ESCCON 2011

**European Space Components Conference**
**ESA ESTEC**
**(Newton 1 and 2 Conference Rooms)**

**Final Programme of Thursday 17 March 2011**
**Chairman: A. Coello - Vera / Thales Alenia Space**

| | | |
|---|---|---|
| 14:00 – 14:20 | Supply chain for a mixed-signal ASIC – example of a solution<br>*H. Hegny, Director Technology and Analysis, TESAT-Spacecom* |
| 14:20 – 14:50 | ESCC Past and Future – the Components Technology Board<br>*J-C. Tual, ASTRIUM, as chairman of the ESCC CTB* |
| 14:50 – 15:15 | ESCC Past and Future – the Policy and Standards Working Group<br>*P. Lay, CNES, as chairman of the ESCC PSWG* |
| 14:50 – 15:15 | High Reliability products for Space use<br>*W. Kübler, Infineon Technologies AG* |
| 15:30 | Concluding remarks |

ESCC

PIONEERING WITH PASSION

# Supply Chain for a mixed-signal ASIC – example of a solution

**ESCCON 2011**

**15.-17.03.2011**

**Helmut Hegny, Volker Lück**

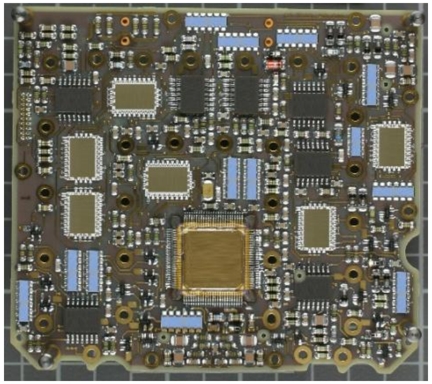
**Contact: Helmut.Hegny@tesat.de**

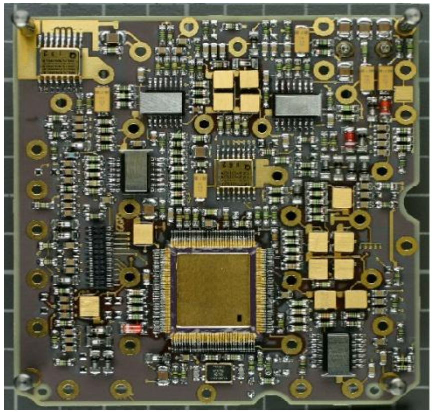
# Agenda

- Why mixed-signal ASICs?
- Examples of mixed signal ASICs
- General Supply Chain
- Supply Chain Options & Assessment
- Supply Chain Examples
- Conclusions

# Why mixed-Signal ASICs ?

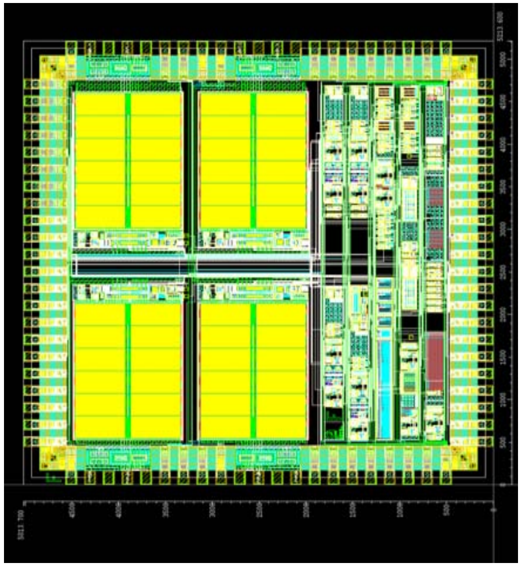
- Higher Performance
- Less Power
- Less Area
- Less Mass
- Less Cost
- Higher Reliability





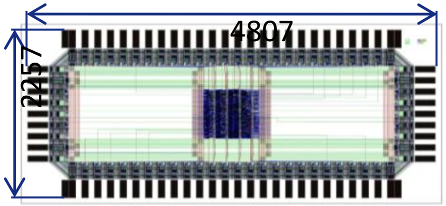
13x ICs → 7x ICs
6x resistor arrays → 0x resistor arrays
double side population → single side population

