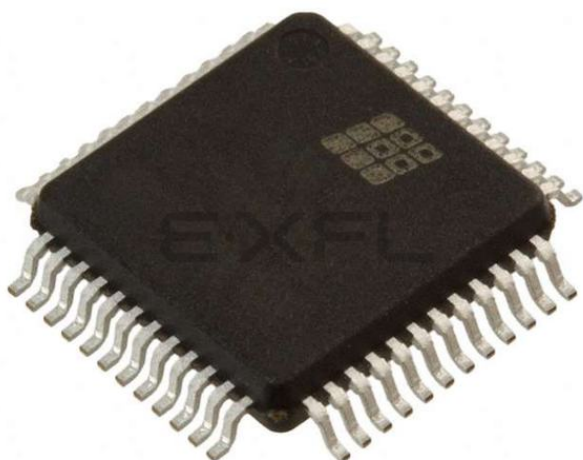




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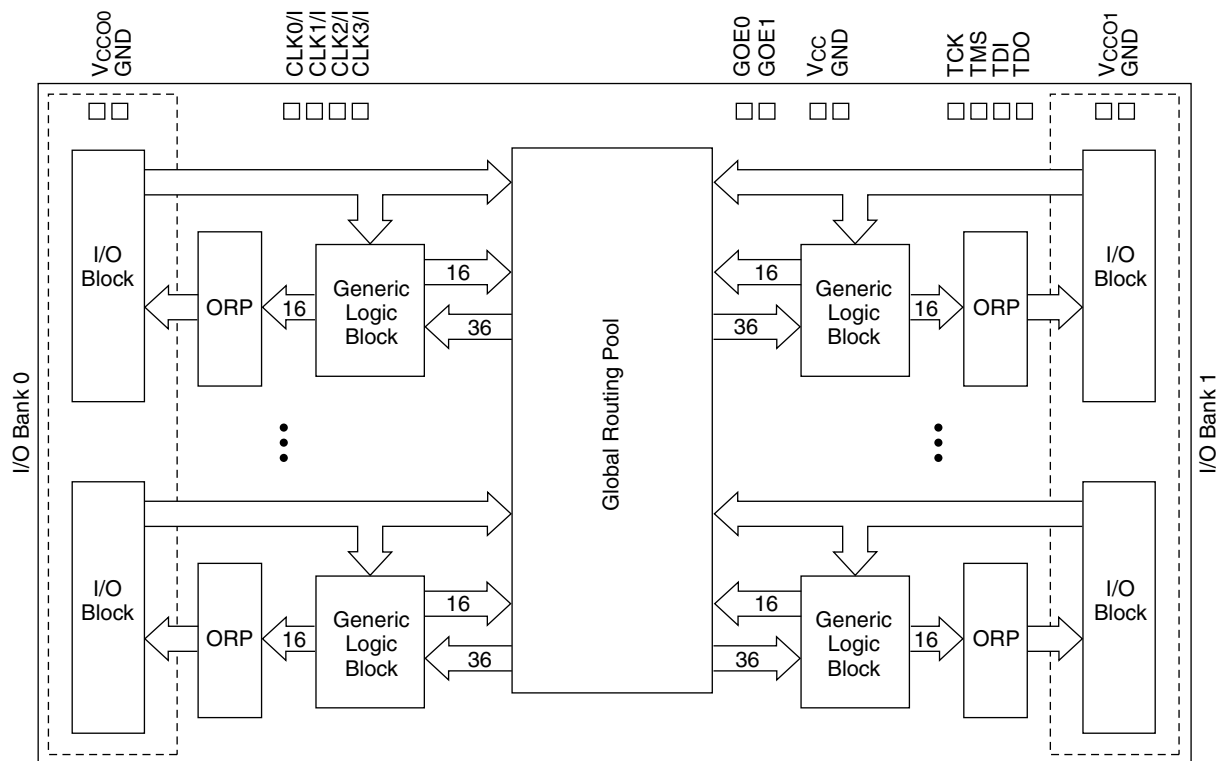
### Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

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           | 2.5 ns                                                                                                                                                            |
| Voltage Supply - Internal       | 3V ~ 3.6V                                                                                                                                                         |
| Number of Logic Elements/Blocks | 2                                                                                                                                                                 |
| Number of Macrocells            | 32                                                                                                                                                                |
| Number of Gates                 | -                                                                                                                                                                 |
| Number of I/O                   | 32                                                                                                                                                                |
| Operating Temperature           | 0°C ~ 90°C (TJ)                                                                                                                                                   |
| Mounting Type                   | Surface Mount                                                                                                                                                     |
| Package / Case                  | 48-LQFP                                                                                                                                                           |
| Supplier Device Package         | 48-TQFP (7x7)                                                                                                                                                     |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4032v-25t48c">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4032v-25t48c</a> |

**Figure 1. Functional Block Diagram**

The I/Os in the ispMACH 4000 are split into two banks. Each bank has a separate I/O power supply. Inputs can support a variety of standards independent of the chip or bank power supply. Outputs support the standards compatible with the power supply provided to the bank. Support for a variety of standards helps designers implement designs in mixed voltage environments. In addition, 5V tolerant inputs are specified within an I/O bank that is connected to  $V_{CC0}$  of 3.0V to 3.6V for LVCMOS 3.3, LVTTTL and PCI interfaces.

## ispMACH 4000 Architecture

There are a total of two GLBs in the ispMACH 4032, increasing to 32 GLBs in the ispMACH 4512. Each GLB has 36 inputs. All GLB inputs come from the GRP and all outputs from the GLB are brought back into the GRP to be connected to the inputs of any other GLB on the device. Even if feedback signals return to the same GLB, they still must go through the GRP. This mechanism ensures that GLBs communicate with each other with consistent and predictable delays. The outputs from the GLB are also sent to the ORP. The ORP then sends them to the associated I/O cells in the I/O block.

### Generic Logic Block

The ispMACH 4000 GLB consists of a programmable AND array, logic allocator, 16 macrocells and a GLB clock generator. Macrocells are decoupled from the product terms through the logic allocator and the I/O pins are decoupled from macrocells through the ORP. Figure 2 illustrates the GLB.

- 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

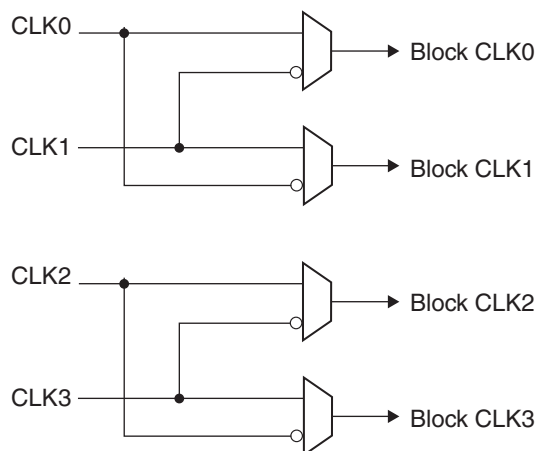
The ispMACH 4000 family architecture accommodates both block-level and macrocell-level set and reset capability. There is one block-level initialization term that is distributed to all macrocell registers in a GLB. At the macrocell level, two product terms can be “stolen” from the cluster associated 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**



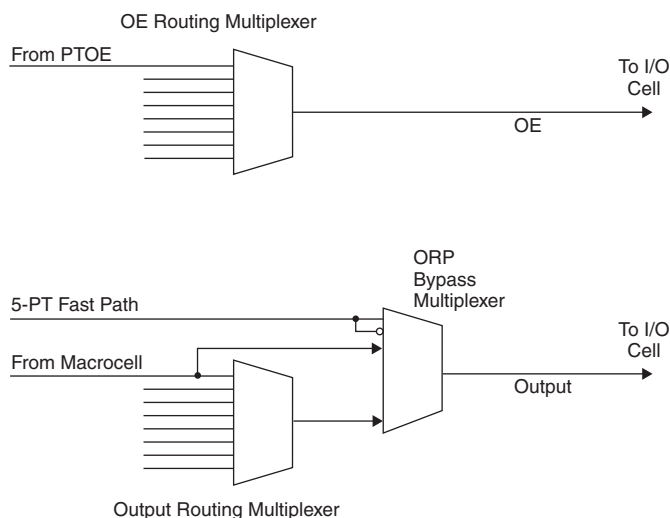
## Output Routing Pool (ORP)

The Output Routing Pool allows macrocell outputs to be connected to any of several I/O cells within an I/O block. This provides greater flexibility in determining the pinout and allows design changes to occur without affecting the pinout. The output routing pool also provides a parallel capability for routing macrocell-level OE product terms. This allows the OE product term to follow the macrocell output as it is switched between I/O cells. Additionally, the output routing pool allows the macrocell output or true and complement forms of the 5-PT bypass signal to bypass the output routing multiplexers and feed the I/O cell directly. The enhanced ORP of the ispMACH 4000 family consists of the following elements:

- Output Routing Multiplexers
- OE Routing Multiplexers
- Output Routing Pool Bypass Multiplexers

Figure 7 shows the structure of the ORP from the I/O cell perspective. This is referred to as an ORP slice. Each ORP has as many ORP slices as there are I/O cells in the corresponding I/O block.

