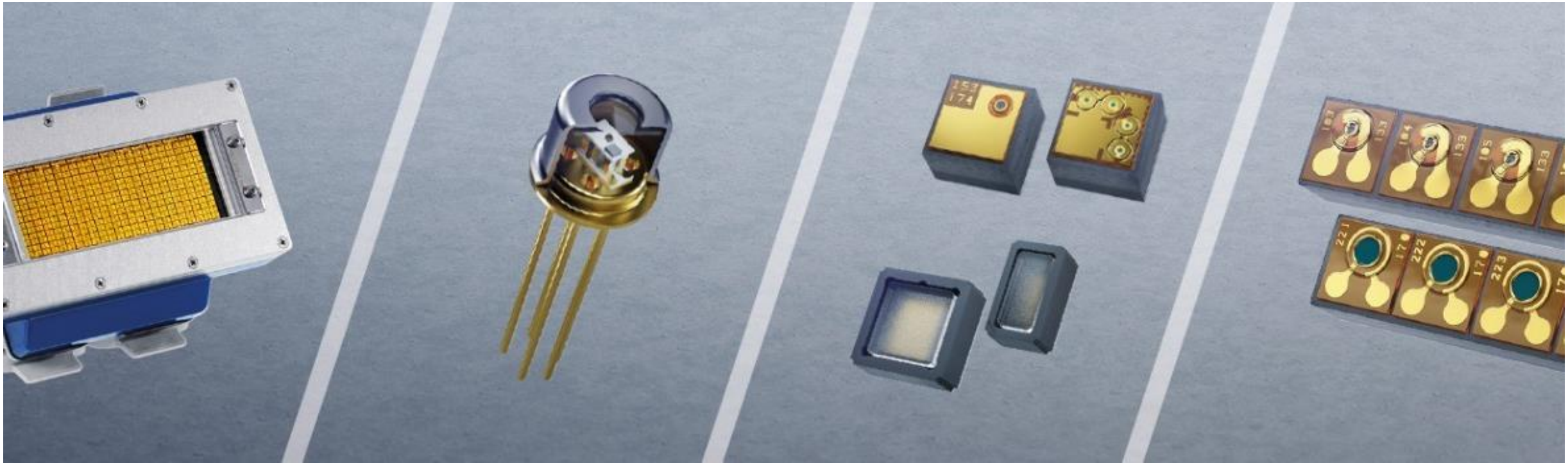


980nm VCSEL&PD for automotive application

Kevin Lu | TPC

TRUMPF

Agenda

01 TRUMPF Group

02 TRUMPF Photonic Components

03 980nm VCSEL and PD for automotive data communication

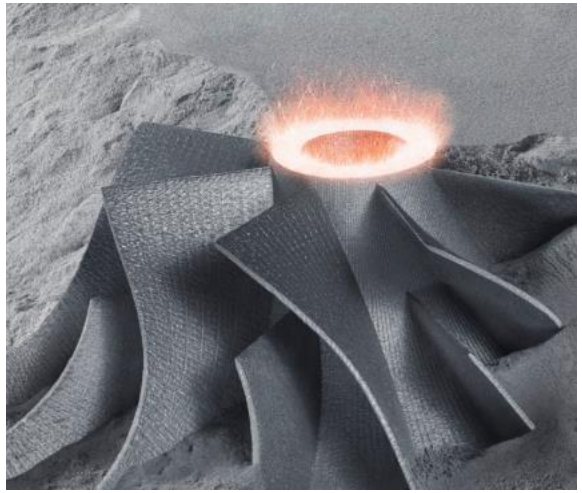
TRUMPF GROUP

TRUMPF is…

Family business

Technology leader

Close to the customer



Innovation guarantor

At a glance - Key corporate figures

Fiscal year 2022/23

Sales revenues (in bn. €)

5.4

+27 %

Order intake (in bn. €)

5.1

-8.8 %

Employees on June 30, 2023 (Quantity)

18,352

+10.9 %

Earnings before taxes and interest (EBIT) (in m. €)

615

+31.4 %

EBIT margin

11.5 %

R+D costs (in m. €)

476

+6.3 %

R+D quota

8.9 %

Investments (in m. €)

