ECSS-Q-ST-60Crev.2 Training (L2)

Ralf de Marino
Noordwijk
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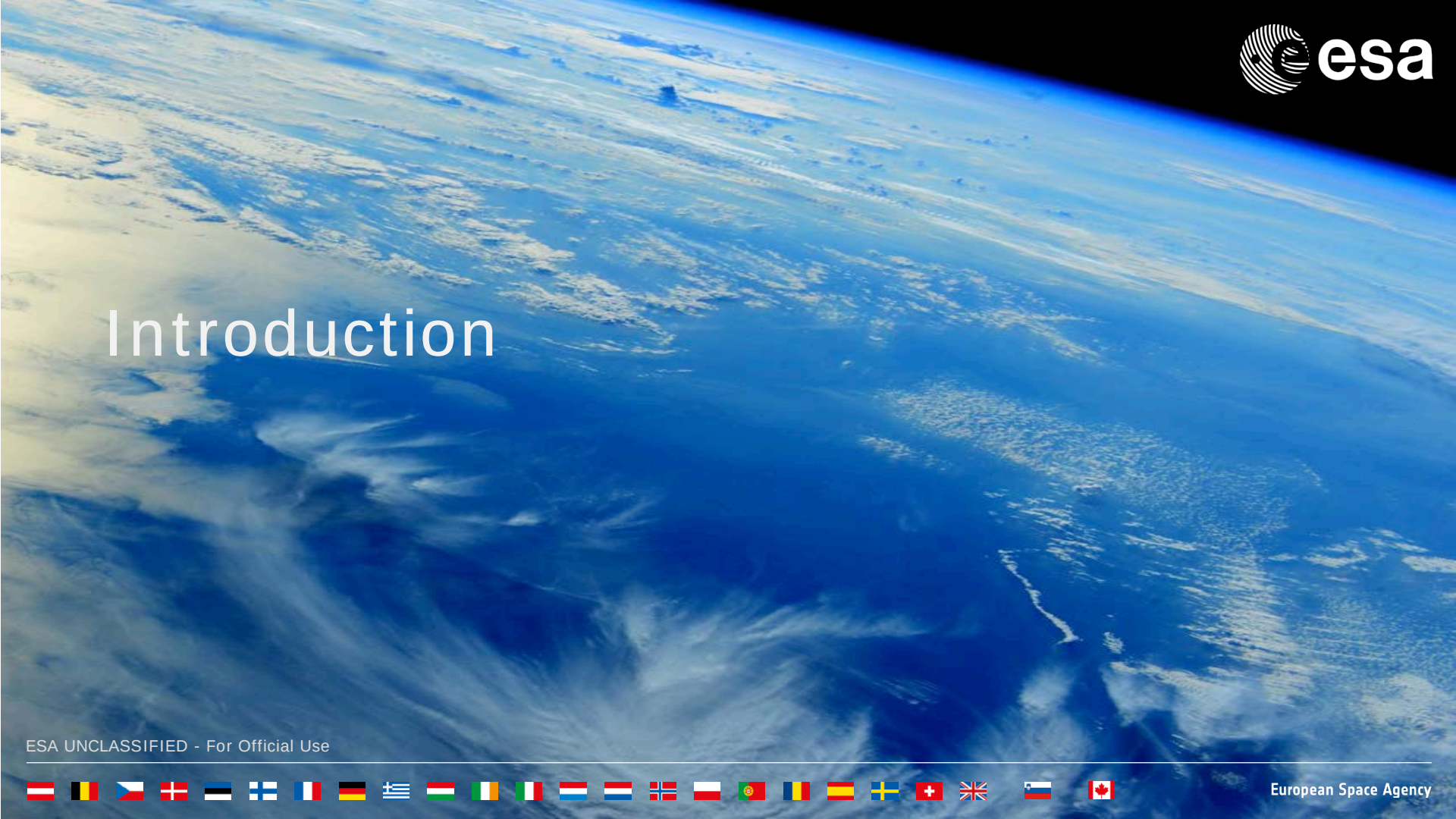


Introduction

Disclaimer and Gentle Reminder

Standards are desired to be

clear, pragmatic, correct, consistent, stable (5 years typical review cycle), ….
and pertinent to support the area of business that they are established for.

But they exist in a dynamic world in terms of technology and business practices (incl. legal & regulatory aspects).

They have been created by human beings, a species known to have the propensity for error.

Nothing is perfect – so read documents carefully !

At times during this course we will have to point out to you some known bugs (already slated for correction) and maybe with your help, e.g. your questions, we can identify further items to improve, to do even better in the future.

Among the Flaws … already corrected

Just to illustrate what can be encountered

ECSS-Q-ST-60Crev1 : e.g. paragraph omission / inadvertent renumbering

Clause 5.2.2.3 Preferred Sources is missing (much of 4.2.2.3 applies)

Further : incomplete sentences, misspellings, typos, …

ECSS-Q-ST-60Crev2 is pretty clean right now

In case of doubts go to https://ESCIES.ORG

complementary information is and pre-revision errata will be posted there as pertinent under 'ESCC Executive Notifications' such as a future update to Table 7 with more JAXA specifications that have been compared and found to be equivalent to ESCC and or MIL

ECSS-Q-ST-30-11Crev1 includes some requirements that are not derating related but were found to be of value by the members of the expert WG –

So until a more proper place will be found : **Sorry for any irritations this may cause !**

A word on motivation & not restricted to EEE components

ECSS Standards and the ESCC System are based on real life experience gained since the human space adventure started. (which is true for many other documents / systems too !!!)

They are the embodiment of lessons learned and best practices demonstrated across the themes covered.

Product Assurance is an ENGINEERING DISCIPLINE and not the hobby horse of paper tigers and bureaucrats.

Thus, the requirements as defined do have a tangible, preventative purpose.

PA as an independent function is a necessary, complementary and constructive consultancy and watchdog for all management and engineering activities and best applied in a non-dogmatic manner. It is based on experience, knowledge and common sense.

EEE Components in ECSS today
and time permitting covered by the course

Space Product Assurance

ECSS-Q-ST-60Crev2 EEE Components

ECSS-Q-ST-60-02C **ASIC and FPGA Development**

ECSS-Q-ST-60-05C **Generic Procurement Requirements for Hybrids**

ECSS-Q-ST-60-12C **Design, Selection, Procurement and Use of Die Form MMICs**

ECSS-Q-ST-60-13C Commercial EEE Components

ECSS-Q-ST-60-14C **Relifing Procedure – EEE Components**

ECSS-Q-ST-60-15C **Radiation Hardness Assurance – EEE Components** (ESA Adoption Notice ESSB-AS-Q-008 issue 1)

ECSS-Q-ST-30-11Crev1 **Derating – EEE Components**

Also important to know

ECSS-Q-HB-30-01A (Jan. 2011) Worst Case Analysis

It is an equipment [(sub-)system] oriented analysis of a circuit build with components. The pertinence and value of a WCA depends on the accuracy and completeness of the relevant input data, which are the component characteristics.

Attention !

Data sheets are often incomplete and loosely defined.

“Subject to change without notice”

Component Detail Specifications are defining accept / reject criteria needed for establishing compliance in procurement and are often insufficient as a baseline for application design.

Note that e.g. Hybrid Microcircuits can be rather complex by themselves and may need their own WCA, as do System on Chip (SoC), ASIC and FPGA designs.

Also important to know

ECSS-Q-HB-30-08A (Jan. 2011) Components reliability data sources and their use

The ECSS publication date is recent, but this can not be claimed for the majority of the sources listed.

E.g. MIL-HDBK-217 Notice 2, Dec. 1992 … and then it became a victim of the US DoD Acquisition Reform,

budget cancelled, all work stopped, no revival in sight, although it has been repeatedly attempted

Notice 2 is already marked as

… for guidance only – do not cite this document as a requirement

But it remains still a de facto standard/reference used world wide and not only in the space business.

Be Aware : Dependable component reliability data is a precious resource and not always readily available.

Also important to know

ECSS-Q-TM-30-12A End of Life Parameter Drifts – EEE Components

Extracted from the former ECSS-Q-60-11 Derating document

Published as Technical Memorandum due to the age of the data (= questionable validity, lack of data to cover extended operating life to 18/20 years)

Several years ago ESA commissioned a study (without data production by accelerated testing) to identify options to close the data gap (e.g. degradation modeling, Physics of Failure approach, etc.). Its results were not conclusive enough to revise the TM but confirmed that extrapolations can only be justified and need to be verified with representative data => at a COST !!!

ECSS-Q-TM-70-51A Termination of Optical Fibres

And of course all those documents listed in the Normative References clause of those standards already mentioned

The latest addition

ECSS-Q-HB-60-02A , 1 Sept. 2016

Space Product Assurance - Techniques for Radiation Effects Mitigation in ASICs and FPGAs

A Handbook on Radiation Hardening by Design

Based on numerous ASIC (Application Specific Integrated Circuit) and ASSP (Application Specific Standard Product) developments for space applications under contracts with ESA and other organisations this handbook compiles their results, the findings of related studies and best reported practices.

