

Lead Side Mold Flash of DRL Package

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Abstract

In this application brief we share the package design details of SOT-563 and SOT583 packages and the physical and reliability performance complied with industry standards established by JEDEC and IPC. No BLR risk for these packages has been confirmed based on our assessments.

Introduction

Small Outline Transistor (SOT) packages are very popular surface mount packages that were introduced to the electronic industry three decades ago and are commonly used for consumer electronic products. Recently these packages are being used in automotive applications thus requiring higher quality and reliability performance for component soldering, solder joint strength, and board level reliability.

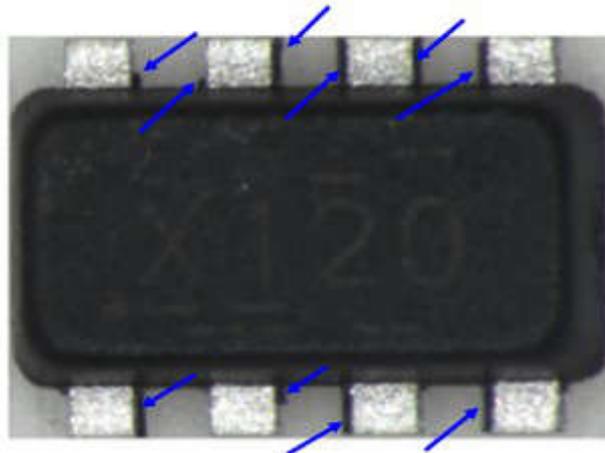


Figure 1. Lead Side Mold Flash

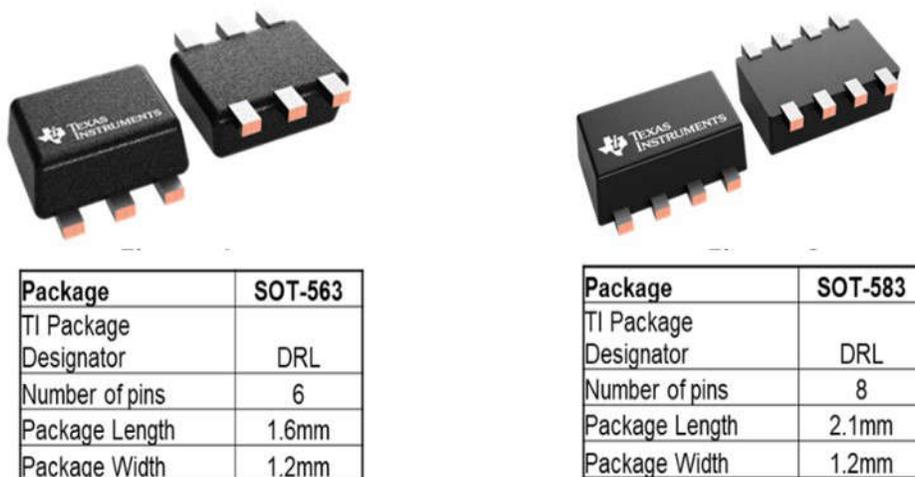


Figure 2. SOT-563 and SOT-583 Packages

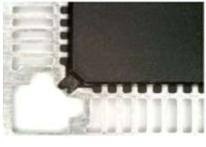
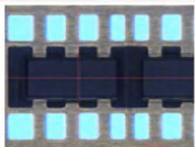
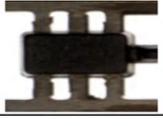
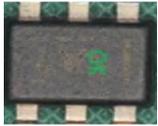
Lead Side Mold Flash is Allowed Per JEDEC MO-293 for SOT-5X3 Package

JEDEC MO-293 standard specifically addresses an acceptance of mold flash on the lead side of SOT-563 and SOT-583 packages. Mold flash between leads is allowed to the full length of the leads according to JEDEC MO-293 Specification.

