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June 11, 2015

To whom it may concern:

This is to notify you that Littelfuse has accomplished a lead frame design enhancement for Thyristor TO218 products. Littelfuse existing Thyristor TO218 products fully meet datasheet specification including soldering conditions detailed in Application Note AN1004. It has been discovered, however, that some customer's application conditions can exceed these parameters especially in manual soldering operations. The purpose of implementing this new design is to enhance the product reliability and stability under extreme soldering conditions.

Qualification efforts are complete and the products with new design are going to be delivered in Aug 2015. Please see the attached documentation for change detail and affected part numbers.

All affected products have been fully qualified in accordance with established performance and reliability criteria. The attached pages summarize the qualification results. Full qualification data and/or samples will be available upon request.

If you have any questions or concerns, please contact our local Sales team or Assistant Product Manager, Jia Zhu.

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## Qualification Report

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To: Those who may concern  
From: Maggie Xu, Senior Product Engineer, Littelfuse Semiconductor (Wuxi), Co., Ltd.  
Date: June 10<sup>th</sup>, 2015  
Ref: ETR69160/69163/69156/69158/69169  
Subject: **Thyristor TO218 Products Lead Frame Enhancement**

This is to report lead frame design enhancement of Littelfuse TO218 Thyristor products. Littelfuse existing Thyristor TO218 products fully meet datasheet specification including soldering conditions detailed Application Note AN1004.

### 1. Introduction

Littelfuse add serration on lead frame die pad area as package design enhancement for TO218 packaging products.

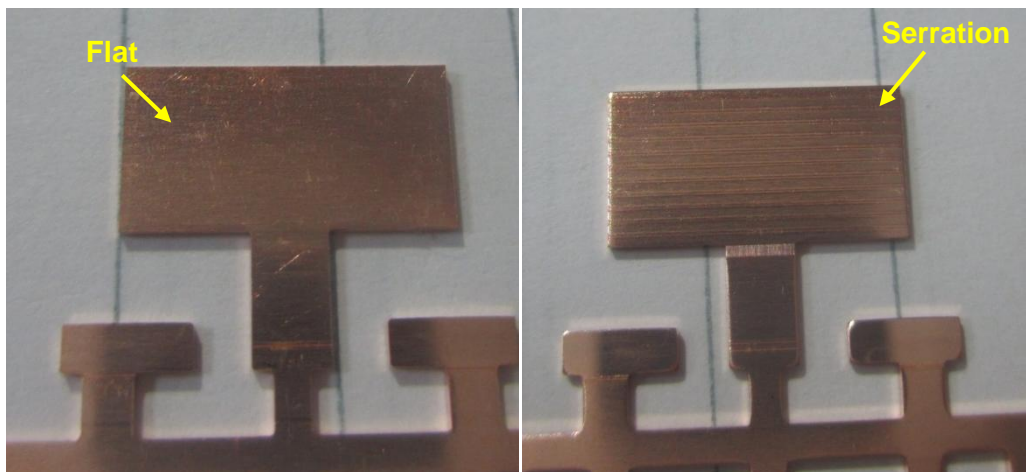


FIG 1 Existing L/F

FIG 2 Serrated L/F

Compared to existing lead frame design, serrated lead frame could reduce excessive solder build-up around die edge which minimizes the possibility of electrical short caused by extreme soldering operation conditions.

All affected product with serrated lead frame will follow function requirement of parametric, dynamic characteristic and reliability performance stated in datasheet file.

## 2. Qualification Test

### 1) Sample ID, QTY and applicable tests

Sample Properties			ETR #	Sample QTY	Applicable tests			
ID #	Lead frame type	Solder volume			Solder Dip (280°C, 10S)	AC Blocking	Temperature Cycling	Thermal Resistance
Group A	Existing L/F	Standard	69160 69163	77	X	X	X	X
Group B	Serrated L/F	Standard	69158	77	X	X	X	X

Note 1: Soldering dip of 280°C 10S is soldering condition committed per Littelfuse Application Note AN1004.

