

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

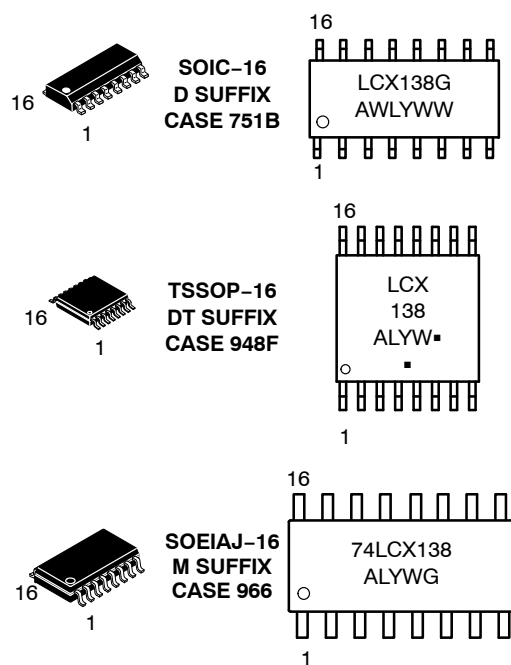
- Designed for 2.3 V to 3.6 V V_{CC} Operation
- 5 V Tolerant Inputs – Interface Capability With 5 V TTL Logic
- LVTTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current (10 μ A) Substantially Reduces System Power Requirements
- Latchup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



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MARKING DIAGRAMS



A = Assembly Location
WL, L = Wafer Lot
Y = Year
WW, W = Work Week
G or ▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

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

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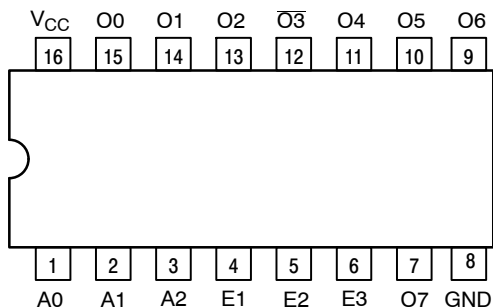


Figure 1. Pinout: 16-Lead (Top View)

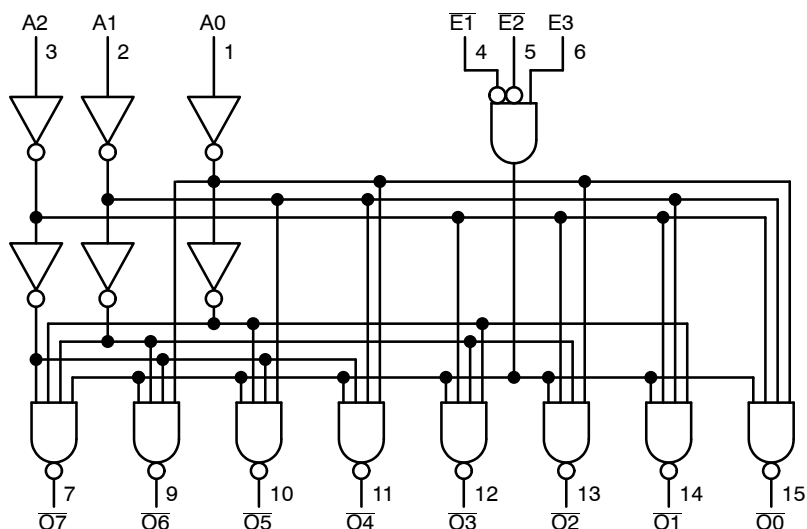


Figure 2. Logic Diagram

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 | 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

