



ZYWYN CORPORATION

Reliability Qualification Report

ZD1637 Inductor Based Step-Up Converter
(For White LED Driver or DC Bias IC)

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Reliability Life Test Result

Life Test

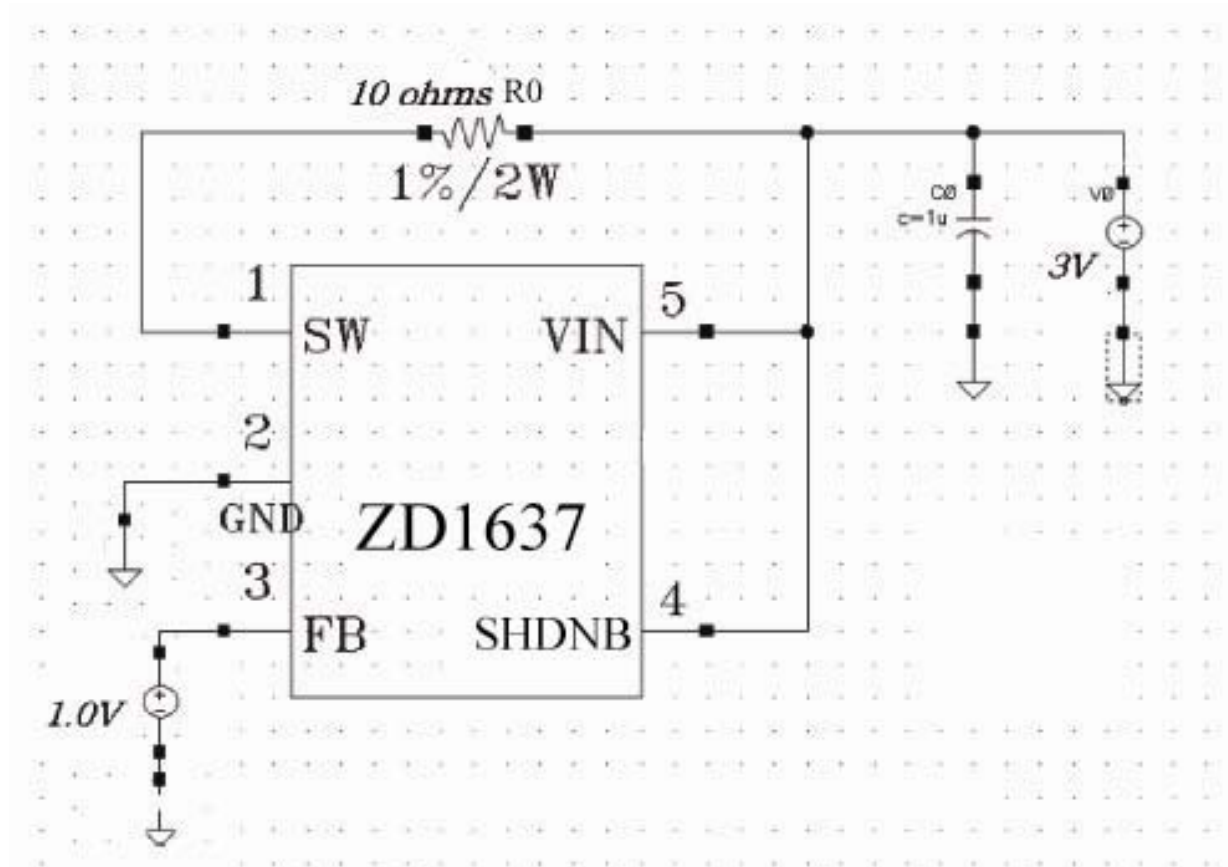
Life Testing is performed to determine if device has any fundamental reliability related failure mechanisms, which can be divided into 4 main groups:

