Photonics News

Company Newspaper of the LASER COMPONENTS Group

July 2014
Issue 33

Our Own Semiconductor Production Facility in Arizona Expanded

InGaAs PIN Photodiodes by LASER COMPONENTS DG

The LASER COMPONENTS Detector Group (LC DG) has been manufacturing Si and InGaAs avalanche photodiodes in Tempe, Arizona – the traditional center of semiconductor manufacturing in the U.S.A. – since 2004.

In addition to production, LASER COMPONENTS also conducts product-oriented research: The latest result of this research was the InGaAs and extended InGaAs PIN photodiodes introduced at the end of 2013. There are three product families available:

- IG17: Regular InGaAs with a response up to 1700 nm
- IG22: Wavelength-extended InGaAs with a response up to 2200 nm
- IG26: Wavelength-extended InGaAs with a response up to 2600 nm

All versions are panchromatic on a standard basis, which means that they also function in the visible spectral range. Additional advantages include a high linearity, an excellent sensitivity, and a low temperature coefficient of the sensitivity. Many different housings are available (e.g., SMD, chip on sub-mount, and thermoelectrically-cooled housings).

A special case is the version with an active area diameter of 1.3 mm – it yields 70% more signal than a detector with a diameter of 1 mm – while retaining the TO-46 housing with a 4.8 mm cap diameter.

Uncooled versions in a standard TO housing are generally available from stock – at competitive prices.

In addition to the standard portfolio, we also deliver customer-specific solutions. These primarily include components with special coatings on the windows, which are manufactured in Germany using IBS technology and then metallized, cut, and soldered to the caps by LC DG.

The main applications of IR detectors include laser monitoring, spectroscopy, FTNIR, and contact-free temperature measurements.

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LC Pyro Group

LASER COMPONENTS Expands Through Acquisition. Pyroelectric Detectors Now Manufactured In House.

The LASER COMPONENTS Group expands its Infrared Detector activities and acquires the majority ownership of U.S.-based manufacturer Microwatt Applications, LLC.

As of July 2014, Microwatt will operate under the name LASER COMPONENTS Pyro Group, Inc. and as a subsidiary of LASER COMPONENTS Detector Group who already manufacture a successful line of IR semiconductor detectors. Microwatt's location in Florida will remain and be gradually expanded.

Microwatt manufactures Pyroelectric Detectors based on $LiTaO_3$ for industrial gas analysis, medical technology and flame recognition. Also produced are Pyroelectric Detectors based on DLaTGS as the sensing material used in premium applications such as FTIR spectrometers and THz which are gaining in importance in the market place.

Please join us and take a look at our new Pyroelectric Detectors on our web site or by simply giving us a call. As always we look forward to working with you.

Gary B. Hayes
CEO/General Manager

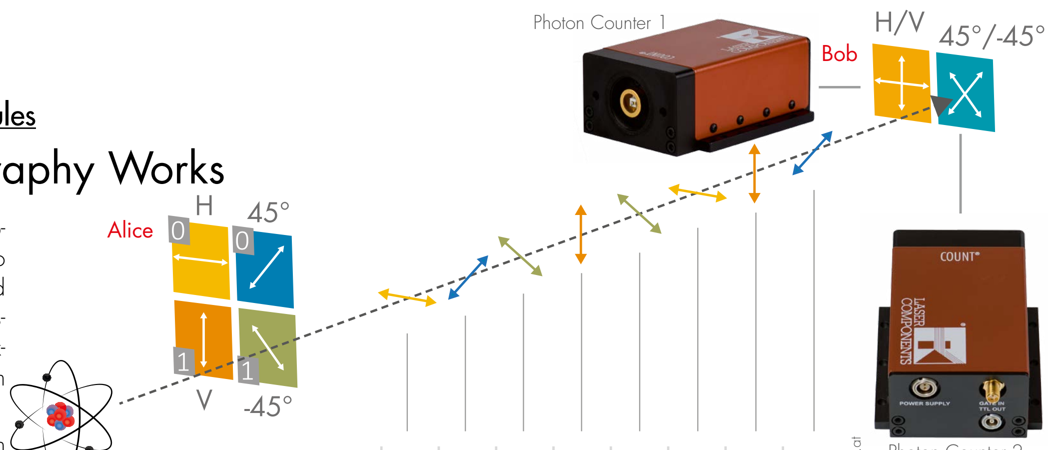
Application Fields for COUNT Modules

How Quantum Cryptography Works

Data security and data exchange are topics with increasing importance. How do you prevent data from being intercepted by a third party? The solution lies in cryptography: The message must be encoded. But what if the key exchange is intercepted? This is where quantum cryptography comes into play.

