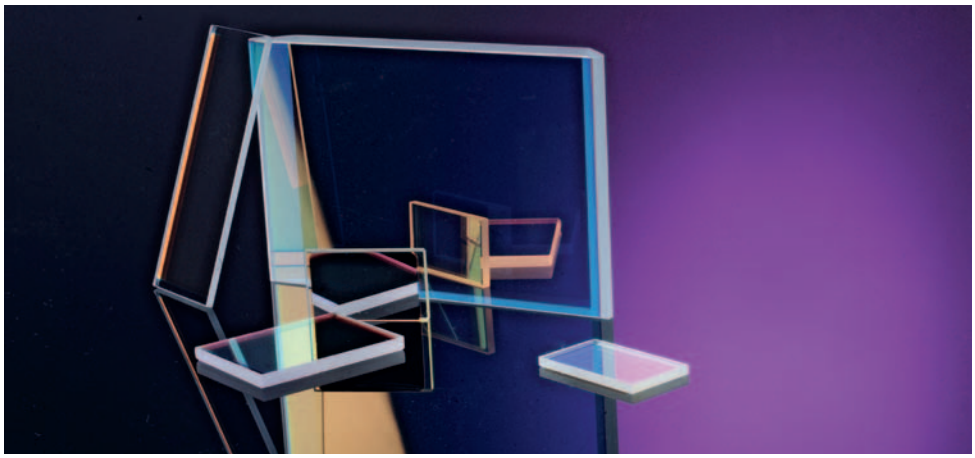
PHOTONICS NEWS

Company Newspaper of the LASER COMPONENTS Group

October 2011
Issue 26

Adjustable Beam Splitters

Innovative Variable Beam Splitters



High power beam splitters are used to split a laser beam; they are applied just as often as mirrors or output couplers.

The challenge in producing these components is the very strict observance of the tolerances necessary to achieve exact results when splitting a beam. To split a laser beam into two partial beams of equal intensity, beam splitters are required that both reflect and transmit precisely 50% of the energy. Conventional production of such a dielectric layer has a tolerance of ± 3% or higher. In a worst case scenario the partial beams could exhibit an output power of 47 W and 53 W after split up of an original 100 W beam. With a special IBS coating, the tolerance can be reduced to just ± 1%.

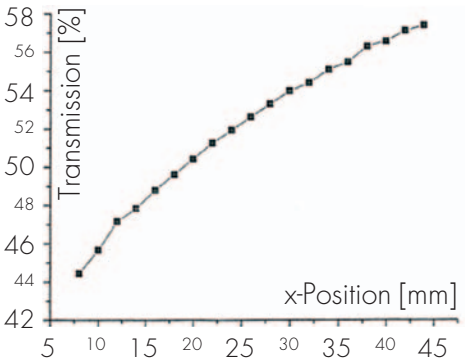
Actively Adjustable Beam Splitters

In very challenging applications a laser user will want to avoid tolerances of even ± 1%. In addition, there are applications in which one ends up with different losses in each beam path after adjustment. In these cases the desire for a beam splitter that can be actively adjusted is large.

Variable Beam Splitters

For these applications, LASER COMPONENTS has designed a variable beam splitter that has a position-dependent reflection profile. By moving the beam splitter one can obtain a reflection value between 45% and 55% depending on the position. The values can be continuously adjusted. The curve depicted shows an exemplary reflection profile across the position.

The coating is produced using an IAD process; therefore, it does not exhibit a noteworthy drift. Due to the active adjustment, the laser beam cannot only be very precisely split, but it can be split without any absorption losses.



Robert Gulino
gulino@laser-components.com

Webcode: US26-001

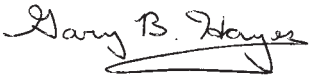
25th Anniversary of LASER COMPONENTS Optics Coating Facility

For 25 years now the LASER COMPONENTS optics coating facility located in Germany has been in operation. Through the years with continued laser optic production, R&D and advanced coating technology implementation, we produce some of the finest laser optics in the world. According to ISO Certification production standards our hard dielectric coatings from 193 nm to 5 microns consistently result in the highest laser damage power thresholds found in the industry. With now 25 years of experience and investment we are pleased that our dedicated work enables us to offer you coated optics of the highest quality.

Our coating technologies include E-beam (also referred to as PVD Physical Vapor Deposition), IAD (Ion-Assisted Deposition) and IBS (Ion Beam Sputtering). Coatings available as example are multiple AR, broadband AR, MgF_2 single layer, high power, cw/fs, and long-pass/short-pass for output couplers, beam splitters, thin film polarizers, Gaussian mirrors and mirrors in various shapes. Optical fiber end face AR coatings are applied in routine production.

