PRODUCT / PROCESS CHANGE NOTIFICATION

1. PCN basic data	
1.1 Company	STMicroelectronics International N.V
1.2 PCN No.	AMS/23/14135
1.3 Title of PCN	Internal pad re-layout of AIS2DW12TR.
1.4 Product Category	Pls refer to the Products List.
1.5 Issue date	2023-05-22

2. PCN Team	
2.1 Contact supplier	
2.1.1 Name	ROBERTSON HEATHER
2.1.2 Phone	+1 8475853058
2.1.3 Email	heather.robertson@st.com
2.2 Change responsibility	
2.2.1 Product Manager	Andrea Mario ONETTI
2.1.2 Marketing Manager	Simone FERRI
2.1.3 Quality Manager	Michele CALDERONI

3. Change		
3.1 Category	3.2 Type of change	3.3 Manufacturing Location
General Product & Design	Die redesign: Mask or mask set change with new die design ? Pad modification (sizes, vertical structure, metal thickness)	ST CROLLES, ST ROUSSET, ST MALTA,ST AGRATE

4. Description of change		
	Old	New
4.1 Description	Current pad disposition.	New pad disposition and optimized test flow.
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	No Impact	

5. Reason / motivation for change	
5.1 Motivation	The pad re-layout allows a more linear test flow (thanks to better robustness) and then capacity increase.
5.2 Customer Benefit	QUALITY IMPROVEMENT

6. Marking of parts / traceability of change	
6.1 Description	by dedicated code.

7. Timing / schedule	
7.1 Date of qualification results	2023-04-18
7.2 Intended start of delivery	2024-04-01
7.3 Qualification sample available?	Upon Request

8. Qualification / Validation			
8.1 Description	14135 20230426 #_AIS2DW12_BOM_change_01.pdf		
8.2 Qualification report and qualification results	Available (see attachment)	Issue Date	2023-05-22

9. Attachments (additional documentations)
14135 Public product.pdf 14135 20230426 #_AIS2DW12_BOM_change_01.pdf

10. Affected parts		
10. 1 Current		10.2 New (if applicable)
10.1.1 Customer Part No	10.1.2 Supplier Part No	10.1.2 Supplier Part No
	AIS2DW12TR	

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PCN #14135

AIS2DW12: BOM Change and Activation of ST Rousset as additional diffusion plant for AIS2DW12 ASIC *VB60* die

STMicroelectronics
MEMS Sensors Division - Analog and MEMS Group

April 18th , 2023

Agenda

1 Change description

2 Humidity absorption: failure mechanism explanation

3 5M/1E Analysis

4 Product Traceability

5 Change Validation Plan

6 Results

7 Conclusions

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Change description 1/3

- **Objective:**
  - Improve the device quality performance in terms of robustness against humidity absorption.
  - Increase the manufacturing output capacity with final test flow optimization.
  - Increase in manufacturing output capacity by the activation of ST Rousset as additional diffusion plant.

- **Change details**:

  - **AIS2DW12 BOM Change:** the layout of internal ASIC and MEMS pads will be aligned to the design solution already implemented, validated and qualified on ST Automotive MEMS sensor product AIS2IH.
  - **AIS2DW12 Final Test Flow optimization**: final test flow will be optimized in order to address the increase manufacturing output capacity driven by the AIS2DW12 BOM Change.
  - **Activation of ST Rousset:** VB60 ASIC die used in AIS2DW12 product is currently diffused only in ST Crolles plant. With the change, ST Rousset will be activated as additional diffusion plant where VB60 ASIC will be diffused. The HCMOS9A technology, applied for VB60 ASIC die, is being diffused in ST Rousset for more than 10 years and it is currently used in other ST Automotive products

