



Welcome to [E-XFL.COM](https://www.e-xfl.com)

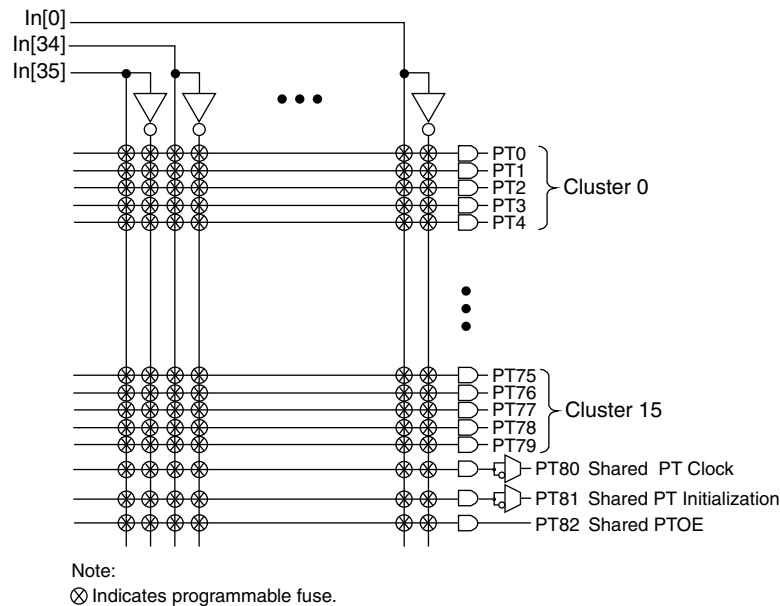
### Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

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           | 5 ns                                                                                                                                                              |
| Voltage Supply - Internal       | 2.3V ~ 2.7V                                                                                                                                                       |
| Number of Logic Elements/Blocks | 8                                                                                                                                                                 |
| Number of Macrocells            | 128                                                                                                                                                               |
| Number of Gates                 | -                                                                                                                                                                 |
| Number of I/O                   | 64                                                                                                                                                                |
| Operating Temperature           | 0°C ~ 90°C (TJ)                                                                                                                                                   |
| Mounting Type                   | Surface Mount                                                                                                                                                     |
| Package / Case                  | 100-LQFP                                                                                                                                                          |
| Supplier Device Package         | 100-TQFP (14x14)                                                                                                                                                  |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4128b-5t100c">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4128b-5t100c</a> |

**Figure 3. AND Array**

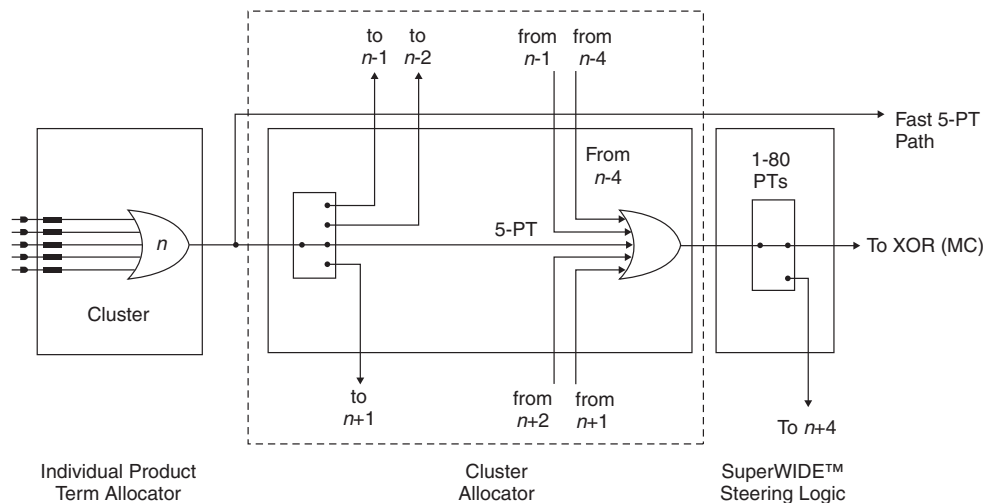
## Enhanced Logic Allocator

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

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

- Product Term Allocator
- Cluster Allocator
- Wide Steering Logic

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

**Figure 4. Macrocell Slice**

- 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

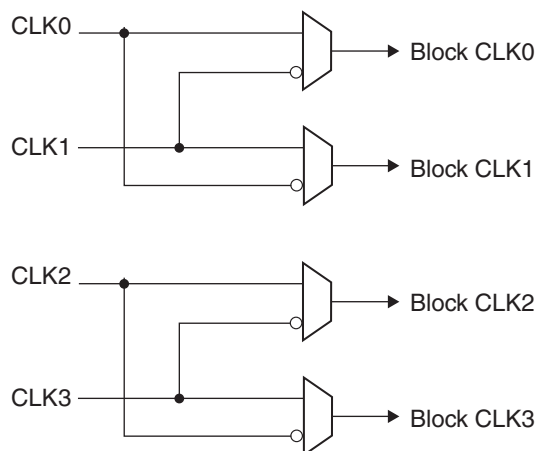
The ispMACH 4000 family architecture accommodates both block-level and macrocell-level set and reset capability. There is one block-level initialization term that is distributed to all macrocell registers in a GLB. At the macrocell level, two product terms can be “stolen” from the cluster associated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



## I/O Recommended Operating Conditions

| Standard                          | $V_{CCO}$ (V) <sup>1</sup> |      |
|-----------------------------------|----------------------------|------|
|                                   | Min.                       | Max. |
| LVTTL                             | 3.0                        | 3.6  |
| LVC MOS 3.3                       | 3.0                        | 3.6  |
| Extended LVC MOS 3.3 <sup>2</sup> | 2.7                        | 3.6  |
| LVC MOS 2.5                       | 2.3                        | 2.7  |
| LVC MOS 1.8                       | 1.65                       | 1.95 |
| PCI 3.3                           | 3.0                        | 3.6  |

1. Typical values for  $V_{CCO}$  are the average of the min. and max. values.

2. ispMACH 4000Z only.

