



# MMA845xQ

## 3-Axis, digital accelerometer

Rev. 1.1 — 5 May 2016

MMA845xQQR01

Qualification report

COMPANY CONFIDENTIAL

## 1 Introduction

This document describes the qualification report of the 3-Axis, digital accelerometer, including:

- Accelerated environmental stress tests
- Accelerated lifetime simulation tests
- Package assembly integrity tests
- Cavity package integrity tests
- Die fabrication reliability tests
- Electrical verification tests

**Table 1. General information**

Technology	ASIC: TSMC 0.180 micron
	MEMS: HD Poly
Package	16-pin QFN, 3 mm x 3 mm x 1 mm
Die size	ASIC: 1.955 mm x 0.931 mm
	G-cell: 2.09 mm x 1.32 mm
Part operating temperature	−40 °C to 85 °C
Quartz Tracking #	223724
Number of Lots	3
CAB Approval Date	2013-05-23

**Table 2. Fab, assembly and final test sites**

ASIC	TSMC
G-cell	OHT
Package	Amkor-K1
Test	Amkor-K3



Table 3. Lots and maskset

Lots	LOT A:	
	LOT B:	
	LOT C:	
Maskset	Gyro	M00Z
	ASIC	N16D

Table 4. Approvals

PE Approval	PRQE Approval	PLM Approval
<b>Name:</b> Patricia Monteilh	<b>Name:</b> Bobby Mays	<b>Name:</b> Dan Sadler

## 2 Orderable part numbers

- MMA8451Q
- MMA8452Q
- MMA8453Q

## 3 Abbreviations

The following list describes the abbreviations used in this document.

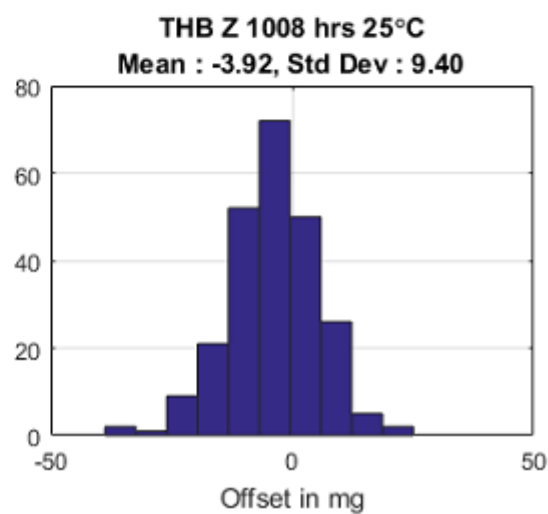
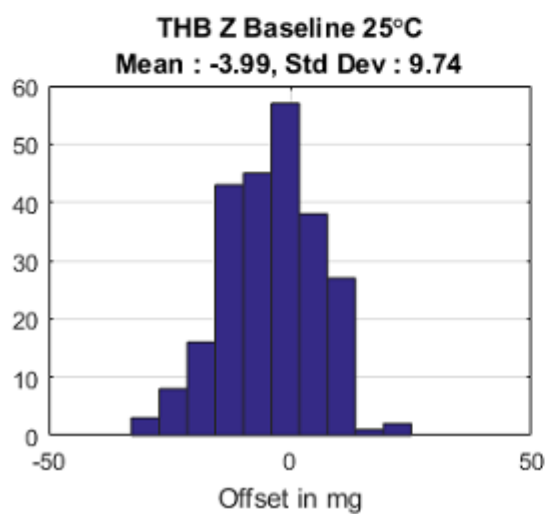
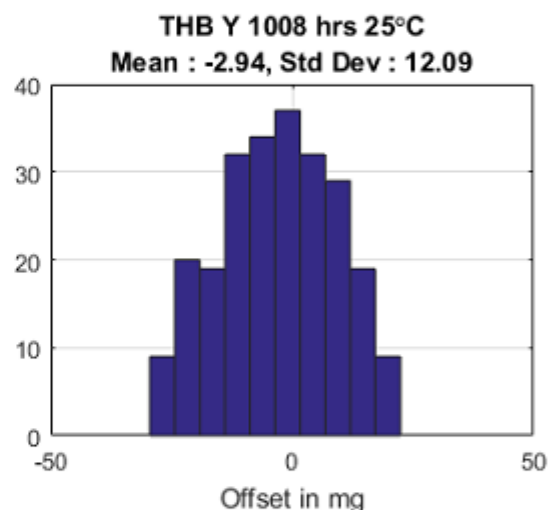
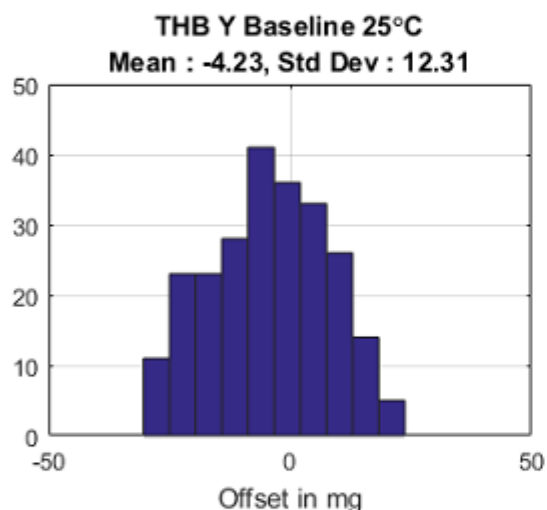
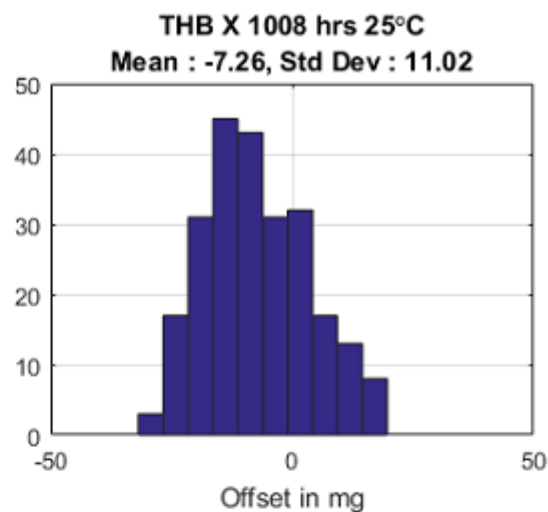
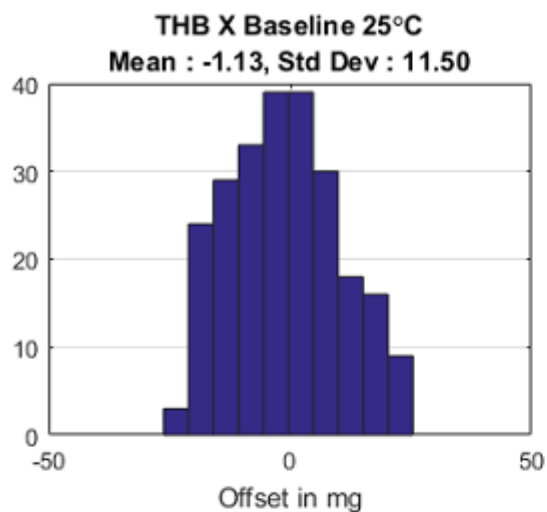
Abbreviation	Description
CDM	Charged Device Model
CSAM	Confocal Scanning Acoustic Microscopy
DRB	Data Retention Rate
ED	Electrical Distributions
ELFR	Early Life Failure Rate
EM	Electromigration
EMC	Electro-magnetic Compatibility
GL	Gas Leakage
HBM	Human Body Model
HCI	Hot Carrier Integrity
HTOL	High Temperature Operating Life
HTSL	High Temperature Storage Life
LU	Latch Up
MM	Machine Model
MS	Mechanical Shock
MSL	Moisture Sensitivity Level

