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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       | 2.3V ~ 2.7V                                                                                                                                                           |
| Number of Logic Elements/Blocks | 16                                                                                                                                                                    |
| Number of Macrocells            | 256                                                                                                                                                                   |
| Number of Gates                 | -                                                                                                                                                                     |
| Number of I/O                   | 64                                                                                                                                                                    |
| Operating Temperature           | -40°C ~ 105°C (TJ)                                                                                                                                                    |
| Mounting Type                   | Surface Mount                                                                                                                                                         |
| Package / Case                  | 100-LQFP                                                                                                                                                              |
| Supplier Device Package         | 100-TQFP (14x14)                                                                                                                                                      |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4256b-75tn100i">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4256b-75tn100i</a> |

- Block CLK2
- Block CLK3
- PT Clock
- PT Clock Inverted
- Shared PT Clock
- Ground

### Clock Enable Multiplexer

Each macrocell has a 4:1 clock enable multiplexer. This allows the clock enable signal to be selected from the following four sources:

- PT Initialization/CE
- PT Initialization/CE Inverted
- Shared PT Clock
- Logic High

### Initialization Control

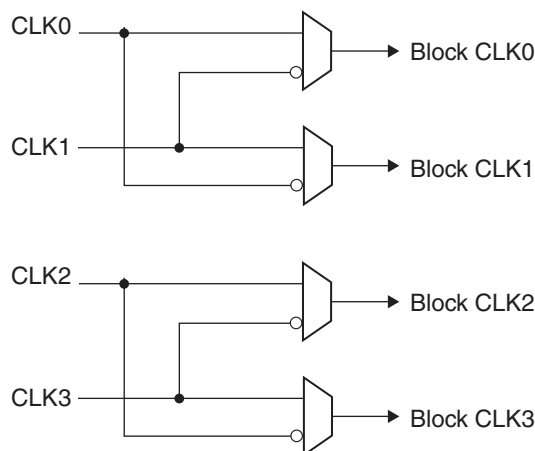
The ispMACH 4000 family architecture accommodates both block-level and macrocell-level set and reset capability. There is one block-level initialization term that is distributed to all macrocell registers in a GLB. At the macrocell level, two product terms can be “stolen” from the cluster associated with a macrocell to be used for set/reset functionality. A reset/preset swapping feature in each macrocell allows for reset and preset to be exchanged, providing flexibility.

Note that the reset/preset swapping selection feature affects power-up reset as well. All flip-flops power up to a known state for predictable system initialization. If a macrocell is configured to SET on a signal from the block-level initialization, then that macrocell will be SET during device power-up. If a macrocell is configured to RESET on a signal from the block-level initialization or is not configured for set/reset, then that macrocell will RESET on power-up. To guarantee initialization values, the  $V_{CC}$  rise must be monotonic, and the clock must be inactive until the reset delay time has elapsed.

### GLB Clock Generator

Each ispMACH 4000 device has up to four clock pins that are also routed to the GRP to be used as inputs. These pins drive a clock generator in each GLB, as shown in Figure 6. The clock generator provides four clock signals that can be used anywhere in the GLB. These four GLB clock signals can consist of a number of combinations of the true and complement edges of the global clock signals.

**Figure 6. GLB Clock Generator**



- LVTTTL
- LVCMOS 1.8
- LVCMOS 3.3
- 3.3V PCI Compatible
- LVCMOS 2.5

All of the I/Os and dedicated inputs have the capability to provide a bus-keeper latch, Pull-up Resistor or Pull-down Resistor. A fourth option is to provide none of these. The selection is done on a global basis. The default in both hardware and software is such that when the device is erased or if the user does not specify, the input structure is configured to be a Pull-up Resistor.

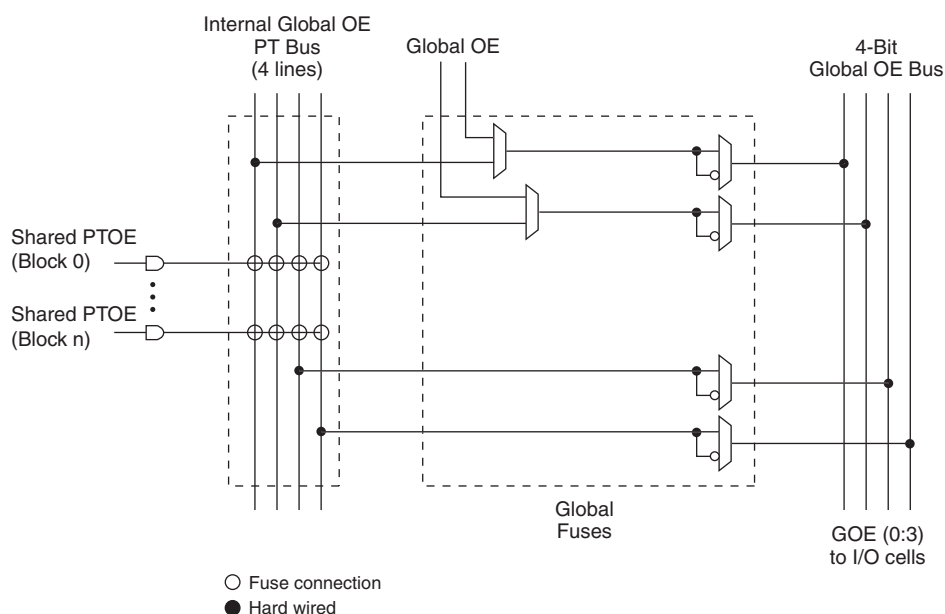
Each ispMACH 4000 device I/O has an individually programmable output slew rate control bit. Each output can be individually configured for fast slew or slow slew. The typical edge rate difference between fast and slow slew setting is 20%. For high-speed designs with long, unterminated traces, the slow-slew rate will introduce fewer reflections, less noise and keep ground bounce to a minimum. For designs with short traces or well terminated lines, the fast slew rate can be used to achieve the highest speed.

## Global OE Generation

Most ispMACH 4000 family devices have a 4-bit wide Global OE Bus, except the ispMACH 4032 device that has a 2-bit wide Global OE Bus. This bus is derived from a 4-bit internal global OE PT bus and two dual purpose I/O or GOE pins. Each signal that drives the bus can optionally be inverted.

Each GLB has a block-level OE PT that connects to all bits of the Global OE PT bus with four fuses. Hence, for a 256-macrocell device (with 16 blocks), each line of the bus is driven from 16 OE product terms. Figures 9 and 10 show a graphical representation of the global OE generation.

**Figure 9. Global OE Generation for All Devices Except ispMACH 4032**



## Supply Current, ispMACH 4000Z (Cont.)

### Over Recommended Operating Conditions

| Symbol                    | Parameter                      | Condition                                      | Min. | Typ. | Max. | Units |
|---------------------------|--------------------------------|------------------------------------------------|------|------|------|-------|
| <b>ispMACH 4256ZC</b>     |                                |                                                |      |      |      |       |
| ICC <sup>1, 2, 3, 5</sup> | Operating Power Supply Current | V <sub>CC</sub> = 1.8V, T <sub>A</sub> = 25°C  | —    | 341  | —    | μA    |
|                           |                                | V <sub>CC</sub> = 1.9V, T <sub>A</sub> = 70°C  | —    | 361  | —    | μA    |
|                           |                                | V <sub>CC</sub> = 1.9V, T <sub>A</sub> = 85°C  | —    | 372  | —    | μA    |
|                           |                                | V <sub>CC</sub> = 1.9V, T <sub>A</sub> = 125°C | —    | 468  | —    | μA    |
| ICC <sup>4, 5</sup>       | Standby Power Supply Current   | V <sub>CC</sub> = 1.8V, T <sub>A</sub> = 25°C  | —    | 13   | —    | μA    |
|                           |                                | V <sub>CC</sub> = 1.9V, T <sub>A</sub> = 70°C  | —    | 32   | 55   | μA    |
|                           |                                | V <sub>CC</sub> = 1.9V, T <sub>A</sub> = 85°C  | —    | 43   | 90   | μA    |
|                           |                                | V <sub>CC</sub> = 1.9V, T <sub>A</sub> = 125°C | —    | 135  | —    | μA    |

1. T<sub>A</sub> = 25°C, frequency = 1.0 MHz.

2. Device configured with 16-bit counters.

3. I<sub>CC</sub> varies with specific device configuration and operating frequency.

4. V<sub>CCO</sub> = 3.6V, V<sub>IN</sub> = 0V or V<sub>CCO</sub>, bus maintenance turned off. V<sub>IN</sub> above V<sub>CCO</sub> will add transient current above the specified standby I<sub>CC</sub>.

