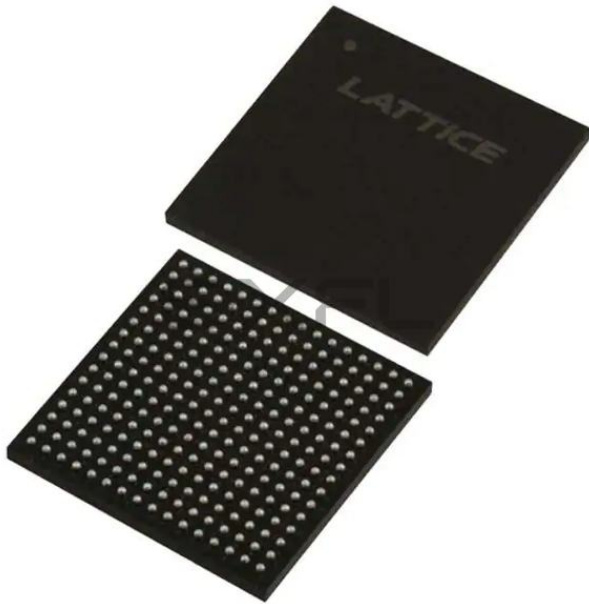




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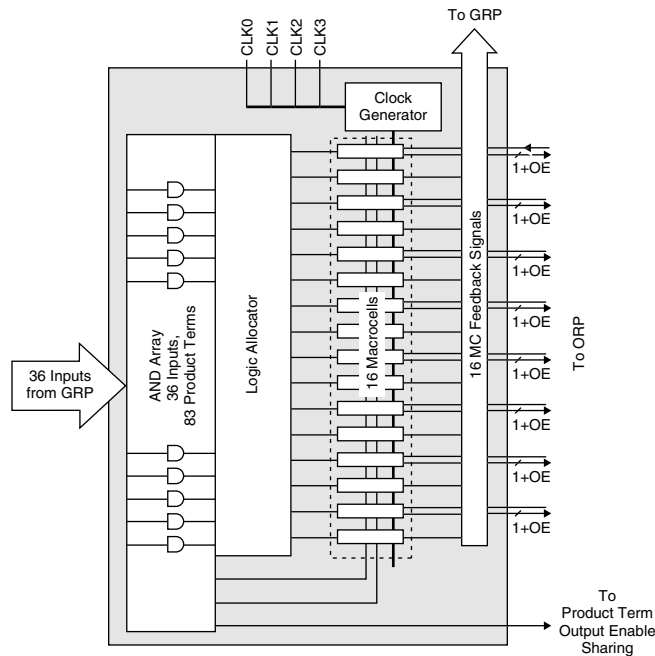
Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

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	Active
Programmable Type	In System Programmable
Delay Time tpd(1) Max	7.5 ns
Voltage Supply - Internal	3V ~ 3.6V
Number of Logic Elements/Blocks	16
Number of Macrocells	256
Number of Gates	-
Number of I/O	160
Operating Temperature	-40°C ~ 105°C (TJ)
Mounting Type	Surface Mount
Package / Case	256-LBGA
Supplier Device Package	256-FTBGA (17x17)
Purchase URL	https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4256v-75ftn256bi

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.

- 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

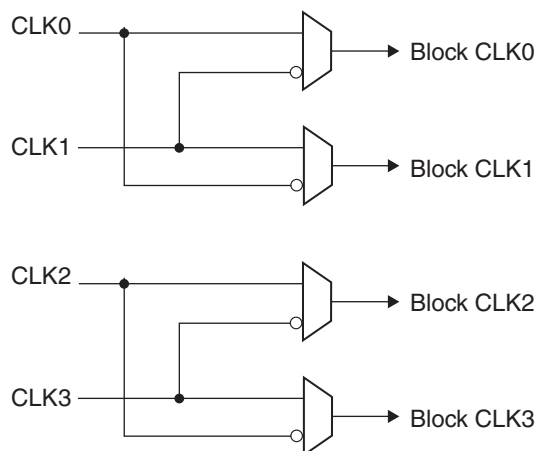
The ispMACH 4000 family architecture accommodates both block-level and macrocell-level set and reset capability. There is one block-level initialization term that is distributed to all macrocell registers in a GLB. At the macrocell level, two product terms can be “stolen” from the cluster associated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



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 ^{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	V _{CC} = 1.8V, T _A = 25°C	—	341	—	μA
		V _{CC} = 1.9V, T _A = 70°C	—	361	—	μA
		V _{CC} = 1.9V, T _A = 85°C	—	372	—	μA
		V _{CC} = 1.9V, T _A = 125°C	—	468	—	μA
ICC ^{4, 5}	Standby Power Supply Current	V _{CC} = 1.8V, T _A = 25°C	—	13	—	μA
		V _{CC} = 1.9V, T _A = 70°C	—	32	55	μA
		V _{CC} = 1.9V, T _A = 85°C	—	43	90	μA
		V _{CC} = 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.

