Reliability Qualification Report

ZD32XX Charge Pump Based WLED Display Driver

Date: May 25, 2006
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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:	Charge Pump Based WLED Display Driver
Device Type:	ZD3200/ZD3210/ZD3202/ZD3203/ZD3205 /ZD3213
Mask Sets:	MS169/ MS180/ MS138/ MS173/ MS175 MS181
Process:	Episil Mixed Mode 0.5µm 2 Poly-2Metal CMOS Process
Wafer Manufacturer:	Episil Technologies, Inc.
Package Type:	6-Pin TSOT23/8-Pin MSOP/10-Pin MSOP/10-Pin DFN
Package Manufacturer:	Lingsen Precision Industries, Ltd., Unisem (M) Berhad
Die Attach Adhesive:	CRM-1033BF
Bond Wire:	NL5 1.0 mil
Test:	HTOL 500 hrs, 3.3V 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
ZD3200LES6	500 hr @ 3.3V	515905.3	2/04/2006	125	16	0
ZD3200LES6	1000 hr @ 3.3V	515905.3	2/24/2006	125	16	0

Device Type	HTOL Test	Lot Number	Date Completed	Burn-In Temperature (°C)	Sample Size	No. of Fails
ZD3210LES6	500 hr @ 3.3V	577928.2L2	2/04/2006	125	8	0
ZD3210LES6	1000 hr @ 3.3V	577928.2L2	2/24/2006	125	8	0

Device Type	HTOL Test	Lot Number	Date Completed	Burn-In Temperature (°C)	Sample Size	No. of Fails
ZD3202LEU	500 hr @ 3.3V	592604	2/04/2006	125	8	0
ZD3202LEU	1000 hr @ 3.3V	592604	2/24/2006	125	8	0

Device Type	HTOL Test	Lot Number	Date Completed	Burn-In Temperature (°C)	Sample Size	No. of Fails
ZD3203LEU	500 hr @ 3.3V	592606	2/04/2006	125	7	0
ZD3203LEU	1000 hr @ 3.3V	592606	2/24/2006	125	7	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 Episil Mixed Mode 0.5µm 2 Poly-2Metal CMOS Process products have been calculated and are listed below.

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD3200LES6	60%	22.8	394.5	2006.9
ZD3200LES6	90%	57.4	991.2	5041.9

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD3210LES6	60%	45.7	789.1	4013.8
ZD3210LES6	90%	114.7	1982.4	10083.9

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD3202LEU	60%	45.7	789.1	4013.8
ZD3202LEU	90%	114.7	1982.4	10083.9

Device Type	Confidence Level	+25°C	+55°C	+75°C
ZD3203LEU	60%	52.2	901.8	4587.3
ZD3203LEU	90%	131.1	2265.6	11524.5

1 FIT = 1 failure per billion device hours

ESD Test Results

32xx series devices were submitted for Human Body Model ESD test.

Summary:

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD3200LES6	±2000V HBM	515905.3	12/15/2005	24	0

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD3210LES6	±2000V HBM	577928.2L2	12/15/2005	24	0

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD3202LEU	±2000V HBM	592604.	1/13/2006	12	0

Device Type	ESD Test	Lot Number	Date Completed	Sample Size	No. of Fails
ZD3203LEU	±2000V HBM	592606.	1/13/2006	12	0

Temp Cycle Test Result

Zywyn's ZD3200LES6 and ZD3210LES6 WLED driver products are packaged in a 6-Pin TSOT-23 Green Package. Packaged Qualification Reliability Report which consists of, among others, Temp Cycle Test, is attached for reference. The report shows the devices pass the test with no failure.

Zywyn's ZD3202LEU, ZD3203LEU, ZD3205LEU, and ZD3213LEU WLED driver products are packaged in 10-Pin MSOP and 10-Pin DFN Green Packages. Packaged Qualification Reliability Report which consists of, among others, Temp Cycle Test, is attached for reference. The report shows the devices pass the test with no failure. The report is attached for reference.

Zywyn intends to perform the Temp Cycle test on all of the WLED driver devices per Mil-Std-883. Test Result will be provided as soon as it becomes available.