316

+44.7 %

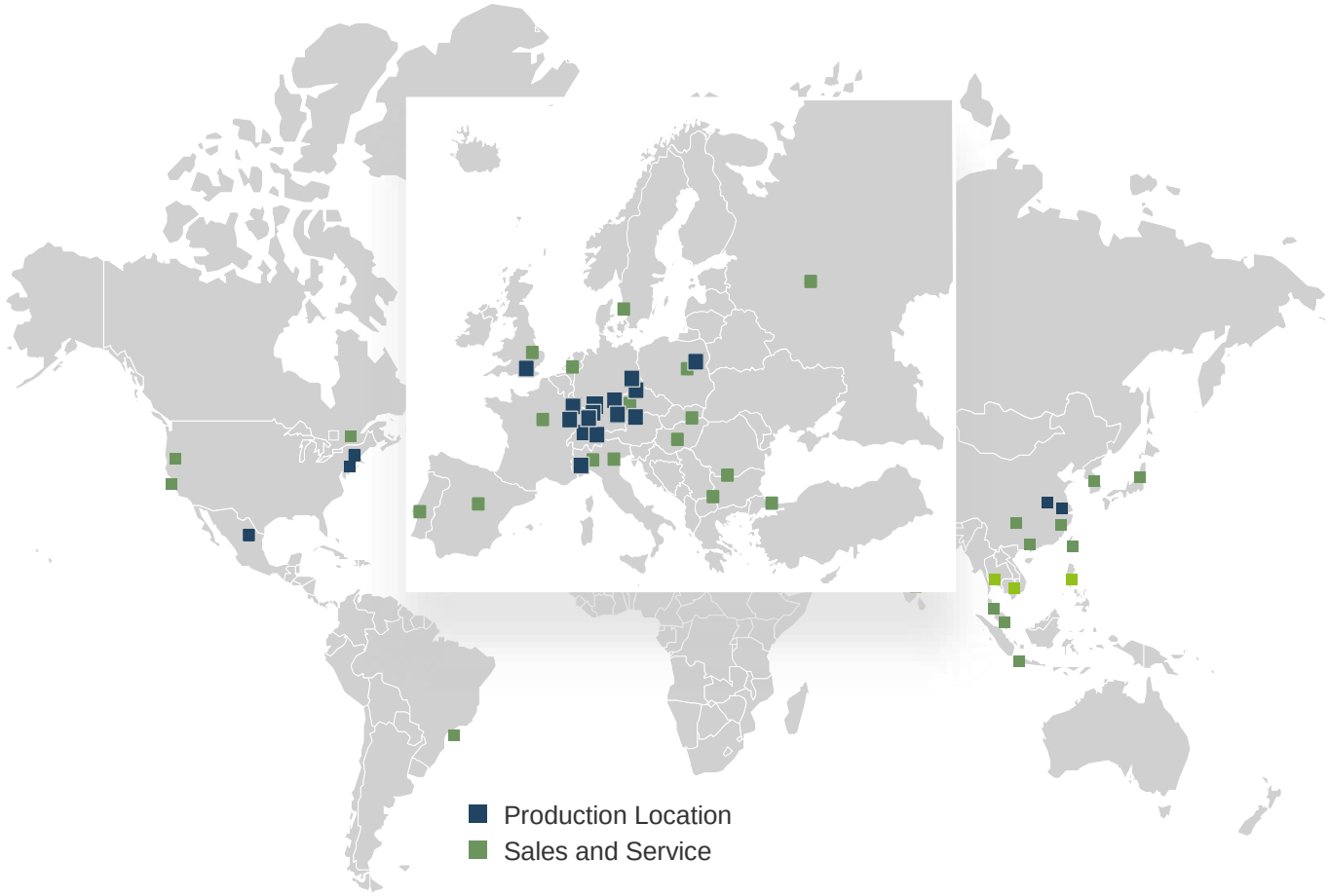
Worldwide presence

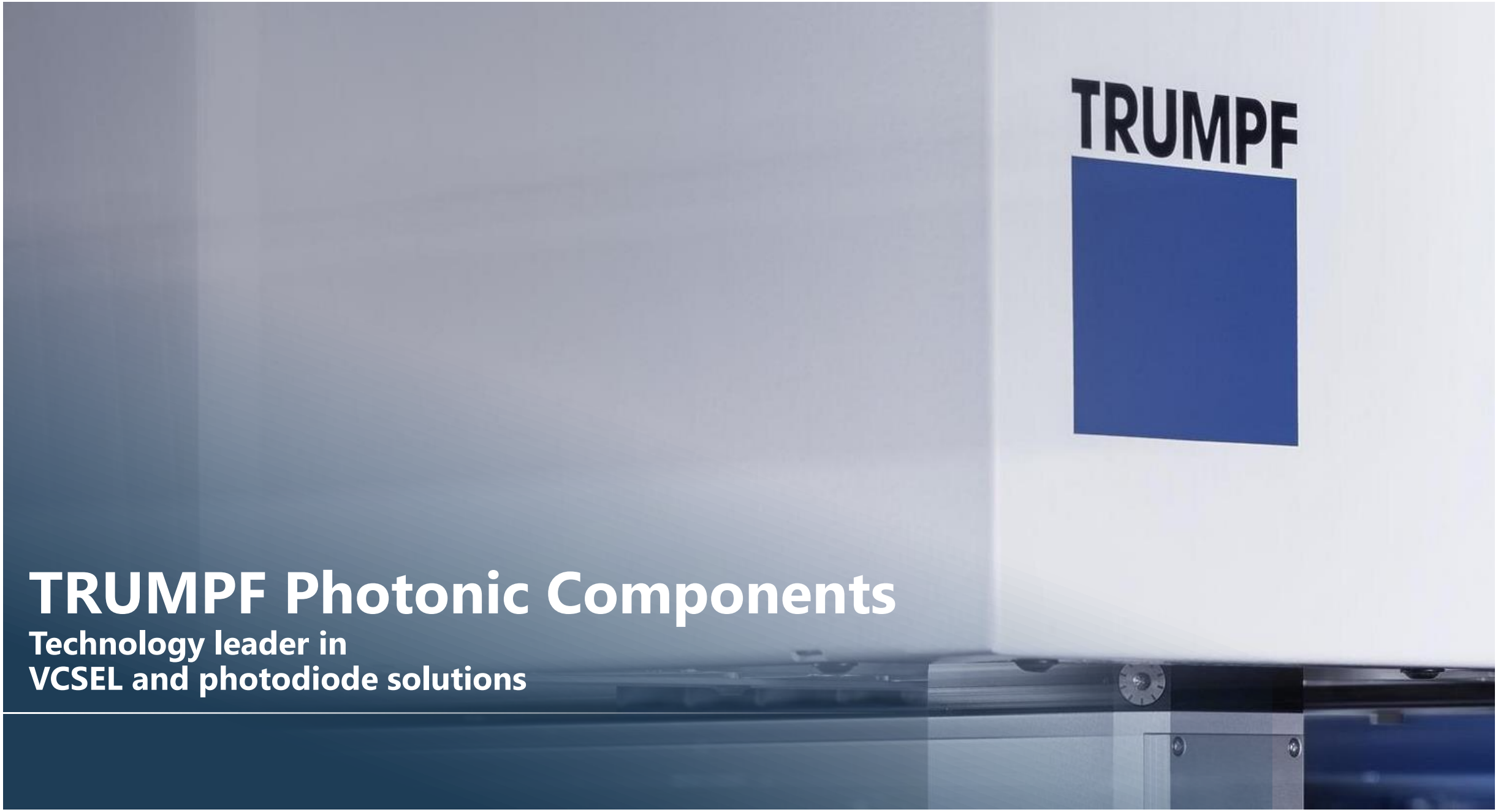
Close to our customers worldwide with over 70 locations

Locations worldwide

Germany	America
14	11

Europe (without GER)	Asia/Pacific/ Others
29	17

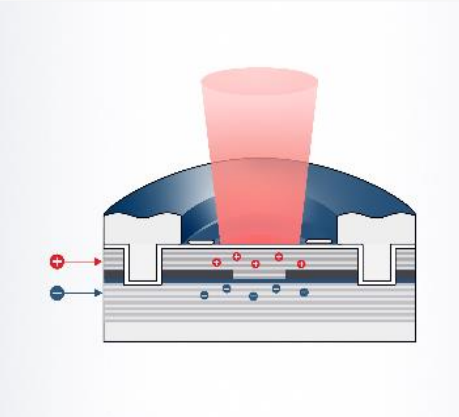




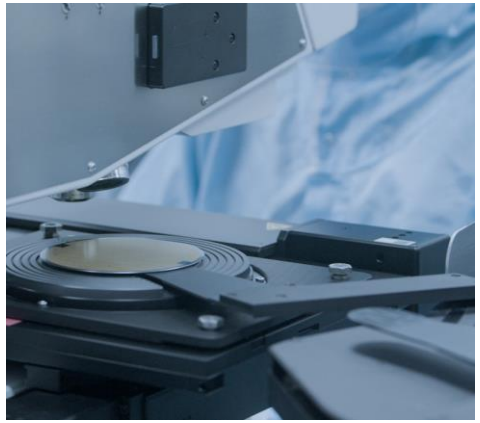
TRUMPF Photonic Components

Technology leader in VCSEL and photodiode solutions

TRUMPF Photonic Components is…



20 years legacy in VCSEL & Photodiode
Supported by a strong IP portfolio



High volume supplier into multiple markets
Over 2,5 billion devices shipped

International footprint
Headquarters in Germany and locations worldwide

Strength in innovation
Top talents in-house, investing with a 30% quota in R&D projects

