Power & Sensor Systems Business Update

1 July 2021
Andreas Urschitz, Division President Power & Sensor Systems
PSS at a glance

PSS revenue and Segment Result Margin

- CAGR(FY16-FY20): 6.7%
- [EUR m]
- 2.041
- 2.148
- 2.318
- 2.445
- 2.650
- 1.566
- 17%
- 20%
- 23%
- 24%
- 24%
- 24%

FY20 revenue split by product group

- MOSFETs (incl. SiC, GaN)
- RF & sensors
- power ICs
- other (incl. HiRel)

Key customers

- Alibaba.com
- Amazon
- Artesyn
- Baidu
- Bosch
- Boeing
- Delta
- Ericsson
- Google
- Goertek
- Hewlett Packard Enterprise
- LG
- Makita
- NXP
- Nokia
- Osram
- Samsung
- Siemens
- SK Hynix
- Sony
- TDK
- Texas Instruments
- Uniti
- ZTE

2021-07-01

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Market outlook for PSS division’s target applications

### Applications (% of FY20 segment revenue)*

#### Computing
- ~20%
- Acceleration towards cloud computing to continue
- Pandemic-driven stay at home and work at home effects continue to favor notebook sales

#### Communication
- ~9%
- In general, long-term drivers due to 5G still intact
- However, trade tensions generate some uncertainty around speed of roll-out in China and other regions

#### Smartphone
- ~19%
- Strong rebound expected driven mainly by economic recovery and migration towards 5G phones
- Potential risk due to reduced smartphone growth due to shortages, regional weaker demand (India/China), 5G slower boost than expected

#### Consumer
- ~20%
- Consumer electronics, including e.g. game consoles, clear beneficiaries from stay at home
- Battery-powered tools continue to show strong momentum
- Consumer spending may be re-allocated to more leisure-oriented activities

#### Industrial
- ~23%
- Automotive and other industrial segments show strong recovery; however, automotive production has taken hits from chip shortages

### Market Outlook for H2 CY21

- Structural drivers expected to stay in cloud computing and good momentum for enterprise servers
- Demand for CY22 supported by limited supply in CY21 (catch-up effects)

### Market Outlook for CY22

- 5G cycle will continue to drive telecom equipment spending in CY22
- 5G replacement cycle expected to continue to drive demand growth
- Demand expected to decline in some consumer areas as TVs in light of re-allocation of consumer spending
- Demand in renewable energy, EV charging and automotive expected to be healthy
- Tailwinds from stimuli packages for EV and green energy in US and EU

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* does not sum up to 100% due to other applications not shown here
Main applications addressed by PSS sensors portfolio

**MEMS microphone**
- Best audio performance
- Low power consumption

**3D radar (24/60 GHz)**
- Ultra-low power consumption
- Presence detection/Vital Sensing

**3D ToF image sensor**
- Best price/performance
- Face ID (biometrics), VR/AR

**Environmental**
- High precision and Small form factor
- Measure CO₂

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**Main applications**

- **Smartphone**
  - True wireless stereo headsets
  - Smart speaker
  - Laptop & Tablet

- **Automotive**
  - Smart home
  - TV
  - Security camera
  - Smart building

- **Smartphone: world-facing and user-facing**
  - Robotics
  - Automotive in-cabin sensing
  - Payment terminals

- **Heating, ventilation, air conditioning (HVAC)**
  - Air purifier
  - Smart thermostat
  - CO₂/virus risk reduction

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Based on our technology leadership in sensors we are providing three different alternatives to our customers.

