PHOTONICS NEWS

LASER COMPONENTS USA, Inc. Magazine #38 ▪ 04|17 laser-components.com

Drones: Opportunities and Challenges

Safety with Laser Scanners

Alcohol Control in the Car

New Products

Editorial

…is something that every businessperson would happily venture if only to better protect their investment decisions.
When we at LASER COMPONENTS review our data, and analyze our indicators, we do not have any reason to doubt that business will continue to develop positively. We experienced the same energy at the latest SPIE Photonics West, the world's premiere conference and exhibition in optics and photonics, welcoming over 23,000 researchers and industry professionals. The comprehensive conference covers more than 4,700 presentations, giving center stage to brain research, LEDs to streamline data to computers, additive manufacturing, and much more. During one of the industry events, public affairs specialists also reported on continued funding in the U.S.A for advanced manufacturing, cancer research, and a 10-year authorization for the BRAIN initiative with an optics and photonics roadmap. Being part of this dynamic event, we have introduced more than 6 new product developments and innovations, targeting LiDAR, material processing, spectroscopy, 3D vision, … All applications that are considered game changers in the near future.

How is it that we are still able to glimpse so positively into the future, and how do we strengthen our upcoming investments?

In the past few years, LASER COMPONENTS has completed the transition from an exclusive sales office to one of the leading components manufacturers. Last year, the percentage of the products manufactured in house (of the entire LASER COMPONENTS Group taken together) was more than 70%. Over the course of the past few years, we have also been able to establish many key technologies in house.

Photonic applications are an integral part of everyday life and play an increasingly crucial role in consumer products. Lasers and detectors will be integrated more and more into products in the automobile industry, smartphones, and, most recently, the rapidly-growing drone market. Due to its existing technology pool, LASER COMPONENTS is an extremely attractive supplier. The growth potential is quite large due to these untapped market possibilities.
The contribution our components already make to increasing safety measures in everyday life is described in this edition.

Sincerely,

Gary Hayes
CEO/General Manager, LASER COMPONENTS USA, Inc.

Content

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LASER COMPONENTS USA, Inc.
116 South River Road, Building C
Bedford, NH 03110, USA
Phone: (603) 821 7040
Fax: (603) 821 7041
www.laser-components.com
info@laser-components.com

Drones Will Change the World

Science Fiction Was Yesterday

The Federal Aviation Administration (FAA) registered over 468,214 hobbyist owners of drones in the US within the first 6 months after it began its registration program in December 2015. The rapid rise in the sale of drones increases the risk of collisions, crashes, and accidents. Now it is time for clear regulations to ensure air traffic safety beyond model airfields. In 2016 the FAA received over 100 reports per month about flying objects in close proximity to airplanes and helicopters. Even though the FAA has not confirmed any collision between a civil aircraft and a private drone, they want to send a clear message on where and how to safely operate unmanned aircrafts.

Drones are unmanned aerial vehicles (UAVs) that can be used privately or commercially. They often pose concerns about privacy and are no stranger to controversy. In addition to safety-relevant regulations, it is crucial to observe local data privacy laws. Because the federal government has not regulated privacy in the airspace, many states are passing their own laws. This leads to many uncertainties and regular updating of information is required.

Commercial use opens up entirely new application possibilities for drones; discussions in this direction presumably include parcel delivery via UAVs. Horror scenarios paint pictures of flying objects filling the sky. The application of UAVs in civil protection or disaster control is undisputed: fire-fighting and sea and mountain rescue missions can be coordinated more efficiently with UAVs. In the future, industrial facilities will also be able to be monitored by drones to detect gas leaks, for example. Feasibility studies are being carried out to test their use in production facilities.

Drones in Fire Department Operations

UAV systems are already used today in rescue missions. In the most straightforward fire department operations, they are used to localize the source of the fire, which is especially useful in forest fires when initiating targeted fire-fighting operations.
These systems should also be used to save lives in accidents involving the transportation of hazardous materials. Drones aid in determining the condition of the injured or whether there are leaks, detecting hazardous materials, and measuring the concentration of the hazardous materials. With this data, dispersion forecasts of pollutant clouds can be deduced and appropriate preventive measures coordinated.

Sensor Technology Challenges

Small UAVs, weighing between 0.55 and 55 pounds, must be operated under a specific set of rules and are currently only allowed to fly within direct sight of the operator. However, modifications of these rules will continue to happen with the ultimate goal to allow autonomous drones. Therefore, high demands will have to be placed on their safety systems to maintain adherence to flight rules and air traffic control. Autonomous UAVs will have to be able to determine their exact position at any time and react automatically to external influences. Sophisticated sensor technology is then necessary for aircraft operations.
Continue reading on the next page ➔

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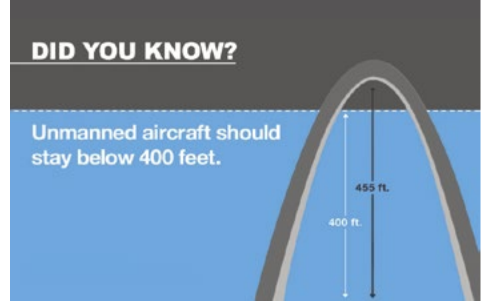
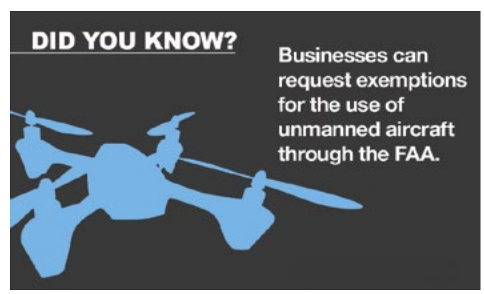




Photos: Know Before You Fly


Paketkopter in Reit im Winkel; Source: Deutsche Post AG; © Andreas Heddergott

Safe Flying

Take-off and landing are particularly challenging at high-speed winds. It is necessary to quickly offset so-called gust effects and, thus, be able to determine the exact position. Satellite navigation and reference measurements aid this procedure. The interaction between the flight calculator and the navigation and air-data sensors makes it possible to take effective countermeasures.

