

# DN74LS138

## 3-line to 8-line Decoders / Demultiplexers

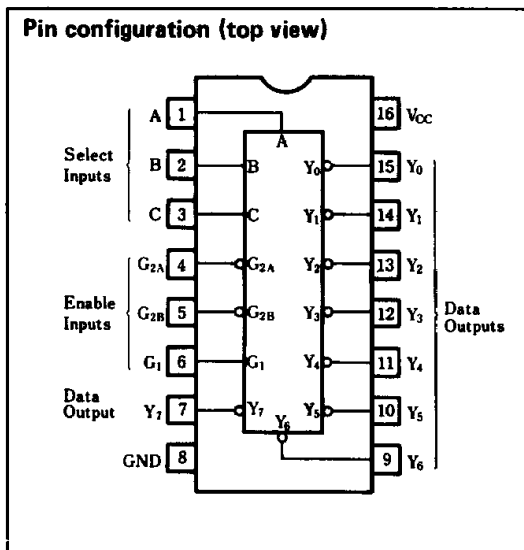
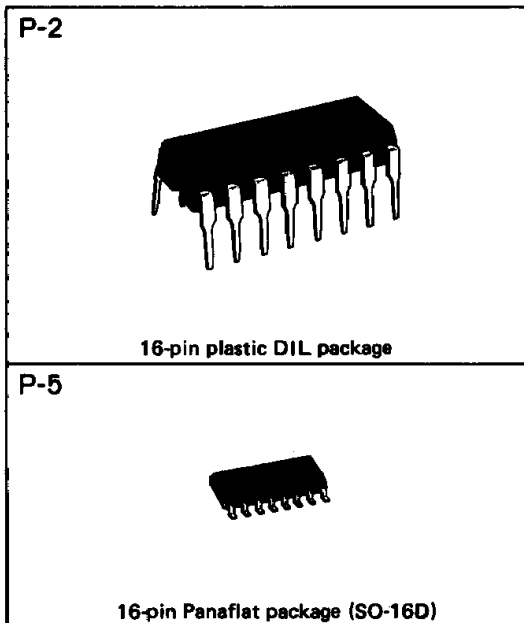
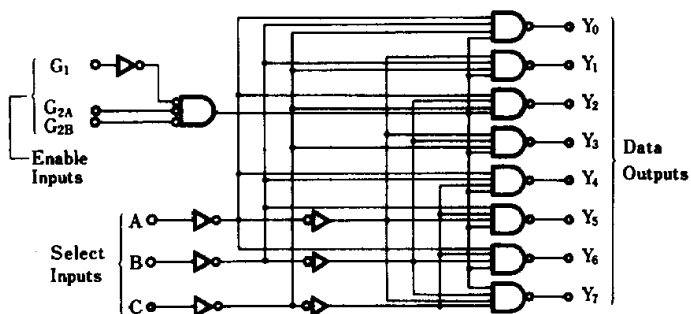
### ■ Description

DN74LS138 is a 3-bit decimal to octal decoder/demultiplexer with enable inputs.

### ■ Features

- Three types of enable inputs
- Quaternary to hexadecimal decoder/demultiplexer capability with no externally connected parts
- Wide operating temperature range ( $T_a = -20$  to  $+75^\circ\text{C}$ )

### ■ Logic diagram



### ■ Recommended operating conditions

| Parameter                   | Sym       | Min  | Typ  | Max  | Unit             |
|-----------------------------|-----------|------|------|------|------------------|
| Supply voltage              | $V_{CC}$  | 4.75 | 5.00 | 5.25 | V                |
| Output current              | $I_{OH}$  |      |      | -400 | $\mu\text{A}$    |
|                             | $I_{OL}$  |      |      | 8    | mA               |
| Operating temperature range | $T_{opr}$ | -20  | 25   | 75   | $^\circ\text{C}$ |

■ DC characteristics (Ta = -20 ~ +75°C)

