PRODUCT/PROCESS CHANGE NOTIFICATION

PCN CRP/11/6886
Notification Date 11/02/2011

Design change of trays for BGA packages 27x27 and 35x35

Table 1. Change Implementation Schedule

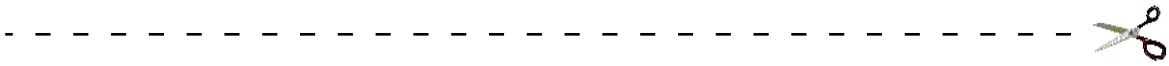
Forecasted implementation date for change	01-Feb-2012
Forecasted availabillity date of samples for customer	26-Oct-2011
Forecasted date for **STMicroelectronics** change Qualification Plan results availability	26-Oct-2011
Estimated date of changed product first shipment	01-Feb-2012

Table 2. Change Identification

Product Identification (Product Family/Commercial Product)	Tray for PBGA 27x27 & PBGA 35x35
Type of change	Packing
Reason for change	Improvement of quality of trays
Description of the change	The stacking height of the trays will increase from 1.27mm to 2.00mm to improve device capture. In addition, the tray pocket design will be changed from Substrate-support to Floor-support to reduce potential substrate damage to the packages.
Product Line(s) and/or Part Number(s)	See attached
Description of the Qualification Plan	See attached
Change Product Identification	Identification is managed through the QA Number
Manufacturing Location(s)	Please Refer To The Description Of The Change

Table 3. List of Attachments

Customer Part numbers list	
Qualification Plan results	



Customer Acknowledgement of Receipt	**PCN CRP/11/6886**
Please sign and return to STMicroelectronics Sales Office	**Notification Date 11/02/2011**

☐ Qualification Plan Denied	Name:
☐ Qualification Plan Approved	Title:
	Company:
☐ Change Denied	Date:
☐ Change Approved	Signature:

Remark

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DOCUMENT APPROVAL

Name	Function
Sibille, Marie-Helene	Corporate Quality Manager
Low, Patrick	Process Owner

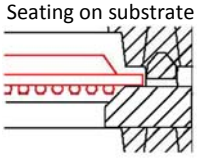
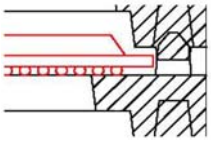
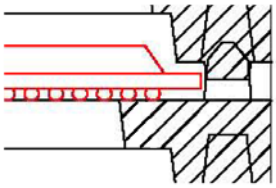
Design change of trays for BGA packages 27x27 and 35x35

WHAT:

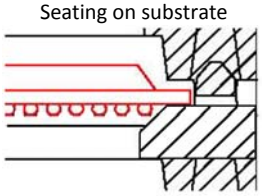
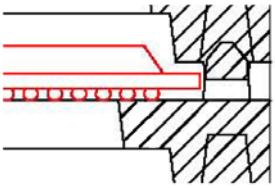
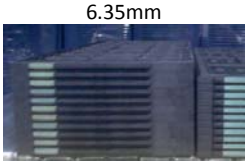
The characteristics of trays for BGA packages 27x27 and 35x35 are being modified and standardized for quality improvement purpose.
As a result, the supplier, PEAK will replace the current supplier for trays of packages 27x27 and will be used as a second source for trays of packages 35x35.

With the new Floor Support Design, the total height of stacked trays will be reduced.
For 10 stacked trays, the total stacked tray height will decrease from 63.5mm to 56.2mm. The individual tray thickness (7.62mm) will remain the same. Only the tray stacking pitch is reduced.

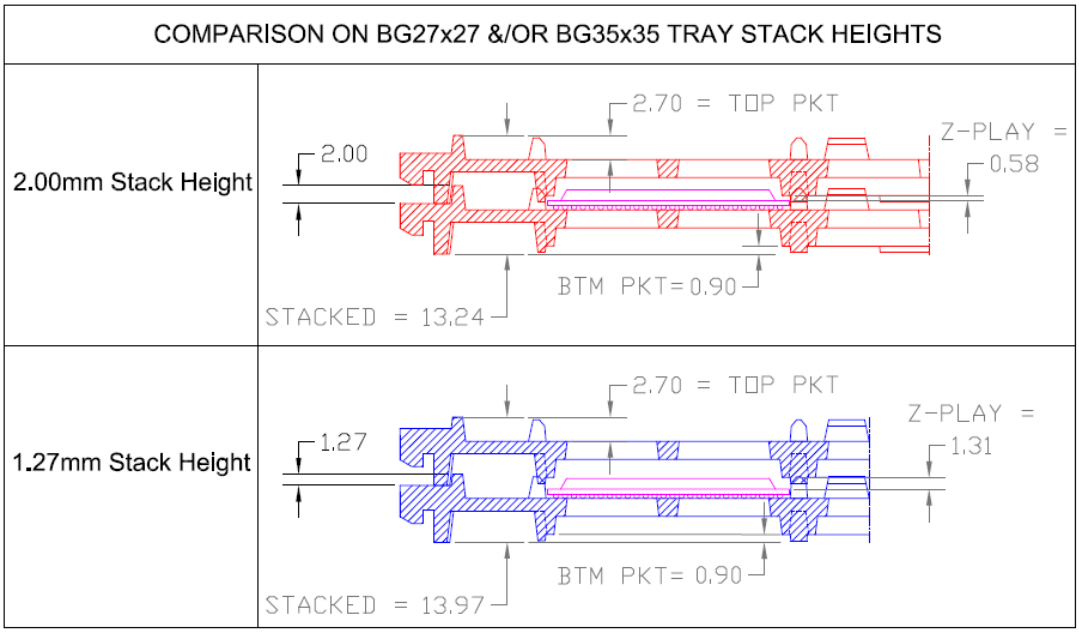
Tray for packages 27x27

	Before		After
Pocket Design	Seating on substrate 	Seating on balls Floor Support Design 	Seating on balls Floor Support Design 
Tray Stacking pitch	6.35mm 		5.62mm 

Tray for packages 35x35

	Before	After
Pocket Design	Seating on substrate 	Seating on balls Floor Support  Design
Tray Stacking pitch	6.35mm 	5.62mm 
Device Protection	Device protruding out of tray	Device inside pocket

As indicated in the below graphics, with a lower tray stacking pitch of 5.62mm (corresponding to a stack height of 2.00mm), there is less Z-play between the tray and the package as compared to a tray stacking pitch of 6.35mm (corresponding to a stack height of 1.27mm).



As a result, this reduces the risk of damage during the drop test and the risk of having double units with a spatial reduction between the package and the bottom of the tray.

WHY:

The reason of this change are:

1) Improvement of Device Placement,
2) Reduction of substrate & ball defects due to drop test damage,
3) Reduction of substrate damage at corners with better device capture.
4) Elimination of the possibility to have two devices on top of each other.
5) Corrective action following a customer issue about the damage of substrate

WHEN:

The first modified products will be shipped at minimum 3 months after the publication of this PCN

HOW:

The following pages introduce the results of the qualification performed in Malta and Muar (Malaysia) plants.

Qualification of new BGA 35x35 Tray

ST Spec: 8080190
ST Code of sample under test : 3CP70942/3CP20735 (bakeable)
3CP73175 (non-bakeable)
Suppliers : PEAK
Supplier Part Nos. : PEAK (TH BG3535 1.5 0308 6 bL2)

Aim: To qualify a new tray for BGA 35x35 to eliminate corner substrate chipping defects.

Fig.1 Design of BGA 35x35 tray under qualification – Top side

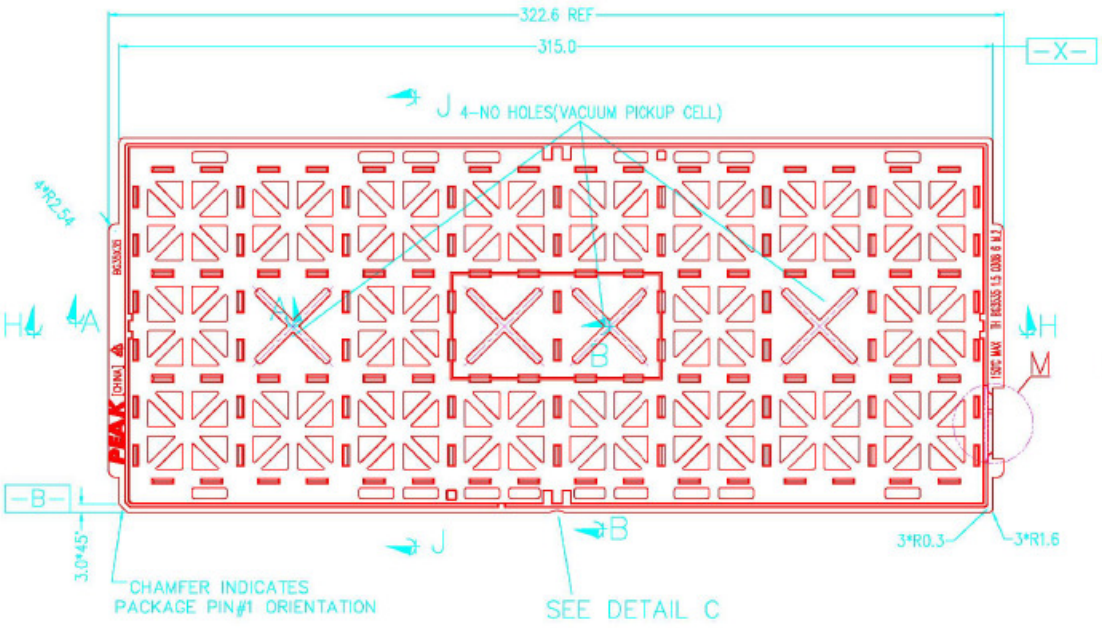


Fig.2 Design of BGA 35x35 tray under qualification – Long Edge

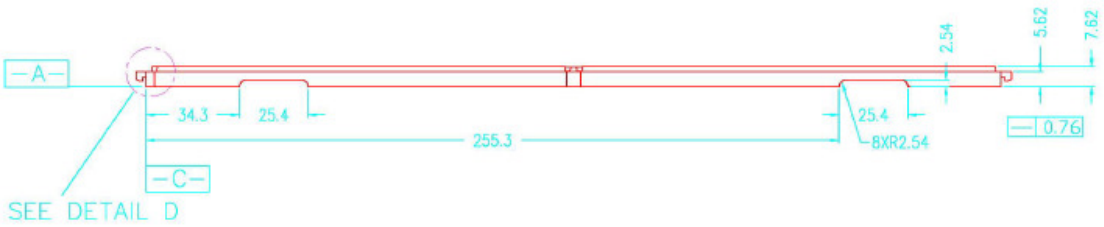


Fig.3 Design of BGA 35x35 tray under qualification – Short edge

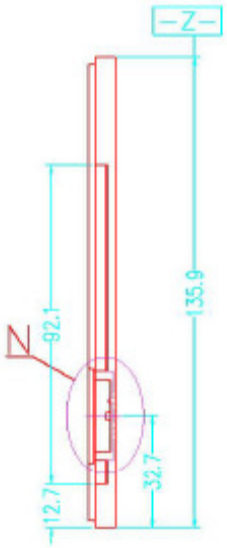


Fig.4 Design of BGA 35x35 tray under qualification – Bottom side

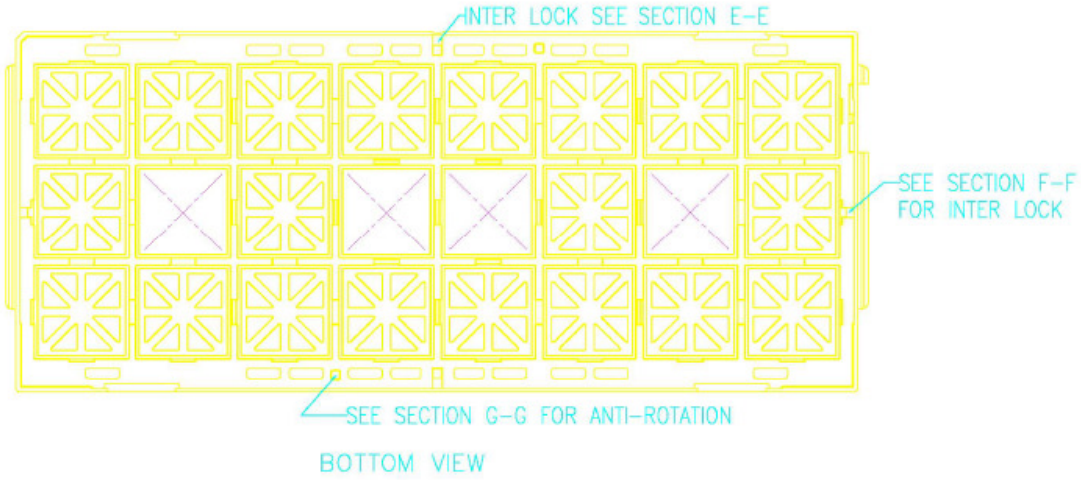
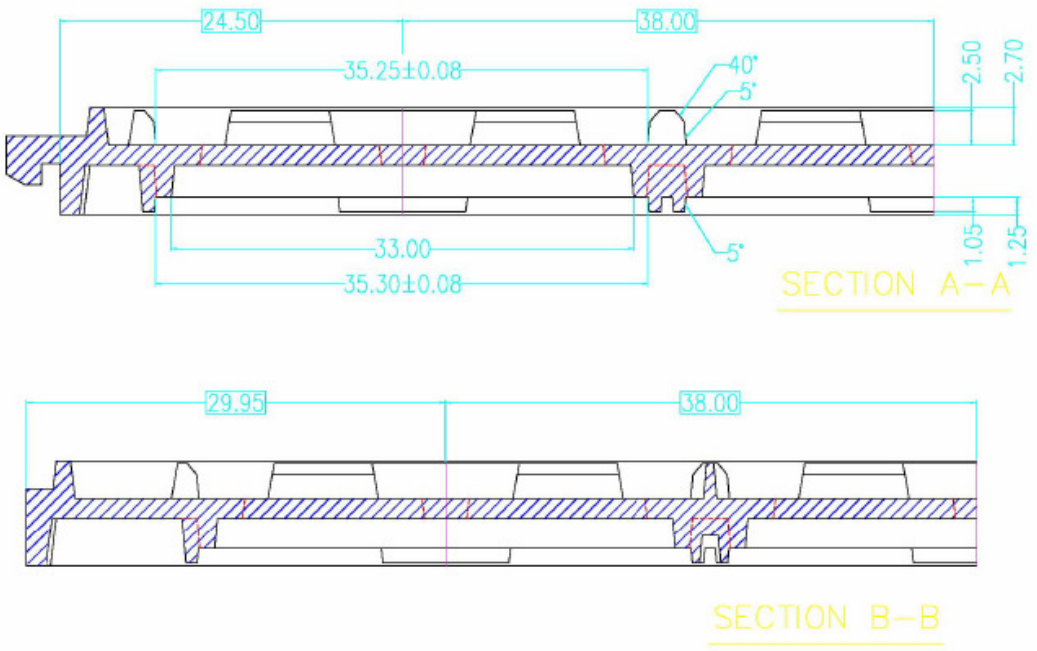


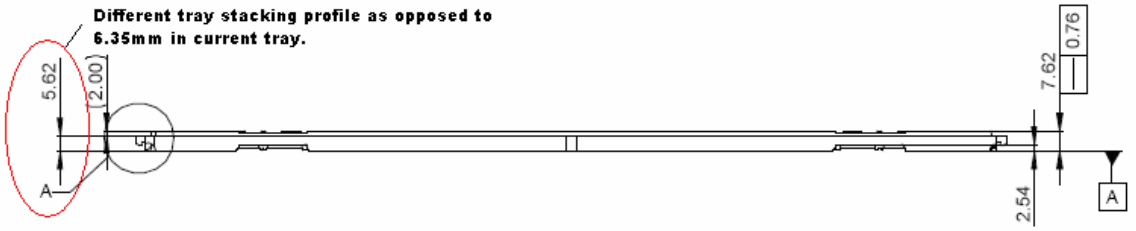
Fig.5 Design of BGA 35x35 tray under qualification – Detailed pocket design

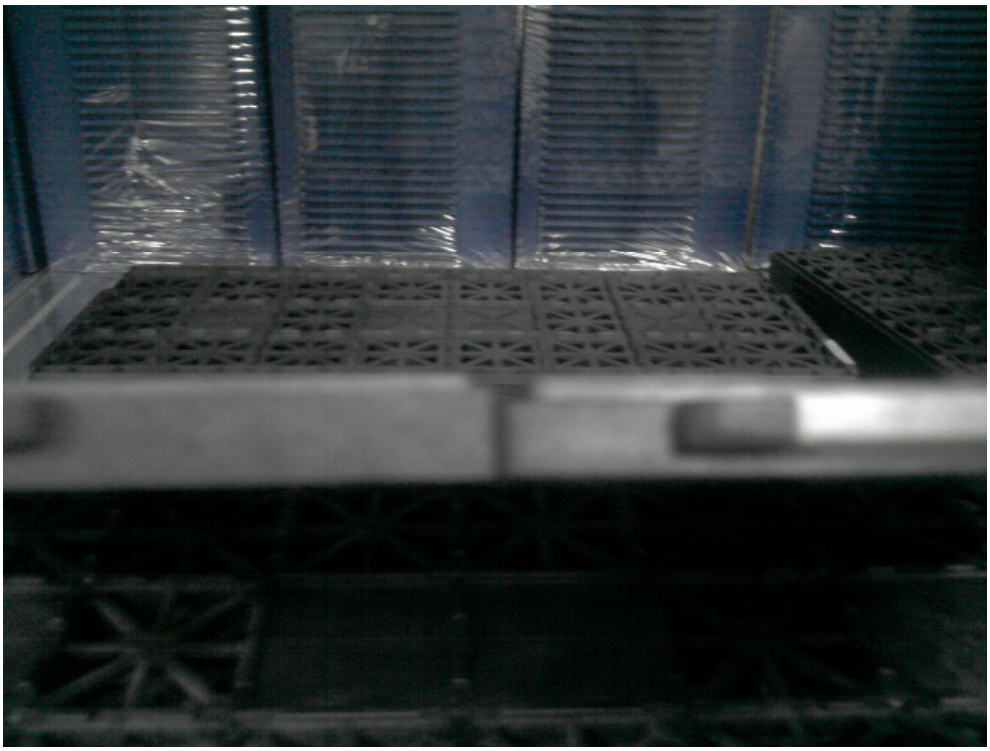


Visual Inspection Report:

Items	Visual Inspection	Yes	No	Quantities	Remarks
1	Chip/Crack		✓	N/A	
2	Align with ST specification	✓		N/A	
3	Tray matrix	✓ (8x3)		N/A	
4	Full fence			N/A	Full fence apply for QFP packages
5	Meet JEDEC standard requirement	✓		N/A	
6	Contain stain or foreign material		✓	N/A	

This tray has a different stacking profile from the current BGA 35x35 tray. The tray stacking pitch for this tray is 5.62mm whilst the current tray has a stacking pitch of 6.35mm. Note: Overall tray thickness remains the same 7.62mm.





Current and proposed tray showing same overall thickness but different stacking pitch

A stack of 11 trays comparison between current tray and proposed tray

Baking tests (Bakeable trays only)

3 cycles baking

Methodology

1. Sample of 10 trays
2. Duration: 24 hrs for each cycle. After each cycle, the tray must be left to cool at production environment for a minimum of 1hr before starting the second baking.
3. Temperature: 125 deg.C (Refer to spec number 0033575).
4. Baking can be done with or without units.
5. Trays must be strapped using Velcro belt.(Strapping refer to spec number 0056593).
6. Measure the warp after the 3rd. cycle. The the warp should be <0.50mm.

