EV12AD550B Callisto QML-V qualification report

Revision date :	**05/02/2019**
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Scope :	**BUSINESS UNIT BMS ASSEMBLAGE - ASSY**

Last revision approved by :

Approved by	Approbation Status	Date
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1. DOCUMENT AMENDMENT RECORD

Author	Issue	Date	Reason for change
HIBON Vincent	A	05/02/2019	New document

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2. OBJECT

This document presents the results of the tests performed for the qualification of EV12AD550BMGC (Callisto “B version”) product from the Teledeyne e2v Grenoble hermetic flip chip technology.

EV12AD500AMGC product (Callisto “A version”) is already qualified : see NE.31S.216579 report.
Compared with the A version, the difference is :

- A new mask revision
- A new passivation opening / UBM size
- A new underfill

This document identifies the delta qualification to be done and the results obtained.

3. APPLICABLE STANDARDS AND DOCUMENTS

MIL-PRF-38535 : Integrated circuits (microcircuits) manufacturing, general specification for performance specification
MIL-STD-883 : Test Method Standard Microcircuits

ESCC N° 2269000 “Evaluation test programme for monolithic Integrated circuits”
ESCC N° 9000 “Integrated circuits, monolithic, hermetically sealed”

NE.31S.216579 : Hermetic flip chip technology / EV12AD550AMGC “Callisto” product qualification report – ST bicmos9 wafer process – ASE bumping – Teledyne e2V assembly – Six sigma column attachment

4. PRODUCTS EV12AD550B VS EV12AD550A ANALYSIS

Die	EV12AD550A	EV12AD550B
Mask	VN80A	VO02A
Process name	ST BiCMOS9	same
Process type	0.13µm CMOS; High speed SiGe:C bipolar	same
Die size	5.5 x 6.5 mm	same
Passivation	SiO2 & SiN	same
Die thickness	725 µm	same
UBM (Under Bump Metallization) deposition process	sputtering	same
UBM (Under Bump Metallization) type and thickness	Ti (0.2 µm) / NiV (0.5 µm) / Cu (0.8 µm)	same
Passivation opening / UBM size	70 µm / 90 µm	80 µm / 100 µm
Solder bump deposition process	Printing	same
Solder bump type	Sn63Pb37	same
Solder bump pitch	250 µm	same
Solder bump diameter	100 +/- 15 µm	same
Solder bump height	100 +/- 15 µm	same

Package	EV12AD550A	EV12AD550B
Package type	Ceramic Column Grid Array CCGA 323	same
Package material	AlN	same
Package outline	21 x 21 mm	same
Landing pad composition	NiAu	same
Solder Columns attach	323 columns 6 sigma (embedded copper ribbon / Pb85Sn15 core material / Sn63Pb37 finishing)	same
Column diameter	0.41 mm	same
Column height	2.20 mm	same
Column pitch	1.0 mm	same
Underfill material (internal reference)	106923U	107532U
TIM (Thermal Interface Material) material (internal reference)	107439	same
Lid material / finish	Kovar / Ni	same
Marking type	laser	same

There are 3 changes :

- A new die design
- New passivation opening / UBM size
- A new underfill

5. PHYSICS OF FAILURE / TCV RELIABILITY ASSESMENT

5.1 Wafer fabrication / foundry process

No change (same Bicmos9 wafer process) : see NE.31S.216579 document §5.1

5.2 Assembly and packaging

During assembly development phase, reliability tests have been performed on specific test vehicles : Callisto daisy chain die assembled on AlN daisy chain substrate equivalent to Callisto substrate.
2 daisy chain are embedded in the die :

- Al cap daisy chain (to detect potential cracks in the bumps)
- M1 to M6 metal levels on the peripheral (which is the most stressed area) to validate the integrity of the different die layers

Temperature cycling tests have been done on these test vehicles without TIM and lid (better underfill inspection).
Results are detailed below :

Configuration without TIM and lid (underfill inspection) :

Test type	Test method	Criteria	Sampling	Status
Temperature cycling	6 reflows 220°C peak temperature accord. To J-STD-020 1500 cycles accord. To TM 1010 cond. C (-65°C/+150°C)	Die Continuity testing @ -55°C, 25°C, +125°C Underfill C-SAM inspection	24	Pass

6. PROCESS QUALIFICATION TEST

6.1 Process qualification test plan

Qualification test plan are established according to :

- MIL-PRF-38535 requirements :
  - Group A, B, C and D requirements
  - Table H-IA and table H-IIA requirements
- European standards ESCC2269000 and ESCC9000 requirements

The changes between A and B version and, according to MIL-PRF-38535 Table A-I, the corresponding tests to be done are:

Major changes		Test
c	Die structure	Group A and C-1
d	Mask changes affecting die size or active element	Group A and C-1
x	Flip chip devices: Solder bump materials/dimension, Wafer bumping process, Underfill process and materials selection	Group A, B, C and D

Tests done for the qualification of A version (see details in NE.31S.216579 report) and status for the B version are given below :

Package oriented qualification tests :

Test / group or standard		Impact due to the change (A version → B version)	Conclusion
Temperature cycling	/	New underfill	To perform for EV12AD550B
Thermal shocks – temperature cycling – moisture resistance	TABLE H-IIA	New underfill	To perform for EV12AD550B
Mechanical (shocks-vibration-constant acceleration)	D4	n/a (same package)	By similarity with EV12AD550A No test

Thermal vacuum	ESCC 2269000 standard	n/a (same TIM / lid interface)	By similarity with EV12AD550A No test
Resistance to soldering heat	D9	New underfill	To perform for EV12AD550B
Package construction analysis	/	New underfill	To perform for EV12AD550B
Flip chip die shear (prior underfill dispense)	B2	New passivation opening / UBM size	To perform for EV12AD550B
Solderability	B3	n/a (same column / land package interface)	By similarity with EV12AD550A No test
Terminal strength (column pull test)	B4	n/a (same column / land package interface)	By similarity with EV12AD550A No test
Salt atmosphere	D5	n/a (same package)	By similarity with EV12AD550A No test
Residual gas analysis	D6	New underfill	To perform for EV12AD550B

Die oriented qualification test :

Test / group or standard		**Impact due to the change (A version → B version)**	**Conclusion**
Life Test	C	New mask revision	To perform for EV12AD550B 2000 hrs (*) on 22 parts
ESD HBM	TABLE H-IIA	New mask revision	To perform for EV12AD550B
Latch up	TABLE H-IIA	New mask revision	To perform for EV12AD550B

(*) 4000 hours Life Test has already been performed on one wafer lot from ST bicmos9 wafer process : see NE.31S.216579 report §6.5.1.5.

Die evaluation test :

Test	**Impact due to the change (A version → B version)**	**Conclusion**
Die SEM analysis	New mask revision New passivation opening / UBM size	To perform for EV12AD550B
Bump shear	New passivation opening / UBM size	To perform for EV12AD550B

Summary of the plan, according to this analysis, is given below.

Note : Tests are done without columns. To take into account the thermal stress induced by column attach process, preconditioning equivalent to column attach thermal profile has been applied on the

samples (except for die specific tests – ESD and Latch up): see condition in NE.31S.216579 document §6.4.2.

Qualification accord. to MIL-PRF-38535 requirements

Characterization

Parts from FM flow w/o columns

3 parts
Flip chip die shear (w/o underfill)
(screening results)
TM 2011 cond. F

Reflow simulation x 3
(to simulate solder column attachment)

15 parts
Fine & gross leaks
TM 1014 cond. A & C
C-SAM inspection
Thermal shocks 15 cycles cond. C, TM 1011
Temp. cycling 100 cycles cond. C , TM 1010
Moisture resistance 10 cycles, TM 1004
Fine & gross leaks
TM 1014 cond. A & C
C-SAM inspection
Electrical tests
-55, 25, +125°C

