

Fiber-Based Solutions for Optical Metrology

Maximum Measuring Accuracy with Light



WEINERT Fiber Optics is a Global Market Leader

in the field of high-quality,
end-to-end engineered and
manufactured fiber optical solutions
for metrology applications.

We serve metrology equipment makers, integrators, and end-users with fiber optic probes, assembled bundles, arrays, patch-cords and light guides, structured cables for sensing, as well as special optical devices such as switches, shutters, splitters and couplers for in- and off-line inspection purposes across all industries. This includes semiconductor equipment, laboratory equipment, medical diagnostic equipment and test equipment for process industries.



Our products help >

- to measure the properties and composition of solids, liquids, powders and gases from the DUV, UV-VIS, up to NIR-IR spectral range.
- to measure the physical, dynamic and geometric properties of materials, such as temperature, pressure, vibration, or distance.
- to measure color, film and coating thickness, or endpoints in wafer manufacturing.
- and much more ...

We have long experience >

- with tight measurement tolerances.
- with product deployment under the harshest environmental conditions.
- with hybrid solutions, i.e. copper + fiber.
- with certifications: CoC, ATEX, UL, CPR, CE

In product design, we first and foremost focus on the success of our customer and offer made-to-measure solutions. Although WEINERT integrates a full value chain of fiber optics production (glass-preform, standard- and special fibers, fiber optic and hybrid structured cables, optical switches and shutters), we act component-agnostic, meaning we will source the components your application requires.

In manufacturing, we apply the highest workmanship standards to ensure that functionality and reliability of our products meet our customers' expectation. We offer repair and maintenance case-dependent under both warranty and non-warranty terms.

Here are some of our references >

- NASA New Horizon mission
- MIT Raman Probe for Diabetes detection
- Probe for Blade Tip Timing

Our production sites in USA and Europe provide >

- Global engineering team
- In-house machine shop with manual and CNC-machining
- Direct coupling of laser diodes to fibers
- Active fiber alignment equipment
- Fully equipped lab to test optical properties
- CNC video and XRF measurement
- Cleanroom
- ISO 9001- & ISO 13485- certification
- ITAR-registration

Fiber Optic Probes

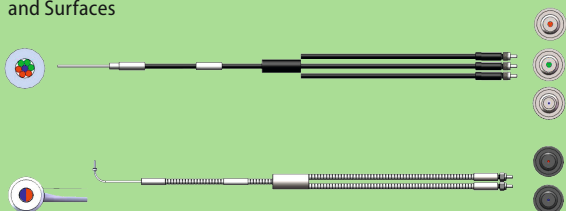
Fiber optic probes enable fast accurate measurements, improving your workflow and productivity, and eliminating the need for expensive cuvettes. When used off-line, probes remove the need to prepare instrument-specific samples and are especially useful when measuring, for example, very large, hot, cold, radioactive or otherwise dangerous, solid, or remotely located materials and substances. For in-line optical measurements, probes can be integrated into larger equipment devices to provide real-time data.



