

BERLINER GLAS GROUP – AN INTRODUCTION. WELCOME.



THE BERLINER GLAS GROUP AT A GLANCE.

MEDIUM-SIZED, INNOVATIVE, EXPORT-DRIVEN.



Legal form:
private-owned company



Executives:

- ▶ Dr. Andreas Nitze
- ▶ David Schwem



Year of foundation:
1952



Sales in 2018:
223 million Euro

- ▶ 92 % Photonics
- ▶ 8 % Technical Glass

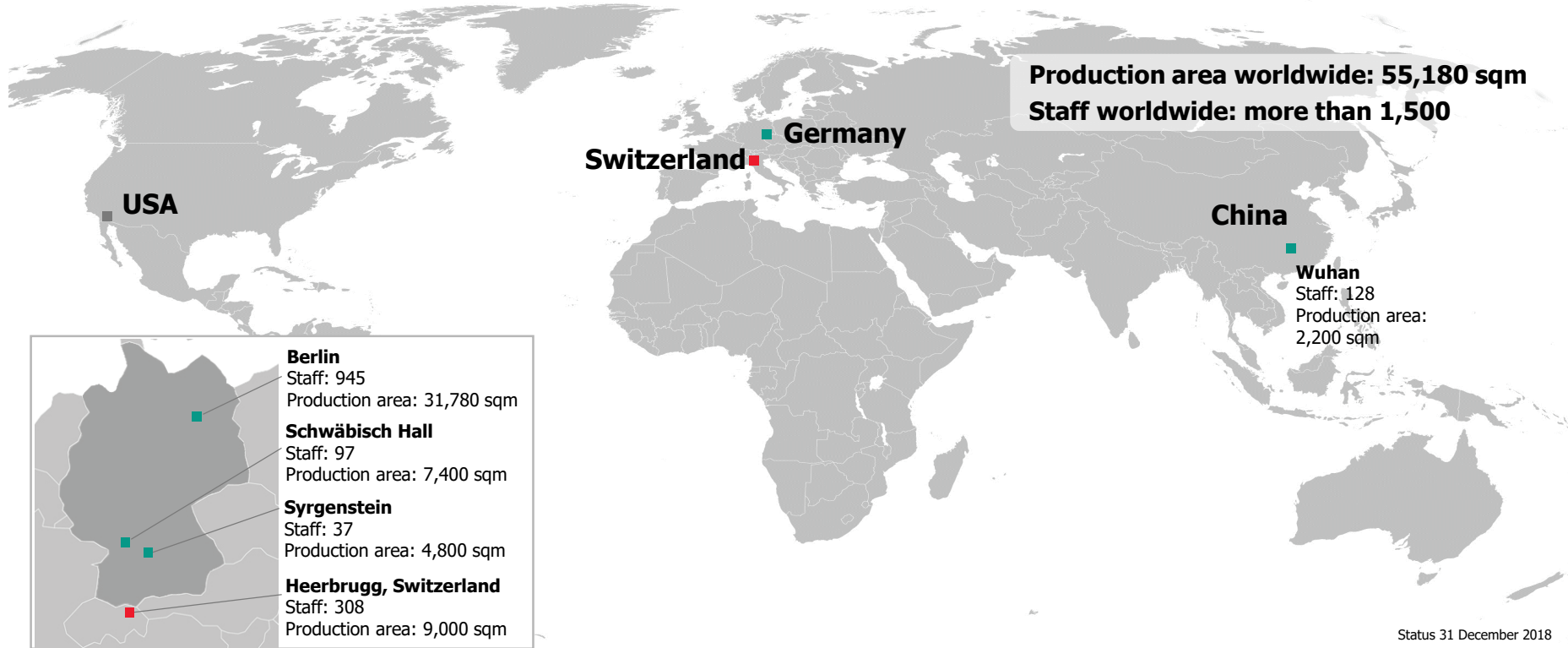


Business areas:

- ▶ Photonics
- ▶ Technical Glass

WHERE CAN YOU FIND US?

CLOSE TO OUR CUSTOMERS – IN EUROPE, THE US AND ASIA.



WHAT DO WE OFFER?

APPLICATIONS WITH LIGHT.

Many of our customers are...

- ▶ **Global players** within the different market segments

Their products are ...

- ▶ technically advanced **light-using products**

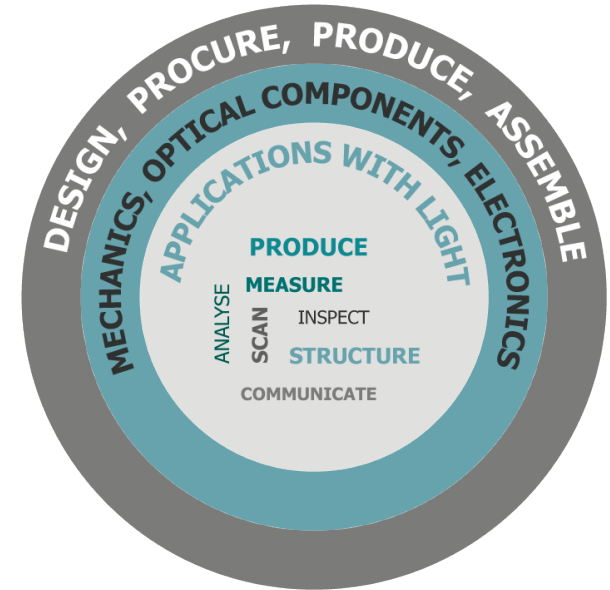
In cooperation with the customers we create ...

- ▶ innovative (sub-) **system solutions using** optical, mechanical and electronic components (OEM)

Our services:

- ▶ **design and development**
- ▶ professional **worldwide procurement**
- ▶ reliable **production of key components, assembly and system integration**

Substantial contribution to the process chain of our customers



WHAT WILL OUR CUSTOMERS RECEIVE?

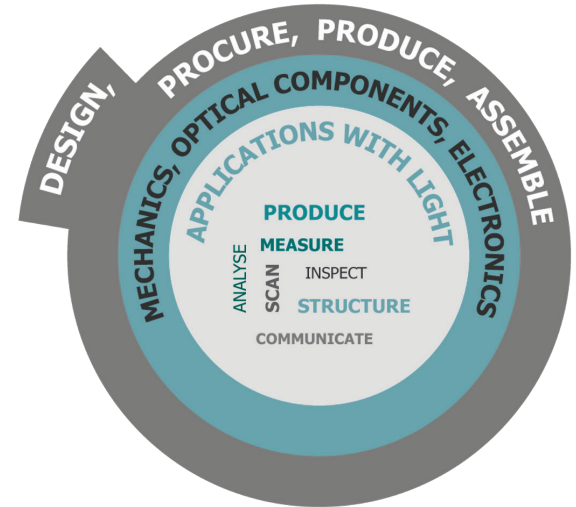
MANY ADVANTAGES AND A LOT OF BENEFITS.