**Figure 7. ORP Slice**



## Output Routing Multiplexers

The details of connections between the macrocells and the I/O cells vary across devices and within a device dependent on the maximum number of I/Os available. Tables 5-9 provide the connection details.

**Table 6. ORP Combinations for I/O Blocks with 8 I/Os**

| I/O Cell | Available Macrocells                 |
|----------|--------------------------------------|
| I/O 0    | M0, M1, M2, M3, M4, M5, M6, M7       |
| I/O 1    | M2, M3, M4, M5, M6, M7, M8, M9       |
| I/O 2    | M4, M5, M6, M7, M8, M9, M10, M11     |
| I/O 3    | M6, M7, M8, M9, M10, M11, M12, M13   |
| I/O 4    | M8, M9, M10, M11, M12, M13, M14, M15 |
| I/O 5    | M10, M11, M12, M13, M14, M15, M0, M1 |
| I/O 6    | M12, M13, M14, M15, M0, M1, M2, M3   |
| I/O 7    | M14, M15, M0, M1, M2, M3, M4, M5     |

**Table 10. ORP Combinations for I/O Blocks with 12 I/Os**

| I/O Cell | Available Macrocells                 |
|----------|--------------------------------------|
| I/O 0    | M0, M1, M2, M3, M4, M5, M6, M7       |
| I/O 1    | M1, M2, M3, M4, M5, M6, M7, M8       |
| I/O 2    | M2, M3, M4, M5, M6, M7, M8, M9       |
| I/O 3    | M4, M5, M6, M7, M8, M9, M10, M11     |
| I/O 4    | M5, M6, M7, M8, M9, M10, M11, M12    |
| I/O 5    | M6, M7, M8, M9, M10, M11, M12, M13   |
| I/O 6    | M8, M9, M10, M11, M12, M13, M14, M15 |
| I/O 7    | M9, M10, M11, M12, M13, M14, M15, M0 |
| I/O 8    | M10, M11, M12, M13, M14, M15, M0, M1 |
| I/O 9    | M12, M13, M14, M15, M0, M1, M2, M3   |
| I/O 10   | M13, M14, M15, M0, M1, M2, M3, M4    |
| I/O 11   | M14, M15, M0, M1, M2, M3, M4, M5     |

## ORP Bypass and Fast Output Multiplexers

The ORP bypass and fast-path output multiplexer is a 4:1 multiplexer and allows the 5-PT fast path to bypass the ORP and be connected directly to the pin with either the regular output or the inverted output. This multiplexer also allows the register output to bypass the ORP to achieve faster  $t_{CO}$ .

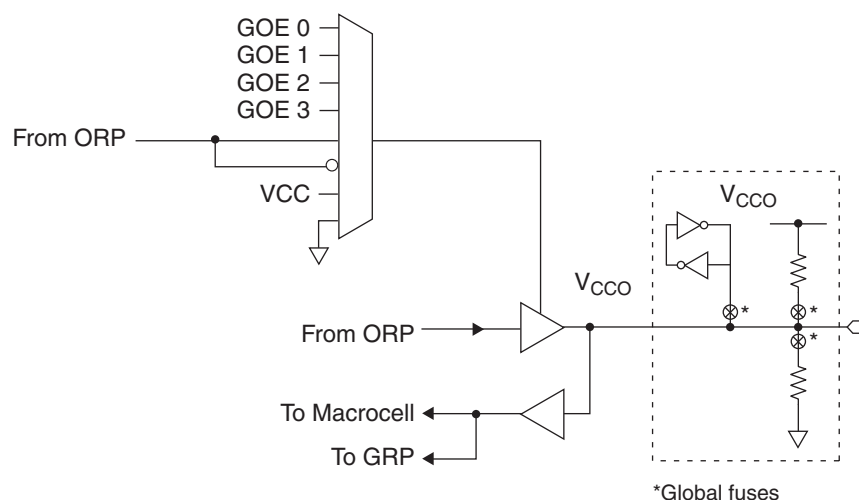
## Output Enable Routing Multiplexers

The OE Routing Pool provides the corresponding local output enable (OE) product term to the I/O cell.

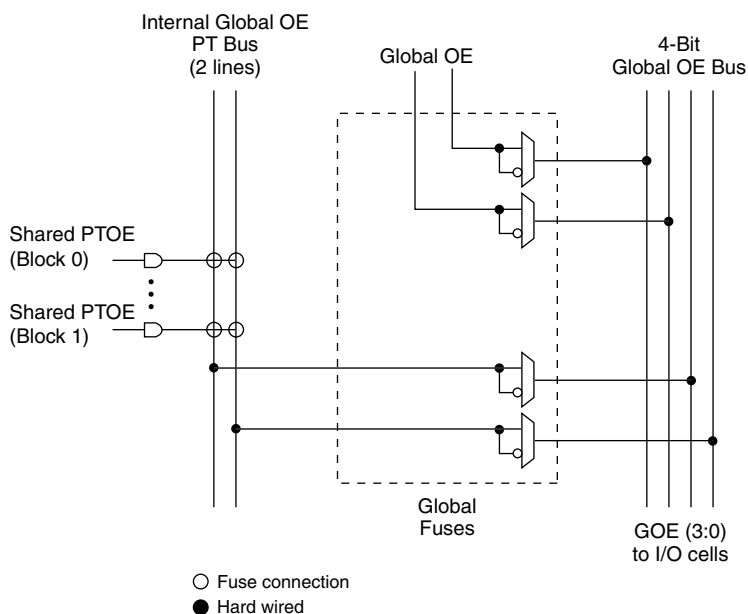
## I/O Cell

The I/O cell contains the following programmable elements: output buffer, input buffer, OE multiplexer and bus maintenance circuitry. Figure 8 details the I/O cell.

**Figure 8. I/O Cell**



Each output supports a variety of output standards dependent on the  $V_{CCO}$  supplied to its I/O bank. Outputs can also be configured for open drain operation. Each input can be programmed to support a variety of standards, independent of the  $V_{CCO}$  supplied to its I/O bank. The I/O standards supported are:

**Figure 10. Global OE Generation for ispMACH 4032**

## Zero Power/Low Power and Power Management

The ispMACH 4000 family is designed with high speed low power design techniques to offer both high speed and low power. With an advanced  $E^2$  low power cell and non sense-amplifier design approach (full CMOS logic approach), the ispMACH 4000 family offers SuperFAST pin-to-pin speeds, while simultaneously delivering low standby power without needing any “turbo bits” or other power management schemes associated with a traditional sense-amplifier approach.

The zero power ispMACH 4000Z is based on the 1.8V ispMACH 4000C family. With innovative circuit design changes, the ispMACH 4000Z family is able to achieve the industry’s “lowest static power”.