## DC Electrical Characteristics

### Over Recommended Operating Conditions

| Symbol                 | Parameter                                             | Condition                                                                       | Min.             | Typ. | Max.             | Units   |
|------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------|------------------|------|------------------|---------|
| $I_{IL}, I_{IH}^{1,4}$ | Input Leakage Current (ispMACH 4000Z)                 | $0 \leq V_{IN} < V_{CCO}$                                                       | —                | 0.5  | 1                | $\mu A$ |
| $I_{IH}^1$             | Input High Leakage Current (ispMACH 4000Z)            | $V_{CCO} < V_{IN} \leq 5.5V$                                                    | —                | —    | 10               | $\mu A$ |
| $I_{IL}, I_{IH}^1$     | Input Leakage Current (ispMACH 4000V/B/C)             | $0 \leq V_{IN} \leq 3.6V, T_j = 105^\circ C$                                    | —                | —    | 10               | $\mu A$ |
|                        |                                                       | $0 \leq V_{IN} \leq 3.6V, T_j = 130^\circ C$                                    | —                | —    | 15               | $\mu A$ |
| $I_{IH}^{1,2}$         | Input High Leakage Current (ispMACH 4000V/B/C)        | $3.6V < V_{IN} \leq 5.5V, T_j = 105^\circ C$<br>$3.0V \leq V_{CCO} \leq 3.6V^1$ | —                | —    | 20               | $\mu A$ |
|                        |                                                       | $3.6V < V_{IN} \leq 5.5V, T_j = 130^\circ C$<br>$3.0V \leq V_{CCO} \leq 3.6V^1$ | —                | —    | 50               | $\mu A$ |
| $I_{PU}$               | I/O Weak Pull-up Resistor Current (ispMACH 4000Z)     | $0 \leq V_{IN} \leq 0.7V_{CCO}$                                                 | -30              | —    | -150             | $\mu A$ |
|                        | I/O Weak Pull-up Resistor Current (ispMACH 4000V/B/C) | $0 \leq V_{IN} \leq 0.7V_{CCO}$                                                 | -30              | —    | -200             | $\mu A$ |
| $I_{PD}$               | I/O Weak Pull-down Resistor Current                   | $V_{IL} (MAX) \leq V_{IN} \leq V_{IH} (MIN)$                                    | 30               | —    | 150              | $\mu A$ |
| $I_{BHLS}$             | Bus Hold Low Sustaining Current                       | $V_{IN} = V_{IL} (MAX)$                                                         | 30               | —    | —                | $\mu A$ |
| $I_{BHHS}$             | Bus Hold High Sustaining Current                      | $V_{IN} = 0.7 V_{CCO}$                                                          | -30              | —    | —                | $\mu A$ |
| $I_{BHLO}$             | Bus Hold Low Overdrive Current                        | $0V \leq V_{IN} \leq V_{BHT}$                                                   | —                | —    | 150              | $\mu A$ |
| $I_{BHHO}$             | Bus Hold High Overdrive Current                       | $V_{BHT} \leq V_{IN} \leq V_{CCO}$                                              | —                | —    | -150             | $\mu A$ |
| $V_{BHT}$              | Bus Hold Trip Points                                  | —                                                                               | $V_{CCO} * 0.35$ | —    | $V_{CCO} * 0.65$ | V       |
| $C_1$                  | I/O Capacitance <sup>3</sup>                          | $V_{CCO} = 3.3V, 2.5V, 1.8V$                                                    | —                | 8    | —                | pf      |
|                        |                                                       | $V_{CC} = 1.8V, V_{IO} = 0 \text{ to } V_{IH} (MAX)$                            | —                |      | —                |         |
| $C_2$                  | Clock Capacitance <sup>3</sup>                        | $V_{CCO} = 3.3V, 2.5V, 1.8V$                                                    | —                | 6    | —                | pf      |
|                        |                                                       | $V_{CC} = 1.8V, V_{IO} = 0 \text{ to } V_{IH} (MAX)$                            | —                |      | —                |         |
| $C_3$                  | Global Input Capacitance <sup>3</sup>                 | $V_{CCO} = 3.3V, 2.5V, 1.8V$                                                    | —                | 6    | —                | pf      |
|                        |                                                       | $V_{CC} = 1.8V, V_{IO} = 0 \text{ to } V_{IH} (MAX)$                            | —                |      | —                |         |

1. Input or I/O leakage current is measured with the pin configured as an input or as an I/O with the output driver tristated. It is not measured with the output driver active. Bus maintenance circuits are disabled.

2. 5V tolerant inputs and I/O should only be placed in banks where  $3.0V \leq V_{CCO} \leq 3.6V$ .

3.  $T_A = 25^\circ C$ ,  $f = 1.0MHz$

4.  $I_{IH}$  excursions of up to 1.5 $\mu A$  maximum per pin above the spec limit may be observed for certain voltage conditions on no more than 10% of the device's I/O pins.

## ispMACH 4000Z External Switching Characteristics

### Over Recommended Operating Conditions

| Parameter                     | Description <sup>1, 2, 3</sup>                                                    | -35  |      | -37  |      | -42  |      | Units |
|-------------------------------|-----------------------------------------------------------------------------------|------|------|------|------|------|------|-------|
|                               |                                                                                   | Min. | Max. | Min. | Max. | Min. | Max. |       |
| t <sub>PD</sub>               | 5-PT bypass combinatorial propagation delay                                       | —    | 3.5  | —    | 3.7  | —    | 4.2  | ns    |
| t <sub>PD_MC</sub>            | 20-PT combinatorial propagation delay through macrocell                           | —    | 4.4  | —    | 4.7  | —    | 5.7  | ns    |
| t <sub>S</sub>                | GLB register setup time before clock                                              | 2.2  | —    | 2.5  | —    | 2.7  | —    | ns    |
| t <sub>ST</sub>               | GLB register setup time before clock with T-type register                         | 2.4  | —    | 2.7  | —    | 2.9  | —    | ns    |
| t <sub>SIR</sub>              | GLB register setup time before clock, input register path                         | 1.0  | —    | 1.1  | —    | 1.3  | —    | ns    |
| t <sub>SIRZ</sub>             | GLB register setup time before clock with zero hold                               | 2.0  | —    | 2.1  | —    | 2.6  | —    | ns    |
| t <sub>H</sub>                | GLB register hold time after clock                                                | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| t <sub>HT</sub>               | GLB register hold time after clock with T-type register                           | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| t <sub>HIR</sub>              | GLB register hold time after clock, input register path                           | 1.0  | —    | 1.0  | —    | 1.3  | —    | ns    |
| t <sub>HIRZ</sub>             | GLB register hold time after clock, input register path with zero hold            | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| t <sub>CO</sub>               | GLB register clock-to-output delay                                                | —    | 3.0  | —    | 3.2  | —    | 3.5  | ns    |
| t <sub>R</sub>                | External reset pin to output delay                                                | —    | 5.0  | —    | 6.0  | —    | 7.3  | ns    |
| t <sub>RW</sub>               | External reset pulse duration                                                     | 1.5  | —    | 1.7  | —    | 2.0  | —    | ns    |
| t <sub>PTOE/DIS</sub>         | Input to output local product term output enable/disable                          | —    | 7.0  | —    | 8.0  | —    | 8.0  | ns    |
| t <sub>GPTOE/DIS</sub>        | Input to output global product term output enable/disable                         | —    | 6.5  | —    | 7.0  | —    | 8.0  | ns    |
| t <sub>GOE/DIS</sub>          | Global OE input to output enable/disable                                          | —    | 4.5  | —    | 4.5  | —    | 4.8  | ns    |
| t <sub>CW</sub>               | Global clock width, high or low                                                   | 1.0  | —    | 1.5  | —    | 1.8  | —    | ns    |
| t <sub>GW</sub>               | Global gate width low (for low transparent) or high (for high transparent)        | 1.0  | —    | 1.5  | —    | 1.8  | —    | ns    |
| t <sub>WIR</sub>              | Input register clock width, high or low                                           | 1.0  | —    | 1.5  | —    | 1.8  | —    | ns    |
| f <sub>MAX</sub> <sup>4</sup> | Clock frequency with internal feedback                                            | —    | 267  | —    | 250  | —    | 220  | MHz   |
| f <sub>MAX</sub> (Ext.)       | clock frequency with external feedback, [1 / (t <sub>S</sub> + t <sub>CO</sub> )] | —    | 192  | —    | 175  | —    | 161  | MHz   |

