

## *Self Qualification Plan (update 18-Feb-2004)*

*Lead (Pb) free lead-finish of below packages*

*(H)(T) SSOP*

*(H)(V) SO (J)(P)*

*PLCC*

*HVQFN (Amkor Korea only)*

*assembled in*

*Philips Semiconductors Calamba (PSC)*

*Philips Semiconductors Thailand (PST)*

*Philips Semiconductors Kaohsiung (PSK)*

*Subcontractors Amkor, ASE and NSEB*

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Summary of the updates:

1. Moved data+results of phase 3 products to report RNR-83-04/RdH/RdH-2001.
2. Added more results and other minor updates
3. Renumbered report into RNR-83-04/RdH/RdH-2003

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**Reference documents**

E3 presentation Pb-free, as attachment to the CPCN. Available on the Pb-free website.

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## 1. Introduction

Throughout the electronics industry, the desire for Pb-free ( Pb = lead ) components is a hot topic. Customers and manufacturers alike are keen to ensure that new regulations in Europe, the US and Far East are complied with, sooner rather than later :

- In Europe, a EU directive on Restrictions on the use of Hazardous Substances (RoHS) requires the elimination of lead in electronics by July 1<sup>st</sup>, 2006.
- In Japan, electronic waste and recycling laws oblige manufacturers to eliminate or recover their waste products containing lead
- In the United States, laws banning or restricting the use of lead are already in place for many products and there is an increasing demand for a ban.

In a move to standardize the use of Pb-free packages and stimulating the further development of Pb-free technologies, Philips Semiconductors, Infineon Technologies and STMicroelectronics – Europe’s three largest semiconductor manufacturers (E3)– have shown their joined commitment to work towards the elimination of lead (Pb) in electronic systems and to improve environmental protection, e.g. in recycling or disposal processes of electronic devices. Starting in February 2001, the 3 companies are using a common definition for moisture sensitivity level (MSL) testing of semiconductor components and assesses factors such as solderability and reliability of alternative materials. The co-operation highlight is the common project “PROTIN” as a EU-funded approach for pure-Sn ( Sn = tin ) plating.

Please see the latest E3 presentation on Pb-free as attachment to the CPCN.

The Philips Pb-free solutions for leadframe based packages are :

- matte Sn postplating + postbake 1 hr 150 °C  
(for QFP, PLCC, SOJ, VSO and HVQFN/HVSON from ATK)

and

- NiPdAu preplating  
(for in-house assembled SO, SSOP, TSSOP, see note 1 + note 2 below)

With this change, Philips will introduce NiPdAu as Pb-free solution for all in-house assembled SO/SSOP/TSSOP packages, and matte Sn for all other packages.

In the long term roadmap, the part of NiPdAu might be increased to other families.

Note 1: end-customers who need Pb-free packages faster than the conversion roadmap, might be supplied in matte Sn as a temporary alternative to NiPdAu.

Note 2: major subcons Amkor and NSEB have committed to follow Philips in-house solution of NiPdAu. NSEB will be qualified under this Self-Qual plan. For Amkor, a separate qualification will be organized and notified in 2<sup>nd</sup> half of 2004.

This document presents an overview of the qualification plan to qualify above mentioned Pb-free, leadframe based packages.

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## 2. Assembly Facilities

### *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.

### *PSK*

Philips Semiconductors Kaohsiung is the first organization set up in the Republic of China by Philips Electronics in 1966. In 1969 the IC assembly started in the Nantze Export Processing Zone ("Nantze EPZ") in Kaohsiung, Taiwan. At present the floor space is 49,000 square meters and the total number of employees is 2700. Package family portfolio and test capabilities of PSK consists of DIP, SILP, SO, VSO, SSOP, QFP and BGA.

PSK has received Ford TQE (Total Quality Excellence) award, ISO9002, ISO900 and ISO140001 certification. In 1997 PSK received QS-9000 certification and the Japan Quality Medal.

In June 2003, PSK was ISO/TS 16949 2002 certified.

### *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.

### *AMKOR*

AMKOR is one of Philips preferred subcontractors and is established in 1968. Amkor has grown to be a world-class leader in integrated circuit (IC) packaging, assembly and test services. AMKOR has assembly factories in Korea (ATK), Taiwan (ATT), China (ATC) and the Philippines (ATP). Package family portfolio of AMKOR/ANAM consists of amongst others DIP, SO, SSOP, PLCC, QFP, (LF)BGA and CSP. AMKOR is certified SAC level 1.

### *ASE*

Advanced Semiconductor Engineering, Inc. (ASE Inc.) is the largest independent IC packaging company in Taiwan. The Company was founded in 1984. Commercial production began at the packaging facility located in the Nantze Export Processing Zone ("Nantze EPZ") in Kaohsiung, Taiwan in July 1984.

Package family portfolio of ASE consists of amongst others DIP, SO, SSOP, PLCC, CSP, QFP and (LF)BGA. ASE is certified SAC level 1.

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*NSEB*

NS Electronics Bangkok (NSEB) facility has been operated in Bangkok since 1973 under the flag of National Semiconductors and operates as an independent Assembly and Test subcontractor since 1993. Presently NSEB employs approximately 2,800 employees. The building has a total floor space of 180,000 square feet. NSEB is capable in assembly and test of a wide range of IC packages, which include DIP, SO, SSOP, TSSOP and PLCC packages.

NSEB obtained ISO9002 in 1994 and ISO14001 in 1998 and is certified SAC level 1.

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### 3. Materials

#### 3.1 Pb-free materials selected, per package family

Below table indicates the new lead-finish materials, per package family and per assy location. The current plating material is mentioned for reference.

Table 1 : overview materials per package per assembly site

Package	Assy Site	Current plating	New plating	Remarks
<b>Leadframe based SMD packages</b>				
QFP families	All	SnPb	Matte Sn	
SO	In-house	SnPb	NiPdAu	Matte Sn for advance needs
SO	Subcon	SnPb	Matte Sn	
SSOP	In-house	SnPb	NiPdAu	Matte Sn for advance needs
SSOP	Subcon	SnPb	Matte Sn	
TSSOP/HTSSOP	In-house	SnPb	NiPdAu	Matte Sn for advance needs
TSSOP/HTSSOP	Subcon	SnPb	Matte Sn	
SOJ	Subcon	SnPb	Matte Sn	
VSO	PSK	SnPb	Matte Sn	
HSOP	PSK	SnPb	Matte Sn	
PLCC	Subcon	SnPb	Matte Sn	
<b>Leadless SMD packages</b>				
HVQFN	Amkor Korea	SnPb	Matte Sn	Other HVQFN are Pb-free now
HVSON	Amkor Korea	SnPb	Matte Sn	Other HVSON are Pb-free now

A number of Philips' packages are already Pb-free. Their plating is either Pb-free since long, or NiPdAu leadframes were used from their introduction date. See table 2.

