# Lattice Semiconductor Corporation - LC4512B-75TN176I Datasheet

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## Understanding Embedded - CPLDs (Complex Programmable Logic Devices)

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

## Applications of Embedded - CPLDs

| Details | |
|---|---|
| Product Status | Obsolete |
| Programmable Type | In System Programmable |
| Delay Time tpd(1) Max | 7.5 ns |
| Voltage Supply - Internal | 2.3V ~ 2.7V |
| Number of Logic Elements/Blocks | 32 |
| Number of Macrocells | 512 |
| Number of Gates | - |
| Number of I/O | 128 |
| Operating Temperature | -40°C ~ 105°C (TJ) |
| Mounting Type | Surface Mount |
| Package / Case | 176-LQFP |
| Supplier Device Package | 176-TQFP (24x24) |
| Purchase URL | https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4512b-75tn176i |

## Absolute Maximum Ratings[1, 2, 3]

| | ispMACH 4000C/Z (1.8V) | ispMACH 4000B (2.5V) | ispMACH 4000V (3.3V) |
|---|---|---|---|
| Supply Voltage ($V_{CC}$) | -0.5 to 2.5V | -0.5 to 5.5V | -0.5 to 5.5V |
| Output Supply Voltage ($V_{CCO}$) | -0.5 to 4.5V | -0.5 to 4.5V | -0.5 to 4.5V |
| Input or I/O Tristate Voltage Applied[4, 5] | -0.5 to 5.5V | -0.5 to 5.5V | -0.5 to 5.5V |
| Storage Temperature | -65 to 150°C | -65 to 150°C | -65 to 150°C |
| Junction Temperature ($T_j$) with Power Applied | -55 to 150°C | -55 to 150°C | -55 to 150°C |

1. Stress above those listed under the “Absolute Maximum Ratings” may cause permanent damage to the device. Functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.
2. Compliance with Lattice Thermal Management document is required.
3. All voltages referenced to GND.
4. Undershoot of -2V and overshoot of ($V_{IH}$ (MAX) + 2V), up to a total pin voltage of 6.0V, is permitted for a duration of < 20ns.
5. Maximum of 64 I/Os per device with VIN > 3.6V is allowed.

## Recommended Operating Conditions

| Symbol | Parameter | | Min. | Max. | Units |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage for 1.8V Devices | ispMACH 4000C | 1.65 | 1.95 | V |
| | | ispMACH 4000Z | 1.7 | 1.9 | V |
| | | ispMACH 4000Z, Extended Functional Voltage Operation | 1.6[1, 2] | 1.9 | V |
| | Supply Voltage for 2.5V Devices | | 2.3 | 2.7 | V |
| | Supply Voltage for 3.3V Devices | | 3.0 | 3.6 | V |
| $T_j$ | Junction Temperature (Commercial) | | 0 | 90 | C |
| | Junction Temperature (Industrial) | | -40 | 105 | C |
| | Junction Temperature (Extended) | | -40 | 130 | C |

1. Devices operating at 1.6V can expect performance degradation up to 35%.
2. Applicable for devices with 2004 date codes and later. Contact factory for ordering instructions.

## Erase Reprogram Specifications

| Parameter | Min. | Max. | Units |
|---|---|---|---|
| Erase/Reprogram Cycle | 1,000 | — | Cycles |

Note: Valid over commercial temperature range.

## Hot Socketing Characteristics[1,2,3]

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $I_{DK}$ | Input or I/O Leakage Current | $0 \le V_{IN} \le 3.0V$, Tj = 105°C | — | ±30 | ±150 | µA |
| | | $0 \le V_{IN} \le 3.0V$, Tj = 130°C | — | ±30 | ±200 | µA |

1. Insensitive to sequence of $V_{CC}$ or $V_{CCO}$. However, assumes monotonic rise/fall rates for $V_{CC}$ and $V_{CCO}$, provided ($V_{IN}$ - $V_{CCO}$) ≤ 3.6V.
2. $0 < V_{CC} < V_{CC}$ (MAX), $0 < V_{CCO} < V_{CCO}$ (MAX).
3. $I_{DK}$ is additive to $I_{PU}$, $I_{PD}$ or $I_{BH}$. Device defaults to pull-up until fuse circuitry is active.

## 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 | Vcc = 3.3V | — | 13 | — | mA |
| | | Vcc = 2.5V | — | 13 | — | mA |
| | | Vcc = 1.8V | — | 3 | — | mA |

1. $T_A$ = 25°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°C

## Supply Current, ispMACH 4000Z

**Over Recommended Operating Conditions**

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

# Supply Current, ispMACH 4000Z (Cont.)

**Over Recommended Operating Conditions**

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **ispMACH 4256ZC** | | | | | | |
| ICC[1, 2, 3, 5] | Operating Power Supply Current | Vcc = 1.8V, $T_A$ = 25°C | — | 341 | — | µA |
| | | Vcc = 1.9V, $T_A$ = 70°C | — | 361 | — | µA |
| | | Vcc = 1.9V, $T_A$ = 85°C | — | 372 | — | µA |
| | | Vcc = 1.9V, $T_A$ = 125°C | — | 468 | — | µA |
| ICC[4, 5] | Standby Power Supply Current | Vcc = 1.8V, $T_A$ = 25°C | — | 13 | — | µA |
| | | Vcc = 1.9V, $T_A$ = 70°C | — | 32 | 55 | µA |
| | | Vcc = 1.9V, $T_A$ = 85°C | — | 43 | 90 | µA |
| | | Vcc = 1.9V, $T_A$ = 125°C | — | 135 | — | µA |

