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<input checked="" type="checkbox"/>	Semtech Canada Corporation, 4281 Harvester Road, Burlington, Ontario L7L 5M4 Canada
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<input type="checkbox"/>	Semtech Neuchatel Sarl, Route des Gouttes d'Or 40, CH-2000 Neuchatel Switzerland
<input type="checkbox"/>	Nanotech Semiconductor, Semtech Corporation, 2 West Point Court, Bristol, United Kingdom, BS32 4PY
<input type="checkbox"/>	Semtech Corpus Christi SA de CV, Carretera Matamorros Edificio 7, Reynosa, Tamaulipas, Mexico 88780
<input type="checkbox"/>	Semtech Triune, 1101 Resource Drive, Suite 121, Plano TX 75074
<input type="checkbox"/>	

Change Details

Part Number(s) Affected:

GN2403BIBE3, GN2403SBIBE3, GN2404BIBE3,
GN2407BIBE3, GN2407SBIBE3, GN2408BIBE3,
GN2409BIBE3, GN2410FBIBE3, GN2410BIBE3,
GN2411BIBE3, GN2412BIBE3, GN2415BIBE3,
GT1704-IBE3, GT1706-IBE3

Customer Part Number(s) Affected:

N/A

Description, Purpose and Effect of Change:

Purpose of Change:

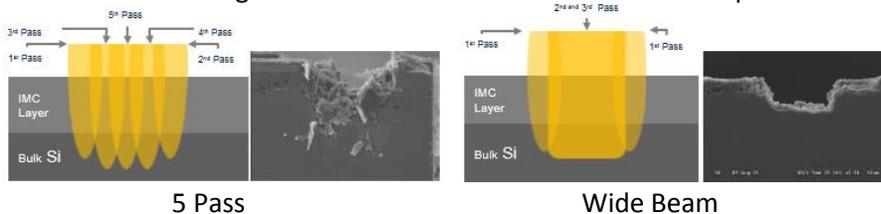
Semtech's Assembly Subcontractor, Amkor Technology Taiwan Ltd, has issued a final change notice: PCN171130 "Semtech LG/Dicing Saw Improvement". The proposed change is to optimize process at Laser Grooving and Wafer Saw to minimize risk of sidewall crack and topside chip out occurrence

- Laser grooving improvement by:
 - Increasing keep-out-zone from seal ring to side wall >5um (decreasing laser groove kerf width)
 - Optimizing overall shape/profile of the groove – Wide beam Laser Grooving
 - Decreasing overall EPA (energy density per area) – Wide beam Laser Grooving
- Wafer saw improvement (Z1 blade):
 - Blade grit concentration reduction
 - Blade thickness reduction to accommodate resizing of laser grooving kerf width

Description of Laser Grooving Change:

Wide (Multi) Beam is a method in laser grooving that allows for reduction of total applied energy by decreasing the amount of passes required with similar results as "V" beam method

- This process allows better kerf properties and more clearance from seal ring. This minimizes risk for top side chipping or ILD layer delamination.
- This also allows better Z1 sawing and consistent kerf to achieve >5um keep out zone.



Change Classification	<input checked="" type="checkbox"/> Major <input type="checkbox"/> Minor	Impact to Form, Fit, Function	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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PRODUCT / PROCESS CHANGE NOTIFICATION

PCN-000434

Date: 12 February, 2018

P2/2

Impact to Data Sheet	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	New Revision or Date	<input type="checkbox"/> N/A
Impact to Performance, Characteristics or Reliability:			
The changes to the process are intended to improve the reliability of the product by preventing the sidewall cracking and topside chip out.			
Implementation Date	1 st April 2018	Work Week	WW13
Last Time Ship (LTS) Of unchanged product	30 th April 2018	Affecting Lot No. / Serial No. (SN)	
Sample Availability	2 nd March 2018	Qualification Report Availability	2 nd Jan 2018
Supporting Documents for Change Validation/Attachments:			
<ul style="list-style-type: none"> Amkor PCN Changes 			
Issuing Authority			
Semtech Business Unit:	Signal Integrity Products		
Semtech Contact Info:	Robert Potter Semtech EMEA Ltd. Quality Manager, St. James Court B, Great Park Road, Bradley Stoke, Bristol BS32 4QJ United Kindom rpotter@semtech.com		
FOR FURTHER INFORMATION & WORLDWIDE SALES COVERAGE: http://www.semtech.com/contact/index.html#support			