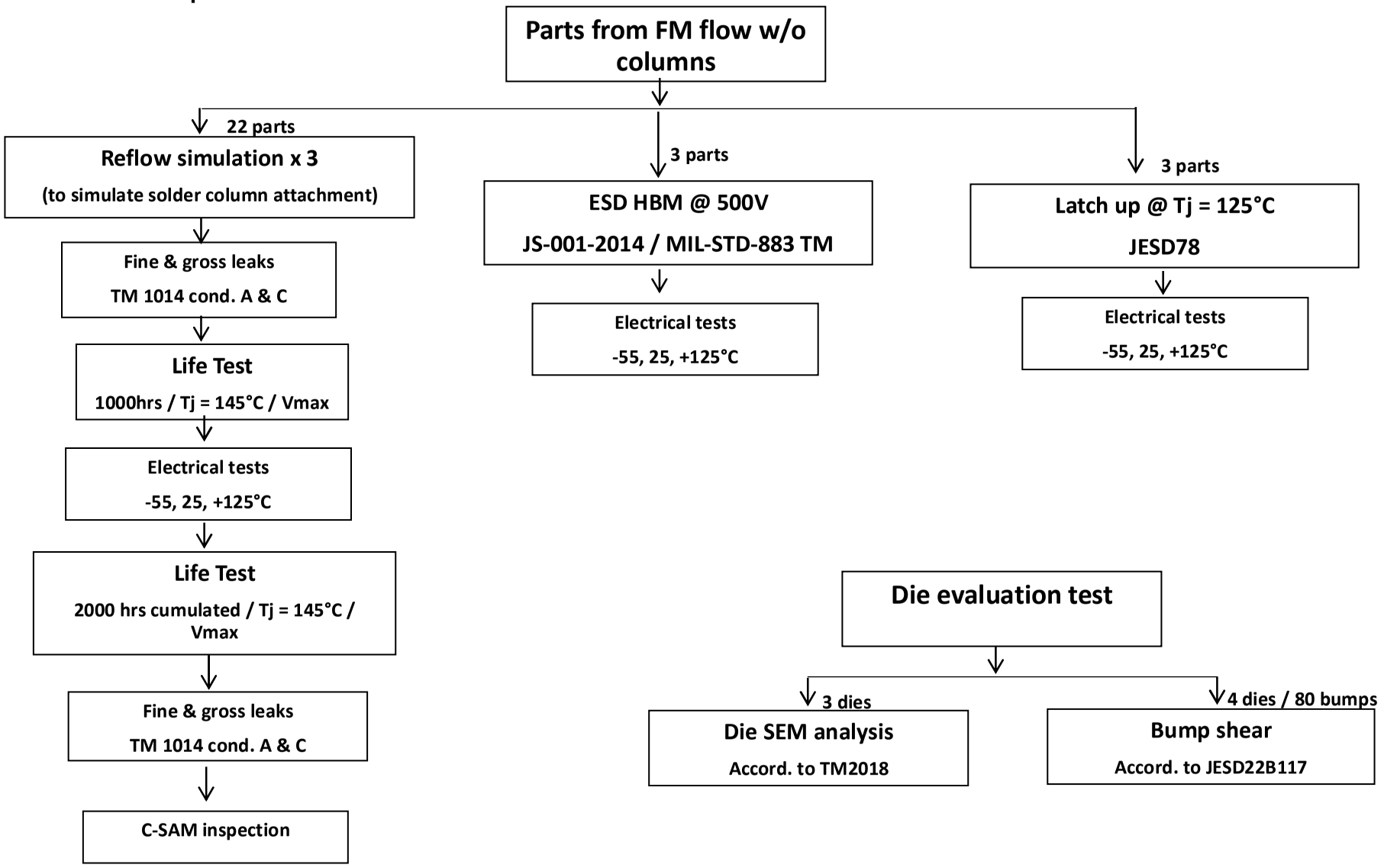
15 parts
Fine & gross leaks
TM 1014 cond. A & C
C-SAM inspection
Temperature cycling
TM 1010 cond. B (-55°C/+125°C) 1500 cycles
Fine & gross leaks
TM 1014 cond. A & C
C-SAM inspection
Electrical tests
-55, 25, +125°C
2 parts
Construction analysis

5 parts
Resistance to soldering heat
Reflow simulation x 3 (x6 in all)
Fine & gross leaks
TM 1014 cond. A & C
C-SAM inspection
Electrical tests
-55, 25, +125°C
Resistance to soldering heat
Reflow simulation x 14 (x20 in all)
Fine & gross leaks
TM 1014 cond. A & C
C-SAM inspection
Electrical tests
-55, 25, +125°C

2 parts
Construction analysis

4 parts
Internal gas analysis
TM 1018

Die oriented qualification tests :



6.2 Test vehicle

The test vehicle used for this qualification is EV12AD550BMGC product (Callisto B version) described §4.

6.3 Screening flow and devices identification

A “FM like” flow has been used: with all FM screening steps and done in production mode.

Devices are issued from one wafer diffusion lot (J703EVW).

One assembly lot has been used for the flip chip report and underfill dispense steps and then split in 2 different lots after internal visual inspection:

- 660265921S : sealed in W41 2017 (assy DC 1741) and TIM batch #1 used
- 660265921 : sealed in W49 2017 (assy DC 1749) and TIM batch #2 used

Devices process flow and assembly lots information are summarized in the table below :

OPERATION	FM like	Assembly lot	
Sawing	100%	660265921	
Die selection for SEM analysis	Sampling		
Die Visual selection	100%		
Customer visual inspection	n/a		
Package Serial marking	100%		
Package outgassing	100%		
Flip chip report	100%		
Flip chip die shear	Sampling		
Underfill dispense and polymerisation	100%		
CSAM inspection (underfill)	100%		
Internal Visual inspection	100%		
Customer visual inspection	n/a		
TIM dispense and polymerisation	100%	660265921S	660265921
Sealing	100%		
Marking	100%		
Serial marking	100%		
Stabilization	100%		
Temperature cycling, 10 cycles	100%		
Fine and gross leak	100%		
CSAM inspection (TIM)	100%		
Pre ambient electrical measurements	100%		
Dynamic burn-in 240Hrs @ 125°C	100%(*)		
Intermediate ambient electrical measurements	100%(*)		
static burn-in 144 hrs @ 125°C	100%(*)		
Post ambient electrical measurements	100%(*)		
High temp. electrical measurements	100%(*)		
Low temp. electrical measurements	100%(*)		

External Visual Inspection	100%		
Customer final external visual inspection	n/a		

(*) not done for ESD and Latch up tests

As allowed by MIL-PRF-38535K, complete group A tests are performed on LGA packaged devices; after column attach, an electrical test is performed at 25°C to verify that no electrical/mechanical damage has been introduced due to the column attach process.

6.4 Process performance characterization

Characterization of EV12AD550B product has been performed at ambient, -55°C and +125°C with DC, AC and full functional electrical parameters. This characterization was performed on prototype parts.
Main characterization results are available in the product datasheet.

6.5 Process qualification test results

6.5.1 Die oriented qualification tests

6.5.1.1 Die SEM analysis

Die SEM analysis have been performed on 3 dies from J703EVW diffusion lot.
The following items have been performed :

- Visual inspection (according to MIL-STD-883 method 2010)
- View of die and die marking
- Die measurements
- Vertical and horizontal technology dimensions measurements

Results are summarized below :

TEST ***Acceptable criteria***	**METHOD** ***Condition***	**Sample**	**Fail**	**Status**
Construction analysis *ST Bicmos9 spec.*	MIL-STD-883 TM2010 / TM2018 ESA/SCC Basic Specification N° 21400	3 dies	0	***Pass***

No defect was observed after optical inspection according to MIL-STD-883 TM2010.

Vertical and horizontal technology dimensions are in line with ST specification (note : no thickness limit values given by ST) and no weak point was detected.

Conclusion:

EV12AD550BMGC die mask VO02A is conform with ST bicmos9 specification

6.5.1.2 Bump shear

Bumps shear test has been done on 4 dies from J703EVW diffusion lot : 2 dies / wafer; 2 wafers; 20 bumps / die (80 bumps in all).
Results are synthesized below :

Test	Method	Condition	CA / CR	Fail / Ok
Bump shear	JESD22B117	Condition A (low shear speed) Min : 24.35 g ⇔ 2 g / mils² (with UBM diameter = 100 µm) (ASE spec.)	80(*) / 0	Pass

(*) 80 bumps from 4 dies

Test condition	
Equipment	Dage 4000 / BS250
Shear height	5µm
Shear speed	150µm/s

Bump shear results				
	Die 1 wafer #1	**Die 2 wafer #1**	**Die 1 wafer #2**	**Die 2 wafer #2**
1	42,28	41,5	41,89	40,03
2	42,81	44,97	44,41	39,64
3	40,36	43,22	44,14	44,6
4	39,89	44,63	44,23	43,5
5	42,62	41,18	45,15	44,65
6	42,61	45,44	42,75	42,81
7	42,85	39,44	38,57	40,34
8	50,84	42,32	42,83	44,79
9	41,28	41,25	41,72	41,84
10	44,61	45,27	41,51	38,4
11	43,81	36,35	42,72	38,94
12	44,51	45,13	42,39	40,14
13	45,23	37,98	44,83	43,16
14	44,9	39,78	50,48	42,32
15	42,13	42,89	40,31	38,68
16	44,54	38,7	42,69	38,93
17	40,9	39,01	43,77	43,73
18	47,05	42	42,99	40,38
19	43,78	45,81	47,35	45,22
20	43,68	44,77	44,15	42,09
Min	39.9	36.4	38.6	38.4
Max	50.8	45.8	50.5	45.2
Mean	43.5	42.1	43.4	41.7
Std dev.	2.5	2.8	2.5	2.3

Failure mode : ductile (fracture within the bump).

Values are reproducible from die to die and wafer to wafer and above the specification (cpk > 2).

Conclusion:

EV12AD550BMGC die has passed with success bump shear test.

