



ZYWYN CORPORATION

Reliability Qualification Report

ZD3313/ZD3315
High Voltage Inductorless
Regulated 4-Channel LED Driver

Date: February 9, 2010
Revision: 1.2

ZD3313/ZD3315 High Voltage Inductorless Regulated 4-Channel LED Driver Reliability
Report

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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:	High Voltage Inductorless Regulated 4-Channel LED Driver
Device Type:	ZD3313/ZD3315
Mask Sets:	MS186C/MS186F
Processes:	Episil 0.5 μ m 2 Poly-2Metal 40V BCD Process
Wafer Manufacturer:	Episil Technologies, Inc.
Package Type:	2x3 8-Pin DFN, 8-Pin MSOP
Package Manufacturer:	UNISEM (M) BERHAD in Malaysia, GREATEK ELECTRONICS IN Taiwan
Die Attach Adhesive:	CRM-1033BF
Bond Wire:	Gold wire 1.2 mil
Test:	Refer to Reliability Test Results in UNISEM (M) BERHAD and GREATEK ELECTRONICS Reliability report
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
ZD3315	500 hr	788605.1	01/29/2008	100	20	0
ZD3315	1000 hr	788605.1	02/19/2008	100	20	0

Device Type	HTOL Test	Lot Number	Date Completed	Burn-In Temperature (°C)	Sample Size	No. of Fails
ZD3313	500 hr	788605.2	01/29/2008	100	20	0
ZD3313	1000 hr	788605.2	02/19/2008	100	20	0

FIT Rate Calculation

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

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

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, Ea, 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 75°C operation at both 60% and 90% confidence levels for the ZD850 using Episil 0.5µm 2 Poly-2Metal 40V BCD Process have been calculated and are listed below.

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD3315	60%	177.53	3042.08	15404.25
ZD3315	90%	446.12	7644.57	38709.97

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD3313	60%	177.53	3042.08	15404.25
ZD3313	90%	446.12	7644.57	38709.97

1 FIT = 1 failure per billion device hours

Mean Time Between Failures (Lifetime) for ZD3315/ZD3313

FIT			MTBF (Hours)		
+25°C	+55°C	+75°C	+25°C	+55°C	+75°C
177.53	3042.08	15404.25	5,632,851	328,722	64,917

ESD Test Results

ZD3313/3315 devices were submitted for Human Body Model ESD test.

Summary:

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD3313	±2000V HBM	788605.2	4/25/2008	6	0

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD3315	±2000V HBM	788605.1	4/25/2008	6	0

Temp Cycle Test Result

Zywyn's High Voltage Inductorless Regulated 4-Channel LED Display driver products are packaged in a 2x3 8-Pin DFN and 8-Pin MSOP Green Package. Packaged Qualification Reliability Report which consists of, among others, Temp Cycle Test from vendors, is attached for reference. The report shows the devices pass the test with no failure.

Appendix I

2X3 8-PIN DFN Reliability Report



UNISEM (M) BERHAD
RELIABILITY & QUALITY ASSURANCE
Co. No.: 183314-V

RELIABILITY REPORT

BACKGROUND DESCRIPTION:

Reliability Qualification of
8TSLP (2*3)(Sn) Package at MSL 1@ 260°C Reflow

LOT INFORMATION:

Customer	:		Date Code	:	
Package	:	8TSLP (2*3)(Sn)	Pad Size	:	1.90*1.70 MM
Device	:		Die Size	:	
Lot #	:		Die Structure	:	
Serial #	:		Wire Size	:	1.0 Mils
Epoxy	:	Type - 8290	Part# -	:	421915
	:	Lot # -	Lot # -	:	
Mold Comp.	:	Type - G770HCD	Lead Frame	:	Type - Full Spot
	:	Lot # -	Treatment -	:	No LI
Requestor	:		Date Received	:	
Department	:		Quantity	:	
Prepared by	:			:	
CC	:			:	

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Background:

Reliability Qualification of 8TSLP (2*3)(Sn) Package at MSL1@ 260°C Reflow

Results Summary:

This qualification lot reliability assessment results could be summarized as below:

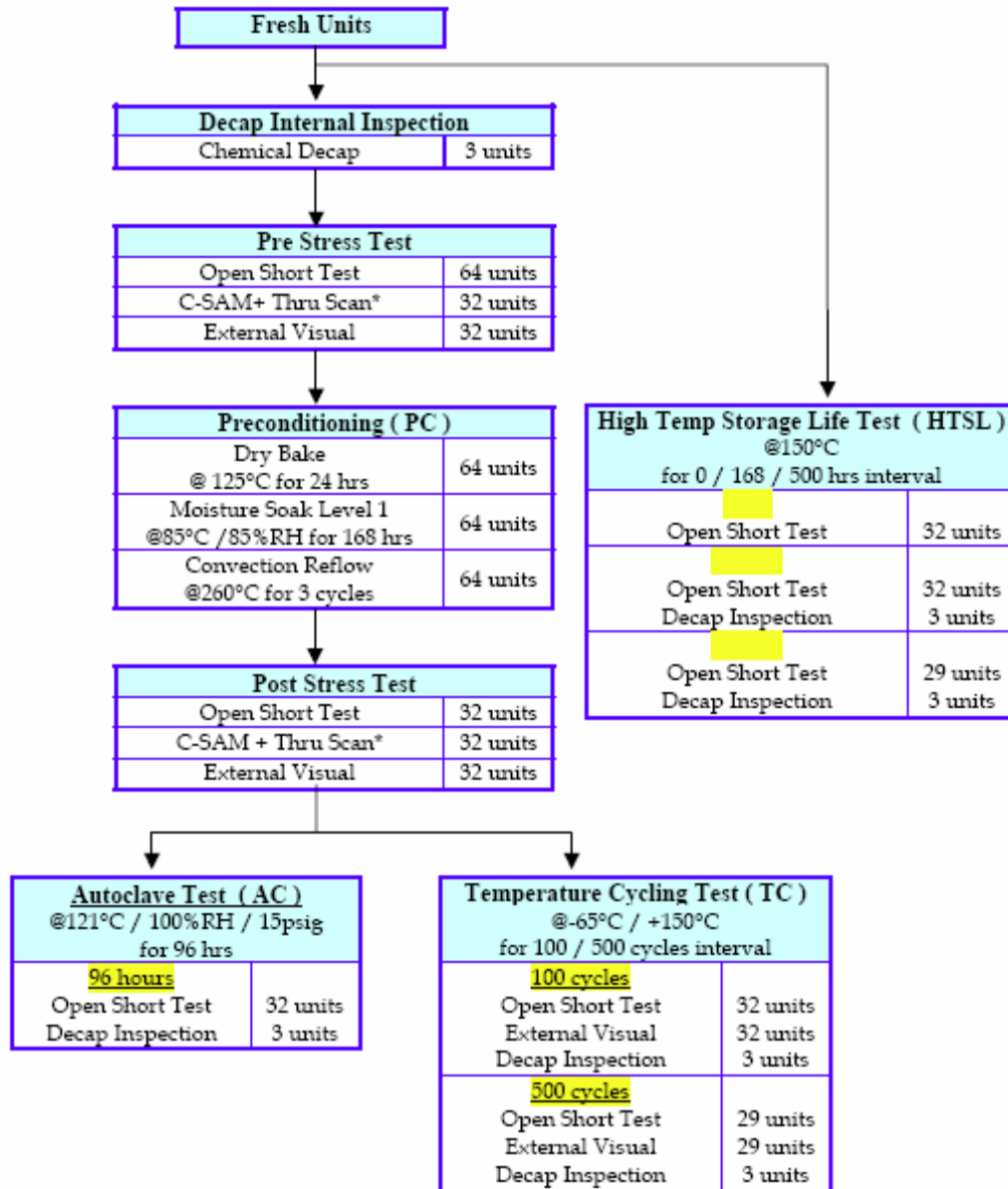
No.	Test Flow	Results		
		Before	After	
1.	Preconditioning Test;			
	(i) Decap Internal Inspection	0/3	N/A	
	(ii) O/S Test	0/64	0/64	
	(iii) External Visual	0/32	0/32	
	(iv) C-SAM - Die surface	0/32	0/32	
	(v) Internal Crack	0/32	0/32	
2.	Autoclave Test After Preconditioning;	96 hrs		
	(i) O/S Test	0/32		
	(ii) Decap Inspection	0/3		
3.	Temperature Cycling Test After Preconditioning;	100cycs	500cycs	
	(i) External Visual	0/32	0/29	
	(ii) O/S Test	0/32	0/29	
	(iii) Decap Inspection	0/3	0/3	
4.	High Temperature Storage Life Test;	0hrs	168hrs	500hrs
	(i) O/S Test	0/32	0/32	0/29
	(ii) Decap Inspection	N/A	0/3	0/3

Conclusion:

The results confirmed this package to be classified as Moisture Sensitive Level 1 at 260°C Convection Reflow as referred to IPC/JEDEC J-STD-020C. The basis for this is no open short test failure, no die delam and no internal crack after preconditioning test, supported by subsequent reliability assessment with no open short test failure.



