M74HC138
3 TO 8 LINE DECODER (INVERTING)

- **HIGH SPEED:**
  \[ t_{PD} = 13\text{ns (TYP.)) at } V_{CC} = 6\text{V} \]
- **LOW POWER DISSIPATION:**
  \[ I_{CC} = 4\mu\text{A(MAX.) at } T_A=25^\circ\text{C} \]
- **HIGH NOISE IMMUNITY:**
  \[ V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)} \]
- **SYMMETRICAL OUTPUT IMPEDANCE:**
  \[ |I_{OH}| = I_{OL} = 4\text{mA (MIN)} \]
- **BALANCED PROPAGATION DELAYS:**
  \[ t_{PLH} = t_{PHL} \]
- **WIDE OPERATING VOLTAGE RANGE:**
  \[ V_{CC} \text{ (OPR)} = 2\text{V to 6V} \]
- **PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 138**

**DESCRIPTION**

The M74HC138 is an high speed CMOS 3 TO 8 LINE DECODER fabricated with silicon gate CMOS technology. If the device is enabled, 3 binary select inputs (A, B, and C) determine which one of the outputs will go low. If enable input G1 is held low or either G2A or G2B is held high, the decoding function is inhibited and all the 8 outputs go high. Three enable inputs are provided to ease cascade connection and application of address decoders for memory systems. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

**ORDER CODES**

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>TUBE</th>
<th>T &amp; R</th>
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<tbody>
<tr>
<td>DIP</td>
<td>M74HC138B1R</td>
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</tr>
<tr>
<td>SOP</td>
<td>M74HC138M1R</td>
<td>M74HC138RM13TR</td>
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<td>TSSOP</td>
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<td>M74HC138TTR</td>
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**PIN CONNECTION AND IEC LOGIC SYMBOLS**

July 2001

1/10
M74HC138

INPUT AND OUTPUT EQUIVALENT CIRCUIT

<table>
<thead>
<tr>
<th>PIN No</th>
<th>SYMBOL</th>
<th>NAME AND FUNCTION</th>
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<tbody>
<tr>
<td>1, 2, 3</td>
<td>A, B, C</td>
<td>Address Inputs</td>
</tr>
<tr>
<td>4, 5</td>
<td>G2A, G2B</td>
<td>Enable Inputs</td>
</tr>
<tr>
<td>6</td>
<td>G1</td>
<td>Enable Input</td>
</tr>
<tr>
<td>9, 10, 11, 12, 13, 14, 15, 17</td>
<td>Y0 to Y7</td>
<td>Data Outputs</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Ground (0V)</td>
</tr>
<tr>
<td>16</td>
<td>VCC</td>
<td>Positive Supply Voltage</td>
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TRUTH TABLE

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<tr>
<th>INPUTS</th>
<th>SELECT</th>
<th>OUTPUTS</th>
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<tr>
<td>ENABLE</td>
<td>G2B</td>
<td>G2A</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>X</td>
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X : Don't Care

LOGIC DIAGRAM

This logic diagram has not been used to estimate propagation delays
ABSOLUTE MAXIMUM RATINGS

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<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>V CC</td>
<td>Supply Voltage</td>
<td>-0.5 to +7</td>
<td>V</td>
</tr>
<tr>
<td>V I</td>
<td>DC Input Voltage</td>
<td>-0.5 to V CC + 0.5</td>
<td>V</td>
</tr>
<tr>
<td>V O</td>
<td>DC Output Voltage</td>
<td>-0.5 to V CC + 0.5</td>
<td>V</td>
</tr>
<tr>
<td>I K</td>
<td>DC Input Diode Current</td>
<td>± 20</td>
<td>mA</td>
</tr>
<tr>
<td>I O</td>
<td>DC Output Diode Current</td>
<td>± 20</td>
<td>mA</td>
</tr>
<tr>
<td>I CC or I GND</td>
<td>DC V CC or Ground Current</td>
<td>± 50</td>
<td>mA</td>
</tr>
<tr>
<td>P D</td>
<td>Power Dissipation</td>
<td>500(*) mW</td>
<td></td>
</tr>
<tr>
<td>T stg</td>
<td>Storage Temperature</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>T L</td>
<td>Lead Temperature (10 sec)</td>
<td>300</td>
<td>°C</td>
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</table>

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

<table>
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<th>Symbol</th>
<th>Parameter</th>
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<th>Unit</th>
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<tr>
<td>V CC</td>
<td>Supply Voltage</td>
<td>2 to 6</td>
<td>V</td>
</tr>
<tr>
<td>V I</td>
<td>Input Voltage</td>
<td>0 to V CC</td>
<td>V</td>
</tr>
<tr>
<td>V O</td>
<td>Output Voltage</td>
<td>0 to V CC</td>
<td>V</td>
</tr>
<tr>
<td>T op</td>
<td>Operating Temperature</td>
<td>-55 to 125</td>
<td>°C</td>
</tr>
<tr>
<td>t r, t f</td>
<td>Input Rise and Fall Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V CC = 2.0V</td>
<td>0 to 1000</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>V CC = 4.5V</td>
<td>0 to 500</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>V CC = 6.0V</td>
<td>0 to 400</td>
<td>ns</td>
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# DC SPECIFICATIONS

