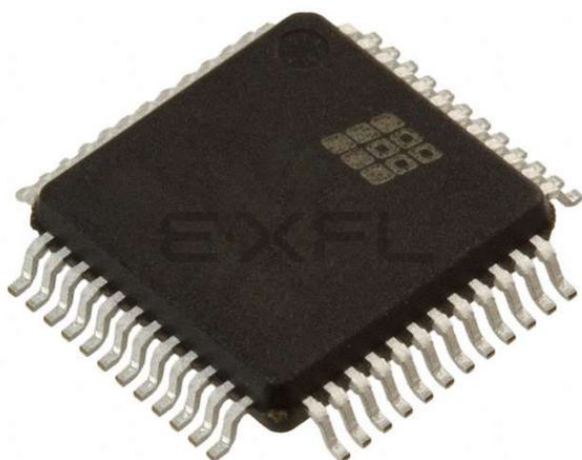




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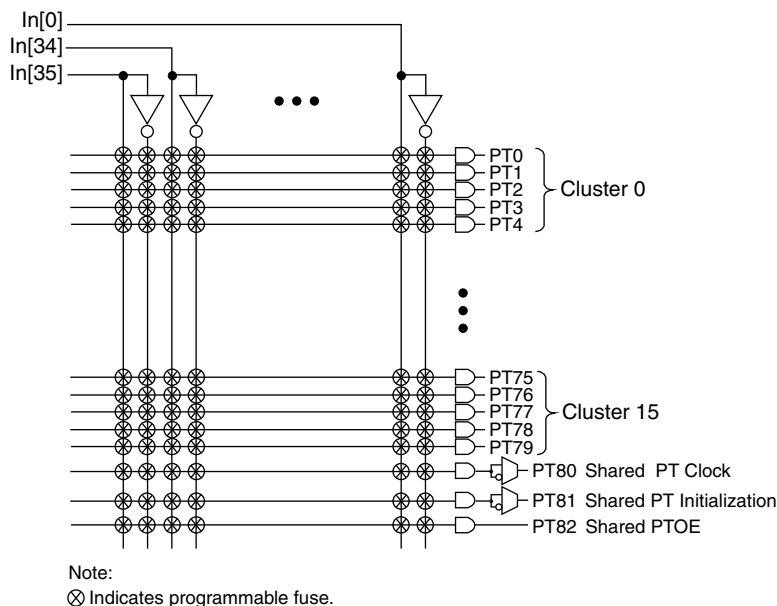
### Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

Embedded - CPLDs, or Complex Programmable Logic Devices, are highly versatile digital logic devices used in electronic systems. These programmable components are designed to perform complex logical operations and can be customized for specific applications. Unlike fixed-function ICs, CPLDs offer the flexibility to reprogram their configuration, making them an ideal choice for various embedded systems. They consist of a set of logic gates and programmable interconnects, allowing designers to implement complex logic circuits without needing custom hardware.

### Applications of Embedded - CPLDs

#### Details

|                                 |                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status                  | Obsolete                                                                                                                                                          |
| Programmable Type               | In System Programmable                                                                                                                                            |
| Delay Time tpd(1) Max           | 7.5 ns                                                                                                                                                            |
| Voltage Supply - Internal       | 3V ~ 3.6V                                                                                                                                                         |
| Number of Logic Elements/Blocks | 4                                                                                                                                                                 |
| Number of Macrocells            | 64                                                                                                                                                                |
| Number of Gates                 | -                                                                                                                                                                 |
| Number of I/O                   | 32                                                                                                                                                                |
| Operating Temperature           | -40°C ~ 105°C (TJ)                                                                                                                                                |
| Mounting Type                   | Surface Mount                                                                                                                                                     |
| Package / Case                  | 48-LQFP                                                                                                                                                           |
| Supplier Device Package         | 48-TQFP (7x7)                                                                                                                                                     |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4064v-75t48i">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4064v-75t48i</a> |

**Figure 3. AND Array**

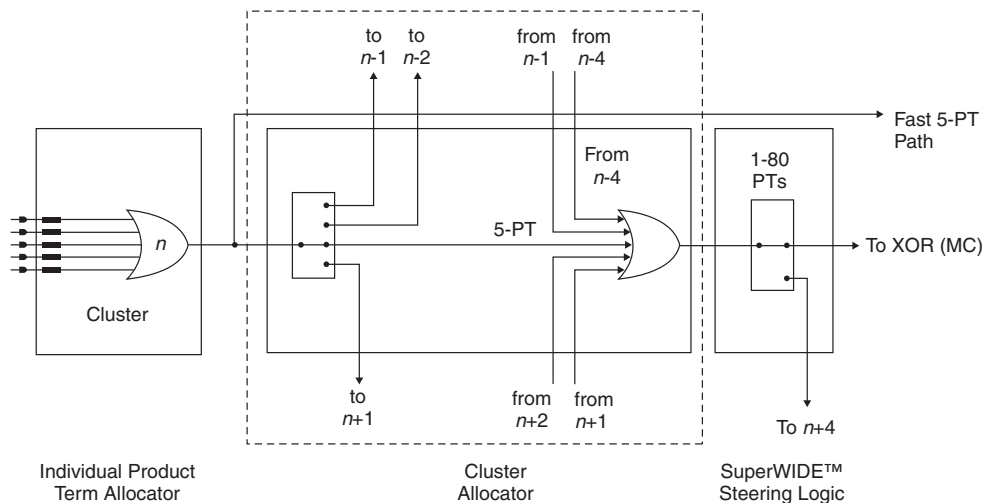
## Enhanced Logic Allocator

Within the logic allocator, product terms are allocated to macrocells in product term clusters. Each product term cluster is associated with a macrocell. The cluster size for the ispMACH 4000 family is 4+1 (total 5) product terms. The software automatically considers the availability and distribution of product term clusters as it fits the functions within a GLB. The logic allocator is designed to provide three speed paths: 5-PT fast bypass path, 20-PT Speed Locking path and an up to 80-PT path. The availability of these three paths lets designers trade timing variability for increased performance.

The enhanced Logic Allocator of the ispMACH 4000 family consists of the following blocks:

- Product Term Allocator
- Cluster Allocator
- Wide Steering Logic

Figure 4 shows a macrocell slice of the Logic Allocator. There are 16 such slices in the GLB.

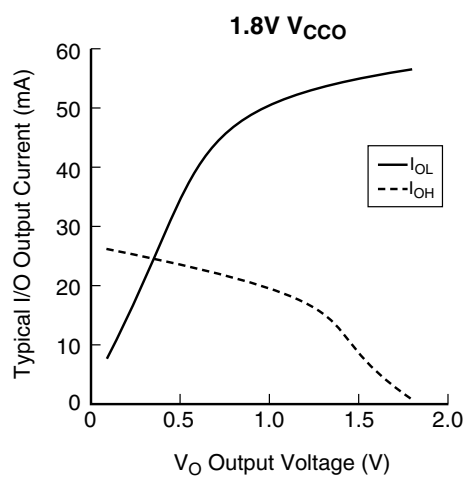
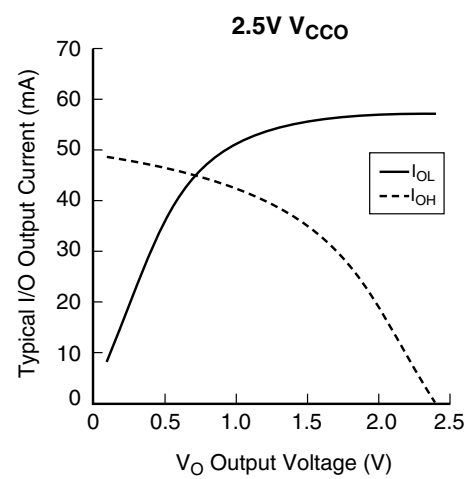
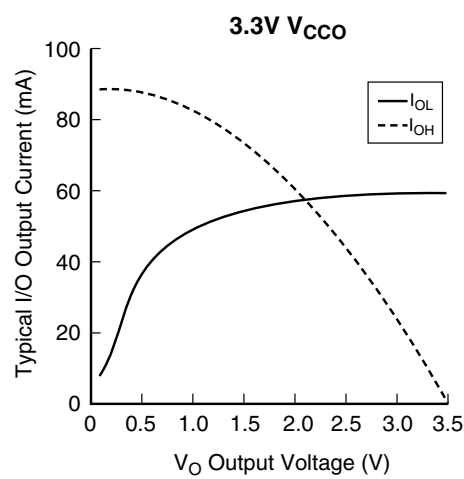
**Figure 4. Macrocell Slice**

## I/O DC Electrical Characteristics

### Over Recommended Operating Conditions

| Standard                | $V_{IL}$ |                              | $V_{IH}$                     |         | $V_{OL}$<br>Max (V) | $V_{OH}$<br>Min (V) | $I_{OL}^1$<br>(mA) | $I_{OH}^1$<br>(mA) |
|-------------------------|----------|------------------------------|------------------------------|---------|---------------------|---------------------|--------------------|--------------------|
|                         | Min (V)  | Max (V)                      | Min (V)                      | Max (V) |                     |                     |                    |                    |
| LVTTTL                  | -0.3     | 0.80                         | 2.0                          | 5.5     | 0.40                | $V_{CCO} - 0.40$    | 8.0                | -4.0               |
|                         |          |                              |                              |         | 0.20                | $V_{CCO} - 0.20$    | 0.1                | -0.1               |
| LVCMOS 3.3              | -0.3     | 0.80                         | 2.0                          | 5.5     | 0.40                | $V_{CCO} - 0.40$    | 8.0                | -4.0               |
|                         |          |                              |                              |         | 0.20                | $V_{CCO} - 0.20$    | 0.1                | -0.1               |
| LVCMOS 2.5              | -0.3     | 0.70                         | 1.70                         | 3.6     | 0.40                | $V_{CCO} - 0.40$    | 8.0                | -4.0               |
|                         |          |                              |                              |         | 0.20                | $V_{CCO} - 0.20$    | 0.1                | -0.1               |
| LVCMOS 1.8<br>(4000V/B) | -0.3     | 0.63                         | 1.17                         | 3.6     | 0.40                | $V_{CCO} - 0.45$    | 2.0                | -2.0               |
|                         |          |                              |                              |         | 0.20                | $V_{CCO} - 0.20$    | 0.1                | -0.1               |
| LVCMOS 1.8<br>(4000C/Z) | -0.3     | $0.35 * V_{CC}$              | $0.65 * V_{CC}$              | 3.6     | 0.40                | $V_{CCO} - 0.45$    | 2.0                | -2.0               |
|                         |          |                              |                              |         | 0.20                | $V_{CCO} - 0.20$    | 0.1                | -0.1               |
| PCI 3.3 (4000V/B)       | -0.3     | 1.08                         | 1.5                          | 5.5     | $0.1 V_{CCO}$       | $0.9 V_{CCO}$       | 1.5                | -0.5               |
| PCI 3.3 (4000C/Z)       | -0.3     | $0.3 * 3.3 * (V_{CC} / 1.8)$ | $0.5 * 3.3 * (V_{CC} / 1.8)$ | 5.5     | $0.1 V_{CCO}$       | $0.9 V_{CCO}$       | 1.5                | -0.5               |

1. The average DC current drawn by I/Os between adjacent bank GND connections, or between the last GND in an I/O bank and the end of the I/O bank, as shown in the logic signals connection table, shall not exceed  $n * 8\text{mA}$ . Where  $n$  is the number of I/Os between bank GND connections or between the last GND in a bank and the end of a bank.



