MC74LVX138

3-to-8 Line Decoder

With 5V−Tolerant Inputs

The MC74LVX138 is an advanced high speed CMOS 3−to−8 line decoder. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

When the device is enabled, three Binary Select inputs (A0 − A2) determine which one of the outputs ($\overline{O0}$ − $\overline{O7}$) will go Low. When enable input E3 is held Low or either $\overline{E2}$ or $\overline{E1}$ is held High, decoding function is inhibited and all outputs go high. E3, $\overline{E2}$, and $\overline{E1}$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

Features

- High Speed: t_{PD} = 5.5 ns (Typ) at V_{CC} = 3.3 V
- Low Power Dissipation: I_{CC} = 4 μA (Max) at T_A = 25 °C
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise: V_{OLP} = 0.5 V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance:
  Human Body Model > 2000 V;
  Machine Model > 200 V
- Pb−Free Packages are Available*

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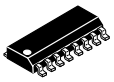
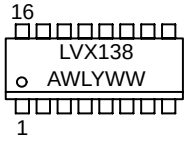
MARKING DIAGRAMS

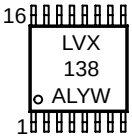


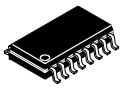
SOIC−16
D SUFFIX
CASE 751B



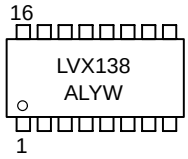


TSSOP−16
DT SUFFIX
CASE 948F





SOEIAJ−16
M SUFFIX
CASE 966



A	=	Assembly Location
WL or L	=	Wafer Lot
Y	=	Year
WW or W	=	Work Week

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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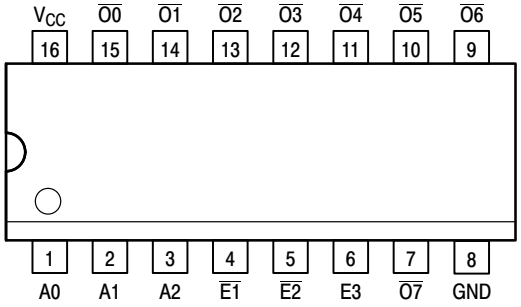


PIN NAMES

Pins	Function
A0−A2	Address Inputs
$\overline{E1}$−$\overline{E2}$	Enable Inputs
E3	Enable Input
$\overline{O0}$−$\overline{O7}$	Outputs

Figure 1. 16−Lead Pinout (Top View)

