



ZYWYN CORPORATION

Reliability Qualification Report

ZSP4491/ZSP4403 EL Silicon Gate Product Family

Date: May 6, 2005

Prepared By: Adrian Wong, QA/Reliability Engineering

Revision: 1.0

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Reliability Life Test Result

Life Test

Life Testing is performed to determine if device has any fundamental reliability related failure mechanisms, which can be divided into 4 main groups:

- Process or die related failures, such as oxide-related defects, metallization-related defects and diffusion-related defects.
- Assembly-related defects such as wire bonding or package-related failures.
- Design-related defects.
- Miscellaneous, undetermined or application-induced failures.

Life Test Result

Product Family:	Electroluminescent Lamp Driver
Device Type:	ZSP4491/ZSP4403
Mask Sets:	MS1033/MS134A
Process:	Zywyn Silicon Gate High Voltage BiCMOS Process
Wafer Manufacturer:	Episil Technologies, Inc.
Package Type:	10L MSOP/8L MSOP
Package Manufacturer:	Lingsen Precision Industries, Ltd./UNISEM
Die Attach Adhesive:	84-1LMISR4
Bond Wire:	NL5 1.0 mil
Test:	HTOL 500 hrs, 3.0V Dynamic Burn-In @125°C
Reference Standard:	Mil-Std-883
Pass/Fail Criteria:	Electrical QA testing to datasheet limits at 25°C before and after stress.

Summary:

Device Type	HTOL Test	Lot Number	Date Completed	Burn-In Temperature (°C)	Sample Size	No. of Fails
ZSP4403EU	500 hr @ 3.0V	B4114224	TBA	125	10	TBA
ZSP4491EU	500 hr @ 3.0V	B3603E48F	12/25/03	125	10	0

FIT Rate Calculation

The FIT (failures in time) is calculated as follows,

$$\text{FR (Chi-squared)} = \chi^2_{2n+2} / (2 \times \text{AF} \times \text{device-hours}) \times 10^9$$

where AF is the acceleration factor and n is the number of failures. The value is highly dependent on the following:

1. Life test conditions (duration, temperature, sample size and number of failures)
2. Activation energy of the potential failure modes

The weighted activation energy, E_a , of observed failure mechanisms of Zywyn products has been determined to be 0.8eV.

Based on the above criteria, the FIT rates at 25°C, 55°C, and 70°C operation at both 60% and 90% confidence levels for Zywyn's Metal Gate High Voltage BiCMOS process products have been calculated and are listed below.

Confidence Level	+25°C	+55°C	+75°C
60%	488.4	5909.5	24529.2
90%	194.4	2352.2	9763.8

1 FIT = 1 failure per billion device hours

ESD Test Results

14 units were submitted for Machine Model ESD test.

All 14 units passed the Machine Model ESD test at $\pm 200V$. A subsequent QA testing of the parts showed the devices met the functional test specifications.

Summary:

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZSP4491EU	$\pm 200V$ Machine Model	B3603E48F	02/10/04	14	0

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZSP4403EU	$\pm 200V$ Machine Model	B4114224	05/10/04	14	0

Temp Cycle Test Result

25 units were submitted for Temperature Cycling Test at UNISEM, Malaysia or Lingsen Precision Industries (LPI), Taiwan.

All 25 units passed the Preconditioning Level 3 and subsequent Temperature Cycling Test. A final QA testing of the 25 devices showed all test units met the Zywyn datasheet electrical specifications. The relevant report from LPI is attached for reference.

Summary:

Device Type	Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZSP4491EU	Preconditioning Level 3	See Appendix 4	See Appendix 4	25	0
ZSP4491EU	Temp Cycle -65 C/10 min. – +150 C/10 min. 24 Cycles	See Appendix 4	See Appendix 4	25	0

Device Type	Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZSP4403EU	Preconditioning Level 3	See Appendix 3	See Appendix 3	25	0
ZSP4403EU	Temp Cycle -65 C/10 min. – +150 C/10 min. 24 Cycles	See Appendix 3	See Appendix 3	25	0

Temp Humidity Bias Test Result

Test I

A total of 10 units of ZSP4422ACN and 10 units of ZSP4423CU were submitted for Temperature Humidity Bias Test (THB) at 85°C/85% R.H./3.0V for 240 hours. A final QA testing of the 20 devices showed all test units met the Zywyn datasheet electrical specifications.