- 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:	Inductor-Based WLED Driver
Device Type:	ZD1637LB5
Mask Sets:	AP3012
Process:	Bipolar Process
Wafer Manufacturer:	BCD Semiconductor Corporation, China
Package Type:	5-pin SOT23 (Green Package)
Packaging Assemblies:	Jiangsu Changjiang Electronics Technology Co., Ltd., China
Die Attach Adhesive:	84-1LMISR4
Bond Wire:	1.0 mil HD3
Molding Compound:	EME6710SJ
Lead Finish:	A194/Ag

Burn-In Circuit:



Test Conditions:

- 1) HTOL 168 hrs, $V_{in} = 3.0V$ DC, $V_{FB} = 1.0V$ DC, Operating Frequency = 1.2MHz, Peak Load Current = 270mA, Duty Cycle = 80%, Dynamic Burn-In @125°C.
- 2) θ_{JA} of the package (5-pin SOT23) = 256°C/W. Circuit power consumption $\approx 90mW@125°C$.
- 3) $R_0 = 10\Omega$, 1%/2W; $C_0 = 1\mu F$.

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 @ 3.0V	Lot Number	Date Completed	Burn-In Temperature (°C)	Sample Size	No. of Fails
ZD1637LB5	168 hr	05844E.4#13	11/16/05	125	80	0
<i>Previous Related Inductor-Based WLED Driver Product Family Burn-In Data Results</i>						
<i>ZD1937LB5</i>	<i>168 hr</i>	<i>04B27E.5#4</i>	<i>04/29/05</i>	<i>125</i>	<i>80</i>	<i>0</i>
<i>ZD1937LB5</i>	<i>500 hr</i>	<i>04B27E.5#4</i>	<i>04/29/05</i>	<i>125</i>	<i>80</i>	<i>0</i>
<i>ZD1937LB5</i>	<i>1000 hr</i>	<i>04B27E.5#4</i>	<i>04/29/05</i>	<i>125</i>	<i>80</i>	<i>0</i>

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, E_a , of observed failure mechanisms of Zywyn products has been determined to be 0.7eV.

Based on the above criteria, the FIT rates at 125°C to 55°C, and 150°C to 55°C operation at 60% confidence level, with a sample size of 77 and 1 unit failure allowed, using the BCD Semiconductor Bipolar Process products, have been calculated and listed here below:

+125°C → +55°C			+150°C → +55°C		
Test Time	Failure Rate	Equivalent Life Time	Test Time	Failure Rate	Equivalent Life Time
168 hours	2020 FIT	0.7 year	168 hours	599 FIT	2 years
500 hours	674 FIT	2 years	500 hours	201 FIT	7 years
1000 hours	337 FIT	4 years	1000 hours	100 FIT	14 years
2000 hours	169 FIT	8 years	2000 hours	50 FIT	28 years

1 FIT = 1 failure per billion device hours

Reliability ESD Test Result – Human Body Model

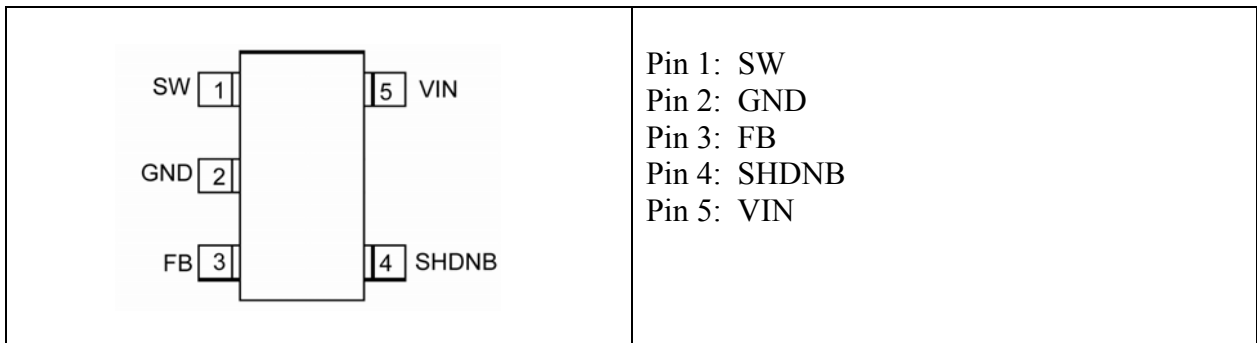
ESD Test Data Input:

Test Vector:	ESD-HBM (Human Body Model)
Reference Standard:	Mil-Std-883E Method 3015.7
Sample Size:	12 units
Test Voltage:	500V~5000V, Steps of $\pm 250V$
Pass/Fail Criteria:	Test for Voltage Change at $1\mu A \pm 30\%$
Test Date:	September 25, 2005
Test Equipment:	Keytek Zapmaster 7/4
Test Equipment S/N#:	0008189
Calibration Date:	July 12, 2005
Recommended Next Calibration Due Date:	July 11, 2006
Environmental Condition At Laboratory:	Actual temperature: $+21.1^{\circ}C \sim +21.2^{\circ}C$ Actual humidity: $42\% \sim 44\% RH$

Test Conditions:

SW, FB, SHDNB, VIN Pins to GND:	+VE ZAP
SW, FB, SHDNB, VIN Pins to GND:	-VE ZAP
SW, GND, FB, SHDNB Pins to VCC:	+VE ZAP
SW, GND, FB, SHDNB Pins to VCC:	-VE ZAP

ZD1637LB5 Pin Configuration:



Test Results:

Test Model: Human Body Model (HBM)	ESD Sensitivity Passing Target: $\pm 3000V$		V Class: 2
Pin Combination	Sample Size	Passed Voltage	Per Mil-Std-883E-3015.7 Test
SW, FB, SHDNB, VIN to GND (+)	#1-1 ~ #1-3	+3000V	Classification: Class 1: 0 volt to 1999 volts Class 2: 2000 volts to 3999 volts Class 3: 4000 volts and up
SW, FB, SHDNB, VIN to GND (-)	#2-1 ~ #2-3	-5000V	
SW, GND, FB, SHDNB to Vcc (+)	#3-1 ~ #3-3	+3250V	
SW, GND, FB, SHDNB to Vcc (-)	#4-1 ~ #4-3	-3000V	

Test Condition: SW, FB, SHDNB, VIN to GND (+)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#1-1	#1-2	#1-3
1	SW	PASS	PASS	PASS
2	GND	GND	GND	GND
3	FB	PASS	5000	4750
4	SHDNB	3750	3250	3500
5	VIN	3500	3750	3500

Test Condition: SW, FB, SHDNB, VIN to GND (-)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#2-1	#2-2	#2-3
1	SW	PASS	PASS	PASS
2	GND	GND	GND	GND
3	FB	PASS	PASS	PASS
4	SHDNB	PASS	PASS	PASS
5	VIN	PASS	PASS	PASS

Test Condition: SW, GND, FB, SHDNB to V _{CC} (+)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#3-1	#3-2	#3-3
1	SW	PASS	PASS	PASS
2	GND	PASS	PASS	PASS
3	FB	PASS	4750	PASS
4	SHDNB	3500	3500	3500
5	VIN	VIN	VIN	VIN

Test Condition: SW, GND, FB, SHDNB to V _{CC} (-)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#4-1	#4-2	#4-3
1	SW	PASS	PASS	PASS
2	GND	3250	3250	3250
3	FB	PASS	PASS	PASS
4	SHDNB	PASS	PASS	PASS
5	VIN	VIN	VIN	VIN

