

# Machine Vision

## OMNIVISION Global Shutter Sensor Technology Optimizes Next- Generation Industrial Barcode Scanners

White Paper

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## Introduction

As resolution requirements increase, manufacturers of machine vision systems for industrial applications face some key challenges in maintaining image quality at high capture speeds, operability under low light, and cost-effectiveness. New backside-illuminated global shutter image sensors from OMNIVISION are ideally suited to address these challenges, delivering higher quality and better performance in a compact design to improve the image-capture capability, in both visible light and near-infrared, of industrial machine vision systems. This application note provides an overview of these new sensors and their benefits for the barcode scanner market.

## What Are Industrial Barcode Scanners?

Industrial barcodes, both 1D (linear) and 2D, are used to track virtually every item utilized in manufacturing, packaging, and shipping for industrial and commercial settings. Applications include high-speed production, inventory/warehouse management, supply chain logistics, healthcare, and many others.



Figure 1. Industrial barcodes appear on a variety of surface types and in varying sizes. To better accommodate this broad range of barcodes, scanners need new types of CMOS image sensors.

Barcode scanners are machine vision systems that capture and decode the information contained in a barcode. Manufactured as handheld wireless units (“scan guns”) – and, increasingly, factory-automation cameras – these scanners acquire, decipher, and report large quantities of data quickly and accurately. Figure 1 shows some different types of barcodes and surfaces that industrial scanners must be able to accommodate to acquire data accurately.

## Opportunities for Technology Improvement

Image-based systems have largely supplanted laser technology in industrial barcode scanners because they are more reliable and can read 2D as well as 1D codes. However, they face some emerging challenges for which new types of image sensors are required. Barcode scanners themselves are getting smaller, which is necessary both for better overall cost-effectiveness and for better integration with other devices. In turn, the image sensors that power the capture capability must be smaller while being able to operate at higher speeds and deliver superior performance without driving up overall scanner cost.

Global shutter (GS) image sensors are industrial sensors that capture high-quality, undistorted images at high speeds. Because all the pixels on the GS sensor expose simultaneously, these sensors can precisely freeze image motion, eliminating the blur or wobble that can happen with traditional sensors during rapid panning or when capturing fast-moving subjects. In industrial applications, barcode scanners require the ability to quickly, accurately, and reliably capture all encoded data. This presents a significant opportunity for GS sensors.

Leveraging its expertise in CMOS image sensors, OMNIVISION has developed two new GS image sensors to specifically address the needs of next-generation industrial barcode scanners: the OG05B1B and OG01H1B.

## OMNIVISION Global Shutter Image Sensors

OMNIVISION's new GS image sensors feature the industry's smallest 2.2-micron ( $\mu\text{m}$ ) backside-illuminated (BSI) pixel for high resolution in a compact design. The sensors deliver high resolution in a small format, and with their ability to capture high-speed moving objects clearly and accurately at high frame rates, they provide the highest available shutter efficiency. They also feature high sensitivity, low noise, and enhanced near-infrared (NIR) quantum efficiency (QE) for industry-leading low-light performance.

Compared to earlier-generation 2.5  $\mu\text{m}$  frontside-illuminated (FSI) GS sensors, the 2.2  $\mu\text{m}$  BSI GS sensors can achieve 1.08x sensitivity with an F2.0 lens and 2.16x sensitivity with an F1.4 lens. The new OG05B1B is a 5-megapixel (MP) resolution CMOS monochrome GS sensor in a 1/2.53-inch optical format. The new OG01H1B is a 1.5MP resolution CMOS monochrome GS sensor in a 1/4.51-inch optical format.

Let's break down some of the features of these new GS image sensors to better illustrate their benefits.

- **Backside Illumination** – OMNIVISION's advanced OmniBSI™ platform enables thinner modules than FSI technology while delivering best-in-class light absorption and advanced image quality due to heightened sensitivity. Because of their large angular response, BSI image sensors have an F-number closer to F1.0, whereas FSI image sensors have only F2.0.

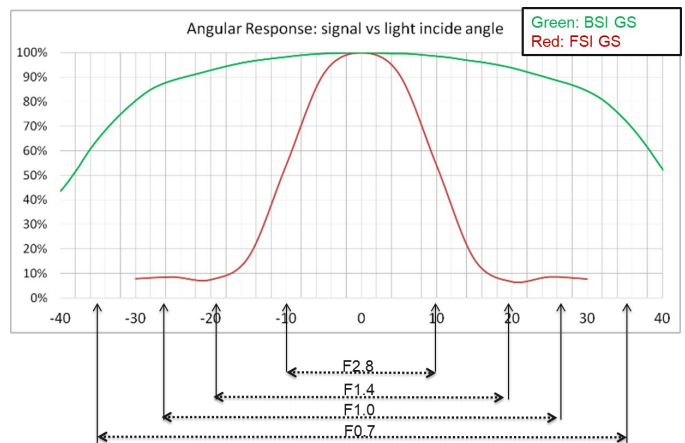


Figure 2. The FSI GS pixel has a lens aperture limit within F2.0 while the BSI GS pixel supports apertures up to F0.7+.

