

PRODUCT / PROCESS CHANGE INFORMATION

1. PCI basic data

1.1 Company		STMicroelectronics International N.V
1.2 PCI No.	AMS/19/11891	
1.3 Title of PCI	AIS2DW12TR: Final Test transfer from ST Castelletto to ST Malta.	
1.4 Product Category	MEMS Automotive ARGENTERA-AIS2DW12 (Tray and T&R)	
1.5 Issue date	2019-12-09	

2. PCI 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
Transfer	Line transfer for a full process or process brick (process step, control plan, recipes) from one site to another site: Testing (SOP 2617)	ST Castelletto and Malta

4. Description of change

	Old	New
4.1 Description	Testing in Castelletto and Finishing in Malta. Equipment: Tester SPEA DOT 110 / Handler SPEA H3570.	Testing and Finising in Malta. Equipment: Tester SPEA DOT 110 / Handler SPEA H3570.
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	No Impact	

5. Reason / motivation for change

5.1 Motivation	ST Castelletto was the product qualification and start-up site. As already planned and communicated via PPAP, and in order to support the necessary capacity expansion, all manufacturing activities related to the back-end (assembly, testing and finishing) have to be executed at ST Malta plant.
5.2 Customer Benefit	CAPACITY INCREASE

6. Marking of parts / traceability of change

6.1 Description	by dedicated FGs
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7. Timing / schedule

7.1 Date of qualification results	2019-11-29
7.2 Intended start of delivery	2020-01-27
7.3 Qualification sample available?	Upon Request

8. Qualification / Validation

8.1 Description	11891 AIS2DW12TR_MALTA validation as Final Test plant.pdf		
8.2 Qualification report and qualification results	Available (see attachment)	Issue Date	2019-12-09

9. Attachments (additional documentations)		
11891 Public product.pdf 11891 AIS2DW12TR_MALTA validation as Final Test plant.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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Public Products List

Public 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

PCI Title : AIS2DW12TR: Final Test transfer from ST Castelletto to ST Malta.

PCI Reference : AMS/19/11891

Subject : Public Products List

Dear Customer,

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

AIS2DW12TR	AIS2DW12	
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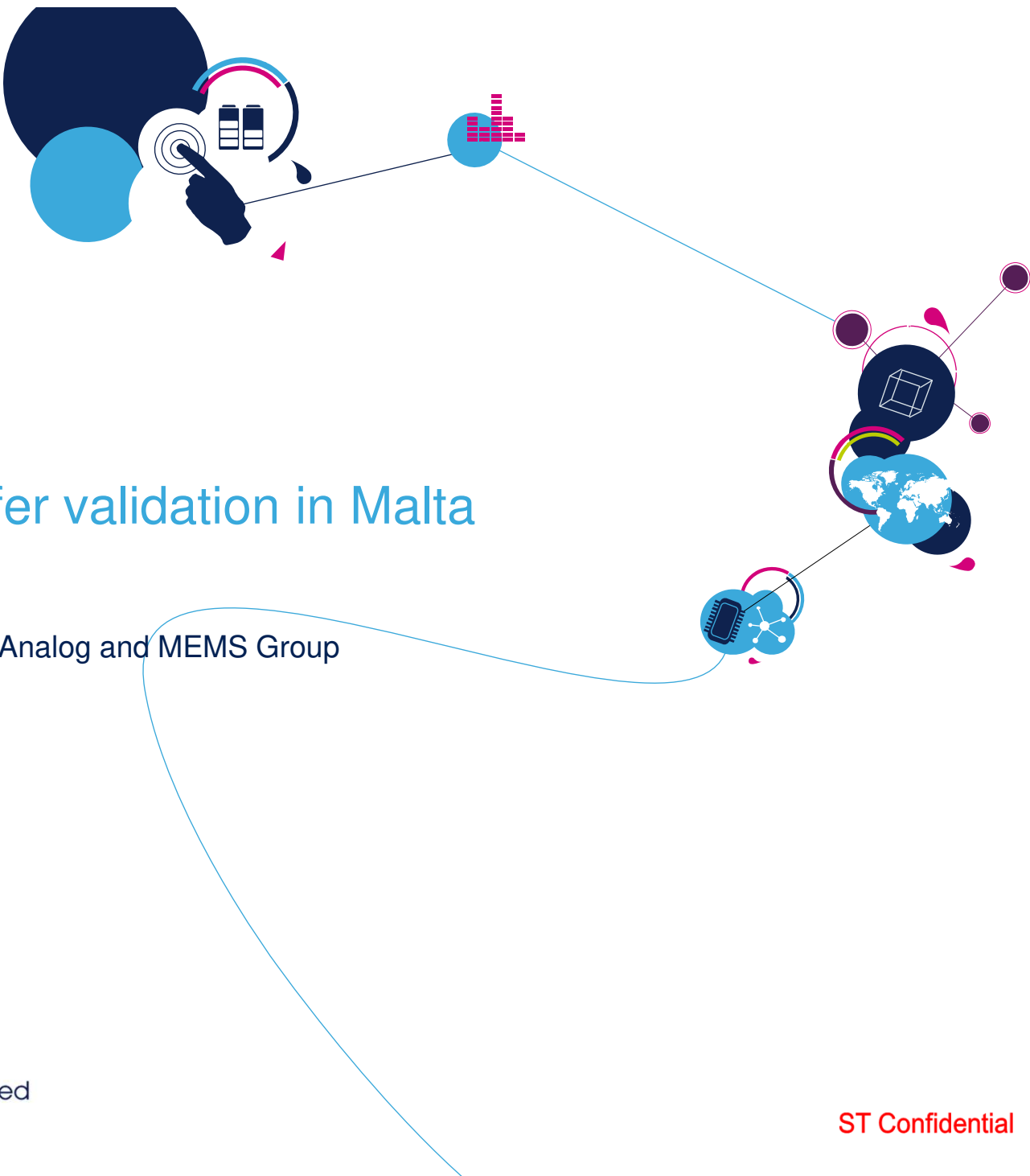
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AIS2DW12

Final test transfer validation in Malta

STMicroelectronics
MEMS Sensors Division - Analog and MEMS Group

November 29th , 2019

Outline of the change

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- Objective:
 - Capacity increase by activation of an additional testing site at ST Malta
- Description of the change:
 - Same testing platform (Tester: SPEA DOT 110 – Handler: SPEA H3570)
 - Same testing flow (see slide #4)
 - Finishing already in Malta (no change)

Change Traceability

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- Traceability:
 - Same Commercial Product (CP) / Ordering Code will be used
 - New Finished Goods (FG) will be applied on the material produced with the new flow
 - Sample availability with new flow available for customer evaluation from wk47
 - Production transfer planned by Q1'2020

	CURRENT	NEW
ST Commercial Product	AIS2DW12 / AIS2DW12TR	AIS2DW12 / AIS2DW12TR
ST Marking	no change	no change
ST Finished Good (TRAY)	AIS2DW12-MFJ1/	AIS2DW12-MDJ2/
ST Finished Good (T&R)	AIS2DW12TR-MFJ1/	AIS2DW12TR-MDJ2/

Final test flow comparison

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Test flow @ ST Castelletto

Final Test (FT)

- FT1 @ room temp
- THS
- Re-test @ room temp (RA)
- Bake
- Test @ high temp (RH)
- QA % @ room temp

Finishing

- Tape and reel (Malta)

Test flow @ ST Kirkop (Malta)

Final Test (FT)

- FT1 @ room temp
- THS
- Re-test @ room temp (RA)
- Bake
- Test @ high temp (RH)
- QA % @ room temp

Finishing

- Tape and reel

Method to validate the transfer

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Test systems use the same tester and handler models in both plants (Tester: SPEA DOT 110 / Handler: SPEA H3570).

