

Status of EEE-Part Development, Evaluation and Qualification in Germany

ESCC Executive Report and News

G. Joormann, DLR (German Aerospace Center)

ESCCON 2016

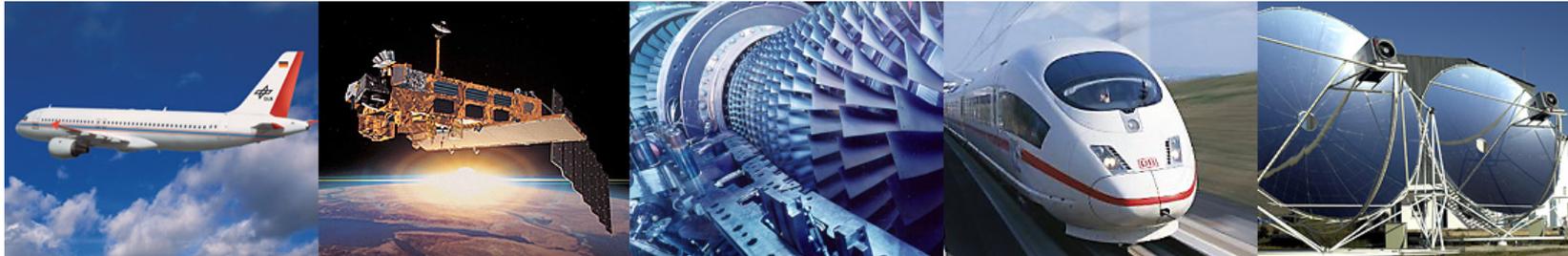


Knowledge for Tomorrow



Introduction DLR German Aerospace Center

- Research Institution
- Space Agency
- Project Management Agency



Research Areas:

- Aeronautics
- Space Research and Technology
- Transport
- Energy
- Defence and Security