Global presence

Focusing on key markets

Headquarter: Ulm (Germany)
incl. R&D & wafer fab I & II

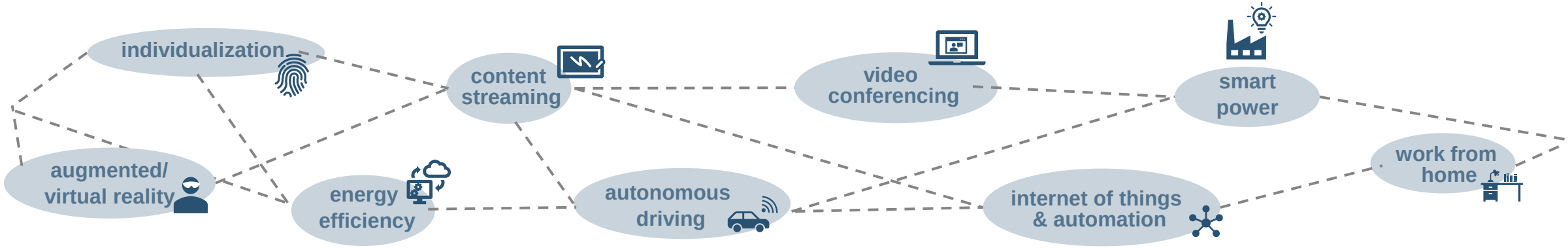
Connected Technology Center:
Aachen(Germany)
Eindhoven (Netherlands)
Princeton/Cranbury (USA)

Foundry III: Taoyuan City (Taiwan)

Sales Offices: Santa Clara (USA)
Taicang, Shenzhen/
Guangzhou (China)
Seoul (South Korea)
Taoyuan City (Taiwan)

Market trends for VCSEL business

Our focus industries



Big Data

Optical interconnects in

- High Performance Computing
- Data center & data storage
- 5G & IoT networks

3D Sensing

Distance/ speed measurement, 3D contour identification & HM-interfaces

- Smartphones
- Hand-held devices & smart wearables
- Computers & access terminals
- Automotive and industrial applications

Digital Manufacturing

Tailored heating solutions

- Additive Manufacturing (LaserProFusion)
- Battery production
- Automotive
- Industrial heating systems

source photo: EOS GmbH

Fields of Application

From datacom to sensing to industrial heating to automotive

Datacom

Data Centers

- Transceivers (TxRx), Active Optical Cables (AOC), embedded optical modules

High Performance Computing

Enterprise Networks

Consumer Datacom

- USB, Thunderbolt, HDMI

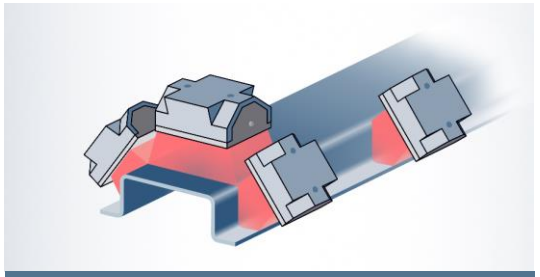
Sensing

Consumer Sensing

- Face recognition
- Proximity sensing
- Laser autofocus
- AR / VR
- User input device

Industrial Sensing

- Environmental and gas sensing



Industrial Heating

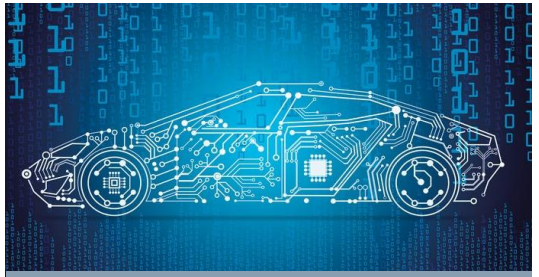
E-Mobility

- Battery foil drying
- Pouch sealing

Composite manufacturing

- Local steel treatment
- Pixelated heating
- Joining of plastic parts

Additive Manufacturing



Automotive

Data transfer

- In-vehicle optical network

Sensing

- In-cabin sensing, driver monitoring
- LiDAR

Heating

- Local softening of body steel

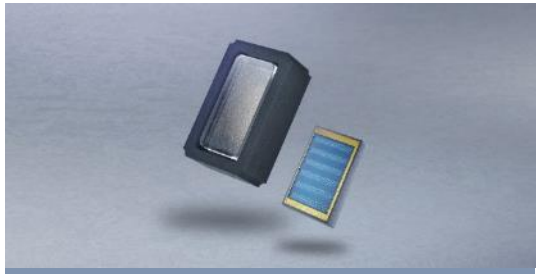
TRUMPF

TRUMPF offers a broad product portfolio

World of VCSELs and photodiodes

Datacom

- 940 nm VCSELs and photodiodes for 100 G
- 850 nm VCSELs and photodiodes
- Up to 56 Gbps bandwidth
- 100Gbps in development
- Various array configurations (1x4, 1x12, …)
- Non-standard wavelengths (940 nm – 1310 nm)
- Single-mode and multimode VCSELs