Summary:

Device Type	THB Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZSP4491EU	85°C/85%/3.0V/240hr	See Appendix 4	See Appendix 4	5	0
ZSP4491EU	85°C/85%/3.0V/240hr	See Appendix 4	See Appendix 4	5	0
ZSP4403EU	85°C/85%/3.0V/240hr	See Appendix 3	See Appendix 3	5	0
ZSP4403EU	85°C/85%/3.0V/240hr	See Appendix 3	See Appendix 3	5	0

Test II

A total of 5 units of ZSP4422ACN and 5 units of ZSP4423CU were submitted for Temperature Humidity Bias Test (THB) at 85°C/85% R.H./3.0V for 1000 hours. A final QA testing of the 10 devices at 500-hour and 1000-hour read points showed all test units met the Zywyn datasheet electrical specifications.

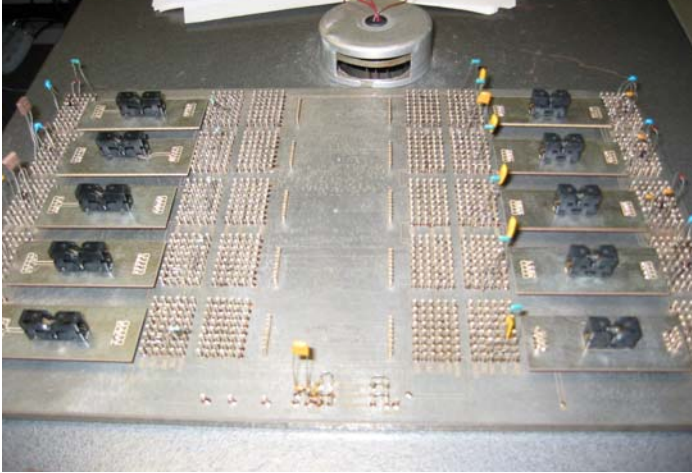
Summary:

Device Type	THB Test	Read Point	Lot Number	Date Completed	Sample Size	No. of Fails
ZSP4491EU	85°C/85%/3.0V	500 hr	See Appendix 4	See Appendix 4	5	0
ZSP4491EU	85°C/85%/3.0V	1000 hr	See Appendix 4	See Appendix 4	5	0

ZSP4403EU	85°C/85%/3.0V	500 hr	See Appendix 3	See Appendix 3	5	0
ZSP4403EU	85°C/85%/3.0V	1000 hr	See Appendix 3	See Appendix 3	5	0

Appendix 1

Burn-in and Burn –in Equipment:



Burn-in Board used for Dynamic Life Test



Burn-in oven used for Dynamic Life and Humidity Test

Appendix 2

ESD Tester Equipment:



Front View of the iMCS model#700



**Front view of the iMCS model # 700
ESD tester with lid open**



Back view of the ESD tester with Machine model/Pulse being used.

Reliability Test Report

可靠度試驗報告

Date: 06/12/2004

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I. Reliability Test Item

試驗名稱

Preconditioning Level 3

II. Sample Information

產品資料

Customer	<u>XXX</u>	Month	<u>05/2004</u>
Package Type	<u>10L MSOP</u>	Leadframe	<u>68X94</u>
Run No.	<u>Q44024</u>	Mold Compound	<u>EME-7351LS</u>
Device Type	<u>ENG(XX089A02A)</u>	Au Wire	<u>1.2mil</u>
Lot No.	<u>A66963.5</u>	Epoxy	<u>84-1LMISR4</u>
Request No.	<u>93170</u>	Die coating	<u>N/A</u>
Lead Plating	<u>Pb-free</u>	Received Date	<u>05/04/2004</u>
Die size	<u>N/A</u>	Remark	<u>N/A</u>

III. Test Conditions

試驗條件

Sample Plan	<u>N=390, AC=0, RE=1</u>
Precondition Level	<u>Level 3</u>
Test Condition	<u>TC 5cycles→Bake 125°C/24hrs→Soak30°C/60% R.H./192hrs→ IR Reflow 245+5/-0°C 3cycles</u>
Test Timing	<input type="checkbox"/> PPCM <u>once/quarter</u> <input type="checkbox"/> New Package <input checked="" type="checkbox"/> Customer Requirement <input type="checkbox"/> Material / process change <input type="checkbox"/> Others