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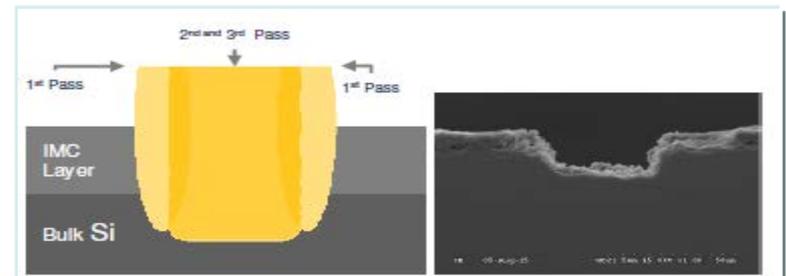
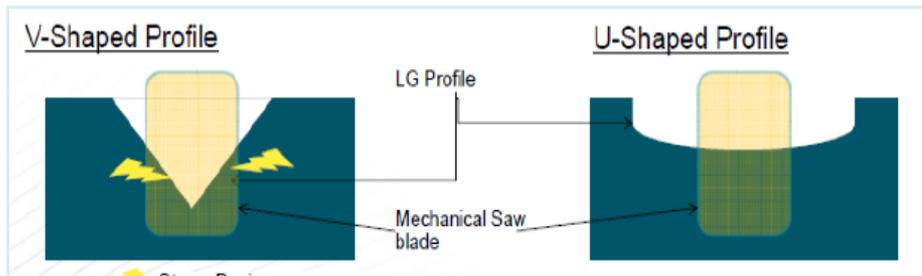
Amkor GN2411 PCN Change

Initial PCN Improvement Actions

Changes were made at Laser Grooving/Wafer Saw to prevent sidewall crack and topside chip out.

- Increasing keep-out-zone from the seal ring by decreasing the laser groove kerf width to 52um (+/- 3um).
- Optimizing the overall shape/profile of the groove – Wide beam Laser Grooving
- Decreasing the overall EPA (energy density per area) – Enable Z1 blade area optimization
- Z1 Blade thickness/grit concentration reduction to enable LG clearance >5um

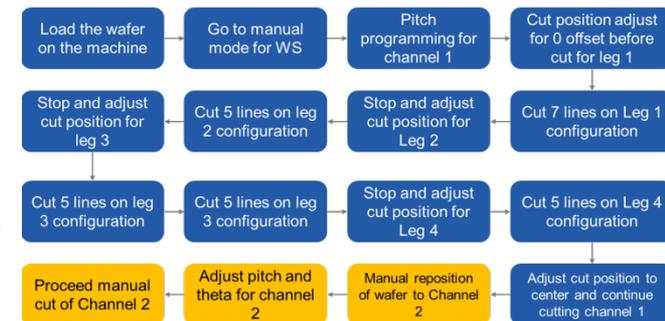
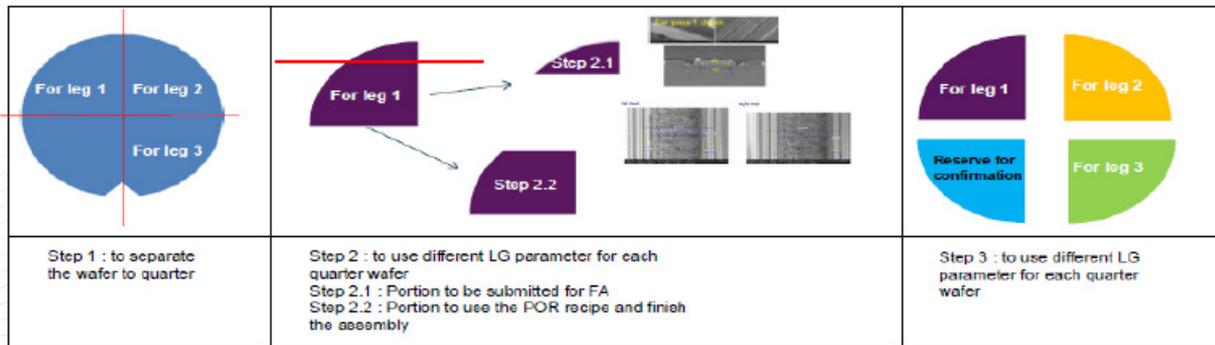
Leg	Condition	SS	LG	Saw	Assembly	Setup	Workmanship/ OS/ X-section	MSL3A+HAST96	MSL3A+TCT300 ,TC500	IR5X
1	Proposed PCN/POR	150	Proposed PCN	Proposed PCN	Standard	5	10	min 45	min 45	min 45
2	Proposed POR + Power	150	Proposed PCN + 0.5W	Proposed PCN	Standard	5	10	min 45	min 45	min 45
3	Proposed POR + Misaligned Groove	150	Proposed PCN + 0.5W	Proposed PCN	Standard	5	10	min 45	min 45	min 45