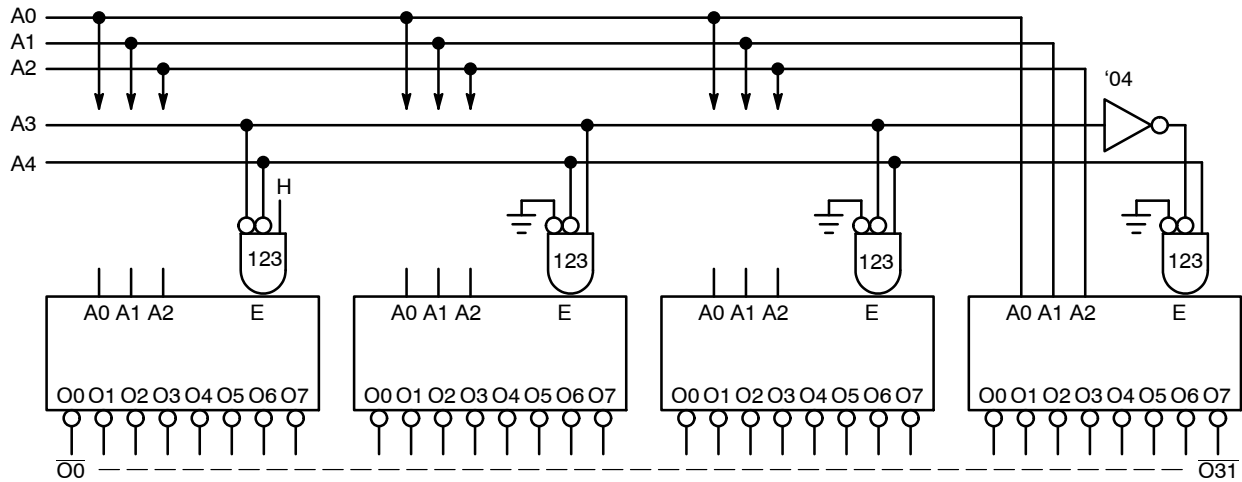


Figure 3. Expansion to 1-of-32 Decoding

ORDERING INFORMATION

| Device | Package | Shipping† |
|-----------------|------------------------|------------------|
| MC74LCX138DR2G | SOIC-16 (Pb-Free) | 2500 Tape & Reel |
| MC74LCX138DTG | TSSOP-16* (Pb-Free) | 96 Units / Rail |
| MC74LCX138DTR2G | TSSOP-16* (Pb-Free) | 2500 Tape & Reel |
| MC74LCX138MELG | 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 | Condition | Value | Units |
|-----------|----------------------------------|--------------------------------------|-----------------------------------|-------|
| 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 | Output in HIGH or LOW State (Note 1) | $-0.5 \leq V_O \leq V_{CC} + 0.5$ | V |
| I_{IK} | DC Input Diode Current | $V_I < \text{GND}$ | -50 | mA |
| I_{OK} | DC Output Diode Current | $V_O < \text{GND}$ | -50 | mA |
| | | $V_O > V_{CC}$ | +50 | 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 |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. I_O absolute maximum rating must be observed.

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RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Typ | Max | Units |
|-----------------|--|------------|----------------------|------------------|-------|
| V _{CC} | Supply Voltage | 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 | 0 | | V _{CC} | V |
| I _{OH} | HIGH Level Output Current | | | -24 -12 -8 | mA |
| I _{OL} | LOW Level Output Current | | | +24 +12 +8 | mA |
| T _A | Operating Free-Air Temperature | -40 | | +85 | °C |
| Δt/ΔV | Input Transition Rise or Fall Rate, V _{IN} from 0.8 V to 2.0 V, V _{CC} = 3.0 V | 0 | | 10 | ns/V |