IV. Test Result

試驗結果 Accept 合格 Reject 不合格

Criteria	Description	Failure/total	Result
Visual Inspection	Package crack or flatness out of spec.	0/390	AC
Electrical Test	The devices must pass electrical test or open/short test Program Name: O/S Q44024.SRC	0/390	AC
C-SAM inspection	Reject if delamination on the die surface or delamination of die paddle is more than 10% if down-bonded.	0/10	AC
Others			

V. Remark 備註: 1.The test results only apply to the device under test, and no part of this report may be abstracted or reproduced.

本報告僅對送測樣品負責，且分離使用無效。

Approved By: David Yen Checked By: S.F.Jean Prepared By:
Y.J.Chang

Date: 6/12/2004 Date: 6/12/2004 Date: 06/12/2004

Reliability Test Report

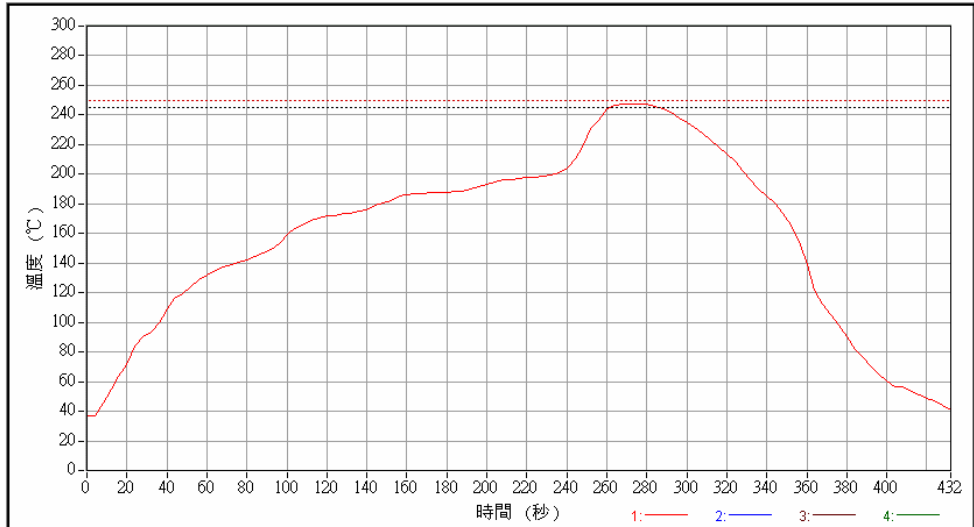
可靠度試驗報告

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Attachment 附件

加熱爐測溫器報告

公司名稱： 菱生精密工業股份有限公司		取樣速率 (分:秒)： 00:04.0	
產品名稱： Fe tray - IC		量測日期 (日/月/年)： 19/05/2004	
列印日期 (日/月/年)： 19/05/2004		量測時間 (時:分:秒)： 17:08:21	
資料檔名稱： Furnace			
速度設定值： 30.0 cm/Min			



各熱區溫度設定值(°C)

熱區	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
設定值 (上)	180	180	190	200	260	0	0	0	0	0	0	0	0	0	0	0
設定值 (下)	180	180	190	200	260	0	0	0	0	0	0	0	0	0	0	0

最高溫度及時間分析

測溫點名稱	最高溫度(°C)	位於(秒)	高於 250°C 時間(秒)	高於 245°C 時間(秒)
1:	247.7	276.0	0.0	24.0
2:	1523.8	0.0	436.0	436.0
3:	1523.8	0.0	436.0	436.0
4:	0.0	0.0	0.0	0.0

測溫點位置

	X mm	Ymm
1:	0.0	0.0
2:	0.0	0.0
3:	0.0	0.0
4:	-----	-----

PCB 移動方向 →

備註

comments here!

