General Presentation Littelfuse Company

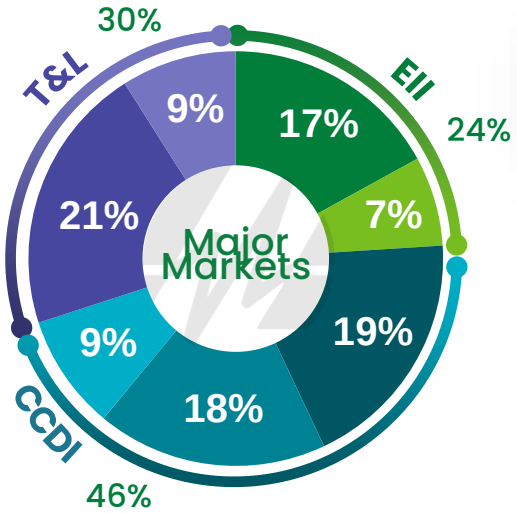
Rémi ANTOINE
October 14th, 2026

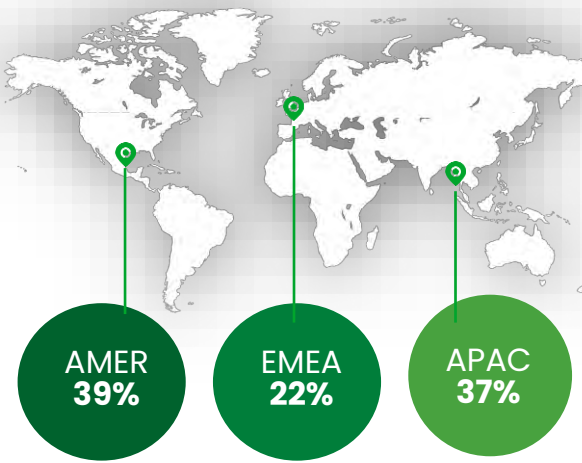


Littelfuse has been shaping solutions for the safe and efficient transfer of electrical energy for **over 100 Years**

NASDAQ: LFUS

1927	Founded
~17,000	Total Employees
$2.4B	2025 Revenue
$9.0B	Market Capital





Transportation & Logistics (T&L)
- Passenger Vehicle (21%)
- Commercial Vehicle (9%)

Computing, Communications & Diversified Industrials (CCDI)
- Data Center & Building Infrastructure (19%)
- Diversified Industrials (18%)
- Consumer Electronics (9%)

Energy and Industrial Infrastructure (EII)
- Industrial Infrastructure (17%)
- Energy Infrastructure (7%)

SBU (Semiconductor Business Unit)

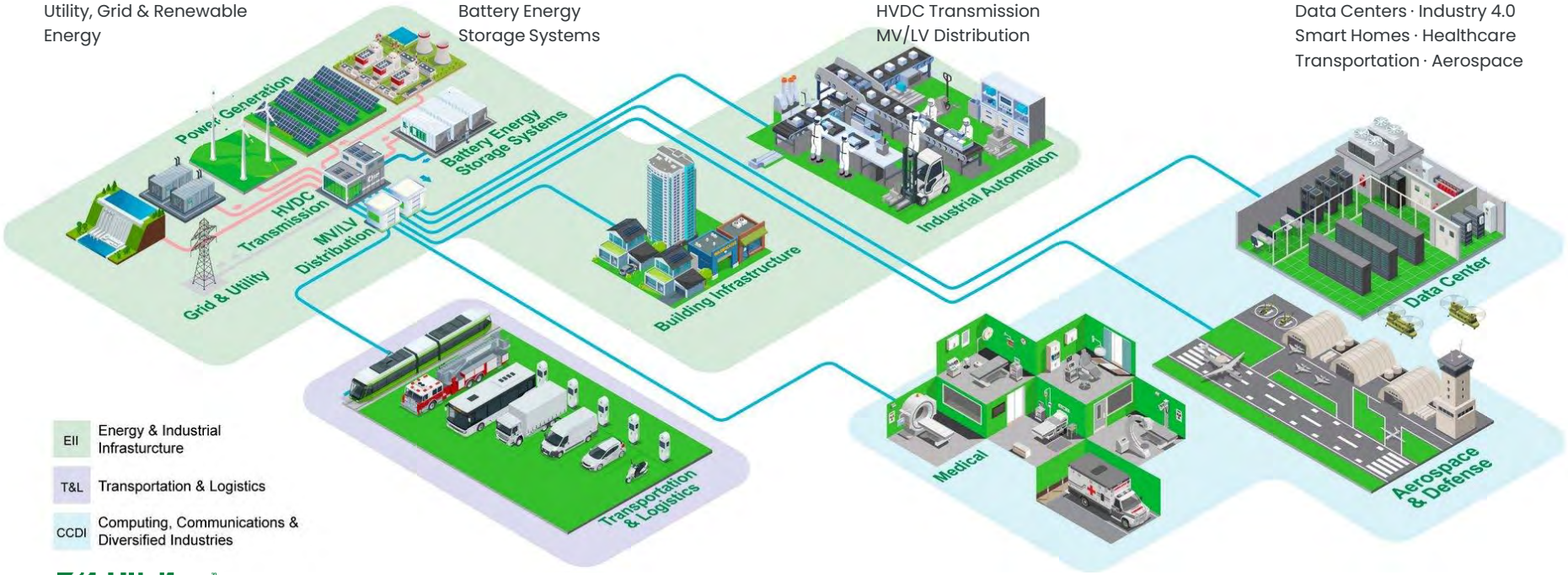
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One partner. Every stage.

Littelfuse protects, controls, and senses at every stage from the point of generation to the point of use.

Protection & Efficiency of Electrical Energy

GENERATE	STORE	TRANSMIT	POWER
Utility, Grid & Renewable Energy	Battery Energy Storage Systems	HVDC Transmission MV/LV Distribution	Data Centers · Industry 4.0 Smart Homes · Healthcare Transportation · Aerospace



Aerospace and Defense Systems

Engineering reliability for Aerospace & Defense systems

A **Power Supply**
AC Fuse, Fuseholder, MOV



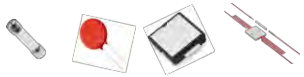
B **Battery Systems**
Fuse, TVS Diode, MOV



C **Power Conversion**
Fuse, AC Bridge, Si/SiC MOSFET



D **DC Distribution**
Fuse, MOV, TVS Diode



Satellites I Commercial Aircrafts | eVTOLs | Military UAVs | Naval Systems



E **Flight Control**
TVS Diode, C&K® switch, Fuse



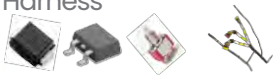
F **Connectivity & Interfaces**
Connectors (D-Sub, Micro-D, SpaceSplice), EWIS



G **Switching & Sensing**
Reed Sensor, Switch



H **Cabin System**
TVS Diode, MOSFET, C&K ® Switch, Connectors, Wire Harness



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Aviation, Defense, and Space – Littelfuse Milestones

Recognized by global space agencies and supplying a wide range of manufacturers

Shaping solutions for the **safe** and **efficient**
transfer of **electrical energy**



Certified by space agencies since 1981



More than 3,000 cumulative years in space



Present in more than 700 satellites, across different applications (Excluding commercial constellations)



Over 10,000 aircraft equipped with harness solutions



Over 15,000 km of harnesses delivered

C&K - Connectors

E.I.S. - Harnesses

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Global support with local resources

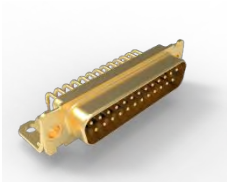


C&K Connect - Main Connector families - Overview

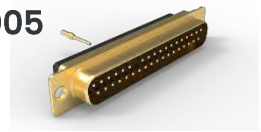
Our D-Sub and Micro-D connectors are ESA approved for spaceflight

D-Sub Connectors Series

D*M Connectors – ESCC 3401 /001
Fixe contacts – All terminations



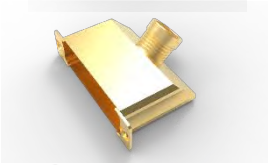
D*MA Connectors – ESCC 3401 /002 /005
Removable crimp contacts



Combo – ESCC 3401 /001 /004 /040
Power and Coax contacts



Backshells – ESCC 3401 /072 /022
Standard and Lightweight designs



Accessories – ESCC 3401 /022
Jackpost, Jackscrew, tools...



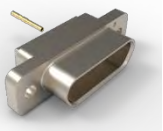
Micro-D Connectors Series

MDM Connectors – ESCC 3401 /029
Fixe contacts – All terminations



MDMA Connectors – ESCC 3401 /077 /078
Removable crimp contacts

Unique Feature: Easily Serviceable



MTB1 Connectors – ESCC 3401 /031
One row connector



Backshell – ESCC 3401 /087
Lightweight designs



Accessories – ESCC 3401 /032
Jackpost, Jackscrew, tools…



Available in two quality level grades: ESA/ESCC or FR022 for commercial space applications

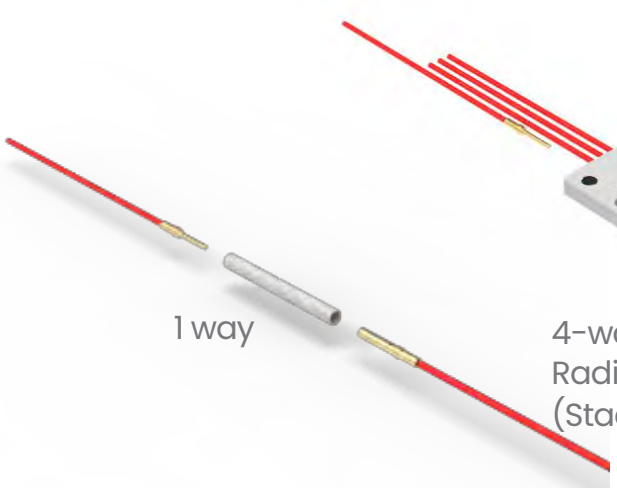
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C&K Connect - Main Connector families - Overview

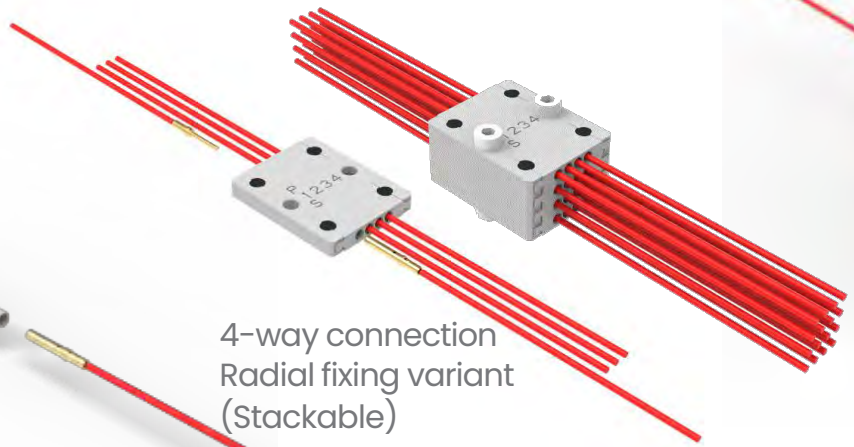
Our SpaceSplice connectors are ESA approved for spaceflight

SpaceSplice platform – ESA/ESCC 3401-097

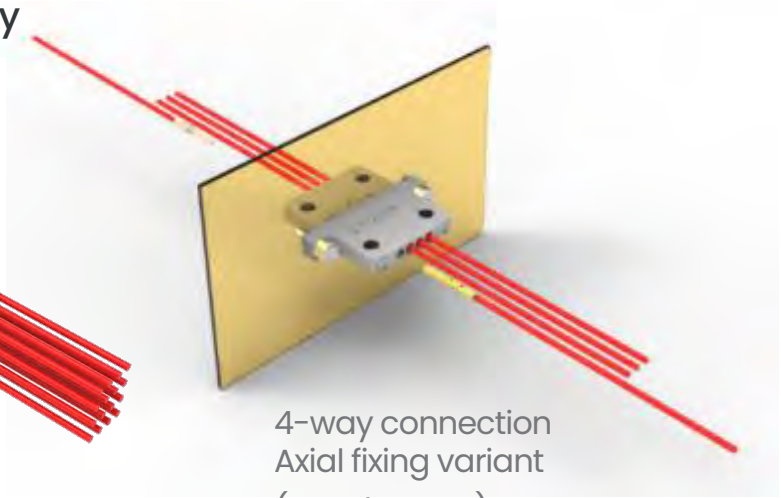
Standardized alternative to hand splicing
Compact one-way or 4-ways wire-to-wire connector
Designed to accept the most used cables gauges (AWG 20 to AWG 30)
Using D*MA crimp and removable contact technology



1 way



4-way connection
Radial fixing variant
(Stackable)



4-way connection
Axial fixing variant
(Panel Mount)

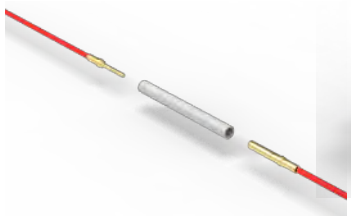
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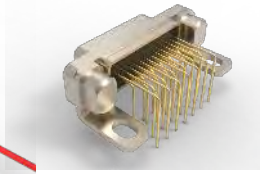
C&K Connect - Connectors ongoing development

Modification and fully new designs include:

Range Extension

- SpaceSplice Family
- Micro-D Family
- Accessories







New technology for easy use and customer integration

- Solderless solution
- Fast Secure Locking system

MIL-83513 Micro-D Connectors qualification in progress

Enhanced Grade

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THANK YOU!

Thanks ESA/ESTEC and CNES for their support

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Expertise Applied | Answers Delivered

Littelfuse.com

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Panasonic Polymer Capacitors for Miniaturization and Better Efficiency for Space

IN Your Future

Shahrokh Kananizadeh

Panasonic INDUSTRY

What reliability means for space electronics

Key reliability considerations for passive components

1 **PARAMETER STABILITY**

Capacitance, LC(uA), ESR, remain controlled across life and environment.

2 **MECHANICAL INTEGRITY**

Terminations and solder joints tolerate launch vibration and repeated thermal movement.

3 **EVIDENCE & TRACEABILITY**

Test data, lot history, controlled changes and a clear failure-analysis path.



Automotive discipline builds reliability

1. **Mature manufacturing**
   High-volume production

2. **Controlled processes (IATF 16949)**
   Repeatability, lot consistency

3. **Harsh-environment design**
   Temperature, vibration, electrical stress.

