

MC74LCX138

Low-Voltage CMOS 3-to-8 Decoder/Demultiplexer

With 5 V-Tolerant Inputs

The MC74LCX138 is a high performance, 3-to-8 decoder/demultiplexer operating from a 2.3 to 3.6 V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A V_I specification of 5.5 V allows MC74LCX138 inputs to be safely driven from 5 V devices. The MC74LCX138 is suitable for memory address decoding and other TTL level bus-oriented applications.

The MC74LCX138 high-speed 3-to-8 decoder/demultiplexer accepts three binary weighted inputs (A0, A1, A2) and, when enabled, provides eight mutually exclusive active-LOW outputs ($\overline{O0}$ – $\overline{O7}$). The LCX138 features three Enable inputs, two active-LOW ($\overline{E1}$, $\overline{E2}$) and one active-HIGH (E3). All outputs will be HIGH unless $\overline{E1}$ and $\overline{E2}$ are LOW, and E3 is HIGH. This multiple enabled function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four LCX138 devices and one inverter (see Figure 1). The LCX138 can be used as an 8-output demultiplexer by using one of the active-LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active-HIGH or active-LOW state.

Current drive capability is 24 mA at the outputs.

Features

- Designed for 2.3 V to 3.6 V V_{CC} Operation
- 5 V Tolerant Inputs – Interface Capability With 5 V TTL Logic
- LVTTTL Compatible
- LVC MOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current (10 μ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V
Machine Model >200 V
- Pb-Free Packages are Available*

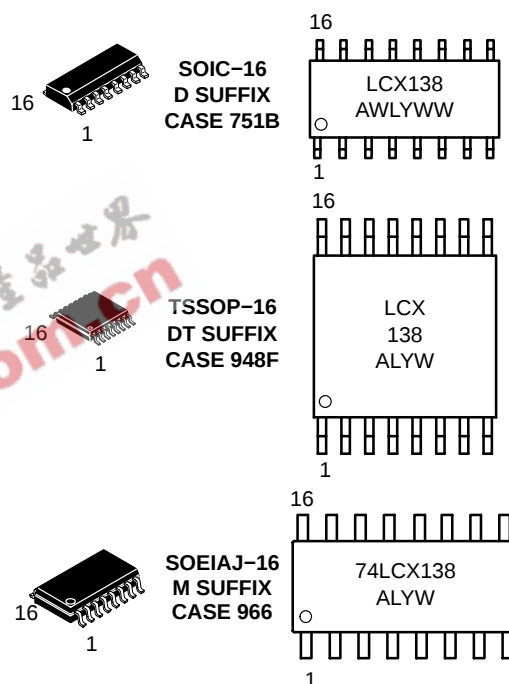
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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MARKING DIAGRAMS



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

ORDERING INFORMATION

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

MC74LCX138

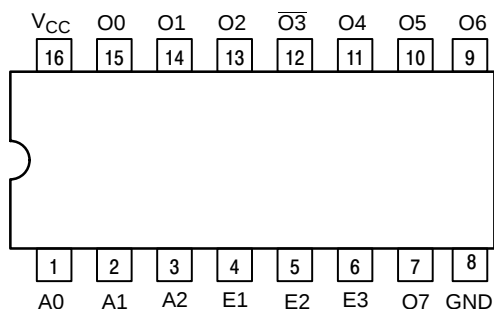


Figure 1. Pinout: 16-Lead (Top View)

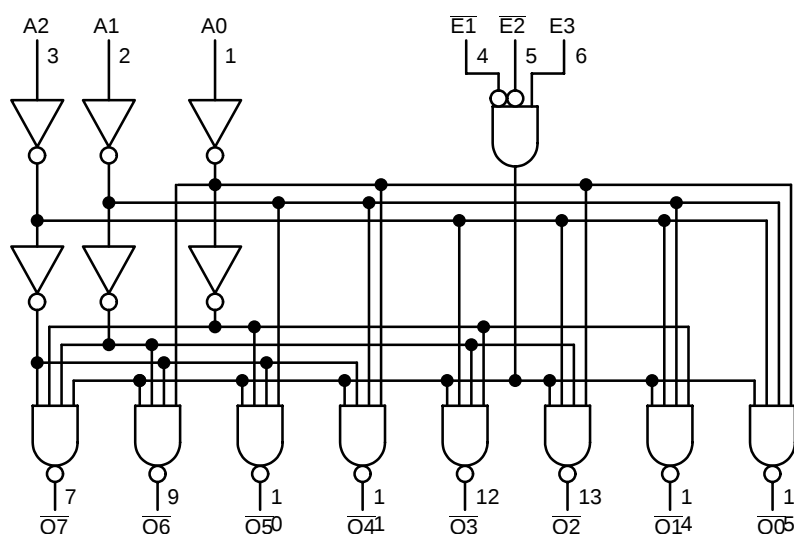


Figure 2. Logic Diagram

PIN NAMES

Pins	Function
A0-A2	Address Inputs
E1-E2	Enable Inputs
E3	Enable Input
O0-O7	Outputs

