

# **DLR UPDATES ON NEW SPACE ACTIVITIES**

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**DLR**

**German  
Space Agency  
at DLR**

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- 5. Cooperation with Japan in the field of Automotive EEE Components**

# 1. German Aerospace Center (DLR)

DLR has approximately 10,000 employees  
at 30 locations in Germany

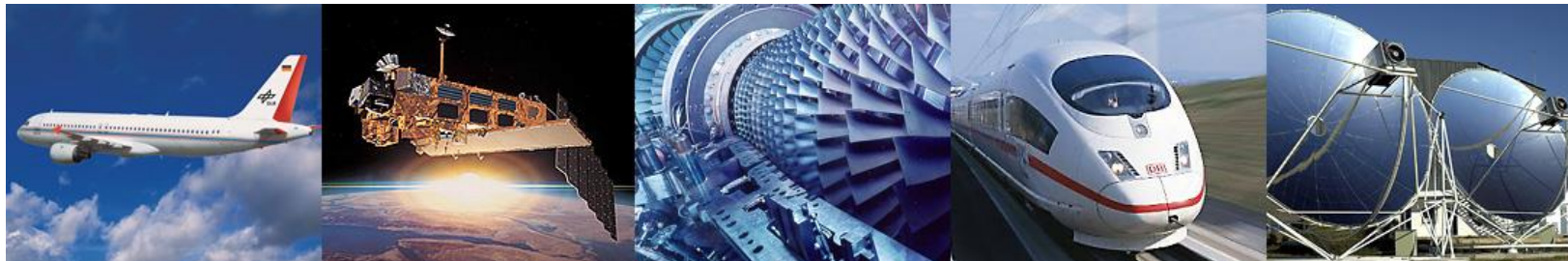
- Research and Technology
- Space Administration
- Project Management Agencies

DLR also has offices in  
Brussels, Paris, Tokyo  
and Washington D.C.

## DLR at a glance

### Research Areas:

Aeronautics, Space Research and Technology, Transport, Energy,  
Defence and Security, Space Administration, Project Management Agency



# 1. German Aerospace Center (DLR)



## Project Management Agencies

The DLR portfolio also includes the DLR Project Management Agency and the Project Management Agency for Aeronautics Research and Technology.

These agencies support their clients in planning, implementing and communicating funding programmes and other measures in research, education and innovation.

## Research and Technology

DLR provides ground-breaking services through the combination of research in aeronautics, space, energy and transport, as well as the cross-sectoral fields of security and digitalization.

With its scientific and technical expertise, DLR strengthens Germany's position as a scientific and economic location.

## German Space Agency at DLR

DLR has been assigned the task of the German national space agency. Acting on behalf of the German Federal Government, the German Space Agency at DLR designs the German space programme and implements it in cooperation with national and international partners.

