Packaged PICs for challenging applications

PhotonFirst, 2026

PHOTONFIRST

Integrated Photonics Sensing

PhotonFirst Technologies

20 years experience in PIC Packaging

Headquartered in Alkmaar, team of +40 FTE

- Research & Development
- Application Development
- Program & Project Management
- Production & PIC Packaging

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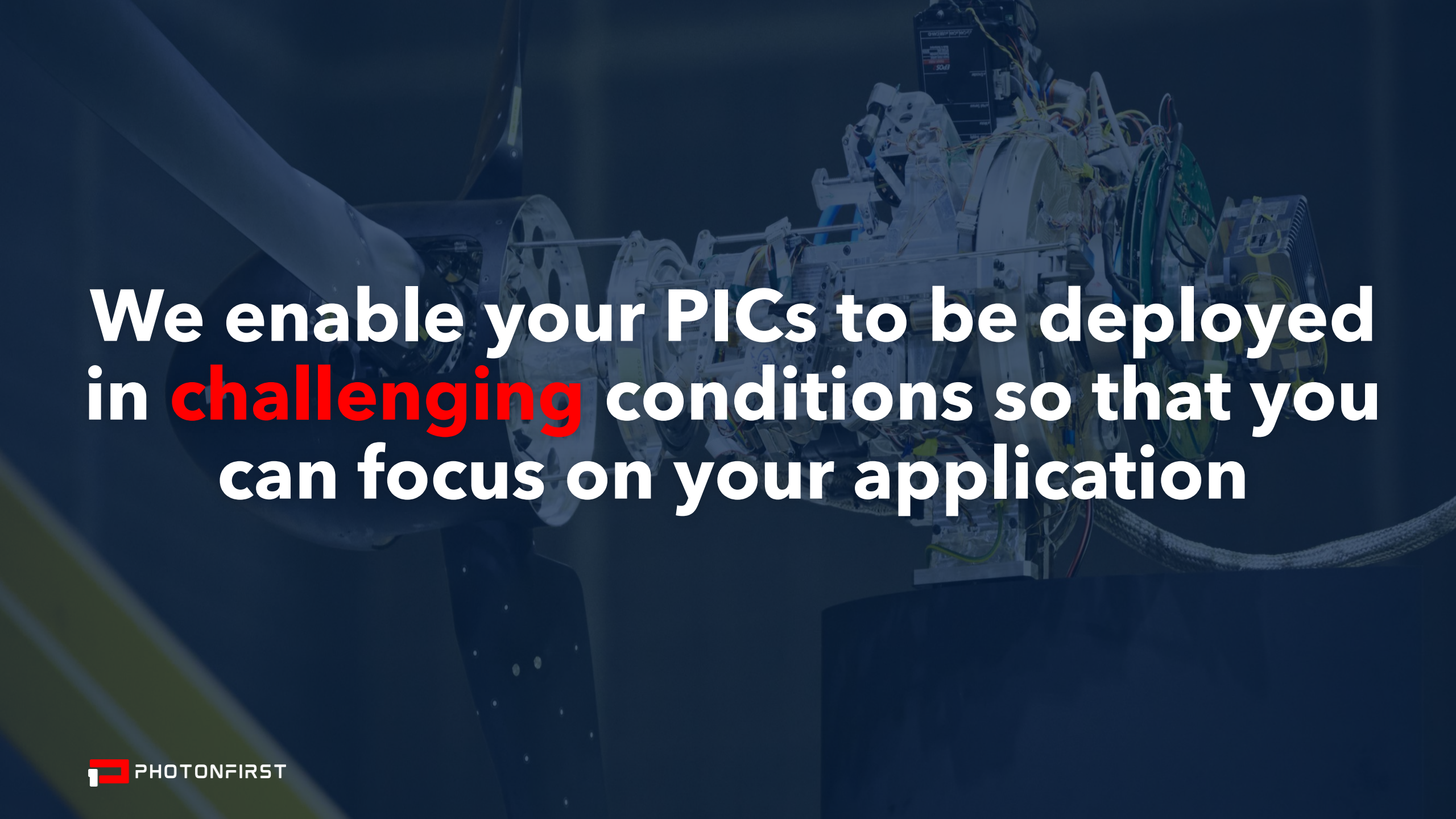
We enable your PICs to be deployed in challenging conditions so that you can focus on your application
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PhotonFirst is Packaging PICs and building Systems for your application

