Space Passive Components Days
ESTEC
ASTRIUM PASSIVE Road-map 2013

Short-term and mid-term road-map

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Together the pioneer of the full range of space solutions
for a better life on Earth

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Introduction

Passive parts are rarely driving the design, but they are key elements for the design performance.

For reliability reasons, most of the passive components are mature. They can be proven through the automotive or medical market. Therefore some more recent technologies could be used.

ASTRIUM roadmap for passive components is based on a balance between proven reliability and innovation, taking into account the robustness and the performance of the designs as well as the competitiveness.

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Some figures of the present situation

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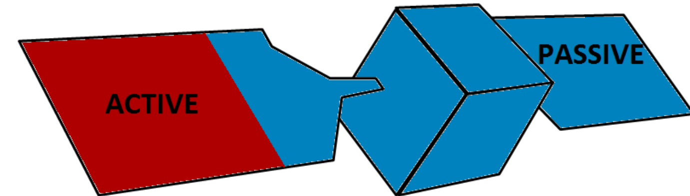
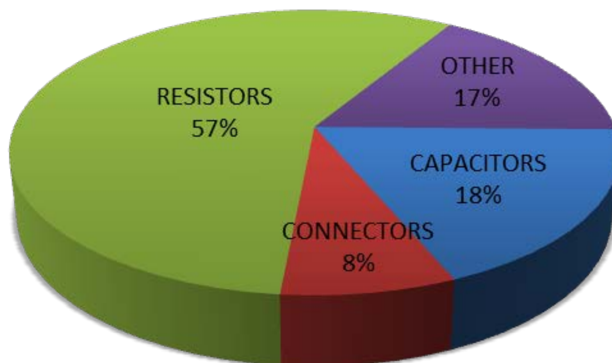
- 70 to 75% of the components used in a satellite are passive components



- A typical platform for Telecommunication satellite is :
  - More 60 000 passive components (total number, wires excluded)
  - More than 700 different items of passive parts



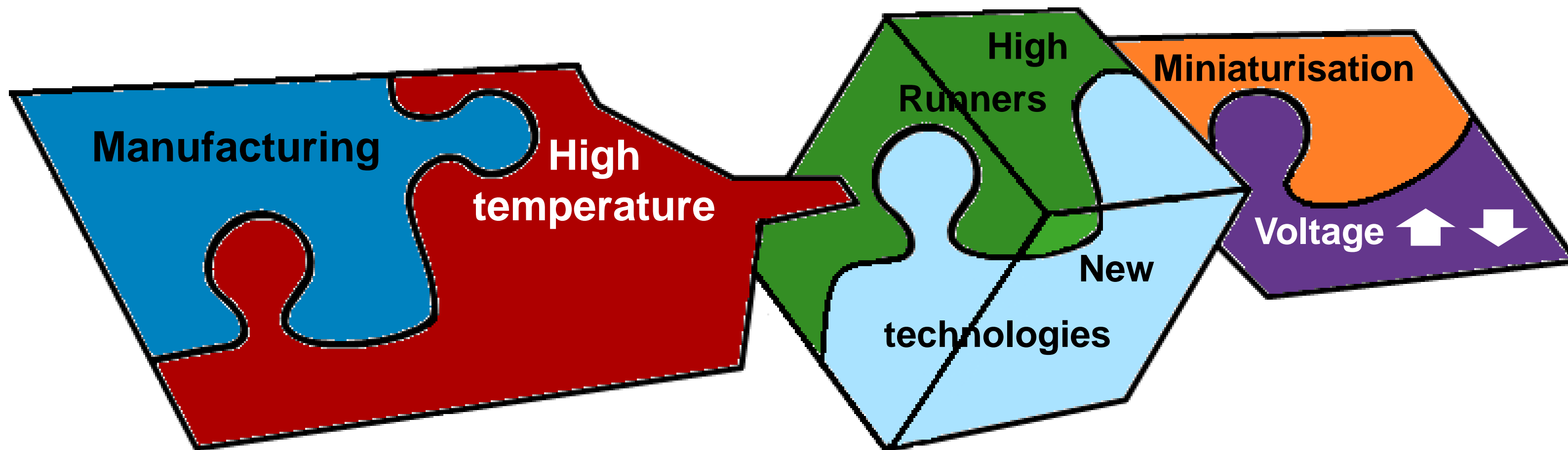
Distribution

Comments :

Resistors and capacitors concentrate 75% of the items

Category “other” contains relays , crystals, fuses. Wires and RF passive parts are excluded.