FB0

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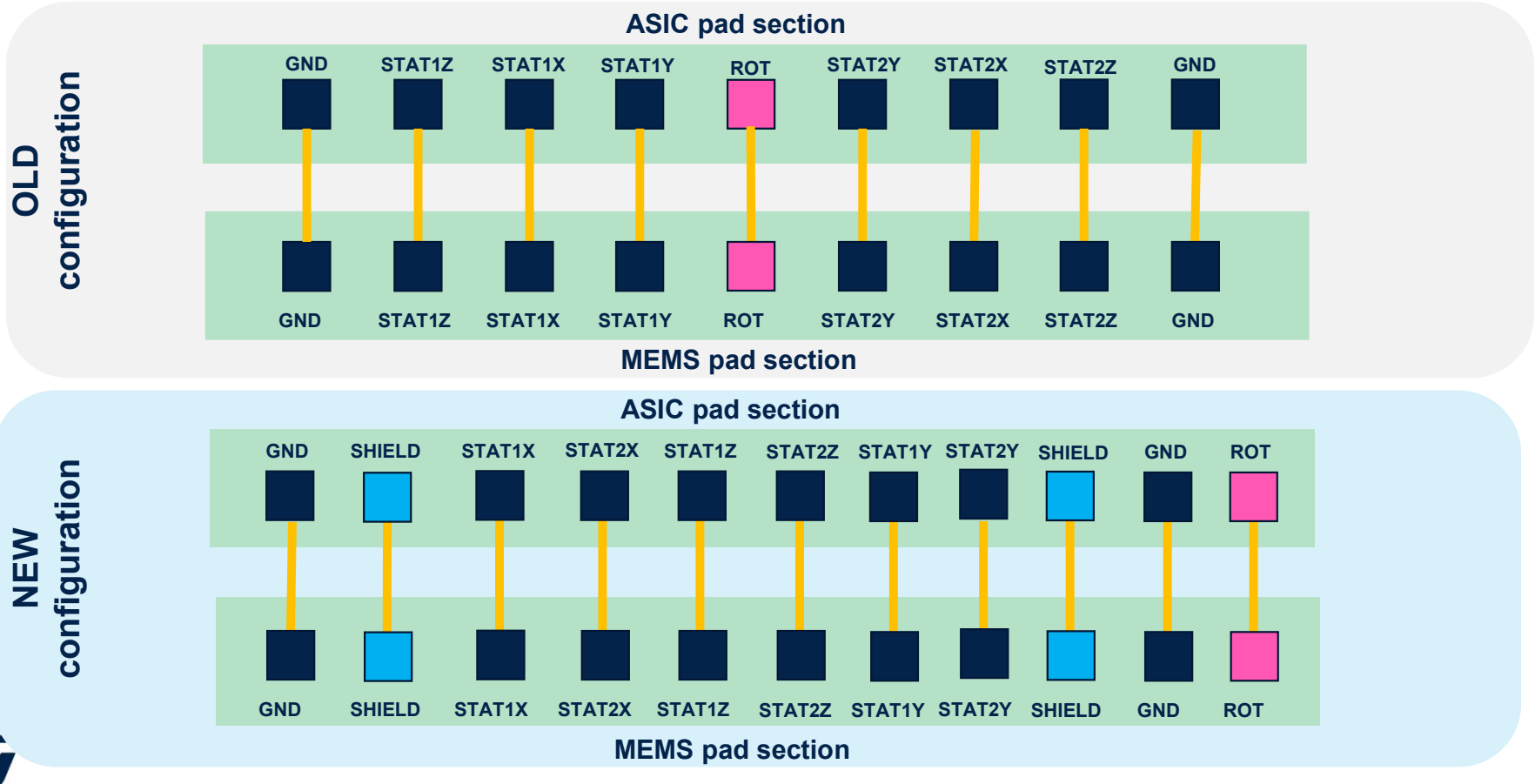
Slide 3

FB0 Rewrite as "validated and qualified on other ST Automotive MEMS sensor product."
Fabio BOTTINELLI, 2023-04-26T09:01:47.872

Change description 2/3

- **AIS2DW12 BOM Change**: the layout of internal ASIC and MEMS pads will be aligned to the design solution already implemented, validated and qualified on ST Automotive MEMS sensor product AIS2IH.

