ELMOS Semiconductor AG
Lead-Free and RoHS Compatibility Program

1. Introduction

In order to achieve the WEEE[1] and RoHS[2], the ELMOS Semiconductor AG has started in 2003 a program to convert the production of ASIC's into RoHS compatible. The conversion to Pb-free components will be finished by end of 2005.
The major subject of this paper is to give an overview of the planned changes.

2. Conversion to RoHS compatibility in general

On January 27, 2003, the European Union passed the Restriction of RoHS legislation, which will become effective July 1, 2006.

Today, all ELMOS ASIC's meet the proposed RoHS components for cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs). Note, this status depends on the current understanding of RoHS and ELMOS knowledge of the materials which were used for assembly.

3. Conversion to 'Green' mold compounds

Additional to the components which were banned till now by RoHS, ELMOS is going to qualify 'Green' mold compounds. A 'Green' ASIC means for ELMOS, a lead (Pb)-free leadfinish additional to a mold compound which does not contain halogens (including bromine). 'Green' mold compounds also do not contain inorganic (red) phosphorous as an alternative flame-retardant system.
Most of the 'Green' ASIC's will be available by end of 2005. This depends on the package type.

For more information on 'Green' ASIC's, please contact your local Account Manager.

4. Conversion to Lead Free

Matte Sn and NiPdAu are currently being used as lead (Pb)-free finishes. Leadfinish depends on package type and assembly location. Samples with lead (Pb)- free finish are available by end of 2004.

For more detailed information, please refer to point 8 (Roadmap) and/or contact your local Account Manager.

1 Directive 2002/96/EC of the European Parliament and of the Council of 27th January 2003 on waste electrical and electronic equipment (WEEE)
2 Directive 2002/95/EC of the European Parliament and of the Council of 27th January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

5. Processing of Surface Mount Devices (SMD)

The processing of Surface Mount Devices (SMD) strongly depends on three major criteria:

A.) Pb free solder B.) Moisture Soaking Level C.) Reflow Profile

The process requirements for the above mentioned criterias and a recommendation regarding mixed unit assembly on PCB of Pb and Pb-free packages will be discussed in the following sub-chapters.

5.1 Pb free solder

Advanced Pb-free solders like tin silver copper (Sn3.8 Ag0.7 Cu) are recommended by the National Electronics Manufacturing Initiative, Inc. (NEMI). Eutectic solder melts at 183°C, SnAgCu melts at 221°C – 227°C. Therefore the soldering temperatures will have to increase 20°C to 30°C.

For more information, please refer to www.nemi.org

5.2 Moisture Soaking Level (MSL)

The Moisture Soaking Level (MSL) is to „identify the classification level of nonhermetic solid state surface mound devices (SMDs) that are sensitive to moisture-induced stress so that they can be properly packaged, stored, and handled to avoid damage during assembly solder reflow attachment and/or repair operations.“[3]

ELMOS standard of moisture sensitivity evaluation is the J-STD-020B of the Institute for Interconnecting and Packaging Electronic Circuits/Joint Electron Devices Engineering Council (IPC/JEDEC). The title of this standard is 'Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices'.

JEDEC classification of Moisture Sensitivity Levels

Level	Moisture Soak Conditions	Dry Pack Needed	Floor Life Time after open Dry Pack
1	85°C/85% RH 168hrs	No	Unlimited
2	85°C/60% RH 168hrs	Yes	1 year @ ≤30°C/60% RH
3	30°C/60% RH 192hrs	Yes	168 hours @ ≤30°C/60% RH
4	30°C/60% RH 96hrs	Yes	72 hours @ ≤30°C/60% RH

For more information, please refer to www.jedec.org

ELMOS plan regarding MSL classification after pb free transition is, to keep the same or better MSL as for packages with a Pb leadfinish (1:1 transition). Materials may have to be modified for that.

