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

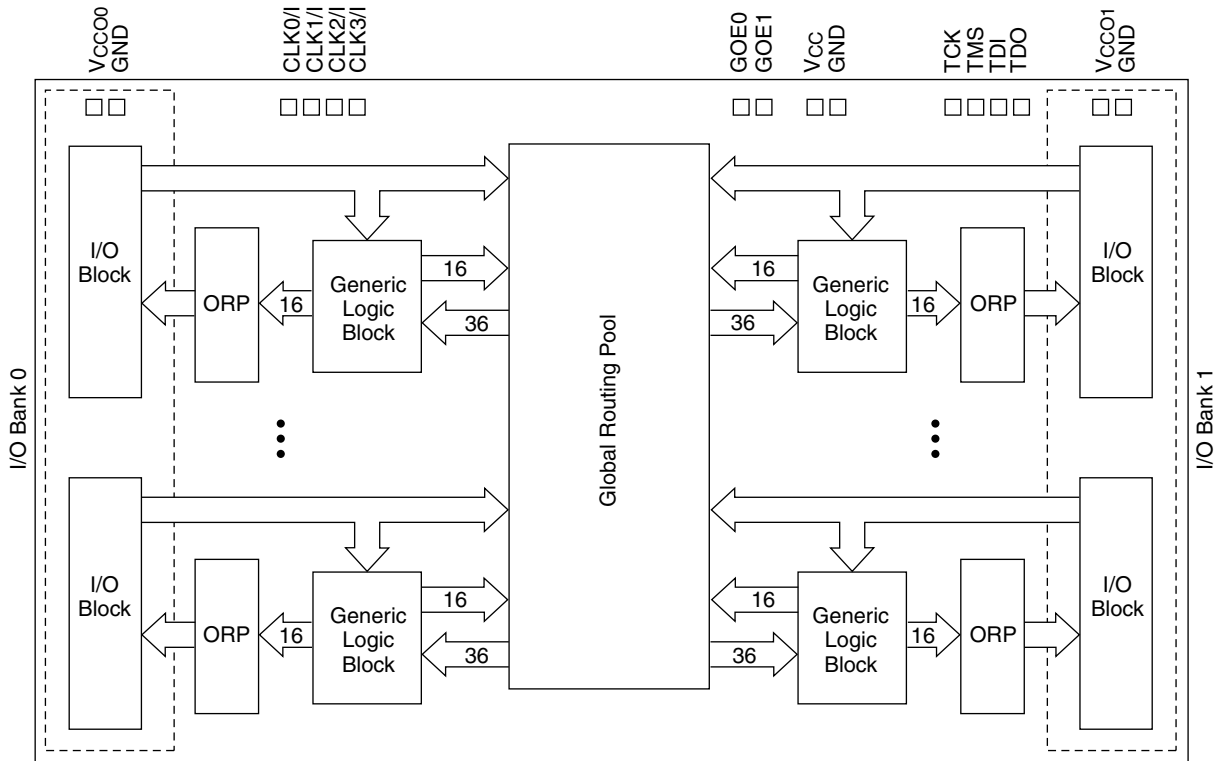
Embedded - CPLDs, or Complex Programmable Logic Devices, are highly versatile digital logic devices used in electronic systems. These programmable components are designed to perform complex logical operations and can be customized for specific applications. Unlike fixed-function ICs, CPLDs offer the 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	3V ~ 3.6V
Number of Logic Elements/Blocks	4
Number of Macrocells	64
Number of Gates	-
Number of I/O	64
Operating Temperature	0°C ~ 90°C (TJ)
Mounting Type	Surface Mount
Package / Case	100-LQFP
Supplier Device Package	100-TQFP (14x14)
Purchase URL	<a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4064v-75t100c">https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4064v-75t100c</a>

Figure 1. Functional Block Diagram



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

### ispMACH 4000 Architecture

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

### Generic Logic Block

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

- Block CLK2
- Block CLK3
- PT Clock
- PT Clock Inverted
- Shared PT Clock
- Ground

### Clock Enable Multiplexer

Each macrocell has a 4:1 clock enable multiplexer. This allows the clock enable signal to be selected from the following four sources:

- PT Initialization/CE
- PT Initialization/CE Inverted
- Shared PT Clock
- Logic High

### Initialization Control

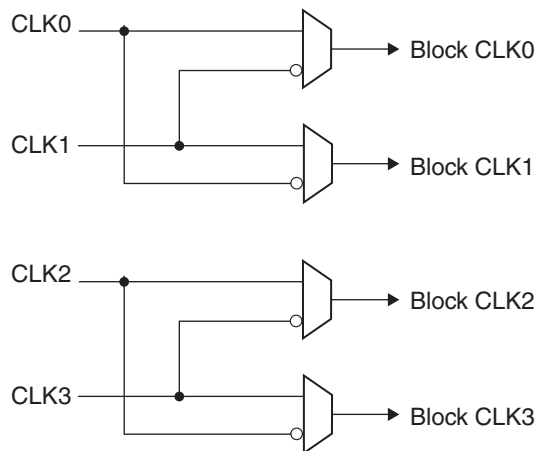
The ispMACH 4000 family architecture accommodates both block-level and macrocell-level set and reset capability. There is one block-level initialization term that is distributed to all macrocell registers in a GLB. At the macrocell level, two product terms can be “stolen” from the cluster associated with a macrocell to be used for set/reset functionality. A reset/preset swapping feature in each macrocell allows for reset and preset to be exchanged, providing flexibility.

