74AC138 • 74ACT138
1-of-8 Decoder/Demultiplexer

General Description
The AC/ACT138 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 AC/ACT138 devices or a 1-of-32 decoder using four AC/ACT138 devices and one inverter.

Features
- I_{CC} reduced by 50%
- Demultiplexing capability
- Multiple input enable for easy expansion
- Active LOW mutually exclusive outputs
- Outputs source/sink 24 mA
- ACT138 has TTL-compatible inputs

Ordering Code:

<table>
<thead>
<tr>
<th>Order Number</th>
<th>Package Number</th>
<th>Package Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>74AC138SC</td>
<td>M16A</td>
<td>16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow</td>
</tr>
<tr>
<td>74AC138SJ</td>
<td>M16D</td>
<td>16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide</td>
</tr>
<tr>
<td>74AC138TC</td>
<td>MTC16</td>
<td>16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide</td>
</tr>
<tr>
<td>74AC138PC</td>
<td>N16E</td>
<td>16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide</td>
</tr>
<tr>
<td>74ACT138SC</td>
<td>M16A</td>
<td>16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow</td>
</tr>
<tr>
<td>74ACT138SJ</td>
<td>M16D</td>
<td>16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide</td>
</tr>
<tr>
<td>74ACT138PC</td>
<td>N16E</td>
<td>16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide</td>
</tr>
</tbody>
</table>

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

Connection Diagram

Logic Symbols

Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Names</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0–A2</td>
<td>Address Inputs</td>
</tr>
<tr>
<td>E1–E2</td>
<td>Enable Inputs</td>
</tr>
<tr>
<td>E3</td>
<td>Enable Input</td>
</tr>
<tr>
<td>O0–O7</td>
<td>Outputs</td>
</tr>
</tbody>
</table>

FACT™ is a trademark of Fairchild Semiconductor Corporation.
Truth Table

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>( E_1 )</td>
<td>( E_2 )</td>
</tr>
<tr>
<td>H</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>H</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

\( H \) = HIGH Voltage Level  \( L \) = LOW Voltage Level  \( X \) = Immaterial

Functional Description

The AC/ACT138 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 \((O_0, O_1, O_2, \ldots, O_7)\). The AC/ACT138 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 AC/ACT138 devices and one inverter (see Figure 1). The AC/ACT138 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.

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)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage ($V_{CC}$)</td>
<td>$-0.5V$ to $+7.0V$</td>
<td></td>
</tr>
<tr>
<td>DC Input Diode Current ($I_{DI}$)</td>
<td>$-20mA$</td>
<td></td>
</tr>
<tr>
<td>$V_I = -0.5V$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_I = V_{CC} + 0.5V$</td>
<td>$+20mA$</td>
<td></td>
</tr>
<tr>
<td>DC Input Voltage ($V_I$)</td>
<td>$-0.5V$ to $V_{CC} + 0.5V$</td>
<td></td>
</tr>
<tr>
<td>DC Output Diode Current ($I_{DO}$)</td>
<td>$-20mA$</td>
<td></td>
</tr>
<tr>
<td>V_O = $-0.5V$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_O = $V_{CC} + 0.5V$</td>
<td>$+20mA$</td>
<td></td>
</tr>
<tr>
<td>DC Output Voltage ($V_O$)</td>
<td>$-0.5V$ to $V_{CC} + 0.5V$</td>
<td></td>
</tr>
<tr>
<td>DC Output Source or Sink Current ($I_{O}$)</td>
<td>$±50mA$</td>
<td></td>
</tr>
<tr>
<td>DC $V_{CC}$ or Ground Current per Output Pin ($I_{CC}$ or $I_{GND}$)</td>
<td>$±50mA$</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature ($T_{STG}$)</td>
<td>$-65°C$ to $+150°C$</td>
<td></td>
</tr>
<tr>
<td>Junction Temperature ($T_J$)</td>
<td>$140°C$</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. The datasheet specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of FACT™ circuits outside datasheet specifications.

### Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage ($V_{CC}$)</td>
<td></td>
<td>$2.0V$ to $6.0V$</td>
</tr>
<tr>
<td>AC</td>
<td></td>
<td>$4.5V$ to $5.5V$</td>
</tr>
<tr>
<td>Input Voltage ($V_I$)</td>
<td></td>
<td>$0V$ to $V_{CC}$</td>
</tr>
<tr>
<td>Output Voltage ($V_O$)</td>
<td>$0V$ to $V_{CC}$</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature ($T_A$)</td>
<td></td>
<td>$-40°C$ to $+85°C$</td>
</tr>
<tr>
<td>Minimum Input Edge Rate ($\Delta V/\Delta t$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT Devices</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DC Electrical Characteristics for AC

