



Lead-Free / Green-Packaging Roadmap





The WEEE Directive

- Specifies legislation to curb the amount of WEEE generated within the European Union (EU)
- Requires the creation and enforcement of recovery and recycling efforts of hazardous materials
- Mandates the removal of some hazardous materials from the manufacture of electrical and electronic products
- Outlines the requirements for collection, treatment, recovery and recycling
- Calls for the mandatory removal of Lead solders by July 1, 2006
 - Includes the removal of Mercury (Hg), Cadmium (Cd) and Hexavalent Chromium (Cr(VI))



The ROHS Directive

- Restriction of the use of Hazardous Substances (ROHS)
- Purpose is to reduce waste management problems linked to substances likely to pose health and environmental risks
- ROHS and WEEE directives apply to the same manufacturers and range of products
- ROHS materials are classified as heavy metals and brominated flame retardants, including:
 - Lead (Pb), Mercury (Hg), Cadmium (Cd), Hexavalent Chromium (Cr(VI)), Polybrominated biphenyls, and Polybrominated diphenyl ether
- By January 1, 2007 new electrical and electronic equipment containing ROHS substances will be restricted from being marketed in EU countries
- Because the ROHS deadline closely follows that of the WEEE, “producer responsibility” issues should be promptly considered
 - Design stage of new product development activities



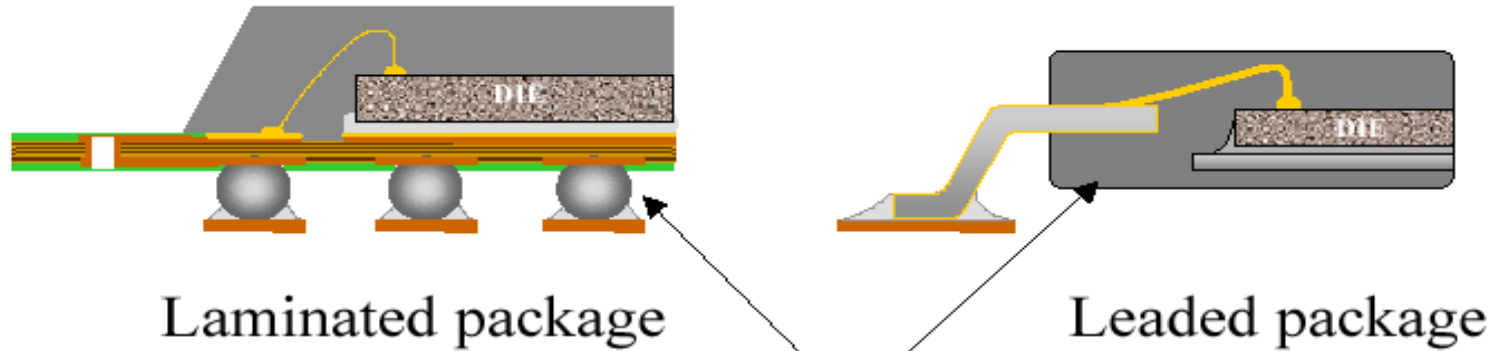
Legerity's Green Project Goals 2003

- Legerity will be a "Green" Supplier by the end of 2004
 - Legerity has qualified PLCC (28, 32, 44 & 64 lead) Packages
 - Legerity has qualified the L/eLQFP and T/eTQFP Packages.
 - Legerity has qualified the QFN (6x6, 7x7, 8x8) Packages
 - Legerity has qualified the SOIC (16, 20, 28) Packages.
 - Legerity has qualified the LBGA (121, 144) Packages.
- Legerity will produce Green-Package products by
 - Restricting manufacturing to only ISO 14000 certified subcontractors
 - Legerity is a fabless semiconductor company that depends on subcontractors for the production and assembly of goods
 - Legerity Engineering will drive Green-Package projects at subcontractor sites
 - Focusing on the production of "Lead-Free" / "Green" components
 - Lead will not intentionally be added during manufacturing process
 - Lead may be present in finished products as an impurity (allowable level is < 1000 ppm)
 - Minimizing the occurrences of elements such as Bromine (Br), Antimony (Sb), Cadmium (Cd), and Lead (Pb) to meet environmental standards
- Legerity will meet the Waste Electrical and Electronic Equipment (WEEE) Directive





Green-Packages



**Lead free solder +
Halogen/Sb free BOM**

Bill of Material	Leaded Packages	Laminated Packages
Lead/Ball	Sn or SnBi	SnAgCu
Die Attach	Br/Sb free	Br/Sb free
Mold Compound	Br/Sb free	Br/Sb free
Leadframe/Substrate	NA	Halogen/ Sb free



Non-Green Bill of Materials (BOM)