Why are the EEE requirements in the Q branch (Product Assurance) ?

As elementary building blocks and “commodity items” they were automatically falling outside of the typical space engineering requirements, which have a main orientation toward system design.

PA has always played an important role since it has always been the exception that EEE space components were designed and build from scratch specifically for space applications. They are mostly derived from conventional designs and produced with established industrial processes. E.g. they may be hardened to withstand the space radiation environment or modified to endure other space application specific stresses. Typically they are evaluated, qualified and procured (= tested) against requirements which are defined in other industrial or space specific standardisation systems, particularly in the US MIL and the ESCC (European Space Component Coordination) systems.

Of course, as later examples will show, there are some grey zones and the classification of individual documents may be arguable from a purist point of view. However, it is the best practice and most effective to put requirement documents within the actual implementation domain (= where the implementation responsibility resides).

Who needs to know about Q-ST-60 … ?

Anyone who is involved in the selection, procurement and control of EEE components for space !

- **Project managers**
- **PA managers / engineers**
- **Engineering mangers**
- **Designers**
- **Procurement engineers**

And Why this is so will hopefully become more clear after this introduction

Which EEE components are covered by Q-ST-60 … ?

It is easier to turn the question around :

The following items are not regarded as EEE components in the frame of ECSS, ESCC and ESA project practice :

- **Batteries**
- **Motors & Drives**
- **Pyrotechnic Devices**
- **Solar Cells (part of solar generator)**
- **Printed Circuit Boards (PCBs)**

- **Everything else from Passives (Wires, Cables, Connectors, Electromechanical, RLC, …) to Actives (all types of Semiconductors, Hybrids, MEMS, etc.) are considered as EEE Components in the Space context**

A few words about ESCC

The European Space Component Coordination (ESCC) system emerged from the previous ESA/SCC system (BoL ~1970)

The ESCC Charter signed in 2002 created a single unified European System for EEE Space Component Specifications, their qualification (ESA authority) and defining a procurement approach for the user industry.

More than its predecessor ESCC is based on an extended partnership involving ESA, National Space Agencies, Component Manufacturers and the User Community (represented by EUROSPACE)

Main Products of ESCC (of particular relevance to parts selection) are the

EPPL : European Preferred Parts List
QPL : Qualified Parts List
EQML: European Qualified Manufacturers List

All ESCC Documents are in the public domain, free of charge : https://escies.org

ECSS-Q-ST-60Crev.2 Training (L2)

Ralf de Marino
Noordwijk
20/06/2017

ECSS-Q-ST-60C Rev.2 What is it for ?

- This **top level** standard defines **requirements for the selection, control, procurement and use of EEE components in a space project and is primarily applicable to the component user**.

- The **customer** (e.g. Space Agency, Operator) of a given space project **defines** the **EEE component requirements** as part of the **project PA** requirements by calling ECSS-Q-ST-60C Rev.2 as an applicable document or by tailoring it. **ECSS-Q-ST-60C is a pre-tailored document and further tailoring should be avoided.**

- These project PA requirements are typically part of the project's phase C/D tender documentation. Q-60 has **contractual relevance** and its **requirements are verifiable.**

- The supplier responds with **a component control plan** to implement those requirements in a manner suitable to facilitate the management of all EEE parts related activities in accordance with the **project constraints,** such as **mission objectives and schedule, in a resource effective and efficient way**.

- The supplier must ensure to **pass these requirements down to lower level suppliers** and verify their compliance.

Major Changes in Rev. 2

- **1) Commercial EEE components were only vaguely addressed in prior versions**
  - Commercial EEE parts are defined as : not designed and intended for space applications

- **With the development of ECSS-Q-ST-60-13C we have now created a suitable standard for commercial EEE parts that is called up in ECSS-Q-ST-60Crev.2**

- **2) Radiation Hardness Assurance requirements are now covered in**
  ECSS-Q-ST-60-15 Radiation Hardness Assurance.
  Please note that for ESA projects the Adoption Notice ESSB-A-Q-008 issue 1 applies that modifies a few requirement clauses e.g. on Radiation Design Margin and dose rate for ELDRS testing.

- **3) The deletion of the Post Programming Burn-In requirement of some heritage FPGA types for which sufficient data exists that demonstrate that Burn-In has not lead to infant mortality failures. (The list of types covered is available on https://escies.org ECSS standards can not explicitly mention manufacturers, trade names and the like.)**

- **This opportunity of revision 2 was also used to make other corrections and clarifications in support of better practices. Other than 1) and 2) above no new requirements were introduced but saved up for future revisions.**

ECSS-Q-ST-60 origin and support in ESA

The present ECSS-Q-ST-60C evolved out of the ESA PSS-01-60 (PSS was the ESA internal standard system, the pre-curser of ECSS) and has therefore a long standing heritage.

It is maintained by a standing Q-60 WG which is a subgroup of the ESCC Policy and Standards WG. This WG has a mandate for all standards in the Q-ST-60 series. It develops and updates these documents and submits them to the ECSS review and approval process.

For level 3 documents in the series e.g. ECSS-Q-ST-60-15C for Radiation Hardness Assurance (RHA) other WGs are formed to gather the necessary expertise.

Technical officers from TEC in the PA&S and Electrical Engineering Department routinely support ESA projects and other entities in the application of ECSS-Q-ST-60C and associated documents

ECSS-Q-ST-60C Rev.2: Highlights

The ECSS-Q-ST-60C Rev.2 is written from **the parts user perspective (= supplier in ECSS context).** Its requirements define the supplier obligations to demonstrate consistently that the components are fit for purpose in a space project.

The standard defines requirements for EEE Parts with respect to their:

- Selection (rules)
- Control (management approach)
- Procurement (purchasing practice)
- Usage (e.g. call-up of derating, storage, shelf-life, …)

The ECSS-Q-ST-60C Rev.2 **only addresses project approval** requirements and includes **requirements for the procurement of non-space qualified parts**.

The Requirements for **EEE Part Qualification and procurement are covered by the ESCC System of Specifications** (European Space Component Coordination).

The Pre-tailoring Approach

The ECSS-Q-ST-60C differentiates three classes of components : [Class 1 highest to Class 3 lowest]

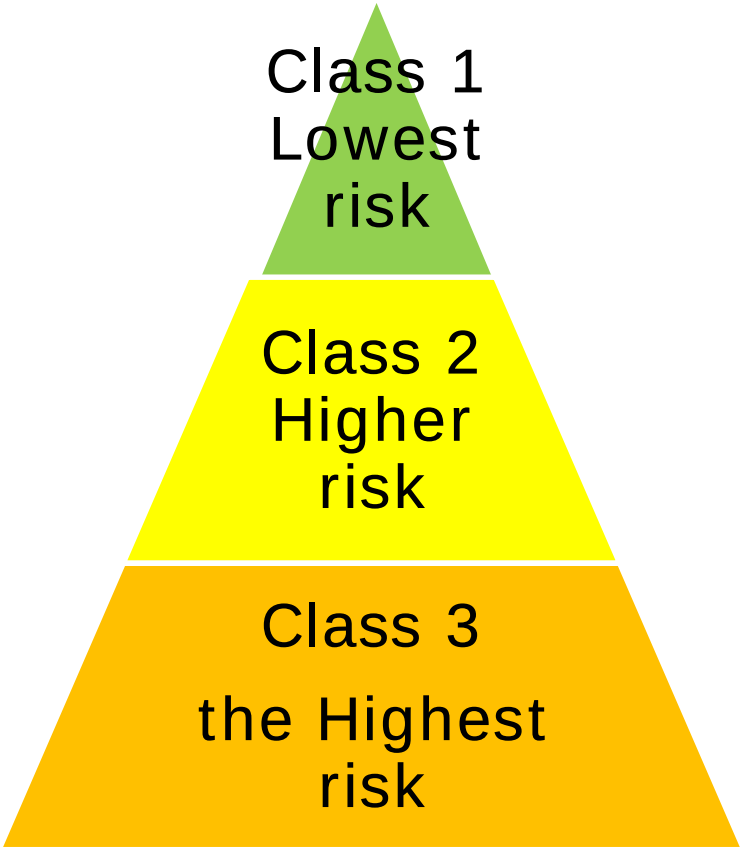
Each Class corresponds to a different level of Product Assurance and thereby the level of risk taken on reliability and quality.