## IEEE 1149.1-Compliant Boundary Scan Testability

All ispMACH 4000 devices have boundary scan cells and are compliant to the IEEE 1149.1 standard. This allows functional testing of the circuit board on which the device is mounted through a serial scan path that can access all critical logic nodes. Internal registers are linked internally, allowing test data to be shifted in and loaded directly onto test nodes, or test node data to be captured and shifted out for verification. In addition, these devices can be linked into a board-level serial scan path for more board-level testing. The test access port operates with an LVCMOS interface that corresponds to the power supply voltage.

## I/O Quick Configuration

To facilitate the most efficient board test, the physical nature of the I/O cells must be set before running any continuity tests. As these tests are fast, by nature, the overhead and time that is required for configuration of the I/Os’ physical nature should be minimal so that board test time is minimized. The ispMACH 4000 family of devices allows this by offering the user the ability to quickly configure the physical nature of the I/O cells. This quick configuration takes milliseconds to complete, whereas it takes seconds for the entire device to be programmed. Lattice’s ispVM® System programming software can either perform the quick configuration through the PC parallel port, or can generate the ATE or test vectors necessary for a third-party test system.

## Supply Current, ispMACH 4000V/B/C

### Over Recommended Operating Conditions

| Symbol                           | Parameter                      | Condition  | Min. | Typ. | Max. | Units |
|----------------------------------|--------------------------------|------------|------|------|------|-------|
| ispMACH 4032V/B/C                |                                |            |      |      |      |       |
| ICC <sup>1,2,3</sup>             | Operating Power Supply Current | Vcc = 3.3V | —    | 11.8 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 11.8 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 1.8  | —    | mA    |
| ICC <sup>4</sup>                 | Standby Power Supply Current   | Vcc = 3.3V | —    | 11.3 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 11.3 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 1.3  | —    | mA    |
| ispMACH 4064V/B/C                |                                |            |      |      |      |       |
| ICC <sup>1,2,3</sup>             | Operating Power Supply Current | Vcc = 3.3V | —    | 12   | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 12   | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 2    | —    | mA    |
| ICC <sup>5</sup>                 | Standby Power Supply Current   | Vcc = 3.3V | —    | 11.5 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 11.5 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 1.5  | —    | mA    |
| ispMACH 4128V/B/C                |                                |            |      |      |      |       |
| ICC <sup>1,2,3</sup>             | Operating Power Supply Current | Vcc = 3.3V | —    | 12   | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 12   | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 2    | —    | mA    |
| ICC <sup>4</sup>                 | Standby Power Supply Current   | Vcc = 3.3V | —    | 11.5 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 11.5 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 1.5  | —    | mA    |
| ispMACH 4256V/B/C                |                                |            |      |      |      |       |
| I <sub>CC</sub> <sup>1,2,3</sup> | Operating Power Supply Current | Vcc = 3.3V | —    | 12.5 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 12.5 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 2.5  | —    | mA    |
| I <sub>CC</sub> <sup>4</sup>     | Standby Power Supply Current   | Vcc = 3.3V | —    | 12   | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 12   | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 2    | —    | mA    |
| ispMACH 4384V/B/C                |                                |            |      |      |      |       |
| I <sub>CC</sub> <sup>1,2,3</sup> | Operating Power Supply Current | Vcc = 3.3V | —    | 13.5 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 13.5 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 3.5  | —    | mA    |
| I <sub>CC</sub> <sup>4</sup>     | Standby Power Supply Current   | Vcc = 3.3V | —    | 12.5 | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 12.5 | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 2.5  | —    | mA    |
| ispMACH 4512V/B/C                |                                |            |      |      |      |       |
| I <sub>CC</sub> <sup>1,2,3</sup> | Operating Power Supply Current | Vcc = 3.3V | —    | 14   | —    | mA    |
|                                  |                                | Vcc = 2.5V | —    | 14   | —    | mA    |
|                                  |                                | Vcc = 1.8V | —    | 4    | —    | mA    |

## ispMACH 4000Z Internal Timing Parameters

Over Recommended Operating Conditions

| Parameter             | Description                                                            | -35  |      | -37  |      | -42  |      | Units |
|-----------------------|------------------------------------------------------------------------|------|------|------|------|------|------|-------|
|                       |                                                                        | Min. | Max. | Min. | Max. | Min. | Max. |       |
| In/Out Delays         |                                                                        |      |      |      |      |      |      |       |
| t <sub>IN</sub>       | Input Buffer Delay                                                     | —    | 0.75 | —    | 0.80 | —    | 0.75 | ns    |
| t <sub>GOE</sub>      | Global OE Pin Delay                                                    | —    | 2.25 | —    | 2.25 | —    | 2.30 | ns    |
| t <sub>GCLK_IN</sub>  | Global Clock Input Buffer Delay                                        | —    | 1.60 | —    | 1.60 | —    | 1.95 | ns    |
| t <sub>BUF</sub>      | Delay through Output Buffer                                            | —    | 0.75 | —    | 0.90 | —    | 0.90 | ns    |
| t <sub>EN</sub>       | Output Enable Time                                                     | —    | 2.25 | —    | 2.25 | —    | 2.50 | ns    |
| t <sub>DIS</sub>      | Output Disable Time                                                    | —    | 1.35 | —    | 1.35 | —    | 2.50 | ns    |
| Routing/GLB Delays    |                                                                        |      |      |      |      |      |      |       |
| t <sub>ROUTE</sub>    | Delay through GRP                                                      | —    | 1.60 | —    | 1.60 | —    | 2.15 | ns    |
| t <sub>MCELL</sub>    | Macrocell Delay                                                        | —    | 0.65 | —    | 0.75 | —    | 0.85 | ns    |
| t <sub>INREG</sub>    | Input Buffer to Macrocell Register Delay                               | —    | 0.91 | —    | 1.00 | —    | 1.00 | ns    |
| t <sub>FBK</sub>      | Internal Feedback Delay                                                | —    | 0.05 | —    | 0.00 | —    | 0.00 | ns    |
| t <sub>PDb</sub>      | 5-PT Bypass Propagation Delay                                          | —    | 0.40 | —    | 0.40 | —    | 0.40 | ns    |
| t <sub>PDi</sub>      | Macrocell Propagation Delay                                            | —    | 0.25 | —    | 0.25 | —    | 0.65 | ns    |
| Register/Latch Delays |                                                                        |      |      |      |      |      |      |       |
| t <sub>S</sub>        | D-Register Setup Time (Global Clock)                                   | 0.80 | —    | 0.95 | —    | 0.90 | —    | ns    |
| t <sub>S_PT</sub>     | D-Register Setup Time (Product Term Clock)                             | 1.35 | —    | 1.95 | —    | 1.90 | —    | ns    |
| t <sub>ST</sub>       | T-Register Setup Time (Global Clock)                                   | 1.00 | —    | 1.15 | —    | 1.10 | —    | ns    |
| t <sub>ST_PT</sub>    | T-register Setup Time (Product Term Clock)                             | 1.55 | —    | 1.75 | —    | 2.10 | —    | ns    |
| t <sub>H</sub>        | D-Register Hold Time                                                   | 1.40 | —    | 1.55 | —    | 1.80 | —    | ns    |
| t <sub>HT</sub>       | T-Resister Hold Time                                                   | 1.40 | —    | 1.55 | —    | 1.80 | —    | ns    |
| t <sub>SIR</sub>      | D-Input Register Setup Time (Global Clock)                             | 0.94 | —    | 0.90 | —    | 1.50 | —    | 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)                              | 1.06 | —    | 1.20 | —    | 1.10 | —    | ns    |
| t <sub>HIR_PT</sub>   | D-Input Register Hold Time (Product Term Clock)                        | 0.88 | —    | 1.00 | —    | 1.00 | —    | ns    |
| t <sub>COi</sub>      | Register Clock to Output/Feedback MUX Time                             | —    | 0.65 | —    | 0.70 | —    | 0.65 | ns    |
| t <sub>CES</sub>      | Clock Enable Setup Time                                                | 1.00 | —    | 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)                                        | 0.80 | —    | 0.95 | —    | 0.90 | —    | ns    |
| t <sub>SL_PT</sub>    | Latch Setup Time (Product Term Clock)                                  | 1.55 | —    | 1.95 | —    | 1.90 | —    | ns    |
| t <sub>HL</sub>       | Latch Hold Time                                                        | 1.40 | —    | 1.80 | —    | 1.80 | —    | ns    |
| t <sub>GOi</sub>      | Latch Gate to Output/Feedback MUX Time                                 | —    | 0.40 | —    | 0.33 | —    | 0.33 | ns    |
| t <sub>PDLi</sub>     | Propagation Delay through Transparent Latch to Output/<br>Feedback MUX | —    | 0.30 | —    | 0.25 | —    | 0.25 | ns    |
| t <sub>SRI</sub>      | Asynchronous Reset or Set to Output/Feedback MUX Delay                 | —    | 0.28 | —    | 0.28 | —    | 1.27 | ns    |
| t <sub>SRR</sub>      | Asynchronous Reset or Set Recovery Delay                               | —    | 2.00 | —    | 1.67 | —    | 1.80 | ns    |
| Control Delays        |                                                                        |      |      |      |      |      |      |       |
| t <sub>BCLK</sub>     | GLB PT Clock Delay                                                     | —    | 1.30 | —    | 1.50 | —    | 1.55 | ns    |
| t <sub>PTCLK</sub>    | Macrocell PT Clock Delay                                               | —    | 1.50 | —    | 1.70 | —    | 1.55 | ns    |
| t <sub>BSR</sub>      | GLB PT Set/Reset Delay                                                 | —    | 1.10 | —    | 1.83 | —    | 1.83 | ns    |
| t <sub>PTSR</sub>     | Macrocell PT Set/Reset Delay                                           | —    | 1.22 | —    | 2.02 | —    | 1.83 | ns    |