Our strengths:

- ▶ 180 employees working in design, engineering or technology service functions; core areas are mechanics, optical components and electronics (12 % of total staff)
- ▶ Highly skilled employees (29 % of the employees are graduates)
- ▶ Innovative strength (High spending on R&D: appx. 10 % of annual turnover)

Your advantages:

- ▶ Understanding of the issues, trends and drivers of your market and understanding of your product and performance
- ▶ Tailor-made solution, ready for volume production
- ▶ Substantial contribution to the performance of your product



WHAT WILL OUR CUSTOMERS RECEIVE?

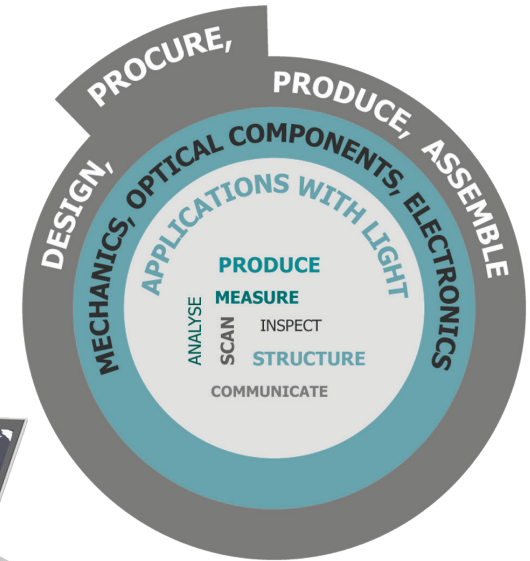
REDUCED COMPLEXITY AND COMPETITIVE PRICES.

Our strengths:

- ▶ Professional supply chain management
- ▶ Worldwide network of suppliers
- ▶ Purchasing organization in China
- ▶ Support and management of more than 300 suppliers

Your advantages:

- ▶ Deliberately designed value chain
- ▶ Competitive prices on a global market
- ▶ Purchasing assemblies will
 - ▶ reduce complexity
 - ▶ minimize risk



WHAT WILL OUR CUSTOMERS RECEIVE?

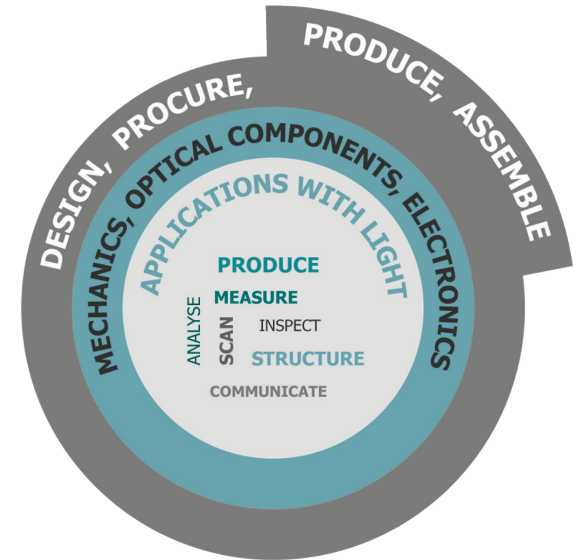
TAILOR-MADE PRODUCTS IN ACCORDANCE WITH SPECIFICATIONS.

Our strengths:

- ▶ Up-to-date production/measurement technologies for key components
 - ▶ High investments in production and measurement processes (19 % of annual turnover)
- ▶ Stable and lean processes
 - ▶ Continuous improvement of
 - ▶ process reliability
 - ▶ cycle time
 - ▶ production flow
 - ▶ flexibility
 - ▶ Certified Quality Management System according to ISO 9001
- ▶ Competitive prices

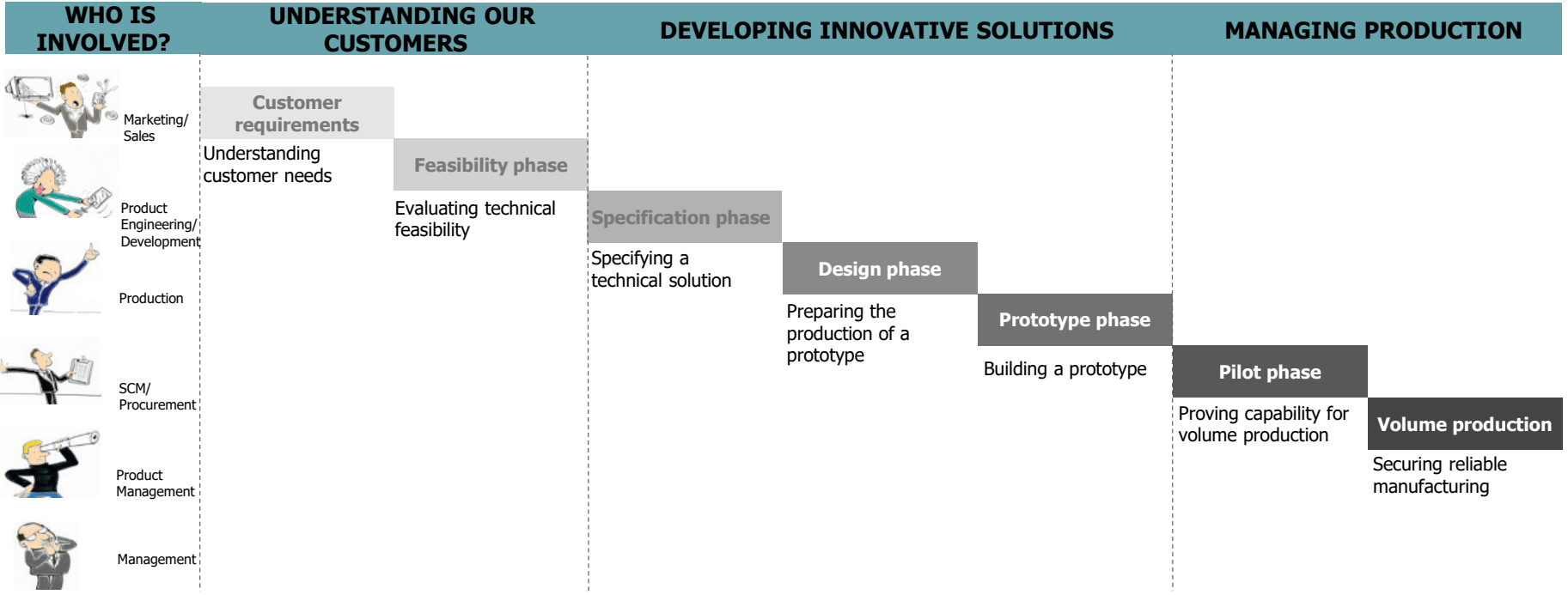
Your advantages:

- ▶ Competitive product, in accordance with specification and the required time frame
- ▶ Marketable lead time
- ▶ Continuous cost improvement



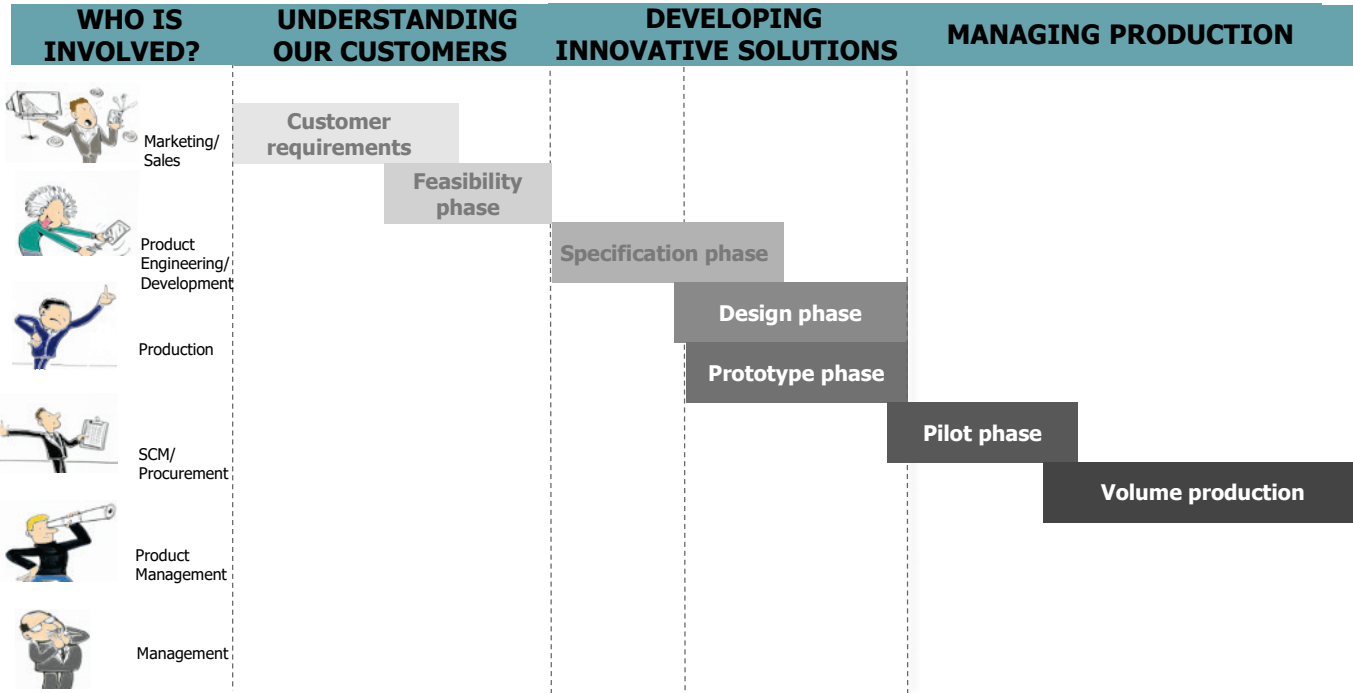
HOW DO WE COOPERATE WITH YOU?

WE LISTEN, DEVELOP, TEST, PROCURE, PRODUCE, DELIVER.

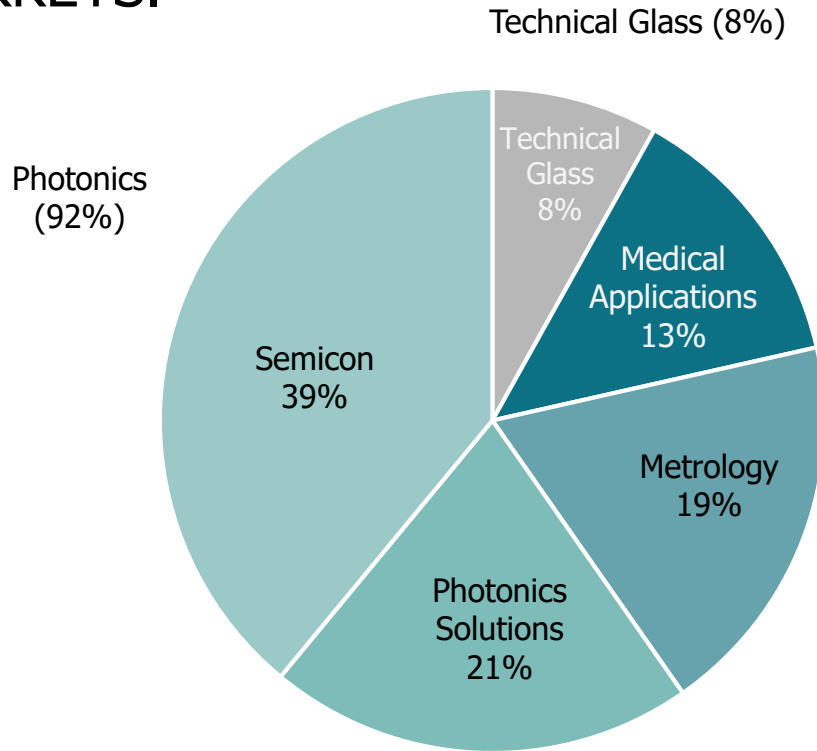


IF REQUIRED, ACCELERATED PROCESS DEVELOPMENT IS POSSIBLE.

WE LISTEN, DEVELOP, TEST, PROCURE, PRODUCE, DELIVER.



WHERE DO YOU FIND US? IN GROWING MARKETS.



TECHNICAL GLASS.
WE MAKE INFORMATION VISIBLE.

TECHNICAL GLASS.

SOLUTIONS FROM ONE SOURCE WITH ALL PROCESS TECHNIQUES.



Display glass and glass touch assemblies

- ▶ Medical technology
- ▶ Industry automation
- ▶ Navigation
- ▶ Marine
- ▶ Agriculture
- ▶ Food
- ▶ Traffic
- ▶ Entertainment systems
- ▶ Home automation



Glass for devices

- ▶ Sight protection screens
- ▶ Mirrors in sensor technology
- ▶ Eye protection glass
- ▶ Microscope slides
- ▶ Optical filters
- ▶ Design parts



Structured surfaces

- ▶ Cover glass/Front panels
- ▶ Instrument glass for vehicle cockpits
- ▶ Lighting glass
- ▶ Glass for touch applications
- ▶ Special etching (clean, relax, smooth)

TECHNICAL GLASS.

