RoHS Compliant Packaging

Lattice Semiconductor is committed to conducting business in a manner consistent with the efficient use of resources and materials, and the preservation of the natural environment.

Lattice Corporate Commitment

Due to increased worldwide environmental concerns, the need for lead-free and halogen-free solutions in electronic components and systems is receiving increased attention within the semiconductor and electronics industries. Lattice is fully supportive of the various industry efforts throughout the world to phase out the use of lead and other undesirable elements from electronic equipment materials and manufacturing processes.

Lattice remains committed to continually reducing its impact on the world's natural environment and works closely with its customers and suppliers to identify and rapidly eliminate hazardous substances from its products.

Resource Conservation

Environmental protection is more than just meeting standards. All corporate activities must be implemented with the environment in mind. Lattice's goal is to develop all new products such that they reduce space, materials and power consumption for an equivalent electrical function. In turn, this allows our customers to continually reduce their impact on the environment.

ISO14001

ISO14001 is an international standard for environmental management systems. Companies that are ISO14001 registered have demonstrated an internal program for the management of hazardous waste and implementation of recycling programs. This recognition certifies a company's commitment to preserving the natural environment. All Lattice subcontract manufacturers are ISO14001 registered, and are routinely reviewed to ensure continued compliance.

Green Packaging Solutions

Lattice has qualified a wide variety of package types in lead-free and halogen-free configurations. These include the Plastic Leaded Chip Carrier (PLCC), Thin Quad Flat Pack (TQFP), Plastic Quad Flat Pack (PQFP), Fine Pitch BGA (fpBGA), Fine Pitch Thin BGA (ftBGA), Chip Array BGA (caBGA), Chip Scale BGA (csBGA), Ultra Chip Scale BGA (ucBGA), Flip Chip BGA (fcBGA), Quad Flat-Pack No Lead Saw-Singulated (QFNS) and Wafer Level Chip Scale Packaging (WLCSP). To better facilitate the industry transition to lead-free and halogen-free PLDs, Lattice offers the following lead-free and halogen-free product families.

- **Optimized FPGA Architecture with High-Performance DSP**
  - LatticeECP3™ (1.2V)
  - LatticeECP2M™ (1.2V)
  - LatticeECP2™ (1.2V)
  - LatticeECP-DSP™ (1.2V)
  - LatticeEC™ (1.2V)

- **LatticeSC™ FPGA for Extreme Performance**
  - LatticeSC (1.2V/1.0V)
  - LatticeSCM™ (1.2V/1.0V)

- **MachXO2™ "Do-it-All" Programmable Logic Devices**
  - MachXO2-ZE (1.2V)
  - MachXO2-HC (3.3V/2.5V)
  - MachXO2-HE (1.2V)

- **MachXO™ Most Versatile Programmable Logic Devices**
  - MachXO (3.3V/2.5V/1.8V/1.2V)
  - AEC-Q100 Qualified LA-MachXO (3.3V/2.5V/1.8V/1.2V)

- **Optimized FPGA Architecture with Non-Volatile Reconfiguration and TransFR™ Technology**
  - LatticeXP2™ (1.2V)
  - AEC-Q100 Qualified LA-LatticeXP2 (1.2V)
  - LatticeXP™ (3.3V/2.5V/1.8V/1.2V)

- **Ultra Low Power CPLDs**
  - ispMACH® 4000ZE (1.8V)

- **Zero-Power CPLDs**
  - ispMACH 4000Z (1.8V)

- **Low-Power CPLDs**
  - ispMACH 4000V/B/C (3.3V/2.5V/1.8V)
  - AEC-Q100 Qualified LA-ispMACH 4000V (3.3V)

- **Platform Manager™ Mixed-Signal Devices**
  - LPTM10-1247
  - LPTM10-12107

- **Power Manager II Mixed-Signal Devices**
  - ProcessorPM™-POWR605
  - ispPAC®-POWR607
  - ispPAC-POWR1014/A
  - AEC-Q100 Qualified LA-ispPAC-POWR1014/A
  - ispPAC-POWR1220AT8
  - ispPAC-POWR6AT6

- **Programmable Clock Generator**
  - ispClock™5600/A
  - ispClock5400D
  - ispClock5300S

Lead-Free & Halogen-Free Packaging Initiative

Lattice Semiconductor is a leader in the development of green packaging solutions. Lattice offers an extensive list of standard products in lead-free and halogen-free packaging.

