

SCHOTT  
glass made of ideas

Let's realize new  
high-speed designs.

SCHOTT TO Headers & Caps





SCHOTT is a leading international technology group in the areas of specialty glass and glass-ceramics. With more than 130 years of outstanding development, materials and technology expertise we offer a broad portfolio of high-quality products and intelligent solutions that contribute to our customers' success.

Based on more than 75 years of expertise in manufacturing vacuum-tight housings with glass-to-metal sealing technology, SCHOTT is the quality and innovation leader in TO headers and caps for high-speed datacom applications. The international presence and technological expertise provided by our local R&D and Sales teams worldwide allows SCHOTT to deliver the best application support to meet your product customization requirements. Developing for and with you, we are your TO partner of choice from prototyping to serial production.

# Why is hermetic packaging so important for high-speed data communication?

## What is hermeticity?

In the context of microelectronics, the term “hermeticity” refers to a vacuum-tight seal that will prevent moisture and harmful gases from penetrating a sealed package. The moisture content allowed inside a hermetic cavity package usually must not exceed 5000 PPM water vapor over the lifetime of the device. Only packages made from glasses, metals and ceramics are considered hermetic.

## How does moisture affect the device?

Hydrogen and water vapor inside a package compromise the performance and reliability of the sensitive encapsulated components. This can lead to:

- Chemical corrosion, causing damage to the metal interconnects
- Electrical leakage across the pins
- Electrical shorts due to dendritic growth of silver and gold
- Change in transmission line impedance
- Light scattering or wavelength drift in photonic components

## Glass-to-metal sealing – The choice for reliable hermeticity

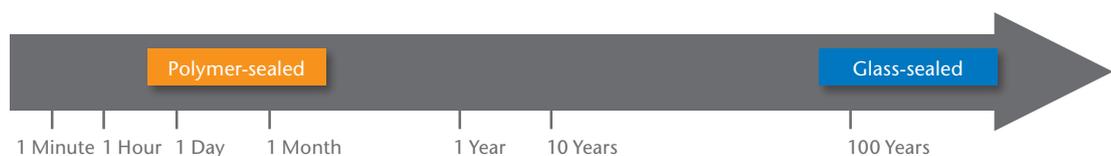
Glass-to-metal sealing has been the technology of choice for decades to manufacture vapor-proof, hermetic packages. The key advantages of hermetic sealing with glass in comparison to non- or quasi-hermetic polymer packaging:

### Glass is fully inorganic and does not outgas

Glass-to-metal sealed packages do not contain any organic substances and therefore do not outgas over time (proven with Residual Gas Analysis Tests).

### Glass seals have a permeability close to zero

Glass-to-metal sealed packages experience virtually no gas permeation. As shown in the below comparison, the critical sealing measure of 5000 PPM water vapor level typically holds below the threshold for nearly 100 years, far exceeding polymer-sealed counterparts.

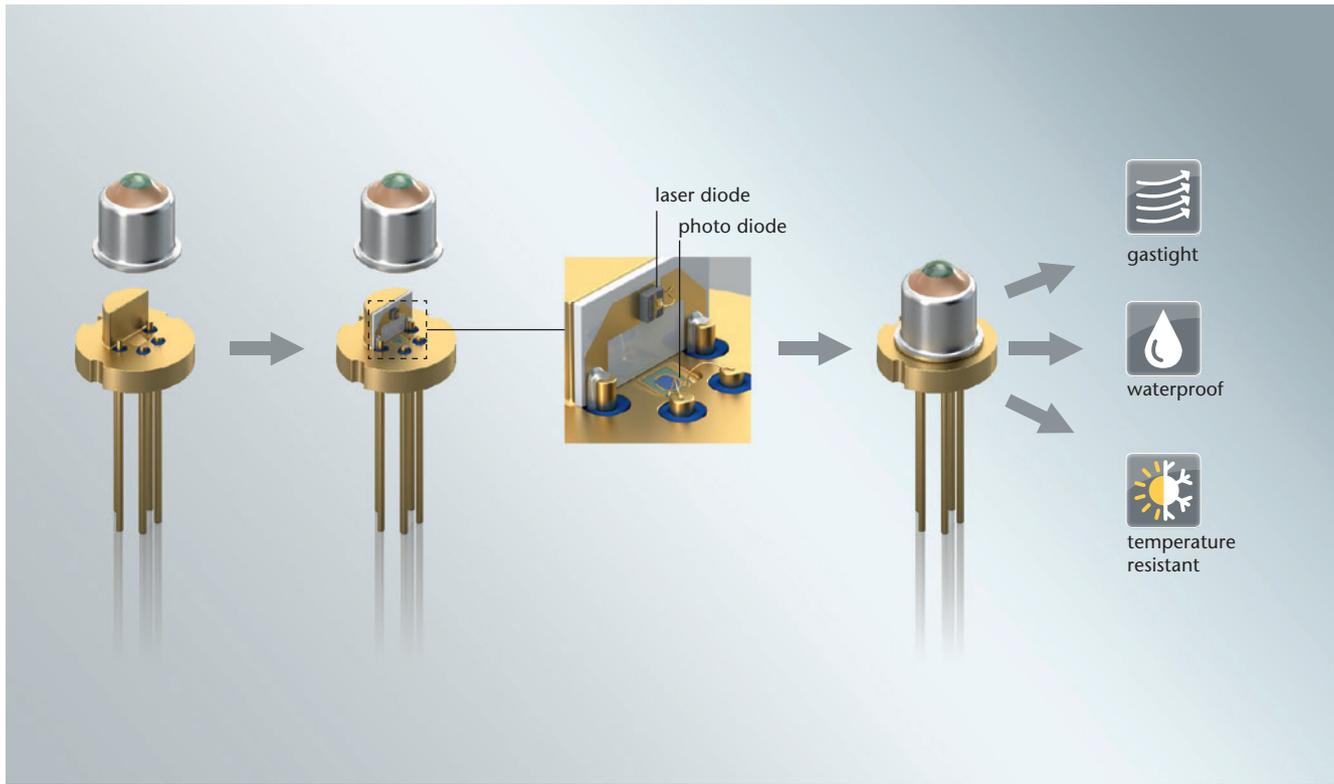


Time until 5000 PPM water vapor content is reached for typical cavity packages with a volume of 0,1 cm<sup>3</sup> (not to scale).



