



Development and Manufacturing of Radar Modules for Automotive Applications

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Outline

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- InnoSenT GmbH
- Radar Applications
- Radar Module
- InnoSenT Quality System
- APQP - Advanced Product Quality Planning
- Design FMEA
- Qualification
- PPAP – Production Part Approval Process
- Radar Manufacturing
- Traceability
- Summery



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InnoSenT GmbH

- Location: Donnersdorf, Germany
- *(Engineering & Manufacturing)*
- Founded: 1999
- Employees: 154
- Turnover 2012: 29.0 Mio. €
- Since 06-2012: Strategic Cooperation with Hella KGaA Hueck & Co.

- Certified according Worldwide Standards
- ISO TS 16949:2009 - ISO 9001:2008 - ISO 14001:2004



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Frequency Matters



Key Facts

- InnoSenT **develops and manufactures** radar hardware
- **Mass production** with over **2 million devices** in 2013
- Main focus on sensors working at **24GHz**, 61GHz and **77GHz** for automotive applications
- **Product portfolio** ranges from **analog radar frontends** up to **complete sensor systems** with digital interface
- **Automotive quality grade** is also applied for industrial business unit
- **Worldwide market presence** for automotive and industrial business unit



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R&D

Team of 45 engineers specialized in:

- Radio technology
- Antenna development
- Automation
- Mechanical engineering
- Digital signal processing

Developing products by using a wide range of technologies tailored to customers needs:

- Radar architecture
- High volume or sample quantities
- Budget



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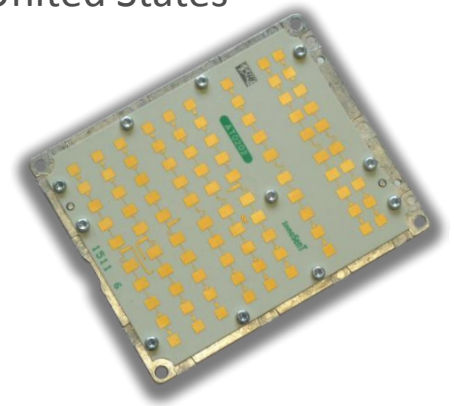
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Automotive Products

- Market introduction of first Lane Change Assist sensor in 2006 together with Hella
- Today, more than 30 car lines of 10 OEMs equipped with InnoSenT 24 GHz radar technology
- OEM customers on three continents, in Asia, Europe and the United States
- Best price-performance ratio is key to our success!
- Continues improvement of our current products



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Radar Applications



Applications with 24GHz ISM-Band Sensor Gen. 2



Lane Change Assist
Blind Spot Detection



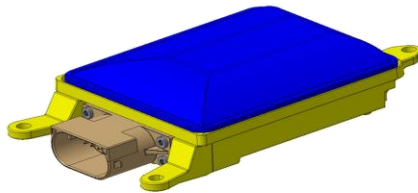
Rear Cross Traffic Alert



Pre Crash Rear

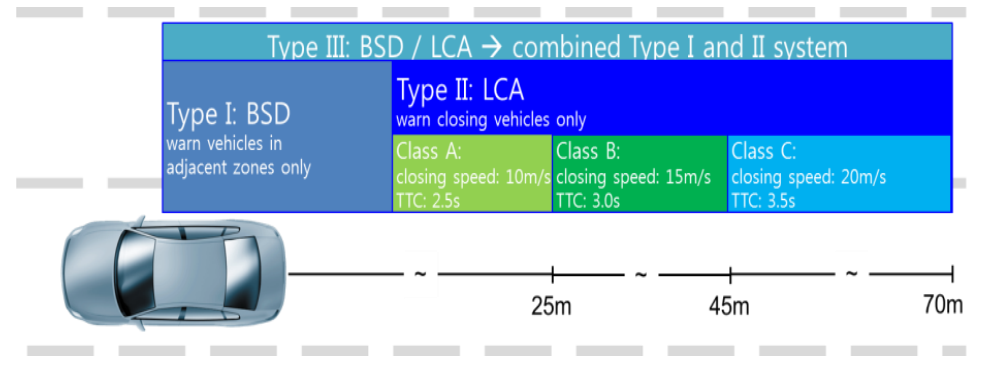
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Source: Hella KGaA Hueck & Co.