TRUTH TABLE

Inputs						Outputs							
E1	E2	E3	A0	A1	A2	O0	O1	O2	O3	O4	O5	O6	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

MC74LCX138

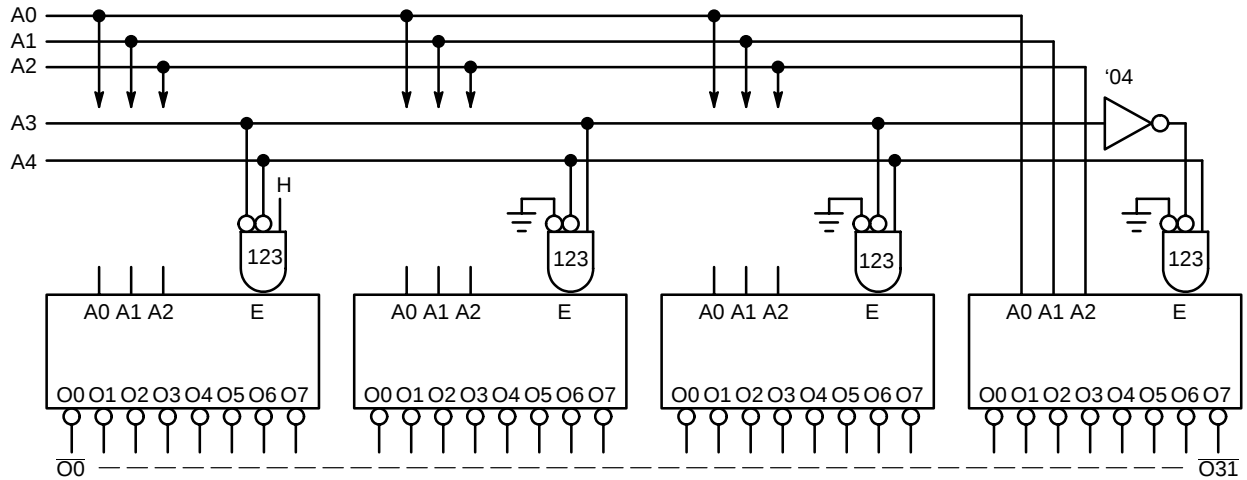


Figure 3. Expansion to 1-of-32 Decoding

ORDERING INFORMATION

Device	Package	Shipping [†]
MC74LCX138DR2	SOIC-16	2500 Tape & Reel
MC74LCX138DR2G	SOIC-16 (Pb-Free)	2500 Tape & Reel
MC74LCX138DT	TSSOP-16*	96 Units / Rail
MC74LCX138DTR2	TSSOP-16*	2500 Tape & Reel
MC74LCX138MEL	SOEIAJ-16	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	Condition	Unit
V_{CC}	DC Supply Voltage	-0.5 to +7.0		V
V_I	DC Input Voltage	$-0.5 \leq V_I \leq +7.0$		V
V_O	DC Output Voltage	$-0.5 \leq V_O \leq V_{CC} + 0.5$	Output in HIGH or LOW State (Note 1)	V
I_{IK}	DC Input Diode Current	-50	$V_I < GND$	mA
I_{OK}	DC Output Diode Current	-50	$V_O < GND$	mA
		+50	$V_O > V_{CC}$	mA
I_O	DC Output Source/Sink Current	± 50		mA
I_{CC}	DC Supply Current Per Supply Pin	± 100		mA
I_{GND}	DC Ground Current Per Ground Pin	± 100		mA
T_{STG}	Storage Temperature Range	-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.

