Automotive Radar Overview 2018
Teardown and RF analysis of large panel of Radar
RF report by Stéphane ELISABETH
October 2018 – version 1
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Executive Summary

- This comparative review has been conducted to provide insights into the structures, technical choices, and designs of 15 automotive Radar sensor products from the leading suppliers. The suppliers include Veoneer (Formerly Autoliv), Bosch Sensortec, Continental, Aptiv (Formerly Delphi Technologies), Denso, ZF/Autocruise, and Valeo.

- We analyze and compare 6 devices that use the 24 GHz frequency band, featuring chipset supplied by STMicroelectronics, Infineon, Analog Devices or UMS and targeting sort ranges application like blind spot detection. We have also looked at 9 devices working in the 77 GHz frequency band more dedicated to multimode radar or long range radar sensing. On this other segments several companies like Infineon, NXP even TowerJazz shares the market. We look at their package dimensions and internal structures, Chipset technologies, antenna design and dimensions, and RF PCB cross-sections, to provide a comprehensive review of Radar Sensors.

- Radar Sensors’ packaging and chipset differ widely according to application. In more than 240 pages, this report includes multiple comparisons based on physical analyses of 15 Radar sensors. It offers device manufacturers and chipset providers the unique possibility of understanding Radar sensor technology evolution.

- At the end, the report will open on the next generation of radar using large available bandwidth of 4 GHz on the 79 GHz frequency band featuring RFCMOS radar chipset from Ainstein. We look at its characteristics and compare the new architecture to former radar on 24 GHz and 77 GHz.
## Radar Sensor

<table>
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<th>OEMs</th>
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<td>BSD and/or RCTA</td>
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<td>AC100</td>
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<td>Valeo</td>
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<td>Ainstein</td>
<td>T-79</td>
<td>Short Range Radar</td>
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</table>
Autonomous Driving Car Roadmap: Radar

- **LEVEL 1**: From 2000
  - Features: SRR BSD, LCA

- **LEVEL 2**: From 2012
  - Features: SRR BSD, RCTA
  - Object detection

- **LEVEL 3**: From 2020
  - Features: USR mode AVP, PA, SRR mode BSD, RCTA, MRR mode AEB pedestrian, LRR mode ACC, AEB
  - High resolution target separation

- **LEVEL 4**: From 2030
  - Features: SRR BSD, PCW, RCW, RCTA, LRR ACC, AEB
  - 3D detection

- **LEVEL 5**: 360° Object recognition
Radar Module Market Forecast

![Radar module forecast ($M)](image-url)
### Physical Comparison – Device Size and Complexity

<table>
<thead>
<tr>
<th>Mfr.</th>
<th>Ref.</th>
<th>Year of certif.</th>
<th>Dimension (mm²)</th>
<th>Board Nb.</th>
<th>Integrated EMI</th>
<th>EMI Thickness (mm)</th>
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- **Physical Analysis**
- **Related Reports**
- **About System Plus**
### Physical Comparison – Board Size and Complexity

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**Physical Analysis**

- 24 GHz
  - Device size & Complexity
  - Board Size & Complexity
  - RF Design
  - Cost of the RF Chipset
- 77 GHz
  - Device size & Complexity
  - Board Size & Complexity
  - RF Design
  - Cost of the RF Chipset
- From 24 GHz to 79 GHz
  - RF Chipset
Physical Comparison – RF Design

- ARS4-A
- MRR1Plus
- BOSCH
- LRR4
- MMRV1
- SRR2
- RACAM
- DENSO
- DNMW008
- SRR3
- K-77
- AINSTEIN

Physical Cost Comparison
- 24 GHz
  - Device size & Complexity
  - Board Size & Complexity
  - RF Design
  - Cost of the RF Chipset
- 77 GHz
  - Device size & Complexity
  - Board Size & Complexity
  - RF Design
  - Cost of the RF Chipset
- From 24 GHz to 79 GHz
  - RF Chipset

Related Reports

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### Physical Comparison – RF Design

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Cost Comparison – RF Chipset

Physical Analysis

- 24 GHz
  - Device size & Complexity
  - Board Size & Complexity
  - RF Design
  - Cost of the RF Chipset

- 77 GHz
  - Device size & Complexity
  - Board Size & Complexity
  - RF Design
  - Cost of the RF Chipset
  - From 24 GHz to 79 GHz
    - RF Chipset
## MODULES HISTORY – 24 GHz

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### Physical Analysis
- **24 GHz**
  - Continental SRR2-A
  - Continental SRR3-B
  - Veoneer NB24BS
  - AutoCruise AC100
  - Valeo MBHL2
- **77 GHz**
  - Continental ARS4-A
  - Bosch MRR1Plus
  - Bosch LRR4
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- 77 GHz
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ARS4-A

77 GHz  Adaptive Cruise Control
Short Range Radar
Continental – ARS4-A – Package View & Dimensions

Physical Analysis
- 24 GHz
  - Continental SRR2-A
  - Continental SRR3-B
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Continental – ARS4-A – Main ICs

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  - Bosch LRR4
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  - Aptiv RACAM
  - Aptiv SRR3
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RF Board Dimensions:

Continental ARS4-A – RF Board Global View – Optical View
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Continental ARS4-A – RF Board Bottom View – Optical View
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- 24 GHz
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  - Continental SRR3-B
  - Veoneer NB248S
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  - Bosch LRR4
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Related Reports
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Continental – ARS4-A – RF Board

- **MMIC Packaging:**  
- **MMIC Dimensions:**  
- **MMIC Technology:**  
- **Output (Differential) Line/Space Width:**  
- **Rx/Tx Line Width:**

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Continental – ARS4-A – RF Board

Physical Analysis
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Continental – ARS4-A – RF Board – Rx MMIC

Physical Analysis
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  - Denso DNMW008
  - Ainstein K-77
- 79 GHz
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Related Reports
- Continental – ARS4-A – RF Board – Rx MMIC
- Continental ARS4-A – MMIC Opening – Receiver – Optical View

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Continental – ARS4-A – RF Board – Antenna

- Patch Dimensions:
- Tx Patch Number:
- Board dimensions:
- Rx Fill Factor:
- Antenna Fill Factor:
Continental – ARS4-A – RF Board – Cross-section

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**Physical Analysis**

- 24 GHz
  - Continental SRR2-A
  - Continental SRR3-B
  - Veoneer NB24BS
  - AutoCruise AC100
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- 79 GHz
  - Ainstein T-79

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SAMPLE
Related Reports

**RF & System**
- Aptiv’s Third Generation of 77 GHz-Based Short-Range Radar (SRR3)
- Ainstein T-79: Automotive 79GHz Short Range Radar
- AWR1642 77 & 79 GHz RFCMOS Radar Chipset from Texas Instruments
- Continental SRR3-B 24GHz Blind-Spot Radar
- Autoliv’s 3rd Generation Automotive Night Vision Camera with FLIR’s ISC0901 Microbolometer
- Continental MFC430TA – Forward Automotive Camera for Advanced Driver Assistance Systems

**MARKET AND TECHNOLOGY REPORTS - YOLE DÉVELOPPEMENT**
- Radar Technologies for Automotive 2018
- MEMS and Sensors for Automotive - Market and Technology Trends 2017
Business Models Fields of Expertise

- Custom Analyses
  (>130 analyses per year)
- Reports
  (>40 reports per year)
- Costing Tools
- Trainings

Company services
- Custom Analyses
- Reports
- Costing Tools
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