

## 74LVQ138

### Low Voltage 1-of-8 Decoder/Demultiplexer

#### General Description

The LVQ138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three LVQ138 devices or a 1-of-32 decoder using four LVQ138 devices and one inverter.

#### Features

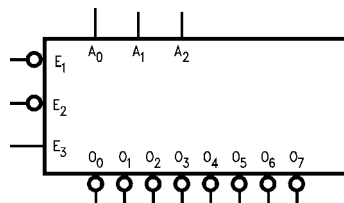
- Ideal for low power/low noise 3.3V applications
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Improved latch-up immunity
- Guaranteed incident wave switching into 75Ω
- 4kV minimum ESD immunity
- Demultiplexing capability
- Multiple input enable for each expansion
- Active LOW mutually exclusive outputs

#### Ordering Code:

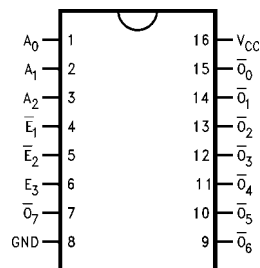
| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| 74LVQ138SC   | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74LVQ138SJ   | M16D           | 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |

Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

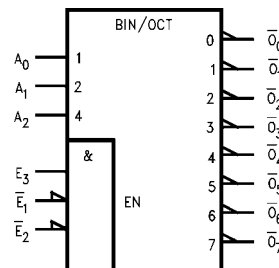
#### Logic Symbols



IEEE/IEC



#### Connection Diagram



#### Pin Descriptions

| Pin Names                           | Description    |
|-------------------------------------|----------------|
| $A_0$ – $A_2$                       | Address Inputs |
| $\overline{E}_1$ – $\overline{E}_2$ | Enable Inputs  |
| $E_3$                               | Enable Input   |
| $\overline{O}_0$ – $\overline{O}_7$ | Outputs        |

## Functional Description

The LVQ138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs ( $A_0$ ,  $A_1$ ,  $A_2$ ) and, when enabled, provides eight mutually exclusive active-LOW outputs ( $\bar{O}_0$ – $\bar{O}_7$ ). The LVQ138 features three Enable inputs, two active-LOW ( $\bar{E}_1$ ,  $\bar{E}_2$ ) and one active-HIGH ( $E_3$ ). All outputs will be HIGH unless  $\bar{E}_1$  and  $\bar{E}_2$  are LOW and  $E_3$  is HIGH. This multiple enable function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four LVQ138 devices and one inverter (see Figure 1). The LVQ138 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.

## Truth Table

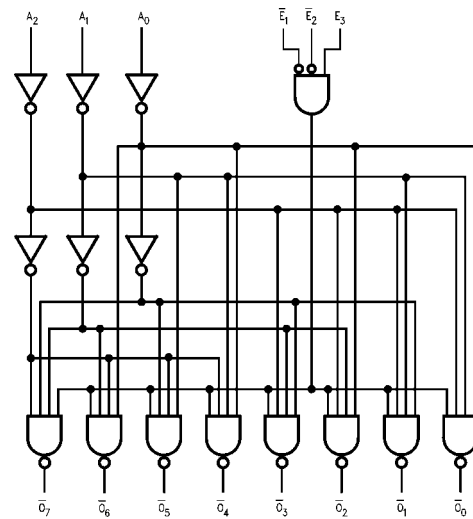
| Inputs      |             |       |       |       |       | Outputs     |             |             |             |             |             |             |             |
|-------------|-------------|-------|-------|-------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| $\bar{E}_1$ | $\bar{E}_2$ | $E_3$ | $A_0$ | $A_1$ | $A_2$ | $\bar{O}_0$ | $\bar{O}_1$ | $\bar{O}_2$ | $\bar{O}_3$ | $\bar{O}_4$ | $\bar{O}_5$ | $\bar{O}_6$ | $\bar{O}_7$ |
| 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           | L           | H           | H           | H           | H           |
| L           | L           | H     | H     | L     | H     | H           | H           | H           | H           | L           | H           | H           | H           |
| L           | L           | H     | L     | H     | H     | H           | H           | H           | H           | H           | L           | H           | H           |
| L           | L           | H     | H     | 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 = Immaterial

## Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

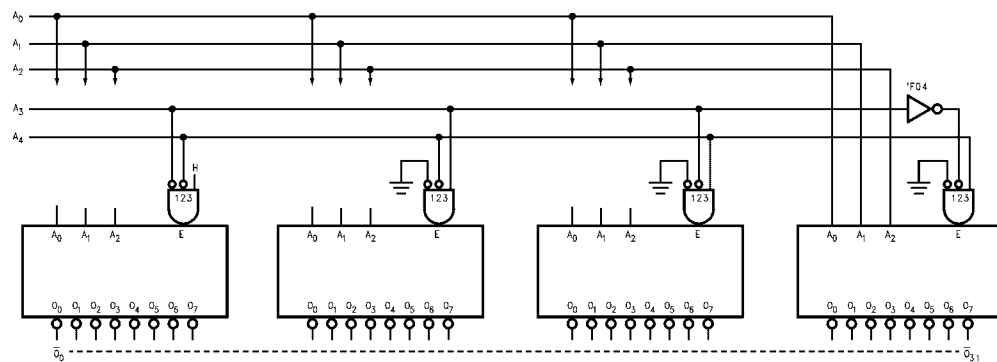


FIGURE 1. Expansion to 1-of-32 Decoding

**Absolute Maximum Ratings**(Note 1)

|                                                            |                          |
|------------------------------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )                                | –0.5V to +7.0V           |
| DC Input Diode Current ( $I_{IK}$ )                        |                          |
| $V_I = -0.5V$                                              | –20 mA                   |
| $V_I = V_{CC} + 0.5V$                                      | +20 mA                   |
| DC Input Voltage ( $V_I$ )                                 | –0.5V to $V_{CC} + 0.5V$ |
| DC Output Diode Current ( $I_{OK}$ )                       |                          |
| $V_O = -0.5V$                                              | –20 mA                   |
| $V_O = V_{CC} + 0.5V$                                      | +20 mA                   |
| DC Output Voltage ( $V_O$ )                                | –0.5V to $V_{CC} + 0.5V$ |
| DC Output Source<br>or Sink Current ( $I_O$ )              | ±50 mA                   |
| DC $V_{CC}$ or Ground Current<br>( $I_{CC}$ or $I_{GND}$ ) | ±200 mA                  |
| Storage Temperature ( $T_{STG}$ )                          | –65°C to +150°C          |
| DC Latch-Up Source or<br>Sink Current                      | ±300 mA                  |

**Recommended Operating Conditions** (Note 2)

|                                                 |                |
|-------------------------------------------------|----------------|
| Supply Voltage ( $V_{CC}$ )                     | 2.0V to 3.6V   |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$ |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$ |
| Operating Temperature ( $T_A$ )                 | –40°C to +85°C |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                |
| $V_{IN}$ from 0.8V to 2.0V                      |                |
| $V_{CC}$ @ 3.0V                                 | 125 mV/ns      |

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:** Unused inputs must be held HIGH or LOW. They may not float.

**DC Electrical Characteristics**

| Symbol           | Parameter                                    | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = −40°C to +85°C | Units | Conditions                                                                                |
|------------------|----------------------------------------------|------------------------|------------------------|-------------------|---------------------------------|-------|-------------------------------------------------------------------------------------------|
|                  |                                              |                        | Typ                    | Guaranteed Limits |                                 |       |                                                                                           |
| V <sub>IH</sub>  | Minimum High Level Input Voltage             | 3.0                    | 1.5                    | 2.0               | 2.0                             | V     | V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> − 0.1V                                         |
| V <sub>IL</sub>  | Maximum Low Level Input Voltage              | 3.0                    | 1.5                    | 0.8               | 0.8                             | V     | V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> − 0.1V                                         |
| V <sub>OH</sub>  | Minimum High Level Output Voltage            | 3.0                    | 2.99                   | 2.9               | 2.9                             | V     | I <sub>OUT</sub> = −50 μA                                                                 |
|                  |                                              | 3.0                    |                        | 2.58              | 2.48                            | V     | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> (Note 3)<br>I <sub>OH</sub> = −12 mA |
| V <sub>OL</sub>  | Maximum Low Level Output Voltage             | 3.0                    | 0.002                  | 0.1               | 0.1                             | V     | I <sub>OUT</sub> = 50 μA                                                                  |
|                  |                                              | 3.0                    |                        | 0.36              | 0.44                            | V     | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> (Note 3)<br>I <sub>OL</sub> = 12 mA  |
| I <sub>IN</sub>  | Maximum Input Leakage Current                | 3.6                    |                        | ±0.1              | ±1.0                            | μA    | V <sub>I</sub> = V <sub>CC</sub> , GND                                                    |
| I <sub>OLD</sub> | Minimum Dynamic (Note 4)                     | 3.6                    |                        |                   | 36                              | mA    | V <sub>OLD</sub> = 0.8V Max (Note 5)                                                      |
| I <sub>OH</sub>  | Output Current                               | 3.6                    |                        |                   | −25                             | mA    | V <sub>OHD</sub> = 2.0V Min (Note 5)                                                      |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current             | 3.6                    |                        | 4.0               | 40.0                            | μA    | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                  |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 3.3                    |                        | 0.8               |                                 | V     | (Note 6)(Note 7)                                                                          |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 3.3                    |                        | −0.8              |                                 | V     | (Note 6)(Note 7)                                                                          |
| V <sub>IHD</sub> | Maximum High Level Dynamic Input Voltage     | 3.3                    | 1.7                    | 2.0               |                                 | V     | (Note 6)(Note 8)                                                                          |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      | 3.3                    | 1.7                    | 0.8               |                                 | V     | (Note 6)(Note 8)                                                                          |