## ispMACH 4000V/B/C External Switching Characteristics

Over Recommended Operating Conditions

| Parameter                     | Description <sup>1, 2, 3</sup>                                                   | -25  |      | -27  |      | -3   |      | -35  |      | Units |
|-------------------------------|----------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|-------|
|                               |                                                                                  | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |       |
| t <sub>PD</sub>               | 5-PT bypass combinatorial propagation delay                                      | —    | 2.5  | —    | 2.7  | —    | 3.0  | —    | 3.5  | ns    |
| t <sub>PD_MC</sub>            | 20-PT combinatorial propagation delay through macrocell                          | —    | 3.2  | —    | 3.5  | —    | 3.8  | —    | 4.2  | ns    |
| t <sub>S</sub>                | GLB register setup time before clock                                             | 1.8  | —    | 1.8  | —    | 2.0  | —    | 2.0  | —    | ns    |
| t <sub>ST</sub>               | GLB register setup time before clock with T-type register                        | 2.0  | —    | 2.0  | —    | 2.2  | —    | 2.2  | —    | ns    |
| t <sub>SIR</sub>              | GLB register setup time before clock, input register path                        | 0.7  | —    | 1.0  | —    | 1.0  | —    | 1.0  | —    | ns    |
| t <sub>SIRZ</sub>             | GLB register setup time before clock with zero hold                              | 1.7  | —    | 2.0  | —    | 2.0  | —    | 2.0  | —    | ns    |
| t <sub>H</sub>                | GLB register hold time after clock                                               | 0.0  | —    | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| t <sub>HT</sub>               | GLB register hold time after clock with T-type register                          | 0.0  | —    | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| t <sub>HIR</sub>              | GLB register hold time after clock, input register path                          | 0.9  | —    | 1.0  | —    | 1.0  | —    | 1.0  | —    | ns    |
| t <sub>HIRZ</sub>             | GLB register hold time after clock, input register path with zero hold           | 0.0  | —    | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| t <sub>CO</sub>               | GLB register clock-to-output delay                                               | —    | 2.2  | —    | 2.7  | —    | 2.7  | —    | 2.7  | ns    |
| t <sub>R</sub>                | External reset pin to output delay                                               | —    | 3.5  | —    | 4.0  | —    | 4.4  | —    | 4.5  | ns    |
| t <sub>RW</sub>               | External reset pulse duration                                                    | 1.5  | —    | 1.5  | —    | 1.5  | —    | 1.5  | -    | ns    |
| t <sub>PTOE/DIS</sub>         | Input to output local product term output enable/disable                         | —    | 4.0  | —    | 4.5  | —    | 5.0  | —    | 5.5  | ns    |
| t <sub>GPTOE/DIS</sub>        | Input to output global product term output enable/disable                        | —    | 5.0  | —    | 6.5  | —    | 8.0  | —    | 8.0  | ns    |
| t <sub>GOE/DIS</sub>          | Global OE input to output enable/disable                                         | —    | 3.0  | —    | 3.5  | —    | 4.0  | —    | 4.5  | ns    |
| t <sub>CW</sub>               | Global clock width, high or low                                                  | 1.1  | —    | 1.3  | —    | 1.3  | —    | 1.3  | —    | ns    |
| t <sub>GW</sub>               | Global gate width low (for low transparent) or high (for high transparent)       | 1.1  | —    | 1.3  | —    | 1.3  | —    | 1.3  | —    | ns    |
| t <sub>WIR</sub>              | Input register clock width, high or low                                          | 1.1  | —    | 1.3  | —    | 1.3  | —    | 1.3  | —    | ns    |
| f <sub>MAX</sub> <sup>4</sup> | Clock frequency with internal feedback                                           | —    | 400  | —    | 333  | —    | 322  | —    | 322  | MHz   |
| f <sub>MAX</sub> (Ext.)       | Clock frequency with external feedback, [1/ (t <sub>S</sub> + t <sub>CO</sub> )] | —    | 250  | —    | 222  | —    | 212  | —    | 212  | MHz   |

1. Timing numbers are based on default LVCMOS 1.8 I/O buffers. Use timing adjusters provided to calculate other standards.

Timing v.3.2

2. Measured using standard switching circuit, assuming GRP loading of 1 and 1 output switching.

3. Pulse widths and clock widths less than minimum will cause unknown behavior.

4. Standard 16-bit counter using GRP feedback.

**ispMACH 4000V/B/C Internal Timing Parameters (Cont.)****Over Recommended Operating Conditions**

| Parameter             | Description                                                         | -2.5 |      | -2.7 |      | -3   |      | -3.5 |      | Units |
|-----------------------|---------------------------------------------------------------------|------|------|------|------|------|------|------|------|-------|
| $t_{PDLi}$            | Propagation Delay through Transparent Latch to Output/ Feedback MUX | —    | 0.25 | —    | 0.25 | —    | 0.25 | —    | 0.25 | ns    |
| $t_{SRi}$             | Asynchronous Reset or Set to Output/Feedback MUX Delay              | 0.28 | —    | 0.28 | —    | 0.28 | —    | 0.28 | —    | ns    |
| $t_{SRR}$             | Asynchronous Reset or Set Recovery Time                             | 1.67 | —    | 1.67 | —    | 1.67 | —    | 1.67 | —    | ns    |
| <b>Control Delays</b> |                                                                     |      |      |      |      |      |      |      |      |       |
| $t_{BCLK}$            | GLB PT Clock Delay                                                  | —    | 1.12 | —    | 1.12 | —    | 1.12 | —    | 1.12 | ns    |
| $t_{PTCLK}$           | Macrocell PT Clock Delay                                            | —    | 0.87 | —    | 0.87 | —    | 0.87 | —    | 0.87 | ns    |
| $t_{BSR}$             | Block PT Set/Reset Delay                                            | —    | 1.83 | —    | 1.83 | —    | 1.83 | —    | 1.83 | ns    |
| $t_{PTSR}$            | Macrocell PT Set/Reset Delay                                        | —    | 1.11 | —    | 1.41 | —    | 1.51 | —    | 1.61 | ns    |
| $t_{GPTOE}$           | Global PT OE Delay                                                  | —    | 2.83 | —    | 4.13 | —    | 5.33 | —    | 5.33 | ns    |
| $t_{PTOE}$            | Macrocell PT OE Delay                                               | —    | 1.83 | —    | 2.13 | —    | 2.33 | —    | 2.83 | ns    |

Timing v.3.2

Note: Internal Timing Parameters are not tested and are for reference only. Refer to the Timing Model in this data sheet for further details.

**ispMACH 4000Z Timing Adders (Cont.)<sup>1</sup>**

| Adder Type                        | Base Parameter                                            | Description                                | -45  |      | -5   |      | -75  |      | Units |
|-----------------------------------|-----------------------------------------------------------|--------------------------------------------|------|------|------|------|------|------|-------|
|                                   |                                                           |                                            | Min. | Max. | Min. | Max. | Min. | Max. |       |
| Optional Delay Adders             |                                                           |                                            |      |      |      |      |      |      |       |
| t <sub>INDIO</sub>                | t <sub>INREG</sub>                                        | Input register delay                       | —    | 1.30 | —    | 1.30 | —    | 1.30 | ns    |
| t <sub>EXP</sub>                  | t <sub>MCELL</sub>                                        | Product term expander delay                | —    | 0.45 | —    | 0.45 | —    | 0.50 | ns    |
| t <sub>ORP</sub>                  | —                                                         | Output routing pool delay                  | —    | 0.40 | —    | 0.40 | —    | 0.40 | ns    |
| t <sub>BLA</sub>                  | t <sub>ROUTE</sub>                                        | Additional block load-ing adder            | —    | 0.05 | —    | 0.05 | —    | 0.05 | ns    |
| t <sub>IOI</sub> Input Adjusters  |                                                           |                                            |      |      |      |      |      |      |       |
| LVTTTL_in                         | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVTTTL standard                      | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| LVC MOS33_in                      | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVC MOS 3.3 standard                 | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| LVC MOS25_in                      | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVC MOS 2.5 standard                 | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| LVC MOS18_in                      | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVC MOS 1.8 standard                 | —    | 0.00 | —    | 0.00 | —    | 0.00 | ns    |
| PCI_in                            | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using PCI compatible input                 | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| t <sub>IOO</sub> Output Adjusters |                                                           |                                            |      |      |      |      |      |      |       |
| LVTTTL_out                        | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as TTL buffer            | —    | 0.20 | —    | 0.20 | —    | 0.20 | ns    |
| LVC MOS33_out                     | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as 3.3V buffer           | —    | 0.20 | —    | 0.20 | —    | 0.20 | ns    |
| LVC MOS25_out                     | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as 2.5V buffer           | —    | 0.10 | —    | 0.10 | —    | 0.10 | ns    |
| LVC MOS18_out                     | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as 1.8V buffer           | —    | 0.00 | —    | 0.00 | —    | 0.00 | ns    |
| PCI_out                           | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as PCI compatible buffer | —    | 0.20 | —    | 0.20 | —    | 0.20 | ns    |
| Slow Slew                         | t <sub>BUF</sub> , t <sub>EN</sub>                        | Output configured for slow slew rate       | —    | 1.00 | —    | 1.00 | —    | 1.00 | ns    |

Note: Open drain timing is the same as corresponding LVC MOS timing.

Timing v.2.2

1. Refer to TN1004, [ispMACH 4000 Timing Model Design and Usage Guidelines](#) for information regarding use of these adders.