For ITAR considerations a Manufacturing License Agreement (MLA) between LASER COMPONENTS USA, Inc. and LASER COMPONENTS Germany is established which allows production of your optics with coatings in accordance with US Department of State, Defense Directorate, Export Control regulations. We are fully ITAR compliant.

We are proud to offer you our 25 years of optics & coatings experience. Please bring us your challenge!



Gary B. Hayes
CEO / General Manager

SPAD or PMT

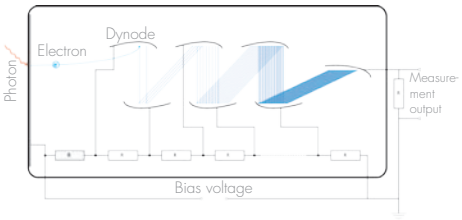
Single Photon Counting – A Comparison between Two Types of Technology

Photon counting applications play an important role in advancements in many different areas such as astronomy, particle sizing, disease diagnosis, medical analysis and imaging methods as well as the most recent area of quantum cryptography. The most spectacular application is surely biomedical research. The use of confocal and STED microscopy led to major advancements in the fluorescence analysis of the structure and function of biological molecules.

Primarily two types of technology are used to detect a small amount of photons:

Photomultiplier – PMT

A photomultiplier typically consists of a photocathode and a downstream secondary electron multiplier in an evacuated (10^{-6}...10^{-5} Pa) glass tube.



Working principle. The photons encounter a photocathode which, depending on the material used, emits an electron in a spectral range starting from 115 nm. The electrons that are set free are accelerated in an electrical field and encounter other electrodes – called dynodes. To ensure that the electrons remain free, the entire assembly is located in a vacuum tube; a high voltage supply of 1-2 kV is required. The electron that encounters the dynode then causes several electrons, so-called secondary electrons, to be emitted. These secondary electrons are accelerated toward the next dynode.

This process is repeated by several dynodes connected in series, producing an avalanche of electrons. This large number of electrons is finally absorbed by the anode, and an electrical pulse is generated that is detected by an electronic counter.

Single Photon Avalanche Diode – SPAD

Avalanche photodiodes, APDs, are highly sensitive and fast photodiodes. They differ from "normal" PIN photodiodes in that during the detection of photons a charge carrier avalanche occurs internally. For this to happen, it is necessary that a bias voltage be applied to the APD to expand the depletion layer.

Specially manufactured Si APDs can also be used as photon counters in "Geiger mode" above the breakdown voltage (VR > VBR). Here, a single photoelectron can initiate an avalanche pulse of approximately 10^8 charge carriers. These types of APDs are also referred to as single photon avalanche diodes (SPADs).

Working principle. Normally, an APD that is operated above the breakdown voltage will conduct a very large current. By using an appropriate circuit, the diode has to be prevented from staying conductive, which would be the result of the large current; the easiest way to accomplish this is by using a series resistor. The voltage drop at the series resistor leads to a reduction in the bias voltage across the APD, which then returns to its ready state as a result. This is referred to as passive quenching. This process is repeated automatically, and the current pulses can be counted. In active quenching, the bias voltage is electronically actively reduced within a few nanoseconds of a breakthrough current being detected. Increasing the bias voltage again to exceed the breakdown voltage leads to the reactivation of the SPAD. Signal processing by the electronics produces dead times of approximately 50 ns allowing count rates of up to 10 MHz to be achieved.

Single Photon Counting Modules

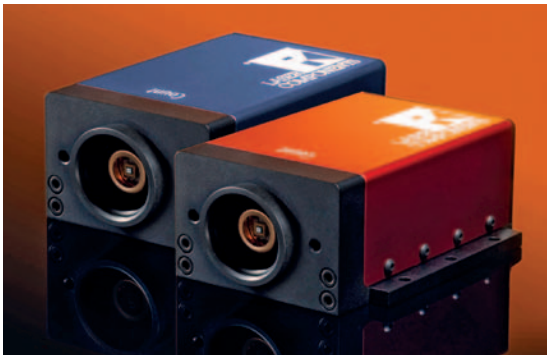
For the user to get the most out of these types of SPADs in terms of performance, complete single photon counting modules are available. In addition to the cooled SPAD, these modules contain complete electronics, including a stabilized high voltage supply and temperature control, in a compact housing. At the output end of these modules, a count pulse can be measured.

Advantages of Each Individual Technology

SPADs have significantly higher quantum efficiency (QE) and a large measurement range from 300 nm to the NIR range.