Reliability Test Flow:





Reliability Test Conditions:

Qualification Test Conditions				
Test	Condition	Reference	S/S	
PC	Dry Bake	Temp. = 125°C for 24 hours	JEDEC J-STD-020C, Level 1	64
	Moisture Soak	Temp. = 85°C; RH = 85% for 192 hours		
	Convection Reflow	Tmax = 260°C for 3 x Cycles		
AC	Temp. = 121°C; RH = 100%; Pressure = 15psig	JESD22-A102-C, Condition C	32	
TC	Thot = 150°C; Tcold = -65°C	JESD22-A104-C, Condition C	32	
HTSL	Thot = 150°C	JESD22-A103-C, Condition B	32	

Reliability Test Results:

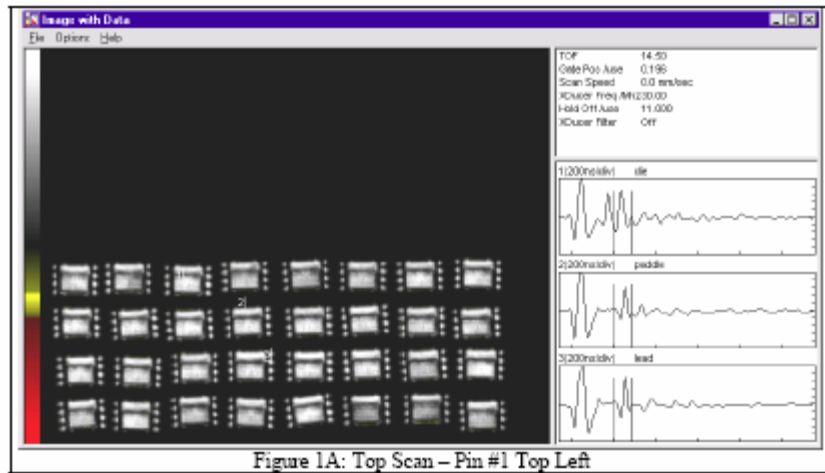
Qualification Test Results								
Test Performed	Test Point	1 st	2 nd	3 rd	4 th			
Decap Internal Inspection	Fresh unit	0/3						
PC	Open Short	0/64	0/64					
	External Visual	Pre / Post	0/32	0/32				
			Die	0/32	0/32			
			Paddle	0/32	9/32			
			Lead	0/32	0/32			
	Internal Crack	0/32	0/32					
AC	Open Short	0/32						
	Decap	0/3						
TC	External Visual	0/32	0/29					
	Open Short	0/32	0/29					
	Decap	0/3	0/3					
HTSL	Open Short	0/32	0/32	0/29				
	Decap	N/A	0/3	0/3				

SAT Reject Criteria for SLP	BEFORE STRESS	AFTER STRESS
Die	Any delam	
Paddle	> 10%	Any delam change > 10% from the initial
Lead	100% delam at any lead	
Die Attach	>10%	

C-SAM inspection was not applicable for
** Die area if there were top coat*
** Die area if there is die overhang or die to paddle ratio ~1.*

