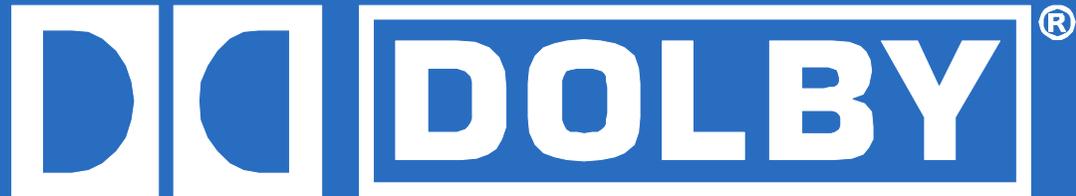


SMART Group
6th European Surface Mount Conference
November 2004

**WEEE and RoHS legislation:
Current status and an industry perspective**

Nigel Burtt
Production Engineering Manager
Dolby Laboratories, Inc. - European HQ
Email: njb@dolby.co.uk
Tel: +44 (0)1793 842132 [direct line with voicemail]

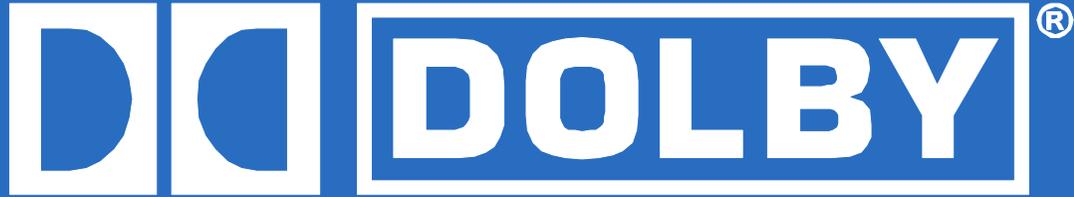




Who are we and what do we do?

- Dolby Laboratories creates technologies that intensify and enhance the entertainment experience, developing systems and manufacturing professional equipment to implement these technologies in the motion picture, broadcasting, and music recording industries. We also license these technologies for use in the consumer electronics industry – current figures show over 1 billion licensed products sold worldwide.
- Founded in London in 1965, we are a privately owned company in the USA, with Head Offices in San Francisco and European headquarters in Wiltshire, England. The company has similarly equipped manufacturing facilities in both locations.
- We also have industry liaison offices in London, New York, Los Angeles, Hong Kong, Shanghai, Beijing, and Tokyo
- SMART Group corporate member since 1997



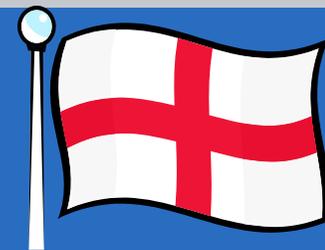


Manufacturing History

- Right from the company's beginnings, it was decided to manufacture professional products in the company's own factories, a strategy which is still followed today.
- Dolby has nearly 40 years of manufacturing experience and an intimate knowledge of what is required to consistently produce dependable products that are used by professionals in a wide variety of industries, including film, television, DVD, music, and video game production.
- We are known around the world for the quality and reliability of our professional products. This standard is upheld by maintaining tight control of the manufacturing process and by utilizing extensive automation. Automating the assembly process ensures accuracy and repeatability, which results in consistently high levels of quality in the finished product.



Dolby Laboratories UK Facility



Dolby Laboratories' European headquarters at Wootton Bassett in Wiltshire. Formally opened on St. George's Day 1993 by Her Royal Highness The Princess Royal.

These offices are responsible for all Dolby operations outside North and South America, Japan and Korea (which are areas covered by our San Francisco facilities).



Dolby Laboratories Inc.

Manufacturing Process Equipment

http://www.dolby.com/about/who_we_are/manufacturing.html#

SMT Assembly

- Dek Horizon printer
- Assembleon Topaz chip-shooter and Emerald-LCS fine-pitch placer
- Heller 1707EXL reflow oven (new install August 2004 to deal with lead-free)
- Metcal BGA3500 rework station and Ersascope inspection tool

Through-hole Assembly

- Universal Instruments DIP, axial and radial auto-insertion
- Blakell LS9000C/920C semi-auto guided insertion
- Blundell CMS400FS wave soldering (lead only – new machine under consideration)
- Vitronics 6748 MySelective selective soldering (installed July 2004 – lead-free ready)

Test

- Teradyne Z1890VP (Prism-Z) In-Circuit-Test
- Audio Precision and Tektronix custom-built functional ATE systems
- Flying Probe Tester (under consideration)



Dolby Laboratories Inc. Professional Product Examples



**Model CP650
Cinema Processor**
– introduced 2000, made in
US & UK, total produced
approx 17k worldwide



**DMA8 Digital Media
Adapter** – introduced
2000, made in UK only, total
1K approx



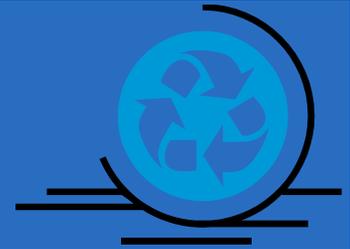
**DP564 Multi-channel
Audio Decoder** –
introduced 2002, made in US
only, total 1K approx

Dolby is a global brand but is only a relatively small manufacturer (SME) for its professional products



WEEE & RoHS Directives

– Background (1)