| Parameter                      | Sym              | Test conditions  | Min | Typ* | Max  | Unit |
|--------------------------------|------------------|--|-----|------|------|------|
| Input voltage                  | V <sub>IH</sub>  |  | 2.0 |      |      | V    |
|                                | V <sub>IL</sub>  |  |     |      | 0.8  | V    |
| Output voltage                 | V <sub>OH</sub>  | V <sub>CC</sub> = 4.75V, V <sub>IH</sub> = 2V<br>V <sub>IL</sub> = 0.8V, I <sub>OH</sub> = -400 μA | 2.7 | 3.4  |      | V    |
|                                | V <sub>OL1</sub> | V <sub>CC</sub> = 4.75V<br>V <sub>IH</sub> = 2V<br>I <sub>OL</sub> = 4 mA                          |     | 0.25 | 0.4  | V    |
|                                | V <sub>OL2</sub> | V <sub>IL</sub> = 0.8V<br>I <sub>OL</sub> = 8 mA   |     | 0.35 | 0.5  | V    |
| Input current                  | I <sub>IH</sub>  | V <sub>CC</sub> = 5.25V<br>V <sub>I</sub> = 2.7V   |     |      | 20   | μA   |
|                                | I <sub>IL</sub>  | V <sub>CC</sub> = 5.25V<br>V <sub>I</sub> = 0.4V   |     |      | -0.4 | mA   |
|                                | I <sub>I</sub>   | V <sub>CC</sub> = 5.25V<br>V <sub>I</sub> = 7V   |     |      | 0.1  | mA   |
| Output short circuit current** | I <sub>OS</sub>  | V <sub>CC</sub> = 5.25V, V <sub>O</sub> = 0V   | -15 |      | -100 | mA   |
| Input clamp voltage            | V <sub>IK</sub>  | V <sub>CC</sub> = 4.75V<br>I <sub>I</sub> = -18 mA   |     |      | -1.5 | V    |
| Supply current***              | I <sub>CC</sub>  | I <sub>CC</sub> = 5.25V  |     | 6.3  | 10   | mA   |

\* When constant at V<sub>CC</sub> = 5V, Ta = 25°C.

\*\* Only one output at a time short circuited to GND. Also, short circuit time to GND within 1 second.

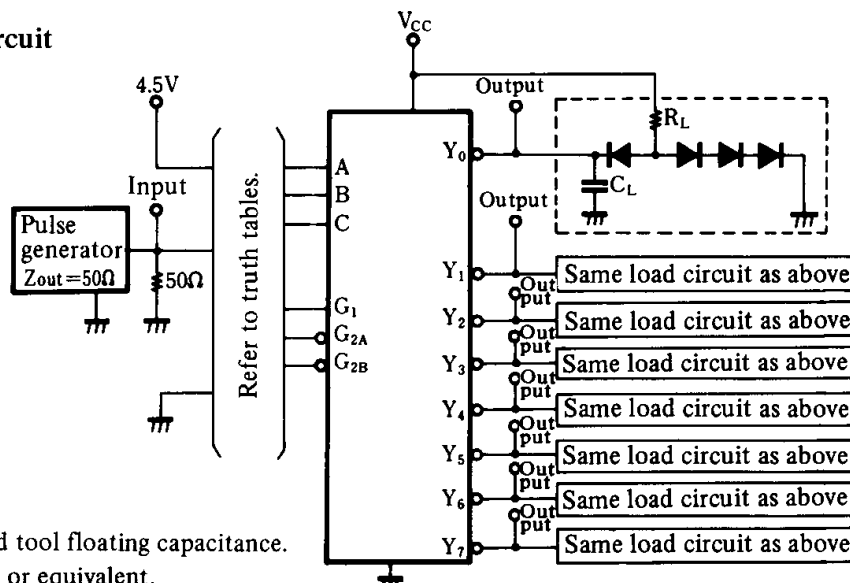
\*\*\* Measured with all outputs open and in enable condition.

■ Switching characteristics (V<sub>CC</sub> = 5V, Ta = 25°C)

| Parameter              | Sym              | Inputs                                   | Outputs | Delay level | Test conditions                                 | Min | Typ | Max | Unit |
|------------------------|------------------|--|---------|-------------|---|-----|-----|-----|------|
| Propagation delay time | t <sub>PLH</sub> | Binary Select A, B, C                    | Y       | 2           | C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 2 kΩ |     | 13  | 20  | ns   |
|                        | t <sub>PHL</sub> |  |         |             |   |     | 27  | 41  | ns   |
|                        | t <sub>PLH</sub> |  |         |             |   | 3   | 18  | 27  | ns   |
|                        | t <sub>PHL</sub> |  |         |             |   |     | 26  | 39  | ns   |
|                        | t <sub>PLH</sub> | Enable G <sub>2A</sub> , G <sub>2B</sub> | Y       | 2           |   |     | 12  | 18  | ns   |
|                        | t <sub>PHL</sub> |  |         |             |   |     | 21  | 32  | ns   |
|                        | t <sub>PLH</sub> | Enable G <sub>1</sub>                    | Y       | 3           |   |     | 17  | 26  | ns   |
|                        | t <sub>PHL</sub> |  |         |             |   |     | 25  | 38  | ns   |

