



WE LOOK AFTER THE EARTH BEAT

# Passive Components TAS Road Map

06/09/2013

Ref.:

THALES ALENIA SPACE INTERNAL

ThalesAlenia  
A Thales / Finmeccanica Company  
Space

83230353-DOC-TAS-EN-001

# Passive Components – TAS Road Map - Summary

- Common requirements for passive parts
- Chip Passive components
- Custom Passive components
- RF Passive components
- Connectors

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company

## Common requirements for passive parts

➤ *Main requirements coming from Equipment & payload road map*

- Equipment/ payload/ design flexibility
- Higher density & integrated solutions
- Increase of dissipated power & operating temperature
- Cost & lead time reductions
- To promote collaboration with European Suppliers

# Passive Components – TAS Road Map - Summary

- Common requirements for passive parts
- **Chip Passive components**
- Custom Passive components
- RF Passive components
- Connectors

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company

## ➤ Chip Passive components :

- Resistors
- Ceramic Capacitors
- Other Capacitors
- High current Fuses

### Global requirements

- To improve accuracy (1% or 0.1%) on some dedicated components packages
- Higher admissible voltage and current

## Chips resistors : preferred

### R0805

- To extend resistors family with 0.1% tolerance
- Higher Voltage for pulse operating condition **up to 100 Volts**



### MCHP1 : High Power resistors

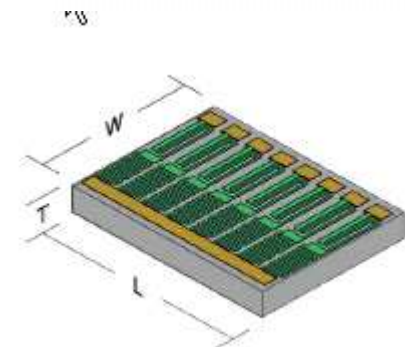
- Widely used on equipment
- To find qualified European solution
- **Package 2512 – power at least 1W**



## Resistors Networks

### Extend Sources for resistors networks

**=> Actual lead time of 6 months becomes a real constraint**





## ➤ Ceramic capacitors

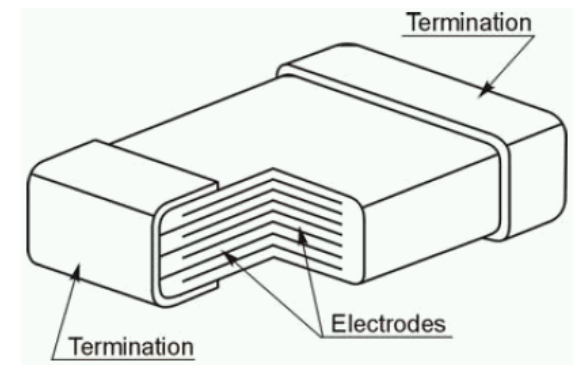
### ➤ MLCC type 1

- To expand Low values capacitors (<1nF) with better accuracy : **1%**
- To get High voltage Capacitors : **> +200V to +400V**

### ➤ MLCC type 2

- To expand value range in low voltage : **< +10V**
- To get high value ( $\mu\text{F}$ ) with **low ESR**

- To improve mechanical withstanding for Both types



=> High values replaced by film capacitors -> good C/V rate

=> Replacement of solid tantalum capacitors by low voltage values for high temperature applications

## ➤ Film plastic

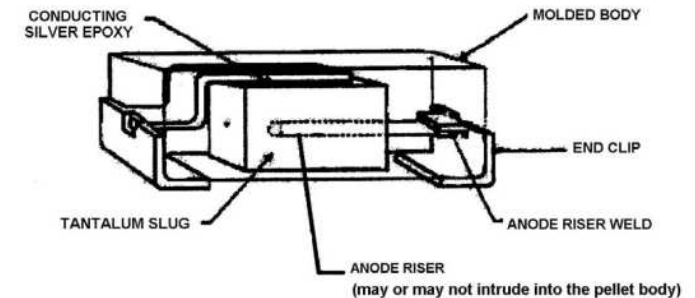
- No anomaly recorded in short circuit
  - To expand the range of low values
  - To reduce size case : **25%**

