PCN Report

Prepared By : Tianhua Wang, Glisten Xu, Kimi Xiong-Product Engineer,
Ada Du-Sr. OSAT Engineer,
Date : 5/9/2023
Device : SOD-123FL Package Product
Revision : 1

1.0 Objective:

The purpose of this project is to qualify two additional assembly & test locations for SOD-123FL Package. Succeeding pages summarize the physical, electrical and reliability test performed in qualification lots.

2.0 Applicable Devices:

Product	Package	Series	Part Numbers
TVS STD/Commercial	SOD-123FL	SMF3.3/SMF3.3-A/SMF4.0	SMF3.3/SMF3.3-A/SMF4.0
		SMF	SMF5.0A~100A SMF5.0A-T13~100A-T13
		SMF (High Voltage)	SMF110A~ 250A
		SMF (Bi-directional)	SMF5.0CA~85CA
		SMF4L	SMF4L5.0A~250A SMF4L9.0CA~51CA

3.0 Assembly, Process & Material Differences/Changes:

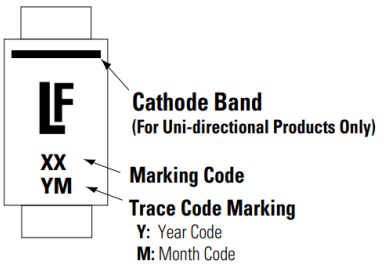
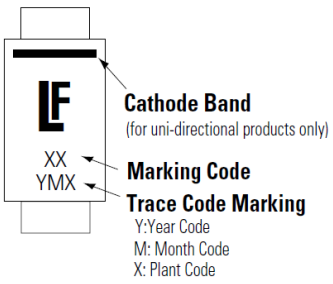
3.1 Assembly and Process Changes

There are no significant changes in the assembly and process method.

3.2 Material Changes

Package	Series	Material	Current site	Additional site A	Additional site B
SOD-123	SMF	Epoxy Molding Compound	E125G	EME-E115	GR640HV-L1 E500-HME
SOD-123	SMF3.3/SMF3.3-A/SMF4.0 SMF (High Voltage) SMF (Bi-directional) SMF4L	Epoxy Molding Compound	EK-1700GH	EME-E115	GR640HV-L1 E500-HME

3.3 Part Marking Trace Code Changes

Series	Before / Trace Code YM	After / Trace Code YMX	Change
SMF SMF4L SMF3.3/SMF3.3-A SMF4.0			Yes

4.0 Reliability Test Results Summary:

Additional Site A:

SOD-123FL				
Test Items	**Condition**	**S/S per PN**	**Results**	**ETR #**
Pre-conditioning	24hrs 125℃ bake/ 168hrs 85%rh, 85℃ soak/3 times 260℃ peak temp. reflow	120	0/720	ETR175996
High Temperature, DC Blocking(HTRB)	At 150℃ for 1008hrs, bias rated VR	77	0/462	
Temperature Cycle(TC)	-55℃&150℃, 1000 cycles, 15 minutes dwell	40	0/240	
High Temperature & Humidity with Bias(H3TRB)	85℃, 85%RH for 1008hrs bias rated VR	40	0/240	
UHAST Unbiased Highly Accelerated Stress Test (UHAST)	Ta = 130°C, 85%RH, 2ATM Duration = 96 Hours	40	0/240	
Resistance to Solder Heat(RSH)	260°C,10 seconds	30	0/180	
Moisture Sensitivity Level(MSL)	Per Jedec J-STD-020D Level 1	22	0/132	
Solderability	ANSI-J-STD-002	22	0/132	

Remark:

1. Tests are conducted without a bias condition unless otherwise stated.
2. Reliability data from product tests that is representative of similar products having structural similarity, commonality of production processes and product technology will be generically applied to those products.
3. Tests are conducted on **SMF5.0A, SMF85A, SMF100A, SMF4L5.0A, SMF4L70A, SMF4L250A**.

Estimate of Failure Rate, MTBF, FITS for a Given Operation Temperature

Temp ℃	% FR/khrs	MTBF (K)	FITS
30	0.0000076	13163061.53	0.08
55	0.00023856	419175.11	2.39
85	0.00171509	58306.01	17.15
100	0.00998019	10019.85	99.80
125	0.07033148	1421.84	703.31
150	0.39351454	254.12	3935.15

4. The **M**ean-**T**ime-**B**etween-**F**ailure (MTBF) in hours and the percent failure rate per 1000 hours (%FR/khr) are computed at a 60% confidence level using the chi square method and the Arrhenius derating model for various junction operating temperatures. For the calculations, a value of 1 eV was used for the activation energy.