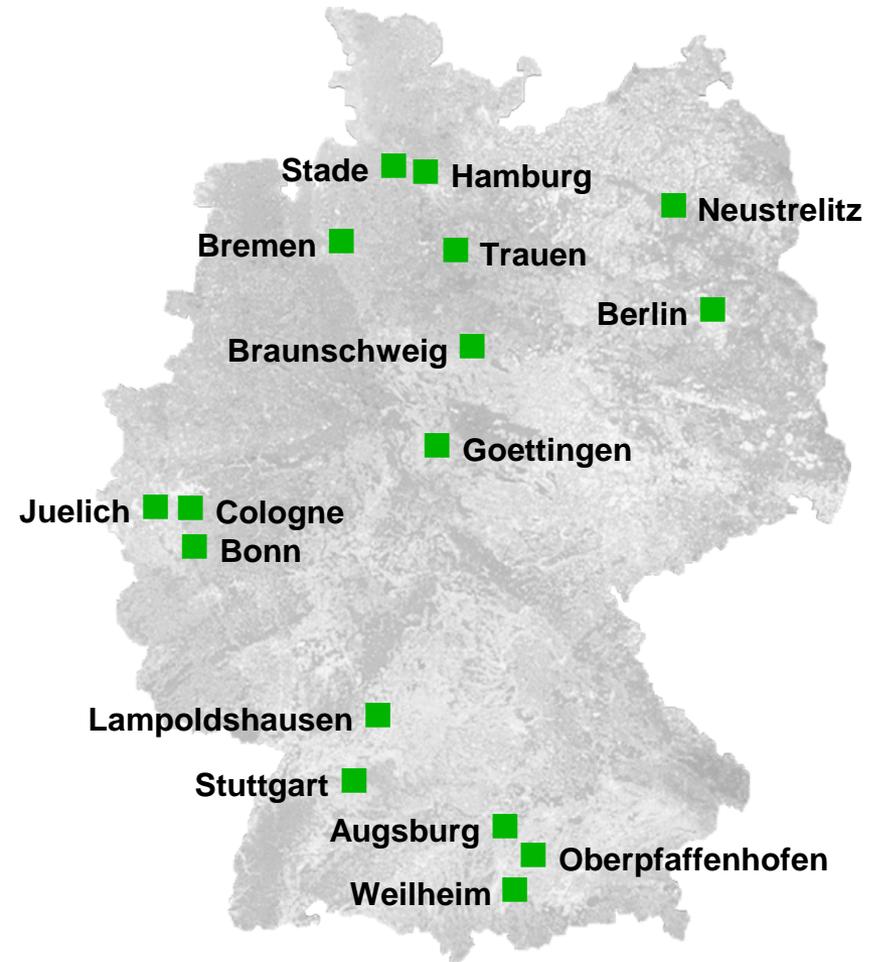


Introduction DLR

Locations and employees

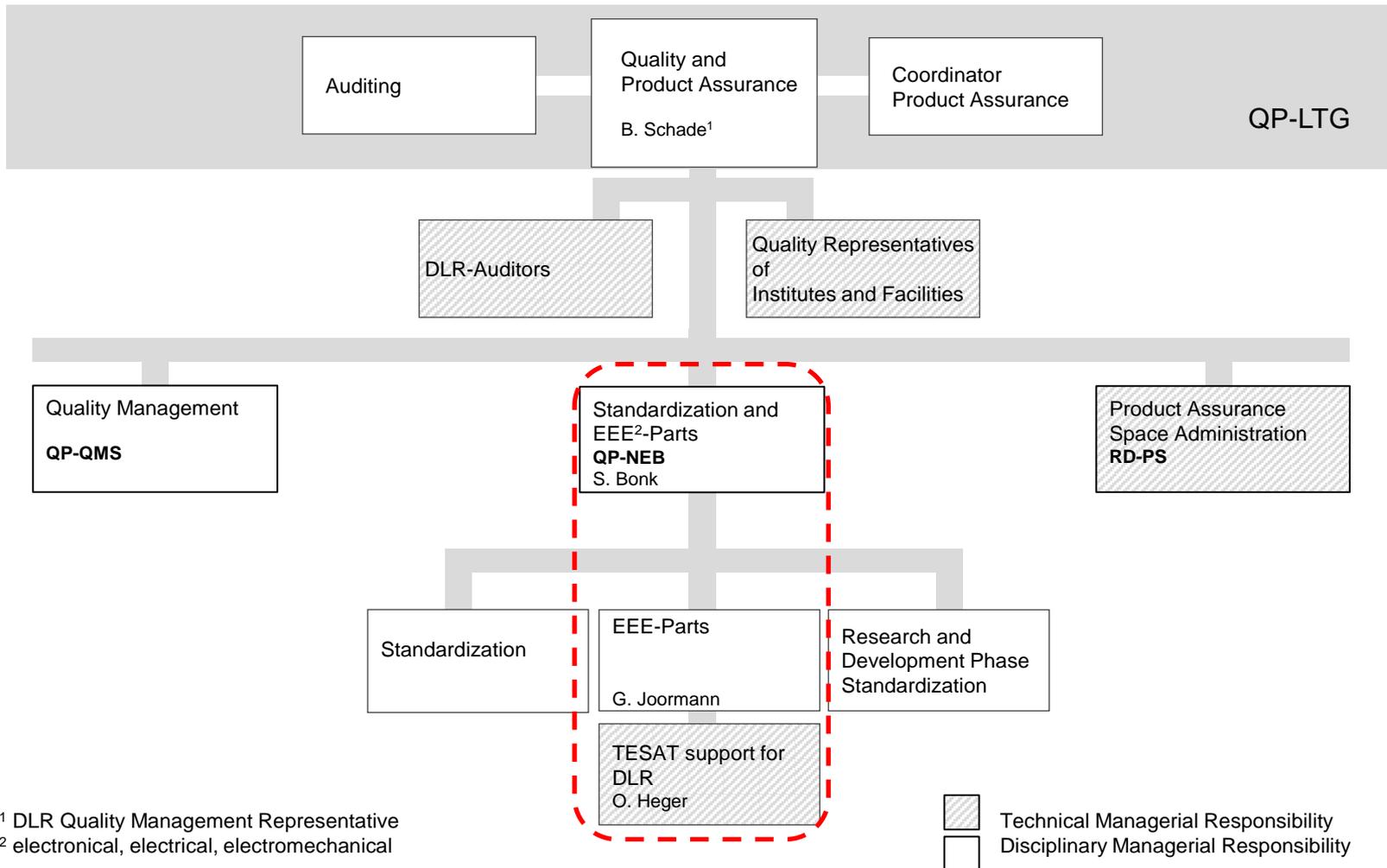
Approx. 8000 employees across
52 institutes and facilities at
■ 16 sites.

Offices in Brussels, Paris,
Tokyo and Washington.