## ➤ Solid tantalum

- High values with low ESR
  - To expand the range of low voltage values : **< 10V**
  - To get **Ultra low ESR**
  - Low jam in multi-anodes

## ➤ Polymer tantalum

- No short circuit in failure mode & Limited derating
  - Need similar to Solid tantalum





## High current Fuse

NO European supplier qualified for high current fuses, majoritary US products are available on space market.

### Products

- Quick acting fuse from European supplier



### Key performances

- Full CMS report
- Rated Current : **5, 10, 15, 20 Amp**
- Operating Voltage: **150 V**
- Low sensitivity to **Pulsed current** applications
- Operating temperature range : **- 55°C to + 125°C**

# Passive Components – TAS Road Map

- Common requirements for passive parts
- Chip Passive components
- **Custom Passive components**
- RF Passive components
- Connectors

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company

## ➤ Custom Passive components :

- Crystals
- Oscillators
- Magnetics
- Miniature EMI filters - Feedthrough

### Global requirements

- To get custom & flexible electrical performances with standard solutions (package and technology)
- To develop hybrid integrated solutions
- To improve lead time

## Crystal

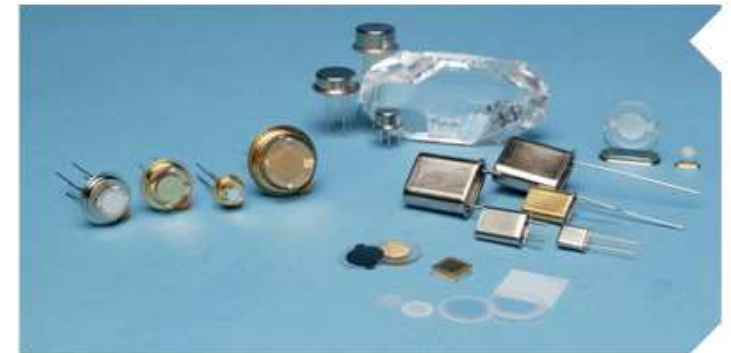
Key component to achieve great performances on telecom satellite receivers. Improve lead time delivery and phase noise behavior.

### Products:

- 50 to 100 Mhz, T807 or SMC Crystal Resonator

### Key performances

- Available in SC, AT,...cut
- High long term stability : **< 1ppm /20 years**
- Low noise around F0 between **10 Hz & 1 KHz**
- Rated power **500 μ watt**
- Low lead time



**=> Hybrid Crystal (Crystal, thermistors, resistors...)**

## ➤ Oscillateur XO

➤ Clock reference for numeric board, No european qualified supplier for these products

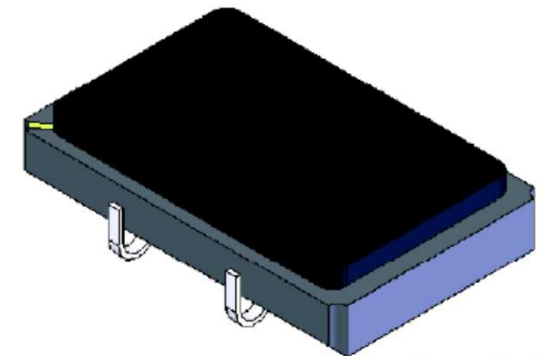
➤ Product:

➤ 10 to 100 Mhz, FP 16 low size or automatic SMC Xtal Oscillator

➤ Key performances

- Global frequency Stability : **+/- 70 ppm**
- Aging : **+/- 15 ppm**
- Supply Voltage : **3,3 V preferred (low consumption)**
- AHCMOS Compatible
- Low lead time and similar cost Vs US supplier

