

BLACK PEARL

Intensive Pixel Technology
by SK hynix



Beautiful Black

The culmination of our persistent effort to achieve bright and clear images in the dark

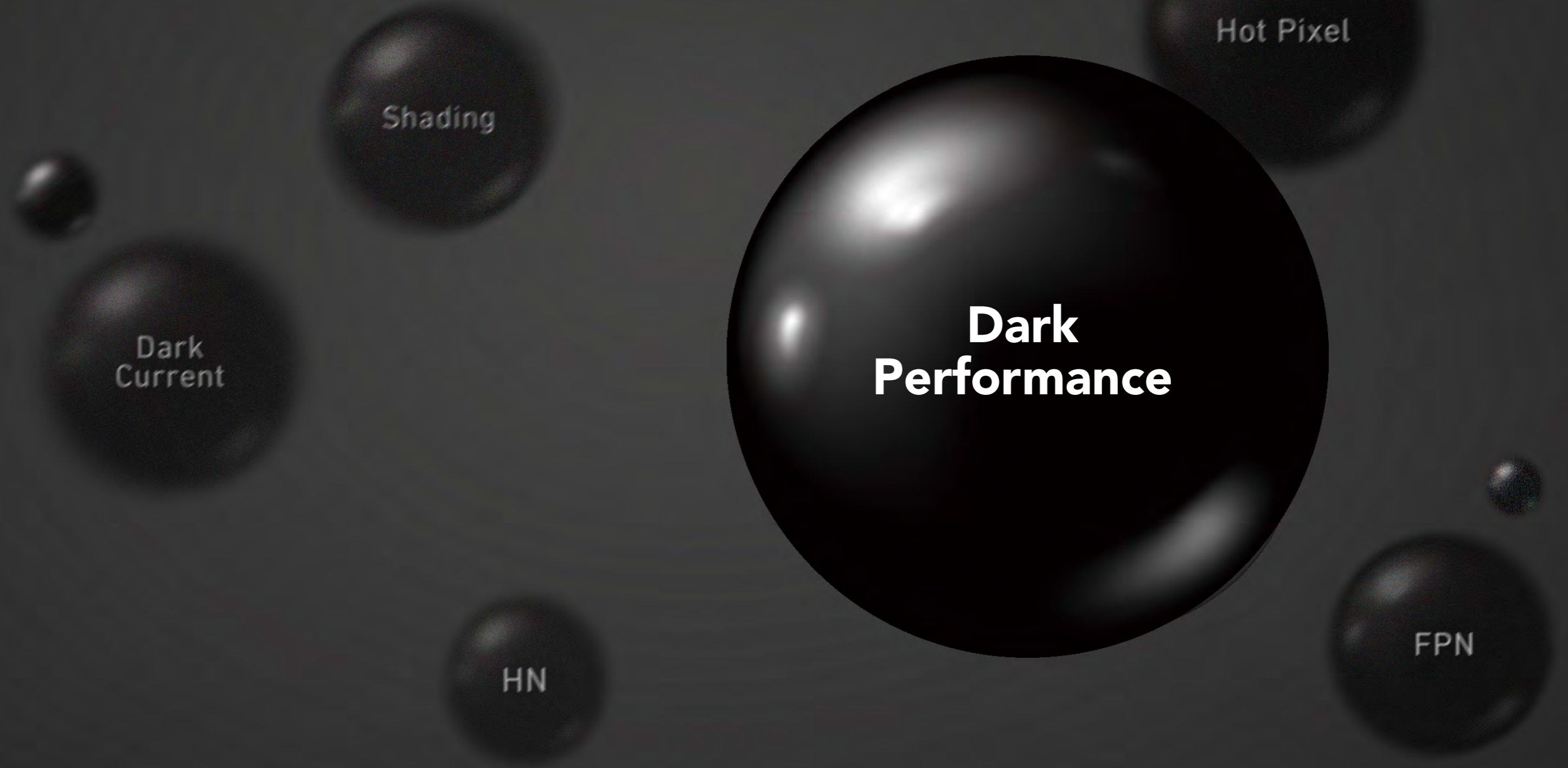
Vivid Impression

Focus on the nature of light
Black as in the real darkness, Colors as in real life



Why Black Pearl?