Appendix I

Zywyn Green Packages Are Ready

For WLED Products: 10-MSOP package from Unisem Malaysia

IR Reflow Profile Conditions	[reflow profile chart]	[reflow profile chart]
Program Name	JESD Sn-Pb Eutectic Assembly (small packages)	**JESD Pb-free Assembly (small packages)**
Peak temperature	235~240°C	**255~260°C**
Pre-heat range/time	100~150°C, 60~120 sec.	**150~200°C, 60~180 sec.**
Time within 5°C of peak temperature	10~30 sec.	**20~40 sec.**
Time maintained above temperature/time	183°C, 60~150 sec.	**255°C, 60~150 sec.**
Time 25°C to peak temperature	6 min. max.	**8 min. max.**
Ramp-up rate	3°C/sec. max.	**3°C/sec. max.**
Ramp-down rate	6°C/sec. max.	**6°C/sec. max.**

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Appendix II

Reliability Test Report

SOT-26 for Molding process change

Purpose：Molding equipment & Leaframe & EMC change

Report No.#REL-92383 Rev. 0

Run# P3A180

Device Type：XC2141C28AMRW

Molding Compound：EME-G600

Reported Date：3-09-2004

Conclusion：These lot passed Precon level 3 with 260℃ peak temp. of IR reflow and the other reliability test according to Lingsen spec.65-1300.

W.P.Huang	S.J. [signature]
Approved By	**Prepared By**
3/09/2004	3/09/2004
Date	**Date**

This report only applies to the device under test, and no part of this report may be abstracted or reproduced.

INTRODUCTION

This is the reliability test report of SOT-26, Run#P3A180 for leadframe, molding compound and molding process qualification. All good die were used for all reliability tests.

All reliability test methods are performed base on JEDEC Standards. The devices selected for the reliability test are subjected to preconditioning process per JEDEC standards 22 A113 preconditioning level 3 with 260℃ peak temperature of IR reflow prior to each test including Pressure Cooker Test, Temperature Cycling Test, High Temperature Storage, and HAST base on Lingsen spec.65-1300. After each reliability test, Open short test is used to check if any electrical failures.

Rejected if electrical failure related to assembly, or package crack after precondition.

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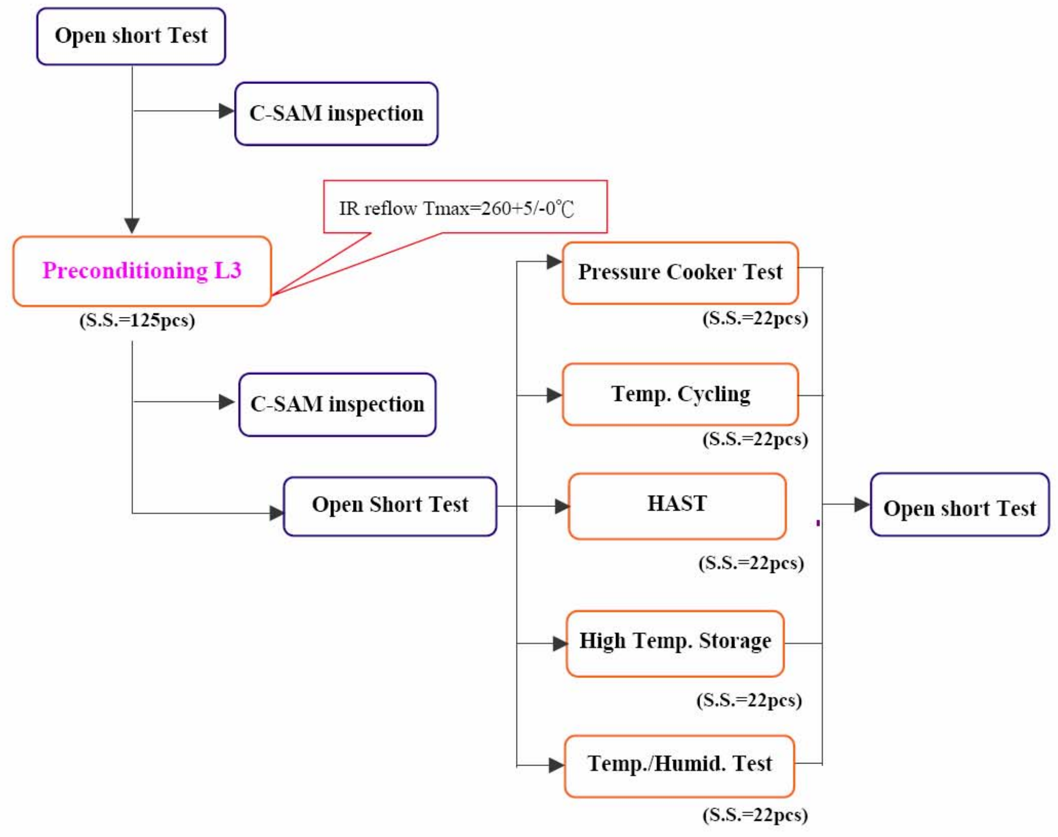
2.0 Sample Information