The dry baking was carried out on a Mazzali Oven in the 'Reliability Lab. The warpage measurements were taken before and after the 3 cycle bake. The measurements were carried out in the toolmaking shop using the surface table and feeler gauges. Six measuring points were taken on every tray according to spec. 8080190 and recorded on a table. Please see below.

Tray warpage after 3 cycle baking test

Warpage (mm)	Side 1	Side 2	Side 3	Side 4	Side 5	Side 6
Sample 1	0.3	0.3	0.2	0.45	0.25	0.55
Sample 2	0.35	0.25	0.15	0.15	0.05	0.3
Sample 3	0.35	0.2	0.1	0.15	0.1	0.3
Sample 4	0.3	0.25	0.1	0.15	0.1	0.25
Sample 5	0.3	0.15	0.1	0.15	0.15	0.3
Sample 6	0.2	0.15	0.15	0.15	0.2	0.25
Sample 7	0.15	0.1	0.15	0.2	0.2	0.15
Sample 8	0.05	0.05	0.2	0.2	0.1	0.15
Sample 9	0.05	0.05	0.2	0.15	0.05	0.1
Sample 10	0.05	0.05	0.3	0.1	0.05	0.15

All readings are within limits.

1 cycle bake

Methodology

1. Sample : 6 trays
2. Duration 48 hrs.
3. Temperature : Base on the temperature mark on the tray. (in our case 150 deg. C)
4. Do not use devices and Velcro belt straps.
5. After the bake cycle measure the tray warpage after leaving the tray to cool to room temperature.

The following table below shows the warpage results after the 48 hrs bake at a temperature of 150 deg.C.

Tray warpage after single cycle baking test

Warpage (mm)	Side 1	Side 2	Side 3	Side 4	Side 5	Side 6
Sample 1	0.1	0.05	0.3	0.2	0.25	0.3
Sample 2	0.1	0.05	0.25	0.15	0.1	0.2
Sample 3	0.2	0.1	0.2	0.2	0.05	0.15
Sample 4	0.15	0.05	0.2	0.3	0.2	0.15
Sample 5	0.2	0.05	0.2	0.2	0.05	0.15
Sample 6	0.2	0.05	0.2	0.2	0.2	0.2

The trays were also checked for the below items:

Items	Result
Any melting point on tray	NO
Any shrinkage on overall length	NO
Any shrinkage on overall thickness	NO
Any shrinkage on pocket dimension	NO
Maximum warpage from 6 corners should not be more than 0.76mm	0.3mm

Outgas material test:

No oxidation of balls was noted after this test.

Drop Test:

The drop test was performed with the packing methodology described in spec number 0056593. The drop test was carried out according to methodology described in specification number 7416802.

Bakeable Tray

Drop Test	Max. coplanarity / microns	Min stand off / microns	Max stand off / microns	Max pitch deviation/ microns
Before drop	80	482	525	37
After Drop	82	480	521	42
Variance	-2	2	4	-5
Visual Inspection	Yes	No		
Chip Tray		✓		
Crack Tray		✓		
Visual defect at unit		✓		

Non-bakeable tray

Drop Test	Max. coplanarity / microns	Min stand off / microns	Max stand off / microns	Max pitch deviation/ microns
Before drop	78	484	531	33
After Drop	81	482	529	34
Variance	-3	2	-2	-1
Visual Inspection	Yes	No		
Chip Tray		✓		
Crack Tray		✓		
Visual defect at unit		✓		

All devices were within limits after all drop tests and minimal variance between readings before drop and after drop were recorded.

Additionally no chipped substrate defects were recorded in the 3 bundles following the 3 drops per bundle as described in spec 7416802 for both the bakeable and non-bakeable tray.

ESD Characteristics:

Equipment used :

Prostat PRS-801 Resistance Meter
Prostat PRV-913 Microprobe Verifier
Prostat probes PRF-922A-B and PRF914
Prostat Psychrometer PHT-771

Methodology

A sample of six trays were used to measure the surface resistance. Each tray was tested at six different points. The accepted limits for the trays should be within 1x10exp5<Rs<1x10exp11.

Every reading was recorded as shown in the table below. Also the relative humidity and temperature were taken note of during the testing.

Bakeable Tray

TESTS	TRAY SAMPLES	SURFACE RESISTANCE MEASUREMENTS					
		Record 1	Record 2	Record 3	Record 4	Record 5	Record 6
SURFACE RESISTANCE TEST	Sample 1	4.9e8	1.2e9	1.4e5	1.5e5	1.4e5	4.4e8
	Sample 2	2.2e5	3.0e5	8.0e5	6.7e8	3.5e8	6.0e8
	Sample 3	1.5e5	1.5e5	7.1e8	7.9e8	2.6e8	6.8e8
	Sample 4	1.1e5	6.4e5	7.1e8	6.0e8	6.8e8	2.5e5
	Sample 5	1.2e5	1.3e5	1.5e5	1.8e5	3.7e8	5.4e5
	Sample 6	1.2e5	6.3e5	3.9e8	7.6e5	2.9e8	1.9e5
SURFACE RESISTANCE AFTER SCRATCHING	Sample 1/ Pocket 1	5.7e8 1.2e9					
TEMP.	23.3°C						
R.H.	49.6%						

Non-Bakeable Tray

TESTS	TRAY SAMPLES	SURFACE RESISTANCE MEASUREMENTS					
		Record 1	Record 2	Record 3	Record 4	Record 5	Record 6
SURFACE RESISTANCE TEST	Sample 1	4.1e10	1.8e10	1.8e10	3.7e9	3.5e10	1.8e10
	Sample 2	1.8e10	1.6e10	9.0e9	5.2e9	4.3e9	2.5e10
	Sample 3	6.7e9	1.6e10	6.2e9	4.1e9	8.3e9	2.1e10
	Sample 4	2.0e9	1.1e10	2.1e10	1.6e10	1.4e10	2.5e10
	Sample 5	1.8e9	3.0e10	7.5e10	3.1e9	3.9e9	2.0e10
	Sample 6	1.8e9	1.6e10	6.5e9	1.6e10	7.9e9	3.9e10
SURFACE RESISTANCE AFTER SCRATCHING	Sample 1/ Pocket 1	Not applicable					
TEMP.	23.5°C						
R.H.	42.9%						

All measurements were within ST specification limits.

Workability Test:

Trays were tested at singulation, on the test handlers and on the finishing scanners. No misplacement was noted during operation. It is to be noted that these trays are designed to eliminate misplacement since pocket is deep and tray fences are chamfered so that device falls inside the pocket.

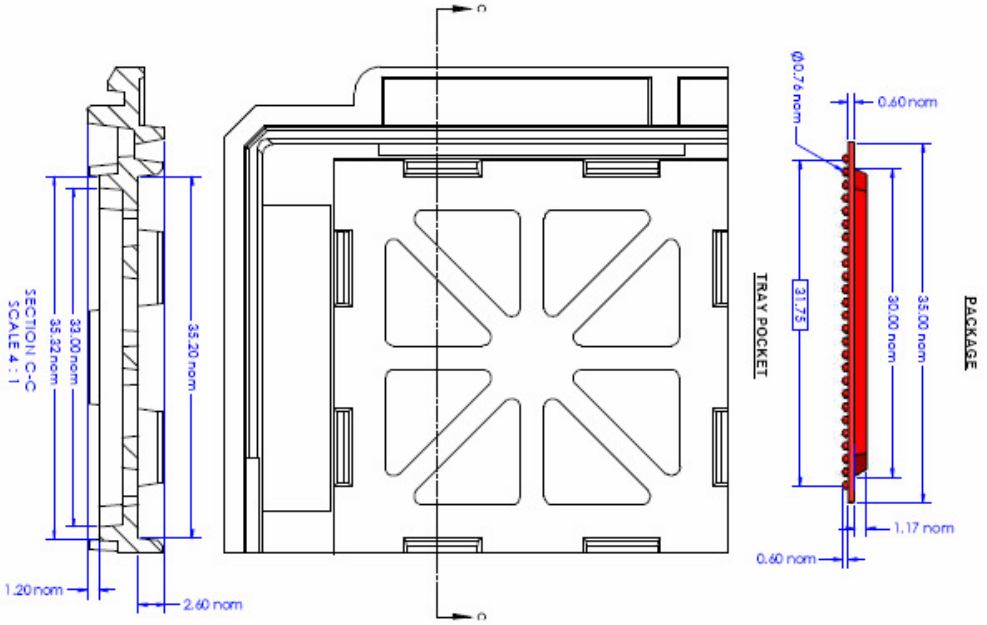
Fit Analysis:

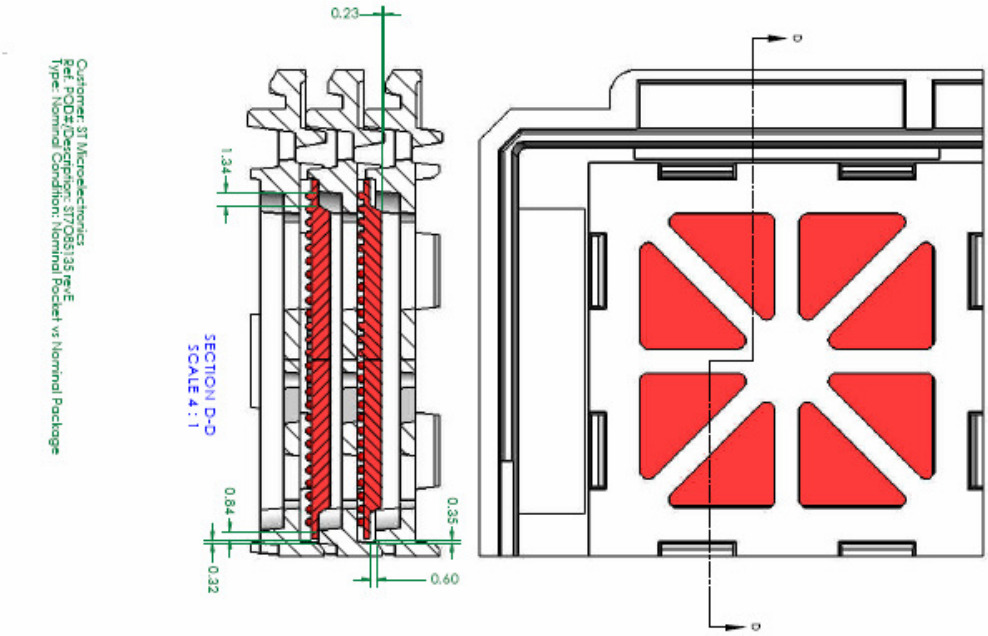
Below is the fit analysis for three BGA 35x35 packages with overall thicknesses ranging from 2.3 to 2.6mm. All the BGA 35x35 with overall thickness between 2.3 to 2.6mm are suitable for this tray. The below packages are all suitable for this tray.

Package Code	PACKAGE_DESCR
0B	PBGA 35x35x2.40 729 6R33x33 1.0
2)	PBGA/HS 35sqx2.3 956 P1.0 b0.6
2P	PBGA 35x35x2.44 748 5R34x34 1.0
7N	PBGA 35x35x2.5 900 4R34 1.0 4L
8H	PBGA532+36 35sqx2.6 7R26 1.27-4L
A0	PBGA708+84 35sq 4-1+3R34 1.0-4L
B7	PBGA580+10035sqx2.6 5R34 1.00-4L
BE	PBGA 352 35sqx2.6 4R26 1.27-2L
BK	PBGA352+36 35sqx2.6 4R26 1.27-4L
BT	PBGA352+36 35sqx2.6 4R26 1.27-4L
F6	PBGA35sq 580+100(7R34 1.0)DEP-4L
GS	PBGA 35x35x2.44 580+144 5R34 1.0
HP	PBGA 35x35x2.3 764+100 6R34 P.1
NL	PBGA/HSp 456 35sqx2.54 5R26 1.27
Z0	PBGA 35x35x2.50 672+100 6R34 1.0

