Reliability Qualification Report

ZD810
Universal High Brightness LED Driver

Date: April 8, 2010
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:	DC/DC LED driver
Device Type:	ZD810
Mask Sets:	09KY9910
Processes:	XHVBCD
Package Type:	8-Pin n-SOIC, 16-Pin n-SOIC
Package Manufacturer:	SPEL Semiconductor
Die Attach Adhesive:	CRM-1076
Bond Wire:	Gold wire 1.0 mil
Test:	Refer to Reliability Test Results in SPEL Semiconductor’s Reliability report
Reference Standard:	JESD22-A113, JESD22-A104, JESD22-A118, JESD22-A103
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
ZD810LEN	500 hr	3927.1	12/30/2009	125	10	0
ZD810LEN	1000 hr	3927.1	01/20/2010	125	10	0

FIT Rate Calculation

The FIT (failures in time) is the 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 ZD810 using XHVBCD Process have been calculated and are listed below.

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD810	60%	177.53	3042.09	15404.21
ZD810	90%	446.12	7644.59	38709.89

1 FIT = 1 failure per billion device hours

ESD Test Results

ZD810 devices were submitted for Human Body Model ESD test.

Summary:

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD810	±2000V HBM	3927.1	2/04/2010	10	0

Temp Cycle Test Result

Zywyn's Universal High Brightness LED Driver products are packaged in an 8-Pin n-SOIC and 16-Pin n-SOIC Green Packages. 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

8-PIN n-SOIC Reliability Report

PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC DEVICE TYPE: XXXX

DEVICE TYPE	: XXXXX
WEEK CODE	: 0931
CUSTOMER LOT#	: YYYYY
PACKAGE	: 8LD SOIC
ASSEMBLY LOCATION	: SPEL, INDIA.
PREPARED BY	: S.Selvaraj Head (QC)
APPROVED BY	: N.J.Chandrasekar Head (QA)
MONTH & YEAR	: Aug, 2009.

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PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC DEVICE TYPE: XXXX

INTRODUCTION

The purpose of this new package qualification report is to document the details of the various internal evaluation tests performed on 8L SOIC devices assembled at SPEL.

PROCEDURE

The following critical parameters and Environmental Reliability stress tests have been examined and the details are listed herewith.

- **Dicing Quality** – Visual check, Kerf width monitor.
- **Die Attach Quality** – Visual check, Die Shear test.
- **Wire Bonding Quality** – Visual check, Wire pull test, Ball shear test, Bond pad crater test.
- **Molding Quality** – Visual check, Wire sweep check.
- **Marking Quality** – Visual check.
- **Lead Finish Quality** – Visual check, Thickness check and Solderability test.
- **Forming Quality** – Visual check, Physical dimension check & Lead Integrity.

RELIABILITY STRESS TESTS :

- **Preconditioned Temperature Cycling test.**
- **Preconditioned Pressure Pot test**
- **Preconditioned High Temperature Storage Life test**
- **Moisture Sensitivity Level 1 Test.**

List of Assembly Equipments Used for Study:

- **Wafer Mounter** : Disco DSM080
- **Dicing Saw** : Disco DAD 651
- **Wafer Wash** : Disco DCS140
- **Die attach** : Alphasem E-8032
- **Wire bond** : K & S Maxum Ultra
- **Encapsulation** : ASA Auto Mold
- **Top Mark** : SYT-AKSA-RO, Sunyang Tech Co, Korea
- **Singulation** : SYDNT-AFST-RO, Sunyang, Korea
- **Plating** : MECO 2400S

List of QA Equipments used:

- Die shear tester : Model # 1750, HMP, USA
- Wire pull tester : Universal Bond Tester 552, Royce Inc , USA
- Ball shear tester : Universal Bond Tester 552, Royce Inc, USA
- X-Ray machine : PCBA Analyser 160NF , Phoenix , Germany
- Optical Comparator : Model # 302-933E, Mitutoyo
- Steam Ager : Model # SAT 1000, Mountain Gate, Singapore
- Solderability Tester : Model # 1900, HMP, USA
- Lead Fatigue Tester : Model # 1500-121, Hybrid

List of Reliability Equipments used:

- Curing Oven : Labline
- Temperature cycler : Espec
- Temperature & Humidity : Blue – M
- Autoclave : Hirayama
- Conventional Oven : Heller
- CSAM : Sonix

PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC DEVICE TYPE: XXXX

Approved BOM list:

Vendor:	
Package Type:	**8LD SOIC**
Number of Leads	08
Die Size	64 x 80 mil
Package size	150 mil
Leadframe:	
Leadframe vendor	ASM
Leadframe Material	A194FH
Pad Size	130 x 95 mils
Lead frame thickness	8.0 mil
Die Attach Epoxy:	
Epoxy Vendor	Sumitomo
Epoxy Type	CRM1076
Gold Wire:	
Wire Vendor	K&S
Wire Type	AW99
Wire Size	1.0 mil
Mold Compound	
Mold Compound Vendor	Hitachi
Mold Compound Type	CEL 8240
Solder Plating	
Solder Vendor	Red Ring
Solder Type	100 % Tin

PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC DEVICE TYPE: XXXX

ACCESSORIES & PROCESS PARAMETER DETAILS

Wafer Mount

Tape used : Nitto
Cure Temp : 100°C
Cure Time : 400sec

Wafer Saw

Machine# : 2
Spindle speed : 30000 rpm
Cutting speed : 1000 mils / sec
Cutting wheel used : 27 HDCC

Wafer Wash

Water Pressure : 1500 PSI
Wash speed : 300 rpm
Wash duration : 80 sec
Dry speed : 1400 rpm
Dry duration : 40 sec

Die Attach

Machine# : 09
Pick up collet : HTR-50
Nozzle type : Single hole
Ejector needle : Single pin
Pick up force : 0.85 Newton
Bond force : 3 Newton
Dispense pressure : 0.062 Mpa
Dispense time : 0.030 ms

Die attach cure

Cure temperature : 175°C
Cure time : 70 minutes (15 min purge, 35 min Cure, 20 min cooling)
Nitrogen flow : 60 SCFH cooling & 100 SCFH in purging

Wire Bond

Capillary type : Peco N1014-60-22-12
Vendor : PECO
Bond temperature : 200°C
Bond force (Pad) : 38 gf
Bond power (Pad) : 60 mW
Bond time (Pad) : 18 mS
Bond force (Lead) : 80 gf
Bond power (Lead) : 85 mW
Bond time (Lead) : 18 mS
Transducer frequency : 64 KHz

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Encapsulation

Clamp Pressure : 44.8 Tons
Transfer Pressure : 0.8 Tons
Temperature : 175°C
Transfer time : 7.5 sec
Cure time : 90 sec

Post mold cure

Cure Temperature : 175°C
Cure Duration : 5 hrs

INPROCESS TEST DATA

Kerf width

Spec : Maximum 70% of street width
Sample size : 2 measurements
Values : 1.44, 1.44 mils

BLT Inspection

Spec : 0.3 – 1.0 mils

BLT values(in mils)	Value1	Value2	Value3	Value4
Wet	0.34	0.33	0.34	0.35
Dry	0.34	0.34	0.34	0.34

Die shear test

Spec : Min. of 2.5 Kgf
Sample size : 4 units
Minimum : 10.4 Kgf
Maximum : 11.6Kgf
Average : 11.0Kgf

Wire pull test

Spec : Min. of 3.0 gf
Sample size : 5 units
Minimum : 6.1 gf
Maximum : 10.9 gf
Average : 8.3 gf

Ball shear test

Spec : Min. of 20 gf
Sample size : 5 units
Minimum : 27.4 gf
Maximum : 39.2 gf
Average : 33.0 gf

Cratering test

Spec : No micro crack occurred in the exposed oxide layer(s) beneath the etched Aluminum layer of the bond pad
Sample size : 2 units
Test result : Pass

Intermetallic test

Spec : Min. of 70%
Sample size : 2 units
Test result : 88%

Ball size : 2.5 mils (Spec: 2~3 times of the wire dia)

Loop height : 7.0 mils (Spec: Max. of 12 mils)

Wire sweep

Spec : < 15.0%
Sample size : 10 units
Minimum : 4.0%
Maximum : 6.0%
Average : 5.0%

