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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       | 1.65V ~ 1.95V                                                                                                                                                         |
| Number of Logic Elements/Blocks | 32                                                                                                                                                                    |
| Number of Macrocells            | 512                                                                                                                                                                   |
| Number of Gates                 | -                                                                                                                                                                     |
| Number of I/O                   | 128                                                                                                                                                                   |
| Operating Temperature           | 0°C ~ 90°C (TJ)                                                                                                                                                       |
| Mounting Type                   | Surface Mount                                                                                                                                                         |
| Package / Case                  | 176-LQFP                                                                                                                                                              |
| Supplier Device Package         | 176-TQFP (24x24)                                                                                                                                                      |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4512c-75tn176c">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4512c-75tn176c</a> |

**Figure 2. Generic Logic Block**

## AND Array

The programmable AND Array consists of 36 inputs and 83 output product terms. The 36 inputs from the GRP are used to form 72 lines in the AND Array (true and complement of the inputs). Each line in the array can be connected to any of the 83 output product terms via a wired-AND. Each of the 80 logic product terms feed the logic allocator with the remaining three control product terms feeding the Shared PT Clock, Shared PT Initialization and Shared PT OE. The Shared PT Clock and Shared PT Initialization signals can optionally be inverted before being fed to the macrocells.

Every set of five product terms from the 80 logic product terms forms a product term cluster starting with PT0. There is one product term cluster for every macrocell in the GLB. Figure 3 is a graphical representation of the AND Array.

**Table 7. ORP Combinations for I/O Blocks with 16 I/Os**

| I/O Cell | Available Macrocells                 |
|----------|--------------------------------------|
| I/O 0    | M0, M1, M2, M3, M4, M5, M6, M7       |
| I/O 1    | M1, M2, M3, M4, M5, M6, M7, M8       |
| I/O 2    | M2, M3, M4, M5, M6, M7, M8, M9       |
| I/O 3    | M3, M4, M5, M6, M7, M8, M9, M10      |
| I/O 4    | M4, M5, M6, M7, M8, M9, M10, M11     |
| I/O 5    | M5, M6, M7, M8, M9, M10, M11, M12    |
| I/O 6    | M6, M7, M8, M9, M10, M11, M12, M13   |
| I/O 7    | M7, M8, M9, M10, M11, M12, M13, M14  |
| I/O 8    | M8, M9, M10, M11, M12, M13, M14, M15 |
| I/O 9    | M9, M10, M11, M12, M13, M14, M15, M0 |
| I/O 10   | M10, M11, M12, M13, M14, M15, M0, M1 |
| I/O 11   | M11, M12, M13, M14, M15, M0, M1, M2  |
| I/O 12   | M12, M13, M14, M15, M0, M1, M2, M3   |
| I/O 13   | M13, M14, M15, M0, M1, M2, M3, M4    |
| I/O 14   | M14, M15, M0, M1, M2, M3, M4, M5     |
| I/O 15   | M15, M0, M1, M2, M3, M4, M5, M6      |

**Table 8. ORP Combinations for I/O Blocks with 4 I/Os**

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

**Table 9. ORP Combinations for I/O Blocks with 10 I/Os**

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

## I/O Recommended Operating Conditions

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

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

2. ispMACH 4000Z only.

## DC Electrical Characteristics

### Over Recommended Operating Conditions

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

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

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

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

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

## 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    |

## Supply Current, ispMACH 4000V/B/C (Cont.)

### Over Recommended Operating Conditions

| Symbol       | Parameter                    | Condition       | Min. | Typ. | Max. | Units |
|--------------|------------------------------|-----------------|------|------|------|-------|
| $I_{CC}^{4}$ | Standby Power Supply Current | $V_{CC} = 3.3V$ | —    | 13   | —    | mA    |
|              |                              | $V_{CC} = 2.5V$ | —    | 13   | —    | mA    |
|              |                              | $V_{CC} = 1.8V$ | —    | 3    | —    | mA    |

1.  $T_A = 25^{\circ}C$ , frequency = 1.0 MHz.
2. Device configured with 16-bit counters.
3.  $I_{CC}$  varies with specific device configuration and operating frequency.
4.  $T_A = 25^{\circ}C$