Hella LCA Sensor Gen. 2

ISO 17787



Source: Hella KGaA Hueck & Co.



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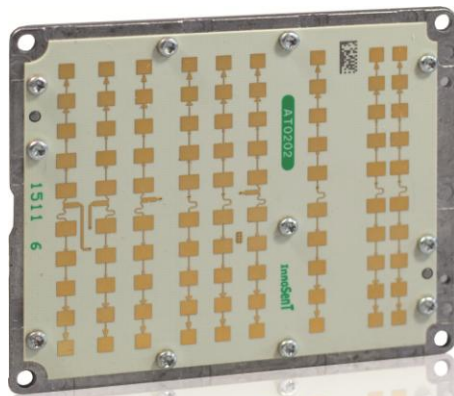


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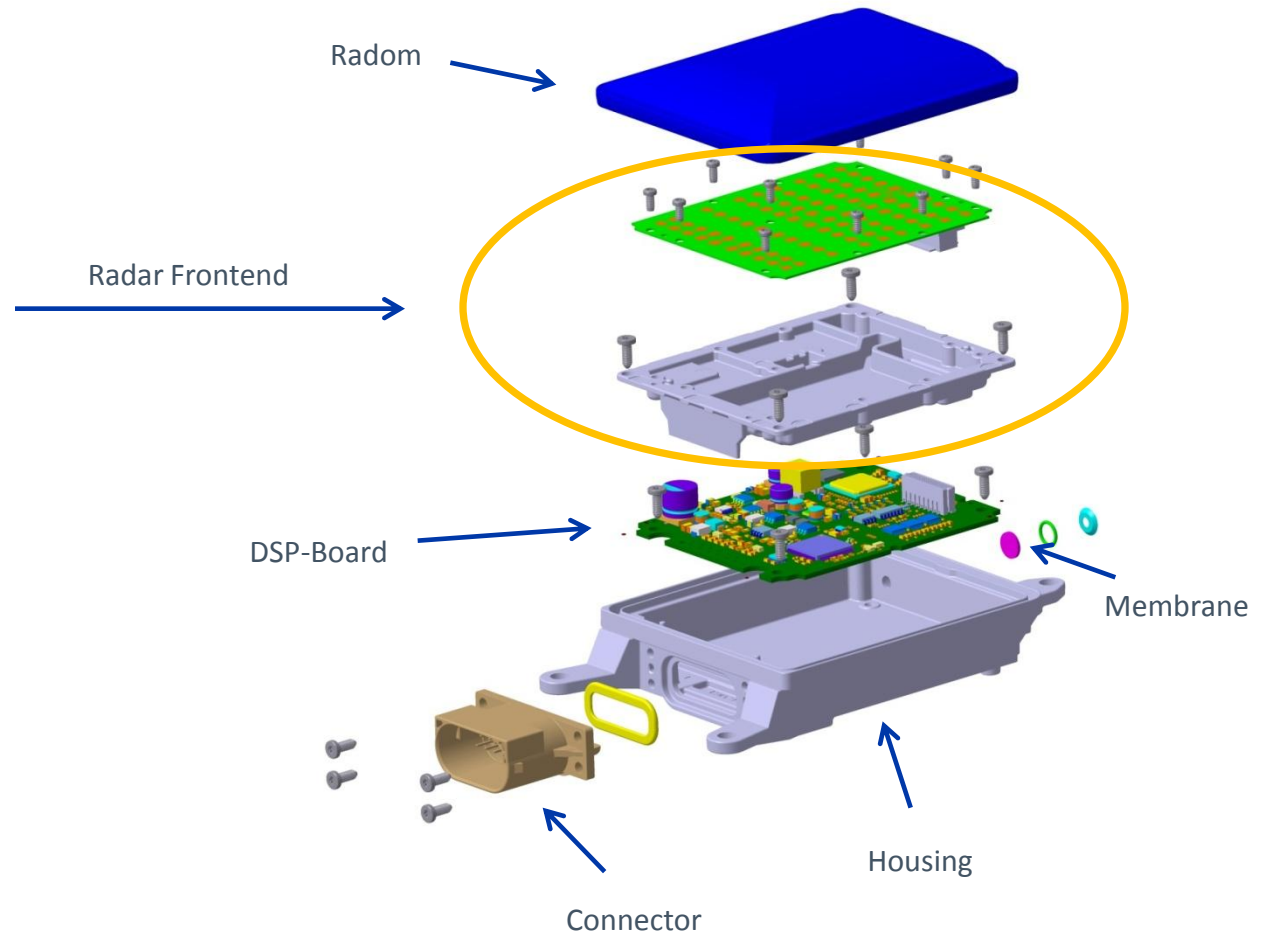