DHL Paketkopter 3.0

DHL Paket tested autonomous cross-country flights in the Bavarian area in Germany at the beginning of 2016. Packages were successfully delivered across 5 miles and ascending 1,640 foot in altitude at quickly-changing weather conditions and high temperature fluctuations. Medicine was able to be expedited to the DHL Skyport in the mountains in just eight minutes; a car would have taken thirty minutes under winter conditions.

This flight was carried out without visual contact; therefore, redundant safety systems were applied and a data link set up with a long range: Radio communication and a mobile phone network made operation possible. Delivery was also carried out intelligently: Loading and unloading of the package were carried out automatically and the batteries were even changed to facilitate an immediate return flight. This flight proved the technical feasibility of such delivery methods. ➔

Dangers of Drones

We will soon see the commercial application of autonomous drones, in which the control pilot does not have visual contact with the UAVs during flight. Another challenge will be tracking enemy drones.

Thus, not only is intelligent automation the focus of development of these flight systems, but also simultaneous drone detection in order to ensure reliable drone defense.

Drone Defense

Multi-sensors are already being used to monitor the airspaces above prisons, government buildings, industrial facilities, and stadiums. If a dangerous drone is detected, there are a few conceivable defense techniques available. The possibility of taking over or destroying a UAV system via electromagnetic fields is currently the topic of research. Attacks via jammers or spoofers could force the drone to return to its starting position, leave its current path, land, or crash.

Counter-drones with capture systems would not be practical because they would have to be very large and controlled in a targeted manner.

The Dutch police are developing an unusual method. They are currently training eagles to catch small drones in flight. You will find a video showing the eagles in action here:
youtube.com/watch?v=HifO-ebmE1s

DHL was the first parcel service worldwide to test the extensive integration of package delivery via UAVs into the delivery chain (dpdhl.de/paketkopter).

Other companies like Amazon and Google are also talking about drones as part of their delivery services. They are working together with NASA and the FAA to build a system that would allow for that kind of air traffic. For daily application of UAVs, it will be necessary to establish the legal parameters of UAV flights and also continue to refine the drones. This is a long-term project and is not likely to be in place before 2019.

Future Project: Autonomy and Swarming

In large-area disasters, drones should be able to fly without active control in order to autonomously analyze a given area and forward the recorded data. Possible application scenarios include nuclear accidents or major earthquakes, in which streets are damaged or the telephone network fails, for example. This autonomous areal analysis is only possible in drone swarms in which the individual UAVs communicate with each other and forward their information and data to ground stations. The fact that drones in a swarm must not be allowed to cause collisions goes without saying.

Prevention of Collision via Distance Measurement

UAVs present a large risk to the cockpits and engines of rescue helicopters and low-flying passenger airplanes. To allow drones to avoid other aircrafts, distance sensors are integrated into autonomous UAVs; depending on the distance to be measured, radar systems or LiDAR systems could be used. LiDAR systems will probably also play a role in so-called near-field navigation near buildings (e.g., for inspection tasks) or even inside buildings. ■

© istock.com/Mooneydriver

Teammembers of RWTH Aachen with the Paketkopter at the DHL Skyport in Reit im Winkl © RWTH Aachen

Autonomous Flight - Products for Distance Measurements

WEB US38-950

It may soon be a requirement that drones be able to measure their distance to obstacles. LASER COMPONENTS offers the components necessary to build inexpensive sensors for this purpose.

Avalanche Photodiodes

Small and inexpensive: the SAH series avalanche photodiodes are packaged in an SMD housing that has an edge length of just 3.1 mm x 1.8 mm. These components are optimized for the wavelengths 850 nm and 905 nm, have a high quantum efficiency, and operate quickly.

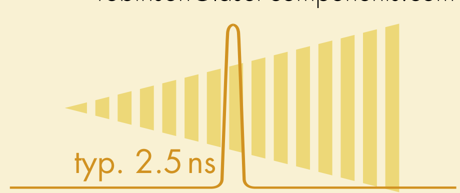
Inexpensive Pulsed Laser Diodes

The UA series pulsed laser diodes are a good counterpart to the inexpensive APDs, featuring power levels of up to 75 W. They are as inexpensive as comparable PLDs in a plastic housing; however, they are of a higher quality with their ultra-precise mechanical tolerances. The hermetically-sealed metal housing has a diameter of 5.6 mm, providing excellent temperature stability of the component.

Pulsed Laser Diodes with Short Pulses

We are ready to introduce pulsed laser diodes that are called QuickSwitch®. This year we will celebrate the introduction of these new components into the market. They are characterized by particularly short pulse widths of just 2.5 ns. A preliminary datasheet is available online under the web code provided. More information will follow over the course of the year. ■

Matt Robinson: +1 603 821 7040
robinson@laser-components.com



Distance Measurements Prevent Collisions

LiDAR Systems for the Recognition of Obstacles

For vehicles to drive autonomously or unmanned aerial vehicles to fly alone, they must be able to recognize obstacles in order to avoid them. Monitoring surroundings using LiDAR systems has many advantages: These systems are not only inexpensive, but they can also measure distances of up to 100 meters. LiDAR is short for **li**ght **d**etection **a**nd **r**anging.