The idea behind so-called quantum key distribution (QKD) is to use single photons instead of entire photon bundles. This way an eavesdropper (referred to as "Eve" in quantum mechanics) cannot simply divert the photons that are sent from Person A to Person B (referred to as "Alice" and "Bob," respectively, in quantum mechanics). Eve would have to copy and then detect the photons to prevent the interception from being detected by Bob. This is precisely what quantum mechanics renders impossible (the so-called "no cloning theorem").

Figure 1 depicts what key generation for coding and decoding data can look like. This so-called BB84 protocol (developed by Bennett and Brassard in 1984) uses the polarization of photons as a means of generating a key sequence. Alice selects one of four polarization states – H (horizontal), V (vertical), +45°, and -45° – and sends such a photon to Bob. She must first indicate which bit value the two orthogonally arranged polarization states have: 0 or 1. In our example, H corresponds to 0, V corresponds to 1, 45° correspond to 0, and -45° correspond to 1. If Bob receives such a photon, he decides whether to measure based on H/V or 45°/-45° and ultimately makes a note of the polarization state (and thus the bit value) of the photon. Bob communicates with Alice in the classic sense, and they compare their base selection. This information, which is of no use to Eve because she does not know the exact results, is sufficient for Alice and Bob to determine which bit values they can use for their key [1].



Alice's Bit	0	0	1	1	1	0	1	0
Bob's Selection	+	+	×	×	+	×	+	×
Bob's Bit	0	1	1	1	0	0	1	0
Key	0	-	1	-	-	-	1	0

Schematics based on www.teilchen.at

Fig. 1: Schematics of the quantum key exchange between Alice and Bob

A further development of the BB84 protocol uses entangled photons, which strongly correlate in their properties, that are sent from a single source to Alice and Bob simultaneously. One such source was developed, for example, by experimental physicists in Prof. Weihs' photonics group at the University of Innsbruck: a pulsed Sagnac source of polarization-entangled photons [2]. Here a nonlinear crystal is used that produces two lower-energy photons at a wavelength of 808 nm from a higher-energy photon at 404 nm. The photons are detected using two "COUNT" SPADs by LASER COMPONENTS.

As secure as these methods are in theory, in practice there is a lot of room for error. The most significant sources of error are the single photon detectors: In theory, they are perfect, identical, and have a detection efficiency of 100%; however, in practice, this is never the case. It is precisely this discrepancy in the detection efficiency of two detectors that quantum hackers use to access the key [3]. An alternative method "blinds" the SPADs with the help of a light pulse and uses the "blind time" of the detector to intercept information [4].

Thanks to the identification of sources of error by quantum hackers, research groups have been able to work on approaches for solutions to these problems and develop a "measurement unit-independent" version of the QKD [5].

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[1] (for more information, see http://www.weltderphysik.de/gebiet/technik/quanten-technik/quanten-kryptographie/) [2] (see http://www.uibk.ac.at/exphys/photonik/people/parametric-downconversion.html)
[3] (see http://arxiv.org/abs/quant-ph/0702262) [4] (see http://arxiv.org/pdf/1008.4593v2.pdf) [5] (see http://arxiv.org/abs/1109.1473)

Now also available at 786 nm and 1550 nm

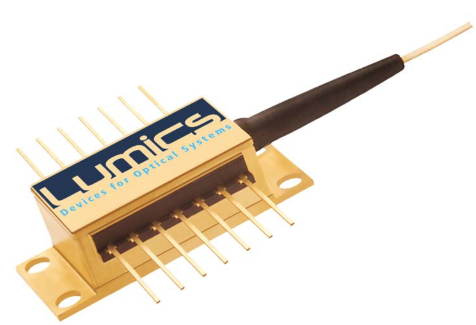
Single Mode Butterfly 14-Pin Modules for Analytic, Sensing & Seeding