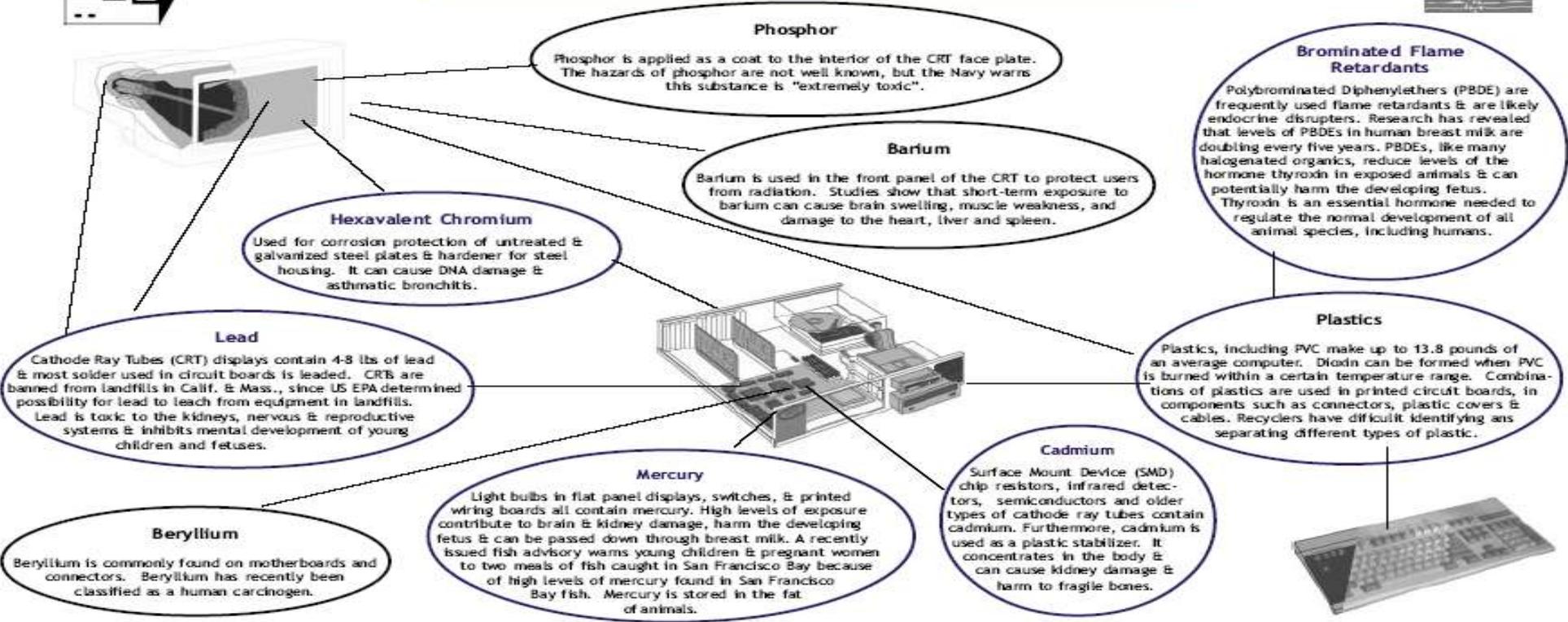
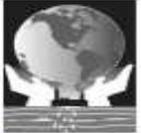
General global concern about environmental contamination due to huge amounts of electronics waste in landfill

- Japan leads the way?
 - Japan's Home Electronics Recycling Law came into force on *April 1 2001*
 - Manufacturers must recycle four types of appliances – washing machines, TVs, fridges and air-conditioners (then accounting for about 80% of all appliances produced in Japan – about 20 million appliances per year.)
 - Previously appliances were crushed and buried as landfill, but there is little land left in densely populated Japan and 20-40% of the waste was thought to have been exported or dumped illegally.

WEEE & RoHS Directives – Background (2)



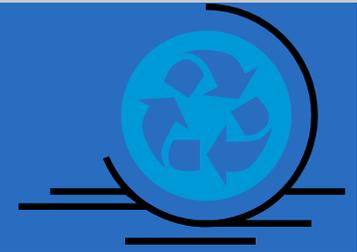
Clean Computer Campaign
Silicon Valley Toxics Coalition
 760 North 1st St. San Jose, CA 95112 svtc@svtc.org http://www.svtc.org 408-287-6707



Images courtesy of Materials for Future Foundation



WEEE & RoHS Directives – Background (3)



Taking the WEEE out of our lives

500 Million Computers estimated to be disposed of in the USA 1997-2007

Plastic	6,320 million lbs
Lead	1,580 million lbs
Cadmium	3 million lbs
Chromium	1.9 million lbs
Mercury	623 lbs

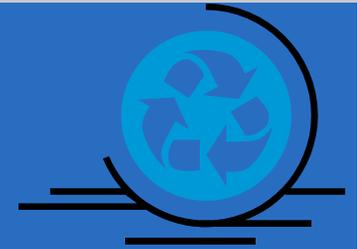


Source: Silicon Valley Toxics Coalition

<http://www.svtc.org/>



WEEE & RoHS Directives – Background (4)



Materials Found in 1 ton of random PCBs

Material	LBS	Material	LBS
Plastics	600	Gold	1
Copper	286	Cadmium	.79
Iron	90	Tantalum	.38
Bromine	56	Palladium	.25
Lead	54	Beryllium	.18
Tin	44	Cobalt	.17
Nickel	40	Cerium	.10
Antimony	22	Platinum	.07
Zinc	9	Lanthanum	.06
Silver	1	Mercury	.02

Source:
Technical
University of
Denmark



WEEE & RoHS Directives

– Background (5)



Why ban lead in solder?

- Lead is a toxin, with increased effects for children and pregnant women, even low levels are known to affect cognition, reproduction and our nervous system.
 - It is absorbed by, and has detrimental effects on, all living organisms – e.g.: bacteria, algae, plants, fish, mammals – and thus enters the food chain.
 - » The primary concern for electronics is the possibility that lead from equipment disposed in landfill will leach out and find its way into water supplies.

WEEE & RoHS Directives

– Background (6)



BUT!...

- The contribution of waste electronics in landfill to lead contamination of the environment is low compared to other sources - e.g. 80% batteries, electronic solder < 0.7% (source: NCMS)
 - The rate at which lead from electronic waste in landfill could leach into the ground and water supplies is disputed and replacement alloys for standard Sn/Pb solder also contain other toxic metals (e.g. In, Bi and Ag) which are said to leach into the ground faster than lead does.
 - Replacement solder alloys have higher melting point temperatures and thus are more damaging to the environment because they require more energy to process
 - DTI assessment July 2004 “...though it is extremely difficult to quantify the benefits that may result from restricting of lead in new EEE products, it is likely that given current exposure rates in the UK **the potential benefits from the RoHS Directive may be somewhat limited.**”

NONE OF THIS MATTERS – IT’S HAPPENING ANYWAY!



WEEE & RoHS Directives

– History (1) some landmarks

May 1990



- Council of Europe – Waste Management Policy
 - Requested establishment of action programmes on waste
 - » WEEE identified as a waste stream to be tackled

November 1996

- European Parliament
 - Requested proposals for directives on waste streams, including WEEE, as well as reducing hazardous substances in waste

WEEE & RoHS Directives

– History (2) some landmarks

February 1997

- European Council – Community Strategy for Waste Management
 - Requested follow-up initiatives on WEEE as soon as possible

June 2000

- European Commission
 - Publishes proposals for WEEE and RoHS Directives

December 2001

- European Parliament and Council
 - “Common Position” text of WEEE and RoHS Directives as agreed by all Member States is published



WEEE & RoHS Directives

– History (3) some landmarks

8th November 2002

- European Parliament and Council
 - Draft Directives agreed and text published

27th January 2003

- European Parliament and Council
 - Directives agreed

February 13th 2003

- European Union Official Journal
 - Directives are published and enter into force



The RoHS Directive & deadlines

European Union Directive 2002/95/EC “on the restriction of the use of certain hazardous substances in electrical and electronic equipment.”