1. I_O absolute maximum rating must be observed.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage Operating Data Retention Only	2.0 1.5	2.5, 3.3 2.5, 3.3	3.6 3.6	V
V_I	Input Voltage	0		5.5	V
V_O	Output Voltage (HIGH or LOW State) (3-State)	0		V_{CC}	V
I_{OH}	HIGH Level Output Current $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$ $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$ $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$			-24 -12 -8	mA
I_{OL}	LOW Level Output Current $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$ $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$ $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$			+24 +12 +8	mA
T_A	Operating Free-Air Temperature	-40		+85	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, V_{IN} from 0.8 V to 2.0 V, $V_{CC} = 3.0\text{ V}$	0		10	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Unit
			Min	Max	
V_{IH}	HIGH Level Input Voltage (Note 2)	$2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$ $2.7\text{ V} \leq V_{CC} \leq 3.6\text{ V}$	1.7 2.0		V
V_{IL}	LOW Level Input Voltage (Note 2)	$2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$ $2.7\text{ V} \leq V_{CC} \leq 3.6\text{ V}$		0.7 0.8	V
V_{OH}	HIGH Level Output Voltage	$2.3\text{ V} \leq V_{CC} \leq 3.6\text{ V}$; $I_{OH} = -100\text{ }\mu\text{A}$ $V_{CC} = 2.3\text{ V}$; $I_{OH} = -8\text{ mA}$ $V_{CC} = 2.7\text{ V}$; $I_{OH} = -12\text{ mA}$ $V_{CC} = 3.0\text{ V}$; $I_{OH} = -18\text{ mA}$ $V_{CC} = 3.0\text{ V}$; $I_{OH} = -24\text{ mA}$	$V_{CC} - 0.2$ 1.8 2.2 2.4 2.2		V
V_{OL}	LOW Level Output Voltage	$2.3\text{ V} \leq V_{CC} \leq 3.6\text{ V}$; $I_{OL} = 100\text{ }\mu\text{A}$ $V_{CC} = 2.3\text{ V}$; $I_{OL} = 8\text{ mA}$ $V_{CC} = 2.7\text{ V}$; $I_{OL} = 12\text{ mA}$ $V_{CC} = 3.0\text{ V}$; $I_{OL} = 16\text{ mA}$ $V_{CC} = 3.0\text{ V}$; $I_{OL} = 24\text{ mA}$		0.2 0.6 0.4 0.4 0.55	V
I_I	Input Leakage Current	$2.3\text{ V} \leq V_{CC} \leq 3.6\text{ V}$; $0\text{ V} \leq V_I \leq 5.5\text{ V}$		± 5	μA
I_{CC}	Quiescent Supply Current	$2.3 \leq V_{CC} \leq 3.6\text{ V}$; $V_I = \text{GND or } V_{CC}$ $2.3 \leq V_{CC} \leq 3.6\text{ V}$; $3.6 \leq V_I \text{ or } V_O \leq 5.5\text{ V}$		10 ± 10	μA
ΔI_{CC}	Increase in I_{CC} per Input	$2.3 \leq V_{CC} \leq 3.6\text{ V}$; $V_{IH} = V_{CC} - 0.6\text{ V}$		500	μA

2. These values of V_I are used to test DC electrical characteristics only.

AC CHARACTERISTICS $t_R = t_F = 2.5\text{ ns}$; $R_L = 500\text{ }\Omega$

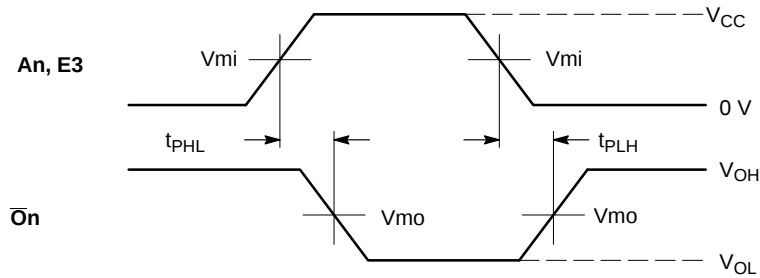
Symbol	Parameter	Waveform	Limits						Unit
			T _A = -40°C to +85°C						
			V _{CC} = 3.3 V ± 0.3 V		V _{CC} = 2.7 V		V _{CC} = 2.5 V ± 0.2 V		
			C _L = 50 pF		C _L = 50 pF		C _L = 30 pF		
			Min	Max	Min	Max	Min	Max	
t _{PLH} t _{PHL}	Propagation Delay An to On	1, 2	1.5 1.5	6.0 6.0	1.5 1.5	7.0 7.0	1.5 1.5	7.2 7.2	ns
t _{PLH} t _{PHL}	Propagation Delay E1, E2 to On	2	1.5 1.5	6.5 6.5	1.5 1.5	7.5 7.5	1.5 1.5	8.4 8.4	ns
t _{PLH} t _{PHL}	Propagation Delay E3 to On	1	1.5 1.5	6.0 6.0	1.5 1.5	7.0 7.0	1.5 1.5	7.2 7.2	ns
t _{OSHL} t _{OSLH}	Output-to-Output Skew (Note 3)			1.0 1.0					ns

3. 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.