Lead Length Design For QFP, Gull Form SOT, and SOT-5X3 Package

SOT-563 and SOT-583 DRL packages have a very short 0.2mm (Table 1) stub lead length or toe overhang outside the molded package body compared with the 0.6mm lead length for Gull wing SOT package and 1.0mm lead length for QFP packages. The short stub lead length design for SOT-563 and SOT-583 cannot accommodate a dambar feature design in the lead frame. Mold flash of QFP and Gull wing leaded package bleeds to the dambar of lead frame during molding. The SOT-5x3 mold flash on lead sides prevent solder creep along the lead sides during DRL component SMT to the application board.

Table 1. Lead Length/Dambar for QFP, Gull SOT, and SOT-5X3 Package

	QFP	Gull Wing SOT	TIPI-DRL 563/583	SUBCON - DRL SOT
Lead Length	1mm	0.6mm	0.2mm	0.2mm
Dambar Design Feasible	YES	YES	NO	NO
Photo				
Lead Finish	NiPdAu or Matte Tin	NiPdAu or Matte Tin	NiPdAu or Matte Tin	NiPdAu or Matte Tin

Due to 0.2mm stub lead length for SOT-563 and SOT-583, IPC-A-610E classifies these packages as bottom termination components (BTC). The bottom side of lead is a solderable side for BTC package and is inspected per IPC-A-610. BTC component classification is also assigned to QFN packages that do not have lead overhang.

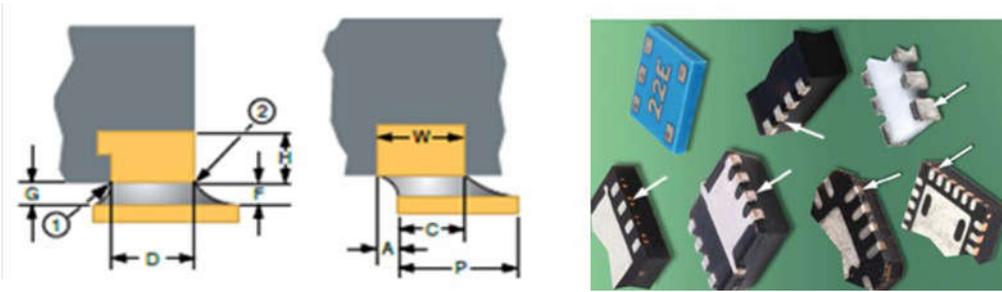


Figure 3. BTC Package Image From IPC

Mold Flash on the Lead Side of SOT-5X3 Package

Short lead length of 0.2mm for SOT-563 and SOT-583 DRL packages does not allow safe design of dambar in lead frame as required by the downstream process and machine capability. Short lead length of DRL packages results in very tight space for designing dambar in the lead frame close to package mold body that results in package chipping due to trim tool coming too close to package mold body during lead trim process. To minimize mold flashing on DRL package a mold flow blocking dam is designed in the molding tool also called mold chase. A mold flash removal process is applied downstream that significantly reduces mold flash on lead sides. A small number of units in a lot may not have lead side mold flash completely removed due to strong adhesion of mold to lead frame. Figure 4 shows generation of mold flash on leads sides and no solder creeping on lead sides during SMT.