## Supply Current, ispMACH 4000Z

### Over Recommended Operating Conditions

| Symbol                    | Parameter                      | Condition                          | Min. | Typ. | Max. | Units |
|---------------------------|--------------------------------|------------------------------------|------|------|------|-------|
| ispMACH 4032ZC            |                                |                                    |      |      |      |       |
| ICC <sup>1, 2, 3, 5</sup> | Operating Power Supply Current | Vcc = 1.8V, T <sub>A</sub> = 25°C  | —    | 50   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 70°C  | —    | 58   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 85°C  | —    | 60   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 125°C | —    | 70   | —    | μA    |
| ICC <sup>4, 5</sup>       | Standby Power Supply Current   | Vcc = 1.8V, T <sub>A</sub> = 25°C  | —    | 10   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 70°C  | —    | 13   | 20   | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 85°C  | —    | 15   | 25   | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 125°C | —    | 22   | —    | μA    |
| ispMACH 4064ZC            |                                |                                    |      |      |      |       |
| ICC <sup>1, 2, 3, 5</sup> | Operating Power Supply Current | Vcc = 1.8V, T <sub>A</sub> = 25°C  | —    | 80   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 70°C  | —    | 89   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 85°C  | —    | 92   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 125°C | —    | 109  | —    | μA    |
| ICC <sup>4, 5</sup>       | Standby Power Supply Current   | Vcc = 1.8V, T <sub>A</sub> = 25°C  | —    | 11   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 70°C  | —    | 15   | 25   | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 85°C  | —    | 18   | 35   | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 125°C | —    | 37   | —    | μA    |
| ispMACH 4128ZC            |                                |                                    |      |      |      |       |
| ICC <sup>1, 2, 3, 5</sup> | Operating Power Supply Current | Vcc = 1.8V, T <sub>A</sub> = 25°C  | —    | 168  | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 70°C  | —    | 190  | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 85°C  | —    | 195  | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 125°C | —    | 212  | —    | μA    |
| ICC <sup>4, 5</sup>       | Standby Power Supply Current   | Vcc = 1.8V, T <sub>A</sub> = 25°C  | —    | 12   | —    | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 70°C  | —    | 16   | 35   | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 85°C  | —    | 19   | 50   | μA    |
|                           |                                | Vcc = 1.9V, T <sub>A</sub> = 125°C | —    | 42   | —    | μA    |

## I/O DC Electrical Characteristics

### Over Recommended Operating Conditions

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

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

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

Over Recommended Operating Conditions

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

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

Timing v.3.2

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

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

4. Standard 16-bit counter using GRP feedback.

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

| Parameter                    | Description           | -45  |      | -5   |      | -75  |      | Units |
|------------------------------|-----------------------|------|------|------|------|------|------|-------|
|                              |                       | Min. | Max. | Min. | Max. | Min. | Max. |       |
| t <sub>P<sub>TOE</sub></sub> | Macrocell PT OE Delay | —    | 2.50 | —    | 2.70 | —    | 2.00 | ns    |

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

Timing v.2.2

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

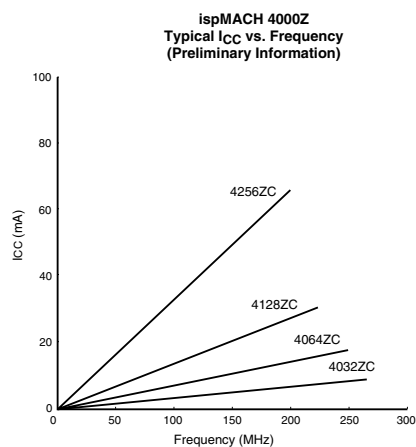
| Adder Type                        | Base Parameter                                            | Description                                | -45  |      | -5   |      | -75  |      | Units |
|-----------------------------------|-----------------------------------------------------------|--------------------------------------------|------|------|------|------|-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

