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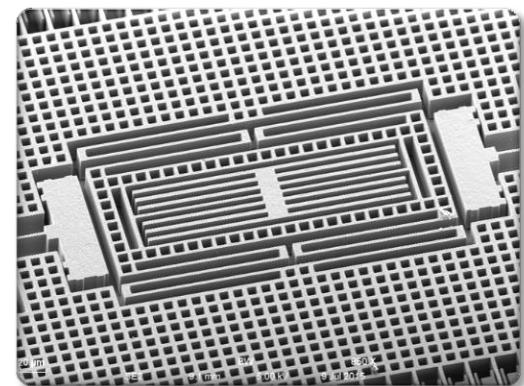
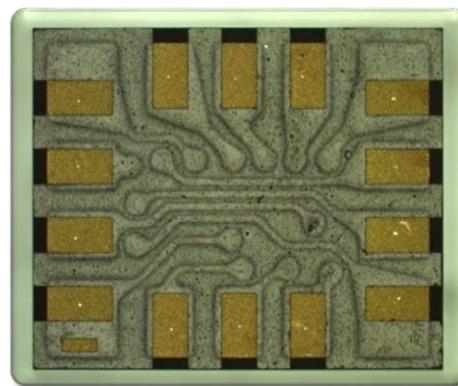
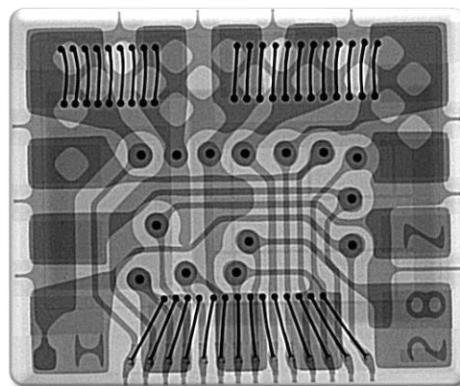


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# BMI160

## Small , Low Power Inertial Measurement Unit



## Product Analysis Report

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To Know



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MEMS Die Plan View  
Analysis****Accelerometer  
MEMS Die Cross Section  
Analysis****Gyroscope  
MEMS Die Plan View  
Analysis****Gyroscope  
MEMS Die Cross Section  
Analysis****Major Findings**

<b>Part Number</b>	<b>BMI160</b>		
<b>Manufacturer</b>	BOSCH		
<b>Description</b>	Small , Low Power Inertial Measurement Unit		
<b>Package Type</b>	LGA-14		
<b>Package Mark</b>	DFP TS		
<b>Package Size</b>	3. mm X 2.56 mm X 0.83 mm		
<b>MEMS</b>	<b>Inertia</b>		
	<b>Accelerometer &amp; Gyroscope A &amp; V Die</b>	<b>Accelerometer MEMS</b>	<b>Gyroscope MEMS</b>
<b>Die Mark</b>	BAI160C (logo) BOSCH ©2014	CMA334M BOSCH(logo)	(logo)CMG 230M
<b>Die Size</b>	2.71 mm X 1.81 mm	0.86 mm X 1.39 mm	1.71 mm X 1.66 mm
<b>Die Thickness</b>	67.3 um	398.88 um	398.88 um
<b>Process</b>	M1P_AL_CMOS_0.18 um	Surface Silicon Process	Surface Silicon Process

**SITRI Sample Report**

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
AnalysisAccelerometer  
MEMS Die Cross Section  
AnalysisGyroscope  
MEMS Die Plan View  
AnalysisGyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

Package Type	LGA -14
Package Mark	DFP TS
Package Size	3.00 mm X 2.50 mm X 0.80 mm
Pin Size	0.25 mm X 0.47 mm
Pin Pitch	0.50 mm

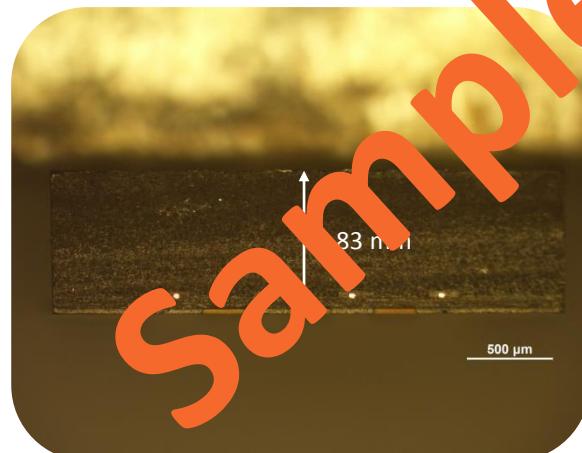


Figure 1.1.3 Package Side View



Figure 1.1.1 Package Top View

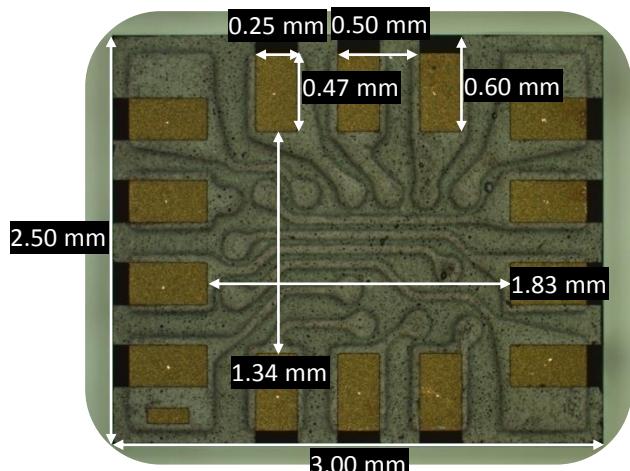


Figure 1.1.2 Package Bottom View

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
AnalysisAccelerometer  
MEMS Die Cross Section  
AnalysisGyroscope  
MEMS Die Plan View  
AnalysisGyroscope  
MEMS Die Cross Section  
Analysis

