IMO Backend Innovation
Divisional Philips Semiconductors
Philips Internal Report No.: RNR-83-05/RdH/RdH-2009
QTS Report Database No.: 050094

Self Qualification Results

NiPdAu lead-free solution of :

TSSOP48 packages

assembled at Philips Semiconductors Thailand
assembled at Philips Semiconductors Calamba

Author: ***Rob de Heus***
Sr. Project Leader Advanced Development
IMO Backend Innovation
Philips Semiconductors Nijmegen
Building BY-1.052
Gerstweg 2, 6534 AE Nijmegen, the Netherlands

Tel: +31-243534835
Tel: +31-243533085
Fax: +31-243533350
E-mail: *rob.de.heus@philips.com*

Issue Date : ***February 1st, 2005, update February 23rd***

Table of Contents

1. Introduction 3
2. Assembly Facilities 4
3. Material details 4
3.1 NiPdAu pre-plated leadframes 4
4. Constructional Details of Test vehicles 5
5. Reliability Test Program 6
5.1 Reliability Test Details 6
5.2 Construction Analysis Tests Descriptions 7
6. Self-qualification results. 8
7. Conclusion 10
8. Implementation 10
9. Document Revision Sheet 10

1. Introduction

The intention of the change to lead-free packages from Philips has been announced in the Advance CPCN for Pb-free, issued in May 2003, CPCN # 200305025.

The final CPCN will be issued in different phases, each phase showing qualification results of a certain group of packages.

This self qualification report presents an overview of the qualification data completed to release the following packages in NiPdAu using MP8000 plastic and Ablestik 8390Pglue :

- TSSOP48 assembled in Philips Semiconductors Thailand.
- TSSOP48 assembled in Philips Semiconductors Calamba.

In order to validate assembly quality and reliability, a self-qualification program has been performed for above mentioned packages.
The results of this qualification demonstrate that Philips Semiconductors can achieve distinctive assembly quality with equal or better product quality and reliability when compared to the lead-tin plated versions of these products.

With the introduction of NiPdAu as lead-free solution, the Bill of Materials (BoM) of the mentioned packages is fully compliant to the RoHS legislation requirements.

2. Assembly Facilities

PST
Philips Semiconductors Thailand has been in operation in Bangkok Thailand since 1974. With a current workforce of approximately 3,800 personnel and its 60,000 square meter site, PST is capable of assembly and test of a wide range of DIP, SILP, SO, T/SSOP, IC Module and Contactless Module packages. Testing for QFP and PLCC is also available at PST.
PST obtained ISO9001 certification in 1991, ISO14001 certification and the internal Philips Quality Award (PQA-90) in 1996, and QS9000 certification in 1997. A strong emphasis on quality improvement programs has also resulted in PST receiving the Golden Pentastar Award from Chrysler Corporation. In August 2003, PST was ISO/TS 16949 2002 certified.

PSC
Philips Semiconductors Calamba is a new, state-of-art facility for the assembly and testing of IC's located at the Light Industry and Science Park II in Calamba. The plant occupies an area of 85,000 square meters of land. Construction of the first phase with a floor area of 17,900 square meters was completed in 1998, while the second phase is already in construction.
Package family portfolio and test capabilities of PSC consists of SSOP/TSSOP, QFP, HVQFN and LF/TFBGA. Philips Semiconductors Calamba successfully passed certification to the QS9000 standard, while ISO 14001 certification was achieved in March 2000.

3. Material details

3.1 NiPdAu pre-plated leadframes

main characteristics :

- good solderability with SnPb and Pb free solders
- good solder joint reliability
- used in high volume
- offered by major lead frame suppliers
- whisker free

NiPdAu pre-plated leadframes are chosen as alternative Pb-free solution and will be applied in SO, SSOP and TSSOP packages. Initially just for in-house assembly, later also at subcontractors delivering to Philips.
Untill subcontractors can offer NiPdAu, their packages will be in matte Sn.
In the long term roadmap, the part of NiPdAu might be increased to other families.