Note 2: AC blocking to evaluate the reliability under bias condition under maximum junction temperature

Note 3: Temperature cycling test to confirm serrated lead frame can withstand mechanical stress during transition between temperatures

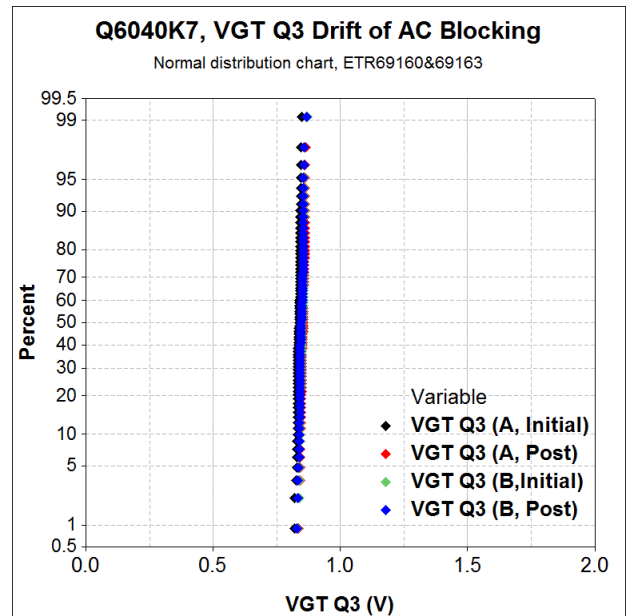
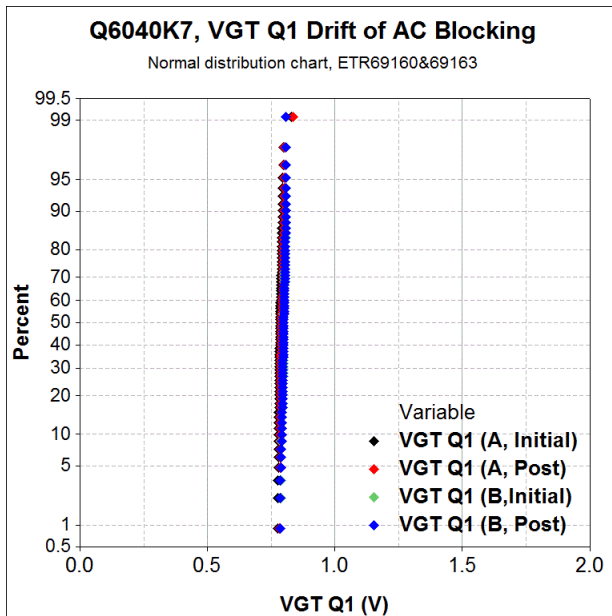
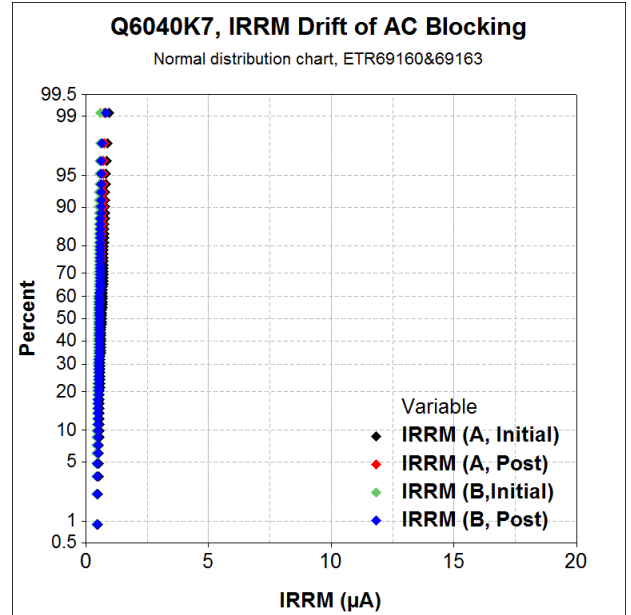
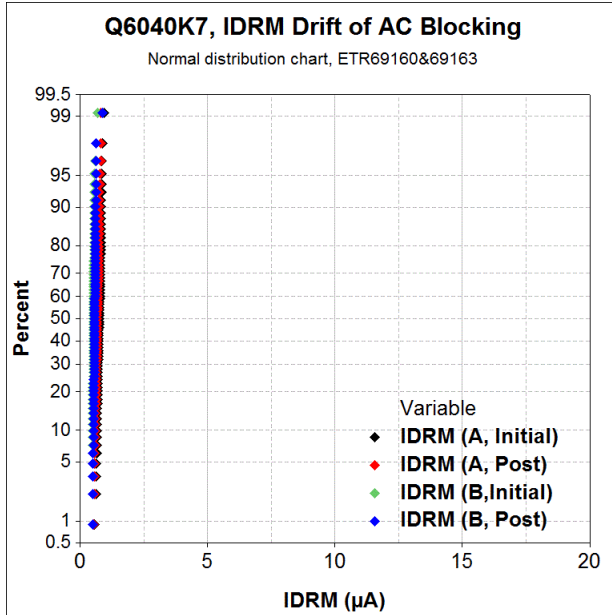
Note 4: Thermal resistance test to confirm serrated lead frame provide same level performance on heat dissipation