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>$V_{CC}$ (V)</th>
<th>$I_{A} = +25°C$</th>
<th>$I_{A} = -40°C$ to +85°C</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IH}$</td>
<td>Minimum HIGH Level Input Voltage</td>
<td>3.0</td>
<td>1.5</td>
<td>2.1</td>
<td>2.1</td>
<td>V</td>
</tr>
<tr>
<td>4.5</td>
<td>2.25</td>
<td>3.15</td>
<td>3.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>2.75</td>
<td>3.85</td>
<td>3.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>Maximum LOW Level Input Voltage</td>
<td>3.0</td>
<td>1.5</td>
<td>0.9</td>
<td>0.9</td>
<td>V</td>
</tr>
<tr>
<td>4.5</td>
<td>2.25</td>
<td>1.35</td>
<td>1.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>2.75</td>
<td>1.65</td>
<td>1.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OH}$</td>
<td>Minimum HIGH Level Output Voltage</td>
<td>3.0</td>
<td>2.99</td>
<td>2.9</td>
<td>2.9</td>
<td>V</td>
</tr>
<tr>
<td>4.5</td>
<td>4.49</td>
<td>4.4</td>
<td>4.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>5.49</td>
<td>5.4</td>
<td>5.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>2.56</td>
<td>2.46</td>
<td>2.46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>3.86</td>
<td>3.76</td>
<td>3.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>4.86</td>
<td>4.76</td>
<td>4.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OL}$</td>
<td>Maximum LOW Level Output Voltage</td>
<td>3.0</td>
<td>0.002</td>
<td>0.1</td>
<td>0.1</td>
<td>V</td>
</tr>
<tr>
<td>4.5</td>
<td>0.001</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>0.001</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>0.36</td>
<td>0.44</td>
<td>0.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>0.36</td>
<td>0.44</td>
<td>0.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>0.36</td>
<td>0.44</td>
<td>0.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{IN}$ (Note 4)</td>
<td>Maximum Input Leakage Current</td>
<td>$5.5$</td>
<td>$±0.1$</td>
<td>$±1.0$</td>
<td>$\mu A$</td>
<td>$V_I = V_{CC}$</td>
</tr>
<tr>
<td>$I_{OL}$ (Note 3)</td>
<td>Minimum Dynamic Output Current</td>
<td>$5.5$</td>
<td>$75mA$</td>
<td>$V_{OLD} = 1.85V$ Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{OHD}$</td>
<td>Output Current (Note 3)</td>
<td>$5.5$</td>
<td>$-75mA$</td>
<td>$V_{OHD} = 3.85V$ Min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{CC}$ (Note 4)</td>
<td>Maximum Quiescent Supply Current</td>
<td>$5.5$</td>
<td>$4.0$</td>
<td>$40.0$</td>
<td>$\mu A$</td>
<td>$V_{IN} = V_{CC}$ or GND</td>
</tr>
</tbody>
</table>
## DC Electrical Characteristics for ACT

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>$V_{CC}$ (V)</th>
<th>$T_A = -25°C$</th>
<th>$T_A = -40°C$ to $+85°C$</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IH}$</td>
<td>Minimum HIGH Level Input Voltage</td>
<td>4.5</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
<td>V $V_{OUT} = 0.1V$ or $V_{CC} = 0.1V$</td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>Maximum LOW Level Input Voltage</td>
<td>4.5</td>
<td>1.5</td>
<td>0.8</td>
<td>0.8</td>
<td>V $V_{OUT} = 0.1V$ or $V_{CC} = 0.1V$</td>
</tr>
<tr>
<td>$V_{OH}$</td>
<td>Minimum HIGH Level Output Voltage</td>
<td>4.5</td>
<td>4.49</td>
<td>4.4</td>
<td>4.4</td>
<td>V $I_{OUT} = -50 \mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5</td>
<td>3.86</td>
<td>3.76</td>
<td>V $V_{IL} = V_{CC}$ or $V_{IH}$ $I_{OL} = 24 mA$ (Note 5)</td>
<td></td>
</tr>
<tr>
<td>$V_{OL}$</td>
<td>Maximum LOW Level Output Voltage</td>
<td>4.5</td>
<td>0.001</td>
<td>0.1</td>
<td>0.1</td>
<td>V $I_{OUT} = 50 \mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.5</td>
<td>0.001</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>$I_{IN}$</td>
<td>Maximum Leakage Current Input</td>
<td>4.5</td>
<td>0.36</td>
<td>0.44</td>
<td>V $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OL} = 24 mA$ (Note 5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.5</td>
<td>0.36</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{CC}$</td>
<td>Maximum Quiescent Supply Current</td>
<td>5.5</td>
<td>4.0</td>
<td>40.0</td>
<td>µA $V_{IN} = V_{CC}$ or GND</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- **Note 5:** All outputs loaded; thresholds on input associated with output under test.
- **Note 6:** Maximum test duration 2.0 ms, one output loaded at a time.

