

## 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 7V, allowing the interface of 5V systems to 3V 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.

- High Speed:  $t_{PD} = 5.5\text{ns}$  (Typ) at  $V_{CC} = 3.3\text{V}$
- Low Power Dissipation:  $I_{CC} = 4\mu\text{A}$  (Max) at  $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise:  $V_{OLP} = 0.5\text{V}$  (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 2000V; Machine Model > 200V

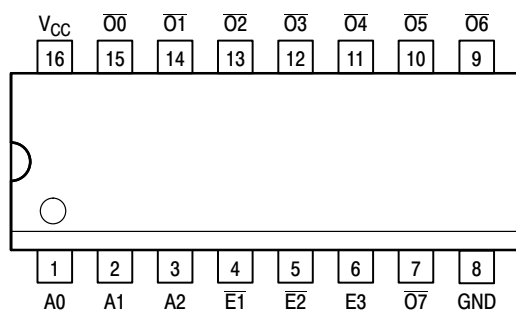


Figure 1. 16-Lead Pinout (Top View)

## MC74LVX138

# LVX

### LOW-VOLTAGE CMOS



**D SUFFIX**  
16-LEAD SOIC PACKAGE  
CASE 751B-05



**DT SUFFIX**  
16-LEAD TSSOP PACKAGE  
CASE 948F-01



**M SUFFIX**  
16-LEAD SOIC EIAJ PACKAGE  
CASE 966-01

#### PIN NAMES

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

# MC74LVX138

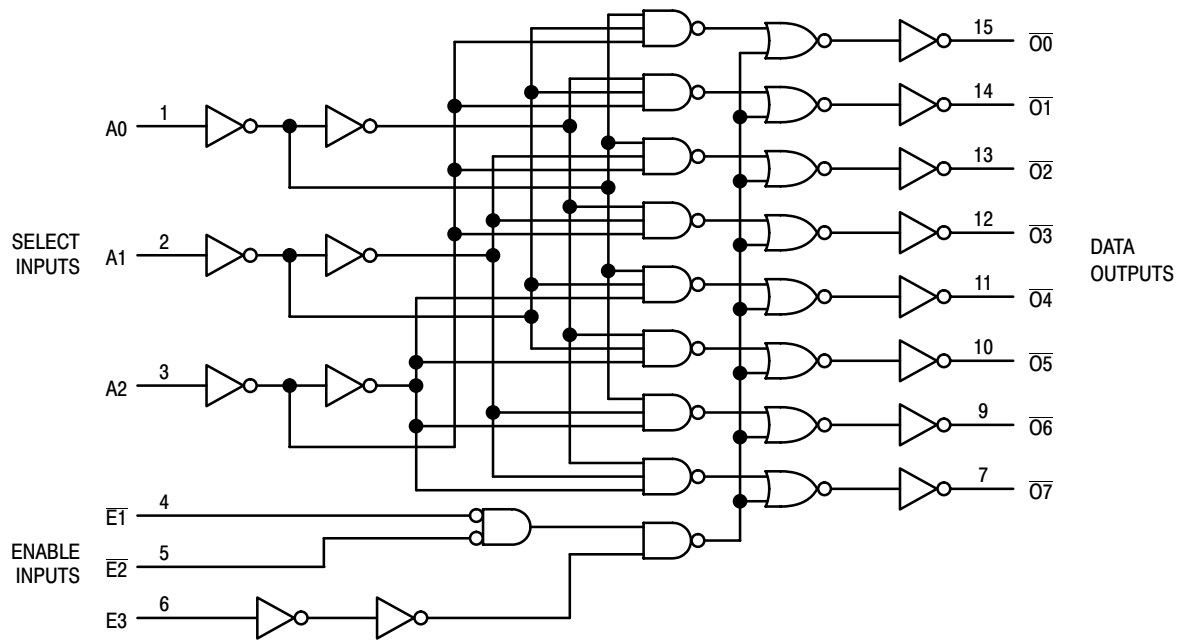


Figure 2. Logic Diagram

| 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  | L  | H  | L  | L  | H       | L  | H  | H  | H  | H  | H  | H  |
| L      | L  | L  | L  | H  | L  | H       | H  | L  | H  | H  | H  | H  | H  |
| L      | L  | H  | L  | L  | H  | H       | H  | H  | H  | L  | H  | H  | H  |
| L      | L  | L  | L  | L  | H  | H       | H  | H  | H  | H  | L  | H  | H  |
| L      | L  | L  | L  | L  | L  | H       | H  | H  | H  | H  | H  | L  | H  |
| L      | L  | L  | L  | L  | L  | 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

