

# Infineon

Green Product

2<sup>nd</sup> level reliability of tin plated components



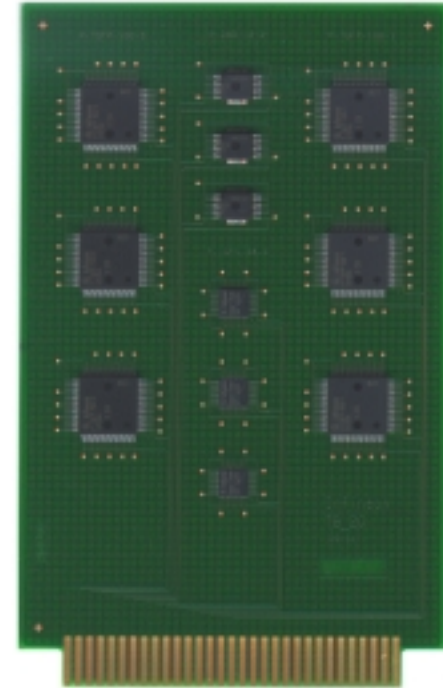
Never stop thinking.

- **Experimental parameters**
  - Testboard, paste, components, T-cycling, Shear test
  - Reflow profile SnPbAg
  - Reflow profile SnAgCu
- **Reliability of components with matt pure tin finish**
  - TQFP-100-5 (Cu)
  - TQFP-100-1 (FeNi42)
  - VQFN-48-4
- **Summary**

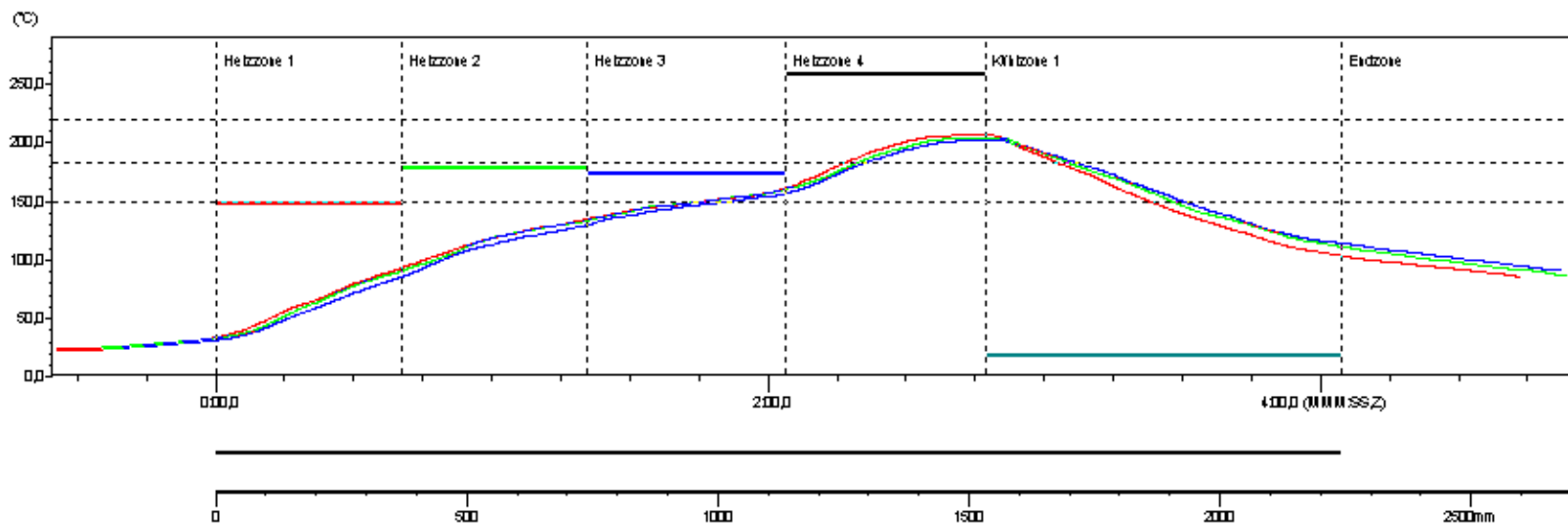
# Board level reliability, Sn finish on components