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

Timing v.2.2

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

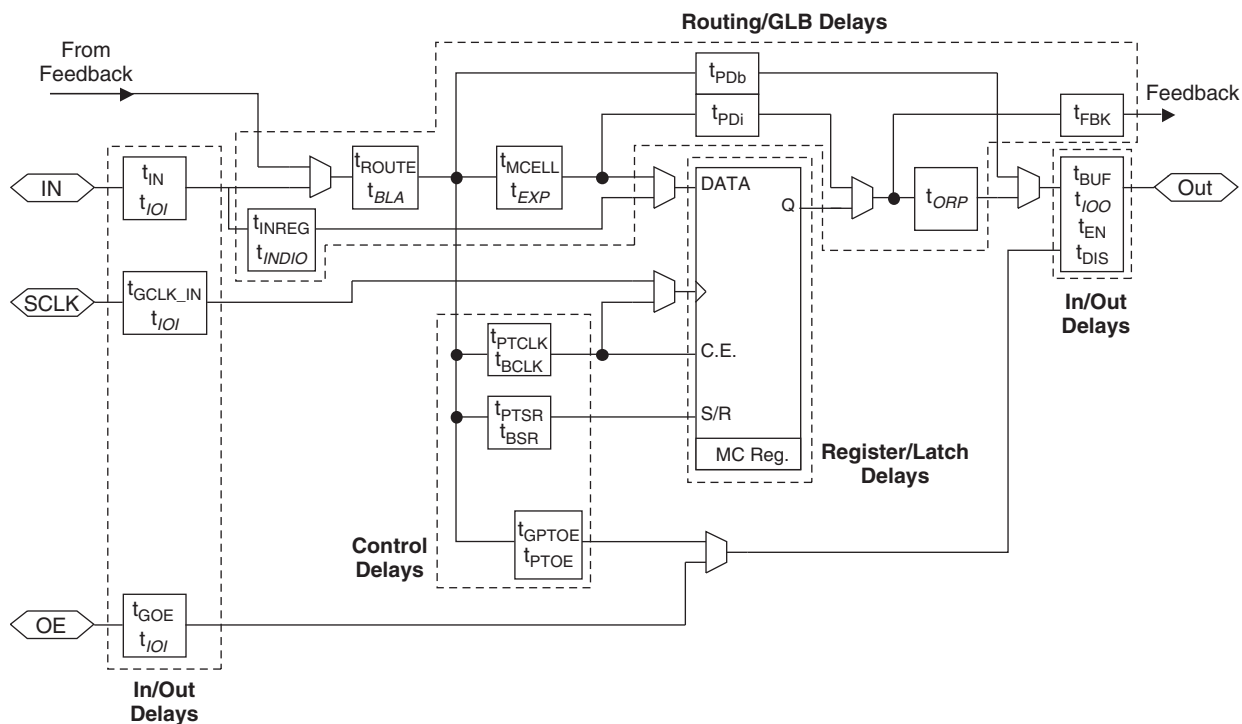
3. Pulse widths and clock widths less than minimum will cause unknown behavior.

4. Standard 16-bit counter using GRP feedback.

## Timing Model

The task of determining the timing through the ispMACH 4000 family, like any CPLD, is relatively simple. The timing model provided in Figure 11 shows the specific delay paths. Once the implementation of a given function is determined either conceptually or from the software report file, the delay path of the function can easily be determined from the timing model. The Lattice design tools report the timing delays based on the same timing model for a particular design. Note that the internal timing parameters are given for reference only, and are not tested. The external timing parameters are tested and guaranteed for every device. For more information on the timing model and usage, refer to TN1004, [ispMACH 4000 Timing Model Design and Usage Guidelines](#).

**Figure 11. ispMACH 4000 Timing Model**



Note: Italicized items are optional delay adders.

