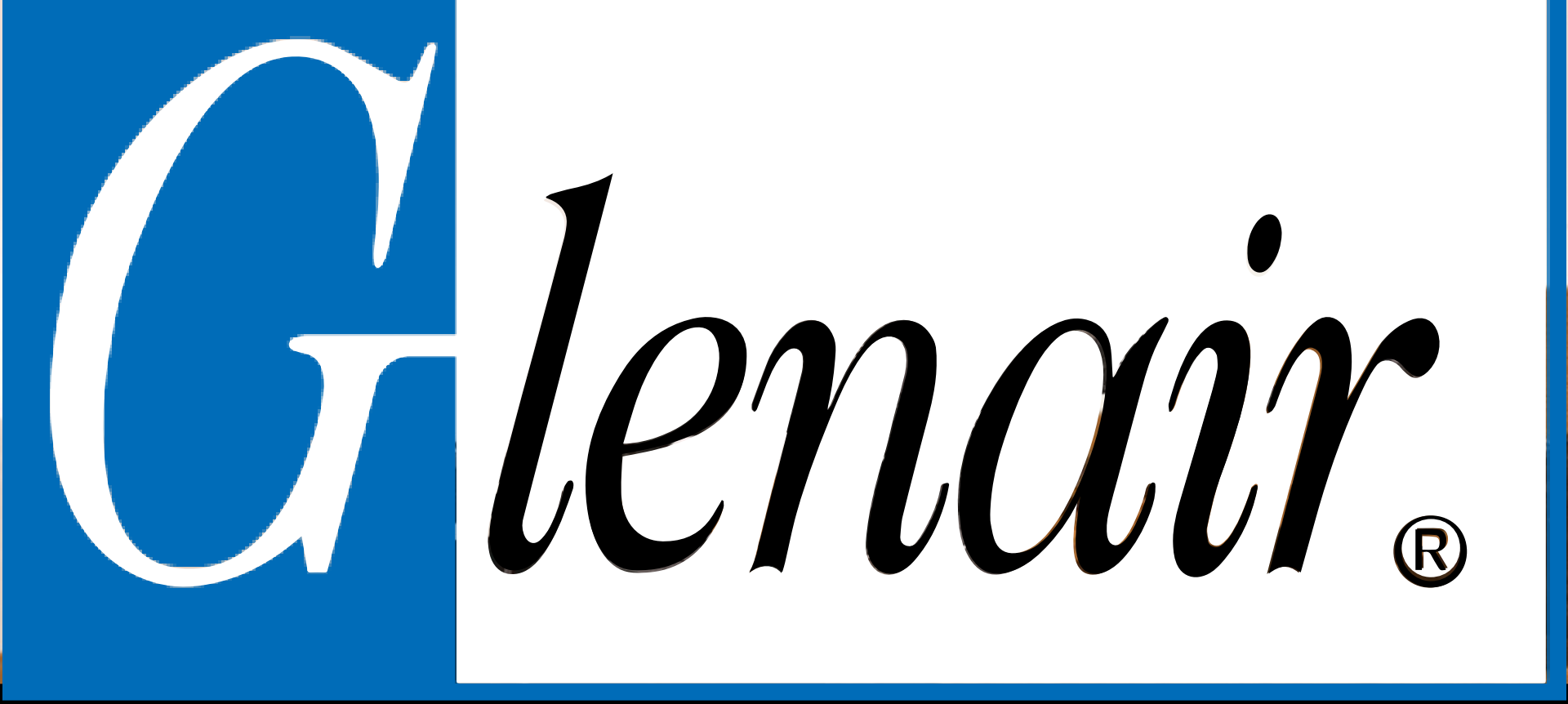



# SPACE-GRADE INTERCONNECT SOLUTIONS

Matt Shingleton – Product Manager, High Speed and Interposers

# Glenair, for over 60 Years product Innovation has been at the heart of our business.

Glenair

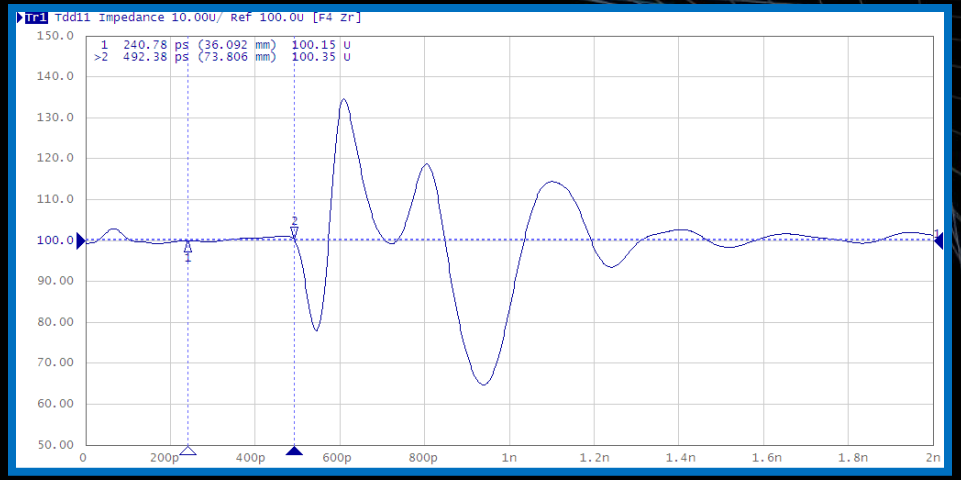
# Glenair interconnect solutions for space – focus session, High Speed GMMD interconnect

- The ever growing demands on industry for faster communication speeds has been a challenge for all over the years.

- In support of industry Glenair have developed a whole range of circular and rectangular interconnect to support your High Speed Interconnect needs.
- Today's presentation will focus of the Glenair GMMD high speed Micro-D connector portfolio.

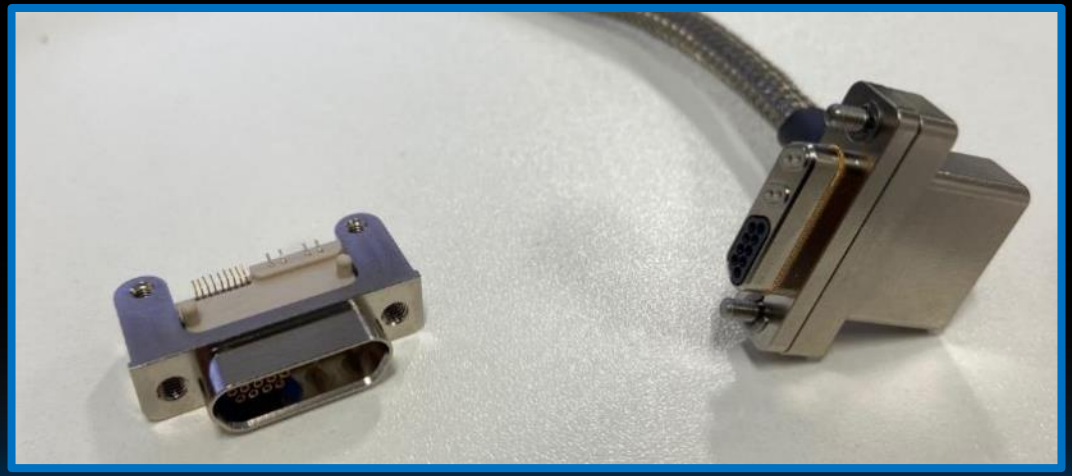
# Standard micro-D

- Micro-D format good for low data rate (<1Gb/s) but:
  - Impedance too low for adjacent contacts
  - Poor shielding between contacts
  - Cross talk and impedance not considered on printed circuit board (PCB) and wire terminations




# GMMD – Modular Micro-D

- High speed micro-D hybrid to offer for high data rate applications
  - 10Gb/s
  - Straight and 90º
  - PCB to cable, PCB-PCB, cable-cable
- Surface Mount Technology (SMT) tails
- Low cross talk
- Balanced impedance
- #24 discrete, #30 data contacts



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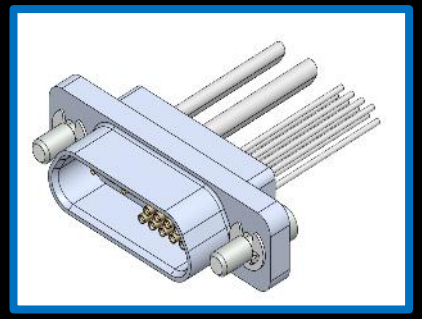
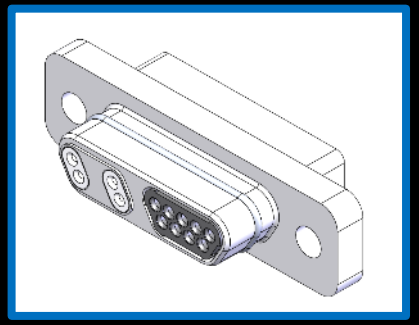
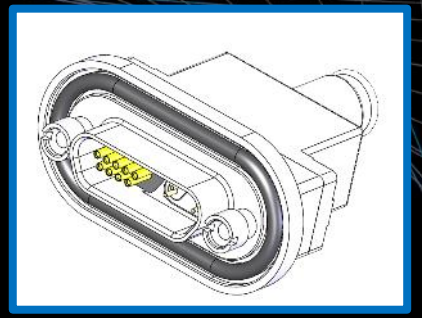
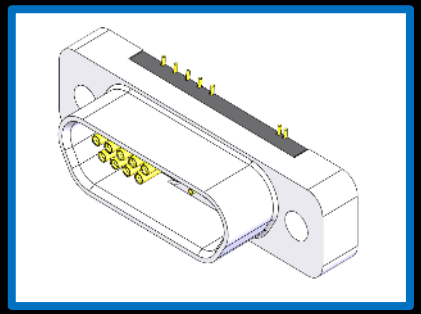
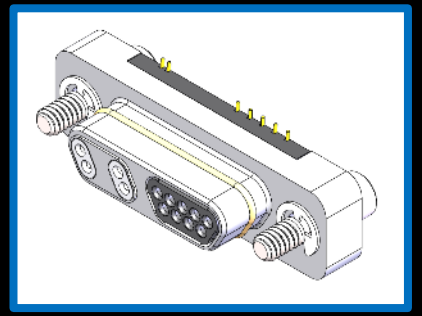
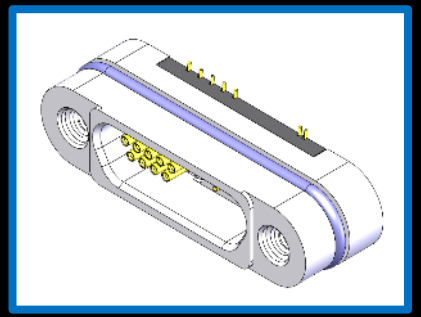
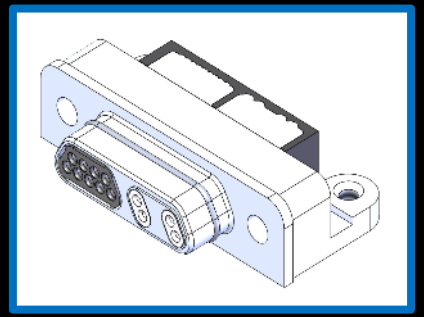
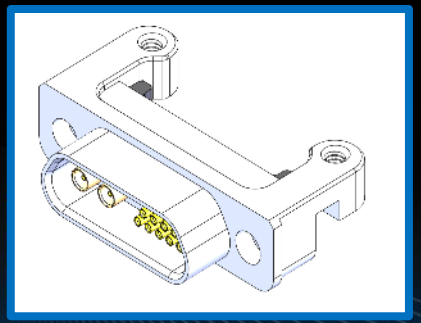
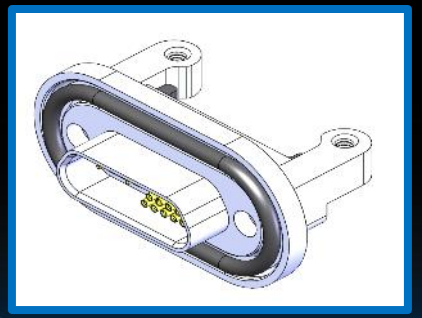
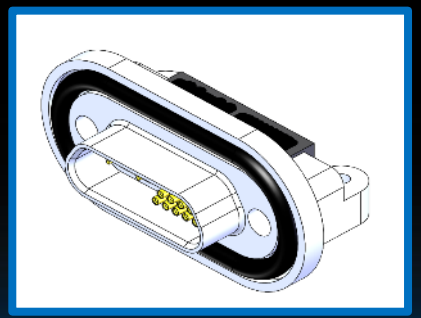
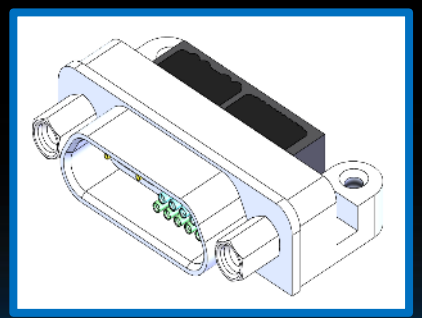
# Plug connectors

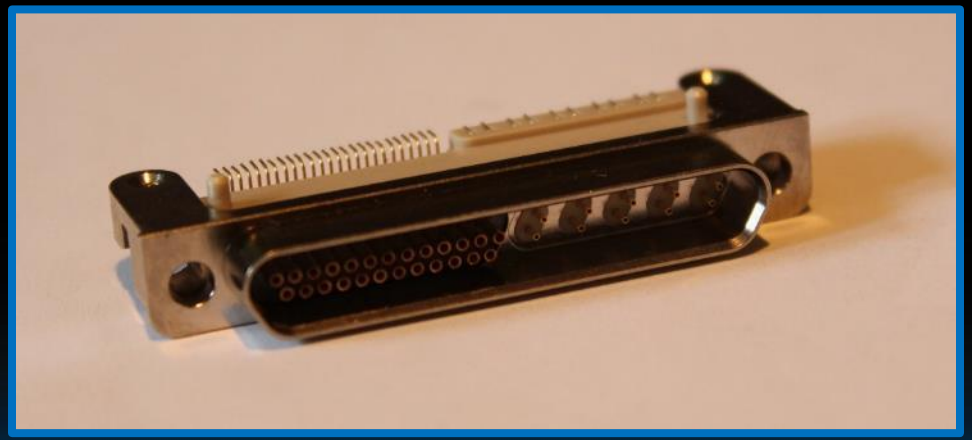
- Canted coil spring included on plug nose to ensure  low resistance ground path from cable screen to box ground/PCB
- Glenair made cable assemblies ensure highest quality

# Shell types

# Variants possible

- Shell sizes from 9 to 67 to house any number of twinax pairs and low speed insulator modules
- 50 and 75Ω coax modules
- Standard micro-D backshells



# Micro-D with coax

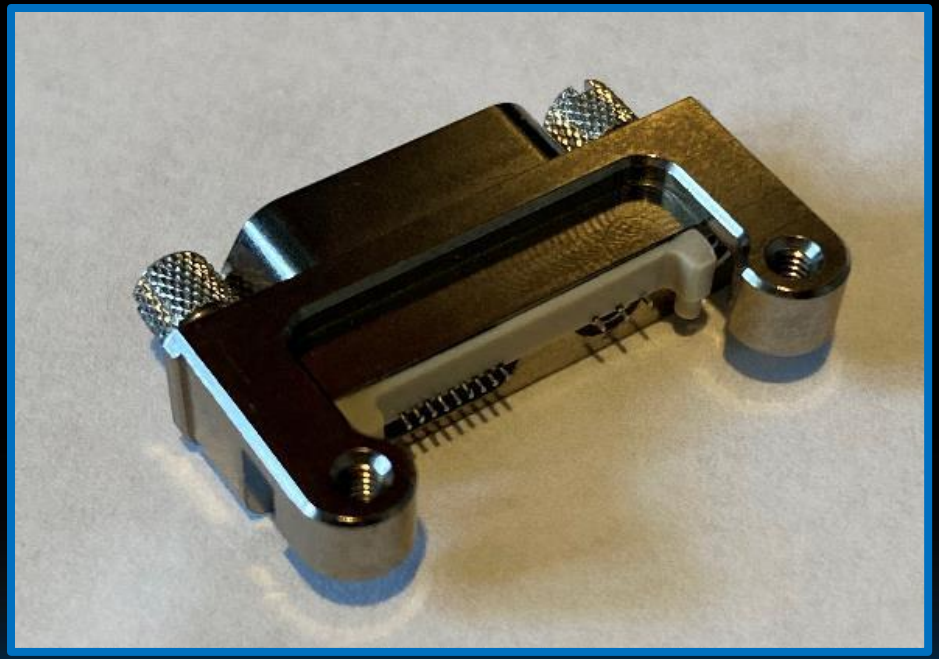
- As an addition to the GMMD range the coax contact is now included
- For RF up to ~30GHz
- Plug cable assemblies made by Glenair terminated to whatever contact needed at the other end, or a flying lead

- Cabled assemblies available for RG405, RG178/9, semi rigid or flexible cable 047

Glenair

# Coax receptacle

- Edge launched PCB SMT
- Arrangement tray to rear of receptacle ensures precise contact to pad alignment

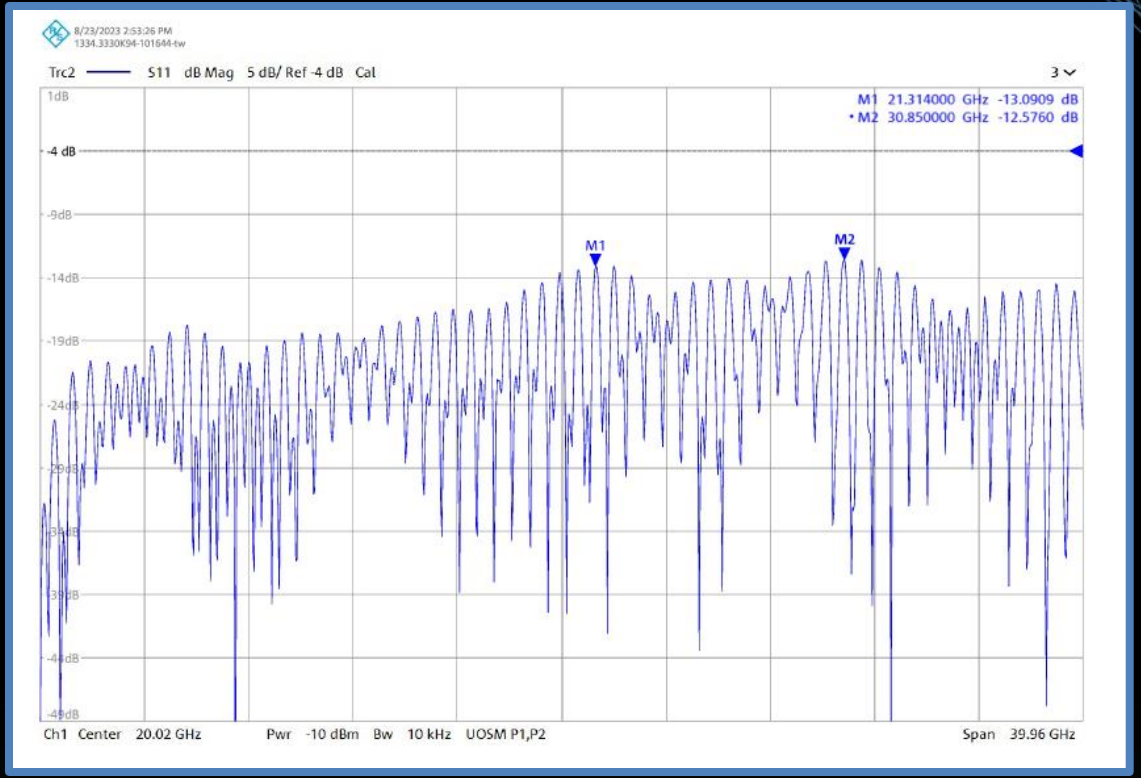


# Coax contact

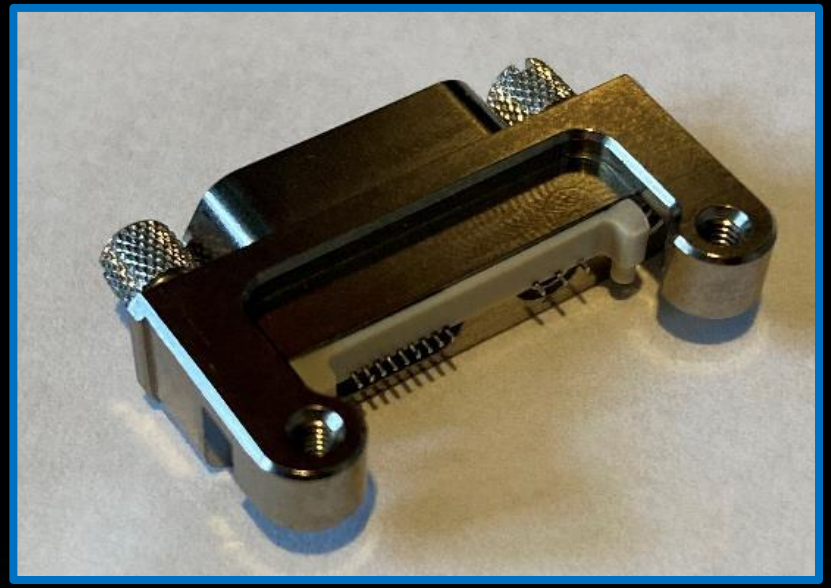
- Centre conductor using a nano contact
- Shield outer 2mm OD
- Housed in an insulating bush to isolate the return path from shell ground
- Hybrids with discrete lines and twinax if required