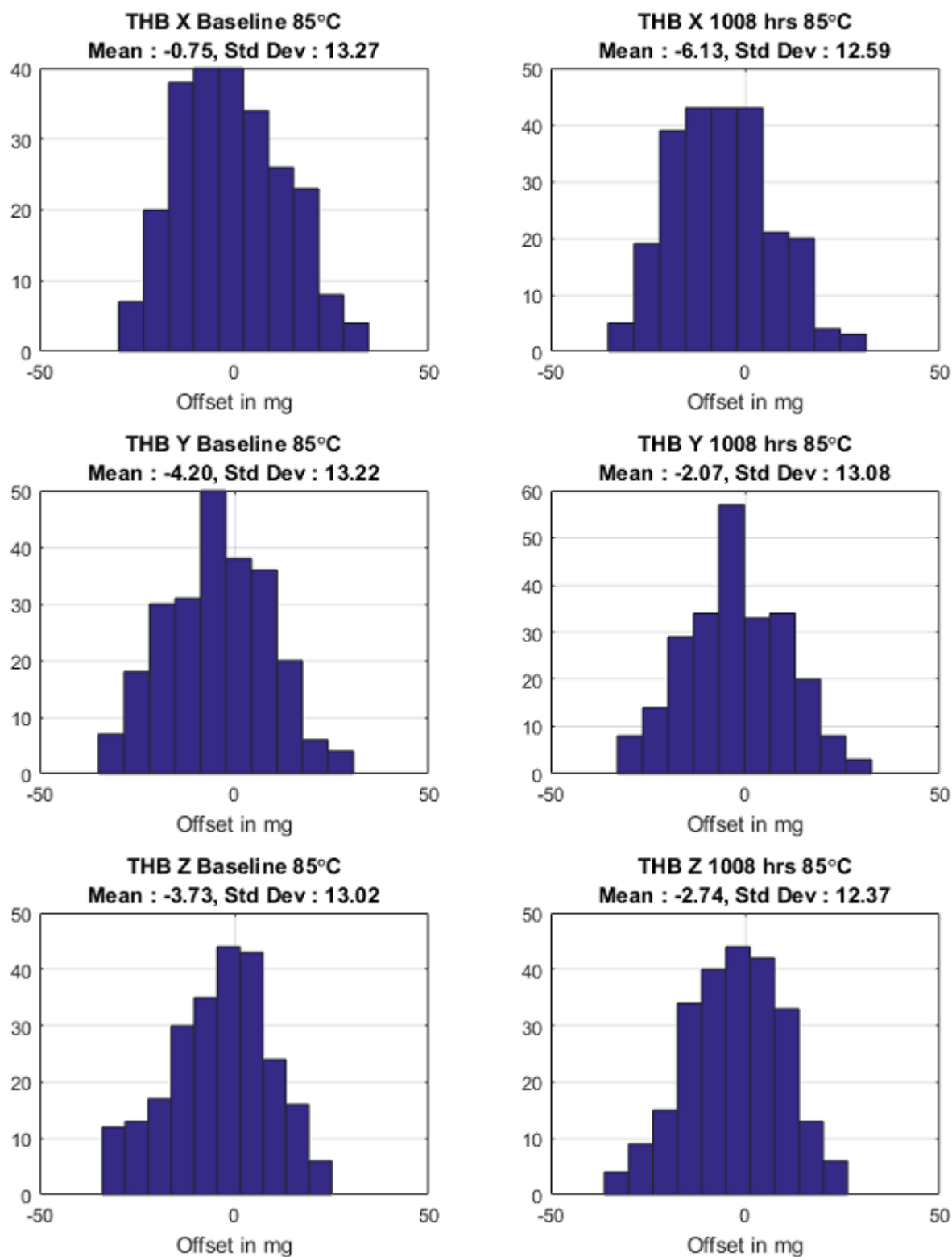
PC	Pre Conditioning
PD	Physical dimensions
SD	Solderability
SER	Soft Error Rate
TC	Temperature Cycling
Tddb	Time Dependent Dielectric Breakdown
THB	Temperature Humidity Bias
UHST	Unbiased HAST
VFV	Variable Frequency Vibration
W/E C	Write/Erase Cycling
WBD	Wire Ball Diameter
WBP	Wire Bond Pull
WBS	Wire Bond Shear
WLH	Wire Loop Height

