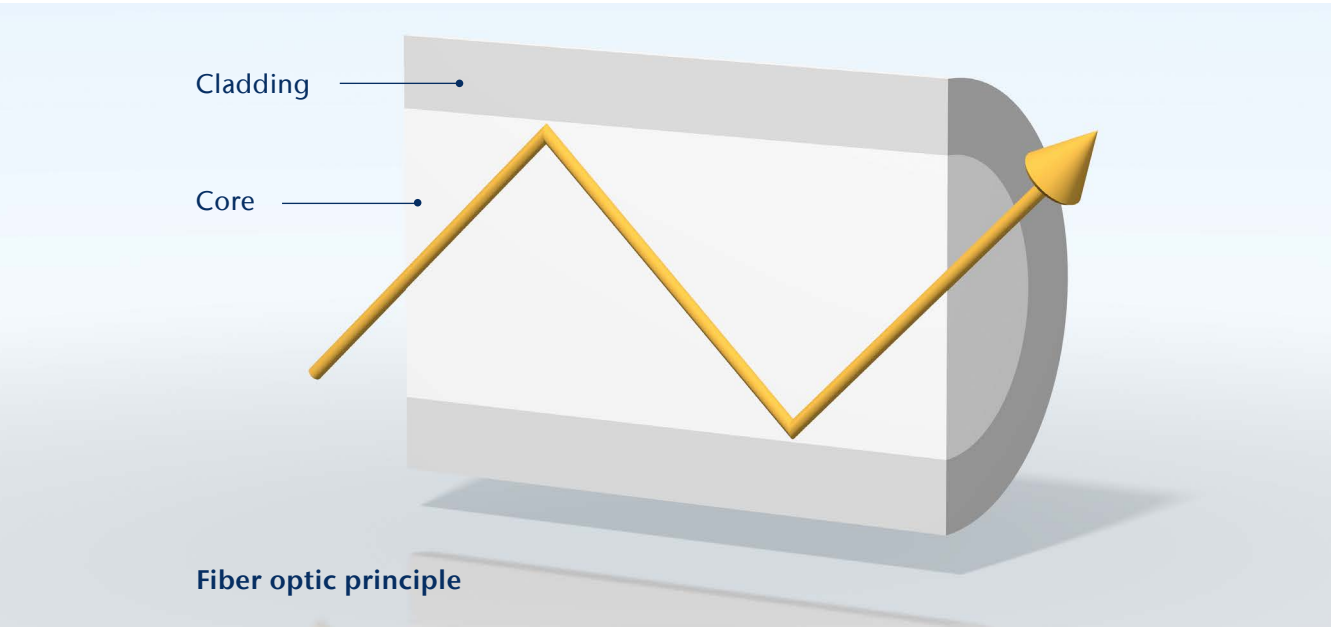
SCHOTT
glass made of ideas

Glass optical fibers
Options and variants

Pioneering the impossible since 1884. When others say no, we say yes. Because at SCHOTT we believe that shared responsibility can release the energy to achieve the impossible. As a global material technology group, we are constantly exploring unique and innovative ways to make a difference for businesses and people. Being a foundation company, SCHOTT has anchored a responsibility for scientific research, society and the environment deeply in its DNA. Represented in over 30 countries by 17,100 employees, we are a highly skilled partner for many high-tech industries: Healthcare, Home Appliances & Living, Consumer Electronics, Semiconductors, Optics, Astronomy, Energy, and Aerospace. Whatever challenges the future might hold, we can't wait to come up with innovative solutions and turn visions into reality.

SCHOTT Lighting and Imaging has been a leading designer and manufacturer of fiber optics and LED solutions for 60 years. We apply our advanced glass technology capabilities to create leading-edge flexible and rigid glass fiber optic guides that transfer images and light with precision, and to produce high-quality LED light sources. Our proficiency in lighting and imaging is improving lives by advancing applications in medical, industrial, aviation, automotive, and defense areas. We provide a full range of services that range from assisting with early-stage product development all the way to serial production.

Content



Fiber optic principle

Fiber optic technology

What are optical glass fibers?