Major Findings



Figure 1.2.3 Package X-ray End View

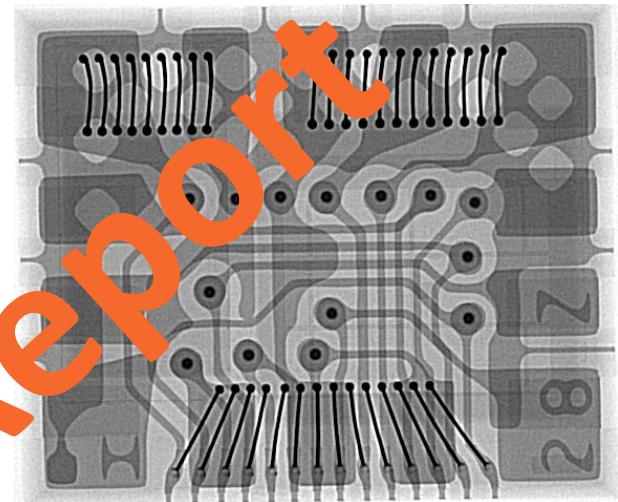


Figure 1.2.1 Package X-ray Top View



Figure 1.2.2 Package X-ray Side View

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

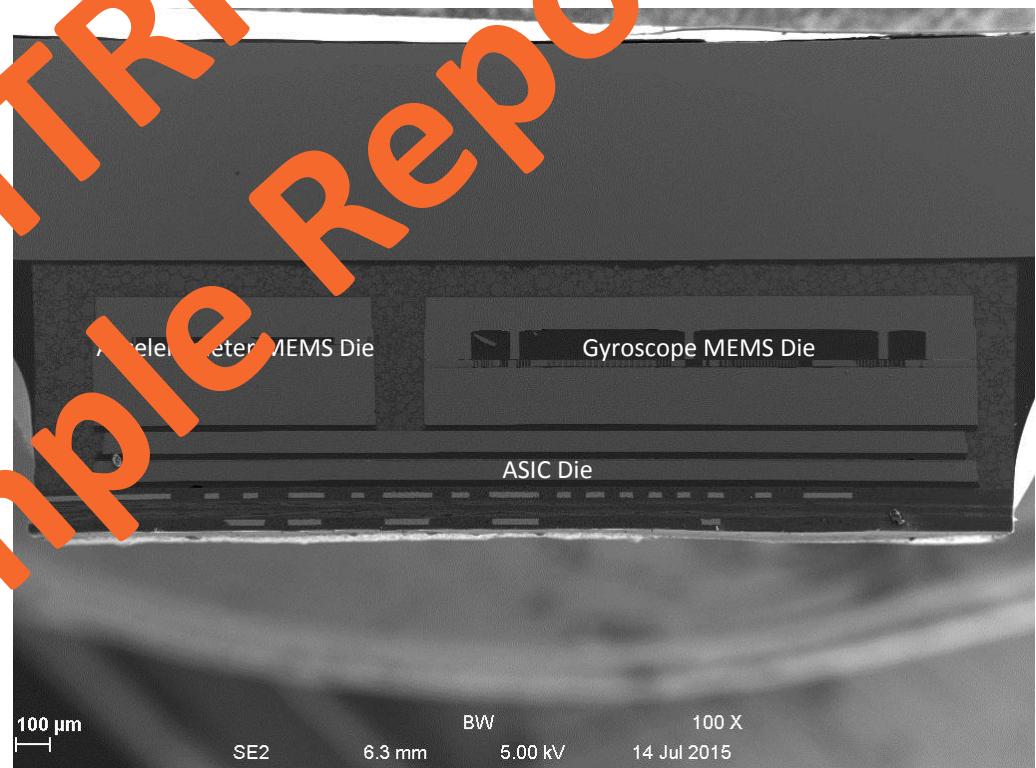
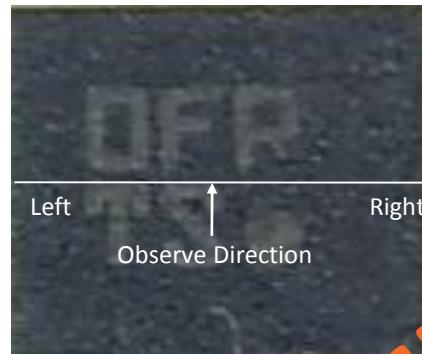


Figure 1.3.1 Cross Section of Package

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings



Figure 1.3.8 Cross Section of Accelerometer MEMS Die Al-Ge Bonding

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
AnalysisAccelerometer  
MEMS Die Cross Section  
AnalysisGyroscope  
MEMS Die Plan View  
AnalysisGyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