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

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

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

Timing v.2.2

**ispMACH 4000V/B/C Timing Adders<sup>1</sup>**

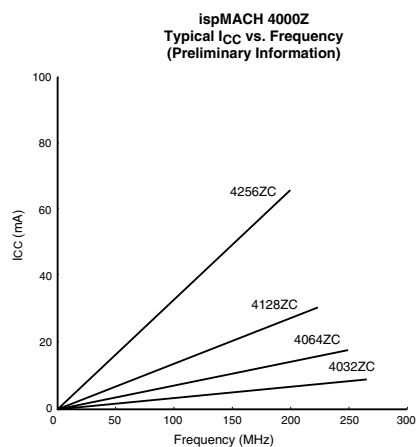
| Adder Type                        | Base Parameter                                            | Description                                | -25  |      | -27  |      | -3   |      | -35  |      | Units |
|-----------------------------------|-----------------------------------------------------------|--------------------------------------------|------|------|------|------|------|------|------|------|-------|
|                                   |                                                           |                                            | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |       |
| Optional Delay Adders             |                                                           |                                            |      |      |      |      |      |      |      |      |       |
| t <sub>INDIO</sub>                | t <sub>INREG</sub>                                        | Input register delay                       | —    | 0.95 | —    | 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 | —    | 0.33 | ns    |
| t <sub>ORP</sub>                  | —                                                         | Output routing pool delay                  | —    | 0.05 | —    | 0.05 | —    | 0.05 | —    | 0.05 | ns    |
| t <sub>BLA</sub>                  | t <sub>ROUTE</sub>                                        | Additional block loading adder             | —    | 0.03 | —    | 0.05 | —    | 0.05 | —    | 0.05 | ns    |
| t <sub>IOI</sub> Input Adjusters  |                                                           |                                            |      |      |      |      |      |      |      |      |       |
| LVTTL_in                          | t <sub>IN</sub> , t <sub>GCLK_IN</sub> , t <sub>GOE</sub> | Using LVTTL standard                       | —    | 0.60 | —    | 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 | —    | 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 | —    | 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 | —    | 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 | —    | 0.60 | ns    |
| t <sub>IOO</sub> Output Adjusters |                                                           |                                            |      |      |      |      |      |      |      |      |       |
| LVTTL_out                         | t <sub>BUF</sub> , t <sub>EN</sub> , t <sub>DIS</sub>     | Output configured as TTL buffer            | —    | 0.20 | —    | 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 | —    | 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 | —    | 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 | —    | 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 | —    | 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 | —    | 1.00 | ns    |

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

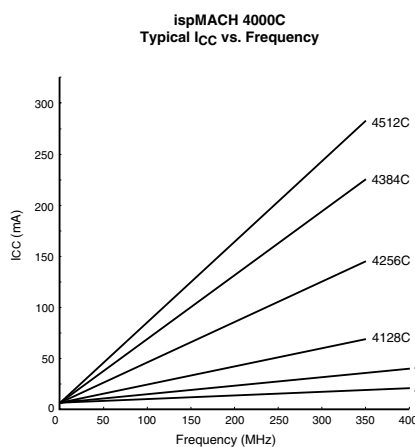
Timing v.3.2

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

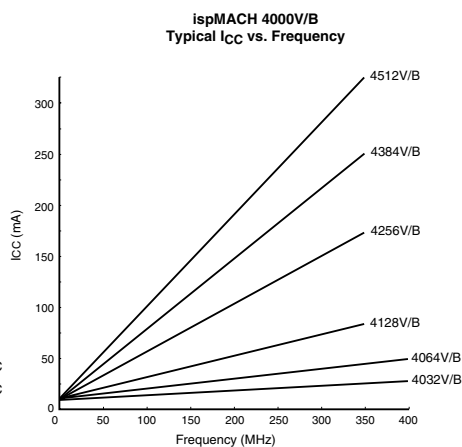
## Power Consumption



Note: The devices are configured with maximum number of 16-bit counters, typical current at 1.8V, 25°C.



Note: The devices are configured with maximum number of 16-bit counters, typical current at 1.8V, 25°C.



Note: The devices are configured with maximum number of 16-bit counters, typical current at 3.3V, 2.5V, 25°C.

## Power Estimation Coefficients<sup>1</sup>

| Device          | A     | B     |
|-----------------|-------|-------|
| ispMACH 4032V/B | 11.3  | 0.010 |
| ispMACH 4032C   | 1.3   | 0.010 |
| ispMACH 4064V/B | 11.5  | 0.010 |
| ispMACH 4064C   | 1.5   | 0.010 |
| ispMACH 4128V/B | 11.5  | 0.011 |
| ispMACH 4128C   | 1.5   | 0.011 |
| ispMACH 4256V/B | 12    | 0.011 |
| ispMACH 4256C   | 2     | 0.011 |
| ispMACH 4384V/B | 12.5  | 0.013 |
| ispMACH 4384C   | 2.5   | 0.013 |
| ispMACH 4512V/B | 13    | 0.013 |
| ispMACH 4512C   | 3     | 0.013 |
| ispMACH 4032ZC  | 0.010 | 0.010 |
| ispMACH 4064ZC  | 0.011 | 0.010 |
| ispMACH 4128ZC  | 0.012 | 0.010 |
| ispMACH 4256ZC  | 0.013 | 0.010 |

1. For further information about the use of these coefficients, refer to TN1005, [Power Estimation in ispMACH 4000V/B/C/Z Devices](#).

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

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

**ispMACH 4128V/B/C Logic Signal Connections: 128-Pin TQFP (Cont.)**

| Pin Number | Bank Number | ispMACH 4128V/B/C |                 |
|------------|-------------|-------------------|-----------------|
|            |             | GLB/MC/Pad        | ORP             |
| 19         | 0           | C13               | C <sup>10</sup> |
| 20         | 0           | C12               | C <sup>9</sup>  |
| 21         | 0           | C10               | C <sup>8</sup>  |
| 22         | 0           | C9                | C <sup>7</sup>  |
| 23         | 0           | C8                | C <sup>6</sup>  |
| 24         | 0           | GND (Bank 0)      | -               |
| 25         | 0           | C6                | C <sup>5</sup>  |
| 26         | 0           | C5                | C <sup>4</sup>  |
| 27         | 0           | C4                | C <sup>3</sup>  |
| 28         | 0           | C2                | C <sup>2</sup>  |
| 29         | 0           | C0                | C <sup>0</sup>  |
| 30         | 0           | VCCO (Bank 0)     | -               |
| 31         | 0           | TCK               | -               |
| 32         | 0           | VCC               | -               |
| 33         | 0           | GND               | -               |
| 34         | 0           | D14               | D <sup>11</sup> |
| 35         | 0           | D13               | D <sup>10</sup> |
| 36         | 0           | D12               | D <sup>9</sup>  |
| 37         | 0           | D10               | D <sup>8</sup>  |
| 38         | 0           | D9                | D <sup>7</sup>  |
| 39         | 0           | D8                | D <sup>6</sup>  |
| 40         | 0           | GND (Bank 0)      | -               |
| 41         | 0           | VCCO (Bank 0)     | -               |
| 42         | 0           | D6                | D <sup>5</sup>  |
| 43         | 0           | D5                | D <sup>4</sup>  |
| 44         | 0           | D4                | D <sup>3</sup>  |
| 45         | 0           | D2                | D <sup>2</sup>  |
| 46         | 0           | D1                | D <sup>1</sup>  |
| 47         | 0           | D0                | D <sup>0</sup>  |
| 48         | 0           | CLK1/I            | -               |
| 49         | 1           | GND (Bank 1)      | -               |
| 50         | 1           | CLK2/I            | -               |
| 51         | 1           | VCC               | -               |
| 52         | 1           | E0                | E <sup>0</sup>  |
| 53         | 1           | E1                | E <sup>1</sup>  |
| 54         | 1           | E2                | E <sup>2</sup>  |
| 55         | 1           | E4                | E <sup>3</sup>  |
| 56         | 1           | E5                | E <sup>4</sup>  |
| 57         | 1           | E6                | E <sup>5</sup>  |
| 58         | 1           | VCCO (Bank 1)     | -               |
| 59         | 1           | GND (Bank 1)      | -               |
| 60         | 1           | E8                | E <sup>6</sup>  |
| 61         | 1           | E9                | E <sup>7</sup>  |

