

# ***Report of Board Level Test***

***ID: 0820***

***Package: MicroPak2™ 1.0x1.0x0.55mm 6LD***

***Product: NC7SV04FHX***

***Test: TMCL, Drop, Cyclic bend***

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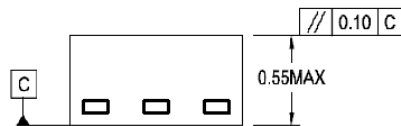
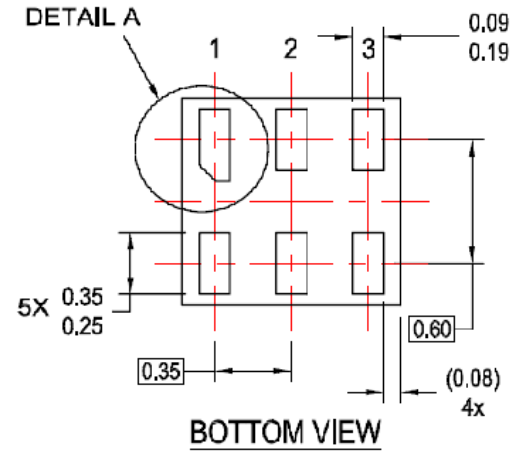
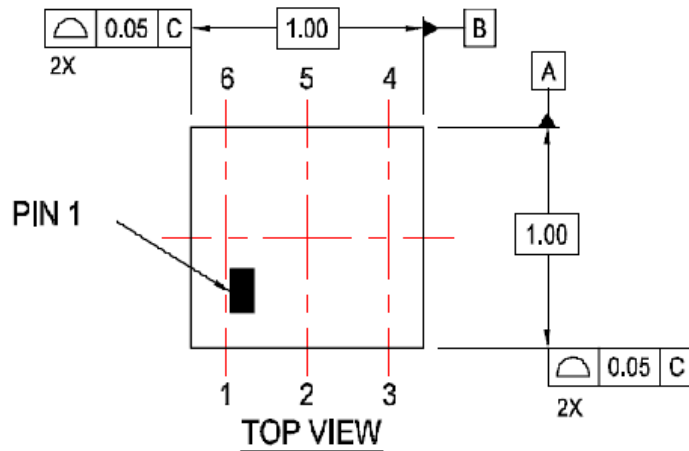
## Purpose

- MicroPak2™ 1.0x1.0x0.55mm 6LD 0.35mm pitch package of daisy chained package was subjected to TMCL, Drop and Cyclic Bend test in its board mounted state to access its solder joint reliability. These tests follow established industry standard and best practices which intend to simulate stress conditions during board mounting and in field application. The tests were requested for the purpose of internal qualification and expected customer requests in future.