GLASS TOUCH ASSEMBLIES.

Design and production of

Glass-Touch-assemblies

- ▶ Display front panels
- ▶ Touch Sensor
- ▶ Controllers
- ▶ Ready-to-install, assembled in the frame

Applications

- ▶ Medical technology
- ▶ Industry automation
- ▶ Navigation systems and marine applications



TECHNICAL GLASS. DISPLAY GLASS.

Characteristics of the display glass

- ▶ Non-reflecting optically coated
- ▶ Non-reflecting optically structured
- ▶ Printed
- ▶ Tempered (thermal or chemical treatments)
- ▶ CNC processed
- ▶ Ready-to-install fully assembled

Material

- ▶ Laminated safety glass with UV- and heat protection



TECHNICAL GLASS.

GLASS FOR DEVICES.

High end finishing of technical glasses from one source

- ▶ Shaping processes (CNC machining, deformation): Shaping, design and safety for the highest demands
- ▶ Screen printing: High quality designs according to customer requirements
- ▶ Hardening process: optimize strength and fracture properties
- ▶ Laminated glass & lamination: combining appearance and functionality

Applications

- ▶ Cover glass/Front panels
- ▶ Instrument glass for vehicle cockpits
- ▶ Lighting glass
- ▶ Glass for touch applications
- ▶ Special etching (clean, relax, smooth)



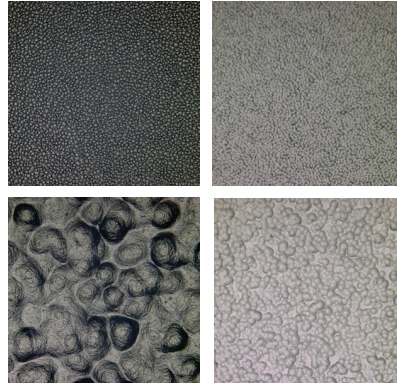
TECHNICAL GLASS. STRUCTURED SURFACES.

Services

- ▶ Standard etchings
- ▶ Customer-specific etchings

Advantages/Benefits

- ▶ Reduction of reflection
- ▶ Transmission enhancement
- ▶ Good haptic of touch glass



Microscopic images of different etched structures

Applications

- ▶ Cover glass/Front panels
- ▶ Instrument glass for vehicle cockpits
- ▶ Lighting glass
- ▶ Glass for touch applications
- ▶ Picture frame glass

SEMICON.

RIGHT TO THE LIMITS OF THE POSSIBLE.



SEMICON.

SOLUTIONS FOR THE SEMICONDUCTOR INDUSTRY.



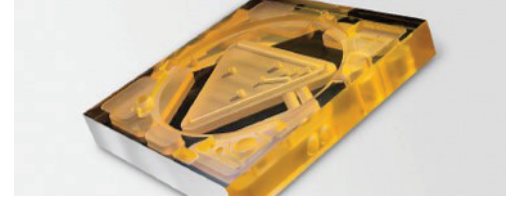
Chucks and precision components

- ▶ Electrostatic chucks
- ▶ Vacuum chucks
- ▶ High-precision structural parts
- ▶ Reference mirrors



Optical systems

- ▶ Opto-mechanical assemblies
- ▶ Opto-electronic systems
- ▶ High-end lenses



Stage modules

- ▶ Modules for integrated precision stages
- ▶ Modules for measurement systems
- ▶ Contract manufacturing

SEMICON: LITHOGRAPHY AND INSPECTION.

ELECTROSTATIC CHUCKS AND VACUUM CHUCKS.

Market characteristics, trends

- ▶ Moore's Law is the driver for shrinking structures
- ▶ Resolution, overlay, performance and cost of ownership are the key factors for competitiveness
- ▶ Few big technology companies dominate the market
- ▶ Next generation lithography: EUV, DSA, WLP

Our strengths

- ▶ 20 years of market experience: we know the current challenges
- ▶ High-precision production and measurement technologies
- ▶ Functional qualification
- ▶ Design expertise using glass and ceramics
- ▶ Functional hard coatings (CVD, PVD)



The solution

Vacuum chucks and electrostatic chucks with

- ▶ flatness $< 1 \mu\text{m}$
- ▶ high clamping force
- ▶ high temperature stability
- ▶ high stiffness

Your benefits

- ▶ A product that is adapted to your application in an optimal way
- ▶ Improvement of overlay
- ▶ Increase of performance
- ▶ Support of the necessary „time-to-market“
- ▶ Minor contamination of the wafer

SEMICON: 3D PACKAGING. ELECTROSTATIC CHUCKS.

Market characteristics, trends

- ▶ ICs are increasingly integrated in the third dimension
- ▶ Middle-end-of-line has been established as a new segment with new process steps (bonding, etching, coating)
- ▶ Very high growth rates are forecasted for WLP

Our strengths

- ▶ Processing of a broad range of materials
- ▶ In-house assembly of electronics for controllers
- ▶ Thermal management

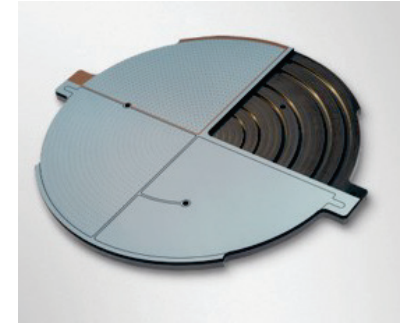
The solution

Electrostatic chucks with the following features

- ▶ a unique combination of ESC and heater
- ▶ high temperature uniformity
- ▶ no wafer sticking
- ▶ integrated solutions with controllers

Your benefits

- ▶ A product that is adapted to your application in an optimal way
- ▶ Secure handling of very thin wafer substrates
- ▶ Short bonding cycle times
- ▶ High bond strength possible



SEMICON: MANUFACTURING EQUIPMENT.

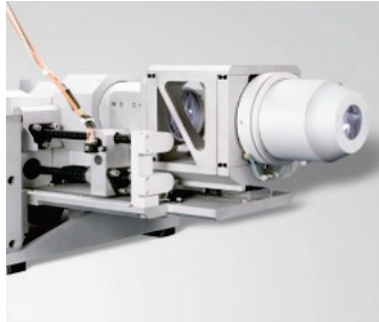
OPTO-MECHANICAL AND OPTO-ELECTRONIC SYSTEMS.