Note that the reset/preset swapping selection feature affects power-up reset as well. All flip-flops power up to a known state for predictable system initialization. If a macrocell is configured to SET on a signal from the block-level initialization, then that macrocell will be SET during device power-up. If a macrocell is configured to RESET on a signal from the block-level initialization or is not configured for set/reset, then that macrocell will RESET on power-up. To guarantee initialization values, the  $V_{CC}$  rise must be monotonic, and the clock must be inactive until the reset delay time has elapsed.

### GLB Clock Generator

Each ispMACH 4000 device has up to four clock pins that are also routed to the GRP to be used as inputs. These pins drive a clock generator in each GLB, as shown in Figure 6. The clock generator provides four clock signals that can be used anywhere in the GLB. These four GLB clock signals can consist of a number of combinations of the true and complement edges of the global clock signals.

**Figure 6. GLB Clock Generator**



**ispMACH 4000Z Internal Timing Parameters (Cont.)**

Over Recommended Operating Conditions

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

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

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

Adder Type	Base Parameter	Description	-45		-5		-75		Units
			Min.	Max.	Min.	Max.	Min.	Max.	
<b>Optional Delay Adders</b>									
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 loading adder	—	0.05	—	0.05	—	0.05	ns
<b>t<sub>IOI</sub> Input Adjusters</b>									
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
<b>t<sub>IOO</sub> Output Adjusters</b>									
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.

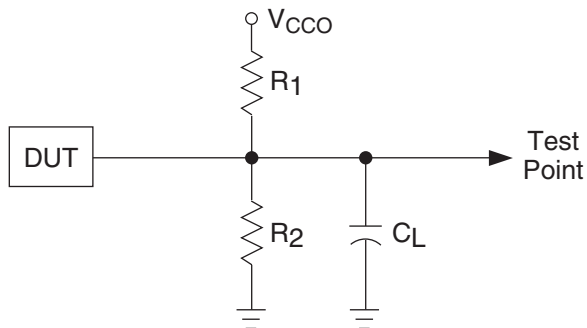
Timing v.2.2

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

### Switching Test Conditions

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

**Figure 12. Output Test Load, LVTTTL and LVCMOS Standards**



0213A/ispM4k

**Table 11. Test Fixture Required Components**

Test Condition	R <sub>1</sub>	R <sub>2</sub>	C <sub>L</sub> <sup>1</sup>	Timing Ref.	V <sub>CCO</sub>
LVCMOS I/O, (L -> H, H -> L)	106Ω	106Ω	35pF	LVCMOS 3.3 = 1.5V	LVCMOS 3.3 = 3.0V
				LVCMOS 2.5 = V <sub>CCO</sub> /2	LVCMOS 2.5 = 2.3V
				LVCMOS 1.8 = V <sub>CCO</sub> /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 <sub>OH</sub> - 0.3	3.0V
LVCMOS I/O (L -> Z)	106Ω	∞	5pF	V <sub>OL</sub> + 0.3	3.0V