FBO

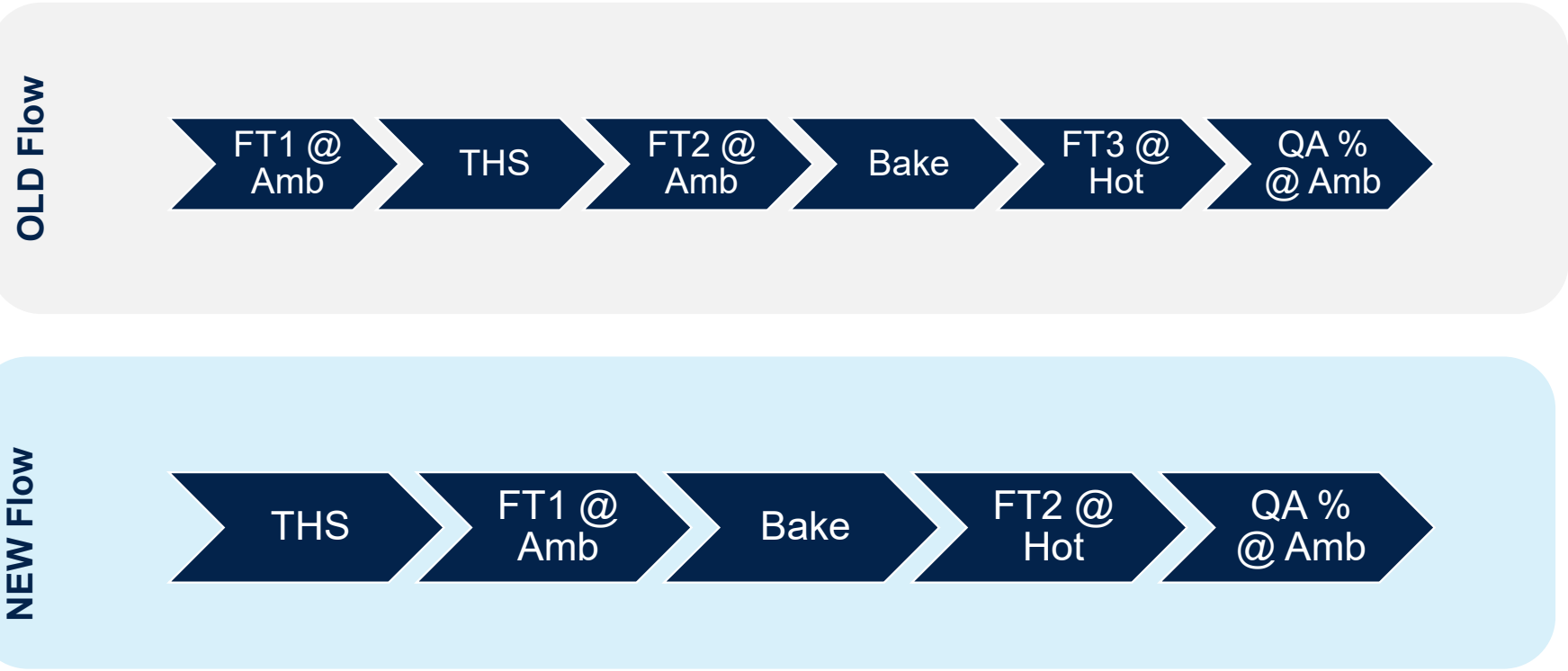


Slide 4

FB0 Modify as: "modified as follow:"
Fabio BOTTINELLI, 2023-04-26T09:03:11.834

Change description 3/3

- **AIS2DW12 Final Test Flow optimization**: final test flow will be optimized in order to address the increase manufacturing output capacity driven by the AIS2DW12 BOM Change.



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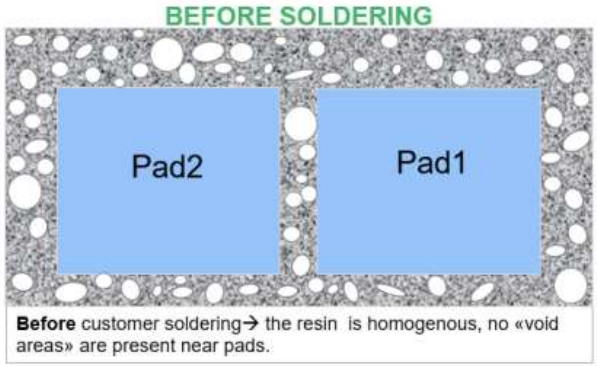
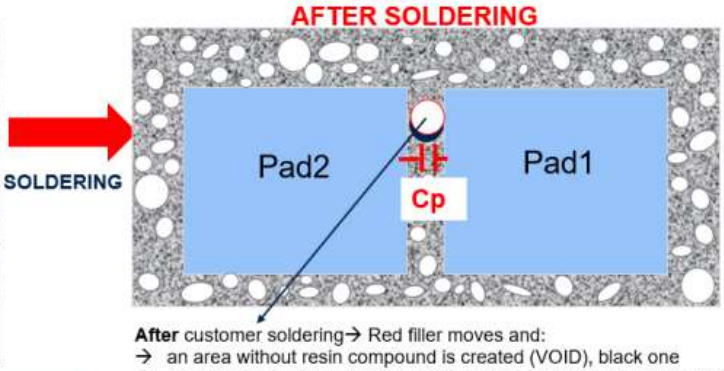
Failure Mechanism explanation: effects of humidity after soldering

- A potential thermomechanical stress at the customer side, induced by soldering process, may trigger the activation of a humidity sensitive phenomenon: the molding properties are modified by the stress moving the compound fillers and creating some voids in the molding. This non-homogeneity in the resin may create some parasitic components which are responsible of the change in some electrical parameters of the device.



Before customer soldering→ the resin is homogenous, no «void areas» are present near pads.



After customer soldering→ Red filler moves and:
→ an area without resin compound is created (VOID), black one
→ A Cp (parasitic electrochemical capacity) is created in the VOID area

Legend:

→ Graphical representation of resin compound with fillers

→ Real aspect of fillers in resin compound

→ Graphical representation of filler re-arranged and consequent creation of a "void area"

→ Real Example of "void area" created by filler movement

At soldering process, package is exposed to a temperature higher than glass transition temperature of resin. This thermo-mechanical stress may induce a slight "movement" of the resin components.