**Note 3:** All outputs loaded; thresholds on input associated with output under test.

**Note 4:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 5:** Incident wave switching on transmission lines with impedances as low as 75Ω for commercial temperature range is guaranteed.

**Note 6:** Worst case package.

**Note 7:** Max number of outputs defined as (n). Data inputs are driven 0V to 3.3V; one output at GND.

**Note 8:** Max number of Data Inputs (n) switching. (n – 1) inputs switching 0V to 3.3V. Input-under-test switching: 3.3V to threshold ( $V_{ILD}$ ), 0V to threshold ( $V_{IHD}$ ),  $f = 1 MHz$ .

## AC Electrical Characteristics

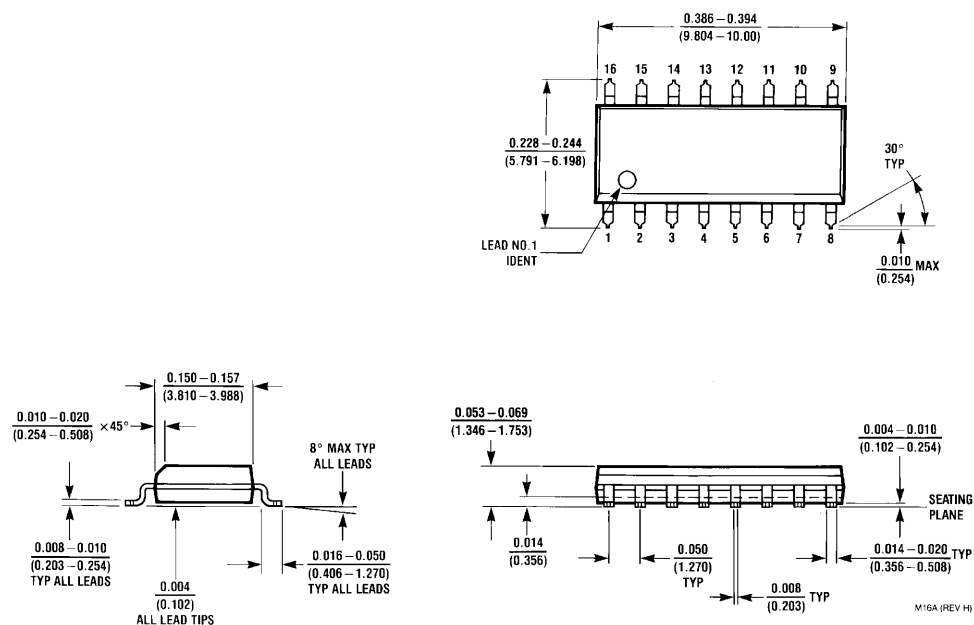
| Symbol                                   | Parameter                                                                     | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |      |      | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Units |
|------------------------------------------|-------------------------------------------------------------------------------|------------------------|--------------------------------------------------|------|------|-----------------------------------------------------------|------|-------|
|                                          |                                                                               |                        | Min                                              | Typ  | Max  | Min                                                       | Max  |       |
| t <sub>PLH</sub>                         | Propagation Delay<br>A <sub>n</sub> to $\overline{O}_n$                       | 2.7<br>3.3 ± 0.3       | 1.5                                              | 10.2 | 18.3 | 1.5                                                       | 21.0 | ns    |
| t <sub>PHL</sub>                         | Propagation Delay<br>A <sub>n</sub> to $\overline{O}_n$                       | 2.7<br>3.3 ± 0.3       | 1.5                                              | 9.6  | 17.6 | 1.5                                                       | 20.0 | ns    |
| t <sub>PLH</sub>                         | Propagation Delay<br>$\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$ | 2.7<br>3.3 ± 0.3       | 1.5                                              | 13.2 | 21.0 | 1.5                                                       | 23.0 | ns    |
| t <sub>PHL</sub>                         | Propagation Delay<br>$\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$ | 2.7<br>3.3 ± 0.3       | 1.5                                              | 11.4 | 19.0 | 1.5                                                       | 21.0 | ns    |
| t <sub>PLH</sub>                         | Propagation Delay<br>E <sub>3</sub> to $\overline{O}_n$                       | 2.7<br>3.3 ± 0.3       | 1.5                                              | 13.2 | 21.8 | 1.5                                                       | 23.5 | ns    |
| t <sub>PHL</sub>                         | Propagation Delay<br>E <sub>3</sub> to $\overline{O}_n$                       | 2.7<br>3.3 ± 0.3       | 1.5                                              | 10.2 | 18.3 | 1.5                                                       | 20.0 | ns    |
| t <sub>OSHL</sub> ,<br>t <sub>OSLH</sub> | Output to Output Skew (Note 9)<br>Data to Output                              | 2.7<br>3.3 ± 0.3       |                                                  | 1.0  | 1.5  |                                                           | 1.5  | ns    |