# Coax test data

- 047 flex cable, 200mm terminated to 2.92s both ends

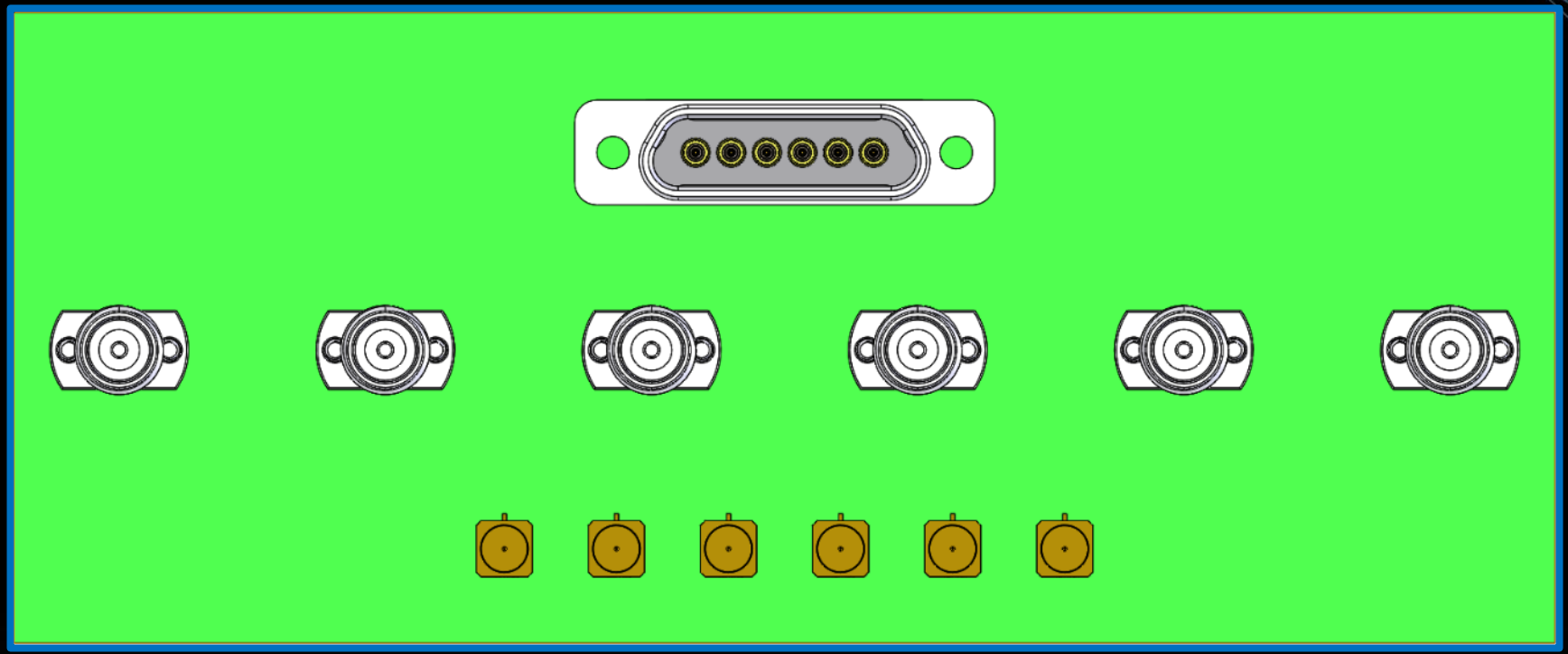


# GMMD horizontal and vertical coax




Glenair

# Board Space Comparison



GMMD-VR6C

6 x 2.92mm Vertical Compression Connectors

6 x SMPM Connectors

# SavCons

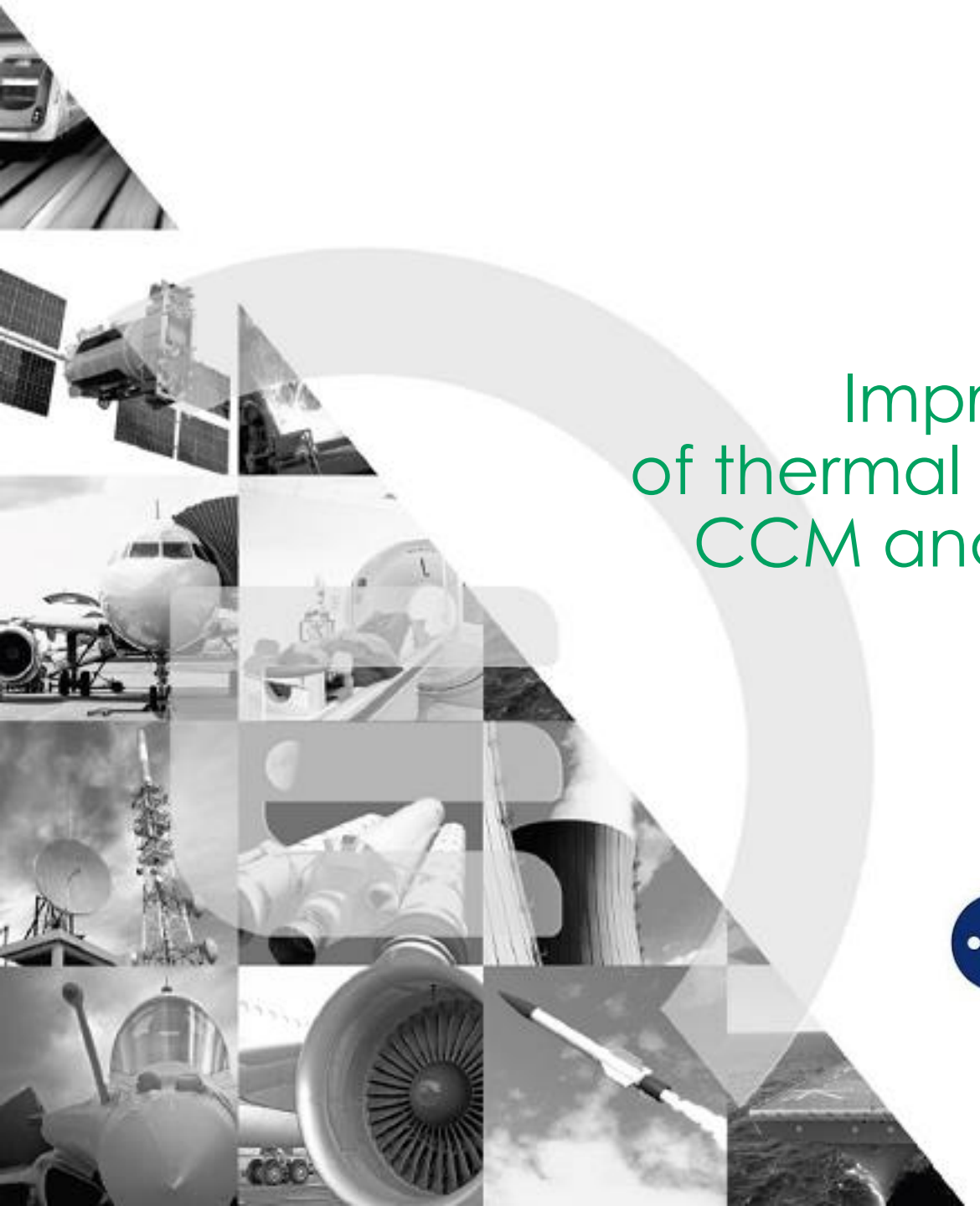
- Available for all GMMD twinax and coax
- Maintains signal integrity, XT and RL

# GMMD Summary

- Rugged, proven contact system (twist pin)
- Catalogue hardware
- Low cross talk, high bandwidth lines, 1,2,3,-16 of… up to 10Gb/s
- RF contacts for up to ~30GHz
- Straight and 90º receptacles

# GMMD Summary

- SMT receptacles for simple PCB mounting and optimum high-speed performance
  - Materials used compliant with high temperature lead free soldering processes
- Nickel or gold-plated shells and backshells
- NASA and ESA screening possible
- All outgassing compliant construction



# Improvement knowledge of thermal behavior of space qualified CCM and SESI component families

Bruno Cogitore

ESA / SPCD 2024

16th october 2024

# REMINDER

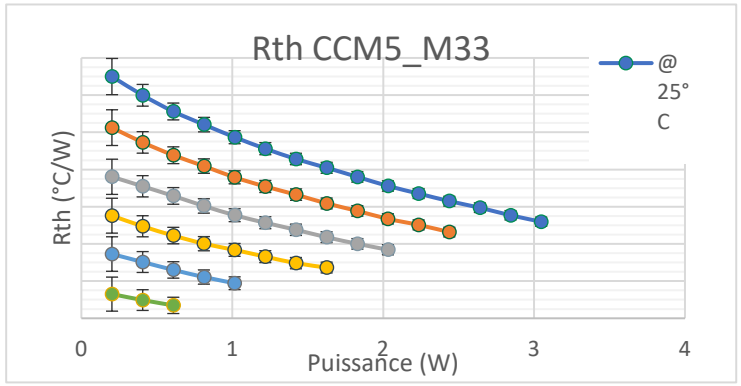
- **In 2022, we characterized CCM and SESI thermal behavior Rth with a measurement bench**

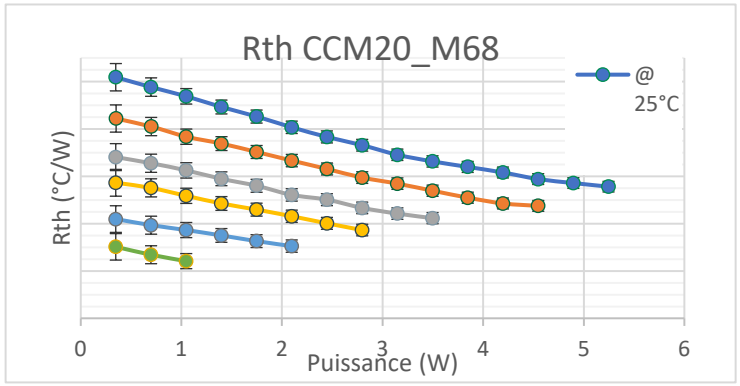
  Bench based on a ventilated monitored oven

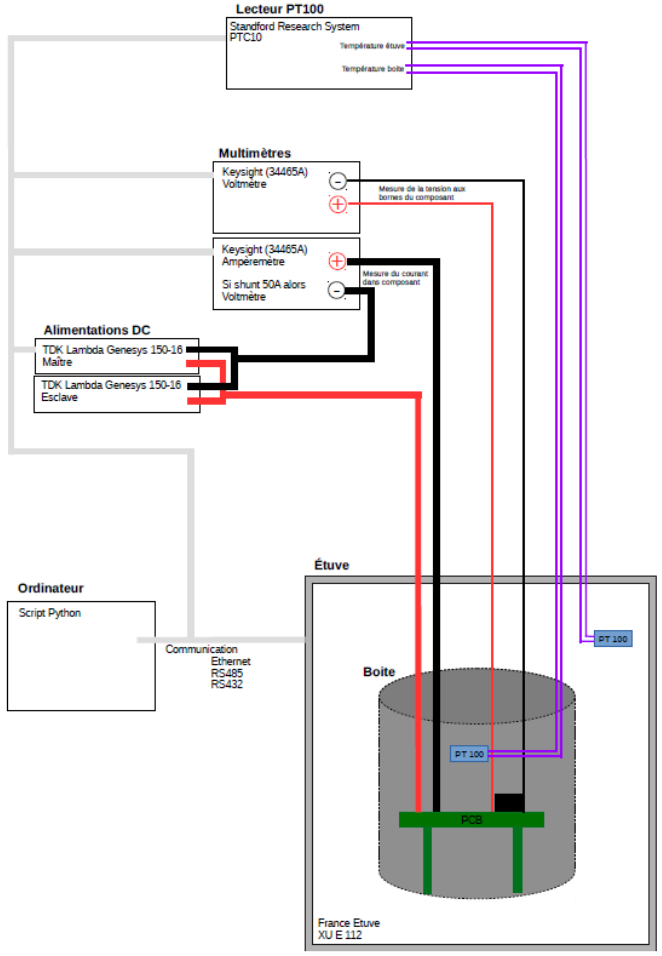
  Component inside a box ensuring natural convection

  Only DC copper losses

- **Results presented at SPCD 2022**




- **Continuation of work in 2 directions**

  Multiplication/Confirmation of results by characterizing typical cases

  Comparison of some results with finite element simulations



EXXELIA

# Complementary experimental characterisations 1/2

- **Definition of 8 typical or extreme cases**
  - 1 Industrial variability : comparing two copies of the same product
  - 2 Component orientation : horizontal / vertical
  - 3 Component in oil
  - 4 Component on a heatsink
  - 5 Component suspended in air
  - 6 Black painted component
  - 7 Component with cut pins
  - 8 Composant insulated in rock wool
- **Measurements performed on 1 CCM20 and 1 SESI22**
  - Nearly 1000 measurements carried out
  - One hundred were duplicates of previous characterizations

# Complementary experimental characterisations 2/2

- **Exemples of results for CCM20**

| Test configuration | Rth at 25°C and 1W (°C/W) |
|---|---|
| Isolated (in rock wool) | 69,9 |
| Pin cut | 35,6 |
| Suspended | 33,1 |
| Horizontal | 31,7 |
| Vertical | 31,4 |
| Black painted | 30,9 |
| On a heatsink | 25,4 |
| In oil | 12,5 |

➔ Validation of results with respect to thermal behavior and qualitative variations

- **Parameters having a big influence on Rth**

  Number of pin connected

  Diameters of wires weld to pins

  Composition of support PCB : proportions of Epoxy and Copper

  Component orientation if Planar (only SESI)

# Comparison with finite element simulations 1/2

- **Software used :**

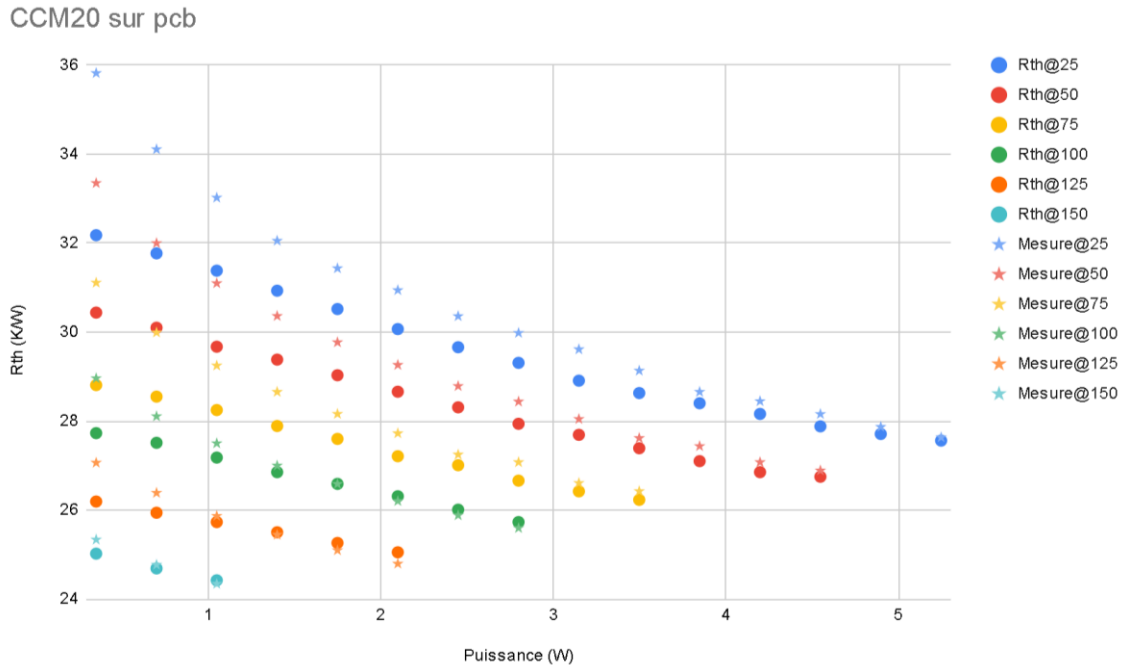
  **CFD Acusolve / Optistruct / ElectroFlo with Simlab interface (ALTAIR)**

- **Exemples of results for CCM20**

  Component on PCB

  All pins connected on only one side (≠ drawing)

  Air natural convection


➔ If T ≥ 75°C and P ≥ 1W, difference between measurement and simulation < **4%**

# Comparison with finite element simulations 2/2

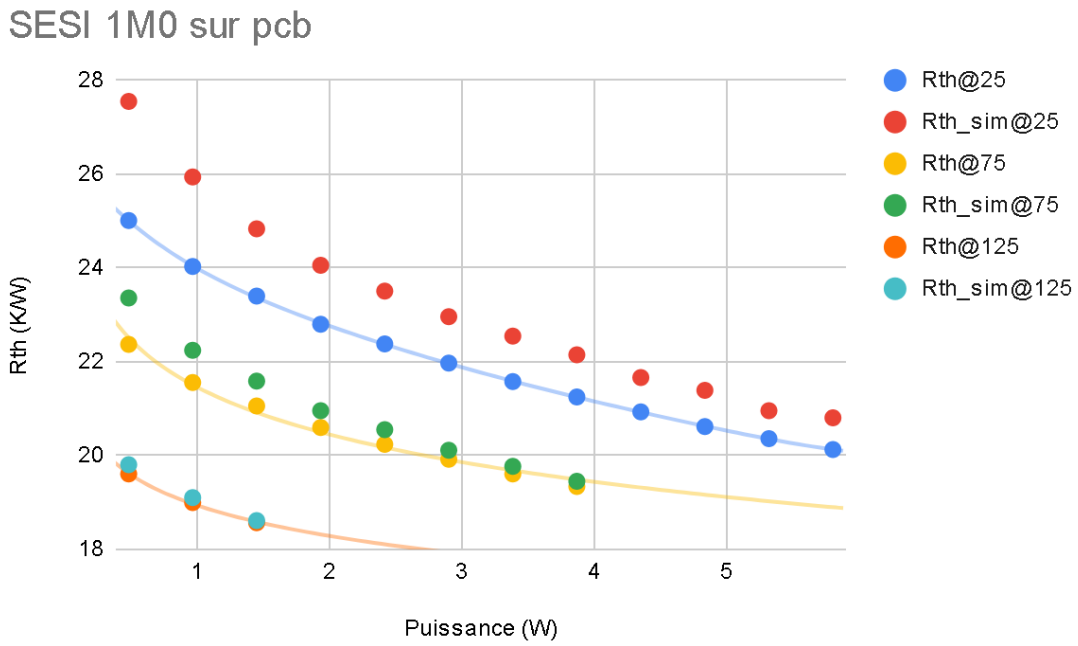
- **Exemples of results for SESI**

  Same situation as CCM20 :

  For T > 75°C and P > 1W

  Diff between meas and simu < 5%

  ➔ Validation of results




- **Conclusions**

  Thermal behavior models of our components are reliable

  We know how to adapt them depending on the environment

- **Perspectives**

  We have some ideas to improve thermal behavior

  Develop a model similar to transistors : 2 or 3 Rth between component and environment

Thank you for your attention

No question, sorry

**Bruno COGITORE**

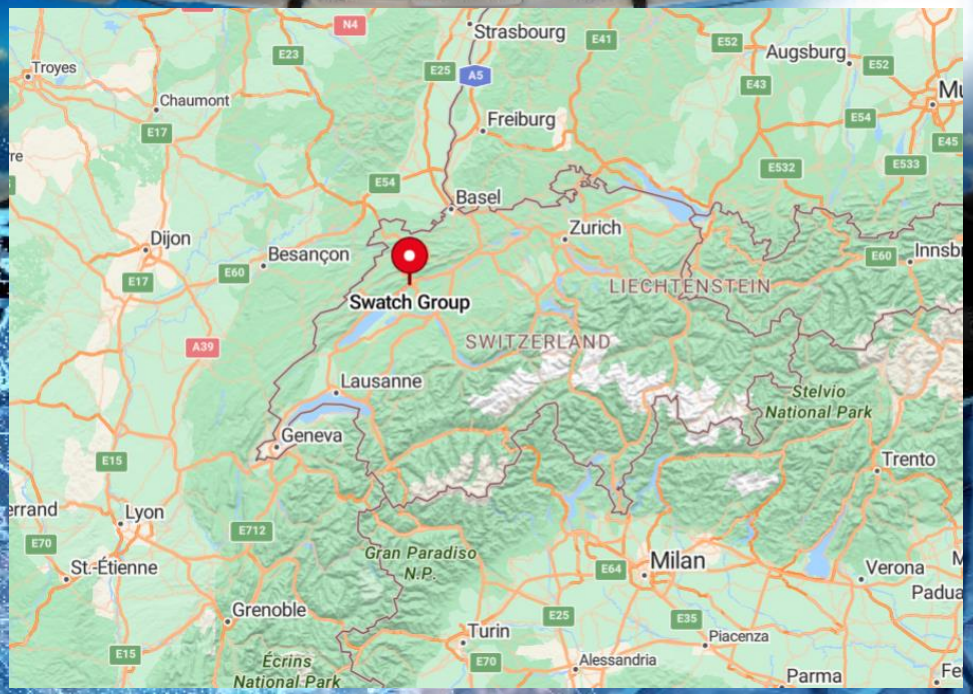
Magnetic Expert / Innovation • Exxelia Magnetics

Phone: +33 (0)4 51 62 13 99

Cell: +33 (0)6 99 36 16 47

**Thank You !**

Visit our website **www.exxelia.com**




# Microcrystal - The art of quartz-based timing components

**Stavros Melachroinos**

**ESA/ESTEC – Oct. 2024**

MICRO CRYSTAL SWITZERLAND

# SWATCH GROUP

- International Group with Sales of 7.88 Billion CHF
- 33’600 Employees Worldwide
- Global Operations
- Strong Financial Background
- Full in-House Capability for all Watch Components

# Micro Crystal at a Glance

**1978**

Company creation

More than 40 years of expertise

Leader for miniature SMD Crystals, Oscillators and Real-Time Clock Modules

Trusted partner of high demand industries

**> 200 mio**

Capacity in parts per year

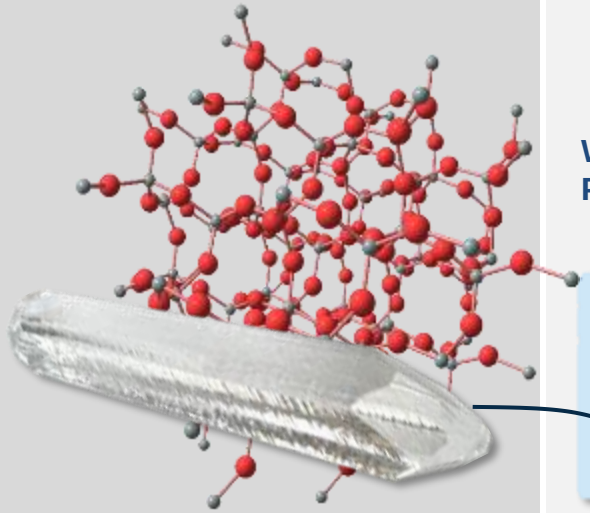
**> 400**

Employees worldwide

# Market Segments & Relative Turnover

| | | | |
|---|---|---|---|
| **INDUSTRIAL** | Smart Grid, Metering, Factory and Process Automation, IIoT, Embedded Systems |  | **30%** |
| **AUTOMOTIVE** | EV charging, Infotainment, Control units, BMS, T-box |  | **17%** |
| **MEDICAL** | Glucose Meters, Defibrillators, Pacemakers, Neurostimulators, Insulin Pumps, Smart Implants |  | **23%** |
| **CONSUMER** | Watches, Smart Home, IoT, Wearables, White Goods |  | **18%** |
| **HIGH DEMANDING APPLICATIONS** | Avionics, Satellite, Aerospace, Down Hole Drilling |  | **12%** |

# Made in Switzerland

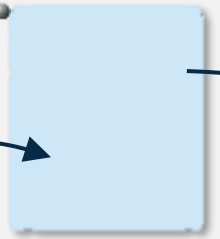


Quartz Bar

Hydrothermal process allows to synthesize SiO2 in the form of a crystal rod with controlled growth.