ispMACH 4000V/B/C Internal Timing Parameters (Cont.)**Over Recommended Operating Conditions**

Parameter	Description	-5		-75		-10		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
t _{GPTOE}	Global PT OE Delay	—	5.58	—	5.58	—	5.78	ns
t _{PTOE}	Macrocell PT OE Delay	—	3.58	—	4.28	—	4.28	ns

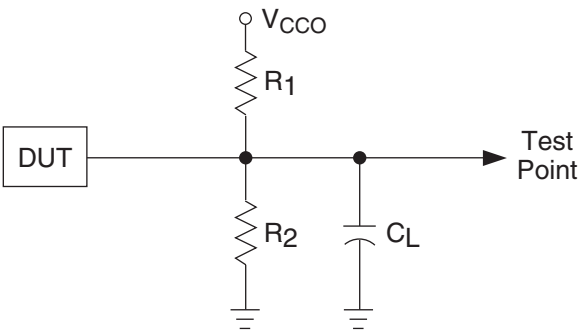
Timing v.3.2

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

Switching Test Conditions

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

Figure 12. Output Test Load, LVTTTL and LVCMOS Standards



0213A/ispm4k

Table 11. Test Fixture Required Components

Test Condition	R_1	R_2	C_L^1	Timing Ref.	V_{CCO}
LVCMOS I/O, (L -> H, H -> L)	106 Ω	106 Ω	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)	∞	106 Ω	35pF	1.5V	3.0V
LVCMOS I/O (Z -> L)	106 Ω	∞	35pF	1.5V	3.0V
LVCMOS I/O (H -> Z)	∞	106 Ω	5pF	$V_{OH} - 0.3$	3.0V
LVCMOS I/O (L -> Z)	106 Ω	∞	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 Connections¹

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 VCCO (Bank 0)	6	6	F3	13, 33, 95	3, 17, 30, 41, 122
VCCO1 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 4064V/B/C/Z, 4128V/B/C/Z, 4256V/B/C/Z Logic Signal Connections:
100-Pin TQFP (Cont.)**

Pin Number	Bank Number	ispMACH 4064V/B/C/Z		ispMACH 4128V/B/C/Z		ispMACH 4256V/B/C/Z	
		GLB/MC/Pad	ORP	GLB/MC/Pad	ORP	GLB/MC/Pad	ORP
83	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-
84	1	D3	D ³	H6	H ³	P12	P ³
85	1	D2	D ²	H4	H ²	P10	P ²
86	1	D1	D ¹	H2	H ¹	P6	P ¹
87	1	D0/GOE1	D ⁰	H0/GOE1	H ⁰	P2/OE1	P ⁰
88	1	CLK3/I	-	CLK3/I	-	CLK3/I	-
89	0	CLK0/I	-	CLK0/I	-	CLK0/I	-
90	-	VCC	-	VCC	-	VCC	-
91	0	A0/GOE0	A ⁰	A0/GOE0	A ⁰	A2/GOE0	A ⁰
92	0	A1	A ¹	A2	A ¹	A6	A ¹
93	0	A2	A ²	A4	A ²	A10	A ²
94	0	A3	A ³	A6	A ³	A12	A ³
95	0	VCCO (Bank 0)	-	VCCO (Bank 0)	-	VCCO (Bank 0)	-
96	0	GND (Bank 0)	-	GND (Bank 0)	-	GND (Bank 0)	-
97	0	A4	A ⁴	A8	A ⁴	B2	B ⁰
98	0	A5	A ⁵	A10	A ⁵	B6	B ¹
99	0	A6	A ⁶	A12	A ⁶	B10	B ²
100	0	A7	A ⁷	A14	A ⁷	B12	B ³

*This pin is input only.

ispMACH 4128V/B/C Logic Signal Connections: 128-Pin TQFP

Pin Number	Bank Number	ispMACH 4128V/B/C	
		GLB/MC/Pad	ORP
1	0	GND	-
2	0	TDI	-
3	0	VCCO (Bank 0)	-
4	0	B0	B ⁰
5	0	B1	B ¹
6	0	B2	B ²
7	0	B4	B ³
8	0	B5	B ⁴
9	0	B6	B ⁵
10	0	GND (Bank 0)	-
11	0	B8	B ⁶
12	0	B9	B ⁷
13	0	B10	B ⁸
14	0	B12	B ⁹
15	0	B13	B ¹⁰
16	0	B14	B ¹¹
17	0	VCCO (Bank 0)	-
18	0	C14	C ¹¹

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

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

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

Ball Number	Bank Number	ispMACH 4064Z		ispMACH 4128Z		ispMACH 4256Z	
		GLB/MC/Pad	ORP	GLB/MC/Pad	ORP	GLB/MC/Pad	ORP
P8	1	NC 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, 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

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) Industrial Devices (Cont.)