The following validation activity was performed in order to confirm that test systems are aligned. Two steps were implemented:

1. First step: to run a small batch of units (30pcs) on both testing equipments and verify that good and failed parts are aligned (pass or showing the same failure bin)
2. Second step: to run correlation units (450pcs) at ambient temperature to confirm ATE (Automatic Test Equipment) alignment between the two sites
3. Third step: to test 10,000 good units coming from the same assembly lot in both sites and validate the overall final test flow

Item	Risk	Validation activity	Validation tests	Sample size
Equipment alignment	Equipment not aligned	Golden samples comparison	I _{dd} / Self-test / Offset / Sensitivity	450pcs
		Single correlation lot run with full flow	I _{dd} / Self-test / Offset / Sensitivity	10,000pcs

Step 1: failed and good units correlation

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		Castelletto					
Malta	RESULT / REF BIN	Pass	OPEN	SHORT	SENSITIVITY X	OFFXSET X	SUPPLY_CURRENT
	PASS / BIN 1	6					
	OPEN / BIN 5		5				
	SHORT / BIN 6			2			
	SENSITIVITY X / BIN 24				1		
	OFFSET X / BIN 21					1	
	SUPPLY_CURRENT / BIN 13						15

All reference good and fails collected in Castelletto show the same software bin when retested in Malta

Step 2: correlation units

Testing plan on correlation units

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- Number of units to be tested: 450pcs
- Sensitivity and offset (FS = 4g, Power Mode 1)
- Self-test (ST):
 - Delta ST1 (positive)
 - Delta ST2 (negative)
- Current consumption:
 - Vdd = 3V, 100Hz
 - Power Down

Acceptance criteria for equipment correlation

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Parameter	Acceptance Criteria
Offset	Difference between average values on the the two equipments < 15mg Difference between standard deviations on the the two equipments in % < 30%
Self Test	Difference between average values on the the two equipments < 20mg Difference between standard deviations on the the two equipments in % < 15%
I_{dd} in Power Down	Difference between average values on the the two equipments in % < 5% Difference between standard deviations on the the two equipments in % < 15%
I_{dd} at 100Hz	Difference between average values on the the two equipments in % < 5% Difference between standard deviations on the the two equipments in % < 15%
Sensitivity	Difference between average values on the the two equipments in % < 2% Difference between standard deviations on the the two equipments in % < 15%

Acceptance criteria are based on product features (IC with electronics and mechanics), equipment knowledge and analogy vs similar cases (experience)

Correlation criteria definition

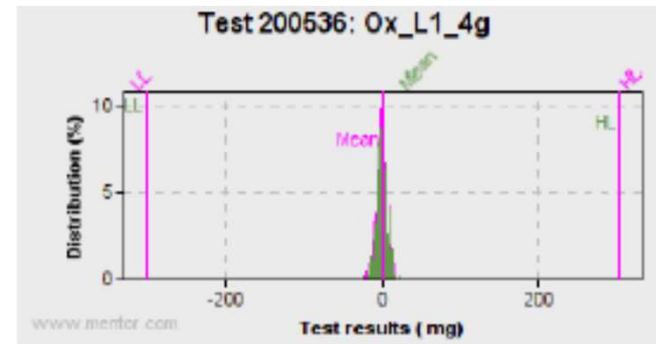
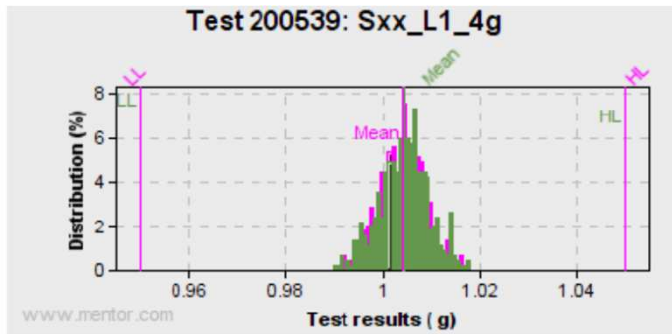
10

- The acceptance criteria are defined by taking into account the expected machine capability (reproducibility and repeatability)
- Based on the expected machine capability, ST defines guard-bands to be applied to test limits in order to guarantee performance as per datasheet specification
- Therefore, confirmation that results are within expected machine capability gives confirmation that defined test limits (including guard-bands) are sufficient to guarantee performance as per datasheet specification

Sensitivity & Offset (Full Scale = 4g, Power Mode 1)

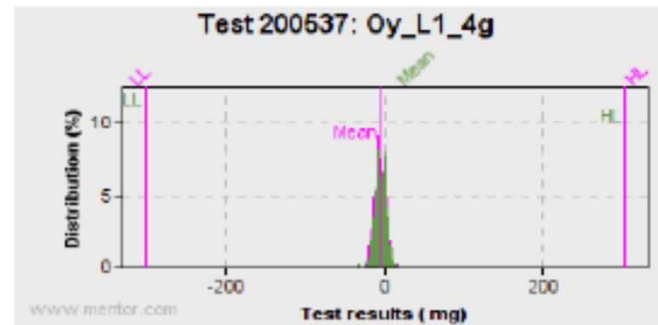
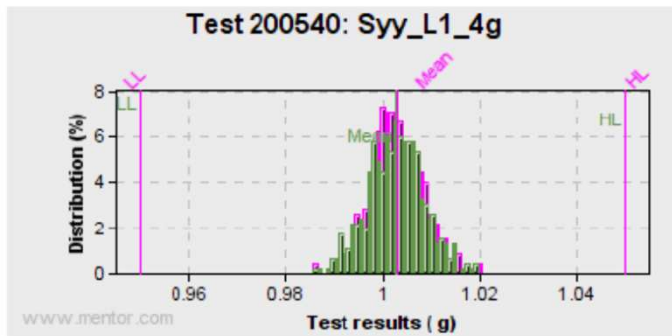
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Sensitivity
X axis



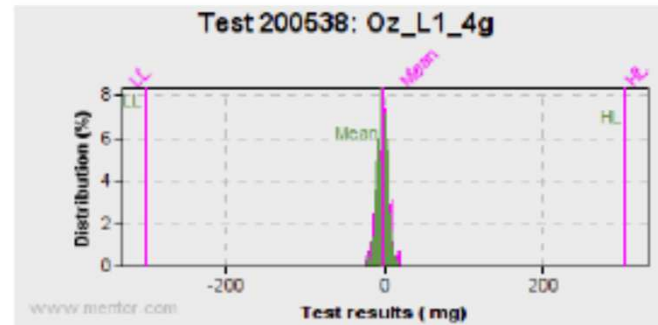
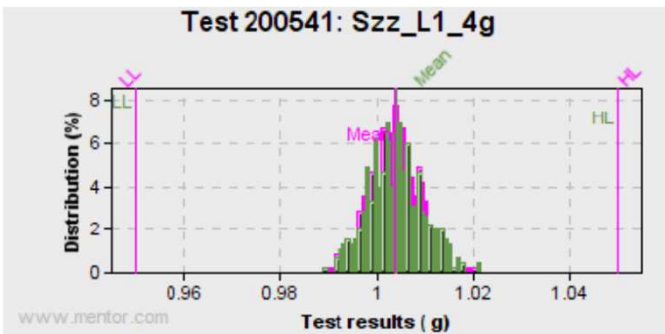
Offset X
axis