1. (Single) Sensor
   - Sensor Technologies
     - MEMS microphone
     - 3D radar
     - 3D ToF image sensor
     - CO₂ gas sensor
   - (Single) Sensor
     - e.g. presence detection
     - Software / Machine Learning
     - SENSOR
       - e.g. XENSIV™ Radar
     - MCU
       - e.g. PSOC

2. (Single) Sensor System
   - e.g. presence detection
   - Software / Machine Learning
   - SENSOR
     - e.g. XENSIV™ Radar
   - MCU
     - e.g. PSOC

3. (Multi) Sensor System
   - e.g. presence detection
   - Software / Machine Learning
   - SENSOR
     - e.g. Microphone
   - MCU
     - e.g. PSOC
   - SENSOR
     - e.g. XENSIV™ Radar
   - MCU
     - e.g. PSOC
Increasing focus on cooperation with market forming customers

Customers

Bosch
Samsung
Sony
Tencent
Continental
Amazon
Facebook
Google
Alibaba
Microsoft
Baidu
Sharpe
Honor
Sony

Joint innovations

Sony High-End over-ear headset with MEMS microphone
Portable CO₂ measurement enabled by the CO₂Go device
Xiaomi Mijia 1T smart vacuum cleaner
Samsung Frame TV with 60Ghz solution
Very good traction with high-end sealed dual-membrane technology in hearables

Infineon’s sealed dual-membrane (SDM) XENSIV™ MEMS microphone boosts audio pick-up quality

› Besides high-end smart phones hearables are a major growth driver. Stable and fast growth of hearables market continues
› Projects with OEMs in Europe, US and Japan for true wireless earbuds and over-ear headsets with up to 9 microphones
› Further microphone innovation projects in the pipeline to support hearable trends:
  - Augmented hearing
  - Miniaturization
  - Voice as human machine interface
  - Voice pick-up in very noisy environments
  - 3D recording

Infineon's sealed dual-membrane (SDM) XENSIV™ MEMS microphone boosts audio pick-up quality

› Popular features like active noise cancellation or transparent hearing require up to 9 microphones. Traditional wired headsets include only 1 microphone
› Product portfolio will be increased by two additional high-end microphones launching this year

* Source: Strategy Analytics: Global Bluetooth TWS Headset Sales and Revenue Forecast to 2025. January 2021
For Infineon TWS is a large business opportunity for sensors but also for microcontrollers, connectivity and power

Current use cases / New features and use cases in the future

**Sensors**
- MEMS Speaker
  - Music streaming
  - Communication
  - Navigation info
- VPU / Accelerometer
  - User voice recording
  - Fall detection
  - Crash detection

**Microcontroller & Connectivity**
- Microcontroller
  - Connection with smartphone or wearables
  - Speech recognition
  - Compute assist for earbuds (eg off-line live translation)
  - GPS
  - Memory storage for music
- Connectivity
  - Cloud communication for live translation, voice assistance and music streaming

**Power**
- Power stage
  - Internal power management
  - Wireless charging
  - USB charging

**One outer-ear microphone**
- Feedforward ANC
- 3D sound recording for environmental awareness
- Audio input for live translation

**In-ear microphone**
- Feedback ANC
- Heart beat detection
- Body temperature monitoring
Radar offers several use cases for presence detection and health monitoring

**Presence detection**

- **Room Occupancy Devices**
  e.g. human localization & counting

- **Occupancy based heating and ventilation**
  e.g. reduction of CO2 level to prevent spreading of diseases

- **Device switch on/off**
  e.g. reduction of energy consumption (e.g. lamp, TV, air conditioning…)

- **Directional audio effects on individuum**
  e.g. to improve audio quality (e.g. smart speaker, TV)

- **Home surveillance**
  e.g. detection of intruders

**Health monitoring**

- **Sleep monitoring**
  Sleep detection, sleep quality, apnea & snoring detection (radar combined with MEMS microphone)

- **Vital sensing for home Fitness**
  Heart rate and breathing rate measurement (person standing still after exercise)

**Segmentation with radar enables smart devices to recognize each person in the room**
Latest smartphone designs with a full-screen display without a notch or punch-hole are requiring under-display cameras

Infineon is developing a under-display turnkey-solution for ToF world- and user-facing applications with very high performance

The gray value and depth data quality of the under-display images are as good as those obtained with traditional over-display concepts for critical applications like secure face ID

The solution is being developed together with partners. Infineon contributes the high end semiconductor technology, pmd technologies its time-of-flight expertise and imaging specialist Arcsoft the high-end algorithms

The new under-display solution will be available in the fourth quarter of FY21
Infineon 3D ToF is a versatile technology for many consumer applications