During measurement, pulsed laser diodes (PLDs) are used as emitters and avalanche photodiodes (APDs) as receivers; this measurement principle is based on optical time-of-flight (ToF) measurements.

Optical ToF Measurements

The principle of optical ToF measurement can be easily explained: A PLD sends a single short light pulse; ideally, this light propagates undisturbed along the shortest path through the air until it detects an obstacle. At the obstacle, light is reflected and the pulse returned to be detected by an APD. The electronics that connect APDs and PLDs measure the time Δt between sending and receiving the returned light pulse. Because the propagation speed of light is already known, the distance l of an obstacle can be easily calculated from measured time.

Autonomous Driving

The study published by Frost & Sullivan on the "Automotive LiDAR Market for ADAS and Automated Driving, Global 2016" expects the advance of LiDAR technologies in autonomous driving. Application fields range from lane departure warning systems to autopilot functions. Their widespread introduction is expected by the year 2025.

Source: frost.com/mb5c

Basic Physical Principles

Light propagates in a vacuum at light speed c. Measurements in a vacuum yield the following value for c:

$$c = 299{,}792{,}458 \text{ meters/second}$$

In the physical sense, a vacuum is space without matter; therefore, it has an optical density of n = 1.

The smallest dust particles found in the air change this optical density, which is known as the refractive index n. The wavelength and phase speed are smaller than in a vacuum; therefore, the speed of light propagation also changes: $c_{air} = c/n_{air}$

Calculation Example

Imagine for a minute that a light pulse is detected at **Δt = 500 ns**. The obstacle has a distance of l, the measured time refers to the two-way (back and forth) path of light (i.e., 2*d).

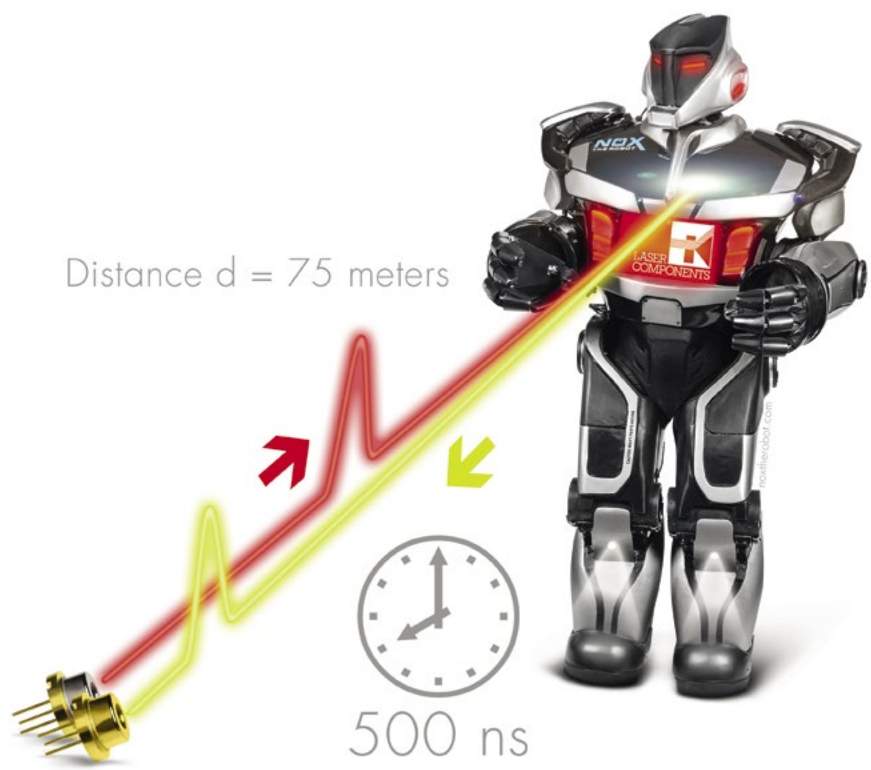
The distance can be measured in your head if you allow for the following approximate values:

$c = 300{,}000{,}000\ m/s = 3*108\ m/s$
$n = 1$

The following equation applies:
$\Delta t = 2*d*n/c = 500\ ns = 5*10^{-7}\ s$
$d = 0.5 * (c * \Delta t) / n$

The distance can be calculated as:
$d = 0.5* (3*108\ m/s * 5*10^{-7}\ s)/1$
$d = 0.5*3*5*10^{1}\ m = 75\ m$

It is impressive to realize just how small the intervals are that are required for measurements at short distances; these intervals extend into the picosecond range, which is the trillionth part of a second. ■



Open Sesame!

High-Tech Equipment is Responsible when Doors Open Automatically

Have you ever walked up to or even into a closed glass door? Or have you ever been caught in a sliding door? Often these types of collisions have a mild outcome and you can look back on such situations and laugh, but sometimes these types of collisions can cause considerable damage: that is why many doors in public institutions are now controlled automatically; sensors are responsible for the safety of these doors and their "intelligence" is increasing.

Automatic Sliding Doors

Almost all supermarkets today are equipped with sliding doors that open automatically, and even rail passenger cars have doors that close almost by themselves. We will enter sensor-controlled door systems almost every day, but have you ever thought about how they actually work?


© istock.com/choja

One-way Light Barriers

The one-way light barrier is a simple opto-electronic safety system to detect persons or objects at the installed height. It uses a light source that emits a permanent beam that is received by a detector on the opposite side. Controlled via electronics, the receiver will send an alarm if it does not detect the light sent by the light source.

