



英飞凌 MEMS Sensor 让智能汽车更美好

Cici Cao

英飞凌科技 大中华区汽车事业部



Agenda

- 1 **Overview of Infineon MEMS Sensor**
- 2 TPMS assisted intelligent tires
- 3 MEMS sensors in intelligent cabin
- 4 Automotive grade Silicon microphone
- 5 MEMS sensors in BMS

公司概况

增长领域



能源
高效绿色



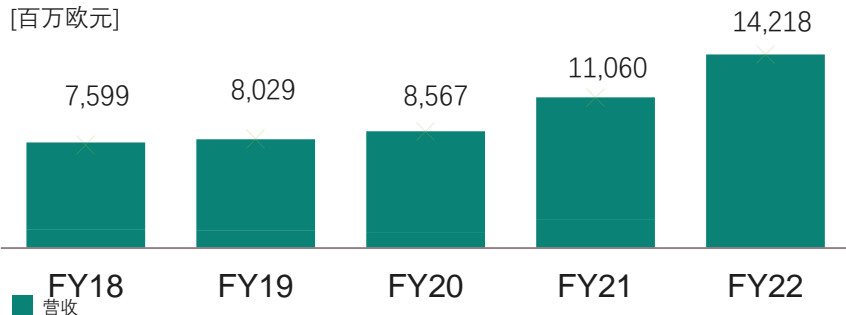
出行
安全清洁



物联网
安全智能

财务数据

[百万欧元]



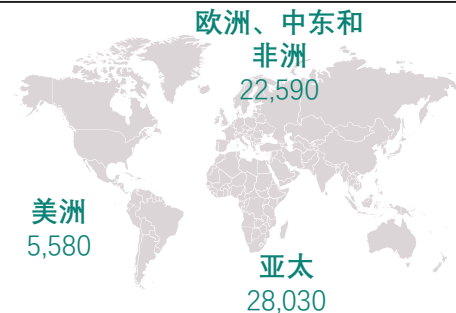
¹ 截至2022年9月30日 | ² 2022财年 (截至2022年9月30日)

员工¹

56,200
全球员工

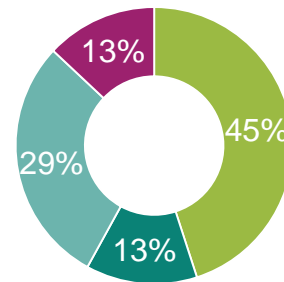
59
研发机构

19
生产工厂¹



各业务部营收²

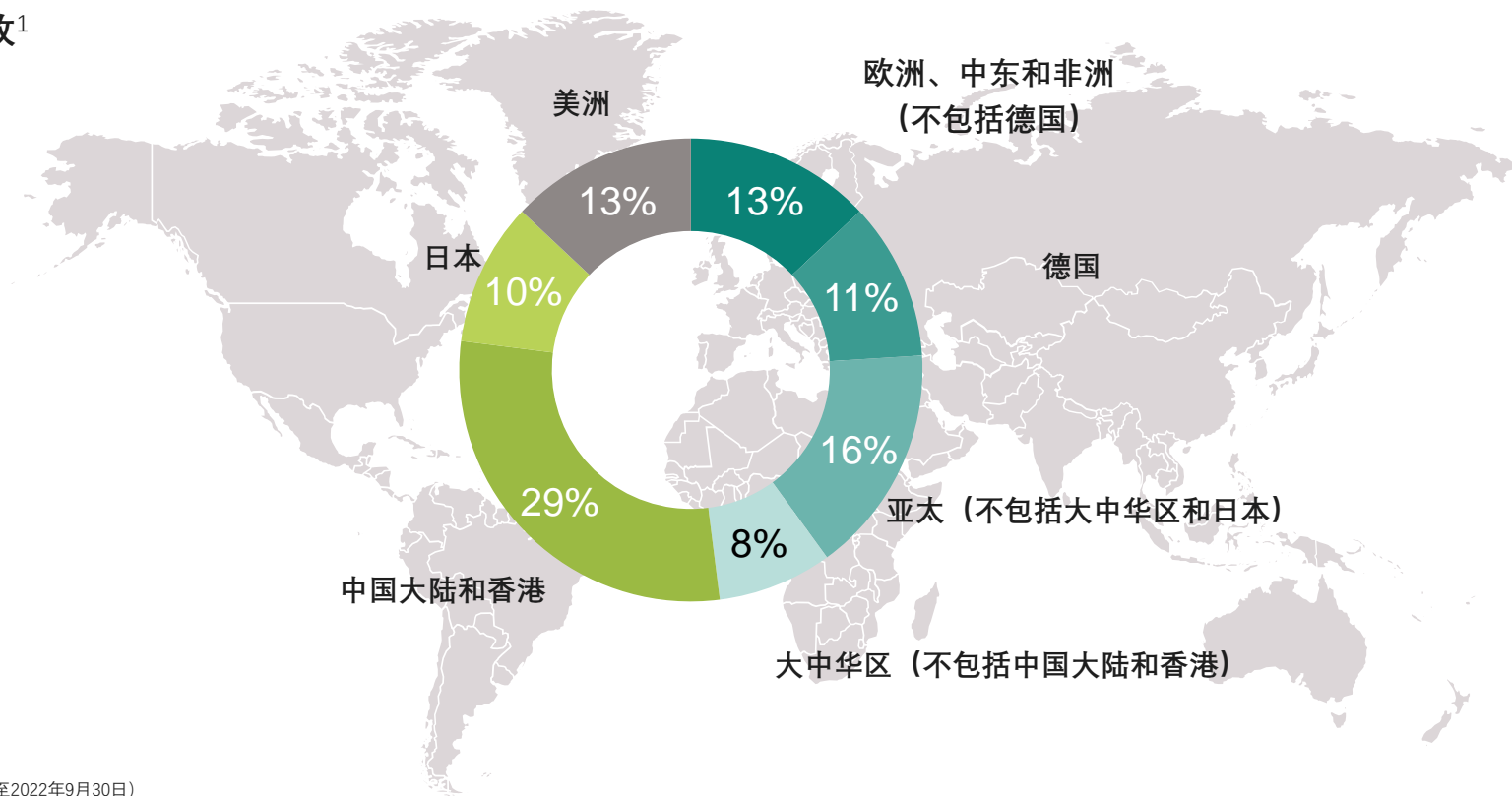
- 汽车电子 (ATV)
- 零碳工业功率 (GIP)
- 电源与传感系统 (PSS)
- 安全互联系统 (CSS)