## Experimental parameters

Testboard:	1,0 mm FR 4, 4 layers, symmetric layout (bottom = top) Finish Cu/OSP and Ni/Au
Stencil thickness:	125 $\mu\text{m}$
Stencil opening	= pad size
Solder paste:	SnPb36Ag2 (Kester 229d, class 3 ROL1) SnAg3.8Cu0.7 (Multicore CR32, class 3, ROL0)
Components:	P-TQFP-100-1 (FeNi42-Leadframe) P-TQFP-100-5 (Cu-Leadframe) P-VQFN-48 (Cu-Leadframe) P-DSO-12 (Cu Leadframe) 24 components per type and test, daisy chain chip
T-cycling:	-40 $^{\circ}\text{C}$ / + 125 $^{\circ}\text{C}$ , T-shock air to air, dwell time 15 min Electrical failure detection online (daisy chain)
Shear test:	speed 500 $\mu\text{m}$ / s

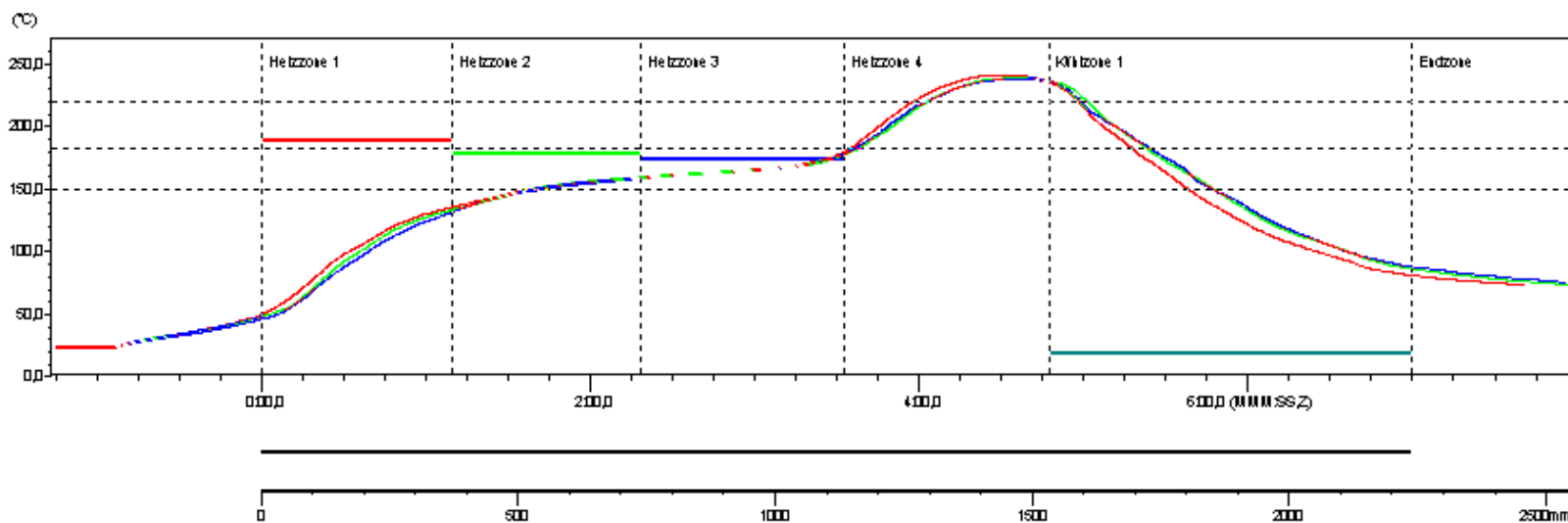


### Reflow profile for SnPbAg assembly



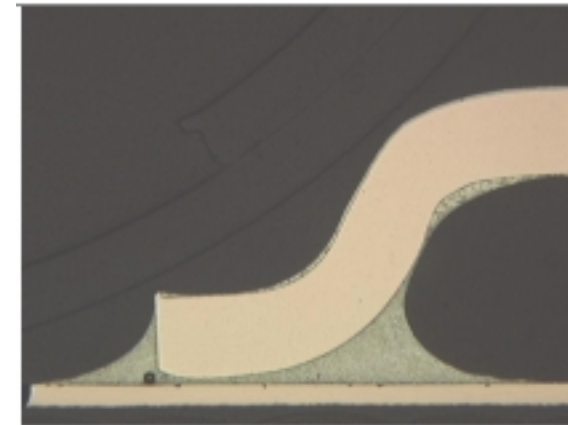
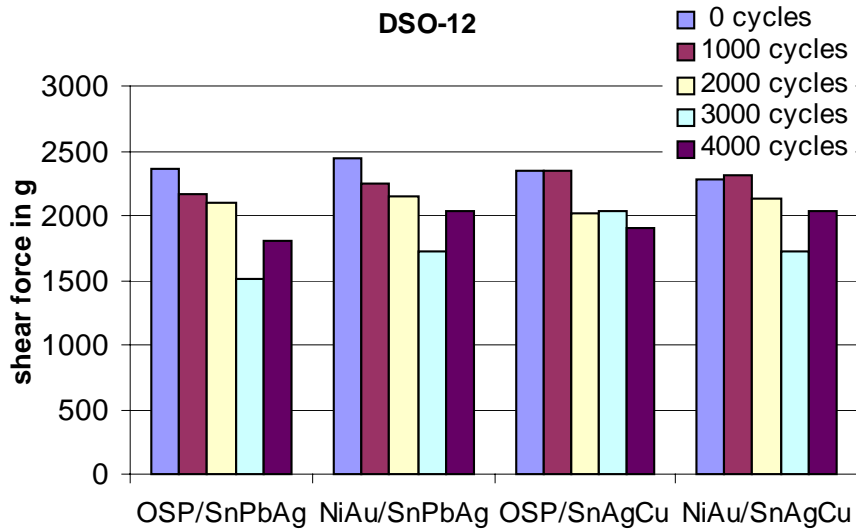