Package	Die Attach	Mold Compound	Lead Finish
PLCC	Hysol K01095	EME6300	Sn/Pb
TQFP/LQFP	Ablestik 8340	EME7351LS	Sn/Pb
ETQFP	CRM1076DP	CEL9220	Sn/Pb
BGA	CRM1580A	Nitto HC-100-XGBT	SnAgPb
QFN	CRM1076DP/QMI519	CEL9220/CEL9220THF1	SnPb



Green Package BOM

Package	Die Attach	Mold Compound	Lead Finish
PLCC	Ablestik 8361J	G600	Matte Sn
TQFP/LQFP	CRM1076DS	CEL9220HF	Matte Sn
E-Pads TQFP/ LQFP	CRM1076DS	CEL9220HF	Matte Sn
BGA	Ablestik 2025D	G760	SnAgCu
QFN	CRM1076DS	CEL9220HF	Matte Sn
SOIC	Ablestik 8361J	G700	Matte Sn



Impact on Assembly

- New Material Set
- Material Properties
 - Epoxy
 - Mold Compound
 - Substrate
- New Process Parameters
 - Plating process
 - Reflow profile (240C - 260C)

Package	Material	Function
Leadframe	Lead finish	Remove Pb from solder
	Mold compound	Remove halogens, improve moisture sensitivity
	Die attach epoxy	Improve adhesion and moisture resistance
	Solder die attach	Remove Pb from solder
Area Array	Solder ball	Remove Pb from solder
	Mold compound & encapsulants	Remove halogens, improve moisture sensitivity & improve adhesion
	Die attach epoxy	Improve adhesion and moisture sensitivity
	Substrate	Remove halogens, improve moisture sensitivity
	Solder mask	Improve adhesion and moisture resistance





Conversion Plan

	2003				2004				2005				2006	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Development		■	■	■	■	■								
Product / Package Qualification			■	■	■	■	■	■						
Ramp to Production					■	■	■	■	■	■				
Production						■	■	■	■	■	■	■	■	
Fully Converted														■



Qualification Matrix

SITE	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
	2004				2005				2006	
ASEM	PL068	QFN08032 PL044 PL032	TQe044 PL028		SO016 QFN06024 TQ128 LQe080	LQe044	SO20 SO028			
ASECL	LQ064	LQ080 TQ080 QFN08032	TQ064 TQ044	LBGA121 LBGA144		LQe080		TFBGA169		
ASEKr										
ATP		SO028								
CARSEM							DDPAK07 PD028		PL044	





Current Status of Package Qualification

Package Type	Package Qualified
SOIC 16	Qualified
SOIC 20	Qualified
SOIC 28	Qualified
SOW 28	Qualified
PDIP 28	Not Planned
PLCC 28	Qualified
PLCC 32	Qualified
PLCC 44	Qualified
PLCC 68	Qualified
LQFP 64	Qualified
eLQFP 44	Qualified
eLQFP 80	Qualified
TQFP 44	Qualified
TQFP 64	Qualified
TQFP 80	Qualified
TQFP 128	Qualified
eTQFP 44	Qualified
QFN 6X6 24	Qualified
QFN 7X7 44	Qualified
QFN 8X8 32	Qualified
LBGA 121	Qualified
LBGA 144	Qualified



Qualification





Qualification Testing

■ Qualification Tests Performed

- HTOL @125°C
 - Durations 168, 500, 1000 and 1500 hours
- Autoclave (96 hours)
- Preconditioning (Jedec Level 3 with IR reflow at 260°C)
- Preconditioning + Temperature Cycle (-65/150°C for 500 cycles)
- Preconditioning + Temperature Humidity Bias (85°C/85% RH for 168-1000 hours)
- High Temperature Storage Life (150° C for 500 hours)
- Solderability
- ESD HBM & CDM
- Tin Whisker Characterizations (4000 hour THT, 4000 cycle TCT)

- **Will Legerity Issue PCN for the transition to Green?**
 - **Yes in cases when Legerity makes a complete conversion and non-Green BOM product is no longer available**
 - A 90-day notice is required
 - PCN 7706 Issued 12/09/04 for over 50 products
 - PCN 8063 Issued 02/02/05 for 17 products
 - **No for products that were developed as Green**
 - Will be covered in datasheet
 - Need Applications Note
 - **No for products that will be offered in both non-Green and Green BOM**
 - These will have unique OPNs - will not require PCN (until complete conversion)



Summary

- All Legerity Package Types were Qualified in Green by EOY2004

- All New Products are developed using Green Materials!
 - Reduces overall cost
 - Datasheets reflect the Green package information.

- Legerity will, for a limited time, supply parts in both non-Green and Green BOM
 - Difficult to manage. Two unique OPNs to schedule.
 - Requires clear communication and forecast from the field.