DC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic | Condition | T _A = -40°C to +85°C | | Units |
|------------------|---------------------------------------|---|---------------------------------|------|-------|
| | | | Min | Max | |
| V _{IH} | HIGH Level Input Voltage (Note 2) | 2.3 V ≤ V _{CC} ≤ 2.7 V | 1.7 | | V |
| | | 2.7 V ≤ V _{CC} ≤ 3.6 V | 2.0 | | |
| V _{IL} | LOW Level Input Voltage (Note 2) | 2.3 V ≤ V _{CC} ≤ 2.7 V | | 0.7 | V |
| | | 2.7 V ≤ V _{CC} ≤ 3.6 V | | 0.8 | |
| V _{OH} | HIGH Level Output Voltage | 2.3 V ≤ V _{CC} ≤ 3.6 V; I _{OH} = -100 μA | V _{CC} - 0.2 | | V |
| | | V _{CC} = 2.3 V; I _{OH} = -8 mA | 1.8 | | |
| | | V _{CC} = 2.7 V; I _{OH} = -12 mA | 2.2 | | |
| | | V _{CC} = 3.0 V; I _{OH} = -18 mA | 2.4 | | |
| V _{OL} | LOW Level Output Voltage | 2.3 V ≤ V _{CC} ≤ 3.6 V; I _{OL} = 100 μA | | 0.2 | V |
| | | V _{CC} = 2.3 V; I _{OL} = 8 mA | | 0.6 | |
| | | V _{CC} = 2.7 V; I _{OL} = 12 mA | | 0.4 | |
| | | V _{CC} = 3.0 V; I _{OL} = 16 mA | | 0.4 | |
| | | V _{CC} = 3.0 V; I _{OL} = 24 mA | | 0.55 | |
| I _I | Input Leakage Current | 2.3 V ≤ V _{CC} ≤ 3.6 V; 0 V ≤ V _I ≤ 5.5 V | | ±5 | μA |
| I _{CC} | Quiescent Supply Current | 2.3 ≤ V _{CC} ≤ 3.6 V; V _I = GND or V _{CC} | | 10 | μA |
| | | 2.3 ≤ V _{CC} ≤ 3.6 V; 3.6 ≤ V _I or V _O ≤ 5.5 V | | ±10 | |
| ΔI _{CC} | Increase in I _{CC} per Input | 2.3 ≤ V _{CC} ≤ 3.6 V; V _{IH} = V _{CC} - 0.6 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 ns; R_L = 500 Ω

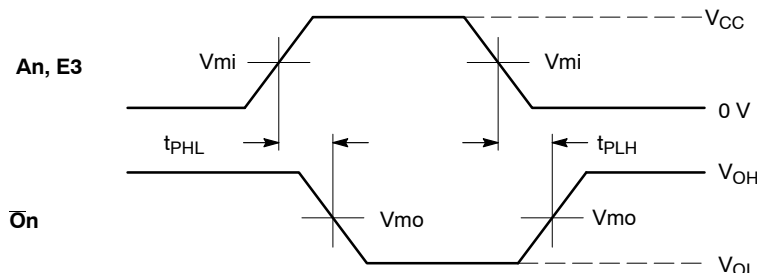
| Symbol | Parameter | Waveform | Limits | | | | | | Units |
|---|--|----------|---------------------------------|------------|-------------------------|-----|---------------------------------|-----|-------|
| | | | T _A = -40°C to +85°C | | | | | | |
| | | | V _{CC} = 3.3 V ± 0.3 V | | V _{CC} = 2.7 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 $\overline{O}n$ | 1, 2 | 1.5 | 6.0 | 1.5 | 7.0 | 1.5 | 7.2 | ns |
| | | | 1.5 | 6.0 | 1.5 | 7.0 | 1.5 | 7.2 | |
| t _{PLH} t _{PHL} | Propagation Delay E1, E2 to $\overline{O}n$ | 2 | 1.5 | 6.5 | 1.5 | 7.5 | 1.5 | 8.4 | ns |
| | | | 1.5 | 6.5 | 1.5 | 7.5 | 1.5 | 8.4 | |
| t _{PLH} t _{PHL} | Propagation Delay E3 to $\overline{O}n$ | 1 | 1.5 | 6.0 | 1.5 | 7.0 | 1.5 | 7.2 | ns |
| | | | 1.5 | 6.0 | 1.5 | 7.0 | 1.5 | 7.2 | |
| t _{OSSLH} 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_{OSSLH}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

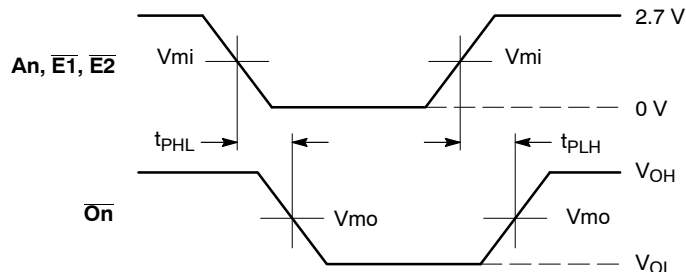
MC74LCX138

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Units |
|-----------|-------------------------------|--|---------|-------|
| 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 |