In sliding door systems, the light sources are in most cases infrared emitting diodes, which are invisible to the human eye. Usually, the sensors are installed at the height of a person's ankles. If the connection between the emitter and the receiver is interrupted, then the door's closing mechanism is suspended for a set time interval. In ground-level doors this safety mechanism is sufficient.

Light barriers are still commonly combined with additional safety mechanisms, for example if it is necessary to step up or down a step when entering a door, making it necessary to protect an arm on a railing from getting caught: the technology ranges from pressure sensors to the installation of further light barriers at different heights.

Light Curtains

Simple light barriers are being replaced more and more often by so-called light curtains. In this technology, many emitters and receiver units form a fine line grid to prevent people or objects from getting caught in a sliding door. Light curtains are also very widespread in industrial applications in which access points must be monitored.

Complex Sensor Technology for Revolving Doors

Revolving doors prevent a draft and save – compared to sliding doors – energy costs. They are, therefore, preferably used in large buildings. The safety requirements are physically trivial for sliding doors and extremely complex for revolving doors. Most safety equipment has to be tested to meet DIN18650 requirements.

We will introduce two standard optoelectronic methods that provide protection via distance measurements: inexpensive triangulation methods and complex laser scanners that use time-of-flight measurements. ■

Optoelectronic Personal Protection via Distance Measurements

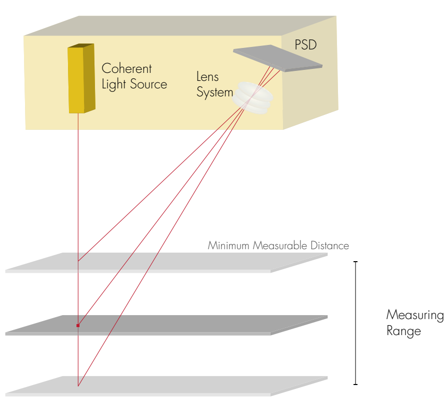
Triangulation and Time-of-Flight Measurements

Distance Measurements using Triangulation

Triangulation is used in automatic revolving doors: If a person stops moving in the door wing, the automatic rotation mechanism has to be stopped automatically to prevent the door from colliding with the person. The optoelectronic sensor consists of a laser diode and a receiver that can determine the position; position-sensitive detectors (PSDs) or CCD cameras are used for this purpose.

Object Recognition

Simply put, object recognition is carried out as follows: In the drawing, you will see sensors that are set up one after the other on the rear door wing to continuously measure the distance to the floor. As soon as the measured distance is reduced, a barrier is recognized and the door system stopped.

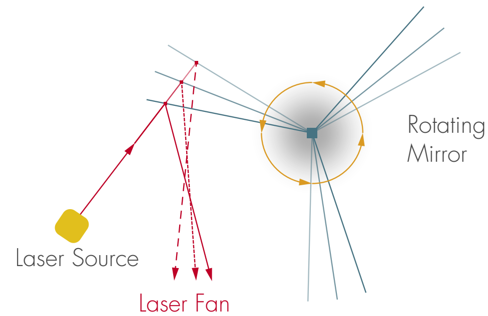


Laser Scanners

If high precision and speed are required, then it is necessary to utilize laser scanners instead of triangulation. In revolving doors, laser scanners are used to protect against trapping; in industrial automation, they are used to protect people from machines. The sensors recognize intrusion into a danger zone and trigger a (machine) stop.

Object Recognition with Laser Scanners

Laser scanners are based on optical time-of-flight measurements (see page 006). The typical assembly of industrial laser scanners requires a rotating mirror for the setup of a two-dimensional surface in order to capture the surroundings (see figure). This type of system achieves a high angular resolution that makes it possible to perform an exact distance measurement and provides a high degree of detail of the scan. Typically, industrial laser scanners capture an angular range of up to 270°; in automotive applications, 360° are captured.
In a three-sided mirror, the scanning area is scanned three times per rotation. If the mirror surfaces were tipped, it would even be possible to scan surfaces that are inclined toward each other rather than a purely two-dimensional surface.



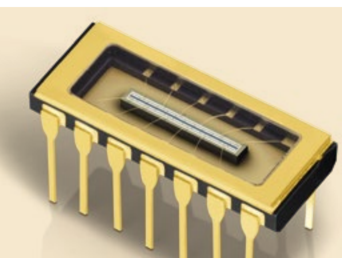
Quality Features of Pulsed Laser Diodes

Laser scanners are used to monitor very different distance ranges. As shown in the calculation on page 006, if an object is measured at a distance of 75 m and a time delay of 500 ms, the pulse for objects at a distance of 2 m is detected after just 13 ns.
Therefore, pulsed laser diodes are required that have the lowest pulse width possible for distance measurements at short distances. The shorter the laser pulse, the higher the precision. Typical versions have a width of less than 10 ns – novel technologies are already in the starting blocks. However, at far distances, it is necessary to ensure that the pulse power is high enough to detect a returning signal.
For both requirements, the trick is to select the right components and switch the laser source and receiver properly. ■

APDs and PLDs for Your Measurements

For distance and speed measurements Pulsed Laser Diodes (PLDs) – at wavelengths of 905 nm – are used in combination with Si PIN or Si Avalanche Photodiodes (APDs).

LASER COMPONENTS manufactures these components and recently introduced a PLD with ultra-short pulses and an APD array, both ideally suited for laser scanners. Under the web code provided, you will find datasheets on the suitable time-of-flight components. ■



WEB US38-952

Paul Buettner: +1 603 821 7040
buettner@lasercomponents.com

Driving Under the Influence: Determining the Breath Alcohol Level

Breathalyzers Combined with Vehicle Immobilizers

"Driving under the influence" and vehicle immobilization are hot topics of discussion. Measurement apparatuses in automobiles are designed to lock the ignition when the driver's alcohol content is too high. It is not until the driver is able to blow an acceptable level into the alcohol ignition interlock breathalyzer that the motor can be started.