Sensing

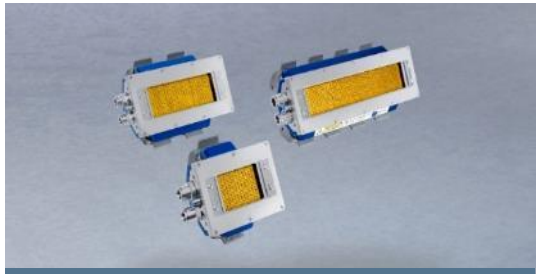
Smallest Chips
- 150 µm chip size
- 2 – 20 mW optical power
- 850 nm and 940 nm emission wavelength

VCSEL arrays
- 0.5 – 4 W (cw)
- High pulse power 10 x cw
- 850 nm and 940 nm emission wavelength
- Short pulses down to 1ns
- Large 2D arrays with addressable zones

TO Can
- 76x nm and 850 nm single-mode, TEC optional

Automotive

- High performing VCSELs and PDs for in-vehicle optical network for data transfer
- 980nm Wavelength
- Wide temperature range



TruHeat VCSEL

- Many chips to scale the power to multi kWs
- Addressable zones
- Slope efficiency ~1 W/A
- 980 nm emission wavelength

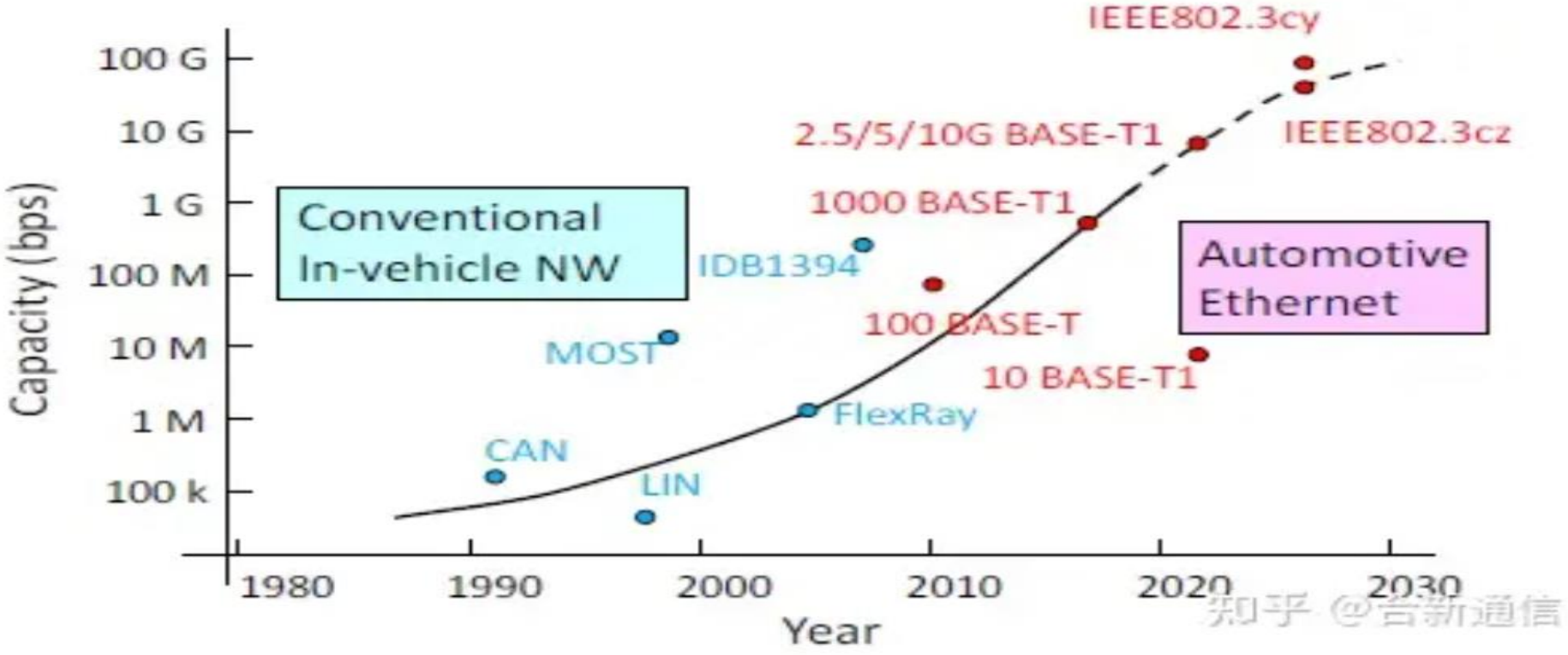
TRUMPF

980nm VCSEL and PD for automotive data communication

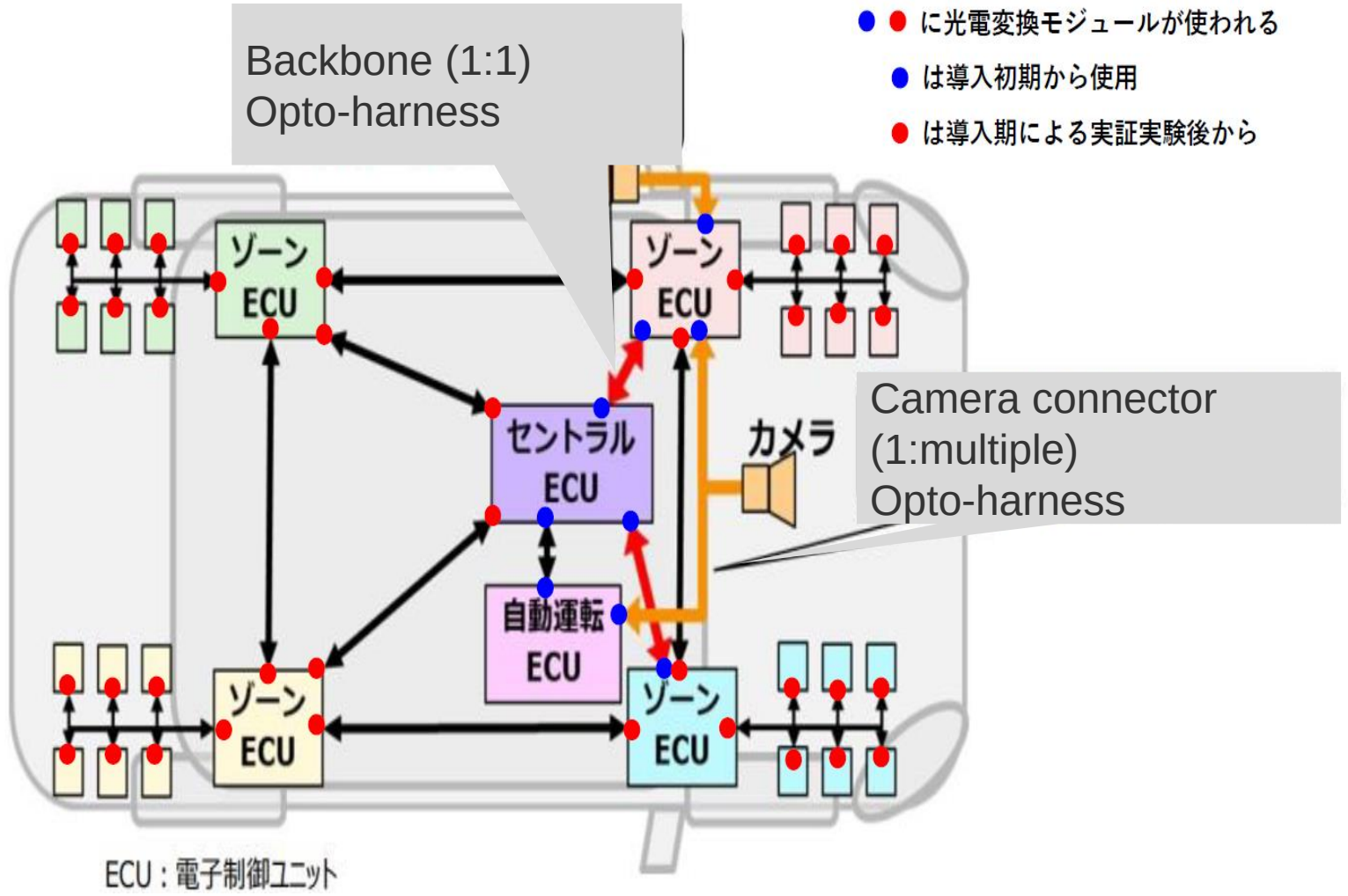
Optical-communication on car

The evolvement of automotive network. Opto-communication has to be adopted on car.

With the development of automotive technology, the information exchanged within a car is expanding significantly.