Reliability ESD Test Result – Machine Model

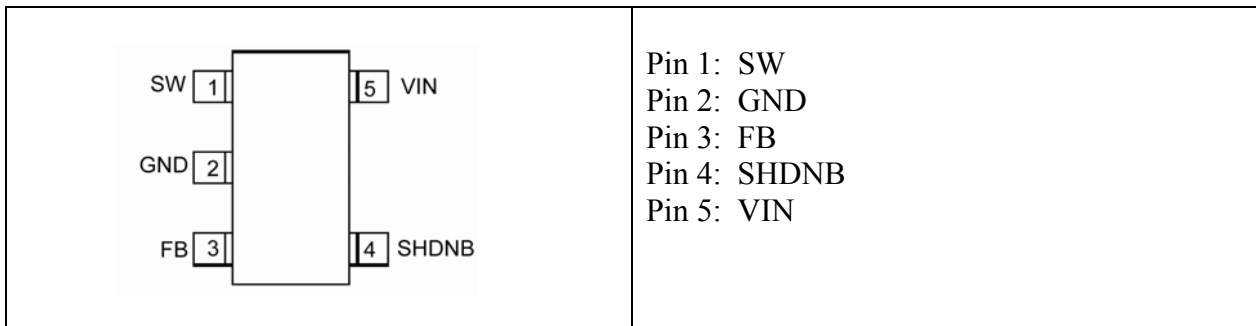
ESD Test Data Input:

Test Vector:	ESD-MM (Machine Model)
Reference Standard:	JEDEC EIA/JESD22-A115
Sample Size:	12 units
Test Voltage:	50V~500V, Steps of $\pm 50V$
Pass/Fail Criteria:	Test for Voltage Change at $1\mu A \pm 30\%$
Test Date:	September 25, 2005
Test Equipment:	Keytek Zapmaster 7/4
Test Equipment S/N#:	0008189
Calibration Date:	July 12, 2005
Recommended Next Calibration Due Date:	July 11, 2006
Environmental Condition At Laboratory:	Actual temperature: $+21.1^{\circ}C \sim +21.2^{\circ}C$ Actual humidity: $42\% \sim 44\% RH$

Test Conditions:

SW, FB, SHDNB, VIN Pins to GND:	+VE ZAP
SW, FB, SHDNB, VIN Pins to GND:	-VE ZAP
SW, GND, FB, SHDNB Pins to VCC:	+VE ZAP
SW, GND, FB, SHDNB Pins to VCC:	-VE ZAP

ZD1637LB5 Pin Configuration:



Test Results:

Test Model: Machine Model (MM)	ESD Sensitivity Passing Target: $\pm 350V$		V Class: B
Pin Combination	Sample Size	Passed Voltage	Per JEDEC EIA/JESD22-A115 Test
SW, FB, SHDNB, VIN to GND (+)	#M1-1 ~ #M1-3	+350V	Classification: Class A: 0 volt to 199 volts Class B: 200 volts to 399 volts Class C: 400 volts and up
SW, FB, SHDNB, VIN to GND (-)	#M2-1 ~ #M2-3	-500V	
SW, GND, FB, SHDNB to Vcc (+)	#M3-1 ~ #M3-3	+500V	
SW, GND, FB, SHDNB to Vcc (-)	#M4-1 ~ #M4-3	-500V	

Test Condition: SW, FB, SHDNB, VIN to GND (+)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#M1-1	#M1-2	#M1-3
1	SW	PASS	PASS	PASS
2	GND	GND	GND	GND
3	FB	PASS	PASS	PASS
4	SHDNB	400	PASS	400
5	VIN	PASS	PASS	PASS

Test Condition: SW, FB, SHDNB, VIN to GND (-)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#M2-1	#M2-2	#M2-3
1	SW	PASS	PASS	PASS
2	GND	GND	GND	GND
3	FB	PASS	PASS	PASS
4	SHDN	PASS	PASS	PASS
5	VIN	PASS	PASS	PASS

Test Condition: SW, GND, FB, SHDNB to V _{CC} (+)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#M3-1	#M3-2	#M3-3
1	SW	PASS	PASS	PASS
2	GND	PASS	PASS	PASS
3	FB	PASS	PASS	PASS
4	SHDNB	PASS	PASS	PASS
5	VIN	VIN	VIN	VIN