台技工業設備股份有限公司製造

Reliability Test Report

可靠度試驗報告

Date: 06/11/2004
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Attachment 附件---C-SAM photo before and after Precondition Level 3

Package: MSOP010 Run No.: Q44024 EMC:EME-7351LS

Fig.1 Before Precondition

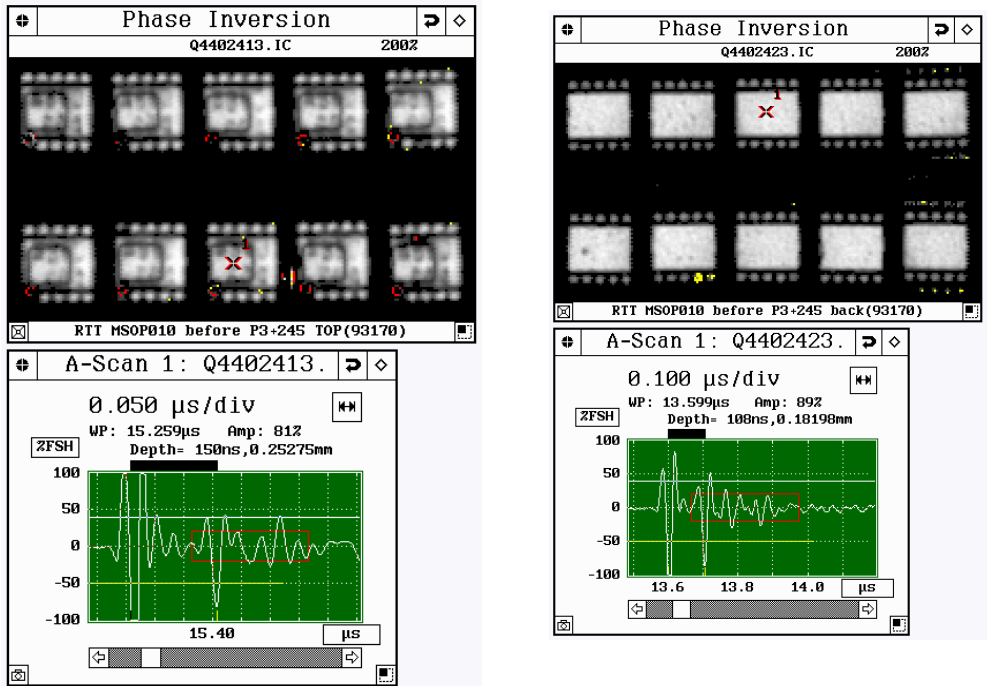
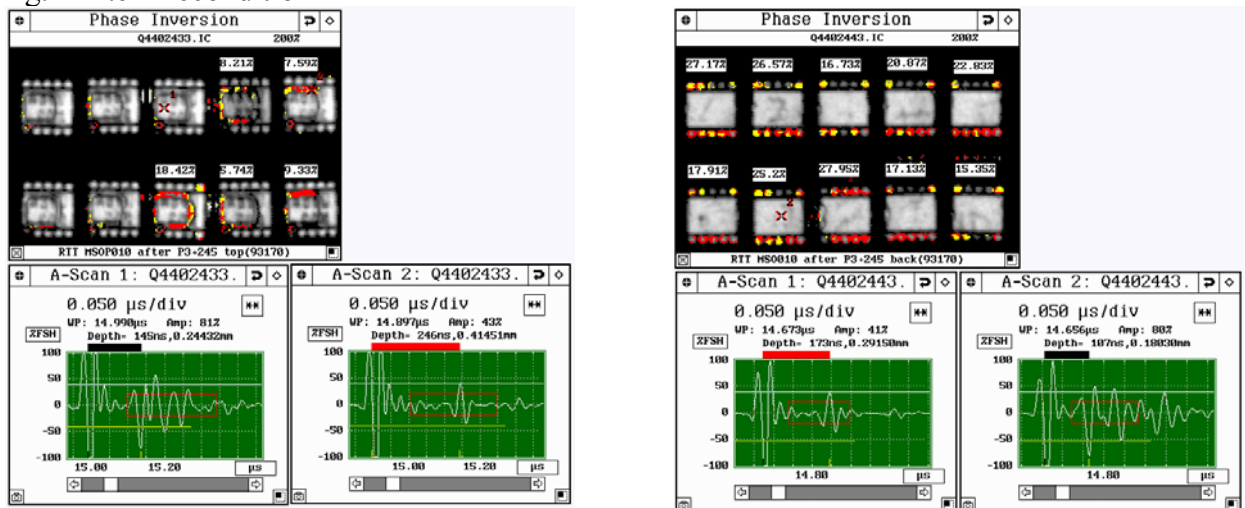


