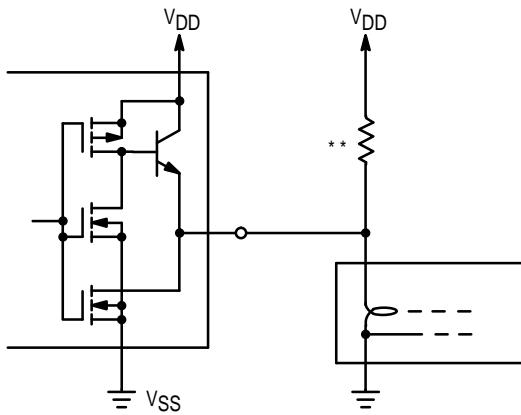
Figure 1. Ambient Temperature Power Derating

CONNECTIONS TO VARIOUS DISPLAY READOUTS

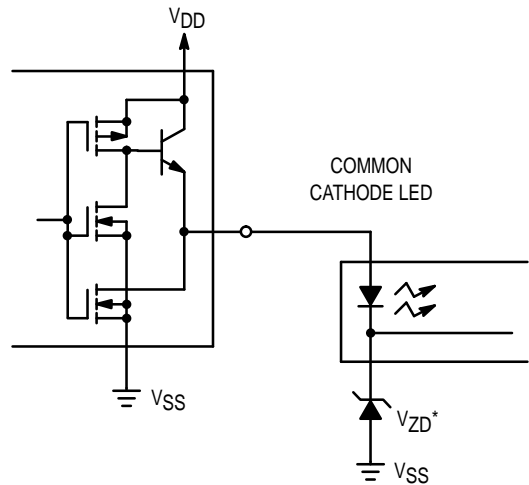
LIGHT EMITTING DIODE (LED) READOUT



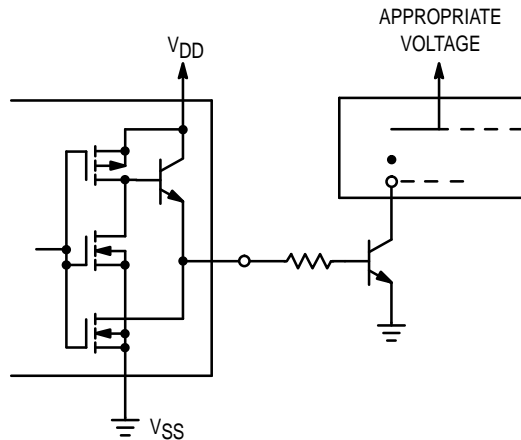
INCANDESCENT READOUT



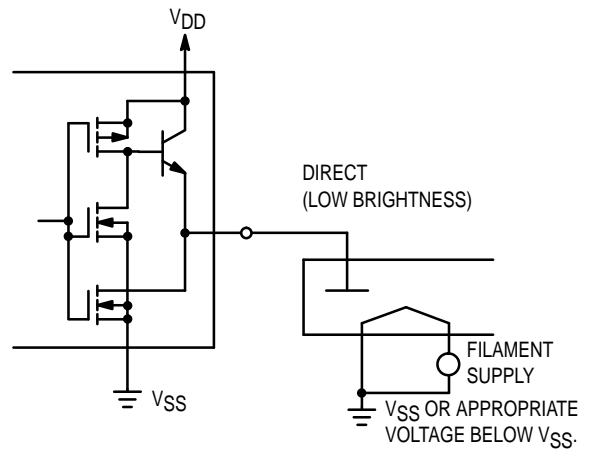
LIGHT-EMITTING DIODE (LED) READOUT USING A ZENER DIODE TO REPLACE DROPPING RESISTORS