6.5.1.3 ESD HBM

ESD HBM Test has been done on 3 devices from 660265921 assembly lot (FM like flow without columns; no burn-in on these parts (see §6.3)) at the level of susceptibility found for A version (i.e. 500 V, see NE.31S.216579 report §6.5.1.3)

Results are synthesized below :

Electrostatic discharge sensitivity					
Step	**Test**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	Electrical test	According to device specification	Ambient, low and high temperature	3 / 0	**Pass**
2	**ESD HBM test**	**JS-001-2014 / MIL-STD- 883 TM3015**	**500V stress voltage 3 positive and 3 negative pulses; 1 s delay separation Pin stress combinations according to Table 2A of JS-001 standard**	-	**-**
3	Electrical test	According to device specification	Ambient, low and high temperature	3 / 0	**Pass**

Conclusion:

EV12AD550BMGC product has passed with success 500V ESD HBM
(Class 1B according to MIL-STD-83 TM3015 classification)

6.5.1.4 Latch up

Latch up Test has been done on 3 devices from 660265921S assembly lot (FM like flow without columns; no burn-in on these parts (see §6.3))

Results are synthesized below :

Latch-up immunity					
Step	**Test**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	Electrical test	According to device specification	Ambient, low and high temperature	3 / 0	**Pass**
2	**Latch-up test**	**JESD78**	**Class II testing : maximum operating junction temp. (Tj = 125°C) Positive and negative I test @ + / - 100 mA Over voltage test @ 1.5 x VDD**	3 / 0	**Pass (No latch up detected)**
3	Electrical test	According to device specification	Ambient, low and high temperature	3 / 0	**Pass**

Conclusion:

EV12AD350AMGC product has passed with success Latch-up test @ Tj = 125°C
(Class II according to JESD78 specification)

6.5.1.5 HTOL test

Life Test has been done on 22 devices from 66026591S lot (15 devices) and 660265921 lot (7 devices) (FM like flow without columns : see §6.3).

Test conditions (see NE.31S.216579 document §6.4.3; no thermal behavior difference between B and A version) :

- Tjdiode ~ 134°C (Tjhotspot ~ 145°C)
- Supply voltage (Positive Analogue supply voltage VCCA, VCCIO ; Positive Digital supply voltage VCCD) = 3.55V +/-15mV

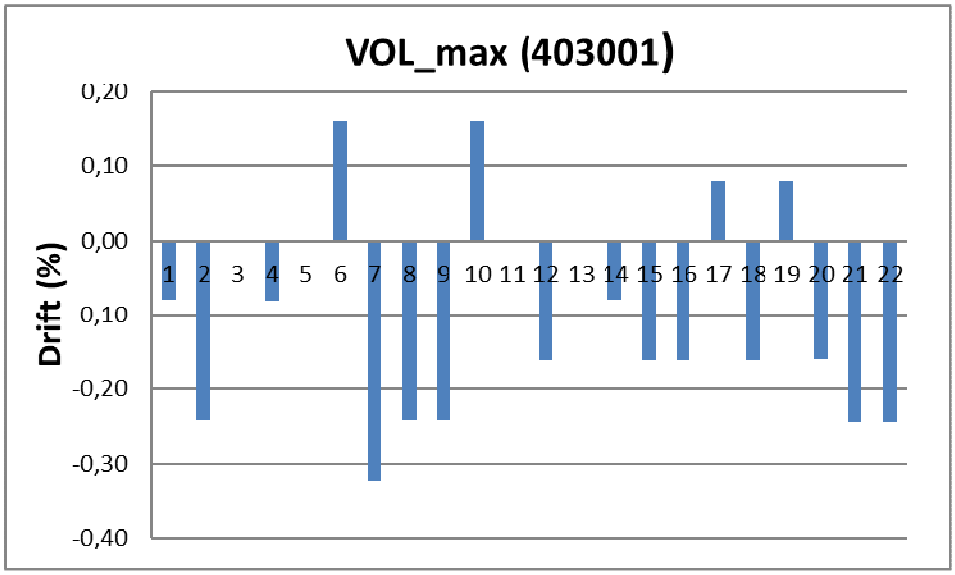
Results are summarized below :

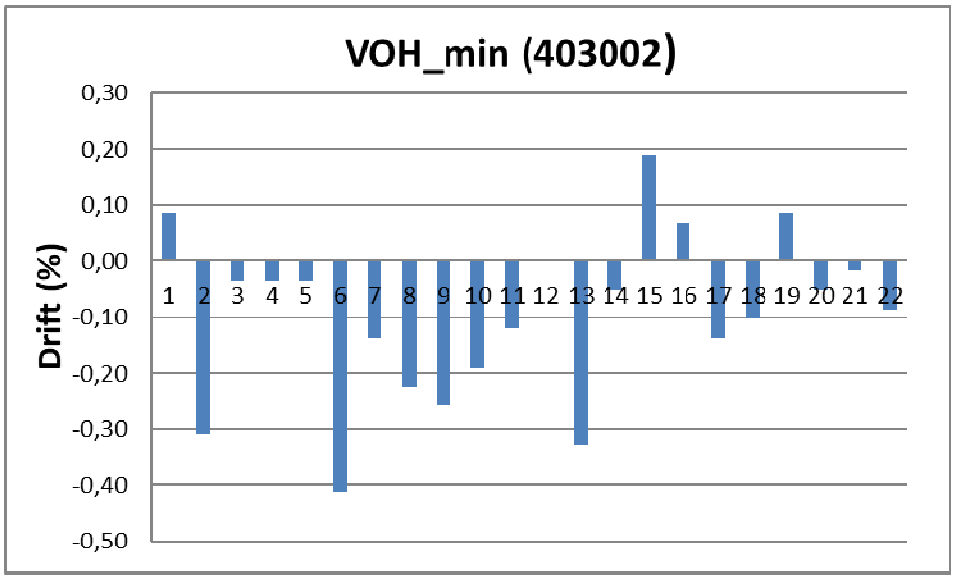
High Temperature Operating Life					
Step	**Test**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	**Colum attach simulation**	**J-STD 020**	**3 reflow cycles according to the profile given in NE.31S.216579 document §6.4.2**	22 / 0	**Pass**
2	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	22 / 0	**Pass**
3	**Life Test 1000hrs**	**MIL-STD-883 TM1005**	**EV12AD550 burn-in spec**	22 / 0	**Pass**
4	Electrical test	According to the detail specification	Ambient temperature	22 / 0	**Pass**
5	**Life Test 1000hrs (2000 hrs cumulated)**	**MIL-STD-883 TM1005**	**EV12AD550 burn-in spec**	22 / 0	**Pass**
6	Electrical test	According to the detail specification	Ambient, Low and High temperatures	22 / 0	**Pass**
7	Ext.Visual insp.	Check evolution vs t0	-	22 / 0	**Pass**
8	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	22 / 0	**Pass**
9	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	-	22 / 0	**Pass**

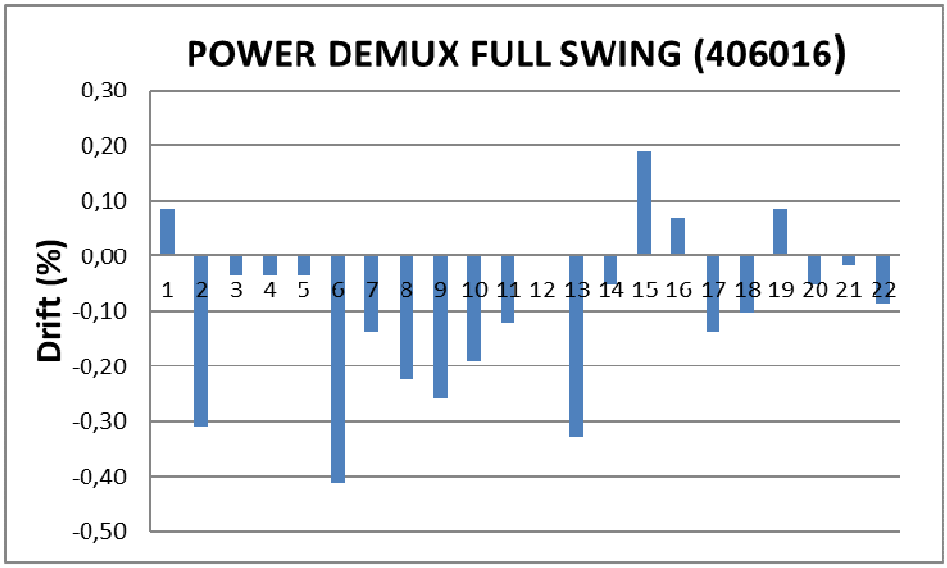
Drift analysis: done on drift parameters defined in the detailed specification, (room temperature electrical measurements)

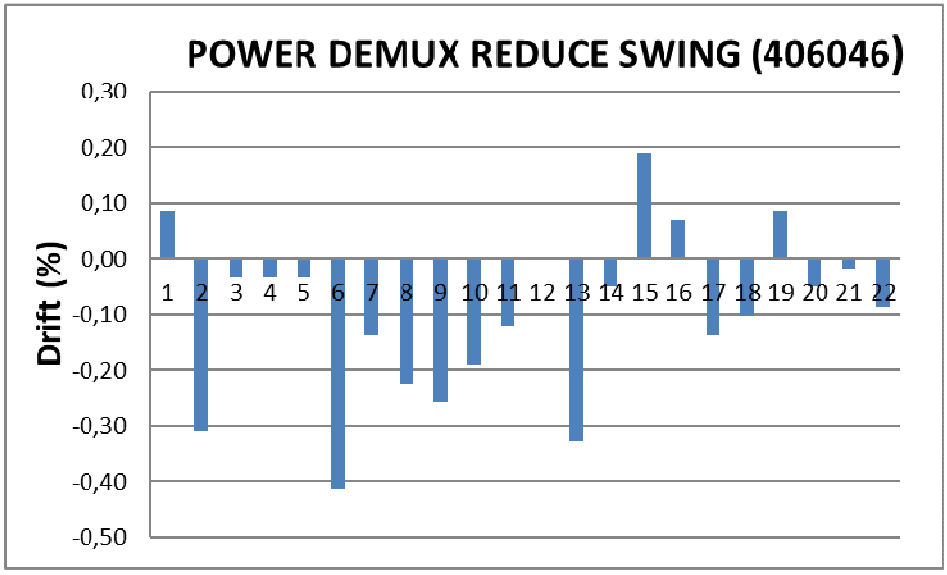
TEST NAME	N°TEST	TEST LIMITS		UNITS
		Low	High	
POWER DEMUX 1:1 FULL_SWING	406016	-5	5	%
POWER DEMUX 1:2 REDUCE_SWING	406046	-5	5	%
POWER STDBY DEMUX 1:2	406076	-5	5	%
VOL_MAX	403001	-5	5	%
VOL_MIN	403002	-5	5	%
SNR AFTERCAL 1900M3G DEMUX 2 -8DBFS	422202	-2	2	%