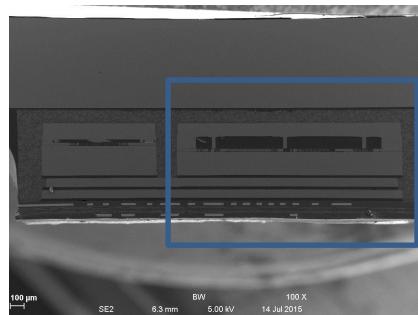


Figure 1.3.9 Cross Section of Package with Dimension, Gyroscope

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

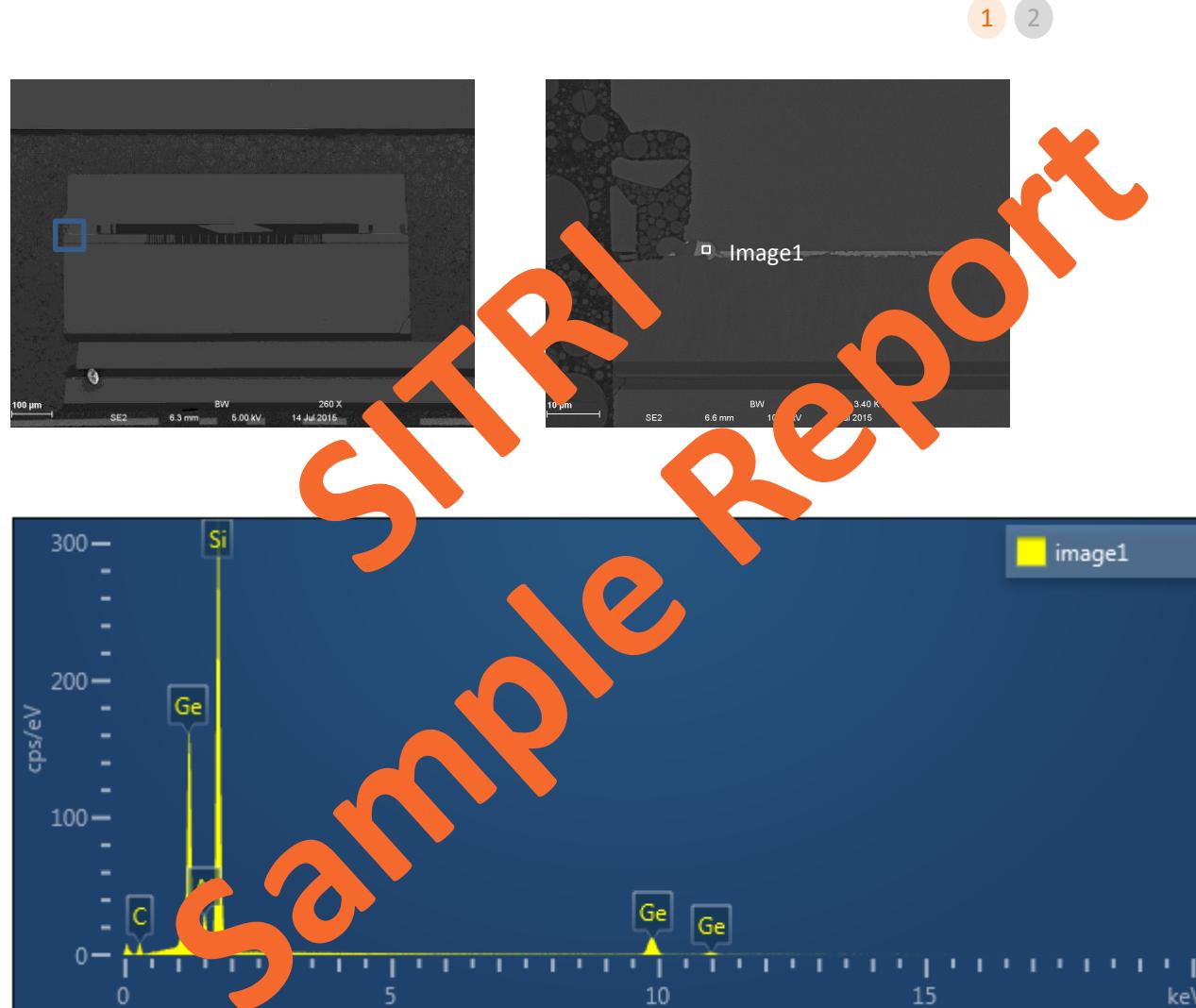


Figure 1.4.1 EDS Analysis of Al-Ge Bonding in Accelerometer MEMS Die

Device Summary

Package Analysis

### Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

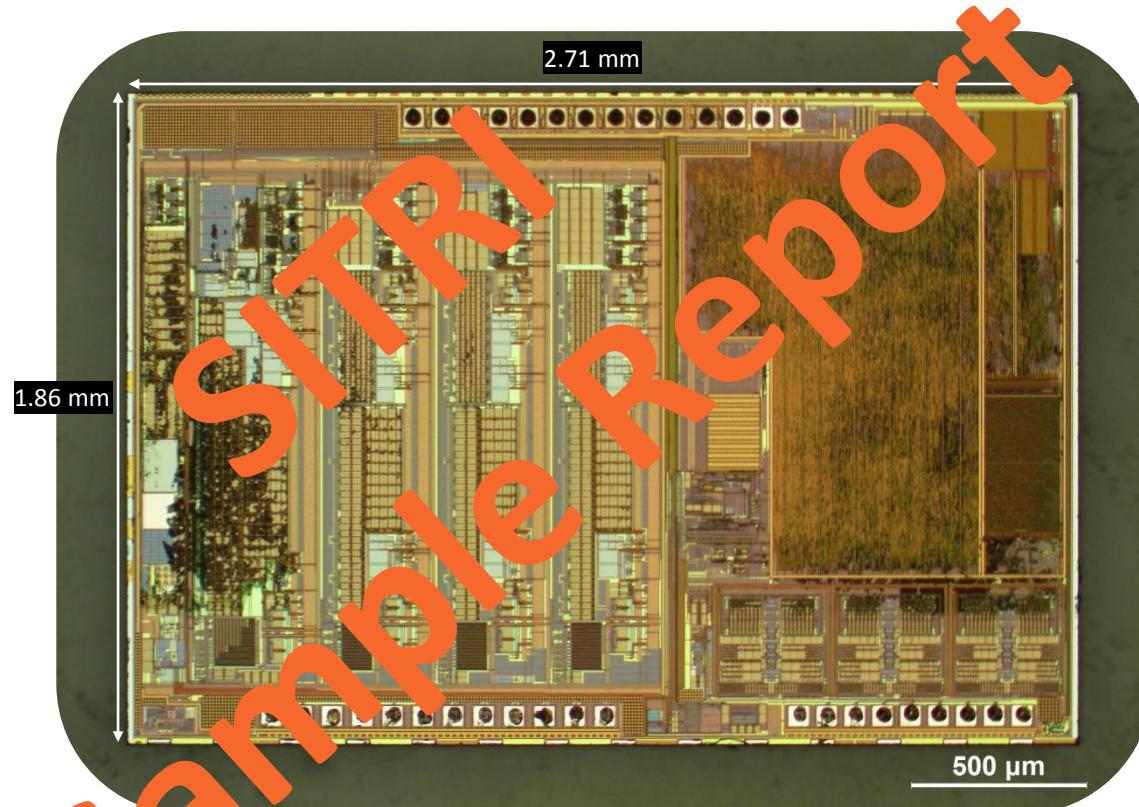


Figure 2.1.1 ASIC Die Photo

Device Summary

Package Analysis

**Die Information**Accelerometer  
MEMS Die Plan View  
AnalysisAccelerometer  
MEMS Die Cross Section  
AnalysisGyroscope  
MEMS Die Plan View  
AnalysisGyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