-aka The RoHS Directive

- A “single market” Directive which must be applied in full in all Member States.
- Article 9: “Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive before **13 August 2004...**”
- Article 6: “Before **13 February 2005**, the Commission shall review the measures provided for in this Directive...” – including possibly removal of current exemptions and adding to list of banned substances!
- Article 4: “Member States shall ensure that, from **1 July 2006**, new electrical and electronic equipment put on the market does not contain **lead**, cadmium...”



RoHS Directive – brief details



- Restricts use of lead, mercury, cadmium, chromium(VI), and PBB/PBDE flame retardants in new electrical and electronic equipment covered by the Directive and sold after 1 July 2006
- “Producer” responsibility – any products you manufacture, re-sell under your own brand, or import or export, and the components that make up those products must comply with the stated requirements by the July 2006 deadline
- Certain applications and types of equipment are classified as exempt, but these exemptions will be reviewed and it cannot be assumed these will remain.

RoHS Directive – Scope

Applies to equipment with operating voltages <1000VAC or <1500VDC

10 broad categories (intended to be illustrative only and not definitive) with 2 currently exempt from RoHS (status due for review Feb 2005):

- Large Household Appliances
- Small Household Appliances
- IT and Telecomms Equipment
- Consumer Equipment
- Lighting Equipment
- Electrical and Electronic Tools
- Toys, Leisure & Sports Equipment
- **Medical Devices (except implants)**
- **Monitoring and Control Instruments**
- Automatic Dispensers

RoHS Directive – Exemptions

- Large stationary industrial tools
- Spares for repair, upgrade or re-use of equipment sold prior to the deadline
- Mercury in certain defined lighting applications
- Lead (oxide) in glass used for CRTs, electronic components and fluorescent tubes
- Lead used as an alloying element with steel, copper and aluminium to obtain specific metal properties
- Lead in high melting point solders (e.g. CBGA balls)
- Lead in solder used in manufacturing assembly of servers and storage systems and of network infrastructure systems
- Lead in ceramic materials used in electronic components
- Cadmium plating except for applications already banned under existing law
- Chromium(VI) specifically used for anti-corrosion properties in refrigerator cooling systems.

It cannot be assumed that these current exemptions will continue to apply



RoHS Directive

– future changes



- Possible future changes to current scope under contracted review by ERA Technology for the Commission with findings published early in 2005 including 7 possible new exemptions
 - Pb used in VHDM pressfit connectors
 - Pb coated C-rings used for Thermal Conduction Modules used on large CPU devices
 - Pb & Cd in optical and filter glass
 - Pb in industrial use optical transceivers
 - Pb in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a Pb content of more than 85% in proportion to the SnPb content
 - Pb used in solders to complete a viable electrical connection internal to Flip Chips.
 - Pb in lead/bronze bearing shells and bushes

The WEEE Directive & deadlines

European Union Directive 2002/96/EC “on waste electrical and electronic equipment”

- aka The WEEE Directive



- Not a “single market” Directive – specifies minimum objectives only, unlike explicit mandatory measures in RoHS
 - May be more/less stringent requirements in different member states!
- Requires all Member States to have transposed the requirements of the Directive into force through national laws by **13 August 2004**
- Systems to be in place by **13 August 2005** and all products made after that date must be identified
- Member states must ensure that by **31 December 2006**, targets for collection, re-use/recycling, and recovery have been met.
- Concept of “producer” (polluter) pays for end-of-life disposal costs

WEEE Directive – brief details

- Requires producers to be responsible for financing the disposal costs of their equipment when it reaches the end of its normal useful life.
- Cost included are those associated with collection, appropriate treatment, and meeting specified targets for re-cycling, recovery and re-use.
- Requires producers to adopt approaches to improve sustainable design and re-cycling, and encourage re-use at the end of the product's life
- Applies not just to new products, there is also collective responsibility for all equipment already on the market and covered by the Directive

WEEE Directive – Scope

Applies to equipment with operating voltages <1000VAC or <1500VDC

All 10 broad categories included:

- Large Household Appliances
- Small Household Appliances
- IT and Telecomms Equipment
- Consumer Equipment
- Lighting Equipment
- Electrical and Electronic Tools
- Toys, Leisure & Sports Equipment
- Medical Devices (except implants)
- Monitoring and Control Instruments
- Automatic Dispensers



WEEE Directive – Exemptions

- Equipment intended specifically for military purposes or directly concerned with national security
- Large stationary industrial tools
- Household luminaires
- Filament light bulbs
- Photovoltaic products, such as solar panels
- Implanted or infected medical devices

As with RoHS, it cannot be assumed that these current exemptions will continue to apply

WEEE & RoHS Directives

– other countries respond?

E.g.

- USA - Californian Electronic Waste Recycling Act of 2003, just one of many new USA state legislative measures taking into account WEEE and RoHS.
- Canada – as of October 2004, TVs, PCs and related equipment currently going into Alberta's landfills will be collected, reused, recycled
- China – draft regulations (proposed to be introduced in **Jan 2006!**) - “Management Methods for the Prevention and Control of Pollution from Electronics Information Products” (mirrors RoHS), also “Policy on Technologies for the Prevention of Pollution Caused by Waste Electrical and Electronic Products” (mirrors WEEE)
- Australia – although favouring a voluntary approach, it’s Government recommends implementing restrictions which “...mirror those adopted by the EU with the same or similar phase out periods.”
- ***WEEE and ROHS Directives will impact the design, production and sale of electrical and electronic equipment all around the world, regardless of where the product is actually designed and manufactured.***



WEEE & RoHS Directives

– UK implementation Stage 1



<http://www.dti.gov.uk/sustainability/weee/index.htm>

28th March 2003

- Stage 1 Consultation
 - Discussion paper published and made available as on-line “E-consultation”
 - » Response deadline 30th May 2003
 - » Report on responses published 28th July 2003

WEEE & RoHS Consultation Forum I

May 15th 2003



WEEE & RoHS Directives

– UK implementation Stage 2



<http://www.dti.gov.uk/sustainability/weee/index.htm>

25th November 2003

- Stage 2 Consultation
 - Discussion paper published
 - » Response deadline 1st March 2004
 - » Report on responses published April 2004



