DLR Activities – Status of EEE Parts Development

Evaluation & Qualification Programs in Germany

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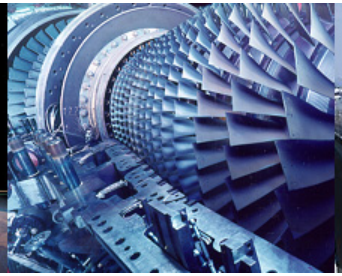
ESSCON 2013

DLR
German Aerospace Center





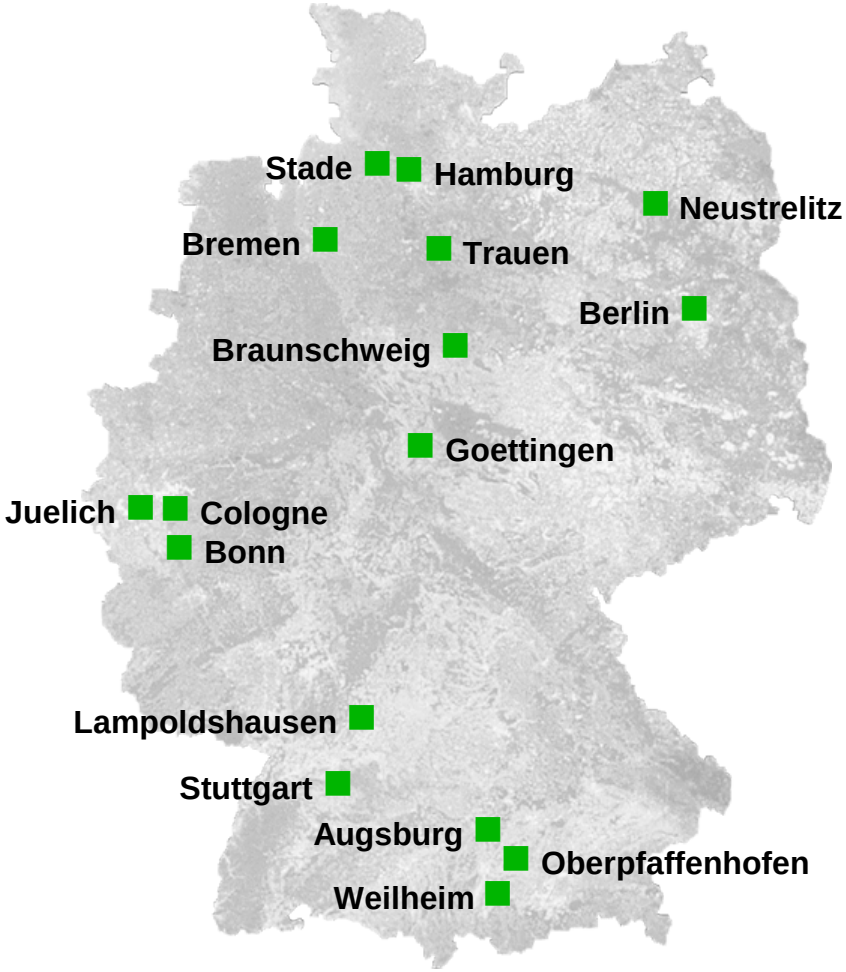
Aeronautics Space Transportation Energy

- Research Institution
- Space Agency
- Project Management Agency

Locations and Employees

7400 employees across
32 institutes and facilities at
- 16 sites.

Offices in Brussels,
Paris, Tokyo and Washington.