Fig.2 After Precondition



Appendix 4

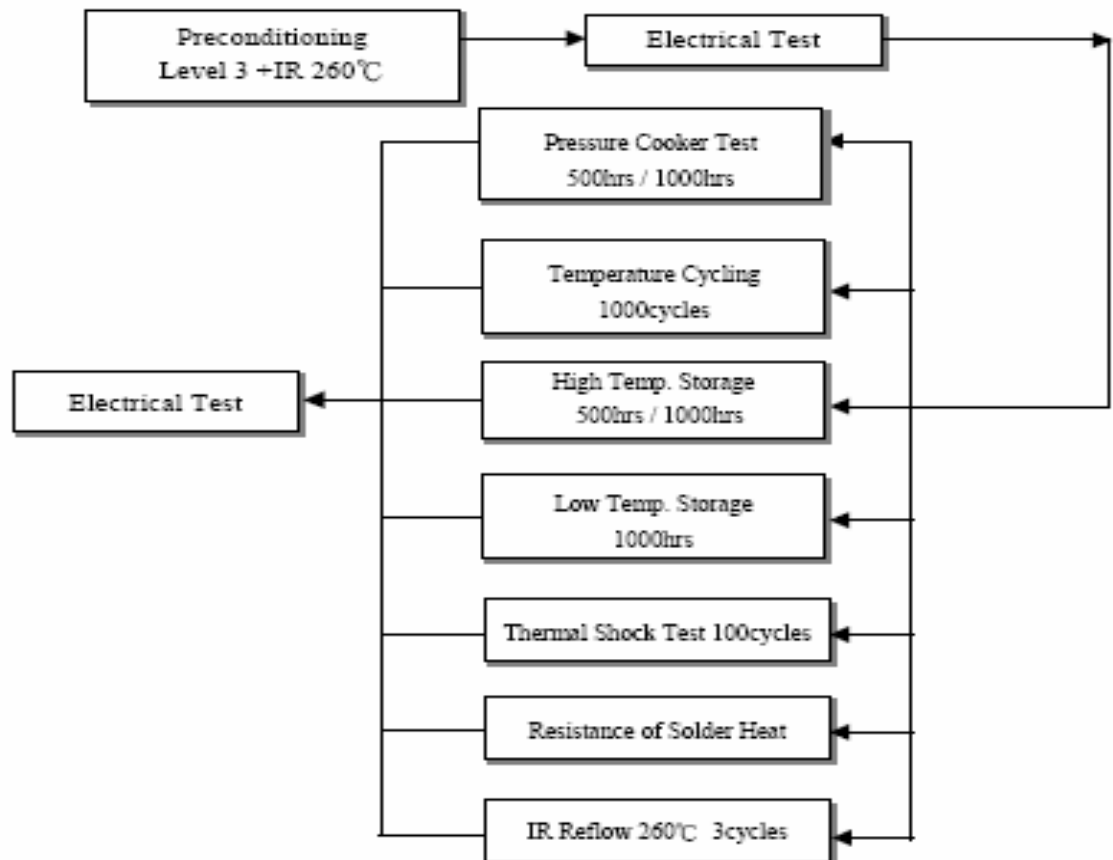


2.0 Reliability Program

2.1 Sample Information

Package Type :	SOP150mil 8L	LeadFrame :	80X80,C194AG
Device Type :	XXXXX	Silver Epoxy :	8340
Lot No. :	22407350	Gold wire :	NL-5 1.2mil
Run No. :	P2C062	Molding Compound :	EME-6600CS-P
Plating :	Sn/Bi 98/2	Total Q'ty :	270EA
Received Date :	2002-12-21	Rel Doc. No. :	91287
Completed Date :	2003-4-10	Coating :	N/A

2.2 Test Flow



3.0 Environment Stress / Mechanical Test

3.1 Preconditioning

This test is performed for SMDs to simulate the stresses from packing through mounting. It included several test steps, as the following :

- ◆Step 1 : Bake 125°C, 24hrs
- ◆Step 2 : Moisture Soak (Level 3 30°C,60%r.h, 192hrs)
- ◆Step 3 : IR Reflow $T_{max}=260^{\circ}\text{C}+5/-0^{\circ}\text{C}$, 3cycles