Device: NC7SV04FHX

Package outline



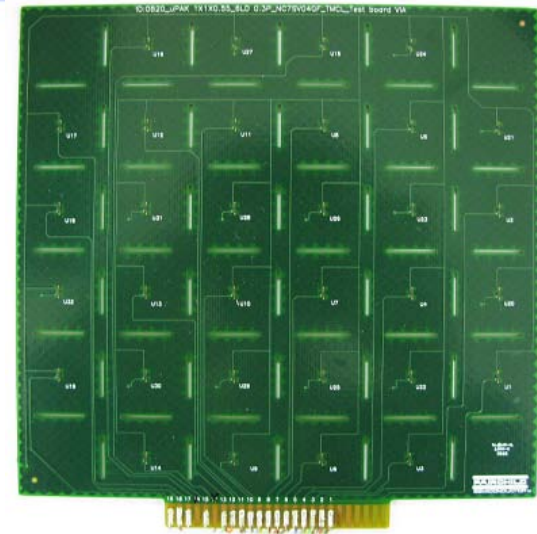


Test	Condition	Failure criteria	Test duration	Sample size	Reference
Thermal cycling	<ul style="list-style-type: none"> <li>•-40 °C / +125 °C temperature extremes</li> <li>•10 min dwell time within +10/-0 °C at hot temperature extreme and +0/-10 °C at cold temperature extreme</li> <li>•≤20 °C / min ramp rate</li> </ul>	The 1 <sup>st</sup> event of 1000 Ω increase in resistance for a duration of 1 μs with additional nine or more events within 10% of the cycles from the initial event	1000 cycles or 63.2% cumulative failure (whichever occurs first)	32 (via in pad)	IPC-9701
Drop	<ul style="list-style-type: none"> <li>•Half sine wave</li> <li>•1500G for 0.5 ms duration</li> </ul>	4 events of discontinuity with increase in resistance greater than 1000 Ω lasting 1 μs or longer in 5 subsequent drops constitute a failure	30 times or until 80% of all devices have failed (whichever is earlier )	60 (no via in pad)	JESD 22-B111
Cyclic bend	<ul style="list-style-type: none"> <li>•Vertical displacement: 2 mm</li> <li>•Cyclic frequency: 1(or 3) Hz</li> <li>•Load profile: sinusoidal</li> <li>•Support span: 110 mm</li> <li>•Load span: 75 mm</li> </ul>	The 1 <sup>st</sup> event of 1000 Ω increase in resistance for a duration of 1 μs with additional nine or more events within 10% of the cycles from the initial event	200,000 cycles or until at least 60% of all units have failed from the initial samples (whichever occurs first)	36 (no via in pad)	JESD 22-B113



## PCB Attributes

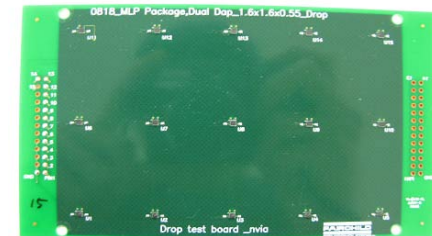
- FR4 Laminate PCB
- Board dimension
  - 150mm x 150mm x 2.35mm: TMCL board
  - 132mm x 77mm x 1mm: Drop/bend board
- Type of via in pad
  - TMCL board: Via in pad
  - Drop board, bend board : No via in pad
- 1 oz Cu trace used
- OSP (Organic Surface Preservative) surface finish



TMCL board

## Solder paste

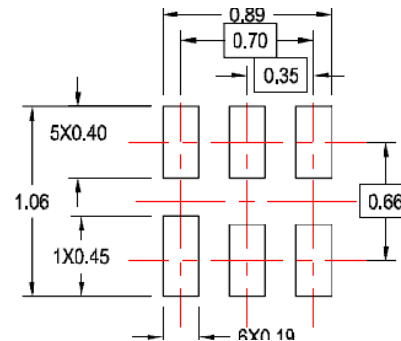
- Sn3.0Ag0.5Cu
- Nihon Handa, PF305-2-700W



Drop board

## Stencil

- Material: SUS304
- Thickness: 5mil
- Opening: 1:1 with land pattern

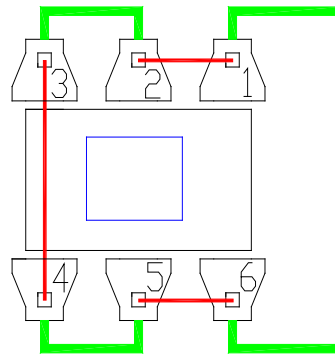


Opening design

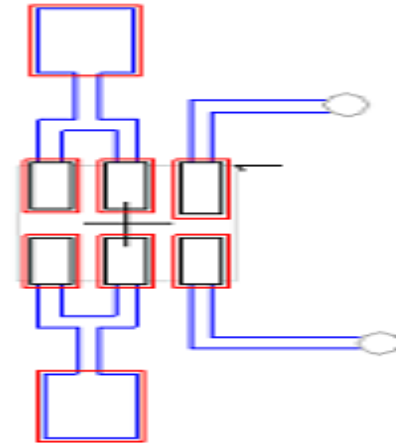


## ❏ Daisy chain net

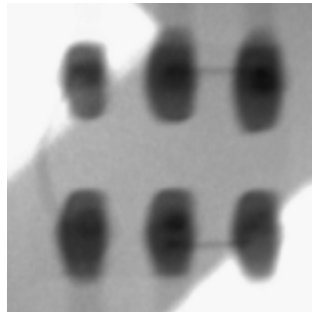
Package side



PWB side



## ❏ Board mounted unit





■ This test is intended to provide information on the wear out performance of the solder joint attachment of surface mount devices to circuit boards where cyclic stresses due to CTE mismatches from thermal loading may result in fatigue-related failures.