3 IPC/JEDEC J-STD-020B Page 1
www.jedec.org

5.3 Reflow Profile

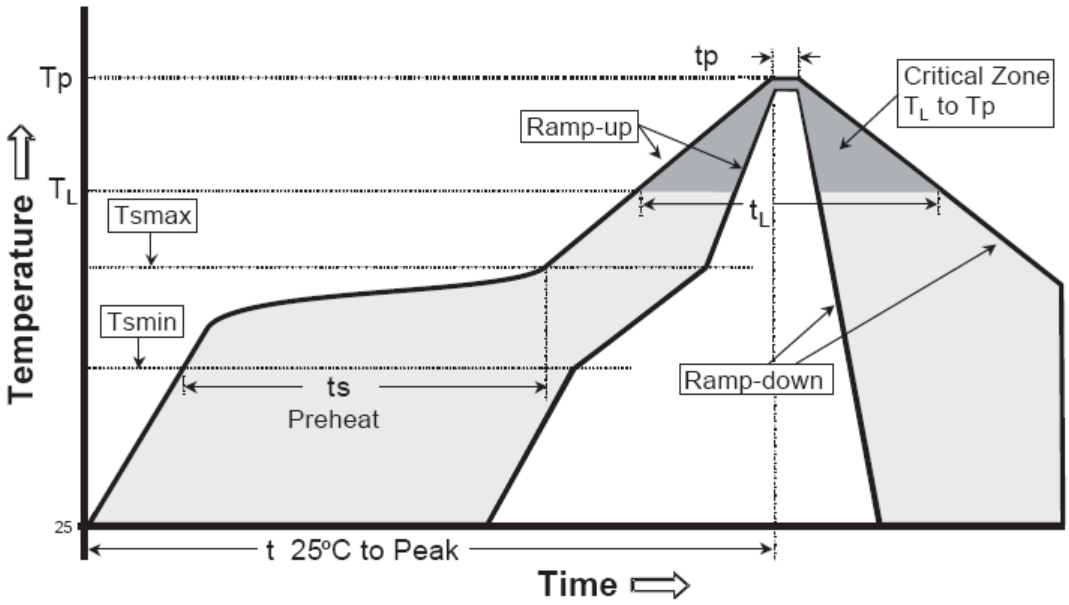
Also the standard temperature reflow profile refers to the JEDEC J-STD-020B.

JEDEC classification of Reflow Profiles.

Profile Feature	Sn-Pb Eutectic Assembly		Pb-Free Assembly	
	Large Body	Small Body	Large Body	Small Body
Average ramp-up rate (T_L to Tp)	3°C/second max.		3°C/second max.	
Preheat – Temperature Min (Ts_{min}) – Temperature Max (Ts_{max}) – Time (min to max) (ts)	100°C 150°C 60-120 seconds		150°C 200°C 60-180 seconds	
Tsmax to T_L – Ramp-up Rate			3°C/second max	
Time maintained above: – Temperature (T_L) – Time (t_L)	183°C 60-150 seconds		217°C 60-150 seconds	
Peak Temperature (Tp)	225 +0/-5°C	240 +0/-5°C	245 +0/-5°C	250 +0/-5°C
Time within 5°C of actual Peak Temperature (tp)	10-30 seconds	10-30 seconds	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.		6°C/second max.	
Time 25°C to Peak Temperature	6 minutes max.		8 minutes max.	

Note: All temperatures refer to topside of the package, measured on the package body surface.

Source: JEDEC J-STD-020B Table 5-2 'Classification Reflow Profiles'



Source: JEDEC J-STD-020B Figure 5-1 'Classification Reflow Profiles'

ELMOS products are always according to the valid J-STD-020.

5.4 Mixed unit assembly on PCB

During the conversion from SnPb Leadfinish to Pb free Leadfinish, it may come to the point were Pb free or Pb leadfinishes are not yet / not anymore available.

The assembly of Pb free parts on a PCB with a Pb solder is in general possible, provided that the Peak Temperature (Tp) of the package and the MSL is according JEDEC J-STD-020B standard. The same is valid for assembly of SnPb parts on a PCB with a Pb free solder.