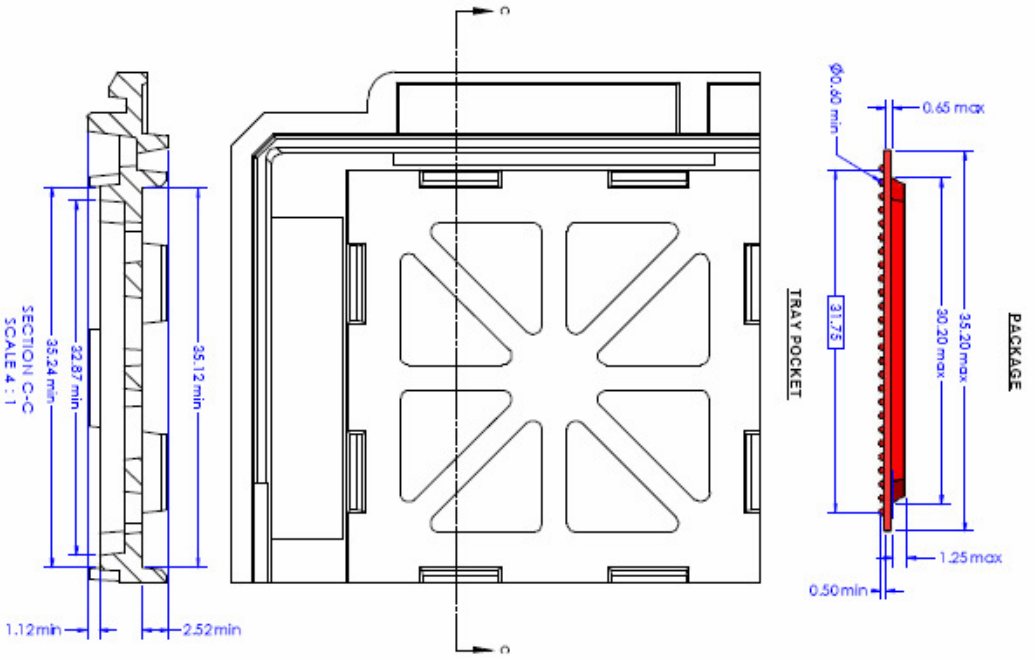
With POA 7085135

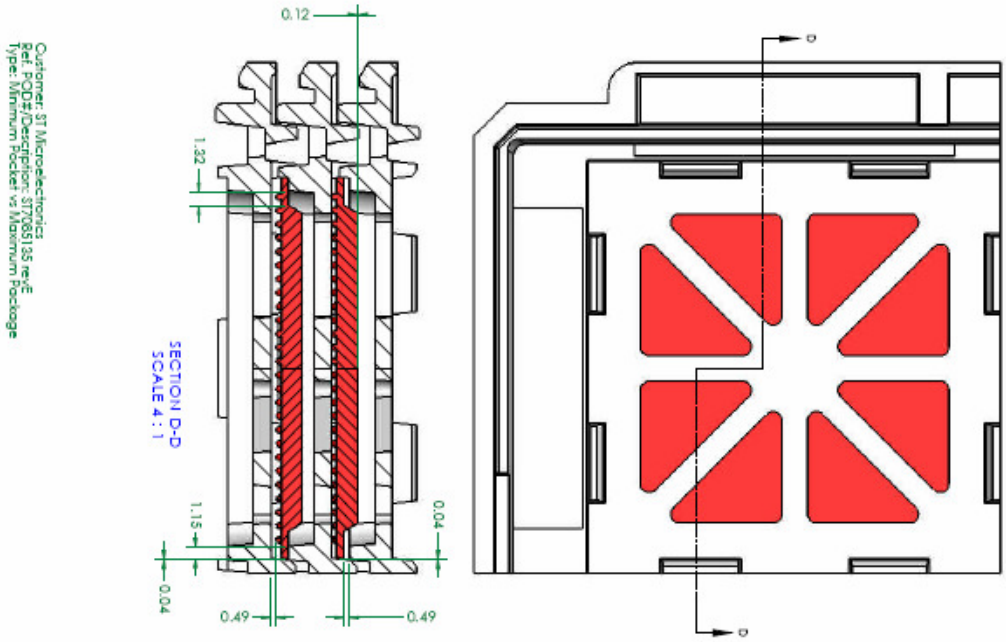
Nominal Conditions



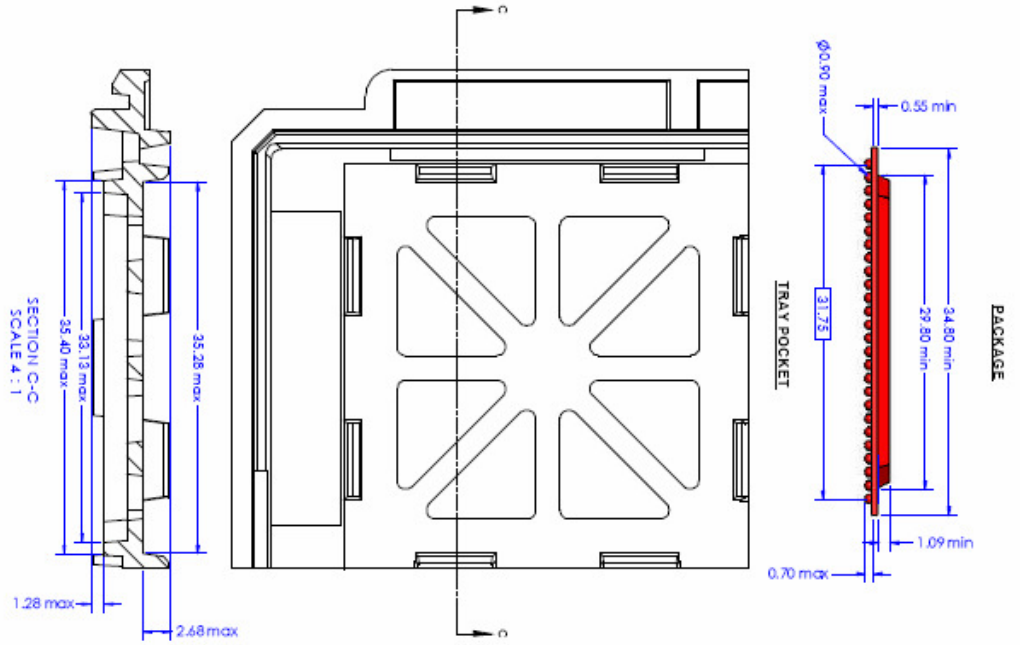


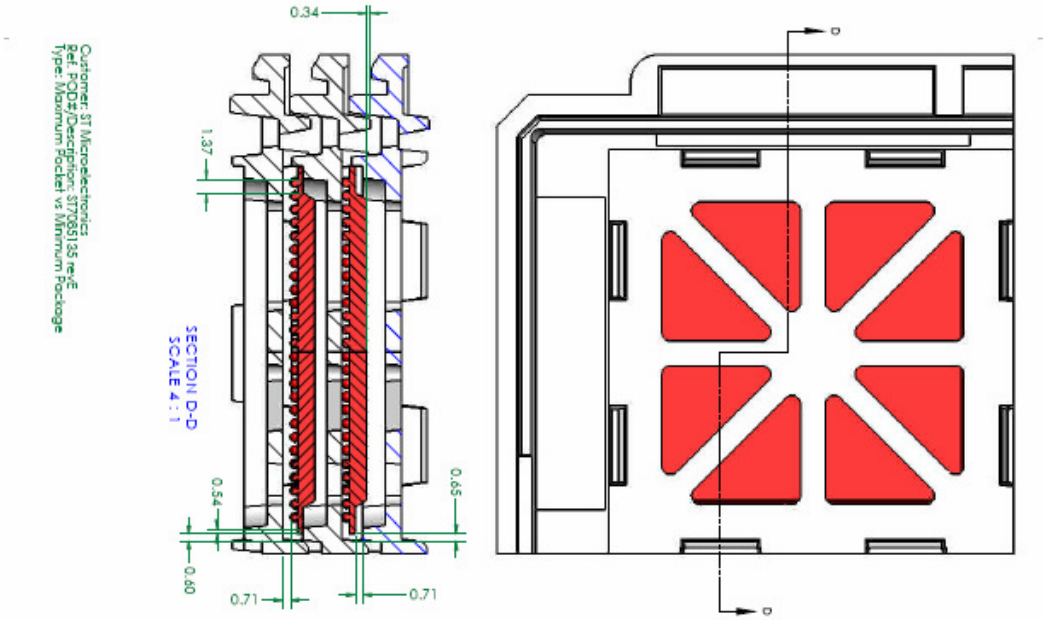
Minimum Pocket vs Maximum Package





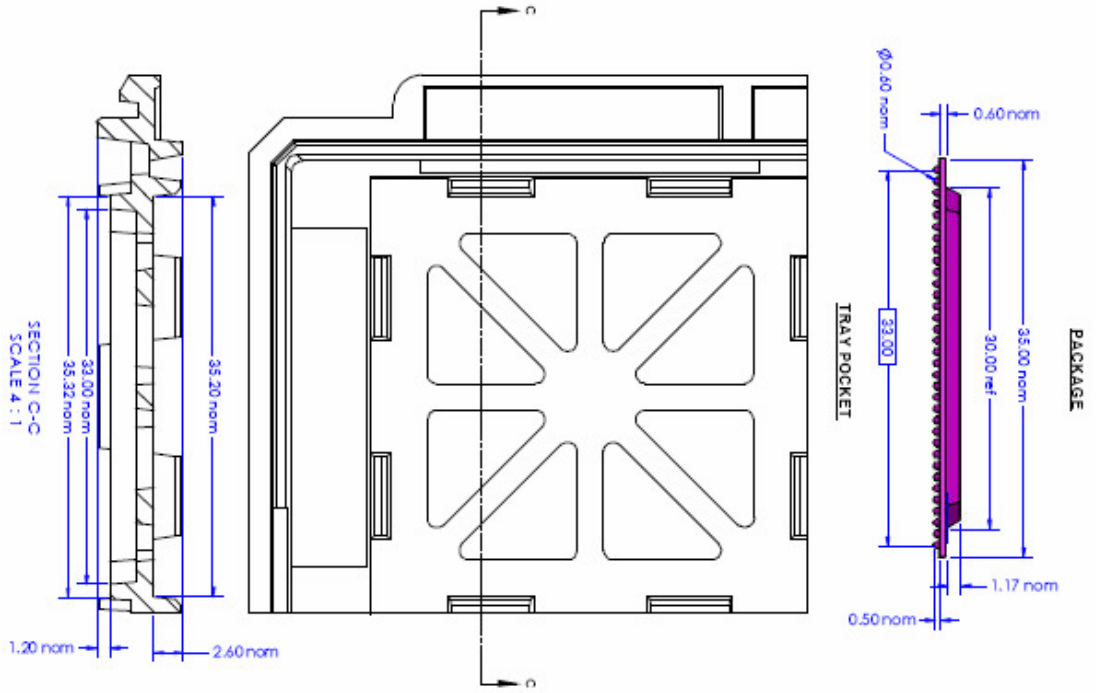
Maximum Pocket vs Minimum Package

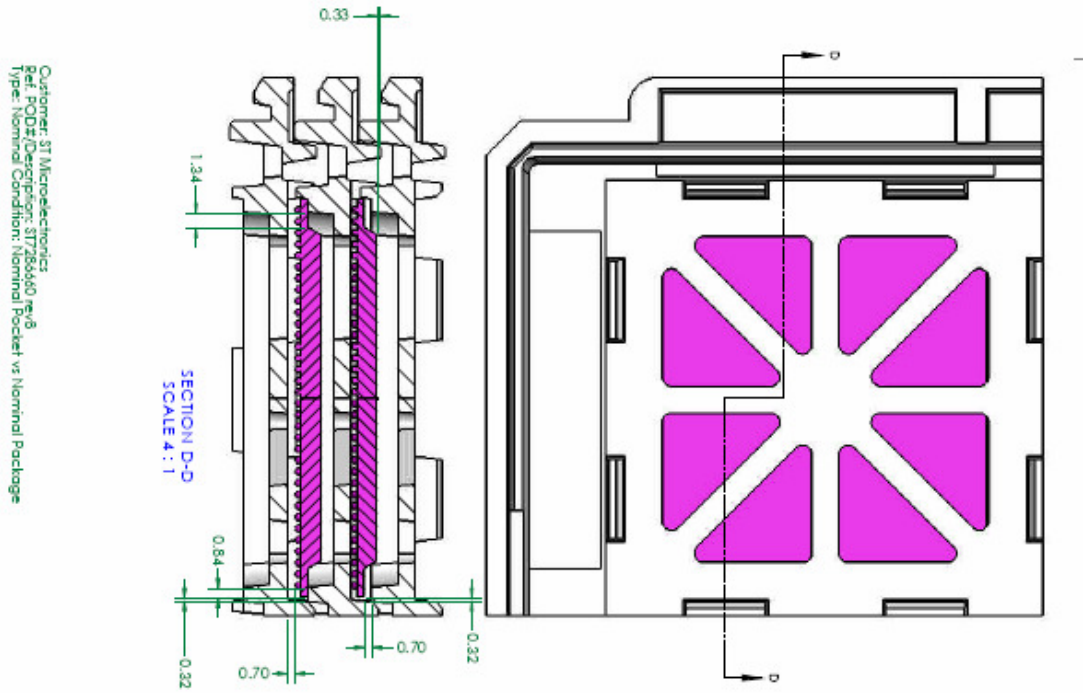




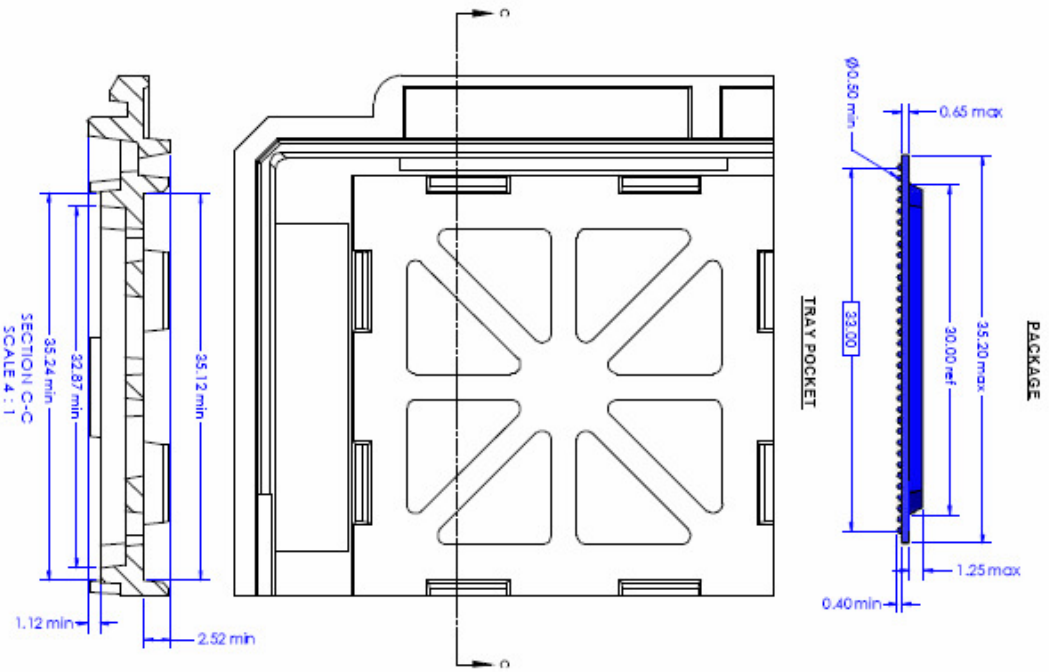
With POA 7286660

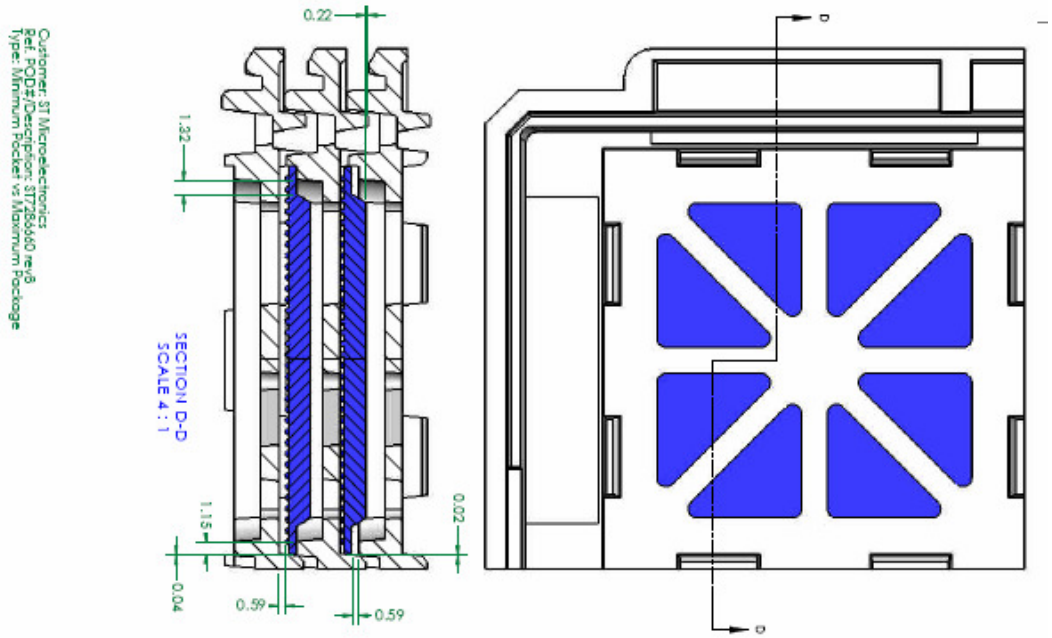
Nominal Conditions



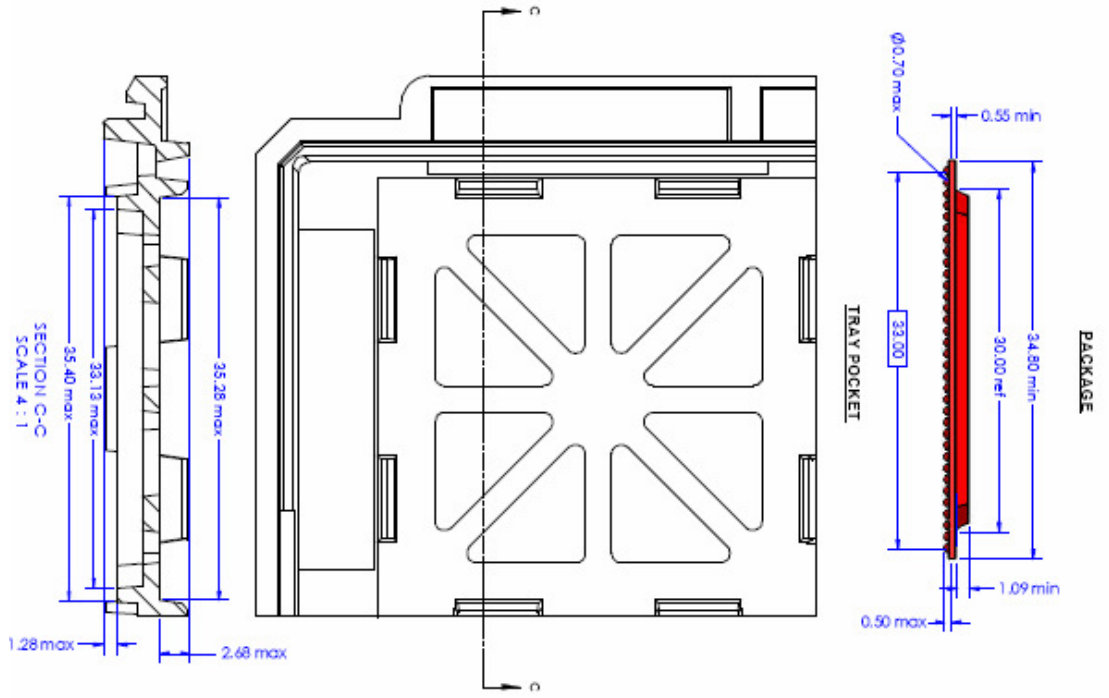


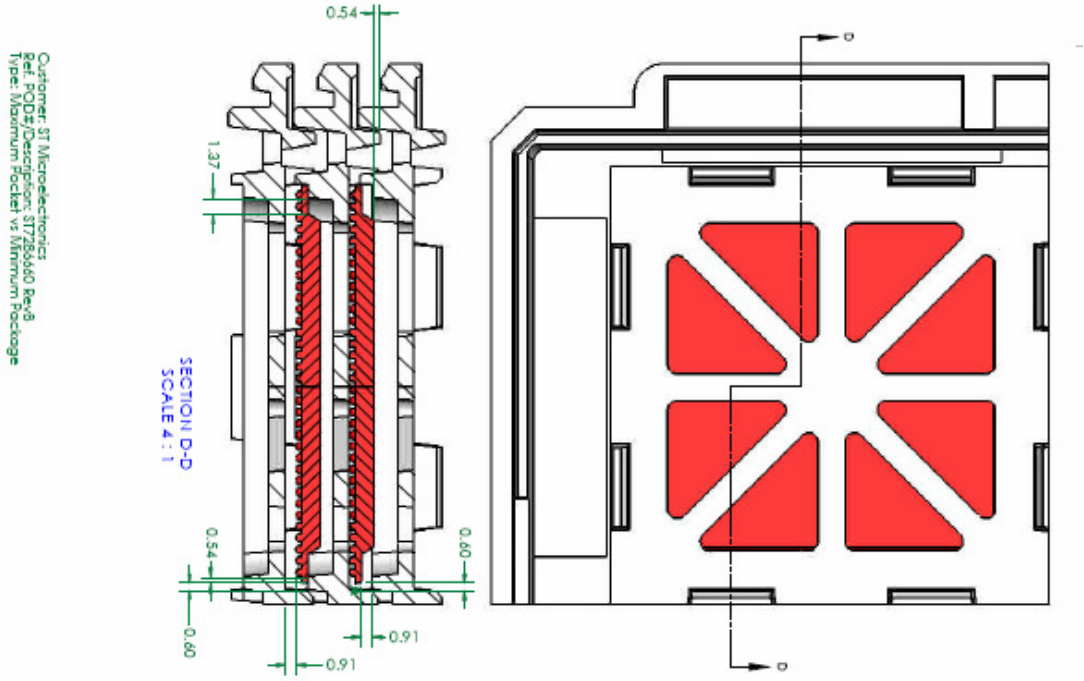
Minimum Pocket vs Maximum Package





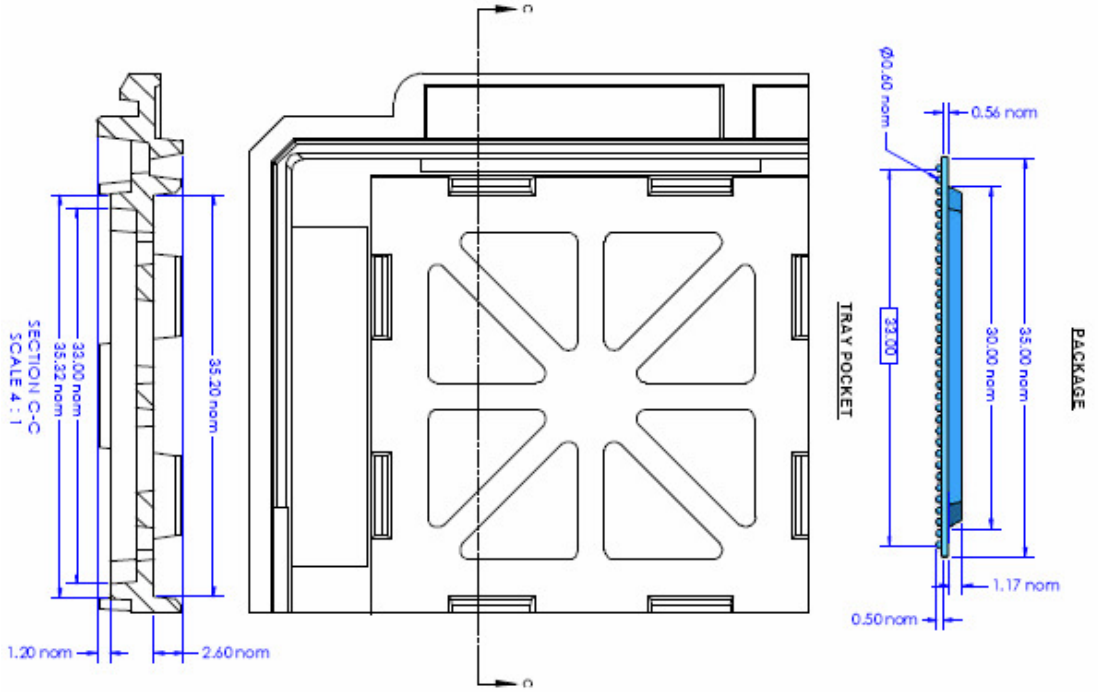
Maximum Pocket vs Minimum Package

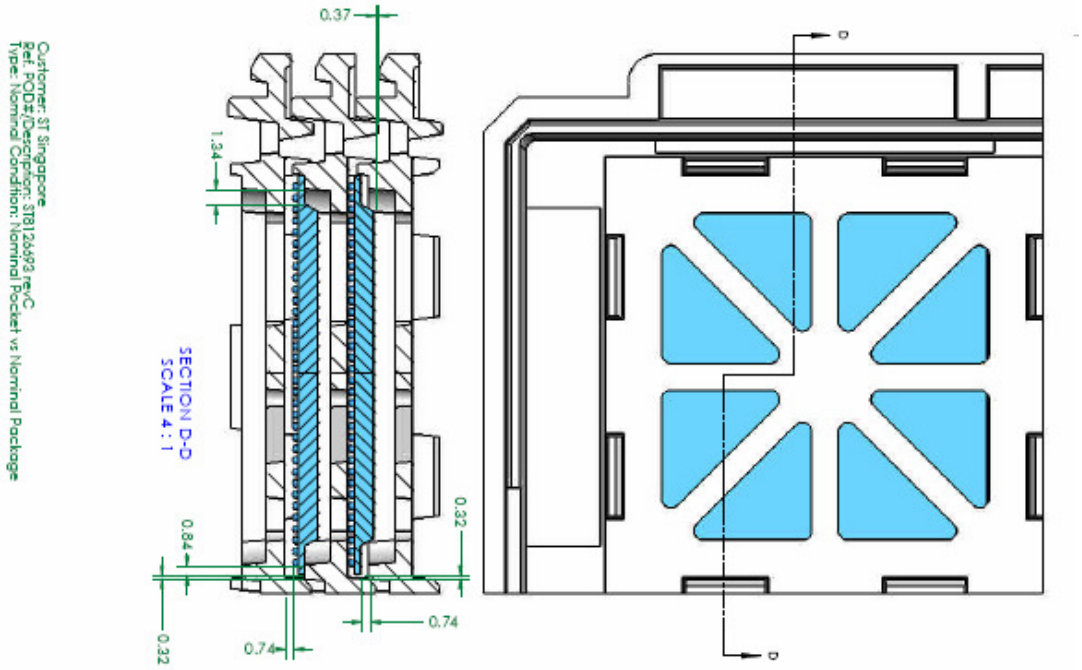




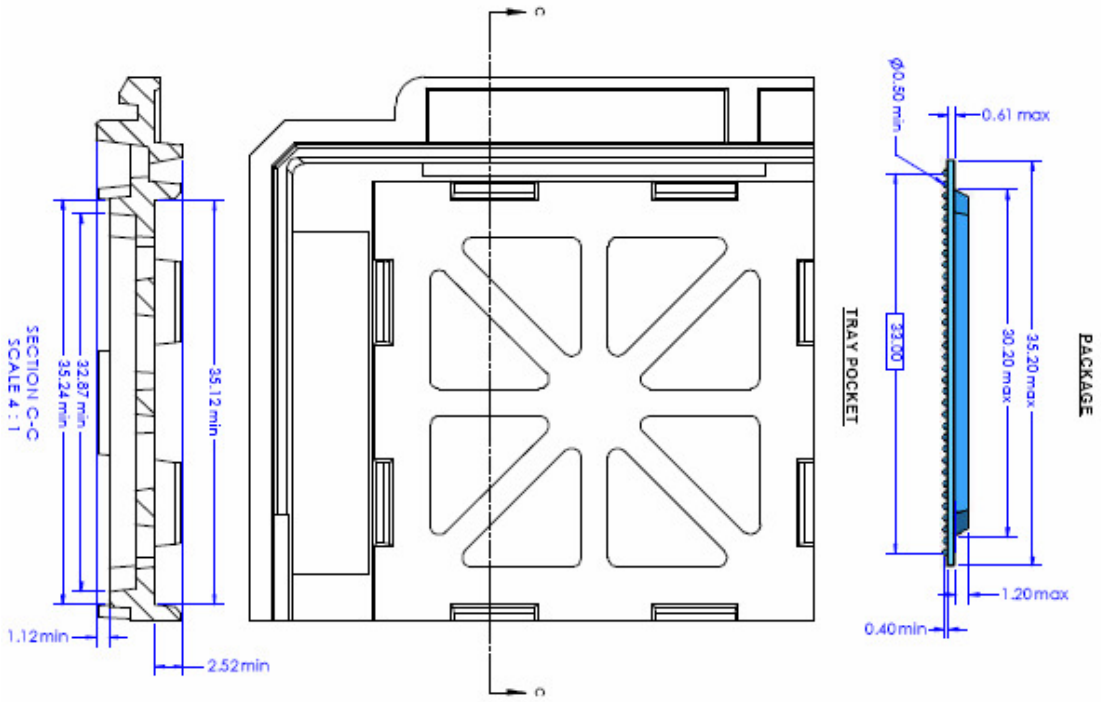
With POA 8126693

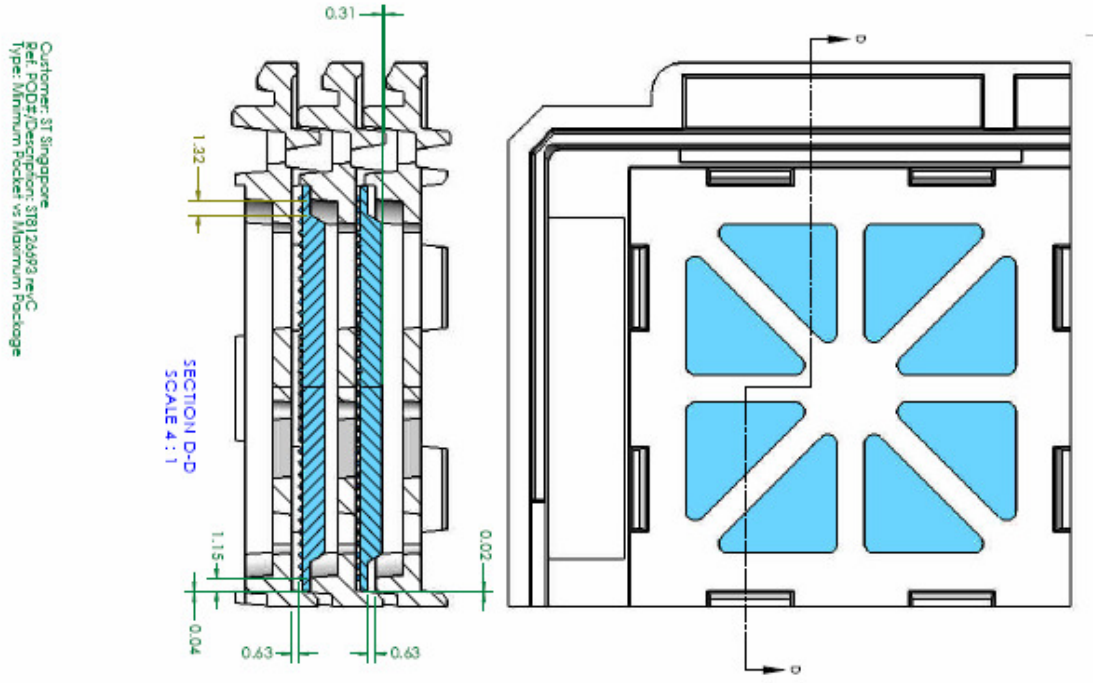
Nominal Conditions



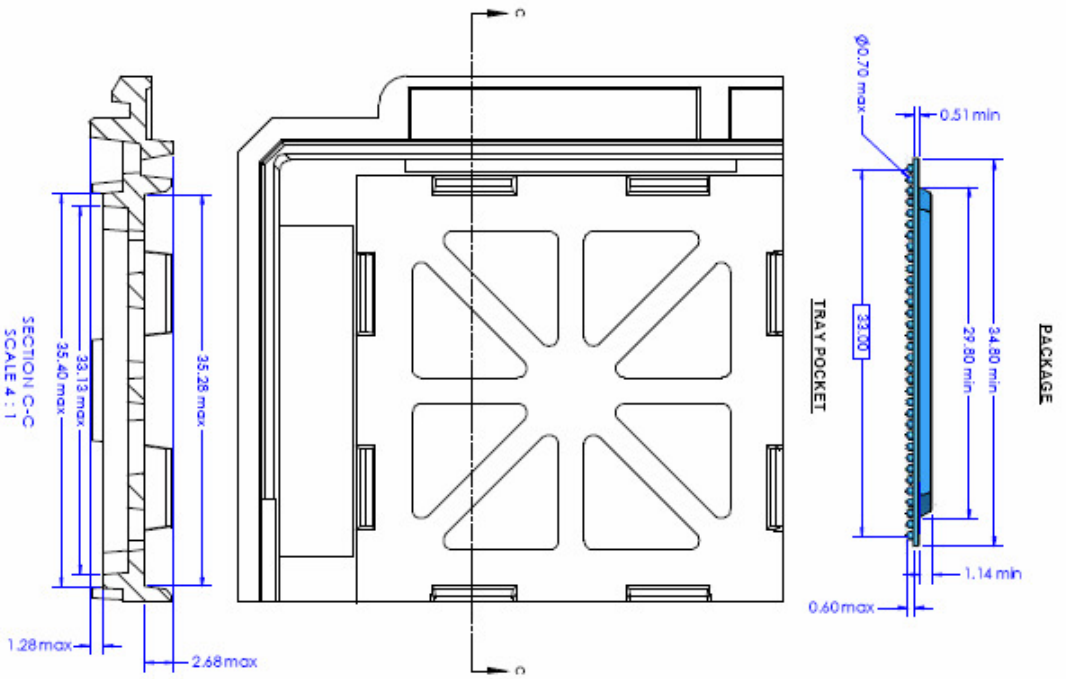


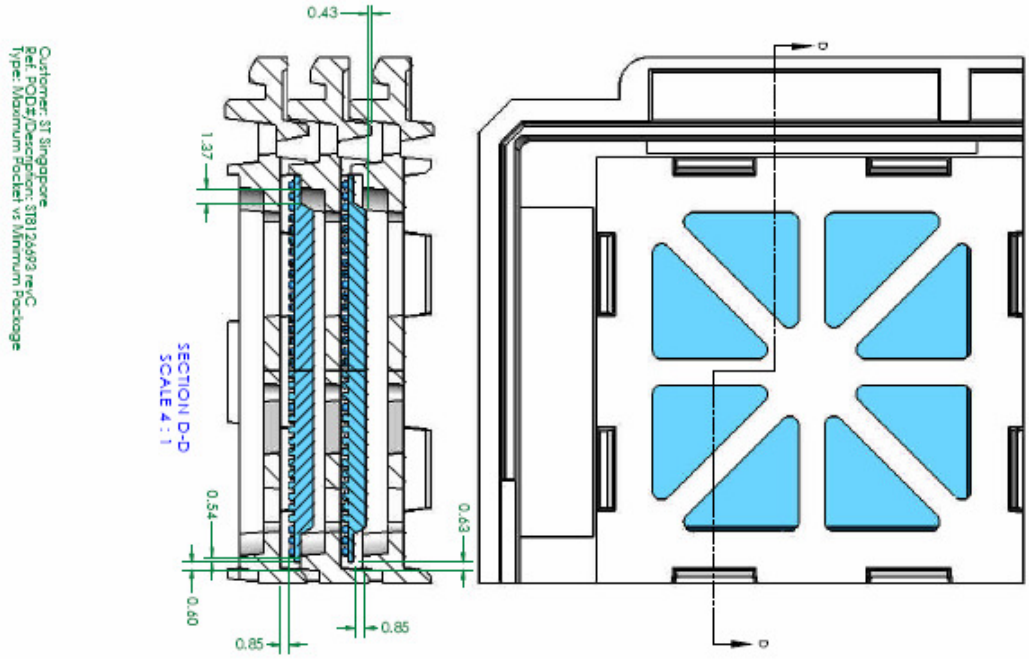
Minimum Pocket vs Maximum Package





Maximum Pocket vs Minimum Package





Conclusion:

There are several quality advantages when using this new design for the BGA 35x35 tray. The pocket design will help in eliminating misplacement in the process. The deep pocket will help in eliminating devices going out of the pocket during transportation. This, together with the fact that devices are not captured from the corners, leads to no substrate damage during drop test unlike all the trays tested before and currently in use.

Since this tray passed all the qualification tests, it can therefore be qualified.

Adrian Vassallo
PBGA Process Engineering
20/12/2010

BGA 27x27 Tray Qualification

Qualification Report- Muar

Date – 19th. July 2011

V.VINCEN- CTF Coordinator
Rosnah – CTF Technician
Steve Lim- ESD Coordinator
CW Lim – QA Eng.
Khalid – Test Eng.
LH Kua- Finishing Eng.

Parts Description

- Part Description
  - Group- MCD
  - Package: BGA 27x27
  - Package Code: XL.
  - *Package: Old. 2nd. Source replace ITW.*
  - Division Contact- CPTM trigger project. Yi Chua.

- Material Description
  - Supplier: Peak
  - Supplier code: TH BG2727 1.2 0410 6 BL 2.
  - Material: MPPO
  - Tray Temperature: 150 Degree C.
  - Number of supplier: One. Peak will be replacing ITW.

Comparison Report

Comparison Report between ITW & Peak

Items	ITW	Peak	Remarks
Tray Matrix	4x10	4x10	Same
Tray Pitch X-Direction	X- Edge- 24.15 X- Pitch – 29.20 Y- Edge- 24.15 Y- Pitch – 29.20	X- Edge- 24.15 X- Pitch – 29.20 Y- Edge- 24.15 Y- Pitch – 29.20	Same
Top cavity design	Stack design	Floor Support	Floor support provide self sitting.
Stack height	1.27	2.0	Can reduce the overall tray stack height. End cap need changes.

Qualification Test Result

Items	Result	Remarks
Visual Inspection	Pass	
Workability Test	Pass	
Drop Test	Pass	
Baking Test	Pass	
ESD Test	Pass	
FIT Test	Pass	

Conclusion: PEAK Tray BGA 27x27 is passed all the Qualification Criteria and able to use for mass production.

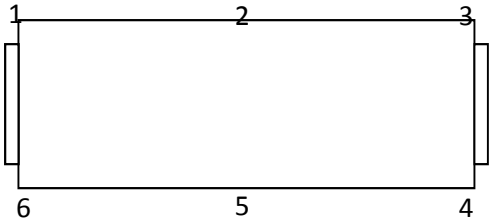
Visual Inspection on Virgin Sample

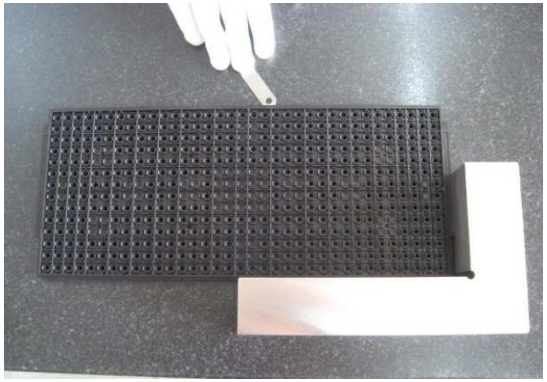
Visual Inspection Items	Yes /No	Remarks
Chip/Crack tray	No	
Tray align with ST Spec	Yes	
Tray matrix align with ST Spec	Yes	
Tray has Anti-reverse Feature	Yes	
Contain stain or foreign material.	No	
Others		

Visual Inspection Result: Pass

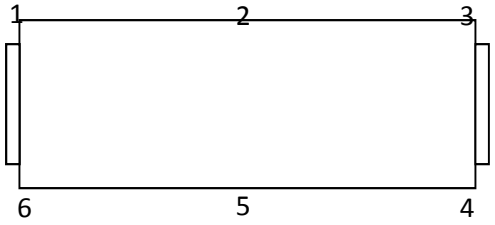
Baking Test

- 3 cycle baking test
  - Sample: 10 trays
  - Duration: 24hrs for each cycle. After each cycle, the tray must leave at production environment for a minimum of 1 hr before start the second baking.
  - Temperature: 125 degree C
  - Strapping method: 3width and 1 length (Longer side)
  - Measure the tray warp after the 3rd. Cycle on all 6 corner.