**Procured**

**Wafer Production**



Quartz Wafer

Thickness
5 mils or
127 µm

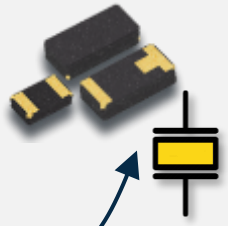
**Crystal Blank Manufacturing**

Crystals on Wafer

Photo-Lithography
Metallization
Etching

Crystal Assembly & Frequency tuning

**AT/ HFF Ceramic Packages**



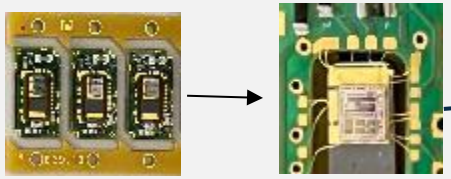
**Clock Oscillators & VCXOs**

Assembled in Ceramic or Kovar LID

**Oven Controlled Oscillators (OCXOs)**

PCBA,
Quartz and IC assembly

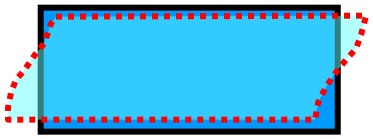
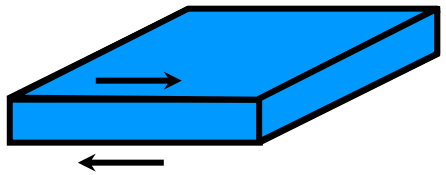
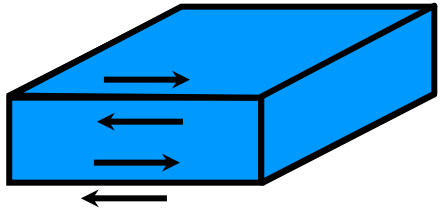
Wire Bonding



**In House Manufacturing**

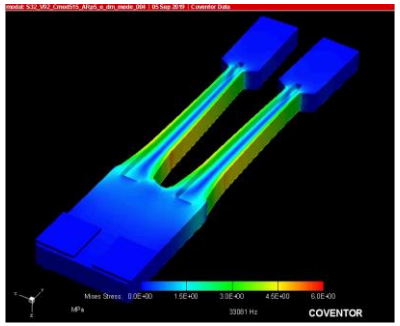
MICRO CRYSTAL SWITZERLAND

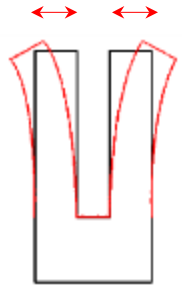
# Oscillation modes of Quartz Crystal

| | | |
|---|---|---|
| Tuning Fork<br>  <br>Flexure Mode |  <br>Extensional Mode | Flexure mode:<br>• < 200 kHz fundamental mode<br>• 200 to 560 kHz overtone mode<br>Extensional mode:<br>• 560 to 2100 kHz<br>Thickness Shear mode:<br>• 2 to 30 MHz fundamental mode<br>• 30 to 250 MHz high frequency fundamental mode / inverted mesa<br>• > 30 MHz as 3rd 5th 7th harmonics |
| AT - Cut<br>  <br>Thickness Shear Mode |  <br>Fundamental Mode Thickness Shear |  <br>Third Overtone Thickness Shear |

# Made in Switzerland

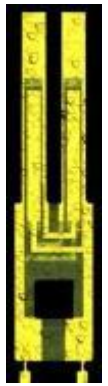
## Tuning Fork

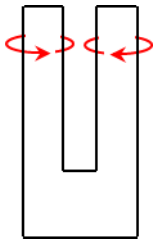


**Flexure**
**10 to 560 kHz**

## Torsion Tuning Fork

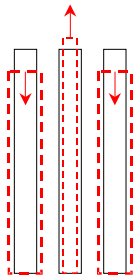




**Torsion**
**200 to 400 kHz**

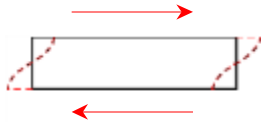
## Length Extension Beam

**Extension**
**0.56 to 2.1 MHz**



**Extension**
**1 MHz**

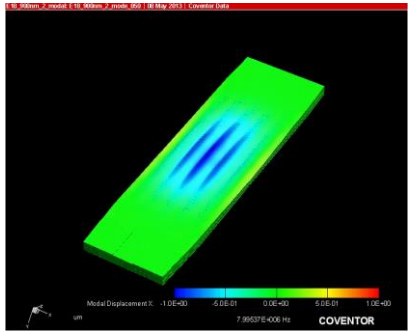
## AT Strip

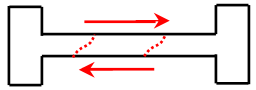


(cross section)

**Thickness Shear**
**8 to 30 MHz**

## HFFAT



(cross section)

**Thickness Shear**
**30 to 250 MHz**

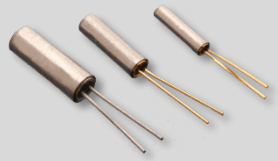
# kHz Tuning Fork Crystals and Oscillators

## Low Power – High Stability – High Reliability

Wide range of load capacitance available, frequency tolerance down to ± 20 ppm

### TF Watch Quartz Crystals

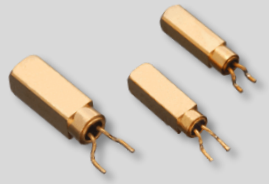
- 32.768 kHz
- Through Hole



The original application and design (for watches & consumer products) since 1978…

### TF Crystals in SMD Metal Package

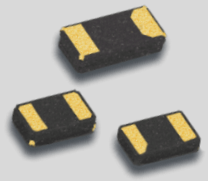
- 30 to 200 kHz
- Au Flashed Can



Low-cost alternative to ceramic package

### TF Crystals in Ceramic Package

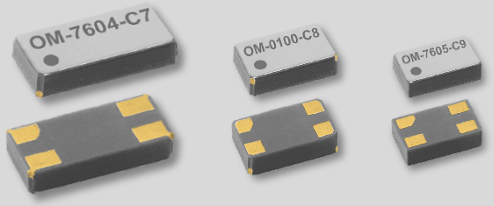
- Extended operating temperature range (-55°C to +125°C)



- Low ESR, Low Thickness
- Available in AEC-Q200 Version

### Oscillators

- Built-in crystal
- 32.768 and 100.000 kHz




- Ultra Low Power
- Miniature Package (C9 Series in 1610)

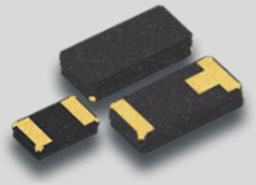
# High Frequency Crystals & Oscillators

## High Performance and High Reliability Applications

**Operation at Temperature up to 210°C, Stability down to ± 0.025 ppm**

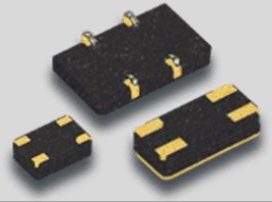
### AT-HFF Crystals

- AT : 8 – 30 MHz
  HFF: 30 – 250 MHz



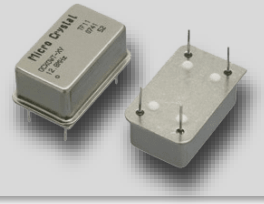
### Clock Oscillators

- 10 kHz – 225 MHz



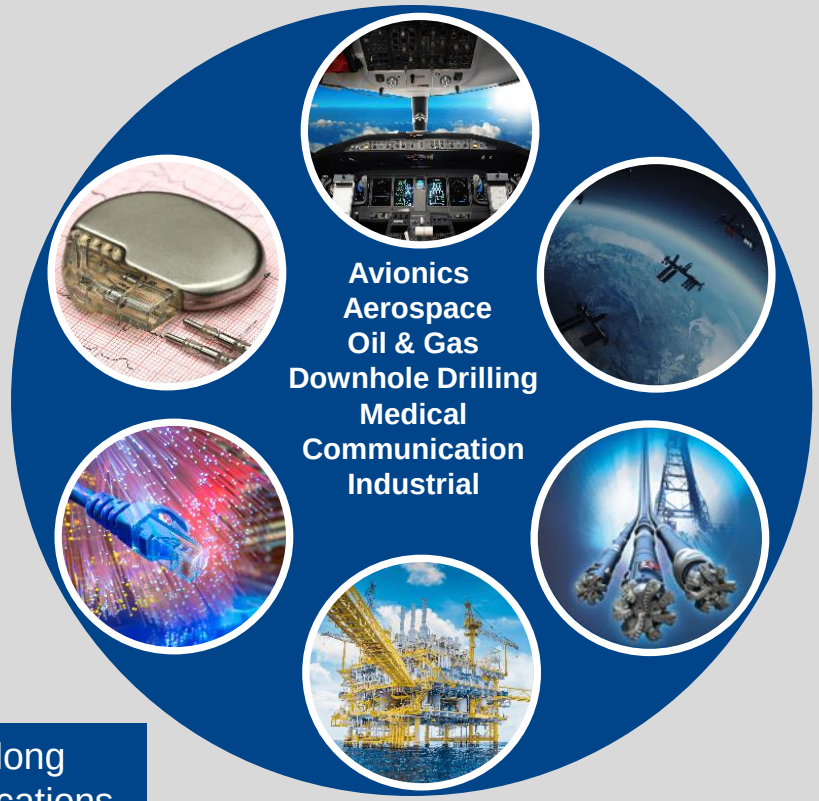
### OCXOs

- up to 120 MHz



### VCXOs

- 5 MHz – 170 MHz


Designed for long lifecycle applications


MICRO CRYSTAL SWITZERLAND
Precision in Timing… Crystal Clear
Thank you for your attention
www.microcrystal.com
Stavros.Melachroinos@microcrystal.ch

# Secure fast lock nano D connectors and small, low cost, quick locking composite connector

Axon’ – Marc AUVRAY

28 octobre 2024

# AXON' Heritage

## From Screwlock

MicroD

- Metallic :
  - ESCC 3401/029
  - MIL-DTL-83513
- Composite :
  - MIL-DTL-83513

NanoD

- ESCC 3401/086
- MIL-DTL-32139

## FastLock

MicroD

- Metallic :
  - DClick ESCC 3401/091
- Composite :
  - /

NanoD

- /

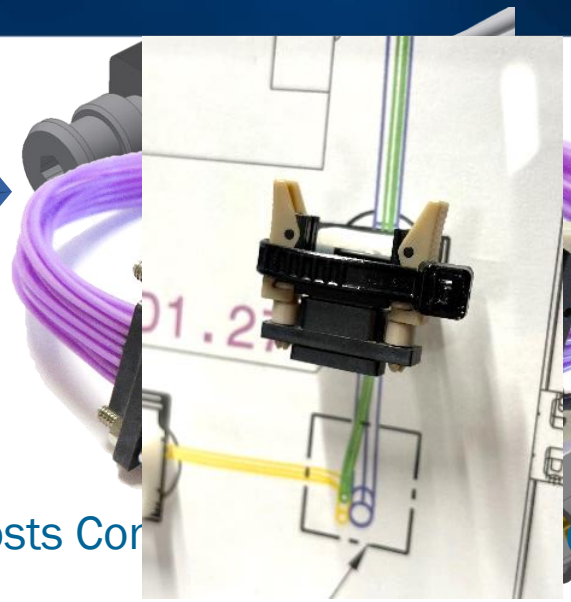
## To

Save time
Avoid tooling

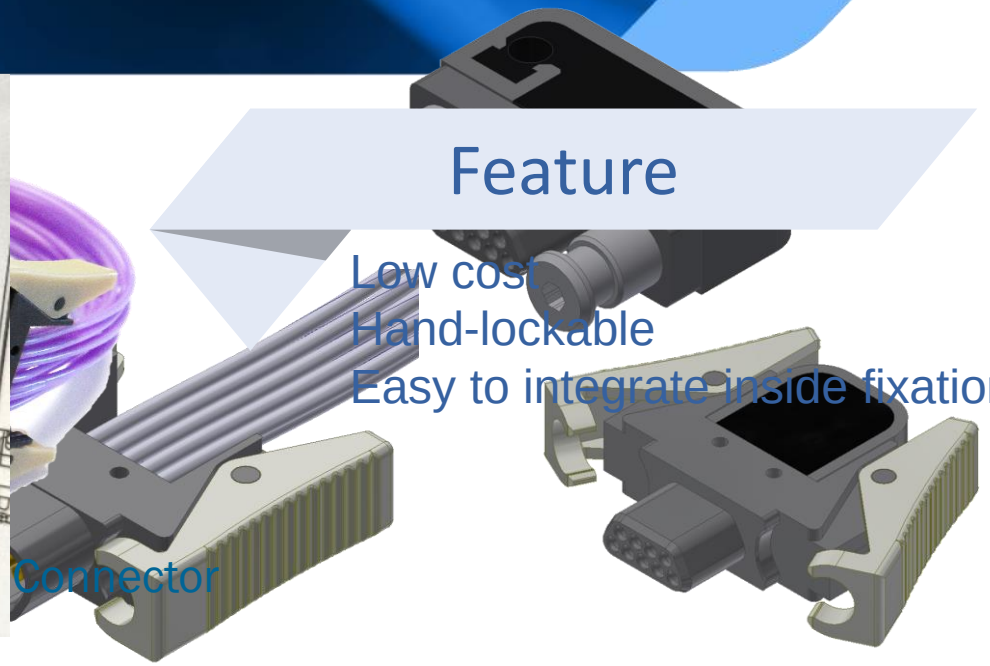
# MicroD DClick Lite

## Range

Composite shell
Size 9 ►51 Ways
Jackpost & Clasps : S/P
Pigtail & PCB



Jackposts Cor



Connector

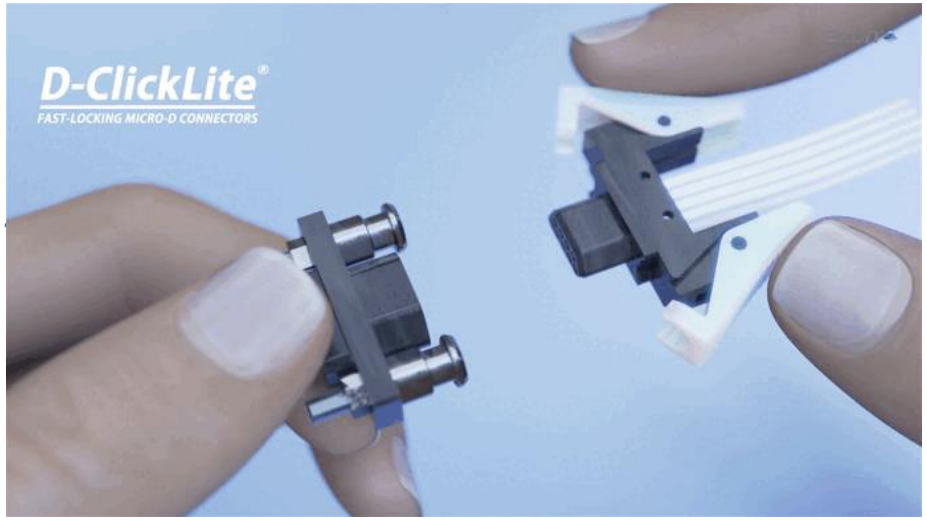
## Feature

Low cost
Hand-lockable
Easy to integrate inside fixation

# MicroD DClick Lite

## Range

Composite shell
Size 9 ►51 Ways
Jackpost & Clasps : S/P
Pigtail & PCB




## Feature

Low cost
Hand-lockable
Easy to integrate inside fixation

## STEP 1

Align the connectors

## STEP 2

Engage the connectors

## STEP 3

Pinch on the clasps – it “clicks” and it’s done!

# SnapLite

## Range

Composite shell
Size 4 Ways
Clasp : S
Pigtail & PCB


Female Connector with clasp

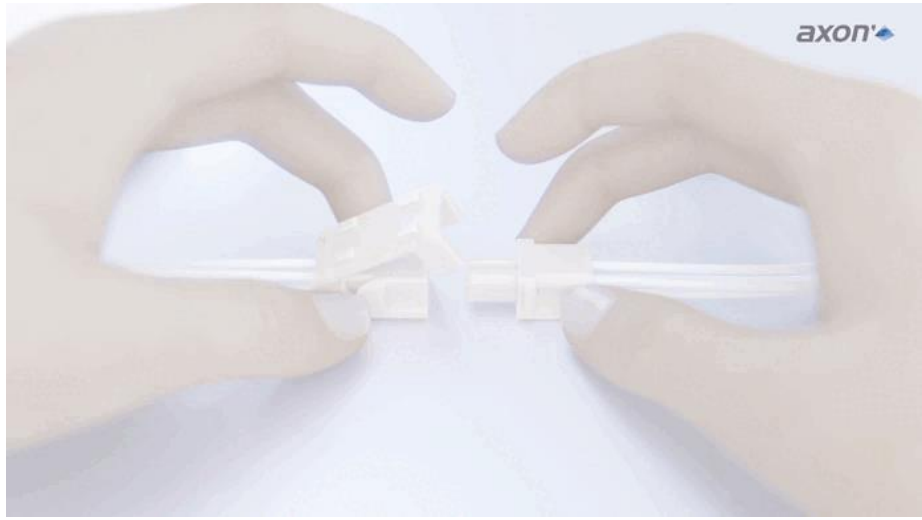
## Feature

MicroD Contacts
Low cost
Hand-lockable
Easy to integrate inside bundle or fixation
ESCC 3401 Detail specification
► ESA review

# SnapLite

## Range

Composite shell
Size 4 Ways
Clasp : S
Pigtail & PCB




## Feature

MicroD Contacts
Low cost
Hand-lockable
Easy to integrate inside bundle or fixation
ESCC 3401 Detail specification
- ► ESA review

## STEP 1

Align the connectors

## STEP 2

Engage the connectors

## STEP 3

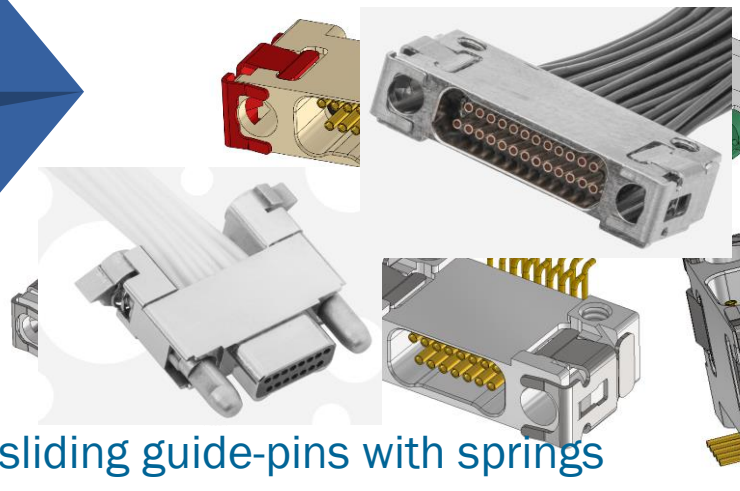
Pinch on the clasp – it “clicks” and it’s done!

# Nano-D fast lock

## Range

Size 9 ►51 Ways
Clip : S
Guide pins : P
Pigtail & PCB

2 locking clips on female connector



2 rotating & sliding guide-pins with springs

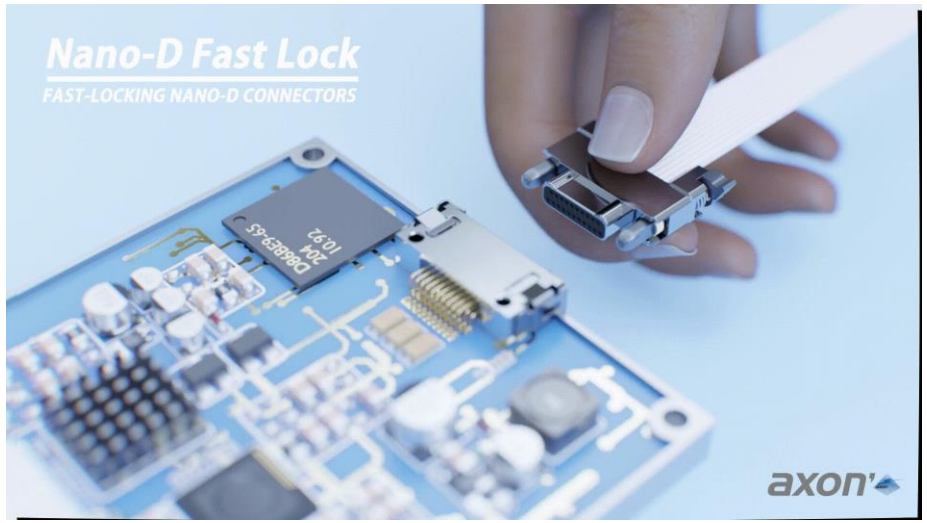
## Feature

Guided mating
Hand-lockable
►No massive tool
►No fragile screw
Secured Locking

# Nano-D fast lock

## Range

Size 9 ►51 Ways
Clip : S
Guide pins : P
Pigtail & PCB




## Feature

Guided mating
Hand-lockable
►No massive tool
►No fragile screw
Secured Locking

## STEP 1

Approach the two connectors

## STEP 2

Engage the connectors

## STEP 3

Push the two guide Pins.” and it’s done!