Market characteristics, trends

- ▶ The features on semiconductor chips are becoming smaller and smaller
- ▶ A higher accuracy and better resolutions for optical metrology and inspection equipment are required
- ▶ Cost of ownership needs to be reduced, by e. g. higher throughput, continuous yield improvement and reduction of development time and efforts

Our strengths

- ▶ Well-established product development process
- ▶ Assembly and metrology in high quality clean rooms (ISO 5 and VOC controlled)
- ▶ Manufacturing of key components
- ▶ Customer-specific metrology
- ▶ Extensive supply chain base



The solution

- ▶ Design, prototype manufacturing and volume production from one source
- ▶ High quality optical assemblies and key components

Your benefits

- ▶ Reduction of complexity in the supply chain
- ▶ Fully qualified products (CoC)
- ▶ Competent partner for all aspects of optical design, manufacturing and assembly

SEMICON: MANUFACTURING EQUIPMENT. STAGE MODULES.

Market characteristics, trends

- ▶ Our customers focus on their core competences
- ▶ Many customer-specific adaptations are realized in volume production
- ▶ Time-to-market is becoming shorter (quick start of production)

Our strengths

- ▶ (Co-)development and project management competence
- ▶ Assembly processes inside and outside of the clean room
- ▶ Extensive testing and qualifying

The solution

- ▶ Reliable, flexible and fast assembly of:
- ▶ Serial and test measuring facilities
- ▶ Basic modules for semiconductor equipment industry with integrated controllers

Your benefits

- ▶ Use of suppliers' innovative capacity
- ▶ Defining of solutions for sub-functions
- ▶ In-house integration of key components and parts of the worldwide supply chain



PHOTONICS SOLUTIONS.

CONVINCING SOLUTIONS FOR YOUR IDEAS.



PHOTONICS SOLUTIONS.

WE MAKE LIGHT WORK.



Space

- ▶ Modules for optical communication between satellites
- ▶ Modules for satellites for environmental monitoring



Laser technology

- ▶ Laser systems for OLED displays
- ▶ Laser expansion systems and beam guiding systems for the industry



High-precision optical components

Optical key components for highly specialized applications, e. g.

- ▶ Cylindrical lenses
- ▶ Aspherical lenses
- ▶ Interferometer mirrors

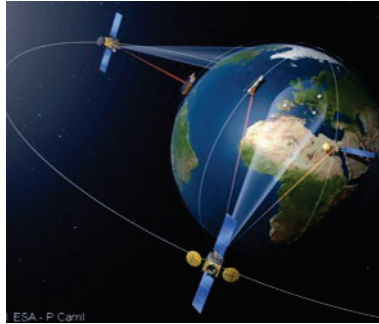
PHOTONICS SOLUTIONS. SPACE.

Market characteristics, trends

- ▶ Space Data Highway – paradigm shift to optical communication in space is in progress
- ▶ Data volume, availability and costs/bit are the drivers for the commercial Satcom market
- ▶ The importance of environmental monitoring from space is increasing

Our strengths

- ▶ Successful participation in space projects
- ▶ Experienced team of engineers
- ▶ Comprehensive production competence
- ▶ AIT clean rooms with ISO 5
- ▶ PM and QM systems according to ECSS standard



The solution

- ▶ Optical systems and components with diffraction limited performance under conditions in space
- ▶ Lightweight mirrors made of ceramics and Zerodur®
- ▶ Realization of the highest requirements for a long-term error-free operation (more than ten years)

Your benefits

- ▶ Space qualified and certified technologies (space heritage)
- ▶ All services from one source (design, development, production)
- ▶ Commitment and quick decision-making
- ▶ Manufacturing sites in Germany and Switzerland

PHOTONICS SOLUTIONS.

LASER TECHNOLOGY.

Market characteristics, trends

- ▶ Laser based procedures replace conventional production technologies
- ▶ Laser based material processing enables high precision and speed
- ▶ Multi-kW and ultrashort pulse laser systems require high-quality optics and mechanics

Our strengths

- ▶ Profound expertise in the handling and processing of fused quartz and glass-ceramics
- ▶ Optical production processes can be scaled up to very large optics
- ▶ Assembling of components and subsystems in clean rooms
- ▶ Design of tailor-made measurement technology

The solution

- ▶ Development and production of the entire system for laser beam conversion
- ▶ Extremely large cylindrical lenses and plane optics to secure long and homogenous line beams
- ▶ Precision components made of Zerodur® and SiSiC

Your benefits

- ▶ One-stop source – from concept to volume production
- ▶ Intelligent project management guarantees competitive time-to-market
- ▶ Decrease of the supplier base by professional SCM

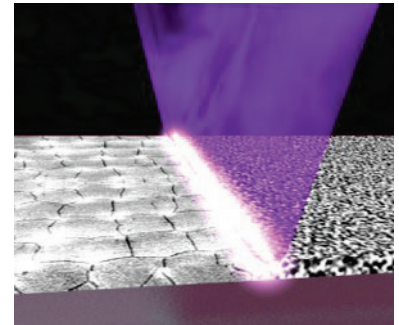


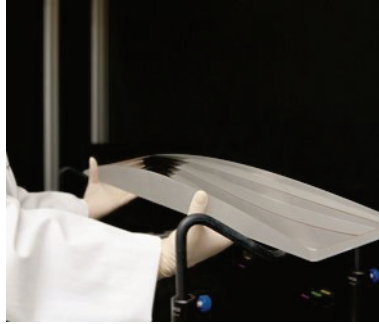
Image: Coherent Inc.

PHOTONICS SOLUTIONS.

HIGH-PRECISION OPTICAL COMPONENTS.

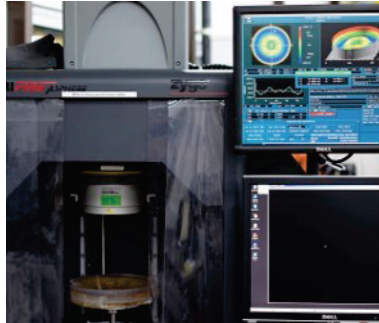
Market characteristics, trends

- ▶ Optical technologies are the drivers of innovation for important fields of technology; optical components and systems are central to a number of technical products
- ▶ High-tech applications require high-precision and complexity of the optical components produced



Our strengths

- ▶ Stable, reliable and lean processes
- ▶ State-of-the-art production technologies
- ▶ Development of tailor-made, sophisticated measurement devices