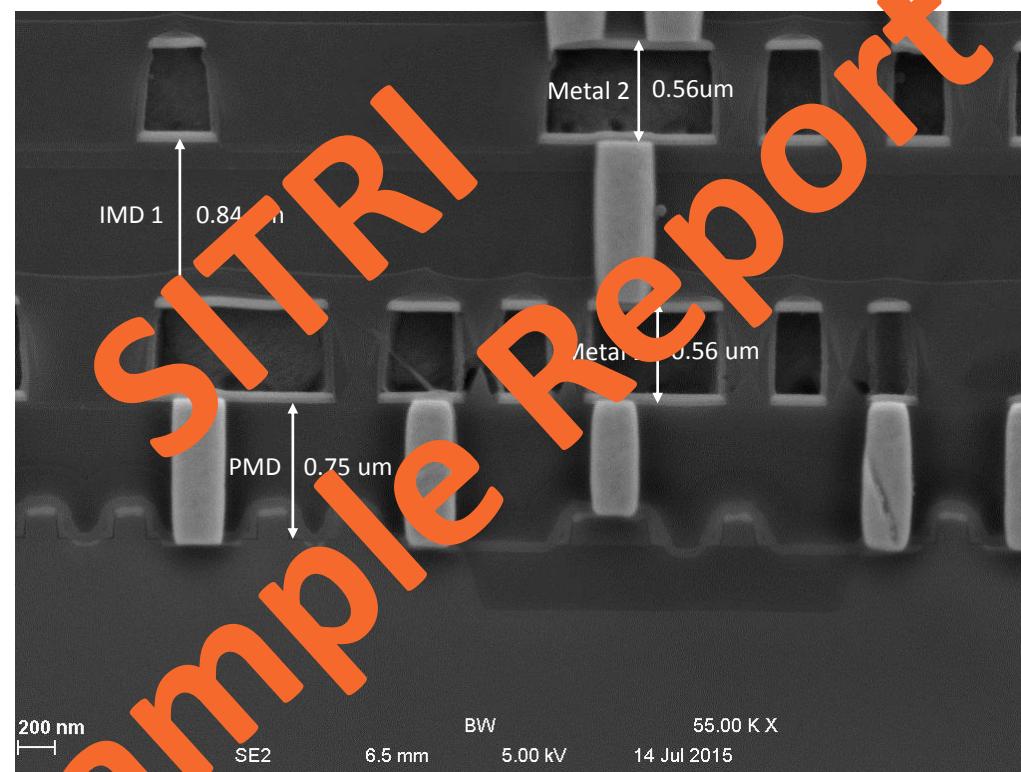


Figure2.1.8 ASIC Die Metal 2 to Metal 1

Device Summary

Package Analysis

## Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

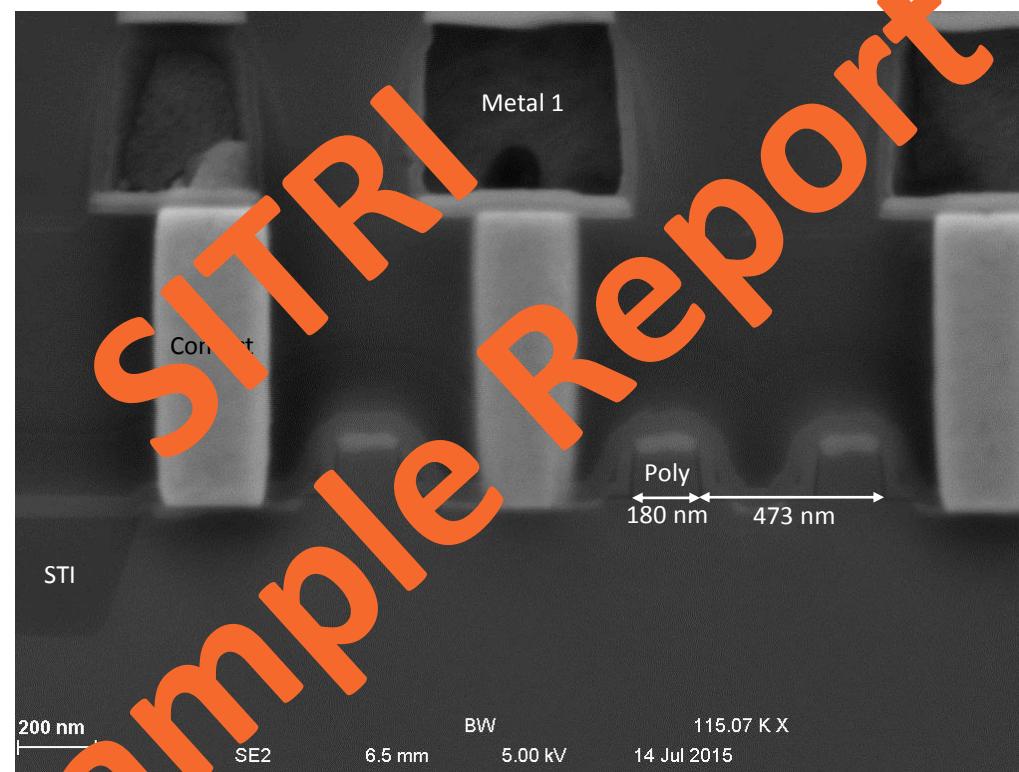


Figure2.1.9 ASIC Die Logic Gate Length

## ASIC Die

## Accelerometer MEMS Die

## Gyroscope MEMS Die

1 2 3 4

Device Summary

Package Analysis

## Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