Additional Site B:

Test Category	Description	Sample P/N	Package	Sample Qty	Littelfuse test Ref#	Contents/ Conditions	Standard	Result Summary
Parametric Test	Electrical Parameters	SMF5.0A	SOD-123FL	267	184153	VBR, IR		100% meet datasheet spec
		SMF85A	SOD-123FL	267	184153			
		SMF100A	SOD-123FL	267	184153			
		SMF6.5CA	SOD-123FL	267	184155			
		SMF4L250A	SOD-123FL	237	184155			
		SMF4L51CA	SOD-123FL	237	184155			
		SMF3.3	SOD-123FL	237	184157			
Reliability Test For SMF Integration From OSAT To Wuxi Inhouse	High Temperatrue Reverse Bias (HTRB)	SMF5.0A	SOD-123FL	77	184153	TA = Tj = 150°C, 1008hrs, DC biased at VR	MIL-STD-750-1 M1038 Method A	0 failures at 1008hours
		SMF85A	SOD-123FL	77	184153			
		SMF100A	SOD-123FL	77	184153			
		SMF6.5CA	SOD-123FL	77	184155			
		SMF4L250A	SOD-123FL	77	184155			
		SMF4L51CA	SOD-123FL	77	184155			
		SMF3.3	SOD-123FL	77	184157			
	High Humidity High Temp Reverse Bias (H3TRB)	SMF5.0A	SOD-123FL	40	184153	TA = 85°C, 85%RH, 1008hours, DC biased at VR	JESD22-A-101	0 failures at 1008hours
		SMF85A	SOD-123FL	40	184153			
		SMF100A	SOD-123FL	40	184153			
		SMF6.5CA	SOD-123FL	40	184155			
		SMF4L250A	SOD-123FL	40	184155			
		SMF4L51CA	SOD-123FL	40	184155			
		SMF3.3	SOD-123FL	40	184157			
	High Temperature Storage Life (HTSL)	SMF5.0A	SOD-123FL	40	184153	TA = T_{STG} = 175°C, 1008hours	JESD22-A-103	0 failures at 1008hours
		SMF85A	SOD-123FL	40	184153			
		SMF100A	SOD-123FL	40	184153			
		SMF6.5CA	SOD-123FL	40	184155			
	Unbiased Highly Accelerated Stress Test (UHAST)	SMF5.0A	SOD-123FL	40	184153	96 hours at TA=130°C & 85%RH	JESD22-A-118	0 failures at 96hours
		SMF85A	SOD-123FL	40	184153			
		SMF100A	SOD-123FL	40	184153			
		SMF6.5CA	SOD-123FL	40	184155			
		SMF4L250A	SOD-123FL	40	184155			
		SMF4L51CA	SOD-123FL	40	184155			
		SMF3.3	SOD-123FL	40	184157			
	Temperature Cycling (TC)	SMF5.0A	SOD-123FL	40	184153	TA: -55°C to 150°C, 15 minutes dwell time, 1000 cycles	JESD22-A104	0 failures at 1000cycles
		SMF85A	SOD-123FL	40	184153			
		SMF100A	SOD-123FL	40	184153			
		SMF6.5CA	SOD-123FL	40	184155			
		SMF4L250A	SOD-123FL	40	184155			
		SMF4L51CA	SOD-123FL	40	184155			
		SMF3.3	SOD-123FL	40	184157			
	Resistance to Solder Heat (RSH)	SMF5.0A	SOD-123FL	30	184153	260°C, 10secs	JESD22-A-111	0 failure after RSH
		SMF85A	SOD-123FL	30	184153			
		SMF100A	SOD-123FL	30	184153			
		SMF6.5CA	SOD-123FL	30	184155			
		SMF4L250A	SOD-123FL	30	184155			
		SMF4L51CA	SOD-123FL	30	184155			
		SMF3.3	SOD-123FL	30	184157			
	Solderability	SMF5.0A	SOD-123FL	10	184153	245°C ± 5°C, 5 ± 0.5s	J-STD-002	0 failure after Solderability
		SMF85A	SOD-123FL	10	184153			
		SMF100A	SOD-123FL	10	184153			
		SMF6.5CA	SOD-123FL	10	184155			
		SMF4L250A	SOD-123FL	10	184155			
		SMF4L51CA	SOD-123FL	10	184155			
		SMF3.3	SOD-123FL	10	184157			