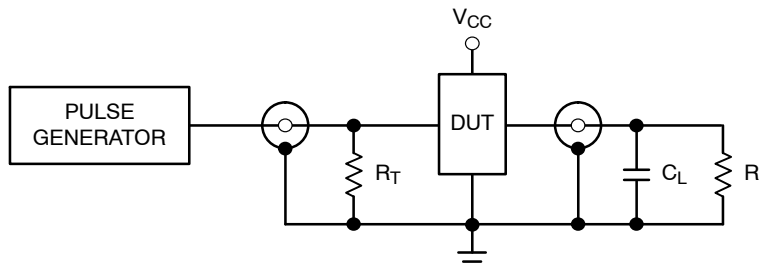
WAVEFORM 1: PROPAGATION DELAYS FOR INVERTING OUTPUTS



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



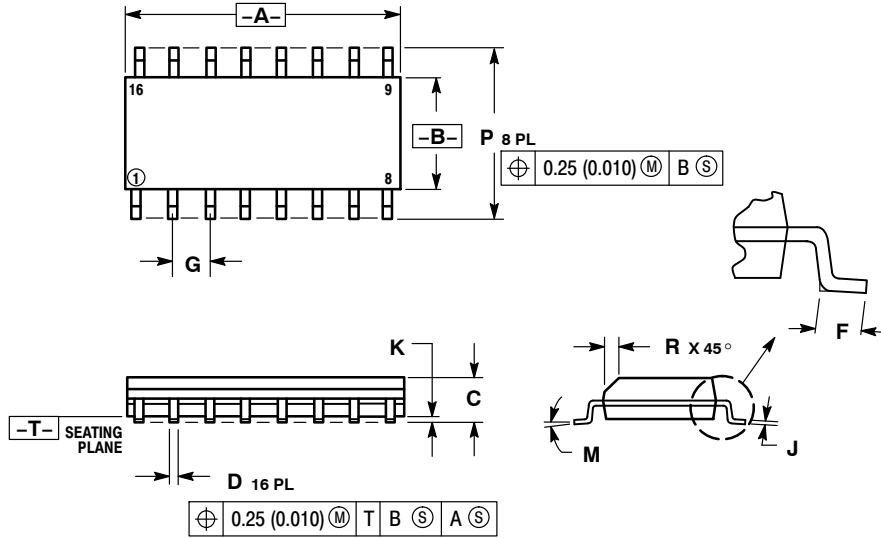
$C_L = 50\text{ pF}$ at $V_{CC} = 3.3 \pm 0.3\text{ V}$ or equivalent (includes jig and probe capacitance)
 $C_L = 30\text{ pF}$ at $V_{CC} = 2.5 \pm 0.2\text{ V}$ or equivalent (includes jig and probe capacitance)
 $R_L = R_1 = 500\ \Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically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

Figure 5. Test Circuit

MC74LCX138

PACKAGE DIMENSIONS

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

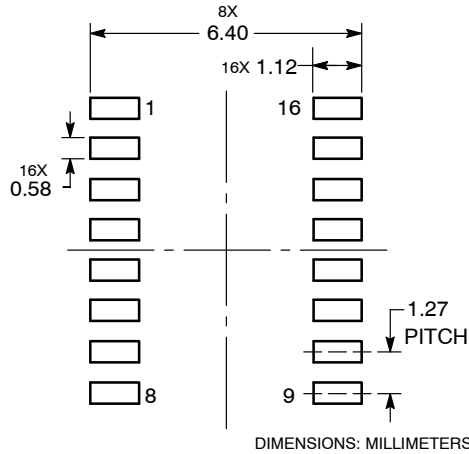


NOTES:

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 $^\circ$ | 7 $^\circ$ | 0 $^\circ$ | 7 $^\circ$ |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