Introduction DLR

Organizational Chart Quality and Product Assurance



¹ DLR Quality Management Representative

² electronical, electrical, electromechanical



Introduction DLR

Tasks and Responsibilities of DLR EEE-Parts Team

Definition of National Technology Development and Qualification Program for EEE-Parts for Space Applications

- Investigation of new technologies for usage in space
- Initiation and support of EEE –Part qualifications of existing and new technologies
- Coordination of national EEE –Part activities (DLR Parts Conference, external team site)
- Identification and prioritization of EEE –Parts demand with respect to the
 - Availability of "strategic parts" in the context of national participation in ESA's European Components Initiative (ECI)
 - European harmonization of EEE –Part activities
 - Strengthening Germany's technological competitiveness
- Member of the European Space Components Coordination (ESCC):
 - Representatives of the National Space Agency and the national interests of the space industry in the ESCC bodies
 - National Executive for ESCC qualifications and audits



Overview of Activities

	Topic	Contractor	Remarks
Finished since 2013	Crystals and Oscillators	KVG Quartz Crystal Technology	Crystals qualified according to ESCC specifications
	RF Connectors	Rosenberger	Qualified according to ESCC specifications
	Assembly- and Test House (ATH)	First Sensor Lewicki GmbH	Qualified according to DLR specifications
	CCGA Soldering Process	Jena-Optronik GmbH	Development and evaluation based on ECSS closed
	Commercial Space ASIC (SPAC 1)	Tesat-Spacecom GmbH & Co.KG	Suitability examination closed, Phase 2 ongoing
	Circulators / Isolators Ku-Band	Tesat-Spacecom GmbH & Co.KG	Activity stopped due to technical impracticality
	Cap. Approval of MMIC LO	OHB System AG	Activity runtime formally closed
	Eval. / Qual. of LTCC Line	Tesat-Spacecom GmbH & Co.KG	Activity runtime formally closed
Running	Evaluation of SG13-Process	IHP GmbH	Goal: Development of PDK based on new library
	Commercial Space ASIC (SPAC 2)	IMST GmbH	Goal: Capability Approval of complete supply chain
	Eval./Qual. High Voltage Diodes	Tesat-Spacecom GmbH & Co.KG	Goal: Qualification according to ESCC specifications
	GaN Power Switching Transistor	Ferdinand-Braun-Institut (FBH)	Goal: Detailed analysis of radiation effects
Planned	High Pin Count Packaging	tbd (Airbus DS / OHB)	Goal: Comparison of different assembly technologies
	Single Chip Synthesizer 1.5-12GHz	IMST GmbH	Goal: Qualification according to ESCC specifications
	Non-destructive analysis of EEE-Parts	SGS Institut Fresenius GmbH	Goal: Analysis of existing tests and their applicability
	PoL Converter SPPL12420	SPACE IC	Goal: Qualification according to ESCC specifications



Finished Activities

Crystals and Oscillators (KVG Quartz Crystal Technology GmbH)

- Crystals:
 - TO5 Package: 8 – 140 MHz qualified according to ESCC
 - TO8 Package: 2.5 – 50 MHz ESCC qualified according to ESCC
- Oscillators:
 - XO and VCXO based Crystal Controlled Oscillators successfully qualified according to DLR specifications
 - Harmonized ESCC specification based on DLR specification
 - KVG decided in 2015 to not apply for extension of qualification

RF Connectors (Rosenberger)

- Based on types SMA, SMA2.9, SMP and TNC successfully qualified according to ESCC



Finished Activities

Assembly- and Test House (ATH) (First Sensor Lewicki GmbH)

- Qualified according to DLR specifications
- Domain: Power MOSFETs, Packages: TO257, TO39, SMD0.5, SMD2
- Demand for domain extension under discussion

Development of CCGA Soldering Process (Jena-Optronik GmbH)

- Chosen packages:
 - Microsemi (former Actel) CG624 SixSigma,
 - Microsemi CG1272 SixSigma and
 - Xilinx CF1752 + modification SixSigma
- Analysis performed on parts packages, inspection methods, PCB- and mechanical design
- Results:
 - ☺ ECSS-Q-ST-70-38C requirements met for CCGA 624 & 127
 - ☹ Microsection revealed cracks in solder columns of CCGA 1752



Finished Activities

Commercial Space ASIC (SPAC Phase 1) (Tesat-Spacecom GmbH & Co.KG)

- Suitability examination, TID and SEE tests performed on test structures
- Activity closed, subsequent Capability Approval ongoing (SPAC Phase 2)

Circulators / Isolators for Ku-Band (Tesat-Spacecom GmbH & Co.KG)

- Activity stopped due to technical impracticality

Capability Approval of MMIC Local Oscillator (OHB System AG)