1. $T_A$ = 25°C, frequency = 1.0 MHz.
2. Device configured with 16-bit counters.
3. $I_{CC}$ varies with specific device configuration and operating frequency.
4. $V_{CCO}$ = 3.6V, $V_{IN}$ = 0V or $V_{CCO,}$ bus maintenance turned off. $V_{IN}$ above $V_{CCO}$ will add transient current above the specified standby $I_{CC}$.
5. Includes $V_{CCO}$ current without output loading.

# I/O DC Electrical Characteristics

**Over Recommended Operating Conditions**

| Standard | $V_{IL}$ | | $V_{IH}$ | | $V_{OL}$ Max (V) | $V_{OH}$ Min (V) | $I_{OL}$[1] (mA) | $I_{OH}$[1] (mA) |
|---|---|---|---|---|---|---|---|---|
| | Min (V) | Max (V) | Min (V) | Max (V) | | | | |
| LVTTL | -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 (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 (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**8mA. 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 4000Z Internal Timing Parameters (Cont.)

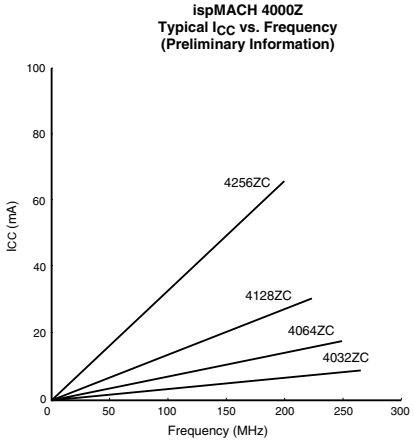
**Over Recommended Operating Conditions**

| Parameter | Description | -45 | | -5 | | -75 | | Units |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| $t_{PTOE}$ | Macrocell PT OE Delay | — | 2.50 | — | 2.70 | — | 2.00 | ns |

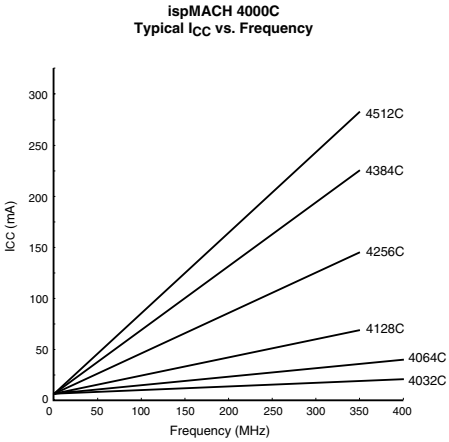
Note: Internal Timing Parameters are not tested and are for reference only. Refer to the timing model in this data sheet for further details.

Timing v.2.2

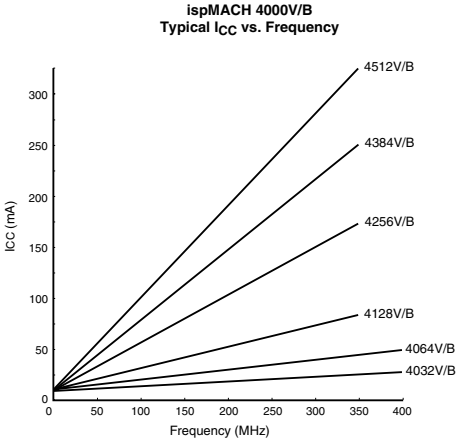
# Power Consumption




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[1]

| 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.

## 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, LVTTL and LVCMOS Standards***

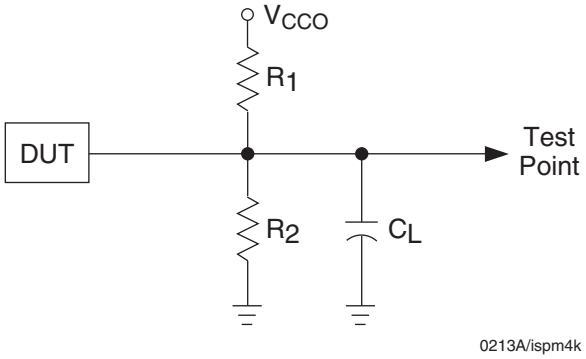



***Table 11. Test Fixture Required Components***

| Test Condition | $R_1$ | $R_2$ | $C_L$[1] | Timing Ref. | $V_{CCO}$ |
|---|---|---|---|---|---|
| LVCMOS I/O, (L -> H, H -> L) | 106Ω | 106Ω | 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) | ∞ | 106Ω | 35pF | 1.5V | 3.0V |
| LVCMOS I/O (Z -> L) | 106Ω | ∞ | 35pF | 1.5V | 3.0V |
| LVCMOS I/O (H -> Z) | ∞ | 106Ω | 5pF | $V_{OH}$ - 0.3 | 3.0V |
| LVCMOS I/O (L -> Z) | 106Ω | ∞ | 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[1]

| Signal | 44-pin TQFP[2] | 48-pin TQFP[2] | 56-ball csBGA[3] | 100-pin TQFP[2] | 128-pin TQFP[2] |
|---|---|---|---|---|---|
| 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 | — | — | **4032Z**: A8, B10, E1, 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^2 | A4 | A^2 |
| 43 | 0 | A3 | A^3 | A6 | A^3 |
| 44 | 0 | A4 | A^4 | A8 | A^4 |