Table 2 : Pb-free packages of today

Package	Assy Site	Current plating	Policy
<b>Leadless SMD packages</b>			
DHVQFN	ATP,PST	NiPdAu	No change
HVQFN	ATP,PSC	NiPdAu	No change
HVSON	ATP,NSEB	NiPdAu	No change
HBCC	ASE	NiPdAu	No change
<b>Leadframe based through hole packages</b>			
DIP,SDIP,HDIP	PSK,PST	Sn / Partly NiPdAu	No change
SILP, DBS	PSK,PST	Sn	No change
RDBS, RBS, TBS	PSK,PST	Sn	No change

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## 3.2 Material Selection background

### 3.2.1 Matte Sn + postbake

main characteristics :

- material availability is good
- closest to SnPb in cost and process
- good solderability with SnPb and Pb free solders
- good solderjoint reliability
- “whisker free” process available (see section 5.3)

A comparison of the available post-plating finishes is showed in below overview :

Table 3 : comparison post-plating materials (source: E3)

Aspect	Sn Bright	Sn Matte	Sn Matte Baked	SnBi Bi<4%	SnCu	SnAg	SnPb
(1) Solder Wettability	+	+	+	+	+/-	+	++
(2) Adhesion to lead-frame	+	+	+	+	+	+	+
(3) Resistance to Leadbending	-	+	+	+/-			++
(4) Soldered joint Reliability	(+)	+	+	+	+	+	+
(5) Corrosion Resistance	+	+	+	+		+	+
(6) Whisker resistance	-	+/-	++	+	-		++
(7) Migration resistance	+	+	+				+
(8) Cost	+	+	+/+++	-	-	--	++
(9) Mass Productivity	++	++	++	+	+	-	++
(10) Compatibility	+	+	+	+	(+)	(+)	+
(11) Eco Impact	++	++	++	+/-	+/-	--	-

### 3.2.2 NiPdAu pre-plated

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.

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#### 4. Constructional Details of Test vehicles

##### 4.1 Test Vehicles Description for matte Sn qualification

Test vehicles for the self qualification program are selected based on the following criteria :

- Assy site
- Package family
- Lead-frame material
- Lead pitch
- Etched / Punched lead-frame
- Exposed die-pad / heatsink

Note: matte Sn vehicles for SO/SSOP/TSSOP from PSC/PST are solely included to cover advance supply, because the final Pb-free solution is NiPdAu.

Table 4 : Test vehicles Description for matte Sn

Lot	PSC-07		ATK-04
Assy Site	PSC		ATK
Package / Pin	SQFP208		HVQFN64
Outline	SOT316-1		SOT804-1
Moulding compound	MP8000		EME G700
Die-Attach Adhesive	EN4085/S2		8290
LF-mat/ pitch/ E or P	CuNi3/0.8/P		CuFe2P/0.5/U
Die Pad Size (mm)	10.00x10.00		4.90x4.90
Die Size (mm)	8.22x8.68		2.65x2.36
Vehicle name	VY21754A		ISP1583BS

Lot	ATP-01	ATP-02	ATP-04
Assy Site	ATP	ATP	ATP
Package / Pin	TSSOP28	PLCC68	TSSOP10
Outline	SOT361-1	SOT188-2	SOT552-1
Moulding compound	G700	MP8000	MP8000
Die-Attach Adhesive	8290	8361J	8390A
LF-mat/ pitch/ E or P	CuNi3/0.65/P	CuCr/1.27/U	CuNi3/0.5/P
Die Pad Size (mm)	3.00x3.50	9.40x9.40	1.73x2.39
Die Size (mm)	2.27x2.65	8.44x6.78	0.92x1.03
Vehicle name	PDIUSB12PW	SAA7110AWP/00	OM5968TT/C1



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<b>Lot</b>	<b>ASE-01</b>	<b>ASE-02</b>
Assy Site	ASE	ASE
Package / Pin	PLCC68	SOJ40
Outline	SOT188-2	SOT449-2
Moulding compound	MP8000	CEL9200
Die-Attach Adhesive	8361J	8361H
LF-mat/ pitch/ E or P	CuZr/1.27/P	CuFe2P/1.27/U
Die Pad Size (mm)	6.60x6.60	6.10x10.16
Die Size (mm)	4.2x3.92	4.72x7.31
Vehicle name	V83C552V8	SAA4955TJ/V1

#### 4.2 Test Vehicles Description for NiPdAu qualification

The change to NiPdAu pre-plated leadframes is considered as a major change with regard to the package construction and robustness. For these reasons a full qualification must be performed.

Test vehicles are selected based on :

- Assy site
- Package family
- Body Size
- Die-pad size
- Exposed die-pad presence

Table 5 shows the test vehicles description for NiPdAu. It is split-up in 8 phases, depending on package/pincount. These 8 phases are also shown in the conversion roadmap.

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**Group 2 : SO14-16-20 other pads / other Business Lines**

Lot	PST-2-08	PST-2-09	PST-2-11	PST-2-12
Assy Site	PST	PST	PST	PST
Package / Pin	SO16	SO16	SO14	SO14
Outline	SOT162-1	SOT162-1	SOT108-1	SOT108-1
Moulding compound	6210	6210	6210	6210
Die-Attach Adhesive	84-1LMISR4	84-1LMISR4	84-1LMISR4	84-1LMISR4
Pitch/ E or P	1.27/P	1.27/P	1.27/ P	1.27/ P
Die Pad Size (mm)	4.20x5.20	3.20x4.00	2.30x5.40	2.30x5.40
Die Size (mm)	3.49x4.02	2.36x3.51	2.06x4.98	2.06x4.98
Vehicle name	CE1460 D C	SAA6579T/V1	PCA82C252T/N3	PCA82C252T/N3
Subpack old	SOT162AH14	SOT162AH13	SOT108AJ7C	SOT108AJ7C

Lot	PST-2-13	PST-2-14	PST-2-15	PST-2-16
Assy Site	PST	PST	PST	PST
Package / Pin	SO16	SO16	SO16	SO14
Outline	SOT109-1	SOT109-1	SOT109-1	SOT108-1
Moulding compound	6210	6210	6210	6210
Die-Attach Adhesive	84-1LMISR4	84-1LMISR4	84-1LMISR4	84-1LMISR4
Pitch/ E or P	1.27/ P	1.27/ P	1.27/ P	1.27/ P
Die Pad Size (mm)	2.20x3.20	2.20x3.20	2.20x4.40	2.30x5.40
Die Size (mm)	1.83x2.92	1.83x2.92	1.95x3.18	2.00x3.63
Vehicle name	TDA8559T/N1	TDA8559T/N1	HEF4795BT	AU5783D
Subpack old	SOT109AJ21	SOT109AJ21	SOT109AJ20	SOT108AJ17

Lot	PST-2-17
Assy Site	PST
Package / Pin	SO14
Outline	SOT108-1
Moulding compound	6210
Die-Attach Adhesive	84-1LMISR4
Pitch/ E or P	1.27/ P
Die Pad Size (mm)	2.30x5.40
Die Size (mm)	2.00x3.63
Vehicle name	AU5783D
Subpack old	SOT108AJ17

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Lot	NSEB-2-11	NSEB-2-12	NSEB-2-13
Assy Site	NSEB	NSEB	NSEB
Package / Pin	SO20	SO20	SO20
Outline	SOT163-1	SOT163-1	SOT163-1
Moulding compound	6210	6210	6210
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	1.27/P	1.27/P	1.27/P
Die Pad Size (mm)	3.20x4.00	3.20x4.00	3.20x4.00
Die Size (mm)	2.32x2.24	2.32x2.24	2.32x2.24
Vehicle name	74HC299D	74HC299D	74HC299D
Subpack old	SOT163xxxx	SOT163xxxx	SOT163xxxx