Standard-Type Probe Examples

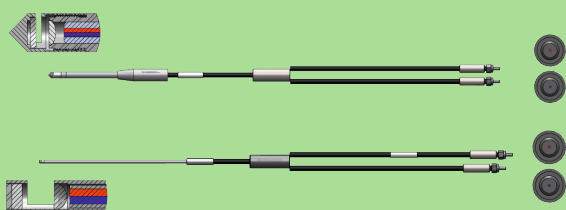
Reflectance Probes

Applications: Reflectance and Fluorescence of Liquids, Powders and Surfaces



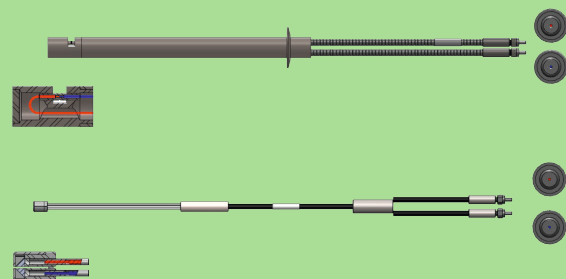
Transreflectance Probes

Applications: Double-pass optical transmission of Liquids and Gases



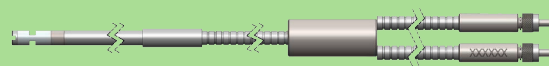
Transmission Probes

Applications: Single-pass optical transmission of Liquids and Gases



Special-Type Probe Examples

Probe Tips – without Epoxy Exposure



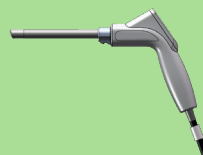
Unique probe tip designs with proprietary seal technology which ensures that epoxies do not come into contact with the analyte.

Prism Probes



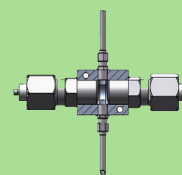
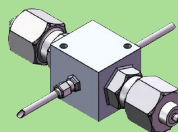
Unique transmission probe tip design for liquid samples which greatly reduces the likelihood of bubbles building up between the optical path for clean and instant measurements.

Handheld Probes



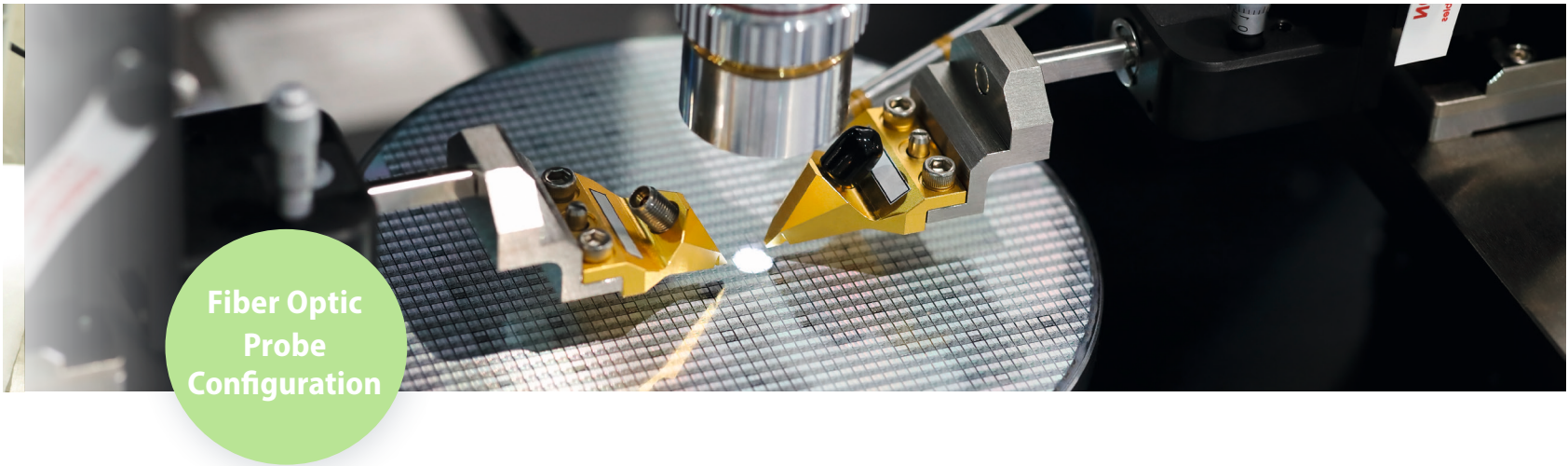
Example of a reflectance probe design which integrates a molded handpiece and electronics together with the fiber optics.

Flow Cells



For use with spectrometers, WEINERT offers to provide customized transmission flow cells integrating lens housings, adjustable path length and optimized to the fiber in use – different design options are available to fit the end user's application.