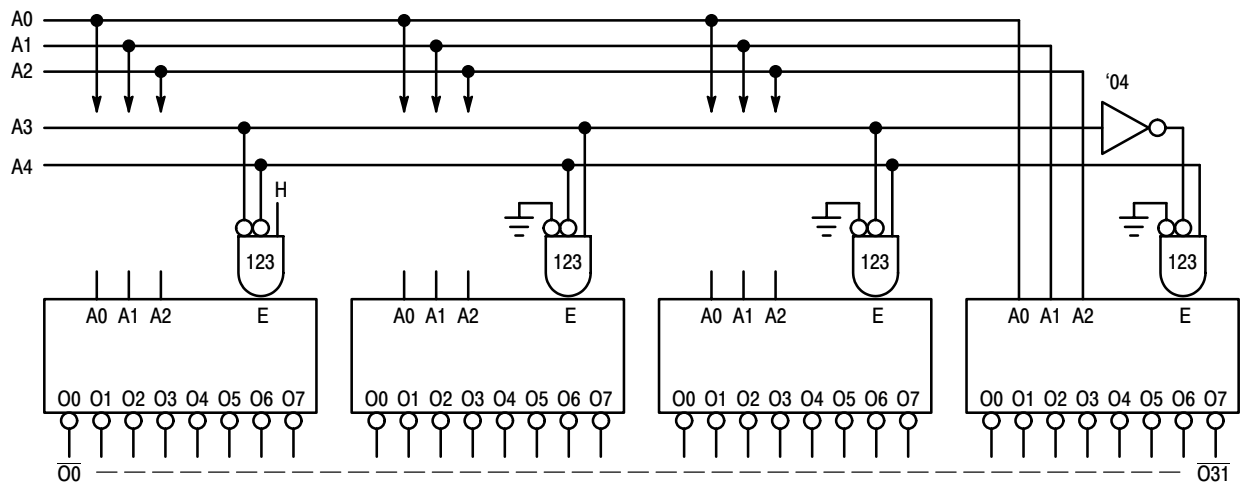


Figure 3. Expansion to 1-of-32 Decoding

# MC74LVX138

## MAXIMUM RATINGS\*

| Symbol           | Parameter                                       | Value                        | Unit |
|------------------|-------------------------------------------------|------------------------------|------|
| V <sub>CC</sub>  | DC Supply Voltage                               | −0.5 to +7.0                 | V    |
| V <sub>in</sub>  | DC Input Voltage                                | −0.5 to +7.0                 | V    |
| V <sub>out</sub> | DC Output Voltage                               | −0.5 to V <sub>CC</sub> +0.5 | V    |
| I <sub>IK</sub>  | Input Diode Current                             | −20                          | mA   |
| I <sub>OK</sub>  | Output Diode Current                            | ±20                          | mA   |
| I <sub>out</sub> | DC Output Current, per Pin                      | ±25                          | mA   |
| I <sub>CC</sub>  | DC Supply Current, V <sub>CC</sub> and GND Pins | ±75                          | mA   |
| P <sub>D</sub>   | Power Dissipation                               | 180                          | mW   |
| T <sub>stg</sub> | Storage Temperature                             | −65 to +150                  | °C   |

\* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute–maximum–rated conditions is not implied.

## RECOMMENDED OPERATING CONDITIONS

| Symbol           | Parameter                                | Min | Max             | Unit |
|------------------|------------------------------------------|-----|-----------------|------|
| V <sub>CC</sub>  | DC Supply Voltage                        | 2.0 | 3.6             | V    |
| V <sub>in</sub>  | DC Input Voltage                         | 0   | 5.5             | V    |
| V <sub>out</sub> | DC Output Voltage                        | 0   | V <sub>CC</sub> | V    |
| T <sub>A</sub>   | Operating Temperature, All Package Types | −40 | +85             | °C   |
| Δt/ΔV            | Input Rise and Fall Time                 | 0   | 100             | ns/V |

## DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter                                                                            | Test Conditions                                                              | V <sub>CC</sub><br>V | T <sub>A</sub> = 25°C |            |                    | T <sub>A</sub> = −40 to 85°C |                    | Unit |
|-----------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------|-----------------------|------------|--------------------|------------------------------|--------------------|------|
|                 |                                                                                      |                                                                              |                      | Min                   | Typ        | Max                | Min                          | Max                |      |
| V <sub>IH</sub> | High–Level Input Voltage                                                             |                                                                              | 2.0<br>3.0<br>3.6    | 1.5<br>2.0<br>2.4     |            |                    | 1.5<br>2.0<br>2.4            |                    | V    |
| V <sub>IL</sub> | Low–Level Input Voltage                                                              |                                                                              | 2.0<br>3.0<br>3.6    |                       |            | 0.5<br>0.8<br>0.8  |                              | 0.5<br>0.8<br>0.8  | V    |
| V <sub>OH</sub> | High–Level Output Voltage<br>(V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub> ) | I <sub>OH</sub> = −50μA<br>I <sub>OH</sub> = −50μA<br>I <sub>OH</sub> = −4mA | 2.0<br>3.0<br>3.0    | 1.9<br>2.9<br>2.58    | 2.0<br>3.0 |                    | 1.9<br>2.9<br>2.48           |                    | V    |
| V <sub>OL</sub> | Low–Level Output Voltage<br>(V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub> )  | I <sub>OL</sub> = 50μA<br>I <sub>OL</sub> = 50μA<br>I <sub>OL</sub> = 4mA    | 2.0<br>3.0<br>3.0    |                       | 0.0<br>0.0 | 0.1<br>0.1<br>0.36 |                              | 0.1<br>0.1<br>0.44 | V    |
| I <sub>in</sub> | Input Leakage Current                                                                | V <sub>in</sub> = 5.5V or GND                                                | 3.6                  |                       |            | ±0.1               |                              | ±1.0               | μA   |
| I <sub>CC</sub> | Quiescent Supply Current                                                             | V <sub>in</sub> = V <sub>CC</sub> or GND                                     | 3.6                  |                       |            | 4.0                |                              | 40.0               | μA   |

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## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0\text{ns}$ )

| Symbol                   | Parameter                                                                 | Test Conditions                                                                                  | $T_A = 25^\circ\text{C}$ |             |              | $T_A = -40 \text{ to } 85^\circ\text{C}$ |              | Unit |
|--------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------|-------------|--------------|------------------------------------------|--------------|------|
|                          |                                                                           |                                                                                                  | Min                      | Typ         | Max          | Min                                      | Max          |      |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay<br>Input to Output                                      | $V_{CC} = 2.7\text{V}$ $C_L = 15\text{pF}$<br>$C_L = 50\text{pF}$                                |                          | 7.1<br>9.6  | 13.8<br>17.3 | 1.0<br>1.0                               | 16.5<br>20.0 | ns   |
|                          |                                                                           | $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$<br>$C_L = 50\text{pF}$                        |                          | 5.5<br>8.0  | 8.8<br>12.3  | 1.0<br>1.0                               | 10.5<br>14.0 |      |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay<br>$\overline{E3}$ to $\overline{O}$                    | $V_{CC} = 2.7\text{V}$ $C_L = 15\text{pF}$<br>$C_L = 50\text{pF}$                                |                          | 8.7<br>11.2 | 16.3<br>19.8 | 1.0<br>1.0                               | 19.5<br>23.0 | ns   |
|                          |                                                                           | $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$<br>$C_L = 50\text{pF}$                        |                          | 6.8<br>9.3  | 10.6<br>14.1 | 1.0<br>1.0                               | 12.5<br>16.0 |      |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay<br>$\overline{E1}$ or $\overline{E2}$ to $\overline{O}$ | $V_{CC} = 2.7\text{V}$ $C_L = 15\text{pF}$<br>$C_L = 50\text{pF}$                                |                          | 8.8<br>11.3 | 16.0<br>19.5 | 1.0<br>1.0                               | 18.5<br>22.0 | ns   |
|                          |                                                                           | $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$<br>$C_L = 50\text{pF}$                        |                          | 6.9<br>9.4  | 10.4<br>13.9 | 1.0<br>1.0                               | 11.5<br>15.0 |      |
| $t_{OSHL}$<br>$t_{OSLH}$ | Output-to-Output Skew<br>(Note 1.)                                        | $V_{CC} = 2.7\text{V}$ $C_L = 50\text{pF}$<br>$V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 50\text{pF}$ |                          |             | 2.5<br>2.5   |                                          | 2.5<br>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                               | $T_A = 25^\circ\text{C}$ |     |     | $T_A = -40 \text{ to } 85^\circ\text{C}$ |     | Unit |
|----------|-----------------------------------------|--------------------------|-----|-----|------------------------------------------|-----|------|
|          |                                         | Min                      | Typ | Max | Min                                      | Max |      |
| $C_{in}$ | 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:  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$ .  $C_{PD}$  is used to determine the no-load dynamic power consumption;  $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$ .

