



■ 3*4K CMOS

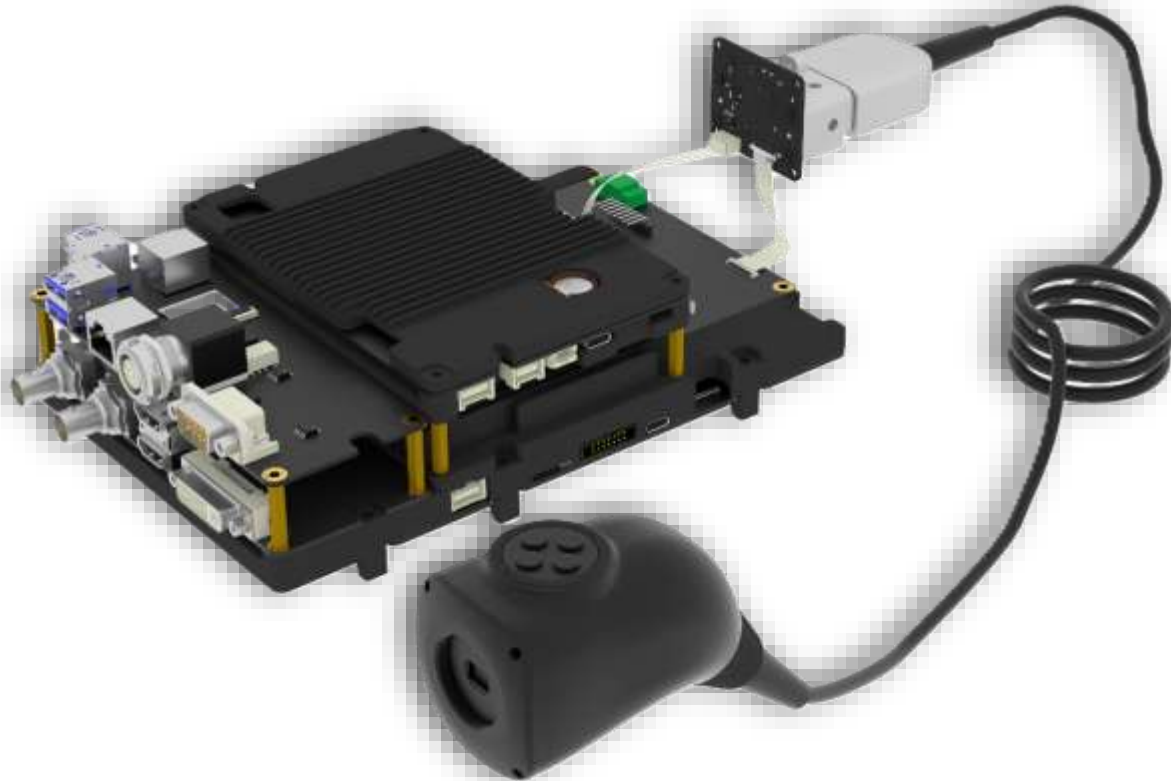
3-CHIP 4K CAMERA SYSTEM

The medical surgical camera system with three 4K sensors in world

■ HW-3CMOS ■ 2026-03-04



■ Model: HW-3CMOS



PROFILE

This camera system features a genuine Sony three-chip 4K camera module, employing three native 4K sensors. The backend is paired with a Xilinx FPGA real-time image processing system. It is three-chip 4K camera system suitable for medical endoscopes and surgical microscopes.



