



World Class Supplier of Leading Edge Electro-Optical Circuit Boards

Integrated Planar Waveguides for
High Speed Data Communication
and Sensing in Space Applications

Agenda

- vario-optics ag
- EOCB Technology in a Nutshell
- Optical Communication Applications
- Miniaturized Optical Sensor Applications
- Conclusions

Felix Betschon
CEO vario-optics ag

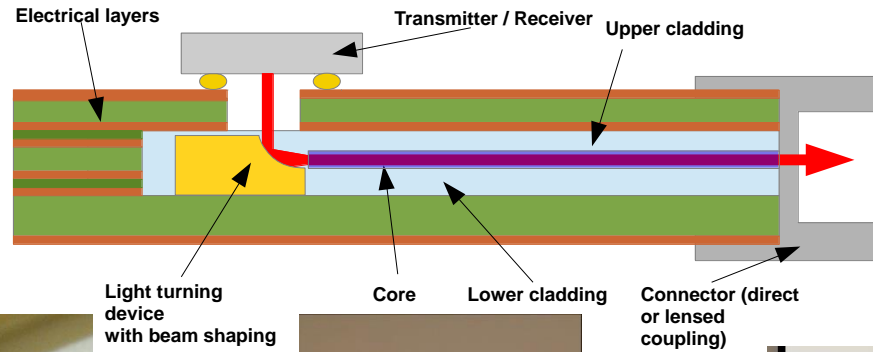
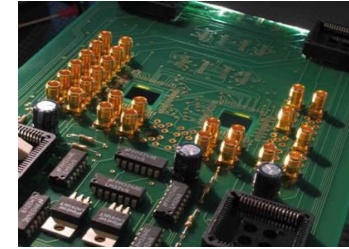
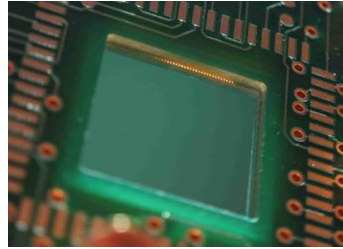
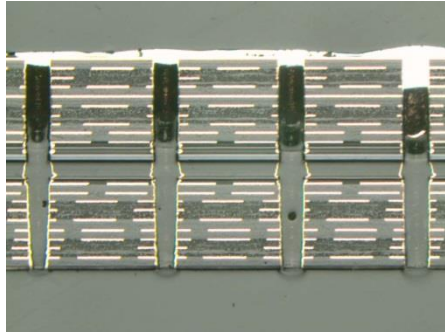
vario-optics ag

Heiden, Switzerland

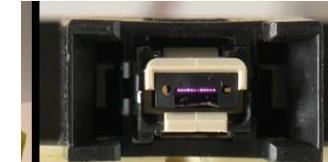
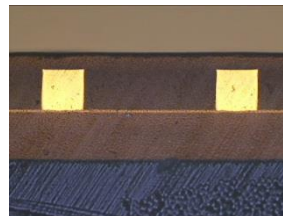
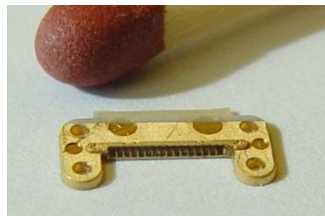
- Young SME based in Switzerland
- Unique technology solution for high-density integration of optics and electronics
- Fabrication and development
- EOCB: Electro-optical circuit board
 - High speed on-board communication
 - Sensors
 - Photonic Packaging