Fiber Optic Probes



Based on a large reservoir of experience in the design and build of fiber optic probes, WEINERT’s philosophy is to work with you to identify and configure fiber optic probes that help your measurement needs most. Our team can either recommend an established probe design or engage in developing a completely new design. Design options are manifold, nonetheless, a few things to consider in this endeavor:

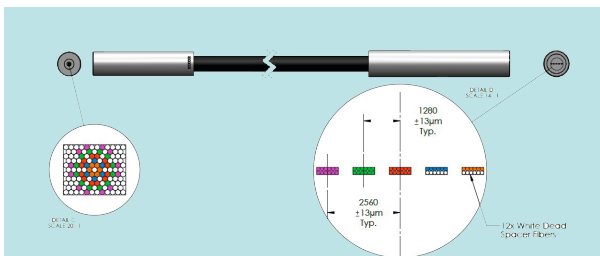
- Selection of the measuring principle such as reflectance, transreflectance, or transmission is a function of the material to be analyzed.
- Selection of the fiber (i.a.) depends on the wavelength spectrum of the molecules or atoms to be analyzed, as well as on the selected spectroscopic measurement technique.
- Specification of the probe tip includes the dimensional footprint requirements, pathlength, shape (e.g. pointed or flat), and whether the probe tip shall be removable or fixed to the probe shaft.
- Selection of materials used for sealing or jacketing is influenced by the environmental conditions that the probe will be exposed to, for example whether the probe tip submerges into liquids and gases and the associated operating environment (e.g., temperature, pressure, chemistry).
- Specification of connections includes both the fiber optical connection to the instrument, for example SMA or FC connectors, as well as a potential process connection, such as flanges or tri-clamp fittings.
- Integration of handpieces and/or electronics such as PCBs, laser diodes, and human interface devices can be another realizable requirement.

Configuration Options (Excerpt)	
Materials for optics	UV fused silica, BK7, sapphire, and others
Materials for probe shaft and tip	stainless steel, nickel alloy (e.g., Inconel, Hastelloy, etc.), titanium, PEEK
Fiber	silica with various coating and buffer materials multimode and singlemode numerous core diameter and NA options options for DUV, UV-Vis, NIR-IR and broadband wavelengths
Probe footprint	Designed to meet customer specifications
Immersion depth	Designed to meet customer specifications
Operating temperatures	-269°C to 1,000°C
Sealing technology	use in liquids and gases, caustic and acidic, vacuum and high pressure environments
Optical connection	(F-)SMA, FC, LC, ST, MTP, other fiber optic standard and customer specific connectors
Process connection	designed to meet customers specifications

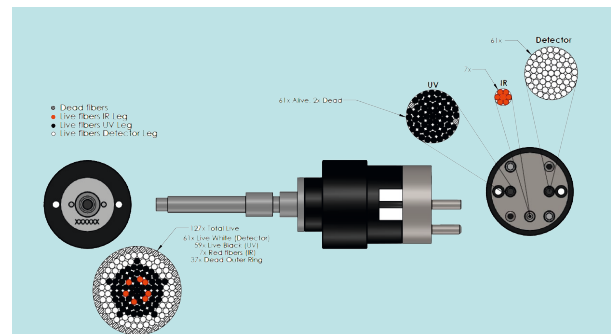
Fiber Bundles, Light Guides and Patchcord Assemblies

Within optical measurement instruments, (e.g. based on absorption, fluorescence, light scattering, OES, mass spectrometry or other PAT equipment) fiber optic assemblies help to relay the excitation light from the light source to the sample and the resultant light back to the detector, passing other optical components such as monochromators, beam splitters and reduces, lenses, gratings, or mirrors. In both off- and in-line scenarios, fiber optic assemblies are also needed to connect the instrument with the probe or sensor.