## 4 Accelerated environmental stress tests

**Table 5. Accelerated environmental stress tests**

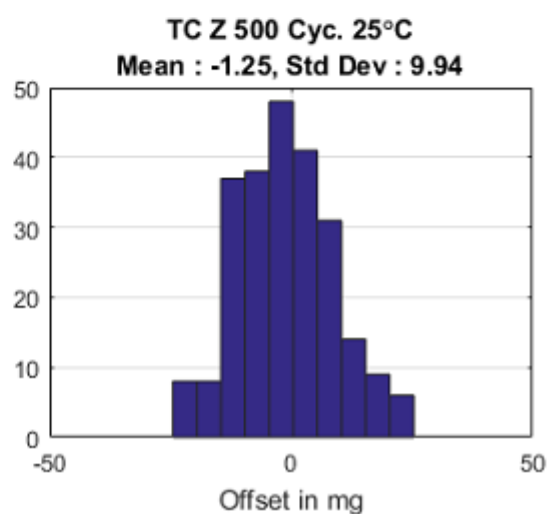
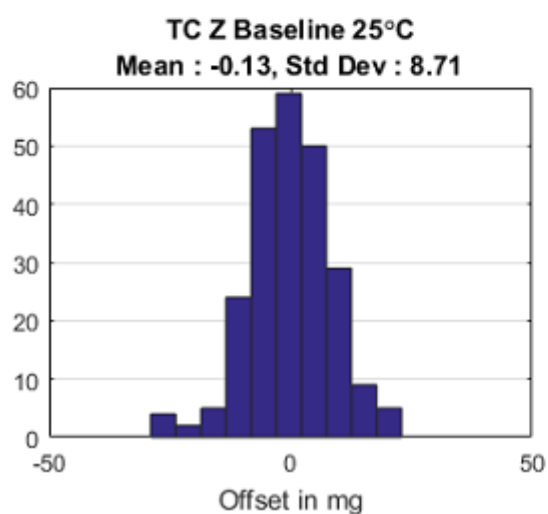
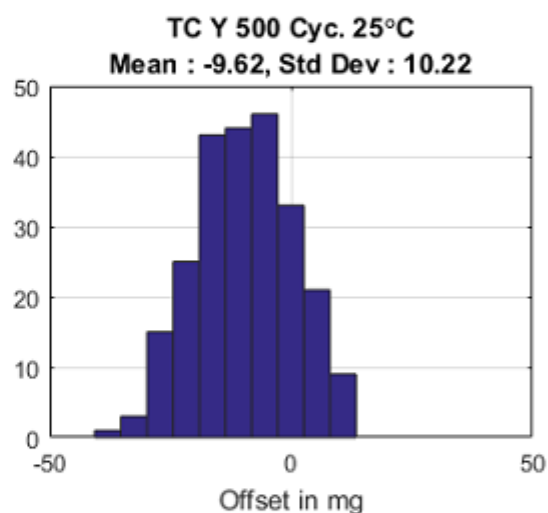
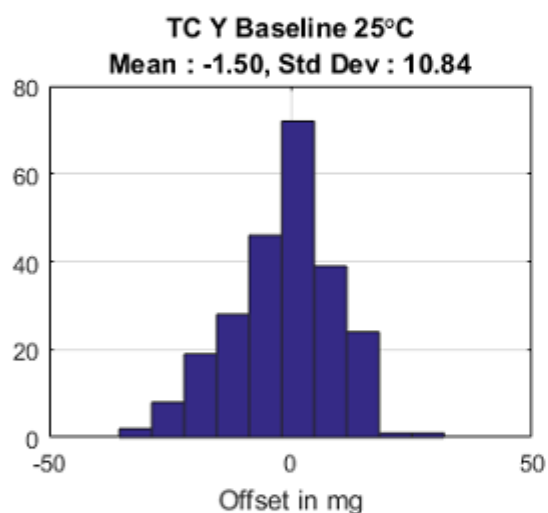
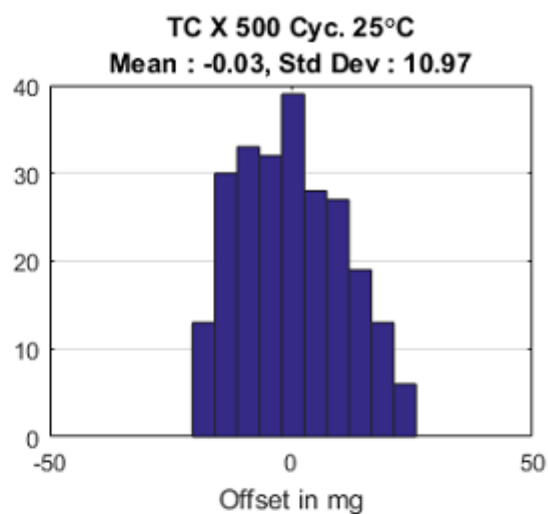
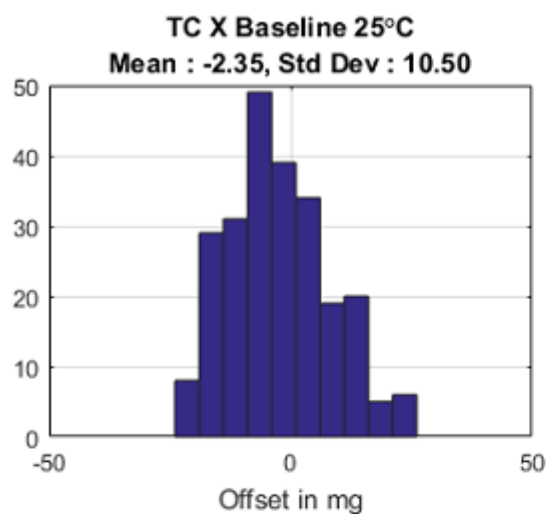
Stress	Test Method	Conditions	Read points	Min Sample Size	# of lots	Total	Results
PC	JA113	MSL = 1 Reflow temp = 260+5/-0 °C  Perform CSAM on 11 units before and after preconditioning.	Test @ RH (Room = 25 °C & Hot = 85 °C)	All			Pass
THB	JA101 JA110	Temperature = 85 °C Humidity = 85 % Bias = 3.6 V  CSAM on 11 units after THB	Test @ RH with stress read points at 1008 hours  Electrical testing must occur within 48 hours after stress readpoint	77	3	231	Pass
UHASt	JA102 JA118	Temperature = 130 °C Humidity = 85 %	Test @ RH with read points at 96 hours  Electrical testing must occur within 48 hours after stress read point	77	3	231	Pass
TC	JA104	Temperature = -40 °C to 125 °C  CSAM on 11 units after each temperature cycle read point	Test @ RH with read points at 850 cycles	77	3	231	Pass
HTSL	J103	Temperature = 125 °C	Test @ RH with read points at 1008 hours	77	3	231	Pass