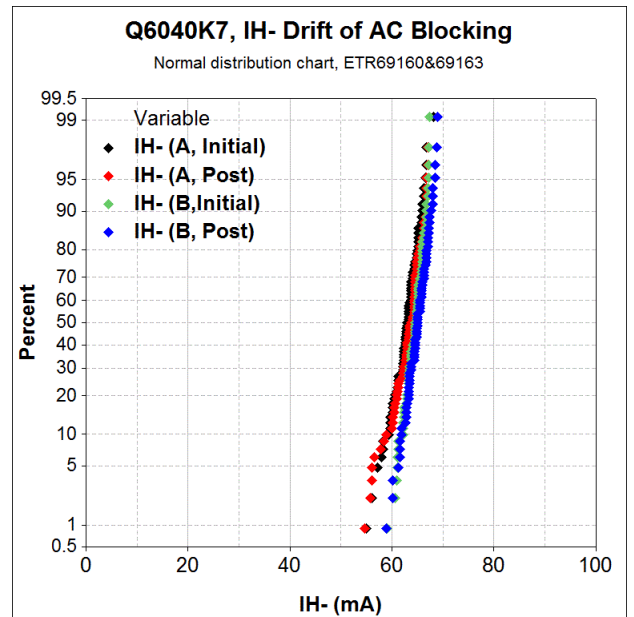
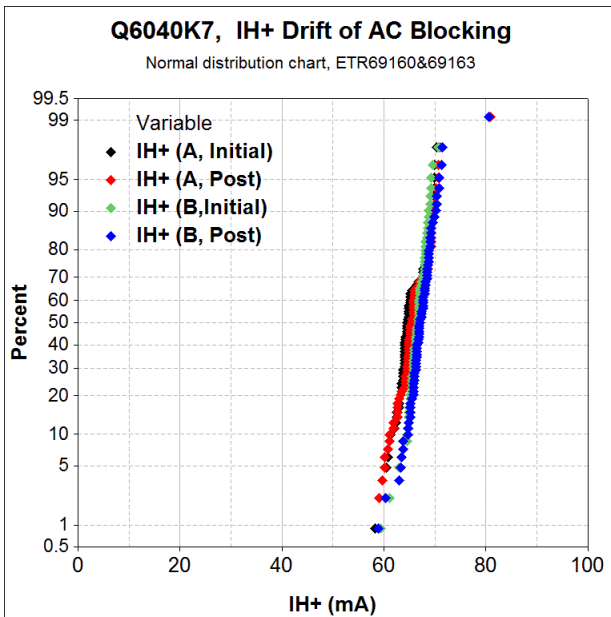
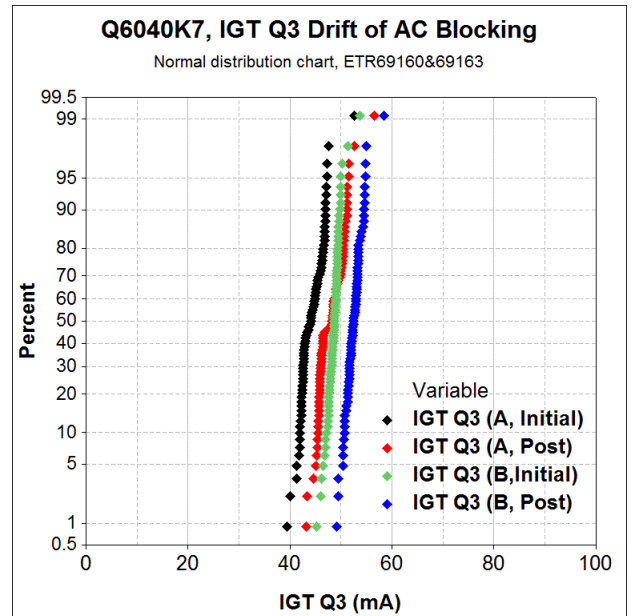
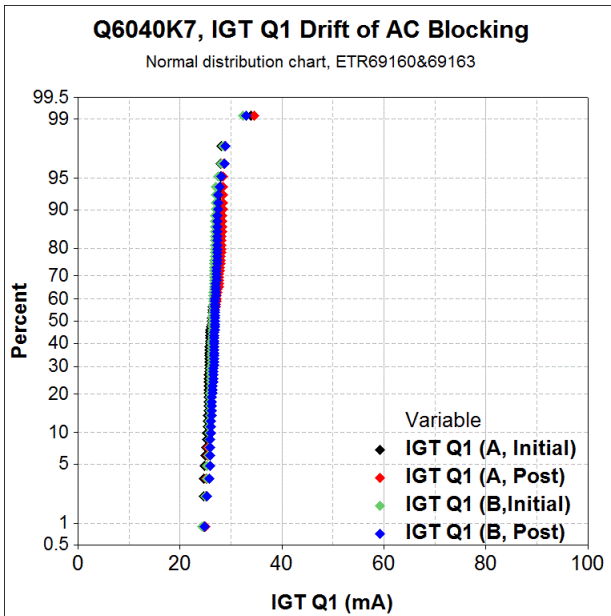
### 2) Test Condition and Result Description