5. Includes V<sub>CCO</sub> current without output loading.

**ispMACH 4000Z Internal Timing Parameters (Cont.)****Over Recommended Operating Conditions**

| Parameter          | Description           | -35  |      | -37  |      | -42  |      | Units |
|--------------------|-----------------------|------|------|------|------|------|------|-------|
|                    |                       | Min. | Max. | Min. | Max. | Min. | Max. |       |
| t <sub>GPTOE</sub> | Global PT OE Delay    | —    | 1.9  | —    | 2.35 | —    | 2.60 | ns    |
| t <sub>PPTOE</sub> | Macrocell PT OE Delay | —    | 2.4  | —    | 3.35 | —    | 2.60 | ns    |

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

Timing v.2.2

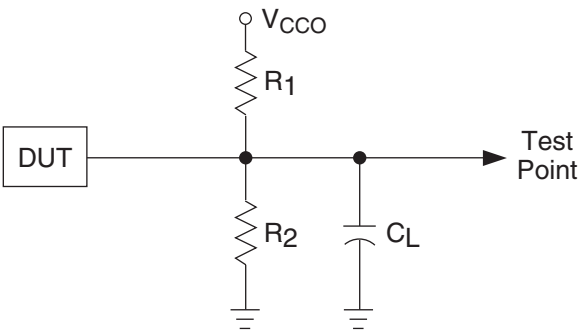
**ispMACH 4000Z Internal Timing Parameters (Cont.)****Over Recommended Operating Conditions**

| Parameter             | Description                                                            | -45  |      | -5   |      | -75  |      | Units |
|-----------------------|------------------------------------------------------------------------|------|------|------|------|------|------|-------|
|                       |                                                                        | Min. | Max. | Min. | Max. | Min. | Max. |       |
| In/Out Delays         |                                                                        |      |      |      |      |      |      |       |
| t <sub>IN</sub>       | Input Buffer Delay                                                     | —    | 0.95 | —    | 1.25 | —    | 1.80 | ns    |
| t <sub>GOE</sub>      | Global OE Pin Delay                                                    | —    | 3.00 | —    | 3.50 | —    | 4.30 | ns    |
| t <sub>GCLK_IN</sub>  | Global Clock Input Buffer Delay                                        | —    | 1.95 | —    | 2.05 | —    | 2.15 | ns    |
| t <sub>BUF</sub>      | Delay through Output Buffer                                            | —    | 1.10 | —    | 1.00 | —    | 1.30 | ns    |
| t <sub>EN</sub>       | Output Enable Time                                                     | —    | 2.50 | —    | 2.50 | —    | 2.70 | ns    |
| t <sub>DIS</sub>      | Output Disable Time                                                    | —    | 2.50 | —    | 2.50 | —    | 2.70 | ns    |
| Routing/GLB Delays    |                                                                        |      |      |      |      |      |      |       |
| t <sub>ROUTE</sub>    | Delay through GRP                                                      | —    | 2.25 | —    | 2.05 | —    | 2.50 | ns    |
| t <sub>MCELL</sub>    | Macrocell Delay                                                        | —    | 0.65 | —    | 0.65 | —    | 1.00 | ns    |
| t <sub>INREG</sub>    | Input Buffer to Macrocell Register Delay                               | —    | 1.00 | —    | 1.00 | —    | 1.00 | ns    |
| t <sub>FBK</sub>      | Internal Feedback Delay                                                | —    | 0.35 | —    | 0.05 | —    | 0.05 | ns    |
| t <sub>PDb</sub>      | 5-PT Bypass Propagation Delay                                          | —    | 0.20 | —    | 0.70 | —    | 1.90 | ns    |
| t <sub>PDi</sub>      | Macrocell Propagation Delay                                            | —    | 0.45 | —    | 0.65 | —    | 1.00 | ns    |
| Register/Latch Delays |                                                                        |      |      |      |      |      |      |       |
| t <sub>S</sub>        | D-Register Setup Time (Global Clock)                                   | 1.00 | —    | 1.10 | —    | 1.35 | —    | ns    |
| t <sub>S_PT</sub>     | D-Register Setup Time (Product Term Clock)                             | 2.10 | —    | 1.90 | —    | 2.45 | —    | ns    |
| t <sub>ST</sub>       | T-Register Setup Time (Global Clock)                                   | 1.20 | —    | 1.30 | —    | 1.55 | —    | ns    |
| t <sub>ST_PT</sub>    | T-register Setup Time (Product Term Clock)                             | 2.30 | —    | 2.10 | —    | 2.75 | —    | ns    |
| t <sub>H</sub>        | D-Register Hold Time                                                   | 1.90 | —    | 1.90 | —    | 3.15 | —    | ns    |
| t <sub>HT</sub>       | T-Resister Hold Time                                                   | 1.90 | —    | 1.90 | —    | 3.15 | —    | ns    |
| t <sub>SIR</sub>      | D-Input Register Setup Time (Global Clock)                             | 1.30 | —    | 1.10 | —    | 0.75 | —    | ns    |
| t <sub>SIR_PT</sub>   | D-Input Register Setup Time (Product Term Clock)                       | 1.45 | —    | 1.45 | —    | 1.45 | —    | ns    |
| t <sub>HIR</sub>      | D-Input Register Hold Time (Global Clock)                              | 1.30 | —    | 1.50 | —    | 1.95 | —    | ns    |
| t <sub>HIR_PT</sub>   | D-Input Register Hold Time (Product Term Clock)                        | 1.00 | —    | 1.00 | —    | 1.18 | —    | ns    |
| t <sub>COi</sub>      | Register Clock to Output/Feedback MUX Time                             | —    | 0.75 | —    | 1.15 | —    | 1.05 | ns    |
| t <sub>CES</sub>      | Clock Enable Setup Time                                                | 2.00 | —    | 2.00 | —    | 2.00 | —    | ns    |
| t <sub>CEH</sub>      | Clock Enable Hold Time                                                 | 0.00 | —    | 0.00 | —    | 0.00 | —    | ns    |
| t <sub>SL</sub>       | Latch Setup Time (Global Clock)                                        | 1.00 | —    | 1.00 | —    | 1.65 | —    | ns    |
| t <sub>SL_PT</sub>    | Latch Setup Time (Product Term Clock)                                  | 2.10 | —    | 1.90 | —    | 2.15 | —    | ns    |
| t <sub>HL</sub>       | Latch Hold Time                                                        | 2.00 | —    | 2.00 | —    | 1.17 | —    | ns    |
| t <sub>GOi</sub>      | Latch Gate to Output/Feedback MUX Time                                 | —    | 0.33 | —    | 0.33 | —    | 0.33 | ns    |
| t <sub>PDLi</sub>     | Propagation Delay through Transparent Latch to Output/<br>Feedback MUX | —    | 0.25 | —    | 0.25 | —    | 0.25 | ns    |
| t <sub>SRi</sub>      | Asynchronous Reset or Set to Output/Feedback MUX Delay                 | —    | 0.97 | —    | 0.97 | —    | 0.28 | ns    |
| t <sub>SRR</sub>      | Asynchronous Reset or Set Recovery Delay                               | —    | 1.80 | —    | 1.80 | —    | 1.67 | ns    |
| Control Delays        |                                                                        |      |      |      |      |      |      |       |
| t <sub>BCLK</sub>     | GLB PT Clock Delay                                                     | —    | 1.55 | —    | 1.55 | —    | 1.25 | ns    |
| t <sub>PTCLK</sub>    | Macrocell PT Clock Delay                                               | —    | 1.55 | —    | 1.55 | —    | 1.25 | ns    |
| t <sub>BSR</sub>      | GLB PT Set/Reset Delay                                                 | —    | 1.83 | —    | 1.83 | —    | 1.83 | ns    |
| t <sub>PTSR</sub>     | Macrocell PT Set/Reset Delay                                           | —    | 1.83 | —    | 1.83 | —    | 2.72 | ns    |
| t <sub>GPTOE</sub>    | Global PT OE Delay                                                     | —    | 4.30 | —    | 4.20 | —    | 3.50 | ns    |

Switching Test Conditions

Figure 12 shows the output test load that is used for AC testing. The specific values for resistance, capacitance, voltage, and other test conditions are shown in Table 11.

Figure 12. Output Test Load, LVTTTL and LVCMOS Standards



0213A/ispm4k

Table 11. Test Fixture Required Components

| Test Condition               | $R_1$        | $R_2$        | $C_L^1$ | Timing Ref.              | $V_{CCO}$          |
|------------------------------|--------------|--------------|---------|--------------------------|--------------------|
| LVCMOS I/O, (L -> H, H -> L) | 106 $\Omega$ | 106 $\Omega$ | 35pF    | LVCMOS 3.3 = 1.5V        | LVCMOS 3.3 = 3.0V  |
|                              |              |              |         | LVCMOS 2.5 = $V_{CCO}/2$ | LVCMOS 2.5 = 2.3V  |
|                              |              |              |         | LVCMOS 1.8 = $V_{CCO}/2$ | LVCMOS 1.8 = 1.65V |
| LVCMOS I/O (Z -> H)          | $\infty$     | 106 $\Omega$ | 35pF    | 1.5V                     | 3.0V               |
| LVCMOS I/O (Z -> L)          | 106 $\Omega$ | $\infty$     | 35pF    | 1.5V                     | 3.0V               |
| LVCMOS I/O (H -> Z)          | $\infty$     | 106 $\Omega$ | 5pF     | $V_{OH} - 0.3$           | 3.0V               |
| LVCMOS I/O (L -> Z)          | 106 $\Omega$ | $\infty$     | 5pF     | $V_{OL} + 0.3$           | 3.0V               |

1.  $C_L$  includes test fixtures and probe capacitance.