Black Pearl implements real darkness in low light with its world's best dark performance

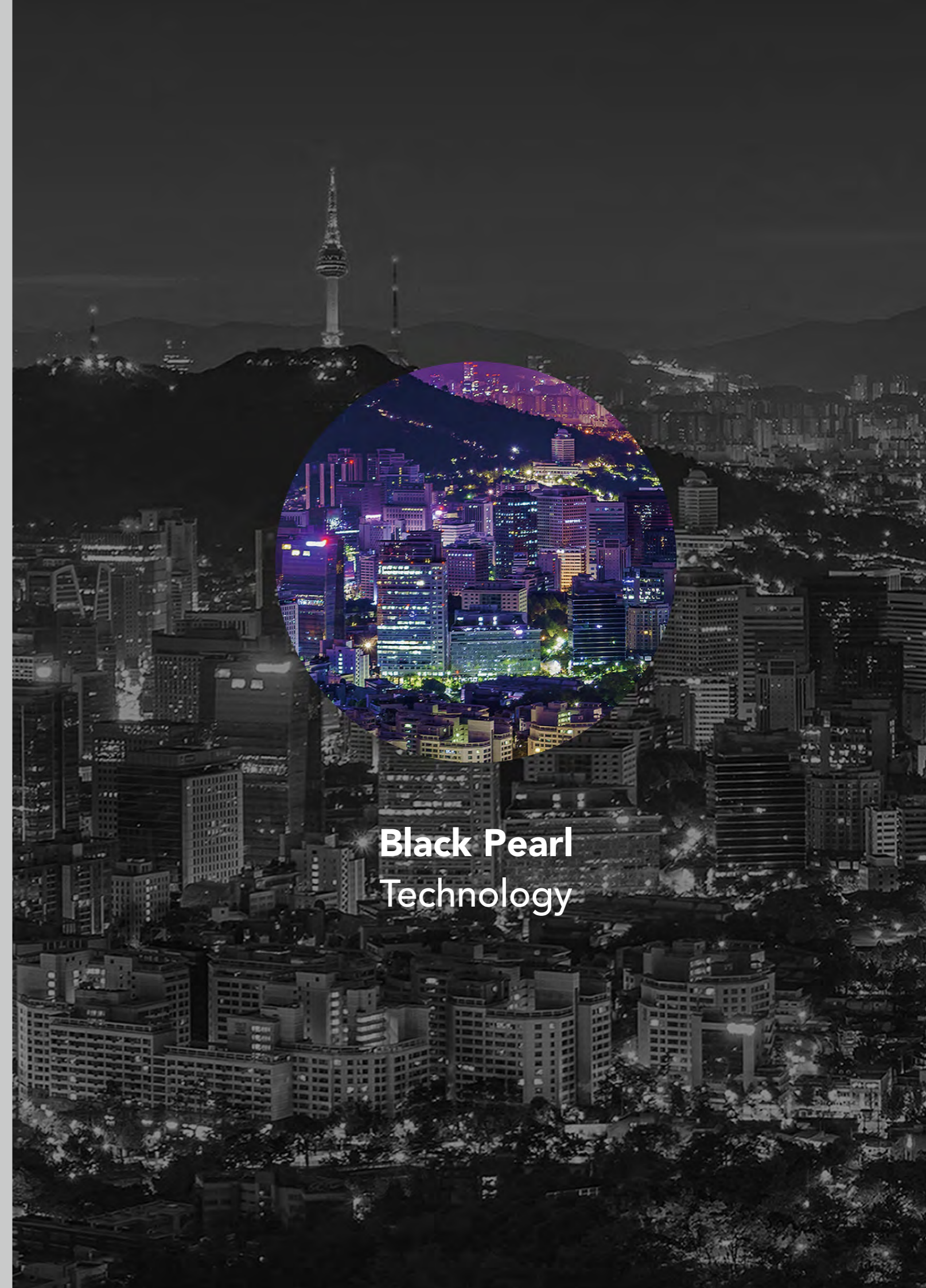


Black Pearl's dramatically-improved
noise characteristics enable
the most realistic images