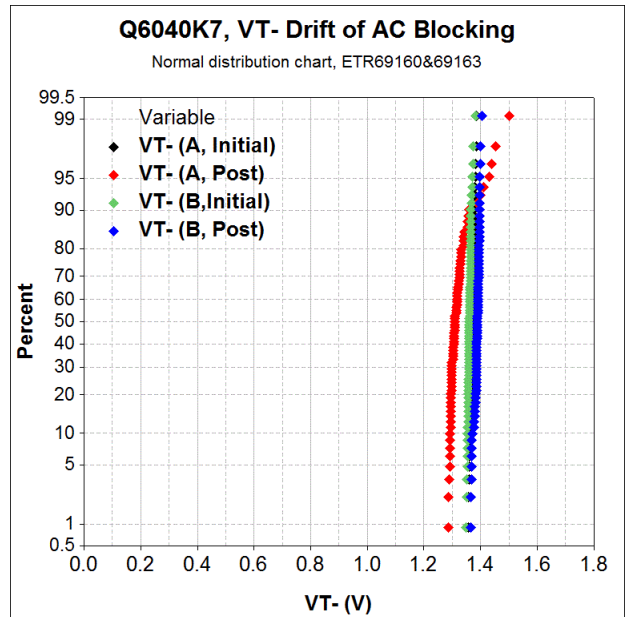
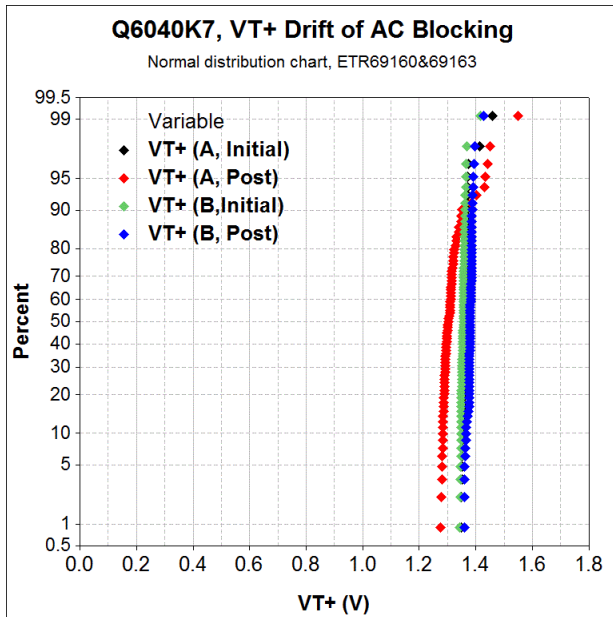
Sample Test Items	Test condition	Sample QTY	ETR Number	Test Result	
				Group A	Group B
Pre-Condition	Solder Dip, 280°C, 10S	77	69160 69163	0/77	0/77
AC Blocking	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours	77	69160	0/77	0/77
Temperature Cycling	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time	77	69163	0/77	0/77
Thermal Resistance	Junction to case (AC)	3	69158	0/3	0/3

### 3) Parametric Distribution in AC Blocking test

No failure and no drift observed in AC blocking test.  
Distribution charts of major parameters are shown as below.