**ispMACH 4064V/B/C/Z, 4128V/B/C/Z, 4256V/B/C/Z Logic Signal Connections:  
100-Pin TQFP**

| Pin Number | Bank Number | ispMACH 4064V/B/C/Z |                 | ispMACH 4128V/B/C/Z |                | ispMACH 4256V/B/C/Z |                |
|------------|-------------|---------------------|-----------------|---------------------|----------------|---------------------|----------------|
|            |             | GLB/MC/Pad          | ORP             | GLB/MC/Pad          | ORP            | GLB/MC/Pad          | ORP            |
| 1          | -           | GND                 | -               | GND                 | -              | GND                 | -              |
| 2          | -           | TDI                 | -               | TDI                 | -              | TDI                 | -              |
| 3          | 0           | A8                  | A <sup>8</sup>  | B0                  | B <sup>0</sup> | C12                 | C <sup>3</sup> |
| 4          | 0           | A9                  | A <sup>9</sup>  | B2                  | B <sup>1</sup> | C10                 | C <sup>2</sup> |
| 5          | 0           | A10                 | A <sup>10</sup> | B4                  | B <sup>2</sup> | C6                  | C <sup>1</sup> |
| 6          | 0           | A11                 | A <sup>11</sup> | B6                  | B <sup>3</sup> | C2                  | C <sup>0</sup> |
| 7          | 0           | GND (Bank 0)        | -               | GND (Bank 0)        | -              | GND (Bank 0)        | -              |
| 8          | 0           | A12                 | A <sup>12</sup> | B8                  | B <sup>4</sup> | D12                 | D <sup>3</sup> |
| 9          | 0           | A13                 | A <sup>13</sup> | B10                 | B <sup>5</sup> | D10                 | D <sup>2</sup> |
| 10         | 0           | A14                 | A <sup>14</sup> | B12                 | B <sup>6</sup> | D6                  | D <sup>1</sup> |
| 11         | 0           | A15                 | A <sup>15</sup> | B13                 | B <sup>7</sup> | D4                  | D <sup>0</sup> |
| 12*        | 0           | I                   | -               | I                   | -              | I                   | -              |
| 13         | 0           | VCCO (Bank 0)       | -               | VCCO (Bank 0)       | -              | VCCO (Bank 0)       | -              |
| 14         | 0           | B15                 | B <sup>15</sup> | C14                 | C <sup>7</sup> | E4                  | E <sup>0</sup> |
| 15         | 0           | B14                 | B <sup>14</sup> | C12                 | C <sup>6</sup> | E6                  | E <sup>1</sup> |
| 16         | 0           | B13                 | B <sup>13</sup> | C10                 | C <sup>5</sup> | E10                 | E <sup>2</sup> |
| 17         | 0           | B12                 | B <sup>12</sup> | C8                  | C <sup>4</sup> | E12                 | E <sup>3</sup> |
| 18         | 0           | GND (Bank 0)        | -               | GND (Bank 0)        | -              | GND (Bank 0)        | -              |
| 19         | 0           | B11                 | B <sup>11</sup> | C6                  | C <sup>3</sup> | F2                  | F <sup>0</sup> |
| 20         | 0           | B10                 | B <sup>10</sup> | C5                  | C <sup>2</sup> | F6                  | F <sup>1</sup> |
| 21         | 0           | B9                  | B <sup>9</sup>  | C4                  | C <sup>1</sup> | F10                 | F <sup>2</sup> |
| 22         | 0           | B8                  | B <sup>8</sup>  | C2                  | C <sup>0</sup> | F12                 | F <sup>3</sup> |
| 23*        | 0           | I                   | -               | I                   | -              | I                   | -              |
| 24         | -           | TCK                 | -               | TCK                 | -              | TCK                 | -              |
| 25         | -           | VCC                 | -               | VCC                 | -              | VCC                 | -              |
| 26         | -           | GND                 | -               | GND                 | -              | GND                 | -              |
| 27*        | 0           | I                   | -               | I                   | -              | I                   | -              |
| 28         | 0           | B7                  | B <sup>7</sup>  | D13                 | D <sup>7</sup> | G12                 | G <sup>3</sup> |
| 29         | 0           | B6                  | B <sup>6</sup>  | D12                 | D <sup>6</sup> | G10                 | G <sup>2</sup> |
| 30         | 0           | B5                  | B <sup>5</sup>  | D10                 | D <sup>5</sup> | G6                  | G <sup>1</sup> |
| 31         | 0           | B4                  | B <sup>4</sup>  | D8                  | D <sup>4</sup> | G2                  | G <sup>0</sup> |
| 32         | 0           | GND (Bank 0)        | -               | GND (Bank 0)        | -              | GND (Bank 0)        | -              |
| 33         | 0           | VCCO (Bank 0)       | -               | VCCO (Bank 0)       | -              | VCCO (Bank 0)       | -              |
| 34         | 0           | B3                  | B <sup>3</sup>  | D6                  | D <sup>3</sup> | H12                 | H <sup>3</sup> |
| 35         | 0           | B2                  | B <sup>2</sup>  | D4                  | D <sup>2</sup> | H10                 | H <sup>2</sup> |
| 36         | 0           | B1                  | B <sup>1</sup>  | D2                  | D <sup>1</sup> | H6                  | H <sup>1</sup> |
| 37         | 0           | B0                  | B <sup>0</sup>  | D0                  | D <sup>0</sup> | H2                  | H <sup>0</sup> |
| 38         | 0           | CLK1/I              | -               | CLK1/I              | -              | CLK1/I              | -              |
| 39         | 1           | CLK2/I              | -               | CLK2/I              | -              | CLK2/I              | -              |
| 40         | -           | VCC                 | -               | VCC                 | -              | VCC                 | -              |
| 41         | 1           | C0                  | C <sup>0</sup>  | E0                  | E <sup>0</sup> | I2                  | I <sup>0</sup> |

**ispMACH 4064Z, 4128Z and 4256Z Logic Signal Connections:  
132-Ball csBGA (Cont.)**

| Ball Number | Bank Number | ispMACH 4064Z   |                   | ispMACH 4128Z   |                   | ispMACH 4256Z  |                  |
|-------------|-------------|-----------------|-------------------|-----------------|-------------------|----------------|------------------|
|             |             | GLB/MC/Pad      | ORP               | GLB/MC/Pad      | ORP               | GLB/MC/Pad     | ORP              |
| D13         | 1           | D10             | D <sup>^</sup> 10 | G4              | G <sup>^</sup> 3  | N6             | N <sup>^</sup> 3 |
| D14         | 1           | D9              | D <sup>^</sup> 9  | G2              | G <sup>^</sup> 2  | N8             | N <sup>^</sup> 4 |
| D12         | 1           | D8              | D <sup>^</sup> 8  | G1              | G <sup>^</sup> 1  | N10            | N <sup>^</sup> 5 |
| C14         | 1           | I               | -                 | G0              | G <sup>^</sup> 0  | N12            | N <sup>^</sup> 6 |
| C13         | 1           | NC              | -                 | VCCO (Bank 1)   | -                 | VCCO (Bank 1)  | -                |
| B14         | -           | TDO             | -                 | TDO             | -                 | TDO            | -                |
| A14         | -           | VCC             | -                 | VCC             | -                 | VCC            | -                |
| A13         | -           | GND             | -                 | GND             | -                 | GND            | -                |
| B13         | 1           | NC              | -                 | H14             | H <sup>^</sup> 11 | O12            | O <sup>^</sup> 6 |
| A12         | 1           | I               | -                 | H13             | H <sup>^</sup> 10 | O10            | O <sup>^</sup> 5 |
| C12         | 1           | D7              | D <sup>^</sup> 7  | H12             | H <sup>^</sup> 9  | O8             | O <sup>^</sup> 4 |
| B12         | 1           | D6              | D <sup>^</sup> 6  | H10             | H <sup>^</sup> 8  | O6             | O <sup>^</sup> 3 |
| A11         | 1           | D5              | D <sup>^</sup> 5  | H9              | H <sup>^</sup> 7  | O4             | O <sup>^</sup> 2 |
| C11         | 1           | D4              | D <sup>^</sup> 4  | H8              | H <sup>^</sup> 6  | O2             | O <sup>^</sup> 1 |
| B11         | 1           | GND (Bank 1)    | -                 | GND (Bank 1)    | -                 | GND (Bank 1)   | -                |
| A10         | 1           | VCCO (Bank 1)   | -                 | VCCO (Bank 1)   | -                 | VCCO (Bank 1)  | -                |
| B10         | 1           | NC              | -                 | H6              | H <sup>^</sup> 5  | P12            | P <sup>^</sup> 6 |
| C10         | 1           | NC              | -                 | H5              | H <sup>^</sup> 4  | P10            | P <sup>^</sup> 5 |
| B9          | 1           | D3              | D <sup>^</sup> 3  | H4              | H <sup>^</sup> 3  | P8             | P <sup>^</sup> 4 |
| A9          | 1           | D2              | D <sup>^</sup> 2  | H2              | H <sup>^</sup> 2  | P6             | P <sup>^</sup> 3 |
| C9          | 1           | D1              | D <sup>^</sup> 1  | H1              | H <sup>^</sup> 1  | P4             | P <sup>^</sup> 2 |
| A8          | 1           | D0/GOE1         | D <sup>^</sup> 0  | H0/GOE1         | H <sup>^</sup> 0  | P2/GOE1        | P <sup>^</sup> 1 |
| B8          | 1           | CLK3/I          | -                 | CLK3/I          | -                 | CLK3/I         | -                |
| C8          | 0           | CLK0/I          | -                 | CLK0/I          | -                 | CLK0/I         | -                |
| B7          | -           | VCC             | -                 | VCC             | -                 | VCC            | -                |
| A7          | 0           | NC <sup>1</sup> | -                 | NC <sup>1</sup> | -                 | I <sup>1</sup> | -                |
| C7          | 0           | A0/GOE0         | A <sup>^</sup> 0  | A0/GOE0         | A <sup>^</sup> 0  | A2/GOE0        | A <sup>^</sup> 1 |
| A6          | 0           | A1              | A <sup>^</sup> 1  | A1              | A <sup>^</sup> 1  | A4             | A <sup>^</sup> 2 |
| B6          | 0           | A2              | A <sup>^</sup> 2  | A2              | A <sup>^</sup> 2  | A6             | A <sup>^</sup> 3 |
| C6          | 0           | A3              | A <sup>^</sup> 3  | A4              | A <sup>^</sup> 3  | A8             | A <sup>^</sup> 4 |
| B5          | 0           | NC              | -                 | A5              | A <sup>^</sup> 4  | A10            | A <sup>^</sup> 5 |
| A5          | 0           | NC              | -                 | A6              | A <sup>^</sup> 5  | A12            | A <sup>^</sup> 6 |
| C5          | 0           | VCCO (Bank 0)   | -                 | VCCO (Bank 0)   | -                 | VCCO (Bank 0)  | -                |
| B4          | 0           | GND (Bank 0)    | -                 | GND (Bank 0)    | -                 | GND (Bank 0)   | -                |
| A4          | 0           | NC              | -                 | A8              | A <sup>^</sup> 6  | B2             | B <sup>^</sup> 1 |
| C4          | 0           | A4              | A <sup>^</sup> 4  | A9              | A <sup>^</sup> 7  | B4             | B <sup>^</sup> 2 |
| A3          | 0           | A5              | A <sup>^</sup> 5  | A10             | A <sup>^</sup> 8  | B6             | B <sup>^</sup> 3 |
| B3          | 0           | A6              | A <sup>^</sup> 6  | A12             | A <sup>^</sup> 9  | B8             | B <sup>^</sup> 4 |
| A2          | 0           | A7              | A <sup>^</sup> 7  | A13             | A <sup>^</sup> 10 | B10            | B <sup>^</sup> 5 |
| A1          | 0           | NC              | -                 | A14             | A <sup>^</sup> 11 | B12            | B <sup>^</sup> 6 |