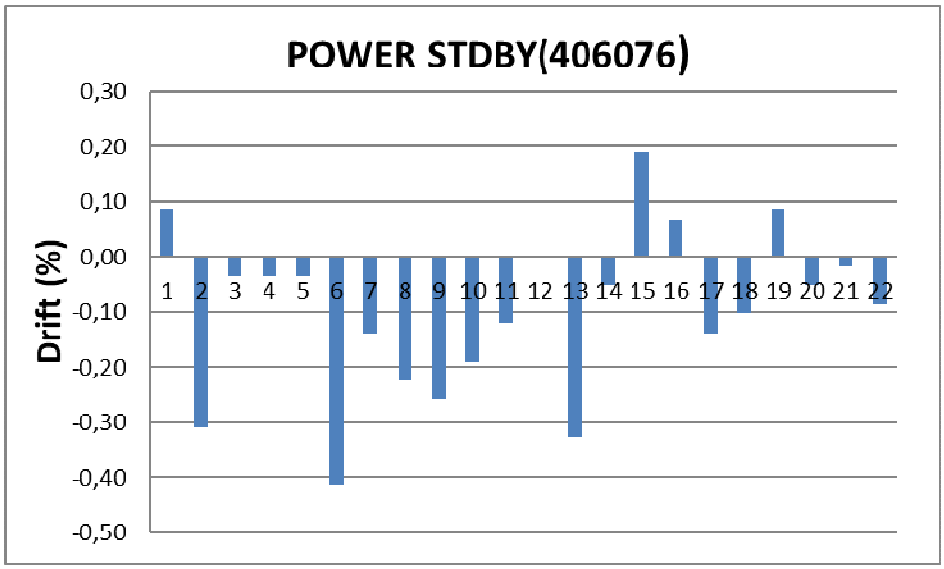
Drifts after 2000 hrs Life Test for the 22 parts in test :

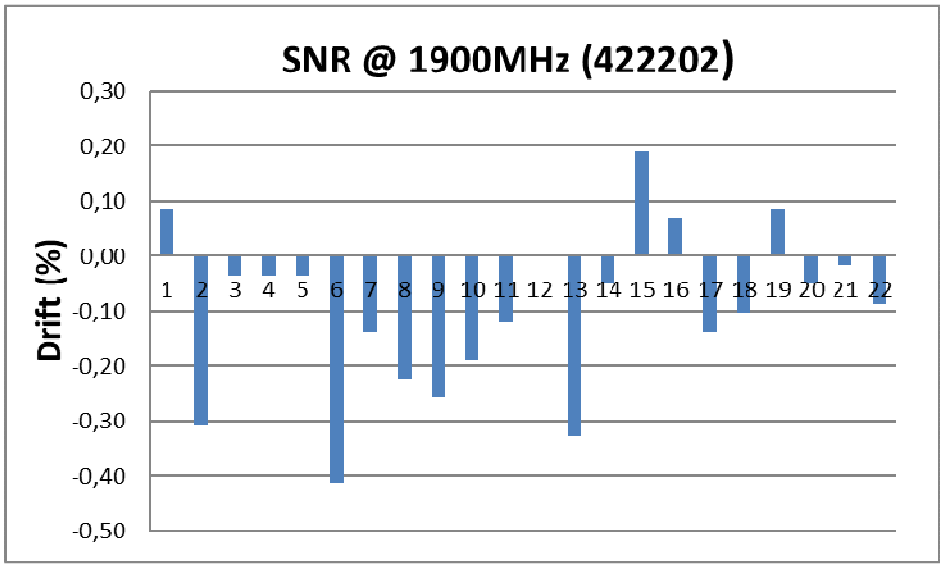






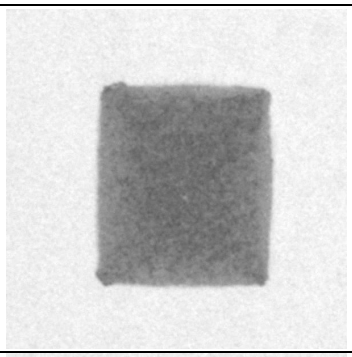
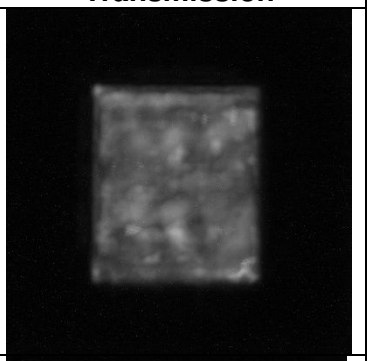
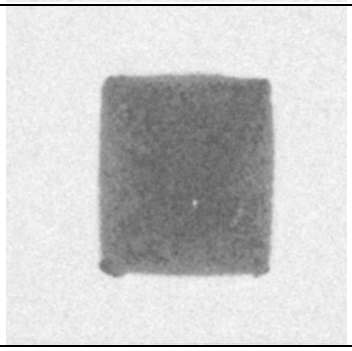
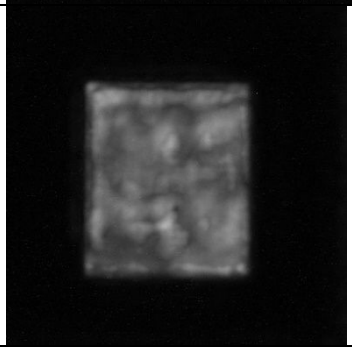






Drifts are low (less than +/-1 %) on all parts and for all parameters.

Concerning C-SAM, no evolution is observed vs “t0” (before tests) images. Typical C-SAM images after 2000 hrs Life Test are shown below :

Reflection	Transmission
	
	

Conclusion:

EV12AD550BMGC product has passed with success 2000Hrs life test

6.5.2 Package oriented qualification tests

6.5.2.1 Flip chip die shear w/o underfill (screening results)

Flip chip die shear test (w/o underfill) have been performed on 3 parts from PO660265921 (tests performed just after flip chip report, before underfill dispense; screening results).

Results are summarized below :

Flip chip die shear					
Step	**Test**	**Method**	**Acceptance criteria**	**CA / CR**	**Fail / Ok**
1	Flip chip die shear	MIL-STD-883 TM 2011 cond. F	> 5 g /bump x 514 bumps = 2.57 kg	3 / 0	Pass

Results summary :

	Mean shear value (kg)	Visual inspection
PO 66026591 (screening results)	17.6 kg	OK (all bumps soldered)

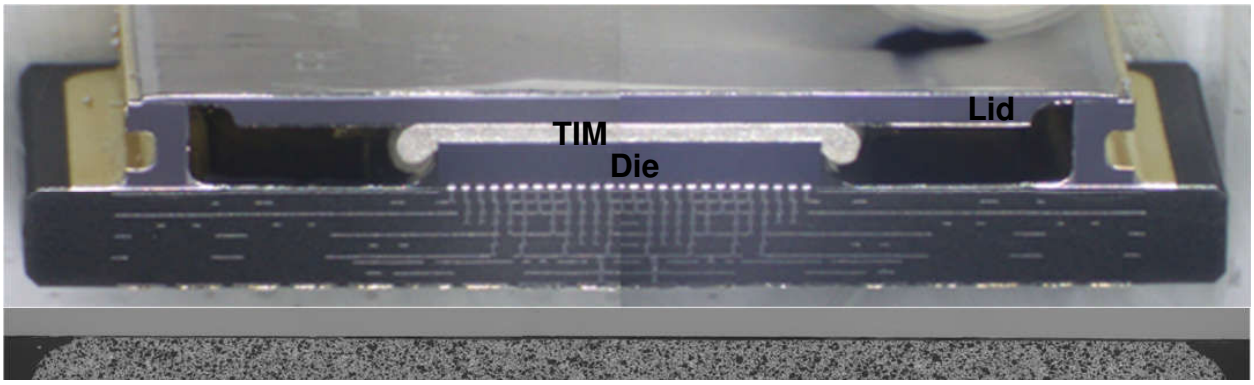
Shear values are far above the specification.