1. C<sub>L</sub> includes test fixtures and probe capacitance.

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

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

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

Pin Number	Bank Number	ispMACH 4032V/B/C/Z		ispMACH 4064V/B/C		ispMACH 4064Z	
		GLB/MC/Pad	ORP	GLB/MC/Pad	ORP	GLB/MC/Pad	ORP
1	-	TDI	-	TDI	-	TDI	-
2	0	A5	A <sup>5</sup>	A10	A <sup>5</sup>	A8	A <sup>5</sup>
3	0	A6	A <sup>6</sup>	A12	A <sup>6</sup>	A10	A <sup>6</sup>
4	0	A7	A <sup>7</sup>	A14	A <sup>7</sup>	A11	A <sup>7</sup>
5	0	GND (Bank 0)	-	GND (Bank 0)	-	GND (Bank 0)	-
6	0	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-
7	0	A8	A <sup>8</sup>	B0	B <sup>0</sup>	B15	B <sup>7</sup>
8	0	A9	A <sup>9</sup>	B2	B <sup>1</sup>	B12	B <sup>6</sup>
9	0	A10	A <sup>10</sup>	B4	B <sup>2</sup>	B10	B <sup>5</sup>
10	0	A11	A <sup>11</sup>	B6	B <sup>3</sup>	B8	B <sup>4</sup>
11	-	TCK	-	TCK	-	TCK	-
12	-	VCC	-	VCC	-	VCC	-
13	-	GND	-	GND	-	GND	-
14	0	A12	A <sup>12</sup>	B8	B <sup>4</sup>	B6	B <sup>3</sup>
15	0	A13	A <sup>13</sup>	B10	B <sup>5</sup>	B4	B <sup>2</sup>
16	0	A14	A <sup>14</sup>	B12	B <sup>6</sup>	B2	B <sup>1</sup>
17	0	A15	A <sup>15</sup>	B14	B <sup>7</sup>	B0	B <sup>0</sup>
18	0	CLK1/I	-	CLK1/I	-	CLK1/I	-
19	1	CLK2/I	-	CLK2/I	-	CLK2/I	-
20	1	B0	B <sup>0</sup>	C0	C <sup>0</sup>	C0	C <sup>0</sup>
21	1	B1	B <sup>1</sup>	C2	C <sup>1</sup>	C1	C <sup>1</sup>
22	1	B2	B <sup>2</sup>	C4	C <sup>2</sup>	C2	C <sup>2</sup>
23	1	B3	B <sup>3</sup>	C6	C <sup>3</sup>	C4	C <sup>3</sup>
24	1	B4	B <sup>4</sup>	C8	C <sup>4</sup>	C6	C <sup>4</sup>
25	-	TMS	-	TMS	-	TMS	-
26	1	B5	B <sup>5</sup>	C10	C <sup>5</sup>	C8	C <sup>5</sup>
27	1	B6	B <sup>6</sup>	C12	C <sup>6</sup>	C10	C <sup>6</sup>
28	1	B7	B <sup>7</sup>	C14	C <sup>7</sup>	C11	C <sup>7</sup>
29	1	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-
30	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-
31	1	B8	B <sup>8</sup>	D0	D <sup>0</sup>	D15	D <sup>7</sup>
32	1	B9	B <sup>9</sup>	D2	D <sup>1</sup>	D12	D <sup>6</sup>

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

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

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

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



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

Pin Number	Bank Number	ispMACH 4128V/B/C	
		GLB/MC/Pad	ORP
62	1	E10	E^8
63	1	E12	E^9
64	1	E14	E^11
65	1	GND	-
66	1	TMS	-
67	1	VCCO (Bank 1)	-
68	1	F0	F^0
69	1	F1	F^1
70	1	F2	F^2
71	1	F4	F^3
72	1	F5	F^4
73	1	F6	F^5
74	1	GND (Bank 1)	-
75	1	F8	F^6
76	1	F9	F^7
77	1	F10	F^8
78	1	F12	F^9
79	1	F13	F^10
80	1	F14	F^11
81	1	VCCO (Bank 1)	-
82	1	G14	G^11
83	1	G13	G^10
84	1	G12	G^9
85	1	G10	G^8
86	1	G9	G^7
87	1	G8	G^6
88	1	GND (Bank 1)	-
89	1	G6	G^5
90	1	G5	G^4
91	1	G4	G^3
92	1	G2	G^2
93	1	G0	G^0
94	1	VCCO (Bank 1)	-
95	1	TDO	-
96	1	VCC	-
97	1	GND	-
98	1	H14	H^11
99	1	H13	H^10
100	1	H12	H^9
101	1	H10	H^8
102	1	H9	H^7
103	1	H8	H^6
104	1	GND (Bank 1)	-