Core Technology Analysis



Image quality performance advantages

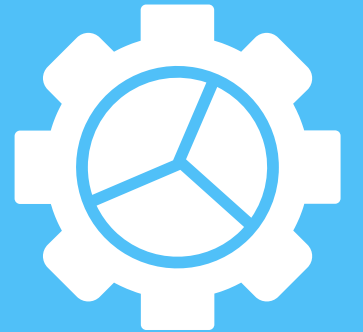


Compared to other 3-chip cameras



Technical Parameter Analysis

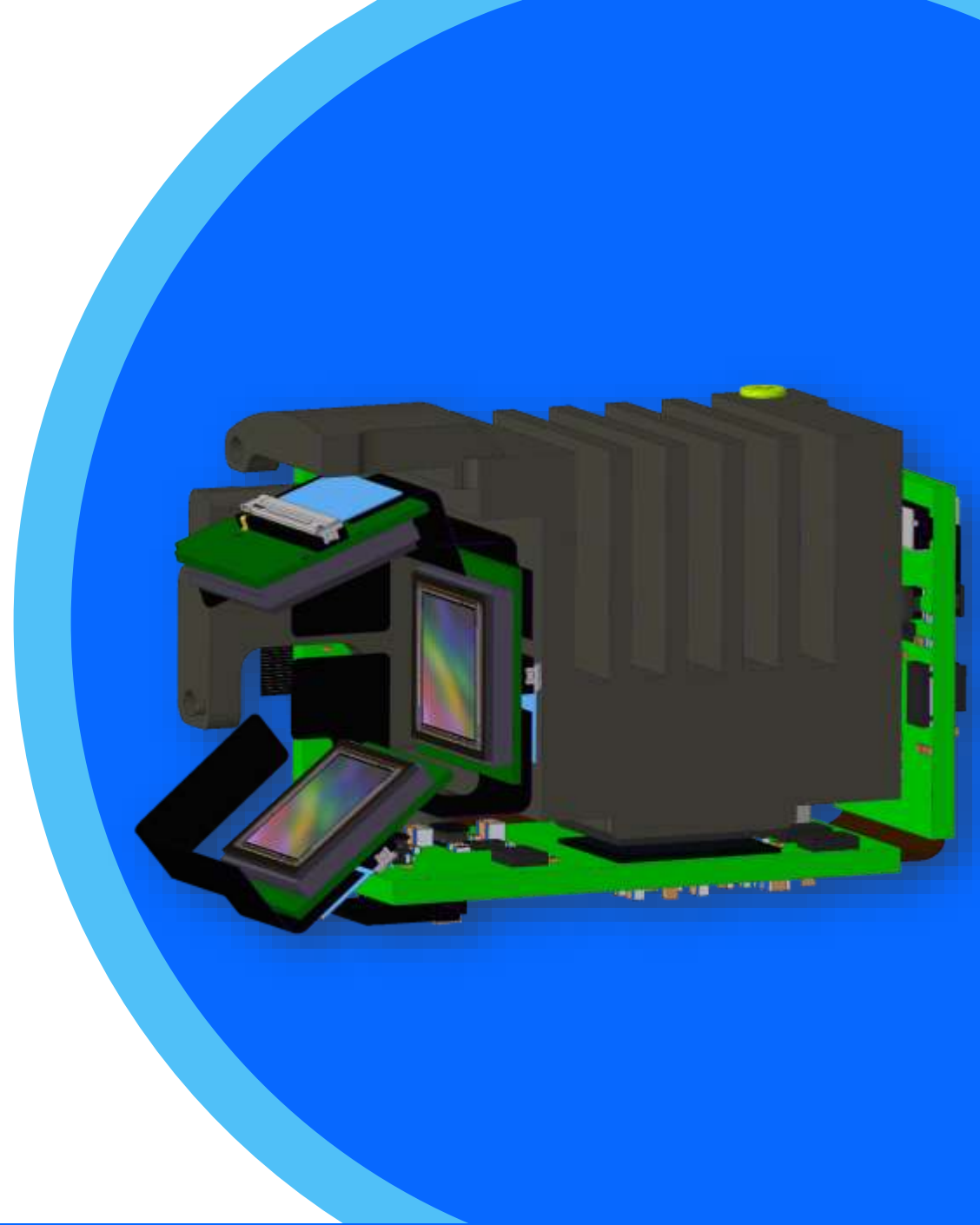
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Analysis of the core technologies of the 3-chip camera