— MTBF Calculation

Estimate of Failure Rate, MTBF, FITS for a Given Operation Temperature

Temp ℃	% FR/khrs	MTBF (K)	FITS
30	0.00000760	13163061.53	0.076
60	0.00023856	419175.11	2.386
80	0.00171509	58306.01	17.151
100	0.00998019	10019.85	99.802
125	0.07033148	1421.84	703.315
150	0.39351454	254.12	3935.145

The **M**ean-**T**ime-**B**etween-Failure (MTBF) in hours and the percent failure rate per 1000 hours (%FR/khr) are computed at a 60% confidence level using the chi square method and the Arrhenius derating model for various junction operating temperatures. For the calculations, a value of 1 eV was used for the activation energy.

Arrhenius derating model: $AF(T) = \exp\left[\frac{Ea}{k}\left(\frac{1}{T_{use}} - \frac{1}{T_{stress}}\right)\right]$

5.0 Packing Method

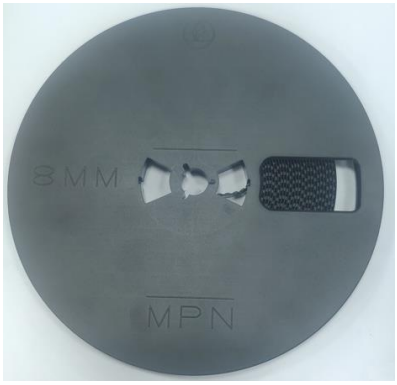
5.1 Packing Material

Packing	Current site Series SMF	Current site Series SMF-high vol/Bi, SMF4L/SMF3.3/4.0	Additional site A	Additional site B
Tape	Hot seal carrier tape	Hot seal carrier tape	Hot seal carrier tape	Hot seal carrier tape
	Details dimension refer to datasheet, remain same	Details dimension refer to datasheet, remain same	Details dimension refer to datasheet, remain same	Details dimension refer to datasheet, remain same
Reel	White Plastic Reel, 7 inches	White Plastic Reel,7 inches	White Plastic Reel, 7 inches	**Black Plastic Reel**,7 inches
	White Plastic Reel, 13 inches		**Blue** Plastic Reel, 13 inches	
Pizza Box	192mm*189mm*69mm, 7 inches (5 reels)	188mm*180mm*20mm, 7 inches (1 reel)	**199mm*182mm*21mm**, 7 inches (1 reel)	**193mm*183mm*22mm,** 7 inches (1 reel)
	340mm*340mm*21mm, 13inches (1 reel)		**345mm*332mm*21mm**, 13inches (1 reel)	
Label	Size:**100mmx40mm**	Size:70mmx40mm	Size:70mmx40mm	Size:70mmx40mm

5.2 Packing Reel outlook：

7inch Reel, existing sites

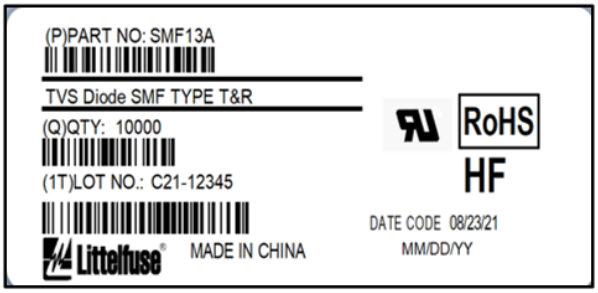
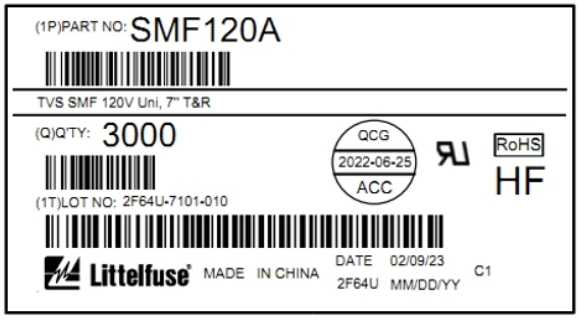
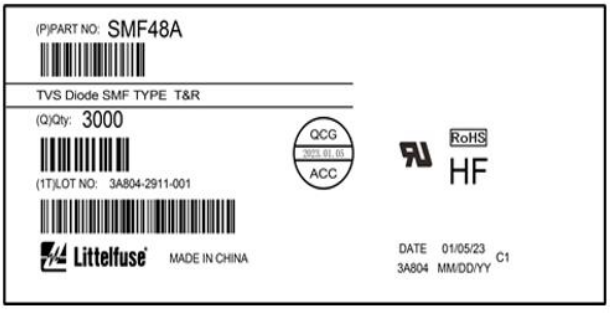