Radar Module

InnoSenT Radar
Frontend: IVQ-640



Hella Radar Sensor – Gen. 2

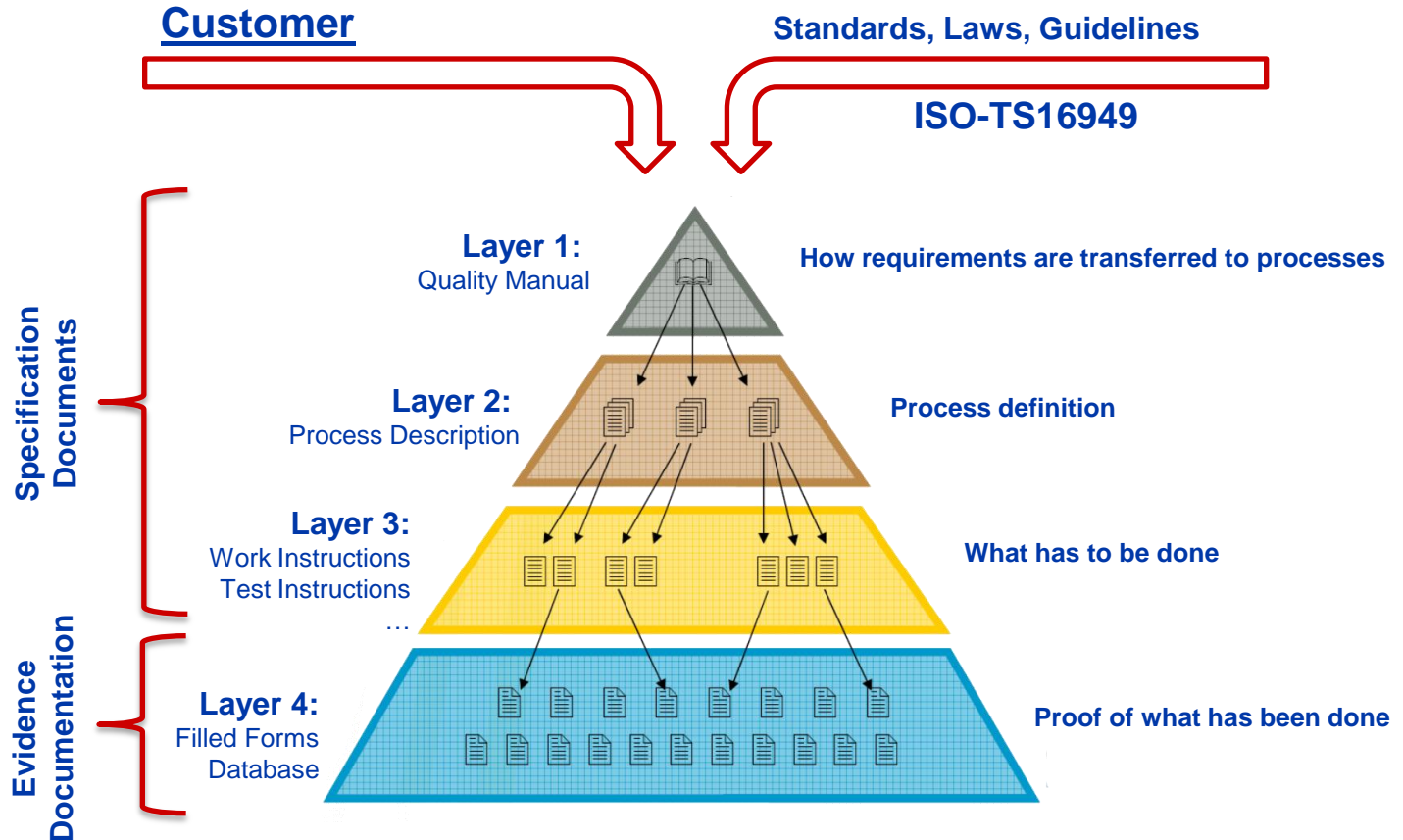


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InnoSenT Quality System



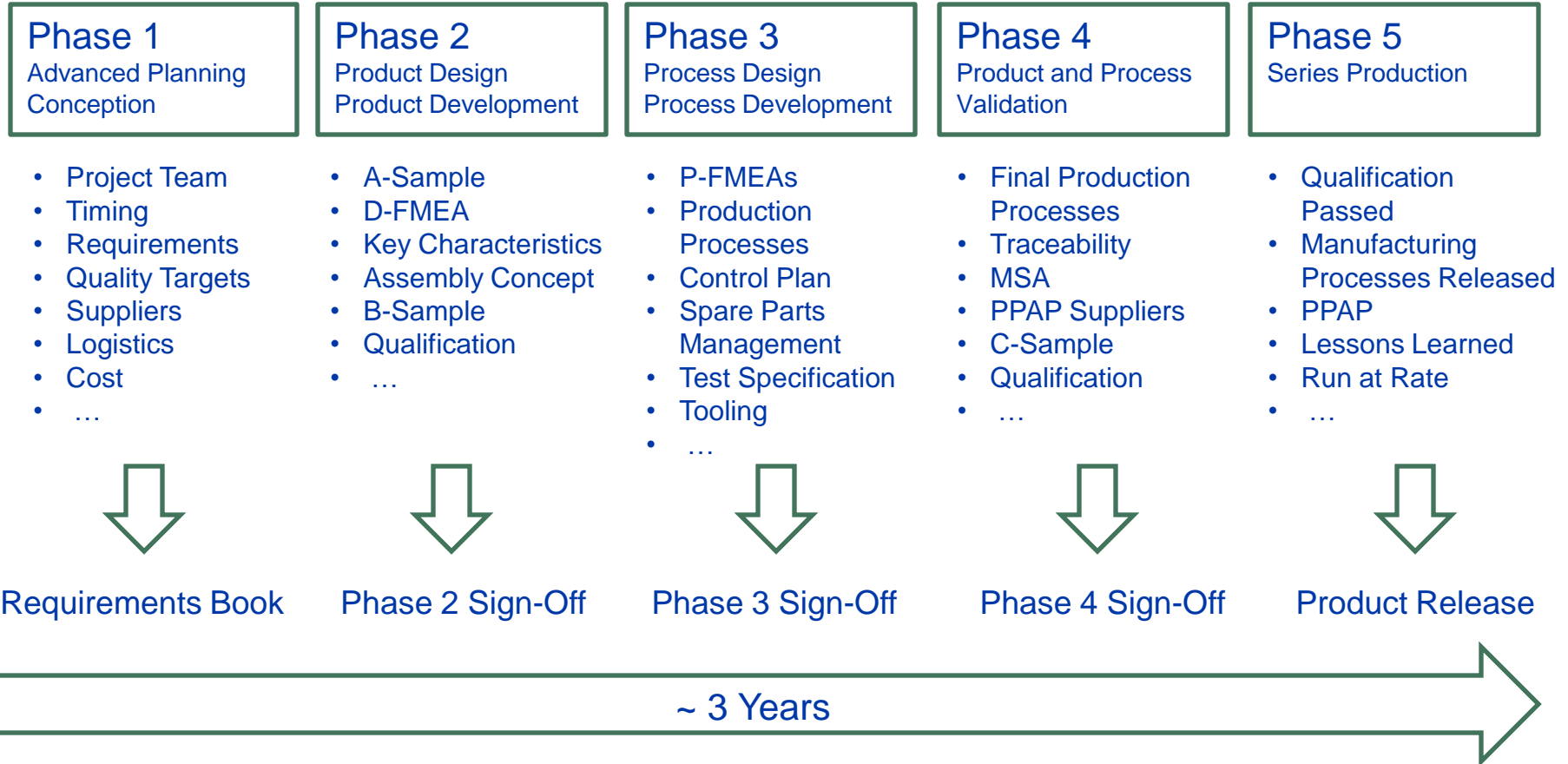
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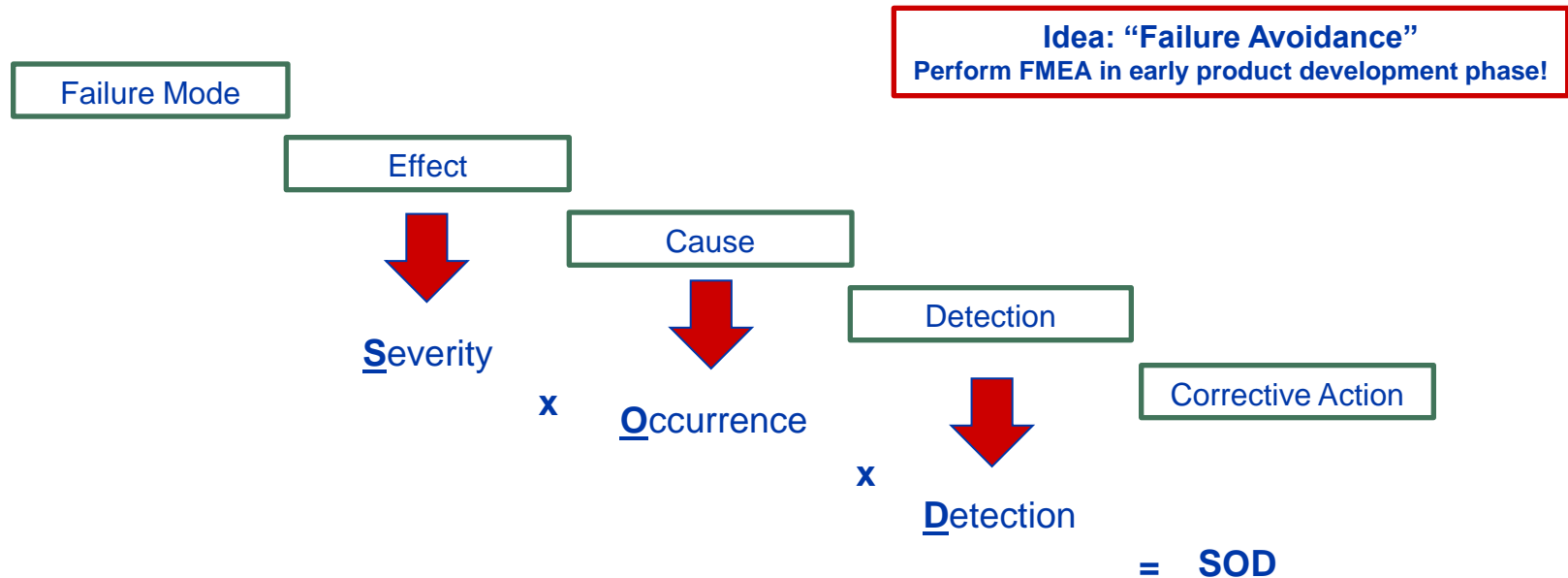


Advanced Product Quality Planning





Risk Assessment for Improved Design



Result:

- Objective rating of failure modes
- Design actions for all possible failures above a predefined SOD threshold to reduce risk
- Requirements for manufacturing processes





Qualification

Component Selection

- Full technical specification for intended use available
- Automotive qualification (AEC-Q100 for active components)
- Audit results & quality history (if available)
- Review of PPAP package
- ...

Product Qualification

- Evaluate corner samples of critical components (e.g., VCOs, LNAs, PCBs, etc..)
- Step Temperature Test between min and max. operating temperature
- Simulate component aging through HTOL and THB storage tests
- Thermal Shock Cycling between min. and max. operating temperature
- Electrical Overstress & ESD
- Component shear tests & sectioning
- ...



