

STANDARDISATION

The ESCC system in brief

1. ESCC is the European Space Components Coordination
 - Collaborative activity between Space Agencies, the European Space Industry, and European component manufacturers related to procurement of EEE components suitable for space applications
 - <https://spacecomponents.org/>
2. ESCIES is the European Space Components Information Exchange System
 - Portal is here: <https://escies.org/>

+ **Photonics**
portal in the
menu list



For users, 3 levels of specifications:

- Basic specification:
 - test methods & methodology & general requirements & evaluation
 - ⇒ applicable to **all EEE components**
- Generic specification:
 - requirements for screening, periodic or LAT and qualification testing
 - ⇒ dedicated to **individual families** of components
- Detail specification:
 - performance, maximum ratings, variants
 - physical dimensions, functional diagram & pin out,
 - deviations from the Generic Specification
 - proposed by manufacturers
 - ⇒ dedicated to **individual components**



- Discrete optoelectronics: LED, photodiode, phototransistor, packaged in ceramic or TO can
 - Generic specification ESCC 5000 for discrete semiconductor components is applicable
 - Several ancillaries specifications are related: ESCC 2045000, 2055000, 2095000, 2135000, 2145000, 2265000
 - Detail ESCC 5403/001 Issue 2 Nov 2015: Photodiode, based on Type AE9493



- Laser diodes
 - Basic specification ESCC 23202 Issue 1 October 2014: Validation and Lot Acceptance Testing, Guidelines for Laser Diodes.
 - Basic specification ESCC 23201 Issue 1 January 2014: Evaluation Test Programme Guidelines for Laser Diode Modules.
- Optical connectors
 - Ancillary specification ESCC 2263010 Issue 3 Sept 2013: Evaluation test programme for optical fibre connector sets
 - Generic specification to be consolidated before submission to PSWG
 - Detail specifications for AVIM and mini-AVIM to be adapted to the generic specification when it is approved



- **CCD and CMOS Image Sensors**
 - Basic ESCC 25000 Issue 2 January 2014: Basic Specification for Electro-Optical Test Methods for Charge Coupled Devices
 - Generic ESCC 9020 Issue 3 Nov 2013: Generic Specification for Charge Coupled Devices Silicon Photosensitive
 - Basic ESCC 2139020 Issue 3 Nov 2013: Terms Definitions Abbreviations Symbols and Units for Charge Coupled Devices
 - Detail ESCC 9610/004 Issue 2 Apr 2014: Charge Coupled Devices, Silicon, Photosensitive, Advanced Inverted Mode Sensor, Back Illuminated, 740 X 514 Image Area, Frame Transfer, based on Type CCD55-20
 - Detail ESCC 9610/005 Issue 2 Apr 2014: Charge Coupled Devices, Silicon, Photosensitive, Front Illuminated, 512 X 512 Image Area, Frame Transfer, based on Type CCD57-10

What is meant by Qualification?



The term Qualification is commonly used in many situations. You can find components that get:

- an **Approval** on a case by case basis which is an **individual and limited authorisation** for one (or a few) specific project applications, based on a given mission profile
- a **full ESCC Qualification** which is a general and **long term authorisation** for use in space and independent of the type of mission
 - Components are part of the ESCC QPL (Qualified Parts List)
 - Components are available at manufacturer as space grade
 - For some specific missions (e.g. radiation, cryogenic applications ...) extra reliability assessment may be necessary
 - ESCC is the European “organism” for space qualification, others space agencies provide Qualification with their standards, see DLA for instance <http://www.landandmaritime.dla.mil/Programs/QmlQpl/>

1. ECSS is the European Cooperation for Space Standardization
 - Initiative established to develop a coherent, single set of user-friendly standards for use in all European space activities
 - <http://ecss.nl/>
 - to download any documents, this is necessary to register!
2. Aim is to provide the **philosophy of testing** not the tests methods.
3. Three ECSS panels:
 - Engineering, ECSS-E-serie
 - Management, ECSS-M-serie
 - Product Assurance, ECSS-Q-serie



There is no specific standard for photonic components

Those standards are used for EEE & photonics components:

- ECSS-Q-ST-60C Rev2: Space product assurance for EEE components
- ECSS-Q-ST-60-05C Rev.1: Generic requirements for hybrids
- ECSS-Q-ST-70-02C: Thermal vacuum outgassing test for the screening of space materials
- ECSS-Q-ST-30-11C Rev 1: Space product assurance, Derating for EEE components

There is a TM applicable to the splices: ECSS-Q-TM-70-51A: Termination of optical fibres

Criteria for choosing a photonic component for space application

Engineering requirements

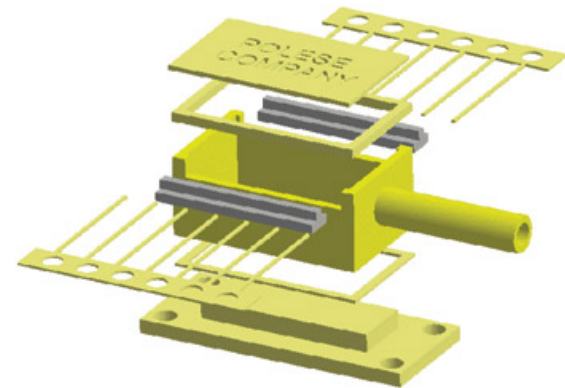
- Performances
- Package:
 - Interface definition
 - Thermal management
- Testing methods/methodology

Mission requirements

- AIT, Ground storage, Launch and In-orbit environment definition
- Product assurance requirements
- Quality assurance

Management requirements

- Availability on the market at the required quantities
- Cost & lead time
- Availability of interlocutor at manufacturer



Procuring and approving use of photonic component: testing flow



C.A.