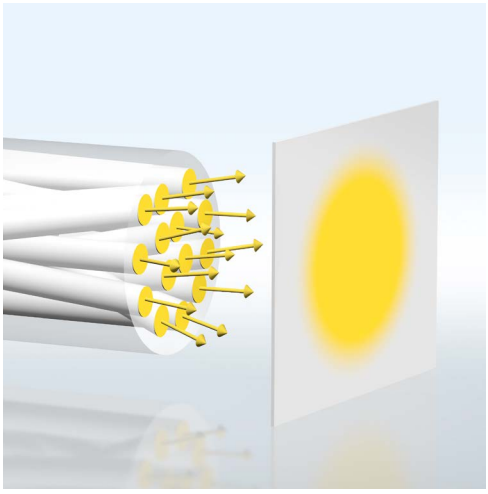
At the heart of all fiber optic technology is the glass fiber. This thin, flexible, and transparent optical component has a diameter about the size of a human hair. Light travels through the core of optical fibers, emitting light or forming images at the fiber bundle's end.

This transmission is possible thanks to two materials with different refractive indices. Glass fibers are composed of a high refractive index core and a low refractive index cladding. The principle of total internal reflection dictates that when light hits the boundary between the core and the cladding below the limiting angle, it's reflected and carried further along the fiber to the end.

Glass optical fibers enable light and image transmission

Light transmission for sensors and control applications

Light guides carry light from one end to the other. The arrangement of SCHOTT's fibers can be randomized to create very homogenous illumination.



Side-light transmission for industrial lighting and sensor applications

Side-emitting light guides are designed to emit light to the side or to work as a sensor.

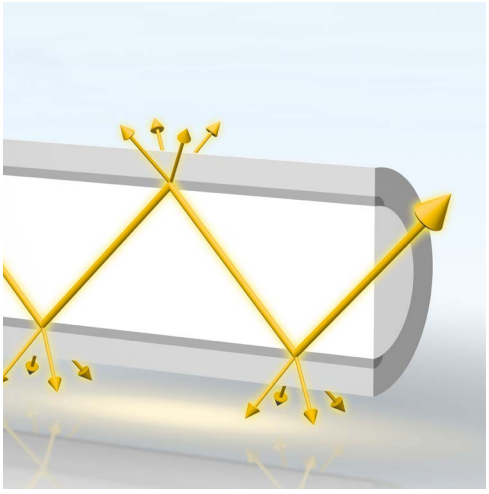
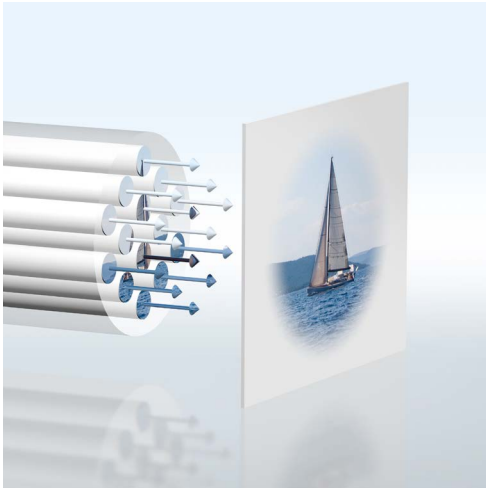


Image transmission for imaging applications

Image guides can transport an image over a long distance and magnify, reduce, or invert it. Each fiber in the image guide acts like a single image pixel, making end-to-end fiber alignment critical.