Photonics Integrated Circuit (PIC)

Image courtesy of www.tno.com

Image courtesy of www.quant.de

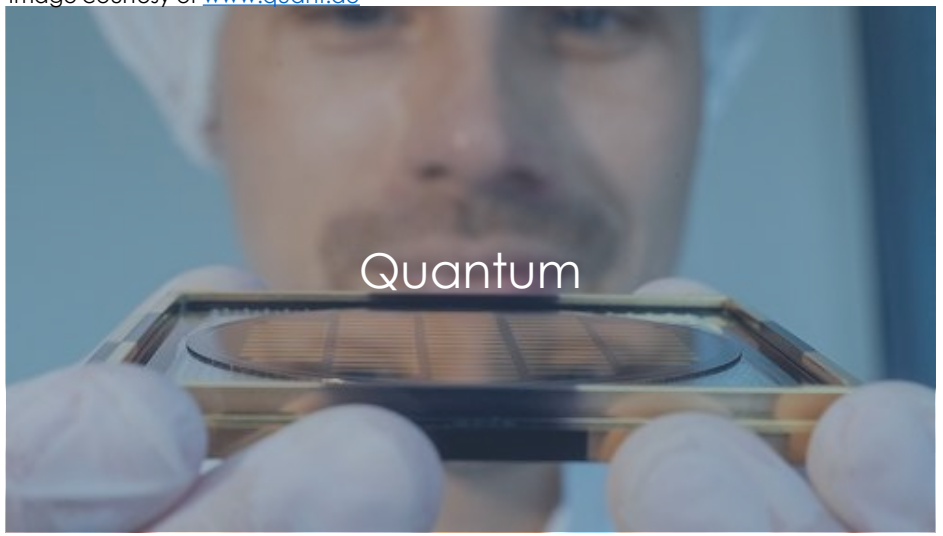

Image courtesy of www.rtx.com

Image courtesy of Three Throne Productions

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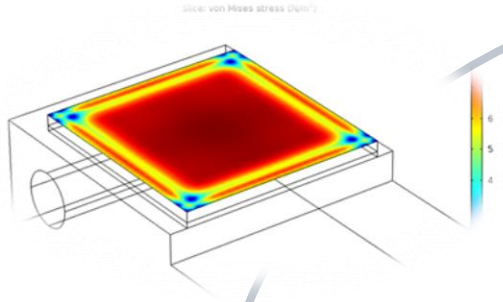
PhotonFirst is Packaging PICs and building Systems for your application

Image courtesy of www.quant.de

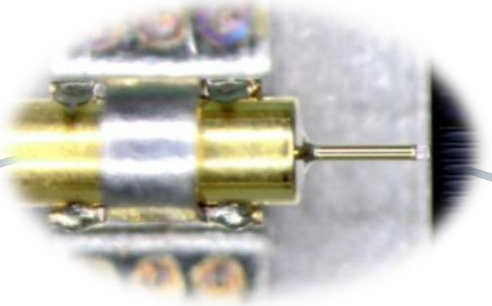
Why is dedicated PIC packaging required?

- The bare die **PIC is fragile** → Most challenging applications require a ruggedised package to improve **reliability & ruggedness**
- The bare die **PIC requires temperature control** → A PIC package and PIC system must provide **thermal stability** and wide operating temperature range
- **PICs are analogue** by their nature → To use a PIC in an application, **co-packaging with electronics** (PCBAs) and software control of the system is required
- Qualification for challenging environments require **meticulous documentation** → Engineering discipline is a must during product and system development

What is required to prepare you PIC for challenging environments?