7inch Reel, additional sites added

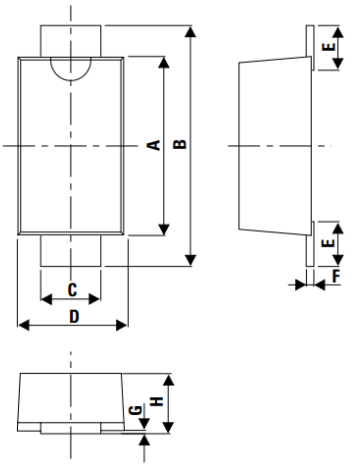
13inch Reel

Existing site	Additional site added
	

5.3 Label on Reel

Current site Series SMF	Current site Series SMF-high vol/Bi, SMF4L/SMF3.3/4.0
	
Additional site A	**Additional site B**
	

6.0 Package Dimensions Changes:



Dimensions		SMF				Changed?
		Before		After		
		Min	Max	Min	Max	
A	SMF5.0A~SMF100A	2.50	2.90	2.50	3.10	**Yes**
	SMF110A~SMF250A SMF5.0CA~SMF85CA	2.90	3.10			
B		3.40	3.90	3.40	3.90	No
C		0.70	1.20	0.70	1.20	No
D		1.50	2.00	1.50	2.00	No
E		0.35	0.90	0.35	0.90	No
F		0.05	0.26	0.05	0.26	No
G		0.00	0.10	0.00	0.10	No
H	SMF5.0A~SMF100A	0.95	1.10	0.90	1.10	**Yes**
	SMF110A~SMF250A SMF5.0CA~SMF85CA	0.90	1.08			

Dimensions	SMF4L&SMF3.3/3.3-A/4.0				Changed?
	Before		After		
	Min	Max	Min	Max	
A	2.90	3.10	2.70	3.10	**Yes**
B	3.50	3.90	3.50	3.90	No
C	0.85	1.05	0.85	1.05	No
D	1.70	2.00	1.70	2.00	No
E	0.43	0.83	0.43	0.83	No
F	0.10	0.25	0.10	0.25	No
G	0.00	0.10	0.00	0.10	No
H	0.90	1.08	0.90	1.08	No

7.0 Electrical Characteristic Summary:

There is no change in electrical characteristics. Characterization data is available upon request.

8.0 Changed Part Identification:

There is no Part used in affected products.

9.0 Recommendations & Conclusions:

Based on the reliability test results, it is determined that the additional backend locations are qualified and certified for production of the listed Littelfuse products.

10.0 Approvals:

Yaling Fan
OSAT Operation Manager
Littelfuse, Wuxi

Peter Liu
Asia OSAT Product Engineering Manager
Littelfuse, Wuxi

Hellen Yang
Product Manager
Littelfuse, Inc.

Appendix I –Affected part number list, existing site 1

Package	Series	Part Numbers	Part Numbers	Part Numbers
SOD-123FL	SMF	SMF5.0A	SFS15A	SMF43A-T13
SOD-123FL	SMF	SMF5.0A-T13	SMF15A	SMF45A
SOD-123FL	SMF	SMF6.0A	SMF15A-T13	SMF45A-T13
SOD-123FL	SMF	SMF6.0A-BW	SMF16A	SMF48A
SOD-123FL	SMF	SMF6.0AS	SMF16A-T13	SMF48A-T13
SOD-123FL	SMF	SMF6.0A-T13	SMF17A	SMF51A
SOD-123FL	SMF	SMF6.5A	SMF17A-T13	SMF51A-T13
SOD-123FL	SMF	SMF6.5A-T13	SMF18A	SMF54A
SOD-123FL	SMF	SMF7.0A	SMF18A-T13	SMF54A-T13
SOD-123FL	SMF	SMF7.0A-T13	SMF20A	SMF58A
SOD-123FL	SMF	SMF7.5A	SMF20A-T13	SMF58A-T13
SOD-123FL	SMF	SMF7.5A-T13	SMF22A	SMF60A
SOD-123FL	SMF	SMF8.0A	SMF22A-T13	SMF60A-T13
SOD-123FL	SMF	SMF8.0A-T13	SMF24A	SMF64A
SOD-123FL	SMF	SMF8.5A	SMF24A-T13	SMF64A-T13
SOD-123FL	SMF	SMF8.5A-T13	SMF26A	SMF70A
SOD-123FL	SMF	SMF9.0A	SMF26A-T13	SMF70A-T13
SOD-123FL	SMF	SMF9.0A-T13	SMF28A	SMF75A
SOD-123FL	SMF	SMF10A	SMF28A-T13	SMF75A-T13
SOD-123FL	SMF	SMF10A-T13	SMF30A	SMF78A
SOD-123FL	SMF	SMF11A	SMF30A-T13	SMF78A-T13
SOD-123FL	SMF	SMF11A-T13	SMF33A	SMF85A
SOD-123FL	SMF	SMF12A	SMF33A-T13	SMF85A-T13
SOD-123FL	SMF	SMF12A-T13	SMF36A	SMF90A
SOD-123FL	SMF	SMF13A	SMF36A-L	SMF90A-T13
SOD-123FL	SMF	SMF13A-T13	SMF36A-T13	SMF100A
SOD-123FL	SMF	SMF14A	SMF40A	SMF100A-T13
SOD-123FL	SMF	SMF14A-L	SMF40A-T13	
SOD-123FL	SMF	SMF14A-T13	SMF43A	

