Sony Semiconductor Solutions Corporation has commercialized the “IMX290LLR”, “IMX178LLJ”, and “IMX226CLJ” monochrome back-illuminated CMOS image sensors for industrial camera applications. These image sensors use the STARVIS™ technology, which was originally developed for security cameras. 2M-, 6M-, and 12M-pixel image sensors can be selected according to the application. In addition to the basic angle of view, the drive mode can be changed to HD, 5M, and 4K according to the imaging subject. These products also support functions that enable imaging in accordance with the surrounding environment, such as the global reset function and multiple exposure function.

**High sensitivity monochrome image sensors**

- *Exmor R is a trademark of Sony Corporation. The Exmor R is a Sony’s CMOS image sensor with significantly enhanced imaging characteristics including sensitivity and low noise by changing fundamental structure of Exmor™ pixel adopted column parallel A/D converter to back-illuminated type.

- **STARVIS**

  *STARVIS is a trademark of Sony Corporation. The STARVIS is back-illuminated pixel technology for CMOS image sensors for surveillance camera applications. It features a sensitivity of 2000 mV or more per 1 μm² (color product, when imaging with a 706 cd/m² light source, F5.6 in 1 s accumulation equivalent), and realizes high picture quality in the visible-light and near infrared light regions.

**Multiangle**

Various angles of view are available for each sensor in addition to all-pixel output. The IMX290LLR can select all-pixel (Full HD) output or HD output. The IMX178LLJ can select all-pixel 6M output or 5M output with an aspect ratio of 4:3, 5:4, or 16:9 in accordance with the application. The IMX226CLJ can select all-pixel 12M output or 4K output, and is capable of imaging at 60 frame/s in ADC 10-bit mode when 4K output is selected. (Table 3-1, Table 3-2, Table 3-3)

**Various functions**

The IMX290LLR and IMX178LLJ support multiple exposure drive, and the exposure time can be changed for each frame. The IMX290LLR also supports the DOL (Digital Overlap)-type HDR (High Dynamic Range) function, and can realize multiple exposures with little exposure time difference. These products are also equipped with the global reset function required by cameras for industrial applications, and use together with a flash makes it possible to obtain images with low distortion.

The IMX178LLJ and IMX226CLJ use a low-voltage LVDS, and the number of channels used can be reduced according to the frame rate. The IMX290LLR can select from low-voltage LVDS, MIPI CSI-2, or CMOS parallel output interfaces in accordance with the interface to be connected.
### Table 1: Device Structure

<table>
<thead>
<tr>
<th>Item</th>
<th>IMX290LLR</th>
<th>IMX178LLJ</th>
<th>IMX226CLJ</th>
</tr>
</thead>
</table>
| Output image size   | Diagonal 6.46 mm (Type 1/2.8) Full HD  
                                 | Diagonal 8.92 mm (Type 1/1.8) all-pixel  
                                 | Diagonal 9.33 mm (Type 1/1.7) 12M  
                                 | Diagonal 9.81 mm (Type 1/1.9) 4K  
                                 | Diagonal 7.83 mm (Type 1/2.0) 4:3  
                                 | Diagonal 7.92 mm (Type 1/2.0) 5:4  
                                 | Diagonal 8.51 mm (Type 1/1.9) 6:4  
| Number of effective pixels | 1945 (H) × 1097 (V) approx. 2.13M pixels  
                                 | 3096 (H) × 2080 (V) approx. 6.44M pixels  
                                 | 4072 (H) × 3046 (V) approx. 12.00M pixels  
                                 | 2.9 μm (H) × 2.9 μm (V)  
                                 | 2.4 μm (H) × 2.4 μm (V)  
                                 | 1.85 μm (H) × 1.85 μm (V)  
| Unit cell size      | Front: 0 pixels, rear: 0 pixels  
                                 | Front: 0 pixels, rear: 0 pixels  
                                 | Front: 10 pixels, rear: 0 pixels  
                                 | Front: 10 pixels, rear: 0 pixels  
                                 | Front: 14 pixels, rear: 0 pixels  
                                 | Front: 16 pixels, rear: 0 pixels  
| Optical blacks      | Horizontal: 0.0 mm  
                                 | Vertical: 0.0 mm  
                                 | Horizontal: 0.0 mm  
                                 | Vertical: 0.0 mm  
                                 | Horizontal: 0.0 mm  
                                 | Vertical: 0.0 mm  
| Input drive frequency | 37.125 MHz / 74.25 MHz  
                                 | 37.125 MHz / 54.0 MHz / 74.25 MHz  
                                 | 72.0 MHz  
| Output Interface    | Low Voltage LVDS 8 ch  
                                 | Low Voltage LVDS 10 ch  
                                 | Low Voltage LVDS 10 ch  
| Package             | 110-pin LGA  
                                 | 128-pin LGA  
                                 | 128-pin LGA  
| Supply voltage VDD (Typ.) | 2.9 V / 1.8 V / 1.2 V  
                                 | 2.9 V / 1.8 V / 1.2 V  
                                 | 2.9 V / 1.8 V / 1.2 V  