1. For device migration considerations, these NC pins are input signal pins in ispMACH 4256Z device.

**ispMACH 4128V and 4256V Logic Signal Connections: 144-Pin TQFP**

| Pin Number | Bank Number | ispMACH 4128V             |                   | ispMACH 4256V   |                  |
|------------|-------------|---------------------------|-------------------|-----------------|------------------|
|            |             | GLB/MC/Pad                | ORP               | GLB/MC/Pad      | ORP              |
| 1          | -           | GND                       | -                 | GND             | -                |
| 2          | -           | TDI                       | -                 | TDI             | -                |
| 3          | 0           | VCCO (Bank 0)             | -                 | VCCO (Bank 0)   | -                |
| 4          | 0           | B0                        | B <sup>^</sup> 0  | C12             | C <sup>^</sup> 6 |
| 5          | 0           | B1                        | B <sup>^</sup> 1  | C10             | C <sup>^</sup> 5 |
| 6          | 0           | B2                        | B <sup>^</sup> 2  | C8              | C <sup>^</sup> 4 |
| 7          | 0           | B4                        | B <sup>^</sup> 3  | C6              | C <sup>^</sup> 3 |
| 8          | 0           | B5                        | B <sup>^</sup> 4  | C4              | C <sup>^</sup> 2 |
| 9          | 0           | B6                        | B <sup>^</sup> 5  | C2              | C <sup>^</sup> 1 |
| 10         | 0           | GND (Bank 0)              | -                 | GND (Bank 0)    | -                |
| 11         | 0           | B8                        | B <sup>^</sup> 6  | D14             | D <sup>^</sup> 7 |
| 12         | 0           | B9                        | B <sup>^</sup> 7  | D12             | D <sup>^</sup> 6 |
| 13         | 0           | B10                       | B <sup>^</sup> 8  | D10             | D <sup>^</sup> 5 |
| 14         | 0           | B12                       | B <sup>^</sup> 9  | D8              | D <sup>^</sup> 4 |
| 15         | 0           | B13                       | B <sup>^</sup> 10 | D6              | D <sup>^</sup> 3 |
| 16         | 0           | B14                       | B <sup>^</sup> 11 | D4              | D <sup>^</sup> 2 |
| 17         | -           | NC <sup>2</sup>           | -                 | I <sup>2</sup>  | -                |
| 18         | 0           | GND (Bank 0) <sup>1</sup> | -                 | NC <sup>1</sup> | -                |
| 19         | 0           | VCCO (Bank 0)             | -                 | VCCO (Bank 0)   | -                |
| 20         | 0           | NC <sup>2</sup>           | -                 | I <sup>2</sup>  | -                |
| 21         | 0           | C14                       | C <sup>^</sup> 11 | E2              | E <sup>^</sup> 1 |
| 22         | 0           | C13                       | C <sup>^</sup> 10 | E4              | E <sup>^</sup> 2 |
| 23         | 0           | C12                       | C <sup>^</sup> 9  | E6              | E <sup>^</sup> 3 |
| 24         | 0           | C10                       | C <sup>^</sup> 8  | E8              | E <sup>^</sup> 4 |
| 25         | 0           | C9                        | C <sup>^</sup> 7  | E10             | E <sup>^</sup> 5 |
| 26         | 0           | C8                        | C <sup>^</sup> 6  | E12             | E <sup>^</sup> 6 |
| 27         | 0           | GND (Bank 0)              | -                 | GND (Bank 0)    | -                |
| 28         | 0           | C6                        | C <sup>^</sup> 5  | F2              | F <sup>^</sup> 1 |
| 29         | 0           | C5                        | C <sup>^</sup> 4  | F4              | F <sup>^</sup> 2 |
| 30         | 0           | C4                        | C <sup>^</sup> 3  | F6              | F <sup>^</sup> 3 |
| 31         | 0           | C2                        | C <sup>^</sup> 2  | F8              | F <sup>^</sup> 4 |
| 32         | 0           | C1                        | C <sup>^</sup> 1  | F10             | F <sup>^</sup> 5 |
| 33         | 0           | C0                        | C <sup>^</sup> 0  | F12             | F <sup>^</sup> 6 |
| 34         | 0           | VCCO (Bank 0)             | -                 | VCCO (Bank 0)   | -                |
| 35         | -           | TCK                       | -                 | TCK             | -                |
| 36         | -           | VCC                       | -                 | VCC             | -                |
| 37         | -           | GND                       | -                 | GND             | -                |
| 38         | 0           | NC <sup>2</sup>           | -                 | I <sup>2</sup>  | -                |
| 39         | 0           | D14                       | D <sup>^</sup> 11 | G12             | G <sup>^</sup> 6 |
| 40         | 0           | D13                       | D <sup>^</sup> 10 | G10             | G <sup>^</sup> 5 |
| 41         | 0           | D12                       | D <sup>^</sup> 9  | G8              | G <sup>^</sup> 4 |
| 42         | 0           | D10                       | D <sup>^</sup> 8  | G6              | G <sup>^</sup> 3 |

**ispMACH 4128V and 4256V Logic Signal Connections: 144-Pin TQFP (Cont.)**

| Pin Number | Bank Number | ispMACH 4128V             |                 | ispMACH 4256V   |                |
|------------|-------------|---------------------------|-----------------|-----------------|----------------|
|            |             | GLB/MC/Pad                | ORP             | GLB/MC/Pad      | ORP            |
| 86         | 1           | F12                       | F <sup>9</sup>  | L8              | L <sup>4</sup> |
| 87         | 1           | F13                       | F <sup>10</sup> | L6              | L <sup>3</sup> |
| 88         | 1           | F14                       | F <sup>11</sup> | L4              | L <sup>2</sup> |
| 89         | 1           | NC <sup>2</sup>           | -               | I <sup>2</sup>  | -              |
| 90         | 1           | GND (Bank 1) <sup>1</sup> | -               | NC <sup>1</sup> | -              |
| 91         | 1           | VCCO (Bank 1)             | -               | VCCO (Bank 1)   | -              |
| 92         | 1           | NC <sup>2</sup>           | -               | I <sup>2</sup>  | -              |
| 93         | 1           | G14                       | G <sup>11</sup> | M2              | M <sup>1</sup> |
| 94         | 1           | G13                       | G <sup>10</sup> | M4              | M <sup>2</sup> |
| 95         | 1           | G12                       | G <sup>9</sup>  | M6              | M <sup>3</sup> |
| 96         | 1           | G10                       | G <sup>8</sup>  | M8              | M <sup>4</sup> |
| 97         | 1           | G9                        | G <sup>7</sup>  | M10             | M <sup>5</sup> |
| 98         | 1           | G8                        | G <sup>6</sup>  | M12             | M <sup>6</sup> |
| 99         | 1           | GND (Bank 1)              | -               | GND (Bank 1)    | -              |
| 100        | 1           | G6                        | G <sup>5</sup>  | N2              | N <sup>1</sup> |
| 101        | 1           | G5                        | G <sup>4</sup>  | N4              | N <sup>2</sup> |
| 102        | 1           | G4                        | G <sup>3</sup>  | N6              | N <sup>3</sup> |
| 103        | 1           | G2                        | G <sup>2</sup>  | N8              | N <sup>4</sup> |
| 104        | 1           | G1                        | G <sup>1</sup>  | N10             | N <sup>5</sup> |
| 105        | 1           | G0                        | G <sup>0</sup>  | N12             | N <sup>6</sup> |
| 106        | 1           | VCCO (Bank 1)             | -               | VCCO (Bank 1)   | -              |
| 107        | -           | TDO                       | -               | TDO             | -              |
| 108        | -           | VCC                       | -               | VCC             | -              |
| 109        | -           | GND                       | -               | GND             | -              |
| 110        | 1           | NC <sup>2</sup>           | -               | I <sup>2</sup>  | -              |
| 111        | 1           | H14                       | H <sup>11</sup> | O12             | O <sup>6</sup> |
| 112        | 1           | H13                       | H <sup>10</sup> | O10             | O <sup>5</sup> |
| 113        | 1           | H12                       | H <sup>9</sup>  | O8              | O <sup>4</sup> |
| 114        | 1           | H10                       | H <sup>8</sup>  | O6              | O <sup>3</sup> |
| 115        | 1           | H9                        | H <sup>7</sup>  | O4              | O <sup>2</sup> |
| 116        | 1           | H8                        | H <sup>6</sup>  | O2              | O <sup>1</sup> |
| 117        | 1           | NC <sup>2</sup>           | -               | I <sup>2</sup>  | -              |
| 118        | 1           | GND (Bank 1)              | -               | GND (Bank 1)    | -              |
| 119        | 1           | VCCO (Bank 1)             | -               | VCCO (Bank 1)   | -              |
| 120        | 1           | H6                        | H <sup>5</sup>  | P12             | P <sup>6</sup> |
| 121        | 1           | H5                        | H <sup>4</sup>  | P10             | P <sup>5</sup> |
| 122        | 1           | H4                        | H <sup>3</sup>  | P8              | P <sup>4</sup> |
| 123        | 1           | H2                        | H <sup>2</sup>  | P6              | P <sup>3</sup> |
| 124        | 1           | H1                        | H <sup>1</sup>  | P4              | P <sup>2</sup> |
| 125        | 1           | H0/GOE1                   | H <sup>0</sup>  | P2/GOE1         | P <sup>1</sup> |
| 126        | 1           | CLK3/I                    | -               | CLK3/I          | -              |
| 127        | 0           | GND (Bank 0)              | -               | GND (Bank 0)    | -              |
| 128        | 0           | CLK0/I                    | -               | CLK0/I          | -              |

**ispMACH 4128V and 4256V Logic Signal Connections: 144-Pin TQFP (Cont.)**

| Pin Number | Bank Number | ispMACH 4128V   |      | ispMACH 4256V  |     |
|------------|-------------|-----------------|------|----------------|-----|
|            |             | GLB/MC/Pad      | ORP  | GLB/MC/Pad     | ORP |
| 129        | -           | VCC             | -    | VCC            | -   |
| 130        | 0           | A0/GOE0         | A^0  | A2/GOE0        | A^1 |
| 131        | 0           | A1              | A^1  | A4             | A^2 |
| 132        | 0           | A2              | A^2  | A6             | A^3 |
| 133        | 0           | A4              | A^3  | A8             | A^4 |
| 134        | 0           | A5              | A^4  | A10            | A^5 |
| 135        | 0           | A6              | A^5  | A12            | A^6 |
| 136        | 0           | VCCO (Bank 0)   | -    | VCCO (Bank 0)  | -   |
| 137        | 0           | GND (Bank 0)    | -    | GND (Bank 0)   | -   |
| 138        | 0           | A8              | A^6  | B2             | B^1 |
| 139        | 0           | A9              | A^7  | B4             | B^2 |
| 140        | 0           | A10             | A^8  | B6             | B^3 |
| 141        | 0           | A12             | A^9  | B8             | B^4 |
| 142        | 0           | A13             | A^10 | B10            | B^5 |
| 143        | 0           | A14             | A^11 | B12            | B^6 |
| 144        | 0           | NC <sup>2</sup> | -    | I <sup>2</sup> | -   |

1. For device migration considerations, these NC pins are GND pins for I/O banks in ispMACH 4128V devices.

2. For device migration considerations, these NC pins are input signal pins in ispMACH 4256V devices.

**ispMACH 4256V/B/C/Z, 4384V/B/C, 4512V/B/C, Logic Signal Connections: 176-Pin TQFP**

| Pin Number | Bank Number | ispMACH 4256V/B/C/Z |     | ispMACH 4384V/B/C |     | ispMACH 4512V/B/C |     |
|------------|-------------|---------------------|-----|-------------------|-----|-------------------|-----|
|            |             | GLB/MC/Pad          | ORP | GLB/MC/Pad        | ORP | GLB/MC/Pad        | ORP |
| 1          | -           | NC                  | -   | NC                | -   | NC                | -   |
| 2          | -           | GND                 | -   | GND               | -   | GND               | -   |
| 3          | -           | TDI                 | -   | TDI               | -   | TDI               | -   |
| 4          | 0           | VCCO (Bank 0)       | -   | VCCO (Bank 0)     | -   | VCCO (Bank 0)     | -   |
| 5          | 0           | C14                 | C^7 | C14               | C^7 | C14               | C^7 |
| 6          | 0           | C12                 | C^6 | C12               | C^6 | C12               | C^6 |
| 7          | 0           | C10                 | C^5 | C10               | C^5 | C10               | C^5 |
| 8          | 0           | C8                  | C^4 | C8                | C^4 | C8                | C^4 |
| 9          | 0           | C6                  | C^3 | C6                | C^3 | C6                | C^3 |
| 10         | 0           | C4                  | C^2 | C4                | C^2 | C4                | C^2 |
| 11         | 0           | C2                  | C^1 | C2                | C^1 | C2                | C^1 |
| 12         | 0           | C0                  | C^0 | C0                | C^0 | C0                | C^0 |
| 13         | 0           | GND (Bank 0)        | -   | GND (Bank 0)      | -   | GND (Bank 0)      | -   |
| 14         | 0           | D14                 | D^7 | E14               | E^7 | G14               | G^7 |
| 15         | 0           | D12                 | D^6 | E12               | E^6 | G12               | G^6 |
| 16         | 0           | D10                 | D^5 | E10               | E^5 | G10               | G^5 |
| 17         | 0           | D8                  | D^4 | E8                | E^4 | G8                | G^4 |
| 18         | 0           | D6                  | D^3 | E6                | E^3 | G6                | G^3 |