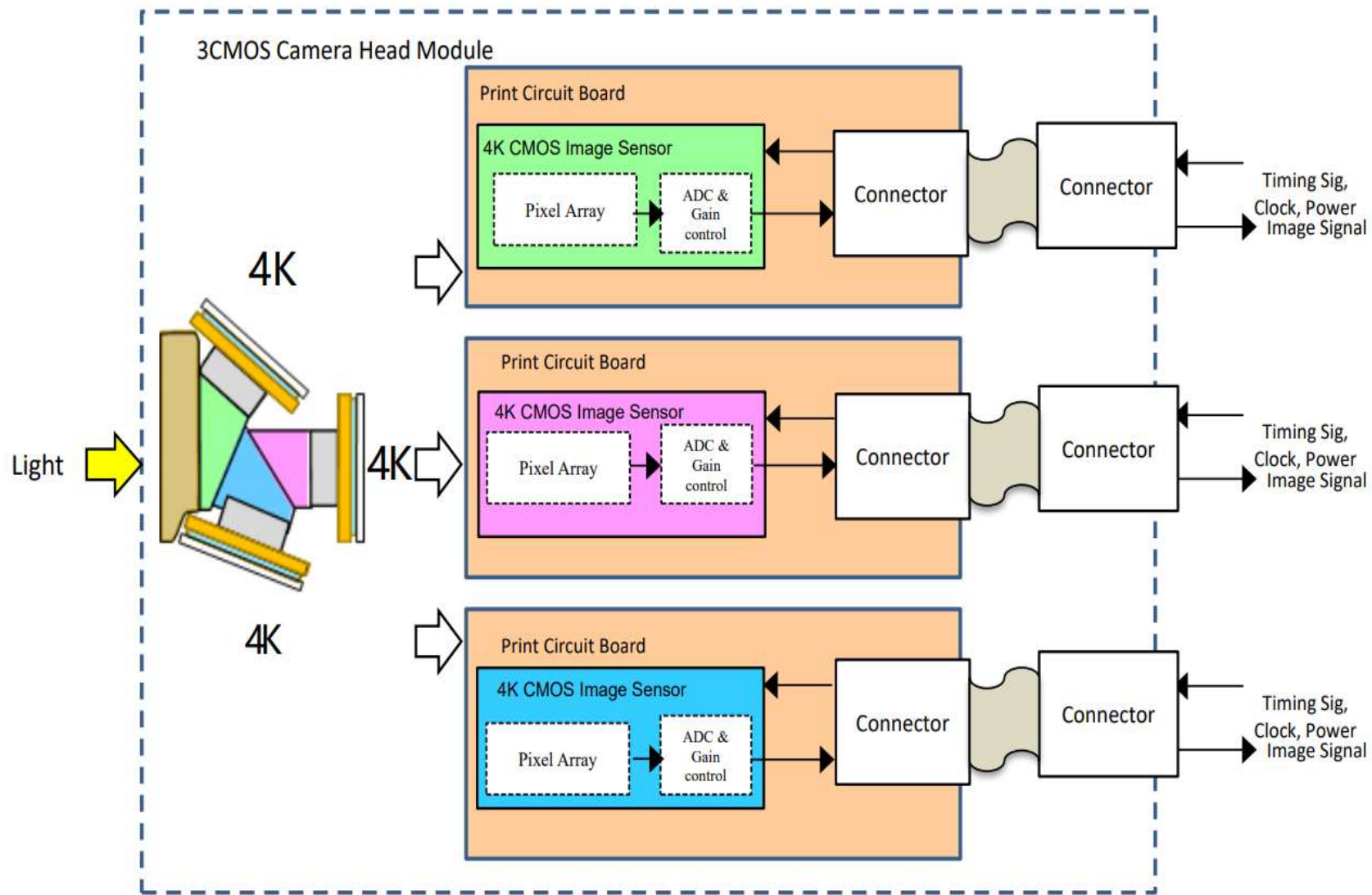


3-chip imaging principle

01

3 native 4K image sensors

Each sensor supports 3840*2160px, with a total pixel count exceeding 24 million. Red, green, and blue light beams are precisely split by a prism, each reaching its dedicated 4K image sensor chip. Signals are read out in parallel, eliminating the need for Bayer interpolation and directly outputting full-sample 4K RAW data. This results in a 2.4x increase in chroma bandwidth and smooth color transitions without jagged edges. Theoretically, it supports up to 12-bit wide color gamut and BT.709 and BT.2020 color spaces for HDR output.



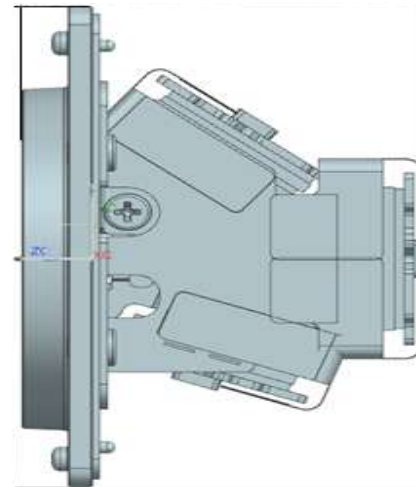
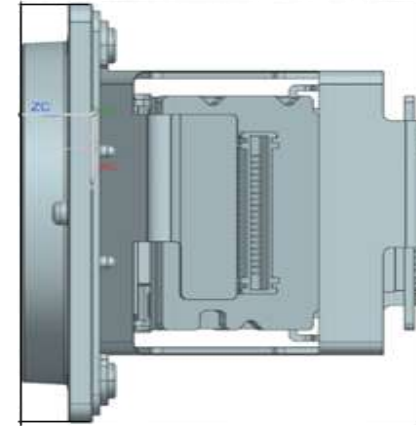
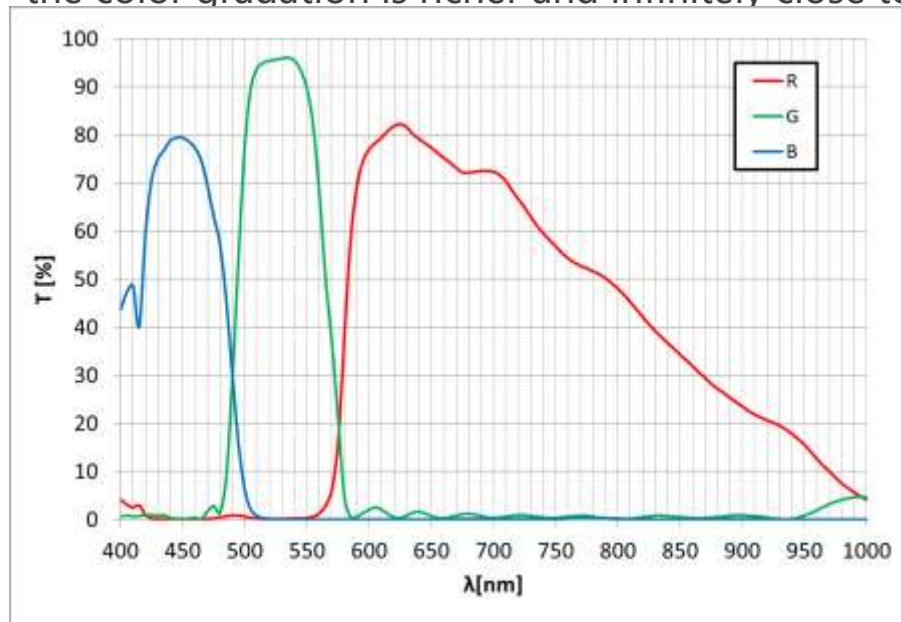
■ Sony's 3-chip optical architecture principle