As of 2012, all states have adopted some sort of ignition-interlock laws as a sentence alternative for drunken drivers. Some states, and in Canada some provinces, even require installing an Ignition-Interlock Device (IID) for all offenders. Repeat offenses have been reduced by 70% while they are installed, but despite these laws, only about one-fifth of those arrested install the interlock.

Ignition Interlock Retrofitting

There are a growing number of people who want to voluntarily install an interlock device in their car. The reasons are manifold and range from protecting young drivers, to making sure that employees don't drink on the job. "Alcoguard" ignition locks can be ordered with Volvo as a special option, but also other technologies are making their way. The measurements are based either on breath alcohol content or alcohol levels directly under the skin.

"Breathe!"

Breathalyzer as Opposed to Blood Sample

In the United States, the legal limit for driving is set at 0.08% Blood Alcohol Concentration (BAC) for those over the age of 21. There are three types for testing BAC, but the most common is breath testing. In some states, you are allowed to request a blood or urine test.

Alcohol consumption can be detected in the blood, as reabsorbed ethanol enters the bloodstream through the oral mucous membrane, the stomach, and especially the small intestine. In the lung alveoli, there is an exchange of gas between ➔

the alcohol from the arterial bloodstream and the air breathed. Therefore, alcohol consumption can be determined via breath gas analysis. It is even possible to determine the concentration of alcohol because there is a physiological correlation between the breath alcohol content (BrAC) and the blood alcohol content (BAC) (Henry's law: average partitioning factor of 1:2100). In order to convert the result of the breath alcohol measurement to a blood alcohol concentration, a blood/breath ratio must be used. There is a lot of dispute on this subject and different countries have each adopted their own assumed value of this ratio, with 2,100:1 being used in the U.S.A. Thus, the following applies: 0.08% BAC = 0.073 g/210l BrAC.

How Breath Alcohol Content is Measured…

There are three major measurement devices based on: an electrochemical sensor, an infrared sensor, or alcosensor. We will discuss the first two:

Electrochemical Sensor

In the electrochemical detection of alcohol, the current produced in the chemical conversion of ethanol is measured.

An electrolyte and at least two opposing electrodes are located in a measuring chamber; these electrodes are connected to an ammeter. A defined air volume is blown into the measurement cell. If ethanol can be detected, a measurable current is produced via a redox reaction. One reaction partner is oxidized (i.e., it releases electrons) and the other is reduced (i.e. it absorbs electrons). The current flow produced in the chemical reaction is equal to the alcohol concentration. One problem with electrochemical sensors is the measurement accuracy, which is reduced with increasing operating hours.

IR Sensor

The easiest method is to use so-called non-dispersive infrared (NDIR) sensors to detect gases. In this method, a measurement cell is irradiated with infrared light, which is collected on the opposite side by a detector. Narrow bandpass filters (interference filters) are mounted in front of the detector.

Gases have characteristic absorption lines that make clear identification possible with the help of absorption spectroscopy. Even the gas concentration can be determined. The Lambert-Beer law, which describes the correlation between a reduction in the beam intensity and the concentration, applies here. This system exhibits long-term stability. ■

A Glimpse into the Future

Driven by the automobile industry, very different methods of measuring alcohol levels and integrating these methods into automobiles are currently being discussed. In addition to the established methods already introduced, laser-based approaches are also being tested. Standard fitting in automobiles is being tested through research programs in the U.S.A.

Creative approaches are also being sought for the measurement apparatuses as well: Instead of a mouthpiece, breath gas can be used for direct measurements. The major challenge to this approach is in all certainty being able to identify the actual driver to exclude fraud. In Australia, camera systems and measurements are currently being combined to properly identify the driver. ■

NEW
Standardfilter for Alcohol-Measurement
more on page 14

Components for Measuring Breath Alcohol Content

Select a Suitable Detector and an Appropriate Filter

Finding a suitable detector for a specific gas measurement still seems theoretically trivial. In order to measure the breath alcohol content (BrAC), the absorption lines of ethanol gas have to be analyzed. They are approximately 9.5 µm, 8.1 µm, 7.2 µm, and 3.4 µm. Theoretically, it would be sufficient to measure the detector signal at a single absorption line; however, it is important to make sure that a cross-sensitivity to other substances that are also in the breath (water, methane, and ethanol) does not exist.