# Why mixed-Signal ASICs ?



ON Semiconductor
Analog functions

+



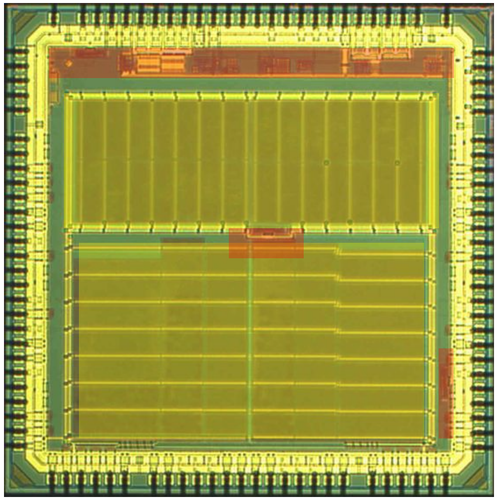

UMC 0.18µ CMOS (DARE)
Digital functions

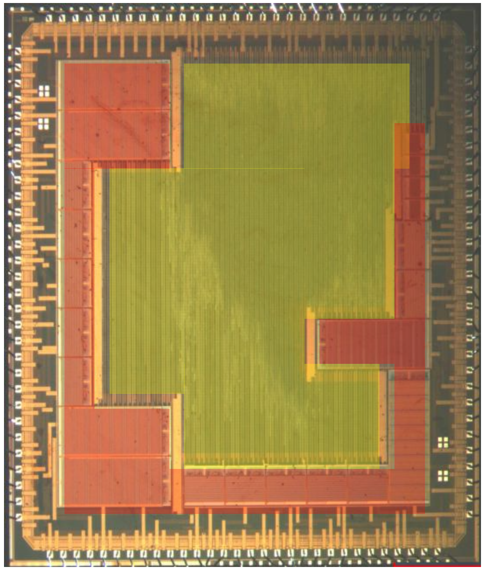
=

Higher Performance
Less Power
Less Area
Less Mass
Less Cost
Higher Reliability

**Project:** REDSAT
**System:** Direct Radiating Antenna
**Designer:** ARQUIMEA & UC3M
**Customer:** EADS CASA ESPACIO
**Final Customer:** HISPASAT

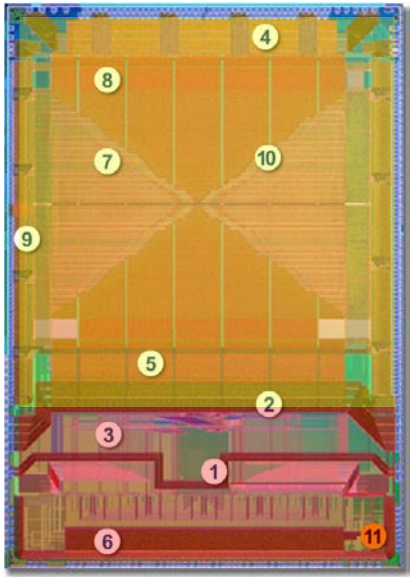
# Examples: Mixed Signal ASIC





TLFA1 (Tesat Testchip)
LFoundry 0.15µ CMOS
Radiation Tested

KNUT (Tesat)
UMC 0.18µ CMOS (DARE)
Radiation Tolerant




Actel Fusion
0.13µ CMOS Flash FPGA
Commercial

# General Supply Chain

| | |
|---|---|
| Management | Design |
| | Layout |
| | Manufacturing |
| | Assembly |
| | Electrical Test |
| | Environmental Tests |
| | Screening |
| | Qualification |

# Supply Chain Options

| | | | | |
|---|---|---|---|---|
| Management | IMEC | Tesat | Serma / Arquimea | and others |
| Design | IMEC | Tesat | TES / Arquimea | and others |
| Layout | IMEC | TES | | and others |
| Manufacturing | UMC | LFoundry | XFab | and others |
| Assembly | HCM | e2v | Indra | and others |
| Electrical Test | Microtest | Serma | IMS | and others |
| Environmental Tests | Maser | Maprad | TRAD | and others |
| Screening | Microtest | Serma | | and others |
| Qualification | IMEC | Serma | Hirex | and others |