PCN Engineering Flow

Process flow carried out to ensure improvements meet quality expectations :

1. Establish LG recipe with 52um kerf requirements.
2. Ensure laser grooving and mechanical sawing recipe meet targets below :
 - Total EPA (energy density per area) : $\leq 1.2 \text{ J/mm}^2$
 - LG kerf width : Target $\pm 3\mu\text{m}$
 - Minimum keep out zone from dummy bar : $> 5\mu\text{m}$
 - LG depth compromises of below targets :
 - ✓ Non TEG location: Target $15\pm 3\mu\text{m}$
 - ✓ TEG location : Target $12\pm 3\mu\text{m}$
 - ✓ Maximum Porosity depth : $< 25 \mu\text{m}$
 - ✓ Bottom width at $10\mu\text{m}$ depth : $> 30\mu\text{m}$



Monitor	Item	L/G Depth	L/G Kerf width	L/G to dummy bar	Bottom width	Laser Profile pattern	X-section (1-pass)	X-section (LG All)	Porosity depth	IR	Side wall inspection	Visual inspection	Heat affect zone check
	Criteria	>10um	Target $\pm 3 \mu\text{m}$	> 5um	10um bottom width : $> 30\mu\text{m}$		10*12um	Dimension confirmation / Recast performance	<25 um	No delam	No crack/delam	As above	No delam
	S/S	5*	5*	5*	5*		2*	2*	2*	2*	5*/2*		1*
	Tool	Laser profiler	Laser profiler	Laser profiler	Laser profiler		X-section	X-section	Data and SEM	IR	OM / SEM	50X magnification	FIB
													

Final PCN Process – Before/After



Process	Item	Original Configuration	Proposed POR/PCN
Laser Grooving	Kerf width	55um	52um
	Depth	>10um	>10um
	Bottom Width	No Monitoring	>30um at 10um depth
	# of laser pass	5	3
	Power	1.6W - 3W	2.5W - 4W
	Freq	100Hz to 150Hz	40Hz to 200Hz
	beam width	10um	10um - 50um
	beam length	10um	10um
	Cut Length	300mm	300mm
	EPA (J/mm2) each pass	0.71 - 1.00	0.25 - 0.40
Wafer Saw	Z1 Blade	ZH05 SD3500	ZH05 SD2000
	Z1 Blade Thickness	38um-43um	38um-40um
	Z2 blade Thickness	30um-35um	30um-35um
	Z1 % Cut	20% - 30%	20% - 30%
	Auto Blade dressing Frequency	Change Blade	every 45 lines

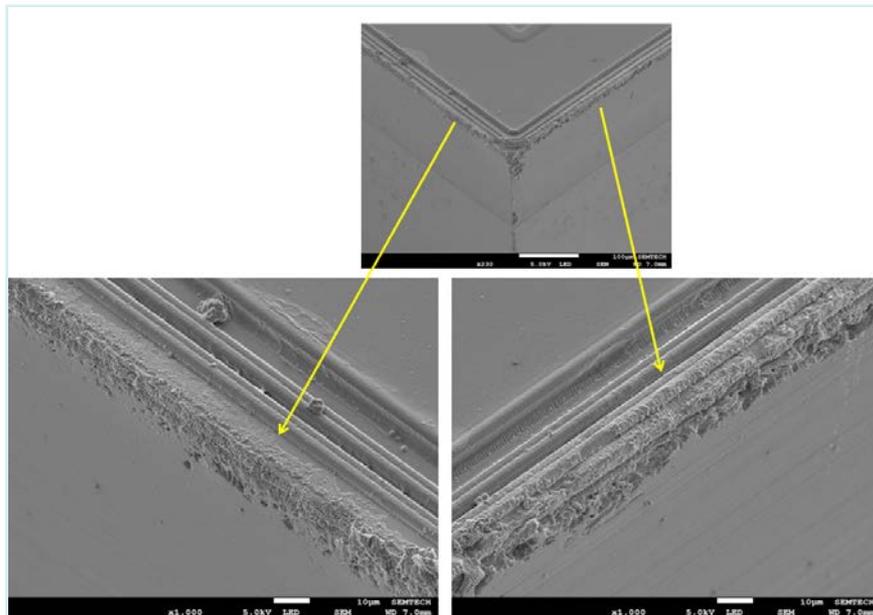
- **Less kerf width with improved Z1 blade thickness**
- **Less total laser energy minimizing risk of side wall damage**
- **Reduced chipping with increased blade dressing**

