Sub-track I – Smart Mobility Presentation
Automotive MEMS sensors for a broad range of automotive applications

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Smart sensors making our world a better place

**Offline Era**

- **2000**: A paradigm change in the man-machine interface
  - MEMS technology: from a concept to a product.

**Online Era**

- **2010**: Sensor proliferation and connections to the Cloud
  - Performance improvement and technology fusion.

**Onlife Era**

- **2020**: The fusion of technology and life
  - MEMS sensors able to sense, process, and act.

**Sustainable Onlife**

- **2020**: Sustainable sensorization of the world
  - MEMS sensors sending only the meaningful data to the cloud
In 2020 approximately three billion tons of CO$_2$ of global emissions are generated by passenger cars.

Combustion engines need to be abandoned.

Politics and regulations to support the migration to electricity.

Cars will be increasingly automated and autonomous.

Source: IEA
The automotive path to the Net Zero Emission target

ICE sales no longer allowed starting from 2035 (target)
In 2050, more than 70% of vehicles are highly automated

Source: IEA
Autonomous transportation is energy-intensive

- Sensors’ accuracy and safety standard compliancy (ISO 26262)
- Artificial intelligence to implement complex processing
- Huge amounts of data exchanges to implement vision and localization processing
Why ST MEMS sensors?

- **Smart**: Sensors able to process data
- **Safe**: Sensors configured to your needs
- **Accurate**: Sensors providing correct data sets

Pre-processed, reliable, and accurate data are key resources for self-driving cars.

- Human centered
- Sustainable
Cars must be capable of taking actions and therefore must be increasingly equipped with AI.

Human centricity is achieved if vehicles are capable of imitating human brains.

Hard-wired AI implementation with optimized power budgets contributes to sustainability goal.
Artificial intelligence techniques can be used to prevent theft or vandalism when a car is parked. They can also predict a car’s status and whereabouts, if it has been towed or stolen.
AI monitoring your car integrity

Somebody hits your care while parked at supermarket
You parked in a no-parking zone

Car is going to be towed while enjoining a dinner with friends
AVs need more and more electronics to be compliant with the highest safety standards

Human centricity is achieved when the car takes care of passenger safety

Embedded circuits implementing hard-wired FuSa contribute to overall power efficiency
Accurate precise positioning

IMU
Accelerometer to calculate velocity
Gyroscope to calculate rotation
ASIL – B compliance

Product available
Camera images can be affected by inclination and vibration, due to steering and road noise. IMU can compensate for any unwanted motion affecting the camera module while driving. Likely ASIL - B
Next-generation smart inertial sensors are based on functional safety ASIL-D and embedded AI.
Accurate sensing enables highly complex algorithms, which are essential for AVs.

Human centricity is achieved if a vehicle is capable of imitating human senses.

Accuracy allows energy savings, and reduces the factory calibration resources and time required.
Telematics and infotainment - navigation

IMU
Accelerometer to calculate velocity
Gyroscope to calculate rotation for vehicle navigation systems

Product available
Automotive MEMS sensors roadmap
## 6-axis automotive IMU portfolio

**A diversified offer to meet any customer need**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Dimensions</th>
<th>Features</th>
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</thead>
</table>
| ASM330LHH   | Auto NON-SAFETY 6-axis IMU                                                 | 2.5 x 3 x 0.86 mm | • Extended temp. range: -40 °C to 105 °C  
• High stability                                           |
| ASM330LHHX  | Auto NON-SAFETY 6-axis IMU with LPM & Machine Learning Core                | 2.5 x 3 x 0.86 mm | • Extended temp. range: -40 °C to 105 °C  
• Low power mode:  
  • Accelerometer 32 µA (typ)  
  • Combo 520 µA (typ)  
  • Embedded FSM and MLC |
| ASM330LHB   | 6-axis IMU + SW solution for ASIL-B systems                               | 2.5 x 3 x 0.86 mm | • Extended temp. range: -40 °C to 105 °C  
• Low power mode:  
  • Accelerometer 32 µA (typ)  
  • Combo 520 µA (typ)  
  • Embedded FSM and MLC  
  • Offered with specific library to be compatible for ASIL-B systems |
| ASM330LHBG1 | 6-axis IMU + SW solution for ASIL-B systems                               | 2.5 x 3 x 0.86 mm | • Extended temp. range: -40 °C to 125 °C  
• Low power mode:  
  • Accelerometer 32 µA (typ)  
  • Combo 520 µA (typ)  
  • Embedded FSM and MLC  
  • Offered with specific library to be compatible for ASIL-B systems |

**AEC-Q100 Grade 2**  
- With low power mode  
- With MLC and FSM  
- With ASIL-B library

**AEC-Q100 Grade 2**  
- With low power mode  
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**AEC-Q100 Grade 2**  
- With low power mode  
- With MLC and FSM  
- With ASIL-B library

**AEC-Q100 Grade 1**  
- With low power mode  
- With MLC and FSM  
- With ASIL-B library
# 3-axis accelerometers for smart driving

## Navigation / TBOX / Antitheft / eCall

<table>
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<tr>
<th>Device</th>
<th>Description</th>
<th>Specifications</th>
</tr>
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</table>
| AIS328DQ | Ideal for Navigation and Anti-theft | • 3 axis digital  
• Extended Top: -40°C to +105°C  
• QFN Package |
| AIS3624DQ | Specific for e-Call | • 3 axis digital  
• Mid-g range axial: FS: up to 24 g  
• Extended Top: -40°C to +105°C  
• QFN Package |
| AIS21H | High performance & versatility: Ultra low power & high resolution / high performance modes | • FS: ±2g / ±4g / ±8g / ±16g  
• ODR 1.6 Hz to 1.6 kHz  
• Extended Top: -40°C to +115°C  
• LGA package with wettable flanks |

## Passive Keyless Entry (PKE)

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</table>
| AIS2DW12 | Ultra low power 3-axis digital accelerometer | • Cur Cons: 0.67 µA @3 V @1.6Hz  
• FS: ±2g / ±4g  
• ODR 1.6 Hz to 100 Hz  
• LGA package |

## Road Noise Cancelling

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</tr>
</thead>
</table>
| AIS25BA | Audio accelerometer | • High and flat bandwidth (min 2 kHz)  
• Low noise (< 2.4 mg RMS)  
• FS ±4g / ±8g  
• TDM Time-Division Multiplexing interface |
Conclusion
Takeaways

The right path is by no means obvious

Smart sensors make our world a better place

Smart  Safe  Accurate
Our technology starts with You

Find out more at www.st.com/MEMS