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

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

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

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

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

| | | ispMACH 4064Z | | ispMACH 4128Z | | ispMACH 4256Z | |
|---|---|---|---|---|---|---|---|
| Ball Number | Bank Number | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP |
| P8 | 1 | NC[1] | - | NC[1] | - | I[1] | - |
| M8 | 1 | NC | - | E0 | E^0 | I2 | I^1 |
| P9 | 1 | C0 | C^0 | E1 | E^1 | I4 | I^2 |
| N9 | 1 | C1 | C^1 | E2 | E^2 | I6 | I^3 |
| M9 | 1 | C2 | C^2 | E4 | E^3 | I8 | I^4 |
| N10 | 1 | C3 | C^3 | E5 | E^4 | I10 | I^5 |
| P10 | 1 | NC | - | E6 | E^5 | I12 | I^6 |
| 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^6 | J2 | J^1 |
| M11 | 1 | C4 | C^4 | E9 | E^7 | J4 | J^2 |
| P12 | 1 | C5 | C^5 | E10 | E^8 | J6 | J^3 |
| N12 | 1 | C6 | C^6 | E12 | E^9 | J8 | J^4 |
| P13 | 1 | C7 | C^7 | E13 | E^10 | J10 | J^5 |
| P14 | 1 | NC | - | E14 | E^11 | J12 | J^6 |
| N14 | - | GND | - | GND | - | GND | - |
| N13 | - | TMS | - | TMS | - | TMS | - |
| M14 | 1 | NC | - | VCCO (Bank 1) | - | VCCO (Bank 1) | - |
| M12 | 1 | NC | - | F0 | F^0 | K12 | K^6 |
| M13 | 1 | C8 | C^8 | F1 | F^1 | K10 | K^5 |
| L14 | 1 | C9 | C^9 | F2 | F^2 | K8 | K^4 |
| L12 | 1 | C10 | C^10 | F4 | F^3 | K6 | K^3 |
| L13 | 1 | C11 | C^11 | F5 | F^4 | K4 | K^2 |
| K14 | 1 | NC | - | F6 | F^5 | K2 | K^1 |
| K13 | 1 | GND (Bank 1) | - | GND (Bank 1) | - | GND (Bank 1) | - |
| K12 | 1 | NC | - | F8 | F^6 | L12 | L^6 |
| J13 | 1 | C12 | C^12 | F9 | F^7 | L10 | L^5 |
| J14 | 1 | C13 | C^13 | F10 | F^8 | L8 | L^4 |
| J12 | 1 | C14 | C^14 | F12 | F^9 | L6 | L^3 |
| H14 | 1 | C15 | C^15 | F13 | F^10 | L4 | L^2 |
| H13 | 1 | I | - | F14 | F^11 | L2 | L^1 |
| H12 | 1 | VCCO (Bank 1) | - | VCCO (Bank 1) | - | VCCO (Bank 1) | - |
| G13 | 1 | NC | - | G14 | G^11 | M2 | M^1 |
| G14 | 1 | NC | - | G13 | G^10 | M4 | M^2 |
| G12 | 1 | D15 | D^15 | G12 | G^9 | M6 | M^3 |
| F14 | 1 | D14 | D^14 | G10 | G^8 | M8 | M^4 |
| F13 | 1 | D13 | D^13 | G9 | G^7 | M10 | M^5 |
| F12 | 1 | D12 | D^12 | G8 | G^6 | M12 | M^6 |
| E13 | 1 | GND (Bank 1) | - | GND (Bank 1) | - | GND (Bank 1) | - |
| E14 | 1 | NC | - | G6 | G^5 | N2 | N^1 |
| E12 | 1 | D11 | D^11 | G5 | G^4 | N4 | N^2 |