Sensitivity
Y axis



Offset Y
axis

Sensitivity
Z axis



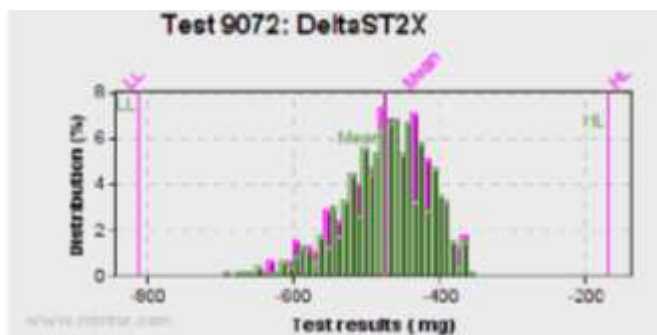
Offset Z
axis

Castelletto
 Malta

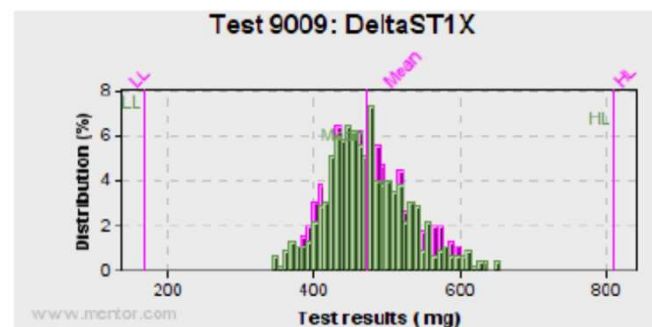
Self-Test

12

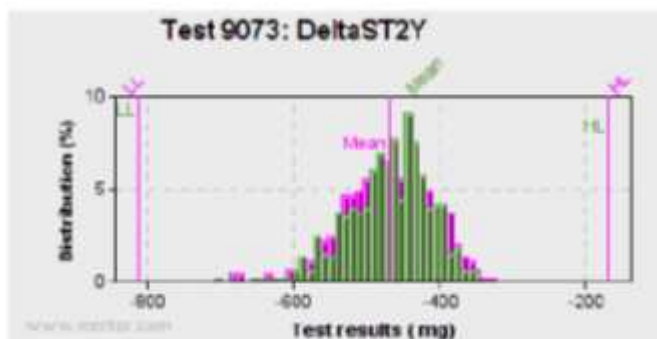
Delta ST2
X axis



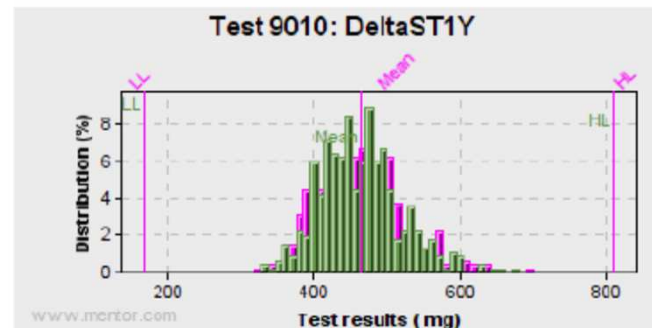
Delta ST1
X axis



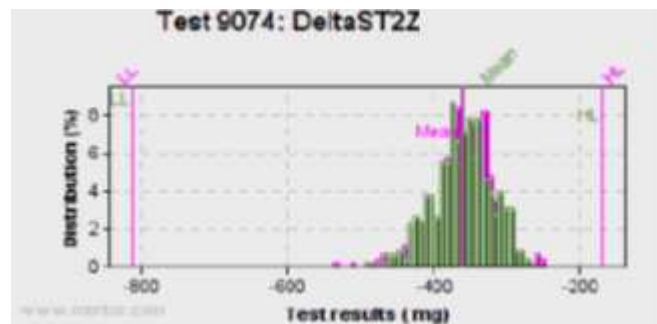
Delta ST2
Y axis



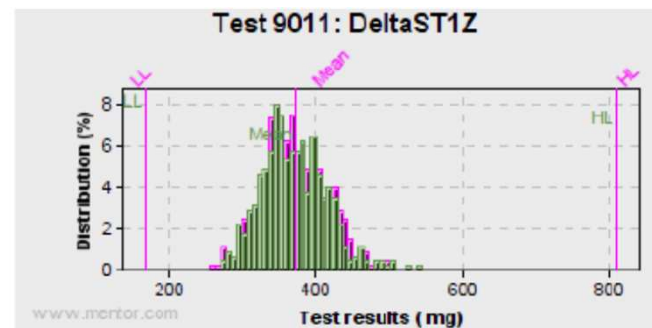
Delta ST1
Y axis



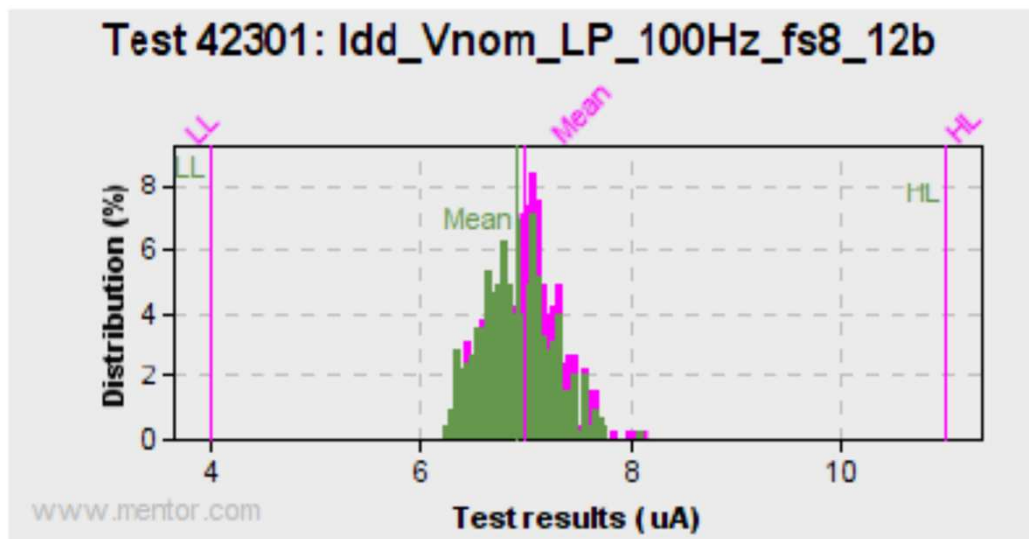
Delta ST2
Z axis



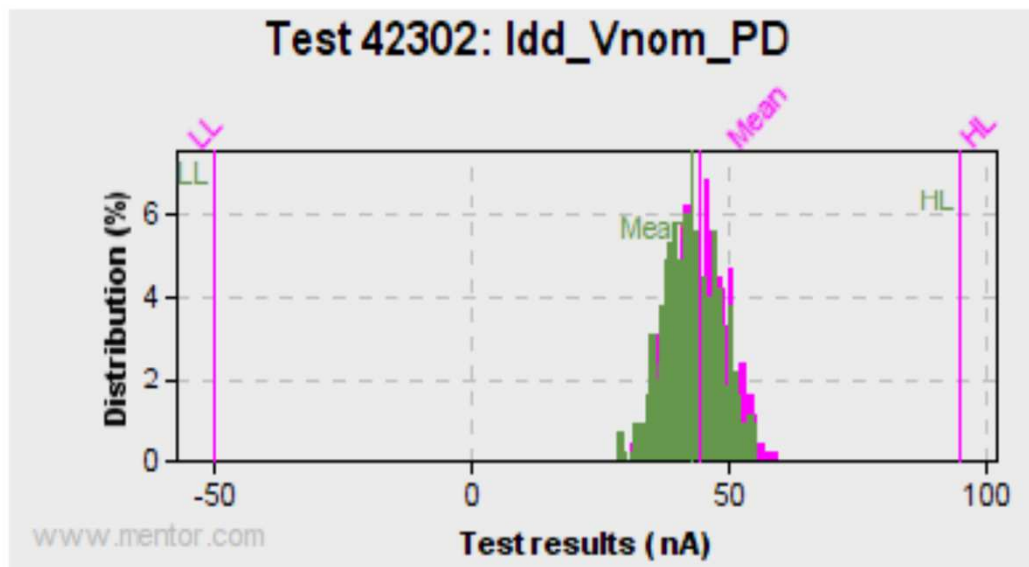
Delta ST1
Z axis



Supply current (I_{dd})