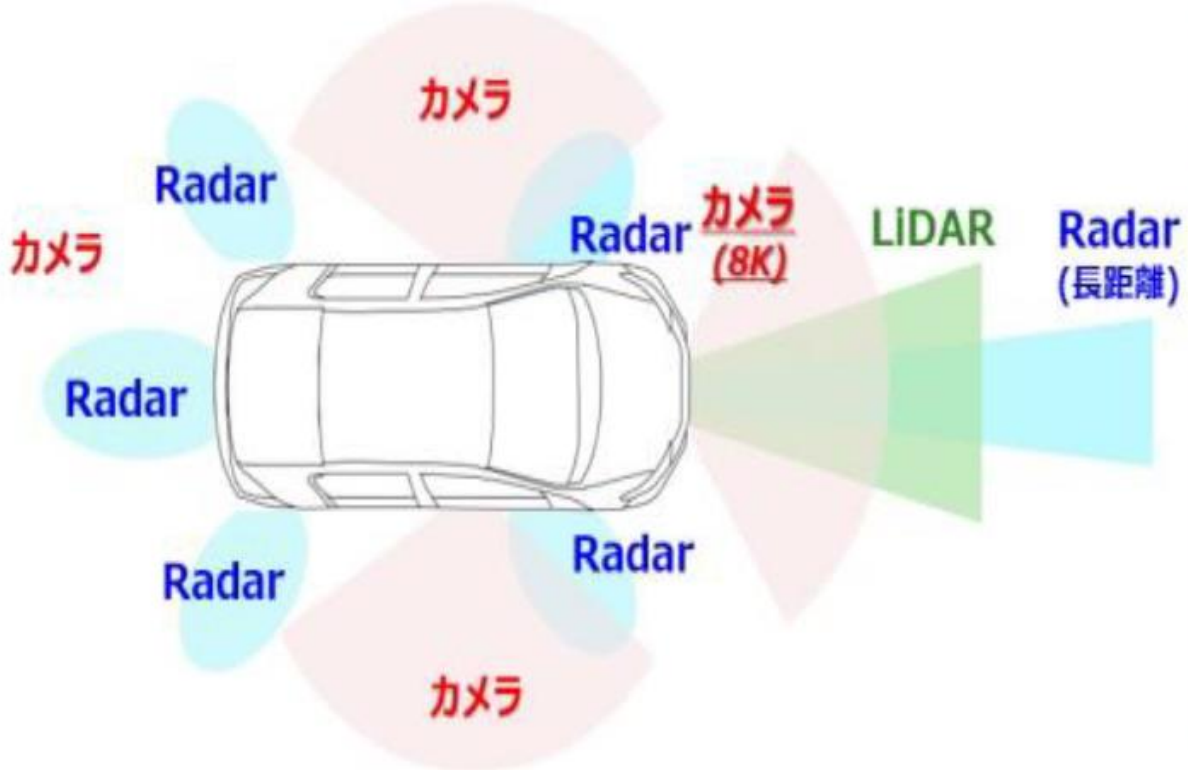
Where to use opto-harness and temperature requirement



Temperature spec for different area	
external	−40C
Roof	105C
In cabin	0−85C
Engine room	125C

Data rate requirement of each appliction

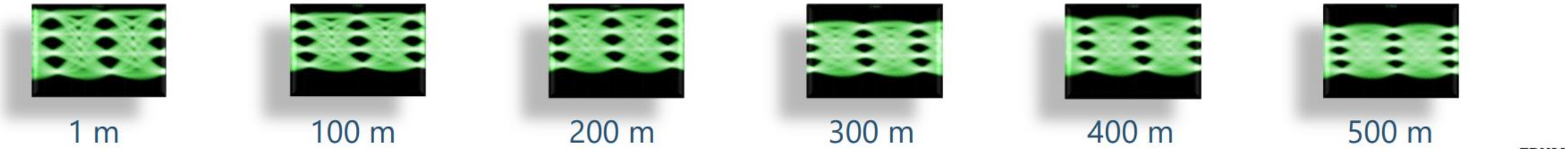
- Various sensors are needed to support autonomous driving which result in high volume of data communication.
- Opto-harness is applicable for ultrahigh speed communication such as 8K camera and backbone



Camera 8K	**> 10Gbps**
カメラ (サラウンドビュー)	< 1Gbps
LiDAR	< 1Gbps
Radar	> 100Mbps
+	
5G通信	> 10Gbps
インフォテインメント	> 100Mbps
Backbone	**> 50Gbps**