**ispMACH 4256V/B/C/Z, 4384V/B/C, 4512V/B/C, Logic Signal Connections:  
176-Pin TQFP (Cont.)**

| Pin Number | Bank Number | ispMACH 4256V/B/C/Z |                | ispMACH 4384V/B/C |                 | ispMACH 4512V/B/C |                 |
|------------|-------------|---------------------|----------------|-------------------|-----------------|-------------------|-----------------|
|            |             | GLB/MC/Pad          | ORP            | GLB/MC/Pad        | ORP             | GLB/MC/Pad        | ORP             |
| 142        | 1           | O0                  | O <sup>0</sup> | GX0               | GX <sup>0</sup> | OX0               | OX <sup>0</sup> |
| 143        | 1           | GND (Bank 1)        | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| 144        | 1           | VCCO (Bank 1)       | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| 145        | 1           | P14                 | P <sup>7</sup> | HX14              | HX <sup>7</sup> | PX14              | PX <sup>7</sup> |
| 146        | 1           | P12                 | P <sup>6</sup> | HX12              | HX <sup>6</sup> | PX12              | PX <sup>6</sup> |
| 147        | 1           | P10                 | P <sup>5</sup> | HX10              | HX <sup>5</sup> | PX10              | PX <sup>5</sup> |
| 148        | 1           | P8                  | P <sup>4</sup> | HX8               | HX <sup>4</sup> | PX8               | PX <sup>4</sup> |
| 149        | 1           | P6                  | P <sup>3</sup> | HX6               | HX <sup>3</sup> | PX6               | PX <sup>3</sup> |
| 150        | 1           | P4                  | P <sup>2</sup> | HX4               | HX <sup>2</sup> | PX4               | PX <sup>2</sup> |
| 151        | 1           | P2/GOE1             | P <sup>1</sup> | HX2/GOE1          | HX <sup>1</sup> | PX2/GOE1          | PX <sup>1</sup> |
| 152        | 1           | P0                  | P <sup>0</sup> | HX0               | HX <sup>0</sup> | PX0               | PX <sup>0</sup> |
| 153        | -           | GND                 | -              | GND               | -               | GND               | -               |
| 154        | 1           | CLK3/I              | -              | CLK3/I            | -               | CLK3/I            | -               |
| 155        | 0           | GND (Bank 0)        | -              | GND (Bank 0)      | -               | GND (Bank 0)      | -               |
| 156        | 0           | CLK0/I              | -              | CLK0/I            | -               | CLK0/I            | -               |
| 157        | -           | VCC                 | -              | VCC               | -               | VCC               | -               |
| 158        | 0           | A0                  | A <sup>0</sup> | A0                | A <sup>0</sup>  | A0                | A <sup>0</sup>  |
| 159        | 0           | A2/GOE0             | A <sup>1</sup> | A2/GOE0           | A <sup>1</sup>  | A2/GOE0           | A <sup>1</sup>  |
| 160        | 0           | A4                  | A <sup>2</sup> | A4                | A <sup>2</sup>  | A4                | A <sup>2</sup>  |
| 161        | 0           | A6                  | A <sup>3</sup> | A6                | A <sup>3</sup>  | A6                | A <sup>3</sup>  |
| 162        | 0           | A8                  | A <sup>4</sup> | A8                | A <sup>4</sup>  | A8                | A <sup>4</sup>  |
| 163        | 0           | A10                 | A <sup>5</sup> | A10               | A <sup>5</sup>  | A10               | A <sup>5</sup>  |
| 164        | 0           | A12                 | A <sup>6</sup> | A12               | A <sup>6</sup>  | A12               | A <sup>6</sup>  |
| 165        | 0           | A14                 | A <sup>7</sup> | A14               | A <sup>7</sup>  | A14               | A <sup>7</sup>  |
| 166        | 0           | VCCO (Bank 0)       | -              | VCCO (Bank 0)     | -               | VCCO (Bank 0)     | -               |
| 167        | 0           | GND (Bank 0)        | -              | GND (Bank 0)      | -               | GND (Bank 0)      | -               |
| 168        | 0           | B0                  | B <sup>0</sup> | B0                | B <sup>0</sup>  | B0                | B <sup>0</sup>  |
| 169        | 0           | B2                  | B <sup>1</sup> | B2                | B <sup>1</sup>  | B2                | B <sup>1</sup>  |
| 170        | 0           | B4                  | B <sup>2</sup> | B4                | B <sup>2</sup>  | B4                | B <sup>2</sup>  |
| 171        | 0           | B6                  | B <sup>3</sup> | B6                | B <sup>3</sup>  | B6                | B <sup>3</sup>  |
| 172        | 0           | B8                  | B <sup>4</sup> | B8                | B <sup>4</sup>  | B8                | B <sup>4</sup>  |
| 173        | 0           | B10                 | B <sup>5</sup> | B10               | B <sup>5</sup>  | B10               | B <sup>5</sup>  |
| 174        | 0           | B12                 | B <sup>6</sup> | B12               | B <sup>6</sup>  | B12               | B <sup>6</sup>  |
| 175        | 0           | B14                 | B <sup>7</sup> | B14               | B <sup>7</sup>  | B14               | B <sup>7</sup>  |
| 176        | -           | VCC                 | -              | VCC               | -               | VCC               | -               |

**ispMACH 4256V/B/C, 4384V/B/C, 4512V/B/C Logic Signal Connections:  
256-Ball ftBGA/fpBGA (Cont.)**

| Ball Number | I/O Bank | ispMACH 4256V/B/C<br>128-I/O |                | ispMACH 4256V/B/C<br>160-I/O |                | ispMACH 4384V/B/C |                | ispMACH 4512V/B/C |                |
|-------------|----------|------------------------------|----------------|------------------------------|----------------|-------------------|----------------|-------------------|----------------|
|             |          | GLB/MC/Pad                   | ORP            | GLB/MC/Pad                   | ORP            | GLB/MC/Pad        | ORP            | GLB/MC/Pad        | ORP            |
| J6          | 0        | E14                          | E <sup>7</sup> | E10                          | E <sup>7</sup> | H14               | H <sup>7</sup> | J14               | J <sup>7</sup> |
| K3          | 0        | NC                           | -              | E12                          | E <sup>8</sup> | G0                | G <sup>0</sup> | I0                | I <sup>0</sup> |
| K4          | 0        | NC                           | -              | E14                          | E <sup>9</sup> | G2                | G <sup>1</sup> | I4                | I <sup>1</sup> |
| L1          | 0        | NC                           | -              | NC                           | -              | I14               | I <sup>7</sup> | K0                | K <sup>0</sup> |
| L2          | 0        | NC                           | -              | NC                           | -              | I12               | I <sup>6</sup> | K2                | K <sup>1</sup> |
| M1          | 0        | NC                           | -              | NC                           | -              | NC                | -              | K4                | K <sup>2</sup> |
| -           | 0        | GND (Bank 0)                 | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -              | GND (Bank 0)      | -              |
| -           | 0        | -                            | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -              | VCCO (Bank 0)     | -              |
| M2          | 0        | NC                           | -              | NC                           | -              | NC                | -              | K6                | K <sup>3</sup> |
| N1          | 0        | NC                           | -              | NC                           | -              | I10               | I <sup>5</sup> | K8                | K <sup>4</sup> |
| M3          | 0        | NC                           | -              | NC                           | -              | I8                | I <sup>4</sup> | K10               | K <sup>5</sup> |
| M4          | 0        | NC                           | -              | F0                           | F <sup>0</sup> | G4                | G <sup>2</sup> | I8                | I <sup>2</sup> |
| N2          | 0        | NC                           | -              | F1                           | F <sup>1</sup> | G6                | G <sup>3</sup> | I12               | I <sup>3</sup> |
| K5          | 0        | F0                           | F <sup>0</sup> | F2                           | F <sup>2</sup> | J0                | J <sup>0</sup> | N0                | N <sup>0</sup> |
| P1          | 0        | F2                           | F <sup>1</sup> | F4                           | F <sup>3</sup> | J2                | J <sup>1</sup> | N2                | N <sup>1</sup> |
| K6          | 0        | F4                           | F <sup>2</sup> | F6                           | F <sup>4</sup> | J4                | J <sup>2</sup> | N4                | N <sup>2</sup> |
| N3          | 0        | F6                           | F <sup>3</sup> | F8                           | F <sup>5</sup> | J6                | J <sup>3</sup> | N6                | N <sup>3</sup> |
| L5          | 0        | F8                           | F <sup>4</sup> | F9                           | F <sup>6</sup> | J8                | J <sup>4</sup> | N8                | N <sup>4</sup> |
| P2          | 0        | F10                          | F <sup>5</sup> | F10                          | F <sup>7</sup> | J10               | J <sup>5</sup> | N10               | N <sup>5</sup> |
| L6          | 0        | F12                          | F <sup>6</sup> | F12                          | F <sup>8</sup> | J12               | J <sup>6</sup> | N12               | N <sup>6</sup> |
| R1          | 0        | F14                          | F <sup>7</sup> | F14                          | F <sup>9</sup> | J14               | J <sup>7</sup> | N14               | N <sup>7</sup> |
| -           | 0        | VCCO (Bank 0)                | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -              | VCCO (Bank 0)     | -              |
| P3          | -        | TCK                          | -              | TCK                          | -              | TCK               | -              | TCK               | -              |
| -           | -        | VCC                          | -              | VCC                          | -              | VCC               | -              | VCC               | -              |
| -           | -        | GND                          | -              | GND                          | -              | GND               | -              | GND               | -              |
| -           | 0        | -                            | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -              | GND (Bank 0)      | -              |
| T2          | 0        | NC                           | -              | G14                          | G <sup>9</sup> | I6                | I <sup>3</sup> | K12               | K <sup>6</sup> |
| M5          | 0        | NC                           | -              | G12                          | G <sup>8</sup> | I4                | I <sup>2</sup> | K14               | K <sup>7</sup> |
| N4          | 0        | G14                          | G <sup>7</sup> | G10                          | G <sup>7</sup> | K14               | K <sup>7</sup> | O14               | O <sup>7</sup> |
| T3          | 0        | G12                          | G <sup>6</sup> | G9                           | G <sup>6</sup> | K12               | K <sup>6</sup> | O12               | O <sup>6</sup> |
| R3          | 0        | G10                          | G <sup>5</sup> | G8                           | G <sup>5</sup> | K10               | K <sup>5</sup> | O10               | O <sup>5</sup> |
| M6          | 0        | G8                           | G <sup>4</sup> | G6                           | G <sup>4</sup> | K8                | K <sup>4</sup> | O8                | O <sup>4</sup> |
| P4          | 0        | G6                           | G <sup>3</sup> | G4                           | G <sup>3</sup> | K6                | K <sup>3</sup> | O6                | O <sup>3</sup> |
| L7          | 0        | G4                           | G <sup>2</sup> | G2                           | G <sup>2</sup> | K4                | K <sup>2</sup> | O4                | O <sup>2</sup> |
| N5          | 0        | G2                           | G <sup>1</sup> | G1                           | G <sup>1</sup> | K2                | K <sup>1</sup> | O2                | O <sup>1</sup> |
| M7          | 0        | G0                           | G <sup>0</sup> | G0                           | G <sup>0</sup> | K0                | K <sup>0</sup> | O0                | O <sup>0</sup> |
| P5          | 0        | NC                           | -              | NC                           | -              | G8                | G <sup>4</sup> | M0                | M <sup>0</sup> |
| R4          | 0        | NC                           | -              | NC                           | -              | G10               | G <sup>5</sup> | M4                | M <sup>1</sup> |
| T4          | 0        | NC                           | -              | NC                           | -              | NC                | -              | L0                | L <sup>0</sup> |
| -           | 0        | GND (Bank 0)                 | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -              | GND (Bank 0)      | -              |
| -           | 0        | VCCO (Bank 0)                | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -              | VCCO (Bank 0)     | -              |