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

| Ball Number | Bank Number | ispMACH 4064Z |                 | ispMACH 4128Z |                 | ispMACH 4256Z |                |
|-------------|-------------|---------------|-----------------|---------------|-----------------|---------------|----------------|
|             |             | GLB/MC/Pad    | ORP             | GLB/MC/Pad    | ORP             | GLB/MC/Pad    | ORP            |
| 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 (Cont.)**

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

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

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

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

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

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

| Pin Number | Bank Number | ispMACH 4256V/B/C/Z |                 | ispMACH 4384V/B/C |                  | ispMACH 4512V/B/C |                  |
|------------|-------------|---------------------|-----------------|-------------------|------------------|-------------------|------------------|
|            |             | GLB/MC/Pad          | ORP             | GLB/MC/Pad        | ORP              | GLB/MC/Pad        | ORP              |
| 101        | 1           | GND (Bank 1)        | -               | GND (Bank 1)      | -                | GND (Bank 1)      | -                |
| 102        | 1           | L14                 | L <sup>14</sup> | AX14              | AX <sup>14</sup> | GX14              | GX <sup>14</sup> |
| 103        | 1           | L12                 | L <sup>12</sup> | AX12              | AX <sup>12</sup> | GX12              | GX <sup>12</sup> |
| 104        | 1           | L10                 | L <sup>10</sup> | AX10              | AX <sup>10</sup> | GX10              | GX <sup>10</sup> |
| 105        | 1           | L8                  | L <sup>8</sup>  | AX8               | AX <sup>8</sup>  | GX8               | GX <sup>8</sup>  |
| 106        | 1           | L6                  | L <sup>6</sup>  | AX6               | AX <sup>6</sup>  | GX6               | GX <sup>6</sup>  |
| 107        | 1           | L4                  | L <sup>4</sup>  | AX4               | AX <sup>4</sup>  | GX4               | GX <sup>4</sup>  |
| 108        | 1           | L2                  | L <sup>2</sup>  | AX2               | AX <sup>2</sup>  | GX2               | GX <sup>2</sup>  |
| 109        | 1           | L0                  | L <sup>0</sup>  | AX0               | AX <sup>0</sup>  | GX0               | GX <sup>0</sup>  |
| 110        | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)     | -                | VCCO (Bank 1)     | -                |
| 111        | 1           | M0                  | M <sup>0</sup>  | DX0               | DX <sup>0</sup>  | JX0               | JX <sup>0</sup>  |
| 112        | 1           | M2                  | M <sup>2</sup>  | DX2               | DX <sup>2</sup>  | JX2               | JX <sup>2</sup>  |
| 113        | 1           | M4                  | M <sup>4</sup>  | DX4               | DX <sup>4</sup>  | JX4               | JX <sup>4</sup>  |
| 114        | 1           | M6                  | M <sup>6</sup>  | DX6               | DX <sup>6</sup>  | JX6               | JX <sup>6</sup>  |
| 115        | 1           | M8                  | M <sup>8</sup>  | DX8               | DX <sup>8</sup>  | JX8               | JX <sup>8</sup>  |
| 116        | 1           | M10                 | M <sup>10</sup> | DX10              | DX <sup>10</sup> | JX10              | JX <sup>10</sup> |
| 117        | 1           | M12                 | M <sup>12</sup> | DX12              | DX <sup>12</sup> | JX12              | JX <sup>12</sup> |
| 118        | 1           | M14                 | M <sup>14</sup> | DX14              | DX <sup>14</sup> | JX14              | JX <sup>14</sup> |
| 119        | 1           | GND (Bank 1)        | -               | GND (Bank 1)      | -                | GND (Bank 1)      | -                |
| 120        | 1           | N0                  | N <sup>0</sup>  | FX0               | FX <sup>0</sup>  | NX0               | NX <sup>0</sup>  |
| 121        | 1           | N2                  | N <sup>2</sup>  | FX2               | FX <sup>2</sup>  | NX2               | NX <sup>2</sup>  |
| 122        | 1           | N4                  | N <sup>4</sup>  | FX4               | FX <sup>4</sup>  | NX4               | NX <sup>4</sup>  |
| 123        | 1           | N6                  | N <sup>6</sup>  | FX6               | FX <sup>6</sup>  | NX6               | NX <sup>6</sup>  |
| 124        | 1           | N8                  | N <sup>8</sup>  | FX8               | FX <sup>8</sup>  | NX8               | NX <sup>8</sup>  |
| 125        | 1           | N10                 | N <sup>10</sup> | FX10              | FX <sup>10</sup> | NX10              | NX <sup>10</sup> |
| 126        | 1           | N12                 | N <sup>12</sup> | FX12              | FX <sup>12</sup> | NX12              | NX <sup>12</sup> |
| 127        | 1           | N14                 | N <sup>14</sup> | FX14              | FX <sup>14</sup> | NX14              | NX <sup>14</sup> |
| 128        | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)     | -                | VCCO (Bank 1)     | -                |
| 129        | -           | TDO                 | -               | TDO               | -                | TDO               | -                |
| 130        | -           | VCC                 | -               | VCC               | -                | VCC               | -                |
| 131        | -           | NC                  | -               | NC                | -                | NC                | -                |
| 132        | -           | NC                  | -               | NC                | -                | NC                | -                |
| 133        | -           | NC                  | -               | NC                | -                | NC                | -                |
| 134        | -           | GND                 | -               | GND               | -                | GND               | -                |
| 135        | 1           | O14                 | O <sup>14</sup> | GX14              | GX <sup>14</sup> | OX14              | OX <sup>14</sup> |
| 136        | 1           | O12                 | O <sup>12</sup> | GX12              | GX <sup>12</sup> | OX12              | OX <sup>12</sup> |
| 137        | 1           | O10                 | O <sup>10</sup> | GX10              | GX <sup>10</sup> | OX10              | OX <sup>10</sup> |
| 138        | 1           | O8                  | O <sup>8</sup>  | GX8               | GX <sup>8</sup>  | OX8               | OX <sup>8</sup>  |
| 139        | 1           | O6                  | O <sup>6</sup>  | GX6               | GX <sup>6</sup>  | OX6               | OX <sup>6</sup>  |
| 140        | 1           | O4                  | O <sup>4</sup>  | GX4               | GX <sup>4</sup>  | OX4               | OX <sup>4</sup>  |
| 141        | 1           | O2                  | O <sup>2</sup>  | GX2               | GX <sup>2</sup>  | OX2               | OX <sup>2</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 4000C (1.8V) Industrial Devices