Appendix I –Affected part number list, existing site 2

Package	Part Numbers	Part Numbers	Part Numbers	Part Numbers
SOD-123FL	SMF3.3	SMF54CA	SMF4L11CA	SMF4L40CA
SOD-123FL	SMF3.3-A	SMF58CA	SMF4L12A	SMF4L43A
SOD-123FL	SMF4.0	SMF60CA	SMF4L12CA	SMF4L43CA
SOD-123FL	SMF5.0CA	SMF64CA	SMF4L13A	SMF4L45A
SOD-123FL	SMF6.0CA	SMF70CA	SMF4L13CA	SMF4L45CA
SOD-123FL	SMF6.5CA	SMF75CA	SMF4L13CA-GS	SMF4L48A
SOD-123FL	SMF7.0CA	SMF78CA	SMF4L14A	SMF4L48CA
SOD-123FL	SMF7.5CA	SMF85CA	SMF4L14CA	SMF4L51A
SOD-123FL	SMF8.0CA	SMF110A	SMF4L15A	SMF4L51CA
SOD-123FL	SMF8.5CA	SMF120A	SMF4L15CA	SMF4L54A
SOD-123FL	SMF9.0CA	SMF130A	SMF4L16A	SMF4L58A
SOD-123FL	SMF10CA	SMF150A	SMF4L16CA	SMF4L60A
SOD-123FL	SMF11CA	SMF160A	SMF4L17A	SMF4L64A
SOD-123FL	SMF12CA	SMF170A	SMF4L17CA	SMF4L70A
SOD-123FL	SMF13CA	SMF180A	SMF4L18A	SMF4L75A
SOD-123FL	SMF14CA	SMF188A	SMF4L18CA	SMF4L78A
SOD-123FL	SMF15CA	SMF200A	SMF4L20A	SMF4L85A
SOD-123FL	SMF16CA	SMF220A	SMF4L20CA	SMF4L90A
SOD-123FL	SMF17CA	SMF250A	SMF4L22A	SMF4L100A
SOD-123FL	SMF18CA	SMF4L5.0A	SMF4L22CA	SMF4L110A
SOD-123FL	SMF20CA	HSMF4L5.5A	SMF4L24A	SMF4L120A
SOD-123FL	SMF22CA	SMF4L6.0A	SMF4L24CA	SMF4L130A
SOD-123FL	SMF24CA	SMF4L6.5A	SMF4L26A	SMF4L150A
SOD-123FL	SMF26CA	HSMF4L7.0A-100	SMF4L26CA	SMF4L160A
SOD-123FL	SMF28CA	SMF4L7.0A	SMF4L28A	SMF4L170A
SOD-123FL	SMF30CA	SMF4L7.5A	SMF4L28CA	SMF4L180A
SOD-123FL	SMF33CA	SMF4L8.0A	SMF4L30A	SMF4L188A
SOD-123FL	SMF36CA	SMF4L8.5A	SMF4L30CA	SMF4L200A
SOD-123FL	SMF40CA	SMF4L9.0A	SMF4L33A	SMF4L220A
SOD-123FL	SMF43CA	SMF4L9.0CA	SMF4L33CA	SMF4L250A
SOD-123FL	SMF45CA	SMF4L10A	SMF4L36A	
SOD-123FL	SMF48CA	SMF4L10CA	SMF4L36CA	
SOD-123FL	SMF51CA	SMF4L11A	SMF4L40A	