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

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

## Applications of Embedded - CPLDs

| Details                         |                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status                  | Obsolete                                                                                                                                                              |
| Programmable Type               | In System Programmable                                                                                                                                                |
| Delay Time tpd(1) Max           | 7.5 ns                                                                                                                                                                |
| Voltage Supply - Internal       | 1.7V ~ 1.9V                                                                                                                                                           |
| Number of Logic Elements/Blocks | 4                                                                                                                                                                     |
| Number of Macrocells            | 64                                                                                                                                                                    |
| Number of Gates                 | -                                                                                                                                                                     |
| Number of I/O                   | 64                                                                                                                                                                    |
| Operating Temperature           | -40°C ~ 105°C (TJ)                                                                                                                                                    |
| Mounting Type                   | Surface Mount                                                                                                                                                         |
| Package / Case                  | 100-LQFP                                                                                                                                                              |
| Supplier Device Package         | 100-TQFP (14x14)                                                                                                                                                      |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4064zc-75t100i">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4064zc-75t100i</a> |

## 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 4000V/B/C External Switching Characteristics (Cont.)****Over Recommended Operating Conditions**

| Parameter        | Description <sup>1, 2, 3</sup>                                             | -5   |      | -75  |      | -10  |      | Units |
|------------------|----------------------------------------------------------------------------|------|------|------|------|------|------|-------|
|                  |                                                                            | Min. | Max. | Min. | Max. | Min. | Max. |       |
| $t_{PD}$         | 5-PT bypass combinatorial propagation delay                                | —    | 5.0  | —    | 7.5  | —    | 10.0 | ns    |
| $t_{PD\_MC}$     | 20-PT combinatorial propagation delay through macrocell                    | —    | 5.5  | —    | 8.0  | —    | 10.5 | ns    |
| $t_S$            | GLB register setup time before clock                                       | 3.0  | —    | 4.5  | —    | 5.5  | —    | ns    |
| $t_{ST}$         | GLB register setup time before clock with T-type register                  | 3.2  | —    | 4.7  | —    | 5.5  | —    | ns    |
| $t_{SIR}$        | GLB register setup time before clock, input register path                  | 1.2  | —    | 1.7  | —    | 1.7  | —    | ns    |
| $t_{SIRZ}$       | GLB register setup time before clock with zero hold                        | 2.2  | —    | 2.7  | —    | 2.7  | —    | ns    |
| $t_H$            | GLB register hold time after clock                                         | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| $t_{HT}$         | GLB register hold time after clock with T-type register                    | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| $t_{HIR}$        | GLB register hold time after clock, input register path                    | 1.0  | —    | 1.0  | —    | 1.0  | —    | ns    |
| $t_{HIRZ}$       | GLB register hold time after clock, input register path with zero hold     | 0.0  | —    | 0.0  | —    | 0.0  | —    | ns    |
| $t_{CO}$         | GLB register clock-to-output delay                                         | —    | 3.4  | —    | 4.5  | —    | 6.0  | ns    |
| $t_R$            | External reset pin to output delay                                         | —    | 6.3  | —    | 9.0  | —    | 10.5 | ns    |
| $t_{RW}$         | External reset pulse duration                                              | 2.0  | —    | 4.0  | —    | 4.0  | —    | ns    |
| $t_{PTOE/DIS}$   | Input to output local product term output enable/disable                   | —    | 7.0  | —    | 9.0  | —    | 10.5 | ns    |
| $t_{GPTOE/DIS}$  | Input to output global product term output enable/disable                  | —    | 9.0  | —    | 10.3 | —    | 12.0 | ns    |
| $t_{GOE/DIS}$    | Global OE input to output enable/disable                                   | —    | 5.0  | —    | 7.0  | —    | 8.0  | ns    |
| $t_{CW}$         | Global clock width, high or low                                            | 2.2  | —    | 2.8  | —    | 4.0  | —    | ns    |
| $t_{GW}$         | Global gate width low (for low transparent) or high (for high transparent) | 2.2  | —    | 2.8  | —    | 4.0  | —    | ns    |
| $t_{WIR}$        | Input register clock width, high or low                                    | 2.2  | —    | 2.8  | —    | 4.0  | —    | ns    |
| $f_{MAX}^4$      | Clock frequency with internal feedback                                     | —    | 227  | —    | 168  | —    | 125  | MHz   |
| $f_{MAX}$ (Ext.) | Clock frequency with external feedback, $[1/(t_S + t_{CO})]$               | —    | 156  | —    | 111  | —    | 86   | MHz   |

