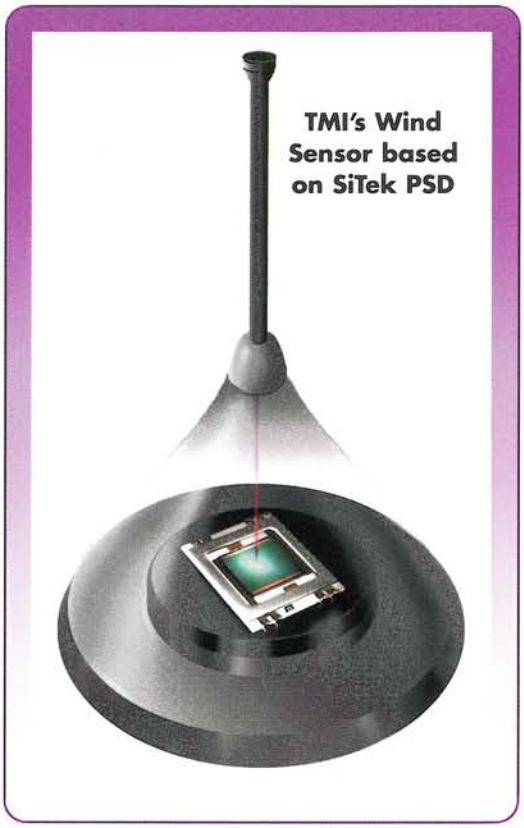
Weather or not, our PSDs measure

TMI's new generation wind sensor (Patent Pending) based on SiTek PSD

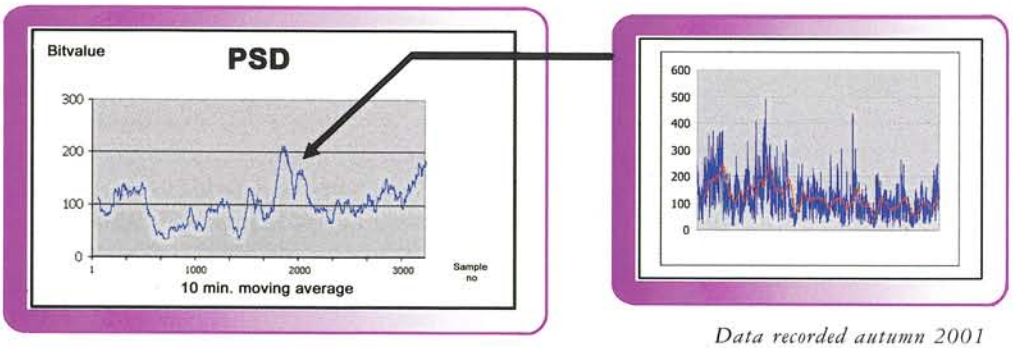
In 1998 Trondheim Maritime Instrumentation (TMI) started the development of a new type of anemometer (wind sensor) based on SiTek's 2L10 PSD. The project was sponsored by the Norwegian Research Council, and the project time was stipulated to 3 years. The main purpose was to construct a sensor with practically no moving parts and an excellent dynamic range. Ordinary cup anemometers suffer from rapid wear during severe weather conditions resulting in high maintenance costs and also fail to give reliable wind data during strong hurricanes. More modern anemometers which use ultrasound also tend to give unreliable data when strong winds occur together with heavy precipitation. Sub zero conditions also cause significant problems in many locations.

The TMI wind sensor prototype was tested in autumn 2001 and showed no limitations with respect to these problems. The sensor has now been tested under extreme weather conditions for approximately half a year (winter season) in Trondheim, Norway; and the preliminary results are outstanding. SiTek's 2L10 PSD was the natural choice for TMI due to its durability under such weather conditions. In addition to a good resolution in the lower end of the scale, the sensor can measure with very high accuracy at much higher wind speeds than any sensor on the commercial market. The sensor has no moving parts (except for the stick which moves appr. 5 mm at high wind speeds - see diagram). We were also very satisfied with the time response Within 0.1 second the sensor goes from maximum to zero without any overshot. This indicates that the material chosen for the flex element is perfectly suitable. This material also holds the performance over a wide temperature range, and according to manufacturer specifications it has a lifespan of 50 years (no ageing due to ultraviolet radiation or weather).



No wind vane is needed since the sensor measures the X- and Y- component of the wind vector. The housing of the sensor comprises all the electronics needed for signal analysis and communication with external equipment. Different protocols and analysis are provided depending on customers' needs. A principle drawing of the sensor is shown above and some data from the prototype tests is given in the charts below.

The wind sensor will now go through a final stage of extensive testing in co-operation with the Norwegian Meteorological Office. It will be launched on the commercial market in the next few months.