**ispMACH 4256V/B/C, 4384V/B/C, 4512V/B/C Logic Signal Connections:  
256-Ball ftBGA/fpBGA (Cont.)**

| Ball Number | I/O Bank | ispMACH 4256V/B/C<br>128-I/O |                  | ispMACH 4256V/B/C<br>160-I/O |                  | ispMACH 4384V/B/C |                   | ispMACH 4512V/B/C |                   |
|-------------|----------|------------------------------|------------------|------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|
|             |          | GLB/MC/Pad                   | ORP              | GLB/MC/Pad                   | ORP              | GLB/MC/Pad        | ORP               | GLB/MC/Pad        | ORP               |
| R5          | 0        | NC                           | -                | NC                           | -                | NC                | -                 | L4                | L <sup>^</sup> 1  |
| T5          | 0        | NC                           | -                | NC                           | -                | I2                | I <sup>^</sup> 1  | L8                | L <sup>^</sup> 2  |
| R6          | 0        | NC                           | -                | NC                           | -                | I0                | I <sup>^</sup> 0  | L12               | L <sup>^</sup> 3  |
| T6          | 0        | NC                           | -                | H14                          | H <sup>^</sup> 9 | G12               | G <sup>^</sup> 6  | M8                | M <sup>^</sup> 2  |
| N7          | 0        | NC                           | -                | H12                          | H <sup>^</sup> 8 | G14               | G <sup>^</sup> 7  | M12               | M <sup>^</sup> 3  |
| P7          | 0        | H14                          | H <sup>^</sup> 7 | H10                          | H <sup>^</sup> 7 | L14               | L <sup>^</sup> 7  | P14               | P <sup>^</sup> 7  |
| R7          | 0        | H12                          | H <sup>^</sup> 6 | H9                           | H <sup>^</sup> 6 | L12               | L <sup>^</sup> 6  | P12               | P <sup>^</sup> 6  |
| L8          | 0        | H10                          | H <sup>^</sup> 5 | H8                           | H <sup>^</sup> 5 | L10               | L <sup>^</sup> 5  | P10               | P <sup>^</sup> 5  |
| T7          | 0        | H8                           | H <sup>^</sup> 4 | H6                           | H <sup>^</sup> 4 | L8                | L <sup>^</sup> 4  | P8                | P <sup>^</sup> 4  |
| M8          | 0        | H6                           | H <sup>^</sup> 3 | H4                           | H <sup>^</sup> 3 | L6                | L <sup>^</sup> 3  | P6                | P <sup>^</sup> 3  |
| N8          | 0        | H4                           | H <sup>^</sup> 2 | H2                           | H <sup>^</sup> 2 | L4                | L <sup>^</sup> 2  | P4                | P <sup>^</sup> 2  |
| R8          | 0        | H2                           | H <sup>^</sup> 1 | H1                           | H <sup>^</sup> 1 | L2                | L <sup>^</sup> 1  | P2                | P <sup>^</sup> 1  |
| P8          | 0        | H0                           | H <sup>^</sup> 0 | H0                           | H <sup>^</sup> 0 | L0                | L <sup>^</sup> 0  | P0                | P <sup>^</sup> 0  |
| -           | -        | GND                          | -                | GND                          | -                | GND               | -                 | GND               | -                 |
| T8          | 0        | CLK1/I                       | -                | CLK1/I                       | -                | CLK1/I            | -                 | CLK1/I            | -                 |
| -           | 1        | GND (Bank 1)                 | -                | GND (Bank 1)                 | -                | GND (Bank 1)      | -                 | GND (Bank 1)      | -                 |
| N9          | 1        | CLK2/I                       | -                | CLK2/I                       | -                | CLK2/I            | -                 | CLK2/I            | -                 |
| -           | -        | VCC                          | -                | VCC                          | -                | VCC               | -                 | VCC               | -                 |
| P9          | 1        | I0                           | I <sup>^</sup> 0 | I0                           | I <sup>^</sup> 0 | M0                | M <sup>^</sup> 0  | AX0               | AX <sup>^</sup> 0 |
| R9          | 1        | I2                           | I <sup>^</sup> 1 | I1                           | I <sup>^</sup> 1 | M2                | M <sup>^</sup> 1  | AX2               | AX <sup>^</sup> 1 |
| T9          | 1        | I4                           | I <sup>^</sup> 2 | I2                           | I <sup>^</sup> 2 | M4                | M <sup>^</sup> 2  | AX4               | AX <sup>^</sup> 2 |
| T10         | 1        | I6                           | I <sup>^</sup> 3 | I4                           | I <sup>^</sup> 3 | M6                | M <sup>^</sup> 3  | AX6               | AX <sup>^</sup> 3 |
| R10         | 1        | I8                           | I <sup>^</sup> 4 | I6                           | I <sup>^</sup> 4 | M8                | M <sup>^</sup> 4  | AX8               | AX <sup>^</sup> 4 |
| M9          | 1        | I10                          | I <sup>^</sup> 5 | I8                           | I <sup>^</sup> 5 | M10               | M <sup>^</sup> 5  | AX10              | AX <sup>^</sup> 5 |
| P10         | 1        | I12                          | I <sup>^</sup> 6 | I9                           | I <sup>^</sup> 6 | M12               | M <sup>^</sup> 6  | AX12              | AX <sup>^</sup> 6 |
| L9          | 1        | I14                          | I <sup>^</sup> 7 | I10                          | I <sup>^</sup> 7 | M14               | M <sup>^</sup> 7  | AX14              | AX <sup>^</sup> 7 |
| N10         | 1        | NC                           | -                | I12                          | I <sup>^</sup> 8 | BX14              | BX <sup>^</sup> 7 | DX0               | DX <sup>^</sup> 0 |
| T11         | 1        | NC                           | -                | I14                          | I <sup>^</sup> 9 | BX12              | BX <sup>^</sup> 6 | DX4               | DX <sup>^</sup> 1 |
| R11         | 1        | NC                           | -                | NC                           | -                | P0                | P <sup>^</sup> 0  | EX0               | EX <sup>^</sup> 0 |
| T12         | 1        | NC                           | -                | NC                           | -                | P2                | P <sup>^</sup> 1  | EX4               | EX <sup>^</sup> 1 |
| N12         | 1        | NC                           | -                | NC                           | -                | NC                | -                 | EX8               | EX <sup>^</sup> 2 |
| -           | 1        | VCCO (Bank 1)                | -                | VCCO (Bank 1)                | -                | VCCO (Bank 1)     | -                 | VCCO (Bank 1)     | -                 |
| -           | 1        | GND (Bank 1)                 | -                | GND (Bank 1)                 | -                | GND (Bank 1)      | -                 | GND (Bank 1)      | -                 |
| R12         | 1        | NC                           | -                | NC                           | -                | NC                | -                 | EX12              | EX <sup>^</sup> 3 |
| T13         | 1        | NC                           | -                | J0                           | J <sup>^</sup> 0 | BX10              | BX <sup>^</sup> 5 | DX8               | DX <sup>^</sup> 2 |
| P12         | 1        | NC                           | -                | J1                           | J <sup>^</sup> 1 | BX8               | BX <sup>^</sup> 4 | DX12              | DX <sup>^</sup> 3 |
| M10         | 1        | J0                           | J <sup>^</sup> 0 | J2                           | J <sup>^</sup> 2 | N0                | N <sup>^</sup> 0  | BX0               | BX <sup>^</sup> 0 |
| R13         | 1        | J2                           | J <sup>^</sup> 1 | J4                           | J <sup>^</sup> 3 | N2                | N <sup>^</sup> 1  | BX2               | BX <sup>^</sup> 1 |
| L10         | 1        | J4                           | J <sup>^</sup> 2 | J6                           | J <sup>^</sup> 4 | N4                | N <sup>^</sup> 2  | BX4               | BX <sup>^</sup> 2 |
| T14         | 1        | J6                           | J <sup>^</sup> 3 | J8                           | J <sup>^</sup> 5 | N6                | N <sup>^</sup> 3  | BX6               | BX <sup>^</sup> 3 |
| M11         | 1        | J8                           | J <sup>^</sup> 4 | J9                           | J <sup>^</sup> 6 | N8                | N <sup>^</sup> 4  | BX8               | BX <sup>^</sup> 4 |

## ispMACH 4000C (1.8V) Industrial Devices

| Family  | Part Number                   | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-------------------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032C | LC4032C-5T48I                 | 32         | 1.8     | 5               | TQFP    | 48             | 32  | I     |
|         | LC4032C-75T48I                | 32         | 1.8     | 7.5             | TQFP    | 48             | 32  | I     |
|         | LC4032C-10T48I                | 32         | 1.8     | 10              | TQFP    | 48             | 32  | I     |
|         | LC4032C-5T44I                 | 32         | 1.8     | 5               | TQFP    | 44             | 30  | I     |
|         | LC4032C-75T44I                | 32         | 1.8     | 7.5             | TQFP    | 44             | 30  | I     |
|         | LC4032C-10T44I                | 32         | 1.8     | 10              | TQFP    | 44             | 30  | I     |
| LC4064C | LC4064C-5T100I                | 64         | 1.8     | 5               | TQFP    | 100            | 64  | I     |
|         | LC4064C-75T100I               | 64         | 1.8     | 7.5             | TQFP    | 100            | 64  | I     |
|         | LC4064C-10T100I               | 64         | 1.8     | 10              | TQFP    | 100            | 64  | I     |
|         | LC4064C-5T48I                 | 64         | 1.8     | 5               | TQFP    | 48             | 32  | I     |
|         | LC4064C-75T48I                | 64         | 1.8     | 7.5             | TQFP    | 48             | 32  | I     |
|         | LC4064C-10T48I                | 64         | 1.8     | 10              | TQFP    | 48             | 32  | I     |
|         | LC4064C-5T44I                 | 64         | 1.8     | 5               | TQFP    | 44             | 30  | I     |
|         | LC4064C-75T44I                | 64         | 1.8     | 7.5             | TQFP    | 44             | 30  | I     |
|         | LC4064C-10T44I                | 64         | 1.8     | 10              | TQFP    | 44             | 30  | I     |
| LC4128C | LC4128C-5T128I                | 128        | 1.8     | 5               | TQFP    | 128            | 92  | I     |
|         | LC4128C-75T128I               | 128        | 1.8     | 7.5             | TQFP    | 128            | 92  | I     |
|         | LC4128C-10T128I               | 128        | 1.8     | 10              | TQFP    | 128            | 92  | I     |
|         | LC4128C-5T100I                | 128        | 1.8     | 5               | TQFP    | 100            | 64  | I     |
|         | LC4128C-75T100I               | 128        | 1.8     | 7.5             | TQFP    | 100            | 64  | I     |
|         | LC4128C-10T100I               | 128        | 1.8     | 10              | TQFP    | 100            | 64  | I     |
| LC4256C | LC4256C-5FT256AI              | 256        | 1.8     | 5               | ftBGA   | 256            | 128 | I     |
|         | LC4256C-75FT256AI             | 256        | 1.8     | 7.5             | ftBGA   | 256            | 128 | I     |
|         | LC4256C-10FT256AI             | 256        | 1.8     | 10              | ftBGA   | 256            | 128 | I     |
|         | LC4256C-5FT256BI              | 256        | 1.8     | 5               | ftBGA   | 256            | 160 | I     |
|         | LC4256C-75FT256BI             | 256        | 1.8     | 7.5             | ftBGA   | 256            | 160 | I     |
|         | LC4256C-10FT256BI             | 256        | 1.8     | 10              | ftBGA   | 256            | 160 | I     |
|         | LC4256C-5F256AI <sup>1</sup>  | 256        | 1.8     | 5               | fpBGA   | 256            | 128 | I     |
|         | LC4256C-75F256AI <sup>1</sup> | 256        | 1.8     | 7.5             | fpBGA   | 256            | 128 | I     |
|         | LC4256C-10F256AI <sup>1</sup> | 256        | 1.8     | 10              | fpBGA   | 256            | 128 | I     |
|         | LC4256C-5F256BI <sup>1</sup>  | 256        | 1.8     | 5               | fpBGA   | 256            | 160 | I     |
|         | LC4256C-75F256BI <sup>1</sup> | 256        | 1.8     | 7.5             | fpBGA   | 256            | 160 | I     |
|         | LC4256C-10F256BI <sup>1</sup> | 256        | 1.8     | 10              | fpBGA   | 256            | 160 | I     |
|         | LC4256C-5T176I                | 256        | 1.8     | 5               | TQFP    | 176            | 128 | I     |
|         | LC4256C-75T176I               | 256        | 1.8     | 7.5             | TQFP    | 176            | 128 | I     |
|         | LC4256C-10T176I               | 256        | 1.8     | 10              | TQFP    | 176            | 128 | I     |
|         | LC4256C-5T100I                | 256        | 1.8     | 5               | TQFP    | 100            | 64  | I     |
|         | LC4256C-75T100I               | 256        | 1.8     | 7.5             | TQFP    | 100            | 64  | I     |
|         | LC4256C-10T100I               | 256        | 1.8     | 10              | TQFP    | 100            | 64  | I     |