- Tests performed on TCV, DEC and RIC, Activity runtime formally closed
- Next steps: Review of final report and application for EPPL pt. 2

Evaluation/Qualification of LTCC Line (Tesat-Spacecom GmbH & Co.KG)

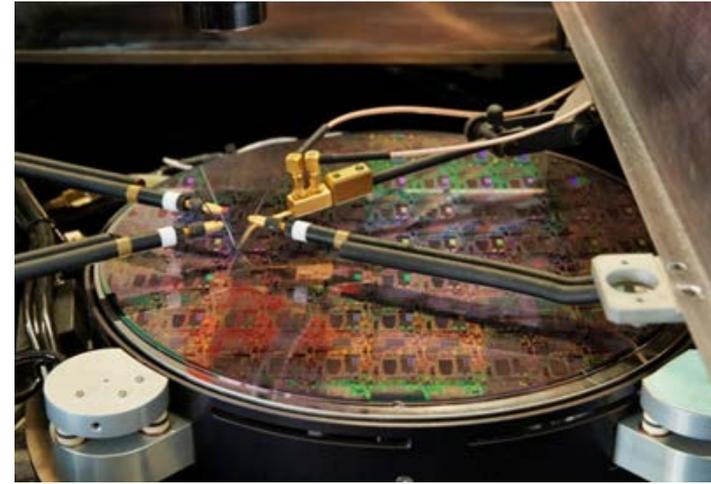
- Evaluation/Qualification successfully closed, standard ESCC life test passed, 8000h LTT and DPA open



Running Activities

Evaluation of SG13-Process

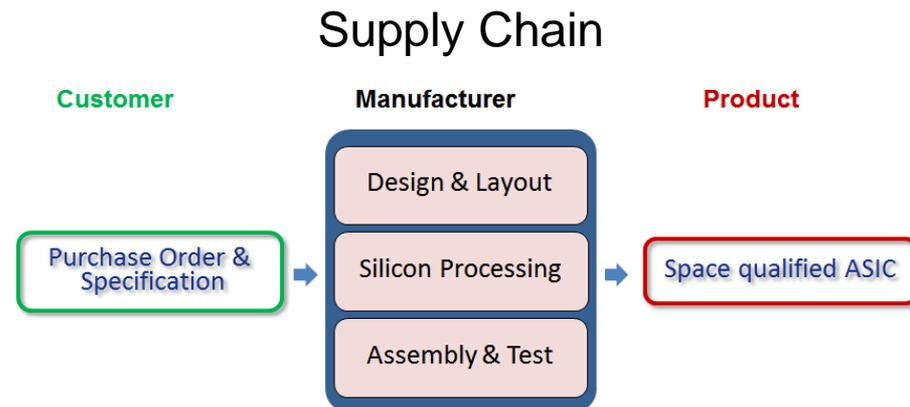
- Contractor: IHP GmbH
- Technology: 130nm SG13S SiGe BiCMOS (IHP)
- Goals:
 - Development of Process Design Kit (PDK) based on new library
 - Radiation characterization of test structures (TCV and DEC)
 - RF Applications e.g. Low Power CMOS transistors
- Status:
 - Design of TCV done, HBT transistors TID radiation hard up to 300krad
 - SEE tests performed on DEC no Latchup, LET = 65MeV/mg/cm²
 - Re-design of final DEC and radiation testing
 - End of project: Q2 2016
 - Subsequent Evaluation and endurance testing of RIC planned (ESA contract ?)



Running Activities

Capability Approval Space ASIC (Phase 2)

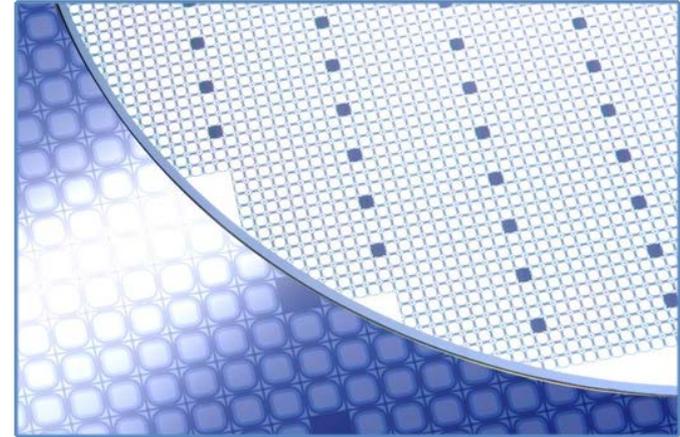
- Contractor: IMST GmbH
- Technology: 180nm CMOS (X-FAB)
- Goals:
 - ESCC Capability Approval of complete supply chain for qualified ASICs
 - Design of test-chip and detailed assessment of the technology
 - Definition and development of Space Library
- Status:
 - PID and Capability Domain drafted
 - Design of ETV done
 - Evaluation Test Plan available
 - Evaluation testing started
 - Radiation tests to be done
 - Improved SEE hardness expected
 - End of project: Q1 2017