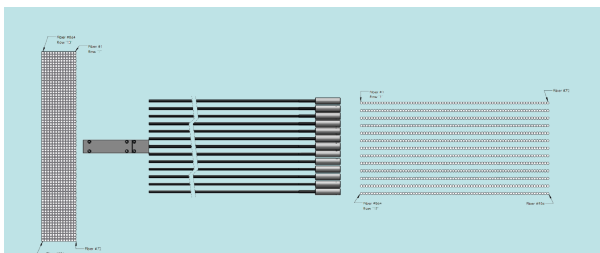
Bundle Examples



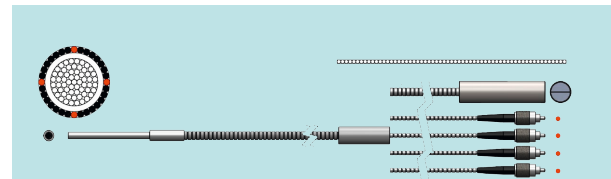
Bundle with >90 fibers in custom-made ferrules with one side mapping fibers in an octagon shape and the other side featuring 5 square arrays positioned in one line



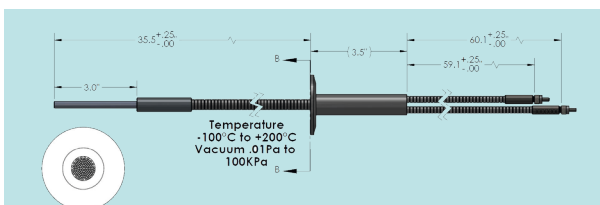
>120 fibers, both for UV and IR measurements, combined in multiple circular arrays in a customized stainless-steel block and separation tube



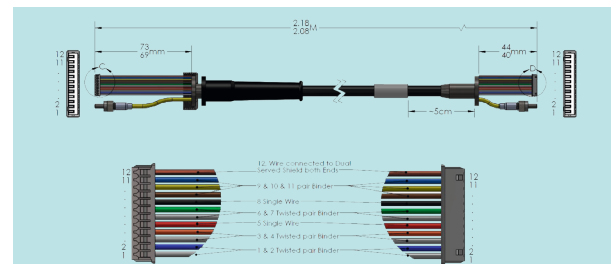
Multi-leg bundle with >900 fibers and each longitudinal line of fibers in the common end corresponding to one of the breakout legs' line array



Multi-leg bundle with >85 fibers inside hypodermic tubing mapped as inner and outer circle in the common end, another linear array and 4 legs terminated with FCs

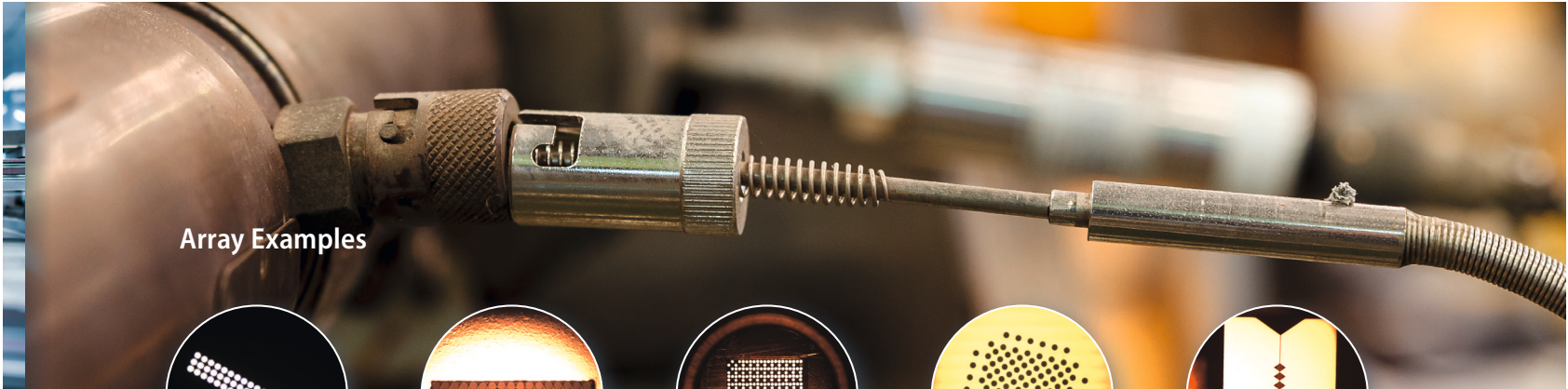


Bifurcated bundle for vacuum and -100°C to +200°C temperature range with >150 randomized fibers in the common end and flange for process connection