# Definition: Supply Chain Option & Assessment Items

| | |
|---|---|
| Management | IMEC |
| Design | IMEC |
| Layout | IMEC |
| Manufacturing | UMC |
| Assembly | HCM |
| Electrical Test | Microtest |
| Environmental Tests | Maser |
| Screening | Microtest |
| Qualification | IMEC |

- Design Space (D)
- Cost (C)
- Time (T)
- Risk (Ri)
- Responsibility (Re)

| D | C | T | Ri | Re |
|---|---|---|---|---|

# Definition: Assessment Items

| | | |
|---|---|---|
| Design Space (D) | Red | firm & fix |
| | Yellow | limited |
| | Green | flexible |
| Cost (C), Time (T), Risk (Ri) | Red | high |
| | Yellow | medium |
| | Green | reasonable |
| Responsibility (Re) | Red | Management takes NO Risk |
| | Green | Management takes Risk |

TESAT SPACECOM

# Example: Supply Chain „pure digital ASIC“

Management

| | |
|---|---|
| Design | Customer |
| Layout | ASIC Vendor |
| Manufacturing | ASIC Vendor |
| Assembly | ASIC Vendor |
| Electrical Test | ASIC Vendor |
| Environmental Tests | ASIC Vendor |
| Screening | ASIC Vendor |
| Qualification | ASIC Vendor |

**One-Stop Shop!**

**ASIC Vendors:**

- Atmel
- Honeywell
- etc

D C T Ri Re

# Example: Mixed Signal ASIC KNUT (TESAT)

Management

| | |
| --- | --- |
| Design | Tesat / IMEC |
| Layout | IMEC |
| Manufacturing | UMC |
| Assembly | HCM |
| Electrical Test | Microtest |
| Environmental Tests | Maser, Maprad |
| Screening | Microtest |
| Qualification | IMEC |

**Coordination of Subcontractors !!!**

D C T Ri Re

# Example: Mixed Signal ASIC TLFA1(Tesat)

Management

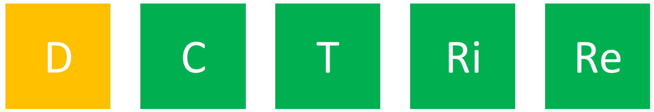
| | |
|---|---|
| Design | Tesat |
| Layout | TES |
| Manufacturing | LFoundry |
| Assembly | HCM |
| Electrical Test | Tesat |
| Environmental Tests (Radiation) | Maprad / Tesat |
| Screening | Tesat |
| Qualification | - |

**Subcontractors may vary !!!**

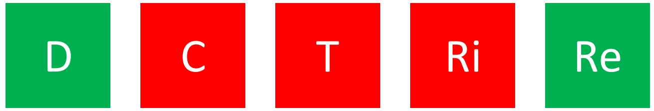
D C T Ri Re

# Supply Chain Options

- Easiest Way: one-stop solution!
  (not available, yet)




- Hardest Way: do it yourself!
  (time- and resource- consuming)




- Smoothest Way: select a paved way!
  (restrictive, no competition)


- Smartest Way: cherry-picking - best fit!
  (increased management overhead)

# Conclusions

- “One-stop solution” is still a wishful thinking.
- “Paved-way solution” is available (e.g. IMEC/UMC).
- “Cherry-picking” is based on previous experience. You have to feel the pain, first.

- Introduction of standards & solutions to enable easy “cherry-picking” necessary.
- Standards & solutions require investment, at best from institutions (ESA or EU) to make them freely available.

- “Fabless” company could make „one-stop-solution“ feasible. Taking on overall responsibility and offer a variety of options.

# ESCC - Past and Future
# The Component Technology Board

Jean-Claude Tual
As CTB chairman

**ESCCON**
**17 March 2011**

# Introducing the CTB

- What is the Component Technology Board ?
- Why a Component Technology Board ?
- What are the objectives and tasks of the CTB ?
- How is the CTB working ?
- What are the major stakes addressed by the CTB ?
- What are the Strengths, Weaknesses, Opportunities and Threats for the CTB ?
- Conclusion

# What is the Component Technology Board ?

ESCC
European Space Components Coordination

- **The Component Technology Board (CTB) is a supporting unit of the ESCC**.

- **The European Space Component Co-ordination (ESCC) is a co-operative arrangement in the field of EEE component and technology** with the goal to establish a world class electronic, electrical and electro-mechanical component system, through which are provided components at competitive costs and suitable for demanding space applications.

