The ECSS -Q-ST-60-13C Approach to Commercial EEE Components
The concept and key requirements
Objective of the presentation: to explain the ECSS requirements on PEMS

1. ORIGIN
2. BASICS
3. COTS SPECIFICITIES
4. CONCEPT
5. CONTENT (SOME HIGHLIGHTS)
6. IMPLEMENTATION DIFFICULTIES
7. CONCLUSION

See also the associated presentation: First experiences with ECSS-Q-ST-60-13C use in CNES projects
1. ORIGIN

- 1995: Starting point, R&D studies, analysis, surveys
- In parallel Microsat (Myriade) development, need for COTS
- Context change:
  - Better, faster & cheaper
  - Best in class
  - QML
  - Manufacturers improvement in reliability
- Projects pressure & needs
- 2004: First CNES several standards & handbooks, case by case oriented
- 2010: Consolidation: partnership with French industry
- JAXA associated to the final spec
- 2013: European building: **ECSS-Q-ST-60-13**
2. SPECIFICITIES

<table>
<thead>
<tr>
<th>Integrated circuits</th>
<th>Space</th>
<th>MIL</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Dedicated or not</td>
<td></td>
<td>commercial</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Dedicated</td>
<td>dedicated, off shore</td>
<td></td>
</tr>
<tr>
<td>Qualification</td>
<td>Agency</td>
<td>Agency/manufacturer</td>
<td>manufacturer</td>
</tr>
<tr>
<td>Specification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td>screening, lot tests</td>
<td></td>
<td>manufacturer</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-55/125°C</td>
<td>-55/125 ; -40/85 ; 0/70</td>
<td></td>
</tr>
<tr>
<td>Package, terminations</td>
<td>Hermetic, majority Sn/Pb</td>
<td>Hermetic, Plastic, Pb free</td>
<td></td>
</tr>
<tr>
<td>Life cycle</td>
<td>Many years</td>
<td>Several year(s)</td>
<td></td>
</tr>
</tbody>
</table>

- Purchasing cost << cost of ownership which includes engineering tasks, additional tests, etc.
- The question is not "COTS authorised or not“ but authorisation with which conditions (i.e. with which additional tests).
3. BASICS (1/3)

- Perimeter limited to active parts (VLSI, discrests)
- Pretailoring included as per 3 risk classes (same as ECSS-Q-ST-60)
- Written by delta with the existing ECSS on 3E parts requirement (ECSS-Q-ST-60C) : to highlight specificities
- Requirements categories :
  - Management (DCL, Parts Control Board)
  - Selection
  - Procurement
  - Inspection
  - Quality
- For performance access, cost motivation at a lesser extent
- Preference to space qualified components
3. BASICS (2/3)

- **Consider specificities:**
  - Pure tin terminations
  - Temperature range
  - Non hermetic packages: storage, humidity test & moisture sensitivity
  - Traceability at trace-code level
  - Need for Manufacturer data collect

- **No specificity for:**
  - Declared components list
  - Parts Control Board
  - Radiation Hardness Assurance

Trace code: Unique Manufacturer identifier to label and trace a quantity of components with a common manufacturing history and thereby common characteristics.
Several trace codes can be part of a same delivery from the manufacturer or the distributor. It is possible to have several diffusion lots in the same trace code.
3. BASICS (3/3)

European Space parts

COTS

TOOL BOX

Selection – Procurement - Use

NASA

JAXA

ESCC

COTS ECSS-Q-ST-60-13 CNES Philippe LAY
4. CONCEPT (1/2)

- Requirements pretailoring:
  - Evaluation
  - Justification doc
  - Screening
  - Lot Test

Class

1. Minimized cost
2. Minimized risk
3. Risk/cost compromise
### 4. CONCEPT (2/2)

<table>
<thead>
<tr>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eval.</strong>&lt;br&gt;CA Elect. charact. HAST 96h or THB 1000h LT 2000h @ 125°C+DPA 500 T/C -55/+125°C</td>
<td><strong>CA Elect. charact. HAST 96h or THB 1000h LT 2000h @ 125°C+DPA 500 T/C -55/+125°C</strong></td>
<td><strong>CA</strong></td>
</tr>
<tr>
<td><strong>Doc.</strong>&lt;br&gt;JD</td>
<td>JD</td>
<td>JD</td>
</tr>
<tr>
<td><strong>Screening</strong>&lt;br&gt;10T/C -55/+125°C Burn in 240h @ 125°C</td>
<td>10T/C -55/+125°C Burn in 160h @ 125°C</td>
<td><strong>CA</strong></td>
</tr>
<tr>
<td><strong>LAT on screened parts (TC, LT, rad)</strong>&lt;br&gt;CA HAST 96h or THB 1000h LT 2000h @ 125°C 100T/C -55/+125°C</td>
<td>CA HAST 96h or THB 1000h LT 1000h @ 125°C 100T/C -55/+125°C</td>
<td>HAST 96h or THB 1000h LT 1000h @125°C 100T/C -55/+125°C</td>
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</tbody>
</table>

**Only PEDs considered**<br><br>**Radiation not included**

- **Required**
- **Case by case**
Temperature:

- Commercial EEE part to be selected in its highest temperature range.
- No usage outside temperature range (!)
- Minimum 10°C margin between maximum manufacturer temperature range and the application (including worst case).
- If margin below 10°C, electrical characterization up to using temperature + 10°C.
5. CONTENT (2/3)

Pure tin:

- Class 1: Sn/Pb solder dip with a qualified process, before screening & Lot test

- Class 2 & 3: Sn/Pb solder dip or risk analysis & mitigation based on collected data + application

Storage for Plastic encapsulated devices:

- Dry Nitrogen
- Dry and ionised air with RH in a range of 15% to 20%
- Dry pack as specified in J-STD-033 for dry pack inspection and control
5. CONTENT (3/3)

Justification Document = data collection including:
- Justification need /trade-off wrt space qualified solution
- Manufacturer max rating
- Data sheet
- Process/techno Changes Notification services
- Life cycle, maturity: (emerging/maturity/decline)
- Lead finish
- Manufacturer qualification, reliability, lot & screening tests, Early Failure Rate
- Manufacturer part traceability: tracecode, datecode, assembly plant, wafer fab, diffusion lot

+ Eval, additional test (screening, Lot test) at user level

For approval
6. IMPLEMENTATION DIFFICULTIES

- Tradeoff with High Rel parts vs preference to High Rel parts
- Engineering resources, focus on the selection step
- Engineering arbitration: to decide when no test is acceptable
- Similarity approach
- A standard not optimized vs case by case approach
- Real cost of ownership/true prices & costs. Debate about the cost reduction drivers:
  - Electrical architecture (design to cost & COTS vs pin to pin replacement)
  - Industrial organisation complexity & interfaces
- Perimeter limited to PEMS
7. CONCLUSION

- COTS Standard, necessary, useful, progressively implemented & experienced

- … And very positive lessons learned see next presentation “First experiences with ECSS-Q-ST-60-13C use in CNES projects” …