Black Pearl's Performance

| Channy's KPI | Conventional 1.12um | Black Pearl 1.0um |
|---------------------------|---------------------|-------------------|
| Full Well Capacity | Base | Improved |
| Dynamic Range (1X) | Base | Improved |
| Dynamic Range (16X) | Base | Improved |
| Max SNR | Base | Improved |
| Dark Temporal Noise (1X) | Base | Improved |
| Dark Temporal Noise (16X) | Base | Improved |
| Black Level Stability | Base | Improved |
| Horizontal FPN | Base | Same |
| Vertical FPN | Base | Improved |
| Horizontal Temporal Noise | Base | Improved |
| Vertical Temporal Noise | Base | Improved |
| Gr-Gb Imbalance | Base | Improved |
| PRNU | Base | Same |
| Blooming | Base | Improved |
| Lag | Base | Improved |
| QE Max | Base | Same |
| Averaged X-talk | Base | Improved |

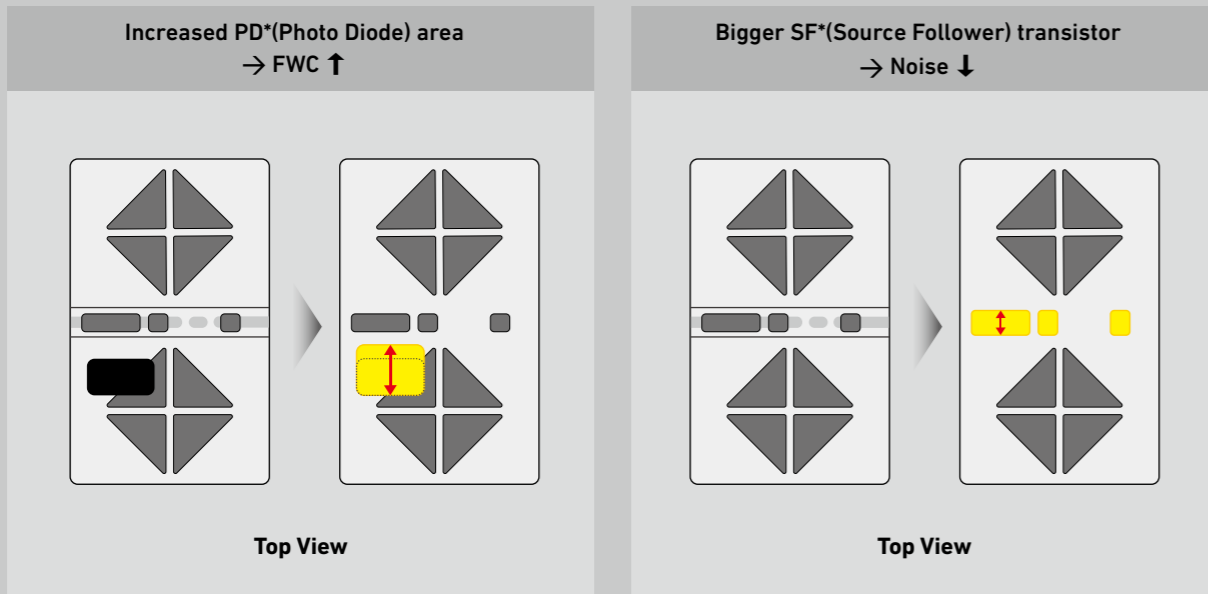


**Black Pearl
Technology**

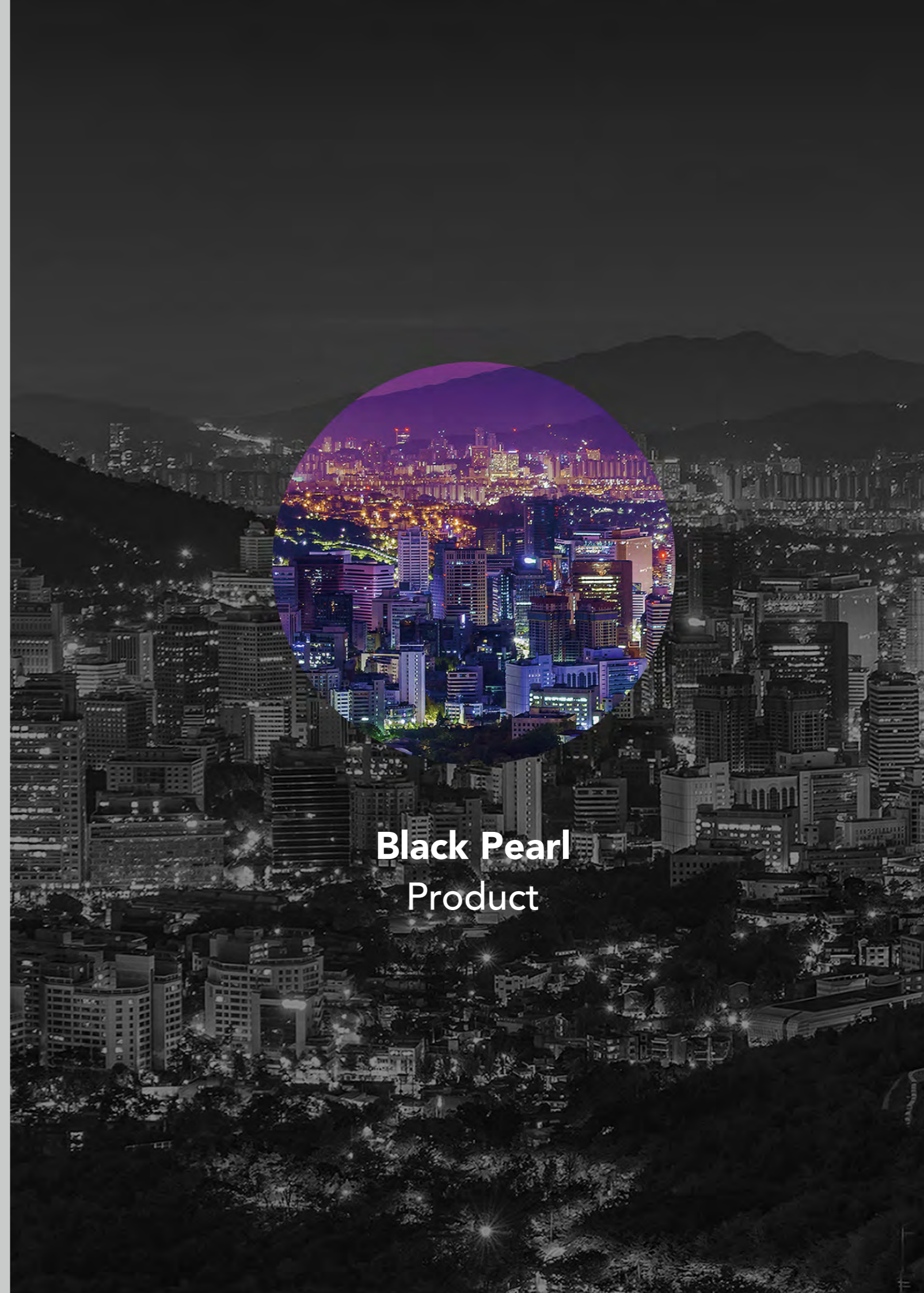
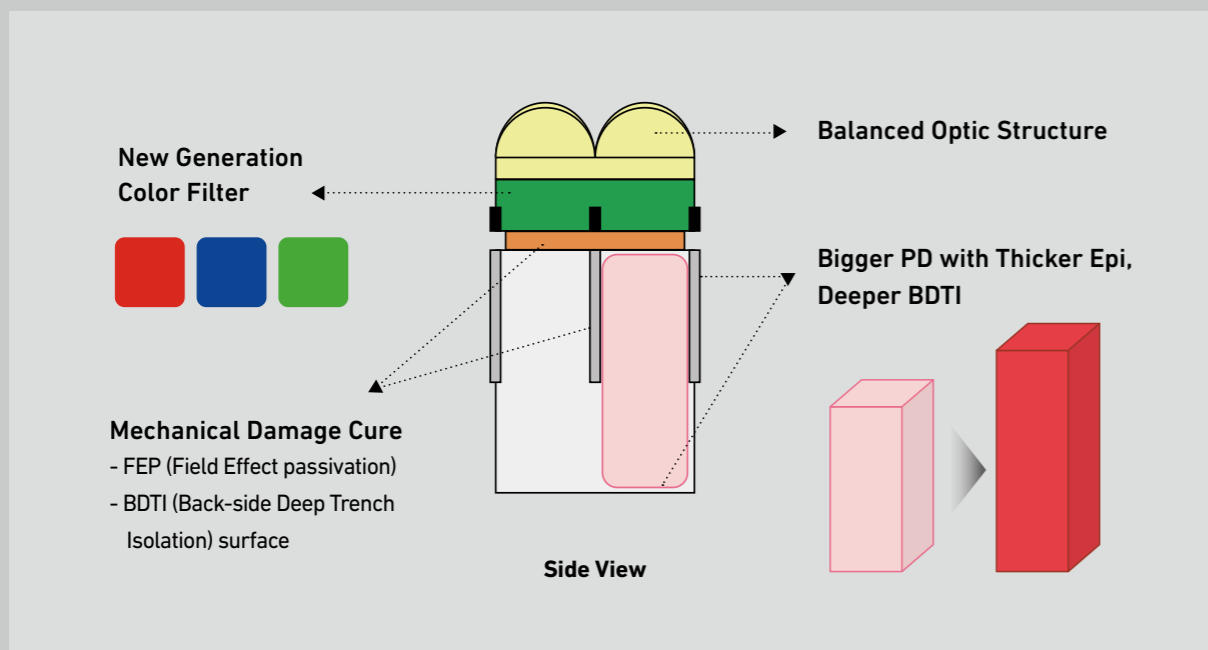
Black Pearl Pixel Technology