如欲了解更多信息, 请访问: [英飞凌2022年度财务报告](#)。

英飞凌的业务遍及世界各主要地区

区域营收¹

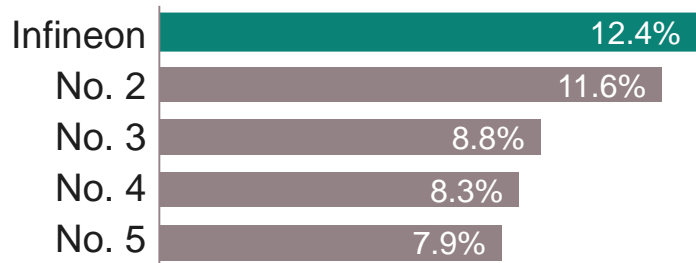


¹ 2022财年 (截至2022年9月30日)

2022年全球汽车半导体市场规模创下历史新高, 英飞凌在全球车用半导体领域排名第一

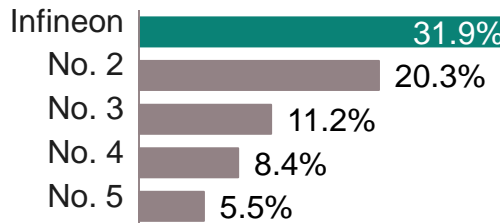


前五大汽车半导体供应商的市场份额

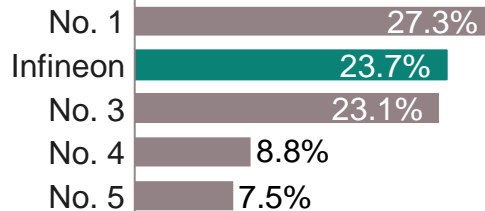


- 全球车用半导体市场规模年增长27.4%，创历史新高，达到594亿美金，汽车半导体含量的增加驱动半导体市场的增长
- 英飞凌积极助力新能源汽车发展，在功率半导体领域排名第一
- 受AURIX™业务增长推动，英飞凌有史以来在微控制器领域排名第二
- 在汽车NOR闪存IC领域排名第一

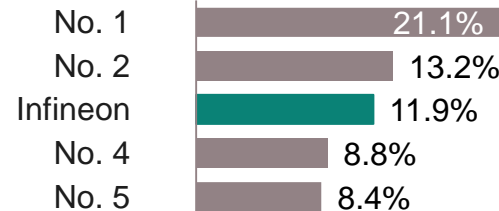
功率半导体



微控制器



传感器



英飞凌拥有业界最全面的汽车半导体产品线，覆盖广泛的汽车应用领域，是全球排名第一的汽车芯片供应商



车身

车载娱乐

底盘

动力总成

自动驾驶/ADAS

传感器 (magnetic, pressure, radar, current, 3D ToF REAL3™, PSoC™ Automotive Multitouch, PSoC™ with CAPSENSE™)

微控制器 (Embedded Power ICs, PSoC™ Automotive, TRAVEO™)

微控制器 (AURIX™)

存储器
(NOR Flash, SRAM, nvSRAM, F-RAM)

功率器件 (MOSFETs, IGBTs, modules, driver ICs, power ICs, LDOs, PMICs, USB Type-C PD)

连接器
(USB)

连接器
(Wi-Fi, BT, BLE)

主要应用

- › 空调系统
- › 车门控制
- › 泵
- › 座椅调节

- › 仪表盘
- › 座舱娱乐
- › 触控
- › 车载充电

- › 制动
- › 转向
- › 稳定系统
- › 悬挂

- › 引擎管理
- › 变速箱
- › 主逆变器
- › 辅助器件

- › 速控
- › 紧急制动
- › 盲点监测
- › 传感器融合

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A Smart Car needs Smart Tires 智能轮胎