3-chip imaging principle

02

Avoid single-chip color aliasing problem

Single-chip designs are prone to producing false colors and moiré patterns in fine textures due to mosaic filters; the three-chip architecture eliminates this defect from the source. The average ΔE value of the Macbeth 24 color chart is <1.2 , which is better than the industry benchmark of ≤ 3 for cinema-grade designs. The Rec.2020 coverage can reach 87%, and the DCI-P3 coverage reaches 99%. For medical scenarios, the color gradation is richer and infinitely close to the real surgical scene.



■ Sony original 3-chip optical prism module

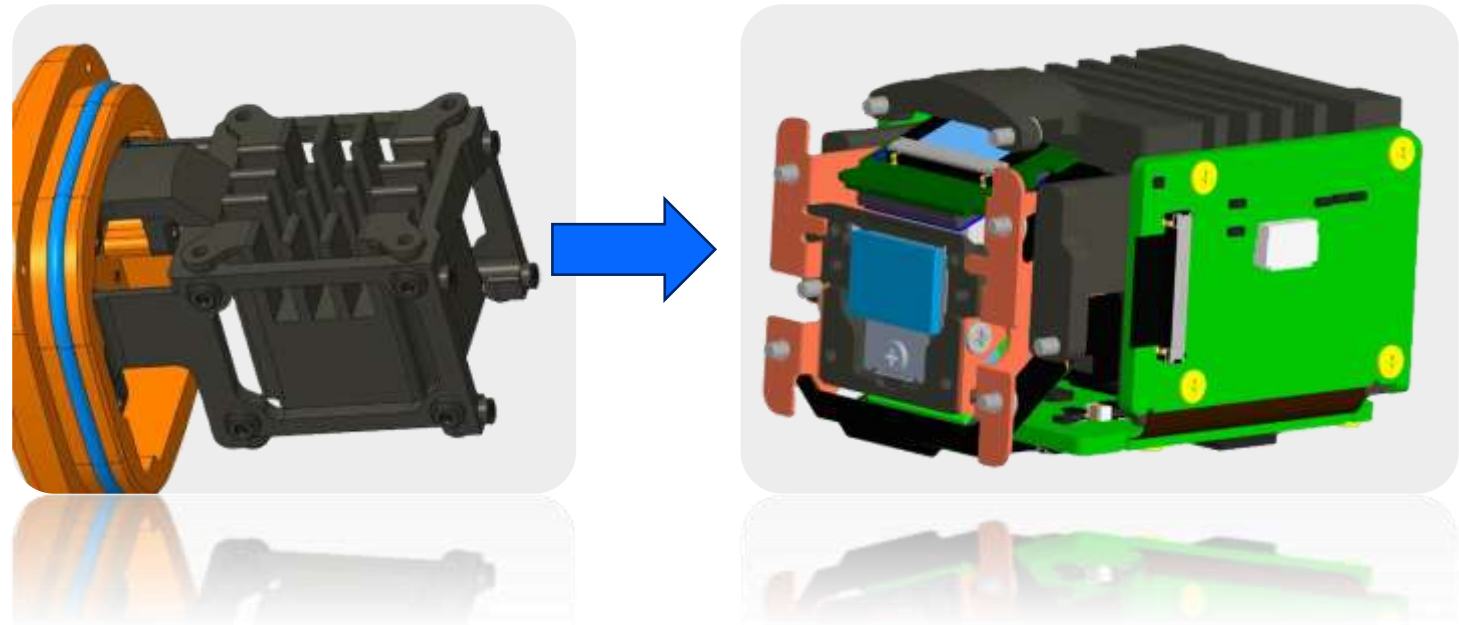
3-chip imaging principle

03

Completely self-developed solutions to overcome 4K transmission and heat dissipation issues

Because this module uses three 4K sensors with a transmission bandwidth exceeding 26.5G, higher transmission rates generate more heat. Utilizing heat sink design principles and real-time thermal simulation through digital twin technology, the volume of the heat dissipation system is effectively reduced by 20%. Multiple modular all-aluminum heat sinks are combined and precisely fitted to PCB components, maintaining heat dissipation stability in harsh environments with vibration and dust, meeting stringent safety standards such as UL94V0.

Ultimately, this enables the three-chip camera to support demanding medical high-temperature and high-pressure sterilization standards.