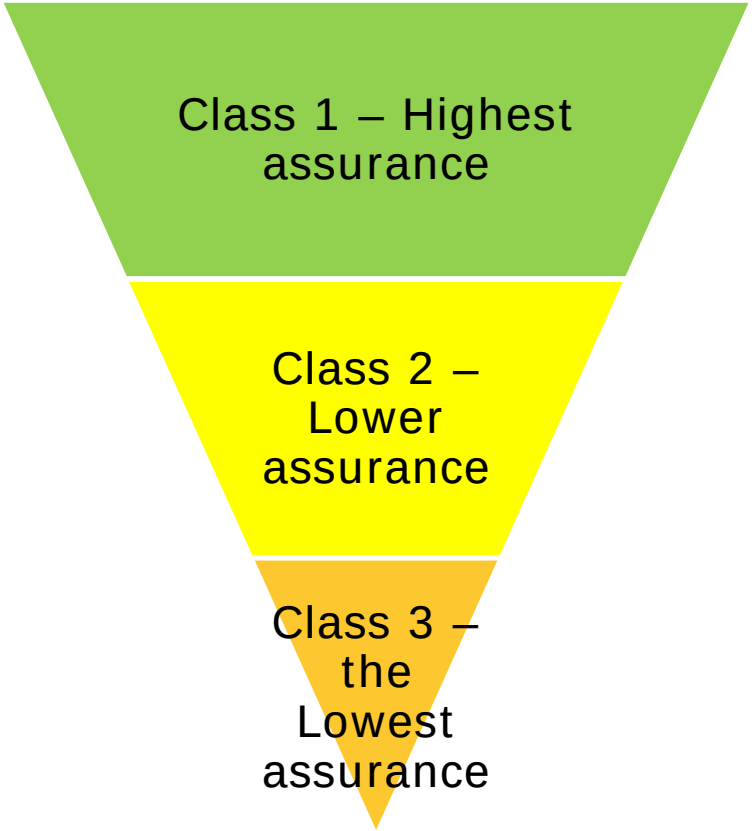
Class 1 components offer the lowest risk, while class 3 components reflect the highest advisable risk.

Note ! This is a qualitative, effort based PA approach. There is no absolute and no relative quantification of the risk difference between the defined classes !

At present there is (still) a consensus that the assurance level for class 3 parts is the lowest permissible for flight.

Risk versus Assurance





Use and tailoring of ECSS-Q-ST-60C

The ECSS-Q-ST-60C rev2 is in the list of ESA approved standards and, as such, it is to be used by all ESA projects in accordance with ESA/ADMIN/IPOL(2007)11 (20 July 2007).

Projects will normally tailor the document to their constraints, add requirements – such as those related to RHA, for example. Most ESA satellite projects specify requirements which meet or exceed Q-60 Class 1; some projects specify Class 2 or some intermediate level between Class 2 and Class 1.

Outside ESA, most commercial telecommunication satellites use requirements that meet or exceed ECSS-Q-ST-60C rev2 Class 1; national government projects, typically for EO, may have requirements along ECSS-Q-ST-60C rev2 Class 2, and smaller platforms targeting new markets and some constellations may have parts requirements similar to Class 3

Document / Requirement Structure

1 Scope
2 Normative references
3 Terms, definitions and abbreviated terms
4 Requirements for Class 1 components
5 Requirements for Class 2 components
6 Requirements for Class 3 components
7 Quality Levels (in tabular form)
Annex A (norm.) Component Control Plan
Annex B (norm.) Declared Components List
Annex C (norm.) Procurement Specification
Annex D (norm.) Part Approval Document
Annex E (inform.) EEE documents delivery per review
Note : the sub-clause structure for Class 2 & 3 is identical to Class 1 but implemented in a tailoring manner

Class 1 : Component Progr. Mgmt.

Component Control Programme

The supplier must establish a **management organisation, define approaches/procedures** (incl. procurement) **compliant with ECSS-M-ST-10**

Note : Decision on central (recommended for more complex projects) or decentralised parts procurement

The supplier must establish a **Component Control Plan** (per Ax A, compulsory for Class 1);

Key elements :

Organisational structure, responsibilities, concurrent engineering;
Lower level supplier control; Procurement system;
Radiation control programme; Component selection and part type reduction;
Component reliability data acquisition and assessment;
Evaluation, testing, approval, inspections, storage, milestone planning, problem management, reporting, compliance matrix

Class 1 : Component Progr. Mgmt. - Parts Control Board

“4.1.3 a. The approval of the selection and usage of EEE parts shall be implemented through Parts Control Boards (PCBs) held between the customer and the supplier (or lower tier subcontractor)”

Chaired by a member of the suppliers PA team + parts engineer + customer representative + …
Review & approve EEE CCP and associated documents;
Part type reduction;
Part approval incl. evaluation results;
Problem assessments (Alerts, non-conformances, RFD, RFW, schedule)
Comparative assessments (initial approval vs. actual docs / sampling)
This means the PCB shall have the complete overview/visibility and approval responsibility incl. RHA aspects for all components used in the project.

Class 1 : Component Progr. Mgmt. - Declared Components List

“4.1.4 a. For each equipment, its supplier shall issue a DCL in an editable and sortable electronic format, …, identifying all component types needed.“

DCL content as per annex B
To be kept under configuration control,
Minimally issued at PDR and CDR (as designed) and TRR (as built)
After CDR all PAD changes require a new customer approval.
Changes during equipment manufacturing need RFW based customer approval before mounting.

DCLs are crucial for determining the impact of alerts (ESA Alert system and others)

Class 1 : Component Progr. Mgmt. - Electrical and Mechanical GSE

“4.1.5 a. EEE components used in GSE, which are physically and directly interfacing to flight hardware, shall be:
Fit, Form and Function compatible;
a. manufactured from materials identical to the flight opposite part and
Ensured to be visibly clean before each connection to flight hardware.

b. Flight hardware connector interfaces to GSE shall interface to a flight compatible connector, as per 4.1.5.a.
Note : This connector can be installed on the test harness or can be a saver.”
Beware : ‘inter-mateability’ between connectors from different manufacturers is often an issue and therefore not recommended !

Class 1 : Component Selection, Evaluation and Approval

To be considered already in the selection process :
Project Requirements (e.g. quality levels, component policy, delivery and manufacturing schedules, quantity, attrition)
Design requirements (e.g. component type, case, dimensions, materials)
Equipment production requirements (e.g. package, thermal and storage constraints, component mounting process),
Operational requirements (e.g. electrical, mechanical, radiation, reliability, assembly, and lifetime).

“The selection, evaluation and approval of commercial EEE components for class 1 programmes shall be performed in conformance with clause 4.2 from ECSS-Q-ST-60-13”

Class 1 : Manufacturer and Component Selection

Components shall be selected on the basis of proven qualification, characterization, and previous space experience and data, relevant with regard to the requirements for the programme, from manufacturers or sources (**preferably European**) employing effective Product Assurance Programmes in manufacturing and test.

Preference shall be given to components which necessitate the least evaluation or qualification effort.

Starting with the design phase of the project the supplier shall ensure **maximum use of preferred (see 4.2.2.3) and qualified components to achieve an effective component reduction** and standardization.

When selecting items, the supplier shall check the current data, applicability of the basis of qualification, problem notifications and alerts, and adequacy of specifications.

All Classes : Parts and Material Restrictions - 1

… non-hermetically sealed materials of components must meet the requirements of ECSS-Q-ST-70 regarding off-gassing, out-gassing, flammability, toxicity and any other criteria specified for the intended use.

… shall evaluate the **robustness** of selected EEE components against the **stresses induced by the assembly techniques to be employed**.

With respect to health and safety, **beryllium oxide** (except if identified in the procurement specification and part marking includes BeO), **cadmium, lithium, magnesium, mercury, zinc, radioactive material** and all material which can cause safety hazards shall not be used.

All Classes : Parts and Material Restrictions - 2

For limited life duration, known instability, safety hazards or reliability risk reasons, EEE components listed below shall **not be used** :

Parts with pure tin on external surfaces (< 3% Pb in case of SnPb) because of 'Whiskers'

Hollow core resistors

Potentiometers (except in mechanisms)

Non-metallurgically bonded diodes

Semiconductor Dice with unglassivated active areas

Wet slug tantalum capacitors other than double seal Ta case constructions

Components with metallurgic bonding inside melting @temp < mounting process

Wire link fuses < 5A

TO5 relays w/o double welding of mechanism to header or with diodes inside

All Classes : Parts and Material Restrictions - 3

For limited life duration, known instability, safety hazards or reliability risk reasons, EEE components listed below shall **not be used for new designs**:

RNC90 > 100 kΩ,
TO3 and DO4/DO5 packages.

The use of pure tin inside a cavity, if technically justified, may be approved by the customer and must be documented in the PAD

Class 1 : Preferred Sources

Parts shall be chosen from the EPPL part I (European Preferred Parts List) which includes all ESCC qualified parts and more

For parts not selected from the EPPL part I, the following sources shall be considered in the following order of precedence:

1. EPPL part II (when compatible with the project requirements)
2. NPSL (NASA Parts Selection List) level 1 and level 2 or 3 (when compatible with the project requirements),
3. MIL QPL's and QML's.

Parts subject to export restrictions or regulations shall not be preferred.

Class 1 : Radiation Hardness Assurance - 1

The radiation requirements for EEE components are project specific.