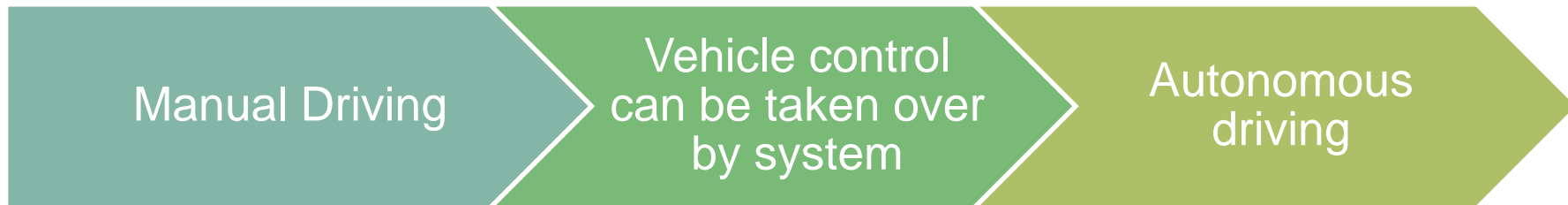
Tire is the only interface between the vehicle to the ground


Smart Tires Needs to

- ❖ Sense the basic tire information
- ❖ Sense the extensive tire condition
- ❖ Sense the ground condition
- ❖ Even adjust the tire foot-print
- ❖ And Connectivity to the vehicle as well as other cars in the area

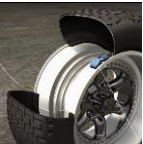


智能TPMS助力ADAS




 **Standard TPMS**

- Pressure measurement
- Temp. measurement
- *APS(Auto-localization)
- *Tire fill assistant



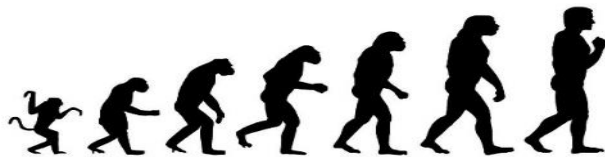
In-Tire TPMS

- Tire ID (information)
- Mileage counter
- Load detection
- Tire wear
- On-Tire APS



Intelligent TPMS

- Road classification
- Friction detection
- Tractive/braking force
- Cornering force
- ...



Additional sensor/system requirements:
Computation power, Memory Size, Energy harvester,
g-sensor performance, Functional safety, High data-rate

英飞凌最新一代 SP49 胎压芯片



Product Content

ASIC:

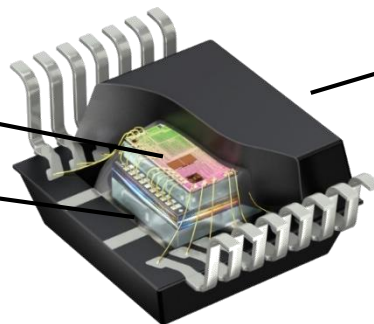
- ARM 0+ core
- 434 / 315MHz Transmission
- LF receiver
- Low power management
- p / g- sensor measurement

Package:

- Package with pressure inlet
- Stress decoupling of MEMS Sensor

MEMS Sensor:

- MEMS chip with p- and g-sensor



Advanced Functionality

- 轮胎胎压监测 Tire pressure sensing: P range 900kPa/1600kPa
- 支持轮胎自动定位 Support tire localization using g-sensor
- **蓝牙TPMS Operation with external BLE IC via I2C**
- **整车载重监测 Intelligent variant for tire load detection**
- **爆胎监测 Support tire burst monitoring**
- **功能安全 ISO26262 ASIL A**

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按摩座椅：压力传感器的应用



Active Wellness



- > Being and feel safe and comfortable
- > Adaptive to personal preferences
- > Autonomous driving



Comfort Driving

Seat comfort functionalities:

- > Massage
- > Lumbar
- > Bucket retain

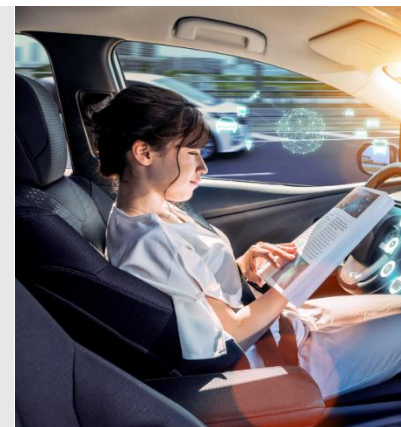


Products

- > Analog interface: **KP236N6165**
- > Digital interface: **KP253** 12bit
KP256 10bit



- > An integrated seat comfort system is using integral air cushions inside the seat to adjust the active multi-contour functions (e.g. massage or lumbar function).
- > In addition, the system constantly monitors the settings (e.g. pressure) during the journey and, in particular, adjusts the pressure in the side cushions according to the driving conditions. Therefore several absolute pressure sensors are needed in order to monitor the pressure inside the system.
- > The seat control unit also controls the massage function with its several air cushions which could be also integrated inside the seat.