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

| Pin Number | Bank Number | ispMACH 4256V/B/C/Z | | ispMACH 4384V/B/C | | ispMACH 4512V/B/C | |
|---|---|---|---|---|---|---|---|
| | | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP |
| 101 | 1 | GND (Bank 1) | - | GND (Bank 1) | - | GND (Bank 1) | - |
| 102 | 1 | L14 | L^7 | AX14 | AX^7 | GX14 | GX^7 |
| 103 | 1 | L12 | L^6 | AX12 | AX^6 | GX12 | GX^6 |
| 104 | 1 | L10 | L^5 | AX10 | AX^5 | GX10 | GX^5 |
| 105 | 1 | L8 | L^4 | AX8 | AX^4 | GX8 | GX^4 |
| 106 | 1 | L6 | L^3 | AX6 | AX^3 | GX6 | GX^3 |
| 107 | 1 | L4 | L^2 | AX4 | AX^2 | GX4 | GX^2 |
| 108 | 1 | L2 | L^1 | AX2 | AX^1 | GX2 | GX^1 |
| 109 | 1 | L0 | L^0 | AX0 | AX^0 | GX0 | GX^0 |
| 110 | 1 | VCCO (Bank 1) | - | VCCO (Bank 1) | - | VCCO (Bank 1) | - |
| 111 | 1 | M0 | M^0 | DX0 | DX^0 | JX0 | JX^0 |
| 112 | 1 | M2 | M^1 | DX2 | DX^1 | JX2 | JX^1 |
| 113 | 1 | M4 | M^2 | DX4 | DX^2 | JX4 | JX^2 |
| 114 | 1 | M6 | M^3 | DX6 | DX^3 | JX6 | JX^3 |
| 115 | 1 | M8 | M^4 | DX8 | DX^4 | JX8 | JX^4 |
| 116 | 1 | M10 | M^5 | DX10 | DX^5 | JX10 | JX^5 |
| 117 | 1 | M12 | M^6 | DX12 | DX^6 | JX12 | JX^6 |
| 118 | 1 | M14 | M^7 | DX14 | DX^7 | JX14 | JX^7 |
| 119 | 1 | GND (Bank 1) | - | GND (Bank 1) | - | GND (Bank 1) | - |
| 120 | 1 | N0 | N^0 | FX0 | FX^0 | NX0 | NX^0 |
| 121 | 1 | N2 | N^1 | FX2 | FX^1 | NX2 | NX^1 |
| 122 | 1 | N4 | N^2 | FX4 | FX^2 | NX4 | NX^2 |
| 123 | 1 | N6 | N^3 | FX6 | FX^3 | NX6 | NX^3 |
| 124 | 1 | N8 | N^4 | FX8 | FX^4 | NX8 | NX^4 |
| 125 | 1 | N10 | N^5 | FX10 | FX^5 | NX10 | NX^5 |
| 126 | 1 | N12 | N^6 | FX12 | FX^6 | NX12 | NX^6 |
| 127 | 1 | N14 | N^7 | FX14 | FX^7 | NX14 | NX^7 |
| 128 | 1 | VCCO (Bank 1) | - | VCCO (Bank 1) | - | VCCO (Bank 1) | - |
| 129 | - | TDO | - | TDO | - | TDO | - |
| 130 | - | VCC | - | VCC | - | VCC | - |
| 131 | - | NC | - | NC | - | NC | - |
| 132 | - | NC | - | NC | - | NC | - |
| 133 | - | NC | - | NC | - | NC | - |
| 134 | - | GND | - | GND | - | GND | - |
| 135 | 1 | O14 | O^7 | GX14 | GX^7 | OX14 | OX^7 |
| 136 | 1 | O12 | O^6 | GX12 | GX^6 | OX12 | OX^6 |
| 137 | 1 | O10 | O^5 | GX10 | GX^5 | OX10 | OX^5 |
| 138 | 1 | O8 | O^4 | GX8 | GX^4 | OX8 | OX^4 |
| 139 | 1 | O6 | O^3 | GX6 | GX^3 | OX6 | OX^3 |
| 140 | 1 | O4 | O^2 | GX4 | GX^2 | OX4 | OX^2 |
| 141 | 1 | O2 | O^1 | GX2 | GX^1 | OX2 | OX^1 |