After soldering process, the resin might have been modified with a different arrangement of fillers inside the resin itself. It may happen that, during this "filler re-arrangement", some "void areas" might have been created.

In case of moisture absorption, the "void areas" might have been filled by an electrochemical solution introducing a parasitic capacity.

This parasitic capacity produces an unbalanced signal at the ASIC input which is interpreted as a signal coming from the sensor itself. This signal is actually an artifice.

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5M/1E Analysis

Change	Element	Actual	New	Remarks
AIS2DW12 BOM Change	**Machine**	Tester : SPEA DOT 110 /Handler SPEA H3570/Finishing	No Change	--
		THS equipment: CH300	No Change	--
	Man	Not Applicable	Not Applicable	No impact on BOM Change
	Material	ASIC: VB60DAx Sensor: SSK93BAx	ASIC: VB60DBx Sensor: SSK87AAx	Same ASIC silicon technology Same MEMS silicon technology
	Measurement	Testing flow: FT1 Amb - THS-FT2 Amb – Bake – FT3 Hot – QA% Amb	Testing flow: THS-FT1 Amb – Bake – FT2 Hot – QA% Amb	BOM Change addresses device robustness against humidity. THS stress remains in the flow as extra protection
	Method	ASIC: HCMOS9A technology MEMS: Thelma technology	No Change	--
	Environment	Not Applicable	Not Applicable	No impact on BOM Change

5M/1E Analysis

Change	Element	Control	Remarks
Additional diffusion plant : VB60 in ST Rousset	**Machine**	Sharing the same equipment used for other automotive products already qualified using same technology	The technology does not change, same mask set
	Man	Different production team	ST fab in Rousset is already qualified for automotive production and operators are well trained and certified
	Material	ASIC Bill of material (BOM)	No change
	Measurement	EWS and FT results and test distribution	No change
	Method	H9A technology (0.13µm process node)	No change. The H9A technology is already qualified and used in Rousset for more than 10 years
	Environment	ST fab in Rousset is qualified for automotive production	

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Product traceability

- AIS2DW12 BOM change:
  - Will not impact on the Commercial Product name.
  - Will not impact the Ordering Code used by customers to allocate orders.
  - Will be traced in ST records as a **new Finished Good (FG) code with suffix –MDJ3 or MDG .**

	CURRENT	NEW
ST Commercial Product	AIS2DW12TR	AIS2DW12TR
ST Marking	No change	No change
ST Finished Good (T&R)	AIS2DW12TR-MDJ2	AIS2DW12TR-MDJ3 (Crolles) AISDW12TR-MDG (Rousset)

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Change Validation plan

- Considering that:
  - New AIS2DW12 BOM is the same as Automotive MEMS product, already qualified for the Automotive market.
- The following 4-steps validation activity has been performed to qualify either the new BOM cand the optimized final test flow:
  1. Reliability activity
  2. Characterization activity
  3. Verification at Final Test of 40k units at all the 3 Temperatures (-40°C, 25°C, 85°C) processed with OLD vs the NEW BOM on both FE diffusion plants, with final check of distributions of key parameters.
  4. Verification at Final Test of 50k units with a dedicated final test flow to prove the improved robustness of the NEW BOM layout against humidity absorption.
- Acceptance criteria are defined as follows:
  - NEW BOM in both FE diffusion plants : Good alignment of test distribution of key parameters on 40k units (see next slide for the acceptance criteria)
  - Optimized Final Test flow: 0 confirmed rejects at the end of 100% QA and at the end of dedicated qualification flow.

Activity #3:Final Test data analysis on key parameters OLD vs NEW BOM on both FE diffusion plants

-40°C, 25°C, 85°C

NEW BOM qualification: Acceptance criteria

Parameter	Acceptance Criteria	
Offset	Difference between average values of the two BOM	< 15mg
	Difference between standard deviations of the two BOM [%]	< 30%
Sensitivity	Difference between average values of the two BOM [%]	< 5%
	Difference between standard deviations of the two BOM [%]	< 33%
Seltest	Difference between average values of the two BOM	< 150mg
	Difference between standard deviations of the two BOM [%]	< 25%
I_{dd} in Power Down	Difference between average values of the two BOM [%]	< 5%
	Max value @ Hot NEW BOM < Max value @ Hot OLD BOM	
I_{dd} in Low Power (Power Mode1)	Difference between average values of the two BOM [%]	< 5%
	Max value @ Hot NEW BOM < Max value @ Hot OLD BOM	

Acceptance criteria are based on product features (IC with electronics and mechanics), equipment knowledge and analogy vs similar cases (experience), considering both the quantity involved and the temperature effect