### Table 2: Image Sensor Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>IMX290LLR</th>
<th>IMX178LLJ</th>
<th>IMX226CLJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (monochrome)</td>
<td>Typ. [F8]</td>
<td>1200 mV</td>
<td>380 mV</td>
</tr>
<tr>
<td>Saturation signal</td>
<td>Min.</td>
<td>914 mV</td>
<td>945 mV</td>
</tr>
</tbody>
</table>

### Table 3-1: Basic Drive Mode (IMX290LLR)

<table>
<thead>
<tr>
<th>Drive mode</th>
<th>Recommended number of recording pixels</th>
<th>Frame rate [Max.] [frame/s]</th>
<th>ADC [bit]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full HD (1080p)</td>
<td>1920 (H) × 1080 (V) approx. 2.07M pixels</td>
<td>60</td>
<td>12 (Low Voltage LVDS/CSI-2)</td>
</tr>
<tr>
<td>HD (720p)</td>
<td>1280 (H) × 720 (V) approx. 0.93M pixels</td>
<td>60</td>
<td>12 (Low Voltage LVDS/CSI-2)</td>
</tr>
</tbody>
</table>

### Table 3-2: Basic Drive Mode (IMX178LLJ)

<table>
<thead>
<tr>
<th>Drive mode</th>
<th>Recommended number of recording pixels</th>
<th>Frame rate [Max.] [frame/s]</th>
<th>ADC [bit]</th>
</tr>
</thead>
<tbody>
<tr>
<td>all-pixel</td>
<td>3072 (H) × 2048 (V) approx. 6.29M pixels</td>
<td>29.97</td>
<td>14</td>
</tr>
<tr>
<td>5M (4:3)</td>
<td>2592 (H) × 1944 (V) approx. 5.04M pixels</td>
<td>29.97</td>
<td>14</td>
</tr>
<tr>
<td>5M (5:4)</td>
<td>2560 (H) × 2048 (V) approx. 5.24M pixels</td>
<td>29.94</td>
<td>14</td>
</tr>
<tr>
<td>5M (16:9)</td>
<td>3072 (H) × 1728 (V) approx. 5.31M pixels</td>
<td>30</td>
<td>14</td>
</tr>
</tbody>
</table>

### Table 3-3: Basic Drive Mode (IMX226CLJ)

<table>
<thead>
<tr>
<th>Drive mode</th>
<th>Recommended number of recording pixels</th>
<th>Frame rate [Max.] [frame/s]</th>
<th>ADC [bit]</th>
</tr>
</thead>
<tbody>
<tr>
<td>12M (4:3)</td>
<td>4000 (H) × 3000 (V) approx. 12.00M pixels</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>4K (17:9)</td>
<td>4096 (H) × 2160 (V) approx. 8.89M pixels</td>
<td>30</td>
<td>12</td>
</tr>
</tbody>
</table>

*Sony reserves the right to change products and specifications without prior notice.*
Back-illuminated Structure CMOS Image Sensor for Security Cameras and Industrial Applications Achieves High Sensitivity and High Dynamic Range

Sony developed back-illuminated structure CMOS image sensor, “IMX178LQJ”, supporting three formats of 4:3, 5:4, and 16:9 ratio with type 1/2 in 5M-Effective pixel. Adopting back-illuminated structure with 2.4 μm unit pixel and 14 bit ADC, it provides all three advantages of high resolution, high sensitivity, and high dynamic range, which are necessary for security cameras.

- Back-illuminated structure 2.4 μm unit pixel
- 10 bit/12 bit/14 bit A/D converters
- Supporting type 1/2 5M effective pixels in 3 formats
- HLP (High Light Performance) mode
- LLP (Low Light Performance) mode
- Pin compatible with the existing product "IMX185LQJ"*1

*1: For details on the IMX185LQJ, see the New Products section of this volume.