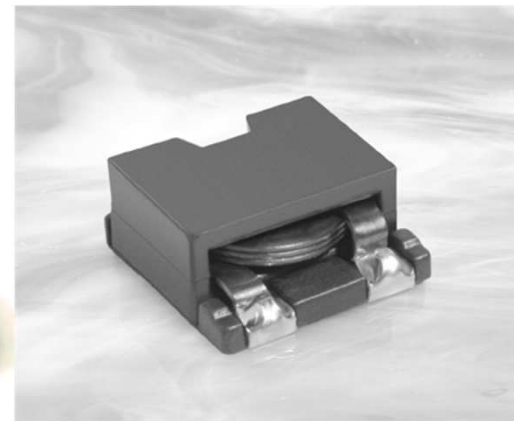
**=> Programmable & reconfigurable XO**



# Passive Components – TAS Road Map – Custom passive components

## ➤ Magnetics

- For the next power supply generation, 3 key technological improvements are required. No state of the art solutions qualified for space applications.
- Product:
  - Power & current transformers, filtering self...
  - Key performances
- 1. To improve reproductiveness of electrical performances (Toroid, RM Core...)
  - Same cost
  - Improvement of winding processes (leakage inductor reproducible and low...)
- 2. To find integrated solutions: size reduction of **-20%**
  - SMD packages
  - Planar solutions



THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
A Thales / Finmeccanica Company  
*Space*



# Passive Components – TAS Road Map – Custom passive components

3. To find materials with optimized Magnetic Flux Saturation limit ( $B_{sat}$ ) at upper temperature (increase of global temperature + 20°C)
  - To increase dissipated powers at equipment level
  - Compliance to TAS industrial process

➤ Additional requirement from specific equipments : Wide Band RF Transformer solutions

- Band : **100MHz to 3GHz**
- Impedance ratio : **1:2**
- I/O impedance : **50/100Ohms**
- Max input Power : **+30dBm**
- Reproducible performances and low cost

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company

## ➤ Miniature EMI filters – Feedthrough (solder-in & screw-in)

➤ Dimensional constraints at equipment level

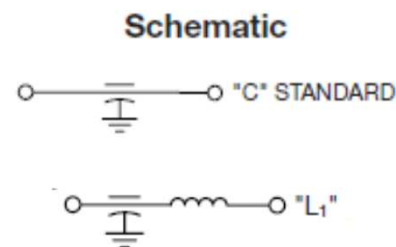
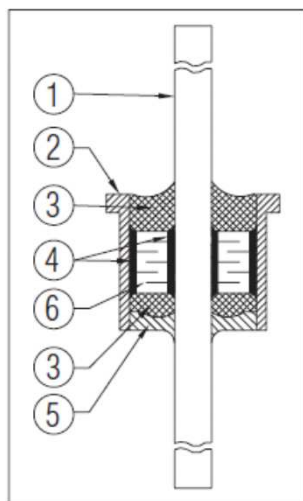
➤ Objective : Housing miniaturization

Focal point : the feedthrough size

→ **size reduction** : 2mm diameter versus actual 4mm diameter

➤ Expected benefits :

➤ A significant gain in term of mass and size of the new generation of LNA.



THALES ALENIA SPACE INTERNAL



ThalesAlenia  
A Thales / Finmeccanica Company  
Space

# Passive Components – TAS Road Map

- Common requirements for passive parts
- Chip Passive components
- Custom Passive components
- **RF Passive components**
- Connectors

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company

## RF Passive components

- Low power Ka band coaxial Isolators/Circulators
- High power coaxial Isolators (L, S and C band)
- Surface mount Isolators (X and Ku band)
- Q & V band Waveguide isolators
- KA Band power Dividers & Couplers
- SMA & SMA 2.9 Attenuators

### Global requirements

- Designed to be glitch free.
- Designed to achieve a shielding effectiveness equal or greater than 75dBi for low power devices / 65dBi for high power devices.