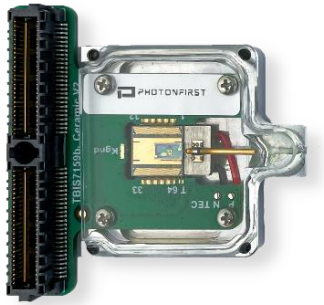


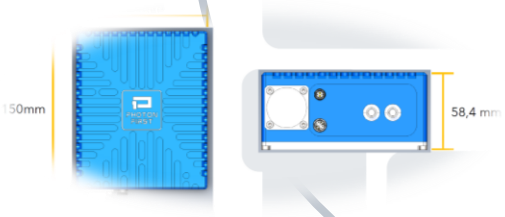
Complex package design and PIC thermal management



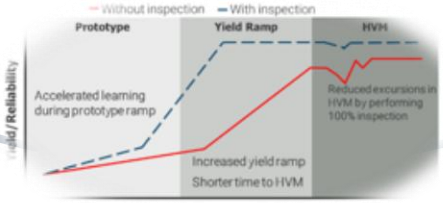
PIC package assembly – especially huge FAU bonding

Custom package design and manufacturing

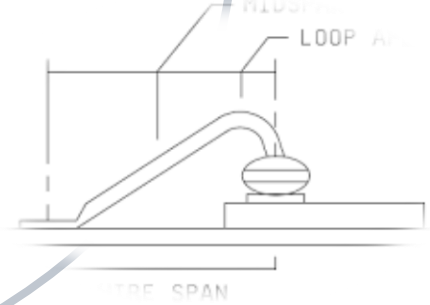




System design experience & capability

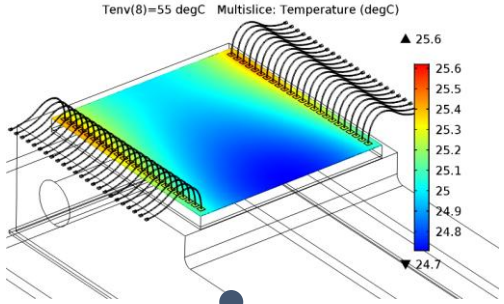


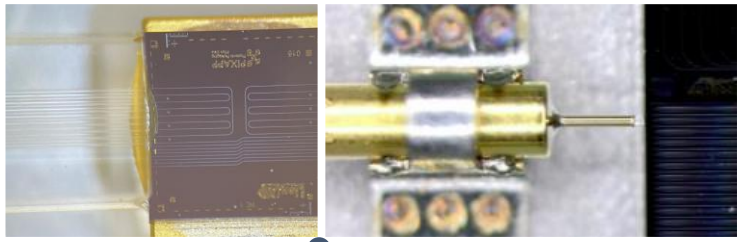
Yield control to scale volume



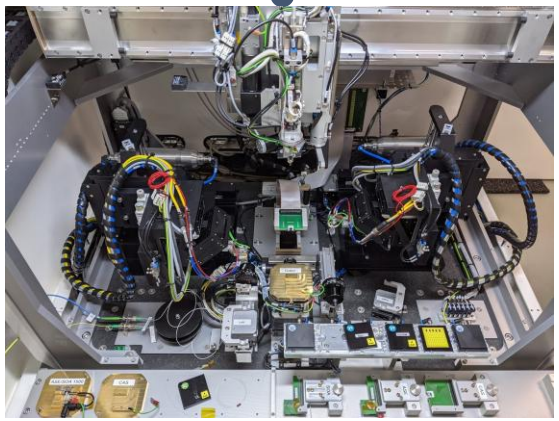
Understanding of qualification (e.g. MIL-883F, DO-160)

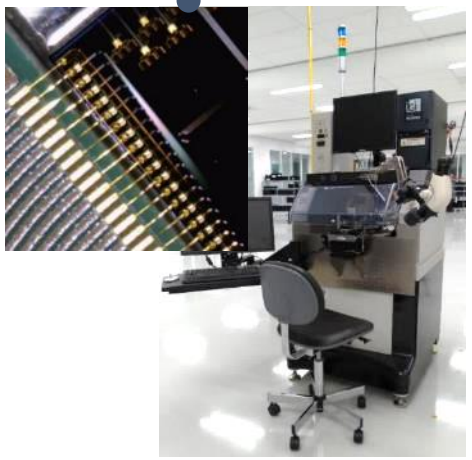
PhotonFirst offers 20+ years experience of end-to-end PIC system development and qualification so our customers can focus on their application