4. **Long-term customer support**

   Inventory Availability, Documentation & traceability

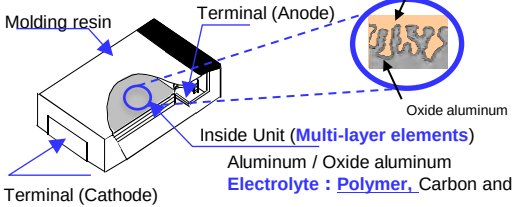


Panasonic Polymer Capacitors & Benefits

Panasonic Polymer Capacitors

SP-Cap — Polymer Aluminum Cap. (Stck element)

(Capacitor features)

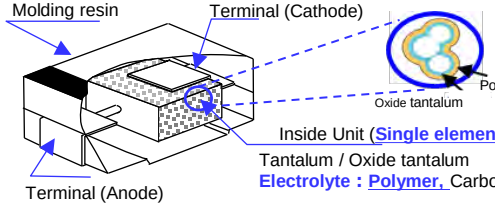




- Ultra-low ESR down to 3 mΩ
- Long Endurance 5500H@135˚ C
- Voltage range 2–6.3 V
- Outgassing test according to NASA & ESA Standards

POSCAP — Polymer Tantalum Cap. (Sintered element)

(Capacitor features)

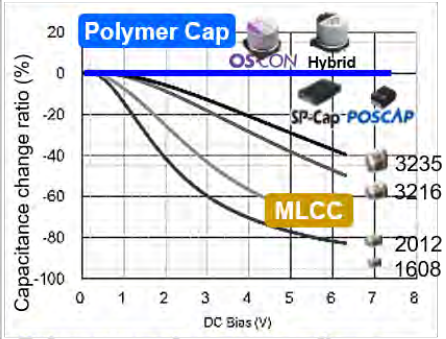




- Low ESR down to 5 mΩ
- High Capacitance in compact sizes
- Voltage range 2–50 V
- Excellent high-frequency performance
- High reliability and heat resistance
- Outgassing test according ESA Standards.

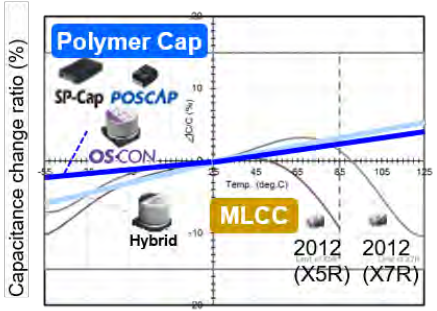
Polymer Capacitor advantages vs MLCC

DC bias Characteristic



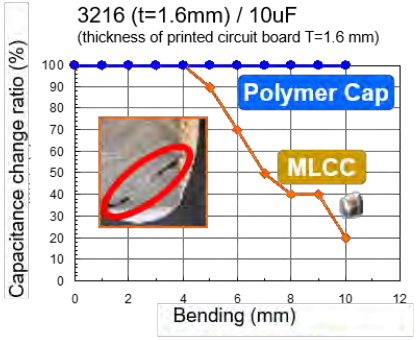
Polymer caps has no capacitance decrease with voltage

Temp. Characteristic



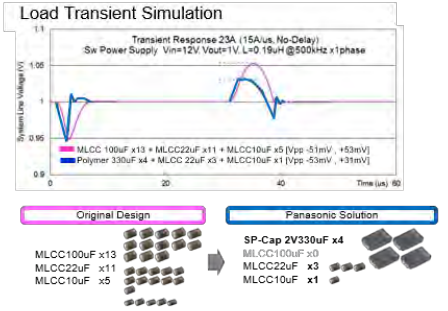
Polymer caps has stable capacitance over a wide temperature range

Bending Test



Polymer caps do not crack

Cap Count Reduction



Polymer caps can reduce cout of MLCCs, which can lead to lower cost (incl. total price, mounting, failure rate)

Benchmark : SP-Cap(High reliability) vs MLCC

SP-Cap's advantage: Effective Capacitance, Quantity, Area & TTL Cost

	SP-Cap	MLCC X6S		
Size: XY mm	**470µF** (2924:7.3x4.3) EEFKX0D471RC	**100µF** 4V (0805:2.0x1.2)	**220µF** 4V (1210:3.2x2.5)	**330µF** 2.5V (1210:3.2x2.5)
Effective Capacitance (µF) after Aging, etc.	470 *Excellent*	47 *-53% down*	117 *-47% down*	204 *-38% down*
Quantity (pcs)	1 	11 	5 	3 
Mounting Area (mm^2)	44	47 Similar	55 Bigger	33 Smaller
Total Cost (index)	1 *Excellent*	2.4x *cost up*	2.2x *cost up*	2.7x *cost up*

Passive Components

Proven on Earth.
Ready for Space.

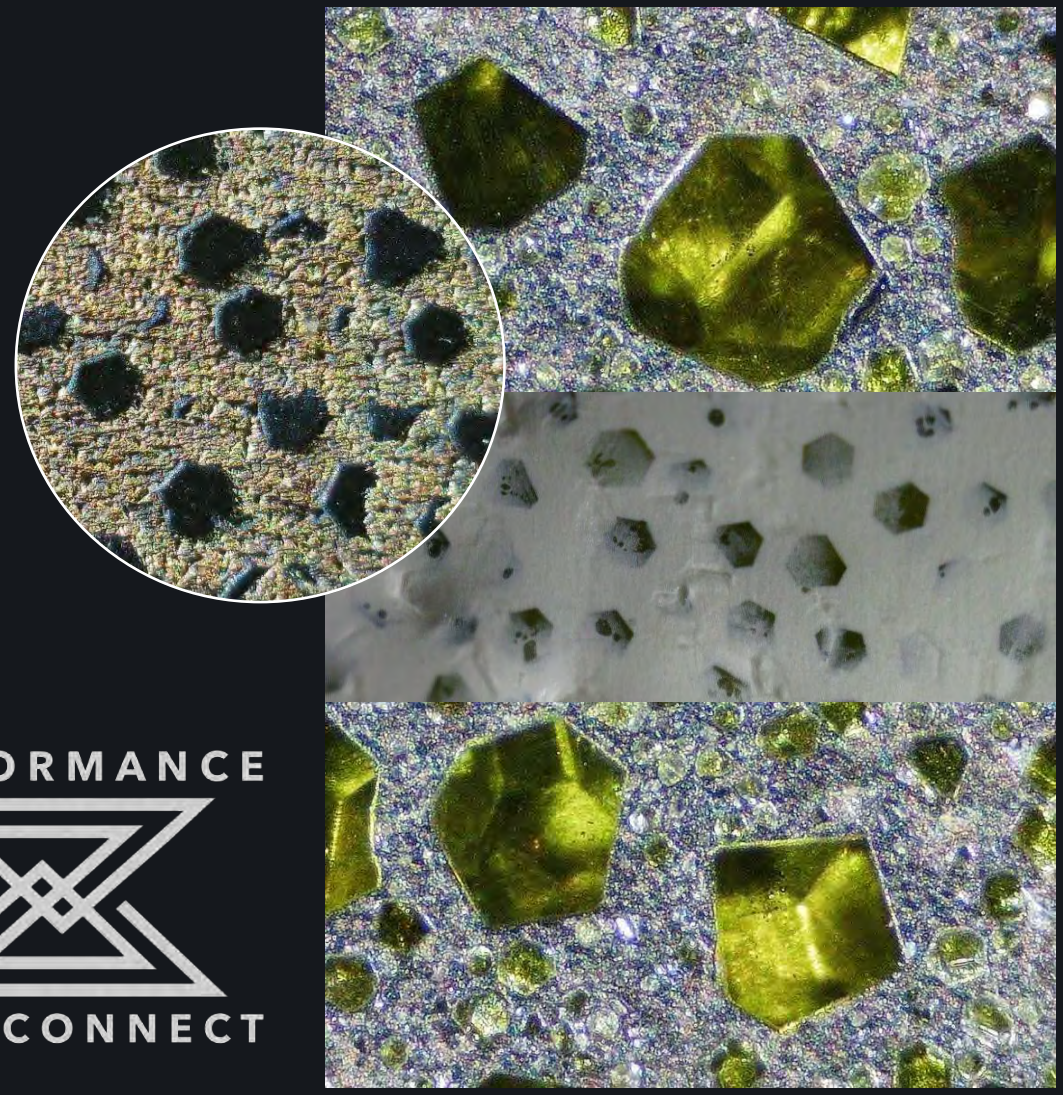


Panasonic INDUSTRY

SPCD 2026 · TECHNICAL INTRODUCTION OF COMPONENTS

Advanced Thermal Interconnect Solutions for ADHA and Other Conduction-Cooled Form Factors

PHENOMENA™ I · PHENOMENA™ II · HYPERVPR™ · HEATBIND™



Gaby Cristian Mindreci
PERFORMANCE INTERCONNECT
ESA/ESTEC, Noordwijk · 13–16 October 2026

PERFORMANCE INTERCONNECT

PHENOMENA · HYPERVPR · HEATBIND

Performance Interconnect: NOT a “me-too company”

develops ADVANCED electrical and thermal interconnects employing PROPRIETARY technologies



Timișoara, Romania: engineering and manufacturing site

2022 PISAS founded in Toulouse, France

2023 Introduction of HYPERBITS™ & S-FECT™ Technology

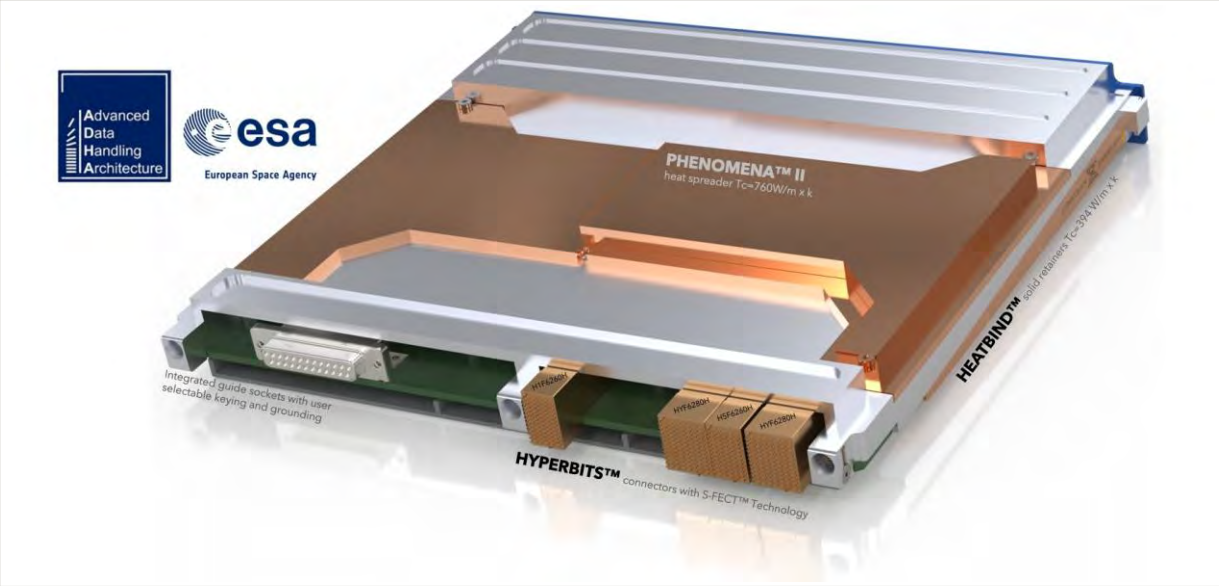
2024 Introduction of HEATBIND™ Solid Retainer System for Conduction Cooling

2025 Introduction of PHENOMENA™ Thermal Composite Materials

2026 Inauguration of **Performance Interconnect Romania**

Electrical: S-FECT™ solderless terminations · HYPERBITS™ HDR connectors · SOFT-PAD™ · ART™ coaxial
Thermal: PHENOMENA™ I paste · PHENOMENA™ II composites · HYPERVPR™ · HEATBIND™ | OpenVPX · SpaceVPX · VNX+ · ADHA

Three products, one solid conduction path from the processor to the chassis



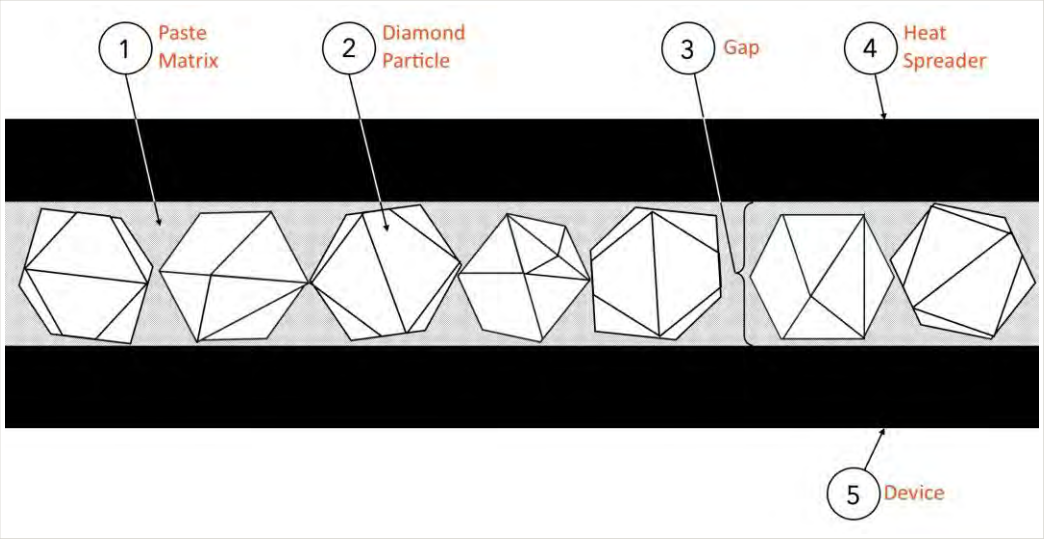
6U ADHA plug-in module built around Performance Interconnect technologies

Processor	heat source
PHENOMENA™ I	diamond TIM · bond line
PHENOMENA™ II	Cu-Di & Al-Di spreaders
HEATBIND™	solid retainer · rail
Chassis	cold wall

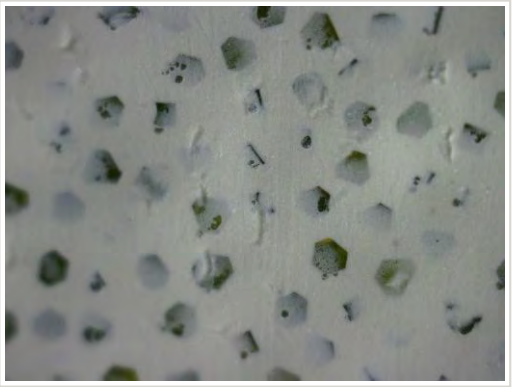
No fluid, no wick, no phase change in the chain:

performance is set by bulk conductivity and contact conductance, so it does not depend on orientation, G-load or microgravity.