2.1 Sample Information

Package Type：	SOT-26	LeadFrame：	1.5X1.0E64TAG matrix
Device Type：	XC2141C28AMRW	Silver Epoxy：	84-1LMISR4
Lot No.：	N/A	Gold wire：	M3 0.9mil
Run No.：	P3A180	Molding Compound：	EME-G600
Die coating：	N/A	Lead Finish	Pb-free
Received Date：	2003-12-11	Total Q'ty：	125pcs
Completed Date：	2004-3-01	Rel Doc. No.：	92383

2.2 Test Flow



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3.0 Environment Stress

3.1 Preconditioning

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

Step 1：Temperature Cycling -40℃~+60℃, 5 cycles

Step 2：Bake 125℃, 24hrs

Step 3：Moisture Soak Level 3 30℃,60%R.H., 192hrs

Step 4：IR Reflow T_{max}= 260+5/-0℃, 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℃ ＊Relative humidity ：100%

＊Pressure：2 atm ＊Test Time：168hrs

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℃/10min ＊Low Temperature：-65℃/10min

＊Test Cycles：500cycles

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℃ Test Time：1000hrs

3.5 Highly-Accelerated Temperature and Humidity Stress Test (HAST)

Evaluate the reliability of non-hermetic packaged devices in humid environments. It employs three conditions of temperature, voltage, and humidity, which accelerated the penetration of moisture.

＊ Temperature：130℃ ＊Relative Humidity：85%

＊ Test Time：100hrs

3.6 Steady-State Temperature and Humidity Life Test

Evaluating the reliability of non-hermetic packaged solid-state devices in humid environments.

Temperature：85℃ Relative Humidity：85%

Test Time：1000hrs

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4.0 Reliability Test Data

Test Item	Conditions	Sample Size	Result
1.Preconditioning Level 3	TC 5cycles,Bake 24hrs, 30℃/ 60%RH / 168hrs,IR Reflow Tmax=260℃, 3cycles	N=125 AC=0	**0/125**
2.Pressure Cooker Test (After Precondition)	121℃ , 100% R.H., 2 atm, 168hrs	N=22 AC=0	**0/22**
3.Temperature Cycling (After Precondition)	-65℃/10min to +150℃/10min 500cycles	N=22 AC=0	**0/22**
4.High Temp. Storage (After Precondition)	150℃, 1000hrs	N=22 AC=0	**0/22**
5.HAST (After Precondition)	130℃, 85% R.H., 100hrs	N=22 AC=0	**0/22**
6.Temp./Humid. Test (After Precondition)	85℃, 85% R.H., 1000hrs	N=22 AC=0	**0/22**

5.0 Reference Documents

J-STD-020 Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices

JESD 22 A113 Preconditioning for Plastic Surface Mount Devices Prior to Reliability Testing