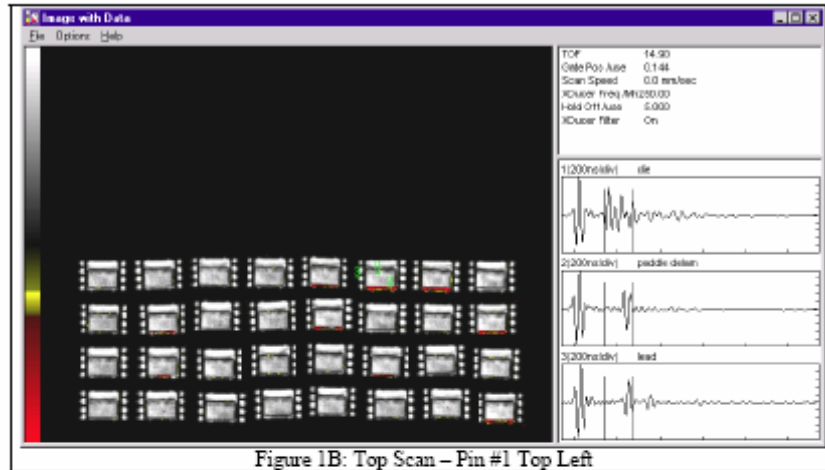


Attachment A – C-SAM Image Before Preconditioning Stress



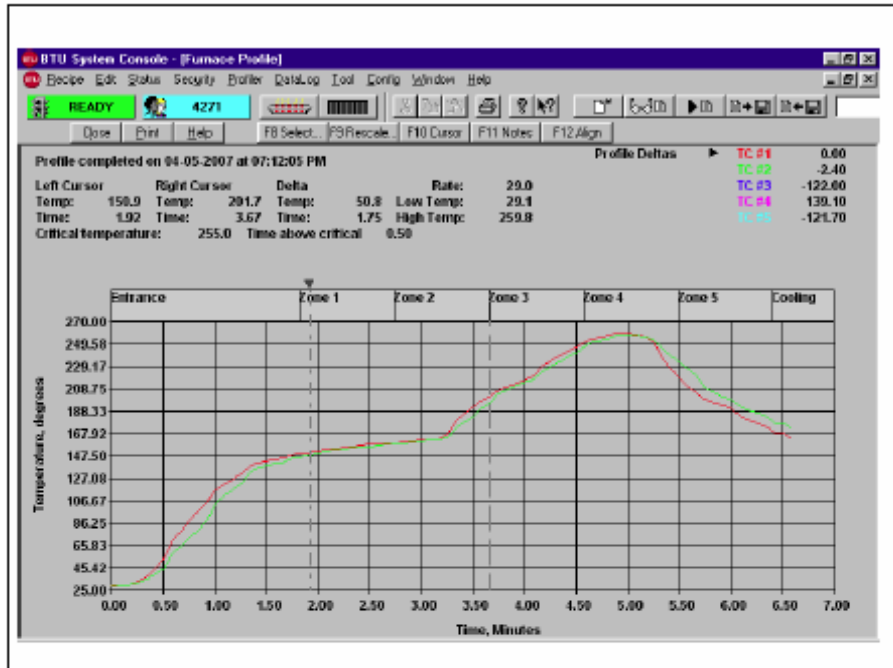


Attachment B – C-SAM Image After Preconditioning Stress





Attachment C – Convection Reflow Profile for STSLP (2*3)(Sn) Package @ 260°C



Appendix II

8-PIN MSOP Reliability Report



UNISEM (M) BERHAD
RELIABILITY & QUALITY ASSURANCE
Co. No.: 183314-V

QUALIFICATION LOT LABORATORY REPORT

BACKGROUND DESCRIPTION:

Reliability Qualification of
8MSOP (SN) Package at MSL1 @ 260°C Reflow

LOT INFORMATION:

Customer	:		Requestor	:	
Package	:	8MSOP (SN)	Department	:	
Device	:		Date Received	:	21-Oct-04
Lot #	:		Quantity	:	120 units
Serial #	:		Prepared by	:	
Die Attach	:	8290	CC	:	
Mold Comp.	:	G600			
Date Code	:	0441			
Pad Size	:	68*94 mils			
Die Size	:	48*27 mils			

REVIEW BY:

Arine
R&QA Engineer

30-Dec-04
Date

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Background:

Reliability Qualification of 8MSOP (SN) Package at MSL1 @ 260°C Reflow

Results Summary:

This qualification lot reliability assessment results could be summarized as below:

No.	Test Flow	Results	Page
1.	Preconditioning	0/64	4
2.	C-SAM	0/32	5, 10, 11
3.	Autoclave Test	0/32	6
4.	Temperature Cycling Test	0/32	7
5.	High Temperature Storage Life Test	0/32	8
6.	Whisker Growth Test		9
	a) THS Test	0/3	
	b) TMCL Test	0/3	

