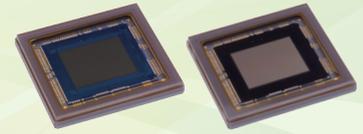


Polarization Image Sensor

Diagonal 11.1 mm (Type 2/3) Approx. 5.07M-Effective Pixel Monochrome/Color
Polarization CMOS Image Sensor



IMX250MZR / MYR

Polarsens

Polarsens is a CMOS Image Sensor pixel technology that has several different angle polarizer formed on chip during the semiconductor process allowing highly accurate alignment with pixel.

*Polarsens and **Polarsens** are trademarks of Sony Corporation.

Polarization Image Sensor with Four-Directional on-chip Polarizer and global shutter function

Sony Semiconductor Solutions has launched a polarization image sensor (polarization sensor): 3.45 μ m, 5.07M-Effective Pixel with four-directional polarizer formed on the photodiode of the image sensor chip targeting the industrial equipment market*¹.

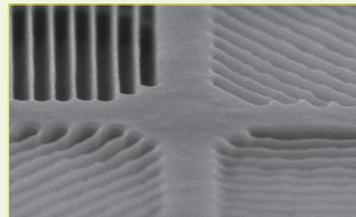
In addition to the brightness and color*², this image sensor can capture polarization information which can not be detected by normal image sensor. This polarization sensor can expand various possibilities in the industrial field such as inspection when visualization and sensing are difficult.

*1. IMX250MYR(color) is planned to be launched in December 2018(As of 20th September 2018)

*2. IMX250MYR(color) only.

Characteristic

- Four-Directional Polarizer formed on chip
- Global shutter function
- High frame rate
- ROI mode, Trigger mode



Polarizer image
Source: Sony, IEDM2016, Lecture number 8.7

Four directional polarizer is formed on the image sensor

IMX250MZR/MYR can capture a four directional polarization image in one shot by the four directional polarizer (Fig.1). It can calculate the direction of polarization and the degree of polarization (DoP) based on the intensity of each directional polarization. Combining with subsequent signal processing, it can capture polarization information*³ in real time*⁴.

*3. Degree of Polarization and Direction of Polarization

*4. Subject to subsequent signal processing power.

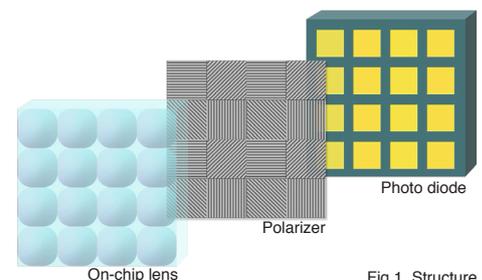


Fig.1. Structure

Polarizer is formed on chip under the on-chip lens layer

With conventional types of polarization sensors, the polarizer is attached on top of the on-chip lens layer (Fig.2), however with Sony Semiconductor Solutions' polarization sensor the polarizer is formed on chip under the on-chip lens layer (Fig.3). A shorter distance between the polarizer and the photodiode improves the extinction ratio*⁵ and the incident angle dependence.

Since the polarizer is formed during the semiconductor process, form and formulation of polarizer, uniformity, mass productivity and durability are excellent compared to conventional polarization sensors. Furthermore, Sony Semiconductor Solutions' Polarization sensor is covered with an anti-reflection layer which helps to reduce reflectance and avoids poor flare and ghost characteristics.

*5. Extinction Ratio

Extinction ratio is a specification to measure polarization. The extinction ratio of polarization image sensor is the ratio between the sensitivity of transmission axis light and the sensitivity of extinction axis light (the sensitivity of transmission axis light / the sensitivity of extinction axis light). The higher the number, the better the specification and performance.

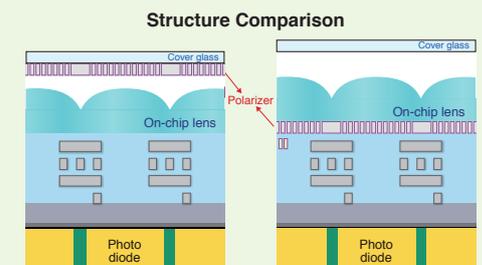


Fig.2. Structure of Conventional Polarization sensor

Fig.3. Structure of Sony Semiconductor Solutions' Polarization sensor



Home page

https://www.sony-semicon.co.jp/products_en/new_pro/september_2018/imx250mzr_my_r_e.html

Global Shutter function

Industrial applications require imaging of fast-moving subjects. However, existing CMOS image sensors are unable to accurately identify fast-moving subjects due to the focal plane distortion as a result of the rolling shutter operation. The IMX250MZR/MYR addresses this issue by providing an analog memory inside each pixel and realizing a global shutter function to enable high-picture-quality imaging without focal plane distortion.

