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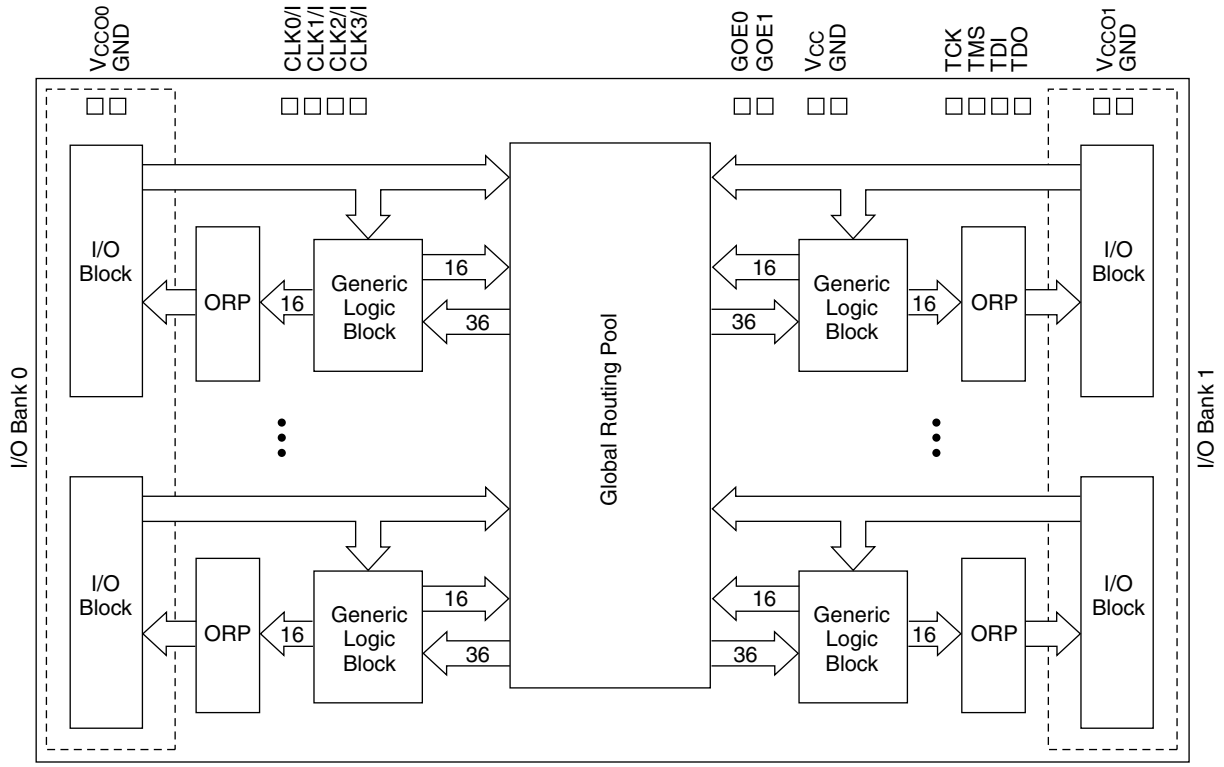
Understanding Embedded - CPLDs (Complex Programmable Logic Devices)

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	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	208
Operating Temperature	0°C ~ 90°C (TJ)
Mounting Type	Surface Mount
Package / Case	256-BGA
Supplier Device Package	256-FPBGA (17x17)
Purchase URL	https://www.e-xfl.com/product-detail/lattice-semiconductor/lc4512b-5f256c

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_{CCO} of 3.0V to 3.6V for LVCMOS 3.3, LVTTL 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.