## AC Electrical Characteristics for AC

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>$V_{CC}$ (V)</th>
<th>$T_A = -25°C$</th>
<th>$T_A = -40°C$ to $+85°C$</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{PLH}$, $t_{PHL}$</td>
<td>Propagation Delay</td>
<td>3.3</td>
<td>1.5</td>
<td>8.5</td>
<td>13.0</td>
</tr>
<tr>
<td>$A_1$ to $O_n$</td>
<td></td>
<td>5.0</td>
<td>1.5</td>
<td>6.5</td>
<td>9.5</td>
</tr>
<tr>
<td>$t_{PLH}$</td>
<td>Propagation Delay</td>
<td>3.3</td>
<td>1.5</td>
<td>8.0</td>
<td>12.5</td>
</tr>
<tr>
<td>$A_1$ to $O_n$</td>
<td></td>
<td>5.0</td>
<td>1.5</td>
<td>6.0</td>
<td>9.0</td>
</tr>
<tr>
<td>$t_{PLH}$</td>
<td>Propagation Delay</td>
<td>3.3</td>
<td>1.5</td>
<td>11.0</td>
<td>15.0</td>
</tr>
<tr>
<td>$E_1$ or $E_2$ to $O_n$</td>
<td></td>
<td>5.0</td>
<td>1.5</td>
<td>8.0</td>
<td>11.0</td>
</tr>
<tr>
<td>$t_{PLH}$</td>
<td>Propagation Delay</td>
<td>3.3</td>
<td>1.5</td>
<td>9.5</td>
<td>13.5</td>
</tr>
<tr>
<td>$E_1$ or $E_2$ to $O_n$</td>
<td></td>
<td>5.0</td>
<td>1.5</td>
<td>7.0</td>
<td>9.5</td>
</tr>
<tr>
<td>$t_{PLH}$</td>
<td>Propagation Delay</td>
<td>3.3</td>
<td>1.5</td>
<td>11.0</td>
<td>15.5</td>
</tr>
<tr>
<td>$E_3$ to $O_n$</td>
<td></td>
<td>5.0</td>
<td>1.5</td>
<td>8.0</td>
<td>11.0</td>
</tr>
<tr>
<td>$t_{PLH}$</td>
<td>Propagation Delay</td>
<td>3.3</td>
<td>1.5</td>
<td>8.5</td>
<td>13.0</td>
</tr>
<tr>
<td>$E_3$ to $O_n$</td>
<td></td>
<td>5.0</td>
<td>1.5</td>
<td>6.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

### Notes:
- **Note 7:** Voltage Range 3.3 is $3.3V ± 0.3V$  
  Voltage Range 5.0 is $5.0V ± 0.5V$
### AC Electrical Characteristics for ACT

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Vcc (V)</th>
<th>$T_A = +25^\circ C$</th>
<th>$T_A = -40^\circ C$ to $+85^\circ C$</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$C_L = 50 \text{ pF}$</td>
<td>$C_L = 50 \text{ pF}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>${\tau}_{PLH}$</td>
<td>Propagation Delay</td>
<td>$A_n$ to $O_n$</td>
<td>5.0</td>
<td>1.5</td>
<td>7.0</td>
</tr>
<tr>
<td>${\tau}_{PHL}$</td>
<td>Propagation Delay</td>
<td>$A_n$ to $O_n$</td>
<td>5.0</td>
<td>1.5</td>
<td>6.5</td>
</tr>
<tr>
<td>${\tau}_{PIL}$</td>
<td>Propagation Delay</td>
<td>$E_1$ or $E_2$ to $O_n$</td>
<td>5.0</td>
<td>2.5</td>
<td>8.0</td>
</tr>
<tr>
<td>${\tau}_{PIL}$</td>
<td>Propagation Delay</td>
<td>$E_1$ or $E_2$ to $O_n$</td>
<td>5.0</td>
<td>2.0</td>
<td>7.5</td>
</tr>
<tr>
<td>${\tau}_{PHL}$</td>
<td>Propagation Delay</td>
<td>$E_3$ to $O_n$</td>
<td>5.0</td>
<td>2.5</td>
<td>8.0</td>
</tr>
<tr>
<td>${\tau}_{PIL}$</td>
<td>Propagation Delay</td>
<td>$E_3$ to $O_n$</td>
<td>5.0</td>
<td>2.0</td>
<td>6.5</td>
</tr>
</tbody>
</table>

**Note 8:** Voltage Range 5.0 is 5.0V ± 0.5V

### Capacitance

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Typ</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{IN}$</td>
<td>Input Capacitance</td>
<td>4.5</td>
<td>pF</td>
<td>$V_{CC} = $ OPEN</td>
</tr>
<tr>
<td>$C_{PD}$</td>
<td>Power Dissipation Capacitance</td>
<td>60.0</td>
<td>pF</td>
<td>$V_{CC} = $ 5.0V</td>
</tr>
</tbody>
</table>
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)

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

M16DRvB1

NOTES:
A. CONFORMS TO EIAJ ED3 72/20 REGISTRATION, ESTABLISHED IN DECEMBER, 1988.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC16
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
Package Number N16E

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

www.fairchildsemi.com