

SN74LS138

1-of-8 Decoder/ Demultiplexer

The LSTTL/MSI SN74LS138 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 LS138 devices or to a 1-of-32 decoder using four LS138s and one inverter. The LS138 is fabricated with the Schottky barrier diode process for high speed and is completely compatible with all ON Semiconductor TTL families.

- Demultiplexing Capability
- Multiple Input Enable for Easy Expansion
- Typical Power Dissipation of 32 mW
- Active Low Mutually Exclusive Outputs
- Input Clamp Diodes Limit High Speed Termination Effects

GUARANTEED OPERATING RANGES

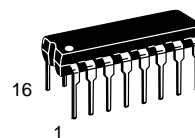
| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------------|-------------------------------------|------|-----|------|------|
| V _{CC} | Supply Voltage | 4.75 | 5.0 | 5.25 | V |
| T _A | Operating Ambient Temperature Range | 0 | 25 | 70 | °C |
| I _{OH} | Output Current – High | | | –0.4 | mA |
| I _{OL} | Output Current – Low | | | 8.0 | mA |



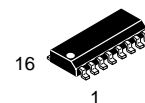
ON Semiconductor™

<http://onsemi.com>

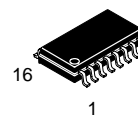
**LOW
POWER
SCHOTTKY**



PLASTIC
N SUFFIX
CASE 648



SOIC
D SUFFIX
CASE 751B



SOEIAJ
M SUFFIX
CASE 966

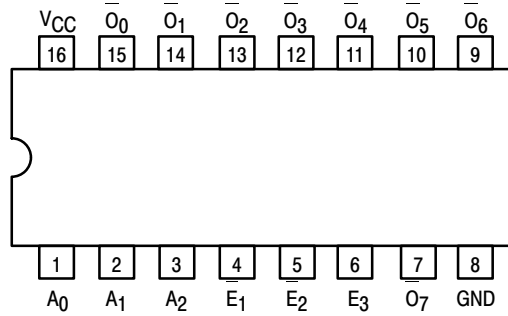
ORDERING INFORMATION

| Device | Package | Shipping |
|--------------|------------|------------------|
| SN74LS138N | 16 Pin DIP | 2000 Units/Box |
| SN74LS138D | SOIC–16 | 38 Units/Rail |
| SN74LS138DR2 | SOIC–16 | 2500/Tape & Reel |
| SN74LS138M | SOEIAJ–16 | See Note 1 |
| SN74LS138MEL | SOEIAJ–16 | See Note 1 |

1. For ordering information on the EIAJ version of the SOIC package, please contact your local ON Semiconductor representative.

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CONNECTION DIAGRAM DIP (TOP VIEW)



NOTE:
The Flatpak version has the same pinouts (Connection Diagram) as the Dual In-Line Package.

PIN NAMES

$A_0 - A_2$ Address Inputs
 E_1, E_2 Enable (Active LOW) Inputs
 E_3 Enable (Active HIGH) Input
 $O_0 - O_7$ Active LOW Outputs

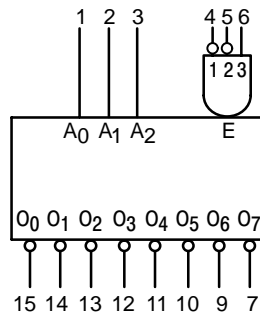
LOADING (Note a)

| | HIGH | LOW |
|-------------|----------|-----------|
| $A_0 - A_2$ | 0.5 U.L. | 0.25 U.L. |
| E_1, E_2 | 0.5 U.L. | 0.25 U.L. |
| E_3 | 0.5 U.L. | 0.25 U.L. |
| $O_0 - O_7$ | 10 U.L. | 5 U.L. |

NOTES:

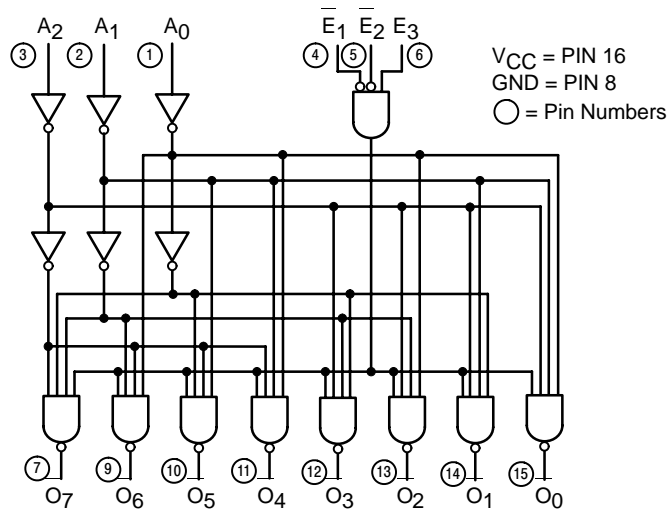
a) 1 TTL Unit Load (U.L.) = 40 μ A HIGH/1.6 mA LOW.

LOGIC SYMBOL



V_{CC} = PIN 16
 GND = PIN 8

LOGIC DIAGRAM



SN74LS138

FUNCTIONAL DESCRIPTION

The LS138 is a high speed 1-of-8 Decoder/Demultiplexer fabricated with the low power Schottky barrier diode process. The decoder accepts three binary weighted inputs (A_0 , A_1 , A_2) and when enabled provides eight mutually exclusive active LOW Outputs (O_0 – O_7). The LS138 features three Enable inputs, two active LOW (E_1 , E_2) and one active HIGH (E_3). All outputs will be HIGH unless E_1 and 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 LS138s and one inverter. (See Figure a.)

The LS138 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 | | | | | | | |
|------------------|------------------|-------|-------|-------|-------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| $\overline{E_1}$ | $\overline{E_2}$ | E_3 | A_0 | A_1 | A_2 | $\overline{O_0}$ | $\overline{O_1}$ | $\overline{O_2}$ | $\overline{O_3}$ | $\overline{O_4}$ | $\overline{O_5}$ | $\overline{O_6}$ | $\overline{O_7}$ |
| 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 | 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 = Don't Care