Optionen...		Temperaturmaxima und -minima in °C			
		Max: Temp	Max: Zeit	Min: Temp	Min: Zeit
1	VQFN-48 Thermofühler 1	208,5	2:41,1	23,0	- 0:35,0
2	DSO-12 (Lead) Thermofühler 2	205,5	2:38,9	24,5	- 0:35,0
3	DSO-12 (Ground) Thermofühler 3	203,0	2:41,4	24,0	- 0:35,0

### Reflow profile for SnAgCu assembly

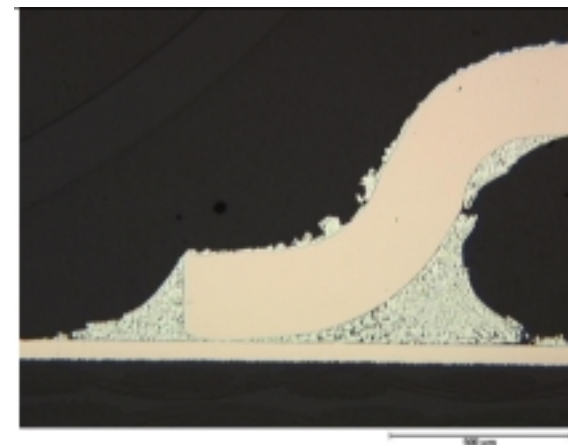


Optionen...		Temperaturmaxima und -minima in °C			
		Max: Temp	Max: Zeit	Min: Temp	Min: Zeit
1	VQFN-48 Thermofühler 1	243,0	4:29,2	23,0	- 1:15,7
2	DSO-12 (Lead) Thermofühler 2	241,0	4:33,6	24,0	- 1:15,7
3	DSO-12 (Ground) Thermofühler 3	239,5	4:29,0	23,5	- 1:15,3

stop thinking  
never



As soldered (SnPbAg on Cu/OSP)



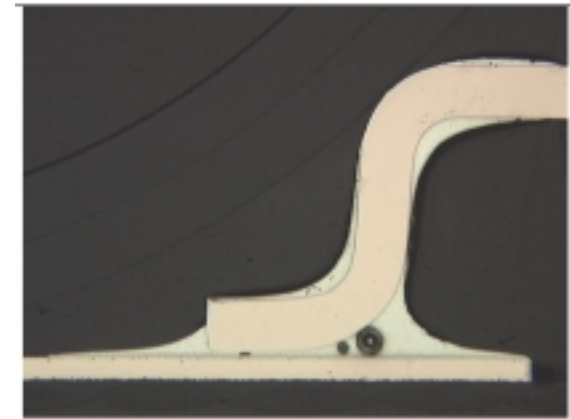
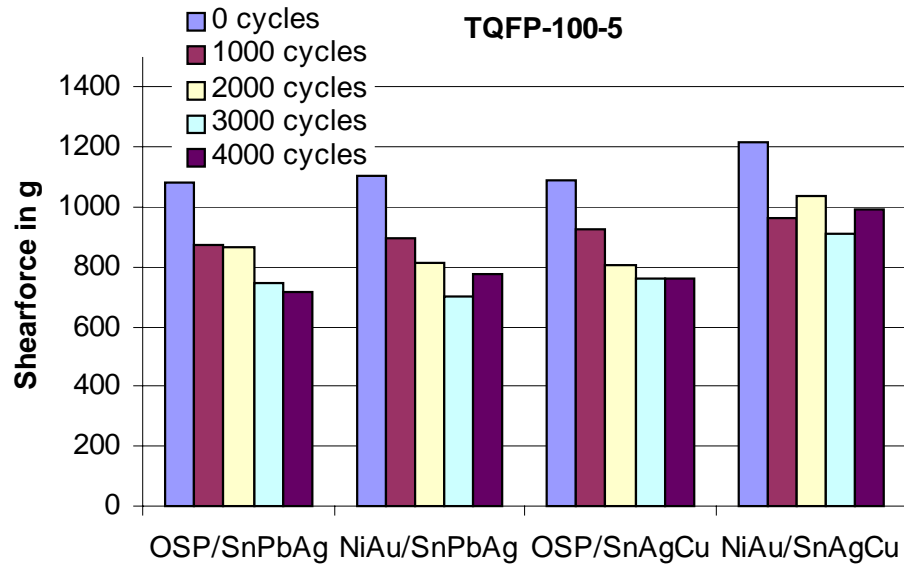
After 4000 T-cycles (SnPbAg on Cu/OSP)