Seat comfort demonstration

Seat comfort application

Lumbar function

- › Average of **2 BAPs** per seat

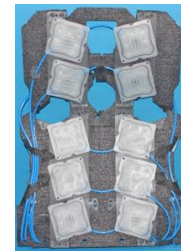
Bucket retaining adjustment

- › Average of **2 BAPs** per seat
- › Equipped only in high class and sports vehicles

Seat massage function

- › Average of **8 BAPs** per seat
- › Equipped only in high-class vehicles

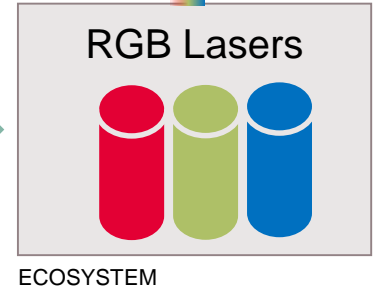
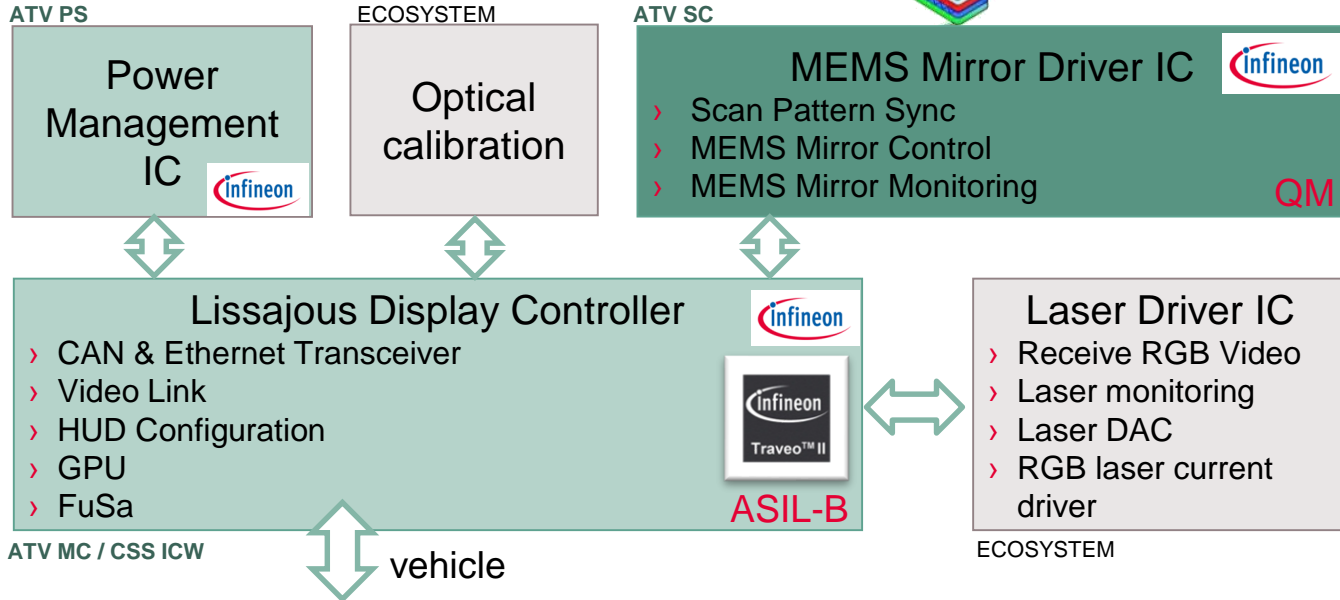
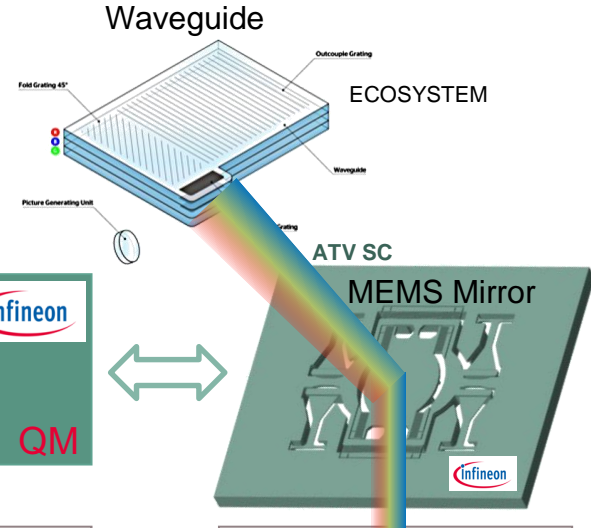
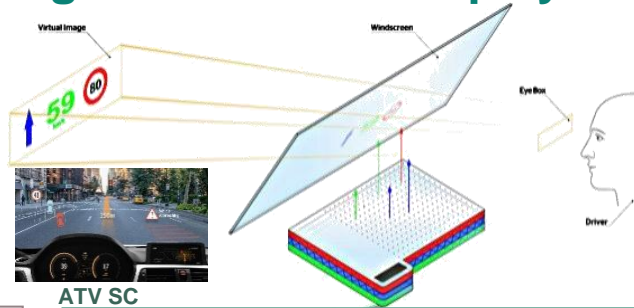
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AR-HUD System Overview - Infineon MEMS LBS offering with MEMS mirror, driver, Power management IC and Display controller