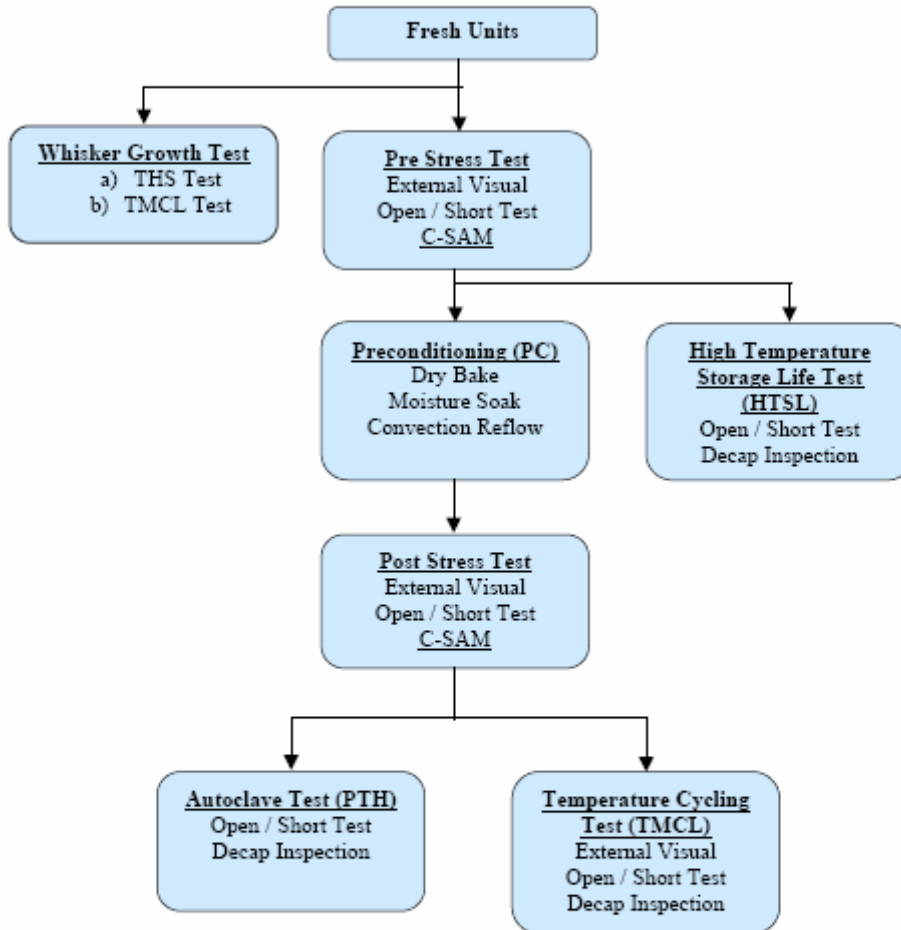
Conclusion:

The results confirmed this package to be classified as Moisture Sensitive Level 1 at 260°C Convection Reflow per Jedec-J-Std-020C.

The basis for this is no open short failure, no die delam and no internal crack after preconditioning test, supported by subsequent reliability assessment with no open short failure.



Reliability Test Flow:





Reliability Test Results:

1 Preconditioning (PC)

Reference : JEDEC J-STD-020C, Level 1
Conditions : Dry Bake ~ Temp. = 125°C for 24 hours
Moisture Soak ~ Temp. = 85°C; RH = 85% for 168 hours
Convection Reflow ~ Tmax = 260°C x 3 Cycles

.....
External Visual Readouts : Pre and Post Stress Test
Sample Size : 32 units
Accept No. : 0 reject

Results (units)
Pre PC : 0/32
Post PC : 0/32

.....
Open/Short Test : Pre and Post Stress Test
Sample Size : 64 units
Accept No. : 0 reject

Results (units)
Pre PC : 0/64
Post PC : 0/64



Reliability Test Results:

2 Scanning Acoustic Microscope (C-SAM)

- Reference : JEDEC J-STD-020C
 In-house C-SAM Criteria :
 Die → Any delam on die surface
 Top paddle → >50% on top die paddle
 Bottom paddle → >50% on bottom die paddle (except TSSOP >10%)
 Lead → >50% on 2 or more leads at top or bottom leads
 * For SLP package, rejects for any delamination.
 * Top scan always refer to the die side.

C-SAM inspection was not applicable for :
 * Die area if there were top coat.
 * Die paddle area if there is die overhang or the die to die paddle size ratio~1.

.....
 C-SAM Readouts : Pre and Post Stress Test
 Sample Size : 32 units
 Accept No. : Die Delam & Internal Crack -- 0 reject

Results

Scan Location		Pre PC (units)	Post PC (units)
Top	Die	0/32	0/32
	Paddle	0/32	0/32
	Lead	0/32	0/32
Bottom	Paddle	0/32	0/32
	Lead	0/32	0/32
Internal Crack		0/32	0/32
Image Reference		Attachment A	Attachment B



Reliability Test Results:

3 Autoclave Test After Preconditioning (PTH)

Reference : JESD22-A102-C, Condition C
Conditions : Temp. = 121°C; RH = 100%; Pressure = 15psi

.....
Open/Short Test : 96 hours
Sample Size : 32 units
Accept No. : 0 reject

Results (units)
96 hours PTH : 0/32

.....
Decap Inspection Readouts : 96 hours
Sample Size : 3 units
Accept No. : 0 reject

Results (units)
96 hours PTH : 0/3



Reliability Test Results:

4 Temperature Cycling Test After Preconditioning (TMCL)

Reference : JESD22-A104-B, Condition C
Conditions : Thot = 150°C; Tcold = -65°C

.....
External Visual Readouts : 100 & 500 cycles
Sample Size : 32 units
Accept No. : 0 reject

Results (units)
100 cycles TMCL : 0/32
500 cycles TMCL : 0/29

.....
Open/Short Test : 100 & 500 cycles
Sample Size : 32 units
Accept No. : 0 reject

Results (units)
100 cycles TMCL : 0/32
500 cycles TMCL : 0/29

.....
Decap Inspection Readouts : 100 & 500 cycles
Sample Size : 3 units
Accept No. : 0 reject

Results (units)
100 cycles TMCL : 0/3
500 cycles TMCL : 0/3



Reliability Test Results:

5 High Temperature Storage Life Test (HTSL)

Reference : JESD22-A103-B, Condition B
Conditions : $T_{hot} = 150^{\circ}\text{C}$

.....
Open/Short Test : 0 & 168 & 500 hours
Sample Size : 32 units
Accept No. : 0 reject

Results (units)
0 hours HTSL : 0/32
168 hours HTSL : 0/32
500 hours HTSL : 0/29

.....
Decap Inspection Readouts : 168 & 500 hours
Sample Size : 3 units
Accept No. : 0 reject

Results (units)
168 hours HTSL : 0/3
500 hours HTSL : 0/3



6 Whisker Growth Test

Reference : NEMI Tin Whisker Test Method Standards, Sept 2003
THS Condition : Temp. = 85°C; RH = 85%
TMCL Condition : Thot = 150°C; Tcold = -65°C

.....
6(a) THS
SEM Inspection Readouts : 168 & 500 hours
Sample Size : 3 units
Accept No. : 0 reject

Results (units)
168 hours THS : 0/3
500 hours THS : 0/3

.....
6(b) TMCL
SEM Inspection Readouts : 100 & 500 cycles
Sample Size : 3 units
Accept No. : 0 reject