- **The CTB is in charge of the formulation of strategic programs and work plans for technology research and development in the area of European EEE space components.**

- **It is also responsible for the harmonization and co-ordination of the collectively funded European space component and technology research and the related development, evaluation, qualification, standardization and quality assurance activities.**

# Why a Component Technology Board ?

- **Availability of reliable Electronic Components is critical.**

  Almost all programs are suffering from technical and quality difficulties in component procurements with significant business impact for systems and equipment manufacturers:
  - Obsolescence issues,
  - Evolution of manufacturer strategy,
  - Major technical problems and delays,
  - Procurement issues from single-source supplier (European and non-European) or non-European suppliers.

- **Availability of adequate and enabling technologies for future missions is critical**
  - Future needs space missions require step improvements (complexity, speed, miniaturisation, reliability, power, ...) compared to current technologies.
  - Increased gap compared to non-European technologies.
    Lack of competitive solutions penalises bid competitiveness (ASIC, FPGAs, Processors, GaN….)

- **Focusing on common components and technologies is a benefit for all actors**
  - The end-user with qualified, field-proven parts,
  - The manufacturers with larger business volumes,
  - The funding organisations with an optimisation of available resources and avoidance of effort duplication.

**The CTB is deemed to address these issues and propose a coordinated vision of all actors on future needs and developments for components**

# What are the objectives and tasks of the CTB ?

- **Identify strategically important EEE components and technologies** anticipated to become standard requirements for future space missions in synergy with other market sectors.

- **Assess the technology trends and available component and technology manufacturer's portfolios and capabilities.**

- **Establish plans to make the technology available in time, at affordable costs and desired quality level for space project users**.
  Define and monitor the required component development, evaluation, qualification, studies and research activities.

- **Propose and support initiatives for the advancement and promotion of European component and technology supply chain** to reduce European dependence for strategically important technologies.

- **Minimise the duplication of efforts and optimise the usage of available resources**.

# How is the CTB working ?

❖ **The CTB is organised with a main board and several expert working groups addressing the different EEE domains : passive, active/silicon, hybrids & packaging, microwave, photonics, MNT, radiation, materials & processes.**

❖ **The CTB is composed of a balanced representation of the European Space community who intends to actively support the CTB initiative**

- ESA and NSA representatives : (~50 people involved)
- Space Industry (primes and equipment manufacturers) (~45 people involved)
- Manufacturer Industry (~40 people involved)
- Other members participating on a case by case basis (manufacturers or labs)

❖ **The CTB proceeds from a common agreement of the future needs and preferred solutions to be developed.**

The key success factors for the CTB hold in the involvement of the whole supply chain (from users to manufacturers including funding organisations) and in the motivation, participation, expertise and delegation of the its expert members.

# What are the major stakes addressed by the CTB ? 1/3

## Develop
## Next Generation Digital Technologies

- **Maintain access to a "0.18µm-like" CMOS technology for the next 5 to 10 years**, particularly for Avionics Platform Equipments
  - As a general purpose, low-cost, medium complexity ASIC and FPGA technology
  - With extension to mixed-signal capabilities to further miniaturise the analog functions

- **Enable future scientific and telecom missions with digital technologies featuring a step improvement in term of complexity, data rate and flexibility,**
  - DSM (Deep Sub Micron) 65 nm CMOS technology identified as Next Generation Digital Technology core following current 0.18µm technology.
  - Development of derived products : ASIC ( ~20 MGates) , HSLL (6Gbps+), FPGA (2Mgates+), DSP (1 GFlops+) started or planned
  - The main stakes here are to:
    - secure a complete end-end-end supply chain compliant with the user requirements and viable for the manufacturers
    - secure the funding required over the next 4 to 5 years
    - demonstrate the reliability and performances of such complex products
    - allow the emergence of an appropriate industrial organisation to design, manufacture and supply this type of technology and products

# What are the major stakes addressed by the CTB ? 2/3

## Improve
## performances, miniaturisation and cost of future systems

- **Improve the miniaturisation, cost, standardisation of space systems with**
  - Advanced packaging and interconnection technologies :
    - High Pin Count packages and associated assembly and PCB technologies
    - flip-chip assembly for high-speed, high complexity DSM ASICs
    - non-hermetic packages
  - Micro and Nano Technologies : mechanical, optical or RF devices
  - Introducing Mixed-ASIC technology for better integration and lower cost of analog interface units
  - Introducing new components in Power electronics for better efficiency and performance