Quantum efficiency refers to the relationship of electrons produced to the incident photons in percentage; it depends on the wavelength. If all other detector properties are the same, the detector with the greatest quantum efficiency is the best choice.

When counting single photons, the **noise** produced by the detector plays an important role. Because one generally counts single photons, the noise of such detectors is no longer given in fW/sqrt [Hz], but rather in c/s (counts/second), which is referred to as the **dark count rate**.



It is important to know that both the quantum efficiency and the dark count rate depend on the operating voltage applied to the detector (see table). The trick is to produce a special diode that makes it possible to achieve maximum quantum efficiency at the smallest possible dark count rate.

Overvoltage [V]	QE @ 405 nm	QE @ 670 nm	QE @ 810 nm	Dark count rate
2,0	30 %	55 %	32 %	15,4 c/s
4,1	36 %	69 %	43 %	31,4 c/s
6,3	40 %	79 %	51 %	57,4 c/s
8,0	43 %	85 %	55 %	91,4 c/s
10,7	45 %	90 %	60 %	138,2 c/s

Table: COUNT performance at different levels of overvoltage

The "VLoK APD" developed by LASER COMPONENTS meets these requirements. The VLoK APD makes that possible today which was unimaginable in the past: dark count rates < 10 c/s at a simultaneous quantum efficiency of > 80% in the red spectral range. Diodes produced now even exhibit efficiencies > 90% @ 670 nm.

Alternatives at Shorter Wavelengths

For single photon counting at shorter wavelengths there used to be no way around using PMTs, particularly because the quantum efficiency of SPADs lacked significantly. Depending on the photocathode material used photomultipliers detect single photons up to 115 nm. The quantum efficiency in this range is approximately 10 - 20%, in the blue spectral range approximately 30%. With the COUNTblue LASER COMPONENTS has recently started offering a UV-enhanced single photon counting module that exhibits efficiencies of > 50% at 405 nm.

Paul Buettner
buettner@laser-components.com
Webcode: US26-029

Machine Vision Laser – Special Design and Standard Products

FLEXPOINT® MV Laser Modules in All Varieties

With the new FLEXPOINT® MVmicro and FLEXPOINT® MVpico series, LASER COMPOMENTS has set the standard for line lasers in image processing.

The MVmicro lasers were developed for standalone application. They have a diameter of 19 mm and a length of 65 mm. The MVpico lasers are optimal for integration in smart cameras. These small components are characterized by a diameter of 10 mm and a length of 50 mm. Both types of lasers are available at different wavelengths and an output power from a few milliwatts up to 100 mW.

The classification of these lasers in the correct laser class is an important aspect for every user. It is the goal of every image processing developer to obtain the maximum amount of output power while complying with laser class 2 or 2M regulations.

You can rely on our experience!

Due to a special measurement process, the MVmicro and MVpico lasers are classified in a lower laser class. That is to say, they are available with more power and still meet laser class 2 or 2M specifications. For example, a laser with a 20° fan angle can be classified in laser class 2M if it has an output power of up to 20 mW. Each laser must be inspected individually.

Kevin King
kking@laser-components.com
Webcode: US26-074

50 mW Version at Reduced Prices

450 nm Laser Diode

The increasing demand for and continuous development of high power blue laser diodes have had a positive effect on the market prices. With its CS450050M3X, LASER COMPONENTS offers a blue laser diode at a wavelength of 450 nm and an optical output power of 50 mW.

The single mode laser diode has a perfect beam quality and comes in an ultra-compact TO38 housing. An operating temperature of -10 °C to +70 °C makes it possible to use this laser diode in a wide range of applications.

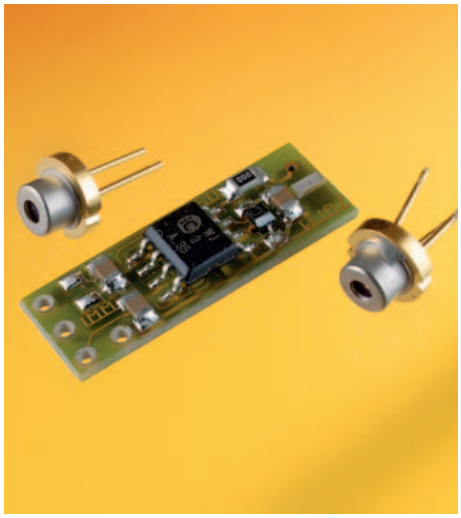
This laser diode is an optimal light source for high resolution display technologies and very large optical data storage applications. Further applications include laser projectors, industry, medical and measurement technology, and biophotonics applications.