### Group 3 : SO8-24-28-32

Lot	PST-3-01	PST-3-02	PST-3-03	PST-3-04
Assy Site	PST	PST	PST	PST
Package / Pin	SO8	SO8	SO8	SO24
Outline	SOT96-1	SOT96-1	SOT96-1	SOT137-1
Moulding compound	6210	6210	6210	MP8000
Die-Attach Adhesive	84-1LMISR4	84-1LMISR4	71-1-D	8390P
Pitch/ E or P	1.27/P	1.27/P	1.27/P	1.27/P
Die Pad Size (mm)	2.10x3.20	2.50x4.42	2.10x2.60	3.20x4.00
Die Size (mm)	1.78x2.79	1.80x1.00	1.10x0.79	1.56x2.05
Vehicle name	PCA82C250T/N4	PHK04P02T	LM358DM	74LVC4245AD
Subpack old	SOT96AJ23	SOT96AJ30	SOT96AJ26	SOT137AM9

Lot	PST-3-05	PST-3-06	PST-3-07	PST-3-08
Assy Site	PST	PST	PST	PST
Package / Pin	SO24	SO28	SO28	SO32
Outline	SOT137-1	SOT136-1	SOT136-1	SOT287-1
Moulding compound	MP8000	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P	8390P
Pitch/ E or P	1.27/P	1.27/P	1.27/P	1.27/P
Die Pad Size (mm)	5.20x6.20	3.20x4.00	4.20x5.20	5.20x6.20
Die Size (mm)	2.74x4.50	1.47x1.30	2.72x2.72	3.35x5.22
Vehicle name	TEA0675T/V2	74BT899 DB	CE1710DA	TEA6360T/V2
Subpack old	SOT137AM22	SOT136AM23	SOT136AM17	SOT287BK2

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Lot	PST-3-09	PST-3-10	PST-3-11	PST-3-12
Assy Site	PST	PST	PST	PST
Package / Pin	SO28	SO8	SO8	SO8
Outline	SOT136-1	SOT96-1		
Moulding compound	MP8000	6210		
Die-Attach Adhesive	8390P	84-1LMISR4		
Chipcoat	YES	1.27/P		
Pitch/ E or P	1.27/P	2.10x3.20		
Die Pad Size (mm)	4.20x5.20	1.78x2.79		
Die Size (mm)	3.07x3.94	PCA82C250T/N4		
Vehicle name	TDA3613T/N2	SOT96AJ23	CE1676D	PHK12NQ03LT
Subpack old	SOT136AM31C	PST		

Lot	PST-3-13	NSEB-3-01	NSEB-3-02	NSEB-3-03
Assy Site	PST	NSEB	NSEB	NSEB
Package / Pin	SO8	SO8	SO8	SO8
Outline	SOT96-1	SOT96-1	SOT96-1	SOT96-1
Moulding compound	6210	6210	6210	6210
Die-Attach Adhesive	84-1LMISR4	84-1LMISR4	84-1LMISR4	84-1LMISR4
Chipcoat	1.27/P	NO	NO	NO
Pitch/ E or P	2.10x3.20	1.27/P	1.27/P	1.27/P
Die Pad Size (mm)	1.78x2.79	2.03x2.03	2.03x2.03	2.03x2.03
Die Size (mm)	PCA82C250T/N4	1.10x0.79	1.10x0.79	1.10x0.79
Vehicle name	SOT96AJ23	NE532-M	NE532-M	NE532-M
Subpack old	PST	SOT96AJ15	SOT96AJ15	SOT96AJ15

#### Group 4 : SSOP14-16-20-24-28

Lot	PST-4-01	PST-4-02	PST-4-03	PST-4-04
Assy Site	PST	PST	PST	PST
Package / Pin	SSOP14	SSOP16	SSOP16	SSOP20
Outline	SOT337-1	SOT338-1	SOT369-1	SOT266-1
Moulding compound	MP8000	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	1.78x1.78	2.10x2.29	2.40x3.80	3.20x4.00
Die Size (mm)	0.68x0.71	0.74x0.94	2.06x3.58	2.44x2.70
Vehicle name	74LVC32ADB	74LVC138ADB	TSA5526AM/C2	SA575DKD
Subpack old	SOT337BC2	SOT338BC2	SOT369CB5	SOT266CH4

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Lot	PST-4-05	PST-4-06	PST-4-07	PST-4-08
Assy Site	PST	PST	PST	PST
Package / Pin	SSOP20	SSOP24	SSOP24	SSOP28
Outline	SOT339-1	SOT340-1	SOT340-1	SOT341-1
Moulding compound	MP8000	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	3.20x4.00	2.70x3.50	3.65x4.50	3.90x5.10
Die Size (mm)	1.88x2.84	1.58x1.77	2.51x3.45	4.20x3.53
Vehicle name	TEA1404TS/N2	74LVC823ADB	SAA1501TS/N3	P87C749EBDDBC
Subpack old	SOT339BC5	SOT340BC3	SOT340BC5	SOT341BE6

Lot	PST-4-09
Assy Site	PST
Package / Pin	SSOP28
Outline	SOT341-1
Moulding compound	MP8000
Die-Attach Adhesive	8390P
Pitch/ E or P	0.65/E
Die Pad Size (mm)	3.50x3.50
Die Size (mm)	1.85x2.22
Vehicle name	UBA2032TS/N2/S1
Subpack old	SOT341BE9

Lot	PSC-4-01	PSC-4-02	PSC-4-03	PSC-4-04
Assy Site	PSC	PSC	PSC	PSC
Package / Pin	SSOP20	SSOP24	SSOP28	SSOP28
Outline	SOT339-1	SOT340-1	SOT341-1	SOT341-1
Moulding compound	MP8000	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P	QMI509
Pitch/ E or P	0.65/P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	2.40x2.70	2.70x3.50	3.90x6.60	3.90x6.60
Die Size (mm)	0.705x0.96	2.52x1.85	3.04x5.11	3.04x5.11
Vehicle name	74HC574DB	TDA5737M/C1	UDA1341TS/N1	UDA1341TS/N1
Subpack old	SOT339DC3	SOT340CC3	SOT341CE6	SOT341CA6

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#### Group 5 : SSOP48-56

Lot	PST-5-01	PST-5-02	PST-5-03
Assy Site	PST	PST	PST
Package / Pin	SSOP48	SSOP56	SSOP56
Outline	SOT370-1	SOT371-1	SOT371-1
Moulding compound	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	2.60x3.20	2.60x4.00	2.60x4.00
Die Size (mm)	1.25x2.21	1.75x2.97	1.75x2.97
Vehicle name	PDI1284P11DL	74ALVT16601DL	74ALVT16601DL
Subpack old	SOT370DB2	SOT371DB3	SOT371DB3

#### Group 6 : TSSOP low pincount from PSC and NSEB

Lot	PSC-6-01	PSC-6-02
Assy Site	PSC	PSC
Package / Pin	TSSOP20	TSSOP20
Outline	SOT360-1	SOT360-1
Moulding compound	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P
Die Pad Size (mm)	2.40x2.70	2.75x4.00
Die Size (mm)	0.82x0.90	1.36x1.45
Vehicle name	74LVC244APW	74LVC574APW
Subpack old	SOT360CC2	SOT360CC4

Lot	NSEB-6-01	NSEB-6-02	NSEB-6-03
Assy Site	NSEB	NSEB	NSEB
Package / Pin	TSSOP8	TSSOP8	TSSOP8
Outline	SOT530-1	SOT530-1	SOT530-1
Moulding compound	KMC184	KMC184	KMC184
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	3.00x2.00	3.00x2.00	3.00x2.00
Die Size (mm)	0.69x0.72	0.69x0.72	0.69x0.72
Vehicle name	CBTS3306PW	CBTS3306PW	CBTS3306PW
Subpack old	SOT530AA3	SOT530AA3	SOT530AA3