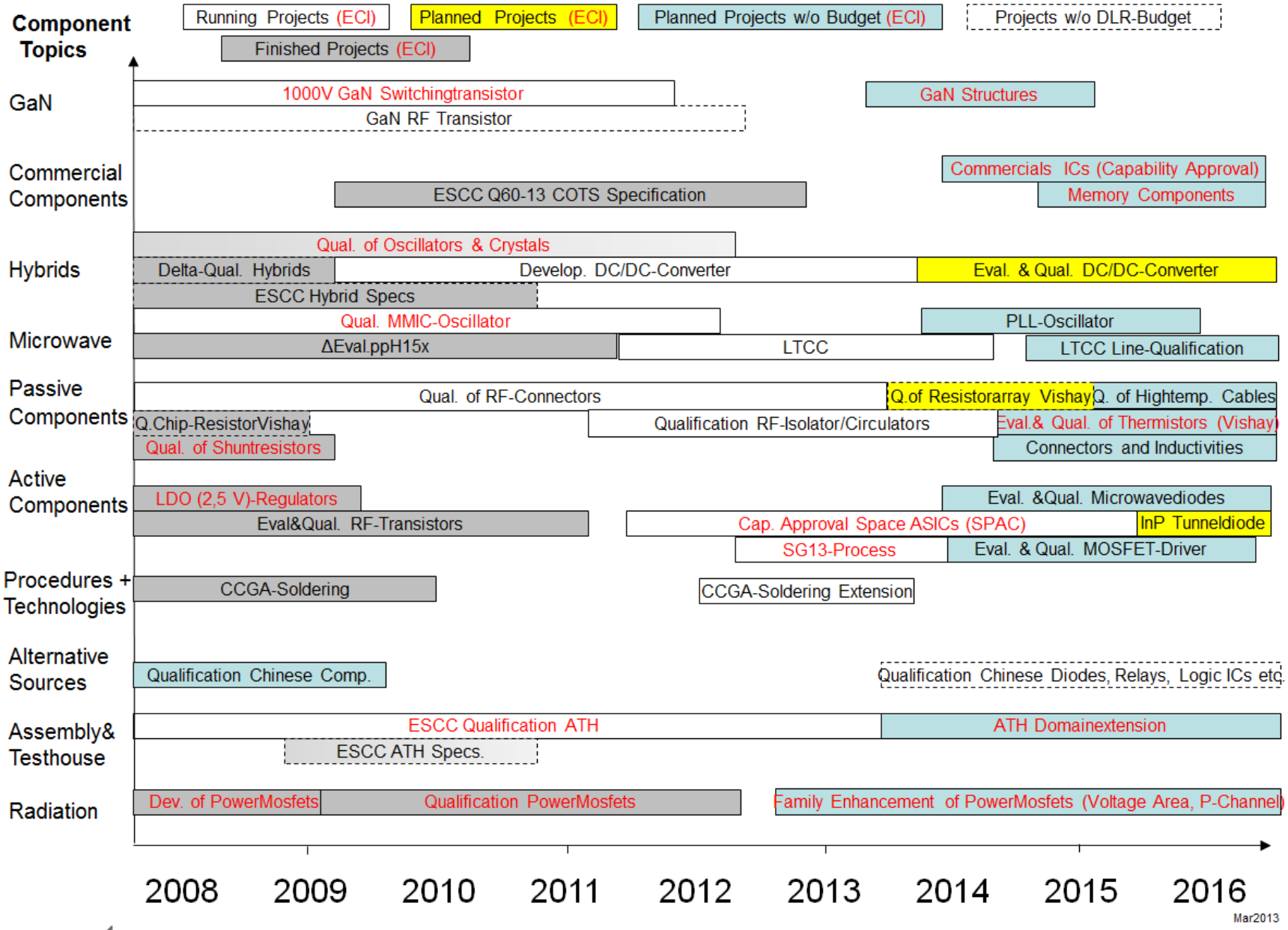
Tasks and Responsibilities within the DLR EEE-Parts Section on behalf of the Space Administration

- Determination and prioritization of the national EEE-parts demand → National technology development and qualification program → increasing EEE-part availability
- Launching EEE-part qualifications
- Performing qualification and re-qualification audits with manufacturers
- Establishing strategies to increase the availability of EEE-parts in the frame of the European programs (ECI, ESCC…)
- Representation of the German Space Administration, German manufacturers and users within the European Space Components Coordination (ESCC)
- EEE-part conferences for user and supplier needs and interests consolidation

Topics of the EEE-Part Conferences

Annual for users and suppliers, division into various priority topics

- Harmonization of the national technology development and qualification program
- EEE-part availability (and application of the QPL / EPPL)
- Qualification procedures
- Technology developments
- Identification of user needs
- Optimization of ESCC procedures
- Parts problems (alerts, export restrictions …)