## ➤ Low power Ka band coaxial Isolators/Circulators

➤ Increase of frequency at payload/equipment level → up to **32GHz**

➤ No European manufacturer space qualified for Ka band coaxial Isolators/Circulators

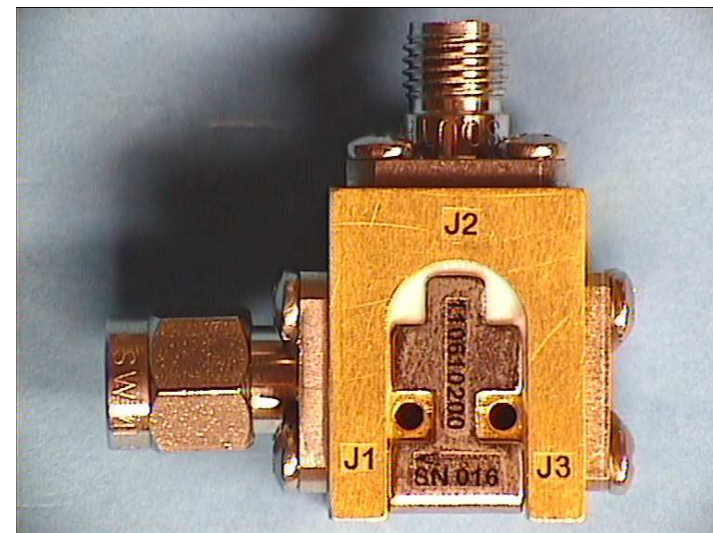
→ Potential risk to procure parts under ITAR restriction

➤ Expected Key performances

➢ Return loss (VSWR) : **23dB**

➢ Isolation : **23dB**

➢ Insertion loss : **< 0.5dB**



## High power coaxial Isolators (L, S and C band)

### Increase of RF power at equipment level (SSPA)

➤ in the short term

➔ up to 150W (L&S band - bandwidth : 100MHz)

➤ in the mid term

➔ up to 120W (C band - bandwidth : 300MHz and 500MHz)

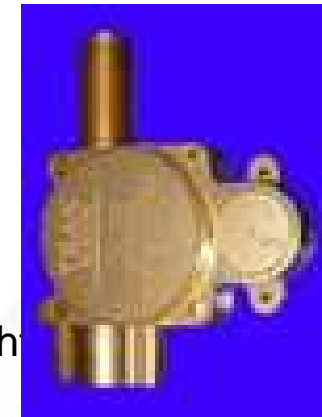
### Key performances

➤ Return loss and isolation : **23dB**

➤ Insertion loss : **< 0.15dB**

### Other requirements

➤ Use of high power connectors with venting holes. Reduced weight





## Surface mount Isolators / Circulators (X & Ku band)

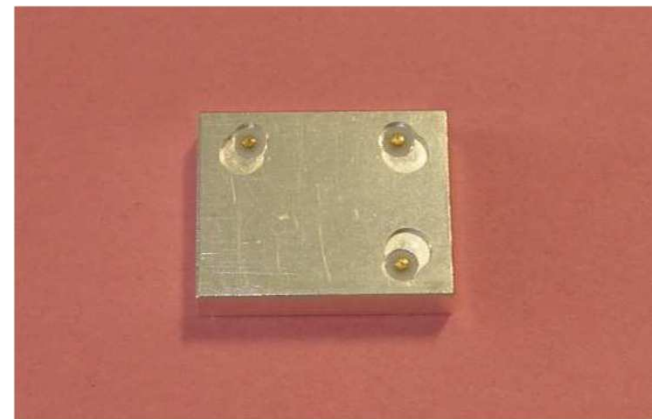
Dimensional constraints at equipment level (thickness) → integrated solutions

Expected benefits :

- A better integration of the Isolators / Circulators on RF boards.
- A significant gain in term of mass and size of the equipments.

