WEEE/RoHS Directives and Impacts on EMC Compliance

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Agenda

- **What is WEEE?**
  - **WEEE Rules**
- **What is RoHS?**
  - **RoHS Rules**
- **Similar Legislation in Process**
- **RoHS Conversion**
- **Effect on EMC**
- **Summary**

What is WEEE?

- Waste Electrical and Electronic Equipment
- Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003
- Requires producers of electronic equipment to manage and fund the tack-back and recycling of their products
- Producers must report the weight and quantity of new products entering the European Union
- Producers must report waste entering the EU's waste stream (must recover 75% of older products and must recycle 65% of the weight of recovered products)
- Products put on the EU's market after August 13, 2005 must have a new label

Important WEEE Rules

- "Historical waste" (put on the market before 13 August 2005) is not the responsibility of the producer
- Products bearing the crossed out wheeled dustbin are the responsibility of the producer to manage the waste
  - Exception: A competing producer replacing a like product must manage the waste
- Waste management providers must be licensed
- The producer must provide technical data to the waste provider (waste industry has developed a simple form)
- Field Spares are not covered by the WEEE Directive
  - Spares must not be included with the reporting of waste products

Scope (Annex IA)

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting Equipment
6. Electrical and electronic tools
7. Toys, leisure and sports equipment
8. Medical devices
9. Monitoring and control instruments
10. Automatic dispensers

Steps to WEEE Compliance

- ✓ Apply the required WEEE label (13 August 2005 deadline)
- Register as a "Producer" with each EU Member State (various dates)
- Develop reporting capabilities:
  - New products shipping into the European Union
  - Waste entering Europe's waste stream (SAP and ACES)
- Report waste entering each EU Member States' waste stream
- Report new products entering each EU Member States

What is RoHS?

- **Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment**
- Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003
- Restricts 6 substances from electronic products "put on the market" in the European Union after July 1, 2006:
  - Lead – circuit cards, metal finishes, cables (Note: lead solder exemption)
  - Cadmium – metal finishes (relay contact surfaces and inductors)
  - Mercury – optical display
  - Hexavalent chromium - metal finishes (sheet steel & threaded fasteners)
  - Polybrominated biphenyls (PBB) - plastics
  - Polybrominated diphenyl ethers (PBDE) - plastics & shrink tube

Important RoHS Rules

- Products "put on the market" after 1 July 2006 must be compliant
  - Products in a warehouse within the EU before 1 July 2006 are not required to comply ("National View" applies)
- Products "put on the market" after 1 July 2006 must use RoHS compliant spare parts
- Products "put on the market" before 1 July 2006 are not required to use RoHS compliant spare parts (RoHS spare parts exemption)
- Non-compliant spare parts may be repaired outside of the EU and re-enter the EU as long as the spare part will be used in a product "put on the market" before 1 July 2006

Affected categories (found in WEEE)

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting Equipment
6. Electrical and electronic tools
7. Toys, leisure and sports equipment
8. Medical devices (currently excluded, proposed 2010)
9. Monitoring and control instruments (currently excluded, proposed 2010)
10. Automatic dispensers

EU Member State National View

- All EU Member States will accept non-compliant products put-on the market before 1 July 2006 (required by the RoHS Directive)
- The "National View" nations interpret "put on the market before 1 July 2006" as referring to their nation only.
- The UK and The Netherlands view the European Union as "the market".
- The Netherlands will restrict the movement of used non-compliant products (from The Netherlands to other EU nations)
- Issues:
  - Non-compliant product movement between EU Member States will be restricted (pending advice from legal)
  - Used non-compliant products residing in an EU Member State may be resold within the same EU Member State (pending advice from legal)
  - Used compliant products may be shipped into any EU Member State (Note: The Netherlands may have restrictions regarding used products, advice pending from legal)

Maximum Concentration Values (MCV)

- Cadmium (0.01% or 100 ppm)
- Lead, Mercury, Hexavalent Chromium, PBB & PBDE (0.1%, 1000 ppm)
- MCV are measured at the “Homogeneous Material”
  - Homogeneous material - a material that can not be mechanically disjointed into different materials.

Definitions:

The term "homogeneous" is understood as "of uniform composition throughout". Examples of "homogeneous materials" are individual types of: plastics, ceramics, glass, metals, alloys, paper, board, resins, coatings.

The term “mechanically disjointed” means that the materials can be, in principle, separated by mechanical actions such as for example: unscrewing, cutting, crushing, grinding and abrasive processes.

RoHS Lead–Solder Exemption

Sun and IBM intend to use the lead-solder exemption offered by the European Commission

“Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications (amended 10 December 2004).”