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<th>Unit</th>
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<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; (V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>T&lt;sub&gt;A&lt;/sub&gt; = 25°C</td>
<td>-40 to 85°C</td>
<td>-55 to 125°C</td>
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<tr>
<td>V&lt;sub&gt;IH&lt;/sub&gt;</td>
<td>High Level Input Voltage</td>
<td>2.0</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5</td>
<td></td>
<td>3.15</td>
</tr>
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<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td>4.2</td>
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<tr>
<td>V&lt;sub&gt;IL&lt;/sub&gt;</td>
<td>Low Level Input Voltage</td>
<td>2.0</td>
<td></td>
<td>0.5</td>
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<td>4.5</td>
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<td>1.35</td>
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<td></td>
<td>6.0</td>
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<td>1.8</td>
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<td>V&lt;sub&gt;OH&lt;/sub&gt;</td>
<td>High Level Output Voltage</td>
<td>2.0</td>
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<td>1.9</td>
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<td>4.5</td>
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<td>4.5</td>
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<td>4.18</td>
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<td>5.68</td>
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<td>Low Level Output Voltage</td>
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<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5</td>
<td></td>
<td>0.0</td>
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<tr>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5</td>
<td></td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>I&lt;sub&gt;I&lt;/sub&gt;</td>
<td>Input Leakage Current</td>
<td>6.0</td>
<td></td>
<td>±0.1</td>
</tr>
<tr>
<td>I&lt;sub&gt;CC&lt;/sub&gt;</td>
<td>Quiescent Supply Current</td>
<td>6.0</td>
<td></td>
<td>4.0</td>
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# AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>l</sub> = 6ns)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; (V)</td>
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<td></td>
</tr>
<tr>
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<td></td>
<td>T&lt;sub&gt;A&lt;/sub&gt; = 25°C</td>
<td>-40 to 85°C</td>
<td>-55 to 125°C</td>
</tr>
<tr>
<td>t&lt;sub&gt;T LH&lt;/sub&gt;</td>
<td>Output Transition Time</td>
<td>2.0</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td>7</td>
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<tr>
<td>t&lt;sub&gt;P LH&lt;/sub&gt;</td>
<td>Propagation Delay Time</td>
<td>2.0</td>
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<td>60</td>
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<tr>
<td></td>
<td>(A, B, C - Y)</td>
<td>4.5</td>
<td></td>
<td>15</td>
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<td>6.0</td>
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<td>13</td>
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<tr>
<td>t&lt;sub&gt;P LH&lt;/sub&gt;</td>
<td>Propagation Delay Time</td>
<td>2.0</td>
<td></td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>(G, G - Y)</td>
<td>4.5</td>
<td></td>
<td>14</td>
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<tr>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td>12</td>
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</table>
CAPACITIVE CHARACTERISTICS

<table>
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<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$V_{CC}$ (V)</td>
<td>$T_A = 25^\circ C$</td>
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<tr>
<td>$C_{IN}$</td>
<td>Input Capacitance</td>
<td>5.0</td>
<td>5</td>
<td>10</td>
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<tr>
<td>$C_{PD}$</td>
<td>Power Dissipation Capacitance (note 1)</td>
<td>5.0</td>
<td>47</td>
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</tbody>
</table>

1) $C_{PD}$ is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC\,(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

TEST CIRCUIT

TEST CIRCUIT

WAVEFORM 1: PROPAGATION DELAYS FOR INVERTING OUTPUTS (f=1MHz; 50% duty cycle)
WAVEFORM 2: PROPAGATION DELAYS FOR NON-INVERTING OUTPUTS (f=1 MHz; 50% duty cycle)
<table>
<thead>
<tr>
<th>DIM.</th>
<th>mm.</th>
<th>inch</th>
</tr>
</thead>
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<tr>
<td></td>
<td>MIN.</td>
<td>TYP</td>
</tr>
<tr>
<td>a1</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0.77</td>
<td>1.65</td>
</tr>
<tr>
<td>b</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>2.54</td>
<td></td>
</tr>
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<td>e3</td>
<td>17.78</td>
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<td>F</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>3.3</td>
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</tr>
<tr>
<td>Z</td>
<td>1.27</td>
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## SO-16 MECHANICAL DATA

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<tr>
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<th>mm. MIN.</th>
<th>mm. TYP.</th>
<th>mm. MAX.</th>
<th>inch MIN.</th>
<th>inch TYP.</th>
<th>inch MAX.</th>
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<tbody>
<tr>
<td>A</td>
<td>1.75</td>
<td></td>
<td></td>
<td>0.068</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.003</td>
<td>0.007</td>
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<tr>
<td>a2</td>
<td>1.65</td>
<td></td>
<td></td>
<td>0.064</td>
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<td>0.46</td>
<td>0.013</td>
<td>0.018</td>
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<td></td>
</tr>
<tr>
<td>b1</td>
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<td>0.25</td>
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<td>0.019</td>
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<td>c1</td>
<td></td>
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<td>45° (typ.)</td>
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<td>9.8</td>
<td>10</td>
<td>0.385</td>
<td>0.393</td>
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<tr>
<td>E</td>
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<td>6.2</td>
<td>0.228</td>
<td>0.244</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
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<td>0.208</td>
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<td>1.27</td>
<td>0.019</td>
<td>0.050</td>
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# TSSOP16 MECHANICAL DATA

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<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
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</tr>
<tr>
<td>A1</td>
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<td>0.002</td>
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<tr>
<td>A2</td>
<td>0.031</td>
<td>0.039</td>
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<tr>
<td>b</td>
<td>0.30</td>
<td>0.007</td>
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<td></td>
</tr>
<tr>
<td>c</td>
<td>0.20</td>
<td>0.004</td>
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<td>0.244</td>
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<td></td>
<td></td>
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<td>e</td>
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<td>0.0256 BSC</td>
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**PIN 1 IDENTIFICATION**

**0080338D**