4. Constructional Details of Test vehicles

Lot	PSC-1	PSC-2	PSC-3
Assy Site	PSC	PSC	PSC
Package / Pin	TSSOP48	TSSOP48	TSSOP48
Outline	SOT362-1	SOT362-1	SOT362-1
Moulding compound	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.5/ P	0.5/ P	0.5/ P
Die Pad Size (mm)	2.60x3.20	2.60x3.20	2.60x3.20
Die Size (mm)	1.09 x 1.86	1.09 x 1.86	1.09 x 1.86
Vehicle name	74LVC16245ADGG	74LVC16245ADGG	74LVC16245ADGG

Lot	PSC-4	PSC-5	PSC-6
Assy Site	PSC	PSC	PSC
Package / Pin	TSSOP48	TSSOP48	TSSOP48
Outline	SOT362-1	SOT362-1	SOT362-1
Moulding compound	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.5/ E	0.5/ E	0.5/ E
Die Pad Size (mm)	2.00x4.00	2.00x4.00	2.00x4.00
Die Size (mm)	1.51 x 2.37	1.51 x 2.37	1.51 x 2.37
Vehicle name	74LVT16373ADGG	74LVT16373ADGG	74LVT16373ADGG

Lot	PST-7-01	PST-7-02
Assy Site	PST	PST
Package / Pin	TSSOP48	TSSOP48
Outline	SOT362-1	SOT362-1
Moulding compound	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P
Pitch/ E or P	0.5/ P	0.5/ E
Die Pad Size (mm)	2.60x3.20	2.00x4.00
Die Size (mm)	1.65 x 2.51	0.86 x 2.66
Vehicle name	74LVT162373DGG	SSTL16877

5. Reliability Test Program

An extensive qualification program has been executed to demonstrate PST and PSC can assemble TSSOP48 packages with a high quality and reliability, using NiPdAu leadframes, MP8000 molding compound and Ablestik 8390 die-attach glue.

The reliability qualification test matrix can be found in Section 6.

In this section the reliability tests are described in detail. These tests are stated in Philips Semiconductors' General Quality Specification (SNW-FQ-611) and the Plastic Package Qualification Guideline (SNW-FA-04-07). AEC_Q100 is used as a guideline for specific automotive products.

5.1 Reliability Test Details

Pcon – Preconditioning
SMD Qualification samples for PPOT, HAST/THBS and TMCL undergo SMD reflow preconditioning before reliability test is performed. This preconditioning is performed in accordance with the latest revision of the IPC/JEDEC J-STD-020C specification, as described in Philips Semiconductors specification SNW-FQ-225A. SMD Packages are preconditioned to the appropriate MSL level using 260 ºC reflow temperature only.

PPOT – Pressure Pot Test
Pressure Pot Test – autoclave (121°C, 100%R.H., 96 hrs release time point), unbiased with Pcon. This test is particularly suitable to evaluate the moisture resistance of the package.

HAST – Highly Accelerated Stress Test
Highly Accelerated Stress Test (130°C/85% R.H., 96 hrs release time point), with electrical bias and Pcon. This test stresses both the electrical endurance of the design/process, as well as the resistance to moisture of the package.

TMCL – Temperature Cycling
Temperature Cycling (air to air –65°C ⇔ +150°C, 500 cyc release point) with Pcon. This test is aimed at the mechanical integrity of the whole product, under the severe circumstances of rapid changes in temperature.

HTSL – High Temperature Storage Life
High Temperature Storage Life (150°C, 1000 hrs release time point). This test evaluates the reliability of the product after long term storage

5.2 Construction Analysis Tests Descriptions

In addition to the reliability evaluation, qualification lots will be subjected to Construction Analysis and Moisture Sensitivity Level assessment testing. Abbreviations used in the tables:

- Visual/Mechanical Inspection (V/M) SNW-FQ-612B
- Lead Finish Inspection (LFNH) Local document
- Moisture Sensitivity Level Assessment SNW-FQ-225B
- X-Ray Inspection (X-RAY) SNW-FQ-312
- SCAT Inspection (SCAT) SNW-FQ-311
- Die Shear Testing (DISH) SNW-FQ-322
- Bond Pull Testing (BPT) SNW-FQ-322
- Bond Shear Testing (BST) SNW-FQ-322
- Cross Section Inspection (CROSS) SNW-FQ-314
- Solderability Inspection (SOLD) SNW-FQ-221

6. Self-qualification results.

Table 1: *"Wet" Reliability Stress Tests*

Package	Lot No.	Device	PCON 260 °C	PPOT			HAST		
				pcon	**96 hrs**	192 hrs	pcon	**96 hrs**	192 hrs
TSSOP48	PSC-01	74LVC16245ADGG	L1	0/77	0/77	0/77	0/45	0/43	0/43
TSSOP48	PSC-02	74LVC16245ADGG	L1	0/77	0/77	0/77	0/45	0/45	0/45
TSSOP48	PSC-03	74LVC16245ADGG	L1	0/77	0/77	0/77	0/45	0/45	0/45
TSSOP48	PSC-04	74LVT16373ADGG	L1	0/77	0/77	-	-	-	-
TSSOP48	PSC-05	74LVT16373ADGG	L1	0/77	0/77	-	-	-	-
TSSOP48	PSC-06	74LVT16373ADGG	L1	0/77	0/77	-	-	-	-
TSSOP48	PST-7-01	74LVT162373DGG	L1	0/77	0/77	-	-	-	-
TSSOP48	PST-7-02	SSTL16877	L1	0/77	0/77	-	0/45	0/45	-

Reliability qualification requirements time points are shown in bold, additional time points are for engineering evaluation.