■ Temperature cycling requirement

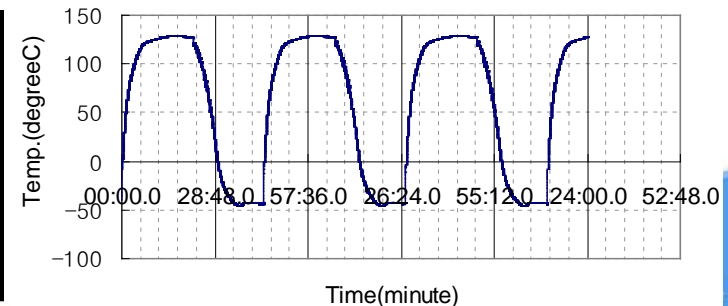
- Temperature range:  $-40\text{ }^{\circ}\text{C}(+0/-10\text{ }^{\circ}\text{C}) \sim 125\text{ }^{\circ}\text{C}(+10/-0\text{ }^{\circ}\text{C})$
- Dwell time: 10 min
- Temperature ramp rate: less than or equal to  $20\text{ }^{\circ}\text{C}/\text{min}$

■ Actual temperature profile

(Min:sec)

Cycle	Dwell time		Ramp time (Ramp rate)		Cycle time
	< $-40^{\circ}\text{C}$	> $125^{\circ}\text{C}$	Heat up	Cool down	
1 <sup>st</sup>	10:10	11:40	10:20 ( $16^{\circ}\text{C}/\text{min}$ )	11:52 ( $14^{\circ}\text{C}/\text{min}$ )	44:02
2 <sup>nd</sup>	10:15	12:12	09:50 ( $17^{\circ}\text{C}/\text{min}$ )	11:53 ( $14^{\circ}\text{C}/\text{min}$ )	43:30
3 <sup>rd</sup>	10:06	12:10	09:52 ( $17^{\circ}\text{C}/\text{min}$ )	11:53 ( $14^{\circ}\text{C}/\text{min}$ )	43:21
Avg.	10:10	12:00	10:00	11:53	43:38

Hot peak temp:  $128.5^{\circ}\text{C}$ ,  
Cold peak temp:  $-45.9^{\circ}\text{C}$





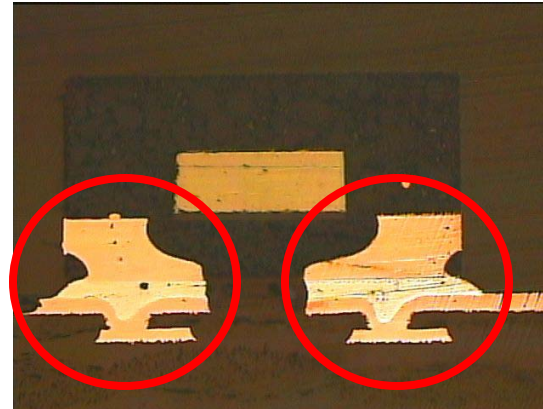
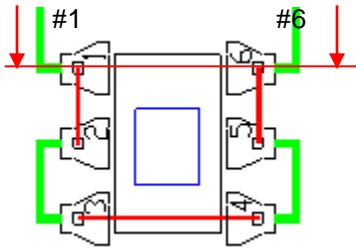
## ❏ Cycles of failure

Unit #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Failure cycle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unit #	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Failure cycle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Devices tested up to 1000 cycles with No failures occurring.



## Inspection of Solder joint



#6

#1



- Sample: Unit 1
- No crack was observed in #1 and #6 joint.