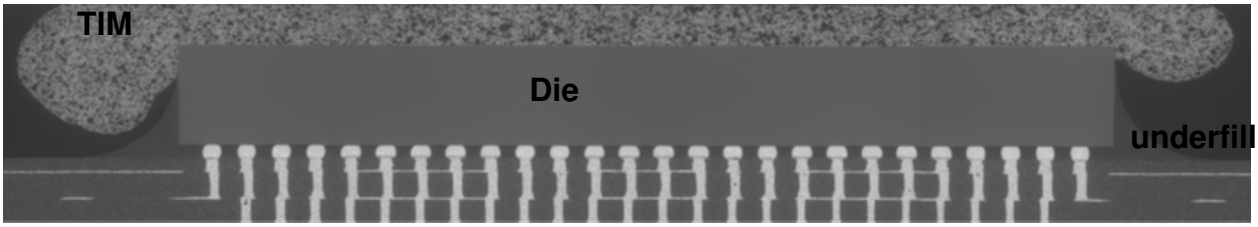
6.5.2.2 Construction analysis

Construction analysis has been performed on 2 parts from 66026591S lot (1 device) and 660265921 lot (1 device) (FM like flow without columns : see §6.3).
Results are similar between the 2 devices.

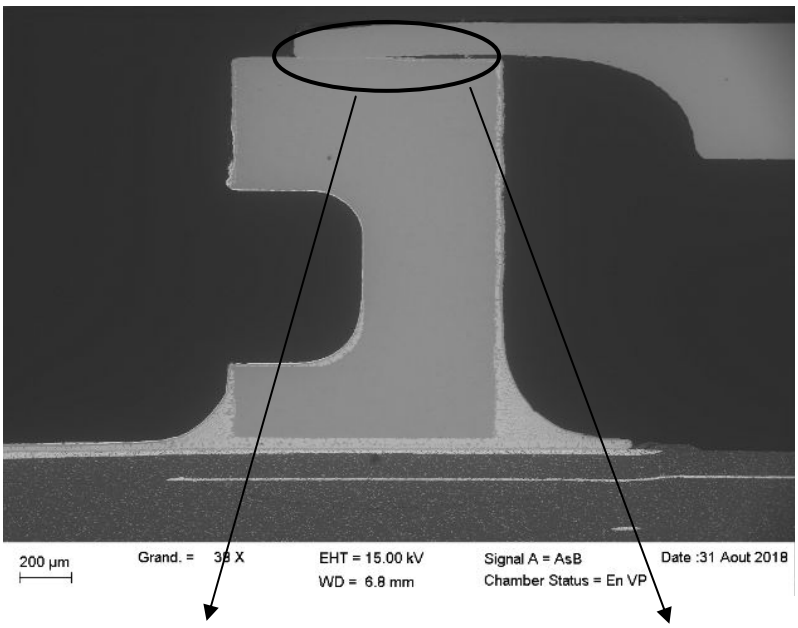
Typical images are given below :

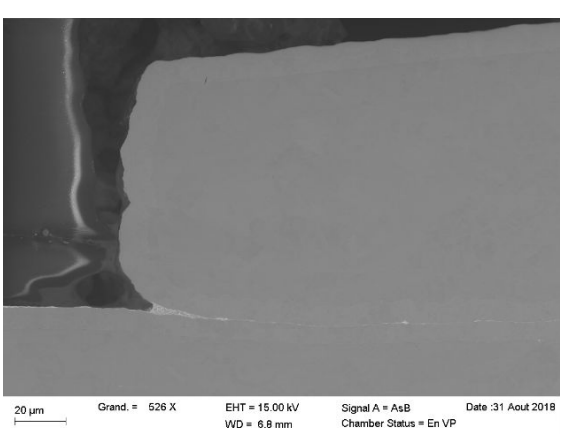
General views:

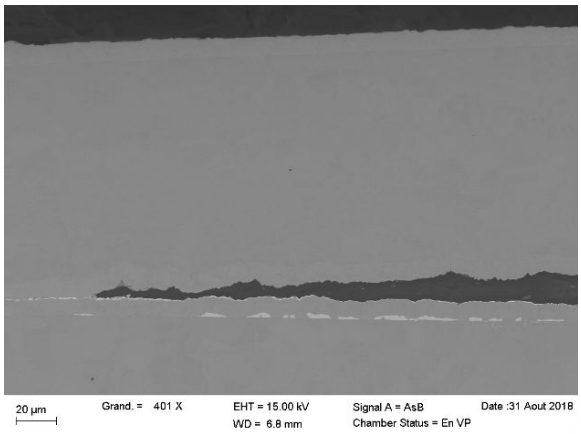




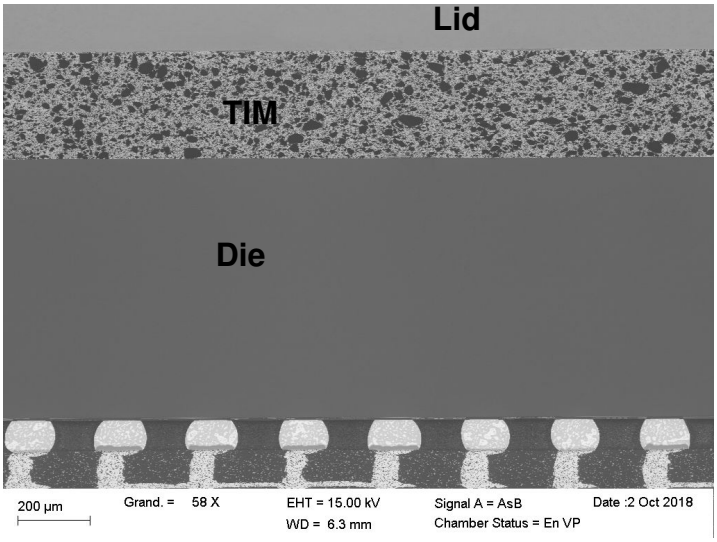
Sealing:





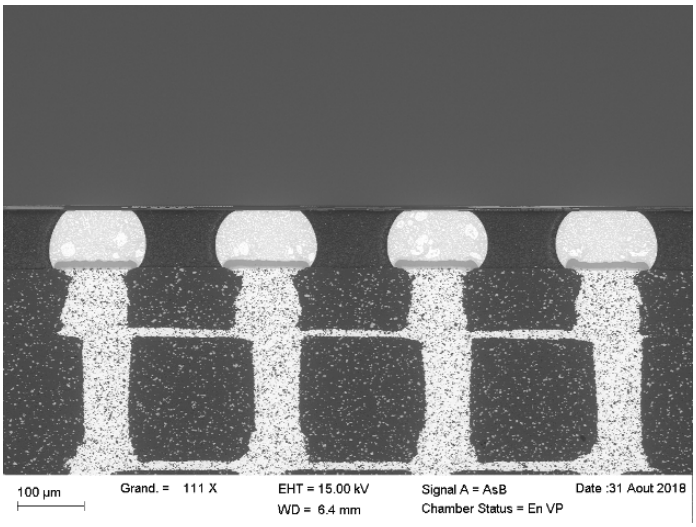


TIM / lid and TIM / die interface (middle of the die):

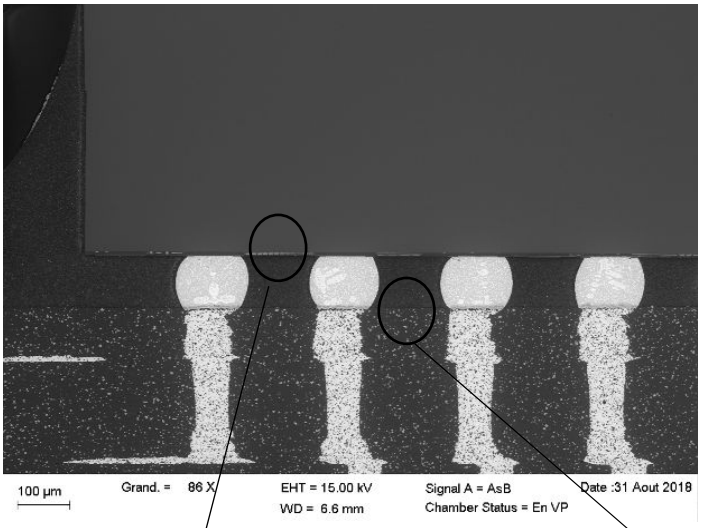


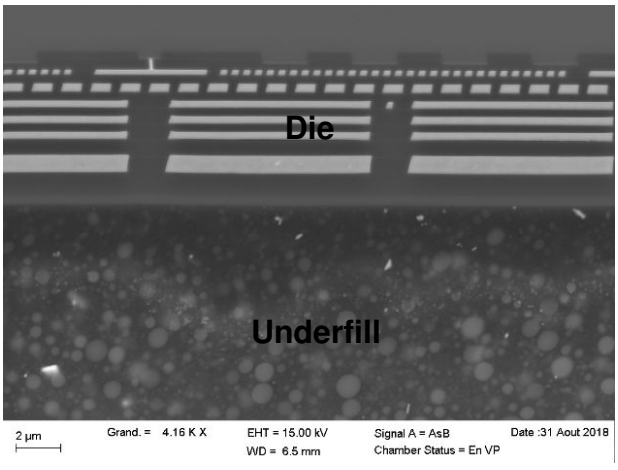
Bumps and package / underfill / die interfaces:

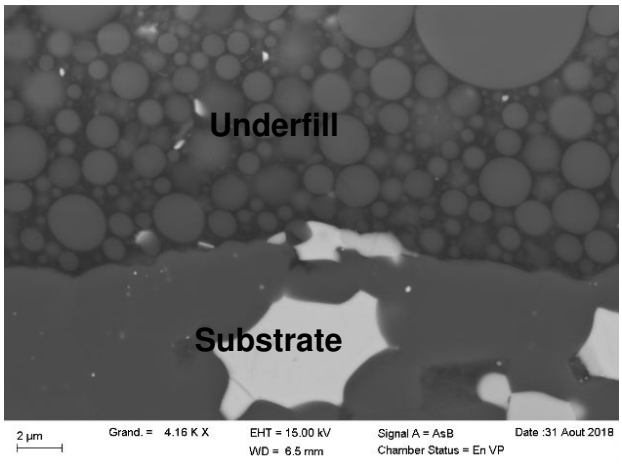
Bumps on the middle :