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

Timing v.3.2

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

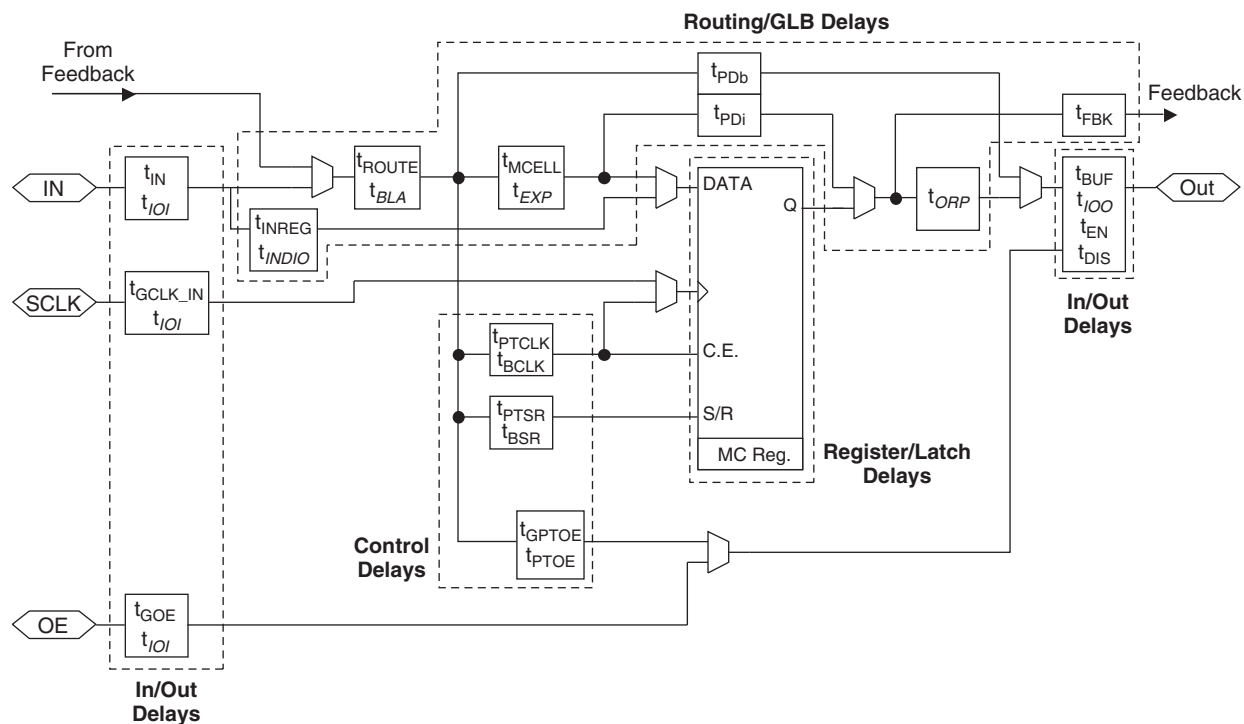
3. Pulse widths and clock widths less than minimum will cause unknown behavior.

4. Standard 16-bit counter using GRP feedback.

## 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 4000V/B/C Internal Timing Parameters

Over Recommended Operating Conditions

| Parameter             | Description                                                            | -5   |      | -75  |      | -10  |      | Units |
|-----------------------|------------------------------------------------------------------------|------|------|------|------|------|------|-------|
|                       |                                                                        | Min. | Max. | Min. | Max. | Min. | Max. |       |
| In/Out Delays         |                                                                        |      |      |      |      |      |      |       |
| t <sub>IN</sub>       | Input Buffer Delay                                                     | —    | 0.95 | —    | 1.50 | —    | 2.00 | ns    |
| t <sub>GOE</sub>      | Global OE Pin Delay                                                    | —    | 4.04 | —    | 6.04 | —    | 7.04 | ns    |
| t <sub>GCLK_IN</sub>  | Global Clock Input Buffer Delay                                        | —    | 1.83 | —    | 2.28 | —    | 3.28 | ns    |
| t <sub>BUF</sub>      | Delay through Output Buffer                                            | —    | 1.00 | —    | 1.50 | —    | 1.50 | ns    |
| t <sub>EN</sub>       | Output Enable Time                                                     | —    | 0.96 | —    | 0.96 | —    | 0.96 | ns    |
| t <sub>DIS</sub>      | Output Disable Time                                                    | —    | 0.96 | —    | 0.96 | —    | 0.96 | ns    |
| Routing/GLB Delays    |                                                                        |      |      |      |      |      |      |       |
| t <sub>ROUTE</sub>    | Delay through GRP                                                      | —    | 1.51 | —    | 2.26 | —    | 3.26 | ns    |
| t <sub>MCELL</sub>    | Macrocell Delay                                                        | —    | 1.05 | —    | 1.45 | —    | 1.95 | ns    |
| t <sub>INREG</sub>    | Input Buffer to Macrocell Register Delay                               | —    | 0.56 | —    | 0.96 | —    | 1.46 | ns    |
| t <sub>FBK</sub>      | Internal Feedback Delay                                                | —    | 0.00 | —    | 0.00 | —    | 0.00 | ns    |
| t <sub>PDb</sub>      | 5-PT Bypass Propagation Delay                                          | —    | 1.54 | —    | 2.24 | —    | 3.24 | ns    |
| t <sub>PDi</sub>      | Macrocell Propagation Delay                                            | —    | 0.94 | —    | 1.24 | —    | 1.74 | ns    |
| Register/Latch Delays |                                                                        |      |      |      |      |      |      |       |
| t <sub>S</sub>        | D-Register Setup Time (Global Clock)                                   | 1.32 | —    | 1.57 | —    | 1.57 | —    | ns    |
| t <sub>S_PT</sub>     | D-Register Setup Time (Product Term Clock)                             | 1.32 | —    | 1.32 | —    | 1.32 | —    | ns    |
| t <sub>ST</sub>       | T-Register Setup Time (Global Clock)                                   | 1.52 | —    | 1.77 | —    | 1.77 | —    | ns    |
| t <sub>ST_PT</sub>    | T-Register Setup Time (Product Term Clock)                             | 1.32 | —    | 1.32 | —    | 1.32 | —    | ns    |
| t <sub>H</sub>        | D-Register Hold Time                                                   | 1.68 | —    | 2.93 | —    | 3.93 | —    | ns    |
| t <sub>HT</sub>       | T-Register Hold Time                                                   | 1.68 | —    | 2.93 | —    | 3.93 | —    | ns    |
| t <sub>SIR</sub>      | D-Input Register Setup Time (Global Clock)                             | 1.52 | —    | 1.57 | —    | 1.57 | —    | 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)                              | 0.68 | —    | 1.18 | —    | 1.18 | —    | ns    |
| t <sub>HIR_PT</sub>   | D-Input Register Hold Time (Product Term Clock)                        | 0.68 | —    | 1.18 | —    | 1.18 | —    | ns    |
| t <sub>COi</sub>      | Register Clock to Output/Feedback MUX Time                             | —    | 0.52 | —    | 0.67 | —    | 1.17 | ns    |
| t <sub>CES</sub>      | Clock Enable Setup Time                                                | 2.25 | —    | 2.25 | —    | 2.25 | —    | ns    |
| t <sub>CEH</sub>      | Clock Enable Hold Time                                                 | 1.88 | —    | 1.88 | —    | 1.88 | —    | ns    |
| t <sub>SL</sub>       | Latch Setup Time (Global Clock)                                        | 1.32 | —    | 1.57 | —    | 1.57 | —    | ns    |
| t <sub>SL_PT</sub>    | Latch Setup Time (Product Term Clock)                                  | 1.32 | —    | 1.32 | —    | 1.32 | —    | ns    |
| t <sub>HL</sub>       | Latch Hold Time                                                        | 1.17 | —    | 1.17 | —    | 1.17 | —    | ns    |
| t <sub>GOi</sub>      | Latch Gate to Output/Feedback MUX Time                                 | —    | 0.33 | —    | 0.33 | —    | 0.33 | ns    |
| t <sub>PDLi</sub>     | Propagation Delay through Transparent Latch to Output/<br>Feedback MUX | —    | 0.25 | —    | 0.25 | —    | 0.25 | ns    |
| t <sub>SRI</sub>      | Asynchronous Reset or Set to Output/Feedback MUX<br>Delay              | 0.28 | —    | 0.28 | —    | 0.28 | —    | ns    |
| t <sub>SRR</sub>      | Asynchronous Reset or Set Recovery Time                                | 1.67 | —    | 1.67 | —    | 1.67 | —    | ns    |
| Control Delays        |                                                                        |      |      |      |      |      |      |       |
| t <sub>BCLK</sub>     | GLB PT Clock Delay                                                     | —    | 1.12 | —    | 1.12 | —    | 0.62 | ns    |
| t <sub>PTCLK</sub>    | Macrocell PT Clock Delay                                               | —    | 0.87 | —    | 0.87 | —    | 0.87 | ns    |
| t <sub>BSR</sub>      | GLB PT Set/Reset Delay                                                 | —    | 1.83 | —    | 1.83 | —    | 1.83 | ns    |
| t <sub>PTSR</sub>     | Macrocell PT Set/Reset Delay                                           | —    | 2.51 | —    | 3.41 | —    | 3.41 | ns    |