3.2 Pressure Cooker Test

Evaluating the moisture resistance of non-hermetic packaged IC. It employs severe conditions of pressure, humidity, and temperature that accelerate the penetration of moisture. The test conditions as the followings :

- ◆Temperature : 121°C
- ◆Relative humidity : 100%
- ◆Pressure : 2 atm
- ◆Test Time : 168hrs / 500hrs

3.3 Temperature Cycling

To determine the resistance of a package to extremes of high and low temperature, and to the effect of alternate exposures to these extremes.

- ◆High Temperature : 150°C
- ◆Low Temperature : -85°C
- ◆Test Cycle : 1000cycles

3.4 High Temperature Storage

To determine the effect on solid-state electronic devices of storage at high temperature without electrical stress applied.

- ◆Temperature : 150°C
- ◆Test Time : 500hrs/1000hrs

3.5 Low Temperature Storage

- ◆Temperature : -85°C
- ◆Test Time : 1000hrs

3.6 Thermal Shock Test

- ◆Temperature : -85°C/5min~+150°C/5min
- ◆Test Cycle : 100cycles

Test 3.6 and 3.7 were performed by IST that have IECQ certification.

4.0 Reliability Test Data

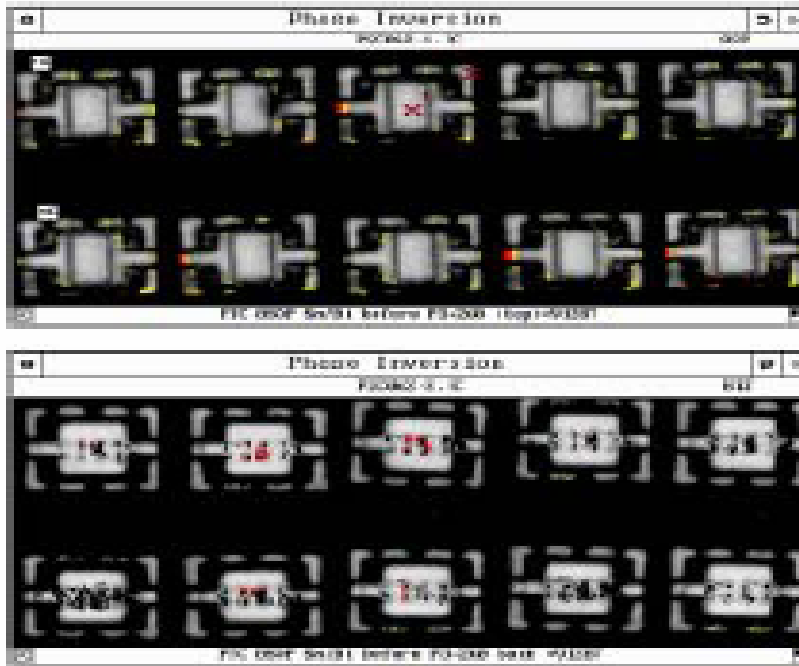
Test Item	Conditions	Sample Size	Test Result (Fail/Pass)		AC/RE
1.Preconditioning Level 3	Bake 24hrs, 30°C /80%R.H., 192hrs , IR Reflow 260°C 3cycles	N=270 AC=0	0/270		ACC
2.Pressure Cooker Test (After Preconditioning)	121°C ,100% R.H., 2 atm,	N=45 AC=0	168H	500H	ACC
			0/45	0/45	
3.Temperature Cycling (After Preconditioning)	-85°C to +150°C 1000cycles	N=45 AC=0	0/45		ACC
4.High Temp. Storage (After Preconditioning)	150°C	N=45 AC=0	500H	1000H	ACC
			0/45	0/45	
5.Low Temp. Storage (After Preconditioning)	-85°C , 1000hrs	N=45 AC=0	0/45		ACC
6.Thermal Shock Test (After Preconditioning)	-85°C to +150°C 100cycles	N=45 AC=0	0/45		ACC
7.Solder heat Test (After Preconditioning)	260°C ,10sec	N=22 AC=0	0/22		ACC
8.IR Reflow Test (After Preconditioning)	Tmax=240°C , 1 cycle	N=22 AC=0	0/22		ACC

5.0 Summary

The SOP150mil 8L package with Sn/Bi plating, RUN#P2C062 using EME-6600CS-P molding compound that assembly by Lingsen were passed preconditioning level 3 with 260°C peak temperature of IR Reflow and the other reliability tests according to XXX request.

