To our customers,

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Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: \url{http://www.renesas.com}

April 1\textsuperscript{st}, 2010
Renesas Electronics Corporation

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HD74LS138
3-Line-to-8-Line Decoders / Demultiplexers

The HD74LS138 decodes one-of-eight line dependent on the conditions at the three binary select inputs and the three enable inputs. Two active-low and one active-high enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented without external inverters and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications.

Features

- Ordering Information

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Package Type</th>
<th>Package Code (Previous Code)</th>
<th>Package Abbreviation</th>
<th>Taping Abbreviation (Quantity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD74LS138P</td>
<td>DILP-16 pin</td>
<td>PRDP0016AE-B (DP-16FV)</td>
<td>P</td>
<td>-</td>
</tr>
<tr>
<td>HD74LS138FPEL</td>
<td>SOP-16 pin (JEITA)</td>
<td>PRSP0016DH-B (FP-16DAV)</td>
<td>FP</td>
<td>EL (2,000 pcs/reel)</td>
</tr>
<tr>
<td>HD74LS138RPEL</td>
<td>SOP-16 pin (JEDEC)</td>
<td>PRSP0016DG-A (FP-16DNV)</td>
<td>RP</td>
<td>EL (2,500 pcs/reel)</td>
</tr>
</tbody>
</table>

Note: Please consult the sales office for the above package availability.

Pin Arrangement

(Top view)
### Function Table

<table>
<thead>
<tr>
<th>Enable</th>
<th>Select</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>G2*</td>
<td>C</td>
</tr>
<tr>
<td>X</td>
<td>H</td>
<td>X</td>
</tr>
<tr>
<td>L</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>H</td>
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<tr>
<td>H</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

* : \( G_2 = G_{2A} + G_{2B} \)

### Block Diagram

![Block Diagram](image)

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>( V_{CC} )</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage</td>
<td>( V_{IN} )</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_T )</td>
<td>400</td>
<td>mW</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td>–65 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note: Voltage value, unless otherwise noted, are with respect to network ground terminal.

### Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>( V_{CC} )</td>
<td>4.75</td>
<td>5.00</td>
<td>5.25</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>( I_{CH} )</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td>( I_{OL} )</td>
<td>—</td>
<td>—</td>
<td>8</td>
<td>mA</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>( T_{opr} )</td>
<td>–20</td>
<td>25</td>
<td>75</td>
<td>°C</td>
</tr>
</tbody>
</table>
### Electrical Characteristics

(Ta = –20 to +75 °C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>min.</th>
<th>typ.*</th>
<th>max.</th>
<th>Unit</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>V&lt;sub&gt;IH&lt;/sub&gt;</td>
<td>2.0</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;IL&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>0.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output voltage</td>
<td>V&lt;sub&gt;OH&lt;/sub&gt;</td>
<td>2.7</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 4.75 V, V&lt;sub&gt;IH&lt;/sub&gt; = 2 V, V&lt;sub&gt;IL&lt;/sub&gt; = 0.8 V, I&lt;sub&gt;OH&lt;/sub&gt; = –400 µA</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;OL&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>0.4</td>
<td>V</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 4.75 V, V&lt;sub&gt;IH&lt;/sub&gt; = 2 V, I&lt;sub&gt;OL&lt;/sub&gt; = 4 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>0.5</td>
<td>V</td>
<td>V&lt;sub&gt;IL&lt;/sub&gt; = 0.8 V, I&lt;sub&gt;OL&lt;/sub&gt; = 8 mA</td>
</tr>
<tr>
<td>Input current</td>
<td>I&lt;sub&gt;IH&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>20</td>
<td>µA</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 5.25 V, V&lt;sub&gt;I&lt;/sub&gt; = 2.7 V</td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;IL&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>–0.4</td>
<td>mA</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 5.25 V, V&lt;sub&gt;I&lt;/sub&gt; = 0.4 V</td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;I&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>0.1</td>
<td>mA</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 5.25 V, V&lt;sub&gt;I&lt;/sub&gt; = 7 V</td>
</tr>
<tr>
<td>Short-circuit output current</td>
<td>I&lt;sub&gt;OS&lt;/sub&gt;</td>
<td>–20</td>
<td>—</td>
<td>–100</td>
<td>mA</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 5.25 V</td>
</tr>
<tr>
<td>Supply current</td>
<td>I&lt;sub&gt;CC&lt;/sub&gt;</td>
<td>—</td>
<td>6.3</td>
<td>10</td>
<td>mA</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 5.25 V, Outputs enabled and open</td>
</tr>
<tr>
<td>Input clamp voltage</td>
<td>V&lt;sub&gt;IK&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>–1.5</td>
<td>V</td>
<td>V&lt;sub&gt;CC&lt;/sub&gt; = 4.75 V, I&lt;sub&gt;N&lt;/sub&gt; = –18 mA</td>
</tr>
</tbody>
</table>