One diamond particle spans the gap: a gap-matched monolayer TIM



1 matrix · 2 diamond particle · 3 gap · 4 heat spreader · 5 device



- Mono-crystalline diamond (> 2000 W/m·K), particle ≥ 80% of the gap
- Nano AlN fills between diamonds; polysiloxane binder < 15% by mass
- Part numbers PHEN0050–PHEN0500 by gap class

Gap class	Effective k at 75–85 °C
50 µm	14–20 W/m·K
100–300 µm	15–22 W/m·K
400–500 µm	16–24 W/m·K

−55 to +200 °C

operating range; dropping point 300 °C

6.0×10^{-7} kPa

vacuum compatible

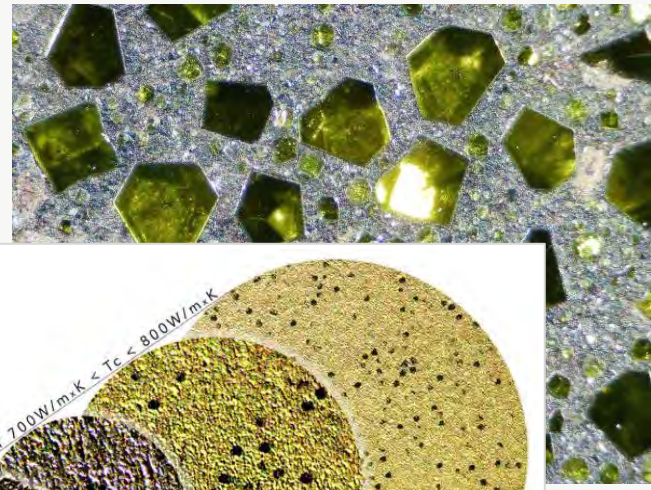
TML 0.13-0.15%

low outgassing (extrapolated); ECSS test pending

10^{12}–10^{14} Ω/cm²

NC grade, electrically insulating

Copper-diamond and aluminium-diamond spreaders: Superior Tc, with CTE close to silicon packages



Property	Copper-diamond (Cu-Di)	Aluminium-diamond (Al-Di)
Thermal conductivity thickness dependent	700 - 760 W/m·K	550 - 700 W/m·K
CTE	5.0–7.2 ppm/K (20–200 °C)	5.0–7.5 ppm/K (25–150 °C)
Density	5.0–6.0 g/cm³	3.1–3.3 g/cm³
Thermal cycling	< 5% Tc loss, 1000 cycles, −55/+175 °C	< 10% Tc loss, 1000 cycles, −65/+150 °C
Flexural strength	300–500 MPa	≥ 350 MPa
Size / tolerance	Per project	0.2 mm to 300 × 300 mm, ±0.05 mm

Sintered mono-crystalline diamond with high-purity Cu or Al powder.



Gravity agnostic

solid material: same behaviour under launch G-loads and in zero gravity

High Tc

superior thermal conduction due to high diamond content

CTE matching

very close to CTE to semiconductor packaging materials

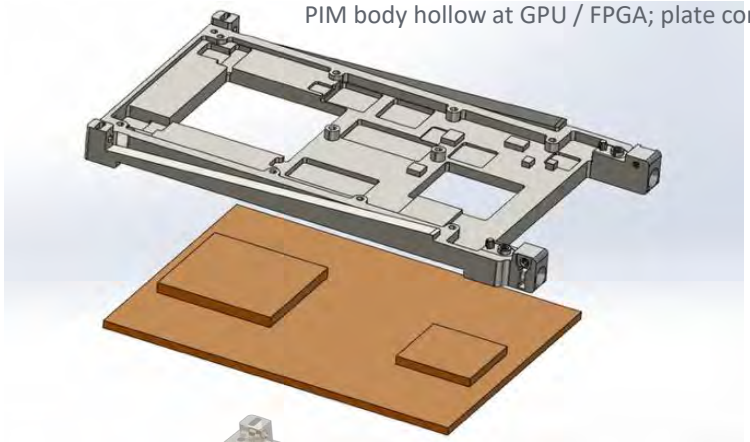
Composite Cu-Di heat plate goes straight from the processor into the slot:

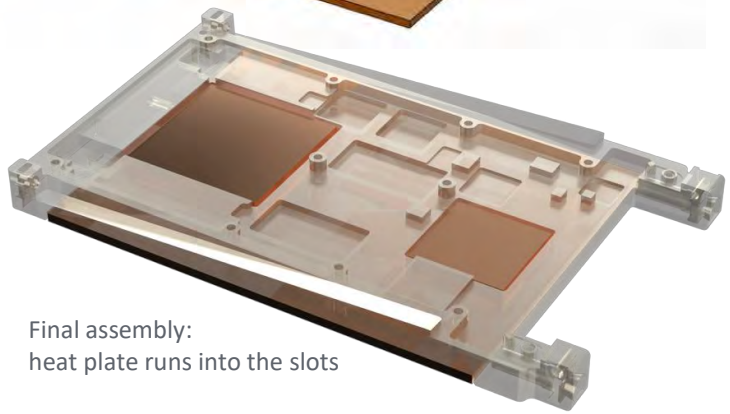
VPX REDI™

APPLICATION EXAMPLE

120 W 3U VPX

PIM body hollow at GPU / FPGA; plate contacts the devices



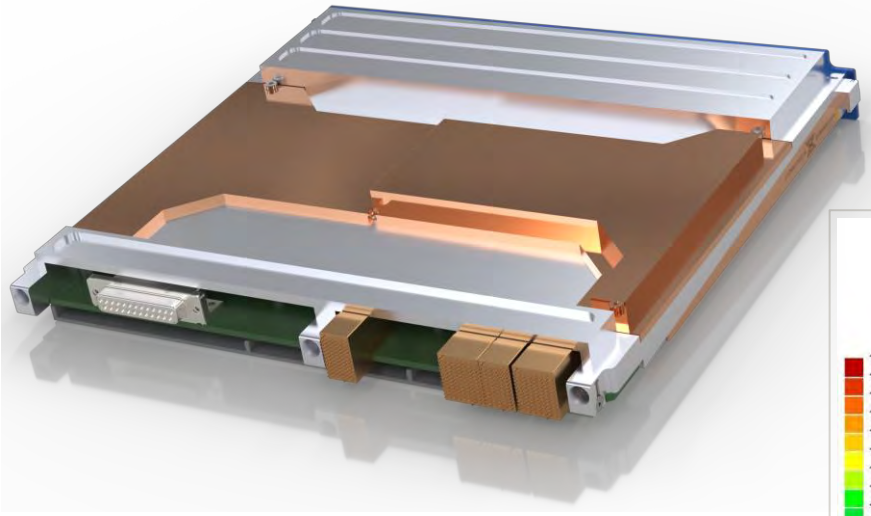


Final assembly:
heat plate runs into the slots

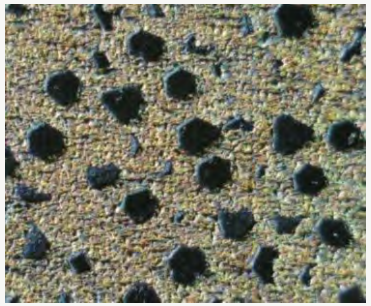
Advanced Data Handling Architecture

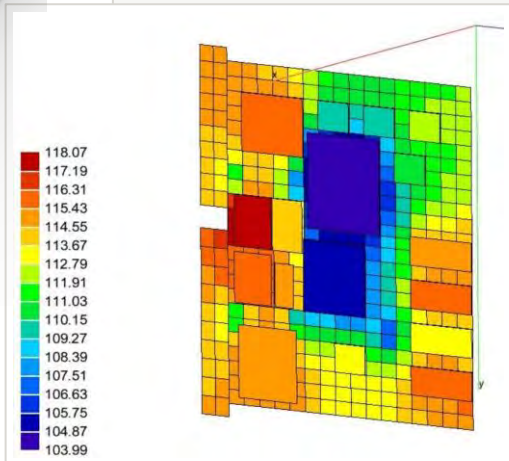
APPLICATION EXAMPLE

110 W total power on 6U ADHA PCB



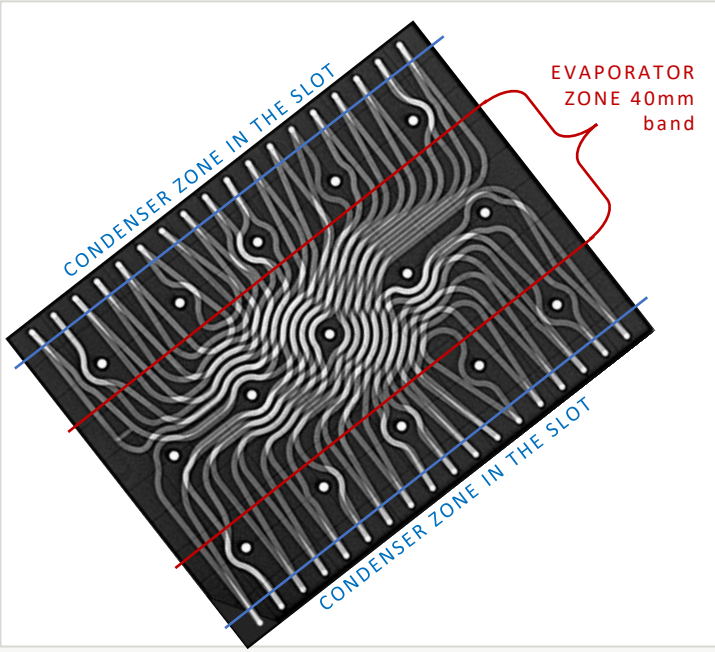
70 W AMD Versal Core,
simulated in vacuum (Madrid Space model, Dec 2025)



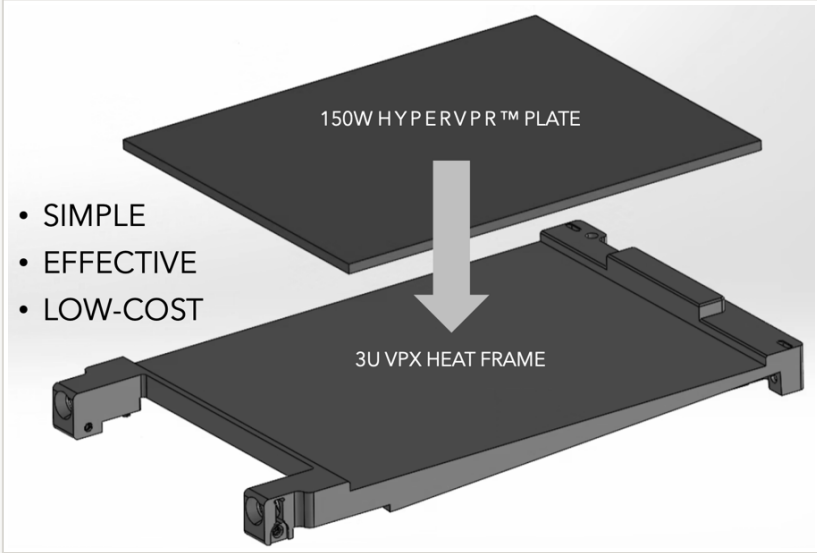


Reduced processor temperature
(simulation)

HYPERVPR™: 150 W pulsating heat-pipe plate that bolts onto an existing 3U VPX heat frame



PHP3U3M150W channel layout



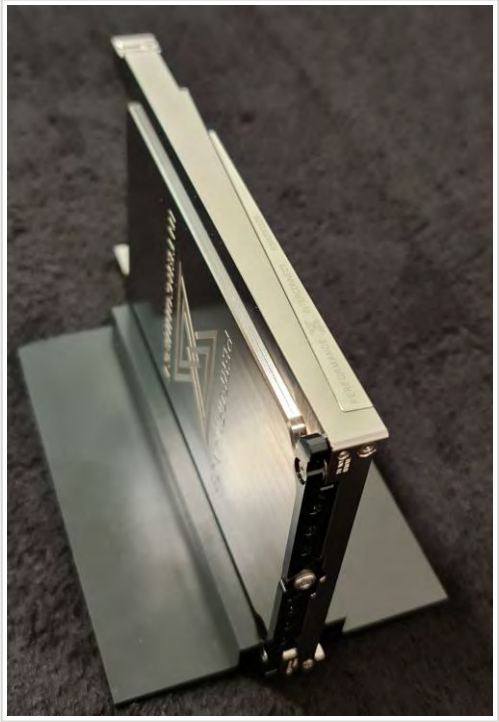
External mounting: no heat pipes embedded in the frame

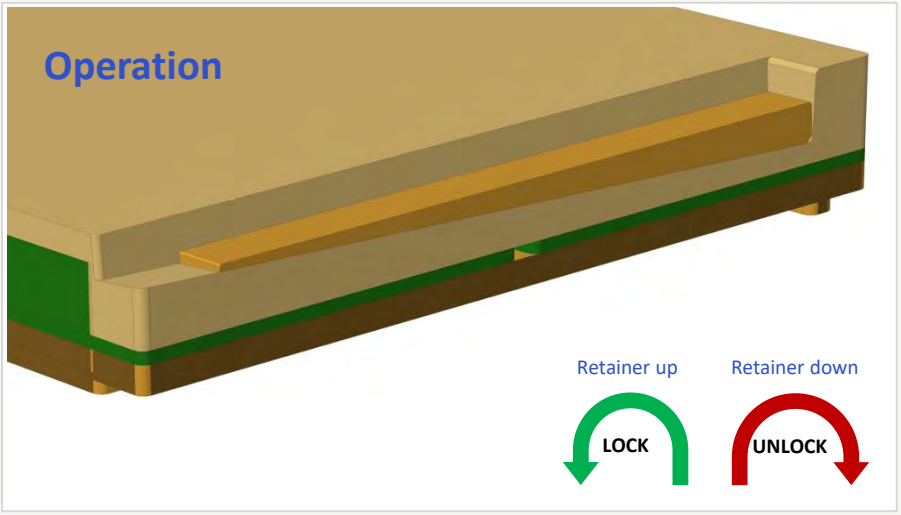
Part number	PHP3U3M150W
Material	Aluminium 3003
Finish	Matte black hard anodising
Rating	150 W, 3U, 3 mm plate
Operating	−50 °C to +150 °C
Mounting	15 screws onto the heat frame



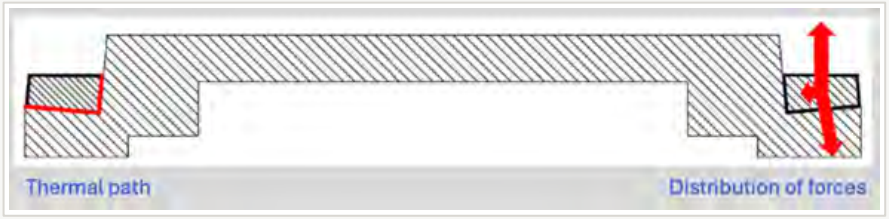
How it works: heat enters along a 40 mm evaporator band over the hot components; the working fluid oscillates through the serpentine channels and releases heat in the condenser zones that sit in the card slots. Simple, effective, low-mass, high performance.