**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>

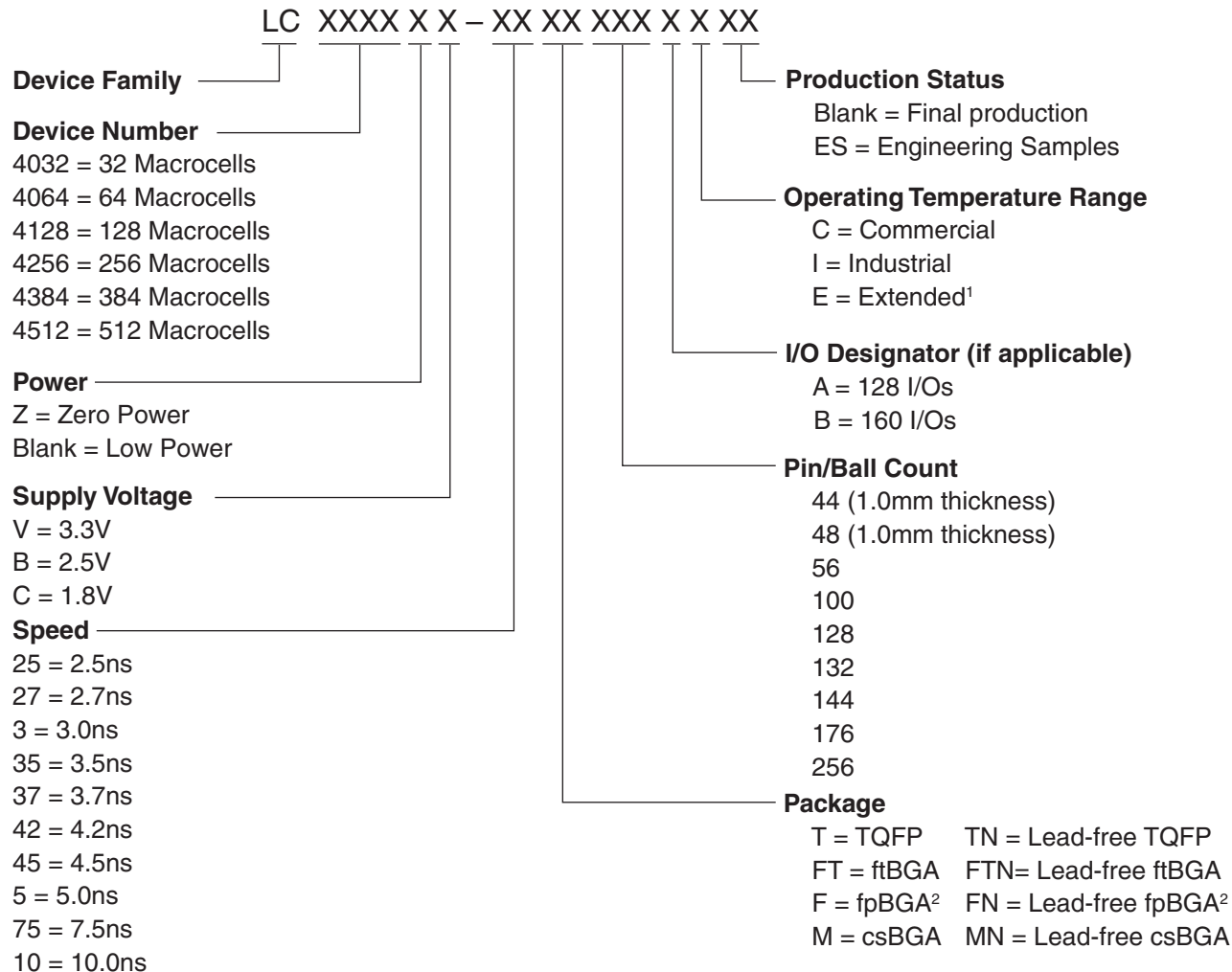
**ispMACH 4256V/B/C/Z, 4384V/B/C, 4512V/B/C, Logic Signal Connections:  
176-Pin TQFP (Cont.)**

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

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

Ball Number	I/O Bank	ispMACH 4256V/B/C 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
-	-	-	-	-	-	VCC	-	VCC	-
-	-	GND	-	GND	-	GND	-	GND	-
C3	-	TDI	-	TDI	-	TDI	-	TDI	-
-	0	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-
B1	0	C14	C^7	C14	C^9	C14	C^7	C14	C^7
F5	0	C12	C^6	C12	C^8	C12	C^6	C12	C^6
D3	0	C10	C^5	C10	C^7	C10	C^5	C10	C^5
C1	0	C8	C^4	C9	C^6	C8	C^4	C8	C^4
C2	0	C6	C^3	C8	C^5	C6	C^3	C6	C^3
E3	0	C4	C^2	C6	C^4	C4	C^2	C4	C^2
D2	0	C2	C^1	C4	C^3	C2	C^1	C2	C^1
F6	0	C0	C^0	C2	C^2	C0	C^0	C0	C^0
D1	0	NC	-	C1	C^1	F6	F^3	H0	H^0
E2	0	NC	-	C0	C^0	F4	F^2	H4	H^1
E4	0	NC	-	NC	-	D6	D^3	F4	F^2
G5	0	NC	-	NC	-	D4	D^2	F6	F^3
E1	0	NC	-	NC	-	NC	-	F8	F^4
-	0	-	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-
-	0	GND (Bank 0)	-	GND (Bank 0)	-	GND (Bank 0)	-	GND (Bank 0)	-
F2	0	NC	-	NC	-	NC	-	F10	F^5
F1	0	NC	-	NC	-	D2	D^1	F12	F^6
G1	0	NC	-	NC	-	D0	D^0	F14	F^7
G6	0	NC	-	D14	D^9	F2	F^1	H8	H^2
G4	0	NC	-	D12	D^8	F0	F^0	H12	H^3
H6	0	D14	D^7	D10	D^7	E14	E^7	G14	G^7
G3	0	D12	D^6	D9	D^6	E12	E^6	G12	G^6
H5	0	D10	D^5	D8	D^5	E10	E^5	G10	G^5
G2	0	D8	D^4	D6	D^4	E8	E^4	G8	G^4
H1	0	D6	D^3	D4	D^3	E6	E^3	G6	G^3
H2	0	D4	D^2	D2	D^2	E4	E^2	G4	G^2
H3	0	D2	D^1	D1	D^1	E2	E^1	G2	G^1
H4	0	D0	D^0	D0	D^0	E0	E^0	G0	G^0
-	0	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-
-	0	-	-	GND (Bank 0)	-	GND (Bank 0)	-	GND (Bank 0)	-
J4	0	E0	E^0	E0	E^0	H0	H^0	J0	J^0
J3	0	E2	E^1	E1	E^1	H2	H^1	J2	J^1
J2	0	E4	E^2	E2	E^2	H4	H^2	J4	J^2
J1	0	E6	E^3	E4	E^3	H6	H^3	J6	J^3
K1	0	E8	E^4	E6	E^4	H8	H^4	J8	J^4
J5	0	E10	E^5	E8	E^5	H10	H^5	J10	J^5
K2	0	E12	E^6	E9	E^6	H12	H^6	J12	J^6