### Polymer ages naturally

- Polymeric materials have an inherent diffusive and absorbent characteristic due to their organic composition. Outgassing, during the curing process or during operation can compromise the ambient environment, leading to critical rates of vapor pressure, moisture level and condensation.
- Non-hermetic or quasi-hermetic cavity packages with polymer sealing materials typically reach critical permeation rates after a period of just a few days to several weeks. This is caused by diffusion of water and other gases through the polymer structure.



**TO cans – key components for hermetic protection:** Transistor outline headers and lenses are assembled to form a hermetically sealed “TO can” for reliable encapsulation, protecting sensitive semiconductor components from any adverse effects.

## Hermetic TO cans – Key components for high performance optical assemblies

### Hermetic glass-to-metal sealing technology – A core competency of SCHOTT

While glass-to-metal sealing is the most proven technology to produce hermetic packages, the art of permanently connecting glass with metal has only been mastered by a few. Due to the typically different coefficients of thermal expansion, expert knowledge of materials and processes is key to achieve long-term stability of the hermetic seal.

SCHOTT has more than 75 years of experience doing exactly that. Our glass-to-metal sealing technology is used to manufacture hermetic housings and feedthroughs for a broad variety of challenging applications. In addition to data/telecom, we serve industries with demand for quality hermetically-sealed packages such as automotive, aviation & aerospace and medical electronics.

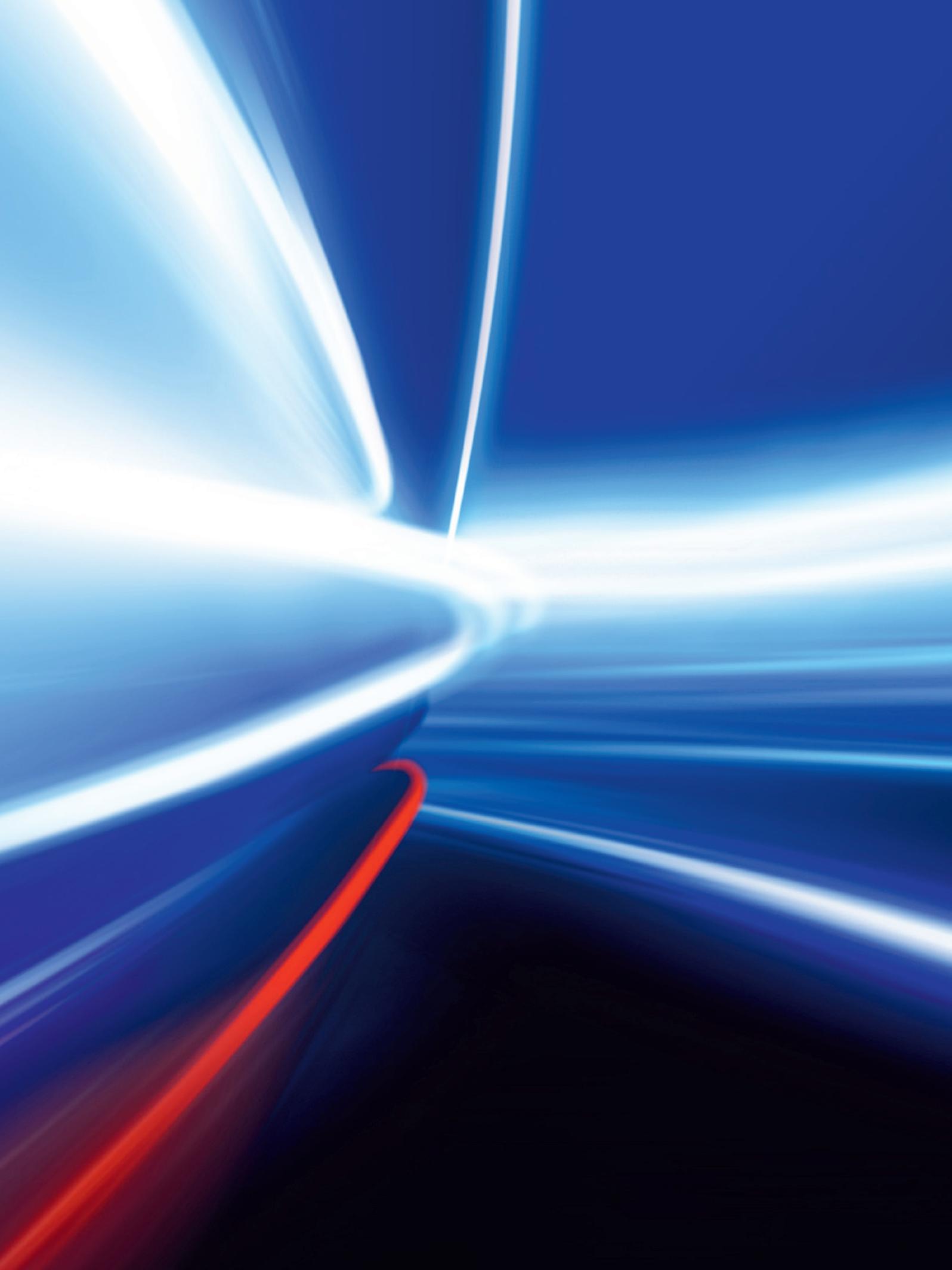


Application of TO cans in BOSA (Bi-Directional Optical Sub Assemblies).

### High-performance chips need high-performance housings

SCHOTT is the technology and innovation leader in Transistor Outline (TO) headers and caps for data/telecom applications. During their final assembly, they are welded shut to form a hermetically sealed "TO can package" that provides reliable encapsulation and protects sensitive semiconductor components from any adverse effects.