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Lot	NSEB-6-04	NSEB-6-05	NSEB-6-06
Assy Site	NSEB	NSEB	NSEB
Package / Pin	TSSOP14	TSSOP14	TSSOP14
Outline	SOT402-1	SOT402-1	SOT402-1
Moulding compound	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	1.78x1.78	1.78x1.78	1.78x1.78
Die Size (mm)	0.49x0.61	0.49x0.61	0.49x0.61
Vehicle name	74LVC08APW	74LVC08APW	74LVC08APW
Subpack old	SOT402CA4	SOT402CA4	SOT402CA4

#### Group 7 : TSSOP32-48-56

Lot	PST-7-01	PST-7-03	PST-7-02
Assy Site	PST	PST	PST
Package / Pin	TSSOP48	TSSOP48	TSSOP56
Outline	SOT362-1	SOT362-1	SOT364-1
Moulding compound	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.65/P		0.65/P
Die Pad Size (mm)	2.60x3.20		2.60x4.00
Die Size (mm)	1.65x2.51	0.86x2.66	1.08x3.03
Vehicle name	74LVT162373DGG	SSTL16877	PCA9504A DGG A
Subpack old	SOT362DB5		SOT364DB4

Lot	PSC-7-01	PSC-7-02	PSC-7-03	PSC-7-04
Assy Site	PSC	PSC	PSC	PSC
Package / Pin	TSSOP48	TSSOP56	TSSOP32	TSSOP32
Outline	SOT362-1	SOT364-1	SOT487-1	SOT487-1
Moulding compound	KMC184	KMC184	MP8000	KMC184
Die-Attach Adhesive	8390P	8390P	8390P	8390P
Pitch/ E or P	0.5/P	0.5/P	0.65/E	0.65/P
Die Pad Size (mm)	2.60x3.20	2.60x4.00	4.00x5.00	3.00x3.00
Die Size (mm)	2.32x2.45	2.12x3.52	3.06x3.67	1.84x1.84
Vehicle name	ISP1181BDGG	PCK2023DGG	CV8732DR	OM5946ATT/C1
Subpack old	SOT362CC5	SOT364CC4	SOT487DC4	SOT487EC3

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Lot	PSC-7-05	PSC-7-06	PSC-7-07
Assy Site	PSC	PSC	PSC
Package / Pin	TSSOP48	TSSOP56	TSSOP56
Outline	SOT362-1	SOT364-1	SOT364-1
Moulding compound	KMC184	KMC184	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.5/E	0.5/P	0.5/P
Die Pad Size (mm)	2.0x4.0	2.90x5.00	2.90x5.00
Die Size (mm)	1.56x2.95	2.533x3.737	2.533x3.737
Vehicle name	74LVT162245BDG	SC28L202A1D56	SC28L202A1D56
Subpack old	SOT362CC6	SOT364...	SOT364DC5

### Group 8 : HTSSOP in PST and PSC

Lot	PST-8-01	PST-8-02	PST-8-03
Assy Site	PST	PST	PST
Package / Pin	HTSSOP20	HTSSOP20	HTSSOP20
Outline	SOT527-1	SOT527-1	SOT527-1
Moulding compound	MP8000	MP8000	MP8000
Die-Attach Adhesive	8390P	8390P	8390P
Pitch/ E or P	0.65/P	0.65/P	0.65/P
Die Pad Size (mm)	3.00x4.20	3.00x4.20	3.00x4.20
Die Size (mm)	0.79x1.03	0.79x1.03	0.79x1.03
Vehicle name	UAA3590TW/C1	UAA3590TW/C1	UAA3590TW/C1
Subpack old	SOT527BB2	SOT527BB2	SOT527BB2

Lot	PSC-8-01	PSC-8-02	
Assy Site	PSC	PSC	
Package / Pin	HTSSOP32	HTSSOP38	
Outline	SOT549-1	SOT633-1	
Moulding compound	MP8000	KMC184	
Die-Attach Adhesive	8390P	8390P	
Pitch/ E or P	0.65/E	0.65/U	
Die Pad Size (mm)	3.50x5.00	4.00x5.00	
Die Size (mm)	2.23x1.31	2.30x3.06	
Vehicle name	SZA1015TT	TDA663AA1	
Subpack old			



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## 5. Reliability Test Program

An extensive qualification program will be executed to demonstrate that PST, PSC, PSK Amkor, ASE and NSEB can assemble Pb-free packages with a high quality and reliability.

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

### 5.1 Reliability Test Descriptions

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.

#### *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-020B specification, as described in Philips Semiconductors specification SNW-FQ-225A. SMD Packages are preconditioned to the appropriate MSL level. Peak temperatures per table 8.

#### *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.

#### *THBS – Temperature Humidity Bias Stress*

Temperature Humidity Bias Stress (85°C/85% R.H., 1000 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. This test is sometimes done instead of HAST

#### *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

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## 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 per the following test methods :

- |   |                                       |                |
|---|---------------------------------------|----------------|
| • | 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     |

## 5.3 Whiskers: mechanism, counter-measures and test

### 5.3.1 Mechanism.

In order to understand the impacts of matte Sn plating, Philips is performing an extensive whisker research program. Topics of interest are a.o. :

- definition what is a whisker, understand the growing-mechanism
- plating characteristics such as layer thickness, grain size, crystal orientation
- leadframe base material impact
- counter measures for whisker growth
- recommendations for process control and process/product release tests.
- cooperate within E3 to have consensus within Europe's large players

Appendix A, E3 presentation, is showing the results and conclusions of the whisker research activities by the E3.

### 5.3.2 Whisker control counter measures

Philips IC will apply the following steps to eliminate whisker growth:

- Thickness control : Sn layer thickness to be 7.5  $\mu\text{m}$  minimum.
- Post-baking operation of 1 hour at 150 °C. The post-bake conditions are after plating, but before trim&form. ( no post-bake for FeNi leadframes)

### 5.3.3 The following whisker tests will be performed as part of the self-qualification plan.

Test A

Storage at ambient (18°C -25 °C / 30-70% RH).

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Inspect after 0, 4, 12 and 26 wks. Keep parts and do extended readpoints after 52 , 78 and 104 weeks.

Sample size : 10 post-baked samples

Accept when after 26 weeks not any whisker longer than 15 µm is found

#### Test B

TMCL 500 cycles -35°C/ 125 °C, minimum dwell time 7 minutes

(this test for Copper-based leadframes only)

Note: this is not an acceleration test !!

Sample size : 10 post-baked samples.

Accept when no whiskers above 40 µm are found.

#### Test C

Storage at 55 °C and 85% RH.

Inspect after 8 weeks and after 26 weeks.

Note: this is not an acceleration test !!

Sample size : 10 post-baked samples.

Accept when after 8 weeks no whiskers above 20 µm are found.

Accept when after 26 weeks no whiskers above 40 µm are found.

## 5.4 Moisture Sensitivity Level assessment.

### 5.4.1 Moisture Sensitivity Level characterisation under Pb-free conditions.

To qualify NiPdAu pre-plated lead-frames, MSLA test is part of the qualification work.

For the lead-finish change from SnPb into matte Sn, MSLA test is not needed because lead-finish does not impact the MSL level of a package.

However, as shown in section 5.4.2, Pb-free soldering temperatures are 20°C higher than standard soldering.

Higher temperatures can have an effect on the MSL behaviour. Eventually, the MSL level under Pb-free conditions can be higher than under the SnPb conditions. The end-customer has to respect the storing and handling precautions as defined in the appropriate MSL definitions.

