QHYCCD

QHY990/991

FEATURES AND SPECIFICATIONS

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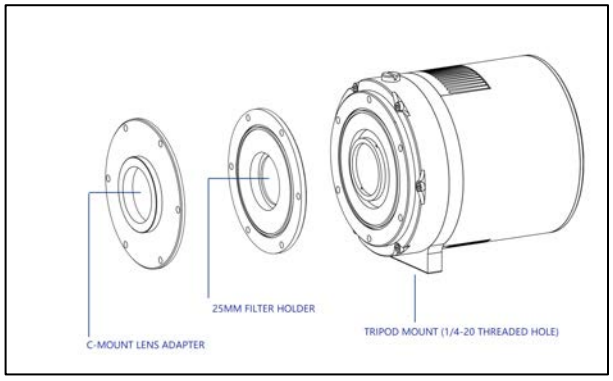
QHYCCD is pleased to offer two new scientific cameras with Short Wavelength Infrared (SWIR) capability.

OVERVIEW

The QHY990 and QHY991 are cooled, short wavelength infrared cameras using Sony's IMX990 and IMX991 InGaAs sensors with square 5um pixel arrays. The IMX991 is a 0.4-megapixel sensor and the IMX990 has 1.31 megapixels. These sensors have wide band response (0.4um-1.7um) with high sensitivity. Quantum efficiency is approximately 77% at 1200nm. By using the Cu-Cu interconnect technology, the sensor has very low FPN noise and a low defect pixel ratio.



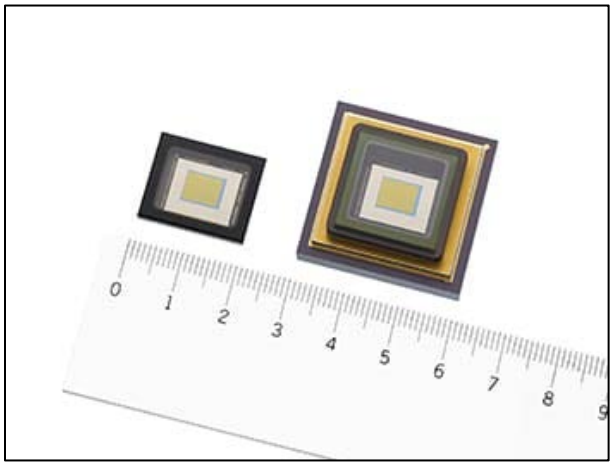
Both the QHY990 and QHY991 include a 25mm filter holder, a common filter size in laboratory applications. The SWIR filter is easily installed inside the camera. With this adapter, the camera maintains a standard 17.5mm C-mount back focal distance.

The QHY990 and QHY991 are available in both air cooling and liquid cooling versions. With air cooling, the camera achieves a delta of -35C degrees below ambient temperature. With room temperature liquid cooling, a delta of -45C below ambient is achieved and with chilled liquid, a delta of -60C to -80C below ambient can be achieved. Typically, InGaAs sensors have higher dark current than Silicon-based material. We therefor recommend selecting the liquid cooling version for applications requiring exposures longer than a few seconds (e.g., >5 sec) or more.

SENSOR DETAILS

The new products employ Sony's original SenSWIR technology, in which photodiodes are formed on an indium gallium arsenide (InGaAs) compound semiconductor layer and are connected via Cu-Cu connection with the silicon (Si) layer which forms the readout circuit - a design which enables high-sensitivity over a broad range of wavelengths. This breakthrough yields a SWIR image sensor that is compact yet capable of delivering seamless image capture over a broad range of wavelengths covering from the visible to invisible light spectrum in the short-wavelength infrared range (wavelength: 0.4µm to 1.7µm).

Employing these products enables sensing even in wavelengths not visible to the human eye, making possible the development of cameras and testing equipment for various applications and contributing to the development of diversifying industrial equipment.