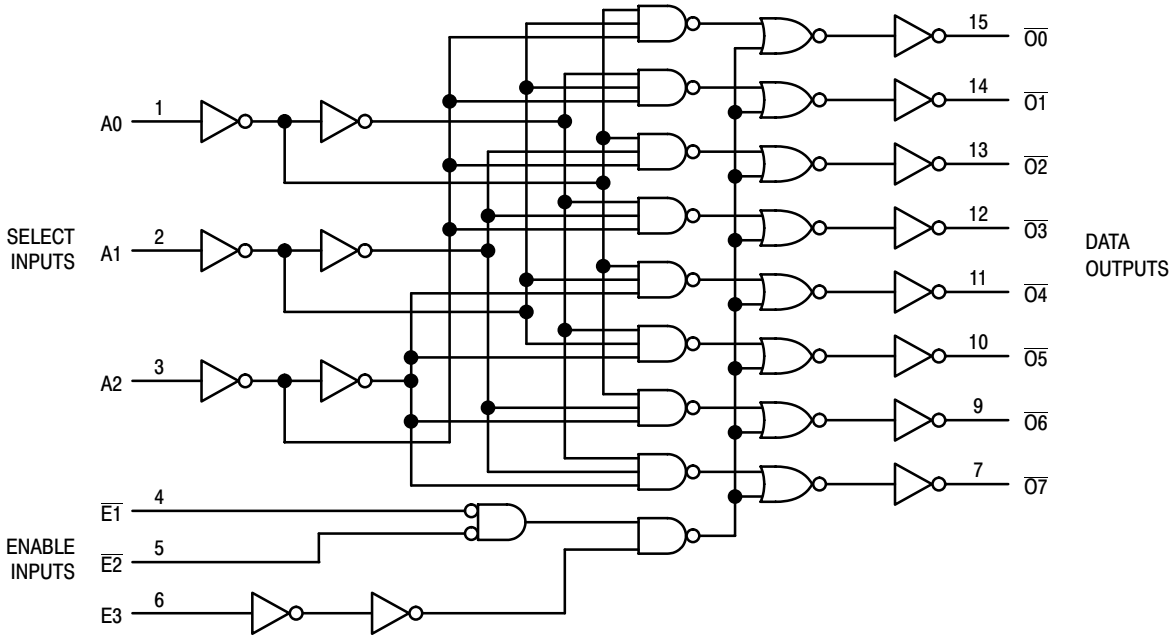


Figure 2. Logic Diagram

INPUTS						OUTPUTS							
$\overline{E1}$	$\overline{E2}$	E3	A0	A1	A2	$\overline{O0}$	$\overline{O1}$	$\overline{O2}$	$\overline{O3}$	$\overline{O4}$	$\overline{O5}$	$\overline{O6}$	$\overline{O7}$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = High Voltage Level; L = Low Voltage Level; X = High or Low Voltage Level and Transitions Are Acceptable; For I_{CC} reasons, DO NOT FLOAT Inputs

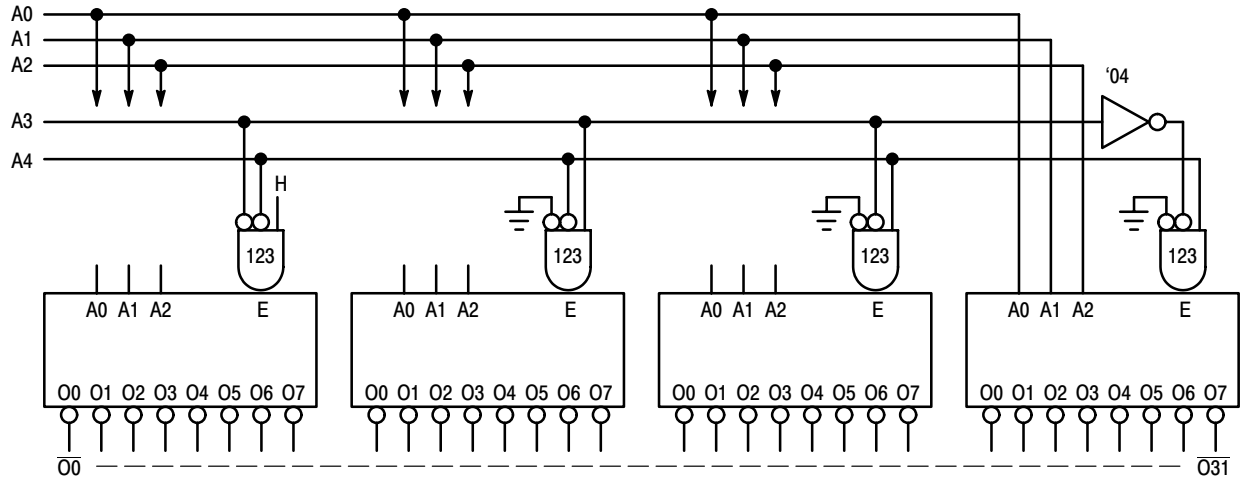


Figure 3. Expansion to 1−of−32 Decoding

ORDERING INFORMATION

Device	Package	Shipping†
MC74LVX138DR2	SOIC−16	2500 Tape & Reel
MC74LVX138DR2G	SOIC−16 (Pb−Free)	2500 Tape & Reel
MC74LVX138DTR2	TSSOP−16*	2500 Tape & Reel
MC74LVX138M	SOEIAJ−16	50 Units / Rail
MC74LVX138MG	SOEIAJ−16 (Pb−Free)	50 Units / Rail
MC74LVX138MEL	SOEIAJ−16	2000 Tape & Reel
MC74LVX138MELG	SOEIAJ−16 (Pb−Free)	2000 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.
*This package is inherently Pb−Free.

MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage	–0.5 to +7.0	V
V_{in}	DC Input Voltage	–0.5 to +7.0	V
V_{out}	DC Output Voltage	–0.5 to V_{CC} +0.5	V
I_{IK}	Input Diode Current	−20	mA
I_{OK}	Output Diode Current	±20	mA
I_{out}	DC Output Current, per Pin	±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	±75	mA
P_D	Power Dissipation	180	mW
T_{stg}	Storage Temperature	–65 to +150	°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.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Supply Voltage	2.0	3.6	V
V_{in}	DC Input Voltage	0	5.5	V
V_{out}	DC Output Voltage	0	V_{CC}	V
T_A	Operating Temperature, All Package Types	−40	+85	°C
$\Delta t/\Delta V$	Input Rise and Fall Time	0	100	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} V	T_A = 25°C			T_A = − 40 to 85°C		Unit
				Min	Typ	Max	Min	Max	
V_{IH}	High−Level Input Voltage		2.0 3.0 3.6	1.5 2.0 2.4	− − −	− − −	1.5 2.0 2.4	− − −	V
V_{IL}	Low−Level Input Voltage		2.0 3.0 3.6	− − −	− − −	0.5 0.8 0.8	− − −	0.5 0.8 0.8	V
V_{OH}	High−Level Output Voltage (V_{in} = V_{IH} or V_{IL})	I_{OH} = −50μA I_{OH} = −50μA I_{OH} = −4mA	2.0 3.0 3.0	1.9 2.9 2.58	2.0 3.0 −	− − −	1.9 2.9 2.48	− − −	V
V_{OL}	Low−Level Output Voltage (V_{in} = V_{IH} or V_{IL})	I_{OL} = 50μA I_{OL} = 50μA I_{OL} = 4mA	2.0 3.0 3.0	− − −	0.0 0.0 −	0.1 0.1 0.36	− − −	0.1 0.1 0.44	V
I_{in}	Input Leakage Current	V_{in} = 5.5V or GND	3.6	−	−	±0.1	−	±1.0	μA
I_{CC}	Quiescent Supply Current	V_{in} = V_{CC} or GND	3.6	−	−	4.0	−	40.0	μA

AC ELECTRICAL CHARACTERISTICS (Input t_r = t_f = 3.0ns)

Symbol	Parameter	Test Conditions		T_A = 25°C			T_A = − 40 to 85°C		Unit
				Min	Typ	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay Input to Output	V_{CC} = 2.7V	C_L = 15pF C_L = 50pF	− −	7.1 9.6	13.8 17.3	1.0 1.0	16.5 20.0	ns
		V_{CC} = 3.3 ± 0.3V	C_L = 15pF C_L = 50pF	− −	5.5 8.0	8.8 12.3	1.0 1.0	10.5 14.0	
t_{PLH}, t_{PHL}	Propagation Delay E3 to $\overline{O}$	V_{CC} = 2.7V	C_L = 15pF C_L = 50pF	− −	8.7 11.2	16.3 19.8	1.0 1.0	19.5 23.0	ns
		V_{CC} = 3.3 ± 0.3V	C_L = 15pF C_L = 50pF	− −	6.8 9.3	10.6 14.1	1.0 1.0	12.5 16.0	
t_{PLH}, t_{PHL}	Propagation Delay $\overline{E1}$ or $\overline{E2}$ to $\overline{O}$	V_{CC} = 2.7V	C_L = 15pF C_L = 50pF	− −	8.8 11.3	16.0 19.5	1.0 1.0	18.5 22.0	ns
		V_{CC} = 3.3 ± 0.3V	C_L = 15pF C_L = 50pF	− −	6.9 9.4	10.4 13.9	1.0 1.0	11.5 15.0	
t_{OSHL} t_{OSLH}	Output−to−Output Skew (Note 1)	V_{CC} = 2.7V V_{CC} = 3.3 ±0.3V	C_L = 50pF C_L = 50pF	− −	− −	2.5 2.5	− −	2.5 2.5	ns

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH−to−LOW (t_{OSHL}) or LOW−to−HIGH (t_{OSLH}); parameter guaranteed by design.