**ispMACH 4032V/B/C and 4064V/B/C Logic Signal Connections:  
44-Pin TQFP**

| Pin Number | Bank Number | ispMACH 4032V/B/C |                 | ispMACH 4064V/B/C |                |
|------------|-------------|-------------------|-----------------|-------------------|----------------|
|            |             | GLB/MC/Pad        | ORP             | GLB/MC/Pad        | ORP            |
| 1          | -           | TDI               | -               | TDI               | -              |
| 2          | 0           | A5                | A <sup>5</sup>  | A10               | A <sup>5</sup> |
| 3          | 0           | A6                | A <sup>6</sup>  | A12               | A <sup>6</sup> |
| 4          | 0           | A7                | A <sup>7</sup>  | A14               | A <sup>7</sup> |
| 5          | 0           | GND (Bank 0)      | -               | GND (Bank 0)      | -              |
| 6          | 0           | VCCO (Bank 0)     | -               | VCCO (Bank 0)     | -              |
| 7          | 0           | A8                | A <sup>8</sup>  | B0                | B <sup>0</sup> |
| 8          | 0           | A9                | A <sup>9</sup>  | B2                | B <sup>1</sup> |
| 9          | 0           | A10               | A <sup>10</sup> | B4                | B <sup>2</sup> |
| 10         | -           | TCK               | -               | TCK               | -              |
| 11         | -           | VCC               | -               | VCC               | -              |
| 12         | -           | GND               | -               | GND               | -              |
| 13         | 0           | A12               | A <sup>12</sup> | B8                | B <sup>4</sup> |
| 14         | 0           | A13               | A <sup>13</sup> | B10               | B <sup>5</sup> |
| 15         | 0           | A14               | A <sup>14</sup> | B12               | B <sup>6</sup> |
| 16         | 0           | A15               | A <sup>15</sup> | B14               | B <sup>7</sup> |
| 17         | 1           | CLK2/I            | -               | CLK2/I            | -              |
| 18         | 1           | B0                | B <sup>0</sup>  | C0                | C <sup>0</sup> |
| 19         | 1           | B1                | B <sup>1</sup>  | C2                | C <sup>1</sup> |
| 20         | 1           | B2                | B <sup>2</sup>  | C4                | C <sup>2</sup> |
| 21         | 1           | B3                | B <sup>3</sup>  | C6                | C <sup>3</sup> |
| 22         | 1           | B4                | B <sup>4</sup>  | C8                | C <sup>4</sup> |
| 23         | -           | TMS               | -               | TMS               | -              |
| 24         | 1           | B5                | B <sup>5</sup>  | C10               | C <sup>5</sup> |
| 25         | 1           | B6                | B <sup>6</sup>  | C12               | C <sup>6</sup> |
| 26         | 1           | B7                | B <sup>7</sup>  | C14               | C <sup>7</sup> |
| 27         | 1           | GND (Bank 1)      | -               | GND (Bank 1)      | -              |
| 28         | 1           | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -              |
| 29         | 1           | B8                | B <sup>8</sup>  | D0                | D <sup>0</sup> |
| 30         | 1           | B9                | B <sup>9</sup>  | D2                | D <sup>1</sup> |
| 31         | 1           | B10               | B <sup>10</sup> | D4                | D <sup>2</sup> |
| 32         | -           | TDO               | -               | TDO               | -              |
| 33         | -           | VCC               | -               | VCC               | -              |
| 34         | -           | GND               | -               | GND               | -              |
| 35         | 1           | B12               | B <sup>12</sup> | D8                | D <sup>4</sup> |
| 36         | 1           | B13               | B <sup>13</sup> | D10               | D <sup>5</sup> |
| 37         | 1           | B14               | B <sup>14</sup> | D12               | D <sup>6</sup> |
| 38         | 1           | B15/GOE1          | B <sup>15</sup> | D14/GOE1          | D <sup>7</sup> |
| 39         | 0           | CLK0/I            | -               | CLK0/I            | -              |
| 40         | 0           | A0/GOE0           | A <sup>0</sup>  | A0/GOE0           | A <sup>0</sup> |
| 41         | 0           | A1                | A <sup>1</sup>  | A2                | A <sup>1</sup> |



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

| 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            |
| 42         | 1           | C1                  | C <sup>1</sup>  | E2                  | E <sup>1</sup> | I6                  | I <sup>1</sup> |
| 43         | 1           | C2                  | C <sup>2</sup>  | E4                  | E <sup>2</sup> | I10                 | I <sup>2</sup> |
| 44         | 1           | C3                  | C <sup>3</sup>  | E6                  | E <sup>3</sup> | I12                 | I <sup>3</sup> |
| 45         | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)       | -              | VCCO (Bank 1)       | -              |
| 46         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |
| 47         | 1           | C4                  | C <sup>4</sup>  | E8                  | E <sup>4</sup> | J2                  | J <sup>0</sup> |
| 48         | 1           | C5                  | C <sup>5</sup>  | E10                 | E <sup>5</sup> | J6                  | J <sup>1</sup> |
| 49         | 1           | C6                  | C <sup>6</sup>  | E12                 | E <sup>6</sup> | J10                 | J <sup>2</sup> |
| 50         | 1           | C7                  | C <sup>7</sup>  | E14                 | E <sup>7</sup> | J12                 | J <sup>3</sup> |
| 51         | -           | GND                 | -               | GND                 | -              | GND                 | -              |
| 52         | -           | TMS                 | -               | TMS                 | -              | TMS                 | -              |
| 53         | 1           | C8                  | C <sup>8</sup>  | F0                  | F <sup>0</sup> | K12                 | K <sup>3</sup> |
| 54         | 1           | C9                  | C <sup>9</sup>  | F2                  | F <sup>1</sup> | K10                 | K <sup>2</sup> |
| 55         | 1           | C10                 | C <sup>10</sup> | F4                  | F <sup>2</sup> | K6                  | K <sup>1</sup> |
| 56         | 1           | C11                 | C <sup>11</sup> | F6                  | F <sup>3</sup> | K2                  | K <sup>0</sup> |
| 57         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |
| 58         | 1           | C12                 | C <sup>12</sup> | F8                  | F <sup>4</sup> | L12                 | L <sup>3</sup> |
| 59         | 1           | C13                 | C <sup>13</sup> | F10                 | F <sup>5</sup> | L10                 | L <sup>2</sup> |
| 60         | 1           | C14                 | C <sup>14</sup> | F12                 | F <sup>6</sup> | L6                  | L <sup>1</sup> |
| 61         | 1           | C15                 | C <sup>15</sup> | F13                 | F <sup>7</sup> | L4                  | L <sup>0</sup> |
| 62*        | 1           | I                   | -               | I                   | -              | I                   | -              |
| 63         | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)       | -              | VCCO (Bank 1)       | -              |
| 64         | 1           | D15                 | D <sup>15</sup> | G14                 | G <sup>7</sup> | M4                  | M <sup>0</sup> |
| 65         | 1           | D14                 | D <sup>14</sup> | G12                 | G <sup>6</sup> | M6                  | M <sup>1</sup> |
| 66         | 1           | D13                 | D <sup>13</sup> | G10                 | G <sup>5</sup> | M10                 | M <sup>2</sup> |
| 67         | 1           | D12                 | D <sup>12</sup> | G8                  | G <sup>4</sup> | M12                 | M <sup>3</sup> |
| 68         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |
| 69         | 1           | D11                 | D <sup>11</sup> | G6                  | G <sup>3</sup> | N2                  | N <sup>0</sup> |
| 70         | 1           | D10                 | D <sup>10</sup> | G5                  | G <sup>2</sup> | N6                  | N <sup>1</sup> |
| 71         | 1           | D9                  | D <sup>9</sup>  | G4                  | G <sup>1</sup> | N10                 | N <sup>2</sup> |
| 72         | 1           | D8                  | D <sup>8</sup>  | G2                  | G <sup>0</sup> | N12                 | N <sup>3</sup> |
| 73*        | 1           | I                   | -               | I                   | -              | I                   | -              |
| 74         | -           | TDO                 | -               | TDO                 | -              | TDO                 | -              |
| 75         | -           | VCC                 | -               | VCC                 | -              | VCC                 | -              |
| 76         | -           | GND                 | -               | GND                 | -              | GND                 | -              |
| 77*        | 1           | I                   | -               | I                   | -              | I                   | -              |
| 78         | 1           | D7                  | D <sup>7</sup>  | H13                 | H <sup>7</sup> | O12                 | O <sup>3</sup> |
| 79         | 1           | D6                  | D <sup>6</sup>  | H12                 | H <sup>6</sup> | O10                 | O <sup>2</sup> |
| 80         | 1           | D5                  | D <sup>5</sup>  | H10                 | H <sup>5</sup> | O6                  | O <sup>1</sup> |
| 81         | 1           | D4                  | D <sup>4</sup>  | H8                  | H <sup>4</sup> | O2                  | O <sup>0</sup> |
| 82         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |

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

| 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            |
| 83         | 1           | VCCO (Bank 1)       | -              | VCCO (Bank 1)       | -              | VCCO (Bank 1)       | -              |
| 84         | 1           | D3                  | D <sup>3</sup> | H6                  | H <sup>3</sup> | P12                 | P <sup>3</sup> |
| 85         | 1           | D2                  | D <sup>2</sup> | H4                  | H <sup>2</sup> | P10                 | P <sup>2</sup> |
| 86         | 1           | D1                  | D <sup>1</sup> | H2                  | H <sup>1</sup> | P6                  | P <sup>1</sup> |
| 87         | 1           | D0/GOE1             | D <sup>0</sup> | H0/GOE1             | H <sup>0</sup> | P2/OE1              | P <sup>0</sup> |
| 88         | 1           | CLK3/I              | -              | CLK3/I              | -              | CLK3/I              | -              |
| 89         | 0           | CLK0/I              | -              | CLK0/I              | -              | CLK0/I              | -              |
| 90         | -           | VCC                 | -              | VCC                 | -              | VCC                 | -              |
| 91         | 0           | A0/GOE0             | A <sup>0</sup> | A0/GOE0             | A <sup>0</sup> | A2/GOE0             | A <sup>0</sup> |
| 92         | 0           | A1                  | A <sup>1</sup> | A2                  | A <sup>1</sup> | A6                  | A <sup>1</sup> |
| 93         | 0           | A2                  | A <sup>2</sup> | A4                  | A <sup>2</sup> | A10                 | A <sup>2</sup> |
| 94         | 0           | A3                  | A <sup>3</sup> | A6                  | A <sup>3</sup> | A12                 | A <sup>3</sup> |
| 95         | 0           | VCCO (Bank 0)       | -              | VCCO (Bank 0)       | -              | VCCO (Bank 0)       | -              |
| 96         | 0           | GND (Bank 0)        | -              | GND (Bank 0)        | -              | GND (Bank 0)        | -              |
| 97         | 0           | A4                  | A <sup>4</sup> | A8                  | A <sup>4</sup> | B2                  | B <sup>0</sup> |
| 98         | 0           | A5                  | A <sup>5</sup> | A10                 | A <sup>5</sup> | B6                  | B <sup>1</sup> |
| 99         | 0           | A6                  | A <sup>6</sup> | A12                 | A <sup>6</sup> | B10                 | B <sup>2</sup> |
| 100        | 0           | A7                  | A <sup>7</sup> | A14                 | A <sup>7</sup> | B12                 | B <sup>3</sup> |

\*This pin is input only.

**ispMACH 4128V/B/C Logic Signal Connections: 128-Pin TQFP**

| Pin Number | Bank Number | ispMACH 4128V/B/C |                 |
|------------|-------------|-------------------|-----------------|
|            |             | GLB/MC/Pad        | ORP             |
| 1          | 0           | GND               | -               |
| 2          | 0           | TDI               | -               |
| 3          | 0           | VCCO (Bank 0)     | -               |
| 4          | 0           | B0                | B <sup>0</sup>  |
| 5          | 0           | B1                | B <sup>1</sup>  |
| 6          | 0           | B2                | B <sup>2</sup>  |
| 7          | 0           | B4                | B <sup>3</sup>  |
| 8          | 0           | B5                | B <sup>4</sup>  |
| 9          | 0           | B6                | B <sup>5</sup>  |
| 10         | 0           | GND (Bank 0)      | -               |
| 11         | 0           | B8                | B <sup>6</sup>  |
| 12         | 0           | B9                | B <sup>7</sup>  |
| 13         | 0           | B10               | B <sup>8</sup>  |
| 14         | 0           | B12               | B <sup>9</sup>  |
| 15         | 0           | B13               | B <sup>10</sup> |
| 16         | 0           | B14               | B <sup>11</sup> |
| 17         | 0           | VCCO (Bank 0)     | -               |
| 18         | 0           | C14               | C <sup>11</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 (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 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 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             |
| R14         | 1        | J10                          | J <sup>5</sup> | J10                          | J <sup>7</sup> | N10               | N <sup>5</sup>  | BX10              | BX <sup>5</sup> |
| P13         | 1        | J12                          | J <sup>6</sup> | J12                          | J <sup>8</sup> | N12               | N <sup>6</sup>  | BX12              | BX <sup>6</sup> |
| N13         | 1        | J14                          | J <sup>7</sup> | J14                          | J <sup>9</sup> | N14               | N <sup>7</sup>  | BX14              | BX <sup>7</sup> |
| M12         | 1        | NC                           | -              | NC                           | -              | P4                | P <sup>2</sup>  | FX0               | FX <sup>0</sup> |
| T15         | 1        | NC                           | -              | NC                           | -              | P6                | P <sup>3</sup>  | FX2               | FX <sup>1</sup> |
| -           | -        | VCC                          | -              | VCC                          | -              | VCC               | -               | VCC               | -               |
| -           | -        | GND                          | -              | GND                          | -              | GND               | -               | GND               | -               |
| -           | 1        | -                            | -              | GND (Bank 1)                 | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| P14         | -        | TMS                          | -              | TMS                          | -              | TMS               | -               | TMS               | -               |
| -           | 1        | VCCO (Bank 1)                | -              | VCCO (Bank 1)                | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| L12         | 1        | NC                           | -              | NC                           | -              | NC                | -               | FX4               | FX <sup>2</sup> |
| R16         | 1        | NC                           | -              | NC                           | -              | P8                | P <sup>4</sup>  | FX6               | FX <sup>3</sup> |
| N14         | 1        | NC                           | -              | NC                           | -              | P10               | P <sup>5</sup>  | FX8               | FX <sup>4</sup> |
| P15         | 1        | K14                          | K <sup>7</sup> | K14                          | K <sup>9</sup> | O14               | O <sup>7</sup>  | CX14              | CX <sup>7</sup> |
| L11         | 1        | K12                          | K <sup>6</sup> | K12                          | K <sup>8</sup> | O12               | O <sup>6</sup>  | CX12              | CX <sup>6</sup> |
| P16         | 1        | K10                          | K <sup>5</sup> | K10                          | K <sup>7</sup> | O10               | O <sup>5</sup>  | CX10              | CX <sup>5</sup> |
| K11         | 1        | K8                           | K <sup>4</sup> | K9                           | K <sup>6</sup> | O8                | O <sup>4</sup>  | CX8               | CX <sup>4</sup> |
| M14         | 1        | K6                           | K <sup>3</sup> | K8                           | K <sup>5</sup> | O6                | O <sup>3</sup>  | CX6               | CX <sup>3</sup> |
| K12         | 1        | K4                           | K <sup>2</sup> | K6                           | K <sup>4</sup> | O4                | O <sup>2</sup>  | CX4               | CX <sup>2</sup> |
| N15         | 1        | K2                           | K <sup>1</sup> | K4                           | K <sup>3</sup> | O2                | O <sup>1</sup>  | CX2               | CX <sup>1</sup> |
| N16         | 1        | K0                           | K <sup>0</sup> | K2                           | K <sup>2</sup> | O0                | O <sup>0</sup>  | CX0               | CX <sup>0</sup> |
| M15         | 1        | NC                           | -              | K1                           | K <sup>1</sup> | BX6               | BX <sup>3</sup> | HX0               | HX <sup>0</sup> |
| M13         | 1        | NC                           | -              | K0                           | K <sup>0</sup> | BX4               | BX <sup>2</sup> | HX4               | HX <sup>1</sup> |
| -           | 1        | -                            | -              | VCCO (Bank 1)                | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| -           | 1        | GND (Bank 1)                 | -              | GND (Bank 1)                 | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| M16         | 1        | NC                           | -              | NC                           | -              | NC                | -               | FX10              | FX <sup>5</sup> |
| L15         | 1        | NC                           | -              | NC                           | -              | P12               | P <sup>6</sup>  | FX12              | FX <sup>6</sup> |
| L16         | 1        | NC                           | -              | NC                           | -              | P14               | P <sup>7</sup>  | FX14              | FX <sup>7</sup> |
| J11         | 1        | NC                           | -              | L14                          | L <sup>9</sup> | BX2               | BX <sup>1</sup> | HX8               | HX <sup>2</sup> |
| K15         | 1        | NC                           | -              | L12                          | L <sup>8</sup> | BX0               | BX <sup>0</sup> | HX12              | HX <sup>3</sup> |
| J12         | 1        | L14                          | L <sup>7</sup> | L10                          | L <sup>7</sup> | AX14              | AX <sup>7</sup> | GX14              | GX <sup>7</sup> |
| K13         | 1        | L12                          | L <sup>6</sup> | L9                           | L <sup>6</sup> | AX12              | AX <sup>6</sup> | GX12              | GX <sup>6</sup> |
| K14         | 1        | L10                          | L <sup>5</sup> | L8                           | L <sup>5</sup> | AX10              | AX <sup>5</sup> | GX10              | GX <sup>5</sup> |
| K16         | 1        | L8                           | L <sup>4</sup> | L6                           | L <sup>4</sup> | AX8               | AX <sup>4</sup> | GX8               | GX <sup>4</sup> |
| J16         | 1        | L6                           | L <sup>3</sup> | L4                           | L <sup>3</sup> | AX6               | AX <sup>3</sup> | GX6               | GX <sup>3</sup> |
| J15         | 1        | L4                           | L <sup>2</sup> | L2                           | L <sup>2</sup> | AX4               | AX <sup>2</sup> | GX4               | GX <sup>2</sup> |
| H16         | 1        | L2                           | L <sup>1</sup> | L1                           | L <sup>1</sup> | AX2               | AX <sup>1</sup> | GX2               | GX <sup>1</sup> |
| J13         | 1        | L0                           | L <sup>0</sup> | L0                           | L <sup>0</sup> | AX0               | AX <sup>0</sup> | GX0               | GX <sup>0</sup> |
| -           | 1        | VCCO (Bank 1)                | -              | VCCO (Bank 1)                | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| -           | 1        | -                            | -              | GND (Bank 1)                 | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| J14         | 1        | M0                           | M <sup>0</sup> | M0                           | M <sup>0</sup> | DX0               | DX <sup>0</sup> | JX0               | JX <sup>0</sup> |