6. Method of Qualification

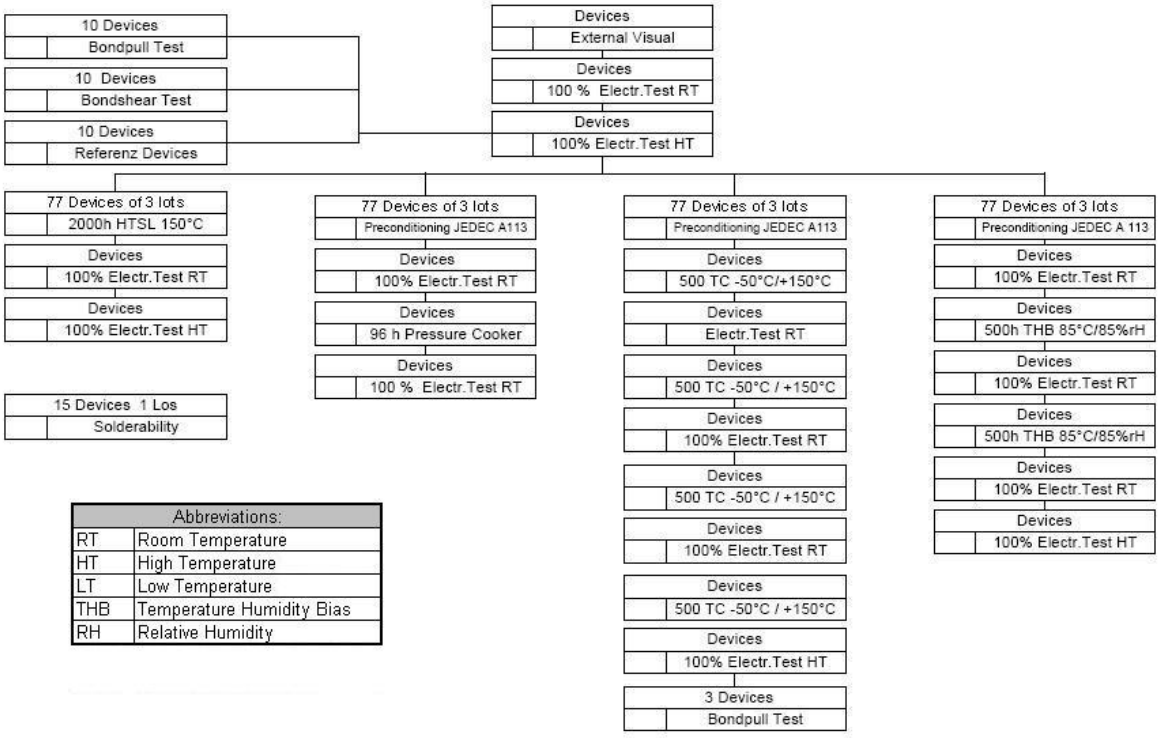
The ELMOS Package Qualification regarding Pb free / Green ASIC's is made according the standard AEC–Q100 of the Automotive Electronics Council. Custom specific qualifications may be available on request.