HEATBIND™: one solid copper body adds a second heat path from frame to rail





Push-pull operation with integrated ramps



Thermal path (left) and clamping-force distribution (right)

394 W/m·K

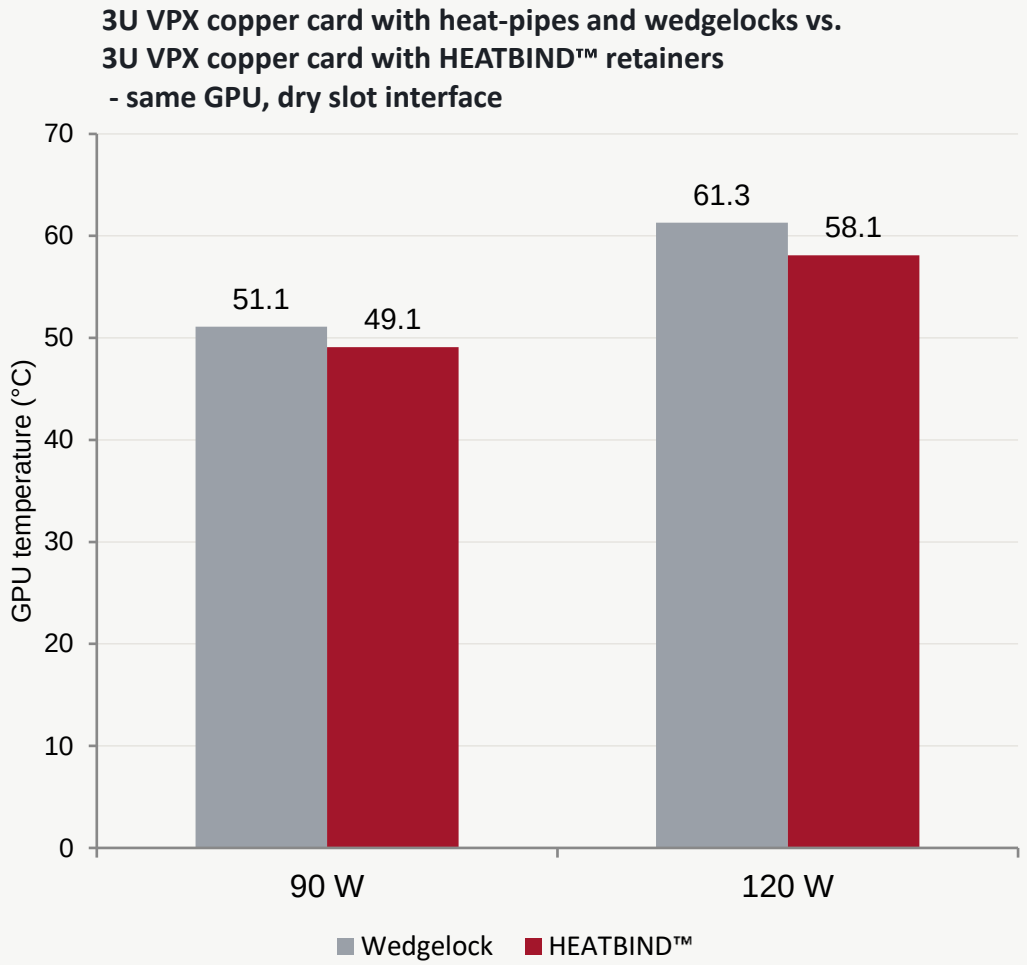
solid copper retainer body

200 kg

clamping force into the slot, ADHA form factor

- Bi-planar contact: $1/R = 1/R_1 + 1/R_2$, total rail resistance falls
- More frame-to-rail contact area than a segmented wedgelock
- Vibration-proof lock with visual indicator, ≤ 1.3 N·m
- Patent WO2025157948 A1

Measured: 3.2 °C cooler processor at 120 W, and 40 g shock passed



−3.2 °C

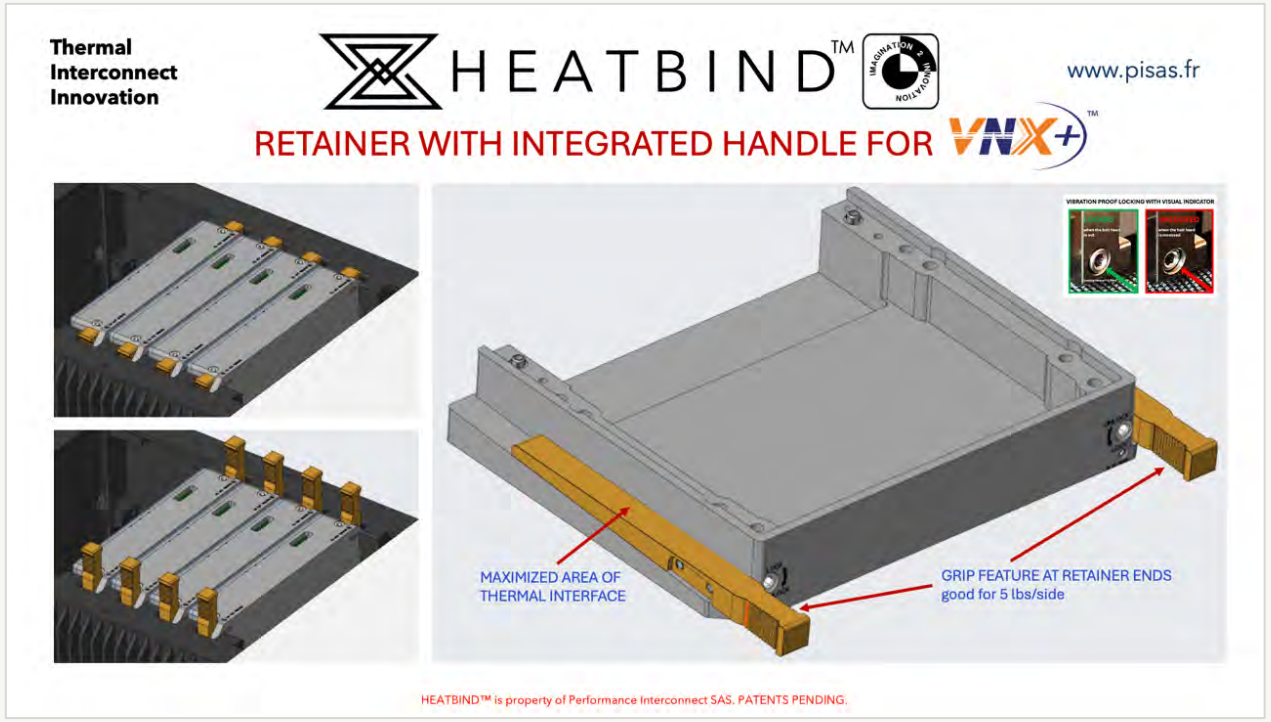
at 120 W (−2.0 °C at 90 W); gain grows with power

25 Grms

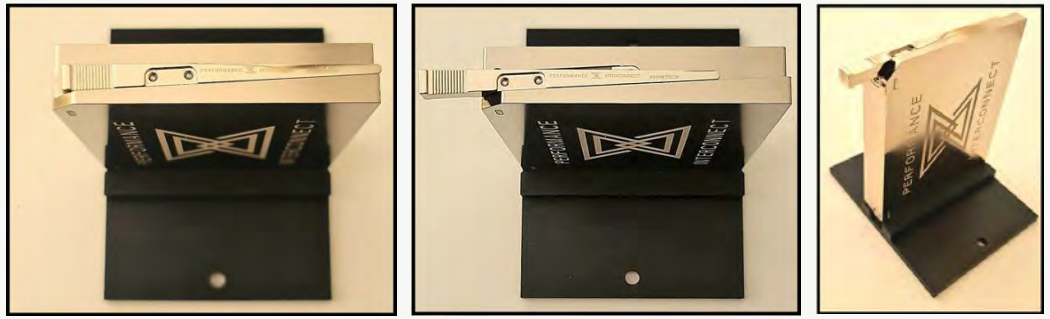
random, 3 axes; sine 10 g, 5–2000 Hz; 40 g, 11 ms shock

- Thermal: VITA 47.1 method, liquid-cooled fixture, Wolf Advanced Technology (07/01/2025)
- Vibration and shock: MIL-STD-810H, Paragon Systems, A2LA accredited (29/11/2024)
- No module movement, preload loss or rail fretting
- Terrestrial 3U VPX results; the ADHA retainer shares the concept

The retainer family extends across VPX, SpaceVPX, VNX+ and ADHA



VNX+ retainer with integrated handle: maximised thermal interface, grip at the retainer ends





Advanced Data Handling Architecture — Solid copper retainers

OpenVPX / SpaceVPX	Solid retainers, heat-frames with integrated ramps, blind-mating accessories
VNX+ / SpaceVNX+	Retainer with integrated handle, heat-frames with integrated ramps, chassis
ADHA 6U	Retainers with 200 kg clamping force, heat-frames with integrated ramps, chassis

Next: ECSS qualification of PHENOMENA™ TIM & more HEATBIND™ form factors

Now

- Cu-Di and Al-Di characterised
- HEATBIND™ thermal, vibration and shock measured
- 6U ADHA module thermal model

Next

- ECSS-Q-ST-70-02C micro-VCM test of PHENOMENA™ I
- Instrumented 6U ADHA module test
- Al 6063 vs Al-Di vs Cu-Di spreader runs

Roadmap

- ECSS qualification of PHENOMENA™ materials
- HEATBIND™ for more form factors and power densities
- Thermal + electrical: S-FECT™ and HYPERBITS™ in the same module

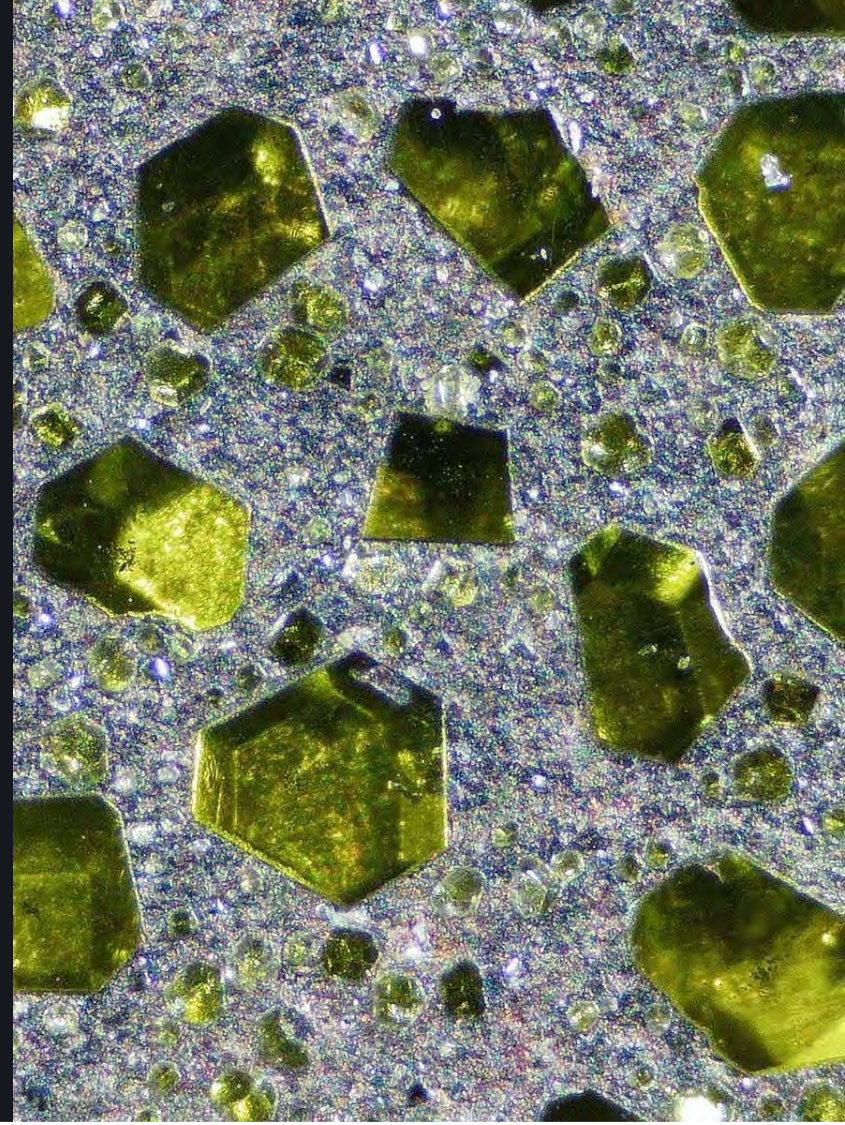
Target: high-reliability space platforms that need efficient heat rejection in conduction-cooled architectures.

PERFORMANCE INTERCONNECT

Thank you!