Electro-Optical Circuit Board Based on Photolitho

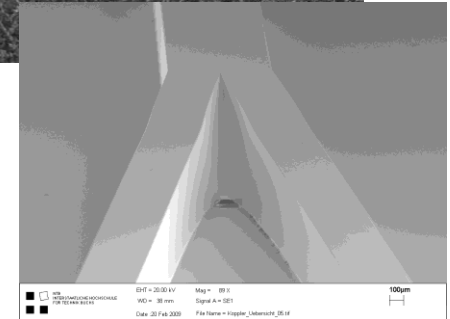
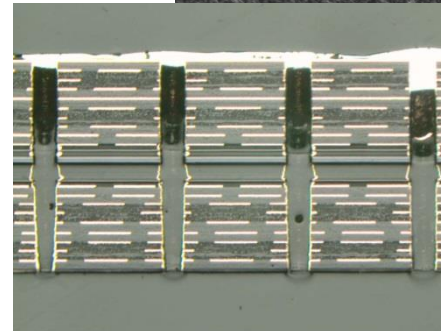
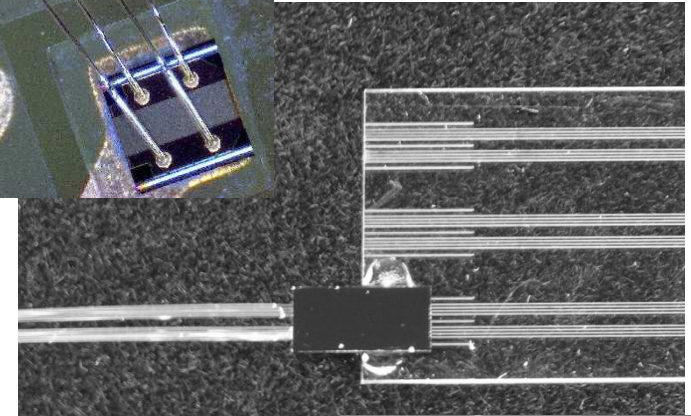
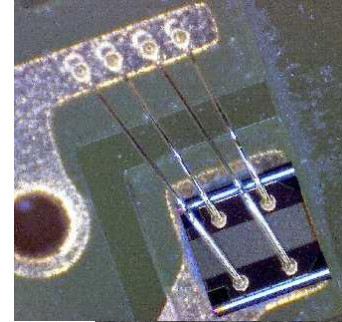


Light turning device with beam shaping



Key Features

- Optical layer integrated into PCB (20+1)
- Large panel format manufacturing 305 x 460mm²
- Polymer or glass optical waveguide layers
 - UV-curing of polymers by lithography or laser imaging
 - Ion-diffused glass singlemode waveguides for long-wavelengths in cooperation with FhG IZM
- Multimode (30 – 500 μm), Singlemode (2 -10 μm)
- Insertion loss down to 0.05 dB/cm (λ-dependence)
- Polymers and Glass to withstand 85°C/85%r.H. >2000h
- Robust against harsh environment (incl. radiation)



EOCB's for High Speed on Board Communication

- 1.4 Tb/s on board communication
- 20 electrical layers – 1 multimode optical layer, 265 x 420 mm²
- 4 mid-board optical engines (Finisar)
- Xilinx Virtex FPGA for simultaneous coding, switching, BER & eye diagram measurements on all 48 optical channels
- Automated assembly (Benchmark) incl. double sided reflow soldering



H2020 ICT-STREAMS:

EOCB Technology Platform for Miniaturized High Performance Computing

- Consortium of 9 partners, covering the whole supply chain
- Efficient optical any-to-any communication for multi-socket boards (beyond 4 nodes)
 - low-latency & low energy (no switch)
 - up to 25TBit/s
 - Adiabatic coupling scheme between SiPh and EOCB
- Overcome limitations of electrical interconnects for multi-sockets

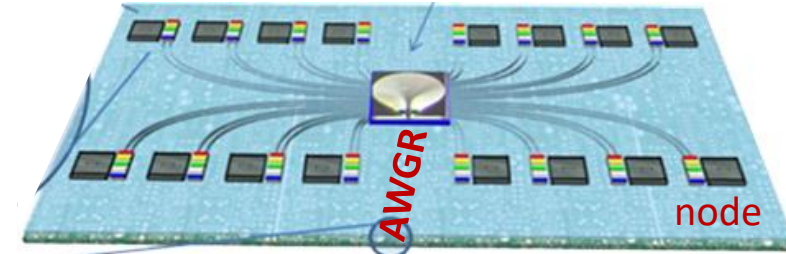
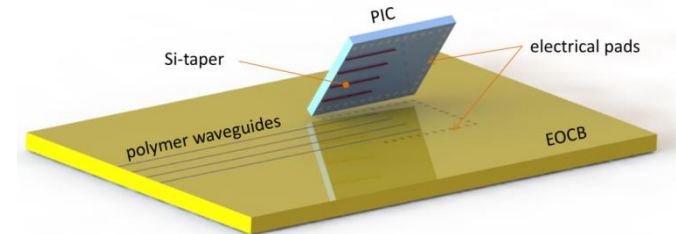