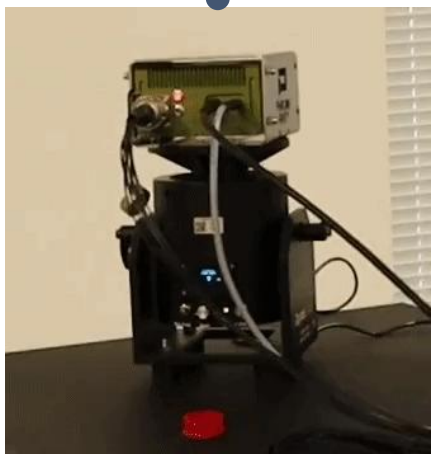




PIC Package Design → PIC Testing → Die-bonding → Wire-bonding → Fiber-Alignment → System Integration & qualification

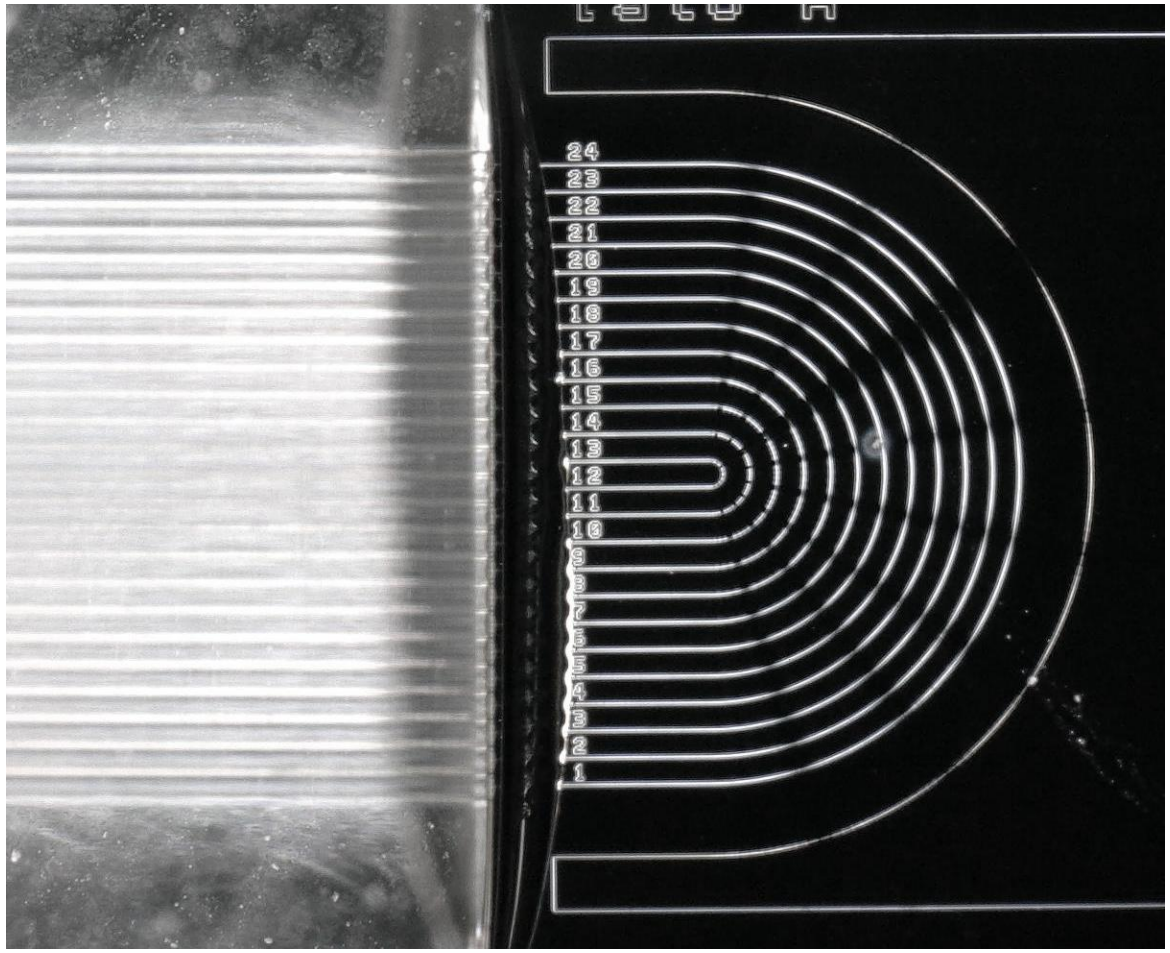




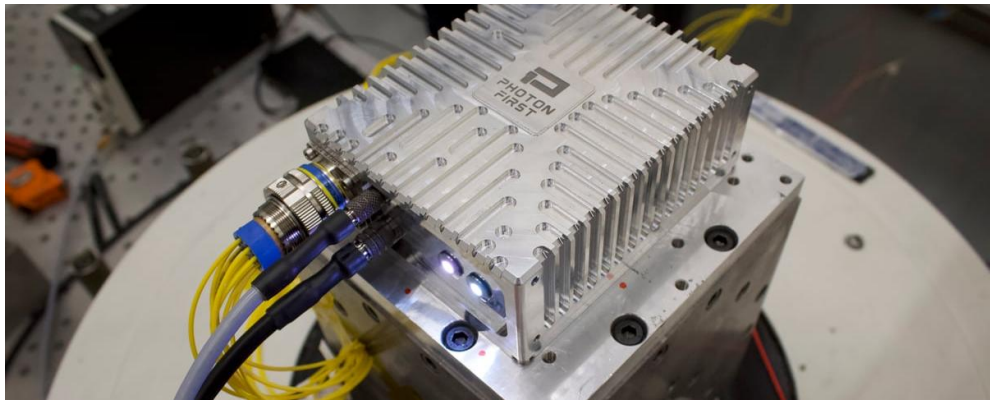


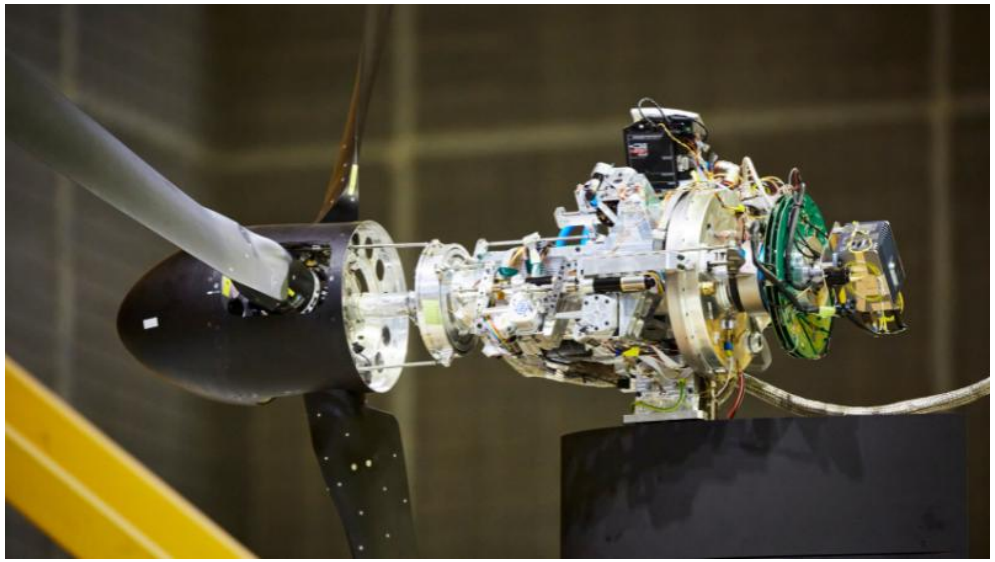
On the topic of Quantum specific PIC packaging challenges