Results (units)
100 cycles TMCL : 0/3
500 cycles TMCL : 0/3



Attachment A – C-SAM Image Before Preconditioning Stress

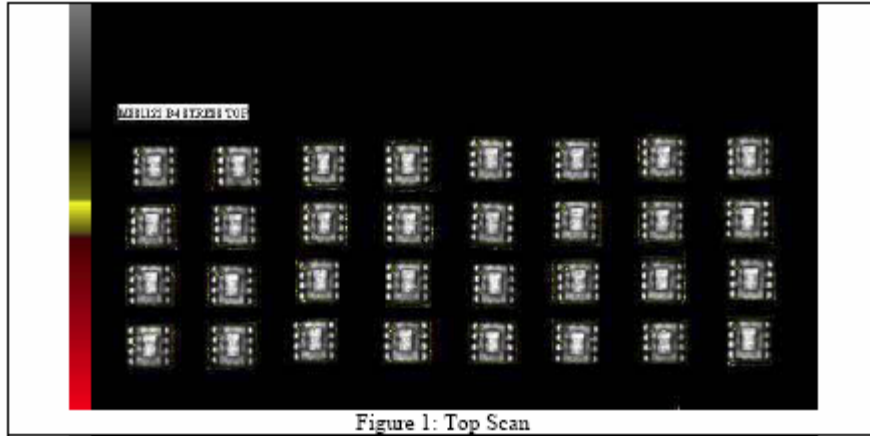


Figure 1: Top Scan

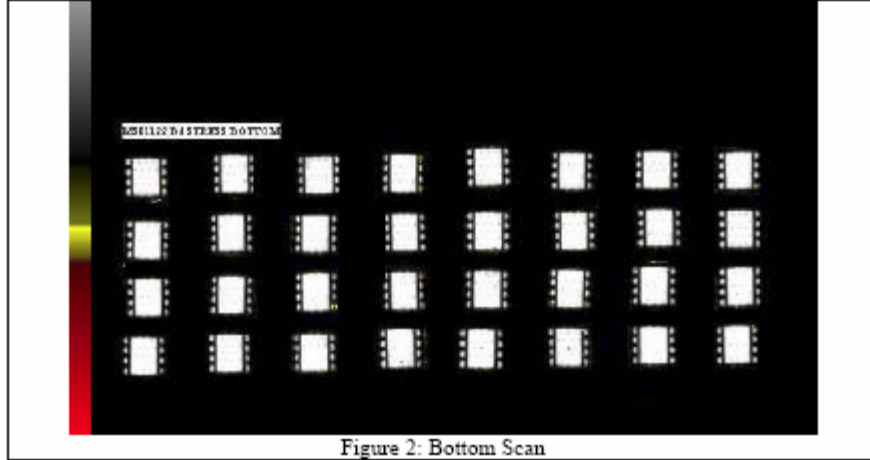


Figure 2: Bottom Scan



Attachment B – C-SAM Image After Preconditioning Stress

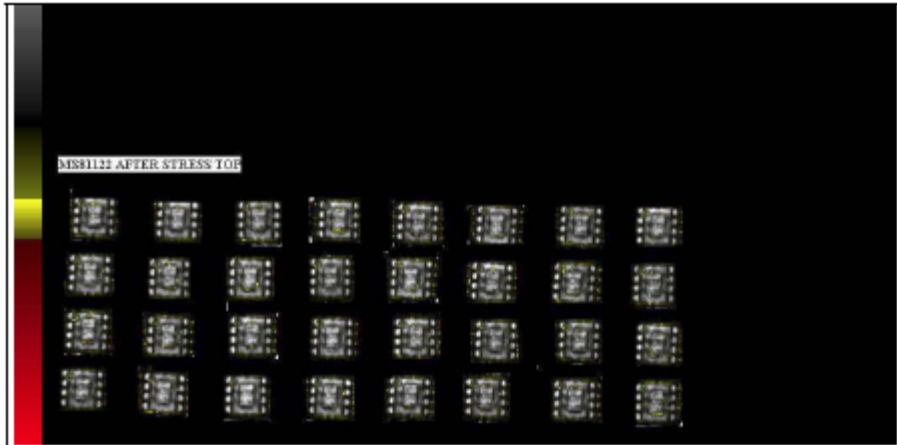


Figure 1: Top Scan

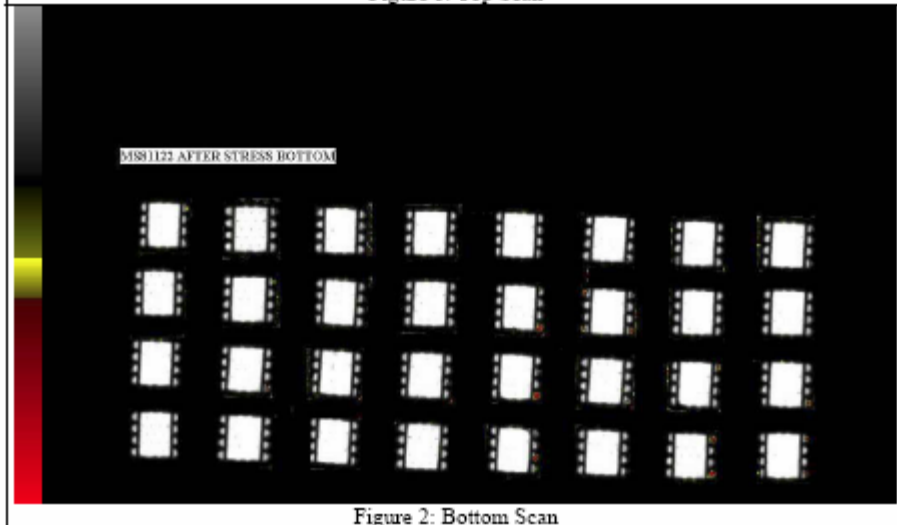
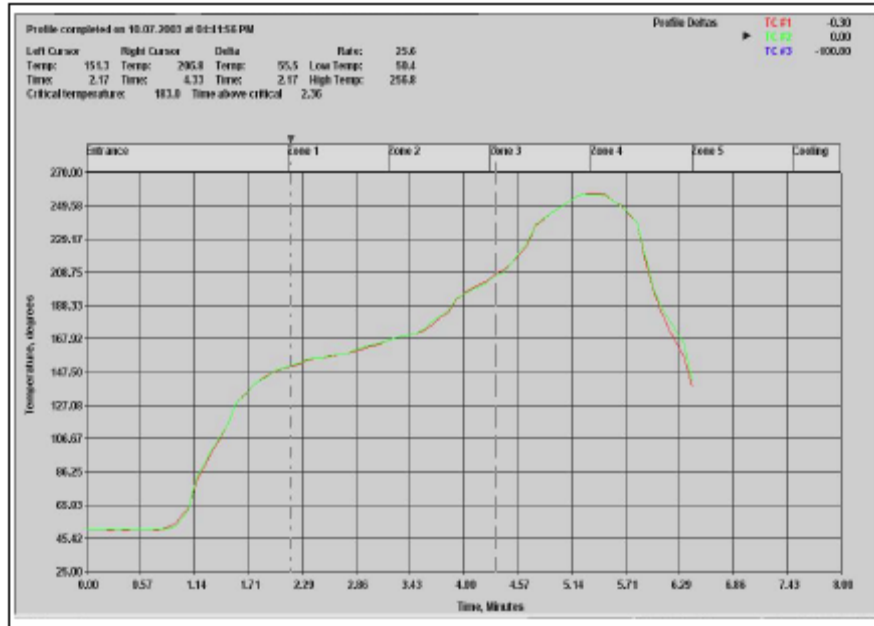