  - Use shim gauge to measure the war-page.





3th. cycle baking test result



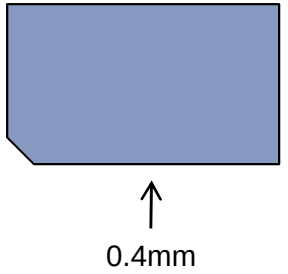
War page measurements	Side1	Side2	Side 3	Side4	Side5	Side6
Sample1	0.25	0.20	0.25	0.15	0.20	0.40
Sample2	0.20	0.15	0.25	0.15	0.25	0.25
Sample3	0.20	0.15	0.20	0.20	0.20	0.25
Sample4	0.15	0.20	0.20	0.25	0.20	0.25
Sample5	0.15	0.15	0.15	0.15	0.20	0.15
Sample6	0.15	0.20	0.15	0.15	0.20	0.15
Sample7	0.10	0.20	0.10	0.10	0.20	0.10
Sample8	0.10	0.15	0.10	0.10	0.15	0.10
Sample9	0.05	0.10	0.05	0.05	0.10	0.05
Sample10	0.05	0.10	0.05	0.05	0.10	0.05

Max. war-page is 0.4mm versus spec of 0.5mm

3cycle baking result: Pass

Single baking

- Single baking
  - Sample: 6 trays not stacked
  - Duration: 24hrs.
  - Temperature: 150 degree C
  - Strapping method: 3width and 1 length (Longer side)
  - Measure the tray warp,all 6 corner.
  - Use shim gauge to measure the war-page.



Items	Descriptions	Result
1	Point on tray (Any melting)	No
2	On Overall Length (Any shrinkage)	No
3	On overall thickness (Any shrinkage)	No
4	On pocket dimension (Any shrinkage)	No
5	6 corner reading on war page, not more than 0.76mm	0.3 mm

One cycle baking result: Pass

Workability Test

Process	Machine	Objective	Samples	Reject Criteria	Result
Assy- SSS Process Step	n/a	n/a	n/a	n/a	No parts assembly in Muar
Test Handler	Advantec 4642	Able to pick and place without any problem	1 trays	Placement issue Chip Package	Pending because equipment not available
Finishing	STI	Able to pick and place without any problem	1 trays	Placement issue Chip Package	Good

Workability Result: Pass.
Pending workability at test area.

Drop Test Procedure

- Drop test procedure
  - One tray with units prepared as normal production packing.
  - The reel drop at 1.2 meters height for 3 times.
  - The units were re-inspect to determine the integrity of the quality

1st Drop: Flat at bottom

2nd Drop: on the side

3rd Drop: on the angle

- **Visual inspection after drop test:**

Inspection Items	Visual Inspection Results
Damage Ball	No
Chip Package	No
Chip Tray	No
Crack tray	No

Drop Test Result: Pass

ESD Test

Surface resistance on PEAK BGA 27MM X 27MM(Blue Color Insert) Trays			
(1) 1.5 E 06 ohms	(2) 2.1 E 07 ohms	(3) 2.8 E 06 ohms	(4) 5.8 E 06 ohms
Passed	Passed	Passed	Passed

Conclusion : The evaluated(BGA 27X27) trays had Passed in ESD assessment and meet our ESD criteria requirement.

ESD Good Acceptance Limit Is > 1.0X10exp04ohms to <1.0X10exp11 ohms

ESD results: Passed in ESD buyoff and meet our ESD criteria requirement.

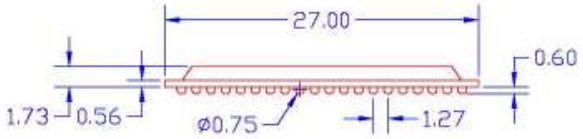
FIT Test

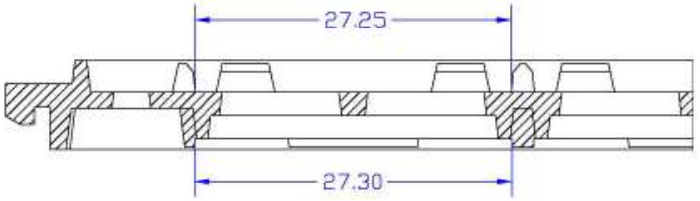
FPBGA 27X27 SIMULATION

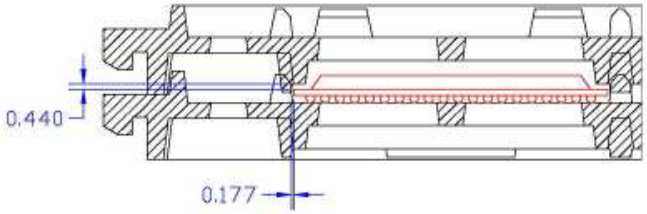
PKG. : STMicro XL

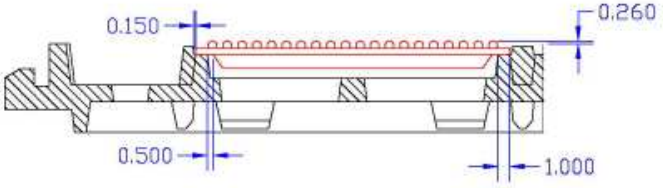
TRAY : TH BG2727 1.2 0410 6 bL2

TRAY – NOMINAL
PKG – NOMINAL
— TYPICAL CONDITIONS









PASS

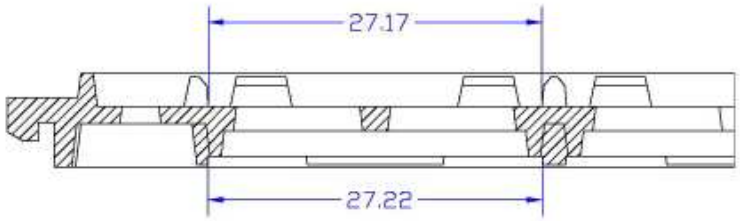
Fit Test

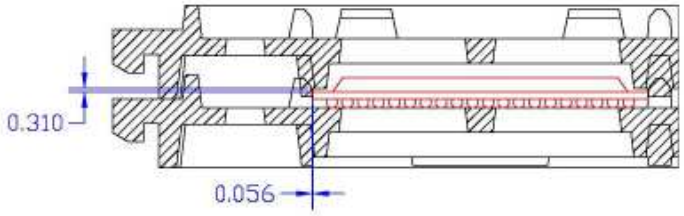
FPBGA 27X27 SIMULATION

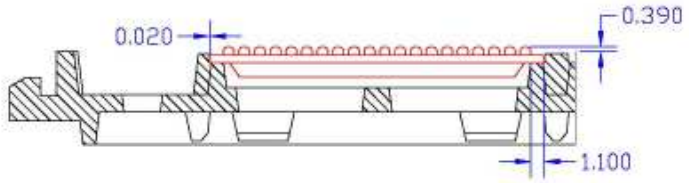
PKG. : STMicro XL

TRAY : TH BG2727 1.2 0410 6 bL2

TRAY – MINIMUM
PKG – MAXIMUM
— WORST CONDITIONS (A)







PASS

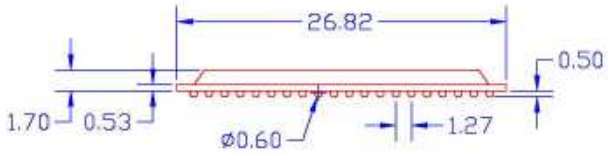
FIT Test

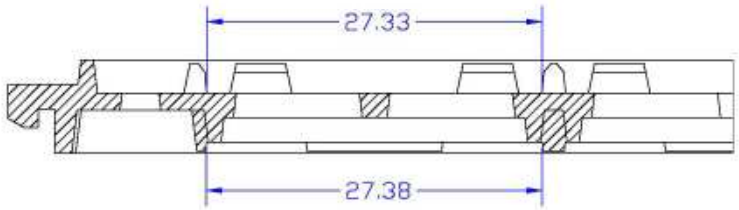
FPBGA 27X27 SIMULATION

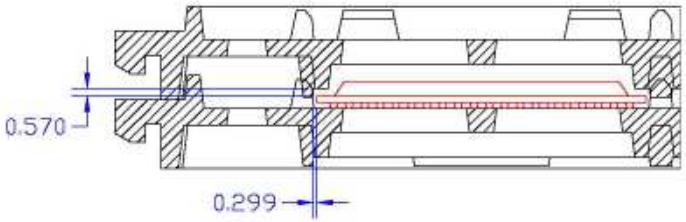
PKG. : STMicro XL

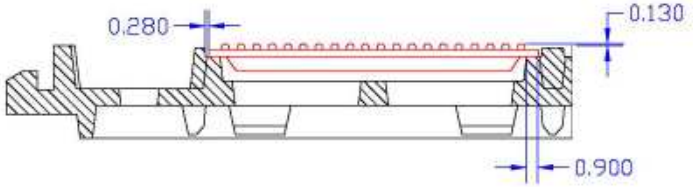
TRAY : TH BG2727 1.2 0410 6 bL2

TRAY – MAXIMUM
PKG – MINIMUM
— WORST CONDITIONS (B)









PASS

Qualification of new BGA 27x27 Tray

ST Spec: 8080190
ST Code of sample under test : 3CP(bakeable)
3CP (non-bakeable)
Suppliers : PEAK
Supplier Part Nos. : TH BG2727 1.2 0410 6 bL2

Aim: To qualify a new tray for BGA 27x27 to eliminate corner substrate chipping defects.