# Conclusion

## From Screwlock

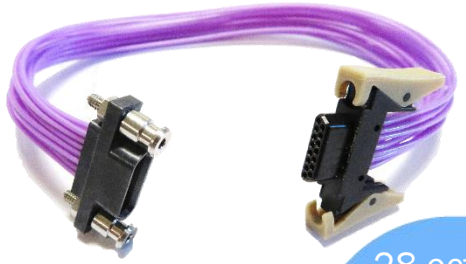
MicroD
- Metallic :
  ESCC 3401/029
  MIL-DTL-83513
- Composite :
  MIL-DTL-83513

NanoD
ESCC 3401/086
MIL-DTL-32139

## To

Save time
Avoid tooling

## FastLock



MicroD
- Metallic :
  DClick ESCC 3401/091
- Composite :
  **DclickLite & SnapLite**

NanoD
**Nano-D fast lock**

# Conclusion

## From Screwlock

MicroD
- Metallic :
  ESCC 3401/029
  MIL-DTL-83513
- Composite :
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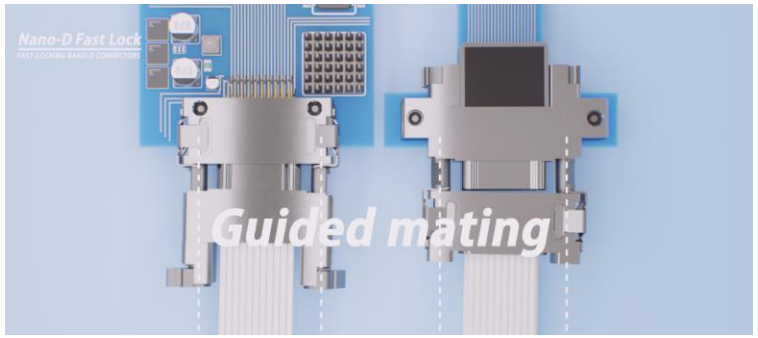
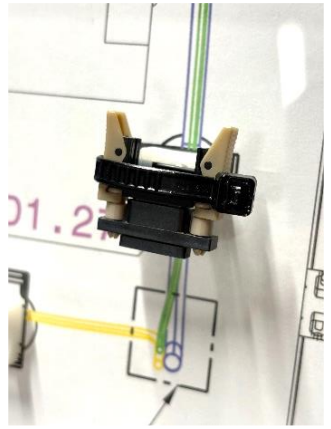
NanoD
ESCC 3401/086
MIL-DTL-32139




## To

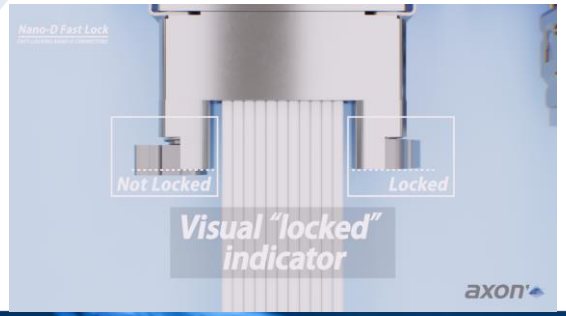
Save time
Avoid tooling
► Save space
Secure mating
Secure locking
► Ease inspection of locking
Ease integration



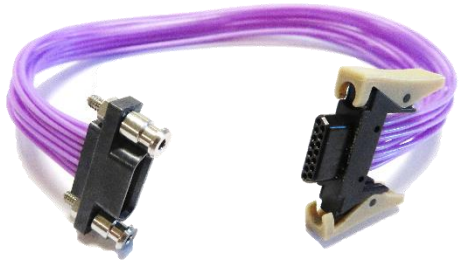
## FastLock

MicroD
- Metallic :
  DClick ESCC 3401/091
- Composite :
  DclickLite & SnapLite

NanoD
Nano-D fast lock



# Thank you for your Attention



AVIONICS, SPACE, AEROSPACE, CRITICAL APPLICATIONS

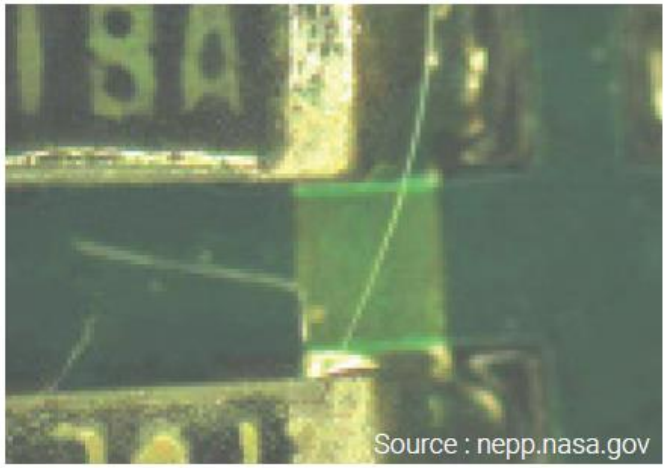
# High reliability assemblies and the threat of tin whiskers to passive components

Ensuring safety and performance in high-stress environments

RETRONIX
A JABIL COMPANY

Tony Boswell / tony.boswell@retronix.com

# Tin Whiskers




- The exact cause of tin whisker growth is still not fully understood.
- It is known that a whisker grows from its base and that the tin around the base does not thin as the whisker grows.
- It seems that the energy for growth comes from micro strains present in the tin or from externally applied pressure.
- Tin whiskers can easily short two connections damaging the chip and causing the PCB to fail.
- Failure is NOT an option in the high reliability sectors of space, avionics and defence.

# Examples of satellite failures caused by tin whiskers

| Type | Satellite Name |
|---|---|
| Complete Loss | Galaxy VII, PanAmSat (2000) |
| Complete Loss | Solidaridad 1, SatMex (2000) |
| Complete Loss | Galaxy IIIR, PanAmSat (2006) |

| Type | Satellite Name |
|---|---|
| Partial Failure | Cassini Spacecraft Plasma Spectrometer (2016) |
| Faulty System | Shuttle Electronic Systems |

# Tin Whisker Failures Beyond Space

- Northrop Grumman electronic systems failures
- Patriot & Phoenix Missiles
- F-15 Fighters
- Heart Pacemakers
- Multiple Automotive Instances

# GEIA standard



## FOREWORD

This standard was prepared to standardize the requirements for using robotic hot solder dip to replace the finish on certain electronic piece parts. The requirements within this standard were derived from existing industry standards and a collaboration of suppliers and customers.

The intent of this standard is for suppliers and customers to incorporate these requirements into their operations to provide a consistent and well-controlled process. This standard does not apply to original piece part manufacturers who build piece parts with a hot solder dip finish.

The Hot Solder Dip Task Group, under the direction of the Government Electronics and Information Association (GEIA), prepared this standard. This revision was prepared by the G-24 committee of SAE. All addenda of this standard are informative in nature.

## INTRODUCTION

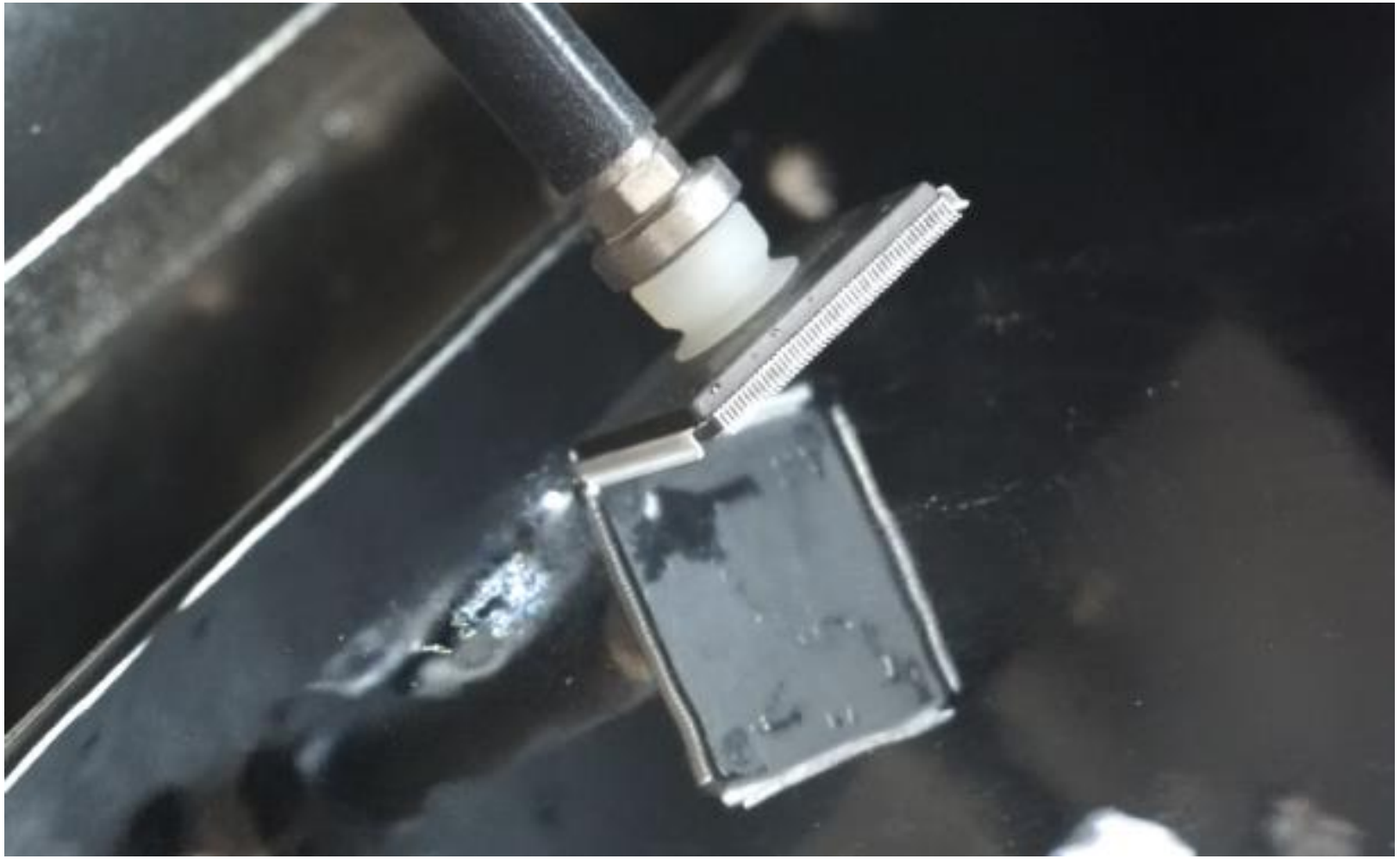
There are two major reasons to solder dip piece parts: solderability concerns and tin whisker mitigation. Solder dip for tin-whisker mitigation differs from solder dip for solderability in that for tin whisker mitigation the termination needs to be coated over its entire length, right up to the package surface. During solder dip, the piece part experiences temperature differences significantly greater than those present during typical board-level assembly. In addition, the fluxes used during the dipping process can become trapped in a minor delamination, like that commonly found in plastic piece parts, which can lead to reliability issues. To avoid these concerns, the solder dip process needs to be qualified and carefully controlled. To decrease the possibility of failure of the piece part after being solder dipped and to ensure a quality process is performed each time, requirements for performing robotic hot solder dipping are presented in this standard.

This standard was designed for the replacement of pure tin and Pb-free tin alloy finishes with SnPb finishes for subsequent assembly with SnPb solder. Aspects of this standard may be applicable to other finish changes. Replacement finishes other than SnPb should be evaluated for tin whisker mitigation prior to implementation.

Due to the need to completely control the rates of immersion and emersion of the terminations and the dwell times in and between each process step, only Robotic Hot Solder Dip is addressed in this standard. Semi-automatic or purely manual solder dipping are processes that may not be capable of completely controlling the rates of immersion and emersion of the terminations and only providing an approximate dwell dipping time (time of total immersion to the required depth) in the solder bath. Greater variation in the process may cause a higher chance of damage, including latent reliability problems. At this time, it is felt that manual dipping, the types of piece parts that can be manually dipped successfully, and the controls needed on a manual dip process are not well enough understood to be included in an industry standard. Note that the manual dipping required for full finish replacement is different than manual dipping currently practiced for meeting solderability requirements because of the increased need of 100% coverage all the way to the body to prevent whisker growth.

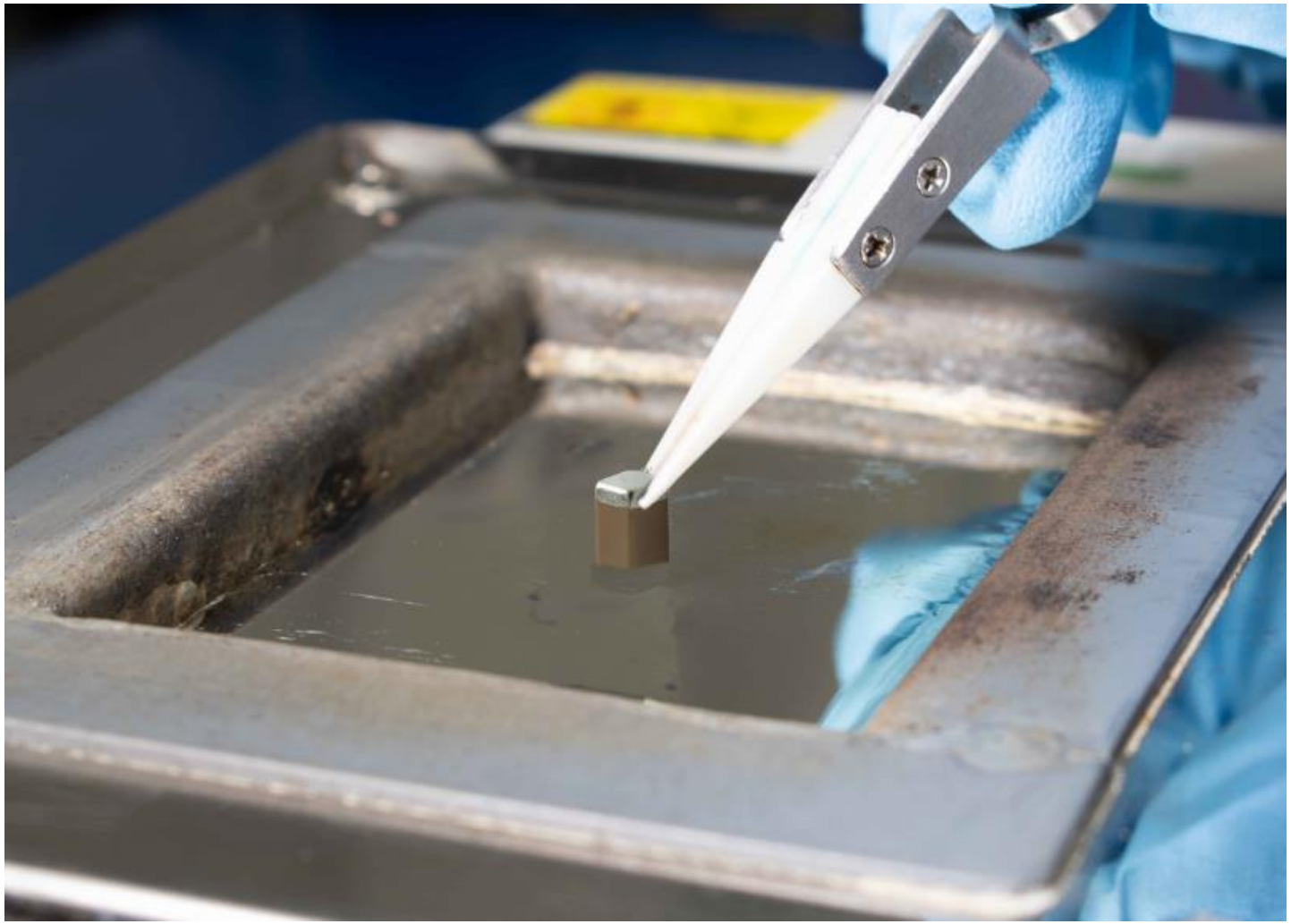
Certain piece-part package styles may not lend themselves to robotic hot solder dipping and may require the use of a soldering iron, over-plating, or other methods to coat the termination. It is expected that some of the general requirements and testing requirements of this standard would apply to these operations. However, these methods have not been fully reviewed at this time. The application of aspects of this standard to other material replacement methods is considered to be