**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             |
| H15         | 1        | M2                           | M <sup>1</sup> | M1                           | M <sup>1</sup> | DX2               | DX <sup>1</sup> | JX2               | JX <sup>1</sup> |
| H14         | 1        | M4                           | M <sup>2</sup> | M2                           | M <sup>2</sup> | DX4               | DX <sup>2</sup> | JX4               | JX <sup>2</sup> |
| H13         | 1        | M6                           | M <sup>3</sup> | M4                           | M <sup>3</sup> | DX6               | DX <sup>3</sup> | JX6               | JX <sup>3</sup> |
| G16         | 1        | M8                           | M <sup>4</sup> | M6                           | M <sup>4</sup> | DX8               | DX <sup>4</sup> | JX8               | JX <sup>4</sup> |
| H12         | 1        | M10                          | M <sup>5</sup> | M8                           | M <sup>5</sup> | DX10              | DX <sup>5</sup> | JX10              | JX <sup>5</sup> |
| G15         | 1        | M12                          | M <sup>6</sup> | M9                           | M <sup>6</sup> | DX12              | DX <sup>6</sup> | JX12              | JX <sup>6</sup> |
| H11         | 1        | M14                          | M <sup>7</sup> | M10                          | M <sup>7</sup> | DX14              | DX <sup>7</sup> | JX14              | JX <sup>7</sup> |
| F16         | 1        | NC                           | -              | M12                          | M <sup>8</sup> | CX0               | CX <sup>0</sup> | IX0               | IX <sup>0</sup> |
| G13         | 1        | NC                           | -              | M14                          | M <sup>9</sup> | CX2               | CX <sup>1</sup> | IX4               | IX <sup>1</sup> |
| G14         | 1        | NC                           | -              | NC                           | -              | EX14              | EX <sup>7</sup> | KX0               | KX <sup>0</sup> |
| F15         | 1        | NC                           | -              | NC                           | -              | EX12              | EX <sup>6</sup> | KX2               | KX <sup>1</sup> |
| E16         | 1        | NC                           | -              | NC                           | -              | NC                | -               | KX4               | KX <sup>2</sup> |
| -           | 1        | GND (Bank 1)                 | -              | GND (Bank 1)                 | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| -           | 1        | -                            | -              | VCCO (Bank 1)                | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| E15         | 1        | NC                           | -              | NC                           | -              | NC                | -               | KX6               | KX <sup>3</sup> |
| G12         | 1        | NC                           | -              | NC                           | -              | EX10              | EX <sup>5</sup> | KX8               | KX <sup>4</sup> |
| E13         | 1        | NC                           | -              | NC                           | -              | EX8               | EX <sup>4</sup> | KX10              | KX <sup>5</sup> |
| D16         | 1        | NC                           | -              | N0                           | N <sup>0</sup> | CX4               | CX <sup>2</sup> | IX8               | IX <sup>2</sup> |
| E14         | 1        | NC                           | -              | N1                           | N <sup>1</sup> | CX6               | CX <sup>3</sup> | IX12              | IX <sup>3</sup> |
| G11         | 1        | N0                           | N <sup>0</sup> | N2                           | N <sup>2</sup> | FX0               | FX <sup>0</sup> | NX0               | NX <sup>0</sup> |
| D15         | 1        | N2                           | N <sup>1</sup> | N4                           | N <sup>3</sup> | FX2               | FX <sup>1</sup> | NX2               | NX <sup>1</sup> |
| F11         | 1        | N4                           | N <sup>2</sup> | N6                           | N <sup>4</sup> | FX4               | FX <sup>2</sup> | NX4               | NX <sup>2</sup> |
| C16         | 1        | N6                           | N <sup>3</sup> | N8                           | N <sup>5</sup> | FX6               | FX <sup>3</sup> | NX6               | NX <sup>3</sup> |
| F12         | 1        | N8                           | N <sup>4</sup> | N9                           | N <sup>6</sup> | FX8               | FX <sup>4</sup> | NX8               | NX <sup>4</sup> |
| D14         | 1        | N10                          | N <sup>5</sup> | N10                          | N <sup>7</sup> | FX10              | FX <sup>5</sup> | NX10              | NX <sup>5</sup> |
| C15         | 1        | N12                          | N <sup>6</sup> | N12                          | N <sup>8</sup> | FX12              | FX <sup>6</sup> | NX12              | NX <sup>6</sup> |
| B16         | 1        | N14                          | N <sup>7</sup> | N14                          | N <sup>9</sup> | FX14              | FX <sup>7</sup> | NX14              | NX <sup>7</sup> |
| -           | 1        | VCCO (Bank 1)                | -              | VCCO (Bank 1)                | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| C14         | -        | TDO                          | -              | TDO                          | -              | TDO               | -               | TDO               | -               |
| -           | -        | VCC                          | -              | VCC                          | -              | VCC               | -               | VCC               | -               |
| -           | -        | GND                          | -              | GND                          | -              | GND               | -               | GND               | -               |
| -           | 1        | -                            | -              | GND (Bank 1)                 | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| A15         | 1        | NC                           | -              | NC                           | -              | EX6               | EX <sup>3</sup> | KX12              | KX <sup>6</sup> |
| B14         | 1        | NC                           | -              | NC                           | -              | EX4               | EX <sup>2</sup> | KX14              | KX <sup>7</sup> |
| E12         | 1        | O14                          | O <sup>7</sup> | O14                          | O <sup>9</sup> | GX14              | GX <sup>7</sup> | OX14              | OX <sup>7</sup> |
| A14         | 1        | O12                          | O <sup>6</sup> | O12                          | O <sup>8</sup> | GX12              | GX <sup>6</sup> | OX12              | OX <sup>6</sup> |
| C13         | 1        | O10                          | O <sup>5</sup> | O10                          | O <sup>7</sup> | GX10              | GX <sup>5</sup> | OX10              | OX <sup>5</sup> |
| D13         | 1        | O8                           | O <sup>4</sup> | O9                           | O <sup>6</sup> | GX8               | GX <sup>4</sup> | OX8               | OX <sup>4</sup> |
| E11         | 1        | O6                           | O <sup>3</sup> | O8                           | O <sup>5</sup> | GX6               | GX <sup>3</sup> | OX6               | OX <sup>3</sup> |
| B13         | 1        | O4                           | O <sup>2</sup> | O6                           | O <sup>4</sup> | GX4               | GX <sup>2</sup> | OX4               | OX <sup>2</sup> |
| F10         | 1        | O2                           | O <sup>1</sup> | O4                           | O <sup>3</sup> | GX2               | GX <sup>1</sup> | OX2               | OX <sup>1</sup> |