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

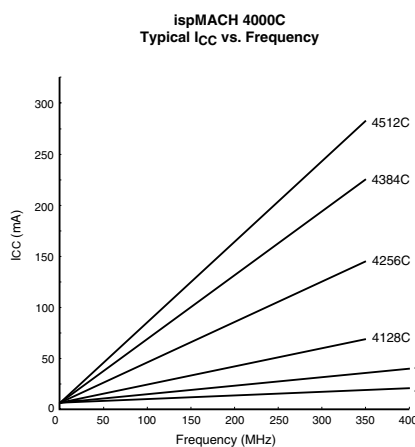
Timing v.2.2

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

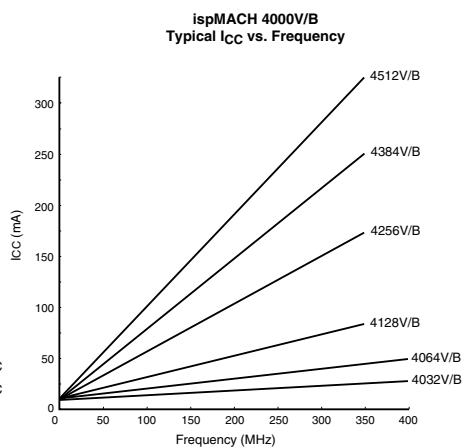
## Power Consumption



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



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



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

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

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

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

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

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

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

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

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

| Pin Number | Bank Number | ispMACH 4128V   |                   | ispMACH 4256V  |                  |
|------------|-------------|-----------------|-------------------|----------------|------------------|
|            |             | GLB/MC/Pad      | ORP               | GLB/MC/Pad     | ORP              |
| 43         | 0           | D9              | D <sup>^</sup> 7  | G4             | G <sup>^</sup> 2 |
| 44         | 0           | D8              | D <sup>^</sup> 6  | G2             | G <sup>^</sup> 1 |
| 45         | 0           | NC <sup>2</sup> | -                 | I <sup>2</sup> | -                |
| 46         | 0           | GND (Bank 0)    | -                 | GND (Bank 0)   | -                |
| 47         | 0           | VCCO (Bank 0)   | -                 | VCCO (Bank 0)  | -                |
| 48         | 0           | D6              | D <sup>^</sup> 5  | H12            | H <sup>^</sup> 6 |
| 49         | 0           | D5              | D <sup>^</sup> 4  | H10            | H <sup>^</sup> 5 |
| 50         | 0           | D4              | D <sup>^</sup> 3  | H8             | H <sup>^</sup> 4 |
| 51         | 0           | D2              | D <sup>^</sup> 2  | H6             | H <sup>^</sup> 3 |
| 52         | 0           | D1              | D <sup>^</sup> 1  | H4             | H <sup>^</sup> 2 |
| 53         | 0           | D0              | D <sup>^</sup> 0  | H2             | H <sup>^</sup> 1 |
| 54         | 0           | CLK1/I          | -                 | CLK1/I         | -                |
| 55         | 1           | GND (Bank 1)    | -                 | GND (Bank 1)   | -                |
| 56         | 1           | CLK2/I          | -                 | CLK2/I         | -                |
| 57         | -           | VCC             | -                 | VCC            | -                |
| 58         | 1           | E0              | E <sup>^</sup> 0  | I2             | I <sup>^</sup> 1 |
| 59         | 1           | E1              | E <sup>^</sup> 1  | I4             | I <sup>^</sup> 2 |
| 60         | 1           | E2              | E <sup>^</sup> 2  | I6             | I <sup>^</sup> 3 |
| 61         | 1           | E4              | E <sup>^</sup> 3  | I8             | I <sup>^</sup> 4 |
| 62         | 1           | E5              | E <sup>^</sup> 4  | I10            | I <sup>^</sup> 5 |
| 63         | 1           | E6              | E <sup>^</sup> 5  | I12            | I <sup>^</sup> 6 |
| 64         | 1           | VCCO (Bank 1)   | -                 | VCCO (Bank 1)  | -                |
| 65         | 1           | GND (Bank 1)    | -                 | GND (Bank 1)   | -                |
| 66         | 1           | E8              | E <sup>^</sup> 6  | J2             | J <sup>^</sup> 1 |
| 67         | 1           | E9              | E <sup>^</sup> 7  | J4             | J <sup>^</sup> 2 |
| 68         | 1           | E10             | E <sup>^</sup> 8  | J6             | J <sup>^</sup> 3 |
| 69         | 1           | E12             | E <sup>^</sup> 9  | J8             | J <sup>^</sup> 4 |
| 70         | 1           | E13             | E <sup>^</sup> 10 | J10            | J <sup>^</sup> 5 |
| 71         | 1           | E14             | E <sup>^</sup> 11 | J12            | J <sup>^</sup> 6 |
| 72         | 1           | NC <sup>2</sup> | -                 | I <sup>2</sup> | -                |
| 73         | -           | GND             | -                 | GND            | -                |
| 74         | -           | TMS             | -                 | TMS            | -                |
| 75         | 1           | VCCO (Bank 1)   | -                 | VCCO (Bank 1)  | -                |
| 76         | 1           | F0              | F <sup>^</sup> 0  | K12            | K <sup>^</sup> 6 |
| 77         | 1           | F1              | F <sup>^</sup> 1  | K10            | K <sup>^</sup> 5 |
| 78         | 1           | F2              | F <sup>^</sup> 2  | K8             | K <sup>^</sup> 4 |
| 79         | 1           | F4              | F <sup>^</sup> 3  | K6             | K <sup>^</sup> 3 |
| 80         | 1           | F5              | F <sup>^</sup> 4  | K4             | K <sup>^</sup> 2 |
| 81         | 1           | F6              | F <sup>^</sup> 5  | K2             | K <sup>^</sup> 1 |
| 82         | 1           | GND (Bank 1)    | -                 | GND (Bank 1)   | -                |
| 83         | 1           | F8              | F <sup>^</sup> 6  | L14            | L <sup>^</sup> 7 |
| 84         | 1           | F9              | F <sup>^</sup> 7  | L12            | L <sup>^</sup> 6 |
| 85         | 1           | F10             | F <sup>^</sup> 8  | L10            | L <sup>^</sup> 5 |