**ispMACH 4000V/B/C Timing Adders<sup>1</sup> (Cont.)**

| Adder Type                        | Base Parameter                                            | Description                                | -5   |      | -75  |      | -10  |      | Units |
|-----------------------------------|-----------------------------------------------------------|--------------------------------------------|------|------|------|------|------|------|-------|
|                                   |                                                           |                                            | Min. | Max. | Min. | Max. | Min. | Max. |       |
| Optional Delay Adders             |                                                           |                                            |      |      |      |      |      |      |       |
| t <sub>INDIO</sub>                | t <sub>INREG</sub>                                        | Input register delay                       | —    | 1.00 | —    | 1.00 | —    | 1.00 | ns    |
| t <sub>EXP</sub>                  | t <sub>MCELL</sub>                                        | Product term expander delay                | —    | 0.33 | —    | 0.33 | —    | 0.33 | ns    |
| t <sub>ORP</sub>                  | —                                                         | Output routing pool delay                  | —    | 0.05 | —    | 0.05 | —    | 0.05 | ns    |
| t <sub>BLA</sub>                  | t <sub>ROUTE</sub>                                        | Additional block loading adder             | —    | 0.05 | —    | 0.05 | —    | 0.05 | ns    |
| t <sub>IOI</sub> Input Adjusters  |                                                           |                                            |      |      |      |      |      |      |       |
| LVTTTL_in                         | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVTTTL standard                      | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| LVC MOS33_in                      | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVC MOS 3.3 standard                 | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| LVC MOS25_in                      | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVC MOS 2.5 standard                 | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| LVC MOS18_in                      | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVC MOS 1.8 standard                 | —    | 0.00 | —    | 0.00 | —    | 0.00 | ns    |
| PCI_in                            | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using PCI compatible input                 | —    | 0.60 | —    | 0.60 | —    | 0.60 | ns    |
| t <sub>IOO</sub> Output Adjusters |                                                           |                                            |      |      |      |      |      |      |       |
| LVTTTL_out                        | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as TTL buffer            | —    | 0.20 | —    | 0.20 | —    | 0.20 | ns    |
| LVC MOS33_out                     | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as 3.3V buffer           | —    | 0.20 | —    | 0.20 | —    | 0.20 | ns    |
| LVC MOS25_out                     | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as 2.5V buffer           | —    | 0.10 | —    | 0.10 | —    | 0.10 | ns    |
| LVC MOS18_out                     | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as 1.8V buffer           | —    | 0.00 | —    | 0.00 | —    | 0.00 | ns    |
| PCI_out                           | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as PCI compatible buffer | —    | 0.20 | —    | 0.20 | —    | 0.20 | ns    |
| Slow Slew                         | t <sub>BUF</sub> , t <sub>EN</sub>                        | Output configured for slow slew rate       | —    | 1.00 | —    | 1.00 | —    | 1.00 | ns    |

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

Timing v.3.2

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

**ispMACH 4032V/B/C/Z and 4064V/B/C/Z Logic Signal Connections:  
48-Pin TQFP (Cont.)**

| Pin Number | Bank Number | ispMACH 4032V/B/C/Z |                   | ispMACH 4064V/B/C |                  | ispMACH 4064Z |                  |
|------------|-------------|---------------------|-------------------|-------------------|------------------|---------------|------------------|
|            |             | GLB/MC/Pad          | ORP               | GLB/MC/Pad        | ORP              | GLB/MC/Pad    | ORP              |
| 33         | 1           | B10                 | B <sup>^</sup> 10 | D4                | D <sup>^</sup> 2 | D10           | D <sup>^</sup> 5 |
| 34         | 1           | B11                 | B <sup>^</sup> 11 | D6                | D <sup>^</sup> 3 | D8            | D <sup>^</sup> 4 |
| 35         | -           | TDO                 | -                 | TDO               | -                | TDO           | -                |
| 36         | -           | VCC                 | -                 | VCC               | -                | VCC           | -                |
| 37         | -           | GND                 | -                 | GND               | -                | GND           | -                |
| 38         | 1           | B12                 | B <sup>^</sup> 12 | D8                | D <sup>^</sup> 4 | D6            | D <sup>^</sup> 3 |
| 39         | 1           | B13                 | B <sup>^</sup> 13 | D10               | D <sup>^</sup> 5 | D4            | D <sup>^</sup> 2 |
| 40         | 1           | B14                 | B <sup>^</sup> 14 | D12               | D <sup>^</sup> 6 | D2            | D <sup>^</sup> 1 |
| 41         | 1           | B15/GOE1            | B <sup>^</sup> 15 | D14/GOE1          | D <sup>^</sup> 7 | D0/GOE1       | D <sup>^</sup> 0 |
| 42         | 1           | CLK3/I              | -                 | CLK3/I            | -                | CLK3/I        | -                |
| 43         | 0           | CLK0/I              | -                 | CLK0/I            | -                | CLK0/I        | -                |
| 44         | 0           | A0/GOE0             | A <sup>^</sup> 0  | A0/GOE0           | A <sup>^</sup> 0 | A0/GOE0       | A <sup>^</sup> 0 |
| 45         | 0           | A1                  | A <sup>^</sup> 1  | A2                | A <sup>^</sup> 1 | A1            | A <sup>^</sup> 1 |
| 46         | 0           | A2                  | A <sup>^</sup> 2  | A4                | A <sup>^</sup> 2 | A2            | A <sup>^</sup> 2 |
| 47         | 0           | A3                  | A <sup>^</sup> 3  | A6                | A <sup>^</sup> 3 | A4            | A <sup>^</sup> 3 |
| 48         | 0           | A4                  | A <sup>^</sup> 4  | A8                | A <sup>^</sup> 4 | A6            | A <sup>^</sup> 4 |