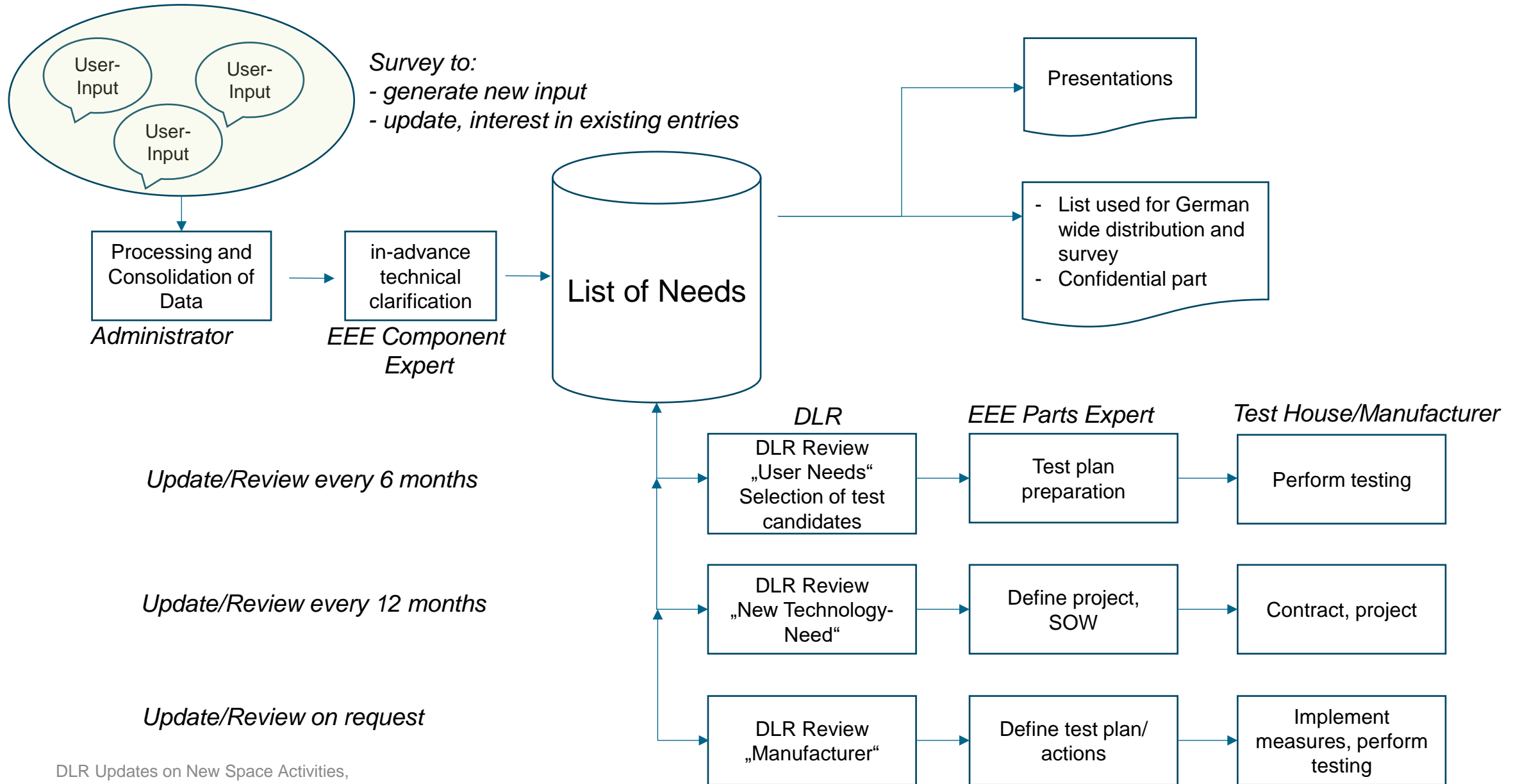
# 1. DLR EEE-Components Division Objectives



## 2. Survey to Determine the Need of EEE Components in Germany

- Conduct a survey to determine the need of EEE components in Germany, create a list comprising three sections:
  - **User needs/requirements list:** Need for tests to demonstrate suitability of automotive/COTS parts for space applications
  - **Technology Development list:** Establishment of a supply chain or development of new space technologies for EEE components in Germany
  - **Manufacturer list:** Proposals from manufacturers on components that were not designed for space applications but could be analysed for suitability
- Development of a concept for the survey, management and regular updating of the list
- Achieving the greatest possible added value for the German industry utilising synergies, strengthening manufacturers and Germany as a business location
- Selection based on detailed evaluation and defined selection criteria
- Survey has been started in February 2025

# 2. Survey Concept



# 3. National Exchange Platform: Space2Motion Network

## Space2Motion Working Group Automotive EEE Components



One of 5 working groups of the INNOspace®-Initiative Space2Motion:



**Electronic, electric and electromechanic Automotive Components for Space Applications**

### Objective:

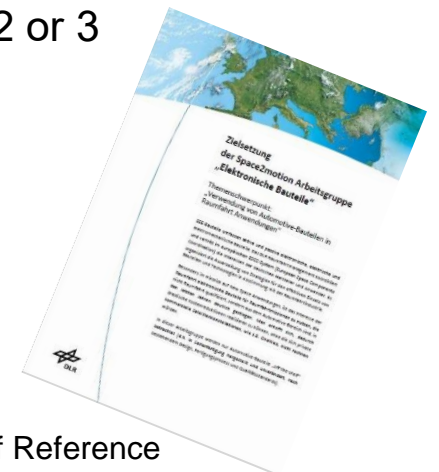
Investigation of the suitability of AEC-Q qualified components (according to AEC-Q100, -Q101 and -Q200) for space applications as defined in the Terms of Reference

### Targeted Results:

- Class 1 components, baseline ECSS-Q-ST-60-13C Rev. 1, based on users' need testing to class 2 or 3
- Data and information exchange via the DLR exchange platform

### Working Group:

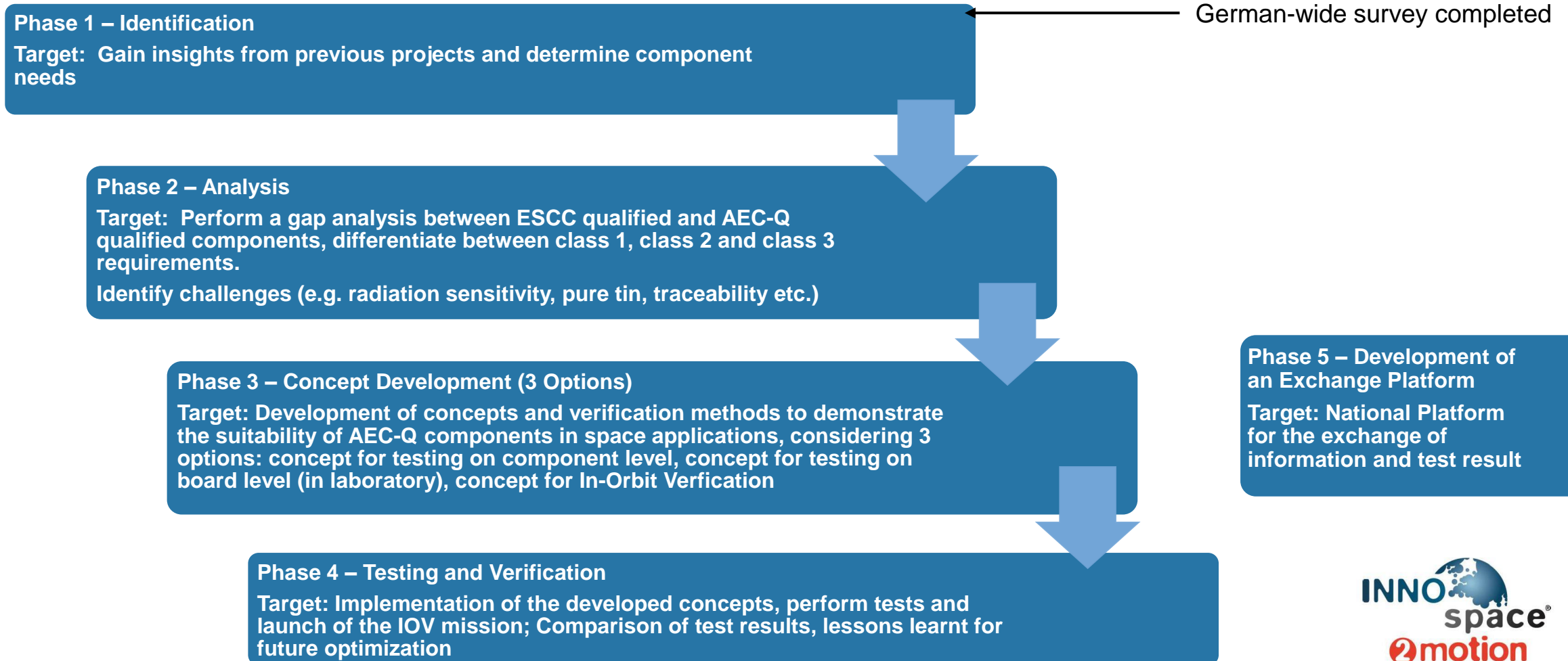
- Members from 43 companies/institutes
- Structured in 5 phases
- Activities started with preparations and a pilot project