- No electrical or mechanical failure up to 4000 T-cycles
- Excellent reliability with SnPb and lead-free solder for both board finish types
- Solder coarsening without cracks for SnPbAg
- First cracks for SnAgCu along intermetallic phase after 4000 cycles



# Board level reliability, Sn finish on components

## TQFP-100-5 (Cu)



As soldered (SnAgCu on Ni/Au)



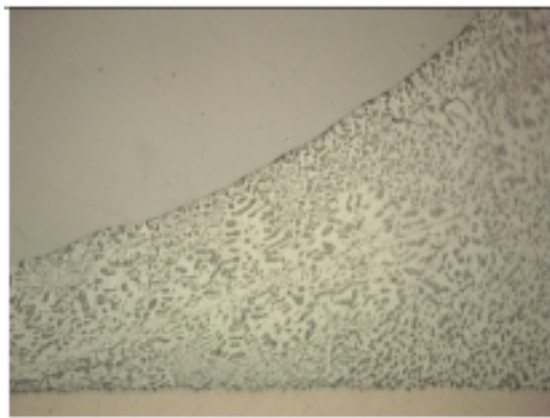
After 4000 T-cycles (SnAgCu on Ni/Au)

- No electrical or mechanical failure up to 4000 T-cycles
- Excellent reliability with SnPb and lead-free solder for both board finish types
- Solder coarsening without cracks for SnPbAg
- First intergranular cracks for SnAgCu starting at solder heel after 4000 cycles

# Board level reliability, Sn finish on components

## TQFP-100-1 (FeNi42)

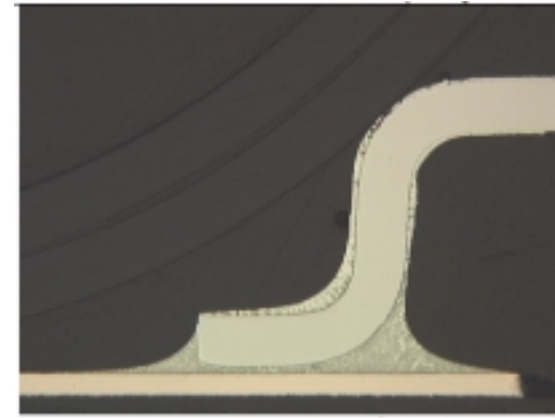
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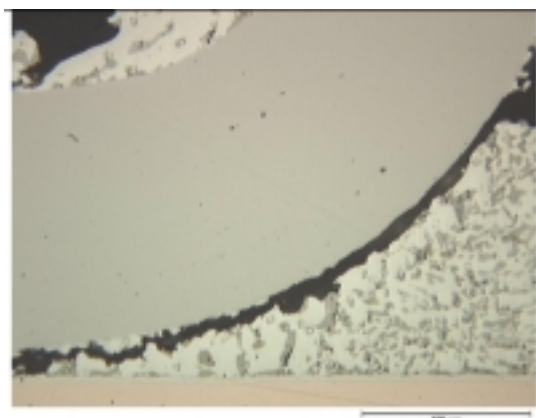
As soldered (SnPbAg on Cu/OSP)