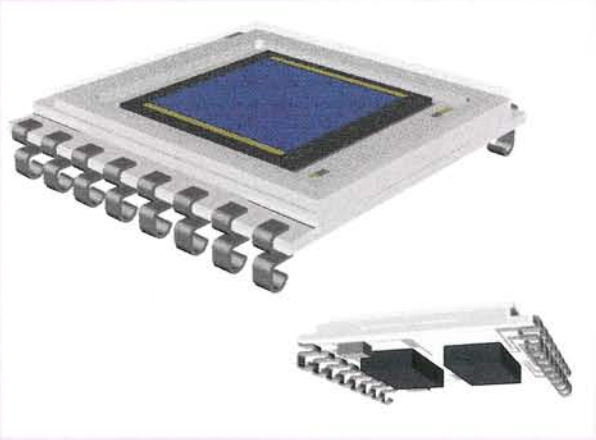


Data recorded autumn 2001

New SiTek Product ! see inside

New SiTek Product !

Happy New Year from SiTek !



In order to facilitate the operation of our PSDs, we have developed a dedicated signal processing circuit. All components necessary to obtain the sum and difference signals from a two- or one-dimensional PSD have been concentrated on a 20,5 x 20,5 mm² ceramic thick film substrate. There will be several versions available. The new devices will be available early next year. Keep your eyes on our website www.sitek.se for more information.

Exhibition in Stockholm

The Electronic/EP fair was quite a success for us. The exhibition, held in Stockholm, lasted for four days. It had over 370 exhibitors and attracted nearly 11,000 visitors. All the employees at Sitek were involved to make this event the best in our history. We had to work hard during the exhibition because our stand was very popular and we received a lot of credit for its design. In fact there were many more visitors and questions than we expected. It's good to know that PSD technology is generating so much interest. Our stand displayed what SiTek can offer as a company. We showed some well-known components along with our ES-PSD and patented NT-PSD which demonstrated both our capabilities in custom design and what PSDs can do for you.

We thank you all for this success, particularly our American distributor On-Track and of course Expo Design who helped us to build our stand. We have personally contacted all those who visited the stand and have welcomed a number of new customers and created a lot of exciting business oportunities as a result. Our next exhibition in Sweden will be held in Gothenburg at the beginning of September 2003. More information will be available nearer the time and we look forward to seeing you there.

Visit SiTek at the Components and Electronics Production Exhibition in Gothenburg 2-5 Sept 2003

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Custom design processing for improved PSD performance, part II

The PSDs within SiTek's standard product range are well known for their excellent performance with high linearity, great resolution and high speed. However, like all standard devices, these PSDs have been developed to fit a wide range of applications, something that leads to necessary compromises when it comes to parameter optimisation. By optimising the manufacturing process for a specific application, the PSD performance can be enhanced further, giving a higher value product for the customer.

Reflectivity

As stated in Non-Contact 2/01, the main advantage of optimising the AR coating for a certain wavelength is that it optimises the responsivity. But even when you have a lot of light and can manage with a lower responsivity there is an important reason to use an AR coating optimised for the specific wavelength.

When the light hits the PSD surface some of the light will be reflected. When this reflected light hits other surrounding surfaces it might be reflected back on to the PSD causing errors in the measurement. With an optimised AR coating the reflected light is kept well below 2 % of the incoming light, which eliminates the cause of secondary reflections.

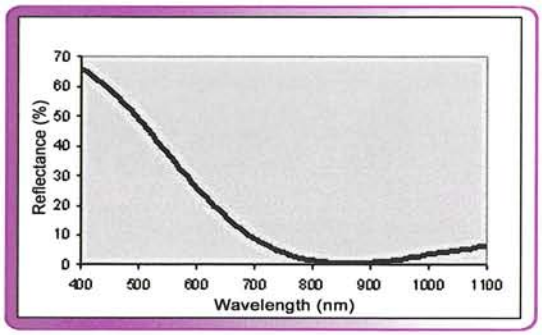


Figure 1. Spectral reflectivity for SiTek detector with AR coating optimised for 850 nm.

Speed

With todays fast electronics, the demand for high speed devices increases. Even though the PSD, due to its simple design, is much faster than other, more complex, position sensing devices, it is possible to significantly increase the speed by process optimisation. The rise time of the PSD is mainly determined by the RC product of the inter electrode resistances and the PN-junction capacitance. In SiTek's manufacturing process we are equiped to optimise both of these parameters in order to increase the speed. For large area devices it is possible to reduce the rise time by several orders of magnitude with this optimisation.