3-chip 4K camera module



02

Image quality performance advantages

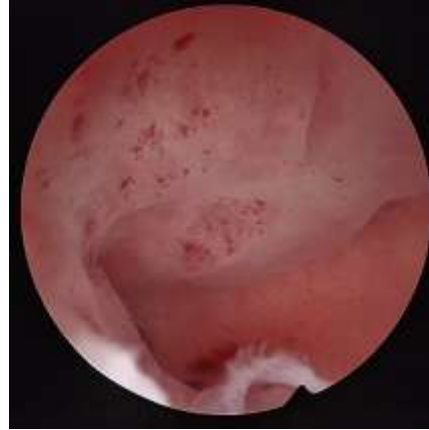
Let the camera become the surgeon's eyes



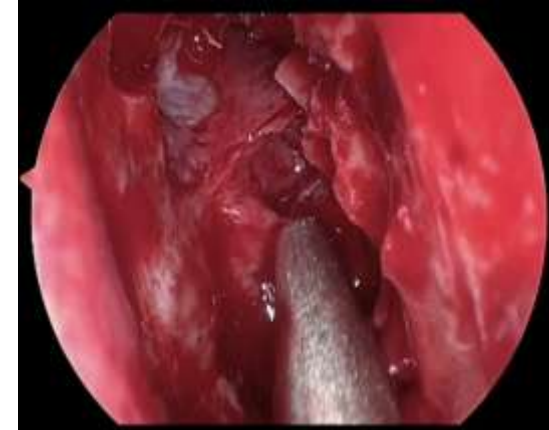
Improved color reproduction accuracy

Enhance tissue recognition capabilities to ensure surgical safety

The three-chip system features an 18-axis color phase matrix and 20 stops of color latitude. Professional testing shows that the three-chip system achieves a PSNR 4.2dB higher than Bayer's solution. In scenarios such as medical endoscopy color matching, it maintains over 98% color consistency and fidelity. In cases of severe bleeding, the bleeding point blends closely with the surrounding tissue, allowing doctors to quickly locate the bleeding point and implement emergency hemostasis.



Cervical surgery bleeding points



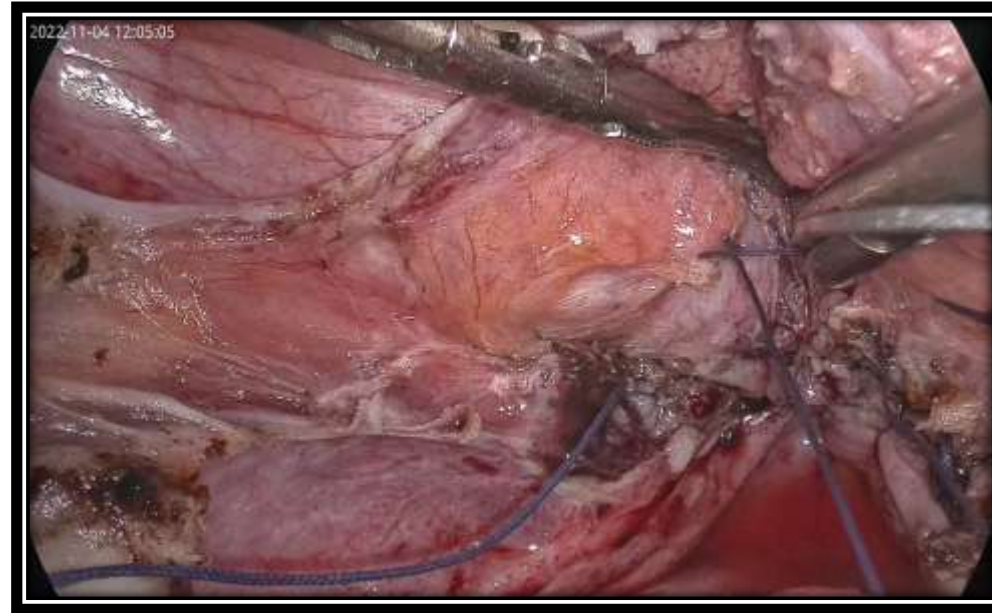
Bleeding after sinus surgery



Improved dynamic range and reduced dark noise

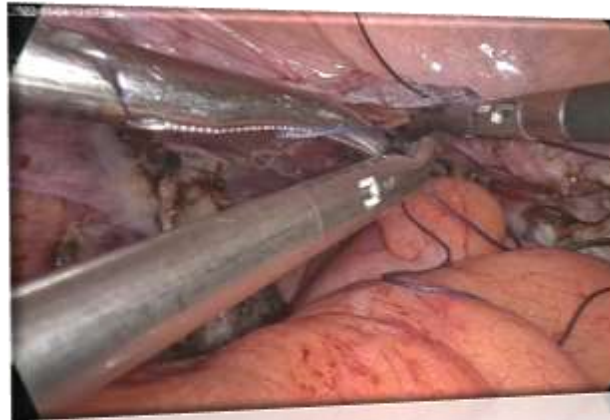
Dark noise control level

Three native high signal-to-noise ratio 4K CMOS sensors feature automatic 3D noise reduction (ANS) in dark areas, resulting in a 55% reduction in noise compared to a single CMOS sensor of the same size. This eliminates noticeable noise and graininess in obscured areas of the image, preserving the natural texture and quality of tissues and mucous membranes.



Highlight detail retention

Super HDR is achieved by utilizing complementary gains from three sensors, and the AE algorithm of FPGA is used to suppress bright areas and compensate for brightness in dark areas, thereby improving the surgical field of vision and comfort.