Table 5. Product Term Expansion Capability

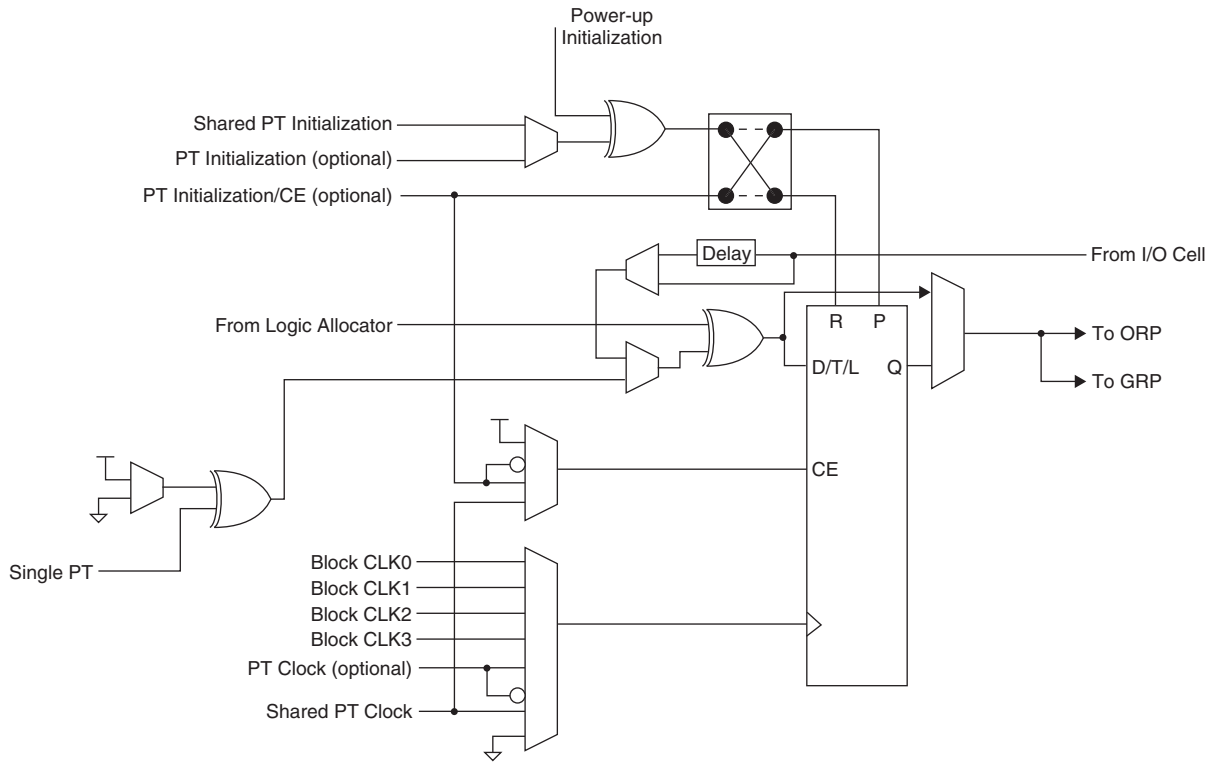
Expansion Chains	Macrocells Associated with Expansion Chain (with Wrap Around)	Max PT/ Macrocell
Chain-0	M0 M4 M8 M12 M0	75
Chain-1	M1 M5 M9 M13 M1	80
Chain-2	M2 M6 M10 M14 M2	75
Chain-3	M3 M7 M11 M15 M3	70

Every time the super cluster allocator is used, there is an incremental delay of t_{EXP}. When the super cluster allocator is used, all destinations other than the one being steered to, are given the value of ground (i.e., if the super cluster is steered to M (n+4), then M (n) is ground).

Macrocell

The 16 macrocells in the GLB are driven by the 16 outputs from the logic allocator. Each macrocell contains a programmable XOR gate, a programmable register/latch, along with routing for the logic and control functions. Figure 5 shows a graphical representation of the macrocell. The macrocells feed the ORP and GRP. A direct input from the I/O cell allows designers to use the macrocell to construct high-speed input registers. A programmable delay in this path allows designers to choose between the fastest possible set-up time and zero hold time.