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

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

| Ball Number | I/O Bank | ispMACH 4256V/B/C 128-I/O | | ispMACH 4256V/B/C 160-I/O | | ispMACH 4384V/B/C | | ispMACH 4512V/B/C | |
|---|---|---|---|---|---|---|---|---|---|
| | | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP | GLB/MC/Pad | ORP |
| C12 | 1 | O0 | O^0 | O2 | O^2 | GX0 | GX^0 | OX0 | OX^0 |
| E10 | 1 | NC | - | O1 | O^1 | CX8 | CX^4 | MX0 | MX^0 |
| A13 | 1 | NC | - | O0 | O^0 | CX10 | CX^5 | MX4 | MX^1 |
| D12 | 1 | NC | - | NC | - | NC | - | LX0 | LX^0 |
| - | 1 | GND (Bank 1) | - | GND (Bank 1) | - | GND (Bank 1) | - | GND (Bank 1) | - |
| - | 1 | VCCO (Bank 1) | - | VCCO (Bank 1) | - | VCCO (Bank 1) | - | VCCO (Bank 1) | - |
| B12 | 1 | NC | - | NC | - | NC | - | LX4 | LX^1 |
| A12 | 1 | NC | - | NC | - | EX2 | EX^1 | LX8 | LX^2 |
| B11 | 1 | NC | - | NC | - | EX0 | EX^0 | LX12 | LX^3 |
| A11 | 1 | NC | - | P14 | P^9 | CX12 | CX^6 | MX8 | MX^2 |
| D10 | 1 | NC | - | P12 | P^8 | CX14 | CX^7 | MX12 | MX^3 |
| C10 | 1 | P14 | P^7 | P10 | P^7 | HX14 | HX^7 | PX14 | PX^7 |
| B10 | 1 | P12 | P^6 | P9 | P6 | HX12 | HX^6 | PX12 | PX^6 |
| A10 | 1 | P10 | P^5 | P8 | P^5 | HX10 | HX^5 | PX10 | PX^5 |
| A9 | 1 | P8 | P^4 | P6 | P^4 | HX8 | HX^4 | PX8 | PX^4 |
| F9 | 1 | P6 | P^3 | P4 | P^3 | HX6 | HX^3 | PX6 | PX^3 |
| B9 | 1 | P4 | P^2 | P2 | P^2 | HX4 | HX^2 | PX4 | PX^2 |
| E9 | 1 | P2/GOE1 | P^1 | P1/GOE1 | P^1 | HX2/GOE1 | HX^1 | PX2/GOE1 | PX^1 |
| C9 | 1 | P0 | P^0 | P0 | P^0 | HX0 | HX^0 | PX0 | PX^0 |
| - | - | GND | - | GND | | GND | - | GND | - |
| D9 | 1 | CLK3/I | - | CLK3/I | - | CLK3/I | - | CLK3/I | - |
| - | 0 | GND (Bank 0) | - | GND (Bank 0) | - | GND (Bank 0) | - | GND (Bank 0) | - |
| B8 | 0 | CLK0/I | - | CLK0/I | - | CLK0/I | - | CLK0/I | - |
| - | - | VCC | - | VCC | - | VCC | - | VCC | - |
| D8 | 0 | A0 | A^0 | A0 | A^0 | A0 | A^0 | A0 | A^0 |
| C8 | 0 | A2/GOE0 | A^1 | A1/GOE0 | A^1 | A2/GOE0 | A^1 | A2/GOE0 | A^1 |
| A8 | 0 | A4 | A^2 | A2 | A^2 | A4 | A^2 | A4 | A^2 |
| A7 | 0 | A6 | A^3 | A4 | A^3 | A6 | A^3 | A6 | A^3 |
| B7 | 0 | A8 | A^4 | A6 | A^4 | A8 | A^4 | A8 | A^4 |
| E8 | 0 | A10 | A^5 | A8 | A^5 | A10 | A^5 | A10 | A^5 |
| D7 | 0 | A12 | A^6 | A9 | A^6 | A12 | A^6 | A12 | A^6 |
| F8 | 0 | A14 | A^7 | A10 | A^7 | A14 | A^7 | A14 | A^7 |
| C7 | 0 | NC | - | A12 | A^8 | F14 | F^7 | D0 | D^0 |
| A6 | 0 | NC | - | A14 | A^9 | F12 | F^6 | D4 | D^1 |
| B6 | 0 | NC | - | NC | - | D14 | D^7 | E0 | E^0 |
| A5 | 0 | NC | - | NC | - | D12 | D^6 | E4 | E^1 |
| B5 | 0 | NC | - | NC | - | NC | - | E8 | E^2 |
| - | 0 | VCCO (Bank 0) | - | VCCO (Bank 0) | - | VCCO (Bank 0) | - | VCCO (Bank 0) | - |
| - | 0 | GND (Bank 0) | - | GND (Bank 0) | - | GND (Bank 0) | - | GND (Bank 0) | - |
| D5 | 0 | NC | - | NC | - | NC | - | E12 | E^3 |
| A4 | 0 | NC | - | B0 | B^0 | F10 | F^5 | D8 | D^2 |

## 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 128-I/O | | ispMACH 4256V/B/C 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 |
| E7 | 0 | NC | - | B1 | B^1 | F8 | F^4 | D12 | D^3 |
| A3 | 0 | B0 | B^0 | B2 | B^2 | B0 | B^0 | B0 | B^0 |
| F7 | 0 | B2 | B^1 | B4 | B^3 | B2 | B^1 | B2 | B^1 |
| B4 | 0 | B4 | B^2 | B6 | B^4 | B4 | B^2 | B4 | B^2 |
| C5 | 0 | B6 | B^3 | B8 | B^5 | B6 | B^3 | B6 | B^3 |
| A2 | 0 | B8 | B^4 | B9 | B^6 | B8 | B^4 | B8 | B^4 |
| E6 | 0 | B10 | B^5 | B10 | B^7 | B10 | B^5 | B10 | B^5 |
| B3 | 0 | B12 | B^6 | B12 | B^8 | B12 | B^6 | B12 | B^6 |
| C4 | 0 | B14 | B^7 | B14 | B^9 | B14 | B^7 | B14 | B^7 |
| D4 | 0 | NC | - | NC | - | D10 | D^5 | F0 | F^0 |
| E5 | 0 | NC | - | NC | - | D8 | D^4 | F2 | F^1 |
| - | - | VCC | - | VCC | - | VCC | - | VCC | - |
| - | - | - | - | - | - | GND | - | GND | - |
| - | 0 | - | - | - | - | GND (Bank 0) | - | GND (Bank 0) | - |

Note: VCC, VCCO and GND are tied together to their respective common signal on the package substrate. See Power Supply and NC Connections table for VCC/ VCCO/GND pin definitions.