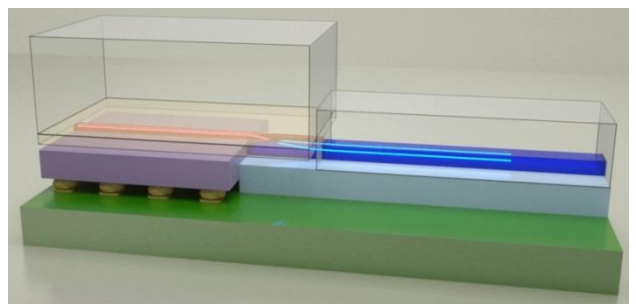
Illustration of AWGR based server board



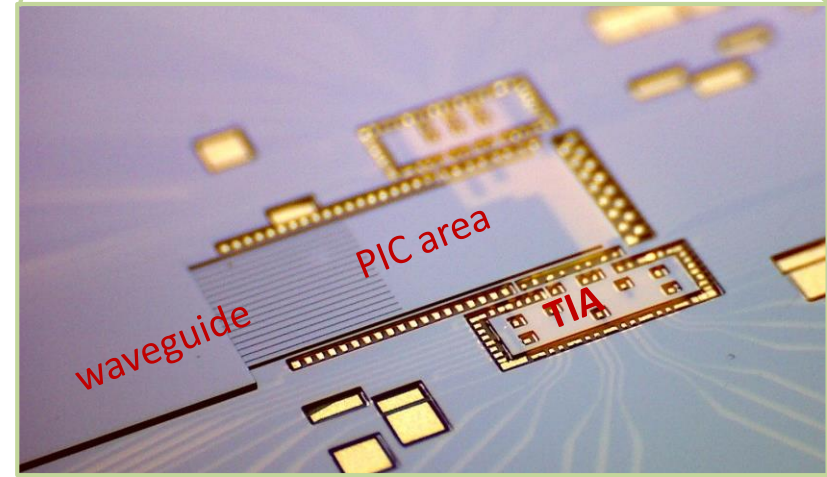
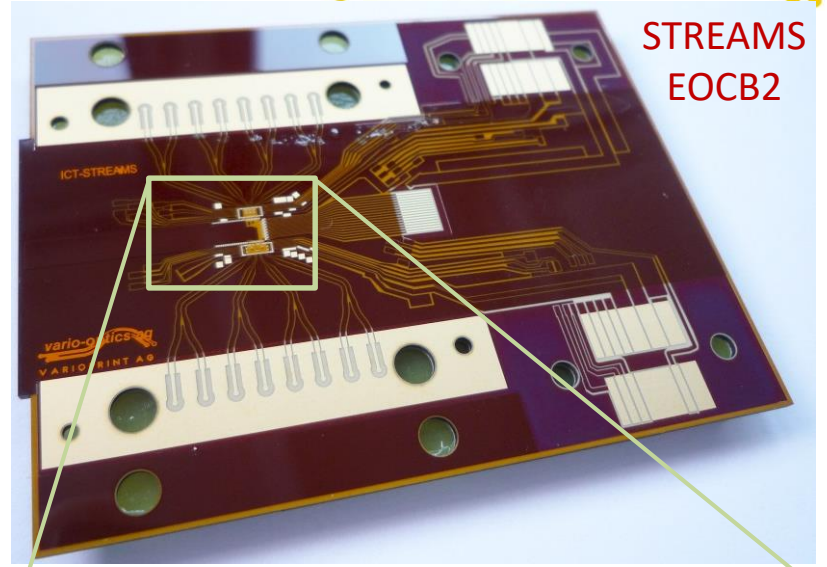
source: www.ict-streams.eu