Fig.1 Design of BGA 27x27 tray under qualification

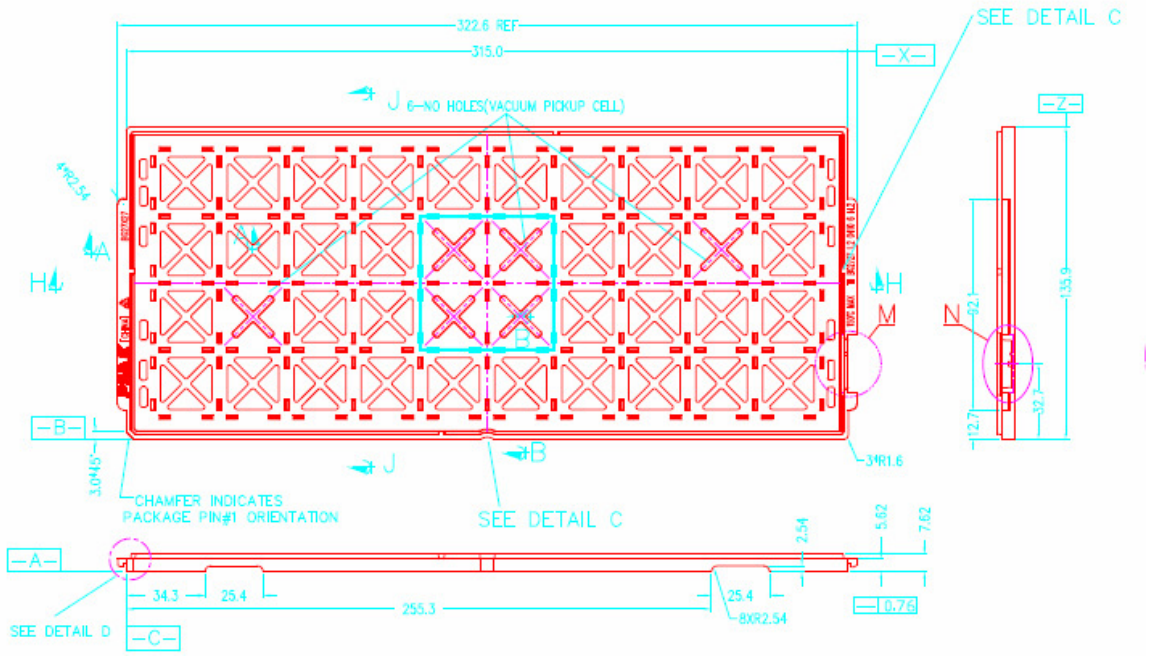


Fig.2 Design of BGA 27x27 tray under qualification – Bottom side

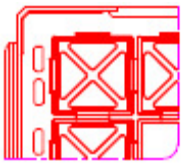
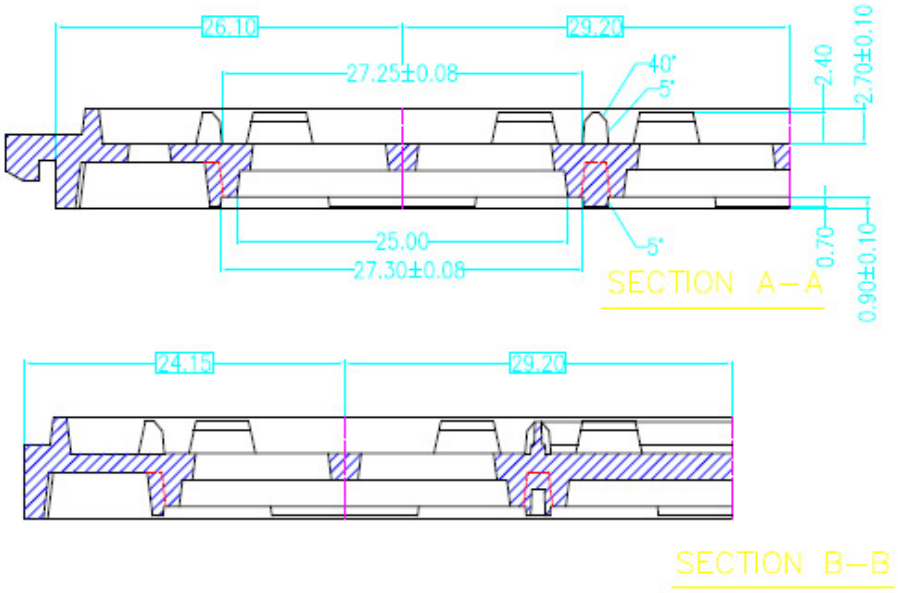


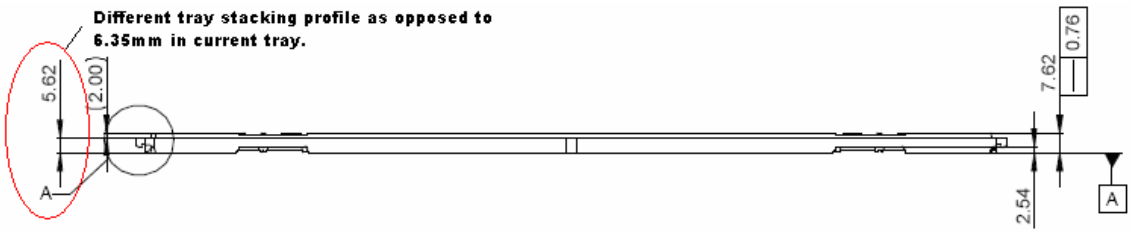
Fig.3 Design of BGA 27x27 tray under qualification – Detailed pocket design

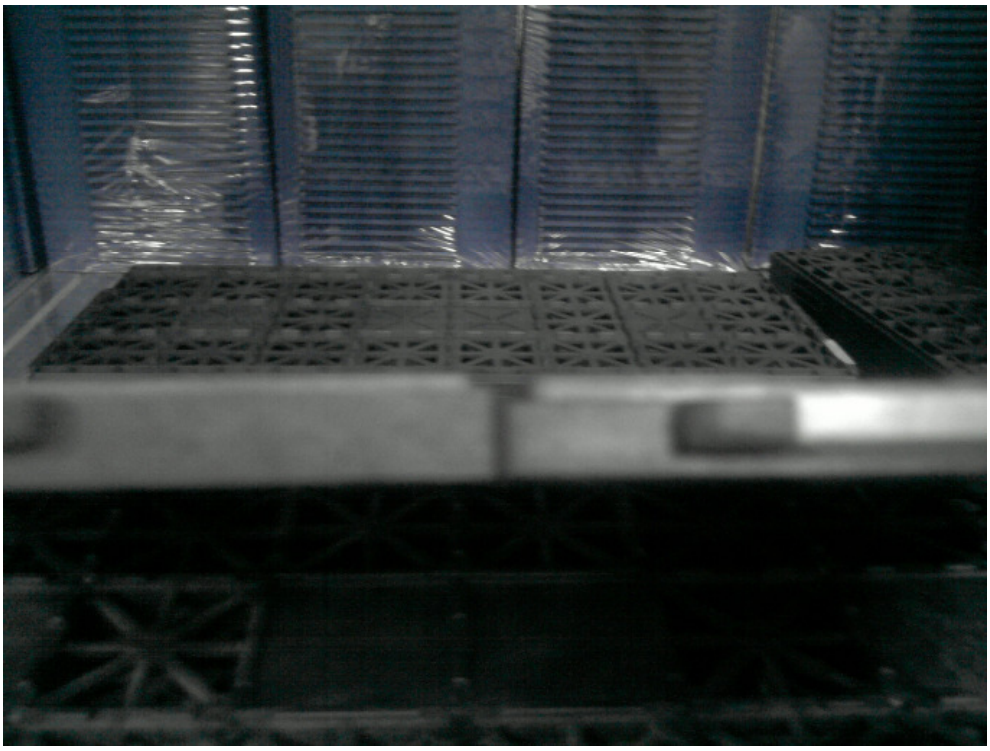


Visual Inspection Report:

Items	Visual Inspection	Yes	No	Quantities	Remarks
1	Chip/Crack		✓	N/A	
2	Align with ST specification	✓		N/A	
3	Tray matrix	✓ (10x4)		N/A	
4	Full fence			N/A	Full fence apply for QFP packages
5	Meet JEDEC standard requirement	✓		N/A	
6	Contain stain or foreign material		✓	N/A	

This tray has a different stacking profile from the current BGA 27x27 tray. The tray stacking pitch for this tray is 5.62mm whilst the current tray has a stacking pitch of 6.35mm. Note: Overall tray thickness remains the same 7.62mm.





Current and proposed tray showing same overall thickness but different stacking pitch

A stack of 11 trays comparison between current tray and proposed tray

Baking tests (Bakeable trays only)

3 cycles baking

Methodology

1. Sample of 10 trays
2. Duration: 24 hrs for each cycle. After each cycle, the tray must be left to cool at production environment for a minimum of 1hr before starting the second baking.
3. Temperature: 125 deg.C (Refer to spec number 0033575).
4. Baking can be done with or without units.
5. Trays must be strapped using Velcro belt.(Strapping refer to spec number 0056593).
6. Measure the warp after the 3rd. cycle. The tray warp should be <0.50mm.

The dry baking was carried out on a Mazzali Oven in the 'Reliability Lab. The warpage measurements were taken before and after the 3 cycle bake. The measurements were carried out in the toolmaking shop using the surface table and feeler gauges. Six measuring points were taken on every tray according to spec. 8080190 and recorded on a table. Please see below.

Tray warpage after 3 cycle baking test

Warpage (mm)	Side 1	Side 2	Side 3	Side 4	Side 5	Side 6
Sample 1	0.3	0.05	0.35	0.35	0	0.35
Sample 2	0.25	0.1	0.35	0.3	0	0.25
Sample 3	0.25	0.1	0.35	0.45	0	0.2
Sample 4	0.2	0.1	0.3	0.4	0	0.2
Sample 5	0.15	0.1	0.3	0.35	0	0.15
Sample 6	0.2	0.1	0.3	0.4	0.05	0.2
Sample 7	0.2	0.1	0.35	0.35	0	0.2
Sample 8	0.2	0.1	0.45	0.3	0	0.1
Sample 9	0.1	0.05	0.4	0.2	0	0.2
Sample 10	0.15	0.05	0.35	0.2	0	0.05

All readings are within limits.

1 cycle bake

Methodology

1. Sample : 6 trays
2. Duration 48 hrs.
3. Temperature : Base on the temperature mark on the tray. (in our case 150 deg. C)
4. Do not use devices and Velcro belt straps.
5. After the bake cycle measure the tray warpage after leaving the tray to cool to room temperature.

The following table below shows the warpage results after the 48 hrs bake at a temperature of 150 deg.C.

Tray warpage after single cycle baking test

Warpage (mm)	Side 1	Side 2	Side 3	Side 4	Side 5	Side 6
Sample 1	0.15	0.15	0.35	0.4	0.1	0.2
Sample 2	0.2	0.1	0.45	0.45	0.05	0.15
Sample 3	0.2	0.1	0.35	0.2	0.05	0.2
Sample 4	0.2	0.1	0.35	0.25	0	0.2
Sample 5	0.25	0.05	0.35	0.35	0.05	0.1
Sample 6	0.3	0.05	0.45	0.5	0.05	0.1

The trays were also checked for the below items:

Items	**Result**
Any melting point on tray	NO
Any shrinkage on overall length	NO
Any shrinkage on overall thickness	NO
Any shrinkage on pocket dimension	NO
Maximum warpage from 6 corners should not be more than 0.76mm	0.45mm

Outgas material test:

No oxidation of balls was noted after this test.

Drop Test:

The drop test was performed with the packing methodology described in spec number 0056593. The drop test was carried out according to methodology described in specification number 7416802.

Bakeable Tray

Drop Test	Max. coplanarity / microns	Min stand off / microns	Max stand off / microns	Max pitch deviation/ microns
Before drop	75	478	530	31
After Drop	78	476	527	32
Variance	-3	2	3	-1
Visual Inspection	Yes	No		
Chip Tray		✓		
Crack Tray		✓		
Visual defect at unit		✓		

Non-bakeable tray

Drop Test	Max. coplanarity / microns	Min stand off / microns	Max stand off / microns	Max pitch deviation/ microns
Before drop	74	490	522	25
After Drop	77	485	521	28
Variance	-3	5	1	-3
Visual Inspection	Yes	No		
Chip Tray		✓		
Crack Tray		✓		
Visual defect at unit		✓		

All devices were within limits after all drop tests and minimal variance between readings before drop and after drop were recorded.

Additionally no chipped substrate defects were recorded in the 3 bundles following the 3 drops per bundle as described in spec 7416802 for both the bakeable and non-bakeable tray.

ESD Characteristics:

Equipment used :

Prostat PRS-801 Resistance Meter
Prostat PRV-913 Microprobe Verifier
Prostat probes PRF-922A-B and PRF914
Prostat Psychrometer PHT-771

Methodology

A sample of six trays were used to measure the surface resistance. Each tray was tested at six different points. The accepted limits for the trays should be within 1x10exp5<Rs<1x10exp11.

Every reading was recorded as shown in the table below. Also the relative humidity and temperature were taken note of during the testing.

Bakeable Tray

TESTS	**TRAY SAMPLES**	**SURFACE RESISTANCE MEASUREMENTS**					
		Record 1	Record 2	Record 3	Record 4	Record 5	Record 6
SURFACE RESISTANCE TEST	Sample 1	7.6e5	7.1e6	1.9e6	2.8e6	1.4e6	4.4e6
	Sample 2	4.9e6	1.5e7	1.5e6	6.8e6	4.9e6	1.1e6
	Sample 3	1.1e6	2.8e6	5.7e5	1.3e7	1.7e7	1.2e6
	Sample 4	4.4e7	3.3e7	5.5e6	7.8e6	1.5e6	1.5e7
	Sample 5	2.1e6	1.2e7	1.7e6	2.8e6	8.6e6	2.0e6
	Sample 6	3.0e6	9.2e6	8.3e6	1.2e7	1.1e7	1.8e6
SURFACE RESISTANCE AFTER SCRATCHING	Sample 1/ Pocket 1	7.3e8 9.4e8					
TEMP.	23.5°C						
R.H.	50%						

Non-Bakeable Tray

TESTS	TRAY SAMPLES	SURFACE RESISTANCE MEASUREMENTS					
		Record 1	Record 2	Record 3	Record 4	Record 5	Record 6
SURFACE RESISTANCE TEST	Sample 1	2e10	4.8e10	3.2e10	3.6e10	5.5e10	4.9e10
	Sample 2	1.4e10	6.6e10	5.2e10	5.2e10	7.9e10	7.0e10
	Sample 3	7.9e10	1.3e10	5.9e10	1.6e10	2.5e10	8.4e10
	Sample 4	7.6e10	5.1e10	4.7e10	9.1e10	1.6e10	2.9e10
	Sample 5	3.5e9	7.4e10	5.7e10	3.6e10	7.1e10	5.4e09
	Sample 6	9.2e9	5.0e10	9.4e10	7.5e07	4.1e10	1.6e10
SURFACE RESISTANCE AFTER SCRATCHING	Sample 1/ Pocket 1	Not applicable					
TEMP.	23.5°C						
R.H.	50%						

All measurements were within ST specification limits.

Workability Test:

Trays were tested at singulation, on the test handlers and on the finishing scanners. No misplacement was noted during operation. It is to be noted that these trays are designed to eliminate misplacement since pocket is deep and tray fences are chamfered so that device falls inside the pocket.

Fit Analysis:

With Package 0B
With Packages 6N-BD-RQ
With Package 52
With Package A0AT
With Packages FF-3J-0C
With Package RF
With Packages RL-MF-8T-10
With Package UJ
With Packages 1Q-GM-SW
With Package XL

All the Fit Analyses passed.

Conclusion:

There are several quality advantages when using this new design for the BGA 27x27 tray. The pocket design will help in eliminating misplacement in the process. The deep pocket will help in eliminating devices going out of the pocket during transportation. This, together with the fact that devices are not captured from the corners, leads to no substrate damage during drop test unlike all the trays tested before and currently in use.

Since this tray passed all the qualification tests, it can therefore be qualified.

Adrian Vassallo
PBGA Process engineering
09/03/2011

Qualification of new ITW BGA 35x35 Tray

ST Spec: 8080190
ST Code of sample under test : 3CP70942/3CP20735 (bakeable)
3CP73175 (non-bakeable)
Suppliers : ITW
Supplier Part Nos. : 1032-12

Aim: To qualify a new tray for BGA 35x35 to eliminate corner substrate chipping defects.