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

| Family | Part Number | Macrocells | Voltage | $t_{PD}$ | Package | Pin/Ball Count | I/O | Grade |
|---|---|---|---|---|---|---|---|---|
| LC4384C | LC4384C-5FT256I | 384 | 1.8 | 5 | ftBGA | 256 | 192 | I |
| | LC4384C-75FT256I | 384 | 1.8 | 7.5 | ftBGA | 256 | 192 | I |
| | LC4384C-10FT256I | 384 | 1.8 | 10 | ftBGA | 256 | 192 | I |
| | LC4384C-5F256I[1] | 384 | 1.8 | 5 | fpBGA | 256 | 192 | I |
| | LC4384C-75F256I[1] | 384 | 1.8 | 7.5 | fpBGA | 256 | 192 | I |
| | LC4384C-10F256I[1] | 384 | 1.8 | 10 | fpBGA | 256 | 192 | I |
| | LC4384C-5T176I | 384 | 1.8 | 5 | TQFP | 176 | 128 | I |
| | LC4384C-75T176I | 384 | 1.8 | 7.5 | TQFP | 176 | 128 | I |
| | LC4384C-10T176I | 384 | 1.8 | 10 | TQFP | 176 | 128 | I |
| LC4512C | LC4512C-5FT256I | 512 | 1.8 | 5 | ftBGA | 256 | 208 | I |
| | LC4512C-75FT256I | 512 | 1.8 | 7.5 | ftBGA | 256 | 208 | I |
| | LC4512C-10FT256I | 512 | 1.8 | 10 | ftBGA | 256 | 208 | I |
| | LC4512C-5F256I[1] | 512 | 1.8 | 5 | fpBGA | 256 | 208 | I |
| | LC4512C-75F256I[1] | 512 | 1.8 | 7.5 | fpBGA | 256 | 208 | I |
| | LC4512C-10F256I[1] | 512 | 1.8 | 10 | fpBGA | 256 | 208 | I |
| | LC4512C-5T176I | 512 | 1.8 | 5 | TQFP | 176 | 128 | I |
| | LC4512C-75T176I | 512 | 1.8 | 7.5 | TQFP | 176 | 128 | I |
| | LC4512C-10T176I | 512 | 1.8 | 10 | TQFP | 176 | 128 | I |

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

**ispMACH 4000B (2.5V) Commercial Devices**

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

**ispMACH 4000B (2.5V) Commercial Devices (Cont.)**

| Device | Part Number | Macrocells | Voltage | $t_{PD}$ | Package | Pin/Ball Count | I/O | Grade |
|---|---|---|---|---|---|---|---|---|
| LC4256B | LC4256B-3FT256AC | 256 | 2.5 | 3 | ftBGA | 256 | 128 | C |
| | LC4256B-5FT256AC | 256 | 2.5 | 5 | ftBGA | 256 | 128 | C |
| | LC4256B-75FT256AC | 256 | 2.5 | 7.5 | ftBGA | 256 | 128 | C |
| | LC4256B-3FT256BC | 256 | 2.5 | 3 | ftBGA | 256 | 160 | C |
| | LC4256B-5FT256BC | 256 | 2.5 | 5 | ftBGA | 256 | 160 | C |
| | LC4256B-75FT256BC | 256 | 2.5 | 7.5 | ftBGA | 256 | 160 | C |
| | LC4256B-3F256AC[1] | 256 | 2.5 | 3 | fpBGA | 256 | 128 | C |
| | LC4256B-5F256AC[1] | 256 | 2.5 | 5 | fpBGA | 256 | 128 | C |
| | LC4256B-75F256AC[1] | 256 | 2.5 | 7.5 | fpBGA | 256 | 128 | C |
| | LC4256B-3F256BC[1] | 256 | 2.5 | 3 | fpBGA | 256 | 160 | C |
| | LC4256B-5F256BC[1] | 256 | 2.5 | 5 | fpBGA | 256 | 160 | C |
| | LC4256B-75F256BC[1] | 256 | 2.5 | 7.5 | fpBGA | 256 | 160 | C |
| | LC4256B-3T176C | 256 | 2.5 | 3 | TQFP | 176 | 128 | C |
| | LC4256B-5T176C | 256 | 2.5 | 5 | TQFP | 176 | 128 | C |
| | LC4256B-75T176C | 256 | 2.5 | 7.5 | TQFP | 176 | 128 | C |
| | LC4256B-3T100C | 256 | 2.5 | 3 | TQFP | 100 | 64 | C |
| | LC4256B-5T100C | 256 | 2.5 | 5 | TQFP | 100 | 64 | C |
| | LC4256B-75T100C | 256 | 2.5 | 7.5 | TQFP | 100 | 64 | C |
| LC4384B | LC4384B-35FT256C | 384 | 2.5 | 3.5 | ftBGA | 256 | 192 | C |
| | LC4384B-5FT256C | 384 | 2.5 | 5 | ftBGA | 256 | 192 | C |
| | LC4384B-75FT256C | 384 | 2.5 | 7.5 | ftBGA | 256 | 192 | C |
| | LC4384B-35F256C[1] | 384 | 2.5 | 3.5 | fpBGA | 256 | 192 | C |
| | LC4384B-5F256C[1] | 384 | 2.5 | 5 | fpBGA | 256 | 192 | C |
| | LC4384B-75F256C[1] | 384 | 2.5 | 7.5 | fpBGA | 256 | 192 | C |
| | LC4384B-35T176C | 384 | 2.5 | 3.5 | TQFP | 176 | 128 | C |
| | LC4384B-5T176C | 384 | 2.5 | 5 | TQFP | 176 | 128 | C |
| | LC4384B-75T176C | 384 | 2.5 | 7.5 | TQFP | 176 | 128 | C |
| LC4512B | LC4512B-35FT256C | 512 | 2.5 | 3.5 | ftBGA | 256 | 208 | C |
| | LC4512B-5FT256C | 512 | 2.5 | 5 | ftBGA | 256 | 208 | C |
| | LC4512B-75FT256C | 512 | 2.5 | 7.5 | ftBGA | 256 | 208 | C |
| | LC4512B-35F256C[1] | 512 | 2.5 | 3.5 | fpBGA | 256 | 208 | C |
| | LC4512B-5F256C[1] | 512 | 2.5 | 5 | fpBGA | 256 | 208 | C |
| | LC4512B-75F256C[1] | 512 | 2.5 | 7.5 | fpBGA | 256 | 208 | C |
| | LC4512B-35T176C | 512 | 2.5 | 3.5 | TQFP | 176 | 128 | C |
| | LC4512B-5T176C | 512 | 2.5 | 5 | TQFP | 176 | 128 | C |
| | LC4512B-75T176C | 512 | 2.5 | 7.5 | TQFP | 176 | 128 | C |