These single mode fiber pigtailed butterfly 14-pin modules are new: Lumics' hermetically sealed BTF14 modules at 1550 nm and 786 nm. They are manufactured as per Telcordia standard GR-468-CORE – therefore an internal temperature control and a monitor photodiode are integrated, too. Other available wavelengths are 786, 793, 808, 850, 915, 980, 1012, 1025, 1032, 1064, 1070, and 1080 nm. Customer-specific wavelengths can be manufactured on request.

The BFT14 series can be either driven cw with an output power up to 500 mW or pulsed (up to 2 W). All BTF 14-pin modules can also be delivered as a compact table top solution with an integrated laser diode driver.

Choose your own configuration:

- Polarization maintaining fiber up to 12 dB extinction ratio.
- Fiber bragg grating with spectral width from 1 nm in standard configuration down to 0.15 pm.
- Wavelength locking in pulsed operation down to 3 ns for fiber laser seeding or temperature sensing.
- With standard connectors like SMA, FC/PC, or FC/APC.



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High-Power Coatings in the UV Range

Complex IBS Coatings Starting at 266 nm

We use the IBS coater to manufacture particularly complex coating designs with more than 100 layers. Ion beam sputtering (IBS) makes it possible to create very compact and homogeneous layers that retain barely any water and are thus extremely low drift. This combination makes the coatings insensitive to temperature fluctuations.

As a result, mirrors with reflections of R > 99.99% can be manufactured that are required for gyro applications or complex layer designs.

Thin-film polarizers and complex mirror coatings are now also available at 266 nm!

To date, IBS coatings have been available in the wavelength range from 400 nm to 3000 nm. A new coating material now makes it possible to create coatings in the spectral range starting at 260 nm. For the first time, complex mirror coatings are available in the standard wavelengths 266 nm and 355 nm in house, as well as thin-film polarizers in the UV range.

Coatings from 260 nm to 3000 nm

The new coating material can be used with all wavelengths between 260 nm and 3000 nm. The new material has already exhibited improved damage thresholds over the material used to date – as shown by measurements taken at the wavelengths 532 nm, 1064 nm, and 2 µm. At the wavelength 1064 nm (20 ns, 20 Hz), the damage threshold values were several times higher than those of conventional layers.

This new material holds the promise of an important advancement for many laser applications. Not only are the high damage thresholds and the wide wavelength range an improvement, but this new material promises the ability to produce novel and very specialized coatings.

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Interested in a Joint Project?

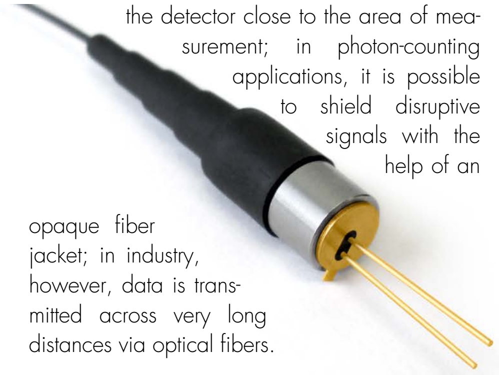
Are you interested in new options and on the search for a coating with extraordinary characteristics? Then contact us today. We are currently planning more test coatings and optimization steps. You will profit from this by working together with us to advance IBS technology.

Detect Small Amounts of Light Using a Fiber

Avalanche Photodiodes with Fiber Pigtails

LASER COMPONENTS DG now manufactures avalanche photodiodes with fiber pigtails. With a semiautomatic assembly unit, the fibers can be adjusted exactly to within a few µm and thus achieve output coupling efficiencies of almost 100%. The pigtailing technology is very flexible – almost any combination of APD and fiber can be implemented: all optical fibers with a core diameter of < 600 µm can be combined with our APDs in a TO-46 housing.