PHENOMENA™ I	gap-matched diamond monolayer TIM, 14–24 W/m·K, −55 to +200 °C
PHENOMENA™ II	Cu-Di 700–760 and Al-Di 550–700 W/m·K, CTE 5–7.5 ppm/K
HYPERVPR™	150 W bolt-on pulsating heat-pipe plate for 3U VPX
HEATBIND™	394 W/m·K solid retainer, 40 g shock passed

gaby@pisas.fr · +33 6 33 08 50 62 · www.pisas.fr



PHENOMENA HYPERVPR HEATBIND

exens SOLUTIONS

TOGETHER FOR EXCELLENCE



MINIATURISED SELF-BIASED CIRCULATORS AND ISOLATORS FOR GaN APPLICATIONS

SPCD 2026

October 14th , 2026

Presenter: Hassane SANKARA (hassane.sankara@exens-solutions.com)
R&D RF & AI Engineer, Exens group

Background

Project funded by ESA

MINIATURISED SELF-BIASED CIRCULATORS AND ISOLATORS

Contrat n° 4000150671/25/NL/VR/mmo

ESA Program Managers

Léo FARHAT

Joacquim JIMENEZ

Hussain ALLAEDDINE

Objectives

Objective 1

Remove bulky external magnets with self-biased ferrite

Objective 2

Boost compactness and integration up to Ka-band and beyond

Objective 3

Complete EM design, fabrication and characterization

Objective 4

Validate the technology at TRL 4

Programm

- **KOM** — Feb 2026
- **PDR** — Jun 2026
- **TRR** — Mar 2027
- **CDR** — Oct 2027
- **Final Review** — Feb 2028

Technical Specification

Parameters		Units	Min (baseline)	Max (baseline)	Comments
Operating Frequency Range		GHz	17.3	20.2	Target extension up to 21.2 GHz
Insertion Loss		dB		0.7	Target: 0.7 dB
Return Loss		dB	19		
Isolation		dB	19		
Power Handling	Average (Forward)	W	5		
	Average (Reverse)				
Temperature Range	Operating	°C	-30 to +80		
	Non-Operating		-40 to +90		
Mass		g			
Envelope		mm3		5 x 5 x 1.5	
Package Interface					TBD

Circulators and Isolators

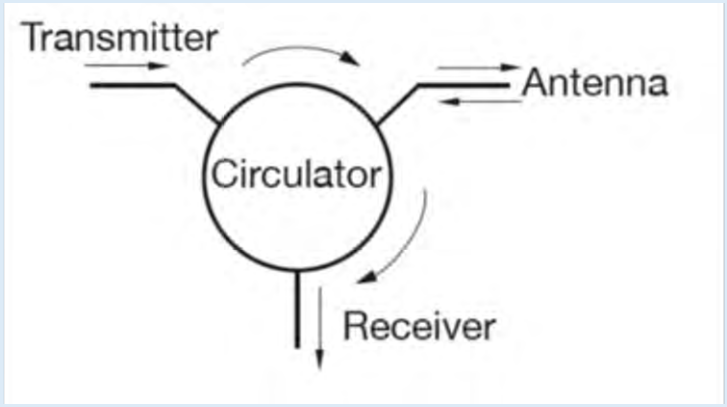


fig. 1 : Circulator for TX/RX system

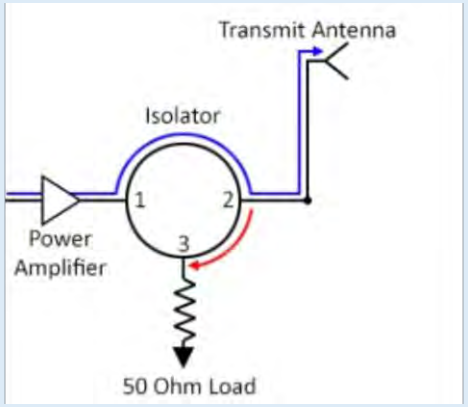


fig. 2 : Isolator for PA protection

Why Circulators and Isolators Are Essential in Space RF Systems ?

SSPA/LNA protection

against reflected power and load mismatch

Isolation and signal routing

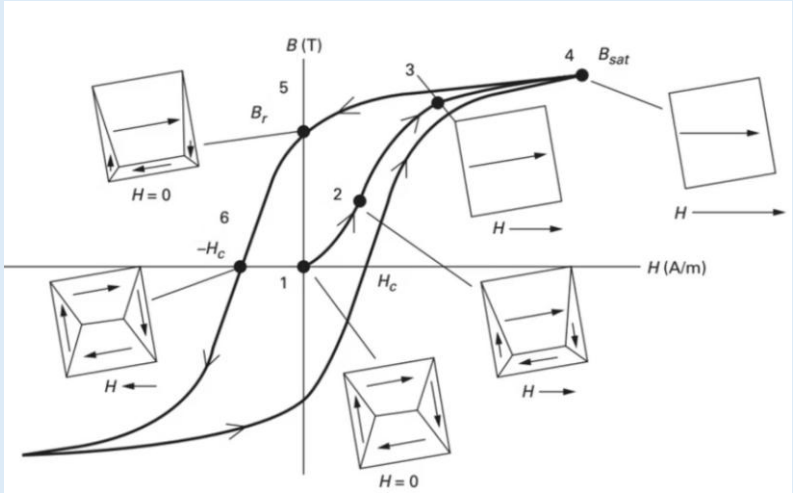
in AESA antennas and beam-forming networks

Enhanced reliability

for GEO, MEO and LEO communication payloads

What is ferrite biasing ?

Hysteresis loop



Weiss domains align with H. Magnetisation rises from point 1 to saturation B_sat (point 4), then falls back to remanence B_r at H = 0. The coercive field H_c reverses it.

Biasing applies a magnetic field to the ferrite, making its circulation non-reciprocal.

Why biasing works

- Ferrite responds to an applied magnetic field.
- This field sets the non-reciprocal circulation.
- Weiss domains on the hysteresis loop show the biasing.

Standard ferrite vs self-biased ferrite

Ferrite standard

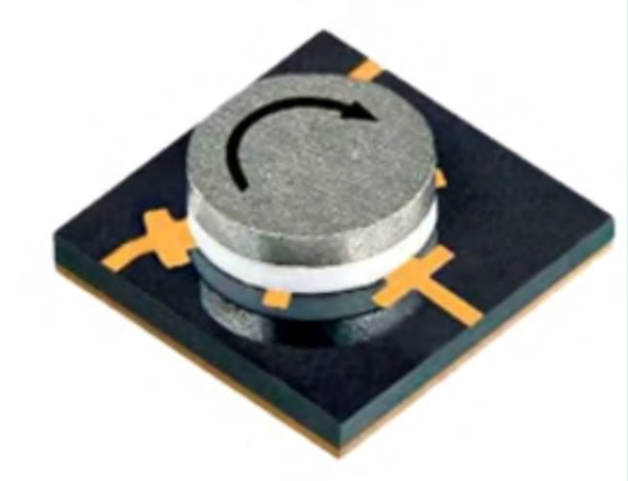


Fig. 1 : Microstrip circulator with standard ferrite

Self-biased ferrite

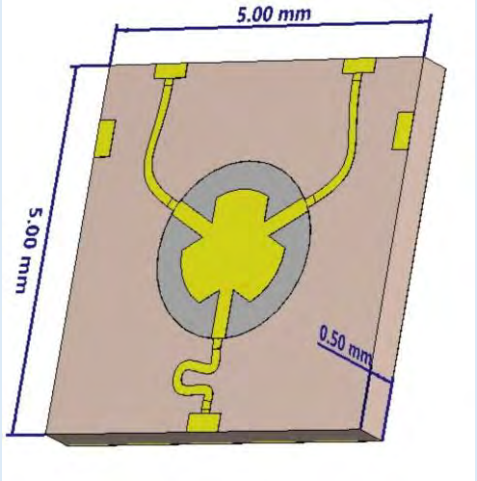


Fig. 2 : Microstrip circulator with self-biased ferrite

Main difference: no magnet, saving space and mass

How to bias the ferrite without a magnet?

By precisely controlling substitution in the crystal with Sr^{2+} or Ba^{2+} ions

Standard ferrite vs self-biased ferrite

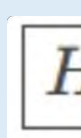
Standard ferrite

$$H_i = H_k + H_{ext} - N_z 4\pi M_r$$

Hk < 100Oe for the YIG ferrite

Self-biased ferrite

$$H_i = H_k + H_{ext} - N_z 4\pi M_r$$



$$H_i = H_k - N_z 4\pi M_r$$

Hk > 10,000 Oe for the self-biased ferrite

- H_i: Effective internal magnetic field experienced by the spins
- H_k: Anisotropy field
- H_{ext}: External magnetic field applied by a permanent magnet
- N_z: Demagnetization factor along the z-axis
- M_r: Remanent magnetization
- $N_z 4\pi M_r$: Demagnetizing field opposing the magnetization

High Hk gives a strong internal bias field but shifts ferrimagnetic resonance.
Trade-off: high Hk → high Delta H (polycrystalline) → insertion losses

Standard ferrite vs self-biased ferrite

Standard ferrite

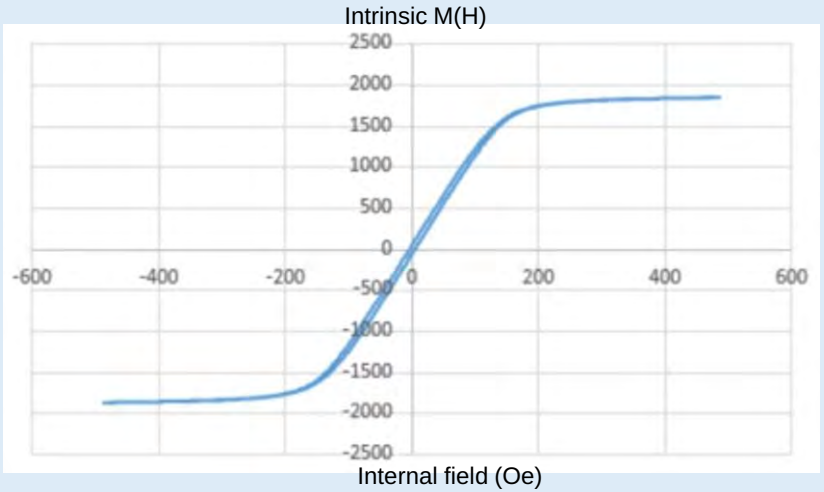


fig.1 : Standard ferrite YK21 hysteresis loop

Key values of the hysteresis loop :

- Ms = 1860 Gauss
- Mr = 51.3 Gauss
- Hc = 4.02 Oe

Self-biased ferrite

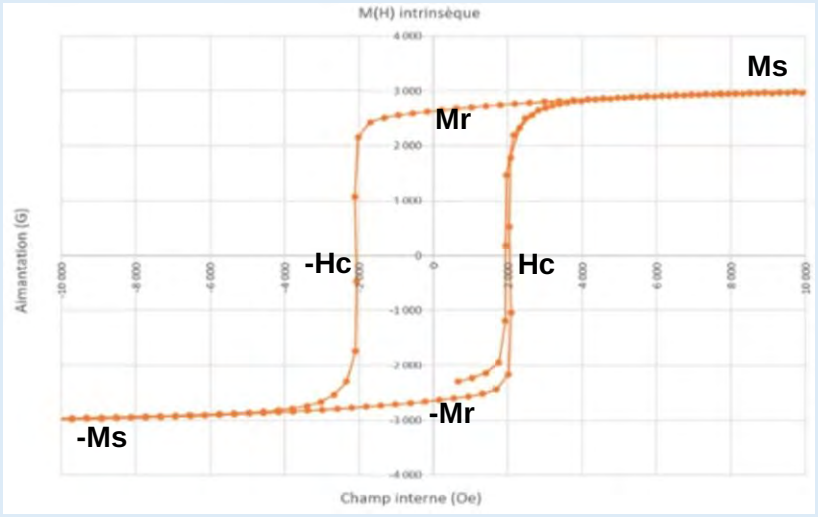


fig.2 : Self-biased ferrite hysteresis loop

Key values of the hysteresis loop :

- Ms = 3000 Gauss
- Mr = 2600 Gauss
- Hc = 2000 Oe

Self-biased ferrites require :

- High Mr → strong internal bias field (no magnet)
- High Hc → magnetic stability

Why microstrip?

Current constraints

- **AESA** (Active Electronically Scanned Array) systems require a very high level of integration
- Conventional circulator technologies often occupy considerable space

Remaining substrate area

can integrate additional RF functions, such as:

- Power Amplifiers (PA)
- Filters
- Couplers
- Other front-end RF building blocks

Benefits

Higher integration density

More compact T/R modules for AESA applications.

Fewer RF interconnects

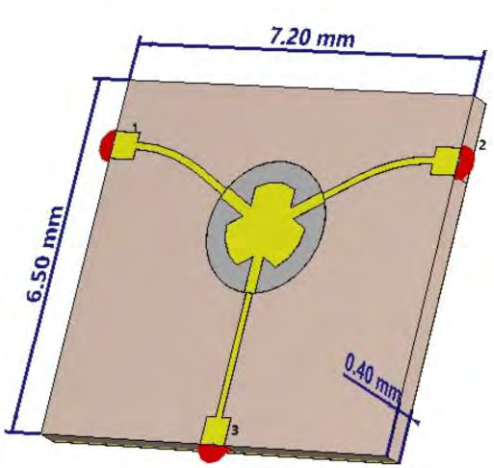
Fewer solder joints and adhesive interfaces.

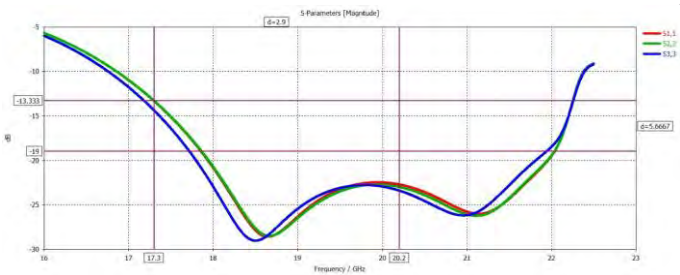
System-level cost

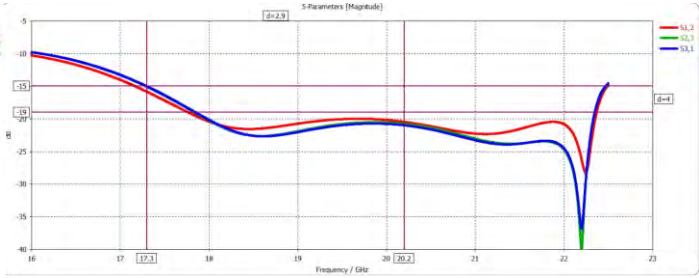
Potential cost reduction at system level.