The supplier responsible for the hardware design shall demonstrate the compliance of its components selection with the radiation constraints of the project in terms of cosmic radiation (Heavy Ions), electromagnetic, trapped (charged particles – electrons, protons – in radiation belts) and solar (flares) with due consideration to the mission orbit, trajectory, duration, the associated spatial and temporal variations of the radiation environment as well as all protective factors such as shielding.

The supplier shall assess the actual radiation tolerance of the selected components for compliance with the radiation requirements in term of total dose, displacement damage and Single Events Effects (SEE).

Class 1 : Radiation Hardness Assurance - 2

The supplier shall identify components which are not compliant with the radiation requirements as critical radiation sensitive components.

The supplier shall implement a Radiation Hardness Assurance Programme, in conformance with the requirements of ECSS-Q-ST-60-15, documented by a plan to be approved by the customer, for radiation sensitive components, covering the collection of all relevant information and specifying the necessary actions in terms of evaluation and procurement testing, planning and control.

The supplier shall issue an Equipment Radiation Analysis document identifying all sensitive components w.r.t. the relevant radiation effects, possibly their impact and giving an adequate engineering solution (e.g. local shielding, design solution, specific test, and RVT) for the relevant equipment.
The Equipment Radiation Analysis document shall be submitted to the customer for approval.

NOTE : More detailed environment information in ECSS-E-ST-10-12 (calculation & margins) and ECSS-Q-ST-60-15 + ESA Adoption Notice ESSB-AS-Q-008 issue 1, for ECSS-Q-ST-60-15

Class 1 : Derating

Derating is the deliberate reduction of a few suitable electrical parameters (from maximum limits) used in an application circuit to reduce part stress levels and achieve a longer life time.

EEE component derating rules to be implemented in designs are defined in ECSS-Q-ST-30-11. These rules are type specific and not discussed in this course.

Note : the present version of ECSS-Q-ST-30-11 contains additional design recommendations which are not derating rules in the actual sense. They were included because the WG considered them to be of value but could not accommodate them in a more suitable document.

For wire link fuses > 5A, the current derating factor shall be 50 % with an additional derating of 0,2 %/°C for an increase in the temperature of fuse body above 25 °C.

Class 1 : Component Evaluation - 1

Unless there is already a pertinent and approved demonstration that a component has the ability to conform to the requirements for functional performance, quality, dependability, and environmental resistance as required for the project the supplier shall perform a component evaluation programme producing such evidence.

An evaluation plan addressing the following items shall be sent to the customer for approval :
1. Component Manufacturer Assessment (as per clause 4.2.3.2),
2. Constructional Analysis (as per clause 4.2.3.3),
3. Evaluation Testing (as per clause 4.2.3.4),
4. Radiation Hardness (as per clause 4.2.3.4b.5).

In the definition of the evaluation programme any information including pertinent reliability, analysis and test data from the manufacturer of the component and previous use in comparable applications shall be considered.
Omission of any of these elements, or the introduction of alternative activities, shall be justified.
Suitable Evaluation Test Plans are available in the ESCC System for many component types (ESCC 22600 and document numbers 226xxxx)

Class 1 : Component Evaluation - 2

All tests and inspections shall be carried out on representative samples of the component type from the current production of the manufacturer selected for the component procurement for the flight hardware.

For programmable devices, the representativeness shall include the programming hardware tools and the compatibility of the software.

The supplier shall review the evaluation results to determine their impact on the content of the procurement specification which shall be amended as necessary.

The supplier shall summarize the evaluation results in the evaluation report and send it to the customer for approval.

NOTE : ECSS-E-ST-10-04 and ECSS-E-ST-10-12 provide guidance for the assessment of the space environmental aspects.

Class 1 : Component Manufacturer Assessment

<u>This does not apply to Space qualified components (ESCC, MIL, JAXA)</u>

The purpose of the manufacturer assessment is to determine his capability, to ensure the adequacy of its organization, plant and facilities, and to ascertain his fitness to supply components to the appropriate specifications for space application.

The supplier shall perform an evaluation against the ESCC Basic Specification No. 20200 and the ancillary specifications for the subject component families and shall include, but not necessarily be limited to, a survey of:

1. The overall manufacturing facility and its organization and management,
2. The manufacturer's system for inspection and manufacturing control including all relevant specifications, procedures, and internal documents,
3. The production line used for the component.

The complete manufacturer assessment, including the survey report and the associated corrective actions, shall be part of the evaluation report.

Class 1 : Constructional Analysis

This does not apply to Space qualified components (ESCC, MIL, JAXA)

The primary aim is to provide an early indication of a component's constructional suitability for meeting the specified performances of the space project application.

Constructional analysis shall be carried out on representative components.
Note : two parts meeting the same specification often have different constructions

The Constructional Analysis shall comprise destructive and non-destructive inspections, analysis, and testing, to identify:
1. Design and construction technology,
2. Materials used,
3. Inherent reliability aspects,
4. Quality of workmanship,
5. Potential hazards.
The findings of the analysis shall be contained within a Constructional Analysis Report and shall be included in the Evaluation Report.

Class 1 : Evaluation Testing

<u>This does typically not apply to Space qualified components (ESCC, MIL, JAXA)</u>

The evaluation shall determine which inspections or tests are required to provide the confidence that the component type under evaluation, when assembled and tested in accordance with the procurement specification, successfully meets the project requirements.

The supplier shall review the already existing data in order to adapt and minimize the content of the evaluation testing while ensuring that there are inputs and pertinent results covering the following topics:

1. Endurance test (operating at elevated temperature and electrical stress),
2. Mechanical stress (shock, vibration, constant acceleration),
3. Environmental stress (thermal shock, temperature cycling, high and low temperature storage, humidity),
4. Assembly capability testing,
5. Radiation testing, for total dose and single event effects sensitivity.

NOTE : For guidance refer to ESCC basic specification no. 22600 and the ancillary specifications for the subject component families.

Class 1 : Parts Approval Document and Process

The approval process must be fully traceable and includes :
1. A PAD in conformance with Annex D (or corresponding information included in the DCL) is required for space qualified parts when:
(a) additional controls are required (e.g. precap, buy-off, LAT or LVT, RVT, DPA),
(b) used outside the specified limits, (this is very risky and not recommended !)
(c) specific tests are required during procurement as per Table 7-1,
(d) pure tin is used inside or outside the part (as stated in the detail specification).

2. All other space qualified parts listed in the DCL are approved through the DCL review,
3. For any other part a PAD, in conformance with Annex D is required,
4. For any commercial part, a Justification Document, as per ECSS-Q-ST-60-13 (clause 4.2.4), is required, instead of a PAD.
When required an approved PAD typically triggers the procurement
In case the evaluation results are changing the procurement conditions documented in the PAD or the JD (as per clause 4.2.3.1), a new revision of the PAD or the JD shall be submitted to the customer for approval.

Class 1 : Procurement

Class 1 components shall meet the quality levels and supplementary conditions specified in Table 7-1.
The supplier shall be responsible for manufacturer surveillance and control throughout the procurement programme.

For parts which are not space qualified, the supplier shall put in place a configuration control system to ensure that any change of the product (e.g. mask, manufacturing and assembly process) affecting evaluation, performance, quality, reliability and interchangeability is communicated to him by the manufacturer (e.g. PCN).
The supplier shall ensure the compatibility of the change with its application.
The change shall be submitted to the customer for approval.
To reduce the risk of procuring counterfeit components, when parts are not directly procured from the manufacturer, the supplier shall procure parts only from distributors duly franchised by the parts manufacturer. (For ESCC manufacturers distributors are being listed on https://escies.org)

The procurements of the commercial EEE components for class 1 programs shall be performed in conformance with the requirements of clause 4.3 of ECSS-Q-ST-60-13.

Class 1 : Screening

All components to be incorporated into flight standard hardware shall meet the quality level specified in Table 7-1, shall be procured as qualified (if available) and be subjected to screening. The screening test requirements shall be defined such that accumulated stress does not jeopardize component reliability.
All screening tests shall be performed at the component manufacturer's premises or at a facility approved either by the qualification approval authority, where applicable (e.g. ESCC), or otherwise by the supplier.

For active parts (transistors, diodes) packaged in TO3, DO4 or DO5, the PIND test method shall be submitted to the customer's approval.
PIND – Particle Impact Noise Test : to detect lose (conductive) particles in the cavity

In case a component is not available in a qualified version according to quality level specified in Table 7-1, the screening of the component shall meet the screening flow defined by the generic specifications listed in Table 7-1.
In case of X-rays inspection, the total dose deposited shall be less than 1/10 of the product acceptable dose (TID).