7.0 Attachments

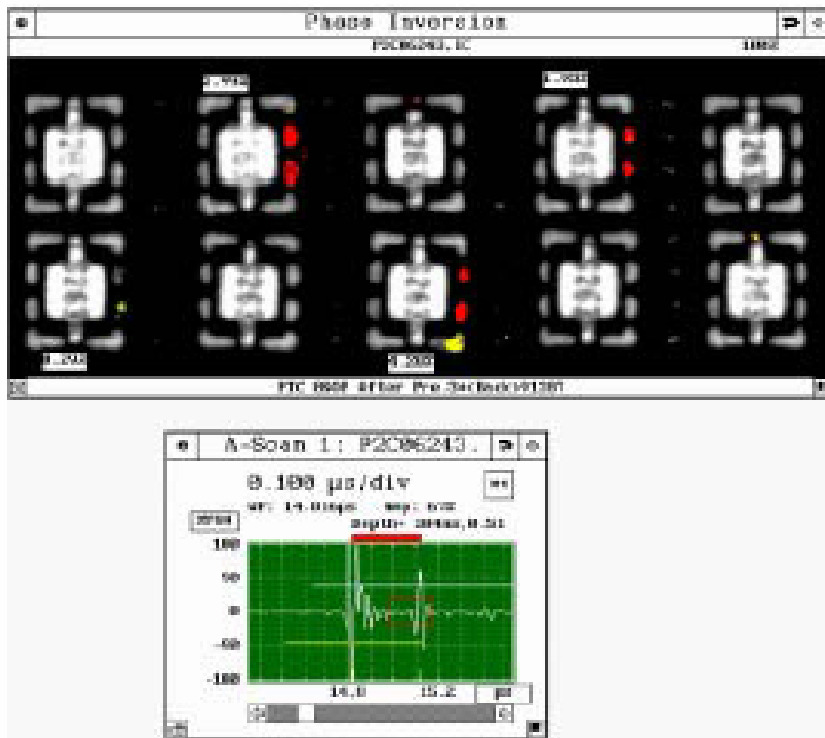
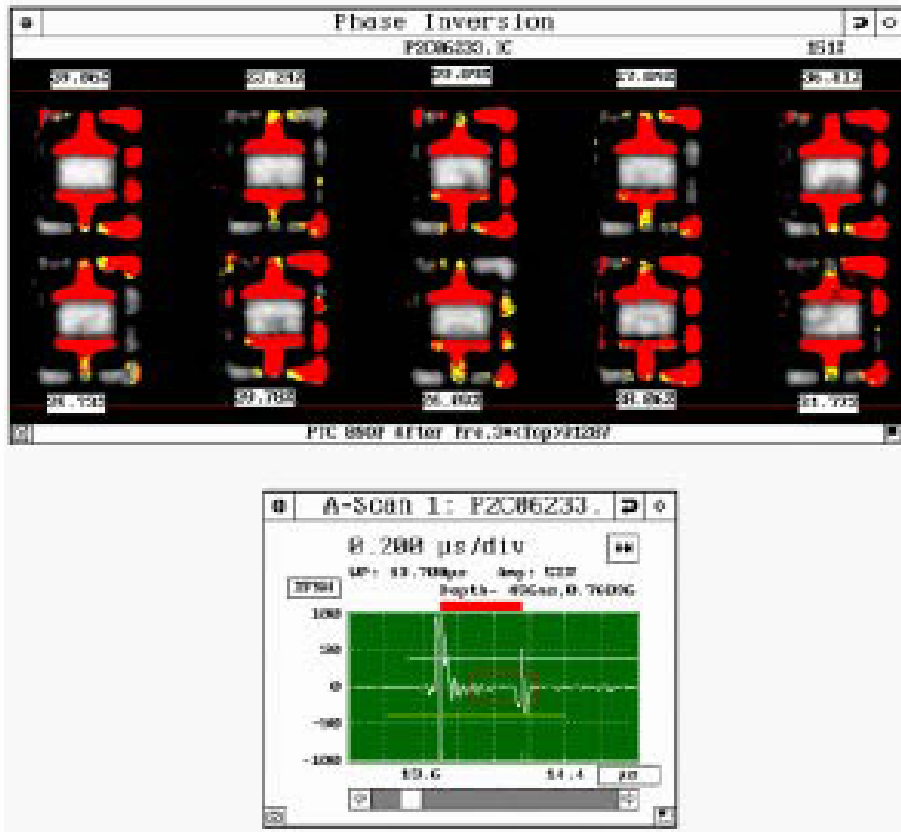
7.1 SAT photo before and after Precondition (for reference)