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

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

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

Timing v.2.2

ispMACH 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.

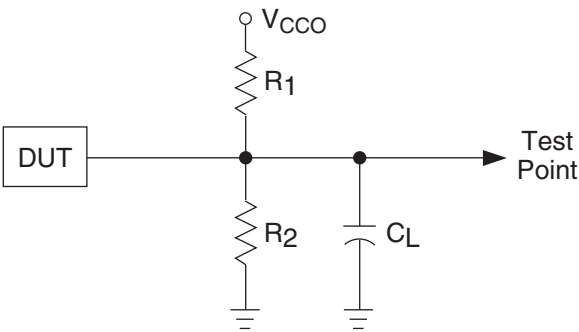
Timing v.3.2

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

Switching Test Conditions

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

Figure 12. Output Test Load, LVTTTL and LVCMOS Standards



0213A/ispm4k

Table 11. Test Fixture Required Components

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

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



**ispMACH 4000V/B/C/Z Power Supply and NC Connections<sup>1</sup>**

| Signal                 | 44-pin TQFP <sup>2</sup> | 48-pin TQFP <sup>2</sup> | 56-ball csBGA <sup>3</sup>                        | 100-pin TQFP <sup>2</sup> | 128-pin TQFP <sup>2</sup> |
|------------------------|--------------------------|--------------------------|---------------------------------------------------|---------------------------|---------------------------|
| VCC                    | 11, 33                   | 12, 36                   | K2, A9                                            | 25, 40, 75, 90            | 32, 51, 96, 115           |
| VCCO0<br>VCCO (Bank 0) | 6                        | 6                        | F3                                                | 13, 33, 95                | 3, 17, 30, 41, 122        |
| VCCO1<br>VCCO (Bank 1) | 28                       | 30                       | E8                                                | 45, 63, 83                | 58, 67, 81, 94, 105       |
| GND                    | 12, 34                   | 13, 37                   | H3, C8                                            | 1, 26, 51, 76             | 1, 33, 65, 97             |
| GND (Bank 0)           | 5                        | 5                        | D3                                                | 7, 18, 32, 96             | 10, 24, 40, 113, 123      |
| GND (Bank 1)           | 27                       | 29                       | G8                                                | 46, 57, 68, 82            | 49, 59, 74, 88, 104       |
| NC                     | —                        | —                        | <b>4032Z:</b> A8, B10, E1,<br>E3, F8, F10, J1, K3 | —                         | —                         |

1. All grounds must be electrically connected at the board level. However, for the purposes of I/O current loading, grounds are associated with the bank shown.
2. Pin orientation follows the conventional order from pin 1 marking of the top side view and counter-clockwise.
3. Pin orientation A1 starts from the upper left corner of the top side view with alphabetical order ascending vertically and numerical order ascending horizontally.