WEEE & RoHS Directives

– UK implementation Stage 3



http://www.dti.gov.uk/sustainability/weee/index.htm#Consultation_on_Government_implementation

Due to start “Late Spring” 2004

- Stage 3 Consultation
 - Draft regulations and non-statutory guidance documentation published **30th July 2004!**
 - » Response deadline 29th. October 2004
 - » UK, along with other EU members, misses the 13 August 2004 transposition deadline set in the Directives, but the implementation timetable is still adhered to



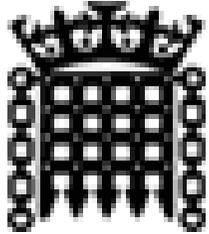
WEEE & RoHS Consultation Forum II

Oct 5th 2004



WEEE & RoHS Directives

– UK implementation Stage 4



Transposition into UK Law

- Regulations expected to be in place in “Autumn 2004”
 - 2 statutory instruments
 - » “The Waste Electrical and Electronic Equipment (Producer Responsibility) Regulations 2004”
 - » “The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2004”

RoHS Directive

– expected UK implementation details (1)

- Maximum Concentration Values (MCV) and definitions clarified based on a draft guidance document released by the RoHS Technical Adaptation Committee (TAC) in July 2004
 - up to 0.1% by weight in “homogenous materials” for Pb, Hg, Cr(VI), and PBB and PBDE flame retardants
 - up to 0.01% by weight in “homogenous materials” for Cd
 - » “Homogeneous material” means a material, of uniform composition throughout, that can not be mechanically disjointed (unscrewed, cut, crushed, ground, abraded) into other different materials
 - e.g.: a semiconductor package contains many homogeneous materials - plastic moulding material of the package, plating coatings on the lead-frame, the lead frame itself and the die gold-bonding wires – each material must be compliant with RoHS



RoHS Directive

– expected UK implementation details (2)

- Additional exemptions are assumed pending guidance from TAC
 - products intended solely for military use or to protect national security
 - products where the main power source is not electricity (e.g. gas central heating boiler exempt, but system thermostat is within scope)
 - products where the primary function does not require electrical or electronic components (e.g. musical greetings cards)
 - products that are part of equipment or a fixed installation that in itself does not already fall within the scope of the Directive, providing the product does not have a direct function outside of this usage (e.g. onboard aircraft lighting equipment.)
 - batteries, either fixed or disposable (but WEEE still applies)

RoHS Directive

– expected UK implementation details (3)

- Demonstrating compliance
 - self declaration of compliance, but must be able to provide on request satisfactory evidence of product compliance in the form of relevant technical data which is regularly updated and re-assessed, e.g.
 - » supplier declaration records
 - » producer analysis of own end products
 - Producers are required to keep compliance data records up to 4 years after each product was placed on the market
 - Market surveillance and tests will be carried out to detect non-compliant product

RoHS Directive

– expected UK implementation details (4)



- Failure to comply

- Fines for non-compliance offence up to £5K on summary conviction, or unlimited fine if convicted on indictment
- Fines for failure to produce compliance documentation on request
- Where corporate body is at fault via consent, connivance or negligence of director, manager or similar officer, that person is deemed to have committed an offence in addition to the corporate body
 - » “Due Diligence” can be used as a defence where it can be shown all reasonable steps have been taken to guarantee compliance. Where an offence has occurred because of a third party, that third party can be held liable and prosecuted as though they committed the offence.

WEEE Directive

– expected UK implementation details (1)



National Clearing House (NCH) to be established with the following duties:

- Provides and administers a register of individual producers and compliance scheme collectives
- Recovers registration fees
- Maintains list of designated WEEE collection facilities
- Collects data from registrants and allocates WEEE responsibility based upon market share
- Correctly handles commercially sensitive data from producers
- Reports defaulting registrants
- Provides dispute mechanism and independent arbitration

WEEE Directive

– expected UK implementation details (2)

Producer Responsibility:

- Producers may fulfill their obligations either individually or collectively via a compliance scheme
- Individual producers/compliance scheme collectives must register with the NCH by August 13 2005 and annually thereafter
- NCH registrants must provide annual UK sales data each year from 2004 onwards (2004 figures to be provided by Aug 12 2005)
 - » data required is for number of units and total weight (ratio not defined!)
 - » used to apportion share of WEEE costs for separate collection, recovery and recycling to each producer/compliance scheme
- Must finance allocated collection, recovery, re-use/recycling and disposal costs of own products when they reach the end of normal useful life.
- Must report evidence to NCH of WEEE treatment at authorised facilities and of meeting the specified recovery/recycling/re-use targets



WEEE Directive

– expected UK implementation details (3)

Compliance Schemes:

- Must arrange members' registration with the NCH
- Must themselves register annually with and be approved by relevant authority
- Should be expected to exist for 3 years min. and show plans to do so
- Provide required compliance evidence and data on behalf of its membership
- Assume members' obligations and responsibilities for WEEE, including any penalties for non-compliance
- Promote re-use and recycling
 - » For example, contracted arrangements for disposal of PCs to refurbishment houses and charities

WEEE Directive

– expected UK implementation details (4)

Exemptions from scope:

- additional exemptions have been assumed
 - products where the main power source is not electricity
 - products where the primary function does not require electrical or electronic components
 - products that are part of equipment or a fixed installation that in itself does not already fall within the scope of the Directive, providing the product does not have a direct function outside of this usage
- Note that each member state can interpret the scope of the WEEE Directive differently and so these exemptions apply only to UK

WEEE Directive

– expected UK implementation details (5)

Business WEEE

- Certain different arrangements apply for WEEE from products sold to household users (retail), and those sold to business end-users (B2B)
 - For “future WEEE” – i.e. products supplied B2B after the Aug 2005 deadline – the normal producer responsibility applies, however, producer and user can freely negotiate how to allocate future end-of-life costs during commercial transactions over B2B product sales.
 - B2B producers also have responsibility for “historical WEEE” - i.e. supplied prior deadline - when it reaches end of life, if it is discarded by the business user and an equivalent replacement product is obtained from the producer, irrespective of whether they supplied the original product.
 - » But, if the product is discarded but no replacement procured, then the WEEE responsibility passes to the user.