Main drivers for the future needs



1. Manufacturing : less through-hole components
2. High runners : standard functions
3. Miniaturisation : hugely Res &Cap required by digital application
4. High temperature : GaN amplifiers
5. Changes in voltage : more high and low voltage, less medium voltage
6. New technologies

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1- Manufacturing

Through hole components : trend to disappear

- Leaded power resistors (RER/ RWR) : to be replaced by SMD versions (Range 1 to 3W , values between 100mohms to 10ohms)
- CLR 79 : few remaining applications

Industrial manufacturing : automated assembly

- Objective : having the maximum of components mounted by automatic lines.

2- High runners (1/2)

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The most part of the passive components used in satellites will still come from qualified (ESCC or MIL) range.

- Ceramic capacitors : chips " standards values" from QPLs (1206 or 0805)
- Ceramic capacitors : SMPS (multi-chips stacked series)
- Film capacitors : for their self-healing properties (PM90 and PM94 or extended range), mainly used in power electronics .
- Chip solid tantalum capacitors: standard and low ESR type from QPLs and extended range ; more and more used for output filtering (DC-DC converter and POL), energy tank and decoupling.

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2- High runners (2/2)

- Resistances : chips thick and thin film from QPLs
- Resistances : PHR when precision is needed.
- Connectors : Sub D, Sub D HD, MHD, KN, MDM
- Relays : mainly latching relays (GP250, TL12, EL215) and thermostats
- Others : thermistors 15kΩ

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3 - Miniaturisation : a strong axis

2 mains reasons : lowest voltage supplying for IC and highest frequency

- Ceramic capacitors : lower chip sizes 0603 and down to 0402 (for instance FPGA decoupling) ➔ (ratio value/size) consequently BME could be used (with respect to HiREL rules).
- Tantalum capacitors : lower voltages and the new generation of low ESR tantalum capacitors make possible the use of Ta capacitors as output filtering (for example TES MnO2 multi anodes or T530 polymer multi anodes)
- Chip resistors : the standard size could become 0603 instead of 0805 and more and more 0402 . 0201 is not yet planned
- Connectors : the power and working voltage limit the miniaturisation. Handling operation is another limitation.

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4 - High temperature

GaN amplifiers can operate at 125°C until 150°C

- Ceramic capacitors, tantalum capacitors, chip resistors : all the main manufacturers proposed 200°C range. It is necessary to validate the long term reliability (15 years) and the performance at high temperature.
- Capacitor on silicon (like IPdia) could be an alternative to type I ceramic.
- Need also of high temperature magnetics
- Related problems to solve : compatibility with PCB /substrate, terminations, mounting process (high temperature soldering)

5 - Change in voltage : higher and lower (1/2)

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IC Voltage rating be lower and lower : more and more 3.3V and 2.5V indeed 1.8V.

- Low voltage ceramic capacitors (16V or less if the reliability can be proven). Must be characterized in voltage at rated voltage.
- More tantalum capacitors can be used.
- Higher frequency, for capacitors and connectors 7 to 8Ghz (until 15/16 for mid-term)

Some high voltage applications (few needs)

- Connectors / relays working under 600V/700V

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5 - Change in voltage : higher and lower (2/2)

For power, 100V is more and more used (Telecom application)

- Difficulties to use tantalum technology (need of 200V rating)
- Need for 200V rated capacitors (few qualified chip ceramic types)
- Need for power (1 to 3W) surface mount resistors (100mohms to 10ohms) to replace RER/RWR type.
- Relays / thermostat working under 100V (from 1 to 5A ; max 15A for some cases)