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

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

| Family  | Part Number                  | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|------------------------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4384C | LC4384C-5FT256I              | 384        | 1.8     | 5               | ftBGA   | 256            | 192 | I     |
|         | LC4384C-75FT256I             | 384        | 1.8     | 7.5             | ftBGA   | 256            | 192 | I     |
|         | LC4384C-10FT256I             | 384        | 1.8     | 10              | ftBGA   | 256            | 192 | I     |
|         | LC4384C-5F256I <sup>1</sup>  | 384        | 1.8     | 5               | fpBGA   | 256            | 192 | I     |
|         | LC4384C-75F256I <sup>1</sup> | 384        | 1.8     | 7.5             | fpBGA   | 256            | 192 | I     |
|         | LC4384C-10F256I <sup>1</sup> | 384        | 1.8     | 10              | fpBGA   | 256            | 192 | I     |
|         | LC4384C-5T176I               | 384        | 1.8     | 5               | TQFP    | 176            | 128 | I     |
|         | LC4384C-75T176I              | 384        | 1.8     | 7.5             | TQFP    | 176            | 128 | I     |
|         | LC4384C-10T176I              | 384        | 1.8     | 10              | TQFP    | 176            | 128 | I     |
| LC4512C | LC4512C-5FT256I              | 512        | 1.8     | 5               | ftBGA   | 256            | 208 | I     |
|         | LC4512C-75FT256I             | 512        | 1.8     | 7.5             | ftBGA   | 256            | 208 | I     |
|         | LC4512C-10FT256I             | 512        | 1.8     | 10              | ftBGA   | 256            | 208 | I     |
|         | LC4512C-5F256I <sup>1</sup>  | 512        | 1.8     | 5               | fpBGA   | 256            | 208 | I     |
|         | LC4512C-75F256I <sup>1</sup> | 512        | 1.8     | 7.5             | fpBGA   | 256            | 208 | I     |
|         | LC4512C-10F256I <sup>1</sup> | 512        | 1.8     | 10              | fpBGA   | 256            | 208 | I     |
|         | LC4512C-5T176I               | 512        | 1.8     | 5               | TQFP    | 176            | 128 | I     |
|         | LC4512C-75T176I              | 512        | 1.8     | 7.5             | TQFP    | 176            | 128 | I     |
|         | LC4512C-10T176I              | 512        | 1.8     | 10              | TQFP    | 176            | 128 | I     |

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

## ispMACH 4000B (2.5V) Commercial Devices

| Device  | Part Number     | Macrocells | Voltage | t <sub>PD</sub> | Package | Pin/Ball Count | I/O | Grade |
|---------|-----------------|------------|---------|-----------------|---------|----------------|-----|-------|
| LC4032B | LC4032B-25T48C  | 32         | 2.5     | 2.5             | TQFP    | 48             | 32  | C     |
|         | LC4032B-5T48C   | 32         | 2.5     | 5               | TQFP    | 48             | 32  | C     |
|         | LC4032B-75T48C  | 32         | 2.5     | 7.5             | TQFP    | 48             | 32  | C     |
|         | LC4032B-25T44C  | 32         | 2.5     | 2.5             | TQFP    | 44             | 30  | C     |
|         | LC4032B-5T44C   | 32         | 2.5     | 5               | TQFP    | 44             | 30  | C     |
|         | LC4032B-75T44C  | 32         | 2.5     | 7.5             | TQFP    | 44             | 30  | C     |
| LC4064B | LC4064B-25T100C | 64         | 2.5     | 2.5             | TQFP    | 100            | 64  | C     |
|         | LC4064B-5T100C  | 64         | 2.5     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4064B-75T100C | 64         | 2.5     | 7.5             | TQFP    | 100            | 64  | C     |
|         | LC4064B-25T48C  | 64         | 2.5     | 2.5             | TQFP    | 48             | 32  | C     |
|         | LC4064B-5T48C   | 64         | 2.5     | 5               | TQFP    | 48             | 32  | C     |
|         | LC4064B-75T48C  | 64         | 2.5     | 7.5             | TQFP    | 48             | 32  | C     |
|         | LC4064B-25T44C  | 64         | 2.5     | 2.5             | TQFP    | 44             | 30  | C     |
|         | LC4064B-5T44C   | 64         | 2.5     | 5               | TQFP    | 44             | 30  | C     |
|         | LC4064B-75T44C  | 64         | 2.5     | 7.5             | TQFP    | 44             | 30  | C     |
| LC4128B | LC4128B-27T128C | 128        | 2.5     | 2.7             | TQFP    | 128            | 92  | C     |
|         | LC4128B-5T128C  | 128        | 2.5     | 5               | TQFP    | 128            | 92  | C     |
|         | LC4128B-75T128C | 128        | 2.5     | 7.5             | TQFP    | 128            | 92  | C     |
|         | LC4128B-27T100C | 128        | 2.5     | 2.7             | TQFP    | 100            | 64  | C     |
|         | LC4128B-5T100C  | 128        | 2.5     | 5               | TQFP    | 100            | 64  | C     |
|         | LC4128B-75T100C | 128        | 2.5     | 7.5             | TQFP    | 100            | 64  | C     |