IMX990 SWIR image sensor
Left: Ceramic LGA package
Right: Ceramic PGA package with built-in thermoelectric cooling

The recent demand to reduce manpower and ensure standardization in the industrial equipment field is driving a growing need for image sensors capable of capturing images in the invisible light spectrum of the short-wavelength infrared range. However, traditional SWIR image sensors face manufacturing challenges in miniaturizing pixels and increasing pixel count, as well as various other issues including low sensitivity in the visible light spectrum and analog output that makes multifunctionality difficult. These factors have inhibited the penetration and increased applications of industrial cameras using conventional technology.

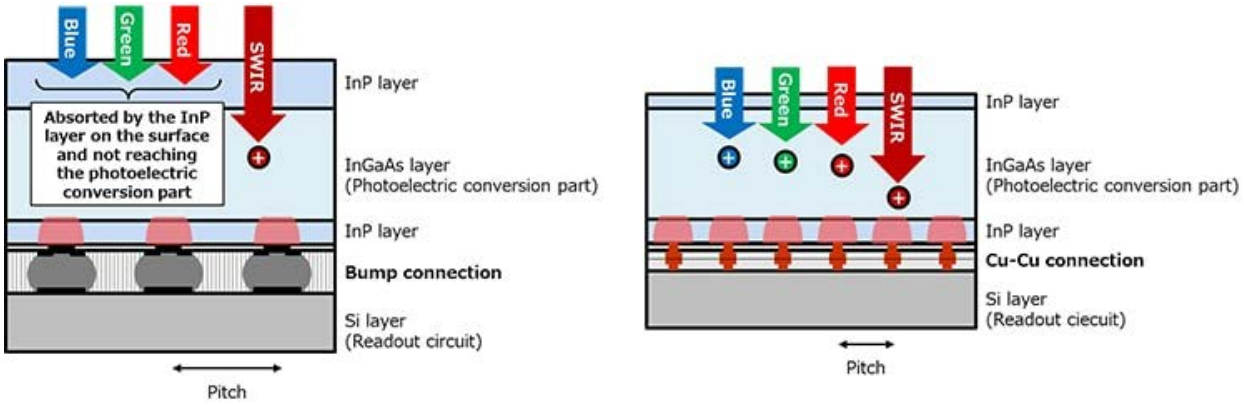
Sony's new sensors employ the stacking technology using Cu-Cu connection that Sony has developed for years along with Sony's original SWIR image sensor technology, delivering high image quality and a more compact sensor size thanks to miniaturization, as well as high sensitivity imaging in a broad range of wavelengths covering both the visible and invisible spectrum. The new products also support digital output, matching the performance of current CMOS image sensors for industrial equipment.

Going forward, Sony will propose these products for use in a wide range of industrial applications such as material selection, contaminant inspection, and semiconductor inspection, aiming to contribute to improved productivity.

SENSOR DESIGN FEATURES

When bonding the InGaAs layer, which forms the light receiving photodiodes, and the Si layer, which forms the readout circuit, using conventional bump connections, it is necessary to secure a certain bump pitch, which makes it difficult to achieve a smaller pixel size compared to current industrial CMOS sensors.