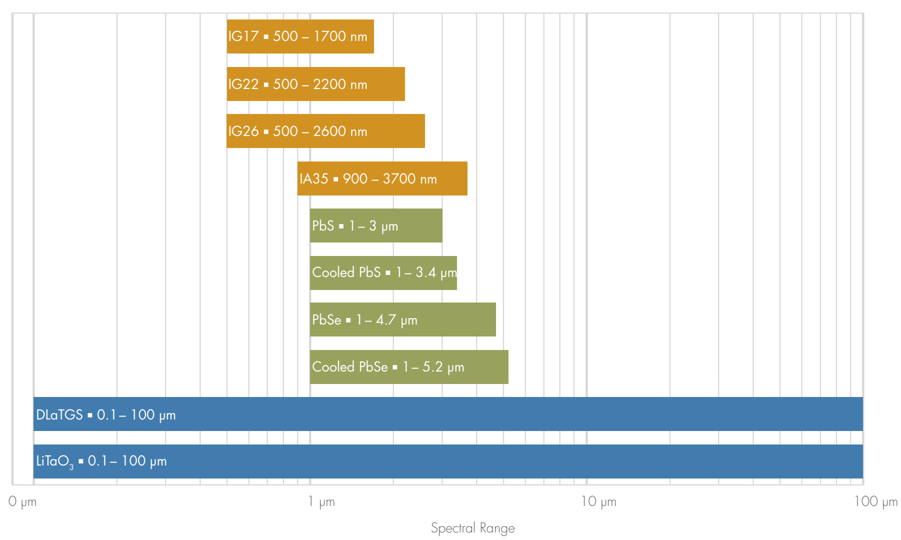
Filter Selection

IR detectors are polychromatic. A suitable filter is required to detect a specific gas or measure a specific wavelength: Bandpass filters only allow the beams of a specific wavelength range to pass.
Thus, the success of the measurement always depends on the quality of the filter: the spectral width must line up precisely with the absorption line being measured, and the transmission of the filter should be as high as possible.
For BrAC measurements, analysis of the wavelengths 3.4 µm and 9.5 µm has become the standard.

Detector Selection

The shorter wavelength could be identified using different detector types: According to the overview, InAs, PbSe, cooled PbS and PbSe, and pyroelectric detectors are all suited for use. Exclusive observation at 3.4 µm is critical, because the absorption lines of water vapor and methane gas are approximately equal.
The air in the breath contains moisture. In a worst-case scenario, it would not be possible to strictly separate ethanol and water vapor at 3.4 µm. As a greenhouse gas, methane can also be detected in the air; thus, the problem is the same.

Measurement at the wavelength of 9.5 µm is more significant, thus the selection of pyroelectric detectors is more likely.
The pyros can house up to four independent detector chips with an integrated bandpass filter in a single housing. One channel often serves as a reference, and the others are there for gas detection.
The simultaneous measurement of a gas using two filters would be possible and is actually carried out as such in practice when a high dynamic range is required for measurement. ■



Production Capacity of Pyroelectric Detectors Expanded

$LiTaO_3$ and DLaTGS Detectors can be Manufactured in Large Quantities with all Standard Filters.

WEB US38-922

LASER COMPONENTS Pyro Group's production capacity has been expanded: they are now able to manufacture all standard pyroelectric detectors in large quantities.
A new modular design ensures the rapid availability of all versions.

"Standard" refers to all components listed in the catalog and on the datasheets: this includes detectors in voltage and current mode; one, two, three, and four-channel detectors based on $LiTaO_3$; and DLaTGS pyros for FTIR applications.

The range of standard filters is impressive. We have seventeen different types of filters and thus the largest standard assortment available on the market. We are proud of our new bandpass filters, which were developed for current trends in gas measurement technology. ■

Jim Dell: +1 603 821 7040
dell@laser-components.com

Massive Impact

80 Participants, 11 Nations, 42 Presentations

The purpose of the **"International IR WORKshop,"** which was last held in November 2016, is to share the latest news and developments from the infrared world. Forty-two presentations in two consecutive days was very demanding on the wide international audience. In a concentrated working environment, the main players from the infrared world presented the latest developments from their specialized fields followed by a brief Q&A session. Short two to three-minute presentations just before the breaks rounded off the program.

This sector is self-confident, has a growing number of young people, is fond of discussion, and has a clear, commercial focus. Fittingly, the French market researcher and expert in optics and photonics Thierry Robin opened the IR WORKshop with his contribution.

IR Detectors. The IR WORKshop proceeded to a classic session on "IR Detectors," providing a variety of information that ranges from non-invasive glucose measurement via semiconductor alternatives to Mercury Cadmium Telluride (MCT), then to increasing the performance of pyroelectric detectors, and finally to trendsetting in the Internet of Things (IoT).

IR Components. The second of three sessions provided insights on advances in „IR Components". Research in chalcogenide glasses is heading in the direction of aspheres and free-form optics. The goal here is the development of lighter and more robust IR cameras for use in aerospace and driver assistance systems.

The main focus regarding the emitters was on broadband light sources because the enormous advances made by Quantum Cascade Lasers (QCLs) could even be the subject of a whole conference in itself.

Applications. Finally, novel applications were presented. The versatility of it best shows that IR technologies are leaving their niche markets. Spectral skin measurements were the subject of discussion, as well as identifying hot and cold spots on train tracks to detect defective brakes.

We expect to see the miniaturization of IR measurement methods and their further integration into smartwatches and smartphones – and not just for so-called health applications. Discussions also ensued during the introduction of an app for the detection of moisture in flour or the research of automobile gas emissions at toll stations. ■

A more detailed report is available under the following web code: WEB US38-IR

Coming Soon in the USA

After the third event, our IR WORKshop has become firmly established among leading IR experts. In the future, this event will take place in a similar format in the USA as well. In even years the WORKshop will stay in Olching/Munich, Germany.

Further information can be found on our website: www.ir-workshop.info

Take Your Footage to the Next Level

colorPol® Polarizers Will Do the Job

WEB US38-0011

Polarization is well known and used in various optical applications to reduce unwanted reflections to a minimum while contrast is enhanced. For example, in photography, this effect is used to reduce glare from objects or to increase contrast in pictures. Undesired reflections can disturb detected images in complex applications when you have to identify different objects or to compare them to given parameters. With the use of polarizers, these unwanted reflections can be reduced to enhance the contrast and enable the application to work.

Cash handling machines

Everyone is familiar with this situation, you put a bank note in a vending machine and it is refused several times before the detection system can clearly identify it. Most of the time the reason for this behavior is unwanted reflexions. Paper money around the world is made of a lot of different materials to make it unique and difficult to counterfeit. The reflections of these materials are difficult to eliminate by optical detection systems and cause problems to identify and verify bank notes.