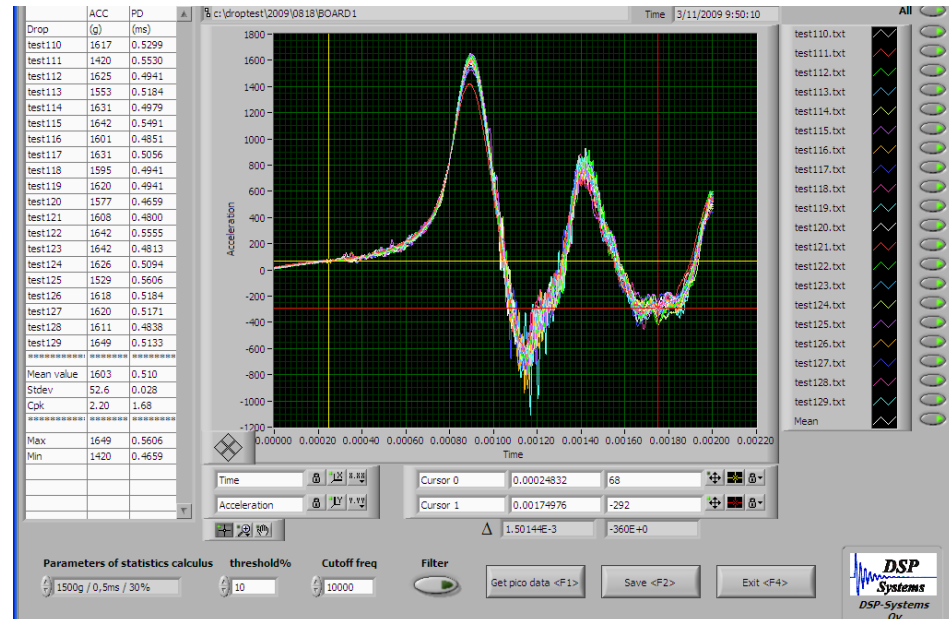
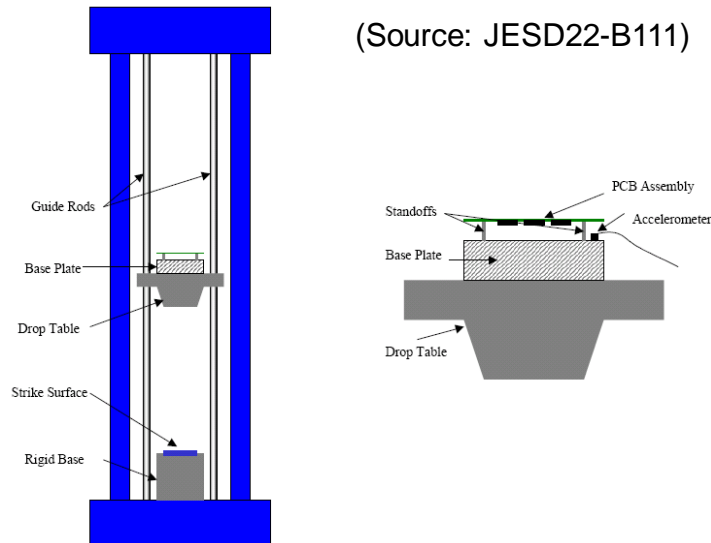


❑ This test method is intended to determine the ability of the mounted component to withstand moderately severe shocks such as a result of sudden applied force or sudden change in motion produced by handling, transportation, normal field operation, accidental misuse or drop of the product.

❑ Test condition

- Half sine wave 1500G in 0.5 msec (simulates a drop height of 1.120m of any handheld product)
- Drop count: 30

❑ Test apparatus and mounting scheme



Drop pulse (actual)



## Drop count of failure

Board ID	Unit number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1															
2															
3															
4															

- Devices tested to 30 drops with No failures

cf. Resistance of daisy chain net before and after drop test

(Unit: Ω)