MEMS LBS system IFX chipset + Ecosystem components



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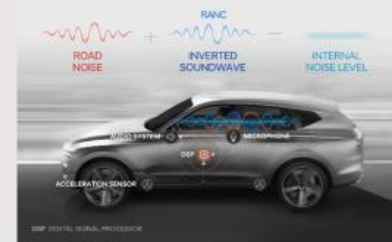
车规级硅麦克风(AEC-Q103)



INTERIOR - SPEECH



INTERIOR – ANC (Acoustic Noise Cancellation)



EXTERIOR – Siren Detection




EXTERIOR – Contact/Road detection



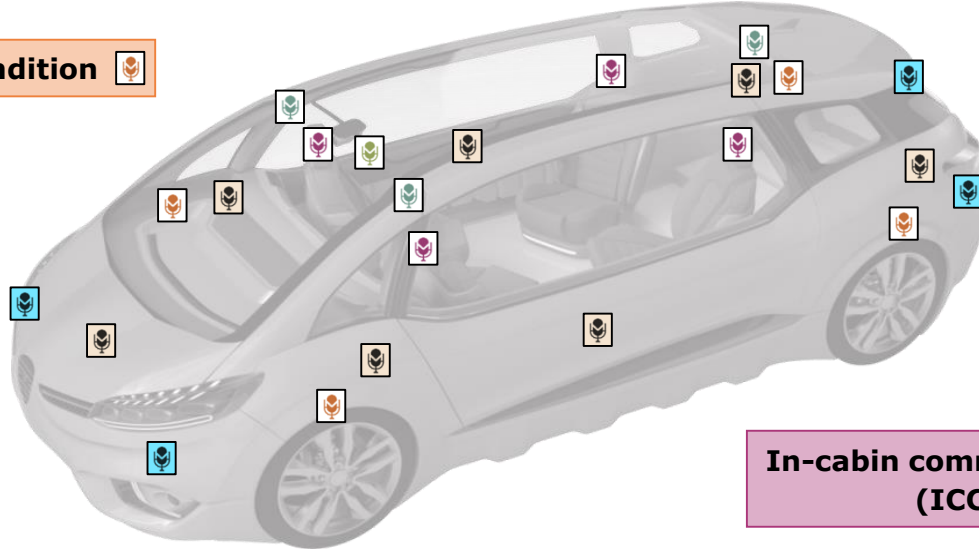
The scope of application for MEMS microphones in the automotive segment are the following:



Hands free / e-call / Voice cmd (HF) 


Active Noise Cancellation (ANC) 

Road Condition 

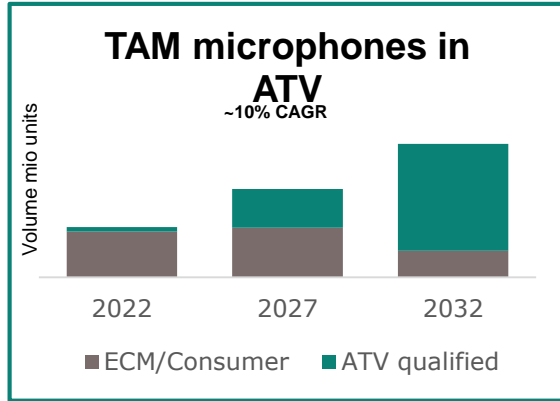


In-cabin communication (ICC) 

Siren detection (Ambulance/Police) 

Contact detection (CoSSy) 

Very attractive automotive (ATV) MEMS microphone market: high growth and many use cases emerging



Source: Infineon internal market model

- ### ATV market trends
- > MEMS technology vs Electret (ECM)
 - > High temperatures and long-term availability
 - > Future platforms and use-cases require full automotive qualification

Market drivers today

Future market drivers

| | | Market Size 2027 |
|----------|----------------------------------|------------------|
| In-cabin | Hands free/ e-call/HMI | ● |
| | Active noise cancellation | ◐ |
| | In-cabin communication | ◑ |
| Exterior | Siren detection | ◐ |
| | External voice interaction | ◑ |
| | Damage detection /Road detection | ◐ |

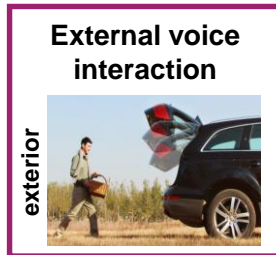


Infineon First automotive qualified MEMS microphone

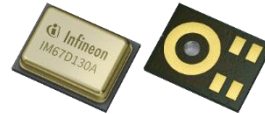
- New potential collaboration for AD/ADAS applications