Nominal Voltage
100Hz
Power mode 1



Nominal Voltage
Power Down

Test summary table on the 450 correlation units

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Test number	Test name	Measure	Castelletto (Cast)		Malta		Delta Ave (Malta - Cast)	Delta Ave % (Malta - Cast)/Cast	Delta sigma (Malta - Cast)	Delta sigma % (Malta - Cast)/Cast
			Average	Sigma	Average	Sigma				
9009	DeltaST1X	mg	474.317	56.7787	474.333	54.2655	0.02	0.00	-2.51	-0.53
9010	DeltaST1Y	mg	464.116	55.6198	464.137	56.945	0.02	0.00	1.33	2.38
9011	Delta ST1Z	mg	371.667	44.14	371.906	43.7852	0.24	0.06	-0.35	-0.8
9072	Delta ST2X	mg	-474.834	58.7346	-474.324	57.6498	0.51	-0.11	-1.08	-1.85
9073	Delta ST2Y	mg	-469.404	56.6371	-469.429	60.2954	-0.02	0.01	3.66	6.46
9074	Delta ST2Z	mg	-360.351	39.9552	-360.455	41.7192	-0.10	0.03	1.76	4.41
42301	Idd_Vnom_LP_100Hz_fs8_12b	uA	6.90989	0.331313	7.00877	0.351353	0.10	1.43	0.02	6.05
42302	Idd_Vnom_PD	nA	43.0815	5.27062	44.4543	5.36329	1.37	3.19	0.09	1.76
200536	Ox_L1_4g	mg	0.006386	6.20038	0.004964	6.78179	0.00	-22.27	0.58	9.38
200537	Oy_L1_4g	mg	-4.59635	6.70392	-4.944712	6.84747	-0.35	7.58	0.14	2.14
200538	Oz_L1_4g	mg	-2.10563	6.58615	-1.86903	7.70742	0.24	-11.24	1.12	17.02
200539	Sxx_L1_4g	mg	1004.4	5.05978	1004.15	5.40616	-0.25	-0.02	0.35	6.85
200540	Syy_L1_4g	mg	1002.74	5.81415	1002.83	5.40616	0.09	0.01	-0.41	-7.02
200541	Szz_L1_4g	mg	1004.09	5.71382	1003.79	5.20127	-0.30	-0.03	-0.51	-8.97

Correlation results vs acceptance criteria

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Parameter	Acceptance Criteria	Actual Results	Test outcome
Offset	Delta Ave < 15mg Delta sigma % < 30%	< 15mg < 30%	PASS
Self Test	Delta Ave < 20mg Delta sigma % < 15%	< 20mg < 15%	PASS
I _{dd} in Power Down	Delta Ave % < 5% Delta Sigma % < 15%	< 5% < 15%	PASS
I _{dd} at 100Hz	Delta Ave % < 5% Delta Sigma % < 15%	< 5% < 15%	PASS
Sensitivity	Delta Ave % > 2% Delta Sigma % < 15%	< 5% < 15%	PASS

According with the defined acceptance criteria, the two systems can be considered aligned

Step3:
production lot (10Ku @ FT1)

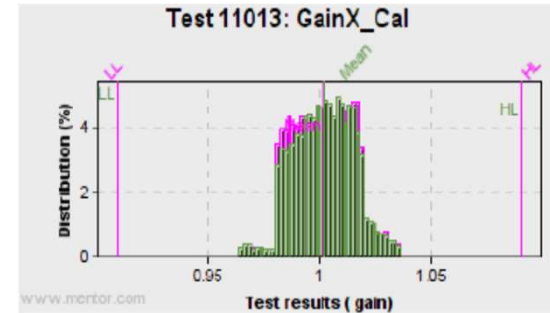
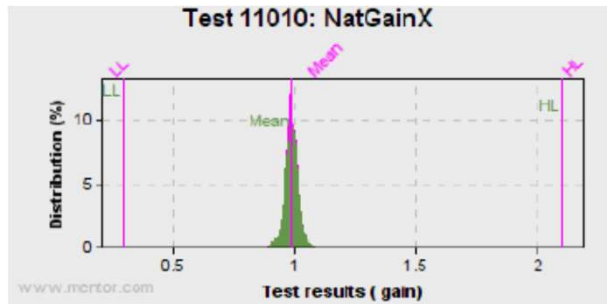
Natural sensitivity / Trimmed sensitivity

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Castelletto

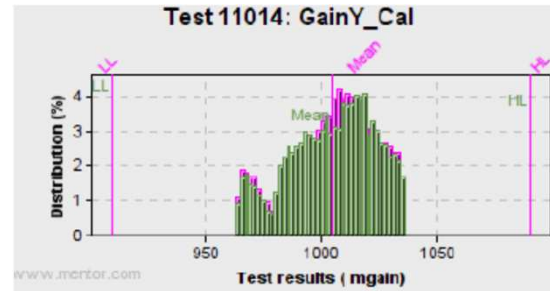
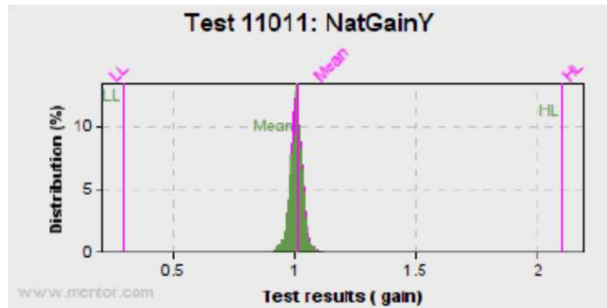
Malta

Natural
sensitivity
X axis



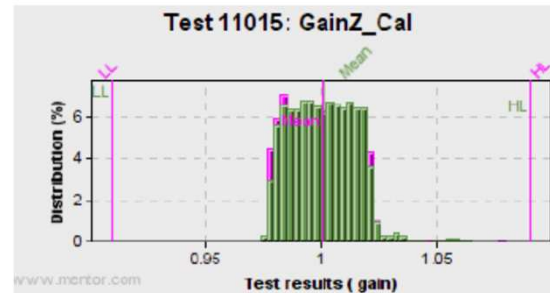
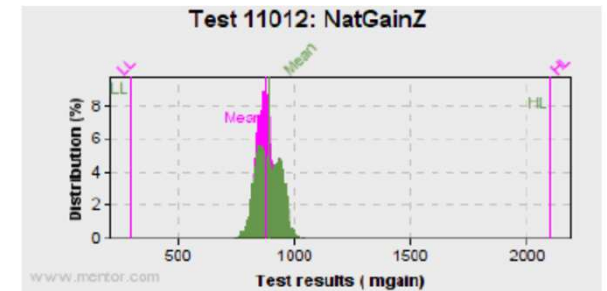
Sensitivity
after trimming
X axis