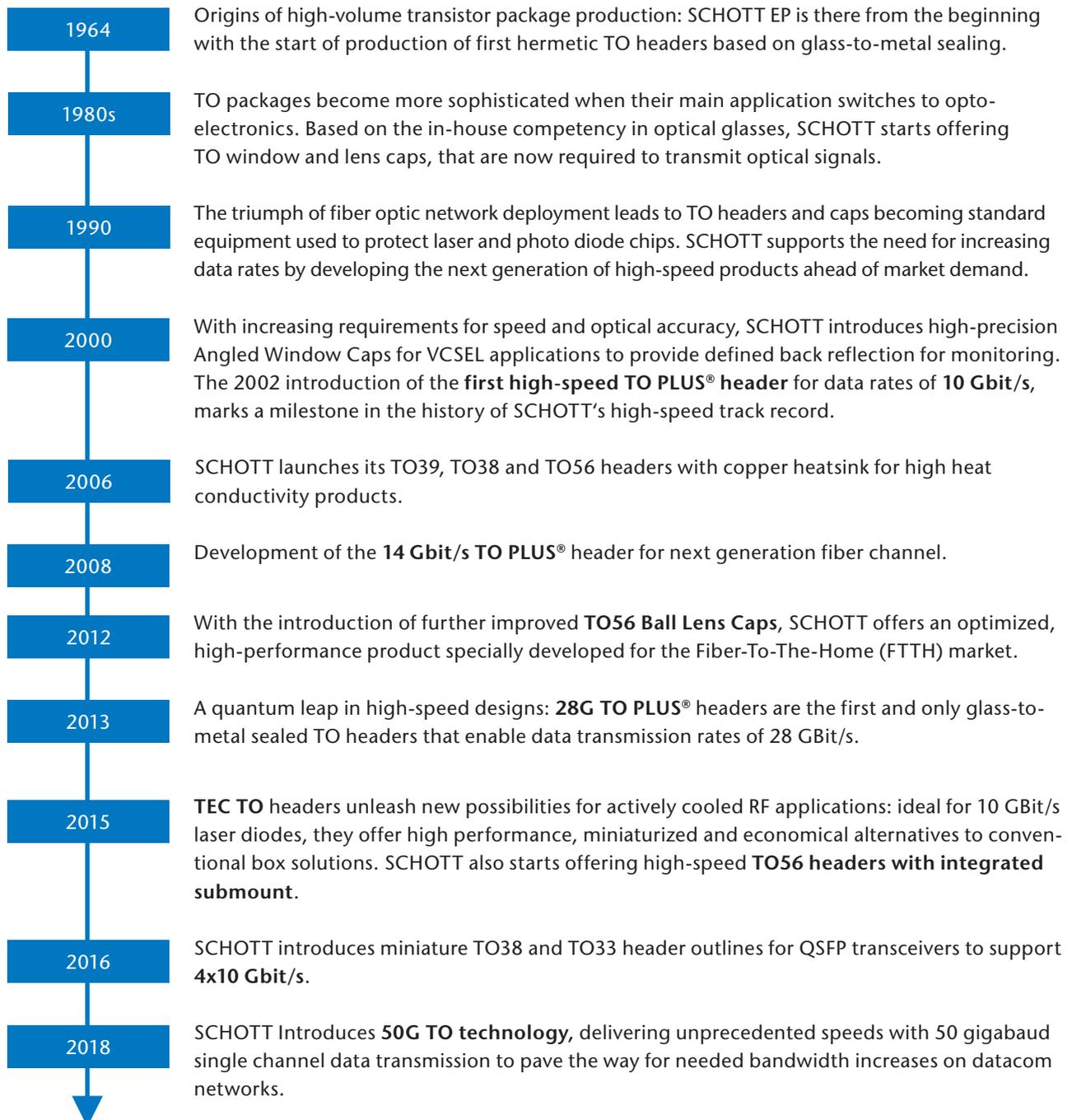
High-performance TO packages with vacuum-tight hermetic seals can only be produced with headers and caps that meet the most strict durability requirements. Built on a foundation of more than 50 years of experience in the TO field, SCHOTT's focus is on providing the most stable in-spec quality that allows excellent processability in our customers' production. Perfectly-matching TO headers and caps as well as extensive customization possibilities enable our customers to develop high-performance optical assemblies for next-generation high-speed infrastructure.



## Our innovation track record

The basis for current and next generation high-speed designs.

Recognized as a world leader in glass science and processing, SCHOTT's development of specialty glasses for the permanent sealing of glass and metal dates back to the 1930s. The first generation of today's high-speed TO PLUS® headers were introduced in 1964. With more than 50 years of research and applied knowledge in the TO field, SCHOTT continues to be a leading force in designing and manufacturing innovative high-speed designs that support next-generation data- and telecom infrastructure.



# High performance. Reliable lot-to-lot quality.

The cornerstones to enable stable processes in your production.

Highest quality and processability of TO components are essential to enable high throughput and superior performance, especially in applications that require high-speed transmission or reception of optical signals. SCHOTT possesses vast knowledge that is essential in the production of these high-quality components.

### Glass and Optical Coating

We are one of the few glass-to-metal sealing houses with in-house development, production and processing of glass with special properties. SCHOTT's optical glass and coating competence is a large benefit for our TO caps and lenses customers who demand the highest quality and precision.

### Plating

High-quality plating is important for processability of TO products. All Electronic Packaging sites have their own in-house plating know-how and experts.

### Tool Manufacture

Precise melting fixtures are essential in the manufacture of high-quality TO packages. At SCHOTT, the fixtures are designed in-house to keep ultimate control over this important aspect.