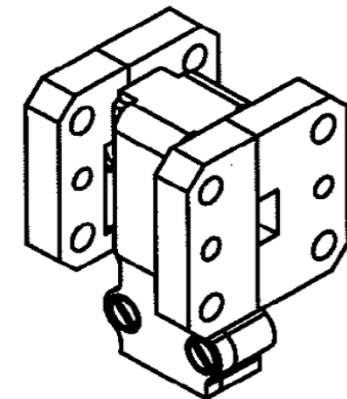
Key performances :

- Return loss and isolation : **20dB**
- Insertion loss : **< 0.25dB**



## ➤ Q & V band Waveguide isolators

- Dimensional constraints at equipment level → integrated solutions
- Increase of frequency at payload/equipment level → from 40GHz to 52GHz
- Expected benefits :
  - A low insertion loss performance with regard to the very high frequency.
  - An integrated solution : waveguide size WR19.
- Key performances :
  - Return loss and isolation : **20dB**
  - Insertion loss : **< 0.3dB**



## KA Band power Dividers & Couplers:

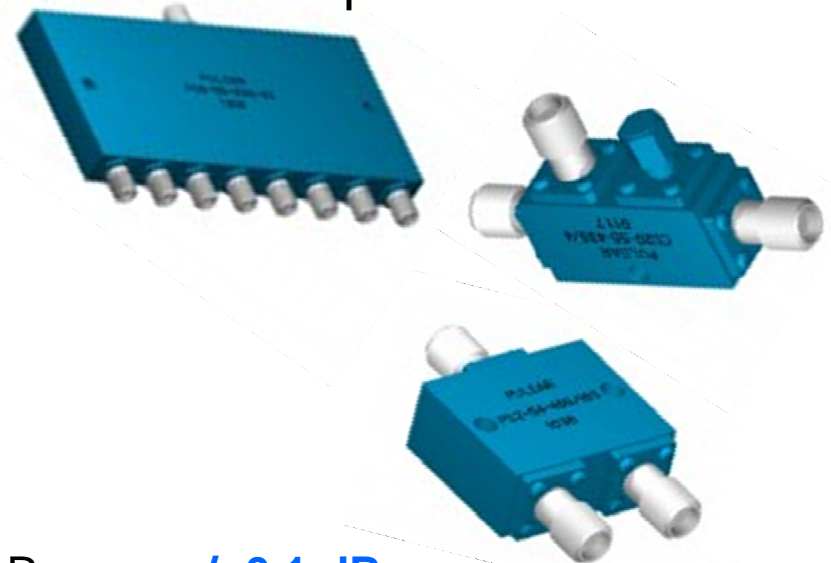
➤ Increase of frequency on the payload input section → up to **32GHz**.

### ➤ Products:

- 4 ways, 3 dB Hybride couplers
- 3 ways , 6, 10 & 20 dB Directional couplers
- 2, 4, 6 & 8 ways Low power dividers

### ➤ Key performances

- Return loss (VSWR) : **22 dB (1.15) typical**
- Low insertion loss variation on operating freq. Range : **+/- 0.1 dB**
- Low insertion loss variation on operating temp. Range : **+/- 0.1 dB**
- Glitch free, No insertion loss jump on thermal cycling : **< 0.05 dB**



**=> Hybrid solutions with integrated Isolator**

## ➤ SMA & SMA 2.9 Attenuators

➤ RF hardness global performances and reliability improvement

➤ Products:

- 0 – 30 dB, DC - 22 Ghz Coaxial SMA attenuator
- 0 – 30 dB, 18 - 32 Ghz Coaxial SMA 2.9 attenuator



➤ Key performances

- Ruggedized mechanical design
- Return loss (VSWR) : **22 dB (1.15) typical**
- Low insertion loss variation on operating freq. Range : **+/- 0.1 dB**
- Glitch free, No insertion loss jump on thermal cycling : **< 0.05 dB**