Pixel Layout Modification

Removed STI(Shallow Trench Isolation)



Pixel Process Optimization



Black Pearl
Product

Black Pearl Product

Small Form Factor 13Mp/8Mp Solution

- Fit for tele camera of high resolution main camera supporting over 3 times optical zoom
- Smallest module size is advantageous for full display

| Features | Hi-1337 | Hi-847 |
|-------------------|---|---|
| Resolution | 13Mp (4208 x 3120) | 8Mp (3264 x 2448) |
| Optical Format | 1/3.4" | 1/4.4" |
| Pixel Size | 1.0um BDTI | |
| Frame Rate | 30fps @ Full 60fps @ FHD 120fps @ HD | 30fps @ Full 60fps @ FHD 90fps @ HD |
| PDAF | PDAF type II/III (16 x 8 Pattern) | |
| On-chip Functions | Frame Sync for Dual Camera (Flexible) 2D LSC, 2D DPC (with PDAF DPC) | |

Multi Camera Tele

13Mp Tele 1/3" 1.12um 13Mp Tele 1/3.4" 1.0um

Module Height ↓

A high-resolution main camera needs a tele camera with higher resolution

Small Size

1/3" 13Mp → 1/3.4" 13Mp (Size 20% ↓)

1/4" 8Mp → 1/4.4" 8Mp (Size 15% ↓)