### Stamping

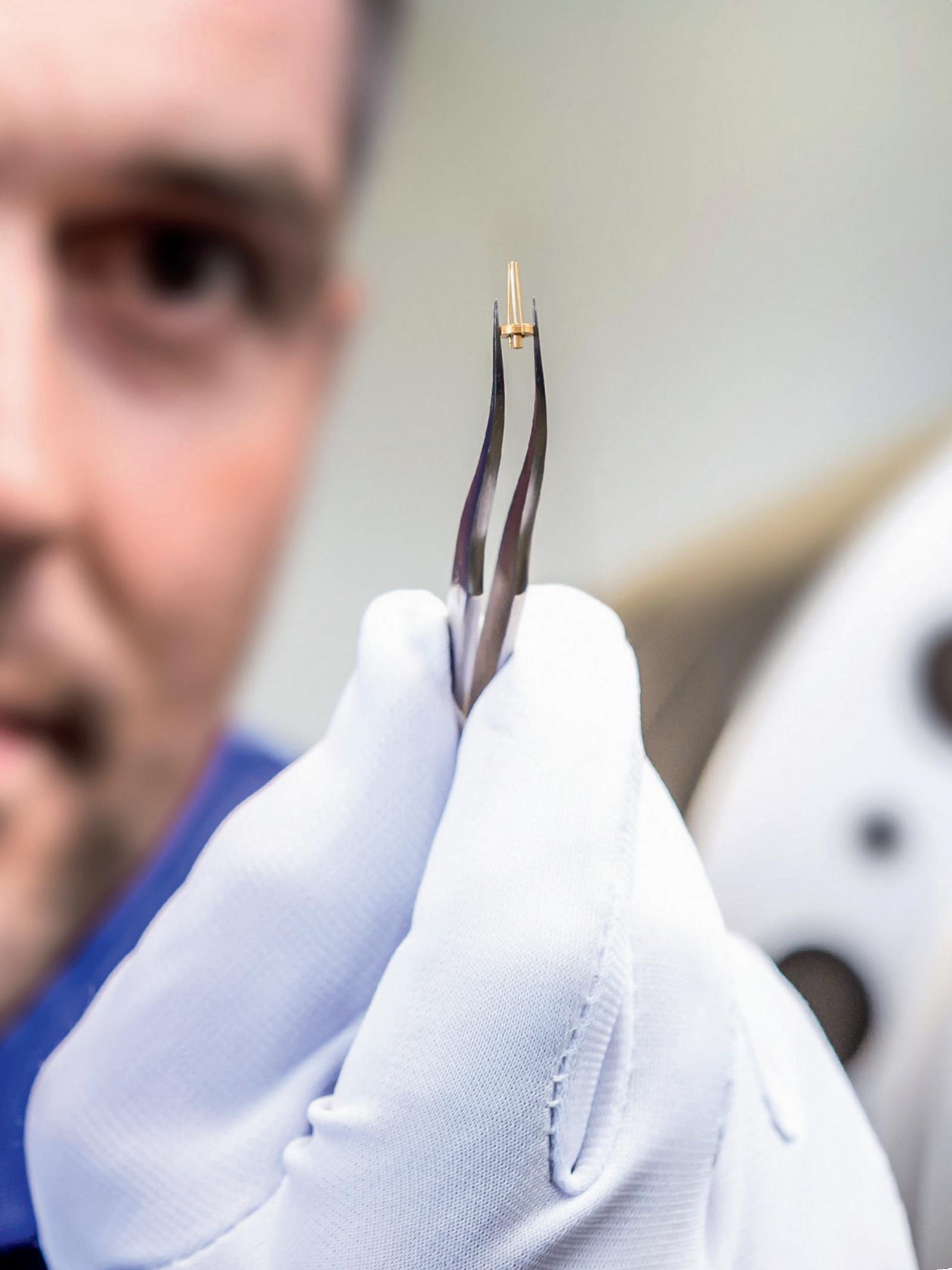
Stamped parts are a key ingredient for cost-effective packages. High quality stamped parts are important to maintain repeatable quality and processability of the components.

### Brazing

SCHOTT combines its glass-to-metal sealing expertise with brazing process know-how to add additional components to TO packages, such as ground pins and heat sinks.

Your requirements	How we achieve it
Reliable hermeticity	Reliable hermetic packaging is a precondition to enable superior performance, especially with increasing bandwidth demands, that require high-speed transmission or reception of optical signals. SCHOTT's products meet the highest reliability requirements thanks to our experience and technological leadership in glass-to-metal sealing.
High throughput, Processability	TO headers and caps from SCHOTT combine high-performance designs with narrow tolerances and robust glass-to-metal seals. The mechanical stability of our products enables high throughput in your production thanks to excellent ease of use and processability.
Wire bondability, Die attachability	Constant, uniform plating quality of our products enables high process stability in your wire bonding and die attach processes.
Weldability, Solderability	Our customers receive products with excellent surface quality thanks to strict monitoring and control of material properties and superior overall material quality. This enhances weldability of the TO caps and soldering of the leads for a reliably hermetic seal.
Stable optical properties	TO caps and lenses from SCHOTT are manufactured with very low variability of the optical properties thanks to tight control over our in-house melting processes. This is essential to achieve good coupling efficiency.





# Let's develop new high-speed designs.

We innovate for and with you.

## We innovate for you

SCHOTT's launch of the first ever 10 Gbit/s TO PLUS® header marked one of the most significant breakthroughs in the history of high-speed design. Since then, SCHOTT has proactively supported the requirement for continuously increasing data rates by already developing the next generation of high-speed products before the market demands it.

## Platform developments – Made to be customized

Our R&D specialists utilize their experience and market knowledge to anticipate future customer challenges and develop solutions for these potential problems before they occur. All of SCHOTT's high-performance TO header platforms are made to be modified to suit customer specifications. Typical modifications include size alterations, pin number, pin positioning, or special material requirements.

## We innovate with you

You can count on complete and comprehensive support from SCHOTT in your product design and development process. By working closely together, we can make sure your desired functionality and performance specifications are met. SCHOTT can help make customer designs a reality thanks to a broad base of available tools.