※ Switching parameter measurement information

1. Measurement circuit



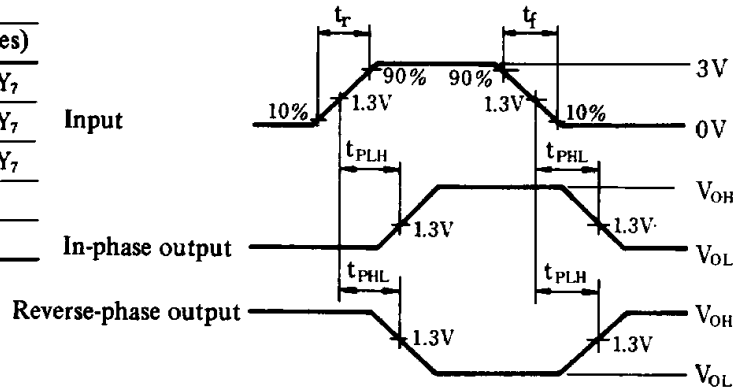
Notes

1. C<sub>L</sub> includes probe and tool floating capacitance.
2. Diodes are all MA161 or equivalent.

2. Relationships of inputs/outputs to delay level

| Input                             | Output                          |                |                |                |                                 |                |                |                |
|-----------------------------------|---------------------------------|----------------|----------------|----------------|---------------------------------|----------------|----------------|----------------|
|                                   | Delay level (2-stages)          |                |                |                | Delay level (3-stages)          |                |                |                |
| A                                 | Y <sub>0</sub>                  | Y <sub>2</sub> | Y <sub>4</sub> | Y <sub>6</sub> | Y <sub>1</sub>                  | Y <sub>3</sub> | Y <sub>5</sub> | Y <sub>7</sub> |
| B                                 | Y <sub>0</sub>                  | Y <sub>1</sub> | Y <sub>4</sub> | Y <sub>5</sub> | Y <sub>2</sub>                  | Y <sub>3</sub> | Y <sub>6</sub> | Y <sub>7</sub> |
| C                                 | Y <sub>0</sub>                  | Y <sub>1</sub> | Y <sub>2</sub> | Y <sub>3</sub> | Y <sub>4</sub>                  | Y <sub>5</sub> | Y <sub>6</sub> | Y <sub>7</sub> |
| G <sub>1</sub>                    |                                 |                |                |                | Y <sub>0</sub> ~ Y <sub>7</sub> |                |                |                |
| G <sub>2A</sub> , G <sub>2B</sub> | Y <sub>0</sub> ~ Y <sub>7</sub> |                |                |                |                                 |                |                |                |

3. Waveforms



Notes

1. Input waveform:  $t_r \leq 15\text{ns}$ ,  $t_f \leq 6\text{ns}$ , PRR = 1MHz, duty cycle = 50%.

■ Truth tables

| Inputs         |                  |        |   |   | Outputs        |                |                |                |                |                |                |                |
|----------------|------------------|--------|---|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Enable         |                  | Select |   |   |                |                |                |                |                |                |                |                |
| G <sub>1</sub> | G <sub>2</sub> * | C      | B | A | Y <sub>0</sub> | Y <sub>1</sub> | Y <sub>2</sub> | Y <sub>3</sub> | Y <sub>4</sub> | Y <sub>5</sub> | Y <sub>6</sub> | Y <sub>7</sub> |
| X              | H                | X      | X | X | H              | H              | H              | H              | H              | H              | H              | H              |
| L              | X                | X      | X | X | H              | H              | H              | H              | H              | H              | H              | H              |
| H              | L                | L      | L | L | L              | H              | H              | H              | H              | H              | H              | H              |
| H              | L                | L      | L | H | H              | L              | H              | H              | H              | H              | H              | H              |
| H              | L                | L      | H | L | H              | H              | L              | H              | H              | H              | H              | H              |
| H              | L                | L      | H | H | H              | H              | H              | L              | H              | H              | H              | H              |
| H              | L                | H      | L | L | H              | H              | H              | H              | L              | H              | H              | H              |
| H              | L                | H      | L | H | H              | H              | H              | H              | H              | L              | H              | H              |
| H              | L                | H      | H | L | H              | H              | H              | H              | H              | H              | L              | H              |
| H              | L                | H      | H | H | H              | H              | H              | H              | H              | H              | H              | L              |

Notes

1. \* G<sub>2</sub> = G<sub>2A</sub> + G<sub>2B</sub>
2. H: HIGH voltage level.  
L: LOW voltage level.  
X: Either HIGH or LOW; doesn't matter.