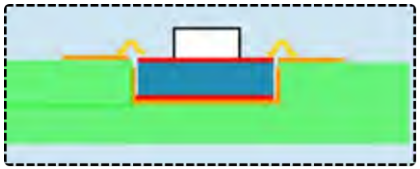
EM Simulations

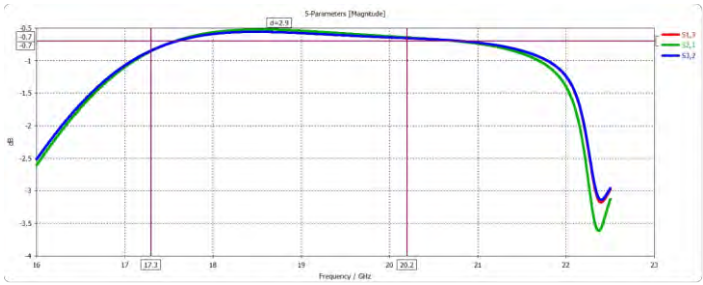
First simulation: Mr=221 kA/m, Hk=10 kOe, Hi=7800 Oe











Hexaferrite

Alumina substrate

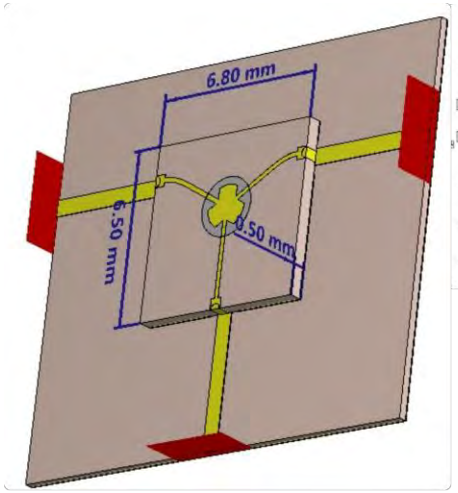
Promising preliminary results: wire bonding version

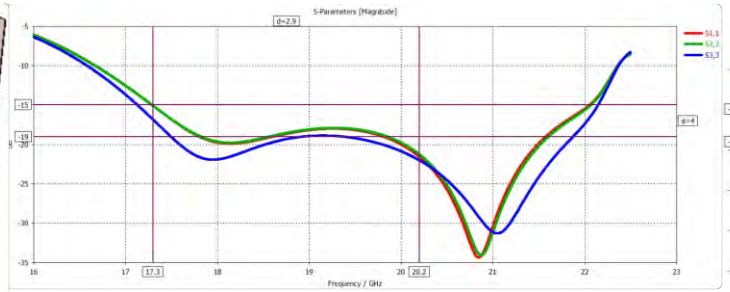
→ Results should improve at the start of the band

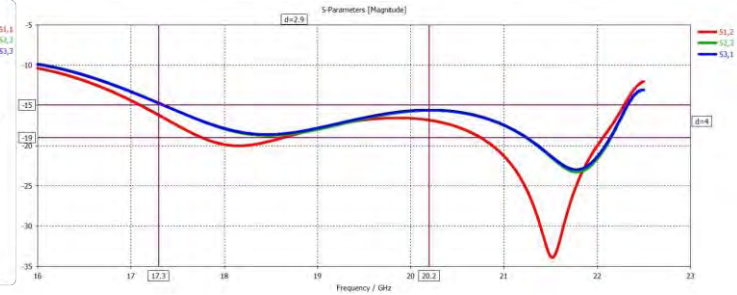
→ Dimensions must be optimised

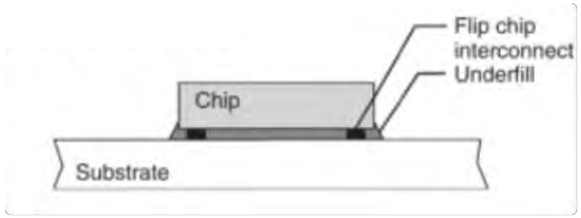
EM Simulations

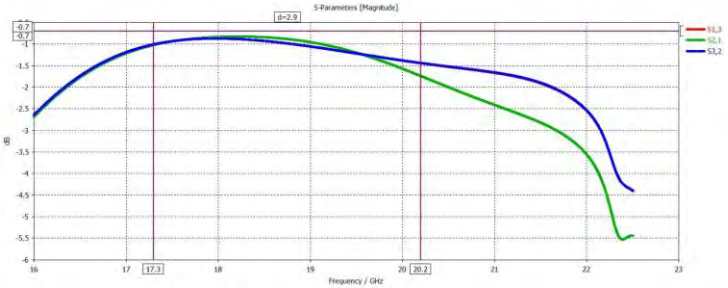
First simulation: Mr=221 kA/m, Hk=10 kOe, Hi=7800 Oe











Hexaferrite

Alumina substrate

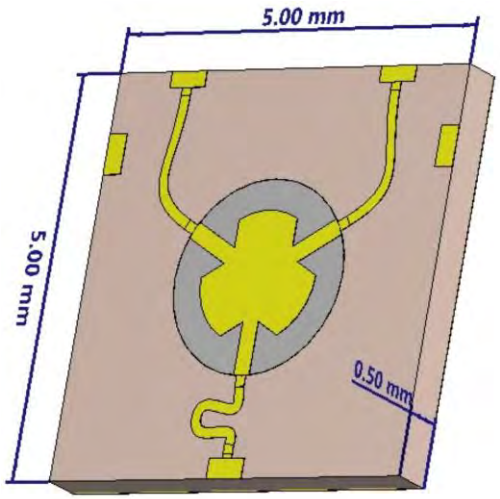
Promising preliminary results for the SMD version

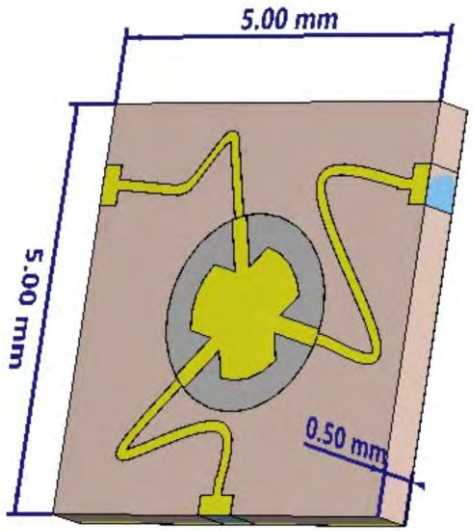
→ Insertion loss includes the test jig

→ Results should improve at the start

→ Dimensions must be optimised

→ Ideas to reduce dimensions for the 5x5 mm specification





Hexaferrite

Alumina substrate

Conclusion



See you at the next SPCD, when the real prototypes of self-biased circulators/isolators will be ready to space qualification.

Exens work AI in RF domain

SPCD is an opportunity to network and exchange ideas. Interested in AI for RF? Let's talk.

From RF documents to engineering intelligence

Turning technical documentation into actionable design knowledge

Can AI become an RF designer?

From automated synthesis to simulation, layout and verification

AI-driven RF design: from assistance to autonomy

Moving from optimization help to autonomous circuit and EM design

Can AI find better RF architectures ?

Generative and inverse design for RF systems



CM-HVLP

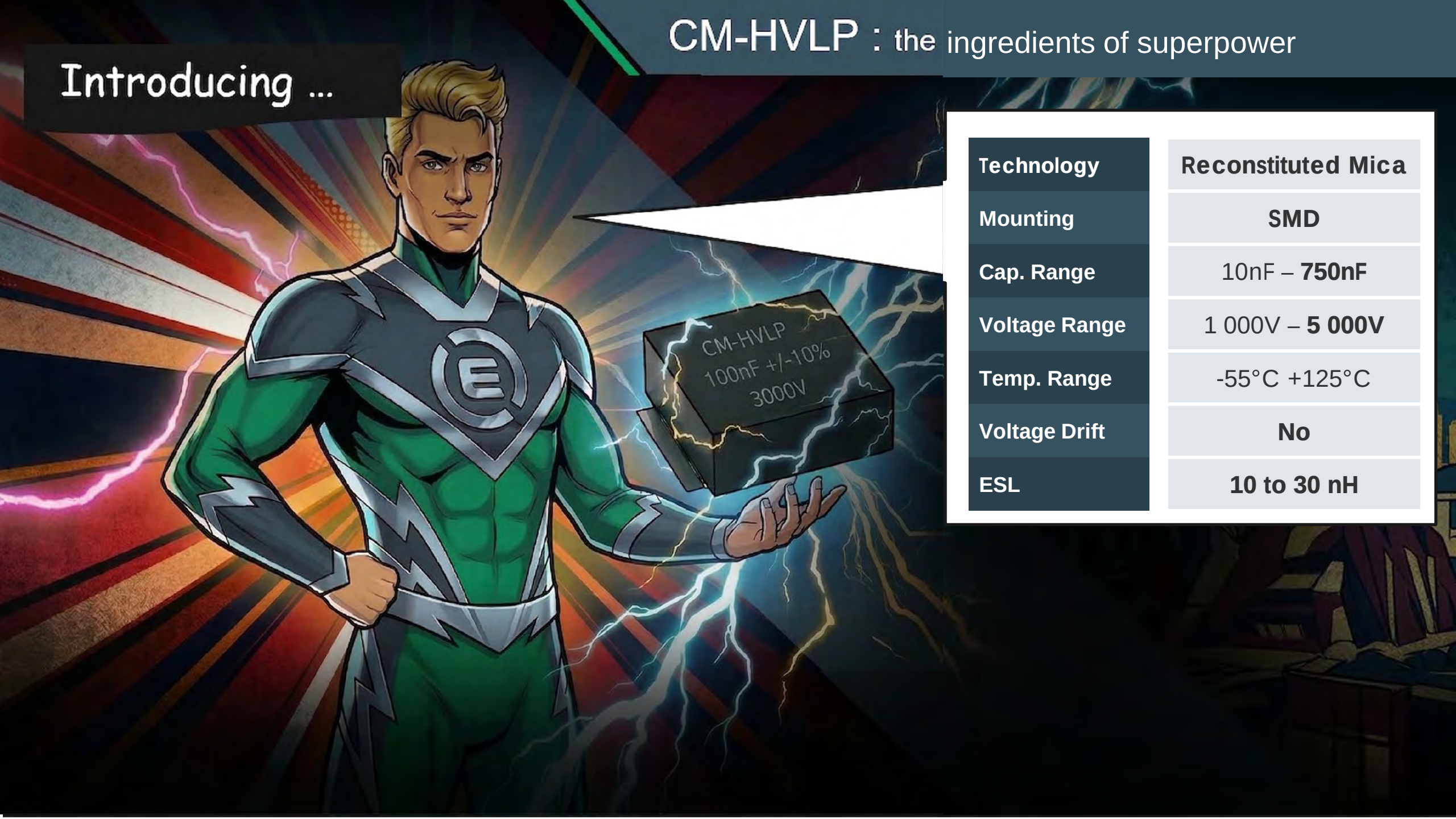
Compact **SMD** package for **high voltage pulse** and **filtering** applications

14/10/2026

www.exxelia.com

CM-HVLP : the ingredients of superpower

Introducing ...

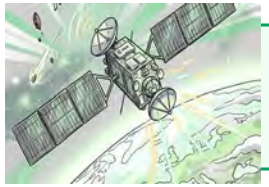


Technology	**Reconstituted Mica**
Mounting	**SMD**
Cap. Range	10nF – **750nF**
Voltage Range	1 000V – **5 000V**
Temp. Range	-55°C +125°C
Voltage Drift	**No**
ESL	**10 to 30 nH**

CM-HVLP - 2 components in one – Pulse or Filtering



Where Mica Wins: High Voltage Pulse & Filtering



No capacitance drift under DC bias: **rated capacitance is maintained in operation**

Stable over temperature: **(ΔC) −5% at −55 °C / +5% at +125 °C**



Pulse Applications

- Up to **5 kV** discharge voltage
- Low ESL: **10-30 nH** > fast discharge
- Low dielectric losses (tan δ ≤ 0.005)
- High peak current capability: Up to **4,000 A**

- Thruster/PPU
- TWT / traveler wave tube systems
- Missile ignition
- Engine Exciter
- Power switching
- Medical pulse equipment



High Voltage Filtering

- Voltage rating: up to **4 kV**
- Long lifetime: up to **300,000 hours** at 0.6 × Un, 110 °C

- HV power supplies
- Energy infrastructure
- Aerospace & industrial MCU
- EV / charging systems



One solution for both pulse stress and high-voltage filtering

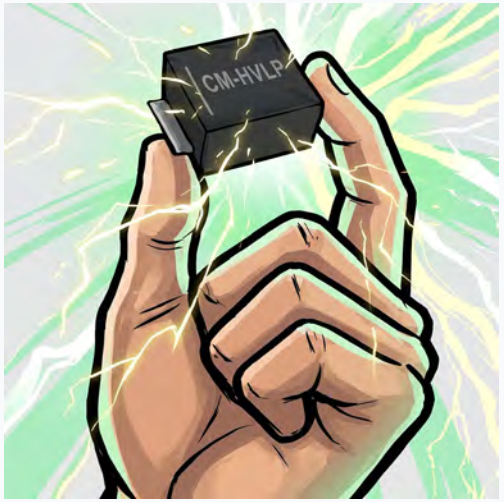
EXXELIA

4 things to remember

01

Easy Integration

SMD design with a small footprint and low profile for effortless assembly.



02

2 Functions in One

High Pulse or High voltage filtering integrated into a single component.



03

Robust & Stable

High reliability under stress with no cracks and no capacitance drift.



04

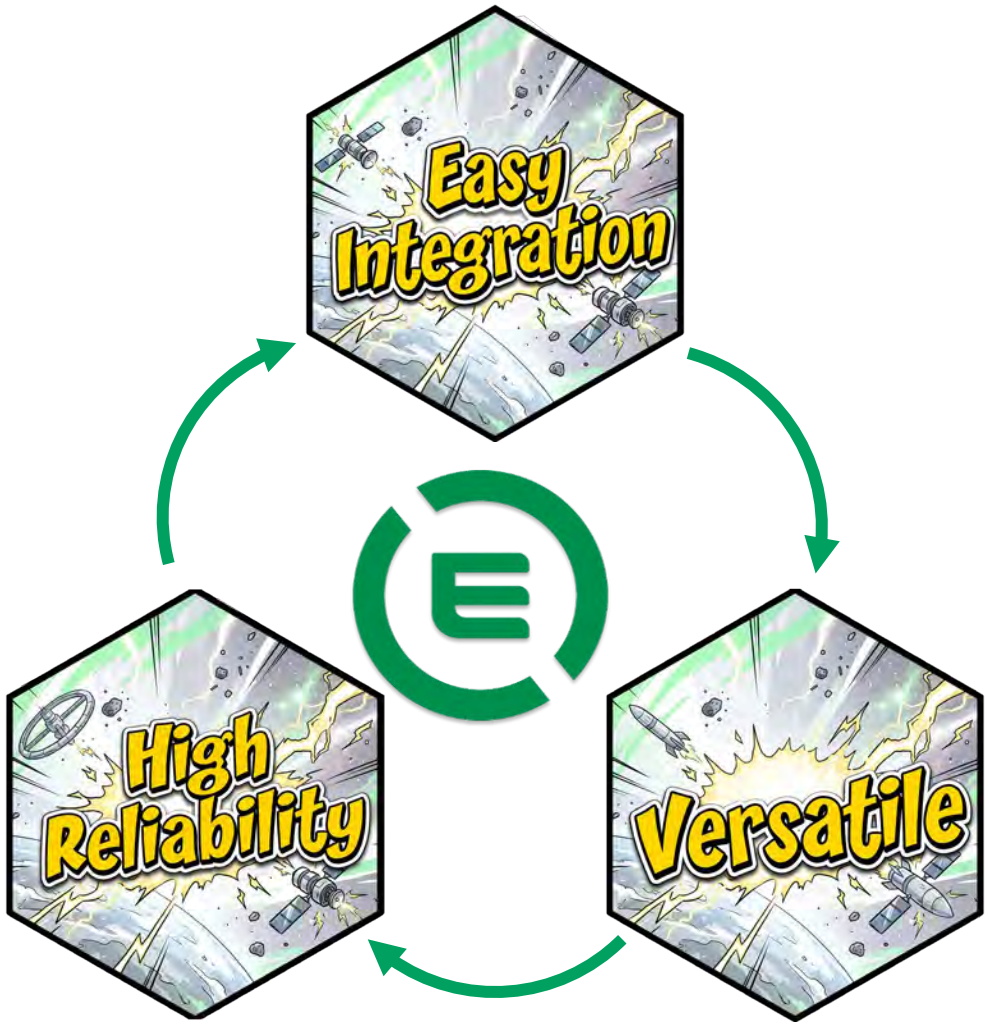
European or US Production

Dual sourcing capability ensuring supply chain security and compliance.