JESD 22 A102 Accelerated Moisture Resistance-unbiased Autoclave

JESD 22 A103 High Temperature Storage Life

JESD 22 A104 Temperature Cycling

JESD 22 A110 HAST

Lingsen spec#65-1300 Procedure for Reliability Test

Lingsen spec#65-1301 Preconditioning for Reliability Test

Lingsen spec#65-7320 Work Instruction for Pressure Cooker Test

Lingsen spec#65-7329 Work Instruction for Temperature Cycling

Lingsen spec#65-7327 Work Instruction for High Temperature Storage

Lingsen spec#65-7329 Work Instruction for Temperature and Humidity Test

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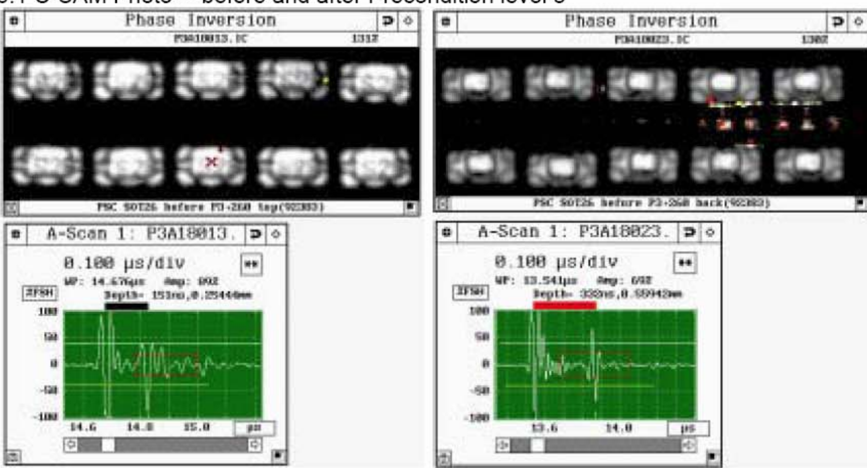
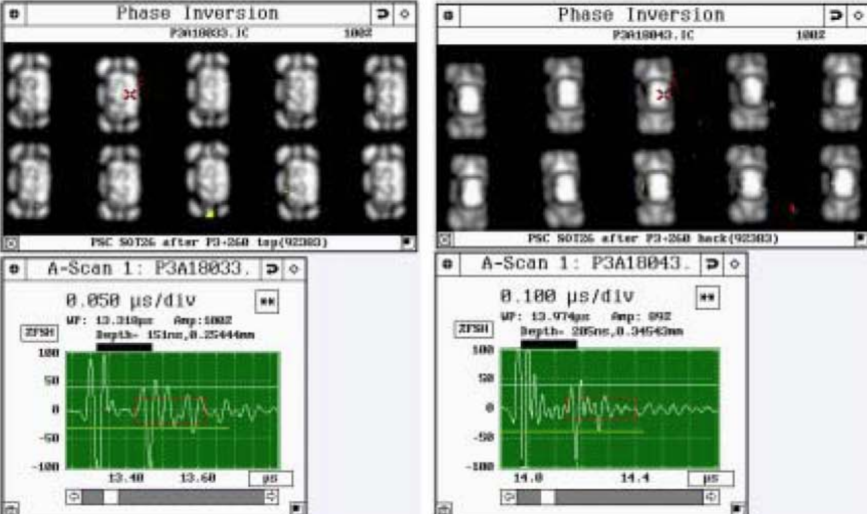
6.0 Attachment

6.1 C-SAM Photo--- before and after Precondition level 3



C-SAM Photo--- after Precondition level 3



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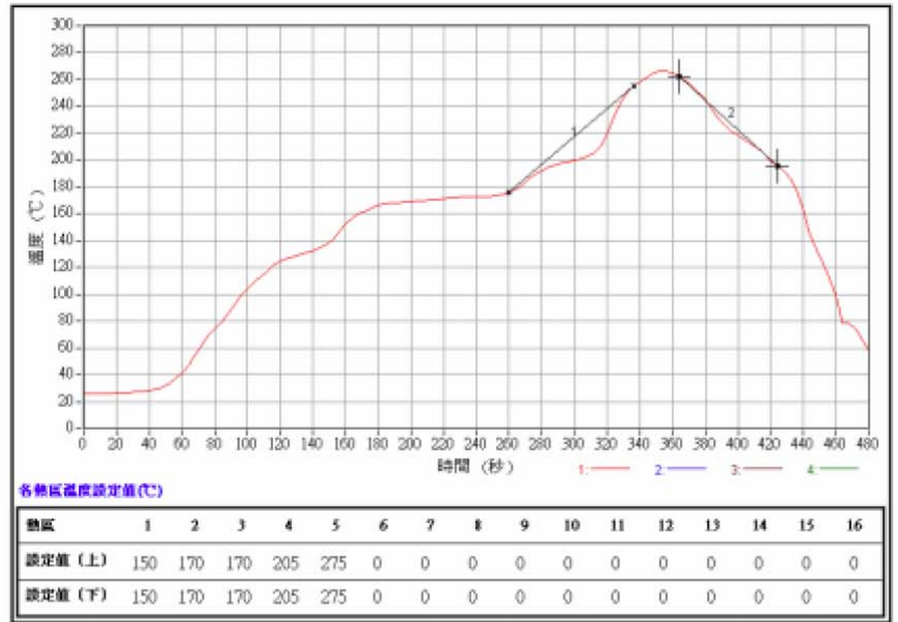
6.2 IR Reflow Profile for Precondition