H2020 ICT-STREAMS: EOCB as Host for PICs

- Simultaneous electrical and optical bonding
 - Very planar substrate
 - Optical interface for adiabatic coupling
 - Combination of RF-dielectric materials supporting more than 60 Gbit/s electrical signalling
 - Singlemode optical waveguides for WDM
- STREAMS-concept could be the basis for compact and light-weight computing and communication systems

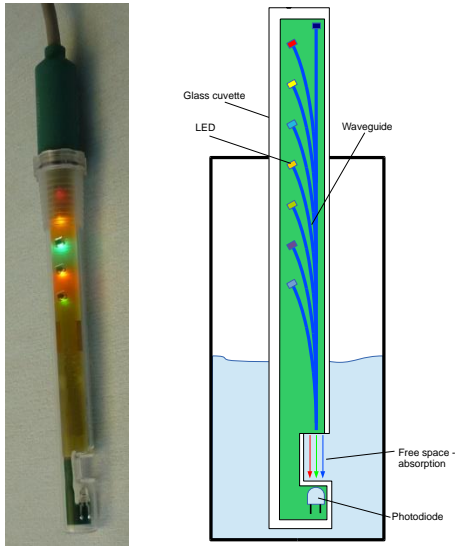


EOCB ready for adiabatic PIC direct attach (Lamprecht et. al., ECTC2018)

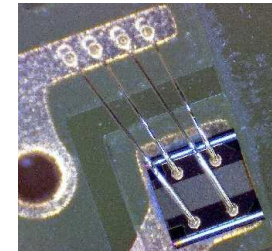
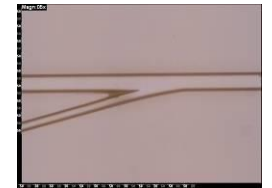
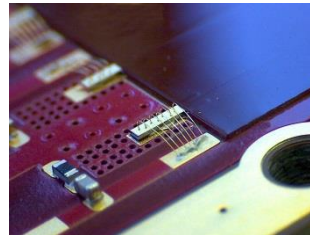
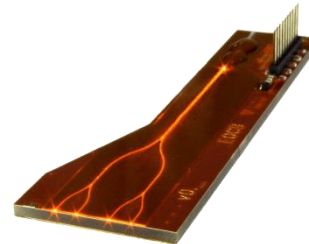


EOCB's for Highly Integrated Sensors (Multimode)

- Electro-optical PH-Optrode
- Laser source for medical application
- Laser range finder with passively assembled laserdiode and fibers

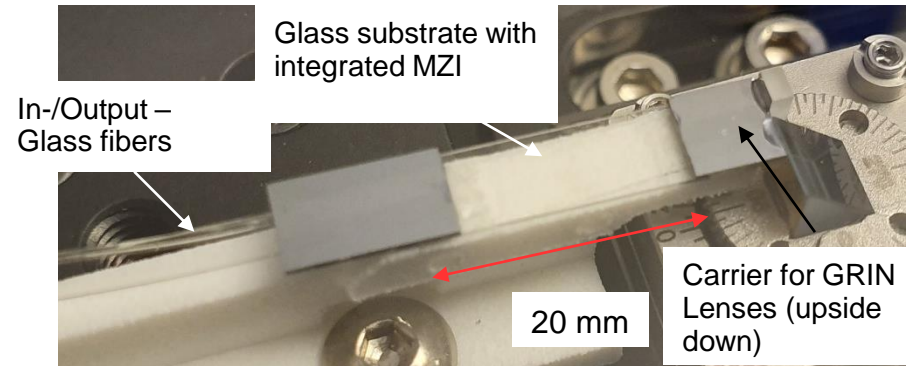
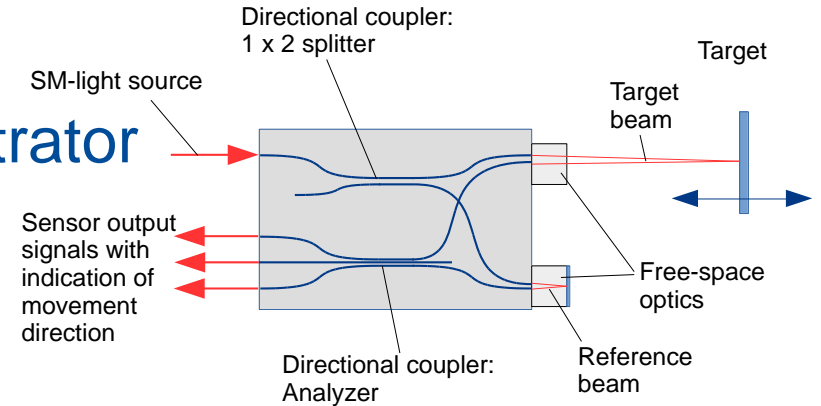