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

| Symbol    | Characteristic                           | $T_A = 25^\circ\text{C}$ |      | 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    |

# MC74LVX138

## SWITCHING WAVEFORMS

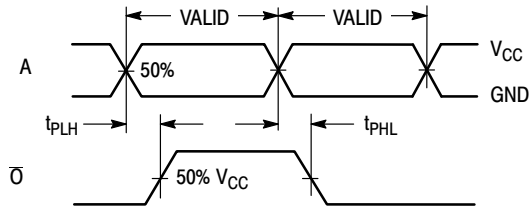


Figure 1.

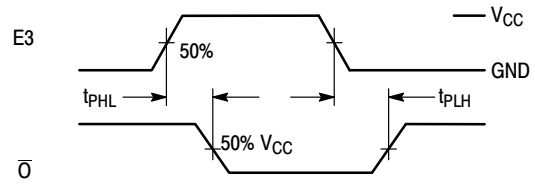


Figure 2.

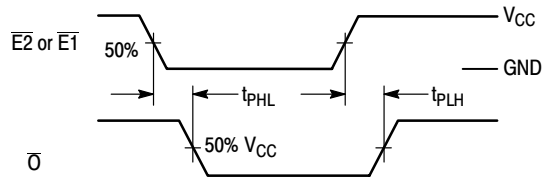
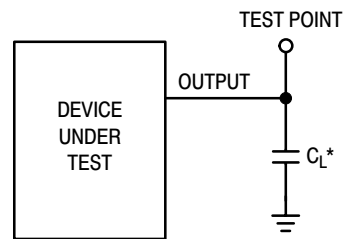


Figure 4.

## TEST CIRCUIT



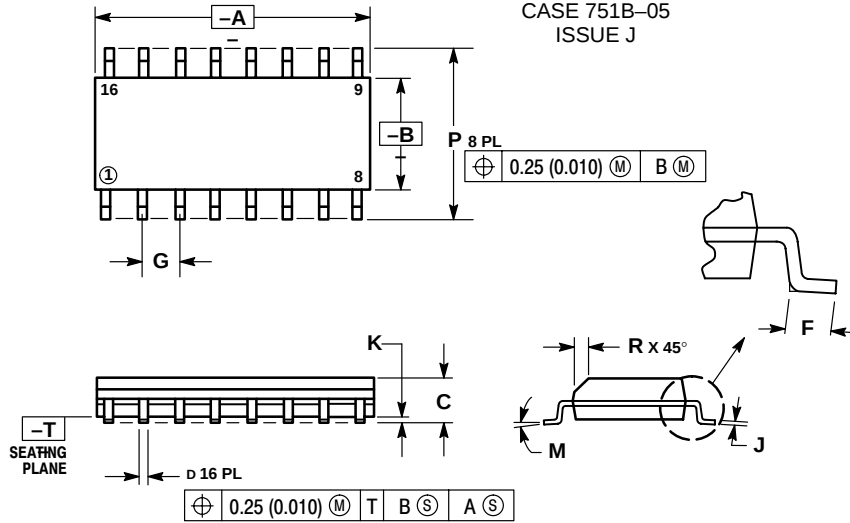
\*Includes all probe and jig capacitance

Figure 5.