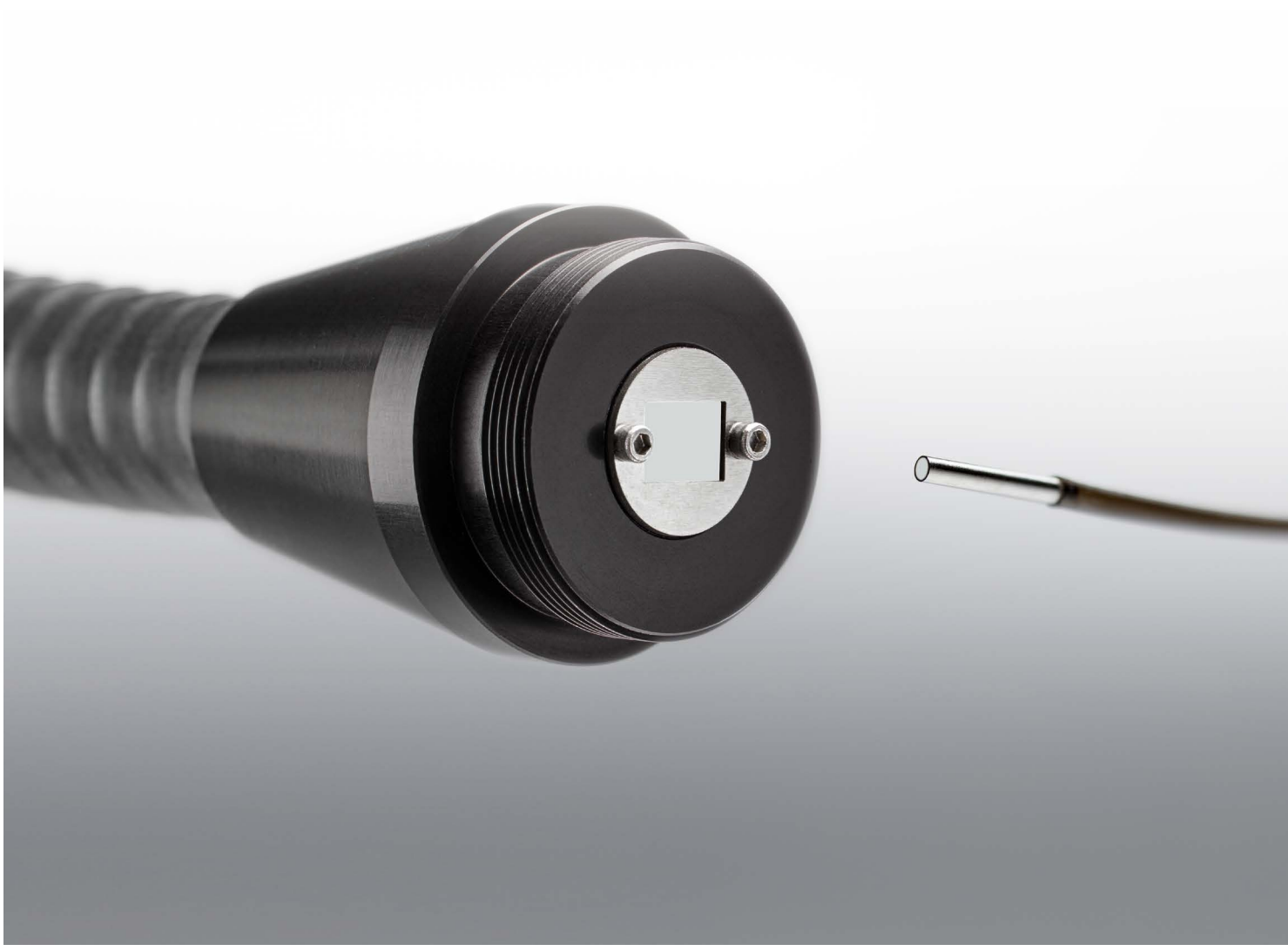


Components

Guide types

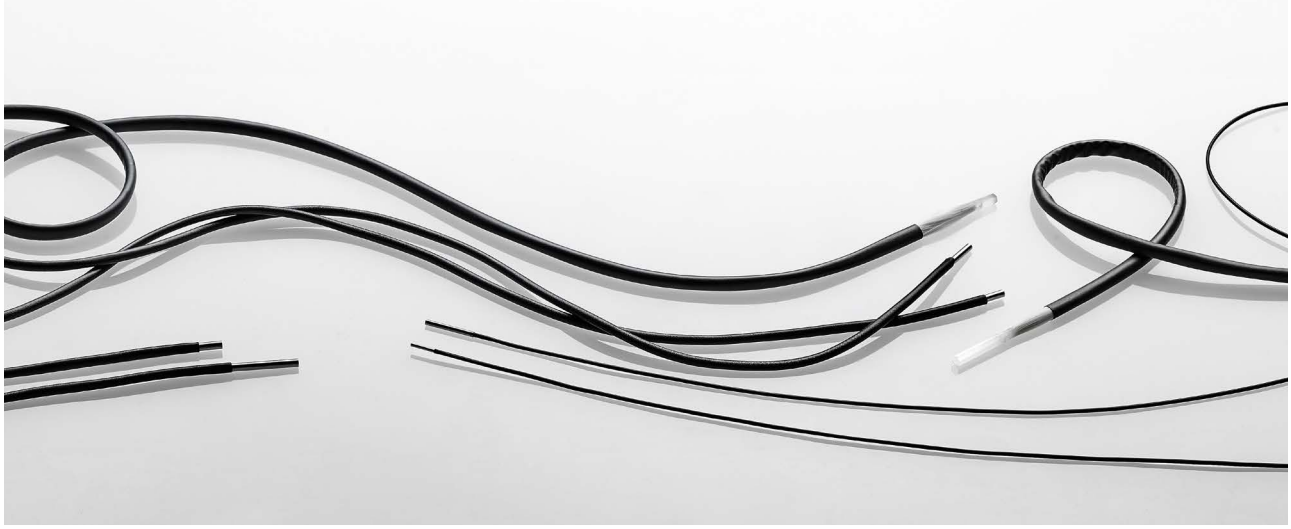
Optical guides based on glass fibers are available in flexible or rigid formats. Flexible light or image guides are often longer than rigid guides and are typically used when the target lies around a corner or in a narrow space. When used in movable setups, the guide must be very flexible and able to withstand repeated bending.