Fit for Bezel-less Display

Black Pearl Product

Volume Zone 16Mp Solution

- Bayer sensor optimized for ultra-wide camera
- Bayer sensor replacing existing 1.12um 16Mp in rear main camera
- Quad sensor for front camera with quad to bayer re-mosaic

| Features | Hi-1634 | Hi-1634Q |
|-------------------|--|-------------------------------|
| Resolution | 16Mp (4565 x 3496) | |
| Optical Format | 1/3" | |
| Pixel Size | 1.0um BDTI | |
| Frame Rate | 30fps @ 16Mp 60fps @ UHD 120fps @ FHD | *120fps @ 4Mp 120fps @ FHD |
| PDAF | PDAF type II/III (16 x 8 Pattern) | Not Supported |
| On-chip Functions | Frame Sync for Multi Camera (Flexible) 2D LSC, 2D DPC (with PDAF DPC) | |

*Depends on V-Blank time

- CRA 35.2°
- Higher sensitivity
- Flare-free
- Frame sync for master and slave
- Better PDAF performance

[Quad] [Bayer]

Sensitivity ↑ (2.0um Effect) Resolution ↑

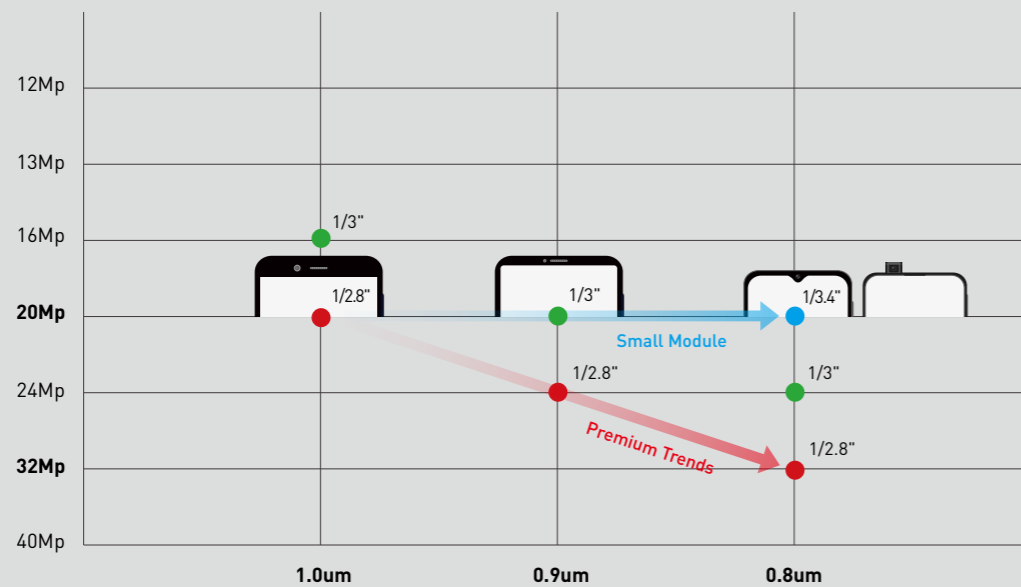
Black Pearl Product

High Resolution Ultra-wide 20Mp Solution

- Next to 16Mp for premium ultra-wide camera
- Smallest 20Mp FF module with NeOPAC 3D PKG suitable for front camera

| Features | Hi-2021 |
|-------------------|--|
| Resolution | 20Mp (5,184 x 3,880) |
| Optical Format | 1/2.8" |
| Pixel Size | 1.0um BDTI |
| Frame Rate | 30fps@20Mp 120fps @ FHD |
| PDAF | PDAF type II/III (16 x 8 Pattern) |
| On-chip Functions | Frame Sync for Multi Camera (Flexible) 2D LSC, 2D DPC (with PDAF DPC) |

Front Camera Optical Format by Pixel Size



**Black Pearl
Premium
Coming Soon
in 2020**