- **Offer advanced capabilities to future payloads and instruments**, particularly in
  - Microwave with
    - Development of GaN technology which will enable a new generation of high performance SSPA.
    - continuous development of standard space-qualified microwave parts
  - Photonics with
    - Advanced laser, photodiodes and other photonics components for Telecom and Sciences applications
    - Future imaging sensors for Earth Observation and Sciences applications

## What are the major stakes addressed by the CTB ? 3/3

### Maintain
### the reliability and affordability of future systems
### and the sustainability of supply chain

- **Develop secured and sustainable sources for reliable and affordable active and passive components by**
  - Definition of qualification plan (AQP) for needed components, technologies and capabilities.

- **Understand and mitigate the effects of radiation on EEE components**
  - Knowledge of radiation environment, effects and induced failures,
  - Develop test methods,
  - Develop mitigation techniques.

- **Analyse and mitigate the impacts of RoHS and REACH directives** on the supply chain of components and materials and on Space Electronics assembly processes.
  - Mitigate the risks of using lead-free components by appropriate measures and procedures,
  - Develop knowledge of lead-free finishes, lead free assembly process, reliability of lead free assemblies

# Strengths, Weaknesses, Opportunities and Threats for the CTB

## Strengths

- Cohesion of European Space Component Community through ESCC.
- High motivation and implication of all actors with support of agencies, Eurospace and manufacturers.
- Strong European technology basis with key enabling technologies; DSM, ADC/DAC, GaN, active, passive and RF components, MNT.

## Opportunities

- Stable, long term funding scheme for components & technologies as proposed at ESA.
- New models based on commercial technologies: use of COTS and commercial foundries.
- Cooperation with other sectors now facing similar constraints (automotive, aeronautics).
- Cooperation with non-European and/or non-Space agencies.

## Weaknesses

- Availability of resources and funding, particularly in some domains (packaging)
- Very long process from technology selection
  -> to funding
  -> to development
  -> to qualification and to flight
- Main capabilities located only in a few countries with lower contribution in small countries.
- Link and impact of CTB recommandations on agencies plans

## Threats

- Quick reshaping of the component manufacturing industry , with possible sudden disruption or change of the supply chain, that could endanger future plans
- Less control on the supply chain and on the reliability of technologies. Less access to information.
- Pressure on budget reducing capacity for European space developments and increasing gap compared to non-European competitors.

# Conclusion

- CTB is an active and successful platform for preparing roadmaps and work plans for commonly agreed future needs.

- Transforming these plans into products available on time, at the right cost, is quite more difficult.

- **Could we still afford and succeed these developments on a European-only, Space-only basis ?**

  **Should synergies and coordination be extended to other non-space sectors and non-European organisations ?**

- For future, even if the European Component Supply Chain is facing threats and difficulties, there are new opportunities to pursue the main goal of the CTB :
  *to ensure the availability for the European Space Community of reliable, qualified, high performance and enabling components through sustainable supply chains, supported by adequate development and qualification programs*.

**The challenge for the CTB is to adapt to the new context and to keep the momentum for coordination between all stakeholders.**

# Thank you for your attention !

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as CTB chairman

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# ESCC Past and future

by the **P**olicy & **S**tandard **W**orking **G**roup





Philippe LAY as Policy & Standard Working Group Chairman
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France
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# 1. Organisation (1/2)

- ESCC stands for **E**uropean **S**pace **C**omponents **C**oordination
- Membership : Agencies, Industry, manufacturers