Natural
sensitivity
Y axis



Sensitivity
after trimming
Y axis

Natural
sensitivity
Z axis

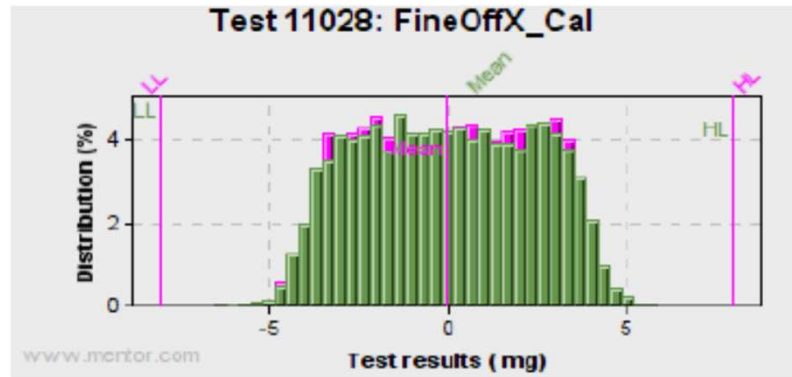


Sensitivity
after trimming
Z axis

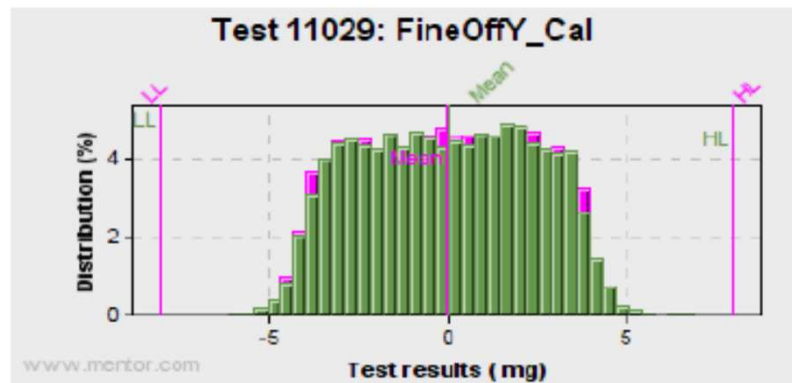
Trimmed Offset

18

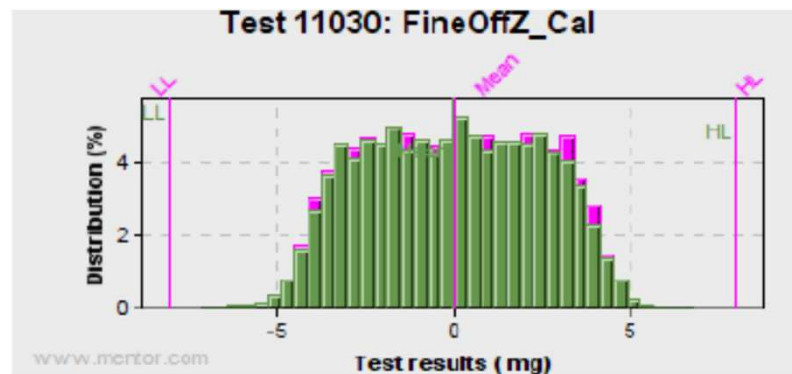
Castelletto
Malta



Offset
after trimming
X axis



Offset
after trimming
Y axis



Offset
after trimming
Z axis

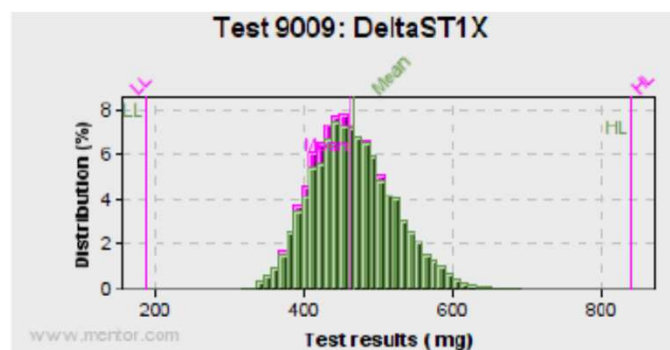
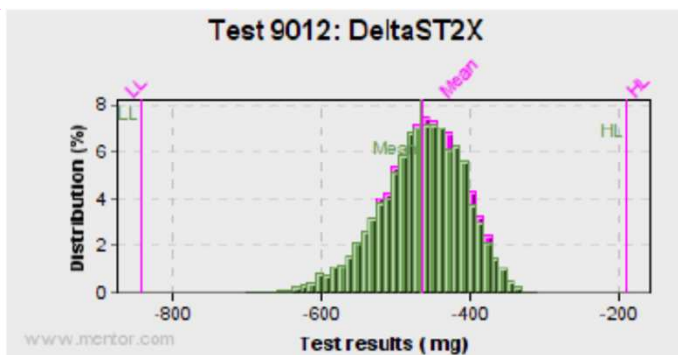
Self-test

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Castelletto

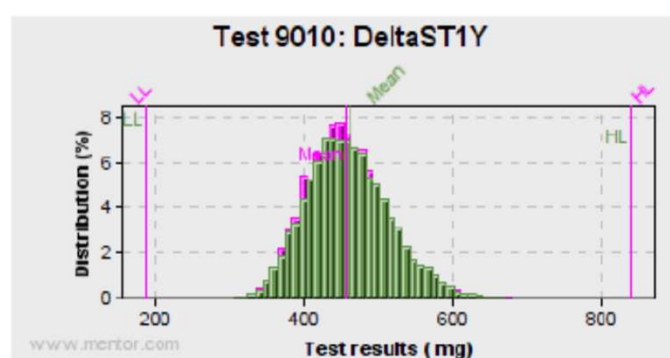
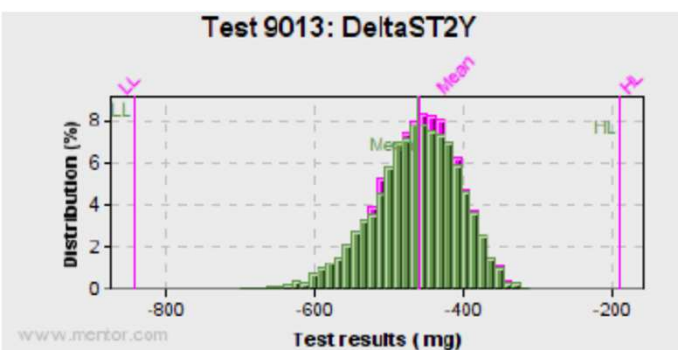
Malta

Delta ST2
X axis



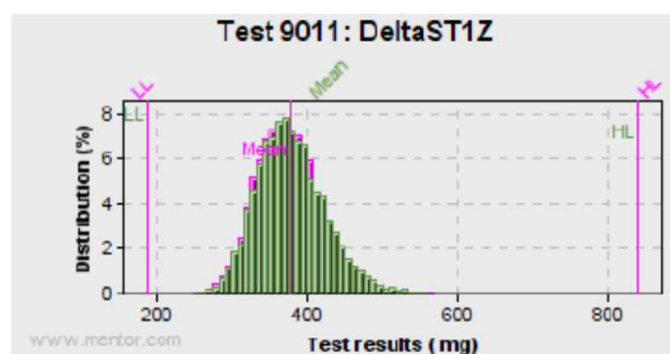
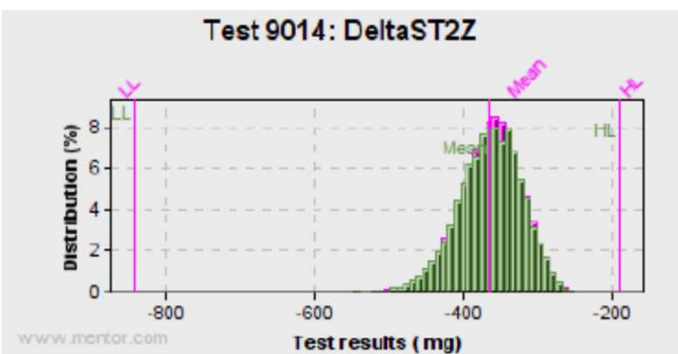
Delta ST1
X axis