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

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

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

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

## ispMACH 4000C (1.8V) Industrial Devices

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

## ispMACH 4000B (2.5V) Industrial Devices

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

**ispMACH 4000Z (Zero Power, 1.8V) Lead-Free Industrial Devices (Cont.)**

| Device   | Part Number       | Macrocells | Voltage | t <sub>PD</sub> | Package         | Pin/Ball Count | I/O | Grade |
|----------|-------------------|------------|---------|-----------------|-----------------|----------------|-----|-------|
| LC4064ZC | LC4064ZC-5MN132I  | 64         | 1.8     | 5               | Lead-free csBGA | 132            | 64  | I     |
|          | LC4064ZC-75MN132I | 64         | 1.8     | 7.5             | Lead-free csBGA | 132            | 64  | I     |
|          | LC4064ZC-5TN100I  | 64         | 1.8     | 5               | Lead-free TQFP  | 100            | 64  | I     |
|          | LC4064ZC-75TN100I | 64         | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | I     |
|          | LC4064ZC-5MN56I   | 64         | 1.8     | 5               | Lead-free csBGA | 56             | 32  | I     |
|          | LC4064ZC-75MN56I  | 64         | 1.8     | 7.5             | Lead-free csBGA | 56             | 32  | I     |
|          | LC4064ZC-5TN48I   | 64         | 1.8     | 5               | Lead-free TQFP  | 48             | 32  | I     |
|          | LC4064ZC-75TN48I  | 64         | 1.8     | 7.5             | Lead-free TQFP  | 48             | 32  | I     |
| LC4128ZC | LC4128ZC-75MN132I | 128        | 1.8     | 7.5             | Lead-free csBGA | 132            | 96  | I     |
|          | LC4128ZC-75TN100I | 128        | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | I     |
| LC4256ZC | LC4256ZC-75TN176I | 256        | 1.8     | 7.5             | Lead-free TQFP  | 176            | 128 | I     |
|          | LC4256ZC-75MN132I | 256        | 1.8     | 7.5             | Lead-free csBGA | 132            | 96  | I     |
|          | LC4256ZC-75TN100I | 256        | 1.8     | 7.5             | Lead-free TQFP  | 100            | 64  | I     |

**ispMACH 4000Z (Zero Power, 1.8V) Lead-Free Extended Temperature Devices**

| Device   | Part Number       | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|----------|-------------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032ZC | LC4032ZC-75TN48E  | 32         | 1.8     | 7.5             | Lead-free TQFP | 48             | 32  | E     |
| LC4064ZC | LC4064ZC-75TN100E | 64         | 1.8     | 7.5             | Lead-free TQFP | 100            | 64  | E     |
|          | LC4064ZC-75TN48E  | 64         | 1.8     | 7.5             | Lead-free TQFP | 48             | 32  | E     |
| LC4128ZC | LC4128ZC-75TN100E | 128        | 1.8     | 7.5             | Lead-free TQFP | 100            | 64  | E     |
| LC4256ZC | LC4256ZC-75TN176E | 256        | 1.8     | 7.5             | Lead-free TQFP | 176            | 128 | E     |
|          | LC4256ZC-75TN100E | 256        | 1.8     | 7.5             | Lead-free TQFP | 100            | 64  | E     |