Component Topics
Running Projects (ECI)
Planned Projects (ECI)
Planned Projects w/o Budget (ECI)
Projects w/o DLR-Budget
Finished Projects (ECI)
GaN
1000V GaN Switchingtransistor
GaN RF Transistor
GaN Structures
Commercial Components
Commercials ICs (Capability Approval)
ESCC Q60-13 COTS Specification
Memory Components
Hybrids
Qual. of Oscillators & Crystals
Delta-Qual. Hybrids
Develop. DC/DC-Converter
Eval. & Qual. DC/DC-Converter
ESCC Hybrid Specs
Microwave
Qual. MMIC-Oscillator
PLL-Oscillator
ΔEval.ppH15x
LTCC
LTCC Line-Qualification
Passive Components
Qual. of RF-Connectors
Q.of Resistorarray Vishay
Q. of Hightemp. Cables
Q.Chip-ResistorVishay
Qualification RF-Isolator/Circulators
Eval.& Qual. of Thermistors (Vishay)
Qual. of Shuntresistors
Connectors and Inductivities
Active Components
LDO (2,5 V)-Regulators
Eval. &Qual. Microwavediodes
Eval&Qual. RF-Transistors
Cap. Approval Space ASICs (SPAC)
InP Tunneldiode
SG13-Process
Eval. & Qual. MOSFET-Driver
Procedures + Technologies
CCGA-Soldering
CCGA-Soldering Extension
Alternative Sources
Qualification Chinese Comp.
Qualification Chinese Diodes, Relays, Logic ICs etc.
Assembly& Testhouse
ESCC Qualification ATH
ATH Domainextension
ESCC ATH Specs.
Radiation
Dev. of PowerMosfets
Qualification PowerMosfets
Family Enhancement of PowerMosfets (Voltage Area, P-Channel)
2008
2009
2010
2011
2012
2013
2014
2015
2016
Mar2013

Closed Activities

Product	Manufacturer	Action	Started	Status
Diodes und RF-Transistors	Infineon	Evaluation and qualification	07/2008	Closed Qualification closed, report available, listed on ESCC QPL
Power MOSFETs	Infineon	Product development, evaluation and qualification	08/2008	Closed Qualification closed, good characteristics, radhard, listed on ESCC QPL
GaN 1000 V switching transistor	Tesat	Development	07/2007	Closed 250 V / 250 A and 1000 V / 5 A normally-off switching transistors developed

All activities of the National technology development and qualification program of EEE parts for space applications:
http://www.dlr.de/qp/desktopdefault.aspx/tabid-3091/4699_read-6881/

Ongoing National Qualification Activities – Overview

- KVG: Crystals and oscillators
- Rosenberger: RF connectors
- Lewicki: Assembly- and Test-House
- Kayser-Threde: Qualification of a Local Oscillator MMIC (Cap. Approval)
- Tesat: Commercial ASIC (SPAC)
- Tesat: Circulators / Isolators
- Jena-Optronik: Qualification of a CCGA Soldering Process
- IHP: Evaluation of IHP-SG13 Process
- Tesat: LTCC-Line

National Qualification Activities

Crystals and Oscillators

KVG Quartz Crystal Technology, Neckarbischofsheim

Crystals: TO5 Package: 8,0 -140 MHz qualified
TO8 Package: 2,5 - 50 MHz qualified

Oscillators: DIL14 (4 Pins), Flat pack
XOs: 8,192 MHz - 125 MHz
VCXOs: 10 MHz - 90 MHz

Status Oscillators :

- Qualification finished successfully
- Test report available, DPA results to be updated
- Problems: Cracks in the glass feed troughs of the Flat pack packages
  RGA values outside the specification
- Root cause: Test adapter
- Note: Qualification done based on DLR specifications

National Qualification Activities

RF Connectors

Rosenberger Hochfrequenztechnik, Tittmoning

Types: SMA, SMA 2.92, SMP, TNC

Status:

- Evaluations tests of Types SMA, SMA 2.92 & TNC available, test reports accepted by ESA
- October 2012: Manufacturer audit and Qualification-Kick-Off for SMA, SMA 2.92 und TNC
- Detail Specification for SMP prepared
- Evaluations tests of PCB connectors done (special PCBs manufactured)
- Contract extension until June 2013

National Qualification Activities

Assembly- and Test-House

Lewicki Microelectronic, Oberdischingen

Domain:

- Assembly- and Test of Power-MOSFETs
- Packages: TO257, TO39, SMD0.5, SMD2

Status:

- Evaluation phase running until 03/2013
- Documents are up to date (DLR specifications on DLR website soon)
- Problems on encapsulation of SMD2, SMD05, TO257 packages solved (parameters for welding fixed)
- Optimization of process chain (ESD protection, bonding fixture…)
- Approval for qualification in stages (now encapsulation of qualification samples)

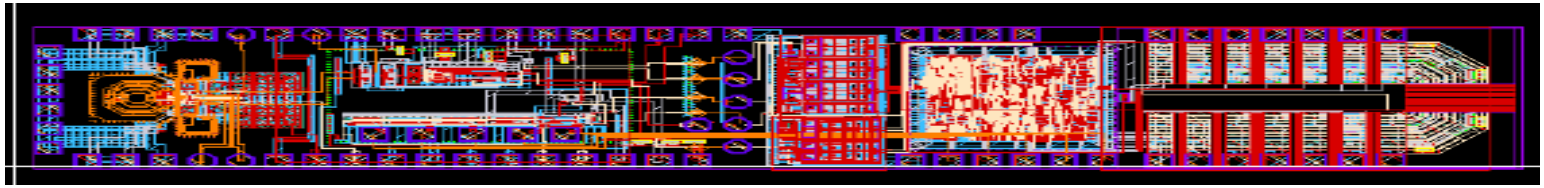
National Qualification Activities

Qualification of a Local Oscillator MMIC (Capability Approval)

Kayser-Threde, München; IHP, Frankfurt/O; RHe, Radeberg

Capability Approval of SGB25V Process

- TCV, RIC: all tests finished successfully
- DEC: Failures with CMOS shift register after necessary revision, test setup in order, further failures on ECL shift register (VCO), studies ongoing, LTT parameter to be verified and fixed
- CA and ESD reports still not available
- Contract extension until June 2013



National Qualification Activities

Commercial ASIC (SPAC)

Tesat Spacecom, Backnang; IMST, Kamp-Lintfort

Capability Review and Approval

- Project currently stopped, original partner insolvent, fab. closed
- Projects redefined with new partner, company IMST in Kamp-Lintfort
- Contract situation: Phase 1 about continuing March 2013
  Phase 2 to be redefined

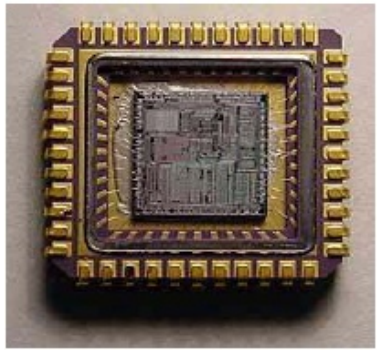
Planned work:

Phase 1: Suitability examination

- Development of test structures for TID and SEE tests
- Review of the process of radiation tolerance
- Creation of library

Phase 2: Capability approval

- Creating the necessary documents
  (Domain description, PID, test plans ...)
- Preparation of test samples
- Performing tests



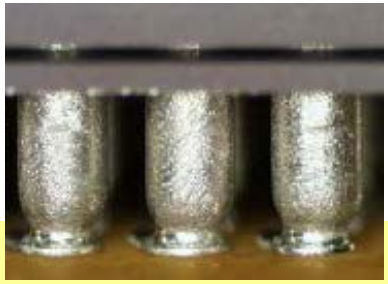
National Qualification Activities

Circulators / Isolators

Tesat Spacecom, Backnang

ESCC Qualification of COAX Circulators/Isolators (Ku-band, 10.7 - 12.75 GHz)