6.1 Overview

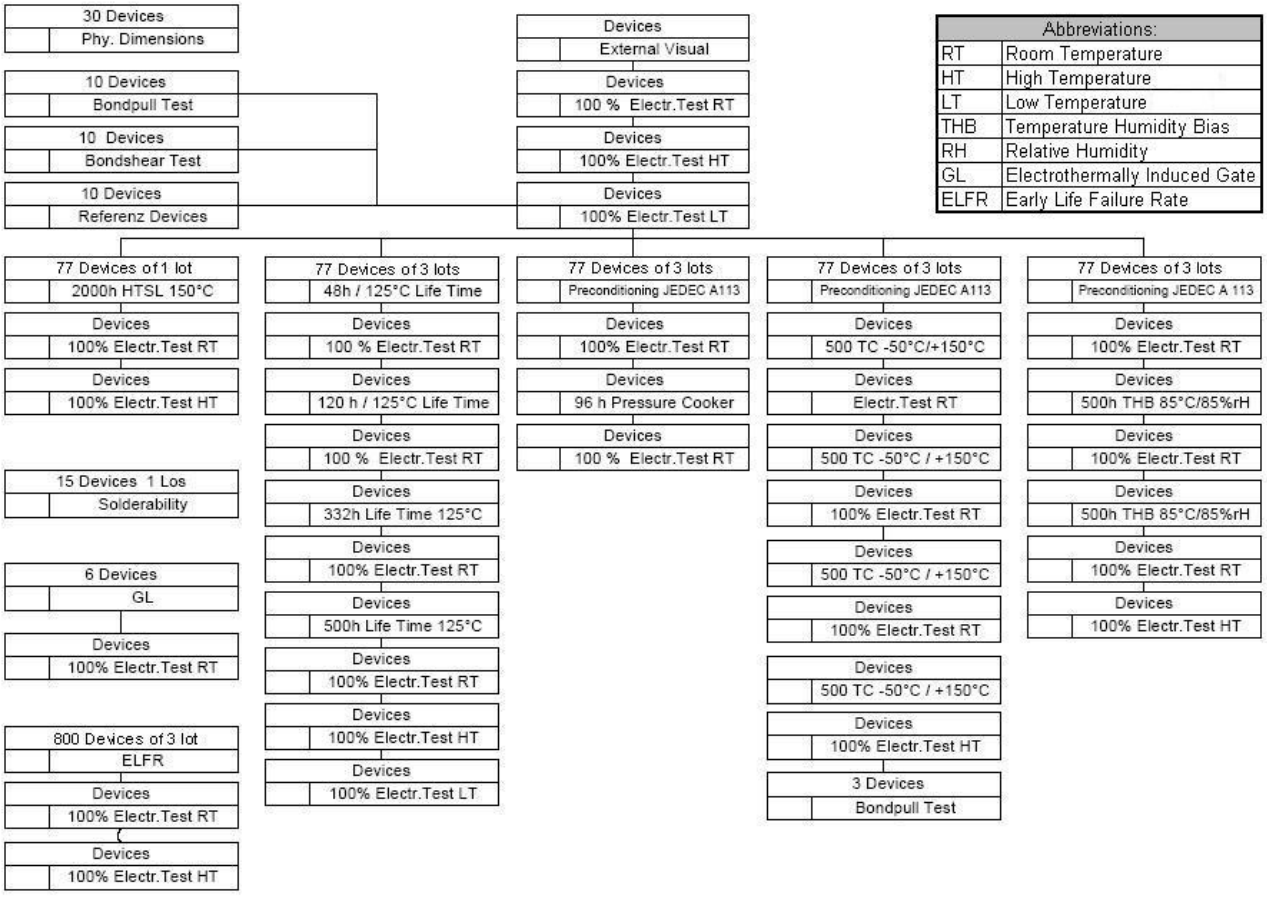
The different test steps vary in terms a Pb free or a Green ASIC qualification is performed.