Terms of Reference

# 3. Space2Motion Working Group Automotive EEE Components

## 3.1. Structure and Procedure



# 3. Space2Motion Working Group Automotive EEE Components

## 3.1. Targeted Results

### For space equipment manufacturers/EEE parts users

- After successful test campaign, proof of suitability of selected AEC-Q/automotive parts in space applications
- Complete data packages for use as evidence in the Justification Document
- Cost and time savings for users, risk reduction
- Availability of screened parts for direct use in equipment for space applications
- Extended range of components available for space applications (e.g. replacements for parts subject to export restrictions, new functionalities)
- Benefit from synergies

### For automotive EEE parts manufacturers:

- New market and customers
- Perspective: Depending on the evaluation result and the manufacturer's interest  
→ efforts for inclusion in EPPL Part 2

# 3. Space2Motion Working Group Automotive EEE Components



## 3.2. Completed Activities



### 1. Work package structure based on the terms of reference

- Breakdown of phase 2 and 3 into work packages
- Identification of the work packages that can be carried out either fully or partially independently from the outcome of phase 1 → „Pilot phase“
- „**Pilot phase**“ with the target to gain experience: develop a concept for testing on component level and perform testing on a subgroup of parts

### 2. Set-up of a data exchange platform

- DLR EEE Parts Portal (Sharepoint): Password-protected central place for all working group related documents, interim results etc.
- Collect participants' feedback via the platform

### 3. DLR Internal Procedures and Templates, examples:

- Mitigation Options in case of missing traceability evidence, Risk Analysis template, Selection Criteria for Pilot Phase and „real“ Phase etc.

### 4. Consolidated list of EEE parts for pilot phase based on the needs of German users and proposals of automotive parts manufacturers

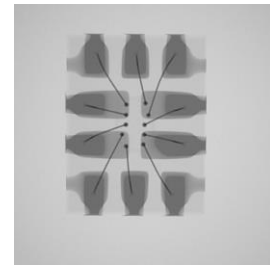
### 5. Selection of test candidates for pilot phase



# 3. Space2Motion Working Group Automotive EEE Components

## 3.2. Pilot Phase Test Campaign

Pilot Phase – 8 Test candidates, Testing on component level				
Infineon	Nexperia	Bosch	Rosenberger	Isabellenhütte
TLF51801ELV TLS202A1MBV TLE4935L	74AUP2G57GU 74AUP1G17GW (Logic lcs)	BT1M1200013 die, 1200V, SiC	H-MTD based on LV214	BVR Resistor Series, 5W 4026
TLS202A1MBV: completed TLF51801ELV: in progress	AEC-Q qualification completed; Evaluation in progress	AEC-Q qualification completed; In progress; NDA	Evaluation testing completed	Completed



74AUP2G57  
X-Ray Photograph



**Continuous selection process**

- based on the need of German users
- according to defined selection criteria
- focus on AEC-Q / automotive parts



Component Level	Board Level	In-Orbit-Verification
Selection of additional test candidates follows *)	Selection of test candidates follows	Selection of test candidates follows



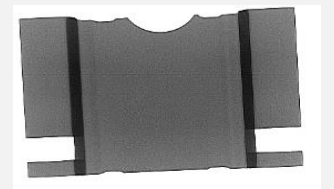
\*) based on German-wide EEE-components survey