	Important/relevant for	Available tools @ SCHOTT
<b>Mechanical design</b>	For both TO header and TO cap designs – to perform simulations, especially with regards to simulation of sealing glass requirements and performance	<ul style="list-style-type: none"> <li>• CAD</li> <li>• Finite Element Analysis</li> </ul>
<b>Electrical design</b>	Electrical simulations are an essential part of developing high-frequency TO header designs.	<ul style="list-style-type: none"> <li>• EM field simulation</li> <li>• RF Circuit Simulator</li> </ul>
<b>Thermal design</b>	With increasing data rates and performance, there are potential issues with thermal management that need to be addressed. Our simulation tools can provide valuable insights on the ideal choice of materials for TO headers.	<ul style="list-style-type: none"> <li>• Finite Element Analysis</li> </ul>
<b>Optical design</b>	Optical simulations of TO cap and lens designs are vital to ensure that customer requirements for fiber coupling can be realized.	<ul style="list-style-type: none"> <li>• Ray tracing</li> <li>• Coating simulation</li> </ul>

## TO Headers

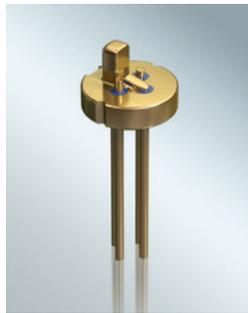
TO headers are used in nearly all areas of microelectronic packaging applications – on both the transmitter and on the receiver side of transceivers, in high-speed data transfer, and in UV/VIS/IR sensor applications. SCHOTT TO PLUS® headers are specially designed for implementation in laser and photo diode components. They meet the highest data transfer speed demands and enable the creation of optical components that provide high throughput rates for large volumes of data.

As THE TO house, SCHOTT offers a broad variety of TO header platforms for datacom and sensor applications:

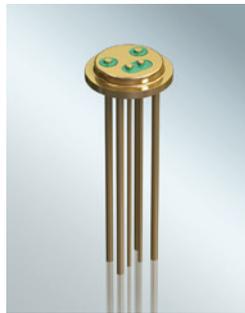
### Datacom applications



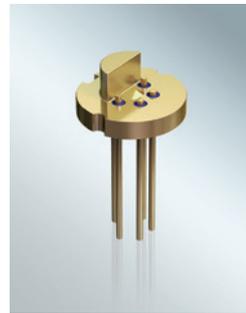
TO33 Header



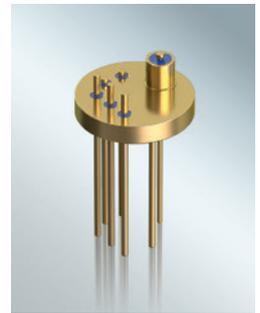
TO38 Header



TO46 PLUS® Header

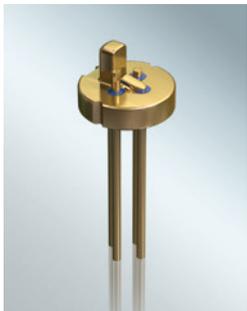


TO56 PLUS® Header

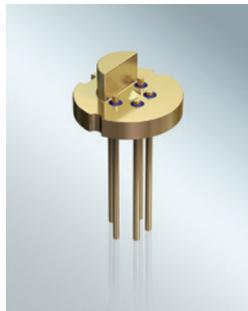


TEC TO Header

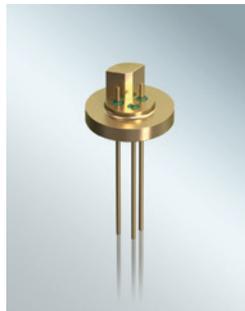
### Laser packaging applications



TO38 Header

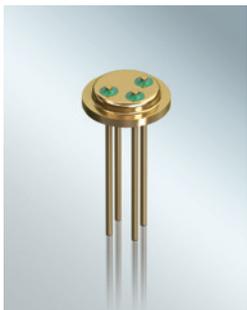


TO56 PLUS® Header

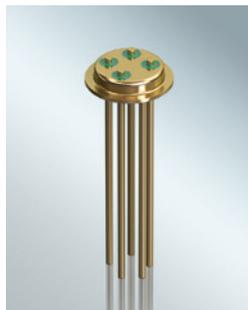


9 mm TO Header

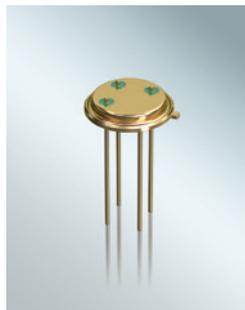
### Sensor/LED applications



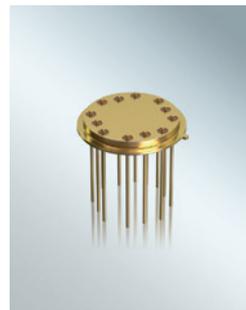
TO41 Header



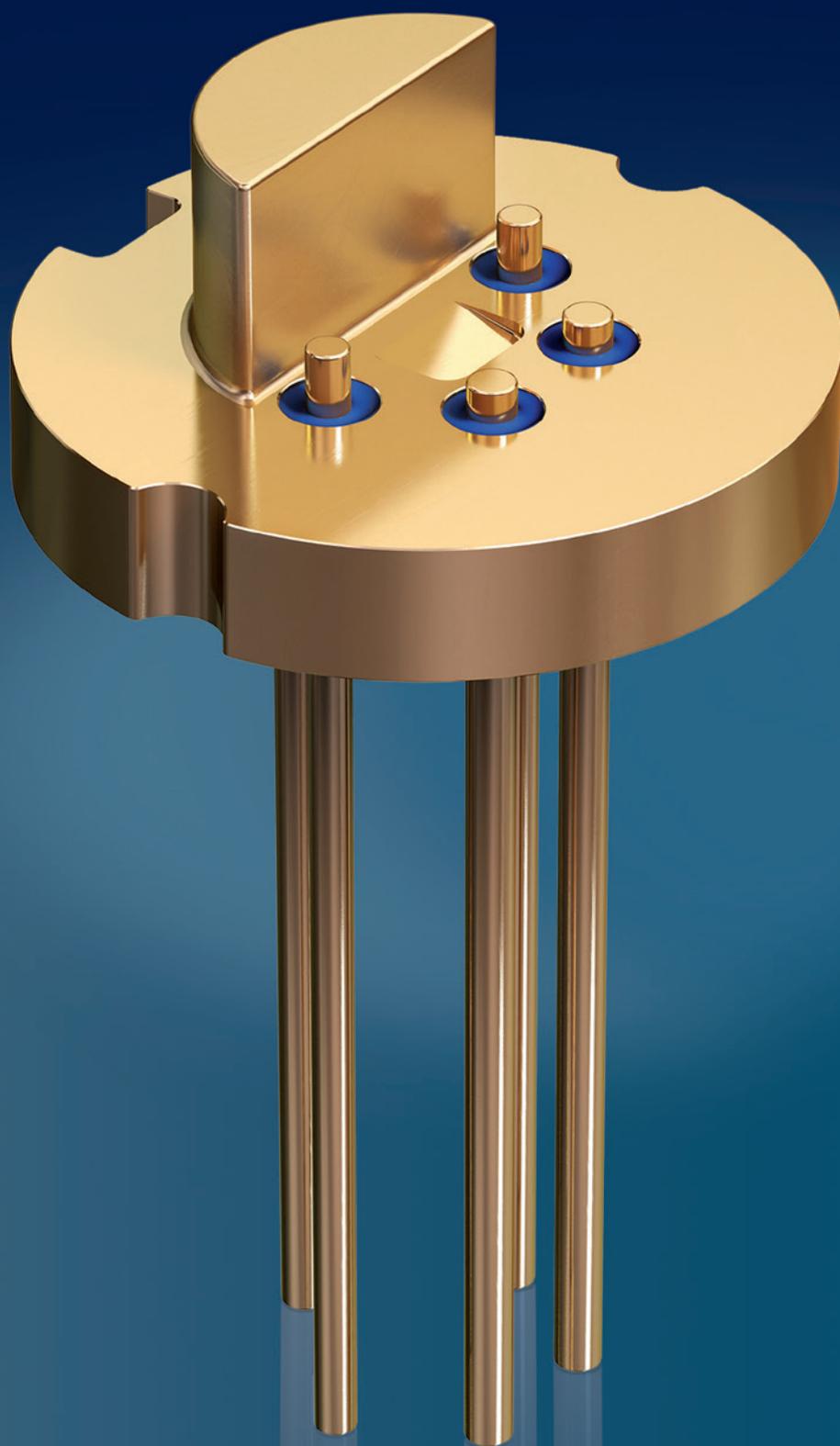
TO46 Header



TO39 Header



TO8 Header





Ball Lens Caps

# Ultra High Precision TO Caps

SCHOTT Ultra High Precision TO caps meet the highest precision requirements for light beam input and output. To manufacture these components, the glass body and metal frame are soldered together in a cleanroom environment so the narrow tolerances of the optical properties are not compromised.

## Specialty Glass Expertise

For high-precision applications, the glass lens or window must remain undisturbed during the soldering process. Our technological leadership assures that the lenses and windows are developed and processed to an extremely high quality standard.

## Coating Expertise

SCHOTT TO caps can be supplied with special optical coatings, such as anti-reflection coatings to increase transmission. Beam splitter coatings can be applied to provide defined back reflection. Filter coatings are used to block certain wavelengths.

## Ball Lens Caps

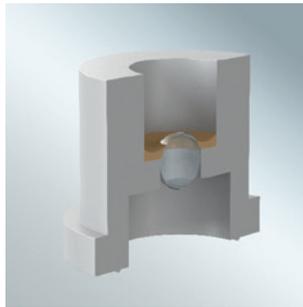
These caps were specially developed for colimation and point-to-point imaging in laser diode to fiber coupling applications. SCHOTT can develop custom-made glass types to suit individual coupling efficiency specifications, such as refractive indices and ball lens diameters. Our ball lens caps are optimized for high stability of the focal point. Stable optical properties are achieved through the first-class quality of the ball lens roundness and close control of the ball lens position for welding purposes.

## Angled/ Flat Window Caps

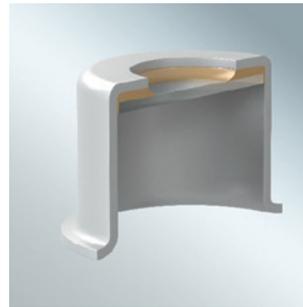
Ultra High Precision Window Caps are manufactured to provide the highest levels of light transmission, further enhanced through AR coatings and the use of high-precision optical glass discs. These TO caps can be made in a variety of different geometric shapes:



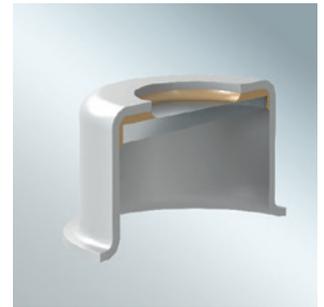
**Angled Window Cap**  
Provides signal reflection for the monitor diode, mostly in VCSEL applications. Stable accuracy of the glass disc angle offers excellent processability.



**Machined Cap (Lens and Window)**  
Manufactured with extremely tight tolerances and highest mechanical stability, offering minimized variation in our customers processes. Machined TO caps can be fully customized.



**Flat Window Cap**  
Wide variety of applications. In data and telecom, flat window caps are mostly used for photo diode and sensor applications.



**Wedge Window Cap**  
Prevents back reflection of light in Test & Measurement Applications. SCHOTT is one of very few suppliers that offer this product for low volume, high requirement applications.