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

| Device  | Part Number                    | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|--------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4064C | LC4064C-25TN100C               | 64         | 1.8     | 2.5             | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4064C-5TN100C                | 64         | 1.8     | 5               | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4064C-75TN100C               | 64         | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4064C-25TN48C                | 64         | 1.8     | 2.5             | Lead-free TQFP  | 48             | 32  | C     |
|         | LC4064C-5TN48C                 | 64         | 1.8     | 5               | Lead-free TQFP  | 48             | 32  | C     |
|         | LC4064C-75TN48C                | 64         | 1.8     | 7.5             | Lead-free TQFP  | 48             | 32  | C     |
|         | LC4064C-25TN44C                | 64         | 1.8     | 2.5             | Lead-free TQFP  | 44             | 30  | C     |
|         | LC4064C-5TN44C                 | 64         | 1.8     | 5               | Lead-free TQFP  | 44             | 30  | C     |
|         | LC4064C-75TN44C                | 64         | 1.8     | 7.5             | Lead-free TQFP  | 44             | 30  | C     |
| LC4128C | LC4128C-27TN128C               | 128        | 1.8     | 2.7             | Lead-free TQFP  | 128            | 92  | C     |
|         | LC4128C-5TN128C                | 128        | 1.8     | 5               | Lead-free TQFP  | 128            | 92  | C     |
|         | LC4128C-75TN128C               | 128        | 1.8     | 7.5             | Lead-free TQFP  | 128            | 92  | C     |
|         | LC4128C-27TN100C               | 128        | 1.8     | 2.7             | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4128C-5TN100C                | 128        | 1.8     | 5               | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4128C-75TN100C               | 128        | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | C     |
| LC4256C | LC4256C-3FTN256AC              | 256        | 1.8     | 3               | Lead-free ftBGA | 256            | 128 | C     |
|         | LC4256C-5FTN256AC              | 256        | 1.8     | 5               | Lead-free ftBGA | 256            | 128 | C     |
|         | LC4256C-75FTN256AC             | 256        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 128 | C     |
|         | LC4256C-3FTN256BC              | 256        | 1.8     | 3               | Lead-free ftBGA | 256            | 160 | C     |
|         | LC4256C-5FTN256BC              | 256        | 1.8     | 5               | Lead-free ftBGA | 256            | 160 | C     |
|         | LC4256C-75FTN256BC             | 256        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 160 | C     |
|         | LC4256C-3FN256AC <sup>1</sup>  | 256        | 1.8     | 3               | Lead-free fpBGA | 256            | 128 | C     |
|         | LC4256C-5FN256AC <sup>1</sup>  | 256        | 1.8     | 5               | Lead-free fpBGA | 256            | 128 | C     |
|         | LC4256C-75FN256AC <sup>1</sup> | 256        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 128 | C     |
|         | LC4256C-3FN256BC <sup>1</sup>  | 256        | 1.8     | 3               | Lead-free fpBGA | 256            | 160 | C     |
|         | LC4256C-5FN256BC <sup>1</sup>  | 256        | 1.8     | 5               | Lead-free fpBGA | 256            | 160 | C     |
|         | LC4256C-75FN256BC <sup>1</sup> | 256        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 160 | C     |
|         | LC4256C-3TN176C                | 256        | 1.8     | 3               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4256C-5TN176C                | 256        | 1.8     | 5               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4256C-75TN176C               | 256        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4256C-3TN100C                | 256        | 1.8     | 3               | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4256C-5TN100C                | 256        | 1.8     | 5               | Lead-free TQFP  | 100            | 64  | C     |
|         | LC4256C-75TN100C               | 256        | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | C     |
| LC4384C | LC4384C-35FTN256C              | 384        | 1.8     | 3.5             | Lead-free ftBGA | 256            | 192 | C     |
|         | LC4384C-5FTN256C               | 384        | 1.8     | 5               | Lead-free ftBGA | 256            | 192 | C     |
|         | LC4384C-75FTN256C              | 384        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 192 | C     |
|         | LC4384C-35FN256C <sup>1</sup>  | 384        | 1.8     | 3.5             | Lead-free fpBGA | 256            | 192 | C     |
|         | LC4384C-5FN256C <sup>1</sup>   | 384        | 1.8     | 5               | Lead-free fpBGA | 256            | 192 | C     |
|         | LC4384C-75FN256C <sup>1</sup>  | 384        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 192 | C     |
|         | LC4384C-35TN176C               | 384        | 1.8     | 3.5             | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4384C-5TN176C                | 384        | 1.8     | 5               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4384C-75TN176C               | 384        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | C     |

**ispMACH 4000C (1.8V) Lead-Free Commercial Devices (Cont.)**

| Device  | Part Number                   | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|---------|-------------------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4512C | LC4512C-35FTN256C             | 512        | 1.8     | 3.5             | Lead-free ftBGA | 256            | 208 | C     |
|         | LC4512C-5FTN256C              | 512        | 1.8     | 5               | Lead-free ftBGA | 256            | 208 | C     |
|         | LC4512C-75FTN256C             | 512        | 1.8     | 7.5             | Lead-free ftBGA | 256            | 208 | C     |
|         | LC4512C-35FN256C <sup>1</sup> | 512        | 1.8     | 3.5             | Lead-free fpBGA | 256            | 208 | C     |
|         | LC4512C-5FN256C <sup>1</sup>  | 512        | 1.8     | 5               | Lead-free fpBGA | 256            | 208 | C     |
|         | LC4512C-75FN256C <sup>1</sup> | 512        | 1.8     | 7.5             | Lead-free fpBGA | 256            | 208 | C     |
|         | LC4512C-35TN176C              | 512        | 1.8     | 3.5             | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4512C-5TN176C               | 512        | 1.8     | 5               | Lead-free TQFP  | 176            | 128 | C     |
|         | LC4512C-75TN176C              | 512        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | C     |