Delta ST2
Y axis



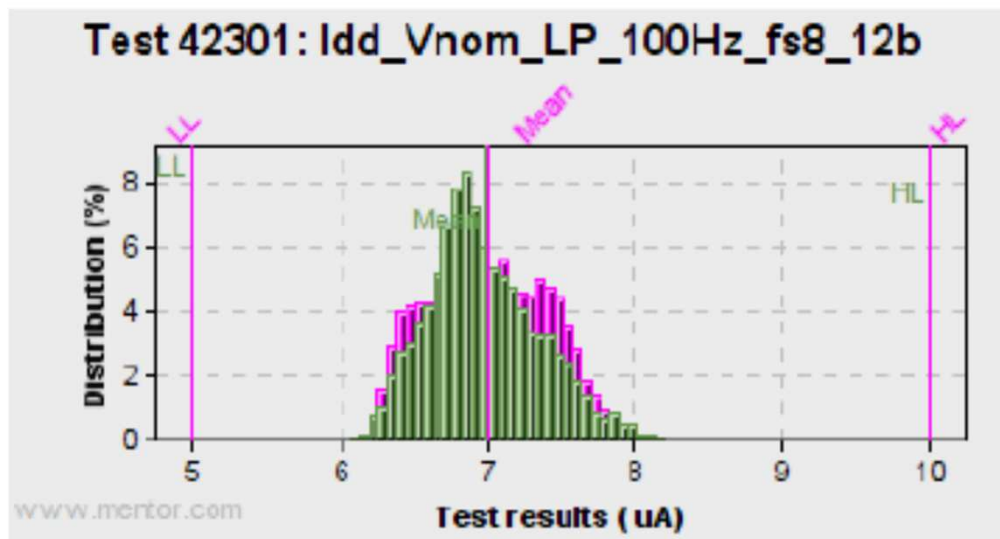
Delta ST1
Y axis

Delta ST2
Z axis

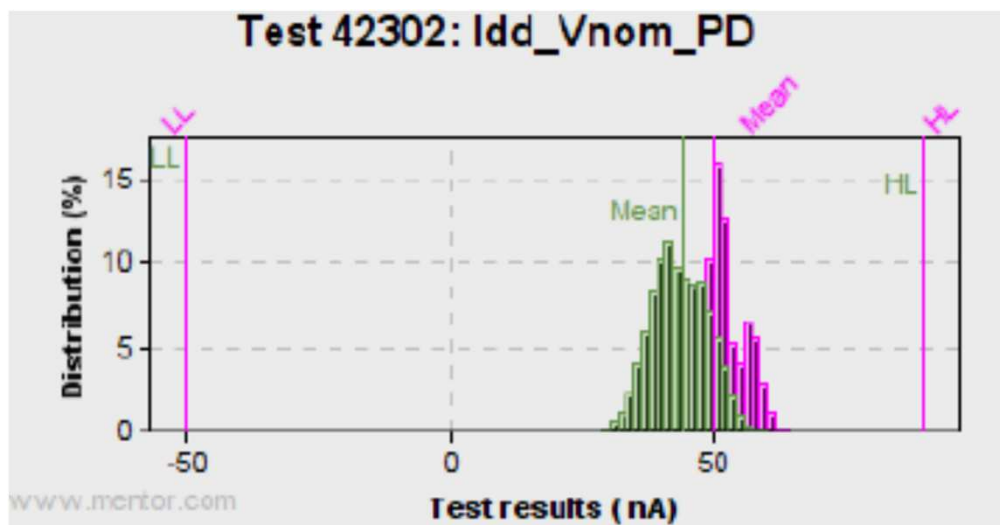


Delta ST1
Z axis

Supply current (I_{dd})



Nominal Voltage
100Hz
Power mode 1



Nominal Voltage
Power Down

Production lot (10Ku @ RA)

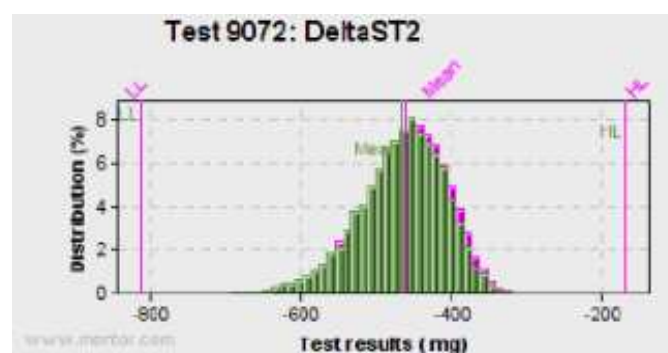
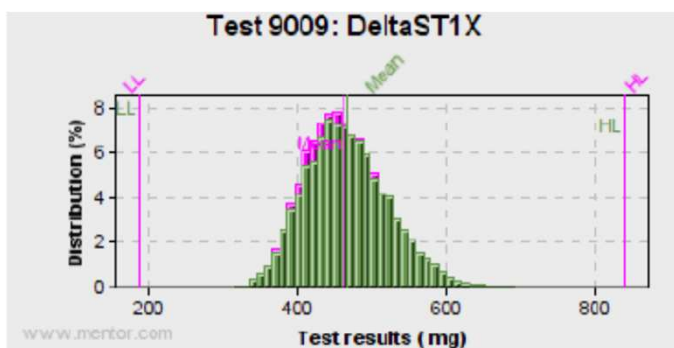
Self-test

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Castelletto

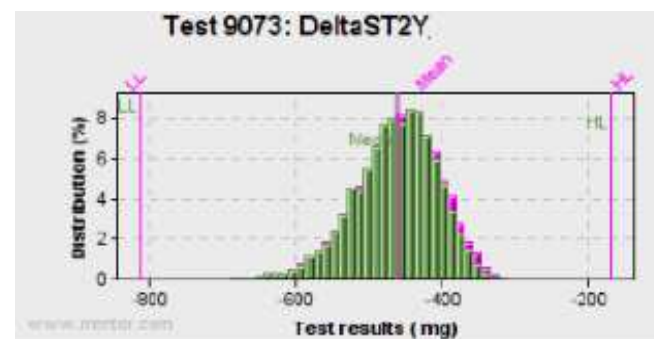
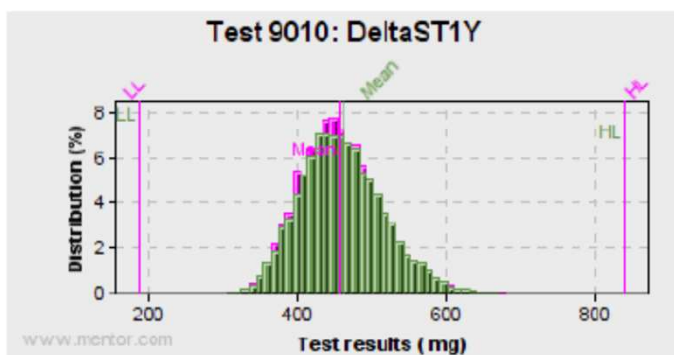
Malta

Delta ST2
X axis



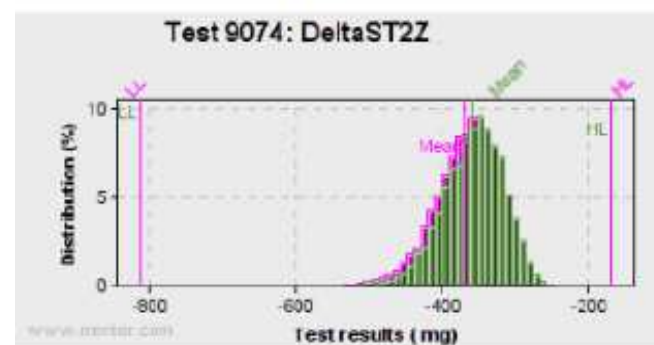
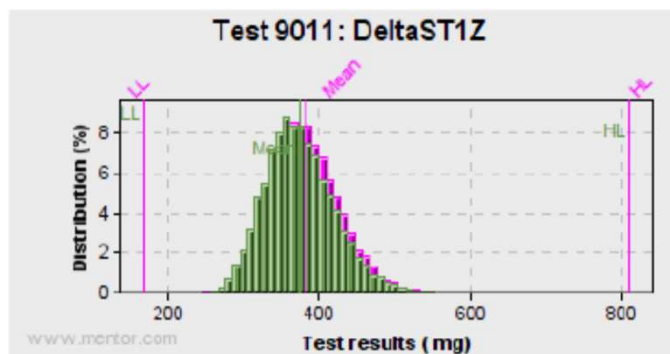
Delta ST1
X axis