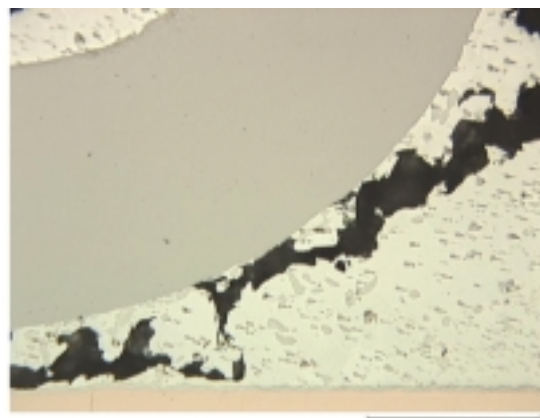
As soldered (SnAgCu on Cu/OSP)



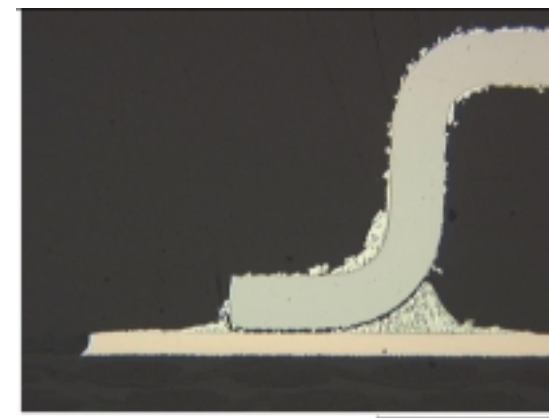
As soldered (SnPbAg on Cu/OSP)



After 2000 T-cycles (SnPbAg on Cu/OSP)



After 2000 T-cycles (SnAgCu on Cu/OSP)

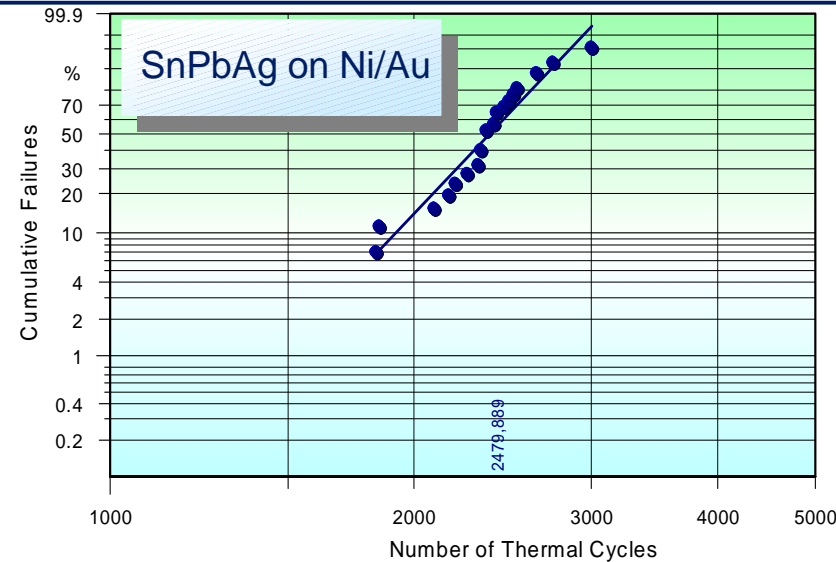
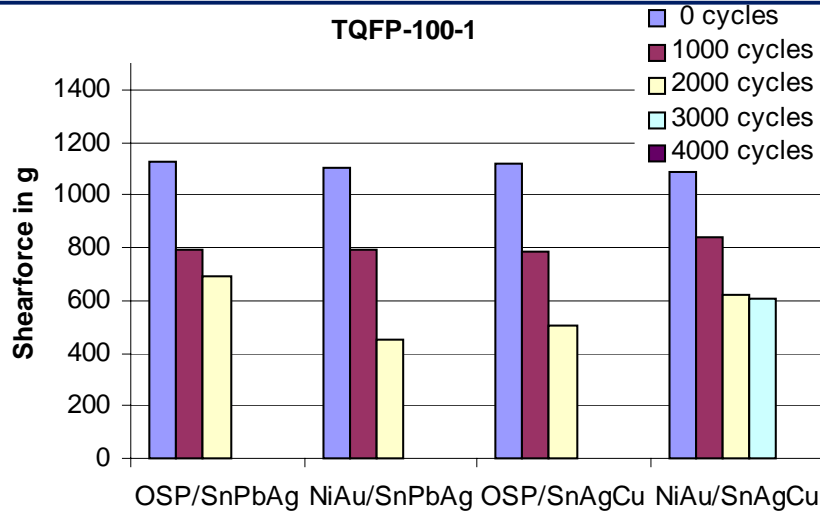