GAS DISCHARGE READOUT



FLUORESCENT READOUT



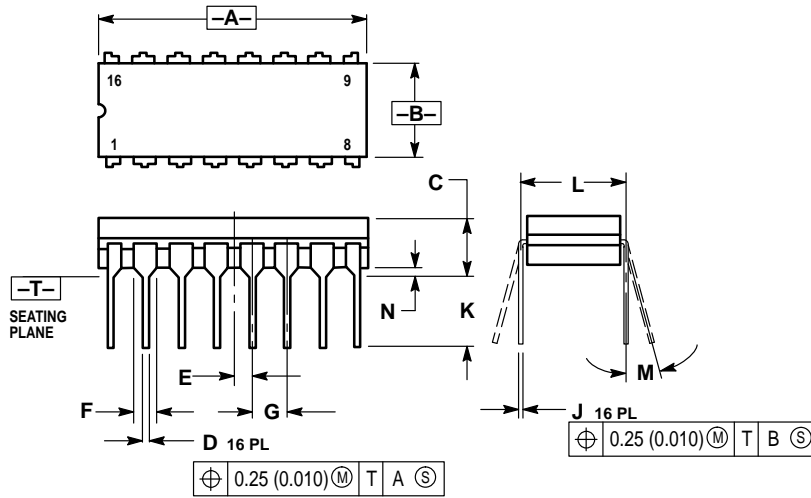
* V_{ZD} should be set at $V_{DD} - 1.3\text{ V} - V_{LED}$. Wattage of zener diode must be calculated for number of segments and worst-case conditions.

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

(Caution: Absolute maximum working voltage = 18.0 V)

OUTLINE DIMENSIONS

L SUFFIX CERAMIC DIP PACKAGE CASE 620-10 ISSUE V

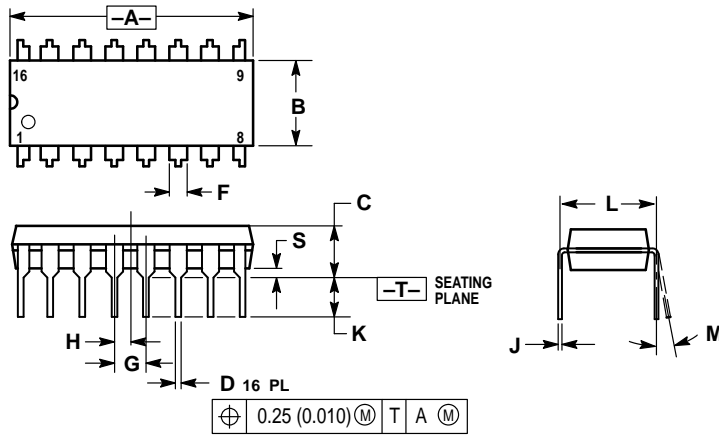


NOTES:

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



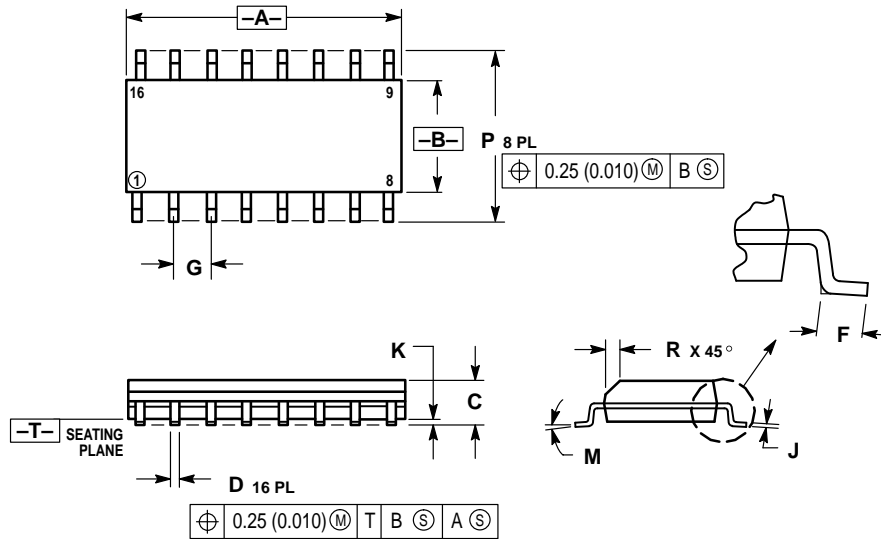
NOTES:

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
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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MC14547B/D