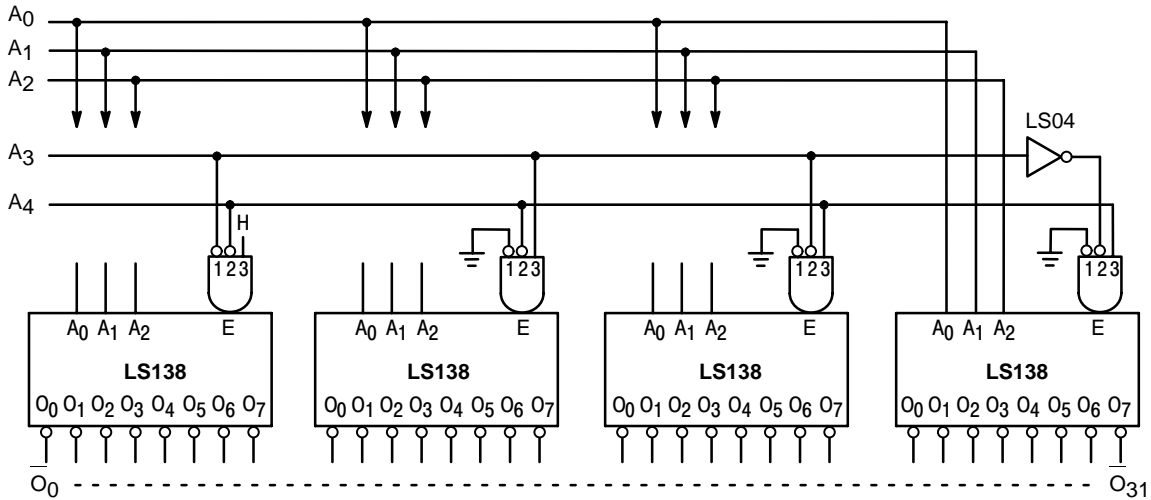


Figure a

SN74LS138

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

| Symbol | Parameter | Limits | | | Unit | Test Conditions |
|-----------------|--------------------------------|--------|-------|------|------|---|
| | | Min | Typ | Max | | |
| V _{IH} | Input HIGH Voltage | 2.0 | | | V | Guaranteed Input HIGH Voltage for All Inputs |
| V _{IL} | Input LOW Voltage | | | 0.8 | V | Guaranteed Input LOW Voltage for All Inputs |
| V _{IK} | Input Clamp Diode Voltage | | -0.65 | -1.5 | V | V _{CC} = MIN, I _{IN} = -18 mA |
| V _{OH} | Output HIGH Voltage | 2.7 | 3.5 | | V | V _{CC} = MIN, I _{OH} = MAX, V _{IN} = V _{IH} or V _{IL} per Truth Table |
| V _{OL} | Output LOW Voltage | | 0.25 | 0.4 | V | I _{OL} = 4.0 mA V _{CC} = V _{CC} MIN, V _{IN} = V _{IL} or V _{IH} per Truth Table |
| | | | 0.35 | 0.5 | V | |
| I _{IH} | Input HIGH Current | | | 20 | μA | V _{CC} = MAX, V _{IN} = 2.7 V |
| | | | | 0.1 | mA | V _{CC} = MAX, V _{IN} = 7.0 V |
| I _{IL} | Input LOW Current | | | -0.4 | mA | V _{CC} = MAX, V _{IN} = 0.4 V |
| I _{OS} | Short Circuit Current (Note 2) | -20 | | -100 | mA | V _{CC} = MAX |
| I _{CC} | Power Supply Current | | | 10 | mA | V _{CC} = MAX |

2. Not more than one output should be shorted at a time, nor for more than 1 second.

AC CHARACTERISTICS (T_A = 25°C)

| Symbol | Parameter | Levels of Delay | Limits | | | Unit | Test Conditions |
|--------------------------------------|--|-----------------|--------|----------|----------|------|---|
| | | | Min | Typ | Max | | |
| t _{PLH} t _{PHL} | Propagation Delay Address to Output | 2 2 | | 13 27 | 20 41 | ns | V _{CC} = 5.0 V C _L = 15 pF |
| t _{PLH} t _{PHL} | Propagation Delay Address to Output | 3 3 | | 18 26 | 27 39 | ns | |
| t _{PLH} t _{PHL} | Propagation Delay E ₁ or E ₂ Enable to Output | 2 2 | | 12 21 | 18 32 | ns | |
| t _{PLH} t _{PHL} | Propagation Delay E ₃ Enable to Output | 3 3 | | 17 25 | 26 38 | ns | |

AC WAVEFORMS

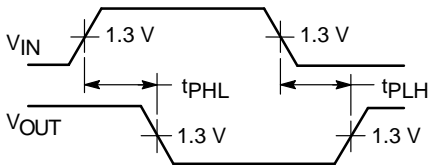


Figure 1.

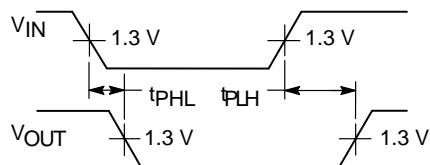
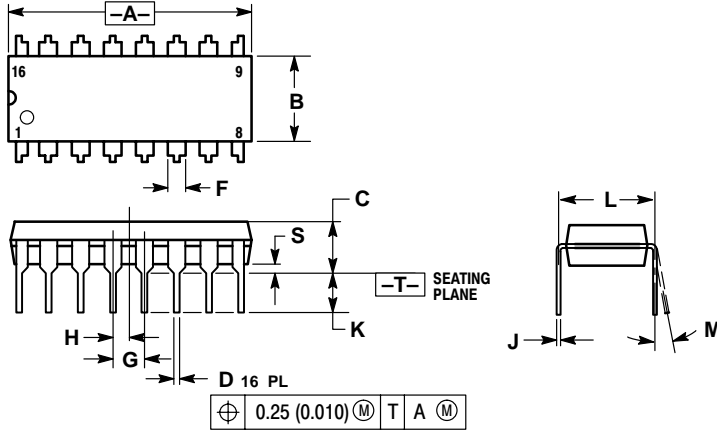


Figure 2.