# QFP / TSOP and other leaded devices



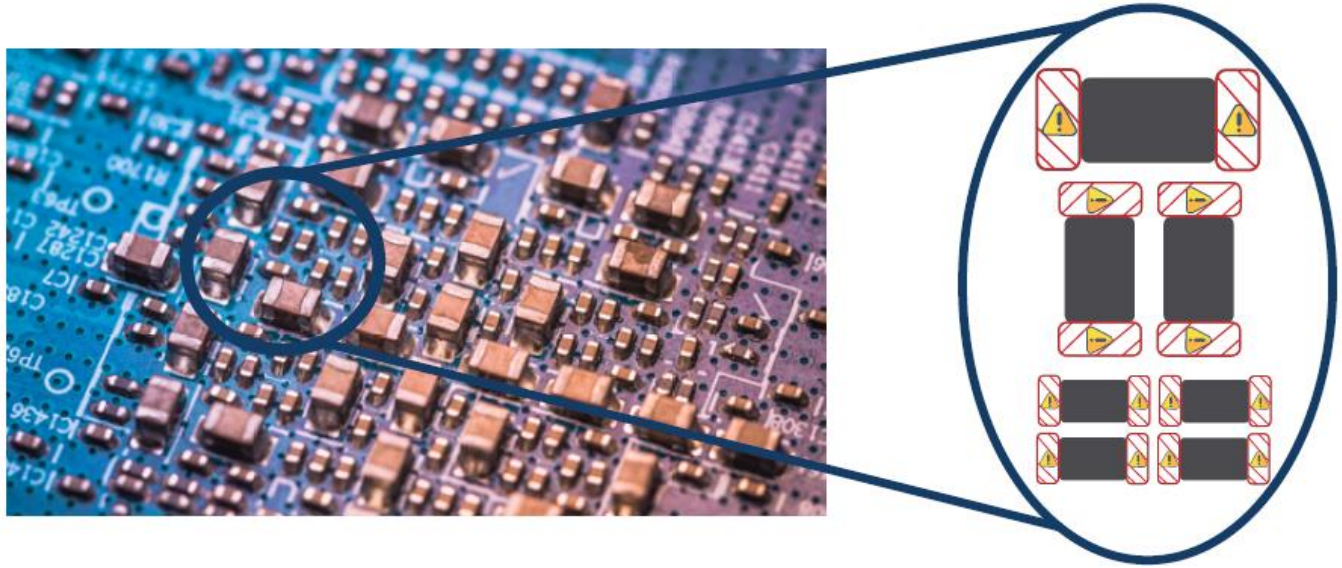
  

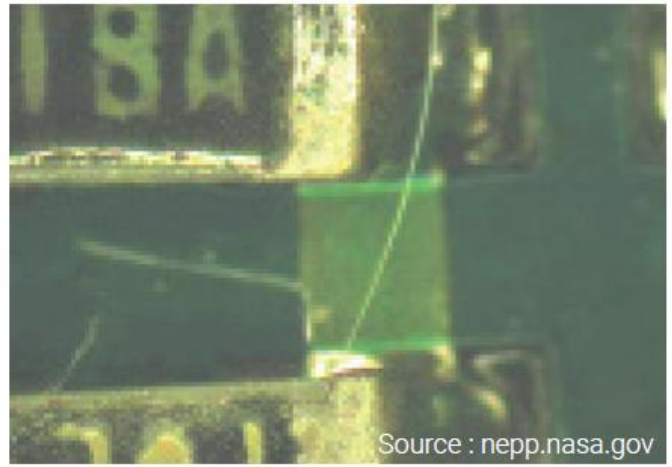
# Small Chip Components – Hand dipped

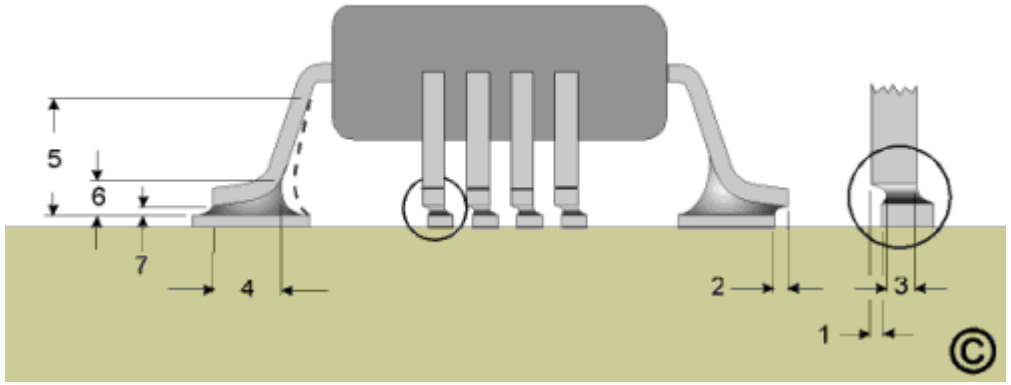


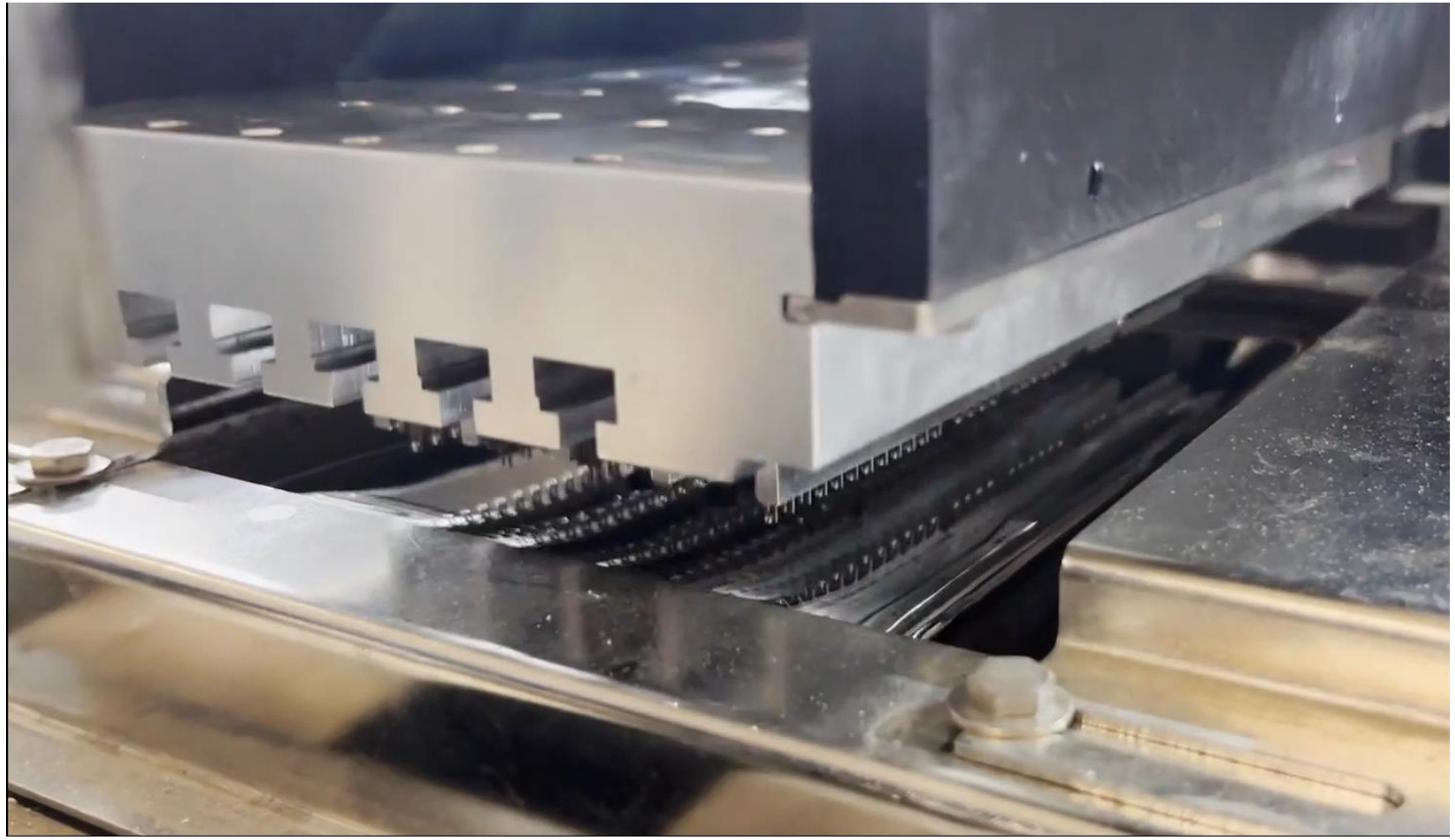
# Small Chip Components – GEIA Standard





# GEIA STD Tinning



# Next Steps

We can now process all components from lead free to tin/lead in accordance with the GEIA standard.

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# Thank You

**Tony Boswell / tony.boswell@retronix.com**

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A JABIL COMPANY

VISHAY
The DNA of tech.™

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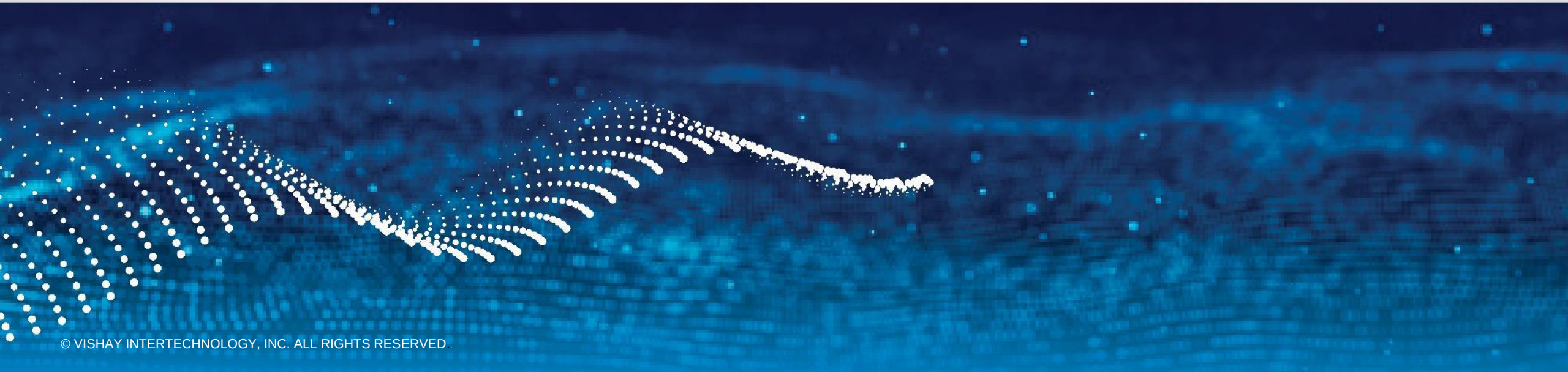
VISHAY
The DNA of tech.™

# EP2 HIGH ENERGY & MODULES

V V



# VISHAY WET TANTALUM PRODUCT LINES

## Wet Tantalums

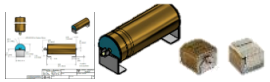
## $MnO_2$

### Leaded

WET AXIAL
MIL QPL / DSCC

### SMD

SMD MOUNTING
WET



### Specific

WET
HIGH ENERGY SPECIALITY

**STANDARD QUAL**

**135D**
500g Shock
80g Vibration
54g Random
3V reverse

**ST / STE**
100g Shock
20g Vibration
No reverse

**T16**
500g Shock
80g Vibration
54g Random
1.5 to 3V
reverse

**T18**
500g Shock
80g Vibration
54g Random
1.5 to 3V
reverse

**T34**
**134D**
**200° C**
500g Shock
80g Vibration
54g Random
No reverse

**T11**
**230° C**
100g Shock
20g Vibration
No reverse

**T22**
**125° C**

**EP1 High Energy**
50G Shock,20G sine,
19.4G Random

**HE3 / HE5**
**High Energy**
50G Shock,
20G sine,
12G Random

**HIGH SPECIFICATIONS**

**T24**
**200° C**

**EP2**
**High Energy**
50G Shock,20G sine,
19.4G Random

**MIL ESTABLISHED RELIABILITY.**

**MIL-39006**
**Qualified range**

**DLA 93026**
**DLA 10004**
**CLR65-91**
**Qualified range**

**DLA 13017**

**MIL 39006/33**

**DLA 15005**

**T22**
**125° C**
**DLA 19001**

**EP1 High Energy**
**DLA 20002**

**HE3 High Energy**
**DLA 10011**

**SPACE / MEDICAL**

**MIL-39006**
**Qualified range**
**Mil, Space**

**CLR65-91**
**Qualified range**
**Mil, Space**

**WET AXIAL**
**Tantalum case**
**Customer Specification**

**T22**
**125° C**
Space Grade: dla 20012
Inc LAT

**EP1 High Energy**
**Customer Specification**

**HE5 High Energy**
**Customer Specification**

**M36 SMD Fixture**
**(Available on WET Leaded range)**

**EP2**
**Module**
**High Energy**
**Serie or**
**Parallel association**

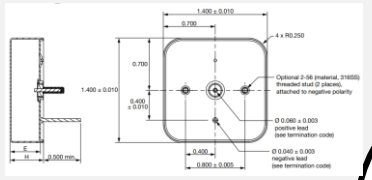
**SPECIAL ARRAYS**
**Customer specifications**

# TANTALUM WET HIGH ENERGY EP2

## SERIES AND CARACTERISTICS

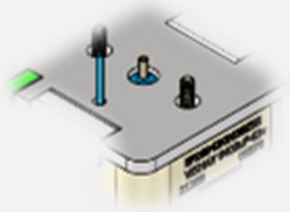
### ❑ EP2 High Energy High vibration & acceleration

- ➢ *based on experience EP1, HE3 and HE5 , Previously released products 2010*
- ➢ *Based on hermetically sealled design*
- ➢ Shock tested : 50g / HF Vibration: 20g / Random Vibration: 20g
- Weight: EP2A 55-60g / EP2B 80-90g / EP2C 110-120g
- Dimensions 1.4 x 1.4 in.


### ❑erformance Characteristics

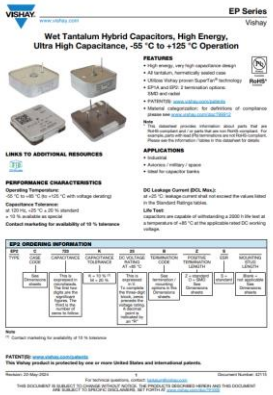
- ✓ *Ope. Temp: -55 ºC to +125 ºC*
- ✓ *Cap Range: 1100 µF - 72000 µF*
- ✓ *Cap Tol: ± 10 %, ± 20 %*
- ✓ *Voltage Rating: 25 - 125 VDC*
- ✓ *Case A to D (1 to 4 anodes)*



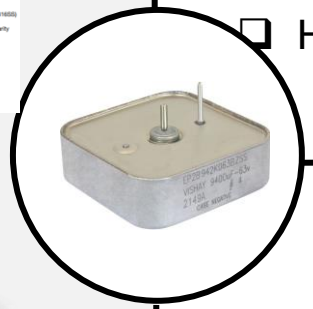
### ❑ Options:

- ➢ Studded design available to secure PCB fixation
- ➢ Spacer for flat mounting
- ➢ Universal base available for SMD configuration. available with studs version as well.

## KEY FEATURES




- ❑ DLA 15010 qualified on key ratings
- ❑ High energy density (above 2 Joule/cc)
- ❑ No aging or reforming required
- ❑ High operation temperature. Stable parameters
- ❑ Electrical characteristics stability - No wear out mechanism due to hermetic construction
- ❑ Harsh Environment Resistant



**EP2 AND EP1 RATINGS AND CASE CODES (ESR mΩ)**

| µF | 25 V | 35 V | 50 V | 60 V | 63 V | 80 V | 100 V | 110 V | 125 V |
|---|---|---|---|---|---|---|---|---|---|
| 1500 | | | | | | | | | EP2A (100) |
| 1900 | | | | | | | | | EP1A (100) / EP2A (100) |
| 2000 | | | | | | | | | EP1A (100) / EP2A (100) |
| 2200 | | | | | | | | EP2A (85) | EP1A (110) |
| 2700 | | | | | | | | | EP2B (45) |
| 3000 | | | | | | | EP1A (65) / EP2A (65) | | EP2B (45) |
| 3300 | | | | | | | EP1A (70) | | |
| 3600 | | | | | | | | | EP2B (50) / EP2C (25) |
| 3800 | | | | | | | | | EP2B (50) |
| 4000 | | | | | | EP1A (55) / EP2A (55) | | EP2B (40) | |
| 4200 | | | | | | | EP2B (30) | | |
| 4400 | | | | | | EP1A (60) | EP2B (30) | | |
| 4500 | | | | | | | | | EP2C (25) |
| 5300 | | | | | | | | | EP2C (35) |
| 5600 | | | | | | | EP2C (20) | | EP2C (35) |
| 5800 | | | | | | | EP2B (35) | | |
| 6000 | | | | | EP1A (50) / EP2A (50) | EP2B (27) | | EP2C (27) | |
| 6300 | | | | EP2A (50) | | | | | |
| 6600 | | | | | EP1A (60) | | EP2C (20) | | |
| 7000 | | | | | | EP2B (30) | | | EP2D (20) |
| 7900 | | | | | | | EP2C (25) | | |

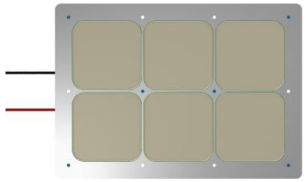
**EP2 AND EP1 RATINGS AND CASE CODES (ESR mΩ)**

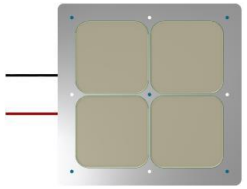
| µF | 25 V | 35 V | 50 V | 60 V | 63 V | 80 V | 100 V | 110 V | 125 V |
|---|---|---|---|---|---|---|---|---|---|
| 8000 | | | | | | EP2B (30) | | EP2D (20) | |
| 9000 | | | | | | EP2B (30) / EP2C (18) | EP2C (25) | | |
| 9400 | | | | | EP2B (25) | | | | |
| 10 500 | | | | | | | EP2D (20) | | |
| 11 000 | | | | | EP2B (25) | | | | |
| 12 000 | | | EP1A (50) / EP2A (50) | | EP2B (25) | EP2C (20) | | | |
| 12 600 | | | | EP2B (25) | | | | | |
| 13 000 | | | EP1A (50) / EP2A (50) | | EP2B (25) | | | | |
| 14 000 | | | | | EP2C (17) | EP2C (20) | | | |
| 15 000 | | | EP1A (60) | | | | | | |
| 16 000 | | | | | | EP2D (15) | | | |
| 17 000 | | | EP2B (25) | | | | | | |
| 18 000 | | | | | EP2C (20) | | | | |
| 19 000 | | | | EP2C (17) | | | | | |
| 22 000 | | EP1A (40) / EP2A (40) | EP2B (25) | | | | | | |
| 23 000 | | | EP2C (17) | | | | | | |
| 24 000 | | | EP2B (27) | | EP2D (12) | | | | |
| 25 000 | | | | EP2D (15) | | | | | |
| 30 000 | EP1A (30) / EP2A (30) | | | | | | | | |
| 32 000 | | EP2B (20) | | | | | | | |
| 33 000 | | | EP2C (17) | | | | | | |
| 34 000 | | | EP2C (18) | | | | | | |
| 36 000 | | EP2B (22) | | | | | | | |
| 37 000 | | | EP2C (20) | | | | | | |
| 40 000 | | EP2B (22) | | | | | | | |
| 44 000 | | | EP2D (15) | | | | | | |
| 47 000 | | EP2C (15) | | | | | | | |
| 48 000 | EP2B (20) | EP2C (15) | EP2D (15) | | | | | | |
| 58 000 | | EP2C (17) | | | | | | | |
| 70 000 | | EP2D (12) | | | | | | | |
| 72 000 | EP2C (15) | | | | | | | | |
| 96 000 | EP2D (12) | | | | | | | | |

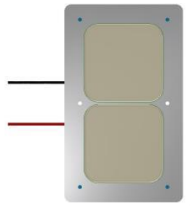
**DLA 15010**

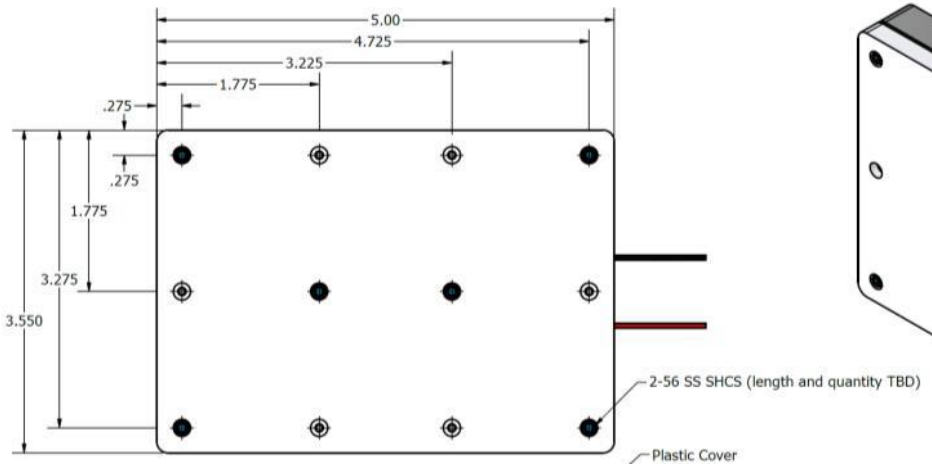
EP2B 22mF-50V
EP2C 33mF-50V
EP2C 19mF-60V
EP2B 9.4mF-63V
EP2C 14mF-63V
EP2B 9F-80V
EP2B 3mF-125V
expending

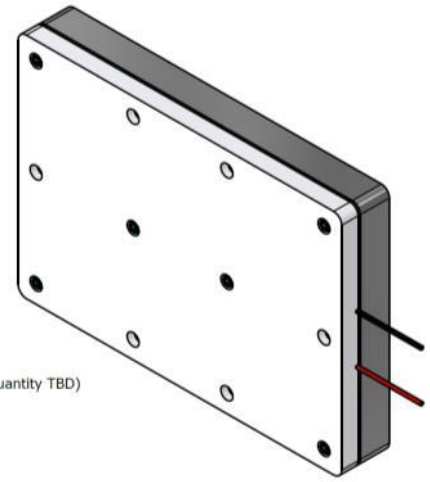
# STANDARD MODULES EP2 WET TANTALUM



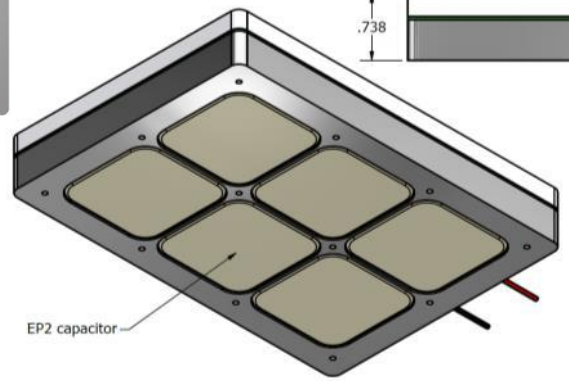


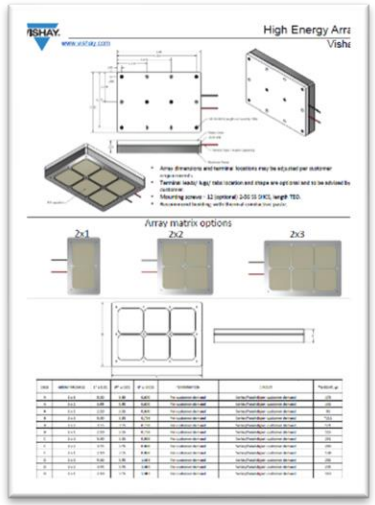




**EP2 Horizontal stack Serie and Parallel association Voltage 500 V designed**




- ❑ Array dimensions and terminal locations may be adjusted per customer requirements.
- ❑ Terminal leads/ lugs/ tabslocation and shape are optional and to be advised by the customer.
- ❑ Mounting screws = 12 (optional) 2-56 SS SHCS.
- ❑ Recommend bedding with thermal conductive paste.