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

| Pin Number | Bank Number | ispMACH 4032V/B/C |                | ispMACH 4064V/B/C |                |
|------------|-------------|-------------------|----------------|-------------------|----------------|
|            |             | GLB/MC/Pad        | ORP            | GLB/MC/Pad        | ORP            |
| 42         | 0           | A2                | A <sup>2</sup> | A4                | A <sup>2</sup> |
| 43         | 0           | A3                | A <sup>3</sup> | A6                | A <sup>3</sup> |
| 44         | 0           | A4                | A <sup>4</sup> | A8                | A <sup>4</sup> |

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

| 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            |
| 1          | -           | TDI                 | -               | TDI               | -              | TDI           | -              |
| 2          | 0           | A5                  | A <sup>5</sup>  | A10               | A <sup>5</sup> | A8            | A <sup>5</sup> |
| 3          | 0           | A6                  | A <sup>6</sup>  | A12               | A <sup>6</sup> | A10           | A <sup>6</sup> |
| 4          | 0           | A7                  | A <sup>7</sup>  | A14               | A <sup>7</sup> | A11           | A <sup>7</sup> |
| 5          | 0           | GND (Bank 0)        | -               | GND (Bank 0)      | -              | GND (Bank 0)  | -              |
| 6          | 0           | VCCO (Bank 0)       | -               | VCCO (Bank 0)     | -              | VCCO (Bank 0) | -              |
| 7          | 0           | A8                  | A <sup>8</sup>  | B0                | B <sup>0</sup> | B15           | B <sup>7</sup> |
| 8          | 0           | A9                  | A <sup>9</sup>  | B2                | B <sup>1</sup> | B12           | B <sup>6</sup> |
| 9          | 0           | A10                 | A <sup>10</sup> | B4                | B <sup>2</sup> | B10           | B <sup>5</sup> |
| 10         | 0           | A11                 | A <sup>11</sup> | B6                | B <sup>3</sup> | B8            | B <sup>4</sup> |
| 11         | -           | TCK                 | -               | TCK               | -              | TCK           | -              |
| 12         | -           | VCC                 | -               | VCC               | -              | VCC           | -              |
| 13         | -           | GND                 | -               | GND               | -              | GND           | -              |
| 14         | 0           | A12                 | A <sup>12</sup> | B8                | B <sup>4</sup> | B6            | B <sup>3</sup> |
| 15         | 0           | A13                 | A <sup>13</sup> | B10               | B <sup>5</sup> | B4            | B <sup>2</sup> |
| 16         | 0           | A14                 | A <sup>14</sup> | B12               | B <sup>6</sup> | B2            | B <sup>1</sup> |
| 17         | 0           | A15                 | A <sup>15</sup> | B14               | B <sup>7</sup> | B0            | B <sup>0</sup> |
| 18         | 0           | CLK1/I              | -               | CLK1/I            | -              | CLK1/I        | -              |
| 19         | 1           | CLK2/I              | -               | CLK2/I            | -              | CLK2/I        | -              |
| 20         | 1           | B0                  | B <sup>0</sup>  | C0                | C <sup>0</sup> | C0            | C <sup>0</sup> |
| 21         | 1           | B1                  | B <sup>1</sup>  | C2                | C <sup>1</sup> | C1            | C <sup>1</sup> |
| 22         | 1           | B2                  | B <sup>2</sup>  | C4                | C <sup>2</sup> | C2            | C <sup>2</sup> |
| 23         | 1           | B3                  | B <sup>3</sup>  | C6                | C <sup>3</sup> | C4            | C <sup>3</sup> |
| 24         | 1           | B4                  | B <sup>4</sup>  | C8                | C <sup>4</sup> | C6            | C <sup>4</sup> |
| 25         | -           | TMS                 | -               | TMS               | -              | TMS           | -              |
| 26         | 1           | B5                  | B <sup>5</sup>  | C10               | C <sup>5</sup> | C8            | C <sup>5</sup> |
| 27         | 1           | B6                  | B <sup>6</sup>  | C12               | C <sup>6</sup> | C10           | C <sup>6</sup> |
| 28         | 1           | B7                  | B <sup>7</sup>  | C14               | C <sup>7</sup> | C11           | C <sup>7</sup> |
| 29         | 1           | GND (Bank 1)        | -               | GND (Bank 1)      | -              | GND (Bank 1)  | -              |
| 30         | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)     | -              | VCCO (Bank 1) | -              |
| 31         | 1           | B8                  | B <sup>8</sup>  | D0                | D <sup>0</sup> | D15           | D <sup>7</sup> |
| 32         | 1           | B9                  | B <sup>9</sup>  | D2                | D <sup>1</sup> | D12           | D <sup>6</sup> |