Test Condition: SW, GND, FB, SHDNB to V _{CC} (-)				
\\ Fail Voltage \\ (units:V)		Test Sample#		
Test Pin	Pin Description	#M4-1	#M4-2	#M4-3
1	SW	PASS	PASS	PASS
2	GND	PASS	PASS	PASS
3	FB	PASS	PASS	PASS
4	SHDNB	PASS	PASS	PASS
5	VIN	VIN	VIN	VIN

Reliability ESD Test Result – Latch-Up Test

ESD Test Data Input:

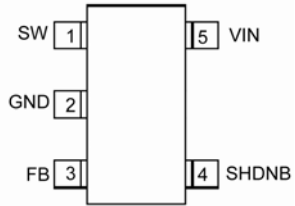
Test Vector: ESD/Latch-Up
Reference Standard: JEDEC Standard No. 78, August 1997
Sample Size: 3 units
Test Voltage: Positive Current Trigger, +20mA~+200mA,
+20mA Step (+);
Negative Current Trigger, -20mA~-200mA,
-20mA Step (-);
V Supply Over-Voltage Test, +5V~+8V,
+1V Step (+)
Pass/Fail Criteria: <25mA, (10mA+I_{normal}); >25mA, (1.4xI_{normal})
Test Date: September 25, 2005

Test Equipment: Keytek Zapmaster 7/4
Test Equipment S/N#: 0008189
Calibration Date: July 12, 2005
Recommended Next
Calibration Due Date: July 11, 2006
Environmental Condition At Laboratory: Actual temperature: +22.3°C ~ +22.5°C
Actual humidity: 45% ~ 47% RH

Test Conditions:

- 1) The positive or negative current pulse (I-Test) or voltage pulse (V_{supply} over-voltage Test) applied to any pin under test in an attempt to induce latch-up.
- 2) Ground pins are not tested for latch-up.

ZD1637LB5 Pin Configuration:

	<p>Pin 1: SW Pin 2: GND Pin 3: FB Pin 4: SHDNB Pin 5: VIN</p> <p>I/O: SW I/P: FB, SHDN VCC: VIN GND: GND</p>
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Test Results:

Test Model: ESD/Latch-Up Trigger Model	Tested Pins	Sample Size	Trigger Source Induced Latch-Up	IT Class: 3 Per JEDEC Std. #78, Aug. 1997 Test
+IT	I/P	3	+200mA	Class1: +IT: 0 mA ~ +39 mA -IT: 0 mA ~ -39 mA
	I/O		+200mA	
-IT	I/P	3	-200mA	Class2: +IT: +40 mA ~ +99 mA -IT: -40 mA ~ -99 mA
	I/O		-200mA	
Vsupply Over-Voltage Test	VCC_5V	3	+8V	Class3: +IT: +100 mA and up -IT: -100 mA and below

Test Condition: Positive Current I				
\\ Triggered Current \\ (units:mA)		Tested Sample#		
Test Pin	Pin Description	#1	#2	#3
1	SW	PASS	PASS	PASS
2	GND	VSS	VSS	VSS
3	FB	PASS	PASS	PASS
4	SHDNB	PASS	PASS	PASS
5	VIN	VIN	VIN	VIN

Test Condition: Negative Current I				
\\ Triggered Current \\ (units:mA)		Tested Sample#		
Test Pin	Pin Description	#4	#5	#6
1	SW	PASS	PASS	PASS
2	GND	VSS	VSS	VSS
3	FB	PASS	PASS	PASS
4	SHDNB	PASS	PASS	PASS
5	VIN	VIN	VIN	VIN

Test Condition: Vsupply OVER-VOLTAGE Test				
\\ Triggered Voltage \\ (units:V)		Tested Sample#		
Test Pin	Pin Description	#7	#8	#9
2	GND	VSS	VSS	VSS
5	VIN	PASS	PASS	PASS