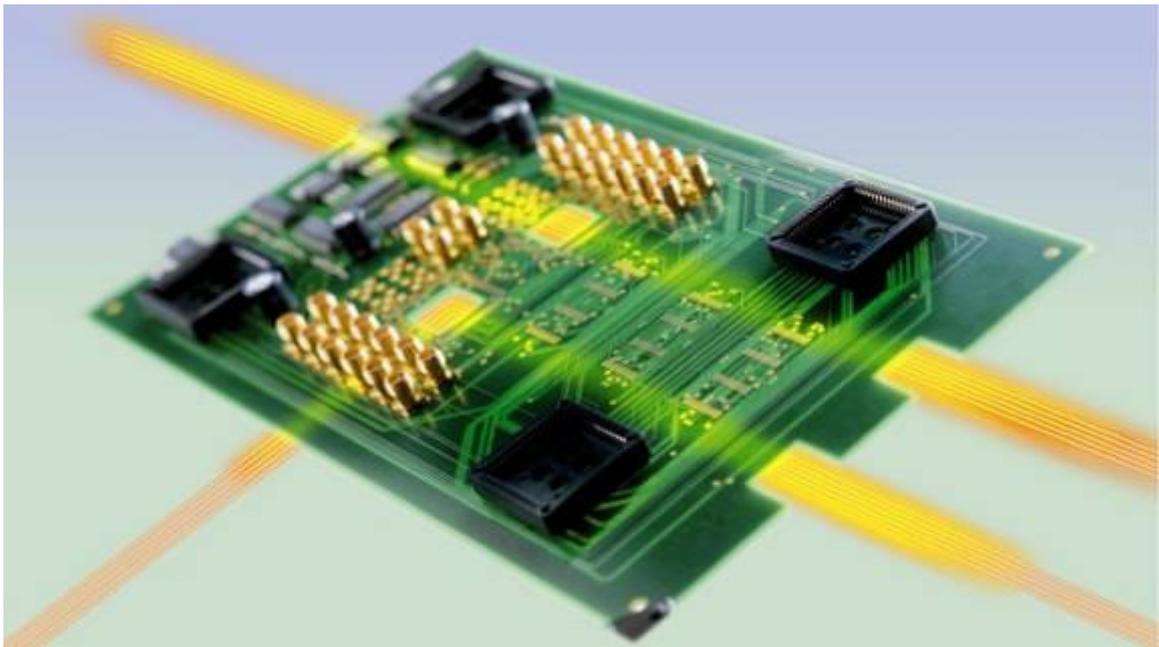




## **Electro-Optical Circuit Board Technology**



***Lights up Printed Circuit Boards***

## vario-optics ag – Leading EOCB Supplier

vario-optics ag, founded in 2009 as a spin-off of the well-known Varioprint AG, with location in Heiden (Switzerland) is a leading supplier of Electro Optical Circuit Boards (EOCB).

With this new technology, vario-optics ag has made significant investments, not only in the product technology but also in the development of the production process technology and the necessary infrastructure. The products are sold globally, to all major markets, such as telecom, industry, medical, automotive, military and aerospace.



Fig. 1 Premises of vario-optics ag

## Advantages of Optical Signal Transmission

Optical signal transmission provides many big advantages, other than **enormous bandwidth**:

- **Reduced complexity**; electrical signal transmission at high bandwidth requires high design efforts to ensure signal integrity
- **Higher integration density** can be reached, because distortions between optical waveguides are significantly lower
- **Reduced costs**, due to reduced complexity and the higher integration density
- **Increased transmission reliability**, also under harsh conditions (robust against electromagnetic distortions, explosive and radioactive environments, etc.)
- **Reduced power losses** and heat dissipation
- **Galvanic separation**: optics can be used to transmit data without having any electrical connection

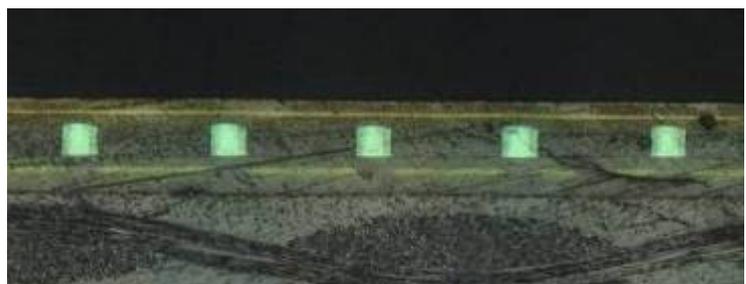
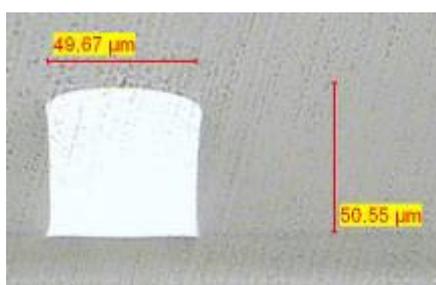
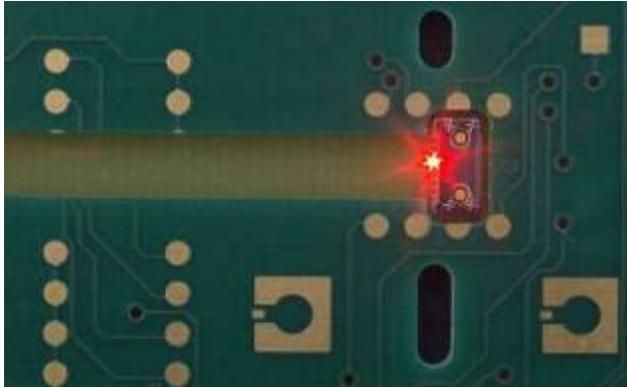