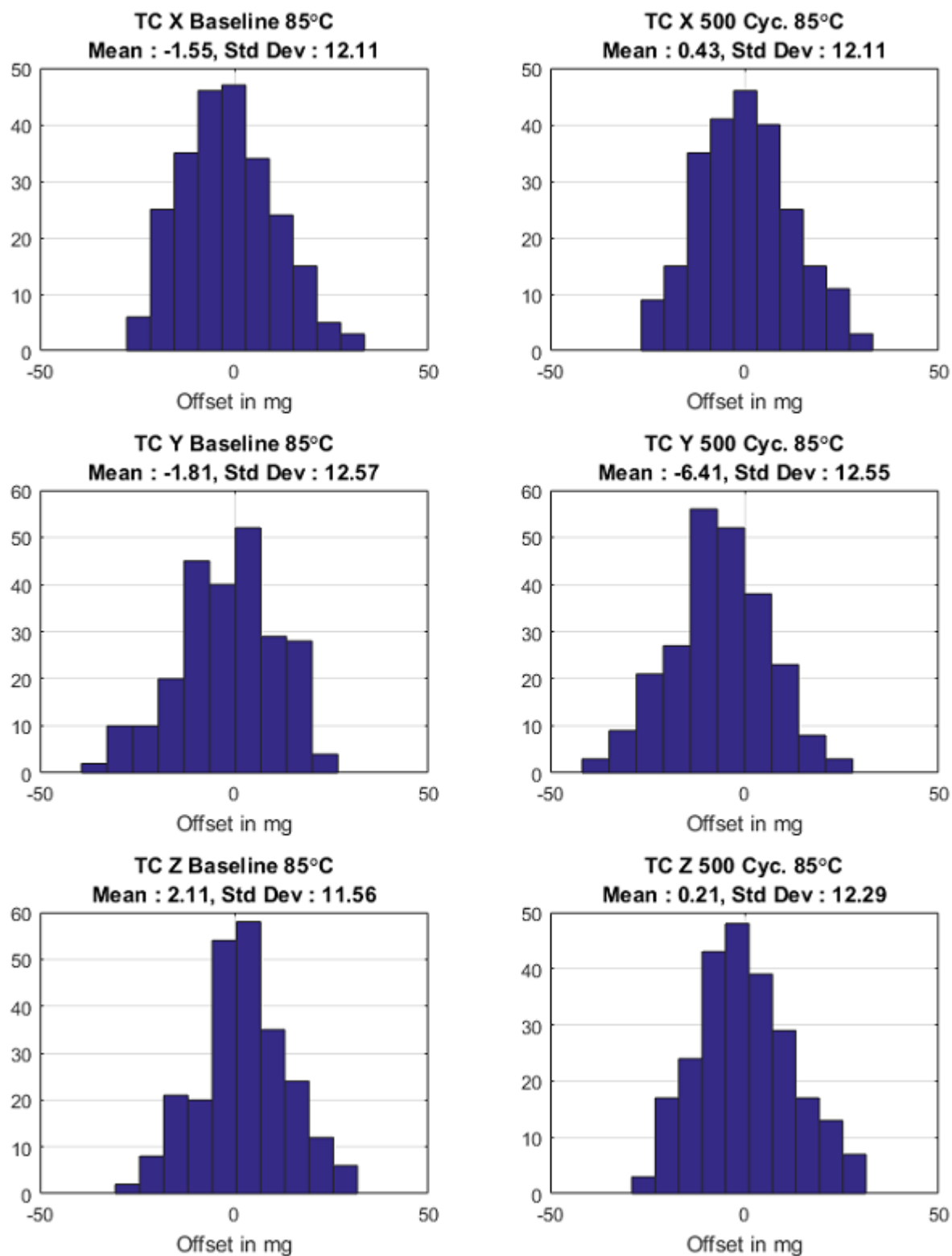




Data is based on MMA8451Q

Figure 1. THB results





Data is based on MMA8451Q

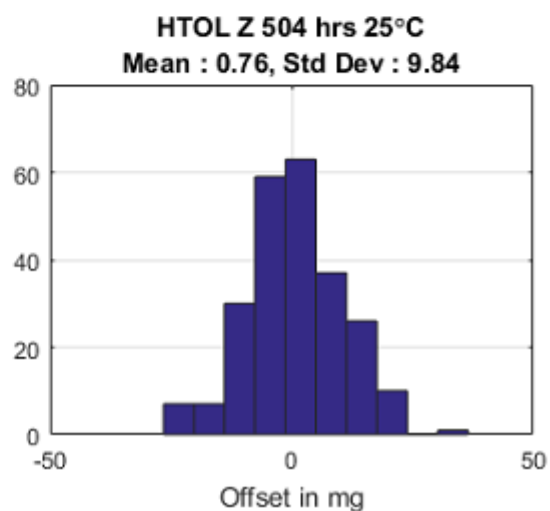
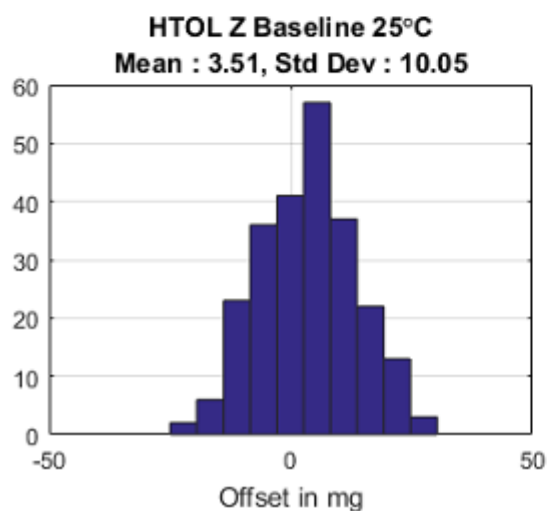
