White Paper

HDR Beyond the Numbers

A Technical Comparison of Sony IMX900 Quad HDR and IMX676 DOL-HDR and Clear HDR

THE IMAGINGSOURCE
TECHNOLOGY BASED ON STANDARDS

Contents

1. Introduction

Sony IMX900 and Sony IMX676 (also applies to other STARVIS 2 sensors such as IMX675 and IMX678) have an HDR function, but it is fundamentally not the same type of HDR. This is an important distinction if you're comparing them for an industrial camera.

In a nutshell:

	Sony IMX900	Sony IMX676
Sensor family	Pregius S	STARVIS 2
Shutter	Global shutter	Rolling shutter
HDR technology	Quad HDR	Digital Overlap HDR + Clear HDR
How HDR is achieved	Different exposure times assigned to 4 pixels in a 2×2 group	Multiple exposures / gains, depending on HDR mode
Exposures spatially	4 pixels = 4 exposure conditions	Exposure conditions are combined temporally / within sensor processing
HDR image composition	Not performed inside sensor	Sensor provides HDR output modes
Motion artifacts	Potentially very low because of global shutter / spatial approach	DOL HDR can produce motion artifacts; Clear HDR is intended to mitigate this
Main application philosophy	Industrial inspection, high-speed moving objects	Surveillance / high-contrast scenes, especially where HDR and low light matter

Sony explicitly describes the IMX900's Quad HDR as setting individual exposure times for the four pixels in each 2×2 pixel unit. For example, the four pixels can use short, medium and long exposures simultaneously. Sony also states that HDR compositing itself is not included in the sensor and has to be performed downstream.

The IMX676, on the other hand, explicitly offers Digital Overlap HDR and Clear HDR.

2. IMX900: Quad HDR

This is probably the biggest difference. The IMX900 monochrome uses a 2×2 pixel block:

Long Exposure	Medium Exposure
Medium Exposure	Short Exposure

Sony allows the exposure time of each of those four pixels to be controlled independently.

So instead of:

Capture the same pixel several times with different exposures

the IMX900 effectively does:

Capture different pixels with different exposures at the same time.

Sony calls this Quad HDR. This can provide a very large exposure range. Sony's documentation gives an example with exposure ratios of up to 576:1.

But there is a catch. You don't directly get one conventional HDR pixel from the sensor.

You get four images/pixel groups representing different exposure conditions, and HDR reconstruction/compositing needs to happen downstream, i.e., on the host PC.

Sony explicitly says:

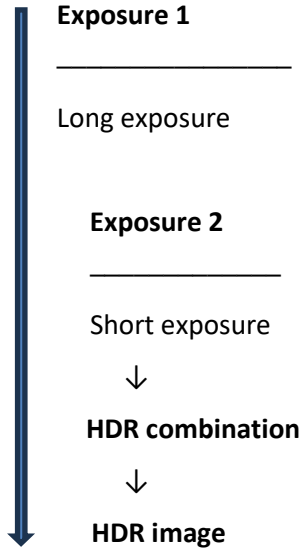
HDR compositing is not included.

So, the camera/ISP/software has to do the reconstruction. This is quite different from the usual "HDR mode" marketing terminology.

3. IMX676: DOL-HDR

The IMX676 has Digital Overlap HDR (DOL-HDR).

Conceptually:



Here the sensor captures the scene using different exposure conditions and the data is combined to extend the dynamic range.

The IMX676 supports 2-frame and 3-frame DOL-HDR, according to documentation describing the sensor.
The problem with this traditional multi-exposure approach is obvious - the scene can move between exposures.

For example:

Frame 1: 🚗

Frame 2: 🚗

Frame 3: 🚗

When the frames are combined, you can get ghosting or motion artifacts.

This is one reason why Clear HDR is interesting on the IMX676.

4. IMX676: Clear HDR

Clear HDR is designed to obtain HDR information while reducing the motion problems associated with sequential exposure capture.

Clear HDR, also known as Single Exposure Dual Gain, captures two images simultaneously by setting High Conversion Gain (HCG) for the dark region and Low Conversion Gain (LCG) for the bright region.

The output images at different gains are synthesized to achieve a wider dynamic range than a single-exposure image.

This technique is suitable for detecting fast-moving objects and for low-light conditions.

5. The important distinction for a camera comparison

5.1 IMX900 Quad HDR

Spatial multi-exposure HDR

Different pixels in a 2×2 group → different exposure times → HDR reconstruction downstream.

Strength:

- Very interesting for industrial inspection
- Global shutter
- Can achieve an extremely large exposure ratio
- No conventional temporal sequence of the same pixel

Weakness:

- You need downstream reconstruction
- Could suffer from motion artifacts, but potentially better results than DOL-HDR
- Because different pixels have different exposures, the HDR reconstruction is more complicated than simply merging two conventional frames
- Effective spatial sampling/resolution considerations need to be taken into account

5.2 IMX676 DOL-HDR

Temporal multi-exposure HDR

Same scene → different exposure conditions → data combined to create HDR.

Strength:

- More conventional HDR architecture
- Well suited to high-contrast scenes
- Sensor provides dedicated HDR functionality

Weakness:

- Conventional DOL-HDR can suffer from motion artifacts

- Rolling shutter adds another consideration for moving objects

5.3 IMX676 Clear HDR

Single Exposure - Dual Gain

Strength:

- LCG and HCG data are derived from the exact same exposure window. There is absolutely no temporal offset. This ensures zero ghosting on moving objects, making it mathematically impossible for the layers to be misaligned. It can capture very dark scenes by boosting gain.

Weakness:

- With Clear HDR, increasing exposure helps reduce noise and improve clarity in dark regions, but it can lead to overexposure in bright areas.
- Potentially higher noise: The entire scene is captured with the same exposure time, while brightness differences are compensated through different gain levels. Higher gain can result in increased noise, particularly in darker image areas.

6. Symmary

IMX900's HDR isn't simply "better" or "worse" than IMX676's HDR. It is designed for a different imaging philosophy.

The IMX900 combines global shutter + Quad HDR + Quad Shutter Control + Fast AE, which is a very industrial-oriented feature set. Sony specifically positions it for applications such as barcode reading, robot picking and high-speed inspection.

The IMX676 is a STARVIS 2 sensor originating from the security-camera world, where high dynamic range, low-light sensitivity and features such as Clear HDR are major priorities.

Revision History

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