**Part Number Description**



1. For automotive AEC-Q100 compliant devices, refer to the LA-ispMACH 4000V/Z Automotive Family Data Sheet (DS1017).  
 2. Use ftBGA package. fpBGA package devices have been discontinued via PCN#14A-07.

**ispMACH 4000 Family Speed Grade Offering**

	-25	-27	-3	-35	-37	-42	-45	-5		-75			-10
	Com	Com	Com	Com	Com	Com	Com	Com	Ind	Com	Ind	Ext	Ind
ispMACH 4032V/B/C												1	
ispMACH 4064V/B/C												1	
ispMACH 4128V/B/C												1	
ispMACH 4256V/B/C													
ispMACH 4384V/B/C													
ispMACH 4512V/B/C													
ispMACH 4032ZC												1	
ispMACH 4064ZC												1	
ispMACH 4128ZC												1	
ispMACH 4256ZC													

1. 3.3V only.

## Ordering Information

Note: ispMACH 4000 devices are all dual marked except the slowest commercial speed grade ispMACH 4000Z devices. For example, the commercial speed grade LC4128C-5T100C is also marked with the industrial grade -75I. The commercial grade is always one speed grade faster than the associated dual mark industrial grade. The slowest commercial speed grade ispMACH 4000Z devices are marked as commercial grade only.

## Conventional Packaging

### ispMACH 4000ZC (Zero Power, 1.8V) Commercial Devices

Device	Part Number	Macrocells	Voltage	t <sub>PD</sub>	Package	Pin/Ball Count	I/O	Grade
LC4032ZC	LC4032ZC-35M56C	32	1.8	3.5	csBGA	56	32	C
	LC4032ZC-5M56C	32	1.8	5	csBGA	56	32	C
	LC4032ZC-75M56C	32	1.8	7.5	csBGA	56	32	C
	LC4032ZC-35T48C	32	1.8	3.5	TQFP	48	32	C
	LC4032ZC-5T48C	32	1.8	5	TQFP	48	32	C
	LC4032ZC-75T48C	32	1.8	7.5	TQFP	48	32	C
LC4064ZC	LC4064ZC-37M132C	64	1.8	3.7	csBGA	132	64	C
	LC4064ZC-5M132C	64	1.8	5	csBGA	132	64	C
	LC4064ZC-75M132C	64	1.8	7.5	csBGA	132	64	C
	LC4064ZC-37T100C	64	1.8	3.7	TQFP	100	64	C
	LC4064ZC-5T100C	64	1.8	5	TQFP	100	64	C
	LC4064ZC-75T100C	64	1.8	7.5	TQFP	100	64	C
	LC4064ZC-37M56C	64	1.8	3.7	csBGA	56	32	C
	LC4064ZC-5M56C	64	1.8	5	csBGA	56	32	C
	LC4064ZC-75M56C	64	1.8	7.5	csBGA	56	32	C
	LC4064ZC-37T48C	64	1.8	3.7	TQFP	48	32	C
	LC4064ZC-5T48C	64	1.8	5	TQFP	48	32	C
	LC4064ZC-75T48C	64	1.8	7.5	TQFP	48	32	C
LC4128ZC	LC4128ZC-42M132C	128	1.8	4.2	csBGA	132	96	C
	LC4128ZC-75M132C	128	1.8	7.5	csBGA	132	96	C
	LC4128ZC-42T100C	128	1.8	4.2	TQFP	100	64	C
	LC4128ZC-75T100C	128	1.8	7.5	TQFP	100	64	C
LC4256ZC	LC4256ZC-45T176C	256	1.8	4.5	TQFP	176	128	C
	LC4256ZC-75T176C	256	1.8	7.5	TQFP	176	128	C
	LC4256ZC-45M132C	256	1.8	4.5	csBGA	132	96	C
	LC4256ZC-75M132C	256	1.8	7.5	csBGA	132	96	C
	LC4256ZC-45T100C	256	1.8	4.5	TQFP	100	64	C
	LC4256ZC-75T100C	256	1.8	7.5	TQFP	100	64	C