After 2000 T-cycles (SnPbAg on Cu/OSP)

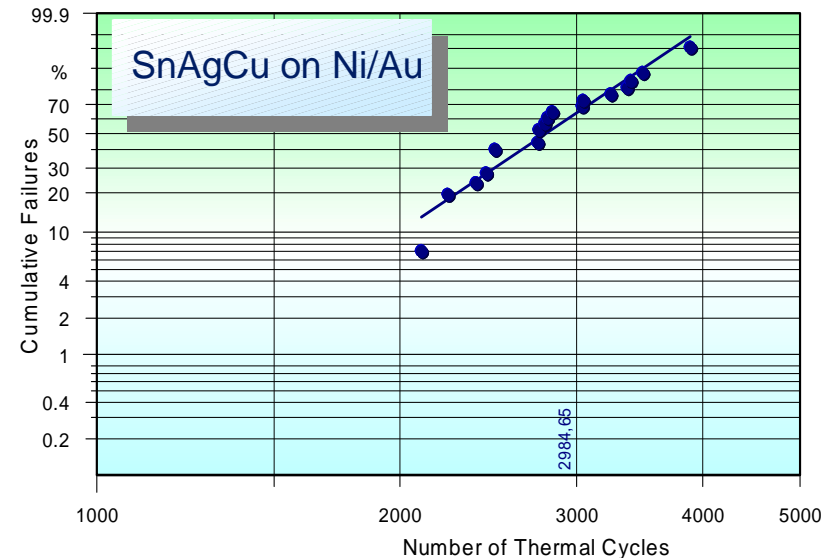


# Board level reliability, Sn finish on components

## TQFP-100-1 (FeNi42), ctd



- 100 % mechanical failure for SnPbAg and SnAgCu after > 2000 cycles
- SnAgCu on Ni/Au shows slightly superior reliability
- Crack propagation along intermetallics for SnPbAg solder and intergranular for SnAgCu solder
- Limited reliability due to cte mismatch of solder and FeNi42 leadframe

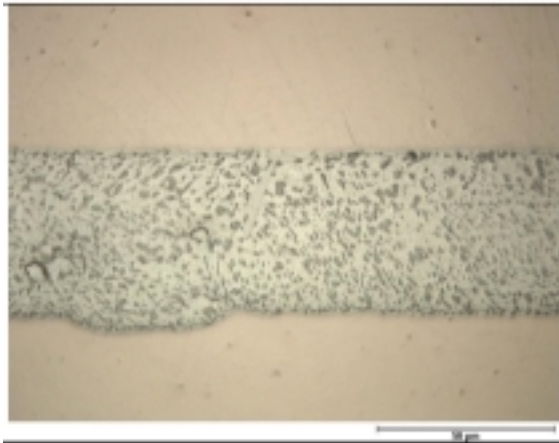


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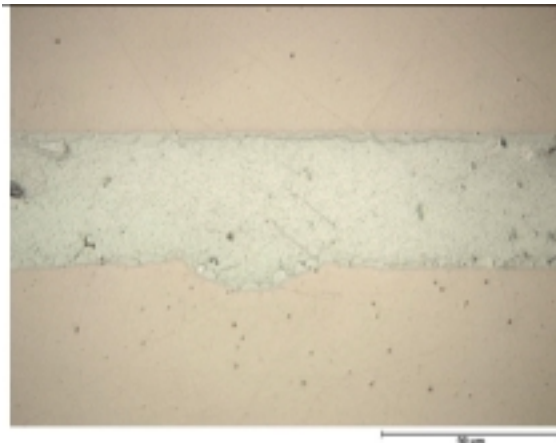
# Board level reliability, Sn finish on components