## ispMACH 4000C (1.8V) Lead-Free Industrial Devices (Cont.)

| Device  | Part Number                    | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|--------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4256C | LC4256C-5FTN256AI              | 256        | 1.8     | 5               | Lead-free ftBGA | 256            | 128 | I     |
|         | LC4256C-75FTN256AI             | 256        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 128 | I     |
|         | LC4256C-10FTN256AI             | 256        | 1.8     | 10              | Lead-free ftBGA | 256            | 128 | I     |
|         | LC4256C-5FTN256BI              | 256        | 1.8     | 5               | Lead-free ftBGA | 256            | 160 | I     |
|         | LC4256C-75FTN256BI             | 256        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 160 | I     |
|         | LC4256C-10FTN256BI             | 256        | 1.8     | 10              | Lead-free ftBGA | 256            | 160 | I     |
|         | LC4256C-5FN256AI <sup>1</sup>  | 256        | 1.8     | 5               | Lead-free fpBGA | 256            | 128 | I     |
|         | LC4256C-75FN256AI <sup>1</sup> | 256        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 128 | I     |
|         | LC4256C-10FN256AI <sup>1</sup> | 256        | 1.8     | 10              | Lead-free fpBGA | 256            | 128 | I     |
|         | LC4256C-5FN256BI <sup>1</sup>  | 256        | 1.8     | 5               | Lead-free fpBGA | 256            | 160 | I     |
|         | LC4256C-75FN256BI <sup>1</sup> | 256        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 160 | I     |
|         | LC4256C-10FN256BI <sup>1</sup> | 256        | 1.8     | 10              | Lead-free fpBGA | 256            | 160 | I     |
|         | LC4256C-5TN176I                | 256        | 1.8     | 5               | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4256C-75TN176I               | 256        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4256C-10TN176I               | 256        | 1.8     | 10              | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4256C-5TN100I                | 256        | 1.8     | 5               | Lead-free TQFP  | 100            | 64  | I     |
|         | LC4256C-75TN100I               | 256        | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | I     |
|         | LC4256C-10TN100I               | 256        | 1.8     | 10              | Lead-free TQFP  | 100            | 64  | I     |
| LC4384C | LC4384C-5FTN256I               | 384        | 1.8     | 5               | Lead-free ftBGA | 256            | 192 | I     |
|         | LC4384C-75FTN256I              | 384        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 192 | I     |
|         | LC4384C-10FTN256I              | 384        | 1.8     | 10              | Lead-free ftBGA | 256            | 192 | I     |
|         | LC4384C-5FN256I <sup>1</sup>   | 384        | 1.8     | 5               | Lead-free fpBGA | 256            | 192 | I     |
|         | LC4384C-75FN256I <sup>1</sup>  | 384        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 192 | I     |
|         | LC4384C-10FN256I <sup>1</sup>  | 384        | 1.8     | 10              | Lead-free fpBGA | 256            | 192 | I     |
|         | LC4384C-5TN176I                | 384        | 1.8     | 5               | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4384C-75TN176I               | 384        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4384C-10TN176I               | 384        | 1.8     | 10              | Lead-free TQFP  | 176            | 128 | I     |
| LC4512C | LC4512C-5FTN256I               | 512        | 1.8     | 5               | Lead-free ftBGA | 256            | 208 | I     |
|         | LC4512C-75FTN256I              | 512        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 208 | I     |
|         | LC4512C-10FTN256I              | 512        | 1.8     | 10              | Lead-free ftBGA | 256            | 208 | I     |
|         | LC4512C-5FN256I <sup>1</sup>   | 512        | 1.8     | 5               | Lead-free fpBGA | 256            | 208 | I     |
|         | LC4512C-75FN256I <sup>1</sup>  | 512        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 208 | I     |
|         | LC4512C-10FN256I <sup>1</sup>  | 512        | 1.8     | 10              | Lead-free fpBGA | 256            | 208 | I     |
|         | LC4512C-5TN176I                | 512        | 1.8     | 5               | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4512C-75TN176I               | 512        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4512C-10TN176I               | 512        | 1.8     | 10              | Lead-free TQFP  | 176            | 128 | I     |

1. Use ftBGA package. fpBGA package devices have been discontinued via PCN#14A-07.

## ispMACH 4000B (2.5V) Lead-Free Commercial Devices

| Device  | Part Number                    | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|--------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4032B | LC4032B-25TN48C                | 32         | 2.5     | 2.5             | Lead-Free TQFP  | 48             | 32  | C     |
|         | LC4032B-5TN48C                 | 32         | 2.5     | 5               | Lead-Free TQFP  | 48             | 32  | C     |
|         | LC4032B-75TN48C                | 32         | 2.5     | 7.5             | Lead-Free TQFP  | 48             | 32  | C     |
|         | LC4032B-25TN44C                | 32         | 2.5     | 2.5             | Lead-Free TQFP  | 44             | 30  | C     |
|         | LC4032B-5TN44C                 | 32         | 2.5     | 5               | Lead-Free TQFP  | 44             | 30  | C     |
|         | LC4032B-75TN44C                | 32         | 2.5     | 7.5             | Lead-Free TQFP  | 44             | 30  | C     |
| LC4064B | LC4064B-25TN100C               | 64         | 2.5     | 2.5             | Lead-Free TQFP  | 100            | 64  | C     |
|         | LC4064B-5TN100C                | 64         | 2.5     | 5               | Lead-Free TQFP  | 100            | 64  | C     |
|         | LC4064B-75TN100C               | 64         | 2.5     | 7.5             | Lead-Free TQFP  | 100            | 64  | C     |
|         | LC4064B-25TN48C                | 64         | 2.5     | 2.5             | Lead-Free TQFP  | 48             | 32  | C     |
|         | LC4064B-5TN48C                 | 64         | 2.5     | 5               | Lead-Free TQFP  | 48             | 32  | C     |
|         | LC4064B-75TN48C                | 64         | 2.5     | 7.5             | Lead-Free TQFP  | 48             | 32  | C     |
|         | LC4064B-25TN44C                | 64         | 2.5     | 2.5             | Lead-Free TQFP  | 44             | 30  | C     |
|         | LC4064B-5TN44C                 | 64         | 2.5     | 5               | Lead-Free TQFP  | 44             | 30  | C     |
|         | LC4064B-75TN44C                | 64         | 2.5     | 7.5             | Lead-Free TQFP  | 44             | 30  | C     |
| LC4128B | LC4128B-27TN128C               | 128        | 2.5     | 2.7             | Lead-Free TQFP  | 128            | 92  | C     |
|         | LC4128B-5TN128C                | 128        | 2.5     | 5               | Lead-Free TQFP  | 128            | 92  | C     |
|         | LC4128B-75TN128C               | 128        | 2.5     | 7.5             | Lead-Free TQFP  | 128            | 92  | C     |
|         | LC4128B-27TN100C               | 128        | 2.5     | 2.7             | Lead-Free TQFP  | 100            | 92  | C     |
|         | LC4128B-5TN100C                | 128        | 2.5     | 5               | Lead-Free TQFP  | 100            | 92  | C     |
|         | LC4128B-75TN100C               | 128        | 2.5     | 7.5             | Lead-Free TQFP  | 100            | 92  | C     |
| LC4256B | LC4256B-3FTN256AC              | 256        | 2.5     | 3               | Lead-Free ftBGA | 256            | 128 | C     |
|         | LC4256B-5FTN256AC              | 256        | 2.5     | 5               | Lead-Free ftBGA | 256            | 128 | C     |
|         | LC4256B-75FTN256AC             | 256        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 128 | C     |
|         | LC4256B-3FTN256BC              | 256        | 2.5     | 3               | Lead-Free ftBGA | 256            | 160 | C     |
|         | LC4256B-5FTN256BC              | 256        | 2.5     | 5               | Lead-Free ftBGA | 256            | 160 | C     |
|         | LC4256B-75FTN256BC             | 256        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 160 | C     |
|         | LC4256B-3FN256AC <sup>1</sup>  | 256        | 2.5     | 3               | Lead-Free fpBGA | 256            | 128 | C     |
|         | LC4256B-5FN256AC <sup>1</sup>  | 256        | 2.5     | 5               | Lead-Free fpBGA | 256            | 128 | C     |
|         | LC4256B-75FN256AC <sup>1</sup> | 256        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 128 | C     |
|         | LC4256B-3FN256BC <sup>1</sup>  | 256        | 2.5     | 3               | Lead-Free fpBGA | 256            | 160 | C     |
|         | LC4256B-5FN256BC <sup>1</sup>  | 256        | 2.5     | 5               | Lead-Free fpBGA | 256            | 160 | C     |
|         | LC4256B-75FN256BC <sup>1</sup> | 256        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 160 | C     |
|         | LC4256B-3TN176C                | 256        | 2.5     | 3               | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4256B-5TN176C                | 256        | 2.5     | 5               | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4256B-75TN176C               | 256        | 2.5     | 7.5             | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4256B-3TN100C                | 256        | 2.5     | 3               | Lead-Free TQFP  | 100            | 64  | C     |
|         | LC4256B-5TN100C                | 256        | 2.5     | 5               | Lead-Free TQFP  | 100            | 64  | C     |
|         | LC4256B-75TN100C               | 256        | 2.5     | 7.5             | Lead-Free TQFP  | 100            | 64  | C     |