**=> Fast Locking Coaxial Attenuator**



# Passive Components – TAS Road Map

- Common requirements for passive parts
- Chip Passive components
- Custom Passive components
- RF Passive components
- **Connectors**

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company

## ✦ Connectors :

- ✦ Interposer Connectors
- ✦ High Data Rate Connectors
- ✦ SMA 2.4 Connectors
- ✦ High power Connectors
- ✦ Fast locking Connectors

## Global requirements

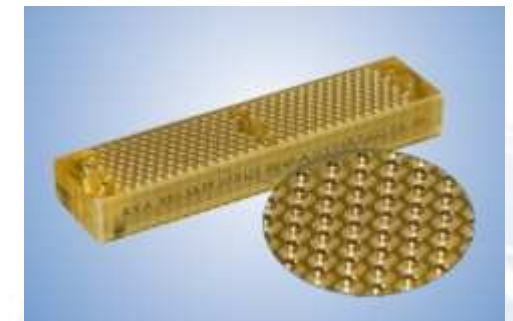
- ✦ High density solutions
- ✦ Solderless and competitive solutions
- ✦ Fast plugging solutions



## Interposer Connectors :

- Integrated solutions for Board to board / Hybrid to board connection (up to 48 contacts)
  - Dimensional constraints at equipment level (thickness).
  - Expected benefits : significant cost reductions (solderless connectors). Higher flexibility during assembly phase. Easy to repair at unit level if needed.
- The interposer connector type RXA is ESA qualified but TAS is looking for a wide range of **configuration options** (flexible solution) based on the **RXA design**
  - Thickness, pitch and overall dimensions.

⇒ **Interposer connectors for RF applications (up to 20GHz)**

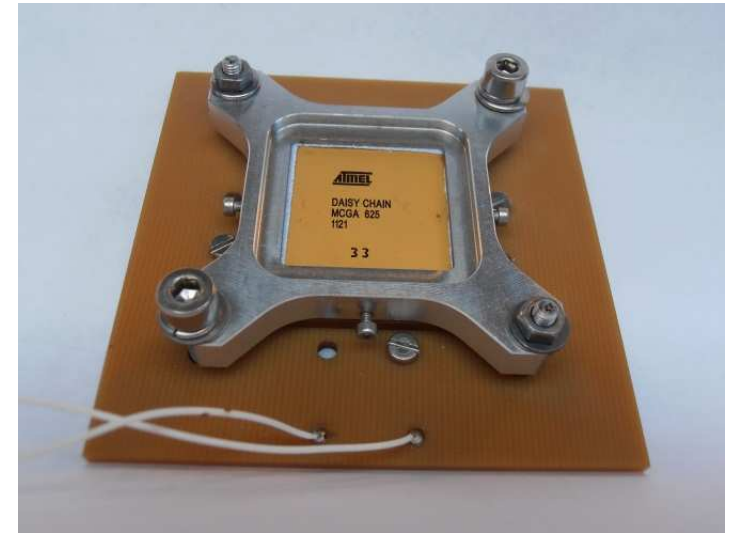


# Passive Components – TAS Road Map – Connectors

➤ Integrated solutions for Board to Component connection

➤ Key performances

- High density : 2000 contacts
- Pitch : 0.8mm
- Good heating dissipation
- Good alignment of the assembly  
(PCB footprint – interposer – component)
- Small size – low cost



➤ Other need for interface equipment connections based on solderless solutions → Solderless D-Sub connectors.

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

ThalesAlenia  
Space  
A Thales / Finmeccanica Company

## ➤ High Data Rate Connectors (End to End solution)

- Increase **flow of digital data** between board to board & Unit to unit. High density and important number of connections is required.