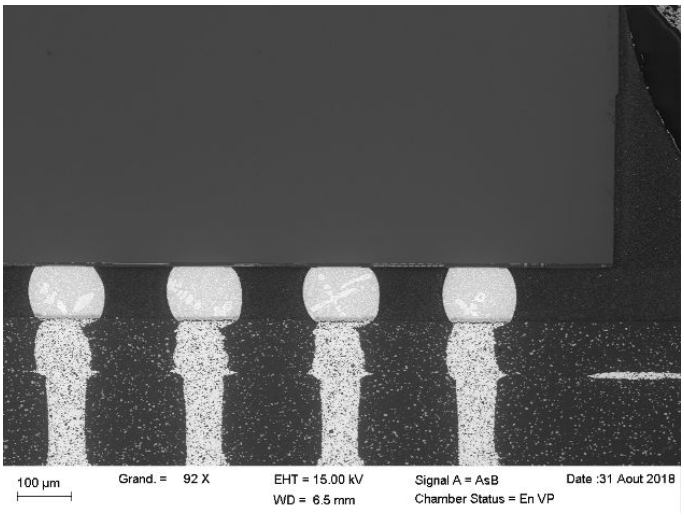
Bumps on the left side :







Bumps on the right side :



This analysis shows the good quality of the assembly.

6.5.2.3 Internal gas analysis

Internal gas analysis test has been done on 4 devices from 66026591S lot (2 devices) and 660265921 lot (2 devices) (FM like flow without columns : see §6.3).
Note : due to lack of parts, the 2 devices from 660265921 lot have been taken from electrical rejects.
A burn-in simulation has been performed on these 2 parts : storage 384 hrs @ 125°C without bias; by mistake, a storage 384 hrs @ 90°C has also been done on these 2 parts.

Results are synthesized below :

Internal gas analysis					
Step	**Test**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	Colum attach simulation	J-STD 020	3 reflow cycles according to the profile given in NE.31S.216579 document §6.4.2	4 / 0	Pass
2	Internal gas analysis	MIL-STD-883 TM 1018	Prebake 16-24 hrs @ 100°C	4 / 0	Pass

ECHANTILLON		103	104
Pression Perçage	torr	46.8	46.8
Température	°C	101.2	100.5
Volume	cc·atm	0.230	0.230
Azote	%v	98.9	98.8
Oxygène	ppmv	ND	ND
Argon	ppmv	260	270
CO2	ppmv	8 087	8 586
Humidité	ppmv	1 011	1 128
Hydrogène	ppmv	242	237
Hélium	ppmv	ND	ND
Fluorocarbones	ppmv	ND	ND
Hydrocarbon	ppmv	549	587
Méthanol	ppmv	950	1 023

66026591S lot

ECHANTILLON		22	25
Pass/Fail		PASS	PASS
Pression Perçage	torr	47.3	48.8
Température	°C	100.1	100.1
Volume	cc·atm	0.232	0.240
Azote	ppmv	974 663	976 276
Oxygène	ppmv	ND P	1 350 P
Argon	ppmv	303	482
CO2	ppmv	17 412	15 384
Humidité	ppmv	3 843 P	2 668 P
Hydrogène	ppmv	721	919
Hélium	ppmv	ND	ND
Fluorocarbones	ppmv	ND P	ND P
Hydrocarbon	ppmv	900	868
Méthanol	ppmv	2 157	2 053

660265921 lot

No failure according to MIL-STD-883 TM 1018 standard's criteria :

- ➔ water vapour content < 5000 ppm
- ➔ oxygen content < 10 000 ppm
- ➔ fluorocarbon < 50 ppm

Note : water vapour content is higher for # 22 and 25 than for # 103 and 104. This is probably due to the fact that # 22 and 25 have seen 384 hrs @ 90°C + 384 hrs @ 125°C.

Conclusion:

EV12AD550BMGC product has passed with success Internal gas analysis test.

6.5.2.4 Temperature cycling

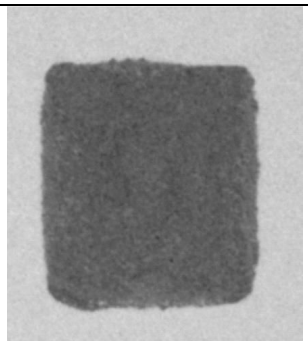
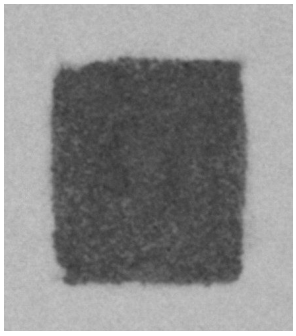
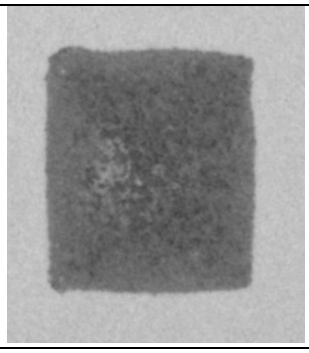
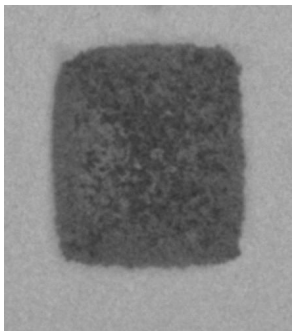
Temperature cycling has been done on 15 devices from 66026591S lot (10 devices) and 660265921 lot (5 devices) (FM like flow without columns : see §6.3).

Results are synthesized below :

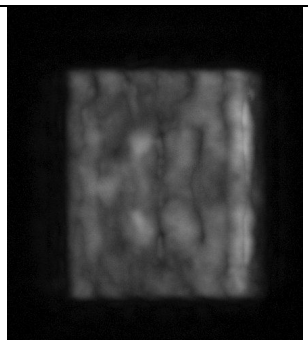
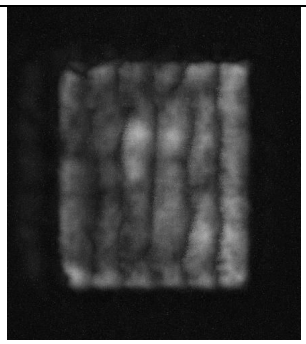
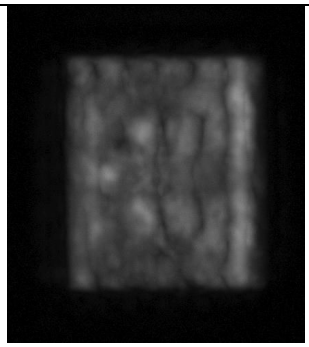
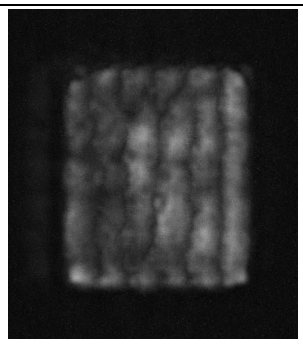
Temperature cycling					
Step	**Test / control**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	**Colum attach simulation**	**J-STD 020**	**3 reflow cycles according to the profile given in NE.31S.216579 document §6.4.2**	15 / 0	**Pass**
2	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	15 / 0	**Pass**
3	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	Reflection and transmission images	15 / 0	**Pass (*)**
4	**Temperature cycling**	**MIL STD 883 TM 1010**	**Cond. B : 1500 x (-55°C /+125°C)**	15 / 0	**Pass**
5	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	15 / 0	**Pass**
6	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	Reflection and transmission images	15 / 0	**Pass (*)**
7	Electrical test	According to device specification	Ambient, Low and High temperatures	15 / 0	**Pass**
8	Ext.Visual insp.	ESCC 20500 / MIL-STD-883 TM 2009	-	15 / 0	**Pass**
9	Destructive physical analysis	Internal procedure	Cross sections; The following item is examined : • Lid sealing • Bumps • Lid / TIM and TIM / die interface • Die / underfill and underfill / substrate interface	2	**Pass (**)**

(*) Reflection and transmission images are done to validate good TIM / lid and TIM / die adhesions and absence of defects in the assembly (die, underfill…). After 1500 TC, no difference is observed vs “t0” (before tests) images as shown below on 2 representative parts:

Reflection image:

T0	1500 TC
	
	

Transmission image :

T0	1500 TC
	
	