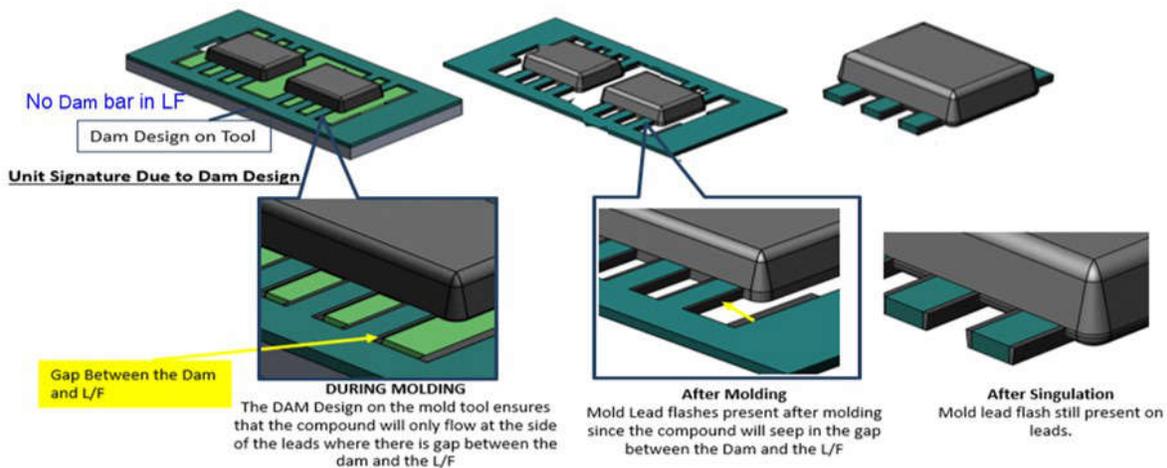


Figure 4. Mold Flashing on the Lead Side of SOT-5X3 Package

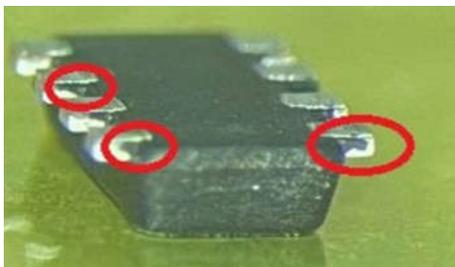


Figure 5. Mold Flash on the Lead Side

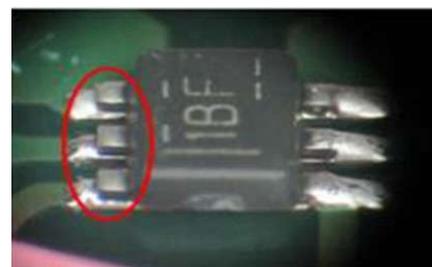


Figure 6. No Solder on the Lead Side During SMT

SOT-563 and SOT-583 Package Reliability Performance – TI Data

TI has done extensive reliability testing of SOT-563 and SOT-583 packages. Multiple products have successfully completed component level reliability (CLR) qualification tests along with board level reliability (BLR) tests. BLR

tests are performed per the specifications and standards in [Table 2](#). BLR test board SMT stencil land pattern design aligns to IPC-610, Bottom Termination Component (BTC) solder joint inspection.

Table 2. BLR Test Condition

BLR Temperature Cycle Test Conditions and Sample Sizes					
End Application	Board Thickness	Sample Size	Pass Criteria	Industry Standard	
Automotive	1.6mmt	32	0 Fail thru 1K cyc	IPC-9701	
Commercial	1.0mmt	32	0 Fail thru 1K cyc	IPC-9701	

Table 3. BLR Test Results

Package	BLR Board	BLR TC Condition	Sample Size / Fail	BLR Cycles Passed	Remarks
SOT-583	1.6mm 8ML FR4 (Auto)	TC2 -40/125C 60min (Auto)	32/0	4916	Test terminated after 4916 cyc
SOT-583	1.0mm 8ML FR4 (Commercial)	TC3 -40/125C 30min (Commercial)	32/0	7793	Test terminated after 7793 cyc
SOT-563	1.6mm 8ML FR4 (Auto)	TC2 -40/125C 60min (Auto)	32/0	6098	Test terminated after 6098 cyc
SOT-563	1.0mm 8ML FR4 (Commercial)	TC3 -40/125C 30min (Commercial)	32/0	6909	Test terminated after 6909 cyc

Conclusion

SOT DRL packages are popular and are used in large quantities in both commercial and automotive end applications. DRL packages must be treated as bottom termination packages (BTC) as classified by IPC-A-610. DRL packages from TI meet and exceed the physical and reliability standards published by IPC and Jedec specifications applicable to these packages. TI is working on reducing the lead side flash and improving the solderability of DRL package.

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