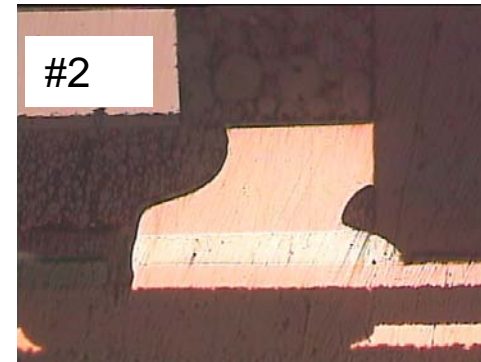
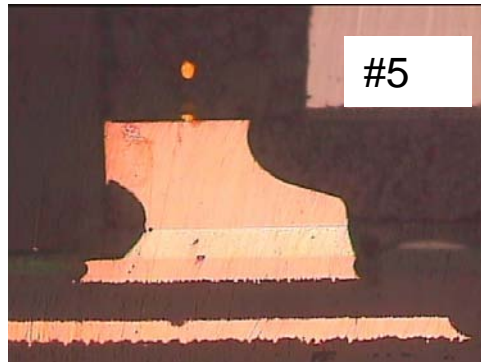
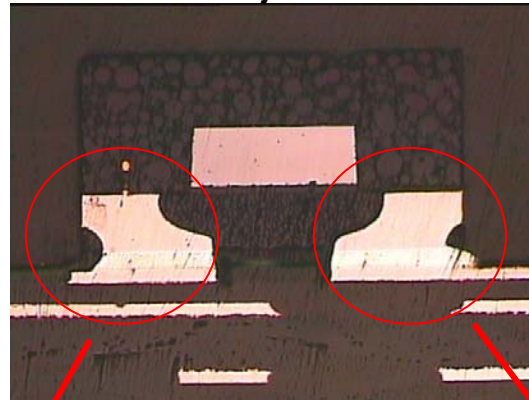
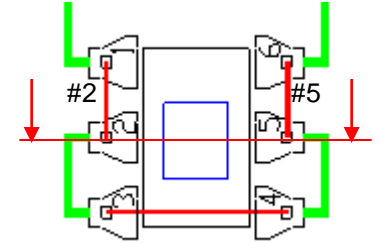
Unit	Board 1		Change (%)	Board 2		Change (%)	Board 3		Change (%)	Board 4		Change (%)
	Initial	30 drop		Initial	30 drop		Initial	30 drop		Initial	30 drop	
1	1.719	1.715	-0.2	2.388	2.382	-0.3	2.529	2.533	0.2	2.754	2.749	-0.2
2	1.966	1.962	-0.2	2.449	2.444	-0.2	2.604	2.613	0.3	2.732	2.728	-0.1
3	2.471	2.466	-0.2	2.499	2.510	0.4	2.685	2.692	0.3	2.879	2.874	-0.2
4	2.191	2.177	-0.6	2.576	2.588	0.5	2.703	2.715	0.4	1.695	1.677	-1.1
5	2.258	2.245	-0.6	2.677	2.683	0.2	2.775	2.788	0.5	1.929	1.913	-0.8
6	2.324	2.310	-0.6	2.572	2.582	0.4	2.817	2.831	0.5	2.170	2.152	-0.8
7	2.392	2.382	-0.4	2.669	2.675	0.2	2.983	3.001	0.6	2.409	2.388	-0.9
8	2.384	2.372	-0.5	2.741	2.748	0.3	1.700	1.682	-1.1	2.669	2.646	-0.9
9	2.485	2.470	-0.6	2.718	2.711	-0.3	2.173	2.157	-0.7	2.402	2.384	-0.7
10	2.569	2.556	-0.5	1.693	1.697	0.2	2.407	2.390	-0.7	2.523	2.503	-0.8
11	2.722	2.710	-0.4	1.941	1.943	0.1	2.387	2.373	-0.6	2.677	2.661	-0.6
12	1.677	1.689	0.7	2.177	2.175	-0.1	2.444	2.433	-0.5	2.685	2.666	-0.7
13	1.964	1.937	-1.4	2.420	2.422	0.1	2.560	2.561	0.0	2.755	2.737	-0.7
14	2.175	2.184	0.4	2.677	2.679	0.1	2.569	2.563	-0.2	2.752	2.734	-0.7
15	2.417	2.421	0.2	2.408	2.410	0.1	2.679	2.672	-0.3	2.898	2.877	-0.7

•Resistance reading after TMCL, drop or cyclic bend test shall be utilized only as reference data because its change is not always consistent in event based failure.



## Inspection of Solder joint

- Sample: Board 1, unit 1
- No crack was observed in #2 and #5 joint.

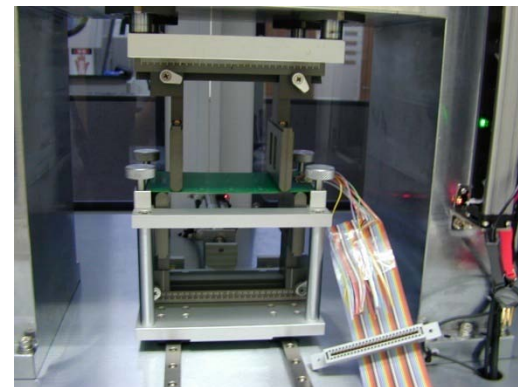
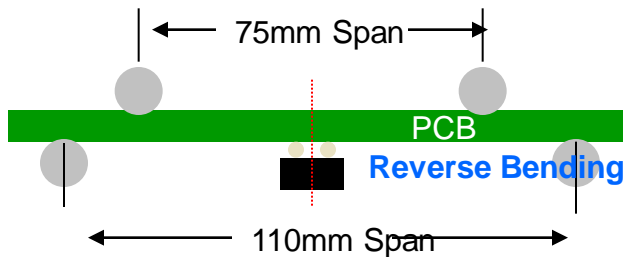




■ This test is intended to characterize the fracture strength of a component's board level interconnects. The monotonic bend characterization results provide a measure of fracture resistance to flexural loading that may occur during conventional non-cyclic board assembly and test operations, and supplements existing standards that address mechanical shock or impact during shipping, handling or field operation.