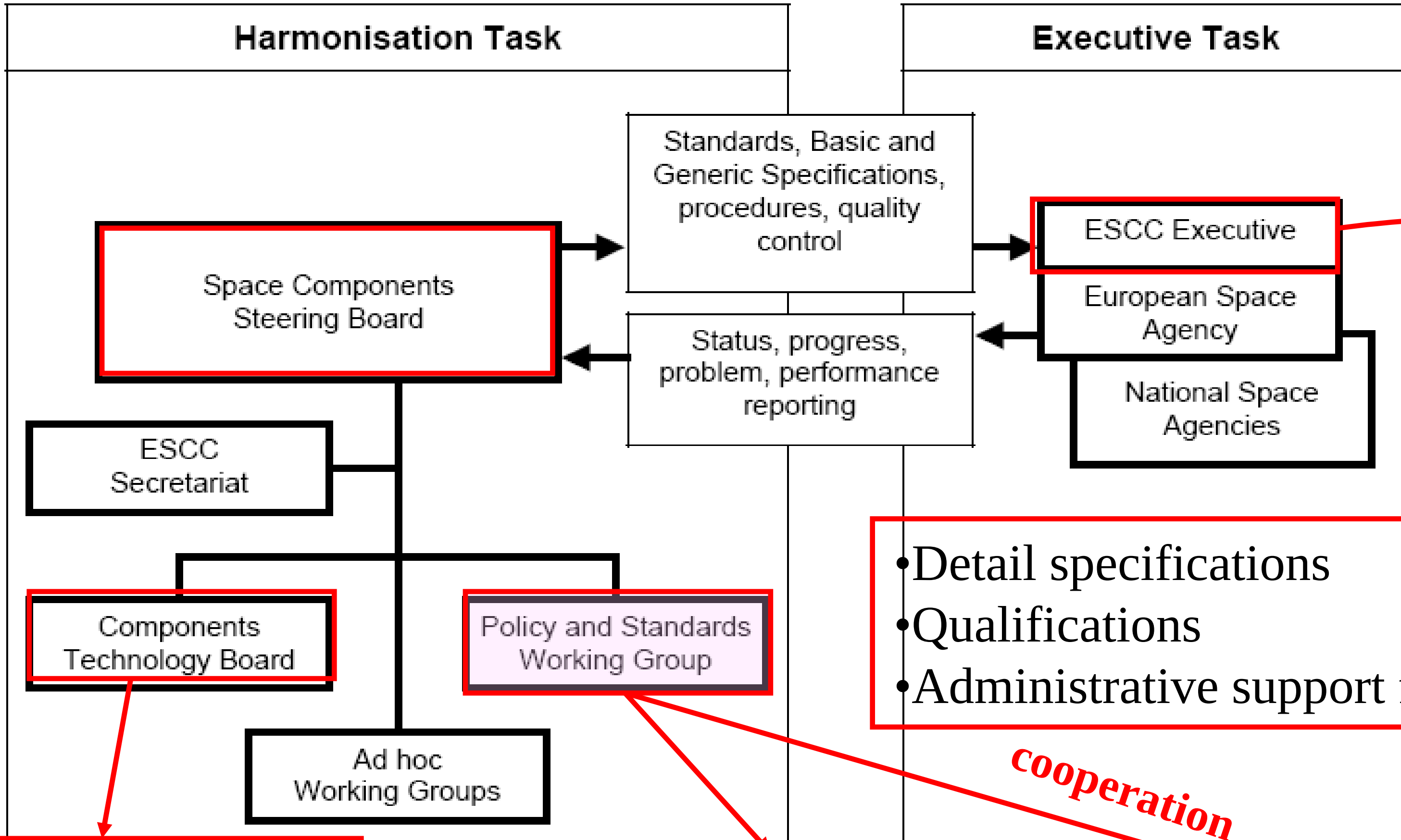
- The ESCC System is applicable to **E**lectrical **E**lectronic **E**lectromechanical (EEE) Components
  - Electronic : ICs ( LSI, VLSI), transistors, diodes …
  - Electrical : resistors, heaters, capacitors, connectors, cables, crystals, thermistors, fuses …
  - Electromechanical : relays, switches …

- ESCC = set of requirements to **evaluate**, **qualify**, **procure** (screening, lot test) European EEE components

- QPL = **Q**ualified **P**arts **L**ist; QML = Qualified Manufacturers List
- EPPL = **E**uropean **P**referred **P**arts **L**ist includes European & non European parts, not only qualified ones

- 3 ways to qualify : component qualification, capability approval, technology flow qualification.