Figure 5. Macrocell

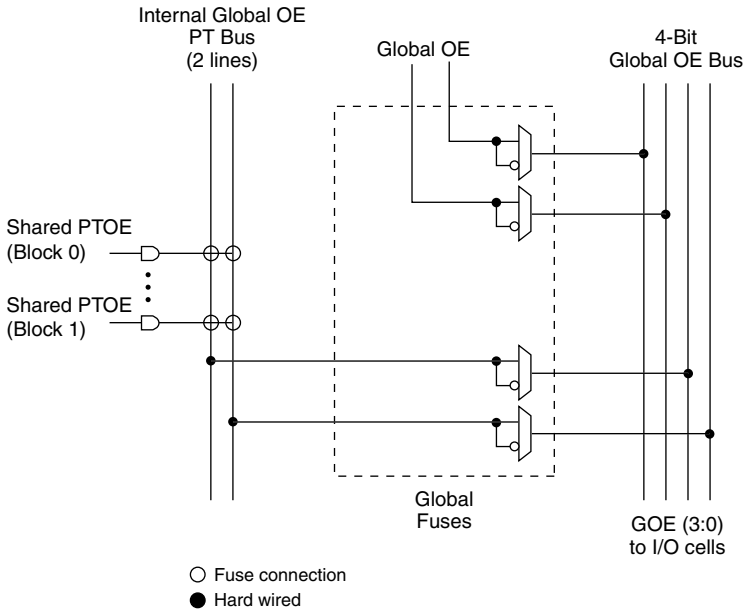


Enhanced Clock Multiplexer

The clock input to the flip-flop can select any of the four block clocks along with the shared PT clock, and true and complement forms of the optional individual term clock. An 8:1 multiplexer structure is used to select the clock. The eight sources for the clock multiplexer are as follows:

- Block CLK0
- Block CLK1

Figure 10. Global OE Generation for ispMACH 4032



Zero Power/Low Power and Power Management

The ispMACH 4000 family is designed with high speed low power design techniques to offer both high speed and low power. With an advanced E^2 low power cell and non sense-amplifier design approach (full CMOS logic approach), the ispMACH 4000 family offers SuperFAST pin-to-pin speeds, while simultaneously delivering low standby power without needing any “turbo bits” or other power management schemes associated with a traditional sense-amplifier approach.

The zero power ispMACH 4000Z is based on the 1.8V ispMACH 4000C family. With innovative circuit design changes, the ispMACH 4000Z family is able to achieve the industry’s “lowest static power”.

IEEE 1149.1-Compliant Boundary Scan Testability

All ispMACH 4000 devices have boundary scan cells and are compliant to the IEEE 1149.1 standard. This allows functional testing of the circuit board on which the device is mounted through a serial scan path that can access all critical logic notes. Internal registers are linked internally, allowing test data to be shifted in and loaded directly onto test nodes, or test node data to be captured and shifted out for verification. In addition, these devices can be linked into a board-level serial scan path for more board-level testing. The test access port operates with an LVCMOS interface that corresponds to the power supply voltage.

I/O Quick Configuration

To facilitate the most efficient board test, the physical nature of the I/O cells must be set before running any continuity tests. As these tests are fast, by nature, the overhead and time that is required for configuration of the I/Os’ physical nature should be minimal so that board test time is minimized. The ispMACH 4000 family of devices allows this by offering the user the ability to quickly configure the physical nature of the I/O cells. This quick configuration takes milliseconds to complete, whereas it takes seconds for the entire device to be programmed. Lattice's ispVM® System programming software can either perform the quick configuration through the PC parallel port, or can generate the ATE or test vectors necessary for a third-party test system.

I/O Recommended Operating Conditions

Standard	V_{CCO} (V)[1]	
	Min.	Max.
LVTTL	3.0	3.6
LVCMOS 3.3	3.0	3.6
Extended LVCMOS 3.3[2]	2.7	3.6
LVCMOS 2.5	2.3	2.7
LVCMOS 1.8	1.65	1.95
PCI 3.3	3.0	3.6

1. Typical values for V_{CCO} are the average of the min. and max. values.
2. ispMACH 4000Z only.

DC Electrical Characteristics

Over Recommended Operating Conditions

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

1. Input or I/O leakage current is measured with the pin configured as an input or as an I/O with the output driver tristated. It is not measured with the output driver active. Bus maintenance circuits are disabled.
2. 5V tolerant inputs and I/O should only be placed in banks where $3.0V \le V_{CCO} \le 3.6V$.
3. $T_A = 25°C$, f = 1.0MHz
4. I_{IH} excursions of up to 1.5µA maximum per pin above the spec limit may be observed for certain voltage conditions on no more than 10% of the device's I/O pins.