Robert Gulino
gulino@laser-components.com
Webcode: US26-048

Developed by Us for You!

Inexpensive Drivers for cw Laser Diodes

The inexpensive LSC-025 driver was developed for M- and N-type cw laser diodes with a maximum operating current of 250 mA. The wide range of supply voltage of up to 5 VDC allows the operation of blue, red, and NIR laser diodes. These diodes can be either cw operated or pulsed up to 30 kHz.



The monitor current is used as a reference value when stabilizing the power of cw laser diodes. It can be anywhere between 50 µA and 500 µA. Irrespective of outside influences, the desired output power remains extremely constant within an accuracy of 1.5%.

The driver is used in combination with a suitable laser diode in industrial and medical laser diode modules, night-vision devices, barcode readers, leveling lasers, and laser measurement technology.

The LSC-035 is equipped with an additional protective circuit that prevents damage resulting from an ESD, high temperatures, or current peaks. Supply voltage transients are also filtered safely.

Robert Gulino
gulino@laser-components.com
Webcode: US26-055

LASER COMPONENTS USA, Inc.
9 River Road,
Hudson, NH 03051, USA
www.laser-components.com
info@laser-components.com
Phone: (603) 821 7040
Fax: (603) 821 7041

RETURN SERVICE REQUESTED

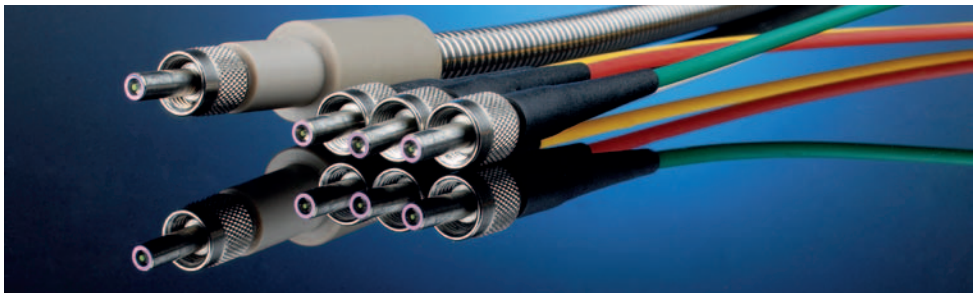
PHOTONICS NEWS

October 2011
Issue 26

New Standards for High Power Applications

Fiber Optic Cables with Coated End Faces

The recently-introduced coatings, designed for use on optical fiber end faces, have been in great demand by customers. With these coatings back reflections are reduced by nearly 3 % at the interface between glass and air. LASER COMPONENTS has continued to make developments in this area, which has resulted in new standard designs, the suitability of which for high vacuum coating processes has been tested and proven.

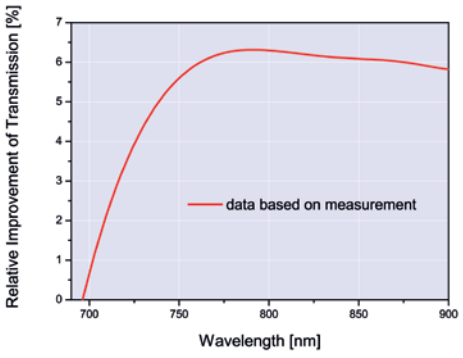


Many customers, and their applications, require – in addition to the optical coating – a robust and, yet, flexible metal jacket as a protective covering around the optical fiber. We use a corrugated tube made of stainless steel (see the cable on the left in the photo) and, thus, the best metal jacket available. The protective tubing has an outer diameter of 7.1 mm, does not contain any plastic parts, and is free of any oily or fatty residues.

To ensure that the connection between two optical fiber plugs connected by a metal jacket is potential free, vacuum-suitable isolators are mounted on both ends between the plug and the metal jacket.

If less robust protective jackets are required, we offer AR-coated fibers which are also available with protective jackets made of Teflon. The tubes have an outer diameter of 2.2 mm and are available in different colors.

The jackets described above will be available in the future on a standard basis for coated fibers.



Naturally, these fibers will also be available as so-called "bare fibers" (i.e., without a protective jacket).

The SMA connector and D-80 plug, which is compatible with the Mitsubishi LD-80, have established themselves on the market for high power applications. Both connectors have a free-standing fiber; the fiber bore hole of said connectors can be adjusted for use with different types of fibers. For very high power, we recommend using plugs with copper ferrules to optimally conduct the accumulating heat. The body of the D-80 plug is equipped with cooling fins for this purpose.

Kevin King
kking@laser-components.com
Webcode: US26-018