# 1. Organisation (2/2)




- Detail specifications
- Qualifications
- Administrative support function

- Annual qual. programme
- 5 years R&D strategy
- Trend analysis
- Studies and research
- Evaluations

- Generic/Basic spec.
- Policy matters
- Promotion

EUROPEAN COOPERATION FOR SPACE STANDARDIZATION

# 2. PSWG Mission

cooperation

- Generic/Basic spec.
- Policy matters
- Promotion

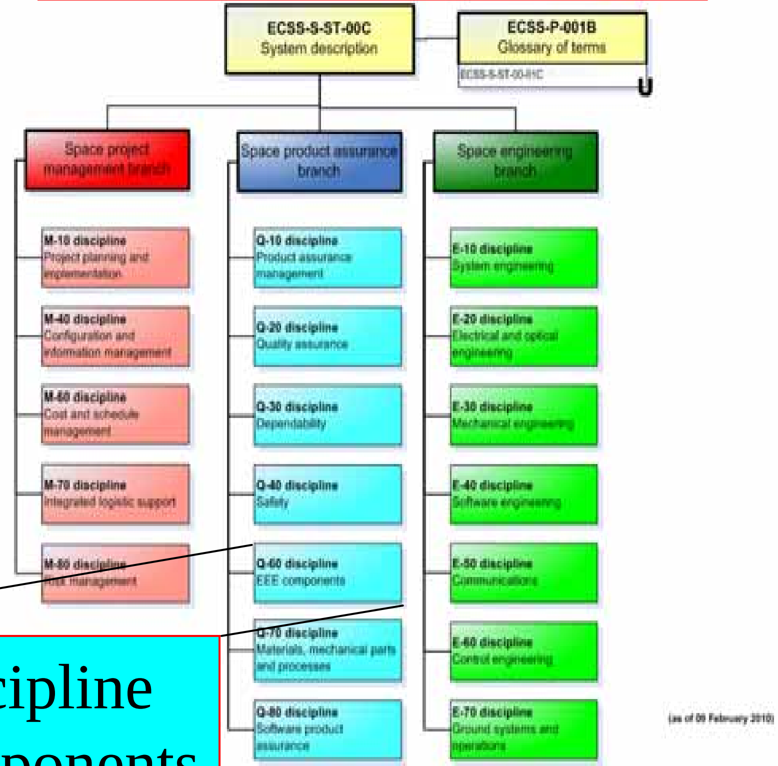
EUROPEAN COOPERATION
ECSS
FOR SPACE STANDARDIZATION

esccies.org
european space components information exchange system

**EPPL | *European Preferred Parts List***

***Issue: 17***

***Issue Date: 2010-12-15***




PSWG =
- ideas sharing and confrontations,
- actions & follow-up,
- directions choices,
- priorities definitions, arbitrations,
- approvals, decisions

Q-60 Discipline
EEE Components

# 3. Achievements (1/4): ESCC (1/2)

**ESCC specifications approval (change or new)**

Since 2002, through 75 Document Change Request among 150 generic & Basic spec:

Basic Specifications :

- QML implementation : ESCC25400 ; ESCC2544001
- Establish Reliability for resistors : 4001 ; 26000 (Failure Rate Level Sampling Plans and Procedures )
- Minimum Quality System Requirements : ESCC 24600
- Recommendations for the evaluation & procurement of non standard electronic parts : ESCC 23100 & ESCC 23500 (lead finish)
- Qualification : ESCC 20100
- Component Manufacturer Evaluation : ESCC 20200

Generic Specifications :

- CCD : ESCC 9020
- Integrated circuits , discrete : ESCC 9000, ESCC5000
- Resistors : 4009
- Crystal Resonator : ESCC3501
- Relays (Evaluation Test Plan, Screening)
- Switch /thermostat : ESCC 3702
- Coils : ESCC 3201

## NASA Parts Selection List - Application Notes

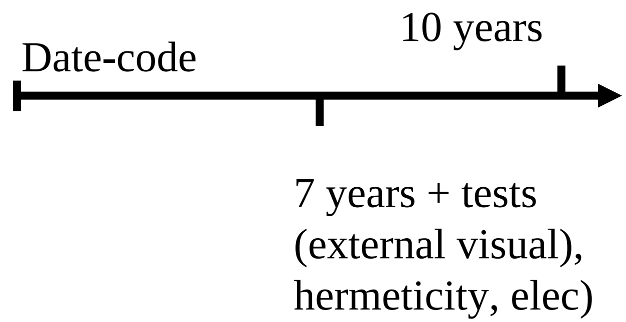
- Guidance for users
- Review & disposition of the 180 Application Notes
- Work performed in May 2010
- Recorded in an Excel® file (available in the ESCIES site)