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	T_A = 25°C			T_A = − 40 to 85°C		Unit
		Min	Typ	Max	Min	Max	
Cin	Input Capacitance	−	4	10	−	10	pF
C_{PD}	Power Dissipation Capacitance (Note 2)	−	34	−	−	−	pF

2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$. C_{PD} is used to determine the no−load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f$ = 3.0ns, C_L = 50pF, V_{CC} = 3.3V, Measured in SOIC Package)

Symbol	Characteristic	T_A = 25°C		Unit
		Typ	Max	
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	−	0.5	V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	−	−0.5	V
V_{IHD}	Minimum High Level Dynamic Input Voltage	−	2.0	V
V_{ILD}	Maximum Low Level Dynamic Input Voltage	−	0.8	V

SWITCHING WAVEFORMS

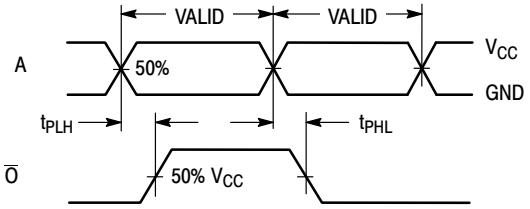


Figure 4. .

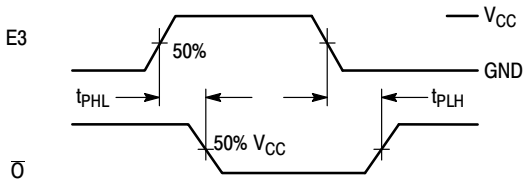


Figure 5. .

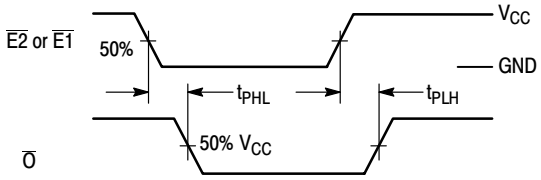
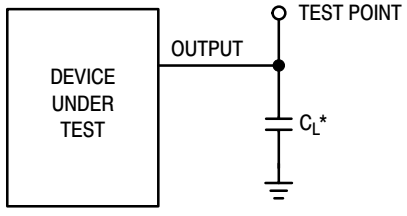


Figure 6.

TEST CIRCUIT

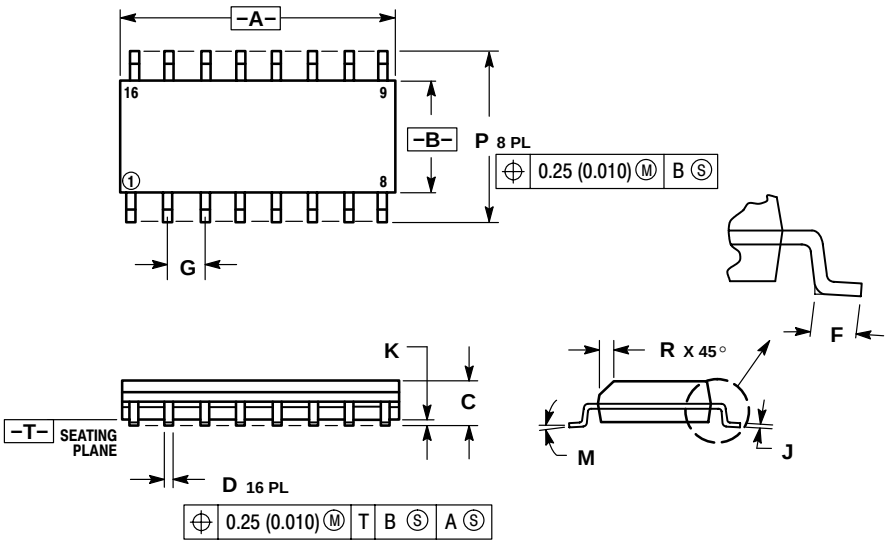


*Includes all probe and jig capacitance

Figure 7.