Supply Current, ispMACH 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.

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.

ispMACH 4000Z Internal Timing Parameters (Cont.)

Over Recommended Operating Conditions

Parameter	Description	-35		-37		-42		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{GPTOE}	Global PT OE Delay	—	1.9	—	2.35	—	2.60	ns
t_{PTOE}	Macrocell PT OE Delay	—	2.4	—	3.35	—	2.60	ns

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

Timing v.2.2

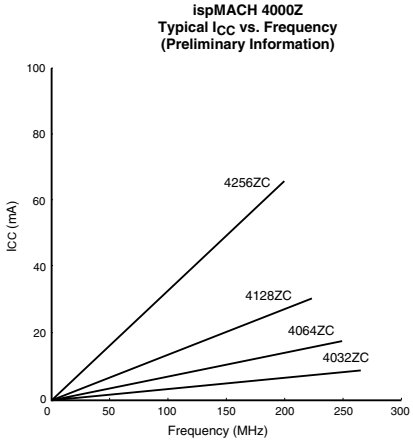
ispMACH 4000Z Timing Adders [1]

Adder Type	Base Parameter	Description	-35		-37		-42		Units
			Min.	Max.	Min.	Max.	Min.	Max.	
Optional Delay Adders									
t_{INDIO}	t_{INREG}	Input register delay	—	1.00	—	1.00	—	1.30	ns
t_{EXP}	t_{MCELL}	Product term expander delay	—	0.40	—	0.40	—	0.45	ns
t_{ORP}	—	Output routing pool delay	—	0.40	—	0.40	—	0.40	ns
t_{BLA}	t_{ROUTE}	Additional block loading adder	—	0.04	—	0.05	—	0.05	ns
t_{IOI} Input Adjusters									
LVTTL_in	t_{IN}, t_{GCLK_IN}, t_{GOE}	Using LVTTL standard	—	0.60	—	0.60	—	0.60	ns
LVCMOS33_in	t_{IN}, t_{GCLK_IN}, t_{GOE}	Using LVCMOS 3.3 standard	—	0.60	—	0.60	—	0.60	ns
LVCMOS25_in	t_{IN}, t_{GCLK_IN}, t_{GOE}	Using LVCMOS 2.5 standard	—	0.60	—	0.60	—	0.60	ns
LVCMOS18_in	t_{IN}, t_{GCLK_IN}, t_{GOE}	Using LVCMOS 1.8 standard	—	0.00	—	0.00	—	0.00	ns
PCI_in	t_{IN}, t_{GCLK_IN}, t_{GOE}	Using PCI compatible input	—	0.60	—	0.60	—	0.60	ns
t_{IOO} Output Adjusters									
LVTTL_out	t_{BUF}, t_{EN}, t_{DIS}	Output configured as TTL buffer	—	0.20	—	0.20	—	0.20	ns
LVCMOS33_out	t_{BUF}, t_{EN}, t_{DIS}	Output configured as 3.3V buffer	—	0.20	—	0.20	—	0.20	ns
LVCMOS25_out	t_{BUF}, t_{EN}, t_{DIS}	Output configured as 2.5V buffer	—	0.10	—	0.10	—	0.10	ns
LVCMOS18_out	t_{BUF}, t_{EN}, t_{DIS}	Output configured as 1.8V buffer	—	0.00	—	0.00	—	0.00	ns
PCI_out	t_{BUF}, t_{EN}, t_{DIS}	Output configured as PCI compatible buffer	—	0.20	—	0.20	—	0.20	ns
Slow Slew	t_{BUF}, t_{EN}	Output configured for slow slew rate	—	1.00	—	1.00	—	1.00	ns

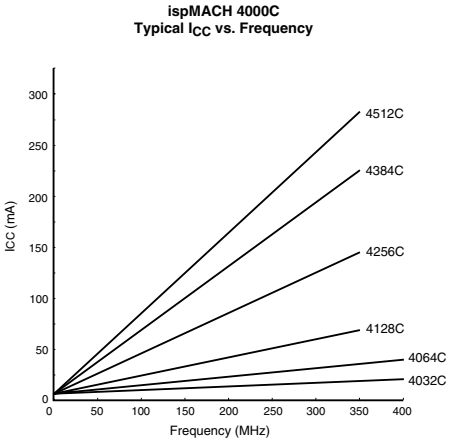
Note: Open drain timing is the same as corresponding LVCMOS timing. Timing v.2.2

1. Refer to TN1004, ispMACH 4000 Timing Model Design and Usage Guidelines for information regarding the use of these adders.