Delta ST2
Y axis



Delta ST1
Y axis

Delta ST2
Z axis

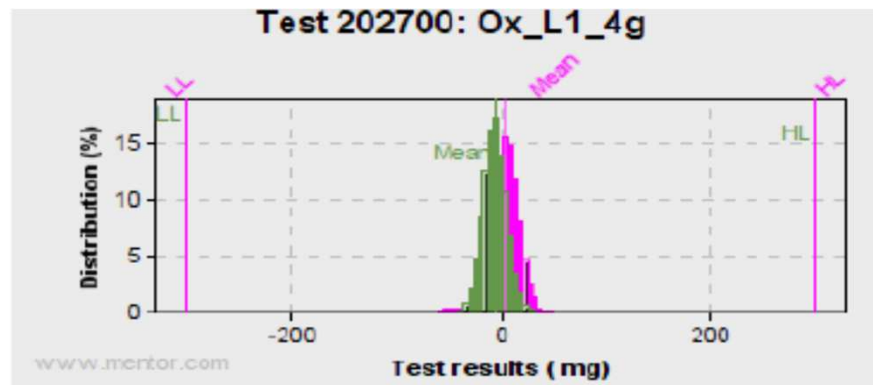


Delta ST1
Z axis

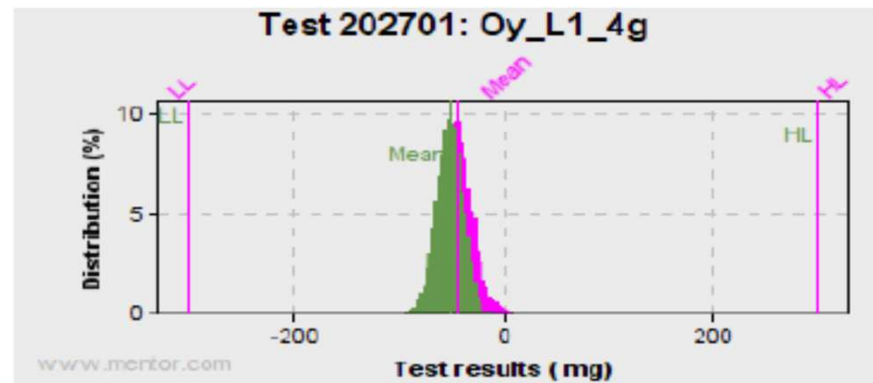
Castelletto
Malta

Offset (Full Scale = 4g, Power Mode 1)

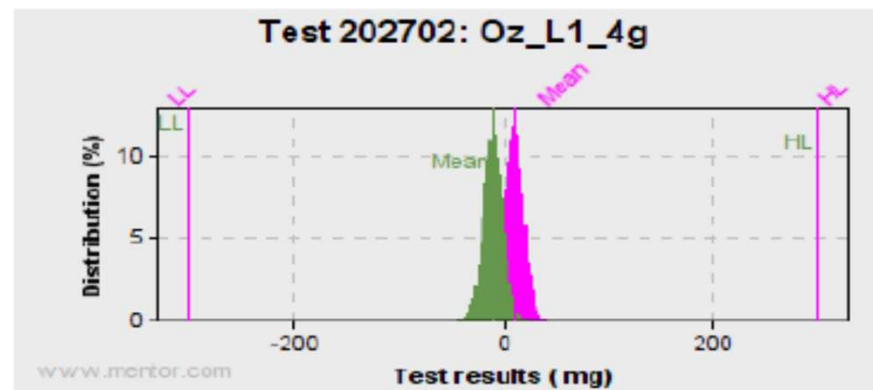
23



Offset
X axis



Offset
Y axis



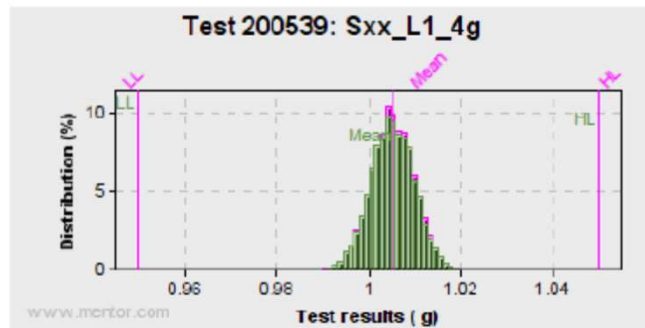
Offset
Z axis

Production lot (10Ku @ RH)

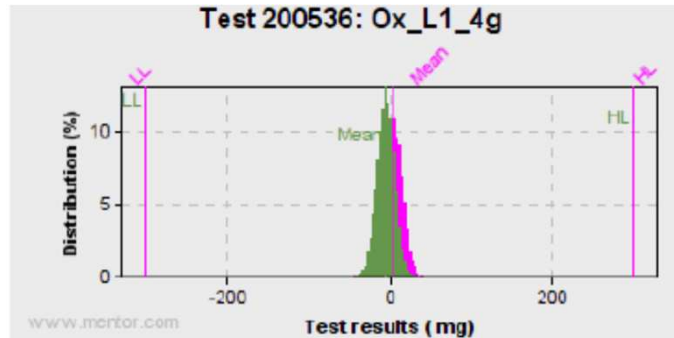
Sensitivity & Offset (Full Scale = 4g, Power Mode 1)