Discount Price on Samples

With colorPol® polarizers, we can help to improve optical conditions to eliminate such effects. There are much more applications in everyday use, where colorPol® polarizers can assist to make things more effective. LASER COMPONENTS offers discount pricing on its evaluation set of four to six of the high-performance colorPol® polarizers. Eval Kits consist of 10 x 10 mm² polarizers and is limited to 2 pieces per type and 1 kit per customer. ■

Huyen Vu: +1 603 821 7040
hvu@laser-components.com

LiDAR for Safer Aviation

Diode Lasers Detect Wind Shifts

WEB US38-0091

Wind shear is a change in wind speed and/or direction over a short distance, which can cause loss of airspeed and lift to an aircraft. When this happens, a pilot needs to compensate for this loss, but can only do this at an altitude high enough. This phenomenon is a potential danger, particularly when landing an aircraft.

LiDAR is an upcoming technology, particularly suitable to detect changes in wind flow velocity. The light-based solution is able to depict the airflow in great detail, both spatially and temporally. There are already radar-based detection systems, however, LiDAR proves to be more reliable. One of the main issues with radar is its sensitivity to interference from other radars and even from its own signals bouncing on nearby obstacles. ■

Mike Tuohy +1 603 821 7040
tuohy@laser-components.com

Single-mode diode lasers are suitable to be integrated in LiDAR systems. When installed on-board an aircraft the system will then be able to detect and measure these so-called wind shear. LASER COMPONENTS offers a broad range of Lumics' fiber-pigtailed diode lasers in different configurations, ranging from a 14-pin butterfly package, to a (ultra) narrow linewidth, to an 8-pin uncooled miniDIL. They come in several NIR wavelengths, reaching up to 1.2 W output power.

New Products

Customized APD Arrays for LiDAR Applications

Configuration and Size of Pixels can be Selected Freely

WEB US38-952

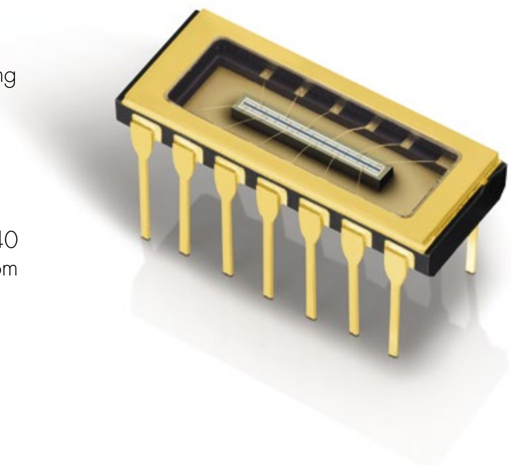
LASER COMPONENTS Detector Group introduced its first APD array at Photonics West: A line array with twelve elements in a DIL housing that is ideally suited for LiDAR applications.

The new arrays are based on fast, low-noise avalanche photodiodes made of silicon that are arranged in a monolithic row. The sensitivity was optimized for the wavelength range from 800 nm to 900 nm; additional features include a low temperature coefficient and a very small gap (of just 40 µm) between the elements.

The linear Si APD arrays are developed according to customer specifications; both the number and size of the elements can be defined individually.

Two-dimensional matrix arrays will be available soon. ■

Paul Buettner: +1 603 821 7040
buettner@laser-components.com



Five New Bandpass Filters for Pyroelectric Detectors

Well Done! It has Never Been so Easy to Equip Your Detector for Different Gas Measurements

WEB US38-922

Bandpass filters for IR detectors: With five new products, we offer the largest range of standard products worldwide so that you may measure whatever you want! There are seventeen different filters in total.

IR detectors are polychromatic. This means that they not only detect a wavelength but a whole bandwidth, which ranges from 0.1 µm to 100 µm in pyroelectric detectors.

These bandpass filters are either directly mounted to the fixed cap of the detector or are available as a separate cap that can be attached to an existing pyroelectric detector. We will introduce our five new filters here:

Filter B: Reference Filter
A reference filter should not have gas absorption bands. The tested and proven H filter generally does not have these bands, unless there is SO_2 in the gas mixture. In this case, use the B filter:
λ_{peak} = 3.86 µm, Δλ = 90 nm

Filter A: CO_2 Filter
We have worked for over a year with a manufacturer of CO_2 sensors to find the ideal CO_2 filter with the best signal possible and a simple linearization for regulation of air-conditioning systems. The following specification has been proven to be the best:
λ_{peak} = 4.265 µm, Δλ = 110 nm

Filter M: Water Vapor Filter
Water vapor is found in almost any mixture, and it often leads to an interfering background. Attempts to measure this with a 2.94 µm filter, for example, are faced with the problem of CO_2 cross-sensitivity. The M filter has been proven to be reliable in practical applications:
λ_{peak} = 5.78 µm, Δλ = 180 nm

Filter S: Methane Filter
Methane has generally always been measured at 3.33 µm; however, this is not very specific. To improve upon this, a correct spectrum can be measured or laser methods used. Alternatively, an S filter can be used that operates at a longer-wave band:
λ_{peak} = 7.91 µm, Δλ = 160 nm

Filter O: Alcohol Filter
Measuring the alcohol level is becoming more and more popular, which just screams for a standard filter:
λ_{peak} = 9.50 µm, Δλ = 450 nm ■

Jim Dell: +1 603 821 7040
dell@laser-components.com

Dual-Band Mirrors for CO_2 Lasers and Pilot Lasers

Silicon-Based Beam-Guiding Components Transmit Several Wavelengths at High Efficiency

WEB US38-0001

Pilot lasers are used in systems with invisible CO_2 processing lasers to determine the beam's point of impact. The beam guidance of both lasers is the same, which leads to problems: If the beam-guiding components are not optimized for the wavelengths used, they "swallow" light. In silicon mirrors, the light of the pilot laser was almost not visible anymore.