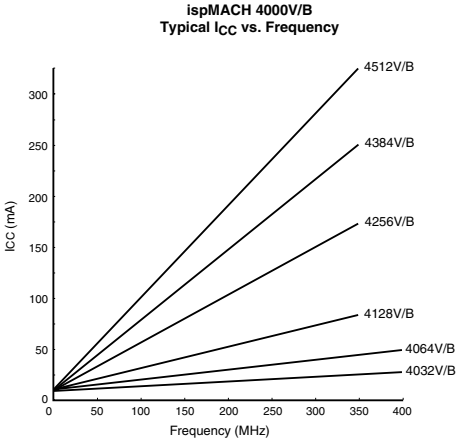
Power Consumption



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



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



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

Power Estimation Coefficients[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.

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

Pin Number	Bank Number	ispMACH 4064V/B/C/Z		ispMACH 4128V/B/C/Z		ispMACH 4256V/B/C/Z	
		GLB/MC/Pad	ORP	GLB/MC/Pad	ORP	GLB/MC/Pad	ORP
42	1	C1	C^1	E2	E^1	I6	I^1
43	1	C2	C^2	E4	E^2	I10	I^2
44	1	C3	C^3	E6	E^3	I12	I^3
45	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-
46	1	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-
47	1	C4	C^4	E8	E^4	J2	J^0
48	1	C5	C^5	E10	E^5	J6	J^1
49	1	C6	C^6	E12	E^6	J10	J^2
50	1	C7	C^7	E14	E^7	J12	J^3
51	-	GND	-	GND	-	GND	-
52	-	TMS	-	TMS	-	TMS	-
53	1	C8	C^8	F0	F^0	K12	K^3
54	1	C9	C^9	F2	F^1	K10	K^2
55	1	C10	C^10	F4	F^2	K6	K^1
56	1	C11	C^11	F6	F^3	K2	K^0
57	1	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-
58	1	C12	C^12	F8	F^4	L12	L^3
59	1	C13	C^13	F10	F^5	L10	L^2
60	1	C14	C^14	F12	F^6	L6	L^1
61	1	C15	C^15	F13	F^7	L4	L^0
62*	1	I	-	I	-	I	-
63	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-
64	1	D15	D^15	G14	G^7	M4	M^0
65	1	D14	D^14	G12	G^6	M6	M^1
66	1	D13	D^13	G10	G^5	M10	M^2
67	1	D12	D^12	G8	G^4	M12	M^3
68	1	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-
69	1	D11	D^11	G6	G^3	N2	N^0
70	1	D10	D^10	G5	G^2	N6	N^1
71	1	D9	D^9	G4	G^1	N10	N^2
72	1	D8	D^8	G2	G^0	N12	N^3
73*	1	I	-	I	-	I	-
74	-	TDO	-	TDO	-	TDO	-
75	-	VCC	-	VCC	-	VCC	-
76	-	GND	-	GND	-	GND	-
77*	1	I	-	I	-	I	-
78	1	D7	D^7	H13	H^7	O12	O^3
79	1	D6	D^6	H12	H^6	O10	O^2
80	1	D5	D^5	H10	H^5	O6	O^1
81	1	D4	D^4	H8	H^4	O2	O^0
82	1	GND (Bank 1)	-	GND (Bank 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^7	G4	G^2
44	0	D8	D^6	G2	G^1
45	0	NC[2]	-	I[2]	-
46	0	GND (Bank 0)	-	GND (Bank 0)	-
47	0	VCCO (Bank 0)	-	VCCO (Bank 0)	-
48	0	D6	D^5	H12	H^6
49	0	D5	D^4	H10	H^5
50	0	D4	D^3	H8	H^4
51	0	D2	D^2	H6	H^3
52	0	D1	D^1	H4	H^2
53	0	D0	D^0	H2	H^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^0	I2	I^1
59	1	E1	E^1	I4	I^2
60	1	E2	E^2	I6	I^3
61	1	E4	E^3	I8	I^4
62	1	E5	E^4	I10	I^5
63	1	E6	E^5	I12	I^6
64	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-
65	1	GND (Bank 1)	-	GND (Bank 1)	-
66	1	E8	E^6	J2	J^1
67	1	E9	E^7	J4	J^2
68	1	E10	E^8	J6	J^3
69	1	E12	E^9	J8	J^4
70	1	E13	E^10	J10	J^5
71	1	E14	E^11	J12	J^6
72	1	NC[2]	-	I[2]	-
73	-	GND	-	GND	-
74	-	TMS	-	TMS	-
75	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-
76	1	F0	F^0	K12	K^6
77	1	F1	F^1	K10	K^5
78	1	F2	F^2	K8	K^4
79	1	F4	F^3	K6	K^3
80	1	F5	F^4	K4	K^2
81	1	F6	F^5	K2	K^1
82	1	GND (Bank 1)	-	GND (Bank 1)	-
83	1	F8	F^6	L14	L^7
84	1	F9	F^7	L12	L^6
85	1	F10	F^8	L10	L^5