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

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

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

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

| Device | Part Number | Macrocells | Voltage | $t_{PD}$ | Package | Pin/Ball Count | I/O | Grade |
|---|---|---|---|---|---|---|---|---|
| LC4512V | LC4512V-35FT256C | 512 | 3.3 | 3.5 | ftBGA | 256 | 208 | C |
| | LC4512V-5FT256C | 512 | 3.3 | 5 | ftBGA | 256 | 208 | C |
| | LC4512V-75FT256C | 512 | 3.3 | 7.5 | ftBGA | 256 | 208 | C |
| | LC4512V-35F256C[1] | 512 | 3.3 | 3.5 | fpBGA | 256 | 208 | C |
| | LC4512V-5F256C[1] | 512 | 3.3 | 5 | fpBGA | 256 | 208 | C |
| | LC4512V-75F256C[1] | 512 | 3.3 | 7.5 | fpBGA | 256 | 208 | C |
| | LC4512V-35T176C | 512 | 3.3 | 3.5 | TQFP | 176 | 128 | C |
| | LC4512V-5T176C | 512 | 3.3 | 5 | TQFP | 176 | 128 | C |
| | LC4512V-75T176C | 512 | 3.3 | 7.5 | TQFP | 176 | 128 | C |

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

**ispMACH 4000V (3.3V) Industrial Devices**

| Family | Part Number | Macrocells | Voltage | $t_{PD}$ | Package | Pin/Ball Count | I/O | Grade |
|---|---|---|---|---|---|---|---|---|
| LC4032V | LC4032V-5T48I | 32 | 3.3 | 5 | TQFP | 48 | 32 | I |
| | LC4032V-75T48I | 32 | 3.3 | 7.5 | TQFP | 48 | 32 | I |
| | LC4032V-10T48I | 32 | 3.3 | 10 | TQFP | 48 | 32 | I |
| | LC4032V-5T44I | 32 | 3.3 | 5 | TQFP | 44 | 30 | I |
| | LC4032V-75T44I | 32 | 3.3 | 7.5 | TQFP | 44 | 30 | I |
| | LC4032V-10T44I | 32 | 3.3 | 10 | TQFP | 44 | 30 | I |
| LC4064V | LC4064V-5T100I | 64 | 3.3 | 5 | TQFP | 100 | 64 | I |
| | LC4064V-75T100I | 64 | 3.3 | 7.5 | TQFP | 100 | 64 | I |
| | LC4064V-10T100I | 64 | 3.3 | 10 | TQFP | 100 | 64 | I |
| | LC4064V-5T48I | 64 | 3.3 | 5 | TQFP | 48 | 32 | I |
| | LC4064V-75T48I | 64 | 3.3 | 7.5 | TQFP | 48 | 32 | I |
| | LC4064V-10T48I | 64 | 3.3 | 10 | TQFP | 48 | 32 | I |
| | LC4064V-5T44I | 64 | 3.3 | 5 | TQFP | 44 | 30 | I |
| | LC4064V-75T44I | 64 | 3.3 | 7.5 | TQFP | 44 | 30 | I |
| | LC4064V-10T44I | 64 | 3.3 | 10 | TQFP | 44 | 30 | I |
| LC4128V | LC4128V-5T144I | 128 | 3.3 | 5 | TQFP | 144 | 96 | I |
| | LC4128V-75T144I | 128 | 3.3 | 7.5 | TQFP | 144 | 96 | I |
| | LC4128V-10T144I | 128 | 3.3 | 10 | TQFP | 144 | 96 | I |
| | LC4128V-5T128I | 128 | 3.3 | 5 | TQFP | 128 | 92 | I |
| | LC4128V-75T128I | 128 | 3.3 | 7.5 | TQFP | 128 | 92 | I |
| | LC4128V-10T128I | 128 | 3.3 | 10 | TQFP | 128 | 92 | I |
| | LC4128V-5T100I | 128 | 3.3 | 5 | TQFP | 100 | 64 | I |
| | LC4128V-75T100I | 128 | 3.3 | 7.5 | TQFP | 100 | 64 | I |
| | LC4128V-10T100I | 128 | 3.3 | 10 | TQFP | 100 | 64 | I |