**ispMACH 4032Z and 4064Z Logic Signal Connections: 56-Ball csBGA**

| Ball Number | Bank Number | ispMACH 4032Z   |                   | ispMACH 4064Z  |                  |
|-------------|-------------|-----------------|-------------------|----------------|------------------|
|             |             | GLB/MC/Pad      | ORP               | GLB/MC/Pad     | ORP              |
| B1          | -           | TDI             | -                 | TDI            | -                |
| C3          | 0           | A5              | A <sup>^</sup> 5  | A8             | A <sup>^</sup> 5 |
| C1          | 0           | A6              | A <sup>^</sup> 6  | A10            | A <sup>^</sup> 6 |
| D1          | 0           | A7              | A <sup>^</sup> 7  | A11            | A <sup>^</sup> 7 |
| D3          | 0           | GND (Bank 0)    | -                 | GND (Bank 0)   | -                |
| E3          | 0           | NC <sup>1</sup> | -                 | I <sup>1</sup> | -                |
| E1          | 0           | NC <sup>1</sup> | -                 | I <sup>1</sup> | -                |
| F3          | 0           | VCCO (Bank 0)   | -                 | VCCO (Bank 0)  | -                |
| F1          | 0           | A8              | A <sup>^</sup> 8  | B15            | B <sup>^</sup> 7 |
| G3          | 0           | A9              | A <sup>^</sup> 9  | B12            | B <sup>^</sup> 6 |
| G1          | 0           | A10             | A <sup>^</sup> 10 | B10            | B <sup>^</sup> 5 |
| H1          | 0           | A11             | A <sup>^</sup> 11 | B8             | B <sup>^</sup> 4 |
| J1          | 0           | NC              | -                 | I              | -                |
| K1          | -           | TCK             | -                 | TCK            | -                |
| K2          | -           | VCC             | -                 | VCC            | -                |
| H3          | -           | GND             | -                 | GND            | -                |
| K3          | -           | NC <sup>1</sup> | -                 | I <sup>1</sup> | -                |
| K4          | 0           | A12             | A <sup>^</sup> 12 | B6             | B <sup>^</sup> 3 |
| H4          | 0           | A13             | A <sup>^</sup> 13 | B4             | B <sup>^</sup> 2 |
| H5          | 0           | A14             | A <sup>^</sup> 14 | B2             | B <sup>^</sup> 1 |

**ispMACH 4032Z and 4064Z Logic Signal Connections: 56-Ball csBGA (Cont.)**

| Ball Number | Bank Number | ispMACH 4032Z   |                 | ispMACH 4064Z  |                |
|-------------|-------------|-----------------|-----------------|----------------|----------------|
|             |             | GLB/MC/Pad      | ORP             | GLB/MC/Pad     | ORP            |
| K5          | 0           | A15             | A <sup>15</sup> | B0             | B <sup>0</sup> |
| H6          | 0           | CLK1/I          | -               | CLK1/I         | -              |
| K6          | 1           | CLK2/I          | -               | CLK2/I         | -              |
| H7          | 1           | B0              | B <sup>0</sup>  | C0             | C <sup>0</sup> |
| K7          | 1           | B1              | B <sup>1</sup>  | C1             | C <sup>1</sup> |
| K8          | 1           | B2              | B <sup>2</sup>  | C2             | C <sup>2</sup> |
| K9          | 1           | B3              | B <sup>3</sup>  | C4             | C <sup>3</sup> |
| K10         | 1           | B4              | B <sup>4</sup>  | C6             | C <sup>4</sup> |
| J10         | -           | TMS             | -               | TMS            | -              |
| H8          | 1           | B5              | B <sup>5</sup>  | C8             | C <sup>5</sup> |
| H10         | 1           | B6              | B <sup>6</sup>  | C10            | C <sup>6</sup> |
| G10         | 1           | B7              | B <sup>7</sup>  | C11            | C <sup>7</sup> |
| G8          | 1           | GND (Bank 1)    | -               | GND (Bank 1)   | -              |
| F8          | 1           | NC <sup>1</sup> | -               | I <sup>1</sup> | -              |
| F10         | 1           | NC <sup>1</sup> | -               | I <sup>1</sup> | -              |
| E8          | 1           | VCCO (Bank 1)   | -               | VCCO (Bank 1)  | -              |
| E10         | 1           | B8              | B <sup>8</sup>  | D15            | D <sup>7</sup> |
| D8          | 1           | B9              | B <sup>9</sup>  | D12            | D <sup>6</sup> |
| D10         | 1           | B10             | B <sup>10</sup> | D10            | D <sup>5</sup> |
| C10         | 1           | B11             | B <sup>11</sup> | D8             | D <sup>4</sup> |
| B10         | 1           | NC <sup>1</sup> | -               | I <sup>1</sup> | -              |
| A10         | -           | TDO             | -               | TDO            | -              |
| A9          | -           | VCC             | -               | VCC            | -              |
| C8          | -           | GND             | -               | GND            | -              |
| A8          | 1           | NC <sup>1</sup> | -               | I <sup>1</sup> | -              |
| A7          | 1           | B12             | B <sup>12</sup> | D6             | D <sup>3</sup> |
| C7          | 1           | B13             | B <sup>13</sup> | D4             | D <sup>2</sup> |
| C6          | 1           | B14             | B <sup>14</sup> | D2             | D <sup>1</sup> |
| A6          | 1           | B15/GOE1        | B <sup>15</sup> | D0/GOE1        | D <sup>0</sup> |
| C5          | 1           | CLK3/I          | -               | CLK3/I         | -              |
| A5          | 0           | CLK0/I          | -               | CLK0/I         | -              |
| C4          | 0           | A0/GOE0         | A <sup>0</sup>  | A0/GOE0        | A <sup>0</sup> |
| A4          | 0           | A1              | A <sup>1</sup>  | A1             | A <sup>1</sup> |
| A3          | 0           | A2              | A <sup>2</sup>  | A2             | A <sup>2</sup> |
| A2          | 0           | A3              | A <sup>3</sup>  | A4             | A <sup>3</sup> |
| A1          | 0           | A4              | A <sup>4</sup>  | A6             | A <sup>4</sup> |

1. For device migration considerations, these NC pins are input signal pins in ispMACH 4064Z devices.

**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 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            |
| E3          | 0           | NC            | -               | B8            | B <sup>6</sup>  | D12           | D <sup>6</sup> |
| F2          | 0           | A12           | A <sup>12</sup> | B9            | B <sup>7</sup>  | D10           | D <sup>5</sup> |
| F1          | 0           | A13           | A <sup>13</sup> | B10           | B <sup>8</sup>  | D8            | D <sup>4</sup> |
| F3          | 0           | A14           | A <sup>14</sup> | B12           | B <sup>9</sup>  | D6            | D <sup>3</sup> |
| G1          | 0           | A15           | A <sup>15</sup> | B13           | B <sup>10</sup> | D4            | D <sup>2</sup> |
| G2          | 0           | I             | -               | B14           | B <sup>11</sup> | D2            | D <sup>1</sup> |
| G3          | 0           | VCCO (Bank 0) | -               | VCCO (Bank 0) | -               | VCCO (Bank 0) | -              |
| H2          | 0           | NC            | -               | C14           | C <sup>11</sup> | E2            | E <sup>1</sup> |
| H1          | 0           | B15           | B <sup>15</sup> | C13           | C <sup>10</sup> | E4            | E <sup>2</sup> |
| H3          | 0           | B14           | B <sup>14</sup> | C12           | C <sup>9</sup>  | E6            | E <sup>3</sup> |
| J1          | 0           | B13           | B <sup>13</sup> | C10           | C <sup>8</sup>  | E8            | E <sup>4</sup> |
| J2          | 0           | B12           | B <sup>12</sup> | C9            | C <sup>7</sup>  | E10           | E <sup>5</sup> |
| J3          | 0           | NC            | -               | C8            | C <sup>6</sup>  | E12           | E <sup>6</sup> |
| K2          | 0           | GND (Bank 0)  | -               | GND (Bank 0)  | -               | GND (Bank 0)  | -              |
| K1          | 0           | NC            | -               | C6            | C <sup>5</sup>  | F2            | F <sup>1</sup> |
| K3          | 0           | B11           | B <sup>11</sup> | C5            | C <sup>4</sup>  | F4            | F <sup>2</sup> |
| L2          | 0           | B10           | B <sup>10</sup> | C4            | C <sup>3</sup>  | F6            | F <sup>3</sup> |
| L1          | 0           | B9            | B <sup>9</sup>  | C2            | C <sup>2</sup>  | F8            | F <sup>4</sup> |
| L3          | 0           | B8            | B <sup>8</sup>  | C1            | C <sup>1</sup>  | F10           | F <sup>5</sup> |
| M1          | 0           | I             | -               | C0            | C <sup>0</sup>  | F12           | F <sup>6</sup> |
| M2          | 0           | NC            | -               | VCCO (Bank 0) | -               | VCCO (Bank 0) | -              |
| N1          | -           | TCK           | -               | TCK           | -               | TCK           | -              |
| P1          | -           | VCC           | -               | VCC           | -               | VCC           | -              |
| P2          | -           | GND           | -               | GND           | -               | GND           | -              |
| N2          | 0           | I             | -               | D14           | D <sup>11</sup> | G12           | G <sup>6</sup> |
| P3          | 0           | B7            | B <sup>7</sup>  | D13           | D <sup>10</sup> | G10           | G <sup>5</sup> |
| M3          | 0           | B6            | B <sup>6</sup>  | D12           | D <sup>9</sup>  | G8            | G <sup>4</sup> |
| N3          | 0           | B5            | B <sup>5</sup>  | D10           | D <sup>8</sup>  | G6            | G <sup>3</sup> |
| P4          | 0           | B4            | B <sup>4</sup>  | D9            | D <sup>7</sup>  | G4            | G <sup>2</sup> |
| M4          | 0           | NC            | -               | D8            | D <sup>6</sup>  | G2            | G <sup>1</sup> |
| N4          | 0           | GND (Bank 0)  | -               | GND (Bank 0)  | -               | GND (Bank 0)  | -              |
| P5          | 0           | VCCO (Bank 0) | -               | VCCO (Bank 0) | -               | VCCO (Bank 0) | -              |
| N5          | 0           | NC            | -               | D6            | D <sup>5</sup>  | H12           | H <sup>6</sup> |
| M5          | 0           | B3            | B <sup>3</sup>  | D5            | D <sup>4</sup>  | H10           | H <sup>5</sup> |
| N6          | 0           | B2            | B <sup>2</sup>  | D4            | D <sup>3</sup>  | H8            | H <sup>4</sup> |
| P6          | 0           | B1            | B <sup>1</sup>  | D2            | D <sup>2</sup>  | H6            | H <sup>3</sup> |
| M6          | 0           | B0            | B <sup>0</sup>  | D1            | D <sup>1</sup>  | H4            | H <sup>2</sup> |
| P7          | 0           | NC            | -               | D0            | D <sup>0</sup>  | H2            | H <sup>1</sup> |
| N7          | 0           | CLK1/I        | -               | CLK1/I        | -               | CLK1/I        | -              |
| M7          | 1           | CLK2/I        | -               | CLK2/I        | -               | CLK2/I        | -              |
| N8          | -           | VCC           | -               | VCC           | -               | VCC           | -              |