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
86	1	F12	F^9	L8	L^4
87	1	F13	F^10	L6	L^3
88	1	F14	F^11	L4	L^2
89	1	NC[2]	-	I[2]	-
90	1	GND (Bank 1)[1]	-	NC[1]	-
91	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-
92	1	NC[2]	-	I[2]	-
93	1	G14	G^11	M2	M^1
94	1	G13	G^10	M4	M^2
95	1	G12	G^9	M6	M^3
96	1	G10	G^8	M8	M^4
97	1	G9	G^7	M10	M^5
98	1	G8	G^6	M12	M^6
99	1	GND (Bank 1)	-	GND (Bank 1)	-
100	1	G6	G^5	N2	N^1
101	1	G5	G^4	N4	N^2
102	1	G4	G^3	N6	N^3
103	1	G2	G^2	N8	N^4
104	1	G1	G^1	N10	N^5
105	1	G0	G^0	N12	N^6
106	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-
107	-	TDO	-	TDO	-
108	-	VCC	-	VCC	-
109	-	GND	-	GND	-
110	1	NC[2]	-	I[2]	-
111	1	H14	H^11	O12	O^6
112	1	H13	H^10	O10	O^5
113	1	H12	H^9	O8	O^4
114	1	H10	H^8	O6	O^3
115	1	H9	H^7	O4	O^2
116	1	H8	H^6	O2	O^1
117	1	NC[2]	-	I[2]	-
118	1	GND (Bank 1)	-	GND (Bank 1)	-
119	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-
120	1	H6	H^5	P12	P^6
121	1	H5	H^4	P10	P^5
122	1	H4	H^3	P8	P^4
123	1	H2	H^2	P6	P^3
124	1	H1	H^1	P4	P^2
125	1	H0/GOE1	H^0	P2/GOE1	P^1
126	1	CLK3/I	-	CLK3/I	-
127	0	GND (Bank 0)	-	GND (Bank 0)	-
128	0	CLK0/I	-	CLK0/I	-