# 3. Space2Motion Working Group Automotive EEE Components

## 3.2. Pilot Phase Test Campaign - Status and Results

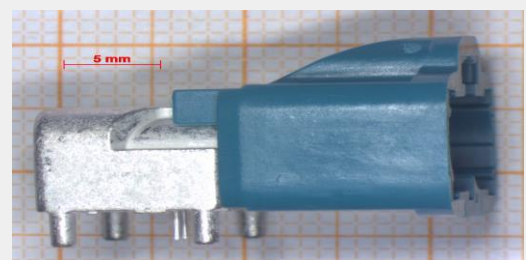
### Isabellenhütte BVR-I and BVR-Z Resistor Range

- Evaluation and Screening of AEC-Q200 qualified BVR series iaw. ECSS-Q-ST-60-13 class 1, test methods per ESCC4001 successfully completed
- Listed in EPPL part 2

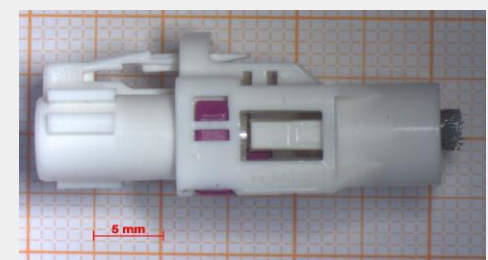


### Rosenberger H-MTD (High-Speed Modular Twisted-Pair Data) Connectors

- Test Plan covers screening and LAT1 per ESCC3401 and recognizes the tests already performed by Rosenberger iaw. LV214 Specification, Construction Analysis
- Testing completed, Report under discussion with Rosenberger and will be finalized in March 2025.



PCB Connector E6S20B-40MT5-Y (Variant "Z")

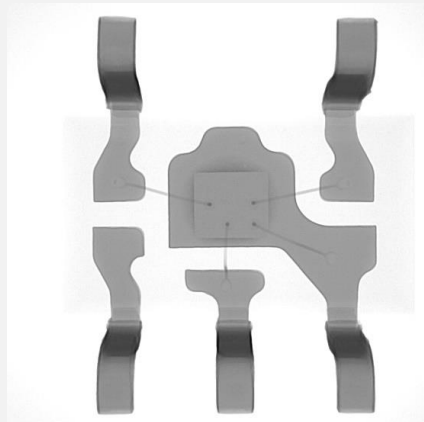


Cable Assembly Connector E6K10B-1CAZ5-Y

# 3. Space2Motion Working Group Automotive EEE Components

## 3.2. Pilot Phase Test Campaign - Status and Results

### Nexperia 74AUP2G57GU 74AUP1G17GW



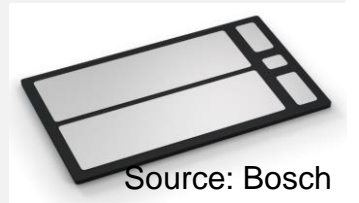
74AUP1G17, X-Ray Photograph

- AEC-Q100 qualification completed
- Upscreened parts will be offered in two finishes Sn or retinned SnPb
- Change in assembly method after first procurement, procurement of a new lot of 74AUP1G17GW
- Completed:
  - Construction Analysis, screening of samples
  - Heavy Ion Single Event Test (74AUP1G17):  
SEL immune, SET observed from LET 46.1 MeV cm<sup>2</sup>/mg but are extremely rare: saturated cross section of 5E-7 cm<sup>2</sup>
- Status:
  - TID test in planning
  - Evaluation in progress
- Expected completion in June 2025