The solution

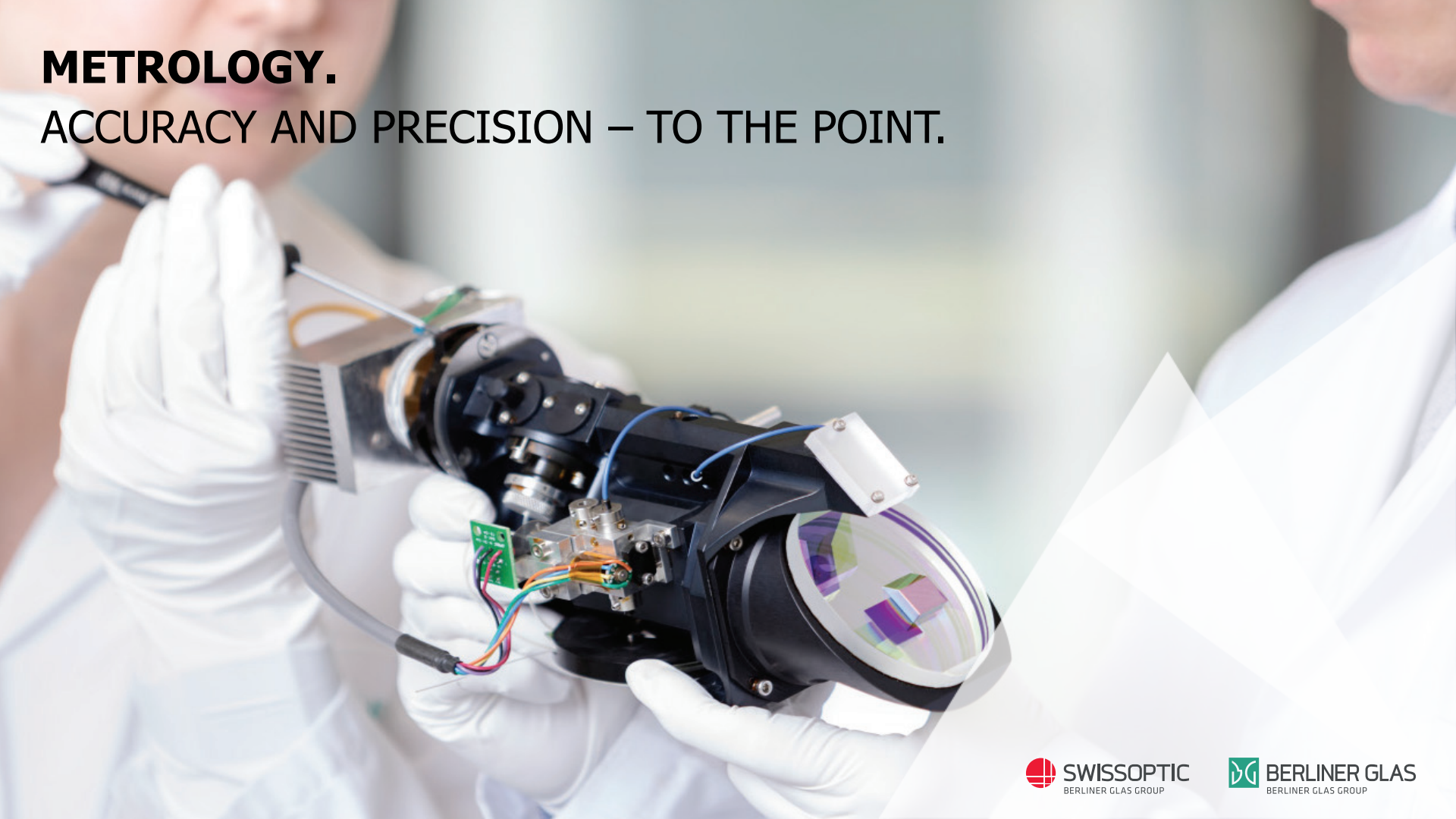
- ▶ High-precision optical components that substantially contribute to the entire system, e. g.:
- ▶ Cylindrical lenses and mirrors as well as plane optics with lengths of up to 2,000 mm
- ▶ Rotationally symmetric aspherical lenses and mirrors (with a diameter of up to 250 mm), off-axis aspheres and freeforms

Your benefits

- ▶ One-stop source – from concept to volume production
- ▶ Intelligent project management guarantees competitive time-to-market
- ▶ Competitive prices on a global market

METROLOGY.

ACCURACY AND PRECISION – TO THE POINT.



METROLOGY.

OPTO-MECHANICAL SYSTEMS FOR INNOVATIVE LASER BASED METROLOGY.



Geodesy

- ▶ Theodolites
- ▶ Total stations
- ▶ Laser scanners



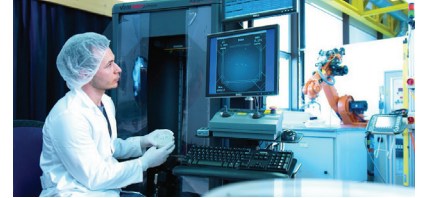
Photogrammetry

- ▶ OEM lenses for aerial cameras
- ▶ Beam splitters



Industrial surveying

- ▶ Laser trackers
- ▶ White light scanners



Industrial metrology

- ▶ Opto-electronic sensors
- ▶ Interferometer lenses

METROLOGY.

OPTO-MECHANICAL SYSTEMS FOR INNOVATIVE LASER BASED METROLOGY.

Market characteristics, trends

- ▶ High accuracy of portable devices
- ▶ Compact, lighter, faster, and at the same time less expensive
- ▶ Automation options
- ▶ Industry 4.0 requires smart sensor systems

Our strengths

- ▶ Competence in development
- ▶ Measurement technology perfectly aligned to the production technology
- ▶ Assembling competence incl. quality check of complete systems
- ▶ Global sourcing with qualified partners



The solution

- ▶ TPS total stations
- ▶ Aerial camera lenses for photogrammetric measurements
- ▶ Integration of superior aspherical lenses
- ▶ Opto-electronic sensor systems
- ▶ Application-specific systems engineering

Your benefits

- ▶ System responsibility – from concept to prototype to volume production
- ▶ Excellent knowledge of the processes and of product requirements
- ▶ Inhouse assembly & testing of the whole device
- ▶ Possibility to relocate the volume production to our subsidiary in China

MEDICAL APPLICATIONS.
HEALTH IN A NEW LIGHT.



MEDICAL APPLICATIONS.

CONTRIBUTION TO INNOVATIONS IN MEDICAL TECHNOLOGY.



Ophthalmology

Optical components and systems for

- ▶ Ophthalmic lasers (LASIK)
- ▶ Eye diagnostics (fundus imaging systems, OCT etc.)



Dentistry

- ▶ Dental measuring cameras
- ▶ Dental video cameras
- ▶ Intraoral cameras
- ▶ Caries detection systems
- ▶ Lab scanners



Endoscopy

- ▶ 3-chip cameras, autoclavable
- ▶ 2-chip cameras, VIS-NIR
- ▶ Endoscopes
- ▶ Autoclavable lenses
- ▶ Chip-on-tip



Life Sciences

- ▶ Lens systems
- ▶ Broadband lenses
- ▶ Microscope lenses
- ▶ Laser modules
- ▶ Spectrometers

MEDICAL APPLICATIONS.

OPHTHALMOLOGY.