Metrohm



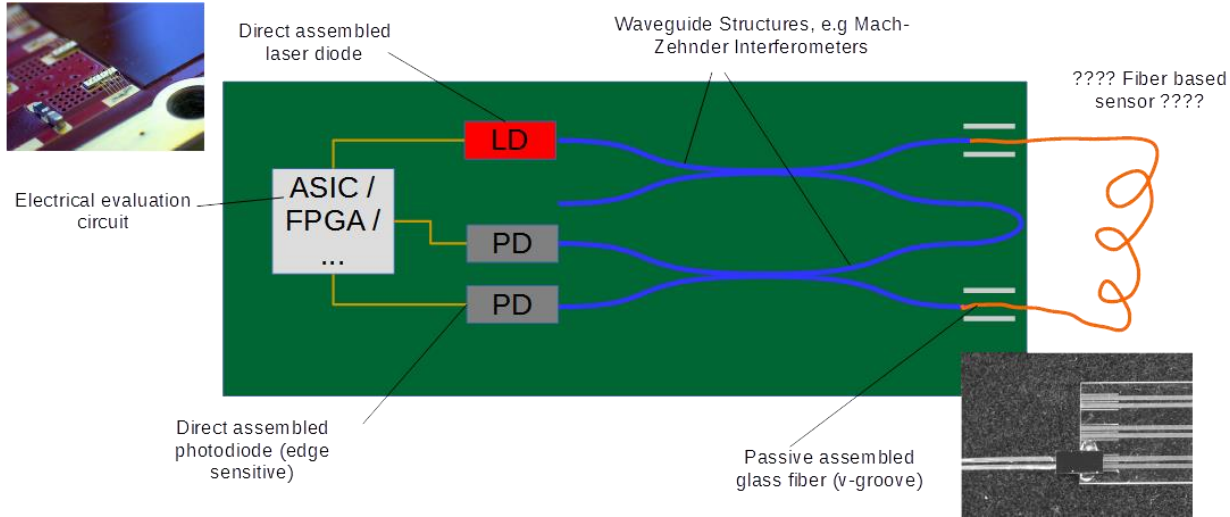
Miniaturized Interferometer for Displacement Sensing

- Integrated sensor technology demonstrator
- Singlemode waveguides (5 μ m)
- Measurement range: 200 μ m
- Sensor resolution: < 2 nm
- Highly integrated: 6 x 20 mm²
- Passive assembly of optical components



Kremmel et. al., Optical Engineering 2018

Integrated Micro Optics for Fiber Sensing?



- E.g. for distributed sensing of stress, temperature etc.
- Cost effective assembly platform for fibers
- Directly attached active components

Conclusion and Outlook

- WE OFFER an alternative approach for novel and creative solutions for future space applications:
 - Miniaturized and light weight optical systems for high speed signalling and sensing
 - Replacement of electrical solutions enabling reduction of power consumption, increase of bandwidth and protection against environmental influences
- WE NEED
 - System partners with corresponding needs to for space applications
 - Space component manufacturers and assembly houses



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The future is bright!

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