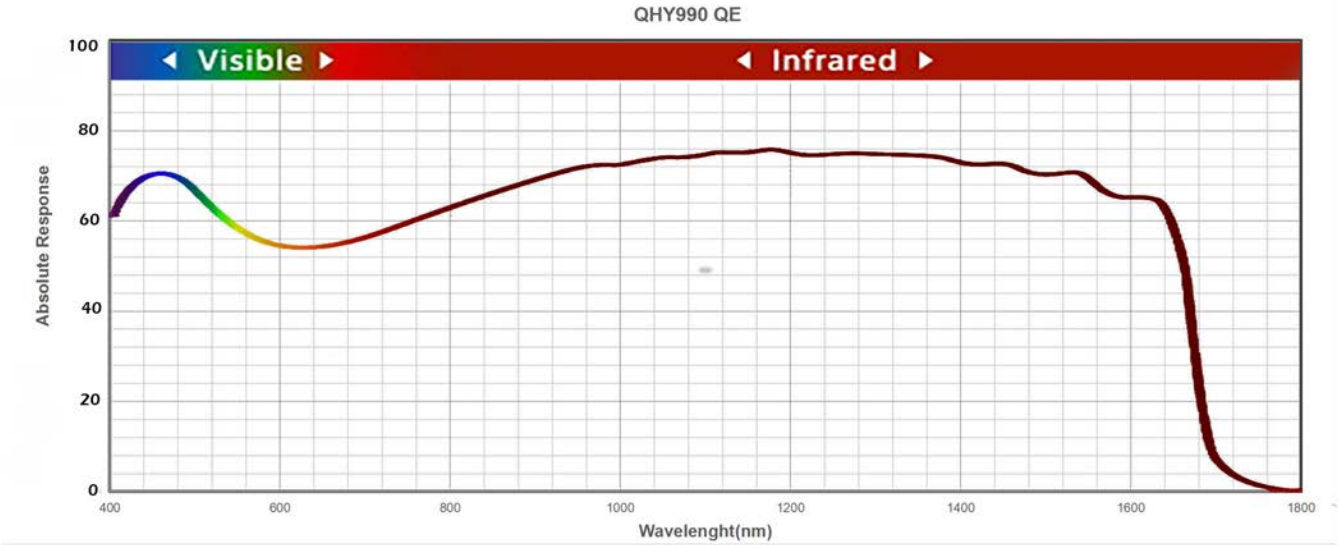
This had made miniaturization a serious challenge. The Sony's new products, however, feature a smaller pixel pitch made possible by the Cu-Cu connection, resulting in the industry's smallest 5µm pixel size. This, in turn, makes it possible to reduce camera size while maintaining SXGA (IMX990)/VGA (IMX991) resolution, contributing to improved testing precision.



Left: Bump connection; Right: Cu-Cu connection

IMAGE IN BOTH VISIBLE LIGHT AND INVISIBLE NIR LIGHT

Sony's original SWIR image sensor technology is used to make the top InP layer, which absorbs visible light, thinner, making it possible to transmit light to the InGaAs layer underneath, delivering high quantum efficiency even in the visible range. This design enables imaging in a broad range of wavelengths from 0.4µm to 1.7µm, enabling the use of a single camera instead of the conventional multiple that were required to capture visible light and SWIR. This results in lower system costs and faster speeds thanks to the reduced image processing load, allowing for a dramatic expansion in testing range.



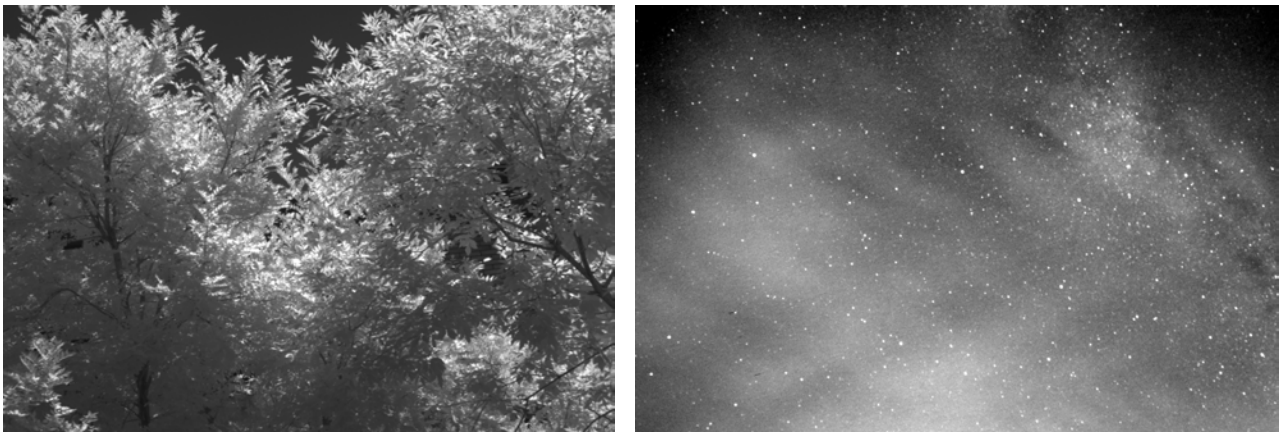
Sample Image Set 1

Switching light sources makes it possible to obtain the surface information and subsurface information of the apples simultaneously. Left: visible light; Right: short-wavelength infrared