WEEE Directive

– expected UK implementation details (6)

Household WEEE

- Retailers and distributors
 - Must provide free in-store WEEE take-back, or make alternative arrangements via a registered compliance scheme, where the customer purchases an equivalent replacement product for another at the end of its life
 - Should ensure that customers are both informed of the WEEE take-back arrangements and encouraged to use all separate WEEE collection facilities offered
 - May show end-of-life costs of WEEE as point of sale information for “historical WEEE” for a limited period, but NOT for “future WEEE”
- Producers
 - Must provide financial guarantees for end-of-life costs in the event of them being in business no longer



WEEE & RoHS Directives

– So what do you need to do?

First step - get everyone involved!

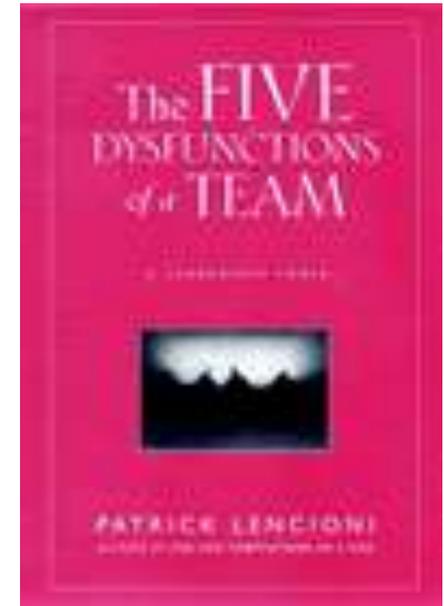
- Read the Directives and published guidance documents!
- Envirowise guide aimed at MDs and CEOs “Actions You Need To Take!”
 - <http://www.envirowise.gov.uk/envirowisev3.nsf/key/GG415>
- Envirowise guide aimed at marketing, design and operations executives
 - <http://www.envirowise.gov.uk/envirowisev3.nsf/key/GG416>
- Envirowise guide aimed at designers
 - <http://www.envirowise.gov.uk/envirowisev3.nsf/key/GG427>
- Your job depends on it!

Dolby Laboratories Inc.

RoHS & WEEE project activities (1)

Corporate RoHS/WEEE Implementation Initiative

- Senior VP level co-ordinator based in US head office
- Multi-disciplinary team
 - Manufacturing
 - Design
 - Engineering
 - Quality
 - Marketing
 - Management
- Multi-site (US and UK)
- Biweekly video conferences
- Objective driven from senior management downwards



We don't have all the answers, even with this level of planned participation there remain many considerable challenges and obstacles

Dolby Laboratories Inc.

RoHS & WEEE project activities (2)

Are we in or out?

- Dolby products do not fit neatly into any of the 10 categories that define the scope of RoHS and WEEE
 - Have sought advice from contacts made at DTI and EU DG Environment on matters which define our products in relation to the Directives
 - » Some contacts sympathetic and say we may have an argument for claiming to be outside the scope
 - » Generally answer is that you must make up your own mind with help of your own legal advice if guidelines are not clear
 - » **Thus we have assumed we have to comply in full, until we know different**
 - Cheaper than letting lawyers decide?!



Dolby Laboratories Inc.

RoHS & WEEE project activities (3)

Attempt to understand real practical impact

- Read and respond to consultation documents, e.g.
 - DTI
 - EU
 - Soldertec
 - JEITA
 - IPC
- Attend relevant seminars (select carefully!)
- Utilise Smart-e-link forum as knowledgebase
- Envirowise FastTrack visit

<http://www.envirowise.gov.uk/envirowisev3.nsf/key/Visits>

- DesignTrack visit

<http://www.envirowise.gov.uk/envirowisev3.nsf/key/CROD5LUHZR>



Dolby Laboratories Inc.

RoHS & WEEE project activities (4)

Process Timeline

- (1) Choose alloy
 - SnAgCu
- (2) Check current soldering processes
 - SMT reflow
 - » Run profiles on existing oven, check with dummy test PCBs
 - » Specify replacement oven if required and run trials with supplier before purchase
 - » repeat dummy PCB tests after installation of new oven
 - » Create viable hybrid process Pb parts/Pb-F paste, Pb-F parts/Pb paste or combination thereof
 - Wave soldering
 - » Keep existing machine for interim period and possibly continued processing of exempt spares
 - » Specify replacement machine and run offsite trials – MUST have Pb-F parts and PCBs to avoid bath contamination
 - Selective soldering
 - » Specify machine that can be upgraded for Pb-F and can cope with interim period changeover from SnPb
 - Hand soldering and Rework
 - » Current tip temperatures increase, cored no-clean solder wire higher flux content?
 - » BGA and large QFP hot air rework, heaters and air flow control adequate?
- (3) Test PCB trials – check process quality and reliability
- (4) Product trial
- (5) Product changeover – parallel processes required!



Dolby Laboratories Inc.

RoHS & WEEE project activities (5)

SMT Component Timeline

- **(1) Convert to Pb-F terminated SMT components ASAP**
 - Many parts already Pb-F and solder perfectly well with SnPb existing hybrid process
 - Query over use of Pb-F BGAs with Pb paste, assembly issues raised to be tested
 - » Create separate internal part numbers and do not mix
- **(2) Check all parts on each product converted to Pb-F SMT can survive higher Pb-F reflow profile**
 - Ideally want both process compliance and Pb-F compliance, but the former is more important to create viable hybrid process
- **(3) Successful Pb-F process with Pb-F parts**
- **(4) Ultimately we need compliant process and parts by Jan 1 2006 to avoid non-compliant finished goods inventory close to the deadline**



Dolby Laboratories Inc.

RoHS & WEEE project activities (6)

PTH Component Timeline

- (1) Hybrid machine soldering processes not viable as Pb-F solder bath would be contaminated by Pb components
- (2) Parallel process development required as product changeover is achieved

Also need to consider PCBs

- Standard FR4 inadequate?
- Replacement for HASL
- Solderability of all finishes impaired

and all bought-in assemblies/cables etc!

Dolby Laboratories Inc.

RoHS & WEEE project activities (7)

Product catalogue rationalisation

- Dolby products are typically characterised by
 - Long life span
 - Low-medium volume
 - High mix/wide variety of different PCBs
 - B2B transactions with distributors
 - Upgrades and add-ons to bring new technologies to existing customers without obsoleting current equipment
- Product catalogue contains many mature items which continue to have regular, albeit low demand, which are uneconomic to apply engineering and design resources to in order to create new compliant versions
 - Marketing and manufacturing have created a “culled” catalogue to identify products that will be made obsolete and prioritise those which must be made compliant
 - » Some difficult decisions to make
 - » Some customer needs no longer fulfilled!