25

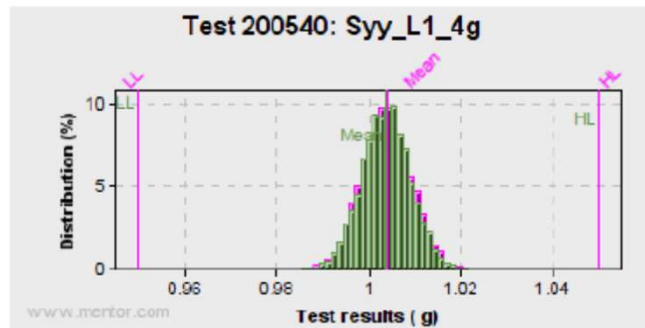
Sensitivity
X axis



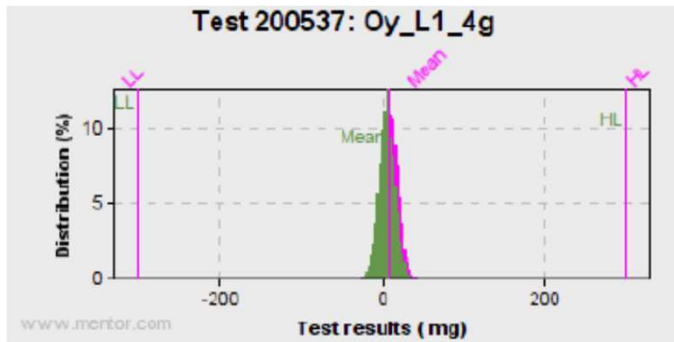
Offset X
axis



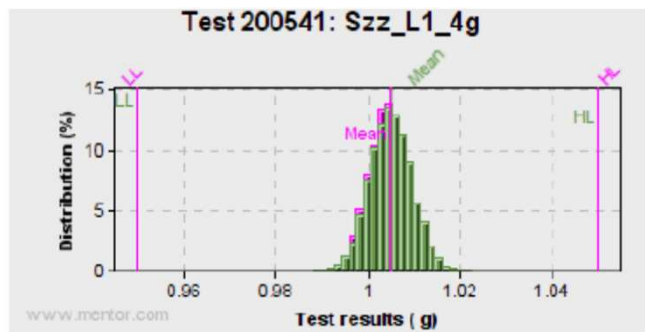
Sensitivity
Y axis



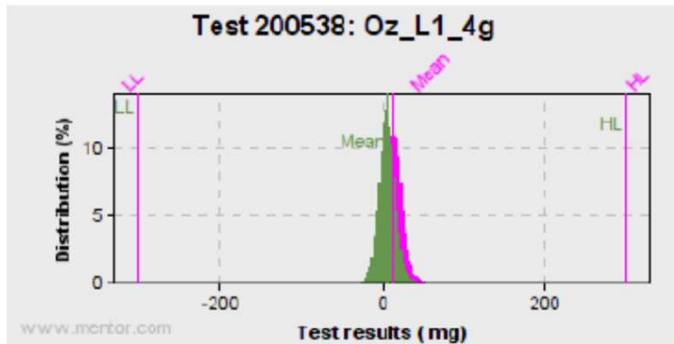
Offset Y
axis



Sensitivity
Z axis

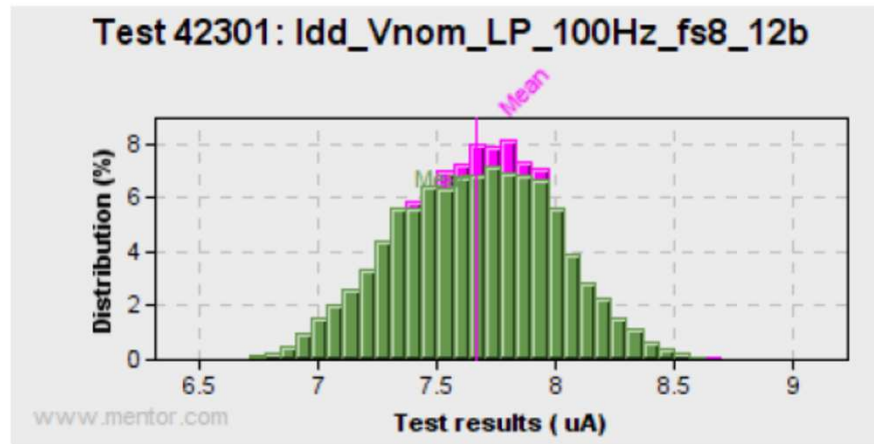


Offset Z
axis

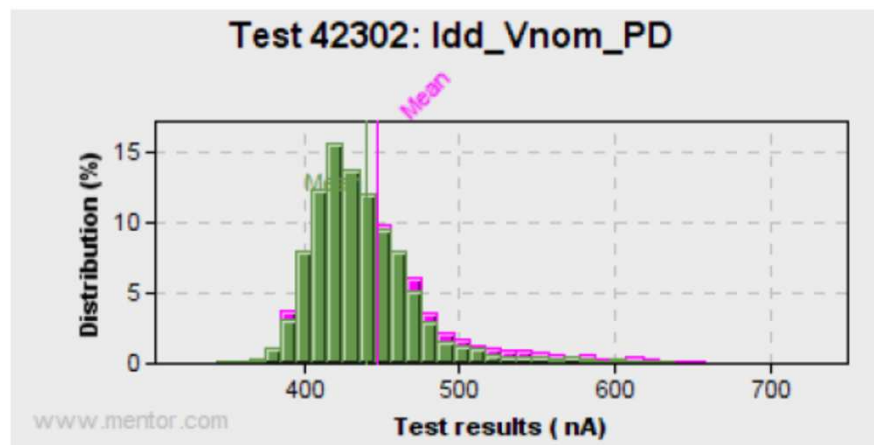


Supply current (I_{dd})

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Nominal Voltage
100Hz
Power mode 1



Nominal Voltage
Power Down

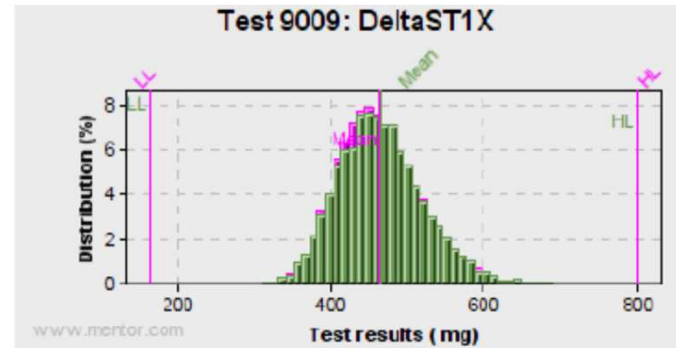
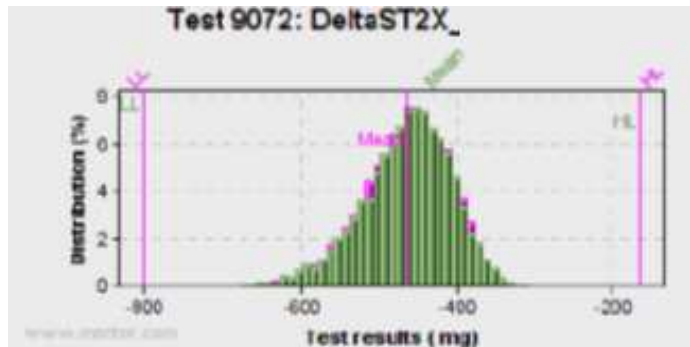
Self-test

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Castelletto

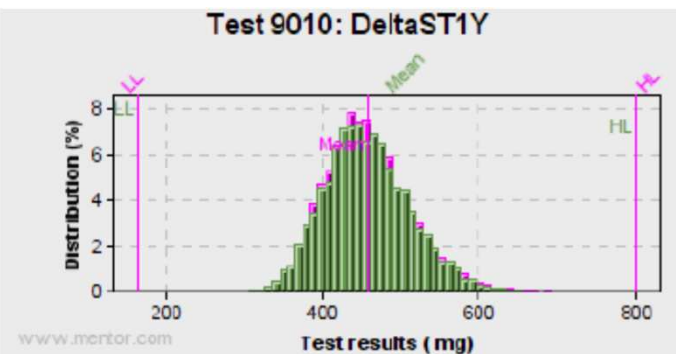
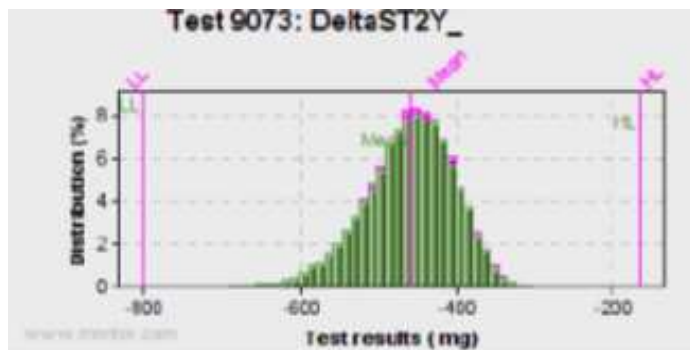
Malta

Delta ST2
X axis



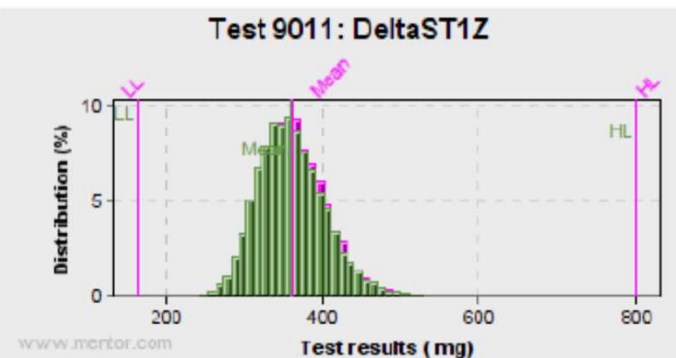
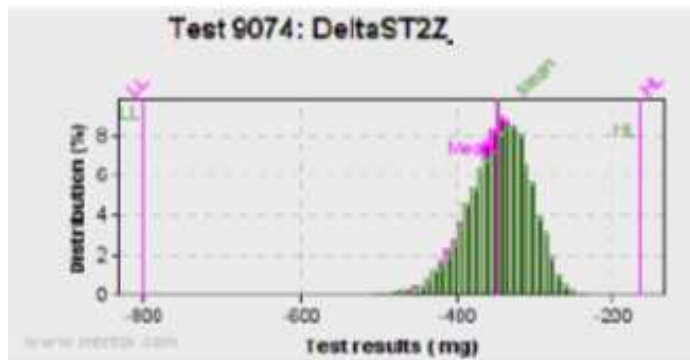
Delta ST1
X axis

Delta ST2
Y axis



Delta ST1
Y axis

Delta ST2
Z axis



Delta ST1
Z axis

Conclusions

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- Based on the defined acceptance criteria and the data gathered during the equipment correlation test and the production run, the testing site of ST Kirkop (Malta) is validated for the final test of the device AIS2DW12