**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             |
| C12         | 1        | O0                           | O <sup>0</sup> | O2                           | O <sup>2</sup> | GX0               | GX <sup>0</sup> | OX0               | OX <sup>0</sup> |
| E10         | 1        | NC                           | -              | O1                           | O <sup>1</sup> | CX8               | CX <sup>4</sup> | MX0               | MX <sup>0</sup> |
| A13         | 1        | NC                           | -              | O0                           | O <sup>0</sup> | CX10              | CX <sup>5</sup> | MX4               | MX <sup>1</sup> |
| D12         | 1        | NC                           | -              | NC                           | -              | NC                | -               | LX0               | LX <sup>0</sup> |
| -           | 1        | GND (Bank 1)                 | -              | GND (Bank 1)                 | -              | GND (Bank 1)      | -               | GND (Bank 1)      | -               |
| -           | 1        | VCCO (Bank 1)                | -              | VCCO (Bank 1)                | -              | VCCO (Bank 1)     | -               | VCCO (Bank 1)     | -               |
| B12         | 1        | NC                           | -              | NC                           | -              | NC                | -               | LX4               | LX <sup>1</sup> |
| A12         | 1        | NC                           | -              | NC                           | -              | EX2               | EX <sup>1</sup> | LX8               | LX <sup>2</sup> |
| B11         | 1        | NC                           | -              | NC                           | -              | EX0               | EX <sup>0</sup> | LX12              | LX <sup>3</sup> |
| A11         | 1        | NC                           | -              | P14                          | P <sup>9</sup> | CX12              | CX <sup>6</sup> | MX8               | MX <sup>2</sup> |
| D10         | 1        | NC                           | -              | P12                          | P <sup>8</sup> | CX14              | CX <sup>7</sup> | MX12              | MX <sup>3</sup> |
| C10         | 1        | P14                          | P <sup>7</sup> | P10                          | P <sup>7</sup> | HX14              | HX <sup>7</sup> | PX14              | PX <sup>7</sup> |
| B10         | 1        | P12                          | P <sup>6</sup> | P9                           | P <sup>6</sup> | HX12              | HX <sup>6</sup> | PX12              | PX <sup>6</sup> |
| A10         | 1        | P10                          | P <sup>5</sup> | P8                           | P <sup>5</sup> | HX10              | HX <sup>5</sup> | PX10              | PX <sup>5</sup> |
| A9          | 1        | P8                           | P <sup>4</sup> | P6                           | P <sup>4</sup> | HX8               | HX <sup>4</sup> | PX8               | PX <sup>4</sup> |
| F9          | 1        | P6                           | P <sup>3</sup> | P4                           | P <sup>3</sup> | HX6               | HX <sup>3</sup> | PX6               | PX <sup>3</sup> |
| B9          | 1        | P4                           | P <sup>2</sup> | P2                           | P <sup>2</sup> | HX4               | HX <sup>2</sup> | PX4               | PX <sup>2</sup> |
| E9          | 1        | P2/GOE1                      | P <sup>1</sup> | P1/GOE1                      | P <sup>1</sup> | HX2/GOE1          | HX <sup>1</sup> | PX2/GOE1          | PX <sup>1</sup> |
| C9          | 1        | P0                           | P <sup>0</sup> | P0                           | P <sup>0</sup> | HX0               | HX <sup>0</sup> | PX0               | PX <sup>0</sup> |
| -           | -        | GND                          | -              | GND                          | -              | GND               | -               | GND               | -               |
| D9          | 1        | CLK3/I                       | -              | CLK3/I                       | -              | CLK3/I            | -               | CLK3/I            | -               |
| -           | 0        | GND (Bank 0)                 | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -               | GND (Bank 0)      | -               |
| B8          | 0        | CLK0/I                       | -              | CLK0/I                       | -              | CLK0/I            | -               | CLK0/I            | -               |
| -           | -        | VCC                          | -              | VCC                          | -              | VCC               | -               | VCC               | -               |
| D8          | 0        | A0                           | A <sup>0</sup> | A0                           | A <sup>0</sup> | A0                | A <sup>0</sup>  | A0                | A <sup>0</sup>  |
| C8          | 0        | A2/GOE0                      | A <sup>1</sup> | A1/GOE0                      | A <sup>1</sup> | A2/GOE0           | A <sup>1</sup>  | A2/GOE0           | A <sup>1</sup>  |
| A8          | 0        | A4                           | A <sup>2</sup> | A2                           | A <sup>2</sup> | A4                | A <sup>2</sup>  | A4                | A <sup>2</sup>  |
| A7          | 0        | A6                           | A <sup>3</sup> | A4                           | A <sup>3</sup> | A6                | A <sup>3</sup>  | A6                | A <sup>3</sup>  |
| B7          | 0        | A8                           | A <sup>4</sup> | A6                           | A <sup>4</sup> | A8                | A <sup>4</sup>  | A8                | A <sup>4</sup>  |
| E8          | 0        | A10                          | A <sup>5</sup> | A8                           | A <sup>5</sup> | A10               | A <sup>5</sup>  | A10               | A <sup>5</sup>  |
| D7          | 0        | A12                          | A <sup>6</sup> | A9                           | A <sup>6</sup> | A12               | A <sup>6</sup>  | A12               | A <sup>6</sup>  |
| F8          | 0        | A14                          | A <sup>7</sup> | A10                          | A <sup>7</sup> | A14               | A <sup>7</sup>  | A14               | A <sup>7</sup>  |
| C7          | 0        | NC                           | -              | A12                          | A <sup>8</sup> | F14               | F <sup>7</sup>  | D0                | D <sup>0</sup>  |
| A6          | 0        | NC                           | -              | A14                          | A <sup>9</sup> | F12               | F <sup>6</sup>  | D4                | D <sup>1</sup>  |
| B6          | 0        | NC                           | -              | NC                           | -              | D14               | D <sup>7</sup>  | E0                | E <sup>0</sup>  |
| A5          | 0        | NC                           | -              | NC                           | -              | D12               | D <sup>6</sup>  | E4                | E <sup>1</sup>  |
| B5          | 0        | NC                           | -              | NC                           | -              | NC                | -               | E8                | E <sup>2</sup>  |
| -           | 0        | VCCO (Bank 0)                | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -               | VCCO (Bank 0)     | -               |
| -           | 0        | GND (Bank 0)                 | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -               | GND (Bank 0)      | -               |
| D5          | 0        | NC                           | -              | NC                           | -              | NC                | -               | E12               | E <sup>3</sup>  |
| A4          | 0        | NC                           | -              | B0                           | B <sup>0</sup> | F10               | F <sup>5</sup>  | D8                | D <sup>2</sup>  |



## Ordering Information

Note: ispMACH 4000 devices are all dual marked except the slowest commercial speed grade ispMACH 4000Z devices. For example, the commercial speed grade LC4128C-5T100C is also marked with the industrial grade -75I. The commercial grade is always one speed grade faster than the associated dual mark industrial grade. The slowest commercial speed grade ispMACH 4000Z devices are marked as commercial grade only.

## Conventional Packaging

### ispMACH 4000ZC (Zero Power, 1.8V) Commercial Devices

| Device   | Part Number      | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|----------|------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032ZC | LC4032ZC-35M56C  | 32         | 1.8     | 3.5             | csBGA   | 56             | 32  | C     |
|          | LC4032ZC-5M56C   | 32         | 1.8     | 5               | csBGA   | 56             | 32  | C     |
|          | LC4032ZC-75M56C  | 32         | 1.8     | 7.5             | csBGA   | 56             | 32  | C     |
|          | LC4032ZC-35T48C  | 32         | 1.8     | 3.5             | TQFP    | 48             | 32  | C     |
|          | LC4032ZC-5T48C   | 32         | 1.8     | 5               | TQFP    | 48             | 32  | C     |
|          | LC4032ZC-75T48C  | 32         | 1.8     | 7.5             | TQFP    | 48             | 32  | C     |
| LC4064ZC | LC4064ZC-37M132C | 64         | 1.8     | 3.7             | csBGA   | 132            | 64  | C     |
|          | LC4064ZC-5M132C  | 64         | 1.8     | 5               | csBGA   | 132            | 64  | C     |
|          | LC4064ZC-75M132C | 64         | 1.8     | 7.5             | csBGA   | 132            | 64  | C     |
|          | LC4064ZC-37T100C | 64         | 1.8     | 3.7             | TQFP    | 100            | 64  | C     |
|          | LC4064ZC-5T100C  | 64         | 1.8     | 5               | TQFP    | 100            | 64  | C     |
|          | LC4064ZC-75T100C | 64         | 1.8     | 7.5             | TQFP    | 100            | 64  | C     |
|          | LC4064ZC-37M56C  | 64         | 1.8     | 3.7             | csBGA   | 56             | 32  | C     |
|          | LC4064ZC-5M56C   | 64         | 1.8     | 5               | csBGA   | 56             | 32  | C     |
|          | LC4064ZC-75M56C  | 64         | 1.8     | 7.5             | csBGA   | 56             | 32  | C     |
|          | LC4064ZC-37T48C  | 64         | 1.8     | 3.7             | TQFP    | 48             | 32  | C     |
|          | LC4064ZC-5T48C   | 64         | 1.8     | 5               | TQFP    | 48             | 32  | C     |
|          | LC4064ZC-75T48C  | 64         | 1.8     | 7.5             | TQFP    | 48             | 32  | C     |
| LC4128ZC | LC4128ZC-42M132C | 128        | 1.8     | 4.2             | csBGA   | 132            | 96  | C     |
|          | LC4128ZC-75M132C | 128        | 1.8     | 7.5             | csBGA   | 132            | 96  | C     |
|          | LC4128ZC-42T100C | 128        | 1.8     | 4.2             | TQFP    | 100            | 64  | C     |
|          | LC4128ZC-75T100C | 128        | 1.8     | 7.5             | TQFP    | 100            | 64  | C     |
| LC4256ZC | LC4256ZC-45T176C | 256        | 1.8     | 4.5             | TQFP    | 176            | 128 | C     |
|          | LC4256ZC-75T176C | 256        | 1.8     | 7.5             | TQFP    | 176            | 128 | C     |
|          | LC4256ZC-45M132C | 256        | 1.8     | 4.5             | csBGA   | 132            | 96  | C     |
|          | LC4256ZC-75M132C | 256        | 1.8     | 7.5             | csBGA   | 132            | 96  | C     |
|          | LC4256ZC-45T100C | 256        | 1.8     | 4.5             | TQFP    | 100            | 64  | C     |
|          | LC4256ZC-75T100C | 256        | 1.8     | 7.5             | TQFP    | 100            | 64  | C     |