- Quantum Applications requires **huge channels counts** → Fiber Array Unit (FAU) can sometimes reach >140 channels
- Assembling, Testing, Packaging and **Handling of PICs with large FAUs is challenging** → Experience and dedicated package designs are key to success
- Quantum applications also require a **large number of Electronic interfaces** → The “simple” art of wire bonding suddenly becomes a major challenge
- Exotic materials that are currently used in **Quantum PICs do not have standard PIC Packaging solutions** → Flexibility in development of customized PIC packaging process flows is important for success

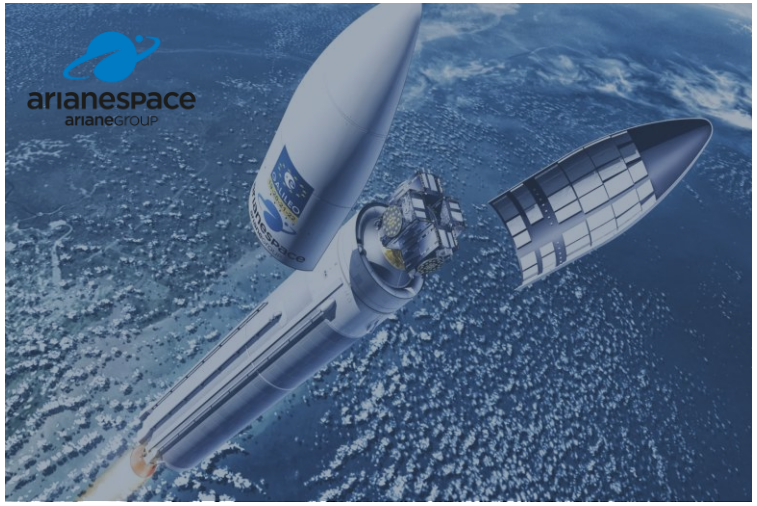


PhotonFirst brings deep Productisation Expertise for demanding markets, backed by 20+ years of experience in flight-qualified PIC-based systems





Trusted by OEMs and Startups

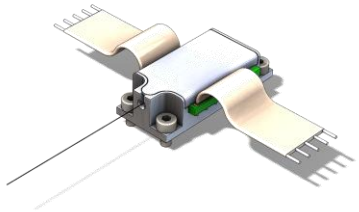


We support leading companies to deliver next-generation PIC based applications

Capability snapshot: PIC Package Design & Engineering

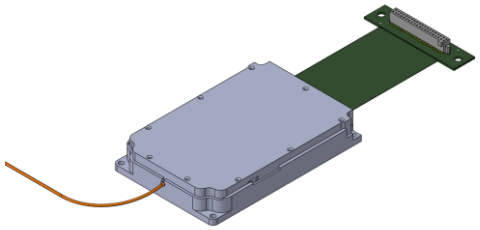
Standard Packages

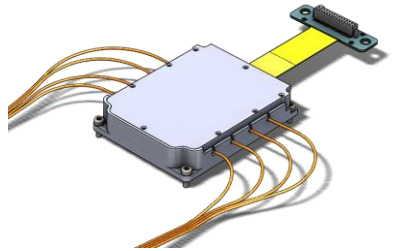
- **Generic** (open) package intended for prototyping
- **Butterfly** package
- PCBA integration with DC and/or RF connectivity



Customised Packages

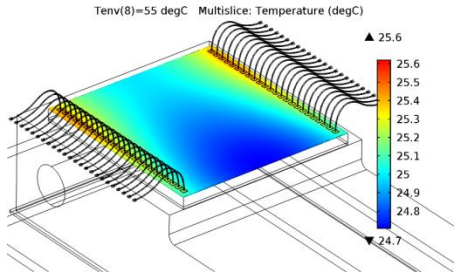
- **Custom housing form-factors**, materials, feed-throughs
- **Multi-die** & Multi-contacts packages
- Customized **thermal management** (sinks, high control)
- Front-end electronics and **PCBA integration into package** (low-noise, high speed)
- **DC and RF** connectivity options
- **Hermetic** fibre feed-throughs
- **Ruggedised** electronics and thermal management (-45°C ~ +85°C)