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PPAP – Production Part Approval Process



PPAP Motivation

- Requirements have been understood by the supplier
- Prove of capability to supply conforming products
- A system is implemented that will prevent the shipment of non-conforming products

PPAP Elements

- PSW (Part Submission Warrant) - signed summary of PPAP package
- Design Records
- Engineering Approval
- Summary of D-FMEA and P-FMEA
- Control Plan
- Measurement System Analysis
- Dimensional Results
- Samples

- ...
- ...



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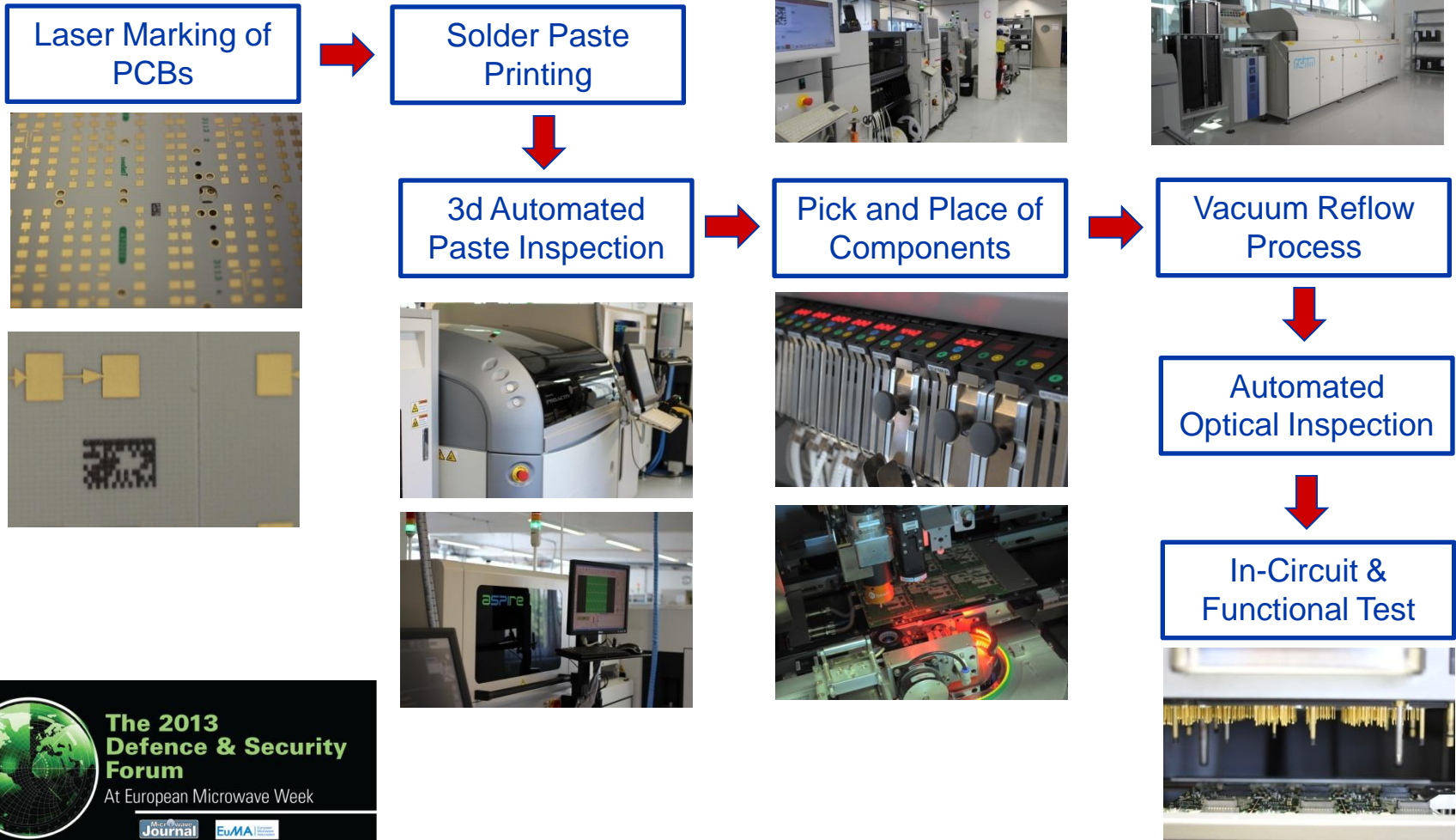