Class 1 : Customer Source Inspection

The procurement entity shall carry out, at the manufacturer's premises, a customer pre-encapsulation (precap) inspection e.g. as per ESCC No. 21002, for non-space qualified part types listed below:

1. Capacitors (ceramic, mica and plastic film)
2. Crystals
3. Oscillators
4. Discrete semiconductors (including diodes and transistors)
5. Filters
6. Fuses (cermet)
7. Inductors, coils and transformers (not applicable to in-house products)
8. Monolithic microcircuits (including MMICs)
9. Hybrid circuits
10. Relays
11. Resistors (high precision, fixed, metal foil – RNC90)
12. Switches (including mechanical and thermal)
13. Optoelectronic devices (e.g. opto-couplers, LEDs, CCDs and sensors).

A precap inspection is required for critical space qualified parts , including as a minimum relays, crystals, oscillators and hybrids.

Class 1 : Lot Acceptance

The supplier shall ensure that any lot/date code of EEE parts is submitted to a lot acceptance procedure (in line with applied normative systems) according to the following rules:

1. Space qualified parts:

ESCC: not required due to periodic lot validation testing by the manufacturer

MIL: mfr. QCI or TCI i.a.w. the quality level of the MIL specification is OK

2. Non-space qualified parts:

(a) The content of the lot acceptance is ESCC level LAT1 or level LAT2 or LVT (subgroups 1, 2 and 3) or a comparable QCI (Quality Conformance Inspection in MIL).

(b) In absence of any changes (design, construction, process) LAT may be replaced by the review of available data less than 2 years old.

(c) In case of partial available data, any complementary lot acceptance content is defined by the supplier subject to PCB agreement.

(d) The PCB documents and justifies any reduced lot acceptance based on available data for customer approval.

The sample size for lot acceptance, which may be reduced in some cases, shall be submitted to the customer for approval through the PAD process (see clause 4.2.4).

Class 1 : Final Customer Source Inspection (Buy-Off)

The procurement entity shall carry out, at the manufacturer's premises, a final customer source inspection for non-space qualified parts, based on inspections, tests and review activities to verify that the requirements of the purchase order are met prior to shipment of the flight parts. (ESCC guideline document 21003.)

The buy-off shall include:

1. **External visual inspection,**
2. **Witnessing electrical measurements,**
3. **Verifying mechanical dimensions,**
4. **Review and verification of the data-package.**

The buy-off may be replaced by an incoming inspection at the procurement entity's facilities. If this is chosen then it has to be declared in the PAD submitted to the customer for approval.

Class 1 : Incoming Inspection

The incoming inspection (e.g. ESCC 21004) verifies conformance with the PO and includes :
All parts: (a) Marking control,
(b) Quantity verification,
(c) Packing checking,
(d) Review of the manufacturer delivered documentation,
(e) Additional tests based on the type of component, criticality and heritage with the manufacturer (e.g. solderability tests, electrical tests),
(f) for termination finish non-Au, lead finish check as per ESCC 25500.
For the non-space qualified parts, when the final customer source inspection has not been performed, the following additional items:
(a) External visual inspection by sampling (AQL 0,65% level II or 20 parts min)
(b) Electrical measurements at room temperature on 20 parts or 100% (if lot size < 20 parts), (in practice not performed on very complex parts e.g. microprocessors

If the parts have passed successfully a final CSI (or buy-off), the incoming inspection may be reduced to the following minimum:

1. **Verification of the manufacturer's CoC,**
2. **Packing checking,**
3. **Quantity verification.**

Class 1 : Radiation Verification Testing (RVT)

Radiation sensitive components, as defined in clause 4.2.2.4, and for which applicable existing test data is insufficient shall be subjected to RVT.

RVT shall be performed in accordance with internationally recognized standards, such as ESCC Basic Specifications No. 22900 or per MIL-STD-750 Test Method 1019 (discretes), MIL-STD-883 Test Method 1019 (microcircuits).

If RVT is applicable a PAD in conformance with Annex D shall be issued and processed as per clause 4.2.4.

The results of RVT shall be documented by a report.

When RVT is performed in the frame of the project, the supplier shall send the related report to the customer for information.

Class 1 : Destructive Physical Analysis (DPA)

e.g. as defined through MIL-STD-1580 or per ESCC No. 21001

> **“A DPA is a systematic, logical, detailed examination of parts during various stages of physical disassembly, conducted on a sample of completed parts from a given lot, wherein parts are examined for a wide variety of design, workmanship and processing problems that may not show up during normal screening tests. The purpose of theses analyses is to determine those lots of parts delivered by a vendor, which have anomalies or defects, such that they could at some later date, cause a degradation or catastrophic failure of a system.”**

MIL-STD-1580B is presently under revision

Class 1 : Destructive Physical Analysis (DPA)

Non-space qualified parts : on 3 samples per lot/date code for :

1. Capacitors (glass, ceramic, tantalum and variable)
2. Crystals
3. Oscillators
4. Discrete semiconductors (including diodes and transistors)
5. Filters
6. Monolithic microcircuits (including MMICs)
7. Hybrid circuits
8. Relays
9. Switches (including mechanical and thermal)
10. Optoelectronic devices (e.g. opto-couplers, LED's, CCD's and sensors)
11. Passive microwave devices (e.g. mixers, couplers, isolators and switches)

Space qualified parts : on 3 samples per lot/date code on critical space qualified parts, including as a minimum relays and oscillators. For other space qualified parts families, DPA is not required.

If approved through the PAD process the sample size may be reduced.

Class 1 : Relifing – ECSS-Q-ST-60-14C

When components from a supplier's or parts procurement agent's stock are used, the following criteria shall be met:

1. **The parts are stored according to the minimum conditions given in clause 4.4,**
2. **The minimum overall requirements (including screening) are in accordance with the project requirements,**
3. **The lot/date code homogeneity and traceability can be demonstrated,**
4. **The EEE parts documentation is available and the content is acceptable in accordance with the project requirements (including radiation data, if necessary),**
5. **There are no open NCR's and no unresolved alerts with respect to their date code.**

Relifing applies after 7 years of storage and, if successful, validates the parts usage for another 3 years. After 10 years of storage parts are deemed unfit for flight.
Yes, it is odd that we do not have maximum storage limits for equipments (but long term storage is under discussion now)

Note : there is no relifing concept in the MIL system and also NASA does not have any such requirement,
There is a high degree of diversity among component manufacturers regarding shelf life rules

Class 1 : Handling and Storage

The supplier shall establish and implement procedures for handling and storage of components in order to prevent possible degradation.

The procedures shall be applicable at any facility dealing with components for flight application.

On request, handling and storage procedures shall be sent to the customer for review.

As a minimum, the following areas shall be covered:

1. Control of the environment in accordance with ESCC Basic Specification No. 24900.

2. Measures and facilities to segregate and protect components during receiving inspection, storage, and delivery to manufacturing.

3. Control measures to ensure that electrostatic discharge susceptible components are identified and handled only by trained personnel using anti static packaging and tools.

Class 1 : QA – Alerts

The supplier shall take into account all received alerts from international alert systems, from manufacturers or sent by the customer and shall validate that there are no alerts on the proposed parts with respect to the batch information (including date-code).

If alerts become available at a later stage, the supplier shall analyse the alerts, analyse the project risk and propose an action plan for customer approval.

The supplier shall initiate and distribute within the project notifications for all major problems arising on EEE parts during procurement, incoming inspection or during all levels of equipment manufacturing or testing, which are of general concern.

The major Alert Systems are the US GIDEP and ESA Alerts. Both secure the detailed alert information in a private domain.
Other organisations maintain also proprietary alert systems with strict access control (e.g. CNES, JAXA, NASA GSFC, …)
The rules for the ESA Alert system are in the public domain https://alerts.esa.int
Use of the ESA Alert system is compulsory for ESA projects.

Class 1 : QA – Traceability and Lot Homogeneity

The traceability of all components shall be maintained during manufacturing, testing, through incoming, storage, and installation at the procurer and user of the component in accordance with programme PA requirements.

In any case, the traceability requirements imposed by the supplier on the EEE parts manufacturer or distributor shall allow managing the adequacy of the tests performed by the supplier (i.e. evaluation, lot validation, any additional test or inspection).

The traceability of EEE parts during installation in equipment, shall be ensured by the supplier through maintaining the traceability to the manufacturer's lot/date code number of the EEE parts actually mounted.

If the as built DCL has not yet been delivered, the supplier shall be able to provide this information (part type actually installed with its relevant lot/date code number) within one week.

Lot homogeneity is a key requirement and applies also for sampling tests.

Class 1 : One time programmable devices

For FPGA, ECSS-Q-ST-60-02 shall apply.
The PAD shall allow traceability to the information related to the procurement of blank parts, the programming process and the acceptance of the programmed parts.
One time programmable components shall be submitted to a post-programming sequence.
For FPGA types without a clear and defined heritage, a post-programming burn-in shall be applied, in conformance with ESCC9000 subclause 8.21, for a minimum duration of 160 h.
NOTE: FPGA types with defined heritage are documented in the report: ESCC REP 010 SCSB Decisions Regarding OTP FPGA PPBI, available on https://escies.org.