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^4	L8	L^4	P8	P^4
61	0	H6	H^3	L6	L^3	P6	P^3
62	0	H4	H^2	L4	L^2	P4	P^2
63	0	H2	H^1	L2	L^1	P2	P^1
64	0	H0	H^0	L0	L^0	P0	P^0
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^0	M0	M^0	AX0	AX^0
71	1	I2	I^1	M2	M^1	AX2	AX^1
72	1	I4	I^2	M4	M^2	AX4	AX^2
73	1	I6	I^3	M6	M^3	AX6	AX^3
74	1	I8	I^4	M8	M^4	AX8	AX^4
75	1	I10	I^5	M10	M^5	AX10	AX^5
76	1	I12	I^6	M12	M^6	AX12	AX^6
77	1	I14	I^7	M14	M^7	AX14	AX^7
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^0	N0	N^0	BX0	BX^0
81	1	J2	J^1	N2	N^1	BX2	BX^1
82	1	J4	J^2	N4	N^2	BX4	BX^2
83	1	J6	J^3	N6	N^3	BX6	BX^3
84	1	J8	J^4	N8	N^4	BX8	BX^4
85	1	J10	J^5	N10	N^5	BX10	BX^5
86	1	J12	J^6	N12	N^6	BX12	BX^6
87	1	J14	J^7	N14	N^7	BX14	BX^7
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^7	O14	O^7	CX14	CX^7
94	1	K12	K^6	O12	O^6	CX12	CX^6
95	1	K10	K^5	O10	O^5	CX10	CX^5
96	1	K8	K^4	O8	O^4	CX8	CX^4
97	1	K6	K^3	O6	O^3	CX6	CX^3
98	1	K4	K^2	O4	O^2	CX4	CX^2
99	1	K2	K^1	O2	O^1	CX2	CX^1
100	1	K0	K^0	O0	O^0	CX0	CX^0

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 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
H15	1	M2	M^1	M1	M^1	DX2	DX^1	JX2	JX^1
H14	1	M4	M^2	M2	M^2	DX4	DX^2	JX4	JX^2
H13	1	M6	M^3	M4	M^3	DX6	DX^3	JX6	JX^3
G16	1	M8	M^4	M6	M^4	DX8	DX^4	JX8	JX^4
H12	1	M10	M^5	M8	M^5	DX10	DX^5	JX10	JX^5
G15	1	M12	M^6	M9	M^6	DX12	DX^6	JX12	JX^6
H11	1	M14	M^7	M10	M^7	DX14	DX^7	JX14	JX^7
F16	1	NC	-	M12	M^8	CX0	CX^0	IX0	IX^0
G13	1	NC	-	M14	M^9	CX2	CX^1	IX4	IX^1
G14	1	NC	-	NC	-	EX14	EX^7	KX0	KX^0
F15	1	NC	-	NC	-	EX12	EX^6	KX2	KX^1
E16	1	NC	-	NC	-	NC	-	KX4	KX^2
-	1	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-
-	1	-	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-
E15	1	NC	-	NC	-	NC	-	KX6	KX^3
G12	1	NC	-	NC	-	EX10	EX^5	KX8	KX^4
E13	1	NC	-	NC	-	EX8	EX^4	KX10	KX^5
D16	1	NC	-	N0	N^0	CX4	CX^2	IX8	IX^2
E14	1	NC	-	N1	N^1	CX6	CX^3	IX12	IX^3
G11	1	N0	N^0	N2	N^2	FX0	FX^0	NX0	NX^0
D15	1	N2	N^1	N4	N^3	FX2	FX^1	NX2	NX^1
F11	1	N4	N^2	N6	N^4	FX4	FX^2	NX4	NX^2
C16	1	N6	N^3	N8	N^5	FX6	FX^3	NX6	NX^3
F12	1	N8	N^4	N9	N^6	FX8	FX^4	NX8	NX^4
D14	1	N10	N^5	N10	N^7	FX10	FX^5	NX10	NX^5
C15	1	N12	N^6	N12	N^8	FX12	FX^6	NX12	NX^6
B16	1	N14	N^7	N14	N^9	FX14	FX^7	NX14	NX^7
-	1	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-	VCCO (Bank 1)	-
C14	-	TDO	-	TDO	-	TDO	-	TDO	-
-	-	VCC	-	VCC	-	VCC	-	VCC	-
-	-	GND	-	GND	-	GND	-	GND	-
-	1	-	-	GND (Bank 1)	-	GND (Bank 1)	-	GND (Bank 1)	-
A15	1	NC	-	NC	-	EX6	EX^3	KX12	KX^6
B14	1	NC	-	NC	-	EX4	EX^2	KX14	KX^7
E12	1	O14	O^7	O14	O^9	GX14	GX^7	OX14	OX^7
A14	1	O12	O^6	O12	O^8	GX12	GX^6	OX12	OX^6
C13	1	O10	O^5	O10	O^7	GX10	GX^5	OX10	OX^5
D13	1	O8	O^4	O9	O^6	GX8	GX^4	OX8	OX^4
E11	1	O6	O^3	O8	O^5	GX6	GX^3	OX6	OX^3
B13	1	O4	O^2	O6	O^4	GX4	GX^2	OX4	OX^2
F10	1	O2	O^1	O4	O^3	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
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