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

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

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

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

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

| 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            |
| -           | -        | -                            | -              | -                            | -              | VCC               | -              | VCC               | -              |
| -           | -        | GND                          | -              | GND                          | -              | GND               | -              | GND               | -              |
| C3          | -        | TDI                          | -              | TDI                          | -              | TDI               | -              | TDI               | -              |
| -           | 0        | VCCO (Bank 0)                | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -              | VCCO (Bank 0)     | -              |
| B1          | 0        | C14                          | C <sup>7</sup> | C14                          | C <sup>9</sup> | C14               | C <sup>7</sup> | C14               | C <sup>7</sup> |
| F5          | 0        | C12                          | C <sup>6</sup> | C12                          | C <sup>8</sup> | C12               | C <sup>6</sup> | C12               | C <sup>6</sup> |
| D3          | 0        | C10                          | C <sup>5</sup> | C10                          | C <sup>7</sup> | C10               | C <sup>5</sup> | C10               | C <sup>5</sup> |
| C1          | 0        | C8                           | C <sup>4</sup> | C9                           | C <sup>6</sup> | C8                | C <sup>4</sup> | C8                | C <sup>4</sup> |
| C2          | 0        | C6                           | C <sup>3</sup> | C8                           | C <sup>5</sup> | C6                | C <sup>3</sup> | C6                | C <sup>3</sup> |
| E3          | 0        | C4                           | C <sup>2</sup> | C6                           | C <sup>4</sup> | C4                | C <sup>2</sup> | C4                | C <sup>2</sup> |
| D2          | 0        | C2                           | C <sup>1</sup> | C4                           | C <sup>3</sup> | C2                | C <sup>1</sup> | C2                | C <sup>1</sup> |
| F6          | 0        | C0                           | C <sup>0</sup> | C2                           | C <sup>2</sup> | C0                | C <sup>0</sup> | C0                | C <sup>0</sup> |
| D1          | 0        | NC                           | -              | C1                           | C <sup>1</sup> | F6                | F <sup>3</sup> | H0                | H <sup>0</sup> |
| E2          | 0        | NC                           | -              | C0                           | C <sup>0</sup> | F4                | F <sup>2</sup> | H4                | H <sup>1</sup> |
| E4          | 0        | NC                           | -              | NC                           | -              | D6                | D <sup>3</sup> | F4                | F <sup>2</sup> |
| G5          | 0        | NC                           | -              | NC                           | -              | D4                | D <sup>2</sup> | F6                | F <sup>3</sup> |
| E1          | 0        | NC                           | -              | NC                           | -              | NC                | -              | F8                | F <sup>4</sup> |
| -           | 0        | -                            | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -              | VCCO (Bank 0)     | -              |
| -           | 0        | GND (Bank 0)                 | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -              | GND (Bank 0)      | -              |
| F2          | 0        | NC                           | -              | NC                           | -              | NC                | -              | F10               | F <sup>5</sup> |
| F1          | 0        | NC                           | -              | NC                           | -              | D2                | D <sup>1</sup> | F12               | F <sup>6</sup> |
| G1          | 0        | NC                           | -              | NC                           | -              | D0                | D <sup>0</sup> | F14               | F <sup>7</sup> |
| G6          | 0        | NC                           | -              | D14                          | D <sup>9</sup> | F2                | F <sup>1</sup> | H8                | H <sup>2</sup> |
| G4          | 0        | NC                           | -              | D12                          | D <sup>8</sup> | F0                | F <sup>0</sup> | H12               | H <sup>3</sup> |
| H6          | 0        | D14                          | D <sup>7</sup> | D10                          | D <sup>7</sup> | E14               | E <sup>7</sup> | G14               | G <sup>7</sup> |
| G3          | 0        | D12                          | D <sup>6</sup> | D9                           | D <sup>6</sup> | E12               | E <sup>6</sup> | G12               | G <sup>6</sup> |
| H5          | 0        | D10                          | D <sup>5</sup> | D8                           | D <sup>5</sup> | E10               | E <sup>5</sup> | G10               | G <sup>5</sup> |
| G2          | 0        | D8                           | D <sup>4</sup> | D6                           | D <sup>4</sup> | E8                | E <sup>4</sup> | G8                | G <sup>4</sup> |
| H1          | 0        | D6                           | D <sup>3</sup> | D4                           | D <sup>3</sup> | E6                | E <sup>3</sup> | G6                | G <sup>3</sup> |
| H2          | 0        | D4                           | D <sup>2</sup> | D2                           | D <sup>2</sup> | E4                | E <sup>2</sup> | G4                | G <sup>2</sup> |
| H3          | 0        | D2                           | D <sup>1</sup> | D1                           | D <sup>1</sup> | E2                | E <sup>1</sup> | G2                | G <sup>1</sup> |
| H4          | 0        | D0                           | D <sup>0</sup> | D0                           | D <sup>0</sup> | E0                | E <sup>0</sup> | G0                | G <sup>0</sup> |
| -           | 0        | VCCO (Bank 0)                | -              | VCCO (Bank 0)                | -              | VCCO (Bank 0)     | -              | VCCO (Bank 0)     | -              |
| -           | 0        | -                            | -              | GND (Bank 0)                 | -              | GND (Bank 0)      | -              | GND (Bank 0)      | -              |
| J4          | 0        | E0                           | E <sup>0</sup> | E0                           | E <sup>0</sup> | H0                | H <sup>0</sup> | J0                | J <sup>0</sup> |
| J3          | 0        | E2                           | E <sup>1</sup> | E1                           | E <sup>1</sup> | H2                | H <sup>1</sup> | J2                | J <sup>1</sup> |
| J2          | 0        | E4                           | E <sup>2</sup> | E2                           | E <sup>2</sup> | H4                | H <sup>2</sup> | J4                | J <sup>2</sup> |
| J1          | 0        | E6                           | E <sup>3</sup> | E4                           | E <sup>3</sup> | H6                | H <sup>3</sup> | J6                | J <sup>3</sup> |
| K1          | 0        | E8                           | E <sup>4</sup> | E6                           | E <sup>4</sup> | H8                | H <sup>4</sup> | J8                | J <sup>4</sup> |
| J5          | 0        | E10                          | E <sup>5</sup> | E8                           | E <sup>5</sup> | H10               | H <sup>5</sup> | J10               | J <sup>5</sup> |
| K2          | 0        | E12                          | E <sup>6</sup> | E9                           | E <sup>6</sup> | H12               | H <sup>6</sup> | J12               | J <sup>6</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             |
| 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 4000C (1.8V) Commercial Devices (Cont.)