EXXELIA

What you need to know about the CM-HVLP superpower



Easy integration

Small footprint, SMD, low profile

Versatile

Pulse or filtering, easier for multiple applications without any export licence restrictions

High-reliability

Strong heritage on space and defense projects. Robust material and strong qualifications



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

SRT-Microcéramique — Manufacturer Presentation

SPCD 2026

Laurent Wallet

SRT-Microcéramique

14 Octobre 2026

History & Milestones









1982 — Creation of Microcéramique in Paris area

1998 — Buyout by former Vendôme's Vitramon directors with participation of German resistor manufacturer SRT



2001 — Relocation to Vendôme

2010 — Buyout by a Thales operation director to develop Mil/Space market

2019 — Buyout by Paul-Emile Faure, dipl Engineer from Ecole Centrale Paris, along with key engineers



2021 — Selected by French government as a key company in the "Plan de Relance" program

2022 — beneficiary of the recovery plan, investment component of €1,300k



2023 — Mylar process full line installation

2026-27 — Factory extension

ESCC Part 2 listing in progres

Each ownership transition kept the Vendôme team, know-how and equipment base

SRT-Microcéramique

Heritage & European Manufacturing

- ✓ Former MLCC site in Vendôme (Vishay-Vitramon, 250 employees, later transferred to Israel)
- ✓ Founded by former Vitramon directors
- ✓ One of only two MLCC manufacturers in Europe
- ✓ 100% French production

Unique Positioning

- ✓ Independent firm with experienced team
- ✓ PME dry process technology
- ✓ Up-to date equipment (New mylar line since 2022)
- ✓ Direct engineer contact & high reactivity
- ✓ Short lead times vs. industry giants
- ✓ Wide production range and services

High-Reliability Expertise

- ✓ Defense, Aerospace, Medical, Space
- ✓ Complete in-house qualification lab:
  - Burn-in chambers
  - Thermal shock equipment
  - Humidity testing, Life testing
  - X-Ray fluorescence analysis
  - …
- ✓ Extensive retinning & qualification experience









Market Challenges in Space Components

The Sourcing Challenge

- ✓ Tens of component per BOM among millions of references
- ✓ Small part of the cost large part of the quality sourcing issue
- ✓ Space qualification requirement add to complexity

Current Market Constraints

- ✓ Limited supplier base
- ✓ Long lead times (20-52 weeks)
- ✓ High costs
- ✓ Massive gap between fully qualified and COTS/AEC-Q200

Industry Need

→ Flexible solutions

→ Faster delivery

→ Competitive pricing

Services

Termination change

Au, Ag, Ag/Pd, SnPb

Cu/Sn, SAC, HMP

Medical & space

Ag polymer termination

Test & screening

Burn-in, thermal shock

High-rel screening

Customer-specific plans

Full LAT programs

Added-value processing

High-precision sorting 0.05%

High CV cap up-screening

Taping / T&R

Stack assembly

Modern, up-to-date equipment — everything under one roof

Wide range of additional services covering space, medical and defense needs

Quality standards aligned with AEC-Q200, ESCC 3009 and MIL-PRF-55681

SRT Product Range

Two Complementary Technologies

PME Technology

100% Made in Vendôme, France

- ✓ Sizes: 0402 to 80150
- ✓ Voltage: 25V to 15kV
- ✓ NPO, X7R, N2T ceramics
- ✓ SMD, filters, radials, stacking

Lead time: 6-10 weeks (excluding LAT)

BME Technology

Sourced & Requalified

- ✓ Low Voltage, high capacitance
- ✓ Small sizes, down to 0201
- ✓ AEC-Q200 preferred
- ✓ Full traceability

Lead time: 2-4 weeks (excluding LAT)

Both Available: in accordance with MIL-PRF-55681 | ESCC 3009 | COTS+ | Custom

Product Range - Detailed Specifications

PME Technology

100% European Manufacturing - Vendôme, France

Technical Range:

- ✓ Sizes: from 0402 to 80150
- ✓ Type: SMD chips, EMI filters, Stacks, Radials
- ✓ Voltage: 25V to 15,000V
- ✓ Dielectrics: NPO (ultra-stable), X7R (high cap), N2T/P2200 (power/pulse)

Standard Production Quality:

- ✓ DPA per lot, 100% visual inspection
- ✓ Termination thickness & solderability testing per lot
- ✓ Wide termination portfolio: NiSn, CuSn, AgPd, SnPb, SAC305, Gold, Polymer

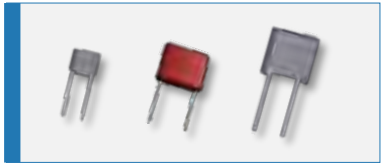
High-Reliability Options:

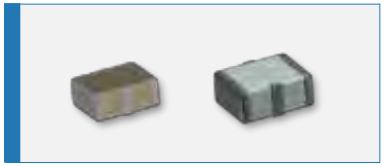
- ✓ Screening per MIL-PRF-55681, ESCC 3009
- ✓ Custom qualification programs
- ✓ Full LAT programs available

Manufacturing Advantage: PME dry process, new mylar line (2022), full supply chain control, no obsolescence risk















Product Range - Detailed Specifications

BME Technology

Base Metal Electrodes – Sourced and requalified

Sourcing Strategy:

- ✓ Manufacturer-agnostic with extensive supplier database
- ✓ AEC-Q200 qualified sources preferred
- ✓ Full component traceability from source to delivery
- ✓ Source freezing protocol once qualified

In-House Requalification:

- ✓ DPA per lot, complete electrical characterization
- ✓ Validation against manufacturer specs
- ✓ Additional screening tests as required

Application Focus - Why BME?

- ✓ Low voltage (≤100V) + High capacitance (≥1µF)
- ✓ Ultra-small packages (0201, 0402) for miniaturized systems
- ✓ High-density designs for modern satellite electronics
- ✓ Cost-sensitive missions (NewSpace, constellations)

Value-Add Services:

- ✓ Component selection support & cross-referencing
- ✓ Termination changes for whisker mitigation
- ✓ Assembly into stacking configurations
- ✓ Up-screening from automotive to space-grade

High-Reliability Versions:

- ✓ ESCC 3009 framework screening
- ✓ ECSS-Q-ST-60-13C Rev2 COTS+: Class 1, 2, 3
- ✓ Design phase with chosen commercial part
- ✓ Full Class 1 flying parts with LAT documentation
- ✓ Tinned 0201

High Reliability Screening Level Overview

Comprehensive screening programs in accordance with ESCC 3009, MIL-PRF-55681, and COTS+ framework

PRODUCTION CONTROL

Comparaison of the Screening/Testing of the standard and High Reliability SRT-Microcéramique components

	TEST/STRESS	STANDARD SMD	STACKS SRMC RADIALS	HIGH TEMPERATURE	IAW ESA-ESCC3009	COTS1	COTS2	COTS3	IAW MIL-PRF-55681 GROUP A	IAW MIL-PRF-123 GROUP A
	SCOPE	PME MLCC X7R, BX, NPO, N2T, High Q	Encapsulated, Dipped radial and Stacks SRMC	Type 1, Type 2 Chips	SRT PME BME, Radials, Stacks, X7R, BX, N2T, NPO, High Q	Class 1 BME Chips	Class 2 BME Chips	Class 3 BME Chips	SRT PME BME X7R, NPO, BX, N2T, High Q	SRT PME BME X7R, BX, NPO, N2T, High Q
PROCESS / SCREENING	Burn-In		100% Chips 24H +Stack 48H Tmax 2Un PDA 6.5%	100% 168H Tmax 2Un PDA 6.5%	100% 96H Tmax 2Un PDA 5%	100% 96H Tmax 2Un PDA 5%	100% 96H Tmax 2Un PDA 5% for non AEC-Q200	100% 96H Tmax 2Un PDA 5% for non AEC-Q200	100% 100H Min Tmax 2Un PDA 8%	100% 168H Min 0.1%/1pc last 48H 125°C 2Un PDA 5%
	Capa, DF, IR, VP (25°C)	100%	100%	100%	100%	100%	100%	100%	100%	100%
	IR (125°C)								Sample	Sample
	Voltage Breakdown	10 pcs/lot	10 pcs/lot	10 pcs/lot	10 pcs/lot	10 pcs/lot	10 pcs/lot	10 pcs/lot	10 pcs/lot	10 pcs/lot
	Dimension	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot
	DPA	per lot	per lot	per lot	per lot	per lot	per lot	per lot	per lot	per lot
	Visual	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Resistance to soldering heat	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot	5 pcs/lot

Flexible Space Component Offering

1

Complete BOM

PME & BME components

Class 1 flying parts with LAT

Short lead time

Cost competitive

ALTER Doeet listed

2

Qualification program

Capacitors, resistors

Customer-selected

Standard programs

Tailored programs

3

Retinning Services

Passive & active

Dipping or plating

Termination change

Best solution basis

Direct contact with engineers building and qualifying capacitors

High reactivity / Short lead times

Key Takeaways

✓ European Excellence

One of only two MLCC manufacturers in Europe with 40+ years heritage

✓ Tin Whisker Expert

Proven retinning process eliminating satellite failure risks

✓ Flexible Qualification

ESCC 3009, MIL-PRF-55681, COTS+ - choose your level

✓ Speed Advantage

6-10 weeks delivery vs 20-52 weeks industry standard

✓ Complete Testing

100% in-house capabilities for faster turnaround

✓ EPPL Part 2 Engagement

Ongoing discussions with CNES & ESA

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Quality • Flexibility • Speed • Innovation

Thank You

European excellence in ceramic capacitors for space applications

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flying capacitor	402	3446	1,49
boost converter design	398	3248	4,83
dual active bridge converter	395	6647	2,41
boost converter	329	62751	9,23
resistor symbol	328	138151	1,61
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dab converter	267	7821	3,59
ripple current	259	11624	4,49
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ohm's law	201	546085	3,98
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buck converter design calculation	176	709	2,27
flyback converter design	170	4727	6,57
llc converter	166	14019	5,66
low esr capacitor	160	10585	3,87
mlcc	144	155078	5,38
common mode choke	141	41723	2,98
boost converter circuit	136	18389	8,29
dab topology	135	639	1,2
capacitor charging and discharging	126	3788	2,35
flyback transformer	125	49183	5,33
boost converter calculator	112	2525	6,75
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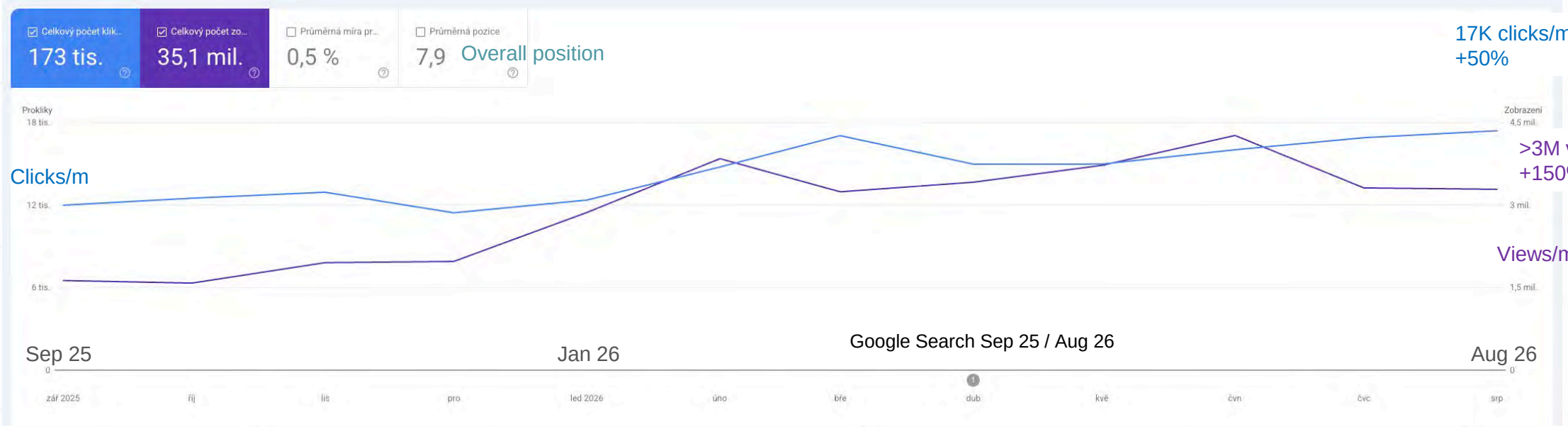
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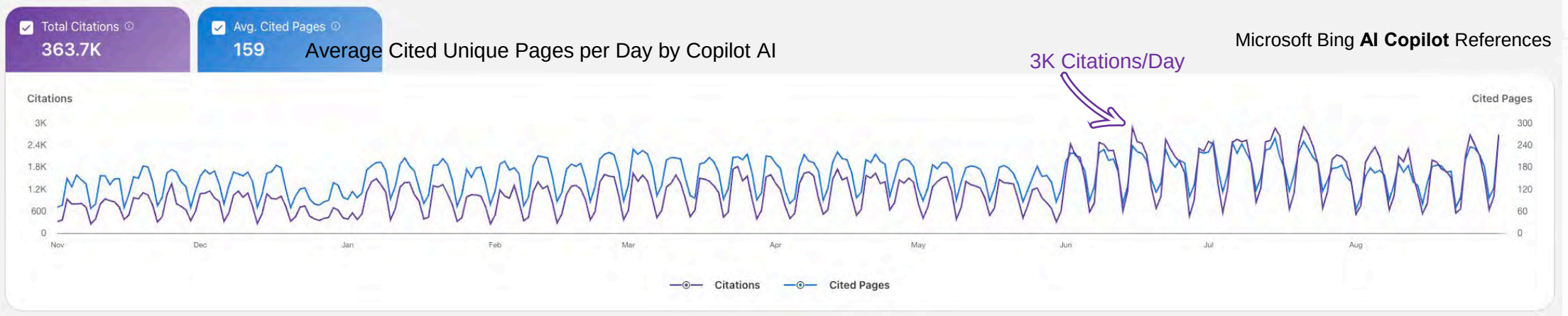
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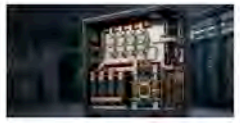
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Murata has introduced the DLW32SH_MF series of surface-mount common mode choke coils for noise suppression on automotive CAN and CAN FD signal lines.

The Murata new series combines a 1210-inch footprint with a metal-terminal structure, AEC-Q200 compliance, and operation up to 150°C, addressing network interfaces located in high-temperature vehicle zones.