For detail information please refer to www.aecouncil.com

ELMOS qualification flow of Pb free ASIC's



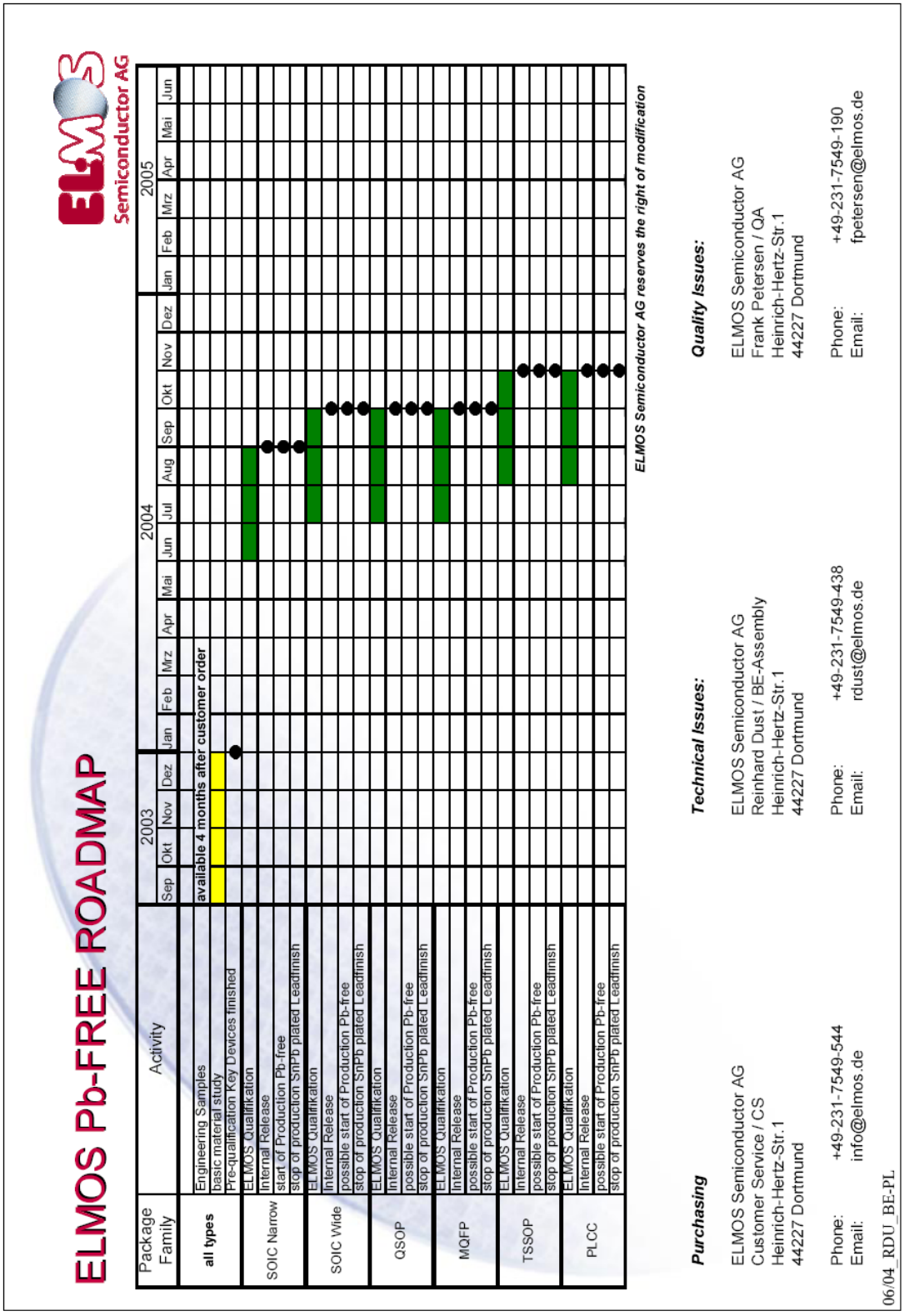
ELMOS qualification flow of 'Green' ASIC's



7. Product Change Plan

The leadfinish change from SnPb to Pb-free will be handled by ELMOS standard Product Change Notifications (PCN). The changes are implemented only after customer approval of the concerning PCN.

8. Roadmap


ELMOS Pb-FREE ROADMAP
Semiconductor AG
2003
2004
2005
Sep Okt Nov Dez Jan Feb Mrz Apr Mai Jun Jul Aug Sep Okt Nov Dez Jan Feb Mrz Apr Mai Jun
Package Family
Activity
all types
Engineering Samples
basic material study
available 4 months after customer order
Pre-qualification Key Devices finished
SOIC Narrow
ELMOS Qualifikation
Internal Release
start of Production Pb-free
stop of production SnPb plated Leadfinish
SOIC Wide
ELMOS Qualifikation
Internal Release
possible start of Production Pb-free
stop of production SnPb plated Leadfinish
QSOP
ELMOS Qualifikation
Internal Release
possible start of Production Pb-free
stop of production SnPb plated Leadfinish
MQFP
ELMOS Qualifikation
Internal Release
possible start of Production Pb-free
stop of production SnPb plated Leadfinish
TSSOP
ELMOS Qualifikation
Internal Release
possible start of Production Pb-free
stop of production SnPb plated Leadfinish
PLCC
ELMOS Qualifikation
Internal Release
possible start of Production Pb-free
stop of production SnPb plated Leadfinish
ELMOS Semiconductor AG reserves the right of modification
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06/04_RDU_BE-PL