## VQFN-48-4

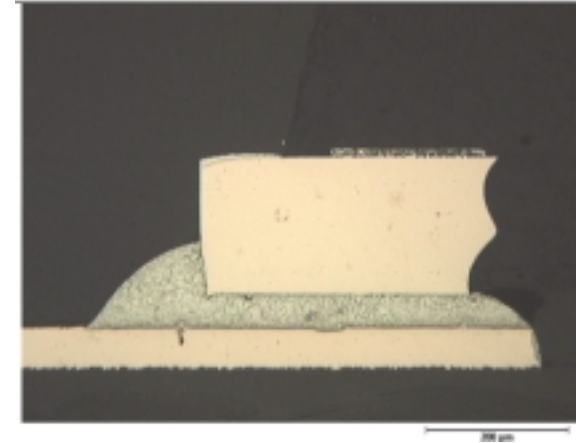
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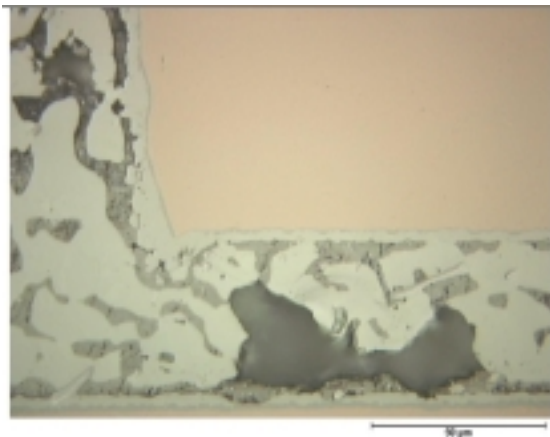
As soldered (SnPbAg on Cu/OSP)



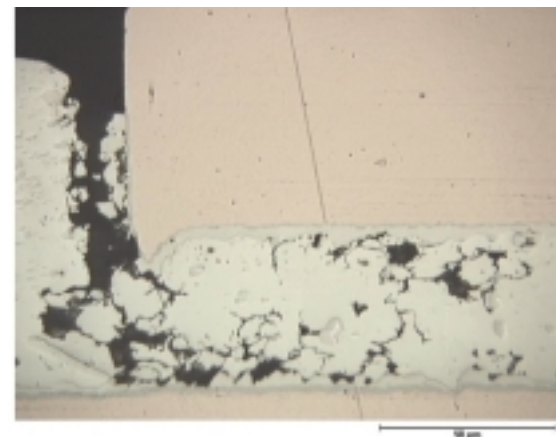
As soldered (SnAgCu on Cu/OSP)



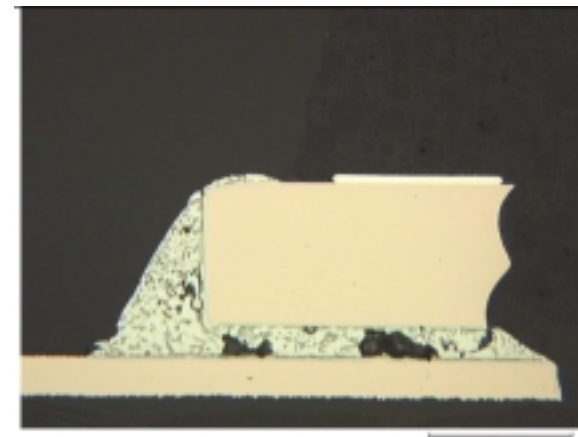
As soldered (SnPbAg on Cu/OSP)



After 4000 T-cycles (SnPbAg on Cu/OSP)



After 4000 T-cycles (SnAgCu on Cu/OSP)