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

| Pin Number | Bank Number | ispMACH 4064V/B/C/Z |                 | ispMACH 4128V/B/C/Z |                | ispMACH 4256V/B/C/Z |                |
|------------|-------------|---------------------|-----------------|---------------------|----------------|---------------------|----------------|
|            |             | GLB/MC/Pad          | ORP             | GLB/MC/Pad          | ORP            | GLB/MC/Pad          | ORP            |
| 42         | 1           | C1                  | C <sup>1</sup>  | E2                  | E <sup>1</sup> | I6                  | I <sup>1</sup> |
| 43         | 1           | C2                  | C <sup>2</sup>  | E4                  | E <sup>2</sup> | I10                 | I <sup>2</sup> |
| 44         | 1           | C3                  | C <sup>3</sup>  | E6                  | E <sup>3</sup> | I12                 | I <sup>3</sup> |
| 45         | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)       | -              | VCCO (Bank 1)       | -              |
| 46         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |
| 47         | 1           | C4                  | C <sup>4</sup>  | E8                  | E <sup>4</sup> | J2                  | J <sup>0</sup> |
| 48         | 1           | C5                  | C <sup>5</sup>  | E10                 | E <sup>5</sup> | J6                  | J <sup>1</sup> |
| 49         | 1           | C6                  | C <sup>6</sup>  | E12                 | E <sup>6</sup> | J10                 | J <sup>2</sup> |
| 50         | 1           | C7                  | C <sup>7</sup>  | E14                 | E <sup>7</sup> | J12                 | J <sup>3</sup> |
| 51         | -           | GND                 | -               | GND                 | -              | GND                 | -              |
| 52         | -           | TMS                 | -               | TMS                 | -              | TMS                 | -              |
| 53         | 1           | C8                  | C <sup>8</sup>  | F0                  | F <sup>0</sup> | K12                 | K <sup>3</sup> |
| 54         | 1           | C9                  | C <sup>9</sup>  | F2                  | F <sup>1</sup> | K10                 | K <sup>2</sup> |
| 55         | 1           | C10                 | C <sup>10</sup> | F4                  | F <sup>2</sup> | K6                  | K <sup>1</sup> |
| 56         | 1           | C11                 | C <sup>11</sup> | F6                  | F <sup>3</sup> | K2                  | K <sup>0</sup> |
| 57         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |
| 58         | 1           | C12                 | C <sup>12</sup> | F8                  | F <sup>4</sup> | L12                 | L <sup>3</sup> |
| 59         | 1           | C13                 | C <sup>13</sup> | F10                 | F <sup>5</sup> | L10                 | L <sup>2</sup> |
| 60         | 1           | C14                 | C <sup>14</sup> | F12                 | F <sup>6</sup> | L6                  | L <sup>1</sup> |
| 61         | 1           | C15                 | C <sup>15</sup> | F13                 | F <sup>7</sup> | L4                  | L <sup>0</sup> |
| 62*        | 1           | I                   | -               | I                   | -              | I                   | -              |
| 63         | 1           | VCCO (Bank 1)       | -               | VCCO (Bank 1)       | -              | VCCO (Bank 1)       | -              |
| 64         | 1           | D15                 | D <sup>15</sup> | G14                 | G <sup>7</sup> | M4                  | M <sup>0</sup> |
| 65         | 1           | D14                 | D <sup>14</sup> | G12                 | G <sup>6</sup> | M6                  | M <sup>1</sup> |
| 66         | 1           | D13                 | D <sup>13</sup> | G10                 | G <sup>5</sup> | M10                 | M <sup>2</sup> |
| 67         | 1           | D12                 | D <sup>12</sup> | G8                  | G <sup>4</sup> | M12                 | M <sup>3</sup> |
| 68         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |
| 69         | 1           | D11                 | D <sup>11</sup> | G6                  | G <sup>3</sup> | N2                  | N <sup>0</sup> |
| 70         | 1           | D10                 | D <sup>10</sup> | G5                  | G <sup>2</sup> | N6                  | N <sup>1</sup> |
| 71         | 1           | D9                  | D <sup>9</sup>  | G4                  | G <sup>1</sup> | N10                 | N <sup>2</sup> |
| 72         | 1           | D8                  | D <sup>8</sup>  | G2                  | G <sup>0</sup> | N12                 | N <sup>3</sup> |
| 73*        | 1           | I                   | -               | I                   | -              | I                   | -              |
| 74         | -           | TDO                 | -               | TDO                 | -              | TDO                 | -              |
| 75         | -           | VCC                 | -               | VCC                 | -              | VCC                 | -              |
| 76         | -           | GND                 | -               | GND                 | -              | GND                 | -              |
| 77*        | 1           | I                   | -               | I                   | -              | I                   | -              |
| 78         | 1           | D7                  | D <sup>7</sup>  | H13                 | H <sup>7</sup> | O12                 | O <sup>3</sup> |
| 79         | 1           | D6                  | D <sup>6</sup>  | H12                 | H <sup>6</sup> | O10                 | O <sup>2</sup> |
| 80         | 1           | D5                  | D <sup>5</sup>  | H10                 | H <sup>5</sup> | O6                  | O <sup>1</sup> |
| 81         | 1           | D4                  | D <sup>4</sup>  | H8                  | H <sup>4</sup> | O2                  | O <sup>0</sup> |
| 82         | 1           | GND (Bank 1)        | -               | GND (Bank 1)        | -              | GND (Bank 1)        | -              |