To determine the MSL level under Pb-free board soldering conditions, an extensive MSL characterisation programm was performed. Representative packages from all families were subjected to MSL- and to Reliability tests, both under standard and Pb-free reflow conditions. Based on the results of the packages tested, Pb-free MSL judgements for ALL IC packages will be made and will be provided to the Business Lines for Pb-free type-MSL judgements. From July 2003 onwards, both standard and Pb-free MSL are printed on the shipping box labels. (as announced per Customer Information Note 200303009)

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#### 5.4.2 Pb-free reflow profiles applied by Philips.

In July 2002 the IPC/JEDEC has published a new standard: J-STD-020B. The three companies of E3 will adapt to this new standard. Existing results, based on the earlier proposal, are remaining valid. The new standard is inline with the earlier announced European approach.

For small size semiconductor packages the standard J/STD-020B will be exceeded. The commodity market demands for small size packages a 260°C peak temperature while testing the device for MSL-classification. The E3 will exceed the standard J/STD-020B in this aspect and continue to incorporate the market demands for high level quality endurance measures, based on international standards.

The details of the Pb-free reflow profiles as applied by Philips are shown in the tables 6 and 7 and figure 1 shows the typical reflow profile.

Table 6 : Convection solder reflow requirements:

Reflow Condition	SnPb		Pb-Free	
	Large Body	Small Body	Large Body	Small Body
Average ramp-up rate (T <sub>L</sub> to Peak)	3°C/second max.		3°C/second max.	
Preheat				
- Temperature Min (T <sub>smin</sub> )	100 °C		150 °C	
- Temperature Max (T <sub>smax</sub> )	150 °C		200 °C	
- Time (min to max) (ts)	60-120 seconds		60-180 seconds	
T <sub>smax</sub> to T <sub>L</sub>				
- Ramp-up Rate	3°C/second max.		3°C/second max.	
Time maintained above:				
- Temperature (T <sub>L</sub> )	183°C		217°C	
- Time (t <sub>L</sub> )	60-150 seconds		60-150 seconds	
Peak Temperature <sup>3</sup> (T <sub>p</sub> )	225°C +0/-5°C	240°C +0/-5°C	245°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature <sup>2</sup> (t <sub>p</sub> )	10-20 seconds	10-20 seconds	10-30 seconds	10-30 seconds
Ramp-down Rate	6°C/second max.		6°C/second max.	
Time 25°C to Peak Temperature	180-360 seconds.		300-480 seconds	

Notes:

1. All temperatures refer to topside of the package as measured on the centre of the plastic body surface.
2. Time within 5°C of actual peak temperature is allowed to have a range of 10-30 sec if needed due to convection oven/board loading limitations.
3. Peak temperature is allowed to have a range of +5/-5°C if needed due to convection oven/board loading limitations
4. Parts must exactly meet the reflow requirements to be considered valid for MSLA assessment.
5. Between exposures, parts shall be allowed to cool down to room temperature, for 5 minutes minimum.

Figure 1. MSLA Test Profile.

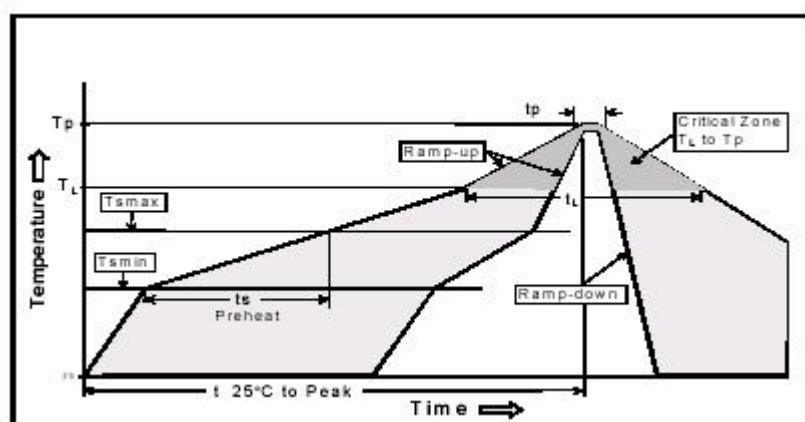


Table 7 : Peak temperature requirements and large/small body definition:

	Large Body Packages		Small Body Packages
Reflow Condition	Pkg Thickness $\geq 2.5$ mm	Pkg Thickness $< 2.5$ mm And Pkg Volume $\geq 350$ mm <sup>3</sup>	Pkg Thickness $< 2.5$ mm And Pkg Volume $< 350$ mm <sup>3</sup>
SnPb	Peak Temp <sup>2</sup> 225 +0/-5 °C		Peak Temp <sup>2</sup> 240+0/-5 °C
Pb-Free	Peak Temp <sup>2</sup> 245 +0/-5 °C		Peak Temp <sup>2</sup> 260+0/-5 °C

Notes:

1. Package volume is defined as body-height x width x length, but excludes external leads and non-integral heatsinks.
2. Peak temperature is allowed to have a range of +5/-5°C if needed due to convection oven/board loading limitations.

## 5.5 Board Level Reliability

To ensure that Pb-free packages can be mounted to customer boards in a reliable way, extensive research has been performed.

Both matte Sn plated products and NiPdAu pre-plated products were mounted to boards and subjected to appropriate tests.

Standard and Pb-free board soldering processes were tested both to ensure forward / backward compatibility for end-customers who did not yet change to Pb-free soldering conditions.

The E3 presentation as attached to the CPCN shows the results and conclusions of the E3 Board Level Reliability tests.

## 6. Qualification Test Matrix

The qualification tests to be performed are selected based on the General Quality Specification per SNW-FQ-611. The basis for the GQS is a standard FMEA risk assesment approach.

Tests to be done are listed in table 8:

Table 8

Test Name	Change to Matte Sn	Change to NiPdAu
PPOT-96h + PCON SnPb cond. (*)	Yes	Yes
PPOT-96h + PCON Pb-free cond.	Yes	Yes
HAST-96h + PCON SnPb cond. (*)	For selected types	For selected types
HAST-96h + PCON Pb-free cond.	For selected types	For selected types
TMCL-200c + PCON SnPb cond. (*)	No	Yes
TMCL-200c + PCON Pb-free cond.	No	Yes
TMCL-500c + PCON SnPb cond. (*)	No	For selected types
TMCL-500c + PCON Pb-free cond.	No	For selected types
HTSL-1000h	No	Yes
WHISKER TESTS A+B+C	Yes	No
VISUAL MECHANICAL	Yes	For selected types
LEAD-FINISH INSPECTION	Yes	For selected types
SOLDER-ABILITY TEST	Yes	For selected types
MSLA SnPb condition (*)	No	For selected types
MSLA Pb-free condition	No	For selected types
XRAY INSPECTION	No	For selected types
SCAT INSPECTION	No	For selected types
DIE-SHEAR	No	For selected types
BONDPULL/ BALL SHEAR	No	For selected types
BONDPULL AFTER TMCL 500c	No	For selected types
CROSS-SECTION	No	For selected types

Legend:

Yes = test will be performed

No = test not applicable

(\*) = in case Pb-free MSL is equal to SnPb MSL, this test can be skipped

For selected types = structural similarity will be applied to cover the other vehicles.