BSI pixel advantages include:

- Higher NIR sensitivity
- Higher FWC
- Higher shutter efficiency
- Large angle response

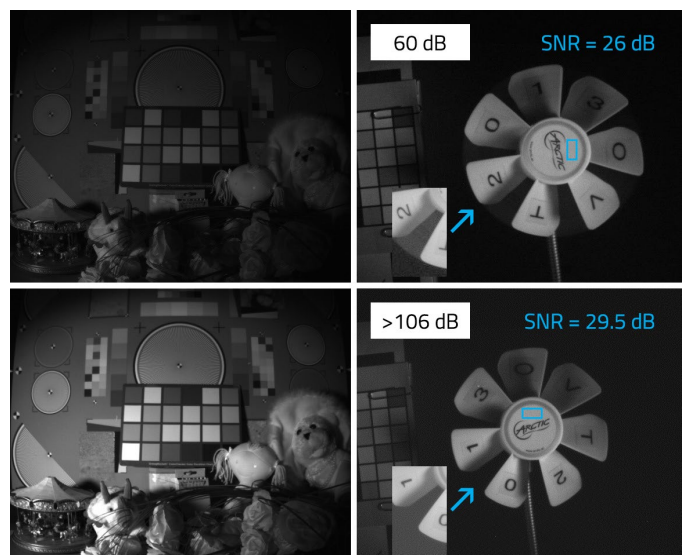


Figure 3. The first two images (top row) were scanned using an FSI GS sensor and the second two images (bottom row) were scanned using a BSI GS sensor.

- Near-infrared quantum efficiency – QE indicates the effectiveness of an imaging device in converting incident photons into electrons. Both new sensors employ OMNIVISION’s proven Nyxel® NIR sensor technology, which boosts QE to 700–1050 nm for image sensors that see better and farther regardless of light level, while using less power. These 3x QE improvements enable capture of sharp, bright images and delivery of optimum image data.

These parameters are important indicators of the new GS image sensors’ ability to optimize image capture of barcode scanners regardless of low-light conditions (e.g., dark warehouses, trucks, shelving, etc.), ensuring accurate data reading and decoding. Figure 2 compellingly illustrates the stark difference in quality and detail between images captured with and without Nyxel® technology.



Figure 4. The image at right was scanned using an image sensor that integrates OMNIVISION’s Nyxel® technology. The difference is “like night and day” compared to the non-Nyxel® scan at left.

- Advanced packaging – The two new GS image sensors utilize OMNIVISION’s PureCel®Plus-S stacked-die architecture, which features a 20% increase in full-well capacity and increased signal-to-noise ratio compared to previous models, enabling higher dynamic range for best-in-class performance. The sensors also utilize the chip-scale package technology for the smallest possible dimensions.

The table summarizes key specifications for the two new sensors.

	OG05B1B	OG01H1B
<b>Resolution</b>	2592 x 1944 (5MP)	1440 x 1080 (1.5MP)
<b>Frame Rate</b>	60 fps	120 fps
<b>Shutter Efficiency</b>	106 dB	106 dB
<b>Optical Format</b>	1/2.53"	1/4.51"
<b>QE in Visible</b>	89.6% @ 530 nm	
<b>QE in NIR with Nyxel®</b>	Boosts QE to 700-1050 nm 58% QE @ 850 nm, 36% QE @ 940 nm	
<b>Interface</b>	4-Lane MIPI & DVP	4-Lane MIPI & DVP
<b>External Trigger Snapshot Mode</b>	Enables Back-End Exposure Control for Improved Accuracy	

## Summary

Barcode scanning applications have become more sophisticated, imposing resolution and size requirements on image-based machine vision systems that existing solutions cannot meet. Global shutter image sensors offer unique benefits for this application that will enable OEMs to bring better-quality, more accurate scanners to market.

As the leading provider of CMOS image sensors for a wide variety of markets, including automotive, medical, security, computing, and IoT, OMNIVISION is bringing this leadership to bear in the burgeoning machine vision market, focusing initially on industrial barcode scanners. The company’s new GS image sensors for this application – the first to be produced by its new Machine Vision Unit – reflect OMNIVISION’s dedication to understanding customers’ needs and product roadmaps and developing innovative vision solutions to address them.

## About OMNIVISION

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OMNIVISION is a global fabless semiconductor organization that develops advanced digital imaging, analog, and touch & display solutions for multiple applications and industries, including mobile phones; security and surveillance; automotive; computing; medical; machine vision; and IoT/emerging applications. Its award-winning innovative technologies enable a smoother human / machine interface in many of today's commercial devices. Find out more at [www.ovt.com](http://www.ovt.com).

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