High Sensitivity

To achieve high sensitivity, which is one of the most important characteristics for security cameras, this time Sony developed back-illuminated structure 2.4 μm unit pixel and accomplished the equivalent sensitivity as the existing back-illuminated structure 2.8 μm unit pixel, "IMX136LQJ"*2. Also near infrared sensitivity was improved from the IMX136LQJ, which is equivalent to the IMX236LQJ*3, and it is suitable for Day/Night cameras and near infrared light LED used as auxiliary light.

- "IMX136LQJ"*2: See the New Products section in CX-NEWS, Volume 68.
- "IMX236LQJ"*3: For details on the IMX236LQJ, see the New Products section of this volume.

High Dynamic Range

Dynamic range is determined by the ratio of saturation signal and dark random noise. The IMX178LQJ featuring 14 bit ADC reduced quantization noise and also suppressed dark random noise. At the result, high dynamic range was achieved, which is equivalent to the existing 3.75 μm unit pixel, the IMX104LQJ*4. It enables clear image quality in light and dark areas even for the objects with high contrast.

- "IMX104LQJ"*4: See the New Products section in CX-NEWS, Volume 68.

Image Format

The format for image size of security camera is typically 4:3, 5:4 for fisheye lens, or 16:9 for full HD. The IMX178LQJ supports all these three formats in 5M pixels high resolution. Also it secures high resolution as well as high sensitivity and high dynamic range at the same time, therefore the specification works best for high performance security cameras with type 1/2 lenses.

Compatibility with Existing Sony Products

The IMX178LQJ is pin compatible with the 3.75 μm unit pixel full HD image sensor, the ICX185LQJ, supporting type 1/2 lenses. If you are using the IMX185LQJ, please do not miss the chance to try the performance of the IMX178LQJ.
All-pixel Scan, and 5M Pixels in Three Formats: 4:3, 5:4, and 16:9

Number of recommended recording pixels: All-pixel scan approx. 6.29M pixels (3:2), approx. 5.04M pixels (4:3), approx. 5.24M pixels (5:4), and approx. 5.31M pixels (16:9).

Photograph 1

All-pixel scan recommended recording
3072H × 2048V

5M 4:3
recommended recording
2592H × 1944V

5M 5:4
recommended recording
2560H × 2048V

5M 16:9
recommended recording
3072H × 1728V

Photograph 2

Sample Images

(recommended recording approx. 5.04M pixels, 4:3, ADC 12 bit mode, 59.94 frame/s)

Photograph 3

High Dynamic Range Imaging

(recommended recording approx. 5.04M pixels, 4:3, 29.97 frame/s HLP mode, internal gain 0 dB, F5.6)

Table 1

<table>
<thead>
<tr>
<th>Item</th>
<th>IMX178LQJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>image size</td>
<td>Diagonal 8.92 mm (Type 1/1.8) Approx. 6.39M pixels all-pixel scan</td>
</tr>
<tr>
<td>Unit cell size</td>
<td>2.4 μm (H) × 2.4 μm (V)</td>
</tr>
<tr>
<td>Optical blacks</td>
<td>Forward: 0 pixels, rear: 0 pixels</td>
</tr>
<tr>
<td>Input drive frequency</td>
<td>54 MHz/7 MHz/25 MHz/25 MHz/125 MHz</td>
</tr>
<tr>
<td>Package</td>
<td>128-pin LGA</td>
</tr>
<tr>
<td>Supply voltage Vcc (Typ.)</td>
<td>2.9 V/1.8 V/1.2 V</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Item</th>
<th>IMX178LQJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (F5.6)</td>
<td>Typ. 425 mV</td>
</tr>
<tr>
<td>Saturation signal</td>
<td>Min. 945 mV</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Drive mode</th>
<th>Number of recommended recording pixels</th>
<th>ADC</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-pixel scan</td>
<td>3072H × 2048V (approx. 6.29M pixels)</td>
<td>12 bit 29.97 frame/s</td>
</tr>
<tr>
<td>5M 4:3</td>
<td>2592H × 1944V (approx. 5.04M pixels)</td>
<td>12 bit 59.94 frame/s</td>
</tr>
<tr>
<td>5M 5:4</td>
<td>2560H × 2048V (approx. 5.24M pixels)</td>
<td>12 bit 29.97 frame/s</td>
</tr>
<tr>
<td>5M 16:9</td>
<td>3072H × 1728V (approx. 5.31M pixels)</td>
<td>12 bit 60 frame/s</td>
</tr>
</tbody>
</table>