AEC-Q qualified microphones serve exterior applications



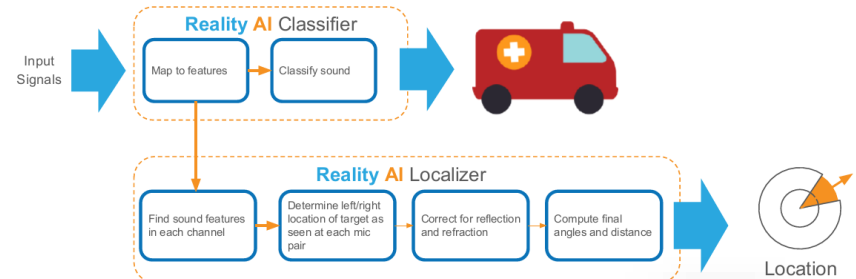
Example for SiMic in AD/ADAS application



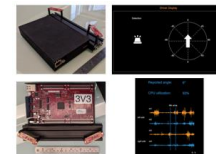
IM67D130A

Digital MEMS microphone is now available

“Teaching cars how to hear with Infineon automotive microphones and microcontrollers”



Demonstrator available
Whitepaper available

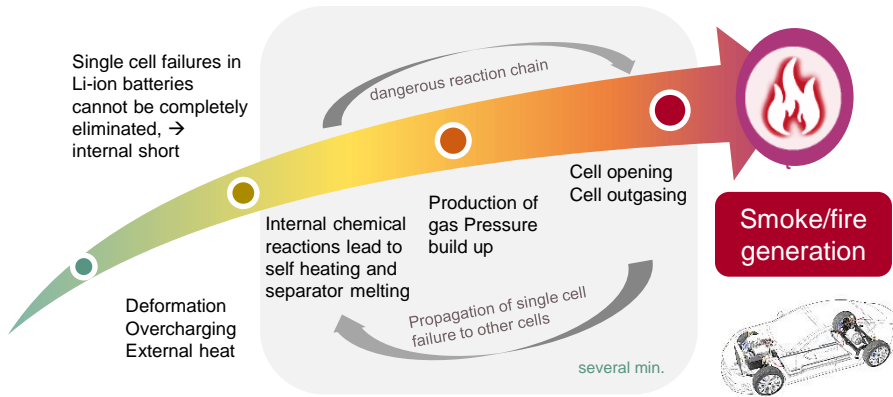


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BMS (热失控监测) in BEV

Thermal Runaway must be detected fast...



**GTR20
Regulation**

5mn to leave
the car after
early warning

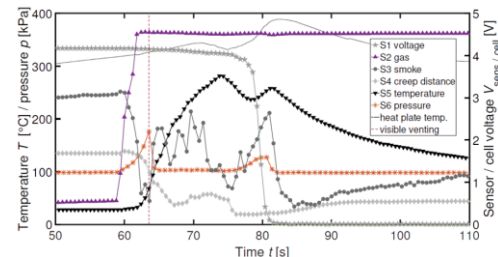
**Detection
speed is KEY**

Enough time for
passengers to
escape

**Gas sensing
as alternative
and supporting
method**

...with Hydrogen gas sensor?

- › Detection of H₂ gas produced by damaged or deteriorate batteries, released by outgassing event
- › Small time advantage over pressure sensors expected
- › Support of “state of the art” principles like pressure sensors or temperature sensors.
- › Low power by low sampling rate
- › Advantage in challenging pack dimensions



Fast Thermal Runaway Detection for Lithium-Ion Cells in Large Scale Traction Batteries, Sascha Koch et. Al. 2018 MDPI Batteries



英飞凌 MEMS Sensor 技术分享

Clark Li
英飞凌科技 大中华区汽车事业部



SP49 vs. SP40+ overview

ASIC:

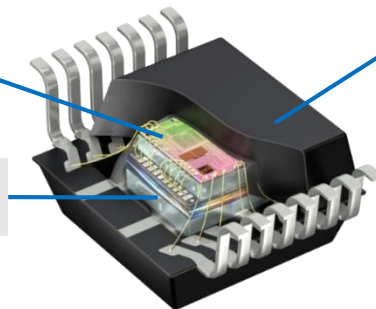
- Same wafer technology
- New MCU: 32-bit ARM M0+
- New ASIC design to match new & changed requirements

Package:

- Same package outline dimensions
- Same footprint
- Same package concept

Sensor:

- Re-use of proven TP4 concept



Easy change at customer: same footprint and outline dimensions and pin compatible to SP4x