<table>
<thead>
<tr>
<th>Mobile Phones – User Facing</th>
<th>Mobile Phones – World Facing</th>
<th>Consumer Robotics</th>
<th>Augmented- &amp; Virtual Reality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face ID</td>
<td>Bokeh</td>
<td>Robot</td>
<td>AR</td>
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<tr>
<td>Hand ID</td>
<td>Virtual Retail</td>
<td>Last Mile</td>
<td>Control</td>
</tr>
<tr>
<td>Payment</td>
<td>AR Gaming</td>
<td>Collision avoidance</td>
<td>AR Gaming</td>
</tr>
<tr>
<td>3D Gestures</td>
<td>3D Scanning</td>
<td>Navigation</td>
<td>Mapping</td>
</tr>
</tbody>
</table>

- **Mobile Phones – User Facing**
  - Face ID
  - Hand ID
  - Payment
  - 3D Gestures

- **Mobile Phones – World Facing**
  - Bokeh
  - Virtual Retail
  - AR Gaming
  - 3D Scanning

- **Consumer Robotics**
  - Robot
  - Last Mile
  - Collision avoidance
  - Navigation

- **Augmented- & Virtual Reality**
  - AR
  - Control
  - AR Gaming
  - Mapping
Infineon XENSIV™ PAS CO2 sensor enables highly-precise CO₂ measuring in an extremely small size

Photoacoustic spectroscopy (PAS) technology based on Infineon's high (SNR) signal-to-noise ratio MEMS microphone

- Infineon XENSIV™ PAS CO2 sensor enables highly-precise, cost-effective and space saving CO₂ measuring
- The technology offers an exceptionally small form factor (14 mm x 13.8 mm x 7.5 mm) that is 4x smaller and 3x lighter (2 grams) than the typical NDIR (non-dispersive infrared) sensor, allowing for more than 75% space savings in customer systems
- The SMD package ensures compatibility with high-volume manufacturing standards, enabling cost-effective, fast assembly and system integration
- Advanced compensation and configuration algorithms enable a plug-&-play sensor performance and fast design-to-market

XENSIV™ PAS CO2 leads to demand-oriented & energy efficient control of air conditioning systems

XENSIV™ PAS CO2 sensor measures the CO₂ level
Infineon’s product portfolio perfectly fits into existing key elements of a Smart Building

### Lighting
- LED drivers, lighting control, sensor solutions for presence detection

### HVAC systems
- Intelligent power modules for motor control and sensor portfolio for airflow & air quality measurement and IoT use cases such as zoning or predictive maintenance (e.g. PAS CO2 sensor, pressure sensor, radar sensor)

### Network Power Infrastructure
- Power MOSFETs, power control ICs for reliable and power efficient network power infrastructure

### Access control systems
- Turnkey smart card security solutions
- Trusted platform modules (TPMs) for security gateways
- Secure elements for embedded access control solutions
Infineon system solution addresses IoT market via combining XENSIV™ sensors, PSoC™ 6 MCU & connectivity

Key facts

› Infineon offers system solutions comprising of sensor, MCU, connectivity and software libraries (apps, SDKs)
› BLE functionality monolithically integrated on MCU
› IoT target applications for radar: entrance control or presence detection for smart home and smart building
› Radar solutions are anonymous and therefore respecting privacy
› First orders for presence detection received from several Asian customers
› Radar solution can perfectly be combined with Infineon’s XENSIV™ PAS CO2 sensor for air quality monitoring

Example offering: Combination of sensors, microcontrollers and connectivity in development kit

Advantages of radar over passive infrared

› super compact design; smaller system sizes
› determination of person’s direction, speed, distance
› programmable; can flexibly be adapted to the target application
› higher accuracy; more precise measurements of detected objects
Sensor markets targeted by PSS offer attractive growth potential

**MEMS microphone market**

<table>
<thead>
<tr>
<th>FY</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
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<tr>
<td>[EUR m]</td>
<td>1.251</td>
<td>1.494</td>
<td>1.641</td>
<td>1.841</td>
<td>1.920</td>
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Source: Infineon estimates

