

Self Qualification Plan

TSSOP56 packages using:

- NiPdAu preplated frames*
- Hysol QMI-519 die-attach*
- Nitto GE7470 plastic*

assembled at Philips Semiconductors Thailand

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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.

TSSOP packages have been qualified by using the original BOM of 8390 and MP8000. However, due to the increased reflow temperatures as defined by J-STD 020C, for several TSSOP packages Philips observed MSL degradation to level 3 or 4. MP8000 was tested and also showed unacceptable MSL levels.

To restore these MSL levels, Philips has qualified the following new material set to be used in critical TSSOP packages :

This material set is Hysol QMI-519 die-attach in combination with Nitto GE7470 plastic.

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 above mentioned materials, these packages fully comply to the RoHS 2006 legislations and also fulfils the future legislation on banning of Halogenes and Antimony Oxides. Combination of the new die-attach glues and the new molding compounds improves the package quality, especially towards the higher reflow temperatures which are required for leadfree soldering.

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.

3. Material details

3.1 Molding Compounds

Nitto GE7470 is a SiO₂ filled epoxy moulding compounds designed for improved JEDEC moisturizing performance and HTSL performance. In Table 1 the properties of Nitto GE7470 are compared to the reference material MP8000.

Table 1: Manufacturers Typical Properties of MP8000 and Nitto 7470

Molding Compound Properties	Current Production MP8000 NITTO	Planned Change GE7470 NITTO
Resin type	epoxy cresol novalac	hydrophobic epoxy resin
Hardener type	phenol novalac	
Filler content (%)	75	89.5
Flame-retardant system	brominated epoxy + antimony oxide	Magnesium hydroxide
Antimony oxide	yes	No
T _g (°C)	140	130
Specific gravity	1.88	2.00
□ ₁ (ppm/°C)	16.1	9
□ ₂ (ppm/°C)	64.7	34
Flexural strength @RT (N/mm ²)	140	187
Flexural modulus @RT (N/mm ²)	12200	25000
Flexural strength @240°C (N/mm ²)	20	15 @ 260°C
Flexural modulus @240°C (N/mm ²)	1000	420 @ 260°C
Dielectric Constant at 1MHz	3.8	3.6
Dissipation Factor at 1MHz	0.8	0.003
Volume Resistivity at 150°C (Ωcm)	7X10 ¹³	0.5X10 ¹²
Thermal Conductivity (W/mK)	0.75	1.04
UL94-V0 Flammability	1/8"	1/8"
Oxygen index	38	
Polymer mass (%)	22	11.5

3.2 Die Attach Glues

Hysol QMI-519 is a silver filled die-attach glue, designed for improved JEDEC moisturizing performance. In Table 2 the properties of QMI-519 is compared to the reference material Ablebond 8390.

Table 2: Manufacturers Typical Properties of Ablebond 8390 and Hysol QMI-519.

Die Attach Properties	Current Production Ablebond 8390 ABLESTIK	Planned Change QMI-519 HYSOL
Adhesive Type	Epoxy	Epoxy
Filler	Silver	Silver
Viscosity @ 25°C	9,800 cps	7,800 cps
Thixotropic Index	4.5	4.4
Volume Resistivity	0.002 Ω-cm	0.00007 Ω-cm
Thermal Conductivity @ 121°C	1.0 W/m ² K	3.8 W/m ² K
Glass Transition Temp	60°C	40 °C
Coefficient of Thermal Expansion		
- Below Tg	83 ppm/°C	20 ppm/°C
- Above Tg	165 ppm/°C	80 ppm/°C
Ionic Data		
- Chlorine	< 1 ppm	< 20 ppm
- Sodium	< 3 ppm	< 20 ppm
- Potassium	< 1 ppm	< 20 ppm
Water Extract		
- Conductivity	70 μmhos/cm	--
- pH	7.4	
Storage Life	1 year at -40°C	1 year at -40°C