加熱爐測溫器報告

公司名稱： 菱生精密工業股份有限公司
產品名稱： Fe tray - IC
列印日期（日／月／年）： 18/12/2002　　取樣速率（分：秒）： 00:04.0
資料檔名稱： Furnace　　量測日期（日／月／年）： 18/12/2002
速度設定值： 30.0 cm/Min　　量測時間（時：分：秒）： 13:52:02



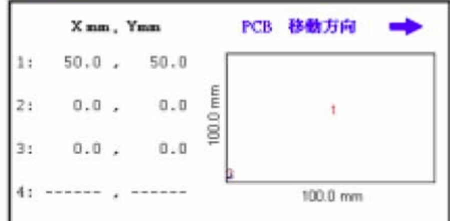
各熱區溫度設定值(℃)

熱區	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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

最高溫度及時間分析

測溫點名稱	最高溫度(℃)	位於(秒)	高於 217℃ 時間(秒)	高於 217℃ 時間(秒)
1.center	265.8	352.0	84.0	84.0
2:	1523.8	0.0	484.0	484.0
3:	1523.8	0.0	484.0	484.0
4:	0.0	0.0	0.0	0.0

測溫點位置



備註

his profile is applied to Lead free products.

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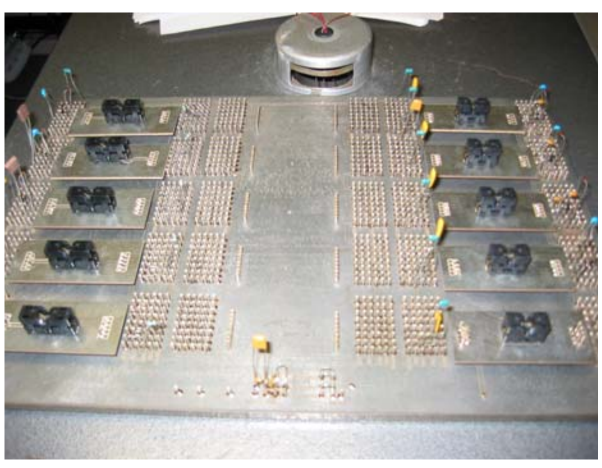
Appendix III

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

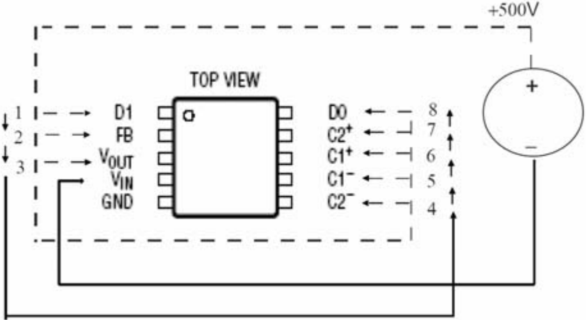
Front view of the iMCS model #700 with lid open

