

Harnessing the Potential of Position Sensitive Detectors in Automated Systems

In a world increasingly shaped by automated systems, ensuring their accuracy and proper calibration is a critical concern in both industries and daily life. At the core of this challenge lies the need for detectors with impeccable spectral resolution and rapid response times, particularly when harnessing the capabilities of coherent light across various materials and environments.

The demand for systems providing accurate information on the position, angle, distortion, or vibration of both direct and reflected light has surged globally. One key solution proposed by Hamamatsu Photonics is its Position Sensitive Detectors (PSD). Known for their monolithic structure, these devices offer fast response rates, minimal dark current, and high reliability, making them ideal for a variety of applications, such as distance measurement and triangulation distance measurement.

Applications using Position Sensitive Detectors

Triangulation Distance Measurement

Triangulation is a well-established technique for measuring distance. A light source emits a beam that is focused onto a target by a projection lens. The reflected light is then captured onto the PSD photosensitive surface by a receiving lens. The distance of the target can be accurately determined by the movement of the light spot from the center of the PSD.

The main advantage of this method is its ability to measure distance efficiently and accurately, regardless of the reflectance of the target object and variations in



Image 1: Non-contact measurement of material thickness.

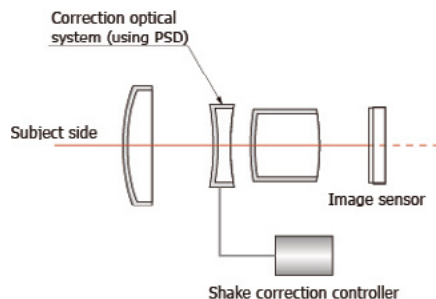
the light source power. This method is frequently used in laser displacement meters, as shown in Image 1, where it is used to calculate the thickness of the material with a non-contact measurement.

Direct Position Detection

PSDs excel in collecting very fast signals, which is key to direct position detection. Moving objects pass under a beam, and the position of the object is provided by the detection of light in the photosensitive area of the PSD after moving through a slit. This principle can also be used for image corrections, like camera-shake correction. The PSD is used to detect and control the movement and position of the slit incorporated within the correction optical system.



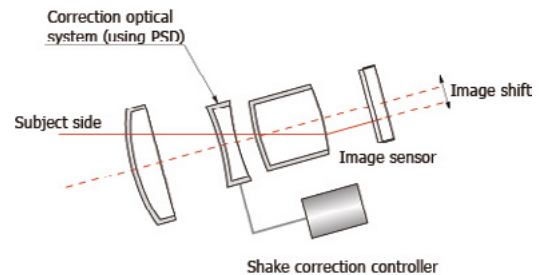
(a) State with no camera shake



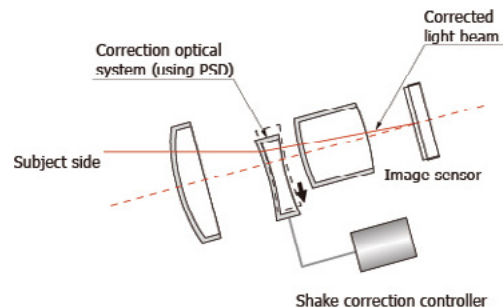
When a person has shaky hands, the movement can cause the camera's image to shift off-center. To counter this, a correction optical system that uses a PSD detects these movements. It then

adjusts the camera's optical path to move the image back to the center of the image sensor's photosensitive area. This process ensures that the captured image remains stable and in focus, despite any hand tremors.

(b) State when camera shake occurred



(c) State when camera shake was corrected by moving the correction optical system occurred

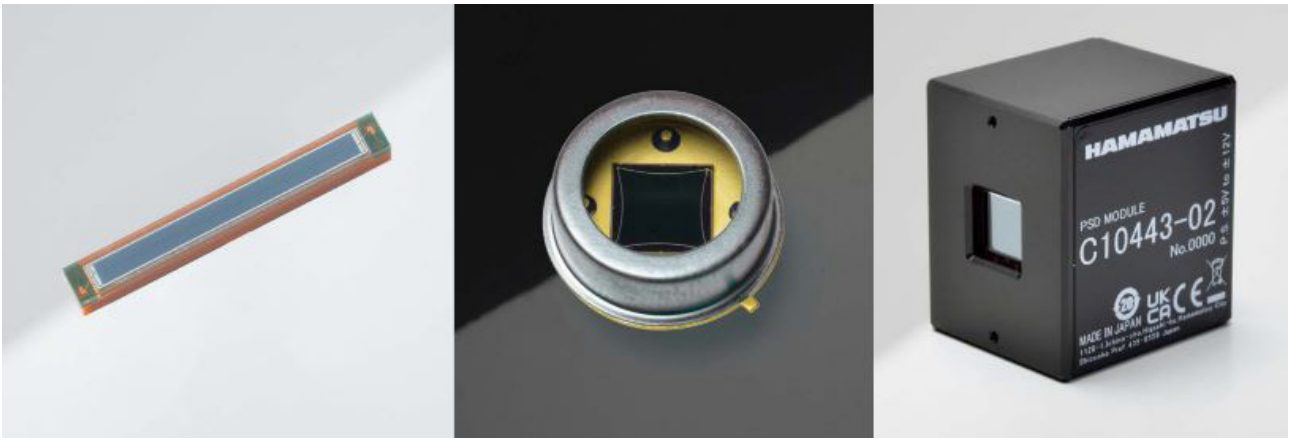


This principle is also applied in autofocus systems within projectors.

There are other applications that can benefit from PSDs. Depending on the specific application and case, the requirements for sensors can be very different. Hamamatsu has developed a broad range of linear and area PSDs in various configurations and sizes, tailored to different applications. Additional circuits and modules can also be provided to facilitate testing and configuration.



View the complete [Position Sensitive Detectors \(PSDs\) product range](#)^[1]



Structure and Operating Principle

What distinguishes these PSDs is their unique composition – a seamless integration of PIN photodiodes without the surface P-type resistive layer. These monolithic devices incorporate a complete structure and circuit etched onto a single piece of Silicon. With a uniform resistive layer adorning one or both surfaces of a high-resistivity semiconductor substrate and a pair of electrodes to extract position signals, these detectors offer a reliable and robust performance.

Conclusion

With the continuous increase of automation in everyday life, precise, robust, and fast detectors are vital for determining the precise position of objects. The Position-Sensitive Detector is one of the primary candidates for this application, offering very low noise and reliability.

Hamamatsu is a worldwide leader in manufacturing optoelectronic devices and systems. Our trusted production methods result in high-quality, stable products that offer significant added value to our customers.

Discover more on our Position Sensor Detectors by visiting www.hamamatsu.com^[2] or contact us at info@hamamatsu.eu to discuss your project requirements.

References

^[1] Hamamatsu Photonics, PSD (position sensitive detector), Selection guide, February 2025, [online]: <https://www.hamamatsu.com/eu/en/product/optical-sensors/distance-position-sensor/psd.html>

^[2] Hamamatsu Photonics, Position-sensitive detectors (PSDs), Product overview, [online]: <https://www.hamamatsu.com/eu/en/product/optical-sensors/distance-position-sensor/psd.html>