Procure several parts from several manufacturers:

- Perform a performance assessment
 - Perform a construction analysis + some pre-evaluation tests
- ⇒ select the manufacturer based on the compared results

EVAL

Procure enough parts from the selected manufacturer to:

- Perform an Evaluation testing
- ⇒ lessons learnt and improvement of the built / design for flight models

QUALIF

Procure FM from the selected manufacturer to:

- Get the FM + spares + attritions
 - Perform the Lot Acceptance Tests (or periodic testing)
- ⇒ Delivery shall happen after the LAT results are available

Procuring and approving use of photonic component: QA flow



C.A.

- Collect the mission environment and the applicable PA requirements
- Discuss with the manufacturer to expected failures modes and on QA matters
- Collect lessons learnt from previous projects and known issues
- Define the tests for construction analysis
- Review and analyse the tests reports
- Participate to the approval of the manufacturer selection

EVAL

- Participate to write the draft procurement specification, including evaluation tests sequence, screening tests, qualification sequence, delivered documentation, acceptance reviews
- Review and approve the draft PID (product identification document) written by the manufacturer,
- Review the Evaluation test plan and approve the Evaluation test reports

QUALIF

Before manufacturing starts:

- Review and approve the updated PID written by the manufacturer
- Participate to write the updated procurement specification

During manufacturing:

- Performs the customer inspections: precap / postcap, customer buy-off
- Review the screening tests results and check for lot rejection criteria
- Review the Lot Acceptance Tests plan and approve the LAT reports
- Participate the incoming inspection at reception

PID = guarantee the representativeness of tested devices (design, materials, processes, tests methods and criteria)

Procuring and **approving use** of photonic component: PA flow



C.A.

- Provide the mission environment and the applicable PA requirements

ECSS-Q-ST-60C Rev.2
21 October 2013

EVAL

- Approve the procurement specification, Evaluation test plan, Qualification test plan, Radiation test plan, all summarised in the PAD (Part Approval Document) = as-design PAD approval
- Participate to the Non Conformance review Boards

QUALIF

- Approve the PAD (Part Approval Document) = as-built PAD approval
- Participate to the Non Conformance review Boards
- Review the incoming construction analysis

**PAD not signed =
part not approved to
be used**

Topics to be discussed with the component manufacturer



The formal review of the manufacturer processes is the **PID review**.

But some items have to be discussed with the manufacturer in advance:

Design

- Space friendly materials
 - no pure tin,
 - low outgassing epoxies,
 - materials compatible with each others (corrosion)

Testing

- Test benches
- Pass / fail criteria
- Yield survey?

Manufacturing

- Batch size
- Bake materials prior use
- List of reworks and the repairs allowed
- Storage during manufacturing
- Traceability

Quality

- Incoming inspection? Criteria?
- Step subcontracted? How is this controlled?
- Qualification of operators
- Quality inspections vs "self control"

The procurement specification will define all aspects of the component.

- Performances: spectral characteristics, noise, stability
- Design: chips, package, add-on, fibre if any, interface definition
- Operation: input/output power, operating temperatures, wavelength, modulation, consumption, etc **end of life**
- Environment: specify the lifetime, radiations levels, mechanical stress, thermal stress, humidity exposure on ground, and storage duration to assess the hermeticity
- Manufacturing: single batch approach for all sub parts, screening definition for chips, add-on, fibre, define the allowed reworks, low outgassing materials
- Testing: evaluation and qualification plan, test methods, screening definition,
- Quality and Product Assurance: focus on reliability and traceability, define the customers reviews as early as possible, the list of documents to be delivered, how the hardware is accepted for delivery, criteria for batch rejection

Table D-1: PAD sheet

PROJECT:		Doc n°:		Prepared by:	
		Issue:		Date:	
Approval requested by:.....					
Family:.....		Fcode []		Group:..... Gcode []	
Component Number:.....					
Commercial Equivalent Designation:.....					
Manufacturer/ Country:.....					
Technology/Characteristics (value or range of values with tolerance, voltage, package etc):					
Pure tin free (Y/N) []					
Generic specification:.....					
Detail specification:.....		Issue:.....		Rev:..... variant:.....	
Specification amendment:		Issue:.....		Rev:..... variant:.....	
Quality level:.....		Procurement by:.....			
APPROVAL STATUS					
EPPL Part 1/2 listed (1/2/N) []					
ESCC QPL or EQML listed (Y/N) []					
MIL QPL or QML listed (Y/N) [] If yes: QPL/QML Reference:.....					
Other approvals/former usage					
Evaluation programme required (Y/N) []					
If yes reference of the Evaluation Programme:.....					
PROCUREMENT INSPECTIONS and TESTS					
Precap (Y/N) []					
Lot acceptance:					
ESCC LAT/LVT level or subgroup []					
MIL QCI/TCI group []					
Buy-off (Y/N) []					
DPA (Y/N) [] if yes: sample size					
Complementary tests					
RADIATION HARDNESS DATA					
Radiation Hardness Assurance Plan applicable (Y/N)[]					
Doc. Ref.:					
Total Dose Effects:					
Evaluation Test Data (report) reference:					
Single Event Effects: SEL/SEU/SET/SEFI/SEB/SEGR/others: (cross out when non applicable)					
Evaluation Test Data (report) reference:					
RVT required (Y/N)[]					
REMARKS					
Approval customer			Date		
Approval first-level supplier			Date		

ECSS-Q-ST-60C Rev.2
21 October 2013



Space product assurance

Electrical, electronic and
electromechanical (EEE)
components

Thank you for your attention

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