**Note 9:** 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<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

## Capacitance

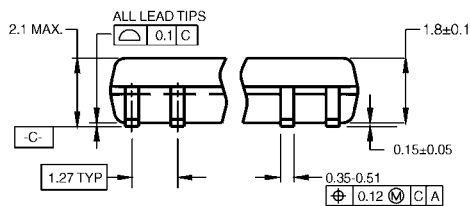
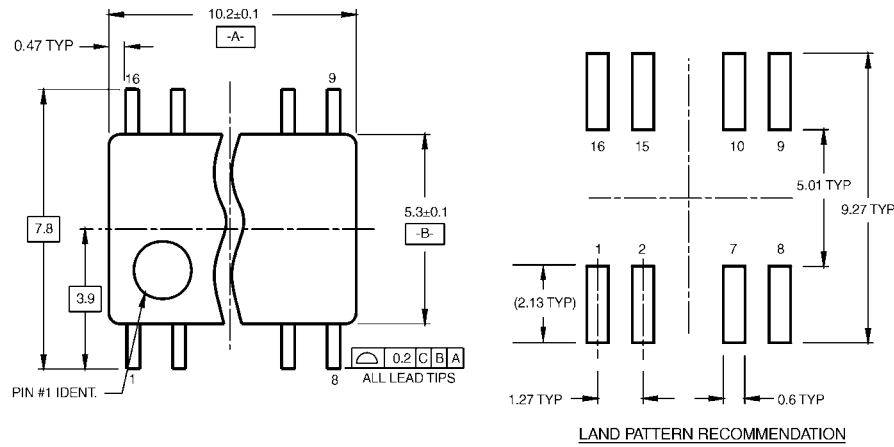
| Symbol                    | Parameter                     | Typ | Units | Conditions             |
|---------------------------|-------------------------------|-----|-------|------------------------|
| C <sub>IN</sub>           | Input Capacitance             | 4.5 | pF    | V <sub>CC</sub> = Open |
| C <sub>PD</sub> (Note 10) | Power Dissipation Capacitance | 45  | pF    | V <sub>CC</sub> = 3.3V |

**Note 10:** C<sub>PD</sub> is measured at 10 MHz.

**Physical Dimensions** inches (millimeters) unless otherwise noted


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow**  
**Package Number M16A**

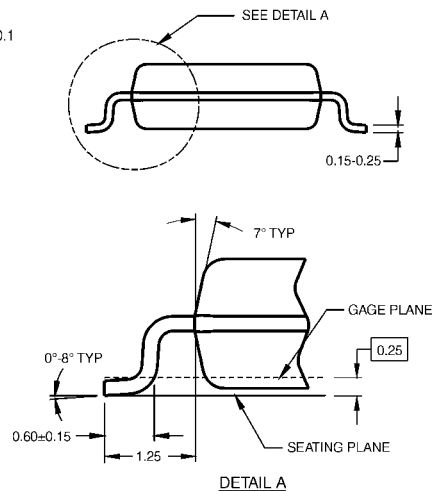
## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



### NOTES:

- CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1



### 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M16D

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