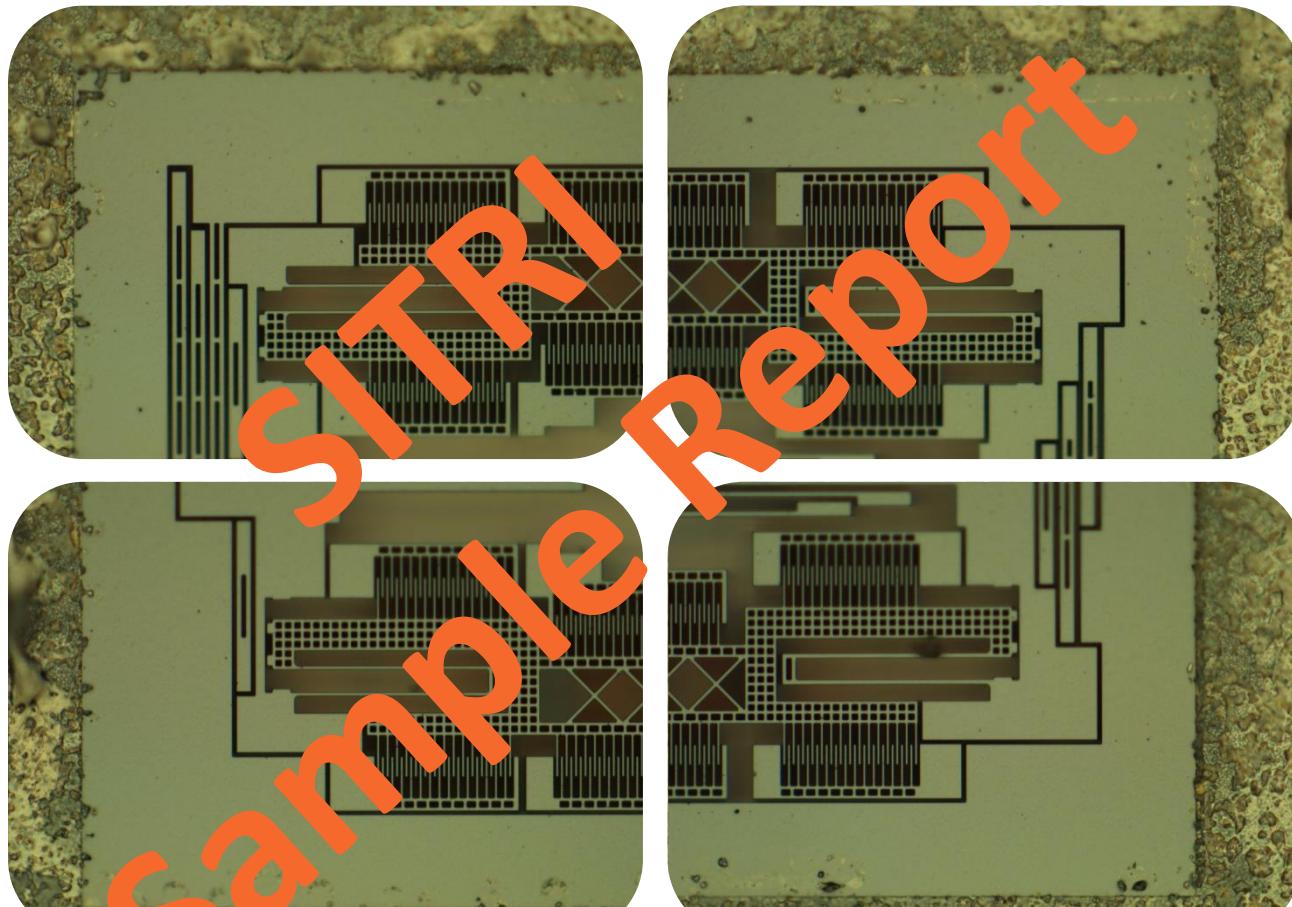


Figure 2.3.3 Gyroscope MEMS Die Corner

OM

SEM

1 2 3 4 5 6 7 8 9 10 11 12

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

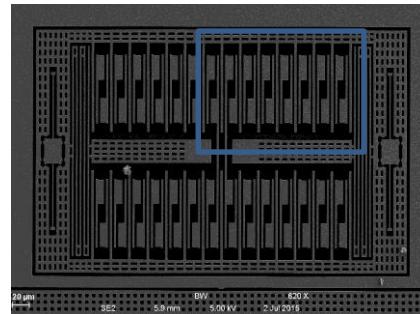


Figure3.2.3 Accelerometer MEMS Die SEM Plan View Image, Plates in X-axis

OM

SEM

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

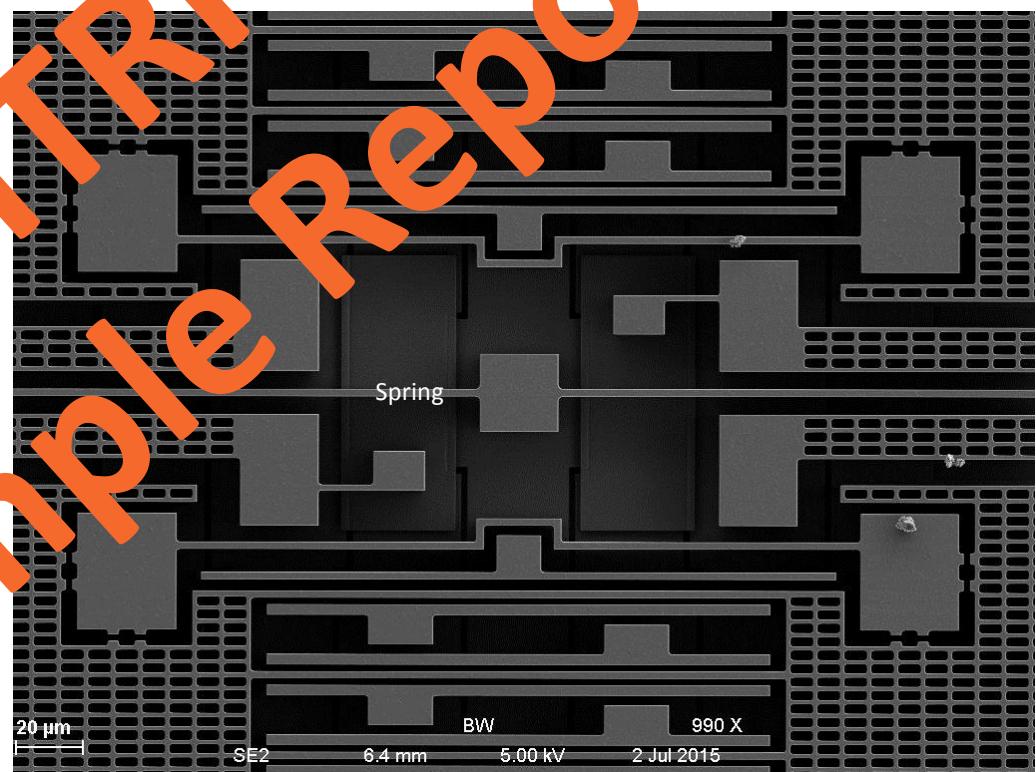
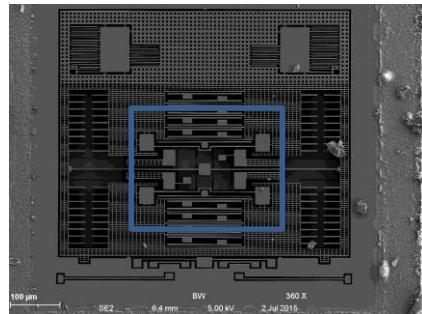