Adaptability to complex lighting environments

With a built-in real-time brightness dynamic adaptive algorithm, it can match white balance with one click when switching between different endoscopy departments, facing narrow cavities such as sinus endoscopes or exoscopy rooms such as neurosurgery with different color temperatures inside and outside the room eliminating the need for manual adjustment of color and brightness by the camera in post-production.

3-chip native 4K high resolution

01

Original and Uninterpolated

All three sensors utilize Sony's exclusive native 1/3.1" CMOS sensor, capturing 4K 12-bit high color gamut RAW data and transmitting it to the back-end FPGA image processor, outputting 4K 600p resolution via HDMI 2.0 or 12G-SDI UHD interfaces.

02

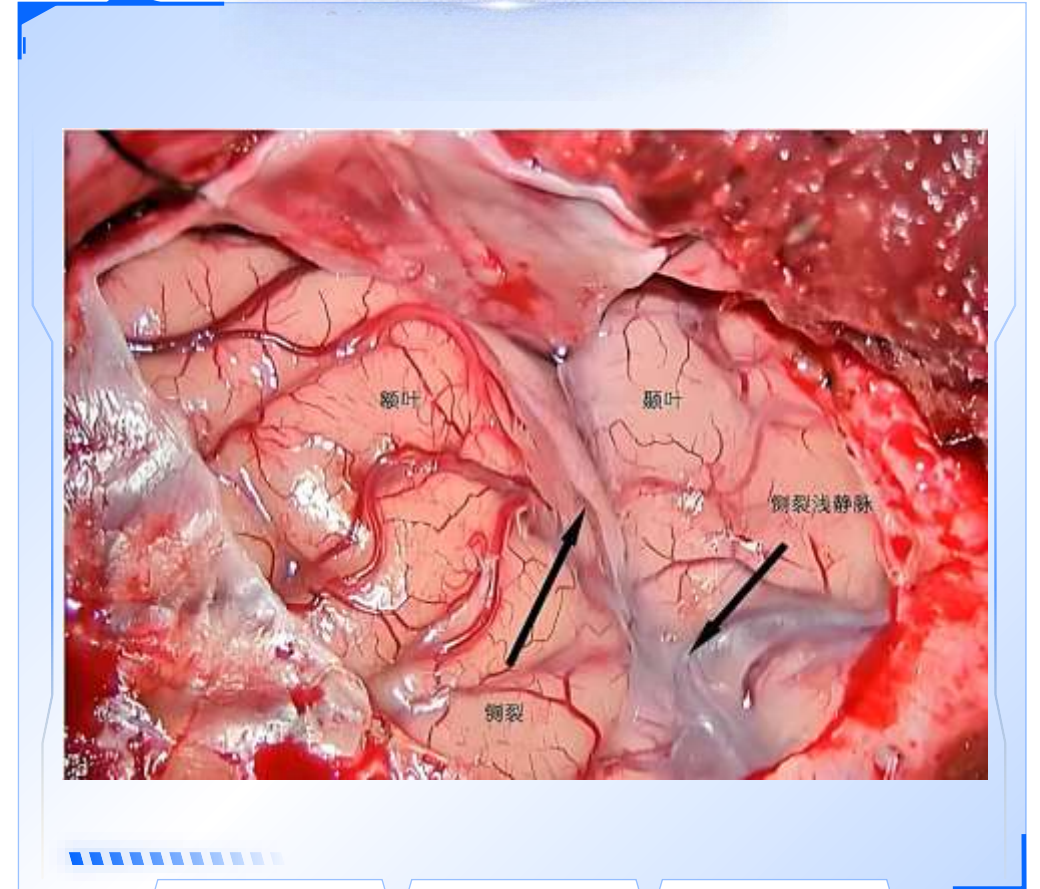
High pixel count, high resolution

A three-chip 4K camera has approximately 26.5 million effective pixels (full RGB sampling), while a single-chip 4K camera has only 8.8 million effective pixels. This difference reduces sharpness loss by 15%, resulting in richer and more realistic image details.

03

Actual resolution measurement data

The 3-chip system achieves an effective horizontal resolution of 3800 TVL in 4K mode, a 31% improvement over the single-chip solution. This advantage is particularly evident in scenarios requiring fine detail, such as microsurgical neurosurgery.



Neurosurgery



03

Comparison to other 3-chip cameras

A common understanding within the healthcare industry:

Currently, cameras on the market that claim to be 4K three-chip cameras are all built with three 1080P CMOS sensors, and then output a 3840*2160 resolution through back-end interpolation. In principle, this is still a FULL HD 1080P resolution. Although its clarity is sufficient for general surgical use, the loss of detail is more obvious when using digital zoom at a distance or displaying on a 55-inch large screen.



Comparison to other 3-chip cameras

01

Native 4K, retaining full pixels

Native 3-Chip 4K : 3x 4K CMOS

Other 3-Chip 4K : 3x HD CMOS

Native 3-chip 4K captures data at 4K resolution from the signal acquisition source, with each frame directly corresponding to the RAW data captured by the 4K sensor, preserving complete pixels and richer details. This offers significant advantages in applications such as surgical microscopes or endoscopes, particularly in areas like blood vessel textures, tissue structures, and minute lesions.