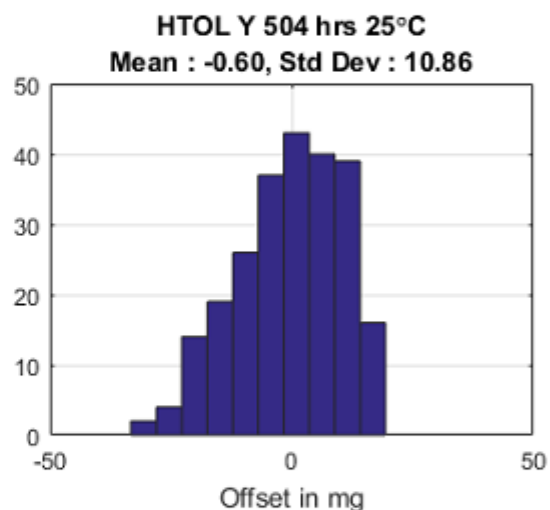
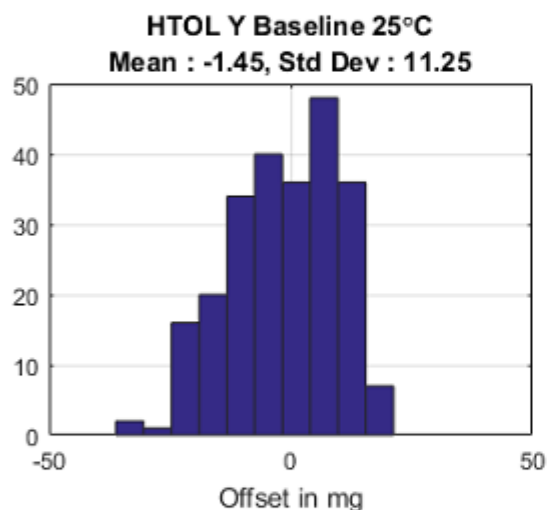
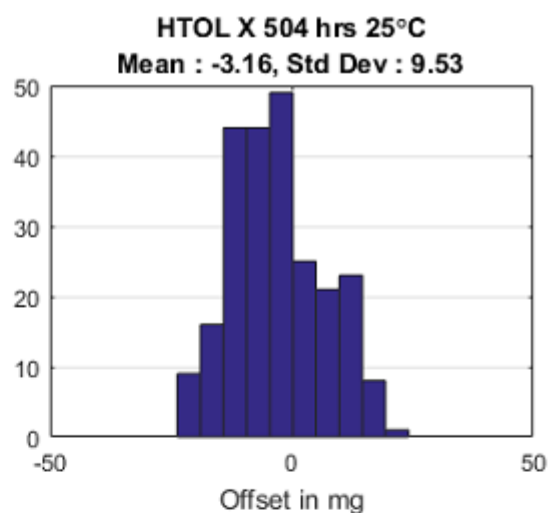
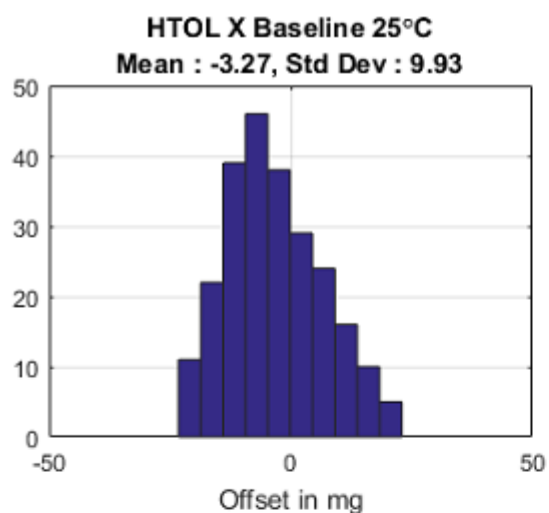
Figure 2. TC results