Hybrid duplex style bundle combining an AR-coated fiber and a terminated electrical cable in a stainless-steel monocoil

Fiber Bundles, Light Guides and Patchcord Assemblies



Array Examples

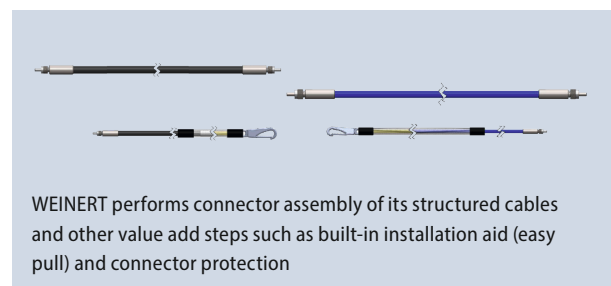
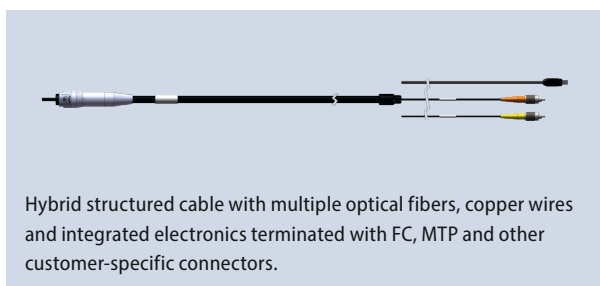
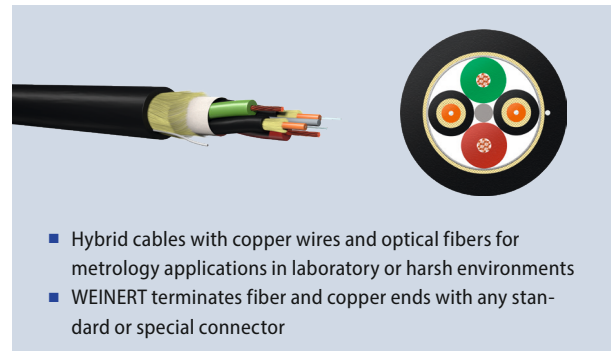
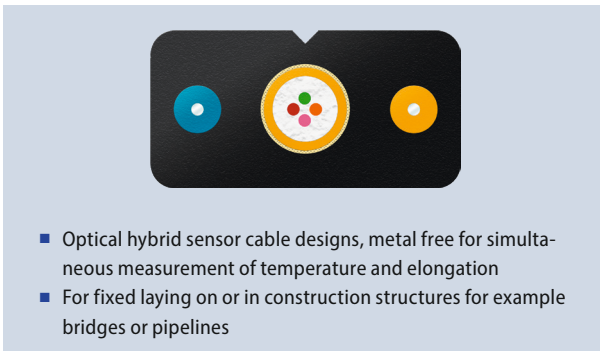
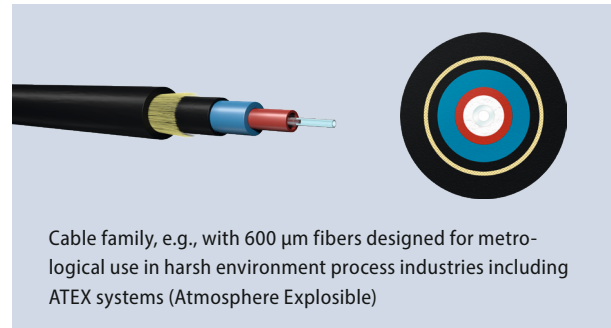
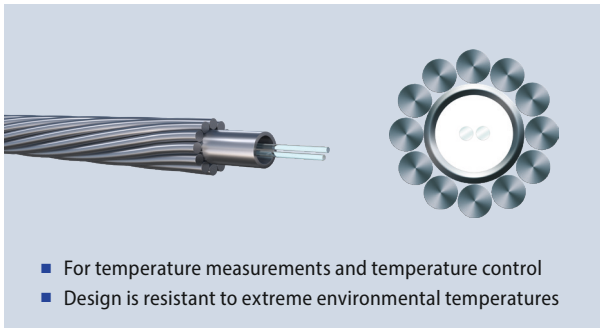