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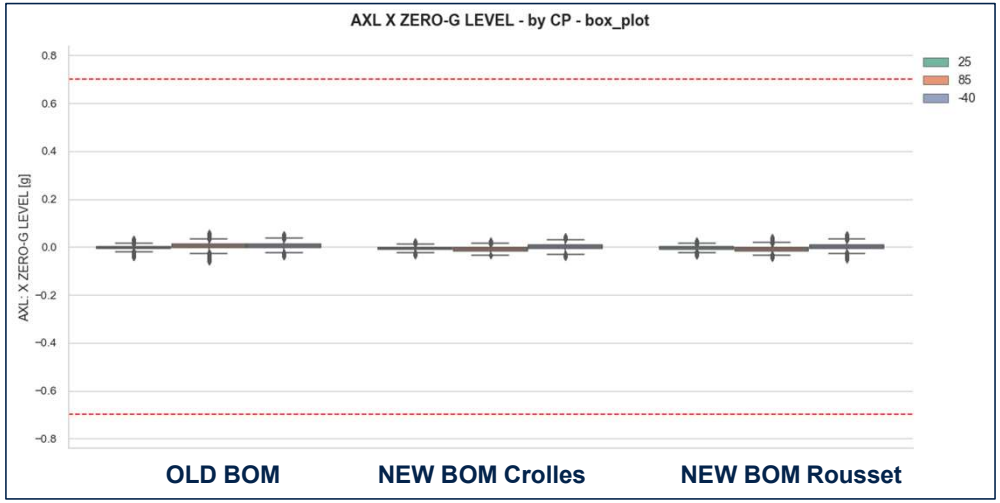
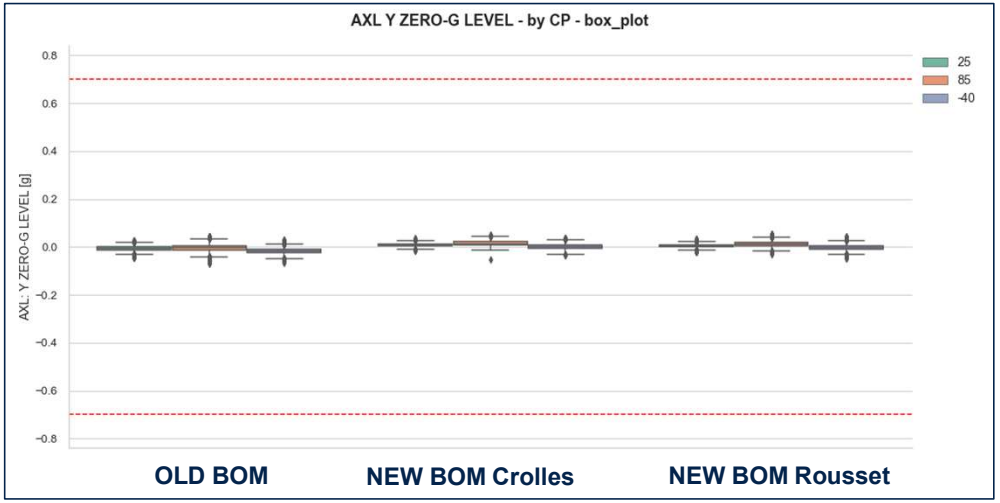
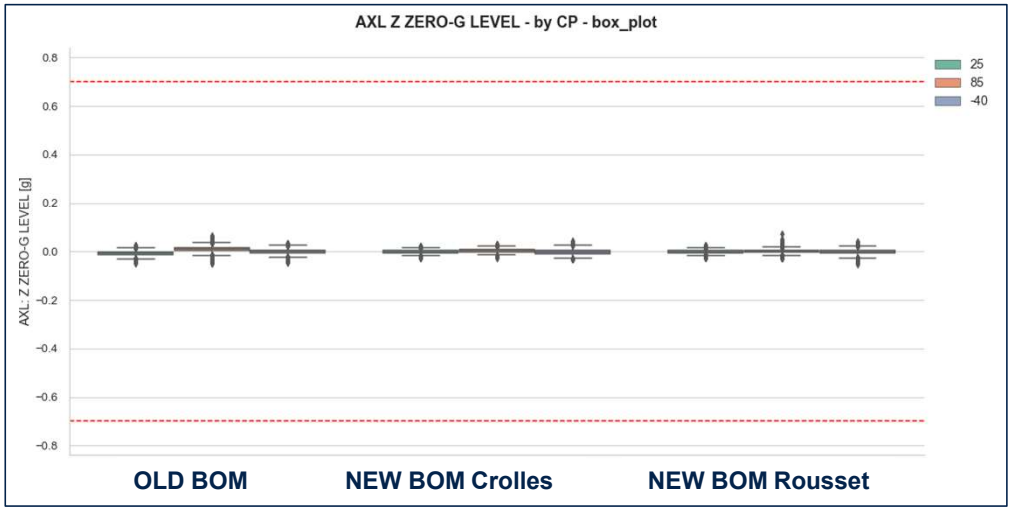
Parameter: Offset