Figure3.2.8 Accelerometer MEMS Die SEM Plan View Image, Spring in Y-axis

1 2 3 4 5 6 7 8 9 10 11 12

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

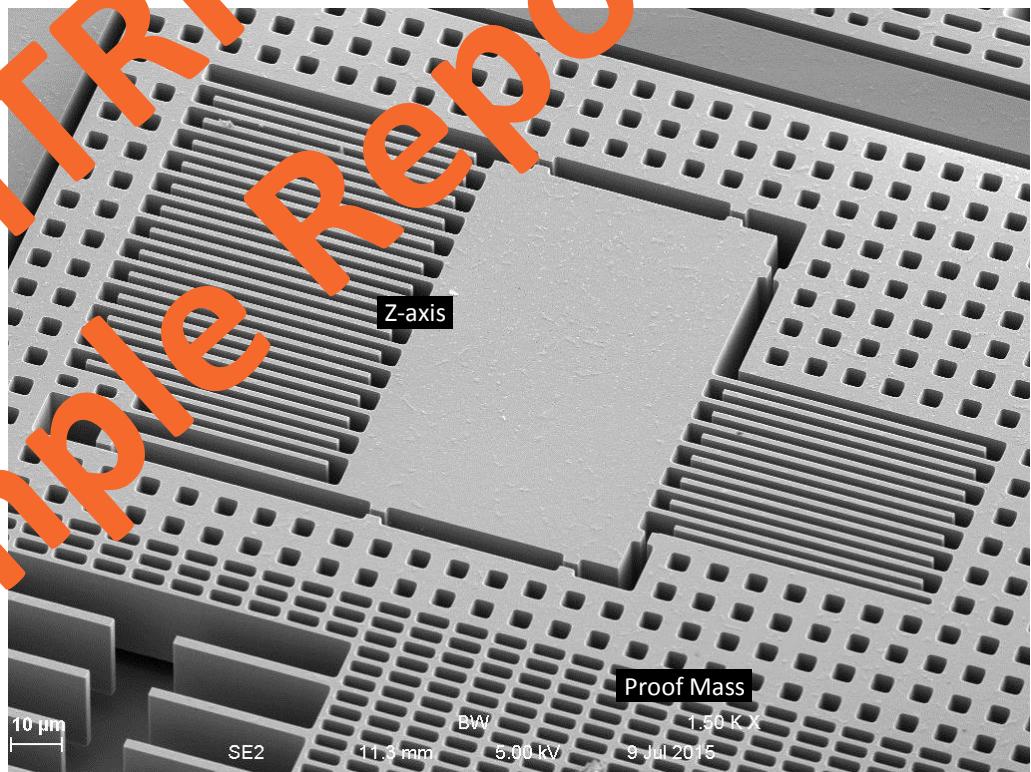
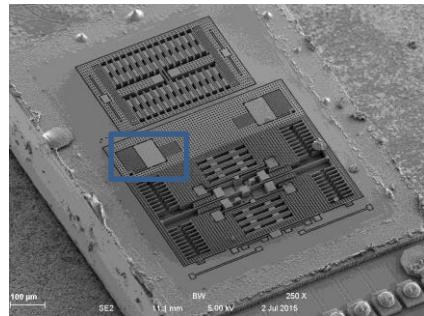