# APPLICATION AND EXPERIENCE

## Typical Space/Aerospace application

- ❑ Rocket Ignition / re-ignition
- ❑Motor / actuators driving
- ❑ Backup of key equipment (Transponder, flight computer)
- ❑ Higher voltages possible by serie association (customer design or Vishay module) – Electric thruster up to 2000v
- ❑GaN , SiC voltage increase requirement
- ❑Laser driver (distance, communication)
- ❑SA Radar primary power supply pulse

## Roadmap

D 6 mF / 125v case 4 anodes ESR down to 12 mOhms
C 96 mF / 25v C 58mF / 35v – C 18 mF / 63v
C 12 mF / 80v -

## Trend and requirements

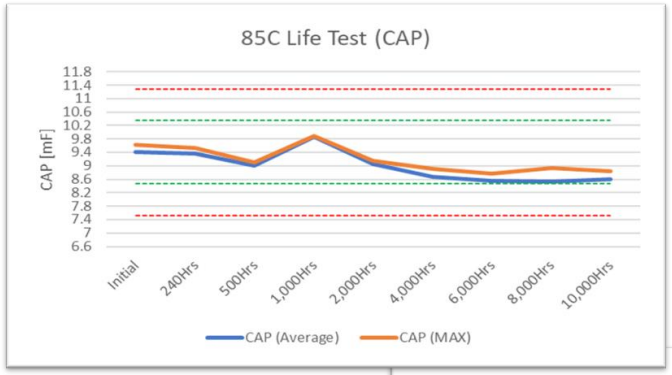
- ❑ lower ESR for higher Ripple Current and faster start up
- ❑ Improved thermal dissipation by lower ESR and thermal increase withstanding
- ❑ Shock & Vibration resistance increase
- ❑ Higher cap and Voltage

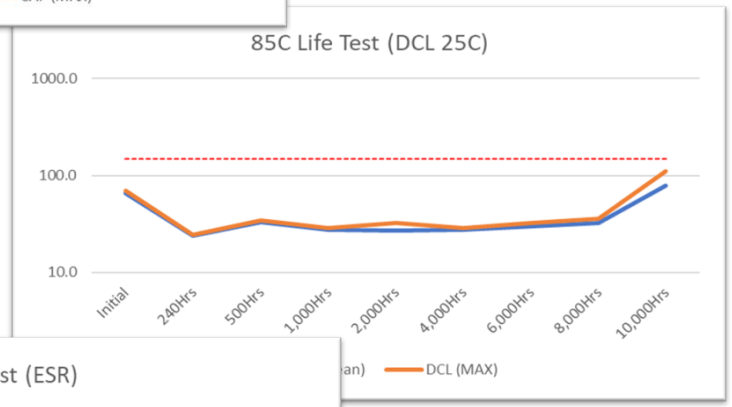
## Thermal Management

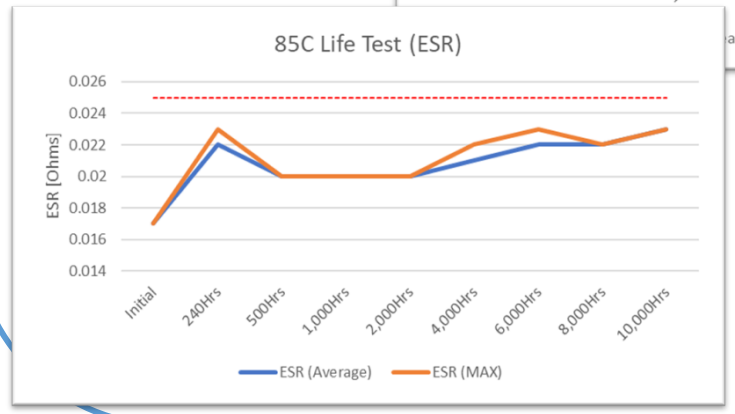
| **EP2B 9400uF-63V 25 mOhms 25°C** | **Normal ripple max** *below 75°C in continuous mode* | **limited ripple max** *stay below 125°C during pulse* |
|---|---|---|
| At 20Hz: | 6.53A | 13.06A in 10min |
| At 50Hz: | 7.76A | 15.52A reach in 10 min |

# EP2 STABILITY & LIFETEST

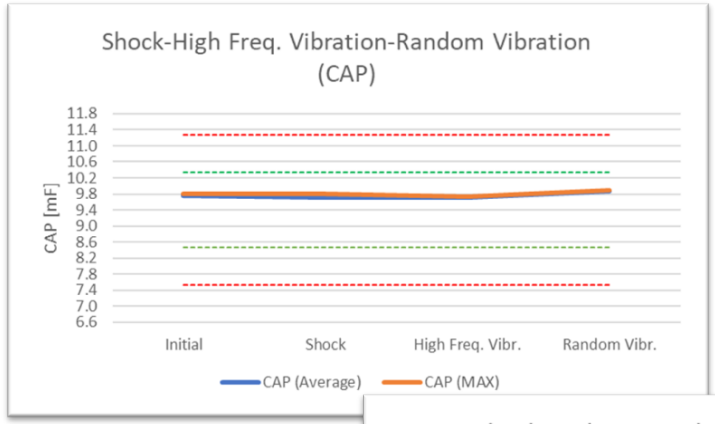
## EP2B 9.4mF-63V Electrical Reliability

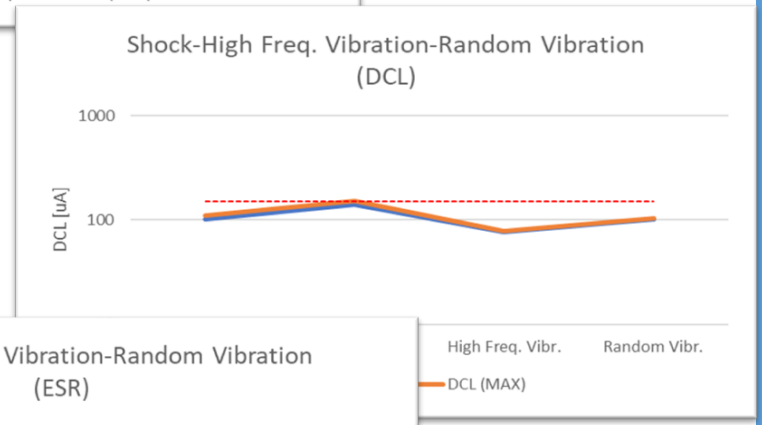


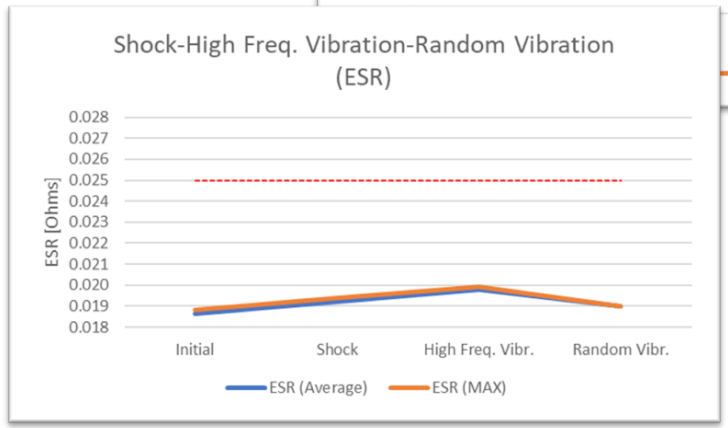



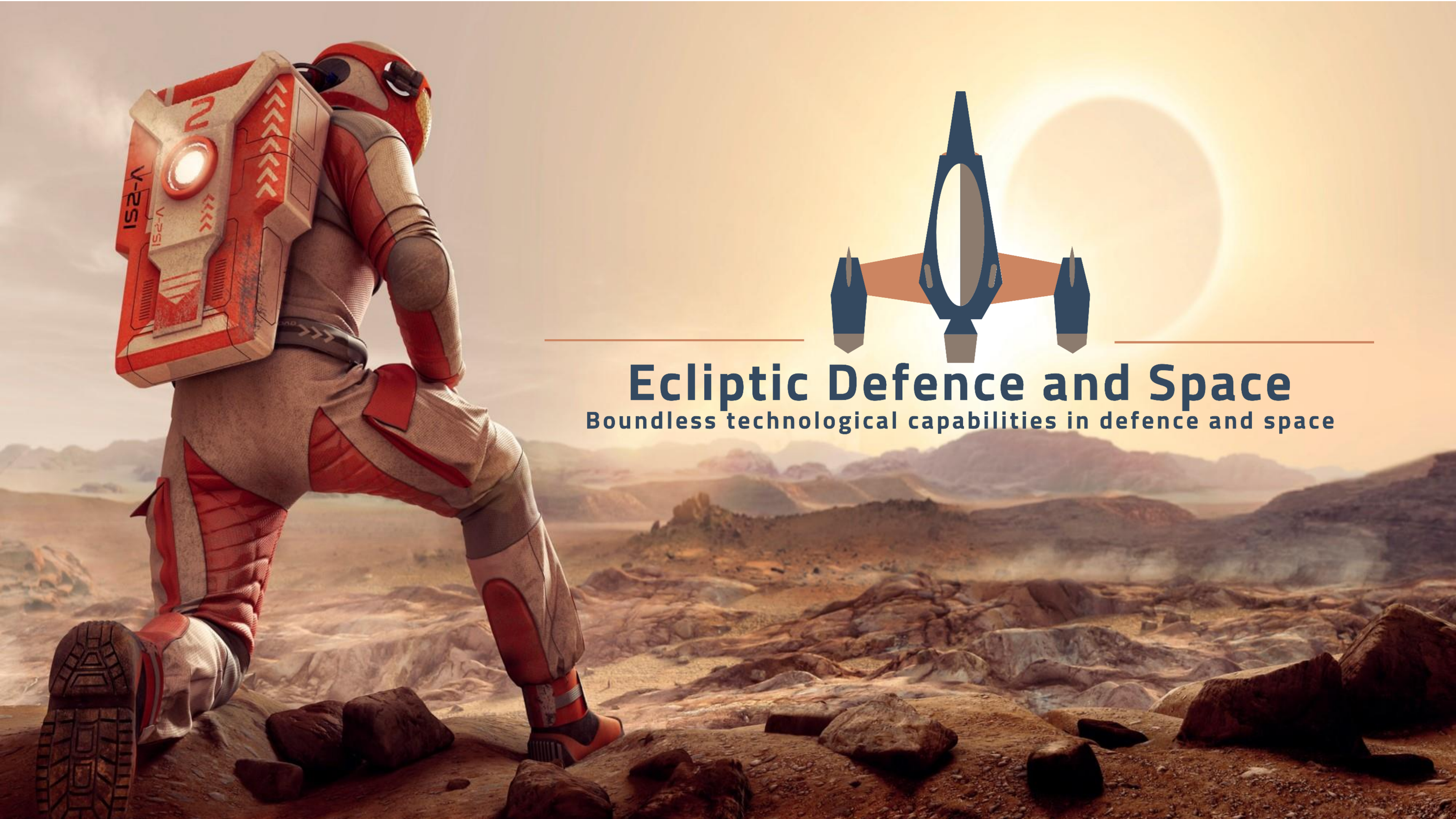




## EP2B 9.4mF-63V Mechanical Reliability





# Ecliptic Defence and Space

## Boundless technological capabilities in defence and space

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Boundless technological capabilities in defence and space

# ECLIPTIC DEFENCE AND SPACE (EDS)

## COMPANY PRESENTATION

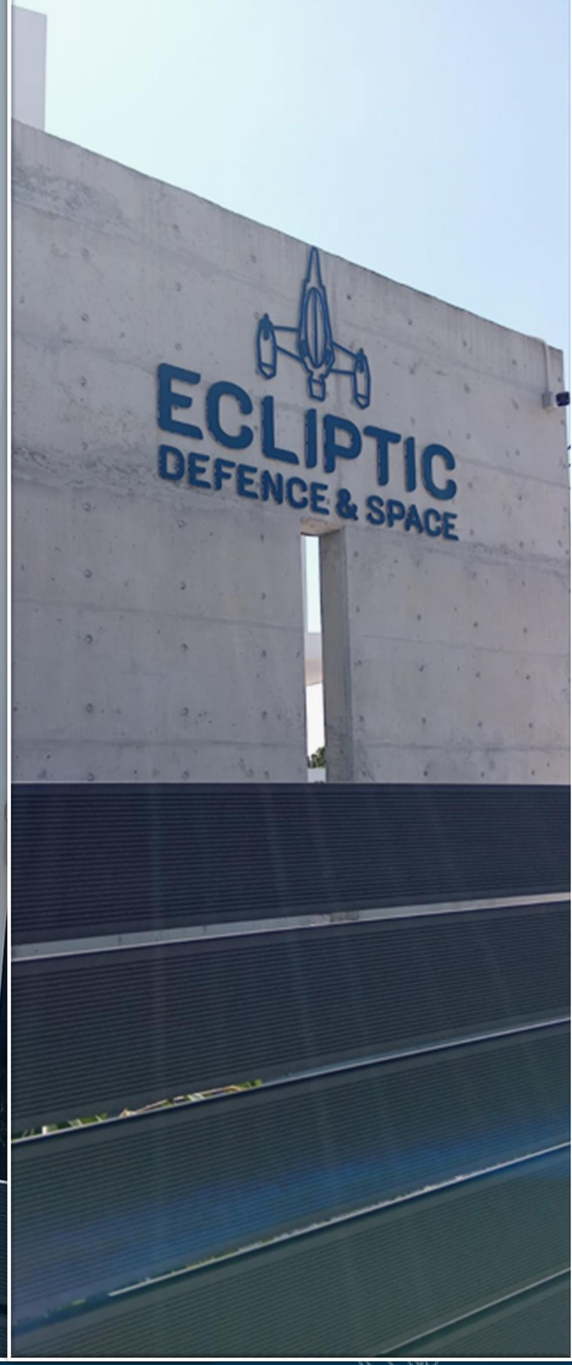
SPCD
SPACE PASSIVE COMPONENT DAYS

- Company overview
- Strategic objectives/ vision
- Company's laboratories
- Component & Subsystem-level capabilities
- High-Power SIW components for telecom satellite missions

# COMPANY OVERVIEW

- Foundation Date: April 2020 (First Contracts in August 2021)
- Activities: Design, Manufacturing & Testing of RF & Microwave Components, Subsystems and Systems for Defence and Space platforms
- Core Technology Expertise: Radio Frequency & Microwave Technologies with a focus on complex Substrate Integrated Waveguide structures
- Team: Currently a team of 14 engineers with industrial expertise (RF Engineers, Electronic Engineers, Mechanical and PA/QA Specialist)
- Premises location: A 3-storey building (493 sq.m) in Nicosia housing our Design Offices, Prototyping Laboratories and Small-Scale manufacturing areas. Within 2025/2026, EDS will acquire additional manufacturing facilities to implement forecasted production needs.
- Space development projects won: 11 projects from the European Space Agency (ESA), 1 from the Cyprus Research and Innovation Foundation (IRF).
- Main Subcontractors/End-customers: Thales Alenia Space & Airbus are participating in the projects with product specifications.

* All space developments can evolve into defence products with minor modifications

# STRATEGIC OBJECTIVES/ VISION

SPCD
SPACE PASSIVE COMPONENT DAYS

- Establish a Large-Scale, state-of-the-art Development and Testing Infrastructure for RF & Microwave components, subsystems and systems.
- Become an integral part of the European/ International LSI's space supply chain
- Build the manufacturing capacity to deliver on high-volume orders at the required reliability.
- Establish strong collaborations/ partnerships with European and global space organisations to undertake larger projects and further developments of ground-breaking RF technologies.

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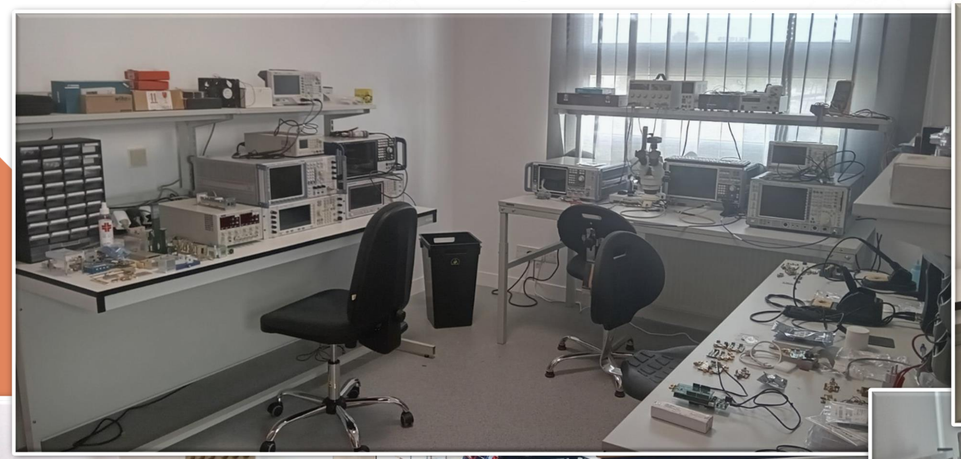
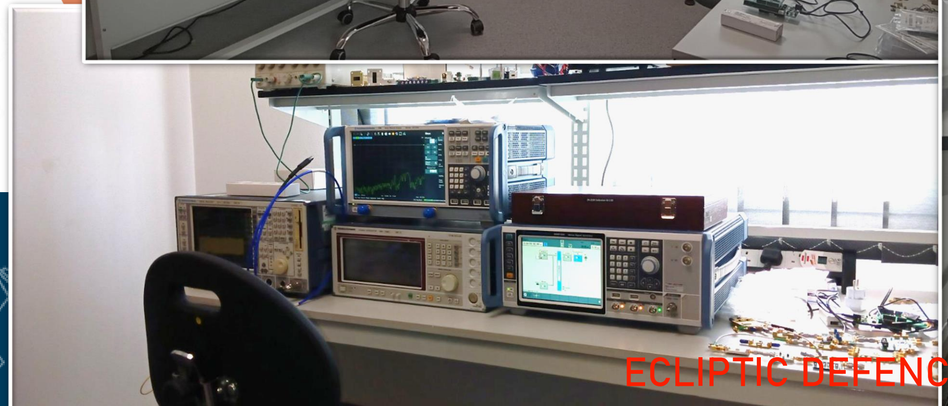
# COMPANY'S LABORATORIES

SPCD
SPACE PASSIVE COMPONENT DAYS

- High RF Power Test Laboratory
- Low RF Power Electronics Test Laboratory
- Environmental Test Laboratory (ISO 7 Cleanroom)
- RF Electronics Processing and Inspection Laboratory
- EMC Test Laboratory
- Mechanical Inspection Laboratory
- General Electronics Testing Laboratory



# COMPONENT & SUBSYSTEM-LEVEL CAPABILITIES

The design and manufacture of bespoke space-grade and defence-grade components and subsystems from UHF to Q-Band:

| Low Power Active Components | Low Power Passive Components | High Power Planar Active Components | High Power Waveguide Passive Components | Subsystems |
|---|---|---|---|---|
| LNA's | Filters | High Power Amplifiers (GaN) modules | Isolators, Circulators | Receivers(Radar, Altimeter, Radiometer,Scatterometer) |
| Gain Blocks | Couplers | T/R multi-chip Modules | Couplers | Upconverters |
| Switches (PIN) | Attenuators | | Filters | Synthesizers |
| Attenuators (PIN) | Antennas | | High-Power Load terminations | Transmitters, SSPA's |
| Phase-shifters (PIN) | Combiners | | Spatial Power Combiners | Input Multiplexers |
| Oscillators (DRO) | Dividers | | Binary-type combiners | TT&C, PDT's |
| | Metamaterial implementations of the above | | Attenuators | Analog beamformers |

Ecliptic Defence and Space
Boundless technological capabilities in defence and space

# HIGH-POWER SIW-BASED COMPONENTS

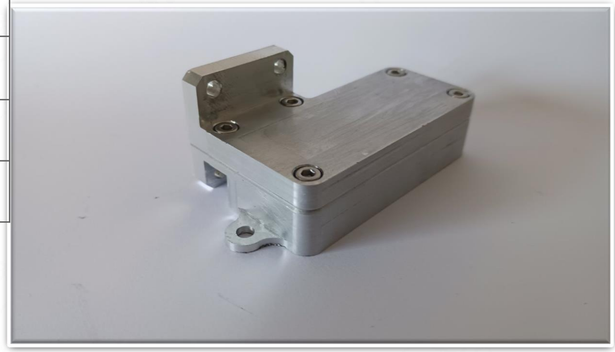
SPACE PASSIVE COMPONENT DAYS

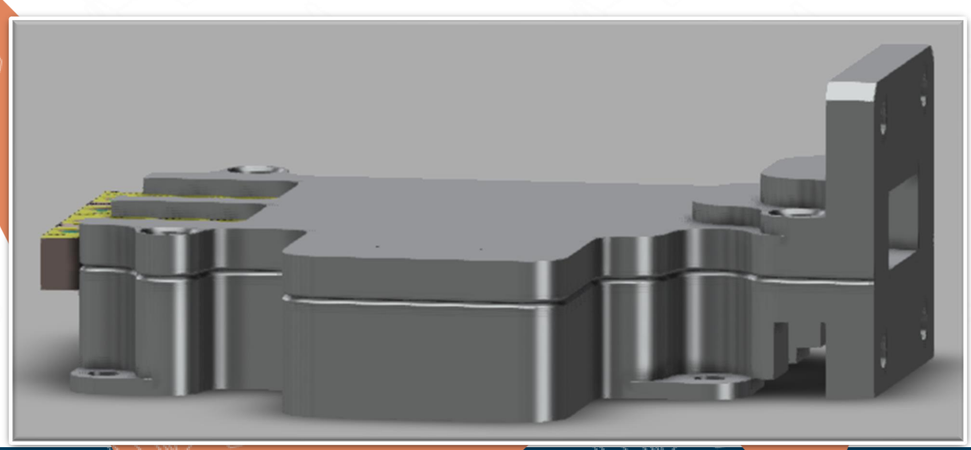
Powered by Ecliptic's HYWAIS® technology

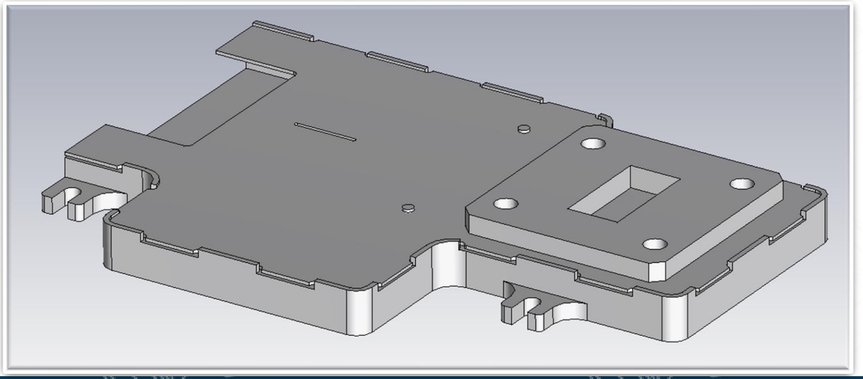
| U-COMBS Ultra-Low-Loss Combiners (Ka-Band) | |
|---|---|
| Insertion Loss | 0.45 |
| Return Loss (all ports) | 19 dB |
| Input Port Isolation | 19 dB |
| Reverse Isolation | 22 dB |
| Max Forward power | 100 W CW |

| U-COMBS Ultra-Low-Loss Combiners (Ku-Band) | |
|---|---|
| Insertion Loss | 0.45 |
| Return Loss (all ports) | 20 dB |
| Input Port Isolation | 20 dB |
| Reverse Isolation | 26 dB |
| Max Forward power | 120 W CW |