Configuration Options (Excerpt)	
Fiber	Silica/silica, borosilicate, PCF, POF, wide NA-range, Deep-UV to IR, >1000 fibers per bundle possible
Active bundle surface geometries	Circular, semi-circular, square, rectangular, line, ring, segmented ring
Bundle design	Single leg, dual-leg (bifurcated), multi-leg
Bundle variant	Glued, sorted, color-marked, randomized
Connectors	SMA, FC, ST, LC, MTP, SC and others
Coatings	Reflective or anti-reflective
Jacketing	SSTL, PVC-covered BX, Silicone Monocoil, PEEK, Vacuum feedthroughs
Integration of optical components	Homogenizing rods, polarizer, waveplates, lenses, lens arrays, mirrors, fused fiber end caps, circulators

Fiber Optic Structured Cables and Assemblies

We have extensive know-how, decades of experience and a highly flexible production setup to realize the design and manufacturing of application-optimized structured optical and hybrid cables for metrology and industrial settings. Our portfolio includes indoor, outdoor, and universal cables with optical standard and special glass or plastic fibers for laboratory and harsh environment, extremely high temperature ranges, or mobile use in drag chains. Cables with UL-approvals are available. In addition, we offer to terminate our optical and hybrid structured cables with the most appropriate connectors and installation aid systems such as pulling eyes to provide our customers with a ready-to-install solution.

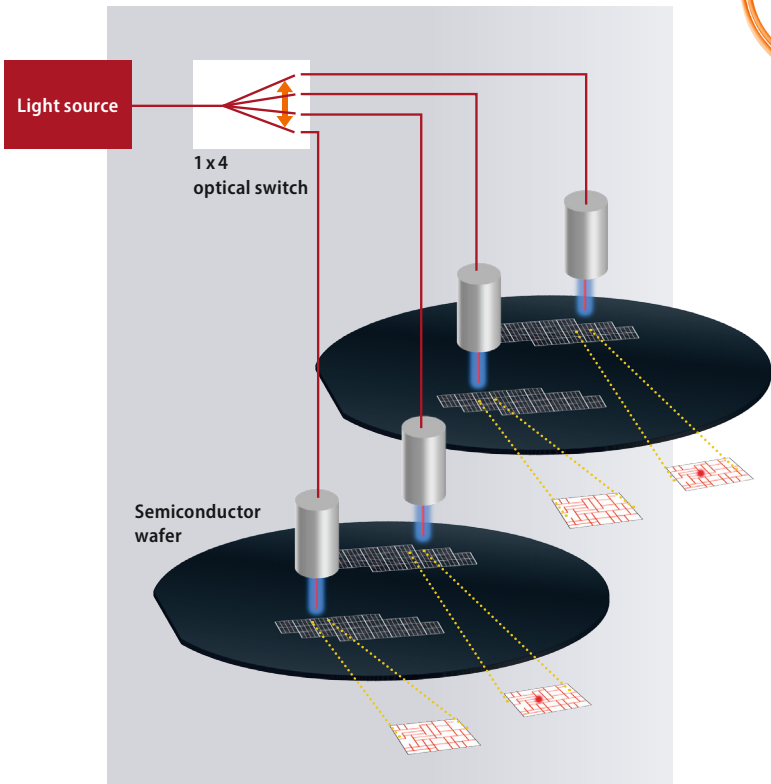
Structured Connecting Cables, both Optic and Hybrid Copper/Optic



Light Switching for Optical Systems

By integrating fiber optical single- or multimode switches from WEINERT into the measurement system, the system's efficiency can be improved. Our switches limit the need of several light sources and detectors for systems that measure at multiple locations. Based on a unique patented micro-mechanical / micro-optical concept, our switches provide excellent switching parameters, high flexibility and long-term stability. The switches are available for a broad wavelength range from the Ultraviolet to Infrared and can be fabricated with practically all possible fiber types.