Radar Manufacturing



PCB Population Process



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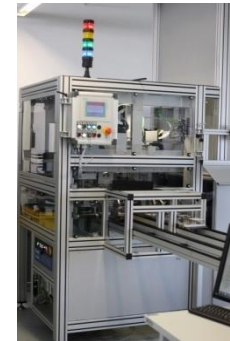
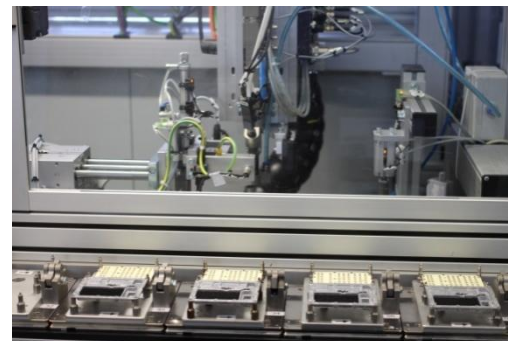
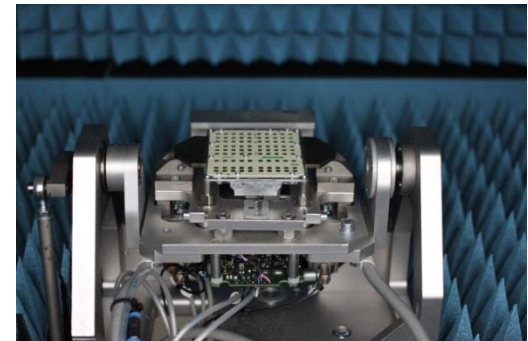
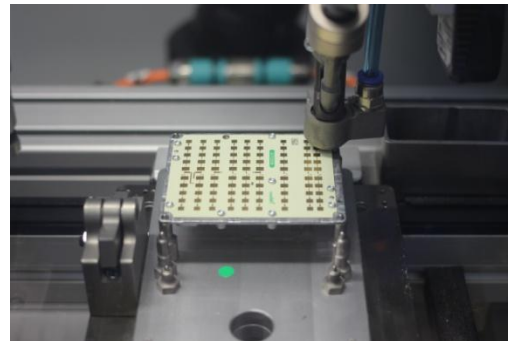
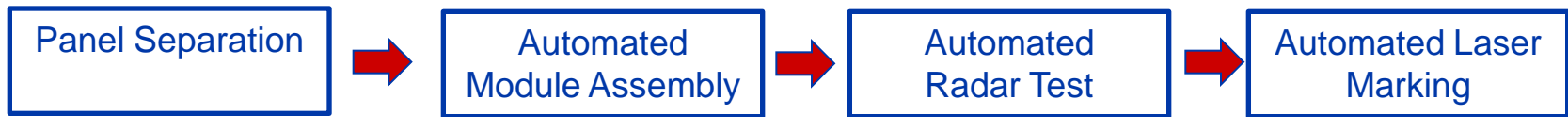




Radar Manufacturing (cont.)



Radar Module Assembly and Test



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Traceability



Traceability

- InnoSenT has implemented a traceability system that allows the tracking of manufacturing processes and electrical components populated.
- As a final check before shipment of goods it is verified that all production tests have been passed successfully for each individual radar module.
- All data is stored in a central data base and can be reviewed in case of returns.
- The lot and reel number for each component is referred to the radar serial number.



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Summery



Summery

- As an ISO-TS 16949 certified company InnoSenT has developed an implemented a quality system that is compliant with the ISO standard and is very much focused on the customer needs.
- Product Quality is the most important feature of any product developed and manufactured at InnoSenT.
- Some insight has been given to the production of Generation 2 Radar Sensors for Lane Change Applications.



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