NASA Electronic Parts and Packaging Program

Technology Information for Future NASA Missions

# 3. Achievements (3/4) : ECSS (1/2)

- ECSS-Q-ST-60C : Requirements (see next slide)
- ECSS-Q-ST-60-14 : Relifing
  - Storage & removal from storage




- ECSS-Q-ST-60-02 : ASICS/FPGA
  - ASIC and FPGA development
- ECSS-Q-ST-60-05 : Hybrids
  - Generic procurement requirements for hybrids
- ECSS-Q-ST-60-12 : MMIC
  - Design, selection, procurement and use of die form monolithic microwave integrated circuits (MMICs)

- *No direct PSWG role for :*
  - *ECSS-Q-ST-30-11 /derating,*
  - *ECSS-Q-HB-30-12 /end of life parameters ESCC Spec*



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# 3. Achievements (4/4) : ECSS (2/2)

- **Pre-tailoring included** : 3 classes of requirements (assurance/risk trade-off)
- Typical requirements (non exhaustive)
  - Declared Components List
  - Parts/material restriction
  - Preferred sources
  - Parts Approval
  - Evaluation
  - Screening / Quality levels
  - Lot test
  - Final Customer Source Inspection
  - Incoming Inspection
  - Radiation
  - Destructive Physical Analysis
  - Relifing
  - Handling/ storage
  - Traceability
  - Alerts
  - Hybrids
  - Microwave monolithic integrated circuits
  - One time programmable devices


ECSS-Q-ST-60C Rev.1
6 March 2009

EUROPEAN COOPERATION
ECSS
FOR SPACE STANDARDIZATION

Space product assurance

Electrical, electronic and electromechanical (EEE) components

ECSS Secretariat
ESA-ESTEC
Requirements & Standards Division
Noordwijk, The Netherlands

# 4. Challenge

- Manufacturers trends :
  - offshore subcontracting, non integrated, fabless, fablight, dispersed, word wild, pan European
- New technologies / products : Non monolithic / non simple / non single parts :
  - Opto cable+ connector , Oscillators, Laser diodes, µp + capa, MultiChip modules, etc.
- Test method : Radiation (TID, DD SEE, etc.) Policy : requirements update (evaluation, test method)

# 5. Short term work plan (1/3)



## ESCC specifications

- Pure tin / Lead free Incoming test :
  - Should take benefit of existing standards
- Non Pure tin requirements :
  - ESCC specifications consolidations : checking of the exhaustiveness of the requirements through the whole ESCC system
  - Will be managed via DCRs
- ESCC capability approval for hybrids
- Oscillators : Generic spec
- Laser diodes (specific WG)
  - Evaluation test Plan + Generic spec
- Optical connectors (specific WG)
  - Synergy with the ECI 2 activity (Manufacturer Diamond / AVIM connectors)
  - Basic, Generic, 2 detail specs
- Assembly & Test House : certification

# 5. Short term work plan (2/3)

## ECSS :

- ECSS-Q-ST-60-13 (COTS)
  - Kick-off done : 07/12/2010, Final draft 12/2011 (**The schedule is really a challenge**,)
  - Limited perimeter : monolithic active parts
  - Pre-tailoring as per ECSS-Q-ST-60C
  - Order of preference : Space Qualified parts

- ECSS-Q-ST-60-15 / Radiation Hardness Assurance

# 5. Short term work plan (3/3)

**ESCC promotion :**

- Availability of Manufacturers ESCC qualification data on ESCIES
- ESCC QPL : improve the management of the end of validity dates
- Training courses : Second session 22-23/03/2011
- Better visibility of the ESCC QML versus ESCC QPL

- For the projects Parts Management , Declared Components Tool : put in place a single form sheet/tool (standardization, 3$^{E}$ lists compilation, etc.)

# 6. Conclusion

- Since 2003, the PSWG is a balanced, operational European working group, which practically contributes to the ESCC health, stability, development & improvement.
- Policy decisions have to consider :
  - Technical concerns and new technologies insertion
  - ESCC organisation, rules and consistency
  - The economic situation
- The activity work plan considers :
  - Need
  - Maturity
  - Reasonable feasibility