Passive way of life!
Good Performances & Quality Time
ACTIVITIES

ESA has funded 51 activities (including CCNs) involving Passive components since 2012.

Total Budget: 12.55 M€.
-270K€ per activity
-7 new activities per year
- activities to be stared in 2019
ESCC for Passive Components

Thanks to national space agencies, manufacturers and ESA funding:

From 2009 to 2019:

- More than 100 ESCC certificates. (almost x2 compared to 2009)

- Tens of new qualified technologies and components: Base metal electrode ceramic capacitor, flex ceramic capacitor termination, multi-anode tantalum capacitor, SAW filter, fuses, shunt, platinum sensor, circulator and isolator, RF cable assembly, fast locking connector, RF connector SMA 2.9, SMP and high power TNC

- New ESCC generic standards: oscillator, cable assembly, RF passive specifications, etc.
Good Performances & Quality Time

- Rectangular Connectors
- RF Connectors
- Fuses
- Supercapacitors
- Ceramic Capacitors
- Tantalum Capacitors
Ceramic Capacitors: Performances

<table>
<thead>
<tr>
<th></th>
<th>25V</th>
<th>50V</th>
<th>100V</th>
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<tr>
<td>0805</td>
<td>68nF</td>
<td>68nF</td>
<td>47nF</td>
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<tr>
<td>2220</td>
<td>1.5(\mu)F</td>
<td>1.5(\mu)F</td>
<td>1(\mu)F</td>
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Ceramic Capacitors: Performances

<table>
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<th>2009</th>
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<tr>
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<tr>
<td>2220</td>
<td>1.5μF</td>
<td>1.5μF</td>
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<table>
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<td>10nF</td>
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<tr>
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<td>68nF</td>
<td>68nF</td>
<td>47nF</td>
<td>15nF</td>
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<tr>
<td>1μF</td>
<td>470nF</td>
<td>100nF</td>
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<tr>
<td>2220</td>
<td>1.5μF</td>
<td>1.5μF</td>
<td>1μF</td>
<td>330nF</td>
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<tr>
<td>22μF</td>
<td>10μF</td>
<td>1μF</td>
<td>4.7μF</td>
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</tr>
</tbody>
</table>
Tantalum Capacitors: Performances

![Graph showing ESR in mOhm against Capacitor value in micro Farad for 2007, 2018, and 2019 data points.](image)

8.
Supercapacitors: Quality

- Several on-going activities in order to develop new technologies: CDC, VACNT, etc.

- Today, we are building reliability figures.

- Objective: European supply chain for supercapacitors and bank of supercapacitors

  Life test on 800 parts at 55°C - 0.85 × Vr
Fuses: Quality Time

- Qualified technologies: MGA-S and HCSF fuses, Schurter
- Under what conditions the fuse should operate?
  Proper use of fuse is complex.

A fuse is most of the time a resistor but should go to open circuit when overcurrent.
RF connectors: Time to market

Qualified high power TNC VHP connectors, Radiall

10 years from development to ESCC qualification!

No equivalent in the world in terms of power for TNC

Need driven by roadmap on RF power

Currently, in integration in many RF components with Very High Power (VHP) levels
Rectangular Connectors: Time to Market

• MMC originally developed in the frame of an ESA funded TRP activity:

  « Miniaturisation of Power/Coaxial Connectors »

• Successful ESCC evaluation but 2 years of delay. Why 2 year of delay?

• TRL9, since 2 weeks!!!
Bye-bye good quality time?

In Europe, we have one of the largest portfolio of passive components manufactured, qualified and tested for space applications.

This was ONLY possible because we built it and we have prepared for it.

But it came with TIME and COST.
New Space Era

How is the weather?
Is it warm enough?
Automotive Parts

Parts manufactured and tested for a vehicle.

As for car brands, it is based on trust.

Based on zero defect manufacturing -> no screening.
AEC-Q200 for Space

- Based on defined family range and similar to ESCC PID.

- Based on one initial qualification with numerous tested parts.

Maintenance in case of process change:
Note: A letter or "." indicates that performance of that stress test should be considered (not necessarily required) for the appropriate process change.

We speak about:
TRUSTED manufacturers= Fabricants de confiance
AEC-Q200 for Space

- Relevance of tests for space?
AEC-Q200 for Space

AEC-Q200 life test for ceramic capacitors

<table>
<thead>
<tr>
<th>Temperature K</th>
<th>Derated voltage x Vr</th>
<th>Test temperature K</th>
<th>Test voltage x Vr</th>
<th>Test duration (hours)</th>
<th>Year equivalent (years)</th>
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<tr>
<td>ESCC life</td>
<td>358</td>
<td>0,6</td>
<td>398</td>
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<td>AEC-Q200 life</td>
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<td>0,6</td>
<td>398</td>
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<tr>
<td>ESCC screening</td>
<td>358</td>
<td>0,6</td>
<td>398</td>
<td>2</td>
<td>125</td>
</tr>
</tbody>
</table>

- All ESCC part are passing the AEC-Q200 life test: several millions of parts!
- It is not demonstrated that all AEC-Q200 tested parts would pass the ESCC life test
- This is enough for automotive applications: 500,000km at 50km/hours is equivalent to 10,000 hours of use (less than 2 years). 19 years life test for less than 2 years of use: Margin is almost x 10.
- Is that enough for Space applications?
AEC-Q200 for Space

- Do we fly without screening?

- Range of ESCC qualified parts are based on automotive line.

- ESCC screening is rejecting in the order of 1 parts for 3000 – 5000 parts.

- For AEC-Q200, in order to find a defect, tests in initial qualification should be performed on 5000 parts in life test; in reality, tests are performed "only" on (order of) 1000 parts.

- Is that OK for space applications?
AEC-Q200 for Space

- Is that OK for space applications?
The answer is: We don’t know!

- why that?
Reject = out of spec but may be not a critical defect.

We are not monitoring the burn-in, no information about early and end life failures: we don’t know if failures occur at the beginning or at the end.

Some application may be tolerant for failures: decoupling, redundancy.
What should be done?

At component Level

- Establish a common approach and understanding of "trusted manufacturers".
- Inclusion of passive components in ECSS-Q-ST-60-13 (currently, includes only active parts).

Therefore, we need DATA&statistics analysis on Screening tests.
Do we have these information?

- Studies on burn-in failures: different technologies and manufacturers
- Number of rejects
- Type of rejects
- When and how failures appear?
What should be done?

At Project Level

- Applications like SpaceX (manned missions) may still need a high reliability level as one failure can be catastrophic.

- Applications like OneWeb may be different: is it critical if 1 or 10 satellites fail(s) in a constellation of ~900?

- Therefore, at project level, one should choose the adequate component level and possibly up to the board, equipment or satellite level (with a link to components ECSS-Q-60 classes' definition).
Is the New space era a threat for the passive way of life?

Hopefully not, of course if we are well prepared.