Sensors that Achieve High Picture Quality with a 1.75 µm Unit Pixel Size

IMX029/IMX034/IMX043/IMX058 3M-Pixel, 5M-Pixel, and 8M-Pixel CMOS Sensors for Cellular Phone Cameras

Along with the recent trend towards higher pixel counts in cameras included in cellular phones, these cameras are also approaching digital still cameras in their level of functionality. Furthermore, contemporary cellular phones are becoming even thinner thus increasing the needs for further miniaturization in the built-in camera system. Sony has now developed a series of 1.75 µm unit pixel size CMOS sensors that includes 3M-pixel, 5M-pixel, and 8M-pixel sensors. These sensors achieve the industry's highest speed and image quality by adopting column-parallel A/D conversion *1.

IMX029:
- Diagonal 4.51 mm (Type 1/4) 3.22M effective pixels
- High-speed serial interface

IMX058:
- Diagonal 4.51 mm (Type 1/4) 3.22M effective pixels
- High-speed parallel interface

IMX034:
- Diagonal 5.71 mm (Type 1/3.2) 5.15M effective pixels
- High-speed parallel interface

IMX043:
- Diagonal 7.18 mm (Type 1/2.5) 8.12M effective pixels
- High-speed parallel interface

*1: See the Featuring section in CX-News Vol. 47.
*2: See the New Products section in CX-News Vol. 46.
*3: See the New Products section in CX-News Vol. 48.

Achieving both Miniaturization and Improved Picture Quality

The frequency with which cameras included in cellular phones, in which pixel counts are increasing, are used in daily life is increasing due to their portability. Furthermore, since the number of users who use these devices as personal recording media is increasing, the demand for improved picture quality is increasing as well. At the same time, the importance of the design of cellular phones is increasing in the market, and the number of models that not only feature small sizes and light weights but that also appeal to users by emphasizing their thinness is increasing. Therefore the demands for further miniaturization in cameras included in cellular phones can be just as strong as the demands for even higher picture quality.

Sony has recently developed the 2.5 µm unit pixel IMX018*2 and 2.0 µm unit pixel IMX020*3 compact, high picture quality CMOS sensors, which have been well received by the market due to their superlative imaging characteristics, including their high picture quality, high resolution, and high frame rates. Now, to respond to further market demands, we have developed compact, high picture quality CMOS sensor products based on a 1.75 µm unit pixel. To increase the size of the pixel aperture even slightly, we have adopted a Cu process that can implement even finer interconnects, and, by developing a new condenser structure, have succeeded in improving the condensing performance relative to the angle of incidence of the light on the sensor. (See figure 1.) Also, we achieved both a high electron efficiency (photoelectric conversion efficiency) and a high saturation signal level by improving the semiconductor process and achieved the same high signal-to-noise ratio as the IMX020 despite the pixel miniaturization.

Extensive Variations

In the IMX034 and IMX043, we adopted the same 2-channel data strobe sub-LVDS serial interface used in the IMX020, thus making it possible to read out all 8M pixels from the IMX043 at 15 frame/s. While this results in high-speed signals that reach 130 MHz at 10 bits/pixel in this case, this allows stable transfers even in cellular phones. Furthermore, we are responding to a wide range of market needs by also releasing the 10-bit CMOS parallel interface IMX058 and the 1-channel data strobe sub-LVDS serial interface IMX029 3M-pixel products.

Another point is that the percentage of cameras included in cellular phones that provide an AF function is increasing. In this 1.75 µm unit pixel CMOS sensor series, Sony contributes to reduced system costs and module miniaturization by including drivers that can also control AF actuators.

VOICE

Are you dissatisfied with cellular phone camera image quality? I certainly am. This is why I was willing to struggle with image quality improving technologies, no matter how difficult they were. As a result, the developers and staff on this project were able to create sensors with these characteristics.