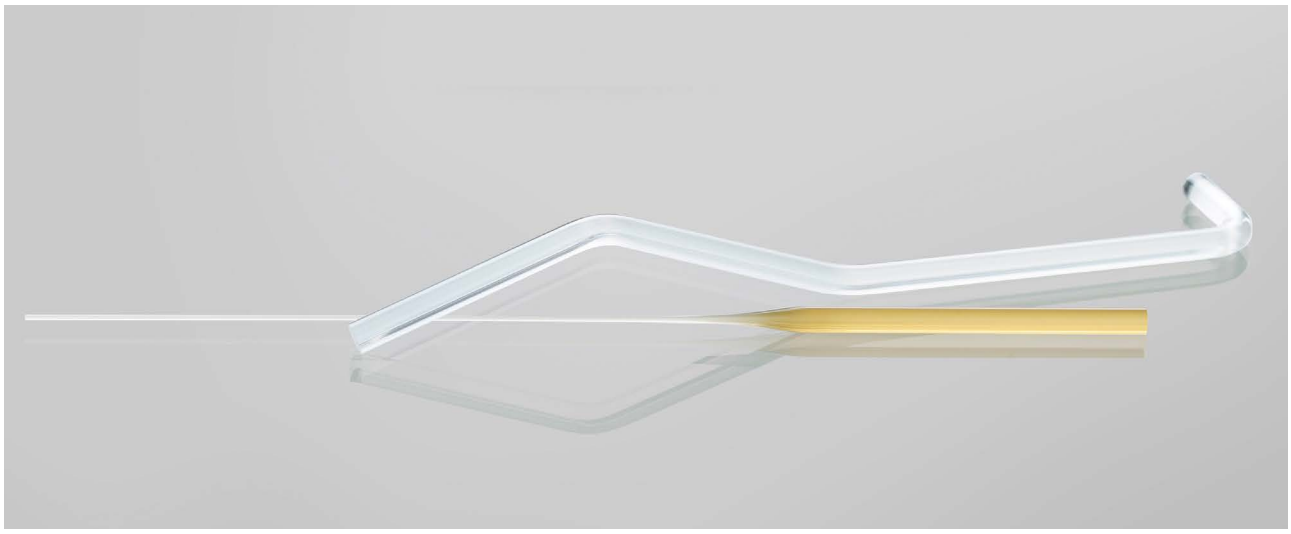
Rigid fiber optic rods are solid fiber optic elements that can be used to transmit light, images, or signals over short distances when flexibility is not required. Versions that combine flexible and rigid properties are also available.



Lengths, diameters, and bending radii

Fiber optic light guides and images guides can be custom-tailored for individual applications. Working with our customers we develop optomechanical solutions for wavelengths ranging from ultraviolet to near infrared regions with nanometer tolerances. Fiber optic guides are available with various lengths, diameters, and bending radii.





Sheathings

Sheathing is more than simply packaging for fiber bundles. It is an integral structural component that can be used to meet specific application needs. If, and for how long, a light or image guide operates reliably depends to a large extent on the protective sheathing used.