The supplier shall prepare a post-programming procedure for customer's approval, depending on part types (including when necessary electrical tests, programming conditions and equipment, programming software version qualified by the supplier, burn-in conditions, additional screening tests and specific marking after programming) as applicable per 4.6.4d.
The lot acceptance procedure, as defined in clause 4.3.5, shall be performed on devices coming from the flight lot/date code and programmed on the same kind of hardware tools and compatible software.
In case of several designs based on the same lot of blank parts, the lot acceptance procedure, as defined in clause, 4.3.5, may be limited to one representative flight programmed design.

Documentation and Quality Levels

Please refer to Table 4-1 in the actual document which lists all documents, customer actions/involvement and comments, if any.

ECSS-Q-ST-60C rev2 : Classes/EEE parts Quality Levels

For Microcircuits:

Class	Quality Level
1	ESCC or QMLV *
2	ESCC or QMLQ or COTS+
3	ESCC or MIL B or COTS+

For other part types refer to Tables 7-n (n = class)

Class 1, Class 2 and Class 3

In ECSS-Q-ST-60C

Class 1 is addressed in Clause 4
Class 2 is addressed in Clause 5
Class 3 is addressed in Clause 6

All of these clauses have precisely the same structure and sub-clause headings to make a comparison as simple as possible.

The major differences between the classes are summarised in the next slide.

Some facts for consideration

•The ‘catalogue’ of space qualified components is not (and can not reasonably expected to be) aligned with all project / innovation needs – but Development Programmes like the European Space Component Initiative have made a notable difference in expanding the choices

•Space qualification of components is consuming resources and takes time roughly proportional to its complexity

•It is therefore necessary to provide for systematic and pragmatic rules to increase the available space component portfolio and accommodate short project schedules and limited budgets.

•The type and number of requirements have an influence on effort and schedule

•Necessarily this leads to the risk conscious reduction of requirements w.r.t. qualification pedigree (e.g. terrestrial MIL vs. Space), reduction of Product Assurance practices such as reduced testing, screening, inspection and documentation and reviews. All of which are to some degree reflected in the class definitions.

•Q-ST-60-13C defines the requirements for a limited set of active commercial components.

•The use of commercial components is not intended to replace space qualified parts but to close gaps in the qualified parts range.

Three classes in comparison (top level)

	CLASS 1	CLASS 2	CLASS 3
- Compliance to ECSS-M-00	required	not required	not required
- EEE parts control plan	required	compliance matrix compliance matrix	
- PCB	required	required	not required
- “as built” DCLs	required	required	not required
- Type red. & pref. process	required	not required	not required
-- Mfr assessment (evaluation)	required	not required	not required
- Approval process	DCL (qualified) PAD (not qualified)	DCL (qualified & EPPL/NSPL) PAD (others)	DCL (qualif & not qualif)
- Procurement spec	normative or project	normative -> datasheet	normative -> datasheet (for review)
- Quality levels			
+ integrated circuits	ESCC or QML/V	ESCC or QML/Q-M + PIND	ESCC or 883B screening
+ discrete active	ESCC or JANS	ESCC or JANTXV + PIND	ESCC or JANTXV
+ standard passive	ESCC/C, EFR-R	ESCC/C, EFR-R, CECC qual + BI	ESCC/C, EFR-R, CECC qual + BI
+ relays	ESCC/B	ESCC/B or MIL/R + ESCC screen	ESCC/B, MIL/R + ESCC screen
+ hybrids	ECSS-Q60-05 level 1 or QML/K	ECSS-Q60-05 level 2 or QML/K	ECSS-Q60-05 level 2 or QML/H + PIND
- Customer precap	required (non qual & few qual)	required (some non qual types)	not required
- Lot acceptance test	required (data < 2 years)	required	required –
- Customer buy-off	required (non qualified)	required (some non qual types)	not required
- DPA	required (non qualified)	required (some non qual types)	required (non qual. relays)
- Alerts	required	only handle alerts received	only handle alerts received
- Lot homogeneity	required	not required (except for rad)	not required (except for rad)

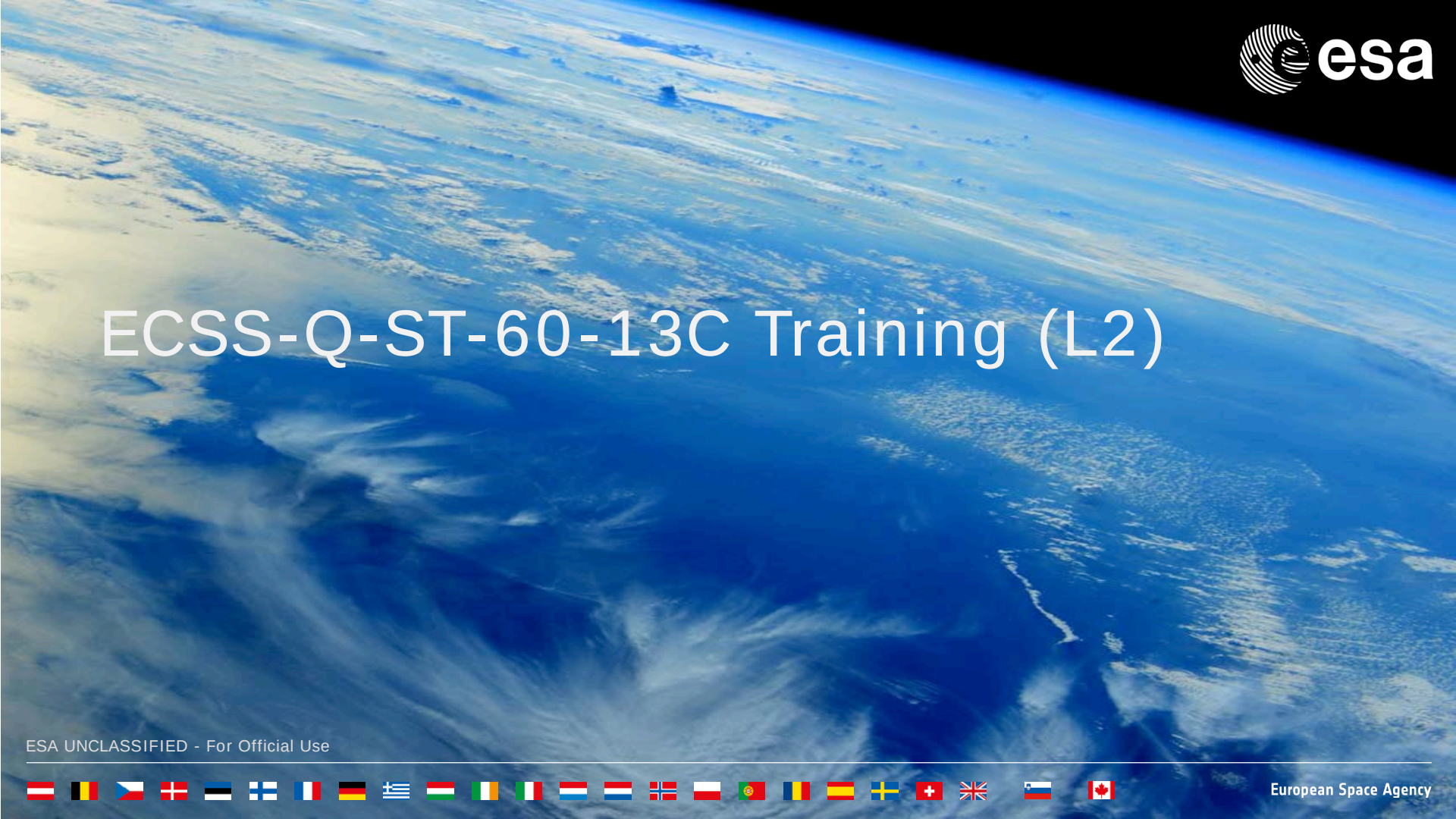
References

www.esa.int
www.ECSS.nl
https://escies.org contains among others
European Preferred Parts List, ESCC QPL/QML
ESCC specifications, Radiation Effects Database, ESCCON Proceedings,
Technology and EEE components information, links
http://landandmaritimeapps.dla.mil/ US-MIL specs and Qualifications #
https://nepp.nasa.gov/ NASA Electronic Parts and Packaging website
https://assist.dla.mil best quick search facility for US MIL-System docs
http://radhome.gsfc.nasa.gov/top.htm NASA Radiation home page

note recent change of web address

ESA Materials and EEE Component Laboratory

http://multimedia.esa.int/Videos/2012/09/Crystal-Oscilator-Investigation-Stories-from-the-Materials-and-Electrical-Components-Lab



ECSS-Q-ST-60-13C Training (L2)

Definition

Commercial Component

Part neither designed, nor manufactured in accordance with military or space standards

Franchised distributor

Distributor officially and contractually authorised by the manufacturer to resell his product(s)

Caution : the procurement of commercial EEE components directly from the manufacturer is unfortunately an exception. To minimise the risk of procuring counterfeit material only duly authorised (by the manufacturer) distribution channels must be used. This authorisation must be verified.