For the details see sections 6.1 and 6.2

### 6.1 Self-qualification program matte Sn + postbake packages

Legend:

Green = Test completed and PASS

Yellow = Samples in the lab

White = no sample in lab yet

**Table 9: Reliability Test matte Sn**

Package	Lot No.	Device	MSL/ temp.	PPOT			HAST		
				pcon	96 hrs	192 hrs	Pcon	96 hrs	192 hrs
SQFP208	PSC-07	VY21754A	3/245	0/77	0/77	77	-	-	-
SOJ40	ASE-02	SAA4955TJ/V1	3/245	0/77	0/77	-	0/77 <sup>(2)</sup>	0/77 <sup>(2)</sup>	0/77 <sup>(2)</sup>
HVQFN64	ATK-04	ISP1583BS	2/260	3x0/77	3x0/77	3x0/77	3x0/77	3x0/77	3x0/77
PLCC68	ATP-02	SAA7110AWP/00	3/245	77	77	-	-	-	-
PLCC68	ASE-01	V83C552V8	3/225	0/77	0/77	-	-	-	-
PLCC68	ASE-01	V83C552V8	4/245	0/77	0/77	-	-	-	-
TSSOP10	ATP-04	OM5968TT/C1	1/260	0/77	0/77	-	0/45	0/45	-
TSSOP28	ATP-01	PDIUBS12PW	1/260	0/77	0/77	-	0/45	0/45	-

(2) THBS test done i.s.o. HAST

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

**Table 10: Construction Analysis tests matte Sn.**

Package	Lot No.	Device	Construction Analysis Tests					
			V/M	LFNH	SOLD-A <sup>(1)</sup>	SOLD-B <sup>(1)</sup>	SOLD-C <sup>(1)</sup>	SOLD-D <sup>(1)</sup>
SQFP208	PSC-07	VY21754A	0/15	0/9	0/11	0/11	0/11	0/11
SOJ40	ASE-02	SAA4955TJ/V1	0/15	0/9	11	11	11	11
HVQFN64	ATK-04	ISP1583BS	0/15	0/9	11	11	11	11
PLCC68	ATP-02	SAA7110AWP/00	15	9	11	11	11	11
PLCC68	ASE-01	V83C552V8	0/15	0/9	11	11	11	11
TSSOP10	ATP-04	OM5968TT/C1	0/45	0/9	0/11	0/11	0/11	0/11
TSSOP28	ATP-01	PDIUBS12PW	0/45	0/9	0/11	0/11	0/11	0/11

(1) conditions for solderability testing :

A : SnPb solder after 8h steam age, 5 sec, 215 °C

B : SnPb solder after 16h dry-bake, 5 sec, 215 °C

C : SAC solder after 8h steam age, 3 sec, 245 °C

D : SAC solder after 16h dry-bake, 3 sec, 245 °C

RMA is the standard flux.

**Table 11: Whisker Tests Results matte Sn**

Package	Lot No.	Device	Whisker Test Results				
			Whisker Test A <sup>(1)</sup>		Whisker Test B	Whisker Test C <sup>(1)</sup>	
			Readpoint in wks from assy	longest whisker in µm	longest whisker in µm After TMCL 500x	Readpoint in wks from assy	longest whisker in µm
SQFP208	PSC-07	VY21754A	26wks	0	0	8 wks	0
SOJ40	ASE-02	SAA4955TJ/V1	26wks	0	16	26 wks	0
HVQFN64	ATK-04	ISP1583BS	26wks	0	10	8 wks	0
PLCC68	ATP-02	SAA7110AWP/00	26wks	0	13	8 wks	0
PLCC68	ASE-01	V83C552V8	26wks	0	18	26 wks	0
TSSOP10	ATP-04	OM5968TT/C1	26wks	0	0	8 wks	0
TSSOP28	ATP-01	PDIUBS12PW	26wks	0	0	8 wks	0



## 6.2 Self-qualification program NiPdAu packages

Table 12 : Reliability Tests NiPdAu

Package	Lot No.	Device	PPOT			HAST			TMCL			HTSL	
			Pcon	96 hrs	192 hrs	pcon	96 hrs	192 hrs	Pcon	200c	500c	1000h	2000h
SO16	PST-2-08	CE1460 D C	L3 0/77	0/77	!	!	!	!	L3 0/77	0/77	!	0/77	!
SO16	PST-2-09	SAA6579T/V1	L1 0/77	0/77	!	L1 0/45	0/45	0/45	L1 0/77	0/77	0/77	0/77	0/77
SO14	PST-2-11	PCA82C252T/N3	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SO14	PST-2-12	PCA82C252T/N3	L1 0/77	0/77	!	!	!	!	0/77	0/77	!	77	!
SO16	PST-2-13	TDA8559T	L1 0/7	77	!	L1 0/45	0/45	!	L1 0/77	0/77	!	77	!
SO16	PST-2-14	TDA8559T	L1 0/77	77	!	L1 0/45	0/45	!	L1 0/77	0/77	!	77	!
SO16	PST-2-15	HEF4795BT	L3 0/77	0/77	!	!	!	!	L3 0/77	0/77	!	77	!
SO14	PST-2-16	AU5783D	L3 0/77	0/77	!	!	!	!	L3 0/77	0/77	!	0/77	!
SO14	PST-2-17	AU5783D	L3 0/77	0/77	!	!	!	!	L3 0/77	0/77	!	0/77	!

SO20	NSEB-2-11	74HC299D				45	45						
SO20	NSEB-2-12	74HC299D				45	45						
SO20	NSEB-2-13	74HC299D				45	45						
S08	PST-3-01	PCA82C250T/N4	L1 0/77	77	77	L1 0/77	0/77	0/77	L1 0/77	0/77	0/77	0/77	77
S08	PST-3-02	PHK04P02T	L1 0/77	0/77	-	-	-	-	L1 0/77	0/77	-	0/77	-
S08	PST-3-03	LM358DM	L1 0/77	0/77	-	-	-	-	L1 0/77	0/77	-	0/77	-
S024	PST-3-04	74LVC4245AD	L1 0/77	0/77	-	-	-	-	L1 0/77	0/77	-	0/77	-
S024	PST-3-05	TEA0675T/V2	L3 0/77	0/77	-	L3 0/45	0/45	-	L3 0/77	0/77	-	77	-
S028	PST-3-06	74BT899 DB	L1 0/77	0/77	-	-	-	-	L1 0/77	0/77	-	77	-
SO28	PST-3-07	CE1710DA	L3 0/77	0/77	-	-	-	-	L3 0/77	0/77	-	77	-
S032	PST-3-08	TEA6360T/V2	L1 0/77	0/77	-	-	-	-	L1 0/77	0/77	-	77	-
SO28	PST-3-09	TDA3613T/N2	L1 0/77	0/77	-	-	-	-	L1 0/77	0/77	-	77	-
SO8	PST-3-10	PCA82C250T/N4	L1	77	-	-	-	-	-	-	-	-	-
SO8	PST-3-11	CE1676D	77	77	-	-	-	-	77	77	-	77	-
SO8	PST-3-12	PHK12NQ03LT	77	77	-	-	-	-	77	77	-	77	-
SO8	PST-3-13	PCA82C250T/N4	L1	77	-	-	-	-	-	-	-	-	-

SO8	NSEB-3-01	NE532-M	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SO8	NSEB-3-02	NE532-M	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SO8	NSEB-3-03	NE532-M	L1 77	77	!	!	!	!	L1 77	77	!	77	!
SSOP14	PST-4-01	74LVC32ADB	L1 0/77	77	!	!	!	!	L1 0/77	77	!	77	!
SSOP16	PST-4-02	74LVC138ADB	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SSOP16	PST-4-03	TSA5526AM/C2	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SSOP20	PST-4-04	SA575DKD	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SSOP20	PST-4-05	TEA1404TS/N2	L1 0/77	77	!	!	!	!	L1 0/77	77	!	77	!
SSOP24	PST-4-06	74LVC823ADB	L1 0/77	0/77	!	L1 0/45	0/45	!	L1 0/77	0/77	!	77	!
SSOP24	PST-4-07	SAA1501TS/N3	L1 0/77	77	!	!	!	!	L1 0/77	77	!	77	!
SSOP28	PST-4-08	P87C749EBDDBC	L1 0/77	0/77	!	!	!	!	L1 0/77	0/77	!	77	!
SSOP28	PST-4-09	UBA2032TS/N2/S1	L1 0/77	77	!	!	!	!	L1 0/77	77	!	77	!