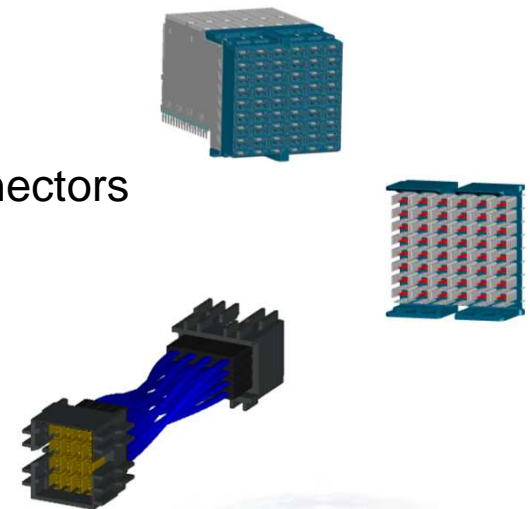
### ➤ Products:

- Up to 48 high density contacts, mother & daughter board connectors
- Module of 4 coaxial or twinax links, unit & cable connectors

### ➤ Key performances

- Solderless, Flexible & Modular solution
- High density, pitch/contact : **3 mm**
- Digital Speed : **6.25 Gbit/s.**
- Mixed Signal : **High speed + Power + DC signal modules**

**=> Optical Module for Ultra high speed solutions**

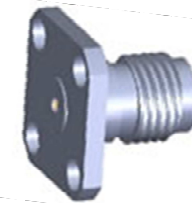


## ➤ SMA 2.4 Connectors

➤ Increase of space operating frequency **up to 50 Ghz** for dual use broadband payload.

### ➤ Products

- Thread-IN & Four Hole Flange, SMA 2.4 Female connector



### ➤ Key performances

- For glass seal
- Return loss (VSWR) : **22 dB (1.15) typical**
- Low RF leakage : **<- 90 dB**
- Wide operating temperature range : **- 55°C to + 165°C**



**=> END to END solution, Unit connectors & Coaxial cables**

**=> Shall be expand up to 65 Ghz, with SMA 1.85 connectors**

## High power Connectors

➤ Increase of power at payload level, development of SSPA & OMUX high power solution up to **C band**.

### Products:

- Four Hole Flange, venting holes, TNC Female connector

### Key performances

- CW power : 250 W
- **Low sensibility** of Multipactor & Corona
- Return loss (VSWR) : **25 dB (1.12) typical**
- Wide operating temperature range : **- 55°C to + 165°C**



**=> END to END solution, Unit connector & Coaxial cable**



## Fast locking Connectors

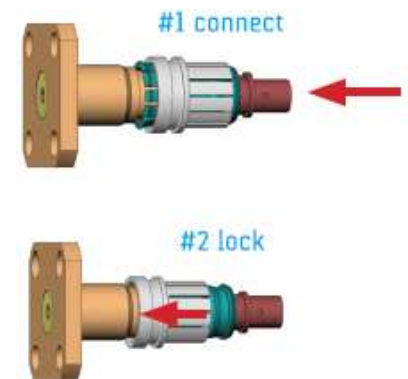
➤ Increase of unit density on telecom payload integration with a size reduction of 20 % on unit.

### Products

- Thread-IN, 2 or 4 Hole Flange, Fast locking Female connector
- Male connector for multi-size coaxial cable

### Key performances

- Smaller than 30% of SMA & High density
- Robust Locking 450 N , - 3 second to connect & disconnect
- Frequency Range : DC – 22 Ghz (KU, Low KA Band)
- Return loss (VSWR) : **22 dB (1.15) typical**
- Low RF leakage : **< - 90 dB at 22 Ghz**



**=> END to END solution, Unit connectors & Coaxial cables**

**=> Should be expanded up to 32 Ghz for KA band**



***Thanks For Your  
Attention***

06/09/2013

Ref.:

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2012, Thales Alenia Space

**ThalesAlenia**  
Space  
A Thales / Finmeccanica Company