## Precision TO Caps

SCHOTT's precision caps are commonly referred to as "molded" or "direct seal caps" because they are sealed hermetically by fusing the glass directly to the metal frame without the use of any interface materials. This fusion process must be designed in a way that ensures the glass cools down with minimal formation of bubbles or inclusions and correct optical properties. The highly robust glass-to-metal connection of SCHOTT TO caps provides excellent mechanical stability and processability in our customers' production.

### Specialty Glass Expertise

Precise control of lens shape and achievable window planarity are essential to achieve stable product properties in the application. Our high quality windows and convex (plano and biconvex) lenses can be supplied in a wide range of designs to meet customer specifications.

### Coating Expertise

SCHOTT TO caps can be supplied with special optical coatings to increase transmission. SCHOTT offers specialty glass with the highest UV transmission properties.



#### Integrated Mini Lens Cap

The lens cap standard for single mode receiver applications; Efficient and economical lens cap that fulfills all application demands and offers accurate imaging properties.



#### Molded Window Cap

For multi-mode coupling with external lenses.

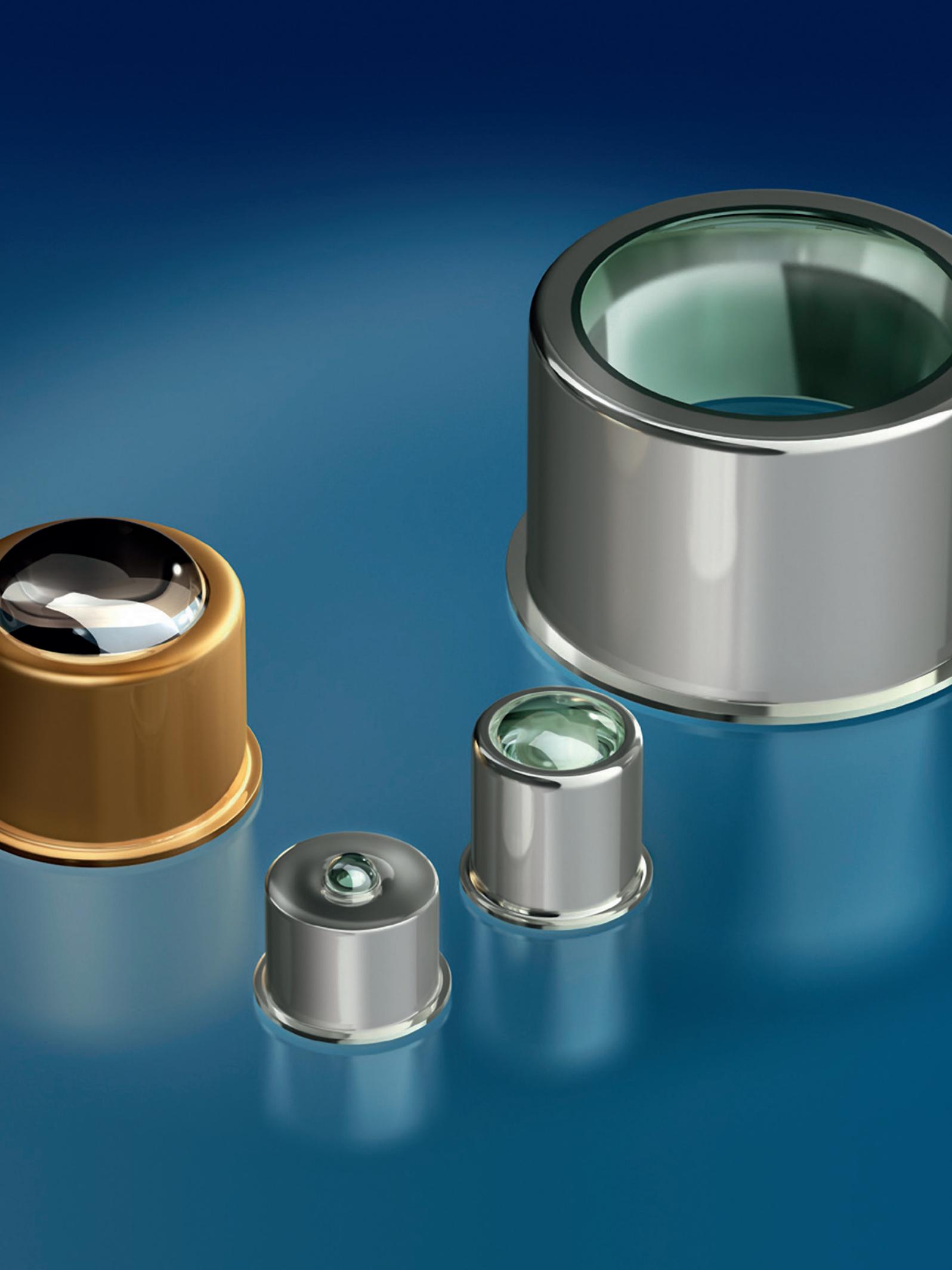


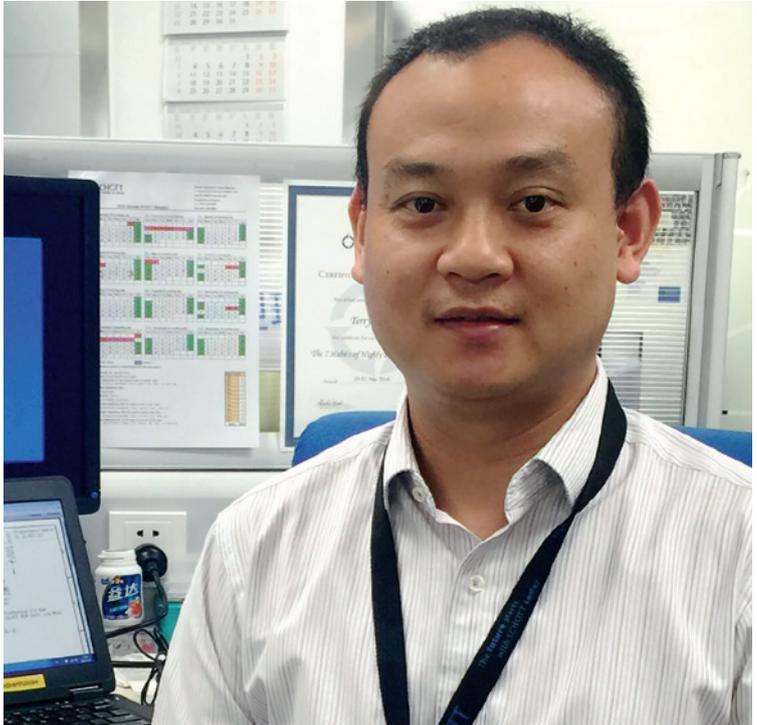
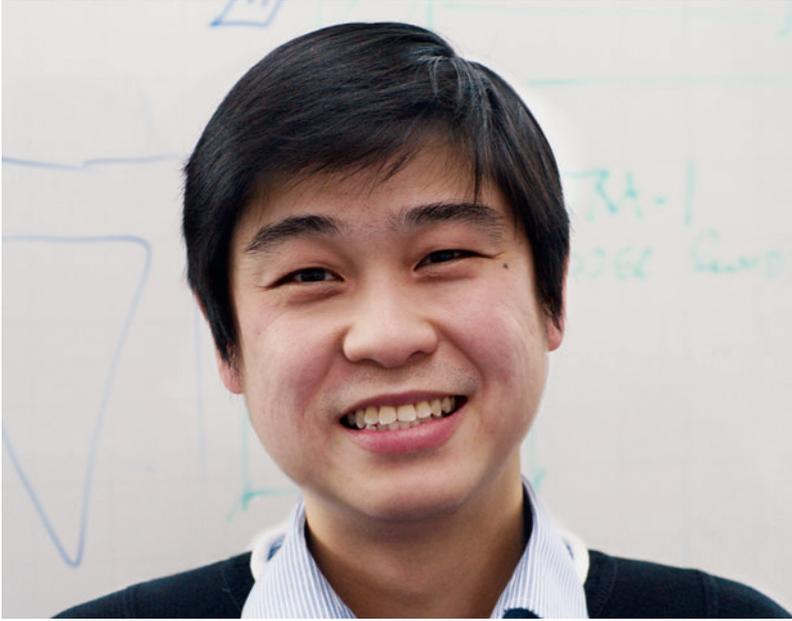