SN74LS138

PACKAGE DIMENSIONS

N SUFFIX
PLASTIC PACKAGE
CASE 648-08
ISSUE R



NOTES:

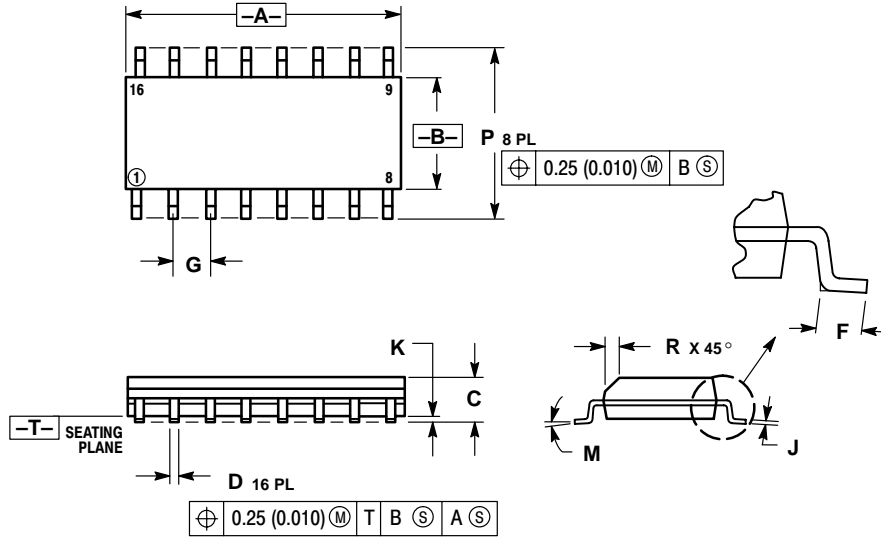
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.740 | 0.770 | 18.80 | 19.55 |
| B | 0.250 | 0.270 | 6.35 | 6.85 |
| C | 0.145 | 0.175 | 3.69 | 4.44 |
| D | 0.015 | 0.021 | 0.39 | 0.53 |
| F | 0.040 | 0.70 | 1.02 | 1.77 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.050 BSC | | 1.27 BSC | |
| J | 0.008 | 0.015 | 0.21 | 0.38 |
| K | 0.110 | 0.130 | 2.80 | 3.30 |
| L | 0.295 | 0.305 | 7.50 | 7.74 |
| M | 0° 10° | | 0° 10° | |
| S | 0.020 | 0.040 | 0.51 | 1.01 |

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PACKAGE DIMENSIONS

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



NOTES:

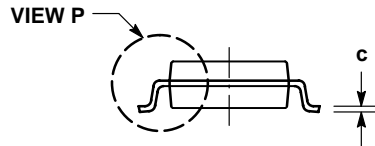
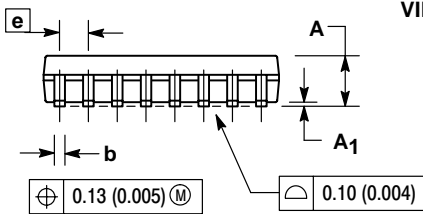
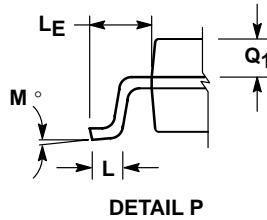
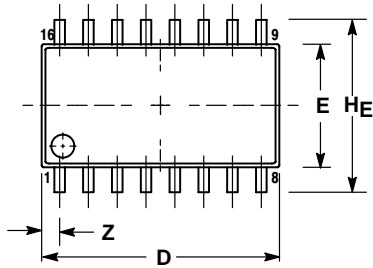
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL 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 |

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PACKAGE DIMENSIONS


M SUFFIX
SOEIAJ 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 | --- | 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 | |
| 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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