This exemption applies to the circuit cards and lead electroplated to the circuit card components. This exemption applies to many types of components (flex circuits, motors, fans, cable connectors, etc.). The RoHS Directive requires the European Commission to review the exemption every four years.

Exemption may expire December 2008, extended to December 2012, or may be postponed until early-2010 (likely).

Similar Environmental Legislation

- California RoHS (01 January 2007)
- China RoHS and WEEE (01 March 2007)
- 25 US States have proposed e-waste laws
- RoHS Japan (consumer products)
- EU is considering adding substances to RoHS

RoHS Conversion Issues Encountered

- Supplier readiness and knowledge about RoHS
- Mixed BOM's (i.e. leaded and lead-free components)
- Raw Card Material Changes
- Part numbering systems by vendors and CM's
- Using server and storage equipment in other products that require full RoHS compliance
- "Green" vs RoHS compliant components
- Functional changes
- Component cut in dates and availability

RoHS Conversion Issues Encountered

- Prototype vs production solder processes
  - Solder fountain/wave solder
- Solder profile changes
- Supplier Process Validation
  - Using dummy kits and 3rd parties to validate process

The Effect of RoHS on EMC

Basic Guidelines

- Is testing necessary?
  - Equipment modifications or changes which does not degrade the EMC/EMI characteristics.
  - Definition of degradation
- Changes not requiring a test
  - Any minor part change or manufacturing change which is not included on any EMC/EMI sensitivity list.
    - Most changes are typically on a sensitivity list.
  - EMC expert opinion/recommendation whether the change degrades EMC/EMI performance.
    - Document the recommendation
      - Based on previous experiences
      - Modeling
      - Etc.

Mechanical Parts

- Current flow associated with radiated emissions
  - Transmission mechanism
  - “Equivalent” antennae and gaps
- Frame
  - Plating/Coatings
    - Non-conductive films
  - Paint
    - Conductive
    - Non-conductive
  - Bonding parts, fasteners, and washers
- Shields and gaskets
- Size and tolerance changes

Platings and Coatings

An Ω/inch^2 DC measurement for a new plating or coating is inadequate to indicate how they will do at high frequency for return currents on enclosures.

Howard W. Johnson and Martin Graham, High-Speed Signal Propagation (Upper Saddle River, NJ: Prentice Hall PTR, 2003), page 61.

Table 2.2—Skin Depth of Conductive Media

	Carbon steel SAE1045	Stainless steel[1]	Nickel	Copper, annealed	Aluminum	Soil (Earth)[2]
Relative magnetic permeability	1000	500	100	1	1	1
Conductivity (S/m)	$5.80 \cdot 10^6$	$1.16 \cdot 10^6$	$1.16 \cdot 10^7$	$5.80 \cdot 10^7$	$3.55 \cdot 10^7$	0.1
Frequency (Hz)	**Skin depth (mm)**					
60	0.85	2.7	1.9	8.5	11.	205.
10^3	0.21	0.66	0.47	2.1	2.7	50.
10^4	0.066	0.21	0.15	0.66	0.85	16.
10^5	0.021	0.066	0.047	0.21	0.27	5.0
10^6	0.0066	0.021	0.015	0.066	0.085	1.6
10^7	0.0021	0.0066	0.0047	0.021	0.027	0.52
10^8	0.00066	0.0021	0.0015	0.0066	0.0085	0.20
10^9	0.00021	0.00066	0.00047	0.0021	0.0027	0.16
10^{10}	0.000066	0.00021	0.00015	0.00066	0.00085	0.16

NOTE (1)—Values for steel alloys vary tremendously. Some stainless steels have almost no magnetic properties. See [3], p. 163, and [4], p. 244.
NOTE (2)—Above 100 MHz the Earth is no longer a good conductor, so the formula for skin depth changes.

Cables, Connectors, and Filters

- Mechanical size and tolerance changes
  - Loop inductance
  - Grounding effectiveness
- Bonding
  - Screws, nuts, washers, and other mechanical fasteners
  - Wire/Connector interface
  - Mechanical interface
  - Corrosion and time dependence
- Connector Insertion Life
- Equivalent filter electrical performance at critical frequencies

Printed Circuit Boards

- A modified layout for RoHS should be treated as a new layout using the normal PCB design rules.
- “Equivalent” Replacement Modules
  - Package changes
  - Technology enhancements associated with RoHS module.
    - Faster signal rise/fall times
      - “New” critical nets
      - Trace impedance matching
    - Faster internal clock(s)
    - Critical pin locations (power, ground, high speed signals, etc.)
- PCB I/O filters:
  - equivalent electrical performance at critical frequencies
  - I/O grounding
- Decoupling

Summary

From an EMC/EMI viewpoint, a RoHS design should be based on previous proven design guidelines.