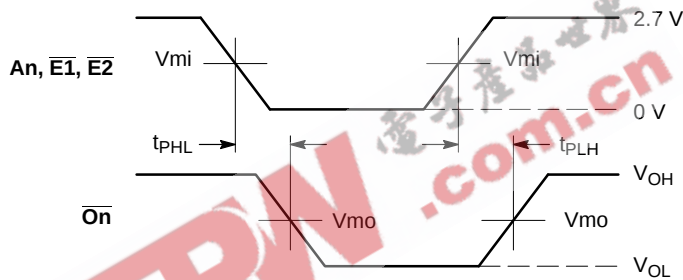
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CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Unit
C_{IN}	Input Capacitance	$V_{CC} = 3.3 \text{ V}$, $V_I = 0 \text{ V}$ or V_{CC}	7	pF
C_{OUT}	Output Capacitance	$V_{CC} = 3.3 \text{ V}$, $V_I = 0 \text{ V}$ or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	10 MHz, $V_{CC} = 3.3 \text{ V}$, $V_I = 0 \text{ V}$ or V_{CC}	25	pF



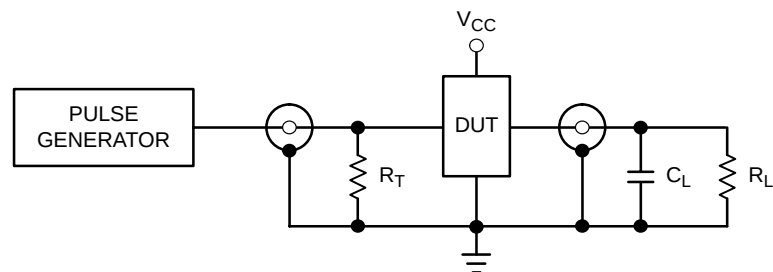
WAVEFORM 1: PROPAGATION DELAYS FOR INVERTING OUTPUTS



WAVEFORM 2: PROPAGATION DELAYS FOR NON-INVERTING OUTPUTS

Symbol	V_{CC}		
	$3.3 \text{ V} \pm 0.3 \text{ V}$	2.7 V	$2.5 \text{ V} \pm 0.2 \text{ V}$
V_{mi}	1.5 V	1.5 V	$V_{CC}/2$
V_{mo}	1.5 V	1.5 V	$V_{CC}/2$

Figure 4. AC Waveforms



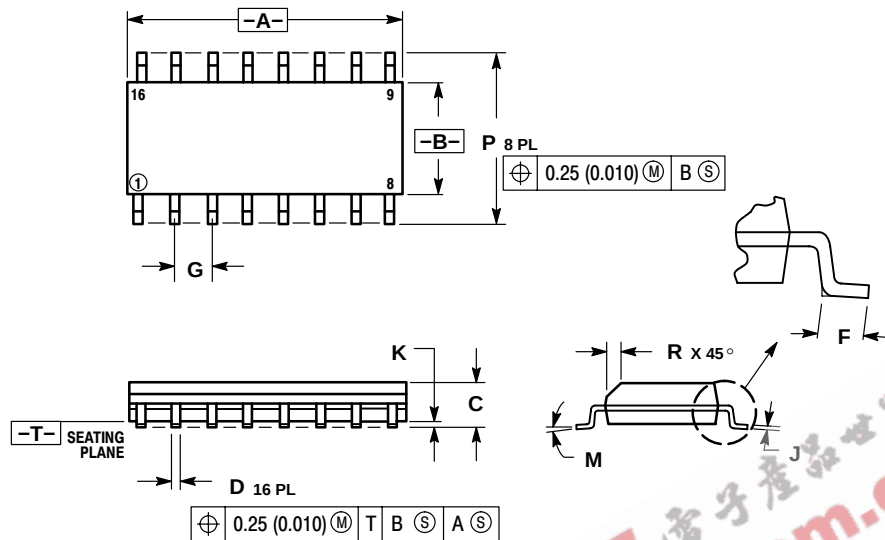
$C_L = 50 \text{ pF}$ at $V_{CC} = 3.3 \pm 0.3 \text{ V}$ or equivalent (includes jig and probe capacitance)
 $C_L = 30 \text{ pF}$ at $V_{CC} = 2.5 \pm 0.2 \text{ V}$ or equivalent (includes jig and probe capacitance)
 $R_L = R_1 = 500 \Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 5. Test Circuit