U-COMBS Units will undergo ESCC qualification in 2025/2026







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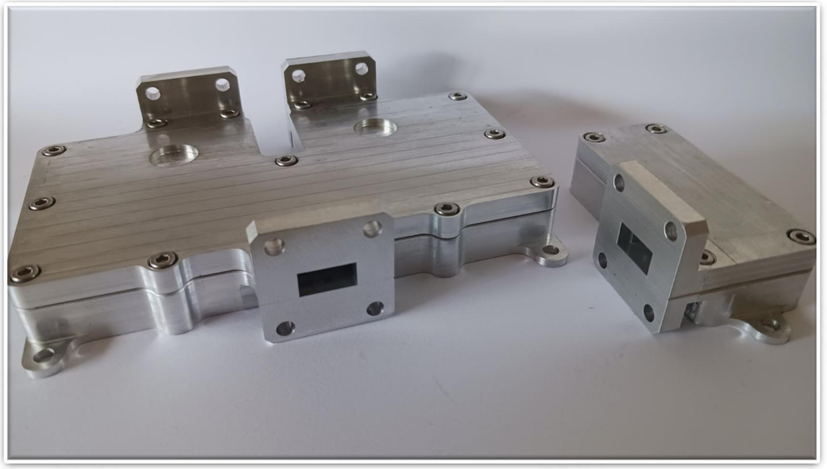
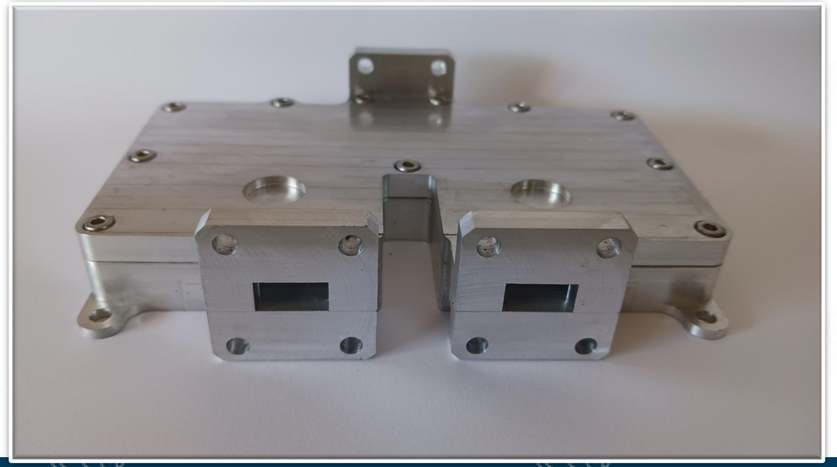
# HIGH-POWER SIW-BASED COMPONENTS

SPACE PASSIVE COMPONENT DAYS

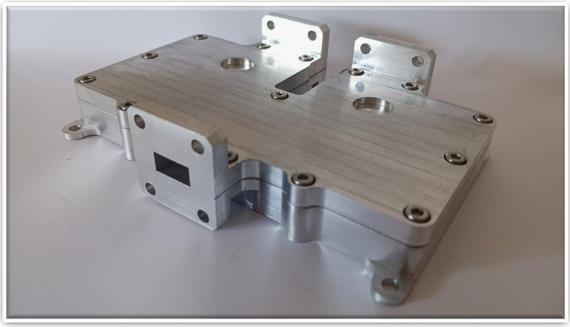
Powered by Ecliptic's HYWAIS® technology

| INKAIDUS IsoCombiners (Ka-Band) | |
|---|---|
| Insertion Loss | 0.6 dB |
| Return Loss (all ports) | 18 dB |
| Input Port Isolation | 24 dB |
| Reverse Isolation | 22dB |
| Max Forward power | 120 W CW |





INKAIDUS Units will undergo ESCC qualification in 2025/2026



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# HIGH-POWER SIW-BASED COMPONENTS

SPACE PASSIVE COMPONENT DAYS

Powered by Ecliptic's HYWAIS® Technology.

| FINISST IsoFilters (Ka-Band) | |
|---|---|
| Insertion Loss | 0.6 dB |
| Return Loss (all ports) | 19 dB |
| Out-of-band rejection | 20 dB |
| Isolation | 22 dB |
| Max Forward power | 90 W CW |

| QuBISS Isolators (Q-Band) | |
|---|---|
| Insertion Loss | 0.3 dB |
| Return Loss (all ports) | 22 dB |
| Isolation | 22 dB |
| Max Forward power | 40 W CW |

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Ecliptic Defence and Space
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# ECLIPTIC DEFENCE AND SPACE

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Nicosia/ Cyprus

Where Possibilities Connect™

# BizLink ESCC Cables and custom Solutions for Space applications

Friesoythe

BizLink

# Markets and Offerings

*Together we will form a leading global interconnect company*

## BizLink (2021)

Sales
~ € 916 m

Employees
~ 11,200

**Markets**

- Industrial
- IT DataComm
- Automotive
- Electrical Appliacne

**Sites: 26 worldwide**

Main footprint and customers in Asia and USA

**Offerings**

Cable manufacturing and cable systems for many requirements / standards

+

## IN BG (2021)

Sales
€ 544 m

Employees
~ 3,400

**Markets**

- Factory Automation
- Healthcare
- Machinery & Sensors
- Marine
- Space
- Telecommunication Systems
- Silicone

**Sites: in 10 countries**

Main footprint and customers in Europe, USA and China

**Offerings**

Cable manufacturing, cable systems, and services for standard and tailor-made requirements

## BizLink + IN BG

- ✓ Truly global market presence – strengthening activities and leveraging potential in Europe, North America and Asia
- ✓ Complementary global production network, technology, and product portfolio
- ✓ Solid financial power
- ✓ Innovation driver

# BizLink Special Cables Germany

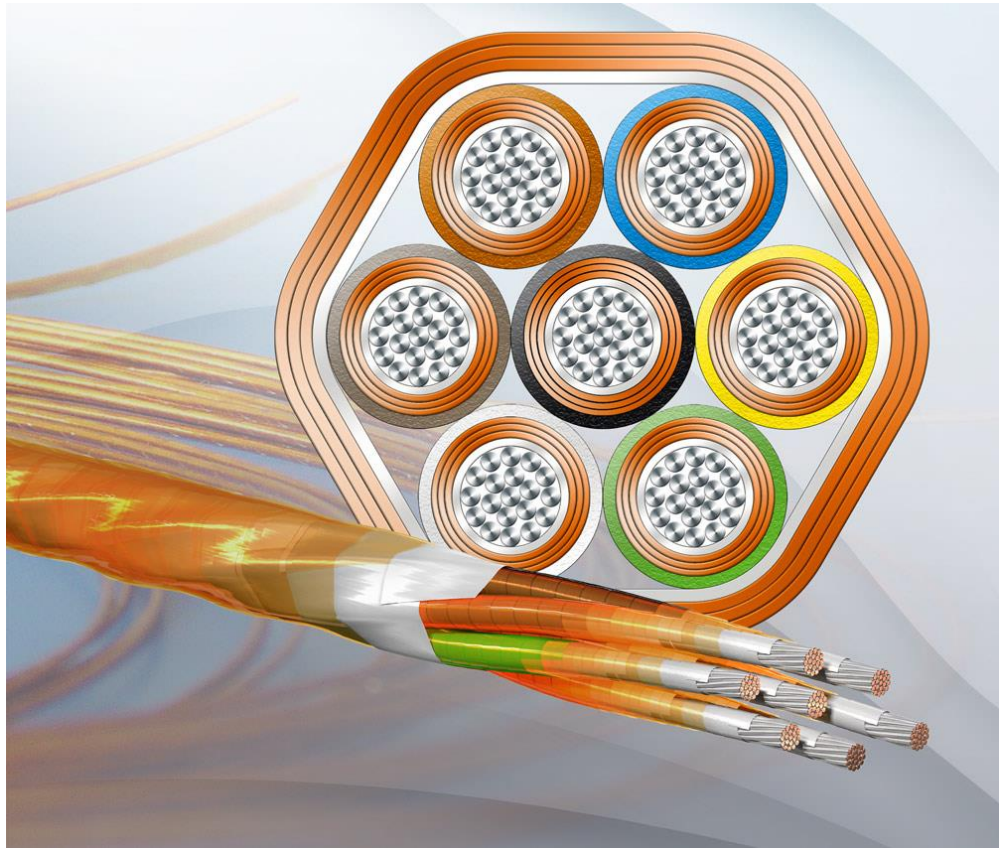
## Business Units:

**Automation & Drives**

**Healthcare**

**High-Performance Computing (HPC)**

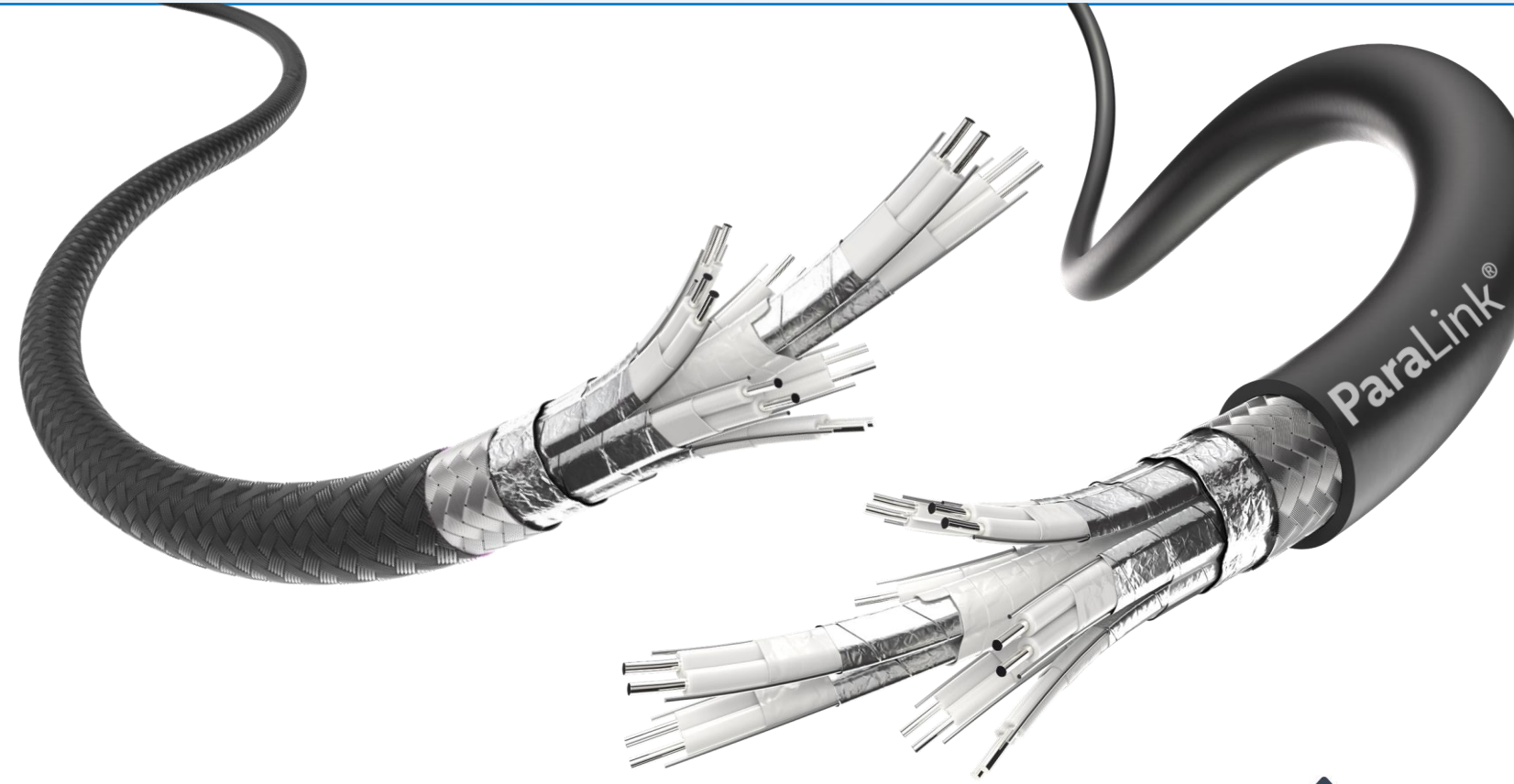
# ESCC space grade cables



- In accordance with ESCC 3901-018,-019 or -021 specifications
- Lightweight and thin
- Highly flexible
- Low-outgassing material use
- Resistant to extreme temperature ranges from -200 to +200 °C
- Vibration and shock resistant
- Voltage rating: up to 600 V

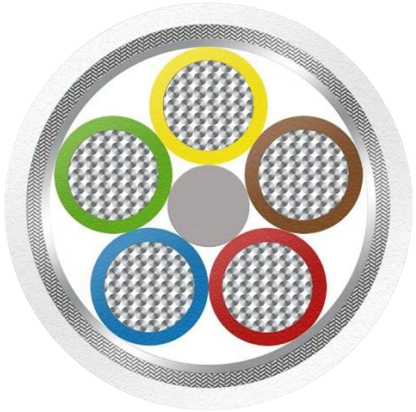
# ParaLink® high speed data cables

- For transmission of signals with speeds up to 224  Gbit/s per lane (PAM 4). Suck-out free till 60GHz.
- Parallel pairs (Twinax), separately shielded
- Various construction options, e.g.
  - AWG sizes 24 to 34
  - Miniaturization line (AWG 34 to 38)
  - Number of pairs 1 to 24
  - Hybrid solutions
  - Space suitable

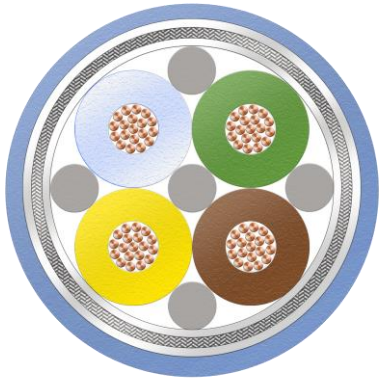



# Space cables, ground and flight harnesses

Custom space cables

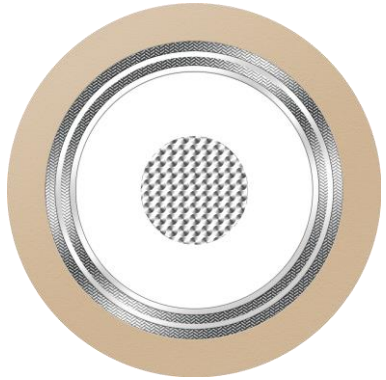


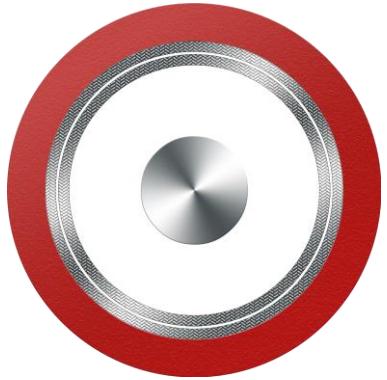
Onboard Data Network cables

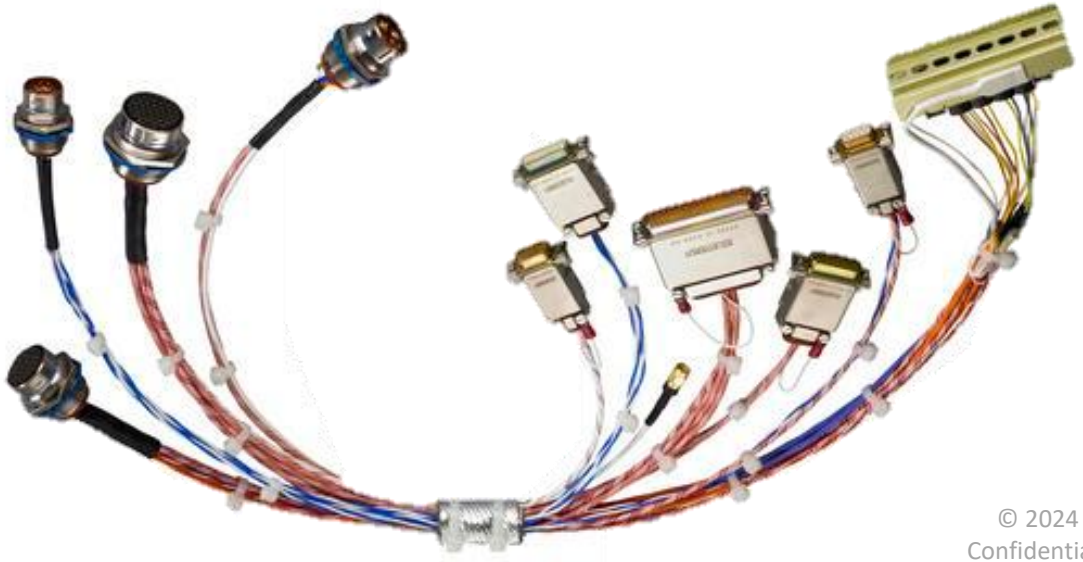


- Build-to-print services and module assembly for space applications
- Lightweight and small
- Low-outgassing
- Resistant to extreme temperature ranges from -200 to +200 °C
- Vibration and shock resistant
- Voltage rating: up to 600 V
- Insulations of PFA, FEP, Polyimide, PTFE, ETFE possible

50Ω, 75 Ω Standard and customized Coax solutions suitable for space applications

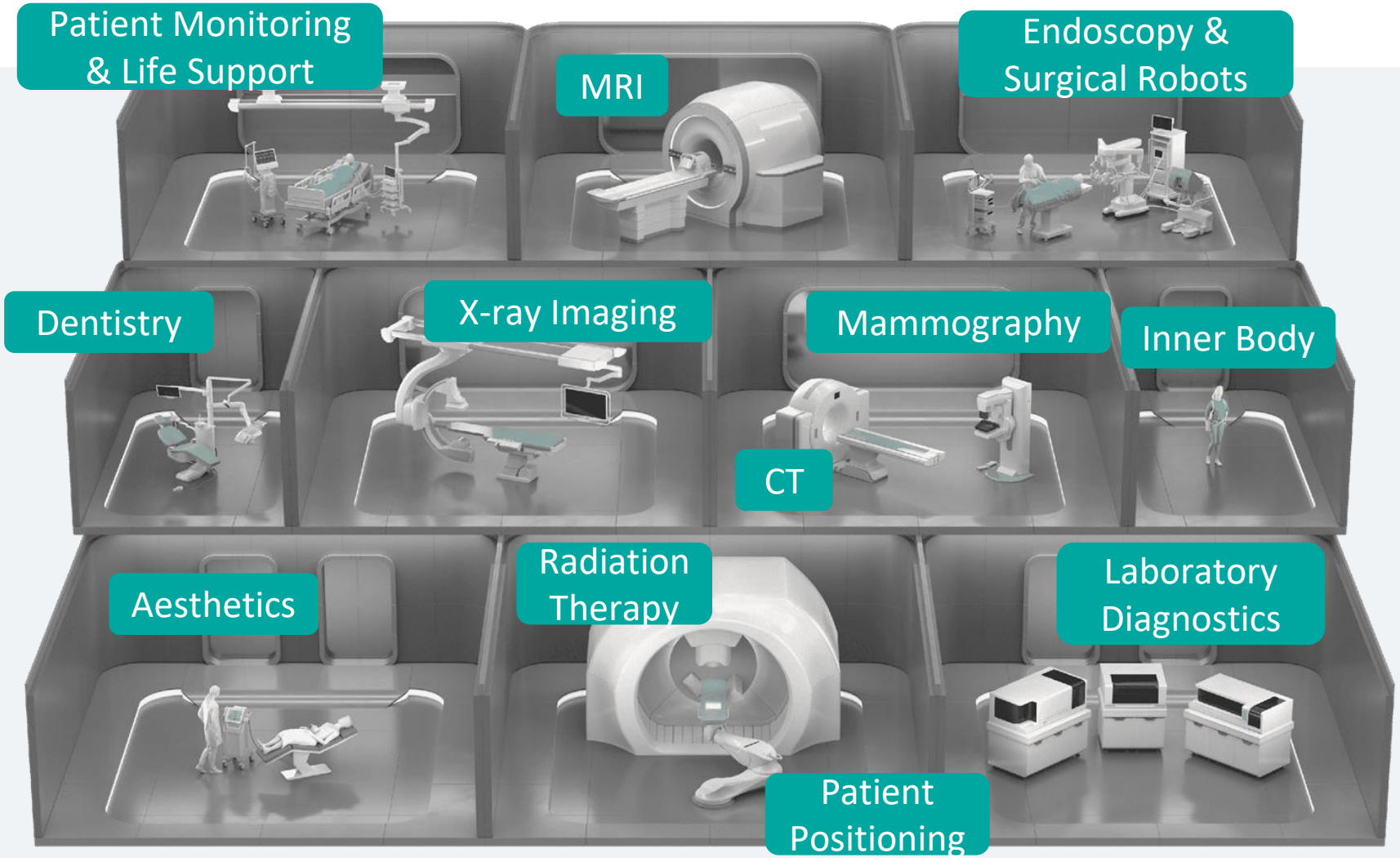






ECSS-Q-70 -26 & -08

# BizLink Healthcare solutions



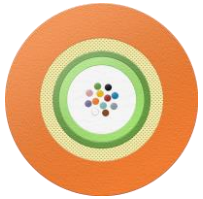

Potentially candidates for Space applications in our Healthcare solutions!

# BizLink Healthcare solutions


- for moderate mechanical stress installation inside device
- UL-Style accordance typically included

e.g.

Ethernet patch cable

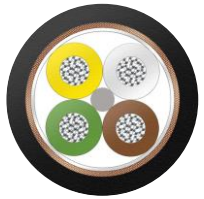


Fiber optic patch cable


- for high & diverse mechanical stress installation inside or next to device
- UL-Style accordance & disinfectibility typically included

e.g.

Crush-resistant footswitch cable (also trailable)



Stressable X-ray cable with copper alloy


- for fix & flexible installation with increased hygienic requirements
- disposable or biocompatibility compliance included

e.g.

Tensile strong handswitch cable

Extra-thin body coil cable

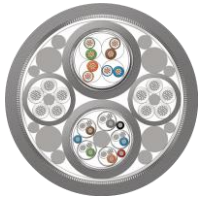
Reusable ECG trunk cable


**Whatever is needed.**

**Challenge us!**

e.g.