### ispMACH 4000ZC (1.8V, Zero Power) Industrial Devices

Device	Part Number	Macrocells	Voltage	t <sub>PD</sub>	Package	Pin/Ball Count	I/O	Grade
LC4032ZC	LC4032ZC-5M56I	32	1.8	5	csBGA	56	32	I
	LC4032ZC-75M56I	32	1.8	7.5	csBGA	56	32	I
	LC4032ZC-5T48I	32	1.8	5	TQFP	48	32	I
	LC4032ZC-75T48I	32	1.8	7.5	TQFP	48	32	I

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

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

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



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

Family	Part Number	Macrocells	Voltage	t <sub>PD</sub>	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 <sup>1</sup>	256	3.3	5	fpBGA	256	128	I
	LC4256V-75F256AI <sup>1</sup>	256	3.3	7.5	fpBGA	256	128	I
	LC4256V-10F256AI <sup>1</sup>	256	3.3	10	fpBGA	256	128	I
	LC4256V-5F256BI <sup>1</sup>	256	3.3	5	fpBGA	256	160	I
	LC4256V-75F256BI <sup>1</sup>	256	3.3	7.5	fpBGA	256	160	I
	LC4256V-10F256BI <sup>1</sup>	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 <sup>1</sup>	384	3.3	5	fpBGA	256	192	I
	LC4384V-75F256I <sup>1</sup>	384	3.3	7.5	fpBGA	256	192	I
	LC4384V-10F256I <sup>1</sup>	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 <sup>1</sup>	512	3.3	5	fpBGA	256	208	I
	LC4512V-75F256I <sup>1</sup>	512	3.3	7.5	fpBGA	256	208	I
	LC4512V-10F256I <sup>1</sup>	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.

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

Device	Part Number	Macrocells	Voltage	t <sub>PD</sub>	Package	Pin/Ball Count	I/O	Grade
LC4256C	LC4256C-5FTN256AI	256	1.8	5	Lead-free ftBGA	256	128	I
	LC4256C-75FTN256AI	256	1.8	7.5	Lead-free ftBGA	256	128	I
	LC4256C-10FTN256AI	256	1.8	10	Lead-free ftBGA	256	128	I
	LC4256C-5FTN256BI	256	1.8	5	Lead-free ftBGA	256	160	I
	LC4256C-75FTN256BI	256	1.8	7.5	Lead-free ftBGA	256	160	I
	LC4256C-10FTN256BI	256	1.8	10	Lead-free ftBGA	256	160	I
	LC4256C-5FN256AI <sup>1</sup>	256	1.8	5	Lead-free fpBGA	256	128	I
	LC4256C-75FN256AI <sup>1</sup>	256	1.8	7.5	Lead-free fpBGA	256	128	I
	LC4256C-10FN256AI <sup>1</sup>	256	1.8	10	Lead-free fpBGA	256	128	I
	LC4256C-5FN256BI <sup>1</sup>	256	1.8	5	Lead-free fpBGA	256	160	I
	LC4256C-75FN256BI <sup>1</sup>	256	1.8	7.5	Lead-free fpBGA	256	160	I
	LC4256C-10FN256BI <sup>1</sup>	256	1.8	10	Lead-free fpBGA	256	160	I
	LC4256C-5TN176I	256	1.8	5	Lead-free TQFP	176	128	I
	LC4256C-75TN176I	256	1.8	7.5	Lead-free TQFP	176	128	I
	LC4256C-10TN176I	256	1.8	10	Lead-free TQFP	176	128	I
	LC4256C-5TN100I	256	1.8	5	Lead-free TQFP	100	64	I
LC4256C-75TN100I	256	1.8	7.5	Lead-free TQFP	100	64	I	
LC4256C-10TN100I	256	1.8	10	Lead-free TQFP	100	64	I	
LC4384C	LC4384C-5FTN256I	384	1.8	5	Lead-free ftBGA	256	192	I
	LC4384C-75FTN256I	384	1.8	7.5	Lead-free ftBGA	256	192	I
	LC4384C-10FTN256I	384	1.8	10	Lead-free ftBGA	256	192	I
	LC4384C-5FN256I <sup>1</sup>	384	1.8	5	Lead-free fpBGA	256	192	I
	LC4384C-75FN256I <sup>1</sup>	384	1.8	7.5	Lead-free fpBGA	256	192	I
	LC4384C-10FN256I <sup>1</sup>	384	1.8	10	Lead-free fpBGA	256	192	I
	LC4384C-5TN176I	384	1.8	5	Lead-free TQFP	176	128	I
	LC4384C-75TN176I	384	1.8	7.5	Lead-free TQFP	176	128	I
LC4384C-10TN176I	384	1.8	10	Lead-free TQFP	176	128	I	
LC4512C	LC4512C-5FTN256I	512	1.8	5	Lead-free ftBGA	256	208	I
	LC4512C-75FTN256I	512	1.8	7.5	Lead-free ftBGA	256	208	I
	LC4512C-10FTN256I	512	1.8	10	Lead-free ftBGA	256	208	I
	LC4512C-5FN256I <sup>1</sup>	512	1.8	5	Lead-free fpBGA	256	208	I
	LC4512C-75FN256I <sup>1</sup>	512	1.8	7.5	Lead-free fpBGA	256	208	I
	LC4512C-10FN256I <sup>1</sup>	512	1.8	10	Lead-free fpBGA	256	208	I
	LC4512C-5TN176I	512	1.8	5	Lead-free TQFP	176	128	I
	LC4512C-75TN176I	512	1.8	7.5	Lead-free TQFP	176	128	I
LC4512C-10TN176I	512	1.8	10	Lead-free TQFP	176	128	I	