A novel dual-band coating on silicon substrates creates mirrors that offer high reflection values for the processing wavelength 10.6 µm and simultaneously reflects the light of red pilot lasers with a high yield. At an angle of incidence (AOI) of 45°, the following values can be achieved:

$R_{(10.6\ \mu m)}$ > 99,8%
$R_{(600-700\ nm)}$ > 90,0%

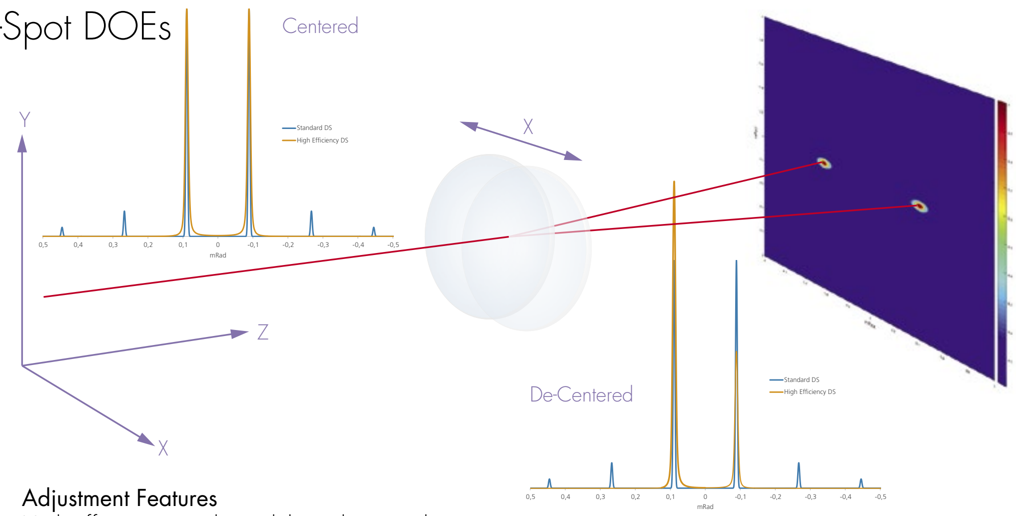
The low phase shift of approximately ±2° is also noteworthy.

In addition to silicon mirrors, copper mirrors are also used for light of the wavelength 10.6 µm. However, silicon substrates have major advantages: Unlike pure metal mirrors, they are significantly lighter. Furthermore, silicon mirrors are free of thorium and have a surface resistance that does not scratch as quickly during cleaning. ■

Huyen Vu: +1 603 821 7040
hvu@lasercomponents.com

HEDS – High-Efficiency Double-Spot DOEs

Special Beam Splitter for High Efficiency



WEB US38-949

The new diffractive double-spot elements from Holo/OR have an efficiency of 97%; previous standard versions only achieved 81%.

High-Efficiency Double-Spot (HEDS)
Diffractive beam splitters split the incoming beam into beams with equal properties. The intensity of all partial beams corresponds approximately to the total intensity of the incoming beam. For the new "high-efficiency double-spot DOEs," this means that each partial beam is >48% of the total intensity!

Advantage: No Higher Diffraction Orders
In previous versions, part of the light had higher diffraction orders; this is shown in blue in the graph. The HEDS elements have higher diffraction orders that are negligibly small: This is an advantage in critical applications.

HEDS are available for wavelengths from 193 nm to 10.6 µm.

Adjustment Features
High efficiency is achieved through a novel design that requires the centering of the HEDS in the beam path. When shifted, the spot shape and total efficiency of the element remain unchanged; however, the power distribution between both spots changes. This property can be used advantageously for the fine adjustment of the split ratio; for example, instead of a 50:50 ratio, a ratio of 47:53 could be set.

These elements are used, for example, in lithography, perforation, laser cutting, and other material processing applications. ■

Mike Tuohy: +1 603 821 7040
tuohy@laser-components.com

FLEXPOINT® Mini Available at 520 nm

New Wavelength for the Smallest Laser Module

WEB US38-074

The FLEXPOINT® Mini series is now also available with laser diodes at a wavelength of 520 nm.

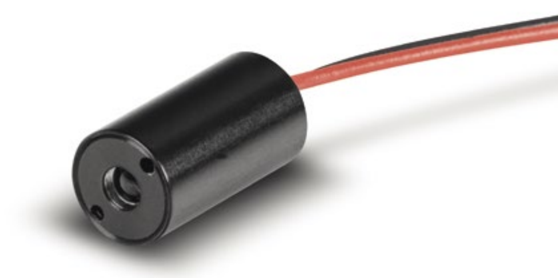
The output power level can be customized to meet your needs: Values between 0.4 mW and 5 mW are available.

Depending on the output power level selected, the laser modules fall into the laser class 1, 2, or 3R.

Upon customer request, a digital modulation can be integrated to turn the laser on and off quickly.

These laser modules are particularly handy: The housing is only 40 mm long and has a diameter of 8 mm. The modules are operated at a supply voltage of 4.5 V to 6 V. ■

Carol Howard: +1 603 821 7040
howard@laser-components.com



LASER COMPONENTS USA, Inc.
116 South River Road, Building C
Bedford, NH 03110, USA

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