SSOP20	PSC-4-01	74HC574DB	77	77	77	45	45	45	77	77	77	77	-
SSOP24	PSC-4-02	TDA5737M/C1	77	77	77	-	-	-	77	77	77	77	-
SSOP28	PSC-4-03	UDA1341TS/N1	77	77	77	45	45	-	77	77	77	77	-
SSOP28	PSC-4-04	UDA1341TS/N1	77	77	77	45	45	-	77	77	77	77	-
SSOP48	PST-5-01	PDI1284P11DL	L.1 77	77	-	-	-	-	L.1 77	77	-	77	-
SSOP56	PST-5-02	74ALVT16601DL	L.1 77	77	-	L.1 45	45	-	L.1 77	77	-	77	-
SSOP56	PST-5-03	74ALVT16601DL	L.1 77	77	-	L.1 45	45	-	L.1 77	77	-	77	-
TSSOP20	PSC-6-01	74LVC244APW	77	77	77	45	45	45	77	77	77	77	-
TSSOP20	PSC-6-02	74LVC574APW	77	77	-	-	-	-	77	77	-	77	-
TSSOP8	NSEB-6-01	CBTS3306PW	77	77	-	45	45	-	77	77	-	77	-
TSSOP8	NSEB-6-02	CBTS3306PW	77	77	-	45	45	-	77	77	-	77	-
TSSOP8	NSEB-6-03	CBTS3306PW	77	77	-	45	45	-	77	77	-	77	-

TSSOP14	NSEB-6-04	74LVC08APW	L.1 0/77	77	-	-	-	-	L.1 0/77	77	-	77	-
TSSOP14	NSEB-6-05	74LVC08APW	L.1 0/77	77	-	-	-	-	L.1 0/77	77	-	77	-
TSSOP14	NSEB-6-06	74LVC08APW	L.1 0/77	77	-	-	-	-	L.1 0/77	77	-	77	-
TSSOP48	PST-7-01	74LVT162373DGG	L.1 77	77	-	-	-	-	L.1 77	77	-	77	-
TSSOP48	PST-7-03	SSTL16877	L.1 0/77	0/77	-	L.1 0/45	45	-	L.1 0/77	0/77	-	77	-
TSSOP56	PST-7-02	PCA9504A DGG A	L.4 0/77	77	-	L.4 0/45	45	-	L.4 0/77	77	-	0/77	-
TSSOP48	PSC-7-01	ISP1181BDGG	77	77	77	-	-	-	77	77	77	77	-
TSSOP56	PSC-7-02	PCK2023DGG	77	77	77	-	-	-	77	77	77	77	-
TSSOP32	PSC-7-03	CV8732DR	77	77	77	-	-	-	77	77	77	77	-
TSSOP32	PSC-7-04	OM5946ATT/C1	77	77	77	45	45	45	77	77	77	77	-
TSSOP48	PSC-7-05	74LVT162245BDG	77	77	77	-	-	-	77	77	77	77	-
TSSOP56	PSC-7-06	SC28L202A1D56	77	77	77	-	-	-	77	77	77	77	-
TSSOP56	PSC-7-07	SC28L202A1D56	77	77	77	-	-	-	77	77	77	77	-

HTSSOP20	PST-8-01	UAA3590TW/C1	<b>77</b>	<b>77</b>	-	-	-	-	<b>77</b>	<b>77</b>	-	<b>77</b>	-
HTSSOP20	PST-8-02	UAA3590TW/C1	<b>77</b>	<b>77</b>	-	-	-	-	<b>77</b>	<b>77</b>	-	<b>77</b>	-
HTSSOP20	PST-8-03	UAA3590TW/C1	<b>77</b>	<b>77</b>	-	-	-	-	<b>77</b>	<b>77</b>	-	<b>77</b>	-
HTSSOP32	PSC-8-01	SZA1015TT	<b>77</b>	<b>77</b>	-	-	-	-	<b>77</b>	<b>77</b>	-	<b>77</b>	-
HTSSOP38	PSC-8-02	TDA663AA1	<b>77</b>	<b>77</b>	-	-	-	-	<b>77</b>	<b>77</b>	-	<b>77</b>	-

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

**Table 13: Construction Analysis tests NiPdAu.**

Package	Lot No.	Device	Construction Analysis Tests								
			MSLA Pb-free	V/M	LFNH	SOLD	XRAY	SCAT	DISH	BP/BS	CROSS
SO16	PST-2-08	CE1460 D C	L3	15	9	4x11	8	8	3	3	3
SO16	PST-2-09	SAA6579T/V1	L2	0/15	0/9	4x0/11	0/8	0/8	0/3	0/3	0/3
SO14	PST-2-11	PCA82C252T/N3	L2	15	9	4x11	8	8	3	3	3
SO14	PST-2-12	PCA82C252T/N3	L2	15	9	4x11	8	8	3	3	3
SO16	PST-2-13	TDA8559T	L2	-	-	-	-	-	-	-	-
SO16	PST-2-14	TDA8559T	L2	-	-	-	-	-	-	-	-
SO16	PST-2-15	HEF4795BT	L3	-	-	-	-	-	-	-	-
SO14	PST-2-16	AU5783D	L3	15	9	4x11	8	8	3	3	3
SO14	PST-2-17	AU5783D	L3	15	9	4x11	8	8	3	3	3
SO20	PST-2-18	SAA6588T/V2	L3	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.

Package	Lot No.	Device	Construction Analysis Tests								
			MSLA Pb-free	V/M	LFNH	SOLD	XRAY	SCAT	DISH	BP/BS	CROSS
SO20	NSEB-2-11	74HC299D	14								3
SO20	NSEB-2-12	74HC299D	14								3
SO20	NSEB-2-13	74HC299D	14								3
S08	PST-3-01	PCA82C250T/N4	L1	15	9	4x11	8	8	3	3	3
S08	PST-3-02	PHK04P02T	L1	15	9	4x11	8	8	3	3	3
S08	PST-3-03	LM358DM	L1	15	9	4x11	8	8	3	3	3
S024	PST-3-04	74LVC4245AD	L1	15	9	4x11	8	8	3	3	3
S024	PST-3-05	TEA0675T/V2	L3	15	9	4x11	8	8	3	3	3
S028	PST-3-06	74BT899 DB	L1	15	9	4x11	8	8	3	3	3
SO28	PST-3-07	CE1710DA	L3	15	9	4x11	8	8	3	3	3
S032	PST-3-08	TEA6360T/V2	L1	15	9	4x11	8	8	3	3	3
SO28	PST-3-09	TDA3613T/N2	L1	15	9	4x11	8	8	3	3	3
S08	NSEB-3-01	NE532-M	14	15	9	4x11	8	8	3	3	3
S08	NSEB-3-02	NE532-M	14	15	9	4x11	8	8	3	3	3
S08	NSEB-3-03	NE532-M	14	15	9	4x11	8	8	3	3	3