Figure3.2.12 Accelerometer MEMS Die SEM Angle View Image, Z-axis

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

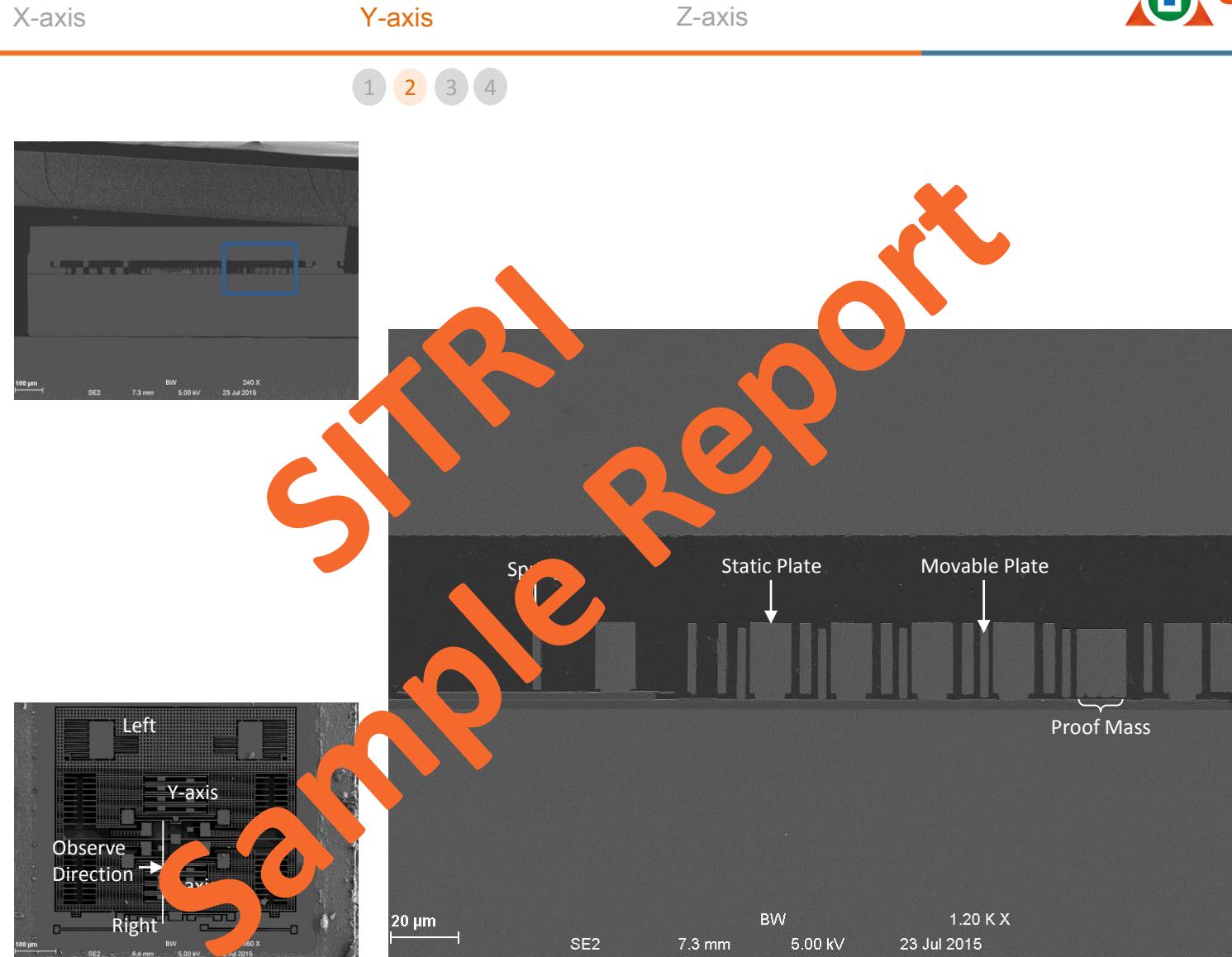


Figure4.2.2 Accelerometer MEMS Cross Section SEM Image with Description, Y-axis

X-axis

Y-axis

Z-axis

1 2 3 4 5 6 7 8

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

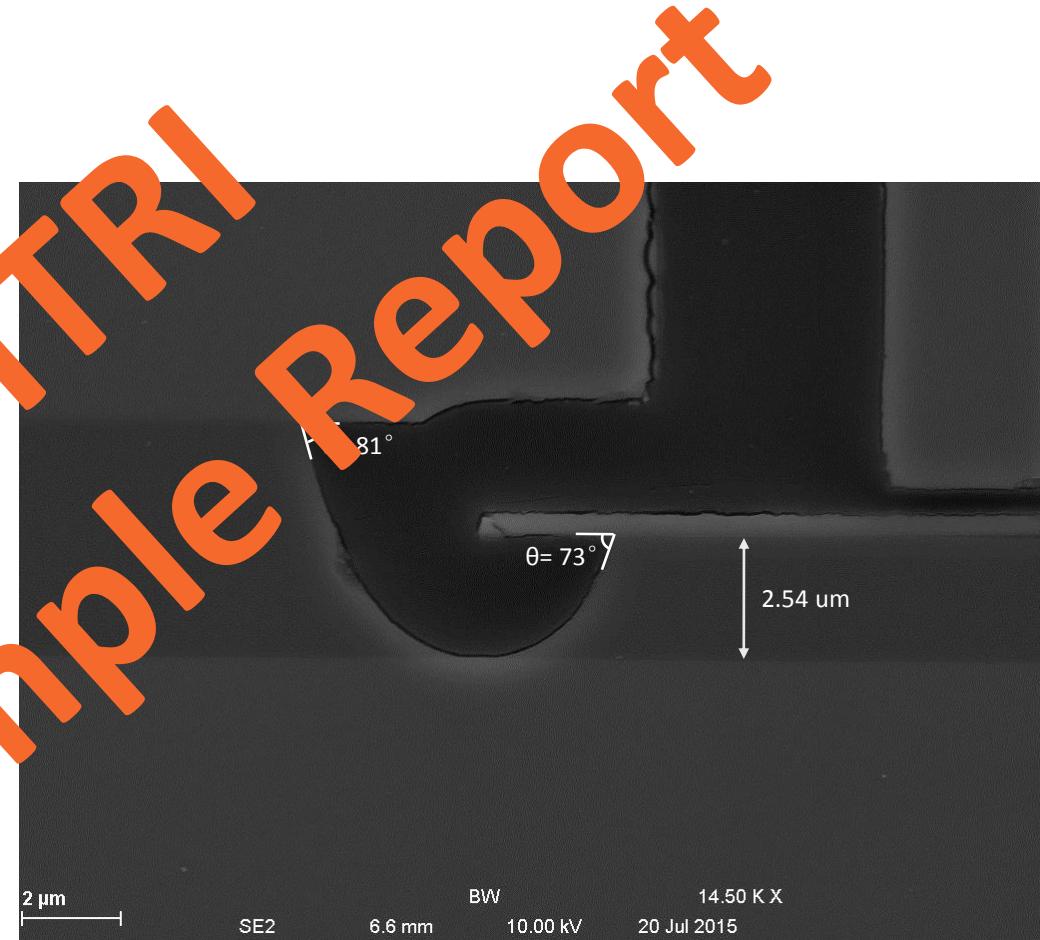
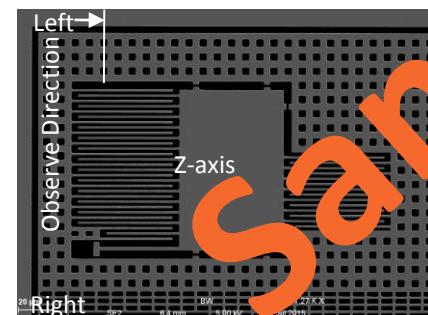
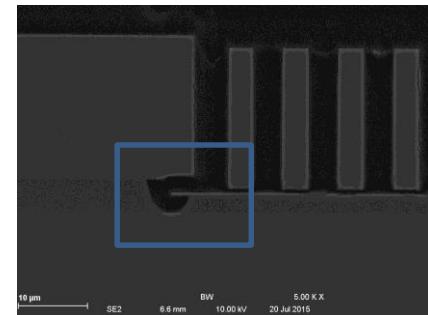