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

**ispMACH 4000C (1.8V) Lead-Free Industrial Devices**

| Device  | Part Number      | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|---------|------------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032C | LC4032C-5TN48I   | 32         | 1.8     | 5               | Lead-free TQFP | 48             | 32  | I     |
|         | LC4032C-75TN48I  | 32         | 1.8     | 7.5             | Lead-free TQFP | 48             | 32  | I     |
|         | LC4032C-10TN48I  | 32         | 1.8     | 10              | Lead-free TQFP | 48             | 32  | I     |
|         | LC4032C-5TN44I   | 32         | 1.8     | 5               | Lead-free TQFP | 44             | 30  | I     |
|         | LC4032C-75TN44I  | 32         | 1.8     | 7.5             | Lead-free TQFP | 44             | 30  | I     |
|         | LC4032C-10TN44I  | 32         | 1.8     | 10              | Lead-free TQFP | 44             | 30  | I     |
| LC4064C | LC4064C-5TN100I  | 64         | 1.8     | 5               | Lead-free TQFP | 100            | 64  | I     |
|         | LC4064C-75TN100I | 64         | 1.8     | 7.5             | Lead-free TQFP | 100            | 64  | I     |
|         | LC4064C-10TN100I | 64         | 1.8     | 10              | Lead-free TQFP | 100            | 64  | I     |
|         | LC4064C-5TN48I   | 64         | 1.8     | 5               | Lead-free TQFP | 48             | 32  | I     |
|         | LC4064C-75TN48I  | 64         | 1.8     | 7.5             | Lead-free TQFP | 48             | 32  | I     |
|         | LC4064C-10TN48I  | 64         | 1.8     | 10              | Lead-free TQFP | 48             | 32  | I     |
|         | LC4064C-5TN44I   | 64         | 1.8     | 5               | Lead-free TQFP | 44             | 30  | I     |
|         | LC4064C-75TN44I  | 64         | 1.8     | 5               | Lead-free TQFP | 44             | 30  | I     |
|         | LC4064C-10TN44I  | 64         | 1.8     | 10              | Lead-free TQFP | 44             | 30  | I     |
| LC4128C | LC4128C-5TN128I  | 128        | 1.8     | 5               | Lead-free TQFP | 128            | 92  | I     |
|         | LC4128C-75TN128I | 128        | 1.8     | 7.5             | Lead-free TQFP | 128            | 92  | I     |
|         | LC4128C-10TN128I | 128        | 1.8     | 10              | Lead-free TQFP | 128            | 92  | I     |
|         | LC4128C-5TN100I  | 128        | 1.8     | 5               | Lead-free TQFP | 100            | 64  | I     |
|         | LC4128C-75TN100I | 128        | 1.8     | 7.5             | Lead-free TQFP | 100            | 64  | I     |
|         | LC4128C-10TN100I | 128        | 1.8     | 10              | Lead-free TQFP | 100            | 64  | I     |

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

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

**ispMACH 4000V (3.3V) Lead-Free Extended Temperature Devices**

| Device  | Part Number      | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|---------|------------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032V | LC4032V-75TN48E  | 32         | 3.3     | 7.5             | Lead-free TQFP | 48             | 32  | E     |
|         | LC4032V-75TN44E  | 32         | 3.3     | 7.5             | Lead-free TQFP | 44             | 30  | E     |
| LC4064V | LC4064V-75TN100E | 64         | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | E     |
|         | LC4064V-75TN48E  | 64         | 3.3     | 7.5             | Lead-free TQFP | 48             | 32  | E     |
|         | LC4064V-75TN44E  | 64         | 3.3     | 7.5             | Lead-free TQFP | 44             | 30  | E     |
| LC4128V | LC4128V-75TN144E | 128        | 3.3     | 7.5             | Lead-free TQFP | 144            | 96  | E     |
|         | LC4128V-75TN128E | 128        | 3.3     | 7.5             | Lead-free TQFP | 128            | 92  | E     |
|         | LC4128V-75TN100E | 128        | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | E     |
| LC4256V | LC4256V-75TN176E | 256        | 3.3     | 7.5             | Lead-free TQFP | 176            | 128 | E     |
|         | LC4256V-75TN144E | 256        | 3.3     | 7.5             | Lead-free TQFP | 144            | 96  | E     |
|         | LC4256V-75TN100E | 256        | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | E     |

**For Further Information**

In addition to this data sheet, the following technical notes may be helpful when designing with the ispMACH 4000V/B/C/Z family:

- TN1004, [ispMACH 4000 Timing Model Design and Usage Guidelines](#)
- TN1005, [Power Estimation in ispMACH 4000V/B/C/Z Devices](#)

**Revision History**

| Date          | Version | Change Summary                                                                                                                                                                                              |
|---------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| —             | —       | Previous Lattice releases.                                                                                                                                                                                  |
| July 2003     | 17z     | Changed device status for LC4064ZC and LC4128ZC to production release and updated/added AC and DC parameters as well as ordering part numbers for LC4064ZC and LC4128ZC devices.                            |
|               |         | Improved leakage current specifications for ispMACH 4000Z. For ispMACH 4000V/B/C IIL, IIH condition now includes 0V and 3.6V end points ( $0 \leq V_{IN} \leq 3.6V$ ).                                      |
|               |         | Added 132-ball chip scale BGA power supply and NC connections.                                                                                                                                              |
|               |         | Added 132-ball chip scale BGA logic signal connections for LC4064ZC, LC4128ZC and LC4256ZC devices.                                                                                                         |
|               |         | Added lead-free package designators.                                                                                                                                                                        |
| October 2003  | 18z     | Hot socketing characteristics footnote 1. has been enhanced; Insensitive to sequence of VCC or VCCO. However, assumes monotonic rise/fall rates for Vcc and Vcco, provided $(V_{IN} - V_{CCO}) \leq 3.6V$ . |
|               |         | Improved LC4064ZC t <sub>S</sub> to 2.5ns, t <sub>ST</sub> to 2.7ns and f <sub>MAX</sub> (Ext.) to 175MHz, LC4128ZC t <sub>CO</sub> to 3.5ns and f <sub>MAX</sub> (Ext.) to 161MHz (version v.2.1).         |
|               |         | Improved associated internal timing numbers and timing adders (version v.2.1).                                                                                                                              |
|               |         | Added ispMACH 4000V/B/C/Z ORP Reference Tables.                                                                                                                                                             |
|               |         | Enhanced ORP information in device pinout tables consistent with the ORP Combinations for I/O Blocks tables (table 6, 7, 8 and 9 in page 9-11).                                                             |
|               |         | Corrected GLB/MC/Pad information in the 256-fpBGA pinouts for the LC4256V/B/C 160-I/O version.                                                                                                              |
|               |         | Added the ispMACH 4000 Family Speed Grade Offering table.                                                                                                                                                   |
|               |         | Added the ispMACH 4128ZC Industrial and Automotive Device OPNs                                                                                                                                              |
| December 2003 | 19z     | Added the ispMACH 4032ZC and 4064ZC Industrial and Automotive Device OPNs                                                                                                                                   |