Before/After Changes – Kerf Width

Action : Reduce Laser Grooving kerf width from ~55um to 52um providing safety margin away from die side wall/dummy bar

Before

Laser Grooving Width: >55um
Z1 Blade : HCFE
Z2 Blade : HEFD
Centering : +/- 3um



After

Laser Grooving Width : 52um
Z1 Blade : ZH05
Z2 Blade : HEFD
Centering : +/- 3um



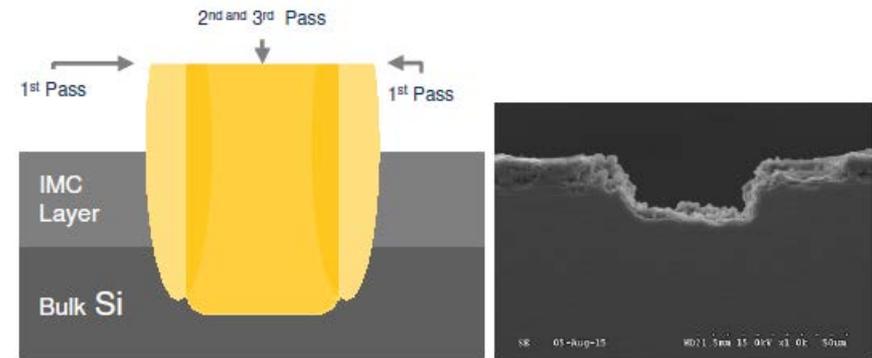
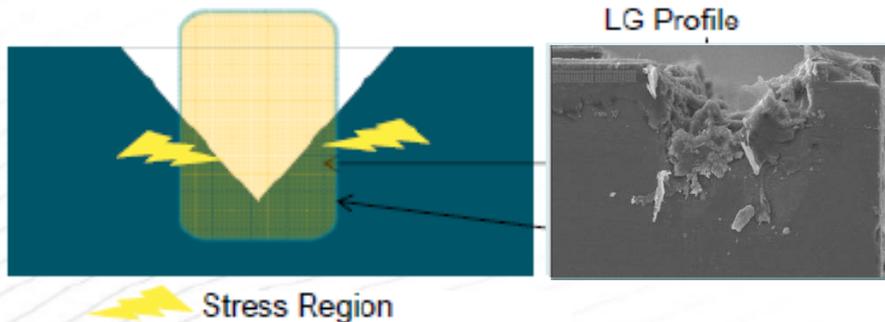
Before/After Changes – LG Profile

Action : Optimizing laser groove profile from V groove to U Groove (wide beam) to reduce stress on side wall.

Before

After

V-Shaped Profile



- V shape profile is widely used in high volume production laser grooving standards.
- Risk of blade to hit sidewall at certain stress points and initiate Si sidewall cracking towards the active layers

- U-Groove/Wide Beam method in laser grooving allows for the reduction of total applied energy by decreasing the amount of passes required. Less risk of defects.
- The wide kerf/clearance allows Z1 blade to saw thru without risk of damaging side wall.
- This profile maintain the below targets :
 - Laser Width – overall laser width target +/-3um
 - Laser Depth – low K layers are properly remove
 - KOZ (Keep out zone) between seal ring to laser edge sufficient to prevent possible metal redeposition/heat dissipation
 - Porosity width should be less than 25um