3SEN QA RELIABILITY LAB
Van 2nd Road, T.E.P.Z. Taichung, Taiwan 427 R.O.C.
(04)25335120 FAX : (04)25327904

Date :
Page

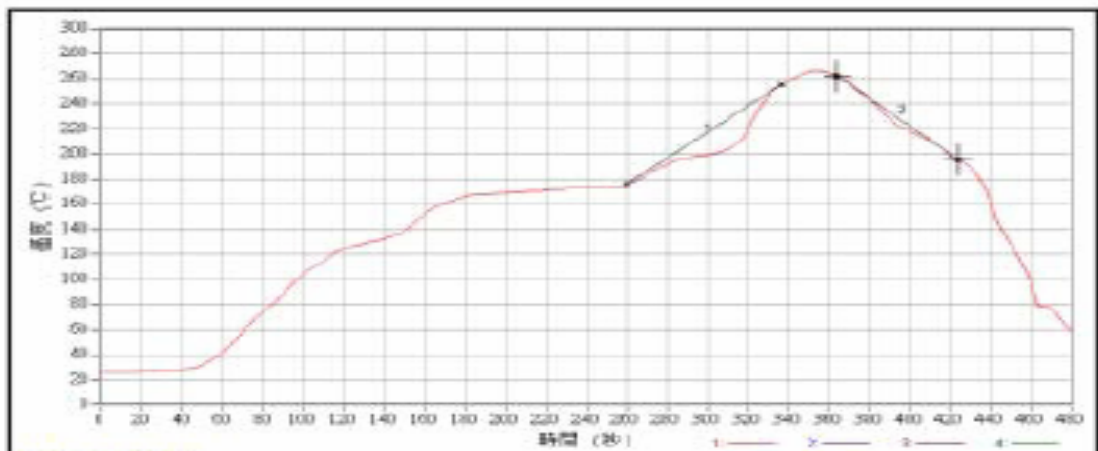
7.1 SAT photo before and after Precondition (for reference)



7.2 IR Reflow Profile for IR Reflow Test

加熱爐溫度報告

公司名稱:	凌生精密工業股份有限公司	取樣速率(分:秒):	00:04.0
產品名稱:	Fe tray - IC	量測日期(日/月/年):	16/12/2002
列印日期(日/月/年):	16/12/2002	量測時間(時:分:秒):	13:52:02
資料檔名稱:	Furnace		
速度設定值:	30.0 cm/Min		



各階段溫度設定表(°C)

階段	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	85
設定值(上)	150	170	170	205	275	0	0	0	0	0	0	0	0	0	0	0
設定值(下)	150	170	170	205	275	0	0	0	0	0	0	0	0	0	0	0

最高溫度及時間列表

階段名稱	最高溫度(°C)	位於	高於 31°C 時間(秒)	高於 31°C 時間(秒)
1:soak	265.0	352.3	04.0	04.0
2:	1523.8	0.3	484.0	484.0
3:	1523.8	0.3	484.0	484.0
6:	0.0	0.3	0.0	0.0

溫度感位置

X mm, Y mm	IC 移動方向
1: 50.0, 50.0	→
2: 0.0, 0.0	
3: 0.0, 0.0	
4: -----, -----	

備註

This profile is applied to Lead free products.

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LINGSEN QA RELIABILITY LAB

 5-1 Nan 2nd Road, T.E.P.Z. Taichung, Taiwan 427 R.O.C.

EL : (04)25335120 FAX : (04)25327904

E-mail : sjjean@lingsen.com.tw

Date : 14-Apr-200

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