Package	Lot No.	Device	Construction Analysis Tests								
			MSLA Pb-free	V/M	LFNH	SOLD	XRAY	SCAT	DISH	BP/BS	CROSS
SSOP14	PST-4-01	74LVC32ADB	14	15	9	4x11	8	8	3	3	3
SSOP16	PST-4-02	74LVC138ADB	L1	15	9	4x11	8	8	3	3	3
SSOP16	PST-4-03	TSA5526AM/C2	14	15	9	4x11	8	8	3	3	3
SSOP20	PST-4-04	SA575DKD	L1	15	9	4x11	8	8	3	3	3
SSOP20	PST-4-05	TEA1404TS/N2	L1	15	9	4x11	8	8	3	3	3
SSOP24	PST-4-06	74LVC823ADB	L1	15	9	4x11	8	8	3	3	3
SSOP24	PST-4-07	SAA1501TS/N3	L1	15	9	4x11	8	8	3	3	3
SSOP28	PST-4-08	P87C749EBDDBC	14	15	9	4x11	8	8	3	3	3
SSOP28	PST-4-09	UBA2032TS/N2/S1	14	15	9	4x11	8	8	3	3	3
SSOP20	PSC-4-01	74HC574DB	14	15	9	4x11	8	8	3	3	3
SSOP24	PSC-4-02	TDA5737M/C1	14	15	9	4x11	8	8	3	3	3
SSOP28	PSC-4-03	UDA1341TS/N1	14	15	9	4x11	8	8	3	3	3
SSOP28	PSC-4-04	UDA1341TS/N1	14	15	9	4x11	8	8	3	3	3
SSOP48	PST-5-01	PDI1284P11DL	14	15	9	4x11	8	8	3	3	3
SSOP56	PST-5-02	74ALVT16601DL	14	15	9	4x11	8	8	3	3	3
SSOP56	PST-5-03	74ALVT16601DL	14	15	9	4x11	8	8	3	3	3

Package	Lot No.	Device	Construction Analysis Tests								
			MSLA Pb-free	V/M	LFNH	SOLD	XRAY	SCAT	DISH	BP/BS	CROSS
TSSOP20	PSC-6-01	74LVC244APW	L1	15	9	4x11	8	8	3	3	3
TSSOP20	PSC-6-02	74LVC574APW	14	15	9	4x11	8	8	3	3	3
TSSOP8	NSEB-6-01	CBTS3306PW	14	15	9	4x11	8	8	3	3	3
TSSOP8	NSEB-6-02	CBTS3306PW	14	15	9	4x11	8	8	3	3	3
TSSOP8	NSEB-6-03	CBTS3306PW	14	15	9	4x11	8	8	3	3	3
TSSOP14	NSEB-6-04	74LVC08APW	14	15	9	4x11	8	8	3	3	3
TSSOP14	NSEB-6-05	74LVC08APW	14	15	9	4x11	8	8	3	3	3
TSSOP14	NSEB-6-06	74LVC08APW	14	15	9	4x11	8	8	3	3	3
TSSOP48	PST-7-01	74LVT162373DGG	14	15	9	4x11	8	8	3	3	3
TSSOP48	PST-7-03	SSTL16877	L1								
TSSOP56	PST-7-02	PCA9504A DGG A	L4	15	9	4x11	8	8	3	3	3
TSSOP48	PSC-7-01	ISP1181BDGG	14	15	9	4x11	8	8	3	3	3
TSSOP56	PSC-7-02	PCK2023DGG	14	15	9	4x11	8	8	3	3	3
TSSOP32	PSC-7-03	CV8732DR	14	15	9	4x11	8	8	3	3	3
TSSOP32	PSC-7-04	OM5946ATT/C1	14	15	9	4x11	8	8	3	3	3
TSSOP48	PSC-7-05	74LVT162245BDG									
TSSOP56	PSC-7-06	SC28L202A1D56									
TSSOP56	PSC-7-07	SC28L202A1D56									

Package	Lot No.	Device	Construction Analysis Tests								
			MSLA Pb-free	V/M	LFNH	SOLD	XRAY	SCAT	DISH	BP/BS	CROSS
HTSSOP20	PST-8-01	UAA3590TW/C1	14	15	9	4x11	8	8	3	3	3
HTSSOP20	PST-8-02	UAA3590TW/C1	14	15	9	4x11	8	8	3	3	3
HTSSOP20	PST-8-03	UAA3590TW/C1	14	15	9	4x11	8	8	3	3	3
HTSSOP32	PSC-8-01	SZA1015TT	14	15	9	4x11	8	8	3	3	3
HTSSOP38	PSC-8-02	TDA663AA1	14	15	9	4x11	8	8	3	3	3

**Table 14:** Construction Analysis tests NiPdAu, additional tests for automotive.

Package	Lot No.	Device	Construction Analysis Tests		
			BPT after TMCL 500c		
S08	PST-3-01	PCA82C250T/N4	0/5		

Assembly & Test Organization Philips Semiconductors	<b>Self Qualification Plan: Leadfree for xSOx, xSSOP, PLCC and HVQFN families</b>	Document Number RNR-83-04/RdH/RdH-2003
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## 7. Conclusion

An extensive qualification program will be executed to demonstrate that:

- PST, PSC and NSEB can assemble SO/SSOP/TSSOP packages in NiPdAu at a high quality and reliability level.
- PSC,PSK,PST and subcons Amkor, ASE can assemble Pb-free packages with a high quality and reliability, using matte Sn as lead-finish material

With the positive completion of the Qualification tests, the Assembly and Test Organization Philips Semiconductors announces the release of NiPdAu pre-plated leadframes for SO/SSOP/TSSOP assembled in PST, PSC and NSEB, and matte Sn leadfinish in PSC, PSK, PST, Amkor and ASE.

## 8. Implementation

For a detailed implementation schedule see "Conversion Roadmap" as attached to the CPCN.

## 9. Document Revision Sheet

R E V I S I O N   S H E E T			
DATE yyyy/mm/dd	REV	DESCRIPTION	AUTHOR
2003-05-02	01	Self Qualification Plan for Lead (Pb) free lead-finish of leadframe-based IC packages.	Rob de Heus
2003-05-23	02	Minor changes per BL input. Added AEC_Q100 tests for selected vehicles.	Rob de Heus
2003-05-28	03	Added AEC_Q100 tests for Logic parts in NiPd. Remove HTSL 2000h as required test.	Rob de Heus
2003-09-30	04	1. NSEB will be qualified in NiPdAu in stead of matte Sn. 2. Moved data+results of SO14/16/20 (phase 1 to NiPdAu) to report RNR-83-03/RdH/RdH-2036. 3. Removed solderability-test details because Philips spec SNW-FQ-221 was updated recently. 4. Added note 2 in 'Introduction' regarding NiPdAu qualification at Amkor and NSEB. 5. Other minor updates	Rob de Heus
2003-12-09	05	1. Moved data+results of QFP-families (phase 2 of CPCN ) to report RNR-83-03/RdH/RdH-2045 2. Added more vehicles for NSEB in NiPdAu. 3. Added SO14/16 at PST in 84-1LMI die-attach. 4. other minor updates	Rob de Heus

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2004-01-27	06	1. Moved data+results of phase 3 products to report RNR-83-04/RdH/RdH-2001. 2. Added interim results 3. Other minor updates	Rob de Heus
2004-02-18	07	Added more results, renumbered report into RNR-83-04/RdH/RdH-2003	Rob de Heus