Key features and benefits

- **Automotive CAN FD focus:** Murata positions the DLW32SH_MF series for common-mode noise suppression on CAN and CAN FD networks, where higher communication speed can increase sensitivity to conducted and radiated noise.
- **High-temperature capability:** The published operating-temperature range is -55°C to +150°C, allowing evaluation in ECUs and network nodes exposed to elevated under-hood or locally self-heated conditions.
- **Compact footprint:** The components use a 1210-inch package size, specified as 3.2 mm × 2.5 mm.
- **Metal-terminal structure:** Murata states that the new terminal construction is intended to provide high reliability and durability. The announcement does not provide comparative test data against earlier products, so the relevant qualification documentation and current datasheet should be reviewed for final assessment.
- **AEC-Q200 compliance:** This is a passive-component stress-test qualification standard. It supports component-level qualification, but it does not replace vehicle-, module-, or system-level validation.

Related Posts

Murata Expands Automotive Metal Power Inductor Range

Murata Launches 100V 10 µF Lead-Type MLCCs for 48V Systems

Single Pair Ethernet for Humanoid Robot In-Robot Networks

Technical highlights

Part number	Common-mode inductance	Rated current at +25°C	Rated current at +105°C	Rated current at +150°C	Maximum DC resistance
DLW32SH510MF2	51 µH (+50%/-30%) at 0.1 MHz	125 mA	90 mA	50 mA	1.5 Ω
DLW32SH101MF2	100 µH (+50%/-30%) at 0.1 MHz	115 mA	90 mA	50 mA	2.3 Ω

Both listed parts are specified for an operating-temperature range of -55°C to +150°C and are stated by Murata to comply with AEC-Q200.

The rated-current values are explicitly temperature dependent. For design engineers, this means the 150°C current rating—not the 125°C figure—must be used when the final local ambient temperature, copper temperature, and component self-heating can approach the maximum operating condition.

Common-mode inductance is specified at 0.1 MHz with a broad +50%/-30% tolerance. It is therefore not sufficient on its own to predict attenuation across the CAN FD spectrum. The current datasheet should be checked for impedance-versus-frequency characteristics, differential-mode behaviour, and applicable measurement conditions.

Application fit

The DLW32SH_MF series is relevant where a CAN or CAN FD connection needs common-mode noise suppression and the thermal environment may exceed the capability of lower-temperature components. The stated 150°C capability can be important in modules installed near hot vehicle zones, but the actual part temperature must still be derived from the assembled board and enclosure conditions.

The compact 3.2 mm × 2.5 mm footprint can support dense ECU layouts. However, package area alone does not establish mechanical robustness: PCB bending, terminal-pad geometry, solder-joint quality, mounting orientation, and local board stiffness should be evaluated for the finished assembly.

Design-in notes for engineers

- **Validate signal integrity:** Check the final CAN/CAN FD transceiver, cable, common-mode choke, termination network, connectors, and PCB routing together. Verify eye performance, timing margin, common-mode voltage range, and communication robustness across supply, temperature, and network-load conditions.
- **Review frequency data:** Select the inductance value using the official impedance and attenuation characteristics at frequencies relevant to the noise problem. A 0.1 MHz inductance rating does not directly define high-frequency EMC performance.
- **Apply temperature derating:** Use the published current limit applicable to the expected component temperature. At 150°C, both announced part numbers are rated at 50 mA.
- **Check DC resistance:** The maximum DC resistance contributes to series voltage drop and resistive dissipation. Confirm its effect on the CAN transceiver's differential and common-mode operating conditions.
- **Verify common- and differential-mode behaviour:** A choke intended to suppress common-mode energy can also introduce parasitic effects that influence differential data transmission. Validate with the actual cable harness, termination arrangement and transceiver.
- **Control PCB layout:** Keep the choke close to the connector or defined interface boundary where appropriate; maintain pair symmetry; minimise stubs, and avoid routing the filtered interface near aggressive switching-current loops.
- **Confirm qualification scope:** AEC-Q200 compliance is relevant for component screening, but final release still requires the applicable automotive customer requirements, ECU validation plan, EMC tests, thermal tests, and reliability assessments.
- **Use current documentation:** Murata's current datasheet, product documentation, land-pattern recommendation, packaging details, and reliability information control final schematic, layout, purchasing, and production release.

For practical background on EMC filters and the role of common mode chokes, see EMC Design Fundamentals: Safe Use of Varistors and Common Mode Chokes in Mains and Data-Line Filters.

Further reading

- Common Mode Chokes Selection for 4th Ensuring a Non-Degraded Communication System
- EMC Design Fundamentals: Safe Use of Varistors and Common Mode Chokes in Mains and Data-Line Filters
- Murata Releases 1210 Metal Terminal Common Mode Choke for 1Mbps TTS In-Vehicle Ethernet
- Murata Expands High-Cutoff Frequency Chip Common Mode Chokes

Source

This article is based on Murata's manufacturer press release announcing the DLW32SH_MF series. Engineers should consult the current Murata datasheet and applicable product documentation before final component qualification, schematic release, PCB release, or production approval.

References

1. Murata press release: DLW32SH_MF common mode choke coils for automotive CAN FD
2. Murata product finder: DLW32SH_MF series

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Murata Launches Common Mode Choke Coils with Metal Terminal Structure for Automotive CAN FD Supporting Maximum Operating Temperature of 150°C

9/10/2026

Murata announces the launch and mass production of the common mode choke coil 'DLW32SH_MF' series compliant with the strictest DCMR Class 3 requirements of the automotive network CAN FD standard, supporting a maximum operating temperature of 150°C. Despite their compact 1210-inch (3.2mm × 2.5mm) size, the products adopt a metal terminal structure to achieve high reliability and durability. Mass production has already begun.

In recent years, advancements in autonomous driving systems and advanced driver assistance systems (ADAS) are driving the shift from conventional CAN (up to 1Mbps) to CAN FD, which enables higher-speed and higher-capacity communication. However, as speeds increase, systems become more susceptible to noise, making high-performance noise suppression components essential.

To address these needs, Murata has developed the DLW32SH_MF series, which is well suited for noise suppression on signal lines in automotive networks, including CAN and CAN FD.

The 'DLW32SH510MF2' offers a common mode inductance of 51µH (+50%/-30%) at 0.1MHz, rated currents of 125mA at 125°C, 90mA at 140°C, and 50mA at 150°C, with a maximum DC resistance of 1.5Ω.
The 'DLW32SH101MF2' offers 100µH (+50%/-30%) at 0.1MHz, rated currents of 115mA at 125°C, 90mA at 140°C, and 50mA at 150°C, with a maximum DC resistance of 2.3Ω. Both products have an operating temperature range of -55°C to 150°C and comply with the AEC-Q200 standard.

Leveraging Murata's proprietary winding and ferrite assembly technologies, combined with the newly adopted metal terminal structure, these products deliver superior reliability and durability compared to our previous products.

For additional product details, please visit the product page.
For inquiries regarding this products, please contact us.

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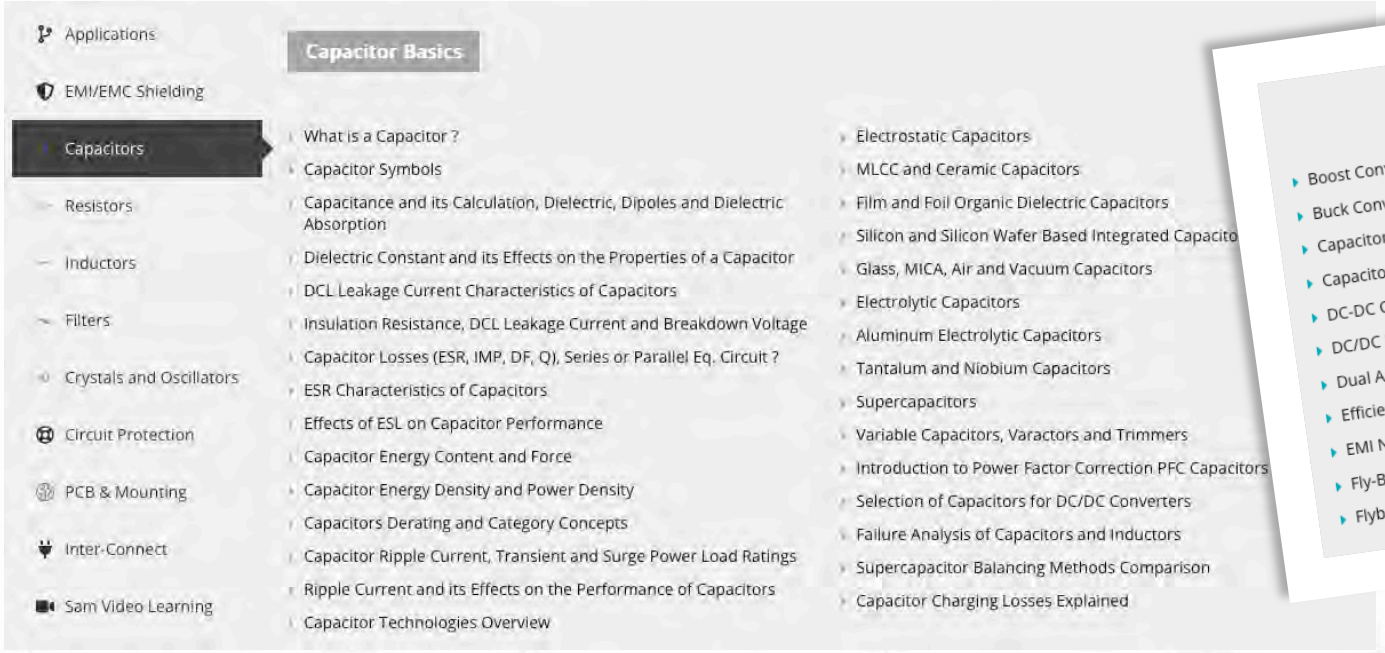
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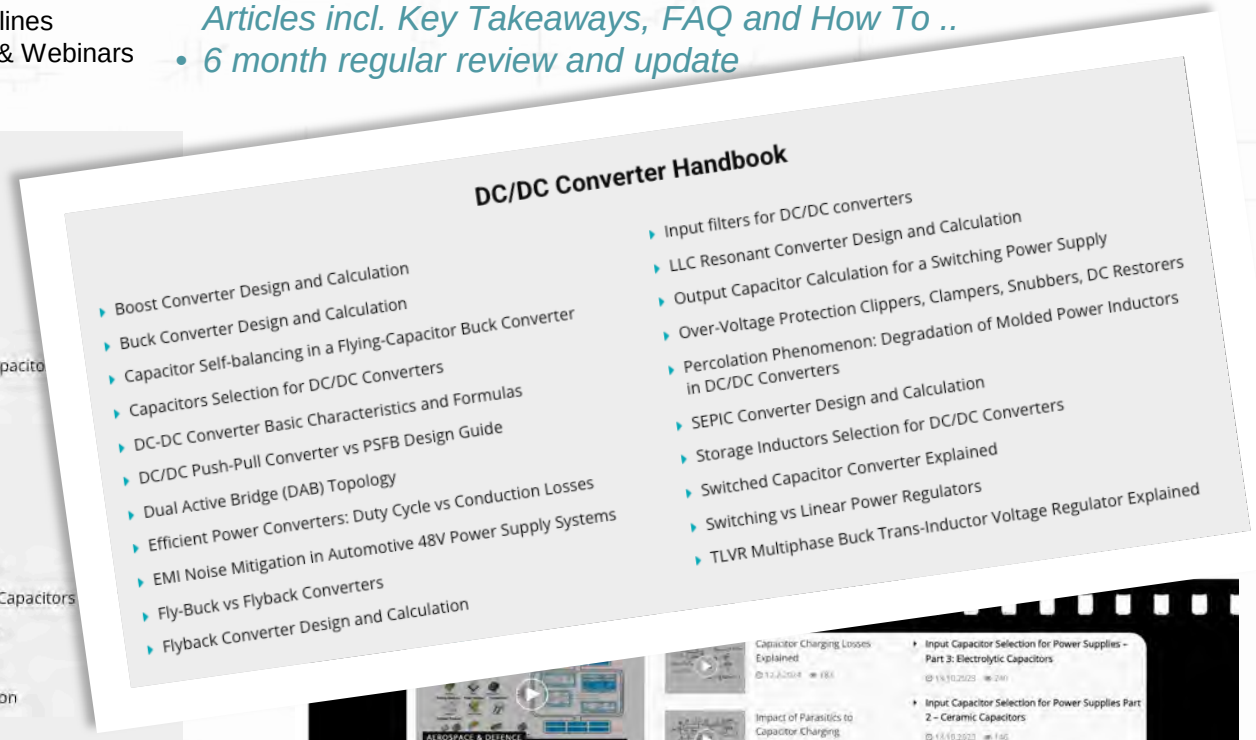
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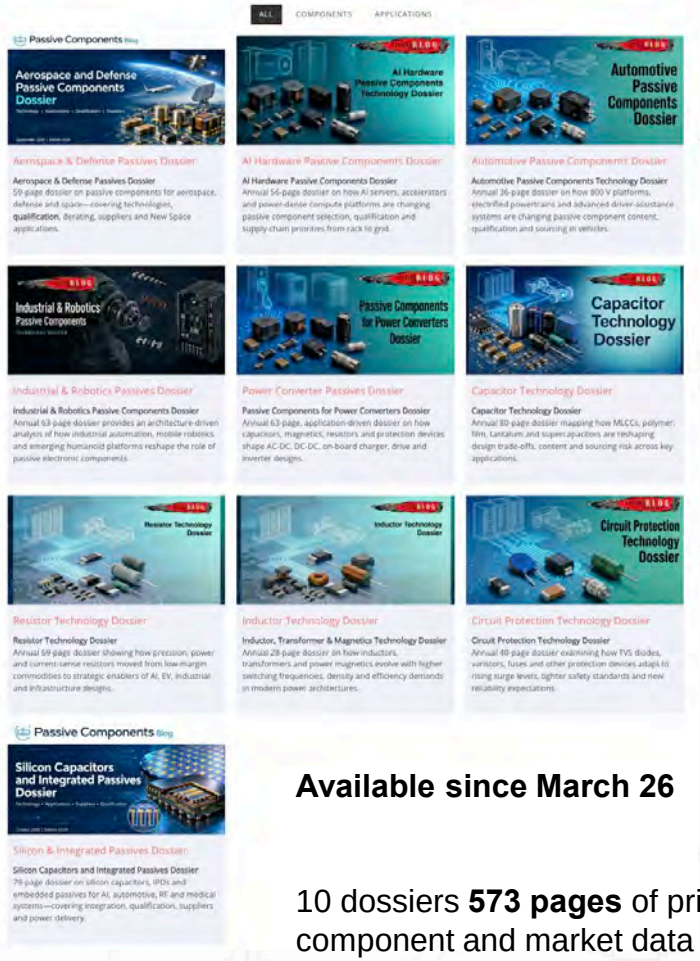
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