Fig.1 Design of BGA 35x35 tray under qualification – Top side

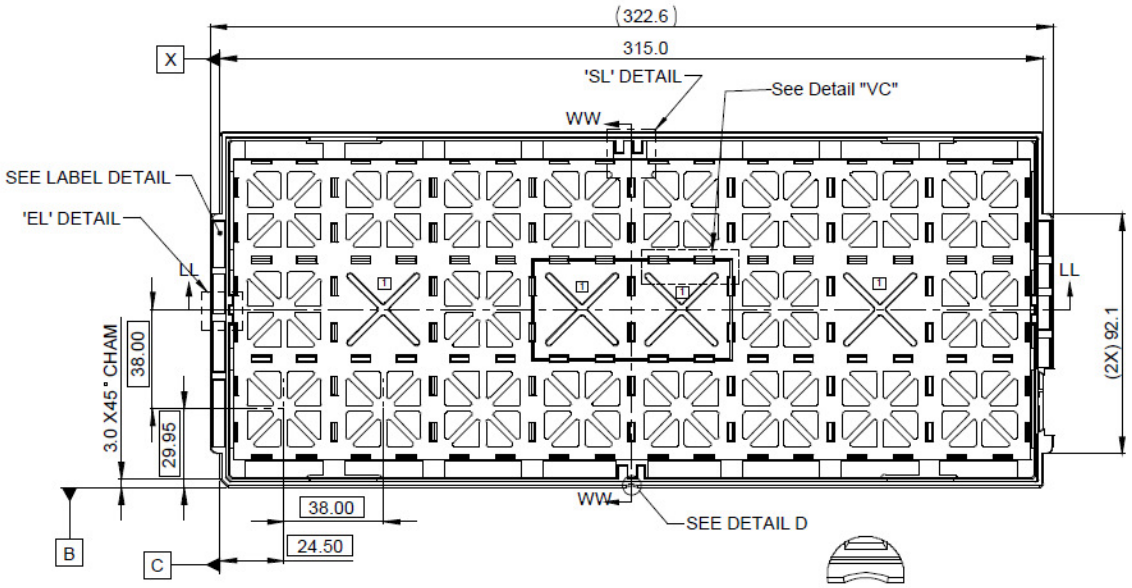


Fig.2 Design of BGA 35x35 tray under qualification – Long Edge

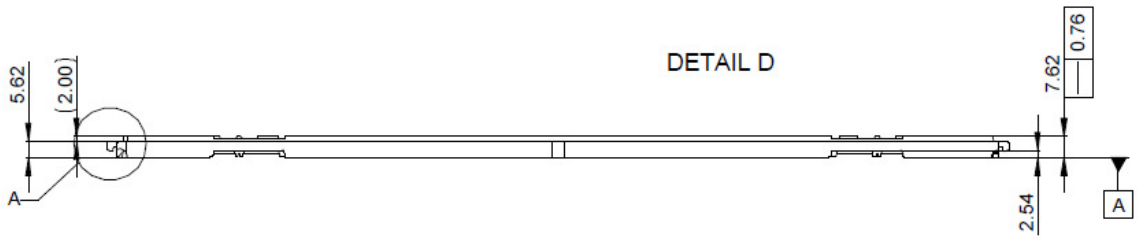


Fig.3 Design of BGA 35x35 tray under qualification – Short edge

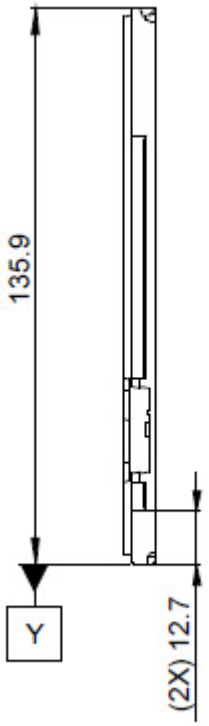


Fig.4 Design of BGA 35x35 tray under qualification – Bottom side

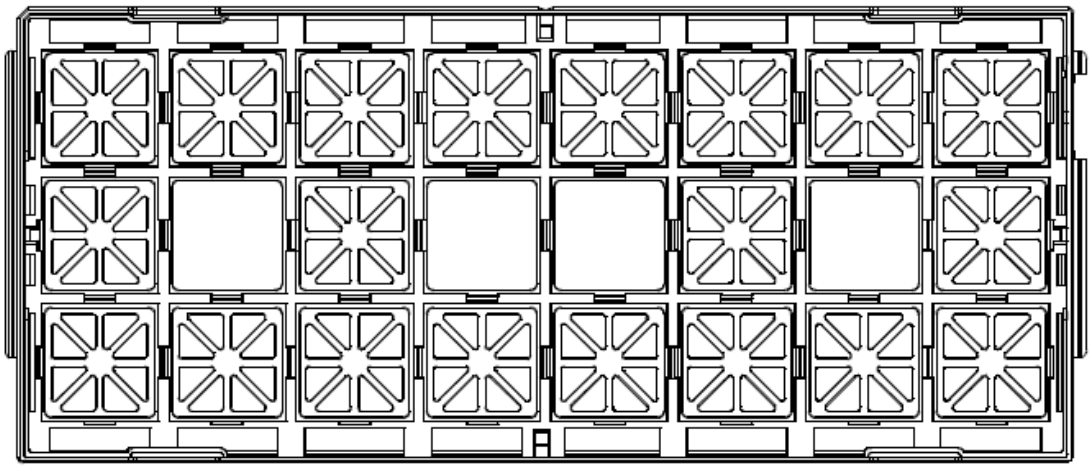
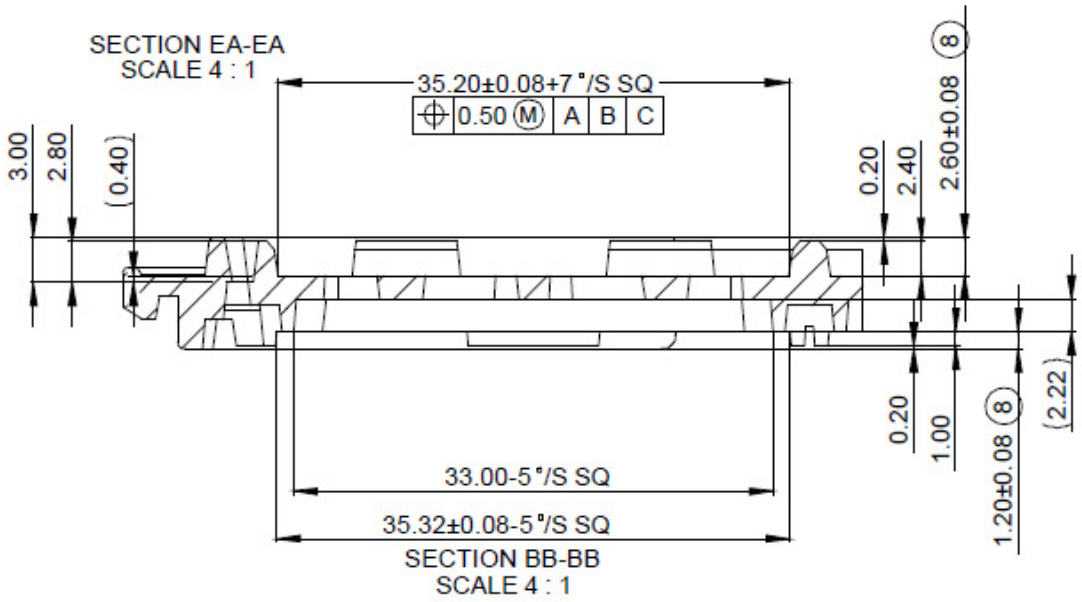


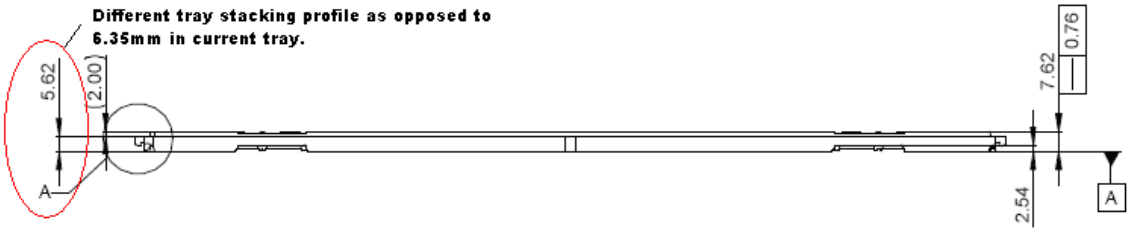
Fig.5 Design of BGA 35x35 tray under qualification – Detailed pocket design

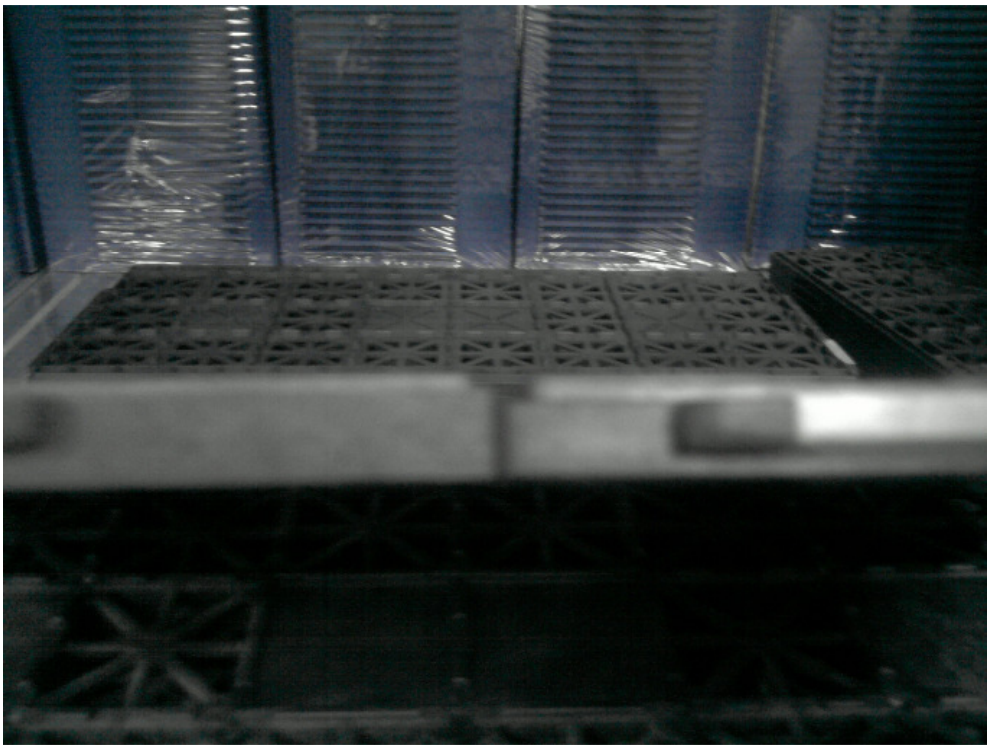


Visual Inspection Report:

Items	Visual Inspection	Yes	No	Quantities	Remarks
1	Chip/Crack		✓	N/A	
2	Align with ST specification	✓		N/A	
3	Tray matrix	✓ (8x3)		N/A	
4	Full fence			N/A	Full fence apply for QFP packages
5	Meet JEDEC standard requirement	✓		N/A	
6	Contain stain or foreign material		✓	N/A	

This tray has a different stacking profile from the current BGA 35x35 tray. The tray stacking pitch for this tray is 5.62mm whilst the current tray has a stacking pitch of 6.35mm. Note: Overall tray thickness remains the same 7.62mm.





Current and proposed tray showing same overall thickness but different stacking pitch

A stack of 11 trays comparison between current tray and proposed tray

Baking tests (Bakeable trays only)

3 cycles baking

Methodology

1. Sample of 10 trays
2. Duration: 24 hrs for each cycle. After each cycle, the tray must be left to cool at production environment for a minimum of 1hr before starting the second baking.
3. Temperature: 125 deg.C (Refer to spec number 0033575).
4. Baking can be done with or without units.
5. Trays must be strapped using Velcro belt.(Strapping refer to spec number 0056593).
6. Measure the warp after the 3rd. cycle. The the warp should be <0.50mm.

The dry baking was carried out on a Mazzali Oven in the 'Reliability Lab. The warpage measurements were taken before and after the 3 cycle bake. The measurements were carried out in the toolmaking shop using the surface table and feeler gauges. Six measuring points were taken on every tray according to spec. 8080190 and recorded on a table. Please see below.

Tray warpage after 3 cycle baking test

Warpage (mm)	Side 1	Side 2	Side 3	Side 4	Side 5	Side 6
Sample 1	0.15	0.15	0.15	0.15	0.15	0.1
Sample 2	0.15	0.1	0.15	0.2	0.15	0.2
Sample 3	0.15	0.05	0.15	0.15	0.1	0.15
Sample 4	0.1	0.05	0.15	0.2	0.15	0.15
Sample 5	0.15	0.05	0.15	0.15	0.1	0.15
Sample 6	0.15	0	0.15	0.15	0.1	0.15
Sample 7	0.2	0.05	0.15	0.15	0.05	0.15
Sample 8	0.15	0.05	0.15	0.15	0.1	0.1
Sample 9	0.15	0.05	0.15	0.15	0.15	0.15
Sample 10	0.15	0.05	0.15	0.15	0.15	0.15

All readings are within limits.

1 cycle bake

Methodology

1. Sample : 6 trays
2. Duration 48 hrs.
3. Temperature : Base on the temperature mark on the tray. (in our case 150 deg. C)
4. Do not use devices and Velcro belt straps.
5. After the bake cycle measure the tray warpage after leaving the tray to cool to room temperature.

The following table below shows the warpage results after the 48 hrs bake at a temperature of 150 deg.C.

Tray warpage after single cycle baking test

Warpage (mm)	Side 1	Side 2	Side 3	Side 4	Side 5	Side 6
Sample 1	0.15	0.25	0.1	0.15	0.2	0.2
Sample 2	0.15	0.2	0.15	0.1	0.1	0.1
Sample 3	0.15	0.1	0.2	0.15	0.05	0.1
Sample 4	0.2	0.3	0.15	0.25	0.15	0.1
Sample 5	0.1	0.2	0.25	0.15	0.1	0.2
Sample 6	0.15	0.15	0.2	0.15	0.2	0.15

The trays were also checked for the below items:

Items	Result
Any melting point on tray	NO
Any shrinkage on overall length	NO
Any shrinkage on overall thickness	NO
Any shrinkage on pocket dimension	NO
Maximum warpage from 6 corners should not be more than 0.76mm	0.3mm

Outgas material test:

No oxidation of balls was noted after this test.

Drop Test:

The drop test was performed with the packing methodology described in spec number 0056593. The drop test was carried out according to methodology described in specification number 7416802.

Bakeable Tray

Drop Test	Max. coplanarity / microns	Min stand off / microns	Max stand off / microns	Max pitch deviation/ microns
Before drop	78	481	520	20
After Drop	79	477	518	22
Variance	-1	4	2	-2
Visual Inspection	Yes	No		
Chip Tray		✓		
Crack Tray		✓		
Visual defect at unit		✓		

Non-bakeable tray

Drop Test	Max. coplanarity / microns	Min stand off / microns	Max stand off / microns	Max pitch deviation/ microns
Before drop	77	473	518	25
After Drop	80	472	518	27
Variance	-3	1	0	-2
Visual Inspection	Yes	No		
Chip Tray		✓		
Crack Tray		✓		
Visual defect at unit		✓		

All devices were within limits after all drop tests and minimal variance between readings before drop and after drop were recorded.

Additionally no chipped substrate defects were recorded in the 3 bundles following the 3 drops per bundle as described in spec 7416802 for both the bakeable and non-bakeable tray.

ESD Characteristics:

Equipment used :

Prostat PRS-801 Resistance Meter
Prostat PRV-913 Microprobe Verifier
Prostat probes PRF-922A-B and PRF914
Prostat Psychrometer PHT-771

Methodology

A sample of six trays were used to measure the surface resistance. Each tray was tested at six different points. The accepted limits for the trays should be within 1x10exp5<Rs<1x10exp11.

Every reading was recorded as shown in the table below. Also the relative humidity and temperature were taken note of during the testing.

Bakeable Tray

TESTS	TRAY SAMPLES	SURFACE RESISTANCE MEASUREMENTS					
		Record 1	Record 2	Record 3	Record 4	Record 5	Record 6
SURFACE RESISTANCE TEST	Sample 1	2.1e8	3.0e8	1.3e8	1.2e10	1.1e9	1.1e8
	Sample 2	6.6e8	1.8e8	6.9e7	1.0e10	1.3e8	2.8e8
	Sample 3	7.4e8	4.1e8	9.2e8	1.1e10	7.5e7	4.5e8
	Sample 4	1.6e8	4.8e8	1.8e8	1.3e10	2.1e9	1.2e9
	Sample 5	1.1e8	2.8e8	4.5e8	1.2e9	1.6e8	4.8e8
	Sample 6	1.1e9	1.3e8	7.3e7	2.1e9	1.8e8	1.3e10
SURFACE RESISTANCE AFTER SCRATCHING	Sample 1/ Pocket 1	5.6e8 3.5e8					
TEMP.	19.3°C						
R.H.	43.3%						

Non-Bakeable Tray

TESTS	TRAY SAMPLES	SURFACE RESISTANCE MEASUREMENTS					
		Record 1	Record 2	Record 3	Record 4	Record 5	Record 6
SURFACE RESISTANCE TEST	Sample 1	5.7e9	8.6e9	2.3e10	9.4e9	3.5e10	2.6e10
	Sample 2	2.5e10	2.9e10	1.4e10	2.2e10	1.9e10	1.9e10
	Sample 3	2.6e10	2.2e10	9.4e9	5.1e10	2.5e10	1.3e10
	Sample 4	1.3e10	1.9e10	1.6e10	2.1e10	1.5e10	1.9e10
	Sample 5	1.6e10	1.4e10	2.6e10	1.9e10	1.6e10	1.6e10
	Sample 6	4.6e10	1.9e10	2.5e10	1.5e10	1.4e10	2.1e10
SURFACE RESISTANCE AFTER SCRATCHING	Sample 1/ Pocket 1	Not applicable					
TEMP.	19.3°C						
R.H.	43.3%						

All measurements were within ST specification limits.

Workability Test:

Trays were tested at singulation, on the test handlers and on the finishing scanners. No misplacement was noted during operation. It is to be noted that these trays are designed to eliminate misplacement since pocket is deep and tray fences are chamfered so that device falls inside the pocket.