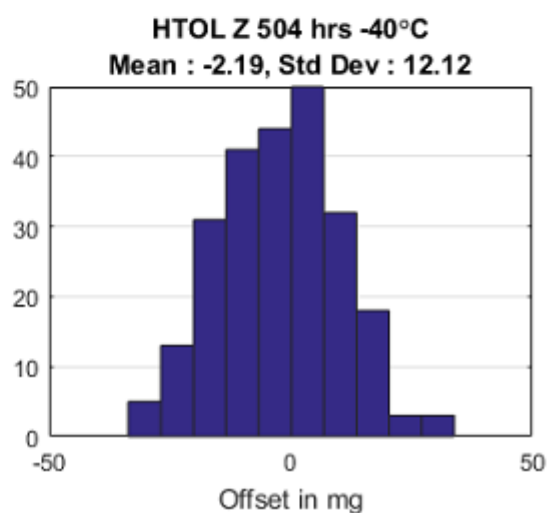
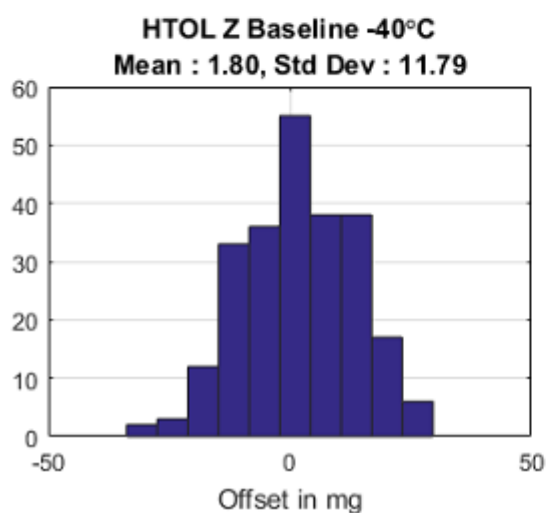
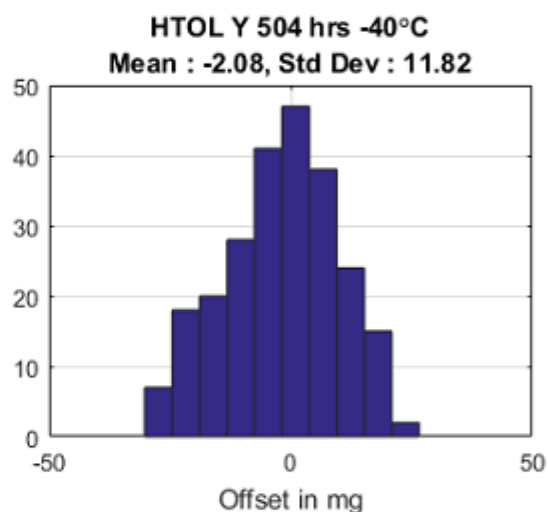
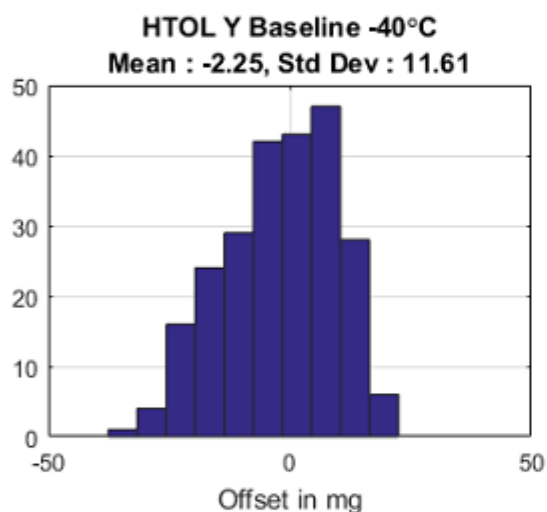
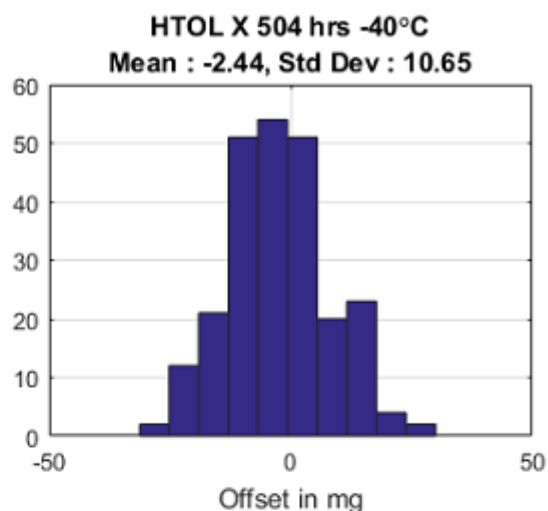
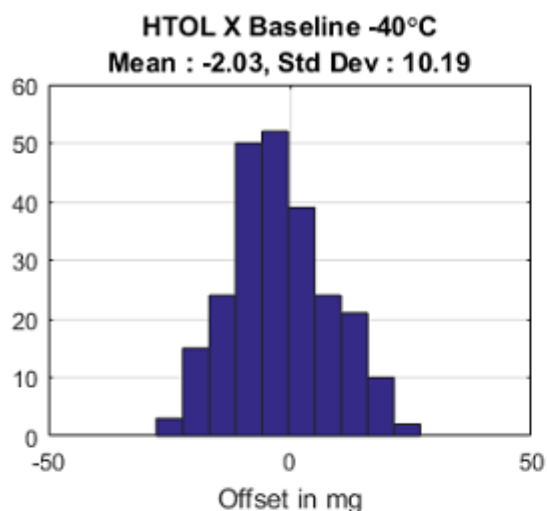