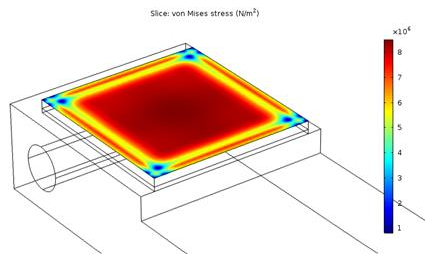




Modelling, Simulation, Validation

- Thermal management & stress analysis (CTE (mis)matches)
- Recipe dev, packaging process dev (IQ/OQ/PQ)
- Environmental qualification (climate chamber)
- Accelerated thermal aging tests





Capability snapshot: (Rugged) Coupling and bonding

Electrical assembly

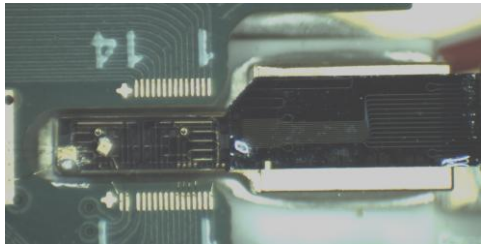
- **Sturdy connections** between PIC and electronics (Wire bonding according to **MIL-STD-883F**)
- Interposer PCB
- Low-noise electronics for pre-processing

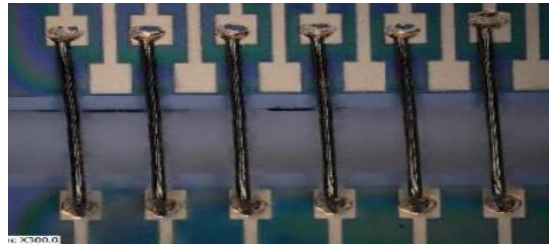
Optical assembly

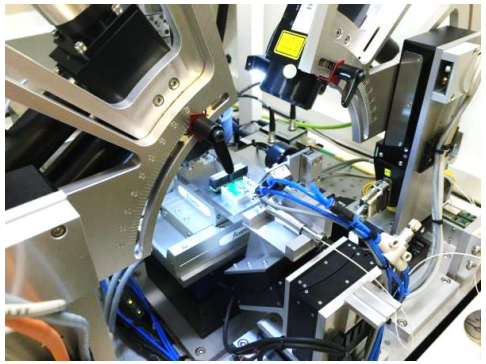
- Single fibre and Fibre Array Unit (FAU)
- **Ultra-stable fibre alignment** (laser welding) for harsh environments
- A-thermal, shock resistant interfaces
- UHNA, PMF, Lensed, SMF
- PIC-to-PIC assembly (including flip-chip)

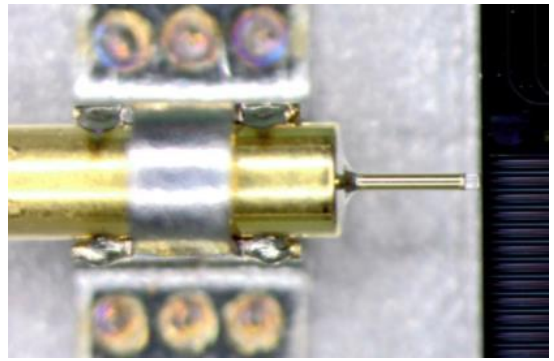
Thermal and Mechanical assembly

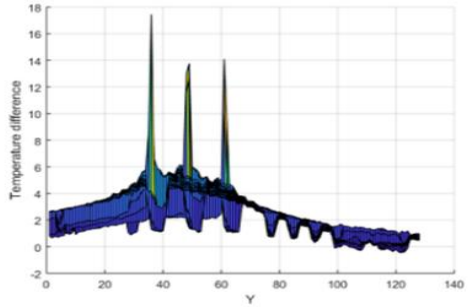
- Precision die bonding
- Protection against dust and damage
- EMI shielding with PCB and housing
- Heat dissipation from PIC with TEC