SCHOTT offers many different types of sheathings so that fiber bundles can be protected in various challenging mechanical, physical, and chemical environments.

Example sheathings:

- Metal-PVC
- Stainless steel interlock
- Stainless steel interlock with silicone covering
- Thin wall silicone or FEP
- Extrusion options with PVC, TPU, FEP

Terminations and connectors

End ferrules for bonded/epoxied light guides are made of aluminum, brass, stainless steel, nickel silver, or other materials. For hot-fused components, the end ferrules are made from stainless steel.

Ferrule material and connector examples

- German silver and brass
- Stainless steel (medical grade)
- Aluminum (in particular for milled housings)
- Anodizing options upon request
- Polymer housings milled or injection molded
- Standard industrial connectors: SMA, ST, FC
- Standard medical connectors: Storz, Olympus, ACMI

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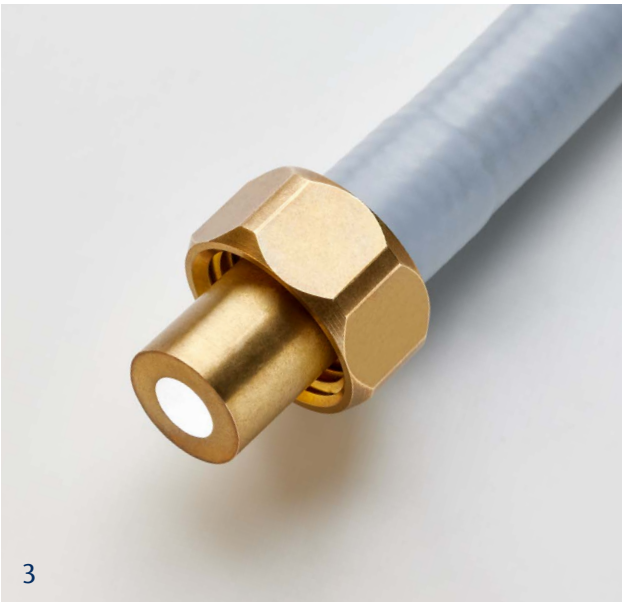

3

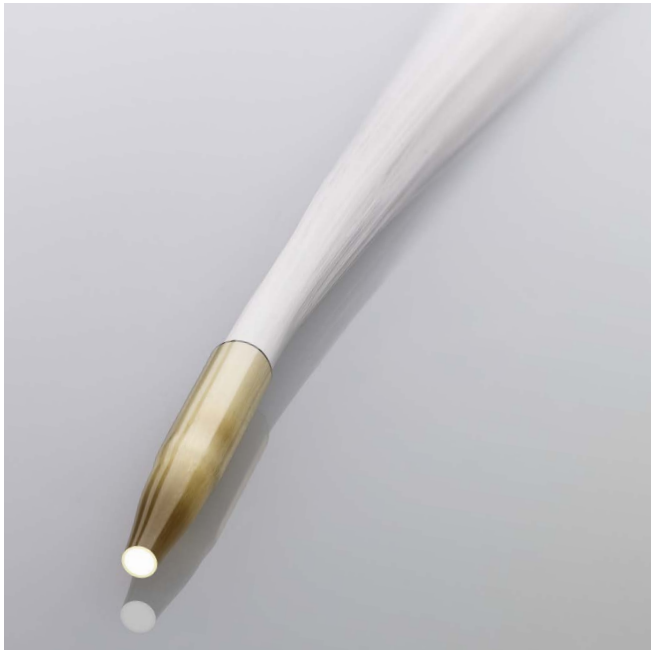

4

1 | C-Mount
2 | C-Mount adapter
3 | Customized thread
4 | LC
5 | ST


5

Glass tube fusion

The hot-fused ends of flexible light guides can be tapered. Compared to other solutions where a taper is added to the end of the light guide, this process reduces the number of



optical interfaces where light can be lost and hence, improves light output. In addition, the design allows the the guides to be used in high-temperature environments.

Light guide

Options

Cross section transformers/Spot-to-line assemblies

Light guides can be fabricated in a variety of complex geometries to meet the requirements of advanced sensing measurement devices.

Cross-section transformers can be used at the object end to change a specific type of fiber bundle into a form that matches the geometry of the detector. For example, this is useful for spot-to-line assemblies where a fiber bundle that is round at the object end is transformed into a line. Other transformations are also possible.