# 3. Space2Motion Working Group Automotive EEE Components

## 3.2. Pilot Phase Test Campaign - Status and Results

<p><b>Infineon</b> <b>TLS202A1MBV</b> Voltage Regulator</p>	<ul style="list-style-type: none"><li>• Construction Analysis and 2000 hrs Life Test completed</li><li>• Heavy Ion Single Event Test No Single Event Latch-up was observed at LET = 62.5 MeV•cm<sup>2</sup> /mg Single Event Transients are observed down to LET 3.3 MeV•cm<sup>2</sup> /mg</li><li>• Total Ionizing Dose Test per ESCC22900, dose rate 360 rad(Si)/h : All devices stay functional and tested parameter are within the min/max limits specified in the datasheet up to 100 krad(Si)</li></ul>
<p><b>Infineon</b> <b>TLF51801ELV</b> DC/DC Step Down Controller</p>	<ul style="list-style-type: none"><li>• Construction Analysis and 2000 hrs Life Test completed</li><li>• Radiation testing under preparation</li></ul>
<p><b>Bosch</b> BT1M1200013, Silicon carbide trench MOS with 1200V, RDS<sub>on</sub>13 mΩ</p>	<ul style="list-style-type: none"><li>• AEC-Q101 qualified,</li><li>• Evaluation iaw. ECSS-Q-ST-60-13C Rev.1</li><li>• Assembly in package, start with SEE testing and perform afterwards TID, continue with balanced evaluation</li><li>• SEE test completed with exceptionally good SEE test results</li><li>• Non-disclosure Agreement</li></ul>



# 3. Space2Motion Working Group Automotive EEE Components

## 3.3. Summary: Process, Baseline, Lessons Learnt

### Baseline:

- Procurement of the selected AEC-Q/automotive components from a single lot
  - For evaluation tests
  - For later use as flight parts after completed screening
- Perform the evaluation testing based on the ECSS-Q-ST-60-13C Rev.1
  - Recognition of tests performed by manufacturer on AEC-Q parts → reduced evaluation testing
  - Start with Construction Analysis
  - Radiation testing TID and SEE following ECSS-Q-ST-60-15C, ESCC25100, ESCC22900
    - Increased sample size in case of missing traceability information
    - Start with SEE test and perform TID testing only based on acceptable SEE test results
- On positive Evaluation test result: perform screening of the lot

### Some Lessons Learnt:

- EEE components advertised as AEC-Q qualified may not yet have completed that qualification
- Availability of commercial / AEC-Q components is usually better, but not guaranteed (procurement during chip crisis phase → introduced delay)
- Level of information (esp. Traceability) from the manufacturer can vary greatly:  
e.g. full data package, no information, information at (high) extra cost → requires mitigation measures or NDA

# 3. Space2Motion Working Group Automotive EEE Components

## 3.3. Preparations for Concept Development for In-Orbit-Verification (IOV) Mission



### 1. IOV Concept Development

**Studies** on feasible orbits / missions / mission duration to yield statistically valid data. Interim Results – IOV/IOD:

IOV/IOD looks suitable:

For devices that have a very high Heavy ion SEE sensitivity, for devices that are sensitive to Proton-induced SEE, if SEL is not critical, in the time frame of a few months to 1 year

IOV/IOD not suitable:

If SEL is a concern; to test TID, in the time frame of less than several months (cannot distinguish between insensitive parts and low statistics)

### 2. Radiation Sensor for IOV

Concepts for realizing such a radiation sensor system are being developed. Goals:

- Lowest possible costs
- On the same board as the test system
- Ideally uses electronic components as sensors
- Measures the dose and flow of SEE-generating particles, ideally provides information on the LET of the particles

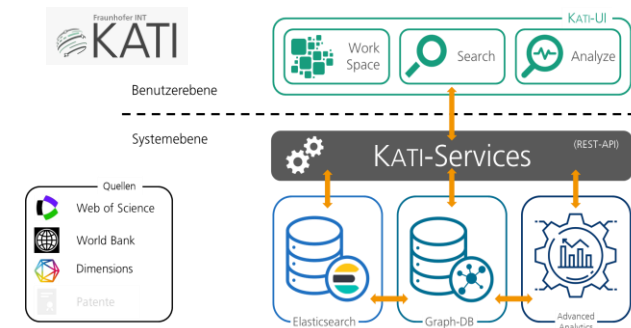
### 3. Actor Analysis for IOV

„Knowledge Analytics“ on publication and patent databases

Which players in Germany are working on this topic (and publishing or patenting)?

What is the international situation?