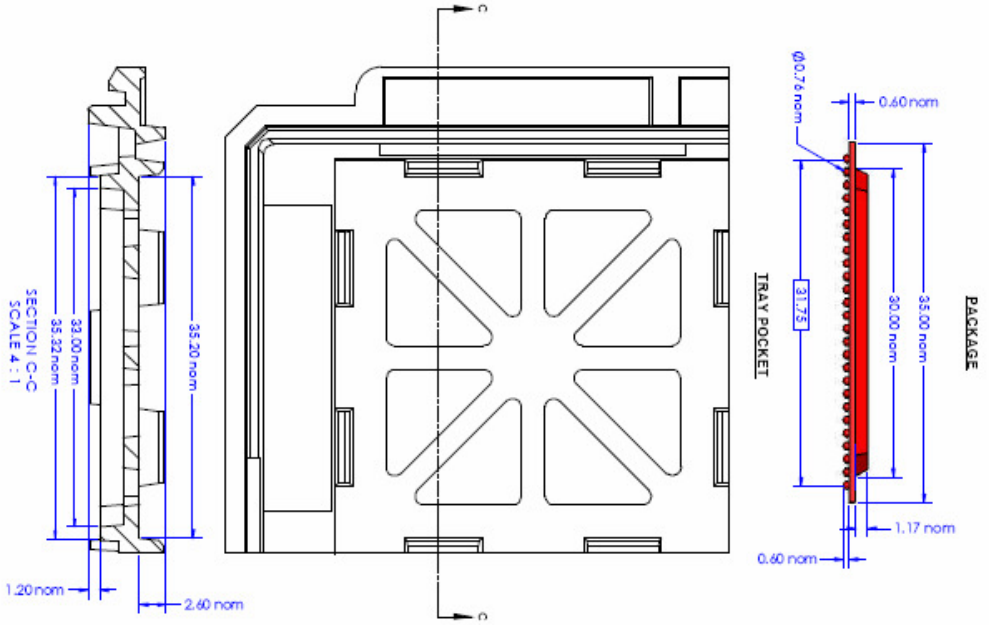
Fit Analysis:

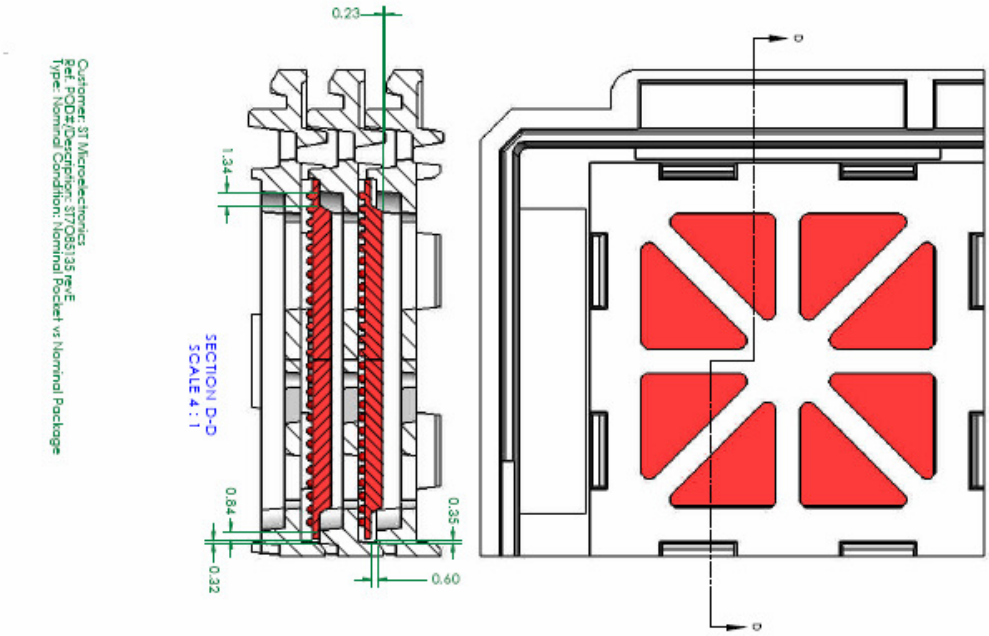
Below is the fit analysis for three BGA 35x35 packages with overall thicknesses ranging from 2.3 to 2.6mm. All the BGA 35x35 with overall thickness between 2.3 to 2.6mm are suitable for this tray. The below packages are all suitable for this tray.

Package Code	PACKAGE_DESCR
0B	PBGA 35x35x2.40 729 6R33x33 1.0
2)	PBGA/HS 35sqx2.3 956 P1.0 b0.6
2P	PBGA 35x35x2.44 748 5R34x34 1.0
7N	PBGA 35x35x2.5 900 4R34 1.0 4L
8H	PBGA532+36 35sqx2.6 7R26 1.27-4L
A0	PBGA708+84 35sq 4-1+3R34 1.0-4L
B7	PBGA580+10035sqx2.6 5R34 1.00-4L
BE	PBGA 352 35sqx2.6 4R26 1.27-2L
BK	PBGA352+36 35sqx2.6 4R26 1.27-4L
BT	PBGA352+36 35sqx2.6 4R26 1.27-4L
F6	PBGA35sq 580+100(7R34 1.0)DEP-4L
GS	PBGA 35x35x2.44 580+144 5R34 1.0
HP	PBGA 35x35x2.3 764+100 6R34 P.1
NL	PBGA/HSp 456 35sqx2.54 5R26 1.27
Z0	PBGA 35x35x2.50 672+100 6R34 1.0