Fig. 2 Cross section of optical wave guides

## Our Technology and Process Know How



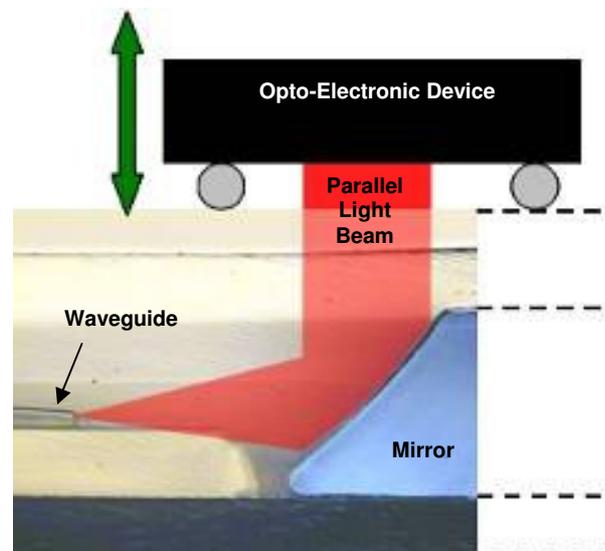
*Fig. 3 Perpendicular emitted light beam*

vario-optics long-term efforts lead to an electro-optical printed circuit board with well defined interfaces to transmitter and receiver modules. The optical layer consists of planar polymer waveguides and mirror elements. Data transmission rates of  $> 10$  Gb/s per channel with damping rates of  $< 0.05$  dB/cm and coupling losses  $< 1.2$  dB per interface are easily feasible. vario-optics has experience with a large variety of substrates (rigid, flex and rigid-flex).

The electro-optical printed circuit board of vario-optics is equipped with a well-defined, tolerance friendly interface. The required accuracy of the following placement of the optical components is relatively low, which enables a cheap final assembly of the electro-optical components.

The design of the electro-optical printed circuit board relies on manufacturing processes which are compatible with the standard photolithographic processes for electrical printed circuit boards. It allows manufacturing the standard format for PCB's, which can be produced with standard machines available on the market.

Since 2006 more than 3.5 km of waveguides have been produced in monthly production runs with permanently improved quality control according to the standards for PCB production. For this, vario-optics can base on an installed infrastructure, which is operated within a class 10'000 clean-room. vario-optics is currently capable of producing up to 100 electro-optical circuit panels per week with the size of 305mm x 460mm. The processes are easily scalable depending on the required production quantities.



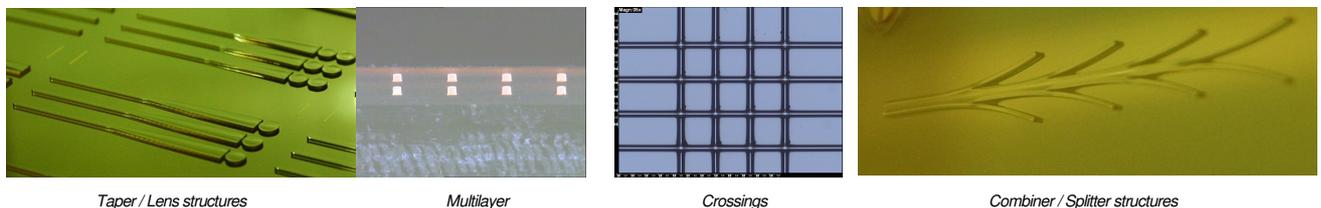
*Fig. 4 Cross section of a coupling element with parallel (collimated) light beam which allows a tolerance friendly placement of transceiver modules*



Fig. 5 EOCB manufacturing infrastructure: Polymer Coating, Laser Direct Imaging and Clean room

vario-optics can rely on a wide network of expertise from institutes, universities and optics specialists. One particularly important association is the cooperation with IBM which was established in 2003. Since then, the two companies have been working closely together on establishing production processes and materials for the electro-optical backplane.

vario-optics EOCB technology perfectly fits also for sensor applications. In addition to the general advantage of optical signal transmission is the extra design freedom because of the photolithographic production process - e.g. splitters, combiners, lens-structures in high density can be easily implemented and produced.



Taper / Lens structures

Multilayer

Crossings

Combiner / Splitter structures

Fig. 6 vario-optics EOCB technology permits virtually any planar optical structure

vario-optics is widely seen as technology leader in EOCB-technology with an advantage of at least 2 years over the next competitors. This emerges mainly from:

- Mature waveguide technology for datacom-, telecom- and sensor applications
- Tolerance friendly light coupling interface
- Mature production technology with processes and standards comparable to the conventional electrical printed circuit board technology
- Unique, standard CAD interface to customer
- Installed infrastructure, capable of the production of 100 panels per week