Lattice's lead-free and halogen-free products are fully RoHS compliant, meeting the European Parliament Directive entitled "Restrictions on the use Of Hazardous Substances" (RoHS). This directive prohibits the use of the following elements in electrical/electronic equipment sold after 7/1/2006: cadmium (Cd), lead (Pb), mercury (Hg), hexavalent chromium (Cr+6), polybrominated biphenyls (PBBs) and polybrominated diphenylethers (PBDEs).

Backward Compatible Packages

All Lattice RoHS compliant TQFP, PLCC, PQFP and QFNS packages are "backward compatible" with conventional leaded manufacturing methodologies. This backward compatibility allows users to surface mount lead-free and halogen-free packages onto lead-based PCBs and/or use lead-free and halogen-free packaging with lead-containing solders. Users can now procure a single, lead-free or halogen-free component from Lattice and use it in either a leaded or lead-free manufacturing environment without any issues. This capability greatly simplifies the inventory management challenges associated with migration from conventional lead-based to lead-free manufacturing.

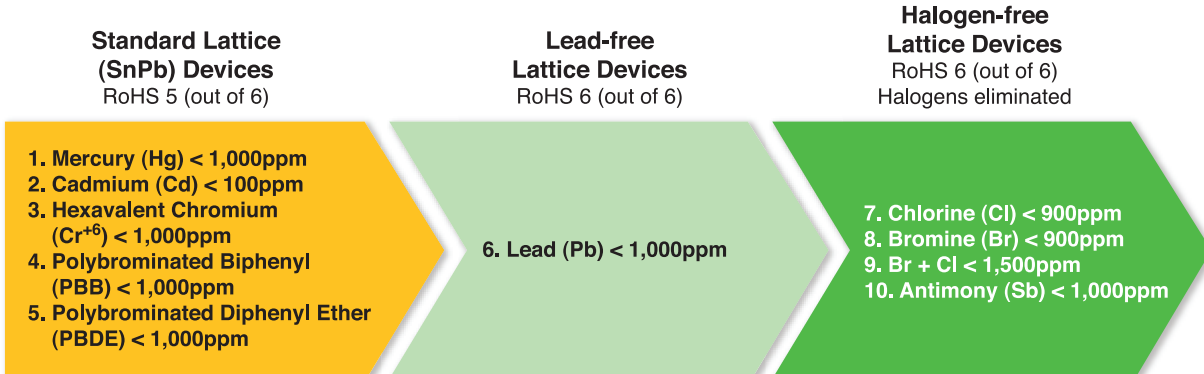## Lead-Free & Halogen-Free Reflow Profile

Lattice's RoHS compliant packages are qualified to Level 1, 3 or 4 moisture resistance, depending on the package type, with peak reflow temperatures of either 260°C, 250°C or 245°C, consistent with IPC/JEDEC J-STD-020, Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices. Reliability tests include high temperature operating life (HTOL), surface mount preconditioning testing, temperature cycling, moisture resistance testing, biased highly accelerated stress test (HAST) and unbiased HAST. Lattice's lead-free products are qualified to the reflow profiles described in the product bulletin Reflow Profile for Lattice Lead-Free, Halogen-Free, RoHS Compliant Products, available on the Lattice web site at www.latticesemi.com.

Typical Conditions for Lead-Free and Halogen-Free Reflow Soldering
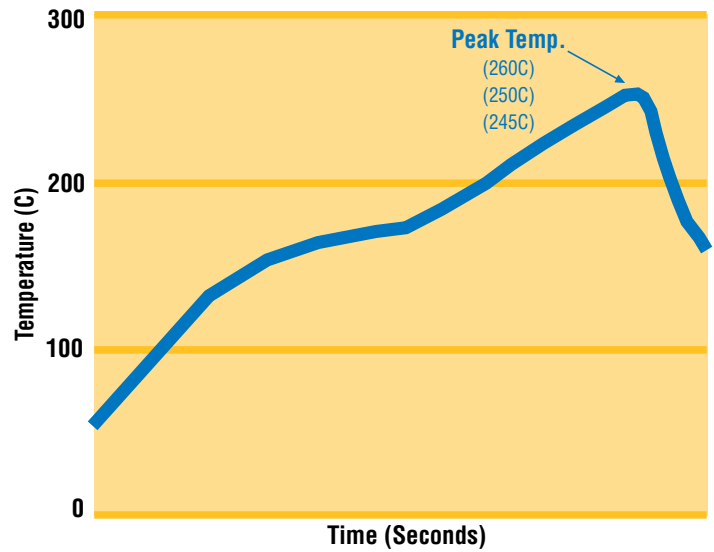
Lead-Free & Halogen-Free Peak Reflow Temp.	Moisture Sensitivity Level (MSL)	Package
260 + 0/-5°C	1	24-/32-QFNS
	3	TQFP, csBGA, ucBGA, 256-caBGA, 48-/64-QFNS, 100-fpBGA, 208-ftBGA, 256-ftBGA (Option 1), 324-ftBGA
250 + 0/-5°C	1	20-PLCC
	3	332-caBGA, fpBGA (>208 balls), 256-ftBGA (Option 2)
245 + 0/-5°C	1	28-PLCC
	3	PQFP, 44-PLCC
	4	fcBGA , 84-PLCC

For specific reflow profiles, see Lattice Technical Note TN1076.