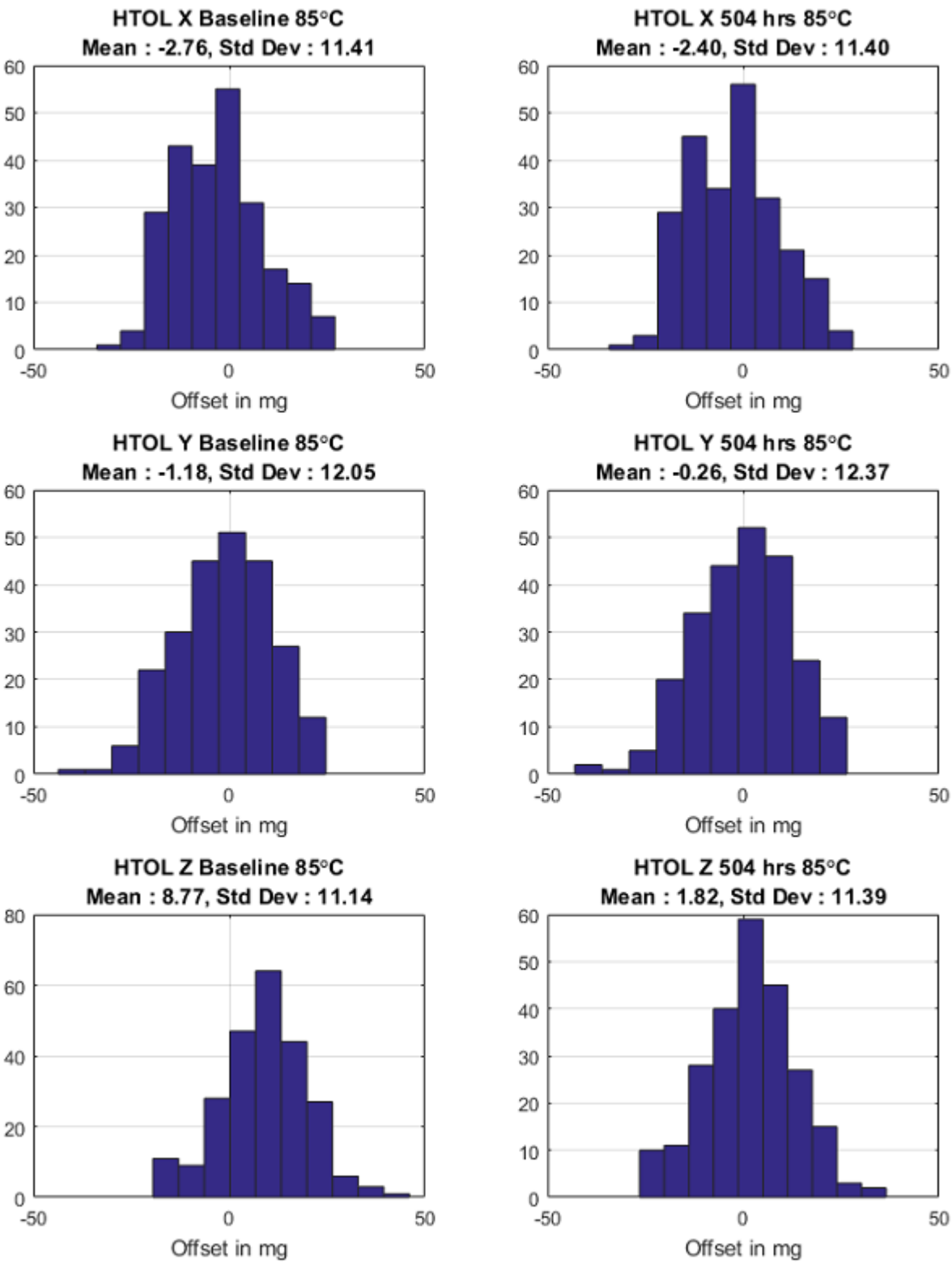
## 5 Accelerated lifetime simulation tests