- **Activities:**
  - Phase 1: Evaluation
  - Phase 2: Qualification
- **Status:**
  - PID (Process Identification Document) und evaluation test plan drafts available
  - ESCC detail specifications und evaluation plan drafts prepared (have to be reworked)
  - Manufacturing of evaluation samples stopped because redesign necessary
  - Changes of design: gap welding changed to lead bonding, different package material; SMA connector with DC edge; Ferrite lasts over complete frequency range; higher temperature stability; one design for whole frequency range
  - Delay: approx. 18 months => end of project February 2015



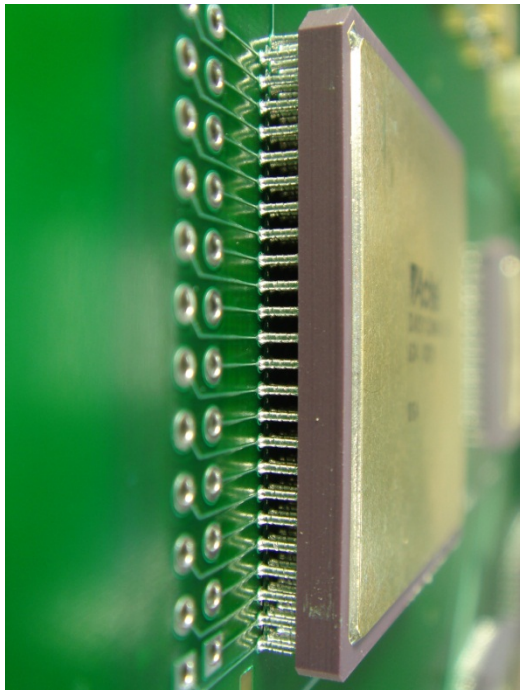
National Qualification Activities

Development of a CCGA Soldering Process

Jena Optronik, Jena

Parts:

- Actel CG624 Six Sigma Columns
- Actel CG1272 Six Sigma Columns
- Xilinx CF1752 + alteration with Six Sigma Columns



Activities:

- **Phase 1: Analysis phase finished**
  - Analysis of columns → Six Sigma Columns
  - Analysis of PCB material → FR4, Thermount NT85
  - Analysis of design variants → Corner Pins, AL Frame
  - Analysis of stress conditions →1500x Temp. cycles
  - Analysis of inspection → combination of methods
- **Phase 2: Qualification**
  - Parts procurement (624CCGA,1272CCGA, 1752CCGA)
  - Manufacturing of test samples
  - Performing tests
  - Assessment of results
  - Documentation
- End of project December 2013

National Qualification Activities

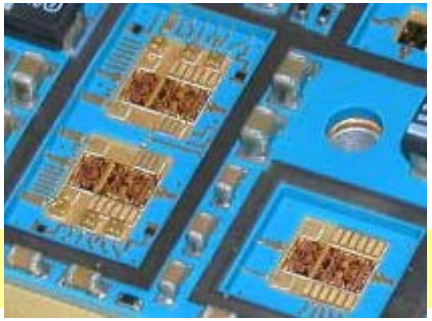
Evaluation of IHP-SG13-Process

IHP, Frankfurt/Oder

SG13: Mixed Signal 130 nm technology with focus on high frequencies and low power CMOS transistors

- **Three phases planned:**
  - Phase 1 Radiation Investigation — DLR contract
  - Phase 2 Evaluation — ESA contract
  - Phase 3 Qualification — t. b. d.
- 16. October 2012: Phase 1 Kick-off Meeting at DLR
- **Activities in phase 1 (Radiation Investigation)**
  - Development of a Design-Kit based on a new library
  - Definition, construction and test of TCV
  - Radiation tests on TCV
  - Definition, construction and test of DEC
  - Radiation tests on DEC
  - Suitability check of a RIC
    (Phase 2: Evaluation of RIC planned via ESA contract)
- End of phase 1 December 2014

National Qualification Activities



Tesat Spacecom, Backnang

LTCC Line

Evaluation and qualification of an LTCC Line

- **Activities: (non-)hermetic module**
  - Phase 1: Evaluation (Pre-phase on „non-hermetic”-Ericsson-Module as TCV)
  - Phase 2: Qualification (up to 8000 hLT)

