Electro-optical circuit boards

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Outline

- Introduction
- Planar polymer waveguide technology
- Demonstrators, prototypes and pre-series
- Conclusions
History

2002  • Varioprint starts development of EOCB technology

2004  • Clean Room installation
       • Patent filed for light coupling concept

2005  • Electro- Optical Circuit Board (EOCB) demonstrated (SMT)

2006  • Establishing EOCB fabrication processes
       • Successful EOCB development projects

2007  • Winner of the „Swiss Technology Award 2007“
       • EOCB demonstrator at the Hannover Fair

2008  • Automated Assembly of electro-optical components (FAPS Uni Nürnberg)

2009  • Spin-off vario-optics ag
Mission Statement

- Development of production technologies for electro-optical printed circuit boards (EOCB) and optical solutions

- Manufacturing of electro-optical functional models, prototypes and small to medium series

- Providing engineering services to customers
Targeted Markets

- ICT (Information and Communication Technology):
  - Computercom
  - HPCS (high performance computing) / Super computing
  - Datacom – switches, servers, storage devices

- Optical sensors and light delivery
  - Industrial and consumer electronics
Advantages of Optical Interconnects

- Bandwidth density
- Power efficiency
- Insusceptible to EMI

- Novel integration concepts
- Galvanic separation
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Polymer Waveguide Technology

EOCB – Building Blocks

Optical ports: Vertical coupling mirror Edge connector

Waveguides
Polymer Waveguide Technology

Status:

Dimension: 50 x 50 µm² - 500 x 500 µm²

Numerical aperture: 0.33

Optical attenuation: 0.05 dB/cm [850nm]
Fabrication Process

Lower cladding
- Deposition
- UV-Curing

Core layer
- Mask photolithography
- Laser direct Imaging

Upper cladding
- Deposition
- UV-Curing

Lamination
Panel-based Manufacturing

Challenges
- High temperature & high pressure
- Harsh environments
- Mechanical stress

Advantages
- Large area
- Batch process
Polymer Waveguide Technology

- Planar waveguide fabrication

Splitter
Combiner

Crossings

Taper
Lense structures

Laminated
Optical Ports

Function: Connection to optical elements
- Optical engine / optical subassembly
- Backplane / Fiber bundle

Types of optical ports:
- Edge connectors
- Vertical coupling mirrors
- Custom specific connector / coupling devices
Connector

- **Connector system basing on MPX-standard**
- **Passive alignment concept**
- **Rigid flex electro-optical circuit boards**
- **12 waveguides (50µm x 50µm)**
Vertical coupling mirrors

- Injection molded mirror
- 90° light beam deflection
- Embedded in the optical layer
Coupling Mirror

**Vertical Coupling Mirror**
- 8 mirrors / 500µm
- Injection molded with alignment features
- Metal coating
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Data-Link Demonstrator

- Automated assembly of electro-optical components
- Optical transmission of audio signals
Data-Link Demonstrator

- 8 channels data-link
- Mirrors for vertical coupling
- 10 Gb/s Eye-diagram
Example Project Optical Backplane

- Demonstrator for future storage systems
- 10 electrical layers
- 1 optical layer
- Size of waveguides: 60µm x 60µm
Optical Backplane Demonstrator

- Daughterboard – backplane system
- Connector based on MPX-standard

3.2 Gb/s
Example Project: Optical Sensor

- Integrated electro-optical sensor for color detection
- Optical layer thickness 500µm
- Pre-series stage
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Conclusion

- **EOCBs for Optical Interconnects**
  - Planar polymer waveguide technology

- **EOCB production capabilities**
  - Compatible with PCB fabrication
  - Cost-efficient processes
The Future is Bright!