Dolby Laboratories Inc.

RoHS & WEEE project activities (8)

Adjust product mix

- Must minimise stocks of non-compliant components and finished goods
- Need to identify
 - » Components notified as being made obsolete or discontinued allowing appropriate Last-Time-Buy (LTB) stocks to be purchased if required
 - » Obsolete/End-of-Life (EOL) parts for which LTB was made in the past
- Need to attempt to adjust forecast and MRP to accommodate RoHS compliant component lead-times and initial cost variances during transition period to compliance
- Also overheads and standard costs to be adjusted as needed

Dolby Laboratories Inc.

RoHS & WEEE project activities (9a)

Product Lifecycle Management



Currently use Agile software to manage component and product engineering design database. Providing ECO driven revision level control of all parts, products and design and manufacturing documentation. Can link in to our MRP/ERP systems and CAD software

<http://www.agile.com>

Dolby Laboratories Inc.

RoHS & WEEE project activities (9b)

Product Governance and Compliance



Agreed to participate in beta development trials of new feature in latest Agile platform release, specifically aimed at assuring compliance with requirements of WEEE, RoHS and EUP (more on this later!) or similar compliance issues for other markets.

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RoHS & WEEE project activities (9c)

Agile Product Governance & Compliance – Proposed Features

- Provides a means for collaboration with suppliers to collect material data for supplier material declarations
- Gives an overall environmental view of the product BOM to check for compliance with re-use, recycling, and banned material targets
- Manages regulatory documentation and specifications, tracking recovery manifests and disposal certificates of destruction
- Allows environmental compliance management (i.e. WEEE) across the product lifecycle to collect, track, analyze, report and dispose of hazardous material (i.e. RoHS) content in products - tracks all product material content by country regulation
- "Design for Environment" capability combining the enterprise product record with material and regulatory attributes — enabling designers to build products that meet environmental regulatory requirements, leading to proactive Design-for-Environment of products against material restrictions (i.e. EUP Directive)

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RoHS & WEEE project activities (10)

Adding newly qualified Pb-F parts as they become available for inclusion on Approved Vendor List (AVL)

- Not just Pb-F terminations but also RoHS compliant and must survive Pb-F reflow
- Moisture Sensitivity Level (MSL) likely to be increased compared to previous Pb part – more dedicated storage facilities
- Possibly long lead-times, high minimum order quantities, extra cost initially
- Manufacturer's data and assurances hard to obtain
- Never-ending task for designers and component engineers who are already fully occupied
 - May need third-party help

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RoHS & WEEE project activities (11)

Pb/Pb-F component phase-in/phase-out management

- More difficult for Dolby or similar SMEs due to
 - Large MOQs
 - Many parts low usage and thus reels with long shelf life
 - Wide range of different parts
 - Many high-value, single-sourced parts
 - » Which can lead to major design impact!
- Implemented custom tracking database to interface with MRP system (MAPICS)
 - Operates in conjunction with review of existing designs that have life beyond 2006

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RoHS & WEEE project activities (12b)

Pb/Pb-F test vehicle process

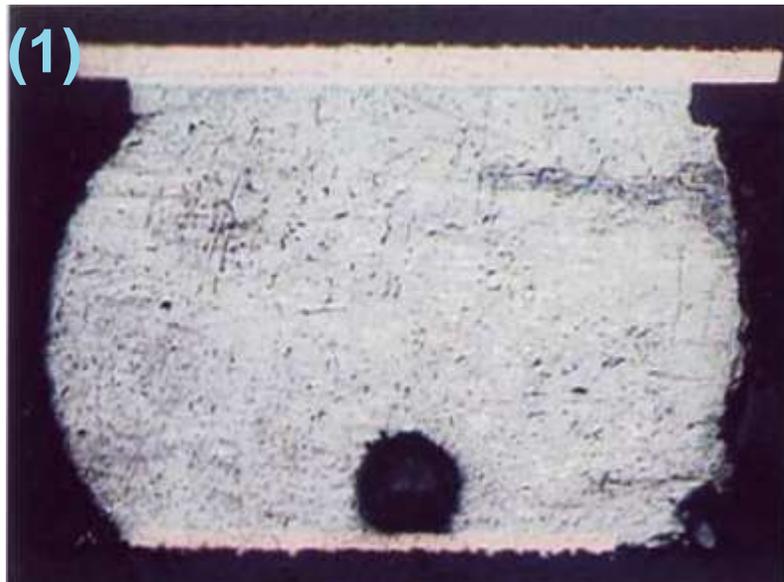
- Each factory produces with original Conceptronic J60 4/5–zone oven and profiles used logged and recorded
 - (1) 5 x assemblies of Pb-F BGAs soldered with Pb paste
 - (2) 5 x assemblies of Pb BGAs soldered with Pb-F paste
 - (3) Control batch of 5 x assemblies of Pb BGAs and Pb paste
- Test continuity and resistance of each daisy-chain
- Connect all chains in series and check linearity with curve-tracer, also measure voltage across each individual chain with known load current applied
- Representative anomalies identified by measurement then viewed and recorded with x-ray and SEM analysis, and then cross-sectioning
- Samples retained for shear strength tests before and after exposure to thermal cycling tests

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RoHS & WEEE project activities (12c)

Pb-F BGA/Pb paste test finding summary

- Unexplained (coincidental?) variations in resistance
 - (1) Higher resistance chains typically appeared to have more and larger voids and Pb-F balls had collapsed (fully-reflowed)
 - (2) Lower resistance chains had less and smaller voids, with Pb-F balls not collapsed (paste reflow only)