Note:  * V<sub>CC</sub> = 5 V, Ta = 25°C

### Switching Characteristics

(V<sub>CC</sub> = 5 V, Ta = 25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Inputs</th>
<th>Output</th>
<th>Levels of delay</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>Unit</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propagation delay time</td>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>Binary select A, B, C</td>
<td>Y</td>
<td>2</td>
<td>—</td>
<td>13</td>
<td>20</td>
<td>ns</td>
<td>C&lt;sub&gt;L&lt;/sub&gt; = 15 pF, R&lt;sub&gt;L&lt;/sub&gt; = 2 kΩ</td>
</tr>
<tr>
<td></td>
<td>t&lt;sub&gt;PHL&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>18</td>
<td>—</td>
<td>27</td>
<td>41</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>26</td>
<td>—</td>
<td>26</td>
<td>39</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>Enable G&lt;sub&gt;1&lt;/sub&gt;, G&lt;sub&gt;2A&lt;/sub&gt;, G&lt;sub&gt;2B&lt;/sub&gt;</td>
<td>Y</td>
<td>2</td>
<td>—</td>
<td>12</td>
<td>18</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t&lt;sub&gt;PHL&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>21</td>
<td>—</td>
<td>21</td>
<td>32</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>17</td>
<td>—</td>
<td>17</td>
<td>26</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t&lt;sub&gt;PHL&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>—</td>
<td>25</td>
<td>38</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>
Testing Method

Test Circuit

![Test Circuit Diagram]

Notes:
1. C<sub>i</sub> includes probe and jig capacitance.
2. All diodes are 1S2074(H).

Waveform

![Waveform Diagram]

Note: Input pulse; \( t_{TLH} \leq 15 \text{ ns}, t_{THL} \leq 6 \text{ ns}, \text{ PRR} = 1 \text{ MHz}, \text{ duty cycle 50%} \)
## Relation Between Input and Output to Levels of Delay

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs 2 levels of delay</th>
<th>Outputs 3 levels of delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$Y_0$, $Y_2$, $Y_4$, $Y_6$</td>
<td>$Y_1$, $Y_3$, $Y_5$, $Y_7$</td>
</tr>
<tr>
<td>B</td>
<td>$Y_0$, $Y_1$, $Y_4$, $Y_5$</td>
<td>$Y_2$, $Y_3$, $Y_6$, $Y_7$</td>
</tr>
<tr>
<td>C</td>
<td>$Y_0$, $Y_1$, $Y_2$, $Y_3$</td>
<td>$Y_4$, $Y_5$, $Y_6$, $Y_7$</td>
</tr>
<tr>
<td>$G_1$</td>
<td></td>
<td>$Y_0$ to $Y_7$</td>
</tr>
<tr>
<td>$G_{2A}, G_{2B}$</td>
<td></td>
<td>$Y_0$ to $Y_7$</td>
</tr>
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</table>
### Package Dimensions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Reference</th>
<th>Dimension in Millimeters</th>
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<tbody>
<tr>
<td>Max</td>
<td>Nom</td>
<td>Min</td>
</tr>
<tr>
<td>e₁</td>
<td>5.06</td>
<td>5.06</td>
</tr>
<tr>
<td>D</td>
<td>19.2</td>
<td>19.2</td>
</tr>
<tr>
<td>E</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td>A ⊥</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>b₂</td>
<td>0.40</td>
<td>0.46</td>
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<tr>
<td>b₁</td>
<td>0.19</td>
<td>0.25</td>
</tr>
<tr>
<td>a</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>x</td>
<td>2.54</td>
<td>2.54</td>
</tr>
<tr>
<td>Z</td>
<td>1.12</td>
<td>1.12</td>
</tr>
<tr>
<td>L</td>
<td>2.54</td>
<td>2.54</td>
</tr>
</tbody>
</table>

**NOTE:**
1. DIMENSIONS*1 (Nom)/*2 (Nom) "AND"*3 DO NOT INCLUDE MOLD FLASH.
2. DIMENSION*4 DOES NOT INCLUDE TRIM OFFSET.

---

**Terminal Cross Section**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Max</td>
<td>Nom</td>
</tr>
<tr>
<td>D</td>
<td>10.06</td>
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<tr>
<td>E</td>
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<tr>
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<tr>
<td>A₂</td>
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<tr>
<td>L</td>
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<tr>
<td>L₁</td>
<td>1.15</td>
</tr>
</tbody>
</table>

**Detail F**

(Non/Pd/Au plating)
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