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

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

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

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

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

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

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

Device	Part Number	Macrocells	Voltage	t_{PD}	Package	Pin/Ball Count	I/O	Grade
LC4384B	LC4384B-35FTN256C	384	2.5	3.5	Lead-Free ftBGA	256	192	C
	LC4384B-5FTN256C	384	2.5	5	Lead-Free ftBGA	256	192	C
	LC4384B-75FTN256C	384	2.5	7.5	Lead-Free ftBGA	256	192	C
	LC4384B-35FN256C[1]	384	2.5	3.5	Lead-Free fpBGA	256	192	C
	LC4384B-5FN256C[1]	384	2.5	5	Lead-Free fpBGA	256	192	C
	LC4384B-75FN256C[1]	384	2.5	7.5	Lead-Free fpBGA	256	192	C
	LC4384B-35TN176C	384	2.5	3.5	Lead-Free TQFP	176	128	C
	LC4384B-5TN176C	384	2.5	5	Lead-Free TQFP	176	128	C
	LC4384B-75TN176C	384	2.5	7.5	Lead-Free TQFP	176	128	C
LC4512B	LC4512B-35FTN256C	512	2.5	3.5	Lead-Free ftBGA	256	208	C
	LC4512B-5FTN256C	512	2.5	5	Lead-Free ftBGA	256	208	C
	LC4512B-75FTN256C	512	2.5	7.5	Lead-Free ftBGA	256	208	C
	LC4512B-35FN256C[1]	512	2.5	3.5	Lead-Free fpBGA	256	208	C
	LC4512B-5FN256C[1]	512	2.5	5	Lead-Free fpBGA	256	208	C
	LC4512B-75FN256C[1]	512	2.5	7.5	Lead-Free fpBGA	256	208	C
	LC4512B-35TN176C	512	2.5	3.5	Lead-Free TQFP	176	128	C
	LC4512B-5TN176C	512	2.5	5	Lead-Free TQFP	176	128	C
	LC4512B-75TN176C	512	2.5	7.5	Lead-Free TQFP	176	128	C

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

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

Device	Part Number	Macrocells	Voltage	t_{PD}	Package	Pin/Ball Count	I/O	Grade
LC4032B	LC4032B-5TN48I	32	2.5	5	Lead-Free TQFP	48	32	I
	LC4032B-75TN48I	32	2.5	7.5	Lead-Free TQFP	48	32	I
	LC4032B-10TN48I	32	2.5	10	Lead-Free TQFP	48	32	I
	LC4032B-5TN44I	32	2.5	5	Lead-Free TQFP	44	30	I
	LC4032B-75TN44I	32	2.5	7.5	Lead-Free TQFP	44	30	I
	LC4032B-10TN44I	32	2.5	10	Lead-Free TQFP	44	30	I
LC4064B	LC4064B-5TN100I	64	2.5	5	Lead-Free TQFP	100	64	I
	LC4064B-75TN100I	64	2.5	7.5	Lead-Free TQFP	100	64	I
	LC4064B-10TN100I	64	2.5	10	Lead-Free TQFP	100	64	I
	LC4064B-5TN48I	64	2.5	5	Lead-Free TQFP	48	32	I
	LC4064B-75TN48I	64	2.5	7.5	Lead-Free TQFP	48	32	I
	LC4064B-10TN48I	64	2.5	10	Lead-Free TQFP	48	32	I
	LC4064B-5TN44I	64	2.5	5	Lead-Free TQFP	44	30	I
	LC4064B-75TN44I	64	2.5	7.5	Lead-Free TQFP	44	30	I
	LC4064B-10TN44I	64	2.5	10	Lead-Free TQFP	44	30	I