MC74LCX138

PACKAGE DIMENSIONS

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

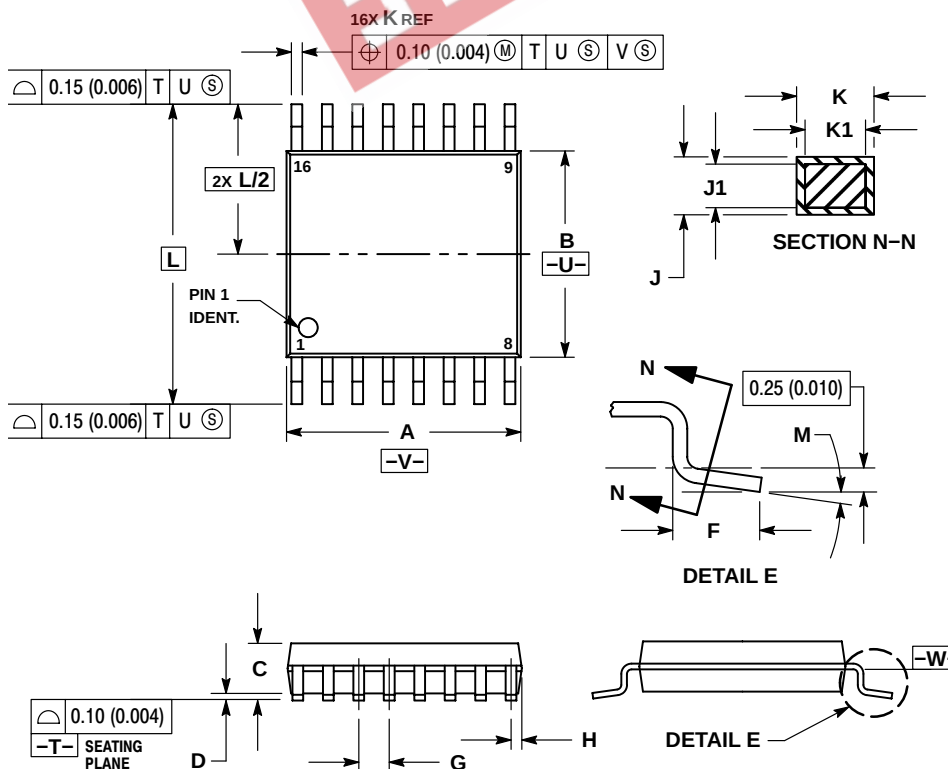


NOTES:

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.

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

TSSOP-16
DT SUFFIX
CASE 948F-01
ISSUE O



NOTES:

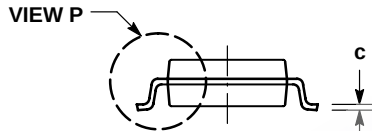
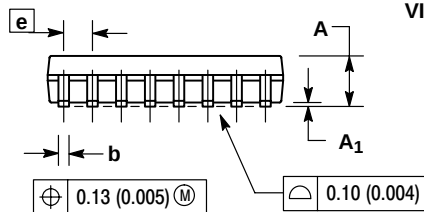
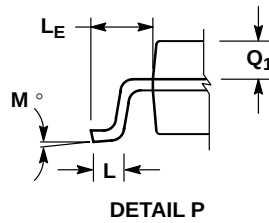
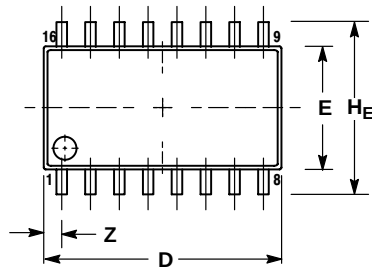
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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-.

DIM	MILLIMETERS		INCHES	
	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°

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PACKAGE DIMENSIONS

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).

DIM	MILLIMETERS		INCHES	
	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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