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

| Pin Number | Bank Number | ispMACH 4128V/B/C |                 |
|------------|-------------|-------------------|-----------------|
|            |             | GLB/MC/Pad        | ORP             |
| 105        | 1           | VCCO (Bank 1)     | -               |
| 106        | 1           | H6                | H <sup>5</sup>  |
| 107        | 1           | H5                | H <sup>4</sup>  |
| 108        | 1           | H4                | H <sup>3</sup>  |
| 109        | 1           | H2                | H <sup>2</sup>  |
| 110        | 1           | H1                | H <sup>1</sup>  |
| 111        | 1           | H0/GOE1           | H <sup>0</sup>  |
| 112        | 1           | CLK3/I            | -               |
| 113        | 0           | GND (Bank 0)      | -               |
| 114        | 0           | CLK0/I            | -               |
| 115        | 0           | VCC               | -               |
| 116        | 0           | A0/GOE0           | A <sup>0</sup>  |
| 117        | 0           | A1                | A <sup>1</sup>  |
| 118        | 0           | A2                | A <sup>2</sup>  |
| 119        | 0           | A4                | A <sup>3</sup>  |
| 120        | 0           | A5                | A <sup>4</sup>  |
| 121        | 0           | A6                | A <sup>5</sup>  |
| 122        | 0           | VCCO (Bank 0)     | -               |
| 123        | 0           | GND (Bank 0)      | -               |
| 124        | 0           | A8                | A <sup>6</sup>  |
| 125        | 0           | A9                | A <sup>7</sup>  |
| 126        | 0           | A10               | A <sup>8</sup>  |
| 127        | 0           | A12               | A <sup>9</sup>  |
| 128        | 0           | A14               | A <sup>11</sup> |

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

| Ball Number | Bank Number | ispMACH 4064Z |                 | ispMACH 4128Z |                | ispMACH 4256Z |                |
|-------------|-------------|---------------|-----------------|---------------|----------------|---------------|----------------|
|             |             | GLB/MC/Pad    | ORP             | GLB/MC/Pad    | ORP            | GLB/MC/Pad    | ORP            |
| B1          | -           | GND           | -               | GND           | -              | GND           | -              |
| B2          | -           | TDI           | -               | TDI           | -              | TDI           | -              |
| C1          | 0           | NC            | -               | VCCO (Bank 0) | -              | VCCO (Bank 0) | -              |
| C3          | 0           | NC            | -               | B0            | B <sup>0</sup> | C12           | C <sup>6</sup> |
| C2          | 0           | A8            | A <sup>8</sup>  | B1            | B <sup>1</sup> | C10           | C <sup>5</sup> |
| D1          | 0           | A9            | A <sup>9</sup>  | B2            | B <sup>2</sup> | C8            | C <sup>4</sup> |
| D3          | 0           | A10           | A <sup>10</sup> | B4            | B <sup>3</sup> | C6            | C <sup>3</sup> |
| D2          | 0           | A11           | A <sup>11</sup> | B5            | B <sup>4</sup> | C4            | C <sup>2</sup> |
| E1          | 0           | NC            | -               | B6            | B <sup>5</sup> | C2            | C <sup>1</sup> |
| E2          | 0           | GND (Bank 0)  | -               | GND (Bank 0)  | -              | GND (Bank 0)  | -              |