A MAJOR Difference

Between Space Qualified and commercial parts :
Space Qualified Components come with a warranty documented in a lot specific Certificate of Compliance (CoC) to the applicable specification/requirements and a manufacturer commitment to support the user experiencing problems in their application.

A Commercial Component comes with a more limited guarrantee and will only be replaced if the manufacturer accepts that a defective product has been delivered. You must expect any user support provided to be tailored to the commercial value of the order.

Do not ignore the default disclaimer on the data sheet of commercial components : Subject to change without notice.
Typically you will not know about Process Changes, Design Changes, actual Test Coverage, Supply Chain and other relevant details.
Data sheet parameters may be incomplete and parameter limits more loosely defined to ensure production yield and profit margin.

Reduction of Hazardous Substances (RoHS) in electrical and electronic equipment

The vast majority of commercial components available in Europe is in conformity with European legislation in particular the RoHS Directive 2002/95/EC superseded in 2011 by the RoHS Recast Directive.
Although it grants an exception to anything intended to send into space this exception is of course irrelevant for products intended for terrestrial use.

Among others RoHS prohibits the use of Lead (Pb) which has been a standard ingredient of solders and electrical contacts (in the widest sense). This has spurred the use of pure Tin (Sn). Pure tin has the propensity to form whiskers which can lead in many ways to fatal short circuits. A minimum lead content of 3% lead is demonstratably sufficient to suppress this effect and is the firm requirement for terminal finishes. Pure tin is prohibited for EEE components for space applications.

For this reason all commercial components have to be re-tinned.
If used in the internal device construction a careful assessment has to be performed if the associated risk can be acceptable for the intended application.
This has further repercussions on the board level assembly materials and processes. Pb-free solders are typically requiring higher temperature, the temperature range of components is narrower, the glass transition temperature of encapsulants has to be respected, …..

The purpose of ECSS-Q-ST-60-13C

A quote from its introduction

**“This standard is based on and complementary to ECSS-Q-ST-60C (with upward revisions).
This standard can only be used in conjunction with ECSS-Q-ST-60C in its current revision. This standard applies only to commercial components - as defined in its scope - which meet defined technical parameters that are on the system application level demonstrated to be unachievable with existing space components or only achievable with qualitative and quantitative penalties. These penalties must be spelled out, as a minimum, in terms of quantifiable parameters such as: functional capability, parts count, power dissipation, frequency of operation, data/signal processing efficiency, interconnect complexity, mass, volume, … “**

This means : If system performance can not be achieved with available (qualified) space components, then the compliance to ECSS-Q-ST-60-13 requirements can verify the suitability of a commercial EEE component for flight application.

It is not a standard to reduce EEE component cost !

The scope of ECSS-Q-ST-60-13C

This standard defines the requirements for selection, control, procurement and usage of EEE commercial components for space projects.
This standard is applicable to commercial encapsulated active monolithic parts (integrated circuits and discrete):

- **diodes**
- **microwave diodes**
- **integrated circuits**
- **microwave integrated circuits (MMIC)**
- **transistors**
- **microwave transistors**

- **Note : the package maybe hermetic or non-hermetic (e.g. plastic)**

Although falling into the category of semiconductor components, the following families of EEE components are not addressed by the present issue of ECSS-Q-ST-60-13C but it can be used as case by case guideline for the following:

- **photodiodes**
- **light emitting diodes (LED)**
- **phototransistors**
- **opto-couplers**
- **laser diodes**

NOT in the scope of ECSS-Q-ST-60-13C

This standard is not applicable to the commercial parts from the following families:

Capacitors, connectors, crystals, filters, fuses,
heaters, inductors, microwave passive parts,
oscillators, relays,
Resistors, switches, thermistors, transformers,
cables & wires,
hybrids,
surface acoustic waves (SAW),
charge coupled devices (CCD),
active pixel sensors (APS)

Until further notice : this exclusion is based on recurrent project experiences and remains true at present. Required engineering efforts are typically exceeding potential parts cost savings and reliability test results may not permit usage approval.

Basic Approach

- **Within the PA&S requirements ECSS-Q-ST-60 is made applicable with or without tailoring. As ECSS-Q-ST-60 and ECSS-Q-ST-60-13 are pre-tailored, further tailoring should be avoided.**
- **The supplier defines a component control plan that systematically implements those requirements enabling the component selection, approval, procurement, handling, etc. compatible with the project schedule and in a cost-efficient way.**
- **The supplier ensures that the applicable parts requirements are passed down to lower level suppliers and ensures their compliance to these parts requirements.**

Traceability – a key PA&S requirement

Traceability is necessary to establish lot homogeneity allowing the use of statistical methods. While adherence to this concept is standard practice for space qualified products (and in some other areas) associating detailed information with a date code, this information is not typically available from the producers of commercial components.

However, a larger number of reputable commercial component manufacturers are using a 'trace code' as a unique identifier to label and trace a quantity of components with a common manufacturing history and thereby common characteristics.

The manufacturer may often not be willing to share the information associated with this code with a customer and the distributor may not pass this trace code automatically to the customer. There is no industrial trace code standard

Procuring commercial parts with an explicit single trace code requirement is therefore the only way to have a minimum level of traceability and a potential for lot homogeneity

NOTE 1 : The notion of "lot of EEE parts" used for the radiation and lot acceptance tests is defined by the trace code.

NOTE 2 : Several trace codes can be part of a same delivery from the manufacturer or the distributor.

NOTE 3 : It is possible to have several diffusion lots (as per ESCC 21300) in the same trace code.

Document structure overview

ECSS-Q-ST-60-13 is a tailored version of ECSS-Q-ST-60
Both documents have an identical structure and all clauses of ECSS-Q-ST-60 and all of its annexes are listed in 60-13 (the differentiation of three classes is maintained).

These requirements are either marked as applicable, not applicable, modified or new.

Only modified and new requirements are fully elaborated.

The text for ‘applicable’ and ‘not applicable’ requirements is not repeated in ECSS-Q-ST-60-13

Clause 7 : Quality levels – are not applicable in 60-13

New is clause 8 Evaluation and lot acceptance for retinned parts
New is clause 9 Pure tin lead finish – risk analysis
New is Annex F (normative) Justification document – DRD
New is Annex G (informative) Difference between the three classes
New is Annex H (informative) Flow chart for construction analysis and destructive physical analysis

The Justification Document

The Parts Approval Document (PAD) defined and called up in ECSS-Q-ST-60 does not apply to the 60-13.
Instead ECSS-Q-ST-60-13 uses and defines in Annex F the Justification Document which is required by all three classes.

Both documents, PAD and JD, serve the same purpose to make the selection and approval process transparent and controlled.

While the PAD largely relies on the availability of a component detail specifications or procurement specifications and their amendments, if any, the JD has to explicitly list many detailed parts characteristics as relevant for the evaluation test program and Lot Acceptance provisions.

The amount of data collected in the JD decreases from class 1 to class 3.
However this does not mean that it will be sufficient and acceptable for a class 3 component to refer to a data sheet and state that this part is needed by the project because it is procurable.

The fact that a part may be in production for a while and worked satisfactorily in a breadboard is clearly not sufficient for a flight approval.

Aspects of Plastic Encapsulation

The vast majority of commercial semiconductor products are encapsulated in plastic, typically with Epoxy type resins and numerous types of additives.

Plastic Encapsulated Microcircuits (PEM) are by definition deemed to be non-hermetic.

There are many different molding compounds in use and formulations tend to vary, resulting in changing material properties including variations in ‘glass transition temperature’.

These plastics contain volatile elements which are outgassing over time (mass loss + contamination source) and enhance the water vapor absorption (moisture ingress -> popcorning, delamination cracking)

COMMERCIAL COMPONENTS CAVEAT

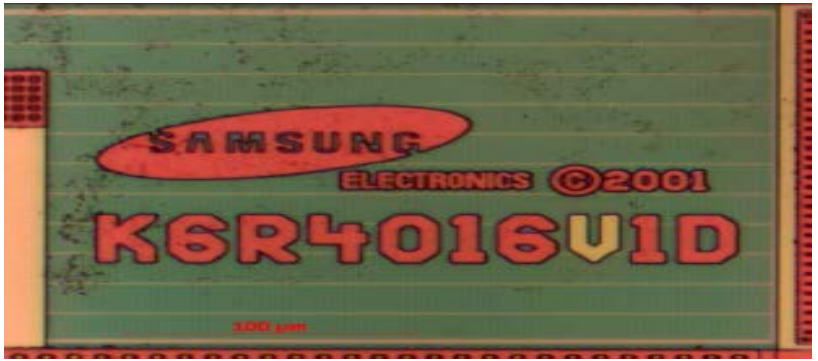
A spacecraft periodically orbiting through the South Atlantic Anomaly experiences frequent subsystem anomalies. The cause is soon traced to radiation induced latch-up events (so far non-destructive) in a type of SRAM used in various functions.
Samsung SRAMs K6R4016V1C-TI10 procured with single lot requirement were delivered with the following marking :

COMMERCIAL COMPONENTS CAVEAT

Procurement records were checked and DPA reports analysed.
The DPAs clearly showed that the lot consisted of a mixed population of parts of two die revisions (C&D), easily distinguishable by X-Ray inspection showing different die size, aspect ratios and lead frames. Die revision C had been ordered. Die revision D was long known to have much inferior SEE behavior and particularly more LU sensitive than die revision C.
Unfortunately no action was taken to X-ray or visually inspect the full lot in order to eliminate the parts with die revision D before assembly.
LL : Look at the facts and take corrective actions !