PACKAGE DIMENSIONS

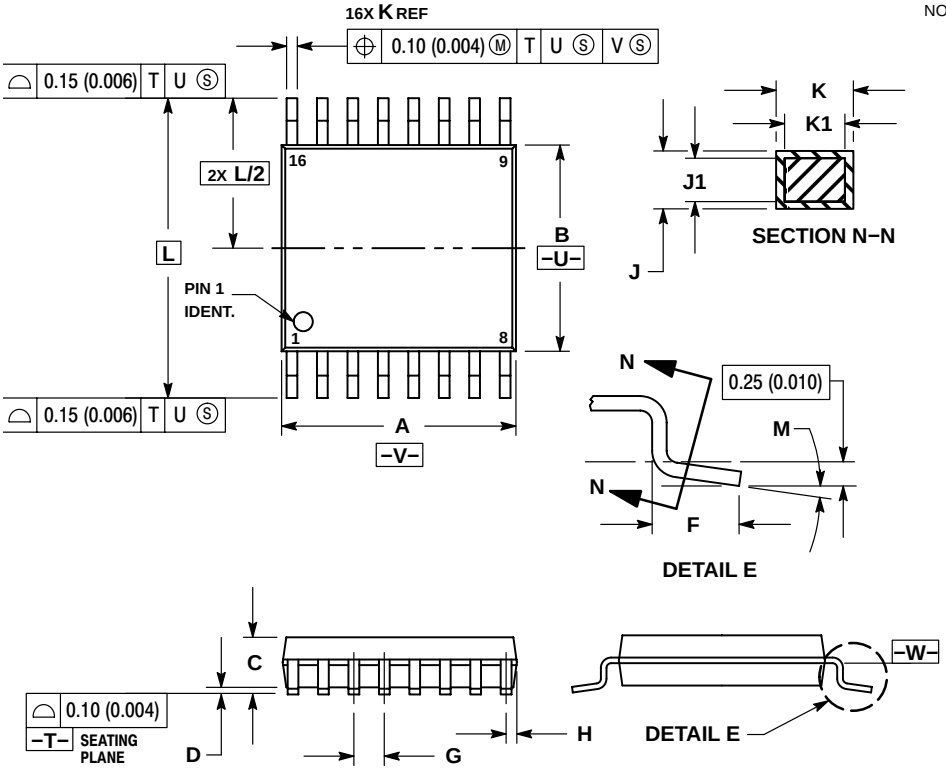
SOIC−16
D SUFFIX
CASE 751B−05
ISSUE J



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

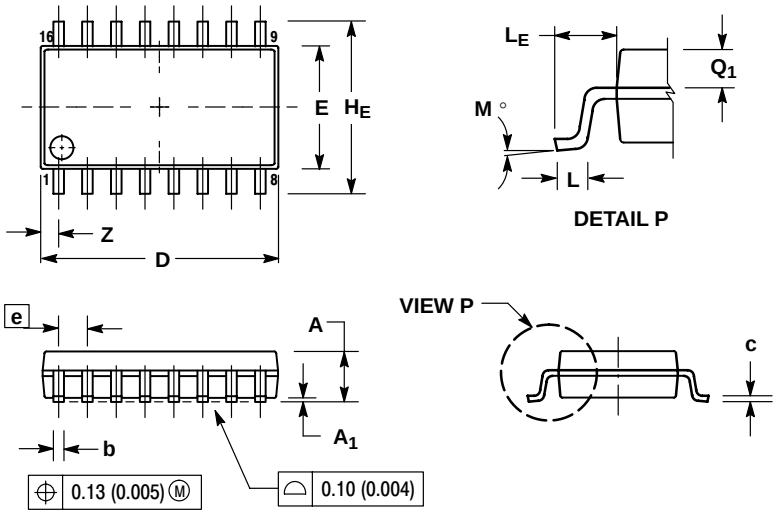
TSSOP−16
DT SUFFIX
CASE 948F−01
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

SOEIAJ−16
M SUFFIX
CASE 966−01
ISSUE O



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).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	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_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	0.78	---	0.031

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