**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            |
| P8          | 1           | NC <sup>1</sup> | -               | NC <sup>1</sup> | -               | I <sup>1</sup> | -              |
| M8          | 1           | NC              | -               | E0              | E <sup>0</sup>  | I2             | I <sup>1</sup> |
| P9          | 1           | C0              | C <sup>0</sup>  | E1              | E <sup>1</sup>  | I4             | I <sup>2</sup> |
| N9          | 1           | C1              | C <sup>1</sup>  | E2              | E <sup>2</sup>  | I6             | I <sup>3</sup> |
| M9          | 1           | C2              | C <sup>2</sup>  | E4              | E <sup>3</sup>  | I8             | I <sup>4</sup> |
| N10         | 1           | C3              | C <sup>3</sup>  | E5              | E <sup>4</sup>  | I10            | I <sup>5</sup> |
| P10         | 1           | NC              | -               | E6              | E <sup>5</sup>  | I12            | I <sup>6</sup> |
| M10         | 1           | VCCO (Bank 1)   | -               | VCCO (Bank 1)   | -               | VCCO (Bank 1)  | -              |
| N11         | 1           | GND (Bank 1)    | -               | GND (Bank 1)    | -               | GND (Bank 1)   | -              |
| P11         | 1           | NC              | -               | E8              | E <sup>6</sup>  | J2             | J <sup>1</sup> |
| M11         | 1           | C4              | C <sup>4</sup>  | E9              | E <sup>7</sup>  | J4             | J <sup>2</sup> |
| P12         | 1           | C5              | C <sup>5</sup>  | E10             | E <sup>8</sup>  | J6             | J <sup>3</sup> |
| N12         | 1           | C6              | C <sup>6</sup>  | E12             | E <sup>9</sup>  | J8             | J <sup>4</sup> |
| P13         | 1           | C7              | C <sup>7</sup>  | E13             | E <sup>10</sup> | J10            | J <sup>5</sup> |
| P14         | 1           | NC              | -               | E14             | E <sup>11</sup> | J12            | J <sup>6</sup> |
| N14         | -           | GND             | -               | GND             | -               | GND            | -              |
| N13         | -           | TMS             | -               | TMS             | -               | TMS            | -              |
| M14         | 1           | NC              | -               | VCCO (Bank 1)   | -               | VCCO (Bank 1)  | -              |
| M12         | 1           | NC              | -               | F0              | F <sup>0</sup>  | K12            | K <sup>6</sup> |
| M13         | 1           | C8              | C <sup>8</sup>  | F1              | F <sup>1</sup>  | K10            | K <sup>5</sup> |
| L14         | 1           | C9              | C <sup>9</sup>  | F2              | F <sup>2</sup>  | K8             | K <sup>4</sup> |
| L12         | 1           | C10             | C <sup>10</sup> | F4              | F <sup>3</sup>  | K6             | K <sup>3</sup> |
| L13         | 1           | C11             | C <sup>11</sup> | F5              | F <sup>4</sup>  | K4             | K <sup>2</sup> |
| K14         | 1           | NC              | -               | F6              | F <sup>5</sup>  | K2             | K <sup>1</sup> |
| K13         | 1           | GND (Bank 1)    | -               | GND (Bank 1)    | -               | GND (Bank 1)   | -              |
| K12         | 1           | NC              | -               | F8              | F <sup>6</sup>  | L12            | L <sup>6</sup> |
| J13         | 1           | C12             | C <sup>12</sup> | F9              | F <sup>7</sup>  | L10            | L <sup>5</sup> |
| J14         | 1           | C13             | C <sup>13</sup> | F10             | F <sup>8</sup>  | L8             | L <sup>4</sup> |
| J12         | 1           | C14             | C <sup>14</sup> | F12             | F <sup>9</sup>  | L6             | L <sup>3</sup> |
| H14         | 1           | C15             | C <sup>15</sup> | F13             | F <sup>10</sup> | L4             | L <sup>2</sup> |
| H13         | 1           | I               | -               | F14             | F <sup>11</sup> | L2             | L <sup>1</sup> |
| H12         | 1           | VCCO (Bank 1)   | -               | VCCO (Bank 1)   | -               | VCCO (Bank 1)  | -              |
| G13         | 1           | NC              | -               | G14             | G <sup>11</sup> | M2             | M <sup>1</sup> |
| G14         | 1           | NC              | -               | G13             | G <sup>10</sup> | M4             | M <sup>2</sup> |
| G12         | 1           | D15             | D <sup>15</sup> | G12             | G <sup>9</sup>  | M6             | M <sup>3</sup> |
| F14         | 1           | D14             | D <sup>14</sup> | G10             | G <sup>8</sup>  | M8             | M <sup>4</sup> |
| F13         | 1           | D13             | D <sup>13</sup> | G9              | G <sup>7</sup>  | M10            | M <sup>5</sup> |
| F12         | 1           | D12             | D <sup>12</sup> | G8              | G <sup>6</sup>  | M12            | M <sup>6</sup> |
| E13         | 1           | GND (Bank 1)    | -               | GND (Bank 1)    | -               | GND (Bank 1)   | -              |
| E14         | 1           | NC              | -               | G6              | G <sup>5</sup>  | N2             | N <sup>1</sup> |
| E12         | 1           | D11             | D <sup>11</sup> | G5              | G <sup>4</sup>  | N4             | N <sup>2</sup> |