### ispMACH 4000ZC (1.8V, Zero Power) Industrial Devices

| Device   | Part Number     | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|----------|-----------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032ZC | LC4032ZC-5M56I  | 32         | 1.8     | 5               | csBGA   | 56             | 32  | I     |
|          | LC4032ZC-75M56I | 32         | 1.8     | 7.5             | csBGA   | 56             | 32  | I     |
|          | LC4032ZC-5T48I  | 32         | 1.8     | 5               | TQFP    | 48             | 32  | I     |
|          | LC4032ZC-75T48I | 32         | 1.8     | 7.5             | TQFP    | 48             | 32  | I     |

## ispMACH 4000B (2.5V) Industrial Devices (Cont.)

| Family  | Part Number                  | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|------------------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4384B | LC4384B-5FT256I              | 384        | 2.5     | 5               | ftBGA   | 256            | 192 | I     |
|         | LC4384B-75FT256I             | 384        | 2.5     | 7.5             | ftBGA   | 256            | 192 | I     |
|         | LC4384B-10FT256I             | 384        | 2.5     | 10              | ftBGA   | 256            | 192 | I     |
|         | LC4384B-5F256I <sup>1</sup>  | 384        | 2.5     | 5               | fpBGA   | 256            | 192 | I     |
|         | LC4384B-75F256I <sup>1</sup> | 384        | 2.5     | 7.5             | fpBGA   | 256            | 192 | I     |
|         | LC4384B-10F256I <sup>1</sup> | 384        | 2.5     | 10              | fpBGA   | 256            | 192 | I     |
|         | LC4384B-5T176I               | 384        | 2.5     | 5               | TQFP    | 176            | 128 | I     |
|         | LC4384B-75T176I              | 384        | 2.5     | 7.5             | TQFP    | 176            | 128 | I     |
|         | LC4384B-10T176I              | 384        | 2.5     | 10              | TQFP    | 176            | 128 | I     |
| LC4512B | LC4512B-5FT256I              | 512        | 2.5     | 5               | ftBGA   | 256            | 208 | I     |
|         | LC4512B-75FT256I             | 512        | 2.5     | 7.5             | ftBGA   | 256            | 208 | I     |
|         | LC4512B-10FT256I             | 512        | 2.5     | 10              | ftBGA   | 256            | 208 | I     |
|         | LC4512B-5F256I <sup>1</sup>  | 512        | 2.5     | 5               | fpBGA   | 256            | 208 | I     |
|         | LC4512B-75F256I <sup>1</sup> | 512        | 2.5     | 7.5             | fpBGA   | 256            | 208 | I     |
|         | LC4512B-10F256I <sup>1</sup> | 512        | 2.5     | 10              | fpBGA   | 256            | 208 | I     |
|         | LC4512B-5T176I               | 512        | 2.5     | 5               | TQFP    | 176            | 128 | I     |
|         | LC4512B-75T176I              | 512        | 2.5     | 7.5             | TQFP    | 176            | 128 | I     |
|         | LC4512B-10T176I              | 512        | 2.5     | 10              | TQFP    | 176            | 128 | I     |

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

## ispMACH 4000V (3.3V) Commercial Devices

| Device  | Part Number     | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-----------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032V | LC4032V-25T48C  | 32         | 3.3     | 2.5             | TQFP    | 48             | 32  | C     |
|         | LC4032V-5T48C   | 32         | 3.3     | 5               | TQFP    | 48             | 32  | C     |
|         | LC4032V-75T48C  | 32         | 3.3     | 7.5             | TQFP    | 48             | 32  | C     |
|         | LC4032V-25T44C  | 32         | 3.3     | 2.5             | TQFP    | 44             | 30  | C     |
|         | LC4032V-5T44C   | 32         | 3.3     | 5               | TQFP    | 44             | 30  | C     |
|         | LC4032V-75T44C  | 32         | 3.3     | 7.5             | TQFP    | 44             | 30  | C     |
| LC4064V | LC4064V-25T100C | 64         | 3.3     | 2.5             | TQFP    | 100            | 64  | C     |
|         | LC4064V-5T100C  | 64         | 3.3     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4064V-75T100C | 64         | 3.3     | 7.5             | TQFP    | 100            | 64  | C     |
|         | LC4064V-25T48C  | 64         | 3.3     | 2.5             | TQFP    | 48             | 32  | C     |
|         | LC4064V-5T48C   | 64         | 3.3     | 5               | TQFP    | 48             | 32  | C     |
|         | LC4064V-75T48C  | 64         | 3.3     | 7.5             | TQFP    | 48             | 32  | C     |
|         | LC4064V-25T44C  | 64         | 3.3     | 2.5             | TQFP    | 44             | 30  | C     |
|         | LC4064V-5T44C   | 64         | 3.3     | 5               | TQFP    | 44             | 30  | C     |
|         | LC4064V-75T44C  | 64         | 3.3     | 7.5             | TQFP    | 44             | 30  | C     |

## ispMACH 4000V (3.3V) Extended Temperature Devices

| Device  | Part Number     | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-----------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032V | LC4032V-75T48E  | 32         | 3.3     | 7.5             | TQFP    | 48             | 32  | E     |
|         | LC4032V-75T44E  | 32         | 3.3     | 7.5             | TQFP    | 44             | 30  | E     |
| LC4064V | LC4064V-75T100E | 64         | 3.3     | 7.5             | TQFP    | 100            | 64  | E     |
|         | LC4064V-75T48E  | 64         | 3.3     | 7.5             | TQFP    | 48             | 32  | E     |
|         | LC4064V-75T44E  | 64         | 3.3     | 7.5             | TQFP    | 44             | 30  | E     |
| LC4128V | LC4128V-75T144E | 128        | 3.3     | 7.5             | TQFP    | 144            | 96  | E     |
|         | LC4128V-75T128E | 128        | 3.3     | 7.5             | TQFP    | 128            | 92  | E     |
|         | LC4128V-75T100E | 128        | 3.3     | 7.5             | TQFP    | 100            | 64  | E     |
| LC4256V | LC4256V-75T176E | 256        | 3.3     | 7.5             | TQFP    | 176            | 128 | E     |
|         | LC4256V-75T144E | 256        | 3.3     | 7.5             | TQFP    | 144            | 96  | E     |
|         | LC4256V-75T100E | 256        | 3.3     | 7.5             | TQFP    | 100            | 64  | E     |