Fiber Optical Switches

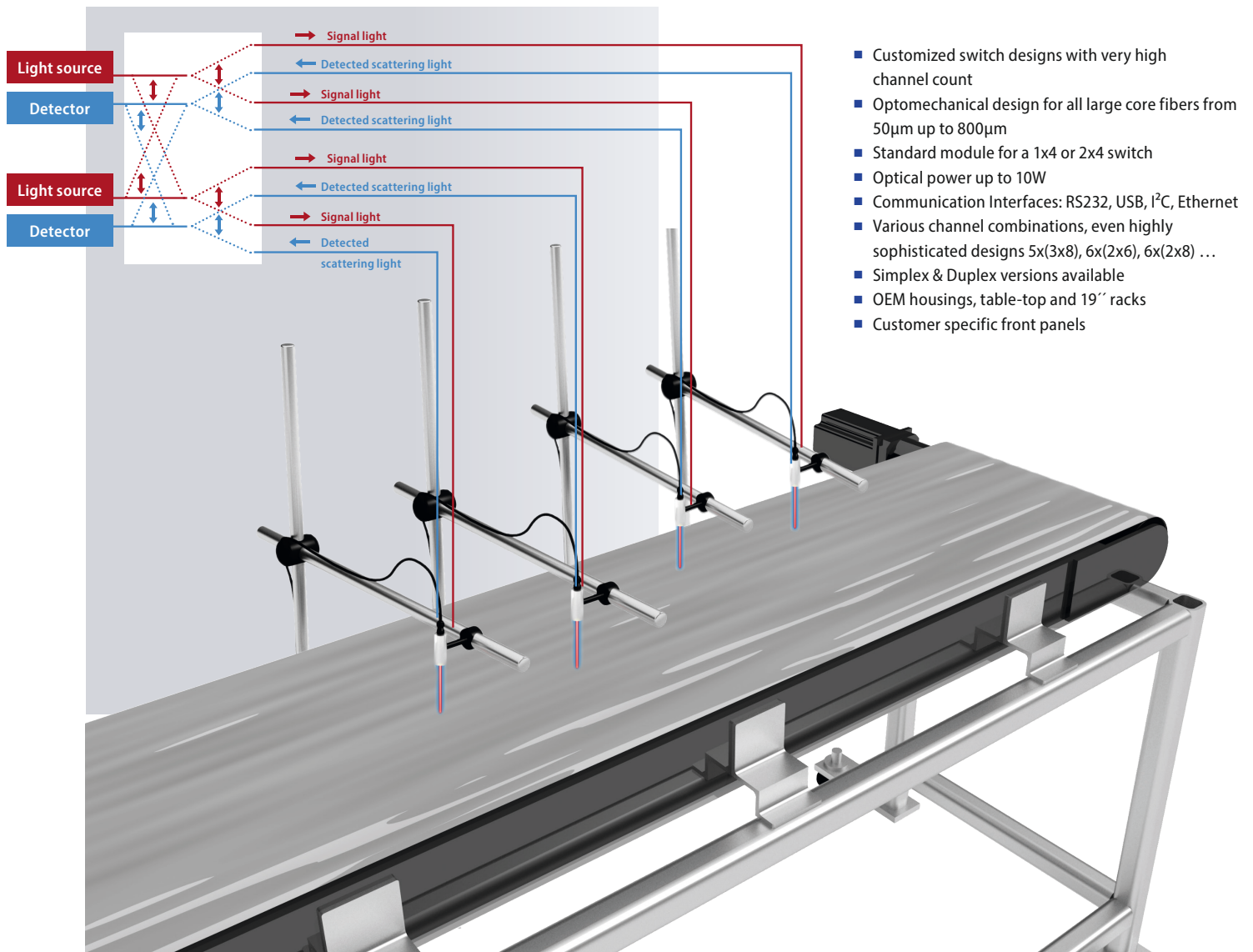


- The integration of a WEINERT switch in any 1x2, 1x4, 1x6, 1x8, 1x... configurations offers a considerable reduction of measurement system costs from the use of only one light source to excite light into numerous fibers.
- WEINERT's fiber optical switches are also available in 2xN configurations with two fibers in every route, one to bring in the light from the light source to the sample (excitation fiber), and one to bring the captured light back to the detector (signal fiber).
- By integrating our switches, the measurement system can be downsized while enhancing the throughput. The system can work with only one instrument, establishing a "one central light source" and "one single detector" system.
- For process safety purposes, a second instrument can be integrated in case the first one fails or needs to be shut down for maintenance or repair.