- **Status:**
  - PID (Process Identification Document) draft available
  - Domain description available
  - Evaluation test plan available as draft (8000 hLT, 800 cycles)
  - After meeting with ESA in Nov. 2012: Approval for construction of evaluation test samples
  - Line survey planned for 04/2013 (evaluation test results available, qualification plan)

- End of project: October 2014

Planned Activities (1)

Product	Manufacturer	Activity	Planned start	Started	Status
Radiation characterization of parts	Telefunken Semiconductors	Radiation characterization	2013		PoL Converter, Extended common mode LVDS Driver / Receiver chosen from product portfolio → see backup (Feedback from inquiry)
Assembly- and Test House	NN	Extension of qualified domain	2014 ?		Can start only after successful certification of ATH
PoL Converter	IHP	Evaluation und Qualification / Capability Approval	? (2011)		Qualification of product and line; can start only after finished development of product
ADC/DAC-Converter	Kayser-Threde/IHP	Development and Evaluation	2007	ESA-2007	DAC: Inside ECI3 in 2010 TRP defined and closed in 2012; ADC: tender made in autumn 2012 16 Bit, 20 MSPS
Up and Down converter as MMIC	Kayser-Threde/IHP	Development and Evaluation	2008		Already started as LTCC circuit in project Keramis
High temperature cables	Leoni Special Cables	Development, Evaluation and Qualification	2009		Planned by ESA inside ECI-3 Planned partner: Axon (Germany)

Planned Activities (2)

Product	Manufacturer	Activity	Planned start	Started	Status
SAW filter	Vectron	Evaluation and qualification	2011		Product (Norspace ESCC TFQ QML listed); available, already in use in space applications, → No additional need
LVHC converter	Advanced Space Power Equipment	Evaluation and qualification	?		Evaluation and qualification of a PoI-converter preferable → Qualification not planned any longer
Radiation characterization on commercial function modules	Astrium	Radiation characterization			Was meant for realization of PoL converter → not planned any longer
SiC high voltage diodes	Infineon / Tesat	Suitability check (definition of package, assembly, test)	2011		Commercial product available, → Currently no need
Chinese Parts 2	Tesat	Continued project: evaluation and qualification	2011		Continuation of cooperation with CAST, → Currently no need
16 bit ADC circuit	Jena-Optronik / IHP	Development, evaluation and qualification	2011		Only user identified: JOP; Additional need?
Power MOSFETs	Infineon	Development and qualification TO254- and TO257 Package	?		Focus on SMD packages; Need is unclear
FPGA	ATMEL	Development, construction and qualification	?		Proposal of ATMEL, Seek for funding
GaN-Technology	UMS, FBH, IAF, ?	Need?	?		Feedback → Inquiry of EEE-parts conference

Thank you for your attention!

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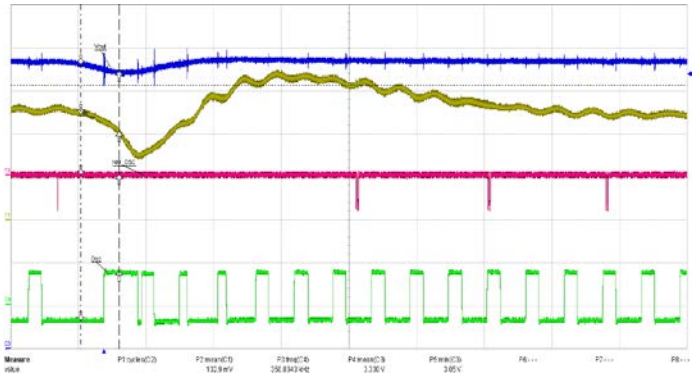

Telefunken Semiconductors
Components for ESCC Qualification

- Point-of-Load Converter
  - TID 100krad: no fails, max 10% drift
  - SEE 60.7MeV/(mg/cm2): no fails →
  - High efficiency > 90%
  - VIN ≤ 26V, IOUT ≤ 3A
- LVDS Receiver & Driver
  - TID 100krad: no fails, max 4% drift
  - SEE will follow soon
  - -7V to 12V extended common mode →
  - ESD 8kV HBM
- **volodymyr.burkhay@telefunkensemi.com**