Before/After Changes – Quality Gate

Action : Increase quality gatings to meet Laser Groove and sawing standards

Before

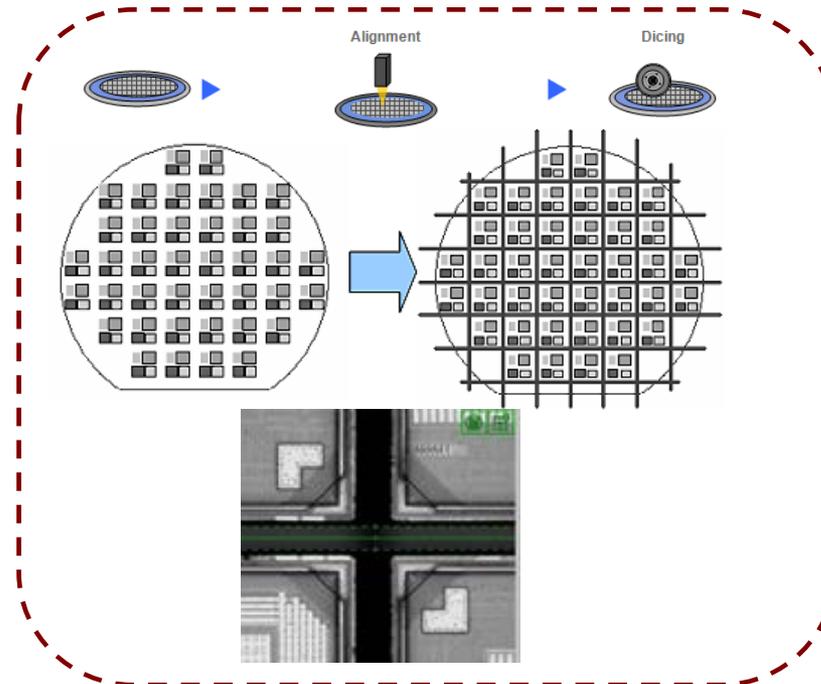
- LG Kerf Check : 10 lines
- Wafer Saw Kerf Check : 10 lines
- Auto dressing : New blade only



After

- LG Kerf Check : 5 lines
- Wafer Saw Kerf Check : 5 lines
- Auto dressing : every 45 lines
- LG kerf/width using profiler for every new setup
- 100% AOI
- IR inspection after UF curing process : Sampling

KERF CHECK (SAW/LG)



PCN REL Results – Quantity Mapping

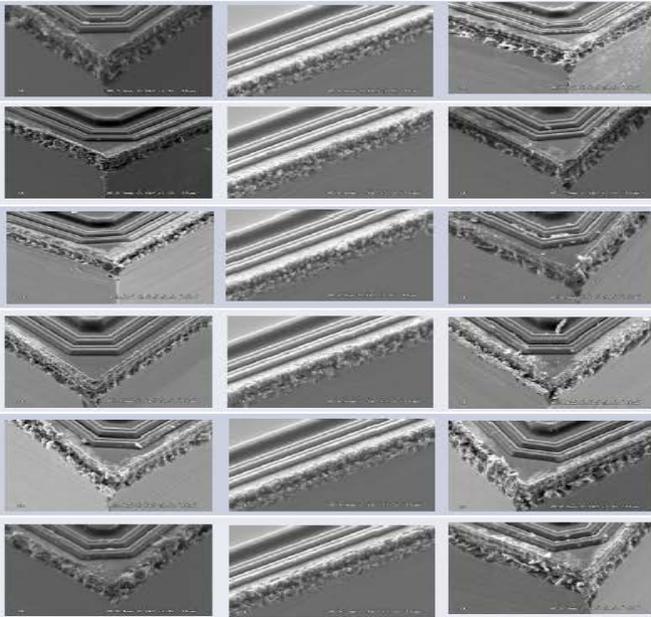


		HAST 96				TC300		TC500	
Customer lot	In	Out	Customer lot	In	Out	In	Out		
128044.1	85	85	128044.1	84	84	84	84		
128045.1	77	77	128045.1	77	77	77	77		
128046.1	75	75	128046.1	74	74	74	74		