- Scientific publications primarily from the USA, China, Germany.
- Patents primarily from China



Source: Fraunhofer INT

# 3. Space2Motion Working Group Automotive EEE Components

## 3.4. Outlook

### Way forward over the next few years:

- Space2Motion working group members submit project proposals which fit the terms of reference and objectives of the working group
- Forming teams with Space2Motion working group members to carry out the project
- Continuous parts selection process, every 6 months



### Outlook:

Expansion of activities to

- COTS components in general
- Link to  
Space2Health  
Space2Agriculture



# 4. Technology Assessment and Preselection Activities on Commercial Components for Space Applications

## 4.1. Assessment of Commercial Optical Transceivers

### 1. Amphenol AAOP (Active Optics Products), Berlin

#### Commercial optical transceivers:

QEPT & LEAP OBT 12x full duplex Transceiver (300 Gbps/ Multimode 850 nm)

**Objective:** : Assessment of commercial optical transceiver for space applications

- ESA Contract: assessment of the reliability by evaluation with focus on non-hermetic package aspects
- **DLR Contract:** filling the gap by focusing on the **radiation** characterization

#### Status:

- TID testing on OBT samples completed
- SEE Test performed with CNES collaboration in Sept. 2024, OBT shows high SEE sensitivity
- QEPT optical transceiver selected as most promising type
- Proton beam time obtained through RADNEXT project, preparation of Displacement Damage test campaign on transceiver type QEPT ongoing

#### Next Steps:

- DD test on QEPT scheduled for April 2025
- Expected completion: June 2025

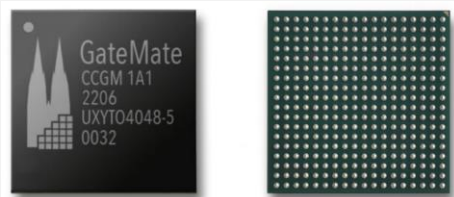


# 4. Technology Assessment and Preselection Activities on Commercial Components for Space Applications

## 4.2. Assessment of a Commercial FPGA

### 2. Cologne Chip AG, Cologne

#### GateMate™ FPGA A1



**Objective:** Assessment of the Single Event Effect sensitivity of a commercial FPGA for space application: CCGM1A1: 20k CPEs, 1.2 Mb RAM, 4 PLLs, 1 5Gb/s Serdes, 162 I/Os 1.2 V to 2.5 V, DDR-Support, 3 Performance Modes

#### **Status:**

1. Heavy Ion Test performed at CERN for LET from 12 to 38 MeV\*cm<sup>2</sup>/mg at room temp. Neither SEL nor other destructive events observed
2. Heavy Ion Test performed at UCL for LET of 16 and 62 MeV\*cm<sup>2</sup>/mg
  - Beam time obtained through RADNEXT project
  - Radiation performance greatly improved with higher core voltages

#### **Next Steps:**

- Analysis of the radiation test data obtained from the test campaign at UCL is ongoing

### Analogous approach in future on other commercial components:

- „Pre-selection“ tests on commercial parts
- Continuous with further Evaluation and/or start of ESCC qualification project pending result of evaluation/characterization tests

# 5. International Cooperation

## Cooperation with Japan



- **First German-Japanese workshop on "Use of automotive EEE components in space applications" took place in 2021**
- DLR and JAXA approved the extended framework agreement entitled **"Inter Agency Arrangement for Strategic Partnership"** on 05.04.22
- Decision of DLR & JAXA to establish a cooperation in the field of automotive EEE components **"Implementing Arrangement concerning cooperative activities related to usage of automotive components in space application"** signed in Nov. 2023.

**Open Exchange between Germany and Japan (Workshops twice a year),**  
organized by DLR and JAXA

**4th German-Japanese workshop on "Automotive EEE components in space applications"**  
21.03.2024 (online)

**5th Workshop on 22.11.2024 in Bremen, Germany (hybrid event)**

- Network Agreement has been finalized. Access to Workshops and submission of project ideas only for Network Members in future.
- First project ideas of bi-national consortia under DLR and JAXA evaluation.

# Questions & Answers



Thank you very much for your attention!