Dual or multibranch options

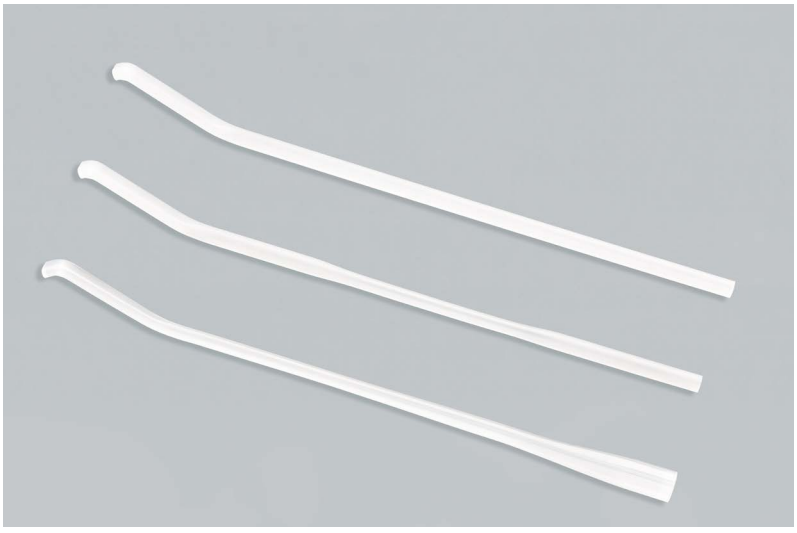
Homogenized glass optical fibers can be divided into multiple branches. This can be used to create a light guide that splits a signal for detection by several photodiodes. By using different diodes, an even light measurement along the spectrum can be achieved.

Individual fiber arrangements and geometries are suitable for hazardous and hot environments.

Extreme geometries

SCHOTT's special production processes facilitate extreme bending angles and tapering, which are highly valuable in applications where space is precious.

We also offer a wide range of geometries with small tolerances and consistent reproduction.



Subassemblies

Optical subassemblies

SCHOTT offers customized optical subassemblies for a range of industrial uses. Besides fiber optics, subassemblies can include a comprehensive suite of components such as lenses, filters, dichroic mirrors, and homogenizers, all customized to meet the unique requirements of each application.

Mechanical subassemblies

To seamlessly integrate our light guides into your application, we offer tailored mechanical subassemblies such as high-temperature housings and protection using SCHOTT NEXTREMA® and Quarzal. Additional assemblies include couplings and feedthroughs for vacuum-tight applications. Hybrid solutions that combine optical and electrical links and harnesses are available.

Image guide

Options

Fused imaging fiber optics

SCHOTT fused imaging fiber optics transmit a high quality image with minimal distortion and transmission loss. We can transform your vision into fused fiber optics with customized forms, shapes, lengths, and diameters.

Each custom solution is developed for specific applications and environments.