■ Test configuration for cyclic bend test

- 4 point bend test setup with support Anvils: 110 & Load Anvils: 75mm span.
- Reverse cyclic bending.
- FSC designed equipment used



Cyclic bend test setup



## ■ Cycles of failure

Board ID	Unit number								
	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									

- No failure occurred until 200K cycles.

cf. Resistance of daisy chain net before and after cyclic bend test

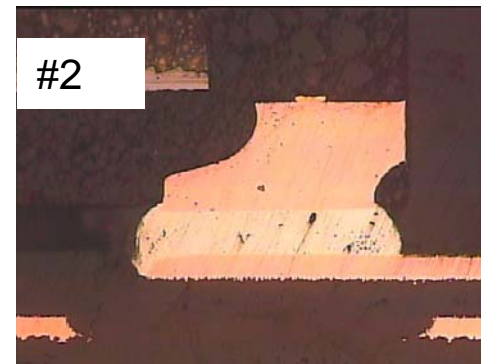
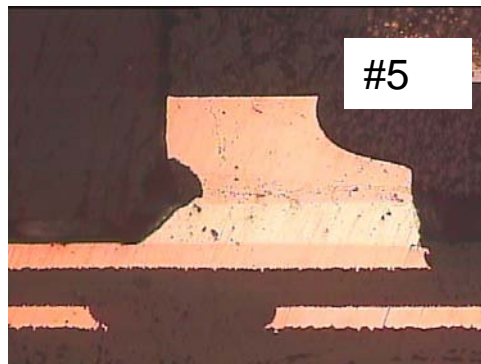
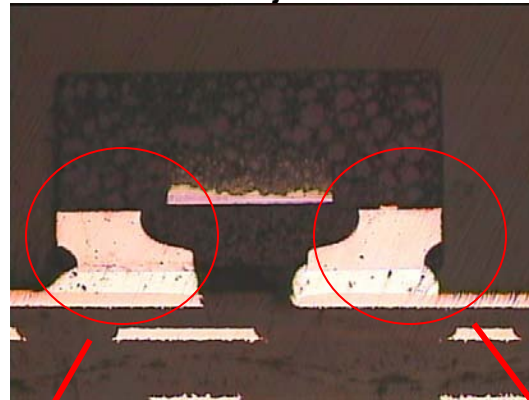
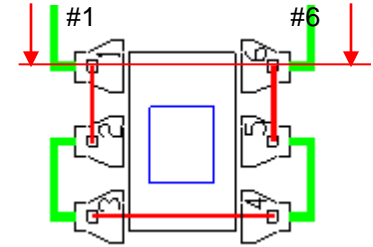
(Unit: Ω)

Unit	Board 1		Change (%)	Board 2		Change (%)	Board 3		Change (%)	Board 4		Change (%)
	Initial	200k cycle		Initial	200k cycle		Initial	200k cycles		Initial	200k cycle	
1	0.802	0.806	0.5	0.775	0.778	0.4	0.586	0.582	-0.7	0.789	0.786	-0.4
2	1.224	1.220	-0.3	1.056	1.053	-0.3	1.021	1.023	0.2	1.023	1.020	-0.3
3	1.308	1.309	0.1	1.317	1.319	0.2	1.263	1.267	0.3	1.306	1.303	-0.2
4	1.398	1.396	-0.1	1.316	1.314	-0.2	1.313	1.311	-0.2	1.367	1.364	-0.2
5	1.443	1.440	-0.2	1.357	1.356	-0.1	1.389	1.387	-0.1	1.425	1.422	-0.2
6	1.511	1.509	-0.1	1.488	1.487	-0.1	1.460	1.457	-0.2	1.521	1.518	-0.2
7	1.661	1.663	0.1	1.644	1.642	-0.1	1.556	1.552	-0.3	1.642	1.637	-0.3
8	1.781	1.779	-0.1	1.646	1.644	-0.1	1.627	1.624	-0.2	1.752	1.748	-0.2
9	1.674	1.671	-0.2	1.644	1.641	-0.2	1.651	1.649	-0.1	1.624	1.620	-0.2



## Inspection of Solder joint

- Sample: Board 1, unit 1
- No crack was observed in #1 and #6 joints.





- MicroPak2 1.0x1.0x0.55mm 6LD was tested in the PWB level thermal cycling, drop and cyclic bend test as specified in FSC-QAR-0024.
  - The package passed the thermal cycling test (-40~125°C, 1000 cycles).
  - The package passed the drop test (1500G for 0.5ms, 30 drops).
  - The package passed the cyclic bend test (2mm deflection, 1Hz, 200k cycles).