Standard Lattice (SnPb) Devices
RoHS 5 (out of 6)

1. Mercury (Hg) < 1,000ppm
2. Cadmium (Cd) < 100ppm
3. Hexavalent Chromium (Cr+6) < 1,000ppm
4. Polybrominated Biphenyl (PBB) < 1,000ppm
5. Polybrominated Diphenyl Ether (PBDE) < 1,000ppm

Lead-free Lattice Devices
RoHS 6 (out of 6)

6. Lead (Pb) < 1,000ppm

Halogen-free Lattice Devices
RoHS 6 (out of 6)
Halogens eliminated

7. Chlorine (Cl) < 900ppm
8. Bromine (Br) < 900ppm
9. Br + Cl < 1,500ppm
10. Antimony (Sb) < 1,000ppm

Green Packaging From Lattice

Product Family	Device Family	Device Family Description	Halogen-Free (RoHS6/6)		Lead-Free (RoHS6/6)	
			Backward Compatible	Standard	Backward Compatible	Standard
LatticeECP3	LatticeECP3	Low Power, High-Value, SERDES-Capable FPGA				256-fpBGA 484-fpBGA 672-fpBGA 1156-fpBGA
LatticeECP2/M	LatticeECP2/M	High-Value FPGA, High End Features + SERDES			144-TQFP 208-PQFP	256-fpBGA 484-fpBGA 672-fpBGA 900-fpBGA 1152-fpBGA
LatticeECP/EC	LatticeECP-DSP	1.2V Low-Cost FPGA with Embedded High-Performance DSP			100-TQFP 144-TQFP 208-PQFP	256-fpBGA 484-fpBGA 672-fpBGA
	LatticeEC	1.2V Low-Cost FPGA for High-Volume Applications				
LatticeSC/M	LatticeSC	Extreme Performance 90nm FPGA				256-fpBGA 900-fpBGA 1020-fcBGA 1152-fcBGA 1704-fcBGA
	LatticeSCM					
LatticeXP2	LatticeXP2	Low-cost, non-volatile FPGA with flexiFLASH architecture			144-TQFP 208-PQFP	132-csBGA 256-ftBGA 484-fpBGA 672-fpBGA
	LA-LatticeXP2	AEC-Q100 qualified flexiFLASH architecture FPGA			144-TQFP 208-PQFP	132-csBGA 256-ftBGA
LatticeXP	LatticeXP "C"	1.8V/2.5V/3.3V Low-Cost Non-Volatile FPGAs with TransFR Technology			100-TQFP 144-TQFP 208-PQFP	256-fpBGA 388-fpBGA 484-fpBGA
	LatticeXP "E"	1.2V Low-Cost Non-Volatile FPGAs with TransFR Technology				
MachXO2	MachXO2 "HC"	3.3V/2.5V High-Performance PLD	100-TQFP 144-TQFP	25-WLCSP 36-WLCSP 64-ucBGA 132-csBGA 184-csBGA 256-caBGA 256-ftBGA 332-caBGA 484-fpBGA		
	MachXO2 "HE"	1.2V High-Performance PLD				
	MachXO2 "ZE"	1.2V Low-Power PLD				
MachXO	MachXO "C"	1.8V/2.5V/3.3V PLD			100-TQFP 144-TQFP	100-csBGA 132-csBGA 256-caBGA 256-ftBGA 324-ftBGA
	MachXO "E"	1.2V PLD				
	LA-MachXO "C"	1.8V/2.5V/3.3V AEC-Q100 Qualified PLD				256-ftBGA 324-ftBGA
	LA-MachXO "E"	1.2V AEC-Q100 Qualified PLD				

Green Packaging From Lattice (Continued)