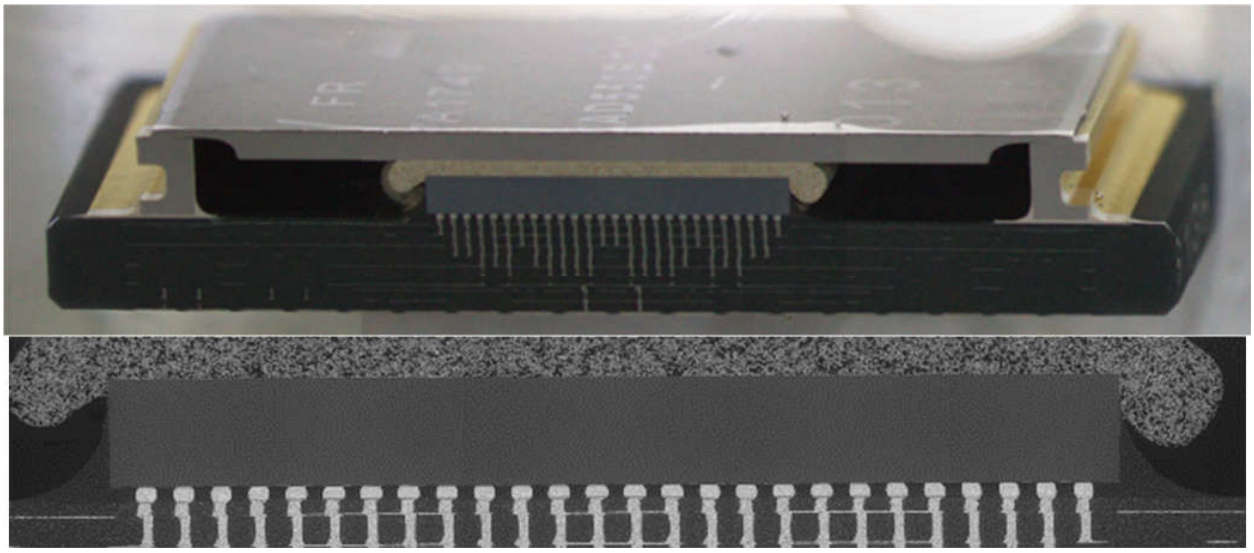
(**) Destructive physical analysis show a very good quality of the parts even after 1500 TC :

- no issue concerning lid sealing
- no delamination at underfill interfaces

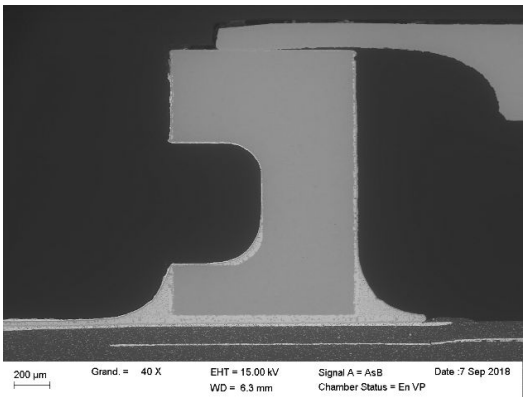
- only very small delaminations (~200 µm long) at TIM / lid interface only at the edges, not above the die; no delamination at TIM / die interface
- no cracks observed on bumps.

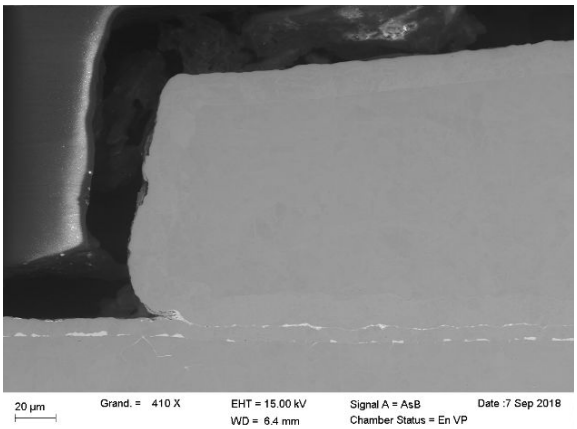
Typical images are given below :

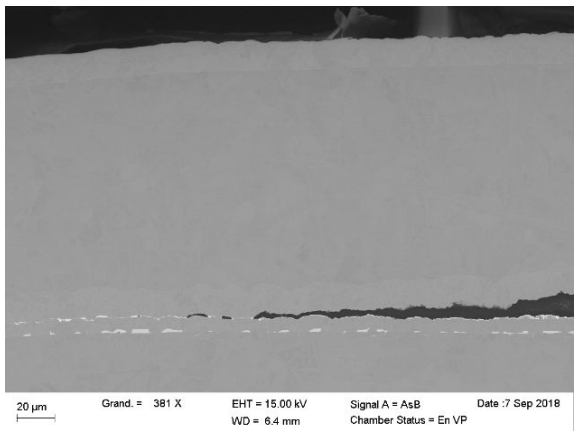
General views:



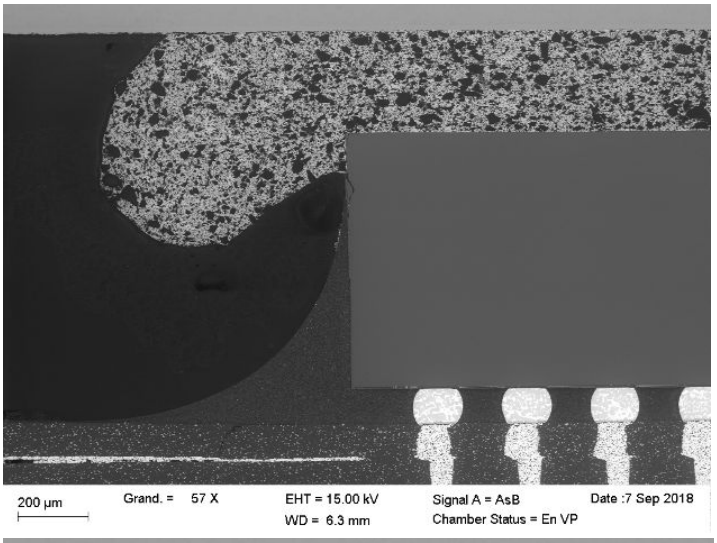
Sealing :



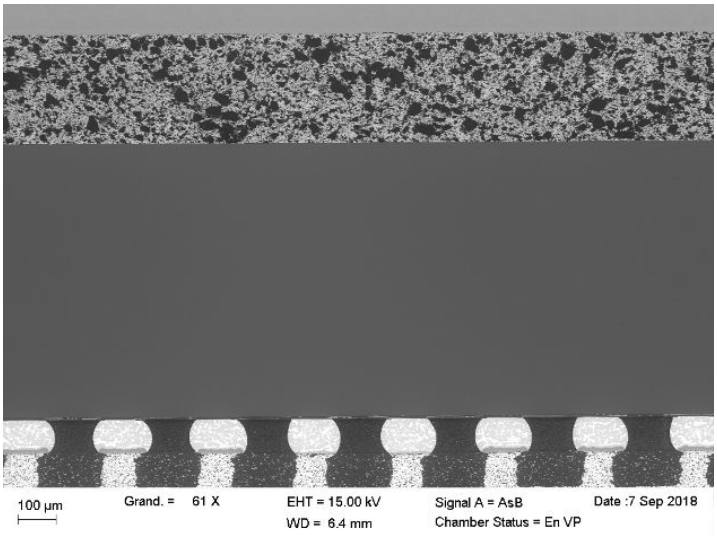




Die / TIM / lid interfaces:



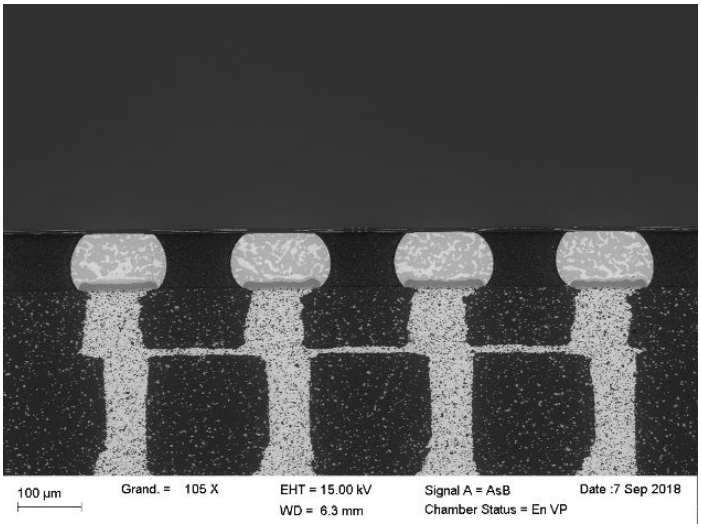
left side



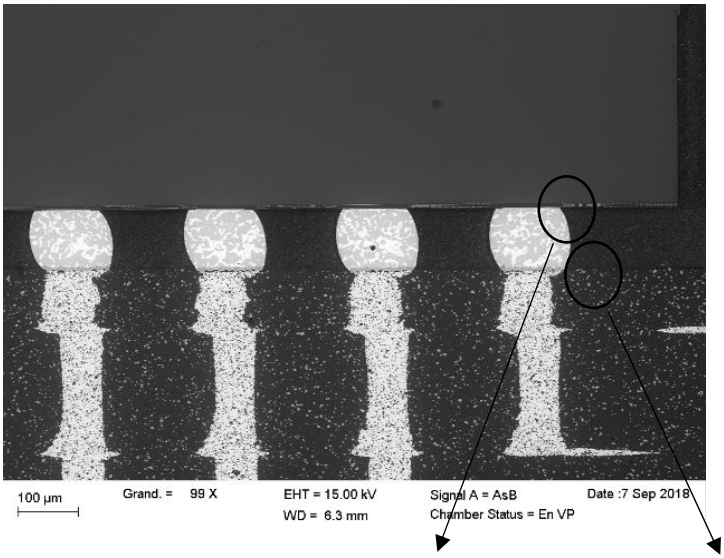
middle of the die

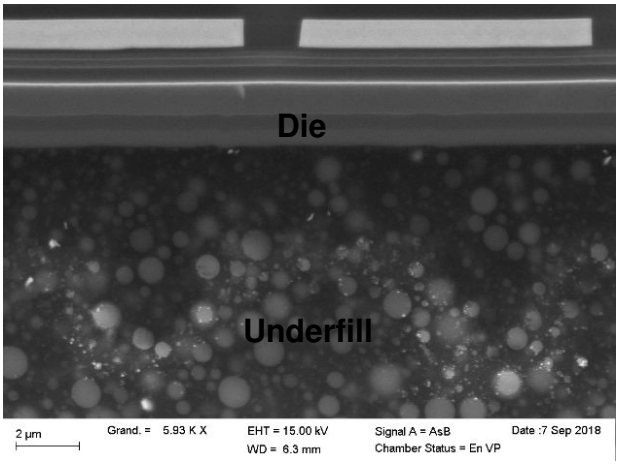
Bumps and package / underfill / die interfaces:

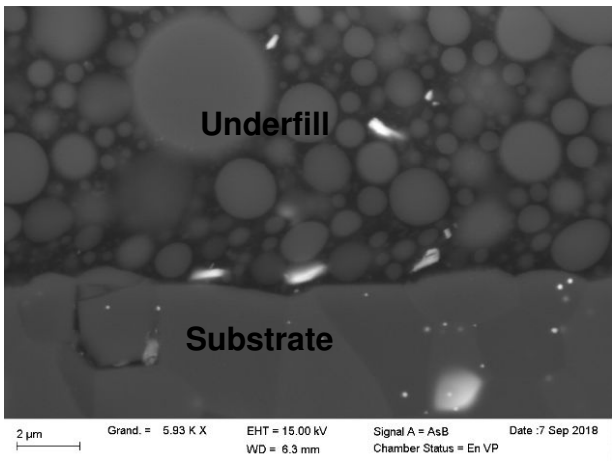
Bumps on the middle :



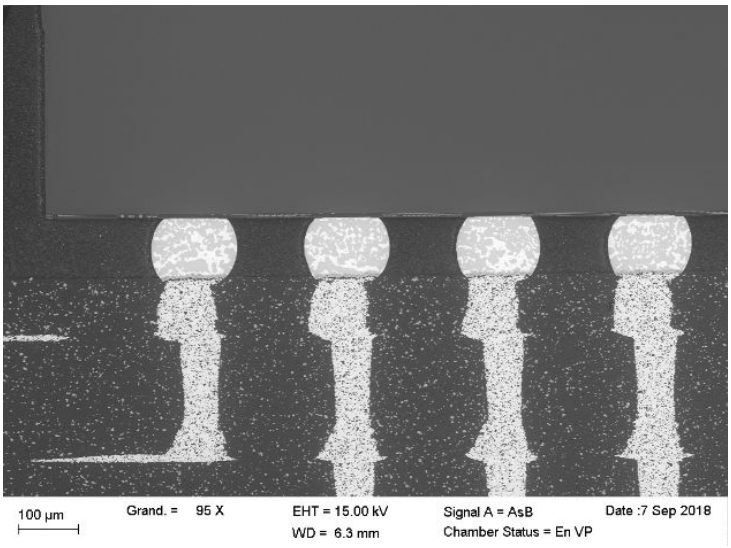
Bumps on the right side :







Bumps on the left side :



Conclusion:

EV12AD550BMGC product has passed with success temperature cycling tests. Destructive Physical Analysis performed after 1500 cycles confirms the good quality of the assembly.

6.5.2.5 Thermal tests : Thermal shocks / temperature cycling / moisture resistance

Thermal tests have been done on 15 devices from 66026591S lot (10 devices) and 660265921 lot (5 devices) (FM like flow without columns : see §6.3).
Results are synthesized below :

Thermal test					
Step	**Test / control**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	**Colum attach simulation**	**J-STD 020**	**3 reflow cycles according to the profile given in NE.31S.216579 document §6.4.2**	15 / 0	**Pass**
2	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	15 / 0	**Pass**
3	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	Reflection and transmission images	15 / 0	**Pass**
4	**Thermal shocks**	**MIL STD 883 TM 1011**	**Cond. C : 15 x (-65°C / +150°C)**	15 / 0	**Pass**
5	**Temperature cycling**	**MIL STD 883 TM 1010**	**Cond. C : 100 x (-65°C / +150°C)**	15 / 0	**Pass**
6	**Moisture resistance test**	**MIL STD 883 TM 1004**	**10 cycles, without bias**	15 / 0	**Pass**
7	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	15 / 0	**Pass**
8	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	Reflection and transmission images	15 / 0	**Pass (*)**
9	Electrical test	According to device specification	Ambient, Low and High temperatures	15 / 0	**Pass**
10	Ext.Visual insp.	ESCC 20500 / MIL-STD-883 TM 2009	-	15 / 0	**Pass**

(*) no difference vs “t0” (before tests) images

Conclusion:

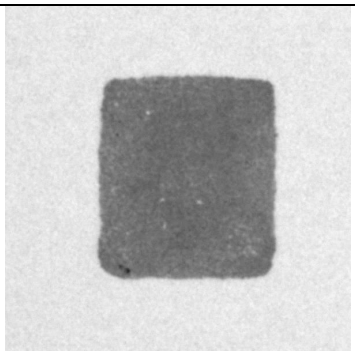
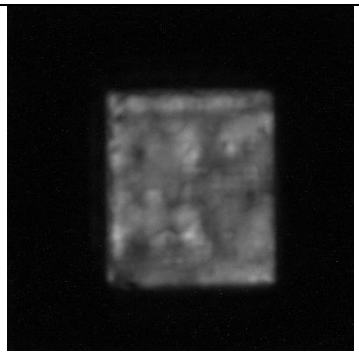
EV12AD550BMGC product has passed with success thermal tests

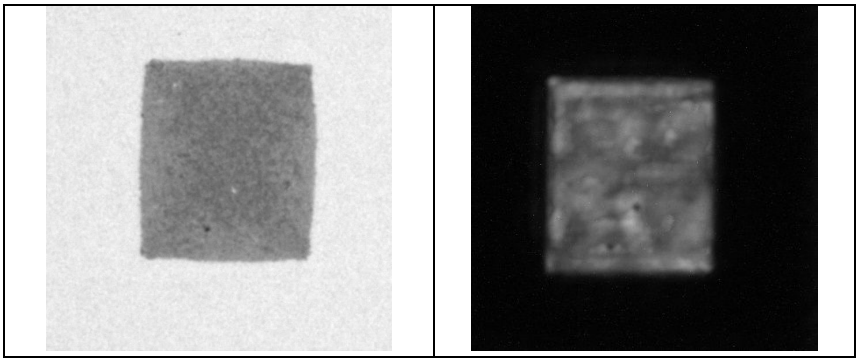
6.5.2.6 Resistance to soldering heat

Resistance to soldering heat test has been done on 5 devices from 66026591S lot (4 devices) and 660265921 lot (1 device) (FM like flow without columns : see §6.3).
Results are synthesized below :

Resistance to soldering heat					
Step	**Test / control**	**Method**	**Condition**	**CA / CR**	**Fail / Ok**
1	**Colum attach simulation**	**J-STD 020**	**3 reflow cycles according to the profile given in NE.31S.216579 document §6.4.2**	5 / 0	**Pass**
2	**Resistance to soldering heat**	**J-STD 020 / MIL-STD-883 TM 2036**	**3 additional reflow cycles according to the profile given in NE.31S.216579 document §6.4.2 (6 reflows in all)**	5 / 0	**Pass**
3	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	5 / 0	**Pass**
4	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	Reflection and transmission images	5 / 0	**Pass**
5	Electrical test	According to device specification	Ambient, Low and High temperatures	5 / 0	**Pass**
6	Ext.Visual insp.	ESCC 20500 / MIL-STD-883 TM 2009	-	5 / 0	**Pass**
7	**Resistance to soldering heat**	**J-STD 020 / MIL-STD-883 TM 2036**	**14 additional reflow cycles according to the profile given in NE.31S.216579 document §6.4.2 (20 reflows in all)**	5 / 0	**Pass**
8	Fine/Gross leaks	MIL STD 883 TM 1014	Cond. A1 / C1	5 / 0	**Pass**
9	C-SAM inspection	Internal spec according to MIL-STD-883 TM2030	Reflection and transmission images	5 / 0	**Pass (*)**
10	Electrical test	According to device specification	Ambient, Low and High temperatures	5 / 0	**Pass**
11	Ext.Visual insp.	ESCC 20500 / MIL-STD-883 TM 2009	-	5 / 0	**Pass**

(*) After 20 reflows, no difference is observed vs “t0” (before tests) images. Typical C-SAM images after 20 reflows are shown below :

Reflection	Transmission
	



No delamination observed.

7. CONCLUSION

All the analyses and tests performed for the qualification, according to MIL-PRF-38535 requirements, of EV12AD550BMGC product (Callisto “B version”) are compliant.
EV12AD550BMGC product from the Teledeyne e2v Grenoble hermetic flip chip technology is qualified.

END OF DOCUMENT