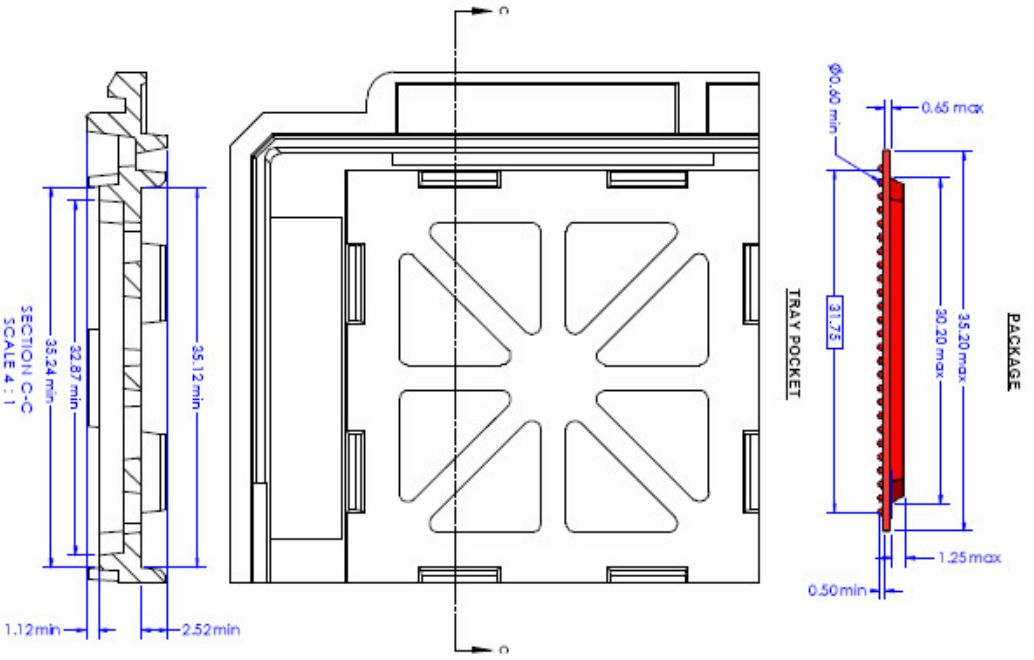
With POA 7085135

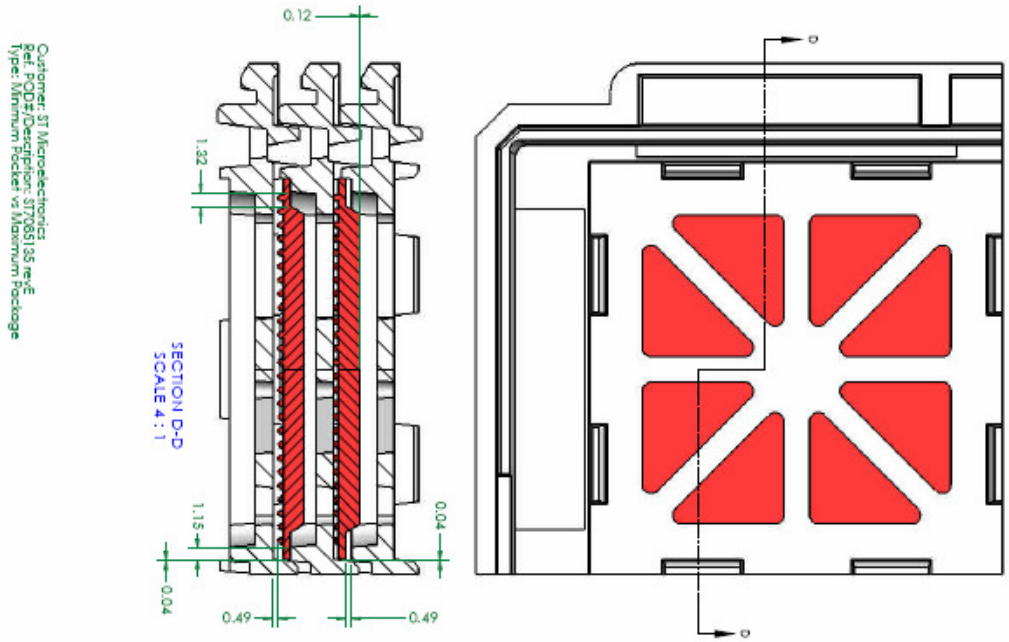
Nominal Conditions



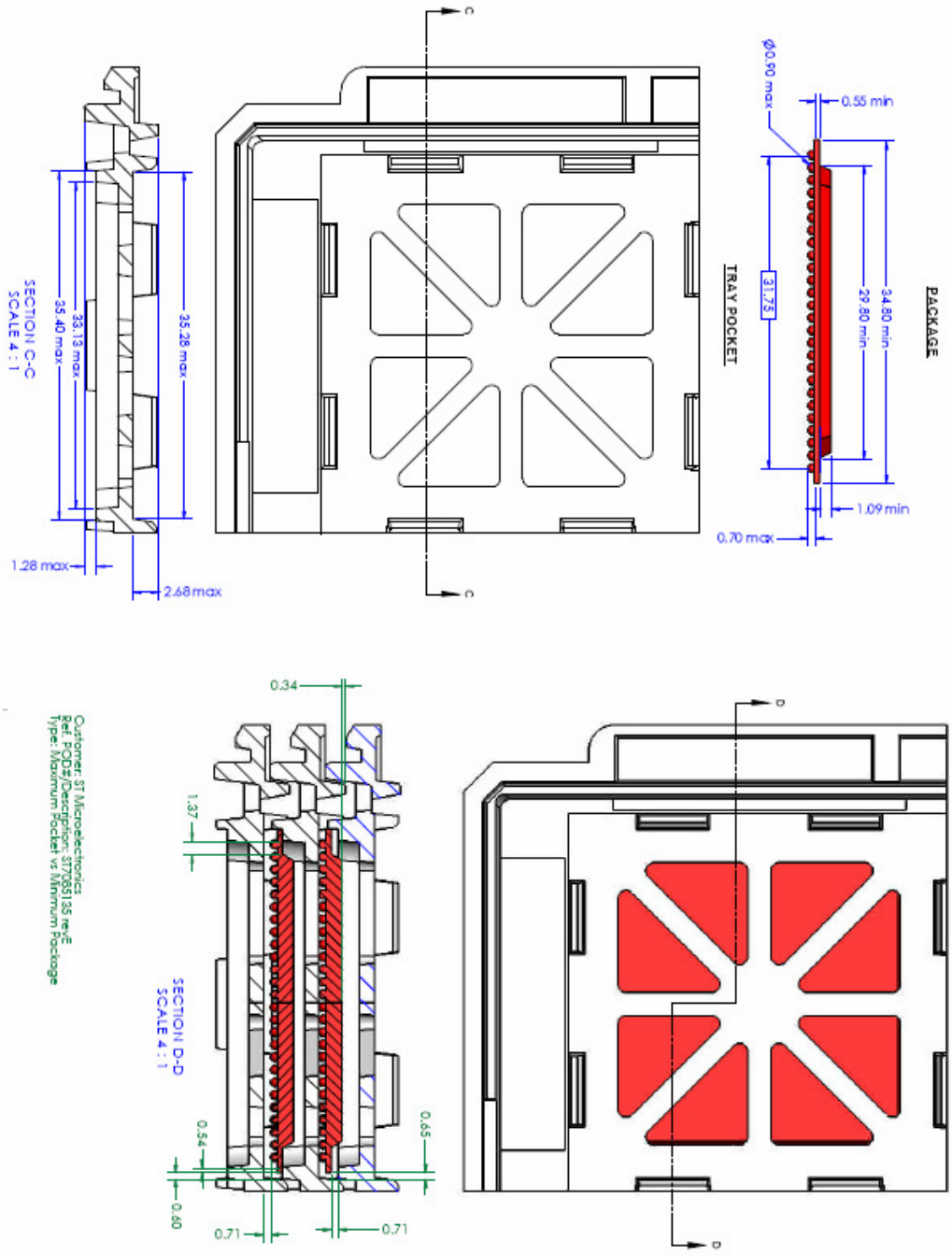


Minimum Pocket vs Maximum Package



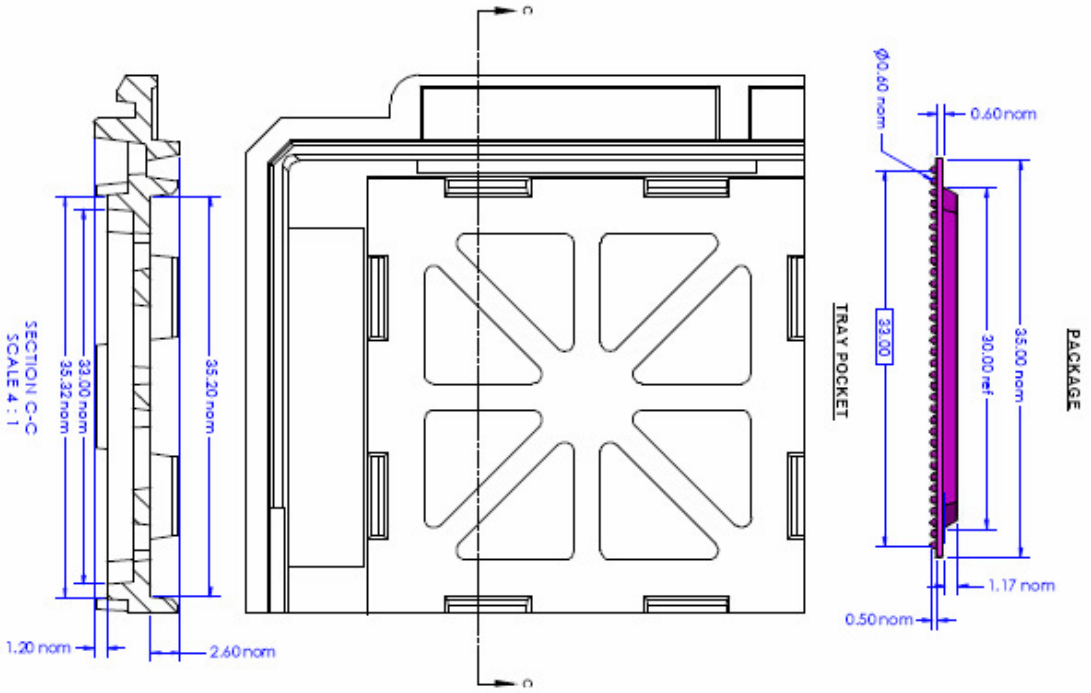


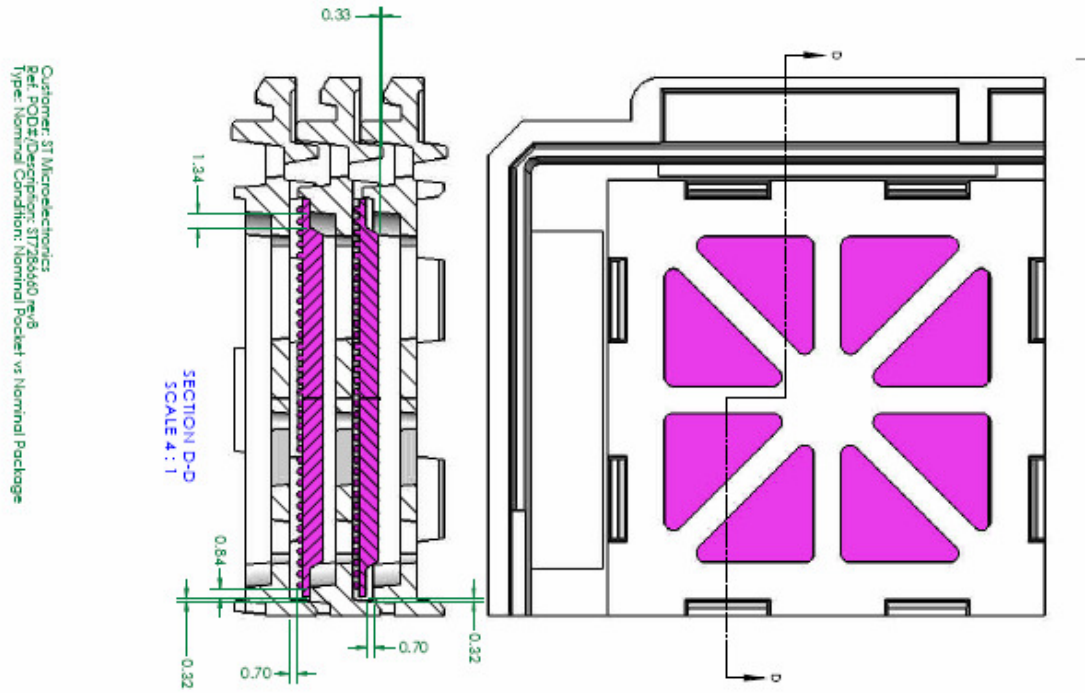
Maximum Pocket vs Minimum Package



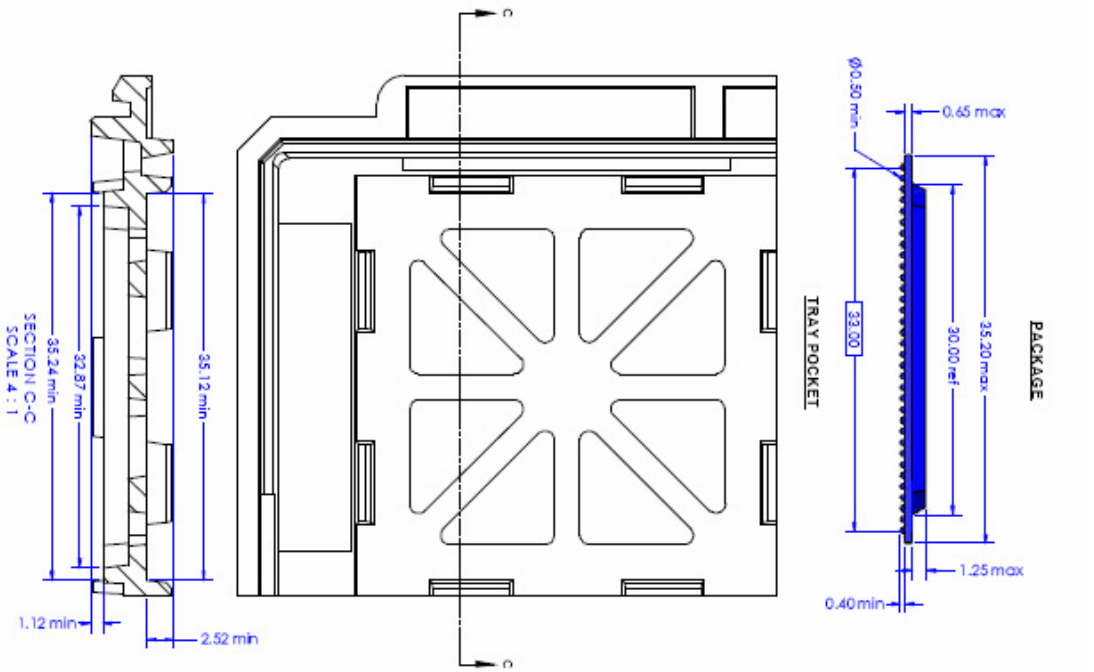
With POA 7286660

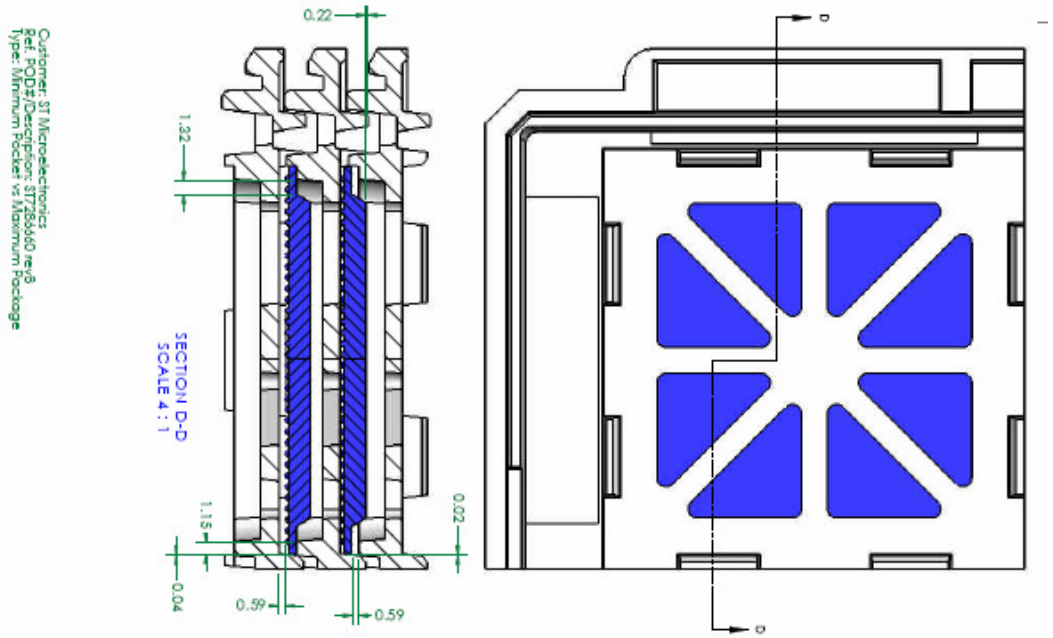
Nominal Conditions



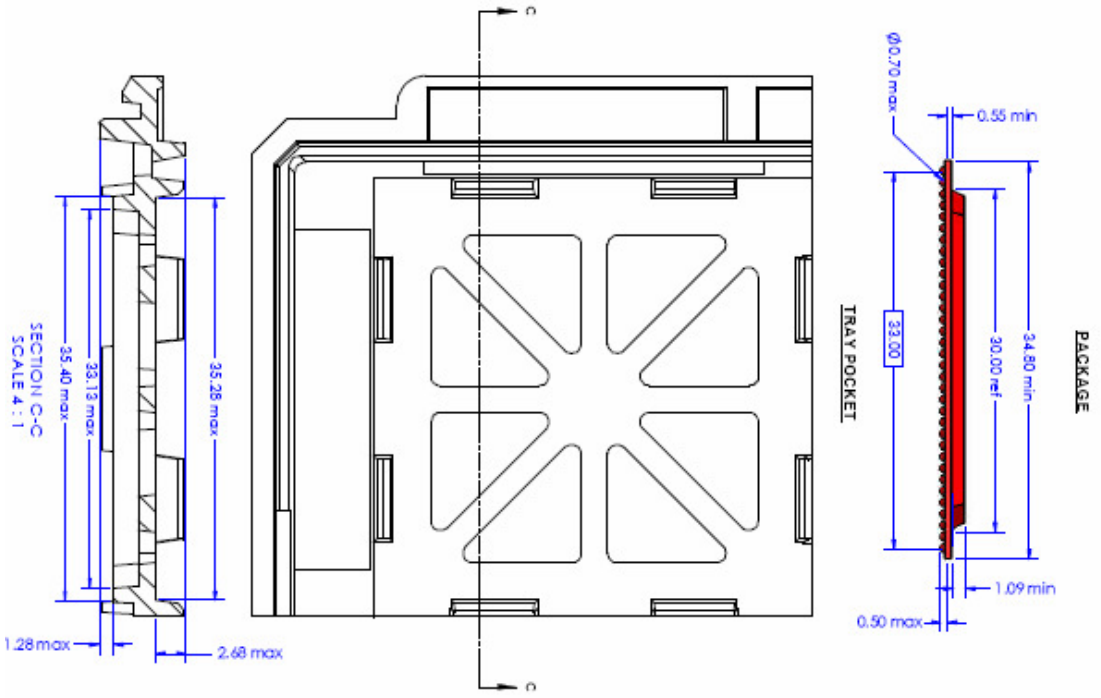


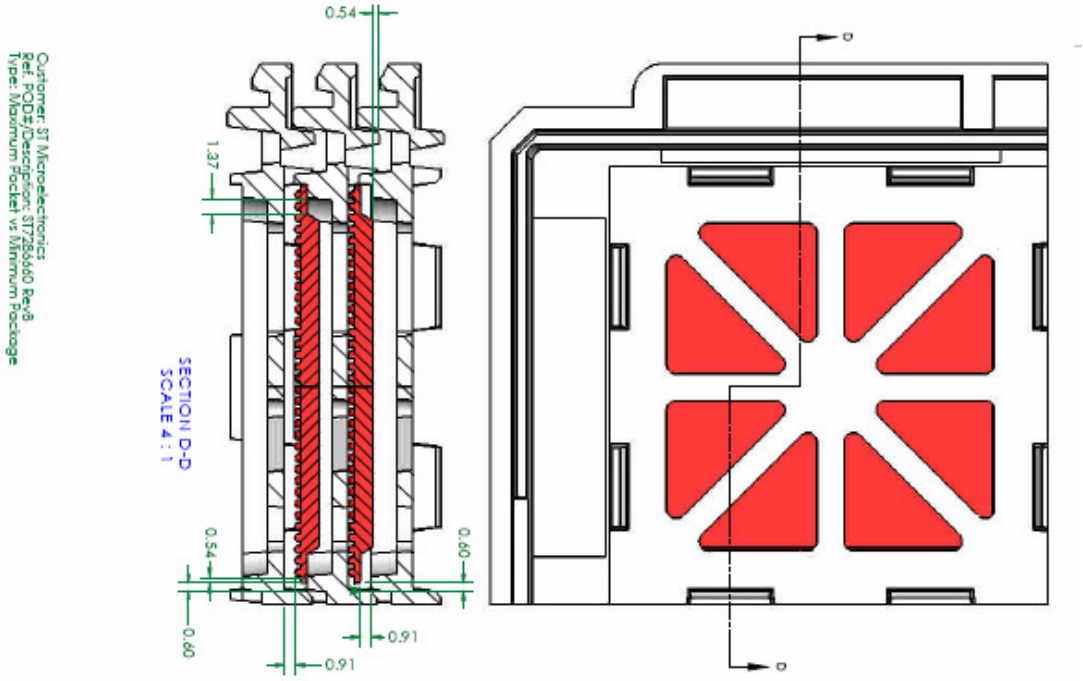
Minimum Pocket vs Maximum Package





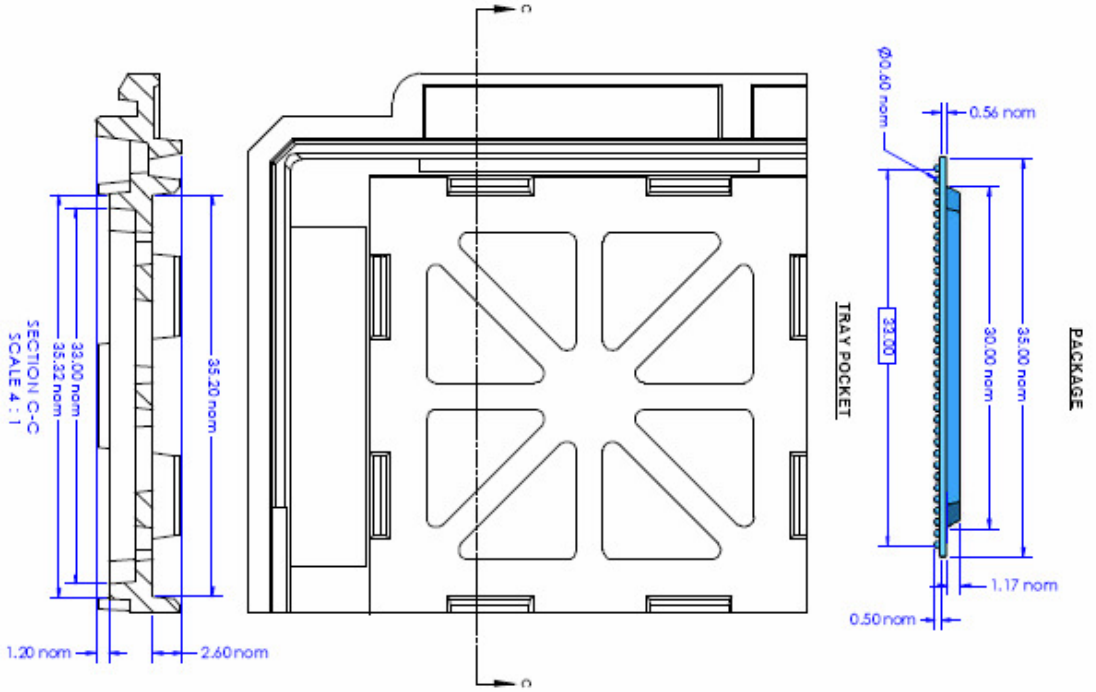
Maximum Pocket vs Minimum Package

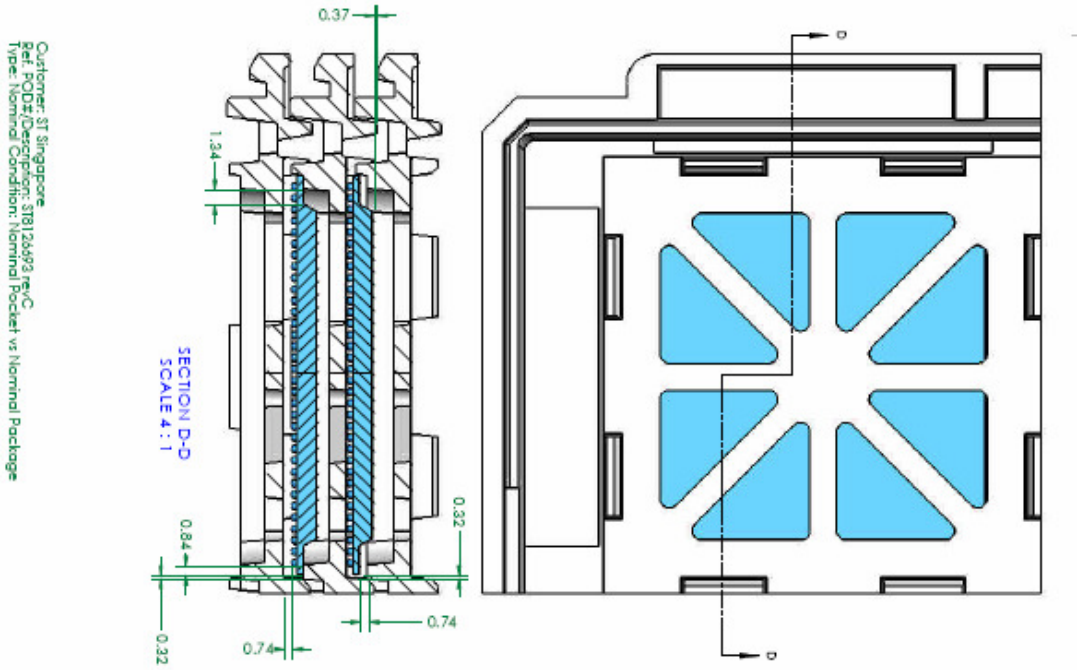




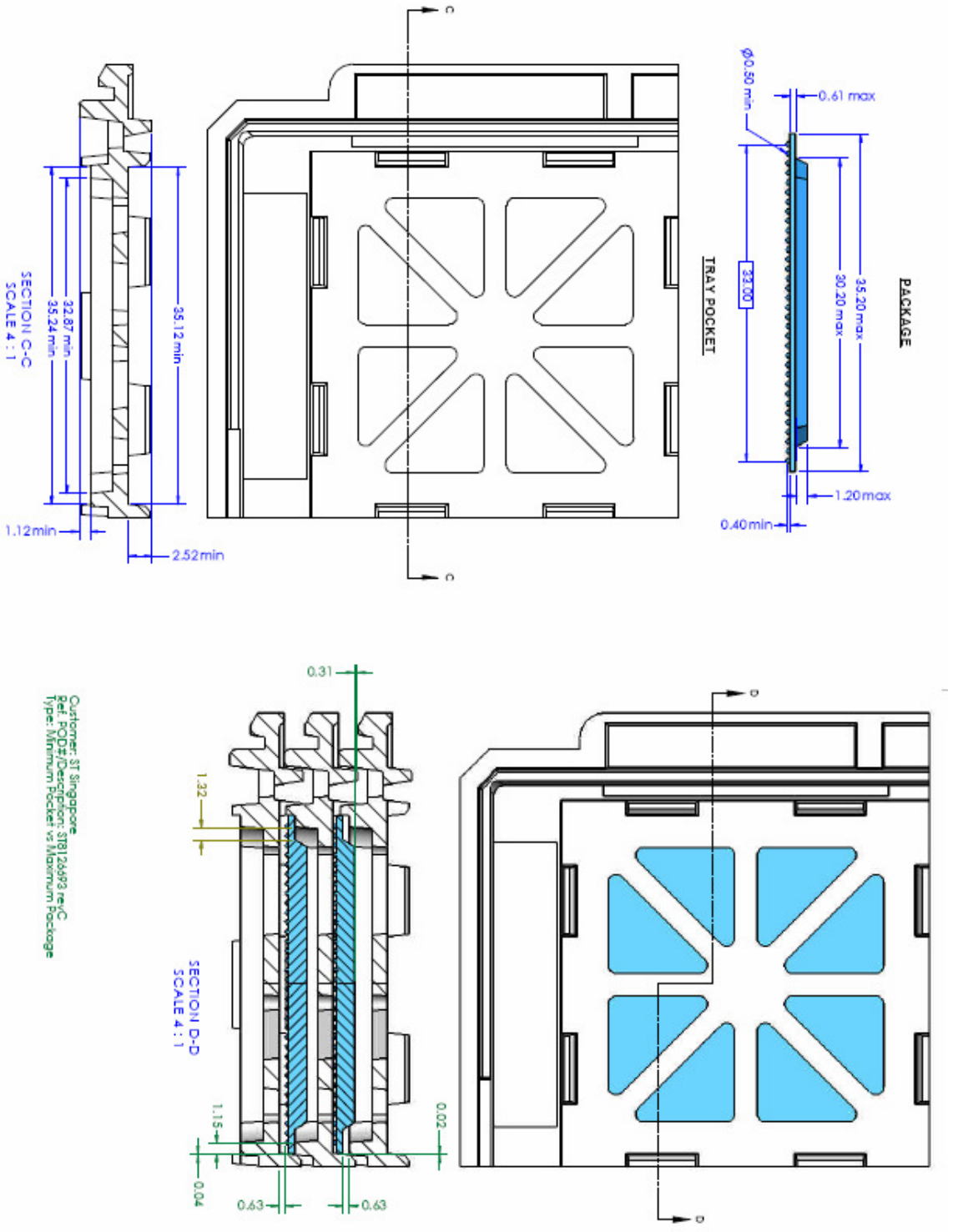
With POA 8126693

Nominal Conditions

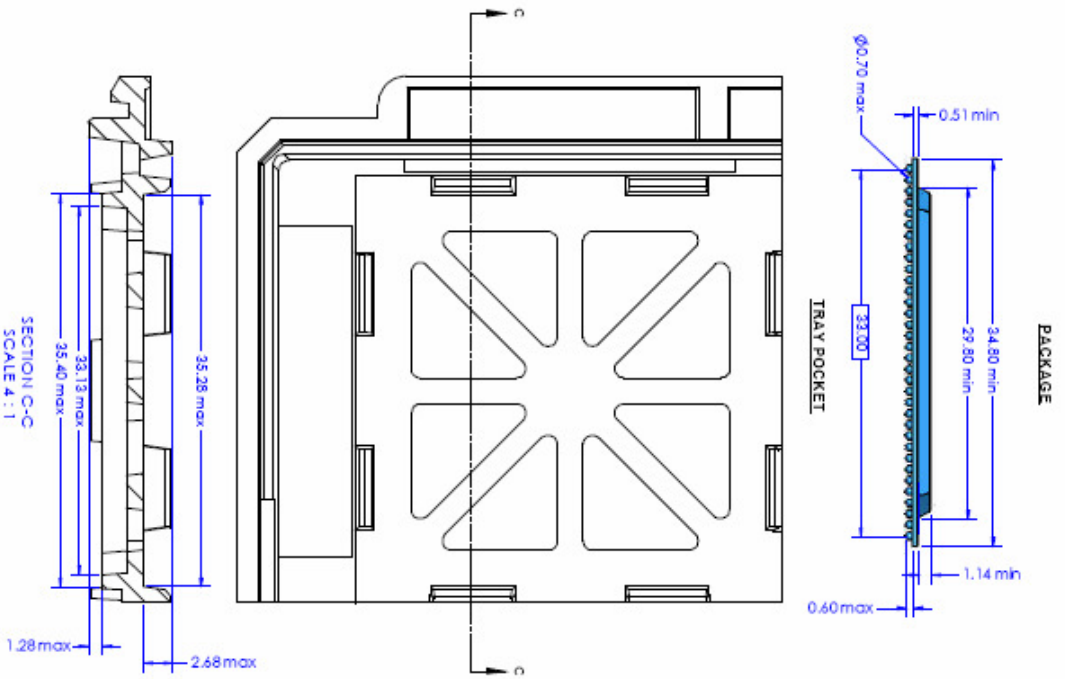


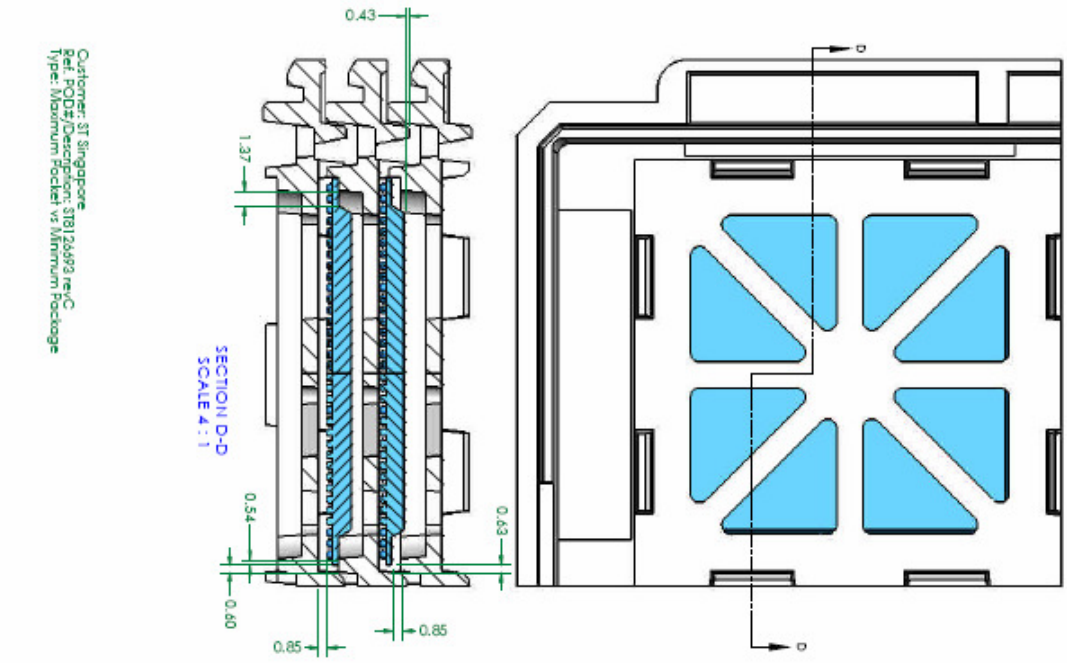


Minimum Pocket vs Maximum Package



Maximum Pocket vs Minimum Package





Conclusion:

There are several quality advantages when using this new design for the BGA 35x35 tray. The pocket design will help in eliminating misplacement in the process. The deep pocket will help in eliminating devices going out of the pocket during transportation. This, together with the fact that devices are not captured from the corners, leads to no substrate damage during drop test unlike all the trays tested before and currently in use.

Since this tray passed all the qualification tests, it can therefore be qualified.

Adrian Vassallo
PBGA Process Engineering
25/11/2010

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