### 3. Comparison Test and Drift Study

#### 1) Sample ID, QTY and applicable tests

Sample Properties			ETR #	Sample QTY	Applicable tests	
ID #	Lead frame type	Solder volume			Solder Dip (280°C, 30S)	AC Blocking
Group C	Existing L/F	1.5 x STD.	69169	20	X	X
Group D	Serrated L/F	1.5 x STD.		20	X	X

Note 1: 1.5 times of standard solder paste volume in assembly is to have test samples with extreme solder condition

#### 2) Test Condition and Result Description

Sample Test Items	Test condition	Sample QTY	ETR Number	Test Result	
				Group C	Group D
Solder Dip	280°C, 30S before AC blocking	20x2	69169	0/20	0/20
AC Blocking	MIL-STD-750, M-1040, Cond A Applied AC 1000Vpeak @ 125°C for 48hrs	20	69169	1/20	0/20

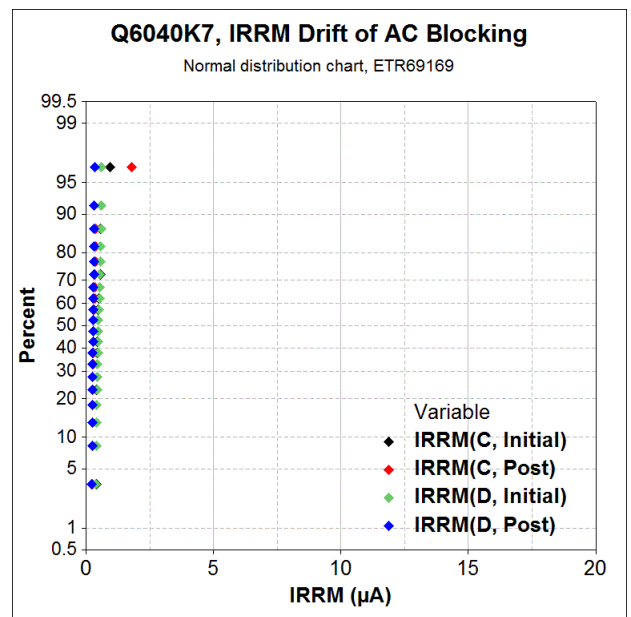
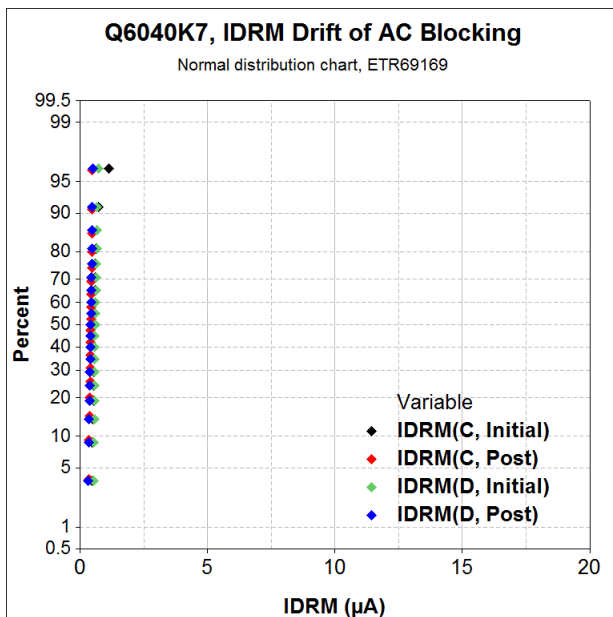
Note 1: Soldering dip of 280°C 30S to simulate extreme customer soldering condition beyond Littelfuse Application Note AN1004 indication (280°C 10S)

Note 2: AC blocking to evaluate the reliability under bias condition under maximum junction temperature

Note 3: **One** sample in Group C assembled with existing lead frame shown electrical short at AC Blocking 48hrs read point  
**No** failure found in Group D in testing with serrated lead frame

### 3) Leakage Drift Analysis Between Group C&D

Except for one failure in Group C\_AC Blocking test, rest of the units performed same level leakage drift.



### 4. Conclusion

According to above test results, Littelfuse concluded that serrated lead frame is qualified for Thyristor TO218 products.