Specifications for Optical Switch		
Number of channels		1x2, 1x4, 1x8, 1x12, 1x16, 2x4, 2x8 -> Other channel counts on request
Operating wavelength	[nm]	Depending only on fiber characteristics
Switching frequency	[s ⁻¹]	≤ 50
Guaranteed lifetime	[cycles]	≤ 10 ⁹

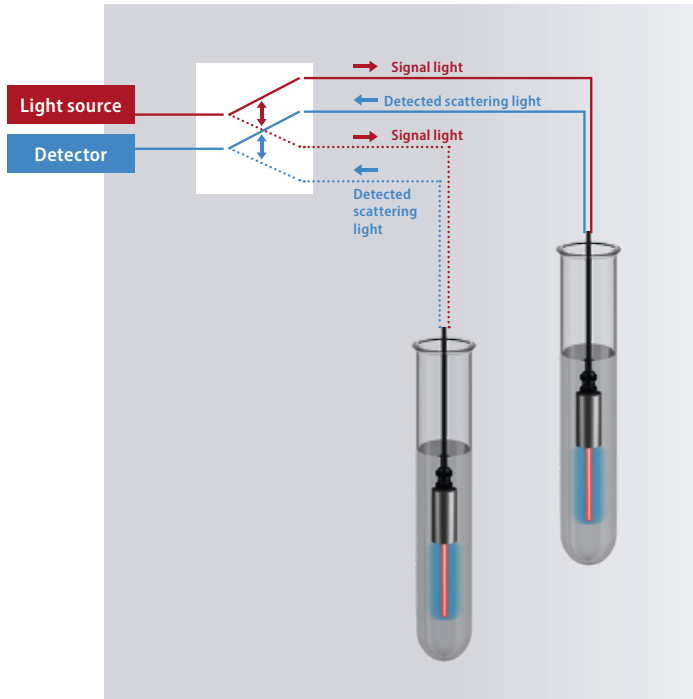
Fiber Optical Switches

Application examples for WEINERT's fiber optical switches include laser guiding systems for confocal fluorescence and laser scanning microscopy, fiber optic strain and temperature sensors for pipelines, bridges, tunnels etc., fiber optical measurement systems for environmental monitoring and optoelectronic devices for in-line testing.



Fiber Optical Switches

For semiconductor manufacturing, a WEINERT 2xN switch can be integrated in a pattern-defect detection system, and a 1xN switch can be a part of an OCT measurement system for wafer thickness measurement. For industrial manufacturing, 1xN or 2xN switches can facilitate the effective and cost-efficient in-line quality inspection of coatings or sealings by measuring at multiple spots in a very short amount of time. In life sciences, switches with a high channel count can be integrated in multi-vessel dissolution measurement systems.



For more information about our portfolio of fiber optical single- and multimode switches and shutters, performance characteristics and configuration options, please take a look at our more extensive brochure “FiberSwitch – Light switching for optical systems.”

Specifications for Multimode Fiber Switches:		NIR - IR	UV - VIS
Wavelength	[nm]	400 - 2300	200 - 700
IL (up to 4 channels)	[dB]	≤ 1.0	
Repeatability	[dB]	≤ 0.03	
Switching time	[ms]	5 ... 20	
Guaranteed lifetime	[cycles]	≤ 10 ⁹	
Operating voltage typ.	[V]	5	
Operating temperature	[°C]	0 ... +60	

Further Applications for Multimode Switches

- Temperature and pressure measurement
- Spectroscopic measurement of combustion processes
- Combination of different switches for different parameters
- One common control module with different interfaces for more switches possible



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