02

Dark area image quality improvement

Native 3-Chip 4K:

With a noise reduction performance improvement of over 50%, no noise reduction algorithm is needed, and the clarity can still be consistent with that of well-lit areas, even in shaded areas.

Other 3-Chip 4K :

Interpolation AI super-resolution (such as Swin2SR, DLSS): Although it can make the back-end output conform to the 4K standard, it is still limited by the amount of original information, and the pixel details in dark areas are severely lost.

03

Color transition enhancement

Native 3-Chip 4K:

When HDR is supported, the black levels are pure and the color transitions are natural. The saturation of the 24 color charts under the Rec.709 color gamut is increased by an average of 8.3%.

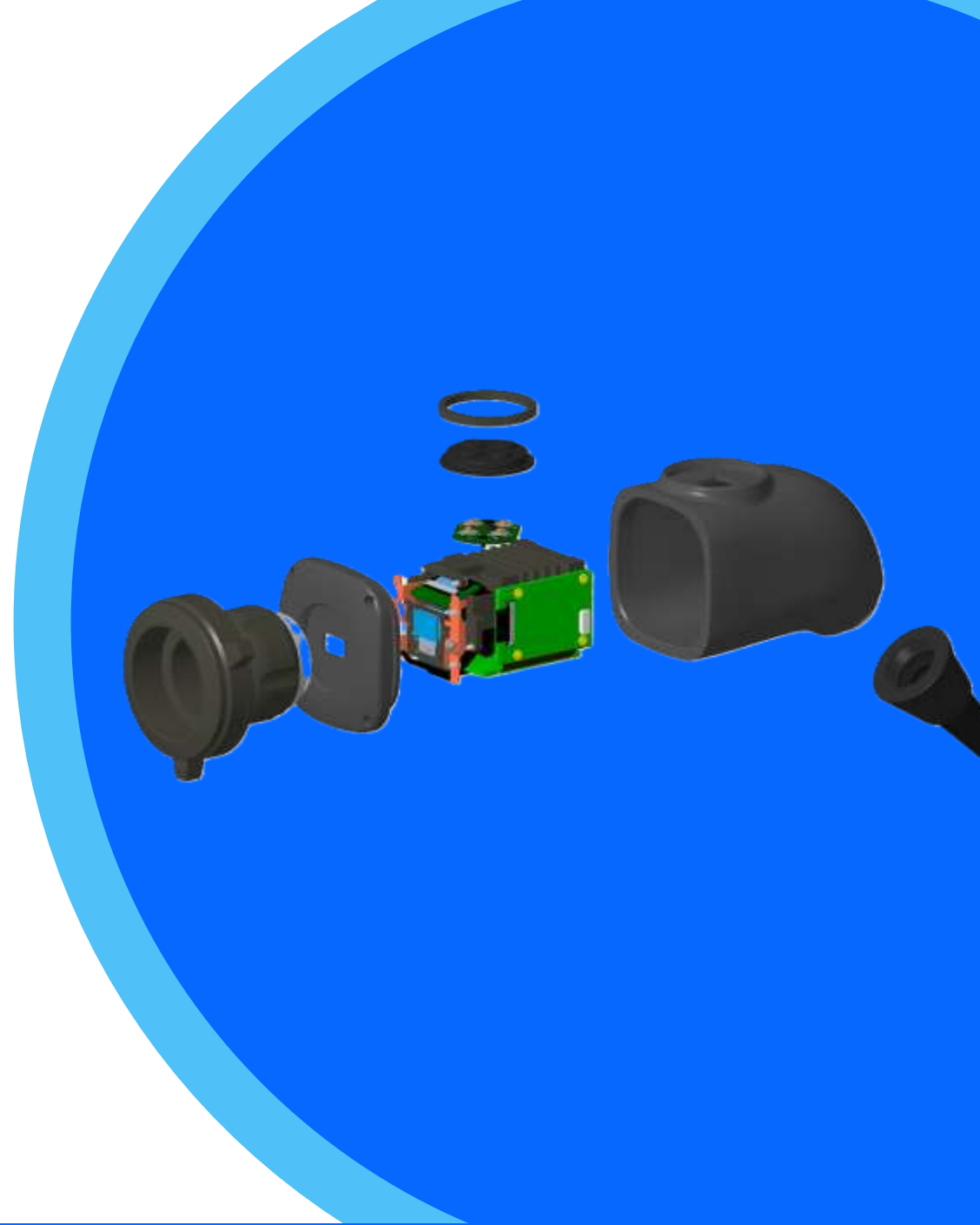
Other 3-Chip 4K :

Interpolated 4K is prone to banding and compression artifacts in high-contrast surgical scenes.



04

Technical Parameter Analysis



Core performance parameters

Effective pixels and sensor size

3x1/3.1" 8MP CMOS,
24 million pixels in total ,
Output resolution 3840*2160px

Frame rate and bit rate support range

4K 60fps real-time output,
latency <50ms, H.265
encoding, 4K video recording.