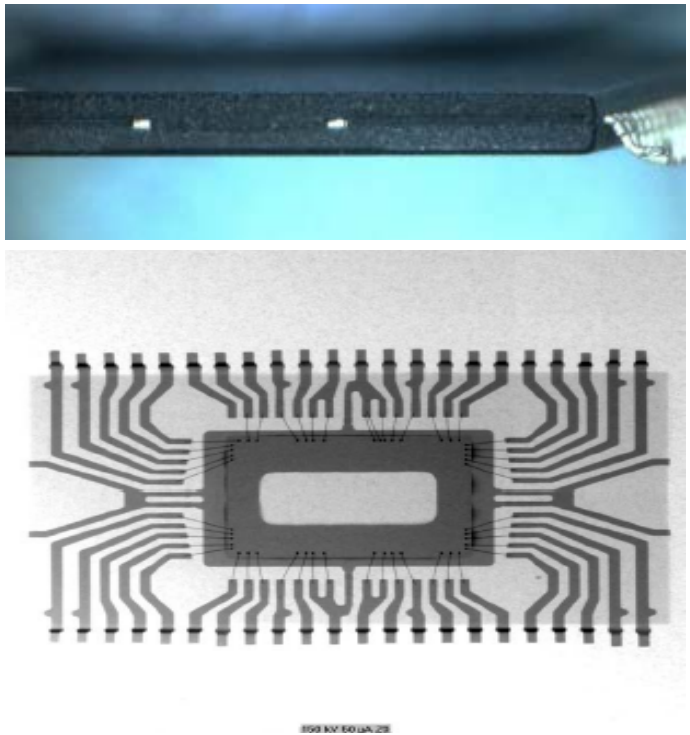
die marking rev. C

die marking rev. D

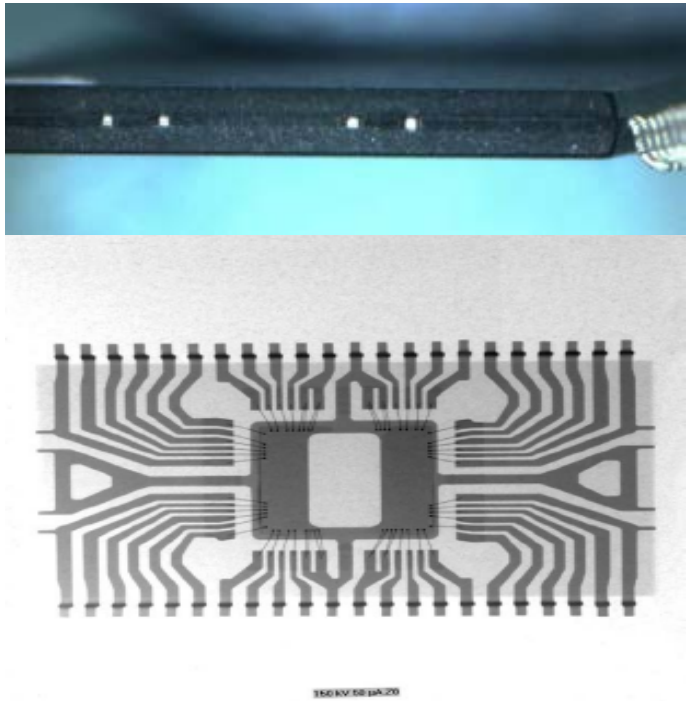


COMMERCIAL COMPONENTS CAVEAT

Die rev. C parts

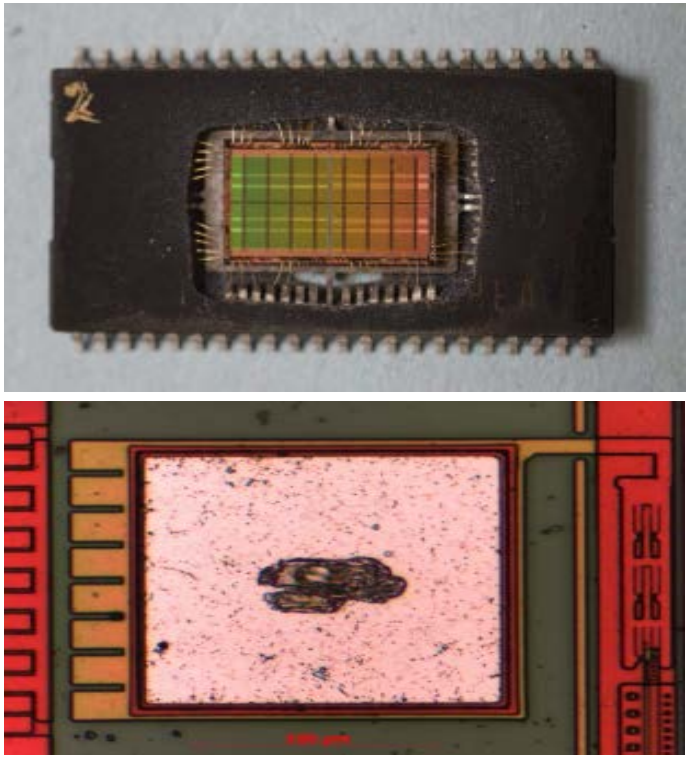


Die rev. D parts

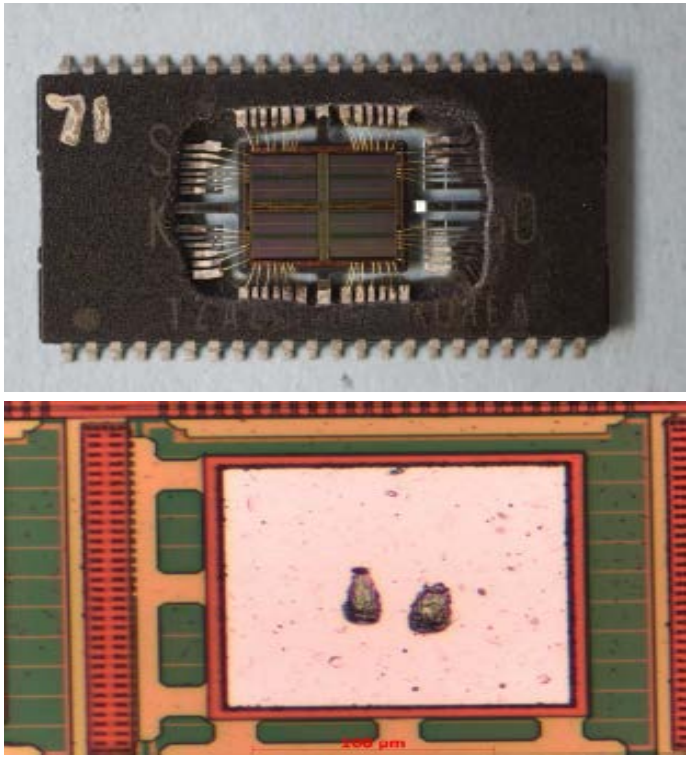


COMMERCIAL COMPONENTS CAVEAT

Die rev. C parts



Die rev. D parts



COMMERCIAL COMPONENTS CAVEAT

At the time of procurement the part type was obsolete.
The part marking was identical, contrary to typical industrial practice.
The parts were not procured from an authorised distributor.
Procurement documentation is rather limited, however, there is no evidence of any kind suggesting a counterfeiting activity.
This experience very clearly illustrates the risks associated with commercial grade parts.

<u>Today ECSS-Q-ST-60-13C requires :</u>
"Each procured EEE part shall be traceable to a manufacturer assigned trace code.

Note: The procurement of a single trace code per delivery lot should be preferred and encouraged.

Each trace code shall be maintained as is through the entire supply chain including distributor.

Note: As far as possible, commercial parts should be ordered in the manufacturer's standard packing quantities or multiples thereof to avoid distributor re-packing and handling and to preserve the traceability information usually included on the original manufacturer packaging."

For further questions

Please consult ESCIES

The European Space Components Information Exchange System

https://escies.org

Or contact

Ralf de Marino

Special Advisor to the PA&S Department

ESA Directorate of Technology, Engineering and Quality

ralf.de.marino@esa.int

Thank you for your attention !