Acceptance criteria satisfied







– – – Datasheet limits

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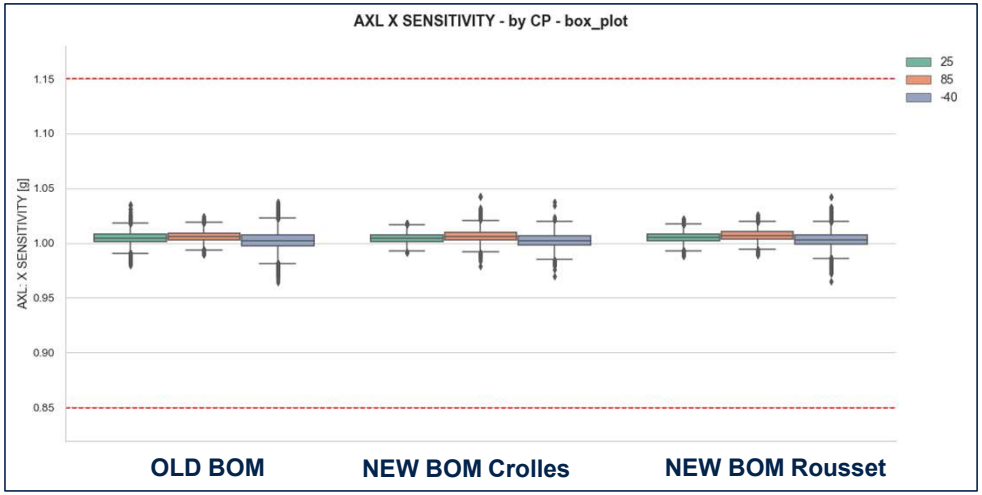
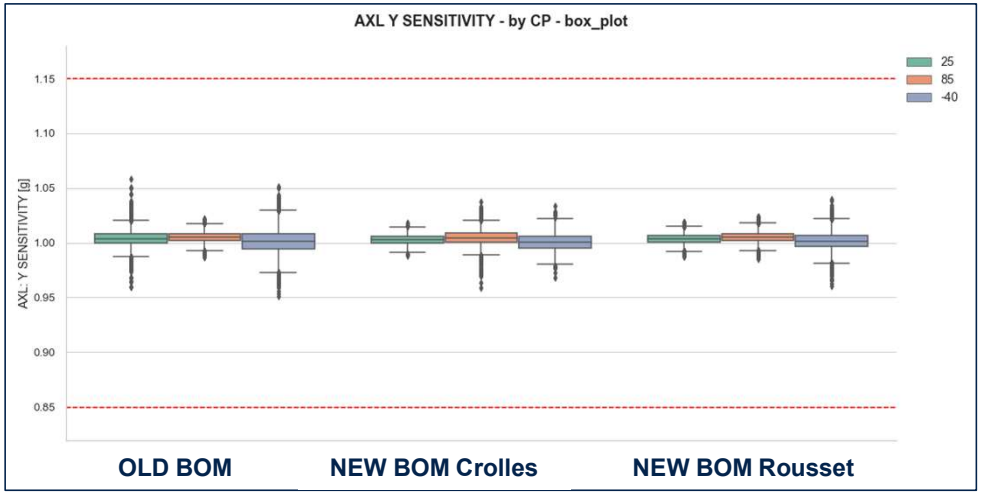
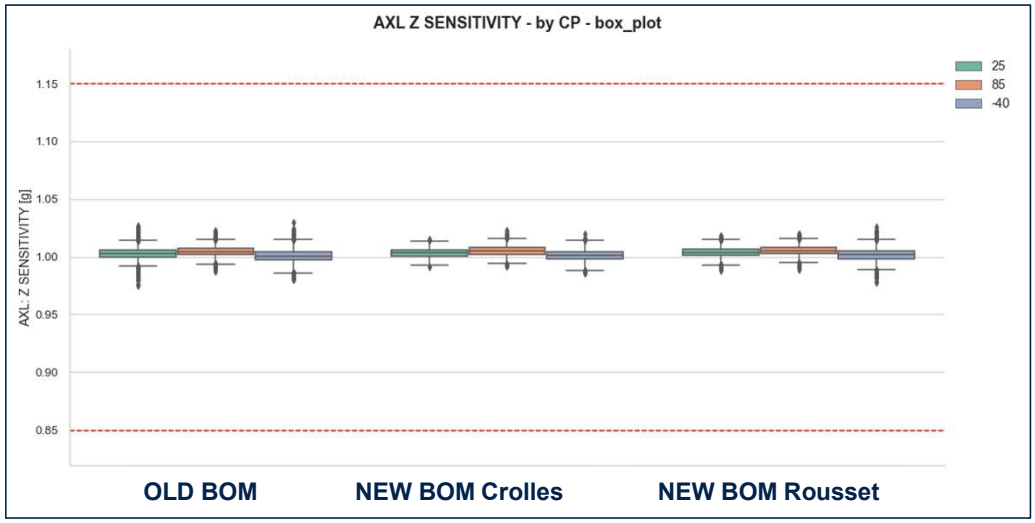
Parameter: Sensitivity