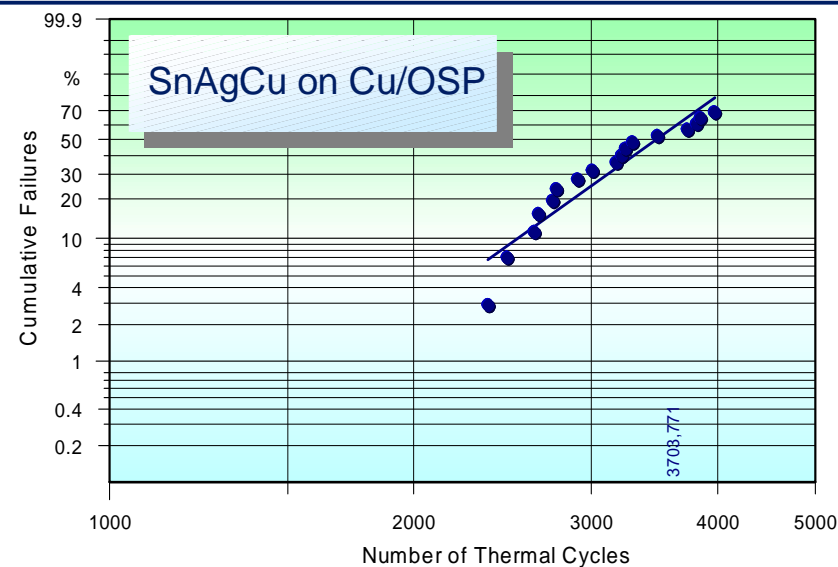
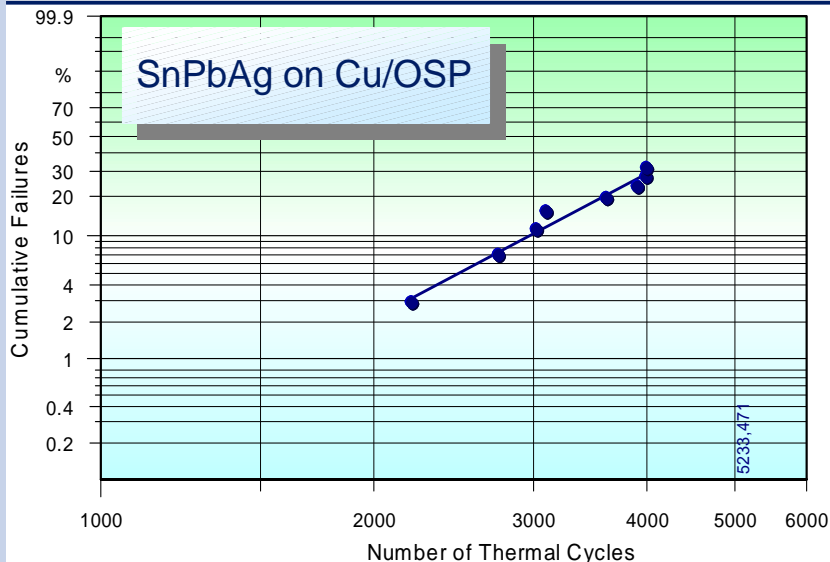


After 4000 T-cycles (SnPbAg on Cu/OSP)

# Board level reliability, Sn finish on components

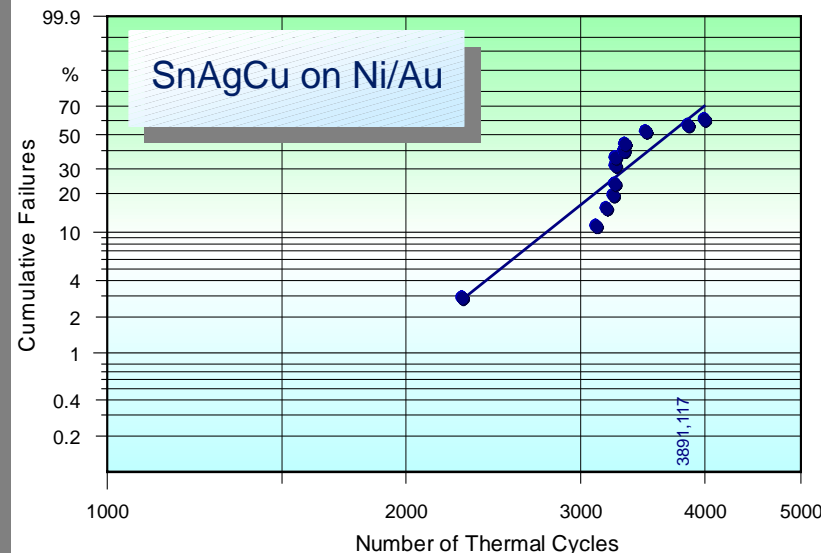
## VQFN-48-4, ctd

stop thinking  
never



- Shear strength not tested (non-lead)
- Characteristic lifetime larger with SnPbAg (>4000 T-cycles) solder than with SnAgCu solder (>3700 T-cycles)
- First electrical failures >> 2000 cycles
- Crack propagation intergranular
- Non-wetting of cut edge without significant influence on reliability

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## Summary

- The reliability is mainly influenced by the solder alloy (and the leadframe material)
- SnAgCu joints with slightly lower reliability for Cu-leadframe based components and slightly superior reliability for FeNi42 based components compared to SnPbAg joints
- Little but inconsistent influence of the board pad metallisation can be observed
- > 4000 T-cycles passed with 14 x 14 gullwing package (Cu leadframe) and 6 x 7 power package
- > 2000 T cycles passed with 7 x 7 non-leaded QFN package
- > 1500 cycles passed with 14 x 14 gullwing package (FeNi42 leadframe)

## Conclusion

The board level reliability of tin plated components is comparable to that of SnPb plated components.