Table 2: *"Dry" Reliability Stress Tests*

Package	Lot No.	Device	PCON 260 °C	TMCL				HTSL
				Pcon	**200 cyc**	500 cyc	1000 cyc	**1000 hrs**
TSSOP48	PSC-01	74LVC16245ADGG	L1	0/77	0/77	0/77	0/77	0/77
TSSOP48	PSC-02	74LVC16245ADGG	L1	0/77	0/77	0/77	0/77	0/77
TSSOP48	PSC-03	74LVC16245ADGG	L1	0/77	0/77	0/77	0/77	0/77
TSSOP48	PSC-04	74LVT16373ADGG	L1	0/77	0/77	0/77	-	0/77
TSSOP48	PSC-05	74LVT16373ADGG	L1	0/77	0/77	0/77	-	0/77
TSSOP48	PSC-06	74LVT16373ADGG	L1	0/77	0/77	0/77	-	0/77
TSSOP48	PST-7-01	74LVT162373DGG	L1	0/77	0/77	-	-	0/77
TSSOP48	PST-7-02	SSTL16877	L1	0/77	0/77	0/77	-	0/77

Reliability qualification requirements time points are shown in bold, additional time points are for engineering evaluation.

Table 3: *Construction Analysis*

Package	**Lot No.**	**Device**	**Construction Analysis Tests**								
			MSLA 260 °C	V/M	LFNH	SOLD See note	XRAY	SCAT	DISH	BP/BS	CROSS
TSSOP48	PSC-01	74LVC16245ADGG	L2	0/15	0/9	4x 0/11	0/22	0/22	0/3	0/3	0/3
TSSOP48	PSC-02	74LVC16245ADGG	L2	0/15	0/9	4x 0/11	0/22	0/22	0/3	0/3	0/3
TSSOP48	PSC-03	74LVC16245ADGG	L2	0/15	0/9	4x 0/11	0/22	0/22	0/3	0/3	0/3
TSSOP48	PSC-04	74LVT16373ADGG	L3	0/15	0/9	4x 0/11	0/22	0/22	0/3	0/3	0/3
TSSOP48	PSC-05	74LVT16373ADGG	L3	0/15	0/9	4x 0/11	0/22	0/22	0/3	0/3	0/3
TSSOP48	PSC-06	74LVT16373ADGG	L3	0/15	0/9	4x 0/11	0/22	0/22	0/3	0/3	0/3
TSSOP48	PST-7-01	74LVT162373DGG	L2	0/15	0/9	4x 0/11	0/8	0/8	0/3	0/3	0/3
TSSOP48	PST-7-02	SSTL16877	L3	-	-	4x 0/11	-	-	-	-	

Note:
11 parts tested in SnPb solder after 8h steam age, 5 sec, 215 ºC
11 parts tested in SnPb solder after 16h dry-bake, 5 sec, 215 ºC
11 parts tested in SAC solder after 8h steam age, 3 sec, 245 ºC
11 parts tested in SAC solder after 16h dry-bake, 3 sec, 245 ºC
RMA flux used for all tests.

7. Conclusion

An extensive qualification program has been executed to demonstrate that PST and PSC can assemble TSSOP48 packages in NiPdAu pre-plated lead-frames at a high quality and reliability level.

With the positive completion of the Qualification tests, the IC Manufacturing Operations of Philips Semiconductors announces the release of NiPdAu pre-plated leadframes for use in TSSOP48 assembled in PST+PSC,

via CPCN200305025S7

8. Implementation

Deliveries will start from May 2005 onwards.

9. Document Revision Sheet

R E V I S I O N S H E E T			
DATE yyyy/mm/dd	REV	DESCRIPTION	AUTHOR
2005-02-01	01	Self Qualification Results for NiPdAu pre-plated leadframes for TSSOP48 packages in PST and PSC.	Rob de Heus
2005-02-23	02	Minor update	Rob de Heus