Furthermore, we hope that by providing this diverse lineup from 3M to 8M pixels even more customers will try out these products.

Photograph 1 Sample 8M-Pixel Image

Figure 1 Pixel Incident Angle Characteristics

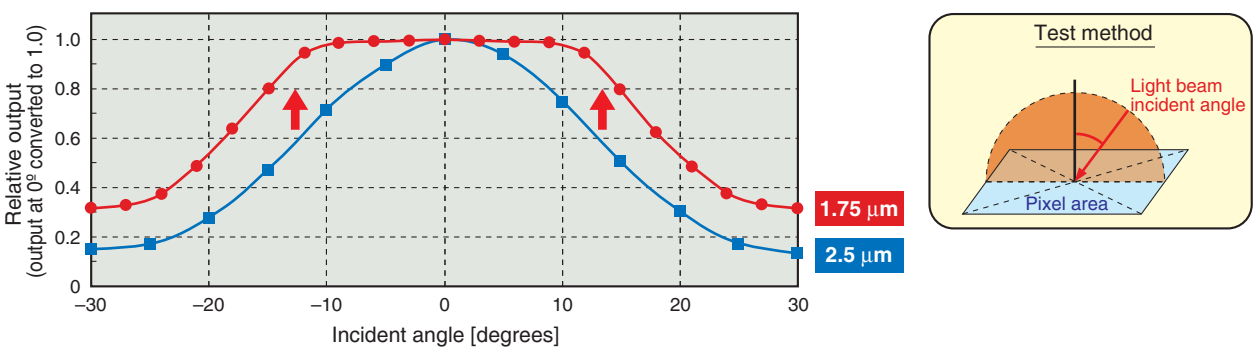

Table 1 Device Structure

Item		IMX029	IMX034	IMX043	IMX058
Image size		Diagonal 4.51 mm (Type 1/4)	Diagonal 5.71 mm (Type 1/3.2)	Diagonal 7.18 mm (Type 1/2.5)	Diagonal 4.51 mm (Type 1/4)
Format		4:3	←	←	←
Fabrication process		1-poly 4-metal 0.14 µm CMOS	←	←	←
Output format		Digital 10-bit 1-channel Sub-LVDS serial output	Digital 10-bit 2-channel Sub-LVDS serial output	←	Digital 10-bit CMOS level parallel output
Control signal interface		3-wire serial, I^2C	←	←	←
Total number of pixels		Approx. 3.36M (2120H × 1584V)	Approx. 5.33M (2664H × 2000V)	Approx. 8.3M (3320H × 2500V)	Approx. 3.36M (2120H × 1584V)
Number of effective pixels		Approx. 3.22M (2072H × 1552V)	Approx. 5.15M (2616H × 1968V)	Approx. 8.12M (3288H × 2468V)	Approx. 3.22M (2072H × 1552V)
Unit cell size		1.75 µm (H) × 1.75 µm (V)	←	←	←
Optical black	Horizontal	Front: 48 pixels, rear: 0 pixels	Front: 48 pixels, rear: 0 pixels	Front: 32 pixels, rear: 0 pixels	Front: 48 pixels, rear: 0 pixels
	Vertical	Front: 32 pixels, rear: 0 pixels	Front: 32 pixels, rear: 0 pixels	Front: 32 pixels, rear: 0 pixels	Front: 32 pixels, rear: 0 pixels
Power supply specifications	Analog	2.7 V	←	←	←
	Digital	1.8 V	←	←	←
	Digital interface	1.8 V or 2.7 V	←	←	←
PGA		4.17 dB (Max.)	←	←	←

Table 2 Imaging Characteristics

Item		IMX029	IMX034	IMX043	IMX058	Remarks
Sensitivity (F5.6)	Min.	90 mV	←	←	←	3200K, 706 cd/m^2, 1/30 s accumulation, G signal
Saturation signal	Min.	235 mV	330 mV	290 mV	330 mV	Ta = 60˚C