**ispMACH 4000B (2.5V) Lead-Free Commercial Devices (Cont.)**

| Device  | Part Number                   | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|-------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4384B | LC4384B-35FTN256C             | 384        | 2.5     | 3.5             | Lead-Free ftBGA | 256            | 192 | C     |
|         | LC4384B-5FTN256C              | 384        | 2.5     | 5               | Lead-Free ftBGA | 256            | 192 | C     |
|         | LC4384B-75FTN256C             | 384        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 192 | C     |
|         | LC4384B-35FN256C <sup>1</sup> | 384        | 2.5     | 3.5             | Lead-Free fpBGA | 256            | 192 | C     |
|         | LC4384B-5FN256C <sup>1</sup>  | 384        | 2.5     | 5               | Lead-Free fpBGA | 256            | 192 | C     |
|         | LC4384B-75FN256C <sup>1</sup> | 384        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 192 | C     |
|         | LC4384B-35TN176C              | 384        | 2.5     | 3.5             | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4384B-5TN176C               | 384        | 2.5     | 5               | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4384B-75TN176C              | 384        | 2.5     | 7.5             | Lead-Free TQFP  | 176            | 128 | C     |
| LC4512B | LC4512B-35FTN256C             | 512        | 2.5     | 3.5             | Lead-Free ftBGA | 256            | 208 | C     |
|         | LC4512B-5FTN256C              | 512        | 2.5     | 5               | Lead-Free ftBGA | 256            | 208 | C     |
|         | LC4512B-75FTN256C             | 512        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 208 | C     |
|         | LC4512B-35FN256C <sup>1</sup> | 512        | 2.5     | 3.5             | Lead-Free fpBGA | 256            | 208 | C     |
|         | LC4512B-5FN256C <sup>1</sup>  | 512        | 2.5     | 5               | Lead-Free fpBGA | 256            | 208 | C     |
|         | LC4512B-75FN256C <sup>1</sup> | 512        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 208 | C     |
|         | LC4512B-35TN176C              | 512        | 2.5     | 3.5             | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4512B-5TN176C               | 512        | 2.5     | 5               | Lead-Free TQFP  | 176            | 128 | C     |
|         | LC4512B-75TN176C              | 512        | 2.5     | 7.5             | Lead-Free TQFP  | 176            | 128 | C     |

1. Use ftBGA package. fpBGA package devices have been discontinued via PCN#14A-07.

**ispMACH 4000B (2.5V) Lead-Free Industrial Devices**

| Device  | Part Number      | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|---------|------------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032B | LC4032B-5TN48I   | 32         | 2.5     | 5               | Lead-Free TQFP | 48             | 32  | I     |
|         | LC4032B-75TN48I  | 32         | 2.5     | 7.5             | Lead-Free TQFP | 48             | 32  | I     |
|         | LC4032B-10TN48I  | 32         | 2.5     | 10              | Lead-Free TQFP | 48             | 32  | I     |
|         | LC4032B-5TN44I   | 32         | 2.5     | 5               | Lead-Free TQFP | 44             | 30  | I     |
|         | LC4032B-75TN44I  | 32         | 2.5     | 7.5             | Lead-Free TQFP | 44             | 30  | I     |
|         | LC4032B-10TN44I  | 32         | 2.5     | 10              | Lead-Free TQFP | 44             | 30  | I     |
| LC4064B | LC4064B-5TN100I  | 64         | 2.5     | 5               | Lead-Free TQFP | 100            | 64  | I     |
|         | LC4064B-75TN100I | 64         | 2.5     | 7.5             | Lead-Free TQFP | 100            | 64  | I     |
|         | LC4064B-10TN100I | 64         | 2.5     | 10              | Lead-Free TQFP | 100            | 64  | I     |
|         | LC4064B-5TN48I   | 64         | 2.5     | 5               | Lead-Free TQFP | 48             | 32  | I     |
|         | LC4064B-75TN48I  | 64         | 2.5     | 7.5             | Lead-Free TQFP | 48             | 32  | I     |
|         | LC4064B-10TN48I  | 64         | 2.5     | 10              | Lead-Free TQFP | 48             | 32  | I     |
|         | LC4064B-5TN44I   | 64         | 2.5     | 5               | Lead-Free TQFP | 44             | 30  | I     |
|         | LC4064B-75TN44I  | 64         | 2.5     | 7.5             | Lead-Free TQFP | 44             | 30  | I     |
|         | LC4064B-10TN44I  | 64         | 2.5     | 10              | Lead-Free TQFP | 44             | 30  | I     |

## ispMACH 4000V (3.3V) Lead-Free Commercial Devices

| Device  | Part Number      | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|---------|------------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032V | LC4032V-25TN48C  | 32         | 3.3     | 2.5             | Lead-free TQFP | 48             | 32  | C     |
|         | LC4032V-5TN48C   | 32         | 3.3     | 5               | Lead-free TQFP | 48             | 32  | C     |
|         | LC4032V-75TN48C  | 32         | 3.3     | 7.5             | Lead-free TQFP | 48             | 32  | C     |
|         | LC4032V-25TN44C  | 32         | 3.3     | 2.5             | Lead-free TQFP | 44             | 30  | C     |
|         | LC4032V-5TN44C   | 32         | 3.3     | 5               | Lead-free TQFP | 44             | 30  | C     |
|         | LC4032V-75TN44C  | 32         | 3.3     | 7.5             | Lead-free TQFP | 44             | 30  | C     |
| LC4064V | LC4064V-25TN100C | 64         | 3.3     | 2.5             | Lead-free TQFP | 100            | 64  | C     |
|         | LC4064V-5TN100C  | 64         | 3.3     | 5               | Lead-free TQFP | 100            | 64  | C     |
|         | LC4064V-75TN100C | 64         | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | C     |
|         | LC4064V-25TN48C  | 64         | 3.3     | 2.5             | Lead-free TQFP | 48             | 32  | C     |
|         | LC4064V-5TN48C   | 64         | 3.3     | 5               | Lead-free TQFP | 48             | 32  | C     |
|         | LC4064V-75TN48C  | 64         | 3.3     | 7.5             | Lead-free TQFP | 48             | 32  | C     |
|         | LC4064V-25TN44C  | 64         | 3.3     | 2.5             | Lead-free TQFP | 44             | 30  | C     |
|         | LC4064V-5TN44C   | 64         | 3.3     | 5               | Lead-free TQFP | 44             | 30  | C     |
|         | LC4064V-75TN44C  | 64         | 3.3     | 7.5             | Lead-free TQFP | 44             | 30  | C     |
| LC4128V | LC4128V-27TN144C | 128        | 3.3     | 2.7             | Lead-free TQFP | 144            | 96  | C     |
|         | LC4128V-5TN144C  | 128        | 3.3     | 5               | Lead-free TQFP | 144            | 96  | C     |
|         | LC4128V-75TN144C | 128        | 3.3     | 7.5             | Lead-free TQFP | 144            | 96  | C     |
|         | LC4128V-27TN128C | 128        | 3.3     | 2.7             | Lead-free TQFP | 128            | 92  | C     |
|         | LC4128V-5TN128C  | 128        | 3.3     | 5               | Lead-free TQFP | 128            | 92  | C     |
|         | LC4128V-75TN128C | 128        | 3.3     | 7.5             | Lead-free TQFP | 128            | 92  | C     |
|         | LC4128V-27TN100C | 128        | 3.3     | 2.7             | Lead-free TQFP | 100            | 64  | C     |
|         | LC4128V-5TN100C  | 128        | 3.3     | 5               | Lead-free TQFP | 100            | 64  | C     |
|         | LC4128V-75TN100C | 128        | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | C     |

## ispMACH 4000V (3.3V) Lead-Free Commercial Devices (Cont.)

| Device  | Part Number                    | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|--------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4256V | LC4256V-3FTN256AC              | 256        | 3.3     | 3               | Lead-free ftBGA | 256            | 128 | C     |
|         | LC4256V-5FTN256AC              | 256        | 3.3     | 5               | Lead-free ftBGA | 256            | 128 | C     |
|         | LC4256V-75FTN256AC             | 256        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 128 | C     |
|         | LC4256V-3FTN256BC              | 256        | 3.3     | 3               | Lead-free ftBGA | 256            | 160 | C     |
|         | LC4256V-5FTN256BC              | 256        | 3.3     | 5               | Lead-free ftBGA | 256            | 160 | C     |
|         | LC4256V-75FTN256BC             | 256        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 160 | C     |
|         | LC4256V-3FN256AC <sup>1</sup>  | 256        | 3.3     | 3               | Lead-free fpBGA | 256            | 128 | C     |
|         | LC4256V-5FN256AC <sup>1</sup>  | 256        | 3.3     | 5               | Lead-free fpBGA | 256            | 128 | C     |
|         | LC4256V-75FN256AC <sup>1</sup> | 256        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 128 | C     |
|         | LC4256V-3FN256BC <sup>1</sup>  | 256        | 3.3     | 3               | Lead-free fpBGA | 256            | 160 | C     |
|         | LC4256V-5FN256BC <sup>1</sup>  | 256        | 3.3     | 5               | Lead-free fpBGA | 256            | 160 | C     |
|         | LC4256V-75FN256BC <sup>1</sup> | 256        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 160 | C     |
|         | LC4256V-3TN176C                | 256        | 3.3     | 3               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4256V-5TN176C                | 256        | 3.3     | 5               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4256V-75TN176C               | 256        | 3.3     | 7.5             | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4256V-3TN144C                | 256        | 3.3     | 3               | Lead-free TQFP  | 144            | 96  | C     |
|         | LC4256V-5TN144C                | 256        | 3.3     | 5               | Lead-free TQFP  | 144            | 96  | C     |
|         | LC4256V-75TN144C               | 256        | 3.3     | 7.5             | Lead-free TQFP  | 144            | 96  | C     |
|         | LC4256V-3TN100C                | 256        | 3.3     | 3               | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4256V-5TN100C                | 256        | 3.3     | 5               | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4256V-75TN100C               | 256        | 3.3     | 7.5             | Lead-free TQFP  | 100            | 64  | C     |
| LC4384V | LC4384V-35FTN256C              | 384        | 3.3     | 3.5             | Lead-free ftBGA | 256            | 192 | C     |
|         | LC4384V-5FTN256C               | 384        | 3.3     | 5               | Lead-free ftBGA | 256            | 192 | C     |
|         | LC4384V-75FTN256C              | 384        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 192 | C     |
|         | LC4384V-35FN256C <sup>1</sup>  | 384        | 3.3     | 3.5             | Lead-free fpBGA | 256            | 192 | C     |
|         | LC4384V-5FN256C <sup>1</sup>   | 384        | 3.3     | 5               | Lead-free fpBGA | 256            | 192 | C     |
|         | LC4384V-75FN256C <sup>1</sup>  | 384        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 192 | C     |
|         | LC4384V-35TN176C               | 384        | 3.3     | 3.5             | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4384V-5TN176C                | 384        | 3.3     | 5               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4384V-75TN176C               | 384        | 3.3     | 7.5             | Lead-free TQFP  | 176            | 128 | C     |
| LC4512V | LC4512V-35FTN256C              | 512        | 3.3     | 3.5             | Lead-free ftBGA | 256            | 208 | C     |
|         | LC4512V-5FTN256C               | 512        | 3.3     | 5               | Lead-free ftBGA | 256            | 208 | C     |
|         | LC4512V-75FTN256C              | 512        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 208 | C     |
|         | LC4512V-35FN256C <sup>1</sup>  | 512        | 3.3     | 3.5             | Lead-free fpBGA | 256            | 208 | C     |
|         | LC4512V-5FN256C <sup>1</sup>   | 512        | 3.3     | 5               | Lead-free fpBGA | 256            | 208 | C     |
|         | LC4512V-75FN256C <sup>1</sup>  | 512        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 208 | C     |
|         | LC4512V-35TN176C               | 512        | 3.3     | 3.5             | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4512V-5TN176C                | 512        | 3.3     | 5               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4512V-75TN176C               | 512        | 3.3     | 7.5             | Lead-free TQFP  | 176            | 128 | C     |

1. Use ftBGA package. fpBGA package devices have been discontinued via PCN#14A-07.