| Device  | Part Number                   | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-------------------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4128C | LC4128C-27T128C               | 128        | 1.8     | 2.7             | TQFP    | 128            | 92  | C     |
|         | LC4128C-5T128C                | 128        | 1.8     | 5               | TQFP    | 128            | 92  | C     |
|         | LC4128C-75T128C               | 128        | 1.8     | 7.5             | TQFP    | 128            | 92  | C     |
|         | LC4128C-27T100C               | 128        | 1.8     | 2.7             | TQFP    | 100            | 64  | C     |
|         | LC4128C-5T100C                | 128        | 1.8     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4128C-75T100C               | 128        | 1.8     | 7.5             | TQFP    | 100            | 64  | C     |
| LC4256C | LC4256C-3FT256AC              | 256        | 1.8     | 3               | ftBGA   | 256            | 128 | C     |
|         | LC4256C-5FT256AC              | 256        | 1.8     | 5               | ftBGA   | 256            | 128 | C     |
|         | LC4256C-75FT256AC             | 256        | 1.8     | 7.5             | ftBGA   | 256            | 128 | C     |
|         | LC4256C-3FT256BC              | 256        | 1.8     | 3               | ftBGA   | 256            | 160 | C     |
|         | LC4256C-5FT256BC              | 256        | 1.8     | 5               | ftBGA   | 256            | 160 | C     |
|         | LC4256C-75FT256BC             | 256        | 1.8     | 7.5             | ftBGA   | 256            | 160 | C     |
|         | LC4256C-3F256AC <sup>1</sup>  | 256        | 1.8     | 3               | fpBGA   | 256            | 128 | C     |
|         | LC4256C-5F256AC <sup>1</sup>  | 256        | 1.8     | 5               | fpBGA   | 256            | 128 | C     |
|         | LC4256C-75F256AC <sup>1</sup> | 256        | 1.8     | 7.5             | fpBGA   | 256            | 128 | C     |
|         | LC4256C-3F256BC <sup>1</sup>  | 256        | 1.8     | 3               | fpBGA   | 256            | 160 | C     |
|         | LC4256C-5F256BC <sup>1</sup>  | 256        | 1.8     | 5               | fpBGA   | 256            | 160 | C     |
|         | LC4256C-75F256BC <sup>1</sup> | 256        | 1.8     | 7.5             | fpBGA   | 256            | 160 | C     |
|         | LC4256C-3T176C                | 256        | 1.8     | 3               | TQFP    | 176            | 128 | C     |
|         | LC4256C-5T176C                | 256        | 1.8     | 5               | TQFP    | 176            | 128 | C     |
|         | LC4256C-75T176C               | 256        | 1.8     | 7.5             | TQFP    | 176            | 128 | C     |
|         | LC4256C-3T100C                | 256        | 1.8     | 3               | TQFP    | 100            | 64  | C     |
|         | LC4256C-5T100C                | 256        | 1.8     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4256C-75T100C               | 256        | 1.8     | 7.5             | TQFP    | 100            | 64  | C     |
| LC4384C | LC4384C-35FT256C              | 384        | 1.8     | 3.5             | ftBGA   | 256            | 192 | C     |
|         | LC4384C-5FT256C               | 384        | 1.8     | 5               | ftBGA   | 256            | 192 | C     |
|         | LC4384C-75FT256C              | 384        | 1.8     | 7.5             | ftBGA   | 256            | 192 | C     |
|         | LC4384C-35F256C <sup>1</sup>  | 384        | 1.8     | 3.5             | fpBGA   | 256            | 192 | C     |
|         | LC4384C-5F256C <sup>1</sup>   | 384        | 1.8     | 5               | fpBGA   | 256            | 192 | C     |
|         | LC4384C-75F256C <sup>1</sup>  | 384        | 1.8     | 7.5             | fpBGA   | 256            | 192 | C     |
|         | LC4384C-35T176C               | 384        | 1.8     | 3.5             | TQFP    | 176            | 128 | C     |
|         | LC4384C-5T176C                | 384        | 1.8     | 5               | TQFP    | 176            | 128 | C     |
|         | LC4384C-75T176C               | 384        | 1.8     | 7.5             | TQFP    | 176            | 128 | C     |
| LC4512C | LC4512C-35FT256C              | 512        | 1.8     | 3.5             | ftBGA   | 256            | 208 | C     |
|         | LC4512C-5FT256C               | 512        | 1.8     | 5               | ftBGA   | 256            | 208 | C     |
|         | LC4512C-75FT256C              | 512        | 1.8     | 7.5             | ftBGA   | 256            | 208 | C     |
|         | LC4512C-35F256C <sup>1</sup>  | 512        | 1.8     | 3.5             | fpBGA   | 256            | 208 | C     |
|         | LC4512C-5F256C <sup>1</sup>   | 512        | 1.8     | 5               | fpBGA   | 256            | 208 | C     |
|         | LC4512C-75F256C <sup>1</sup>  | 512        | 1.8     | 7.5             | fpBGA   | 256            | 208 | C     |
|         | LC4512C-35T176C               | 512        | 1.8     | 3.5             | TQFP    | 176            | 128 | C     |
|         | LC4512C-5T176C                | 512        | 1.8     | 5               | TQFP    | 176            | 128 | C     |
|         | LC4512C-75T176C               | 512        | 1.8     | 7.5             | TQFP    | 176            | 128 | C     |