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

| Device  | Part Number     | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|---------|-----------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032C | LC4032C-25TN48C | 32         | 1.8     | 2.5             | Lead-free TQFP | 48             | 32  | C     |
|         | LC4032C-5TN48C  | 32         | 1.8     | 5               | Lead-free TQFP | 48             | 32  | C     |
|         | LC4032C-75TN48C | 32         | 1.8     | 7.5             | Lead-free TQFP | 48             | 32  | C     |
|         | LC4032C-25TN44C | 32         | 1.8     | 2.5             | Lead-free TQFP | 44             | 30  | C     |
|         | LC4032C-5TN44C  | 32         | 1.8     | 5               | Lead-free TQFP | 44             | 30  | C     |
|         | LC4032C-75TN44C | 32         | 1.8     | 7.5             | Lead-free TQFP | 44             | 30  | C     |

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

| Device  | Part Number      | Macrocells | Voltage | t <sub>PD</sub> | Package        | Pin/Ball Count | I/O | Grade |
|---------|------------------|------------|---------|-----------------|----------------|----------------|-----|-------|
| LC4032V | LC4032V-5TN48I   | 32         | 3.3     | 5               | Lead-free TQFP | 48             | 32  | I     |
|         | LC4032V-75TN48I  | 32         | 3.3     | 7.5             | Lead-free TQFP | 48             | 32  | I     |
|         | LC4032V-10TN48I  | 32         | 3.3     | 10              | Lead-free TQFP | 48             | 32  | I     |
|         | LC4032V-5TN44I   | 32         | 3.3     | 5               | Lead-free TQFP | 44             | 30  | I     |
|         | LC4032V-75TN44I  | 32         | 3.3     | 7.5             | Lead-free TQFP | 44             | 30  | I     |
|         | LC4032V-10TN44I  | 32         | 3.3     | 10              | Lead-free TQFP | 44             | 30  | I     |
| LC4064V | LC4064V-5TN100I  | 64         | 3.3     | 5               | Lead-free TQFP | 100            | 64  | I     |
|         | LC4064V-75TN100I | 64         | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | I     |
|         | LC4064V-10TN100I | 64         | 3.3     | 10              | Lead-free TQFP | 100            | 64  | I     |
|         | LC4064V-5TN48I   | 64         | 3.3     | 5               | Lead-free TQFP | 48             | 32  | I     |
|         | LC4064V-75TN48I  | 64         | 3.3     | 7.5             | Lead-free TQFP | 48             | 32  | I     |
|         | LC4064V-10TN48I  | 64         | 3.3     | 10              | Lead-free TQFP | 48             | 32  | I     |
|         | LC4064V-5TN44I   | 64         | 3.3     | 5               | Lead-free TQFP | 44             | 30  | I     |
|         | LC4064V-75TN44I  | 64         | 3.3     | 7.5             | Lead-free TQFP | 44             | 30  | I     |
|         | LC4064V-10TN44I  | 64         | 3.3     | 10              | Lead-free TQFP | 44             | 30  | I     |
| LC4128V | LC4128V-5TN144I  | 128        | 3.3     | 5               | Lead-free TQFP | 144            | 96  | I     |
|         | LC4128V-75TN144I | 128        | 3.3     | 7.5             | Lead-free TQFP | 144            | 96  | I     |
|         | LC4128V-10TN144I | 128        | 3.3     | 10              | Lead-free TQFP | 144            | 96  | I     |
|         | LC4128V-5TN128I  | 128        | 3.3     | 5               | Lead-free TQFP | 128            | 92  | I     |
|         | LC4128V-75TN128I | 128        | 3.3     | 7.5             | Lead-free TQFP | 128            | 92  | I     |
|         | LC4128V-10TN128I | 128        | 3.3     | 10              | Lead-free TQFP | 128            | 92  | I     |
|         | LC4128V-5TN100I  | 128        | 3.3     | 5               | Lead-free TQFP | 100            | 64  | I     |
|         | LC4128V-75TN100I | 128        | 3.3     | 7.5             | Lead-free TQFP | 100            | 64  | I     |
|         | LC4128V-10TN100I | 128        | 3.3     | 10              | Lead-free TQFP | 100            | 64  | I     |