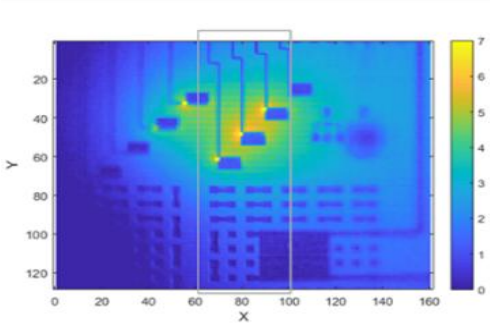












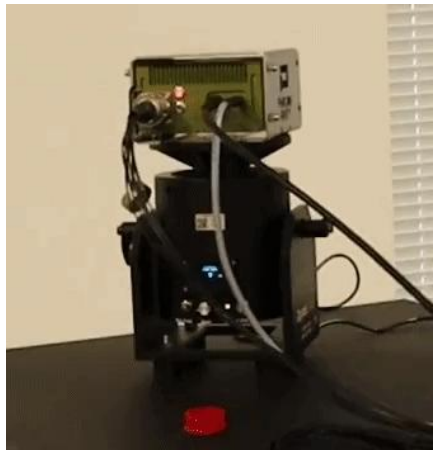
Capability Snapshot: Harsh Environments qualification

Testing and Qualification (Die-, module- and system-level)

- Pull & shear tests; Thermocycling; Shock testing; EMC testing
- **Qualification (e.g. EMC, DO-160, MIL-STD-883T, HALT)**
- **Radiation-tested** packages, processes and glues
- Reliability (accelerated lifetime) testing

Track Record

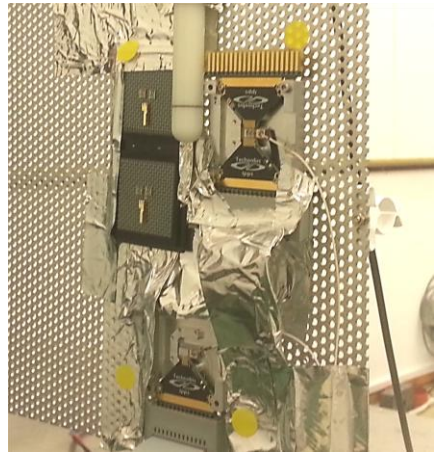
- Successful completion of the **engineering journey (TRL 1-9)** of our own PIC-based FBG-interrogators for harsh environments
- Extensive **experience in Harsh Environment** testing and qualifying products and PICs
- Systems and PICs that are **Radiation-tested**



Shaker (shock test)

Climate chamber

EMC testing together with NLR



Radiation test of PICs
@ C0-60 Facility, ESTEC, NL

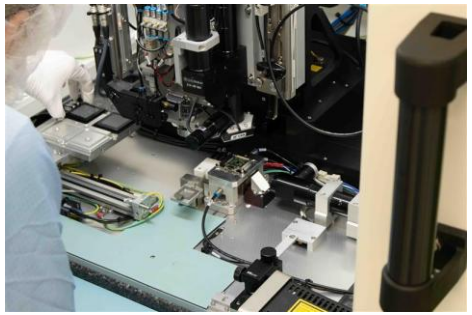
Module, Product Design and Manufacturing capabilities targeting volume production

Quality and Supply-Base Control

- **Fully documented** and traceable assembly process flows
- **ISO9001** certified
- **EN9100**-based development process and documentation
- Production process qualification (IQ/OQ/PQ to control operations of production)
- Capacity and capability to **setup dedicated assembly lines** for key customers

Deep domain-knowledge to support your PIC qualification process

- **20+ years of engineering experience** in preparing PICs for Real World environments
- High level **know-how of relevant qualification standards**
- **State-of-the-Art facilities** to package, test and validate packaged PICs for Harsh Environments



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Thank you for your attention.
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