Gas sensing is an emerging opportunity for various applications

FCEV

- › Leakage Sensor
- › Exhaust Sensor
- › Anode Sensor
- › BMS Sensor



H2-ICE

- › Leakage Sensor
- › Crankshaft leakage Sensor



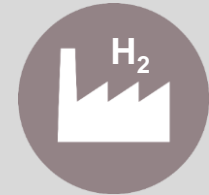
BEV

- › Thermal runaway detection
- › Water intrusion



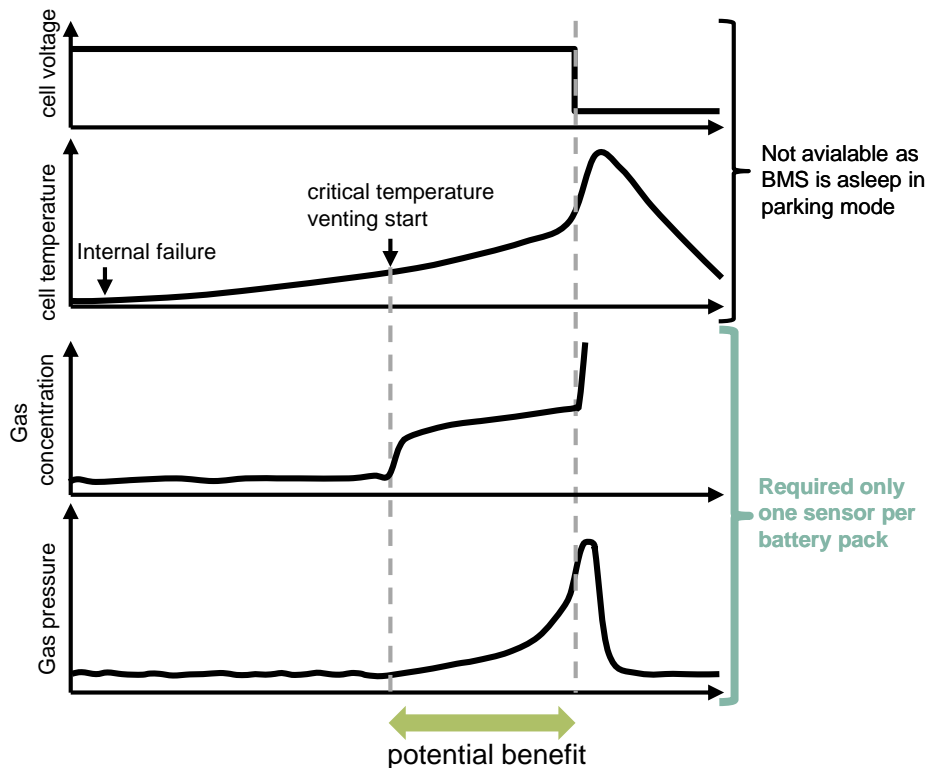
Infrastructure

- › Leakage Sensor
- › Gas Quality
- › Other Gases (CO2)
- › Coolant leak (HVAC)
- › Seasonal storage



* TC: Thermal conductivity

Thermal Runaway Detection – gas venting and pressure increase

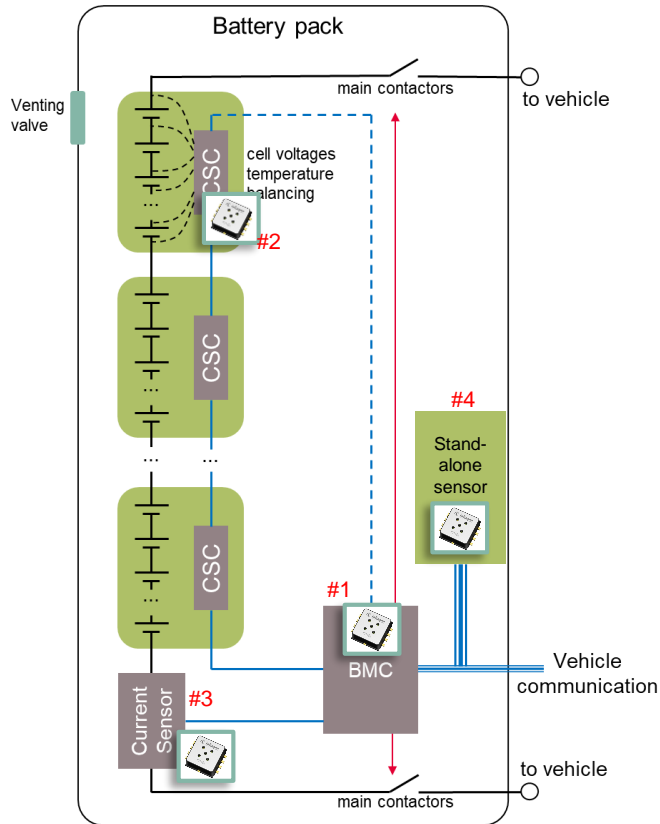


Runaway sequence may vary, venting may start earlier or at same time as full runaway

- Depending on cell chemistry and battery architecture
- New application, most customers also in learning phase
- All EV battery topologies and chemistries show pressure peak at runaway

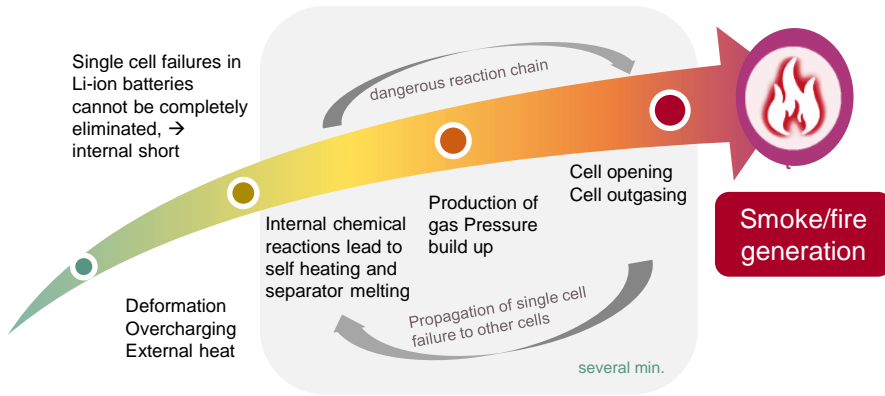
Application background (BMS)