Figure4.3.5 Accelerometer MEMS Cross Section SEM Image with Dimensions, Z-axis

OM

SEM

[1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [11](#) [12](#) [13](#) [14](#)

Device Summary

Package Analysis

Die Information

Accelerometer  
MEMS Die Plan View  
Analysis

Accelerometer  
MEMS Die Cross Section  
Analysis

Gyroscope  
MEMS Die Plan View  
Analysis

Gyroscope  
MEMS Die Cross Section  
Analysis

Major Findings

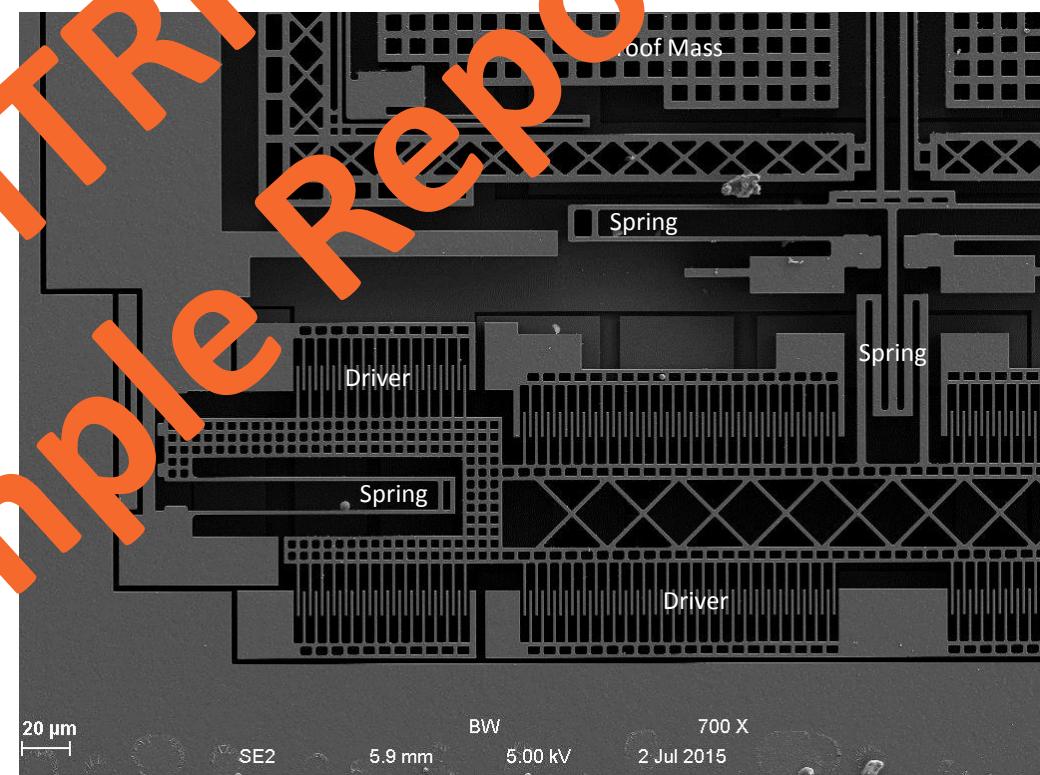
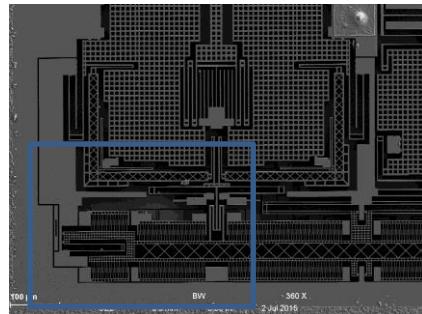


Figure5.2.4 Gyroscope SEM Plan View Image, Y-axis

## Ineria Process Flow

## Major Finding Points

1 2 3



## Ineria Process Flow

## Major Finding Points

Device Summary

- The BMI160 is an inertial measurement unit (IMU) consisting of a state-of-the-art 3-axis, low-g accelerometer and a low power 3-axis gyroscope. It has been designed for low power, high precision 6-axis and 9-axis applications in mobile phones, tablets, wearable devices, remote controls, game controllers, head-mounted devices and toys.

Package Analysis

- The BMI160 is available in a compact 16 pin 0.50 x 0.83 mm<sup>3</sup> LGA package.

Die Information

- The die size of accelerometer and gyroscope ASIC is 2.71 mm x 1.86 mm and the die thickness is 67.45 um.

Accelerometer  
MEMS Die Plan View  
Analysis

- The die size of accelerometer MEMS is 0.86 mm x 1.39 mm and the die thickness is 398.88 um.

Accelerometer  
MEMS Die Cross Section  
Analysis

- The die size of gyroscope MEMS is 1.71 mm x 1.66 mm and die thickness is 398.88 um.

Gyroscope  
MEMS Die Plan View  
Analysis

- The isolation process of accelerometer and gyroscope ASIC die is regular STI(shallow trench isolation). The technology node is 0.18um. The accelerometer and gyroscope ASIC die is manufactured in aluminum planarization process with 4 metal layers.

Gyroscope  
MEMS Die Cross Section  
Analysis

- The accelerometer MEMS die and gyroscope MEMS die is manufactured in surface silicon process. The height of polysilicon2 in

accelerometer MEMS die is 20.80 um. The height of polysilicon2 in gyroscope MEMS die is 20.65 um.

- The accelerometer MEMS die and the gyroscope MEMS die use Al-Ge bonding process.

## Major Findings