High Frame Rate

The column-parallel A/D conversion technology of Sony CMOS image sensors is used to realize high-speed imaging of up to 163.4 [frame/s] (ADC 8-bit) for the IMX250MZR/MYR. This enabled further increasing the processing speed for industrial applications.

ROI mode and trigger mode

The IMX250MZR/MYR are equipped with a variety of functions needed for industrial applications, such as ROI mode and trigger mode. ROI mode crops arbitrary areas, and up to $8 \times 8 = 64$ locations can be set. Various exposure methods are provided for trigger mode, which controls the exposure time using an external pulse.

Sample image

Glass inspection (scratch and stain)



Fig.4. Normal image

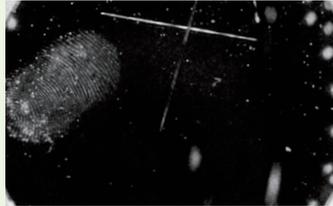


Fig.5. Degree of Polarization image

These examples show dents and dust on a homogenous glass plane. We can easily find scratches and stains (fingerprint and dust) due to differences in the degree of polarization (Fig.4,5).

Tablet filling inspection



Fig.6. Normal image

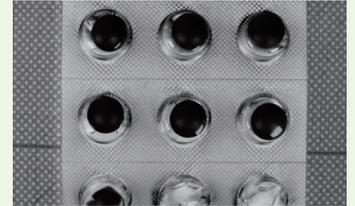


Fig.7. Degree of Polarization image

Thanks to the difference in the degree of polarization between the tablet and the aluminum package, it is easy to identify whether the tablets are filled in or not (Fig.7).

Distortion inspection



Fig.8. Normal image

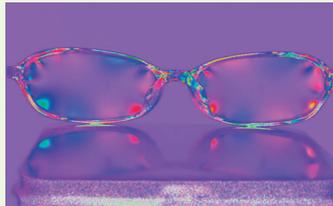


Fig.9. Polarization Direction image

With the information of direction of polarization, we can identify both distortions and the direction of distortion of the plane (Fig.9).

Removal reflection



Fig.11. Normal image



Fig.12. Removed reflection image

The information of polarization can be used to remove reflections (Fig.11). IMX250MZR / MYR has a four-directional polarizer which can simultaneously remove reflection in multi planes (Fig.11).

All images were generated by a bundled software of IMX250MZR/IMX250MYR evaluation board.

< Table 1 > Device Structure

Item	IMX250MZR / MYR	
Pixel	Four-directional Polarization	
Image size	Diagonal 11.1 mm (Type 2/3) progressive scan mode Diagonal 7.7 mm (Type 1/2.35) Full-HD mode	
Number of effective pixels	2464 (H) × 2056 (V) approx. 5.07M pixels	
Unit cell size	3.45 μm (H) × 3.45 μm (V)	
Optical blacks	Horizontal	Front : 0 pixels, rear : 0 pixels
	Vertical	Front : 10 pixels, rear : 0 pixels
Input drive frequency	37.125 MHz / 54.0 MHz / 74.25 MHz	
Package	226-pin LGA	
Supply voltage VDD (Typ.)	3.3 V / 1.8 V / 1.2 V	

< Table 2 > Image Sensor Characteristics

Item	IMX250MZR / MYR	Remarks
sensitivity (monochrome)	Typ.[F8]	342 mV
Sensitivity (color)	Typ.[F5.6]	430 mV
Saturation signal	Min.	1001 mV
		T _j = 60 °C

< Table 3 > Basic Drive Mode

Product name	Drive mode	Recommended number of recording pixels	ADC [bit]	Frame rate (Max.) [frame/s]
IMX250MZR/MYR	Progressive scan	2448 (H) × 2048 (V) approx. 5.01M pixels	12	89.5
			10	144.7
	Full-HD	1920 (H) × 1080 (V) approx. 2.07M pixels	8	163.4
			12	120.0
			10	120.0