MARK QUALITY

Mark permanency	
Laser mark	
Visual Check	Pass
Sample Size (units)	50 units

PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC **DEVICE TYPE:** XXXX

SOLDERABILITY TEST - Bath: Sn/Ag/Cu

Sample Size : 5 Units
Pre-conditioning : 8 Hrs Steam aging
Test Conditions : Bath Temperature 245 -5/+10°C
Flux type : Alpha "R8" Type
Solder bath composition : Sn: 95.5%, Ag (3.0-4.0), Cu(0.5-1)

Acceptance criteria : **95% coverage (min)**
Coverage : 99%
Test Result : Pass

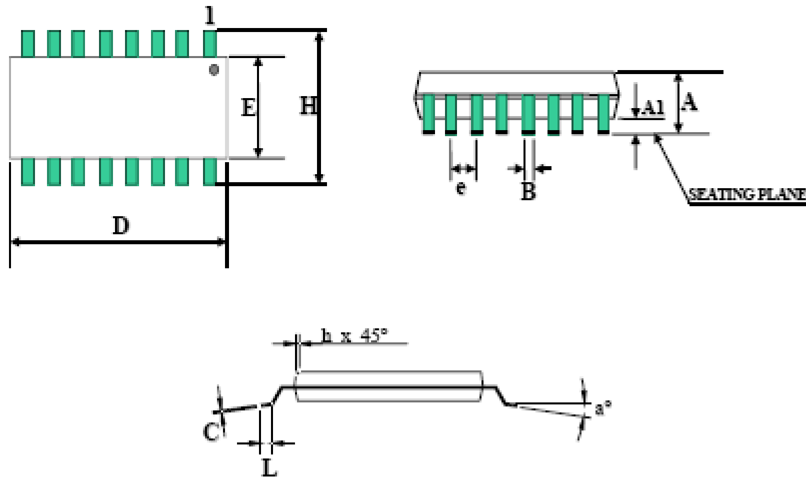
FORMING QUALITY

Visual Check	Pass
Sample Size (units)	5 units

LEAD FATIQUE TEST

Sample Size : 3 Units & 3 leads / unit
Visual pre-inspection : Nil Defects
Weight suspended : 3.0 oz
Degree of angle : 0° to +15° & back through 0° to –15° and back to 0°
No.of cycles : 3
Test Result : **Pass**

PACKAGE DIMENSIONS:



Dimension	Specifications (mils)	Sample Size	Average (mils)
Package Width (E)	150-157	5	154.2
Package Length (D)	188-197		192.5
Package Thickness (A)	60-68		64.6
Co-planarity	3.0 mils (Max)		0.6
Lead Pitch (e)	50 BSC		50.1
Lead Spread (H)	230-244		239.5
Foot Length (L)	23-29		25.2
Stand Off (A1)	4-8		6.0
Angle(a°)	0°-8°		3.5°

LEAD FINISH QUALITY

Spec	400 to 800 micron
Visual Check	Passed
Average Thickness (micro-inches)	511.7
Maximum Thickness (micro-inches)	522.3
Minimum Thickness (micro-inches)	495.3
Sample Size	10

LEAD FINISH QUALITY: Matte finish

PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC DEVICE TYPE: XXXX

RELIABILITY STRESS TESTS:

Environmental Reliability Stress Tests					
Stress Name	Reference Standard	Stress Condition & Duration	Electrical Test quantity (nos)		Electrical Test Result
			In	Out	
Preconditioning test	JESD22-A113 LEVEL 1	External Visual @ 40X. Température Cycle @ Ta = -40 ⇔ +60°C, 5 Cycles Stabilization Bake @ Ta = 125°C, 24 Hrs. Moisture soak @ Ta/RH = 85°C/85%, 168 Hrs. Solder Reflow @ 260°C, 3 Cycles.	75	75	Pass
Preconditioned Temperature Cycling	JESD22-A104	-65°C ⇔ +150°C, 500Cycles	25	25	Pass
Preconditioned Unbiased HAST	JESD22-A118	130°C; 85% Rh, 96 Hrs	25	25	Pass
High Temperature Storage Life test	JESD22-A103	150°C; 1000 Hrs	25	25	Pass

PACKAGE QUALIFICATION REPORT
PACKAGE: 8SOIC **DEVICE TYPE:** XXXX

Moisture Sensitivity Level evaluation:

Preconditioning Test:

11 units were subjected to preconditioning tests as follows:

Conditions: JEDEC JESD22-A113 LEVEL 1

a) External visual examination @ 40X to screen for mechanical failures
b) Temperature cycle @ Ta= -40°C to +60°C, 5 cycles *to simulate shipping conditions.*
c) Stabilization bake @ Ta=125°C, 24 hours *to remove all moisture from the package.*
d) Moisture soak @ Ta / RH =85 °C / 85 %, 168 hours *to simulate to maximum floor life.*
e) Solder reflow @ Tmax = 260°C, 3 cycles *to simulate one solder reflow and two rework cycles.*

Final Electrical Test result: Pass.

Scanning Acoustic Microscope (CSAM) before & after preconditioning tests :

CSAM performed on all the units before and after as per the test conditions **J-STD-020: Pass**

MSL Test Result:

Inspection details	
External Crack	Nil
Internal Crack	Nil
Delamination in critical areas:	
Die \ Mold compound	Nil
Lead Fingers \ Mold Compound	Nil

Conclusion:

- Moisture Sensitivity Level for **08Ld SOIC: Level 1**
- Dry Pack is not required for these packages.

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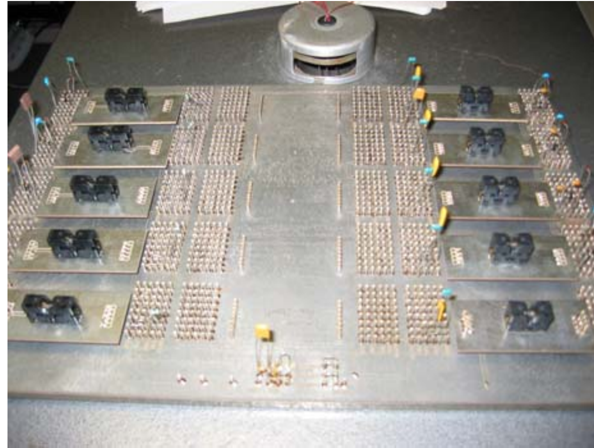
Appendix II

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

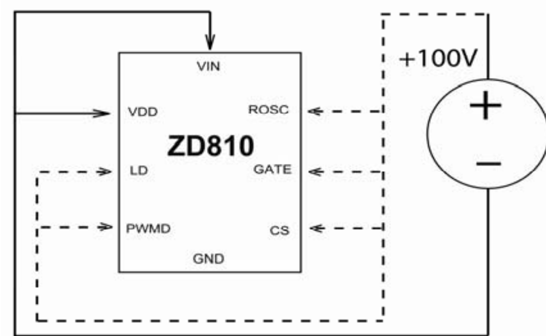
Front view of the iMCS model #700 with lid open

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

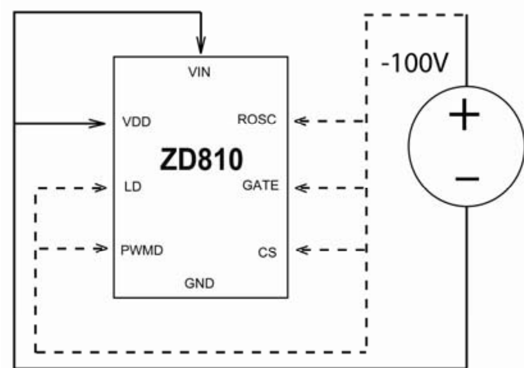
Appendix III

ESD Test Sequence for 8-PIN n-SOIC

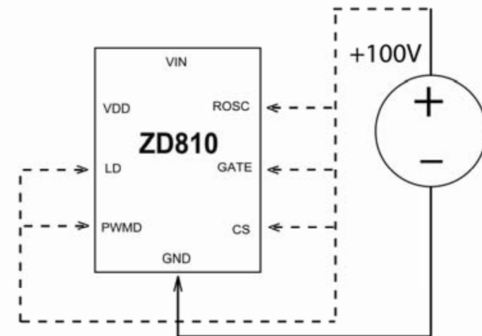
Step 1. Connect VIN to ground and apply +100V to each pin, one at a time.



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