**3D ToF image sensor market**

<table>
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<th>FY</th>
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<th>2023</th>
<th>2024</th>
<th>2025</th>
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<tr>
<td>[EUR m]</td>
<td>171</td>
<td>476</td>
<td>908</td>
<td>1282</td>
<td>1475</td>
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</table>

Source: Infineon estimates

**Radar IC market (24 GHz and 60 GHz only)**

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<th>FY</th>
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<th>2023</th>
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<th>2025</th>
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<tr>
<td>[EUR m]</td>
<td>154</td>
<td>219</td>
<td>347</td>
<td>467</td>
<td>601</td>
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</table>

Source: Infineon estimates

**Environmental sensor market***

<table>
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<th>FY</th>
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<th>2023</th>
<th>2024</th>
<th>2025</th>
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<tr>
<td>[EUR m]</td>
<td>285</td>
<td>361</td>
<td>456</td>
<td>559</td>
<td>700</td>
</tr>
</tbody>
</table>

Source: Infineon estimates

* Infineon is addressing smart building, smart home, smart appliances, consumer IoT devices and automotive. Source: Infineon estimates
Part of your life. Part of tomorrow.
Andreas Urschitz, Division President
Power & Sensor Systems

› Born in 1972 in Klagenfurt, Austria
› Studies of Commercial Science at WU Vienna
› First position within Infineon in product planning & strategy
› Further positions in production, sales and marketing
› Since 2012: Division President Power & Sensor Systems (PSS) (formerly PMM)
   – Since 2012, PSS revenue grew by a factor of three and PSS’ market share in the area of power semiconductors (MOSFETs) more than doubled*
   – PSS results FY20: Revenue: €2,650 million, Segment result: €636 million, Segment result margin: 24%*

* Source: Infineon Annual Report, 2012 and 2020
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANC</td>
<td>adaptive noise cancellation</td>
</tr>
<tr>
<td>AR</td>
<td>augmented reality</td>
</tr>
<tr>
<td>BLE</td>
<td>Bluetooth Low Energy</td>
</tr>
<tr>
<td>CAGR</td>
<td>compound annual growth rate</td>
</tr>
<tr>
<td>GaN</td>
<td>gallium nitride</td>
</tr>
<tr>
<td>GPS</td>
<td>global positioning system</td>
</tr>
<tr>
<td>HVAC</td>
<td>heating, ventilation, air conditioning</td>
</tr>
<tr>
<td>IC</td>
<td>integrated circuit</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>MCU</td>
<td>microcontroller unit</td>
</tr>
<tr>
<td>MEMS</td>
<td>micro electro-mechanical systems</td>
</tr>
<tr>
<td>MOSFET</td>
<td>metal-oxide silicon field-effect transistor</td>
</tr>
<tr>
<td>NDIR</td>
<td>non-dispersive infrared</td>
</tr>
<tr>
<td>OEM</td>
<td>original equipment manufacturer</td>
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<tr>
<td>PAS</td>
<td>photoacoustic spectroscopy</td>
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<tr>
<td>PSoC</td>
<td>programmable system-on-chip</td>
</tr>
<tr>
<td>RF</td>
<td>radio frequency</td>
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<tr>
<td>SDM</td>
<td>sealed dual-membrane</td>
</tr>
<tr>
<td>Si</td>
<td>silicon</td>
</tr>
<tr>
<td>SiC</td>
<td>silicon carbide</td>
</tr>
<tr>
<td>SMD</td>
<td>surface-mounted device</td>
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<tr>
<td>SNR</td>
<td>signal-to-noise ratio</td>
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<tr>
<td>SoC</td>
<td>system-on-chip</td>
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<tr>
<td>ToF</td>
<td>time-of-flight</td>
</tr>
<tr>
<td>TPM</td>
<td>trusted platform module</td>
</tr>
<tr>
<td>TWS</td>
<td>true wireless stereo</td>
</tr>
<tr>
<td>USB</td>
<td>universal serial bus</td>
</tr>
<tr>
<td>VPU</td>
<td>voice processing unit</td>
</tr>
<tr>
<td>VR</td>
<td>virtual reality</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>wireless fidelity</td>
</tr>
</tbody>
</table>
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