System Architecture, Sensor Integration



- › BMS (battery management system):
 - › BMC: battery management controller (1x per battery pack)
 - › CSC: cell supervision circuit (1x per battery module)
 - › Current sensor (1x per battery pack)
- › Pressure sensor integration
 - › Main requirement: inside battery pack with one common air volume (instantaneous pressure rise anywhere in compartment)
- › Gas sensor integration
 - › Requirements:
 - › Inside battery pack with one common air volume
 - › Depending on topology several sensors might be required due to gas diffusion behavior
- › Integration options for pressure and gas sensor
 - › #1: On BMS master
 - › #2: On one CSC
 - › #3: On current sensor
 - › #4: Inside „standalone“ or satellite sensor

THERMAL RUNAWAY DETECTION



GTR20 Regulation

5mn to leave the car after early warning

Detection speed is KEY

Enough time for passengers to escape

Gas sensing as alternative and supporting method

KP467: Parking Mode

Key Feature

TC Gas Sensor: Venting/Gassing Detection

- > Developed for EV Battery Pressure Monitoring
- > Low Power Monitoring mode for autonomous pressure gradient detection and wake up feature
- > Ultra low power consumption
- > ISO26262 compliant device with ASIL B rating

- > Thermal conductivity gas sensor for battery, fuel cell and industrial applications
- > robust and stable sensor concept for safety applications
- > High sensitivity
- > Low power consumption
- > ISO26262 compliant device with ASIL A rating
- > Additional time benefits for gas sensor in runaway / venting detection

KP467
Smart low power pressure sensor

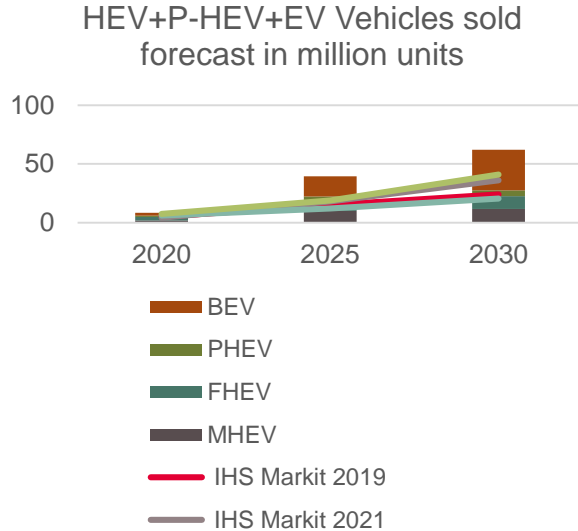
TC Gas Sensor



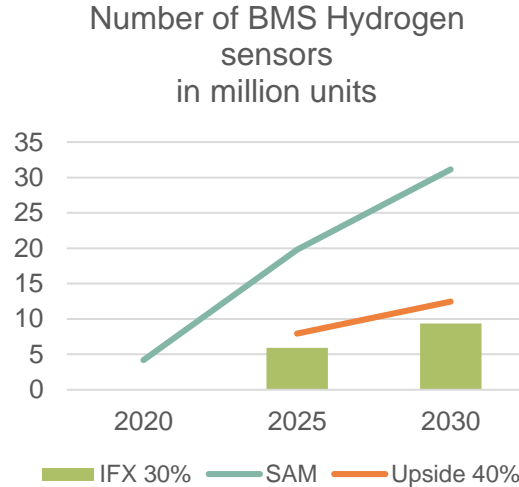
HEV+P-HEV+EV market estimation based on total vehicle sales and BMS H₂ penetration rate assumptions



HEV+P-HEV+EV annual car production



IFX's potential WW H₂ BMS market share



Notes & Assumptions

TR detection is applicable to all battery vehicles, incl. hybrids

1x sensor per battery pack (>12V) is anticipated

H₂ gas sensing applicability:

- pouch type soft cells mostly (a hard aluminum sealed cell is unlikely to open and release gas earlier)
- very small cylindrical hard cells (eg. Tesla), where a pressure sensor might not be able to show a pressure increase
- newly introduced LFP cells (mainly Tesla considers these), where small/no pressure peak is expected at runaway

Sources:
 Infineon: BID market guidance, June 2022
 IHS Markit: Alternative Propulsion Forecast, September 2019, August 2021
 Avicenne Energy: The Rechargeable Battery Market and Main Trends 2018-2030, April 2019

Note:
 Calculation assumptions:
 SAM is 50% of Infineon's BID market guidance, June 2022
 (Pouch type soft cells, Small cylindrical hard cells (eg. Tesla/BMW), newly introduced LFP cells (Tesla))
 IFX's market share is roughly assumed with 30% of the TAM, with a realistic upside of 40%