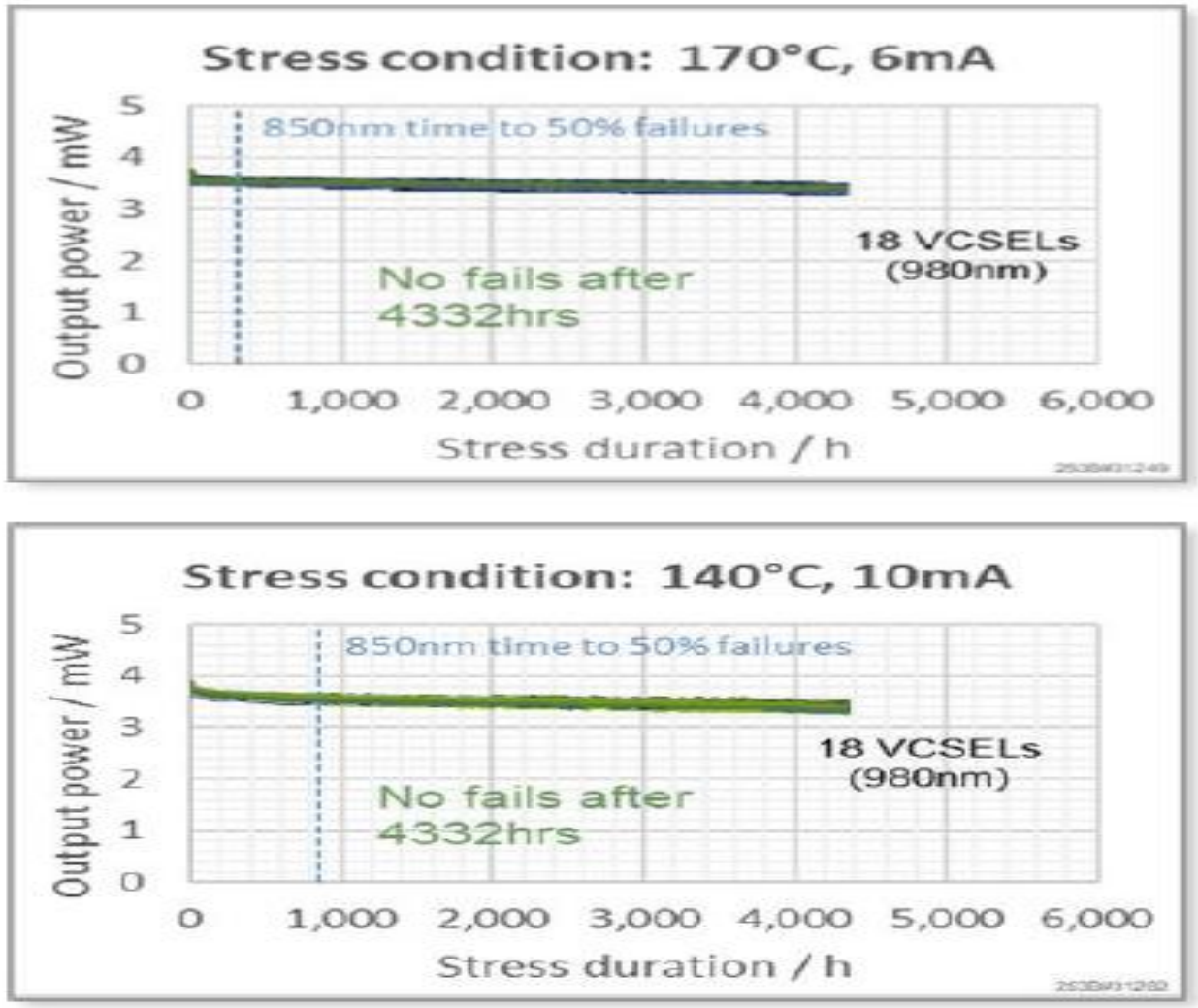
TRUMPF's one chip solution to address all needs

Wavelength	Application	Data rate	Length	Temperature range
980nm	Camera signal transfer, LiDAR, infotainment	56G	Up to 40m (IEEE standard OM3 fiber) Up to 500m (optimized fiber for 980nm)	-40-125C (target spec)



J. Hellmig, X. Chen, R. Safaisini, A. Juarez, J. Dragt, J. E. Hurley, P. Moser, B. Sassiya, R. King, G. Larisch, M. Li, and R. Koerner, "56G VCSEL Transmission at 980 nm across 500 m Multimode Fiber," in *Optical Fiber Communication Conference (OFC) 2024*, **Technical Digest Series (Optica Publishing Group, 2024), paper Th1B.3.**

Why 980nm is recommended



With time being, there is almost no failure on 980nm, while about 50% failure happened on 850nm. Conclusion: 980nm has better performance and higher reliability on high temperature, is more suitable for the application in high temperature environment.

Kevin Lu
TRUMPF Photonic Components