Product Family	Device Family	Device Family Description	Halogen-Free (RoHS6/6)		Lead-Free (RoHS6/6)	
			Backward Compatible	Standard	Backward Compatible	Standard
ispMACH 4000 (Continued)	**ispMACH 4000V**	3.3V Low-Power CPLD			44-TQFP 48-TQFP 100-TQFP 128-TQFP 144-TQFP 176-TQFP	256-ftBGA
	ispMACH 4000B	2.5V Low-Power CPLD				
	ispMACH 4000C	1.8V Low-Power CPLD				
	LA-ispMACH 4000V	3.3V AEC-Q100 Qualified Low-Power CPLD			44-TQFP 48-TQFP 100-TQFP 128-TQFP 144-TQFP	
Platform Manager	**LPTM10-1247**	In-System Programmable Power and Digital Board Management	128-TQFP			
	LPTM10-12107			208-ftBGA		
Power Manager	**ProcessorPM-POWR605**	Power Supply Supervisor, Reset Generator and Watchdog Timer			24-QFNS	
	ispPAC-POWR607	Power Supply Supervisor, Reset Generator, Watchdog Timer and Sequencing Controller			32-QFNS	
	ispPAC-POWR1014/A	Power Supply Supervisor, Reset Generator, Watchdog Timer and Sequencing Controller			48-TQFP	
	LA-ispPAC-POWR1014/A	AEC-Q100 Qualified In-System Programmable Power Supply Supervisor, Reset Generator and Sequencing Controller			48-TQFP	
	ispPAC-POWR1220AT8	Power Supply Supervisor, Reset Generator, Sequencing, Trimming and Managing Controller			100-TQFP	
	ispPAC-POWR6AT6	Power Supply Monitoring and Margining Controller			32-QFNS	
ispClock	**ispClock5300S**	Ultra-low Jitter In-System Programmable Differential Clock			48-TQFP 64-TQFP	
	ispClock5400D	Ultra-low Phase Noise, Zero-Delay Buffer Clock			48-QFNS 64-QFNS	
	ispClock5600/A	In-System Programmable Clock Generator			48-TQFP 100-TQFP	
ispLSI® 1000E	**ispLSI 1016E**	5V In-System Programmable High Density PLD			44-PLCC 84-PLCC 44-TQFP 100-TQFP 128-TQFP 128-PQFP	
	ispLSI 1032E					
	ispLSI 1048E					
ispLSI 2000A	**ispLSI 2032A**	5V In-System Programamble High Density PLD			44-PLCC 84-PLCC 44-TQFP 48-TQFP 100-TQFP 128-TQFP 176-TQFP 128-PQFP 160-PQFP	
	ispLSI 2064A					
	ispLSI 2096A					
	ispLSI 2128A					
ispLSI 2000VE	**ispLSI 2032VE**	3.3V In-System Programmable High Density SuperFAST PLD			44-TQFP 48-TQFP 100-TQFP 128-TQFP 176-TQFP	208-fpBGA
	ispLSI 2096VE					
	ispLSI 2192VE					

Green Packaging From Lattice

Product Family	Device Family	Device Family Description	Halogen-Free (RoHS6/6)		Lead-Free (RoHS6/6)	
			Backward Compatible	Standard	Backward Compatible	Standard
ispMACH 4A3	M4A3-32	High Performance E²CMOS® 3.3V CPLD Family			44-TQFP 44-PLCC 48-TQFP 100-TQFP 144-TQFP 208-PQFP	256-fpBGA
	M4A3-64					
	M4A3-192					
	M4A3-512					
ispMACH 4A5	M4A5-32	High Performance E²CMOS 5V CPLD Family			44-TQFP 44-PLCC 48-TQFP 100-TQFP 100-PQFP 144-TQFP 208-PQFP	
	M4A5-64					
	M4A5-128					
	M4A5-192					
ispXPLD 5000MX	ispXPLD 5000MV	3.3V high Density CPLD + Memory			208PQFP	256-fpBGA 484-fpBGA 672-fpBGA
	ispXPLD 5000MB	2.5V High Density CPLD + Memory				
ispXPGA®	ispXPGA-B, EB	3.3V/2.5V Non-Volatile, Infinitely Reconfigurable FPGA				256-fpBGA
ORCA® 4 FPSC	ORT82G5[1]/42G5	1.5V ORCA 4 FPSC Plus Embedded High-Performance ASIC Core				484-fpBGA 680-fpBGA[1]
	ORT8850H/L					
ispGDX2™	ispGDX2-V, EV	3.3V High Performance Digital Crosspoint Switch				100-fpBGA 208-fpBGA 484-fpBGA
ispGDXVA	ispGDX80VA	3.3V In-System Programmable Generic Digital Crosspoint			100-TQFP	208-fpBGA 388-fpBGA
	ispGDX160VA					
	ispGDX240VA					

1. Lead-free version is supported without heat spreader.
2. Also halogen-free.

Note: Reference appropriate data sheet for valid part number and package combinations.

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