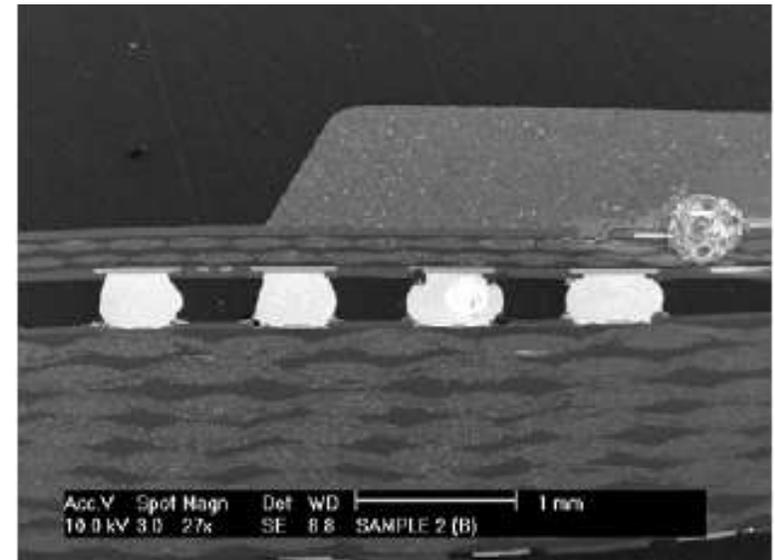
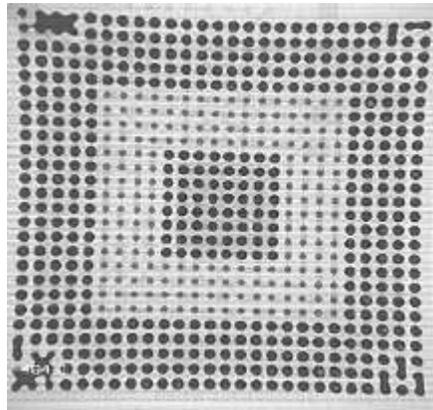
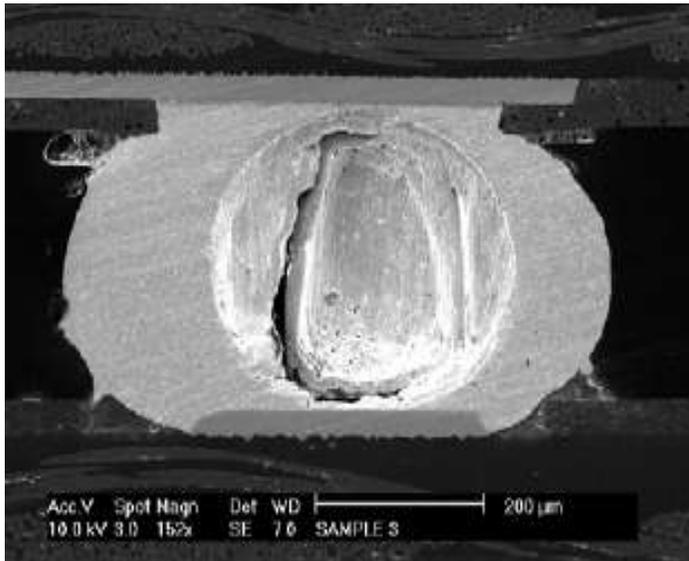


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RoHS & WEEE project activities (12d)

Pb BGA/Pb-F paste test findings

- More and larger voids in general than Pb-F BGA/Pb paste test, but no apparent correlation between resistance and voiding this time
- Solder shorts
 - some evidence of popcorn cracking



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RoHS & WEEE project activities (12e)

Pb/Pb-F paste test conclusions

- With Pb-F BGAs/Pb paste, US factory had many more defects than UK factory.
 - Both profiles peak at around 210°C, but US profile faster/shorter/steeper ramps
- With Pb BGAs/Pb-F paste, UK factory had many more defects than US factory
 - US profile faster/shorter/steeper ramps and 234°C peak, UK profile slower and higher 249°C peak
- **New oven with more zones suggested to widen process window and increase profile control**

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RoHS & WEEE project activities (13a)

New reflow oven – selection criteria (1)

- Pb-F ready – high reliability heaters and blowers suitable for higher temperatures and good supplier support in both UK and USA
 - Currently our profiles are set (for Sn62Pb36Ag2 alloy solder paste melting at 179°C) to peak at 210-215°C to allow for sensitive components such as LEDs and plastic film capacitors.
 - The most popular lead-free solder paste alloy, which is fast becoming the expected industry standard, is SnAgCu and melts around 215-220°C depending on the exact alloy proportions. This means typically that peak temperatures of 230-250°C are required.



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RoHS & WEEE project activities (13b)

New reflow oven – selection criteria (2)

- Efficient and uniform heat transfer for low ΔT
 - most modern convection ovens will have no problem at all working at the higher temperatures, but where there is already a wide variation of thermal demand across a PCB (large ΔT ,) this does cause problems if the heat transfer characteristics of the oven are inferior
 - e.g. if a multilayer PCB has a large BGA or QFP with significant ground or power plane copper around it, in order to achieve the correct peak reflow temperatures to solder this component, it may result in smaller components located in other less thermally-demanding areas of the PCB being exposed to temperatures much higher than we might desire.
 - has led to return in popularity of vapour-phase reflow

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RoHS & WEEE project activities (13c)

New reflow oven – selection criteria (3)

- Efficient cooling
 - Higher temperatures also mean that the oven must be able to cool more efficiently if wanting to maintain current throughput rates
 - Protects operators handling PCBs leaving the oven
 - Cooling rate must be well controlled
 - » More rapid cooling could cause damage to the components or the PCB itself
 - » Slower cooling may give rise to poor solder joint structure, with dull, crystalline appearance

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RoHS & WEEE project activities (13d)

New reflow oven – selection criteria (4)

- Centre-Board-Support?
 - Hotter reflow profile means PCBs are more prone to expansion and contraction, sag and warp, particularly for larger boards and double-sided SMT. This may cause component alignment problems
- Increased maintenance?
 - Auto-lubrication

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RoHS & WEEE project activities (13e)

New reflow oven – selection criteria (5)

- Inert atmosphere soldering?
 - Higher temperatures mean increased oxidisation and thus reduced solderability
 - In consequence, the use of an inert atmosphere is recommended by many to counteract the higher oxidisation rates and to reduce peak temperature requirements and ΔT problems
 - » Inert atmospheres have also been found improve solder joint structure – plus reducing defects such as solder bridging, mid-chip solder balling, component tomb-stoning etc.
 - » but machines more expensive and running costs MUCH higher.

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RoHS & WEEE project activities (13f)

New reflow oven – selection criteria (6)

- Gas residue content management and separation
 - Lead-free solder pastes typically additional rosin content compared to similar no-clean lead-containing pastes
 - This will cause an increase in flux residue build-up and in addition the higher temperatures cause actual evaporation of the resin content of the PCB laminate itself to increase significantly (8-fold!) compared to that experienced with lead-based solder paste profiles
 - » An effective gas residue management system is recommended to prevent this additional condensate load adversely contaminating the process (both the machine and the PCBs being processed!) and causing more maintenance problems.

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RoHS & WEEE project activities (13g)

New reflow oven – selection criteria (7)

- More zones for better process control
 - BUT
 - » No reduction on current max and min board size handling
 - » No major increase in exhaust extraction capacity requirements
 - » No reduction in current throughput rate
 - AND

No increase in current footprint!!