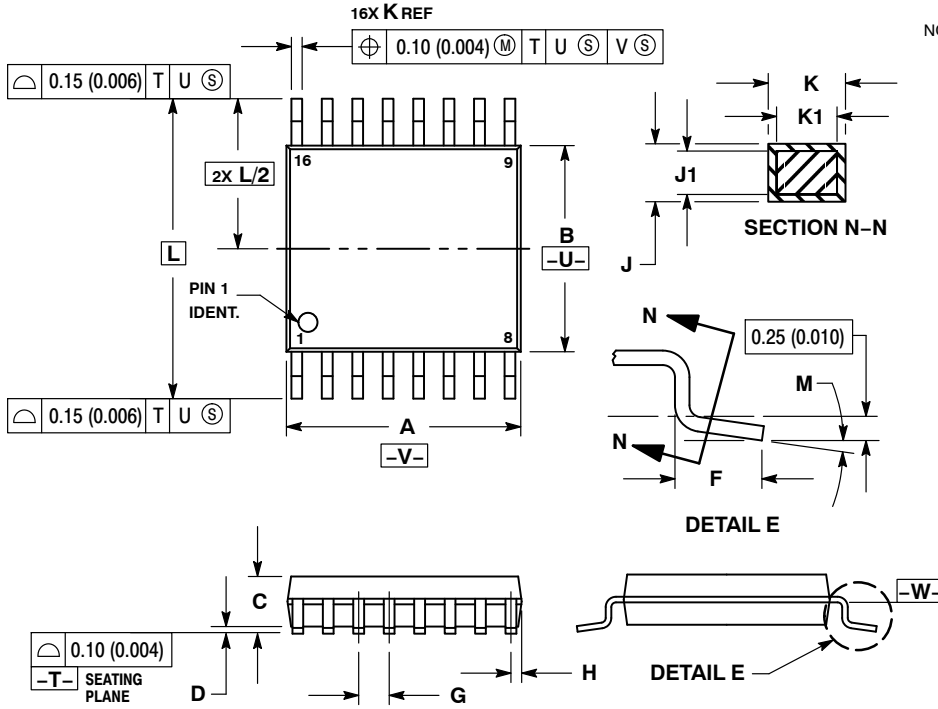
SOLDERING FOOTPRINT



MC74LCX138

PACKAGE DIMENSIONS

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

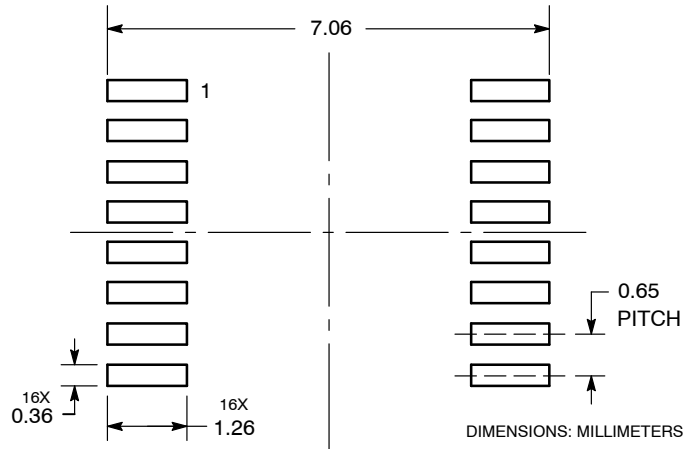


NOTES:

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° |

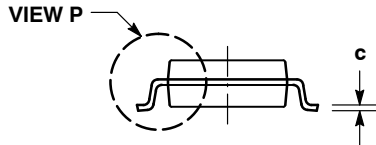
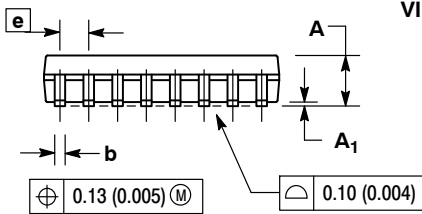
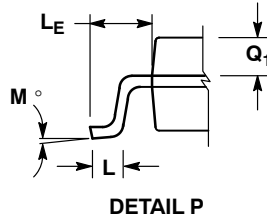
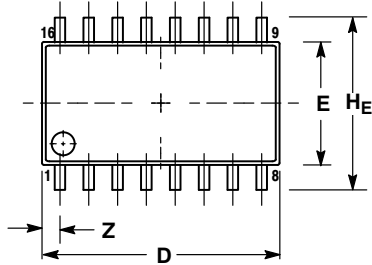
SOLDERING FOOTPRINT



MC74LCX138

PACKAGE DIMENSIONS

SOEIAJ-16
M SUFFIX
CASE 966-01
ISSUE A



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 | 0.10 | 0.20 | 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 | |
| HE | 7.40 | 8.20 | 0.291 | 0.323 |
| L | 0.50 | 0.85 | 0.020 | 0.033 |
| LE | 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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