**ispMACH 4000V (3.3V) Industrial Devices (Cont.)**

| Family | Part Number | Macrocells | Voltage | $t_{PD}$ | Package | Pin/Ball Count | I/O | Grade |
|---|---|---|---|---|---|---|---|---|
| LC4256V | LC4256V-5FT256AI | 256 | 3.3 | 5 | ftBGA | 256 | 128 | I |
| | LC4256V-75FT256AI | 256 | 3.3 | 7.5 | ftBGA | 256 | 128 | I |
| | LC4256V-10FT256AI | 256 | 3.3 | 10 | ftBGA | 256 | 128 | I |
| | LC4256V-5FT256BI | 256 | 3.3 | 5 | ftBGA | 256 | 160 | I |
| | LC4256V-75FT256BI | 256 | 3.3 | 7.5 | ftBGA | 256 | 160 | I |
| | LC4256V-10FT256BI | 256 | 3.3 | 10 | ftBGA | 256 | 160 | I |
| | LC4256V-5F256AI[1] | 256 | 3.3 | 5 | fpBGA | 256 | 128 | I |
| | LC4256V-75F256AI[1] | 256 | 3.3 | 7.5 | fpBGA | 256 | 128 | I |
| | LC4256V-10F256AI[1] | 256 | 3.3 | 10 | fpBGA | 256 | 128 | I |
| | LC4256V-5F256BI[1] | 256 | 3.3 | 5 | fpBGA | 256 | 160 | I |
| | LC4256V-75F256BI[1] | 256 | 3.3 | 7.5 | fpBGA | 256 | 160 | I |
| | LC4256V-10F256BI[1] | 256 | 3.3 | 10 | fpBGA | 256 | 160 | I |
| | LC4256V-5T176I | 256 | 3.3 | 5 | TQFP | 176 | 128 | I |
| | LC4256V-75T176I | 256 | 3.3 | 7.5 | TQFP | 176 | 128 | I |
| | LC4256V-10T176I | 256 | 3.3 | 10 | TQFP | 176 | 128 | I |
| | LC4256V-5T144I | 256 | 3.3 | 5 | TQFP | 144 | 96 | I |
| | LC4256V-75T144I | 256 | 3.3 | 7.5 | TQFP | 144 | 96 | I |
| | LC4256V-10T144I | 256 | 3.3 | 10 | TQFP | 144 | 96 | I |
| | LC4256V-5T100I | 256 | 3.3 | 5 | TQFP | 100 | 64 | I |
| | LC4256V-75T100I | 256 | 3.3 | 7.5 | TQFP | 100 | 64 | I |
| | LC4256V-10T100I | 256 | 3.3 | 10 | TQFP | 100 | 64 | I |
| LC4384V | LC4384V-5FT256I | 384 | 3.3 | 5 | ftBGA | 256 | 192 | I |
| | LC4384V-75FT256I | 384 | 3.3 | 7.5 | ftBGA | 256 | 192 | I |
| | LC4384V-10FT256I | 384 | 3.3 | 10 | ftBGA | 256 | 192 | I |
| | LC4384V-5F256I[1] | 384 | 3.3 | 5 | fpBGA | 256 | 192 | I |
| | LC4384V-75F256I[1] | 384 | 3.3 | 7.5 | fpBGA | 256 | 192 | I |
| | LC4384V-10F256I[1] | 384 | 3.3 | 10 | fpBGA | 256 | 192 | I |
| | LC4384V-5T176I | 384 | 3.3 | 5 | TQFP | 176 | 128 | I |
| | LC4384V-75T176I | 384 | 3.3 | 7.5 | TQFP | 176 | 128 | I |
| | LC4384V-10T176I | 384 | 3.3 | 10 | TQFP | 176 | 128 | I |
| LC4512V | LC4512V-5FT256I | 512 | 3.3 | 5 | ftBGA | 256 | 208 | I |
| | LC4512V-75FT256I | 512 | 3.3 | 7.5 | ftBGA | 256 | 208 | I |
| | LC4512V-10FT256I | 512 | 3.3 | 10 | ftBGA | 256 | 208 | I |
| | LC4512V-5F256I[1] | 512 | 3.3 | 5 | fpBGA | 256 | 208 | I |
| | LC4512V-75F256I[1] | 512 | 3.3 | 7.5 | fpBGA | 256 | 208 | I |
| | LC4512V-10F256I[1] | 512 | 3.3 | 10 | fpBGA | 256 | 208 | I |
| | LC4512V-5T176I | 512 | 3.3 | 5 | TQFP | 176 | 128 | I |
| | LC4512V-75T176I | 512 | 3.3 | 7.5 | TQFP | 176 | 128 | I |
| | LC4512V-10T176I | 512 | 3.3 | 10 | TQFP | 176 | 128 | I |

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