Market characteristics, trends

- ▶ The market is characterized by a high demand for laser eye surgery as well as corresponding diagnostics
- ▶ The demographic change leads to an increasing demand for cataract surgery

Our strengths

- ▶ Many years of market experience: We know the physiological requirements of eye treatments and surgeries
- ▶ Development and production from one source
- ▶ Reliable qualification and documentation of our systems guarantee high product and patient safety



The solution

- ▶ Optical solutions that optimally comply with the specifications of the complete system of our customers
- ▶ Light systems with high output illumination

Your benefits

- ▶ A system that is adapted to the application in an optimal way
- ▶ No compromises compared to standard „catalog optics“
- ▶ From the optical design to volume production – all services from one source

MEDICAL APPLICATIONS.

DENTISTRY.

Market characteristics, trends

- ▶ A complete digital process chain is the condition for further innovations
- ▶ Focus lies on the patient's wellbeing: fast and pain free treatment
- ▶ Accuracy of measurement is improved continuously

Our strengths

- ▶ Provider of OEM/PLM system solutions
- ▶ >10 years of experience in:
 - ▶ Optical design
 - ▶ Product design
 - ▶ Competence in assembling
 - ▶ After sales service
 - ▶ Global supply chain management
- ▶ Clean rooms: levels ISO 5-8
- ▶ ISO 13485 certified

The solution

- ▶ Dental measuring cameras
- ▶ Dental video cameras
- ▶ Digital intraoral scanners
- ▶ Caries detection systems
- ▶ Digital lab scanners
- ▶ Feasibility studies

Your benefits

- ▶ Optics – Electronics – Mechanics:
We are your one-stop source
 - ▶ Development
 - ▶ Manufacturing
 - ▶ Sourcing
 - ▶ After sales service
- ▶ Cost-optimized high-volume solutions



Images: Sirona Dental Systems GmbH

MEDICAL APPLICATIONS.

ENDOSCOPY.

Market characteristics, trends

- ▶ 3D endoscopy
- ▶ HD resolution
- ▶ Autoclavability
- ▶ High-speed transmission of impression data is necessary
- ▶ Combined applications with fluorescence

Our strengths

- ▶ Provider of OEM/PLM system solutions
- ▶ >10 years of experience in:
 - ▶ Optical design
 - ▶ Product design
 - ▶ Competence in assembling
 - ▶ After sales service
 - ▶ Global supply chain management
- ▶ Clean rooms: levels ISO 5-8
- ▶ ISO 13485 certified

The solution

- ▶ Multi-chip prism components
- ▶ Autoclavable camera
- ▶ High-precision 6-axis alignment
- ▶ Complete color information per pixel
- ▶ Chip-on-tip
- ▶ 3D visualization

Your benefits

- ▶ High definition
- ▶ High light yield
- ▶ Flexible applications
- ▶ Innovative and tailor-made solutions



MEDICAL APPLICATIONS. LIFE SCIENCES.

Market characteristics, trends

- ▶ The trend towards personalized medicine/point of care requires small and mobile medical equipment
- ▶ Analysis of the smallest samples, high throughput and detection of extremely weak signals are key factors for competitiveness
- ▶ Cost pressure is the driver for automation

Our strenghts

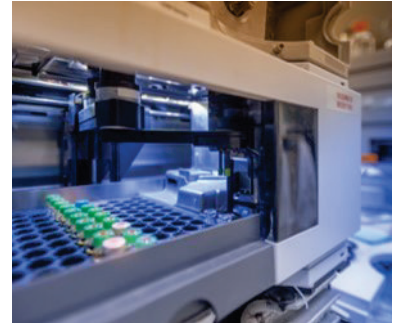
- ▶ Provider of OEM/PLM system solutions
- ▶ > 10 years of experiences in:
 - ▶ Optical design
 - ▶ Product design
 - ▶ Competence in assembling
 - ▶ After sales service
 - ▶ Global supply chain management
- ▶ Clean rooms: levels ISO 5-8
- ▶ ISO 13485 certified

The solution

- ▶ Opto-electronic components
- ▶ E. g. multi-chip prism components used in fluorescence detection
- ▶ Broadband lenses with a broad spectrum: 200–1,000 nm
- ▶ Microscope lenses
- ▶ Spectrometers

Your benefits

- ▶ Optics – Electronics – Mechanics: We are your one-stop source
 - ▶ Development
 - ▶ Manufacturing
 - ▶ Sourcing
 - ▶ After sales service
- ▶ Cost-optimized high-volume solutions



HOW DO WE OPERATE?

ON A BROAD BASE. HIGHLY SPECIALIZED.



Semicon

- ▶ Lithography
- ▶ Wafer handling
- ▶ 3D Integration
- ▶ Coating
- ▶ Inspection
- ▶ Metrology



Photonics Solutions

- ▶ Space
- ▶ Laser technology
- ▶ High-precision optical components



Metrology

- ▶ Geodesy
- ▶ Photogrammetry
- ▶ Industrial surveying
- ▶ Industrial metrology



Medical Applications

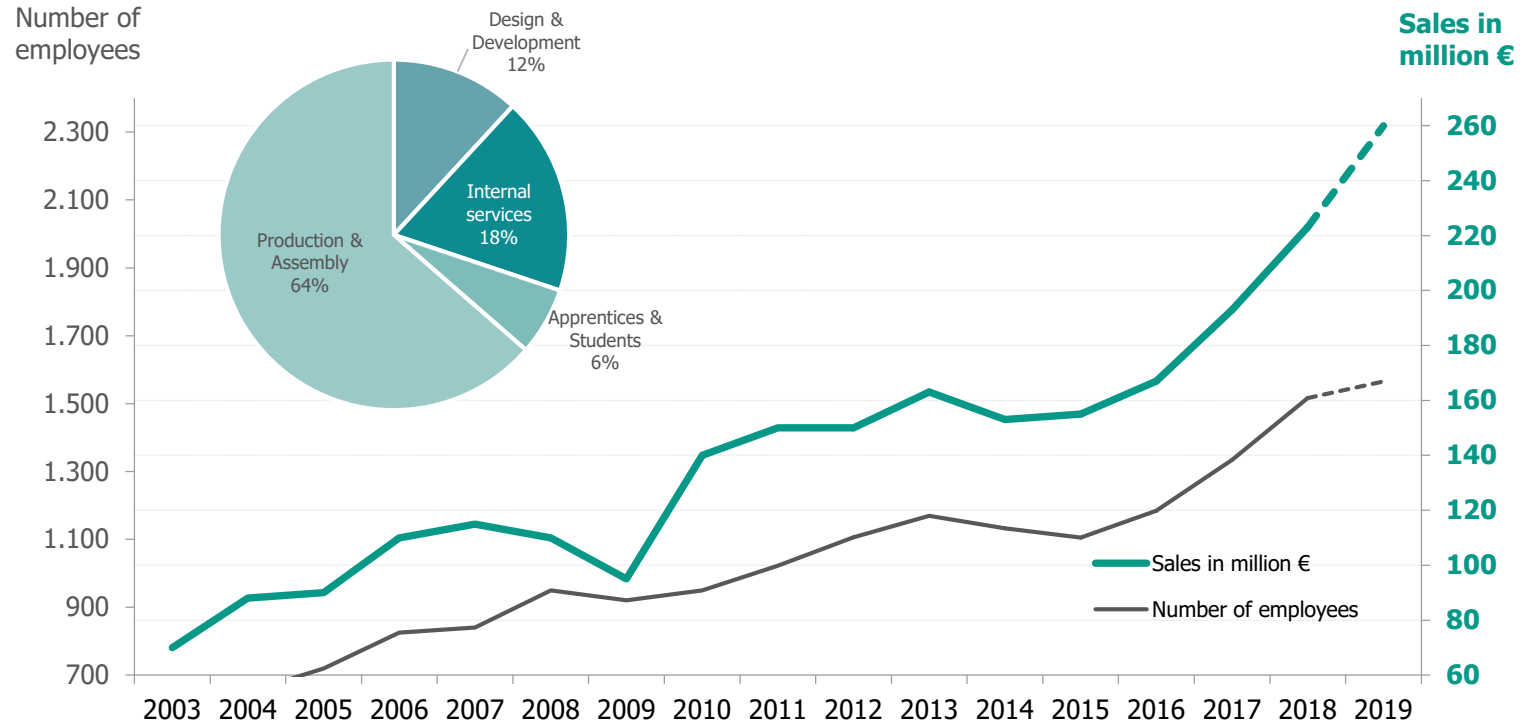
- ▶ Ophthalmology
- ▶ Dentistry
- ▶ Endoscopy
- ▶ Life Sciences