## ispMACH 4000B (2.5V) Lead-Free Industrial Devices (Cont.)

| Device  | Part Number                    | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|--------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4128B | LC4128B-5TN128I                | 128        | 2.5     | 5               | Lead-Free TQFP  | 128            | 92  | I     |
|         | LC4128B-75TN128I               | 128        | 2.5     | 7.5             | Lead-Free TQFP  | 128            | 92  | I     |
|         | LC4128B-10TN128I               | 128        | 2.5     | 10              | Lead-Free TQFP  | 128            | 92  | I     |
|         | LC4128B-5TN100I                | 128        | 2.5     | 5               | Lead-Free TQFP  | 100            | 64  | I     |
|         | LC4128B-75TN100I               | 128        | 2.5     | 7.5             | Lead-Free TQFP  | 100            | 64  | I     |
|         | LC4128B-10TN100I               | 128        | 2.5     | 10              | Lead-Free TQFP  | 100            | 64  | I     |
| LC4256B | LC4256B-5FTN256AI              | 256        | 2.5     | 5               | Lead-Free ftBGA | 256            | 128 | I     |
|         | LC4256B-75FTN256AI             | 256        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 128 | I     |
|         | LC4256B-10FTN256AI             | 256        | 2.5     | 10              | Lead-Free ftBGA | 256            | 128 | I     |
|         | LC4256B-5FTN256BI              | 256        | 2.5     | 5               | Lead-Free ftBGA | 256            | 160 | I     |
|         | LC4256B-75FTN256BI             | 256        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 160 | I     |
|         | LC4256B-10FTN256BI             | 256        | 2.5     | 10              | Lead-Free ftBGA | 256            | 160 | I     |
|         | LC4256B-5FN256AI <sup>1</sup>  | 256        | 2.5     | 5               | Lead-Free fpBGA | 256            | 128 | I     |
|         | LC4256B-75FN256AI <sup>1</sup> | 256        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 128 | I     |
|         | LC4256B-10FN256AI <sup>1</sup> | 256        | 2.5     | 10              | Lead-Free fpBGA | 256            | 128 | I     |
|         | LC4256B-5FN256BI <sup>1</sup>  | 256        | 2.5     | 5               | Lead-Free fpBGA | 256            | 160 | I     |
|         | LC4256B-75FN256BI <sup>1</sup> | 256        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 160 | I     |
|         | LC4256B-10FN256BI <sup>1</sup> | 256        | 2.5     | 10              | Lead-Free fpBGA | 256            | 160 | I     |
|         | LC4256B-5TN176I                | 256        | 2.5     | 5               | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4256B-75TN176I               | 256        | 2.5     | 7.5             | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4256B-10TN176I               | 256        | 2.5     | 10              | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4256B-5TN100I                | 256        | 2.5     | 5               | Lead-Free TQFP  | 100            | 64  | I     |
|         | LC4256B-75TN100I               | 256        | 2.5     | 7.5             | Lead-Free TQFP  | 100            | 64  | I     |
|         | LC4256B-10TN100I               | 256        | 2.5     | 10              | Lead-Free TQFP  | 100            | 64  | I     |
| LC4384B | LC4384B-5FTN256I               | 384        | 2.5     | 5               | Lead-Free ftBGA | 256            | 192 | I     |
|         | LC4384B-75FTN256I              | 384        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 192 | I     |
|         | LC4384B-10FTN256I              | 384        | 2.5     | 10              | Lead-Free ftBGA | 256            | 192 | I     |
|         | LC4384B-5FN256I <sup>1</sup>   | 384        | 2.5     | 5               | Lead-Free fpBGA | 256            | 192 | I     |
|         | LC4384B-75FN256I <sup>1</sup>  | 384        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 192 | I     |
|         | LC4384B-10FN256I <sup>1</sup>  | 384        | 2.5     | 10              | Lead-Free fpBGA | 256            | 192 | I     |
|         | LC4384B-5TN176I                | 384        | 2.5     | 5               | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4384B-75TN176I               | 384        | 2.5     | 7.5             | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4384B-10TN176I               | 384        | 2.5     | 10              | Lead-Free TQFP  | 176            | 128 | I     |
| LC4512B | LC4512B-5FTN256I               | 512        | 2.5     | 5               | Lead-Free ftBGA | 256            | 208 | I     |
|         | LC4512B-75FTN256I              | 512        | 2.5     | 7.5             | Lead-Free ftBGA | 256            | 208 | I     |
|         | LC4512B-10FTN256I              | 512        | 2.5     | 10              | Lead-Free ftBGA | 256            | 208 | I     |
|         | LC4512B-5FN256I <sup>1</sup>   | 512        | 2.5     | 5               | Lead-Free fpBGA | 256            | 208 | I     |
|         | LC4512B-75FN256I <sup>1</sup>  | 512        | 2.5     | 7.5             | Lead-Free fpBGA | 256            | 208 | I     |
|         | LC4512B-10FN256I <sup>1</sup>  | 512        | 2.5     | 10              | Lead-Free fpBGA | 256            | 208 | I     |
|         | LC4512B-5TN176I                | 512        | 2.5     | 5               | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4512B-75TN176I               | 512        | 2.5     | 7.5             | Lead-Free TQFP  | 176            | 128 | I     |
|         | LC4512B-10TN176I               | 512        | 2.5     | 10              | Lead-Free TQFP  | 176            | 128 | I     |

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

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

| Device  | Part Number                    | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|--------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4256V | LC4256V-5FTN256AI              | 256        | 3.3     | 5               | Lead-free ftBGA | 256            | 128 | I     |
|         | LC4256V-75FTN256AI             | 256        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 128 | I     |
|         | LC4256V-10FTN256AI             | 256        | 3.3     | 10              | Lead-free ftBGA | 256            | 128 | I     |
|         | LC4256V-5FTN256BI              | 256        | 3.3     | 5               | Lead-free ftBGA | 256            | 160 | I     |
|         | LC4256V-75FTN256BI             | 256        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 160 | I     |
|         | LC4256V-10FTN256BI             | 256        | 3.3     | 10              | Lead-free ftBGA | 256            | 160 | I     |
|         | LC4256V-5FN256AI <sup>1</sup>  | 256        | 3.3     | 5               | Lead-free fpBGA | 256            | 128 | I     |
|         | LC4256V-75FN256AI <sup>1</sup> | 256        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 128 | I     |
|         | LC4256V-10FN256AI <sup>1</sup> | 256        | 3.3     | 10              | Lead-free fpBGA | 256            | 128 | I     |
|         | LC4256V-5FN256BI <sup>1</sup>  | 256        | 3.3     | 5               | Lead-free fpBGA | 256            | 160 | I     |
|         | LC4256V-75FN256BI <sup>1</sup> | 256        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 160 | I     |
|         | LC4256V-10FN256BI <sup>1</sup> | 256        | 3.3     | 10              | Lead-free fpBGA | 256            | 160 | I     |
|         | LC4256V-5TN176I                | 256        | 3.3     | 5               | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4256V-75TN176I               | 256        | 3.3     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4256V-10TN176I               | 256        | 3.3     | 10              | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4256V-5TN144I                | 256        | 3.3     | 5               | Lead-free TQFP  | 144            | 96  | I     |
|         | LC4256V-75TN144I               | 256        | 3.3     | 7.5             | Lead-free TQFP  | 144            | 96  | I     |
|         | LC4256V-10TN144I               | 256        | 3.3     | 10              | Lead-free TQFP  | 144            | 96  | I     |
|         | LC4256V-5TN100I                | 256        | 3.3     | 5               | Lead-free TQFP  | 100            | 64  | I     |
|         | LC4256V-75TN100I               | 256        | 3.3     | 7.5             | Lead-free TQFP  | 100            | 64  | I     |
|         | LC4256V-10TN100I               | 256        | 3.3     | 10              | Lead-free TQFP  | 100            | 64  | I     |
| LC4384V | LC4384V-5FTN256I               | 384        | 3.3     | 5               | Lead-free ftBGA | 256            | 192 | I     |
|         | LC4384V-75FTN256I              | 384        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 192 | I     |
|         | LC4384V-10FTN256I              | 384        | 3.3     | 10              | Lead-free ftBGA | 256            | 192 | I     |
|         | LC4384V-5FN256I <sup>1</sup>   | 384        | 3.3     | 5               | Lead-free fpBGA | 256            | 192 | I     |
|         | LC4384V-75FN256I <sup>1</sup>  | 384        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 192 | I     |
|         | LC4384V-10FN256I <sup>1</sup>  | 384        | 3.3     | 10              | Lead-free fpBGA | 256            | 192 | I     |
|         | LC4384V-5TN176I                | 384        | 3.3     | 5               | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4384V-75TN176I               | 384        | 3.3     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4384V-10TN176I               | 384        | 3.3     | 10              | Lead-free TQFP  | 176            | 128 | I     |
| LC4512V | LC4512V-5FTN256I               | 512        | 3.3     | 5               | Lead-free ftBGA | 256            | 208 | I     |
|         | LC4512V-75FTN256I              | 512        | 3.3     | 7.5             | Lead-free ftBGA | 256            | 208 | I     |
|         | LC4512V-10FTN256I              | 512        | 3.3     | 10              | Lead-free ftBGA | 256            | 208 | I     |
|         | LC4512V-5FN256I <sup>1</sup>   | 512        | 3.3     | 5               | Lead-free fpBGA | 256            | 208 | I     |
|         | LC4512V-75FN256I <sup>1</sup>  | 512        | 3.3     | 7.5             | Lead-free fpBGA | 256            | 208 | I     |
|         | LC4512V-10FN256I <sup>1</sup>  | 512        | 3.3     | 10              | Lead-free fpBGA | 256            | 208 | I     |
|         | LC4512V-5TN176I                | 512        | 3.3     | 5               | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4512V-75TN176I               | 512        | 3.3     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|         | LC4512V-10TN176I               | 512        | 3.3     | 10              | Lead-free TQFP  | 176            | 128 | I     |

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