Window Cap with integrated optical filter  
For sensor applications.

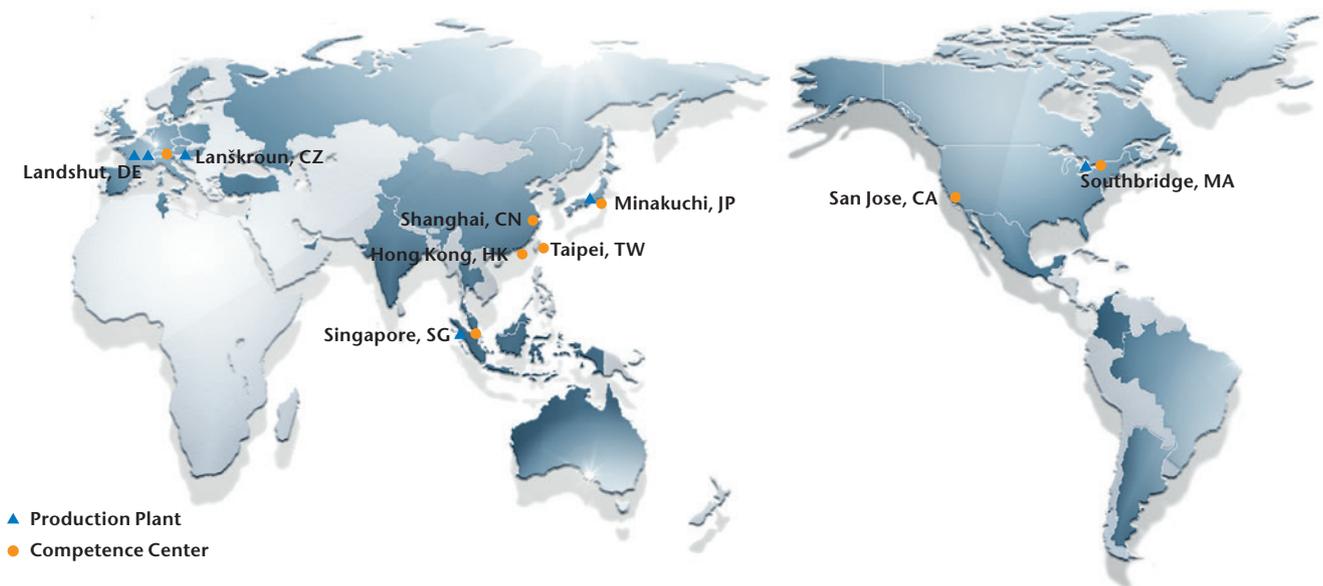


#### General Purpose Lenses and Windows

For opto-electronic applications like photoresistors, photo diodes and LEDs.







## Worldwide R&D and Sales Support

### Local application support

We strongly believe in consulting with our customers on the best possible solutions that perfectly fit their individual requirements. As a member of the SCHOTT Group, we benefit from a large range of in-house process know-how, including glass development, melting, and processing. Our Electronic Packaging business is built on the additional knowledge of metal processing, plating, and finishing. SCHOTT's TO specialists aim utilize our international set-up and technological expertise to provide customers with the best application support and consult with you in regards to product customization requirements.

### Sales support worldwide

„If you have a headache, you can call us around the corner“. This is the motto that applies to all of our Sales experts around the world. Our dedicated Electronic Packaging competence centers in Asia, Europe and the US enable us to provide our customers with fast, local and competent customer service. The SCHOTT Group as a whole offers global customer support through its production locations and sales offices in 35 countries.

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