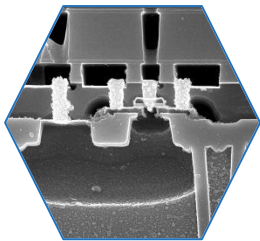
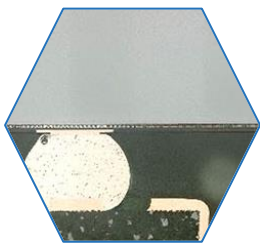


Automotive Radar Comparison 2021

Detailed analysis of technologies and cost of the main radar systems and their chipsets, including radar from Continental, Bosch, Denso, and others.



Title: Automotive Radar Comparison 2021

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In the next few years, autonomous driving will become reality. To achieve this innovation, the number of vision technologies has increased to provide functionality and safety for drivers and passengers. Among these vision technologies, radar systems are the best-established and most secure, introduced in 2000 with short-range radar (SRR) systems dedicated to blind-spot or lane-crossing detection. Today, vehicles from several suppliers offer 'level 3' automation whereby drivers are on standby but can be hands-off for periods of time. These vehicles integrate around five radar systems, including SRR and long-range radar (LRR), which support emergency breaking and adaptive cruise control. To track how this technology is evolving and see what's on the horizon, now is the perfect time to investigate every player and compare radar original equipment manufacturers (OEMs), module suppliers, and current technologies. To this end, the first imaging radar from Continental is included in this comparison.

This comparative technology study provides insights regarding technology data for radio-frequency (RF) chipsets and antenna boards in radar systems. Also included is a study of 15 radar systems from several OEMs such as Veoneer (formerly Autoliv), Robert Bosch, Continental, Aptiv (formerly Delphi Technologies), Denso, ZF/TRW, Hella, Hyundai/Mobis, and SteelMate.

Through teardowns of a large variety of radar systems, we have extracted the main RF chipsets and boards and physically analyzed them. We have also sectioned the RF boards, all in order to show the various OEMs' technical and

economic choices and provide an overview of the market. Market share differs depending on the frequency and the application. At 24 GHz, STMicroelectronics is at the low end. At 77 GHz, Infineon and NXP have led the way for many years, but it appears that Texas Instruments is catching up.

This report includes a description of each component and statistical analyses for most radar systems, focusing on the RF board. Moreover, a complete MMIC die analysis, processes, and board cross-sections are provided, along with a complete cost analysis and a selling price estimation of the chipset. Finally, we compare the costs of the main systems in order to explain OEM choices and supplier preferences. Please note that the main board analyses, along with full BOMs and system cost, are not covered in this report.

COMPLETE TEARDOWN WITH:

- Complete bills-of-materials for the RF chipsets
- Comparison between suppliers
- Comparison between Tier-1s
- Cost comparison between the main radar systems
- Cost comparison between the main chipsets
- Detailed photos
- Precise measurements
- Materials analysis
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis

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Radar Module Market Analysis

Module History: 24 GHz and 77GHz

Radar Analysis: Aptiv, Continental, Bosch, Mando, Hella, Denso, Hyundai Mobis, ZF/TRW, Veoneer, and SteelMate

- Physical analysis methodology
- RF Board: Overview, antenna, chipset, PCB cross-section and structure

Component analysis: Infineon, NXP, Denso, Texas Instruments, STMicroelectronics, MediaTek

- Package analysis
 - ✓ Package view and dimensions
 - ✓ Package cross-section

- ✓ Package process analysis
- Die analysis
 - ✓ Die view and dimensions
 - ✓ Die delayering and main block ID
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Peggy Gallois joined System Plus Consulting's laboratory of micro-electronics team in July 2019. She previously worked in the laboratory of metallographic expertise for Dassault Aviation near Paris.



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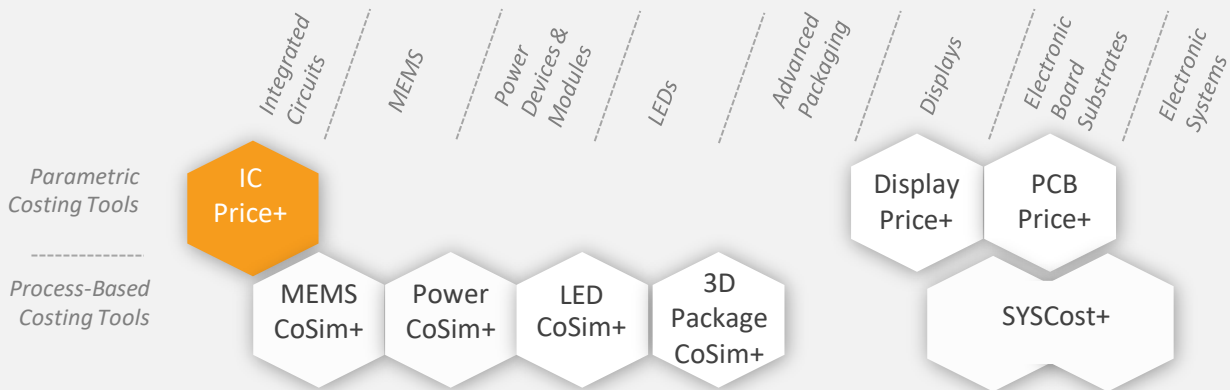
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