The advantages of fiber coupling are obvious: in medical technology or analytical measurement technology, it is not often ideal to have the detector close to the area of measurement; in photon-counting applications, it is possible to shield disruptive signals with the help of an opaque fiber jacket; in industry, however, data is transmitted across very long distances via optical fibers.



Product portfolio: Initially, we offer our SAP-series Geiger-mode APDs and the particularly low-noise IAG-series InGaAs APDs on a standard basis. Hermetically sealed and with high mechanical durability, these APDs exceed the requirements of the Telcordia GR-468 standard.

The development of APDs according to customer specifications is inexpensive and possible at any time.

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New World Record: Up to 650 Watts at 905 nm

Peak Performance of Pulsed Laser Diodes at 650 W in a TO-18 Housing

LASER COMPONENTS Canada has set a new world record with its pulsed laser diodes at 905 nm: peak power levels of up to 650 W emitted from a small TO-18 housing. They are based on "multi-junction" laser technology and are available on a standard basis.

This special laser technology contains several epitaxially integrated emitters with a total emitting area of 200 µm x 10 µm. At a pulse length of 150 ns, it is possible to achieve a peak performance of at least 70 W from a single chip.

The metal housing allows a higher thermal load, which permits overdriving the diode and ultimately leads to the achievement of an output of up to 650 W from a stacked array design. Due to the combination of a small emitter area and an extremely high peak performance, the new 3J08 series is optimally suited for fiber coupling.

These pulsed laser diodes are used in low-level laser therapy, among other things. This is an alternative (veterinary) medical treatment that is carried out using monochromatic and coherent light. The goal of treatment is to reduce pain, accelerate the healing of wounds, and fight infections.

Further areas of application include rangefinding, speed guns, laser radar, security scanners, laser light curtains, and test and measurement systems.

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Digital Electronics Allow Customers to Learn More about Their Laser

FLEXPOINT® Laser Modules Now Available with Microprocessor Control

More information for customers: Selected FLEXPOINT® laser modules can now be equipped with microprocessors. Via a serial UART interface, users can monitor, for example, the operating hours or the temperature on the inside.

But not only that: the interface also allows the modules to very easily and quickly be digitally or analogously modulated. In addition, the digital electronics allow greater power stability; depending on the laser diode, the fluctuations are only 1-2% (in analog circuits, this value can reach up to 5%).

Microprocessor-controlled laser electronics offer many technical possibilities: Together with our customer, we agree on which parameters are necessary for the application and which information should be readout from the laser module. We would be happy to exchange ideas with you.

We currently implement digital electronics based on customer requests or automatically in laser modules having ambitious specifications. At the moment, this new technology is available for the following products:

- Dot and line lasers
- Long-range alignment lasers
- MVmicro series image processing lasers

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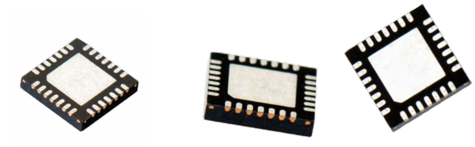

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LASER COMPONENTS

Plug&Play APD Modules up to 25 MHz

A-CUBE Turns Detecting the Smallest Amount of Light into Child's Play

Optical power in the fW range can be easily detected using avalanche photodiodes. For easy plug&play application, we are introducing our A-CUBE APD modules: these small modules detect light quickly and reliably in the spectral range from 400 nm to 1700 nm.

The heart of the A-CUBE is a low-noise Si or InGaAs avalanche photodiode with a preamplifier and an integrated high-voltage power supply. Temperature compensation is also integrated that allows operation across a wide temperature range at a constant amplification.

InGaAs detectors allow measurements in the spectral range between 1000 nm and 1650 nm; the silicon versions allow measurements between 400 nm and 1100 nm. Both versions are available in different bandwidths: from DC to 25 MHz.

This shielded housing with an edge length of just 40 mm can be integrated into optical benches with a single click. It only requires an additional 12 V power supply to operate the APD. With this setup, detection of the smallest amount of light is child's play. The A-CUBEs are available on an optional basis with an FC connection.

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