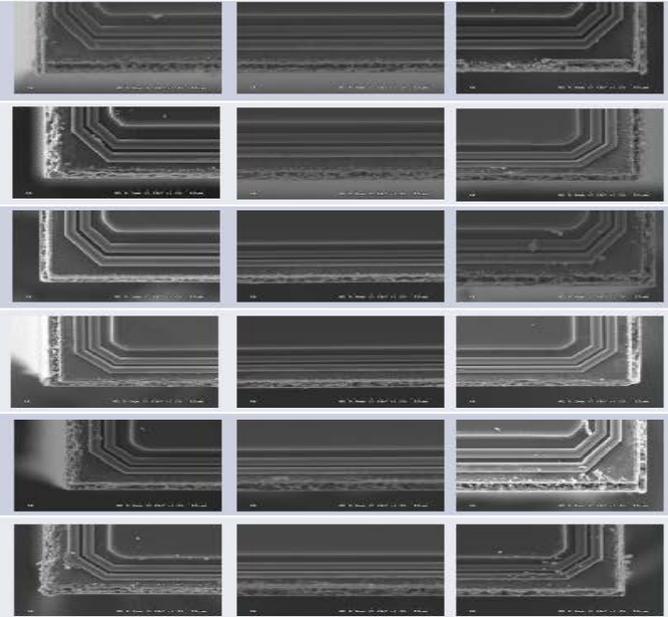
- **Passed 100% REL (MSL3A /HAST96hrs/TC500) with zero chipping.**
- **Kerf profile all units >5um width from side wall.**
- **Z1 blade effectiveness zero chipping with CPK >1.67**

REL Results - Inspection

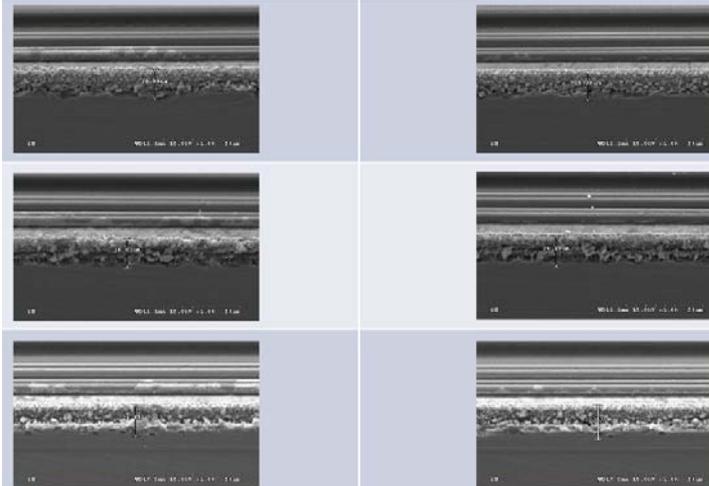
SEM Tilt Side view



SEM Top view



SEM Side view – Porosity Depth



Validation Run



Action : Validation lot build with PCN process. Results for full build below :

Device	GN2411BIE3		
MO Lot No.	FC7440062 (PCN)		
Wafer Lot No.	PF6A47.00		
Act. QTY	4518		
Items	In	Out	Yield%
Invoice	4518	4518	100%
2 nd Opt	4518	4402	97.43%
Die Attach	4402	4402	100%
D/A Flux Clean	4402	4402	100%
Underfill Dispensing	4402	4402	100%
3 rd Opt	4402	4398	99.91%
Laser Mark	4398	4398	100%
Ball Attach	4398	4398	100%
FVI	4398	4396	99.95%
Packing	4396	4396	100%
Act. Assembly Yield (%)	97.29%		

No chipping defects found from AOI

No chipping defects found from IR

Cosmetic defects

Action : Final Test result for Post REL

DeviceNo	CustomerLotNo	TestQty	PassQty	FailQty	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	FinalYield
GN2411BIE3-01	163117.1	500	500	0	500	0	0	0	0	0	0	0	100.00%

PCN Summary



- PCN results meets package requirements with no change in form/fit/function. Risk on chipping significantly reduced.
- Wide Beam LG Dicing PCN met all condition below :
 - Laser Width (criteria: 55um +/-3)
 - Minimum keep out zone from outer seal ring > 5um
 - Bottom width at 10um depth : >30um
 - LG depth: Non TEG location Target 15+/-3um, TEG location : Target 12+/-3um
 - Z1 Blade: ZH05 SD2000N1 50
- All lots (PCN/Validation) passed MSL3A /HAST96hrs /TC500. FA inspection indicate no risk of chipping.
- Inspection gating has been improved to include 100% AOI and IR inspection.
- Semtech is ready for Mass Production on current PCN process.