Need for higher power for RF cables

- Connectors / cables for C- Band until 110/120 W
- Cables for Ku-Band 30-40W operating with wide temperature cycles (-150°C /+150°C).
- Qualified high voltage connectors (600/1000V)
- High speed digital harness (6Gbps)

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6 - New technologies / New products

New products

- Polymer tantalum (hermetic version) would replace some ceramic capacitors.
- BME ceramic capacitors for their ratio volume / capacitance
- High speed (>6Gbps), high density connectors for PCB (BGA or through-hole)
- Self regulated heater (*HeatSelf*)
- Super-capacitors : (European manufacturers identified : *Skeleton* or *Hutchinson).* Several applications are interesting
  - Bus regulation (bank of supercaps)
  - Complement to Battery
  - Impulsive power application to blow actuator or VHLC switching
  - Memory supply …

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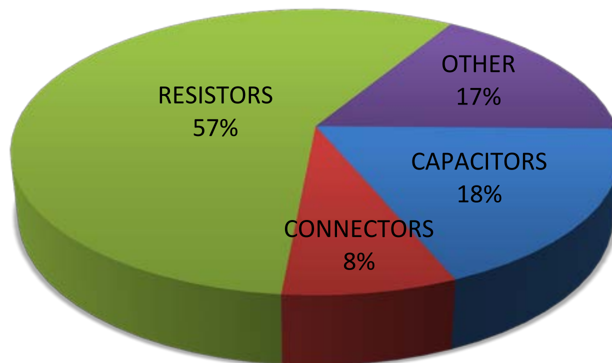
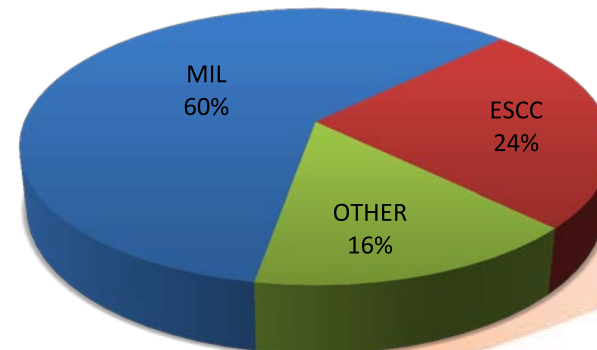
Need to be competitive (1/2)

- When using qualified parts, the process of approval by our customers is less stringent (less costly).
- ECSS system takes into account the needs from the industry more than the MIL system (example : qualification of small ceramic capacitors 0603 next 0402, and soon BME, tantalum multi anode…). Some ESCC parts are more performing compared to MIL (example PHR).
- But we use more passive parts according MIL than ECSS (platform Telecom) : mainly for cost reasons.





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Need to be competitive (2/2)

The gap between MIL and ESCC prices is increasing. (MIL ↓, ESCC↑)

For examples some comparative figures for equivalent products from QPLs :

- product A : ESCC = MIL + 7%
- product B : ESCC = MIL + 20% (typical value)
- product C : ESCC = MIL x 2
- product D : ESCC = MIL x 10

The market constrains are strong and we need to take care of each cost.

Cost saving - in line with mission quality requirements - is clearly an objective of our roadmap.

Remind in 1999, ESA had carried out a study in order to reduce the price of the ESCC components. Estimation was a cost saving between 5 to 35% and lead time saving between 10 to 40% for passive parts. Are these conclusions still valid ?

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Conclusion

- The ASTRIUM passive roadmap is balancing between "old" components with proven reliability and "new" promising components.
- Lot of attractive passive components coming from the European manufacturers could be used in next years (e.g BME, low ESR tantalum…).
- ESA studies, present and future, contribute to provide the users with high performance components
- The competitiveness is more than ever a concern and forms a strong push towards the ESCC system to flexibly adapt to market needs (right trade-off between quality, cost and technological break through).

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