Sample Image Set 2

Material sorting utilizing differences in short-wavelength infrared light absorption rates
Left: visible light; Right: short-wavelength infrared

Sample Image Set 3



Left: QHY990 Image in daytime with 16mm F/1.4 SWIR lens @F2.8, 1200-1800nm filter, Gain=0, 1.3ms exposure;
Right: QHY990 image of night sky with 16mm F/1.4 SWIR lens @F1.4, 1200-1800nm filter, 29 x 2 sec. exposures stacked.

ENHANCED CAPABILITIES WITH DIGITAL OUTPUT

Although conventional SWIR image sensors generally have an analog output, the new products support digital output to deliver the same performance as current industrial CMOS image sensors. Although analog output sensors require a digital conversion circuit or other functionality for industrial equipment on the camera, these products already include this functionality, reducing the number of steps in camera development and making multifunction camera development easier.

SPECIFICATIONS

Model	QHY990	QHY991
CMOS Sensor	IMX990 SWIR Sensor	IMX991 SWIR Sensor
FPA Material	InGaAs	InGaAs
Pixel Size	5.0um x 5.0um	5.0um x 5.0um
Total Pixels	1392 x 1052 (Including optically black pixels)	752 x 520 (Including optically black pixels)
Effective Pixel Area	1296 x 1032	656 x 520
Effective Pixels	1.3 Megapixels	0.4 Megapixels
Effective Image Area	1/2-inch	1/4-inch
AD Sample Depth	12-bit A/D	12-bit A/D
Shutter Type	Electric Global Shutter	Electric Global Shutter
QE	77% @ 1200nm	77% @ 1200nm
Full Well	120ke- typical	120ke- typical
Typical Read Noise *	Low Gain 150e-, Med Gain 50e-, High Gain 20e-	Low Gain 150e-, Med Gain 50e-, High Gain 20e-
Frame Rate	66 FPS @ Full Resolution 12-bit 137 FPS @ 480 Lines 12-bit 256 FPS @ 240 Lines 12-bit 518 FPS @ 100 Lines 12-bit 925 FPS @ 40 Lines 12-bit 1150 FPS @ 20 Lines 12-bit	133 FPS @ Full resolution 12-bit 254 FPS @ 240 Lines 12-bit 510 FPS @ 100 Lines 12-bit 700 FPS @ 40 Lines 12-bit 830 FPS @ 20 Lines 12-bit
Trig Function	Hardware Trig-In Socket (RCA type). Opto-isolated	Hardware Trig-In Socket (RCA type). Opto-isolated
Cooling System	Dual Stage TE Cooler	Dual Stage TE Cooler
Cooling Performance	-35C below ambient with air cooling -45C below ambient with room temp liquid cooling -60C to -80C below ambient with chilled liquid cooling	-35C below ambient with air cooling -45C below ambient with room temp liquid cooling -60C to -80C below ambient with chilled liquid cooling
Computer Interface	USB3.0	USB3.0
Lens Interface	C-Mount	C-Mount
Telescope Interface	1.25-inch Adapter	1.25-inch Adapter
Basic Interface	Flange with 6-M3 screw holes	Flange with 6-M3 screw holes
Filter Adapter	Supports D=25mm and D=25.4mm filters	Supports D=25mm and D=25.4mm filters
Back Focal Length	C-Mount, 1.25inch adapter 17.5mm with filter adapter, 14.5mm without filter adapter 12.5mm with basic Interface	C-Mount, 1.25inch adapter 17.5mm with filter adapter, 14.5mm without filter adapter 12.5mm with basic Interface

* Measured values after bias frame FPN calibration

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PERFORMANCE CHARACTERISTICS