Technical Glass

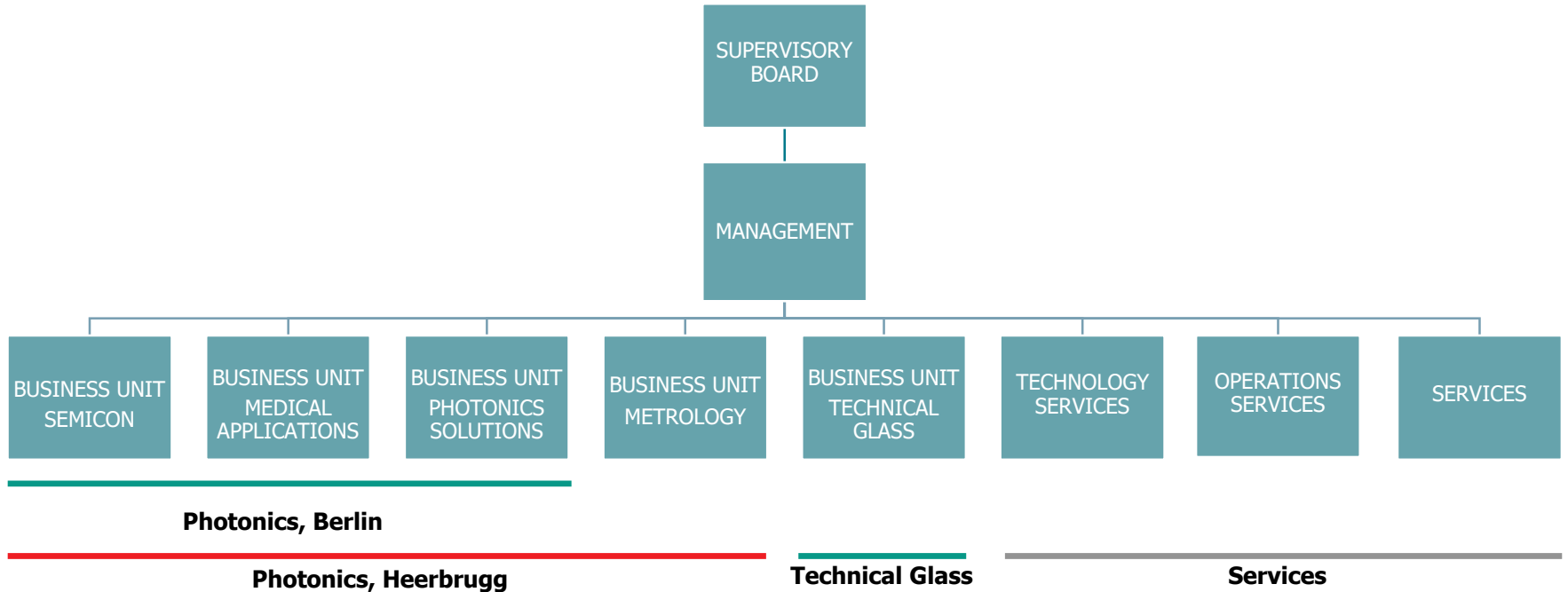
- ▶ Display glass and glass touch assemblies
- ▶ Glass for devices
- ▶ Structured surfaces

HOW DO WE SECURE CONTINUOUS GROWTH? THROUGH SUSTAINABLE SOLUTIONS AND WITH OUR EMPLOYEES.



OUR ORGANIZATION.

CLEAR FOCUS – FLAT HIERARCHIES.



GOOD REASONS TO CHOOSE THE BERLINER GLAS GROUP. AT LEAST FIVE.

CUSTOMER FOCUS

We help to accelerate your innovation and be first to market

- ▶ An understanding of the topics, trends and drivers in your market
- ▶ An understanding of your product and your service
- ▶ An understanding of your objective

INNOVATIVE SOLUTIONS

Attractive solutions for your customers will increase your revenue and market share

- ▶ Expertise to develop the most demanding components and assemblies
- ▶ Tailor-made solutions that are ready for volume production
- ▶ An important contribution to the performance of your product

NETWORK WITH STRONG PARTNERS

Assemblies reduce your complexity and risk in purchasing

- Worldwide sourcing guarantees a competitive price/performance ratio
- ▶ Worldwide network of capable suppliers: reliable and cost-conscious

RELIABLE PRODUCTION

You profit from a flawless production in the ramp up phase and on-time delivery of your products

- ▶ The products supplied meet the highest quality requirements
- ▶ Competitive lead times
- ▶ Continuous cost improvement
- ▶ Investments in the best employees, equipment and processes

LONG-TERM ORIENTATION

You get a fast, reliable, flexible and competent partner

- ▶ Family-run business
- ▶ Pursuit of long-term and partner-like business relations
- ▶ Investments in qualification and further training at all levels
- ▶ Focus on financial stability

**WE HELP OUR CUSTOMERS TO GET TO THE TOP.
AND TO REMAIN THERE.**