Acceptance criteria satisfied







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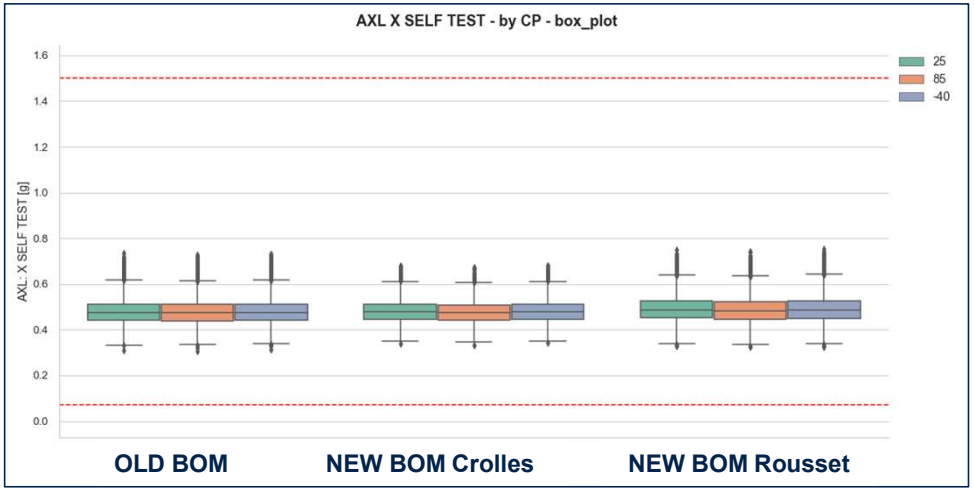
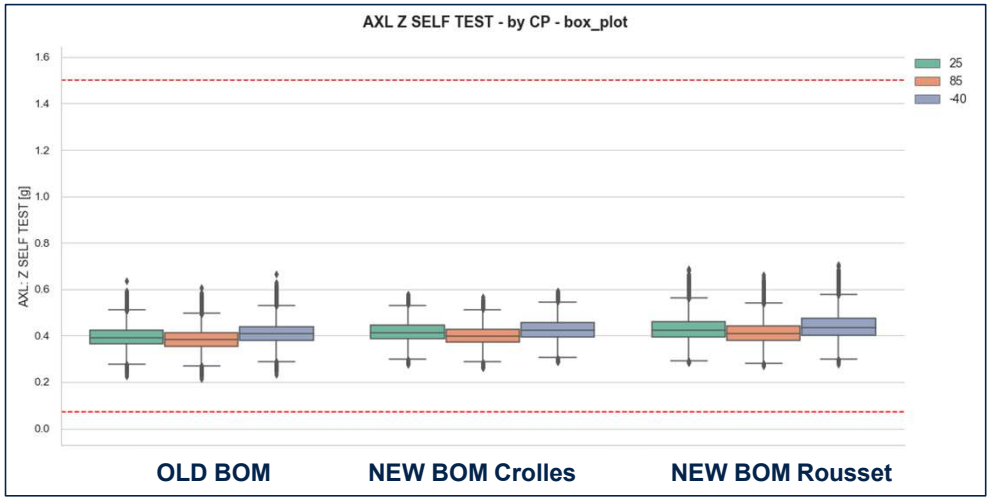
Parameter: Self Test