4. Constructional Details of Test vehicles

Lot	1	2	3
Assy Site	PST	PST	PST
Package / Pin	TSSOP56	TSSOP56	TSSOP56
Outline	SOT364-1	SOT364-1	SOT364-1
Moulding compound	Nitto 7470	Nitto 7470	Nitto 7470
Die-Attach Adhesive	QMI-519	QMI-519	QMI-519
Pitch/ E or P	0.5 / P	0.5 / P	0.5 / P
Die Pad Size (mm)	2.60 x 4.00	2.60 x 4.00	2.60 x 4.00
Die Size (mm)	1.08 x 3.03	1.08 x 3.03	1.08 x 3.03
Vehicle name	PCA9504ADGGA	PCA9504ADGGA	PCA9504ADGGA
Wire diameter (µm)	25	25	25

Lot	4	5	6
Assy Site	PST	PST	PST
Package / Pin	TSSOP56	TSSOP56	TSSOP56
Outline	SOT364-1	SOT364-1	SOT364-1
Moulding compound	Nitto 7470	Nitto 7470	Nitto 7470
Die-Attach Adhesive	QMI-519	QMI-519	QMI-519
Pitch/ E or P	0.5 / P	0.5 / P	0.5 / P
Die Pad Size (mm)	2.60 x 4.00	2.60 x 4.00	2.60 x 4.00
Die Size (mm)	1.26 x 2.29	1.26 x 2.29	1.26 x 2.29
Vehicle name	74LVT16646A	74LVT16646A	74LVT16652A
Wire diameter (µm)	20	20	20

5. Reliability Test Program

An extensive qualification program has been executed to demonstrate that PST can assemble TSSOP packages with a high quality and reliability, using NiPdAu leadframes, Nitto GE7470 molding compound and Hysol QMI-519 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 tests.

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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 °C 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 plan.

Table 3: “Wet” Reliability Stress Tests

Package	Lot No.	Device	PCON 260 °C	PPOT			HAST		
				pcon	96 hrs	192 hrs	pcon	96 hrs	192 hrs
TSSOP56	1	PCA9504ADGGA	L1	77	77	77	45	45	45
TSSOP56	2	PCA9504ADGGA	L1	77	77	77	45	45	45
TSSOP56	3	PCA9504ADGGA	L1	77	77	77	45	45	45

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

Table 4: “Dry” Reliability Stress Tests

Package	Lot No.	Device	PCON 260 °C	TMCL				HTSL 1000 hrs
				Pcon	200 cyc	500 cyc	1000 cyc	
TSSOP56	1	PCA9504ADGGA	L1	77	77	77	77	77
TSSOP56	2	PCA9504ADGGA	L1	77	77	77	77	77
TSSOP56	3	PCA9504ADGGA	L1	77	77	77	77	77
TSSOP56	4	74LVT16646A	L1	77	77	77	77	-
TSSOP56	5	74LVT16646A	L1	77	77	77	77	-
TSSOP56	6	74LVT16652A	L1	77	77	77	77	-

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

Table 5: Construction Analysis

Package	Lot No.	Device	Construction Analysis Tests								
			MSLA 260 °C	V/M	LFNH	SOLD See note	XRAY	SCAT	DISH	BP/BS	CROSS
TSSOP56	1	PCA9504ADGGA	14	15	9	4x11	8	8	3	3	3
TSSOP56	2	PCA9504ADGGA	14	15	9	4x11	8	8	3	3	3
TSSOP56	3	PCA9504ADGGA	14	15	9	4x11	8	8	3	3	3

Note:

11 parts tested in SnPb solder after 8h steam age, 5 sec, 215 °C

11 parts tested in SnPb solder after 16h dry-bake, 5 sec, 215 °C

11 parts tested in SAC solder after 8h steam age, 3 sec, 245 °C

11 parts tested in SAC solder after 16h dry-bake, 3 sec, 245 °C

RMA flux used for all tests.

Table 6: Additional tests for automotive.

Package	Lot No.	Device	Construction Analysis Tests		
			BPT after TMCL 500c		
TSSOP56	1	PCA9504ADGGA	5		
TSSOP56	4	74LVT16646A	5		

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7. Conclusion

An extensive qualification program will be executed to demonstrate that PST can assemble TSSOP packages in NiPdAu, QMI-519 and Nitto GE7470 plastic 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 TSSOP56 assembled in PST.

8. Implementation

Deliveries will start from August 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
2005-04-05	01	Self Qualification Results for NiPdAu pre-plated leadframes for TSSOP56 packages in PST, using QMI-519 and Nitto GE7470.	Rob de Heus
2005-06-01	02	Added 3 qual batches	Rob de Heus