# MC74LVX138

## OUTLINE DIMENSIONS

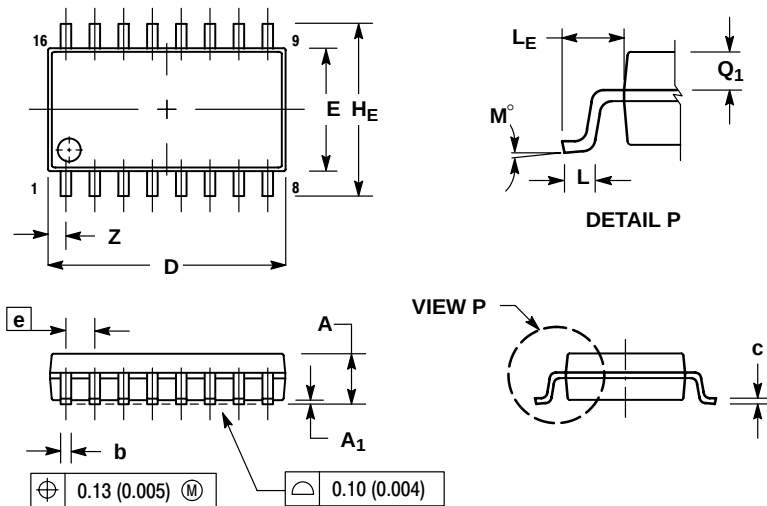
### D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



- 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 |

### M SUFFIX PLASTIC SOIC EIAJ PACKAGE CASE 966-01 ISSUE O



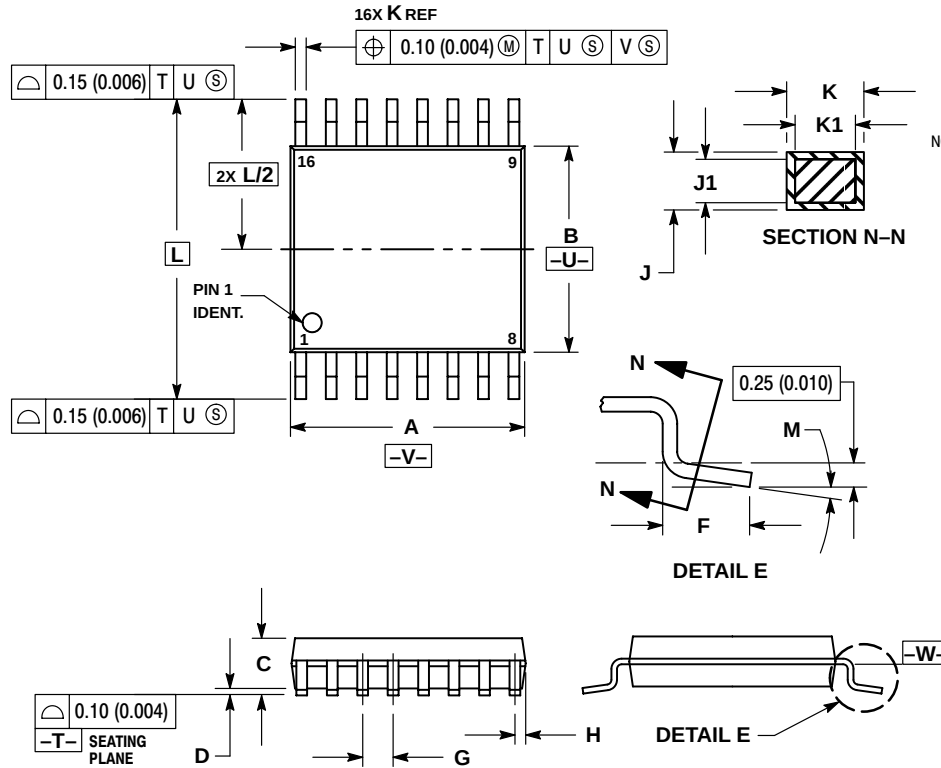
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. TERMINAL NUMBERS ARE SHOWN 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              | 9.80        | 10.00 | 0.386     | 0.393 |
| A <sub>1</sub> | 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 <sub>E</sub> | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| L <sub>E</sub> | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0°          | 10°   | 0°        | 10°   |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 0.78  | ---       | 0.031 |

# MC74LVX138

## OUTLINE DIMENSIONS

DT SUFFIX  
PLASTIC TSSOP PACKAGE  
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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