**Table 6. Accelerated lifetime simulation tests**

Stress	Test Method	Conditions	Read points	Min Sample Size	# of lots	Total	Results
HTOL	JA108	Temperature = 125 °C Bias = 3.6 V	TEST @ RHC (Room = 25 °C Hot = 85 °C Cold = -40 °C) with read points at 1008 hours  Electrical testing must occur within 96 hours after stress read point	77	3	231	Pass
ELFR	JA108	Temperature = 125 °C Bias = 3.6 V	Test @ RH with read points at 48 hours	306	3	918	Pass







Data is based on MMA8451Q

Figure 3. HTOL results

## 6 Package assembly integrity tests

Table 7. Package assembly integrity tests

Stress	Test Method	Conditions	Read points	Min Sample Size	# of lots	Total	Results
WBS	AEC Q100-001	—	Cpk $\geq$ 1.67	30 bonds from minimum 5 units	3	15	Pass
WBP	M2011	Cond. C or D	Cpk $\geq$ 1.67	30 bonds from minimum 5 units	3	15	Pass
PD	JB100	Physical Dimensions – PD per 98A drawing	Cpk $\geq$ 1.67	10	3	30	Pass
SD	JB102	Solderability 8 hour Steam age (1 hour for Au-plated leads) prior to test on devices which have received Burn-in.	Greater than 95 % lead coverage of critical areas	15	1	15	Pass
DIMENSIONAL & BOM VERIFICATION	NXP Spec	1. PPE to verify PD against valid 98A drawing. 2. PPE to verify qual lot ERF BOM is accurate.	—	10	3	30	Pass

## 7 Cavity package integrity tests

Table 8. Cavity package integrity tests

Stress	Test Method	Conditions	Read points	Min Sample Size	# of lots	Total	Results
MS	JEDEC	5000 g, half sine at 0.05 ms in both directions of each axis - 5 pulses. Device is unpowered.	TEST @ R	39	3	117	Pass
DROP – 1.8 meters	NXP Spec	Drop Height = 1.8 Meters Surface = concrete, Orientation = random 10 drops	TEST @ R with read points after 10 drops	39	3	117	Pass
VFV	MilStd883-2007	Variable, 20 Hz to 40 Hz @ 20 g peak then 40 Hz to 2000 Hz @ 50 g peak; 4 cycles each axis, 4 minutes each cycle	TEST @ R	39	3	117	Pass
Solder joint reliability	AEC-100	Temp Cycle = -40°C to +125°C  Dwell ≥ 15 min Transfer ≤ 5 min or 200 cycles QP	Test @ RH 200 QP	77	3	231	Pass

## 8 Die fabrication reliability tests

**Table 9. Die fabrication reliability tests**

Stress	Test Method	Conditions	Read points	Min Sample Size	# of lots	Total	Results
EM	NXP spec	—	—	—	—	—	Pass
TDDB	NXP spec	—	—	—	—	—	Pass
HCI	NXP spec	—	—	—	—	—	Pass <sup>[1]</sup>

[1] Data provided by TSMC: TSMC 0.18 µm Mixed Signal Ultra-Low Leakage (ULL) with OTP 1P6M Salicide Al\_FSG 1.8 & 3.3 V

## 9 Electrical verification tests

**Table 10. Electrical verification tests**

Stress	Test Method	Conditions	Read points	Min Sample Size	# of lots	Total	Results
ESD (HBM)	JESD22	Voltage test levels at 500, 1000, 1500 and 2000 V 2500 V (FIO)	Test @ RH	3 units per voltage level	2	30	Pass <sup>[1]</sup>
ESD (MM)	JESD22	Voltage test levels at 50, 100, 150 and 200 V (QP). 300 V (FIO) FCDM can be used to replace MM.	Test @ RH	3 units per voltage level	2	30	Pass <sup>[2]</sup>
ESD (CDM)	JESD22	250 V / 500 V for qual 750 V / 1500 V (FIO)  Corner pins $\geq 750$ V All other pins $\geq 500$ V  Electrical testing must occur within 96 hours after stress read point	Test @ RH	3 units per voltage level	2	30	Pass <sup>[3]</sup>
LU	JESD22	Temperature = 85 °C	Test @ RH  I = $\pm 100$ mA	6	2	12	Pass
ED	AEC-Q100-009	—	Test @ RHC	30	3	90	Pass <sup>[4]</sup>
GL	AEC-Q100-006	Temperature = 155 °C Time = 4 min V = +400 V/-400 V  Electrical testing must occur within 96 hours after stress readpoint	Test @ R	6	2	12	Pass

[1] Passed 2500 V

[2] Passed 300 V

[3] Passed 1500 V

[4] Qual Acceptance criteria : Cpk  $\geq 1.33$



## 10 Revision history

Table 11. Revision history

Document ID	Release date	Supersedes
MMA8452QQR01 v.1.1	20160505	MMA8452QQR01 v.1.0
Modifications:	<ul style="list-style-type: none"><li>• The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate.</li><li>• Addition of <a href="#">Figure 1</a>.</li><li>• Addition of <a href="#">Figure 2</a>.</li><li>• Addition of <a href="#">Figure 3</a>.</li></ul>	
MMA8452QQR01 v.1.0	20151206	—

## 11 Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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