Figure 2: Bottom Scan



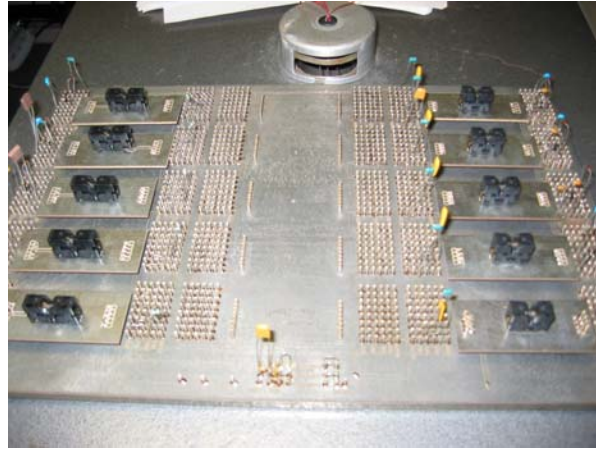
Attachment C – Convection Reflow Profile for 8MSOP (SN) Package at 260°C



Appendix III

Testing Equipment

Burn-in board and burn-in quipment



Burn-in Board used for testing



Burn-in oven used for testing

ESD Testing Equipment



Front view of the iMCS model #700



Front view of the iMCS model #700 with lid open

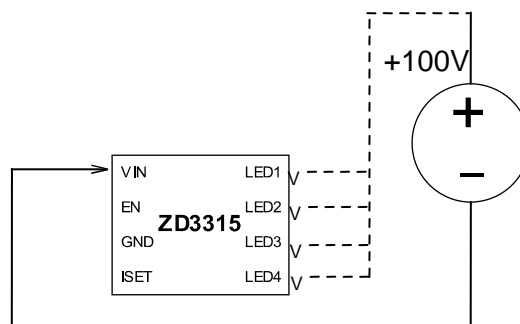


Back view of the ESD Tester with the Machine Model/Pulse Model being used

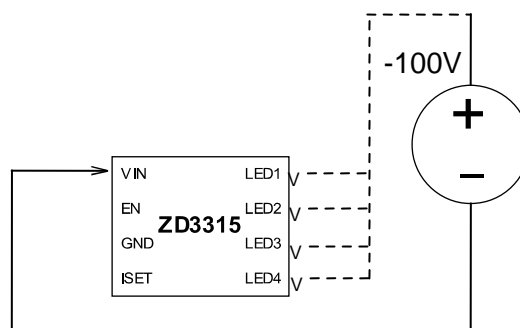
Appendix IV

ESD Test Sequence for 2x3 8-Pin DFN & 8-Pin MSOP

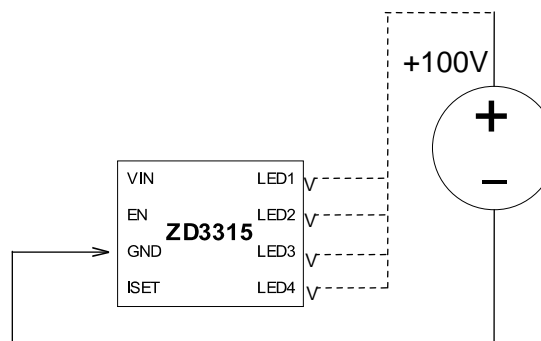
Step 1. Connect VIN to ground and apply +100V to each pin, one at a time.



Step 2. Repeat Step 1 using -100V.



Step 3. Connect GND to ground and apply +100V to each pin, one at a time.



Step 4. Repeat Step 3 using -100V.

Step 5. Check DUT for damage.

Step 6. If DUT is undamaged, repeat Steps 1-5 for two additional units.

Step 7. When three units pass sequence, repeat Steps 1-6 for three additional parts and increase voltage by |100|V until |2000|V is reached and passed