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

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

Device	Part Number	Macrocells	Voltage	t <sub>PD</sub>	Package	Pin/Ball Count	I/O	Grade
LC4128B	LC4128B-5TN128I	128	2.5	5	Lead-Free TQFP	128	92	I
	LC4128B-75TN128I	128	2.5	7.5	Lead-Free TQFP	128	92	I
	LC4128B-10TN128I	128	2.5	10	Lead-Free TQFP	128	92	I
	LC4128B-5TN100I	128	2.5	5	Lead-Free TQFP	100	64	I
	LC4128B-75TN100I	128	2.5	7.5	Lead-Free TQFP	100	64	I
	LC4128B-10TN100I	128	2.5	10	Lead-Free TQFP	100	64	I
LC4256B	LC4256B-5FTN256AI	256	2.5	5	Lead-Free ftBGA	256	128	I
	LC4256B-75FTN256AI	256	2.5	7.5	Lead-Free ftBGA	256	128	I
	LC4256B-10FTN256AI	256	2.5	10	Lead-Free ftBGA	256	128	I
	LC4256B-5FTN256BI	256	2.5	5	Lead-Free ftBGA	256	160	I
	LC4256B-75FTN256BI	256	2.5	7.5	Lead-Free ftBGA	256	160	I
	LC4256B-10FTN256BI	256	2.5	10	Lead-Free ftBGA	256	160	I
	LC4256B-5FN256AI <sup>1</sup>	256	2.5	5	Lead-Free fpBGA	256	128	I
	LC4256B-75FN256AI <sup>1</sup>	256	2.5	7.5	Lead-Free fpBGA	256	128	I
	LC4256B-10FN256AI <sup>1</sup>	256	2.5	10	Lead-Free fpBGA	256	128	I
	LC4256B-5FN256BI <sup>1</sup>	256	2.5	5	Lead-Free fpBGA	256	160	I
	LC4256B-75FN256BI <sup>1</sup>	256	2.5	7.5	Lead-Free fpBGA	256	160	I
	LC4256B-10FN256BI <sup>1</sup>	256	2.5	10	Lead-Free fpBGA	256	160	I
	LC4256B-5TN176I	256	2.5	5	Lead-Free TQFP	176	128	I
	LC4256B-75TN176I	256	2.5	7.5	Lead-Free TQFP	176	128	I
	LC4256B-10TN176I	256	2.5	10	Lead-Free TQFP	176	128	I
	LC4256B-5TN100I	256	2.5	5	Lead-Free TQFP	100	64	I
LC4256B-75TN100I	256	2.5	7.5	Lead-Free TQFP	100	64	I	
LC4256B-10TN100I	256	2.5	10	Lead-Free TQFP	100	64	I	
LC4384B	LC4384B-5FTN256I	384	2.5	5	Lead-Free ftBGA	256	192	I
	LC4384B-75FTN256I	384	2.5	7.5	Lead-Free ftBGA	256	192	I
	LC4384B-10FTN256I	384	2.5	10	Lead-Free ftBGA	256	192	I
	LC4384B-5FN256I <sup>1</sup>	384	2.5	5	Lead-Free fpBGA	256	192	I
	LC4384B-75FN256I <sup>1</sup>	384	2.5	7.5	Lead-Free fpBGA	256	192	I
	LC4384B-10FN256I <sup>1</sup>	384	2.5	10	Lead-Free fpBGA	256	192	I
	LC4384B-5TN176I	384	2.5	5	Lead-Free TQFP	176	128	I
	LC4384B-75TN176I	384	2.5	7.5	Lead-Free TQFP	176	128	I
	LC4384B-10TN176I	384	2.5	10	Lead-Free TQFP	176	128	I
LC4512B	LC4512B-5FTN256I	512	2.5	5	Lead-Free ftBGA	256	208	I
	LC4512B-75FTN256I	512	2.5	7.5	Lead-Free ftBGA	256	208	I
	LC4512B-10FTN256I	512	2.5	10	Lead-Free ftBGA	256	208	I
	LC4512B-5FN256I <sup>1</sup>	512	2.5	5	Lead-Free fpBGA	256	208	I
	LC4512B-75FN256I <sup>1</sup>	512	2.5	7.5	Lead-Free fpBGA	256	208	I
	LC4512B-10FN256I <sup>1</sup>	512	2.5	10	Lead-Free fpBGA	256	208	I
	LC4512B-5TN176I	512	2.5	5	Lead-Free TQFP	176	128	I
	LC4512B-75TN176I	512	2.5	7.5	Lead-Free TQFP	176	128	I
LC4512B-10TN176I	512	2.5	10	Lead-Free TQFP	176	128	I	