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RoHS & WEEE project activities (14)

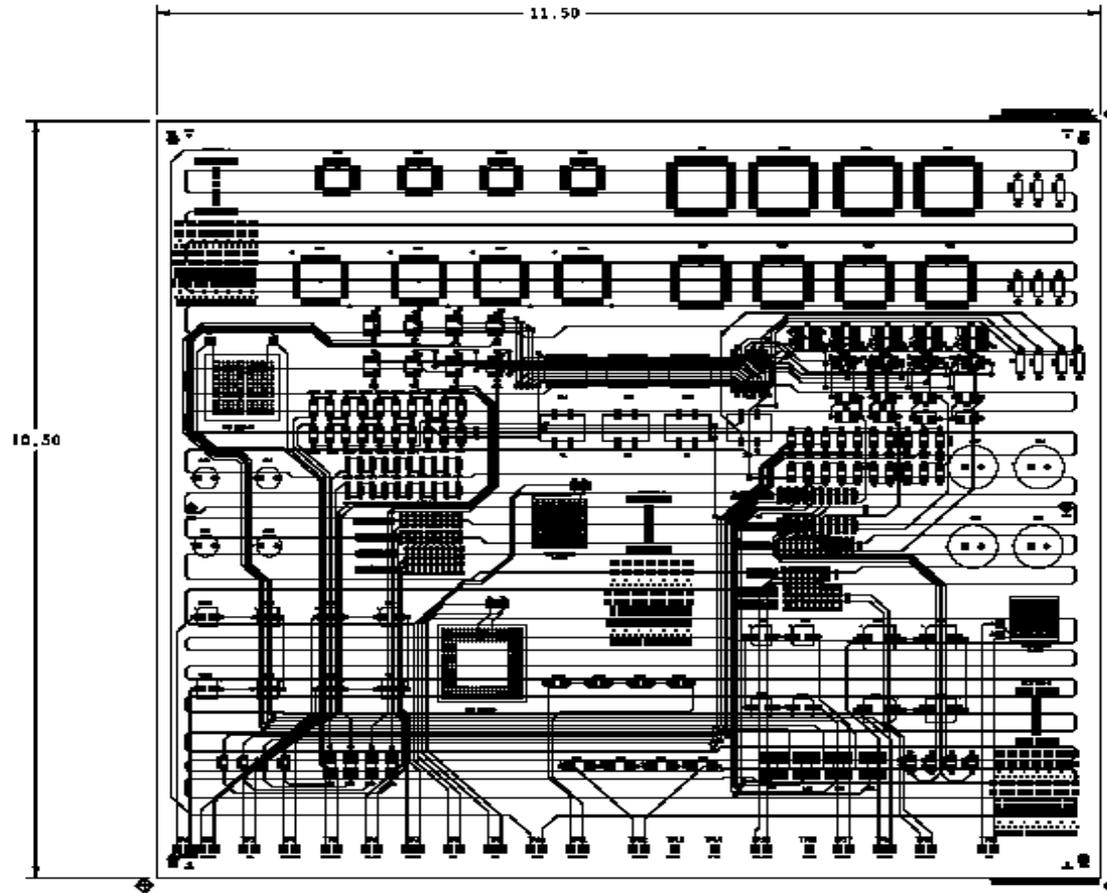
Further tests in progress

- (1) Repeat Pb/Pb-F mixture test with BGA test PCB on new oven in both factories and add Pb-F BGA/Pb-F component control batch to test
- (2) Third party design of custom SMT test vehicle to our specification and repeat build and test regime
- (3) Selection of target SMT Pb-F product and procurement of compliant BOM. Build for internal reliability and field beta tests
- (4) Extension of tests to wave solder process - then selective and hand soldering, and rework!



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RoHS & WEEE project activities (14a)



DRILL CHART			
ALL UNITS ARE IN MILS			
FIGURE	SIZE	PLATED	QTY
-	20.0	PLATED	534
-	28.0	PLATED	2
-	38.0	PLATED	81
-	128.0	NON-PLATED	4

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RoHS & WEEE project activities (15)

NPL Studio project participant



“Measuring the Reliability of Electronics Assemblies During the Transition Period to Lead-free Soldering”

Also participant to the possible extension of SMART PPM project to

“LEADOUT”

- an EU sponsored (€4.6M) Sixth Framework Programme of collective research, that is intended to assist SMEs implement lead free soldering



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RoHS & WEEE project activities (16)

Consider producer compliance schemes for WEEE

“REPIC” – Recycling Electrical Producers Industry Consortium announced in January 2004 - 12 start-up members:- including Alba, B&W Loudspeakers, Candy, Philips, SMEG and Whirlpool.

- Sony, Braun, Electrolux and Hewlett-Packard revealed proposals for the **“European Recycling Platform” (ERP)** in November 2003.

- **“B2B Compliance”** formed in August 2004 by GAMBICA, a trade association for instrumentation, control, automation and lab technology in the UK.

- Note that after implementation of the Packaging Waste Directive around 90% of obligated UK producers use a compliance scheme rather than registering for individual compliance.



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RoHS & WEEE project activities (17)

Visit a recycler!

Local contacts through:

<http://www.icer.org.uk>

For example:

<http://www.wastechnique.com/>

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RoHS & WEEE project activities (18)

Last-Time-Buy accommodation!?

- Any scope for an interpretation, exemption or extension in the laws to cover obsolete and non-compliant components already in stock as last-time-buys used to manufacture existing products, where re-design is impractical and/or uneconomic?
 - Also include components where supplier notifies current Pb part will not be converted to Pb-Free process compatible/RoHS compliant?
 - Global campaigning/lobbying initiative launched by Avaya and AeA
 - To get involved contact below

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More Directives – further work?

Examples of other related new legislation



- EU Integrated Product Policy (IPP) & EUP Directive
 - EUP = “On establishing a framework for the setting of Eco-design requirements for Energy-Using Products”
 - » EUP at draft proposal stage but suggests this should become law in member states by 31st of December 2005, and manufacturers will be obligated to comply from the 1st of July 2006.
- Proposed revised Directive on Batteries and Spent Batteries
 - EU member states to collect and recycle all batteries, with the following targets from 2004: 75% consumer batteries collected (disposable or rechargeable); 95% industrial batteries collected; no less than 55% of all materials recovered from the collection of spent batteries will be recycled
 - » Expected to be issued by the EC late 2004



THAT'S ALL FOLKS!

THANKS FOR LISTENING!

Any Questions?

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