FPGA Image Processor

Equipped with 26.2 Mb of
embedded memory, 352
input/output ports, and capable
of stable operation at up to
2400MT/s.

Interfaces and Extensibility

2 x 12G-SDI ports, 2 x HDMI 2.0
ports, 1 x DVI port, 4 x USB 3.0
ports, HCOM, DP9 port

01

02

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02

○ Camera Head performance

01

IP68 waterproof

Fully waterproof design, 4 customizable buttons, lightweight design for comfortable grip.

02

Low-temperature plasma & high-temperature and high-pressure sterilization

The handle shell is made with a special process and uses imported Japanese coating materials. The prisms of the three-chip module are bonded using a special high-temperature resistant adhesive.

03

Gold finger connector

Flat connector, gold-plated process, stable transmission, reliable plug-in/plug-out.



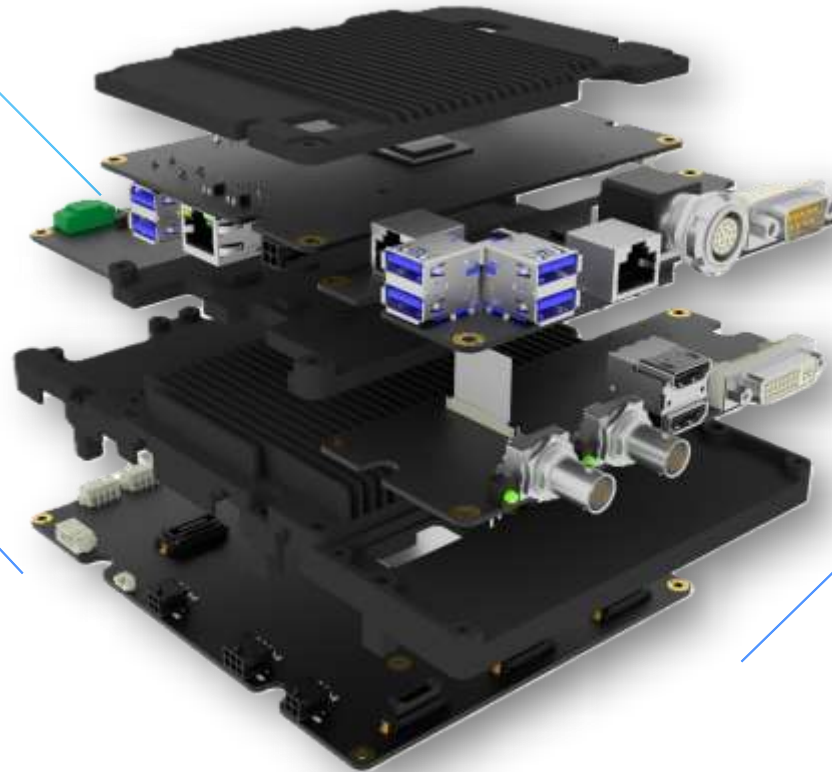
○ Image processor performance

XILINX high-performance FPGA

FPGA enables high-efficiency parallel processing of low-latency real-time enhanced medical images

Multi-functional platform processing

Compatible with 3-chip 4K, 2-chip 4K/3D/fluorescence/4K, single-chip 4K and dual-mirror combination.



Interconnection

Supports linkage with fluorescent & 3D multi-color light sources
Supports interactive communication with external devices such as insufflators

Stable and reliable

Multi-layer all-aluminum modular heat sink with active heat dissipation, stable and reliable.

Technical Specifications

Camera Head

Sensor	3 x 4K 1/3.1" SONY CMOS
Highest Pixel	24 Megapixels
Output resolution	3840*2160px
Camera Head Button	4 customization

FPGA Image Algorithm

Color adjustment	RGB 18-axis
Image enhancement	1-10
Dark area improvement	1-10
Digital noise reduction	1-10
Remove moiré patterns	ON/OFF

Camera Host

Menu function	Department, White Balance, Brightness, Chroma, Sharpness, Saturation, Contrast, Dynamic Range, Contour Enhancement, Gain, Gamma, De-grid, Photo, Video, Zoom
Video format	MP4
Photo format	JPG
Video recording interface	USB
Encoding technology	H.265

Performance indicators

Signal-to-noise ratio	55dB, tolerance -20%.
Luminance response frequency	The linear fit coefficient is not less than 0.98.
Spatial response frequency	TF30%=83C/o MTF50%=69C/o
Modulation Transfer Function (MTF)	Horizontal MTF50 = 5207 LW/PH (602LP/MM)
Static Image Tolerance	DR=200, tolerance -20%
Output Port	2x HDMI2.0, 2x 12G SDI, 1x DVI 4x USB3.0, 1x DP9,1xCOM,1x Lemo



○ Contact

Website

www.zmtc-tec.com/en

Email

zhupz@zmtc-tec.com

Address

2nd Floor, ShengBo Industry Zone, Long
Hua District, Shen Zhen, Guangdong
Province, China



Thanks

Shenzhen ZMTC Technology Co.,Ltd