Running Activities

ESCC Eval./Qual. High Voltage Diodes

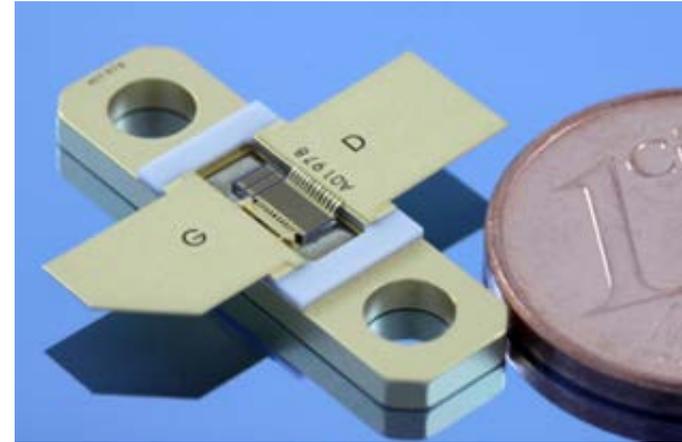
- Contractor: Tesat-Spacecom GmbH & Co.KG
- Previous project included comparison of Si and SiC technologies
- Decision based on SEE test results was to qualify Si diodes and not SiC diodes
- Goals
 - Development of thermally optimized package
 - Specified breakdown voltage: 1475V
 - Optimized radiation hardness at high voltage levels
 - ESCC Evaluation and Qualification of Si high voltage diodes
- Status:
 - Electrical performance tests show good results
 - SEB occurred at 950V → re-design necessary
 - Different Package materials to be checked
 - End of project: Q3 2017



Running Activities

GaN Power Switching Transistor

- Contractor: Ferdinand-Braun-Institut (FBH)
- Project is based on experiences and results of previous project
- Goal:
 - Detailed analysis of radiation effects on several different GaN epitaxy structures dependent on Si/SiC substrates
 - Risk assessment preparing decision for subsequent space evaluation
- Status:
 - First test run revealed SEE fails, drain leakage current increases
- In Preparation:
 - Improvement of SEE hardness and drain leakage current
 - Additional survey on passive structures & radiation testing
 - Next radiation testing campaign on active parts planned for CW16
 - End of project: Q2 2016



Planned Activities

High Pin Count Packaging assembly technologies (tbd Airbus DS / OHB)

- Comparison, development and evaluation of Micro Coil Springs soldering process and Solderless Clamping Method

Single Chip Synthesizer 1.5-12GHz (IMST GmbH)

- NOVELO Chip available based SGB25RH technology
- Eval./Qual. of Single Chip Synthesizer 1.5-12GHz

Non-destructive analysis of EEE-Parts (SGS Institut Fresenius GmbH)

- Analysis of existing non-destructive tests and applicability on space
- Practical evaluation with application on FPGAs as first step

Point of Load (PoL) Converter (SPACE IC)

- Evaluation/Qualification of PoL Converter SPPL12420 according to ESCC



Thank you for your attention!

Focal Points EEE-Parts

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Abbreviations

ASIC	= Application Specific Integrated Circuit
CCGA	= Ceramic Column Grid Array
CMOS	= Complementary Metal–Oxide–Semiconductor
DEC	= Dynamic Evaluation Circuit
DPA	= Destructive Physical Analysis
EEE	= Electrical Electronic and Electromechanical
ECSS	= European Cooperation for Space Standardization
ESCC	= European Space Components Coordination
EPPL	= European Preferred Parts List
ETV	= Evaluation Test Vehicle
GaN	= Gallium Nitride
LET	= Line Energy Transfer
PID	= Process Identification Document
RF	= Radio Frequency
RIC	= Representative Integrated Circuit
SEB	= Single Event Burnout
SEE	= Single Event Effect
Si	= Silicon
SiC	= Silicon Carbide
SiGe	= Silicon Germanium
TCV	= Technology Characterizing Vehicle

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