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

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

Device	Part Number	Macrocells	Voltage	t <sub>PD</sub>	Package	Pin/Ball Count	I/O	Grade
LC4256V	LC4256V-5FTN256AI	256	3.3	5	Lead-free ftBGA	256	128	I
	LC4256V-75FTN256AI	256	3.3	7.5	Lead-free ftBGA	256	128	I
	LC4256V-10FTN256AI	256	3.3	10	Lead-free ftBGA	256	128	I
	LC4256V-5FTN256BI	256	3.3	5	Lead-free ftBGA	256	160	I
	LC4256V-75FTN256BI	256	3.3	7.5	Lead-free ftBGA	256	160	I
	LC4256V-10FTN256BI	256	3.3	10	Lead-free ftBGA	256	160	I
	LC4256V-5FN256AI <sup>1</sup>	256	3.3	5	Lead-free fpBGA	256	128	I
	LC4256V-75FN256AI <sup>1</sup>	256	3.3	7.5	Lead-free fpBGA	256	128	I
	LC4256V-10FN256AI <sup>1</sup>	256	3.3	10	Lead-free fpBGA	256	128	I
	LC4256V-5FN256BI <sup>1</sup>	256	3.3	5	Lead-free fpBGA	256	160	I
	LC4256V-75FN256BI <sup>1</sup>	256	3.3	7.5	Lead-free fpBGA	256	160	I
	LC4256V-10FN256BI <sup>1</sup>	256	3.3	10	Lead-free fpBGA	256	160	I
	LC4256V-5TN176I	256	3.3	5	Lead-free TQFP	176	128	I
	LC4256V-75TN176I	256	3.3	7.5	Lead-free TQFP	176	128	I
	LC4256V-10TN176I	256	3.3	10	Lead-free TQFP	176	128	I
	LC4256V-5TN144I	256	3.3	5	Lead-free TQFP	144	96	I
	LC4256V-75TN144I	256	3.3	7.5	Lead-free TQFP	144	96	I
	LC4256V-10TN144I	256	3.3	10	Lead-free TQFP	144	96	I
	LC4256V-5TN100I	256	3.3	5	Lead-free TQFP	100	64	I
	LC4256V-75TN100I	256	3.3	7.5	Lead-free TQFP	100	64	I
LC4256V-10TN100I	256	3.3	10	Lead-free TQFP	100	64	I	
LC4384V	LC4384V-5FTN256I	384	3.3	5	Lead-free ftBGA	256	192	I
	LC4384V-75FTN256I	384	3.3	7.5	Lead-free ftBGA	256	192	I
	LC4384V-10FTN256I	384	3.3	10	Lead-free ftBGA	256	192	I
	LC4384V-5FN256I <sup>1</sup>	384	3.3	5	Lead-free fpBGA	256	192	I
	LC4384V-75FN256I <sup>1</sup>	384	3.3	7.5	Lead-free fpBGA	256	192	I
	LC4384V-10FN256I <sup>1</sup>	384	3.3	10	Lead-free fpBGA	256	192	I
	LC4384V-5TN176I	384	3.3	5	Lead-free TQFP	176	128	I
	LC4384V-75TN176I	384	3.3	7.5	Lead-free TQFP	176	128	I
LC4384V-10TN176I	384	3.3	10	Lead-free TQFP	176	128	I	
LC4512V	LC4512V-5FTN256I	512	3.3	5	Lead-free ftBGA	256	208	I
	LC4512V-75FTN256I	512	3.3	7.5	Lead-free ftBGA	256	208	I
	LC4512V-10FTN256I	512	3.3	10	Lead-free ftBGA	256	208	I
	LC4512V-5FN256I <sup>1</sup>	512	3.3	5	Lead-free fpBGA	256	208	I
	LC4512V-75FN256I <sup>1</sup>	512	3.3	7.5	Lead-free fpBGA	256	208	I
	LC4512V-10FN256I <sup>1</sup>	512	3.3	10	Lead-free fpBGA	256	208	I
	LC4512V-5TN176I	512	3.3	5	Lead-free TQFP	176	128	I
	LC4512V-75TN176I	512	3.3	7.5	Lead-free TQFP	176	128	I
	LC4512V-10TN176I	512	3.3	10	Lead-free TQFP	176	128	I

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

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

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

## For Further Information

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

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

## Revision History

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