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

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

ispMACH 4000V (3.3V) Commercial Devices

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

ispMACH 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) Extended Temperature Devices

Device	Part Number	Macrocells	Voltage	t _{PD}	Package	Pin/Ball Count	I/O	Grade
LC4032V	LC4032V-75T48E	32	3.3	7.5	TQFP	48	32	E
	LC4032V-75T44E	32	3.3	7.5	TQFP	44	30	E
LC4064V	LC4064V-75T100E	64	3.3	7.5	TQFP	100	64	E
	LC4064V-75T48E	64	3.3	7.5	TQFP	48	32	E
	LC4064V-75T44E	64	3.3	7.5	TQFP	44	30	E
LC4128V	LC4128V-75T144E	128	3.3	7.5	TQFP	144	96	E
	LC4128V-75T128E	128	3.3	7.5	TQFP	128	92	E
	LC4128V-75T100E	128	3.3	7.5	TQFP	100	64	E
LC4256V	LC4256V-75T176E	256	3.3	7.5	TQFP	176	128	E
	LC4256V-75T144E	256	3.3	7.5	TQFP	144	96	E
	LC4256V-75T100E	256	3.3	7.5	TQFP	100	64	E

Lead-Free Packaging**ispMACH 4000Z (Zero Power, 1.8V) Lead-Free Commercial Devices**

Device	Part Number	Macrocells	Voltage	t _{PD}	Package	Pin/Ball Count	I/O	Grade
LC4032ZC	LC4032ZC-35MN56C	32	1.8	3.5	Lead-free csBGA	56	32	C
	LC4032ZC-5MN56C	32	1.8	5	Lead-free csBGA	56	32	C
	LC4032ZC-75MN56C	32	1.8	7.5	Lead-free csBGA	56	32	C
	LC4032ZC-35TN48C	32	1.8	3.5	Lead-free TQFP	48	32	C
	LC4032ZC-5TN48C	32	1.8	5	Lead-free TQFP	48	32	C
	LC4032ZC-75TN48C	32	1.8	7.5	Lead-free TQFP	48	32	C
LC4064ZC	LC4064ZC-37MN132C	64	1.8	3.7	Lead-free csBGA	132	64	C
	LC4064ZC-5MN132C	64	1.8	5	Lead-free csBGA	132	64	C
	LC4064ZC-75MN132C	64	1.8	7.5	Lead-free csBGA	132	64	C
	LC4064ZC-37TN100C	64	1.8	3.7	Lead-free TQFP	100	64	C
	LC4064ZC-5TN100C	64	1.8	5	Lead-free TQFP	100	64	C
	LC4064ZC-75TN100C	64	1.8	7.5	Lead-free TQFP	100	64	C
	LC4064ZC-37MN56C	64	1.8	3.7	Lead-free csBGA	56	32	C
	LC4064ZC-5MN56C	64	1.8	5	Lead-free csBGA	56	32	C
	LC4064ZC-75MN56C	64	1.8	7.5	Lead-free csBGA	56	32	C
	LC4064ZC-37TN48C	64	1.8	3.7	Lead-free TQFP	48	32	C
	LC4064ZC-5TN48C	64	1.8	5	Lead-free TQFP	48	32	C
	LC4064ZC-75TN48C	64	1.8	7.5	Lead-free TQFP	48	32	C
LC4128ZC	LC4128ZC-42MN132C	128	1.8	4.2	Lead-free csBGA	132	96	C
	LC4128ZC-75MN132C	128	1.8	7.5	Lead-free csBGA	132	96	C
	LC4128ZC-42TN100C	128	1.8	4.2	Lead-free TQFP	100	64	C
	LC4128ZC-75TN100C	128	1.8	7.5	Lead-free TQFP	100	64	C
LC4256ZC	LC4256ZC-45TN176C	256	1.8	4.5	Lead-free TQFP	176	128	C
	LC4256ZC-75TN176C	256	1.8	7.5	Lead-free TQFP	176	128	C
	LC4256ZC-45MN132C	256	1.8	4.5	Lead-free csBGA	132	96	C
	LC4256ZC-75MN132C	256	1.8	7.5	Lead-free csBGA	132	96	C
	LC4256ZC-45TN100C	256	1.8	4.5	Lead-free TQFP	100	64	C
	LC4256ZC-75TN100C	256	1.8	7.5	Lead-free TQFP	100	64	C

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

Device	Part Number	Macrocells	Voltage	t _{PD}	Package	Pin/Ball Count	I/O	Grade
LC4032ZC	LC4032ZC-5MN56I	32	1.8	5	Lead-free csBGA	56	32	I
	LC4032ZC-75MN56I	32	1.8	7.5	Lead-free csBGA	56	32	I
	LC4032ZC-5TN48I	32	1.8	5	Lead-free TQFP	48	32	I
	LC4032ZC-75TN48I	32	1.8	7.5	Lead-free TQFP	48	32	I

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

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

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

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

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

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

Device	Part Number	Macrocells	Voltage	t _{PD}	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