Acceptance criteria satisfied





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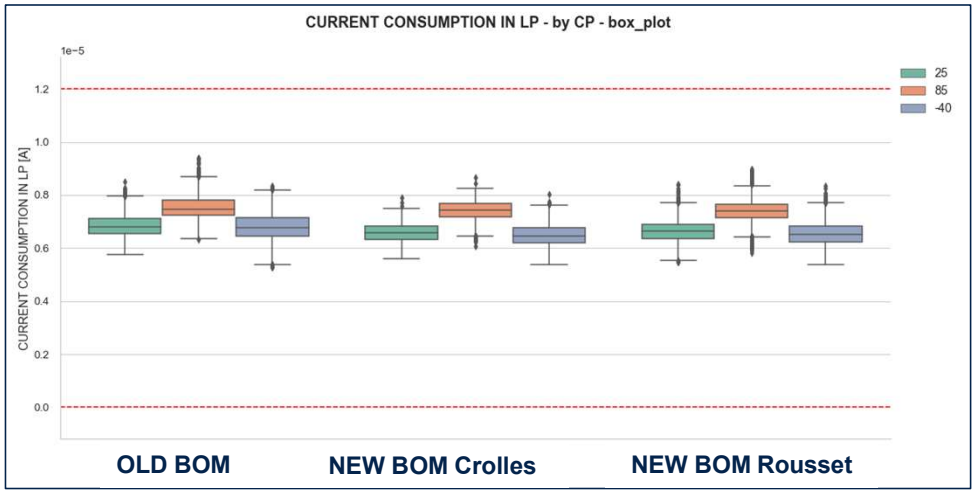
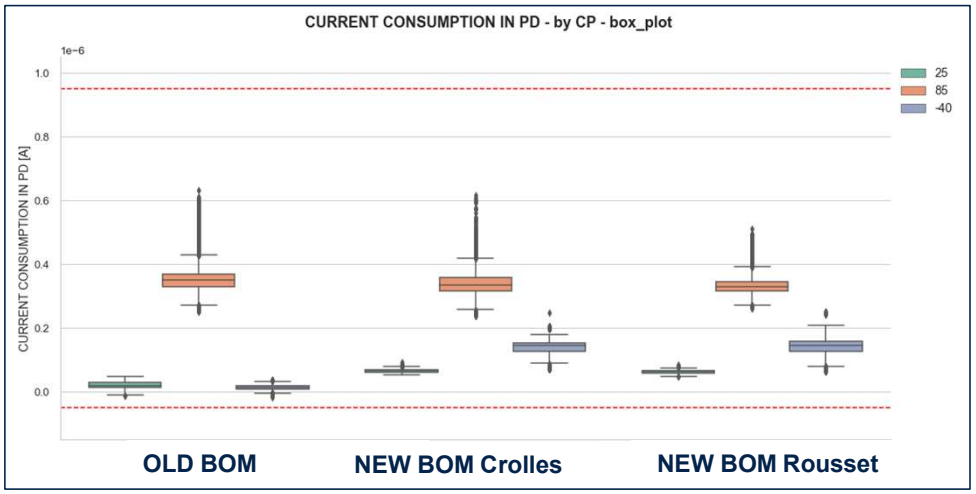
Parameter: Current consumption

Acceptance criteria satisfied





– – – Datasheet limits

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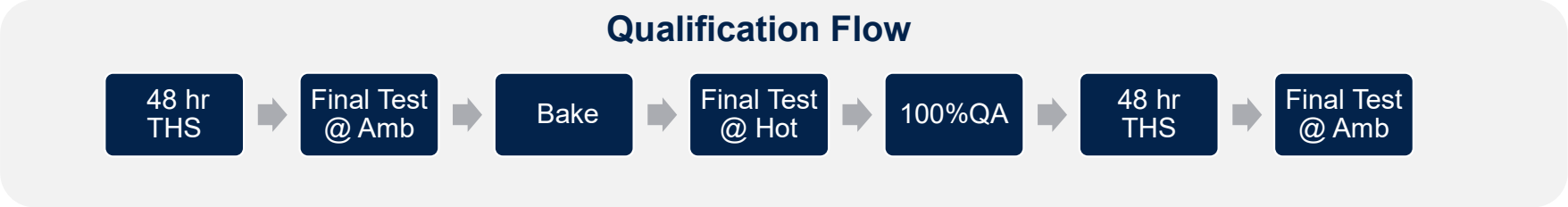
Activity #4: dedicated qualification final test flow

robustness against humidity assessment

Optimized final test flow qualification: Acceptance criteria

- To validate the Optimized Test flow and the robustness of the NEW BOM layout against humidity absorption, 50k units have been submitted to the below dedicated final test flow:



- **Acceptance Criteria** : 0 confirmed rejects at the end of 100% QA and at the end of dedicated qualification flow.

- **Results**:
  - 0 confirmed rejects at the end of 100% QA
  - 0 confirmed rejects at the end of dedicated qualification flow

Acceptance criteria satisfied

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Conclusions

- Considering that:
  1. The successful completion of the reliability activity
  2. The successful completion of the characterization activity
  3. The successful completion of the verification at Final Test of 40k units at all the 3 Temperatures
  4. The successful completion of the verification of the optimized test flow

AIS2DW12 BOM Change has been qualified on both FE diffusion plants

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Public Products List

Publict Products are off the shelf products. They are not dedicated to specific customers, they are available through ST Sales team, or Distributors, and visible on ST.com

PCN Title : Internal pad re-layout of AIS2DW12TR.

PCN Reference : AMS/23/14135

Subject : Public Products List

Dear Customer,

Please find below the Standard Public Products List impacted by the change.

AIS2DW12TR		

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