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

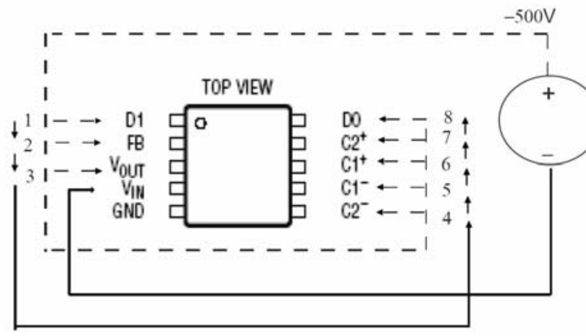
Appendix IV

ESD Test Sequence for 10-MSOP

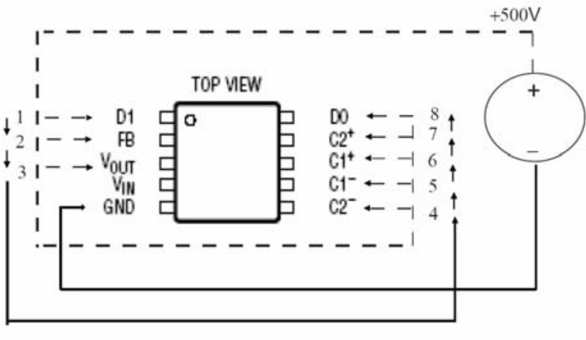
Step 1. Connect VIN to ground and give +500V to each pin.



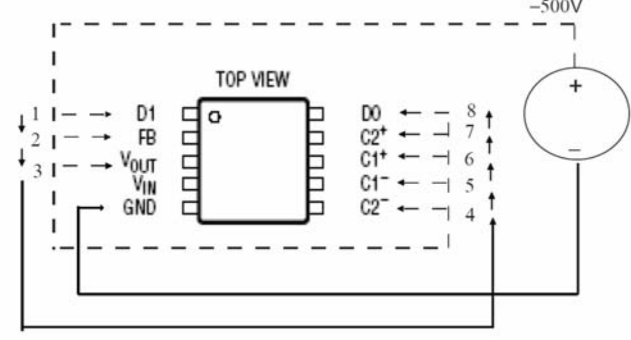
Step 2. Then give -500V to each pin.



Step 3. Connect GND to ground and give +500V to each pin.

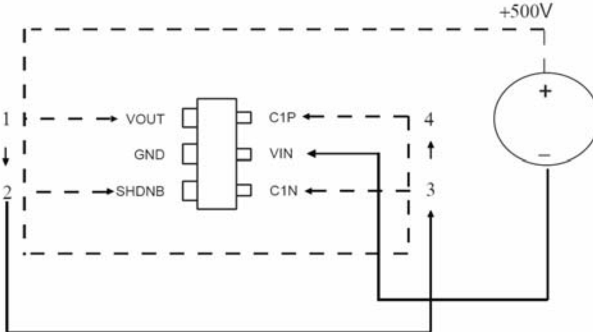


Step 4. Then give -500V to each pin.
Step 5. Check DUT for damage.
Step 6. If DUT is undamaged, repeat Steps 1-5 for two additional units.
Step 7. When three units pass sequence, repeat Steps 1-6 for three additional parts and increase voltage by |500|V until |2000|V is reached and passed

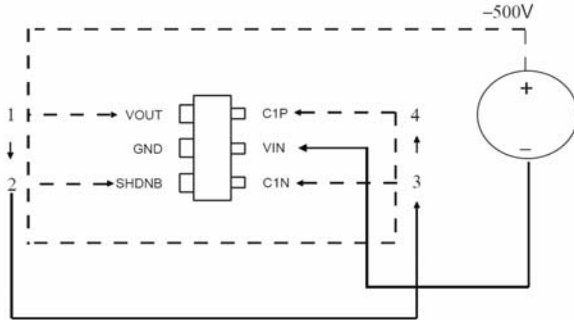


ESD Test Sequence for 6-TSOT

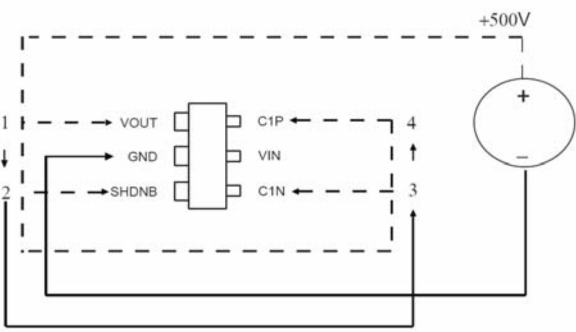
Step 1. Connect VIN to ground and give +500V to each pin.



Step 2. Then give -500V to each pin.



Step 3. Connect GND to ground and give +500V to each pin.



Step 4. Then give -500V to each pin.
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 |500|V until |2000|V is reached and passed