‘All-in-one’ C-arm custom cable



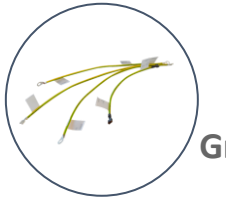
Vision system breakout cable

# X-ray cable system solutions

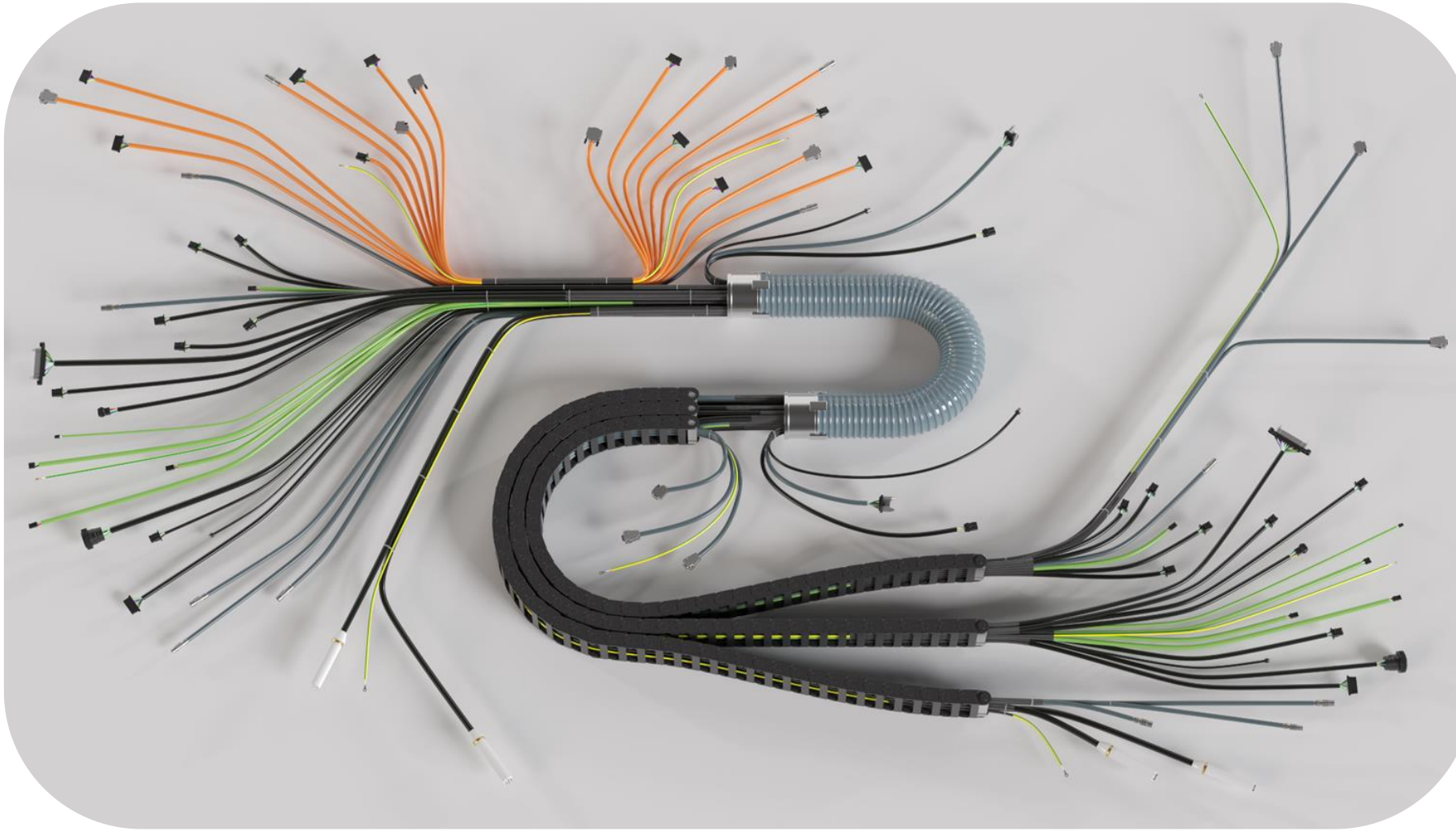
Fiber optic cables (POF, PCF & silica)

Cat 5,6 & 7 Ethernet cables

Coaxial cables

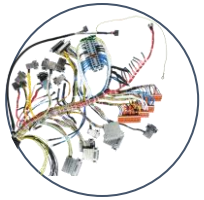


Grounding cables



Optional electronic unit integration

Optional drag-chain unit integration



Optional switchboard unit integration

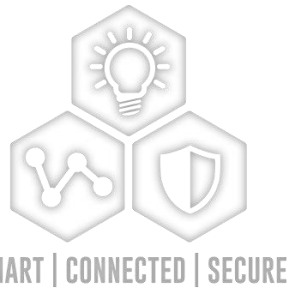
Optional custom C-arm cable integration

etc...

| | |
|---|---|
| **Your contact** | **Jogli Maldonado** |
| Job title | Product Engineer |
| Address | BizLink Special Cables Germany GmbH<br>Eschstrasse 1<br>26169 Friesoythe<br>Germany |
| E-mail | jogli_maldonado@bizlinktech.com |


# Microchip Frequency Technology GmbH
# Neckarbischofsheim (NBH)
## Overview / Product Portfolio

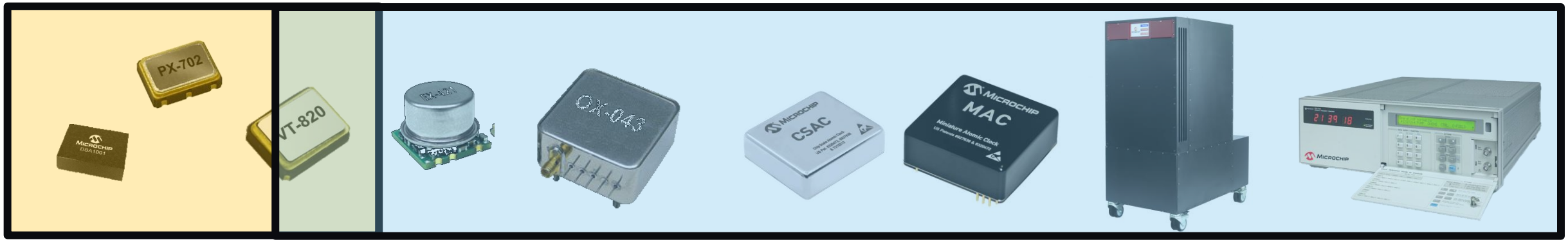

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions




**Oliver Terasa**

Oct-2024

# MCHP Frequency Control Products




1E-7 1E-8 1E-9 1E-10 1E-11 1E-16

Daily Frequency Aging

- MEMS
- Crystal Oscillator (XO)
- Temperature Compensated (TCXO)
- Evacuated Miniature (EMXO)
- Oven Controlled (OCXO)
- Chip Scale Atomic Clock (CSAC)
- Rubidium
- Hydrogen Maser
- Cesium



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# Microchip in Europe

- **>2700 employees**

- **Job Functions**
  - Research & Development
  - Procurement
  - Engineering
  - Manufacturing
  - Quality
  - Test
  - Sales Support
  - Technical Support

- **Key Markets**
  - Aerospace & Defense
  - Industrial
  - Automotive
  - Communications
  - Consumer Appliance
  - Data Center & Computing

# Vectron Oscillator Products Factories



**Mount Holly Springs (MHS), US**

- Hybrid & Discrete Manufacturing
- Crystal Manufacturing

**Neckarbischofsheim (NBH), Germany**

- Hybrid & Discrete Manufacturing
- Crystal Manufacturing

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# Aerospace & Defense Segment

## Applications

**Radar**
- Low g-sensitivity
- Low Phase Noise

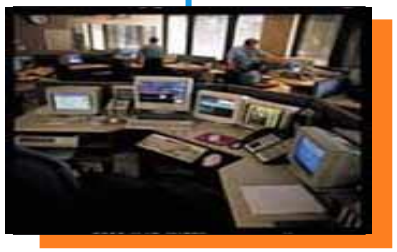
**Avionics**
- High frequency
- Low g-sensitivity
- Low Phase Noise

**GPS Guided Munitions**
- Low g-sensitivity
- Fast warm up

**XO TCXO**
**VCXO OCXO**
**VCSO SAW**
**Crystal Filter**

**Satellite Controls**

**Tactical Encrypted Radio**
- Low power consumption
- Small size
- Low Phase Noise



**Command And Control**
- Low Phase Noise /Low Jitter
- High frequency
- Low aging



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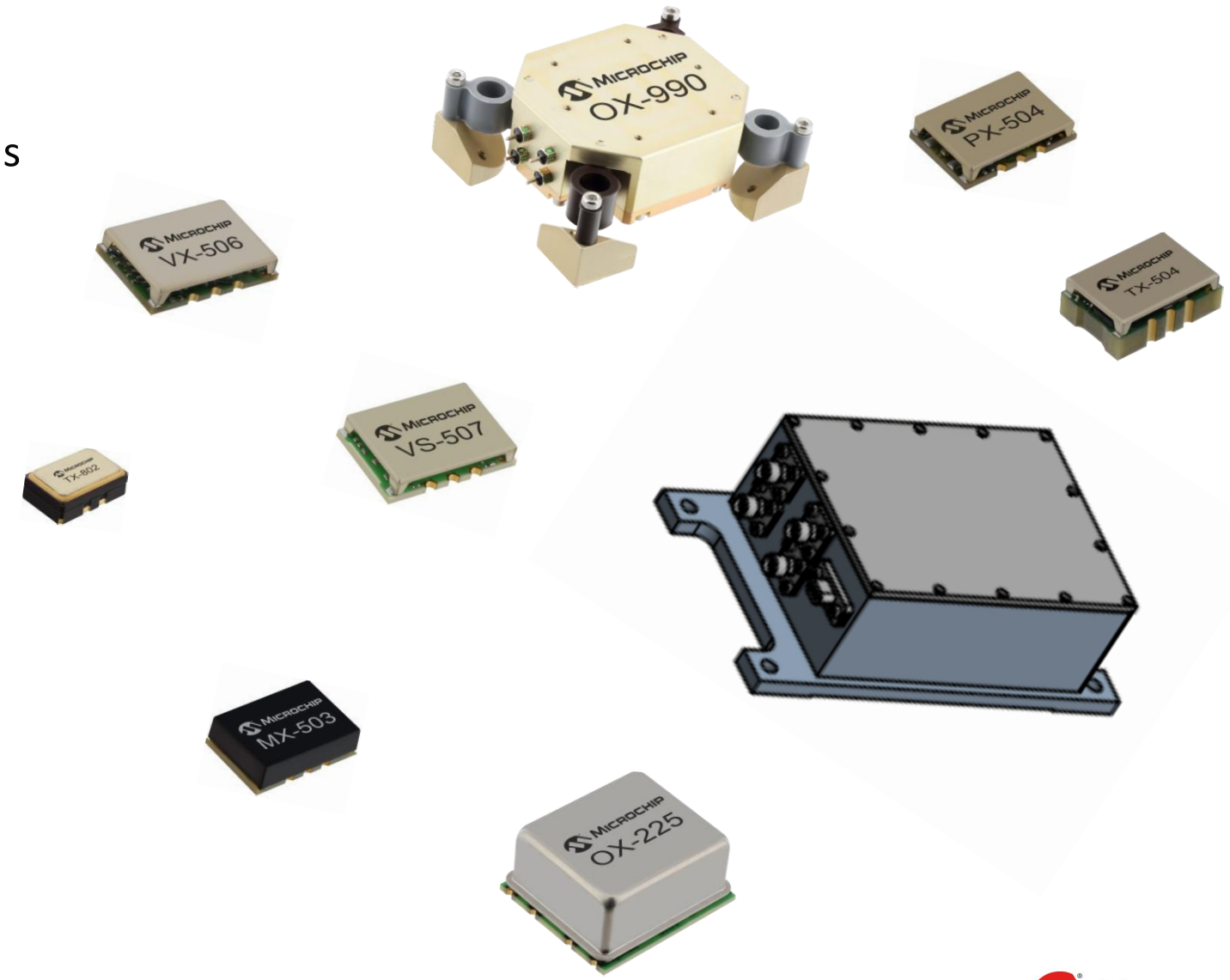
# Aerospace & Defense Product Roadmap

## Targeted Features

- **Low g-sensitivity**
  - OCXO, TCXO, VCXO, VCSO, CW-Crystals
- **Low Phase Noise**
  - OCXO, TCXO, VCXO, CW-Crystals
- **Low Jitter**
  - VCSO
- **Vibration hardened**
  - OCXO
- **High/Multi Frequency Output**
  - OCXO, VCSO, VCXO, PXO
- **Low Power / High Performance**
  - TCXO, MCXO
- **Holdover / Aging / High stability**
  - OCXO



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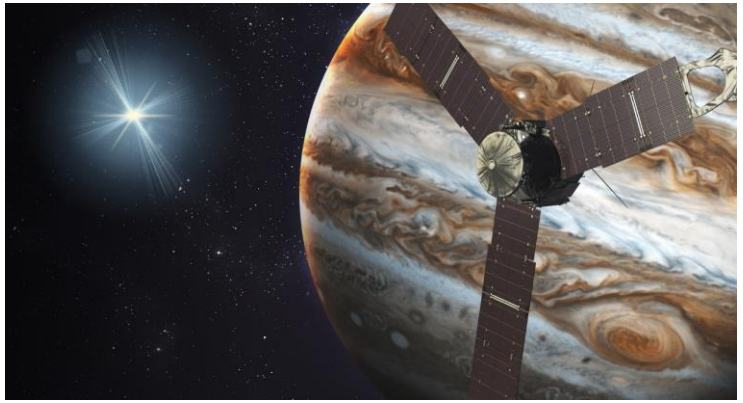
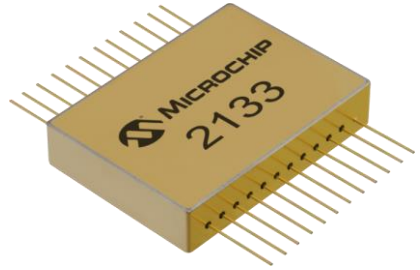
# Extensive Flight Heritage

## Microchip frequency control devices on-board…..

- Founded as McCoy Electronics in Mount Holly Springs, PA in the 1950's
- First successful US space mission in 1958
- First Lunar Landing in 1969
- Furthest manmade object from Earth – Voyager 1 – launched in 1977
  - ✓ 24 billion kilometers
  - ✓ 47 years of operation
- Fly-by of every planet in our solar system
- Spacecraft on surface of Moon, Venus, Mars, and Titan
- Spacecraft intentionally impacted Mercury, Jupiter, Saturn and Sun
- Deep Space, GEO, LEO, Telescopes, Landers, Rovers, Manned, Launch Vehicles
- Occupying eleven sockets on NASA's Perseverance rover
- Primary supplier of clock oscillators for JPL's upcoming Europa mission

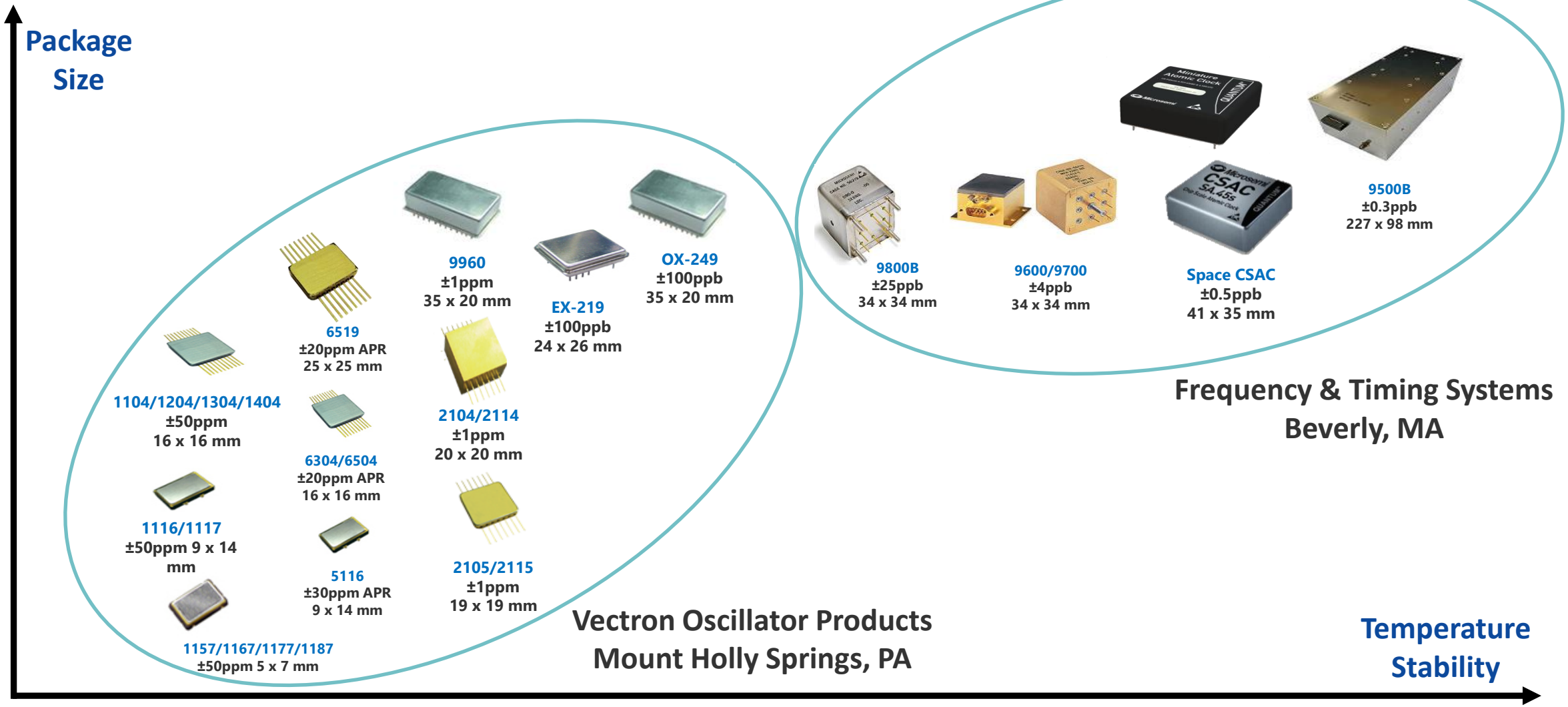


| | | | | |
|---|---|---|---|---|
| **1960s** | Apollo | Gemini | Pioneer | Intelsat |
| **1970s** | GPS | Viking | Nimbus | Voyager |
| **1980s** | Galileo | Milstar | Magellan | Space Shuttle |
| **1990s** | Centaur | Cassini-Huygens | Hubble Telescope | ISS |
| **2000s** | Mars Spirit | Mars Odyssey | New Horizons | Global Star II |
| **2010s** | Orion | GPS III | GOES-R | Juno |
| **2020s** | JWST | Perseverance | Vulcan Centaur | Europa (planned) |



# Flight Heritage of Microchip Crystals/Oscillators

## Microchip Space Qualified Oscillators

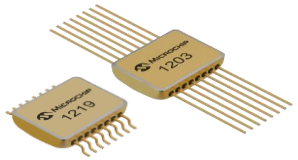


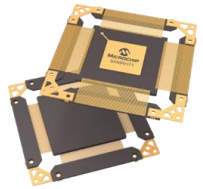
# LVDS Clocks – Quad Complementary Output

## DOC203679, Rev J (100 krad)
## DOC206903, Rev F (300 krad)

- Popular for driving RT FPGAs (**RT PolarFire**, RTG4, VIRTEX 4QV/5QV, et al)
- **Quad** complementary output pairs available from 12 MHz to 200 MHz
- Industry standard 16x16mm 20FP enclosure
- **Model numbers include:**
  - **1216 – 100 krad TID, Straight Lead**
  - **1280 – 100 krad TID, Lead Formed**
  - **1616 – 300 krad TID, Straight Lead**
  - **1680 – 300 krad TID, Lead Formed**
- Uses 5962R/F microcircuits and high FT bipolar transistors possessing wafer lot specific RLAT
- Output buffer rated to 120 MeV-cm$^2$/mg (SEL) and 67 MeV-cm$^2$/mg (SET/SEU)
- Bipolar transistor verified by separate testing not to diminish SET threshold of LVDS microcircuits

# Characterized Reference Clocks for a Total Solution



| Microchip Platform | Product Type | Timing Application Note |
|---|---|---|
| RTG4 | Rad Hard FPGA | AN3216 |
| VSC854(x)RT | Rad Tolerant Ethernet PHY | AN3503 |
| SAMRH71FA20 | Rad Hard Microcontroller | AN3520 Revised |
| ATmegaS64M1 | Rad Tolerant Microcontroller | AN3567 |
| ATmegaS128 | Rad Tolerant Microcontroller | AN3568 |
| SAM3X8ERT | Rad Tolerant Microcontroller | AN3659 Revised |
| SAMV71Q2RT | Rad Tolerant Microcontroller | AN3660 Revised |
| RT PolarFire | Rad Hard FPGA | AN5225 NEW |
| VSC8574RT | Rad Tolerant Ethernet PHY | In Process |
| SAMD21RT | Rad Tolerant Microcontroller | In Process |
| HPSC | Rad Hard FPGA | Planned |

# Solutions from COTS to Traditional Space

Cubesat

TID ≥ 100krad Tested
SEE/DDD Characterized

Traditional Space
RHBD – Radiation Hardened By Design

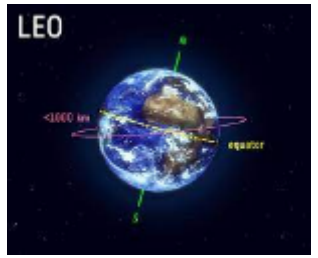
TID < 50krad By Design
SEL Verified

Ground
Based Systems

L-Series
RT – Radiation Tolerant

COTS

Low
Earth
Orbit




MEO/GEO/Deep
Space Applications

Extended Temp, Rugged

Quality
Grade

Radiation Performance





MICROCHIP

# L-Series – LEO Quartz Oscillator Family

## LX-703 - XO

- 1.25MHz – 135MHz CMOS
- ≤ 100 ppm Temp Stability
- 5x7mm SMT Package


## LT-400 - TCXO

- 20MHz – 160MHz SINE
- ≤ 5 ppm Temp Stability
- 4 Pin DIP


## LT-802 - TCXO (Q1-2025)

- 10 to 50MHz
- ±280ppb (-40/105°C)
- 5x3.2mm SMT Package


## LM-010 - PPS Disciplined Oscillator (Q4-2024)

- 12 Hour Holdover < 4 uS
- 24 Hour Holdover < 8 uS
- < 5ppb Temp Stability

## LO-200 - OCXO

- 10MHz-20MHz SINE
- ≤ 20 ppb Temp Stability
- 1” x 1”


## LO-201 - OCXO

- 100MHz-120MHz SINE
- ≤ 200 ppb Temp Stability
- 1” x 1”


## LO-202 - OCXO

- 20MHz-35MHz SINE
- ≤ 50 ppb Temp Stability
- 1” x 1”



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# Thank You!