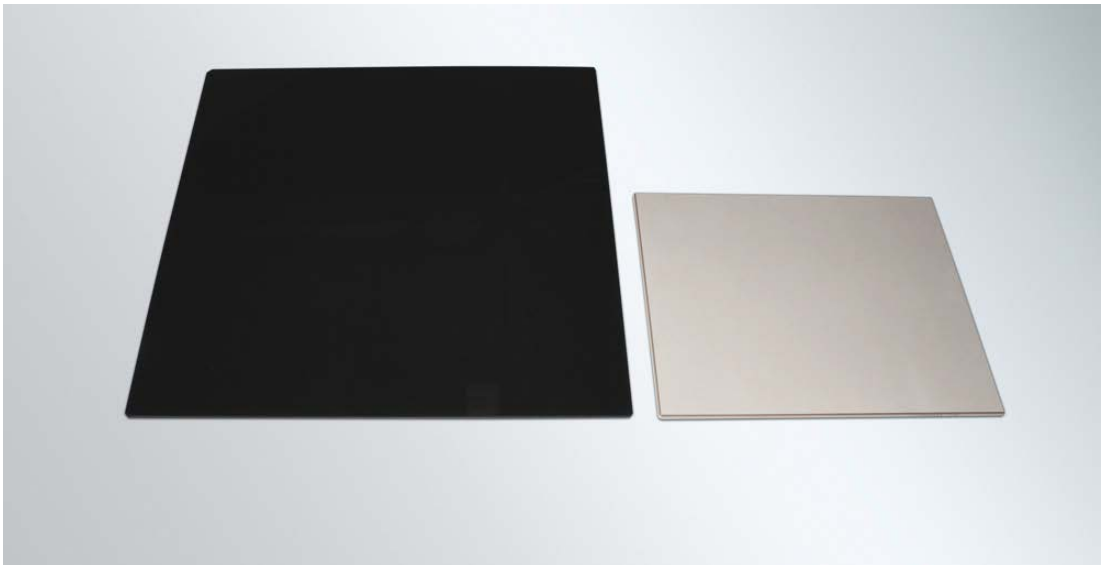
Tapers

A taper provides a reliable method of magnifying or reducing an image with minimum distortion in image transfer applications. Whether you require image coupling to CCD or CMOS devices or for intensified video or biological imaging, we can find a high-performance solution.

Faceplates

Widely used for high resolution 'zero thickness' image transfer applications, fiber optic faceplates can be coupled to CCD, CMOS, and OLED devices to enable image intensification, remote viewing, field flattening, and x-ray imaging.

In opto-electronic applications, coated faceplates are used as both input and output high resolution image transfer windows. In some applications, the x-ray absorption properties of the fiber optic plates protect the photodetectors from damage and prevent electronic noise affecting the images.



Straight thrus and inverter

SCHOTT's fused imaging fiber optic straight thrus transfer an image 1:1 from its input surface to its output surface with high resolution.

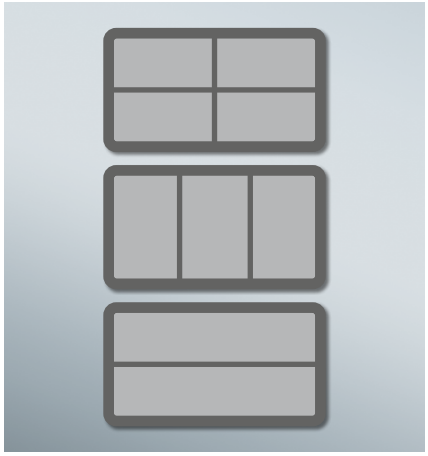
A fiber optic image inverter twists an image in a specific angle (for example 180 degrees) from its input surface to its output surface. An inverter provides the advantages of a compact, vacuum-tight, and lightweight image transfer package.

How it works:

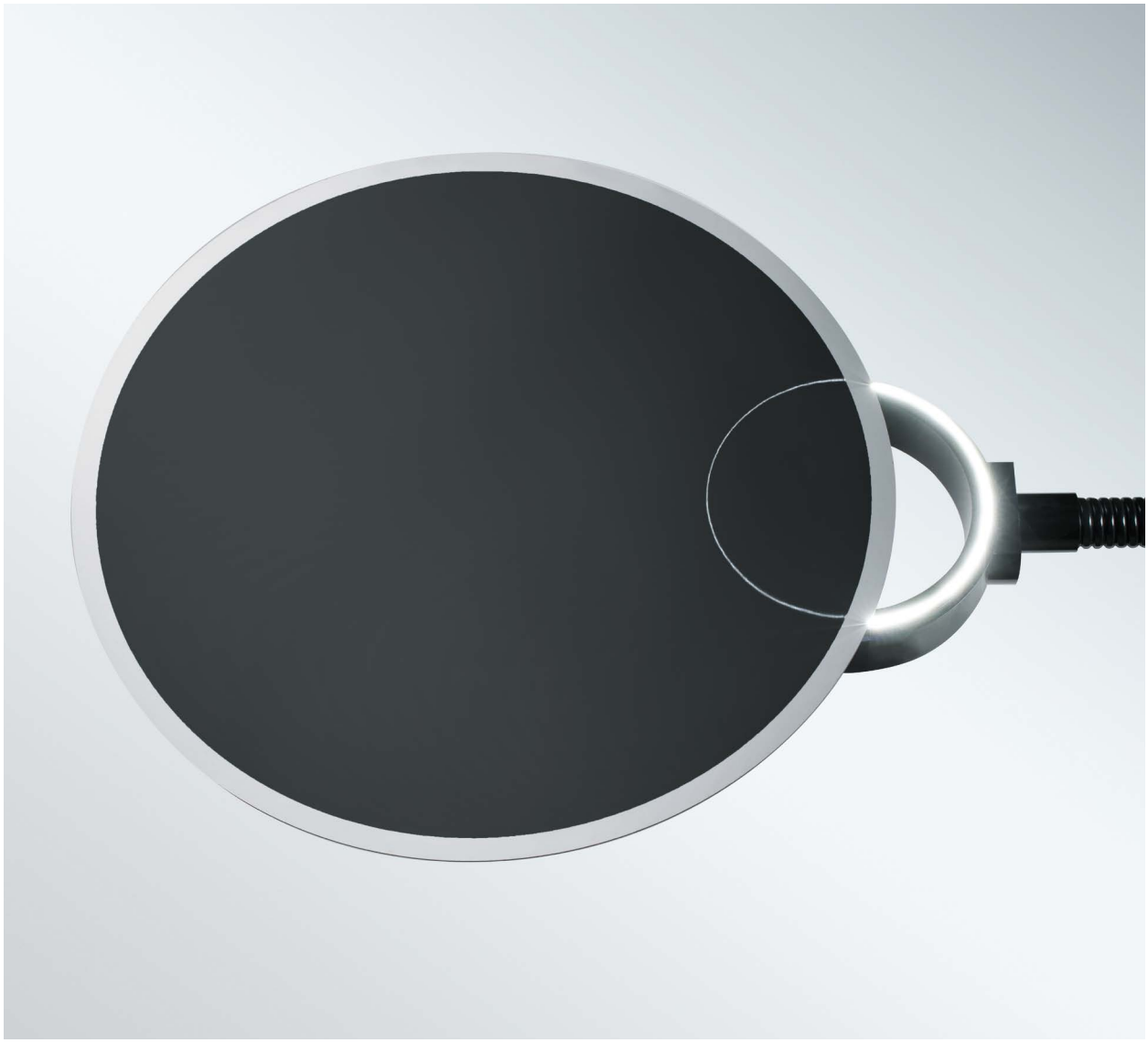
Each bundle corresponds to a different segment in the image guide. The image above shows an assembler with four arms, different numbers of arms and different layouts are possible.

Image assembler | multiple arms

Image assemblers combine multiple arms into a single output. A camera with software can then easily detect separated and isolated information from each segment.



Examples of different output layouts.



Laser-structured glass capillary arrays

Capillary arrays are circular or rectangular glass plates with tiny holes arranged in two dimensions at regularly spaced intervals. With an innovative laser-based process SCHOTT can produce plates up to 40 x 40 cm with open area ratios of more than 75%. This enables many applications, for example, next-generation X-ray detector technologies in both medical and industrial imaging systems.

Why SCHOTT?

The SCHOTT Lighting and Imaging team has 60 years of experience in developing and producing advanced glass optical fiber solutions. With our know-how in fused silica and polymer fibers as well as mechanical, thermal, optical, and electronic engineering, we offer you the ideal partnership for designing new, future-oriented products for challenging fields and markets.

Deep engineering expertise and strong R&D support for innovative, customized products with a competitive edge

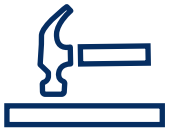
Our global team of experts offers comprehensive technical know-how in fiber optics, optical glass, and lighting and imaging system design. As a team, we can turn your bright idea into a manufacturable, successful product. We provide smart, cutting-edge technology and solutions that fit seamlessly into your engineering process.

Collaborative approach for a dynamic partnership with creative impact

Our experts are solution-oriented, open-minded, and work with team spirit. This provides new impetus and an agile, productive workflow for an advanced process that benefits from progressive ideas at every stage. Our approach enables successful development of an optimized final product.

Large resources and stable structure for 100% reliable supply

Our locations in more than 30 countries and automated processes, give us the flexibility to scale from making a few pieces to mass production. With fast, flexible responses, we adapt efficiently to your needs, offering new opportunities for on-time development.



Stable processes for consistent product quality

SCHOTT tracks all relevant production parameters, allowing traceability and transparency. Our experienced teams carry out their jobs with the highest precision. We use an ISO class 7/8 cleanroom and follow global standards like ISO 9001, ISO 14001, and ISO 13485.

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