**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             |
| 60         | 0           | H8                  | H <sup>4</sup> | L8                | L <sup>4</sup> | P8                | P <sup>4</sup>  |
| 61         | 0           | H6                  | H <sup>3</sup> | L6                | L <sup>3</sup> | P6                | P <sup>3</sup>  |
| 62         | 0           | H4                  | H <sup>2</sup> | L4                | L <sup>2</sup> | P4                | P <sup>2</sup>  |
| 63         | 0           | H2                  | H <sup>1</sup> | L2                | L <sup>1</sup> | P2                | P <sup>1</sup>  |
| 64         | 0           | H0                  | H <sup>0</sup> | L0                | L <sup>0</sup> | P0                | P <sup>0</sup>  |
| 65         | -           | GND                 | -              | GND               | -              | GND               | -               |
| 66         | 0           | CLK1/I              | -              | CLK1/I            | -              | CLK1/I            | -               |
| 67         | 1           | GND (Bank 1)        | -              | GND (Bank 1)      | -              | GND (Bank 1)      | -               |
| 68         | 1           | CLK2/I              | -              | CLK2/I            | -              | CLK2/I            | -               |
| 69         | -           | VCC                 | -              | VCC               | -              | VCC               | -               |
| 70         | 1           | I0                  | I <sup>0</sup> | M0                | M <sup>0</sup> | AX0               | AX <sup>0</sup> |
| 71         | 1           | I2                  | I <sup>1</sup> | M2                | M <sup>1</sup> | AX2               | AX <sup>1</sup> |
| 72         | 1           | I4                  | I <sup>2</sup> | M4                | M <sup>2</sup> | AX4               | AX <sup>2</sup> |
| 73         | 1           | I6                  | I <sup>3</sup> | M6                | M <sup>3</sup> | AX6               | AX <sup>3</sup> |
| 74         | 1           | I8                  | I <sup>4</sup> | M8                | M <sup>4</sup> | AX8               | AX <sup>4</sup> |
| 75         | 1           | I10                 | I <sup>5</sup> | M10               | M <sup>5</sup> | AX10              | AX <sup>5</sup> |
| 76         | 1           | I12                 | I <sup>6</sup> | M12               | M <sup>6</sup> | AX12              | AX <sup>6</sup> |
| 77         | 1           | I14                 | I <sup>7</sup> | M14               | M <sup>7</sup> | AX14              | AX <sup>7</sup> |
| 78         | 1           | VCCO (Bank 1)       | -              | VCCO (Bank 1)     | -              | VCCO (Bank 1)     | -               |
| 79         | 1           | GND (Bank 1)        | -              | GND (Bank 1)      | -              | GND (Bank 1)      | -               |
| 80         | 1           | J0                  | J <sup>0</sup> | N0                | N <sup>0</sup> | BX0               | BX <sup>0</sup> |
| 81         | 1           | J2                  | J <sup>1</sup> | N2                | N <sup>1</sup> | BX2               | BX <sup>1</sup> |
| 82         | 1           | J4                  | J <sup>2</sup> | N4                | N <sup>2</sup> | BX4               | BX <sup>2</sup> |
| 83         | 1           | J6                  | J <sup>3</sup> | N6                | N <sup>3</sup> | BX6               | BX <sup>3</sup> |
| 84         | 1           | J8                  | J <sup>4</sup> | N8                | N <sup>4</sup> | BX8               | BX <sup>4</sup> |
| 85         | 1           | J10                 | J <sup>5</sup> | N10               | N <sup>5</sup> | BX10              | BX <sup>5</sup> |
| 86         | 1           | J12                 | J <sup>6</sup> | N12               | N <sup>6</sup> | BX12              | BX <sup>6</sup> |
| 87         | 1           | J14                 | J <sup>7</sup> | N14               | N <sup>7</sup> | BX14              | BX <sup>7</sup> |
| 88         | -           | VCC                 | -              | VCC               | -              | VCC               | -               |
| 89         | -           | NC                  | -              | NC                | -              | NC                | -               |
| 90         | -           | GND                 | -              | GND               | -              | GND               | -               |
| 91         | -           | TMS                 | -              | TMS               | -              | TMS               | -               |
| 92         | 1           | VCCO (Bank 1)       | -              | VCCO (Bank 1)     | -              | VCCO (Bank 1)     | -               |
| 93         | 1           | K14                 | K <sup>7</sup> | O14               | O <sup>7</sup> | CX14              | CX <sup>7</sup> |
| 94         | 1           | K12                 | K <sup>6</sup> | O12               | O <sup>6</sup> | CX12              | CX <sup>6</sup> |
| 95         | 1           | K10                 | K <sup>5</sup> | O10               | O <sup>5</sup> | CX10              | CX <sup>5</sup> |
| 96         | 1           | K8                  | K <sup>4</sup> | O8                | O <sup>4</sup> | CX8               | CX <sup>4</sup> |
| 97         | 1           | K6                  | K <sup>3</sup> | O6                | O <sup>3</sup> | CX6               | CX <sup>3</sup> |
| 98         | 1           | K4                  | K <sup>2</sup> | O4                | O <sup>2</sup> | CX4               | CX <sup>2</sup> |
| 99         | 1           | K2                  | K <sup>1</sup> | O2                | O <sup>1</sup> | CX2               | CX <sup>1</sup> |
| 100        | 1           | K0                  | K <sup>0</sup> | O0                | O <sup>0</sup> | CX0               | CX <sup>0</sup> |

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

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

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

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

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

## ispMACH 4000V (3.3V) Commercial Devices

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



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

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

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

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

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

**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                                                                                                                                   |

**Revision History (Cont.)**

| Date          | Version | Change Summary                                                                                                                        |
|---------------|---------|---------------------------------------------------------------------------------------------------------------------------------------|
| January 2004  | 20z     | ispMACH 4000Z data sheet status changed from preliminary to final. Documents production release of the ispMACH 4256Z device.          |
|               |         | Added new feature - ispMACH 4000Z supports operation down to 1.6V.                                                                    |
|               |         | Added lead-free packaging ordering part numbers for the ispMACH 4000Z/C/V devices.                                                    |
| April 2004    | 21z     | Updated $I_{PU}$ (I/O Weak Pull-up Resistor Current) max. specification for the ispMACH 4000V/B/C; -150 $\mu$ A to -200 $\mu$ A.      |
| November 2004 | 22z     | Added User Electronic Signature section.                                                                                              |
|               |         | Added ispMACH 4000B (2.5V) Lead-Free Ordering Part Numbers.                                                                           |
| December 2004 | 22z.1   | Updated Further Information section.                                                                                                  |
| February 2006 | 22z.2   | Clarification to ispMACH 4000Z Input Leakage ( $I_{IH}$ ) specification.                                                              |
| March 2007    | 22.3    | Updated ispMACH 4000 Introduction section.                                                                                            |
|               |         | Updated Signal Descriptions table.                                                                                                    |
| June 2007     | 22.4    | Updated Features bullets to include reference to "LA" automotive data sheet under the "Broad Device Offering" bullet.                 |
|               |         | Added footnote 1 to Part Number Description to reference the "LA" automotive data sheet.                                              |
|               |         | Changed device temperature references from 'Automotive' to "Extended Temperature" for non-AEC-Q100 qualified devices.                 |
| November 2007 | 23.0    | Added 256-ftBGA package Ordering Part Number information per PCN#14A-07.                                                              |
| May 2009      | 23.1    | Correction to $t_{CW}$ , $t_{GW}$ , $t_{WIR}$ and $f_{MAX}$ parameters in ispMACH 4000Z External Switching Characteristics table.     |
|               |         | Correction to $t_{CW}$ , $t_{GW}$ , $t_{WIR}$ and $f_{MAX}$ parameters in ispMACH 4000V/B/C External Switching Characteristics table. |