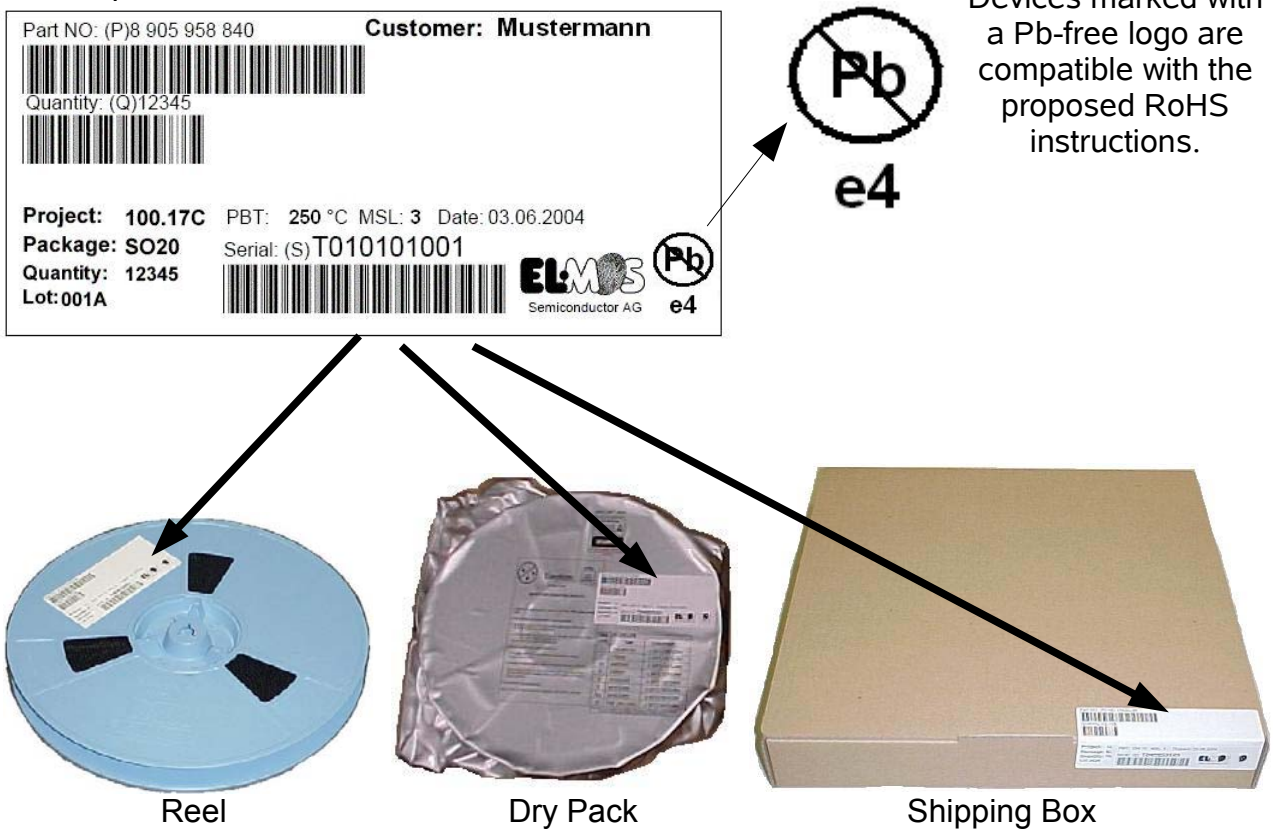
9. Identification of Lead-Free products

Lead free identification of Packages:
- Traceability is always given by lot-no. + datecode.

Lead free identification of Shipping material:
- Lead free logo and 2nd level interconnect code according JEDEC Standard JESD97[4] on product label (Reel, Dry Pack and Shipping-Box):

  The following categories describe the Pb-free 2nd level interconnect terminal finish:
  - e3 – Sn
  - e4 – NiPdAu

ELMOS product label



4 JEDEC Standard JESD97 „Marking, Symbols, and Labels for Identification of Lead (Pb) Free Assemblies, Components, and Devices“
www.jedec.org