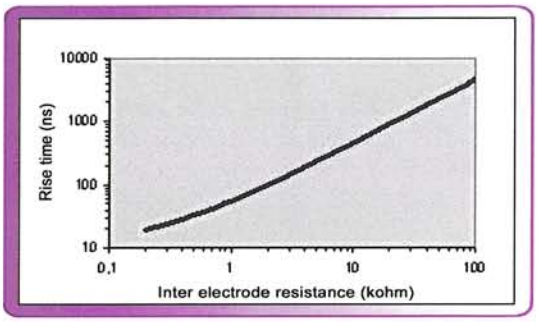


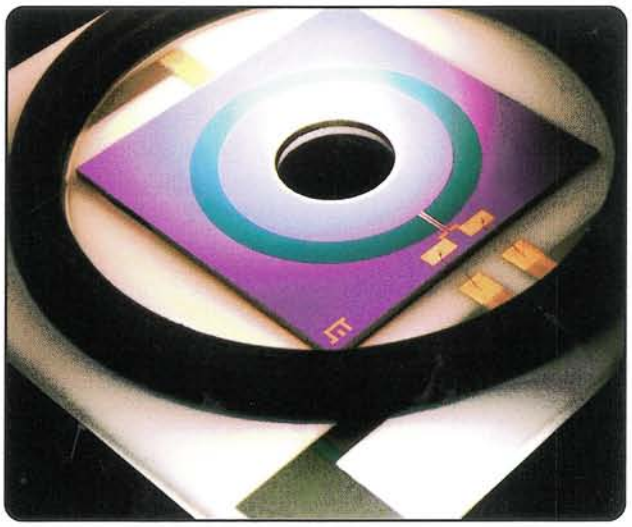
Figure 2. The rise time of a PSD can be changed by several orders of magnitude by varying the inter electrode resistance.

Size and Shape

Not only electro-optical parameters can be tuned to fit the customers needs but also the size and the shape of the device. The size can be varied almost endlessly. Short, wide devices as well as long, narrow ones are possible. Only the starting material sets the limit.

The shape is also variable. During our 26 years, SiTek has custom designed not only rectangular and square devices, but a large number of odd shaped PSDs as well. These include circular, trapezoidal and sector shaped ones.

So, as you can see from these two articles on custom design processing, there is a lot that can be done in order to optimise the performance of the PSD for a specific application. SiTek supply such PSDs to satisfied customers worldwide and our versitility means that we can always find the best solution for your needs.



SiTek's circular PSD

See our website **www.sitek.se** for previous Non-Contact issues

Beyond Light

That SiTek makes the best PSDs available for sensing the position of a lightspot is well known. That they also function well with other types of radiation than light is a little less known. Sitek's detectors convert light energy to electrical signals that contain information about the position and intensity of the energy received.

One way of looking at light radiation is to say that light is delivered in the form of particles called "photons". Depending on how much energy a photon has, it can be classified in different spectral regions.
The photons in all of these regions have the same electromagnetic nature, but because of their varying energies, interact with matter very differently. For example, the photons within the visible region of the spectrum (approximately 400 - 700 nm wavelength) interact with the retina in the human eye to create the sensation of light in our brains. In a PSD (which is based on a Si- PIN- photodiode) that is exposed to energy greater than 1.12 eV (wavelength less than 1100 nm) electron-hole pairs are created. The p-n junction field separates these photogenerated carriers and a current proportional to the number of electron-hole pairs created is divided up between the detector electrodes and flows through an external circuit.

Unfortunately at shorter wavelengths (and thus higher energies) the photons find it hard to penetrate the Si base material to create carriers. This means that the number of carriers generated per impinging photon will decrease at these short wavelengths. Hence the output current will drop as the wavelength goes down. A normal PSD will respond down to a wavelength of about 400 nm.
The trick is to bring the p-n junction as close to the sensing surface of the PSD as possible. This means that the region (called the "dead layer" or "window thickness") that the radiation has to cross to reach the p-n junction field is as thin as possible. Dead layers as thin as 50 nm have successfully been accomplished in our processes, and as our customers will tell you, been used with great success in position detectors for higher energy radiation such as X-ray or gamma ray photons.

Theoretically the detection efficiency should be close to 100 % at 10 keV falling to approximately 1% at 150 keV. For energies above approximately 60 keV, photons interact almost entirely through Compton scattering. For this reason the overall detection efficiency is maintained at a fairly constant 1% over a wide range of photon energies.

Recently SiTek introduced the ES (Enhanced Sensitivity) components. These components have a built in amplification which gives more current output for a given energy input compared to the standard PIN-photodiodes. The new components are really, large area phototransistors but the interesting thing is that this technology can also be applied to all our UV and "Nuclear" detectors boosting the sensitivity about 50 times. Thus a response value of 10 A/W at a wavelength of 200 nm is quite possible to reach. The same goes for detectors used at higher energies. The ES technology can be applied to PSDs as well as to ordinary photodiodes.

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Overview of the Electromagnetic Spectrum

Type of radiation	Radio	Micro-waves	Infrared	Near-infrared	Visible	Ultra-violet	X-rays	Gamma-Rays
Wave-length	> 1 mm	1mm-25 um	25 um-2.5 um	2.5 um-750 nm	750 nm-400 nm	400 nm -1 nm	1 nm-1 pm	< 1pm

SiTek® ELECTRO OPTICS

Published by
SiTek Electro Optics AB, Ögärdesvägen 13A, SE-433 30 Partille, Sweden.
Tel: +46-31-340 03 30
Fax:+46-31-340 03 40
Website: www.sitek.se
E-mail: info@sitek.se