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

## ispMACH 4000B (2.5V) Industrial Devices

| Family  | Part Number                   | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-------------------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032B | LC4032B-5T48I                 | 32         | 2.5     | 5               | TQFP    | 48             | 32  | I     |
|         | LC4032B-75T48I                | 32         | 2.5     | 7.5             | TQFP    | 48             | 32  | I     |
|         | LC4032B-10T48I                | 32         | 2.5     | 10              | TQFP    | 48             | 32  | I     |
|         | LC4032B-5T44I                 | 32         | 2.5     | 5               | TQFP    | 44             | 30  | I     |
|         | LC4032B-75T44I                | 32         | 2.5     | 7.5             | TQFP    | 44             | 30  | I     |
|         | LC4032B-10T44I                | 32         | 2.5     | 10              | TQFP    | 44             | 30  | I     |
| LC4064B | LC4064B-5T100I                | 64         | 2.5     | 5               | TQFP    | 100            | 64  | I     |
|         | LC4064B-75T100I               | 64         | 2.5     | 7.5             | TQFP    | 100            | 64  | I     |
|         | LC4064B-10T100I               | 64         | 2.5     | 10              | TQFP    | 100            | 64  | I     |
|         | LC4064B-5T48I                 | 64         | 2.5     | 5               | TQFP    | 48             | 32  | I     |
|         | LC4064B-75T48I                | 64         | 2.5     | 7.5             | TQFP    | 48             | 32  | I     |
|         | LC4064B-10T48I                | 64         | 2.5     | 10              | TQFP    | 48             | 32  | I     |
|         | LC4064B-5T44I                 | 64         | 2.5     | 5               | TQFP    | 44             | 30  | I     |
|         | LC4064B-75T44I                | 64         | 2.5     | 7.5             | TQFP    | 44             | 30  | I     |
|         | LC4064B-10T44I                | 64         | 2.5     | 10              | TQFP    | 44             | 30  | I     |
| LC4128B | LC4128B-5T128I                | 128        | 2.5     | 5               | TQFP    | 128            | 92  | I     |
|         | LC4128B-75T128I               | 128        | 2.5     | 7.5             | TQFP    | 128            | 92  | I     |
|         | LC4128B-10T128I               | 128        | 2.5     | 10              | TQFP    | 128            | 92  | I     |
|         | LC4128B-5T100I                | 128        | 2.5     | 5               | TQFP    | 100            | 64  | I     |
|         | LC4128B-75T100I               | 128        | 2.5     | 7.5             | TQFP    | 100            | 64  | I     |
|         | LC4128B-10T100I               | 128        | 2.5     | 10              | TQFP    | 100            | 64  | I     |
| LC4256B | LC4256B-5FT256AI              | 256        | 2.5     | 5               | ftBGA   | 256            | 128 | I     |
|         | LC4256B-75FT256AI             | 256        | 2.5     | 7.5             | ftBGA   | 256            | 128 | I     |
|         | LC4256B-10FT256AI             | 256        | 2.5     | 10              | ftBGA   | 256            | 128 | I     |
|         | LC4256B-5FT256BI              | 256        | 2.5     | 5               | ftBGA   | 256            | 160 | I     |
|         | LC4256B-75FT256BI             | 256        | 2.5     | 7.5             | ftBGA   | 256            | 160 | I     |
|         | LC4256B-10FT256BI             | 256        | 2.5     | 10              | ftBGA   | 256            | 160 | I     |
|         | LC4256B-5F256AI <sup>1</sup>  | 256        | 2.5     | 5               | fpBGA   | 256            | 128 | I     |
|         | LC4256B-75F256AI <sup>1</sup> | 256        | 2.5     | 7.5             | fpBGA   | 256            | 128 | I     |
|         | LC4256B-10F256AI <sup>1</sup> | 256        | 2.5     | 10              | fpBGA   | 256            | 128 | I     |
|         | LC4256B-5F256BI <sup>1</sup>  | 256        | 2.5     | 5               | fpBGA   | 256            | 160 | I     |
|         | LC4256B-75F256BI <sup>1</sup> | 256        | 2.5     | 7.5             | fpBGA   | 256            | 160 | I     |
|         | LC4256B-10F256BI <sup>1</sup> | 256        | 2.5     | 10              | fpBGA   | 256            | 160 | I     |
|         | LC4256B-5T176I                | 256        | 2.5     | 5               | TQFP    | 176            | 128 | I     |
|         | LC4256B-75T176I               | 256        | 2.5     | 7.5             | TQFP    | 176            | 128 | I     |
|         | LC4256B-10T176I               | 256        | 2.5     | 10              | TQFP    | 176            | 128 | I     |
|         | LC4256B-5T100I                | 256        | 2.5     | 5               | TQFP    | 100            | 64  | I     |
|         | LC4256B-75T100I               | 256        | 2.5     | 7.5             | TQFP    | 100            | 64  | I     |
|         | LC4256B-10T100I               | 256        | 2.5     | 10              | TQFP    | 100            | 64  | I     |

## ispMACH 4000V (3.3V) Commercial Devices (Cont.)

| Device  | Part Number                   | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-------------------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4128V | LC4128V-27T144C               | 128        | 3.3     | 2.7             | TQFP    | 144            | 96  | C     |
|         | LC4128V-5T144C                | 128        | 3.3     | 5               | TQFP    | 144            | 96  | C     |
|         | LC4128V-75T144C               | 128        | 3.3     | 7.5             | TQFP    | 144            | 96  | C     |
|         | LC4128V-27T128C               | 128        | 3.3     | 2.7             | TQFP    | 128            | 92  | C     |
|         | LC4128V-5T128C                | 128        | 3.3     | 5               | TQFP    | 128            | 92  | C     |
|         | LC4128V-75T128C               | 128        | 3.3     | 7.5             | TQFP    | 128            | 92  | C     |
|         | LC4128V-27T100C               | 128        | 3.3     | 2.7             | TQFP    | 100            | 64  | C     |
|         | LC4128V-5T100C                | 128        | 3.3     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4128V-75T100C               | 128        | 3.3     | 7.5             | TQFP    | 100            | 64  | C     |
| LC4256V | LC4256V-3FT256AC              | 256        | 3.3     | 3               | ftBGA   | 256            | 128 | C     |
|         | LC4256V-5FT256AC              | 256        | 3.3     | 5               | ftBGA   | 256            | 128 | C     |
|         | LC4256V-75FT256AC             | 256        | 3.3     | 7.5             | ftBGA   | 256            | 128 | C     |
|         | LC4256V-3FT256BC              | 256        | 3.3     | 3               | ftBGA   | 256            | 160 | C     |
|         | LC4256V-5FT256BC              | 256        | 3.3     | 5               | ftBGA   | 256            | 160 | C     |
|         | LC4256V-75FT256BC             | 256        | 3.3     | 7.5             | ftBGA   | 256            | 160 | C     |
|         | LC4256V-3F256AC <sup>1</sup>  | 256        | 3.3     | 3               | fpBGA   | 256            | 128 | C     |
|         | LC4256V-5F256AC <sup>1</sup>  | 256        | 3.3     | 5               | fpBGA   | 256            | 128 | C     |
|         | LC4256V-75F256AC <sup>1</sup> | 256        | 3.3     | 7.5             | fpBGA   | 256            | 128 | C     |
|         | LC4256V-3F256BC <sup>1</sup>  | 256        | 3.3     | 3               | fpBGA   | 256            | 160 | C     |
|         | LC4256V-5F256BC <sup>1</sup>  | 256        | 3.3     | 5               | fpBGA   | 256            | 160 | C     |
|         | LC4256V-75F256BC <sup>1</sup> | 256        | 3.3     | 7.5             | fpBGA   | 256            | 160 | C     |
|         | LC4256V-3T176C                | 256        | 3.3     | 3               | TQFP    | 176            | 128 | C     |
|         | LC4256V-5T176C                | 256        | 3.3     | 5               | TQFP    | 176            | 128 | C     |
|         | LC4256V-75T176C               | 256        | 3.3     | 7.5             | TQFP    | 176            | 128 | C     |
|         | LC4256V-3T144C                | 256        | 3.3     | 3               | TQFP    | 144            | 96  | C     |
|         | LC4256V-5T144C                | 256        | 3.3     | 5               | TQFP    | 144            | 96  | C     |
|         | LC4256V-75T144C               | 256        | 3.3     | 7.5             | TQFP    | 144            | 96  | C     |
|         | LC4256V-3T100C                | 256        | 3.3     | 3               | TQFP    | 100            | 64  | C     |
|         | LC4256V-5T100C                | 256        | 3.3     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4256V-75T100C               | 256        | 3.3     | 7.5             | TQFP    | 100            | 64  | C     |
| LC4384V | LC4384V-35FT256C              | 384        | 3.3     | 3.5             | ftBGA   | 256            | 192 | C     |
|         | LC4384V-5FT256C               | 384        | 3.3     | 5               | ftBGA   | 256            | 192 | C     |
|         | LC4384V-75FT256C              | 384        | 3.3     | 7.5             | ftBGA   | 256            | 192 | C     |
|         | LC4384V-35F256C <sup>1</sup>  | 384        | 3.3     | 3.5             | fpBGA   | 256            | 192 | C     |
|         | LC4384V-5F256C <sup>1</sup>   | 384        | 3.3     | 5               | fpBGA   | 256            | 192 | C     |
|         | LC4384V-75F256C <sup>1</sup>  | 384        | 3.3     | 7.5             | fpBGA   | 256            | 192 | C     |
|         | LC4384V-35T176C               | 384        | 3.3     | 3.5             | TQFP    | 176            | 128 | C     |
|         | LC4384V-5T176C                | 384        | 3.3     | 5               | TQFP    | 176            | 128 | C     |
|         | LC4384V-75T176C               | 384        | 3.3     | 7.5             | TQFP    | 176            | 128 | C     |

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**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     |